Bridge Inspection Report

2007 Annual Bridge Inspection Report for Raft Island Bridge

July 2007

Raft Island Improvement Association
Pierce County, Washington

Prepared for:
Raft Island Improvement Association
P.O. Box 332
Gig Harbor, Washington 98335-0332

Prepared by:
Exeltech Consulting, Inc.
2590 Willamette Drive NE, Suite 101
Lacey, Washington 98516

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Statement of Purpose

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Statement of Purpose

Exeltech Consulting, Inc. was retained by the Raft Island Improvement Association to provide services to evaluate the Raft Island Bridge as part of its annual routine inspection. The scope of work as proposed by the Raft Island Improvement Association is to determine the current condition of the existing structure and then provide maintenance recommendations for repair, as necessary. These services include completing an on-site visit to visually inspect the existing bridge structure and provide a written assessment report of the current condition of the bridge structure. The assessment report will include maintenance recommendations.

The following assumptions were made for this project:

1. The inspection will be a visual inspection and observation of the bridge superstructure and substructure, not requiring special equipment, other than a ladder or kayak.
2. No non-destructive or destructive testing will be conducted during the inspection of the bridge superstructure and substructure, except hammer soundings will be made near the mud line on all timber piling, and borings will be taken where indicated by the soundings. All borings will be plugged with treated timber dowels.
3. Inspection around heavily-vegetated areas will be conducted without major disturbance to the existing vegetation.
4. A chemical composition evaluation will not be conducted on the existing bridge superstructure or substructure.
5. Inspection of the structure will be conducted over a two day period, during low tide and high tide the first day and during low tide the second day.

The scope of services agreed to for this project is as follows:

1. Existing Plans and Reports: The previous inspection reports as well as the as-built drawings will be reviewed prior to the on-site visit. Review of the previous inspection reports and plans will provide the inspector with a baseline condition of the structure, for which an assessment can be made of the current condition of the bridge.
2. Field Visit Inspection: A visual field inspection will be conducted, at a mutually-agreeable time.
3. Inspection Report: A written assessment report document will be provided, which summarizes the results of the visual inspection conducted during the on-site visit. It will include a bridge management format for the members, which give the quantities of the members and the condition state of the members.

General Information

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General Information

RAFT ISLAND: RAFT ISLAND BRIDGE

PIERCE COUNTY, WASHINGTON

INSPECTION LOG

Date:	July 14, 2007 (inspection started at 9:30 a.m., finishing at 8:00 p.m.)
Weather:	Clear, 65° in the morning, warming to 80° in the afternoon
Tides:	Low tide, -3.0 at 12:11 p.m. and high tide, 14.19 at 7:41 p.m.
Inspector:	Ron Smith, PE

GENERAL DESCRIPTION

Bridge Name:	**Raft Island Bridge**
Location:	**Pierce County, WA**
Over:	**Carr Inlet channel between Raft Island and Gig Harbor Peninsula**
Type:	**Prestressed concrete channel girders supported by timber bents**

Superstructure:

45 ~17-foot prestressed concrete channel girders (7 channel girders for each span)

1 ~23-foot prestressed concrete channel girders (7 channel girders for each span)

Substructure:

47 4 Timber Pile Bents

Number of Lanes:	Two-lane structure
Orientation:	Longitudinal axis of bridge is oriented north-south as indicated per the design plans. For conformity and inspection designation purposes, Bent 1 is the south abutment and Span 1 is designated as the first span adjacent to the mainland. The piles and channel girders are numbered left to right with "A" furthest left while looking north towards Raft Island. This sign convention follows the recommendations of the Washington State Department of Transportation *Bridge Inspection Manual*. Note that previous inspections had numbered these components starting with "1."
Posting:	The bridge is posted for 16 tons for a Type 3 load, 28 tons for a Type 3S2 load, and 28 tons for a Type 3-3 load. The speed posting is 15 mph.

Historical Perspective of Structure

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Historical Perspective of the Structures

The Raft Island Bridge serves as the main access to Raft Island and its residents from the mainland. The bridge consists of 46 prestressed concrete channel girders supported on four pile timber bents. The bridge measures 788 feet and consists of forty-five 17-foot spans and one 23-foot span, per the as-built plans. The bridge spans across a waterway serving as a major throughway for boats anchored in the inlet. Most of the boat traffic utilizes the opening under the 23-foot span. At high tide, the water is 10 to 20 feet deep under the 23-foot span. At low tides of approximately minus 2 foot and lower, the entire substructure above the mud line is exposed and accessible.

The original drawings indicate that bridge was built in the 1957 with a H15-44 design live load. The clear width of the structure between curbs is 20 feet, while the out-to-out width of the structure is 21 feet. The bridge railing system consists of painted metal W beams attached to the inside face of 8- by 8-inch treated timber posts. The posts are attached to the sides of the exterior channel girders and to 6- by 9-inch cast-in-place curbs. Expansion joints are present at the south abutment and at Bent 16 and Bent 32. The existing deck is composed of an asphalt concrete overlay over a waterproof membrane.

Based upon the review of previous reports, a major rehabilitation project was conducted on the bridge in 1992. The work consisted of splicing in ten new piles, replacing approximately 12 braces, and placing 2 inches of new asphalt over a new membrane. In 1994 some minor work was conducted, consisting of encapsulating a couple of decaying piles and replacing some bracing members. Between 2002 and 2005, steel wide-flange girders were installed under four of the exterior channel girders to strengthen the girders. Additional maintenance work has also been completed over the years, including the last recorded maintenance work performed in 2006, in which areas of spalled concrete and exposed reinforcement were patched.

Inspection Results

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Inspection Results

The 2007 inspection focused on the substructure, which has been noted in previous reports to exhibit varying degrees of deterioration. During the course of this annual inspection, all 188 piles were sounded at the ground line, 3 feet to 4 feet and 6 feet to 7 feet aboveground, except at the shorter end bents. In addition, a ladder was used to access a few piles and caps where visual conditions suggested further investigation was needed. All 322 channel girders were visually inspected from the ground during low tide and from a kayak during high tide.

The following is a summary of the findings from the field inspection.

Superstructure

Prestressed Concrete Channel Girders

The following is a summary of the concrete spalls with exposed steel reinforcement or prestress strand, and cracks in the concrete found during the field inspection of the prestressed concrete channel girders:

Summary of Results

Description	Location
Spalled concrete on girder soffit with exposed steel reinforcement	Span 6: Girder G – two 4″ diameter shallow spalls
	Span 16: Girder A – three 3″ diameter shallow spalls
	Span 24: Girder A – one 3″ diameter shallow spall
	Span 26: Girder A – one 3″ diameter shallow spall
	Span 28: Girder A – one 3″ diameter shallow spall and two small delaminations
	Span 29: Girder A – one 3″ diameter shallow spall
	Span 31: Girder A – three 3″ to 4″ diameter shallow spalls – see Photo 10
	Span 44: Girder A – one 3″ diameter shallow spall
Spalled concrete on girder web with exposed prestress strand	Span 22: Girder G – east web has two shallow spalls 8″ long and 6″ long – see Photos 8 and 9
Concrete crack formation (non-superficial surface cracking)	Span 13: Girder F – soffit has 5′ long leaching rust stained crack along centerline – see Photo 5
	Span 16: Girder G – east web has 12″ diagonal crack with delaminating concrete – see Photo 7
	Span 36: Girder A – bottom of east web has 1′ long rust stained crack – see Photo 14

See Appendix C for a more detailed list of channel girder defects and Appendix E for additional photos.

