NH Route 152 over the North River

Bridge Replacement

Nottingham 40612

NHDES WETLANDS PERMIT APPLICATION

Submitted for:

NH Department of Transportation
7 Hazen Drive
Concord, NH 03302

Prepared by:

GM2 Associates, Inc.
197 Loudon Road, Suite 310
Concord, NH 03301

April 2024

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Bridge Replacement
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STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION

Water Division / Land Resources Management

Check the Status of your Application

RSA/Rule: RSA 482-A/Env-Wt 100-900

APPLICANT'S NAME: NHDOT **TOWN NAME:** Nottingham

Administrative Use Only	Administrative Use Only	Administrative Use Only	File No.:
			Check No.:
			Amount:
			Initials:

A person may request a waiver of the requirements in Rules Env-Wt 100-900 to accommodate situations where strict adherence to the requirements would not be in the best interest of the public or the environment but is still in compliance with RSA 482-A. A person may also request a waiver of the standards for existing dwellings over water pursuant to RSA 482-A:26, III(b). For more information, please consult the Waiver Request Form.

SECTION 1 - REQUIRED PLANNING FOR ALL PROJECTS (Env-Wt 306.05; RSA 482-A:3, I(d)(2)) Please use the Wetland Permit Planning Tool (WPPT), the Natural Heritage Bureau (NHB) DataCheck Tool, the Aquatic Restoration Mapper, or other sources to assist in identifying key features such as: Priority Resource Areas (PRAs), protected species or habitats, coastal areas, designated rivers, or designated prime wetlands.	
Has the required planning been completed?	● Yes ○ No
Does the property contain a PRA? If yes, provide the following information:	● Yes ○ No
• Does the project qualify for an Impact Classification Adjustment (e.g. NH Fish and Game Department (NHFG) and NHB agreement for a classification downgrade) or a Project-Type Exception (e.g. Maintenance or Statutory Permit-by-Notification (SPN) project)? See Env-Wt 407.02 and Env-Wt 407.04.	○ Yes ● No
• Protected species or habitat? o If yes, species or habitat name(s): Blanding's and spotted turtle o NHB Project ID #: NHB23-3677	● Yes ○ No
• Bog?	○ Yes ● No
• Floodplain wetland contiguous to a tier 3 or higher watercourse?	● Yes ○ No
• Designated prime wetland or duly-established 100-foot buffer?	○ Yes ● No
• Sand dune, tidal wetland, tidal water, or undeveloped tidal buffer zone?	○ Yes ● No
Is the property within a Designated River corridor? If yes, provide the following information: • Name of Local River Management Advisory Committee (LAC): Lamprey River • A copy of the application was sent to the LAC on Month: Day: Year:	● Yes ○ No

For dredging projects, is the subject property contaminated? • If yes, list contaminant:	◯ Yes ◉ No
Is there potential to impact impaired waters, class A waters, or outstanding resource waters?	◉ Yes ◯ No
For stream crossing projects, provide watershed size (see WPPT or Stream Stats): 6,810 acres	

SECTION 2 - PROJECT DESCRIPTION (Env-Wt 311.04(i))

Provide a description of the project and the purpose of the project, the need for the proposed impacts to jurisdictional areas, an outline of the scope of work to be performed, and whether impacts are temporary or permanent.

The project involves the replacement of the existing NH Route 152 bridge over the North River (Bridge No. 141/127) in Nottingham. The existing bridge is a reinforced concrete jack-arch structure with a 17-foot span and is currently on the State's Red List. Proposed work includes the replacement of the existing bridge with a 30-foot span bridge. The bridge will be widened two feet and the project includes 300 feet of roadway widening on each end of the bridge to transition the additional width on each side of the roadway at each bridge approach back to the existing roadway. The bridge will be closed during construction and traffic will be detoured.

The purpose of the project is to improve safety by replacing a deteriorated bridge. Rehabilitation of the existing bridge is not feasible due to the poor condition of the existing substructure. In addition, the existing bridge is undersized and does not convey the 100-year storm. The proposed project will increase the hydraulic capacity of the crossing.

The total amount of proposed wetland and watercourse impact is 4,841 square feet and 256 linear feet. This includes 2,401 square feet (182 linear feet) of permanent watercourse impact and 1,203 square feet (74 linear feet) of temporary watercourse impact. In addition, approximately 538 square feet of permanent impact and approximately 699 square feet of temporary impact to Priority Resource Area wetlands is proposed.

The permanent impacts will occur from the construction of the new bridge abutments and the placement of stone for scour protection and a wildlife crossing shelf. In addition, a small amount of permanent wetland impact will occur south of the bridge for roadway slope work. Temporary stream impacts will result from dewatering and stream diversion during construction.

SECTION 3 - PROJECT LOCATION

Separate wetland permit applications must be submitted for each municipality within which wetland impacts occur.

ADDRESS: NH Route 152 over the North River

TOWN/CITY: Nottingham

TAX MAP/BLOCK/LOT/UNIT: N/A

US GEOLOGICAL SURVEY (USGS) TOPO MAP WATERBODY NAME: North River
☐ N/A

(Optional) LATITUDE/LONGITUDE in decimal degrees (to five decimal places): 43.149, 71.113

SECTION 4 - APPLICANT (DESIRED PERMIT HOLDER) INFORMATION (Env-Wt 311.04(a)) If the applicant is a trust or a company, then complete with the trust or company information.		
NAME: NH Department of Transportation (Contact: Jason Tremblay, P.E.)		
MAILING ADDRESS: 7 Hazen Drive, PO Box 483		
TOWN/CITY: Concord	STATE: NH	ZIP CODE: 03302
EMAIL ADDRESS: Jason.A.Tremblay@dot.nh.gov		
FAX:	PHONE: 603-271-2731	
ELECTRONIC COMMUNICATION: By initialing here, I hereby authorize NHDES to communicate all matters relative to this application electronically. JAT		

SECTION 5 - AUTHORIZED AGENT INFORMATION (Env-Wt 311.04(c)) ☐ N/A		
LAST NAME, FIRST NAME, M.I.: Riordan, Jennifer M.		
COMPANY NAME: GM2 Associates, Inc.		
MAILING ADDRESS: 197 Loudon Road, Suite 310		
TOWN/CITY: Concord	STATE: NH	ZIP CODE: 03301
EMAIL ADDRESS: jriordan@gm2inc.com		
FAX:	PHONE: 603-856-7854	
ELECTRONIC COMMUNICATION: By initialing here, I hereby authorize NHDES to communicate all matters relative to this application electronically. JMR		

SECTION 6 - PROPERTY OWNER INFORMATION (IF DIFFERENT THAN APPLICANT) (Env-Wt 311.04(b)) If the owner is a trust or a company, then complete with the trust or company information. ☒ Same as applicant		
NAME:		
MAILING ADDRESS:		
TOWN/CITY:	STATE:	ZIP CODE:
EMAIL ADDRESS:		
FAX:	PHONE:	
ELECTRONIC COMMUNICATION: By initialing here, I hereby authorize NHDES to communicate all matters relative to this application electronically.		

SECTION 7 - RESOURCE-SPECIFIC CRITERIA ESTABLISHED IN Env-Wt 400, Env-Wt 500, Env-Wt 600, Env-Wt 700, OR Env-Wt 900 HAVE BEEN MET (Env-Wt 313.01(a)(3))

Describe how the resource-specific criteria have been met for each chapter listed above (please attach information about stream crossings, coastal resources, prime wetlands, or non-tidal wetlands and surface waters):

Env-Wt 400: Wetland resources were delineated in accordance with Env-Wt 400. Additional information is provided in the enclosed Wetland Delineation Report.
Env-Wt 500: The project meets the criteria of Env-Wt 527 (Public Highways). The project has been designed to avoid and minimize wetland impacts where possible.
Env-Wt 600: The project is not within a coastal area.
Env-Wt 700: There are no prime wetlands within or adjacent to the project.
Env-Wt 900: The project involves the replacement of an existing Tier 3 crossings. The additional information required by Env-Wt 900 is enclosed.

SECTION 8 - AVOIDANCE AND MINIMIZATION

Impacts within wetland jurisdiction must be avoided to the maximum extent practicable (Env-Wt 313.03(a)).* Any project with unavoidable jurisdictional impacts must then be minimized as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization and the Wetlands Permitting: Avoidance, Minimization and Mitigation fact sheet. For minor or major projects, a functional assessment of all wetlands on the project site is required (Env-Wt 311.03(b)(10)).*

Please refer to the application checklist to ensure you have attached all documents related to avoidance and minimization, as well as functional assessment (where applicable). Use the Avoidance and Minimization Checklist, the Avoidance and Minimization Narrative, or your own avoidance and minimization narrative.

**See Env-Wt 311.03(b)(6) and Env-Wt 311.03(b)(10) for shoreline structure exemptions.*

SECTION 9 - MITIGATION REQUIREMENT (Env-Wt 311.02)

If unavoidable jurisdictional impacts require mitigation, a mitigation pre-application meeting must occur at least 30 days but not more than 90 days prior to submitting this Standard Dredge and Fill Permit Application.

Mitigation Pre-Application Meeting Date: Month: Day: Year: 1/17/2024

(☐ N/A - Mitigation is not required)

SECTION 10 - THE PROJECT MEETS COMPENSATORY MITIGATION REQUIREMENTS (Env-Wt 313.01(a)(1)c)

Confirm that you have submitted a compensatory mitigation proposal that meets the requirements of Env-Wt 800 for all permanent unavoidable impacts that will remain after avoidance and minimization techniques have been exercised to the maximum extent practicable: ■ I confirm submittal.

(☐ N/A – Compensatory mitigation is not required)

SECTION 11 - IMPACT AREA (Env-Wt 311.04(g))

For each jurisdictional area that will be/has been impacted, provide square feet (SF) and, if applicable, linear feet (LF) of impact, and note whether the impact is after-the-fact (ATF; i.e., work was started or completed without a permit).

For intermittent and ephemeral streams, the linear footage of impact is measured along the thread of the channel. *Please note, installation of a stream crossing in an ephemeral stream may be undertaken without a permit per Rule Env-Wt 309.02(d), however other dredge or fill impacts should be included below.*

For perennial streams/rivers, the linear footage of impact is calculated by summing the lengths of disturbances to the channel and banks.

Permanent (PERM.) impacts are impacts that will remain after the project is complete (e.g., changes in grade or surface materials).

Temporary (TEMP.) impacts are impacts not intended to remain (and will be restored to pre-construction conditions) after the project is completed.

JURISDICTIONAL AREA		PERM. SF	PERM. LF	PERM. ATF	TEMP. SF	TEMP. LF	TEMP. ATF
Wetlands	Forested Wetland	126		☐	0		☐
	Scrub-shrub Wetland	412		☐	699		☐
	Emergent Wetland			☐			☐
	Wet Meadow			☐			☐
	Vernal Pool			☐			☐
	Designated Prime Wetland			☐			☐
	Duly-established 100-foot Prime Wetland Buffer			☐			☐
Surface	Intermittent / Ephemeral Stream			☐			☐
	Perennial Stream or River	2,401	81	☐	1,203	21	☐
	Lake / Pond			☐			☐
	Docking - Lake / Pond			☐			☐
	Docking - River			☐			☐
Banks	Bank - Intermittent Stream			☐			☐
	Bank - Perennial Stream / River	0	101	☐	0	53	☐
	Bank / Shoreline - Lake / Pond			☐			☐
Tidal	Tidal Waters			☐			☐
	Tidal Marsh			☐			☐
	Sand Dune			☐			☐
	Undeveloped Tidal Buffer Zone (TBZ)			☐			☐
	Previously-developed TBZ			☐			☐
	Docking - Tidal Water			☐			☐
TOTAL		2,939	182		1,902	74	

SECTION 12 - APPLICATION FEE (RSA 482-A:3, I)

☐ **MINIMUM IMPACT FEE**: Flat fee of $400.

☐ **NON-ENFORCEMENT RELATED, PUBLICLY-FUNDED AND SUPERVISED RESTORATION PROJECTS, REGARDLESS OF IMPACT CLASSIFICATION:** Flat fee of $400 (refer to RSA 482-A:3, 1(c) for restrictions).

■ **MINOR OR MAJOR IMPACT FEE:** Calculate using the table below:

Permanent and temporary (non-docking): 4,841	SF	× $0.40 =	$ 1936.4
Seasonal docking structure:	SF	× $2.00 =	$
Permanent docking structure:	SF	× $4.00 =	$
Projects proposing shoreline structures (including docks) add $400 =			$
		Total =	$ 1936.4
The application fee for minor or major impact is the above calculated total or $400, whichever is greater =			$ 1936.4

$1,936.40

SECTION 13 - PROJECT CLASSIFICATION (Env-Wt 306.05) Indicate the project classification.		
☐ Minimum Impact Project	☐ Minor Project	☒ Major Project

SECTION 14 - REQUIRED CERTIFICATIONS (Env-Wt 311.11)	
Initial each box below to certify:	
Initials: JMR	To the best of the signer's knowledge and belief, all required notifications have been provided.
Initials: JMR	The information submitted on or with the application is true, complete, and not misleading to the best of the signer's knowledge and belief.
Initials: JMR	The signer understands that: • The submission of false, incomplete, or misleading information constitutes grounds for NHDES to: 1. Deny the application. 2. Revoke any approval that is granted based on the information. 3. If the signer is a certified wetland scientist, licensed surveyor, or professional engineer licensed to practice in New Hampshire, refer the matter to the joint board of licensure and certification established by RSA 310-A:1.
Initials: N/A	If the applicant is not the owner of the property, each property owner signature shall constitute certification by the signer that he or she is aware of the application being filed and does not object to the filing.

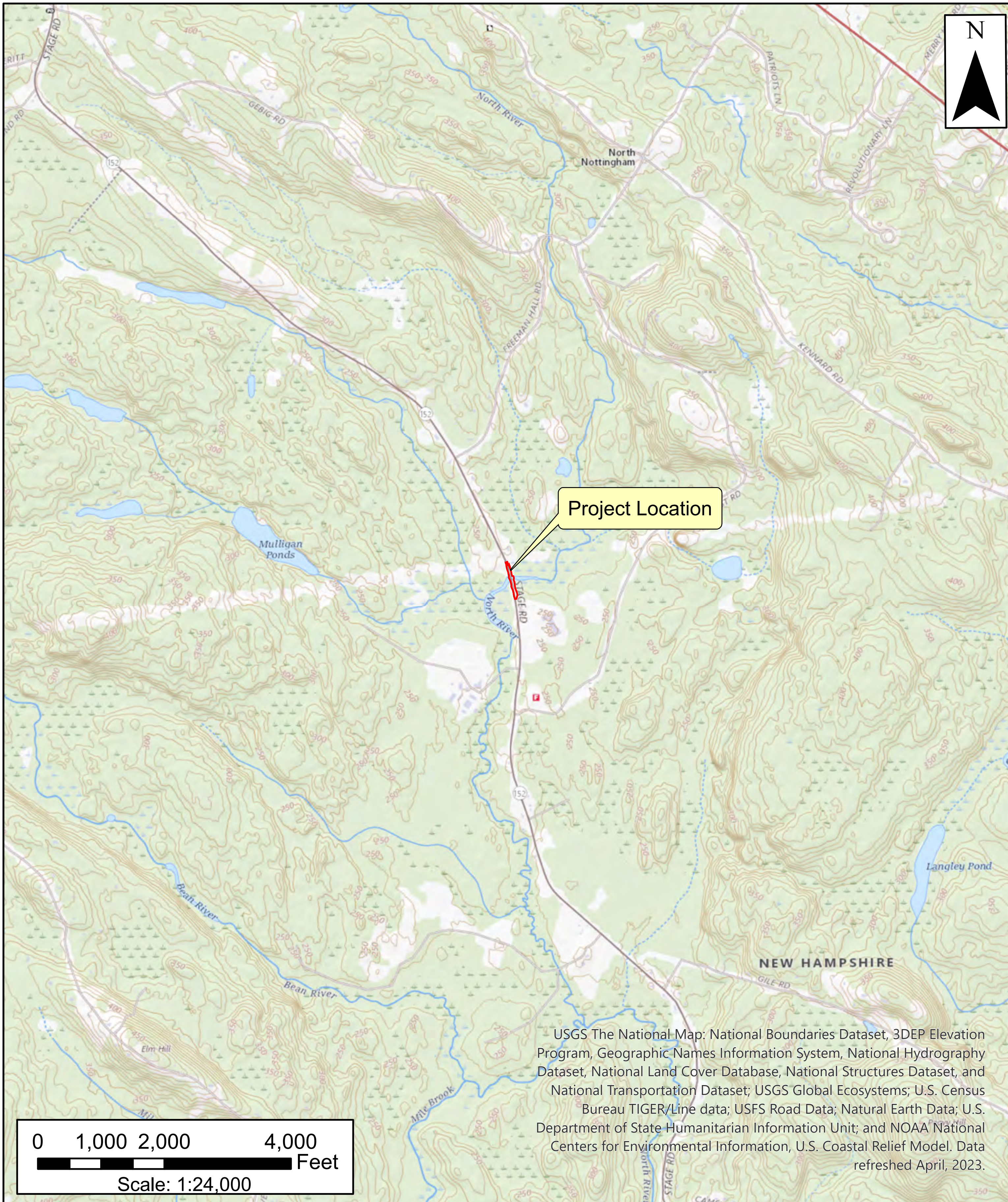
SECTION 15 - REQUIRED SIGNATURES (Env-Wt 311.04(d); Env-Wt 311.11)		
SIGNATURE (OWNER):	PRINT NAME LEGIBLY:	DATE:
SIGNATURE (APPLICANT, IF DIFFERENT FROM OWNER): Jason A. Tremblay	PRINT NAME LEGIBLY: Jason Tremblay	DATE: 04/03/24
SIGNATURE (AGENT, IF APPLICABLE): Jennifer Riordan	PRINT NAME LEGIBLY: Jennifer Riordan	DATE: 4/3/24

SECTION 16 - TOWN / CITY CLERK SIGNATURE (Env-Wt 311.04(f))	
As required by RSA 482-A:3, I(a)(1), I hereby certify that the applicant has filed four application forms, four detailed plans, and four USGS location maps with the town/city indicated below.	
TOWN/CITY CLERK SIGNATURE: Exempt, State Agency per RSA 482-A:31(a)(1)	PRINT NAME LEGIBLY:
TOWN/CITY: Nottingham	DATE:

DIRECTIONS FOR TOWN/CITY CLERK:
Per RSA 482-A:3, I(a)(1)

1. IMMEDIATELY sign the original application form and four copies in the signature space provided above.
2. Return the signed original application form and attachments to the applicant so that the applicant may submit the application form and attachments to NHDES by mail or hand delivery.
3. IMMEDIATELY distribute a copy of the application with one complete set of attachments to each of the following bodies: the municipal Conservation Commission, the local governing body (Board of Selectmen or Town/City Council), and the Planning Board.
4. Retain one copy of the application form and one complete set of attachments and make them reasonably accessible for public review.

DIRECTIONS FOR APPLICANT:
Submit the original permit application form bearing the signature of the Town/City Clerk, additional materials, and the application fee to NHDES by mail or hand delivery at the address at the bottom of this page. Make check or money order payable to "Treasurer – State of NH".



New Hampshire DOT Department of Transportation

USGS Location Map

Nottingham 40612

NH Route 152 over North River

Nottingham, NH

GM2

Supplemental Narrative

Project Description

The project involves the replacement of the existing bridge that carries NH Route 152 over the North River (Bridge No. 141/127) in Nottingham. The existing bridge is a reinforced concrete jack-arch structure with a 17-foot clear span and is currently on the State's Red List. Proposed work includes the replacement of the existing bridge with a 30-foot clear span bridge. The existing bridge is 28 feet wide. Since the standard width for state routes is 30 feet, the proposed bridge will be 2 feet wider than the existing bridge. The project includes 300 feet of roadway widening on each end of the bridge to transition the additional width on each side of the roadway at each bridge approach back to the existing roadway. The bridge will be closed during construction and traffic will be detoured.

The purpose of the project is to improve safety by replacing a deteriorated bridge. Rehabilitation of the existing bridge is not feasible due to the poor condition of the existing substructure. In addition, the existing bridge is undersized and does not convey the 100-year storm. The proposed project will increase the hydraulic capacity of the crossing and the new bridge will accommodate the 100-year storm.

Permanent easements will be required near the bridge on both sides of NH Route 152. Temporary easements will be required for the approach roadway slope work to the north and south of the bridge. The property on the west side of NH Route 152 (Fernald property, locally known as Mulligan Forest) is under a conservation easement that is held by the Society for the Protection of NH Forests (SPNHF). The project will require the acquisition of temporary and permanent easements on this property. Coordination with SPNHF has been initiated and an on-site meeting between NHDOT and SPNHF was held in September 2023. A public hearing was held on March 21, 2024 and the easements will be obtained prior to the start of construction.

The proposed project will result in permanent and temporary impacts to the North River and adjacent floodplain wetlands. These impacts are further described below. Approximately 2,750 square feet of tree clearing is anticipated.

The widening of the bridge and roadway will increase the amount of impervious surface (pavement) by approximately 2,375 square feet. Since the project involves less than 50,000 square feet of overall disturbance, stormwater treatment in accordance with the NHDES Alteration of Terrain rules is not required. Stormwater runoff will sheet flow from the roadway into open drainage ditches, similar to existing conditions. This proposed increase in impervious surface is not expected to be substantial enough to have an impact on water quality in the project area. Erosion and sediment controls will be used to minimize temporary water quality impacts during construction.

Existing Conditions / Wetland Resources

The project area includes Bridge No. 141/127 and NH Route 152, the North River, adjacent floodplain wetlands, electric transmission lines, and upland forested areas. All four bridge quadrants consist of emergent/scrub-shrub wetland, with small, forested wetland areas near the southern end of the project. The surrounding area consists of undeveloped forested land and wetlands, scattered rural residential areas, and commercial/industrial development. The transmission line runs east to west and is located just north of the bridge. A house and daycare are located southeast of the project area and Nottingham Elementary School is further to the south.

Wetland resources were delineated in May 2019 and were field verified and updated in December 2023. The wetland resources are summarized in the enclosed Wetland Delineation Report.

The North River does not have a regulatory floodway, however the entire project area is mapped as Zone A floodplain (refer to enclosed FEMA Flood Insurance Rate Map). Floodplain wetlands are located in all four bridge quadrants. These wetlands are considered Priority Resource Areas (PRAs) since they are adjacent to a Tier 3 stream. The NH Route 152/North River crossing is a Tier 3 crossing based on watershed size. The crossing is also within a NH Designated River corridor (Lamprey River watershed), a 100-year floodplain, and an area with protected species habitat.

Wetland & Watercourse Impacts

The total amount of proposed wetland and watercourse impact is 4,841 square feet and 256 linear feet. This includes 2,401 square feet (182 linear feet) of permanent perennial stream impact and 1,203 square feet (74 linear feet) of temporary perennial stream impact. In addition, approximately 538 square feet of permanent impact and approximately 699 square feet of temporary impact to PRA wetlands is proposed. The proposed impacts are further summarized in the table below.

The permanent impacts will occur from the construction of the new bridge abutments and the placement of stone for scour protection and a wildlife crossing shelf. In addition, a small amount of permanent wetland impact (160 square feet) will occur south of the bridge for roadway slope work. Temporary wetland and watercourse impacts will result from dewatering and stream diversion during construction.

Impacts to PRA wetlands from the roadway slope work were avoided and minimized by steepening slopes where possible. In the northeast, northwest, and southeast bridge quadrants, impacts to the PRA wetlands from roadway work were avoided. Stone fill is necessary on the roadway embankment to the southeast of the bridge, but the stone fill will end at the wetland edge and no impacts to this wetland area are proposed. Impacts to PRA wetlands in the southwest bridge quadrant were minimized by steepening the roadway slopes. As mentioned above, only 160 square feet of permanent PRA wetland impact is proposed from roadway slope work.

Proposed Wetland & Watercourse Impacts

	Permanent		**Temporary**	
	SF	**LF**	**SF**	**LF**
Forested Wetland	126*	--	0	--
Emergent/Scrub-Shrub Wetland	412*	--	699*	--
Perennial Stream (North River)	2,401	81	1,203	21
Bank – Perennial Stream	0**	101	0**	53
Total	**2,939**	**182**	**1,902**	**74**

*Priority Resource Area (floodplain wetland contiguous to a Tier 3 watercourse)
**There is no defined bank within the project area. The floodplain wetlands extend from the North River, with no observable break in slope. For calculating impacts, the areas (square footage) are accounted for under wetland impact, since there is no bank area. Linear footage of bank impact was measured along the edge of each side of the channel (at the ordinary high water line, which at this site also corresponds to Top of Bank).

Impaired Waters

The segment of the North River within the project area (Assessment Unit ID NHRIV600030705-13) is listed as impaired for pH. Temporary and permanent impacts within the North River are proposed, however the project is not anticipated to affect the pH of the river. There are no Class A or Outstanding Resource Waters within or adjacent to the project area.

Mitigation

The proposed permanent stream impacts (2,401 square feet / 182 linear feet) are considered self-mitigating under Env-Wt 902.27 since the proposed bridge replacement will improve hydraulic capacity, aquatic organism passage, and geomorphic compatibility at the crossing. The design meets all requirements of Env-Wt 904.01 and meets the requirements of Env-Wt 904.07 and 904.09 except for the span requirements. Although the proposed bridge does not meet the span requirements under the stream crossing rules, it will lengthen the span from 17 feet to 30 feet and accommodate more of the bankfull width compared to the existing structure. In addition, a wildlife crossing shelf will be constructed on one side of the stream along the southern bridge abutment. The shelf will be 4 feet wide and will be constructed with riprap that is backfilled with finer material.

The proposed permanent impacts to PRA wetlands (538 square feet) are proposed to be mitigated through an in-lieu fee payment to the NHDES Aquatic Resource Mitigation (ARM) Fund. Using the NHDES ARM Fund Wetland Payment calculator, the required fee for 538 square feet of forested and emergent/scrub-shrub wetland impact is $2,786.97 (refer to enclosed ARM Fund calculator spreadsheet).

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION ATTACHMENT A: MINOR AND MAJOR PROJECTS

Water Division/Land Resources Management

Wetlands Bureau

Check the Status of your Application

RSA/ Rule: RSA 482-A/ Env-Wt 311.10; Env-Wt 313.01(a)(1); Env-Wt 313.03

APPLICANT'S NAME: **NHDOT** **TOWN NAME:** Nottingham

Attachment A is required for *all minor and major projects*, and must be completed *in addition* to the Avoidance and Minimization Narrative or Checklist that is required by Env-Wt 307.11.

For projects involving construction or modification of non-tidal shoreline structures over areas of surface waters having an absence of wetland vegetation, only Sections I.X through I.XV are required to be completed.

PART I: AVOIDANCE AND MINIMIZATION

In accordance with Env-Wt 313.03(a), the Department shall not approve any alteration of any jurisdictional area unless the applicant demonstrates that the potential impacts to jurisdictional areas have been avoided to the maximum extent practicable and that any unavoidable impacts have been minimized, as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization.

SECTION I.I - ALTERNATIVES (Env-Wt 313.03(b)(1))

Describe how there is no practicable alternative that would have a less adverse impact on the area and environments under the Department's jurisdiction.

1. NO BUILD - THIS WOULD RESULT IN LESS IMPACT THAN THE PROPOSED ACTION, BUT THE EXISTING BRIDGE IS STRUCTURALLY DEFICIENT AND WOULD POSE A SAFETY CONCERN AS IT CONTINUED TO DETERIORATE. THE EXISITING CROSSING IS UNDERSIZED AND DOES NOT CONVEY THE 100-YEAR STORM. THE NO-BUILD ALTERNATIVE WOULD NOT ADDRESS THESE ISSUES.

2. REPLACEMENT WITH A LONGER SPAN BRIDGE - A PROPOSED SPAN OF APPROXIMATELY 66 FEET WOULD BE REQUIRED TO FULLY COMPLY WITH THE STREAM CROSSING RULES (2.2 X BANKFULL WIDTH FOR TYPE E STREAMS). THE AVERAGE MEASURED BANKFULL WIDTH IS 30 FEET. ALTHOUGH THIS ALTERNATIVE WOULD BETTER ACCOMMODATE THE BANKFULL WIDTH COMPARED TO THE PROPOSED ACTION, THERE ARE PHYSICAL CONSTRAINTS AT THE SITE THAT LIMIT THE SIZE OF THE PROPOSED STRUCTURE. THIS ALTERNATIVE WOULD REQUIRE RAISING THE ROAD AND WOULD RESULT IN A LARGER AMOUNT OF PERMANENT WETLAND IMPACT COMPARED TO THE PROPOSED 30-FOOT SPAN BRIDGE. THIS ALTERNATIVE WOULD ALSO COST APPROXIMATELY 50% MORE THAN THE PROPOSED ACTION AND WOULD RESULT IN MORE IMPACTS TO ADJACENT PROPERTIES.

3. PROPOSED ACTION - REPLACEMENT WITH A 30-FOOT CLEAR SPAN RIGID FRAME PRECAST BRIDGE - ALTHOUGH THE PROPOSED ACTION DOES NOT MEET THE SPAN REQUIREMENTS OF THE STREAM CROSSING RULES, IT WILL IMPROVE AQUATIC ORGANISM PASSAGE, HYDRAULIC CAPACITY, AND GEOMORPHIC COMPATABILITY BY PROVIDING A LONGER SPAN COMPARED TO THE EXISITING BRIDGE (30 FEET VS 17 FEET). THE PROPOSED ACTION WILL ALSO INCLUDE THE ADDITION OF A WILDLIFE SHELF AT THE CROSSING AND THE NEW BRIDGE WILL CONVEY THE 100-YEAR STORM.

SECTION I.II - MARSHES (Env-Wt 313.03(b)(2)) Describe how the project avoids and minimizes impacts to tidal marshes and non-tidal marshes where documented to provide sources of nutrients for finfish, crustacean, shellfish, and wildlife of significant value.
N/A - The project does not involve impacts to marshes.
SECTION I.III - HYDROLOGIC CONNECTION (Env-Wt 313.03(b)(3)) Describe how the project maintains hydrologic connections between adjacent wetland or stream systems.
The project will maintain hydrologic connections along the North River and adjacent wetland systems by replacing an existing crossing. The project will improve the hydraulic capacity of the structure and lengthen the span from 17 feet to 30 feet. This will result in improvement to the overall stream/wetland system.

SECTION I.IV - JURISDICTIONAL IMPACTS (Env-Wt 313.03(b)(4))

Describe how the project avoids and minimizes impacts to wetlands and other areas of jurisdiction under RSA 482-A, especially those in which there are exemplary natural communities, vernal pools, protected species and habitat, documented fisheries, and habitat and reproduction areas for species of concern, or any combination thereof.

There are no exemplary natural communites or vernal pools within or adjacent to the project area. The NH Natural Heritage Bureau Report indicated that there are known records of the following state-listed species within the vicinity of the project: climbing hempvine, American eel, Blanding's turtle, bridle shiner, Northern black racer, spotted turtle, and wood turtle. A survey for climbing hempvine was conducted in 2023 and the plant species was not found within or adjacent to the project area (refer to enclosed NHB correspondence).

Consultation with the NH Fish and Game Department (NHFG) for state-listed wildlife species has occurred. NHFG recommended several conservation measures (refer to enclosed correspondence). These measures will be included as environmental commitments in the construction plans/contract documents. A wildlife shelf is proposed along the southern bridge abutment to facilitate small animal passage through the project area.

The USFWS IPaC report indicated that northern long-eared bat (NLEB) and monarch butterfly may occur within the project area. A No Effect Determination for NLEB was received using the Rangewide Determination Key in IPaC (refer to enclosed correspondence).

No long-term impacts to fish habitat are anticipated since the project will maintain existing hydrologic connections and flows at the crossing. Temporary disturbance will occur during construction. The stream will be diverted and the work area dewatered. Erosion and sediment controls and other Best Management Practices will be used to minimize water quality impacts during construction.

SECTION I.V - PUBLIC COMMERCE, NAVIGATION, OR RECREATION (Env-Wt 313.03(b)(5))

Describe how the project avoids and minimizes impacts that eliminate, depreciate or obstruct public commerce, navigation, or recreation.

The project is not anticipated to impact public commerce or navigation. The North River is not considered a navigable waterway by the US Coast Guard.

The project will result in temporary impacts to traffic during construction. Accelerated construction techniques are proposed to limit the duration of bridge closure during construction.

The segment of the North River near the project does not appear to be used for recreational boating due to the size of the channel and the height of the existing bridge. The bridge is used as an access point for fishing. This access will be maintained post-construction. Temporary impacts to recreational fishing will occur during construction.

SECTION I.VI - FLOODPLAIN WETLANDS (Env-Wt 313.03(b)(6))

Describe how the project avoids and minimizes impacts to floodplain wetlands that provide flood storage.

The entire project is located within a Zone A floodplain and the wetlands adjacent to the North River provide flood storage. Grading associated with the construction of the new bridge abutments and the placement of stone for scour protection will impact floodplain wetlands on both sides of NH Route 152. A small amount of floodplain wetland impact (160 SF) is also proposed from roadway slope work. Proposed grading near the bridges and road was minimized where possible to reduce wetland impacts. The unavoidable impacts to floodplain wetlands (approximately 538 square feet of permanent impact) are located near the wetland edges and no substantial loss of flood storage is anticipated.

Outside of the roadway, the project will result in an estimated 100 cubic yards of fill within the Zone A floodplain (this includes both wetland and upland areas). An estimated 55 cubic yards will be removed, so the project will result in a net fill of approximately 45 cubic yards within Zone A floodplain. Given the extensive floodplain wetlands within the surrounding area, this fill is not expected to have a noticeable impact on overall flood storage.

Approximately 699 square feet of temporary impact to floodplain wetlands will result from construction access and dewatering. These impacts will be restored once construction is complete and will not cause long-term impacts to flood storage.

SECTION I.VII - RIVERINE FORESTED WETLAND SYSTEMS AND SCRUB-SHRUB – MARSH COMPLEXES (Env-Wt 313.03(b)(7))

Describe how the project avoids and minimizes impacts to natural riverine forested wetland systems and scrub-shrub – marsh complexes of high ecological integrity.

The wetlands within the project area are part of a large scrub-shrub/marsh complex that is associated with the North River. They are Priority Resource Areas (floodplain wetlands adjacent to a Tier 3 stream) and also have high ecological integrity. Proposed impacts are located along the edges of the wetlands, near the existing crossing, in a portion of the wetland complex that has lower ecological integrity compared to the interior, undisturbed portion.

Although the project will result in permanent impact to scrub-shrub wetlands (approximately 538 square feet), it will improve hydraulic capacity and aquatic organism passage at the NH Route 152/North River crossing, which is expected to have a positive effect on the overall wetland complex.

SECTION I.VIII - DRINKING WATER SUPPLY AND GROUNDWATER AQUIFER LEVELS (Env-Wt 313.03(b)(8))

Describe how the project avoids and minimizes impacts to wetlands that would be detrimental to adjacent drinking water supply and groundwater aquifer levels.

Overall, the project will not result in a large amount of fill within wetlands and surface waters. Since the project involves the replacement of an existing stream crossing, impacts are unavoidable. Proposed grading has been minimized to reduce impacts. Groundwater aquifer levels are not expected to be adversely affected by the project since the majority of the adjacent wetlands will remain undisturbed and hydrologic connectivity will be improved. The project will increase the amount of impervious surface (pavement) by approximately 2,375 square feet. This increase is not expected to be substantial enough to have a noticeable impact on groundwater quality or quantity.

SECTION I.IX - STREAM CHANNELS (Env-Wt 313.03(b)(9))

Describe how the project avoids and minimizes adverse impacts to stream channels and the ability of such channels to handle runoff of waters.

Overall, the project will improve the condition of the stream channel at the NH Route 152 crossing once construction is complete. Temporary and permanent impacts are expected to the North River, however the replacement bridge will have a lengthened span, allowing for improved handling of runoff waters and greater hydraulic capacity. Riprap is necessary to protect the bridge abutment from scour. Natural streambed material will be placed in the center of the channel and over the flatter areas of riprap.

No adverse effects to the overall ability of the stream channel and wetland system to handle runoff are expected.

SECTION I.X - SHORELINE STRUCTURES - CONSTRUCTION SURFACE AREA (Env-Wt 313.03(c)(1)) Describe how the project has been designed to use the minimum construction surface area over surface waters necessary to meet the stated purpose of the structures.
N/A - The project does not involve shoreline structures.

SECTION I.XI - SHORELINE STRUCTURES - LEAST INTRUSIVE UPON PUBLIC TRUST (Env-Wt 313.03(c)(2)) Describe how the type of construction proposed is the least intrusive upon the public trust that will ensure safe docking on the frontage.
N/A - The project does not involve shoreline structures.

SECTION I.XII - SHORELINE STRUCTURES – ABUTTING PROPERTIES (Env-Wt 313.03(c)(3)) Describe how the structures have been designed to avoid and minimize impacts on ability of abutting owners to use and enjoy their properties.
N/A - The project does not involve shoreline structures.

SECTION I.XIII - SHORELINE STRUCTURES – COMMERCE AND RECREATION (Env-Wt 313.03(c)(4)) Describe how the structures have been designed to avoid and minimize impacts to the public's right to navigation, passage, and use of the resource for commerce and recreation.
N/A - The project does not involve shoreline structures.

SECTION I.XIV - SHORELINE STRUCTURES – WATER QUALITY, AQUATIC VEGETATION, WILDLIFE AND FINFISH HABITAT (Env-Wt 313.03(c)(5)) Describe how the structures have been designed, located, and configured to avoid impacts to water quality, aquatic vegetation, and wildlife and finfish habitat.
N/A - The project does not involve shoreline structures.

SECTION I.XV - SHORELINE STRUCTURES – VEGETATION REMOVAL, ACCESS POINTS, AND SHORELINE STABILITY (Env-Wt 313.03(c)(6)) Describe how the structures have been designed to avoid and minimize the removal of vegetation, the number of access points through wetlands or over the bank, and activities that may have an adverse effect on shoreline stability.
N/A - The project does not involve shoreline structures.

PART II: FUNCTIONAL ASSESSMENT
REQUIREMENTS Ensure that project meets the requirements of Env-Wt 311.10 regarding functional assessment (Env-Wt 311.04(j); Env-Wt 311.10).
FUNCTIONAL ASSESSMENT METHOD USED: US Army Corps of Engineers Highway Methodology Workbook Supplement
NAME OF CERTIFIED WETLAND SCIENTIST (FOR NON-TIDAL PROJECTS) OR QUALIFIED COASTAL PROFESSIONAL (FOR TIDAL PROJECTS) WHO COMPLETED THE ASSESSMENT: JENNIFER RIORDAN (CWS #269)
DATE OF ASSESSMENT: 1/11/2024
Check this box to confirm that the application includes a NARRATIVE ON FUNCTIONAL ASSESSMENT: ☒
For minor or major projects requiring a standard permit without mitigation, the applicant shall submit a wetland evaluation report that includes completed checklists and information demonstrating the RELATIVE FUNCTIONS AND VALUES OF EACH WETLAND EVALUATED. Check this box to confirm that the application includes this information, if applicable: ☒ Note: The Wetlands Functional Assessment worksheet can be used to compile the information needed to meet functional assessment requirements.

AVOIDANCE AND MINIMIZATION WRITTEN NARRATIVE

Water Division/Land Resources Management Wetlands Bureau

Check the Status of your Application

RSA/ Rule: RSA 482-A/ Env-Wt 311.04(j); Env-Wt 311.07; Env-Wt 313.01(a)(1)b; Env-Wt 313.01(c)

APPLICANT'S NAME: NHDOT **TOWN NAME:** Nottingham

An applicant for a standard permit shall submit with the permit application a written narrative that explains how all impacts to functions and values of all jurisdictional areas have been avoided and minimized to the maximum extent practicable. This attachment can be used to guide the narrative (attach additional pages if needed). Alternatively, the applicant may attach a completed Avoidance and Minimization Checklist (NHDES-W-06-050) to the permit application.

SECTION 1 - WATER ACCESS STRUCTURES (Env-Wt 311.07(b)(1))
Is the primary purpose of the proposed project to construct a water access structure?

No. The project is a bridge replacement project that does not involve the construction of a water access structure.

SECTION 2 - BUILDABLE LOT (Env-Wt 311.07(b)(1))
Does the proposed project require access through wetlands to reach a buildable lot or portion thereof?

No

SECTION 3 - AVAILABLE PROPERTY (Env-Wt 311.07(b)(2))*
For any project that proposes permanent impacts of more than one acre, or that proposes permanent impacts to a PRA, or both, are any other properties reasonably available to the applicant, whether already owned or controlled by the applicant or not, that could be used to achieve the project's purpose without altering the functions and values of any jurisdictional area, in particular wetlands, streams, and PRAs?

**Except as provided in any project-specific criteria and except for NH Department of Transportation projects that qualify for a categorical exclusion under the National Environmental Policy Act.*

The project involves less than one acre of permanent wetland impact but includes 538 square feet of permanent impact to PRA wetlands.

Since the project involves the replacement of an existing stream crossing, there are no other feasible properties available. Relocating NH Route 152 would result in a greater amount of wetland impact since there are large PRA wetlands on both sides of the existing crossing. The project is at an existing crossing and the wetland impacts are at the edge of the roadway.

Although the project will result in permanent impacts to PRAs, it will improve the conditions at the NH Route 152/North River crossing by lengthening the bridge span and improving hydraulic capacity, aquatic organism passage, and geomorphic compatability, as well as constructing wildlife shelves to allow for animal passage. These improvements will benefit the overall wetland system near the North River.

SECTION 4 - ALTERNATIVES (Env-Wt 311.07(b)(3))

Could alternative designs or techniques, such as different layouts, different construction sequencing, or alternative technologies be used to avoid impacts to jurisdictional areas or their functions and values as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization?

The majority of the proposed permanent impact is associated with the construction of the new bridge abutments, the placement of stone for scour protection, and the wildlife shelf within the channel and banks. This will not result in a loss of wetland and stream functions since the project will improve hydraulic capacity, aquatic organism and wildlife passage, and geomorphic compatiblity at the crossing. The use of soft armoring techniques around the new bridge is not feasible. Stone is needed to protect the abutments from scour. Natural streambed material will be placed in the center of the channel and over the flatter areas of riprap. Voids within the stone riprap for the wildlife shelf will be filled with finer material to create a relatively smooth surface for wildlife.

A small amount of permanent wetland impact (160 square feet) will occur south of the bridge for roadway slope work. Complete avoidance of wetland impacts from roadway slope work was not possible since a small amount of roadway widening is required to match the wider bridge. Impacts to the PRA wetlands along the roadway were minimized by steepening the proposed roadway embankment and using armored slopes.

During construction, the bridge will be closed and traffic will be detoured. Other traffic control options would result in a greater amount of impact to jurisdictional areas. Phased construction to maintain one lane of traffic in each direction would require further widening of the proposed bridge and additional impacts. Construction of an offline temporary bridge would allow the roadway to remain fully open during construction but this would also result in additional wetland and stream impacts.

SECTION 5 - CONFORMANCE WITH Env-Wt 311.10(c) (Env-Wt 311.07(b)(4))**

How does the project conform to Env-Wt 311.10(c)?

***Except for projects solely limited to construction or modification of non-tidal shoreline structures only need to complete relevant sections of Attachment A*.

A functional assessment was completed for the wetlands within the project area (functional assessment forms are enclosed).

The project is not expected to impact the functions provided by the wetland systems within and adjacent to the project area. All impacts are located next to the bridge and NH Route 152, within lower functioning portions of the wetland. Impacts to the higher quality, interior portions of the wetlands will be avoided. The project will ultimately improve the exisiting conditions at the crossing by providing a longer span.

The wetland system within and adjacent to the project provide ecological integrity, fish and aquatic life habitat, flood storage, groundwater recharge, noteworthiness, nutrient trapping, production export, scenic quality, sediment trapping, shoreline anchoring, uniqueness/heritage, wetland-based recreation, and wetland-dependent wildlife habitat. Of these, all are provided at the principal level except groundwater recharge, scenic quality, and wetland-dependent recreation.

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: November 20, 2019
LOCATION OF CONFERENCE: John O. Morton Building
ATTENDED BY:

NHDOT
Sarah Large
Ron Crickard
Andrew O'Sullivan
Arin Mills
Toney Weatherbee
Tobey Reynolds
Rick Faul
Kerry Ryan
Rebecca Martin
Stephanie Micucci
David Scott

ACOE
Mike Hicks
Rick Kristoff

NHDES
Karl Benedict
Seta Detzel

NH Fish & Game
Carol Henderson

NH NHB
Amy Lamb

Consultants/Public Participants
Tom Levins
Jennifer Riordan

PRESENTATIONS/ PROJECTS REVIEWED THIS MONTH: *(minutes on subsequent pages)*

(When viewing these minutes online, click on a project to zoom to the minutes for that project.)

Andy further clarified this will be under the existing rules and during a flooding event the roadway will not be compromised. Seta and Karl stated if the crossing is attenuating water then an alternative design is appropriate, but if the water overtops the roadway an analysis will be required to ensure the integrity of the roadway will be maintained. Karl mentioned alternative design is required if the water will overtop the pipe and alternative design will be required. Sarah said we will verify with project manager on calculations and determine the appropriate form.

Arin discussed the 5'CMP crossing further downstream and that much of the flood storage capacity will be held in the upstream agricultural wet meadow. Upstream east and downstream is a forested wetland. The design plan was shown with the 5' extension on the inlet and 6' on the outlet to extend the road shoulder, no perch. Resource review found no NHB "hits", NLEB consistency determination, no FEMA floodplains, it is a Tier 2 crossing, a proposed AoT permit by rule and has "No Potential to Cause Effect" for cultural review. Arin showed and discussed the erosion control plan of the coffer dam and dewatering into silt bags with erosion control at the perimeter. Arin said the anticipated total impacts are 932 s.f. of permanent and 1,215 s.f. of temporary. Seta asked the anticipated construction date and Arin said summer of 2020. There was a review of the plans and both temporary and permanent impacts. Sarah agreed that a meeting with Lori would be set up to discuss mitigation requirements and potential for self-mitigation under the existing rules.

Mike verified IPaC results and Arin said 4(d) rule consistency was determined as the NLEB was the only species returned for both locations.

This project has not been previously discussed at a Monthly Natural Resource Agency Coordination Meeting.

Nottingham, #40612

Tom Levins from GM2 Associates provided an overview of the project, which involves the replacement of the bridge that carries NH Route 152 over the North River in Nottingham. The project is currently in the preliminary design phase and alternatives are being considered. The substructure has deteriorated to a point that rehabilitation is not a feasible option. The existing width of 29 feet is also substandard and the existing hydraulic opening does not convey the Q100 storm event. The project is currently scheduled to advertise in 2024.

The existing bridge was constructed in 1925 and rebuilt in 1970. The existing span is 17 feet. The bridge is on the State's Red List and the purpose of the project is to replace the deteriorated bridge. Alternatives that are being considered include:

- 20-foot clear span. This is the minimum required to convey the Q100 storm event. It would not convey the Q500 storm event. Analysis to determine upstream and downstream impacts is ongoing. This alternative would not require raising the grade of the road and would therefore have less impact on the adjacent wetlands and properties.
- 38-foot clear span. This would meet the Stream Crossing Rules (if 1.2xBFW+2 equation is used). The road would need to be raised, resulting in more impact to adjacent wetlands and properties.

Traffic control options include closing NH Route 152 for 21 to 28 days and detouring traffic. This option would utilize accelerated bridge construction. Another option is phased construction with one lane, signalized alternating traffic.

Karl Benedict (NHDES) asked if the project is located in a floodplain. Tom confirmed that it's in a Zone A floodplain. Karl also asked about watershed size. Jenn Riordan (GM2) stated that the watershed is approximately 6,800 acres so it's a Tier 3 crossing.

Jenn provided an overview of the natural resources. The North River is a Designated River as part of the Lamprey River Watershed. It's also subject to the Shoreland Water Quality Protection Act. There are emergent/scrub-shrub wetlands adjacent to the North River on both sides of NH Route 152. The area is very flat. At the time of the wetland delineation, the North River had very slow flow velocity. The bankfull width was determined to be approximately 30 feet and the Rosgen classification is Type E.

There was a discussion of whether a longer span is necessary for compliance with the NHDES Stream Crossing Rules since the crossing is on a Type E stream. NHDES stated that the entrenchment ratio multiplier should be used on Type E streams (2.2xBFW). The span would likely need to be 60 or more feet to be compliant with the Stream Crossing Rules. Seta Detzel (NHDES) mentioned that floodplain pipes could be used in combination with a smaller span to help with flood capacity. Since a span of 60+ feet would require raising the grade of the road and would have permanent impacts to wetlands and adjacent properties, the project will likely need to use a shorter span and apply for Alternative Design. Karl mentioned that the Alternative Design technical report will need to address the reasons why the project cannot meet full compliance with the Stream Crossing Rules. Karl also recommended completing the Stream Crossing Worksheet available on the NHDES website.

Federally-listed species within the project vicinity include northern long-eared bat and small whorled pogonia. No small whorled pogonia plants were observed during the field visit. No evidence of bats was observed during a survey of the bridge. State-listed species include American eel, Blanding's turtle, Northern black racer, and spotted turtle. The project is also within a brook floater zone. GM2 contacted Kim Tuttle (NHF&G) and Kim responded that no impacts to eels or brook floater mussels are expected. NHF&G recommended the following conditions for turtle and snake species:

- Cover road shoulder on south side of bridge with black silt fence fabric if work will begin after turtle nesting season (June 1st)
- Use wildlife-friendly erosion control matting
- Distribute turtle and snake flyers to contractors and include notes/photos on plans

Conservation land (an easement held by the Society for the Protection of NH Forests) is located on the west side of Route 152.

For cultural resource review, a bridge inventory was completed and it was determined to be Not Eligible for the Register of Historic Places. A Phase IA/IB archaeological survey was completed. No evidence of cultural features or deposits was found and no further survey is recommended. The report is being finalized and still needs to be submitted to DHR.

Sarah Large commented that permanent impacts to the emergent/scrub-shrub wetlands should be avoided. The goal should be to widen the bridge opening but also minimize permanent impacts. Jenn mentioned that the project will be presented at another Natural Resource Agency Meeting once impacts have been determined.

Mike Hicks (ACOE) asked if the US Coast Guard had commented on the project. Sarah responded that the USCG had not reviewed the meeting agenda yet.

This project has not been previously discussed at a Monthly Natural Resource Agency Coordination

Meeting.

Bethlehem, #26763 (X-A004(296))
The proposed project will address a culvert under Main Street (US Route 302) between Maple Street (NH Route 142) and Congress Road in Bethlehem. The stream through the structure is a tributary to Barrett Brook. The inlet is near the Bethlehem Visitor Center and Heritage Society building and the outlet is near the Maia Papaya and White Mountain Transmission shops.

Stephanie Micucci described that the culvert is made up of several different sections, is quite old and is deteriorating. She described that the culvert goes under a local business parking lot. S. Micucci also shared that there have been sink holes developing over the culvert and the connecting drainage lines on US 302 and in the Maia Papaya parking lot.

S. Micucci explained that the project has received a wetland permit, which does not expire until 2023. She described that the project had gone out to bid and a contractor was selected in the fall of 2018. She described the permitted scope of work. The permitted scope of work includes replacing the concrete retaining walls at the inlet in-kind, lining the culvert with plastic in one section and corrugated metal tunnel liner plate in another section. The permitted project had been to line 35 feet at the inlet with elliptical plastic pipe and line the remainder (145 feet) with corrugated metal tunnel liner plate. The space in between the existing pipe and the liner was planned to be filled with grout. The perch at the outlet would be eliminated by adding simulated streambed material to build up the area at the outlet. No excavation at the outlet was proposed to avoid impacting contaminated material in the vicinity. The permitted project would also repair the drainage under US Route 302 to help prevent future sink holes. The velocities in the pipe were expected to be similar to the existing condition under the permitted design. S. Micucci explained that adult brook trout would be expected to potentially be able to pass through the pipe under the permitted design. Construction was intended to be completed in the fall of 2019.

S. Micucci explained that District and Construction Bureau folks raised concerns during construction about reducing the effective culvert size with a liner. They were concerned because of observed high water levels at the inlet under the existing condition. Highway Design reviewed the hydraulic analysis, which validated District’s concerns. After several discussions between the Bureaus of Highway Design, Bridge Design, Construction, Environment, Materials and Research, and District, a new scope of work was developed. S. Micucci explained that due to the size and scope of the advertised contract, the proposed new scope would only extend the life of the culvert and the vicinity under the advertised contract (Revision after Proposal), but is not anticipated to be a long term solution. It is understood that the crossing would likely still need to be improved/replaced in the future. Tobey Reynolds explained that its condition would be monitored regularly through the culvert inventory program and by District.

The current proposed scope is intended to mitigate the risk of a substantial failure and extend the life of the existing culvert, instead of waiting longer to design and build a longer term solution. A Revision After Proposal is intended for January of 2020 with construction in the spring of 2020. Under the new proposal only one of the concrete retaining walls would be replaced at the inlet, likely reducing the impacts, and the remainder of the project would have the same impacts. The west side concrete retaining wall is leaning, so this wall is proposed to be replaced with a precast modular block retaining wall. The project would also use shotcrete to fill in the voids in the box culvert (100’) and shotcrete line the invert of the steel arch pipe. The shotcrete liner is a little rougher than a standard reinforced concrete pipe.

Mike Hicks inquired about the methods of construction. T. Reynolds explained that the liner is installed in the dry, so there will be a water diversion. S. Micucci explained that the velocity in the metal section of pipe is anticipated to be higher than the current velocity. The team is coordinating with John Magee of NH

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: January 20, 2021
LOCATION OF CONFERENCE: Virtual meeting held via Zoom

ATTENDED BY:

NHDOT
Sarah Large
Matt Urban
Andrew O'Sullivan
Ron Crickard
Mark Hemmerlein
Arin Mills
Rebecca Martin
James McMahon
Ralph Sanders
Toney Weatherbee
Jason Tremblay
Chuck Corliss
Tim Boodey
Marc Laurin
Jennifer Reczek
Tobey Reynolds
Dan Prehemo
Gerry Bedard

ACOE
Mike Hicks

EPA
Beth Alafat
Jeanie Brochi

NHDES
Lori Sommer
Karl Benedict
Ann-Elizabeth Pelonzi

The Nature Conservancy
Pete Steckler

Consultants/ Public Participants
Jennifer Riordan
Tom Levins
Lee Carbonneau
Thomas Marshall
Gene McCarthy

PRESENTATIONS/ PROJECTS REVIEWED THIS MONTH: *(minutes on subsequent pages)*

(When viewing these minutes online, click on a project to zoom to the minutes for that project.)

Lori said the project is likely under the threshold for mitigation, and therefore will likely not be required. She mentioned, since this project involves a tier 1 crossing, if the project is a minimum impact project mitigation is not required; and even if the project classification is a minor, the impacts will likely be under the threshold for mitigation. Karl reiterated that the threshold for a minor impact project is less than 200 LF along the watercourse.

Amy Lamb mentioned via email she has no concerns. Mike Hicks, Jeanie Brochi and Pete Steckler all had no comments. Karl added one last comment specific to the draft impact plans shown at the meeting; the area between the pipe extensions would be considered permanent and will need to be adjusted on the plans.

This project has not been previously discussed at the Monthly Natural Resource Agency Coordination Meeting.

Nottingham, #40612

Jenn Riordan (GM2) presented the project, which includes replacement of the NH Route 152 bridge over the North River in Nottingham. The project is state funded so the US Army Corps of Engineers (ACOE) is the lead federal agency, not FHWA. The project was previously presented at the November 2019 Natural Resource meeting. Since then, the design has progressed and wetland/stream impacts of the preferred alternative have been estimated.

The area adjacent to the bridge is mostly wetland. Powerlines are located to the north. A house and daycare are located southeast of the bridge and Nottingham Elementary School is located further south. A house is also located to the northeast.

The existing bridge is a reinforced concrete jack-arch structure with a 17-foot span. It was constructed in 1925 and rebuilt in 1970. It has stone and concrete abutments and wingwalls and is currently on the State’s Red List. The existing bridge does not convey the 100-year storm but there is no known history of flooding at the site.

The Preferred Alternative involves replacement of the bridge with a 30-foot span structure. Rehabilitation of the bridge is not a viable option since the substructure has deteriorated to a point where it can’t be repaired. The existing hydraulic opening is also a concern. The entire bridge needs to be replaced. The project will also involve 200 feet of roadway widening on each side of the bridge. A second bridge replacement alternative that is being evaluated is a 66-foot span structure. This would be compliant with the NHDES Stream Crossing Rules, but would have more wetland impacts and would cost approximately 50% more than the 30-foot span.

There are several traffic control options. The Preferred Alternative would involve closing the bridge during construction and detouring traffic. The detour is about 20 miles on state roads and 12 miles on local roads. The bridge would be closed for 28 days. Construction would take one season. This traffic control option would have the least amount of impact to environmental resources and would only take one construction season. Another alternative would involve phased construction, which would maintain one lane of traffic in each direction. This would require additional widening of the proposed structure. Construction would take two seasons. The third traffic control alternative would involve construction of an offline temporary bridge that would allow the road to remain open during construction, but would result in additional wetland impacts. Construction with a temporary bridge would take two seasons.

Design of the project is ongoing. A Public Officials Meeting is scheduled for February 8, 2021. The advertisement date is currently in 2024.

The natural resources at the site include Priority Resource Area (PRA) wetlands on both sides of NH Route 152 and the North River. The North River is a Tier 3 crossing (watershed is 6,800 acres), a NH Designated River (as part of the Lamprey River watershed), and subject to the Shoreland Water Quality Protection Act. The site is located within a Zone A floodplain, but there is no floodway. It is assumed that water quality treatment will not be required since the ground disturbance will be well under 50,000 SF for AoT and the site is not within a MS4 regulated community. There are two public water supply wells located south of the site. A daycare well is located approximately 150 feet south of the southern project limit. The well for Nottingham Elementary School is located approximately 1,200 feet southeast of the project limit. These distances are based on the NHDES OneStop Mapper. GM2 needs to coordinate with the NHDES Drinking Water Bureau regarding any specific recommendations.

LCHIP conservation land is located along the west side of NH Route 152, outside of the NHDOT ROW. Several federal- and state-listed species were identified in the IPac and NHB reports. Federal species include northern long-eared bat and small whorled pogonia. No evidence of bats was observed in the bridge and no small whorled pogonia plants were found at the site. There is potential habitat for small whorled pogonia located further from the bridge in the forested upland areas. State-listed species include brook floater, American eel, Blanding's turtle, Northern black racer, and spotted turtle. NH Fish and Game was contacted regarding these species. They indicated that no impacts to eels or brook floater mussels are expected. They also recommended the following conditions for turtle and snake species: cover road shoulder on the south side of the bridge with silt fence fabric if work will begin after turtle nesting season begins; use wildlife-friendly erosion control matting; and distribute turtle and snake flyers to contractors and include notes/photos on project plans. The Nature Conservancy placed wildlife cameras at the site to obtain information on wildlife passage.

The stream crossing rules were discussed. Bankfull width (BFW) is approximately 30 feet and the North River is a Type E stream near the project. A 66-foot bridge span would be compliant with the NHDES Stream Crossing Rules (2.2 x BFW). The project will need to apply for Alternative Design since the Preferred Alternative is a 30-foot bridge span. A longer span would require raising the road and would increase permanent wetland impacts. The 66-foot span alternative would also cost over 50% more compared to the 30-foot span alternative.

Wetland impacts for the Preferred Alternative (30-foot span with bridge closure during construction) are estimated at 3,416 SF of wetland impact and 182 LF of stream impact. This includes 1,164 SF of permanent wetland/stream impact and 105 LF of permanent stream impact, as well as 2,252 SF of temporary wetland/stream impact and 77 LF of temporary stream impact. The Preferred Alternative has the least amount of wetland impact. The 66-foot span alternative would result in more wetland impact from roadway work. Phased construction would require additional bridge widening, resulting in more wetland impact. A temporary bridge during construction would result in additional temporary wetland impacts.

The wetland/stream impacts associated with the Preferred Alternative are associated with bridge replacement. The roadway approach widening will avoid wetlands. The Preferred Alternative appears to be self-mitigating since it will lengthen the bridge span from 17 to 30 feet and will improve hydraulic capacity (the proposed bridge will convey the 100-year flood while the existing bridge does not). The Preferred Alternative also includes the addition of a wildlife shelf under the bridge to improve wildlife passage in the project area.

The resource agencies then provided comments on the project.

Karl Benedict (NHDES)

- Agree with the approach to apply for Alternative Design
- The stream impacts seem to be self-mitigating due to the hydraulic improvements, although permanent impacts to PRA wetlands located above ordinary high water will need to be mitigated. Jenn Riordan confirmed that this would include approximately 236 SF of impact as currently shown for the Preferred Alternative.
- Asked if the amount of new impervious surface has been quantified. Tom Levins replied that the area has not been determined but it would likely be around a 10% increase. Karl mentioned the need to confirm if AoT requirements need to be met.

Lori Sommer (NHDES)

- Agreed that permanent PRA wetland impacts need to be mitigated. She commented that she would like to see the plans.
- Local conservation commission should be contacted, but since it is such a small amount of mitigation, an ARM fund payment would be appropriate in this case.
- Impacts to the LCHIP property on the west side of NH Route 152 should be discussed with Lori. Jenn Riordan commented that the LCHIP property is on the west side outside of the ROW and she doesn't believe there will be impacts.
- Agreed that the project is self-mitigating for the stream impacts. Since the wildlife shelf is part of the proposed mitigation, a post-construction report and follow-up monitoring would be needed.
- Do floodplain culverts need to be considered as part of the Alternative Design review? Karl responded that accommodating the 100-year flood event meets this requirement.

Pete Steckler (TNC)

- The project intersects the Connect the Coast planning effort. TNC placed two wildlife cameras at the site: one at the bridge and one southeast in the floodplain area. Currently, there is not much opportunity for wildlife crossing at the existing bridge, there is no dry area below the abutments, so no place for animals to walk. Not many animals were observed but there are a lot of people who fish near the bridge. The floodplain camera detected various species. A floodplain culvert may perform better for wildlife passage than a shelf under the bridge.
- Most larger animals would be expected to stick to the forested edge of the wetland area and not walk out in the more open area where they would be more exposed. However, smaller floodplain dependent species like raccoons and mink would be anticipated to potentially use a shelf.

Liz Pelonzi (NHDES)

- Liz suggested that GM2 reach out to her regarding the daycare well. Rebecca received an email from Liz which she will forward to Jenn Riordan. If this well is within 200 feet of the project, Level 4 protection measures are recommended.

Mike Hicks (ACOE)

- Is this a Section 106 No Adverse Effect? Jenn Riordan responded that the bridge was determined Not Eligible.

Jean Brochi (EPA)arol

- No comments

Amy Lamb was not in attendance but Sarah Large reported that she had no concerns, but that the NHB report was expired.

Wildlife passage was discussed further, particularly the use of the adjacent floodplain/forest habitat and the potential for floodplain culverts. Pete Steckler said that bear will pass through a 48-inch culvert. He recommended a 5-foot culvert, if the road profile allows for it. A wildlife shelf is still useful if the design doesn't allow for a floodplain/wildlife crossing culvert.

This project was previously discussed at the 11/20/2019 Monthly Natural Resource Agency Coordination Meeting.

Harts Location, #40595-2

Arin Mills, NHDOT Environmental Manager, presented the railroad bridge repair project which carries the Conway Scenic Railroad (CSRR), bridge #81.82, over Kedron Brook in Harts Location and within Crawford Notch State Park. The railroad line was described as an active line operated by CSRR as a lessee and provides tourist service in all seasons with the exception of winter. A figure showed the line runs from Conway to Luneburg, VT and the active line is only the Conway to Whitefield section. Arin further described the line is owned and maintained by the State of NH and was constructed in ~1886 with very limited plans of construction. The track is a Class II track with a max speed of 20 MPH and the DOT ROW is 49.5' wide from centerline.

Kedron Brook is a mountainous stream which flows from the steep terrain on Mt Willey, and flows ~0.5 miles from the site reach to the site. From the site Kedron Brook flows ~ 0.3 miles under US 302 and empties into the Saco River. Photos were shown of the existing conditions of the site from the fall of 2020, to include the slope failure on the NE wing of the crossing and slope material which has entered the stream. Project challenges were outlined to include; no roadway access (rail only), limitations of the rail access to include 2 large bridge structures which limit the ability of movement of equipment needed for the project to the site, excessive slope steepness, no existing staging area and limited staging areas at the Arethusa Falls parking lot (DNCR) within the NHDOT ROW of 49.5 ft.

A map showed the proposed (tentative) path where heavy equipment would create a temporary access route from US 302. This access request is in-process with the DNCR, who are receptive to the proposal. Photographs from a site visit conducted in the fall of 2020 showed the forested area and proposed staging area near the failure. Based on the site visit no wetlands were observed along this access route.

Chuck Corliss, NHDOT Operations Engineer, showed a project overview plan with the wetlands field data collected and existing topography of the site. He then showed the location of the proposed Class 5 rip rap would be placed at a 1.5:1 slope to repair and stabilize the failing slope. Chuck then described the proposed staging area required for staging of both material and equipment during construction. At this time the hope is to keep this within the existing DOT ROW (49.5' from centerline), although there is potential for additional clearing within the forest needed for staging. Chuck described a basic access plan to include the installation of erosion control measures, excavation of a ramp to the NE slope to allow movement of excavator and material to the base of the slope. The cofferdam and clean water bypass pipe will allow for clean water flow to be maintained throughout construction.

Chuck showed a preliminary wetland impact plan to include removal of existing material in the stream and placement of stone from the stream channel to the top of the bank to stabilize and repair the failure. Chuck described a basic construction sequence to include installation of erosion control measures, prepare staging area in NE corner, install coffer dam and bypass pipe, excavation of NE corner to the base of the failure, removal of excess material from Brook, installation of stone from Brook and up slope to match existing grade at rail. Once work is completed the staging area will be reseeded and erosion control measures will

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: January 17, 2024
LOCATION OF CONFERENCE: Virtual meeting held via Zoom

ATTENDED BY:

NHDOT
Andrew O'Sullivan
Joshua Brown
Jon Evans
Mark Hemmerlein
Rebecca Martin
Levi Byers
Kerry Ryan
Chris Carucci
David Smith
Rhona Thomson
Curtis Morrill
Arin Mills
Ron Grandmaison
Carol Niewola
Jason Tremblay
Meli Dube
Corey Spetelunas
Hans Weber
Rick Dyment
Lilah Flynn

ACOE
Absent

USCG
Absent

EPA
Jean Brochi

NHDES
Karl Benedict
Seta Detzel
Emily Nichols
Mary Ann Tilton
Eben Lewis

NHB
Absent

NH Fish & Game
Mike Dionne
Kevin Newton
Jared Lamy
Melissa Winters

Federal Highway
Jamie Sikora

US Fish & Wildlife
Absent

The Nature Conservancy
Absent

NH Transportation & Wildlife Workgroup
Absent

Consultants/ Public Participants
Leslie Merrithew
Gregg Cohen
Carl Gross
Jennifer Riordan
Tom Levins

PRESENTATIONS/ PROJECTS REVIEWED THIS MONTH: *(minutes on subsequent pages)*

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considered self-mitigating if natural streambed simulation can be used instead of the stone riprap and if a wildlife shelf can be incorporated.
  - Andrew O'Sullivan (NHDOT) asked if a wildlife shelf is possible and if streambed simulation could be used.
    - Tom Levins (GM2) mentioned that a flatter area is proposed near one of the abutments. This could potentially be utilized as a wildlife shelf. Riprap at the edge of the channel is necessary for scour protection near the abutments. The center of the channel will be natural material.

Mary Ann Tilton (NHDES)

- Reinforced the prime wetland discussion regarding correspondence with the conservation commission. Recommended looking at the October 2023 rule change regarding mitigation (Env-Wt 803.01).

Seta Detzel (NHDES)

- Questioned if the project is self-mitigating if riprap extends beyond the existing abutments. Cross-sections would be helpful. Permanent impacts to prime wetlands and PRAs from roadway widening and farm drive relocation require mitigation.

Kevin Newton (NHFG)

- Asked if brook floater was the only record on the NHB report.
  - Jenn Riordan – The most current NHB report had no records. A previous report had brook floater.

Jared Lamy (NHFG)

- No comments.

Jamie Sikora (FHWA)

- No comments.

Jean Brochi

- Asked if EFH consultation with NOAA is complete.
  - Jenn Riordan confirmed that it was completed. NOAA responded that the project as proposed is not anticipated to adversely affect EFH.

Nottingham, 40612 (Non-fed):

Jenn Riordan (GM2) introduced the project which involves the replacement of the NH Route 152 bridge over the North River in Nottingham. The existing bridge is a reinforced concrete jack-arch structure with a 17-foot span. It is on the State's Red List and does not convey the 100-year storm. The project proposes to replace the existing bridge with a 30-foot span bridge. The new bridge will convey the 100-year storm. The bridge will be widened 2 feet and the project will also involve 200 feet of roadway widening at each end of the bridge. Approximately 2,600 square feet of new impervious surface (pavement) is proposed. The project is not subject to AoT requirements (under 50,000 square feet of disturbance). Temporary and permanent easements will be required.

Bridge rehabilitation is not feasible due to the deteriorated condition of the existing bridge. Replacement with a NHDES stream crossing rules-compliant structure (66-foot span) was evaluated. This alternative is not practicable due to cost and impacts to wetlands and adjacent properties. Several traffic control alternatives were evaluated during preliminary design. Closing the bridge and detouring traffic during construction is proposed. Phased construction would maintain one lane of traffic but would require additional widening and more impacts compared to bridge closure. Construction of a temporary bridge would allow the roadway to remain open, but would result in greater impacts.

Priority Resource Area wetlands (floodplain wetlands adjacent to a Tier 3 stream) are located at all four bridge quadrants. The North River is a Tier 3 crossing, has a Protected Shoreland, and is a Designated River (as part of the Lamprey River watershed). Water quality treatment is not required since the project involves less than 50,000 square feet of disturbance. Public water supply wells are located to the south of the project. Recommendations from the NHDES Drinking & Groundwater Bureau were reviewed during design. Under proposed conditions, runoff from the roadway will generally be directed away from the wellhead protection areas.

The entire project is located within a Zone A floodplain. The property on the west side of NH Route 152 is LCHIP-funded conservation land (easement is held by Society for the Protection of NH Forests). For Section 106, a finding of No Historic Properties Affected was received. The bridge is not eligible for the National Register of Historic Places.

Federally-listed species include northern long-eared bat and monarch butterfly. A No Effect determination was received for northern long-eared bat. Various species were included in the NHB report. A survey for climbing hempvine was completed by FB Environmental in 2023. The plant was not found in the project area. Consultation with the NH Fish & Game Department (NHFG) occurred during preliminary design. Several recommendations were provided by NHFG and these were incorporated into the project. The Nature Conservancy put wildlife cameras at the site to collect data on wildlife movement near the bridge.

A stream crossing assessment was completed using a combination of field observations and desktop analysis (LiDAR data). The depth of the river and adjacent wetlands made access difficult. Measured widths were consistent with field observations. The numbers were also compared to predicted values using the NH Regional Hydraulic Curves. Overall, the values and general characteristics of the North River and typical for a Type E stream. The bankfull width was determined to be approximately 30 feet. Using this width, the stream crossing rules compliant span would be 66 feet (2.2 x BFW). This span length is not practicable due to impacts to adjacent properties and cost. It would require raising the road and would also increase the amount of permanent wetland impact. The proposed 30-foot span bridge meets all requirements of Env-Wt 904.01 and meets all requirements of Env-Wt 904.07 and 904.09 to the maximum extent practicable (meets everything except span requirement).

Approximately 2,939 SF (182 LF) of permanent wetland and stream impact and approximately 1,902 SF (74 LF) of temporary wetland and stream impact is proposed. This includes approximately 538 SF of permanent impact and approximately 669 SF of temporary impact to PRA wetlands. Wetland impacts will result from the construction of the new bridge abutments and there is a small amount impact (160 SF) from roadway slope work. Permanent stream impacts will result from constructing the new bridge abutments, placing stone for scour protection and the wildlife shelf, and minor grading within the stream channel. Temporary impacts will result from stream diversion and access during construction. Other project alternatives (66-foot span bridge, phased construction, and temporary bridge during construction) would have a greater amount of wetland and stream impact.

An ARM fund payment of $2,787 is proposed to mitigate for the 538 SF of permanent PRA wetland impact. The stream impacts are assumed to be self-mitigating since the design is an improvement to hydraulic capacity, aquatic organism passage, and geomorphic compatibility. Less than 200 LF of stream channel and bank impact is proposed.

The meeting was then opened to comments and discussion.

Karl Benedict (NHDES)

- The project appears to meet Env-Wt 904.09.
- Asked if bank linear footage was included in impact calculations. Suggested showing top of bank (TOB) and ordinary high water (OHW) overlayed on plan.
    - Jenn Riordan (GM2) responded that the bank linear footage was included. There is no bank impact area since there is no defined bank, only floodplain wetland (TOB and OHW are the same).
- Asked about a restoration plan for the temporary bridge.
    - Jenn Riordan clarified that a temporary bridge is not proposed. This was evaluated as an alternative traffic control measure. The proposed project involves closing the bridge and detouring traffic during construction.
- Asked if streambed simulation can be included. Need to see a cross-section of the proposed riprap in the channel. Could stream simulation be incorporated on top of the riprap?
    - GM2 will look into this and address in the Wetlands Permit application.

Mary Ann Tilton (NHDES)

- Agree with Karl's comments. No additional comments.

Seta Detzel (NHDES)

- Asked what several of the lines on the wetland impact plan represent.
    - There was discussion between Andrew O'Sullivan, Tom Levins, and Jenn Riordan. The final plans should clearly indicate the proposed bridge abutments, widening, and other items.
- The project appears to meet avoidance and minimization measures and Env-Wt 904.09 and would be considered self-mitigating for the stream impacts.
- Need to breakout PRA wetland impacts separately and mitigate for those impacts.
- Final NHFG consultation may change mitigation determination.

Kevin Newton (NHFG)

- Were any new species included on the updated NHB report?
    - Jenn Riordan responded that bridle shiner was added. This is a historic record.

Melissa Winters (NHFG)

- Emphasized that NHFG should be contacted when a new NHB report is requested or if listed species are observed at sites. Rare species occurrences must be reported to NHFG, along with photos to assist in species identification.

Jared Lamy (NHFG)

- No comments

Jean Brochi (EPA)

- No comments

Hampton-Portsmouth, 26485A (X-A005(269)):

Christine Perron provided an overview of the project, which addresses the second segment of the 9.6-mile Hampton Branch Rail Corridor. The first segment (7.9 miles) was addressed under NHDOT project Hampton-Portsmouth 26485. The current project, 26485A, consists of approximately 1.7 miles beginning at the north side of Drakeside Road in Hampton and continuing north-northeast to the Hampton/North Hampton town line.
The project is being designed by GPI and MJ is completing the environmental review. The purpose of the project is to improve the condition of the trail to accommodate bicycles and pedestrians. This segment of the rail corridor was purchased from Pan Am Railways for the purpose of creating a recreational trail. The rail corridor is currently being used for recreation informally but does not have a consistent surface or width, has two unsafe bridge crossings, and has flooding and drainage issues.

This is one of four rail trail projects in the NHDOT Ten Year Plan that are intended to comprise the off-street portion of the NH Seacoast Greenway. The first of these projects, Hampton-Portsmouth 26485, was reviewed and permitted in 2022 and that project is now under construction. Two other segments of corridor consist of 2.3 miles between Hampton and Hampton Falls (Project 43537), and 2 miles in Seabrook (Project 42609). Each of these projects has independent utility, with access points available for each segment to be utilized on its own, and each segment is undergoing separate permitting efforts. The project being discussed today is scheduled to advertise in September 2024. The remaining two projects are not scheduled for construction until 2030 or later.

The goals for today’s meeting are to get input on the proposed design and preliminary impacts and to confirm the mitigation approach that will be required.

Tim Whitney provided an overview of proposed improvements, which will consist of vegetation clearing, rail tie removal, closed system drainage upgrades, surface drainage re-grading, profile changes, providing new bridge decks on two bridges, and resurfacing of the trail surface. The final trail surface will be a 12 FT wide stone dust trail.

Drainage upgrades will include the replacement of an existing closed drainage system under the railroad that begins behind Hannaford along Route 1 and flows southerly for approximately a 0.5 mile and outlets to the west behind Depot Square. This segment of the trail has drainage and

NHDES AQUATIC RESOURCE MITIGATION FUND
WETLAND PAYMENT CALCULATION
*****INSERT AMOUNTS IN YELLOW CELLS*****

1	**Convert square feet of impact to acres:**	
INSERT SQ FT OF IMPACT	Square feet of impact =	538.00
		43560.00
	Acres of impact =	0.0124
	Total Wetland Credits =	0.0124
2	**Determine acreage of wetland construction:**	
	Forested wetlands:	0.0185
	Tidal wetlands:	0.0371
	All other areas:	0.0185
3	**Wetland construction cost:**	
	Forested wetlands:	$2,008.18
	Tidal Wetlands:	$4,016.36
	All other areas:	$2,008.18
4	**Land acquisition cost (See land value table):**	
INSERT LAND VALUE FROM TABLE WHICH APPEARS TO THE LEFT. (Insert the amount do not copy and paste.)	Town land value:	16965
	Forested wetlands:	$314.30
	Tidal wetlands:	$628.59
	All other areas:	$314.30
5	**Construction + land costs:**	
	Forested wetland:	$2,322.47
	Tidal wetlands:	$4,644.95
	All other areas:	$2,322.47
6	**NHDES Administrative cost:**	
	Forested wetlands:	$464.49
	Tidal wetlands:	$928.99
	All other areas:	$464.49
************	**TOTAL ARM PAYMENT*************	
	Forested wetlands:	$2,786.97
	Tidal wetlands:	$5,573.94
	All other areas:	$2,786.97

NH Route 152 over the North River
Bridge Replacement
Nottingham 40612

WETLAND DELINEATION REPORT

Prepared for:

NH Department of Transportation
7 Hazen Drive
Concord, NH 03302

Prepared by:

GM2 Associates, Inc.

January 2024

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APPENDICES

A. Wetland Delineation Map
B. Wetland Determination Data Forms
C. NHDES Functional Assessment Worksheet

1.0 INTRODUCTION

This report provides a summary of the wetland resources that were delineated for the NH Route 152 crossing over the North River in Nottingham, New Hampshire. The project involves the replacement of the existing bridge (Bridge No. 141/127) that carries NH Route 152 traffic over the North River.

2.0 METHODOLOGY

The study area for the wetland delineation included approximately 100 feet east (upstream) and 100 feet west (downstream) of the crossing and approximately 175 feet north and 370 feet south of the crossing along NH Route 152 (refer to Wetland Delineation Map in Appendix A for the wetland delineation limits).

The delineation was completed on May 31, 2019 by Jennifer Riordan (NH Certified Wetland Scientist #269). Wetland boundaries were field checked and updated on December 7, 2023 by Jennifer Riordan and Ethan Maskiell of GM2 Associates, Inc. (GM2). The wetland delineation was conducted in accordance with the US Army Corps of Engineers (USACE) 1987 Methodology and the USACE Northcentral and Northeast Regional Supplement (2012). Individually-labeled flags were placed in the field to designate the wetland resource boundaries and the flags were survey located. Individually-labeled flags placed in the field during the December 7, 2023 site visit were located with a Trimble Geo7x GPS unit. Ordinary high water (OHW) was also located within the project area. USACE wetland determination data forms were completed in 2019 and 2023 and are included in Appendix B.

Federal wetland classifications were assigned in accordance with “Classification of Wetlands and Deepwater Habitats of the United States” (Federal Geographic Data Committee, 2013). Wetland functions were assessed in accordance with the USACE New England District Highway Methodology Workbook Supplement (1999). A NH Department of Environmental Services Functional Assessment worksheet was completed and is included in Appendix C.

The wetland delineation was conducted during normal conditions, based on a review of the U.S. Drought Monitor map.

3.0 SITE DESCRIPTION

The study area includes the North River, adjacent floodplain wetlands, a powerline right-of-way, and forested upland areas. The area adjacent to the bridge is mostly wetland. Forested upland is located in the southeastern portion of the study area. Tree species within the forested areas include white pine (*Pinus strobus*), northern red oak (*Quercus rubra*), red maple (*Acer rubrum*), and eastern hemlock (*Tsuga canadensis*).

The surrounding area consists of undeveloped forested land and wetlands, with scattered rural residential areas and commercial/industrial development. The powerline right-of-way runs east to west, north of the bridge. A house and daycare are located southeast of the project area and the Nottingham Elementary School is further south.

Conservation land is located on the west side of NH Route 152 (Fernald Lumber property, locally known as Mulligan Forest). The easement is held by the Society for the Protection of NH Forests.

The portion of the North River within the project area has a Zone A floodplain but there is no regulatory floodway, based on a review of the current FEMA Flood Insurance Rate Map.

4.0 SUMMARY OF WETLAND RESOURCES

4.1. North River (OHW)

Classification:

riverine, lower perennial, unconsolidated bottom, permanently flooded (R2UBH)

Ordinary high water (OHW) of the North River was delineated as it flows from east to west at the crossing. The segment of the North River channel under and adjacent to the bridge varies from approximately 30 feet to 45 feet wide. During the site visit in May 2019, the water was approximately 3 to 6 feet deep. The substrate is mucky and mostly consists of sand. Top of bank (TOB) was not delineated since there is no defined bank for the segment of the North River within the project area. Floodplain wetlands extend from the stream, with no observable break in slope. Water in the channel has a very slow velocity and when water levels are high both the channel and surrounding wetlands are inundated.

Vegetation within the river channel includes scattered yellow pond-lily (*Nuphar variegata*) and pickerelweed (*Pontederia cordata*). Vegetation adjacent to the channel includes speckled alder (*Alnus incana*), silky dogwood (*Cornus amomum*), broadleaf meadowsweet (*Spiraea latifolia*), sweetgale (*Myrica gale*), coastal sweet-pepperbush (*Clethra alnifolia*), royal fern (*Osmunda regalis*), and tussock sedge (*Carex stricta*).

Functions provided by the North River include ecological integrity, fish habitat, noteworthiness, production export, scenic quality, uniqueness/heritage, wetland-based recreation, and wetland-dependent wildlife habitat. All of these are provided at the principal level except scenic quality and recreation.

North River
View east (upstream) from bridge
Photo taken 5/31/19

North River
View west (downstream) from bridge
Photo taken 5/31/19

North River (upstream) at bridge
View northwest
Photo taken 5/31/19

4.2. Wetland 4 and Wetland 5 (Flag Series A & Flag Series B)

Classification:

palustrine, emergent, persistent, seasonally flooded/saturated (PEM1E)
palustrine, scrub-shrub, broad leaved deciduous, seasonally flooded/saturated (PSS1E)
palustrine, forested, broad-leaved deciduous, seasonally flooded/saturated (PFO1E)

Wetland 4 (Flag Series A-1 to A-8) is an emergent/scrub-shrub wetland located northwest of Bridge No. 141/127, adjacent to the North River and NH Route 152. Approximately 2 to 4 inches of surface water was present in some areas during the May 2019 site visit, with saturated soils in the remaining areas. Vegetation within the wetland is maintained for the powerline right-of-way.

Wetland 5 (Flag Series B-1 to B-9 and B-100 to B-104) is an emergent/scrub-shrub wetland located southwest of Bridge No. 141/127. The eastern edge of the wetland (near NH Route 152) is forested.

Vegetation in Wetland 4 and Wetland 5 includes broadleaf meadowsweet, coastal sweet-pepperbush, northern arrowwood (*Viburnum recognitum*), royal fern, swollen-beaked sedge (*Carex utriculata*), and tussock sedge. The forested portion of Wetland 5 is vegetated with red maple, highbush blueberry (*Vaccinium corymbosum*), and cinnamon fern (*Osmundastrum cinnamomeum*), with white pine and northern red oak at the edge.

Functions provided by Wetlands 4 and 5 include ecological integrity, flood storage, groundwater recharge, noteworthiness, nutrient trapping, production export, scenic quality, sediment trapping, shoreline anchoring, uniqueness/heritage, wetland-based recreation, and wetland-dependent wildlife habitat. All of these except groundwater recharge, scenic quality, and recreation are provided at the principal level.

Wetlands 4 and 5 extend in a westerly and southwesterly direction adjacent to the North River, beyond the project limits.

Wetland 4 (Flag Series A)
View northwest from bridge
Photo taken 7/9/19

Wetland 5 (Flag Series B)
southwest of bridge
View southwest
Photo taken 5/31/19

Wetland 5 (Flag Series B)
southwest of bridge
View south towards forested portion
Photo taken 5/31/19

4.3. Wetland 3 and Wetland 6 (Flag Series C & Flag Series D)

Classification:

palustrine, emergent, persistent, seasonally flooded/saturated (PEM1E)
palustrine, scrub-shrub, broad leaved deciduous, seasonally flooded/saturated (PSS1E)
palustrine, forested, broad-leaved deciduous, seasonally flooded/saturated (PFO1E)

Wetland 3 (Flag Series C-1 to C-7) is an emergent/scrub-shrub wetland located northeast of Bridge No. 141/127, adjacent to the north side of North River.

Wetland 6 (Flag Series D-1 to D-8) is an emergent/scrub-shrub wetland adjacent to the southeast side of Bridge No. 141/127. The southern edge of the wetland is forested.

