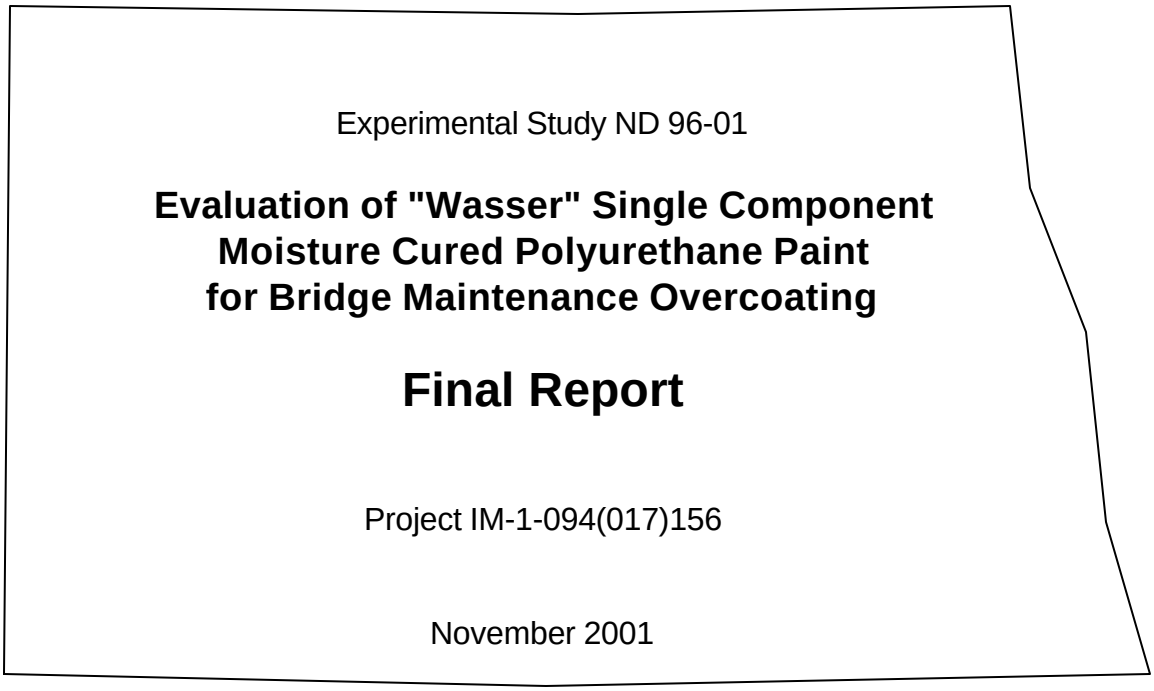
NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

MATERIALS AND RESEARCH DIVISION



Experimental Study ND 96-01

Evaluation of "Wasser" Single Component Moisture Cured Polyurethane Paint for Bridge Maintenance Overcoating

Final Report

Project IM-1-094(017)156

November 2001

Prepared by

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
BISMARCK, NORTH DAKOTA
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U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

EXPERIMENTAL PROJECT REPORT

EXPERIMENTAL PROJECT

EXPERIMENTAL PROJECT NO. (1): STATE **ND** | YEAR **96** | NUMBER **0 1** | SURF

CONSTRUCTION PROJ NO (8): **IM-1-094(017)156**

LOCATION (28): **Burleigh County**

EVALUATION FUNDING (48): 1 **X** HP&R; 2 CONSTRUCTION; 3 DEMONSTRATION; 4 IMPLEMENTATION

NEEP NO. (49):

PROPRIETARY FEATURE (51): X Yes / No

SHORT TITLE

TITLE (52): **Wasser Single Component Moisture Cured Polyurethane Paint for Bridge Maintenance Overcoating**

THIS FORM

DATE (140): MO. **1 1** - YR. **0 1**

REPORTING: 1 INITIAL; 2 **X** ANNUAL; 3 FINAL

KEY WORDS

KEY WORD 1 (145): **BRIDGESUPERSTRUCTURE**

KEY WORD 2 (167): **PAINTS**

KEY WORD 3 (189): **MOISTURE CURED**

KEY WORD 4 (211): **WASSER COATINGS**

UNIQUE WORD (233): **CRUSHED PCC**

PROPRIETARY FEATURE NAME (255):

