

STRUCTURE INSPECTION REPORT

East Broadway Street over Regional Enterprises Spur Track



City of Hopewell

Structure Number: 116-8001

Identification Number: 20470

Plan Number: 252-19A

Number of Pages: 25

STV / RALPH WHITEHEAD ASSOCIATES
Richmond, Virginia

April 16, 2014

STRUCTURE INSPECTION REPORT COVER SHEET

Agency ID: 1168001-00000000020470
Cnty/City: Hopewell

Date of Inspection: 04/16/2014
Feature Intersected: Regional Enterprises Spur
Track

Main Route: 000

Facility Carried: East Broadway Street



APPROACH VIEW
Looking East



APPROACH VIEW
Looking West

STRUCTURE INSPECTION REPORT COVER SHEET



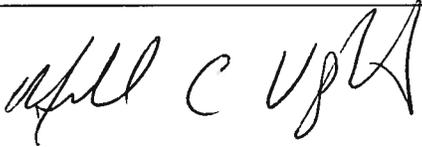
SIDE VIEW
Looking North



SIDE VIEW
Looking South

STRUCTURE INSPECTION REPORT - COMMENTARY

Agency ID: 1168001-00000000020470	Date of Inspection: 04/16/2014
Cnty/City: Hopewell	Feature Intersected: Regional Enterprises Spur Track
Main Route: 000	Facility Carried: East Broadway Street
Location: 0.01 miles east of Riverview Avenue, 0.05 miles west of Ramsey Avenue	
Lead Inspector: Gustavo E. Escorcía, PE (STV Incorporated)	
Additional Inspectors: Michael C. Vaught, PE (STV Incorporated)	

Signature of Lead Inspector		PE Stamp 
Signature of Reviewer		

ORIENTATION	<p>Abutment A is on the west end of the structure. Abutment B is on the east end of the structure. Bents are numbered 1 - 4 from Abutment A. Beams are numbered 1 - 9 from left to right with back to Abutment A and facing Abutment B. Spans are numbered from 1 - 5 from Abutment A.</p>
MISCELLANEOUS (Structure specific items that cannot be included in another section.)	<p>Vertical clearance (21.79' clear from underside of Girder 7 to the top of rail closest to Bent 3).</p> <p>Vertical alignment is poor and limits sight distance due to hump curve. Horizontal alignment is poor for eastbound traffic due to curve in road and existing vegetation, which blocks sight.</p>
SPECIAL REQUIREMENTS (Special Equipment needed or Special Inspections required such as: Fracture Critical, Underwater, Fatigue Prone, Scour Critical, Moveable Bridge, Segmental Concrete, Pin and Hanger, etc.)	<p>24 foot extension ladder to access bent caps. Coordination with Norfolk Southern Railway and Regional Enterprises, Inc. required. Bolt holes and rivets, Fatigue Category B</p>
WORK DONE	<p>Vegetation has been cleared on slope protection of Abutment A. The panels of the posting signs were retouched to improve legibility.</p>
STRUCTURAL ANALYSIS	<p>The load rating for this structure has been reviewed. Retrofitting the structure is required to improve its load rating capacity and to bring the structure back into service.</p>
OVERALL CONDITION	<p>"Imminent" failure condition. Major deterioration and section loss has occurred to the lower ends of the steel columns, connection angles and plates, anchor bolts and nuts. One column exhibits areas in the web and flanges of up to 100% section loss. It is in our opinion that the load is predominately being transferred to the column base/pedestal through the angles attached to the column flanges. The web and portions of the existing flanges appear to have lost all load carrying capacity due to advanced deterioration. Each angle is connected to the</p>

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column flanges with four rivets. The bottom two rivets in each connection appear to have lost all load carrying capacity. This is a significant change from the previous inspection, which was completed on February 27, 2013. A failure in the column base could cause surrounding elements to become overstressed or unstable, potentially leading to a partial or total collapse of the structure. After reviewing the load rating report, it was determined that the amount of deterioration noted in the column base would impact the load rating analysis.