Wetlands 3 and 6 are vegetated with red maple, broadleaf meadowsweet, coastal sweet-pepperbush, northern arrowwood, royal fern, and tussock sedge. The forested portion of Wetland 6 is vegetated with red maple, winterberry holly (*Ilex* verticillata), highbush blueberry (*Vaccinium corymbosum*), three-leaved goldthread (*Coptis trifolia*), and cinnamon fern, with white pine at the edge.

Functions provided by Wetlands 3 and 6 include ecological integrity, flood storage, groundwater recharge, noteworthiness, nutrient trapping, production export, scenic quality, sediment trapping, shoreline anchoring, uniqueness/heritage, wetland-based recreation, and wetland-dependent wildlife habitat. All of these except groundwater recharge, scenic quality, and recreation are provided at the principal level.

Wetlands 3 and 6 extend in an easterly direction adjacent to the North River, beyond the project limits.

Wetland 3 (Flag Series C)
northeast of bridge and north of the North River
View north
Photo taken 5/31/19

Wetland 6 (Flag Series C)
southeast of bridge and south
of the North River with
forested portion further south
View southeast
Photo taken 5/31/19

5.0 STREAM CROSSING ASSESSMENT

The bridge to be replaced (Bridge No. 141/127) carries NH Route 152 over the North River. The watershed size at the crossing is approximately 6,810 acres (10.64 mi^2), making it a Tier 3 crossing. The North River is also a NH Designated River. In accordance with Env-Wt 900, a stream crossing assessment was conducted utilizing a combination of field observations and desktop analysis using aerial imagery and LiDAR data available from NH GRANIT. Field measurements of bankfull width, bankfull depth, and flood prone width were not able to be taken at the time of the site visits on May 31, 2019 and December 7, 2023 due to the depth of the river and adjacent floodplain wetlands, as well the mucky substrate.

A powerline right-of-way and two large adjacent emergent/scrub-shrub wetlands are located on the northern side of the river with scattered areas of forested upland beyond. The southern side also has two large adjacent emergent/scrub shrub wetlands with areas of forested wetland and upland further south. Vegetation adjacent to the channel includes speckled alder, silky dogwood, red maple, broadleaf meadowsweet, sweetgale, coastal sweet-pepperbush, royal fern, and tussock sedge, with yellow pond-lily and pickerelweed present in the channel.

Stream crossing assessment measurements of bankfull width and flood prone width were completed using NH GRANIT LiDAR data for two segments of the river: the NH Route 152 crossing, located approximately 100 feet to approximately 200 feet upstream of the bridge; and a reference reach located approximately 900 feet to 1,000 feet upstream of the bridge (refer to Tables 5-1 and 5-1). The widths that were determined using desktop data and maps were consistent with field observations. The predicted bankfull width based on the New Hampshire 2005 Regional Hydraulic Geometry Curves is 39.7 feet, which is also consistent with the values measured using LiDAR maps.

Water depth observed at the time of the site visits ranged from approximately 3 to 6 feet. Maximum bankfull depth was estimated based on the water depths observed during the site visits and a mean bankfull depth of 4.5 feet was used. The mean bankfull depth predicted by the NH Regional Hydraulic Curves is 2.4 feet, however this value appears to be low based on site observations.

Substrate at the crossing location consists of mostly sand with muck/organic material on top, based on field observations.

Table 5-1
North River – Crossing Location (NH Route 152 Bridge)

	Cross Section 1	Cross Section 2	Cross Section 3	Range	Average
Bankfull Width*	31 feet	30 feet	27 feet	27 – 31 feet	29.3 feet
Mean Bankfull Depth**	4.5 feet	4.5 feet	4.5 feet	4.5 feet	4.5 feet
Width to Depth Ratio	6.9	6.7	6.0	6.0 - 6.9	6.5
Max Bankfull Depth**	6 feet	6 feet	6 feet	6 feet	6 feet
Flood Prone Width*	530 feet	443 feet	460 feet	443 – 530 feet	478 feet
Entrenchment Ratio	17.1	14.8	17.0	14.8 – 17.1	16.3

*Bankfull width and flood prone width were estimated using LiDAR elevation data in GRANIT, combined with aerial photographs, FEMA floodplain maps, and site observations.
**Mean and maximum bankfull depths were estimated based on site observations.

Table 5-2
North River – Reference Reach

	Cross Section 1	Cross Section 2	Cross Section 3	Range	Average
Bankfull Width*	47 feet	53 feet	51 feet	47 – 53 feet	50.3 feet
Mean Bankfull Depth**	4.5 feet	4.5 feet	4.5 feet	4.5 feet	4.5 feet
Width to Depth Ratio	10.4	11.8	11.3	10.4 - 11.8	11.2
Max Bankfull Depth**	6 feet	6 feet	6 feet	6 feet	6 feet
Flood Prone Width*	700 feet	704 feet	773 feet	700 – 773 feet	726 feet
Entrenchment Ratio	14.9	13.3	15.2	13.3 - 15.2	14.5

*Bankfull width and flood prone width were estimated using LiDAR elevation data in GRANIT, combined with aerial photographs, FEMA floodplain maps, and site observations.
**Mean and maximum bankfull depths were estimated based on site observations.

Sinuosity was measured along an approximate 1,600-foot long segment of the North River in GIS using LiDAR elevation data and orthoimagery. This segment is located upstream of Bridge No. 141/127 and includes both the crossing location and reference reach. Based on these measurements, the sinuosity was estimated to be 1.2.

Due to the high entrenchment ratio and a width to depth ratio of less than 12, the Rosgen classification for the segment of the North River near the project is Type E. The measured sinuosity (1.2) is slightly lower than a typical Type E stream (>1.5), however the overall features of the stream, including its wide floodplain wetlands and narrow, deep channel, are characteristic of a Type E stream.

6.0 REFERENCES

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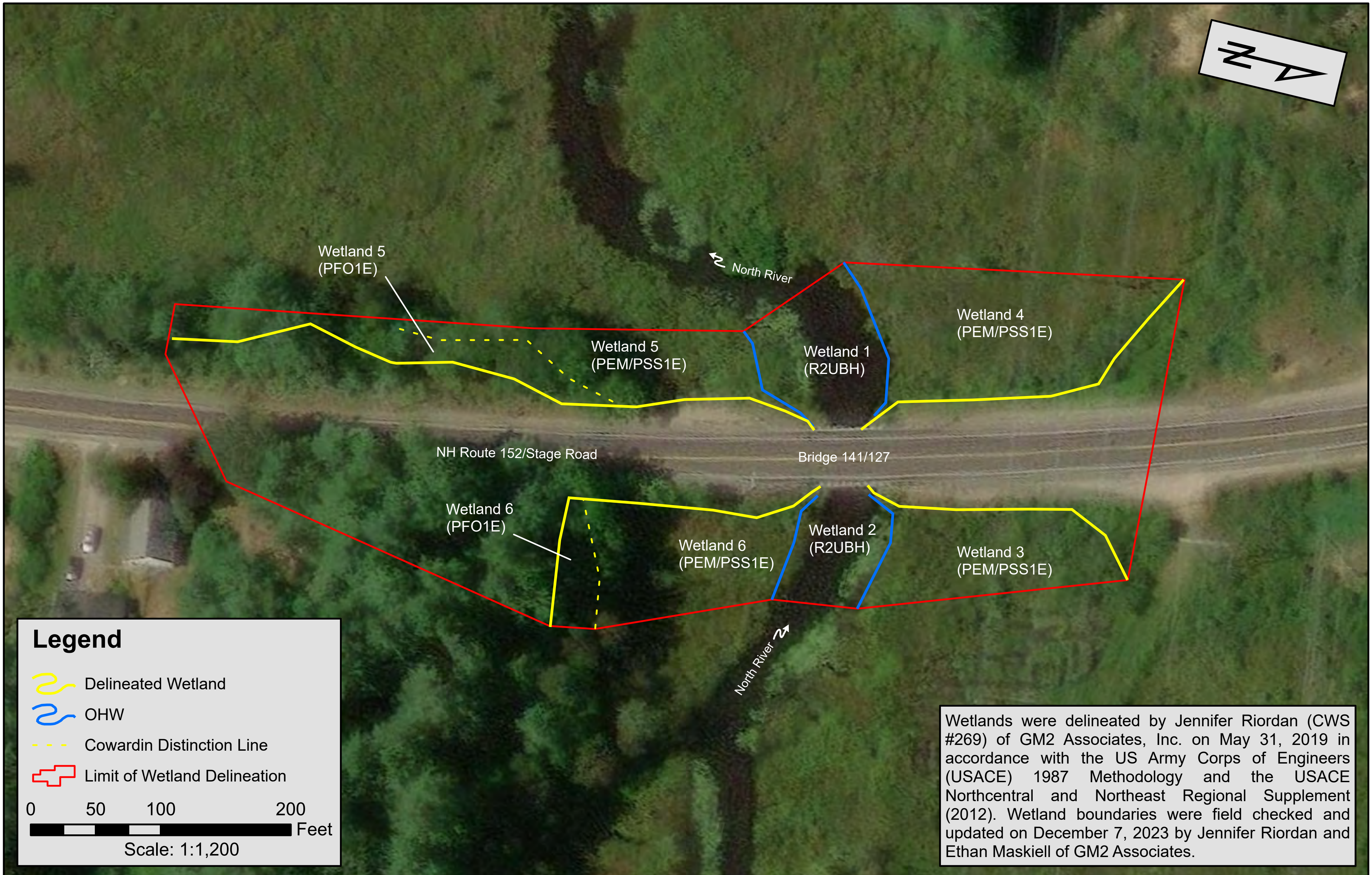
APPENDIX A

Wetland Delineation Map



Wetlands were delineated by Jennifer Riordan (CWS #269) of GM2 Associates, Inc. on May 31, 2019 in accordance with the US Army Corps of Engineers (USACE) 1987 Methodology and the USACE Northcentral and Northeast Regional Supplement (2012). Wetland boundaries were field checked and updated on December 7, 2023 by Jennifer Riordan and Ethan Maskiell of GM2 Associates.

GM2

Wetland Delineation Map

NH Route 152 over the North River
Bridge Replacement
Nottingham 40612

New Hampshire DOT
Department of Transportation

APPENDIX B

Wetland Determination Field Data Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Nottingham 40612 City/County: Nottingham / Rockingham Sampling Date: 5/31/19

Applicant/Owner: NHDOT State: NH Sampling Point: DP-1

Investigator(s): Jenn Riordan Section, Township, Range: ____

Landform (hillside, terrace, etc.): floodplain wetland Local relief (concave, convex, none): concave Slope (%): <1

Subregion (LRR or MLRA): LRR R Lat: 43.149 N Long: 71.114 W Datum: ____

Soil Map Unit Name: 97 - Freetown & Natchaug mucky peats, ponded, 0-2% slopes NWI classification: PEM1E

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

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

Hydrophytic Vegetation Present?	Yes X No ____	**Is the Sampled Area within a Wetland?** **Yes** X **No** ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	If yes, optional Wetland Site ID: Series A

Remarks: (Explain alternative procedures here or in a separate report.)
Vegetation is maintained for powerline right-of-way. Data point is located near flag A-7.

HYDROLOGY

Wetland Hydrology Indicators:

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

- X Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ____ Water Marks (B1)
- ____ Sediment Deposits (B2)
- ____ Drift Deposits (B3)
- ____ Algal Mat or Crust (B4)
- ____ Iron Deposits (B5)
- ____ Inundation Visible on Aerial Imagery (B7)
- ____ Sparsely Vegetated Concave Surface (B8)
- ____ Water-Stained Leaves (B9)
- ____ Aquatic Fauna (B13)
- ____ Marl Deposits (B15)
- X Hydrogen Sulfide Odor (C1)
- ____ Oxidized Rhizospheres on Living Roots (C3)
- ____ Presence of Reduced Iron (C4)
- ____ Recent Iron Reduction in Tilled Soils (C6)
- ____ Thin Muck Surface (C7)
- ____ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ____ Surface Soil Cracks (B6)
- ____ Drainage Patterns (B10)
- ____ Moss Trim Lines (B16)
- ____ Dry-Season Water Table (C2)
- ____ Crayfish Burrows (C8)
- ____ Saturation Visible on Aerial Imagery (C9)
- ____ Stunted or Stressed Plants (D1)
- ____ Geomorphic Position (D2)
- ____ Shallow Aquitard (D3)
- ____ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X No ____	Depth (inches): 2-4"	
Water Table Present?	Yes X No ____	Depth (inches): surface	
Saturation Present? (includes capillary fringe)	Yes X No ____	Depth (inches): surface	**Wetland Hydrology Present? Yes** X **No** ____

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

Remarks:
2-4 inches of surface water present in areas, remaining areas have saturated soils

VEGETATION – Use scientific names of plants.

Sampling Point: DP-1

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. *Spiraea latifolia*	38	Yes	FACW
2. *Clethra alnifolia*	38	Yes	FAC
3. *Viburnum recognitum*	20	Yes	FAC
4.			
5.			
6.			
7.			
	96	=Total Cover	
Herb Stratum (Plot size: 5')			
1. *Osmunda spectabilis*	20	Yes	OBL
2. *Carex utriculata*	38	Yes	OBL
3. *Carex stricta*	20	Yes	OBL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	78	=Total Cover	
Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Vegetation Strata:

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

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

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

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

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)
No vegetation in tree and woody vine strata

SOIL

Sampling Point: DP-1

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

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-14	10YR 2/1	80	10YR 2/2	20		M	Mucky Loam/Clay	slight hydrogen sulfide odor

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- X Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

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

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Nottingham 40612 City/County: Nottingham / Rockingham Sampling Date: 5/31/19

Applicant/Owner: NHDOT State: NH Sampling Point: DP-2

Investigator(s): Jenn Riordan Section, Township, Range: ______

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): convex Slope (%): 5%

Subregion (LRR or MLRA): LRR R Lat: 43.149 N Long: 71.114 W Datum: ______

Soil Map Unit Name: 298 - Pits, sand and gravel NWI classification: Not mapped

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation X , Soil ___ , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___ , Soil ___ , or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

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

Hydrophytic Vegetation Present?	Yes ___ No X	**Is the Sampled Area within a Wetland?**	**Yes** ___ **No** X
Hydric Soil Present?	Yes ___ No X	If yes, optional Wetland Site ID:	______
Wetland Hydrology Present?	Yes ___ No X		

Remarks: (Explain alternative procedures here or in a separate report.)
Vegetation is maintained for powerline right-of-way. Data point located north of flag A-7.

HYDROLOGY

Wetland Hydrology Indicators:

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

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
___ Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

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

Wetland Hydrology Present? **Yes** ___ **No** X

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

Remarks:
No wetland hydrology indicators observed

VEGETATION – Use scientific names of plants.

Sampling Point: DP-2

Tree Stratum (Plot size: 30')

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	

Sapling/Shrub Stratum (Plot size: 15')

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	

Herb Stratum (Plot size: 5')

	Absolute % Cover	Dominant Species?	Indicator Status
1. *Rubus sp.*	10	No	
2. *Betula populifolia*	10	No	FAC
3. *Comptonia peregrina*	38	Yes	UPL
4. *Solidago canadensis*	20	No	FACU
5. *Populus tremuloides*	10	No	FACU
6. *Pteridium aquilinum*	10	No	FACU
7. *Agrostis sp.*	63	Yes	
8. Unknown sedge (no seed)	20	No	
9.			
10.			
11.			
12.			
	181	=Total Cover	

Woody Vine Stratum (Plot size: 30')

	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	10	x 3 =	30
FACU species	40	x 4 =	160
UPL species	38	x 5 =	190
Column Totals:	88 (A)		380 (B)

Prevalence Index = B/A = 4.32

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Vegetation Strata:

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

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

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

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

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)
No vegetation in tree, shrub, and woody vine strata. Vegetation is maintained for powerline right-of-way. Agrostis sp. and unknown sedge not able to be identified (no seed).

SOIL

Sampling Point: DP-2

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

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-14	10YR 3/2	50					Sandy	
	10YR 3/3	50						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

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

Restrictive Layer (if observed):
Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to reflect the NRCS Field Indicators of Hydric Soils version 7.0 March 2013 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

U.S. Army Corps of Engineers **WETLAND DETERMINATION DATA SHEET – Northcentral and Northeast Region** See ERDC/EL TR-12-1; the proponent agency is CECW-CO-R	*OMB Control #: 0710-0024, Exp: 11/30/2024* *Requirement Control Symbol EXEMPT:* *(Authority: AR 335-15, paragraph 5-2a)*

Project/Site: Nottingham 40612 City/County: Nottingham/Rockingham Sampling Date: 12/7/23

Applicant/Owner: NHDOT State: NH Sampling Point: D-Wet

Investigator(s): J.Riordan & E. Maskiell Section, Township, Range: ____

Landform (hillside, terrace, etc.): floodplain wetland Local relief (concave, convex, none): concave Slope %: 2

Subregion (LRR or MLRA): LRR R Lat: 43.148 Long: 71.113 Datum: ____

Soil Map Unit Name: 97 - Freetown and Natchaug mucky peats, ponded, 0 to 2 percent slopes NWI classification: PEM1E/PFO1E

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

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

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes ___ No X	
Wetland Hydrology Present?	Yes X No ___	If yes, optional Wetland Site ID: Wetland D

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

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

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
X Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes X	No ___	Depth (inches): 14
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 2

Wetland Hydrology Present? **Yes** X **No** ___

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

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: D-Wet

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	63	Yes	FAC
2. *Pinus strobus*	10	No	FACU
3.			
4.			
5.			
6.			
7.			
	73	=Total Cover	

Sapling/Shrub Stratum (Plot size: 15')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Ilex verticillata*	20	Yes	FACW
2. *Vaccinium corymbosum*	10	Yes	FACW
3. *Acer rubrum*	10	Yes	FAC
4.			
5.			
6.			
7.			
	40	=Total Cover	

Herb Stratum (Plot size: 5')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Osmundastrum cinnamomeum*	38	Yes	FACW
2. *Coptis trifolia*	10	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	48	=Total Cover	

Woody Vine Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. None			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

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

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

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

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Vegetation Strata:

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

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

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

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

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point D-Wet

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

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-4	10YR 2/2	100					Loamy/Clayey	organic material
4-10	10YR 2/1	100					Mucky Loam/Clay	
10-16	10YR 3/1	100					Mucky Sand	

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

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Mesic Spodic (A17) **(MLRA 144A, 145, 149B)**
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)
___ Red Parent Material (F21) **(MLRA 145)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Red Parent Material (F21) **(outside MLRA 145)**
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

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

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** ___ **No** X

Remarks:
Redox features not observed likely due to saturation

U.S. Army Corps of Engineers **WETLAND DETERMINATION DATA SHEET – Northcentral and Northeast Region** See ERDC/EL TR-12-1; the proponent agency is CECW-CO-R	*OMB Control #: 0710-0024, Exp: 11/30/2024* *Requirement Control Symbol EXEMPT:* *(Authority: AR 335-15, paragraph 5-2a)*

Project/Site: Nottingham 40612 City/County: Nottingham/Rockingham Sampling Date: 12/7/23

Applicant/Owner: NHDOT State: NH Sampling Point: D-Up

Investigator(s): J.Riordan & E. Maskiell Section, Township, Range: ____

Landform (hillside, terrace, etc.): small hillslope Local relief (concave, convex, none): none Slope %: 5

Subregion (LRR or MLRA): LRR R Lat: 43.148 Long: 71.113 Datum: ____

Soil Map Unit Name: 26A - Windsor loamy sand, 0 to 3 percent slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

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

Hydrophytic Vegetation Present?	Yes ___ No X	**Is the Sampled Area within a Wetland?**	**Yes** ___ **No** X
Hydric Soil Present?	Yes ___ No X		
Wetland Hydrology Present?	Yes ___ No X	If yes, optional Wetland Site ID:	___

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

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

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

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

Wetland Hydrology Present? Yes ___ **No** X

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

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: D-Up

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1. *Pinus strobus*	63	Yes	FACU
2. *Fagus grandifolia*	3	No	FACU
3. *Quercus rubra*	3	No	FACU
4. *Tsuga canadensis*	3	No	FACU
5.			
6.			
7.			
	72	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15')			
1. *Acer rubrum*	10	Yes	FAC
2. *Tsuga canadensis*	3	No	FACU
3. *Quercus alba*	3	No	FACU
4.			
5.			
6.			
7.			
	16	=Total Cover	
Herb Stratum (Plot size: 5')			
1. *Kalmia angustifolia*	3	No	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	3	=Total Cover	
Woody Vine Stratum (Plot size: 30')			
1. None			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 50.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	13	x 3 =	39
FACU species	78	x 4 =	312
UPL species	0	x 5 =	0
Column Totals:	91 (A)		351 (B)

Prevalence Index = B/A = 3.86

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

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

Definitions of Vegetation Strata:

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

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) tall.

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

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

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point D-Up

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

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 2/2	100					Loamy/Clayey	sandy loam
3-10	7.5YR 4/6	100					Sandy	loamy sand
10-14	10YR 4/6	100					Sandy	loamy sand

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

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Mesic Spodic (A17) **(MLRA 144A, 145, 149B)**
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)
___ Red Parent Material (F21) **(MLRA 145)**

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Red Parent Material (F21) **(outside MLRA 145)**
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

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

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** ___ **No** X

Remarks:

APPENDIX C

NHDES Functional Assessment Worksheet

WETLANDS FUNCTIONAL ASSESSMENT WORKSHEET

Water Division/Land Resource Management
Wetlands Bureau

Check the Status of your Application

RSA/Rule: RSA 482-A / Env-Wt 311.03(b)(10); Env-Wt 311.10

APPLICANT LAST NAME, FIRST NAME, M.I.: NHDOT

As required by Env-Wt 311.03(b)(10), an application for a standard permit for minor and major projects must include a functional assessment of all wetlands on the project site as specified in Env-Wt 311.10. This worksheet will help you compile data for the functional assessment needed to meet federal (US Army Corps of Engineers (USACE); if applicable) and NHDES requirements. Additional requirements are needed for projects in tidal area; please refer to the Coastal Area Worksheet (NHDES-W-06-079) for more information.

Both a desktop review and a field examination are needed to accurately determine surrounding land use, hydrology, hydroperiod, hydric soils, vegetation, structural complexity of wetland classes, hydrologic connections between wetlands or stream systems or wetland complex, position in the landscape, and physical characteristics of wetlands and associated surface waters. The results of the evaluation are to be used to select the location of the proposed project having the least impact to wetland functions and values (Env-Wt 311.10). This worksheet can be used in conjunction with the Avoidance and Minimization Written Narrative (NHDES-W-06-089) and the Avoidance and Minimization Checklist (NHDES-W-06-050) to address Env-Wt 313.03 (Avoidance and Minimization). If more than one wetland/ stream resource is identified, multiple worksheets can be attached to the application. All wetland, vernal pools, and stream identification (ID) numbers are to be displayed and located on the wetlands delineation of the subject property.

SECTION 1 - LOCATION (USACE HIGHWAY METHODOLOGY)	
ADJACENT LAND USE: transportation, powerline ROW, forest, rural residential	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 10	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Jennifer Riordan (CWS #269)	
DATE(S) OF SITE VISIT(S): 5/31/2019,12/7/2023	DELINEATION PER ENV-WT 406 COMPLETED? ☒ Yes ☐ No
CONFIRM THAT THE EVALUATION IS BASED ON: ☒ Office and ☒ Field examination.	
METHOD USED FOR FUNCTIONAL ASSESSMENT (check one and fill in blank if “other”): ☒ USACE Highway Methodology. ☐ Other scientifically supported method (enter name/ title):	

SECTION 3 - WETLAND RESOURCE SUMMARY (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
WETLAND ID: North River, Flag Series A, B, C, & D	LOCATION: (LAT/ LONG) 43.15/71.11
WETLAND AREA: unknown	DOMINANT WETLAND SYSTEMS PRESENT: riverine, palustrine
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? unknown	COWARDIN CLASS: R2UBH, PEM/PSS1E, PFO1E
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? lower	IS THE WETLAND PART OF: ☒ A wildlife corridor or ☐ A habitat island? IS THE WETLAND HUMAN-MADE? ☐ Yes ☒ No
IS THE WETLAND IN A 100-YEAR FLOODPLAIN? ☒ Yes ☐ No	ARE VERNAL POOLS PRESENT? ☐ Yes ☒ No (If yes, complete the Vernal Pool Table)
ARE ANY WETLANDS PART OF A STREAM OR OPEN-WATER SYSTEM? ☒ Yes ☐ No	ARE ANY PUBLIC OR PRIVATE WELLS DOWNSTREAM/ DOWNGRADIENT? ☒ Yes ☐ No
PROPOSED WETLAND IMPACT TYPE:	PROPOSED WETLAND IMPACT AREA:

SECTION 4 - WETLANDS FUNCTIONS AND VALUES (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)

The following table can be used to compile data on wetlands functions and values. The reference numbers indicated in the "Functions/ Values" column refer to the following functions and values:

1. Ecological Integrity (from RSA 482-A:2, XI)
2. Educational Potential (from USACE Highway Methodology: Educational/Scientific Value)
3. Fish & Aquatic Life Habitat (from USACE Highway Methodology: Fish & Shellfish Habitat)
4. Flood Storage (from USACE Highway Methodology: Floodflow Alteration)
5. Groundwater Recharge (from USACE Highway Methodology: Groundwater Recharge/Discharge)
6. Noteworthiness (from USACE Highway Methodology: Threatened or Endangered Species Habitat)
7. Nutrient Trapping/Retention & Transformation (from USACE Highway Methodology: Nutrient Removal)
8. Production Export (Nutrient) (from USACE Highway Methodology)
9. Scenic Quality (from USACE Highway Methodology: Visual Quality/Aesthetics)
10. Sediment Trapping (from USACE Highway Methodology: Sediment /Toxicant Retention)
11. Shoreline Anchoring (from USACE Highway Methodology: Sediment/Shoreline Stabilization)
12. Uniqueness/Heritage (from USACE Highway Methodology)
13. Wetland-based Recreation (from USACE Highway Methodology: Recreation)
14. Wetland-dependent Wildlife Habitat (from USACE Highway Methodology: Wildlife Habitat)

First, determine if a wetland is suitable for a particular function and value ("Suitability" column) and indicate the rationale behind your determination ("Rationale" column). Please use the rationale reference numbers listed in Appendix A of USACE *The Highway Methodology Workbook Supplement*. Second, indicate which functions and values are principal ("Principal Function/value?" column). As described in *The Highway Methodology Workbook Supplement*, "functions and values can be principal if they are an important physical component of a wetland ecosystem (function only) and/or are considered of special value to society, from a local, regional, and/or national perspective". "Important Notes" are to include characteristics the evaluator used to determine the principal function and value of the wetland.

FUNCTIONS/ VALUES	SUITABILITY (Y/N)	RATIONALE (Reference #)	PRINCIPAL FUNCTION/VALUE? (Y/N)	IMPORTANT NOTES
1	☒ Yes ☐ No		☒ Yes ☐ No	The North River and adjacent wetlands are ecologically important to the area
2	☐ Yes ☒ No	1, 9	☐ Yes ☐ No	Wetland is located close to schools, but safe access and parking are limited
3	☒ Yes ☐ No	1, 3, 4, 7, 10, 14, 16, 17	☒ Yes ☐ No	North River provides fish habitat
4	☒ Yes ☐ No	1, 5, 6, 7, 8, 10, 13, 14	☒ Yes ☐ No	Wetland complex provides flood storage for North River
5	☒ Yes ☐ No	1, 2, 4, 7, 15	☐ Yes ☒ No	Wetland is associated with a perrenial stream. Gravel/sandy soils located adjacent to wetland.
6	☒ Yes ☐ No	1	☒ Yes ☐ No	Wetland is known to contain state-listed turtle species
7	☒ Yes ☐ No	1, 3, 4, 5, 7, 8, 9, 12, 13	☒ Yes ☐ No	Wetland retains water and nutrients during flood events
8	☒ Yes ☐ No	1, 4, 5, 6, 7, 10, 12	☒ Yes ☐ No	Wetland and North River provide food and habitat for fish and wildlife
9	☒ Yes ☐ No	1, 2, 3, 12	☐ Yes ☒ No	Wetland is easily viewed from Route 152
10	☒ Yes ☐ No	1, 2, 4, 10, 12, 14, 16	☒ Yes ☐ No	Wetland likely retains sediment from North River during flood events
11	☒ Yes ☐ No	3, 4, 7, 9, 12, 13	☒ Yes ☐ No	Emergent vegetation in wetland provides stabilization along edge of North River
12	☒ Yes ☐ No	4, 5, 7, 8, 12, 13, 14, 17, 19, 22, 24, 30	☒ Yes ☐ No	Wetland provides habitat for endangered species. North River is a NH Designated River (part of Lamprey River Watershed)
13	☒ Yes ☐ No	2, 6, 8	☐ Yes ☒ No	North River provides fishing opportunities but access and parking at this location is limited
14	☒ Yes ☐ No	2, 5, 6, 7, 8, 13, 17	☒ Yes ☐ No	Wetland and North River provide wildlife habitat. Surrounding area is mostly undeveloped.

SECTION 5 - VERNAL POOL SUMMARY (Env-Wt 311.10)

Delineations of vernal pools shall be based on the characteristics listed in the definition of "vernal pool" in Env-Wt 104.44. To assist in the delineation, individuals may use either of the following references:

- *Identifying and Documenting Vernal Pools in New Hampshire 3rd Ed.*, 2016, published by the New Hampshire Fish and Game Department; or
- The USACE *Vernal Pool Assessment* draft guidance dated 9-10-2013 and form dated 9-6-2016, Appendix L of the USACE New England District *Compensatory Mitigation Guidance*.

All vernal pool ID numbers are to be displayed and located on the wetland delineation of the subject property.

"Important Notes" are to include documented reproductive and wildlife values, landscape context, and relationship to other vernal pools/wetlands.

Note: For projects seeking federal approval from the USACE, please attach a completed copy of The USACE "Vernal Pool Assessment" form dated 9-6-2016, Appendix L of the USACE New England District *Compensatory Mitigation Guidance*.

VERNAL POOL ID NUMBER	DATE(S) OBSERVED	PRIMARY INDICATORS PRESENT (LIST)	SECONDARY INDICATORS PRESENT (LIST)	LENGTH OF HYDROPERIOD	IMPORTANT NOTES
1					
2					
3					
4					
5					

SECTION 6 - STREAM RESOURCES SUMMARY	
DESCRIPTION OF STREAM: lower perrenial	STREAM TYPE (ROSGEN): E
HAVE FISHERIES BEEN DOCUMENTED? ☒ Yes ☐ No	DOES THE STREAM SYSTEM APPEAR STABLE? ☒ Yes ☐ No
OTHER KEY ON-SITE FUNCTIONS OF NOTE:	

The following table can be used to compile data on stream resources. "Important Notes" are to include characteristics the evaluator used to determine principal function and value of each stream. The functions and values reference number are defined in Section 4.

FUNCTIONS/ VALUES	SUITABILITY (Y/N)	RATIONALE	PRINCIPAL FUNCTION/VALUE? (Y/N)	IMPORTANT NOTES
1	☐ Yes ☐ No	Stream resources assessed under Section 4	☐ Yes ☐ No	
2	☐ Yes ☐ No		☐ Yes ☐ No	
3	☐ Yes ☐ No		☐ Yes ☐ No	
4	☐ Yes ☐ No		☐ Yes ☐ No	
5	☐ Yes ☐ No		☐ Yes ☐ No	
6	☐ Yes ☐ No		☐ Yes ☐ No	
7	☐ Yes ☐ No		☐ Yes ☐ No	
8	☐ Yes ☐ No		☐ Yes ☐ No	
9	☐ Yes ☐ No		☐ Yes ☐ No	
10	☐ Yes ☐ No		☐ Yes ☐ No	
11	☐ Yes ☐ No		☐ Yes ☐ No	
12	☐ Yes ☐ No		☐ Yes ☐ No	
13	☐ Yes ☐ No		☐ Yes ☐ No	
14	☐ Yes ☐ No		☐ Yes ☐ No	

SECTION 7 - ATTACHMENTS (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)

☒ Wildlife and vegetation diversity/abundance list.

☒ Photograph of wetland.

☒ Wetland delineation plans showing wetlands, vernal pools, and streams in relation to the impact area and surrounding landscape. Wetland IDs, vernal pool IDs, and stream IDs must be indicated on the plans.

☐ For projects in tidal areas only: additional information required by Env-Wt 603.03/603.04. Please refer to the Coastal Area Worksheet (NHDES-W-06-079) for more information.

National Flood Hazard Layer FIRMette

FEMA

71°7'6"W 43°9'7"N

71°6'29"W 43°8'41"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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 *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

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
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 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

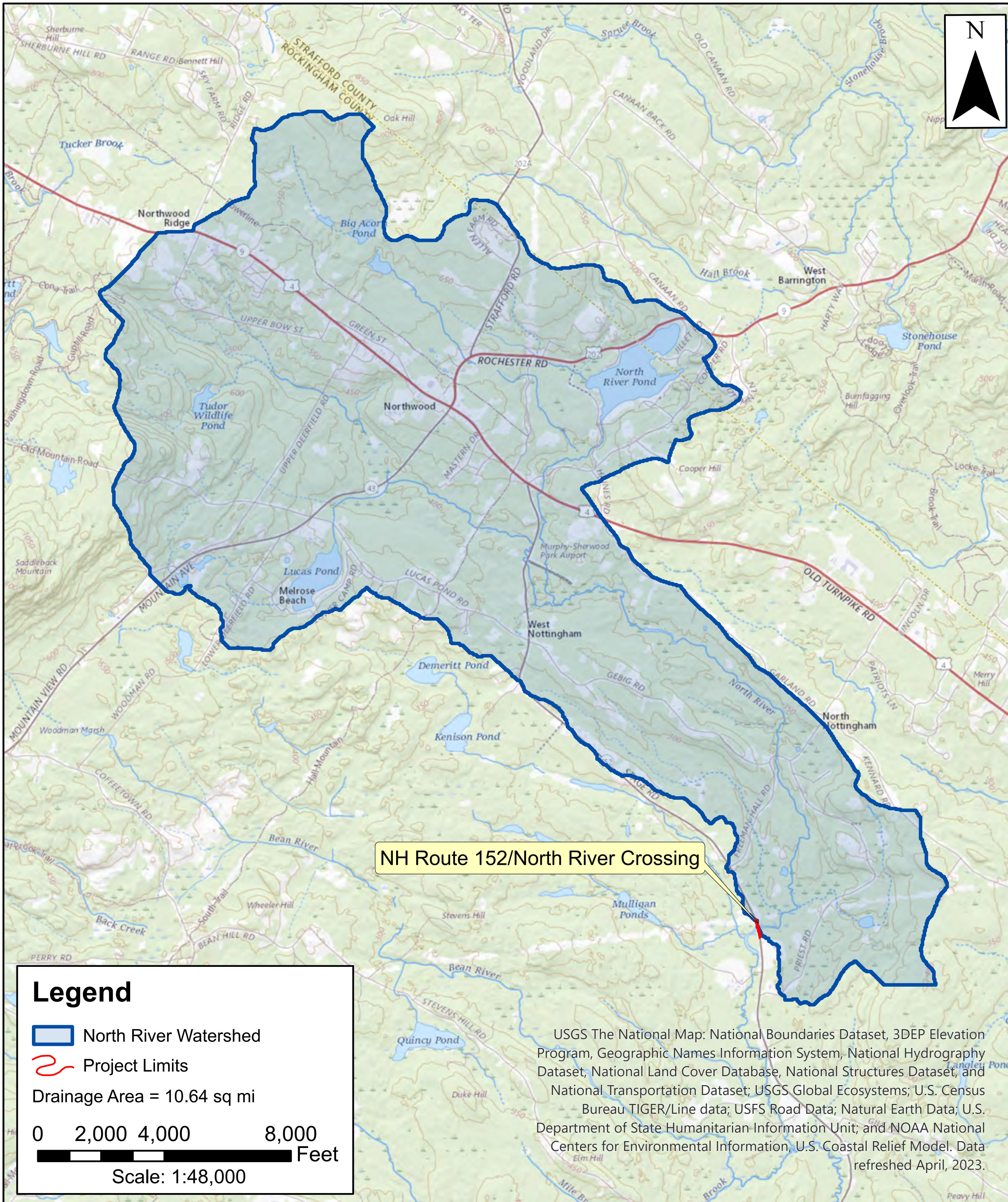
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/7/2022 at 9:34 AM 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: basemap 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.



Watershed Map

Nottingham 40612

NH Route 152 over North River

Nottingham, NH

Stream Crossing Rules (Env-Wt 900)
TECHNICAL REPORT

The project involves the replacement of the existing bridge that carries NH Route 152 over the North River (Bridge No. 141/127) in Nottingham. The existing bridge is a reinforced concrete jack-arch structure with a 17-foot clear span and is currently on the State's Red List. Proposed work includes the replacement of the existing bridge with a 30-foot clear span bridge. The bridge will be widened two feet and the project includes 300 feet of roadway widening on each end of the bridge to transition the additional width on each side of the roadway at each bridge approach back to the existing roadway. The bridge will be closed during construction and traffic will be detoured.

Since the project involves the replacement of an existing Tier 3 crossing, this report addresses the applicable stream crossing rules under Env-Wt 904.09.

Env-Wt 904.09 – Repair, Rehabilitation, or Replacement of Tier 3 and Tier 4 Existing Legal Crossings

Env-Wt 904.09(a) – The repair, rehabilitation, or replacement of tier 3 stream crossings shall be limited to existing legal crossings where the tier classification is based only on the size of the contributing watershed.

The NH Route 152/North River bridge is an existing, legal crossing. It is a Tier 3 crossing based on watershed size (6,810 acres). Also, the crossing is within a Designated River Corridor, 100-year floodplain, and an area with records of protected species.

A project shall qualify under this section only if a professional engineer certifies, and provides supporting analyses to show, that:

Env-Wt 904.09(c)(1) – The existing crossing does not have a history of causing or contributing to flooding that damages the crossing or other human infrastructure or protected species.

The existing crossing does not have a history of causing or contributing to flooding that causes damage to surrounding properties, infrastructure, or protected species habitat. Correspondence with the NHDOT District 6 office indicated that there are no recent recorded occurrences of flooding or overtopping at the crossing location.

Env-Wt 904.09(c)(2)(a) – The proposed alternative meets the general design criteria established in Env-Wt 904.01

Env-Wt 904.01 General Design Considerations

(a) All stream crossings, whether over tidal or non-tidal waters, shall be designed and constructed so as to:

1. Not be a barrier to sediment transport;

The existing 17-foot single-span bridge will be replaced with a 30-foot single span bridge. This is expected to improve sediment transport since the existing undersized bridge likely retains sediment upstream of the crossing. Stone riprap will be placed along the sides of the channel to protect the abutments from scour and construct wildlife crossing shelves, but the natural streambed will be maintained in the center of the channel. In addition, natural streambed material will be placed over the flatter areas of riprap.

2. ***Not restrict high flows and maintain existing low flows;***

   The hydraulic analysis completed for the project indicates that the proposed crossing will convey the 100-year storm with over one foot of freeboard. The existing crossing does not convey the 100-year storm.

   The proposed bridge will maintain existing low flows. Although the bridge will have a larger hydraulic opening, this is not anticipated to impact low flows given the extensive wetland and tributary system upstream of the project.

3. ***Not obstruct or otherwise substantially disrupt the movement of aquatic organisms indigenous to the waterbody beyond the actual duration of construction;***

   The project is expected to improve aquatic organism passage by increasing the existing span at the crossing from 17 feet to 30 feet. The placement of stone riprap is required for scour protection adjacent to the bridge abutments, but the remainder of the channel will be constructed to match the existing natural stream substrate (sand/muck). Natural streambed material will be placed over the flatter areas of riprap. Streambed simulation over the steeper riprap areas is not proposed since the material is unlikely to remain in place.

   A 4-foot-wide wildlife shelf will be constructed on one side of the stream channel along the southern bridge abutment to facilitate small animal passage. The wildlife shelf will be at about the same elevation as the ordinary high water line (231.50 feet). It will be constructed with stone/riprap and backfilled with finer material to create a relatively smooth surface.

   Temporary disturbance to aquatic organism passage is anticipated during construction since the stream will need to be diverted in order to construct the new bridge. Temporary impacts will be restored and the stream will be returned to its natural channel once construction is complete.

4. ***Not cause an increase in the frequency of flooding or overtopping of banks;***

   The project will result in a decrease in the frequency of flooding and overtopping of the banks and roadway due to the larger hydraulic opening. The existing bridge does not convey the 100-year storm. The hydraulic analysis completed for the project indicates that the proposed bridge will accommodate the 100-year design storm with over one foot of freeboard.

5. ***Maintain or enhance geomorphic compatibility by:***

   a) ***Minimizing the potential for inlet obstruction by sediment, wood, or debris; and***
   b) ***Preserving the natural alignment of the stream channel;***

   The project will enhance geomorphic compatibility by lengthening the crossing from 17 feet to 30 feet to span the bankfull width. The existing natural alignment of the stream will be preserved. The segment of the stream channel through the crossing will be reconstructed to match the alignment and elevation of the channel upstream and downstream of the project area.

6. ***Preserve watercourse connectivity where it currently exists;***

   The existing watercourse connectivity within the project area will not be altered.

7. ***Restore watercourse connectivity where:***

    a. ***Connectivity previously was disrupted as a result of human activity(ies); and***
    b. ***Restoration of connectivity will benefit aquatic organisms upstream or downstream of the crossing, or both;***

    N/A

8. ***Not cause erosion, aggradation, or scouring upstream or downstream of the crossing; and***

    The project is anticipated to decrease water velocity at the crossing due to the larger opening of the proposed structure. The following table shows the hydraulic analysis results for the 100-year and 500-year storm events. Stone is proposed near the bridge abutments to protect against scour.

Average Water Velocity at Bridge

	Existing	**Proposed**
100-year storm	9.36 ft/s	8.23 ft/s
500-year storm	10.66 ft/s	10.38 ft/s

9. ***Not cause water quality degradation.***

    The project is not anticipated to cause any permanent impacts to water quality. Erosion and sediment controls will be used to minimize temporary impacts during construction. The stream will be diverted so that work on the bridge abutments and in the channel will occur in dry conditions. Temporary impact areas will be restored and stabilized prior to returning flow to the stream channel.

    Widening of the bridge and roadway will increase the amount of impervious surface (pavement) by approximately 2,375 square feet. Stormwater runoff will sheet flow from the roadway into open drainage ditches, similar to existing conditions. This proposed increase in impervious surface is not expected to be substantial enough to have an impact on water quality in the project area.

Env-Wt 904.09(c)(2)(b) – The proposed stream crossing will maintain or enhance the hydraulic capacity of the stream crossing.

The proposed stream crossing will enhance the hydraulic capacity at the crossing by providing a longer span than the existing bridge. The proposed crossing will accommodate the 100-year storm event with over one foot of freeboard and will also have the capacity to convey the 500-year storm event. The existing crossing does not currently convey the 100-year storm event.

Env-Wt 904.09(c)(2)(c) – The proposed stream crossing will maintain or enhance the capacity of the crossing to accommodate aquatic organism passage.

The project will increase the span at the crossing from 17 feet to 30 feet. This will enhance aquatic organism passage in the project area. A wildlife shelf will be constructed along the southern bridge abutment to allow for small animal passage.

The stream will need to be diverted to construct the new bridge, causing temporary disturbance to aquatic organism passage. The temporary impacts will be restored and the stream will be returned to its natural channel post-construction.

Env-Wt 904.09(c)(2)(d) – The proposed stream crossing will maintain or enhance the connectivity of the stream reaches upstream or downstream of the crossing.

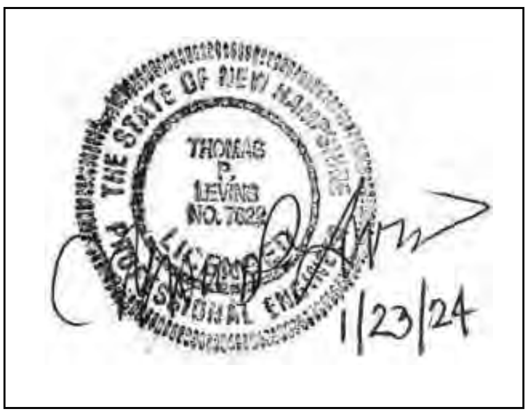
The project will enhance the connectivity of the stream by replacing an undersized bridge with a bridge that spans the bankfull width.

Env-Wt 904.09(c)(2)(e) – The proposed stream crossing will not cause or contribute to the increase in the frequency of flooding or overtopping of the banks upstream or downstream of the crossing.

The hydraulic analysis completed for the project indicates that the proposed bridge will accommodate the 100-year storm event with over one foot of freeboard. The existing bridge does not have adequate capacity to convey the 100-year flood. Since the proposed bridge will improve the hydraulic capacity of the crossing, no increase in the frequency of flooding or overtopping of banks is anticipated.

According to the hydraulic analysis, there will be a minor increase in water surface elevations immediately downstream of NH Route 152 due to the improved opening and reduction in backwater conditions. In consideration of the surrounding floodplain and wetlands, this minor increase will not have an adverse impact on the channel or surrounding properties.

As required by Env-Wt 904.09(c), this report has been certified by a Professional Engineer.



<u>Certified By</u>:
Thomas P. Levins, PE

WETLANDS PERMIT APPLICATION
STREAM CROSSING WORKSHEET
Water Division/Land Resources Management
Wetlands Bureau

RSA/Rule RSA 482-A/ Env-Wt-900

This worksheet can be used to accompany Wetlands Permit Applications when proposing stream crossings.

SECTION 1 - TIER CLASSIFICATIONS

Determine the contributing watershed size at USGS StreamStats.

Note: Plans for tier 2 and 3 crossings shall be designed and stamped by a professional engineer who is licensed under RSA 310-A to practice in New Hampshire.

Size of contributing watershed at the crossing location: 6,810 acres

☐ **Tier 1**: A tier 1 stream crossing is a crossing located on a watercourse where the contributing watershed size is less than or equal to 200 acres.

☐ **Tier 2**: A tier 2 stream crossing is a crossing located on a watercourse where the contributing watershed size is greater than 200 acres and less than 640 acres.

☒ **Tier 3**: A tier 3 stream crossing is a crossing that meets **any** of the following criteria:

- ☒ On a watercourse where the contributing watershed is more than 640 acres.
- ☒ Within a designated river corridor unless:
  - a. The crossing would be a tier 1 stream based on contributing watershed size, or
  - b. The structure does not create a direct surface water connection to the designated river as depicted on the national hydrography dataset as found on GRANIT.
- ☒ Within a 100-year floodplain (see Section 2 below).
- ☒ In a jurisdictional area having any protected species or habitat (NHB DataCheck).
- ☐ In a prime wetland or within a duly-established 100-foot buffer, unless a waiver has been granted pursuant to RSA 482-A:11, IV(b) and Env-Wt 706. Review the Wetlands Permit Planning Tool (WPPT) for town prime wetland and prime wetland buffer maps to determine if your project is within these areas.

☐ **Tier 4**: A tier 4 stream crossing is a crossing located on a tidal watercourse.

SECTION 2 - 100-YEAR FLOODPLAIN

Use the FEMA Map Service Center to determine if the crossing is located within a 100-year floodplain. Please answer the questions below:

☐ **No**: The proposed stream crossing *is not* within the FEMA 100-year floodplain.

☒ **Yes**: The proposed project *is* within the FEMA 100-year floodplain. Zone = A

Elevation of the 100-year floodplain at the inlet: N/A feet (FEMA El. or Modeled El.)

SECTION 3 - CALCULATING PEAK DISCHARGE

Existing 100-year peak discharge (Q) calculated in cubic feet per second (CFS): 1,330 CFS	Calculation method: USGS StreamStats
Estimated bankfull discharge at the crossing location: 381 CFS	Calculation method: Regional Curves

Note: If tier 1, then skip to Section 10

SECTION 4 - PREDICTED CHANNEL GEOMETRY BASED ON REGIONAL HYDRAULIC CURVES *For **tier 2**, **tier 3** and **tier 4** crossings only.*	
Bankfull Width: 39.7 feet	Mean Bankfull Depth: 2.4 feet
Bankfull Cross Sectional Area: 95.6 square feet (SF)	

SECTION 5 - CROSS SECTIONAL CHANNEL GEOMETRY: MEASUREMENTS OF THE EXISTING STREAM WITHIN A REFERENCE REACH

*For **tier 2**, **tier 3** and **tier 4** crossings only.*

Describe the reference reach location: 900-1,000' upstream of crossing

Reference reach watershed size: 6,810 acres

Parameter	**Cross Section 1** Describe bed form (*e.g. pool, riffle, glide*)	**Cross Section 2** Describe bed form (*e.g. pool, riffle, glide*)	**Cross Section 3** Describe bed form (*e.g. pool, riffle, glide*)	Range
Bankfull Width	47 feet	53 feet	51 feet	47-53 feet
Bankfull Cross Sectional Area	SF	SF	SF	SF
Mean Bankfull Depth	~4.5 feet	~4.5 feet	~4.5 feet	~4.5 feet
Width to Depth Ratio	10.4	11.8	11.3	10.4-11.8
Max Bankfull Depth	~6 feet	~6 feet	~6 feet	~6 feet
Flood Prone Width	700 feet	704 feet	773 feet	700-773 feet
Entrenchment Ratio	14.9	13.3	15.2	13.3-15.2

Table 5-1
North River – Crossing Location (NH Route 152 Bridge)

	Cross Section 1	Cross Section 2	Cross Section 3	Range	Average
Bankfull Width*	31 feet	30 feet	27 feet	27 – 31 feet	29.3 feet
Mean Bankfull Depth**	4.5 feet	4.5 feet	4.5 feet	4.5 feet	4.5 feet
Width to Depth Ratio	6.9	6.7	6.0	6.0 - 6.9	6.5
Max Bankfull Depth**	6 feet	6 feet	6 feet	6 feet	6 feet
Flood Prone Width*	530 feet	443 feet	460 feet	443 – 530 feet	478 feet
Entrenchment Ratio	17.1	14.8	17.0	14.8 – 17.1	16.3

*Bankfull width and flood prone width were estimated using LiDAR elevation data in GRANIT, combined with aerial photographs, FEMA floodplain maps, and site observations.
**Mean and maximum bankfull depths were estimated based on site observations.

SECTION 6 - LONGITUDINAL PARAMETERS OF THE REFERENCE REACH AND CROSSING LOCATION

*For **tier 2**, **tier 3** and **tier 4** crossings only.*

Average Channel Slope of the Reference Reach: ~0.002

Average Channel Slope at the Crossing Location: ~0.004

SECTION 7 - PLAN VIEW GEOMETRY

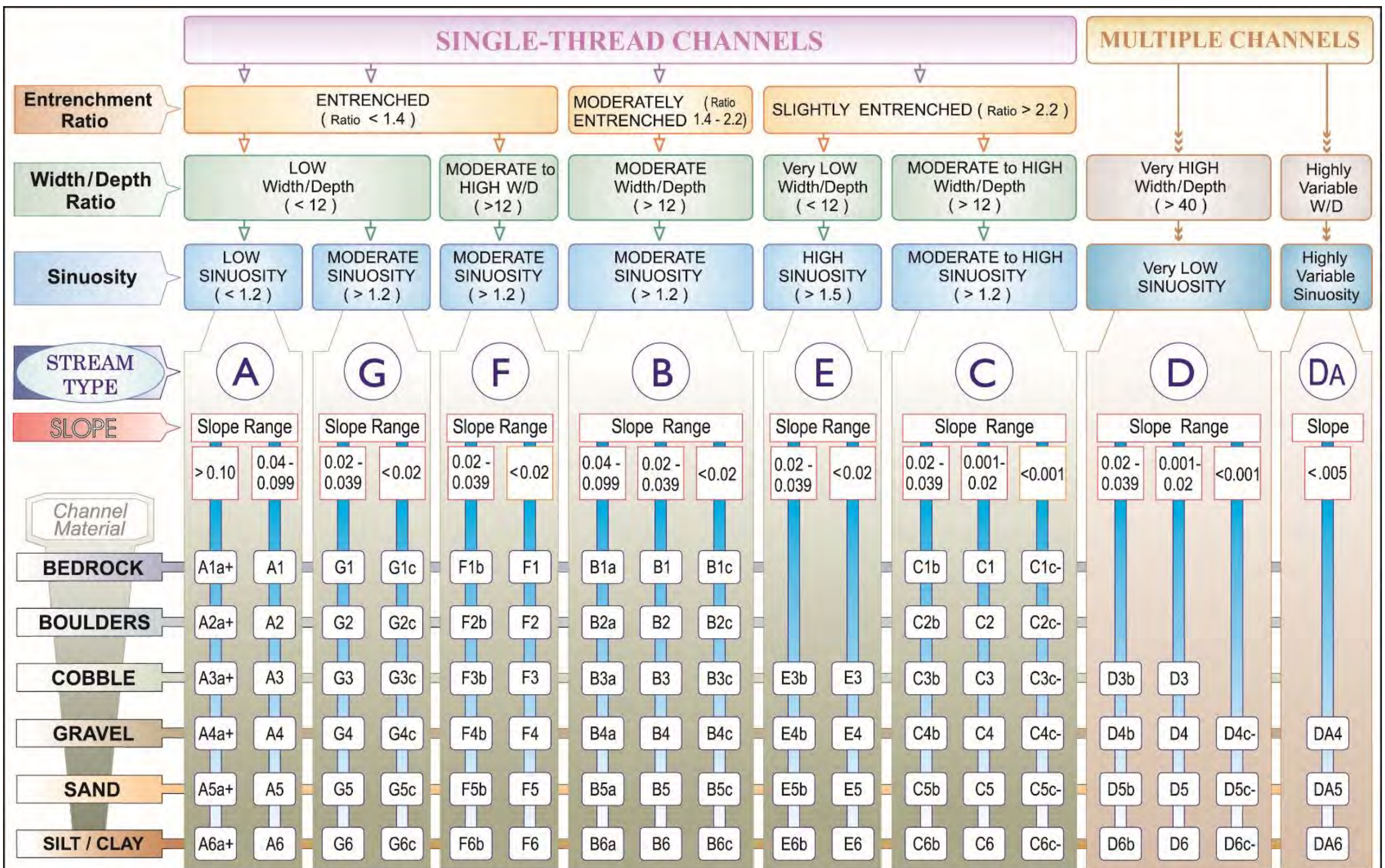
Note: Sinuosity is measured a distance of at least 20 times bankfull width, or 2 meander belt widths.

*For **tier 2**, **tier 3** and **tier 4** crossings only.*

Sinuosity of the Reference Reach: 1.2

Sinuosity of the Crossing Location: 1.2	
SECTION 8 - SUBSTRATE CLASSIFICATION BASED ON FIELD OBSERVATIONS *For **tier 2**, **tier 3** and **tier 4** crossings only.*	
% of reach that is bedrock:	%
% of reach that is boulder:	%
% of reach that is cobble:	%
% of reach that is gravel:	%
% of reach that is sand:	**100** %
% of reach that is silt:	%
SECTION 9 - STREAM TYPE OF REFERENCE REACH *For **tier 2**, **tier 3** and **tier 4** crossings only.*	
Stream Type of Reference Reach:	Type E

*Refer to Rosgen Classification Chart (**Figure 2**) below:*



KEY to the ***ROSGEN*** CLASSIFICATION of NATURAL RIVERS. As a function of the *"continuum of physical variables"* within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units, while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

Figure 2: Reference from Applied River Morphology, Rosgen, 1996.

SECTION 10 - CROSSING STRUCTURE METRICS

Existing Conditions	**Existing Structure Type:**	☒ Bridge span ☐ Pipe arch ☐ Open-bottom culvert ☐ Closed-bottom culvert ☐ Closed-bottom culvert with stream simulation ☐ Other:				
	Existing Crossing Span: *(perpendicular to flow)*	17 feet	**Culvert Diameter:** feet **Inlet Elevation:** El. feet			
	Existing Crossing Length: *(parallel to flow)*	32.7 feet	**Outlet Elevation:** El. feet **Culvert Slope:**			
Proposed Conditions	**Proposed Structure Type:**		**Tier 1**	**Tier 2**	**Tier 3**	**Alternative Design**
	Bridge Span		☐	☐	☒	☐
	Pipe Arch		☐	☐		☐
	Closed-bottom Culvert		☐	☐		☐
	Open-bottom Culvert		☐	☐	☐	☐
	Closed-bottom Culvert with stream simulation		☐	☐	☐	☐
	Proposed Structure Span: *(perpendicular to flow)*	30 feet	**Culvert Diameter:** feet **Inlet Elevation:** El. feet			
	Proposed Structure Length: *(parallel to flow)*	34.7 feet	**Outlet Elevation:** El. feet **Culvert Slope:**			
	Proposed Entrenchment Ratio:* 1.0 *For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only. To accommodate the entrenchment ratio, floodplain drainage structures may be utilized.*					

** Note: Proposed Entrenchment Ratio must meet the minimum ratio for each stream type listed in **Figure 3**, otherwise the applicant must address the Alternative Design criteria listed in Env-Wt 904.10.*

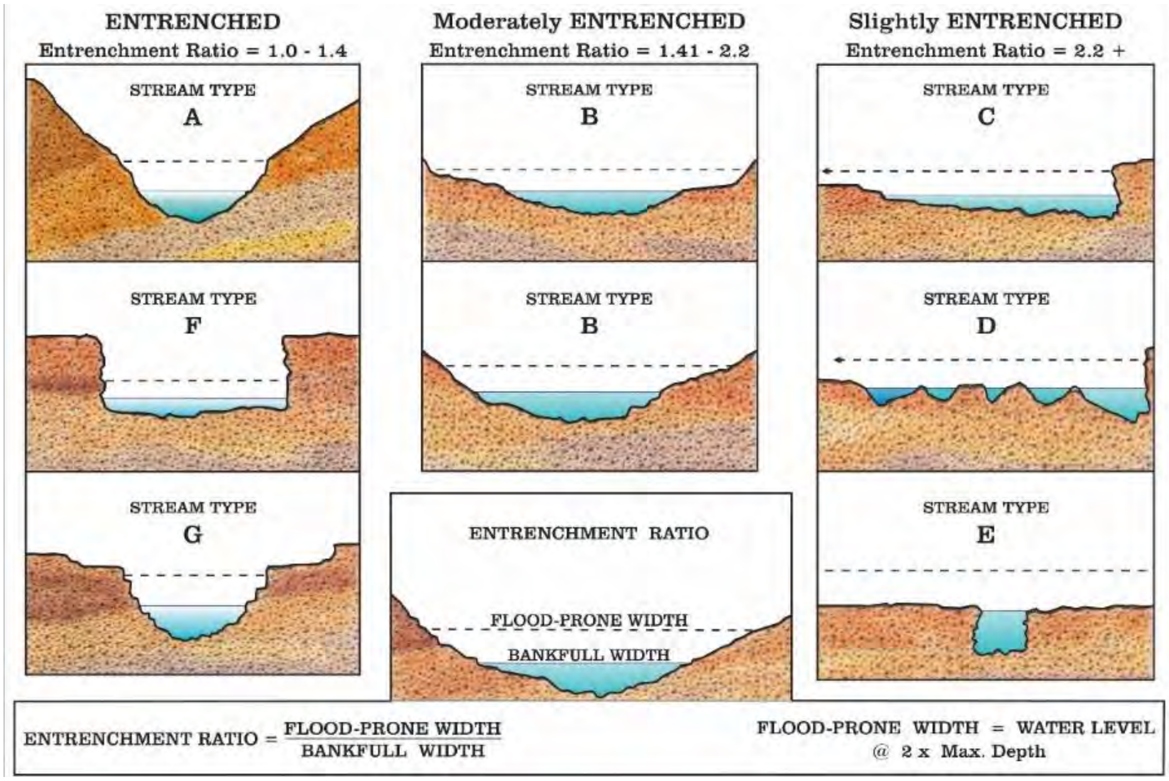


Figure 3: Reference from Applied River Morphology, Rosgen, 1996.

SECTION 11 - CROSSING STRUCTURE HYDRAULICS		
	Existing	**Proposed**
100 year flood stage elevation at inlet:	237.02 ft	234.72 ft
Flow velocity at outlet in feet per second (FPS):	9.36	8.23
Calculated 100 year peak discharge (Q) for the *proposed* structure in CFS:		1,330
Calculated 50 year peak discharge (Q) for the *proposed* structure in CFS:		1,100

SECTION 12 - CROSSING STRUCTURE OPENNESS RATIO

*For **tier 2**, **tier 3** and **tier 4** crossings only.*

Crossing Structure Openness Ratio* =

* Openness box culvert = (height x width)/length
Openness round culvert = (3.14 x radius^2)/length

SECTION 13 - GENERAL DESIGN CONSIDERATIONS

Env-Wt 904.01 requires all stream crossings to be designed and constructed according to the following requirements. Check each box if the project meets these general design considerations.

All stream crossings shall be designed and constructed so as to:

☒ Not be a barrier to sediment transport.

☒ Prevent the restriction of high flows and maintain existing low flows.

☒ Not obstruct or otherwise substantially disrupt the movement of aquatic life indigenous to the waterbody beyond the actual duration of construction.

☒ Not cause an increase in the frequency of flooding or overtopping of banks.

☒ Maintain or enhance geomorphic compatibility by:

a. Minimizing the potential for inlet obstruction by sediment, wood, or debris, and

b. Preserving the natural alignment of the stream channel.

☒ Preserve watercourse connectivity where it currently exists.

☐ Restore watercourse connectivity where:

a. Connectivity previously was disrupted as a result of human activity(ies), and

b. Restoration of connectivity will benefit aquatic life upstream or downstream of the crossing, or both.

☒ Not cause erosion, aggradation, or scouring upstream or downstream of the crossing.

☒ Not cause water quality degradation.

SECTION 14 - TIER-SPECIFIC DESIGN CRITERIA

Stream crossings must be designed in accordance with the tier specific design criteria listed in Part Env-Wt 904.

☒ The proposed project meets the tier specific design criteria listed in Part Env-Wt 904 and each requirement has been addressed in the plans and as part of the wetland application.

SECTION 15 - ALTERNATIVE DESIGN

NOTE: If the proposed crossing does not meet all of the general design considerations, the tier specific design criteria, or the minimum entrenchment ratio for each given stream type listed in **Figure 3**, then an alternative design plan and associated requirements must be addressed pursuant to Env-Wt 904.10.

☐ I have submitted an alternative design and addressed each requirement listed in Env-Wt 904.10.

Replacement of Bridge No. 141/127
Route 152 (Stage Road) over North River
Nottingham, NH
State Project No. 40612

Final Hydraulic Design Report

Prepared for:

New Hampshire Department of Transportation
7 Hazen Drive
Concord, NH 03302

Prepared by:

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Date: November 3, 2022
Revised: -

Prepared By: Michelle K. Handfield, PE

Checked by: Thomas P. Levins, PE

THE STATE OF NEW HAMPSHIRE
THOMAS P. LEVINS
NO. 7622
LICENSED
PROFESSIONAL ENGINEER

Table of Contents

1. Location Maps

Figure 1: Location Map: NH 2015 Orthophoto

Figure 2: Location Map: Google Street Map

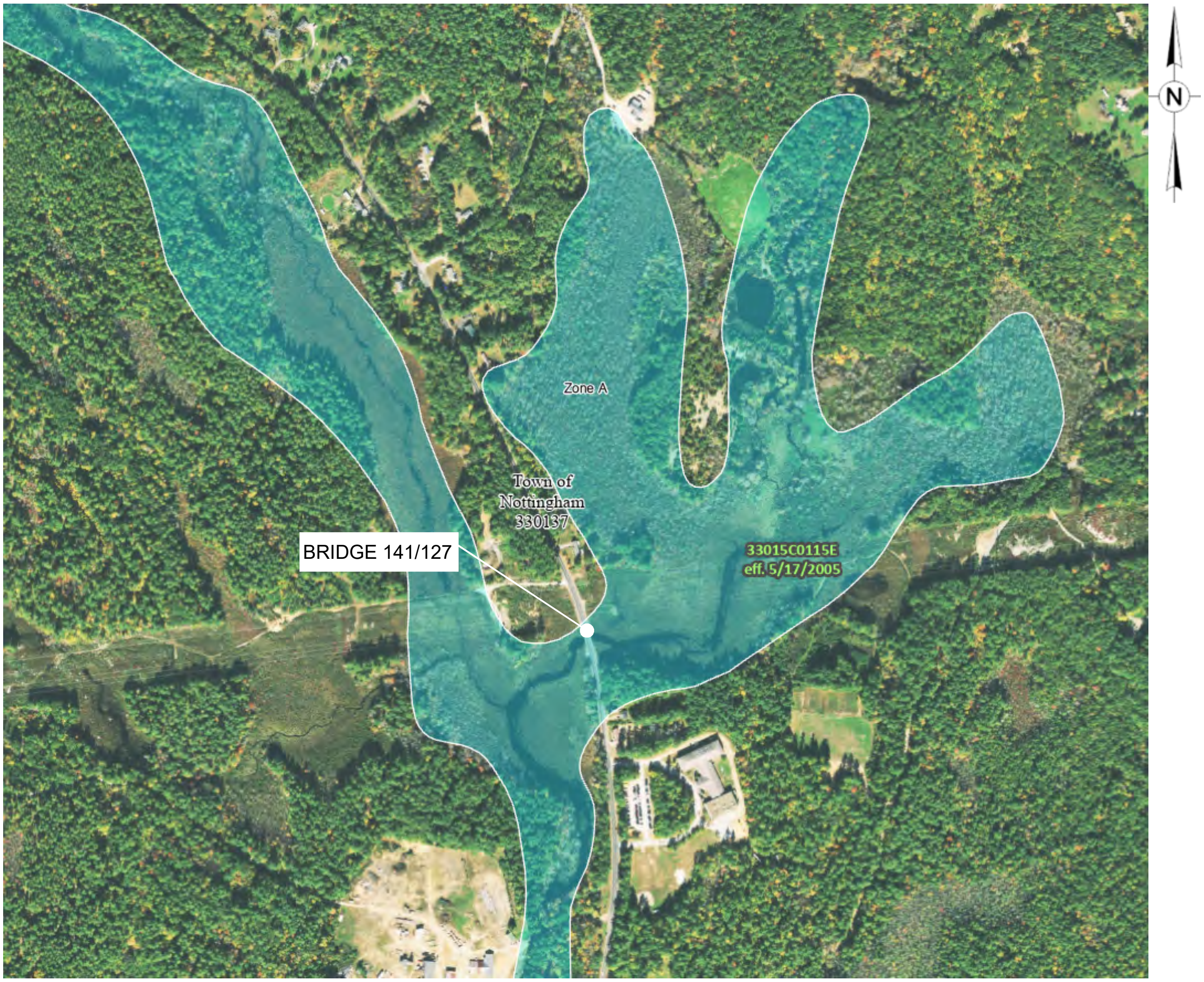


Figure 3: Location Map: FEMA FIRM

2. Introduction

2.1 Background

Replacement of Bridge 141/127 is required to address deficiencies. The following report documents the efforts and results of the hydrologic, hydraulic, and scour analysis of the existing structure and proposed replacement in accordance with the New Hampshire Department of Transportation (NHDOT) Bridge Design Manual (BDM).

2.2 Existing Conditions

Bridge 141/127 carries Route 152 (Stage Road) over the North River in Nottingham. Constructed in 1925 and rebuilt in 1970, the bridge is a single span structure. The superstructure consists of steel beams with a concrete jack arch deck (original) and steel beams with concrete deck (widened section). Abutments and U-back wingwalls are concrete faced stone masonry walls. The existing bridge has a 17-foot clear span, and out-to-out width of 32.7-feet, and a low chord elevation of ±235.50 feet. The Rural Major Collector has an AADT = 3,180 (2017) and is a New Hampshire Tier 3 Bridge.

The deck is in poor (4) condition and with an overall structural evaluation rating of serious (3). It is structurally deficient with a Sufficiency Rating of 35% (2019 Inspection). It is currently listed on the NHDOT's Red List.

The bridge currently has an NBIS Item 113 rating = 8 (Scour Critical Status) and an NBIS Item 61 rating = 6 (Channel and Channel Protection). The North River is characterized by sands, cobble, and boulders. Scour is present under the bridge, with footing exposure along both abutments, as documented in underwater inspections. The observed depth of scour has not increased since 2012.

2.3 Proposed Replacement

The proposed structure will convey the river at the same location of the existing bridge. A rigid concrete frame with a 30' clear span will replace the existing steel girders and concrete jack arch deck. The proposed structure will have concrete headwalls and u-back wingwalls. The new structure will raise existing low chords, improving the hydraulic opening and allow for improvements to the roadway profile to minimize the potential for weir flow. The open bottom structure will maintain the native streambed to facilitate the passage of aquatic organisms and conform to the NHDES' stream crossing rules. A wildlife path will also be constructed under the bridge.

2.4 FEMA Study

The bridge is located within FEMA Zone A per FEMA FIRM 33015C0115E. Zone A has no published FEMA base flood elevations and a detailed study of North River has not been performed.

2.5 Vertical Datum

Vertical coordinates in the report reference North American Vertical Datum of 1988 (NAVD88).

3. Design Criteria

3.1 Hydraulic Design

Route 152 is a Tier 3 highway; per NHDOT BDM Table 2.7.5-1 the Design Flood and Check Flood are 100-year and 500-year frequencies, respectively. One (1) foot freeboard, as measured from the low chord to the Design Flood upstream water surface elevation, is also required.

3.2 Scour Design

For a 100-year hydraulic design storm, scour analysis criteria include a 200-year storm with a 500-year check storm, in accordance with guidelines established in the FHWA's "Evaluating Scour at Bridges" (HEC-18) 5th Edition, Table 2.3. The 100-year storm was also evaluated.

4. Hydrology

4.1 Watershed

The contributing runoff for this location comes from the upper hills and valleys north and northwest of the bridge. North River flows through the existing structure, and continues southerly, eventually flowing into the Lamprey River. At the bridge, North River is a meandering stream with a low slope and a widened reach that passes through an extensive floodplain and wetland. North River is a NH Designated River and Tier 3 crossing. USGS StreamStats for NH was used to determine a drainage area of 10.64 mi^2 and a storage area of 0.73 mi^2.

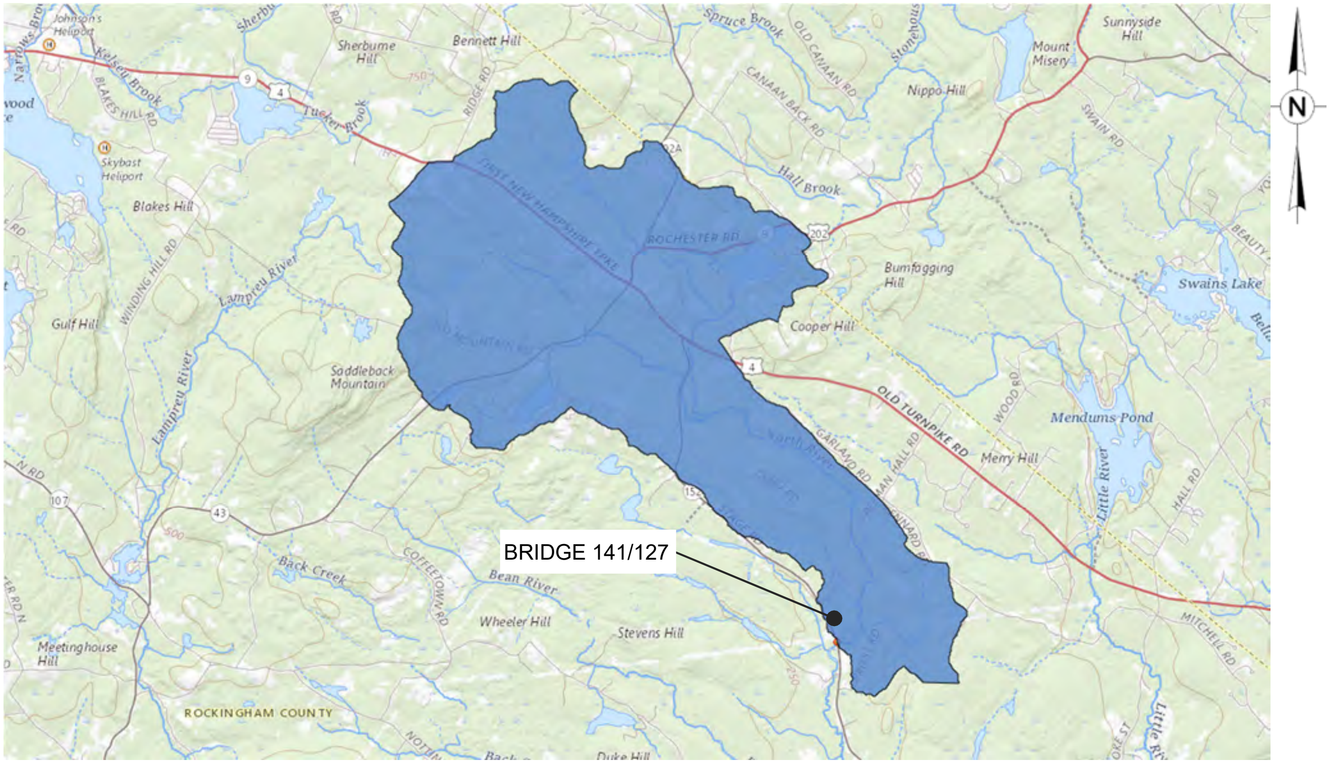


Figure 4: Watershed Map

4.2 Historic Flooding

Primary flooding issues in the region are a result of snowmelt and rain combined with ice dams (Rockingham County FIS). At Bridge 141/127, a historic flood was recorded in March 1936 when the southern bridge approach was overtopped by ±1.5-feet.

4.3 Design Flows

USGS StreamStats for NH or the Natural Resources Conservation Service (NRCS) (SCS) Unit Hydrograph Method are appropriate methods for determining peak flows for an ungaged site. Based on watershed size and available storage, StreamStats was used for the subject bridge. To consider downstream confluences, flows were also computed in StreamStats for a lower reach of North River with a drainage area = 13.68 mi² and a flow change was included in the hydraulic model. StreamStats does not report a 200-year peak flood; a frequency curve was established to obtain the 200-year storm. Back-up data is provided in Appendix C.

DA	Q2	Q5	Q10	Q25	Q50	Q100	Q200	Q500
10.64	315	520	690	920	1100	1330	1540	1880
13.68	390	630	840	1110	1330	1600	1850	2230

Table 1: Peak Flows

5. Hydraulic Analysis

5.1 Methodology

Water surface profiles were developed for the North River for existing and proposed conditions using HEC-RAS version 6.1.

5.2 Model Geometry

The geometric data used is a combination of current field survey and LIDAR obtained from NOAA; vertical datum for the project is NAVD88.

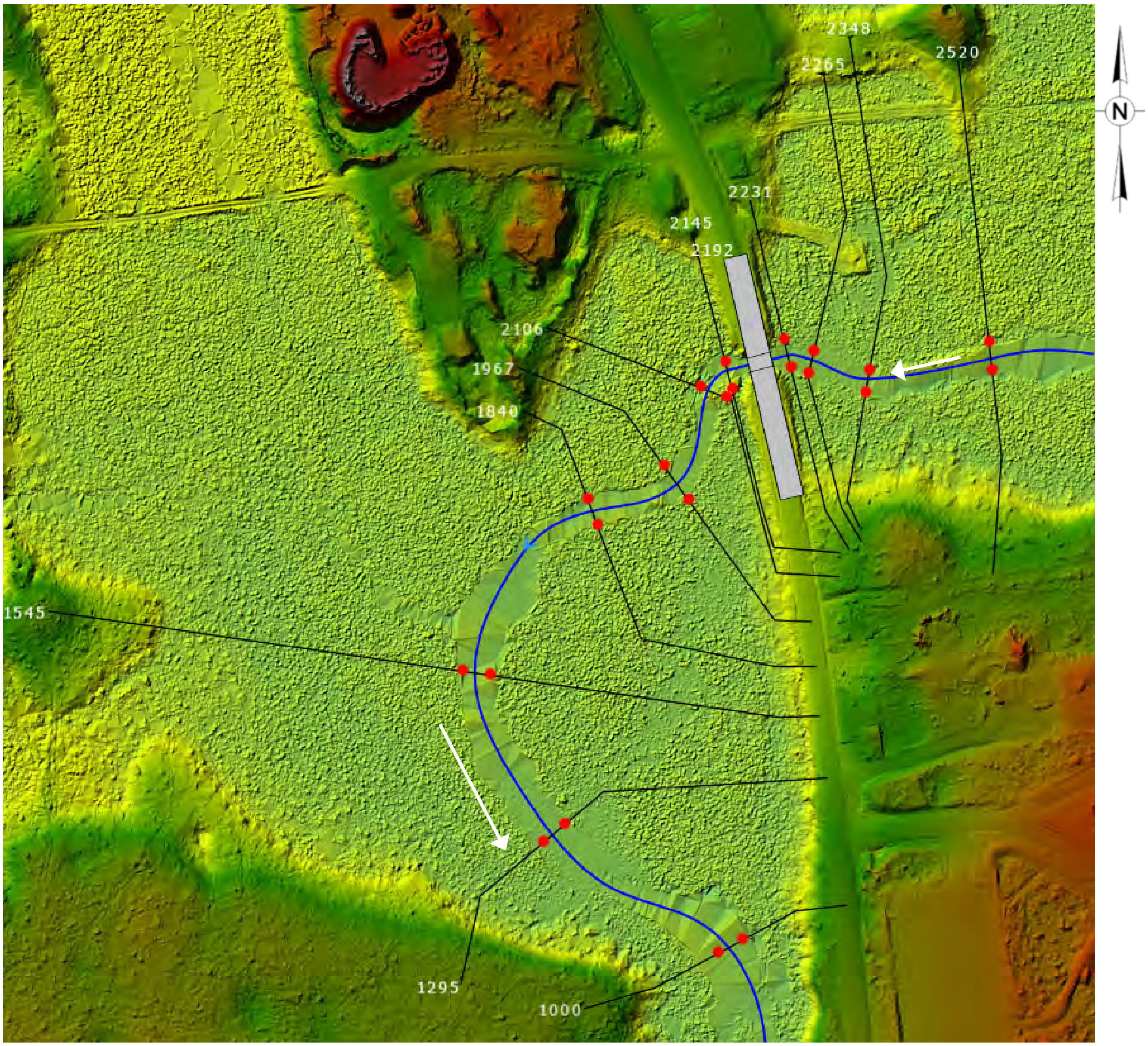


Figure 5: HEC-RAS Cross Section Location Map

5.3 Hydraulic Parameters

This reach of the North River is meandering stream with a low slope and a widened reach that passes through an extensive floodplain and wetland. The river bed is characterized by sand, cobbles, and boulders. Channel and overbank roughness (Manning's 'n' values) were assigned based on observation. For the overbank, a value of 0.08 was used. For the channel, a value of 0.03 was used.

Figure 6: Typical Channel & Overbank Conditions

For contraction and expansion dynamic head losses, values of 0.1 and 0.3 were used except near the bridge where the flow area changes more suddenly. Values of 0.3 and 0.5 were used in this case. Ineffective areas were added for contraction and expansion. Contraction & expansion ratios at the bridges were added at 1:1 ratio and 1:2 ratios, respectively.

Boundary conditions were identified for a subcritical flow regime; normal depth = 0.002 was used as the downstream boundary based on the channel slope.

5.4 Existing Conditions

The following geometric conditions were modeled under existing conditions:

- 17’ Clear span
- Bridge width = 32.7’
- Overtopping relief south of the bridge (low point = 237.00)
- Low chord = 235.50
- Bridge open area = 141.32 ft²

The results are as follows for the Design Flood (1330 CFS):

US 100-YR WSEL	237.02	ft	RS 2265
DS 100-YR WSEL	233.78	ft	RS 2145
Average velocity at bridge	9.36	ft/s	RS 2192 (BR Open Vel)
Minimum Freeboard:	-1.52	ft	LC – US WSEL

The results are as follows for the Check Flood (1880 CFS):

US 500-YR WSEL	237.72	ft	RS 2265
DS 500-YR WSEL	234.60	ft	RS 2145
Average velocity at bridge	10.66	ft/s	RS 2192 (BR Open Vel)
Minimum Freeboard:	-2.22	ft	LC – US WSEL

The existing model indicates the existing bridge does not have adequate capacity to convey the Design Flood without exhibiting weir flow and overtopping of the roadway.

5.5 Proposed Bridge (30' Clear Span)

The following geometric conditions were modeled under proposed conditions:

- 30' Clear span
- Bridge width = 33'
- Improved roadway profile w/raised low point = 237.30
- Raised low chord = 236.25
- Bridge open area = 241.51 ft^2
- 4' wildlife passage shelf along southern abutment

The results are as follows for the Design Flood (1330 CFS):

US 100-YR WSEL	234.72	ft	RS 2265
DS 100-YR WSEL	233.85	ft	RS 2145
Average velocity at bridge	8.23	ft/s	RS 2192 (BR Open Vel)
Minimum Freeboard:	1.53	ft	LC – US WSEL

The results are as follows for the Check Flood (1880 CFS):

US 500-YR WSEL	236.13	ft	RS 2265
DS 500-YR WSEL	234.69	ft	RS 2145
Average velocity at bridge	10.38	ft/s	RS 2192 (BR Open Vel)
Minimum Freeboard:	0.12	ft	LC – US WSEL

The proposed bridge provides the capacity to convey both the Design Flood and Check Flood without weir flow. For the Design Flood, at least 1-foot of freeboard is provided. The proposed bridge eliminates pressure flow conditions at Route 152 for both the Design and Check Flood, thus reducing velocities as compared to existing conditions.

There is a minor increase in water surface elevations that occurs immediately downstream of Route 152 due to the improved opening and reduction in backwater conditions. In consideration of the surrounding floodplain and wetlands, this minor increase will not have an adverse impact on the channel or surrounding properties.

5.6 Stream Crossing Rules Compliant Structure (66' Clear Span)

From the University of New Hampshire (UNH) Stream Crossing guidelines, a numeric standard that has been used to determine the appropriate width of the streambed inside the proposed structure is 1.2x the bankfull width plus 2 feet. There is also mention of using 2.2x the bankfull width for Type E streams, which is recommended by NHDES. The existing bank full width surveyed immediately upstream of the bridge is 30 feet. A compliant span length of 66-feet was calculated (2.2x bankfull width).

The following geometric conditions were modeled for the compliant structure:

- Widened 66' clear span
- Improved roadway profile w/raised low point = 237.30 *same as 30' span*
- Raised low chord = 236.25 *same as 30' span*
- 4' wildlife passage shelf along southern abutment *same as 30' span*

The results are as follows for the Design Flood (1330 CFS):

US 100-YR WSEL	234.35	ft	RS 2265
DS 100-YR WSEL	233.85	ft	RS 2145
Average velocity at bridge	5.71	ft/s	RS 2192 (BR Open Vel)
Minimum Freeboard:	1.90	ft	LC – US WSEL

The results are as follows for the Check Flood (1880 CFS):

US 500-YR WSEL	235.45	ft	RS 2265
DS 500-YR WSEL	234.69	ft	RS 2145
Average velocity at bridge	6.62	ft/s	RS 2192 (BR Open Vel)
Minimum Freeboard:	0.80	ft	LC – US WSEL

Although this alternative meets the NHDES Stream Crossing Rules, the structure exceeds the needs of the project and has increased wetland impacts. The 30-foot clear span precast concrete rigid frame is proposed for replacement as it meets NHDOT hydraulic requirements, provides for wildlife passage requirements, and minimizes wetland impacts.

