Gannett Fleming

pennsylvania
DEPARTMENT OF TRANSPORTATION

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# GEORGE N. WADE BRIDGE REHABILITATION

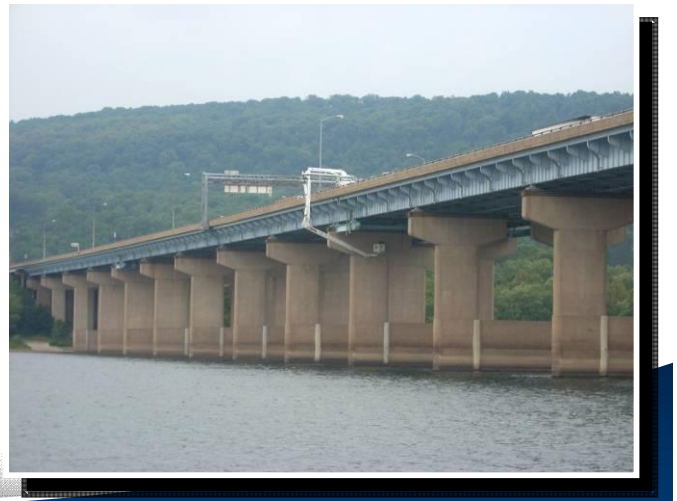
## I-81 Over the Susquehanna River, Norfolk Southern Railroad, and North Front Street






# George N. Wade Bridge

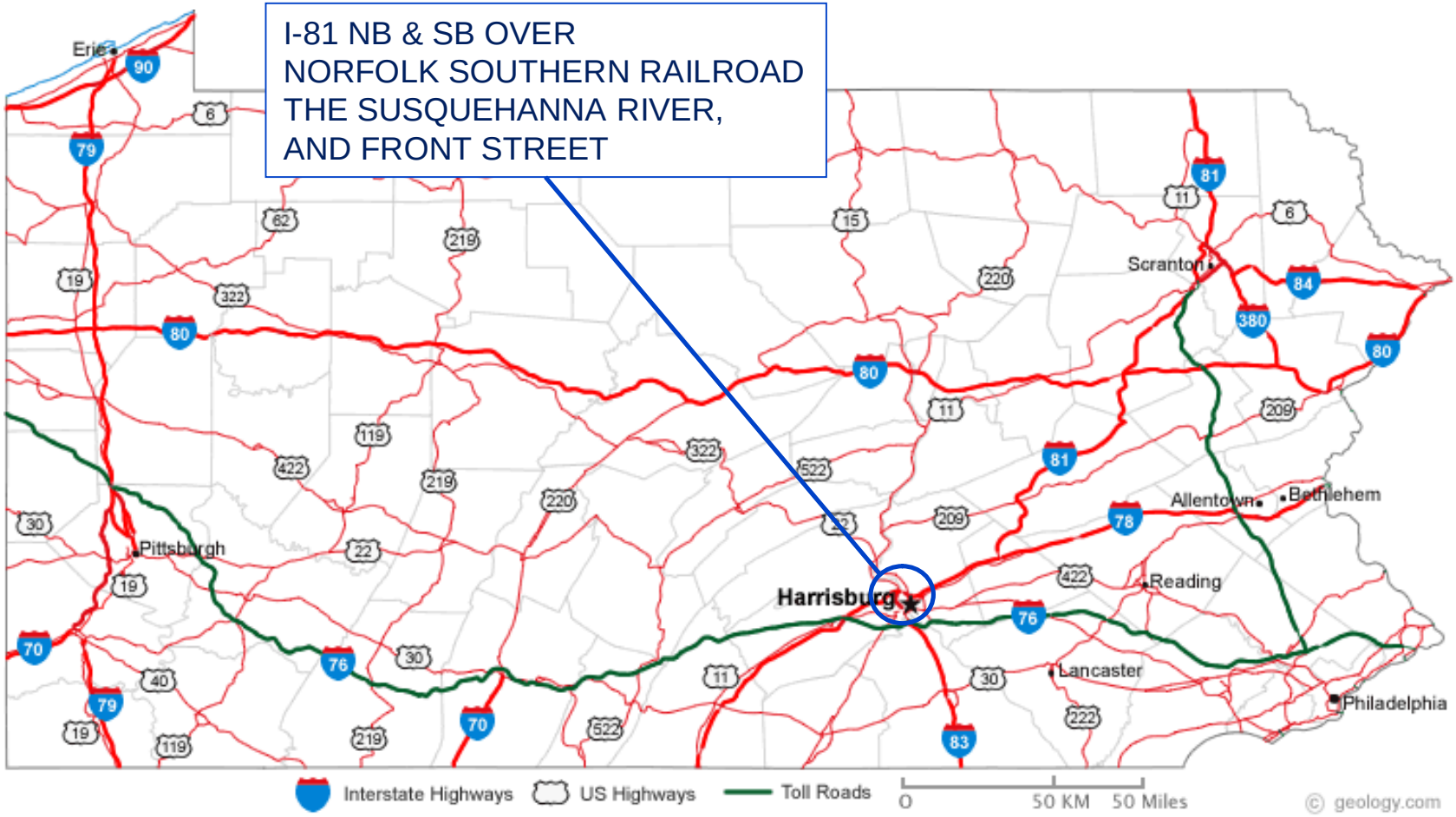
- **What is the George N. Wade Bridge ?**
  - Dual 44 Span Structure – Fracture Critical – Built 1973
    - 10 Approach Spans – Painted Steel Multi-Girder on R/C Multi-Column Bents
    - 34 Mainline Spans – Painted Steel Girder / Floorbeam / Stringer on R/C Hammerhead Piers
    - 6 Pin & Hangers
    - 5188' - Mainline Structure Length
  - 5 Connecting Ramps
    - Curved Steel Multi-Girder on Hammerhead Piers



# George N. Wade Bridge

- **What is the George N. Wade Bridge?**
  - Structurally Deficient Bridge
    - 4 - Condition Rating of Substructure & Superstructure at time of 2007 Routine Inspection
  - 40,239 = ADT (2009)
  - 23% Trucks (9,255)
  - 4.5% - Percentage of District 8-0 deck area that these bridges comprise

# George N. Wade Bridge

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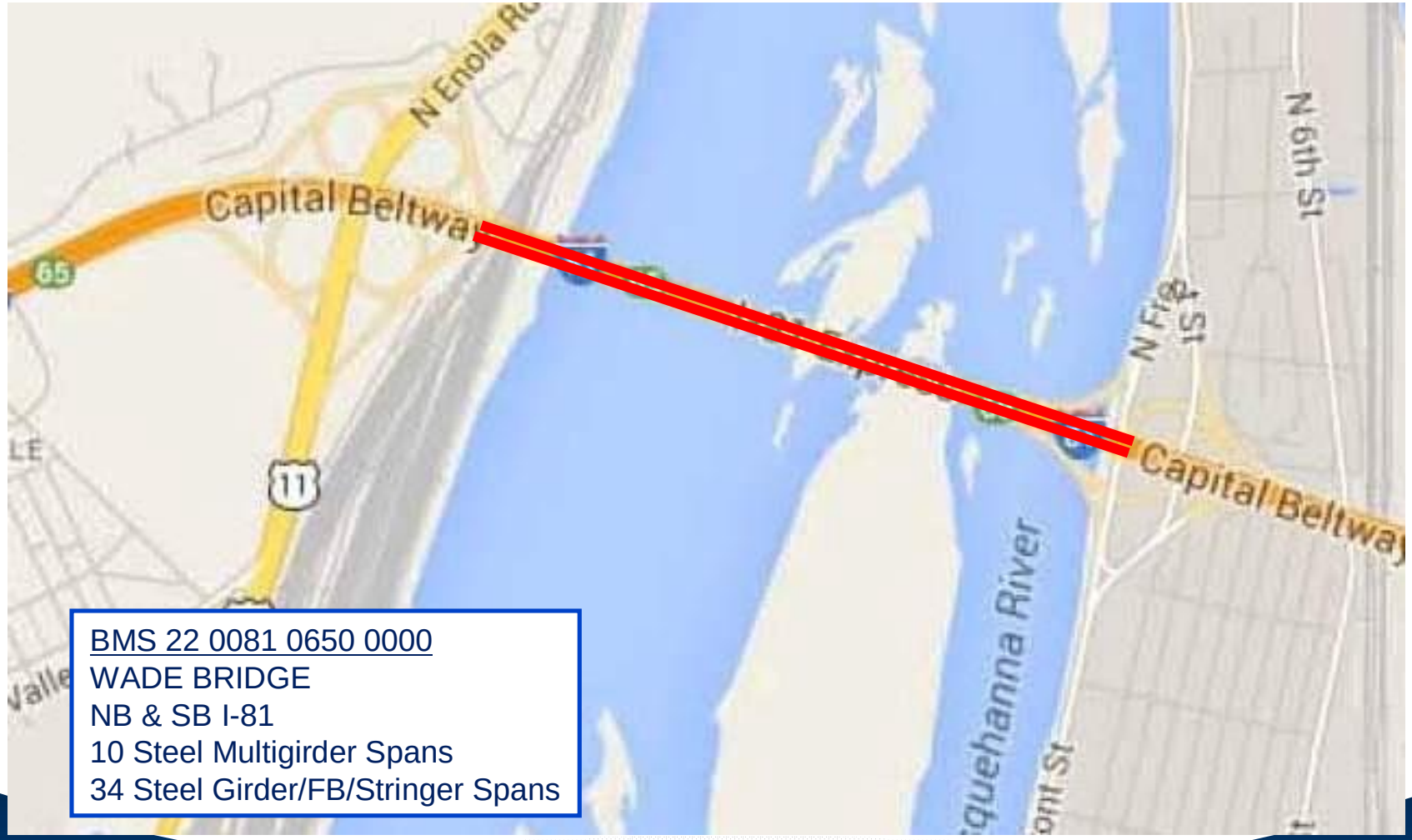
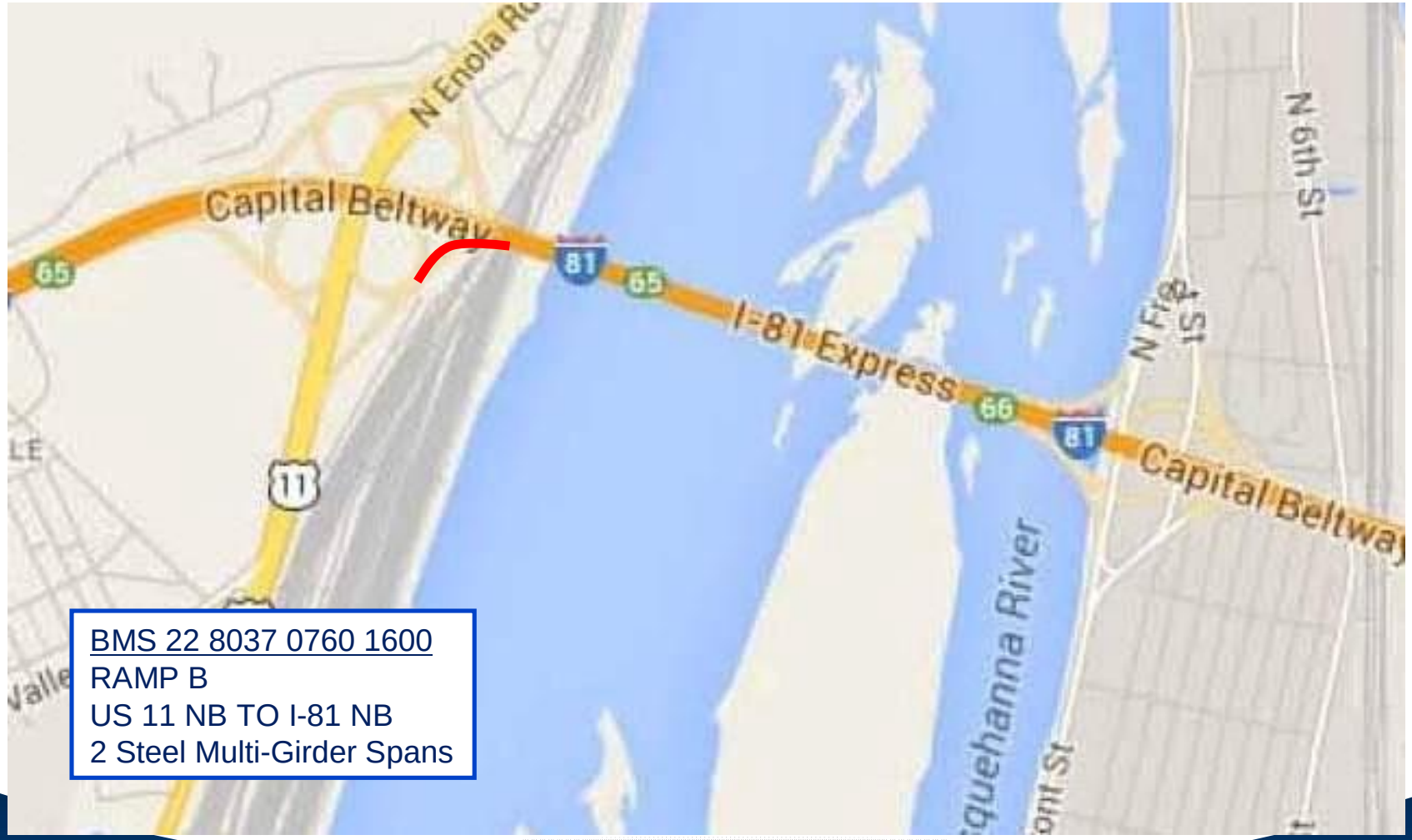
# George N. Wade Bridge



