OHIO DEPARTMENT OF TRANSPORTATION
2014 PHYSICAL CONDITION REPORT

SR 176 NB UNDER I-71 NB
BRIDGE NO. CUY-176-1334

SFN: 1805436

DECEMBER 2014

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SR 176 NB BRIDGE OVER CUYAHOGA RIVER VALLEY
2014 PHYSICAL CONDITION REPORT

TABLE OF CONTENTS

I. INTRODUCTION

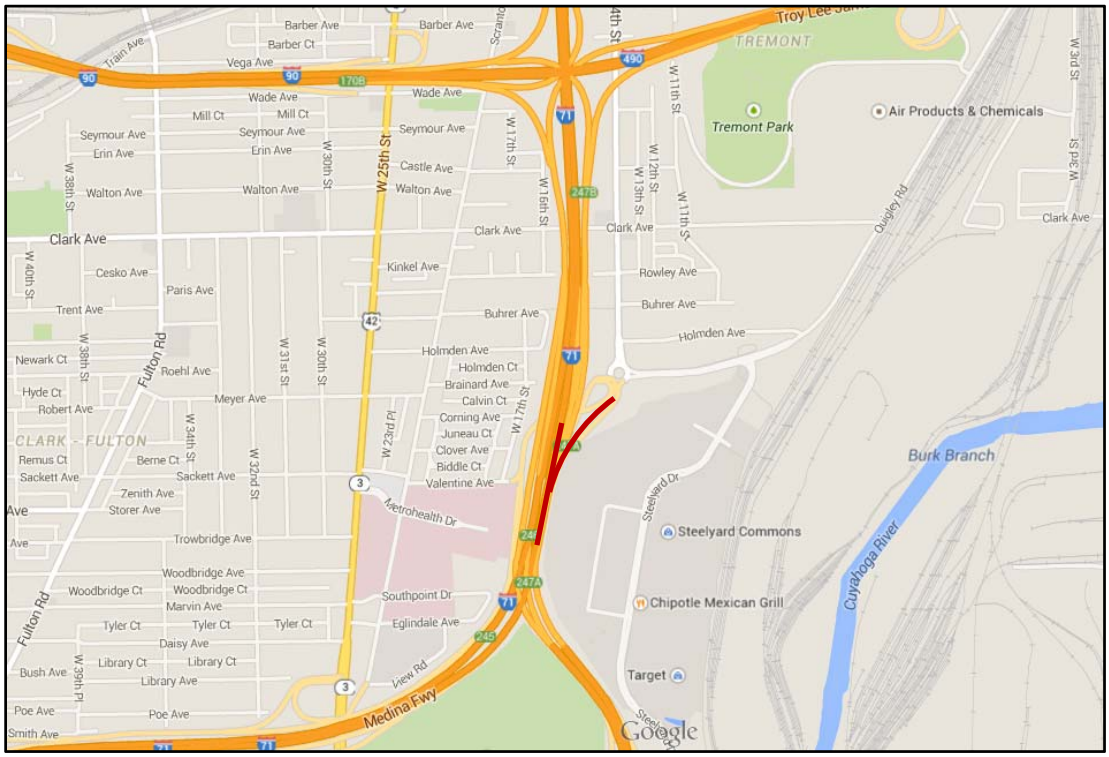

Figure 1 – Jennings Freeway Bridge Location Map.

Bridge Description

The Jennings Freeway Bridge (CUY-176-1334, SFN 1805436) carries Northbound Jennings Freeway traffic in Cleveland, Ohio. Photos 1 and 2 show the Elevation and End Views. A General Plan is shown on Figure 2 and Table 1 summarizes the location and designations of the bridge units shown on Figure 2.

The Jennings Freeway Bridge (CUY-176-1334R) carries three lanes of northbound traffic from I-480 under the I-71 Bridge. The bridge also splits at the north end. The west leg is designated "Ramp J-NBOR" and the east leg is designated "Ramp J-14." The two westerly lanes provide access to northbound I-71 and to eastbound I-490 via Ramp J-NBOR. The east lane provides exiting at West 14th Street via Ramp J-14. The 2010 estimated ADT is 77,850 with 2.8% truck traffic.

The Jennings Freeway Bridge is composed of a continuous rolled steel beam superstructure on concrete cap and column piers. The bridge is not considered fracture critical because it has no steel pier caps and is a multiple beam structure throughout.