5.7 Comparison

HEC-RAS input and outlet results for Existing, Proposed, and the Stream Crossing Rules Compliant Structure are provided in Appendix D. A comparison of the Design Flood water surface profiles, water surface elevations, and velocities for existing and proposed conditions are as follows:

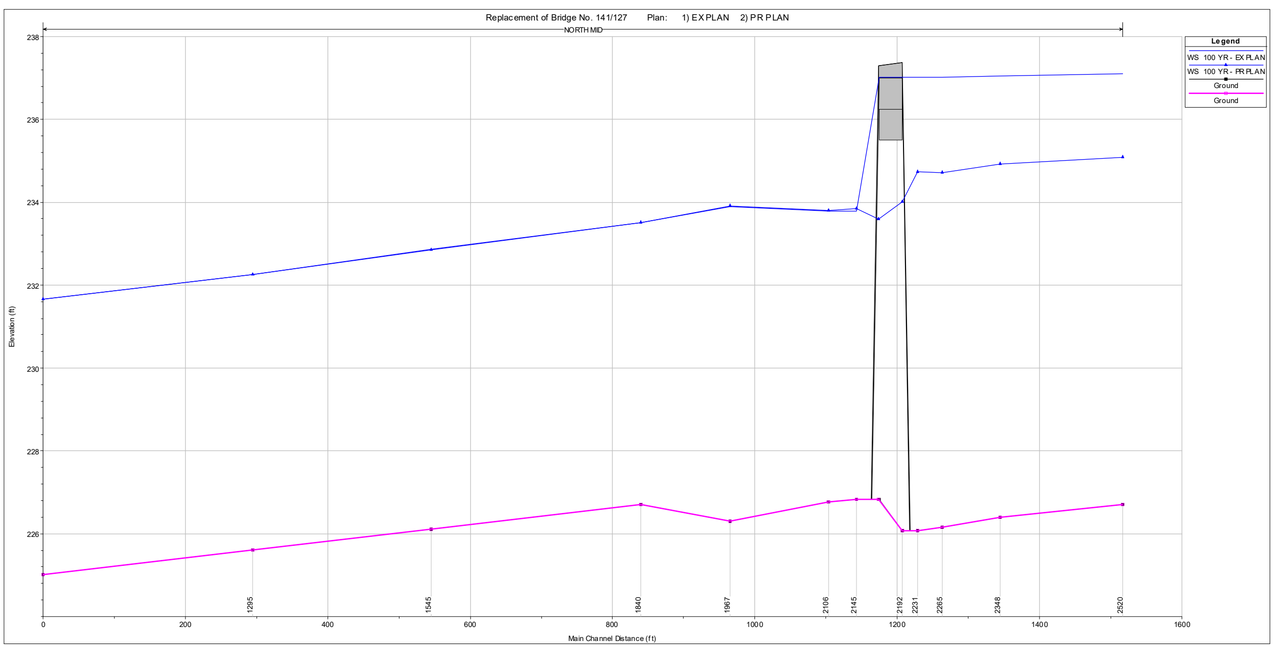


Figure 7: Water Surface Profile Comparison: Design Storm

		WSEL (ft)			Velocity (ft/s)		
RS	Q_{100}	EX	PR	PR vs EX	EX	PR	PR vs EX
2520	1330	237.10	235.09	-2.01	1.80	3.16	1.36
2348	1330	237.06	234.92	-2.14	2.49	4.22	1.73
2265	1330	237.02	234.72	-2.30	2.80	5.05	2.25
2231	1330	237.02	234.73	-2.29	2.52	4.37	1.85
2192							
2145	1330	233.78	233.85	0.07	5.92	5.30	-0.62
2106	1330	233.78	233.80	0.02	5.33	5.28	-0.05
1967	1330	233.90	233.92	0.02	3.26	3.22	-0.04
1840	1330	233.50	233.52	0.02	5.52	5.52	0.00
1545	1600	232.86	232.84	-0.02	6.66	6.76	0.10
1295	1600	232.26	232.26	0.00	7.14	7.14	0.00
1000	1600	231.67	231.67	0.00	7.13	7.13	0.00

Table 2: Design Storm Comparison

6. Stability & Scour Assessment

6.1 Channel Description

The bridge currently has an NBIS Item 113 rating = 8 (Scour Critical Status) and an NBIS Item 61 rating = 6 (Channel and Channel Protection). The North River is characterized by sands, cobble, and boulders. Scour is present under the bridge, with footing exposure along both abutments, as documented in underwater inspections. The observed depth of scour has not increased since 2012.

6.2 Scour Analysis Methodology

In accordance with the BDM and HEC-18 Evaluating Scour at Bridges (FHWA, 5th Ed., April 2012), bridges with a 100-year hydraulic design storm should be evaluated for the 200-year design and 500-year (super flood) event. The 100-year storm was also evaluated. Input data was obtained from the proposed HEC-RAS model discussed above. Velocity distribution tables were evaluated at the main channel approach section RS 2265, bounding section RS 2231, and bridge section RS 2192 BR U to evaluate flow conveyance, critical velocities, and identify input variables. Calculations and annotated output is presented in Appendix E.

6.3 Long Term Scour

Based on observations, inspection reports, and survey data, there is no evidence of significant channel degradation through the subject reach of the North River. There is aggradation at the outlet of the bridge and movement of bed material has exposed the footings, however it is limited to the bridge area suggesting it is the result of localized scour conditions vs. conditions of the overall reach.

6.4 Streambed Material

The bed material consists of sands, cobble, and boulders. Based on sieve analysis, a D_{50} = 0.18 mm was used in the analysis to represent the bed material.

6.5 Contraction Scour

Contraction scour occurs from the reduction of flow area as a result of the embankments, bridge encroaching into the floodplain or main channel, change in the downstream control of the water surface elevation or the location of the bridge in relation to a bend. There are two forms of contraction scour; live-bed and clear-water. Equations are presented in HEC-18, Sections 6.2-6.4.

Live-bed scour occurs when bed material in the upstream reach is transported into the bridge section. Clear-water scour occurs when either no bed material is transported from the upstream reach or the material being transported is mostly in suspension. Based on the size of streambed material, the North River's flow velocities are greater than the bed material's critical velocity and live bed contraction scour governs.

6.6 Local Scour

Local scour at abutments is caused by the acceleration of flow and the development of vortex systems induced by obstructions to the flow. HEC-18 recommends the use of either the HIRE or Froehlich equations. The HIRE equation was developed from data relative to the Mississippi River and is not applicable when the ratio of the projected abutment length to the flow depth is > 25. The HIRE methodology is not applicable at Bridge 141/127. Local scour at the abutments was computed using Froehlich as presented in HEC-18, Section 8.6.1.

6.7 NCHRP 24-20 Abutment Scour

Local scour was also computed using the NCHRP 24-20 methodology outlined in HEC-18. The NCHRP 24-20 approach uses contraction scour as the starting computation, applying a factor for large scale turbulence which occurs in the vicinity of the abutment. Scour depths were computed using equations presented in HEC-18, Section 8.6.3 for live-bed contraction scour with vertical-walls.

6.8 Comparison & Evaluation

A summary of scour depths computed using HEC-18 methods is provided in the following table.

Event	Contraction	Froehlich's		Total Component		NCHRP 24-20
	Live	Left	Right	Left	Right	
	ft	ft	ft	ft	ft	ft
Incipient	2.39	3.66	9.91	6.04	12.29	7.50
200 Year	2.98	4.47	10.83	7.46	13.81	8.76
500 Year	3.99	5.70	12.21	9.69	16.20	10.67

Table 3: Scour Depth Comparison

Froehlich's equations estimate upper limit depths and the resultant total component scour depths are overly conservative for field conditions and the documented scour history. Values computed using the NCHRP 24-20 method are recommended for design.

For proposed conditions, it is recommended to maintain the NBIS Item 113 rating = 8 (Scour Critical Status) and NBIS Item 61 rating = 6 (Channel and Channel Protection).

6.9 Channel Protection

To protect against future scour damage along the new abutments, riprap protection in accordance with HEC-23 is proposed. Computations are provided in Appendix F.

7. Conclusion

The proposed 30-foot span bridge is adequate to convey the Design flood (Q100) yielding greater than one foot of freeboard during the Design flood and adequate conveyance during the Check Flood (Q500). Footings will be designed to withstand 200-year computed scour depths = 8.76-feet. There is a minor increase in water surface elevations that occurs immediately downstream of Route 152 due to the improved opening and reduction in backwater conditions. In consideration of the surrounding floodplain and wetlands, this minor increase will not have an adverse impact on the channel or surrounding properties.

The project will also incorporate riprap along the abutments to provide scour protection.

APPENDIX A: Photographs

NH Route 152: On Bridge Looking North

NH Route 152: On South Approach Looking North

NH Route 152: North Approach Looking North

NH Route 152: North Approach Looking South

NH Route 152: On Bridge Looking Upstream

Bridge: East Fascia

Bridge: West Fascia

Bridge: West Fascia and South Abutment

Bridge: Z-pile and H-pile holes at NE corner

Bridge: H-pile hole at SE corner

APPENDIX B: Data Collection Form

DATA COLLECTION AND FIELD REVIEW

I. GENERAL PROJECT DATA

Bridge No.: 141/127

Town: Nottingham

Feature carried: Route 152 (Stage Road)

Project No: 40612

Feature crossed: North River

Functional class:
- [x] Tier 1, 2 or 3
- [ ] Tier 4 or 5

Year built: 1925

Overall NBIS structure rating: 3

USGS total scour index: -

Year Rebuilt: 1970

NBIS Item 113: 8

Sufficiency rating: 45

Plans available? ○ yes ◉ no

II. SUPERSTRUCTURE INFORMATION

Bridge width: 32.7 (ft)

Number of spans: 1

Bridge length: 23.0 (ft)

Bridge skew: 0 (degrees)

III. HYDROLOGIC AND HYDRAULIC INFORMATION

Watershed area: 10.64 (sq. mi.) (if available from existing plans or report)

Is it tidally influenced? ○ yes ◉ no

What information is available?
- [ ] floodway analysis report
- [ ] FEMA F.I.S.
- [ ] hydraulic report
- [ ] SCEL analysis
- [ ] Other: ____
- [ ] scour report
- [ ] comparative report

Existing Bridge Hydraulic Information *(if available)*:

	Source	2 Yr. Event	10 Yr. Event	50 Yr. Event	100 Yr. Event	500 Yr. Event
Flow rates (cfs)	Streamstats	315	690	1100	1330	1880
	Streamstats	390	840	1330	1600	2230
Precipitation (in)	NOAA	3.22	5.14	7.22	8.18	11.3
Tidal elevations (ft)						

Elevations (ft.)								
At Structure			Water Surface at Approach Cross Section RS 2265					
Streambed	Low Chord	Roadway	2 Yr. Event	10 Yr. Event	50 Yr. Event	100 Yr. Event	500 Yr. Event	
226.07	235.5	237.0	230.94	233.29	236.44	237.02	237.72	

Pressure flow at design storm? ☑ yes ☐ underclearance______(ft.)

Comments: Existing bridge overtops during 100-year Design Flood

IV. SITE DATA

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

Bridge 141/127 carries Route 152 (Stage Road) over the North River in Nottingham. Constructed in 1925 and rebuilt in 1970, the bridge is single span structure. The superstructure consists of steel beams with a concrete jack arch deck (original) and steel beams with concrete deck (widened section). Abutments and U-back wingwalls are concrete faced stone masonry walls. The existing bridge has a 17-foot clear span, and out-to-out width of 32.7-feet, and a low chord elevation of ±235.50 feet.

See Appendix G

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.

The deck is in poor (4) condition and with an overall structural evaluation rating of serious (3). It is structurally deficient with a Sufficiency Rating of 35% (2019 Inspection). It is currently listed on the NHDOT's Red List. Scour is present under the bridge, with footing exposure along both abutments.

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

The southern bridge approach overtopped in March 1936 by 1.5-feet as recorded in the bridge file.

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

Roadway LP south of bridge = 237.0 (Existing) and 237.3 (Proposed)

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.

No apparent impediments

V. PERIPHERAL SITE DATA

A. Hydraulic control – Note location and description.

Roadway LP south of bridge

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

Comments: None.

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

DA = 10.64 sq.mi. Primarily wooded, with clustered development along main roads.

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.

None.

VI. STREAM CHANNEL AND RELATED ASPECTS

A. Stream characterization *(completed with Environmental Project Manager)*

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	≤ 25 mi^2
	Medium	> 25 mi^2 and ≤ 100 mi^2
	Large	> 100 mi^2
Streambed slope	Low	≤ 25 ft/mi
	Moderate	> 25 ft/mi and ≤ 100 ft./mi
	Steep	> 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)

STREAM SIZE	Small (< 30 m wide)	Medium (30–150 m)	Wide (> 150 m)	
FLOW HABIT	Ephemeral	(Intermittent)	Perennial but flashy	Perennial
BED MATERIAL	Silt-clay	Silt	Sand	Gravel / Cobble or boulder
VALLEY SETTING	No valley; alluvial fan	Low relief valley (< 30 m deep)	Moderate relief (30-300 m)	High relief (> 300 m)
FLOOD PLAINS	Little or none (< 2X channel width)	Narrow (2-10 channel width)	Wide (> 10X channel width)	
NATURAL LEVEES	Little or None	Mainly on Concave	Well Developed on Both Banks	
APPARENT INCISION	Not Incised	Probably Incised		
CHANNEL BOUNDARIES	Alluvial	Semi-alluvial	Non-alluvial	
TREE COVER ON BANKS	<50 percent of bankline	50-90 percent	>90 percent	
SINUOSITY	Straight Sinuosity 1-1.05)	Sinuous (1.06-1.25)	Meandering (1.25-2.0)	Highly meandering (>2)
BRAIDED STREAMS	Not braided (<5 percent)	Locally braided (5-35 percent)	Generally braided (>35 percent)	
ANABRANCHED STREAMS	Not anabranched (<5 percent)	Locally anabranched (5-35 percent)	Generally anabranched (>35 percent)	
VARIABILITY OF WIDTH AND DEVELOPMENT OF BARS	Equiwidth; Narrow point bars	Wider at bends; Wide point bars	Random variation; Irregular point and lateral bars	

Source: Adapted From Brice and Blodgett, 1978
(See also FHWA HEC-20, "Stream Stability at Highway Structures" for discussion of the above factors

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.

____

____

____

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 of reduction in the average cross sectional area, the character of obstructions, and the location and spacing of obstructions.

<u>NOTE</u>: 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), with 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. 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

Is there confluence present?	◉ yes		○ no
Angle of attack (flood flow):	○ yes		◉ no
Bends in channel:	☑ upstream of bridge ☐ straight channel reach		☑ downstream of bridge ☑ at bridge
Trapping potential:	☑ low	☐ medium	☐ high
Debris potential:	☑ low	☐ moderate	☐ high
Overtopping relief:	☐ none ☐ on bridge	☑ left approach ☐ relief bridge	☐ right approach ☐ cannot be determined

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

Comments: ______________________________

VIII. VISUAL SCOUR EVIDENCE

USGS observed scour index: -

History of scour problem: ◉ yes ○ no

Comments: Scour is present under the bridge, with footing exposure along both abutments, as documented in underwater inspections. The observed depth of scour has not increased since 2012.

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

CONTRACTION SCOUR SUSCEPTIBILITY

Channel width upstream: 31 (ft.)
Channel width under bridge: 30 (ft.)
Channel width ratio (channel width upstream / channel width under the bridge: 1:1

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 (D50):
@ approach section ______ (in) ☐ sample taken for sieve analysis
@ bridge 0.007 (in) ☑ sample taken for sieve analysis

Contraction scour susceptibility rating: ☐ low ☑ medium ☐ high

Comments: Wide wetland and floodplain with large ineffective flow area upstream and downstream.

ABUTMENT SUSCEPTIBILITY (EXISTING BRIDGE) (if applicable):

Which abutment is worse?: ☐ left ☐ right

Observed scour depth: To footing (ft) Remaining embedment in river bed: Unknown (ft)

Abutment protection:

Type: None

Condition: ☐ good ☐ fair ☐ weathered ☐ poor ☐ slumped ☑ N/A ☐ missing

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

Comments: ______________________________

PIER SUSCEPTIBILITY (EXISTING BRIDGE) (if applicable):

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

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

Pier protection:

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

Condition: ☐ good ☐ fair ☐ weathered ☐ poor ☐ slumped ☐ N\A ☐ missing

Comments: ______________________________

APPENDIX C: Hydrologic Analysis

Historic Flooding Documentation
StreamStats Computations
Flow Frequency Curve
Rainfall Data

STATE HIGHWAY DEPT. Div 6 STEEL SPANS MADE WHP CARD 1 OF 2

DATE 5/7/41 NH CHECKED JCB

TOWN Nottingham NO. 141/127 BRIDGE OVER North River SPAN NO. 1970

RATING H-15 MEMBER DESIGN LIVE LOAD REQUIRED LIVE LOAD POSTED LIVE LOAD YEAR BUILT 1925

NO. AND TYPE SPANS All incased I bm strgrs with conc. jack arches TOTAL LENGTH 23-0"

SKEW — SUPERELEVATION CROWN 1" in 10-6" APPROACH PAVEMENT STG 16'

GENERAL	ALIGNMENT	GRADE	SIGHT DISTANCE	SPAN LENGTH		WIDTH 28'-0"		CLEARANCE	ROAD-WAY	RAIL-ROAD	HIGH WATER
BRIDGE	tan.			C. C. BEARINGS		BETWEEN CURBS	~~21-0~~				
SE REAR APPROACH	"	+1%	500'+	O. O. FLOOR	23-0	BETWEEN RAILS		HORIZONTAL	21-2		
NW FORWARD APPROACH	"	level	"	CLEAR SPAN	17-0	WALKS	—	VERTICAL	open		1-0

DESIGNED BY HIGHWAY DEPT. ~~CONS. ENG.~~ BUILT BY NHHD

MAINTAINED BY STATE ~~TOWN~~ RAILROAD PLANS ON FILE D25 ~~NOT ON FILE~~ ~~TOLL OR~~ FREE

PROJECT NO. SAB 1925 CONTRACTOR Force acct

TOTAL COST $2989.15 STEEL COST FLOOR SLAB COST

TRAFFIC SURVEY DATA A B C D F G H I

WATERWAY. ELEVATION LOW BRIDGE ELEVATION MAXIMUM HIGH WATER Full 1936 AREA BRIDGE OPENING 125 □' ±

ALIGNMENT AND CHARACTER CHANNEL D.A. 6,750 acres. Wooded slopes & North R. Pond

Fin Gr. to str. bed = 10-1" av. Cl. Water Ht = 8-0" av. Water 3-6" av. deep 5/7/41

REMARKS 1936 flood 1-6"± over south approach.

SUBSTRUCTURE	MATERIAL	TYPE	HEIGHT	SUPPORTING MATERIAL	PILES—TYPE	NO.	SIZE	LENGTH	CAPS
REAR ABUTMENT	Old stone	rein conc. faced		soft					
SE FORWARD ABUTMENT	"	"		"					
NW PIERS OR BENTS									

WINGS Same as abuts. parallel type. Old abuts & wings set on log cribbing.

REMARKS Condition very good

Postindex PAT. APR. 3,'23 FEB. 8,'27 96-C-7396-14

SUPERSTRUCTURE. MATERIAL Struct Steel & Conc. SPAN TYPE incased I bm. strgrs *

GRADE TO BRIDGE SEAT 2-1" GRADE TO LOW STEEL

DEPTH PANELS AT PAINT none required except G R

	WEARING COURSE	FLOOR	CURBS	ROAD RAIL	WALK RAIL	BEARINGS EXPANSION	FIXED
MATERIAL	Gravel	Conc	Conc	Wood			
TYPE	Bit. Surf	jack arch	mono	single rail		Sliding type	
HEIGHT	0-5"	13" rise	0-9"			4 ply tar paper	
THICKNESS		6" @ crown	12" wide			south abut.	
FASTENINGS				incased I posts			

FLOOR DRAINAGE none

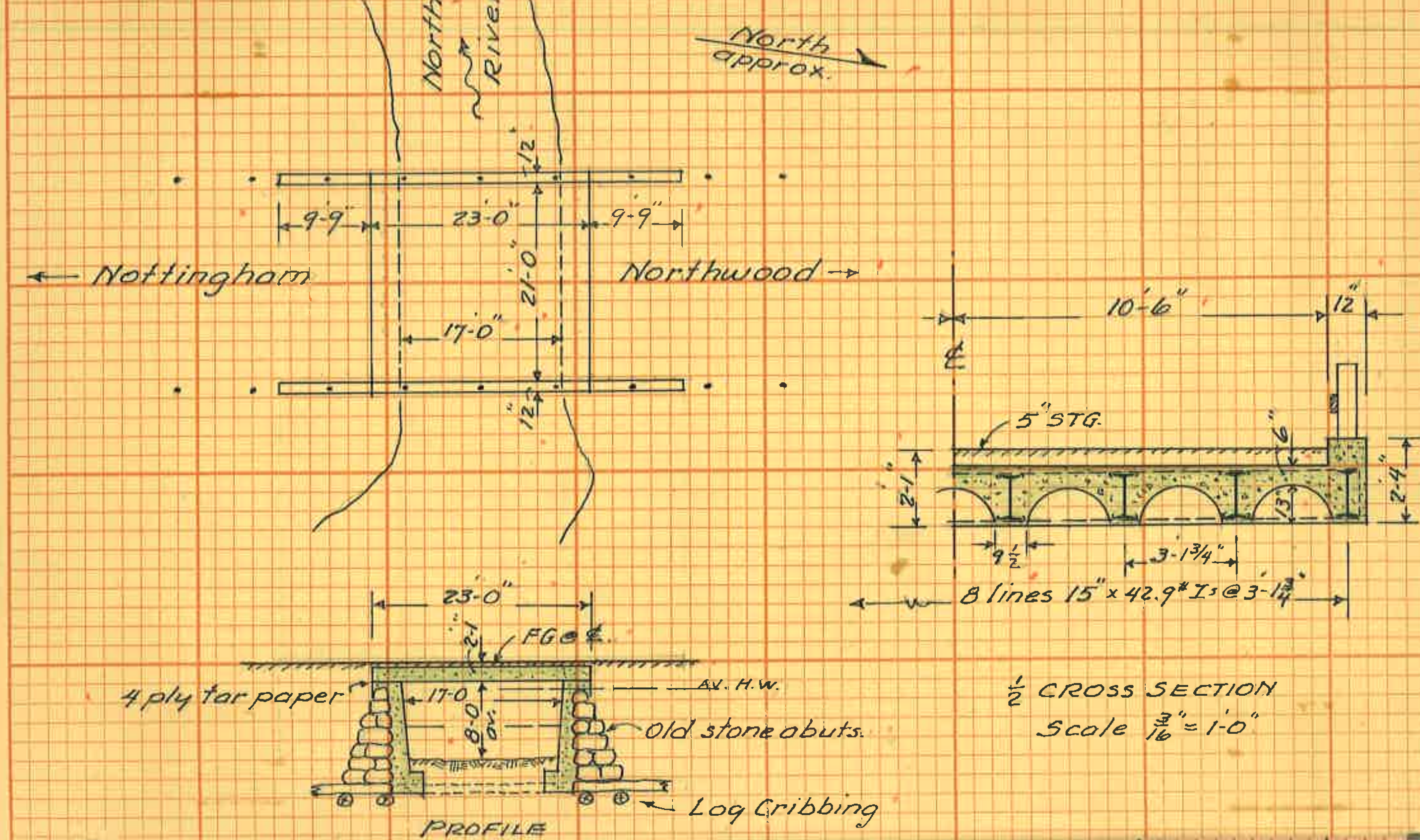
REMARKS General condition very good

* 8 lines 15" x 42.9# Is @ 3-1¾" c-c. 5/8"φ hook rods @ 10-0" c-c.

* Repaired & widened 1970.

5.15 Miles N.W. from Nottingham-Lee T.L.

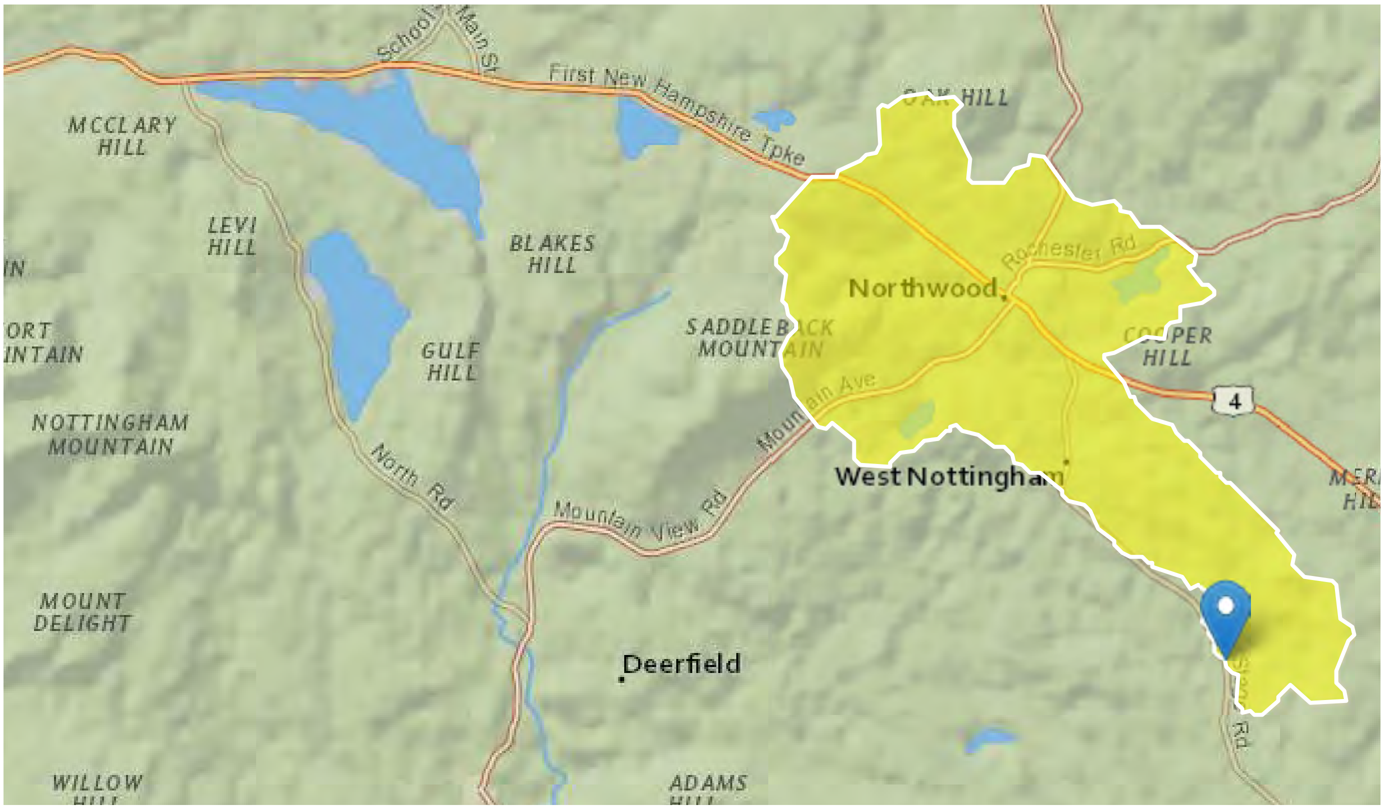
TOWN	BRIDGE NO.	ROUTE	STRENGTH	CLEAR ROADWAY	VERTICAL CLEARANCE
Nottingham	141/127	NH 152	-H6 H6 H8 H10 H12 H15 H20	14'-18' 19'-23' 24'-28' 29'-32'+	-10' 11' 12' 13' 14' 14'+ OC



TOWN	BRIDGE NO.	ROUTE	STRENGTH	CLEAR ROADWAY	VERTICAL CLEARANCE
Nottingham	141/127	NH 152	H15	19'-23'	OC

StreamStats Report
North River at Bridge 141/127

Region ID: NH
Workspace ID: NH20190715195200441000
Clicked Point (Latitude, Longitude): 43.14859, -71.11313
Time: 2019-07-15 15:52:19 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	10.64	square miles
CONIF	Percentaqe of land surface covered by coniferous forest	11.7727	percent
PREBC0103	Mean annual precipitation of basin centroid for January 1 to March 15 winter period	8.35	inches
BSLDEM30M	Mean basin slope computed from 30 m DEM	6.661	percent
MIXFOR	Percentage of land area covered by mixed deciduous and coniferous forest	31.5015	percent

Parameter Code	Parameter Description	Value	Unit
PREG_03_05	Mean precipitation at gaging station location for March 16 to May 31 spring period	9.6	inches
TEMP	Mean Annual Temperature	45.88	degrees F
TEMP_06_10	Basinwide average temperature for June to October summer period	61.86	degrees F
PREG_06_10	Mean precipitation at gaging station location for June to October summer period	18	inches
ELEVMAX	Maximum basin elevation	976.63	feet
SNOFALL	Mean Annual Snowfall	71.719	inches
PREBC_1112	Mean annual precipitation of basin centroid for November 1 to December 31 period	9.37	inches
PRECIPCENT	Mean Annual Precip at Basin Centroid	46.1	inches
PRECIPOUT	Mean annual precip at the stream outlet (based on annual PRISM precip data in inches from 1971-2000)	44.9	inches
MINTEMP_W	Mean winter minimum air temperature over basin surface area	15.413	degrees F
APRAVPRE	Mean April Precipitation	4.187	inches
WETLAND	Percentage of Wetlands	6.863	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	43.3	feet per mi

Seasonal Flow Statistics Parameters[Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	10.64	square miles	3.26	689
CONIF	Percent Coniferous Forest	11.7727	percent	3.07	56.2
PREBC0103	Jan to Mar Basin Centroid Precip	8.35	inches	5.79	15.1
BSLDEM30M	Mean Basin Slope from 30m DEM	6.661	percent	3.19	38.1

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
MIXFOR	Percent Mixed Forest	31.5015	percent	6.21	46.1
PREG_03_05	Mar to May Gage Precipitation	9.6	inches	6.83	11.5
TEMP	Mean Annual Temperature	45.88	degrees F	36	48.7
TEMP_06_10	Jun to Oct Mean Basinwide Temp	61.86	degrees F	52.9	64.4
PREG_06_10	Jun to Oct Gage Precipitation	18	inches	16.5	23.1
ELEVMAX	Maximum Basin Elevation	976.63	feet	260	6290

Seasonal Flow Statistics Flow Report[Low Flow Statewide]

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

Statistic	Value	Unit	PIl	PIu	SE	SEp
Jan to Mar15 60 Percent Flow	9.32	ft^3/s	6.46	12.9	21.2	21.2
Jan to Mar15 70 Percent Flow	7.96	ft^3/s	5.57	11	20.7	20.7
Jan to Mar15 80 Percent Flow	6.6	ft^3/s	4.82	8.79	18.2	18.2
Jan to Mar15 90 Percent Flow	4.9	ft^3/s	3.51	6.62	19.3	19.3
Jan to Mar15 95 Percent Flow	3.84	ft^3/s	2.68	5.28	20.7	20.7
Jan to Mar15 98 Percent Flow	2.97	ft^3/s	1.85	4.47	27.1	27.1
Jan to Mar15 7 Day 2 Year Low Flow	6.33	ft^3/s	4.7	8.29	17.2	17.2
Jan to Mar15 7 Day 10 Year Low Flow	3.59	ft^3/s	2.47	5	21.5	21.5
Mar16 to May 60 Percent Flow	20	ft^3/s	16.1	24.4	12.2	12.2
Mar16 to May 70 Percent Flow	16	ft^3/s	13.1	19.3	11.4	11.4
Mar16 to May 80 Percent Flow	12.3	ft^3/s	9.93	15.1	12.4	12.4
Mar16 to May 90 Percent Flow	9.03	ft^3/s	7.1	11.3	13.7	13.7
Mar16 to May 95 Percent Flow	6.82	ft^3/s	5.27	8.68	14.8	14.8
Mar16 to May 98 Percent Flow	4.8	ft^3/s	3.49	6.43	18.1	18.1
Mar16 to May 7 Day 2 Year Low Flow	8.36	ft^3/s	6.5	10.5	14.5	14.5
Mar16 to May 7 Day 10 Year Low Flow	4.69	ft^3/s	3.54	6.06	16.2	16.2
Jun to Oct 60 Percent Flow	1.69	ft^3/s	0.893	2.89	36.7	36.7
Jun to Oct 70 Percent Flow	1.21	ft^3/s	0.605	2.16	39.9	39.9
Jun to Oct 80 Percent Flow	0.822	ft^3/s	0.377	1.55	44.5	44.5

Statistic	Value	Unit	PIl	PIu	SE	SEp
Jun to Oct 90 Percent Flow	0.5	ft^3/s	0.205	1.01	50.7	50.7
Jun to Oct 95 Percent Flow	0.344	ft^3/s	0.127	0.741	57	57
Jun to Oct 98 Percent Flow	0.259	ft^3/s	0.0888	0.583	61.1	61.1
Jun to Oct 7 Day 2 Year Low Flow	0.585	ft^3/s	0.213	1.22	55.6	55.6
Jun to Oct 7 Day 10 Year Low Flow	0.218	ft^3/s	0.0535	0.548	78.5	78.5
Nov to Dec 60 Percent Flow	8.74	ft^3/s	5.82	12.5	23.3	23.3
Nov to Dec 70 Percent Flow	6.59	ft^3/s	4.19	9.79	25.9	25.9
Nov to Dec 80 Percent Flow	4.82	ft^3/s	2.97	7.35	27.8	27.8
Nov to Dec 90 Percent Flow	3.1	ft^3/s	1.78	4.96	31.6	31.6
Nov to Dec 95 Percent Flow	2.07	ft^3/s	1.05	3.61	38.3	38.3
Nov to Dec 98 Percent Flow	1.3	ft^3/s	0.53	2.6	50.6	50.6
Oct to Nov 7 Day 2 Year Low Flow	4.77	ft^3/s	3.14	6.88	23.3	23.3
Oct to Nov 7 Day 10 Year Low Flow	1.86	ft^3/s	0.955	3.19	36.6	36.6

Seasonal Flow Statistics Citations

Flynn, R.H. and Tasker, G.D.,2002, Development of Regression Equations to Estimate Flow Durations and Low-Flow-Frequency Statistics in New Hampshire Streams: U.S.Geological Survey Scientific Investigations Report 02-4298, 66 p. (http://pubs.water.usgs.gov/wrir02-4298)

Flow-Duration Statistics Parameters[Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	10.64	square miles	3.26	689
PREG_06_10	Jun to Oct Gage Precipitation	18	inches	16.5	23.1
TEMP	Mean Annual Temperature	45.88	degrees F	36	48.7

Flow-Duration Statistics Flow Report[Low Flow Statewide]

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

Statistic	Value	Unit	PIl	PIu	SE	SEp
60 Percent Duration	6.05	ft^3/s	4.43	8.03	18	18
70 Percent Duration	3.86	ft^3/s	2.7	5.32	20.6	20.6

Statistic	Value	Unit	PIl	PIu	SE	SEp
80 Percent Duration	2.17	ft^3/s	1.33	3.33	28	28
90 Percent Duration	1.05	ft^3/s	0.541	1.82	37.5	37.5
95 Percent Duration	0.623	ft^3/s	0.286	1.17	44.1	44.1
98 Percent Duration	0.384	ft^3/s	0.147	0.804	54.3	54.3

Flow-Duration Statistics Citations

Flynn, R.H. and Tasker, G.D.,2002, Development of Regression Equations to Estimate Flow Durations and Low-Flow-Frequency Statistics in New Hampshire Streams: U.S.Geological Survey Scientific Investigations Report 02-4298, 66 p. (http://pubs.water.usgs.gov/wrir02-4298)

Low-Flow Statistics Parameters[Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	10.64	square miles	3.26	689
TEMP	Mean Annual Temperature	45.88	degrees F	36	48.7
PREG_06_10	Jun to Oct Gage Precipitation	18	inches	16.5	23.1

Low-Flow Statistics Flow Report[Low Flow Statewide]

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

Statistic	Value	Unit	PIl	PIu	SE	SEp
7 Day 2 Year Low Flow	0.605	ft^3/s	0.222	1.26	55.7	55.7
7 Day 10 Year Low Flow	0.226	ft^3/s	0.0544	0.575	79.4	79.4

Low-Flow Statistics Citations

Flynn, R.H. and Tasker, G.D.,2002, Development of Regression Equations to Estimate Flow Durations and Low-Flow-Frequency Statistics in New Hampshire Streams: U.S.Geological Survey Scientific Investigations Report 02-4298, 66 p. (http://pubs.water.usgs.gov/wrir02-4298)

Recharge Statistics Parameters[Groundwater Recharge Statewide 2004 5019]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PREG_03_05	Mar to May Gage Precipitation	9.6	inches	6.83	11.54
CONIF	Percent Coniferous Forest	11.7727	percent	3.07	56.18
SNOFALL	Mean Annual Snowfall	71.719	inches	54.46	219.07
PREG_06_10	Jun to Oct Gage Precipitation	18	inches	16.46	23.11
TEMP	Mean Annual Temperature	45.88	degrees F	36.05	48.69
MIXFOR	Percent Mixed Forest	31.5015	percent	6.21	46.13
PREBC_1112	Nov to Dec Basin Centroid Precip	9.37	inches	6.57	15.2
PRECIPCENT	Mean Annual Precip at Basin Centroid	46.1	inches	37.44	75.91
PRECIPOUT	Mean Annual Precip at Gage	44.9	inches	35.83	53.11
MINTEMP_W	Mean Winter Min Temperature	15.413	degrees F	0.8	19.88

Recharge Statistics Flow Report[Groundwater Recharge Statewide 2004 5019]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp
GW_Recharge_Jan_to_Mar15	5.81	in	15.5
GW_Recharge_Mar16_to_May	8.23	in	12.4
GW_Recharge_Jun_to_Oct	2.58	in	26.5
GW_Recharge_Nov_to_Dec	4.49	in	15.8
GW_Recharge_Ann	23.1	in	12.4

Recharge Statistics Citations

Flynn, R.H. and Tasker, G.D.,2004, Generalized Estimates from Streamflow Data of Annual and Seasonal Ground-Water-Recharge Rates for Drainage Basins in New Hampshire, U.S. Geological Survey Scientific Investigations Report 2004-5019, 67 p. (http://pubs.usgs.gov/sir/2004/5019/)

Peak-Flow Statistics Parameters[Peak Flow Statewide SIR2008 5206]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	10.64	square miles	0.7	1290
APRAVPRE	Mean April Precipitation	4.187	inches	2.79	6.23
WETLAND	Percent Wetlands	6.863	percent	0	21.8
CSL10_85	Stream Slope 10 and 85 Method	43.3	feet per mi	5.43	543

Peak-Flow Statistics Flow Report[Peak Flow Statewide SIR2008 5206]

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

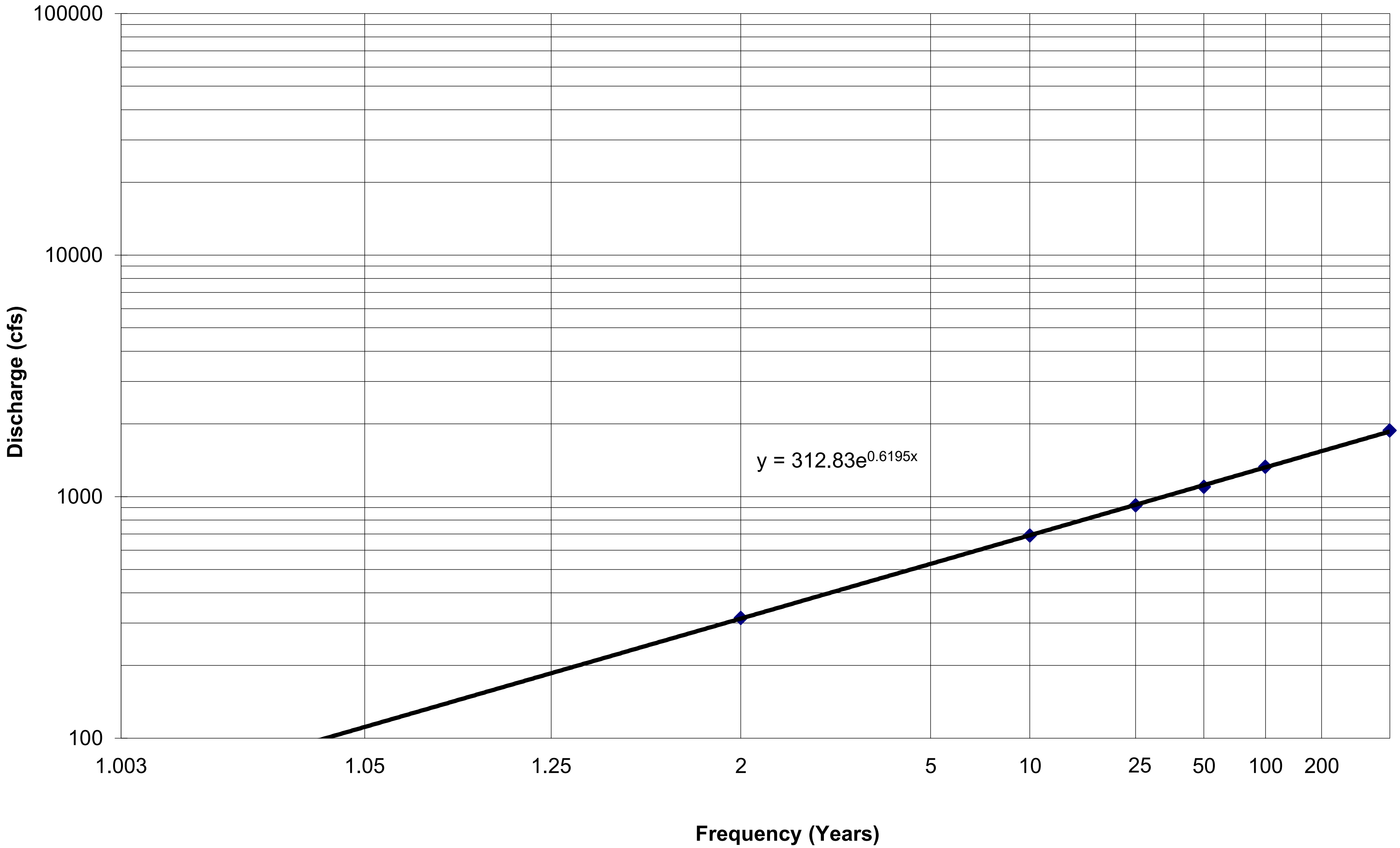
Statistic	Value	Unit	PIl	PIu	SEp	Equiv. Yrs.
2 Year Peak Flood	315	ft^3/s	195	511	30.1	3.2
5 Year Peak Flood	520	ft^3/s	318	853	31.1	4.7
10 Year Peak Flood	691	ft^3/s	414	1150	32.3	6.2
25 Year Peak Flood	918	ft^3/s	533	1580	34.3	8
50 Year Peak Flood	1110	ft^3/s	623	1960	36.4	9
100 Year Peak Flood	1330	ft^3/s	726	2440	38.6	9.8
500 Year Peak Flood	1880	ft^3/s	945	3720	44.1	11

Peak-Flow Statistics Citations

Olson, S.A.,2009, Estimation of flood discharges at selected recurrence intervals for streams in New Hampshire: U.S.Geological Survey Scientific Investigations Report 2008-5206, 57 p. (http://pubs.usgs.gov/sir/2008/5206/)

Application Version: 4.3.8

Bridge No. 141/127, Route 152 over North River
Flood Flow Frequency Curve



Prob. Of Exceedance	Frequency (Years)	Z
0.5	2	0
0.2	5	0.841621386
0.1	10	1.281550794
0.05	20	1.644853
0.04	25	1.750686351
0.02	50	2.053748176
0.01	100	2.326341928
0.005	200	2.575834515
0.002	500	2.878150553

Enter Z (from table above) and Discharge. If the discharge is uknown for a certain frequency, leave fields blank. Do not use zero.

Frequency (Years)	Z	Discharge (cfs)
2	0	315
10	1.281550794	690
25	1.750686351	920
50	2.053748176	1100
100	2.326341928	1330
500	2.878150553	1880

Trendline $y = Ce^{bx}$

Enter C and b from trendline equation (Graph) to compute discharges based on trendline.

C=	312.83
b=	0.6195

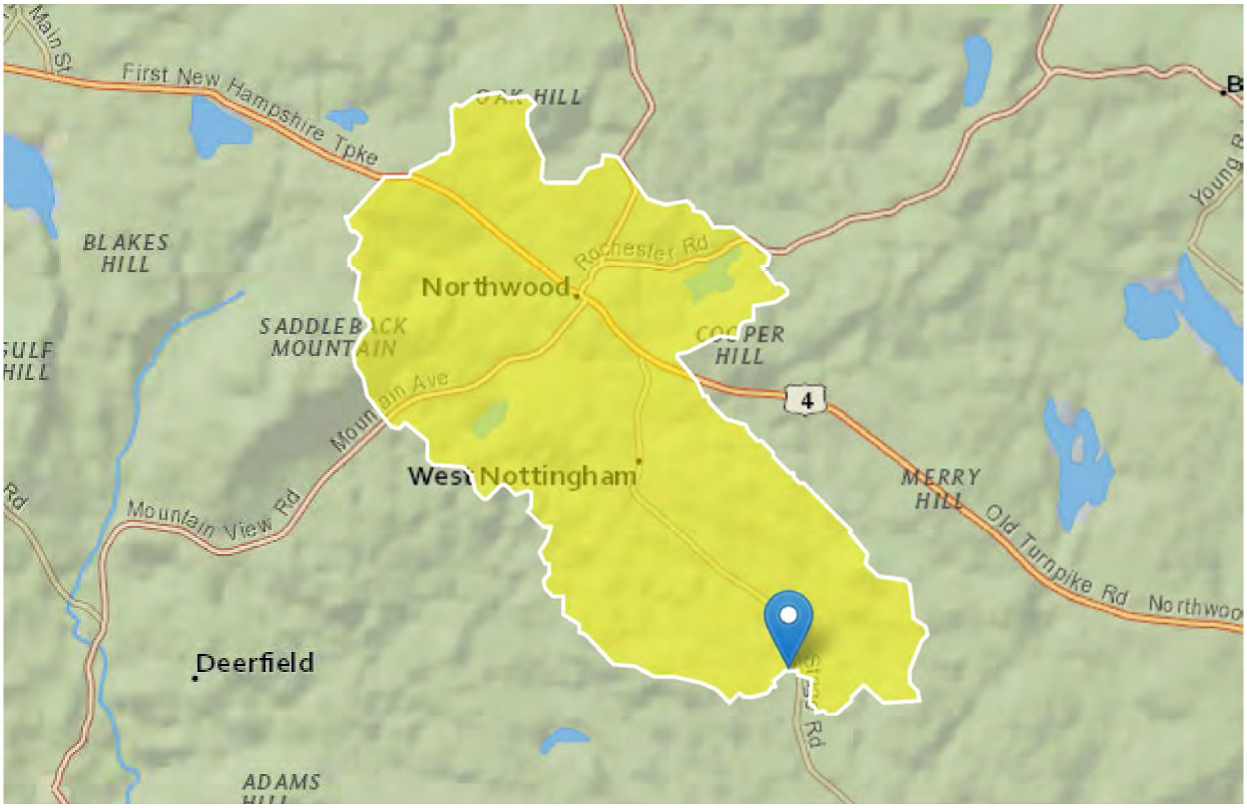
Frequency (Years)	Z	Discharge (cfs)	
2	0	313	
5	0.841621386	527	
10	1.281550794	692	
20	1.644853	867	
25	1.750686351	925	
50	2.053748176	1117	
100	2.326341928	1322	
200	2.575834515	1543	**USE 1540 CFS**
500	2.878150553	1861	

Horizontal Axis Label Positions						
Position	RP	P	Z	Q		
1	1.003	0.997009	-2.748763461	100		
11	1.05	0.952381	-1.668391194	100		
17	1.25	0.8	-0.841621234	100		
22	2	0.5	0	100		
26	5	0.2	0.841621234	100		
28	10	0.1	1.281551566	100		
30	20	0.05	1.644853627	100		
31	25	0.04	1.750686071	1000		
32	50	0.02	2.053748911	100		
33	100	0.01	2.326347874	100		
34	200	0.005	2.575829304	100		
35	500	0.002	2.878161739	100		
Vertical Gridlines						
	RP	Z	Q			
	1.003	-2.74878	100		minval	100
		-2.74878	100000		maxval	100000
	1.05	-1.66839	100			
		-1.66839	100000			
	1.25	-0.84162	100			
		-0.84162	100000			
	2	0	100			
		0	100000			
	5	0.841621	100			
		0.841621	100000			
	10	1.281551	100			
		1.281551	100000			
	20	1.644853	100			
		1.644853	100000			
	25	1.750686	100			
		1.750686	100000			
	50	2.053748	100			
		2.053748	100000			
	100	2.326342	100			
		2.326342	100000			
	200	2.575835	100			
		2.575835	100000			
	500	2.878151	100			
		2.878151	100000			

StreamStats Report
North River Downstream Subject Project

Note: Use for flow change

Region ID: NH
Workspace ID: NH20191028150606290000
Clicked Point (Latitude, Longitude): 43.14740, -71.11469
Time: 2019-10-28 11:06:21 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	13.68	square miles
APRAVPRE	Mean April Precipitation	4.185	inches
WETLAND	Percentage of Wetlands	7.5177	percent

Parameter Code	Parameter Description	Value	Unit
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	43.8	feet per mi

Peak-Flow Statistics Parameters[Peak Flow Statewide SIR2008 5206]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	13.68	square miles	0.7	1290
APRAVPRE	Mean April Precipitation	4.185	inches	2.79	6.23
WETLAND	Percent Wetlands	7.5177	percent	0	21.8
CSL10_85	Stream Slope 10 and 85 Method	43.8	feet per mi	5.43	543

Peak-Flow Statistics Flow Report[Peak Flow Statewide SIR2008 5206]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

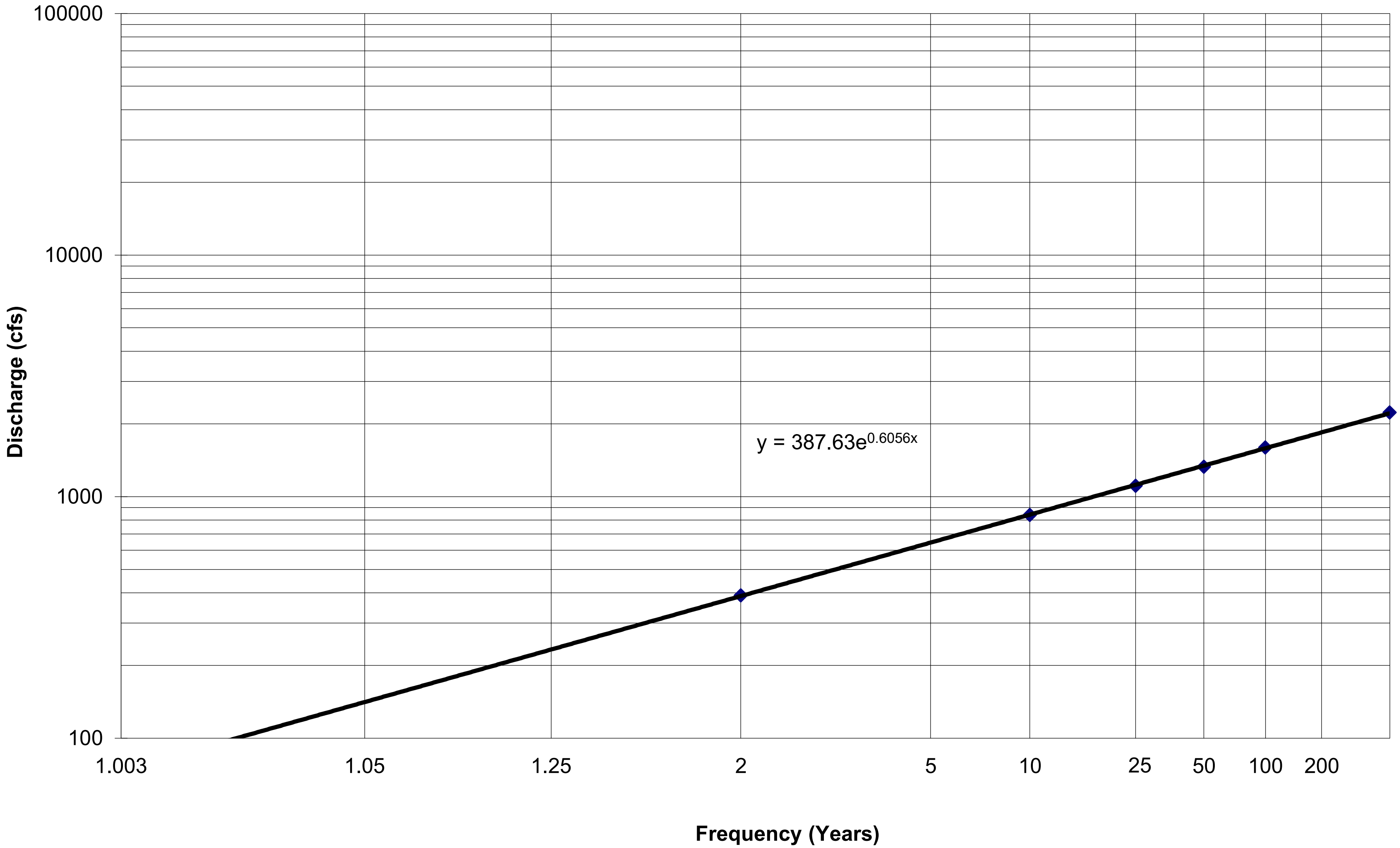
Statistic	Value	Unit	PII	PIu	SEp	Equiv. Yrs.
2 Year Peak Flood	387	ft^3/s	240	626	30.1	3.2
5 Year Peak Flood	634	ft^3/s	388	1040	31.1	4.7
10 Year Peak Flood	838	ft^3/s	503	1400	32.3	6.2
25 Year Peak Flood	1110	ft^3/s	644	1910	34.3	8
50 Year Peak Flood	1330	ft^3/s	751	2350	36.4	9
100 Year Peak Flood	1600	ft^3/s	872	2920	38.6	9.8
500 Year Peak Flood	2230	ft^3/s	1130	4420	44.1	11

Peak-Flow Statistics Citations

Olson, S.A.,2009, Estimation of flood discharges at selected recurrence intervals for streams in New Hampshire: U.S.Geological Survey Scientific Investigations Report 2008-5206, 57 p. (http://pubs.usgs.gov/sir/2008/5206/)

Application Version: 4.3.8

Flow Change Downstream of Bridge No. 141/127, Route 152 over North River
Flood Flow Frequency Curve



Prob. Of Exceedance	Frequency (Years)	Z
0.5	2	0
0.2	5	0.841621386
0.1	10	1.281550794
0.05	20	1.644853
0.04	25	1.750686351
0.02	50	2.053748176
0.01	100	2.326341928
0.005	200	2.575834515
0.002	500	2.878150553

Enter Z (from table above) and Discharge. If the discharge is uknown for a certain frequency, leave fields blank. Do not use zero.

Frequency (Years)	Z	Discharge (cfs)
2	0	390
10	1.281550794	840
25	1.750686351	1110
50	2.053748176	1330
100	2.326341928	1600
500	2.878150553	2230

Trendline $y = Ce^{bx}$

Enter C and b from trendline equation (Graph) to compute discharges based on trendline.

C=	387.63
b=	0.6056

Frequency (Years)	Z	Discharge (cfs)
2	0	388
5	0.841621386	645
10	1.281550794	842
20	1.644853	1050
25	1.750686351	1119
50	2.053748176	1345
100	2.326341928	1586
200	2.575834515	1845
500	2.878150553	2215

USE 1850 CFS

Horizontal Axis Label Positions						
Position	**RP**	**P**	**Z**	**Q**		
1	1.003	0.997009	-2.748763461	100		
11	1.05	0.952381	-1.668391194	100		
17	1.25	0.8	-0.841621234	100		
22	2	0.5	0	100		
26	5	0.2	0.841621234	100		
28	10	0.1	1.281551566	100		
30	20	0.05	1.644853627	100		
31	25	0.04	1.750686071	1000		
32	50	0.02	2.053748911	100		
33	100	0.01	2.326347874	100		
34	200	0.005	2.575829304	100		
35	500	0.002	2.878161739	100		
Vertical Gridlines						
	RP	**Z**	**Q**			
	1.003	-2.74878	100		minval	100
		-2.74878	100000		maxval	100000
	1.05	-1.66839	100			
		-1.66839	100000			
	1.25	-0.84162	100			
		-0.84162	100000			
	2	0	100			
		0	100000			
	5	0.841621	100			
		0.841621	100000			
	10	1.281551	100			
		1.281551	100000			
	20	1.644853	100			
		1.644853	100000			
	25	1.750686	100			
		1.750686	100000			
	50	2.053748	100			
		2.053748	100000			
	100	2.326342	100			
		2.326342	100000			
	200	2.575835	100			
		2.575835	100000			
	500	2.878151	100			
		2.878151	100000			

NOAA Atlas 14, Volume 10, Version 3
Location name: Nottingham, New Hampshire, USA*
Latitude: 43.1482°, Longitude: -71.1128°
Elevation: 233.2 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.304** (0.237-0.393)	**0.364** (0.283-0.470)	**0.462** (0.357-0.598)	**0.544** (0.418-0.708)	**0.656** (0.489-0.892)	**0.740** (0.540-1.03)	**0.828** (0.588-1.19)	**0.928** (0.625-1.36)	**1.07** (0.694-1.63)	**1.19** (0.753-1.85)
10-min	**0.431** (0.335-0.556)	**0.516** (0.401-0.666)	**0.655** (0.507-0.849)	**0.770** (0.593-1.00)	**0.929** (0.693-1.26)	**1.05** (0.766-1.46)	**1.17** (0.833-1.69)	**1.32** (0.885-1.94)	**1.52** (0.983-2.31)	**1.68** (1.07-2.62)
15-min	**0.507** (0.394-0.654)	**0.607** (0.472-0.784)	**0.771** (0.596-0.997)	**0.906** (0.697-1.18)	**1.09** (0.815-1.49)	**1.23** (0.901-1.71)	**1.38** (0.981-1.99)	**1.55** (1.04-2.28)	**1.79** (1.16-2.72)	**1.98** (1.25-3.08)
30-min	**0.695** (0.540-0.896)	**0.832** (0.646-1.07)	**1.06** (0.817-1.37)	**1.24** (0.955-1.62)	**1.50** (1.12-2.04)	**1.69** (1.23-2.35)	**1.89** (1.34-2.72)	**2.12** (1.43-3.12)	**2.45** (1.59-3.73)	**2.72** (1.72-4.23)
60-min	**0.883** (0.686-1.14)	**1.06** (0.820-1.36)	**1.34** (1.04-1.74)	**1.58** (1.21-2.05)	**1.90** (1.42-2.58)	**2.14** (1.57-2.98)	**2.40** (1.71-3.46)	**2.69** (1.81-3.96)	**3.12** (2.02-4.74)	**3.47** (2.19-5.38)
2-hr	**1.16** (0.907-1.49)	**1.39** (1.09-1.79)	**1.77** (1.38-2.28)	**2.08** (1.61-2.70)	**2.52** (1.89-3.41)	**2.84** (2.09-3.93)	**3.18** (2.28-4.59)	**3.59** (2.42-5.26)	**4.20** (2.73-6.36)	**4.72** (3.00-7.29)
3-hr	**1.35** (1.06-1.73)	**1.63** (1.27-2.08)	**2.08** (1.62-2.67)	**2.45** (1.90-3.16)	**2.97** (2.23-4.01)	**3.35** (2.47-4.63)	**3.76** (2.71-5.41)	**4.25** (2.88-6.20)	**5.00** (3.25-7.54)	**5.64** (3.58-8.67)
6-hr	**1.74** (1.37-2.21)	**2.11** (1.66-2.68)	**2.71** (2.13-3.46)	**3.21** (2.51-4.12)	**3.90** (2.96-5.25)	**4.41** (3.28-6.08)	**4.97** (3.60-7.12)	**5.64** (3.82-8.17)	**6.66** (4.35-9.99)	**7.54** (4.81-11.5)
12-hr	**2.18** (1.73-2.75)	**2.67** (2.11-3.37)	**3.48** (2.74-4.40)	**4.14** (3.25-5.28)	**5.06** (3.85-6.77)	**5.74** (4.29-7.86)	**6.48** (4.72-9.24)	**7.37** (5.02-10.6)	**8.74** (5.72-13.0)	**9.92** (6.35-15.1)
24-hr	**2.58** (2.06-3.24)	**3.22** (2.56-4.04)	**4.27** (3.39-5.38)	**5.14** (4.05-6.51)	**6.34** (4.85-8.45)	**7.22** (5.42-9.86)	**8.18** (6.01-11.7)	**9.39** (6.41-13.5)	**11.3** (7.40-16.7)	**12.9** (8.29-19.5)
2-day	**2.91** (2.33-3.62)	**3.70** (2.96-4.62)	**5.01** (3.99-6.26)	**6.08** (4.82-7.65)	**7.57** (5.84-10.1)	**8.65** (6.56-11.8)	**9.86** (7.33-14.1)	**11.4** (7.83-16.3)	**14.0** (9.21-20.6)	**16.3** (10.5-24.4)
3-day	**3.17** (2.54-3.93)	**4.02** (3.23-5.00)	**5.43** (4.34-6.76)	**6.59** (5.23-8.26)	**8.19** (6.34-10.9)	**9.35** (7.12-12.7)	**10.7** (7.95-15.2)	**12.4** (8.49-17.6)	**15.2** (10.0-22.3)	**17.7** (11.4-26.5)
4-day	**3.41** (2.75-4.22)	**4.30** (3.46-5.33)	**5.75** (4.61-7.15)	**6.96** (5.54-8.70)	**8.61** (6.68-11.4)	**9.82** (7.49-13.3)	**11.2** (8.35-15.9)	**13.0** (8.90-18.4)	**15.9** (10.5-23.3)	**18.5** (12.0-27.6)
7-day	**4.13** (3.34-5.08)	**5.06** (4.08-6.23)	**6.58** (5.29-8.13)	**7.84** (6.26-9.74)	**9.57** (7.44-12.6)	**10.8** (8.28-14.6)	**12.2** (9.16-17.3)	**14.1** (9.72-19.9)	**17.1** (11.3-24.9)	**19.8** (12.8-29.4)
10-day	**4.81** (3.90-5.90)	**5.77** (4.67-7.08)	**7.33** (5.92-9.04)	**8.63** (6.92-10.7)	**10.4** (8.12-13.6)	**11.7** (8.97-15.7)	**13.2** (9.84-18.4)	**15.0** (10.4-21.1)	**18.0** (12.0-26.1)	**20.6** (13.4-30.5)
20-day	**6.80** (5.54-8.29)	**7.86** (6.40-9.59)	**9.58** (7.77-11.7)	**11.0** (8.87-13.6)	**13.0** (10.1-16.7)	**14.5** (11.0-19.0)	**16.0** (11.8-21.8)	**17.8** (12.4-24.8)	**20.5** (13.7-29.5)	**22.7** (14.7-33.3)
30-day	**8.44** (6.90-10.3)	**9.57** (7.82-11.6)	**11.4** (9.30-13.9)	**13.0** (10.5-15.9)	**15.1** (11.8-19.2)	**16.7** (12.7-21.7)	**18.3** (13.5-24.6)	**20.1** (14.0-27.8)	**22.5** (15.1-32.3)	**24.4** (15.9-35.7)
45-day	**10.5** (8.59-12.7)	**11.7** (9.58-14.2)	**13.7** (11.2-16.6)	**15.4** (12.5-18.8)	**17.6** (13.8-22.3)	**19.4** (14.8-25.0)	**21.2** (15.5-28.1)	**22.9** (16.0-31.5)	**25.0** (16.8-35.8)	**26.6** (17.4-38.9)
60-day	**12.2** (10.0-14.7)	**13.5** (11.1-16.3)	**15.6** (12.7-18.9)	**17.3** (14.1-21.1)	**19.8** (15.4-24.9)	**21.7** (16.5-27.8)	**23.5** (17.2-30.9)	**25.2** (17.7-34.6)	**27.2** (18.3-38.8)	**28.6** (18.7-41.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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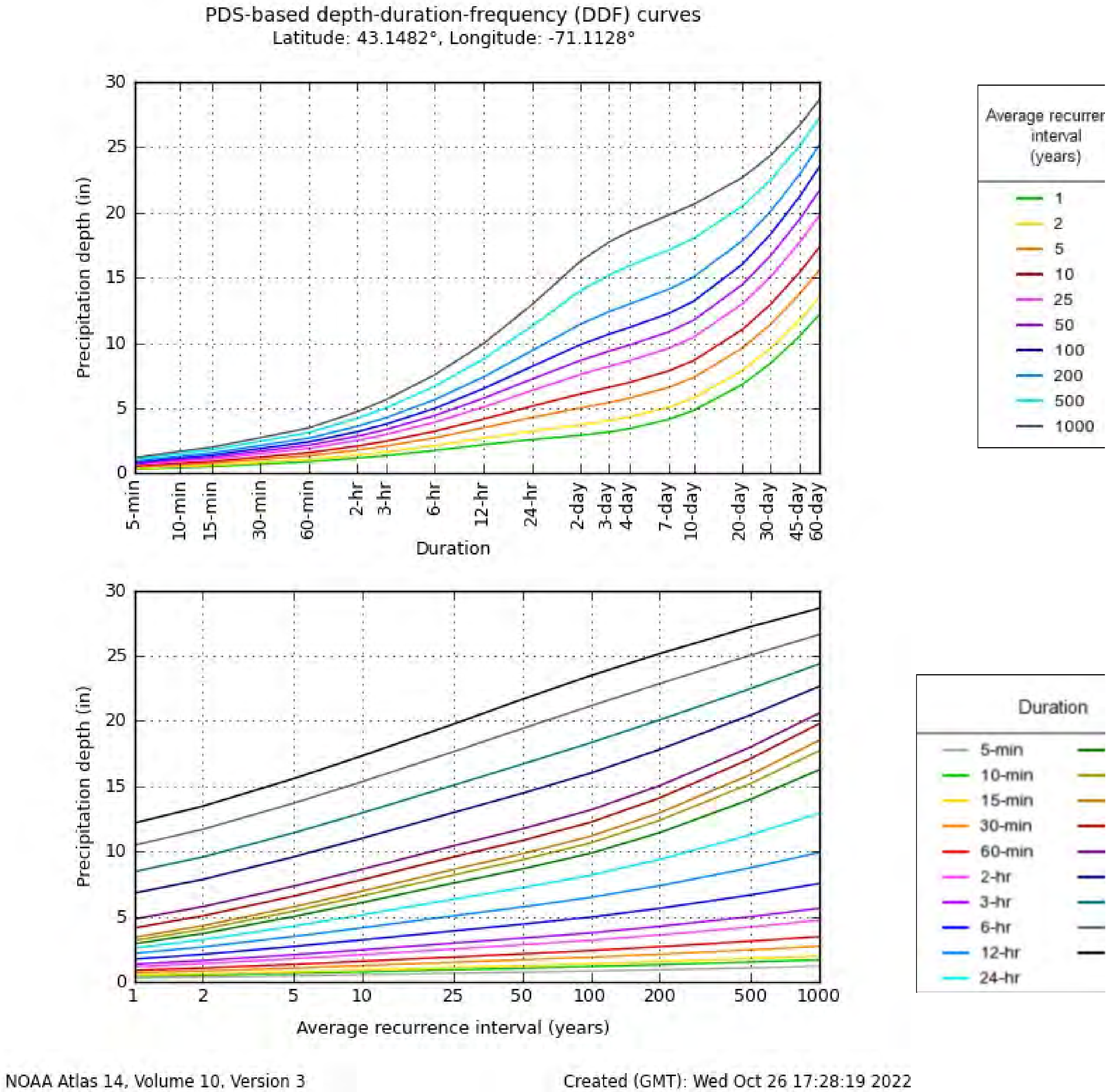
PF graphical



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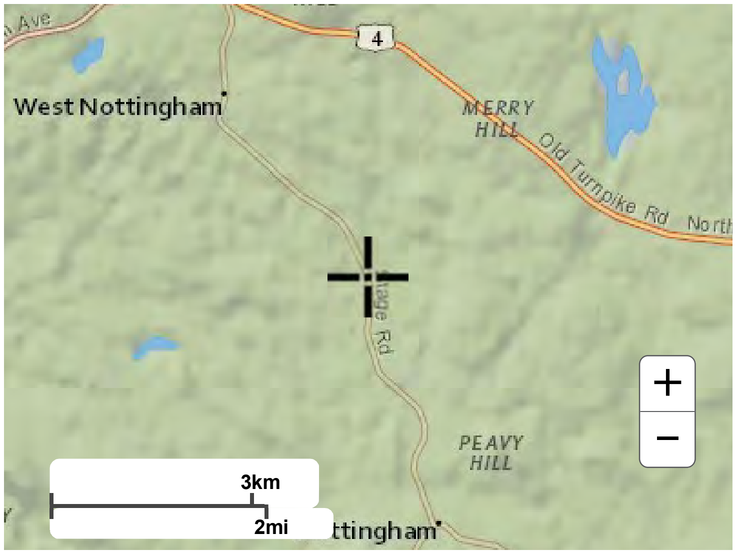
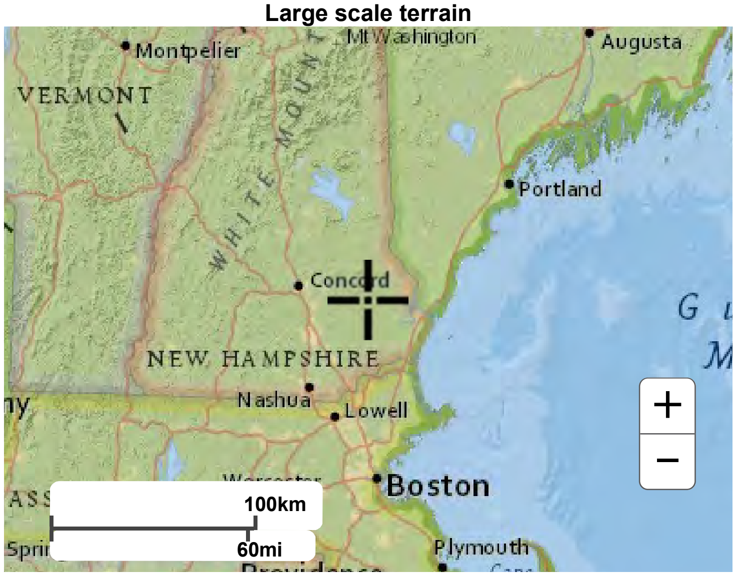
Maps & aerials

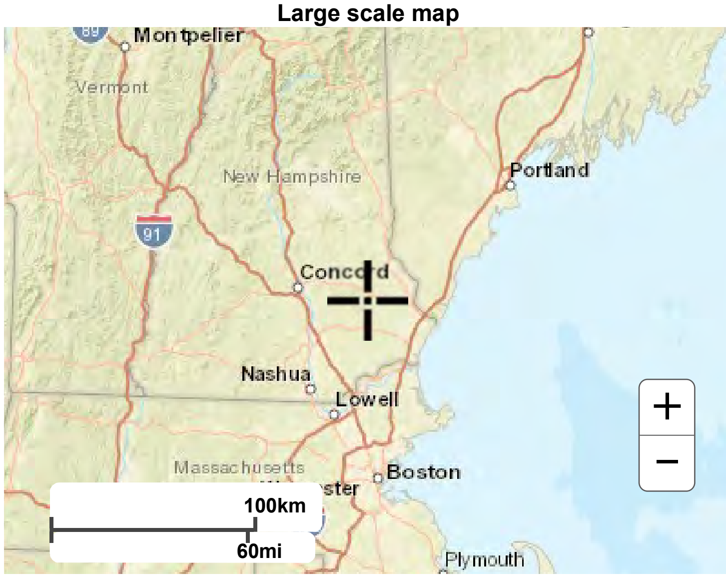
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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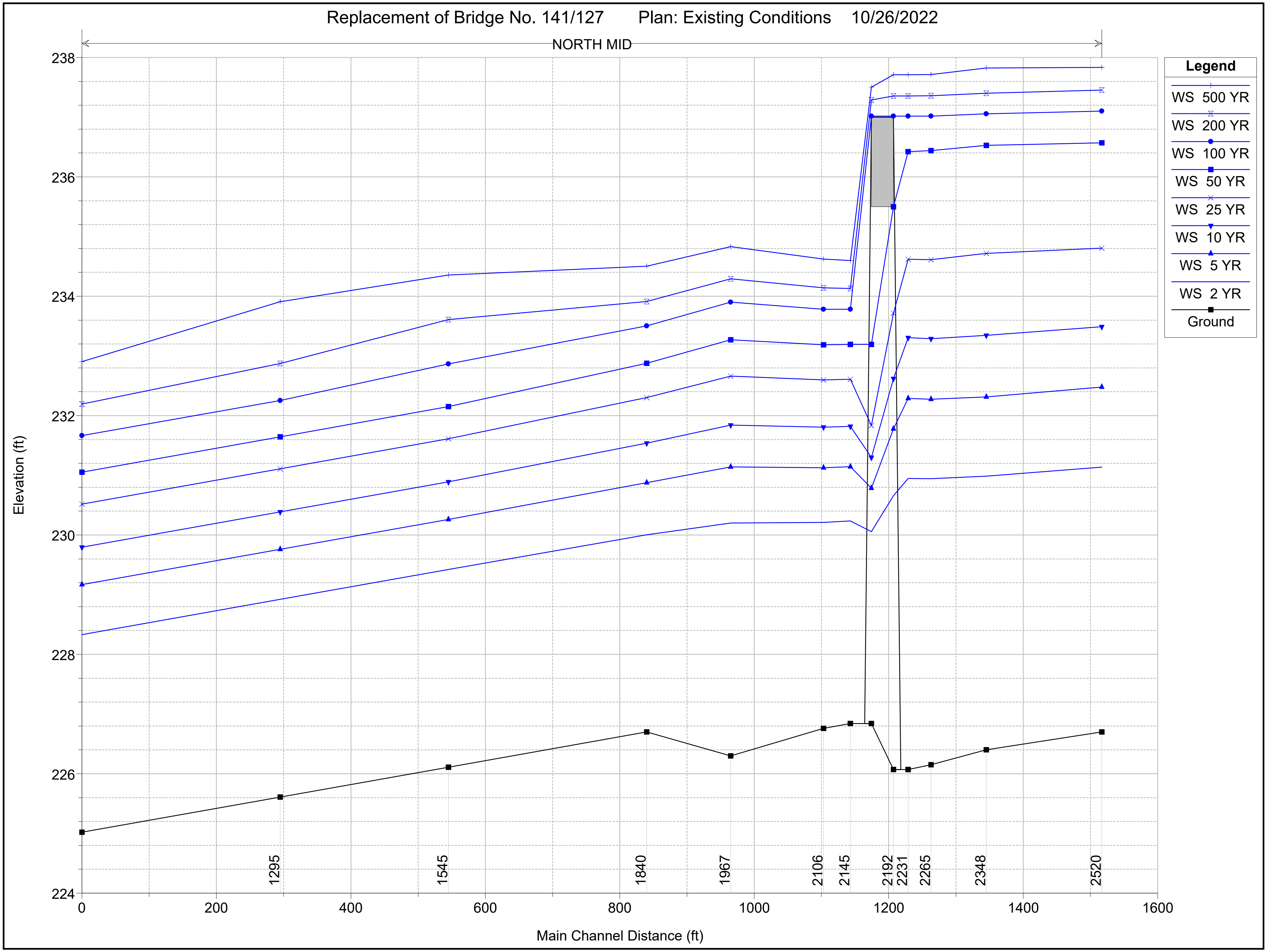
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

APPENDIX D: Hydraulic Analysis

HEC-RAS Input/Output


Replacement of Bridge No. 141/127 Plan: Existing Conditions 10/26/2022
NORTH MID
Legend
WS 500 YR
WS 200 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
Ground
Elevation (ft)
Main Channel Distance (ft)
1295
1545
1840
1967
2106
2145
2192
2231
2265
2348
2520
224
226
228
230
232
234
236
238
0
200
400
600
800
1000
1200
1400
1600

HEC-RAS HEC-RAS 6.1.0 September 2021
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: Replacement of Bridge No. 141/127
Project File : 141-127 Route 152.prj
Run Date and Time: 10/26/2022 12:20:14 PM

Project in English units

Project Description:
NH Route 152 over North River - Final Hydraulic Design Report

PLAN DATA

Plan Title: Existing Conditions
Plan File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.p01

Geometry Title: Existing Conditions
Geometry File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.g01

Flow Title   : StreamStats Design
Flow File   : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.f01

Plan Description:

Existing Conditions
NAVD88 Daturm

Plan Summary Information:

Number of:				
Cross Sections =	11	Multiple Openings =	0
Culverts =	0	Inline Structures =	0
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	=	0.33
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: Subcritical Flow

FLOW DATA

Flow Title: StreamStats Design
Flow File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.f01

Flow Data (cfs)

River	Reach	RS	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR	200 YR	500 YR
NORTH	MID	2520	315	520	690	920	1100	1330	1540	1880
NORTH	MID	1545	390	630	840	1110	1330	1600	1850	2230
North River	RT 152	1971								

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
NORTH	MID	2 YR	Critical	Normal S = 0.002
NORTH	MID	5 YR	Critical	Normal S = 0.002
NORTH	MID	10 YR	Critical	Normal S = 0.002
NORTH	MID	25 YR	Critical	Normal S = 0.002
NORTH	MID	50 YR	Critical	Normal S = 0.002
NORTH	MID	100 YR	Critical	Normal S = 0.002
NORTH	MID	200 YR	Critical	Normal S = 0.002
NORTH	MID	500 YR	Critical	Normal S = 0.002

GEOMETRY DATA

Geometry Title: Existing Conditions
Geometry File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.g01

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2520

INPUT
Description: US LIMIT
Station Elevation Data num= 75

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-298.56	242.06	-278.59	240.38	-264.7	239.67	-255.04	239.15	-243.35	238.18
-225.46	237.92	-218.81	237.25	-208.2	236.68	-199.53	235.96	-192.1	235.02
-187	234.78	-168.2	233.23	-164.44	233.23	-153.38	232.62	-146.37	232.53

-138.12	232.67	-133.06	232.91	-119.47	232.93	-107.01	233.42	-86.52	233.18
-77.55	232.89	-62.5	232.77	-57.16	233.2	-51.19	233.12	-41.29	232.91
-31.1	232.93	-30	232.77	-28.84	232.45	-27.47	232.27	-24.31	231.87
-22.76	231.1	-17.36	230.2	-6.76	226.7	.04	226.8	2.04	226.8
10.44	227	17.64	227.9	21.14	229	21.74	229.7	23.34	231.9
23.7	233.01	35.74	233.39	45.93	233.12	56.19	233.23	63.26	233.55
76.91	233.49	85.59	233.15	93.26	233.03	99.54	232.95	115.89	233.12
121.84	233.32	136.01	233.45	139.96	233.12	145.63	233.25	157.93	233.04
167.15	233.16	181.28	233.04	187.6	232.88	197.74	232.93	204.54	233.27
215.24	233.05	221.6	233.24	230.6	233.25	236.62	233.79	254.39	233.6
266.85	233.72	284.98	234.2	296.98	234.35	318.36	235.29	329.67	235.44
340.49	235.17	358.58	235.76	378.36	237.12	391.61	237.4	413.33	240

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-298.56	.08	-17.36	.03	21.74	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-17.36	21.74	185	172	163	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
318.5	413.33	237.8	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2348

INPUT
Description:
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-212.51	240.46	-209.38	239.92	-207.42	239.76	-202.36	239.04	-198.95	238.81
-190.48	238.06	-187.65	238.02	-175.42	237.3	-168.06	236.61	-157.91	235.35
-154.1	234.74	-143.95	234.45	-139.87	234.44	-134.47	233.96	-126.19	233.71
-118.58	233.26	-108.29	233.41	-99.55	233.3	-95.74	233.05	-90.15	232.88
-84.75	232.89	-80.52	232.88	-76.04	232.8	-72.6	232.47	-66.56	232.44
-63.13	232.75	-59.89	232.78	-53.4	232.93	-50.16	232.94	-44.75	232.94
-38.27	233.04	-32.3	232.92	-27.46	232.7	-20.98	232.59	-20.28	229.6
-16.28	228.8	-7.88	226.8	0	226.43	.72	226.4	8.12	227.8
10.82	229.4	15.12	231.8	15.91	232.52	21.15	232.85	36.24	233
52.31	233.01	60.38	232.59	74.36	232.66	92.07	232.68	98.47	232.7
104.96	232.65	112.46	232.66	132.67	232.41	144.54	232.56	176.29	232.48
186.14	232.56	198.63	232.51	210.23	232.65	245.44	232.58	254.02	233.59
264.41	233.78	271.54	233.76	298.91	233.94	312.48	233.95	318.62	233.78
337.04	233.64	346.64	233.47	355.84	233.34	378.27	233.21	399.64	233.49
421.28	234.34	438.9	236.65	452.8	237.43	478.3	238		

Manning's n Values num= 3

```
     Sta   n Val     Sta   n Val     Sta   n Val
 -212.51     .08  -20.28     .03   10.82     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -20.28   10.82               80      82      82             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
 -212.51  -146.5     237       F
   146.5   478.3   237.8       F

CROSS SECTION


RIVER: NORTH
REACH: MID                RS: 2265

INPUT
Description: BRG APPROACH
Station Elevation Data    num=      72
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -264.42  240.04 -255.02  239.82 -249.54   239.4 -238.56   238.9 -226.67  238.48
 -224.01   238.2 -204.21  236.94 -199.16  236.14 -180.55  234.95 -175.95  234.83
 -154.84  233.52 -140.56  233.76  -132.1  232.91 -119.86  232.72 -111.63  232.57
 -100.32  232.99  -81.78  232.99  -59.88  232.92  -50.94  233.05  -35.51  232.84
  -22.49  232.69  -20.28  229.35  -16.28  228.55   -7.88  226.55       0  226.18
     .72  226.15    8.12  227.55   10.82  229.15   11.06  232.48    30.8  232.45
   46.88  232.64   49.45  233.22   58.44  233.04   76.49  233.36      79   232.5
    87.6   232.5   90.56  232.92   97.26  232.97  109.83  233.38  113.87  232.86
  121.39  232.51   129.1   233.3  130.38  233.91  161.21  234.01  174.11  233.28
  184.49  233.28  189.68   232.8  195.87  232.82  204.22  233.04  221.63  233.31
  235.35  233.44   241.9  233.71  252.81  233.91  259.28  234.22   263.8  234.42
  274.65  234.15  280.11  234.08  284.48  233.55   290.9  233.38  300.85   233.5
  311.23  233.32  320.09  233.25  326.42  233.91  339.09  233.89  342.87  233.77
  355.44  233.42  369.21  233.43  382.73  233.14  389.71  234.01  394.74   235.3
   401.1  236.05  403.63  238.21

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -264.42     .08  -20.28     .03   10.82     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       -20.28   10.82               21      34      43             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
 -264.42   -64.5     237       F
    64.5  403.63   237.8       F

CROSS SECTION
```

```
RIVER: NORTH
REACH: MID                RS: 2231

INPUT
Description: BRG US
Station Elevation Data    num=      79
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -283.71  239.35  -279.8  239.34 -264.32  239.01 -254.45  238.64 -248.85  238.15
 -246.12  238.08 -241.08  237.61 -234.29   237.6 -230.84  237.41 -221.55   237.2
 -218.59  236.88 -210.36  236.63 -203.07  236.15 -198.73  236.03 -195.83  235.77
    -182  234.89 -176.85  234.36 -174.28   234.3 -169.97  233.91 -158.59  233.58
 -151.35  233.37 -142.12  232.96  -134.8  232.86 -125.48  233.11 -122.82  232.69
 -118.24  232.47 -112.53  232.83  -107.9  232.62 -100.95  232.61  -96.52     233
  -91.94  232.99   -84.1  232.73  -81.65  232.51  -75.91   232.5  -64.92  232.55
  -61.34  232.68  -53.35  232.77  -46.86  232.74  -39.19  232.42  -31.34  232.52
  -23.07  232.51     -21  232.58  -18.56  229.22   -8.46  226.88   -5.98  226.37
    2.36  226.07   11.63  227.93   21.25  229.33   25.56  232.49   26.42  232.45
   31.57  233.03   39.01  233.03   52.15  233.26   64.87  233.11   67.97  232.67
   79.17  232.67   81.74  232.76   86.59     233   90.78  233.09   95.88  233.08
   99.76  233.02  104.18  232.78  110.05   232.5  115.19  232.77  118.66  232.78
  126.94  233.24   133.3  233.76  136.25  233.72  142.46     234  145.56  234.35
   149.7  234.47  155.91  234.87  158.94  235.31  165.22  235.99  171.42  236.78
  174.38  237.84   176.6  237.73  194.43  237.63     220  238.16

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -283.71     .08  -18.56     .03   21.25     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        -18.56   21.25               86      86      86              .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
 -283.71   -30.5     237       F
    30.5     220   237.8       F

BRIDGE


RIVER: NORTH
REACH: MID                RS: 2192

INPUT
Description:
Distance from Upstream XS =      22
Deck/Roadway Width        =    32.7
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=      14
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    -340   237.4            -290   237.3            -240   237.2
```

-190	237.1		-140	237		-90	237	
-40	237.1		-8.5	237.5	235.5	8.5	237.6	235.5
60	238		110	238.2		160	238.4	
210	238.6		260	238.9				

Upstream Bridge Cross Section Data
Station Elevation Data   num=   79

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.71	239.35	-279.8	239.34	-264.32	239.01	-254.45	238.64	-248.85	238.15
-246.12	238.08	-241.08	237.61	-234.29	237.6	-230.84	237.41	-221.55	237.2
-218.59	236.88	-210.36	236.63	-203.07	236.15	-198.73	236.03	-195.83	235.77
-182	234.89	-176.85	234.36	-174.28	234.3	-169.97	233.91	-158.59	233.58
-151.35	233.37	-142.12	232.96	-134.8	232.86	-125.48	233.11	-122.82	232.69
-118.24	232.47	-112.53	232.83	-107.9	232.62	-100.95	232.61	-96.52	233
-91.94	232.99	-84.1	232.73	-81.65	232.51	-75.91	232.5	-64.92	232.55
-61.34	232.68	-53.35	232.77	-46.86	232.74	-39.19	232.42	-31.34	232.52
-23.07	232.51	-21	232.58	-18.56	229.22	-8.46	226.88	-5.98	226.37
2.36	226.07	11.63	227.93	21.25	229.33	25.56	232.49	26.42	232.45
31.57	233.03	39.01	233.03	52.15	233.26	64.87	233.11	67.97	232.67
79.17	232.67	81.74	232.76	86.59	233	90.78	233.09	95.88	233.08
99.76	233.02	104.18	232.78	110.05	232.5	115.19	232.77	118.66	232.78
126.94	233.24	133.3	233.76	136.25	233.72	142.46	234	145.56	234.35
149.7	234.47	155.91	234.87	158.94	235.31	165.22	235.99	171.42	236.78
174.38	237.84	176.6	237.73	194.43	237.63	220	238.16		

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-283.71	.08	-18.56	.03	21.25	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.
-18.56	21.25	.3	.5

Ineffective Flow   num=   2

Sta L	Sta R	Elev	Permanent
-283.71	-30.5	237	F
30.5	220	237.8	F

Downstream Deck/Roadway Coordinates
num=   14

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-340	237.4		-290	237.3		-240	237.2	
-190	237.1		-140	237		-90	237	
-40	237.1		-8.5	237.5	235.5	8.5	237.6	235.5
60	238		110	238.2		160	238.4	
210	238.6		260	238.9				

