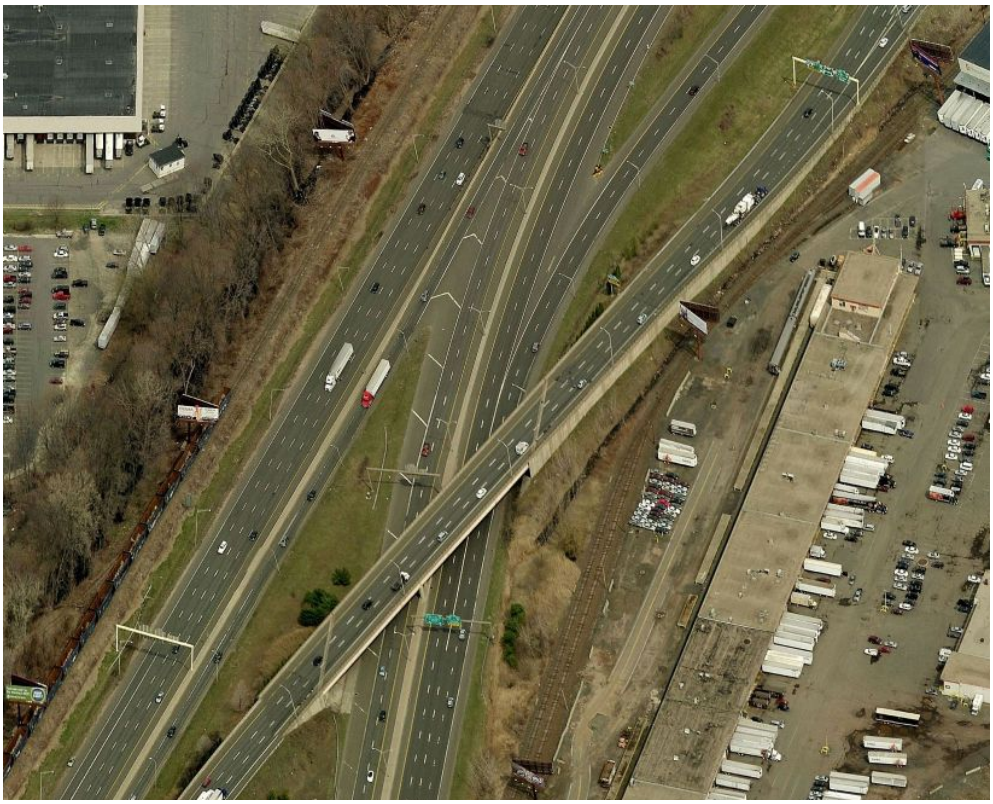
PRELIMINARY TYPE STUDY REPORT

State Project No. 63-703
Proposed Bridge in Hartford
Ramp I-91 NB to Route 5/15 NB over Route 5/15 SB

Prepared For:
State of Connecticut
Department of Transportation
Newington, Connecticut

Submitted: September 2016
Revised: March 2016



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EXECUTIVE SUMMARY

Introduction

CME Associates, Inc. has been retained by the Connecticut Department of Transportation (ConnDOT) to re-design the northbound direction of Interchange 29 on I-91 in Hartford under State Project Number 63-703. Part of this project involves the construction of a new left hand fork ramp carrying Exit 29 northbound traffic over Route 5/15 Southbound. In order to expedite the design process, CME was charged with developing a preliminary structure type study report during the Preliminary Engineering (PE) Phase which was revised during Preliminary Design (PD) Phase.

The I-91/I-84 Interchange and Charter Oak Bridge Project impacts many structures including the Charter Oak Bridge, see Appendix D for a global map of the impacted bridges. This report is preliminary in nature since the final alignment of the interchange is still under development. The layout and clearances of this new bridge is integral with the ramp geometry, therefore the bridge type study was necessary in the PE Phase.

The proposed bridge will carry traffic from I-91 Northbound to Route 5/15 Northbound, spanning over Route 5/15 Southbound. The new ramp connects to the south end of the Charter Oak Bridge and eventually to I-84 Eastbound in the Town of East Hartford. This type study describes the existing site, provides three structure alternates for the proposed bridge, and presents our recommendations for the proposed structure type.

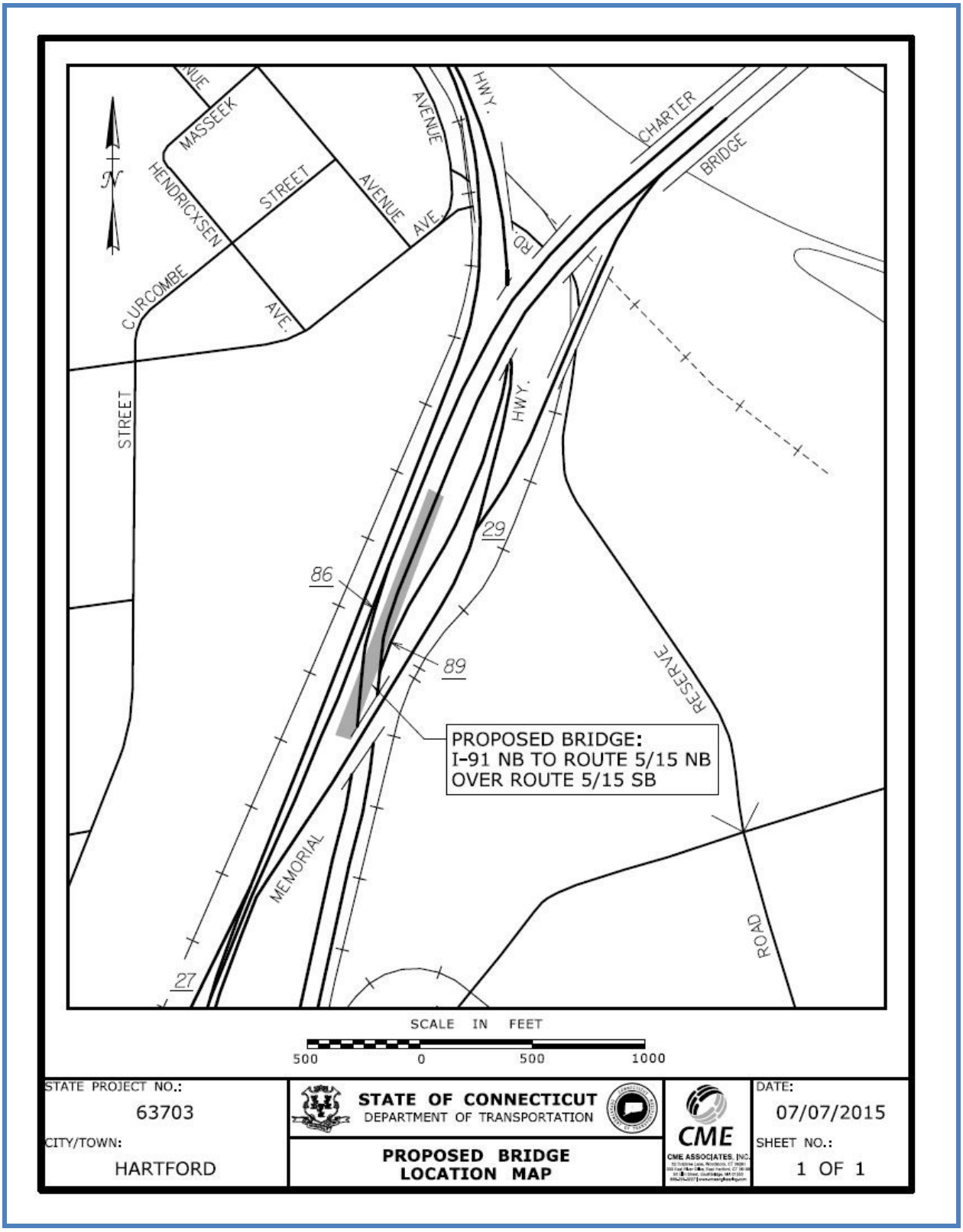
Based upon the evaluation of the proposed bridge, CME recommends Alternate 1A, which consists of a five-span trapezoidal box girder bridge comprised of weathering steel non-integral with substructure with one steel straddle bent cap. This design was driven by the severe skew angle between the proposed bridge and Route 5/15 SB below the bridge and the need to limit the profile of the new ramp to minimize impacts to the south end of the Charter Oak Bridge. The critical controls were the vertical underclearance and the lateral offset or zone of intrusion to the proposed substructure.

Maintenance and Protection of Traffic

Maintenance and Protection of Traffic (MPT) on I-91 and Route 5/15 for the proposed bridge at this location will be part of a project-wide traffic management plan. The final development of traffic management plans will occur during subsequent phases of the design. The project team has investigated potential MPT options for the bridge site. This initial investigation discovered opportunities to build the new bridge in one section without “on-bridge” stage construction. A significant work zone can potentially be established after the widening of Route 5/15 NB in Stage 2. Once complete, traffic will be shifted to the right on Route 5/15 NB and SB in Stage 3 in order to create a work zone that is wide enough for cranes and pile driving equipment.

This report contains more detailed descriptions of the anticipated construction staging including details of lane layouts on Route 5/15 in the vicinity of the bridge work zone, see Appendix C. During construction, temporary shoulder and lane closures may be required on I-91 NB, Route 5/15 NB and Route 5/15 SB in the vicinity of the proposed bridge in order to complete short term work items such as erection of steel girders over traffic lanes. This can be accomplished using normal 15 minute closures during off peak hours.

LOCATION MAP



DESCRIPTION

The Interchange 29 project includes widening I-91 NB south of the Charter Oak Bridge to accommodate an additional lane and reconfiguration of the exit ramp from I-91 NB to Route 5/15 NB. This reconfiguration entails the elimination of the existing right exit ramp and the addition of a new left exit ramp. This requires the construction of a new two lane bridge connecting I-91 NB to Route 5/15 NB over Route 5/15 SB. The new bridge is studied within this report. The existing exit ramp being eliminated as part of this project is Bridge No. 06000C. Bridge No. 06000C is a steel beam and concrete deck structure consisting of 6 spans that was built in 1991. This bridge carries one lane of traffic from I-91 NB to Route 5/15 NB and ties into Bridge No. 06000A at Pier No. 5. The superstructure consists of an 8-1/2" reinforced concrete deck supported by six spans of welded plate girders. The six spans from south to north consist of a four span continuous structure followed by a two span continuous structure. Bridge No. 06000C has a minimum out-to-out width of 29.8' and a minimum curb-to-curb width of 26.0'. The substructure consists of a reinforced concrete abutment and piers that are all pile supported. The northern end of Bridge No. 06000C is supported on two piers that are shared with the mainline Charter Oak Bridge structure.

This existing exit ramp will be replaced with a two lane left exit ramp that begins approximately 2500 feet south of the Charter Oak Bridge. The two lane ramp will span over Route 5/15 SB, just north of the current I-91 NB bridge over Route 5/15 NB and SB, Bridge No. 05922.

The proposed structure alternates presented in this report were evaluated based on: construction duration, construction cost, and future maintenance concerns. All estimates are based on ConnDOT's estimating guidelines.

See Appendix D for a global map of the Charter Oak Bridge Project and impacted culverts and bridges.

Highway Geometrics

Proposed Ramp

The left exit ramp from I-91 NB to Route 5/15 NB will be classified as an Urban Principal Arterial – Interstate; however, due to full access control and design speed, the roadway is considered Urban Freeway. It will be on the National Highway System (NHS) and will be part of the Strategic Highway Network (STRAHNET). The ramp will have a posted speed limit of 55 mph. The design speed for an Urban Freeway in a built-up area ranges from 50-55 mph, according to the ConnDOT Highway Design Manual. The design speed for the ramp geometry is proposed to be 70 mph based on 85th percentile speeds of the adjacent roadways.

The minimum curb-to-curb width of the roadway will be 48' consisting of (2)-12' lanes with (2)-12' shoulders which will be consistent with the approach roadway widths. The bridge will have a varying cross slope of 2% in lanes and 4% in shoulders with a crown at the centerline of the roadway. The proposed horizontal and vertical alignments will be finalized in SL/D phase and will be designed to meet urban freeway criteria.

Route 5/15 Southbound

The roadway below the proposed bridge, Route 5/15 SB, is classified as Urban Principal Arterial-Other Expressway according to the functional classification maps. According to discussions with ConnDOT, Route 5/15 in the vicinity of this project is considered a freeway. It is not on the National Highway System (NHS) and is not part of the Strategic Highway Network (STRAHNET). Route 5/15 SB has a posted speed limit of 55 mph and significant changes to this roadway are not proposed as part of the project. The design speed for an Urban Freeway in a

built-up area ranges from 50-55 mph, according to the ConnDOT Highway Design Manual; however a design speed of 70 mph is proposed based on 85th percentile speeds on the roadway.

Current ConnDOT Freeway design criteria specifies a minimum paved width of 42' comprised of 12' lanes, 10' right shoulder, and an 8' left shoulder. The minimum vertical underclearance for a new bridge over an urban freeway is 16'-3" according to the ConnDOT highway manual. The proposed structure will be designed according to these design standards.

Traffic

Existing right exit ramp from I-91 NB to Route 5/15 NB (Bridge No. 06000C)

According to the most recent inspection report of Bridge No. 06000C, dated October 2013, the estimated Average Daily Traffic (ADT) on the off-ramp is approximately 25,200 vehicles per day with 9% truck traffic. It is assumed that the new ramp will accommodate this traffic plus increases in future traffic volume. The project scope calls for a two lane ramp for this reason.

Route 5/15 Southbound

According to the most recent ConnDOT Traffic Log, the 2014 Average Daily Traffic (ADT) on Route 5/15 SB below the proposed bridge is 27,750 vehicles per day. The proposed bridge will cross Route 5/15 SB only.