Superstructure Units	Total Length	Spans
1B	448'-6"	8B to 13B
2B	393'-9 1/2"	14B to 18B
3BW	225'-11 1/8"	19BW to 21BW
3BE	450'-0"	19BE to 24BE
4BE	366'-0"	25BE to 29BE

Notes: 'A' descriptor indicates structural element of CUY-71-1791R

'B' descriptor indicates structural element of CUY-176-1334R

Piers 8 through 16 are common structure units for both structures.

Table 1 – Superstructure Unit Designation and Orientation

Construction and Maintenance History

Construction of the bridges began in 1965 as part of the Ohio Department of Highways Project 79. Work was not completed until 1969 due to construction delays caused by slope failures that damaged several of the piers supporting both bridges. The original pile caps and pilings were isolated (separated) from the columns, and replaced the caissons and new caps. The foundations of Piers 14, 15, 16, 17A and 17B were modified during the original construction as a result of foundation damage caused by this slope failure. The lower half of Pier 14, 15 and 16 columns were

reinforced with a supplementary concrete jacket and shear walls were connected between the columns.

In 1991, the SR 176 structure, along with I-71 NB structure above, received the following minor rehabilitation repairs:

- The original safety curb with aluminum railings were modified to the deflector shape parapets.
- The deck received a super plasticized dense concrete (SDC) overlay
- All deck expansion joints were retrofitted with elastomeric strip seals.
- The existing drainage systems were replaced.
- All substructure units were patched and sealed.
- The structural steel was cleaned and painted with an OZEU protective coating system.

Photo 1– SR 176 Bridge East Elevation.

Photo 2– SR 176 Bridge Deck View.