CHRONOLOGY

DATE WORK PLAN APPROVED: (277)	DATE FEATURE CONSTRUCTED: (281)	EVALUATION SCHEDULED UNTIL: (285)	EVALUATION EXTENDED UNTIL: (289)	DATE EVALUATION TERMINATED: (293)
11-96	**10-96**	**10-01**		

QUANTITY AND COST

QUANTITY OF UNITS (297): **1**

UNITS (305): 1 LIN. FT; 2 SY; 3 SY-IN; 4 CY; 5 TON; 6 LBS; 7 EACH; 8 LUMP SUM

UNIT COST (*Dollars, Cents*) (306): **40000**

AVAILABLE EVALUATION REPORTS

(315) **X** CONSTRUCTION; **X** PERFORMANCE; **X** FINAL

EVALUATION

CONSTRUCTION PROBLEMS (318): 1 **X** NONE; 2 SLIGHT; 3 MODERATE; 4 SIGNIFICANT; 5 SEVERE

PERFORMANCE (****): 1 EXCELLENT; 2 **X** GOOD; 3 SATISFACTORY; 4 MARGINAL; 5 UNSATISFACTORY

APPLICATION

(320) 1 ADOPTED AS PRIMARY STANDARD; 2 PERMITTED ALTERNATIVE; 3 ADOPTED CONDITIONALLY; 4 **X** PENDING; 5 REJECTED; 6 NOT CONSTRUCTED

(Explain in remarks if 3, 4, 5, or 6 is checked)

REMARKS

321

The single component moisture cured polyurethane paint system with high pressure wash and spot grinding is performing better than the normal practice of blast cleaning and repainting. There is little sign of rust compared to the normal practice of painting.

700

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November 2001

Written by

Bill Kuhlmann / Rhaub Walker

Disclaimer

The contents of this report reflect the views of the author or authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not reflect the official views of the North Dakota Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

EVALUATION OF "WASSER" SINGLE COMPONENT MOISTURE CURED POLYURETHANE PAINT FOR BRIDGE MAINTENANCE OVERCOATING

OBJECTIVE

All bridge structural steel erected or painted in North Dakota before 1985 was coated with lead based paint. This paint was applied over surfaces with little preparation. Abrasive blasting is currently being specified for repainting these bridges because it accomplishes two things:

1.) It optimizes the service life of the new paint system by totally removing the existing paint, millscale, and contaminants.

2.) It optimizes the bond of the new paint system by providing a roughened surface.

Abrasive blasting has become expensive since lead based paints have been declared toxic and subject to regulation. Environmental and worker protection regulations mandate costly measures such as enclosed work areas and collection and proper disposal of all blasting residue.

The objective of this study is to determine if a single component moisture cured polyurethane paint overcoat system such as Wasser, which is marketed as an overcoating system requiring minimal surface preparation, is a viable alternative to our currently specified system.

SCOPE

The scope of this study is to compare the performance of a single component moisture cured polyurethane paint system with a high pressure wash and spot grinding surface preparation to the normal practice of blast cleaning and repainting.

LOCATION

The experimental coating system has been incorporated into North Dakota project IM-1-094(017)156. The bridge selected for this system is bridge number 94-160.649L which is the westbound Haycreek separation structure on Interstate 94 located between reference markers 160 and 161 within the city limits of Bismarck, North Dakota as shown in Appendix A. The control structure is bridge number 160.649R which is the eastbound Haycreek separation structure on Interstate 94. Photo 1 is an overview of the bridge location.

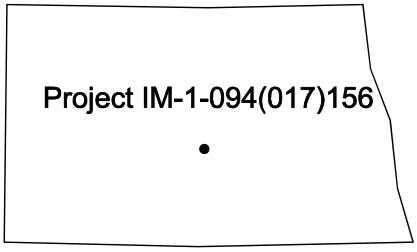


Photo 1: View of the site looking west.

TRAFFIC

Table 1 depicts the westbound one-way traffic estimates at Bridge Number 94-160.649L. The ESAL'S annual percent growth rate estimate is 2.0 %.