One horizontal lateral cross bracing member has perforations with significant section loss near the connection. One bent cap has significant section loss. In general, the structural steel has corrosion with moderate residue pitting and section loss throughout with exfoliations. The expansion joints have failed at both abutments. Abutment seats exhibit concrete disintegration. Significant loss of bearing under masonry plates. Vegetation is growing on the slope protection, Extensive graffiti on superstructure, substructure, and slope protection bents and beams.

RECOMMENDATIONS**CRITICAL RECOMMENDATIONS \$200,000 ***

Because the "imminent" failure of a column base could cause a catastrophic failure of the entire structure, we recommend that the structure be immediately closed to all traffic, both vehicular and pedestrian, until repairs are completed. Once repairs have been completed a new load rating analysis should be performed to determine the appropriate posting limit for the structure.

The following are the anticipated repairs that will be required to be completed in order to bring the structure back into service.

1. Repair lower ends of steel columns, replace connection angles and column support base plates.
2. Replace Bent Cap #4 which has significant section loss.
3. Replace anchor bolts at all bent columns.
4. Replace diagonal bracing between bent columns at each bent.
5. Replace horizontal cross bracing between Bent 1 and 2 and between Bent 3 and 4.
6. Stiffen vertical cross bracing between Bents 1 and 2 and between Bents 3 and 4 which are bowed.
7. Repair concrete pedestals at base of bent columns.

Given the age and overall condition of the existing structure consideration should be given to entirely replacing the existing structure.

OTHER RECOMMENDATIONS \$140,000 *

1. Repair bent railing and weld repair cracked bridge rail or alternately, upgrade railing on bridge.
2. Replace compression seals in the expansion joints at both ends of bridge.
3. Paint angles at ends of bridge that are part of the expansion joints.
4. Repair abutment seats at each abutment.
5. Repair/replace bearing assemblies for all beams at each abutment.
6. Replace bolt that has a sheared off head located at beam to bent cap connection.
7. Clean and paint structure steel.

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8. Install railroad protective crash walls on each side of track at Bents 2 and 3.
9. Install railroad protective fencing on outside of bridge railing along the sidewalk side of the bridge.
10. Clear vegetation from slope protection, substructure elements and superstructure.
11. After retrofits, perform a new load rating and update posting.

APPROACH PAVEMENT RECOMMENDATIONS \$40,000 *

1. Install approach guardrail, approach guardrail terminals, and transitions between approach guardrail and bridge railing at all four corners of bridge.
2. Pave approach roadway to correct settlement of approach at Abutment B.
3. Correct cracked and spalled asphalt pavement of approach at Abutment A.
4. Remove and re-erect No Parking sign on a new post 40 feet further west of the bridge posting sign in order to improve visibility to eastbound vehicles.
5. Raise both posting signs to standard signing heights.
6. Restore railing on top of right wingwall at Abutment A.
7. Replace the left object marker on both approaches since they slope in the wrong direction.

* Does not include cost for railroad flagman or Contractor's required railroad insurance. Does not include cost for design plans or construction engineering and inspection oversight.

