REHABILITATION OF SIX BRIDGES ON I-95, STAFFORD AND SPOTSYLVANIA COUNTIES

Contract Execution Date: 9/21/2016
Completion Date: 11/5/2018

Sharif Ramsis, PhD, PE and Annette Adams, PE

March 1st, 2019
I95 SBL over Potomac Cr. – Pier 2 Col.1(E)

I95 SBL over Ni River – Pier 2 Jacking-Blocking

I95 NBL over Ni River – Pier 2 joint closure, East shoulder
### Bridges location

#### SBL and NBL Route 95 over Potomac Creek
- **County:** (089) Stafford
  - **SBL**
    - **Fed.Str.ID:** 18093
    - **GCR (2015):**
      - Deck: 6
      - Superstructure: 5
      - Substructure: 5
    - **Materials:**
      - (3) Concrete
      - (02) Tee-beam
  - **NBL**
    - **Fed.Str.ID:** 18094
    - **GCR (2015):**
      - Deck: 6
      - Superstructure: 5
      - Substructure: 5
    - **Materials:**
      - (3) Concrete
      - (02) Tee-beam
  - **Geometry:** 137.11'x67.83' 142.46'x61.83'

#### SBL and NBL Route 95 over Aquia Creek
- **County:** (089) Stafford
  - **SBL**
    - **Fed.Str.ID:** 18091
    - **GCR (2015):**
      - Deck: 6
      - Superstructure: 6
      - Substructure: 6
    - **Materials:**
      - (3) Steel
      - (02) Stringer/Multi-beam or Girder
  - **NBL**
    - **Fed.Str.ID:** 18092
    - **GCR (2015):**
      - Deck: 6
      - Superstructure: 5
      - Substructure: 5
    - **Materials:**
      - (3) Steel
      - (02) Stringer/Multi-beam or Girder
  - **Geometry:** 159.33'x67.83' 159.33'x67.83'

#### SBL and NBL Route 95 over Ni River
- **County:** (088) Spotsylvania
  - **SBL**
    - **Fed.Str.ID:** 17941
    - **GCR (2015):**
      - Deck: 5
      - Superstructure: 6
      - Substructure: 6
    - **Materials:**
      - (3) Concrete
      - (02) Tee-beam
  - **NBL**
    - **Fed.Str.ID:** 17942
    - **GCR (2015):**
      - Deck: 5
      - Superstructure: 5
      - Substructure: 5
    - **Materials:**
      - (3) Concrete
      - (02) Tee-beam
  - **Geometry:** 108.12'x67.91' 108.12'x67.91'
Preventive Maintenance Constraints - 1

SBL and NBL Route 95 over Aquia Creek
County: (089) Stafford

   Between Rte. 610 (Garrisonville Rd.) to Prince William Co.
   Exit 143 to Exit 148
   SBL NBL
   71,000 71,000

2. Active Contracts adjacent to bridge locations: I95 Express Lanes Southern Terminus Extension project (UPC#108315), 630 Interchange project (UPC#13558).

3. Limitation of Operation on I95 – single lane or shoulder closures, two lane closures and only 30 min. complete closure on limited schedule.

4. Maintenance of Traffic
   - Drop off/use of barriers, channelization devices, VAWAPM
   - Shoulder strengthening versus Road User’s Cost
   - Steel bridging plates

5. Budget constraints
Preventive Maintenance Constraints - 2

SBL and NBL Route 95 over Potomac Creek County: (089) Stafford

   Rte. 8900 (Centreport Pkwy.) to Rte. 630 (Courthouse Rd.)
   Exit 136 to Exit 140

   SBL                   NBL
   65,000              67,000

2. Active Contracts adjacent to bridge locations: I95 Express Lanes Southern Terminus Extension project (UPC#108315), 630 Interchange project (UPC#13558), Pavement work on I-95 and Rte. 1.

3. Limitation of Operation on I95 – single lane or shoulder closures, two lane closures and only 30 min. complete closure on limited schedule.