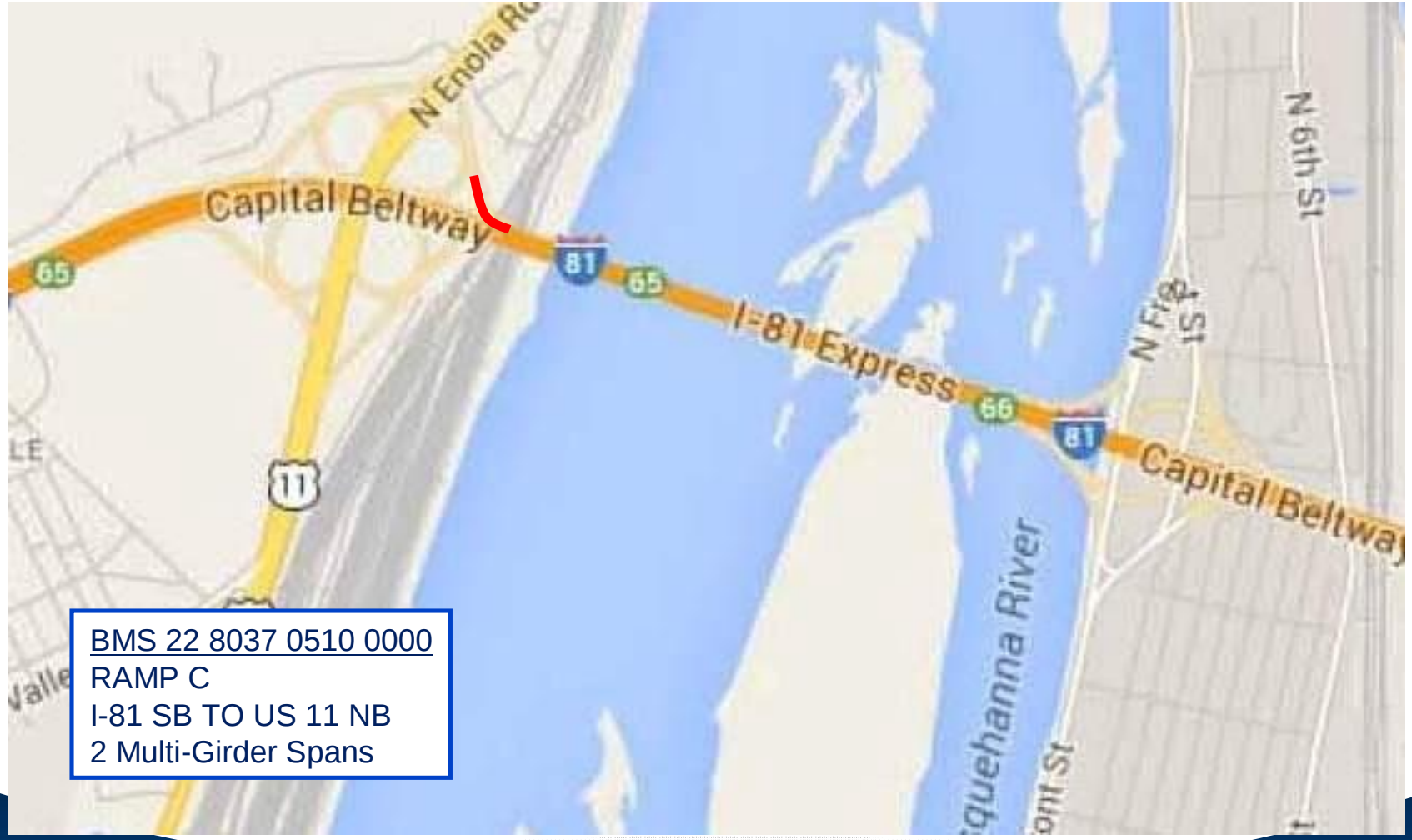

BMS 22 0081 0650 0000
WADE BRIDGE
NB & SB I-81
10 Steel Multigirder Spans
34 Steel Girder/FB/Stringer Spans