PHOTO 10 – GIRDER 31A SOFFIT SPALLS

PHOTO 8 – GIRDER 22G SPALL WITH EXPOSED PRESTRESS IN EAST WEB

PHOTO 9 – GIRDER 22G SPALL WITH EXPOSED PRESTRESS IN EAST WEB

PHOTO 5 – GIRDER 13F – LONGITUDINAL SOFFIT CRACKING AT CENTER

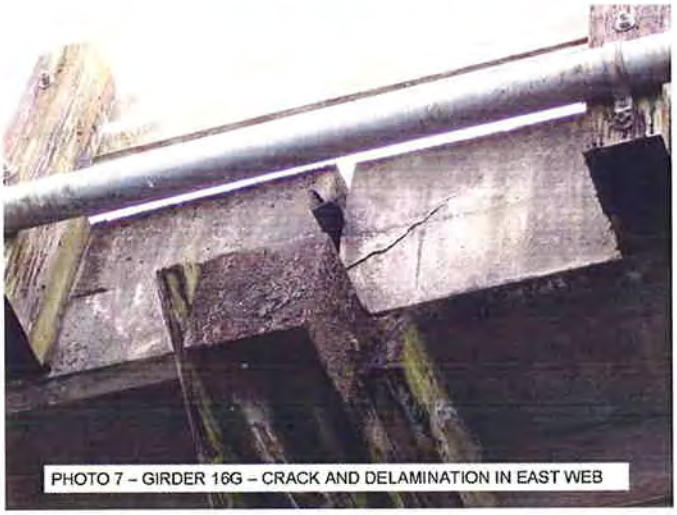

PHOTO 7 – GIRDER 16G – CRACK AND DELAMINATION IN EAST WEB

PHOTO 14 – GIRDER 36A CRACK ALONG BOTTOM OF EAST WEB

Deck Overlay

The asphalt depth is approximately 2 inches. The majority of the cracking and delamination is located near the expansion joints. Most of this distress consists of alligator cracks and visible signs of deterioration of the existing asphalt patches. At the expansion joint there is a "D" spall in the asphalt at the south abutment that is 4 feet 0 inches long by 3 inches wide by 2 inches deep. See Photo 22.

At Bent 32 there is "D" cracking in the asphalt 3 feet 0 inches long at the centerline that is starting to break up. At the north abutment there is cracking full width with some smaller "D" cracking. See Photo 23.

Expansion Joints

The expansion joint at the south abutment is steel-armored elastomeric compression seal. The opening measured 2¼ inches between the steel armor at a temperature of 80 degrees. The armor is loose along the bridge centerline where there is a 4-foot-0-inch-long spall in the asphalt overlay. The hold-down bolts for the steel armor are loose.

The expansion joints at Bents 16 and 32 are strip seals with a measured opening of approximately ½ inch between the steel extrusions at a temperature of 80 degrees. At Bent 32 the extrusion is starting to loosen where the asphalt is breaking up.

At the north abutment there is no visible expansion joint. It is not clear from the plans whether a joint exists.

Bridge Rail

The rail on the structure is a W beam mounted on 8- by 8-inch timber posts. The top of the W beam is approximately 28 inches above the asphalt overlay. There is no approach rail. The east rail in Span 17 is bent out 2 inches over the 5-foot-8-inch post spacing due to traffic impact. See Photo 24.

Approach Roadway

The south approach has several patches, but the patches are not impacting the bridge. The north approach has several large patches and is approximately ¾ inch higher than the bridge, which is causing moderate impact to the bridge. See Photo 23.

Substructure

Piles

All of the piles that were near the center spans of the bridge were encased or buried in a heavy marine growth and silt buildup. The heavy marine growth was removed on two sides of each pile at three heights: ground line, 3 feet to 4 feet, and 6 feet to 7 feet, except at the shorter end bents. This provided access for soundings with a rock hammer and for visual inspection for marine borers. See Photos 16 and 17.

PHOTO 16 – MARINE GROWTH ON CENTER BENTS

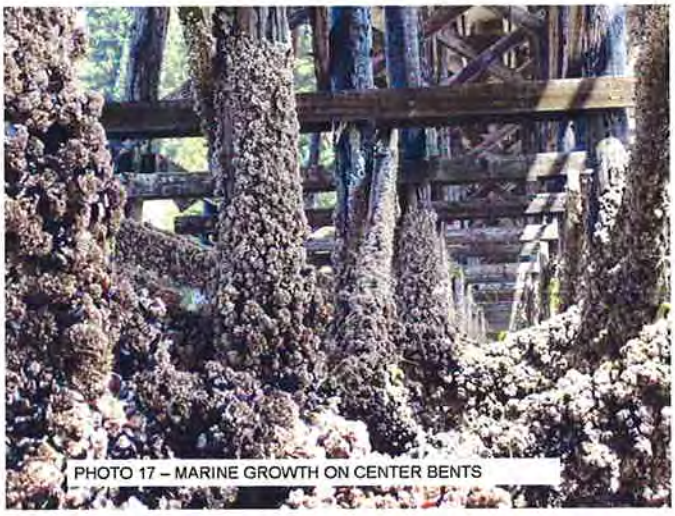

PHOTO 17 – MARINE GROWTH ON CENTER BENTS

The sounding results indicated some audible signs of rot and marine borer damage at three piles. At piles 22A, 22D, and 27D, holes from marine borers were found. Pile 22D also has a surface rot pocket 12 inches high by 3 inches wide by 1 inch deep at the ground line and a small pocket of center rot. These piles were YELLOW TAGGED with flagging indicating that they should be MONITORED for additional damage during the next inspection. See Photos 18, 19, and 20.

PHOTO 18 – PILE 22A YELLOW TAGGED
DUE TO MARINE BORER DAMAGE

PHOTO 19 – PILE 22D YELLOW TAGGED
DUE TO MARINE BORER DAMAGE

PHOTO 20 – PILE 27D YELLOW TAGGED
DUE TO MARINE BORER DAMAGE

At several bent locations, there were checks, also referred to as splits, present that typically extend from the top of the timber pile to around mid-length of the timber pile. The checks had a maximum width of ½ inch and tapered down to nothing. No rot was found at the checks.

At several locations, there are pile repairs that consist of placing a metal sleeve or barrel around the spliced area of the timber pile and encasing the area with concrete to create a splint for the timber pile. At the top of the new section of timber piling, the timber is secured to the pile cap with metal straps and lag screws or bolts. No noticeable deterioration of the splices, other than a layer of rust, is present on the surface of the metal sleeves.

Pile Caps

Pile caps were sounded at the end bents and at a few of the interior bents where timber checks indicated the possibility of rot. Only the cap at the north abutment was drilled. No rot was found.

Bracing

Most of the bracing members are in fair condition with a few members exhibiting varying degrees of rot at the ends of the members. This is particularly true at the upper ends of the diagonals. See Photo 21.

See Appendix D for a more detailed list of substructure defects.

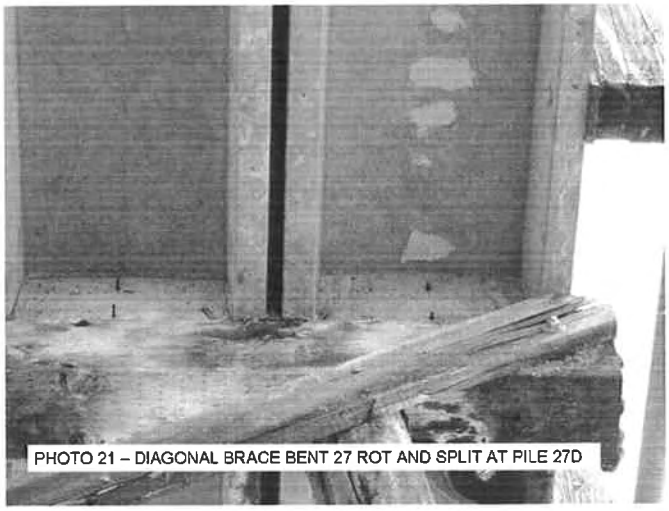

PHOTO 21 – DIAGONAL BRACE BENT 27 ROT AND SPLIT AT PILE 27D

Utilities

Gas

On the west side there is a newer 4½-inch-diameter steel gas line on hangers mounted on the exterior face of the girders.

Other

On the east side there are 2½-inch and 3-inch-diameter steel conduits mounted on the inside of the rail posts and a 4½-inch-diameter PVC conduit mounted outside of the rail posts.