4. Maintenance of Traffic
   - Drop off/use of barriers, channelization devices, VAWAPM
   - Shoulder strengthening versus Road User’s Cost
   - Steel bridging plates

5. Budget constraints
Preventive Maintenance Constraints - 3

SBL and NBL Route 95 over Ni River County: (088) Spotsylvania


2. Active Contracts adjacent to bridge locations: Rte. 606 over I-95 project (UPC#100829), Pavement work on I-95 and Rte. 1.

3. Limitation of Operation on I-95 – single lane or shoulder closures, two lane closures and only 30 min. complete closure on limited schedule.

4. Maintenance of Traffic
   - Drop off/use of barriers, channelization devices, VAWAPM
   - Shoulder strengthening versus Road User’s Cost
   - Steel bridging plates

5. Budget constraints
### Construction chronology of bridges on I-95 SB & NB

<table>
<thead>
<tr>
<th>Crossing</th>
<th>Ni River</th>
<th>Potomac Creek</th>
<th>Aquia Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Built (2 lanes)</strong>&lt;br&gt;-SB&lt;br&gt;-NB</td>
<td>1964 108.12’ x 44’&lt;br&gt; 108.12’ x 44’</td>
<td>1963 137.11’ x 44’&lt;br&gt; 142.46’ x 44’</td>
<td>1963 159.33’ x 44’&lt;br&gt; 159.33’ x 44’</td>
</tr>
<tr>
<td><strong>Widening (3rd lane)</strong>&lt;br&gt;-SB&lt;br&gt;-NB</td>
<td>1988 108.12’ x 23.91’ west&lt;br&gt; 108.12’ x 23.91’ east</td>
<td>1987 137.11’ x 25’ west&lt;br&gt; 142.46’ x 19’ west</td>
<td>1988 159.33’ x 25.41’ west(SIP)&lt;br&gt; 159.33’ x 25.41’ east(SIP)</td>
</tr>
</tbody>
</table>
Rehabilitation Evaluation - 1

- Perform detailed visual examination and delamination marking
- Identify compromised area of deck
- Run field tests for evaluation of deck
- Compare cost of Rehabilitation to Replacement cost
Rehabilitation Evaluation - 2

- Coring and determining depth of chloride penetration

Chloride content threshold = 2 lb/cu.yd.
Rehabilitation Evaluation - 3

- Identify areas of high concentration of chloride content on deck
Rehabilitation Evaluation - 4

- Average clear concrete cover
Field Assessment Photos

PHOTO 4 – DELAMINATED AREA OF WEARING SURFACE LANE 1, SPAN 1, 16' FROM PIER 1

PHOTO 5 – POT HOLE PRESENT NEAR ABUTMENT B LANE 2
PHOTO 6 – UNDERSIDE OF DECK DELAMINATION IN SPAN 2, BAY 7 NEAR MID SPAN

PHOTO 7 – SPALL WITH EXPOSED REBAR IN UNDERSIDE OF DECK, SPAN 3, BAY 6 NEAR ABUTMENT B, 3’L X 1’W X 4’D
PHOTO 11 – OVER PIER 2, 12 LF OF JOINT HAS BROKEN BOND AND IS LEAKING WITH SPALLING

PHOTO 12 – 100% CORROSION ON BEARING PLATE, SPAN 2, BEAM 1 SHOWN
PHOTO 15 – SPAN 2, BEAM 4 AT PIER 1 SPALL WITH EXPOSED REBAR, 3’L X 1’H X 4”D

PHOTO 17 – SPAN 2, BAY 4 AT PIER 1 SPALL WITH EXPOSED REBAR, 60”L X 6”H X 4”D
PHOTO 19 – NUMEROUS HAIRLINE VERTICAL CRACKS WITH CHEMICAL STAINS AT ABUTMENT B, BAY 5

PHOTO 20 – PIER 1 SOUTH ELEVATION NEAR BEAM 5, 3 SF DELAMINATION NEAR TOP OF CAP WITH DEEP CRACKING
Summary of Rehabilitation Recommendations

- Mill 2 inches overlay and replace with 1.5-2 inches of LMC
- Type B and Type C patching of bridge deck
- Eliminate expansion joints at the piers
- Evaluate feasibility of deck slab extension at abutments
- Superstructure surface repairs incl. beam/diaphragm repairs
- Replace bearings
- Substructure surface repairs (piers, abutments)
- Perform load rating
Rehabilitation Design Considerations:

- Safety
- Budget
- Efficiency

I95 NBL over Potomac Cr.
Limitations of Operations on I-95 – Fredericksburg District

- Allowable time is 6.5 or 7.5 hrs. including setting MOT and removing before opening to Traffic at 4:30 AM.