# George N. Wade Bridge



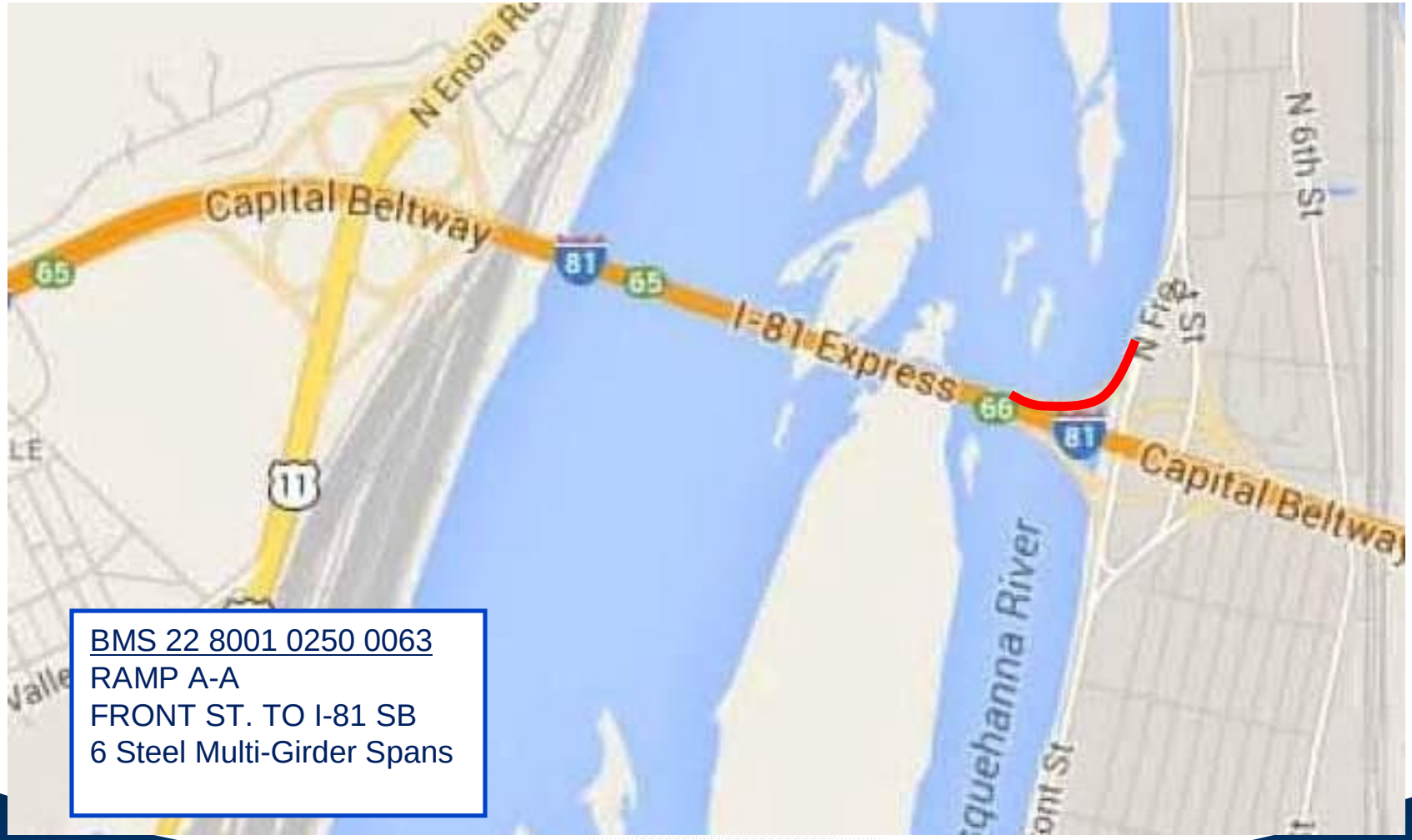

BMS 22 8037 0760 1600
RAMP B
US 11 NB TO I-81 NB
2 Steel Multi-Girder Spans

# George N. Wade Bridge



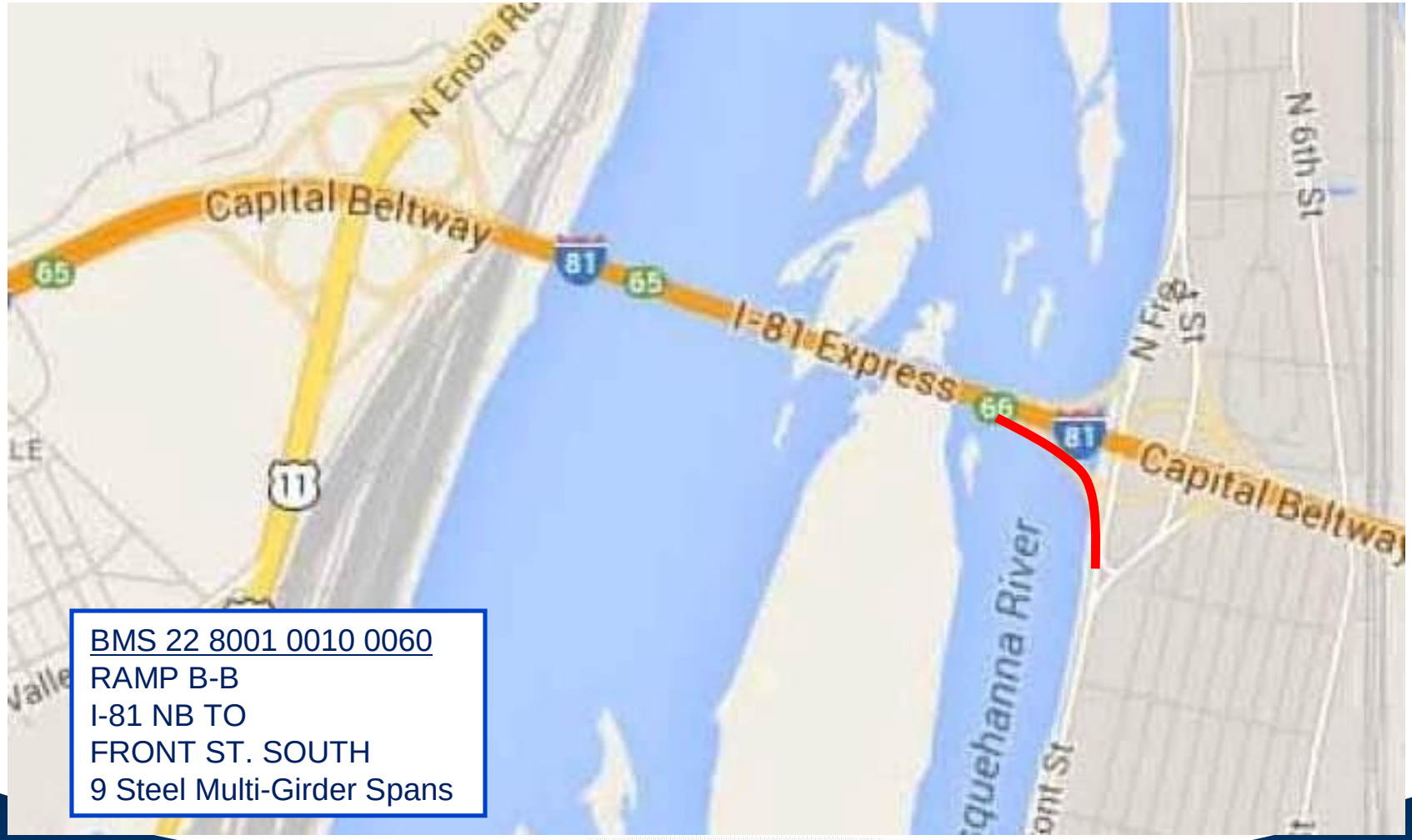

BMS 22 8037 0510 0000
RAMP C
I-81 SB TO US 11 NB
2 Multi-Girder Spans

# George N. Wade Bridge



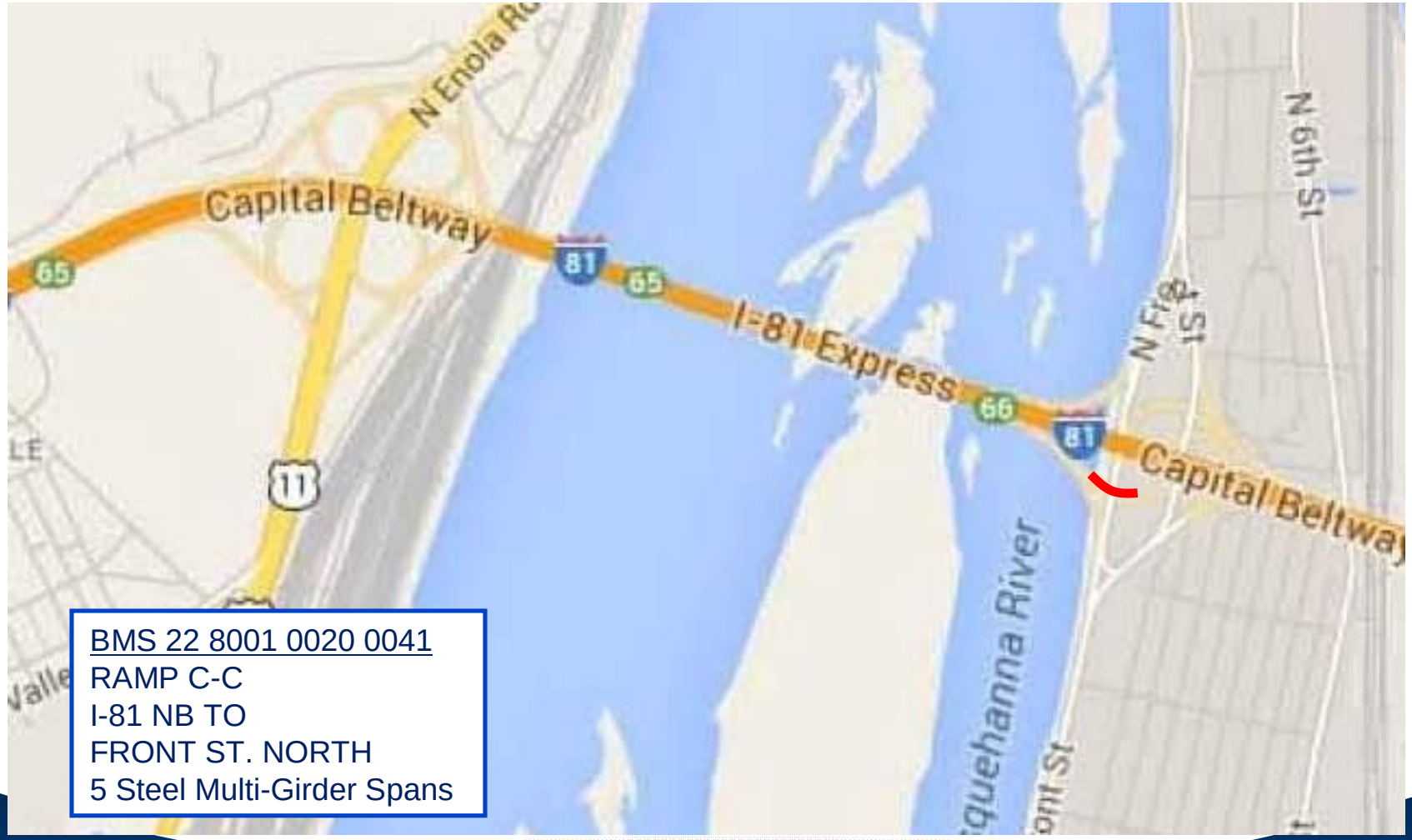

BMS 22 8001 0250 0063
RAMP A-A
FRONT ST. TO I-81 SB
6 Steel Multi-Girder Spans

# George N. Wade Bridge




BMS 22 8001 0010 0060
RAMP B-B
I-81 NB TO
FRONT ST. SOUTH
9 Steel Multi-Girder Spans

# George N. Wade Bridge



# George N. Wade Bridge

BMS 22 8037 0510 0000
RAMP C
I-81 SB TO US 15 NB
2 Multi-Girder Spans

BMS 22 8001 0250 0063
RAMP A-A
FRONT ST. TO I-81 SB
6 Steel Multi-Girder Spans

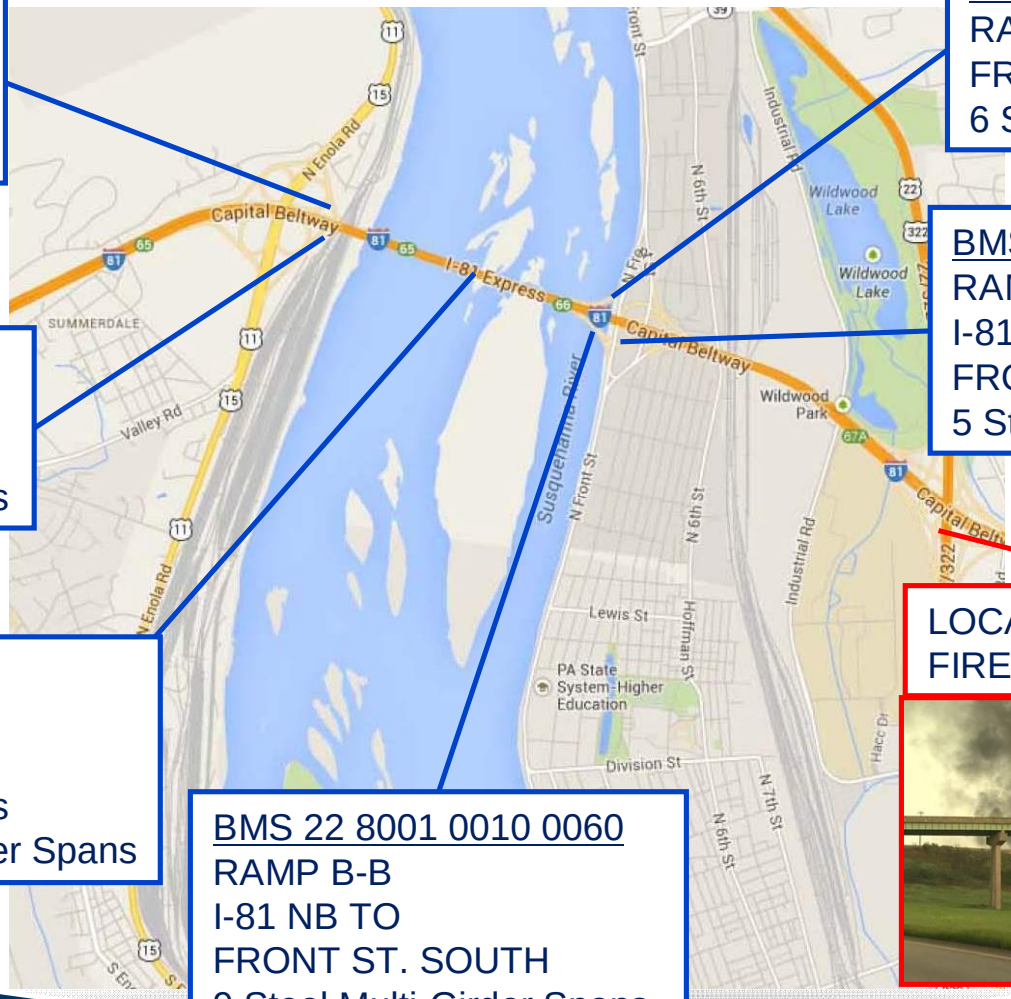
BMS 22 8001 0020 0041
RAMP C-C
I-81 NB TO
FRONT ST. NORTH
5 Steel Multi-Girder Spans

BMS 22 8037 0760 1600
RAMP B
US 15 NB TO I-81 NB
2 Steel Multi-Girder Spans

BMS 22 0081 0650 0000
WADE BRIDGE
NB & SB I-81
10 Steel Multigirder Spans
34 Steel Girder/FB/Stringer Spans

BMS 22 8001 0010 0060
RAMP B-B
I-81 NB TO
FRONT ST. SOUTH
9 Steel Multi-Girder Spans

