



FUSS & O'NEILL

July 14, 2020

Mr. Keith A. Cota, PE  
Chief Project Manager  
New Hampshire Department of Transportation  
7 Hazen Drive  
P.O. Box 483  
Concord, NH 03302

Re: Rail Trail under the Connector Road, Exit 4A  
Type, Span, and Location Study  
Fuss & O'Neill Reference No. 20190127.A10

Dear Mr. Cota:

Fuss & O'Neill is pleased to provide the following TSL Report for the construction of the Exit 4A rail trail bridge that passes under the Connector Road. This report summarizes the layout and structure type for the proposed bridge.

#### Executive Summary

- The bridge will be a new underpass of the Connector Road to accommodate the re-aligned rail trail.
- A precast concrete box culvert is recommended. Due to the length of the culvert, LED lighting is a project requirement.
- The wingwalls will have an ashlar architectural finish.
- An interpretive panel depicting the historical significance of the Manchester & Lawrence Railroad will be installed on the southern approach of the rail trail.

#### Roadway Profile

The profile of the Connector Road was designed to provide a minimum 12-foot vertical clearance from the rail trail wearing surface to the bottom of the structure, accommodate the expected structure depth, and provide a minimum of 2 feet of fill on top of the structure.

#### Geotechnical

Borings have been completed at the approximate southern end of the proposed bridge. The borings indicate that bedrock is approximately 3 feet, or less, below the finished grade of the rail trail. The depth to bedrock for the majority of the structure and the northern wingwalls is unknown.

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### Utilities

There is an existing gas line that runs along the western side of the proposed box that will need to be relocated or removed prior to construction. There is also an AT&T fiber optic line under the existing rail corridor which may be relocated to the new rail trail corridor.

### Structure Type

The roadway width, face of rail to face of rail, is 95 feet. Eastbound and westbound traffic will be divided by a 4-foot raised concrete median. Three 11-foot travel lanes, a 5-foot shoulder, and a 1-foot shoulder adjacent to the median will be provided in the westbound direction and three 11-foot travel lanes, a 5-foot shoulder, and a 2-foot shoulder adjacent to the median will be provided in the eastbound direction. A 6-foot sidewalk with T4 bridge rail will also be provided on either side of the road. The structure is located in a horizontal curve with a superelevation of 2.6%. The profile before the structure will be on a tangent with a point of vertical curve located on the structure at station 1050+50.

The clear-span of the structure will be 20 feet and a minimum clearance envelope of 12-foot by 12-foot must be provided within the structure. The bridge will have a skew of 11°45'26" between the bridge chord along the Connector Road alignment, which was determined based on the horizontal alignments of the rail trail and the Connector Road.

Two buried structure types were evaluated; a precast arch/frame and a precast box culvert. An at-grade structure type was not evaluated as this type would have higher project costs as compared to the buried type. A precast arch or frame option would be supported by cast-in-place spread footings placed directly on bedrock. The use of cast-in-place pedestal walls would also be necessary to provide the height needed for the minimum vertical clearance. The use of the cast-in-place concrete would increase the project cost as compared to the box culvert option, therefore this option is not recommended.

A box culvert option consists of a 20 foot clear span precast concrete box. The borings indicate that the bottom of the box culvert is either at the bedrock surface, or within glacial till or glacial outwash. To provide a uniform bearing material it is recommended to excavate the bedrock, as needed, below the structure and excavate the fill to bedrock, and place structural fill, unless the geotechnical recommendations dictate otherwise. A minimum of 2 feet of fill will be placed on top of the culvert, and the trail inside of the box will consist of a minimum of 6 inches of crushed gravel with 3 inches of hot mix asphalt. Guardrail cannot be driven over the culvert due to the limited depth of the fill on top of the box, therefore the ends of the culvert will be fabricated with the design skew angle to allow bridge rail to be mounted to the headwalls. The length of the box culvert will be 100 feet out-to-out. Due to the length of the box culvert, LED lighting inside of the box will be required.

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### Environmental Commitments

The rail trail crossing is a re-alignment of the abandoned Manchester & Lawrence Railroad. An interpretive panel depicting the historical significance of the Railroad will be installed on the southern approach of the rail trail. Coordination with the local Heritage Commission will be required to determine the specific location and the content of the panel.

The precast wingwalls will have an architectural finish consisting of a stamped ashlar stone pattern.

### Maintenance of Traffic

The proposed structure is located in a section of the Connector Road that is off-alignment of any existing road, however, the southern wingwalls are located in the northern lane of Madden Road. Ultimately the determination of when, and how, to stage the construction of the rail trail culvert will be highly dependent on the construction staging of the nearby roadways, intersections, and supporting the second phase of construction for the Shields Brook Bridge, which is in close proximity.