Repair Recommendations

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Repair Recommendations

The recommendations made here are to stabilize and slow down the deterioration of the bridge. The recommended repairs will not fully arrest the effects of the highly chloride marine environment causing the exposed steel reinforcement and prestress strands to corrode. It is known from the previous inspection reports that lab tests conducted on samples of the concrete indicate that the levels of chloride contamination in the concrete are far above the acceptable limits outlined by the Washington State Department of Transportation.

During this inspection, damage from marine borers was found in a few of the pilings. Although repairs are not required at this time, it does indicate that many timber members will require replacement in the future.

The following is a list of proposed maintenance measures that should be performed within the next year to preserve the condition of the bridge.

Raft Island Bridge Maintenance

Item	Description
Epoxy Crack Injection	Span 16: Girder G, 12″ diagonal crack in east web (2007)
	Span 36: Girder A, 12″ long crack in bottom of west web (2007)
Epoxy Patch Spalls	Span 6: Girder G soffit, two 4″ diameter spalls with exposed rebar (2007)
	Span 16: Girder A soffit, three 3″ diameter spalls with exposed rebar (2007)
	Span 22: Girder G east web, 8″ long and 6″ long spalls with exposed prestress (2007)
	Span 24: Girder A, one 3″ diameter spall with exposed rebar (2006)
	Span 26: Girder A, one 3″ diameter spall with exposed rebar (2005)
	Span 28: Girder A, one 3″ diameter spall with exposed rebar and two delaminations (2006)
	Span 29: Girder A, one 3″ diameter spall with exposed rebar (2007)
	Span 31: Girder A, three 3″ to 4″ diameter spalls with exposed rebar (2006)
	Span 44: Girder A, one 3″ diameter spall with exposed rebar (2007)
Asphalt Overlay Patch and Crack Sealing at Expansion Joints	South abutment: Remove loose overlay, epoxy inject around anchor bolts, tighten expansion joint hold down bolts, patch with asphalt, and seal asphalt edges.
	Bent 32: Remove loose overlay, epoxy inject around anchor bolts, tighten expansion joint hold down bolts, patch with asphalt, and seal asphalt edges.

Future inspections should include cleaning all 188 pilings at the ground line and at several other locations and conducting a visual and sounding inspection. In particular, the YELLOW TAGGED Piles 22A, 22D, and 27D should be monitored for damage, and the bracing with rot should be monitored for damage.

The bridge inspection cycle should be maintained at 12 months because of the condition of the prestressed concrete channel girders and timber pilings.

Verification of Recommended Repairs

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Verification of Recommended Repairs

The repair recommendations from the 2004, 2005, and 2006 inspections were verified as complete with the following exception:

> The asphalt overlay at the south abutment expansion joint has not been patched. This has resulted in continued loosening of the steel armor at the compression seal joint.

This is not a significant structural concern. However, the repair to the asphalt should be conducted within one year to avoid further damage to the joints, and the bracing should be monitored at the next inspection.