Downstream Bridge Cross Section Data
Station Elevation Data   num=   90

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-343.96	239.18	-331.14	238.4	-313.22	237.93	-288.12	237.13	-275.37	236.7
-267.7	235.63	-256.8	234.78	-242.12	234.53	-228.68	234.12	-223.17	233.69

```
 -201.77  233.56 -179.58  233.68 -170.41  233.64 -157.83  233.63 -152.98  233.57
    -150  233.41  -147.3  233.27 -137.67  233.29  -135.3  232.91 -125.71  232.58
  -120.9  232.52 -115.43  232.53  -110.3  232.55 -104.12  232.56  -94.88  232.53
  -87.68   232.6  -82.54  232.64  -79.46  232.65  -77.04  232.47  -69.18  232.56
  -63.01   232.5  -57.39  232.64  -50.67  232.58  -46.08  232.64  -38.34  232.94
  -37.31  232.85  -37.05  232.77  -36.28  232.64  -27.88     230  -23.91  227.46
  -18.08  227.97  -10.78  226.84       0  226.89    6.83   228.1   10.78   230.5
   27.45  232.82   36.48  233.14   44.22  233.34   49.04  233.48   53.41  233.46
   60.34  233.37   73.71  233.36   76.47  232.77   80.34  232.69   91.18  232.87
  100.43  232.96  105.57  233.11  112.77  233.09  125.49  232.85  129.21  233.41
  134.35  233.73  136.41  233.67  138.25   233.6  139.98  233.54  143.44  233.59
  145.66  233.71  148.59  233.59  150.43   233.6  152.81  233.75  156.87  233.83
  160.38  234.29  161.67  234.67  162.96  234.95  165.57  235.09  168.16  235.52
  170.75  235.61  172.05  235.71  173.35  235.89  177.24  236.25  179.23  236.28
  180.24  236.35  182.27  236.34  183.72  236.48  186.28  237.07  188.91  237.77
  189.86   238.2   192.8  239.12  194.47   239.5  197.03  239.88  198.23  239.97

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -343.96     .08  -27.88     .03   10.78     .08

Bank Sta: Left   Right    Coeff Contr.   Expan.
        -27.88   10.78             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
 -343.96  -24.15     236       F
   24.15  198.23   236.8       F

Upstream Embankment side slope             =       1 horiz. to 1.0 vertical
Downstream Embankment side slope           =       1 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

BRIDGE OUTPUT Profile #2 YR

E.G. US. (ft)	231.03	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	230.95	E.G. Elev (ft)	230.95	230.73
Q Total (cfs)	315.00	W.S. Elev (ft)	230.66	230.06
Q Bridge (cfs)	315.00	Crit W.S. (ft)	228.62	229.47
Q Weir (cfs)		Max Chl Dpth (ft)	4.59	3.21
Weir Sta Lft (ft)		Vel Total (ft/s)	4.31	6.59
Weir Sta Rgt (ft)		Flow Area (sq ft)	73.13	47.79
Weir Submerg		Froude # Chl	0.35	0.65
Weir Max Depth (ft)		Specif Force (cu ft)	196.71	133.43
Min El Weir Flow (ft)	237.01	Hydr Depth (ft)	4.22	2.75
Min El Prs (ft)	235.50	W.P. Total (ft)	24.76	21.91
Delta EG (ft)	0.62	Conv. Total (cfs)	7455.2	3981.3
Delta WS (ft)	0.71	Top Width (ft)	17.33	17.37
BR Open Area (sq ft)	141.32	Frctn Loss (ft)	0.10	0.07
BR Open Vel (ft/s)	6.59	C & E Loss (ft)	0.12	0.25
BR Sluice Coef		Shear Total (lb/sq ft)	0.33	0.85
BR Sel Method	Energy only	Power Total (lb/ft s)	1.42	5.62

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.
Note: Momentum answer is not valid if the water surface is above the low chord or

if there is weir flow. The momentum
         answer has been disregarded.
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, water surface was used.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #5 YR

```
  E.G. US. (ft)               232.40    Element                 Inside BR US
Inside BR DS
  W.S. US. (ft)               232.29    E.G. Elev (ft)               232.27
231.94
  Q Total (cfs)               520.00    W.S. Elev (ft)               231.78
230.78
  Q Bridge (cfs)              520.00    Crit W.S. (ft)               229.48
230.34
  Q Weir (cfs)                          Max Chl Dpth (ft)              5.71
 3.93
  Weir Sta Lft (ft)                     Vel Total (ft/s)               5.62
 8.61
  Weir Sta Rgt (ft)                     Flow Area (sq ft)             92.49
60.40
  Weir Submerg                          Froude # Chl                   0.41
 0.77
  Weir Max Depth (ft)                   Specif Force (cu ft)         338.16
247.38
  Min El Weir Flow (ft)       237.01    Hydr Depth (ft)                5.36
 3.49
  Min El Prs (ft)             235.50    W.P. Total (ft)               27.01
23.36
  Delta EG (ft)                 1.00    Conv. Total (cfs)           10408.7
5635.7
  Delta WS (ft)                 1.15    Top Width (ft)                17.25
17.32
  BR Open Area (sq ft)        141.32    Frctn Loss (ft)                0.14
 0.08
  BR Open Vel (ft/s)            8.61    C & E Loss (ft)                0.20
 0.44
  BR Sluice Coef                        Shear Total (lb/sq ft)         0.53
```

1.37
BR Sel Method Energy only Power Total (lb/ft s) 3.00
11.83

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.

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.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #10 YR

E.G. US. (ft)	233.44	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.31	E.G. Elev (ft)	233.27	232.84
Q Total (cfs)	690.00	W.S. Elev (ft)	232.62	231.30
Q Bridge (cfs)	690.00	Crit W.S. (ft)	230.11	230.97
Q Weir (cfs)		Max Chl Dpth (ft)	6.55	4.45
Weir Sta Lft (ft)		Vel Total (ft/s)	6.45	9.96
Weir Sta Rgt (ft)		Flow Area (sq ft)	106.98	69.29
Weir Submerg		Froude # Chl	0.44	0.83
Weir Max Depth (ft)		Specif Force (cu ft)	469.54	

355.12
  Min El Weir Flow (ft)   237.01   Hydr Depth (ft)   6.22
 4.01
  Min El Prs (ft)   235.50   W.P. Total (ft)   28.69
24.39
  Delta EG (ft)   1.30   Conv. Total (cfs)   12741.9
6884.5
  Delta WS (ft)   1.49   Top Width (ft)   17.19
17.28
  BR Open Area (sq ft)   141.32   Frctn Loss (ft)   0.16
 0.09
  BR Open Vel (ft/s)   9.96   C & E Loss (ft)   0.27
 0.61
  BR Sluice Coef   Shear Total (lb/sq ft)   0.68
 1.78
  BR Sel Method   Energy only   Power Total (lb/ft s)   4.40
17.74

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream
         energy. This is not physically possible, the momentum answer has been disregarded.
Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum
         answer has been disregarded.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #25 YR

  E.G. US. (ft)   234.77   Element   Inside BR US
Inside BR DS
  W.S. US. (ft)   234.62   E.G. Elev (ft)   234.55

```
233.97
  Q Total (cfs)               920.00    W.S. Elev (ft)              233.71
231.84
  Q Bridge (cfs)              920.00    Crit W.S. (ft)              230.88
231.73
  Q Weir (cfs)                          Max Chl Dpth (ft)             7.64
 4.99
  Weir Sta Lft (ft)                     Vel Total (ft/s)              7.32
11.71
  Weir Sta Rgt (ft)                     Flow Area (sq ft)           125.72
78.57
  Weir Submerg                          Froude # Chl                  0.47
 0.92
  Weir Max Depth (ft)                   Specif Force (cu ft)        667.54
516.12
  Min El Weir Flow (ft)       237.01    Hydr Depth (ft)               7.34
 4.56
  Min El Prs (ft)             235.50    W.P. Total (ft)              30.88
25.47
  Delta EG (ft)                 1.76    Conv. Total (cfs)          15877.7
8247.7
  Delta WS (ft)                 2.01    Top Width (ft)               17.12
17.25
  BR Open Area (sq ft)        141.32    Frctn Loss (ft)               0.19
 0.09
  BR Open Vel (ft/s)           11.71    C & E Loss (ft)               0.39
 0.86
  BR Sluice Coef                        Shear Total (lb/sq ft)        0.85
 2.40
  BR Sel Method          Energy only    Power Total (lb/ft s)         6.25
28.06
```

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream
         energy. This is not physically possible, the momentum answer has been disregarded.
Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum
         answer has been disregarded.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #50 YR

E.G. US. (ft)	236.55	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	236.42	E.G. Elev (ft)	236.55	234.81
Q Total (cfs)	1100.00	W.S. Elev (ft)	235.50	233.19
Q Bridge (cfs)	1100.00	Crit W.S. (ft)	231.44	232.30
Q Weir (cfs)		Max Chl Dpth (ft)	9.43	6.34
Weir Sta Lft (ft)		Vel Total (ft/s)	7.04	10.79
Weir Sta Rgt (ft)		Flow Area (sq ft)	156.20	101.91
Weir Submerg		Froude # Chl	0.40	0.76
Weir Max Depth (ft)		Specif Force (cu ft)	950.92	672.80
Min El Weir Flow (ft)	237.01	Hydr Depth (ft)		5.94
Min El Prs (ft)	235.50	W.P. Total (ft)	51.45	28.18
Delta EG (ft)	2.90	Conv. Total (cfs)	16220.8	11892.0
Delta WS (ft)	3.23	Top Width (ft)		17.16
BR Open Area (sq ft)	141.32	Frctn Loss (ft)		
BR Open Vel (ft/s)	7.78	C & E Loss (ft)		
BR Sluice Coef	0.37	Shear Total (lb/sq ft)	0.87	1.93
BR Sel Method	Press Only	Power Total (lb/ft s)	6.14	20.85

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.

Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #100 YR

E.G. US. (ft)	237.09	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	237.02	E.G. Elev (ft)	237.09	237.08
Q Total (cfs)	1330.00	W.S. Elev (ft)	237.02	237.02
Q Bridge (cfs)	1323.41	Crit W.S. (ft)	232.11	232.97
Q Weir (cfs)	5.85	Max Chl Dpth (ft)	10.95	10.17
Weir Sta Lft (ft)	-184.29	Vel Total (ft/s)	8.46	9.35
Weir Sta Rgt (ft)	-45.71	Flow Area (sq ft)	157.15	142.28
Weir Submerg	0.00	Froude # Chl	0.45	0.52
Weir Max Depth (ft)	0.09	Specif Force (cu ft)	1298.96	1187.77
Min El Weir Flow (ft)	237.01	Hydr Depth (ft)	2.37	2.14
Min El Prs (ft)	235.50	W.P. Total (ft)	117.87	116.22
Delta EG (ft)	2.78	Conv. Total (cfs)		
Delta WS (ft)	3.23	Top Width (ft)	66.42	66.42
BR Open Area (sq ft)	141.32	Frctn Loss (ft)		
BR Open Vel (ft/s)	9.36	C & E Loss (ft)		
BR Sluice Coef	0.43	Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.

Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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.

BRIDGE OUTPUT Profile #200 YR

E.G. US. (ft)	237.44	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	237.36	E.G. Elev (ft)	237.44	237.39
Q Total (cfs)	1540.00	W.S. Elev (ft)	237.36	237.29
Q Bridge (cfs)	1416.68	Crit W.S. (ft)	232.69	233.56
Q Weir (cfs)	123.33	Max Chl Dpth (ft)	11.29	10.44
Weir Sta Lft (ft)	-231.39	Vel Total (ft/s)	7.17	8.10
Weir Sta Rgt (ft)	-13.19	Flow Area (sq ft)	214.64	190.05
Weir Submerg	0.00	Froude # Chl	0.50	0.58
Weir Max Depth (ft)	0.44	Specif Force (cu ft)	1455.80	1342.84
Min El Weir Flow (ft)	237.01	Hydr Depth (ft)	1.03	0.73
Min El Prs (ft)	235.50	W.P. Total (ft)	259.98	309.27

```
  Delta EG (ft)                   2.68    Conv. Total (cfs)

  Delta WS (ft)                   3.22    Top Width (ft)               208.52
259.47
  BR Open Area (sq ft)          141.32    Frctn Loss (ft)

  BR Open Vel (ft/s)             10.02    C & E Loss (ft)

  BR Sluice Coef                  0.45    Shear Total (lb/sq ft)

  BR Sel Method             Press/Weir    Power Total (lb/ft s)
```

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.

Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Note: For the cross section inside the bridge at the downstream end, the water surface and energy are based on critical depth over the weir.

BRIDGE OUTPUT Profile #500 YR

```
  E.G. US. (ft)                 237.82    Element                    Inside BR US
Inside BR DS
  W.S. US. (ft)                 237.71    E.G. Elev (ft)               237.82
237.82
  Q Total (cfs)                1880.00    W.S. Elev (ft)               237.71
237.50
  Q Bridge (cfs)               1506.17    Crit W.S. (ft)               233.58
234.44
  Q Weir (cfs)                  373.83    Max Chl Dpth (ft)             11.64
10.66
```

Weir Sta Lft (ft)	-243.37	Vel Total (ft/s)	6.31	7.51
Weir Sta Rgt (ft)	37.23	Flow Area (sq ft)	297.73	250.34
Weir Submerg	0.00	Froude # Chl	0.48	0.62
Weir Max Depth (ft)	0.82	Specif Force (cu ft)	1622.84	1538.27
Min El Weir Flow (ft)	237.01	Hydr Depth (ft)	1.12	0.86
Min El Prs (ft)	235.50	W.P. Total (ft)	316.36	342.01
Delta EG (ft)	2.42	Conv. Total (cfs)		
Delta WS (ft)	3.11	Top Width (ft)	264.89	292.21
BR Open Area (sq ft)	141.32	Frctn Loss (ft)		
BR Open Vel (ft/s)	10.66	C & E Loss (ft)		
BR Sluice Coef	0.46	Shear Total (lb/sq ft)		
BR Sel Method	Press/Weir	Power Total (lb/ft s)		

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.

Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Note: For the cross section inside the bridge at the downstream end, the water surface is based on critical depth over the weir. The energy has been projected.

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2145

INPUT
Description: BRG DS
Station Elevation Data num= 90

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-343.96	239.18	-331.14	238.4	-313.22	237.93	-288.12	237.13	-275.37	236.7
-267.7	235.63	-256.8	234.78	-242.12	234.53	-228.68	234.12	-223.17	233.69
-201.77	233.56	-179.58	233.68	-170.41	233.64	-157.83	233.63	-152.98	233.57
-150	233.41	-147.3	233.27	-137.67	233.29	-135.3	232.91	-125.71	232.58
-120.9	232.52	-115.43	232.53	-110.3	232.55	-104.12	232.56	-94.88	232.53
-87.68	232.6	-82.54	232.64	-79.46	232.65	-77.04	232.47	-69.18	232.56
-63.01	232.5	-57.39	232.64	-50.67	232.58	-46.08	232.64	-38.34	232.94
-37.31	232.85	-37.05	232.77	-36.28	232.64	-27.88	230	-23.91	227.46
-18.08	227.97	-10.78	226.84	0	226.89	6.83	228.1	10.78	230.5
27.45	232.82	36.48	233.14	44.22	233.34	49.04	233.48	53.41	233.46
60.34	233.37	73.71	233.36	76.47	232.77	80.34	232.69	91.18	232.87
100.43	232.96	105.57	233.11	112.77	233.09	125.49	232.85	129.21	233.41
134.35	233.73	136.41	233.67	138.25	233.6	139.98	233.54	143.44	233.59
145.66	233.71	148.59	233.59	150.43	233.6	152.81	233.75	156.87	233.83
160.38	234.29	161.67	234.67	162.96	234.95	165.57	235.09	168.16	235.52
170.75	235.61	172.05	235.71	173.35	235.89	177.24	236.25	179.23	236.28
180.24	236.35	182.27	236.34	183.72	236.48	186.28	237.07	188.91	237.77
189.86	238.2	192.8	239.12	194.47	239.5	197.03	239.88	198.23	239.97

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-343.96	.08	-27.88	.03	10.78	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-27.88	10.78	12	40	58	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-343.96	-24.15	236	F
24.15	198.23	236.8	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2106

INPUT
Description:
Station Elevation Data num= 89

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-368.67	239.28	-356.61	238.52	-346	238.04	-320.92	237.18	-309.65	236.83

-305.9	236.61	-298.38	235.9	-292.12	234.7	-289.37	234.58	-285.85	234.11
-279.15	233.95	-266.93	233.85	-254.58	233.69	-246.57	233.6	-229.27	234.06
-220.73	234.25	-204.14	234.03	-197.66	233.48	-192.22	233.44	-187.53	233.63
-179.51	233.73	-174.23	233.44	-159.79	233.36	-153.61	233.23	-149.49	233.35
-140.86	232.55	-134.31	232.51	-131.63	232.49	-124.11	232.51	-121.53	232.72
-110.33	232.87	-87.66	233.04	-84.57	232.84	-77.36	232.78	-73.85	232.49
-65	232.63	-60.88	232.58	-55.94	232.58	-50.57	232.87	-35.19	232.82
-34.82	232.82	-28.12	232.84	-27.88	229.92	-23.91	227.38	-10.78	226.76
0	226.81	6.83	228.02	10.78	230.42	10.79	232.22	14.14	232.59
20.18	232.94	26.69	233.4	32.48	233.17	33.92	232.85	38.96	232.75
41.17	233.76	44.32	234.21	55.65	233.76	61.76	232.93	68.47	232.61
71.15	233.65	73.99	233.84	80.54	233.56	82.68	233.05	89.44	232.85
100.66	232.71	106.03	232.85	108.71	233.3	115.51	233.11	120.79	233.3
124.81	233.73	129.99	233.05	134.2	232.77	142.25	232.71	151.23	232.62
160.88	232.47	167.64	232.48	171.76	232.56	183.09	233.7	188.06	233.38
196.61	234.01	198.54	234.47	209.16	234.85	213.98	236.52	218.81	236.92
224.08	237.66	230.4	238.81	232.83	239.53	239.37	240.5		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-368.67	.08	-27.88	.03	10.78	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-27.88	10.78	158	138	114	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-368.67	-44.15	236	F
44.15	239.37	236.8	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1967

INPUT
Description:
Station Elevation Data num= 70

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.07	237.43	-271.74	237.1	-264.18	236.45	-255.05	236.32	-245.05	234.7
-228.09	233.68	-216.45	233.42	-208.48	233.81	-202.06	233.83	-185.22	233.11
-179.73	232.64	-174.45	232.74	-160.59	232.39	-154.65	232.39	-148.27	232.42
-143.01	232.43	-135.85	232.39	-131.42	232.47	-119.02	232.37	-114.35	232.69
-108.08	232.85	-100.54	232.76	-94.38	232.79	-85.69	232.67	-74.95	232.75
-67.78	232.83	-57.03	232.91	-51.27	232.83	-46.29	232.65	-34.64	232.43
-28.17	232.76	-28.16	229.1	-14.06	227.3	3.74	226.3	21.94	227
29.94	227.9	30.34	232.84	36.11	232.82	39.58	233.06	42.66	232.81
54.02	232.68	67.45	232.81	77.3	233.33	84.47	233.3	99.79	233.36
105.79	233.09	115.02	233.18	127.5	233	133.86	233.56	153.58	233.73
157.41	232.5	168.05	232.68	174.8	232.51	180.4	232.54	189.67	232.41

204.54	232.65	210.09	232.93	214	233.02	224.46	233.64	228.29	233.89
233.08	234.58	237.87	235.57	241.7	236.01	246.49	237.22	252.24	237.9
258.94	239.69	263.73	240.04	268.52	241.19	276.21	242.46	283.81	243.36

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-283.07	.08	-28.16	.03	29.94	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-28.16	29.94	130	125	120	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-283.07	-113.15	236	F
113.15	283.81	236.8	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1840

INPUT
Description:
Station Elevation Data num= 75

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-435.01	237.42	-427.17	237.34	-419.59	236.36	-414.59	236.1	-412.09	235.47
-404.6	234.52	-397.1	234.21	-394.61	233.74	-385.86	233.62	-382.14	233.23
-376.03	233.28	-367.57	232.37	-353.81	232.86	-350.33	233.37	-328.63	233.36
-324.8	232.82	-318.9	232.59	-308.05	232.53	-300.55	232.39	-291.62	232.45
-285.24	232.68	-282.32	233.1	-271.28	232.29	-259.64	232.25	-250.12	232.45
-236.37	232.43	-227.9	232.39	-221.55	232.35	-212.49	232.48	-206.75	232.32
-197.1	232.52	-192.99	233.39	-177.28	233.45	-168.62	233.49	-162.73	233.49
-151.76	233.51	-143.7	233.35	-137.66	233.29	-131.87	232.94	-124.9	232.44
-118.18	232.52	-108.89	233.24	-102.95	233.2	-92.34	232.92	-86.56	232.45
-79.23	232.68	-69.07	232.68	-59.54	232.84	-50.81	232.56	-39.1	232.62
-31.35	232.57	-23.1	233	-21.65	228.5	-14.55	226.8	-4.35	226.7
5.05	227.4	16.65	229.5	18.15	232.6	27.98	233.21	35.76	233.32
53.27	233.37	60.5	232.86	67.54	232.96	70.21	233.54	78.21	233.36
94.12	232.94	107.74	232.72	119.53	233.09	135.32	233.34	150	233.97
157.14	234.77	165.49	237	171.76	238.39	178.01	240.24	182.29	240.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-435.01	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	235	295	340	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-435.01	-175.65	236	F

175.65	182.29	236.8	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1545

INPUT
Description:
Station Elevation Data num= 65

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-480.73	237.79	-466.57	236.33	-462.82	234.54	-447.81	234.36	-431.38	233.55
-409.46	233.27	-388.5	233.11	-370.86	232.95	-343.2	232.97	-325.64	232.41
-311.62	232.36	-295.8	232.29	-273.64	232.2	-248.51	232.53	-243.41	232.27
-232.05	232.35	-216.44	232.45	-201.73	232.68	-190.36	232.67	-182.25	232.57
-162.4	232.67	-132.62	232.57	-123.42	232.5	-85.97	233.02	-69.1	233.43
-55.42	233.75	-26.16	233.77	-21.65	227.91	-14.55	226.21	-4.35	226.11
5.05	226.81	16.65	228.91	18.05	232.67	18.95	232.77	20.43	233.31
41.64	233.03	57.37	232.35	66.05	232.25	85.45	232.73	104.51	232.93
138.05	233.2	162.05	232.43	186.04	232.4	215.49	232.34	228.79	232.38
239.13	232.37	259.3	232.55	285.83	232.28	323.72	232.8	340.54	232.8
354.88	232.82	376.77	232.86	400.77	233.06	408.92	232.93	424.77	233.07
442.46	234.51	450.83	235.77	467.72	236.88	500.68	237.23	529.61	237.25
534.61	238.37	552.4	238.72	555.36	239.27	583.92	241.84	594.56	241.83

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-480.73	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	205	250	285	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-480.73	-323.15	236	F
323.15	594.56	236.8	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1295

INPUT
Description:
Station Elevation Data num= 73

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-403.24	238.81	-394.41	238.51	-388.15	237.61	-381.89	234.7	-376.88	234.48
-374.37	234.03	-364.28	233.38	-358.94	233.43	-346.74	232.37	-339.31	232.43
-330.88	232.35	-319.27	232.08	-312.17	232.85	-301.96	232.88	-295.47	233.14

-274.85	233.11	-272.93	232.7	-261.39	232.42	-248.92	232.44	-237.14	232.38
-226.65	232.31	-219.97	232.81	-212.39	233.09	-197.78	233.18	-195.27	232.85
-189.99	232.66	-185.25	232.51	-178.99	232.54	-165.21	232.45	-161.46	232.91
-151.44	233.27	-137.66	232.97	-121.38	232.6	-114.57	232.37	-107.72	232.38
-94.36	232.18	-87.7	232.32	-82.38	232.3	-61.66	232.5	-53.99	232.55
-48.57	232.27	-40.69	232.21	-35.48	232.38	-22.95	232.21	-21.65	227.41
-14.55	225.71	-4.35	225.61	5.05	226.31	16.65	228.41	17.86	232.19
29.39	232.55	43.58	232.42	49.79	233	55.11	233.08	67.61	232.91
84.38	232.69	90.51	232.4	98.7	232.09	113.93	232.18	123.61	232.28
133.55	232.74	145.11	233.19	156.54	233.35	170.45	234.27	184.12	237.66
186.22	238.49	196.33	240.78	210.45	242.19	219.87	242.61	227.23	242.67
234.59	243.13	243.65	243.09	255.61	243.24				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-403.24	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	295	295	295	.1	.3

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1000

INPUT
Description: DS LIMIT
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-177.41	241.46	-169.62	241.51	-163.4	241.44	-159.61	241.06	-152.07	240.44
-150.81	240.24	-147.03	240	-144.52	239.59	-135.7	238.75	-128.16	237.51
-121.86	235.95	-119.58	235.47	-113.04	234.52	-110.53	234.42	-105.69	233.81
-104.77	233.57	-101.17	233.28	-98.3	233.45	-93.71	233.07	-91.87	233.08
-89.1	233.38	-86.34	233.26	-81.73	232.64	-78.96	232.67	-73.43	232.51
-69.74	232.57	-67.19	232.72	-64.07	233.31	-61.34	232.72	-59.04	232.58
-52.8	232.5	-46.7	232.03	-43.33	231.97	-37.15	232.06	-33.8	232.41
-31.03	232.44	-22.39	232.49	-21.65	226.82	-14.55	225.12	-4.35	225.02
5.05	225.72	16.65	227.82	19.66	232.91	43.94	233.14	49.16	232.96
53.77	232.89	56.53	232.78	62.44	232.88	67.59	232.58	69.23	232.51
77.73	232.18	79.58	232.36	82.32	232.4	83.78	232.82	86.03	233.14
89.72	232.27	93.4	232.14	95.41	232.42	98.93	232.52	106.31	232.78
112.23	233.27	117.48	233.74	122.52	234.41	130.8	235.42	138.63	236.68
140.65	236.93	144.68	237.85	152.74	238.44	157.01	238.78	158.15	239.09
160.79	239.29	168.57	240.27	170.86	240.7	172.88	240.88	175.09	241.39
181.6	241.8	182.95	241.88	188.12	241.93	193.89	242.12	198.54	242.14
206.35	242.5	208.13	242.52	212.87	242.28	217.74	242.33		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

-177.41	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:NORTH

Reach	River Sta.	n1	n2	n3
MID	2520	.08	.03	.08
MID	2348	.08	.03	.08
MID	2265	.08	.03	.08
MID	2231	.08	.03	.08
MID	2192	Bridge		
MID	2145	.08	.03	.08
MID	2106	.08	.03	.08
MID	1967	.08	.03	.08
MID	1840	.08	.03	.08
MID	1545	.08	.03	.08
MID	1295	.08	.03	.08
MID	1000	.08	.03	.08

SUMMARY OF REACH LENGTHS

River: NORTH

Reach	River Sta.	Left	Channel	Right
MID	2520	185	172	163
MID	2348	80	82	82
MID	2265	21	34	43
MID	2231	86	86	86
MID	2192	Bridge		
MID	2145	12	40	58
MID	2106	158	138	114
MID	1967	130	125	120
MID	1840	235	295	340
MID	1545	205	250	285
MID	1295	295	295	295
MID	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: NORTH

Reach	River Sta.	Contr.	Expan.
MID	2520	.1	.3
MID	2348	.1	.3
MID	2265	.3	.5
MID	2231	.3	.5
MID	2192	Bridge	
MID	2145	.3	.5
MID	2106	.1	.3
MID	1967	.1	.3
MID	1840	.1	.3
MID	1545	.1	.3
MID	1295	.1	.3
MID	1000	.1	.3

Profile Output Table - Standard Table 1

Reach E.G. Elev (ft)	River Sta E.G. Slope (ft/ft)	Profile Vel Chnl (ft/s)	Q Total (cfs) Flow Area (sq ft)	Min Ch El (ft) Top Width (ft)	W.S. Elev (ft) Froude # Chl	Crit W.S. (ft)
MID	2520	2 YR	315.00	226.70	231.14	228.65
231.21	0.000393	2.25	142.93	45.62	0.21	
MID	2520	5 YR	520.00	226.70	232.48	229.24
232.59	0.000363	2.68	207.74	52.48	0.21	
MID	2520	10 YR	690.00	226.70	233.49	229.66
233.61	0.000317	2.83	395.79	389.56	0.21	
MID	2520	25 YR	920.00	226.70	234.81	230.14
234.87	0.000175	2.40	1000.76	494.89	0.16	
MID	2520	50 YR	1100.00	226.70	236.57	230.48
236.59	0.000065	1.69	1908.04	577.21	0.10	
MID	2520	100 YR	1330.00	226.70	237.10	230.88
237.13	0.000068	1.80	2190.79	594.18	0.10	
MID	2520	200 YR	1540.00	226.70	237.46	231.23
237.48	0.000074	1.92	2380.56	612.93	0.11	
MID	2520	500 YR	1880.00	226.70	237.83	231.76
237.87	0.000088	2.16	2718.37	619.82	0.12	
MID	2348	2 YR	315.00	226.40	230.99	228.91
231.12	0.000706	2.94	109.33	34.27	0.28	

MID	2348	5 YR	520.00	226.40	232.31	229.61
232.50	0.000639	3.48	156.54	36.60	0.28	
MID	2348	10 YR	690.00	226.40	233.34	230.04
233.53	0.000524	3.59	318.05	394.91	0.26	
MID	2348	25 YR	920.00	226.40	234.72	230.57
234.83	0.000294	3.10	702.94	577.45	0.20	
MID	2348	50 YR	1100.00	226.40	236.53	230.94
236.58	0.000120	2.30	1233.26	605.35	0.14	
MID	2348	100 YR	1330.00	226.40	237.06	231.40
237.11	0.000130	2.49	1426.21	618.94	0.14	
MID	2348	200 YR	1540.00	226.40	237.40	231.80
237.46	0.000145	2.69	1537.47	629.45	0.15	
MID	2348	500 YR	1880.00	226.40	237.82	232.40
237.85	0.000085	2.12	2989.33	654.73	0.12	

MID	2265	2 YR	315.00	226.15	230.94	228.66
231.06	0.000583	2.78	114.26	32.28	0.26	
MID	2265	5 YR	520.00	226.15	232.27	229.35
232.45	0.000561	3.35	157.85	33.26	0.27	
MID	2265	10 YR	690.00	226.15	233.29	229.78
233.49	0.000512	3.63	239.94	316.34	0.26	
MID	2265	25 YR	920.00	226.15	234.61	230.31
234.80	0.000389	3.61	411.07	564.54	0.24	
MID	2265	50 YR	1100.00	226.15	236.44	230.69
236.56	0.000210	3.08	646.44	602.60	0.18	
MID	2265	100 YR	1330.00	226.15	237.02	231.14
237.10	0.000160	2.80	1180.25	607.66	0.16	
MID	2265	200 YR	1540.00	226.15	237.36	231.54
237.45	0.000180	3.04	1272.95	613.40	0.17	
MID	2265	500 YR	1880.00	226.15	237.72	232.15
237.83	0.000225	3.48	1372.42	619.44	0.19	

MID	2231	2 YR	315.00	226.07	230.95	228.55
231.03	0.000408	2.27	141.15	43.27	0.21	
MID	2231	5 YR	520.00	226.07	232.29	229.20
232.40	0.000371	2.69	201.14	46.08	0.22	
MID	2231	10 YR	690.00	226.07	233.31	229.58
233.44	0.000339	2.93	259.23	277.72	0.21	
MID	2231	25 YR	920.00	226.07	234.62	230.03
234.77	0.000295	3.13	339.26	331.40	0.21	
MID	2231	50 YR	1100.00	226.07	236.42	230.35
236.55	0.000191	2.92	449.19	375.81	0.17	
MID	2231	100 YR	1330.00	226.07	237.02	230.74
237.09	0.000131	2.52	1134.20	391.93	0.14	
MID	2231	200 YR	1540.00	226.07	237.36	231.08
237.44	0.000150	2.76	1219.99	401.45	0.16	
MID	2231	500 YR	1880.00	226.07	237.71	231.59
237.82	0.000192	3.20	1314.25	434.42	0.18	

MID	2192		Bridge			
MID	2145	2 YR	315.00	226.84	230.24	228.78
230.41	0.001208	3.32	94.79	38.97	0.35	
MID	2145	5 YR	520.00	226.84	231.14	229.37
231.41	0.001282	4.11	127.94	46.92	0.38	
MID	2145	10 YR	690.00	226.84	231.82	229.79
232.14	0.001266	4.58	156.35	53.93	0.39	
MID	2145	25 YR	920.00	226.84	232.61	230.29
233.01	0.001263	5.12	193.35	127.34	0.40	
MID	2145	50 YR	1100.00	226.84	233.19	230.66
233.64	0.001237	5.44	221.59	228.84	0.40	
MID	2145	100 YR	1330.00	226.84	233.78	231.10
234.31	0.001281	5.92	250.07	378.77	0.42	
MID	2145	200 YR	1540.00	226.84	234.13	231.48
234.76	0.001421	6.46	266.95	388.23	0.44	
MID	2145	500 YR	1880.00	226.84	234.60	232.06
235.40	0.001670	7.33	289.45	407.49	0.49	
MID	2106	2 YR	315.00	226.76	230.21	228.53
230.35	0.000932	2.93	107.45	38.34	0.31	
MID	2106	5 YR	520.00	226.76	231.13	229.11
231.33	0.000998	3.64	142.82	38.76	0.33	
MID	2106	10 YR	690.00	226.76	231.81	229.53
232.07	0.000999	4.08	169.26	38.82	0.34	
MID	2106	25 YR	920.00	226.76	232.60	230.02
232.93	0.001021	4.61	200.62	95.16	0.36	
MID	2106	50 YR	1100.00	226.76	233.19	230.35
233.56	0.001012	4.93	236.44	268.93	0.36	
MID	2106	100 YR	1330.00	226.76	233.78	230.77
234.22	0.001039	5.33	286.16	400.83	0.37	
MID	2106	200 YR	1540.00	226.76	234.14	231.10
234.65	0.001139	5.79	317.20	467.82	0.39	
MID	2106	500 YR	1880.00	226.76	234.62	231.63
235.26	0.001308	6.50	359.93	493.25	0.43	
MID	1967	2 YR	315.00	226.30	230.20	228.02
230.25	0.000302	1.80	175.69	58.29	0.18	
MID	1967	5 YR	520.00	226.30	231.14	228.47
231.22	0.000334	2.26	230.41	58.37	0.20	
MID	1967	10 YR	690.00	226.30	231.84	228.79
231.94	0.000342	2.55	271.43	58.43	0.21	
MID	1967	25 YR	920.00	226.30	232.66	229.16
232.79	0.000354	2.89	321.16	178.76	0.22	

MID	1967	50 YR	1100.00	226.30	233.27	229.42
233.42	0.000347	3.07	421.47	357.18	0.22	
MID	1967	100 YR	1330.00	226.30	233.90	229.73
234.06	0.000343	3.26	562.61	460.12	0.22	
MID	1967	200 YR	1540.00	226.30	234.29	229.98
234.47	0.000362	3.48	651.12	469.34	0.23	
MID	1967	500 YR	1880.00	226.30	234.83	230.37
235.04	0.000395	3.81	773.54	480.17	0.24	

MID	1840	2 YR	315.00	226.70	230.00	228.69
230.17	0.001322	3.29	96.10	39.03	0.37	
MID	1840	5 YR	520.00	226.70	230.88	229.28
231.13	0.001323	4.02	130.53	39.73	0.39	
MID	1840	10 YR	690.00	226.70	231.54	229.67
231.85	0.001280	4.46	157.04	40.27	0.39	
MID	1840	25 YR	920.00	226.70	232.30	230.12
232.69	0.001277	5.00	187.91	55.12	0.40	
MID	1840	50 YR	1100.00	226.70	232.88	230.46
233.31	0.001239	5.31	232.71	289.43	0.40	
MID	1840	100 YR	1330.00	226.70	233.50	230.86
233.96	0.001157	5.52	369.73	518.66	0.40	
MID	1840	200 YR	1540.00	226.70	233.91	231.20
234.37	0.001123	5.68	499.49	544.12	0.40	
MID	1840	500 YR	1880.00	226.70	234.50	231.72
234.94	0.001038	5.80	694.24	559.00	0.39	

MID	1545	2 YR	390.00	226.11	229.42	228.32
229.68	0.001996	4.06	96.99	39.66	0.45	
MID	1545	5 YR	630.00	226.11	230.26	228.95
230.63	0.001990	4.91	130.56	40.61	0.47	
MID	1545	10 YR	840.00	226.11	230.89	229.38
231.36	0.001986	5.50	156.38	41.33	0.49	
MID	1545	25 YR	1110.00	226.11	231.61	229.88
232.20	0.001981	6.14	186.57	42.16	0.50	
MID	1545	50 YR	1330.00	226.11	232.15	230.26
232.82	0.001976	6.59	209.45	42.77	0.51	
MID	1545	100 YR	1600.00	226.11	232.86	230.70
233.52	0.001703	6.66	413.84	569.15	0.48	
MID	1545	200 YR	1850.00	226.11	233.61	231.09
234.03	0.001103	5.80	839.83	828.47	0.40	
MID	1545	500 YR	2230.00	226.11	234.36	231.63
234.64	0.000766	5.19	1318.01	888.27	0.34	

MID	1295	2 YR	390.00	225.61	228.92	
229.18	0.002000	4.06	96.40	38.87	0.45	
MID	1295	5 YR	630.00	225.61	229.76	
230.13	0.002000	4.92	129.09	39.37	0.47	

MID	1295	10 YR	840.00	225.61	230.39		230.86	0.002001	5.52	153.95	39.74	0.49
MID	1295	25 YR	1110.00	225.61	231.11		231.70	0.002003	6.17	182.73	40.16	0.50
MID	1295	50 YR	1330.00	225.61	231.64		232.33	0.002003	6.63	204.36	40.48	0.51
MID	1295	100 YR	1600.00	225.61	232.26		233.05	0.002004	7.14	233.10	98.12	0.52
MID	1295	200 YR	1850.00	225.61	232.87	230.57	233.65	0.001782	7.20	401.12	384.93	0.50
MID	1295	500 YR	2230.00	225.61	233.91	231.13	234.39	0.001090	6.22	915.66	537.47	0.40
MID	1000	2 YR	390.00	225.02	228.33	227.23	228.59	0.002004	4.06	96.23	38.80	0.45
MID	1000	5 YR	630.00	225.02	229.17	227.85	229.54	0.002000	4.92	128.95	39.40	0.47
MID	1000	10 YR	840.00	225.02	229.80	228.29	230.27	0.002002	5.52	153.84	39.86	0.49
MID	1000	25 YR	1110.00	225.02	230.52	228.78	231.11	0.002003	6.17	182.72	40.38	0.50
MID	1000	50 YR	1330.00	225.02	231.05	229.16	231.74	0.002002	6.63	204.51	40.76	0.51
MID	1000	100 YR	1600.00	225.02	231.67	229.61	232.45	0.002002	7.13	229.57	41.21	0.52
MID	1000	200 YR	1850.00	225.02	232.19	229.98	233.08	0.002002	7.56	253.50	56.91	0.53
MID	1000	500 YR	2230.00	225.02	232.90	230.55	233.91	0.002002	8.11	326.78	151.63	0.54

Profile Output Table - Six XS Bridge

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
MID	2265	2 YR	231.06	230.94	228.66	0.02	0.02	32.28	0.22	314.77	0.01	2.78
MID	2265	5 YR	232.45	232.27	229.35	0.02	0.03	33.26	1.08	518.89	0.04	3.35
MID	2265	10 YR	233.49	233.29	229.78	0.01	0.03	316.34	5.43	675.27	9.30	3.63
MID	2265	25 YR	234.80	234.61	230.31	0.01	0.02	564.54	42.46	821.04	56.49	3.61

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  MID          2265          50 YR        236.56      236.44      230.69
0.01         0.00      602.60    99.62      874.43    125.95       3.08
  MID          2265          100 YR       237.10      237.02      231.14
0.00         0.00      607.66   345.74      844.76    139.50       2.80
  MID          2265          200 YR       237.45      237.36      231.54
0.01         0.00      613.40   421.74      950.20    168.06       3.04
  MID          2265          500 YR       237.83      237.72      232.15
0.01         0.00      619.44   540.48     1126.88    212.64       3.48


  MID          2231          2 YR         231.03      230.95      228.55
0.02         0.06       43.27     0.26      314.24      0.50       2.27
  MID          2231          5 YR         232.40      232.29      229.20
0.02         0.11       46.08     1.14      516.45      2.41       2.69
  MID          2231          10 YR        233.44      233.31      229.58
0.02         0.15      277.72     4.50      679.89      5.61       2.93
  MID          2231          25 YR        234.77      234.62      230.03
0.02         0.21      331.40    15.31      889.55     15.14       3.13
  MID          2231          50 YR        236.55      236.42      230.35
                    375.81    31.05     1040.97     27.98       2.92
  MID          2231          100 YR       237.09      237.02      230.74
                    391.93   344.02      957.65     28.33       2.52
  MID          2231          200 YR       237.44      237.36      231.08
                    401.45   418.92     1087.35     33.73       2.76
  MID          2231          500 YR       237.82      237.71      231.59
                    434.42   532.23     1305.41     42.36       3.20

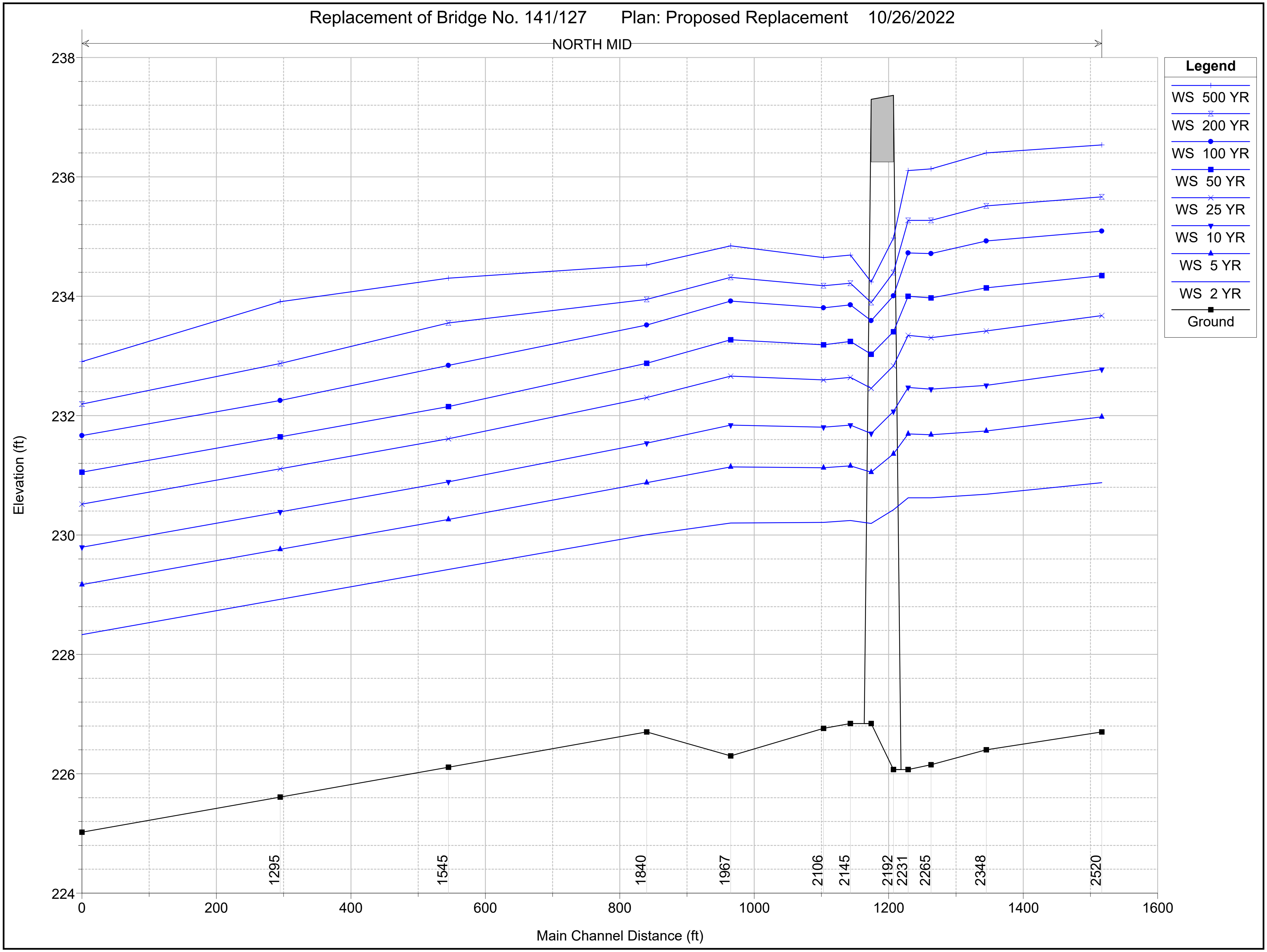

  MID          2192    BR U   2 YR         230.95      230.66      228.62
0.10         0.12       17.33                315.00                  4.31
  MID          2192    BR U   5 YR         232.27      231.78      229.48
0.14         0.20       17.25                520.00                  5.62
  MID          2192    BR U   10 YR        233.27      232.62      230.11
0.16         0.27       17.19                690.00                  6.45
  MID          2192    BR U   25 YR        234.55      233.71      230.88
0.19         0.39       17.12                920.00                  7.32
  MID          2192    BR U   50 YR        236.55      235.50      231.44
                                        1100.00                  7.04
  MID          2192    BR U   100 YR       237.09      237.02      232.11
                     66.42     5.58     1323.41                  8.47
  MID          2192    BR U   200 YR       237.44      237.36      232.69
                    208.52   121.63     1416.68                  9.07
  MID          2192    BR U   500 YR       237.82      237.71      233.58
                    264.89   364.64     1512.48      2.78        9.31


  MID          2192    BR D   2 YR         230.73      230.06      229.47
0.07         0.25       17.37                315.00                  6.59
  MID          2192    BR D   5 YR         231.94      230.78      230.34
0.08         0.44       17.32                520.00                  8.61
```

```
  MID          2192    BR D   10 YR        232.84      231.30      230.97
0.09         0.61       17.28              690.00                  9.96
  MID          2192    BR D   25 YR        233.97      231.84      231.73
0.09         0.86       17.25              920.00                 11.71
  MID          2192    BR D   50 YR        234.81      233.19      232.30
                      17.16              1100.00                 10.79
  MID          2192    BR D   100 YR       237.08      237.02      232.97
                      66.42     5.58     1323.41                  9.36
  MID          2192    BR D   200 YR       237.39      237.29      233.56
                     259.47   121.63     1416.68                 10.02
  MID          2192    BR D   500 YR       237.82      237.50      234.44
                     292.21   364.64     1512.48      2.78       10.52


  MID          2145           2 YR         230.41      230.24      228.78
0.04         0.02       38.97              315.00                  3.32
  MID          2145           5 YR         231.41      231.14      229.37
0.05         0.03       46.92              519.54      0.46        4.11
  MID          2145           10 YR        232.14      231.82      229.79
0.04         0.03       53.93              686.89      3.12        4.58
  MID          2145           25 YR        233.01      232.61      230.29
0.05         0.04      127.34              908.49     11.51        5.12
  MID          2145           50 YR        233.64      233.19      230.66
0.04         0.04      228.84             1077.69     22.31        5.44
  MID          2145           100 YR       234.31      233.78      231.10
0.05         0.05      378.77             1293.28     36.72        5.92
  MID          2145           200 YR       234.76      234.13      231.48
0.05         0.06      388.23             1491.27     48.73        6.46
  MID          2145           500 YR       235.40      234.60      232.06
0.06         0.09      407.49             1811.14     68.87        7.33


  MID          2106           2 YR         230.35      230.21      228.53
0.07         0.03       38.34     0.00     315.00                  2.93
  MID          2106           5 YR         231.33      231.13      229.11
0.07         0.04       38.76     0.00     520.00      0.00        3.64
  MID          2106           10 YR        232.07      231.81      229.53
0.08         0.05       38.82     0.02     689.98      0.00        4.08
  MID          2106           25 YR        232.93      232.60      230.02
0.08         0.06       95.16     0.04     919.86      0.10        4.61
  MID          2106           50 YR        233.56      233.19      230.35
0.08         0.07      268.93     1.69    1095.94      2.38        4.93
  MID          2106           100 YR       234.22      233.78      230.77
0.08         0.08      400.83     8.39    1309.18     12.43        5.33
  MID          2106           200 YR       234.65      234.14      231.10
0.08         0.10      467.82    14.81    1501.99     23.20        5.79
  MID          2106           500 YR       235.26      234.62      231.63
0.09         0.13      493.25    26.62    1807.73     45.65        6.50
```


Replacement of Bridge No. 141/127 Plan: Proposed Replacement 10/26/2022
NORTH MID
Legend
WS 500 YR
WS 200 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
Ground
Elevation (ft)
Main Channel Distance (ft)
238
236
234
232
230
228
226
224
0
200
400
600
800
1000
1200
1400
1600
1295
1545
1840
1967
2106
2145
2192
2231
2265
2348
2520

HEC-RAS HEC-RAS 6.1.0 September 2021
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: Replacement of Bridge No. 141/127
Project File : 141-127 Route 152.prj
Run Date and Time: 10/26/2022 12:20:38 PM

Project in English units

Project Description:
NH Route 152 over North River - Final Hydraulic Design Report

PLAN DATA

Plan Title: Proposed Replacement
Plan File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.p02

Geometry Title: Proposed Replacement
Geometry File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.g02

Flow Title : StreamStats Design
Flow File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.f01

Plan Description:

Proposed Conditions
NAVD88 Daturm

Plan Summary Information:

Number of:					
Cross Sections	=	11	Multiple Openings	=	0
Culverts	=	0	Inline Structures	=	0
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 = 0.33
- 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: Subcritical Flow

FLOW DATA

Flow Title: StreamStats Design
Flow File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.f01

Flow Data (cfs)

River	Reach	RS	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR	200 YR	500 YR
NORTH	MID	2520	315	520	690	920	1100	1330	1540	1880
NORTH	MID	1545	390	630	840	1110	1330	1600	1850	2230
North River	RT 152	1971								

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
NORTH	MID	2 YR	Critical	Normal S = 0.002
NORTH	MID	5 YR	Critical	Normal S = 0.002
NORTH	MID	10 YR	Critical	Normal S = 0.002
NORTH	MID	25 YR	Critical	Normal S = 0.002
NORTH	MID	50 YR	Critical	Normal S = 0.002
NORTH	MID	100 YR	Critical	Normal S = 0.002
NORTH	MID	200 YR	Critical	Normal S = 0.002
NORTH	MID	500 YR	Critical	Normal S = 0.002

GEOMETRY DATA

Geometry Title: Proposed Replacement
Geometry File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.g02

CROSS SECTION

RIVER: NORTH
REACH: MID   RS: 2520

INPUT
Description: US LIMIT
Station Elevation Data   num=   75

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-298.56	242.06	-278.59	240.38	-264.7	239.67	-255.04	239.15	-243.35	238.18
-225.46	237.92	-218.81	237.25	-208.2	236.68	-199.53	235.96	-192.1	235.02
-187	234.78	-168.2	233.23	-164.44	233.23	-153.38	232.62	-146.37	232.53

-138.12	232.67	-133.06	232.91	-119.47	232.93	-107.01	233.42	-86.52	233.18
-77.55	232.89	-62.5	232.77	-57.16	233.2	-51.19	233.12	-41.29	232.91
-31.1	232.93	-30	232.77	-28.84	232.45	-27.47	232.27	-24.31	231.87
-22.76	231.1	-17.36	230.2	-6.76	226.7	.04	226.8	2.04	226.8
10.44	227	17.64	227.9	21.14	229	21.74	229.7	23.34	231.9
23.7	233.01	35.74	233.39	45.93	233.12	56.19	233.23	63.26	233.55
76.91	233.49	85.59	233.15	93.26	233.03	99.54	232.95	115.89	233.12
121.84	233.32	136.01	233.45	139.96	233.12	145.63	233.25	157.93	233.04
167.15	233.16	181.28	233.04	187.6	232.88	197.74	232.93	204.54	233.27
215.24	233.05	221.6	233.24	230.6	233.25	236.62	233.79	254.39	233.6
266.85	233.72	284.98	234.2	296.98	234.35	318.36	235.29	329.67	235.44
340.49	235.17	358.58	235.76	378.36	237.12	391.61	237.4	413.33	240

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-298.56	.08	-17.36	.03	21.74	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-17.36	21.74	185	172	163	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
318.5	413.33	238.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2348

INPUT
Description:
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-212.51	240.46	-209.38	239.92	-207.42	239.76	-202.36	239.04	-198.95	238.81
-190.48	238.06	-187.65	238.02	-175.42	237.3	-168.06	236.61	-157.91	235.35
-154.1	234.74	-143.95	234.45	-139.87	234.44	-134.47	233.96	-126.19	233.71
-118.58	233.26	-108.29	233.41	-99.55	233.3	-95.74	233.05	-90.15	232.88
-84.75	232.89	-80.52	232.88	-76.04	232.8	-72.6	232.47	-66.56	232.44
-63.13	232.75	-59.89	232.78	-53.4	232.93	-50.16	232.94	-44.75	232.94
-38.27	233.04	-32.3	232.92	-27.46	232.7	-20.98	232.59	-20.28	229.6
-16.28	228.8	-7.88	226.8	0	226.43	.72	226.4	8.12	227.8
10.82	229.4	15.12	231.8	15.91	232.52	21.15	232.85	36.24	233
52.31	233.01	60.38	232.59	74.36	232.66	92.07	232.68	98.47	232.7
104.96	232.65	112.46	232.66	132.67	232.41	144.54	232.56	176.29	232.48
186.14	232.56	198.63	232.51	210.23	232.65	245.44	232.58	254.02	233.59
264.41	233.78	271.54	233.76	298.91	233.94	312.48	233.95	318.62	233.78
337.04	233.64	346.64	233.47	355.84	233.34	378.27	233.21	399.64	233.49
421.28	234.34	438.9	236.65	452.8	237.43	478.3	238		

Manning's n Values num= 3

```
     Sta   n Val     Sta   n Val     Sta   n Val
 -212.51     .08  -20.28     .03   10.82     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        -20.28   10.82               80      82      82             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
 -212.51  -159.5   237.3       F
   146.5   478.3   238.6       F

CROSS SECTION


RIVER: NORTH
REACH: MID                RS: 2265

INPUT
Description: BRG APPROACH
Station Elevation Data    num=      72
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -264.42  240.04 -255.02  239.82 -249.54   239.4 -238.56   238.9 -226.67  238.48
 -224.01   238.2 -204.21  236.94 -199.16  236.14 -180.55  234.95 -175.95  234.83
 -154.84  233.52 -140.56  233.76  -132.1  232.91 -119.86  232.72 -111.63  232.57
 -100.32  232.99  -81.78  232.99  -59.88  232.92  -50.94  233.05  -35.51  232.84
  -22.49  232.69  -20.28  229.35  -16.28  228.55   -7.88  226.55       0  226.18
     .72  226.15    8.12  227.55   10.82  229.15   11.06  232.48    30.8  232.45
   46.88  232.64   49.45  233.22   58.44  233.04   76.49  233.36      79   232.5
    87.6   232.5   90.56  232.92   97.26  232.97  109.83  233.38  113.87  232.86
  121.39  232.51   129.1   233.3  130.38  233.91  161.21  234.01  174.11  233.28
  184.49  233.28  189.68   232.8  195.87  232.82  204.22  233.04  221.63  233.31
  235.35  233.44   241.9  233.71  252.81  233.91  259.28  234.22   263.8  234.42
  274.65  234.15  280.11  234.08  284.48  233.55   290.9  233.38  300.85   233.5
  311.23  233.32  320.09  233.25  326.42  233.91  339.09  233.89  342.87  233.77
  355.44  233.42  369.21  233.43  382.73  233.14  389.71  234.01  394.74   235.3
   401.1  236.05  403.63  238.21

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -264.42     .08  -20.28     .03   10.82     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        -20.28   10.82               21      34      43             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
 -264.42   -77.5   237.3       F
    64.5  403.63   238.6       F

CROSS SECTION
```

RIVER: NORTH
REACH: MID RS: 2231

INPUT
Description: BRG US
Station Elevation Data num= 79

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.71	239.35	-279.8	239.34	-264.32	239.01	-254.45	238.64	-248.85	238.15
-246.12	238.08	-241.08	237.61	-234.29	237.6	-230.84	237.41	-221.55	237.2
-218.59	236.88	-210.36	236.63	-203.07	236.15	-198.73	236.03	-195.83	235.77
-182	234.89	-176.85	234.36	-174.28	234.3	-169.97	233.91	-158.59	233.58
-151.35	233.37	-142.12	232.96	-134.8	232.86	-125.48	233.11	-122.82	232.69
-118.24	232.47	-112.53	232.83	-107.9	232.62	-100.95	232.61	-96.52	233
-91.94	232.99	-84.1	232.73	-81.65	232.51	-75.91	232.5	-64.92	232.55
-61.34	232.68	-53.35	232.77	-46.86	232.74	-39.19	232.42	-31.34	232.52
-23.07	232.51	-21	232.58	-18.56	229.22	-8.46	226.88	-5.98	226.37
2.36	226.07	11.63	227.93	21.25	229.33	25.56	232.49	26.42	232.45
31.57	233.03	39.01	233.03	52.15	233.26	64.87	233.11	67.97	232.67
79.17	232.67	81.74	232.76	86.59	233	90.78	233.09	95.88	233.08
99.76	233.02	104.18	232.78	110.05	232.5	115.19	232.77	118.66	232.78
126.94	233.24	133.3	233.76	136.25	233.72	142.46	234	145.56	234.35
149.7	234.47	155.91	234.87	158.94	235.31	165.22	235.99	171.42	236.78
174.38	237.84	176.6	237.73	194.43	237.63	220	238.16		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-283.71	.08	-18.56	.03	21.25	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-18.56	21.25	86	86	86	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-283.71	-43.5	237.3	F
30.5	220	238.6	F

BRIDGE

RIVER: NORTH
REACH: MID RS: 2192

INPUT
Description: Proposed Replacement
30' Clear Span
Distance from Upstream XS = 22
Deck/Roadway Width = 33
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 14

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord

-340	237.4		-290	237.3		-240	237.3	
-190	237.6		-140	238.3		-90	239	
-40	239.2		-21.5	239.1	236.25	8.5	239.1	236.25
60	238.9		110	238.7		160	238.6	
210	238.7		260	238.9				

Upstream Bridge Cross Section Data
Station Elevation Data num= 79

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.71	239.35	-279.8	239.34	-264.32	239.01	-254.45	238.64	-248.85	238.15
-246.12	238.08	-241.08	237.61	-234.29	237.6	-230.84	237.41	-221.55	237.2
-218.59	236.88	-210.36	236.63	-203.07	236.15	-198.73	236.03	-195.83	235.77
-182	234.89	-176.85	234.36	-174.28	234.3	-169.97	233.91	-158.59	233.58
-151.35	233.37	-142.12	232.96	-134.8	232.86	-125.48	233.11	-122.82	232.69
-118.24	232.47	-112.53	232.83	-107.9	232.62	-100.95	232.61	-96.52	233
-91.94	232.99	-84.1	232.73	-81.65	232.51	-75.91	232.5	-64.92	232.55
-61.34	232.68	-53.35	232.77	-46.86	232.74	-39.19	232.42	-31.34	232.52
-23.07	232.51	-21.5	231.5	-17.5	231.5	-8.46	226.88	-5.98	226.37
2.36	226.07	11.63	227.93	21.25	229.33	25.56	232.49	26.42	232.45
31.57	233.03	39.01	233.03	52.15	233.26	64.87	233.11	67.97	232.67
79.17	232.67	81.74	232.76	86.59	233	90.78	233.09	95.88	233.08
99.76	233.02	104.18	232.78	110.05	232.5	115.19	232.77	118.66	232.78
126.94	233.24	133.3	233.76	136.25	233.72	142.46	234	145.56	234.35
149.7	234.47	155.91	234.87	158.94	235.31	165.22	235.99	171.42	236.78
174.38	237.84	176.6	237.73	194.43	237.63	220	238.16		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-283.71	.08	-21.5	.03	21.25	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.
-21.5	21.25	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-283.71	-43.5	237.3	F
30.5	220	238.6	F

Downstream Deck/Roadway Coordinates
num= 14

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-340	237.4		-290	237.3		-240	237.3	
-190	237.6		-140	238.3		-90	239	
-40	239.2		-21.5	239.1	236.25	8.5	239.1	236.25
60	238.9		110	238.7		160	238.6	
210	238.7		260	238.9				

Downstream Bridge Cross Section Data
Station Elevation Data num= 89

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-343.96	239.18	-331.14	238.4	-313.22	237.93	-288.12	237.13	-275.37	236.7

-267.7	235.63	-256.8	234.78	-242.12	234.53	-228.68	234.12	-223.17	233.69
-201.77	233.56	-179.58	233.68	-170.41	233.64	-157.83	233.63	-152.98	233.57
-150	233.41	-147.3	233.27	-137.67	233.29	-135.3	232.91	-125.71	232.58
-120.9	232.52	-115.43	232.53	-110.3	232.55	-104.12	232.56	-94.88	232.53
-87.68	232.6	-82.54	232.64	-79.46	232.65	-77.04	232.47	-69.18	232.56
-63.01	232.5	-57.39	232.64	-50.67	232.58	-46.08	232.64	-38.34	232.94
-37.31	232.85	-37.05	232.77	-36.28	232.64	-21.5	231.5	-17.5	231.5
-10.78	226.84	0	226.89	6.83	228.1	10.78	230.5	27.45	232.82
36.48	233.14	44.22	233.34	49.04	233.48	53.41	233.46	60.34	233.37
73.71	233.36	76.47	232.77	80.34	232.69	91.18	232.87	100.43	232.96
105.57	233.11	112.77	233.09	125.49	232.85	129.21	233.41	134.35	233.73
136.41	233.67	138.25	233.6	139.98	233.54	143.44	233.59	145.66	233.71
148.59	233.59	150.43	233.6	152.81	233.75	156.87	233.83	160.38	234.29
161.67	234.67	162.96	234.95	165.57	235.09	168.16	235.52	170.75	235.61
172.05	235.71	173.35	235.89	177.24	236.25	179.23	236.28	180.24	236.35
182.27	236.34	183.72	236.48	186.28	237.07	188.91	237.77	189.86	238.2
192.8	239.12	194.47	239.5	197.03	239.88	198.23	239.97		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-343.96	.08	-21.5	.03	10.78	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.
-21.5	10.78	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-343.96	-37	236.3	F
24	198.23	237.6	F

Upstream Embankment side slope = 1 horiz. to 1.0 vertical
Downstream Embankment side slope = 1 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
Energy Only

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

BRIDGE OUTPUT Profile #2 YR

E.G. US. (ft)	230.72	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	230.62	E.G. Elev (ft)	230.66	230.55
Q Total (cfs)	315.00	W.S. Elev (ft)	230.42	230.19
Q Bridge (cfs)	315.00	Crit W.S. (ft)	228.61	229.17
Q Weir (cfs)		Max Chl Dpth (ft)	4.35	3.35
Weir Sta Lft (ft)		Vel Total (ft/s)	3.91	4.82
Weir Sta Rgt (ft)		Flow Area (sq ft)	80.65	65.34
Weir Submerg		Froude # Chl	0.33	0.46
Weir Max Depth (ft)		Specif Force (cu ft)	189.18	143.58
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	3.34	2.68
Min El Prs (ft)	236.25	W.P. Total (ft)	28.35	26.80
Delta EG (ft)	0.32	Conv. Total (cfs)	8019.0	5863.2
Delta WS (ft)	0.38	Top Width (ft)	24.14	24.37
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.07	0.05
BR Open Vel (ft/s)	4.82	C & E Loss (ft)	0.04	0.10
BR Sluice Coef		Shear Total (lb/sq ft)	0.27	0.44
BR Sel Method	Energy only	Power Total (lb/ft s)	1.07	2.12

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #5 YR

E.G. US. (ft)	231.84	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	231.69	E.G. Elev (ft)	231.75	231.61
Q Total (cfs)	520.00	W.S. Elev (ft)	231.36	231.05
Q Bridge (cfs)	520.00	Crit W.S. (ft)	229.41	229.92
Q Weir (cfs)		Max Chl Dpth (ft)	5.29	4.21
Weir Sta Lft (ft)		Vel Total (ft/s)	5.00	5.99
Weir Sta Rgt (ft)		Flow Area (sq ft)	104.09	86.76
Weir Submerg		Froude # Chl	0.38	0.51
Weir Max Depth (ft)		Specif Force (cu ft)	318.05	258.41
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	4.01	3.39
Min El Prs (ft)	236.25	W.P. Total (ft)	31.35	29.16
Delta EG (ft)	0.46	Conv. Total (cfs)	11474.6	8888.9
Delta WS (ft)	0.54	Top Width (ft)	25.93	25.57
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.09	0.06
BR Open Vel (ft/s)	5.99	C & E Loss (ft)	0.05	0.17
BR Sluice Coef		Shear Total (lb/sq ft)	0.43	0.64
BR Sel Method	Energy only	Power Total (lb/ft s)	2.13	3.81

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #10 YR

E.G. US. (ft)	232.65	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	232.47	E.G. Elev (ft)	232.54	232.38
Q Total (cfs)	690.00	W.S. Elev (ft)	232.07	231.70
Q Bridge (cfs)	690.00	Crit W.S. (ft)	229.98	230.45
Q Weir (cfs)		Max Chl Dpth (ft)	6.00	4.86
Weir Sta Lft (ft)		Vel Total (ft/s)	5.52	6.61
Weir Sta Rgt (ft)		Flow Area (sq ft)	124.97	104.44
Weir Submerg		Froude # Chl	0.40	0.53
Weir Max Depth (ft)		Specif Force (cu ft)	436.86	365.10
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	4.13	3.45
Min El Prs (ft)	236.25	W.P. Total (ft)	36.97	34.87
Delta EG (ft)	0.54	Conv. Total (cfs)	14088.5	10802.7
Delta WS (ft)	0.63	Top Width (ft)	30.24	30.26
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.10	0.06
BR Open Vel (ft/s)	6.61	C & E Loss (ft)	0.06	0.20
BR Sluice Coef		Shear Total (lb/sq ft)	0.51	0.76
BR Sel Method	Energy only	Power Total (lb/ft s)	2.79	5.04

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #25 YR

E.G. US. (ft)	233.57	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.34	E.G. Elev (ft)	233.44	233.27
Q Total (cfs)	920.00	W.S. Elev (ft)	232.84	232.46
Q Bridge (cfs)	920.00	Crit W.S. (ft)	230.66	231.09
Q Weir (cfs)		Max Chl Dpth (ft)	6.77	5.62
Weir Sta Lft (ft)		Vel Total (ft/s)	6.21	7.23
Weir Sta Rgt (ft)		Flow Area (sq ft)	148.13	127.32
Weir Submerg		Froude # Chl	0.42	0.54
Weir Max Depth (ft)		Specif Force (cu ft)	600.77	517.81
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	4.91	4.21
Min El Prs (ft)	236.25	W.P. Total (ft)	38.51	36.38
Delta EG (ft)	0.60	Conv. Total (cfs)	18437.5	14804.8
Delta WS (ft)	0.71	Top Width (ft)	30.19	30.21
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.10	0.06
BR Open Vel (ft/s)	7.23	C & E Loss (ft)	0.06	0.24
BR Sluice Coef		Shear Total (lb/sq ft)	0.60	0.84
BR Sel Method	Energy only	Power Total (lb/ft s)	3.71	6.10

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #50 YR

E.G. US. (ft)	234.25	Element	Inside BR US	Inside BR DS

```
  W.S. US. (ft)                234.00    E.G. Elev (ft)               234.09
233.93
  Q Total (cfs)               1100.00    W.S. Elev (ft)               233.41
233.03
  Q Bridge (cfs)              1100.00    Crit W.S. (ft)               231.15
231.70
  Q Weir (cfs)                           Max Chl Dpth (ft)              7.34
 6.19
  Weir Sta Lft (ft)                      Vel Total (ft/s)               6.65
 7.61
  Weir Sta Rgt (ft)                      Flow Area (sq ft)            165.34
144.60
  Weir Submerg                           Froude # Chl                   0.43
 0.54
  Weir Max Depth (ft)                    Specif Force (cu ft)         740.07
649.13
  Min El Weir Flow (ft)        237.38    Hydr Depth (ft)                5.48
 4.79
  Min El Prs (ft)              236.25    W.P. Total (ft)               39.65
37.52
  Delta EG (ft)                  0.64    Conv. Total (cfs)           21916.5
18103.2
  Delta WS (ft)                  0.76    Top Width (ft)                30.16
30.18
  BR Open Area (sq ft)         241.51    Frctn Loss (ft)                0.10
 0.06
  BR Open Vel (ft/s)             7.61    C & E Loss (ft)                0.06
 0.27
  BR Sluice Coef                         Shear Total (lb/sq ft)         0.66
 0.89
  BR Sel Method           Energy only    Power Total (lb/ft s)          4.36
 6.76
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #100 YR