LOCATION OF TANKER
FIRE ON RAMP OVER I-81

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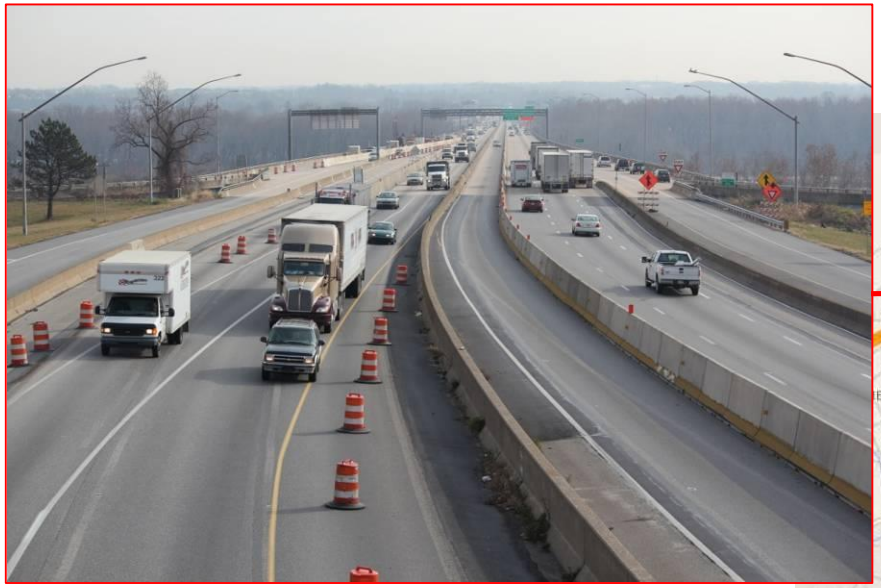
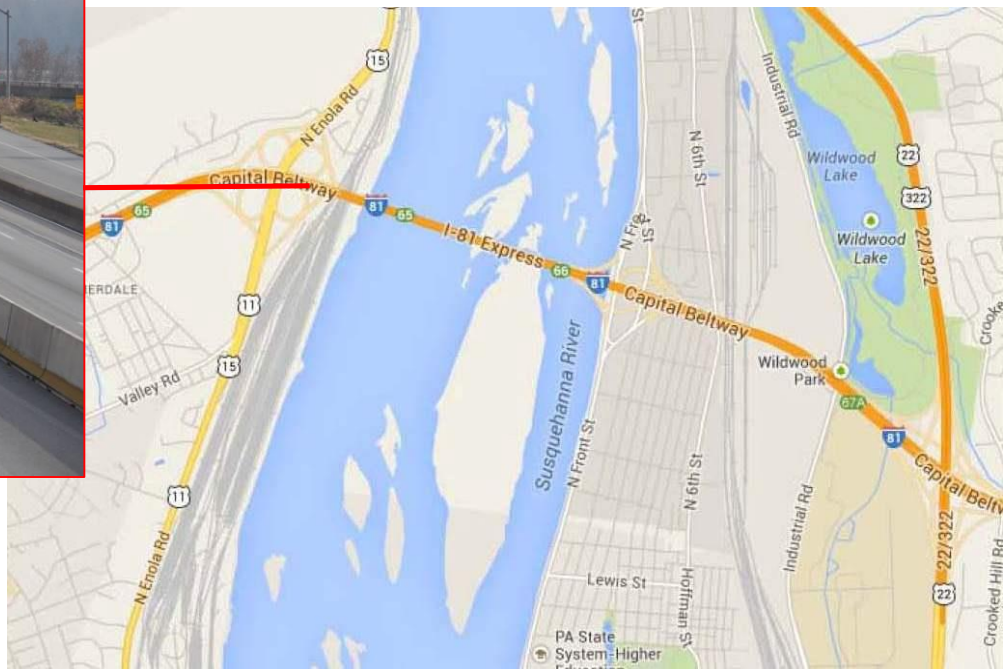
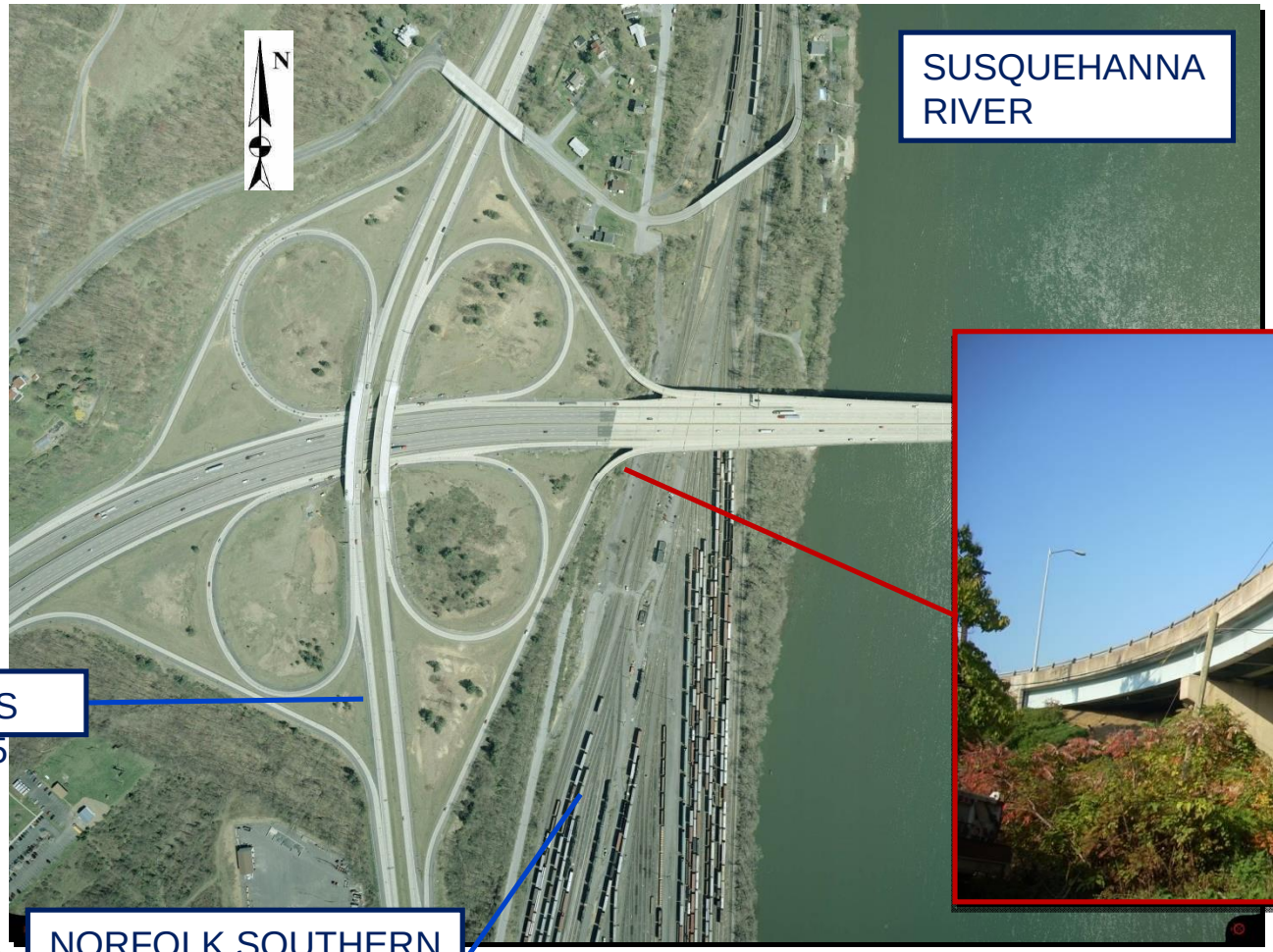
# George N. Wade Bridge