Appendices

Bridge Inspection Report

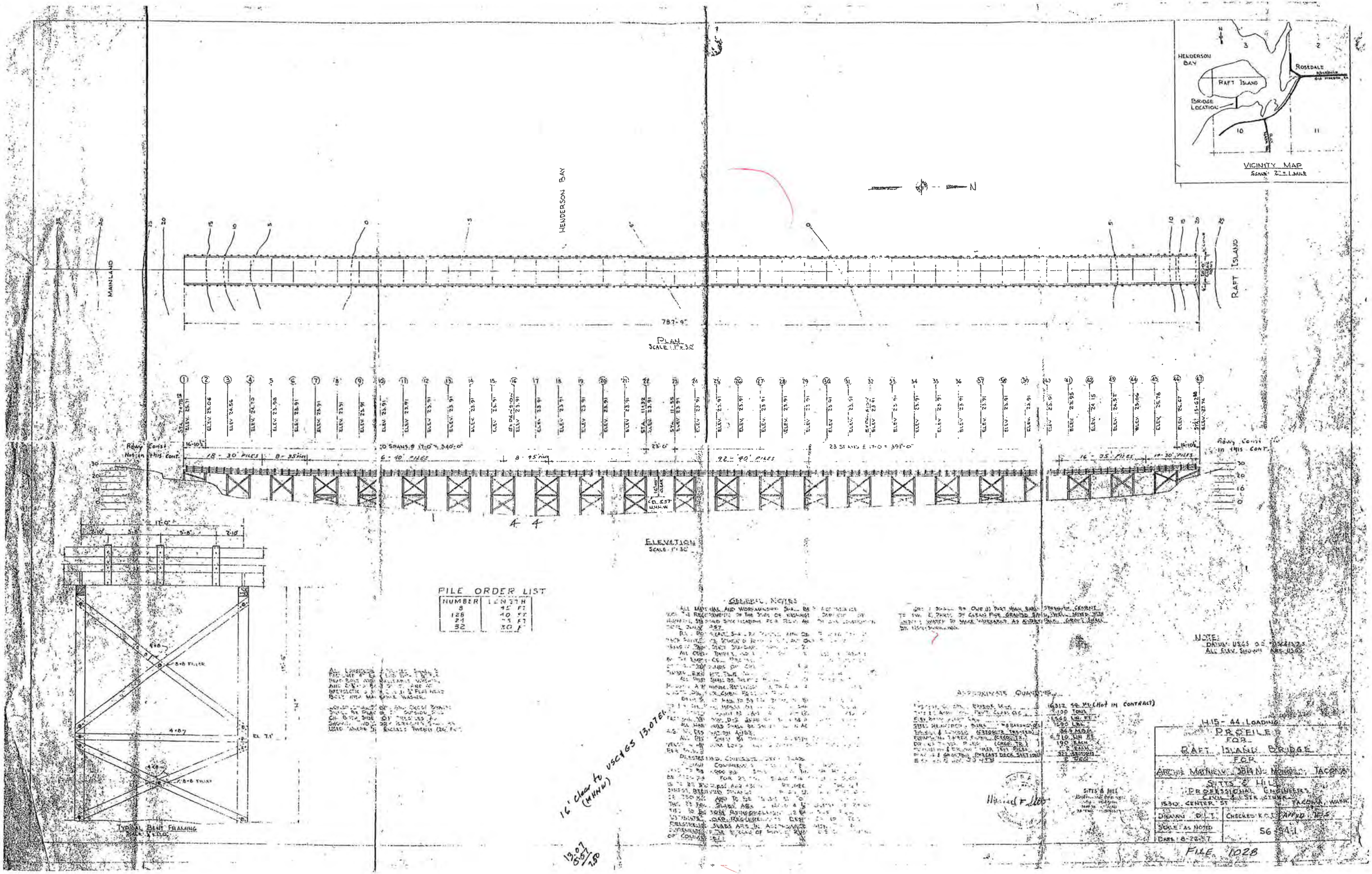
Appendix A

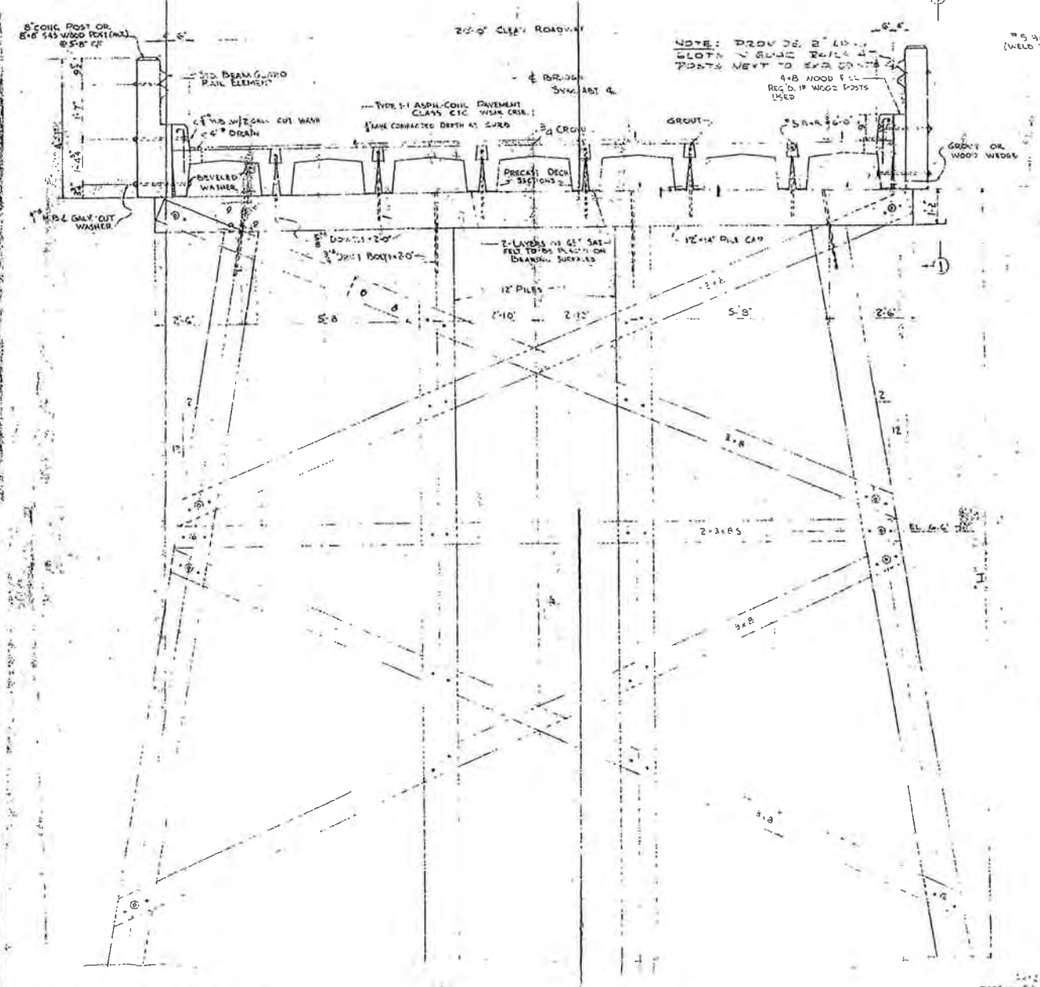
Location Map

Appendix A: Location Map

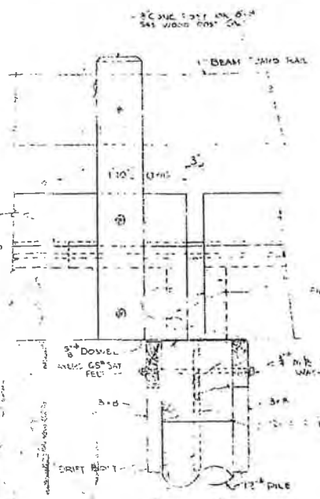
Appendix B

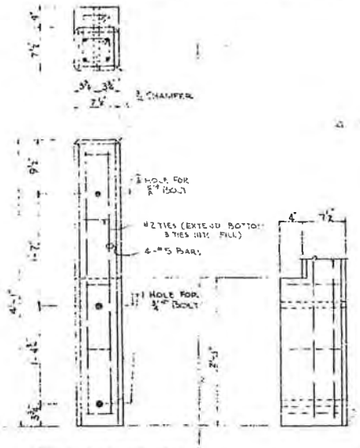
Existing Drawings


HENDERSON BAY
MAINLAND
RAFT ISLAND
787'-9"
PLAN
SCALE: 1"=30'
N
HENDERSON BAY
RAFT ISLAND
BRIDGE LOCATION
ROSEDALE
VICINITY MAP
SCALE: 2" = 1 MILE
Rdwy Const Not in this Cont.
18 - 30' PILES | B - 35 Kips
20 SPANS @ 17'-0" = 340'-0"
6 - 40' PILES
8 - 45 Kips
92 - 90' PILES
23 SPANS @ 17'-0" = 391'-0"
16 - 25' PILES
11 - 30' PILES
Rdwy Const in this Cont.
ELEVATION
SCALE: 1" = 30'
11'-0"
5'-8" FILLER
4'-8"
EL. 7.1'
TYPICAL BENT FRAMING
SCALE: 1/4"=1'-0"
PILE ORDER LIST
NUMBER | LENGTH
8 | 45' FT
128 | 40' FT
21 | 35' FT
32 | 30' FT
GENERAL NOTES
APPROXIMATE QUANTITIES
6312 SQ YDS (Not in Contract)
1100 Tons
1200 Lin. Ft.
1200 Lbs.
864 M.B.M.
6 to Lin Ft
190 Each
572 Sections
2 Each
NOTE:
DATUM: USGS D.S. 0.0 = 0.0 MLLW
All Elev. Shown are USGS
16' clear to USCGS 13.07 ft. (MHHW)
13.07
-5.0
7.50
H15-44 Loading
PROFILE
FOR
RAFT ISLAND BRIDGE
FOR
ARCHIE MATHEWS, JOHN NOWELL, TACOMA
SITTS & HILL
PROFESSIONAL ENGINEERS
CIVIL & STRUCTURAL
1530 CENTER ST. TACOMA, WASH.
DRAWN D.L.T.
CHECKED K.F.S.
APPD. H.F.S.
SCALE AS NOTED
56 - 41
DATE 8-26-57
FILE 1028

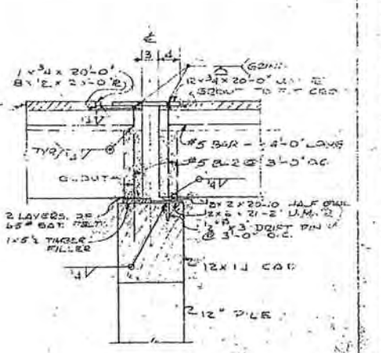


NOTE: PROVIDE 2" I.D. SLOTS IN GUARD RAILS FOR POSTS NEXT TO EXP. JOINTS

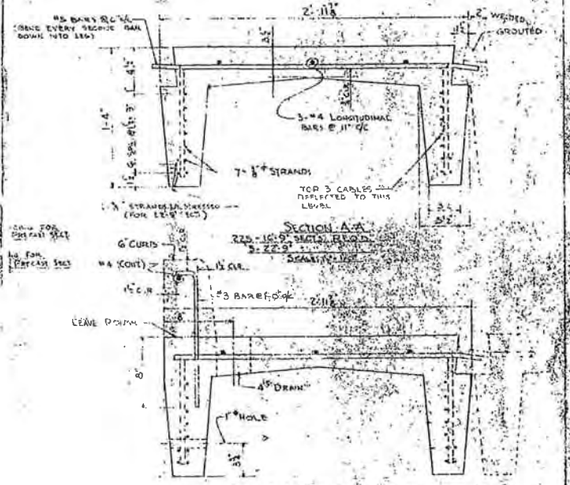




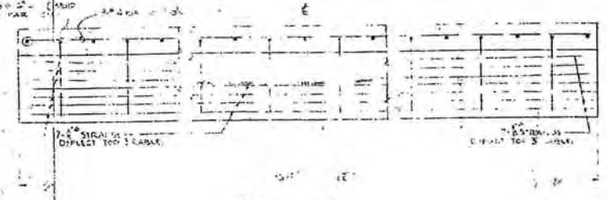
PRECAST CONCRETE POST
2 TO REQUIRED
SCALE 1"=1'-0"

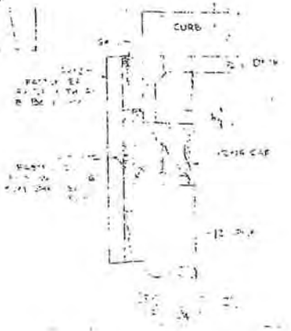


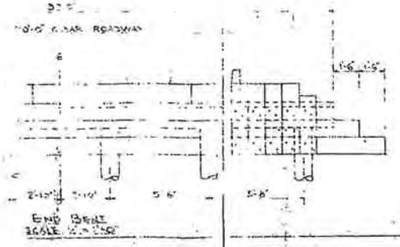
EXPANSION JOINT DETAILS AT BENTS # 16 & #32



SECT. A-A WITH CURB DOWEL
90 DEGREE BENDS WITH 4" SPACE
SCALE: 1" = 1'-0"







ALL DASH AND SWAY RODS SHALL BE FASTENED AT EACH END WITH 1-½" PLATE WASHER NOT LESS THAN 3"x3"x¼" WHERE AND 2-½"x10" BOAT SPIKES AND 2 AT INTERMEDIATE POINTS WITH 2-½"x8" BOAT SPIKES

SWAY BRACING SHALL BE PLACED IN ALL BENTS WHERE THE EXPOSED TOP FELT TWO (2) STORY SWAY SHALL BE USED AS SHOWN ON DRAWING USE TWO 2" SWAY BRACES IN BENTS 7, 11 & 19

TYPICAL SECTION

SITES & HILL
Professional Engineers
CIVIL & STRUCTURAL
1530 CENTER ST. TACOMA, WASH.