There are several feasible options for constructing the culvert. One option would be to reconfigure the intersection of Madden Road and North High Street to the south, which allows the intersection of the Connector Road and North High Street and the culvert to be constructed in one phase. A second option would be to reduce Madden Road to one lane, however this option would require excavation support for the southern wingwalls. Excavation support in this location would likely be very costly due to the shallow depth to bedrock. The last option would be to construct the southern wingwalls, or potentially the southern portion of the box, in a second construction phase when the rail trail itself is constructed.

### Cost Estimate

A preliminary cost estimate, for the bridge only, has been prepared using the slope intercept method. The cost for the base bridge items was calculated using a square foot cost of \$90 for the box culvert and \$115 for the arch. These prices were based recently bid, similar type, projects.

#### Precast Concrete Box Culvert

Base Bridge Items:	\$	770,000
Mobilization (10%):	\$	80,000
Engineering & Permitting (10%)	\$	85,000
Construction Engineering (15%)	\$	130,000
<b>GRAND TOTAL</b>	<b>\$</b>	<b>1,065,000</b>

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Precast Concrete Arch

Base Bridge Items:	\$	855,000
Mobilization (10%):	\$	90,000
Engineering & Permitting (10%)	\$	95,000
Construction Engineering (15%)	\$	145,000
<b>GRAND TOTAL</b>	<b>\$</b>	<b>1,185,000</b>

Recommendations

The recommended bridge type is a 100 foot long, 20-foot span buried precast concrete box culvert founded on structural fill. This option meets all the NHDOT vertical and horizontal clearance requirements for pedestrian trails and is the most economical option.

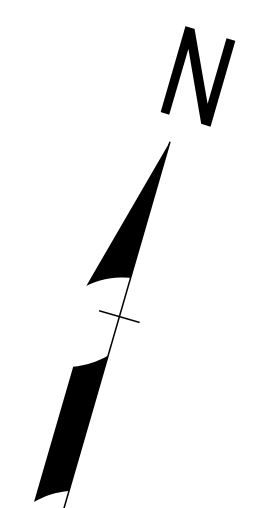
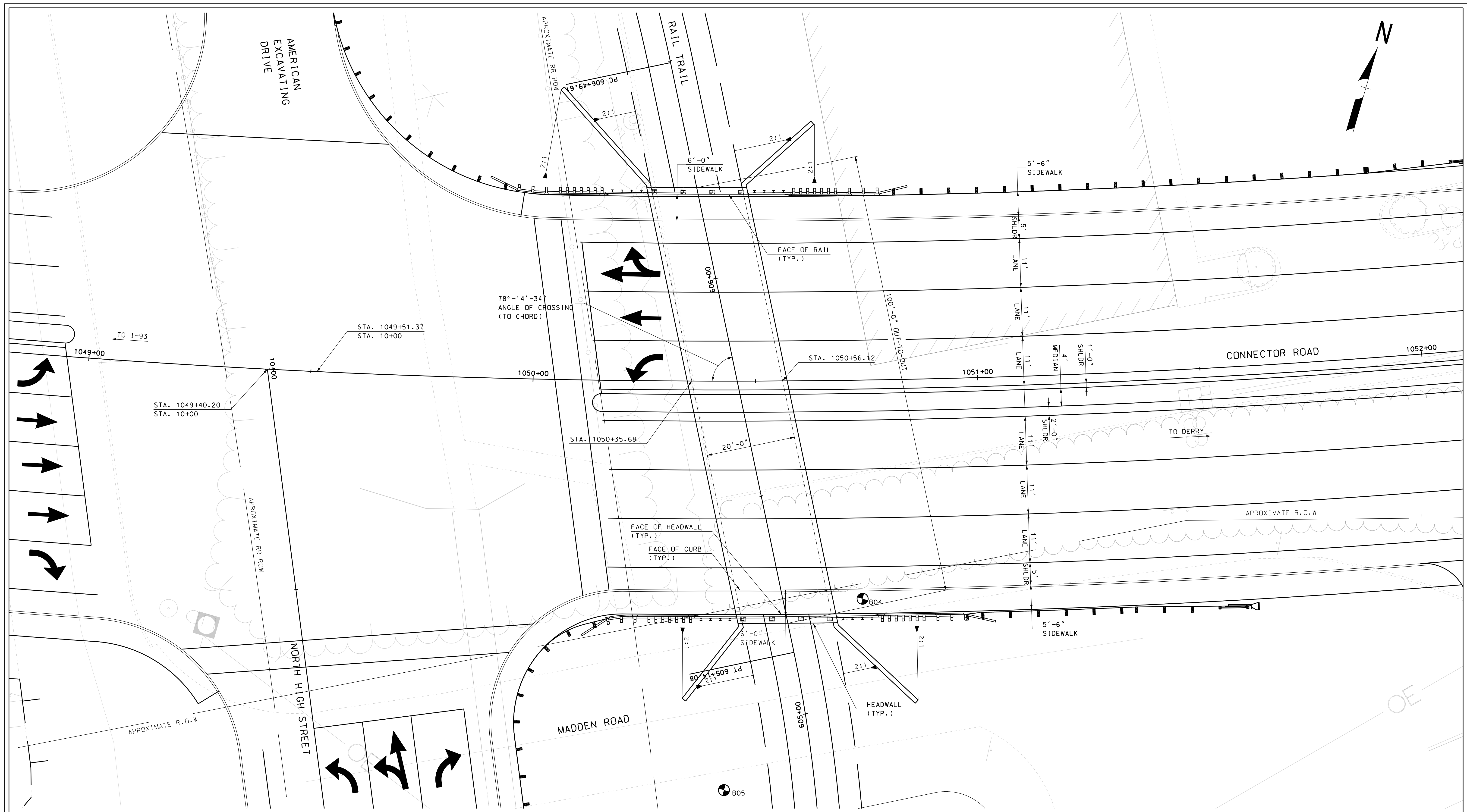
Please contact me if you have questions, comments, or require any additional information.

