US Army Corps
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New York District

WESTCHESTER COUNTY STREAMS, BYRAM RIVER BASIN

FLOOD RISK MANAGEMENT FEASIBILITY STUDY

FAIRFIELD COUNTY, CONNECTICUT AND WESTCHESTER COUNTY, NEW YORK

FINAL INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL IMPACT STATEMENT

APPENDIX B.4:

Structural

1.0 INTRODUCTION

This appendix evaluates the alternatives associated with the removal and replacement of the U.S. Route 1 bridges over the Byram River. The purpose in exploring these alternatives is to lower the water surface elevations upstream of the existing structures which may result in a reduction of the nonstructural plan. This appendix discusses the existing conditions, proposed bridge alternatives, and impacts to the surrounding areas.

2.0 EXISTING CONDITIONS

The existing U.S. Route 1 North Bridge (Southbound) is in poor condition overall. The concrete superstructure is in poor condition, exhibiting cracks and spalling with exposed, corroded reinforcing bars on the primary load carrying members in both spans. The concrete abutments and pier are in fair condition, with only minor surface scaling and efflorescence. The existing superstructure and substructures do not comply with current AASHTO design standards.

The existing U.S. Route 1 South Bridge (Northbound) is in fair condition overall. The stone masonry arch superstructure is in fair condition with localized spalling, map cracking and light to moderate efflorescence within the concrete coating at the underside of the arch in both spans. The stone masonry abutments and pier are in fair condition, with some missing joint mortar. The existing superstructure and substructures do not comply with current AASHTO design standards.

The U.S. Route 1 North Bridge (Southbound) and U.S. Route 1 South Bridge (Northbound) are classified as Urban Principal Arterial roadways (ConnDOT, 2014). The U.S. Route 1 South Bridge (Northbound) currently acts as a dam during the 2- and 1-percent storms, which inflates the water surface elevations at the North Bridge (Southbound). Per Table 'Flood Elevations (Existing Conditions) – Selected Area of Interest Cross Sections' from "Appendix B2 – Hydraulics", the existing Peak Water Surface Elevations at the U.S. Route 1 North Bridge (Southbound) during the 2-percent and 1-percent storm events are 16.1 ft and 17.8 ft, respectively. **Figure 1** shows the water surface profiles in the vicinity of the U.S. Route 1 Bridges during the 100- through 0.2-percent storm events as determined in Appendix B2.

The existing roadway elevation at the U.S. Route 1 North Bridge is approximately 15.3 ft. Therefore, the team determined it would be prudent to use the water surface elevations at the U.S. Route 1 Bridges using a Hydrologic Engineering Center's River Analysis System (HEC RAS) model with the two bridges removed, but assuming the abutments and channel walls will remain. **Table 1** includes this modified existing condition as design criteria for the proposed bridge types. Refer to **Figure 2** in Section 5.0 for plan of existing (and proposed) conditions.

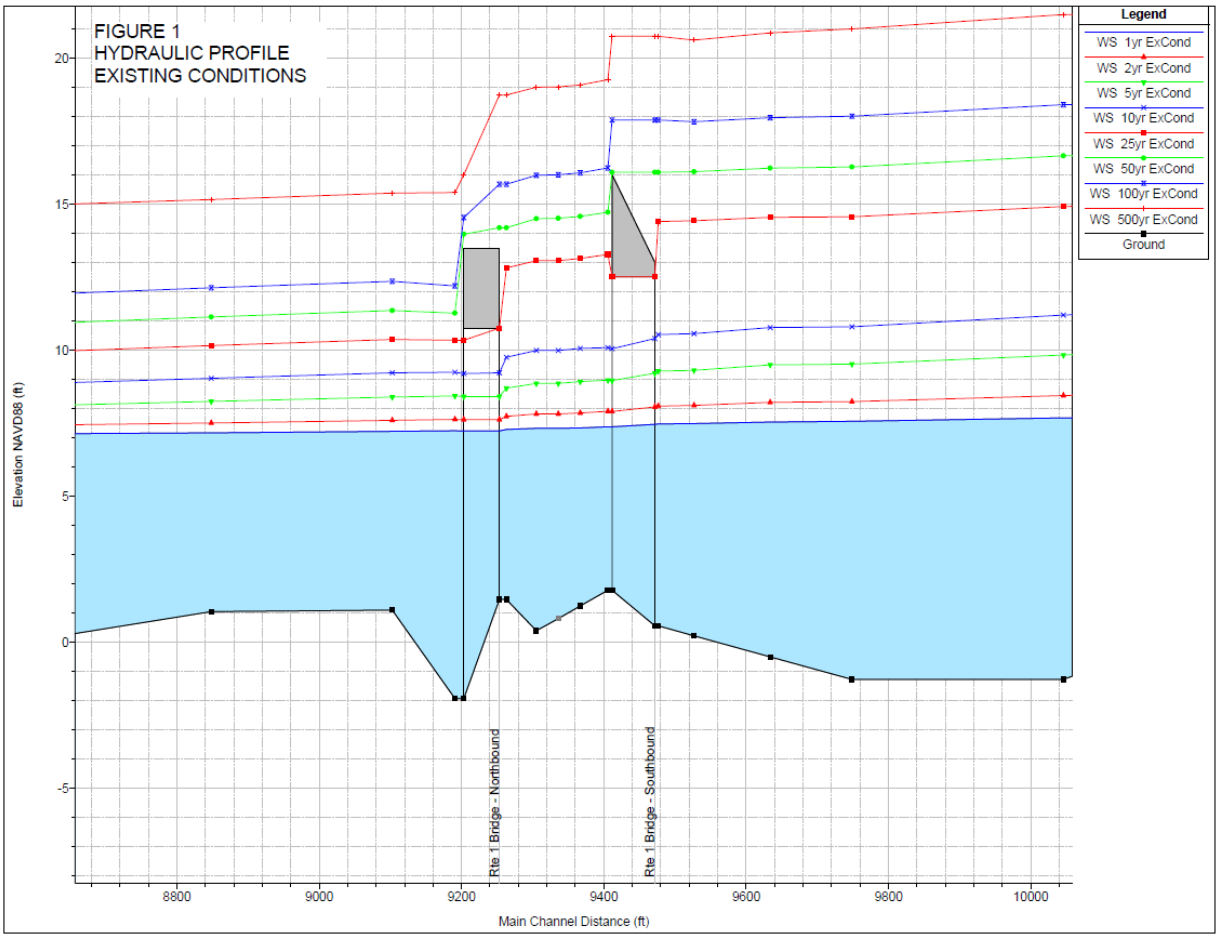
Table 1 Modified Existing Conditions (With U.S. Route 1 Arch Bridges Removed)

Bridge Location (Traffic Direction)	Face of Abutment to Face of Abutment Length (ft)	Water Surface Elevation 2% Storm[1] (ft)	Water Surface Elevation 1% Storm[1] (ft)	Approx. Roadway Elevation (Center Line)[2] (ft)
U.S. Route 1 North (Southbound)	80	12.2	13.2	15.3
U.S. Route 1 South (Northbound)	91	11.4	12.5	13.5

1 – Water surface elevations are based on HEC RAS model run with the existing U.S. Route 1 arch bridges removed.

2 - Existing surface information is based on available Geographic Information System (GIS) data.

Figure 1: Water Surface Profiles during the 100- Through 0.2-percent Storm Events



3.0 PROPOSED BRIDGE TYPES

The team evaluated five superstructure types for the replacement structures. The superstructure types were based upon replacement structures with a 90 ft single span and elevated profile using the guidelines of the New York State Department of Transportation (NYSDOT) Bridge Manual. The following two of the five superstructure types evaluated were identified as feasible:

1) Option 1 - Adjacent Prestressed Concrete Box Beam

   This bridge type will have a total depth of 4'-6" including a 3'-3" beam, 6" deck and approximately 9" cross slope.

   The advantages of this bridge type include the ability to accommodate critical vertical clearance requirements, ease of construction over a waterway and the reduction of trapped debris during high flow events.

2) Option 2 - Steel Plate Multi-girder

   This bridge type will have a total depth of approximately 5'-0" including a 3'-2" girder, 9.5" deck, 3" haunch and 8" cross slope.

   The advantages of this bridge type include a lighter superstructure and the ability to accommodate a large number of utilities.

The team further evaluated reducing the superstructure depth through the use of a single pier with an assumed width of 4 ft. This configuration reduces the bridge to two 45ft simple spans, similar to existing conditions (See Section 4.2 for additional information). As a result of the single center pier, a third bridge type is proposed:

3) Option 3 - Prestressed Concrete Slab Unit

   This type of superstructure is only proposed in conjunction with a pier and the use of two spans of 45 ft. This bridge type will have a total depth of approximately 3'-0" including a 1'-9" slab unit, 6" deck and 9" cross slope.

   The advantages of this bridge type include the ability to accommodate critical vertical clearance requirements, ease of construction over a waterway and the reduction of trapped debris during high flow events.

All three of the feasible superstructure options will require complete replacement of the existing substructures. The new substructures will be designed to meet current AASHTO design standards.

4.0 ALTERNATIVES EVALUATION

Four bridge replacement alternatives were considered for the bridge types noted in Section 3.0:

4.1 Alternative 1 – Maintain Existing Roadway Profile

Alternative 1 consists of replacing both bridges with either of the two proposed feasible bridge types (Options 1 and 2) noted in Section 3.0, in their existing locations and with no roadway profile change. The impacts to surrounding properties would be minor, consisting primarily of temporary easements for grading and construction activities. ADA evaluation should be evaluated in more depth during the design process. Although bridge type Option 3 reduces the water surface elevation, it was not considered as part of this alternative due to the added construction cost, permitting requirements, and potential for debris collection on the pier.

4.2 Alternative 2 – Raised Roadway Profile

Alternative 2 consists of replacing both bridges with the feasible bridge types (Options 1, 2 and 3) noted in Section 3.0 in their existing locations and raising the roadway profile. **Table 2** highlights the change in the roadway profile based on adding the proposed bridge type depth (per Section 3.0) to the water surface elevation for the 100-yr storm as run through a HEC RAS model without the U.S. Route 1 bridges impeding flow, and assuming no pier (Options 1 and 2) as well as with a 4 ft wide pier (Option 3).

Table 2 Alternative 2 Roadway Raised Profile Difference

Bridge Location (Traffic Direction)	Water Surface Elevation 100-yr Storm (ft)	Bridge Type Option #	Bridge Depth (ft) (Type)	Approx. Proposed Roadway Elevation (Center Line) (ft)	Approx. Existing Roadway Elevation (Center Line) [2] (ft)	Roadway Profile Difference from Existing Profile (ft)
U.S. Route 1 North (Southbound)	13.2[1]	1	4.5 (Box Beam)	17.7	15.3	+2.4
		2	5.0 (Steel Girder)	18.2		+2.9
U.S. Route 1 South (Northbound)	12.5[1]	1	4.5 (Box Beam)	17.0	13.5	+3.5
		2	5.0 (Steel Girder)	17.5		+4.0
U.S. Route 1 North (Southbound)	13.5[3]	3	3.0 (2 Span - Prestressed Slab Unit)	16.5	15.3	+1.2

U.S. Route 1 South (Northbound)	12.6[3]	3	3.0 (2 Span - Prestressed Slab Unit)	15.6	13.5	+2.1

1 – Water surface elevations are based on HEC RAS model run with the existing U.S. Route 1 arch bridges removed.

2 - Existing surface information is based on available Geographic Information System (GIS) data.

3 – Water surface elevation is based on HEC RAS model run with 4ft wide pier at the U.S. Route 1 bridges.

4.3 Alternative 3 – Single Bridge North (Southbound) Location

Alternative 3 consists of replacing both bridges with a new single bridge using either of the two feasible proposed bridge types (Options 1 and 2) in Section 3.0, with a single span, and a raised roadway profile in the North Bridge (Southbound) location. As a result of removing the South Bridge (Northbound), the bridge for this alternative will have an approximate width of 70 ft comprised of two sidewalks (8 ft each), two shoulders (3 ft each), and four travel lanes (12 ft each). Bridge type Option 3 was not considered as part of this alternative because the impacts are a result of the increased Right of Way (ROW) width required to accommodate the traffic from the South Bridge as opposed to the difference in elevation of the bridge and roadway.

Table 3 Alternative 3 Single Bridge North (Southbound) Location

Bridge Location (Traffic Direction)	Water Surface Elevation 100-yr Storm [1] (ft)	Bridge Depth (ft) (Type)	Approx. Proposed Roadway Elevation (Center Line) (ft)	Approx. Existing Roadway Elevation (Center Line) [2] (ft)	Roadway Profile Difference from Existing Profile (ft)
U.S. Route 1 North (Southbound)	13.2	4.5 (Box Beam)	17.7	15.3	+2.4
		5.0 (Steel Girder)	18.2		+2.9

1 – Water surface elevations are based on HEC RAS model run with the existing U.S. Route 1 arch bridges removed.

2 - Existing surface information is based on available Geographic Information System (GIS) data.

4.4 Alternative 4 – Single Bridge South (Northbound) Location

Alternative 4 consists of replacing both bridges with a new single bridge using either of the two feasible proposed bridge types (Options 1 and 2) in Section 3.0, with a single span, and a raised roadway profile in the South Bridge (Northbound) location. As a result of removing the North Bridge (Southbound), the bridge for this alternative will have an approximate width of 70ft comprised of two sidewalks (8 ft each), two shoulders (3 ft each), and four travel lanes (12 ft each). Bridge type Option 3 was not considered as part of this alternative because the

impacts are a result of the increased ROW width required to accommodate the traffic from the North Bridge as opposed to the difference in elevation of the bridge and roadway.

Table 4 Alternative 4 Single Bridge South (Northbound) Location

Bridge Location (Traffic Direction)	Water Surface Elevation 100-yr Storm 1 (ft)	Bridge Depth (ft) (Type)	Approx. Proposed Roadway Elevation (Center Line) (ft)	Approx. Existing Roadway Elevation (Center Line) 2 (ft)	Roadway Profile Difference from Existing Profile (ft)
U.S. Route 1 South (Northbound)	12.5	4.5 (Box Beam)	17.0	13.5	+3.5
		5.0 (Steel Girder)	17.5		+4.0

1 – Water surface elevations are based on HEC RAS model run with the existing U.S. Route 1 arch bridges removed.