FRAMING DETAILS FOR RAFT ISLAND BRIDGE

FOR ARCHIE MATTHEWS 3814 N. 6 MONROE TACOMA

DRAWN: DEL. T.	CHECKED: KOS	APPROVED:
SCALE: AS NOTED	56-54-2	
DATE: 8-16-57		

FILE 1028

Appendix B: Existing Drawings

(placeholder for TOC purposes; do not delete)

Appendix C

Summary of Channel Girder Defects

Appendix C: Summary of Channel Girder Defects

SUMMARY OF CHANNEL GIRDER DEFECTS

Span	Description
1	Girder A has epoxy patches along soffit centerline.
2	Girder A has epoxy patches along soffit centerline.
3	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
4	Efflorescence present at various locations along the bottom edge of the webs. Between Girders D and E there is presence of moisture and some minor rust stains visible.
5	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
6	Girder A has epoxy patches along soffit centerline and some efflorescence is present along the bottom edge of the webs at various locations. Two 4" diameter shallow spalls with exposed rebar near drain of Girder G. Cracks are present along the corners of the south end diaphragms of Girders A, B and C.
7	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
8	Girder G has 3" diameter delamination near drain. Moisture and efflorescence present at various locations along the bottom edge of the webs. End diaphragm at north end of Girder A has 4" diameter spall.
9	Girder G has epoxy patches along soffit centerline. Moisture and some efflorescence are present along the bottom edge of the webs at various locations.
10	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
11	Girders A and G have epoxy patches along soffit centerline. Girder A east web has 8" x 4" x 1" spall. Efflorescence present at various locations along the bottom edge of the webs.
12	Girders A, C and D have small spalls along bottom of webs. Girder G has epoxy patches along soffit centerline. Moisture and some efflorescence are present along the bottom edge of the webs at various locations.
13	Girder F has a 5' long rust stained leaching crack. Photo 5. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
14	Girder F has hairline leaching cracking along soffit. Moisture and some efflorescence are present along the bottom edge of the webs at various locations.
15	The girder diaphragms at the north end have poor concrete consolidation along the top and sides with some spalling. Longitudinal restrainers are present at this bent. Photo 6. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
16	Girder A soffit has three 3" diameter shallow spalls with exposed rebar. Girder G has 12" diagonal crack in the east web that is delaminating. Photo 7. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.

SUMMARY OF CHANNEL GIRDER DEFECTS

Span	Description
17	Girder A has epoxy patches along soffit centerline. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs. Girders A, B and C have rust stains from the transverse bars leaching through the concrete cover. Girder C shows early signs of concrete delamination at some of these locations.
18	Girder A has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
19	Girder A has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
20	Girder G has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
21	Girder A has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
22	Girder A has epoxy patches along soffit centerline. Girder G east web has two shallow spalls 8" long and 6" long with exposed prestress strands. Photos 8 and 9. Efflorescence present at various locations along the bottom edge of the webs.
23	Girder G has epoxy patches along soffit centerline. Girder B has exposed steel plate on bottom of west web. Efflorescence present at various locations along the bottom edge of the webs.
24	Girder A soffit has a 3″ diameter shallow spalls with exposed rebar. The west web of Girder E has been patched where there had been exposed prestress strands. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
25	The west web of Girder G has been patched. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
26	Girder A soffit has a 3" diameter shallow spall. Girders A and G have epoxy patches along soffit centerline. The east web of Girder C has been patched where there had been exposed prestress strands. The patch has hairline cracks. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
27	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
28	Girder A soffit has a 3" diameter shallow spall with exposed rebar and two small delaminations. Girder G has epoxy patches along soffit centerline. Moisture and some efflorescence are present along the bottom edge of the webs at various locations.
29	Girder A soffit has a 3" diameter shallow spall with exposed rebar. Girder A has epoxy patches along soffit centerline. Moisture and some efflorescence are present along the bottom edge of the webs at various locations.
30	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
31	Three 3″ to 4″ diameter shallow spalls with exposed rebar in soffit of Girder A. Photo 10. Girder G has epoxy patches along soffit centerline. The web cracks of Girders A and G have been patched at the expansion joint at Bent 32. Moisture and some efflorescence are present along the bottom edge of the webs at various locations.

SUMMARY OF CHANNEL GIRDER DEFECTS

Span	Description
32	The webs of Girders C, D, and G have been patched where there had been exposed prestress strands. There are steel girders under the soffit of Girders A and G to strengthen the girders. There is light rust on the steel girders. Photos 11 and 12.
33	Girder G has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
34	Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
35	Girder G has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
36	Girder A has 1' long rusty crack in the bottom of the east web. Photos 13 and 14. The west web of Girder G has been patched. There is a steel girder under the soffit of Girder A to strengthen the girder. There is light rust on the steel girder. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
37	Girder A has epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
38	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
39	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
40	Girders A and G have epoxy patches along soffit centerline. Efflorescence present at various locations along the bottom edge of the webs.
41	Girder A has epoxy patches along soffit centerline. The west web of Girder A has been patched. The east web of Girder G has been patched. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
42	The west web of Girder A has been patched. There is a steel girder under the soffit of Girder A to strengthen the girder. The girder appears to be coated with a rust inhibitor paint. Photo 15. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
43	Girder G west web has a 6" x 3" x 1" deep spall. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
44	Girder A soffit has 3″ diameter shallow spalls with exposed rebar. Girder A has epoxy patches along soffit centerline. Moisture and some efflorescence are present along the bottom edge of the webs at various locations.
45	Girder A has epoxy patches along soffit centerline. The west web of Girder D has been patched. Moisture, efflorescence, and rust stains present at various locations along the bottom edge of the webs.
46	Moisture and some efflorescence are present along the bottom edge of the webs at various locations.

Appendix D

Summary of Substructure Defects

Appendix D: Summary of Substructure Defects

Summary of Substructure Defects

Bent Number	Description
2	Longitudinal brace is split at connection to Pile 2A.
5	Pile 5A has check open to 1/4" at top.
8	Pile 8D has many checks. Drilled and no rot found.
9	Cap has full length check along bottom.
11	Pile 11D has concrete filled splice at ground line with metal straps at cap.
12	Pile 12A has soft surface at bottom. No rot found.
13	Pile 13C has metal strap at cap indicating pile is a replacement.
16	Pile 16A has steel collar at cap connection.
18	Pile 18C has metal strap at cap indicating pile is a replacement.
20	Pile 20A has concrete filled splice at ground line with metal straps at cap.
20	Pile 20C has concrete filled splice at ground line with metal straps at cap.
22	Pile 22A has marine borer damage at ground line. Pile was YELLOW TAGGED. Photo 18.
22	Pile 22D has marine borer damage at ground line. Also 12" x 3" x 1" deep surface rot and minor center rot. The center rot is a 1" rot pocket. Pile was YELLOW TAGGED. Photo 19.
23	Pile 23A has concrete filled splice at ground line with metal straps at cap.
25	Pile 25B has metal strap at cap indicating pile is a replacement.
27	Pile 27D has marine borer damage at ground line and also open check. Pile was YELLOW TAGGED. Photo 20.
27	Diagonal brace at top east end is split with end rot. Photo 21.
28	Pile 28C has concrete filled splice at ground line with metal straps at cap.
28	Diagonal brace at top west end has end rot and is split at the lower connection to Pile 28D.
30	Pile 30C has concrete filled splice at ground line with metal straps at cap.
31	Pile 31B has a fiberglass wrap at the ground line.
31	Diagonal brace at top west end has end rot.
32	Pile 32A has metal strap at cap indicating pile is a replacement.
32	Pile 32B has metal strap at cap indicating pile is a replacement.
32	Pile 32C has concrete filled splice at ground line with metal straps at cap.
32	Pile 32D has metal strap at cap indicating pile is a replacement.
32	Longitudinal brace has rot at the lower connection to Pile 32C.
33	Pile 33B has concrete filled splice at ground line with metal straps at cap.
38	Diagonal brace at top west end has end rot.
39	Pile 39C has concrete filled splice at ground line with metal straps at cap.