```
  E.G. US. (ft)                235.01    Element                  Inside BR US
```

Inside BR DS

W.S. US. (ft)	234.73	E.G. Elev (ft)	234.82	234.65
Q Total (cfs)	1330.00	W.S. Elev (ft)	234.01	233.59
Q Bridge (cfs)	1330.00	Crit W.S. (ft)	231.86	232.16
Q Weir (cfs)		Max Chl Dpth (ft)	7.94	6.75
Weir Sta Lft (ft)		Vel Total (ft/s)	7.25	8.23
Weir Sta Rgt (ft)		Flow Area (sq ft)	183.42	161.59
Weir Submerg		Froude # Chl	0.45	0.56
Weir Max Depth (ft)		Specif Force (cu ft)	917.00	815.57
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	6.09	5.36
Min El Prs (ft)	236.25	W.P. Total (ft)	40.85	38.65
Delta EG (ft)	0.74	Conv. Total (cfs)	25778.9	21555.9
Delta WS (ft)	0.87	Top Width (ft)	30.13	30.15
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.10	0.06
BR Open Vel (ft/s)	8.23	C & E Loss (ft)	0.07	0.32
BR Sluice Coef		Shear Total (lb/sq ft)	0.75	0.99
BR Sel Method	Energy only	Power Total (lb/ft s)	5.41	8.18

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #200 YR

E.G. US. (ft)	235.59	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.27	E.G. Elev (ft)	235.37	235.16
Q Total (cfs)	1540.00	W.S. Elev (ft)	234.40	233.89
Q Bridge (cfs)	1540.00	Crit W.S. (ft)	232.26	232.57
Q Weir (cfs)		Max Chl Dpth (ft)	8.33	7.05
Weir Sta Lft (ft)		Vel Total (ft/s)	7.89	9.02
Weir Sta Rgt (ft)		Flow Area (sq ft)	195.23	170.64
Weir Submerg		Froude # Chl	0.48	0.60
Weir Max Depth (ft)		Specif Force (cu ft)	1069.16	957.28
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	6.49	5.66
Min El Prs (ft)	236.25	W.P. Total (ft)	41.63	39.25
Delta EG (ft)	0.88	Conv. Total (cfs)	28411.3	23477.1
Delta WS (ft)	1.05	Top Width (ft)	30.10	30.13
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.12	0.06
BR Open Vel (ft/s)	9.02	C & E Loss (ft)	0.09	0.39
BR Sluice Coef		Shear Total (lb/sq ft)	0.86	1.17
BR Sel Method	Energy only	Power Total (lb/ft s)	6.78	10.54

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #500 YR

E.G. US. (ft)	236.47	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	236.10	E.G. Elev (ft)	236.19	235.92
Q Total (cfs)	1880.00	W.S. Elev (ft)	234.97	234.24
Q Bridge (cfs)	1880.00	Crit W.S. (ft)	232.87	233.17
Q Weir (cfs)		Max Chl Dpth (ft)	8.90	7.40
Weir Sta Lft (ft)		Vel Total (ft/s)	8.84	10.38
Weir Sta Rgt (ft)		Flow Area (sq ft)	212.58	181.09
Weir Submerg		Froude # Chl	0.52	0.67
Weir Max Depth (ft)		Specif Force (cu ft)	1326.04	1193.06
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	7.07	6.01
Min El Prs (ft)	236.25	W.P. Total (ft)	42.79	39.95
Delta EG (ft)	1.16	Conv. Total (cfs)	32421.5	25758.1
Delta WS (ft)	1.41	Top Width (ft)	30.07	30.11
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.14	0.07
BR Open Vel (ft/s)	10.38	C & E Loss (ft)	0.14	0.53
BR Sluice Coef		Shear Total (lb/sq ft)	1.04	1.51
BR Sel Method	Energy only	Power Total (lb/ft s)	9.22	15.65

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2145

INPUT
Description: BRG DS
Station Elevation Data num= 90

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-343.96	239.18	-331.14	238.4	-313.22	237.93	-288.12	237.13	-275.37	236.7
-267.7	235.63	-256.8	234.78	-242.12	234.53	-228.68	234.12	-223.17	233.69
-201.77	233.56	-179.58	233.68	-170.41	233.64	-157.83	233.63	-152.98	233.57
-150	233.41	-147.3	233.27	-137.67	233.29	-135.3	232.91	-125.71	232.58
-120.9	232.52	-115.43	232.53	-110.3	232.55	-104.12	232.56	-94.88	232.53
-87.68	232.6	-82.54	232.64	-79.46	232.65	-77.04	232.47	-69.18	232.56
-63.01	232.5	-57.39	232.64	-50.67	232.58	-46.08	232.64	-38.34	232.94
-37.31	232.85	-37.05	232.77	-36.28	232.64	-27.88	230	-23.91	227.46
-18.08	227.97	-10.78	226.84	0	226.89	6.83	228.1	10.78	230.5
27.45	232.82	36.48	233.14	44.22	233.34	49.04	233.48	53.41	233.46
60.34	233.37	73.71	233.36	76.47	232.77	80.34	232.69	91.18	232.87
100.43	232.96	105.57	233.11	112.77	233.09	125.49	232.85	129.21	233.41
134.35	233.73	136.41	233.67	138.25	233.6	139.98	233.54	143.44	233.59
145.66	233.71	148.59	233.59	150.43	233.6	152.81	233.75	156.87	233.83
160.38	234.29	161.67	234.67	162.96	234.95	165.57	235.09	168.16	235.52
170.75	235.61	172.05	235.71	173.35	235.89	177.24	236.25	179.23	236.28
180.24	236.35	182.27	236.34	183.72	236.48	186.28	237.07	188.91	237.77
189.86	238.2	192.8	239.12	194.47	239.5	197.03	239.88	198.23	239.97

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-343.96	.08	-27.88	.03	10.78	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-27.88	10.78	12	40	58	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-343.96	-37	236.3	F
24	198.23	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2106

INPUT

Description:

Station Elevation Data num= 89

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-368.67	239.28	-356.61	238.52	-346	238.04	-320.92	237.18	-309.65	236.83
-305.9	236.61	-298.38	235.9	-292.12	234.7	-289.37	234.58	-285.85	234.11
-279.15	233.95	-266.93	233.85	-254.58	233.69	-246.57	233.6	-229.27	234.06
-220.73	234.25	-204.14	234.03	-197.66	233.48	-192.22	233.44	-187.53	233.63
-179.51	233.73	-174.23	233.44	-159.79	233.36	-153.61	233.23	-149.49	233.35
-140.86	232.55	-134.31	232.51	-131.63	232.49	-124.11	232.51	-121.53	232.72
-110.33	232.87	-87.66	233.04	-84.57	232.84	-77.36	232.78	-73.85	232.49
-65	232.63	-60.88	232.58	-55.94	232.58	-50.57	232.87	-35.19	232.82
-34.82	232.82	-28.12	232.84	-27.88	229.92	-23.91	227.38	-10.78	226.76
0	226.81	6.83	228.02	10.78	230.42	10.79	232.22	14.14	232.59
20.18	232.94	26.69	233.4	32.48	233.17	33.92	232.85	38.96	232.75
41.17	233.76	44.32	234.21	55.65	233.76	61.76	232.93	68.47	232.61
71.15	233.65	73.99	233.84	80.54	233.56	82.68	233.05	89.44	232.85
100.66	232.71	106.03	232.85	108.71	233.3	115.51	233.11	120.79	233.3
124.81	233.73	129.99	233.05	134.2	232.77	142.25	232.71	151.23	232.62
160.88	232.47	167.64	232.48	171.76	232.56	183.09	233.7	188.06	233.38
196.61	234.01	198.54	234.47	209.16	234.85	213.98	236.52	218.81	236.92
224.08	237.66	230.4	238.81	232.83	239.53	239.37	240.5		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-368.67	.08	-27.88	.03	10.78	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-27.88	10.78	158	138	114	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-368.67	-57	236.3	F
44	239.37	237.6	F

CROSS SECTION

RIVER: NORTH

REACH: MID RS: 1967

INPUT

Description:

Station Elevation Data num= 70

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.07	237.43	-271.74	237.1	-264.18	236.45	-255.05	236.32	-245.05	234.7
-228.09	233.68	-216.45	233.42	-208.48	233.81	-202.06	233.83	-185.22	233.11
-179.73	232.64	-174.45	232.74	-160.59	232.39	-154.65	232.39	-148.27	232.42
-143.01	232.43	-135.85	232.39	-131.42	232.47	-119.02	232.37	-114.35	232.69
-108.08	232.85	-100.54	232.76	-94.38	232.79	-85.69	232.67	-74.95	232.75
-67.78	232.83	-57.03	232.91	-51.27	232.83	-46.29	232.65	-34.64	232.43
-28.17	232.76	-28.16	229.1	-14.06	227.3	3.74	226.3	21.94	227

29.94	227.9	30.34	232.84	36.11	232.82	39.58	233.06	42.66	232.81
54.02	232.68	67.45	232.81	77.3	233.33	84.47	233.3	99.79	233.36
105.79	233.09	115.02	233.18	127.5	233	133.86	233.56	153.58	233.73
157.41	232.5	168.05	232.68	174.8	232.51	180.4	232.54	189.67	232.41
204.54	232.65	210.09	232.93	214	233.02	224.46	233.64	228.29	233.89
233.08	234.58	237.87	235.57	241.7	236.01	246.49	237.22	252.24	237.9
258.94	239.69	263.73	240.04	268.52	241.19	276.21	242.46	283.81	243.36

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-283.07	.08	-28.16	.03	29.94	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-28.16	29.94	130	125	120	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-283.07	-126	236.3	F
113	283.81	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1840

INPUT
Description:
Station Elevation Data num= 75

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-435.01	237.42	-427.17	237.34	-419.59	236.36	-414.59	236.1	-412.09	235.47
-404.6	234.52	-397.1	234.21	-394.61	233.74	-385.86	233.62	-382.14	233.23
-376.03	233.28	-367.57	232.37	-353.81	232.86	-350.33	233.37	-328.63	233.36
-324.8	232.82	-318.9	232.59	-308.05	232.53	-300.55	232.39	-291.62	232.45
-285.24	232.68	-282.32	233.1	-271.28	232.29	-259.64	232.25	-250.12	232.45
-236.37	232.43	-227.9	232.39	-221.55	232.35	-212.49	232.48	-206.75	232.32
-197.1	232.52	-192.99	233.39	-177.28	233.45	-168.62	233.49	-162.73	233.49
-151.76	233.51	-143.7	233.35	-137.66	233.29	-131.87	232.94	-124.9	232.44
-118.18	232.52	-108.89	233.24	-102.95	233.2	-92.34	232.92	-86.56	232.45
-79.23	232.68	-69.07	232.68	-59.54	232.84	-50.81	232.56	-39.1	232.62
-31.35	232.57	-23.1	233	-21.65	228.5	-14.55	226.8	-4.35	226.7
5.05	227.4	16.65	229.5	18.15	232.6	27.98	233.21	35.76	233.32
53.27	233.37	60.5	232.86	67.54	232.96	70.21	233.54	78.21	233.36
94.12	232.94	107.74	232.72	119.53	233.09	135.32	233.34	150	233.97
157.14	234.77	165.49	237	171.76	238.39	178.01	240.24	182.29	240.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-435.01	.08	-21.65	.03	16.65	.08

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

-21.65	16.65	235	295	340		.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-435.01	-188.5	236.3	F
175.5	182.29	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1545

INPUT
Description:
Station Elevation Data num= 65

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-480.73	237.79	-466.57	236.33	-462.82	234.54	-447.81	234.36	-431.38	233.55
-409.46	233.27	-388.5	233.11	-370.86	232.95	-343.2	232.97	-325.64	232.41
-311.62	232.36	-295.8	232.29	-273.64	232.2	-248.51	232.53	-243.41	232.27
-232.05	232.35	-216.44	232.45	-201.73	232.68	-190.36	232.67	-182.25	232.57
-162.4	232.67	-132.62	232.57	-123.42	232.5	-85.97	233.02	-69.1	233.43
-55.42	233.75	-26.16	233.77	-21.65	227.91	-14.55	226.21	-4.35	226.11
5.05	226.81	16.65	228.91	18.05	232.67	18.95	232.77	20.43	233.31
41.64	233.03	57.37	232.35	66.05	232.25	85.45	232.73	104.51	232.93
138.05	233.2	162.05	232.43	186.04	232.4	215.49	232.34	228.79	232.38
239.13	232.37	259.3	232.55	285.83	232.28	323.72	232.8	340.54	232.8
354.88	232.82	376.77	232.86	400.77	233.06	408.92	232.93	424.77	233.07
442.46	234.51	450.83	235.77	467.72	236.88	500.68	237.23	529.61	237.25
534.61	238.37	552.4	238.72	555.36	239.27	583.92	241.84	594.56	241.83

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-480.73	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right		Coeff Contr.	Expan.
-21.65	16.65	205	250	285		.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-480.73	-336	236.3	F
232.15	594.56	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1295

INPUT
Description:
Station Elevation Data num= 73

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-403.24	238.81	-394.41	238.51	-388.15	237.61	-381.89	234.7	-376.88	234.48
-374.37	234.03	-364.28	233.38	-358.94	233.43	-346.74	232.37	-339.31	232.43
-330.88	232.35	-319.27	232.08	-312.17	232.85	-301.96	232.88	-295.47	233.14
-274.85	233.11	-272.93	232.7	-261.39	232.42	-248.92	232.44	-237.14	232.38
-226.65	232.31	-219.97	232.81	-212.39	233.09	-197.78	233.18	-195.27	232.85
-189.99	232.66	-185.25	232.51	-178.99	232.54	-165.21	232.45	-161.46	232.91
-151.44	233.27	-137.66	232.97	-121.38	232.6	-114.57	232.37	-107.72	232.38
-94.36	232.18	-87.7	232.32	-82.38	232.3	-61.66	232.5	-53.99	232.55
-48.57	232.27	-40.69	232.21	-35.48	232.38	-22.95	232.21	-21.65	227.41
-14.55	225.71	-4.35	225.61	5.05	226.31	16.65	228.41	17.86	232.19
29.39	232.55	43.58	232.42	49.79	233	55.11	233.08	67.61	232.91
84.38	232.69	90.51	232.4	98.7	232.09	113.93	232.18	123.61	232.28
133.55	232.74	145.11	233.19	156.54	233.35	170.45	234.27	184.12	237.66
186.22	238.49	196.33	240.78	210.45	242.19	219.87	242.61	227.23	242.67
234.59	243.13	243.65	243.09	255.61	243.24				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-403.24	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	295	295	295	.1	.3

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1000

INPUT
Description: DS LIMIT
Station Elevation Data num= 84

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-177.41	241.46	-169.62	241.51	-163.4	241.44	-159.61	241.06	-152.07	240.44
-150.81	240.24	-147.03	240	-144.52	239.59	-135.7	238.75	-128.16	237.51
-121.86	235.95	-119.58	235.47	-113.04	234.52	-110.53	234.42	-105.69	233.81
-104.77	233.57	-101.17	233.28	-98.3	233.45	-93.71	233.07	-91.87	233.08
-89.1	233.38	-86.34	233.26	-81.73	232.64	-78.96	232.67	-73.43	232.51
-69.74	232.57	-67.19	232.72	-64.07	233.31	-61.34	232.72	-59.04	232.58
-52.8	232.5	-46.7	232.03	-43.33	231.97	-37.15	232.06	-33.8	232.41
-31.03	232.44	-22.39	232.49	-21.65	226.82	-14.55	225.12	-4.35	225.02
5.05	225.72	16.65	227.82	19.66	232.91	43.94	233.14	49.16	232.96
53.77	232.89	56.53	232.78	62.44	232.88	67.59	232.58	69.23	232.51
77.73	232.18	79.58	232.36	82.32	232.4	83.78	232.82	86.03	233.14
89.72	232.27	93.4	232.14	95.41	232.42	98.93	232.52	106.31	232.78
112.23	233.27	117.48	233.74	122.52	234.41	130.8	235.42	138.63	236.68
140.65	236.93	144.68	237.85	152.74	238.44	157.01	238.78	158.15	239.09
160.79	239.29	168.57	240.27	170.86	240.7	172.88	240.88	175.09	241.39
181.6	241.8	182.95	241.88	188.12	241.93	193.89	242.12	198.54	242.14

206.35	242.5	208.13	242.52	212.87	242.28	217.74	242.33

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-177.41	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:NORTH

Reach	River Sta.	n1	n2	n3
MID	2520	.08	.03	.08
MID	2348	.08	.03	.08
MID	2265	.08	.03	.08
MID	2231	.08	.03	.08
MID	2192	Bridge		
MID	2145	.08	.03	.08
MID	2106	.08	.03	.08
MID	1967	.08	.03	.08
MID	1840	.08	.03	.08
MID	1545	.08	.03	.08
MID	1295	.08	.03	.08
MID	1000	.08	.03	.08

SUMMARY OF REACH LENGTHS

River: NORTH

Reach	River Sta.	Left	Channel	Right
MID	2520	185	172	163
MID	2348	80	82	82
MID	2265	21	34	43
MID	2231	86	86	86
MID	2192	Bridge		
MID	2145	12	40	58
MID	2106	158	138	114
MID	1967	130	125	120
MID	1840	235	295	340
MID	1545	205	250	285
MID	1295	295	295	295

MID	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: NORTH

Reach	River Sta.	Contr.	Expan.
MID	2520	.1	.3
MID	2348	.1	.3
MID	2265	.3	.5
MID	2231	.3	.5
MID	2192	Bridge	
MID	2145	.3	.5
MID	2106	.1	.3
MID	1967	.1	.3
MID	1840	.1	.3
MID	1545	.1	.3
MID	1295	.1	.3
MID	1000	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
MID	2520	2 YR	315.00	226.70	230.88	228.65	230.97	0.000507	2.43	131.28	44.01	0.24
MID	2520	5 YR	520.00	226.70	231.98	229.24	232.12	0.000523	2.99	182.36	48.53	0.25
MID	2520	10 YR	690.00	226.70	232.77	229.66	232.94	0.000523	3.34	226.44	74.30	0.26
MID	2520	25 YR	920.00	226.70	233.68	230.14	233.86	0.000479	3.55	471.83	423.81	0.25
MID	2520	50 YR	1100.00	226.70	234.34	230.48	234.49	0.000376	3.37	775.90	478.18	0.23
MID	2520	100 YR	1330.00	226.70	235.09	230.88	235.20	0.000287	3.16	1144.55	506.55	0.20
MID	2520	200 YR	1540.00	226.70	235.67	231.23	235.76	0.000243	3.05	1438.02	552.87	0.19
MID	2520	500 YR	1880.00	226.70	236.54	231.76	236.61	0.000194	2.92	1890.38	576.31	0.17

MID	2348	2 YR	315.00	226.40	230.68	228.91	230.84	0.000963	3.23	99.01	33.65	0.32
MID	2348	5 YR	520.00	226.40	231.74	229.61	231.99	0.000985	3.97	135.81	35.80	0.34
MID	2348	10 YR	690.00	226.40	232.51	230.04	232.81	0.000984	4.43	164.78	74.42	0.35
MID	2348	25 YR	920.00	226.40	233.42	230.57	233.73	0.000877	4.68	337.50	417.54	0.34
MID	2348	50 YR	1100.00	226.40	234.14	230.94	234.39	0.000671	4.43	536.67	552.70	0.30
MID	2348	100 YR	1330.00	226.40	234.92	231.41	235.13	0.000525	4.22	766.17	581.00	0.27
MID	2348	200 YR	1540.00	226.40	235.51	231.80	235.69	0.000456	4.14	944.84	589.45	0.26
MID	2348	500 YR	1880.00	226.40	236.40	232.40	236.56	0.000376	4.03	1217.02	603.40	0.24

MID	2265	2 YR	315.00	226.15	230.62	228.66	230.77	0.000793	3.05	103.94	32.05	0.29
MID	2265	5 YR	520.00	226.15	231.68	229.35	231.90	0.000859	3.81	138.19	32.82	0.32
MID	2265	10 YR	690.00	226.15	232.44	229.78	232.73	0.000884	4.30	163.47	33.38	0.33
MID	2265	25 YR	920.00	226.15	233.31	230.31	233.66	0.000896	4.81	247.02	323.90	0.35
MID	2265	50 YR	1100.00	226.15	233.97	230.69	234.32	0.000817	4.92	341.45	512.23	0.34
MID	2265	100 YR	1330.00	226.15	234.72	231.14	235.06	0.000745	5.05	447.02	566.56	0.33
MID	2265	200 YR	1540.00	226.15	235.27	231.55	235.63	0.000721	5.21	526.17	580.23	0.33
MID	2265	500 YR	1880.00	226.15	236.13	232.15	236.50	0.000678	5.41	648.30	600.25	0.32

MID	2231	2 YR	315.00	226.07	230.62	228.55	230.72	0.000566	2.51	127.27	42.59	0.25
MID	2231	5 YR	520.00	226.07	231.69	229.20	231.84	0.000578	3.08	174.08	44.83	0.26
MID	2231	10 YR	690.00	226.07	232.47	229.58	232.65	0.000577	3.44	209.64	52.31	0.27
MID	2231	25 YR	920.00	226.07	233.34	230.03	233.57	0.000584	3.86	272.64	279.00	0.28
MID	2231	50 YR	1100.00	226.07	234.00	230.35	234.25	0.000570	4.09	321.04	313.38	0.28
MID	2231	100 YR	1330.00	226.07	234.73	230.74	235.01	0.000567	4.37	374.84	334.08	0.29

MID	2231	200 YR	1540.00	226.07	235.27	231.07
235.59	0.000584	4.66	415.12	346.64	0.29	
MID	2231	500 YR	1880.00	226.07	236.10	231.59
236.47	0.000601	5.06	476.83	367.53	0.30	
MID	2192		Bridge			
MID	2145	2 YR	315.00	226.84	230.24	228.77
230.40	0.001166	3.14	100.55	39.01	0.34	
MID	2145	5 YR	520.00	226.84	231.16	229.34
231.39	0.001176	3.82	139.50	47.09	0.36	
MID	2145	10 YR	690.00	226.84	231.84	229.75
232.12	0.001131	4.22	174.09	54.17	0.36	
MID	2145	25 YR	920.00	226.84	232.64	230.24
232.97	0.001099	4.67	220.22	140.38	0.37	
MID	2145	50 YR	1100.00	226.84	233.24	230.58
233.61	0.001049	4.92	256.94	231.63	0.37	
MID	2145	100 YR	1330.00	226.84	233.85	231.00
234.27	0.001060	5.30	294.27	382.33	0.37	
MID	2145	200 YR	1540.00	226.84	234.22	231.35
234.71	0.001160	5.76	316.50	391.75	0.40	
MID	2145	500 YR	1880.00	226.84	234.69	231.90
235.31	0.001350	6.51	345.37	413.39	0.43	
MID	2106	2 YR	315.00	226.76	230.21	228.53
230.35	0.000932	2.93	107.45	38.34	0.31	
MID	2106	5 YR	520.00	226.76	231.13	229.11
231.33	0.000998	3.64	142.82	38.76	0.33	
MID	2106	10 YR	690.00	226.76	231.81	229.53
232.07	0.000999	4.08	169.26	38.82	0.34	
MID	2106	25 YR	920.00	226.76	232.60	230.02
232.93	0.001021	4.61	200.64	95.14	0.36	
MID	2106	50 YR	1100.00	226.76	233.19	230.35
233.56	0.001008	4.92	241.75	269.11	0.36	
MID	2106	100 YR	1330.00	226.76	233.80	230.77
234.23	0.001014	5.28	301.24	405.53	0.37	
MID	2106	200 YR	1540.00	226.76	234.17	231.10
234.66	0.001098	5.71	338.10	473.39	0.39	
MID	2106	500 YR	1880.00	226.76	234.65	231.63
235.25	0.001259	6.39	386.05	494.50	0.42	
MID	1967	2 YR	315.00	226.30	230.20	228.02
230.25	0.000302	1.80	175.69	58.29	0.18	
MID	1967	5 YR	520.00	226.30	231.14	228.47
231.22	0.000334	2.26	230.41	58.37	0.20	

MID	1967	10 YR	690.00	226.30	231.84	228.79
231.94	0.000342	2.55	271.43	58.43	0.21	
MID	1967	25 YR	920.00	226.30	232.66	229.16
232.79	0.000354	2.89	323.62	178.80	0.22	
MID	1967	50 YR	1100.00	226.30	233.27	229.42
233.42	0.000345	3.06	431.90	357.28	0.22	
MID	1967	100 YR	1330.00	226.30	233.92	229.73
234.07	0.000335	3.22	585.36	460.57	0.22	
MID	1967	200 YR	1540.00	226.30	234.32	229.98
234.49	0.000351	3.43	680.77	469.97	0.23	
MID	1967	500 YR	1880.00	226.30	234.84	230.37
235.04	0.000385	3.77	806.48	480.30	0.24	

MID	1840	2 YR	315.00	226.70	230.00	228.69
230.17	0.001322	3.29	96.10	39.03	0.37	
MID	1840	5 YR	520.00	226.70	230.88	229.28
231.13	0.001323	4.02	130.53	39.73	0.39	
MID	1840	10 YR	690.00	226.70	231.54	229.67
231.85	0.001280	4.46	157.04	40.27	0.39	
MID	1840	25 YR	920.00	226.70	232.30	230.12
232.69	0.001277	5.00	187.91	55.12	0.40	
MID	1840	50 YR	1100.00	226.70	232.88	230.46
233.31	0.001239	5.31	232.71	289.43	0.40	
MID	1840	100 YR	1330.00	226.70	233.52	230.86
233.97	0.001154	5.52	375.22	523.29	0.40	
MID	1840	200 YR	1540.00	226.70	233.95	231.20
234.39	0.001086	5.61	518.52	545.22	0.39	
MID	1840	500 YR	1880.00	226.70	234.52	231.72
234.95	0.001015	5.74	714.34	559.56	0.38	

MID	1545	2 YR	390.00	226.11	229.42	228.32
229.68	0.001996	4.06	96.99	39.66	0.45	
MID	1545	5 YR	630.00	226.11	230.26	228.95
230.63	0.001990	4.91	130.56	40.61	0.47	
MID	1545	10 YR	840.00	226.11	230.89	229.38
231.36	0.001986	5.50	156.38	41.33	0.49	
MID	1545	25 YR	1110.00	226.11	231.61	229.88
232.20	0.001981	6.14	186.57	42.16	0.50	
MID	1545	50 YR	1330.00	226.11	232.15	230.26
232.82	0.001976	6.59	209.45	42.77	0.51	
MID	1545	100 YR	1600.00	226.11	232.84	230.70
233.53	0.001764	6.76	372.94	553.44	0.49	
MID	1545	200 YR	1850.00	226.11	233.55	231.08
234.04	0.001241	6.12	721.03	824.31	0.42	
MID	1545	500 YR	2230.00	226.11	234.30	231.63
234.65	0.000895	5.58	1139.50	886.53	0.36	

MID	1295	2 YR	390.00	225.61	228.92		229.18	0.002000	4.06	96.40	38.87	0.45
MID	1295	5 YR	630.00	225.61	229.76		230.13	0.002000	4.92	129.09	39.37	0.47
MID	1295	10 YR	840.00	225.61	230.39		230.86	0.002001	5.52	153.95	39.74	0.49
MID	1295	25 YR	1110.00	225.61	231.11		231.70	0.002003	6.17	182.73	40.16	0.50
MID	1295	50 YR	1330.00	225.61	231.64		232.33	0.002003	6.63	204.36	40.48	0.51
MID	1295	100 YR	1600.00	225.61	232.26		233.05	0.002004	7.14	233.10	98.12	0.52
MID	1295	200 YR	1850.00	225.61	232.87	230.57	233.65	0.001782	7.20	401.12	384.93	0.50
MID	1295	500 YR	2230.00	225.61	233.91	231.13	234.39	0.001090	6.22	915.66	537.47	0.40

MID	1000	2 YR	390.00	225.02	228.33	227.23	228.59	0.002004	4.06	96.23	38.80	0.45
MID	1000	5 YR	630.00	225.02	229.17	227.85	229.54	0.002000	4.92	128.95	39.40	0.47
MID	1000	10 YR	840.00	225.02	229.80	228.29	230.27	0.002002	5.52	153.84	39.86	0.49
MID	1000	25 YR	1110.00	225.02	230.52	228.78	231.11	0.002003	6.17	182.72	40.38	0.50
MID	1000	50 YR	1330.00	225.02	231.05	229.16	231.74	0.002002	6.63	204.51	40.76	0.51
MID	1000	100 YR	1600.00	225.02	231.67	229.61	232.45	0.002002	7.13	229.57	41.21	0.52
MID	1000	200 YR	1850.00	225.02	232.19	229.98	233.08	0.002002	7.56	253.50	56.91	0.53
MID	1000	500 YR	2230.00	225.02	232.90	230.55	233.91	0.002002	8.11	326.78	151.63	0.54

Profile Output Table - Six XS Bridge

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
MID	2265	2 YR	230.77	230.62	228.66	0.02	0.02	32.05	0.14	314.85	0.01	3.05
MID	2265	5 YR	231.90	231.68	229.35	0.02	0.04	32.82	0.73	519.25	0.03	3.81

MID	2265		10 YR	232.73	232.44	229.78
0.02	0.05	33.38	1.57	688.38	0.05	4.30
MID	2265		25 YR	233.66	233.31	230.31
0.02	0.06	323.90	8.86	898.16	12.98	4.81
MID	2265		50 YR	234.32	233.97	230.69
0.02	0.05	512.23	36.76	1021.54	41.71	4.92
MID	2265		100 YR	235.06	234.72	231.14
0.02	0.03	566.56	81.29	1163.50	85.21	5.05
MID	2265		200 YR	235.63	235.27	231.55
0.02	0.02	580.23	123.27	1291.15	125.58	5.21
MID	2265		500 YR	236.50	236.13	232.15
0.02	0.00	600.25	197.91	1485.55	196.54	5.41

MID	2231		2 YR	230.72	230.62	228.55
0.02	0.04	42.59	0.18	314.50	0.33	2.51
MID	2231		5 YR	231.84	231.69	229.20
0.02	0.07	44.83	0.80	517.55	1.65	3.08
MID	2231		10 YR	232.65	232.47	229.58
0.02	0.09	52.31	1.67	684.82	3.51	3.44
MID	2231		25 YR	233.57	233.34	230.03
0.02	0.11	279.00	10.72	901.61	7.67	3.86
MID	2231		50 YR	234.25	234.00	230.35
0.02	0.13	313.38	24.48	1061.72	13.80	4.09
MID	2231		100 YR	235.01	234.73	230.74
0.02	0.16	334.08	44.81	1262.88	22.31	4.37
MID	2231		200 YR	235.59	235.27	231.07
0.02	0.20	346.64	64.07	1445.74	30.19	4.66
MID	2231		500 YR	236.47	236.10	231.59
0.03	0.25	367.53	98.73	1737.28	43.99	5.06

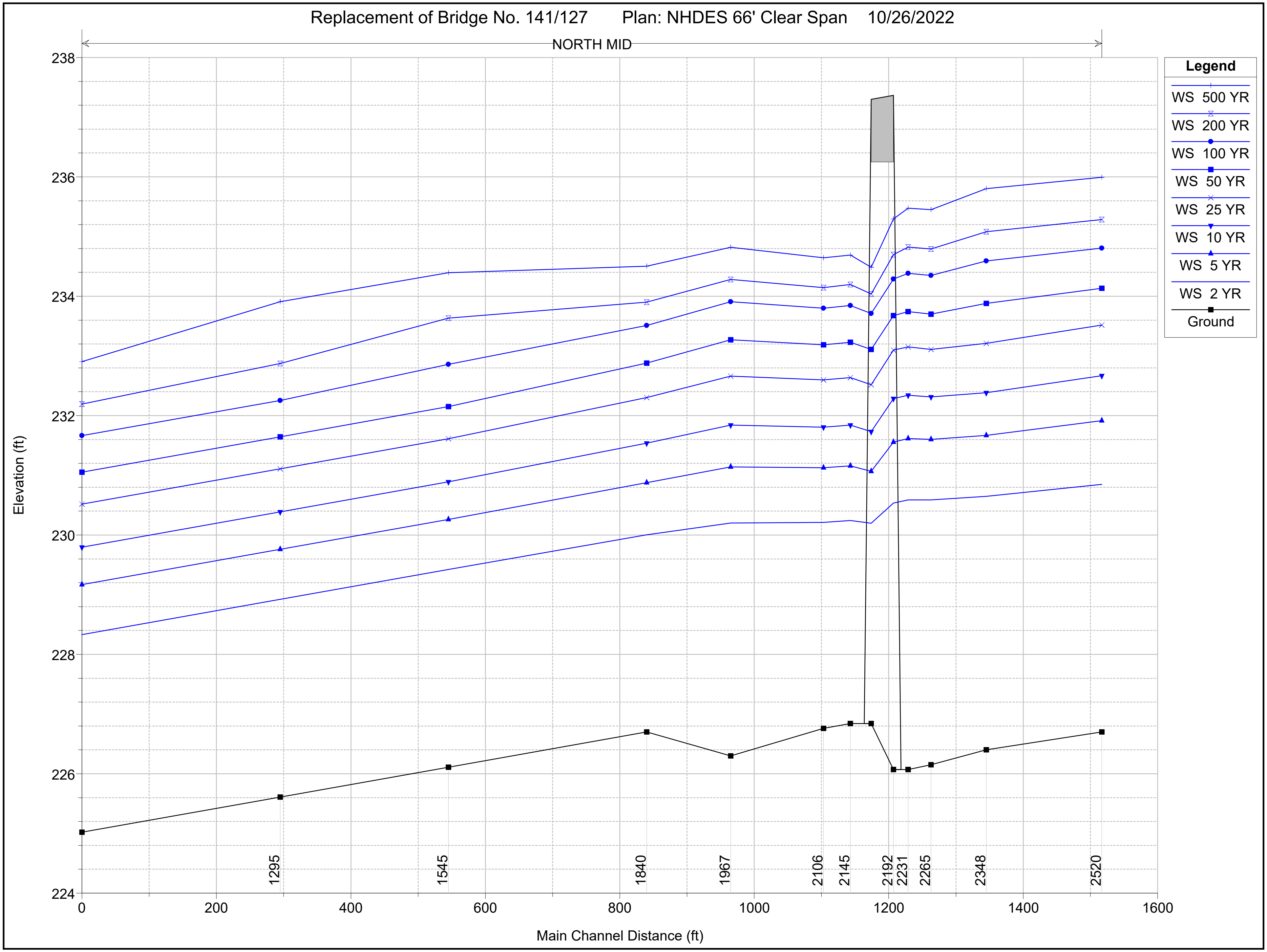
MID	2192	BR U	2 YR	230.66	230.42	228.61
0.07	0.04	24.14		315.00		3.91
MID	2192	BR U	5 YR	231.75	231.36	229.41
0.09	0.05	25.93		520.00		5.00
MID	2192	BR U	10 YR	232.54	232.07	229.98
0.10	0.06	30.24	0.01	689.99		5.52
MID	2192	BR U	25 YR	233.44	232.84	230.66
0.10	0.06	30.19	0.01	919.99		6.21
MID	2192	BR U	50 YR	234.09	233.41	231.15
0.10	0.06	30.16	0.01	1099.99		6.66
MID	2192	BR U	100 YR	234.82	234.01	231.86
0.10	0.07	30.13	0.02	1329.98		7.26
MID	2192	BR U	200 YR	235.37	234.40	232.26
0.12	0.09	30.10	0.02	1539.98		7.89
MID	2192	BR U	500 YR	236.19	234.97	232.87
0.14	0.14	30.07	0.02	1879.98		8.85

MID	2192	BR D	2 YR	230.55	230.19	229.17
0.05	0.10	24.37		315.00		4.82
MID	2192	BR D	5 YR	231.61	231.05	229.92
0.06	0.17	25.57		520.00		5.99
MID	2192	BR D	10 YR	232.38	231.70	230.45
0.06	0.20	30.26	0.00	690.00		6.61
MID	2192	BR D	25 YR	233.27	232.46	231.09
0.06	0.24	30.21	0.01	919.99		7.23
MID	2192	BR D	50 YR	233.93	233.03	231.70
0.06	0.27	30.18	0.02	1099.99		7.61
MID	2192	BR D	100 YR	234.65	233.59	232.16
0.06	0.32	30.15	0.02	1329.98		8.24
MID	2192	BR D	200 YR	235.16	233.89	232.57
0.06	0.39	30.13	0.02	1539.98		9.03
MID	2192	BR D	500 YR	235.92	234.24	233.17
0.07	0.53	30.11	0.03	1879.98		10.39

MID	2145		2 YR	230.40	230.24	228.77
0.04	0.01	39.01	0.01	314.99		3.14
MID	2145		5 YR	231.39	231.16	229.34
0.04	0.01	47.09	0.92	518.61	0.47	3.82
MID	2145		10 YR	232.12	231.84	229.75
0.04	0.01	54.17	3.10	683.82	3.08	4.22
MID	2145		25 YR	232.97	232.64	230.24
0.04	0.00	140.38	7.96	900.78	11.26	4.67
MID	2145		50 YR	233.61	233.24	230.58
0.04	0.00	231.63	14.36	1064.16	21.48	4.92
MID	2145		100 YR	234.27	233.85	231.00
0.04	0.00	382.33	23.44	1271.58	34.99	5.30
MID	2145		200 YR	234.71	234.22	231.35
0.04	0.00	391.75	30.96	1462.86	46.18	5.76
MID	2145		500 YR	235.31	234.69	231.90
0.05	0.01	413.39	43.36	1772.00	64.64	6.51

MID	2106		2 YR	230.35	230.21	228.53
0.07	0.03	38.34	0.00	315.00		2.93
MID	2106		5 YR	231.33	231.13	229.11
0.07	0.04	38.76	0.00	520.00	0.00	3.64
MID	2106		10 YR	232.07	231.81	229.53
0.08	0.05	38.82	0.02	689.98	0.00	4.08
MID	2106		25 YR	232.93	232.60	230.02
0.08	0.06	95.14	0.04	919.86	0.10	4.61
MID	2106		50 YR	233.56	233.19	230.35
0.08	0.07	269.11	3.35	1094.27	2.38	4.92
MID	2106		100 YR	234.23	233.80	230.77
0.07	0.08	405.53	16.44	1300.75	12.81	5.28
MID	2106		200 YR	234.66	234.17	231.10
0.08	0.10	473.39	28.80	1487.31	23.90	5.71

MID	2106	500 YR	235.25	234.65	231.63	
0.09	0.12	494.50	50.51	1783.50	45.99	6.39



Replacement of Bridge No. 141/127 Plan: NHDES 66' Clear Span 10/26/2022
NORTH MID
Legend
WS 500 YR
WS 200 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
Ground
Elevation (ft)
238
236
234
232
230
228
226
224
1295
1545
1840
1967
2106
2145
2192
2231
2265
2348
2520
0
200
400
600
800
1000
1200
1400
1600
Main Channel Distance (ft)

HEC-RAS HEC-RAS 6.1.0 September 2021
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: Replacement of Bridge No. 141/127
Project File : 141-127 Route 152.prj
Run Date and Time: 10/26/2022 12:21:01 PM

Project in English units

Project Description:
NH Route 152 over North River - Final Hydraulic Design Report

PLAN DATA

Plan Title: NHDES 66' Clear Span
Plan File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.p03

Geometry Title: NHDES 66' Clear Span
Geometry File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.g03

Flow Title : StreamStats Design
Flow File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.f01

Plan Description:

Stream Crossing Rules Compliant Structure
66' Clear Span
NAVD88 Daturm

Plan Summary Information:

Number of:	Cross Sections =	11	Multiple Openings =	0
	Culverts =	0	Inline Structures =	0
	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	= 0.33
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: Subcritical Flow

FLOW DATA

Flow Title: StreamStats Design
Flow File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.f01

Flow Data (cfs)

River	Reach	RS	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR	200 YR	500 YR
NORTH	MID	2520	315	520	690	920	1100	1330	1540	1880
NORTH	MID	1545	390	630	840	1110	1330	1600	1850	2230
North River	RT 152	1971								

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
NORTH	MID	2 YR	Critical	Normal S = 0.002
NORTH	MID	5 YR	Critical	Normal S = 0.002
NORTH	MID	10 YR	Critical	Normal S = 0.002
NORTH	MID	25 YR	Critical	Normal S = 0.002
NORTH	MID	50 YR	Critical	Normal S = 0.002
NORTH	MID	100 YR	Critical	Normal S = 0.002
NORTH	MID	200 YR	Critical	Normal S = 0.002
NORTH	MID	500 YR	Critical	Normal S = 0.002

GEOMETRY DATA

Geometry Title: NHDES 66' Clear Span
Geometry File : t:\Projects\New Hampshire\Nottingham_40612\40612\Computations\Hydraulics\HEC-RAS Modeling\HEC-RAS\141-127 Route 152.g03

CROSS SECTION

RIVER: NORTH
REACH: MID   RS: 2520

INPUT
Description: US LIMIT
Station Elevation Data   num=   75

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-298.56	242.06	-278.59	240.38	-264.7	239.67	-255.04	239.15	-243.35	238.18
-225.46	237.92	-218.81	237.25	-208.2	236.68	-199.53	235.96	-192.1	235.02

-187	234.78	-168.2	233.23	-164.44	233.23	-153.38	232.62	-146.37	232.53
-138.12	232.67	-133.06	232.91	-119.47	232.93	-107.01	233.42	-86.52	233.18
-77.55	232.89	-62.5	232.77	-57.16	233.2	-51.19	233.12	-41.29	232.91
-31.1	232.93	-30	232.77	-28.84	232.45	-27.47	232.27	-24.31	231.87
-22.76	231.1	-17.36	230.2	-6.76	226.7	.04	226.8	2.04	226.8
10.44	227	17.64	227.9	21.14	229	21.74	229.7	23.34	231.9
23.7	233.01	35.74	233.39	45.93	233.12	56.19	233.23	63.26	233.55
76.91	233.49	85.59	233.15	93.26	233.03	99.54	232.95	115.89	233.12
121.84	233.32	136.01	233.45	139.96	233.12	145.63	233.25	157.93	233.04
167.15	233.16	181.28	233.04	187.6	232.88	197.74	232.93	204.54	233.27
215.24	233.05	221.6	233.24	230.6	233.25	236.62	233.79	254.39	233.6
266.85	233.72	284.98	234.2	296.98	234.35	318.36	235.29	329.67	235.44
340.49	235.17	358.58	235.76	378.36	237.12	391.61	237.4	413.33	240

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-298.56	.08	-17.36	.03	21.74	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-17.36	21.74	185	172	163	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
318.5	413.33	238.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2348

INPUT
Description:
Station Elevation Data num= 74

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-212.51	240.46	-209.38	239.92	-207.42	239.76	-202.36	239.04	-198.95	238.81
-190.48	238.06	-187.65	238.02	-175.42	237.3	-168.06	236.61	-157.91	235.35
-154.1	234.74	-143.95	234.45	-139.87	234.44	-134.47	233.96	-126.19	233.71
-118.58	233.26	-108.29	233.41	-99.55	233.3	-95.74	233.05	-90.15	232.88
-84.75	232.89	-80.52	232.88	-76.04	232.8	-72.6	232.47	-66.56	232.44
-63.13	232.75	-59.89	232.78	-53.4	232.93	-50.16	232.94	-44.75	232.94
-38.27	233.04	-32.3	232.92	-27.46	232.7	-20.98	232.59	-20.28	229.6
-16.28	228.8	-7.88	226.8	0	226.43	.72	226.4	8.12	227.8
10.82	229.4	15.12	231.8	15.91	232.52	21.15	232.85	36.24	233
52.31	233.01	60.38	232.59	74.36	232.66	92.07	232.68	98.47	232.7
104.96	232.65	112.46	232.66	132.67	232.41	144.54	232.56	176.29	232.48
186.14	232.56	198.63	232.51	210.23	232.65	245.44	232.58	254.02	233.59
264.41	233.78	271.54	233.76	298.91	233.94	312.48	233.95	318.62	233.78
337.04	233.64	346.64	233.47	355.84	233.34	378.27	233.21	399.64	233.49
421.28	234.34	438.9	236.65	452.8	237.43	478.3	238		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-212.51	.08	-20.28	.03	10.82	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-20.28	10.82	80	82	82	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-212.51	-159.5	237.3	F
146.5	478.3	238.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2265

INPUT
Description: BRG APPROACH
Station Elevation Data num= 72

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-264.42	240.04	-255.02	239.82	-249.54	239.4	-238.56	238.9	-226.67	238.48
-224.01	238.2	-204.21	236.94	-199.16	236.14	-180.55	234.95	-175.95	234.83
-154.84	233.52	-140.56	233.76	-132.1	232.91	-119.86	232.72	-111.63	232.57
-100.32	232.99	-81.78	232.99	-59.88	232.92	-50.94	233.05	-35.51	232.84
-22.49	232.69	-20.28	229.35	-16.28	228.55	-7.88	226.55	0	226.18
.72	226.15	8.12	227.55	10.82	229.15	11.06	232.48	30.8	232.45
46.88	232.64	49.45	233.22	58.44	233.04	76.49	233.36	79	232.5
87.6	232.5	90.56	232.92	97.26	232.97	109.83	233.38	113.87	232.86
121.39	232.51	129.1	233.3	130.38	233.91	161.21	234.01	174.11	233.28
184.49	233.28	189.68	232.8	195.87	232.82	204.22	233.04	221.63	233.31
235.35	233.44	241.9	233.71	252.81	233.91	259.28	234.22	263.8	234.42
274.65	234.15	280.11	234.08	284.48	233.55	290.9	233.38	300.85	233.5
311.23	233.32	320.09	233.25	326.42	233.91	339.09	233.89	342.87	233.77
355.44	233.42	369.21	233.43	382.73	233.14	389.71	234.01	394.74	235.3
401.1	236.05	403.63	238.21						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-264.42	.08	-20.28	.03	10.82	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-20.28	10.82	21	34	43	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-264.42	-77.5	237.3	F
64.5	403.63	238.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2231

INPUT
Description: BRG US
Station Elevation Data num= 79

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.71	239.35	-279.8	239.34	-264.32	239.01	-254.45	238.64	-248.85	238.15
-246.12	238.08	-241.08	237.61	-234.29	237.6	-230.84	237.41	-221.55	237.2
-218.59	236.88	-210.36	236.63	-203.07	236.15	-198.73	236.03	-195.83	235.77
-182	234.89	-176.85	234.36	-174.28	234.3	-169.97	233.91	-158.59	233.58
-151.35	233.37	-142.12	232.96	-134.8	232.86	-125.48	233.11	-122.82	232.69
-118.24	232.47	-112.53	232.83	-107.9	232.62	-100.95	232.61	-96.52	233
-91.94	232.99	-84.1	232.73	-81.65	232.51	-75.91	232.5	-64.92	232.55
-61.34	232.68	-53.35	232.77	-46.86	232.74	-39.19	232.42	-31.34	232.52
-23.07	232.51	-21	232.58	-18.56	229.22	-8.46	226.88	-5.98	226.37
2.36	226.07	11.63	227.93	21.25	229.33	25.56	232.49	26.42	232.45
31.57	233.03	39.01	233.03	52.15	233.26	64.87	233.11	67.97	232.67
79.17	232.67	81.74	232.76	86.59	233	90.78	233.09	95.88	233.08
99.76	233.02	104.18	232.78	110.05	232.5	115.19	232.77	118.66	232.78
126.94	233.24	133.3	233.76	136.25	233.72	142.46	234	145.56	234.35
149.7	234.47	155.91	234.87	158.94	235.31	165.22	235.99	171.42	236.78
174.38	237.84	176.6	237.73	194.43	237.63	220	238.16		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-283.71	.08	-18.56	.03	21.25	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-18.56	21.25	86	86	86	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-283.71	-63	237.3	F
47	220	238.6	F

BRIDGE

RIVER: NORTH
REACH: MID RS: 2192

INPUT
Description: Stream Crossing Rules Compliant Structure
66' Clear Span
Distance from Upstream XS = 22
Deck/Roadway Width = 33
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 18

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-340	237.4		-290	237.3		-240	237.3	
-190	237.6		-140	238.3		-90	239	
-41	239.2	226.07	-41	239.2	236.25	-40	239.2	236.25
-21.5	239.1	236.25	8.5	239.1	236.25	25	239.04	236.25
25	239.04	226.07	60	238.9		110	238.7	
160	238.6		210	238.7		260	238.9	

Upstream Bridge Cross Section Data
Station Elevation Data num= 79

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.71	239.35	-279.8	239.34	-264.32	239.01	-254.45	238.64	-248.85	238.15
-246.12	238.08	-241.08	237.61	-234.29	237.6	-230.84	237.41	-221.55	237.2
-218.59	236.88	-210.36	236.63	-203.07	236.15	-198.73	236.03	-195.83	235.77
-182	234.89	-176.85	234.36	-174.28	234.3	-169.97	233.91	-158.59	233.58
-151.35	233.37	-142.12	232.96	-134.8	232.86	-125.48	233.11	-122.82	232.69
-118.24	232.47	-112.53	232.83	-107.9	232.62	-100.95	232.61	-96.52	233
-91.94	232.99	-84.1	232.73	-81.65	232.51	-75.91	232.5	-64.92	232.55
-61.34	232.68	-53.35	232.77	-46.86	232.74	-39.19	232.42	-31.34	232.52
-23.07	232.51	-21.5	231.5	-17.5	231.5	-8.46	226.88	-5.98	226.37
2.36	226.07	11.63	227.93	21.25	229.33	25.56	232.49	26.42	232.45
31.57	233.03	39.01	233.03	52.15	233.26	64.87	233.11	67.97	232.67
79.17	232.67	81.74	232.76	86.59	233	90.78	233.09	95.88	233.08
99.76	233.02	104.18	232.78	110.05	232.5	115.19	232.77	118.66	232.78
126.94	233.24	133.3	233.76	136.25	233.72	142.46	234	145.56	234.35
149.7	234.47	155.91	234.87	158.94	235.31	165.22	235.99	171.42	236.78
174.38	237.84	176.6	237.73	194.43	237.63	220	238.16		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-283.71	.08	-21.5	.03	21.25	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.
-21.5	21.25	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-283.71	-63	237.3	F
47	220	238.6	F

Downstream Deck/Roadway Coordinates
num= 18

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-340	237.4		-290	237.3		-240	237.3	
-190	237.6		-140	238.3		-90	239	
-41	239.2	226.84	-41	239.2	236.25	-40	239.2	236.25
-21.5	239.1	236.25	8.5	239.1	236.25	25	239.04	236.25
25	239.04	226.84	60	238.9		110	238.7	
160	238.6		210	238.7		260	238.9	

Downstream Bridge Cross Section Data

Station Elevation Data   num=   89

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-343.96	239.18	-331.14	238.4	-313.22	237.93	-288.12	237.13	-275.37	236.7
-267.7	235.63	-256.8	234.78	-242.12	234.53	-228.68	234.12	-223.17	233.69
-201.77	233.56	-179.58	233.68	-170.41	233.64	-157.83	233.63	-152.98	233.57
-150	233.41	-147.3	233.27	-137.67	233.29	-135.3	232.91	-125.71	232.58
-120.9	232.52	-115.43	232.53	-110.3	232.55	-104.12	232.56	-94.88	232.53
-87.68	232.6	-82.54	232.64	-79.46	232.65	-77.04	232.47	-69.18	232.56
-63.01	232.5	-57.39	232.64	-50.67	232.58	-46.08	232.64	-38.34	232.94
-37.31	232.85	-37.05	232.77	-36.28	232.64	-21.5	231.5	-17.5	231.5
-10.78	226.84	0	226.89	6.83	228.1	10.78	230.5	27.45	232.82
36.48	233.14	44.22	233.34	49.04	233.48	53.41	233.46	60.34	233.37
73.71	233.36	76.47	232.77	80.34	232.69	91.18	232.87	100.43	232.96
105.57	233.11	112.77	233.09	125.49	232.85	129.21	233.41	134.35	233.73
136.41	233.67	138.25	233.6	139.98	233.54	143.44	233.59	145.66	233.71
148.59	233.59	150.43	233.6	152.81	233.75	156.87	233.83	160.38	234.29
161.67	234.67	162.96	234.95	165.57	235.09	168.16	235.52	170.75	235.61
172.05	235.71	173.35	235.89	177.24	236.25	179.23	236.28	180.24	236.35
182.27	236.34	183.72	236.48	186.28	237.07	188.91	237.77	189.86	238.2
192.8	239.12	194.47	239.5	197.03	239.88	198.23	239.97		

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
-343.96	.08	-21.5	.03	10.78	.08

Bank Sta: Left	Right	Coeff Contr.	Expan.
-21.5	10.78	.3	.5

Ineffective Flow   num=   2

Sta L	Sta R	Elev	Permanent
-343.96	-56.5	236.3	F
40.5	198.23	237.6	F

Upstream Embankment side slope   =   1 horiz. to 1.0 vertical
Downstream Embankment side slope   =   1 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
Energy Only

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

BRIDGE OUTPUT Profile #2 YR

E.G. US. (ft)	230.69	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	230.59	E.G. Elev (ft)	230.66	230.55
Q Total (cfs)	315.00	W.S. Elev (ft)	230.54	230.20
Q Bridge (cfs)	315.00	Crit W.S. (ft)	228.61	229.18
Q Weir (cfs)		Max Chl Dpth (ft)	4.47	3.36
Weir Sta Lft (ft)		Vel Total (ft/s)	2.84	4.76
Weir Sta Rgt (ft)		Flow Area (sq ft)	110.91	66.14
Weir Submerg		Froude # Chl	0.29	0.53
Weir Max Depth (ft)		Specif Force (cu ft)	218.67	143.51
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	2.88	2.55
Min El Prs (ft)	236.25	W.P. Total (ft)	40.13	27.65
Delta EG (ft)	0.29	Conv. Total (cfs)	11046.0	5860.0
Delta WS (ft)	0.34	Top Width (ft)	38.51	25.91
BR Open Area (sq ft)	400.49	Frctn Loss (ft)	0.05	0.05
BR Open Vel (ft/s)	4.76	C & E Loss (ft)	0.07	0.10
BR Sluice Coef		Shear Total (lb/sq ft)	0.14	0.43
BR Sel Method	Energy only	Power Total (lb/ft s)	0.40	2.06

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, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #5 YR

E.G. US. (ft)	231.77	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	231.62	E.G. Elev (ft)	231.74	231.59
Q Total (cfs)	520.00	W.S. Elev (ft)	231.56	231.07
Q Bridge (cfs)	520.00	Crit W.S. (ft)	229.31	229.94
Q Weir (cfs)		Max Chl Dpth (ft)	5.49	4.23
Weir Sta Lft (ft)		Vel Total (ft/s)	3.42	5.73
Weir Sta Rgt (ft)		Flow Area (sq ft)	152.07	90.73
Weir Submerg		Froude # Chl	0.33	0.57
Weir Max Depth (ft)		Specif Force (cu ft)	380.34	258.35
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	3.32	2.86
Min El Prs (ft)	236.25	W.P. Total (ft)	48.07	33.88
Delta EG (ft)	0.38	Conv. Total (cfs)	16592.0	9258.6
Delta WS (ft)	0.46	Top Width (ft)	45.87	31.74
BR Open Area (sq ft)	400.49	Frctn Loss (ft)	0.05	0.06
BR Open Vel (ft/s)	5.73	C & E Loss (ft)	0.10	0.15
BR Sluice Coef		Shear Total (lb/sq ft)	0.19	0.53
BR Sel Method	Energy only	Power Total (lb/ft s)	0.66	3.02

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, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #10 YR

E.G. US. (ft)	232.54	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	232.34	E.G. Elev (ft)	232.51	232.34
Q Total (cfs)	690.00	W.S. Elev (ft)	232.28	231.73
Q Bridge (cfs)	690.00	Crit W.S. (ft)	229.72	230.47
Q Weir (cfs)		Max Chl Dpth (ft)	6.21	4.89
Weir Sta Lft (ft)		Vel Total (ft/s)	3.70	6.00
Weir Sta Rgt (ft)		Flow Area (sq ft)	186.29	114.94
Weir Submerg		Froude # Chl	0.27	0.60
Weir Max Depth (ft)		Specif Force (cu ft)	528.95	366.47
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	3.90	2.60
Min El Prs (ft)	236.25	W.P. Total (ft)	50.51	46.46
Delta EG (ft)	0.42	Conv. Total (cfs)	22839.8	11721.0
Delta WS (ft)	0.50	Top Width (ft)	47.72	44.13
BR Open Area (sq ft)	400.49	Frctn Loss (ft)	0.05	0.06
BR Open Vel (ft/s)	6.00	C & E Loss (ft)	0.12	0.17
BR Sluice Coef		Shear Total (lb/sq ft)	0.21	0.54
BR Sel Method	Energy only	Power Total (lb/ft s)	0.78	3.21

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, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #25 YR

E.G. US. (ft)	233.40	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.15	E.G. Elev (ft)	233.37	233.20
Q Total (cfs)	920.00	W.S. Elev (ft)	233.10	232.52
Q Bridge (cfs)	920.00	Crit W.S. (ft)	230.23	231.10
Q Weir (cfs)		Max Chl Dpth (ft)	7.03	5.68
Weir Sta Lft (ft)		Vel Total (ft/s)	3.90	5.91
Weir Sta Rgt (ft)		Flow Area (sq ft)	236.17	155.80
Weir Submerg		Froude # Chl	0.28	0.49
Weir Max Depth (ft)		Specif Force (cu ft)	737.63	526.03
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	3.58	2.61
Min El Prs (ft)	236.25	W.P. Total (ft)	70.27	62.13
Delta EG (ft)	0.42	Conv. Total (cfs)	30870.5	16847.7
Delta WS (ft)	0.51	Top Width (ft)	66.00	59.68
BR Open Area (sq ft)	400.49	Frctn Loss (ft)	0.05	0.05
BR Open Vel (ft/s)	5.91	C & E Loss (ft)	0.12	0.18
BR Sluice Coef		Shear Total (lb/sq ft)	0.19	0.47
BR Sel Method	Energy only	Power Total (lb/ft s)	0.73	2.76

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, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #50 YR

E.G. US. (ft)	234.01	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.74	E.G. Elev (ft)	233.98	233.82
Q Total (cfs)	1100.00	W.S. Elev (ft)	233.68	233.11
Q Bridge (cfs)	1100.00	Crit W.S. (ft)	230.59	231.70
Q Weir (cfs)		Max Chl Dpth (ft)	7.61	6.27
Weir Sta Lft (ft)		Vel Total (ft/s)	4.01	5.69
Weir Sta Rgt (ft)		Flow Area (sq ft)	274.36	193.22
Weir Submerg		Froude # Chl	0.28	0.47
Weir Max Depth (ft)		Specif Force (cu ft)	916.72	668.66
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	4.16	2.93
Min El Prs (ft)	236.25	W.P. Total (ft)	71.43	69.35
Delta EG (ft)	0.41	Conv. Total (cfs)	37339.2	21431.0
Delta WS (ft)	0.52	Top Width (ft)	66.00	66.00
BR Open Area (sq ft)	400.49	Frctn Loss (ft)	0.05	0.05
BR Open Vel (ft/s)	5.69	C & E Loss (ft)	0.12	0.17
BR Sluice Coef		Shear Total (lb/sq ft)	0.21	0.46
BR Sel Method	Energy only	Power Total (lb/ft s)	0.83	2.61

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, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #100 YR

E.G. US. (ft)	234.68	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	234.39	E.G. Elev (ft)	234.65	234.48
Q Total (cfs)	1330.00	W.S. Elev (ft)	234.29	233.71
Q Bridge (cfs)	1330.00	Crit W.S. (ft)	231.02	232.18
Q Weir (cfs)		Max Chl Dpth (ft)	8.22	6.87
Weir Sta Lft (ft)		Vel Total (ft/s)	4.22	5.71
Weir Sta Rgt (ft)		Flow Area (sq ft)	314.91	233.04
Weir Submerg		Froude # Chl	0.29	0.47
Weir Max Depth (ft)		Specif Force (cu ft)	1142.57	853.92
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	4.77	3.53
Min El Prs (ft)	236.25	W.P. Total (ft)	72.66	70.56
Delta EG (ft)	0.43	Conv. Total (cfs)	44802.8	26713.6
Delta WS (ft)	0.54	Top Width (ft)	66.00	66.00
BR Open Area (sq ft)	400.49	Frctn Loss (ft)	0.05	0.05
BR Open Vel (ft/s)	5.71	C & E Loss (ft)	0.12	0.18
BR Sluice Coef		Shear Total (lb/sq ft)	0.24	0.51
BR Sel Method	Energy only	Power Total (lb/ft s)	1.01	2.92

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, water surface was used.
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, water surface was used.

BRIDGE OUTPUT Profile #200 YR

E.G. US. (ft)	235.15	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	234.82	E.G. Elev (ft)	235.11	234.92
Q Total (cfs)	1540.00	W.S. Elev (ft)	234.70	234.04
Q Bridge (cfs)	1540.00	Crit W.S. (ft)	231.38	232.62
Q Weir (cfs)		Max Chl Dpth (ft)	8.63	7.20
Weir Sta Lft (ft)		Vel Total (ft/s)	4.50	6.05
Weir Sta Rgt (ft)		Flow Area (sq ft)	341.87	254.48
Weir Submerg		Froude # Chl	0.31	0.50
Weir Max Depth (ft)		Specif Force (cu ft)	1324.95	1001.67
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	5.18	3.86
Min El Prs (ft)	236.25	W.P. Total (ft)	73.48	71.21
Delta EG (ft)	0.49	Conv. Total (cfs)	50084.7	29776.9
Delta WS (ft)	0.63	Top Width (ft)	66.00	66.00
BR Open Area (sq ft)	400.49	Frctn Loss (ft)	0.05	0.05
BR Open Vel (ft/s)	6.05	C & E Loss (ft)	0.14	0.21
BR Sluice Coef		Shear Total (lb/sq ft)	0.27	0.60
BR Sel Method	Energy only	Power Total (lb/ft s)	1.24	3.61

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, water surface was used.

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, water surface was used.

BRIDGE OUTPUT Profile #500 YR

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	235.86	E.G. Elev (ft)	235.80	235.57
W.S. US. (ft)	235.47	W.S. Elev (ft)	235.29	234.49
Q Total (cfs)	1880.00	Crit W.S. (ft)	232.00	233.24
Q Bridge (cfs)	1880.00	Max Chl Dpth (ft)	9.22	7.65
Q Weir (cfs)		Vel Total (ft/s)	4.93	6.62
Weir Sta Lft (ft)		Flow Area (sq ft)	381.19	284.09
Weir Sta Rgt (ft)		Froude # Chl	0.33	0.53
Weir Submerg		Specif Force (cu ft)	1625.93	1246.07
Weir Max Depth (ft)		Hydr Depth (ft)	5.78	4.30
Min El Weir Flow (ft)	237.38	W.P. Total (ft)	74.67	72.10
Min El Prs (ft)	236.25	Conv. Total (cfs)	58222.6	34242.3
Delta EG (ft)	0.60	Top Width (ft)	66.00	66.00
Delta WS (ft)	0.78	Frctn Loss (ft)	0.05	0.06
BR Open Area (sq ft)	400.49	C & E Loss (ft)	0.17	0.26
BR Open Vel (ft/s)	6.62	Shear Total (lb/sq ft)	0.33	0.74
BR Sluice Coef		Power Total (lb/ft s)	1.64	4.91
BR Sel Method	Energy only			

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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2145

INPUT
Description: BRG DS
Station Elevation Data num= 90

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-343.96	239.18	-331.14	238.4	-313.22	237.93	-288.12	237.13	-275.37	236.7
-267.7	235.63	-256.8	234.78	-242.12	234.53	-228.68	234.12	-223.17	233.69
-201.77	233.56	-179.58	233.68	-170.41	233.64	-157.83	233.63	-152.98	233.57
-150	233.41	-147.3	233.27	-137.67	233.29	-135.3	232.91	-125.71	232.58
-120.9	232.52	-115.43	232.53	-110.3	232.55	-104.12	232.56	-94.88	232.53
-87.68	232.6	-82.54	232.64	-79.46	232.65	-77.04	232.47	-69.18	232.56
-63.01	232.5	-57.39	232.64	-50.67	232.58	-46.08	232.64	-38.34	232.94
-37.31	232.85	-37.05	232.77	-36.28	232.64	-27.88	230	-23.91	227.46
-18.08	227.97	-10.78	226.84	0	226.89	6.83	228.1	10.78	230.5
27.45	232.82	36.48	233.14	44.22	233.34	49.04	233.48	53.41	233.46
60.34	233.37	73.71	233.36	76.47	232.77	80.34	232.69	91.18	232.87
100.43	232.96	105.57	233.11	112.77	233.09	125.49	232.85	129.21	233.41
134.35	233.73	136.41	233.67	138.25	233.6	139.98	233.54	143.44	233.59
145.66	233.71	148.59	233.59	150.43	233.6	152.81	233.75	156.87	233.83
160.38	234.29	161.67	234.67	162.96	234.95	165.57	235.09	168.16	235.52
170.75	235.61	172.05	235.71	173.35	235.89	177.24	236.25	179.23	236.28
180.24	236.35	182.27	236.34	183.72	236.48	186.28	237.07	188.91	237.77
189.86	238.2	192.8	239.12	194.47	239.5	197.03	239.88	198.23	239.97

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-343.96	.08	-27.88	.03	10.78	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-27.88	10.78	12	40	58	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-343.96	-56.5	236.3	F
40.5	198.23	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 2106

INPUT
Description:
Station Elevation Data num= 89

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-368.67	239.28	-356.61	238.52	-346	238.04	-320.92	237.18	-309.65	236.83
-305.9	236.61	-298.38	235.9	-292.12	234.7	-289.37	234.58	-285.85	234.11
-279.15	233.95	-266.93	233.85	-254.58	233.69	-246.57	233.6	-229.27	234.06
-220.73	234.25	-204.14	234.03	-197.66	233.48	-192.22	233.44	-187.53	233.63
-179.51	233.73	-174.23	233.44	-159.79	233.36	-153.61	233.23	-149.49	233.35
-140.86	232.55	-134.31	232.51	-131.63	232.49	-124.11	232.51	-121.53	232.72
-110.33	232.87	-87.66	233.04	-84.57	232.84	-77.36	232.78	-73.85	232.49
-65	232.63	-60.88	232.58	-55.94	232.58	-50.57	232.87	-35.19	232.82
-34.82	232.82	-28.12	232.84	-27.88	229.92	-23.91	227.38	-10.78	226.76
0	226.81	6.83	228.02	10.78	230.42	10.79	232.22	14.14	232.59
20.18	232.94	26.69	233.4	32.48	233.17	33.92	232.85	38.96	232.75
41.17	233.76	44.32	234.21	55.65	233.76	61.76	232.93	68.47	232.61
71.15	233.65	73.99	233.84	80.54	233.56	82.68	233.05	89.44	232.85
100.66	232.71	106.03	232.85	108.71	233.3	115.51	233.11	120.79	233.3
124.81	233.73	129.99	233.05	134.2	232.77	142.25	232.71	151.23	232.62
160.88	232.47	167.64	232.48	171.76	232.56	183.09	233.7	188.06	233.38
196.61	234.01	198.54	234.47	209.16	234.85	213.98	236.52	218.81	236.92
224.08	237.66	230.4	238.81	232.83	239.53	239.37	240.5		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-368.67	.08	-27.88	.03	10.78	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-27.88	10.78	158	138	114	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-368.67	-76.5	236.3	F
60.5	239.37	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1967

INPUT
Description:
Station Elevation Data num= 70

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-283.07	237.43	-271.74	237.1	-264.18	236.45	-255.05	236.32	-245.05	234.7
-228.09	233.68	-216.45	233.42	-208.48	233.81	-202.06	233.83	-185.22	233.11
-179.73	232.64	-174.45	232.74	-160.59	232.39	-154.65	232.39	-148.27	232.42
-143.01	232.43	-135.85	232.39	-131.42	232.47	-119.02	232.37	-114.35	232.69
-108.08	232.85	-100.54	232.76	-94.38	232.79	-85.69	232.67	-74.95	232.75
-67.78	232.83	-57.03	232.91	-51.27	232.83	-46.29	232.65	-34.64	232.43
-28.17	232.76	-28.16	229.1	-14.06	227.3	3.74	226.3	21.94	227
29.94	227.9	30.34	232.84	36.11	232.82	39.58	233.06	42.66	232.81
54.02	232.68	67.45	232.81	77.3	233.33	84.47	233.3	99.79	233.36
105.79	233.09	115.02	233.18	127.5	233	133.86	233.56	153.58	233.73
157.41	232.5	168.05	232.68	174.8	232.51	180.4	232.54	189.67	232.41
204.54	232.65	210.09	232.93	214	233.02	224.46	233.64	228.29	233.89
233.08	234.58	237.87	235.57	241.7	236.01	246.49	237.22	252.24	237.9
258.94	239.69	263.73	240.04	268.52	241.19	276.21	242.46	283.81	243.36

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-283.07	.08	-28.16	.03	29.94	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-28.16	29.94	130	125	120	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-283.07	-145.5	236.3	F
129.5	283.81	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1840

INPUT
Description:
Station Elevation Data num= 75

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-435.01	237.42	-427.17	237.34	-419.59	236.36	-414.59	236.1	-412.09	235.47
-404.6	234.52	-397.1	234.21	-394.61	233.74	-385.86	233.62	-382.14	233.23
-376.03	233.28	-367.57	232.37	-353.81	232.86	-350.33	233.37	-328.63	233.36
-324.8	232.82	-318.9	232.59	-308.05	232.53	-300.55	232.39	-291.62	232.45

-285.24	232.68	-282.32	233.1	-271.28	232.29	-259.64	232.25	-250.12	232.45
-236.37	232.43	-227.9	232.39	-221.55	232.35	-212.49	232.48	-206.75	232.32
-197.1	232.52	-192.99	233.39	-177.28	233.45	-168.62	233.49	-162.73	233.49
-151.76	233.51	-143.7	233.35	-137.66	233.29	-131.87	232.94	-124.9	232.44
-118.18	232.52	-108.89	233.24	-102.95	233.2	-92.34	232.92	-86.56	232.45
-79.23	232.68	-69.07	232.68	-59.54	232.84	-50.81	232.56	-39.1	232.62
-31.35	232.57	-23.1	233	-21.65	228.5	-14.55	226.8	-4.35	226.7
5.05	227.4	16.65	229.5	18.15	232.6	27.98	233.21	35.76	233.32
53.27	233.37	60.5	232.86	67.54	232.96	70.21	233.54	78.21	233.36
94.12	232.94	107.74	232.72	119.53	233.09	135.32	233.34	150	233.97
157.14	234.77	165.49	237	171.76	238.39	178.01	240.24	182.29	240.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-435.01	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	235	295	340	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-435.01	-208	236.3	F
192	182.29	237.6	F

CROSS SECTION

RIVER: NORTH
REACH: MID RS: 1545

INPUT
Description:
Station Elevation Data num= 65

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-480.73	237.79	-466.57	236.33	-462.82	234.54	-447.81	234.36	-431.38	233.55
-409.46	233.27	-388.5	233.11	-370.86	232.95	-343.2	232.97	-325.64	232.41
-311.62	232.36	-295.8	232.29	-273.64	232.2	-248.51	232.53	-243.41	232.27
-232.05	232.35	-216.44	232.45	-201.73	232.68	-190.36	232.67	-182.25	232.57
-162.4	232.67	-132.62	232.57	-123.42	232.5	-85.97	233.02	-69.1	233.43
-55.42	233.75	-26.16	233.77	-21.65	227.91	-14.55	226.21	-4.35	226.11
5.05	226.81	16.65	228.91	18.05	232.67	18.95	232.77	20.43	233.31
41.64	233.03	57.37	232.35	66.05	232.25	85.45	232.73	104.51	232.93
138.05	233.2	162.05	232.43	186.04	232.4	215.49	232.34	228.79	232.38
239.13	232.37	259.3	232.55	285.83	232.28	323.72	232.8	340.54	232.8
354.88	232.82	376.77	232.86	400.77	233.06	408.92	232.93	424.77	233.07
442.46	234.51	450.83	235.77	467.72	236.88	500.68	237.23	529.61	237.25
534.61	238.37	552.4	238.72	555.36	239.27	583.92	241.84	594.56	241.83

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-480.73	.08	-21.65	.03	16.65	.08

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Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        -21.65   16.65             205     250     285              .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
 -480.73  -355.5   236.3       F
   399.5  594.56   237.6       F

CROSS SECTION


RIVER: NORTH
REACH: MID                RS: 1295

INPUT
Description:
Station Elevation Data    num=      73
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -403.24  238.81 -394.41  238.51 -388.15  237.61 -381.89   234.7 -376.88  234.48
 -374.37  234.03 -364.28  233.38 -358.94  233.43 -346.74  232.37 -339.31  232.43
 -330.88  232.35 -319.27  232.08 -312.17  232.85 -301.96  232.88 -295.47  233.14
 -274.85  233.11 -272.93   232.7 -261.39  232.42 -248.92  232.44 -237.14  232.38
 -226.65  232.31 -219.97  232.81 -212.39  233.09 -197.78  233.18 -195.27  232.85
 -189.99  232.66 -185.25  232.51 -178.99  232.54 -165.21  232.45 -161.46  232.91
 -151.44  233.27 -137.66  232.97 -121.38   232.6 -114.57  232.37 -107.72  232.38
  -94.36  232.18   -87.7  232.32  -82.38   232.3  -61.66   232.5  -53.99  232.55
  -48.57  232.27  -40.69  232.21  -35.48  232.38  -22.95  232.21  -21.65  227.41
  -14.55  225.71   -4.35  225.61    5.05  226.31   16.65  228.41   17.86  232.19
   29.39  232.55   43.58  232.42   49.79     233   55.11  233.08   67.61  232.91
   84.38  232.69   90.51   232.4    98.7  232.09  113.93  232.18  123.61  232.28
  133.55  232.74  145.11  233.19  156.54  233.35  170.45  234.27  184.12  237.66
  186.22  238.49  196.33  240.78  210.45  242.19  219.87  242.61  227.23  242.67
  234.59  243.13  243.65  243.09  255.61  243.24

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -403.24     .08  -21.65     .03   16.65     .08

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        -21.65   16.65             295     295     295              .1       .3

CROSS SECTION


RIVER: NORTH
REACH: MID                RS: 1000

INPUT
Description: DS LIMIT
Station Elevation Data    num=      84
```

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-177.41	241.46	-169.62	241.51	-163.4	241.44	-159.61	241.06	-152.07	240.44
-150.81	240.24	-147.03	240	-144.52	239.59	-135.7	238.75	-128.16	237.51
-121.86	235.95	-119.58	235.47	-113.04	234.52	-110.53	234.42	-105.69	233.81
-104.77	233.57	-101.17	233.28	-98.3	233.45	-93.71	233.07	-91.87	233.08
-89.1	233.38	-86.34	233.26	-81.73	232.64	-78.96	232.67	-73.43	232.51
-69.74	232.57	-67.19	232.72	-64.07	233.31	-61.34	232.72	-59.04	232.58
-52.8	232.5	-46.7	232.03	-43.33	231.97	-37.15	232.06	-33.8	232.41
-31.03	232.44	-22.39	232.49	-21.65	226.82	-14.55	225.12	-4.35	225.02
5.05	225.72	16.65	227.82	19.66	232.91	43.94	233.14	49.16	232.96
53.77	232.89	56.53	232.78	62.44	232.88	67.59	232.58	69.23	232.51
77.73	232.18	79.58	232.36	82.32	232.4	83.78	232.82	86.03	233.14
89.72	232.27	93.4	232.14	95.41	232.42	98.93	232.52	106.31	232.78
112.23	233.27	117.48	233.74	122.52	234.41	130.8	235.42	138.63	236.68
140.65	236.93	144.68	237.85	152.74	238.44	157.01	238.78	158.15	239.09
160.79	239.29	168.57	240.27	170.86	240.7	172.88	240.88	175.09	241.39
181.6	241.8	182.95	241.88	188.12	241.93	193.89	242.12	198.54	242.14
206.35	242.5	208.13	242.52	212.87	242.28	217.74	242.33		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-177.41	.08	-21.65	.03	16.65	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
-21.65	16.65	0	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:NORTH

Reach	River Sta.	n1	n2	n3
MID	2520	.08	.03	.08
MID	2348	.08	.03	.08
MID	2265	.08	.03	.08
MID	2231	.08	.03	.08
MID	2192	Bridge		
MID	2145	.08	.03	.08
MID	2106	.08	.03	.08
MID	1967	.08	.03	.08
MID	1840	.08	.03	.08
MID	1545	.08	.03	.08
MID	1295	.08	.03	.08
MID	1000	.08	.03	.08

SUMMARY OF REACH LENGTHS

River: NORTH

Reach	River Sta.	Left	Channel	Right
MID	2520	185	172	163
MID	2348	80	82	82
MID	2265	21	34	43
MID	2231	86	86	86
MID	2192	Bridge		
MID	2145	12	40	58
MID	2106	158	138	114
MID	1967	130	125	120
MID	1840	235	295	340
MID	1545	205	250	285
MID	1295	295	295	295
MID	1000	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: NORTH

Reach	River Sta.	Contr.	Expan.
MID	2520	.1	.3
MID	2348	.1	.3
MID	2265	.3	.5
MID	2231	.3	.5
MID	2192	Bridge	
MID	2145	.3	.5
MID	2106	.1	.3
MID	1967	.1	.3
MID	1840	.1	.3
MID	1545	.1	.3
MID	1295	.1	.3
MID	1000	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl

MID	2520	2 YR	315.00	226.70	230.85	228.65
230.94	0.000522	2.45	130.06	43.83	0.24	
MID	2520	5 YR	520.00	226.70	231.92	229.24
232.06	0.000549	3.03	179.42	48.03	0.26	
MID	2520	10 YR	690.00	226.70	232.67	229.66
232.85	0.000561	3.41	219.00	69.34	0.27	
MID	2520	25 YR	920.00	226.70	233.52	230.14
233.72	0.000550	3.74	407.10	397.12	0.27	
MID	2520	50 YR	1100.00	226.70	234.13	230.48
234.31	0.000453	3.63	678.01	461.70	0.25	
MID	2520	100 YR	1330.00	226.70	234.81	230.88
234.95	0.000365	3.47	1001.44	494.95	0.23	
MID	2520	200 YR	1540.00	226.70	235.29	231.23
235.41	0.000329	3.44	1242.57	520.59	0.22	
MID	2520	500 YR	1880.00	226.70	235.99	231.76
236.10	0.000282	3.38	1607.91	561.92	0.21	
MID	2348	2 YR	315.00	226.40	230.65	228.91
230.81	0.000999	3.26	97.86	33.58	0.33	
MID	2348	5 YR	520.00	226.40	231.67	229.61
231.92	0.001045	4.04	133.21	35.65	0.35	
MID	2348	10 YR	690.00	226.40	232.39	230.04
232.70	0.001071	4.55	159.13	36.69	0.36	
MID	2348	25 YR	920.00	226.40	233.21	230.57
233.58	0.001042	4.98	285.52	349.64	0.37	
MID	2348	50 YR	1100.00	226.40	233.88	230.94
234.19	0.000839	4.82	463.34	516.12	0.34	
MID	2348	100 YR	1330.00	226.40	234.59	231.41
234.85	0.000681	4.66	665.90	572.05	0.31	
MID	2348	200 YR	1540.00	226.40	235.08	231.80
235.32	0.000625	4.67	813.08	583.15	0.30	
MID	2348	500 YR	1880.00	226.40	235.80	232.40
236.02	0.000555	4.68	1033.32	593.99	0.29	
MID	2265	2 YR	315.00	226.15	230.59	228.66
230.73	0.000823	3.08	102.77	32.02	0.30	
MID	2265	5 YR	520.00	226.15	231.60	229.35
231.84	0.000912	3.88	135.67	32.77	0.33	
MID	2265	10 YR	690.00	226.15	232.31	229.78
232.62	0.000962	4.42	159.17	33.29	0.35	
MID	2265	25 YR	920.00	226.15	233.11	230.31
233.49	0.001023	5.02	219.08	251.94	0.37	
MID	2265	50 YR	1100.00	226.15	233.70	230.69
234.11	0.000978	5.24	303.16	441.93	0.37	
MID	2265	100 YR	1330.00	226.15	234.35	231.14
234.77	0.000935	5.46	395.07	554.82	0.36	
MID	2265	200 YR	1540.00	226.15	234.79	231.55

235.24	0.000954	5.75	457.88	568.10	0.37	
MID	2265	500 YR	1880.00	226.15	235.45	232.15
235.94	0.000973	6.14	551.37	584.39	0.38	
MID	2231	2 YR	315.00	226.07	230.59	228.55
230.69	0.000589	2.54	125.70	42.52	0.25	
MID	2231	5 YR	520.00	226.07	231.62	229.20
231.77	0.000615	3.14	170.64	44.67	0.27	
MID	2231	10 YR	690.00	226.07	232.34	229.58
232.54	0.000630	3.54	203.55	46.19	0.28	
MID	2231	25 YR	920.00	226.07	233.15	230.03
233.40	0.000660	4.01	268.16	256.15	0.30	
MID	2231	50 YR	1100.00	226.07	233.74	230.35
234.01	0.000644	4.23	333.52	299.74	0.30	
MID	2231	100 YR	1330.00	226.07	234.39	230.74
234.68	0.000643	4.51	404.00	323.87	0.30	
MID	2231	200 YR	1540.00	226.07	234.82	231.07
235.15	0.000676	4.82	452.20	336.54	0.31	
MID	2231	500 YR	1880.00	226.07	235.47	231.59
235.86	0.000720	5.26	523.72	351.62	0.33	
MID	2192		Bridge			
MID	2145	2 YR	315.00	226.84	230.24	228.77
230.40	0.001166	3.14	100.55	39.01	0.34	
MID	2145	5 YR	520.00	226.84	231.16	229.34
231.39	0.001176	3.82	139.50	47.09	0.36	
MID	2145	10 YR	690.00	226.84	231.84	229.75
232.12	0.001131	4.22	174.09	54.17	0.36	
MID	2145	25 YR	920.00	226.84	232.64	230.24
232.97	0.001101	4.67	220.85	140.21	0.37	
MID	2145	50 YR	1100.00	226.84	233.23	230.58
233.60	0.001064	4.95	271.14	230.90	0.37	
MID	2145	100 YR	1330.00	226.84	233.85	231.00
234.25	0.001041	5.24	330.89	382.14	0.37	
MID	2145	200 YR	1540.00	226.84	234.20	231.35
234.66	0.001127	5.66	364.89	390.82	0.39	
MID	2145	500 YR	1880.00	226.84	234.69	231.90
235.25	0.001264	6.29	412.92	413.33	0.42	
MID	2106	2 YR	315.00	226.76	230.21	228.53
230.35	0.000932	2.93	107.45	38.34	0.31	
MID	2106	5 YR	520.00	226.76	231.13	229.11
231.33	0.000998	3.64	142.82	38.76	0.33	
MID	2106	10 YR	690.00	226.76	231.81	229.53

232.07	0.000999	4.08	169.26	38.82	0.34	
MID	2106	25 YR	920.00	226.76	232.60	230.02
232.93	0.001021	4.61	201.17	95.14	0.36	
MID	2106	50 YR	1100.00	226.76	233.19	230.35
233.56	0.000999	4.90	253.82	269.40	0.36	
MID	2106	100 YR	1330.00	226.76	233.80	230.77
234.21	0.000994	5.22	326.07	403.97	0.37	
MID	2106	200 YR	1540.00	226.76	234.14	231.10
234.61	0.001079	5.64	370.97	468.53	0.38	
MID	2106	500 YR	1880.00	226.76	234.64	231.63
235.20	0.001199	6.24	439.32	494.25	0.41	

MID	1967	2 YR	315.00	226.30	230.20	228.02
230.25	0.000302	1.80	175.69	58.29	0.18	
MID	1967	5 YR	520.00	226.30	231.14	228.47
231.22	0.000334	2.26	230.41	58.37	0.20	
MID	1967	10 YR	690.00	226.30	231.84	228.79
231.94	0.000342	2.55	271.43	58.43	0.21	
MID	1967	25 YR	920.00	226.30	232.66	229.16
232.79	0.000353	2.89	328.19	178.86	0.22	
MID	1967	50 YR	1100.00	226.30	233.27	229.42
233.41	0.000342	3.05	451.31	357.32	0.22	
MID	1967	100 YR	1330.00	226.30	233.91	229.73
234.06	0.000329	3.19	624.50	460.27	0.22	
MID	1967	200 YR	1540.00	226.30	234.28	229.98
234.44	0.000347	3.40	727.29	469.08	0.23	
MID	1967	500 YR	1880.00	226.30	234.82	230.37
235.01	0.000372	3.70	875.80	480.04	0.24	

MID	1840	2 YR	315.00	226.70	230.00	228.69
230.17	0.001322	3.29	96.10	39.03	0.37	
MID	1840	5 YR	520.00	226.70	230.88	229.28
231.13	0.001323	4.02	130.53	39.73	0.39	
MID	1840	10 YR	690.00	226.70	231.54	229.67
231.85	0.001280	4.46	157.04	40.27	0.39	
MID	1840	25 YR	920.00	226.70	232.30	230.12
232.69	0.001277	5.00	187.91	55.12	0.40	
MID	1840	50 YR	1100.00	226.70	232.88	230.46
233.31	0.001233	5.30	238.38	289.97	0.40	
MID	1840	100 YR	1330.00	226.70	233.51	230.86
233.96	0.001145	5.50	387.23	522.45	0.40	
MID	1840	200 YR	1540.00	226.70	233.90	231.20
234.34	0.001109	5.64	524.76	543.85	0.39	
MID	1840	500 YR	1880.00	226.70	234.50	231.72
234.91	0.001001	5.69	741.27	558.92	0.38	

MID	1545	2 YR	390.00	226.11	229.42	228.32

229.68	0.001996	4.06	96.99	39.66	0.45	
MID	1545	5 YR	630.00	226.11	230.26	228.95
230.63	0.001990	4.91	130.56	40.61	0.47	
MID	1545	10 YR	840.00	226.11	230.89	229.38
231.36	0.001986	5.50	156.38	41.33	0.49	
MID	1545	25 YR	1110.00	226.11	231.61	229.88
232.20	0.001981	6.14	186.57	42.16	0.50	
MID	1545	50 YR	1330.00	226.11	232.15	230.26
232.82	0.001976	6.59	209.45	42.77	0.51	
MID	1545	100 YR	1600.00	226.11	232.86	230.70
233.52	0.001715	6.68	418.16	567.47	0.48	
MID	1545	200 YR	1850.00	226.11	233.63	231.08
234.02	0.001024	5.60	943.32	830.51	0.38	
MID	1545	500 YR	2230.00	226.11	234.39	231.63
234.63	0.000669	4.86	1511.62	891.55	0.31	

MID	1295	2 YR	390.00	225.61	228.92	
229.18	0.002000	4.06	96.40	38.87	0.45	
MID	1295	5 YR	630.00	225.61	229.76	
230.13	0.002000	4.92	129.09	39.37	0.47	
MID	1295	10 YR	840.00	225.61	230.39	
230.86	0.002001	5.52	153.95	39.74	0.49	
MID	1295	25 YR	1110.00	225.61	231.11	
231.70	0.002003	6.17	182.73	40.16	0.50	
MID	1295	50 YR	1330.00	225.61	231.64	
232.33	0.002003	6.63	204.36	40.48	0.51	
MID	1295	100 YR	1600.00	225.61	232.26	
233.05	0.002004	7.14	233.10	98.12	0.52	
MID	1295	200 YR	1850.00	225.61	232.87	230.57
233.65	0.001782	7.20	401.12	384.93	0.50	
MID	1295	500 YR	2230.00	225.61	233.91	231.13
234.39	0.001090	6.22	915.66	537.47	0.40	

MID	1000	2 YR	390.00	225.02	228.33	227.23
228.59	0.002004	4.06	96.23	38.80	0.45	
MID	1000	5 YR	630.00	225.02	229.17	227.85
229.54	0.002000	4.92	128.95	39.40	0.47	
MID	1000	10 YR	840.00	225.02	229.80	228.29
230.27	0.002002	5.52	153.84	39.86	0.49	
MID	1000	25 YR	1110.00	225.02	230.52	228.78
231.11	0.002003	6.17	182.72	40.38	0.50	
MID	1000	50 YR	1330.00	225.02	231.05	229.16
231.74	0.002002	6.63	204.51	40.76	0.51	
MID	1000	100 YR	1600.00	225.02	231.67	229.61
232.45	0.002002	7.13	229.57	41.21	0.52	
MID	1000	200 YR	1850.00	225.02	232.19	229.98
233.08	0.002002	7.56	253.50	56.91	0.53	
MID	1000	500 YR	2230.00	225.02	232.90	230.55

233.91   0.002002   8.11   326.78   151.63   0.54

Profile Output Table - Six XS Bridge

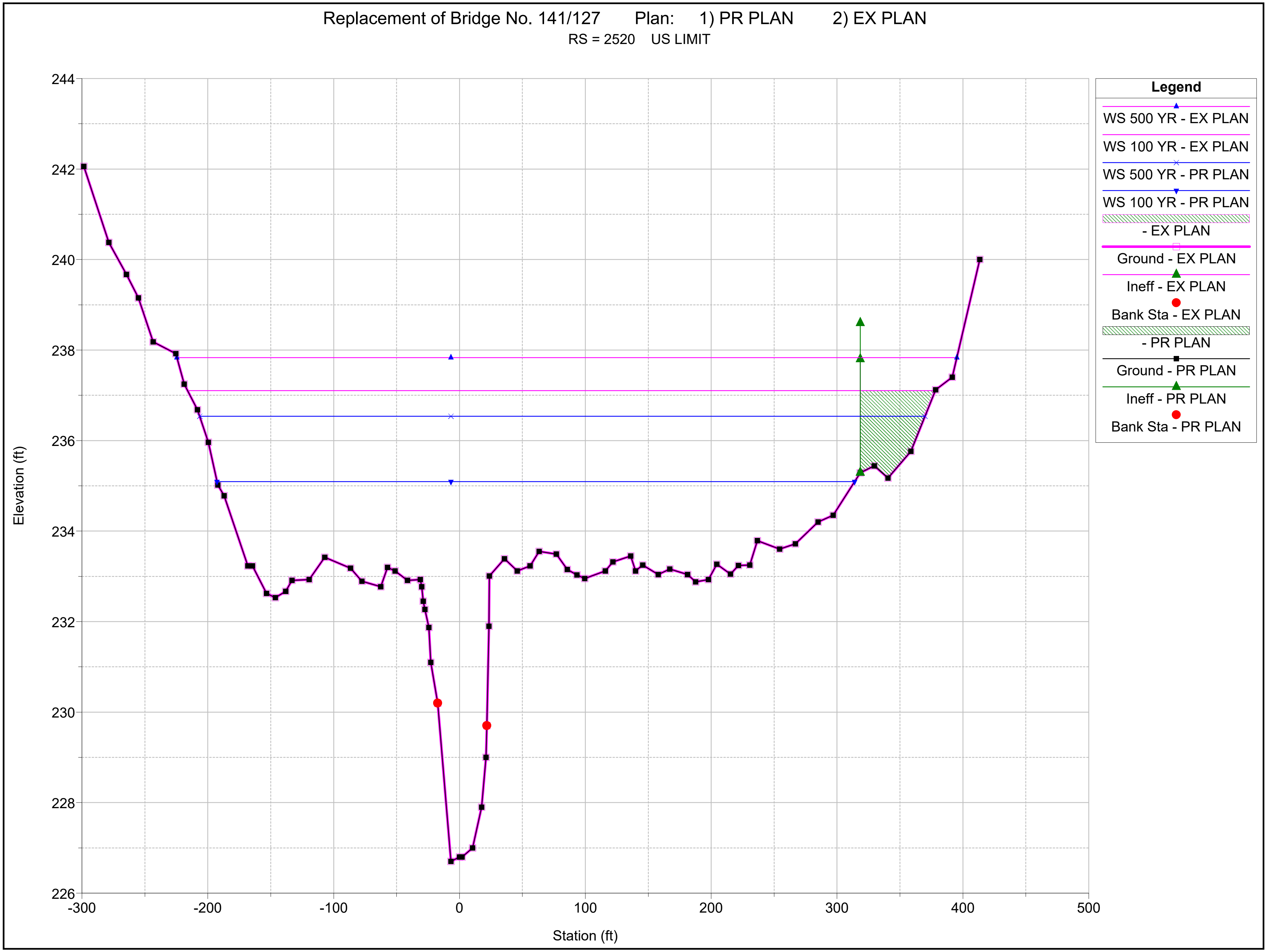
Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
MID	2265	2 YR	230.73	230.59	228.66	0.02	0.02	32.02	0.13	314.86	0.01	3.08
MID	2265	5 YR	231.84	231.60	229.35	0.03	0.04	32.77	0.69	519.29	0.02	3.88
MID	2265	10 YR	232.62	232.31	229.78	0.03	0.05	33.29	1.46	688.49	0.05	4.42
MID	2265	25 YR	233.49	233.11	230.31	0.03	0.07	251.94	3.77	907.12	9.11	5.02
MID	2265	50 YR	234.11	233.70	230.69	0.03	0.07	441.93	25.59	1043.58	30.83	5.24
MID	2265	100 YR	234.77	234.35	231.14	0.03	0.06	554.82	63.47	1197.99	68.54	5.46
MID	2265	200 YR	235.24	234.79	231.55	0.03	0.06	568.10	98.30	1339.15	102.55	5.75
MID	2265	500 YR	235.94	235.45	232.15	0.03	0.05	584.39	161.01	1556.04	162.95	6.14
MID	2231	2 YR	230.69	230.59	228.55	0.02	0.01	42.52	0.17	314.52	0.31	2.54
MID	2231	5 YR	231.77	231.62	229.20	0.02	0.01	44.67	0.76	517.68	1.56	3.14
MID	2231	10 YR	232.54	232.34	229.58	0.02	0.01	46.19	1.56	685.16	3.28	3.54
MID	2231	25 YR	233.40	233.15	230.03	0.02	0.01	256.15	9.86	905.86	4.28	4.01
MID	2231	50 YR	234.01	233.74	230.35	0.02	0.01	299.74	29.07	1056.57	14.37	4.23
MID	2231	100 YR	234.68	234.39	230.74	0.02	0.02	323.87	58.25	1241.32	30.43	4.51
MID	2231	200 YR	235.15	234.82	231.07	0.02	0.02	336.54	84.75	1410.10	45.15	4.82
MID	2231	500 YR	235.86	235.47	231.59	0.02	0.04	351.62	132.14	1676.16	71.71	5.26
MID	2192 BR U	2 YR	230.66	230.54	228.61							

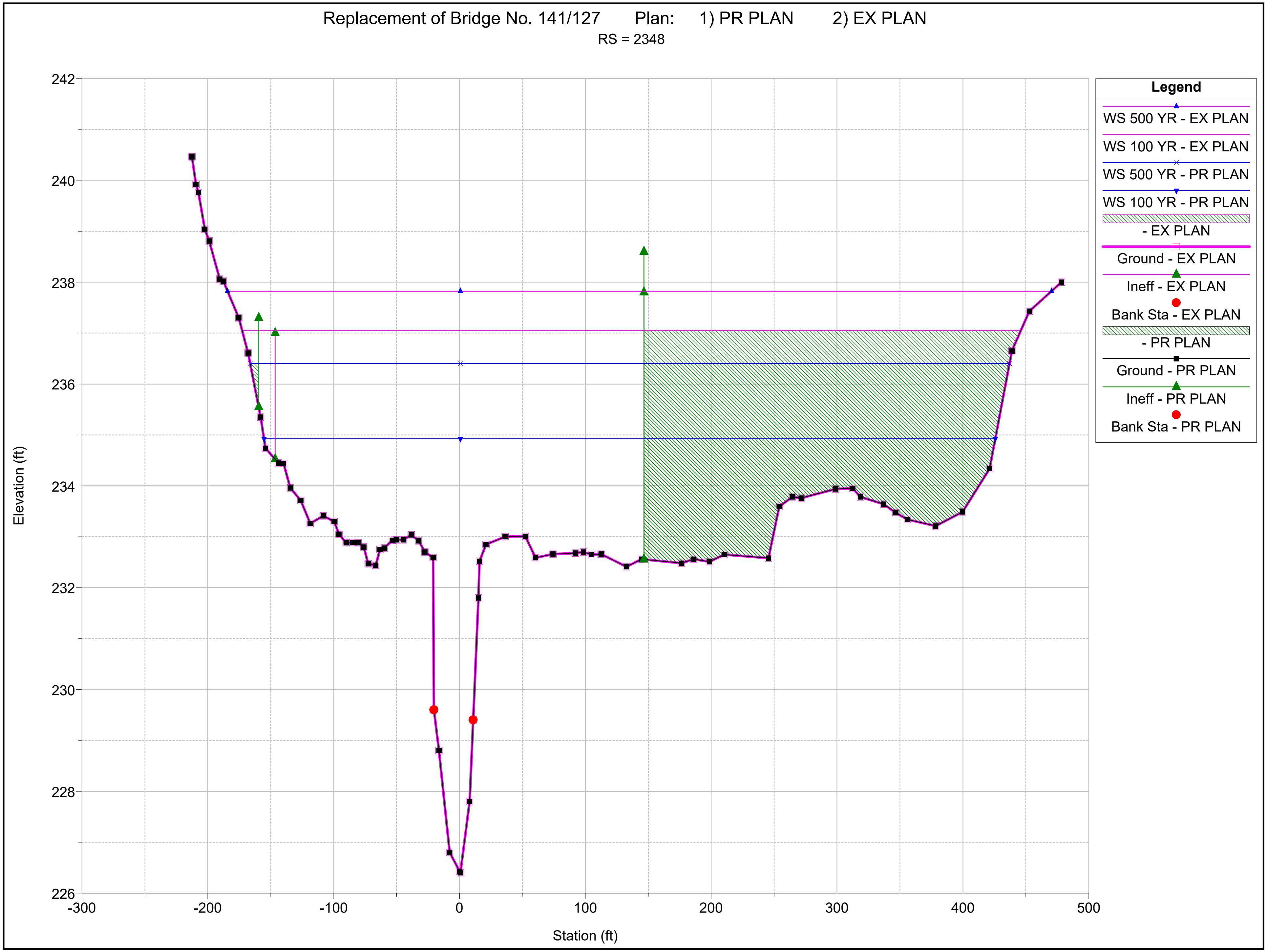
0.05	0.07	38.51		314.67	0.33	2.86
MID	2192	BR U	5 YR	231.74	231.56	229.31
0.05	0.10	45.87	0.00	518.17	1.83	3.48
MID	2192	BR U	10 YR	232.51	232.28	229.72
0.05	0.12	47.72	0.13	686.07	3.80	3.81
MID	2192	BR U	25 YR	233.37	233.10	230.23
0.05	0.12	66.00	5.06	908.19	6.74	4.23
MID	2192	BR U	50 YR	233.98	233.68	230.59
0.05	0.12	66.00	14.25	1076.78	8.97	4.50
MID	2192	BR U	100 YR	234.65	234.29	231.02
0.05	0.12	66.00	27.74	1290.65	11.61	4.86
MID	2192	BR U	200 YR	235.11	234.70	231.38
0.05	0.14	66.00	39.63	1486.52	13.85	5.25
MID	2192	BR U	500 YR	235.80	235.29	232.00
0.05	0.17	66.00	60.50	1802.10	17.40	5.84