Sincerely,



Jaime French, PE  
Bridge Team Lead | Project Manager

Enclosures



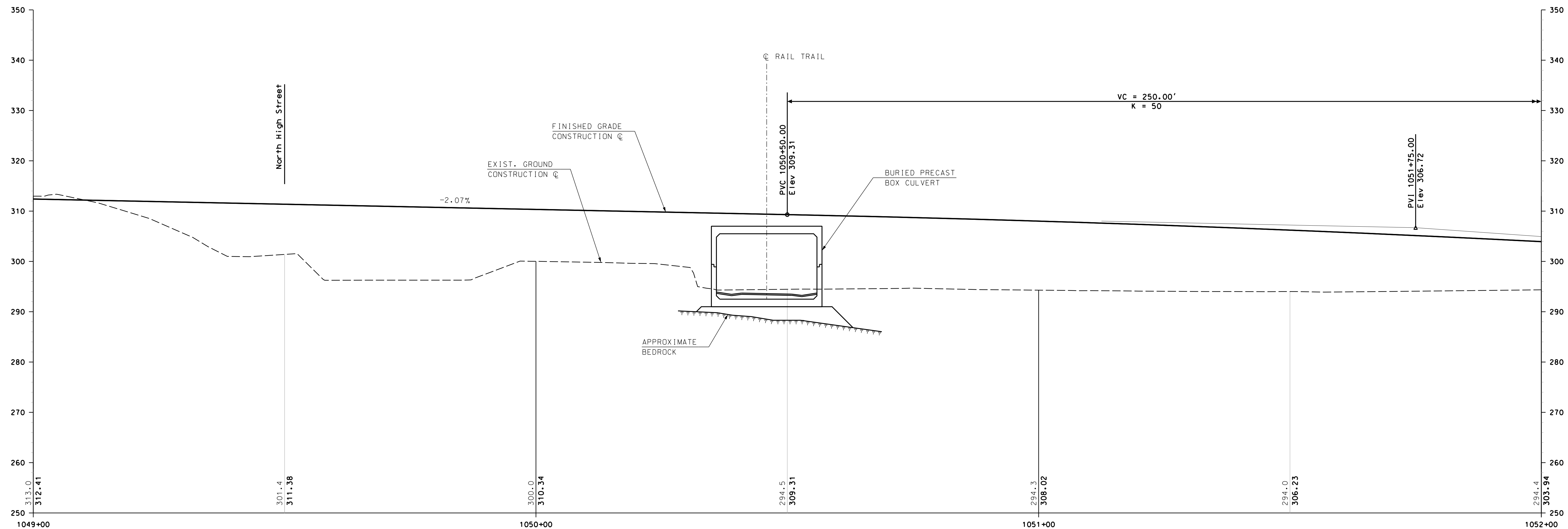
**GENERAL PLAN**  
SCALE: 1" = 10'-0"