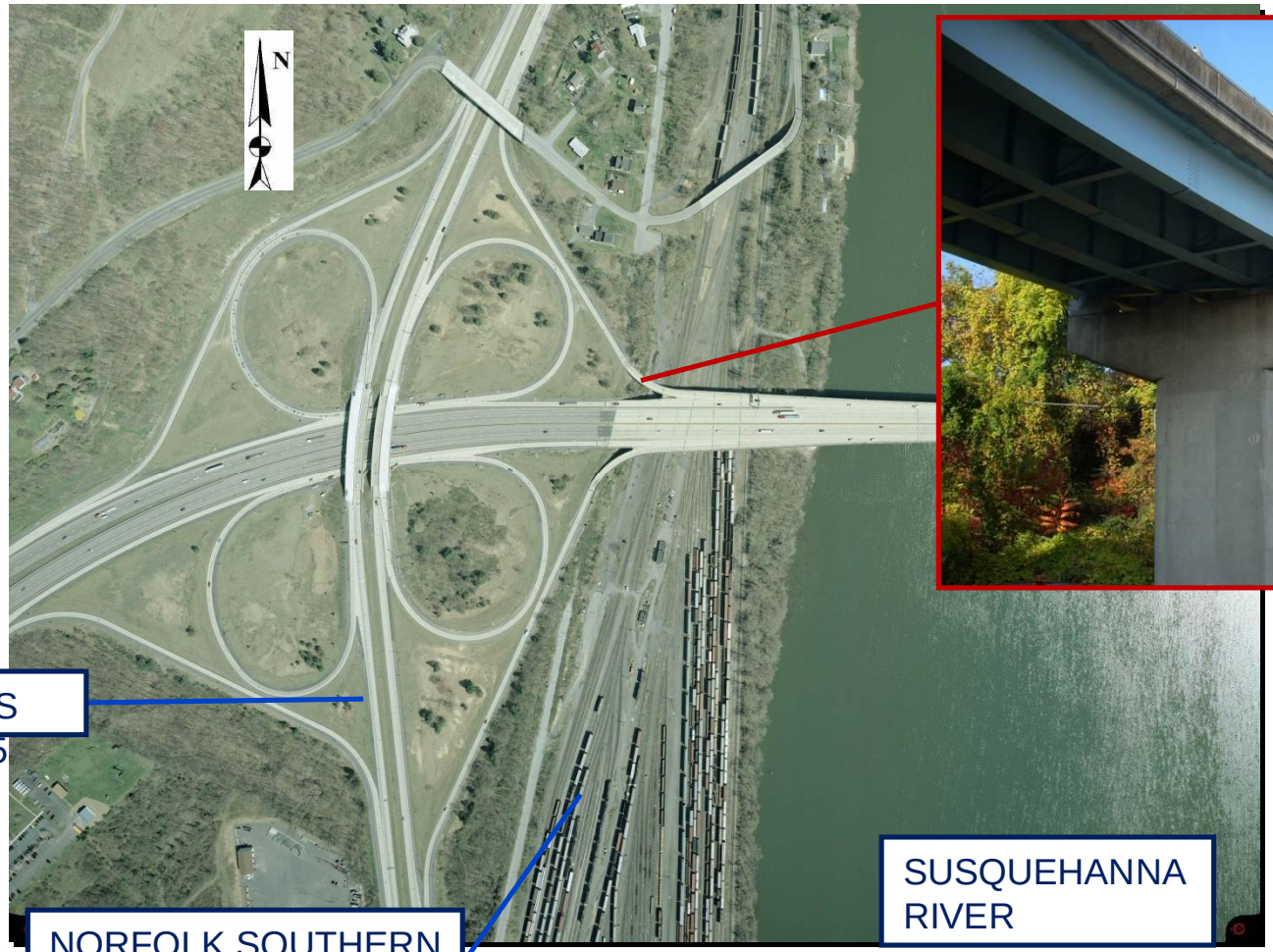


# George N. Wade Bridge



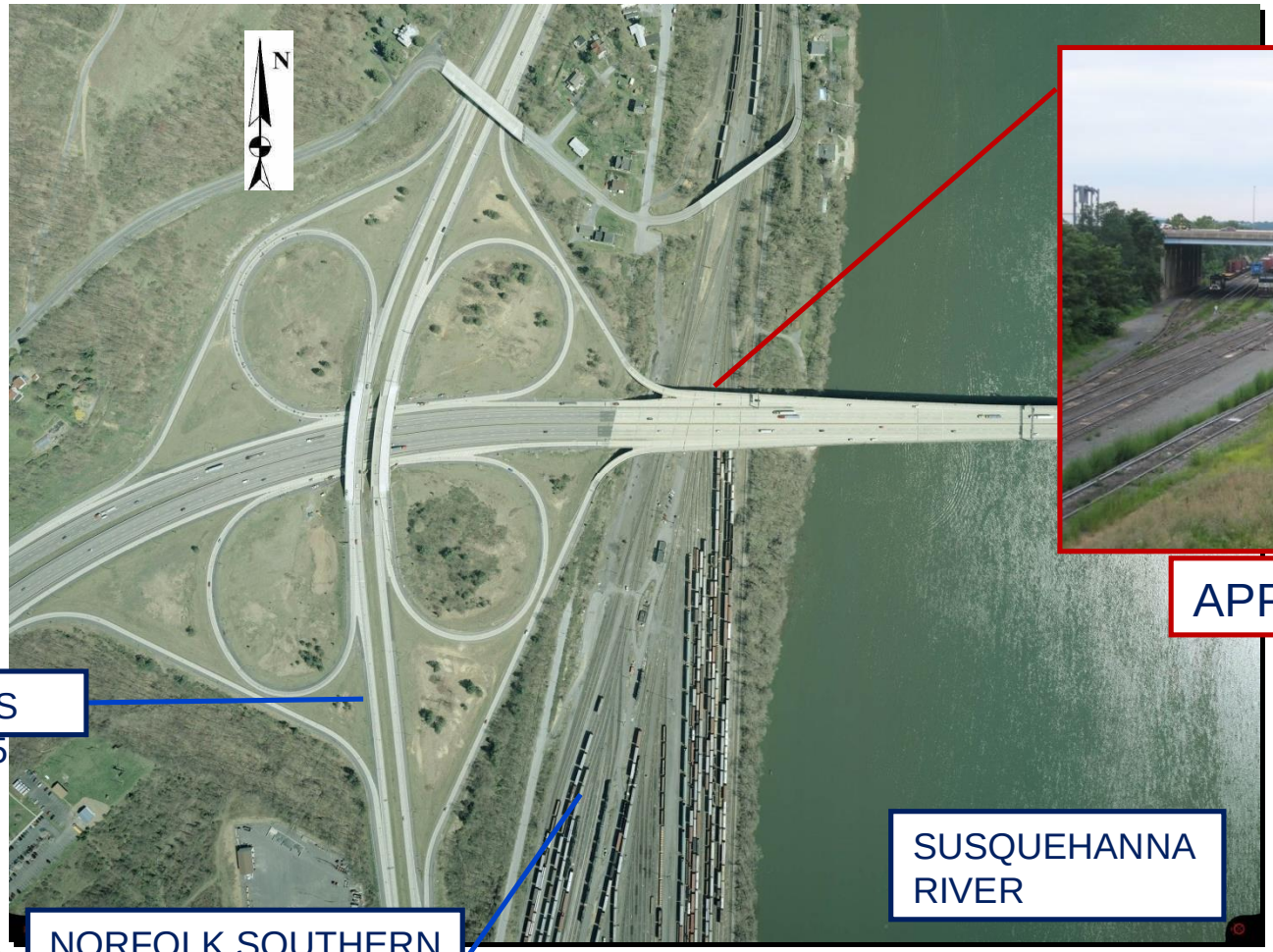

RAMP B

# George N. Wade Bridge




RAMP C

# George N. Wade Bridge



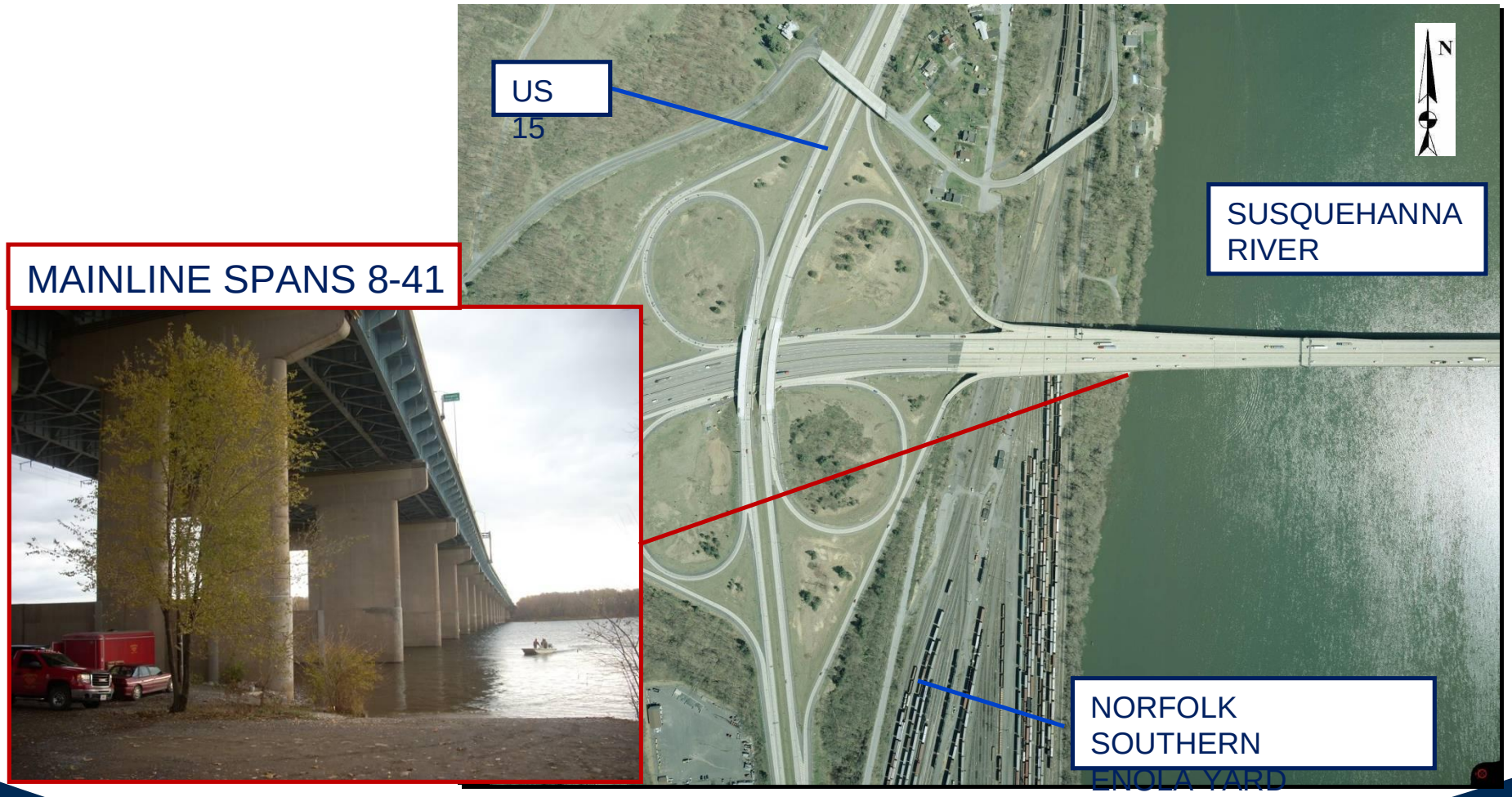

APPROACH SPANS 1-7

US 15

SUSQUEHANNA RIVER

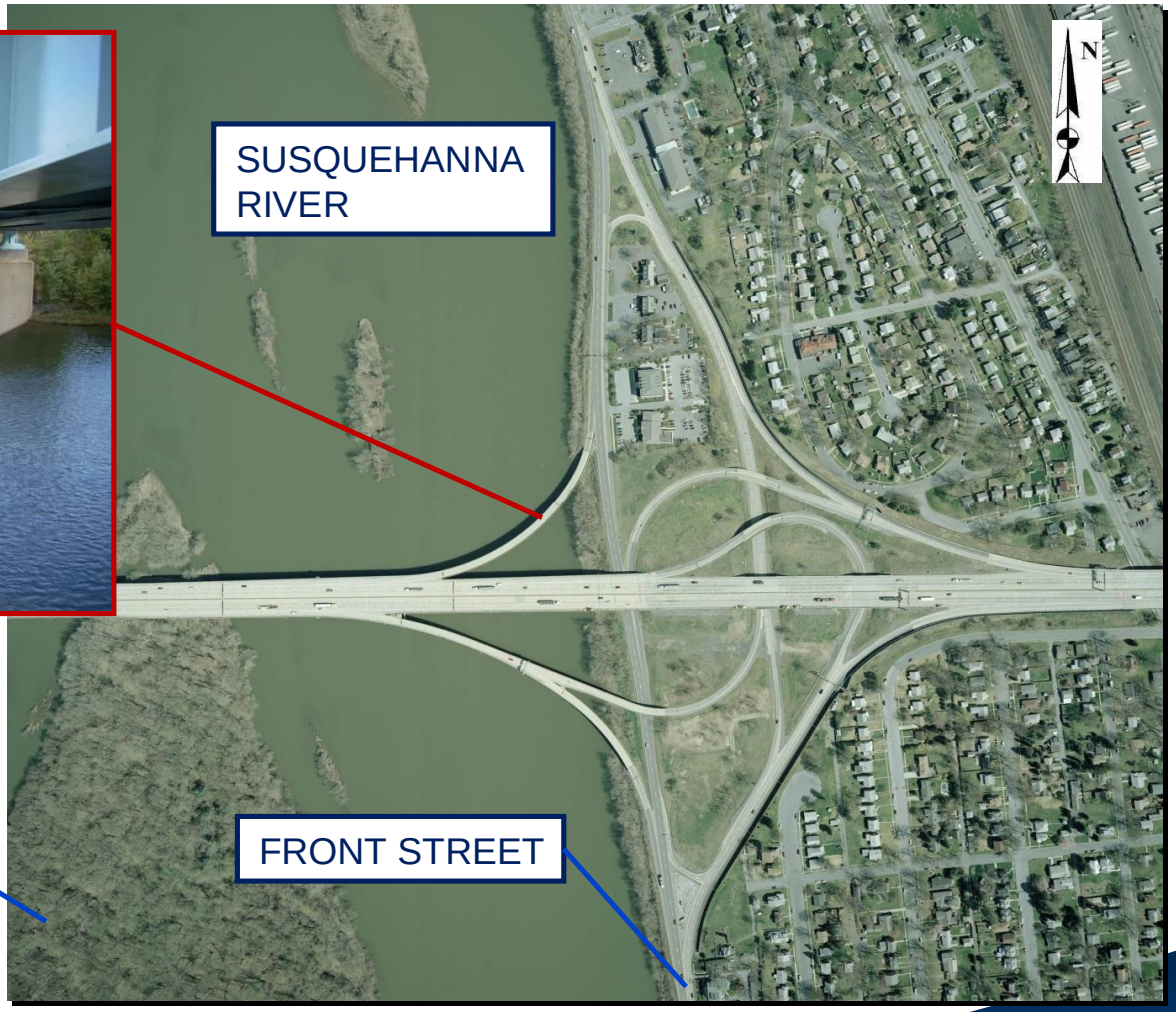
