Chemical Sealers as Corrosion Inhibitors

Naselle River Bridge 101/24

WA-RD 302.1

Final Report
February 1993

Washington State Department of Transportation
Washington State Transportation Commission
Transit, Research, and Intermodal Planning (TRIP) Division
Department of Transportation in cooperation with
U.S. Department of Transportation
Federal Highway Administration

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

TECHNICAL REPORT STANDARD TITLE PAGE

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15. SUPPLEMENTARY NOTES

The study was conducted in cooperation with the U. S. Department of Transportation, Federal Highway Administration.

16. ABSTRACT

Chem-Trete Silane sealer was applied to the prestressed girders and precast piles of the newly constructed Naselle River Bridge 101/24 in Washington State in 1984. The purpose of the experiment was to gain experience with the use of the product and to measure its effectiveness over time in preventing the intrusion of chlorides into prestressed concrete girders and precast concrete piles in marine environments.

Recent rapid chloride permeability tests and chloride testing indicate that this sealer has had little or no effect on reducing the intrusion of chlorides into the concrete.

17. KEY WORDS Sealer, Seal Coat Waterproofing, Concrete Sealer		18. DISTRIBUTION STATEMENT	
19. SECURITY CLASSIF. (of this report) Unclassified	20. SECURITY CLASSIF. (of this page) Unclassified	21. NO. OF PAGES 16	22. PRICE

DOT FORM 310-022 (11 86) -1216-

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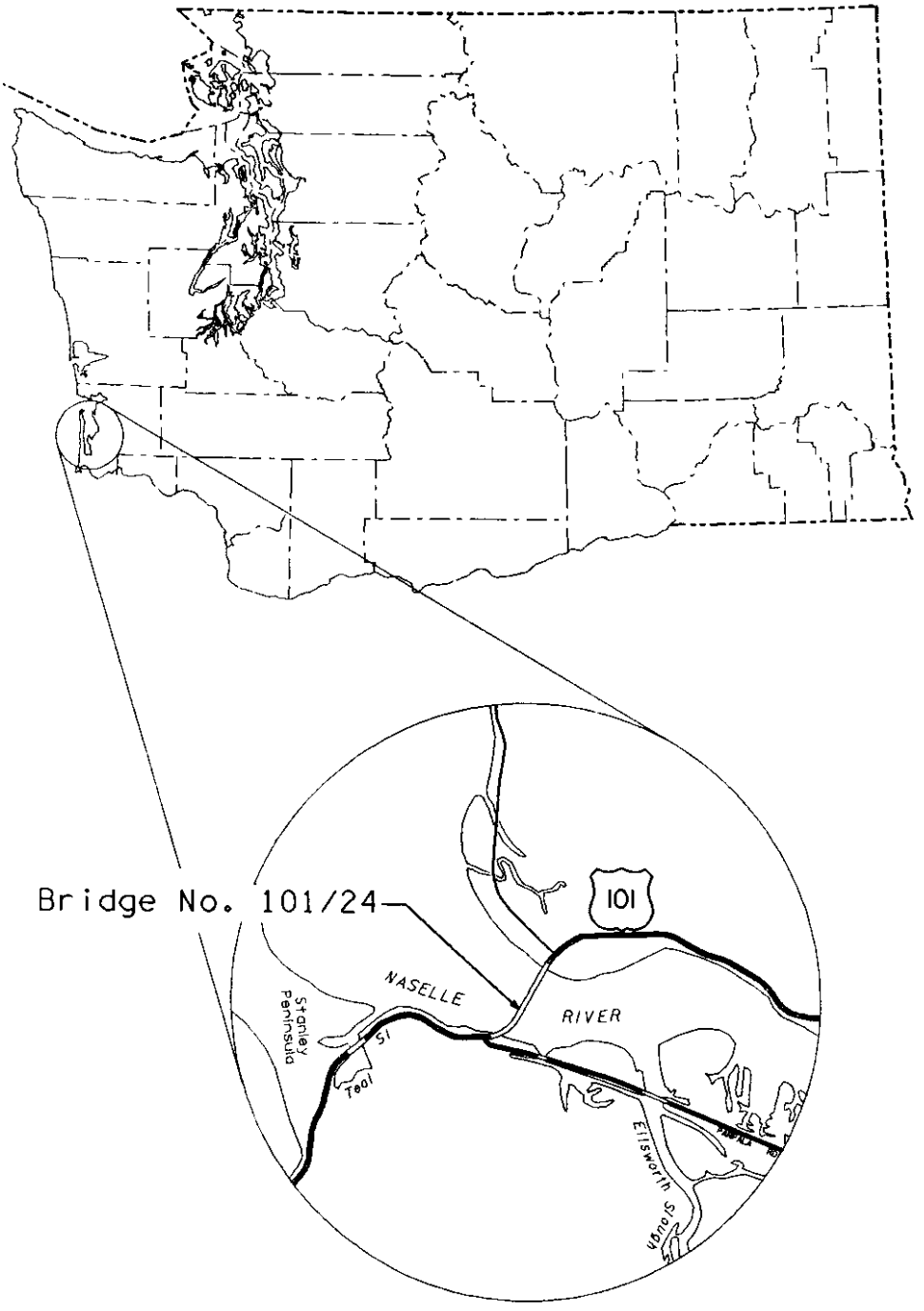
VICINITY MAP