Year	Pass Car	Trucks	Total	Max 30th Hour	Rigid ESALs
1995	4,260	590	4,850	485	750
1997	4,800	700	5,500	560	890
1998	5,140	710	5,850	585	930
2001	5,320	830	6,150	615	1,080

Table 1

DESIGN

The bridge was constructed in 1964 and was scheduled for widening and replacement of the deck while the rest of the roadway was being rebuilt in 1996. This bridge was selected because the adjacent eastbound bridge was repainted in 1995 using the standard procedure of blast cleaning to Steel Structures Painting Council surface preparation #6 (SSPC SP-6 Commercial Blast Cleaning) and repainting with an inorganic Aluminum Filled Epoxy Mastic Primer and a high-build aliphatic polyurethane finish coat.

The project plans for the westbound bridge called for field painting of the existing beams with a three coat system consisting of the following:

1) Wasser MC-MIOZINC (spot primer)
2) Wasser MC-MIOMASTIC (full prime coat)
3) Wasser MC-FERROX A (finish coat)

This paint is a single component moisture cured micaceous iron oxide polyurethane paint that needs a surface preparation as described in special provision SP-171(92) and shown in Appendix B with the following requirements:

1) High pressure water washing with a minimum pressure of 3000 pounds per square inch at the nozzle.
2) Hand/Power tool cleaning areas of extensive rusting to SSPC SP-2 and SSPC SP-3.
3) Prior to painting, all surfaces are to be cleaned with hand brushing and

solvent wiping to SSPC SP-1.

The areas of extensive rusting that were hand/power tool cleaned were to be spot primed using the MC-MIOZINC to a dry film thickness (DFT) of three mils. Then the entire structure was to be primed using the MC-MIOMASTIC to a DFT of three mils. The final coat of paint was to be applied using the MC-FERROX A topcoat to a thickness of three mils.

Photo 2: View of first span to be high pressure washed.

CONSTRUCTION

The high pressure washing of the structure began on October 3, 1996 with Jensen Bridge Painting as the sub-contractor responsible for the painting portion of the contract. Work began with the western most bay as shown in photo 2.

Photo 3: View of trailer mounted high pressure washer.

The contractor expressed concern

about the required minimum temperature for painting on October 3 because of the late start date. The matter was discussed with the paint manufacturer who would warranty the product to 32E F and on October 16 the contractor was permitted to begin painting when the temperature was above 35E F and rising since that was the first time during the project the temperature remained below the specified minimum of 50E F.

Photo 3 exhibits the trailer mounted high pressure wash equipment. Photos 4 and 5 are views of a worker using the high pressure washer on one of the interior beams. Generally the washing and spot grinding went very well. Photo 6 exhibits one of the exterior beams after it has been washed with the high pressure washer. This is an area that requires spot grinding with a power hand grinder. This operation is depicted in photo 7.

Photo 4: Worker performing high pressure washing.

Photo 5: View of worker performing high pressure wash.

Photo 6: View of exterior beam after high pressure wash.

Photo 7: View of worker spot grinding.

This operation also proceeded very well with no complications. The spot priming operation was able to begin October 5 and no problems were encountered. The spot primer was applied with brushes. Photo 8 shows an area after the spot primer had been applied.