NORFOLK SOUTHERN ENOLA YARD

# George N. Wade Bridge



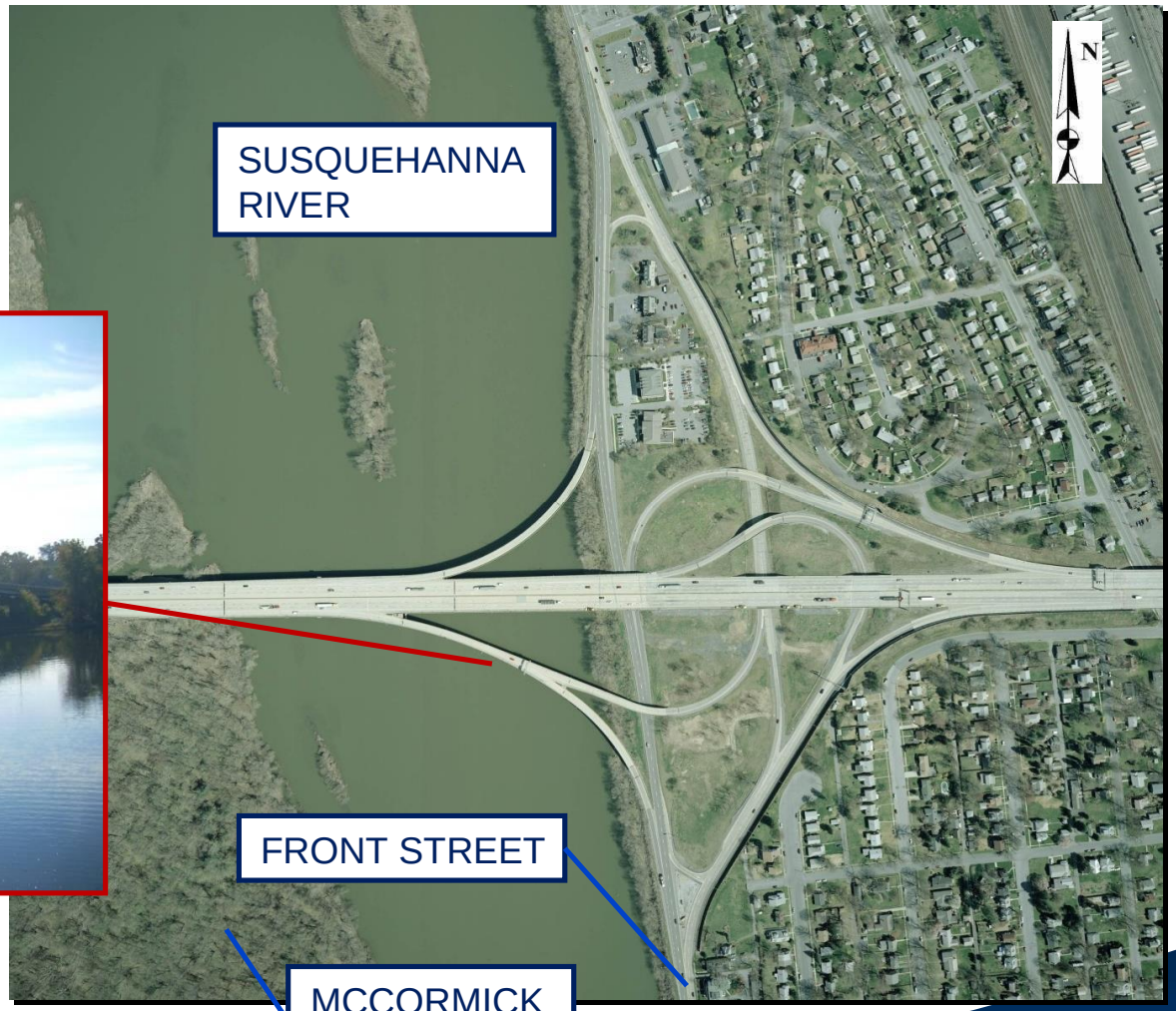
# George N. Wade Bridge

RAMP A-A



# George N. Wade Bridge

RAMP B-B

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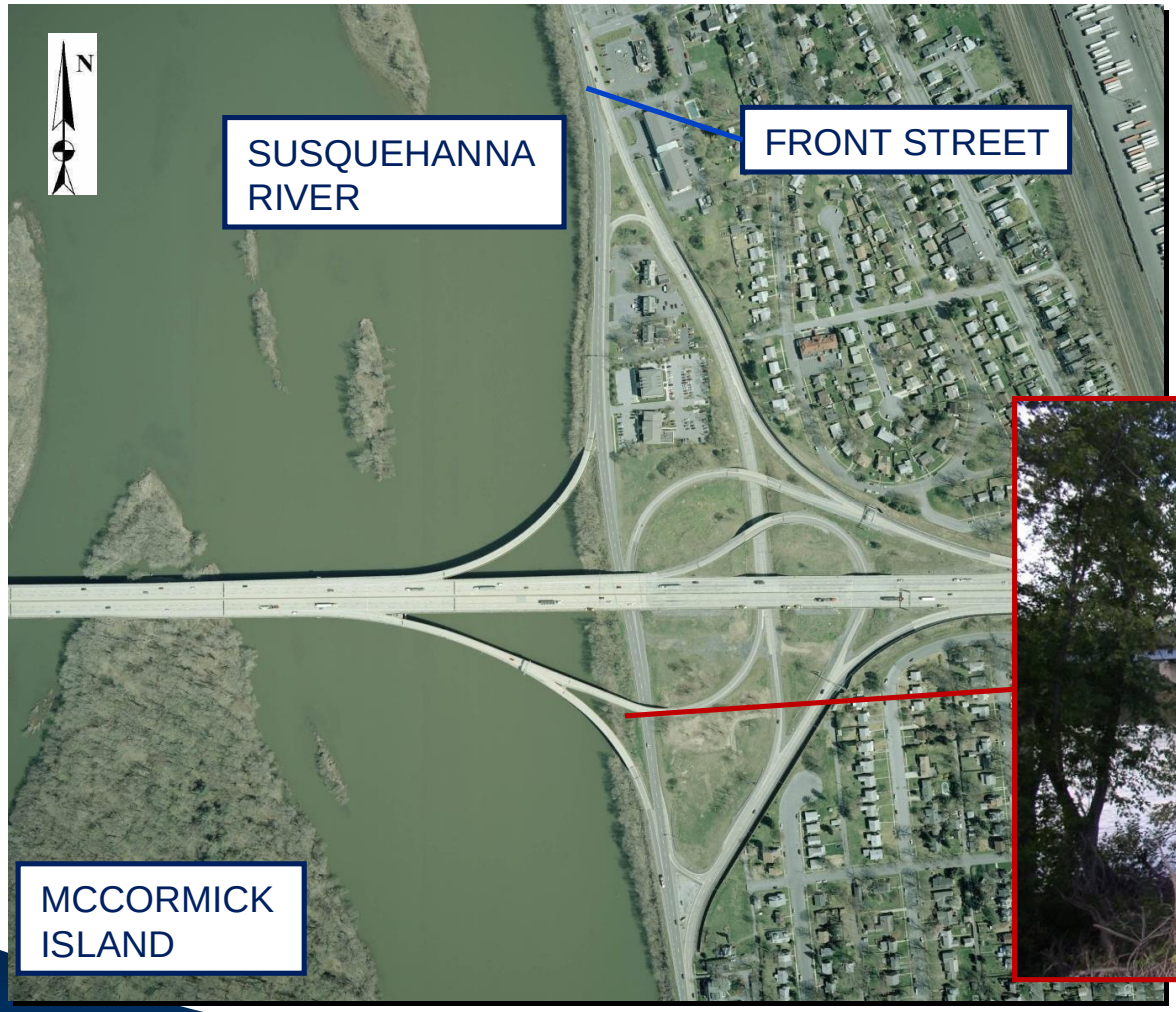
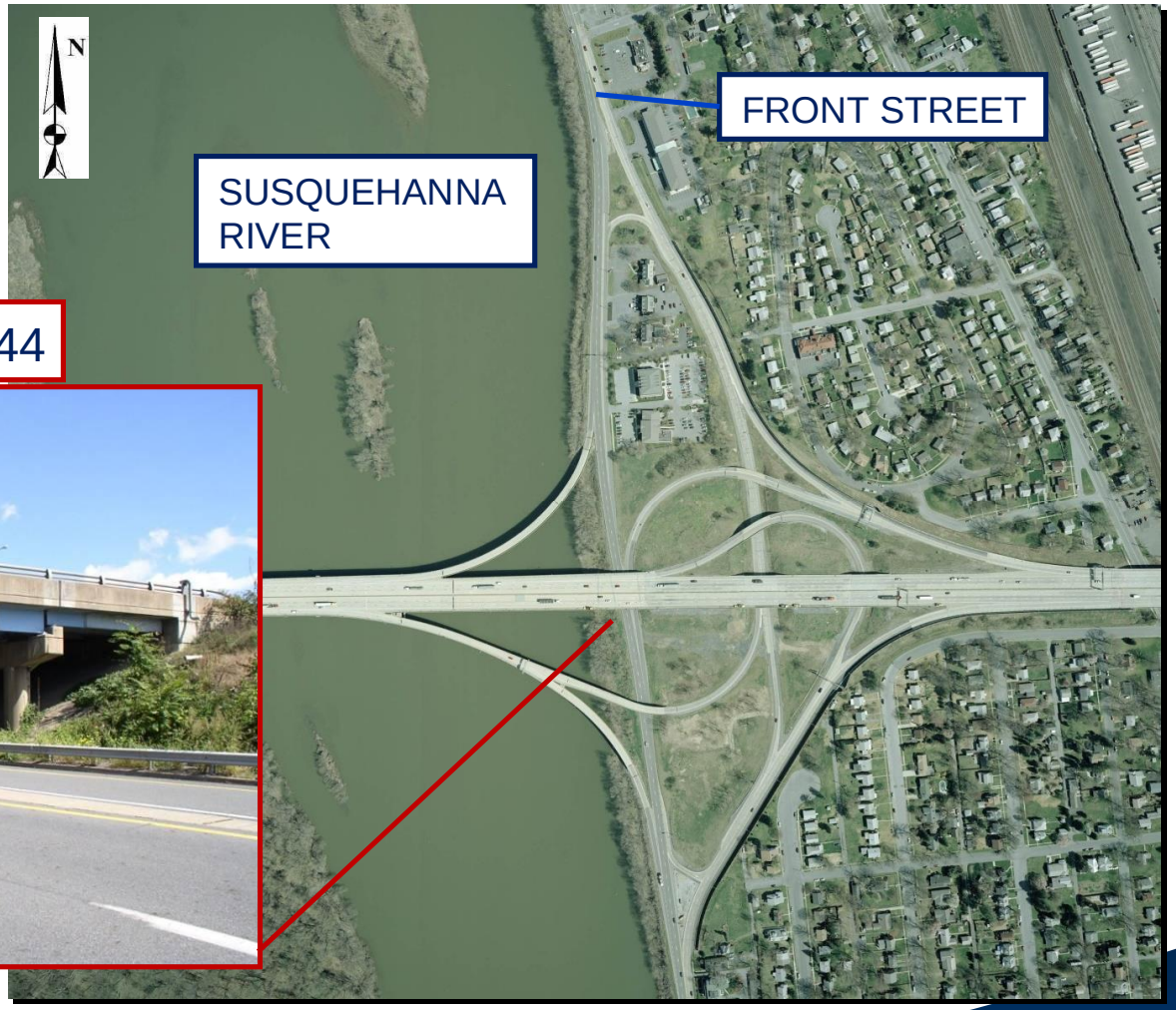
# George N. Wade Bridge