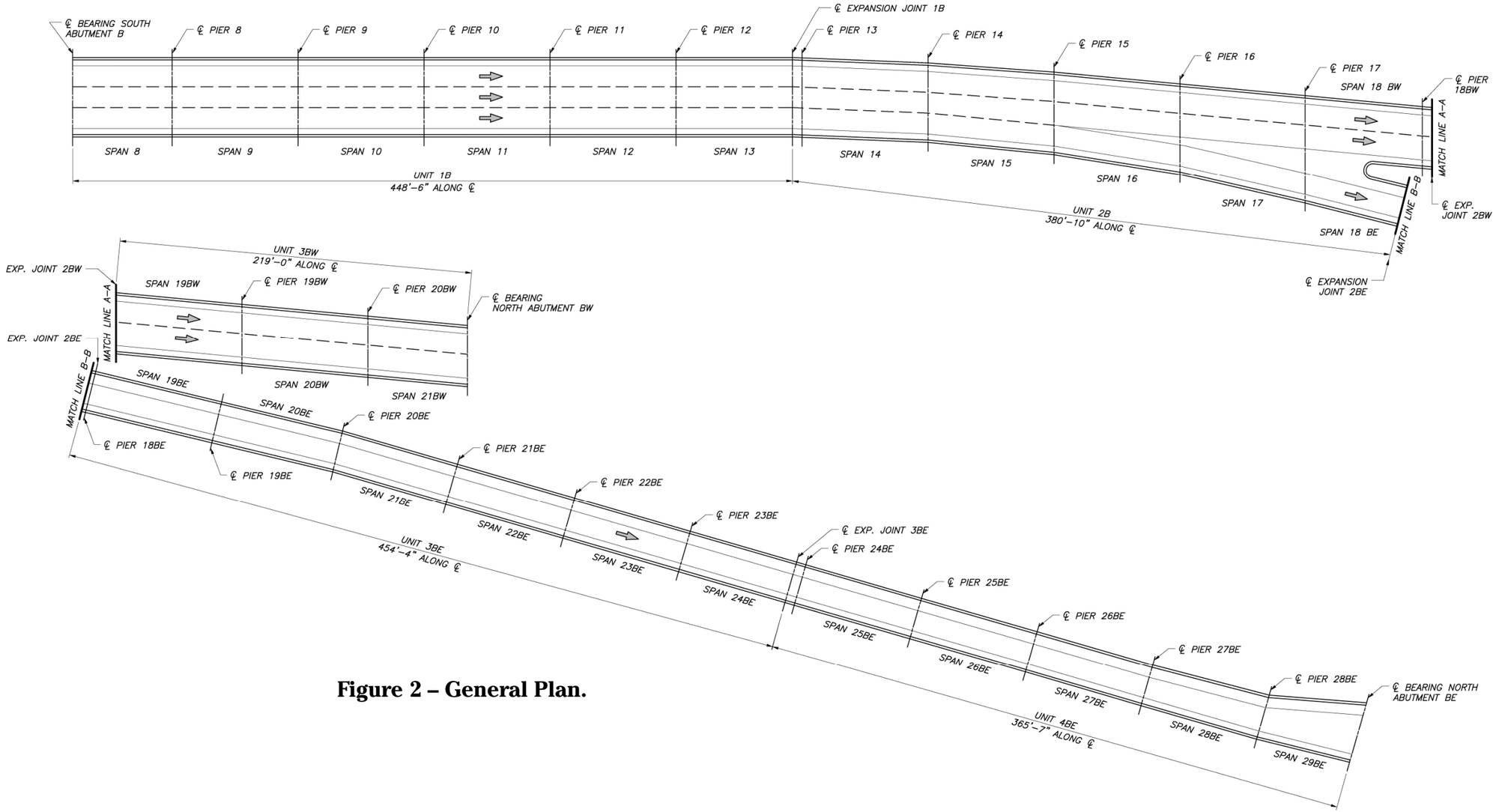

Figure 2 – General Plan.