FIELD OBSERVATIONS

The proposed structure will be replacing Bridge No. 06000C due to its inadequate capacity brought on by a number of factors. The major ones being:

- Inadequate lane capacity
- Inefficient weaving where ramp joins Route 5/15 NB on the Charter Oak Bridge
- Poor roadway geometry including a steep grade on the existing ramp

The new bridge will be a two lane high speed left exit ramp verse the existing one lane right exit ramp. The goal being to convert the existing exit ramp to a high speed highway "split or fork" as opposed to low speed "exit". The new ramp ties into Route 5/15 NB on the left side, thereby eliminating the majority of the current weaving of traffic on the Charter Oak Bridge.

Drainage

There is a formal drainage system within the project limits that will be altered as part of the work. The proposed bridge and the retaining walls on the approaches will have a formal drainage system that ties into the existing system.

Existing drainage within the limits of the new bridge will be modified or relocated as the design develops.

Property

Considering the width of the existing right-of-way which is approximately 250' east from the proposed structure, takings or easements are not anticipated for the construction of this bridge. Takings or easements may be required for the modifications to highways in the vicinity of the bridge. Noise impacts to commercial and private

property owners in the immediate vicinity surrounding the bridge are anticipated to be minimal and the noise level is not anticipated to exceed ambient noise generated by current highway traffic.

Cultural Resources

Developed commercial areas exist to the east of Interchange 29. Brainard Airport is located approximately 0.7 miles to southeast of the interchange. The Regional Market is located nearby to the southeast. The MDC wastewater treatment facility is located farther to the southeast. Bulkeley High School and Colt Park are located to the west. The Providence & Worcester Railroad provides freight service on the Wethersfield Secondary approximately 0.1 miles to the west. There are distribution rails approximately 0.1 miles to the east. Since the new bridge is part of a more significant interchange reconstruction, the cultural impacts of the construction will be addressed under the overall project design.

Environmental Resources

The Connecticut River is located north and east with access at Charter Oak Landing. The Hockanum River runs into the Connecticut River west of the Charter Oak Bridge and Willow Brook to the east. The Wethersfield Cove is approximately 1.5 miles to the south.

There are no wetlands or impacts within the work zone for the new bridge. Minor impacts to wetlands are anticipated as part of the overall interchange project.

LOAD RATING

The proposed bridge will be designed in accordance with the AASHTO LRFD Bridge Design Specifications. At the conclusion of the bridge design, a rating for the HL-93 live load and the ConnDOT special permit vehicle loads will be performed.

Bridge No. 06000C is not posted for live load and will be removed during the project. This existing structure will remain open for the duration of the construction of the new bridge. No independent load rating analyses were performed; however, ConnDOT's latest inspection report, dated October 21, 2013, lists the following live load ratings for this bridge (HS-20):

- Inventory Rating 47.5 Tons
- Operating Rating78.8 Tons

SEISMIC CONSIDERATIONS

The seismic design requirements for this bridge will be according to the requirements of the 2015 Interim revisions to the AASHTO LRFD Bridge Design Specifications, Seventh Edition 2014. The determination of the Seismic Zone for bridges is a function of the Soil Type/Profile and the One Second Long-Period Spectral Acceleration Coefficient.

The plans for the existing Charter Oak Bridge as well as the long retaining wall to the right of Route 5/15 Southbound were reviewed. The boring logs indicate that the soils close to the end of the Charter Oak Bridge are very poor, with thick layers of very soft clay; however the soils improve dramatically to the south of the south abutment of the Charter Oak Bridge. In the vicinity of the new ramp bridge, the layer of clay is much thinner,

which would indicate that a Soil Type E could be assumed. The One Second Long-Period Spectral Acceleration Coefficient for Hartford is 3.5%g. With these two factors, the bridge site would be classified as Seismic Zone 1.

Assuming the seismic design results in this structure falling within Seismic Zone 1, the seismic design will be limited to the connection of the superstructure to the substructure and the seat width of the substructure.

FRACTURE CRITICAL CONSIDERATIONS

To avoid the implementation of fracture critical elements on the new bridge, the team proposes the use of internally redundant bent cap consisting of several tension flanges and webs. Through the use of three or four tension flanges, the team feels that the cap can be classified as non-fracture critical. This can be evaluated during final design via a fracture analysis procedure.

GEOTECHNICAL INFORMATION

Due to concerns about settlement of the clay layer at the abutments, geofoam and lightweight fill is proposed within the limits of the U-type wingwalls. A minimum of 6 feet of lightweight fill, expanded shale layer, will be used as the layer of fill below the pavement structure and above the geofoam. Geofoam is not only a lighter fill alternative but it provides accelerated construction of the roadway. All abutments, wingwalls, and piers are proposed to be pile supported.

To avoid downdrag loads on both new and existing piles the approach embankments in the vicinity of piles will be designed with lightweight fill, either expanded shale aggregate or Geofoam. Approach embankments will be designed to limit settlement near new or existing piles to less than 10 millimeters (0.4”), per FHWA criteria, to avoid downdrag.

Estimated settlements are up to ¼” at both abutments with the use of Geofoam.

For more information refer to the Geotechnical Memorandum being submitted under separate cover.

STRUCTURE TYPE ALTERNATES

Based on the preliminary engineering layout for the interchange, the proposed two lane left exit ramp will begin approximately 2500 feet south of the Charter Oak Bridge and will carry traffic from I-91 NB to Route 5/15 NB. Three alternate bridge configurations have been studied in accordance with the ConnDOT Bridge Manual and address the need for a new bridge along the new alignment.

Each alternate will provide a curb-to-curb width of 48’, consisting of (2)-12’ lanes and (2)-12’ shoulders.

The overall length of the bridge prohibits the use of integral abutments, therefore reinforced concrete cantilever abutments with U-type wingwalls are proposed for each option. The cast-in-place concrete wingwalls will be minimized and transition to proprietary retaining walls beyond the abutment footing/pile cap. The retaining walls will be along both shoulders and between adjacent roadways to raise the approach roadway to the elevations required to tie into the existing Charter Oak Bridge. The wall types proposed for the retaining walls are not included in this study. The walls throughout the project are being studied and will be submitted under a separate cover per the scope of work.

It is required that Route 5/15 NB be shifted to the east to accommodate the new left exit ramp between Route 5/15 NB and SB. No modifications to Bridge No. 05922 are proposed as the shift will occur just north of this bridge.

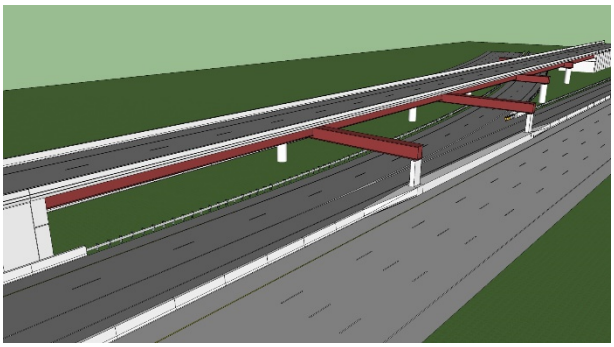
The constructability of the left exit ramp including the bridge was investigated as part of this study and a general sequence is outlined below. The proposed bridge will be constructed offline and the existing ramp bridge, Bridge No. 06000C, will be used to accommodate traffic during the construction of the bridge. Following completion of the new ramp bridge and modifications to the Charter Oak Bridge, the existing ramp including Bridge No. 06000C will be removed in its entirety.

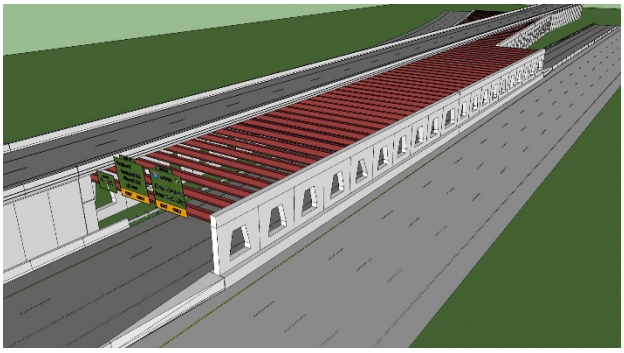
The proposed foundations for all of the proposed substructures are footings supported with driven steel end bearing piles.

The horizontal and vertical geometries are quite complicated at this site. Route 5/15 SB is on a fairly steep downgrade, while the new ramp profile is relatively flat. This means that the portions of the bridge closest to the Charter Oak Bridge have less grade differential than the portions to the south. This poses two critical vertical clearance criteria that needs to be met with each Alternate.

1. The vertical clearance under the west fascia girder near the center of the bridge as the roadway for Route 5/15 SB moves under the bridge.
2. The vertical clearance under the straddle bent cap that spans over Route 5/15 SB or the pier that spans partially over Route 5/15 SB.

Initially, the unusual geometry of this crossing generated many potential structure types. The project team investigated several of these structure types conceptually before focusing on the alternates included within this study. Two structure types that were not included in this structure study include a structure with all piers consisting of straddle bents and a tunnel-like structure with transverse beams. The inset photos below are included for informational purposes only.





Both of these options were discussed at a meeting with ConnDOT July of 2015 and were dismissed as not being viable alternatives to study. As a result of this meeting the project constraints were outlined and CME working with ConnDOT engineers finalized the alternates that are included in this study.

Another decision that came from the meeting was to use a steel bent cap at the straddle bent piers in lieu of a concrete bent cap due to constructability and clearance issues. The three alternates chosen have various features that meet this criteria. Alternate 1 was developed to have moderate span lengths with moderate superstructure depth. Alternate 2 has the maximum span lengths with a minimum number of substructure units. Alternate 3 superstructure is the shallowest requiring shorter spans, but a lower profile.

A preliminary thermal study was performed in the development of this study report in order to determine the types of bridge joints. The goal is to limit deck expansion joints to the abutments, where the beam ends can be properly protected by placing the joints behind the abutment backwall. All of the proposed bridge Alternates have significant lengths (780-880 feet). The approach for thermal movement management is to have fixed bearings at one pier and guided expansion bearings at all other substructure units. Preliminary calculations

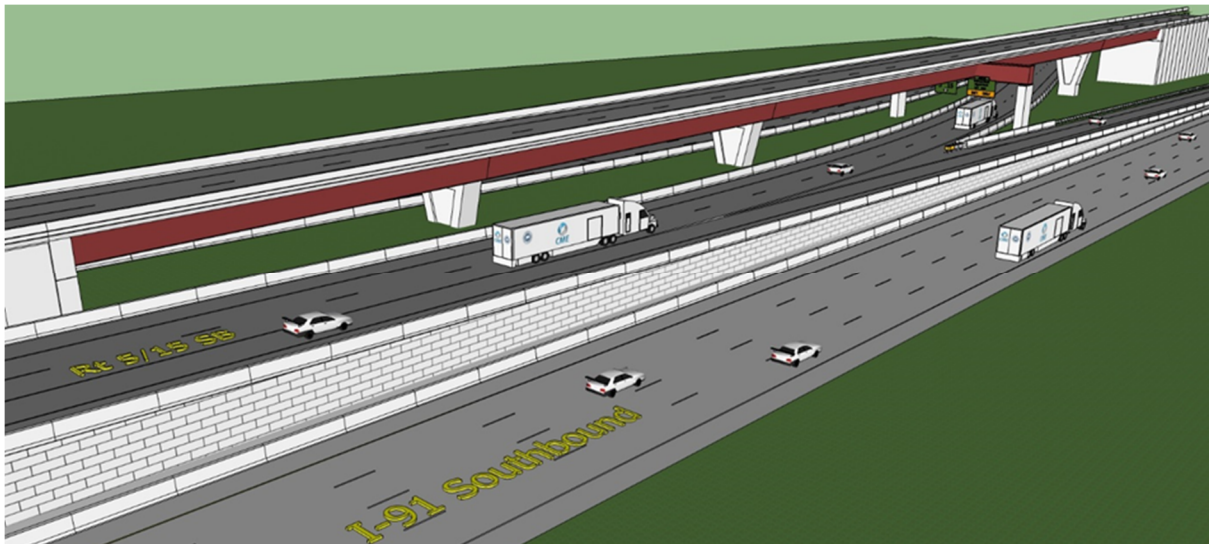
indicate that an open finger joint will be required at one abutment and a strip seal expansion joint at the other abutment. There are no joints proposed at the piers.

All proposed bearings are High Load Multi-Rotational (HLMR) Bearings. HLMR bearings should be considered for moderate to high loads combined with moderate to high movements. Possible bearing types to consider include; pot, disc, or spherical.

A 54" vertical shape barrier will be used at locations where the lateral clearance is a concern and a pier is within the zone of intrusion.

The following are descriptions of the specific features for each alternate included in this study.

Alternate 1 – Five Span Continuous Steel Girder Bridge with Trapezoidal Box Girders



This alternate consists of a 5 span continuous girder superstructure with span lengths from south to north of 140', 215', 215', 170', and 140'. The total bridge length will be 880 feet. The superstructure will be comprised of Grade 50 weathering steel girders composite with an 8.5" cast-in-place reinforced Class "F" concrete deck. The girder type can either be a steel I girder or a trapezoidal box girder. The box girders are typically more efficient at span lengths over 200 feet and aesthetically more pleasing, therefore they were used for this alternate.

As previously stated, full height cantilever abutments are proposed at each end of the bridge in order to limit the overall length of the spans. Pier Nos. 1, 3, and 4 are proposed to be reinforced concrete wall piers with steel integral bent caps which cantilever out to support the exterior girders. A minimum of two (2) bearings can be located under the steel integral bent cap to provide torsional stability for the superstructure.

The significant skew of the roadways creates a detailing challenge near the center of the bridge at Pier No. 2. This limits the use of a wall pier in this area. The only practical solution to this situation is the use of a steel integral straddle bent cap supported by two reinforced concrete columns. The cap will span over Route 5/15 SB. The west column of Pier No. 2 will be located in the gore area between Route 5/15 SB and the ramp to I-91 SB. This column will be protected on both sides by concrete barrier. The east column can be placed in the area between Route 5/15 NB and SB.