**FUSS & O'NEILL**

SUBDIRECTORY	DGN LOCATOR	SHEET SCALE
XX	13065PreGen	AS NOTED

<b>STATE OF NEW HAMPSHIRE</b>					
<b>DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN</b>					
TOWN	DERRY AND LONDONDERRY	BRIDGE NO.	052,110	STATE PROJECT	13065
LOCATION	THE CONNECTOR ROAD OVER RAIL TRAIL				
<b>GENERAL PLAN</b>					BRIDGE SHEET 1 OF 3
DESIGNED	JF	DATE	1/20	CHECKED	SRB 1/20
DRAWN	MWS	DATE	1/20	CHECKED	JF 1/20
QUANTITIES	-	DATE	-	CHECKED	-
ISSUE DATE		FEDERAL PROJECT NO.		SHEET NO.	1
REV. DATE					3



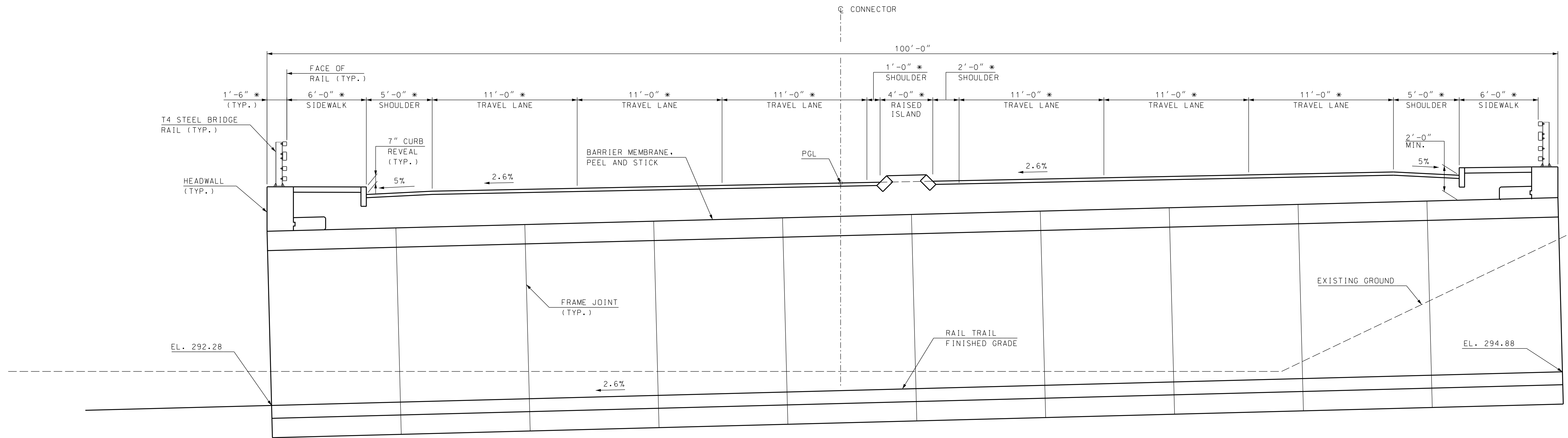
PROFILE  
SCALE: 1" = 10'-0"



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SUBDIRECTORY	DGN LOCATOR	SHEET SCALE
XX	13065BX-Profile	AS NOTED

STATE OF NEW HAMPSHIRE									
DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN									
TOWN	DERRY AND LONDONDERRY			BRIDGE NO.	052/110		STATE PROJECT	13065	
LOCATION THE CONNECTOR ROAD OVER RAIL TRAIL									
<b>PROFILE</b>									
REVISIONS AFTER PROPOSAL		BY	DATE	CHECKED	BY	DATE	BRIDGE SHEET		2 OF 3
		JF	1/20		SRB	1/20	FILE NUMBER		
		MWS	1/20		JF	1/20	TOTAL SHEETS		3
QUANTITIES		-	-	CHECKED	-	-			
ISSUE DATE		FEDERAL PROJECT NO.			SHEET NO.				
REV. DATE		-----			2				