2 - Existing surface information is based on available Geographic Information System (GIS) data.

4.5 Impacts of Alternatives

Table 6 includes impacts to the surrounding properties based on each of the four alternatives for bridge type Options 1 and 2. These impacts are approximate and based on Right of Way information from available Geographic Information System (GIS) data and will require verification through a complete ground survey. **Table 6** does not include impact to utilities (private or public) and drainage which will also require a full survey beyond GIS data to determine types, location, inverts, etc. It also does not explore potential archaeological impacts as it pertains to historical significance/preservation. In addition to **Table 6**, **Table 5** contains the approximate limits of roadway work necessary to achieve the profile difference of the bridge types from Section 3.0 for Alternatives 1-4. The lengths were measured from the limits of each bridge location (i.e. outside the span lengths).

Bridge type Option 3 (2 span - Prestressed Concrete Slab Unit) was proposed to determine if a reduction in the superstructure depth would minimize impacts to the properties surrounding the bridges. Introducing a pier reduces the depth of the superstructure (as compared to bridge type Option 1 and 2) by 1.5-2.0 ft but increases the water surface elevation to 13.5ft (0.3 ft increase from the no pier options). This results in an approximate proposed roadway elevation of the North Bridge of 16.5 ft, which is 1.2-1.7 ft lower than using Option 1 and 2. However, when compared to the existing roadway profile, this still results in a 1.2 ft increase in roadway elevation. In order to accommodate this change, impacts to the surrounding properties immediately adjacent to the bridge (604 N Main St – "Dougie's Stand-By", "Carvel", "Sara's Food Mart"; 11 Hillside Ave - "Accessible Mobility, LLC"; 13 Riverdale Ave – "Clay Health Club & Spa"; 780 W Putnam Ave – ""Exxon" gas station") will be similar to those noted in **Table 6** (Alternative 2). Option 3 will also require the following additional considerations:

- Job specific permitting;
- Longer construction duration;
- Greater impact to streambed work in the water;
- Additional cofferdam for pier construction;
- Temporary construction access to pier location;
- Additional impacts to traffic during construction and traffic detours that will need to be in effect for a longer duration;
- Additional maintenance due to likely debris build up at pier;
- Overall increased cost compared to Options 1 and 2.

Table 5 Limits of Roadway Work per Alternative

Alternative	Bridge Location (Traffic Direction)	Limits (Compass Heading)	Approx. Length of Roadway To be Reconstructed (ft)
1 (Maintain Existing Roadway Profile)	U.S. Route 1 North (Southbound)	NE	150
		SE	150
	U.S. Route 1 South (Northbound)	NE	150
		SW	150
2 (Raised Roadway Profile) [1]	U.S. Route 1 North (Southbound)	NE	250
		SW	200
	U.S. Route 1 South (Northbound)	NE	300
		SW	250
3 (Single Bridge North (Southbound) Location)	U.S. Route 1 North (Southbound)	NE	250
		SW	200
4 (Single Bridge South (Northbound) Location)	U.S. Route 1 South (Northbound)	NE	300
		SW	250

1 – Limits of Roadway Work utilizing bridge type Option 3 (2 Span -Prestressed Concrete Slab Unit) similar to Alternative 2.

Table 6 Property Impacted by Various Alternatives

Alternative	Address	Property Type-Description	Impact Type			
			Site Access (Ingress/Egress)	Structural/Property Use	Aesthetic	Non-Structural/Minor
1 (Maintain Existing Roadway Profile)	604 N Main St, Port Chester, NY 10573	Commercial – "Dougie's Stand By"	• Outdoor patio access (chain link gate) and building entrance below grade and will require a step(s) to accommodate grading (even with maintaining existing roadway profile). • Permanent easement may be required.	• Patio and outdoor seating (approx. 50sqft) below grade and will require a step(s) to accommodate grading (even with maintaining existing roadway profile). • Permanent easement may be required.	• N/A	• N/A
2 (Raised Roadway Profile) [1]	11 Hillside Ave, Port Chester, NY 10573	Commercial – "Accessible Mobility, LLC"	• N/A	• Parking lot would require regrading or 2-3' retaining wall at back of sidewalk to accommodate grade change. • Temporary easement will likely be required.	• N/A	• N/A
	Hillsdale Ave and Riverdale Ave, Port Chester, NY 10573	Commercial – "West Conn" Convenient Store	• Parking lot driveway on Hillside Ave will need to be reconstructed and regraded to accommodate grade change. • Temporary easement will likely be required.	• Parking lot would require regrading to accommodate grade change. • Temporary easement will likely be required.	• N/A	• N/A
	13 Riverdale Ave, Port Chester, NY 10573	Commercial – "CLAY Health Club & Spa"	• Emergency egress stairs would require relocation or a 2-3' retaining wall at back of sidewalk and drainage considerations to accommodate grade change. • Permanent easement may be required.	• Basement windows (8 EA) approx. 6" above the base of the building would require 2-3' retaining wall at back of sidewalk and drainage considerations due to grade change. • Permanent easement may be required.	• N/A	• N/A
	777 W Putnam Ave, Greenwich, CT 06830	Commercial – "Fifth Street Finance"	• Driveways (approx. 150' from East Approach) will need to be reconstructed or relocated to accommodate grade change. • Temporary easement will likely be required	• N/A	• '777' stone sign at driveway entrance will need to be removed and reset to accommodate grade change. • Temporary easement will likely be required.	• Grass at back of sidewalk will need to be regraded to accommodate grade change. • Temporary easement will likely be required.
	780 W Putnam Ave, Greenwich, CT 06830	Commercial – "Exxon" gas station	• Driveway (approx. 50' from East limit of North Bridge) nearly at grade with roadway gutter line will require regrading or relocating to accommodate grade change.	• 'Tiger Mart' Building below grade, set back approx. 40' from North Bridge and 50' from South Bridge roadway gutter line will require drainage considerations to alleviate flooding to accommodate grade change	• Gas pumps and pavement below grade will require drainage considerations to alleviate flooding to accommodate grade change (Note: There are existing catch basins around building. May require relocating these catch	• N/A

Alternative	Address	Property Type-Description	Impact Type			
			Site Access (Ingress/Egress)	Structural/Property Use	Aesthetic	Non-Structural/Minor
			• Wheelchair ramp will require reconstructing or relocating to accommodate grade change. • Driveway (approx. 50’ from East limit of South Bridge) at grade with roadway gutter line may require relocating to accommodate grade change. • Temporary easement will likely be required.	(Note: There are existing catch basins around building. May require relocating these catch basins to accommodate grade change). • Temporary easement will likely be required.	basins to accommodate grade change). • Temporary easement will likely be required.	
2 (Raised Roadway Profile) [1]	604 N Main St, Port Chester, NY 10573	Commercial – “Dougie’s Stand By”	• Outdoor patio access (~48” chain link gate) below grade and will require relocating and a 0.5-1’ retaining wall to accommodate grade change. • Building entrance set back approx. 15’ from roadway gutter line is below grade and will require drainage considerations and 0.5-1’ retaining wall at back of sidewalk to accommodate grade change. • Driveway (approx. 65’from West Limit of bridge) will require reconstructing or relocating to accommodate grade change. • Permanent easement may be required.	• Patio and outdoor seating (approx. 50sqft) below grade and will require a 0.5-1’ retaining wall to accommodate grade change. • Parking lot will require regrading to accommodate grade change. • Permanent easement may be required for patio. • Temporary easement will likely be required for parking lot.	• If retaining wall is required, the patio view of the roadway will be blocked, and may not be aesthetically pleasing to patrons.	• Shrubs/bushes between patio and parking lot entrance will need to be removed and new shrubs/bushes planted to accommodate grade change.
	604 N Main St, Port Chester, NY 10573	Commercial – “Sara Food Mart”	• N/A	• Parking lot (shared with “Dougie’s Stand By” and “Carvel Ice Cream”) will require regrading to accommodate grade change on the North Bridge. • Parking lot (shared with “Allstate” and “Portchester Auto Spa”) will require regrading to accommodate grade change on the South Bridge, potentially removing 2 parking spaces. • Temporary easement will likely be required for parking lot.	• N/A	• N/A
	604 N Main St, Port Chester, NY 10573	Commercial – “Carvel Ice Cream”	• N/A	• Parking lot (shared with “Dougie’s Stand By” and “Sara Food Mart”) will require	• N/A	• Landscaping in front of “Carvel Ice Cream” may need to be removed and new shrubs/bushes

Alternative	Address	Property Type-Description	Impact Type			
			Site Access (Ingress/Egress)	Structural/Property Use	Aesthetic	Non-Structural/Minor
				regrading to accommodate grade change. • Temporary easement will likely be required.		planted to accommodate grade change.
	602 N Main St, Port Chester, NY 10573	Commercial – "Gulf" Gas Station	• Gas station entrance will likely require drainage consideration to accommodate grade change in roadway. • Permanent easement will likely be required.	• Driveway/entrance to gas pumps nearly at grade with existing South Bridge roadway gutter line and will need to be reconstructed or relocated to accommodate grade change. • Gas pumps may need to be reset or relocated to accommodate grade change. • Permanent easement will likely be required.	• N/A	• N/A
	602 N Main St, Port Chester, NY 10573	Commercial – "Portchester Auto Spa"	• 3 garage openings are nearly at grade with existing South Bridge roadway gutter line. Raising the roadway profile will require drainage considerations to alleviate flooding or relocating of the garage openings. • Permanent easement will likely be required.	• Driveway/entrance to garage openings nearly at grade with existing South Bridge roadway gutter line and will need to be relocated to accommodate grade change. • Parking lot will need to be regraded to accommodate grade change. • Permanent easement will likely be required.	• If reduction in the parking lot in front of "Portchester Auto Spa" is required, the number of cars allowed to park may also be reduced.	• N/A
3 (Single Bridge North - Southbound) Location)	11 Hillside Ave, Port Chester, NY 10573	Commercial – "Accessible Mobility, LLC"	• Driveway Entrance on Riverside Ave may need to be relocated to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• Parking lot would be reduced in size to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• Additional pedestrian accommodations would be required to cross Hillside Ave as a four lane roadway.	• N/A
	Hillsdale Ave and Riverdale Ave, Port Chester, NY 10573	Commercial – "West Conn" Convenient Store	• Parking lot driveway on Hillside Ave will need to be relocated and regraded to accommodate grade change and two additional lanes of traffic from removing South (Northbound) Bridge. • Entrance to convenient store may require relocation or step down to accommodate grade change and two additional lanes	• Parking lot would be reduced in size to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• Expanded roadway may detract customers. Additional pedestrian accommodations would be required.	• N/A

Alternative	Address	Property Type-Description	Impact Type			
			Site Access (Ingress/Egress)	**Structural/Property Use**	**Aesthetic**	**Non-Structural/Minor**
			of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.			
	13 Riverdale Ave, Port Chester, NY 10573	Commercial – "CLAY Health Club & Spa"	• Emergency egress stairs would require relocation to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• Building footprint would be within sidewalk/shoulder due to two additional lanes of traffic from removing South (Northbound) Bridge. Permanent easement will likely be required.	• N/A	• N/A
	777 W Putnam Ave, Greenwich, CT 06830	Commercial – "Fifth Street Finance"	• Driveways (approx. 150' from East limit of North Bridge) will need to be reconstructed or relocated to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• N/A	• '777' stone sign at driveway entrance will need to be relocated to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• Grass at back of sidewalk will need to be regraded to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.
	780 W Putnam Ave, Greenwich, CT 06830	Commercial – "Exxon" gas station	• Driveway (approx. 50' from East Approach) nearly at grade with roadway gutter line will require relocating to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Wheelchair ramp will require relocating to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• 'Tiger Mart' Building below grade, set back approx. 40' from North Bridge roadway gutter line will require drainage considerations to alleviate flooding to accommodate grade change and two additional lanes of traffic from removing South (Northbound) Bridge. • 2 parking spaces will be removed to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• Gas pumps and pavement below grade will require drainage considerations to alleviate flooding to accommodate grade change and two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.	• "Exxon" Sign will need relocating to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Air and vacuum station will need relocating to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Trash bin (large) and surrounding fence will require relocating to accommodate two additional lanes of traffic from removing South (Northbound) Bridge. • Permanent easement will likely be required.
	604 N Main St, Port Chester, NY 10573	Commercial – "Dougie's Stand By"	• Outdoor patio access (~48" chain link gate) below grade and within limits of expanded roadway needed to accommodate two additional lanes of traffic due to removal of South Bridge. • Driveway (approx. 65' from West Limit of bridge) will require relocating to accommodate two	• Patio and outdoor seating (approx. 50sqft) below grade and within limits of expanded roadway needed to accommodate two additional lanes of traffic due to removal of South Bridge. • Parking lot will need to be reduced (removing 2-3 parking	• Reduced patio size may impact patron desire to sit closer to roadway or relocate outdoor seating will be required.	• Shrubs/bushes between patio and parking lot entrance will need to be removed and new shrubs/bushes planted to accommodate additional lanes and grade change.