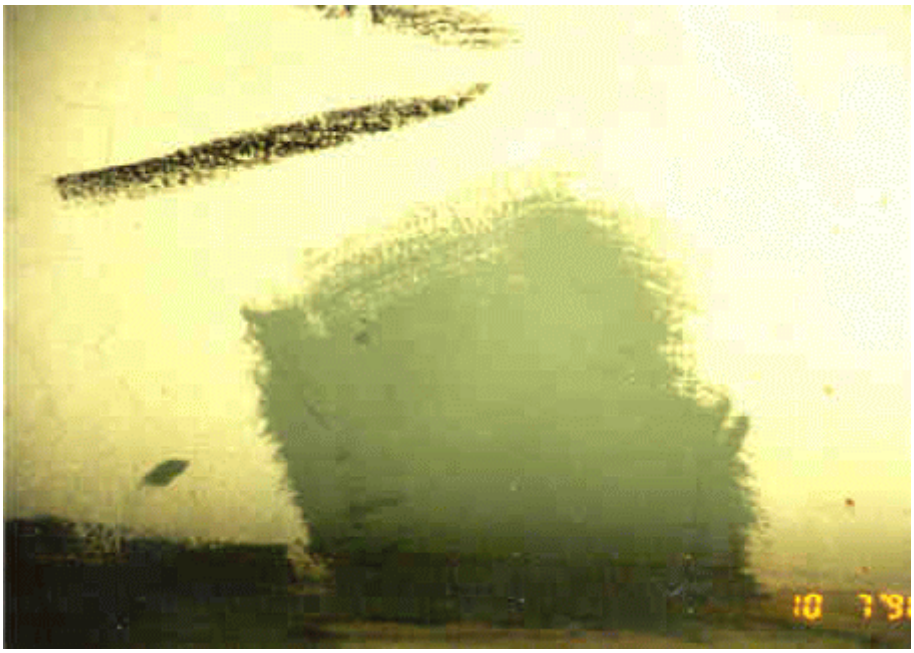


Photo 8: View of spot primed area.

The application of the full prime coat was able to begin on October 5, 1996. The finish coat was started on October 8. The prime coat and finish coat were applied using an airless sprayer and no problems were encountered with these operations. Photo 9 shows one of the exterior beams that had the full prime coat applied. Photo 10 is a close up view of the interior beams at a splice with the prime coat applied. On October 18 the contractor began applying paint when the temperature was below the original specified temperature of 50E F but above 35E F. For the rest of the project the temperatures remained in this range with two days rising above 50E F. The areas involved were the beams of the third and fourth spans. These temperatures did not appear to affect the application of the paint. This can be seen in photo 11 on page 9. The contractor finished the painting on October 24, 1996 . Photo 12 displays a close up view of a beam with the finish coat applied. The contractor had commented at this time on the ease of use with this product.

Photo 9: View of exterior beam with prime coat applied.

Photo 10: Close up view of beam splice with prime coat applied.

Photo 11: View of exterior beam with prime coat applied during cold weather.

Photo 12: Close up view of beam with finish coat applied.

Weather Conditions:

The weather conditions while work was in progress had the ranges as listed in Table 2.

Weather Condition	Minimum	Maximum
Temperature	36E F on 10/24/96	80E F on 10/05/96
Relative Humidity	19% on 10/18/96	77% on 10/05/96
Wind	calm on 10/15/96	19 MPH on 10/08/96

Table 2

COSTS

Refer to Table 3 for the costs associated with the Wasser paint system and the control structure.

Project	Paint System	Costs	
		Painting and/or Sand Blasting	Containment System
Westbound Bridge (94-160.649L)	Wasser	$40,000	N/A
Eastbound Bridge (94-160.649R)	Control Structure	$30,000	*$24,000

*The contractor removed the beams and transported them to a facility offsite for containment. A structure repainted in 1994 had a containment cost of $41,000. The containment was done on site for the 1994 project.

Table 3

The Wasser paint system had a cost savings of $14,000 on this project. The potential cost savings for other projects are $14,000 to $31,000 when compared to this project and the project in 1994.

EVALUATION

The evaluation team conducted the first year evaluation on December 17, 1997. There were no paint failures reported on either bridge. Some damaged areas were noted near the west end of the westbound structure. These appear to have been caused by other construction activities. Photo 13 is of the westbound structure and photo 14 is of the eastbound structure.

Photo 13: View of south side of westbound structure.

Photo 14: View of south side of eastbound structure.

The only discrepancy noted on the westbound structure was the paint color on the touch up areas on the north beam of the westbound structure did not match very well. This condition is shown in photo 15. These areas were caused by the scaffolding hanging from the structure for the deck work damaging the new beam which had been shop painted. All members of the team agreed that due to the location of the beam, this was quite acceptable. The entire evaluation team stated that both paint systems looked "exceptional".

Photo 15: View of north beam on westbound structure.