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DECK	GENERAL CONDITION RATING 7
<u>Wearing Surface</u>	None
<u>Top of Deck</u>	<p>Good: Top of deck has exposed "polished" aggregate, minor hairline longitudinal cracking. Top of deck also has isolated areas of map cracking in Spans 3, 4 and 5.</p> <p>Pavement markings (double yellow lines) are beginning to debond with approximately 10% already missing.</p>
<u>Bottom of Deck</u>	<p>Fair: Metal stay-in-place forms were used. Stay-in-place forms are corroded at abutments. At Abutment B, the concrete within the last flute of the stay-in-place form has spalled off due to water infiltration at the joint. See photo #1. Portion of deck reinforcing is visible. See photo #2. Bottom corner of concrete deck overhang on the left side of bridge in span 5 has entirely spalled off.</p>
<u>Curbs</u>	Good:
<u>Median</u>	None
<u>Sidewalks</u>	Good:
<u>Parapet</u>	Good: Vertical hairline cracks in the left parapet at 3' to 6' spacings.
<u>Railing</u>	<p>Fair: The railing along the right side in Span 2 (adjacent to the sidewalk) is damaged with the three horizontal rails bent outboard 4" suggesting possible vehicular impact. See photo #3. Along the left side, the bottom rail is cracked in Span 3. See photo #4. The railing on the southwest wingwall is heavily corroded and has fallen away from the bridge.</p>
<u>Drains</u>	None
<u>Lighting</u>	No lights on the bridge. A street light is located on the approach roadway on the north side of Abutment A and on the approach roadway on the north side of Abutment B on utility poles.
<u>Utilities</u>	Good: Columbia gas line between Beams 8 and 9.
<u>Expansion Joints</u>	<p>Poor: Armor angles have light surface corrosion. Minor spalling between angles and the approach slabs. The compression seals have failed and are causing water to leak through the joints and onto the abutment seats and bearings. There is also debris buildup in the Abutment B joint. Abutment A seal is heavily deteriorated. See photo #5. Seal is cracked and deteriorated significantly. The Abutment A armor angle anchor bolt has a missing nut at Beam 9. Portions (6 LF) of the Abutment B seal are lying on top of the abutment seat, note daylight through joint. See photo #6&7.</p>

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SUPERSTRUCTURE	GENERAL CONDITION RATING 5
<u>Bearings Devices</u>	Fair: All bearings of both abutments have lost bearing under the masonry plate due to deterioration of the abutment seat concrete. See photo #8. The bearing assemblies at Abutment A have minor surface corrosion with heavy amounts of corrosion on the bearing assembly of Beam 7. The bearing assemblies at Abutment B have a heavy corrosion with loss of section to the anchor bolts and beveled masonry plates.
<u>Stringers</u>	None
GIRDERS, BEAMS OR SLABS	
<u>Beams</u>	Fair: All beams have light surface corrosion. Minor graffiti present on beams. All beams are pitted on the webs and flanges with minor residual loss of section to the bottom flanges of the beams at the bearings.
	The beams in Span 3 have 5% section loss typical with light to moderate corrosion on top of bottom flange. The beam-to-cap connection at the west end of Beam 5 in Span 3 has pack rust.
	The exterior beams have heavier amounts of corrosion with significant amounts of pack rust existing around the bottom of the beam's double angle to bent cap connections.
	Numerous beams have had the original rivets and/or bolts replaced with new bolts. At Bent 3, Beam 4 of Span 3, the center connection bolt head has sheared off from the beam's angle to bent cap connection. See photo #12. Bolt head is missing on the left side angle connection as facing Abutment B. Hold-down bolt for Beam 9 at Bent 4 is deformed due to pack rust.
	Beam 2 in Span 4 has two perforations 1/2" high x 2" wide average at the top of the web near Bent 4.
<u>Diaphragms</u>	None
<u>Cross Frames</u>	None
<u>Bracing</u>	None
FLOORBEAMS	None
TRUSSES	
<u>Portals</u>	None
<u>Bracing</u>	None
PAINT	Fair: Areas of light surface corrosion throughout superstructure and substructure. Several areas of exfoliations have been painted over indicating insufficient cleaning before painting. See photo #22. Pack rust exists at most connections. No active corrosion stains are present. Minor graffiti.