Alternative	Address	Property Type-Description	Impact Type			
			Site Access (Ingress/Egress)	Structural/Property Use	Aesthetic	Non-Structural/Minor
			additional lanes of traffic due to removal of South Bridge. • Permanent easement will likely be required.	spots) and regraded to accommodate grade change and two additional lanes of traffic due to removal of South Bridge. • Permanent easement will likely be required.		
3 (Single Bridge North - Southbound) Location)	604 N Main St, Port Chester, NY 10573	Commercial – "Sara Food Mart"	• N/A	• Parking lot will need to be reduced (removing 2-3 parking spots) and regraded to accommodate grade change and two additional lanes of traffic due to removal of South Bridge. • Permanent easement will likely be required.	• N/A	• N/A
	604 N Main St, Port Chester, NY 10573	Commercial – "Carvel Ice Cream"	• N/A	• Parking lot will need to be reduced (removing 2-3 parking spots) and regraded to accommodate grade change and two additional lanes of traffic due to removal of South Bridge. • Permanent easement will likely be required.	• N/A	• Landscaping in front of "Carvel Ice Cream" may need to be removed to accommodate two additional lanes of traffic due to removal of South Bridge. • Permanent easement will likely be required.
4 (Single Bridge South - Northbound) Location)	780 W Putnam Ave, Greenwich, CT 06830	Commercial – "Exxon" gas station	• Driveway (approx. 50' from East limit of South Bridge) at grade with roadway gutter line will require relocating to accommodate grade change and two additional lanes of traffic from removing North (Southbound) Bridge. • Wheelchair ramp will require relocating to accommodate grade change and two additional lanes of traffic from removing North (Southbound) Bridge. • Permanent easement will likely be required.	• 'Tiger Mart' Building below grade, set back approx. 50' from South Bridge roadway gutter line will require 3-4' retaining wall at the back of sidewalk and/or drainage considerations to alleviate flooding to accommodate grade change and two additional lanes of traffic from removing North (Southbound) Bridge. • 2-3 parking spaces will be removed to accommodate two additional lanes of traffic from removing North (Southbound) Bridge. • Permanent easement will likely be required.	• Gas pumps and pavement below grade will require 3-4' retaining wall at the back of sidewalk and/or drainage considerations to alleviate flooding to accommodate grade change and two additional lanes of traffic from removing North (Southbound) Bridge. • Permanent easement will likely be required.	• "Exxon" Sign will need relocating to accommodate two additional lanes of traffic from removing North (Southbound) Bridge. • Electrical panel will need relocating to accommodate two additional lanes of traffic from removing North (Southbound) Bridge. • Permanent easement will likely be required.

Alternative	Address	Property Type-Description	Impact Type			
			Site Access (Ingress/Egress)	Structural/Property Use	Aesthetic	Non-Structural/Minor
4 (Single Bridge South - Northbound) Location)	604 N Main St, Port Chester, NY 10573	Commercial – "Sara Food Mart"	• N/A	• Parking lot will need to be reduced (removing 2-3 parking spots) and regraded to accommodate grade change and two additional lanes of traffic due to removal of North Bridge. • Permanent easement will likely be required.	N/A	• N/A
	602 N Main St, Port Chester, NY 10573	Commercial – "Gulf" Gas Station	• Gas station entrance will likely require drainage consideration to accommodate grade change in roadway and two additional lanes of traffic due to removal of North Bridge. • Permanent easement will likely be required.	• Driveway/entrance to gas pumps nearly at grade with existing roadway gutter line and will need to be relocated to accommodate grade change and two additional lanes of traffic due to removal of North Bridge. • Gas pumps will need to be relocated to accommodate grade change and two additional lanes of traffic due to removal of North Bridge. • Permanent easement will likely be required.	• N/A	• N/A
	602 N Main St, Port Chester, NY 10573	Commercial – "Portchester Auto Spa"	• 3 garage openings are nearly at grade with existing South Bridge roadway gutter line. Raising the roadway profile and adding two additional lanes of traffic will require relocating of the garage openings due to removal of the North Bridge. • Permanent easement will likely be required.	• Driveway/entrance to garage openings nearly at grade with existing South Bridge roadway gutter line and will need to be relocated to accommodate grade change and two additional lanes of traffic due to removal of the North Bridge. • Parking lot will need to be reduced (3-4 spots) to accommodate grade change and additional lanes of traffic due to removal of North Bridge. • Permanent easement will likely be required.	• Reduction in the parking lot in front of "Portchester Auto Spa" will be required to accommodate the two additional lanes of traffic, which will reduce the number of cars allowed to park.	• N/A

1 – Property Impact utilizing bridge type Option 3 (2 Span -Prestressed Concrete Slab Unit) similar to impacts listed for Alternative 2.

4.6 Scour Analysis

The proposed 80 ft north bridge and the proposed 90 ft south bridge were analyzed for scour utilizing HEC-18 methodology. The proposed bridges were analyzed for abutment and contraction scour for the 1-percent and 0.2-percent floods. No piers are present, so pier scour was not evaluated. The scour results below represent theoretical scour and do not account for any rock that may be present to prevent scour. The presence of rock could limit the scour drastically from the theoretical results. Borings will be required in the channel at the beginning and the end of the proposed bridge locations to verify the presence of rock and establish the limiting elevation and rock quality for resisting scour. This limitation should be evaluated for final design. Rock parameters will be needed to evaluate the rock for potential scour in accordance with HEC-18 Quarrying and Plucking methodology if competent rock is not found at a shallow depth. **Table 7** and **Table 8** below summarize the results from the HEC-18 theoretical results.

Table 7 North Bridge Scour Results

Location	Abutment Scour (ft)	Contraction Scour (ft)	Total Scour (ft)
Left Abutment	17.4	N/A	17.4
Right Abutment	27.0	N/A	27.0

Table 8 South Bridge Scour Results

Location	Abutment Scour (ft)	Contraction Scour (ft)	Total Scour (ft)
Left Abutment	8.6	N/A	8.6
Right Abutment	18.2	N/A	18.2

In accordance with FHWA guidance, countermeasures may be utilized to resist scour for existing structures. For these two bridges, there is little potential for contraction scour, given the vertical abutments and relatively similar opening size of the bridge and adjoining channel upstream and downstream. It is recommended that abutment foundations be founded on competent rock. If it is found that the bedrock does not limit the predicted scour depth, riprap countermeasure would be an appropriate protection against scour in accordance with guidance provided by FHWA HEC-23. The rock size has been calculated such that a minimum D50 of 1.3 feet would be appropriate for the estimated future conditions flow characteristics for both bridges. Refer to Section 6.0 Attachments for riprap calculations.

4.7 Recommendation

Based on Section 4.5 and **Tables 5** and **6**, it is the team's recommendation to further investigate Alternative 2 – Raised Roadway Profile using bridge type Option 1 – Adjacent Prestressed Concrete Box Beam. Alternative 1 – Maintain Existing Roadway Profile does not alleviate flooding concerns and was therefore removed from consideration. Alternatives 3 and 4 – Single Bridge North and South, respectively, would require fee property takings and likely require removal of existing structures in addition to significant temporary and permanent traffic pattern impacts. For this reason, Alternatives 3 and 4 were not considered feasible. Lastly, additional bridge type Option 3 - Prestressed Concrete Slab Unit with Pier was proposed to reduce the superstructure depth, thereby reducing impact to the surrounding properties. It was determined that the roadway and property impacts would be similar to bridge type Options 1 and 2 despite a reduced superstructure depth and would also create additional short term and long term impacts as listed in Section 4.5. Due to these additional impacts and limited reduction of roadway and property impacts, bridge type Option 3 is not recommended.

A full topographic survey of the existing bridges and surrounding properties is recommended to help refine and confirm the impacts listed in **Table 6** for Alternative 2. Refer to Section 6.0 Attachments for plan, profiles and sections for the recommended treatment and limits of grading likely required at each property to accommodate the raised roadway profiles. Also included in the Attachments is a conceptual bridge cost estimate compiled using NYSDOT items and historical weighted average item pricing with contingency for the recommended alternative.

5.0 REFERENCES

"Byram River Flood Study – Appendix B2 on Hydraulics" Prepared by CDM Smith for the City of Greenwich, CT, May 2019

"Connecticut State Numbered Routes and Roads", Connecticut Department of Transportation Bureau of Policy and Planning Office of Roadway Information Systems Roadway Inventory Section, Pages 1-6, December 31, 2014

"A Policy on Geometric Design of Highways and Streets", American Association of State Highway and Transportation Officials (AASHTO), 6th Edition, 2011

"NYSDOT Bridge Manual", January 2008, 1st Edition, April 2014, Addendum #3

"NYSDOT Pay Item Catalog & Weighted Average Bid Pricing", 2015

6.0 ATTACHMENTS

Attachment A – Abutment Riprap Calculations

Attachment B - North and South Bridge Options Plans and Figures

Attachment C - Quantities and Cost Estimates

Attachment A

Abutment Riprap Calculations

JOB: Byram River Bridge (North)		SHEET 1
SUBJECT:		
CALC'D BY: Gambill	DATE: 26-Mar-18	OF 1
CHEK'D BY: Corley	DATE: 26-Mar-18	

ABUTMENT RIPRAP CALCULATIONS - 1% Storm Design

Design Guideline 14

Parameter	Unit	Left Overbank	Channel	Right Overbank		
y	(ft)	0.00	12.55	0.00	Flow Depth	
Q	(cfs)	0	6428	0	Discharge	
A	(sf)	0.0	793.3	0.0	Flow Area	
Setback	(ft)	0	N/A	0		
SBR		0.0	N/A	0.0	Setback Ratio: Setback/Flow Depth	
Vavg	(fps)		8.10		If SBR<5 for Both Abutments, Compute Vavg of Full Bridge Opening)	
Vavg	(fps)	N/A	8.10	N/A	If SBR>5 for Either Abutment, Compute Vavg of Overbank)	
Vavg	(fps)	N/A	8.10	N/A	If SBR<5 for Either Abutment, Compute Characteristic Vavg)	
Vdes	(fps)	N/A	8.1	N/A		
Fr		#VALUE!	0.40	#VALUE!		
Spill-through Abutments						
D50	(ft)	#VALUE!	N/A	#VALUE!	If Fr>0.8, use HEC-23 Eq.14.2	
D50	(ft)	#VALUE!	1.26	#VALUE!	If Fr<0.8, use HEC-23 Eq. 14.1	
		Note: Equations for Spillthrough Abutments, K=0.61 (Fr>0.80) and 0.89 (Fr<0.80)				
		Note: Equations for Vertical Abutments, K=0.69 (Fr>0.8) and 1.02 (Fr<0.80)				
Use the larger of the D_{50} values for both abutments						
	D50=	1.26	ft			
Apron Width	(ft)	0	or 25 ft, from toe			
Riprap Thickness	(ft)	1.89	T=1.5*D50 and not less than D100		D100 =	2.52
High Water Elev.	(ft)	434.6				
Top Elevation	(ft)	436.6				
	Reference: HEC-23 3rd Ed., Design Guideline 14, 2009					

JOB: Byram River Bridge (South)		SHEET 1
SUBJECT:		
CALC'D BY: Gambill	DATE: 26-Mar-18	OF 1
CHEK'D BY: Corley	DATE: 26-Mar-18	

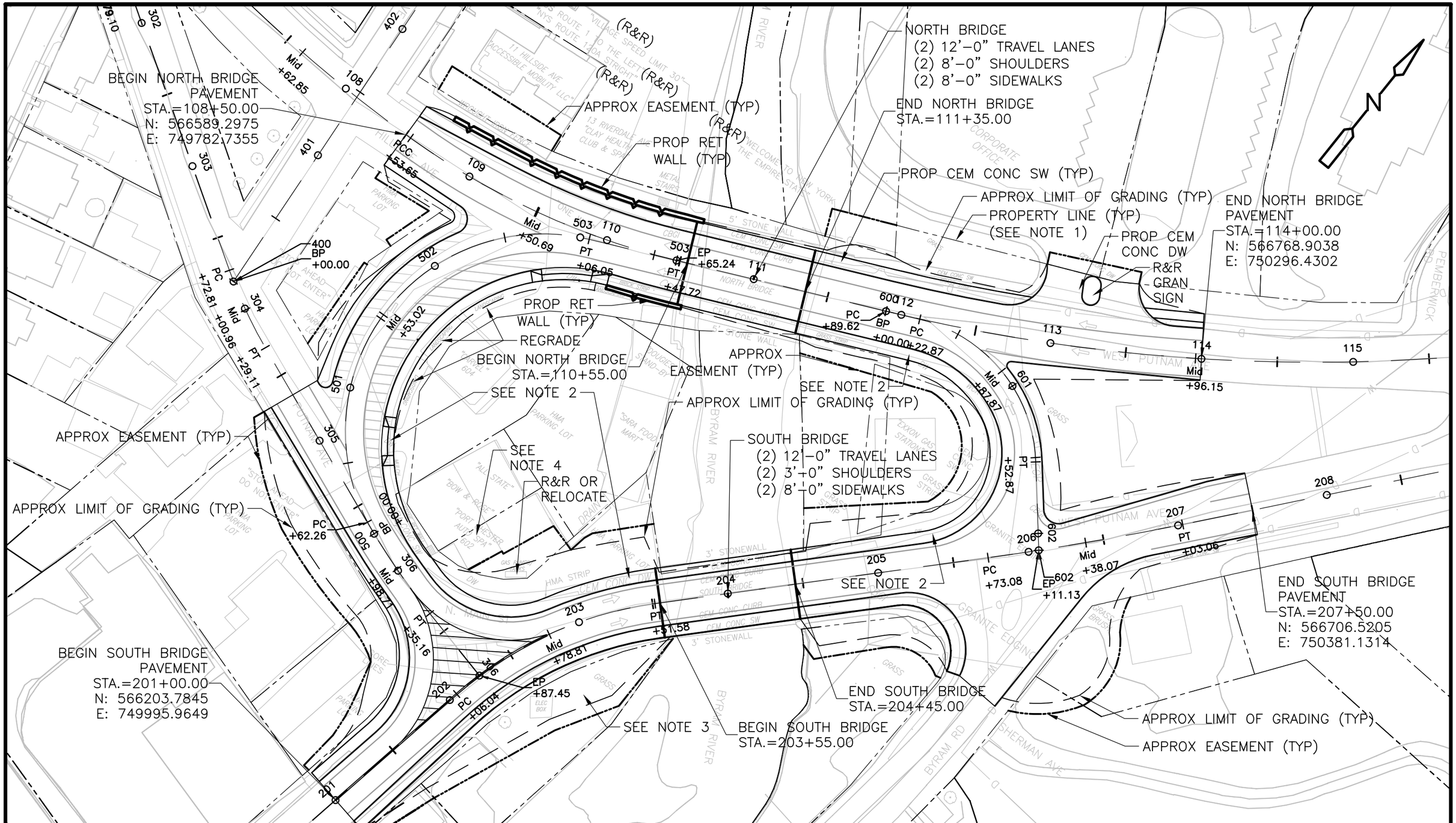
ABUTMENT RIPRAP CALCULATIONS - 1% Storm Design