The second evaluation was on October 9, 2001. Some spot rusting were noted near the east end of the westbound structure (south beam). Photo 16 shows where the rust is starting to appear on the flange. This is only apparent on a four foot section of

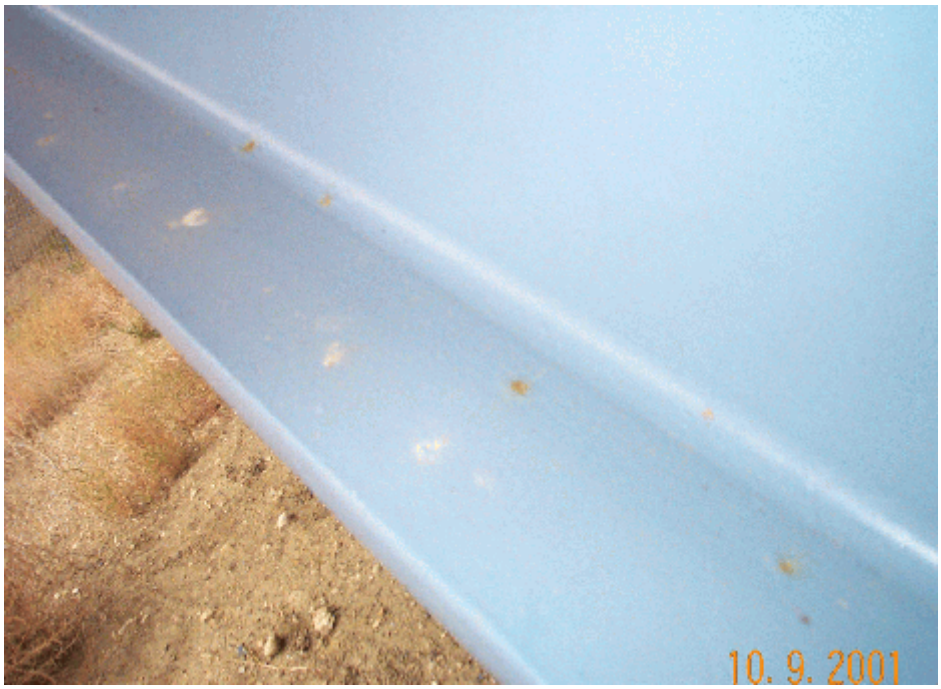


Photo 16: Spot rusting on south beam on westbound structure.

the flange.

Photo 17: Damaged south beam on westbound structure.

A damaged section on the west end of on the westbound structure was also noted (south beam). Photo 17 shows the damaged area. It appeared as if the paint had cracked along the top of the flange area which allowed moisture to enter.

The rest of the structure did not exhibit any other degree of rusting.

The control structure which is the eastbound Haycreek separation structure also had some damaged areas. As shown in Photo 18, staining which is associated with rust has covered much of the flange area. About half of the flanges were effected.

Photo 18: Staining associated with rusting on eastbound structure.

Staining also occurred under the beams. Many beams again were effected. Photo 19 shows a typical beam.

Photo 19: Staining underneath the beam on eastbound structure.

Other areas noted were staining and the presence of rusting starting to show around the bolts.

The paint system on the south beam of the eastbound structure appeared to be in good condition. No visible signs of staining or rust was apparent. Photo 20 shows the south beam of the control structure.

Photo 20: View of south beam on eastbound structure.

SUMMARY

At this time both structures have some staining associated with the forming of rust, however the control structure (eastbound structure) shows more signs of rust starting to appear through the paint.

There did not seem to be any other visible paint failures with either the "Wasser" single component moisture cured polyurethane paint on the westbound structure and the standard system on the eastbound structure.