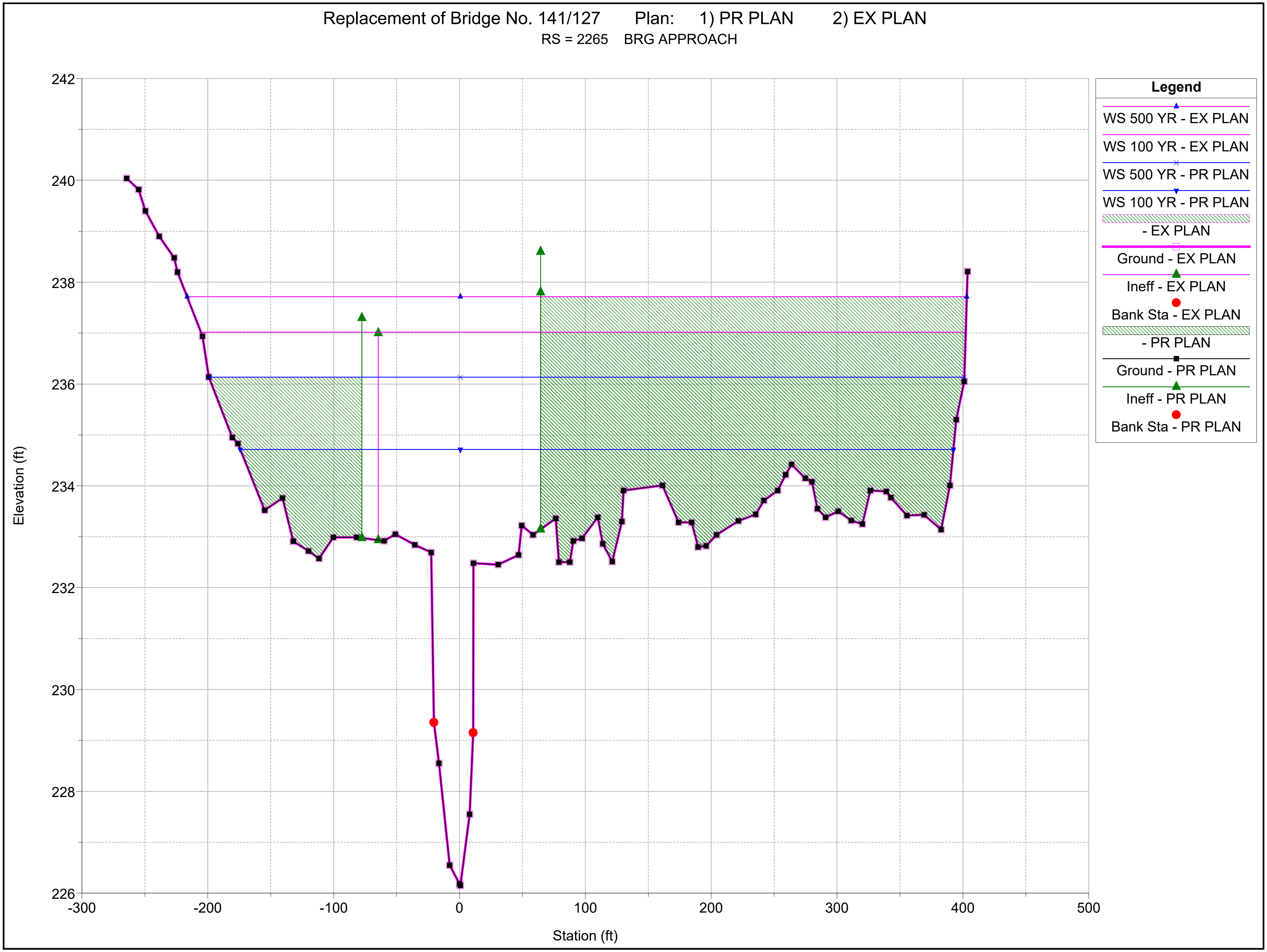
MID	2192	BR D	2 YR	230.55	230.20	229.18
0.05	0.10	25.91		315.00		4.76
MID	2192	BR D	5 YR	231.59	231.07	229.94
0.06	0.15	31.74		519.48	0.52	5.80
MID	2192	BR D	10 YR	232.34	231.73	230.47
0.06	0.17	44.13	0.09	685.62	4.29	6.28
MID	2192	BR D	25 YR	233.20	232.52	231.10
0.05	0.18	59.68	4.32	900.72	14.96	6.70
MID	2192	BR D	50 YR	233.82	233.11	231.70
0.05	0.17	66.00	14.00	1056.75	29.25	6.88
MID	2192	BR D	100 YR	234.48	233.71	232.18
0.05	0.18	66.00	32.55	1250.61	46.84	7.22
MID	2192	BR D	200 YR	234.92	234.04	232.62
0.05	0.21	66.00	46.84	1432.92	60.24	7.81
MID	2192	BR D	500 YR	235.57	234.49	233.24
0.06	0.26	66.00	71.34	1726.41	82.26	8.72

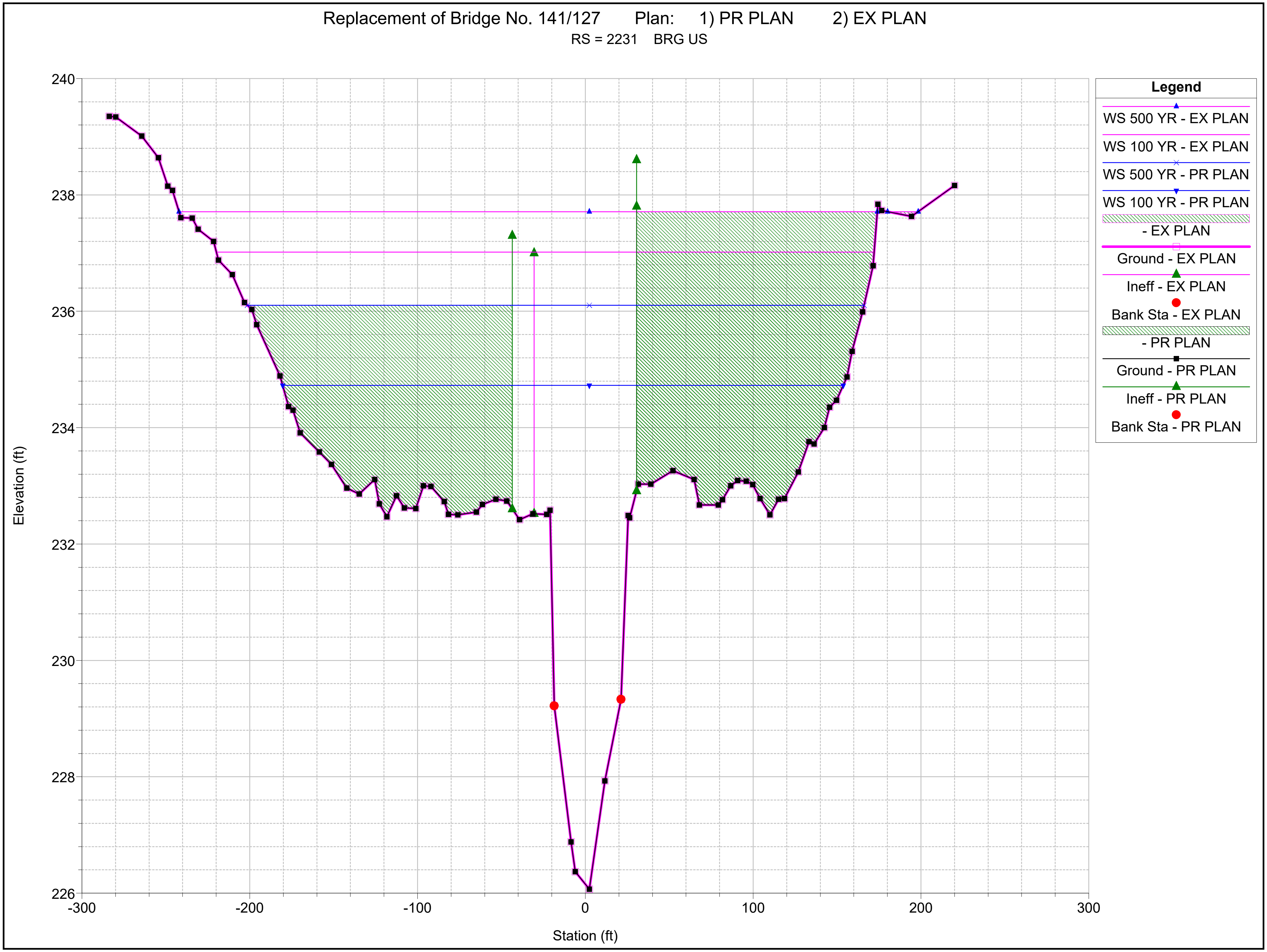
MID	2145		2 YR	230.40	230.24	228.77
0.04	0.01	39.01	0.01	314.99		3.14
MID	2145		5 YR	231.39	231.16	229.34
0.04	0.01	47.09	0.92	518.61	0.47	3.82
MID	2145		10 YR	232.12	231.84	229.75
0.04	0.01	54.17	3.10	683.82	3.08	4.22
MID	2145		25 YR	232.97	232.64	230.24
0.04	0.00	140.21	7.98	901.49	10.53	4.67
MID	2145		50 YR	233.60	233.23	230.58
0.04	0.00	230.90	15.35	1067.64	17.01	4.95
MID	2145		100 YR	234.25	233.85	231.00
0.04	0.00	382.14	35.29	1256.81	37.90	5.24
MID	2145		200 YR	234.66	234.20	231.35
0.04	0.00	390.82	51.56	1433.34	55.10	5.66
MID	2145		500 YR	235.25	234.69	231.90

0.05	0.00	413.33	80.31	1714.25	85.43	6.29	
MID	2106		2 YR	230.35	230.21	228.53	
0.07	0.03	38.34	0.00	315.00		2.93	
MID	2106		5 YR	231.33	231.13	229.11	
0.07	0.04	38.76	0.00	520.00	0.00	3.64	
MID	2106		10 YR	232.07	231.81	229.53	
0.08	0.05	38.82	0.02	689.98	0.00	4.08	
MID	2106		25 YR	232.93	232.60	230.02	
0.08	0.06	95.14	0.08	919.82	0.10	4.61	
MID	2106		50 YR	233.56	233.19	230.35	
0.08	0.07	269.40	8.05	1089.56	2.38	4.90	
MID	2106		100 YR	234.21	233.80	230.77	
0.07	0.08	403.97	31.59	1285.42	12.99	5.22	
MID	2106		200 YR	234.61	234.14	231.10	
0.08	0.09	468.53	52.23	1463.39	24.38	5.64	
MID	2106		500 YR	235.20	234.64	231.63	
0.08	0.11	494.25	90.59	1738.95	50.46	6.24	

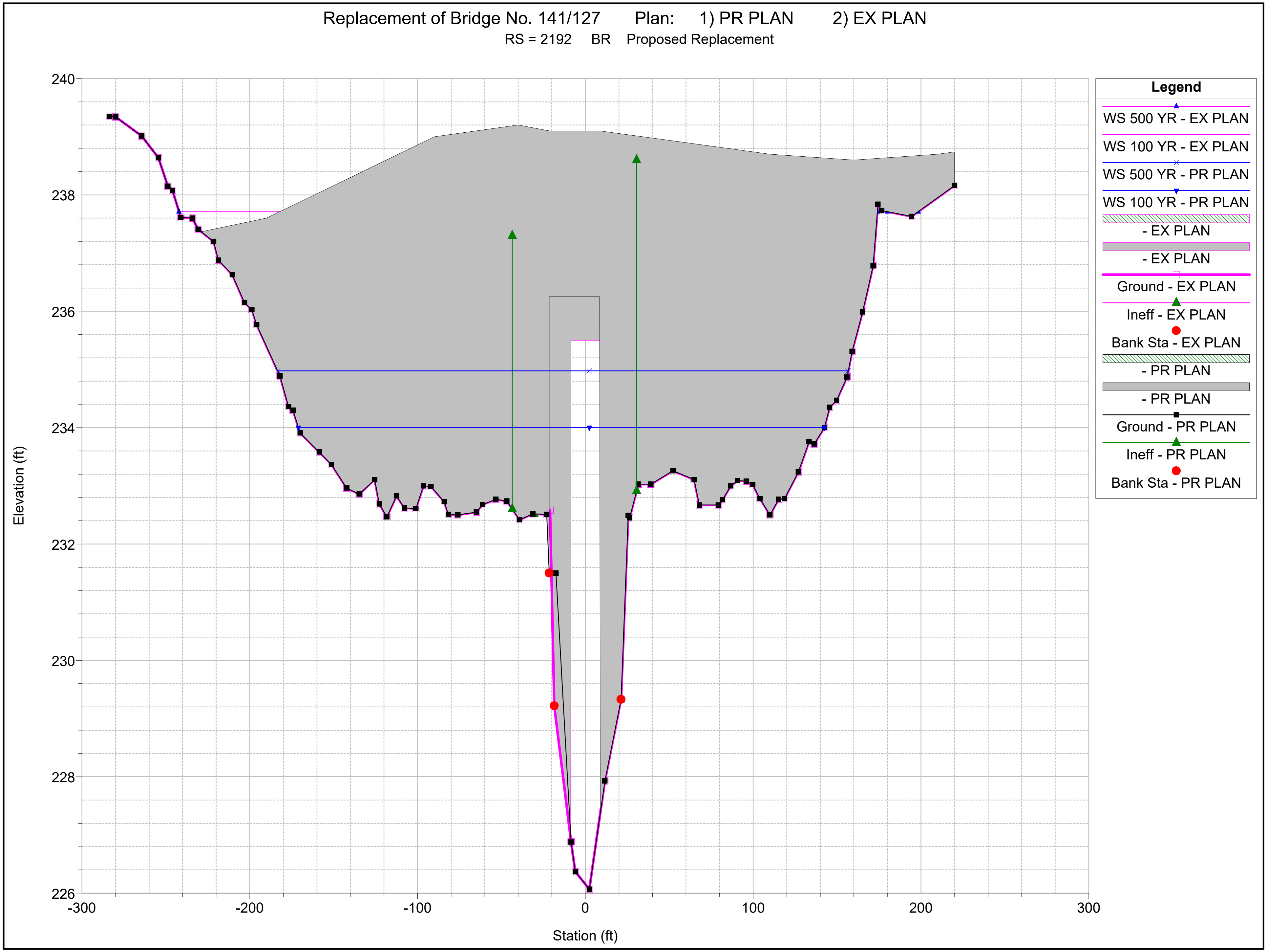

Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 2520 US LIMIT
Elevation (ft)
Station (ft)
244
242
240
238
236
234
232
230
228
226
-300
-200
-100
0
100
200
300
400
500
Legend
WS 500 YR - EX PLAN
WS 100 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - PR PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN


Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 2348
Legend
WS 500 YR - EX PLAN
WS 100 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - PR PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
Station (ft)
242
240
238
236
234
232
230
228
226
-300
-200
-100
0
100
200
300
400
500

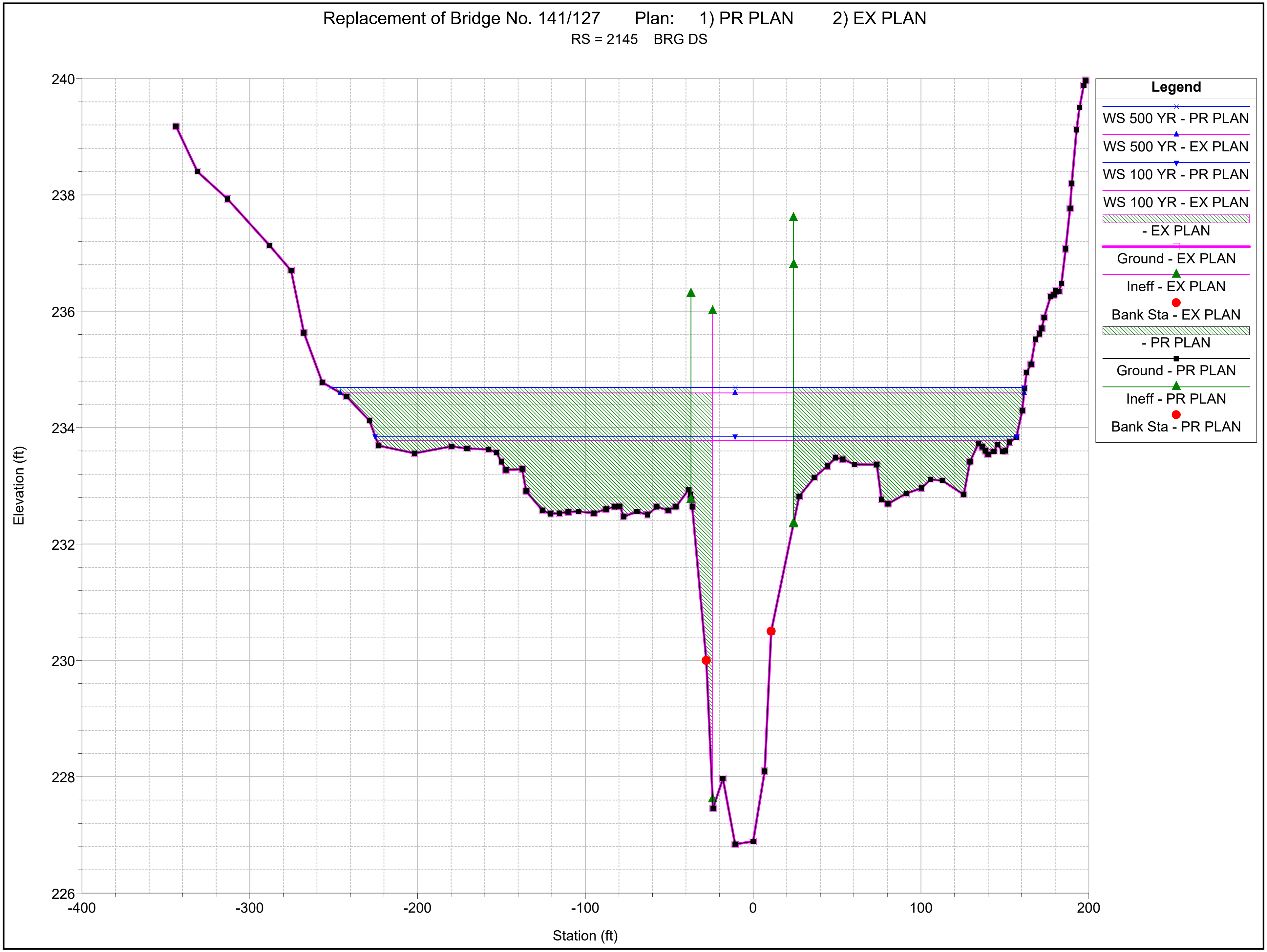

Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 2265 BRG APPROACH
Legend
WS 500 YR - EX PLAN
WS 100 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - PR PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
Station (ft)
242
240
238
236
234
232
230
228
226
-300
-200
-100
0
100
200
300
400
500



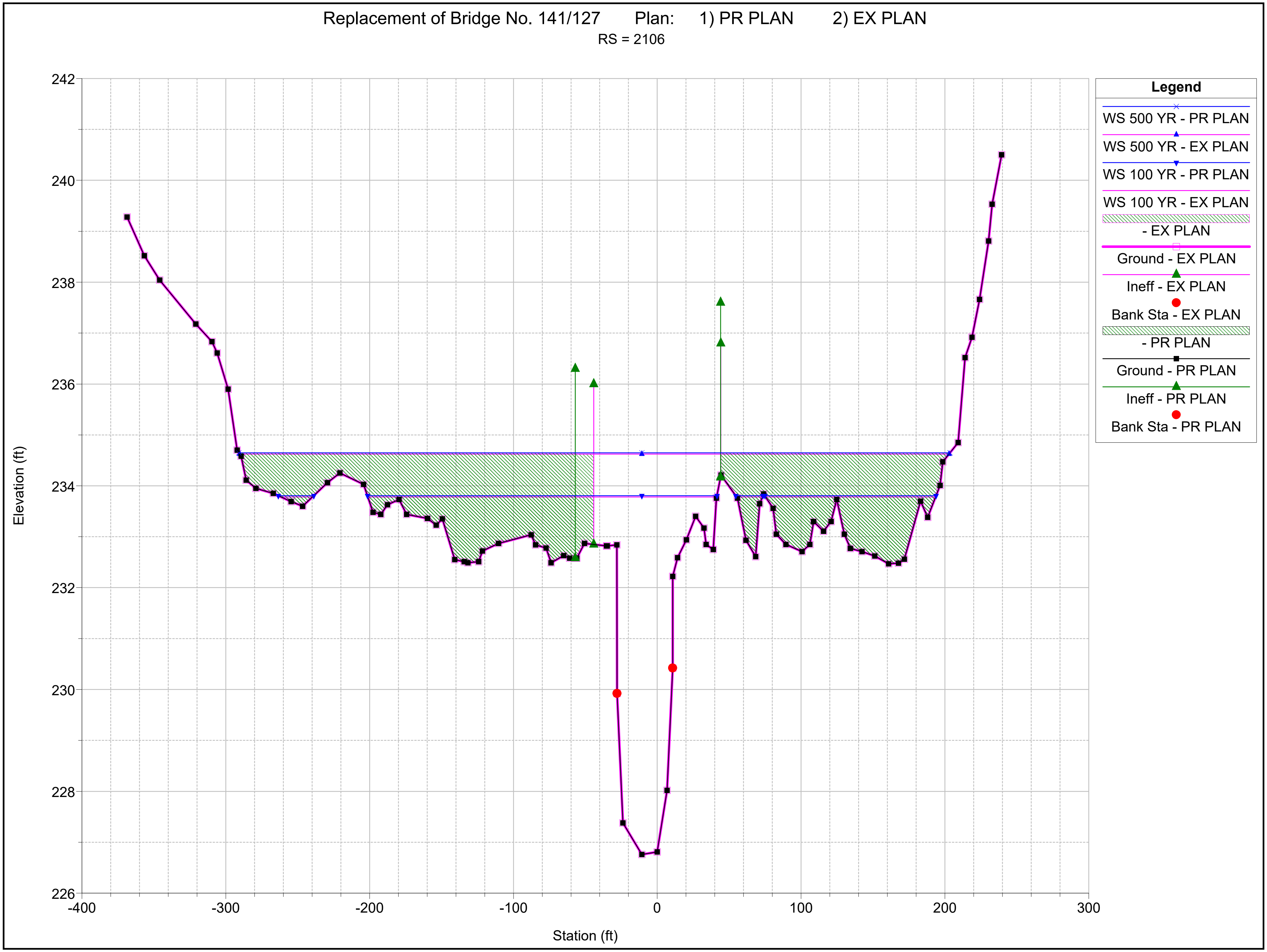
Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 2231 BRG US
Legend
WS 500 YR - EX PLAN
WS 100 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - PR PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
240
238
236
234
232
230
228
226
Station (ft)
-300
-200
-100
0
100
200
300



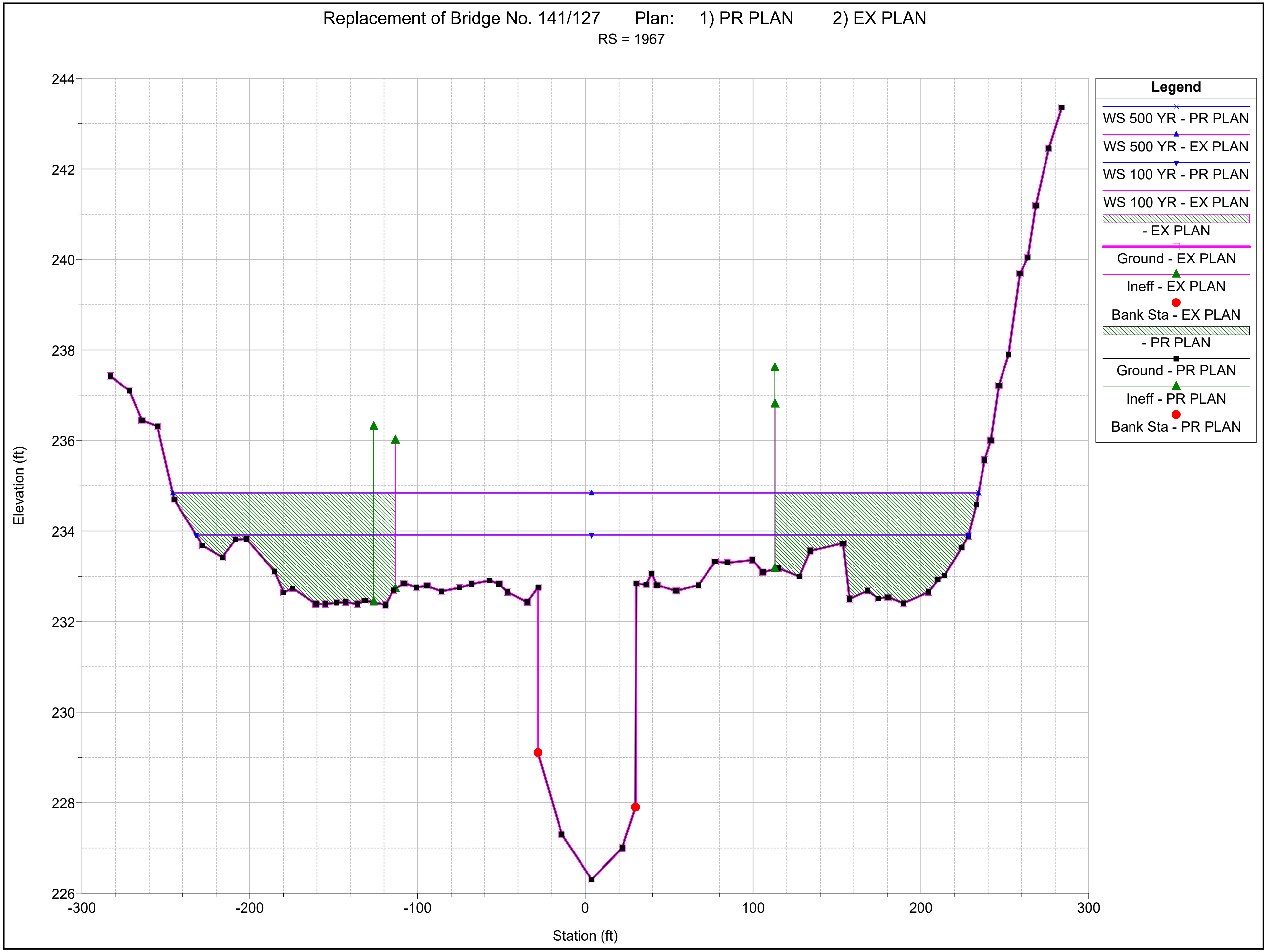
Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 2192 BR Proposed Replacement
Legend
WS 500 YR - EX PLAN
WS 100 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - PR PLAN
- EX PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
Station (ft)
240
238
236
234
232
230
228
226
-300
-200
-100
0
100
200
300



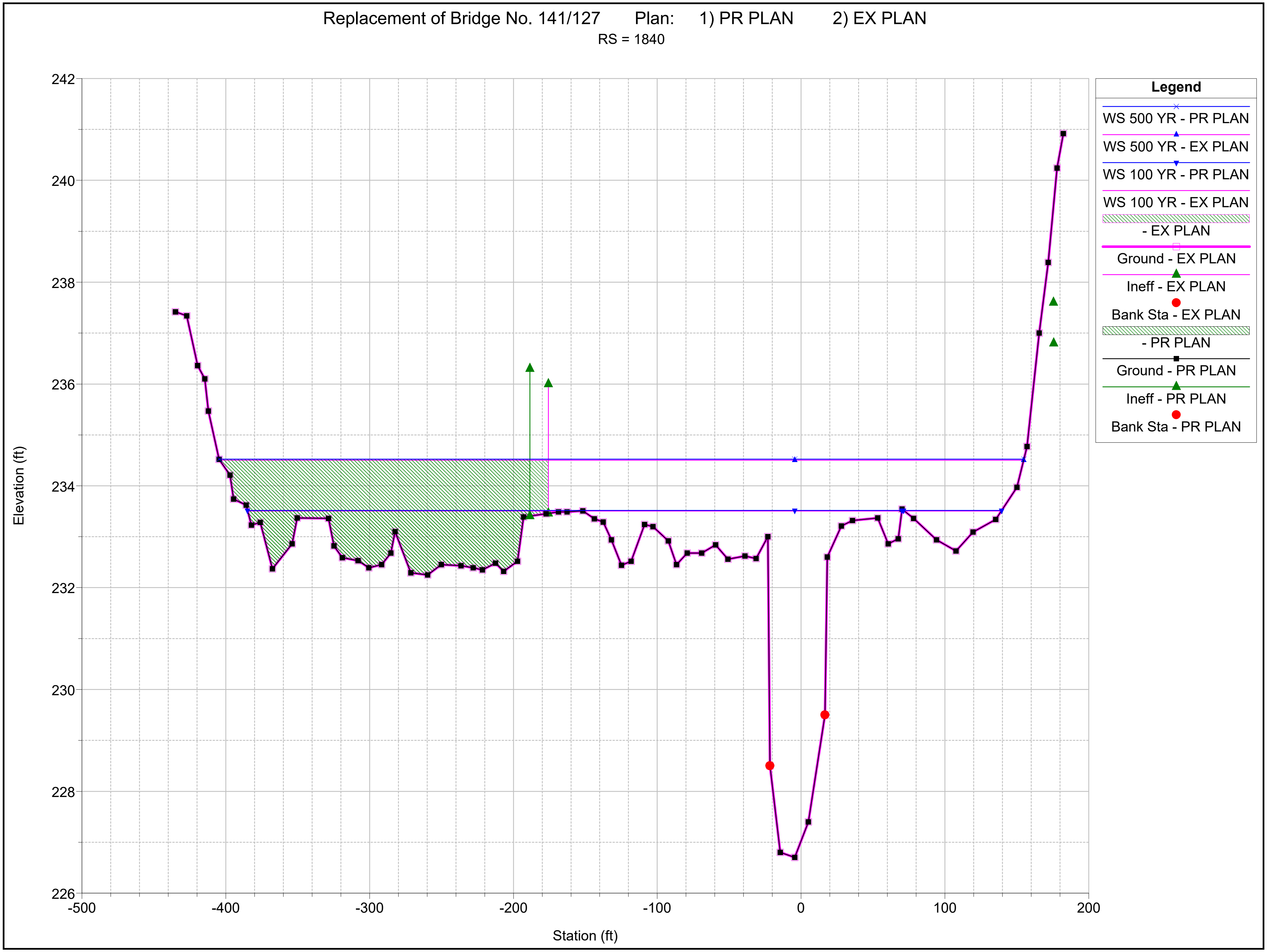
Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 2145 BRG DS
Legend
WS 500 YR - PR PLAN
WS 500 YR - EX PLAN
WS 100 YR - PR PLAN
WS 100 YR - EX PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
Station (ft)
240
238
236
234
232
230
228
226
-400
-300
-200
-100
0
100
200

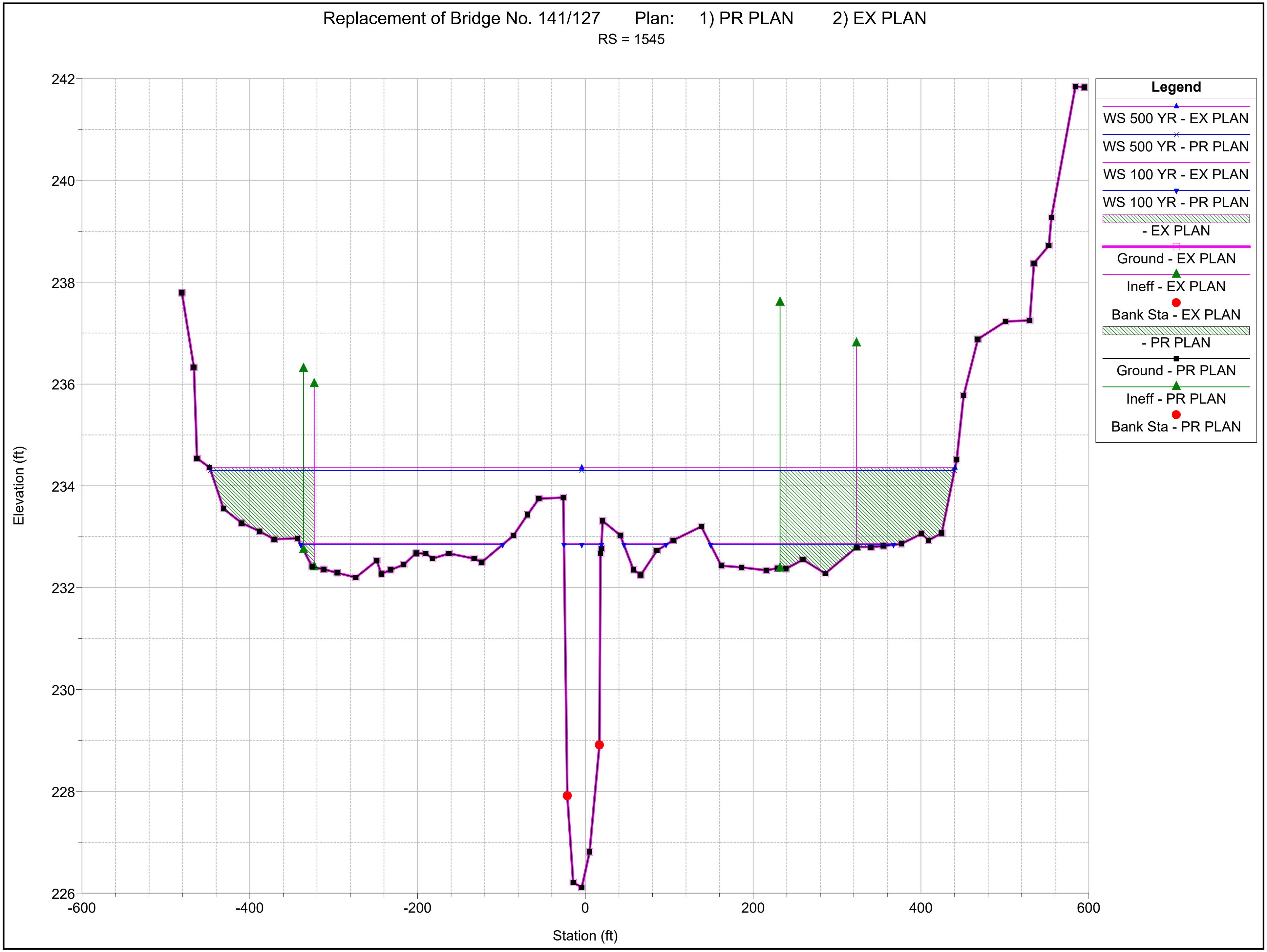


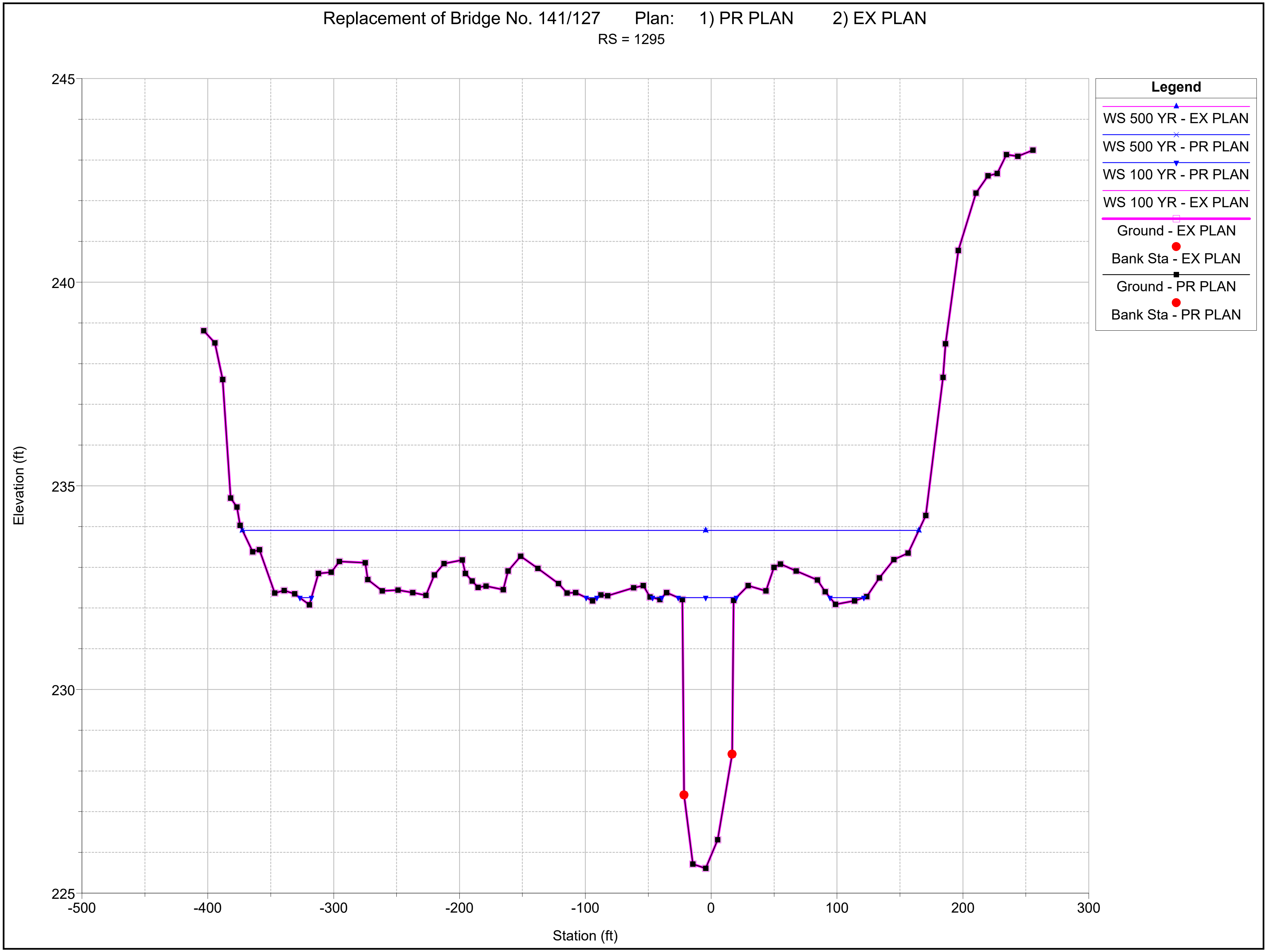
Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 2106
Legend
WS 500 YR - PR PLAN
WS 500 YR - EX PLAN
WS 100 YR - PR PLAN
WS 100 YR - EX PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
242
240
238
236
234
232
230
228
226
-400
-300
-200
-100
0
100
200
300
Station (ft)



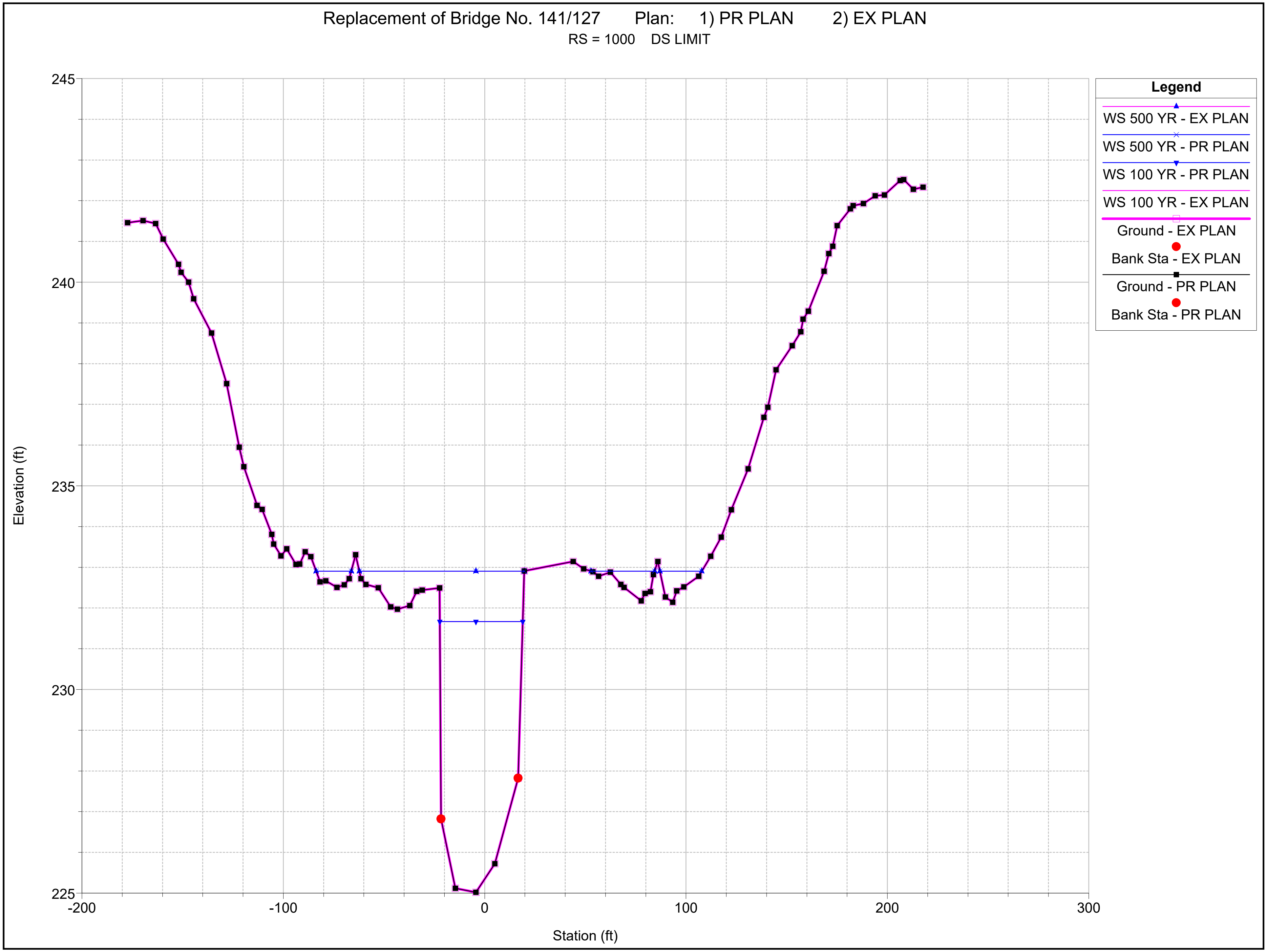
Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 1967
Legend
WS 500 YR - PR PLAN
WS 500 YR - EX PLAN
WS 100 YR - PR PLAN
WS 100 YR - EX PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
244
242
240
238
236
234
232
230
228
226
Station (ft)
-300
-200
-100
0
100
200
300


Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 1840
Legend
WS 500 YR - PR PLAN
WS 500 YR - EX PLAN
WS 100 YR - PR PLAN
WS 100 YR - EX PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
242
240
238
236
234
232
230
228
226
-500
-400
-300
-200
-100
0
100
200
Station (ft)


Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 1545
Elevation (ft)
Station (ft)
242
240
238
236
234
232
230
228
226
-600
-400
-200
0
200
400
600
Legend
WS 500 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - EX PLAN
WS 100 YR - PR PLAN
- EX PLAN
Ground - EX PLAN
Ineff - EX PLAN
Bank Sta - EX PLAN
- PR PLAN
Ground - PR PLAN
Ineff - PR PLAN
Bank Sta - PR PLAN



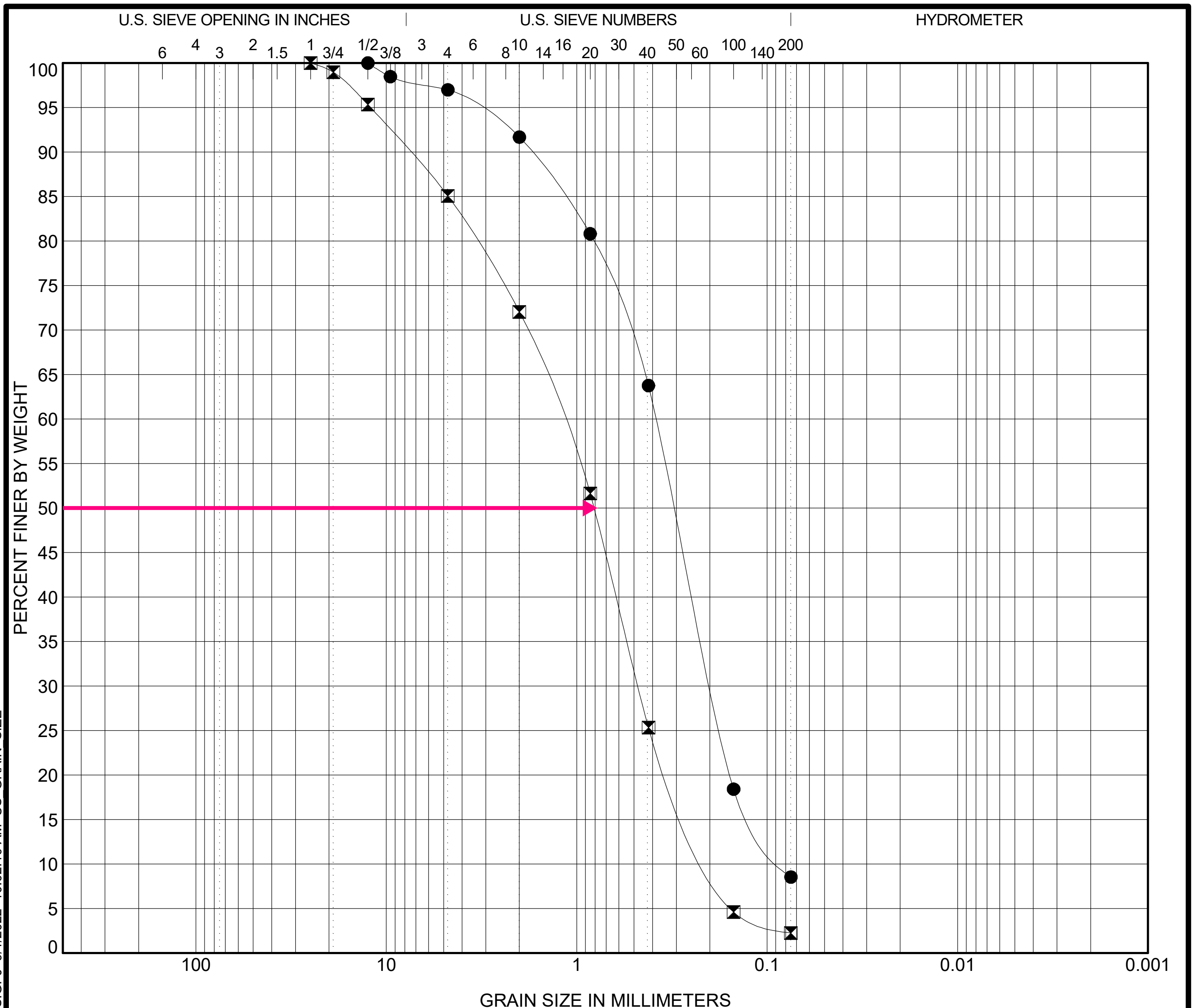
Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 1295
Legend
WS 500 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - PR PLAN
WS 100 YR - EX PLAN
Ground - EX PLAN
Bank Sta - EX PLAN
Ground - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
Station (ft)
245
240
235
230
225
-500
-400
-300
-200
-100
0
100
200
300



Replacement of Bridge No. 141/127 Plan: 1) PR PLAN 2) EX PLAN
RS = 1000 DS LIMIT
Legend
WS 500 YR - EX PLAN
WS 500 YR - PR PLAN
WS 100 YR - PR PLAN
WS 100 YR - EX PLAN
Ground - EX PLAN
Bank Sta - EX PLAN
Ground - PR PLAN
Bank Sta - PR PLAN
Elevation (ft)
Station (ft)
245
240
235
230
225
-200
-100
0
100
200
300

APPENDIX E: Scour Analysis

Sieve Analysis
2018 Underwater Inspection
Scour Calculation Worksheet
HEC-RAS Velocity Distribution Plots



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	USCS Classification	LL	PL	PI	Cc	Cu
●	**Scour Abut B, C 15.0**	**POORLY GRADED SAND w/ SILT (SP-SM)**				**1.19**	**4.64**
⧗	**Scour Abut B, E 19.7**	**POORLY GRADED SAND (SP)**				**0.96**	**6.15**

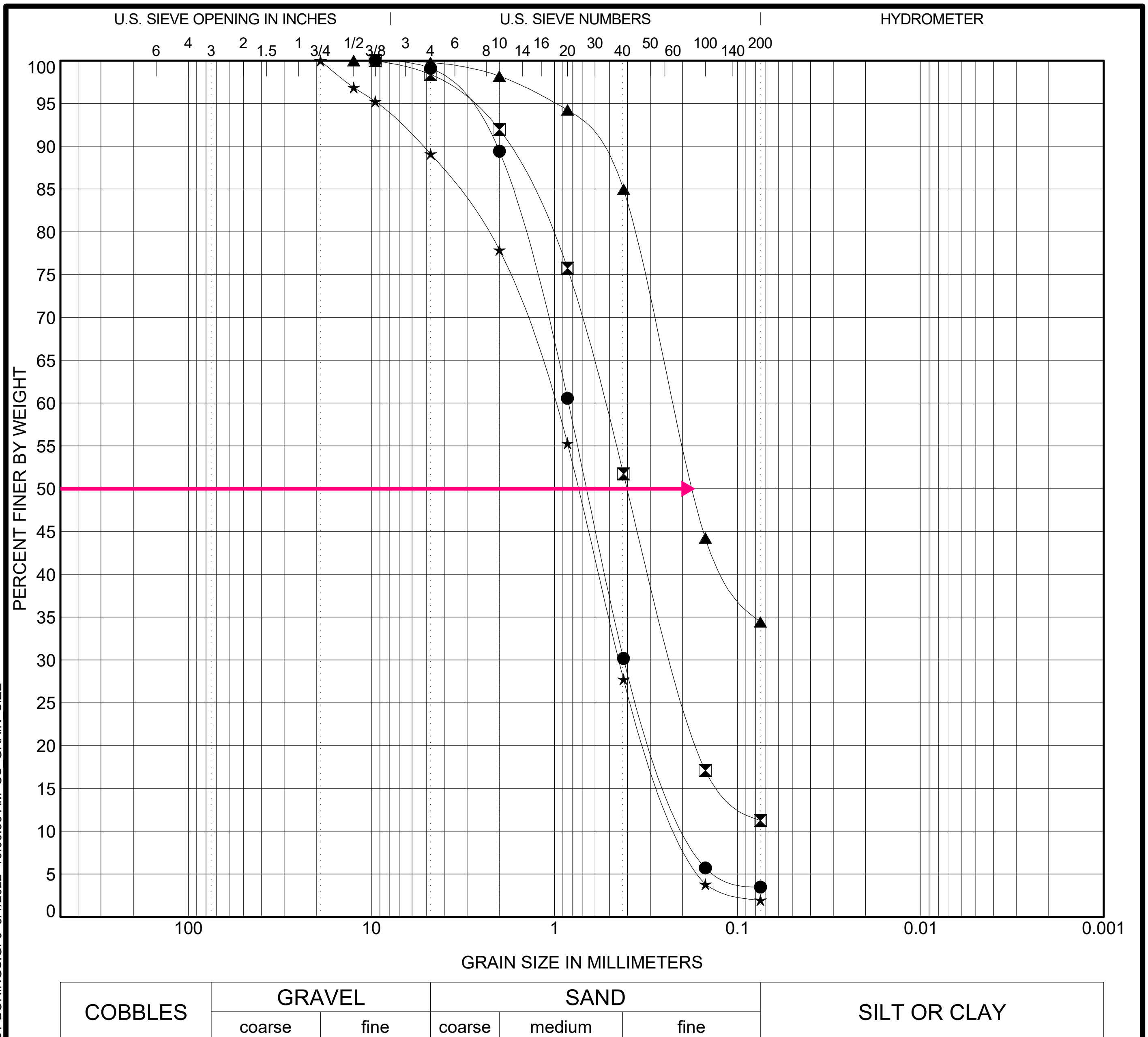
	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**Scour Abut B, C 15.0**	**12.5**	**0.386**	**0.195**	**0.083**	**3.0**	**88.4**	**8.5**	
⧗	**Scour Abut B, E 19.7**	**25**	**1.207**	**0.476**	**0.196**	**14.9**	**82.8**	**2.3**	

State of New Hampshire
Department of Transportation
Bureau of Materials & Research

Project: Nottingham
Location: NH Route 152 over North River
Number: 40612

GRAIN SIZE DISTRIBUTION

AASHTO T27/T11 - Sieve Analysis of Fine and Coarse Aggregates/Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing



	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	**B01, S9**	**22.0**	**POORLY GRADED SAND (SP)**				**1.15**	**4.67**
⧗	**Scour Abut A, A**	**11.4**	**WELL-GRADED SAND w/ SILT (SW-SM)**				**1.40**	**8.27**
▲	**Scour Abut A, B**	**15.0**	**SILTY SAND (SM)**					
★	**Scour Abut A, D**	**19.0**	**POORLY GRADED SAND (SP)**				**1.00**	**5.19**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B01, S9**	**22.0**	**9.525**	**0.839**	**0.417**	**0.18**	**0.9**	**95.6**	**3.5**	
⧗	**Scour Abut A, A**	**11.4**	**9.525**	**0.535**	**0.22**		**1.6**	**87.1**	**11.2**	
▲	**Scour Abut A, B**	**15.0**	**12.5**	**0.223**			**0.2**	**65.3**	**34.4**	
★	**Scour Abut A, D**	**19.0**	**19**	**1.016**	**0.445**	**0.196**	**10.9**	**87.2**	**2.0**	

State of New Hampshire
Department of Transportation
Bureau of Materials & Research

Project: Nottingham
Location: NH Route 152 over North River
Number: 40612

GRAIN SIZE DISTRIBUTION

AASHTO T27/T11 - Sieve Analysis of Fine and Coarse Aggregates/Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing

COLLINS ENGINEERS INC

UNDERWATER INSPECTION FORM - NHDOT STATEWIDE 43104 PROJECT

DATE: 8/2/2021 **FIELD REP.** KEN MORRISON

STRUCTURE ID # / CITY: 141/127, NOTTINGHAM **ROAD/HIGHWAY #:** NH 152

GPS & COORDINATES: 43.148558, -71.113232 **WATERWAY:** NORTH RIVER

ASSESSMENT TEAM: CURTIS CHENEY, P.E., DEREK GALLAGHER (DIVER), DEVAN SACK

PREVIOUS INSPECTION REPORT AVAILABLE: **PLANS AVAILABLE:** **BRIDGE TYPE:**

YES (Date/Originator) 8/10/16, TERRACON NO YES NO IB-C

ACCESS EMBANK. JONBOAT BARGE DIVE BOAT OTHER: N/

COMMENTS: NEXT TO BRIDGE

TRAFFIC REC. FISHING BARGE PONTOON N/A Other:

WEATHER TEMP: 70° WIND: FAIR CLOUDY RAIN

WATER CONDITIONS TEMP: 69° VISIBILITY: 1'

CURRENT: STRONG MODERATE LIGHT NONE

BANK GRASS ROCK GRAVEL DIRT/MUD SAND Other:

INSPECTION METHOD SSA SCUBA WADING OTHER:

BRIDGE SUPPORT TYPE MASONRY REINFORCED CONC. OPEN WEB CLOSED WEB Concrete / Steel / Timber Piles

FOUNDATION TYPE PILE + CAP PILE w/o CAP CAISSON SPREAD FOOTING PIER FOUNDED ON ROCK OTHER: UNK.

CROSS SECTIONS

X		X			UPSTREAM
5'	10'	25'	50'	100'	
X		X			DOWNSTREAM

SOUNDINGS: EQUIPMENT USED: Leveling rod Digital depth finder OTHER: HAMMER

SCOUR SCOUR POCKETS OR TROUGHS YES NO Notes:

FOOTING OR FOUNDATION ELEMENT EXPOSED YES NO Notes: FOOTING EXPOSURE, BOTH ABUT.

SCOUR INCREASED SINCE LAST INSPECTION YES NO Notes:

BOTTOM CONDITIONS BOULDERS COBBLES GRAVEL SAND SILT CLAY BEDROCK OTHER:

DEBRIS: STICKS TIMBERS STEEL TREE LIMBS CONSTRUCTION DEBRIS WASTE CONCRETE TREE TRASH

OTHER:

HEAVY DEBRIS LOCATED AROUND ELEMENT YES NO ELEMENTS:

BRIDGE SUBSTRUCTURE RATING : **PREVIOUS** 3 **CURRENT** 3

CHANNEL AND CHANNEL PROTECTION RATING: **PREVIOUS** 6 **CURRENT** 6

UNDERMINING : YES NO ELEMENTS:

RECOMMENDATIONS :

SUBSTRUCTURES NOT INSPECTED & REASON:

COLLINS ENGINEERS INC

UNDERWATER INSPECTION FORM - NHDOT Statewide 43104 Project

STRUCTURE ID # / CITY: 141/127, NOTTINGHAM

FIELD NOTES | Note: Inspection is limited from the water line to the mud line.

General Notes: Heavy Marine Growth Light Marine Growth
Concrete is generally sound
Masonry: Dry-laid Minor / Moderate / Severe Mortar loss

1. The concrete abutments were covered with a thin layer of marine growth (algae).
2. Hammer soundings of the concrete were performed entire length and depth of the abutments, unsound concrete was observed on both abutment walls. See number 3 for more details.
3. Cracking was observed on both abutment walls on the north end. Efflorescence was observed with no rust staining. Delaminations were found throughout these cracked areas. These areas are approximately 5 feet wide and located above the water line.
4. The sheet pile abutment walls were found to be heavily deteriorated. Areas with large holes showed another layer of sheet piling behind the face. Areas where a probe rod could be pushed through the sheet piling showed that it was backfilled with sand. The heavy corrosion of the sheet piling was confined to the east abutment wall.
5. Cracking was observed in the concrete portion of the underside of the bridge deck. Efflorescence and rust staining was present. Hammer soundings could not be performed from the water at this time.
6. Spalling was found on the upstream corners of the abutment walls. Exposed vertical reinforcing steel was found within the spall on the East abutment wall.
7. Light scaling of the concrete was observed.
8. The bottom material at the structure consisted mainly of sand, silt, large rocks and tree debris.

COLLINS ENGINEERS INC.

PROJECT 141/127 NOTTINGHAM

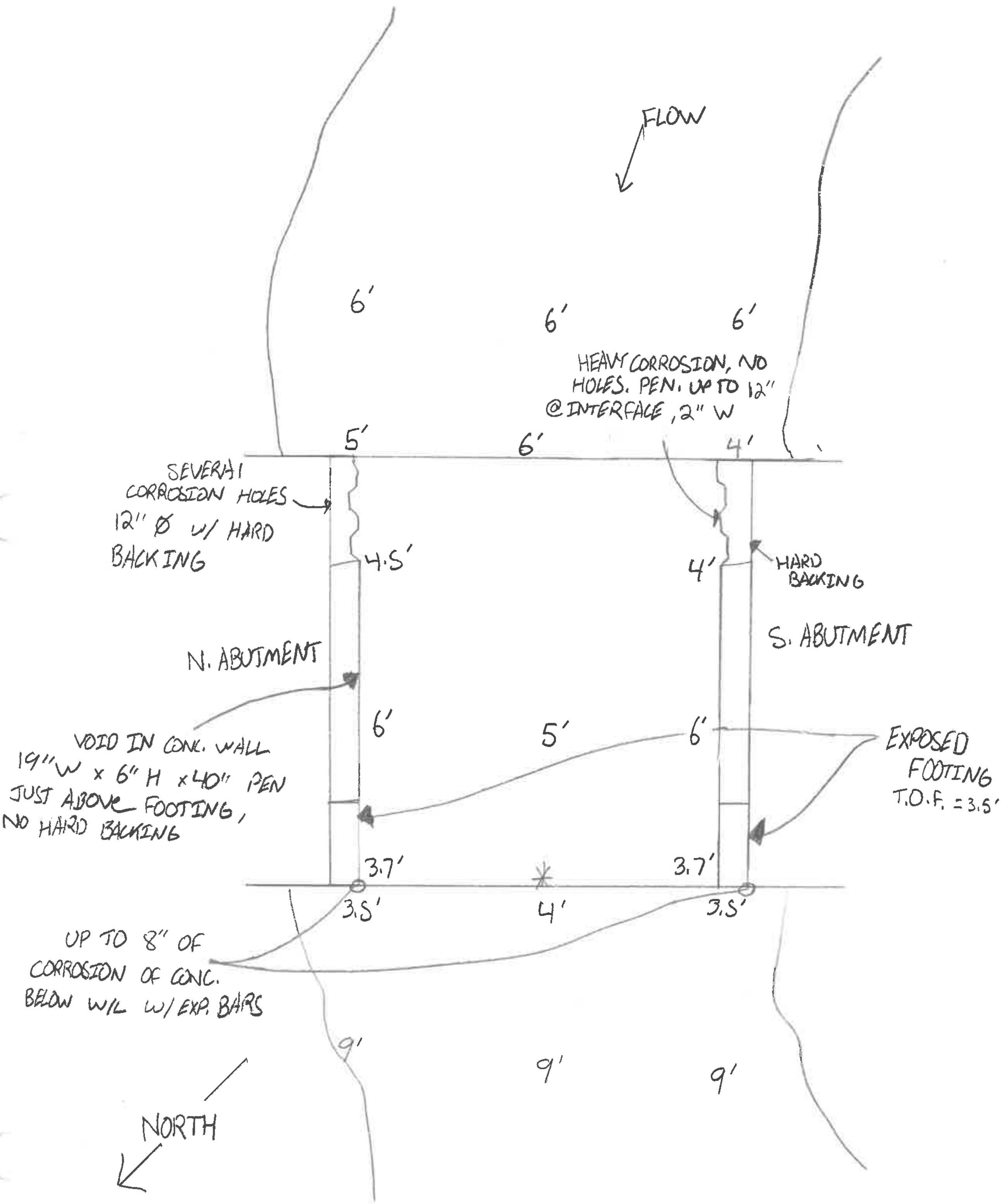
CLIENT

JOB

SHEET NO. OF

BY DS DATE 8/2/2021

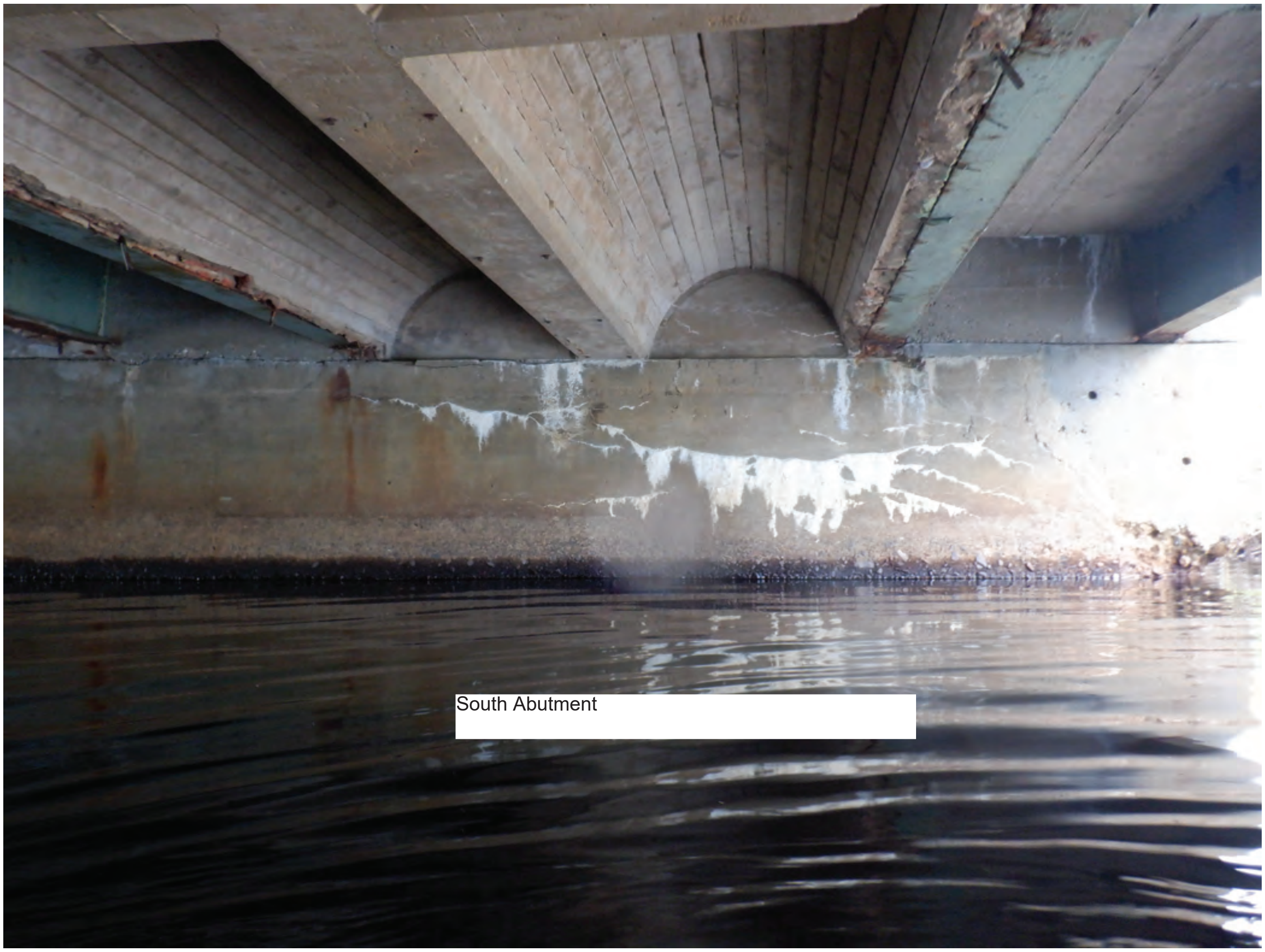
CHKD. BY DATE



* W/L REFERENCE, UPSTREAM, MID SPAN, UNDERSIDE OF DECK TO WATER = 4'

Upstream

Downstream Elevation


South Abutment

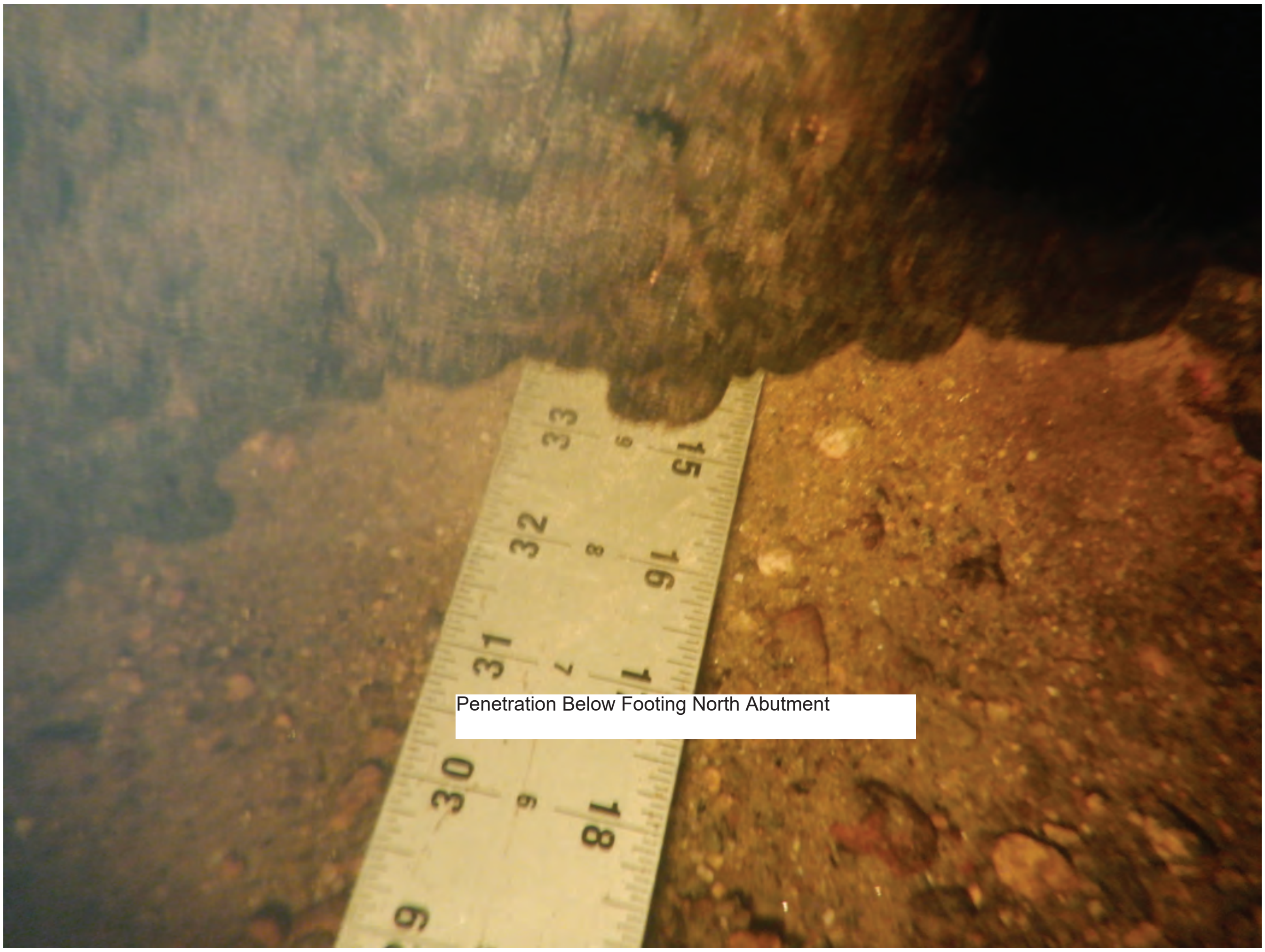

North Abutment

Downstream

Typical Underdeck

Penetration at Steel Sheet Pile in South Abutment

Typical Erosion



Penetration Below Footing North Abutment

HEC-18 SCOUR COMPUTATIONS

Based on HEC-18, Evaluating Scour at Bridges, 5th edition

COMMENTS:

DATE: 10/21/2022

REVISED:

VALUE	*denotes field entered by user or obtained from back-up spreadsheets*
VALUE	*denotes computed field or standard value*
VALUE	*denotes sum or conclusion*

SCOUR SUMMARY

STORM	CONTRACTION		FROEHLICH'S		TOTAL COMPONENT		NCHRP 24-20	VERT. W/ NCHRP 24-20
	LIVE	VERT	LEFT	RIGHT	LEFT	RIGHT		
100-YR	2.39	N/A	3.66	9.91	6.04	12.29	7.50	N/A
200-YR	2.98	N/A	4.47	10.83	7.46	13.81	8.76	N/A
500-YR	3.99	N/A	5.70	12.21	9.69	16.20	10.67	N/A

HEC-RAS MODEL DATA

FILE: **141-127 Route 125.prj**

PLAN: **PR PLAN**

100-YR: **1330 CFS**

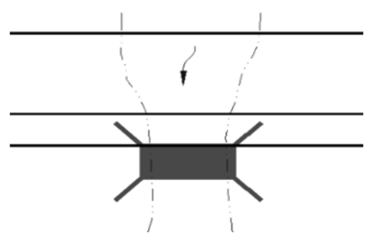
200-YR: **1540 CFS**

500-YR: **1880 CFS**

XS # **2265**

XS # **2231**

XS # **2192 BR U**



PROJECT NOTES/ASSUMPTIONS

1. Full replacement
2. Low flow energy only
3. Sieve analysis depicts poorly graded sand with D50 ranging from 0.18 to 0.80.
   The lower limit was used.

HEC-18 SCOUR COMPUTATIONS

Based on HEC-18, Evaluating Scour at Bridges, 5th edition

COMMENTS:

DATE: 10/21/2022

REVISED:

VALUE	*denotes field entered by user or obtained from back-up spreadsheets*
VALUE	*denotes computed field or standard value*
VALUE	*denotes sum or conclusion*

CONTRACTION SCOUR DETERMINATION

CRITICAL VELOCITY

Ref. HEC-18, page 6.2, Equation 6.1

$$V_c = K_u y^{1/6} (D_{50})^{1/3}$$

If Vc is less than V US of the contraction → Live-Bed Scour

If Vc is greater than V US of the contraction → Clear-Water Scour

VARIABLE		STORM EVENT		
		100-YR	200-YR	500-YR
K_u		11.17	11.17	11.17
y	(ft)	**7.41**	**7.97**	**8.83**
D_{50}	(mm)	**0.18**	**0.18**	**0.18**
D_{50}	(in)	0.007	0.007	0.007
D_{50}	(ft)	0.001	0.001	0.001
V_c	(ft/s)	1.3	1.3	1.3
V	(ft/s)	**5.05**	**5.21**	**5.41**
SCOUR TYPE:		LIVE	LIVE	LIVE

NOTES:

K_u = coefficient (English Units)

y_1 = avg depth in US main chl

Poorly graded sand - scour samples

V = main chl velocity

HEC-18 SCOUR COMPUTATIONS

Based on HEC-18, Evaluating Scour at Bridges, 5th edition

CONTRACTION SCOUR COMPUTATION

LIVE-BED CONTRACTION

Ref. HEC-18, page 6.10, Equations 6.2 and 6.3

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1}\right)^{6/7} \left(\frac{W_1}{W_2}\right)^{k_1}$$

$$y_s = y_2 - y_o$$

CLEAR WATER CONTRACTION

Ref. HEC-18, page 6.12, Equations 6.4 and 6.5

$$y_2 = \left(\frac{K_u Q^2}{D_m^{2/3} W_2^{\,2}}\right)^{3/7}$$

$$V* = (g y_1 S_1)^{1/2} \qquad y_s = y_2 - y_o$$

VARIABLE		STORM EVENT		
		100-YR	200-YR	500-YR
K_u	-	0.0077	0.0077	0.0077
D_m	(ft)	0.001	0.001	0.001
y_1	(ft)	**7.41**	**7.97**	**8.83**
y_o	(ft)	**6.13**	**6.52**	**7.09**
W_1	(ft)	**31.10**	**31.10**	**31.10**
W_2	(ft)	**30.00**	**30.00**	**30.00**
Q_1	(cfs)	**1,164**	**1,291**	**1,486**
Q_2	(cfs)	**1,330**	**1,540**	**1,880**
S_1	(ft/ft)	**0.000745**	**0.000721**	**0.000678**
V*	(ft/s)	0.42	0.43	0.44
w	(m/s)	**0.022**	**0.022**	**0.022**
w	(ft/s)	0.07	0.07	0.07
V*/w	-	5.84	5.96	6.08
k_1	-	0.69	0.69	0.69
y_2	(ft)	8.52	9.50	11.08
SCOUR DEPTH (ft):		2.39	2.98	3.99

NOTES:

- K_u = coefficient (English Units)
- D_m = 1.25 D_{50}
- y_1 = avg depth in US main chl
- y_o = avg existing depth in contracted RS
- W_1 = bottom width US main chl
- W_2 = bridge width - piers
- Q_1 = flow in US chl transporting sed.
- Q_2 = flow in contracted chl
- S_1 = slope of energy grade line of main chl
- V* = shear velocity in the US section
- w = fall velocity of bed material (HEC-18, Figure 6.8)
- V*/w = See table below
- k_1 = Exponent, see table below
- y_2 = avg depth in contracted RS after scour
- y_s = avg contraction scour depth

V*/w	k_1	Mode of Bed Material Transport
< 0.50	0.59	Mostly contact bed material discharge
0.50-2.0	0.64	Some suspended bed material discharge
> 2.0	0.69	Mostly suspended bed material discharge

LIVE BED EXPONENT TABLE (HEC-18 Sec. 6.3)

CONTRACTION & NCHRP INPUT DATA PER HEC-RAS - NOTE: PORTION OF FULL TABLE ONLY

Reach	River Sta	Profile	Q Total (cfs)	Area (sq ft)	Top Width (ft)	Q Channel (cfs)	Vel Total (ft/s)	Flow Area Ch (sq ft)	Top W Act Chan (ft)	Vel Chnl (ft/s)	W.S. Elev (ft)	E.G. Slope (ft/ft)	Hydr Depth C (ft)
MID	2520	100 YR	1330	1144.55	506.55	930.64	1.16	294.27	39.10	3.16	235.09	0.00029	7.53
MID	2520	200 YR	1540	1449.02	552.87	966.71	1.07	316.65	39.10	3.05	235.67	0.00024	8.10
MID	2520	500 YR	1880	1940.48	576.31	1024.01	0.99	350.67	39.10	2.92	236.54	0.00019	8.97
MID	2348	100 YR	1330	1229.40	581.00	967.33	1.74	229.34	31.10	4.22	234.92	0.00053	7.37
MID	2348	200 YR	1540	1573.70	589.45	1024.49	1.63	247.64	31.10	4.14	235.51	0.00046	7.96
MID	2348	500 YR	1880	2104.21	603.40	1110.74	1.54	275.30	31.10	4.03	236.40	0.00038	8.85
MID	2265	100 YR	1330	998.25	**566.56**	**1163.50**	2.98	230.60	**31.10**	**5.05**	234.72	**0.00075**	**7.41**
MID	2265	200 YR	1540	1318.17	**580.23**	**1291.15**	2.93	247.94	**31.10**	**5.21**	235.27	**0.00072**	**7.97**
MID	2265	500 YR	1880	1826.00	**600.25**	**1485.55**	2.90	274.68	**31.10**	**5.41**	236.13	**0.00068**	**8.83**
MID	2231	100 YR	1330	801.46	334.08	1262.88	3.55	288.72	39.81	4.37	234.73	0.00057	7.25
MID	2231	200 YR	1540	986.76	346.64	1445.74	3.71	310.38	39.81	4.66	235.27	0.00058	7.80
MID	2231	500 YR	1880	1284.27	367.53	1737.28	3.94	343.58	39.81	5.06	236.10	0.00060	8.63
MID	2192		Bridge										
MID	2145	100 YR	1330	529.91	382.33	1271.58	4.52	239.97	38.66	5.30	233.85	0.00106	6.21
MID	2145	200 YR	1540	670.73	391.75	1462.86	4.87	254.07	38.66	5.76	234.22	0.00116	6.57
MID	2145	500 YR	1880	860.61	413.39	1772.00	5.44	272.36	38.66	6.51	234.69	0.00135	7.04
MID	2106	100 YR	1330	526.27	405.53	1300.75	4.42	246.32	38.66	5.28	233.80	0.00101	6.37
MID	2106	200 YR	1540	689.20	473.39	1487.31	4.55	260.61	38.66	5.71	234.17	0.00110	6.74
MID	2106	500 YR	1880	920.18	494.50	1783.50	4.87	278.96	38.66	6.39	234.65	0.00126	7.22
MID	1967	100 YR	1330	789.84	460.57	1262.11	2.27	391.43	58.10	3.22	233.92	0.00034	6.74
MID	1967	200 YR	1540	975.58	469.97	1422.85	2.26	414.62	58.10	3.43	234.32	0.00035	7.14
MID	1967	500 YR	1880	1225.85	480.3	1676.58	2.33	445.18	58.1	3.77	234.84	0.00039	7.66
MID	1840	100 YR	1330	538.84	523.29	1272.28	3.54	230.29	38.3	5.52	233.52	0.00115	6.01
MID	1840	200 YR	1540	769.5	545.22	1385.04	2.97	246.78	38.3	5.61	233.95	0.00109	6.44
MID	1840	500 YR	1880	1086.15	559.56	1543.48	2.63	268.78	38.3	5.74	234.52	0.00102	7.02

Plan: PR PLAN NORTH MID RS: 2192 BR U Profile: 100 YR

Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)
1 LOB	-43.50	-21.50	0.02	0.13	2.54	0.00	1.84	0.13	0.01	0.00
2 Chan	-21.50	-12.95	126.33	26.71	9.11	9.50	3.12	4.73	0.49	2.30
3 Chan	-12.95	-4.40	448.61	57.26	9.16	33.73	6.70	7.84	1.04	8.14
4 Chan	-4.40	4.15	603.81	66.71	8.59	45.40	7.80	9.05	1.29	11.68
5 Chan	4.15	12.70	151.24	32.61	11.45	11.37	6.91	4.64	0.47	2.20
						Avg:	**6.13**			

Plan: PR PLAN NORTH MID RS: 2192 BR U Profile: 200 YR

Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)
1 LOB	-43.50	-21.50	0.02	0.14	2.94	0.00	2.01	0.13	0.01	0.00
2 Chan	-21.50	-12.95	161.89	30.07	9.11	10.51	3.52	5.38	0.61	3.26
3 Chan	-12.95	-4.40	518.99	60.61	9.16	33.70	7.09	8.56	1.21	10.40
4 Chan	-4.40	4.15	689.43	70.06	8.59	44.77	8.19	9.84	1.50	14.72
5 Chan	4.15	12.70	169.67	34.35	11.84	11.02	7.28	4.94	0.53	2.63
						Avg:	**6.52**			

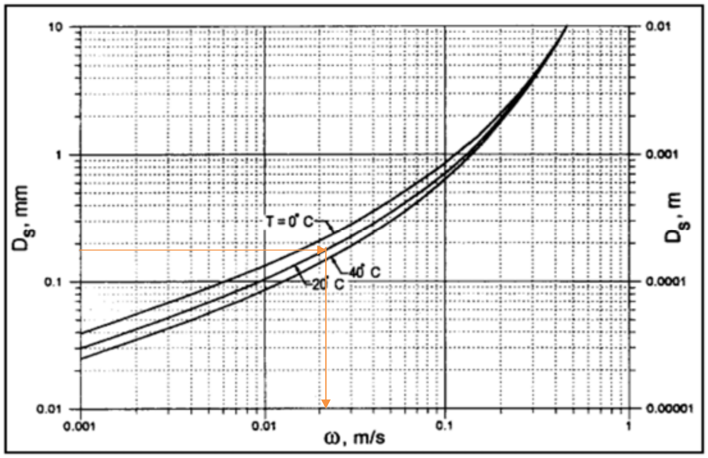
Plan: PR PLAN NORTH MID RS: 2192 BR U Profile: 500 YR

Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)
1 LOB	-43.50	-21.50	0.02	0.16	3.51	0.00	2.20	0.13	0.01	0.00
2 Chan	-21.50	-12.95	223.09	35.00	9.11	11.87	4.09	6.37	0.81	5.14
3 Chan	-12.95	-4.40	632.59	65.54	9.16	33.65	7.67	9.65	1.50	14.50
4 Chan	-4.40	4.15	826.18	74.99	8.59	43.95	8.77	11.02	1.83	20.19
5 Chan	4.15	12.70	198.12	36.90	12.42	10.54	7.82	5.37	0.62	3.35
						Avg:	**7.09**			

Plan: PR PLAN NORTH MID RS: 2192	Profile: 100 YR			
E.G. US. (ft)	235.01	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	234.73	E.G. Elev (ft)	234.82	234.65
Q Total (cfs)	1330	W.S. Elev (ft)	234.01	233.59
Q Bridge (cfs)	**1330**	Crit W.S. (ft)	231.86	232.16
Q Weir (cfs)		Max Chl Dpth (ft)	7.94	6.75
Weir Sta Lft (ft)		Vel Total (ft/s)	7.25	8.23
Weir Sta Rgt (ft)		Flow Area (sq ft)	183.42	161.59
Weir Submerg		Froude # Chl	0.45	0.56
Weir Max Depth (ft)		Specif Force (cu ft)	917	815.57
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	6.09	5.36
Min El Prs (ft)	236.25	W.P. Total (ft)	40.85	38.65
Delta EG (ft)	0.74	Conv. Total (cfs)	25778.9	21555.9
Delta WS (ft)	0.87	Top Width (ft)	30.13	30.15
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.1	0.06
BR Open Vel (ft/s)	8.23	C & E Loss (ft)	0.07	0.32
BR Sluice Coef		Shear Total (lb/sq ft)	0.75	0.99
BR Sel Method	Energy only	Power Total (lb/ft s)	5.41	8.18

Plan: PR PLAN NORTH MID RS: 2192	Profile: 500 YR			
E.G. US. (ft)	236.47	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	236.1	E.G. Elev (ft)	236.19	235.92
Q Total (cfs)	1880	W.S. Elev (ft)	234.97	234.24
Q Bridge (cfs)	**1880**	Crit W.S. (ft)	232.87	233.17
Q Weir (cfs)		Max Chl Dpth (ft)	8.9	7.4
Weir Sta Lft (ft)		Vel Total (ft/s)	8.84	10.38
Weir Sta Rgt (ft)		Flow Area (sq ft)	212.58	181.09
Weir Submerg		Froude # Chl	0.52	0.67
Weir Max Depth (ft)		Specif Force (cu ft)	1326.04	1193.06
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	7.07	6.01
Min El Prs (ft)	236.25	W.P. Total (ft)	42.79	39.95
Delta EG (ft)	1.16	Conv. Total (cfs)	32421.5	25758.1
Delta WS (ft)	1.41	Top Width (ft)	30.07	30.11
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.14	0.07
BR Open Vel (ft/s)	10.38	C & E Loss (ft)	0.14	0.53
BR Sluice Coef		Shear Total (lb/sq ft)	1.04	1.51
BR Sel Method	Energy only	Power Total (lb/ft s)	9.22	15.65

Plan: PR PLAN NORTH MID RS: 2192	Profile: 200 YR			
E.G. US. (ft)	235.59	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.27	E.G. Elev (ft)	235.37	235.16
Q Total (cfs)	1540	W.S. Elev (ft)	234.4	233.89
Q Bridge (cfs)	**1540**	Crit W.S. (ft)	232.26	232.57
Q Weir (cfs)		Max Chl Dpth (ft)	8.33	7.05
Weir Sta Lft (ft)		Vel Total (ft/s)	7.89	9.02
Weir Sta Rgt (ft)		Flow Area (sq ft)	195.23	170.64
Weir Submerg		Froude # Chl	0.48	0.6
Weir Max Depth (ft)		Specif Force (cu ft)	1069.16	957.28
Min El Weir Flow (ft)	237.38	Hydr Depth (ft)	6.49	5.66
Min El Prs (ft)	236.25	W.P. Total (ft)	41.63	39.25
Delta EG (ft)	0.88	Conv. Total (cfs)	28411.3	23477.1
Delta WS (ft)	1.05	Top Width (ft)	30.1	30.13
BR Open Area (sq ft)	241.51	Frctn Loss (ft)	0.12	0.06
BR Open Vel (ft/s)	9.02	C & E Loss (ft)	0.09	0.39
BR Sluice Coef		Shear Total (lb/sq ft)	0.86	1.17
BR Sel Method	Energy only	Power Total (lb/ft s)	6.78	10.54



		100-YR	200-YR	500-YR
D50	(mm)	0.18	0.18	0.18
w	(m/s)	0.022	0.022	0.022

HEC-18 SCOUR COMPUTATIONS

Based on HEC-18, Evaluating Scour at Bridges, 5th edition

COMMENTS:

DATE: 10/21/2022

REVISED:

VALUE *denotes field entered by user or obtained from back-up spreadsheets*

VALUE *denotes computed field or standard value*

VALUE *denotes sum or conclusion*

FROEHLICH'S ABUTMENT SCOUR

Per HEC-18 5th Ed. Section 8.6.1

$$y_s/y_a = 2.27\ K_1\ K_2\ (L'/y_a)^{0.43}\ Fr^{\ 0.61} + 1$$

$$Fr = V_e/(gy_a)^{1/2}$$

$$V_e = Q_e/A_e$$

VARIABLE		STORM EVENT					
		100-YR		200-YR		500-YR	
	ABUTMENT:	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
K_1	-	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Ø	(deg.)	**90.00**	**90.00**	**90.00**	**90.00**	**90.00**	**90.00**
K_2	-	1.00	1.00	1.00	1.00	1.00	1.00
L'	(ft)	**2.68**	**5.03**	**2.98**	**5.17**	**3.34**	**5.35**
L	(ft)	**22.00**	**22.00**	**22.00**	**22.00**	**22.00**	**22.00**
A_e	(ft²)	**52.39**	**109.14**	**64.37**	**121.13**	**82.72**	**139.47**
Q_e	(cfs)	**39.53**	**354.82**	**56.52**	**416.50**	**87.09**	**516.99**
V_e	(ft/s)	0.75	3.25	0.88	3.44	1.05	3.71
y_a	(ft)	2.38	4.96	2.93	5.51	3.76	6.34
Fr	-	0.09	0.26	0.09	0.26	0.10	0.26
SCOUR DEPTH (ft):		**3.66**	**9.91**	**4.47**	**10.83**	**5.70**	**12.21**

NOTES:

K_1 = Coefficient for abutment shape (see table)

Ø = Angle of embankment to flow (Figure 8.5, HEC-18)

K_2 = Coefficient embankment angle = $(Ø/90)^{0.13}$

L' = Length of active flow obstructed by the embankment

L = Length of embankment within effective flow field

A_e = Flow area of the approach xsect obstructed by embankment

Q_e = Flow obstructed by the abutment & approach embankment

V_e = Velocity of obstructed flow

y_a = Ae/L (Average depth of flow on the floodplain)

Fr = Froude Number of approach flow US of the abutment

K_1	Abutment Shape
1.00	vertical-wall
0.82	vertical-wall with ww
0.55	spill-through

TABLE 8.1 HEC-18

HEC-18 SCOUR COMPUTATIONS

Based on HEC-18, Evaluating Scour at Bridges, 5th edition

HIRE ABUTMENT SCOUR

Per HEC-18 5th Ed. Section 8.6.2

$$y_s/y_1 = 4*Fr^{0.33} (K_1/0.55)* K_2$$

If L/y_1< 25, Use Froehlich's equation, otherwise use HIRE equation

VARIABLE		STORM EVENT					
		100-YR		200-YR		500-YR	
	ABUTMENT:	LEFT	RIGHT	LEFT	RIGHT	LEFT	RIGHT
L	(ft)	22.00	22.00	22.00	22.00	22.00	22.00
y_1	(ft)	2.38	4.96	2.93	5.51	3.76	6.34
L/y_1	-	9.24	4.43	7.52	4.00	5.85	3.47
	Use HIRE:	**No**	**No**	**No**	**No**	**No**	**No**

Fr	-	0.09	0.26	0.09	0.26	0.10	0.26
K_1	-	1.00	1.00	1.00	1.00	1.00	1.00
K_2	-	1.00	1.00	1.00	1.00	1.00	1.00
SCOUR DEPTH (ft):		**7.71**	**23.05**	**9.63**	**25.61**	**12.61**	**29.54**

NOTES:

K_1 = Coefficient for abutment shape (See Froehlich)

K_2 = Coefficient embankment angle (See Froehlich)

Fr = Froude Number (See Froehlich)

y_1 = y_a (See Froehlich)

HEC-18 SCOUR COMPUTATIONS

Based on HEC-18, Evaluating Scour at Bridges, 5th edition

NCHRP 24-20 ABUTMENT SCOUR

Per HEC-18 5th Ed. Section 8.6.3

Compute L/B_f to determine NCHRP Scour Condition

	100-YR	200-YR	500-YR
L	44.00	44.00	44.00
B_f	**44.00**	**44.00**	**44.00**
L/B_f	100%	100%	100%

NOTES:

L = Proj. L of embank

B_f = Fldpln width

Projected length of embankment > 75% of the floodplain width, compute using live bed condition
Projected length of embankment < 75% of the floodplain width, compute using clear-water condition

$y_{max} = \alpha_a y_c$ or $y_{max} = \alpha_b y_c$

$y_s = y_{max} - y_o$

$y_c = y_1 *(q_{2c} \div q_1)^{6/7}$

VARIABLE		STORM EVENT		
		100-YR	200-YR	500-YR
CONTRACTION		LIVE	LIVE	LIVE
y_1	(ft)	**7.41**	**7.97**	**8.83**
v_1	(ft/s)	**5.05**	**5.21**	**5.41**
q_1	(ft²/s)	37.42	41.52	47.77
Q_2	(cfs)	**1,330**	**1,540**	**1,880**
W_2	(ft)	**30.00**	**30.00**	**30.00**
q_{2c}	(ft²/s)	44.33	51.33	62.67
$q_{2c} \div q_1$		1.18	1.24	1.31
y_c	(ft)	8.57	9.56	11.14
α_a		**1.74**	**1.75**	**1.75**
α_b		**-**	**-**	**-**
y_{max}	(ft)	14.91	16.73	19.50
y_o	(ft)	7.41	7.97	8.83
SCOUR DEPTH (ft):		7.50	8.76	10.67

NOTES:

y_1 = US flow depth (see contraction comp)

v_1 = US velocity (see contraction comp)

q_1 = US unit discharge (y1*v1)

Q_2 = total Q in bridge (see contr. comp)

W_2 = width bridge opening

q_{2c} = unit discharge in constr. opening (Q_2/W_2

y_c = flow depth including contraction scour

= See Figure 8.10 for ww abutments (live)

= See Figure 8.12 for ww abutments (clea

= max. flow depth resulting from abut scou

y_o = flow depth prior to scour

y_s = average contraction scour depth

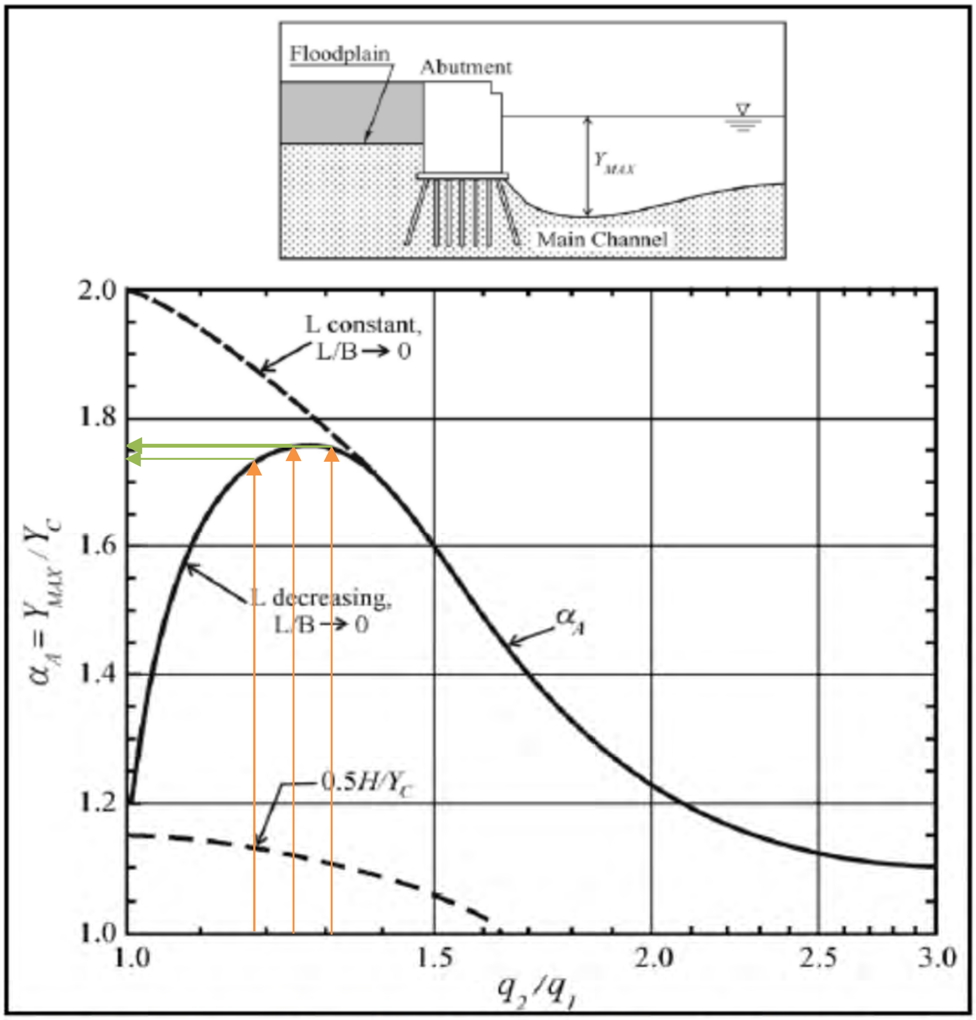


Figure 8.10. Scour amplification factor for wingwall abutments and live-bed conditions (NCHRP 2010b).