Pier No. 2 is the only integral straddle bent cap proposed on the bridge and is due to the high skew angle between the proposed ramp and Route 5/15 SB below the bridge. Different options will be considered to alleviate salt and

deterioration concerns. Efforts to remove the straddle bent were investigated but it would require an impractical span of over 430 feet near the center of the bridge. This span length is beyond the limits of most normal bridges.

Following the Type Study Review meeting held on January 12, 2016, a comment was received to investigate the possibility of removing the integral steel bent caps and provide a more typical substructure, Alternate 1A. Due to the vertical profile of the proposed bridge there is sufficient space to provide hammer head piers at all piers except Pier No. 2. Additional details have been developed for hammerhead piers at Pier Nos. 1, 3, and 4. These details as well as the steel drop cap at the Pier No. 2 straddle bent can be found in Appendix B. The steel bent cap will consist of a minimum of 3 webs and flanges. The hammerhead piers will require post tensioning in accordance with Department policy. At all piers, the removal of the integral caps can provide a minimum vertical underclearance of 16'-6" and sufficient lateral clearance.

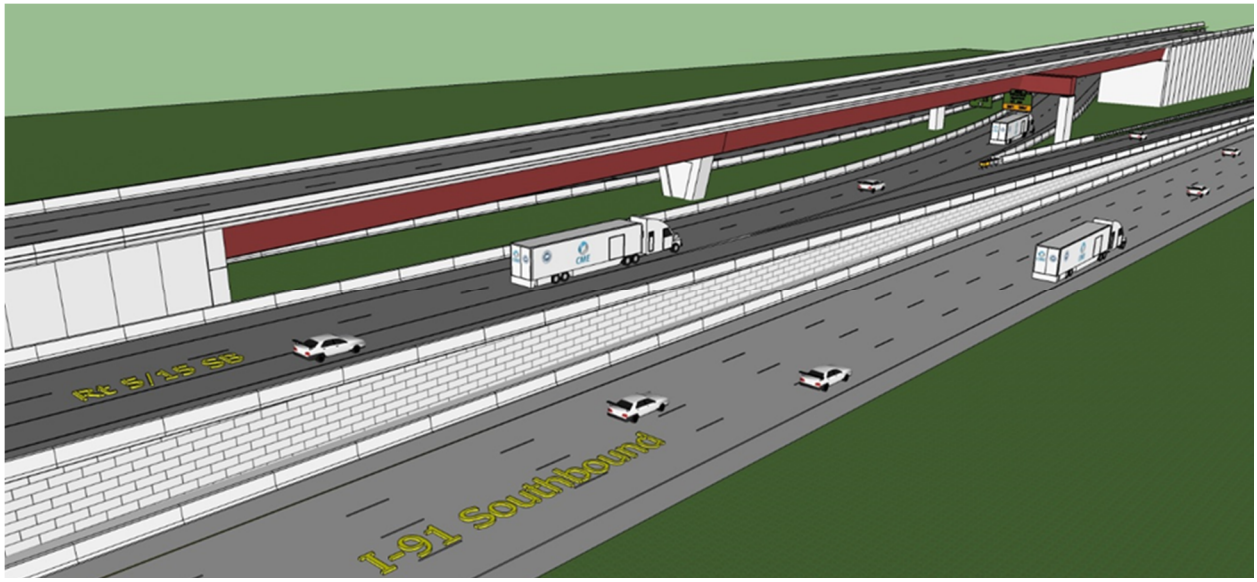
Alternate 1A provides non-integral piers with less structural steel as well as minimizing complex fabrication and connections. Alternate 1 provides longitudinal girders integral with caps which in our opinion is aesthetically more pleasing.

A revised cost has also been developed for Alternate 1 versus 1A, which is shown below. Alternate 1A cost includes changes to the superstructure and substructure based on non-integral bent caps.

The following are the advantages and disadvantages of these alternates:

Advantages	Disadvantages
This design only requires the use of one straddle bent over Route 5/15 SB.	5 spans requires more piers than Alternate 2, which will require more future maintenance.
Shorter spans when compared to Alternate 2, which will facilitate the construction of the structure in the narrow work zone.	The profile of the new ramp will need to be higher than Alternate 3 to achieve the necessary vertical under clearance.
The shorter span lengths will allow for shallower girder depths than Alternate 2. The loads on each pier will be lower resulting in less piles per pier and smaller cap girders.	Pier 2 and skew angle between proposed bridge and Route 5/15 SB limits Route 5/15 SB future widening.
The shallower girder depth minimizes the elevation of the profile required to span Route 5/15 SB.	
No modifications are required to the existing retaining wall on the right side of Route 5/15 SB (when compared to Alternate 3).	
Longer total length reduces the retaining walls required.	
Alternate 1A can eliminate integral bent caps.	

Alternate 2 – Three Span Continuous Steel Girder Bridge



This alternate consists of a 3 span continuous girder superstructure with span lengths from south to north of 250', 280', and 250'. The total bridge will be 780 feet. The superstructure will be comprised of Grade 50 weathering steel girders composite with an 8.5" cast-in-place reinforced Class "F" concrete deck. The girder type can either be a steel I girder or a trapezoidal box girder. The box girders are typically more efficient at span lengths over 200 feet and aesthetically more pleasing, therefore they were used for this alternate.

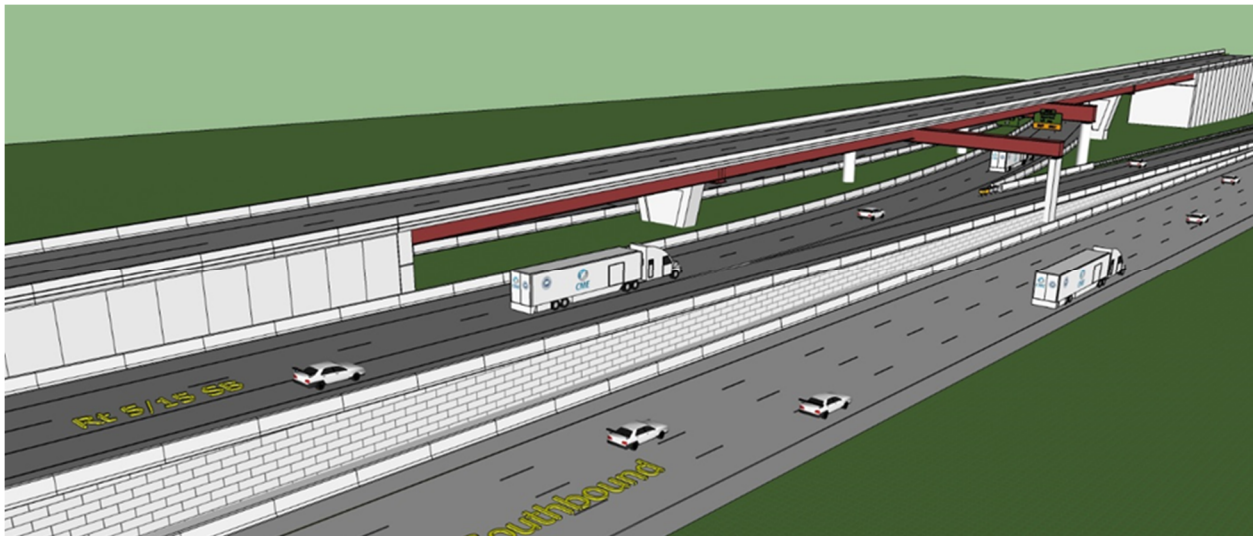
Full height cantilever abutments are proposed at each end of the bridge in order to limit the overall length of the spans. Pier No. 2 is proposed to be a reinforced concrete wall pier with a steel integral bent cap that cantilevers out to support the exterior girders. A minimum of two (2) bearings can be located under the steel integral bent cap to provide torsional stability for the superstructure. Pier No. 1 will consist of a steel integral straddle bent cap supported by two reinforced concrete columns that spans over Route 5/15 SB. Different options will be considered to alleviate salt and deterioration concerns. The west column of Pier No. 1 will be located in the gore area between Route 5/15 SB and the ramp to I-91 SB. This column will be protected on both sides by concrete barrier. The east column can be placed in the area between Route 5/15 NB and SB.

The following are the advantages and disadvantages of this alternate:

Advantages	Disadvantages
This design only requires the use of one straddle bent over Route 5/15 SB.	Longer span lengths will require a deeper superstructure and increased loads on the piers resulting in more piles per pier.
Fewer piers to be constructed over Route 5/15 SB than other alternates.	Large spans will be more difficult to construct than the smaller spans in other alternates.
No modifications are required to the existing retaining wall on the right side of Route 5/15 SB (when compared to Alternate 3).	The profile of the new ramp will need to be higher than Alternate 3 to accommodate the deeper superstructure.
Fewer substructure elements will require less future maintenance than other alternates.	Heavier girder sections will require more splices due to shipping limitations.

Advantages	Disadvantages
Possible to eliminate integral bent caps.	Pier 1 and skew angle between proposed bridge and Route 5/15 SB limits Route 5/15 SB future widening.

Alternate 3 – 5 Span Continuous with Plate Girders



This alternate consists of a 5 span continuous plate girder superstructure with span lengths from south to north of 140', 175', 175', 175', and 140'. The total length is 805'. The superstructure is comprised of Grade 50 weathering steel built up girders composite with an 8.5" cast-in-place reinforced Class "F" concrete deck.

Full height cantilever abutments are proposed at each end of the bridge in order to limit the overall length of the spans. Pier No. 1 is proposed to be reinforced concrete hammer head pier which cantilevers out to support the exterior girder. Pier No. 4 is proposed to be reinforced concrete wall pier with steel integral bent cap that cantilever out to support the exterior girders. A minimum of two (2) bearings can be located under the steel integral bent cap to provide torsional stability for the superstructure. Pier Nos. 2 and 3 consist of steel integral straddle bent caps supported by two reinforced concrete columns that span over Route 5/15 SB. The west column of Pier No. 2 will be located in the gore area between Route 5/15 SB and the ramp to I-91 SB. This column will be protected on both sides by concrete barriers. The west column of Pier No. 3 is founded in the narrow area between I-91 SB and the ramp to I-91 SB from Route 5/15 SB. The east columns for Piers 2 and 3 can be placed in the area between Route 5/15 NB and SB. Different options will be considered to alleviate salt and deterioration concerns for the straddle bents.

The following are the advantages and disadvantages of this alternate:

Advantages	Disadvantages
Shorter girders that are easier to ship, requiring fewer splices.	This design requires the use of two straddle bents over Route 5/15 SB.
Shorter spans will be easier to construct than the larger spans in Alternate 2.	5 spans requires additional piers which will require more future maintenance than Alternate 2.

Advantages	Disadvantages
The profile of the proposed ramp is the lowest and it will have the least impact to the approaches.	Requires a pier column along the right side retaining wall on the ramp to I-91 SB. This may limit the potential for future widening of this ramp.
Plate girders will have a lower cost per pound for fabrication.	Profile requires 3 steel integral bent caps.
	Pier Nos. 2 & 3 and skew angle between proposed bridge and Route 5/15 SB limits Route 5/15 SB future widening & I-91 on-ramp
	Not possible to eliminate integral bent caps due to vertical clearance.

Cost Considerations

The following tables include estimated costs that were developed using ConnDOT 2016 Cost Estimating Guidelines and CTDOT English Bid Item List of January 2016. Appendix A includes the quantity and cost estimates for the three proposed bridges.

Proposed Structure Alternates	Cost of Bridge Only	Additional Costs	Bridge Length	$/SF (bridge only)	Rounded Total Cost
1 – 5 span continuous trapezoidal box girders (Integral)	$ 19,990,000	$ 24,410,000	880’	$440/SF	$44,469,000
1A – 5 span continuous trapezoidal box girders (Non-Integral)	$ 17,861,000	$ 21,833,000	880’	$390/SF	$39,763,000
2 – 3 span continuous trapezoidal box girders	$ 20,103,000	$ 24,465,000	780’	$500/SF	$44,568,000
3 – 5 span continuous plate girders	$ 21,528,000	$ 26,273,000	805’	$520/SF	$47,870,000

Additional Costs – Breakdown**	Alternate 1	Alternate 1A	Alternate 2	Alternate 3
Roadway Items	$ 69,000	$ 69,000	$ 69,000	$ 69,000
Minor Items (10% of Bridge Cost)	$ 2,006,000	$ 1,793,000	$ 2,011,000	$ 2,160,000
Maintenance and Protection of Traffic	$ 3,310,000	$ 2,959,000	$ 3,318,000	$ 3,564,000
Mobilization	$ 2,207,000	$ 1,973,000	$ 2,212,000	$ 2,376,000
Construction Staking	$ 552,000	$ 494,000	$ 553,000	$ 594,000
Incidentals and Contingencies	$ 8,441,000	$ 7,545,000	$ 8,460,000	$ 9,089,000
Utility Relocation	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Escalation to Midpoint Construction Year	$ 7,794,000	$ 6,969,000	$ 7,811,000	$ 8,390,000
Total:	$ 24,410,000	$ 21,833,000	$ 24,465,000	$ 26,273,000

** Breakdowns do not include the cost of the retaining walls for the approach roadways.

RECOMMENDATIONS FOR CONSTRUCTION

As seen above, all Alternates have similar costs. This is due to the fact that all of the Alternates have approximately the same length. Alternate 2 has fewer substructure units; however this savings is offset by the increased cost for the superstructure steel.

Based on the findings, CME recommends Alternate 1A as the preferred alternative for the proposed bridge. This is due to the following:

- It has a lower cost than Alternates 1, 2 and 3.
- It will be easier to construct than the other alternates.
- It has smaller girders than Alternate 2 and one less straddle bent than Alternate 3.
- It has fewer girder pieces to erect over travel lanes when compared to Alternate 3.
- The depth of the superstructure means that it can be built with a reasonable vertical profile.
- Eliminates integral bent caps.

This alternate provides a structure that meets the intended need of the project and will provide a minimum life of 75 years.