Summary of Substructure Defects

Bent Number	Description
40	Pile 40B has concrete filled splice at ground line with metal straps at cap.
41	Pile 41B has concrete filled splice at ground line with metal straps at cap.
42	Diagonal brace at top west end has end rot.
44	Pile 44A has 1/2" wide check starting at top extending down 2/3 the length.
47	Cap has several checks along side. Drilled and no rot found.

Appendix E
Photographs

Appendix E: Photographs

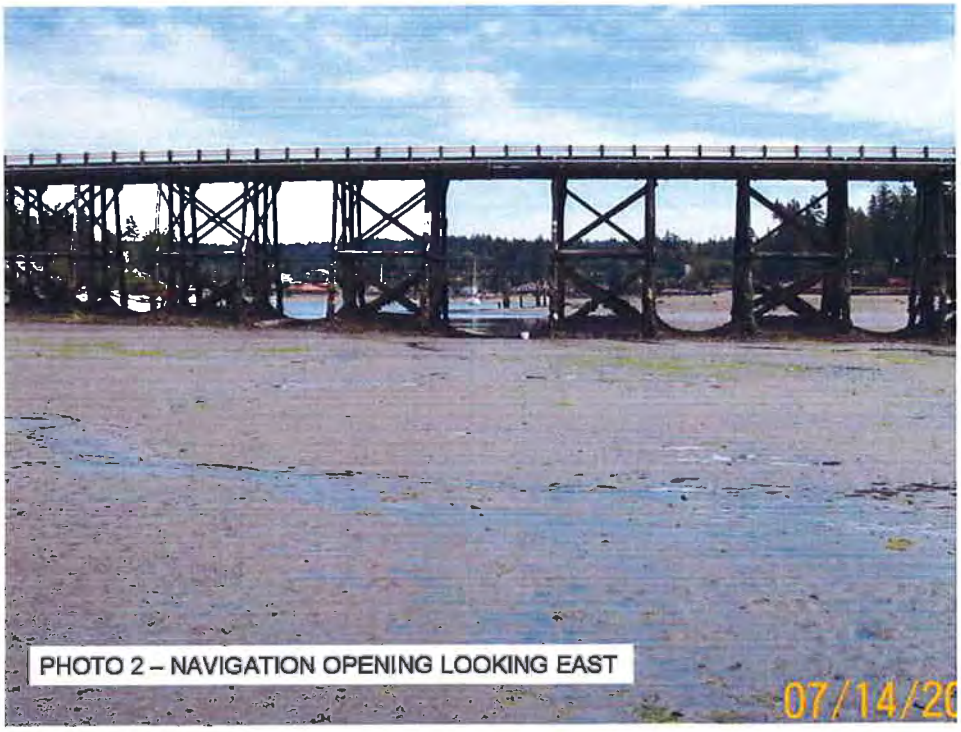


PHOTO 3 – DECK LOOKING NORTH

PHOTO 4 – LOAD POSTING

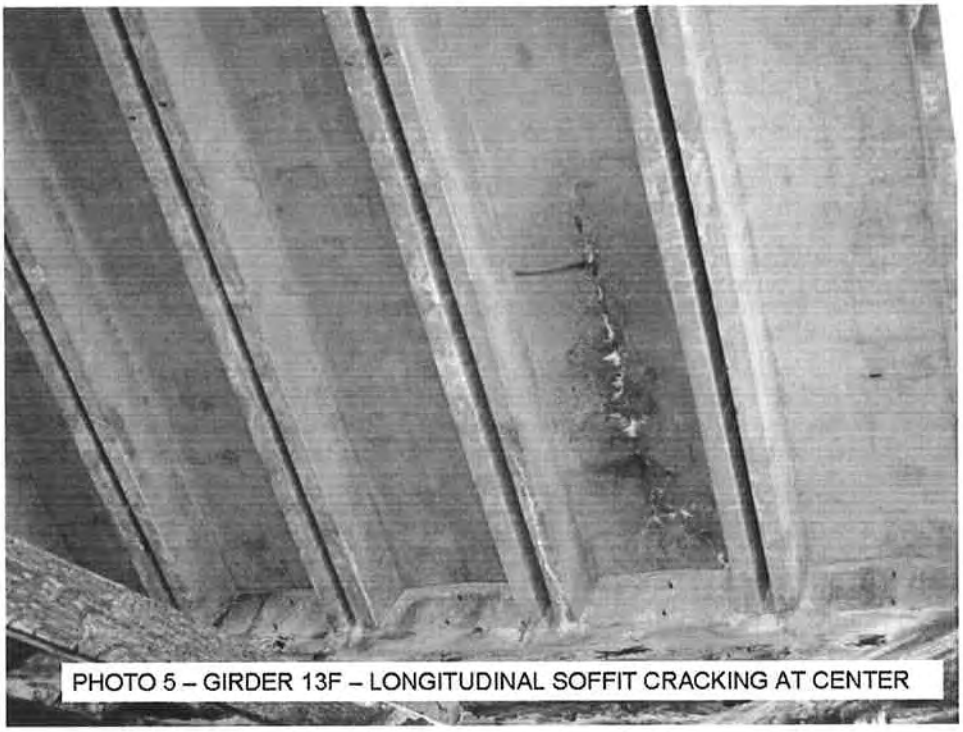


PHOTO 5 – GIRDER 13F – LONGITUDINAL SOFFIT CRACKING AT CENTER

PHOTO 6 – SPAN 15 AT BENT 16 SHOWING DIAPHRAGM SPALLS

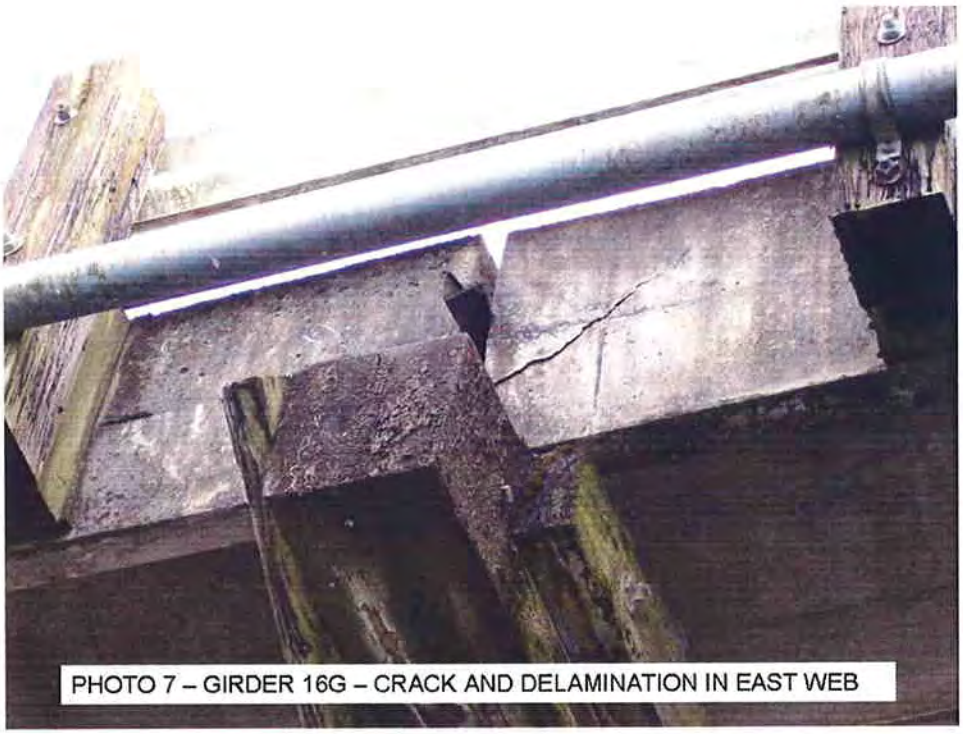


PHOTO 7 – GIRDER 16G – CRACK AND DELAMINATION IN EAST WEB

PHOTO 8 – GIRDER 22G SPALL WITH EXPOSED PRESTRESS IN EAST WEB

PHOTO 9 – GIRDER 22G SPALL WITH EXPOSED PRESTRESS IN EAST WEB

PHOTO 10 – GIRDER 31A SOFFIT SPALLS

PHOTO 11 – SPAN 32 GIRDER STRENGTHENING

PHOTO 12 – GIRDER 32A STRENGTHENING

PHOTO 13 – GIRDER 36A CRACK ALONG BOTTOM OF EAST WEB

PHOTO 14 – GIRDER 36A CRACK ALONG BOTTOM OF EAST WEB

PHOTO 15 – GIRDER 42A RUST INHIBITOR PAINT ON STRENGTHENING BEAM

PHOTO 16 – MARINE GROWTH ON CENTER BENTS

PHOTO 17 – MARINE GROWTH ON CENTER BENTS

PHOTO 18 – PILE 22A YELLOW TAGGED
DUE TO MARINE BORER DAMAGE

PHOTO 19 – PILE 22D YELLOW TAGGED
DUE TO MARINE BORER DAMAGE

PHOTO 20 – PILE 27D YELLOW TAGGED
DUE TO MARINE BORER DAMAGE

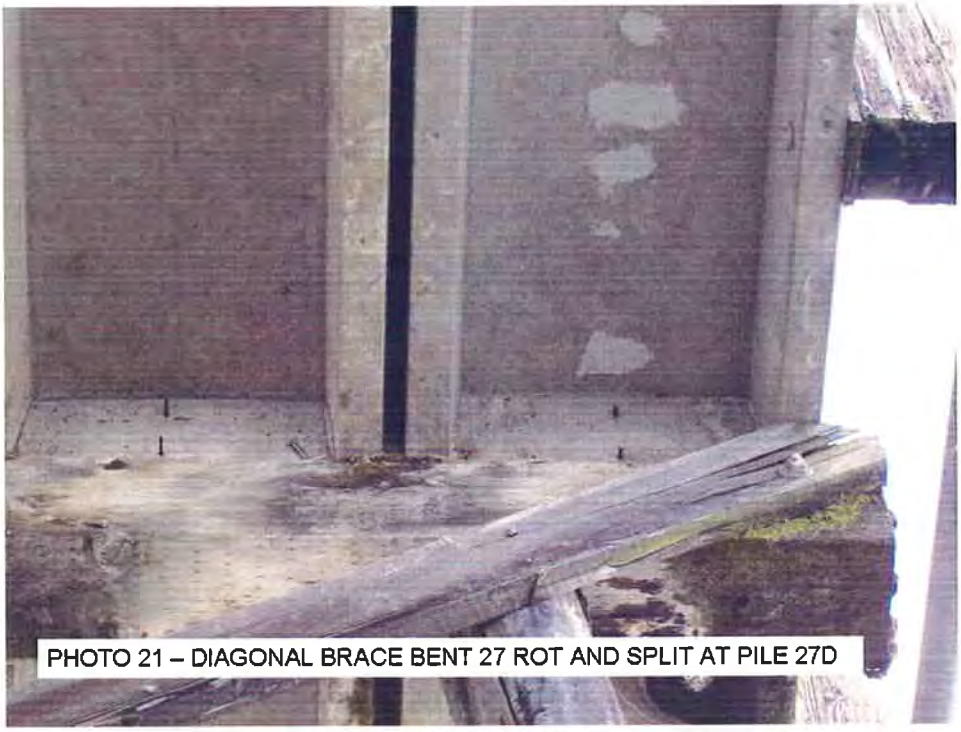


PHOTO 21 – DIAGONAL BRACE BENT 27 ROT AND SPLIT AT PILE 27D

PHOTO 22 - EXPANSION JOINT AT SOUTH ABUTMENT

PHOTO 23 – NORTH APPROACH PATCHED AND NO EXPANSION JOINT

PHOTO 24 – SPAN 17 IMPACT DAMAGE TO EAST BRIDGE RAIL

Appendix F

Inspection Report

Appendix F: Inspection Report

BRIDGE INSPECTION REPORT

Ver Date 8/31/2007

BATS | Status: Submit | Program Mgr: | Agency: Private (Consultant)

Bridge No.	1			Structure Type	PSG
Bridge Name	RAFT ISLAND BRIDGE	Route	00001	Intersecting	CARR INLET
Structure ID	XA104400	MilePost	1.00	Location	RAFT ISLAND DR NW

Inspector's Signature RLS IDent# A1044 Co-Inspector's Signature KNK

Inspection Date 7/14/2007 ~~12:00:00 AM~~

BATS Hours 0.0

	Structural Adqcy	(657)	N	Pier/Abut/Protect	(679)	1957	Year Built	**Inspection Performed:**	