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MACHINERY (MOVABLE SPAN)	None
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SUBSTRUCTURE	GENERAL CONDITION RATING 1
ABUTMENTS	
<u>Wingwalls</u>	The southwest wingwall has a 1¼" top to ½" bottom open vertical crack and had rotated forward 3/8" at the top. See photos #9&10.
<u>Backwalls</u>	Fair: Abutment A has moderate honeycombing throughout.
<u>Bearing Seats</u>	Poor: The entire seat area of both abutments has disintegrated concrete with loss of bearing under the masonry plate of all bearings. See photo #8. Debris (dirt, vegetation, spalled concrete) is also present on the bearing seats in Abutment B only.
<u>Breastwall</u>	Fair: Abutment A has 4 vertical hairline cracks, 7 LF total. Abutment B has one vertical hairline crack, 4 LF total and an area of concrete disintegration on south end 18" wide x 4 LF high with no reinforcing steel exposed. Both breastwalls have minor honeycombing.
<u>Weep Holes</u>	None
<u>Footings</u>	Not visible.
<u>Piles</u>	Not visible.
<u>Undermining</u>	No undermining observed.
<u>Settlement</u>	No signs of settlement observed.
PIERS	
<u>Caps</u>	None
<u>Bearing Seats</u>	None
<u>Walls</u>	None
<u>Columns</u>	None
<u>Stems</u>	None
<u>Footings</u>	None
<u>Piles</u>	None
<u>Bracing</u>	None
<u>Undermining</u>	None
<u>Settlement</u>	None

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BENTS**Caps**

Fair: Bent caps consist of a rolled steel section. Corrosion is present at top flanges of concrete deck to bent cap interface and corrosion is also present on bottom flanges and the upper portions of the web of the bent caps.

Bent cap of Bents 1 and 2 have 5% section loss. At Bent 3 there is also pack rust between the cap and the south column.

Bent cap of Bent 3 has painted over residual section loss on the upper half of the web. There is also pack rust between the cap and the north and south columns, which has warped the bottom flange of the cap and the bearing plate at the top of the column.

Bent cap of Bent 4 has minor exfoliation between Beams 2 and 3 along the underside of the top flange and top one inch of the web. [See photo #22](#). There is also pack rust between the cap and the north column, which has warped the bottom flange of the cap and the bearing plate at the top of the column.

Bearing Seats

None. Beam ends frame into web of bent cap.

Columns

"Imminent" failure: The bottom six inches of the north column on Bent 3 exhibits several perforations in the column web and up to 100% section loss to portions of the web and flanges. Consequently, the bottom of the column web and portions of the existing flanges appear to have lost all load carrying capacity due to advanced deterioration. [See photos #15 & #16](#). Note that each angle is connected to the column flanges with four rivets. The bottom two rivets in each connection appear to have lost all load carrying capacity. A failure in the column base could cause surrounding elements to become overstressed or unstable, potentially leading to a partial or total collapse of the structure.

Also, in the same location it is evident the lack of positive anchor of the column support because the anchors and nuts are severely corroded.

In general, the bottom six inches of the column flanges along the north side of the structure have up to 50% loss of section. Angles connecting the column web and flanges to the base plates at the column bases, two have up to 100% loss of section. [See photo #13](#). Nine anchor bolts have up to 50% loss of section. [See photo #21](#). The inside anchor bolt at the north column at Bent 2 is missing with 100% loss of section. Also, substantial deterioration of the horizontal bracing element is observed at this location. [See photo #14](#).

The column footings have hairline cracks extending from the anchor bolts. There are areas of delamination on the top of the footings. Moderate concrete spalling and disintegration has occurred around the edges of the footings.

Heavy vegetation in Bent 4. [See photos #19 & #20](#).