PROJECT SITE

Introduction

The Washington State Department of Transportation (WSDOT), in search of a method for protecting concrete structures from the intrusion of chloride ions, identified the following chemical sealers, from laboratory tested sealers reported in NCHRP Publication No. 244, as being the most effective in providing a chloride ion barrier:

- Chem-Trete Silane
- EA Sealer
- Penetrating Sealer 1854

This experimental project was designed to provide field experience, and an evaluation of the method of application and the effectiveness of one of the above sealers on newly constructed bridge girders and piles. The contract specifications allowed the use of any of these three sealers. Chem-Trete was selected by the contractor.

Study Site

The Naselle River Bridge (101/24) was selected as an appropriate structure for the chemical seal experiment, due to its marine environment location. The bridge is located on State Route 101, five miles north of the town of Naselle (see vicinity map).

Chem-Trete Silane sealer, manufactured by Dynanit-Nobel, Montville, NJ, was selected for this structure. This sealer was applied to the concrete in multiple

coats, as required to obtain the application rate recommended by the manufacturer.

The sealer was applied in 1984 under WSDOT Contract No. C2641. The preparation of the concrete surface, application method and rate of application, workability of the sealer, uniformity of appearance, and problems were monitored for post-construction reporting.

WSDOT Post-Construction Report entitled "Naselle River Bridge 101/24, Chemical Sealers as Corrosion Inhibitors," WA-RD 105.1, dated March 1987, describes the post-construction monitoring.

Tests and Evaluations

No control girders or piles were provided in this experimental project. Therefore, all field sampling had to be done on prestressed girders and precast piles that were treated with the silane sealer.

Core samples were taken in the field for permeability testing in the lab. The prestressed girder web of the south outside girder of Span 1 was selected because of its ease of accessibility from dry land. Four core samples were taken from the web of this girder. Also, eight chloride powder samples were taken from this girder.

It would have been desirable to take core samples from the columns of the piers for premeability testing, but the pneumatic suction devices for holding the core drill to the concrete will function only on flat surfaces. Therefore, the only field

sampling available was chloride sampling. Chloride samples were taken from the three columns of Pier 2. Two samples per column were taken, one above tide level and one below tide level, for a total of six samples at the pier.

The rapid chloride permeability test results are compatible with those for a high quality concrete exposed to a saltwater environment for eight years, but not one treated with a moisutre intrusion protection system. The chloride content of the samples below the tide mark is extremely high, indicating that the protection system is not preventing the intrusion of chlorides. See Appendix A for complete test results.