RAMP C-C

# George N. Wade Bridge




MAINLINE SPANS 42-44

# George N. Wade Bridge

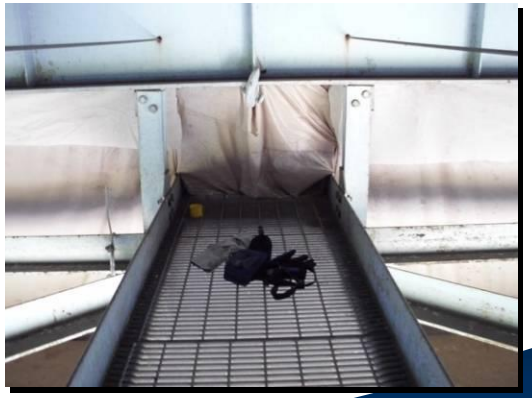
- **Schedule**
  - WO 1 - 2007 Routine Inspection
    - Mainline, 5 Ramps
    - Inventory on Ramps B & C
  - WO 2 - Preliminary Engineering
  - WO 3 - Final Design
  - WO 4 - Construction Services (2009 - 2014)

**2010, 2012 & 2014 Routine Inspections**

- Separate Contract with Michael Baker
- Curved Girder Analysis of All Ramps

# George N. Wade Bridge

- **Inspection Challenges**
  - 2007 was the start of iForms for PENNDOT and mandated for the structure
  - 3 – 2 Man Inspection Teams Including help from a WBE subconsultant (Prime Engineering)
  - Collecting Inspection Data from 3 Teams for iForms and for the inspection report
  - Enola Yard (NS 79 tracks, 275k tons)
    - Worlds Largest through 1956
  - Construction During ‘10 & ‘12 Insps.
  - Susquehanna River Conditions
    - Very Low River but Dangerous

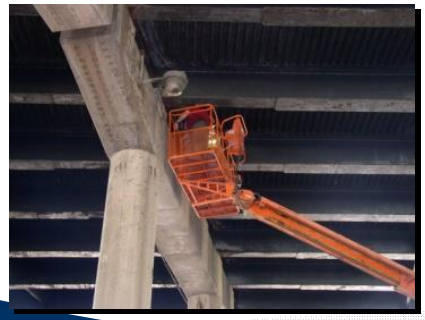


# George N. Wade Bridge

- **History - Major Rehabs**
  - 1974 Latex Modified Concrete Wearing Surface
  - 1990 Post Tensioned Pier Caps 7-41
  - 1990 Auxiliary Bearing (Catcher Beams) Installation at Pin & Hangers
  - 2001 Hoan-like Details drilled

# George N. Wade Bridge

- **Inspection Access**
  - 60’ High Reach
  - 80’ High Reach
  - 40’ Bucket Boat
  - 40’ Bridge Tracker
  - 60’ Bridge Tracker
  - 75’ Snooper



# George N. Wade Bridge

- **Inspection - Deck**
  - Ground Penetrating Radar
    - Compared GPR to chain drag
  - LMC Overlay
    - Deck had <1% debonding/ delaminated concrete
  - Deck Joints
    - Sliding Plate Joints
    - Other Leaking Joints (old version of strip seal joints)
    - Neoprene Troughs under Tooth Dams had Failed

# George N. Wade Bridge

- **Inspection – Deck  Photos**
  - Inspection Findings

Photo 6

# George N. Wade Bridge

- **Inspection – Superstructure Approach Spans**
  - Beam End Section Loss Requiring Repairs in 2007
  - Other Beam End and Steel Deterioration
  - Frozen Bearings
  - Paint Failure

# George N. Wade Bridge

- **Inspection – Beam End Repairs**
  - Temp Support Towers Utilized and Traffic Maintained

# George N. Wade Bridge

- **Inspection - West Shore Beam End Repairs**
  - GF also designed bolted steel plate repairs

# George N. Wade Bridge

- **Inspection – Mainline Superstructure**
  1. Floorbeam Cracks
  2. Section Loss on Double FBs
  3. Auxiliary Bearing Failure
  4. Intersecting Welds
  5. SIP Forms Falling
  6. Hoan Details
  7. Other Fatigue/Fracture Details

Photo 7

# George N. Wade Bridge

- **Inspection - Substructure**
  - High Chloride Content
    - 20.2 lb/cy found
    - DM-4 states 1.4 lb/cy = corrosion
  - Pier 6, 42, & 43 Heavy Spalling & Delam.
  - Voids around Footings
  - Vert. Cracks on Hammer Heads
  - Pedestal Spalls
  - Spalling at P/T End Blocks


Photo 9

# George N. Wade Bridge

- **Inspection – Ramps**
  - Ramps B & C – Paint Failure, No Significant Issues
  - Ramp A-A – Heavy Section Loss to Steel Members under deck open joint
  - Ramp B-B – Rust w/ minor Sect. Loss - top of outside flange
  - Ramp C-C – Heavy Rusting & Beam End Section Loss
  - Ramps B-B & C-C - Spalling & Delam. on piers

# George N. Wade Bridge

## REHABILITATION

# George N. Wade Bridge

- **Rehabilitation**
  - Estimated Rehabilitation Cost = $35,455,789
  - JD Eckman winning bid = $36,448,227
    - Final Contract = $42,298,172
      - (includes additional Work Orders)
    - Let Date 9/3/2009
    - Awarded 9/17/2009
    - Notice to Proceed 10/2/2009
    - Physical Work Complete 8/7/2013

# George N. Wade Bridge

- **Rehabilitation – Challenges**
  - Routine Inspection access during Construction (painting containment in place and other construction equipment)
  - Communications on such a large project with many stakeholders
  - Special Provision for Intrusion Grout Bags (PH level)

# George N. Wade Bridge

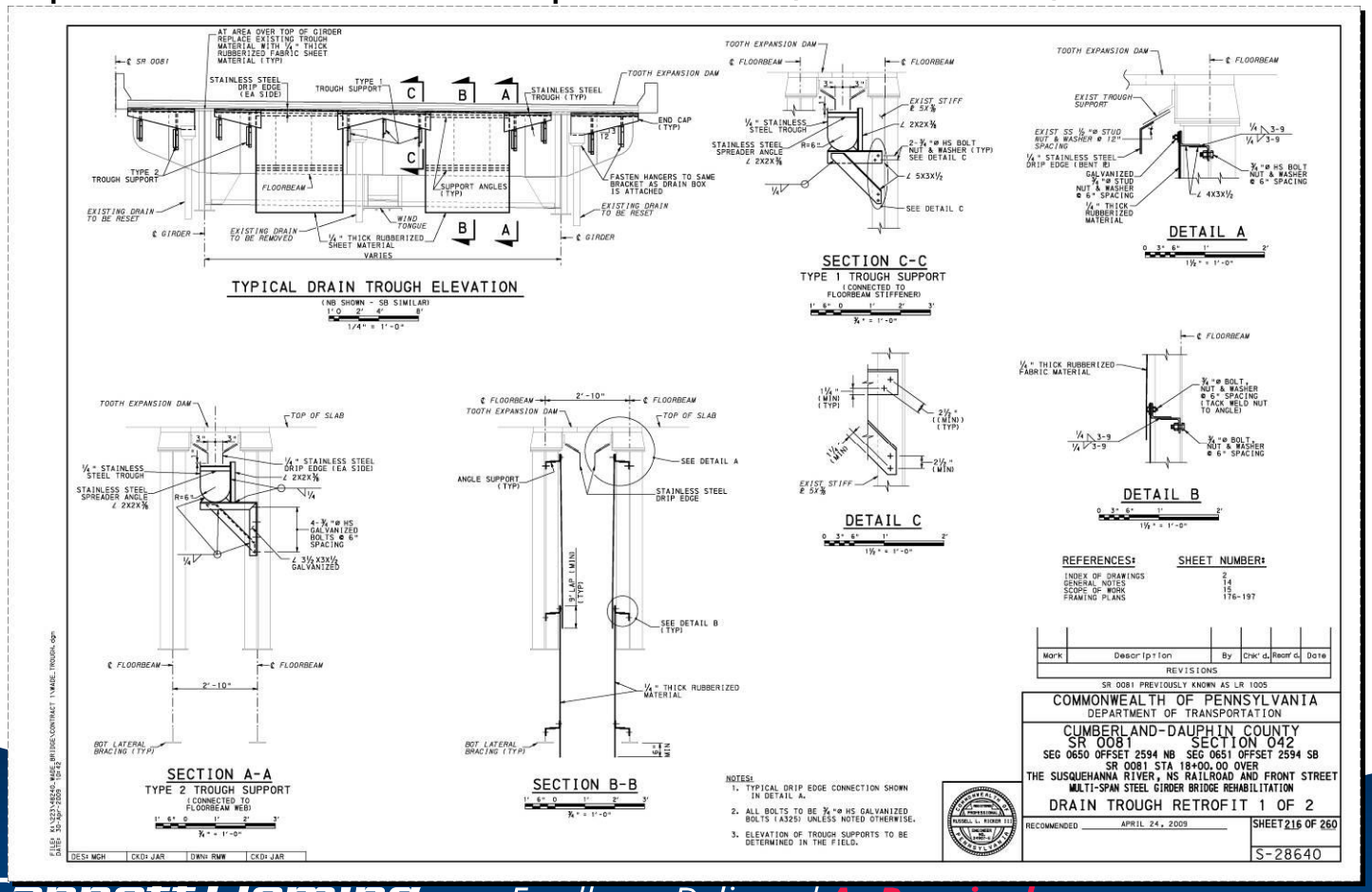
- **Rehabilitation - Deck**
  - 6 Locations - Leaking Joints or Sliding Plates
  - Repair – Replace all leaking joints & sliding plate joints w/ Strip Seals


# George N. Wade Bridge

- **Rehabilitation - Deck**
  - Tooth Dam Troughs torn

# George N. Wade Bridge

- **Rehabilitation - Deck**
  - Repair – Install direct drop curtains (6 Locations)



# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Previous Beam End Repairs (July 2007)
  - Additional Repairs – Bolted Steel Plates (35 Locations at Piers 2 and 3)

# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Type 1 Repairs at K-frame Diaphragms
  - 8 Locations at Pier 1