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<u>Bracing</u>	Poor: All bracing members have light surface corrosion with pitting.		
	The top horizontal bracing member at the Bent 4 north column connection has 75% loss of section at end connection with ten (10) perforations ½" high x ½" wide average at the north column of Bent 4. The gusset plate at this bracing connection has up to 25% loss of section.		
	The cross bracing members between Bents 1 and 2 and Bents 3 and 4 along the south side of the bridge are bowed up to 3". See photos #17 & #18.		
	The gusset connection plates of some bracing members have pack rust that has forced the plates apart from the angles. See photo #11.		
	Heavy vegetation in Bent 1 bracing.		
<u>Miscellaneous</u>	No collision crash walls present at bents adjacent to centerline of track. Current VDOT standards require railroad protective crash walls to be installed at piers/bents located within 50 feet of centerline of track.		
CHANNEL AND SLOPE PROTECTION <u>Scour</u>	GENERAL CONDITION RATING N/A		
	N/A		
<u>Embankment Erosion</u>	Good: No embankment erosion visible.		
<u>Drift</u>	N/A		
<u>Vegetation</u>	Fair: Vegetation is growing on slope protection, abutments, Bents 1 and 4 and on Beam 1 of Span 1.		
<u>Fender Systems</u>	None		
<u>Spur Dikes</u>	None		
<u>Jetties</u>	None		
<u>Riprap</u>	None		
<u>Slope Protection</u>	Satisfactory: Vegetation is growing on slope protection and through joints in the slope protection, which has caused some opening of joints in the concrete.		
	There is an open joint at both abutments between the slope protection and wingwalls and breastwalls. The top of Abutment A slope protection has voids up to 6" wide x 6" deep x 10 LF (See photo #26.). The entire top 12" of Abutment A slope protection sounds hollow when stuck with a hammer. Abutment B exhibits no visible signs of deterioration. The slope protection at the North wing of abutment B has settled 3" but shows no signs of distress.		
<u>Adequacy of Opening</u>	N/A		

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<p>FIELD POSTING</p> <p><u>Actual Posting</u> 2½ Tons</p> <p><u>Legibility</u> Good.</p> <p><u>Visibility</u> Abutment A Approach: Fair. Sign is mounted too low on the post. The sign is located 80'-4" from beginning of bridge.</p> <p>Abutment B Approach: Good. The sign is located 153'-10" from end of bridge. Sign is not set square to road and mounted too low.</p> <p><u>Advanced Warning Signs</u> None</p> <p>(In accordance with Traffic Engineering Division Memorandum TE-244 dated 5-7-94)</p>	
<p>OTHER</p> <p><u>APPROACH PAVEMENT</u></p> <p>Fair: Both concrete approach slabs have exposed "polished" aggregate and scale. Abutment A approach slab has light longitudinal and map cracks. Abutment B approach slab has settled 2" in the WBL and has 70 LF of longitudinal cracking.</p> <p>The asphalt pavement beyond Abutment A approach slab has numerous sealed cracks and multiple patches. See photo #23. Abutment B approach pavement has moderate random cracks. See photo #24. Approach sidewalks have moderate scaling of concrete surface.</p> <p>The slope has settled along the right side at Abutment B, approximately 2½". See photo #25.</p> <p><u>TRAFFIC SAFETY FEATURES</u></p> <p><u>Bridge Railing</u> 0: The railing does not meet current Virginia Department of Transportation (VDOT) standards and does not meet current AASHTO loading requirements. The bridge railing adjacent to the sidewalk does not have railroad protective fencing installed as required by current VDOT standards. The railing on the southern wingwall of Abutment A has fallen off the bridge.</p> <p><u>Transitions</u> 0: No transitions present. Condition does not meet current VDOT standards.</p> <p><u>Approach Guardrail</u> 0: No approach guardrail present. Condition does not meet current VDOT standards.</p> <p><u>Approach Guardrail Terminal</u> 0: No approach guardrail terminals present. Condition does not meet current VDOT standards.</p> <p>OBJECT MARKERS</p> <p>Abutment A Approach: Left and right object markers present. Larger than standard bridge end markers. (see Approach View East). The left object marker slopes in the wrong direction.</p> <p>Abutment B Approach: left object marker is larger than standard bridge end marker. No right object marker present. (see Approach View West). The left object marker slopes in the wrong direction.</p>	

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PHOTOS



Photo # 1 - End of slab concrete spalled off due to water infiltration through deck joint at Abutment B.