FROEHLICH INPUT DATA PER HEC-RAS - 100-YEAR STORM

Plan: PR PLAN NORTH MID RS: 2231 Profile: 100 YR

	Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)	
1	LOB	-187.63	-139.58	0.00	43.49	40.88	0.00	1.07	0.00	0.04	0.00	
2	LOB	-139.58	-91.54	0.00	92.60	48.12	0.00	1.93	0.00	0.07	0.00	
3	LOB	-91.54	-43.50	0.00	99.27	48.06	0.00	2.07	0.00	0.07	0.00	
4	LOB	-43.50	-18.56	44.81	59.39	26.66	3.37	2.38	0.75	0.08	0.06	Abutment at -21.5
5	Chan	-18.56	-10.60	203.03	51.18	8.17	15.27	6.43	3.97	0.22	0.88	
6	Chan	-10.60	-2.64	300.82	64.48	8.07	22.62	8.10	4.67	0.28	1.32	
7	Chan	-2.64	5.33	326.68	67.59	8.02	24.56	8.49	4.83	0.30	1.44	
8	Chan	5.33	13.29	250.72	57.90	8.11	18.85	7.27	4.33	0.25	1.09	Abutment at 8.5
9	Chan	13.29	21.25	181.64	47.57	8.05	13.66	5.98	3.82	0.21	0.80	
10	ROB	21.25	30.50	22.31	26.73	10.31	1.68	2.89	0.83	0.09	0.08	
11	ROB	30.50	68.40	0.00	61.44	37.94	0.00	1.62	0.00	0.06	0.00	*<1% Conveyance*
12	ROB	68.40	106.30	0.00	70.48	37.92	0.00	1.86	0.00	0.07	0.00	
13	ROB	106.30	144.20	0.00	56.91	37.96	0.00	1.50	0.00	0.05	0.00	
14	ROB	144.20	182.10	0.00	2.43	9.49	0.00	0.26	0.00	0.01	0.00	

LEFT ABUTMENT VARIABLES

Left Floodplain Denoted As:

Obstructed Subsection No	**4**	
Obs L Sta	**-43.50**	
L Abutment Sta	**-21.5**	
Obs R Sta	**-18.56**	
% Obstructed	88.21%	= in Subsection
Subsection A_e	**52.39**	= % Obstructed x Area Subsection
Subsection Q_e	**39.53**	= % Obstructed x Flow Subsection
A_e	**52.39**	= Flood. Area + Subsection A_e
Q_e	**39.53**	= Flood. Flow + Subsection Q_e
Effective Embankment (L)	**22.00**	= L Sta Floodplain - L Abut Sta
v_t	**4.73**	
y_t	**3.12**	
Obstructed Embankment (L')	2.68	= Qe/qt where qt = vt * yt

RIGHT ABUTMENT VARIABLES

Right Floodplain Denoted As:

Obstructed Subsection No	**8**	
Obs R Sta	**13.29**	
R Abutment Sta	**8.5**	
Obs L Sta	**5.33**	
% Obstructed	60.18%	= in Subsection
Subsection A_e	**34.84**	= % Obstructed x Area Subsection
Subsection Q_e	**150.87**	= % Obstructed x Flow Subsection
A_e	**109.14**	= Flood. Area + Subsection A_e
Q_e	**354.82**	= Flood. Flow + Subsection Q_e
Effective Embankment (L)	**22.00**	= R Sta Floodplain - R Abut Sta
v_t	**9.05**	
y_t	**7.80**	
Obstructed Embankment (L')	5.03	= Qe/qt where qt = vt * yt

Plan: PR PLAN NORTH MID RS: 2192 BR U Profile: 100 YR

Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)
1 LOB	-43.50	-21.50	0.02	0.13	2.54	0.00	1.84	0.13	0.01	0.00
2 Chan	-21.50	-12.95	126.33	26.71	9.11	9.50	3.12	4.73	0.49	2.30
3 Chan	-12.95	-4.40	448.61	57.26	9.16	33.73	6.70	7.84	1.04	8.14
4 Chan	-4.40	4.15	603.81	66.71	8.59	45.40	7.80	9.05	1.29	11.68
5 Chan	4.15	12.70	151.24	32.61	11.45	11.37	6.91	4.64	0.47	2.20

FROEHLICH INPUT DATA PER HEC-RAS - DESIGN FLOOD

Plan: PR PLAN NORTH MID RS: 2231 Profile: 200 YR

	Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)	
1	LOB	-235.67	-187.63	0.00	0.00	0.35	0.00	0.01	0.00	0.00	0.00	
2	LOB	-187.63	-139.58	0.00	67.58	48.12	0.00	1.41	0.00	0.05	0.00	
3	LOB	-139.58	-91.54	0.00	118.74	48.12	0.00	2.47	0.00	0.09	0.00	
4	LOB	-91.54	-43.50	0.00	125.42	48.06	0.00	2.61	0.00	0.10	0.00	*<1% Conveyance*
5	LOB	-43.50	-18.56	64.07	72.97	26.66	4.16	2.93	0.88	0.10	0.09	Abutment at -21.5
6	Chan	-18.56	-10.60	236.22	55.51	8.17	15.34	6.97	4.26	0.25	1.05	
7	Chan	-10.60	-2.64	340.65	68.81	8.07	22.12	8.64	4.95	0.31	1.54	
8	Chan	-2.64	5.33	368.15	71.92	8.02	23.91	9.03	5.12	0.33	1.67	
9	Chan	5.33	13.29	287.32	62.23	8.11	18.66	7.82	4.62	0.28	1.29	Abutment at 8.5
10	Chan	13.29	21.25	213.41	51.91	8.05	13.86	6.52	4.11	0.24	0.97	
11	ROB	21.25	30.50	30.19	31.77	10.31	1.96	3.43	0.95	0.11	0.11	
12	ROB	30.50	68.40	0.00	82.07	37.94	0.00	2.17	0.00	0.08	0.00	*<1% Conveyance*
13	ROB	68.40	106.30	0.00	91.10	37.92	0.00	2.40	0.00	0.09	0.00	
14	ROB	106.30	144.20	0.00	77.54	37.96	0.00	2.05	0.00	0.07	0.00	
15	ROB	144.20	182.10	0.00	9.19	14.52	0.00	0.64	0.00	0.02	0.00	

LEFT ABUTMENT VARIABLES

Left Floodplain Denoted As:

Obstructed Subsection No	**5**	
Obs L Sta	**-43.50**	
L Abutment Sta	**-21.5**	
Obs R Sta	**-18.56**	
% Obstructed	88.21%	= in Subsection
Subsection A_e	**64.37**	= % Obstructed x Area Subsection
Subsection Q_e	**56.52**	= % Obstructed x Flow Subsection
A_e	**64.37**	= Flood. Area + Subsection A_e
Q_e	**56.52**	= Flood. Flow + Subsection Q_e
Effective Embankment (L)	**22.00**	= L Sta Floodplain - L Abut Sta
v_t	**5.38**	
y_t	**3.52**	
Obstructed Embankment (L')	2.98	= Qe/qt where qt = vt * yt

RIGHT ABUTMENT VARIABLES

Right Floodplain Denoted As:

Obstructed Subsection No	**9**	
Obs R Sta	**13.29**	
R Abutment Sta	**8.5**	
Obs L Sta	**5.33**	
% Obstructed	60.18%	= in Subsection
Subsection A_e	**37.45**	= % Obstructed x Area Subsection
Subsection Q_e	**172.90**	= % Obstructed x Flow Subsection
A_e	**121.13**	= Flood. Area + Subsection A_e
Q_e	**416.50**	= Flood. Flow + Subsection Q_e
Effective Embankment (L)	**22.00**	= R Sta Floodplain - R Abut Sta
v_t	**9.84**	
y_t	**8.19**	
Obstructed Embankment (L')	5.17	= Qe/qt where qt = vt * yt

Plan: PR PLAN NORTH MID RS: 2192 BR U Profile: 200 YR

Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)
1 LOB	-43.50	-21.50	0.02	0.14	2.94	0.00	2.01	0.13	0.01	0.00
2 Chan	-21.50	-12.95	161.89	30.07	9.11	10.51	3.52	5.38	0.61	3.26
3 Chan	-12.95	-4.40	518.99	60.61	9.16	33.70	7.09	8.56	1.21	10.40
4 Chan	-4.40	4.15	689.43	70.06	8.59	44.77	8.19	9.84	1.50	14.72
5 Chan	4.15	12.70	169.67	34.35	11.84	11.02	7.28	4.94	0.53	2.63

FROEHLICH INPUT DATA PER HEC-RAS - SUPERFLOOD

Plan: PR PLAN NORTH MID RS: 2231 Profile: 500 YR

	Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)	
1	LOB	-235.67	-187.63	0.00	5.57	13.81	0.00	0.40	0.00	0.02	0.00	
2	LOB	-187.63	-139.58	0.00	107.64	48.12	0.00	2.24	0.00	0.08	0.00	
3	LOB	-139.58	-91.54	0.00	158.81	48.12	0.00	3.31	0.00	0.12	0.00	
4	LOB	-91.54	-43.50	0.00	165.49	48.06	0.00	3.44	0.00	0.13	0.00	*<1% Conveyance*
5	LOB	-43.50	-18.56	98.73	93.77	26.66	5.25	3.76	1.05	0.13	0.14	Abutment at -21.5
6	Chan	-18.56	-10.60	289.73	62.15	8.17	15.41	7.81	4.66	0.29	1.33	
7	Chan	-10.60	-2.64	403.54	75.45	8.07	21.46	9.48	5.35	0.35	1.87	
8	Chan	-2.64	5.33	433.35	78.56	8.02	23.05	9.87	5.52	0.37	2.03	
9	Chan	5.33	13.29	345.66	68.87	8.11	18.39	8.65	5.02	0.32	1.60	Abutment at 8.5
10	Chan	13.29	21.25	265.00	58.55	8.05	14.10	7.35	4.53	0.27	1.24	
11	ROB	21.25	30.50	43.99	39.48	10.31	2.34	4.27	1.11	0.14	0.16	
12	ROB	30.50	68.40	0.00	113.68	37.94	0.00	3.00	0.00	0.11	0.00	<1% Conveyance
13	ROB	68.40	106.30	0.00	122.71	37.92	0.00	3.24	0.00	0.12	0.00	
14	ROB	106.30	144.20	0.00	109.14	37.96	0.00	2.88	0.00	0.11	0.00	
15	ROB	144.20	182.10	0.00	24.38	22.01	0.00	1.11	0.00	0.04	0.00	

LEFT ABUTMENT VARIABLES

Left Floodplain Denoted As:

Obstructed Subsection No	**5**	
Obs L Sta	**-43.50**	
L Abutment Sta	**-21.5**	
Obs R Sta	**-18.56**	
% Obstructed	88.21%	= in Subsection
Subsection A_e	**82.72**	= % Obstructed x Area Subsection
Subsection Q_e	**87.09**	= % Obstructed x Flow Subsection
A_e	**82.72**	= Flood. Area + Subsection A_e
Q_e	**87.09**	= Flood. Flow + Subsection Q_e
Effective Embankment (L)	**22.00**	= L Sta Floodplain - L Abut Sta
v_t	**6.37**	
y_t	**4.09**	
Obstructed Embankment (L')	3.34	= Qe/qt where qt = vt * yt

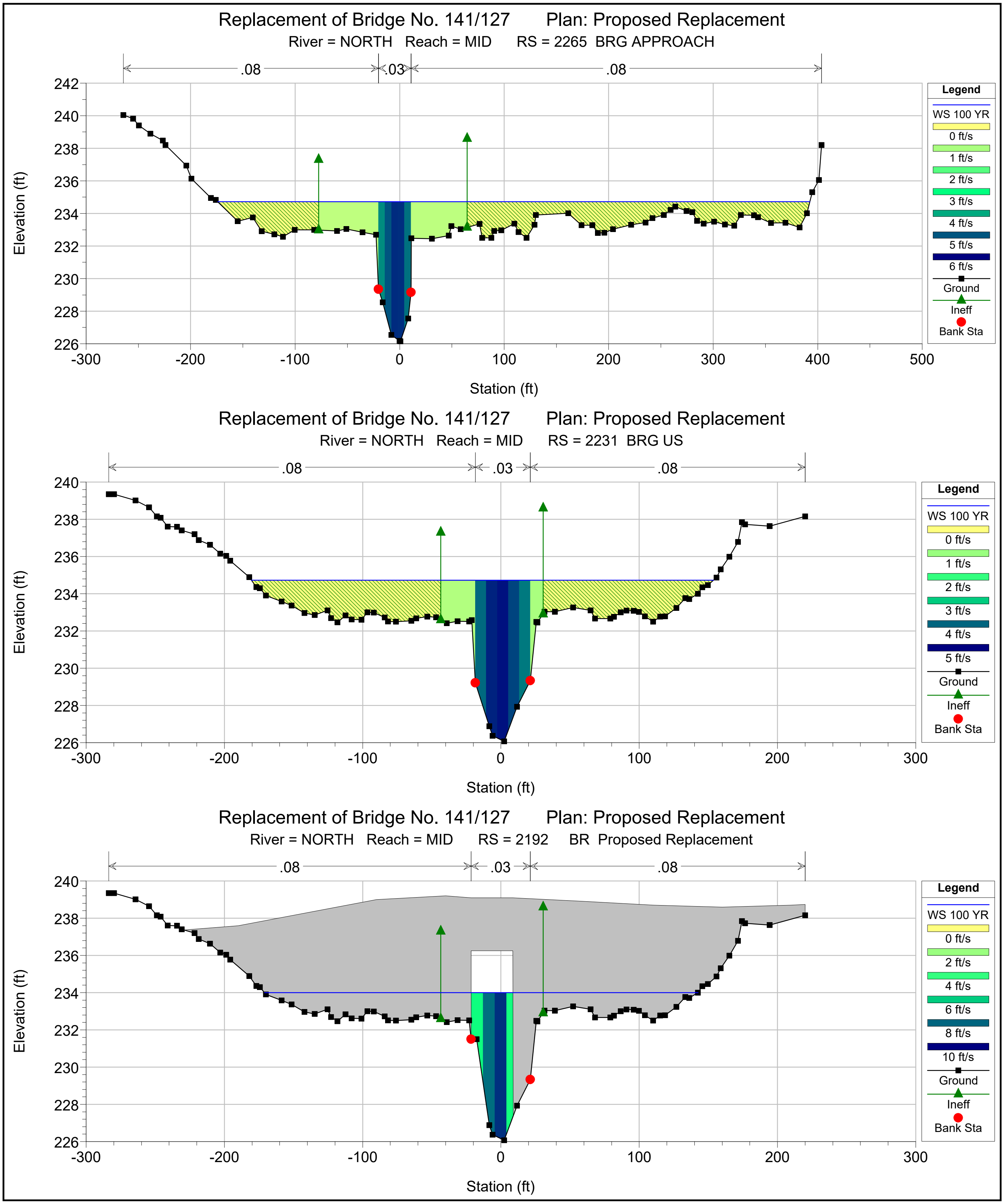
RIGHT ABUTMENT VARIABLES

Right Floodplain Denoted As:

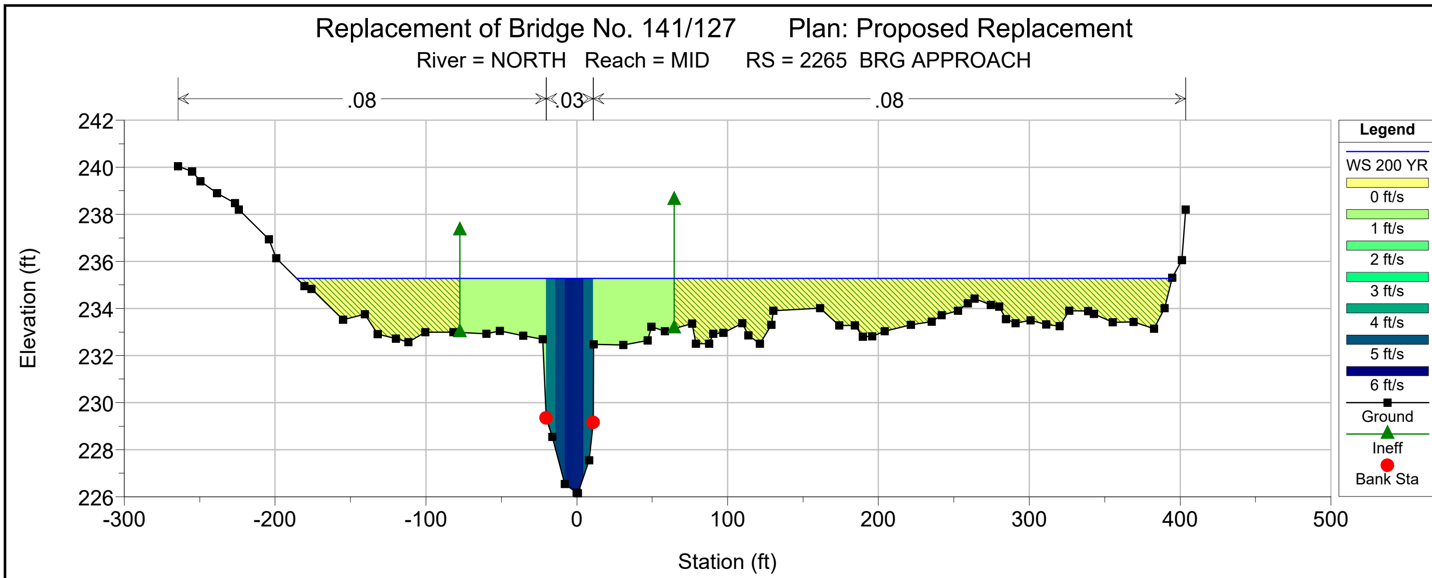
Obstructed Subsection No	**9**	
Obs R Sta	**13.29**	
R Abutment Sta	**8.5**	
Obs L Sta	**5.33**	
% Obstructed	60.18%	= in Subsection
Subsection A_e	**41.44**	= % Obstructed x Area Subsection
Subsection Q_e	**208.00**	= % Obstructed x Flow Subsection
A_e	**139.47**	= Flood. Area + Subsection A_e
Q_e	**516.99**	= Flood. Flow + Subsection Q_e
Effective Embankment (L)	**22.00**	= R Sta Floodplain - R Abut Sta
v_t	**11.02**	
y_t	**8.77**	
Obstructed Embankment (L')	5.35	= Qe/qt

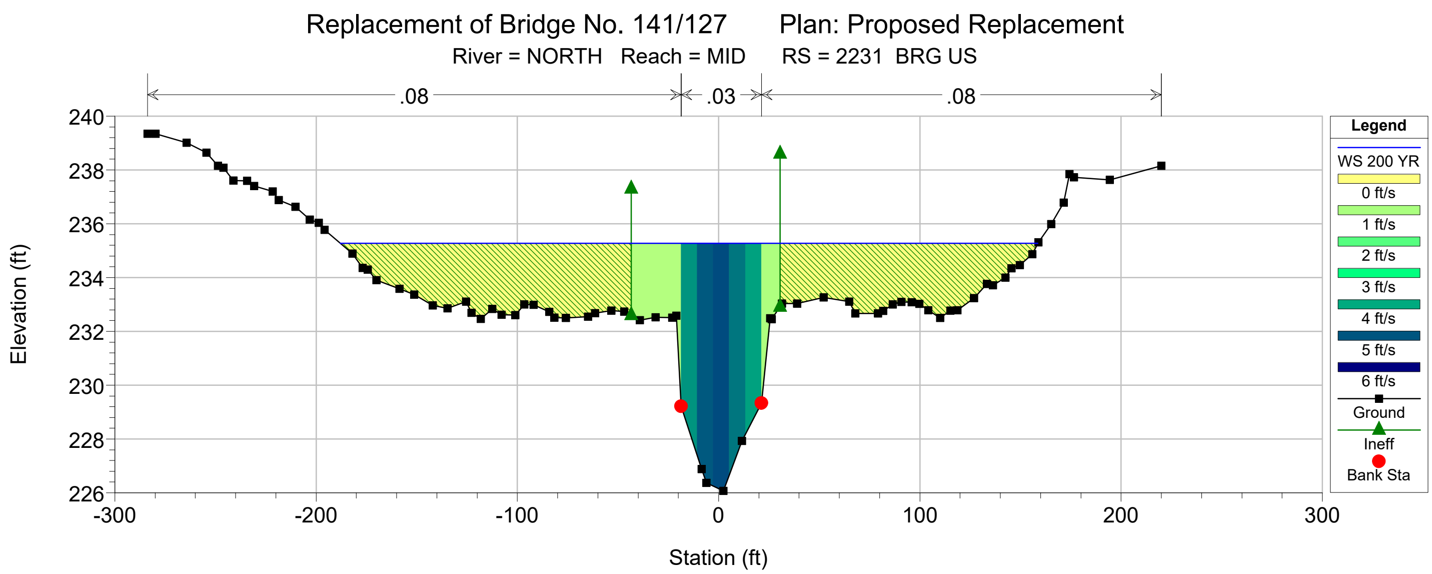
Plan: PR PLAN NORTH MID RS: 2192 BR U Profile: 500 YR

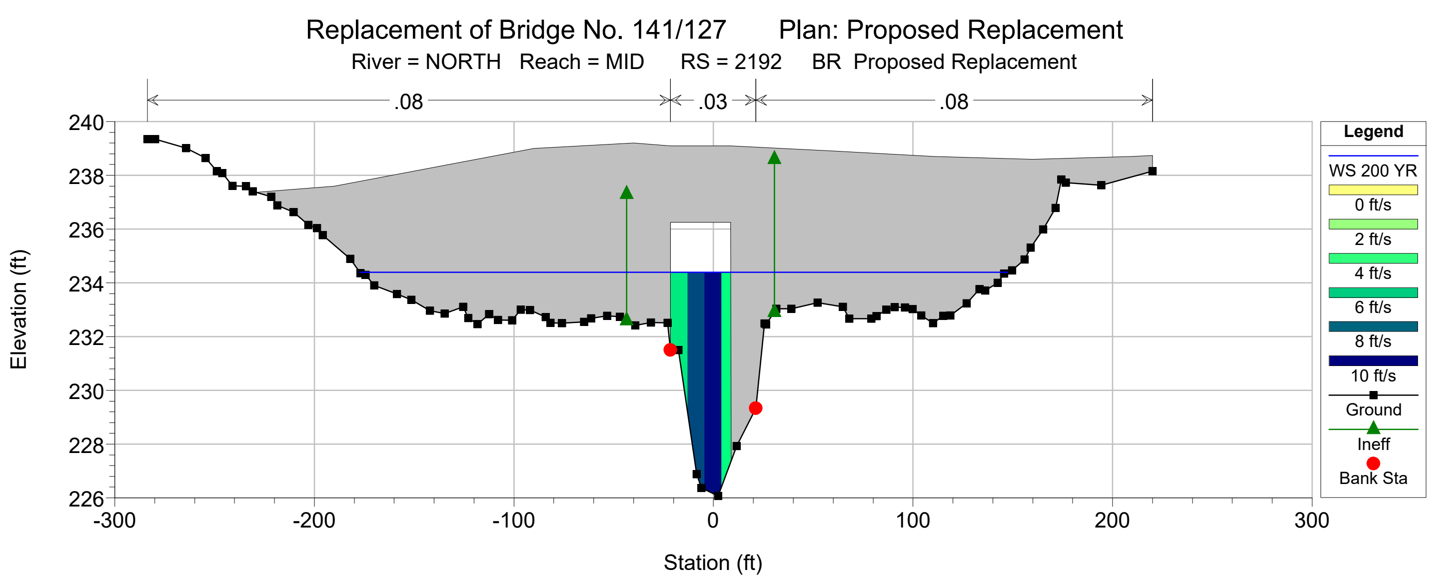
Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)	Shear (lb/sq ft)	Power (lb/ft s)
1 LOB	-43.50	-21.50	0.02	0.16	3.51	0.00	2.20	0.13	0.01	0.00
2 Chan	-21.50	-12.95	223.09	35.00	9.11	11.87	4.09	6.37	0.81	5.14
3 Chan	-12.95	-4.40	632.59	65.54	9.16	33.65	7.67	9.65	1.50	14.50
4 Chan	-4.40	4.15	826.18	74.99	8.59	43.95	8.77	11.02	1.83	20.19
5 Chan	4.15	12.70	198.12	36.90	12.42	10.54	7.82	5.37	0.62	3.35

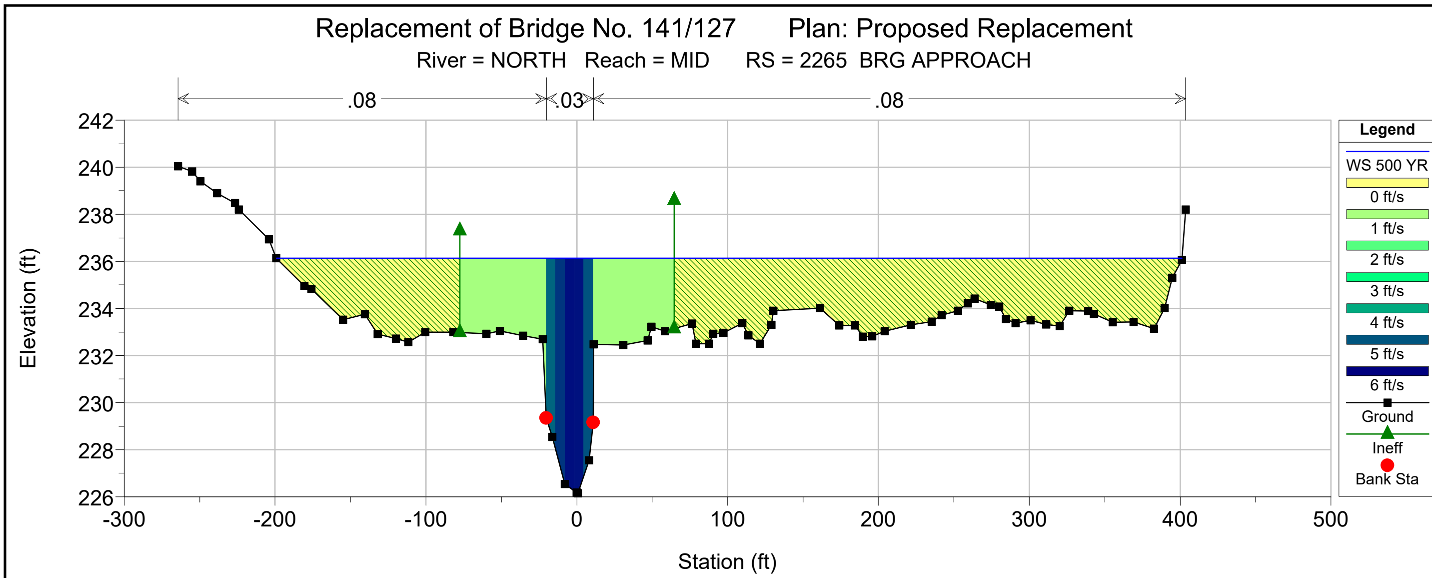


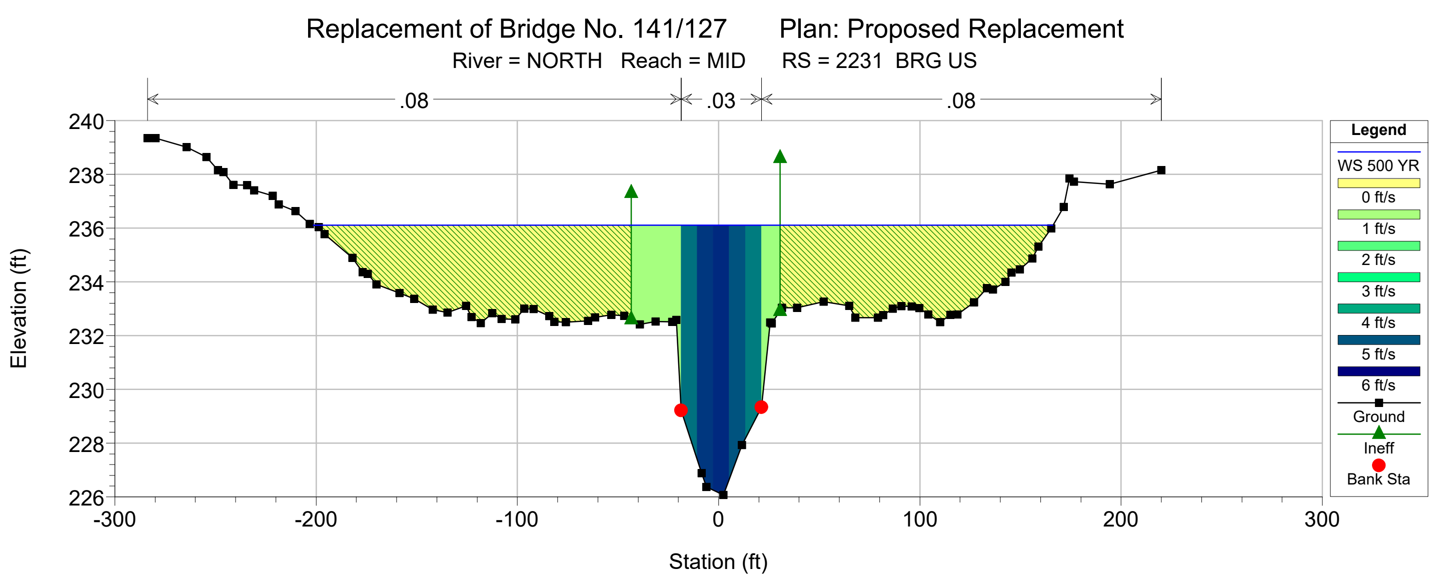
Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2265 BRG APPROACH
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 100 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta
Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2231 BRG US
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 100 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
Ground
Ineff
Bank Sta
Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2192 BR Proposed Replacement
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 100 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Ineff
Bank Sta

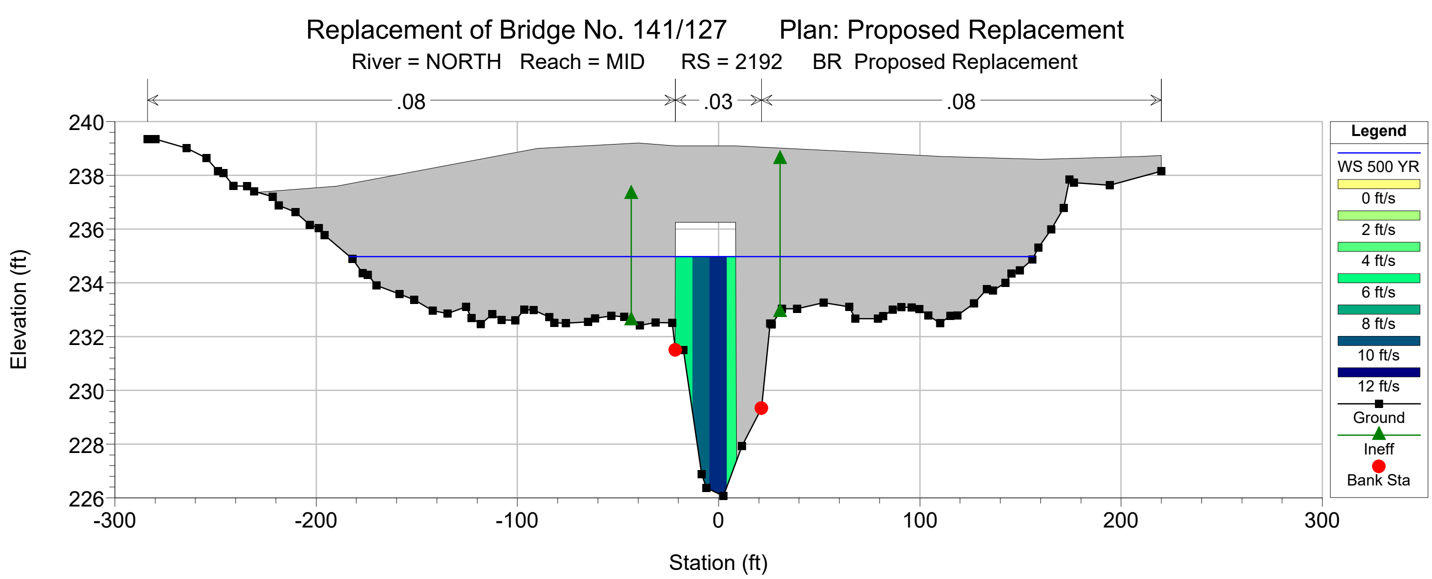

Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2265 BRG APPROACH
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 200 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta


Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2231 BRG US
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 200 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta


Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2192 BR Proposed Replacement
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 200 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Ineff
Bank Sta


Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2265 BRG APPROACH
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 500 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta


Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2231 BRG US
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 500 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta


Replacement of Bridge No. 141/127 Plan: Proposed Replacement
River = NORTH Reach = MID RS = 2192 BR Proposed Replacement
.08
.03
.08
Elevation (ft)
Station (ft)
Legend
WS 500 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Ineff
Bank Sta

APPENDIX F: Channel Protection

GM2
197 Loudon Road, Suite 310
Concord, NH 03301

Job	NOTTINGHAM 40612	**Computed By**	MKH	**Date**	10/26/2022
Description	NH Rte 152 over North River	**Checked By**		**Date**	

ROCK RIPRAP AT BRIDGE ABUTMENTS

References:

1. HEC-RAS: 141-127 Route 125.prj and PR_PLAN (500-Year Storm)
2. HEC-23: Bridge Scour & Stream Instability Countermeasures 3rd Edition, Vol. I & II

Note: This includes updates to Design Guideline (DG) 14 based on FHWA Tech Brief dated 12/15/2020 (FHWA-HIF-19-007) and NCHRP Report 568 Riprap Design Criteria (2000). Revisions to HEC-23 are forthcoming incorporating the modifications.

VALUE	*denotes field entered by user or obtained from back-up spreadsheets*
VALUE	*denotes computed field or standard value*
VALUE	*denotes sum or conclusion*

Table 2.3. Hydraulic Design, Scour Design, and Scour Countermeasure Design Flood Frequencies.

Hydraulic Design Flood Frequency (Q_D)	Scour Design Flood Frequency (Q_S)	Scour Countermeasure Design Flood Frequency (Q_{CM})
Q_{10}	Q_{25}	Q_{50}
Q_{25}	Q_{50}	Q_{100}
Q_{50}	Q_{100}	Q_{200}
Q_{100}	Q_{200}	Q_{500}

Determine Scour Condition

Per FHWA-HIF-19-007 Figures 3 & 4

Scour Condition A: Main Chl	**X**
Scour Condition B: Overbank	

Determine Design Velocity (V)

Q=	**1880 cfs**	= flow in main channel at Bridge	*Ref 1. @ RS 2192*
A=	**212.58 ft²**	= area of flow in main channel at Bridge	*Ref 1. @ RS 2192*
V=	8.84 ft/s	= Q/A	

Determine Froude Number (Fr)

$Fr = V/(gy)^{1/2}$

V=	8.84 ft/s	= design velocity	*Ref 1. @ RS 2192*
g=	32.20 ft/s²	= gravitational acceleration	*Ref 1. @ RS 2192*
W =	**30.00 ft**	= bridge width	
y=	7.09 ft	= average flow depth in main channel (A/W)	
Fr=	0.59		

Determine D_{50}

$$\frac{D_{50}}{y} = \frac{K}{(S_s - 1)}\left(\frac{V^2}{gy}\right) \quad \text{for } F_r \le 0.8 \qquad \frac{D_{50}}{y} = \frac{K}{(S_s - 1)}\left(\frac{V^2}{gy}\right)^{0.14} \quad \text{for } F_r > 0.8$$

S_s =	2.69	= Specific gravity of riprap per NHDOT BDM
Abutment Type =	vertical wall	
Abutment Type Factor, K =	1.02	
d_{50} =	1.47 ft	

GM2
197 Loudon Road, Suite 310
Concordia, NH 03301

Job	NOTTINGHAM 40612	**Computed By**	MKH	**Date**	10/26/2022
Description	NH Rte 152 over North River	**Checked By**		**Date**	

Determine Riprap Class

Based on NCHRP Report 568

Table C8.1. Minimum and maximum allowable particle size in inches.

Nominal Riprap Class by Median Particle Diameter		d_{15}		d_{50}		d_{85}		d_{100}
Class	Size	Min	Max	Min	Max	Min	Max	Max
I	6 in	3.7	5.2	5.7	6.9	7.8	9.2	12.0
III	12 in	7.3	10.5	11.5	14.0	15.5	18.5	24.0
V	18 in	11.0	15.5	17.0	20.5	23.5	27.5	36.0
VII	24 in	14.5	21.0	23.0	27.5	31.0	37.0	48.0
X	42 in	25.5	36.5	40.0	48.5	54.5	64.5	84.0

Use d_{50} = 18 in

d_{100} = **36 in** **Use Item 583.5 Riprap, Class V**

NHDOT Standard Specifications provide the following riprap item:

- Item 583, Riprap
  - Riprap shall be quarry stone of approved quality, hard, durable, subangular to angular in shape, resistant to weathering and free from structural defects such as weak seams and cracks.
  - Riprap is required for erosion protection of bridge structures in waterways, for active waterway channel slopes and bottoms, and for intermittent waterway channels where the Engineer determines riprap protection is required to resist expected high water flow velocities or volumes.
  - The designer shall specify a minimum d_{50} (median stone diameter) for the rock comprising the riprap to correspond with standard classes as noted in the Table 1 of the Specification 583 and FHWA HEC-23 publication.

    Item 583.1 Riprap, Class I
    Item 583.3 Riprap, Class III
    Item 583.5 Riprap, Class V
    Item 583.5 Riprap, Class VII
    Item 583.9 Riprap, Class IX

Determine Riprap Design Parameters

Determine Wide or Narrow Opening:

$W_2/y_o > 6.2$ - Use Wide Opening Parameters
$W_2/y_o \leq 6.2$ - Use Wide Opening Parameters

W_2 = **30.00 ft** = bridge width - piers *Ref 1. @ RS 2192*
y_o = **7.09 ft** = avg existing depth in contracted RS *Ref 1. @ RS 2192*
4.23 Narrow Opening

t_{min} = 36 in = Minimum thickness (Max. of $1.5*d_{50}$ or d_{100}) Ref. 2

FHWA-HIF-19-007

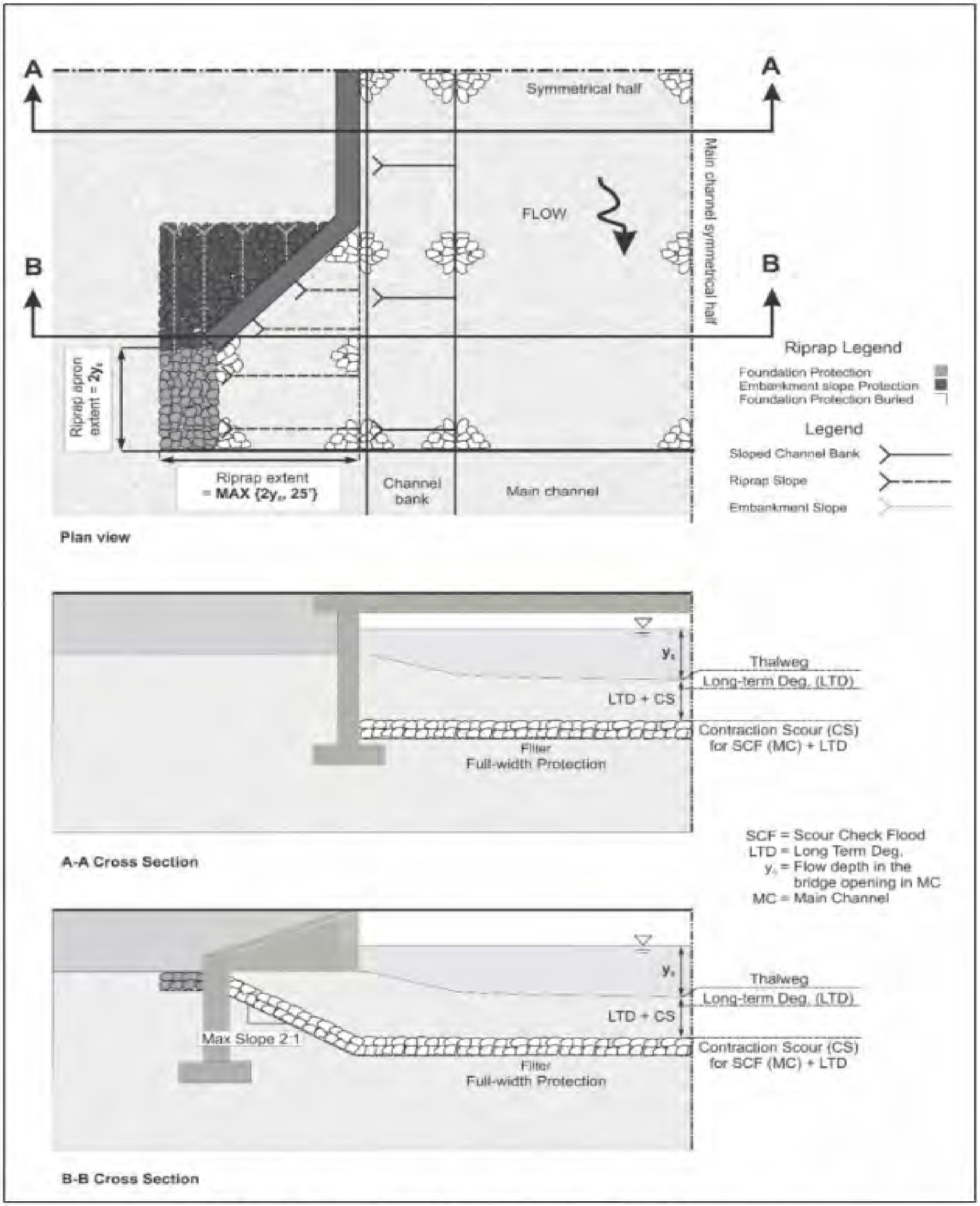
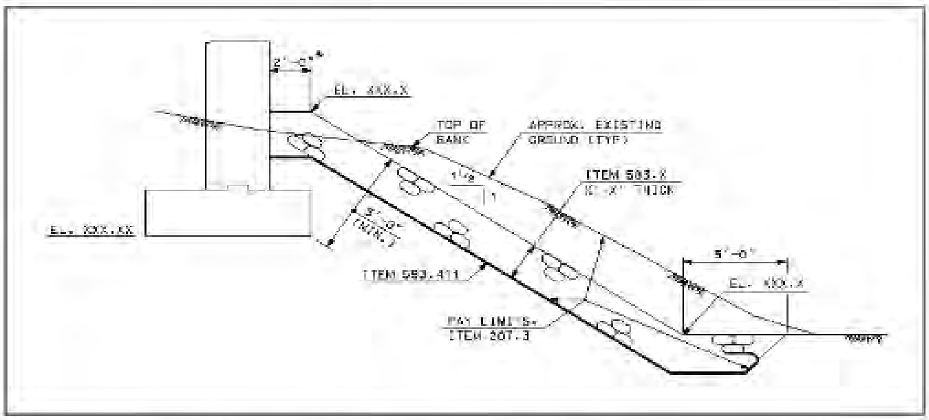


Figure 9: Free-Surface Flow, Narrow-Opening Scour Countermeasure.

197 Loudon Road, Suite 310
Concord, NH 03301

Job	NOTTINGHAM 40612	**Computed By**	MKH	**Date**	10/26/2022
Description	NH Rte 152 over North River	**Checked By**		**Date**	

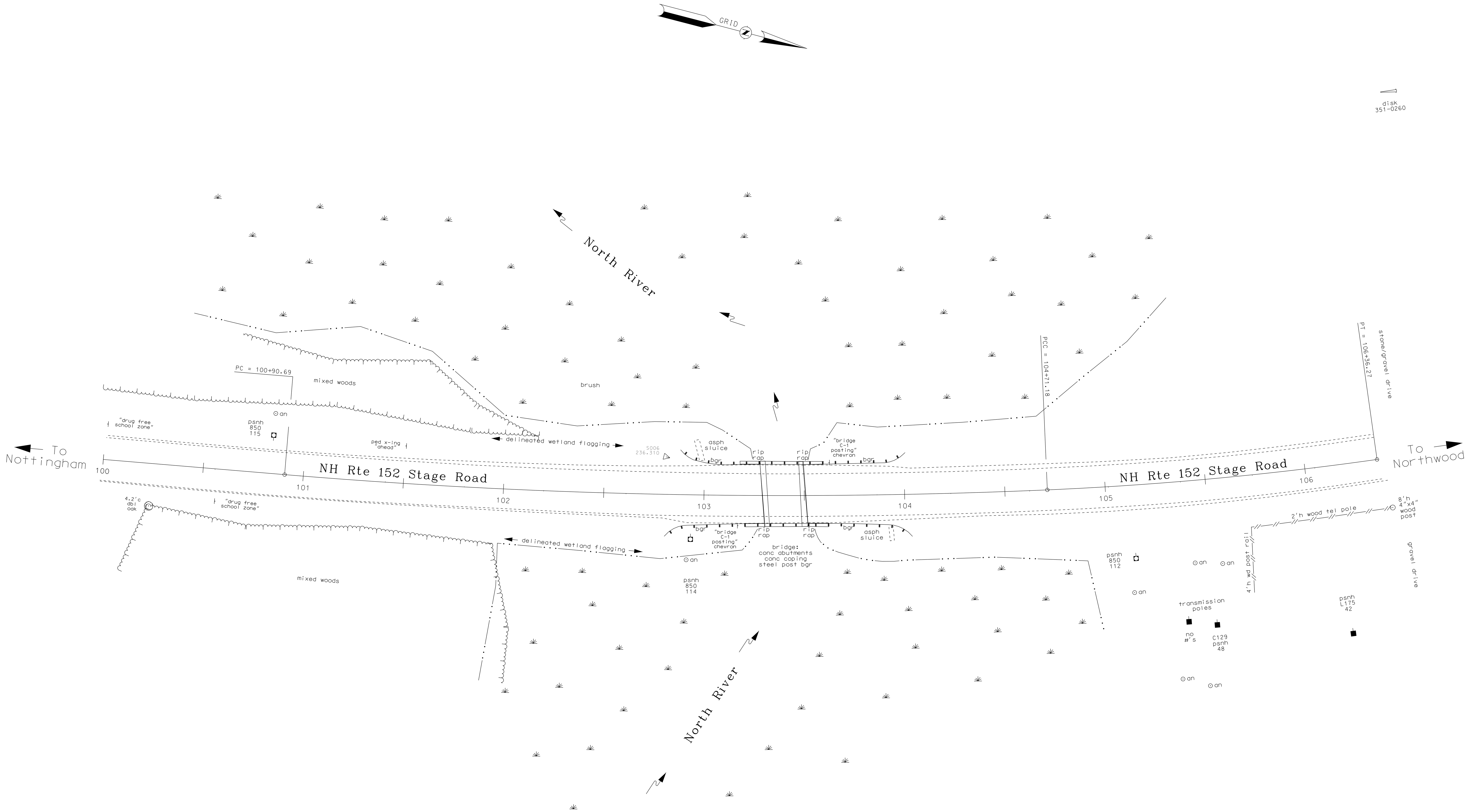


Typical NHDOT Channel Protection Section

Figure 2.7.7-1

* Use 2-ft. (0.6-m) minimum top shelf width unless directed otherwise by the Design Chief, to provide provisions for inspection access.

APPENDIX G: Plans



NOTTINGHAM

40612

PLAN PREPARATION RECORD PLAN

MX SDR FILES PROCESSED BY : SEL

MS DATA ANNOTATED BY : SEL

FIELD INSPECTED BY : SEL,DCA

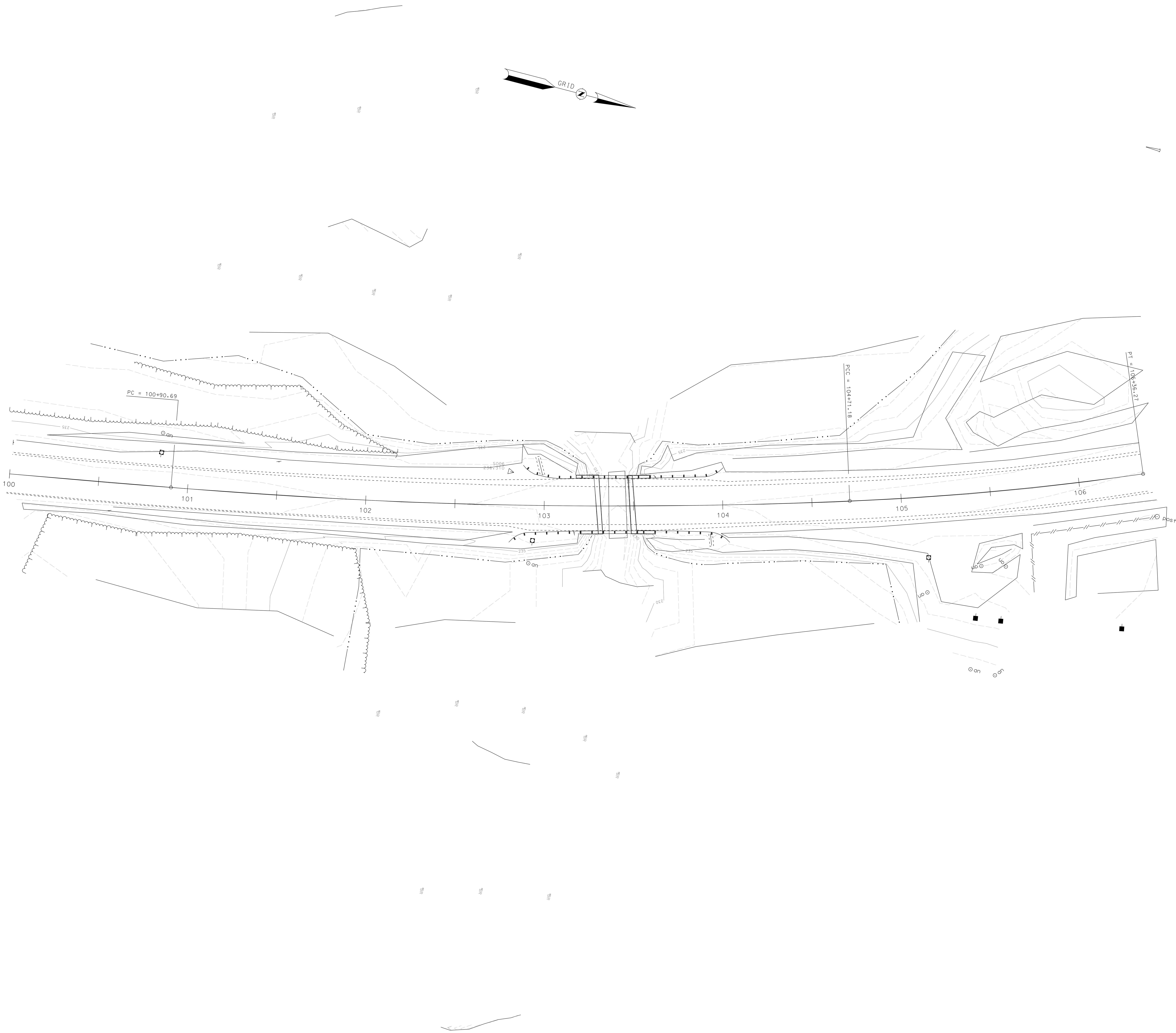
PLAN PREP COMPLETION DATE : 6-10-19

SURVEY COMPLETION DATE : 5-17-19

SURVEY BOOK NUMBERS : 13006

+ N. H. D. O. T. +

SCALE IN FEET



NOTTINGHAM

40612

PLAN PREPARATION RECORD PLAN

MX SDR FILES PROCESSED BY : SEL

MS DATA ANNOTATED BY : SEL

FIELD INSPECTED BY : SEL,DCA

PLAN PREP COMPLETION DATE : 6-10-19

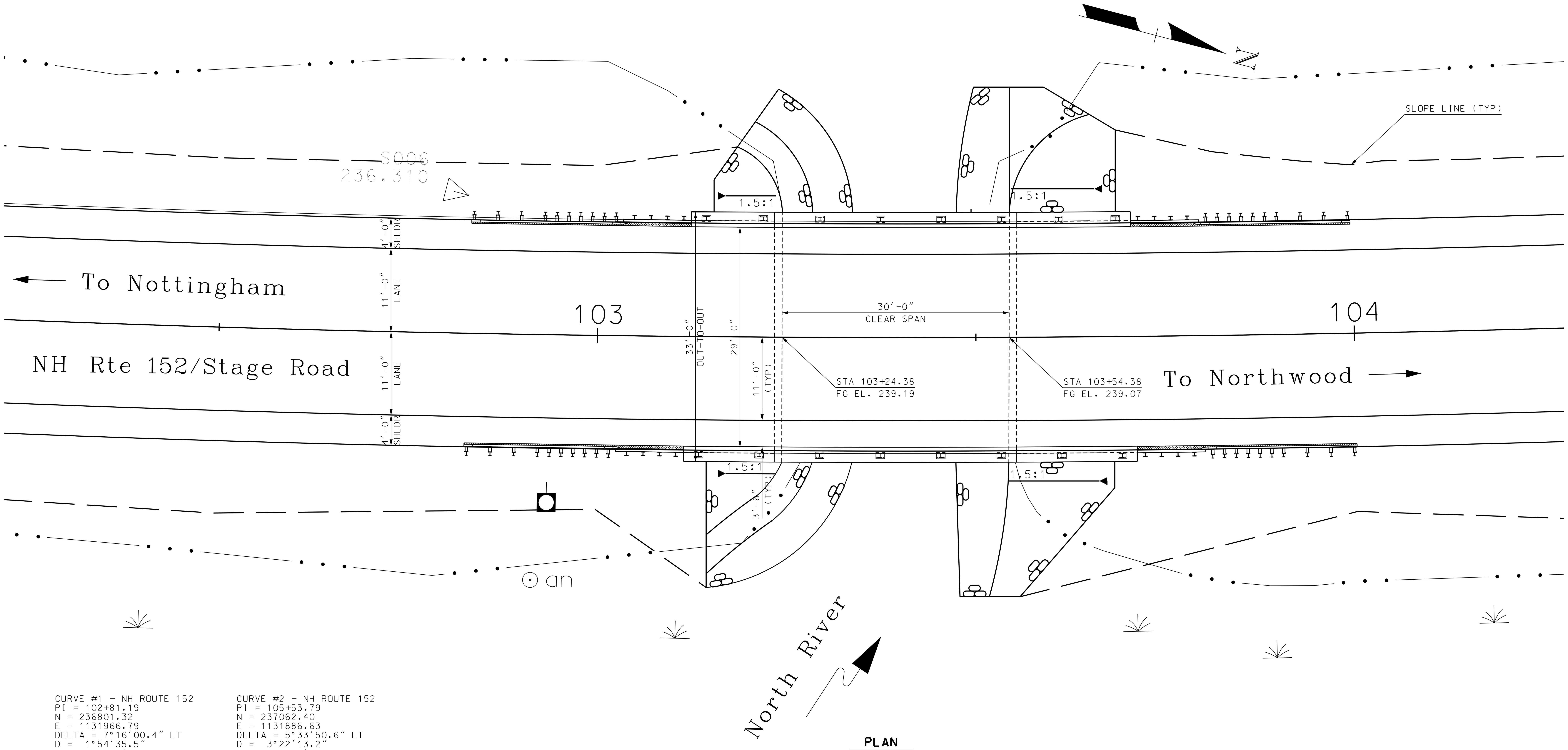
SURVEY COMPLETION DATE : 5-17-19

SURVEY BOOK NUMBERS : 13006

+ N. H. D. O. T. +

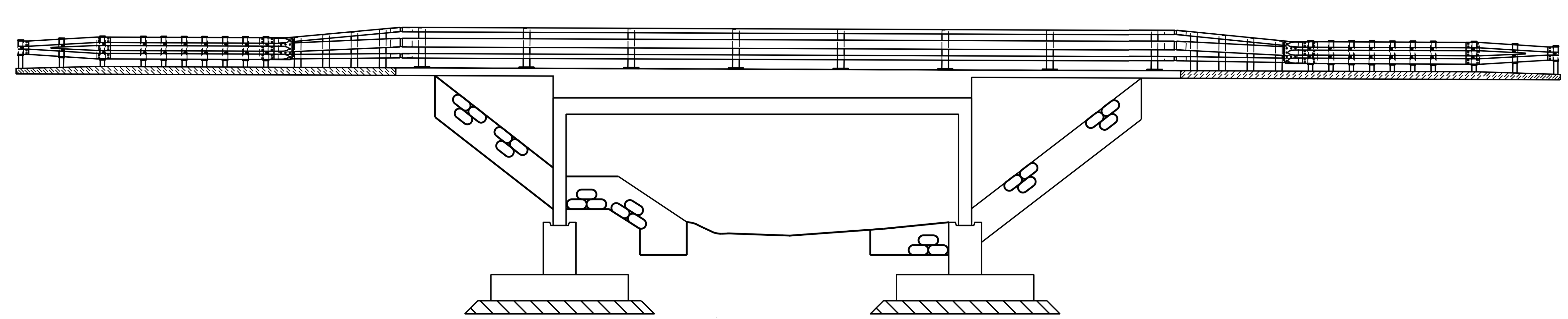
SCALE IN FEET

z.dgn MX 6/10/2019 9:20:34 AM "n34sel"



PLAN
SCALE: 1/8" = 10'

CURVE #1 - NH ROUTE 152	CURVE #2 - NH ROUTE 152
PI = 102+81.19	PI = 105+53.79
N = 236801.32	N = 237062.40
E = 1131966.79	E = 1131886.63
DELTA = 7°16'00.4" LT	DELTA = 5°33'50.6" LT
D = 1°54'35.5"	D = 3°22'13.2"
R = 3000.00'	R = 1700.00'
T = 190.50'	T = 82.61'
L = 380.49'	L = 165.09'
E = 6.04'	E = 2.01'



ELEVATION
SCALE: 1/8" = 10'

TS&L SUBMISSION

PRELIMINARY PLANS
SUBJECT TO CHANGE
DATE 12/15/2021

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN NOTTINGHAM | BRIDGE NO. 141/127 | STATE PROJECT 40612

LOCATION NH ROUTE 152 OVER NORTH RIVER

GENERAL PLAN AND ELEVATION

REVISIONS AFTER PROPOSAL		BY	DATE		BY	DATE
	DESIGNED	TEM	3/20	CHECKED	TPL	3/20
	DRAWN	TEM	3/20	CHECKED	TPL	3/20
	QUANTITIES	---	---	CHECKED	---	---
	ISSUE DATE					
	REV. DATE					

BRIDGE SHEET --- OF ---

FILE NUMBER

FEDERAL PROJECT NO.	SHEET NO.	TOTAL SHEETS
---	1	1

SUBDIRECTORY	.DGN LOCATOR	SHEET SCALE
BRD/PRELIM	40612_GENPLAN	AS NOTED

NHB DataCheck Results Letter
NH Natural Heritage Bureau
Please note: maps and NHB record pages are **confidential** and shall be redacted from public documents.

To: Ethan Maskiell, GM2 Associates, Inc.
197 Loudon Rd, Suite 310
Concord, NH 03281
emaskiell@gm2inc.com

From: NHB Review
NH Natural Heritage Bureau
Main Contact: Ashley Litwinenko - nhbreview@dncr.nh.gov

cc: NHFG Review

Date: 01/03/2024 (valid until 01/03/2025)
Re: DataCheck Review by NH Natural Heritage Bureau and NH Fish & Game
Permits: NHDES - Shoreland Standard Permit, NHDES - Wetland Standard Dredge & Fill - Major, USACE - General Permit

NHB ID: NHB23-3677

Town: Nottingham
Location: Bridge No. 141/127 - NH Route 152 over the North River

Project Description: The project involves the replacement of the NH Route 152 bridge over the North River (Bridge No. 141/127) in Nottingham (NHDOT Project 40612). The existing bridge is a reinforced concrete jack-arch structure with a 17-foot span. It will be replaced with a 30-foot span bridge. The project also involves 200 feet of roadway widening on each side of the bridge to transition the additional 3 feet on each side of the roadway at each bridge approach back to the existing roadway. The bridge would be closed during construction and traffic would be detoured. This is an update to NHB22-3131.

Next Steps for Applicant:

NHB's database has been searched for records of rare species and exemplary natural communities. Please carefully read the comments and consultation requirements below.

NHB Comments: On 12/1/2022, Ashley Litwinenko recommended surveys occur for NHB22-3131 for climbing hempvine. I was unable to find results for this survey. If surveys occurred, please send NHB the results. If surveys have not occurred, please follow Ashley's recommendations to conduct this survey.

NHFG Comments: Please refer to NHFG consultation requirements below.

NHB Consultation

If this NHB DataCheck letter includes records of rare plants and/or natural communities/systems, please contact NHB and provide any requested supplementary materials by emailing nhbreview@dncr.nh.gov.

If this NHB DataCheck letter DOES NOT include any records of rare plants and/or natural communities/systems, no further consultation with NHB is required.

NH Fish and Game Department Consultation

If this NHB DataCheck letter DOES NOT include ANY wildlife species records, then, based on the information submitted, no further consultation with the NH Fish and Game Department pursuant to Fis 1004 is required.

If this NHB DataCheck letter includes a record for a threatened (T) or endangered (E) wildlife species, consultation with the New Hampshire Fish and Game Department under Fis 1004 may be required. To review the Fis 1000 rules (effective February 3, 2022), please go to https://www.wildlife.nh.gov/wildlife-and-habitat/nongame-and-endangered-species/environmental-review. All requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent by mail, and **must include the NHB DataCheck results letter number and "Fis 1004 consultation request" in the subject line**.

If the NHB DataCheck response letter does not include a threatened or endangered wildlife species but includes other wildlife species (e.g., Species of Special Concern), consultation under Fis 1004 is not required; however, some species are protected under other state laws or rules, so coordination with NH Fish & Game is highly recommended or may be required for certain permits. While some permitting processes are exempt from required consultation under Fis 1004 (e.g., *statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule*), coordination with NH Fish & Game may still be required under the rules governing those specific permitting processes, and it is recommended you contact the applicable permitting agency. For projects not requiring consultation under Fis 1004, but where additional coordination with NH Fish and Game is requested, please email NHFGreview@wildlife.nh.gov, and include the NHB DataCheck results letter number and "review request" in the email subject line.

Contact NH Fish & Game at (603) 271-0467 with questions.

NHB Database Records:
The following record(s) have been documented in the vicinity of the proposed project.
Please see the map and detailed information about the record(s) on the following pages.

Plant species	State[1]	Federal	Notes
climbing hempvine (*Mikania scandens*)	E	--	Threats include changes to the hydrology (e.g., water levels) of its habitat and increased sedimentation or nutrients and pollutants in stormwater runoff.

Vertebrate species	State[1]	Federal	Notes
American Eel (*Anguilla rostrata*)	SC	--	Contact the NH Fish & Game Dept (see above).
Blanding's Turtle (*Emydoidea blandingii*)	E	--	Contact the NH Fish & Game Dept (see below).
Bridle Shiner (*Notropis bifrenatus*)*	T	--	Contact the NH Fish & Game Dept (see above).
Northern Black Racer (*Coluber constrictor constrictor*)	T	--	Contact the NH Fish & Game Dept (see above).
Spotted Turtle (*Clemmys guttata*)	T	--	Contact the NH Fish & Game Dept (see below).
Wood Turtle (*Glyptemys insculpta*)	SC	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, “SC” = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list.
An asterisk (*) indicates that the most recent report for that occurrence was 20 or more years ago.

For all animal reviews, refer to ‘IMPORTANT: NHFG Consultation’ section above.

Disclaimer: NHB’s database can only tell you of known occurrences that have been reported to NHFG/NHB. Known occurrences are based on information gathered by qualified biologists or members of the public, reported to our offices, and verified by NHB/NHFG.
However, many areas have never been surveyed, or have only been surveyed for certain species.
NHB recommends surveys to determine what species/natural communities are present onsite.

Jennifer Riordan

From: DNCR: NHB Review <nhbreview@dncr.nh.gov>
Sent: Tuesday, January 9, 2024 11:49 AM
To: Jennifer Riordan
Cc: Ethan Maskiell; Brown, Joshua
Subject: [WARNING-EXT]RE: NHB23-3677 - Nottingham 40612

Hi Jenn,

Thank you for sending along the rare plant survey report for climbing hempvine (*Mikania scandens*). Because the rare plant was not found during thorough surveys in suitable habitat at the appropriate time of year, NHB has no further concerns regarding NHB23-3677.

Thank you,

Maddie Severance (she/her/hers)
Ecological Information Specialist
New Hampshire Natural Heritage Bureau (NHB)
Division of Forests & Lands
NH Dept. of Natural & Cultural Resources
172 Pembroke Rd
Concord, NH 03301
(603)-271-0687 (office)

From: Jennifer Riordan <JRiordan@GM2INC.COM>
Sent: Tuesday, January 9, 2024 9:17 AM
To: DNCR: NHB Review <nhbreview@dncr.nh.gov>
Cc: Ethan Maskiell <EMaskiell@GM2INC.COM>; Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: NHB23-3677 - Nottingham 40612

This email is to follow up on NHB23-3677 (formerly NHB22-3131), NHDOT Project No. 40612 (NH Route 152 over the North River bridge replacement in Nottingham). FB Environmental conducted a survey for climbing hempvine in September 2023. The species was not found within the survey area. Attached is a memo summarizing their survey methodology and results. Please let us know if you have questions or need any further information.

Thanks,

Jenn

CT | RI | NH | MA | NY | FL
www.gm2inc.com

JENNIFER RIORDAN, CWS, CPESC
Senior Environmental Scientist
P 603.856.7854
C 603.724.4950

Brown, Joshua

From: Joshua.R.Brown@dot.nh.gov
Subject: FW: [WARNING-EXT]FW: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Hi Jennifer,

Attached is the final list of NH Fish and Game recommendations. I'm attaching the original email from F&G from back in January and this email following the new NHB that stated no additional recommendations on top of these. That is included below.

Thank you,

Josh Brown **I** 603-271-6916
NHDOT **I** Bureau of Environment
[Wetlands Program]
7 Hazen Drive, Concord, NH 03302

From: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Sent: Tuesday, April 2, 2024 2:24 PM
To: Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: RE: [WARNING-EXT]FW: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Hi Josh,

1. Blanding's Turtle (State endangered), Northern Black Racer (State threatened) and Spotted turtle (State threatened) occur within the vicinity of the project area. All operators and personnel working on or entering the site shall be made aware of the potential presence of these species and shall be provided flyers that help to identify these species, along with NHFG contact information.
2. Rare species information (e.g. identification, observation and reporting of observations, when to contact NHFG immediately and NHFG contact information) shall be communicated during the project's preconstruction meeting prior to work and rare species flyers shall be included on the project's bulletin board. The rare species commitments shall be included in the project's Summary of Environmental Issues and the rare species flyers shall be included in the project's contract. Additionally, rare species information shall be communicated when weekly project progress meetings are held on site.
3. Turtles may be attracted to disturbed ground during nesting season (May 15th – June 30th). All turtle species nests are protected by NH laws. If a nest is observed or suspected, operators shall contact Melissa Winters (603-479-1129) or Josh Megyesy (978-578-0802) at NHFG immediately for further consultation.
4. Black silt fence shall be anchored over the ground surface of exposed soils along the south side of the bridge prior to turtle nesting season to prevent turtles from laying eggs in the work zone.
5. The 30' replacement span bridge structure shall have an open bottom consisting of natural stream material. Stream bed material shall not include sharp, angular surfaces, such as rip-rap. If rip-rap must be used, it shall be covered with natural stream material to mimic upstream and downstream streambed conditions.
6. Dry wildlife passage shall be incorporated into the design considerations under the proposed bridge. Rip-rap or large stones shall be used to construct a wildlife shelf.

7. Voids within rip-rap, such as under the bridge up to the abutments and within the wildlife shelf, shall be filled with finer material (i.e. native material in between rip-rap) to create a relatively smooth surface for wildlife to traverse.
8. All manufactured erosion and sediment control products, with the exception of turf reinforcement mats, utilized for, but not limited to, slope protection, runoff diversion, slope interruption, perimeter control, inlet protection, check dams, and sediment traps shall not contain plastic, or multifilament or monofilament polypropylene netting or mesh with an opening size of greater than 1/8 inches.
9. All observations of threatened or endangered species on the project site shall be reported immediately to the NHFG nongame and endangered wildlife environmental review program by phone at 603-271-2461 and by email at NHFGreview@wildlife.nh.gov, with the email subject line containing the NHB DataCheck tool results letter assigned number, the project name, and the term Wildlife Species Observation.
10. Photographs of the observed species and nearby elements of habitat or areas of land disturbance shall be provided to NHFG in digital format at the above email address for verification, as feasible.
11. In the event a threatened or endangered species is observed on the project site during the term of the permit, the species shall not be disturbed, handled, or harmed in any way prior to consultation with NHFG and implementation of corrective actions recommended by NHFG.
    a. Site operators shall be allowed to relocate wildlife encountered if discovered within the active work zone if in direct harm from project activities. Wildlife shall be relocated in close proximity to the capture location but outside of the work zone and in the direction the individual was heading. NHFG shall be contacted immediately if this action occurs.
12. NHFG, including its employees and authorized agents, shall have access to the property during the term of the permit. NHFG shall contact the NHDOT's Contract Administrator or Environmental Coordinator for the project to coordinate access to the site. In the case of an emergency need for immediate access, NHFG shall contact Kevin Nyhan at 603-271-3226.
13. American Eel (State species of special concern) may occur within the vicinity of the project site. Site operators should be informed of the potential presences of this species.
14. The Wood Turtle flyer will be included in the contract documents and the Summary of Environmental Issues will include a commitment to make personnel aware of the potential presence of this species and a requirement to contact F&G if they are encountered in the project area.

From: Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Sent: Monday, April 1, 2024 3:11 PM
To: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Subject: FW: [WARNING-EXT]FW: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Hi Rebecca!

Can you help me address Jennifer's question below for Nottingham, 40612? I think we just need the email before the last one from Kevin Newton with the last recommendations received to include in the wetlands application.

I checked the project folder in the rare species folder and didn't see the email correspondence.

Thank you,

Josh Brown **I** 603-271-6916
NHDOT **I** Bureau of Environment
Wetlands Program
7 Hazen Drive, Concord, NH 03302

From: Jennifer Riordan <JRiordan@GM2INC.COM>
Sent: Thursday, March 28, 2024 10:25 AM
To: Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: RE: [WARNING-EXT]FW: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

EXTERNAL: Do not open attachments or click on links unless you recognize and trust the sender.

Thanks!

Do you have the final recommendations? I have an email from last April (attached) and some coordination emails between Rebecca and NHFG but not a complete list of the revised recommendations. I believe Rebecca had some comments/revisions to the text and concerns with #4 regarding placing black silt fence fabric over the ground.

Jenn

JENNIFER RIORDAN, CWS, CPESC
P 603.856.7854 | **C** 603.724.4950

From: Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Sent: Thursday, March 28, 2024 9:53 AM
To: Jennifer Riordan <JRiordan@GM2INC.COM>
Cc: Tremblay, Jason <Jason.A.Tremblay@dot.nh.gov>; Darren Blood <DBlood@GM2INC.COM>; Tom Levins <TLevins@GM2INC.COM>; Jennifer Mercer <JMercer@GM2INC.COM>; Ethan Maskiell <EMaskiell@GM2INC.COM>
Subject: [WARNING-EXT]FW: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Hi Jennifer,

FYI – see below as coordination was wrapped up yesterday.

Thanks!
Josh

From: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Sent: Wednesday, March 27, 2024 2:03 PM
To: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: RE: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Hi Rebecca,

NHFG does not have any additional recommendations beyond what was previously discussed. Based on the identification of rare species on site by FB Environmental when they were doing their assessment, NHDOT / contractors should be extra vigilant and should report any sightings to NHFG Nongame program immediately.

Thanks,

Kevin Newton
Wildlife Biologist
NH Fish and Game Department
Wildlife Division
11 Hazen Drive, Concord NH 03301
Phone: 603-271- 5860

New Hampshire Fish and Game requirements for environmental review consultation can be found at: https://gencourt.state.nh.us/rules/state_agencies/fis1000.html. ALL requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail. **The NHB datacheck results letter number needs to be included in the email subject line to read as "NHB*xx-xxxx*_*Project Name*_FIS 1004 Consultation Submittal".**

The requirements for consultation (Fis 1004) shall not apply to the following: statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule. Review requests for these projects or other project types should be submitted to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail – email or mail subject line for these review requests should read **"NHBxx-xxxx_Project Name_ Env. Review Request".**

Please provide shapefiles/KMZ/KMLs of the project site (and relevant features if applicable) with your submittal. Review statements provided in the NHB Datacheck Results letter for additional guidance.

From: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Sent: Wednesday, March 27, 2024 11:08 AM
To: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: RE: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Hello Kevin,

Josh Brown has taken over as the EM for the Nottingham 40612 project and he is preparing to submit the wetlands application. Were there any other conservation measures F&G would like to recommend for this project? Thanks for all of the coordination on this one, it was helpful in our discussions with the design team.

Best wishes,
Rebecca

From: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Sent: Tuesday, January 16, 2024 9:27 AM
To: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Winters, Melissa <Melissa.J.Winters@wildlife.nh.gov>; Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: RE: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Thanks Rebecca.

We will let you know if there are any changes to recommendations for the project.

Have a good week,

Kevin Newton
Wildlife Biologist
NH Fish and Game Department

Wildlife Division
11 Hazen Drive, Concord NH 03301
Phone: 603-271- 5860

New Hampshire Fish and Game requirements for environmental review consultation can be found at: https://gencourt.state.nh.us/rules/state_agencies/fis1000.html. ALL requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail. **The NHB datacheck results letter number needs to be included in the email subject line to read as "NHB*xx-xxxx_Project Name*_FIS 1004 Consultation Submittal".**

The requirements for consultation (Fis 1004) shall not apply to the following: statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule. Review requests for these projects or other project types should be submitted to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail – email or mail subject line for these review requests should read **"NHBxx-xxxx_Project Name_ Env. Review Request".**

Please provide shapefiles/KMZ/KMLs of the project site (and relevant features if applicable) with your submittal. Review statements provided in the NHB Datacheck Results letter for additional guidance.

From: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Sent: Tuesday, January 16, 2024 9:24 AM
To: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Winters, Melissa <Melissa.J.Winters@wildlife.nh.gov>; Brown, Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612, New NHB23-3677

Hello Kevin,

Please see attached the new NHB report for the Nottingham 40612 project.

Thank you,

Rebecca Martin
Plant and Wildlife Program Manager
NH DOT Bureau of Environment
7 Hazen Drive
Concord, NH 03302
(603)271-6781
Rebecca.A.Martin@dot.nh.gov

Brown, Joshua

From: Newton, Kevin
Sent: Friday, January 12, 2024 2:26 PM
To: Martin, Rebecca
Cc: FGC: NHFG review; Winters, Melissa; Brown, Joshua; Benedict, Karl
Subject: RE: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612

Hi Rebecca and Josh,

Melissa shared with me some information regarding rare species records identified by FB consultants associated with an assessment they were completing on site. As a reminder, if they have not already been shared with NHFG (i.e Melissa), please share that information with us as soon as possible so we can add to our records.

Has any work been completed on site? We have also become aware that an updated NHB letter has been completed. Please share that with us as soon as possible as well as any proposed changes (if any) to the site plans or methodology.

Melissa has indicated given the apparent new occurrences of species on site identified by FB environmental as well as the updated NHB datacheck letter, she would like us to take a closer look at the project details and potentially reevaluate project recommendations.

I don't have an issue with the language proposed – Melissa, do you have any thoughts?

Have a good long weekend,

Kevin Newton
Wildlife Biologist
NH Fish and Game Department
Wildlife Division
11 Hazen Drive, Concord NH 03301
Phone: 603-271- 5860

New Hampshire Fish and Game requirements for environmental review consultation can be found at: https://gencourt.state.nh.us/rules/state_agencies/fis1000.html. ALL requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail. **The NHB datacheck results letter number needs to be included in the email subject line to read as "NHB*xx-xxxx_Project Name*_FIS 1004 Consultation Submittal".**

The requirements for consultation (Fis 1004) shall not apply to the following: statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule. Review requests for these projects or other project types should be submitted to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail – email or mail subject line for these review requests should read **"NHBxx-xxxx_Project Name_ Env. Review Request".**

Please provide shapefiles/KMZ/KMLs of the project site (and relevant features if applicable) with your submittal. Review statements provided in the NHB Datacheck Results letter for additional guidance.

From: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Sent: Friday, January 12, 2024 8:04 AM
To: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Winters, Melissa <Melissa.J.Winters@wildlife.nh.gov>; Brown,

Joshua <Joshua.R.Brown@dot.nh.gov>
Subject: RE: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612

Hi Kevin,

The Nottingham 40612 project is working its way towards a wetland permit application. There is a public meeting for the project planned later this month and a public hearing planned in March. Since the major effort now for the project is the wetland permit application, I have passed the project along to Josh Brown in the BOE Wetlands Program (copied here).