RECOMMENDATION

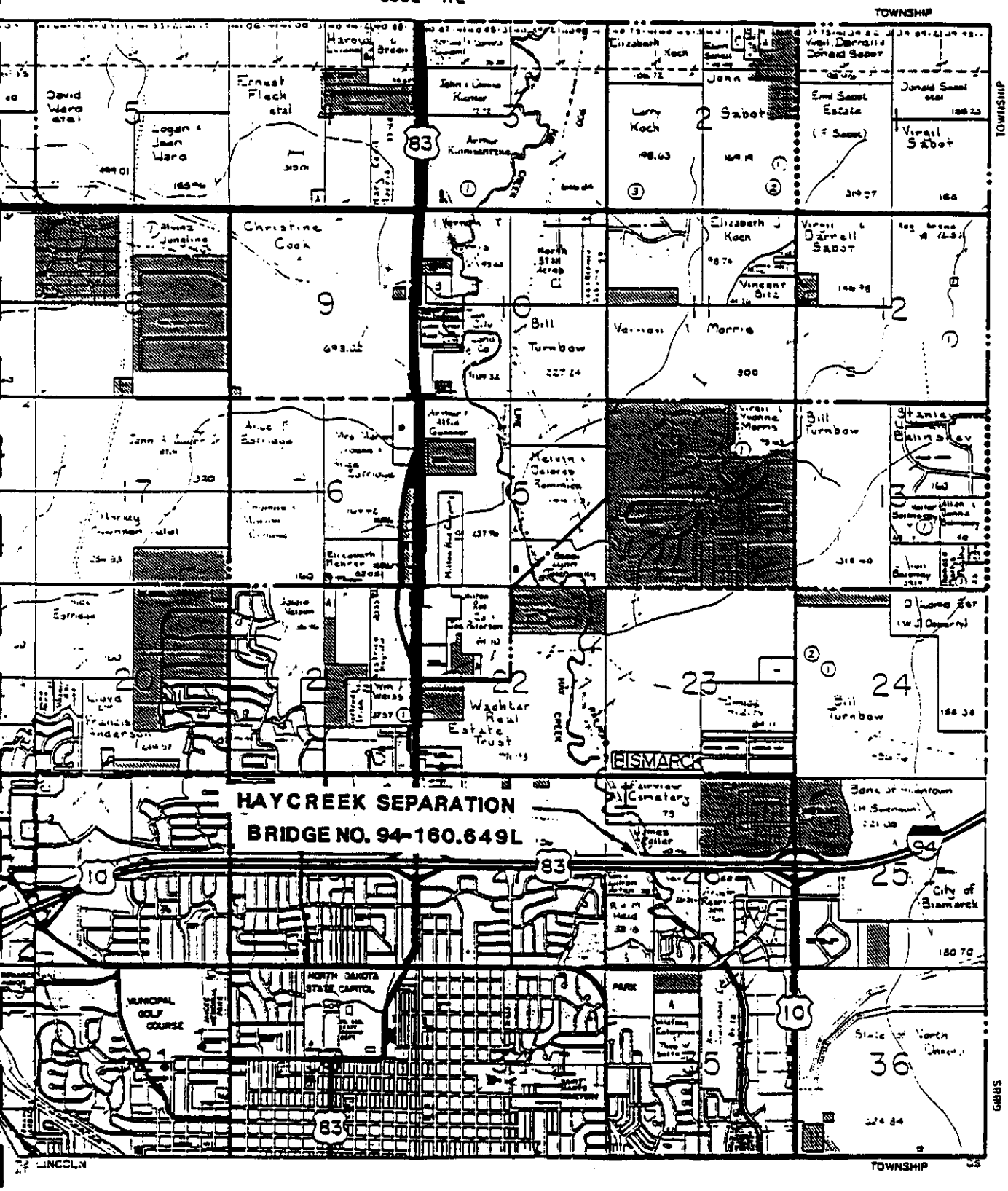
From this study, it has been determined that a single component moisture cured polyurethane paint overcoat system such as Wasser, which is marketed as an overcoating system requiring minimal surface preparation, is a viable alternative.

Appendix A

HAY CREEK

TOWNSHIP: 139 N. RANGE: 80 W

CODE: HE



SEE SMALL TRACT OWNERS SECTION FOLLOWING TOWNSHIP MAPS

Appendix B

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

BRIDGE PAINTING

PROJECT IM-1-094(017)156

FEBRUARY 16, 1996

DESCRIPTION

This work consists of furnishing all experimental paints and paint materials; preparing surfaces to be painted; applying , protecting, and drying paint coatings; and protecting all traffic, adjacent property, and the work itself against spatters or other damage due to painting operations according to Plan details and this Special Provision.

The experimental paint system for field painting of existing beams shall be a three coat system consisting of the following:

a) Wasser MC-MIOZINC
b) Wasser MC-MIOMASTIC
c) Wasser MC- FERROX A

Wasser High-Tech Coatings
Corporate Office
8041 South 228th Suite 102
Kent, WA 98032
(206)850-2967
(800)627-2968
(fax)206-850-3098

MATERIALS

1. The coating system for all steel surfaces to be painted shall consist of three single component, moisture-cure polyurethane coats and shall be manufactured by the same manufacturer and compatible with one another.