	Deck Geometry	(658)	6	Scour	(680)	0	Year Rebuilt	**IT OF NT Date**	**Report Type**
	Underclearance	(659)	6	Approach Rdwy	(681)	L 23	Operating Rating		Routine
1	Operating Level	(660)	9	Retaining Walls	(682)	L 14	Inventory Rating		Fract Critical
8	Alignment Adqcy	(661)	9	Pier Protection	(683)	P	Open Close Posted		Underwater
8	Waterway Adqcy	(662)	0	Bridge Rails	(684)	9999	Vert Over Deck		Special
5	Deck Overall	(663)	0	Transition	(685)	0000	Vert Under		Interim
8	Drains Condition	(664)	0	Guardrails	(686)	N	Vert Under Code		Equipment
5	Superstructure	(671)	0	Terminals	(687)	2.00	Asphalt Depth		Damage
4	Number Utilities	(675)	N	Revise Rating	(688)	15	Speed Limit		Safety
4	Substructure	(676)		Photos Flag	(691)				Short Span
8	Chan/Protection	(677)	N	Soundings Flag	(693)				
9	Culvert	(678)		Measure Clearance	(694)			Suff Rating:	

BMS Elements

Element	Element Description	Total	Units	Env	State 1	State 2	State 3	State 4
13	Bridge Deck Surface	15,760	SF		15,760	0	0	
109	Prestressed Concrete Multiple Web Girder Units	5,516	LF		4,411	901	204	
206	Timber Pile/Column	8	EA		8	0	0	
216	Timber Abutment	60	LF		60	0	0	
228	Timber Submerged Pile/Column	180	EA		156	21	3	
235	Timber Pier Cap	1,034	LF		814	220	0	
330	Metal Bridge Railing	1,576	LF		1,570	6	0	
406	Compression Seal / Steel Header	20	LF		0	0	20	
412	Strip Seal - Anchored	40	LF		20	0	20	
801	AC Overlay with Waterproofing Membrane	15,760	SF		15,720	30	10	

Notes

0 Bridge is oriented south to north. Bridge is posted 16T - 28T - 30T.

13 Spans are concrete channel girders with no topping.

109 The following are girders with spalls and exposed rebar on the soffit: 6G, 16A, 24A, 26A, 28A, 29A 31A and 44A, The spalls were typically 4" in diameter or less and less than 1" deep.
The following girders had cracks that were significant: 13F had a 5' long soffit crack along centerline that was leaching and rust stained. 16G had a 12' long diagonal crack with delaminating concrete in the east web. 36A had a 12" long rust stained crack on the bottom of the east web.
Girder 22G had a spalls 8" long and 6" long on the east web that exposed a prestress strand.
19 girders had patches to the soffit or the web.
Girders 32A, 32G, 36A and 42A have been strengthened by the addition of steel girders bellow the soffit.