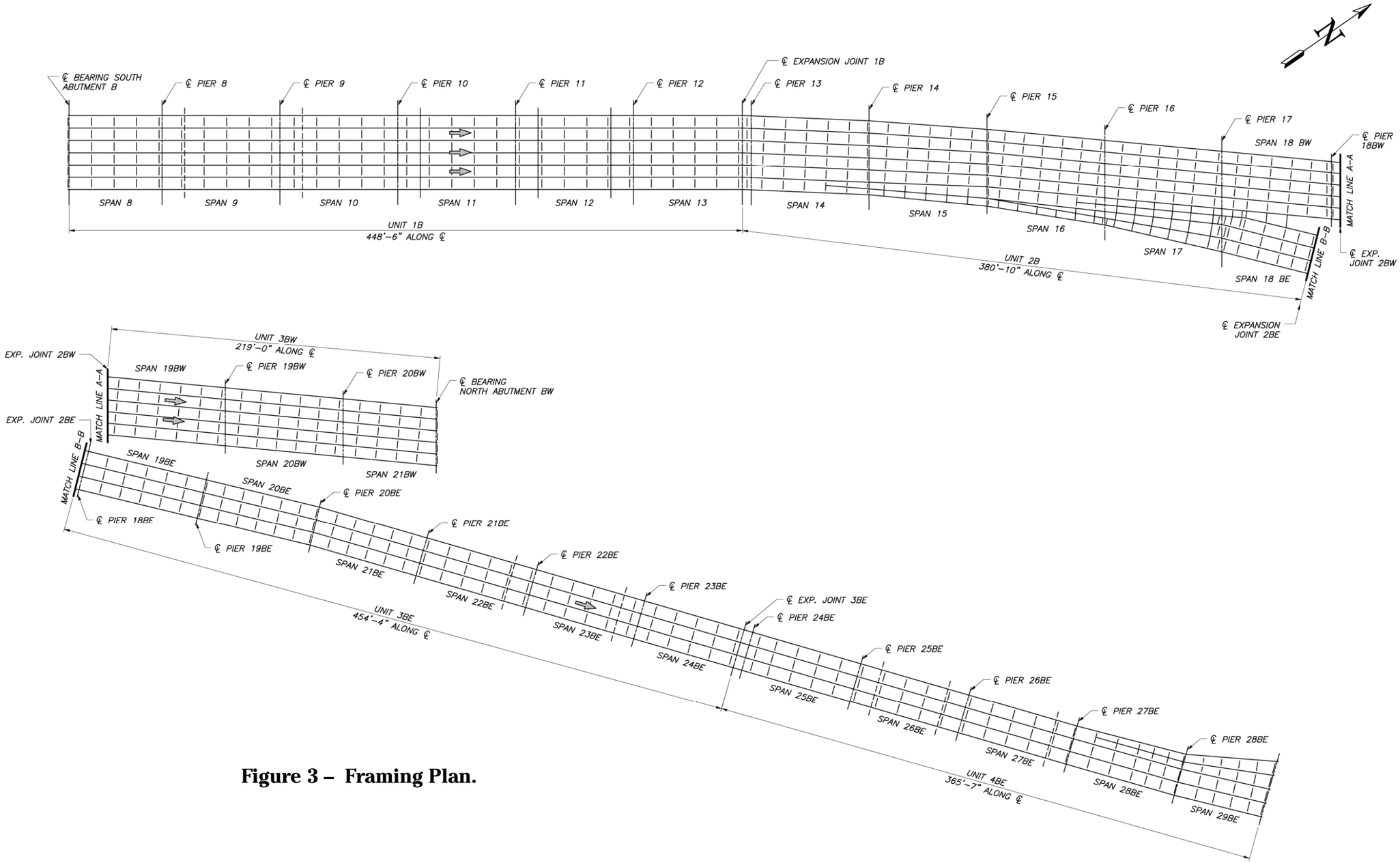

Figure 3 – Framing Plan.

Inspection Procedure

An in-depth inspection was performed by Jones-Stuckey from May 12 through May 15 and May 19 through May 21, 2014. The inspection team included William Vermes, PE (team leader), Michael Jurcak, EI, Dale Arnold, EI, and Todd Roxberry, Bridge Technician. Access to the superstructure and pier surfaces above ground level was achieved via an Aspen Aerial UB 60 snooper truck. Nighttime single lane closure with flaggers was restricted to 7 PM through 6AM. Closure of the W. 14th Street ramp for the inspection of a portion of Span 18B and Units 3BE and 4BE was performed after 1AM with no detour required. The snooper truck, attenuator vehicle and maintenance of traffic were supplied by the Sofis Company.

Deck sounding was performed with a looped heavy-link chain drag during SR 176 single lane closures for the I-71 superstructure inspection above. A delam tool sounding roller was used for sounding of pier columns above arm's reach.

Alignment of the expansion hinge rollers was performed via line and weighted object (Photo 3). Tightness of the rollers was done with a prying force applied by a hammer (Photo 4).

The completed 2014 Bridge Inspection Report Form is included in Appendix A. Appendices B, C, and D include the Deck, Superstructure and Substructure Inspection Findings, respectively.

Photo 3 – Hinge Alignment Measurement.

Photo 4 – Prying Action for Hinge Bearing Check.

Condition Rating Guidelines

Ohio and National Bridge Inspection Standards (NBIS) guidelines for evaluating the condition of bridges have been developed to promote uniformity of bridge inspections performed by different teams and at different times. Table 2 contains the bridge inspection rating matrix established by the Federal Highway Administration (FHWA), using a 0-Failure through 9-Excellent scale, and used by the Ohio Department of Transportation (ODOT). In this report, component conditions will generally be discussed based on the ODOT rating guidelines for individual components, 1-Good through 4-Critical. The General Appraisal, Deck, Superstructure, Substructure, Channel and Approach Summaries, and the Protective Coating System rating will follow the NBIS/ODOT 0 through 9 rating guidelines. Element level condition states were assigned to each item following an element level inspection.

Additionally, this bridge inspection was performed in accordance with the following documents:

- Manual of Bridge Inspection Manual, Ohio Department of Transportation, Revised 2014.
- Manual for Condition Evaluation of Bridge, 2nd Edition, American Association of State Highway and Transportation Officials (AASHTO), 2011.
- Bridge Inspector's Reference Manual (BIRM), U.S. Department of Transportation, revised December 2012.

RATING		CONDITION	RATING GUIDELINES
ODOT	NBIS		
1 – Good	9	Excellent	
	8	Very Good	No problems noted.
	7	Good	Some minor problems present.
2 – Fair	6	Satisfactory	Structural elements show some minor deterioration.
	5	Fair	All primary structural elements are sound but have minor section loss, deterioration spalling or scour.
3 – Poor	4	Poor	Advanced section loss, deterioration, spalling or scour.
	3	Serious	Loss of section, deterioration, spalling or scour has seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
4 – Critical	2	Critical	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
	1	Imminent Failure	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structural stability. Bridge is closely monitored is closed to traffic but corrective action may put bridge back into light service.
	0	Failure	Out of Service, beyond corrective action.

Table 2 – ODOT & NBIS Condition Rating Guidelines.