UTILITY IMPACTS

There are no private or public utilities proposed on the new bridge.

The proposed bridge will carry ConnDOT conduit for proposed bridge lighting that will feed the existing luminaires on the Charter Oak Bridge.

There is a 2-1/2" Rigid Metal Conduit below Route 5/15 SB just north of Bridge No. 05922 with hand holes adjacent the 5/15 SB right shoulder and continues north in the concrete median barrier. No significant impacts to these facilities are anticipated.

There is an electrical box located below the proposed bridge Span No. 1 that will need to be protected and may need to be relocated.

There are roadway luminaires along the existing Route 5/15 median that will need to be relocated.

CONSTRUCTION SEQUENCE AND MAINTENANCE & PROTECTION OF TRAFFIC

The construction of the new bridge is part of a larger interchange reconstruction project. Based on work to date and staging plans submitted in the PD submittal, the overall sequence of construction of this area is as follows:

The existing Exit 29 Ramp and bridge will remain open to traffic until the final stage of construction.

Stage 1

1. Realign Exit 89 ramp (Route 5/15 NB to I-91 NB).
2. Create work zone by shifting Route 5/15 NB traffic to the right, maintaining a minimum of 2 lanes of traffic with minimum allowable shoulders and lane widths.
3. Before major stage construction work begins, modifications will be made to the existing northbound side of the Charter Oak Bridge, Bridge No. 06000A, and approaches. The most significant work involves the re-profiling of the left shoulder to accommodate the future narrower shoulders (high side cross slope shoulder break back).

Stage 2

1. Shift I-91 NB traffic to the left, maintaining 3 lanes of traffic.
2. Widen I-91 to right.
3. Construct portions of the proposed bridge substructure and retaining walls that will not affect the exiting roadway.
4. Create work zone by shifting Route 5/15 NB traffic to the left on the new temporary alignment using minimum allowable shoulders and lane widths, maintaining a minimum of 2 lanes of traffic.
5. Widen Route 5/15 NB to the right. This includes the widening of the first 3 spans of the Charter Oak Bridge, Bridge No. 06000A.

Stage 3

1. Create median work zone by shifting the Route 5/15 NB and SB to the right using minimum allowable shoulders and lane widths. The best access to this work zone would be from Route 5/15 SB, since the roadway crosses under the proposed bridge running right through the work zone. This will allow for delivery of materials and placement of equipment.
2. Shift I-91 NB traffic to the right, maintaining 3 lanes of traffic.
3. Construct remaining portions of the new left exit ramp including Wall 103A, W103B, W104A, W104B and the proposed bridge from I-91 NB to the Charter Oak Bridge within the established work zone.

Stage 4

1. Open proposed ramp to only one lane of traffic in order to allow room for the final stage of construction on the Charter Oak Bridge, Bridge No. 06000A.
2. Remove the existing ramp, Bridge No 06000C.
3. Widen remaining portions of the Charter Oak Bridge, Bridge No. 06000A (4^{th} and 5^{th} spans). Accelerated Bridge Construction methods may be used to expedite this stage since the width of the bridge at this location will be limited.
4. Establish the final lane patterns.

The shifting of Route 5/15 traffic in Stage 3 creates a potentially significant work zone for the construction of the bridge. This will allow for the bridge to be constructed in one stage. The drawings included in Appendix C include details for the potential work zone for each of the bridge piers for Alternate 1. This work zone is sufficient to accommodate the following:

a. Excavation
b. Crane placement
c. Construction of settlement preload areas, if required
d. Pile driving
e. Pier casting
f. Installation of multiple shoring towers to facilitate girder erection.
g. Forming of the deck
h. Pouring of the deck using pumping trucks.

The work zones for Alternates 2 and 3 would be similar to those shown in Alternate 1. Alternate 3 requires the construction of bridge piers between I-91 Southbound and the Route 5/15 Southbound Ramp. CME has investigated the location for these piers. There appears to be sufficient width in the median between these roadways to place a bridge pier without a need to significantly modify the shoulders on the adjacent roadways. Minor adjustments may be required. The construction access for these piers would be accomplished by shifting the traffic on I-91 and the ramp to provide a reasonable work zone. Pile driving for these piers may need to be done on weekends with the closure of one lane of I-91 Southbound if sufficient room for a crane is not possible.

The most difficult portion of the construction is the erection of the pier cap and girders in the area over Route 5/15 SB. It is anticipated that this work will occur on off-peak hours on weekends where Route 5/15 can be reduced down to one lane in each direction. Short-term (15 minute) closures of the remaining lane will be required during the placement of certain steel elements. Steel pier caps are proposed for the straddle bent cap in order to expedite construction over traffic. The straddle bent cap being considered is made up of multiple steel I-Girders that are bolted together after erection. This will allow for the erection of the cap using the standard methods described above. Erection of girders will most likely occur over several days since temporary lane shifts will probably be required. Standard Maintenance and Protection of Traffic Specifications should suffice for most of the work. Another approach that can be investigated could include the erection of all girders in the heavily skewed spans over Route 5/15 using Self Propelled Modular Transporters. It may be possible to erect the girders on top of the transporters and install all girders in a span at one time. All bolted connections will be shop fit prior to bringing to field.

During final design, a constructability plan will be developed. The methods described above will be further explored and a recommended construction sequence finalized. Special traffic management strategies will be developed (if required) at that time.

APPENDICES

Appendix A – Cost Comparisons
Appendix B – Proposed Bridge Drawings
Appendix C – Construction Staging Sections
Appendix D – Charter Oak Project Global Map

Appendix A: Cost Comparisons

CME	COMPUTATION BY: TEG	DATE: 7/7/15	SHEET: 1	OF: 1
	CHECKED BY: JLS	DATE: 7/29/15	CME PROJECT NO.: 063703	
	CLIENT: ConnDOT Charter Oak Bridge Project		CLIENT PROJECT NO.:	

ITEM: New Bridge Alternate 1 - Five spans of continuous steel trapezoidal box girders

Alternate 1: New 5 Span Trapezoidal Box Girder Bridge

1. Install new bridge and components
2. Install earth retaining structures as extensions of the wingwalls
3. Remove existing retaining wall along west side of I-91 NB South of Bridge
4. Proposed Bridge Area (SF): 45619

STRUCTURE ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0203000	STRUCTURE EXCAVATION - EARTH (COMPLETE)	CY	2,330	$29.00	$68,000
0207150	LIGHTWEIGHT FILL	CY	2,221	$81.80	$182,000
0216014	EXPANDED POLYSTYRENE FILL (1.5 PCF DENSITY)	CY	2,239	$85.00	$191,000
0406171	HMA S0.5	TON	280	$103.00	$29,000
0406173	HMA S0.25	TON	560	$96.40	$54,000
0520034	STRIP SEAL EXPANSION JOINT SYSTEM	LF	50	$500.00	$25,000
0520902	INSTALLATION OF FINGER JOINTS	LF	50	$2,500.00	$125,000
0522128	INSTALL BRIDGE BEARINGS	EA	14	$2,500.00	$35,000
0601000	CLASS "A" CONCRETE	CY	2,510	$606.60	$1,523,000
0601201	CLASS "F" CONCRETE	CY	2,520	$830.80	$2,094,000
0602000	DEFORMED STEEL BARS	LB	350,690	$1.40	$491,000
0602006	DEFORMED STEEL BARS - EPOXY COATED	LB	251,200	$1.60	$402,000
0603768	STRUCTURAL STEEL	LS	1	$11,133,900.67	$11,134,000
0702101	FURNISHING STEEL PILES	LB	3,181,130	$0.60	$1,909,000
0702111	DRIVING STEEL PILES	LF	37,290	$25.60	$955,000
0702326	TEST PILE (STEEL HP 12 X 74 - 108' LONG)	EA	6	$15,750.00	$95,000
0707009	MEMBRANE WATERPROOFING (COLD LIQUID ELASTOMERIC)	SY	4,960	$82.60	$410,000
0714050	TEMPORARY EARTH RETAINING SYSTEM	SF	5,140	$15.00	$78,000
0904990	METAL BRIDGE RAIL	LF	2,040	$93.00	$190,000
				STRUCTURE TOTAL:	$19,990,000

ROADWAY ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0305001	PROCESSED AGGREGATE	CY	140	$82.00	$12,000
0406170	HMA S1.0	TON	170	$95.00	$17,000
0406171	HMA S0.5	TON	110	$103.00	$12,000
0822001	TEMPORARY PRECAST CONCRETE BARRIER CURB	LF	700	$39.60	$28,000
				ROADWAY TOTAL:	$69,000

STRUCTURE PLUS ROADWAY SUBTOTAL 1:	$20,059,000
Square Foot Bridge Cost:	**$440.00**

MINOR ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
Minor Items (10% of Subtotal 1)	LS	1	$2,006,000	$2,006,000
			SUBTOTAL 2	$2,006,000

LUMP SUM ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
M & P of Traffic (15% of Subtotal 1 and 2)	LS	1	$3,310,000	$3,310,000
Mobilization (10% of Subtotal 1 and 2)	LS	1	$2,207,000	$2,207,000
Construction Staking (2.5% of Subtotal 1 and 2)	LS	1	$552,000	$552,000
			SUBTOTAL 3	$6,069,000

ENGINEERING PERCENTAGES		TOTAL
Incidentals (10% of Subtotal 1, 2, and 3)	10% INCIDENTALS	$2,814,000
Contingency (20% of Subtotal 1, 2, and 3)	20% CONTINGENCY	$5,627,000
	SUBTOTAL 4	$8,441,000

NON-CONTRACT ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
UTILITY RELOCATION	LS	1	$100,000.00	$100,000
			SUBTOTAL 5	$100,000

ESCALATION TO YEAR OF CONSTRUCTION		TOTAL
5% INFLATION FOR 4.25 YEARS (from estimate date to midpoint of construction=Subtotal*0.05*4.25)	SUBTOTAL 6	$7,794,000
	TOTAL	$44,469,000
	GRAND TOTAL	**$44,469,000**

CME	COMPUTATION BY TEG	DATE 2/1/16	SHEET 1	OF 1
	CHECKED BY JLS	DATE 2/1/16	CME PROJECT NO. 063703	
	CLIENT ConnDOT Charter Oak Bridge Project		CLIENT PROJECT NO.	

ITEM
New Bridge Alternate 1A - Five spans of continuous steel trapezoidal box girders (Non-Integral)

Alternate 1A: New 5 Span Trapezoidal Box Girder Bridge (Non-Integral)

1. Install new bridge and components
2. Install earth retaining structures as extensions of the wingwalls
3. Remove existing retaining wall along west side of I-91 NB South of Bridge
4. Proposed Bridge Area (SF): 45619

STRUCTURE ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0203000	STRUCTURE EXCAVATION - EARTH (COMPLETE)	CY	2,330	$29.00	$68,000
0207150	LIGHTWEIGHT FILL	CY	2,230	$81.80	$183,000
0216014	EXPANDED POLYSTYRENE FILL (1.5 PCF DENSITY)	CY	2,240	$85.00	$191,000
0406171	HMA S0.5	TON	280	$103.00	$29,000
0406173	HMA S0.25	TON	560	$96.40	$54,000
0514310	POST TENSIONING PIER CAP	LF	130	$800.00	$104,000
0520034	STRIP SEAL EXPANSION JOINT SYSTEM	LF	50	$500.00	$25,000
0520902	INSTALLATION OF FINGER JOINTS	LF	50	$2,500.00	$125,000
0522128	INSTALL BRIDGE BEARINGS	EA	20	$2,500.00	$50,000
0601000	CLASS "A" CONCRETE	CY	2,510	$606.60	$1,523,000
0601201	CLASS "F" CONCRETE	CY	2,600	$830.80	$2,161,000
0602000	DEFORMED STEEL BARS	LB	359,820	$1.40	$504,000
0602006	DEFORMED STEEL BARS - EPOXY COATED	LB	251,200	$1.60	$402,000
0603768	STRUCTURAL STEEL	LS	1	$8,432,744.70	$8,433,000
0702101	FURNISHING STEEL PILES	LB	3,594,020	$0.60	$2,157,000
0702111	DRIVING STEEL PILES	LF	42,130	$25.60	$1,079,000
0702326	TEST PILE (STEEL HP 12 X 74 - 108' LONG)	EA	6	$15,750.00	$95,000
0707009	MEMBRANE WATERPROOFING (COLD LIQUID ELASTOMERIC)	SY	4,960	$82.60	$410,000
0714050	TEMPORARY EARTH RETAINING SYSTEM	SF	5,140	$15.00	$78,000
0904990	METAL BRIDGE RAIL	LF	2,040	$93.00	$190,000
				STRUCTURE TOTAL:	$17,861,000

ROADWAY ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0305001	PROCESSED AGGREGATE	CY	140	$82.00	$12,000
0406170	HMA S1.0	TON	170	$95.00	$17,000
0406171	HMA S0.5	TON	110	$103.00	$12,000
0822001	TEMPORARY PRECAST CONCRETE BARRIER CURB	LF	700	$39.60	$28,000
				ROADWAY TOTAL:	$69,000

STRUCTURE PLUS ROADWAY SUBTOTAL 1: $17,930,000

Square Foot Bridge Cost: $390.00

MINOR ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
Minor Items (10% of Subtotal 1)	LS	1	$1,793,000	$1,793,000
			SUBTOTAL 2	$1,793,000

LUMP SUM ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
M & P of Traffic (15% of Subtotal 1 and 2)	LS	1	$2,959,000	$2,959,000
Mobilization (10% of Subtotal 1 and 2)	LS	1	$1,973,000	$1,973,000
Construction Staking (2.5% of Subtotal 1 and 2)	LS	1	$494,000	$494,000
			SUBTOTAL 3	$5,426,000

ENGINEERING PERCENTAGES		TOTAL
Incidentals (10% of Subtotal 1, 2, and 3)	10% INCIDENTALS	$2,515,000
Contingency (20% of Subtotal 1, 2, and 3)	20% CONTINGENCY	$5,030,000
	SUBTOTAL 4	$7,545,000