The design team for the project found your responses helpful (as did I), thank you for taking the time. The only remaining question was of the best way to ensure awareness of the potential presence during construction (#2 and additional recommendation #2). I had an opportunity to confer with the two Bureau of Environment Environmental Coordinators who oversee the NHDOT environmental commitments that pertain to construction activities. They visit the project sites weekly and check in with the Contract Administrators (CA) regularly about the environmental commitments developed during the projects' designs. I asked them what we could commit to *and* realistically expect to happen on the project site during construction. They confirmed that having commitments listed in the Summary of Environmental Issues (the green sheet I mentioned earlier), flyers posted on the bulletin board, and concerns noted at the pre-construction meeting are the best ways to raise awareness. The CA pays attention to these commitments and is generally on site daily (may not be the case with a small paving project) to ensure compliance with all contract commitments. I asked for the Environmental Coordinators help adjusting the recommendation to one that would be most likely to be successful. Could you please review and let me know if you would like to discuss further?

> *Rare species information (e.g. identification, observation and reporting of observations, when to contact NHFG immediately and NHFG contact information) shall be communicated during the project's preconstruction meeting prior to work and rare species flyers shall be included on the project's bulletin board. The rare species commitments shall be included in the project's Summary of Environmental Issues and the rare species flyers shall be included in the project's contract. Additionally, rare species information shall be communicated when weekly project progress meetings are held on site.*

I hope that you had a Happy New Year and enjoyed the holidays!

Best wishes,
Rebecca

Rebecca Martin
Plant and Wildlife Program Manager
NH DOT Bureau of Environment
7 Hazen Drive
Concord, NH 03302
(603)271-6781
Rebecca.A.Martin@dot.nh.gov

From: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Sent: Friday, June 2, 2023 1:09 PM
To: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Winters, Melissa <Melissa.J.Winters@wildlife.nh.gov>
Subject: RE: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612

Hi Rebecca,

Thank you for your comments. We are happy to work with you to better tailor recommendations for DOT projects where possible. If we want to fine-tune, it might be best to schedule a meeting regarding DOT specific recommendation language so we can talk through them. The recommendations you are offering comments on have become standardized for our program, so I'm hesitant to deviate from them too much. I understand your points regarding keeping recommendations on plan sheets vs. moving them to the Summary of Environmental Issues document. I think has the potential to reduce compliance if sub-contractors don't regularly reference the summary document. Typically, applicants make a separate plan sheet that lists out our recommendations and has the flyers included directly on it. I'm happy to provide an example if you would like.

Some responses to your comments below:

•#2: The primary purpose of the tailgate meeting recommendation is to ensure anyone who is working on site is aware (reminded daily) of the potential to encounter rare wildlife while working.. Including this information in the Summary of Environmental Issues and within the project's contract is helpful, but should not replace the recommendation itself. If there is a more appropriate way to word this recommendation for situations where there are not daily meetings before starting work, we are open to suggestions.
•#5: the engineer is correct, the streambed in this case is synonymous with channel.
•#8: Yes, these materials are OK to be included in this design.
•#9: Thank you for pointing out this discrepancy. This item is on our list of corrections to make. Attached is a corrected flyer, which references the NHFGreview@wildlife.nh.gov email, which should be used.
•#10: Animals should not be handled unless in direct harm of project activities.
•#11: Relocation of listed wildlife is allowed only if in direct harm. If an individual is relocated, NHFG needs to be notified immediately to determine if additional action is needed.
•#12: This is an acceptable change.
•Additional recommendation #2: Similar response as to #2 in that we want this information to be reviewed by contractors daily to ensure compliance with reporting protocol and BMPs.

Let me know your thoughts. If you would like to discuss specific language further, I would suggest we schedule a conference call along with Melissa, as she likely would like to Be involved.

Thanks,

Kevin Newton
Wildlife Biologist
NH Fish and Game Department
Wildlife Division
11 Hazen Drive, Concord NH 03301
Phone: 603-271- 5860

From: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>
Sent: Thursday, May 25, 2023 10:19 AM
To: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Winters, Melissa <Melissa.J.Winters@wildlife.nh.gov>; Duclos, Kristin <Kristin.L.Duclos@des.nh.gov>; Jennifer Riordan <jriordan@gm2inc.com>
Subject: RE: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham 40612

Hi Kevin,

Thanks for your help with the review of this project. I checked in with the design team and we have a few questions and suggestions. Could you please review and let me know if you would like to discuss?

One thing I have seen come up on a few projects and meant to check in with you about is the reference to tailgate meetings and inclusion of the rare species information specifically on plan sheets (#2).

- Not all of our contractors have morning tailgate meetings- however, we do have a preconstruction meeting where all of the supervisors/foremen from the Contractor are supposed to be present and all of the important contract commitments are discussed. Our Bureau of Environment Environmental Coordinators attend and go through the project's environmental commitments (including wildlife) and are available to address any Contractor questions. The Environmental Coordinators visit active construction projects to discuss any commitments for the project periodically and our Contract Administrators are regularly onsite during construction to oversee all project commitments. Please see suggested commitment below.
- When we have a specific area of concern (more often for rare plants) it is helpful to put something on the plans, since it has location specific information. When there is not location specific information, we find it more helpful to include this type of information in the contract documents. We have a page called the *Summary of Environmental Issues* that we include in our contracts and it is the only page printed on green paper – everyone know that this page includes a summary of the project's environmental commitments and the color makes it an easy reference.

Best,
Rebecca

New Hampshire Fish and Game – Recommended Permit Conditions

1. Blanding's Turtle (State endangered), Northern Black Racer (State threatened) and Spotted turtle (State threatened) occur within the vicinity of the project area. All operators and personnel working on or entering the site shall be made aware of the potential presence of these species and shall be provided flyers that help to identify these species, along with NHFG contact information.
2. Rare species information (e.g. identification, observation and reporting of observations, when to contact NHFG immediately and NHFG contact information) shall be communicated during morning tailgate meetings prior to work commencement during the construction phase of the project. See Plan Sheet xxxxxx. Include attached flyers to plan sheet set.
   Suggested: Rare species information (e.g. identification, observation and reporting of observations, when to contact NHFG immediately and NHFG contact information) shall be communicated during the project's preconstruction meeting prior to work and rare species flyers shall be included on the project's bulletin board. The rare species commitments shall be included in the project's *Summary of Environmental Issues* and the rare species flyers shall be included in the project's contract.

3. Turtles may be attracted to disturbed ground during nesting season (May 15th – June 30th). All turtle species nests are protected by NH laws. If a nest is observed or suspected, operators shall contact Melissa Winters (603-479-1129) or Josh Megyesy (978-578-0802) at NHFG immediately for further consultation.
4. Black silt fence shall be anchored over the ground surface of exposed soils along the south side of the bridge prior to turtle nesting season to prevent turtles from laying eggs in the work zone.
5. The 30' replacement span bridge structure shall have an open bottom consisting of natural stream material. Stream bed material shall not include sharp, angular surfaces, such as rip-rap. If rip-rap must be used, it shall be covered with natural stream material to mimic upstream and downstream streambed conditions.
   The project engineer asked me to confirm that streambed is synonymous with channel (i.e. not banks and not the wildlife shelf).

6. Dry wildlife passage shall be incorporated into the design considerations under the proposed bridge. Rip-rap or larges stones shall be used to construct a wildlife shelf.
7. Voids within rip-rap, such as under the bridge up to the abutments and within the wildlife shelf, shall be filled with finer material (i.e native material in between rip-rap) to create a relatively smooth surface for wildlife to traverse.

8. All manufactured erosion and sediment control products, with the exception of turf reinforcement mats, utilized for, but not limited to, slope protection, runoff diversion, slope interruption, perimeter control, inlet protection, check dams, and sediment traps shall not contain plastic, or multifilament or monofilament polypropylene netting or mesh with an opening size of greater than 1/8 inches.
   The project engineer asked me to confirm that our typical black silt fence and in water turbidity control is okay to be erected on the project? These do include plastic but would not have openings of 1/8".

9. All observations of threatened or endangered species on the project site shall be reported immediately to the NHFG nongame and endangered wildlife environmental review program by phone at 603-271-2461 and by email at NHFGreview@wildlife.nh.gov, with the email subject line containing the NHB DataCheck tool results letter assigned number, the project name, and the term Wildlife Species Observation.
   The email here is different than the one listed on the wood turtle flyer.

10. Photographs of the observed species and nearby elements of habitat or areas of land disturbance shall be provided to NHFG in digital format at the above email address for verification, as feasible.
11. In the event a threatened or endangered species is observed on the project site during the term of the permit, the species shall not be disturbed, handled, or harmed in any way prior to consultation with NHFG and implementation of corrective actions recommended by NHFG.
    a. Site operators shall be allowed to relocate wildlife encountered if discovered within the active work zone if in direct harm from project activities. Wildlife shall be relocated in close proximity to the capture location but outside of the work zone and in the direction the individual was heading. NHFG shall be contacted immediately if this action occurs.

    The project engineer requested clarification of #10 and #11. For #10, if handling the species would allow for a better picture, should they move it? For #11 the first part says not to disturb the species and the second part says relocation. Does the wildlife relocation only pertain to non-listed species?
12. NHFG, including its employees and authorized agents, shall have access to the property during the term of the permit.
    Please contact the NHDOT's Contract Administrator or Environmental Coordinator, Darrel Elliot 603-419-9822, for the project to coordinate access to the site. Please ensure any F&G employees, or authorized agents, are accompanied by NHDOT personnel to ensure their safe access within construction zones.

Additional Recommendations:

1. American Eel (State species of special concern) may occur within the vicinity of the project site. Site operators should be informed of the potential presences of this species.
2. Wood Turtle (State species of special concern) may occur within the vicinity of the project site. All operators and personnel working on or entering the site should be made aware of the potential presence of these species and should be provided flyers that help to identify these species, along with NHFG contact information. See Plan Sheet xxxxxx. Include attached flyers to plan sheet set.
   Suggested: The Wood Turtle flyer will be included in the contract documents and the *Summary of Environmental Issues* will include a commitment to make personnel aware of the potential presence of this species and a requirement to contact F&G if they are encountered in the project area.

From: Newton, Kevin <Kevin.M.Newton@wildlife.nh.gov>
Sent: Tuesday, April 25, 2023 1:43 PM
To: Martin, Rebecca <Rebecca.A.Martin@dot.nh.gov>; Jennifer Riordan <jriordan@gm2inc.com>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Winters, Melissa <Melissa.J.Winters@wildlife.nh.gov>; Duclos, Kristin <Kristin.L.Duclos@des.nh.gov>
Subject: NHB22-3131, North River, NHDOT Bridge No.141/127, Nottingham

Good afternoon,

New Hampshire Fish and Game has completed review of materials submitted for consultation for NHB22-3131 (*site plans dated)* 01/2020) prepared by GM2 Associates, Inc. The proposed project is the replacement of the existing reinforced concrete jack-arch structure, 17-foot NH Route 152 Bridge (NHDOT Bridge No.141/127) with a 30-foot span bridge over North River located in Nottingham, NH. The proposed project also involves 200 feet of roadway widening on each side of the bridge approach.

NHFG agrees with the incorporation of conservation measures previously provided by NHFG through correspondence with Kim Tuttle in 2019. The replacement bridge, consisting of a 30' open span, should result in improved wildlife passage opportunities if the below recommendations are implemented.

Applications associated with this review:

- NHDES – Wetland Standard Dredge & Fill – Major (pending)
- NHDES – Shoreland Standard Permit (pending)

Based on the NHB datacheck results letter and the information provided in the submission, we request the following recommended permit conditions. THESE RECOMMENDED PERMIT CONDITIONS ARE APPLICABLE TO ALL STATE PERMITS LISTED ABOVE.

- **Please include recommended permit conditions in final plan sheets plans as written below (updated highlighted text as applicable) and provide to NHDES and cc NHFG for final review. Permit reviewers will adopt/include NHFG permit conditions in the permit if approved.**

New Hampshire Fish and Game – Recommended Permit Conditions

1. Blanding's Turtle (State endangered), Northern Black Racer (State threatened) and Spotted turtle (State threatened) occur within the vicinity of the project area. All operators and personnel working on or entering the site shall be made aware of the potential presence of these species and shall be provided flyers that help to identify these species, along with NHFG contact information.
2. Rare species information (e.g. identification, observation and reporting of observations, when to contact NHFG immediately and NHFG contact information) shall be communicated during morning tailgate meetings prior to work commencement during the construction phase of the project. See Plan Sheet xxxxxx. Include attached flyers to plan sheet set.
3. Turtles may be attracted to disturbed ground during nesting season (May 15th – June 30th). All turtle species nests are protected by NH laws. If a nest is observed or suspected, operators shall contact Melissa Winters (603-479-1129) or Josh Megyesy (978-578-0802) at NHFG immediately for further consultation.
4. Black silt fence shall be anchored over the ground surface of exposed soils along the south side of the bridge prior to turtle nesting season to prevent turtles from laying eggs in the work zone.
5. The 30' replacement span bridge structure shall have an open bottom consisting of natural stream material. Stream bed material shall not include sharp, angular surfaces, such as rip-rap. If rip-rap must be used, it shall be covered with natural stream material to mimic upstream and downstream streambed conditions.
6. Dry wildlife passage shall be incorporated into the design considerations under the proposed bridge. Rip-rap or larges stones shall be used to construct a wildlife shelf.
7. Voids within rip-rap, such as under the bridge up to the abutments and within the wildlife shelf, shall be filled with finer material (i.e native material in between rip-rap) to create a relatively smooth surface for wildlife to traverse.
8. All manufactured erosion and sediment control products, with the exception of turf reinforcement mats, utilized for, but not limited to, slope protection, runoff diversion, slope interruption, perimeter control, inlet protection, check dams, and sediment traps shall not contain plastic, or multifilament or monofilament polypropylene netting or mesh with an opening size of greater than 1/8 inches.
9. All observations of threatened or endangered species on the project site shall be reported immediately to the NHFG nongame and endangered wildlife environmental review program by phone at 603-271-2461 and by email

at NHFGreview@wildlife.nh.gov, with the email subject line containing the NHB DataCheck tool results letter assigned number, the project name, and the term Wildlife Species Observation.

10. Photographs of the observed species and nearby elements of habitat or areas of land disturbance shall be provided to NHFG in digital format at the above email address for verification, as feasible.
11. In the event a threatened or endangered species is observed on the project site during the term of the permit, the species shall not be disturbed, handled, or harmed in any way prior to consultation with NHFG and implementation of corrective actions recommended by NHFG.
    a. Site operators shall be allowed to relocate wildlife encountered if discovered within the active work zone if in direct harm from project activities. Wildlife shall be relocated in close proximity to the capture location but outside of the work zone and in the direction the individual was heading. NHFG shall be contacted immediately if this action occurs.
12. NHFG, including its employees and authorized agents, shall have access to the property during the term of the permit.

Additional Recommendations:

1. American Eel (State species of special concern) may occur within the vicinity of the project site. Site operators should be informed of the potential presences of this species.
2. Wood Turtle (State species of special concern) may occur within the vicinity of the project site. All operators and personnel working on or entering the site should be made aware of the potential presence of these species and should be provided flyers that help to identify these species, along with NHFG contact information. See Plan Sheet xxxxxx. Include attached flyers to plan sheet set.

NHFG has completed our review of materials submitted for consultation under FIS 1004. No further coordination with NHFG is requested, and the final recommendations have been transmitted to the applicable permitting agency. Questions or concerns on NHFG recommendations must follow FIS 1004.12. Note that NHFG recommendations may be withdrawn pursuant to FIS 1004.

Sincerely,

Kevin Newton
Wildlife Biologist
NH Fish and Game Department
Wildlife Division
11 Hazen Drive, Concord NH 03301
Phone: 603-271- 5860

New Hampshire Fish and Game requirements for environmental review consultation can be found at: https://gencourt.state.nh.us/rules/state_agencies/fis1000.html. ALL requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail. **The NHB datacheck results letter number needs to be included in the email subject line to read as "NHB*xx-xxxx*_*Project Name*_FIS 1004 Consultation Submittal".**

The requirements for consultation (Fis 1004) shall not apply to the following: statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule. Review requests for these projects or other project types should be submitted to NHFGreview@wildlife.nh.gov or can be sent hardcopy by mail – email or mail subject line for these review requests should read **"NHBxx-xxxx_Project Name_ Env. Review Request".**

Please provide shapefiles/KMZ/KMLs of the project site (and relevant features if applicable) with your submittal. Review statements provided in the NHB Datacheck Results letter for additional guidance.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: 03/26/2024 14:21:50 UTC
Project Code: 2024-0035583
Project Name: Nottingham 40612

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

Updated 4/12/2023 - Please review this letter each time you request an Official Species List, we will continue to update it with additional information and links to websites may change.

About Official Species Lists

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Federal and non-Federal project proponents have responsibilities under the Act to consider effects on listed species.

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested by returning to an existing project's page in IPaC.

Endangered Species Act Project Review

Please visit the "**New England Field Office Endangered Species Project Review and Consultation**" website for step-by-step instructions on how to consider effects on listed species and prepare and submit a project review package if necessary:

https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review

NOTE Please do not use the **Consultation Package Builder** tool in IPaC except in specific situations following coordination with our office. Please follow the project review guidance on our website instead and reference your **Project Code** in all correspondence.

Northern Long-eared Bat - (**Updated 4/12/2023**) The Service published a final rule to reclassify the northern long-eared bat (NLEB) as endangered on November 30, 2022. The final rule went into effect on March 31, 2023. You may utilize the **Northern Long-eared Bat Rangewide Determination Key** available in IPaC. More information about this Determination Key and the Interim Consultation Framework are available on the northern long-eared bat species page:

https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis

For projects that previously utilized the 4(d) Determination Key, the change in the species' status may trigger the need to re-initiate consultation for any actions that are not completed and for which the Federal action agency retains discretion once the new listing determination becomes effective. If your project was not completed by March 31, 2023, and may result in incidental take of NLEB, please reach out to our office at newengland@fws.gov to see if reinitiation is necessary.

Additional Info About Section 7 of the Act
Under section 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether projects may affect threatened and endangered species and/or designated critical habitat. If a Federal agency, or its non-Federal representative, determines that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Federal agency also may need to consider proposed species and proposed critical habitat in the consultation. 50 CFR 402.14(c)(1) specifies the information required for consultation under the Act regardless of the format of the evaluation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/service/section-7-consultations

In addition to consultation requirements under Section 7(a)(2) of the ESA, please note that under sections 7(a)(1) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Please contact NEFO if you would like more information.

Candidate species that appear on the enclosed species list have no current protections under the ESA. The species' occurrence on an official species list does not convey a requirement to consider impacts to this species as you would a proposed, threatened, or endangered species. The ESA does not provide for interagency consultations on candidate species under section 7, however, the Service recommends that all project proponents incorporate measures into projects to benefit candidate species and their habitats wherever possible.

Migratory Birds

In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see:

https://www.fws.gov/program/migratory-bird-permit

https://www.fws.gov/library/collections/bald-and-golden-eagle-management

Please feel free to contact us at **newengland@fws.gov** with your **Project Code** in the subject line if you need more information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat.

Attachment(s): Official Species List

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

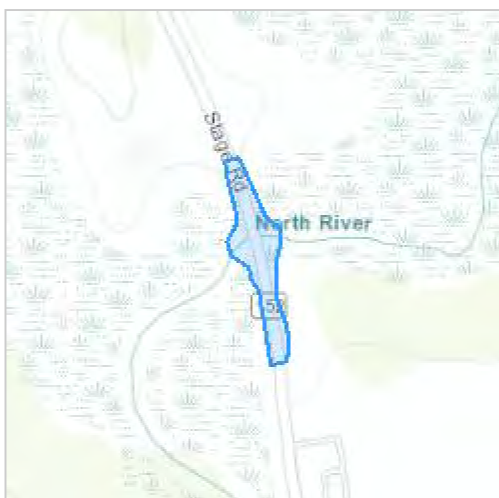
PROJECT SUMMARY

Project Code: 2024-0035583
Project Name: Nottingham 40612
Project Type: Bridge - Replacement
Project Description: The project involves the replacement of the existing bridge that carries NH Route 152 over the North River (Bridge No. 141/127) in Nottingham. The existing bridge is a reinforced concrete jack-arch structure with a 17-foot span and is currently on the State's Red List. Proposed work includes the replacement of the existing bridge with a 30-foot span bridge. The bridge will be widened 2 feet and the project includes 300 feet of roadway widening on each end of the bridge to transition the additional three feet on each side of the roadway at each bridge approach back to the existing roadway. The bridge will be closed during construction and traffic will be detoured.

The total amount of proposed wetland and watercourse impact is 4,841 square feet and 256 linear feet. This includes 2,401 square feet (182 linear feet) of permanent perennial stream impact and 1,203 square feet (74 linear feet) of temporary perennial impact. Approximately 538 square feet of permanent impact and approximately 699 square feet of temporary impact to PRA wetlands is proposed.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@43.148379750000004,-71.11319881821845,14z



Counties: Rockingham County, New Hampshire

ENDANGERED SPECIES ACT SPECIES

There is a total of 3 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 1 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

---

1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Endangered
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. This species only needs to be considered under the following conditions: ▪ This species only needs to be considered if the project includes wind turbine operations. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency:	GM2 Associates, Inc.
Name:	Ethan Maskiell
Address:	197 Loudon Road
Address Line 2:	Suite 310
City:	Concord
State:	NH
Zip:	03301
Email	emaskiell@gm2inc.com
Phone:	6038567854

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Army Corps of Engineers

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: 03/26/2024 14:19:53 UTC
Project code: 2024-0035583
Project Name: Nottingham 40612

Federal Action Agency (if applicable): Army Corps of Engineers

Subject: Record of project representative’s no effect determination for 'Nottingham 40612'

Dear Ethan Maskiell:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on March 26, 2024, for 'Nottingham 40612' (here forward, Project). This project has been assigned Project Code 2024-0035583 and all future correspondence should clearly reference this number. **Please carefully review this letter.**

Ensuring Accurate Determinations When Using IPaC

The Service developed the IPaC system and associated species’ determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into IPaC must accurately represent the full scope and details of the Project.

Failure to accurately represent or implement the Project as detailed in IPaC or the Northern Long-eared Bat Rangewide Determination Key (Dkey), invalidates this letter. ***Answers to certain questions in the DKey commit the project proponent to implementation of conservation measures that must be followed for the ESA determination to remain valid.***

Determination for the Northern Long-Eared Bat

Based upon your IPaC submission and a standing analysis, your project has reached the determination of “No Effect” on the northern long-eared bat. To make a no effect determination, the full scope of the proposed project implementation (action) should not have any effects (either positive or negative), to a federally listed species or designated critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

Under Section 7 of the ESA, if a federal action agency makes a no effect determination, no consultation with the Service is required (ESA §7). If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required except when the Service concurs, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat [50 CFR §402.02, 50 CFR§402.13].

Other Species and Critical Habitat that May be Present in the Action Area

The IPaC-assisted determination for the northern long-eared bat does not apply to the following ESA-protected species and/or critical habitat that also may occur in your Action area:

- Monarch Butterfly *Danaus plexippus* Candidate
- Tricolored Bat *Perimyotis subflavus* Proposed Endangered

You may coordinate with our Office to determine whether the Action may affect the animal species listed above and, if so, how they may be affected.

Next Steps

Based upon your IPaC submission, your project has reached the determination of “No Effect” on the northern long-eared bat. If there are no updates on listed species, no further consultation/coordination for this project is required with respect to the northern long-eared bat. However, the Service recommends that project proponents re-evaluate the Project in IPaC if: 1) the scope, timing, duration, or location of the Project changes (includes any project changes or amendments); 2) new information reveals the Project may impact (positively or negatively) federally listed species or designated critical habitat; or 3) a new species is listed, or critical habitat designated. If any of the above conditions occurs, additional coordination with the Service should take place to ensure compliance with the Act.

If you have any questions regarding this letter or need further assistance, please contact the New England Ecological Services Field Office and reference Project Code 2024-0035583 associated with this Project.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

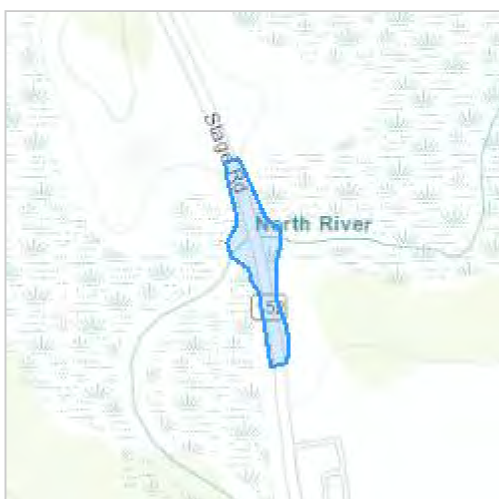
Nottingham 40612

2. Description

The following description was provided for the project 'Nottingham 40612':

> The project involves the replacement of the existing bridge that carries NH Route 152 over the North River (Bridge No. 141/127) in Nottingham. The existing bridge is a reinforced concrete jack-arch structure with a 17-foot span and is currently on the State's Red List. Proposed work includes the replacement of the existing bridge with a 30-foot span bridge. The bridge will be widened 2 feet and the project includes 300 feet of roadway widening on each end of the bridge to transition the additional three feet on each side of the roadway at each bridge approach back to the existing roadway. The bridge will be closed during construction and traffic will be detoured.
>
> The total amount of proposed wetland and watercourse impact is 4,841 square feet and 256 linear feet. This includes 2,401 square feet (182 linear feet) of permanent perennial stream impact and 1,203 square feet (74 linear feet) of temporary perennial impact. Approximately 538 square feet of permanent impact and approximately 699 square feet of temporary impact to PRA wetlands is proposed.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@43.148379750000004,-71.11319881821845,14z



DETERMINATION KEY RESULT

Based on the information you provided, you have determined that the Proposed Action will have no effect on the Endangered northern long-eared bat (Myotis septentrionalis). Therefore, no consultation with the U.S. Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 *et seq.*) is required for those species.

QUALIFICATION INTERVIEW

1. Does the proposed project include, or is it reasonably certain to cause, intentional take of the northern long-eared bat or any other listed species?

   Note: Intentional take is defined as take that is the intended result of a project. Intentional take could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered or proposed species?

   No

2. The proposed action does not intersect an area where the northern long-eared bat is likely to occur, based on the information available to U.S. Fish and Wildlife Service as of the most recent update of this key. If you have data that indicates that northern long-eared bats are likely to be present in the action area, answer "NO" and continue through the key.

   Do you want to make a no effect determination?

   Yes

PROJECT QUESTIONNAIRE

IPAC USER CONTACT INFORMATION

Agency:	GM2 Associates, Inc.
Name:	Ethan Maskiell
Address:	197 Loudon Road
Address Line 2:	Suite 310
City:	Concord
State:	NH
Zip:	03301
Email	emaskiell@gm2inc.com
Phone:	6038567854

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Army Corps of Engineers

New Hampshire DOT
Department of Transportation

William Cass, P.E.
Commissioner

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

David Rodrigue, P.E.
Assistant Commissioner

Andre Briere, Colonel, USAF (RET)
Deputy Commissioner

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RECEIVED
BUREAU OF ENVIRONMENT
JAN 09 2023
NH DEPARTMENT
OF TRANSPORTATION

NOTTINGHAM
40612
RPR 10862

No Historic Properties Affected Memo

Pursuant to the Request for Project Review signed on July 9, 2019 and meetings and discussions on January 14, 2021, and for the purpose of compliance with regulations of the National Historic Preservation Act, the Advisory Council on Historic Preservation's *Procedures for the Protection of Historic Properties* (36 CFR 800), and the US Army Corps of Engineers' *Appendix C*; the NH Division of Historical Resources (SHPO) and the US Army Corps of Engineers (ACOE) have coordinated the identification and evaluation of cultural resources with plans to replace the bridge that carries NH Route 152 over the North River (Bridge No. 141/127) in Nottingham.

Project Description
This project would replace the NH Route 152 bridge over the North River (Bridge No. 141/127) in Nottingham. The existing bridge is a reinforced concrete jack-arch structure with a 17-foot span that was constructed in 1925 and rebuilt in 1970. The preferred alternative would replace the existing structure with a 30-foot span bridge. The preferred alternative also involves 200 feet of roadway widening on each side of the bridge to transition the additional three feet on each side of the roadway at each bridge approach back to the existing roadway. As currently proposed, the bridge would be closed during construction and traffic would be detoured.

Impacts would be limited to the area around the bridge, although some widening of the roadway is required. Easements would be required around the bridge and for slope impacts beyond the existing NHDOT right-of-way.

Analysis
Based on a review pursuant to 36 CFR 800.4, Bridge No 141/127 was found not eligible (NOT0025) for the National Register of Historic Places due to a lack of integrity. A Determination of Eligibility was received on July 16, 2019.

Since the project area is considered archaeologically sensitive, a combined Phase IA/IB archaeological assessment and investigation was completed. No evidence of pre-contact land use or intact Euro-American archaeological resources were found. SHPO concurred with the results of the survey and recommendation that no additional survey was required.

Two potentially historic properties are located southeast of the bridge, at 249 and 251 Stage Road (NH Route 152). For the preferred alternative, impacts near the two properties would be located within the NHDOT right-of-way and no tree clearing near the buildings is anticipated. As such, no impacts to these potentially historic properties are expected from the preferred alternative, and survey was not recommended.

Public Consultation

NHDOT initial contact letters were sent to the Town, including the Historical Society. Additional letters were sent to the NH Conservation Land Stewardship Program, the NH Land and Community Heritage Investment Program, and the NH Land and Water Conservation Fund, the Lamprey Rivers Advisory Committee, and the Strafford Regional Planning Commission. This project was also presented at a Public Officials Meeting on February 8, 2021 and a Public Informational Meeting on November 19, 2021.

Determination of Effect

Based on the project plans, ACOE has determined that there are no historic or archeological resources present in the permit area and that no additional information is needed.

In accordance with the Advisory Council's regulations, we will continue to consult, as appropriate, as this project proceeds.

Jill Edelmann

Jill Edelmann
Cultural Resources Manager

12/27/2022
Date

Concurred with by the NH State Historic Preservation Officer:

Nadine Miller, DSHPO

Nadine Miller
Deputy State Historic Preservation Officer
NH Division of Historical Resources

1/5/2023
Date

c.c. Michael Hicks, ACOE
Rebecca Martin, NHDOT
Jason Tremblay, NHDOT
Jenn Riordan, GM2

US Army Corps of Engineers®
New England District

Appendix B
New Hampshire General Permits
Required Information and USACE Section 404Checklist

USACE Section 404 Checklist

1. Attach any explanations to this checklist. Lack of information could delay a USACE permit determination.
2. All references to “work” include all work associated with the project construction and operation. Work includes filling, clearing, flooding, draining, excavation, dozing, stumping, etc.
3. See GC 3 for information on single and complete projects.
4. Contact USACE at (978) 318-8832 with any questions.
5. The information requested below is generally required in the NHDES Wetland Application. See page 61 for NHDES references and Admin Rules as they relate to the information below.

1. Impaired Waters	Yes	No
1.1 Will any work occur within 1 mile upstream in the watershed of an impaired water? See the following to determine if there is an impaired water in the vicinity of your work area. * https://nhdes-surface-water-quality-assessment-site-nhdes.hub.arcgis.com/ https://www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment https://www4.des.state.nh.us/onestopdatamapper/onestopmapper.aspx	X*	
2. Wetlands	Yes	No
2.1 Are there are streams, brooks, rivers, ponds, or lakes within 200 feet of any proposed work?	X*	
2.2 Are there proposed impacts to tidal SAS, prime wetlands, or priority resource areas? Applicants may obtain information from the NH Department of Resources and Economic Development Natural Heritage Bureau (NHB) DataCheck Tool for information about resources located on the property at https://www4.des.state.nh.us/NHB-DataCheck/.	X*	
2.3 If wetland crossings are proposed, are they adequately designed to maintain hydrology, sediment transport & wildlife passage?	X	
2.4 Would the project remove part or all of a riparian buffer? (Riparian buffers are lands adjacent to streams where vegetation is strongly influenced by the presence of water. They are often thin lines of vegetation containing native grasses, flowers, shrubs and/or trees that line the stream banks. They are also called vegetated buffer zones.)		X
2.5 The overall project site is more than 40 acres?		X
2.6 What is the area of the previously filled wetlands?	~16,500 SF	
2.7 What is the area of the proposed fill in wetlands?	538 SF	
2.8 What % of the overall project sire will be previously and proposed filled wetlands?	~50%	
3. Wildlife	Yes	No
3.1 Has the NHB & USFWS determined that there are known occurrences of rare species, exemplary natural communities, Federal and State threatened and endangered species and habitat, in the vicinity of the proposed project? (All projects require an NHB ID number & a USFWS IPAC determination.) NHB DataCheck Tool: https://www4.des.state.nh.us/NHB-DataCheck/. USFWS IPAC website: https://ipac.ecosphere.fws.gov/	X*	

3.2 Would work occur in any area identified as either "Highest Ranked Habitat in N.H." or "Highest Ranked Habitat in Ecological Region"? (These areas are colored magenta and green, respectively, on NH Fish and Game's map, "2010 Highest Ranked Wildlife Habitat by Ecological Condition.") Map information can be found at: • PDF: https://wildlife.state.nh.us/wildlife/wap-high-rank.html. • Data Mapper: www.granit.unh.edu. • GIS: www.granit.unh.edu/data/downloadfreedata/category/databycategory.html.	X*	
3.3 Would the project impact more than 20 acres of an undeveloped land block (upland, wetland/waterway) on the entire project site and/or on an adjoining property(s)?		X
3.4 Does the project propose more than a 10-lot residential subdivision, or a commercial or industrial development?		X
3.5 Are stream crossings designed in accordance with the GC 31?	X	
4. Flooding/Floodplain Values	Yes	No
4.1 Is the proposed project within the 100-year floodplain of an adjacent river or stream?	X*	
4.2 If 4.1 is yes, will compensatory flood storage be provided if the project results in a loss of flood storage?	N/A - No substantial loss of flood storage anticipated	
5. Historic/Archaeological Resources		
For a minimum, minor or major impact project - a copy of the RPR Form (www.nh.gov/nhdhr/review) with your DES file number shall be sent to the NH Division of Historical Resources as required on Page 37 GC 14(d) of the GP document**	X	
6. Minimal Impact Determination (for projects that exceed 1 acre of permanent impact)	Yes	No
Projects with greater than 1 acre of permanent impact must include the following: • Functional assessment for aquatic resources in the project area. • On and off-site alternative analysis. • Provide additional information and description for how the below criteria are met.	N/A	
6.1 Will there be complete loss of aquatic resources on site?		
6.2 Have the impacts to the aquatic resources been avoided and minimized to the greatest extent practicable?		
6.3 Will all aquatic resource function be lost?		
6.4 Does the aquatic resource (s) have regional significance (watershed or ecoregion)?		
6.5 Is there an on-site alternative with less impact?		
6.6 Is there an off-site alternative with less impact?		
6.7 Will there be a loss to a resource dependent species?		
6.8 Are indirect impacts greater than 1 acre within and adjacent to the project area?		
6.9 Does the proposed mitigation replace aquatic resource function for direct, indirect, and cumulative impacts?		

*Although this checklist utilizes state information, its submittal to USACE is a federal requirement.

** If your project is not within Federal jurisdiction, coordination with NH DHR is not required under Federal law.

USACE Section 404 Checklist (Appendix B)
Supplemental Information

1.1. The segment of the North River within the project area (Assessment Unit ID NHRIV600030705-13) is listed as impaired for pH and mercury, based on a review of the NHDES 2020/2022 Surface Water Quality Assessment Viewer.

2.1. The project involves the repair of the bridge that carries the NH Route 152 over the North River.

2.2. The project proposes impacts to Priority Resource Areas (floodplain wetlands contiguous to a tier 3 watercourse and wetlands that have documented occurrences of protected species habitat).

3.1. The NH Natural Heritage Bureau (NHB) Report (NHB23-3677) indicated that several state-listed species occur within the vicinity of the project area, including: climbing hempvine (endangered), American eel (special concern), Blanding's turtle (endangered), bridle shiner (threatened), northern black racer (threatened), spotted turtle (threatened), wood turtle (special concern). Of these, only Blanding's turtle has a recorded occurrence within the project area. No exemplary natural communities were included in the NHB report.

The USFWS IPaC report indicated that northern long-eared bat (NLEB) and monarch butterfly may occur within the project area. A No Effect Determination for NLEB was received using the Rangewide Determination Key in IPaC.

3.2. The North River and adjacent wetlands within the project area are mapped as "Highest Ranked Habitat in NH".

4.2 The segment of the North River within the project area has a Zone A floodplain but there is no regulatory floodway, based on a review of the FEMA Flood Insurance Rate Map. The hydraulic analysis completed for the project indicated that the proposed bridge would provide the capacity to convey both the 100-year and 500-year flood without weir flow (i.e., flow overtopping the roadway or a controlling grade). For the 100-year flood, over 1 foot of freeboard would be provided. Outside of the roadway, the project would result in an estimated 100 cubic yards of fill within the Zone A floodplain. An estimated 55 cubic yards would be removed, so the project would result in a net fill of approximately 45 cubic yards within Zone A floodplain. Given the extensive floodplain within the surrounding area, this fill would not be expected to have a noticeable impact on overall flood storage.

Photo 1. View south toward the North River and Wetland 6 (Impact Areas A, B, C, and D) in the southeast bridge quadrant. Photo taken on 5/31/2019.

Photo 2. View northwest of Bridge No. 141/127, looking toward Impact Areas C and F (east/upstream side of bridge). Photo taken on 5/31/2019.

Photo 3. View north of downstream (west) side of Bridge No. 141/127, looking toward Impact Areas H, I, J, K, and L. Photo taken on 5/31/2019.

Photo 4. View south of Bridge No. 141/127, looking toward Impact Areas G, H, I, J, K, and L (west/downstream side of bridge). Photo taken on 5/31/2019.

Photo 5. View south toward Impact Areas M and N (Wetland 5), located in the southwest bridge quadrant. Photo taken on 5/31/2019.

Photo 6. View east of the North River upstream of project area. Photo taken on 5/31/2019.

Photo 7. View west of the North River downstream of the project area. Photo taken on 5/31/2019.

Photo 8. View north along NH Route 152 toward Bridge No. 141/127. Photo taken on 5/31/2019.

Construction Sequence

1. Install perimeter controls.
2. Perform necessary clearing operations for access and staging.
3. Install stream diversion and other sedimentation controls/BMPs as needed.
4. Close road and detour traffic.
5. Excavate for bridge foundations.
6. Install precast concrete footings and pedestal walls.
7. Install precast concrete rigid frame and wing walls.
8. Backfill structures.
9. Cast concrete overlay on top of rigid frame.
10. Construct roadway subgrade and pavement.
11. Install guardrail.
12. Stabilize disturbed areas.
13. Remove erosion and sedimentation control measures.

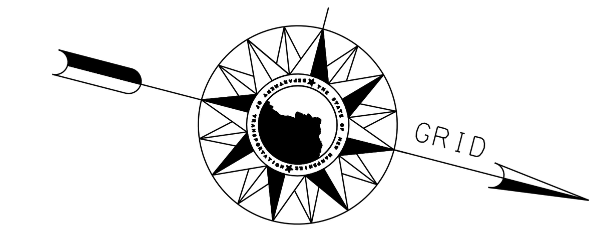
STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

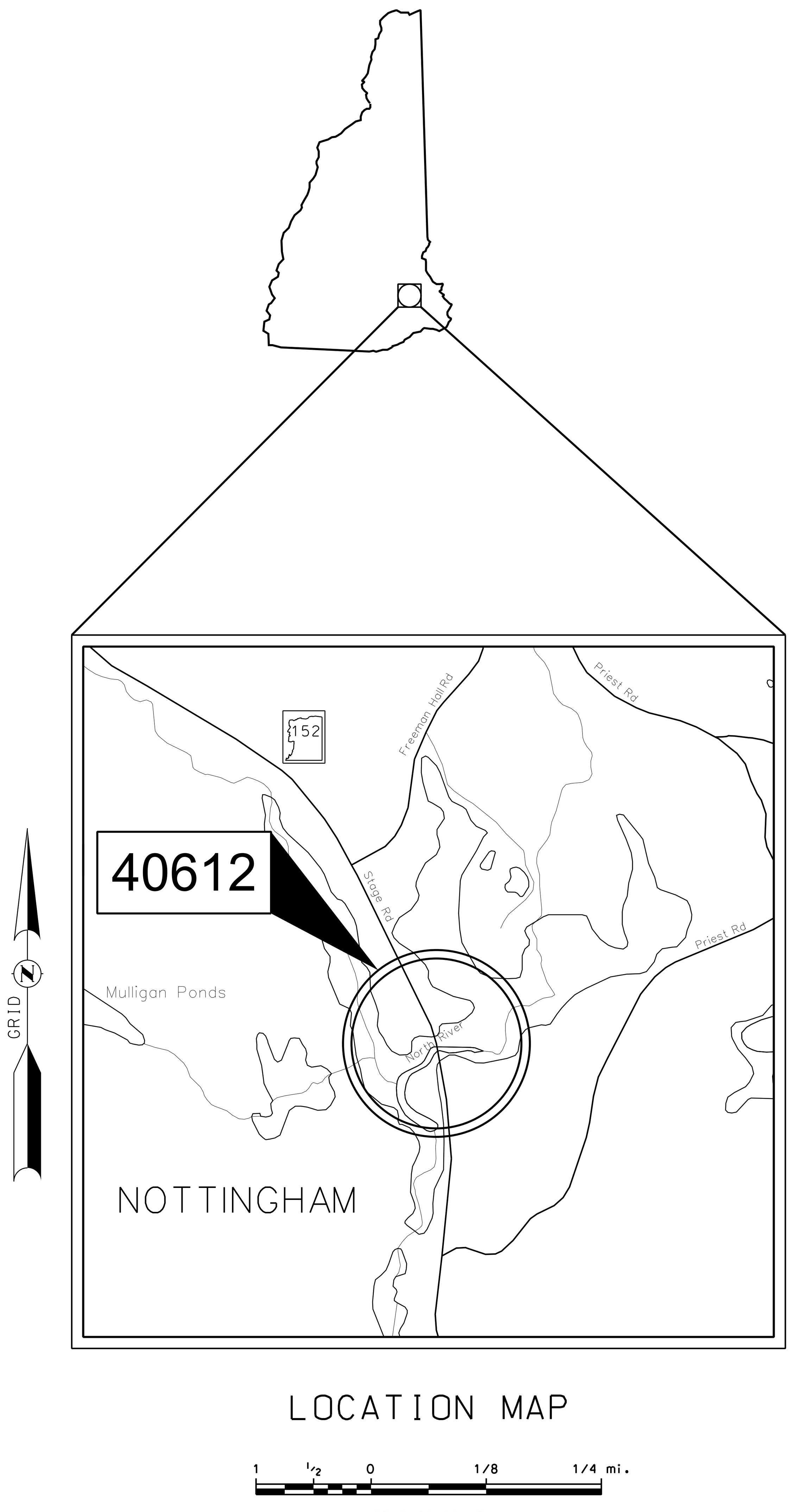
WETLAND PLANS
BRIDGE REPLACEMENT PROJECT

NH PROJECT NO. 40612
NH ROUTE 152 OVER NORTH RIVER
BRIDGE NO. 141/127

DESIGN DATA

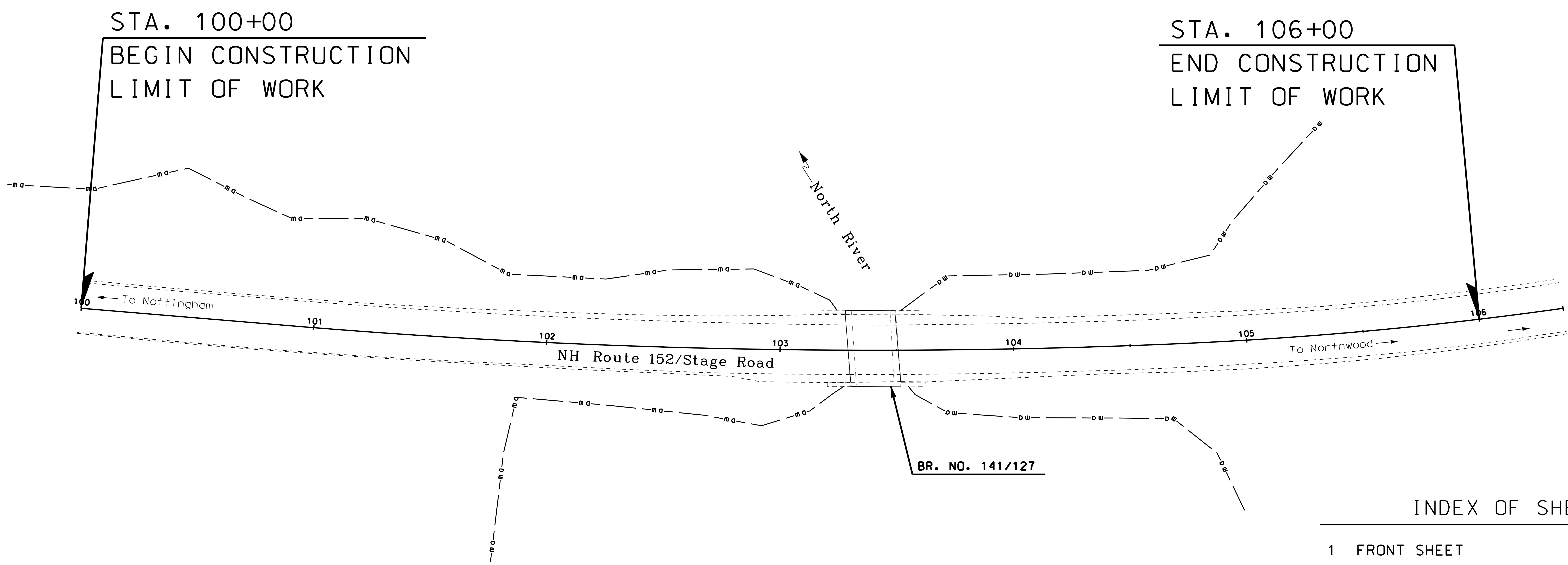
AVERAGE DAILY TRAFFIC 20 22	3415
AVERAGE DAILY TRAFFIC 20 –	–
PERCENT OF TRUCKS	–
DESIGN SPEED	40 MPH
LENGTH OF PROJECT	600 FT





LOCATION MAP

1 1/2 0 1/8 1/4 mi.
GRAPHIC SCALE



INDEX OF SHEETS

1	FRONT SHEET
2-3	STANDARD SYMBOL SHEETS
4	WETLAND IMPACT PLAN
5	EROSION CONTROL NOTES AND STRATEGIES
6	EROSION CONTROL PLAN
7	EXISTING CONDITIONS PLAN
8	GENERAL PLAN AND ELEVATION
9	SITE PLAN AND PROFILE
10	SECTION A-A & STREAM PROFILE

DRAWN BY: C.SWEET DATE 03/2024
CHECKED BY: J.MERCER DATE 03/2024

STATE OF NEW HAMPSHIRE
Jennifer Riordan
No. 269
CERTIFIED WETLAND SCIENTIST
3/27/24
DELINEATION

THE STATE OF NEW HAMPSHIRE
THOMAS P. LEVINS
No. 7092
LICENSED PROFESSIONAL ENGINEER
3/28/24
DESIGN

TOWN OF NOTTINGHAM
COUNTY OF ROCKINGHAM
SCALE: 1" = 30'

FOR CONSTRUCTION AND ALIGNMENT DETAILS - SEE CONSTRUCTION PLANS

GM2 Associates, Inc.
197 Loudon Road, Suite 310
Concord, NH 03301
Tel: 603-856-7854
Fax: 603-856-7855

NHDOT THE STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR APPROVAL:

DIRECTOR OF PROJECT DEVELOPMENT — DATE

APPROVED:

ASSISTANT COMMISSIONER AND CHIEF ENGINEER — DATE

FEDERAL PROJECT NO.	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
--	40612	1	10

GENERAL

	PROPOSED ROADWAY	existing roadway	(pavement removed outside slope lines)
EDGE OF PAVEMENT			
TRAVELED WAY			

DRIVEWAYS — (labelsurface type)

BUILDINGS — (label house or type of building) — (building to be removed)

FOUNDATION — (label type)

LEACH FIELD — leach field

BRIDGE CROSSINGS — STREAM — OVERPASS

STEPS AND WALK — (label type)

INTERMITTENT WATER COURSE

SHORE LINE — river/stream — pond — (label name of water body)

POTENTIAL WET AREA SYMBOL

BRUSH OR WOODS LINE

TREES (PLANS) — (deciduous)(coniferous) (stump)

(show station, circumference in feet & type)

TREE OR STUMP (CROSS-SECTIONS)

HEDGE — (label type)

MONITORING WELL — mon

WELL

FLAG POLE — fp

ORIGINAL GROUND (TYPICALS)

ROCK OUTCROP

ROCK LINE (TYPICALS & SECTIONS ONLY)

	existing	PROPOSED
GUARDRAIL (label type)	bgr cgr	
JERSEY BARRIER		
CURB (LABEL TYPE)		
STONE WALL		
RETAINING WALL (LABEL TYPE)		(points toward retained ground)
FENCE (LABEL TYPE)		

SIGNS — (single post) (double post)

GAS PUMP — gp

FUEL TANK (ABOVE GROUND) — ft (label size & type)

STORAGE TANK FILLER CAP — fc

SEPTIC TANK — S

GRAVE — gr

MAILBOX — mb

VENT PIPE — vp

SATELLITE DISH ANTENNA — da

PHONE — ph

GROUND LIGHT/LAMP POST — gl lp

BORING LOCATION — B

TEST PIT — TP

INTERSTATE NUMBERED HIGHWAY — 293

UNITED STATES NUMBERED HIGHWAY — 3

STATE NUMBERED HIGHWAY — 102

SHORELAND - WETLAND

WETLAND DESIGNATION AND TYPE	2 PUB2E
DELINEATED WETLAND	DW
ORDINARY HIGH WATER	OHW
TOP OF BANK	TOB
TOP OF BANK & ORDINARY HIGH WATER	TOBOHW
NORMAL HIGH WATER	NHW
WIDTH AT BANK FULL	WBF
PRIME WETLAND	PWET
PRIME WETLAND 100' BUFFER	PWET100
NON-JURISDICTIONAL DRAINAGE AREA	NJDA
COWARDIN DISTINCTION LINE	CDL
TIDAL BUFFER ZONE	TBZ
DEVELOPED TIDAL BUFFER ZONE	DTBZ
HIGHEST OBSERVABLE TIDE LINE	HOTL
MEAN HIGH WATER	MHW
MEAN LOW WATER	MLW
VERNAL POOL	VP
SPECIAL AQUATIC SITE	SAS
REFERENCE LINE	REF
WATER FRONT BUFFER	WB50
NATURAL WOODLAND BUFFER	NWB150
PROTECTED SHORELAND	PS250
INVASIVE SPECIES LABEL	I.S. I I.S. II
INVASIVE SPECIES	INV

FLOODPLAIN / FLOODWAY

500 YEAR FLOODPLAIN BOUNDARY	FP500
100 YEAR FLOODPLAIN BOUNDARY	FP100
FLOODWAY	FW

ENGINEERING

CONSTRUCTION BASELINE — 30 31 32

PC, PT, POT (ON CONST BASELINE)

PI (IN CONSTRUCTION BASELINES)

INTERSECTION OR EQUATION OF TWO LINES

ORIGINAL GROUND LINE (PROFILES AND CROSS-SECTIONS)

PROFILE GRADE LINE (PROFILES AND CROSS-SECTIONS)

SLOPE LINE — CLEARING LINE

CLEARING LINE

SLOPE LINE

SLOPE LINE (FILL)

SLOPE LINE (CUT)

PROFILES AND CROSS SECTIONS:
ORIGINAL GROUND ELEVATION (LEFT) — 72.5
FINISHED GRADE ELEVATION (RIGHT) — 79.14

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
11-21-2014	STDSYMB 1		2	10

DRAINAGE

MANHOLE
CATCH BASIN
DROP INLET

cb (existing) (PROPOSED)
di

DRAINAGE PIPE (existing)
DRAINAGE PIPE (PROPOSED)
(label size & type)

UNDERDRAIN (existing) W/ FLUSHING BASIN
UNDERDRAIN (PROPOSED) W/ FLUSHING BASIN
show direction of flow
fb
(label size & type)

HEADER (existing & PROPOSED)
(with stone outlet protection)

END SECTION (existing & PROPOSED)
METAL or PLASTIC
RCP

OPEN DITCH (PROPOSED)

EROSION CONTROL/ STONE SLOPE PROTECTION

BOUNDARIES / RIGHT-OF-WAY

RIGHT-OF-WAY LINE (label type)
RR RIGHT-OF-WAY LINE
PROPERTY LINE
PROPERTY LINE (COMMON OWNER)
TOWN LINE — BOW / CONCORD
COUNTY LINE — COOS / GRAFTON
STATE LINE — MAINE / NEW HAMPSHIRE
NATIONAL FOREST
CONSERVATION LAND — LC
BENCH MARK / SURVEY DISK
BOUND — bnd (PROPOSED)
STATE LINE/ TOWN LINE MONUMENT — S/L T/L
NHDOT PROJECT MARKER
IRON PIPE OR PIN — ip
DRILL HOLE IN ROCK — dh
TAX MAP AND LOT NUMBER — 156 14 — 1642/341 — 6.80 Ac.±
PROPERTY PARCEL NUMBER — 12
HISTORIC PROPERTY — H

UTILITIES

existing PROPOSED

TELEPHONE POLE
POWER POLE
JOINT OCCUPANCY
MISCELLANEOUS/UNKNOWN POLE
GUY POLE OR PUSH BRACE
(plot point at face not center of symbol)

LIGHT POLE
LIGHT ON POWER POLE
LIGHT ON JOINT POLE

POLE STATUS:
REMOVE, LEAVE, PROPOSED, OR TEMPORARY AS APPLICABLE e.g.:
R L P+04 25.0' T+04 25.0'

RAILROAD (label ownership)
RAILROAD SIGN
RAILROAD SIGNAL
UTILITY JUNCTION BOX — jb — JB
OVERHEAD WIRE — OW (label type) — OW

UNDERGROUND UTILITIES

WATER (on existing lines label size, type and note if abandoned) — W — PW
SEWER — S — PS
TELEPHONE — T — PT
ELECTRIC — E — PE
GAS — G — PG
LIGHTING — L — PL
INTELLIGENT TRANSPORTATION SYSTEM — ITS — PITS
FIBER OPTIC — FO — PFO
WATER SHUT OFF — WSO
GAS SHUT OFF — GSO
HYDRANT — hyd — HYD

MANHOLES

SEWER — MHS
TELEPHONE — MHT
ELECTRICAL — MHE
GAS — MHG
UNKNOWN

TRAFFIC SIGNALS / ITS

existing PROPOSED

MAST ARM (existing) — 30' MA (NOTE ANGLE FROM ℄)
OPTICOM RECEIVER
OPTICOM STROBE
TRAFFIC SIGNAL
PEDESTAL WITH PEDESTRIAN SIGNAL HEADS AND PUSH BUTTON UNIT
SIGNAL CONDUIT — C — PC
CONTROLLER CABINET — cc — CC
METER PEDESTAL — mp — MP
PULL BOX — pb — PB
LOOP DETECTOR (QUADRUPOLE) — (label size)
LOOP DETECTOR (RECTANGULAR) — (label size)
CAMERA POLE (CCTV)
FIBER OPTIC DELINEATOR — fod — FOD
FIBER OPTIC SPLICE VAULT — SVF
ITS EQUIPMENT CABINET — its — ITS
VARIABLE SPEED LIMIT SIGN
DYNAMIC MESSAGE SIGN
ROAD AND WEATHER INFO SYSTEM

CONSTRUCTION NOTES

CURB MARK NUMBER - BITUMINOUS — B-1
CURB MARK NUMBER - GRANITE — G-1
CLEARING AND GRUBBING AREA — A
DRAINAGE NOTE — 1
EROSION CONTROL NOTE — A
FENCING NOTE — A
GUARDRAIL NOTE — 1
ITS NOTE — 1
LIGHTING NOTE — A
TRAFFIC SIGNAL NOTE — 1

SHEET 2 OF 2

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
9-1-2016	STDSYMB 2		3	10

LEGEND

WETLAND CLASSIFICATION CODES	
PEM/PSS1E	PALUSTRINE, EMERGENT, PERSISTENT/PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED
R2UBH	RIVERINE, LOWER PERENNIAL, UNCONSOLIDATED BOTTOM, PERMANENTLY FLOODED
PF01E	PALUSTRINE, FORESTED, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED

TYPE OF WETLAND IMPACT	SHADING/ HATCHING
NEW HAMPSHIRE WETLANDS BUREAU (PERMANENT NON-WETLAND)	
NEW HAMPSHIRE WETLANDS BUREAU & ARMY CORP OF ENGINEERS (PERMANENT WETLAND)	
TEMPORARY IMPACTS	

- # WETLAND DESIGNATION NUMBER
- # WETLAND IMPACT LOCATION
- # WETLAND MITIGATION AREA
- MITIGATION

WETLAND NUMBER	WETLAND CLASS	LOCATION IDENTIFIER	WOTUS (Y/N)	AREA IMPACTS PERMANENT NHWB JURISDICTION SF	NHWB JURISDICTION LF	NHWB & ACOE JURISDICTION SF	NHWB & ACOE JURISDICTION LF	TEMPORARY SF	TEMPORARY LF	LINEAR STREAM IMPACTS FOR MITIGATION PERMANENT BANK LEFT LF	BANK RIGHT LF	CHANNEL LF
6	PEM/PSS1E	A	Y		24	108						
6	PEM/PSS1E	B	Y					174	11			
2	R2UBH	C	Y			1292	43					
2	R2UBH	D	Y					555	11			
3	PEM/PSS1E	E	Y					247	15			
3	PEM/PSS1E	F	Y		32	142						
5	PEM/PSS1E	G	Y					80	16			
5	PEM/PSS1E	H	Y		22	58						
1	R2UBH	I	Y			1109	38					
1	R2UBH	J	Y					648	10			
4	PEM/PSS1E	K	Y		23	70						
4	PEM/PSS1E	L	Y					198	11			
5	PF01E	M	Y			126						
5	PEM/PSS1E	N	Y			34						
			TOTAL		101	2939	81	1902	74			

PERMANENT IMPACTS: 2939 SF
TEMPORARY IMPACTS: 1902 SF
TOTAL IMPACTS: 4841 SF

NOTES:

1. WETLANDS WERE DELINEATED BY JENNIFER RIORDAN (CWS #269) OF GM2 ASSOCIATES, INC. ON MAY 31, 2019 IN ACCORDANCE WITH THE US ARMY CORPS OF ENGINEERS (ACOE) 1987 METHODOLOGY AND THE ACOE NORTHCENTRAL AND NORTHEAST REGION SUPPLEMENT (2012).
2. WETLAND BOUNDARIES WERE FIELD CHECKED AND UPDATED ON DECEMBER 7, 2023 BY JENNIFER RIORDAN (CWS #269) OF GM2 ASSOCIATES, INC.
3. PROJECT IS LOCATED WITHIN 100-YEAR ZONE A FLOODPLAIN.

20 0 20 40
SCALE IN FEET

REVISIONS AFTER PROPOSAL: NUMBER | DATE | STATION | STATION | DESCRIPTION

SDR PROCESSED C.SWEET DATE 3/28/2024
NEW DESIGN S.HILL DATE 3/28/2024
SHEET CHECKED J.MERCER DATE 3/28/2024
AS BUILT DETAILS DATE

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION • BUREAU OF BRIDGE DESIGN

WETLAND IMPACT PLAN

GM2

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
40612pwt01	40612	4	10

EROSION CONTROL NOTES AND STRATEGIES

1. Erosion Control/Stormwater Control Selection, Sequencing and Maintenance
   - 1.1. Comply with RSA 485-A:17 Terrain Alteration.
   - 1.2. Install and maintain all erosion control/stormwater controls in accordance with the New Hampshire Stormwater Management Manual, Volume 3, Erosion and Sediment Controls During Construction, December 2008 (BMP Manual), available from the NH Department of Environmental Services (NHDES).
   - 1.3. Install erosion control/stormwater control measures prior to the start of work and in accordance with the manufacturer's recommendations.
   - 1.4. Select erosion control/stormwater control measures based on the size and nature of the project and physical characteristics of the site, including slope, soil type, vegetative cover, and proximity to jurisdictional areas.
   - 1.5. Install perimeter controls prior to earth disturbing activities.
   - 1.6. Install stormwater treatment ponds and drainage swales before rough grading the site.
   - 1.7. Clean, replace, and augment stormwater control measures and infiltration basins as necessary to prevent sedimentation beyond project limits throughout the project duration.
   - 1.8. Inspect erosion and sediment control measures in accordance with Section 645 of the specifications, weekly, and within 24 hours (during normal work hours), of any storm event greater than 0.25 inches of rain in a 24-hour period.
   - 1.9. Contain stockpiles with temporary perimeter controls. Protect inactive soil stockpiles with soil stabilization measures (temporary erosion control seed mix and mulch, soil binder) or cover them with anchored tarps. If the stockpile is to remain undisturbed for more than 14 days, mulch the stockpile.
   - 1.10. Maintain temporary erosion and stormwater control measures in place until the area has been permanently stabilized.
   - 1.11. An area is considered stable if one of the following has occurred:
     - Base course gravels have been installed in areas to be paved;
     - A minimum of 85% vegetative growth has been established;
     - A minimum of 3"of non-erosive material such as stone or rip-rap has been installed;
     - Temporary slope stabilization has been properly installed (see Table 1).
   - 1.12. Direct runoff to temporary practices until permanent stormwater infrastructure is constructed and stabilized.
   - 1.13. Use temporary mulching, permanent mulching, temporary vegetative cover, and permanent vegetative cover to reduce the need for dust control. Use mechanical sweepers on paved surfaces where necessary to prevent dust buildup. Apply water, or other dust inhibiting agents or tackifiers.
   - 1.14. Plan activities to account for sensitive site conditions
     - Sequence construction to limit the duration and area of exposed soils.
     - Clearly flag areas to be protected in the field and provide construction barrier to prevent trafficking outside of work areas.
     - Protect and maximize existing native vegetation and natural forest buffers between construction activities and sensitive areas.
     - When work is undertaken in a flowing watercourse, implement stream flow diversion methods prior to any excavation or filling activity.
   - 1.15. Utilize storm drain inlet protection to prevent sediment from entering a storm drainage system prior to the permanent stabilization of the contributing disturbed area.
   - 1.16. Use care to ensure that sediments do not enter any existing catch basins during construction. Place temporary inlet protection at inlets in areas of soil disturbance that are subject to sedimentation.
   - 1.17. Construct, stabilize, and maintain temporary and permanent ditches in a manner that will minimize scour. Direct temporary and permanent ditches to drain to sediment basins or stormwater collection areas.
   - 1.18. Supplement channel protection measures with perimeter control measures when ditch lines occur at the bottom of long fill slopes. Install the perimeter controls on the fill slope to minimize the potential for fill slope sediment deposits in the ditch line.
   - 1.19. Divert sediment laden water away from drainage inlet structures to the extent possible.
   - 1.20. Install sediment barriers and sediment traps at drainage inlets to prevent sediment from entering the drainage system.
   - 1.21. Clean catch basins, drainage pipes, and culverts if significant sediment is deposited.
   - 1.22. Construct and stabilize dewatering infiltration basins prior to any excavation that may require dewatering.
   - 1.23. Place and stabilize temporary sediment basins or traps at locations where concentrated flow (channels and pipes) discharge to the surrounding environment from areas of unstabilized earth disturbing activities.
   - 1.24. Stabilize, to appropriate anticipated velocities, conveyance channels or pumping systems needed to convey construction stormwater to basins and discharge locations prior to use.
   - 1.25. Size temporary sediment basins to contain the 2-year, 24 hour storm event.
   - 1.26. Size temporary sediment traps to contain 3,600 cubic feet of storage for each acre of drainage area.
   - 1.27. Construct detention basins to accommodate the 2-year, 24-hour storm event.

2. Construction Planning
   - 2.1. Divert off site runoff or clean water away from the construction activities to reduce the volume that needs to be treated on site.
   - 2.2. Divert storm runoff from upslope drainage areas away from disturbed areas, slopes and around active work areas to a stabilized outlet location.
   - 2.3. Construct impermeable barriers, as necessary, to collect or divert concentrated flows from work or disturbed areas.
   - 2.4. Locate staging areas and stockpiles outside of wetlands jurisdiction.
   - 2.5. Do not store, maintain, or repair mobile heavy equipment in wetlands, unless equipment cannot be practicably removed and secondary containment is provided.
   - 2.6. Provide a water truck to control excessive dust, at the discretion of the Contract Administrator.

3. Site Stabilization
   - 3.1. Stabilize all areas of unstabilized soil as soon as practicable, but no later than 45 days after initial disturbance.
   - 3.2. Limit unstabilized soil to a maximum of 5 acres unless documentation is provided that demonstrates that cuts and fills are such that 5 acres is unreasonable.
   - 3.3. Use erosion control seed mix in all inactive construction areas that will not be permanently seeded within two weeks of disturbance and prior to September 15^{th} of any given year in order to achieve vegetative stabilization prior to the end of the growing season.
   - 3.4. Apply, and reapply as necessary, soil tackifiers in accordance with the manufacturer's specifications to minimize soil and mulch loss until permanent vegetation is established.
   - 3.5. Stabilize basins, ditches and swales prior to directing runoff to them.
   - 3.6. Stabilize roadway and parking areas within 72 hours of achieving finished grade.
   - 3.7. Stabilize cut and fill slopes within 72 hours of achieving finished grade.
   - 3.8. When temporarily stabilizing soils and slopes, utilize the techniques outlined in Table 1.
   - 3.9. Stabilize all areas that can be stabilized prior to opening up new areas to construction activities.
   - 3.10. Utilize Table 1 when selecting temporary soil stabilization measures.
   - 3.11. Divert off-site water through the project in an appropriate manner so as not to disturb the upstream or downstream soils, vegetation or hydrology beyond the permitted area.
   - 3.12. Install and maintain construction exits anywhere traffic leaves a construction site onto a public right-of-way.
   - 3.13. Sweep all construction related debris and soil from the adjacent paved roadways, as necessary.

4. Slope Protection
   - 4.1. Intercept and divert storm runoff from upslope drainage areas away from unprotected and newly established areas and slopes to a stabilized outlet or conveyance.
   - 4.2. Consider how groundwater seepage on cut slopes may impact slope stability and incorporate appropriate measures to minimize erosion.
   - 4.3. Convey storm water down the slope in a stabilized channel or slope drain.
   - 4.4. The outer face of the fill slope should be in a loose, ruffled condition prior to turf establishment.

5. Winter Construction
   - 5.1. To minimize erosion and sedimentation impacts, limit the extent and duration of winter excavation and earthwork activities. The maximum amount of disturbed earth shall not exceed a total of 5 acres from May 1^{st} through November 30^{th}, or exceed one acre during winter months, unless the contractor demonstrates to the Department that the additional area of disturbance is necessary to meet the contractor's Critical Path Method (CPM) schedule, and the contractor has adequate resources available to ensure that environmental requirements will be met.
   - 5.2. Construction performed any time between November 30^{th} and May 1^{st} of any year is considered winter construction. During winter construction:
     - Stabilize all proposed vegetation areas which do not exhibit a minimum of 85% vegetative growth by October 15^{th}, or which are disturbed after October 15^{th}, in accordance with Table 1.
     - Stabilize all ditches or swales which do not exhibit a minimum of 85% vegetative growth by October 15^{th}, or which are disturbed after October 15^{th}, in accordance with Table 1.
     - Protect incomplete road surfaces, where base course gravels have not been installed, and where work has stopped for the season after November 30^{th}, in accordance with Table 1.
     - Unless a winter construction plan has been approved by NHDOT, conduct winter excavation and earthwork such that no more than 1 acre of the project is without stabilization an any one time.

6. Wildlife Protection Measures
   - 6.1. Report all observations of threatened and endangered species on the project site to the Department's Bureau of Environment by phone at 603-271-3226 or by email at Bureau16@dot.nh.gov, indicating in the subject line the project name, number, and that a threatened/endangered species was found.
   - 6.2. Photograph the observed species and nearby elements of habitat or areas of land disturbance and provide them to the Department's Bureau of Environment at the above email address.
   - 6.3. In the event that a threatened or endangered species is observed on the project during work, the species shall not be disturbed, handled, or harmed prior to receiving direction from the Bureau of Environment.
   - 6.4. Utilize wildlife friendly erosion control methods when:
     - Erosion control blankets are used,
     - A protected species or habitat is documented,
     - The proposed work is in or adjacent to a priority resource area, and/or when specifically requested by NHB or NHF&G

GUIDANCE ON SELECTING TEMPORARY SOIL STABILIZATION MEASURES
TABLE 1

APPLICATION AREAS	DRY MULCH METHODS				HYDRAULICALLY APPLIED MULCHES[2]				ROLLED EROSION CONTROL BLANKETS[3]			
	HMT	WC	SG	CB	HM	SMM	BFM	FRM	SNSB	DNSB	DNSCB	DNCB
SLOPES[1]												
STEEPER THAN 2:1	NO	NO	YES	NO	NO	NO	NO	YES	NO	NO	NO	YES
2:1 SLOPE	YES1	YES[1]	YES	YES	NO	NO	YES	YES	NO	YES	YES	YES
3:1 SLOPE	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	NO
4:1 SLOPE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
WINTER STABILIZATION	4T/AC	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
CHANNELS												
LOW FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
HIGH FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES

ABBREV.	STABILIZATION MEASURE	ABBREV.	STABILIZATION MEASURE	ABBREV.	STABILIZATION MEASURE
HMT	HAY MULCH & TACK	HM	HYDRAULIC MULCH	SNSB	SINGLE NET STRAW BLANKET
WC	WOOD CHIPS	SMM	STABILIZED MULCH MATRIX	DNSB	DOUBLE NET STRAW BLANKET
SG	STUMP GRINDINGS	BFM	BONDED FIBER MATRIX	DNSCB	2 NET STRAW-COCONUT BLANKET
CB	COMPOST BLANKET	FRM	FIBER REINFORCED MEDIUM	DNCB	2 NET COCONUT BLANKET

NOTES:
1. All slope stabilization options assume a slope length ≤ 10 times the horizontal distance component of the slope, in feet.
2. Do not apply products containing polyacrylamide (PAM) directly to, or within 100 feet of any surface water without NHDES approval.
3. Install all methods in Table 1 per the manufacturer's recommendation for time of year and steepness of slope.

EROSION CONTROL LEGEND

PC — PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

NB/PC — NATURAL BUFFER/PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

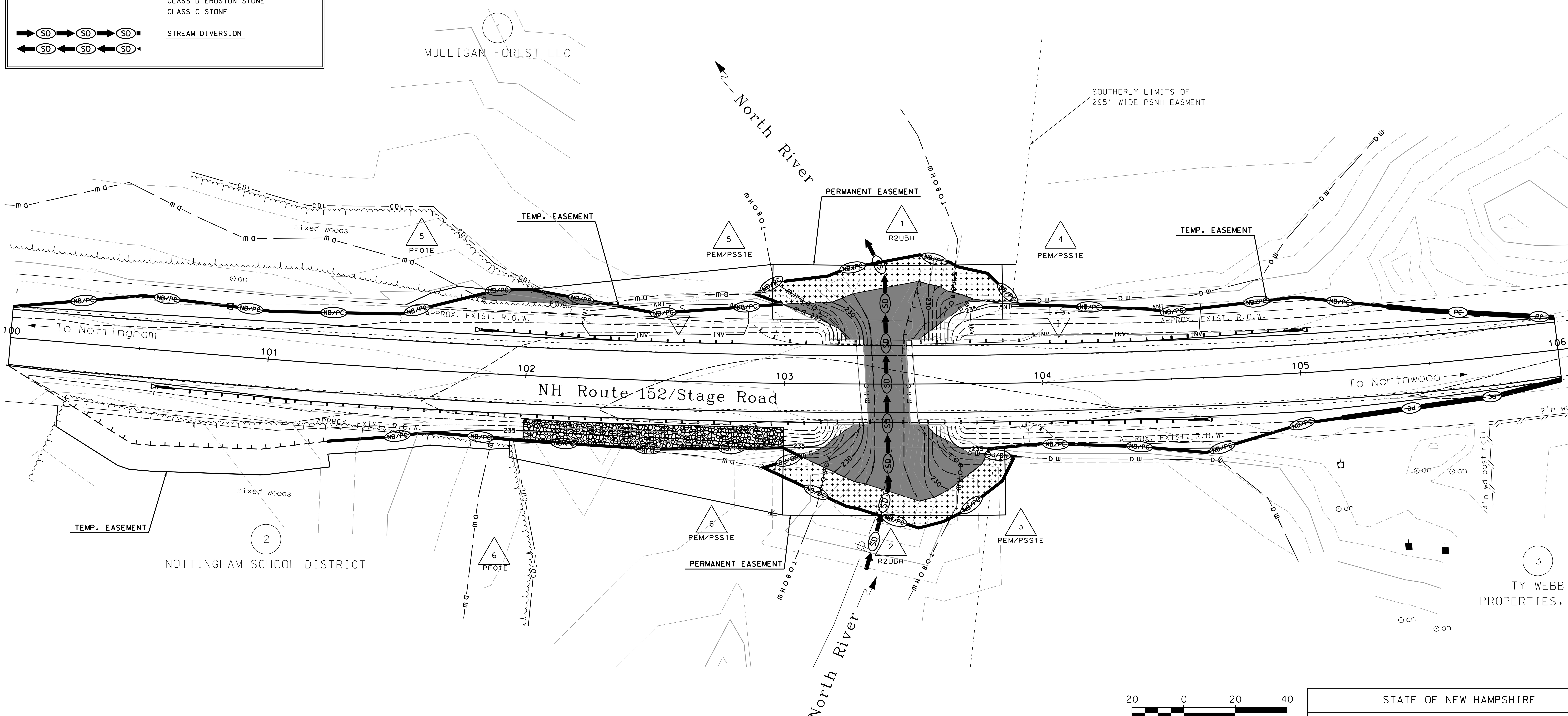
CP — CHANNEL PROTECTION
- STONE CHECK DAMS
- STRAW WATTLES
- CHANNEL MATTING
- CLASS D EROSION STONE
- CLASS C STONE

SD — STREAM DIVERSION

LEGEND

TYPE OF WETLAND IMPACT	SHADING/ HATCHING
NEW HAMPSHIRE WETLANDS BUREAU (PERMANENT NON-WETLAND)	
NEW HAMPSHIRE WETLANDS BUREAU & ARMY CORP OF ENGINEERS (PERMANENT WETLAND)	
TEMPORARY IMPACTS	

- # WETLAND DESIGNATION NUMBER
- # WETLAND IMPACT LOCATION
- # WETLAND MITIGATION AREA
- MITIGATION



20 0 20 40
SCALE IN FEET

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLAN

GM2

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
40612EROC	40612	6	10

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	C.SWEET	DATE	3/28/2024
NEW DESIGN	S.HILL	DATE	3/28/2024
SHEET CHECKED	J.MERCER	DATE	3/28/2024
AS BUILT DETAILS		DATE	

20 0 20 40

SCALE IN FEET

GM2

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

EXISTING CONDITIONS PLAN

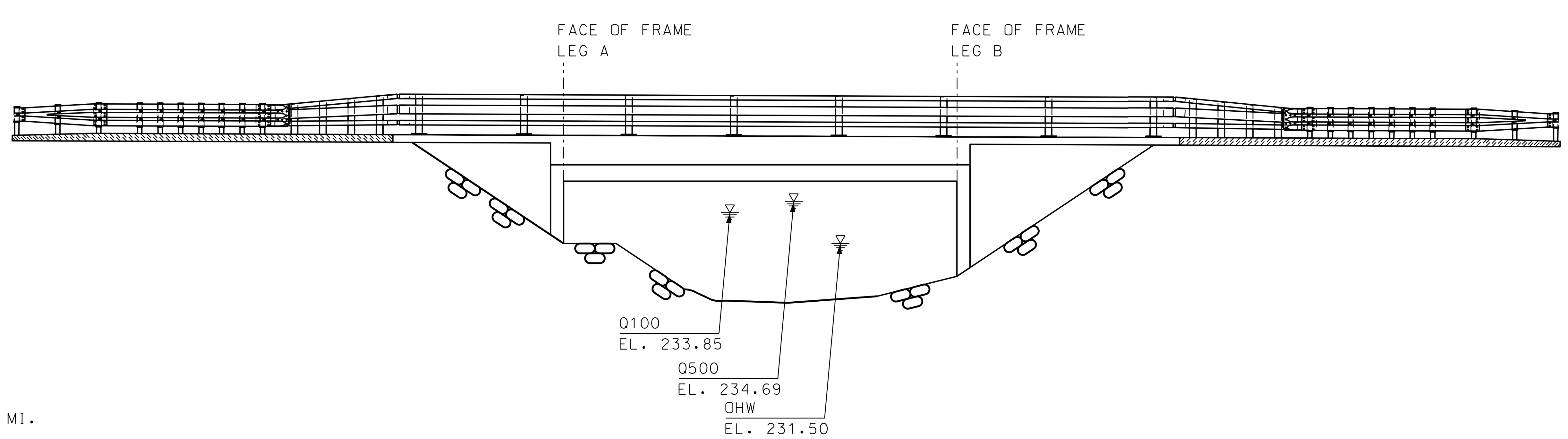
DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
40612ECO	40612	7	10

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	C.SWEET	DATE	3/28/2024
NEW DESIGN	S.HILL	DATE	3/28/2024
SHEET CHECKED	J.MERCER	DATE	3/28/2024
AS BUILT DETAILS		DATE	

PLAN
SCALE: 1/8" = 10'-0"



ELEVATION
SCALE: 1/8" = 10'-0"

HYDRAULIC DATA

1. DRAINAGE AREA: 10.64 SQ. MI.
2. DESIGN FLOOD: Q100 = 1330 CFS
3. DESIGN VELOCITY: 8.23 FPS
4. DESIGN FLOOD ELEVATION: Q100 ELEV. = 233.85
5. CHECK FLOOD: Q500 = 1880 CFS
6. CHECK FLOOD ELEVATION: Q500 ELEV. = 234.69
7. BRIDGE WATERWAY OPENING: 159.2 SF BELOW Q500 ELEV.

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN | BRIDGE NO. | STATE PROJECT
LOCATION

GENERAL PLAN AND ELEVATION

REVISIONS AFTER PROPOSAL

	BY	DATE		BY	DATE
DESIGNED	BJL	11/22	CHECKED	TPL	08/23
DRAWN	BJL	11/22	CHECKED	TPL	08/23
QUANTITIES	ZJG	08/23	CHECKED	BJL	08/23

ISSUE DATE
REV. DATE

FEDERAL PROJECT NO.

BRIDGE SHEET - OF -
FILE NUMBER

SHEET NO.	TOTAL SHEETS
8	10

SUBDIRECTORY	.DGN LOCATOR	SHEET SCALE
BRC/PRELIM	40612gen-env	AS NOTED

SITE PLAN
SCALE: 1/8" = 10'-0"

SUBDIRECTORY	.DGN LOCATOR	SHEET SCALE
BRC/PRELIM	40612site-env	AS NOTED

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN | BRIDGE NO. | STATE PROJECT
LOCATION

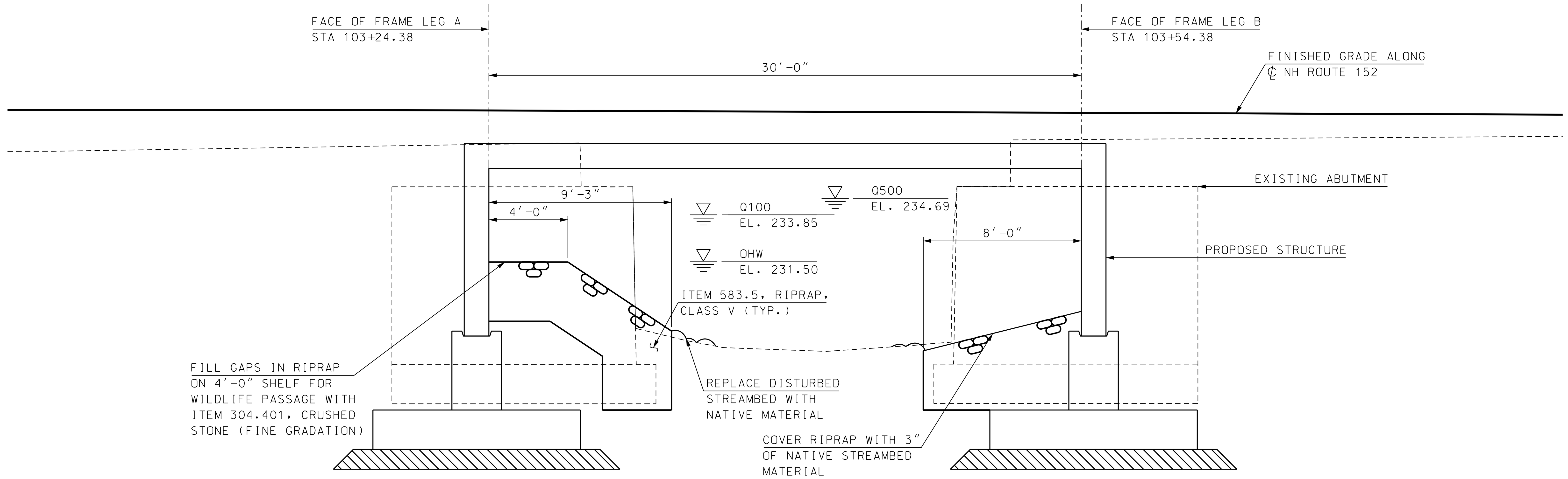
SITE PLAN

REVISIONS AFTER PROPOSAL

	BY	DATE		BY	DATE
DESIGNED	BJL	11/22	CHECKED	TPL	08/23
DRAWN	BJL	11/22	CHECKED	TPL	08/23
QUANTITIES	ZJG	08/23	CHECKED	BJL	08/23

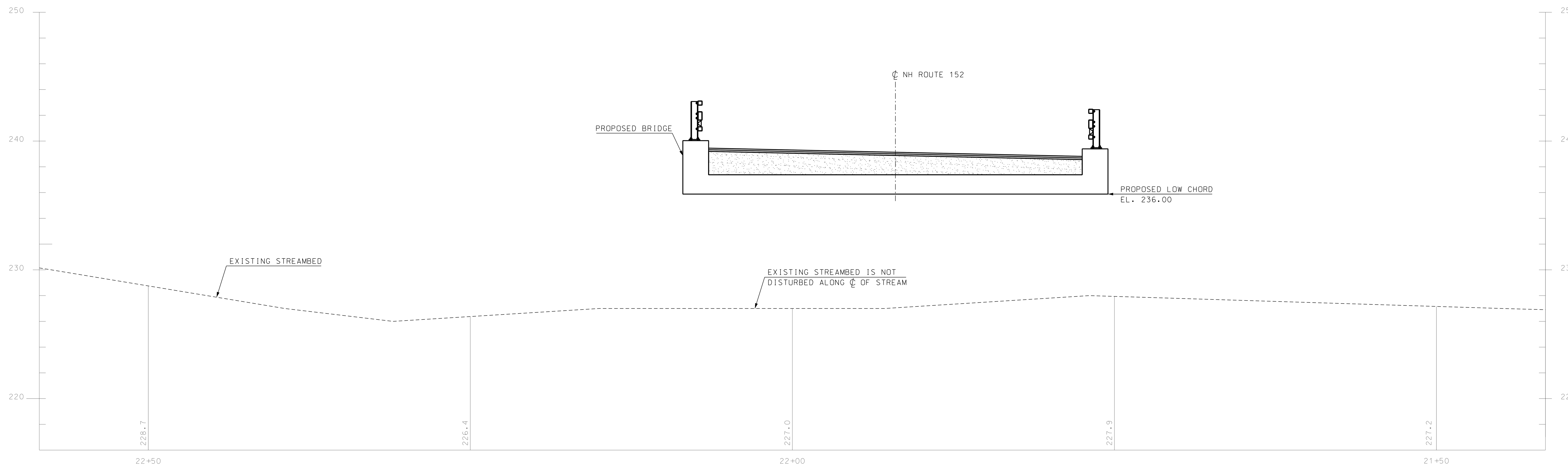
BRIDGE SHEET - OF -
FILE NUMBER

ISSUE DATE	FEDERAL PROJECT NO.	SHEET NO.	TOTAL SHEETS
REV. DATE		9	10



SECTION A-A

SCALE: 1/4" = 1'-0"



NORTH RIVER PROFILE

SCALE: 1/4" = 1'-0"

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN | BRIDGE NO. | STATE PROJECT

LOCATION

SECTION A-A & STREAM PROFILE

BRIDGE SHEET - OF -

FILE NUMBER

REVISIONS AFTER PROPOSAL

	BY	DATE		BY	DATE
DESIGNED	BJL	01/24	CHECKED	TPL	01/24
DRAWN	BJL	01/24	CHECKED	TPL	01/24
QUANTITIES	-	-	CHECKED	-	-

ISSUE DATE | FEDERAL PROJECT NO. | SHEET NO. 10 | TOTAL SHEETS 10

REV. DATE

SUBDIRECTORY	.DGN LOCATOR	SHEET SCALE
BRC/PRELIM	40612profile-env	AS NOTED