II. DECK

The deck is in ***Satisfactory*** Condition, or ***6*** on the NBIS condition rating guidelines. Deck findings are shown in Appendix B. Condition findings of individual deck items are as follows:

Floor

The floor is in ***Fair*** condition. Delaminations and dampness are present in the floor of the mainline section of Units 1B and 2B. Total underside surface area deterioration is less than 5%. In Unit 3BE, the deck soffit exhibits mottled concrete with light efflorescence along the centerline of the floor (Photo 5). In Span 21BE, a four-inch deep soffit spall is present between Beams J and K (Photos 6 and 7). This spall is likely caused by water and salt infiltration through a longitudinal wearing surface cold joint along the entire length of the W. 14th Street Ramp structure in the 1991 wearing surface.

In Span 18, adjacent to Expansion Joint 2B, haunch spalls along Beams D, E and F show that the non-composite deck has separated from the top of beam approximately 1/4-inch. (Photo 8). This separation appears to the result of accumulation of rust above the top flange of Beam F.

Photo 5 – Mottled Floor Soffit with Efflorescence.

Photo 6 – Floor Spall, Span BE.

Photo 7 – Four-Inch Deep Floor Spall Close-Up with Primary Reinforcement Section Loss, Span 21BE.

Photo 7 – 1/4 -Inch Haunch Separation at Beam E, Span 18.

Edge of Floor

The edge of the floor is in ***Fair*** condition. However, local spalls are present along the east edge in Spans 18 and 19BW due to infiltration through Expansion Joint 2BW above (Photo 8).

Wearing Surface

The concrete wearing surface is in ***Poor*** condition. Extensive map cracking is present throughout Units 3BE and 4BE (the W. 14th Street ramp) with several spalls and patches present (Photos 9 & 10). A tabulation of estimated surface area deficiencies is included in Table 3.

Photo 8 – Edge of Floor Spalls at Expansion Joint 2BW.

Photo 9 – Map Cracking, Unit 4BE.

Photo 10 – Wearing Surface Patch, Span 25BE.

Unit No.	Percent of Wearing Surface Sounded	Estimated Percent Deficient
1B	100%	5%
2B	100%	5%
3BW	60%	14%
3BE	100%	28%
4BE	100%	35 to 50% *

Table 3 – Wearing Surface Summary.

Railing

The railing is in ***Fair*** condition. Vertical hairline cracks, isolated delaminations, and spalls less than four square feet in area exist along the interior base of the railing.

Drainage

The drainage is in ***Poor*** Condition. Numerous drainpipes are clogged with debris either at the above ground outlets or within the below ground storm pipes (Photo 11). At the time of this inspection, the grit and debris were heavily deposited along the east gutterline. Since the completion of the inspection, the deposited gutterlines have been cleared via a streetsweeper.

Expansion Joints

The expansion joints are in ***Poor*** condition. All joint membranes have embedded dirt, with all membranes exhibiting tears (Photo 12).

Photo 11 – Clogged Collector & Overflowing Drain Water, Pier 18BE.

Photo 12 – Torn Expansion Joint Membrane, Joint 1-A.

Lighting

The deck lighting mounted on the I-71 pier columns is in ***Fair*** condition. The lights on the west columns of Pier Nos. 6, 11, and 12 are not functioning. Along the east railing at Pier No. 11, the lighting conduit is broken at the junction box (Photo 13). All original metal pull box covers in the base of the east parapet are thin due to constant corrosion (Photo 14). A junction box cover is fractured at the east column of Pier No. 17 (Photo 15).

Photo 13 – Broken Conduit & Exposed Wires,. Pier 11.

Photo 14 – Corroded & Thin Pull Box Cover, Pier 11.

Photo 15 – Fractured Junction Box Cover, Pier 17.

III. SUPERSTRUCTURE

The superstructure is in ***Satisfactory*** Condition, or ***6*** on the NBIS condition rating guidelines. Superstructure findings are shown in Appendix C. Condition findings of individual superstructure items are as follows:

Alignment of Members

The alignment of primary superstructure members is ***Good***.

Beams

The beams are in ***Good*** Condition with minor section loss and deficiencies noted. In Span 15, the Beam L field splice has one bolt not engaged with the lower splice plate of the bottom flange (Photo 16).

Photo 16 – Mis-erected Bottom Flange Splice Bolt, Beam L, Span 15.

Cross Frames

The cross frames are in ***Fair*** Condition. Several cross frames located beneath expansion joints have advance section loss resulting in severed lower connections (Photos 17 & 18).

Photo 17 – Advanced Section Loss on Cross Frame Horizontal Member, Beneath Expansion Joint 2-B, Span 18BW.