NON-CONTRACT ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
UTILITY RELOCATION	LS	1	$100,000.00	$100,000
			SUBTOTAL 5	$100,000

ESCALATION TO YEAR OF CONSTRUCTION		TOTAL
5% INFLATION FOR 4.25 YEARS (from estimate date to midpoint of construction=Subtotal*0.05*4.25)	SUBTOTAL 6	$6,969,000
	TOTAL	$39,763,000

GRAND TOTAL $39,763,000

CME	COMPUTATION BY: TEG	DATE: 7/7/15	SHEET: 1	OF: 1
	CHECKED BY: JLS	DATE: 7/30/15	CME PROJECT NO.: 063703	
	CLIENT: ConnDOT Charter Oak Bridge Project		CLIENT PROJECT NO.:	

ITEM: New Bridge Alternate 2 - Three spans of continuous steel trapezoidal box girders

Alternate 2: New 3 Span Trapezoidal Box Girder Bridge

1. Install new bridge and components
2. Install earth retaining structures as extensions of the wingwalls
3. Remove existing retaining wall along west side of I-91 NB South of Bridge
4. Proposed Bridge Area (SF): 40435

STRUCTURE ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0203000	STRUCTURE EXCAVATION - EARTH (COMPLETE)	CY	1,770	$29.00	$52,000
0207150	LIGHTWEIGHT FILL	CY	1,826	$81.80	$150,000
0216014	EXPANDED POLYSTYRENE FILL (1.5 PCF DENSITY)	CY	2,187	$85.00	$186,000
0406171	HMA S0.5	TON	250	$103.00	$26,000
0406173	HMA S0.25	TON	500	$96.40	$49,000
0520034	STRIP SEAL EXPANSION JOINT SYSTEM	LF	50	$500.00	$25,000
0520902	INSTALLATION OF FINGER JOINTS	LF	50	$2,500.00	$125,000
0522128	INSTALL BRIDGE BEARINGS	EA	10	$2,500.00	$25,000
0601000	CLASS "A" CONCRETE	CY	2,250	$606.60	$1,365,000
0601201	CLASS "F" CONCRETE	CY	2,120	$804.40	$1,706,000
0602000	DEFORMED STEEL BARS	LB	299,170	$1.40	$419,000
0602006	DEFORMED STEEL BARS - EPOXY COATED	LB	225,130	$1.60	$361,000
0603768	STRUCTURAL STEEL	LS	1	$12,202,201.61	$12,203,000
0702101	FURNISHING STEEL PILES	LB	3,030,990	$0.60	$1,819,000
0702111	DRIVING STEEL PILES	LF	35,530	$25.60	$910,000
0702326	TEST PILE (STEEL HP 12 X 74 - 108' LONG)	EA	2	$15,750.00	$32,000
0707009	MEMBRANE WATERPROOFING (COLD LIQUID ELASTOMERIC)	SY	4,430	$82.60	$366,000
0714050	TEMPORARY EARTH RETAINING SYSTEM	SF	2,900	$15.00	$44,000
0904990	METAL BRIDGE RAIL	LF	1,830	$93.00	$171,000
				STRUCTURE TOTAL:	$20,034,000

ROADWAY ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0305001	PROCESSED AGGREGATE	CY	140	$82.00	$12,000
0406170	HMA S1.0	TON	170	$95.00	$17,000
0406171	HMA S0.5	TON	110	$103.00	$12,000
0822001	TEMPORARY PRECAST CONCRETE BARRIER CURB	LF	700	$39.60	$28,000
				ROADWAY TOTAL:	$69,000

STRUCTURE PLUS ROADWAY SUBTOTAL 1:	$20,103,000
Square Foot Bridge Cost:	**$500.00**

MINOR ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
Minor Items (10% of Subtotal 1)	LS	1	$2,011,000	$2,011,000
			SUBTOTAL 2	$2,011,000

LUMP SUM ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
M & P of Traffic (15% of Subtotal 1 and 2)	LS	1	$3,318,000	$3,318,000
Mobilization (10% of Subtotal 1 and 2)	LS	1	$2,212,000	$2,212,000
Construction Staking (2.5% of Subtotal 1 and 2)	LS	1	$553,000	$553,000
			SUBTOTAL 3	$6,083,000

ENGINEERING PERCENTAGES		TOTAL
Incidentals (10% of Subtotal 1, 2, and 3)	10% INCIDENTALS	$2,820,000
Contingency (20% of Subtotal 1, 2, and 3)	20% CONTINGENCY	$5,640,000
	SUBTOTAL 4	$8,460,000

NON-CONTRACT ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
UTILITY RELOCATION	LS	1	$100,000.00	$100,000
			SUBTOTAL 5	$100,000

ESCALATION TO YEAR OF CONSTRUCTION		TOTAL
5% INFLATION FOR 4.25 YEARS (from estimate date to midpoint of construction=Subtotal*0.05*4.25)	SUBTOTAL 6	$7,811,000
	TOTAL	$44,568,000
	GRAND TOTAL	**$44,568,000**

CME	COMPUTATION BY: TEG	DATE: 7/29/15	SHEET: 1	OF: 1
	CHECKED BY: JLS	DATE: 7/30/15	CME PROJECT NO.: 063703	
	CLIENT: ConnDOT Charter Oak Bridge Project		CLIENT PROJECT NO.	

ITEM: New Bridge Alternate 3 - Five spans continuous steel I-girder bridge

Alternate 3: New 5 Span I-Girder Bridge

1. Install new bridge and components
2. Install earth retaining structures as extensions of the wingwalls
3. Remove existing retaining wall along west side of I-91 NB South of Bridge
4. Proposed Bridge Area (SF): 41731

STRUCTURE ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0203000	STRUCTURE EXCAVATION - EARTH (COMPLETE)	CY	2,620	$29.00	$76,000
0207150	LIGHTWEIGHT FILL	CY	1,668	$81.80	$137,000
0216014	EXPANDED POLYSTYRENE FILL (1.5 PCF DENSITY)	CY	1,825	$85.00	$156,000
0406171	HMA S0.5	TON	260	$103.00	$27,000
0406173	HMA S0.25	TON	520	$96.40	$51,000
0520902	INSTALLATION OF FINGER JOINTS	LF	50	$2,500.00	$125,000
0522128	INSTALL BRIDGE BEARINGS	EA	20	$2,500.00	$50,000
0601000	CLASS "A" CONCRETE	CY	2,360	$606.60	$1,432,000
0601201	CLASS "F" CONCRETE	CY	2,420	$830.80	$2,011,000
0602000	DEFORMED STEEL BARS	LB	340,090	$1.40	$477,000
0602006	DEFORMED STEEL BARS - EPOXY COATED	LB	231,650	$1.60	$371,000
0603768	STRUCTURAL STEEL	LS	1	$12,613,917.84	$12,614,000
0702101	FURNISHING STEEL PILES	LB	3,697,240	$0.60	$2,219,000
0702111	DRIVING STEEL PILES	LF	43,340	$25.60	$1,110,000
0702326	TEST PILE (STEEL HP 12 X 74 - 108' LONG)	EA	2	$15,750.00	$32,000
0707009	MEMBRANE WATERPROOFING (COLD LIQUID ELASTOMERIC)	SY	4,560	$82.60	$377,000
0714050	TEMPORARY EARTH RETAINING SYSTEM	SF	5,860	$15.00	$88,000
0904990	METAL BRIDGE RAIL	LF	1,880	$93.00	$175,000
				STRUCTURE TOTAL:	$21,528,000

ROADWAY ITEMS

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
0305001	PROCESSED AGGREGATE	CY	140	$82.00	$12,000
0406170	HMA S1.0	TON	170	$95.00	$17,000
0406171	HMA S0.5	TON	110	$103.00	$12,000
0822001	TEMPORARY PRECAST CONCRETE BARRIER CURB	LF	700	$39.60	$28,000
				ROADWAY TOTAL:	$69,000

STRUCTURE PLUS ROADWAY SUBTOTAL 1:	$21,597,000
Square Foot Bridge Cost:	**$520**

MINOR ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
Minor Items (10% of Subtotal 1)	LS	1	$2,160,000.00	$2,160,000
			SUBTOTAL 2	$2,160,000

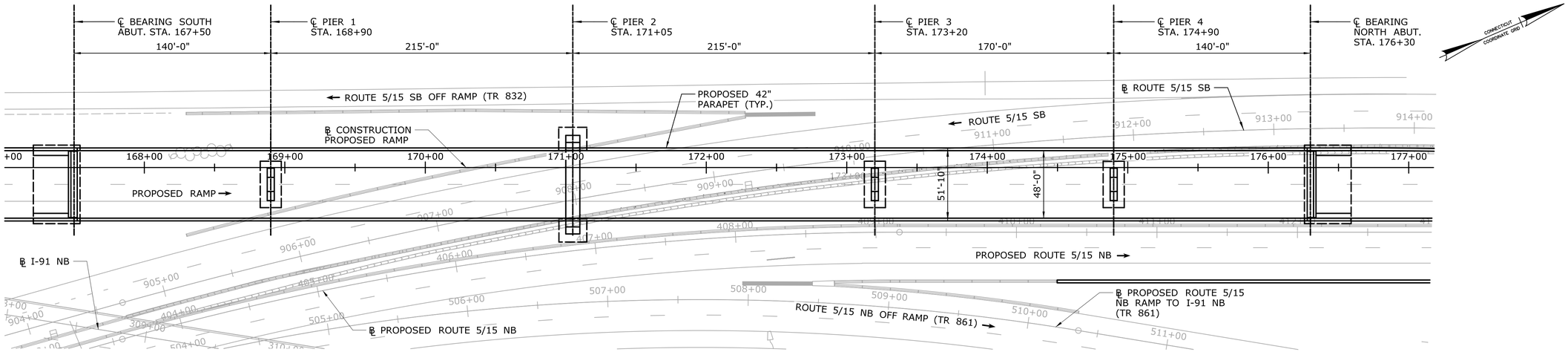
LUMP SUM ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
M & P of Traffic (15% of Subtotal 1 and 2)	LS	1	$3,564,000.00	$3,564,000
Mobilization (10% of Subtotal 1 and 2)	LS	1	$2,376,000.00	$2,376,000
Construction Staking (2.5% of Subtotal 1 and 2)	LS	1	$594,000.00	$594,000
			SUBTOTAL 3	$6,534,000

ENGINEERING PERCENTAGES		TOTAL
Incidentals (10% of Subtotal 1, 2, and 3)	10% INCIDENTALS	$3,030,000
Contingency (20% of Subtotal 1, 2, and 3)	20% CONTINGENCY	$6,059,000
	SUBTOTAL 4	$9,089,000

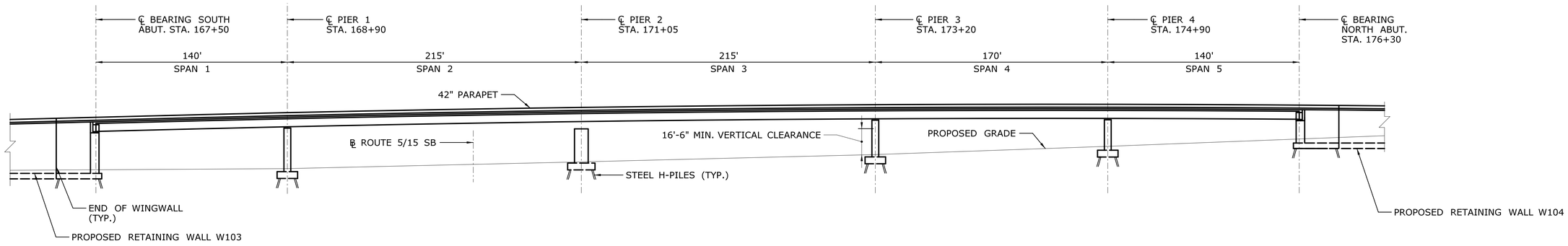
NON-CONTRACT ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL
UTILITY RELOCATION	LS	1	$100,000.00	$100,000
			SUBTOTAL 5	$100,000

ESCALATION TO YEAR OF CONSTRUCTION		TOTAL
5% INFLATION FOR 4.25 YEARS (from estimate date to midpoint of construction=Subtotal*0.05*4.25)	SUBTOTAL 6	$8,390,000
	TOTAL	$47,870,000
	GRAND TOTAL	**$47,870,000**

Appendix B: Proposed Bridge Plans



GENERAL PLAN
SCALE: 1" = 40'-0"



EAST ELEVATION
SCALE: 1" = 40'-0"

PROPOSED BRIDGE I-91 NB TO ROUTE 5/15 NB OVER ROUTE 5/15 SB

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

THE INFORMATION, INCLUDING ESTIMATED QUANTITIES OF WORK, SHOWN ON THESE SHEETS IS BASED ON LIMITED INVESTIGATIONS BY THE STATE AND IS IN NO WAY WARRANTED TO INDICATE THE CONDITIONS OF ACTUAL QUANTITIES OF WORK WHICH WILL BE REQUIRED.