# George N. Wade Bridge

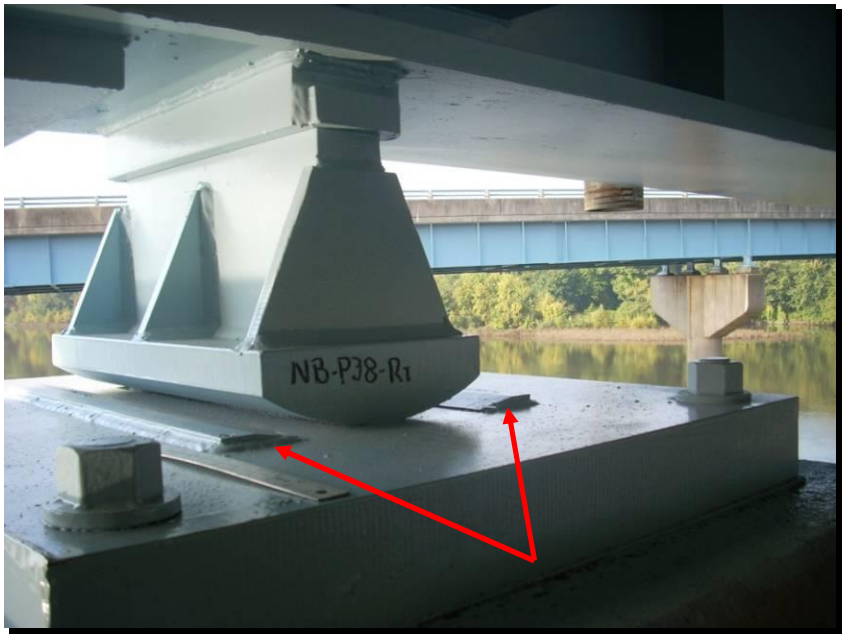
- **Rehabilitation – Superstructure**
  - Type 2 Repairs at Existing Channel Diaphragms
  - 35 Locations at Piers 1, 2, and 3

# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Frozen Sliding Bronze Plate Bearings
  - Repair - Replaced in-kind (168 Locations; all Exp. Brgs in Spans 1-6)


# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Rocker Bearings – Spans 8-41
  - Repair – Welded Wedges to Masonry Plates (127 Loc. - Seismic Retrofit)

# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Paint Type: 3 Coat Organic Zinc System
  - Full Painting (All Steel Surfaces) Performed at:
    - Mainline: Spans 1-7 & 42-44
    - Ramps B, C (West Shore)
    - Ramp C-C (East Shore): Spans CC3-CC5

# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Examples of Full Painting: Ramps C and Mainline Spans 1-7 (multi-girder)

# George N. Wade Bridge

- **Rehabilitation – Superstructure**

  Zone Painting Included:

  - Å All steel surfaces within (1.5x Girder depth) at expansion joints
  - Å Exterior Face and Bottom Flange of Exterior Girders
  - Å All Steel Bearings
  - Å Minor Variations in some areas

  Zone Painting Locations:

  - Å Mainline Spans 8-41 (2-Girder or 3-Girder ï GFS)
  - Å East Shore Ramps AA, BB, and CC (Spans 1&2)

# George N. Wade Bridge

- **Rehabilitation – Superstructure**

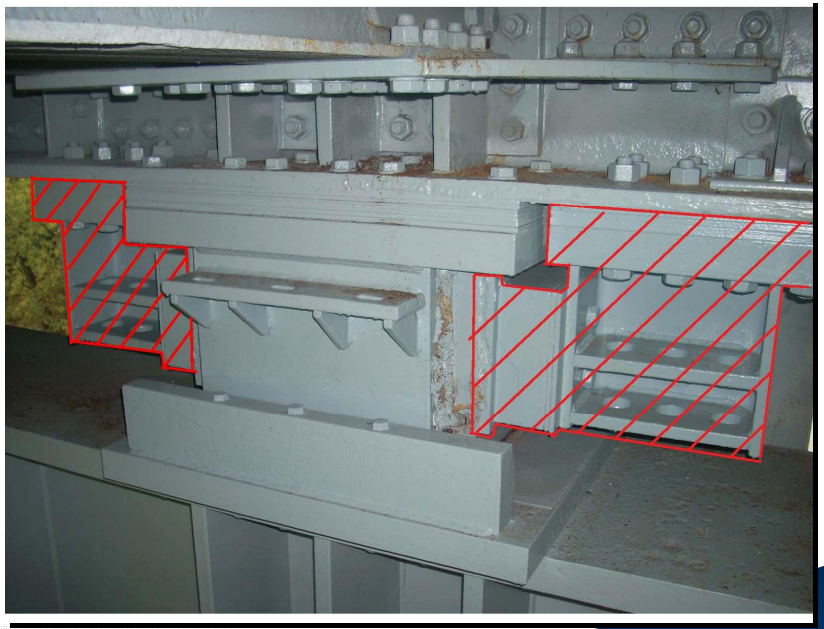
  Zone Painting Photos:

# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Floorbeam Cracks at end of flange weld
  - Repair – Sawcut Crack, Drill Arrest Hole, & Install H.S. Bolt
  - 34 Locations


# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Auxiliary Bearings (Catcher Beam) Failure
  - Repair - Prepared by M&M (original designer)
  - 22 Locations



# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Inters. Welds in Tension Zones – Trans. / Long. Stiff
  - Repair – Remove weld material by drilling large hole
  - 971 Locations

# George N. Wade Bridge

- **Rehabilitation –**
  - Fatigue Details – We
  - Repair - Peening at V
  - 282 Locations

# George N. Wade Bridge

- **Rehabilitation – Superstructure**
  - Fatigue Details – Weld Termination at Gusset Plates (Fatigue Cat. E)
  - Repair - Peening at Weld Toe
  - 1900 Locations


# George N. Wade Bridge

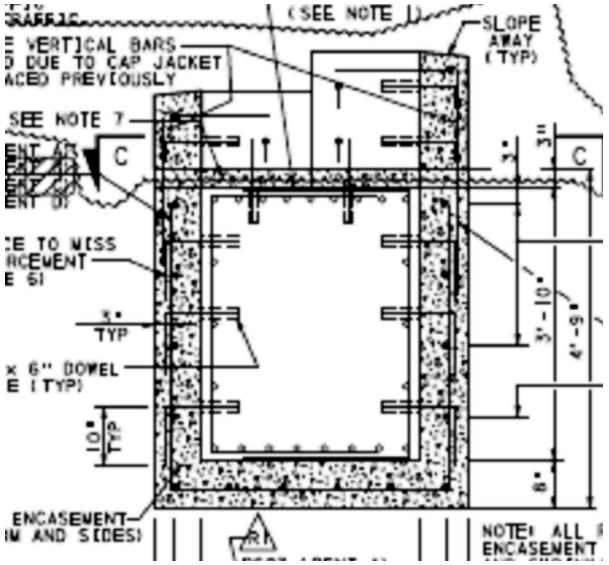
- **Rehabilitation – Superstructure**
  - SIP Form Removal
  - Spans 8 to Span 41 along Median

# George N. Wade Bridge

- **Rehabilitation – Substructure**
  - High Chloride Content
  - Repair - Piers 1 thru 5 – Activated Arc Spray Zinc Coating
  - Repair - Pier 6 – Embedded Anodes

# George N. Wade Bridge

- **Rehabilitation – Substructure**
  - Concrete Caps with Heavy Delamination & Spalling
  - Piers 6, 42, 43
  - Repair – New concrete encasement installed around caps.



# George N. Wade Bridge

- **Rehabilitation – Substructure**
  - Voids Around River Footings
  - Piers 19, 20, 26, 27 and 38
  - Repair – Install Intrusion Grout Bags

# George N. Wade Bridge

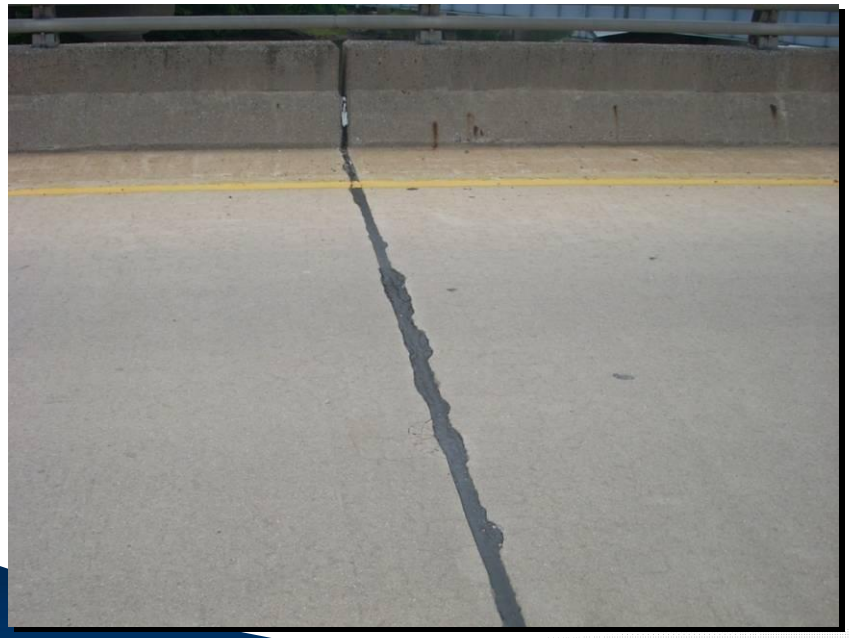
- **Rehabilitation – Substructure**
  - Pier Cap Cracks
  - Repair – Additional Post Tensioning
  - Piers 8-41 Northbound and Southbound

# George N. Wade Bridge

- **Rehabilitation – Substructure**
  - Pedestal Spalls
  - Repair – Install Fabricated Steel Retainers
  - 118 Locations

# George N. Wade Bridge

- **Rehabilitation – Ramps**
  - Ramp A-A
  - Leaking Open Joint Causing Heavy S/L on Steel Below
  - Repair – Removed Joint

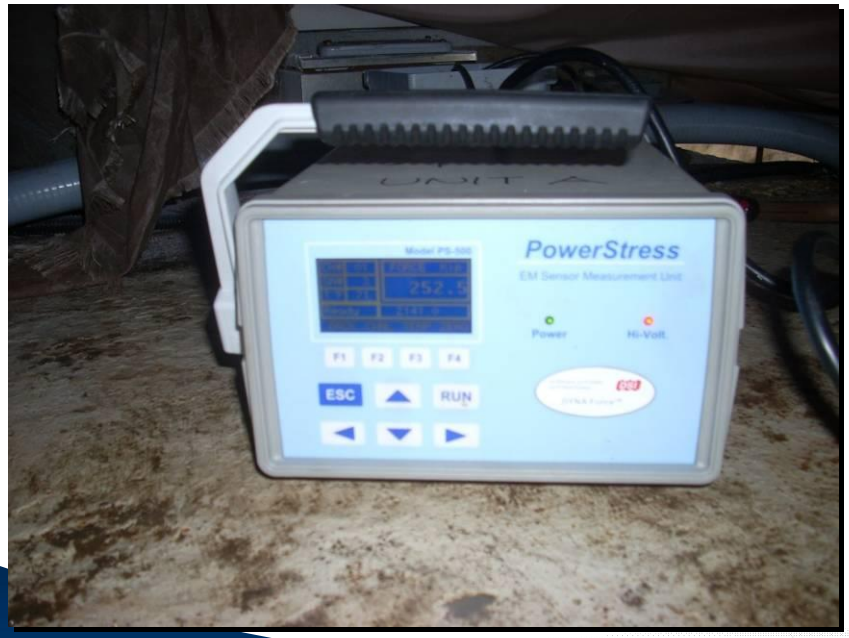


# George N. Wade Bridge

- **Rehabilitation – Ramps**
  - Ramp C-C had most extensive repairs
  - Beam End Section Loss
  - Repair – Bolted Steel Plates

# George N. Wade Bridge

- **Rehabilitation – Additional Photos**
  - Post Tensioning Monitors
  - Piers 8, 15 & 27
  - Measures Force in Tendon




# George N. Wade Bridge

- **Additional Inspection Photos**

# George N. Wade Bridge

## QUESTIONS / COMMENTS?