Photo 18 – 100% Section Loss at Cross Frame Connection, Expansion Joint 1-B, Span 13B.

Protective Coating System

The OZEU protective coating system, applied in 1991, is in ***Fair*** condition. Scattered, freckled rust is common among beam edges and moment plate end welds (Photo 19). Failed paint and active corrosion is common at all hinge locations (Photo 20).

Photo 19 – Typical Freckled Rust on Bottom Flange & Moment Plate Welds

Photo 20 – Typical Failed Paint & Active Corrosion at Hinges.

Bearings

The bearings are in ***Fair*** Condition. The bearing plates do not have anchor bolts, and have a history of sliding longitudinally. Currently, the most noticeable bearing plate shift is at Bearing A, Pier 13, which has shifted 1 $^{1}/_{2}$" northward with measureable rust between the bearing plate and pier seat (Photos 21 and 22). Several bearings at the South Abutment and North Abutment BW have excessive lean with respect to adjacent bearings and contrary to ambient temperature (Photo 23). A summary of bearing findings is included in Table 4.

Photo 21 – 1 $^{1}/_{2}$-Inch Bearing Plate Misalignment, Beam A, Pier 13.

Photo 22 – Rust Accumulation & $^{9}/_{16}$-Inch Lift on Bearing Plate, Beam A, Pier 13.

Photo 22 – Maximum Rotation of Bearing G with Shifted Bearing Plate, North Abutment BW.

No.	Substr. Unit	Beam No.	Comment
1	South Abut.	A	Bearing contracted 6.5°.
2	South Abut.	C	Bearing expanded 6°.
3	South Abut.	F	Bearing expanded 9°.
4	South Abut.	L	Bearing contracted 12.5°.
5	Pier 13	A	Bearing plate shifted 1 1/2" North
6	Pier 14	E	Bearing set 2" east of centerline.
7	North Abut. BE	G	Bearing plate shifted 3" toward backwall. Bearing fully contracted.
8	North Abut. BE	L	Bearing contracted 8°.
9	North Abut. BE	L	Bearing contracted 8°.

Table 4 – Bearing Misalignment Summary.

Hinges

The hinges are in ***Fair*** Condition. Several hinge bearings are not fully seated as evidenced by the movement observed when pried with a hammer (Photo 24). These instances of uneven bearing have varied from previous inspections, i.e. a hinge with movement during one annual inspection may not be present during the next inspection. Uneven hinge bearing may be caused either individually or in combination with the following factors:

1. Debris accumulation beneath the roller.
2. Differential section loss on the roller surface.
3. Deck separation due to corrosion lifting the floor and beam top flanges adjacent to the expansion joints.

Also, active corrosion has resulted in minor section loss among the lower bearing and web stiffeners of the cantilever beam section.

Live Load Response

The live load response is ***Satisfactory***.

Photo 24 – Advanced Rust & Debris Accumulation at Expansion Joint/Hinge 3B.

IV. SUBSTRUCTURE

The substructure is in ***Fair*** Condition, or ***6*** on the NBIS condition rating guidelines. Substructure findings are shown in Appendix D. Condition findings of individual substructure items are as follows:

Abutments and Abutment Seats

The abutments and abutment seats are in ***Fair*** condition with minor deficiencies. Isolated delaminations are present at the South Abutment. Abutment BW exhibits full height areas of spalled and delaminated surfaces between Beams A & B and Beams C & E (Photo 25). Total deteriorated surface areas are included in Table 5.

Backwalls

The backwalls are in Fair condition. Two full height cracks are present on the South Abutment backwall. The Abutment BW back wall has isolated spalls with horizontal and vertical cracks. At 50°F, the top halves of Beams B and C were in contact with the backwall while the top flange of Beam D had only $^1/_2$" clearance to the backwall (Photo 26). Measurement of the expansion joint above showed 1 $^1/_2$ " smaller opening along the north edge line (Beam A) than the south edge line (Beam E).

Photo 25 – Delaminated Surface above Horizontal Crack, Abutment BW.

Photo 26 – Backwall Contact with Beam C, Abutment BW.

Piers and Pier Seats

The piers and pier seats are in ***Fair*** condition with increasing spalls present on east end of the concrete caps of Piers Nos. 8 through 16. This deterioration is caused by salt spray from the SR 176 deck onto the top of the pier cap (Photo 27). Epoxy-urethane sealing applied in 2006 has slowed the chloride infiltration into the concrete, however the concrete corrosion has increased. Deterioration is worst at Pier No. 13 with deep spalls and exposed reinforcement on all four sides of the pier cap (Photos 28 & 29).