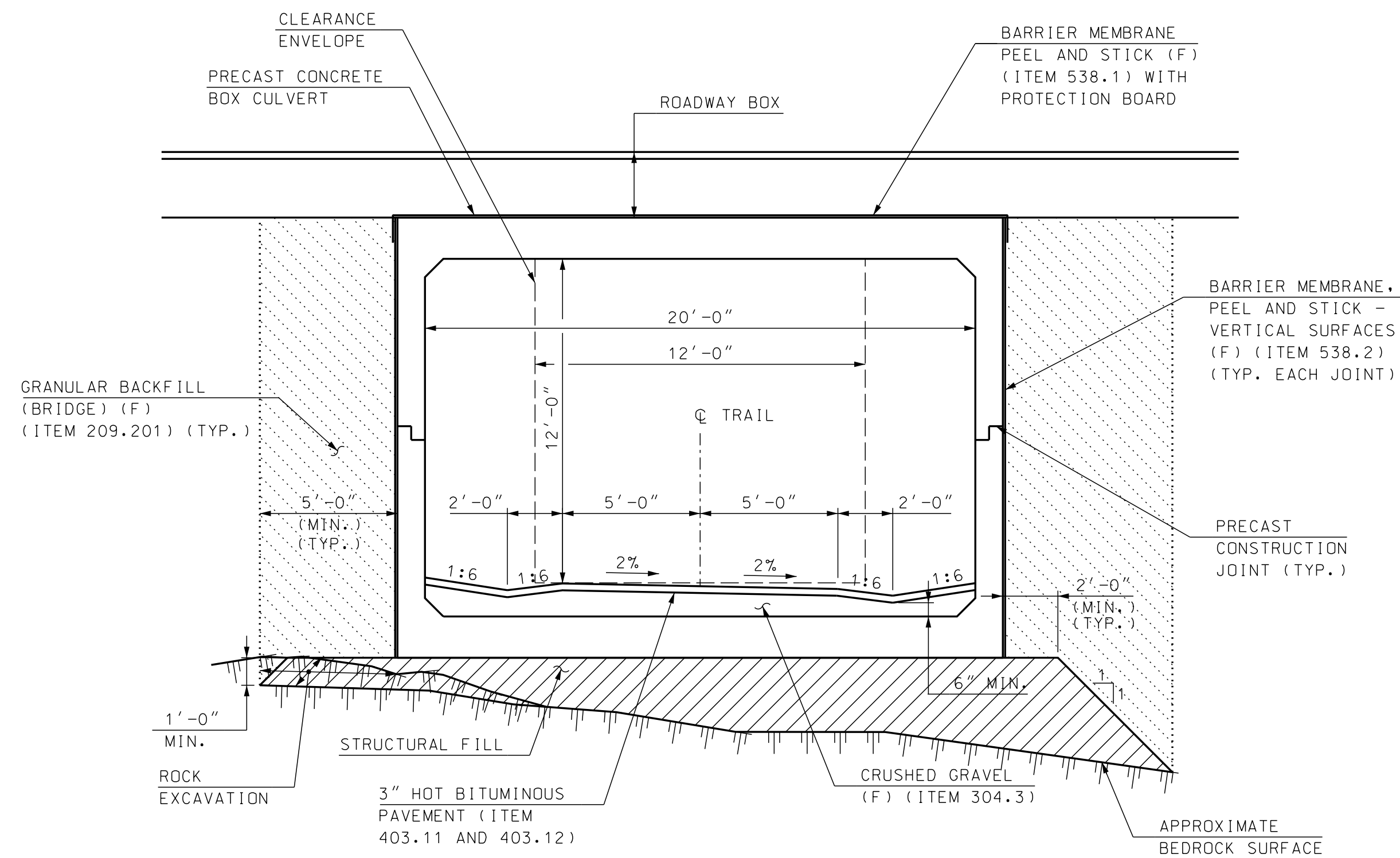


\* MEASURED PERPENDICULAR TO THE ALIGNMENT

### LONGITUDINAL SECTION

(LOOKING UPSTATION ON THE CONNECTOR ROAD)

SCALE: 1/4" = 1'-0"



### TYPICAL PRECAST BOX CULVERT SECTION

SCALE: 1/4" = 1'-0"

STATE OF NEW HAMPSHIRE									
DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN									
TOWN	DERRY AND LONDONDERRY			BRIDGE NO.	052/110		STATE PROJECT	13065	
LOCATION THE CONNECTOR ROAD OVER RAIL TRAIL									
TYPICAL BRIDGE SECTIONS								BRIDGE SHEET	
REVISIONS AFTER PROPOSAL				BY	DATE	CHECKED	SRB	DATE	3 OF 3
				DESIGNED	JF	1/20	CHECKED	SRB	1/20
				DRAWN	MWS	1/20	CHECKED	JF	1/20
				QUANTITIES	-	-	CHECKED	-	-
				ISSUE DATE	FEDERAL PROJECT NO.			SHEET NO.	TOTAL SHEETS
				REV. DATE	-----			3	3



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SUBDIRECTORY	DGN LOCATOR	SHEET SCALE
XX	13065BX-Deck	AS NOTED