2. All paint shall be prepared at the factory ready for application. The addition of thinner or other material to the paint after the paint has been shipped shall not be permitted, except as recommended by the manufacturer and by permission of the Engineer. The Contractor shall furnish paint manufacturer's certification that the paint complies with paint system requirements specified.

3. Tinting - All tinting materials required shall be added to the paint at the time of paint manufacture. Field tinting is not allowed.

4. All containers shall be labeled showing the exact title of the paint, the manufacture'rs name, date of manufacture, manufacturer's batch number, and the specification number and the lot number.

5. Precautions concerning the handling and application of paint shall be shown on the label of the containers.

PHYSICAL PROPERTIES

Coating supplied shall conform to the following minimum requirements:

Spot Primer	
Generic Type:	Micaceous Iron Oxide/Zinc-rich, single component, moisture-cure polyurethane
Vehicle Type:	Moisture-cure polyurethane
Volume Solids:	60% minimum.
Pigment Type:	Micaceous Iron Oxide/Zinc dust
Dry film thickness:	3 mils, minimum
VOC:	Not to exceed 2.8 lb./gal.
Weight per Gallon:	Minimum 20 lb./gal.
Full Primer	
Generic Type	Micaceous Iron Oxide filled, single component, moisture-cure polyurethane.
Vehicle Type:	Moisture-cure polyurethane
Volume Solids:	60% minimum
Pigment Type:	6 lb. min./gal. Micaceous Iron Oxide
Color:	Tinted to distinguish from primer and topcoat
Dry film thickness:	3 mils, minimum
VOC:	Not to exceed 2.8 lb./gal.
Weight per Gallon:	Minimum 16 lb./gal.
Topcoat	
Generic Type	Micaceous Iron Oxide filled, single component, moisture-cure aliphatic polyurethane.
Vehicle Type:	Moisture-cure aliphatic polyurethane
Volume Solids:	60% minimum
Pigment Type:	4.0 lb. min./gal. Micaceous Iron Oxide
Finish:	Flat (low gloss)
Color:	To be specified by the Engineer
Dry film thickness:	3 mils, minimum
VOC:	Not to exceed 2.8 lb./gal.

PERFORMANCE PROPERTIES

1. Corrosion Resistance, ASTM B 117, Salt Spray Test

   Must pass 4000 hours minimum with less than 2 mm creep from scribe. Panels must be 1/8 inch cold rolled steel minimum, having SSPC SP-10 Near White Blast with 2-3 mils angular profile.

2. Accelerated Weathering, ASTM G 53

   Must pass 3000 hours QUV B bulb with no chalking, cracking, or gloss loss greater than 20 percent.

3. Forward Impact, ASTM D 2794

   Must pass minimum 150 lb. impact.

4. Abrasion Resistance, ASTM D 4060

   Less than 90 mg loss on CS-17 wheel, 1000 gram/load, 1000 cycles.

5. Moisture Resistance, ASTM D 4548

   Must pass 1000 hours with no change in appearance.

6. Flexibility, ASTM D 522, Conical Mandrel Bend Test

   Must pass 1/2 inch mandrel bend with no cracking.

Before use of any paint system, the Department shall be furnished a certified test report from an independent testing laboratory. This certified test report shall show that the specific test results meet all quantitative requirements and resistance test requirements of these Specifications. The Certified test report shall contain the exact ratio, by weight, of the pigment component to the vehicle component of the paint used for the tests, the lot tested, the manufacturer's name, brand name of paint, and date of manufacture. New certified test results shall be submitted any time the manufacturing process or the paint formulation is changed, New certified test results may be required when random sampling and testing of material offered for use indicates nonconformance to any of the requirements specified.

To obtain final acceptance of the paint system, a certification shall be furnished stating that the material used was the same as the material tested for manufacturer and brand name approval. The Department may sample and test any or all materials supplied.