Design Guideline 14

Parameter	Unit	Left Overbank	Channel	Right Overbank		
y	(ft)	0.00	11.77	0.00	Flow Depth	
Q	(cfs)	0	6428	0	Discharge	
A	(sf)	0.0	793.3	0.0	Flow Area	
Setback	(ft)	0	N/A	0		
SBR		0.0	N/A	0.0	Setback Ratio: Setback/Flow Depth	
Vavg	(fps)		8.10		If SBR<5 for Both Abutments, Compute Vavg of Full Bridge Opening)	
Vavg	(fps)	N/A	8.10	N/A	If SBR>5 for Either Abutment, Compute Vavg of Overbank)	
Vavg	(fps)	N/A	8.10	N/A	If SBR<5 for Either Abutment, Compute Characteristic Vavg)	
Vdes	(fps)	N/A	8.1	N/A		
Fr		#VALUE!	0.42	#VALUE!		
Spill-through Abutments						
D50	(ft)	#VALUE!	N/A	#VALUE!	If Fr>0.8, use HEC-23 Eq.14.2	
D50	(ft)	#VALUE!	1.26	#VALUE!	If Fr<0.8, use HEC-23 Eq. 14.1	
		Note: Equations for Spillthrough Abutments, K=0.61 (Fr>0.80) and 0.89 (Fr<0.80)				
		Note: Equations for Vertical Abutments, K=0.69 (Fr>0.8) and 1.02 (Fr<0.80)				
Use the larger of the D_{50} values for both abutments						
	D50=	1.26	ft			
Apron Width	(ft)	0	or 25 ft, from toe			
Riprap Thickness	(ft)	1.89	T=1.5*D50 and not less than D100		D100 =	2.52
High Water Elev.	(ft)	434.6				
Top Elevation	(ft)	436.6				
	Reference: HEC-23 3rd Ed., Design Guideline 14, 2009					

Attachment B

North and South Bridge Options Plans and Figures



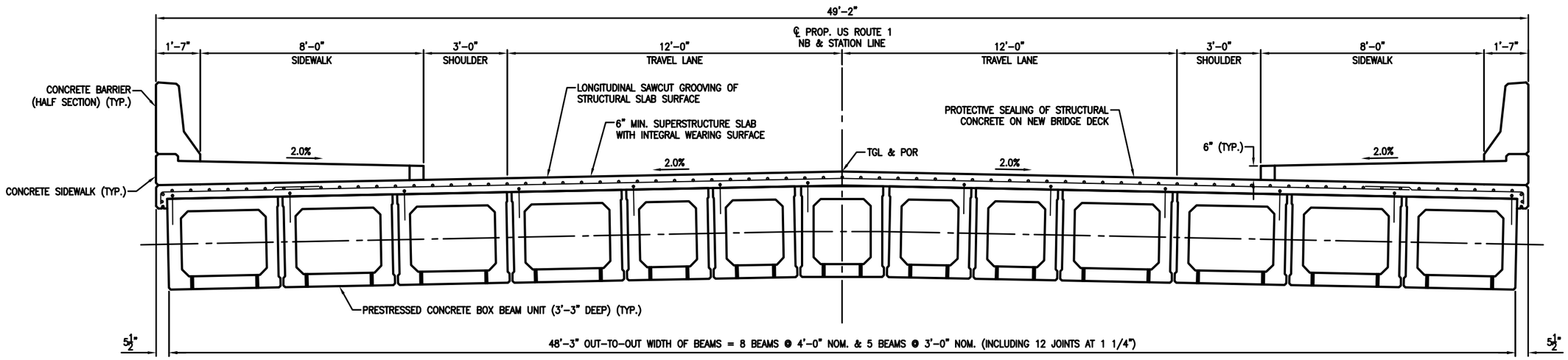
ALTERNATIVE 2 – RAISED ROADWAY PROFILES

NOTES:
1. ALL LINEWORK INCLUDING PROPERTY LINES ARE FROM AVAILABLE GIS DATA.
2. SITE ACCESS/DRIVEWAY TO BE FURTHER REVIEWED DURING DESIGN PROCESS.
3. GRADING ON THIS PROPERTY TO BE FURTHER REVIEWED DURING DESIGN PROCESS.
4. GARAGE OPENINGS MAY BE IMPACTED BY GRADING AND WILL REQUIRE FURTHER REVIEW.

1" = 60'
30 0 60

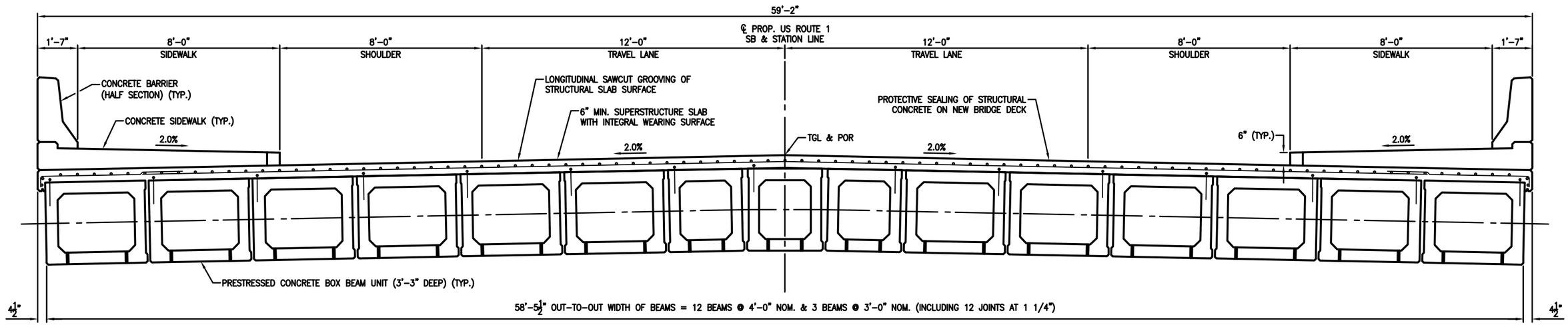
DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			2



SOUTH BRIDGE OPTION 1 TYPICAL SECTION

SCALE: ½" = 1'-0"



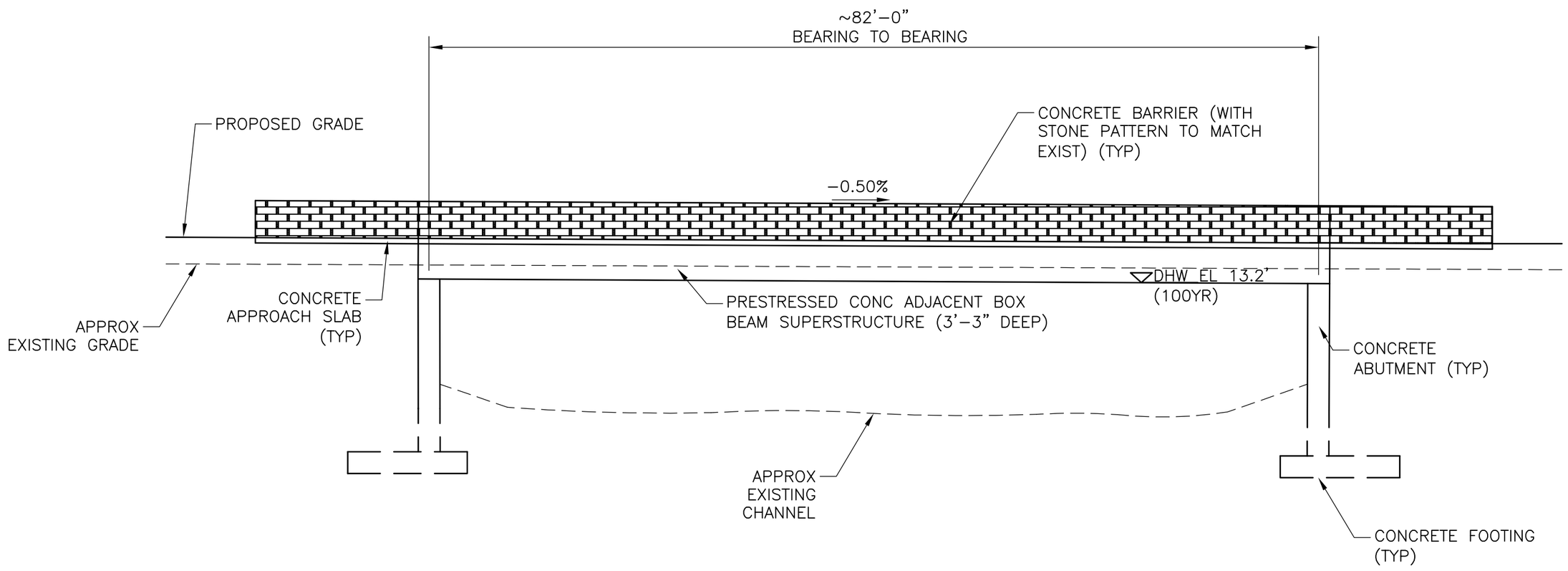
NORTH BRIDGE OPTION 1 TYPICAL SECTION

SCALE: ½" = 1'-0"

1/2" = 1'- 0"
1 0 1 2

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			3



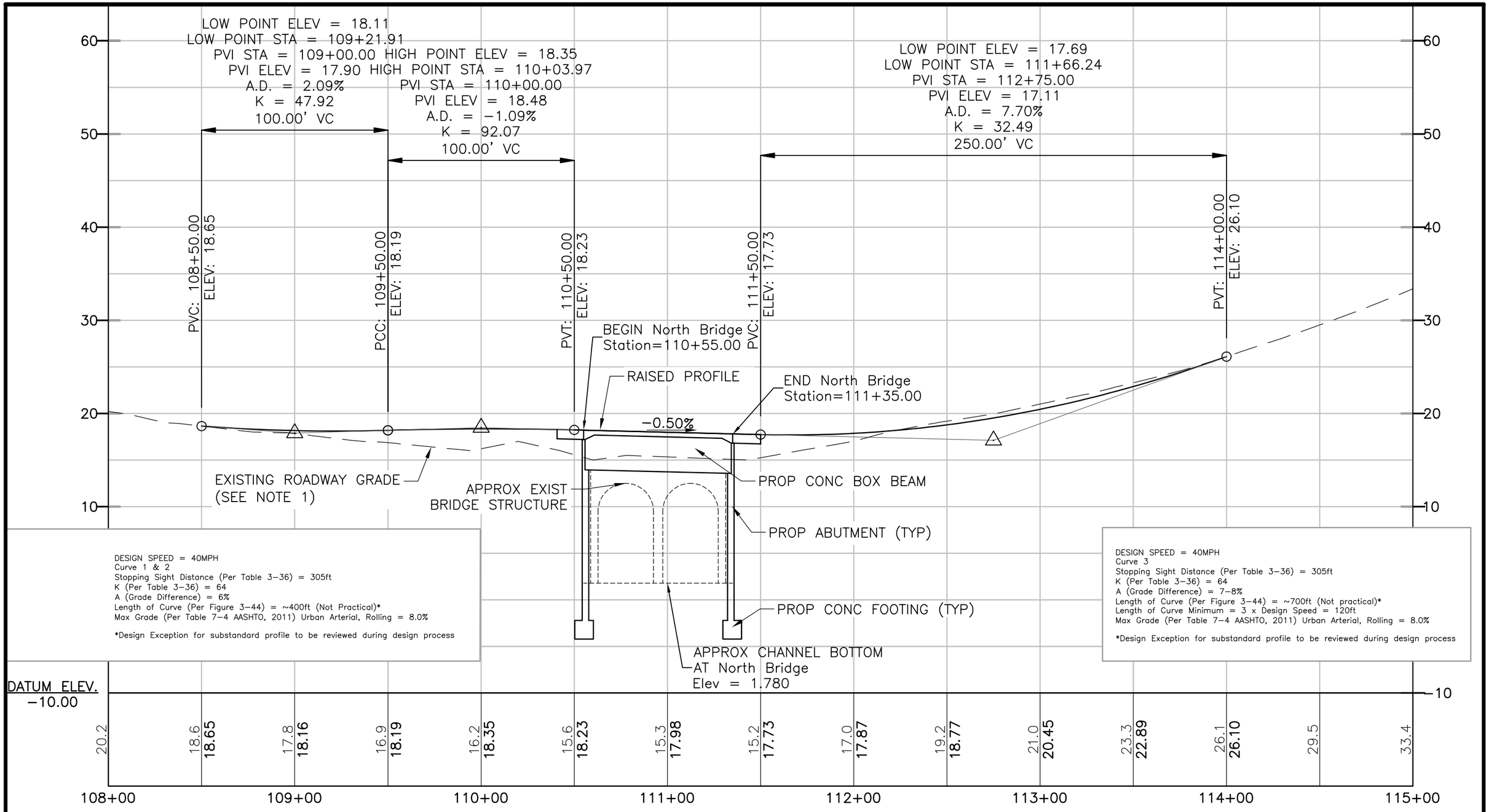
NORTH BRIDGE ELEVATION
ALTERNATIVE 2 – RAISED ROADWAY PROFILES

NOTES:
1. ELEVATIONS AND EXISTING CHANNEL ARE FROM AVAILABLE GIS DATA.
2. DHW ELEVATION IS BASED ON 100YR STORM EVENT.