Photo # 2 - End of slab reinforcing exposed and severely corroded at Abutment B. (a. Longitudinal b. Transverse)

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Photo # 3 - Damage to the three horizontal rails on the railing along the right side of the bridge in Span 2.



Photo # 4 - View of the cracked railing member on the left side of the bridge in Span 3.

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Photo #5 - View of the deteriorated seal at Abutment A.



Photo #6 - View of depressed seal at Abutment B.

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Photo # 7 - View of open expansion joint at Abutment B, note daylight.



Photo #8 - Typical loss of bearing under bearings at abutments.

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Photo # 9 - Side view of Southwest wingwall showing 1¼" top to ½" bottom open vertical crack.



Photo # 10 - View of southwest wingwall showing 3/8" forward rotation at top.

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Photo # 11 - View of typical pack rust between column and bent cap.



Photo # 12 – Center connection bolt head sheared off from 4th beam's angle at Bent 3 (span 3).

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PHOTOS



Photo # 13 - Typical condition of the bases of the north columns of Bents 1-4 (Bent 1 shown)



Photo # 14 - Substantial deterioration of horizontal bracing element, column connecting plates and anchors on the north column of Bent 1.

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Photo # 15 – Column web and flanges areas of up to 100% section loss and substantial deterioration of connection to support components at the north column of Bent 3. The web and portions of the existing flanges appear to have lost all load carrying capacity.



Photo # 16 - This is the back view of the element in the photo above. Note the disintegration of the lower leg of the connecting angle, and the precarious conditions of the remaining part of both anchor bolts where the two nuts are practically missing leaving this column support with no positive anchor.

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PHOTOS



Photo # 17 - Buckling of diagonals for the lateral bracing between the south columns of Bents 3 and 4.

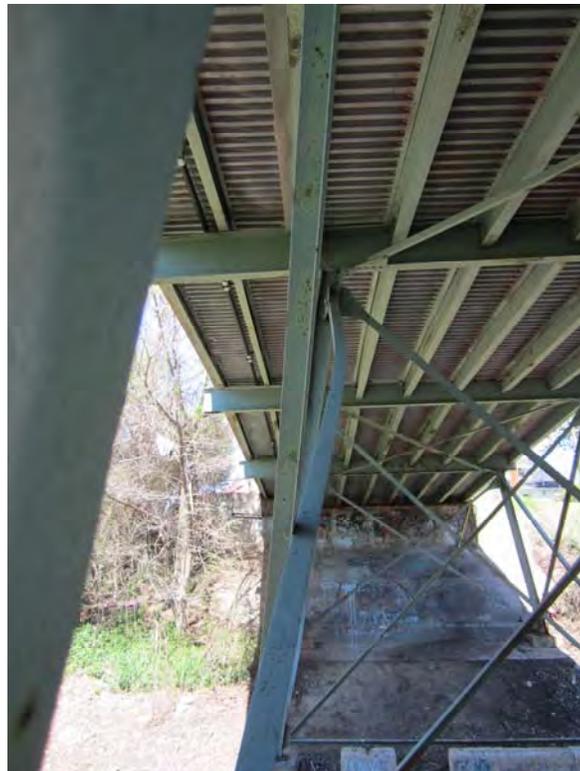


Photo # 18 - Buckling of the two diagonals for the lateral bracing between the south columns of Bents 3 and 4.

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Photo # 19 - Vegetation is growing around north column of Bent 4.



Photo # 20 - Vegetation growing around column bent cap at the north end of Bent 4.

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Photo # 21 – Typical condition of interior anchor bolts at the north columns of Bents 1 to 4.



Photo # 22 – Typical painted over exfoliations indicating insufficient cleaning before painting.

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PHOTOS



Photo # 23 - View of spalls in Abutment A asphalt approach.



Photo # 24 - View of cracks in Abutment B asphalt approach.

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PHOTOS



Photo # 25 - Right side of Abutment B approach slab has settled 2 1/4" ±.



Photo # 26 – Void at the top of slope protection Abutment A.