Conclusions

The results of the testing indicate that the silane sealer has been ineffective at preventing the intrusion of chlorides into the concrete.

Recommendations

An attempt was made to contact the manufacturer of the product to obtain their evaluation and conclusions on the results of the Department's test data. The manufacturer could not be located at the address shown during the construction year or at any forwarding address.

Based upon the test results, it is recommended that this product not be used by WSDOT as a protective sealer on reinforced concrete structures.

Appendix A
Testing

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

INTRA-DEPARTMENTAL COMMUNICATION

DATE: Oct. 15, 1992

FROM: R. G. Finkle/Bob Allison REA
PHONE: Scan 234-4664

SUBJECT: Naselle River Bridge
Silane Sealer Testing

TO: A. H. Walley/O. R. George

Per your request we obtained 4 concrete core samples to determine chloride permeability and 8 powder samples to determine chloride content from Span 1 Girder E on the subject bridge. Additionally, 6 chloride samples were taken from the columns at pier 1. The results are attached.

The samples on test report Lab #CL-4051 were taken from the columns. The odd numbered samples being taken below the high tide mark and the even numbered samples above the high tide mark. The "A" designation represents a sample taken from 0" to 3/4" depth and the "B" represents a sample taken from 3/4" to 1-1/2" depth. Samples on Lab #CL-4052 were taken on the girder at the approximate same locations as the permeability cores. The "A" and "B" samples were taken on the outside of the girder and the "C" and "D" samples were taken on the inside (non-exposed side) of the girder. Note that chloride content below the tide mark is **extremely** high.

The rapid chloride permeability test results shows numbers that you would typically expect of a high quality concrete, but certainly not one treated with some sort of moisture intrusion protection.

My conclusion is the stuff didn't work.

REA

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - MATERIALS LABORATORY
PO Box 167 Olympia/ 1655 S 2nd Ave Tumwater/ WA 98504
Chemistry Section

Test of: **Chlorides**
Date Logged In: 08/21/92
Date Logged Out:
SR: 101
Section: NASELLE R. BR.

Lab. No: **CL-04051**
Lab ID No: 0000028740
District: 4

Bridge Number: 101/24
Bridge Name: NASELLE R. BR.
Number of samples: 12

*** Test report attached ***

Mat. File X General File X
Dist Administrator: 4
Project Engineer:
ALLISON X(2)
Chem Lab: X
Bridge: X

Material: INFORMATIONAL
Remarks:

0132 F2B2 - 12
F2L0-
F2K9-

Rodney G. Finkle, P.E.
Materials Engineer
by: C. L. Sherrell RLS
Date 09/25/92 Telephone 234-7064

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
HEADQUARTERS MATERIALS LABORATORY

LAB NUMBER CL-4051 MS1654
BRIDGE NUMBER
CONTROL FIELD

DATE TESTED 091692
DATE SAMPLED 080492

SAMPLE	STATION	OFFSET	CHLORIDE	ASPHALT
******	*******	******	********	*******
1A			53.0	
1B			22.5	
2A			6.21	
2B			.6	
3A			11.3	
3B			3.99	
4A			11.4	
4B			2.41	
5A			30.8	
5B			21.6	
6A			10.9	
6B			2.5	

~~T2B2 12 0132.~~
MATLS.....X
GENL.....X

PROJ ENG..ALLISON
BRIDGE.....X
CHEM LAB.....X

PAGE 1 OF 1

X(2)

DATE 09-17-1992

Rodney G. Finkle, P.E.
MATERIALS ENGINEER

by C. L. Sherrell

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - MATERIALS LABORATORY
PO Box 167 Olympia/ 1655 S 2nd Ave Tumwater/ WA 98504
Chemistry Section

Test of: **Chlorides**
Date Logged In: 08/21/92
Date Logged Out:
SR: 101
Section: NASELLE R. BR.