1" = 10'
5 0 10

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			4



DESIGN SPEED = 40MPH
Curve 1 & 2
Stopping Sight Distance (Per Table 3–36) = 305ft
K (Per Table 3–36) = 64
A (Grade Difference) = 6%
Length of Curve (Per Figure 3–44) = ~400ft (Not Practical)*
Max Grade (Per Table 7–4 AASHTO, 2011) Urban Arterial, Rolling = 8.0%

*Design Exception for substandard profile to be reviewed during design process

DESIGN SPEED = 40MPH
Curve 3
Stopping Sight Distance (Per Table 3–36) = 305ft
K (Per Table 3–36) = 64
A (Grade Difference) = 7–8%
Length of Curve (Per Figure 3–44) = ~700ft (Not practical)*
Length of Curve Minimum = 3 x Design Speed = 120ft
Max Grade (Per Table 7–4 AASHTO, 2011) Urban Arterial, Rolling = 8.0%

*Design Exception for substandard profile to be reviewed during design process

ALTERNATIVE 2 – RAISED ROADWAY PROFILES
NORTH BRIDGE

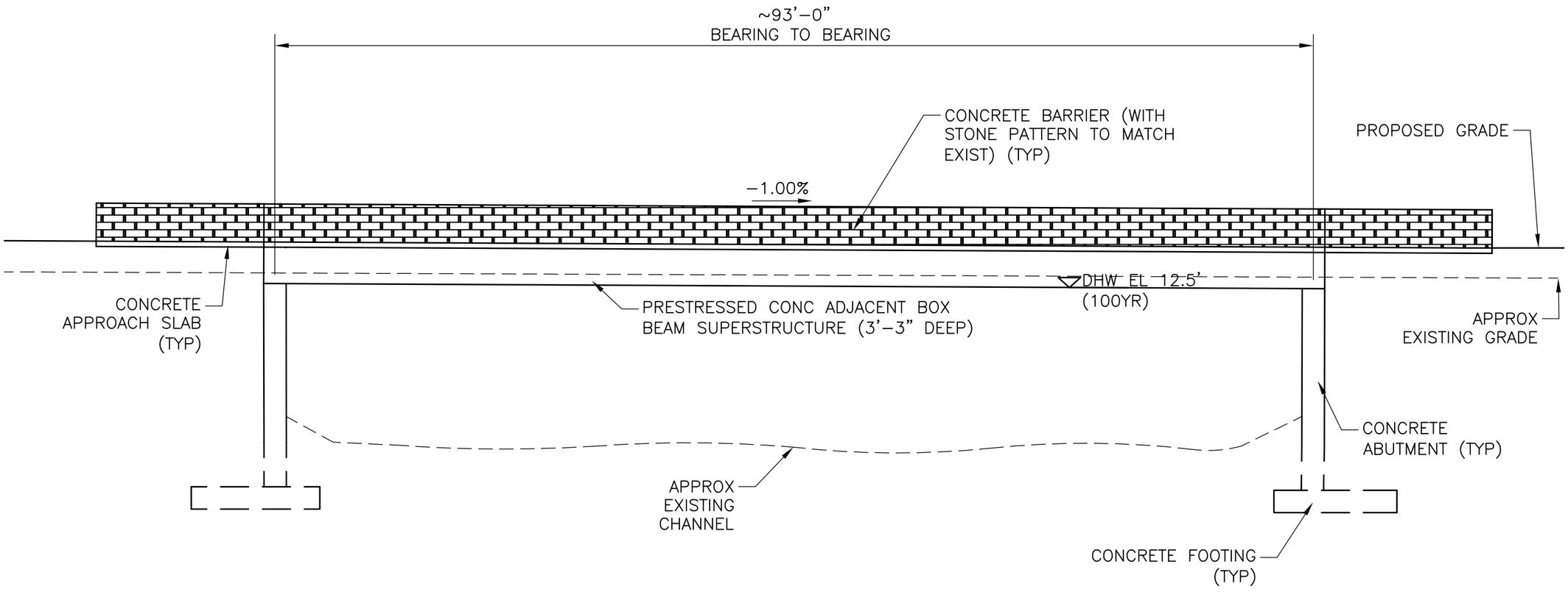
NOTES:
1. PROFILE AND ELEVATIONS ARE FROM AVAILABLE GIS DATA.

HORIZONTAL SCALE: 1" = 50'
25 0 50

VERTICAL SCALE: 1" = 5'
2.5 0 5

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			5



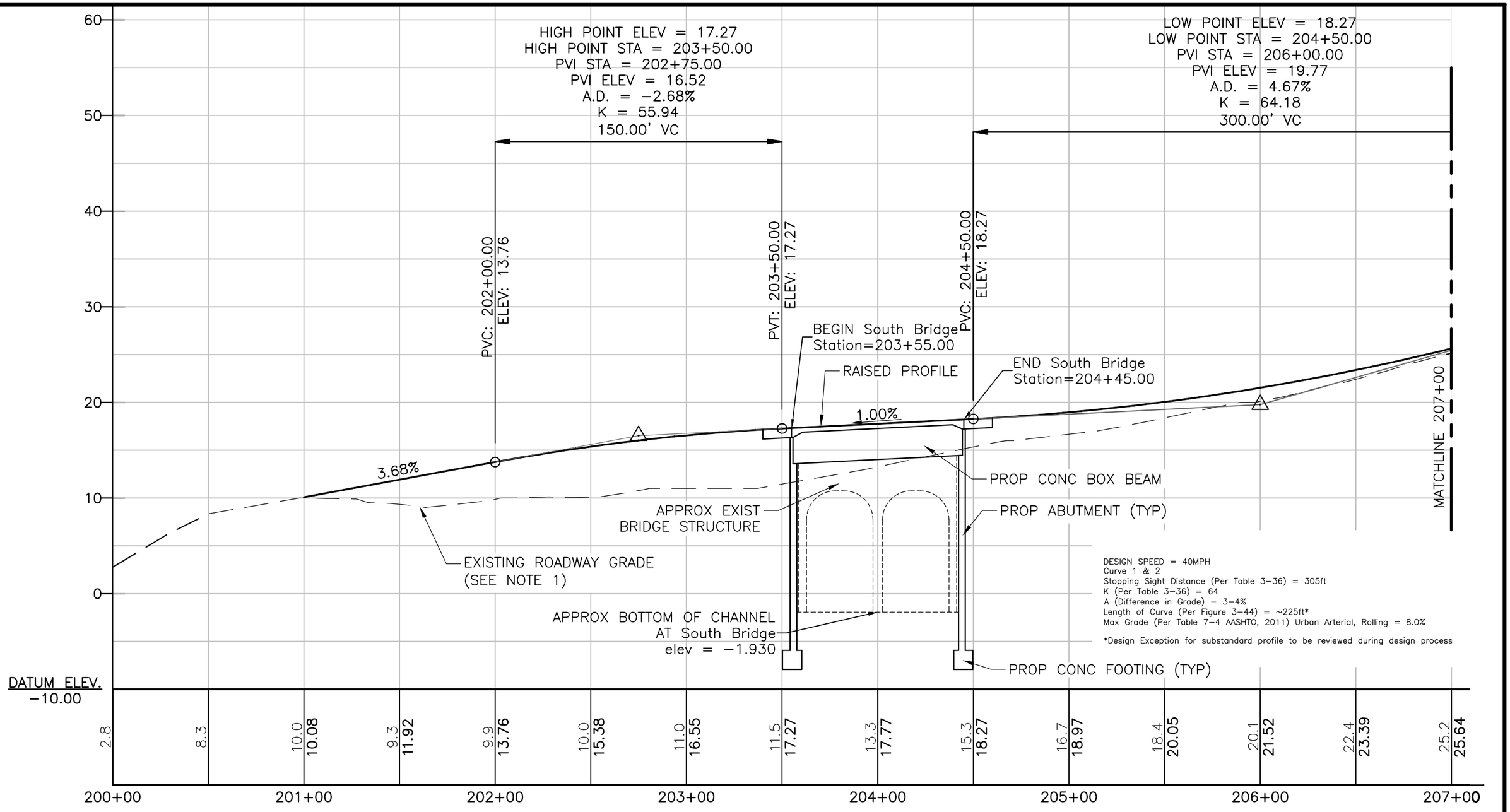
SOUTH BRIDGE ELEVATION
ALTERNATIVE 2 – RAISED ROADWAY PROFILES

NOTES:
1. ELEVATIONS AND EXISTING CHANNEL ARE FROM AVAILABLE GIS DATA.
2. DHW ELEVATION IS BASED ON 100YR STORM EVENT.

1" = 10'
5 0 10

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			6



ALTERNATIVE 2 – RAISED ROADWAY PROFILES SOUTH BRIDGE

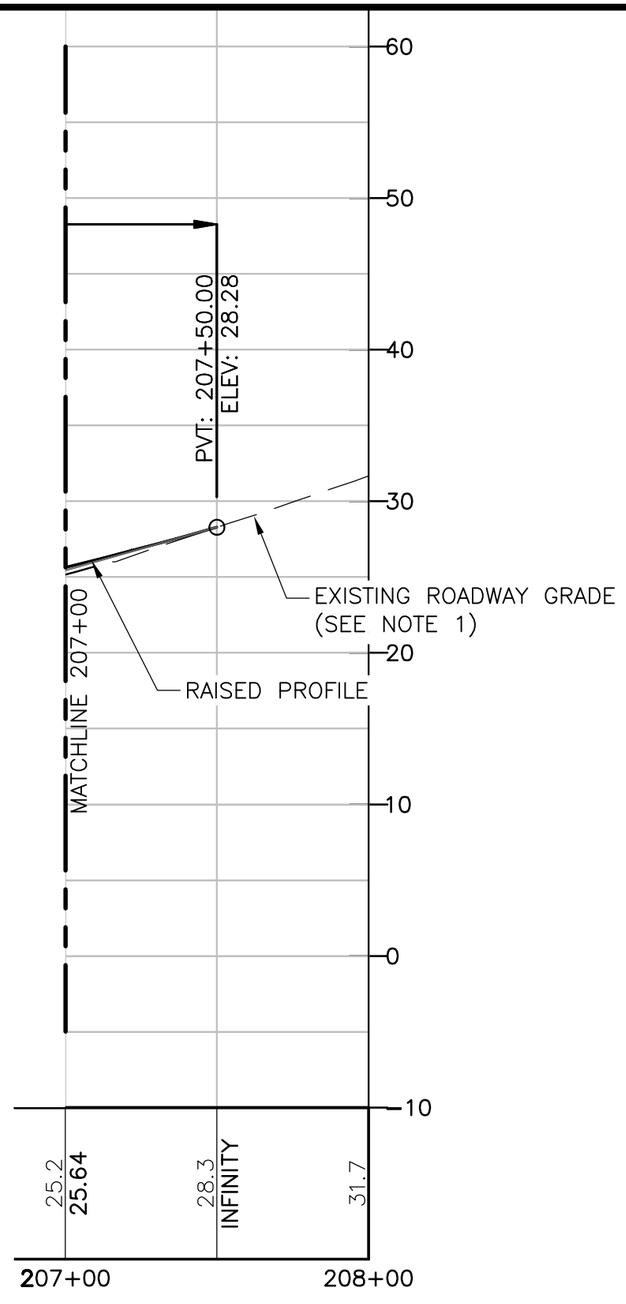
NOTES:
1. PROFILE AND ELEVATIONS ARE FROM AVAILABLE GIS DATA.

HORIZONTAL SCALE: 1" = 50'
25 0 50

VERTICAL SCALE: 1" = 5'
2.5 0 5

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			7



ALTERNATIVE 2 – RAISED ROADWAY PROFILES
SOUTH BRIDGE

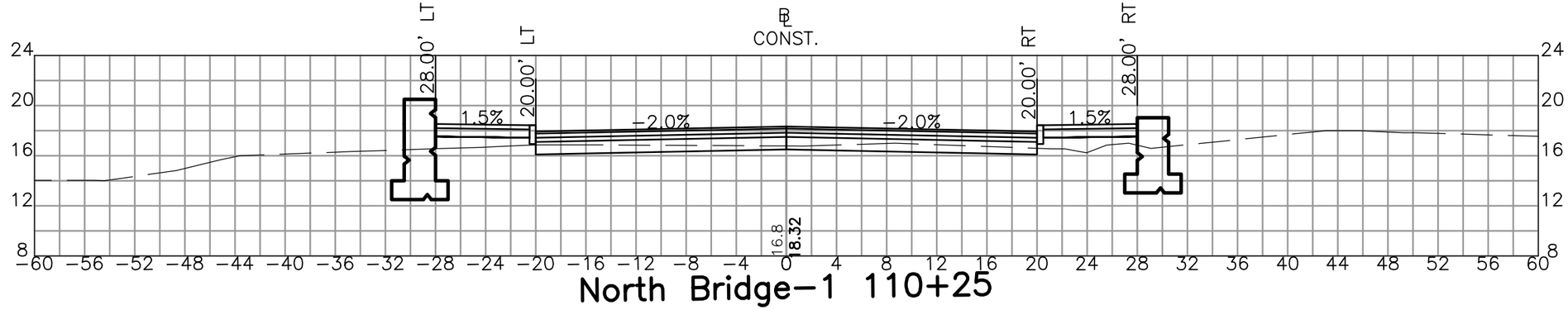
NOTES:
1. PROFILE AND ELEVATIONS ARE FROM AVAILABLE GIS DATA.