Plotted Date: 3/7/2016

DESIGNER/DRAFTER: JLS
CHECKED BY: BLB
SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\SB_MSH_BrPROP_S_01_Gen Plan.dgn

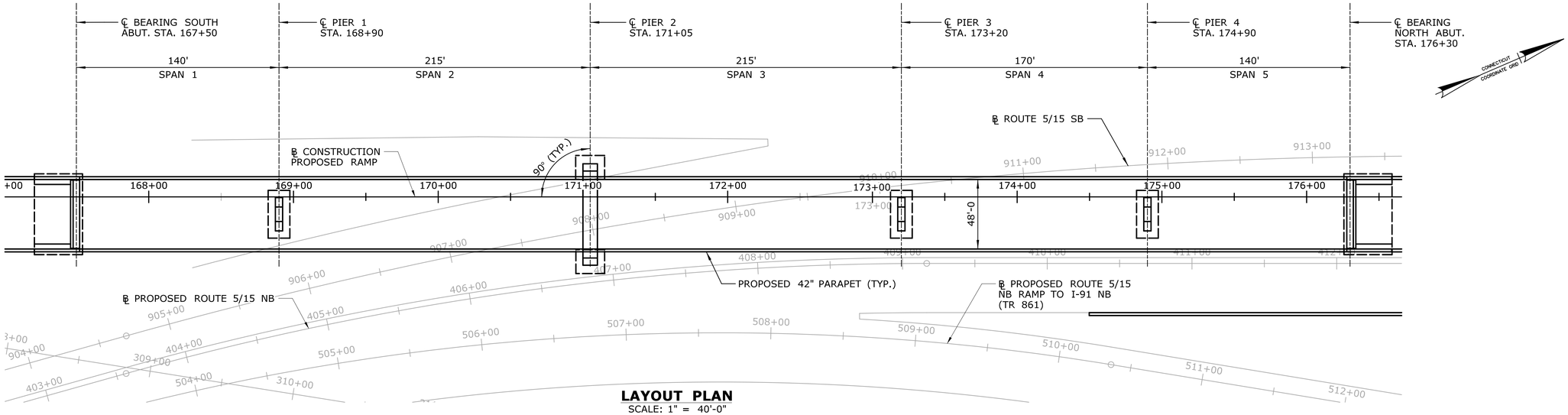
SIGNATURE/
BLOCK:

PROJECT TITLE:
RELOCATION OF I-91 NB INTERCHANGE 29 AND WIDENING OF I-91 NB AND ROUTE 15 NB TO I-84 EB

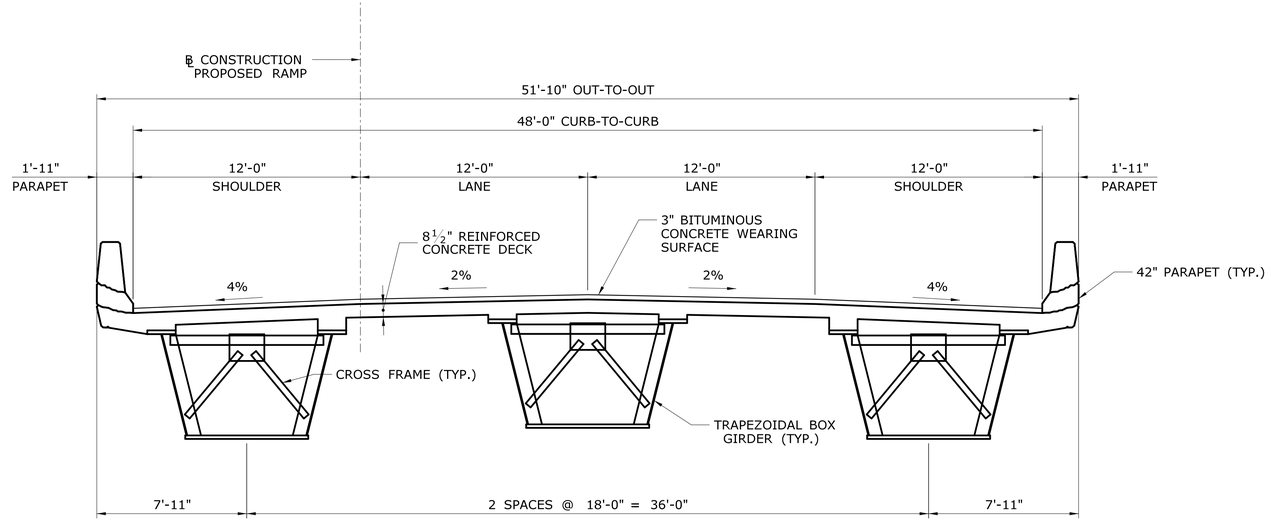
TOWN: **CITY OF HARTFORD**

DRAWING TITLE: **GENERAL PLAN & ELEVATION**

PROJECT NO. **63-703**
DRAWING NO. **S-01**
SHEET NO.



LAYOUT PLAN
SCALE: 1" = 40'-0"



TYPICAL BRIDGE CROSS SECTION
SCALE: ¼" = 1'-0"

PROPOSED BRIDGE I-91 NB TO ROUTE 5/15 NB OVER ROUTE 5/15 SB

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

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Plotted Date: 3/7/2016

DESIGNER/DRAFTER: JLS
CHECKED BY: BLB
SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\SB_MSH_BrPROP_S_02_Layout.dgn

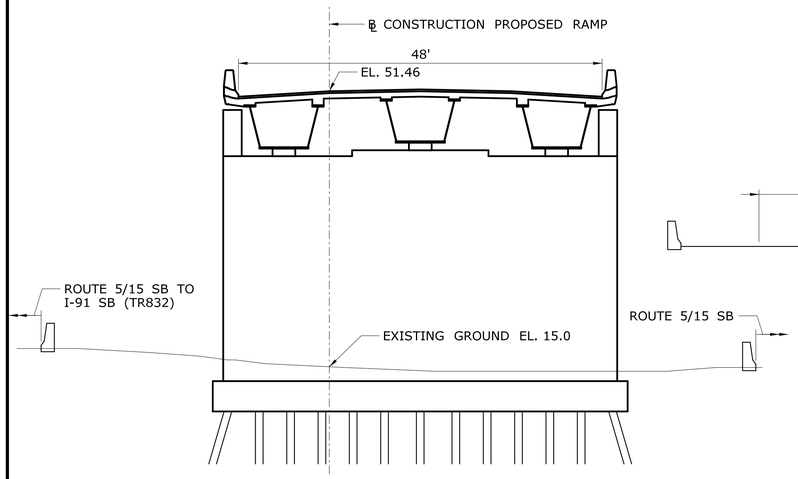
SIGNATURE/
BLOCK:

PROJECT TITLE:
RELOCATION OF I-91 NB INTERCHANGE 29 AND WIDENING OF I-91 NB AND ROUTE 15 NB TO I-84 EB

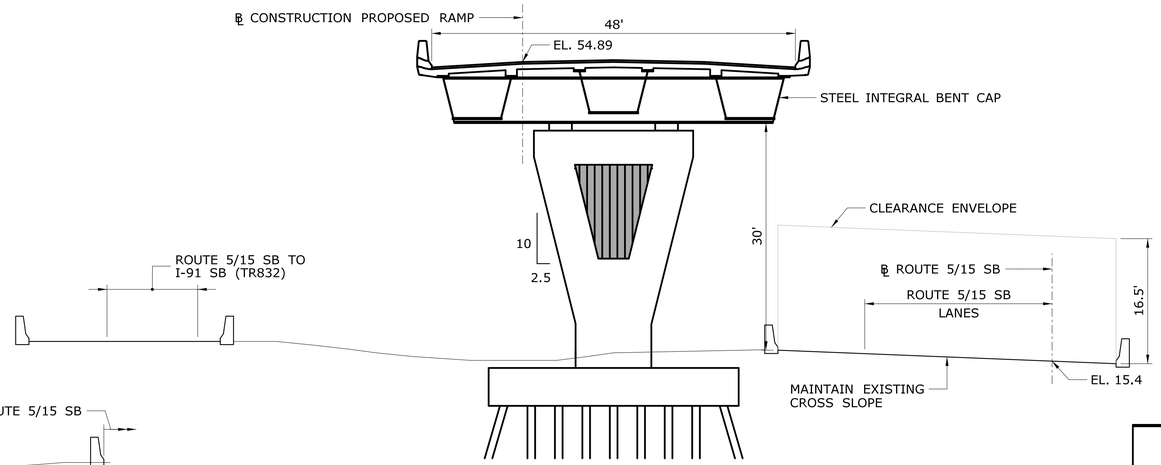
TOWN: **CITY OF HARTFORD**

DRAWING TITLE: **LAYOUT AND TYPICAL CROSS SECTION**

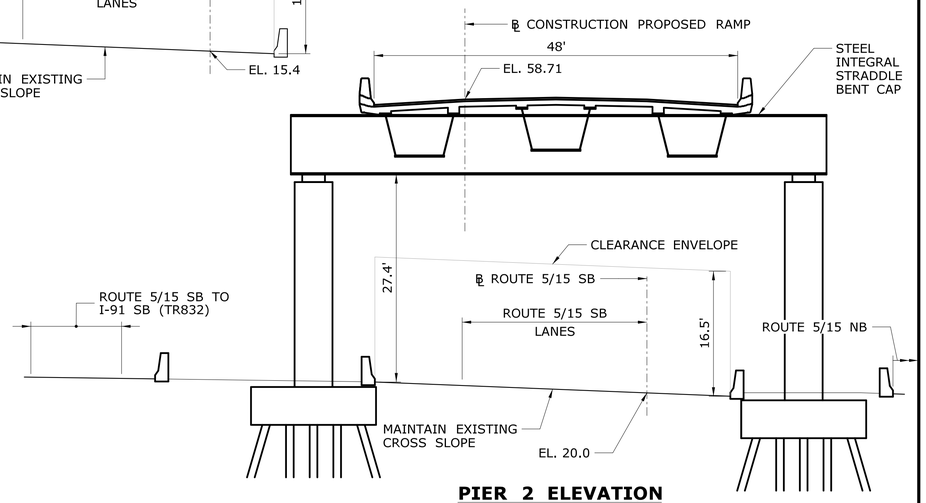
PROJECT NO. **63-703**
DRAWING NO. **S-02**
SHEET NO.



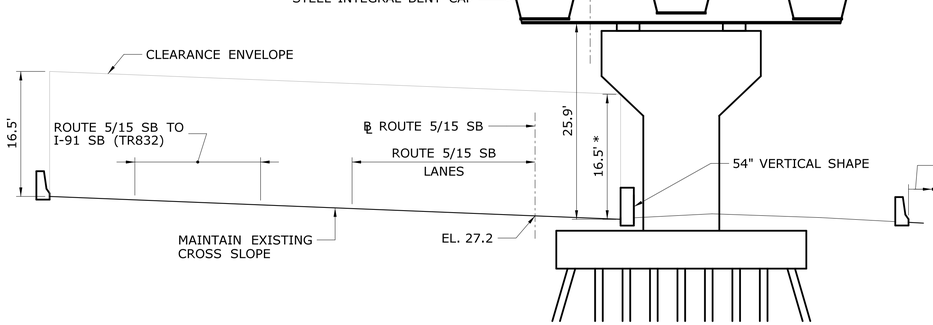
SOUTH ABUTMENT ELEVATION
SCALE: 1" = 10'-0"



PIER 1 ELEVATION
SCALE: 1" = 10'-0"

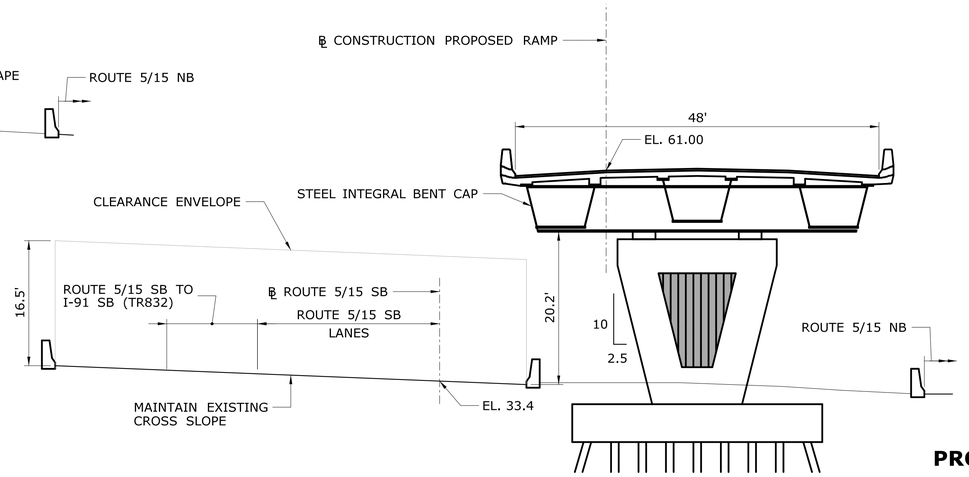


PIER 2 ELEVATION
SCALE: 1" = 10'-0"

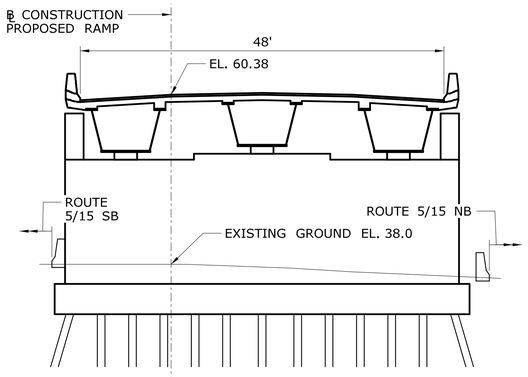


PIER 3 ELEVATION
SCALE: 1" = 10'-0"

* 16'-6" IS MIN VERTICAL CLEARANCE FOR STRUCTURE



PIER 4 ELEVATION
SCALE: 1" = 10'-0"



NORTH ABUTMENT ELEVATION
SCALE: 1" = 10'-0"

NOTE: ALL ELEVATIONS SHOWN LOOKING UPSTATION

PROPOSED BRIDGE I-91 NB TO ROUTE 5/15 NB OVER ROUTE 5/15 SB

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

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Plotted Date: 3/9/2016

DESIGNER/DRAFTER: JLS
CHECKED BY: BLB
SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\SB_MSH_BrPROP_S_03_Sub Elev.dgn