A summary of combined spalled and delaminated surface areas on all piers in included in Table 5.

Photo 27 – Nine-foot x Six-Foot Spall on East Pier Column, Pier 15.

Pier 28 – Pier Cap Spalls & Delaminations, Pier 13 East Face.

Photo 29 – Diagonal Top Spall approximately 3" Deep to indicated No. 18 Bar, Pier 13.

Substructure Unit	Total Deteriorated Surface Area (SF)	Comments
South Abutment	5	Backwall crack between Beam F & L and west of Beam A.
Pier 8	60	
Pier 9	97	
Pier 10	68	
Pier 11	98	
Pier 12	16	
Pier 13	142	
Pier 14	36	
Pier 15	128	
Pier 16	95	
Pier 17	0	
Pier 18BW	14	
Pier 19BW	0	
Pier 20BW	0	
Abutment BW	55	Cracking throughout most of backwall. Horizontal cracks halfway up abutment stem.
Pier 18BE	5	Drainage overflowing due to clogged collector.
Pier 19BE	0	Isolated crack in pier cap.
Pier 20BE	0	Isolated crack in pier cap.
Pier 21BE	0	Isolated crack in pier cap.
Pier 22BE	0	Isolated crack in pier cap.
Pier 23BE	0	Isolated crack in pier cap.
Pier 24BE	4	Isolated crack in pier cap.
Pier 25BE	0	Map cracking on north face of pier cap.
Pier 26BE	0	Isolated crack in pier cap.
Pier 27BE	0	
Pier 28BE	0	
Abutment BE	0	

Table 5 – Substructure Deterioration Summary.

Wingwalls

The wingwalls are in ***Good*** condition. No deficiencies were observed the wingwalls of the three abutments.

Slope Protection

The slope protection at the abutments is in ***Fair*** condition. An erosion rut up three feet deep is present at the east end of the South Abutment due to deck drainage missing the concrete pad along the abutment (Photo 30).

Photo 30 – Slope Protection Erosion, South Abutment.

V. APPROACHES & GENERAL

The approaches are in ***Good*** Condition, or ***7*** on the NBIS condition rating guidelines. Condition findings of individual approach and general items as follows:

Approach Pavement

The approach pavement is in ***Good*** condition.

Approach Slabs

The approach slabs are in ***Good*** condition with no distress noted.

Guard Rail

The approach guard rail is in ***Good*** condition with no deficiencies noted.

Pressure Relief Joints

The pressure relief joints are in ***Good*** condition.

Embankment

The embankment along both approaches is in ***Good*** condition with no erosion or settlement noted.

Land Use

The trees along both sides of the bridge have grown to a height that snooper access is now significantly impeded. Some trimming was performed during this inspection. However, clearance issues between the snooper boom and remaining trees are still present.

VII. SUMMARY & RECOMMENDATIONS

The SR 176 NB Bridge is in ***Satisfactory*** Condition, or ***6*** on the NBIS rating guideline (Table 2, Page 9). The following repairs and maintenance tasks shown in Table 6 are recommended to improve the General Appraisal of the SR 176 Bridge to minimize future repair costs, and to extend the service life of the bridge.

	Repair/Maintenance Task	2015	2016	2017	2018	2019
1.	Monitor alignment of abutments.	X	X	X	X	X
2.	Cut trees impeding snooper access along sides of bridge.		X			
3.	Patch deteriorated substructure components using cathodic protection.				X	
4.	Reset shifted bearing plates and misaligned bearings.				X	
5.	Secure all bearing plates.				X	
6.	Replace concrete wearing surface. (Note: Avoid placement of longitudinal cold joints in W. 14th Street Ramp.)				X	
7.	Clean and restore PCS at hinges.				X	
8.	Restore deficient deck lighting and conduit.				X	

Table 6 – Five-Year Repair & Maintenance Schedule.

APPENDIX A

2014 BRIDGE INSPECTION REPORT FORM

APPENDIX B

2014 DECK INSPECTION FINDINGS

APPENDIX C

2014 SUPERSTRUCTURE INSPECTION FINDINGS

APPENDIX D

2014 SUBSTRUCTURE INSPECTION FINDINGS