HORIZONTAL SCALE: 1" = 50'
25 0 50

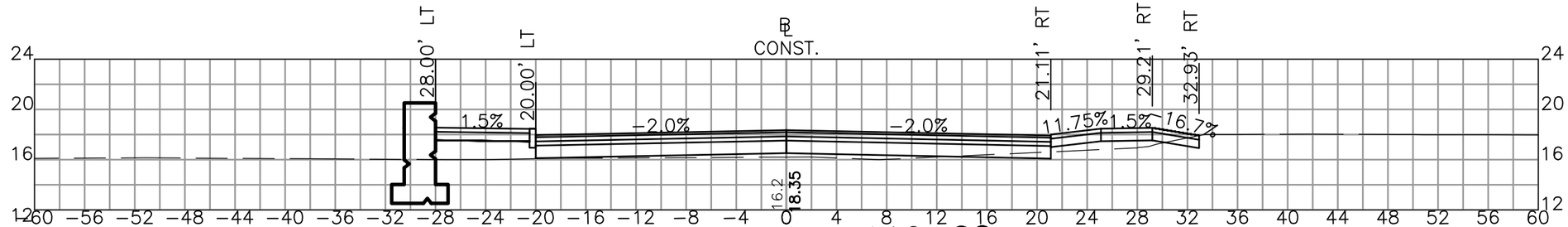
VERTICAL SCALE: 1" = 5'
2.5 0 5

DATE SEPT 2016

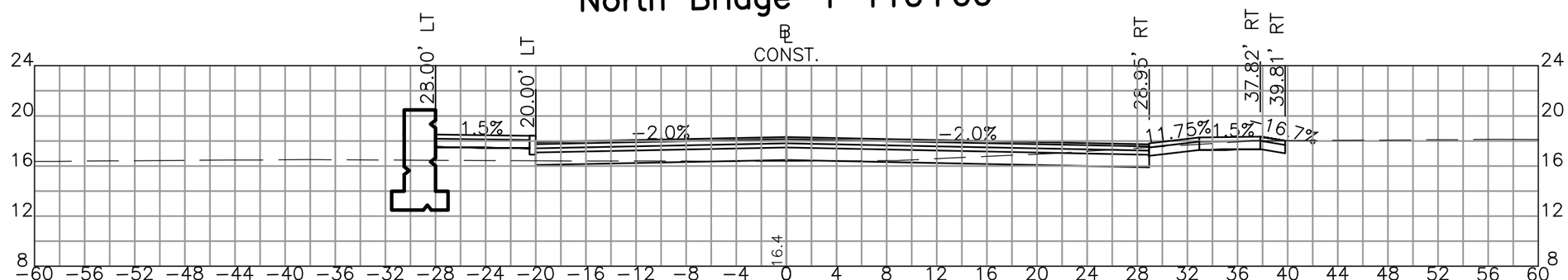
BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			8



North Bridge-1 110+25



North Bridge-1 110+00



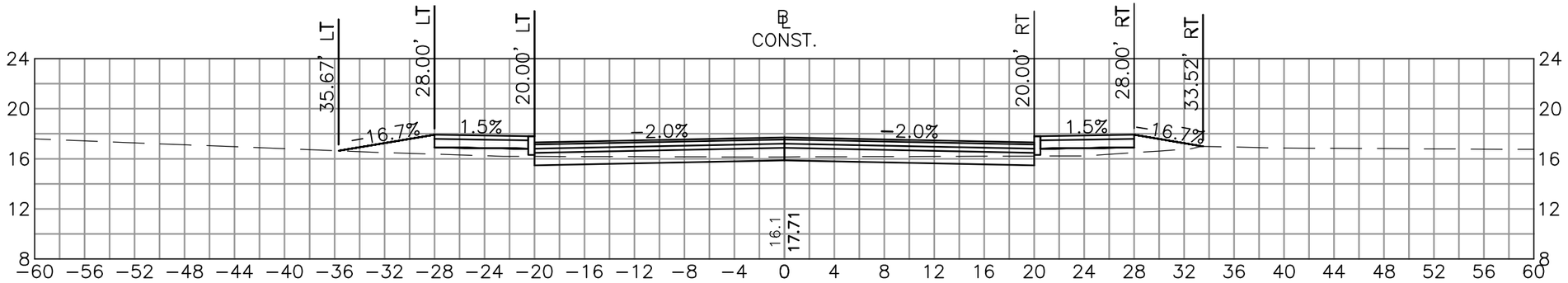
North Bridge-1 109+75

1" = 10'

5 0 10

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			9



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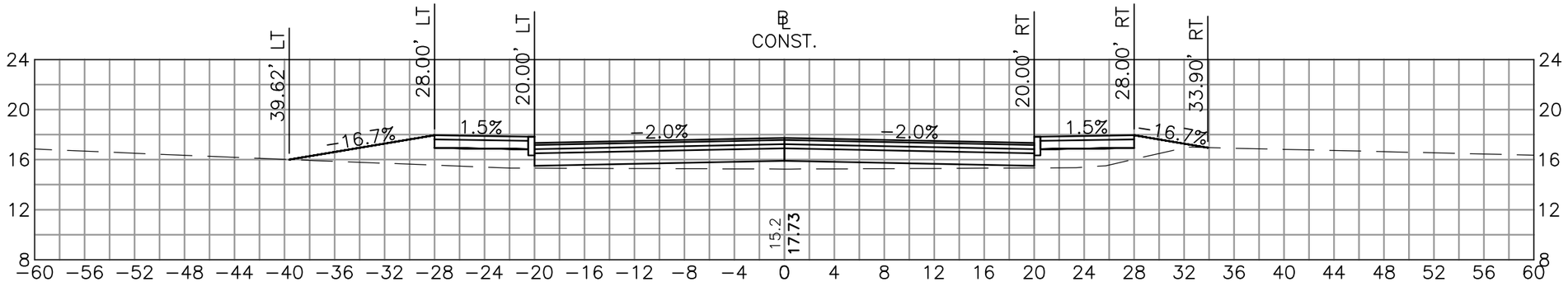

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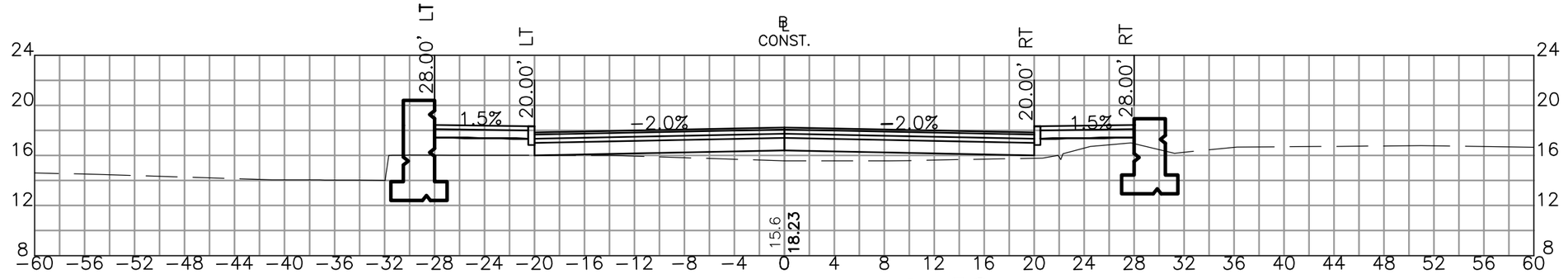


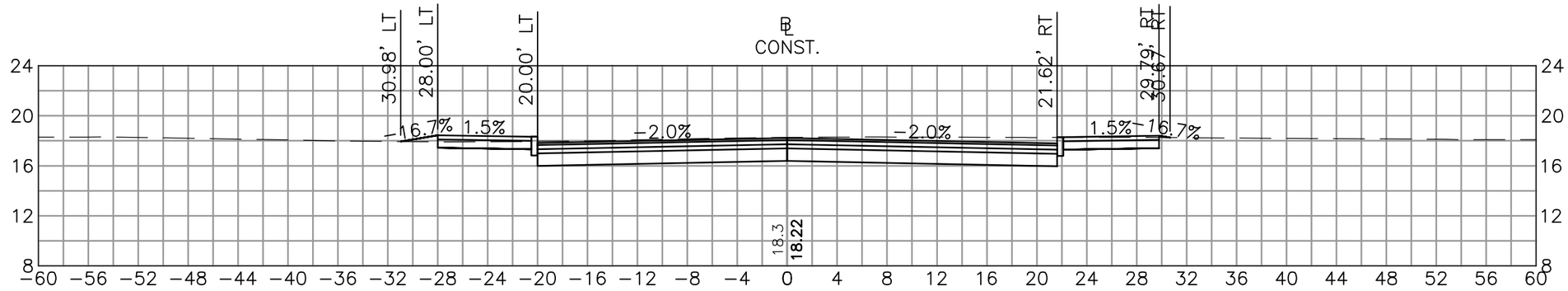
North Bridge–1 110+50

1" = 10'

5 0 10

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		10



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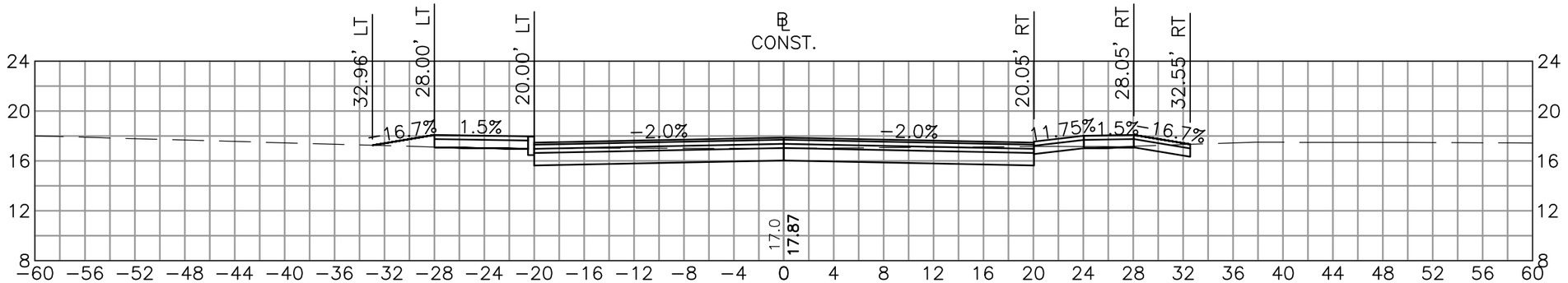


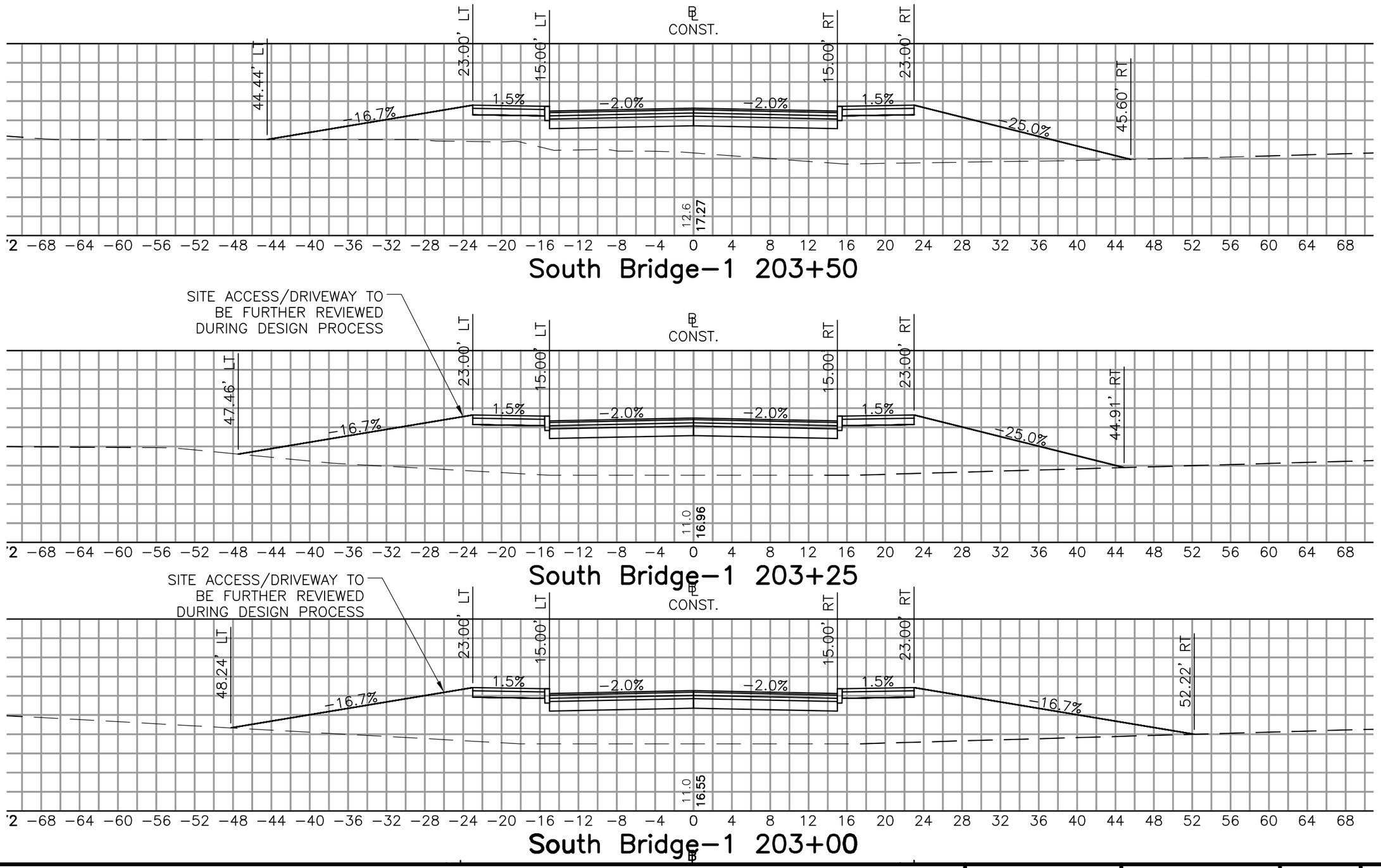
North Bridge–1 112+00

1" = 10'

5 0 10

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			11

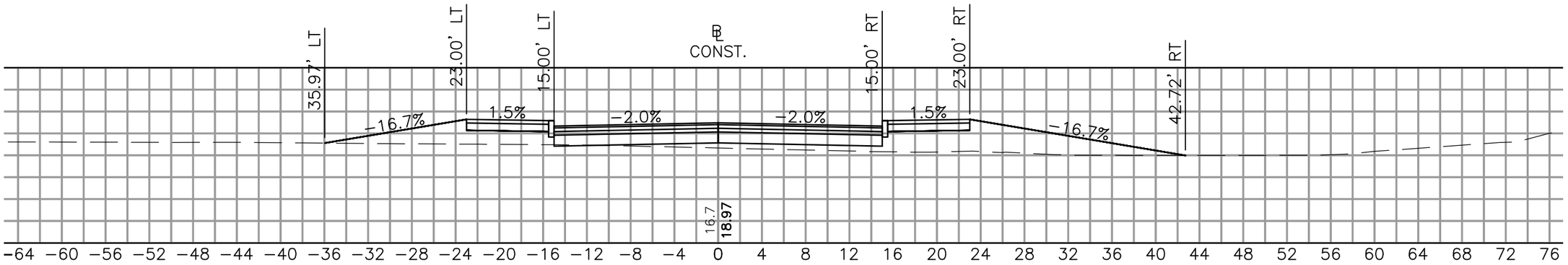


1" = 10'