Lab. No: **CL-04052**
Lab ID No: 0000028741
District: 4

==========

Bridge Number: 101/24
Bridge Name: NASELLE R. BR.
Number of samples: 8

*** Test report attached ***

==========

Mat. File X General File X
Dist Administrator: 4
Project Engineer:
ALLI~~SON~~ X(2)
Chem Lab: X
Bridge: X

Material: INFORMATIONAL
Remarks:

0132 T282- 16
T2LO-
T2K9-

Rodney G. Finkle, P.E.
Materials Engineer
by: C. L. Sherrell CLS
Date 10/08/92 Telephone 234-7064

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
HEADQUARTERS MATERIALS LABORATORY

LAB NUMBER CL-4052 1S1654
BRIDGE NUMBER 101 DATE TESTED 100292
CONTROL FIELD DATE SAMPLED 080492

SAMPLE	STATION	OFFSET	CHLORIDE	ASPHALT
******	*******	******	********	*******
1A			.29	
1B			.27	
1C			.21	
1D			.17	
2A			.51	
2B			1.02	
2C			.2	
2D			.19	
3A			.34	
3B			.35	
3C			.27	
3D			.31	
4A			.25	
4B			.22	
4C			.05	
4D			.29	

~~T2D2 16~~ 0132
MATLS.....X PAGE 1 OF 1
GENL.....X

Rodney G. Finkle, P.E.
MATERIALS ENGINEER

PROJ ENG..ALLISON X(2)
BRIDGE.....X
CHEM LAB.....X DATE 10-02-1992 by C. L. Sherrell

Washington State Department of Transportation

SAMPLE TRANSMITTAL
ACCEPTANCE/ASSURANCE/INDEPENDENT ASSURANCE

NO. 50455

MATERIAL: 4" PCC Cores		CONTRACT NO. MS 1654	HDOTRS. LAB. NO. M-9118, 9119, 9120 & 9121
ACCEPTANCE SAMPLE NO. 1 thru 4	ASSURANCE SAMPLE NO. / I.A.S. NO.	SR NO. 101	DIST. LAB. NO.
BRAND	HEAT NO.	SECTION Naselle R. Br. 101/24	
I.D. NO./LOT NO.	REEL NO.	COUNTY Pacific	CITY/COUNTY/AGENCY CONT. NO.
CERTIFICATE NO.	TRUCK/CAR NO.	CONTRACTOR	
STOCKPILE NO.	PIT NO.	SUBCONTRACTOR	
USED AT STATION	TO STATION	SAMPLED AT Span 1 E	BY Special Projects / DATE 8/4/92
FIELD ☐ ACCEPT ☐ REJECT	BASED ON FIELD TEST NO.	TESTED AT	BY / DATE
	ON DATE		

	0000027880	0000027881	0000027882	Asph.	Max. Density
FIELD	M-9118	M-9119	M-9120		
DIST. LAB.					
SPEC'S.		0000027883			

REMARKS: Mix Design Desired ☐ Yes ☐ No Run Rapid Chloride Permeability on both ends of cores M-9121

DOT FORM 350-066 7/87 DISTRIBUTION: WHITE - With Sample; CANARY - Project Files

Project Engineer: K. Allison 8/6/92
Organization Code: 341010
Phone: (SCAN)

10 AUG 06 '92

TEST OF Rapid Chloride Permeability

Lab. No. M-9118, 19, 20 & 21

		Coulombs
M-9118	Top =	1,713
	Bottom =	2,463
M-9119	Top =	2,206
	Bottom =	2,014
M-9120	Top =	1,623
	Bottom =	
M-9121	Top =	1,908
	Bottom =	2,152

Distribution of Report
Mat'l Files X
Gen'l Files X
Dist. Admin.
Proj. Engr. Allison
Phys. Testing X
Chem. Lab.