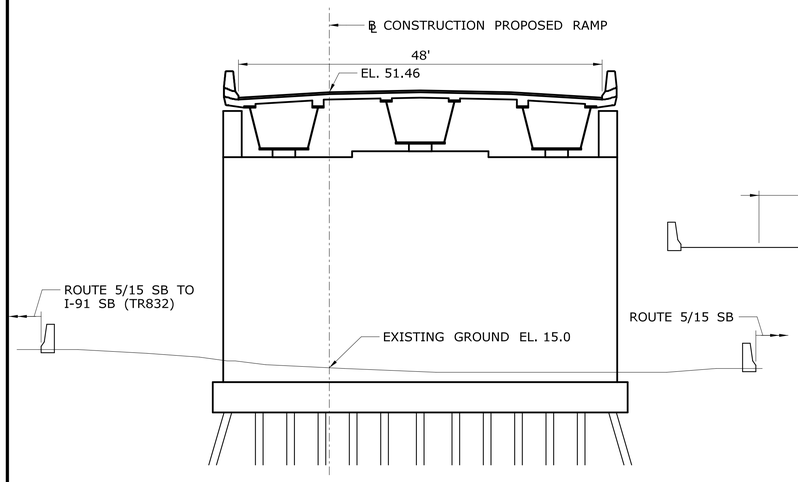
SIGNATURE/
BLOCK:

PROJECT TITLE:
RELOCATION OF I-91 NB INTERCHANGE 29 AND WIDENING OF I-91 NB AND ROUTE 15 NB TO I-84 EB

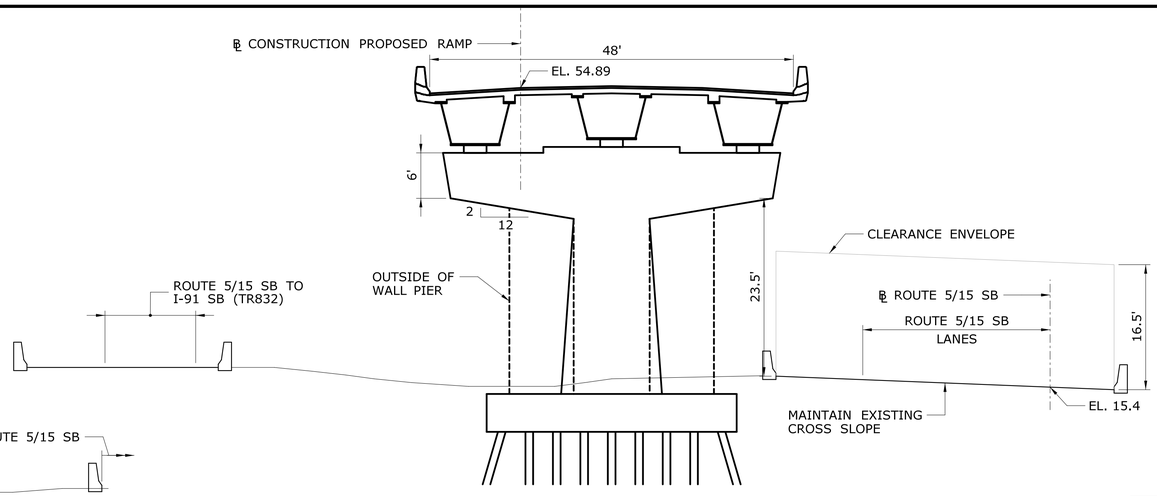
TOWN: **CITY OF HARTFORD**

DRAWING TITLE: **SUBSTRUCTURE ALTERNATE 1**

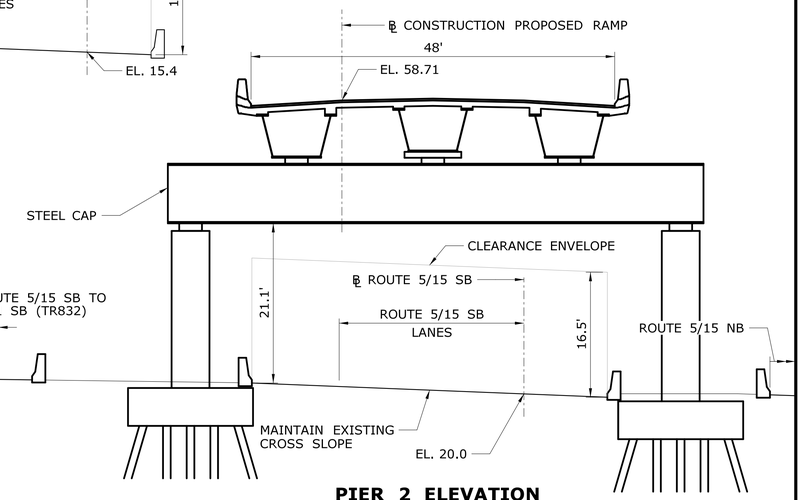
PROJECT NO. **63-703**
DRAWING NO. **S-03**
SHEET NO.



SOUTH ABUTMENT ELEVATION
SCALE: 1" = 10'-0"



PIER 1 ELEVATION
SCALE: 1" = 10'-0"



PIER 2 ELEVATION
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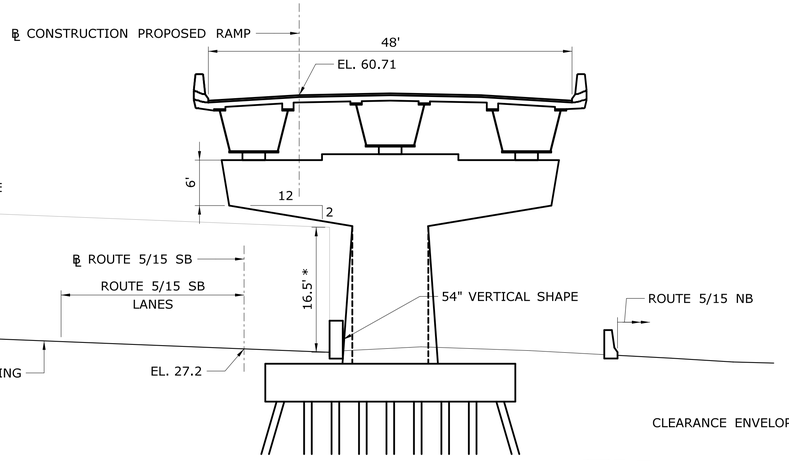
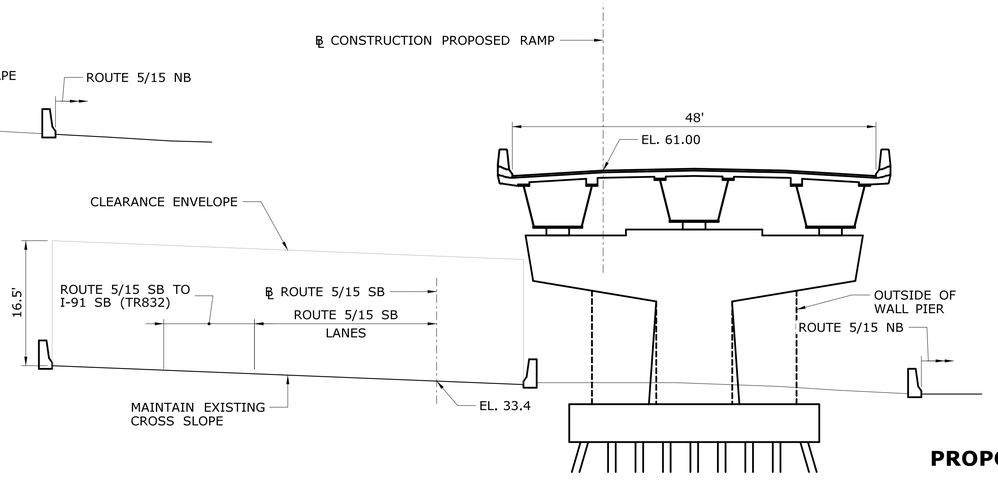
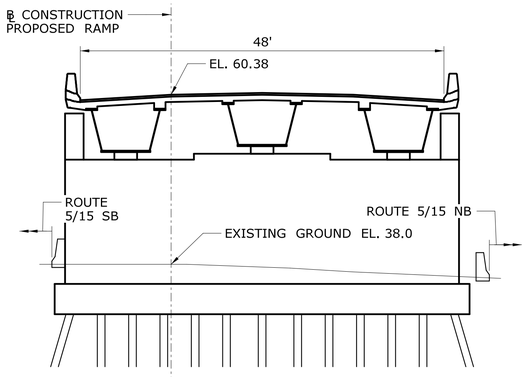


PIER 3 ELEVATION
SCALE: 1" = 10'-0"

* 16'-6" IS MIN VERTICAL CLEARANCE FOR STRUCTURE



PIER 4 ELEVATION
SCALE: 1" = 10'-0"



NORTH ABUTMENT ELEVATION
SCALE: 1" = 10'-0"

NOTE: ALL ELEVATIONS SHOWN LOOKING UPSTATION

PROPOSED BRIDGE I-91 NB TO ROUTE 5/15 NB OVER ROUTE 5/15 SB

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

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Plotted Date: 3/9/2016

DESIGNER/DRAFTER: JLS
CHECKED BY: BLB
SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\SB_MSH_BrPROP_S_03_Sub Elev.dgn

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BLOCK:

PROJECT TITLE:
RELOCATION OF I-91 NB INTERCHANGE 29 AND WIDENING OF I-91 NB AND ROUTE 15 NB TO I-84 EB

TOWN: **CITY OF HARTFORD**

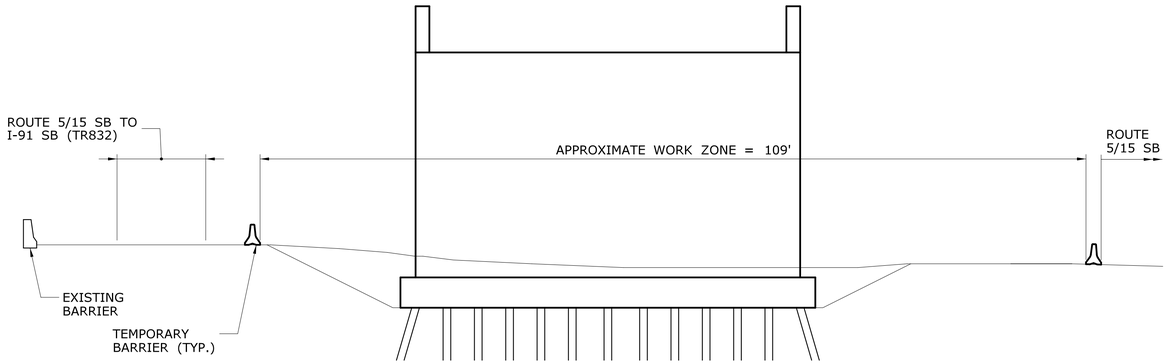
DRAWING TITLE: **SUBSTRUCTURE ALTERNATE 1A**

PROJECT NO. **63-703**
DRAWING NO. **S-04**
SHEET NO.

Appendix C: Construction Staging Sections

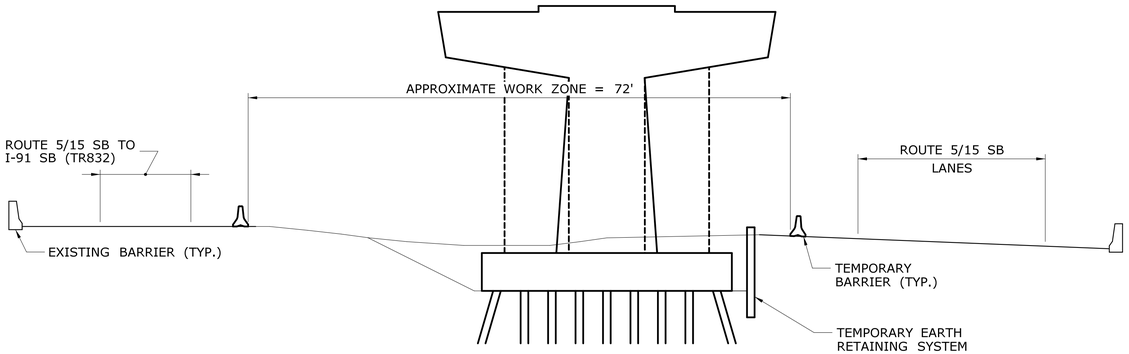
STAGE 2 NOTES:

1. TEMPORARY EARTH RETAINING SYSTEM SHOWN WHEN A 1.5:1 EXCAVATION SLOPE CANNOT BE ACIEVE FOR STRUCTURE EXCAVATION



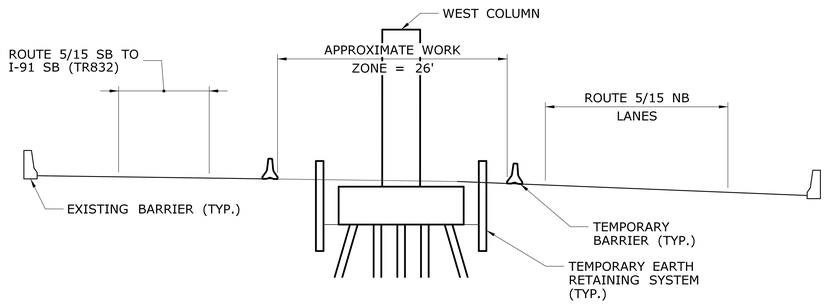
SOUTH ABUTMENT ELEVATION

SCALE: 1" = 10'-0"



PIER 1 ELEVATION

SCALE: 1" = 10'-0"



PIER 2 ELEVATION

SCALE: 1" = 10'-0"

NOTE: ALL ELEVATIONS SHOWN LOOKING UPSTATION

PROPOSED BRIDGE I-91 NB TO ROUTE 5/15 NB OVER ROUTE 5/15 SB

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

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CHECKED BY: BLB

SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\SB_MSH_BrPROP_S_04_Stage_Const.dgn

SIGNATURE/
BLOCK:

PROJECT TITLE:
RELOCATION OF I-91 NB INTERCHANGE 29 AND WIDENING OF I-91 NB AND ROUTE 15 NB TO I-84 EB

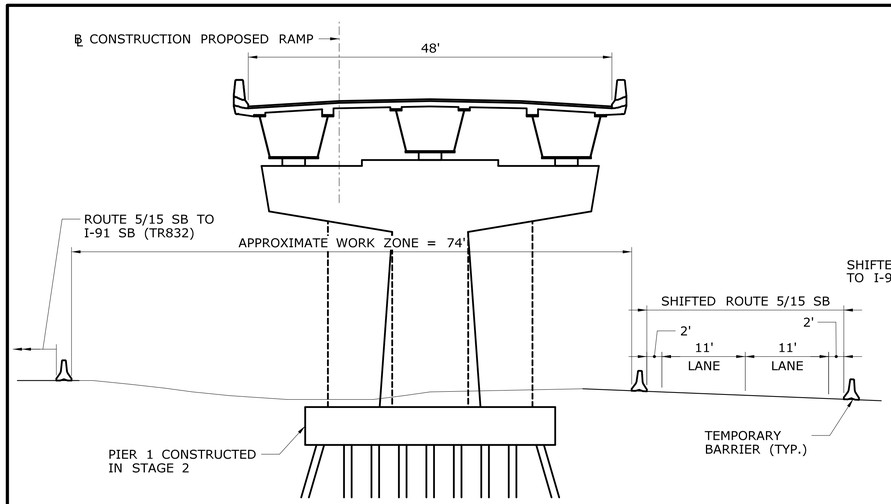
TOWN: **CITY OF HARTFORD**

DRAWING TITLE: **STAGE 2 CONSTRUCTABILITY**

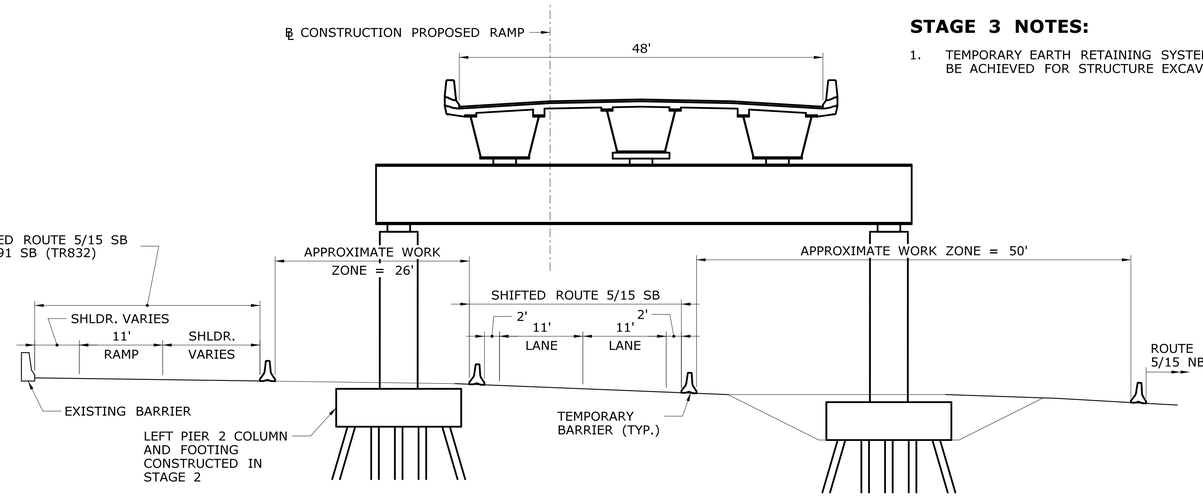
PROJECT NO. **63-703**

DRAWING NO. **S-01**

SHEET NO.



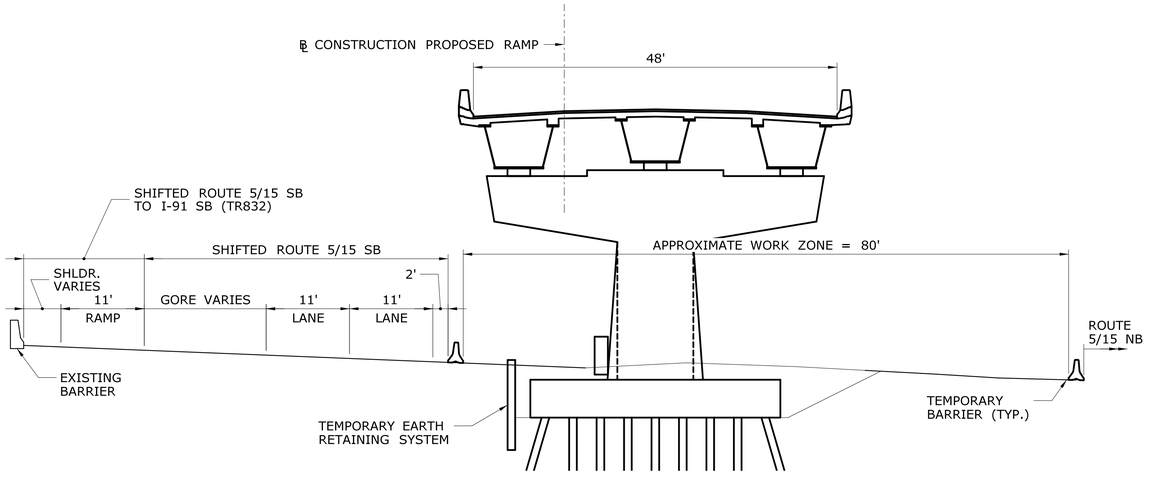
PIER 1 ELEVATION
SCALE: 1" = 10'-0"



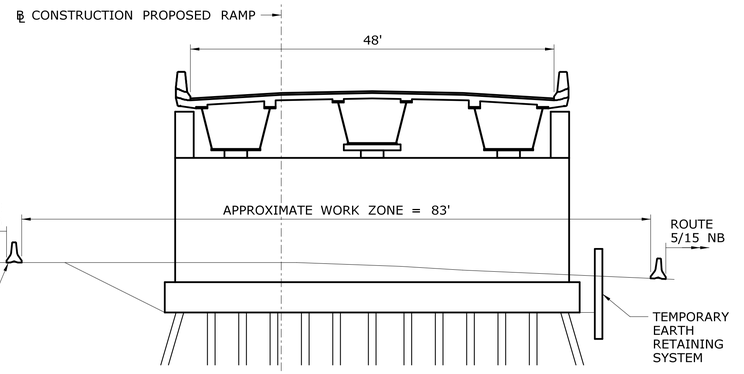
PIER 2 ELEVATION
SCALE: 1" = 10'-0"

STAGE 3 NOTES:

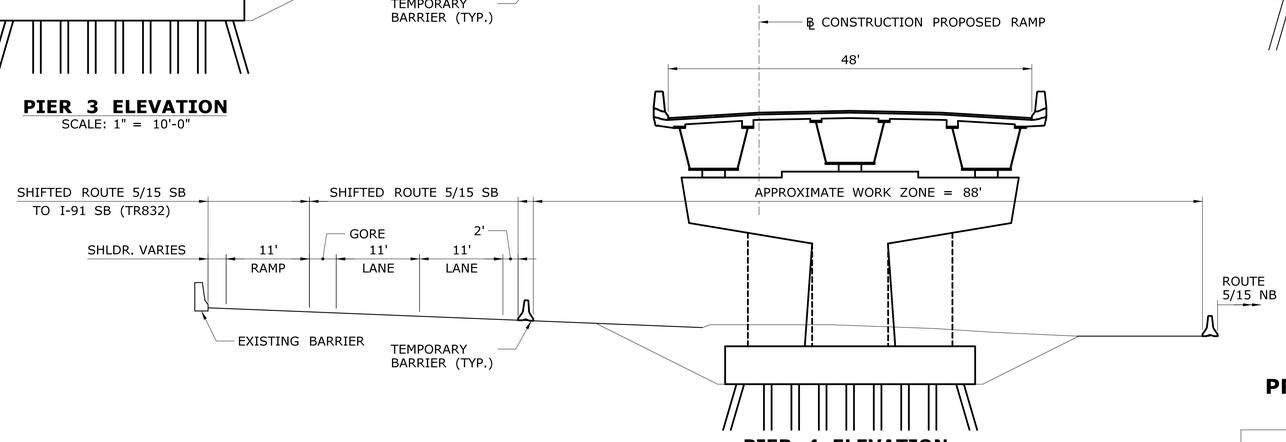
1. TEMPORARY EARTH RETAINING SYSTEM SHOWN WHEN A 1.5:1 SLOPE CANNOT BE ACHIEVED FOR STRUCTURE EXCAVATION



PIER 3 ELEVATION
SCALE: 1" = 10'-0"



NORTH ABUTMENT ELEVATION
SCALE: 1" = 10'-0"



PIER 4 ELEVATION
SCALE: 1" = 10'-0"

PROPOSED BRIDGE I-91 NB TO ROUTE 5/15 NB OVER ROUTE 5/15 SB

PRELIMINARY DESIGN REVIEW

REV.	DATE	REVISION DESCRIPTION	SHEET NO.

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Plotted Date: 3/9/2016

DESIGNER/DRAFTER: JLS
CHECKED BY: BLB
SCALE AS NOTED

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

Filename: ...\SB_MSH_BrPROP_S_04_Stage Const.dgn

SIGNATURE/
BLOCK:

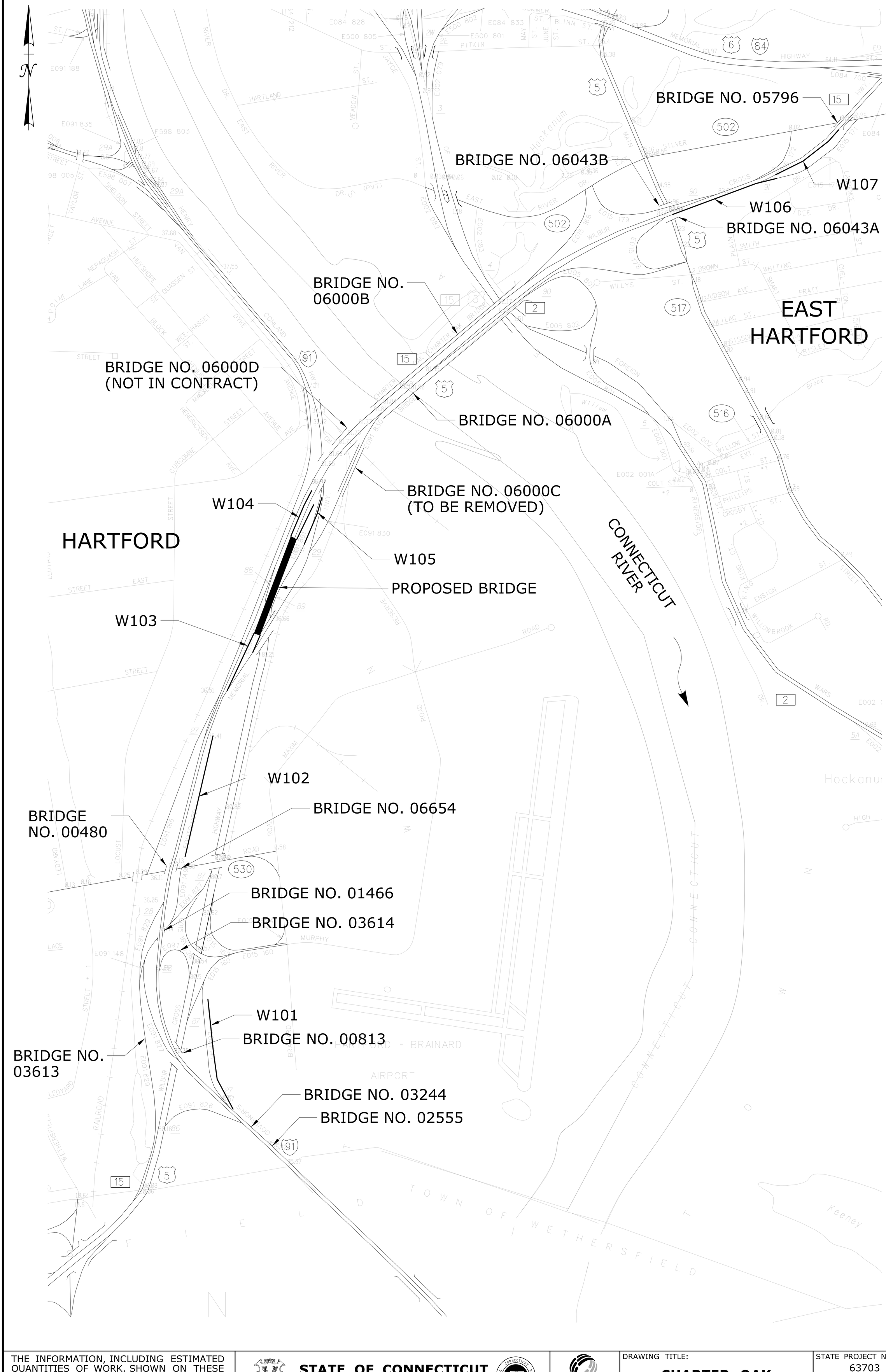
PROJECT TITLE:
RELOCATION OF I-91 NB INTERCHANGE 29 AND WIDENING OF I-91 NB AND ROUTE 15 NB TO I-84 EB

TOWN: **CITY OF HARTFORD**

DRAWING TITLE: **STAGE 3 CONSTRUCTABILITY**

PROJECT NO. **63-703**
DRAWING NO. **S-02**
SHEET NO.

Appendix D: Charter Oak Project Global Map



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STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION

CITY/TOWN:	BRIDGE NO.:	SCALE:
HARTFORD/EAST HARTFORD	NA	1"=1000'

CME
CME ASSOCIATES, INC.
32 Crabtree Lane, Woodstock, CT 06281
333 East River Drive, East Hartford, CT 06108
50 Elm Street, Southbridge, MA 01550
888-291-3227 | www.cmeengineering.com

DRAWING TITLE:
CHARTER OAK PROJECT GLOBAL MAP

STATE PROJECT NO.: 63703
DATE: 08/19/2015
SHEET NO.: 1 OF 1

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CME Project No. 63-703