- Seasonal difference allowing work day schedule for single-lane/shoulder closure. No allowance during summer months.

- Lane or shoulder closure shall be removed when a traffic back-up of greater than 7 miles is created.
Maintenance of Traffic – Rehab. on I-95 bridges

- Numerous short term lane closures for bridge rehabilitation
- Follow guidelines in VAWAPM for the use of channelizing devices / barriers
- Determine alternatives, hazards and cost compared to Road User Cost analysis
- Temporary support system to carry traffic across the joint between allowed lane closures
**Temporary Traffic steel bridging plates (TTP) - 1**

- Driving surface shall be skid resistant
- TTP shall provide a smooth transition for tires
- TTP shall meet requirements for strength and deflection
- TTP shall be securely anchored to the deck
- TTP shall bear a minimum 6 in at each end of the plate
- TTP shall be secured in place with anchor bolts spacing of 18 in
- TTP shall be regularly inspected and deficiencies corrected immediately
Temporary Traffic steel bridging plates (TTP) - 2

• Contractor shall provide detailed design, working drawings and calculations for Department’s review

• Severe weather planning shall be considered during review of shop drawings

• TTP work sequence is planned to allow 2 work shifts to complete joint closure

• Mechanical couplers are included in the plans for the construction joints between phases

• Advance Warning signs shall be in accordance with VAWAPM
Plans for TTP - 1
Plans for TTP - 2

Notes:
Contractor may have to adjust existing rebar in order to install the temporary steel system.
Shop Dwg. for TTP - 3

MECHANICAL COUPLERS TUNNEL TO ACCOMMODATE FUTURE WORK

TRAFFIC

GROUP 2 CHANNELLING BVEOD

NO TOSHIDE WORK WEEK

LAP SPICE AT 36" PLATE TO PART B WORK

RIGHT SHOULDER

RIGHT LANE

CENTER LANE

LEFT LANE

LEFT SHOULDER

SBL PHASE I PLATING PLAN - WEEK 1
SCALE: 1/8" = 1'-0"
Plans for TTP - 4
Deck Closure over the piers – RC T-Beams - 1

- Joint Removal between Beams at Piers
Deck Closure over the piers – RC T-Beams - 2

• Joint Closure between Beams at Piers
Deck Closure over the piers – RC T-Beams - 3

- Joint Removal at Beams at Piers
Deck Closure over the piers – RC T-Beams - 3

- Joint Closure at Beams at Piers
Check Shear stress at support – RC T-Beams

<table>
<thead>
<tr>
<th>Temporary condition - after removing concrete portion</th>
<th>Permanent condition - after joint closure</th>
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<tbody>
<tr>
<td>- Adequate interface shear friction is developed without 1'-7&quot; portions of the joint closure</td>
<td>- Interface shear friction is adequate without the 2 shear stirrups eliminated in the link slab</td>
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<tr>
<td>- No effect on cross section area channeling compressive arching action on shear-plane near support</td>
<td></td>
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<tr>
<td>- Location of critical section for shear-d from internal support shift closer to internal face of support.</td>
<td></td>
</tr>
<tr>
<td>- Development length of the longitudinal bent-up bars is adequate to develop their calculated tension</td>
<td>- Contribution of longitudinal bent-up bars in shear capacity is included.</td>
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Update of BSI report after Rehabilitation

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 County: (089) Stafford
Fed.Str.ID  18093  18094
GCR (2018):
Deck  7  7
Superstructure  6  6
Substructure  6  6
Materials:  (3) Concrete  Concrete
(02) Stringer/Multi-beam or Girder
Geometry:  159.33’x67.83’  159.33’x67.83’

SBL and NBL Route 95 over Aquia Creek
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SBL       NBL
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SBL and NBL Route 95 over Ni River
 County: (088) Spotsylvania
Fed.Str.ID  17941  17942
GCR (2017):
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Geometry:  108.12’x67.91’  108.12’x67.91’
Questions