Material: Informational

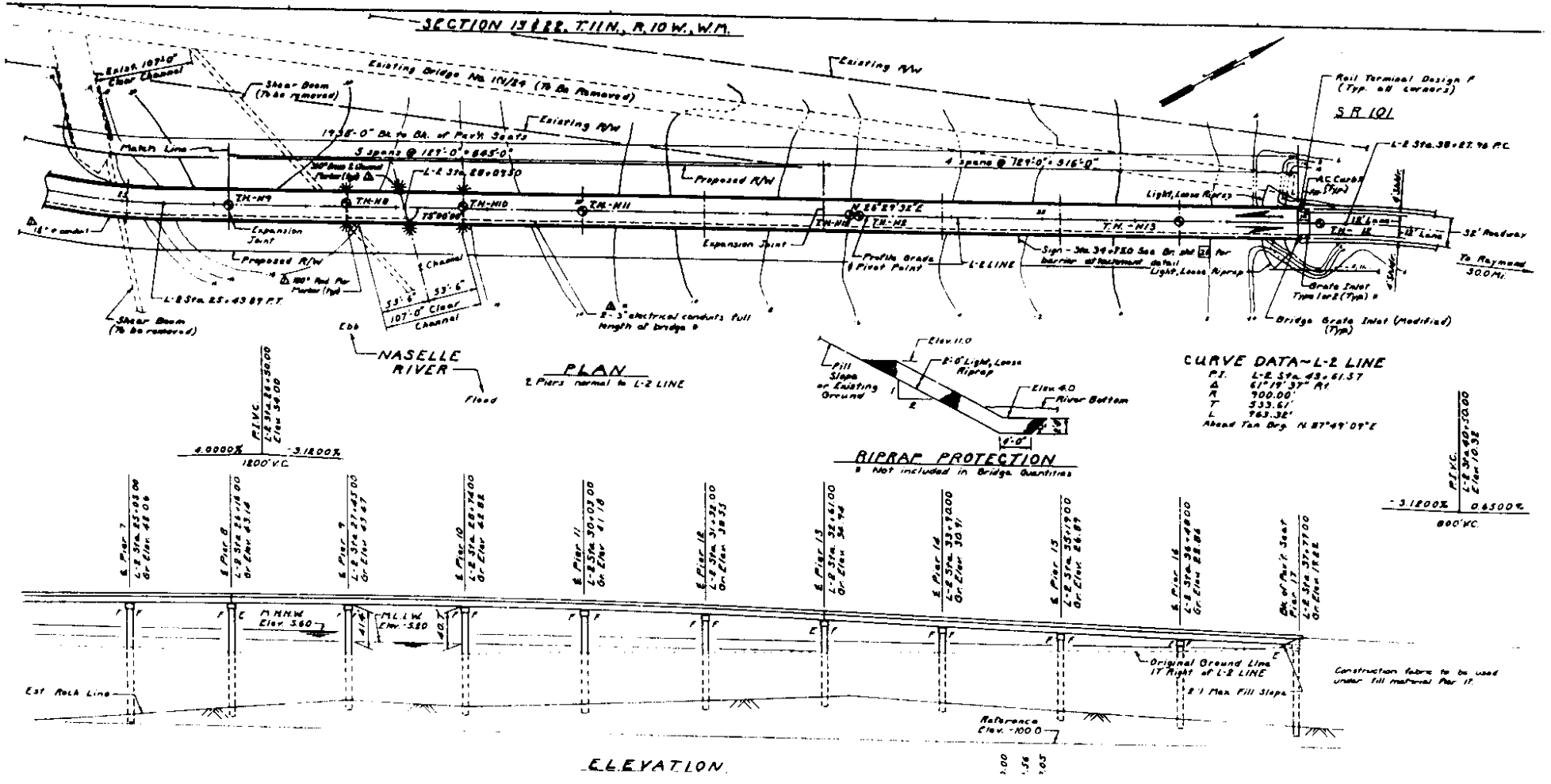
T464-12

Date AUG 18 1992 By LEP