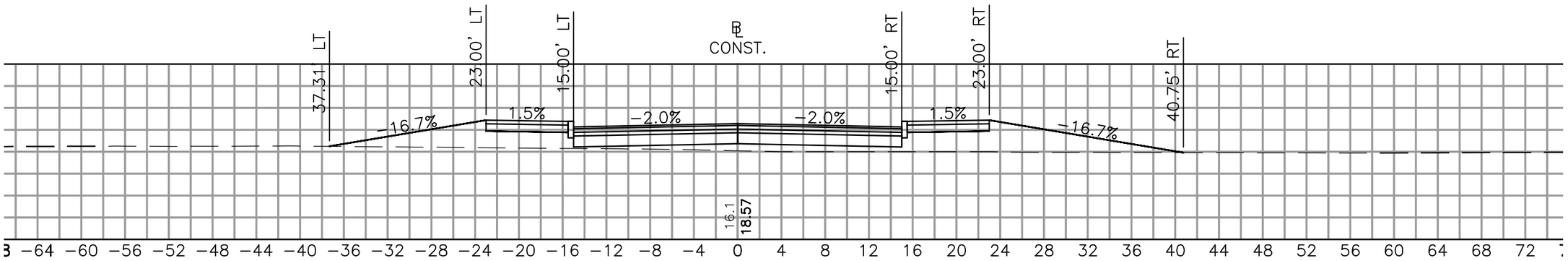
5 0 10

DATE SEPT 2016

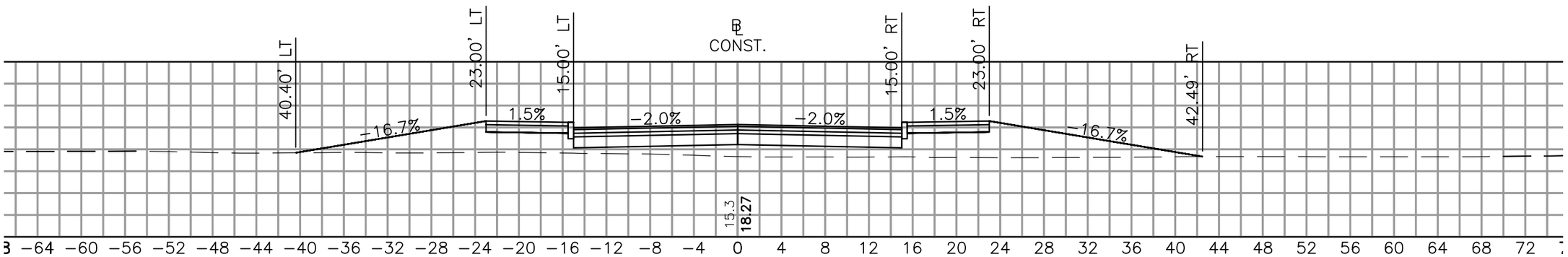
BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		12



South Bridge–1 205+00



South Bridge–1 204+75



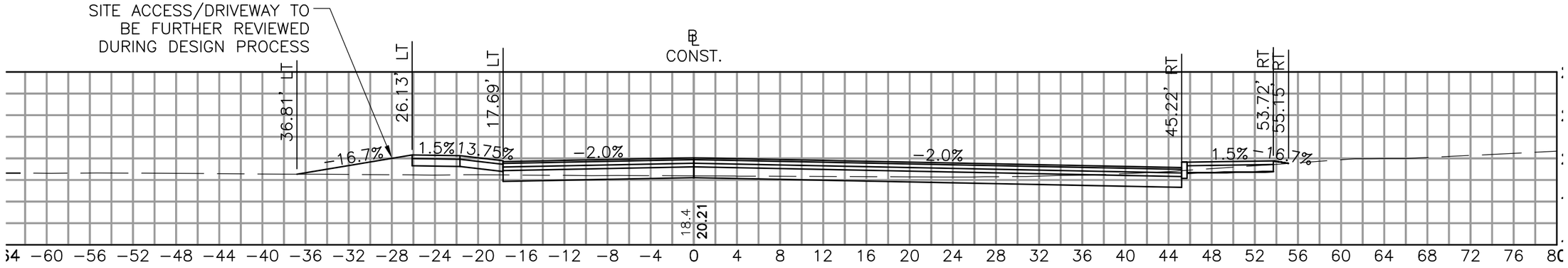
South Bridge–1 204+50

1" = 10'

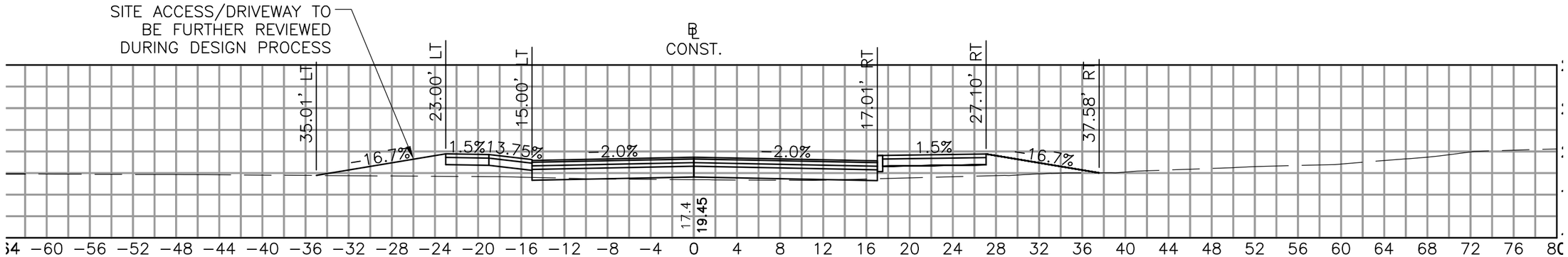
5 0 10

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			13



South Bridge–1 205+50



South Bridge–1 205+25

1" = 10'

5 0 10

DATE SEPT 2016

BYRAM RIVER - TASK 540 A & B		ADDENDUM NO.	FIGURE NO.
SHEET NO.	LOCATION		
			14

Attachment C

Quantities and Cost Estimates

Project: **Byram River Rte 1 Bridge Alternatives**

CDM Smith Project #: Task 540 - Byram River

Date: 08/30/16

Atlernative 2 - Raised Roadway Profiles with Bridge Type Option 1 - Prestressed Concrete Box Beams

Item No.	Description	Units	Quantity	Unit Price	Total Cost
201.07	CLEARING AND GRUBBING	ACRE	0.25	$14,618	$3,655
202.2	REMOVING OLD BITUMINOUS CONCRETE OVERLAY	SY	800.00	$15	$12,064
203.02	UNCLASSIFIED EXCAVATION AND DISPOSAL	CY	8,300.00	$25	$209,243
203.06	SELECT FILL	CY	3,300.00	$47	$156,387
304.0001002	FINE GRADING OF EXISTING SUBBASE	SF	68,200.00	$1	$40,920
304.0197061	CRUSHED STONE AGGREGATE SUBBASE COURSE (12" THICKNESS)	CY	2,600.00	$79	$204,282
402.128202	F2 TOP COURSE HMA, 80 SERIES COMPACTION (2" THICKNESS)	TON	900.00	$93	$83,439
402.258902	F9 BINDER HMA, 80 SERIES COMPACTION (2" THICKNESS)	TON	900.00	$100	$89,550
402.376902	F9 BASE HMA, 60 SERIES COMPACTION (4" THICKNESS)	TON	1,800.00	$83	$150,048
520.0900001	SAW CUTTING ASPHALT CONCRETE	LF	900.00	$3	$2,259
520.5	SAWING CONCRETE	LF	64.00	$7	$437
608.0101	CONCRETE SIDEWALKS AND DRIVEWAYS	CY	500.00	$536	$267,780
688.01	WHITE PREFORMED REFLECT PAVEMENT STRIPES	LF	2,900.00	$2	$5,800
688.02	YELLOW PREFORMED REFLECT PAVEMENT STRIPES	LF	1,100.00	$3	$3,267
999.1	UTILITY ADJUSTMENTS (INCLUDES DRAINAGE, SEWER, UTIL POLES, WATER)	EA	34.00	$475	$16,134
999.2	BRIDGE REPLACEMENT - NORTH - OPTION 1 - BOX BEAMS	LS	1.00	$1,224,800	$1,224,800
999.3	BRIDGE REPLACEMENT - SOUTH - OPTION 1 - BOX BEAMS	LS	1.00	$1,478,400	$1,478,400
999.4	RETAINING WALL	CY	200	$1,200	$240,000
999.5	LANDSCAPING	LS	1	$ 10,000.00	$10,000
999.6	TRAFFIC CONTROL/DETOUR SETUP	LS	1	$419,846.51	$419,847
				Subtotal	*$4,618,312*
	INCIDENTALS (5%)				$231,000
				Subtotal	*$4,849,312*
	CONTINGENCY (25%)				$1,212,000
				Subtotal	*$6,061,312*
697.03	FIELD CHANGE PAYMENT (5%)	LS	1	$303,000	$303,000
				Subtotal	*$6,364,312*
699.040001	MOBILIZATION (10%)	LS	1	$636,000	$636,000
				Subtotal	*$7,000,312*
	INFLATION (5%)				$350,000
				TOTAL	**$7,350,312**

NOTES:

1) NO EASEMENTS/TAKING PRICES WERE CONSIDERED AS PART OF THIS ESTIMATE

2) ITEM 999.1 ASSUMES ADJUSTMENTS OF FRAMES, GRATES, ETC. AND DOES NOT INCLUDE REPLACEMENT OF ANY UTILITIES

ESTIMATE OF QUANTITIES

ITEM NO.	DESCRIPTION	UNITS	QUANTITY
201.07	CLEARING AND GRUBBING	ACRE	0.25
202.2	REMOVING OLD BITUMINOUS CONCRETE OVERLAY	SY	800
203.02	UNCLASSIFIED EXCAVATION AND DISPOSAL	CY	8300
203.06	SELECT FILL	CY	3300
304.0001002	FINE GRADING OF EXISTING SUBBASE	SF	68200
304.0197061	CRUSHED STONE AGGREGATE SUBBASE COURSE (12" THICKNESS)	CY	2600
402.128202	F2 TOP COURSE HMA, 80 SERIES COMPACTION (2" THICKNESS)	TON	900
402.258902	F9 BINDER HMA, 80 SERIES COMPACTION (2" THICKNESS)	TON	900
402.376902	F9 BASE HMA, 60 SERIES COMPACTION (4" THICKNESS)	TON	1800
520.0900001	SAW CUTTING ASPHALT CONCRETE	LF	900
520.5	SAWING CONCRETE	LF	64
608.0101	CONCRETE SIDEWALKS AND DRIVEWAYS	CY	500
688.01	WHITE PREFORMED REFLECT PAVEMENT STRIPES	LF	2900
688.02	YELLOW PREFORMED REFLECT PAVEMENT STRIPES	LF	1100
999.1	UTILITY ADJUSTMENTS (INCLUDES DRAINAGE, SEWER, UTIL POLES, WATER)	EA	34
999.2	BRIDGE REPLACEMENT - NORTH - OPTION 1 - BOX BEAMS	LS	1
999.3	BRIDGE REPLACEMENT - SOUTH - OPTION 1 - BOX BEAMS	LS	1
999.4	RETAINING WALL	CY	200
999.5	LANDSCAPING	LS	1
999.6	TRAFFIC CONTROL/DETOUR SETUP	LS	1
697.03	FIELD CHANGE PAYMENT (5%)	LS	1
699.040001	MOBILIZATION (10%)	LS	1

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 1 of 22

Calculated By: Date:

Checked By: Date:

Total: 0.25 ACRE

Item: 201.07 **Clearing and Grubbing** **Units: ACRE**

Description:
For removal of brush to accommodate grading. 1 ACRE = 43,560 SQFT. Assume approx 0.25 ACRE

Calculations:

0.25 ACRE = 10890 SQFT

Item Total:	**0.25**	**ACRE**
Say:	**0.25**	**ACRE**

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 2 of 22

Calculated By: Date:

Checked By: Date:

Total: 800 SY

Item: 202.2 **Removing Old bituminous concrete overlay** **Units: SY**

Description:

Removal of Misc. HMA. Assume 10% of all HMA Roadway surface.

Calculations:

Total Roadway Area (Inside curb line)	-	Total Internal Turnaround Area	=	Total Bit Conc Roadway	/	9	SQFT/SQYD			
136085 SQFT	-	67930 SQFT	=	68155 SQFT	/	9	=	7573 SQYD	*	0.10
							=	757 SQYD		

Item Total:	**757.3**	**SY**
Say:	**800**	**SY**

Project: Byram River Rte 1 Bridge Alternatives
Sheet No: 3 of 22
Calculated By: Date:
Checked By: Date:
Total: 8,300 CY

Item: 203.02 **Unclassified Excavation and Disposal** **Units: CY**

Description:
Assume all excavation associated with roadway, sidewalk, driveway and grading beyond back of walk. Assume 2ft depth of excavation.

Calculations:

Sidewalk, Driveway Width (ft)				Project Length (according to alignment lengths and assuming 2 sidewalks) (ft)								
				Hillside Ave		Turnaround West		Putnam Ave				
8	*	2	*	(550	+	150	+	200	+			
				West Putnam Ave		Turnaround East						
				+ 650	+	125)	=	26800 SQFT				

Beyond back of sidewalk (5ft)				Project Length (according to alignment lengths and assuming 2 sidewalks) (ft)								
				Hillside Ave		Turnaround West		Putnam Ave				
5	*	2	*	(550	+	150	+	200	+			
				West Putnam Ave		Turnaround East						
				+ 650	+	125)	=	16750 SQFT				

Total Roadway Area (Inside curb line)		Total Internal Turnaround Area		Total Bit Conc Roadway
136085 SQFT	-	67930 SQFT	=	68155 SQFT

Subtotal	111705 SQFT	
Subtotal (CF)	223410 CF	/ 27 CF/CY
Conversion (CY)	8274.44 CY	

Item Total:	**8,274.4**	**CY**
Say:	**8,300**	**CY**

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 4 of 22

Calculated By: Date:

Checked By: Date:

Total: 3,300 CY

Item: 203.06 **Select Fill** **Units: CY**

Description:
Fill needed to raise the North Bridge (Hillside Ave) and South Bridge (West Putnam Ave) roadway profiles.

Calculations:

Per AutoCAD Civil 3D Mass/Haul Diagram which uses Average End Area to calculate Cut/Fill. Below is the Net volume (Fill) required.