BRIDGE INSPECTION REPORT

Ver Date 8/31/2007

BATS | Status: Submit | Program Mgr: | Agency: Private (Consultant)

Bridge No.	1			Structure Type	PSG
Bridge Name	RAFT ISLAND BRIDGE	Route	00001	Intersecting	CARR INLET
Structure ID	XA104400	MilePost	1.00	Location	RAFT ISLAND DR NW

228 All piles were sounded at the ground line and to a height of approx. 7'. Piles 22A, 22D and 27D were YELLOW TAGGED due to marine borer damage 22D had some minor rot.
The following piles have been repaired by using a concrete filled splice at ground line and adding a new section that has a metal strap connection to the cap: 11D, 20A, 20C, 23A, 28C, 30C, 32C, 33B, 39C, 40B and 41B.
The following piles have been replaced as indicated by a metal strap connection at the cap: 13C, 16A, 18C, 25B, 32A, 32B, and 32D.
Pile 31B has a fiberglass wrap at ground line.
The diagonal transverse bracing had end rot at the top connection at many bents.

235 A few of the caps had checks but appeared to be in good condition. The cap at Bent 9 had a a full length check along the bottom. The cap at the north abutment had several checks in the side.

330 Bridge rail is metal W beam on timber posts. There is impact damage to the east rail in Span 17. It is bent out 2" over 5' 8".

406 The compression seal steel header is loose along a 4' length due to a pothole in the ACP overlay.

412 There are strip seal joints at Bents 16 and 32. At Bent 32 the joint header is starting to loosen due to delaminating ACP overlay.

676 Substructure coded down to 4 due to the 21 piles that were either replaced or spliced and the continuing marine borer damage.

801 There is a 2" thick ACP overlay. There is patching and crack sealing along the centerline. At the South Abutment adjacent to the expansion joint there is a 4' x 4" x 2" deep pothole. At the expansion joint at Bent 32 the overlay is delaminating along a 3' long strip.

Repairs

Repair No	Priority	Repair Description	Date Noted	Verified
1	1	Patch the spalls on the following girders: 6G, 16A, 22G, 24A, 26A, 28A, 29A, 31A and 44A.		
2	1	Epoxy crack inject the cracks in Girders 16G and 36A.		
3	1	Patch the overlay at the South Abutment and Bent 32. Tighten the expansion joint hold down bolts before patching.		
4	4	Monitor YELLOW TAGGED PILES 22A, 22D AND 27D which have marine borer damage..		

Inspections Performed and Resources Required

Report Type	Date	IT	Frq	Hrs	Insp	CertNo	Coinsp	Note

Sticky Notes

Creator	Created	Table Reference	Notes
			(No sticky notes for this structure)

Washington State Department of Transportation

WSBIS Inventory Report

8/31/2007

Structure Identifier	Bridge Number	Owner Code	County Number	City Number	Update
XA10440	01	26	27	00000	0

	Bridge Name	Location	Section	Township	Range	Latitude	Longtitude
WB71	RAFT ISLAND BRIDGE	RAFT ISLAND DR NW	10	20	02W	47°19'35.0"	122°40'07.0"

	Feature Intersected	Facilities Carried	Region	FIPS Place Code	Legis District (1)	Legis District (2)	Toll	Custodian	Parallel Structure	Temporary Structure	Fracture Critical Facility	Median	Hist Sig	Open/ Closed	Program Year
WB72	CARR INLET	RAFT ISLAND DR.	01	000000	26		3	26	N			0	4	P	0

	Year Built	Year ReBuilt	Bridge Length	NBIS Length	Maximum Span Length	Lanes On	Lanes Off	Curb to Curb Deck Width	Out to Out Deck Width	Sidewalk Curb Left	Sidewalk Curb Right	Min Vert Clearance Over Deck	Min Vert Clearance Under Bridge	Code	Min Lat UnderClr Right	Code	Min Lat UnderClr Left	Navigation Control	Navigation Vertical Clearance	Navigation Horizontal Clrnce	Vert Lift Min Clrnce	Appr Roadway Width	Skew Angle	Flare
WB73	1957	0	78.8'		23'02			20.0'	21.0'	00.5'	00.5'	99'99"	00'00"	W	000'	W	00.00'	0	000.0			020'	00°	N

	On Under	Right of Way Class	Service Level	Route Number	Mile Post	ADT on Inventory Route	Truck ADT PCT	ADT Year	Future ADT	Future ADT Year	Linear Referencing System Route	LRS Sub Route	Fed Aid Route	National Hwy System	Base Hwy Network	Strahnet	Fed Lands Highway	Fed Funct Class	National Truck Net	Lane Use Direction	Horizontal Clearance Route Dir	Horizontal Clearance Reverse Dir	Max Vertical Clearance Route Dir	Detour Length
WB74	1	8	0	00001	1.00	500	1	2007	1000	2020			0000	0	0	0	0	08	N	2	20'00"			99

	Main Span Material	Main Span Design	Appr Span Material	Appr Span Design	Number of Main Spans	Number of Appr Spans	Inventory Route On	Service On	Service Under	Deck Type	Wearing Surface	Membrane	Deck Protection	Deck Load	Design Method	Oper Rtng Method	Oper Rtng Tons	Inv Rtng Method	Inv Rtng Tons	Design Exception Date	Federal Aid Project	Border State Code	Border State PCT	Border State Structure Identifier
WB75	5	2			4	0	1	5	B	6	2	0	2	L	2	3	L	1	4	/ /				

	Routine Inspection: Freq	Last Inspection Date	Hours On Site	Inspector	Inspection Identification No	Co-Inspector	Structural Adequacy	Geometry Deck	Geometry Adequacy	Underclearance Level	Underclearance Operating	Alignment Adequacy	Waterway Adequacy	Deck Condition	Deck Geometry	Drain Cond	Drains	Scaling Severity	Scaling Percent	Scaling Rating	Rebar Size	Exposed Rebar Sheet	Overall Superstruct	Cob	Sidewalks	Paint	Number of Utilities	Overall Substruct	Channel Protection	Culvert	Pier Abutment	Pier Scour	Approach Roadway Alignment	Approach Roadway Adequacy	Railing Adequacy	Pier Protection	Traffic Safety: Bridge Rail	Trans Rail	Guard Rail	Term	Revise Rating	Repair Status	Cond Check	Photos	Season	Soundings	Clearances	Monitor Structure
WB76	12	07/14/2007	0.10.0	RLS	A.1.044	KNK	X	X	X	1		8	8	5	8	1							5				4	4	8	9	N	6	6	9	9	0	0	0	0	N	Y			L	N			

Sufficiency Rating

	Fracture Critical / UBIT Inspection: Type	Freq	Last Inspection Date	Hours On Site	Inspector	Inspection Identification No	Co-Inspector	Underwater Inspection: Type	Freq	Last Inspection Date	Hours On Site	Inspector	Inspection Identification No	Co-Inspector	Other Special Inspections: Type	Freq	Last Inspection Date	Hours On Site	Inspector	Inspection Identification No	Co-Inspector
WB77			/ /							/ /							/ /				

	Proposed Improvements: Waste Type	Intrusion	Flood Plain	Flood Control	Scour History	Scour Countermeasure	Stability Material	Stability Substruct	Stability Obstruction	Waterway	Stability	Streambed Armament	Streambed Material	Piers in Water	Work On	Work Under	Work Type	Work	Structure Improve Length	Roadway Width	Lanes On	Lanes Under	Total Costs In Thousands	Structure Cost In Thousands	Roadway Cost In Thousands	Estimate Year	Calc	Inspecting Agency: Code	Number	Seismic Status-Superstruct: Main Biennium	Approach Biennium	Seismic Status-Substruct: Main Biennium	Approach Biennium
WB78	S	A	N	N	4	3	N	G	N	M	1	5	3	1			7 8 8		2	0	5000	4000	1000	2032	N	26					

Sufficiency Rating