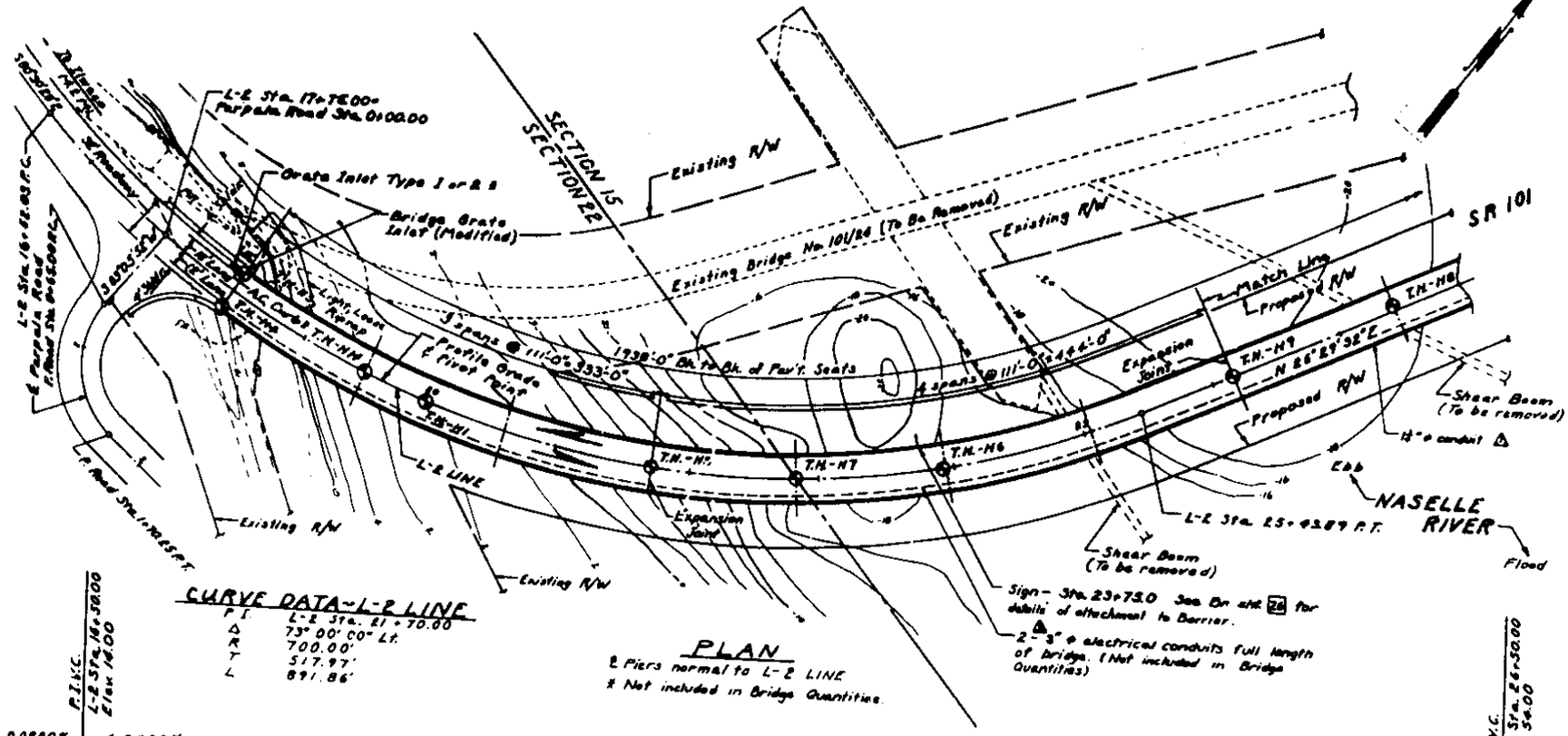
RODNEY G. FINKLE, P.E.
MATERIALS ENGINEER
BY:

DOT FORM 350-034 Revised 10/83

Appendix B
General Layout


SECTION 13 & 22, T.11N., R.10W., W.M.
Existing Bridge No. 101/89 (To Be Removed)
Existing R/W
Shear Boom (To be removed)
Match Line
19'-8" Bk. to Bk. of Perch Seats
5 spans @ 129'-0" = 645'-0"
4 spans @ 129'-0" = 516'-0"
L-2 Sta. 28+07.50
Proposed R/W
Expansion Joint
Rail Terminal Design F (Typ. all corners)
S.R. 101
L-2 Sta. 38+27.96 P.C.
A.C. Curb (Typ.)
Light, Loose Riprap
Profile Grade & Pivot Point
L-2 LINE
Sign - Sta. 34+75.0 See Dr. std 24 for barrier attachment detail
Grate Inlet Type I or 2 (Typ.)
Bridge Grate Inlet (Modified) (Typ.)
32' Roadway
To Raymond 30.0 Mi.
Shear Boom (To be removed)
L-2 Sta. 25+43.87 P.T.
107'-0" Clear Channel
2-3" electrical conduits full length of bridge
NASELLE RIVER
Ebb
Flood
PLAN
2 Piers normal to L-2 LINE
P.I.V.C. L-2 Sta. 24+56.00 Elev. 34.00
4.0000% -3.1200%
1200' V.C.
Fill Slope or Existing Ground
Elev. 11.0
2'-0" Light, Loose Riprap
Elev. 4.0
River Bottom
RIPRAP PROTECTION
Not included in Bridge Quantities
CURVE DATA - L-2 LINE
P.I. L-2 Sta. 43+61.37
Δ 61°19'37" Rt.
R 900.00'
T 533.61'
L 963.32'
Ahead Tan Brg. N 87°49'09"E
P.I.V.C. L-2 Sta. 40+50.00 Elev. 10.32
-3.1200% 0.6500%
800' V.C.
℄ Pier 7 L-2 Sta. 25+05.00 Gr. Elev. 48.06
℄ Pier 8 L-2 Sta. 25+18.00 Gr. Elev. 43.14
℄ Pier 9 L-2 Sta. 27+45.00 Gr. Elev. 45.87
℄ Pier 10 L-2 Sta. 28+74.00 Gr. Elev. 42.82
℄ Pier 11 L-2 Sta. 30+03.00 Gr. Elev. 41.18
℄ Pier 12 L-2 Sta. 31+32.00 Gr. Elev. 39.53
℄ Pier 13 L-2 Sta. 32+61.00 Gr. Elev. 34.94
℄ Pier 14 L-2 Sta. 33+92.00 Gr. Elev. 30.91
℄ Pier 15 L-2 Sta. 35+19.00 Gr. Elev. 26.89
℄ Pier 16 L-2 Sta. 36+48.00 Gr. Elev. 23.84
Bk. of Perch Seat Pier 17 L-2 Sta. 37+77.00 Gr. Elev. 19.82
M.H.H.W. Elev. 5.60
M.L.L.W. Elev. -5.80
Original Ground Line 17' Right of L-2 LINE
2:1 Max. Fill Slope
Construction fabric to be used under fill material Pier 17
Est. Rock Line
Reference Elev. -100.0
ELEVATION

SECTION 15 & 22, T. 11 N., R. 10 W., W.M.



CURVE DATA - L-2 LINE

P.I.	L-2 Sta. 21+70.00
Δ	73° 00' 00" Lt.
R	700.00'
T	517.97'
L	891.86'

PLAN

℄ Piers normal to L-2 LINE

* Not included in Bridge Quantities.

DATUM

Nat'l. Geod. Vert.

DEVELOPED ELEVATION

Grade elevations shown are finish grades on L-2 LINE and are equal

Appendix C
Testing Photographs

Column Chloride Sampling

at Pier 2

Core Drilling the Web of

Span 1 South Outside Prestressed Girder