North Bridge Fill Volume (CY)	+	South Bridge Fill Volume (CY)	=	Total Volume of Fill (CY)
115	+	3130	=	3245 CY

Item Total: 3,245.0 CY

Say: 3,300 CY

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 5 of 22

Calculated By: Date:

Checked By: Date:

Total: 68,200 SF

Item: 304.0001002 **Fine Grading of existing subbase** **Units: SF**

Description:
Area is per roadway limits.

Calculations:

Total Roadway Area (Inside curb line)		-	Total Internal Turnaround Area		=	Total Bit Conc Roadway	
136085	SQFT	-	67930	SQFT	=	68155	SQFT

Item Total:	**68,155.0**	**SF**
Say:	**68,200**	**SF**

Project: Byram River Rte 1 Bridge Alternatives
Sheet No: 6 of 22
Calculated By: Date:
Checked By: Date:
Total: 2,600 CY

Item: 304.0197061 **Crushed Stone aggregate subbase course (12" Thickness)** **Units: CY**

Description:
Area of subbase is per roadway limits. Assumed depth of crushed stone is 12".

Calculations:

Total Roadway Area (Inside curb line)	-	Total Internal Turnaround Area	=	Total Roadway	* 1 (ft)	/ 27 CF/CY
136085 SQFT	-	67930 SQFT	=	(68155 SQFT	* 1)	/ 27 = 2524.259 CY

Item Total:	**2,524.3**	**CY**
Say:	**2,600**	**CY**

Project: Byram River Rte 1 Bridge Alternatives
Sheet No: 7 of 22
Calculated By: Date:
Checked By: Date:
Total: 900 **TON**

Item: 402.128202 **F2 Top Course HMA, 80 Series Compaction (2" Thickness)** **Units: TON**

Description:
Area of top course is per roadway limits. Assumed depth of binder course is 2". 1 Cubic Yard of HMA ~ 2.025 tons.

Calculations:

Total Roadway Area (Inside curb line) - Total Internal Turnaround Area = Total Roadway * (2/12)(ft) / 27 CF/CY

136085 SQFT - 67930 SQFT = (68155 SQFT * 0.16667) / 27 = 420.7 CY

Converted = 851.9 TONS

Item Total: 851.9 TON

Say: 900 TON

Project: Byram River Rte 1 Bridge Alternatives
Sheet No: 8 of 22
Calculated By: Date:
Checked By: Date:
Total: 900 TON

Item: 402.258902 **F9 Binder HMA, 80 series compaction (2" Thickness)** **Units: TON**

Description:
Area of binder course is per roadway limits. Assumed depth of binder course is 2". 1 Cubic Yard of HMA ~ 2.025 tons.

Calculations:

Total Roadway Area (Inside curb line)	-	Total Internal Turnaround Area	=	Total Roadway	* '12)(ft)	/	27 CF/CY
136085 SQFT	-	67930 SQFT	=	(68155 SQFT	* 0)	/	27 = 420.7 CY

Converted = 851.9 TONS

Item Total:	**851.9**	**TON**
Say:	**900**	**TON**

Project: Byram River Rte 1 Bridge Alternatives
Sheet No: 9 of 22
Calculated By: Date:
Checked By: Date:
Total: 1,800 **TON**

Item: 402.376902 **F9 Base HMA, 60 Series Compaction (4" Thickness)** **Units: TON**

Description:
Area of base course is per roadway limits. Assumed depth of base course is 4". 1 Cubic Yard of HMA ~ 2.025 tons.

Calculations:

Total Roadway Area (Inside curb line)	-	Total Internal Turnaround Area	=	Total Roadway	*	(4/12)(ft)	/	27 CF/CY
136085 SQFT	-	67930 SQFT	=	(68155 SQFT	*	0.33333333)	/	27 = 841.42 CY

Converted = 1703.88 TONS

Item Total:	**1,703.9**	**TON**
Say:	**1,800**	**TON**

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 10 of 22

Calculated By: Date:

Checked By: Date:

Total: 900 LF

Item: 520.0900001 **Saw Cutting Asphalt Concrete** **Units: LF**

Description:

Assumed sawcutting required at roadway limits of project and HMA parking lots to meet existing.

Calculations:

Limits of Work (ft)	+	HMA Parking Lots (ft)		
210	+	635	=	845 LF

Item Total:	**845.0**	**LF**
Say:	**900**	**LF**

Project: Byram River Rte 1 Bridge Alternatives
Sheet No: 11 of 22
Calculated By: Date:
Checked By: Date:
Total: 64 LF

Item: 520.5 **Sawing Concrete** **Units: LF**

Description:
Assumed sawcutting required at sidewalk limits of project.

Calculations:

Sidewalk Limit Sawcutting Length (LF)

64 LF

Item Total:	**64.0**	**LF**
Say:	**64**	**LF**

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 12 of 22

Calculated By: Date:

Checked By: Date:

Total: 500 **CY**

Item: 608.0101 **Concrete Sidewalks and Driveways** **Units: CY**

Description:

All existing sidewalks and driveways in the project area to be removed and replaced with new. Assumed concrete depth of 4" for Sidewalk, 6" for Driveway. Therefore used 5" as average.

Calculations:

Sidewalk, Driveway Width (ft)		2		Project Length (according to alignment lengths and assuming 2 sidewalks) (ft)								(5/12) ft
				Hillside Ave		Turnaround West		Putnam Ave				
8	*	2	* (	550	+	150	+	200	+			
				West Putnam Ave		Turnaround East						
			+	650	+	125	)	*	0.4167 ft	=	11167 CF	/ 27 CF/CY

Converted = 413.58 CY

Item Total:	**413.6**	**CY**
Say:	**500**	**CY**

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 13 of 22

Calculated By: Date:

Checked By: Date:

Total: 2,900 LF

Item: 688.01 **White Preformed Reflect Pavement Stripes** **Units: LF**

Description:
New striping for travel lane and shoulder delineation (white).

Calculations:

Bridge	Dashed White Center Line (LF)	+	Solid White Edge Line (LF)		
North	550	+	1100	=	1650 LF
South	310	+	900	=	1210 LF
				Total	2860 LF

Item Total: 2,860.0 LF

Say: 2,900 LF

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 14 of 22

Calculated By: Date:

Checked By: Date:

Total: 1,100 LF

Item: 688.02 **Yellow Preformed Reflect Pavement Stripes** **Units: LF**

Description:
New striping for Gore Lines and Double yellow center line.

Calculations:

Gore Lines	+	Double Yellow Centerline		
800	+	300	=	1100 LF

Item Total:	**1,100.0**	**LF**
Say:	**1,100**	**LF**

Project: Byram River Rte 1 Bridge Alternatives
Sheet No: 15 of 22
Calculated By: Date:
Checked By: Date:
Total: 34 EA

Item: 999.1 **Utility Adjustments (Includes Drainage, Sewer, Util Poles, Water)** **Units: EA**

Description:
Includes only the adjustment of existing utility structures such as CBs, Gate valves, Hydrants, Manholes. Cost is average of these items. This does not include replacement of any utilities.

Calculations:

	Approximate number of each utility
CBs	10
Hydrants	1
Valves	10
Manholes	10
Utility Poles	3
Total =	34 EA

Item Total:	**34.0**	**EA**
Say:	**34**	**EA**

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 16 of 22

Calculated By: Date:

Checked By: Date:

Total: 1,224,800 LS

Item: 999.2 **Bridge Replacement - North - Option 1 - Box Beams** **Units: LS**

Description:

See attached 'PRELIMINARY COST ESTIMATE WORKSHEET (NEW AND REPLACEMENT BRIDGES)' for BIN 1000121

Calculations:

Item Total: ######## LS

Say: 1,224,800 LS

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 17 of 22

Calculated By: Date:

Checked By: Date:

Total: 1,478,400 LS

Item: 999.3 **Bridge Replacement - South - Option 1 - Box Beams** **Units: LS**

Description:

See attached 'PRELIMINARY COST ESTIMATE WORKSHEET (NEW AND REPLACEMENT BRIDGES)' for BIN 1000122

Calculations:

Item Total: 1,478,399.0 LS

Say: 1,478,400 LS

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 18 of 22

Calculated By: Date:

Checked By: Date:

Total: 200 CY

Item: 999.4 **Retaining Wall** **Units: CY**

Description:

Two retaining walls near North Bridge (on Hillside Ave) to accommodate grade change. Cost is based on Item 555.0105 - Concrete for Structures, Class A (CY).

Calculations:

Wall Location	Wall Length (ft)	*	Wall depth (Stem) (ft)	*	Wall Width (ft)	+		
North Side	180		4		3.00			
South Side	52		4		2.5			
	Footing Length (ft)	*	Footing depth (ft)	*	Footing width (ft)	=	Total	
North Side	180		2		5	=	3960	CF
South Side	52		2		5	=	975	CF

Subtotal = 4935 CF / 27 CF/CY

Converted = 183 CY

Item Total: 182.8 CY

Say: 200 CY

Project:
Sheet No: 19 of 22
Calculated By: Date:
Checked By: Date:
Total: 10,000 LS

Item: 999.5 **Landscaping** **Units: LS**

Description:
Includes Loam, seed, mulch and any other landscaping item required to accommodate grade change. Cost is a combination of Seed, mulch and contingency items.

Calculations:

Area of Landscaping (per Clearing and Grubbing)					/	9	SQFT/SQYD	
0.25	Acres	=	10890	SQFT	/	9	=	1210 SQYD
Assume 10	Shrubs						=	10 Shrubs
Assume 5	Trees						=	5 Trees

Items				
209.1003	Seed and Mulch	=	$ 0.66	/ SQYD
611.0412	Shrubs	=	$ 90.60	/ EA
611.0111	Trees	=	$ 1,000.00	/ EA

Lump Sum Cost = $ 6,704.60

Say $ 10,000.00

Item Total: 10,000.0 LS

Say: 10,000 LS

Project: Byram River Rte 1 Bridge Alternatives

Sheet No: 20 of 22

Calculated By: Date:

Checked By: Date:

Total: 0 LS

Item: 999.6 **Traffic Control/Detour Setup** **Units: LS**

Description:
Assumed 10% of total cost.

Calculations:

Item Total:	**0.0**	**LS**
Say:	**0**	**LS**

PRELIMINARY COST ESTIMATE WORKSHEET (NEW AND REPLACEMENT BRIDGES)

P.I.N [ ] B.I.N [1000121] PS&E [ ] Anticipated Year of Construction [2017]

Bridge Name: Route 1 Over Byram River

Prepared by: CDM Smith date: 8/26/16

Number of Spans: 1 Width (ft): 49.17 OR (m): (Width of

Span: 1 (Length al

Length of Spans(ft):	90							
OR Spans (m):								

Superstructure type: PC box beam Radius (ft): 0 OR (m):

Abutment type: solid cantilever Average Abutment Height (ft): 8 OR (m):

Foundation type: piles in poor soil skew in degrees: 15

Length of wingwalls > 60 ft: 0 OR (m): Average ww height ft: 8

Number of Cofferdams 2 water depth, ftg bottom to OHW: Abutments in 4 ft to 6 ft of water

Over Roadway Height (ft): 12 OR (m): (From roadway to bottom of culvert)

Bottom Angle (ft): 80 OR (m): (Length of barrel for culvert & 3-sided frame)

Work Zone Traffic Control: on twin bridge Painted: no

Shoulder Break Area (sq ft): 6516

1A) Base ($/sq ft shoulder break area)	$128			
1B) Culverts & Three sided frames	$0	for openings 20 ft to 40 ft		
2) Foundations	$20			
3) Abutments	$0			
4) Cofferdams	$2			
5) Span Adjustment:	$8			
6) Curved Girders	$0			
7) Long Wingwalls	$0			
8) Stage Construction	$0			
9) Miscellaneous	$0			
Total Cost $/sq ft shoulder break area	$158	X SB Area	6516 =	$1,028,340
			Remove Existing Bridge:	$50,000
			Detour or WZTC:	$50,000
			Channel work or other slope protection:	$0
			Utilities, Asthetics, or MSE Walls:	$0
			Overhead:	$15,000
last updated			3% Inflation per Year:	$34,300
12/17/15	(Includes 4% Mobiliztion)		**TOTAL ESTIMATED BRIDGE SHARE:**	**$1,224,746**

PRELIMINARY COST ESTIMATE WORKSHEET (NEW AND REPLACEMENT BRIDGES)

P.I.N [ ] B.I.N [1000122] PS&E [ ] Anticipated Year of Construction [2017]

Bridge Name: Route 1 Over Byram River

Prepared by: CDM Smith date: 8/26/16

Number of Spans: 1 Width (ft): 59.17 OR (m): [ ] (Width of

Span: 1 (Length al

Length of Spans(ft):	92							
OR Spans (m):								

Superstructure type: PC box beam Radius (ft): 0 OR (m): [ ]

Abutment type: solid cantilever Average Abutment Height (ft): 8 OR (m): [ ]

Foundation type: piles in poor soil skew in degrees: 15

Length of wingwalls > 60 ft: 0 OR (m): [ ] Average ww height ft: 8 [ ]

Number of Cofferdams 2 water depth, ftg bottom to OHW: Abutments in 4 ft to 6 ft of water

Over Roadway Height (ft): 12 OR (m): [ ] (From roadway to bottom of culvert)

Bottom Angle (ft): 80 OR (m): [ ] (Length of barrel for culvert & 3-sided frame

Work Zone Traffic Control: on twin bridge Painted: no

Shoulder Break Area (sq ft): 7841

1A) Base ($/sq ft shoulder break area)	$128				
1B) Culverts & Three sided frames	$0	for openings 20 ft to 40 ft			
2) Foundations	$20				
3) Abutments	$0				
4) Cofferdams	$2				
5) Span Adjustment:	$9				
6) Curved Girders	$0				
7) Long Wingwalls	$0				
8) Stage Construction	$0				
9) Miscellaneous	$0				
Total Cost $/sq ft shoulder break area	$158	X SB Area	7841	=	$1,240,133

Remove Existing Bridge:	$75,000
Detour or WZTC:	$50,000
Channel work or other slope protection:	$0
Utilities, Asthetics, or MSE Walls:	$0
Overhead:	$15,000
3% Inflation per Year:	$41,404
TOTAL ESTIMATED BRIDGE SHARE:	**$1,478,399**

last updated
12/17/15 (Includes 4% Mobiliztion)