CONSTRUCTION REQUIREMENTS

1. SURFACE CLEANING AND PREPARATION

   a) High Pressure Water Washing: High pressure water washing, utilizing equipment capable of a minimum 3000 psi at the nozzle, shall be performed by methods which will remove all dirt, loose paint, and other loose deleterious materials from all painted metal surfaces. Solvent Cleaning, SSPC SP-1 and Hand Tool Cleaning, SSPC SP-2, methods shall be used as necessary to augment water washing.

   b) Hand/Power Tool Cleaning: Areas of extensive rusting that show significant remaining rust, following high-pressure water washing, shall be cleaned in accordance with SSPC SP-2, Hand Tool Cleaning, and SSPC SP-3, Power Tool Cleaning. The edges of the existing sound paint surrounding the spot-cleaned areas shall be feathered and no loose or abrupt edges shall remain.

   c) Prior to painting, all metal surfaces shall be free of all cleaning residue, supplemented with hand-held brushing and solvent wiping (SP-1), if necessary. Cleaning shall be approved by the Engineer prior to painting.

d) Particular attention shall be given to edges, crevices, nuts, bolts and rivets.

e) Removal and disposal of hazardous waste material shall be performed in accordance with all applicable federal, state, county and local regulations.

2. APPLICATION REQUIREMENTS

a) Dry Film Thickness Schedule:

Spot Primer:	3 mils (75 microns) DFT
Full Prime:	3 mils (75 microns) DFT
Topcoat:	3 mils (75 microns) DFT

b) All painting to be performed under this contract shall be performed in conformance with the best practices of the trade, in conformance with recommendations of the coatings manufacturer, and in conformance with applicable portions of the Steel Structures Painting Council specification SSPC PA-1, when those specifications are not in conflict with this Special Provision or the Standard Specifications and Plan Notes. A written copy of the manufacturer's recommendations shall be furnished to the Department. The recommendations shall include the mixing and thinning directions; the recommended spray nozzles and pressures; the minimum drying time; and the procedures for coating bolts, nuts, and washers.

c) All surfaces cleaned to bare metal shall be coated with the specified prime coat the same working day. Any cleaned surface which rusts before the application of the prime coat shall be re-cleaned.

d) Paint film thickness measurements will be made during wet film application, utilizing an approved wet film thickness gage, in conjunction with an approved magnetic or digital dry film gage. One hundred percent of all thickness measurements shall be within the specified minimum dry film thickness. Where thickness measurements fall below the specified minimum, additional applications of paint shall be made as necessary to meet the thickness required, at no additional cost to the Department.

e) Sufficient time shall elapse between successive coats to permit them to dry properly for recoating. Consult specific product data sheets for proper cure times.

f) Weather Conditions. Paint shall only be applied when the air temperature is at or above 50 degrees F and below 100 degrees F. Paint shall not be applied when the air is misty, dusty, or otherwise unsatisfactory for work. The surface temperature of the steel shall be above the dew point (exhibits no moisture condensation) before painting is permitted.

g) Field painting shall not be accomplished until the form work is removed. All parts of the structure and adjacent property shall be protected from splatters of paint or paint materials. Canvas shields or other means may be required to protect traffic. Freshly painted surfaces shall be protected to prevent dust and dirt from contacting these surfaces. Protective shields shall be provided so paint drift does not damage adjacent parts of the structure and adjacent

property. Spray painting shall be suspended whenever the application or drift is not being properly controlled.

h) The Contractor shall have a representative available at the job site to receive and promptly process paint damage claims. The Contractor, or representative, shall record the name and address of the claimant, date, and nature of damage; amount of monetary damages sought, date paid; and promptly report all claims to the Engineer.

i) The spot prime shall be brush applied only. The full prime and top coat may be applied by brush, roller, or spray. After application, the paint film shall be smooth and uniform without skips or areas of excessive paint. When spraying results in unsatisfactory surfaces, paint shall be applied by brushing

METHOD OF MEASUREMENT

Measurement for painting shall be a Lump Sum item for furnishing and delivering all paint materials, preparing the surfaces, and applying the primer and finish coats of paint.

BASIS OF PAYMENT

Payment will be made at the Contract Unit Price as follows:

Pay Item	Pay Unit
Cleaning and Painting	Lump Sum

This payment will be full compensation for all labor, equipment, and materials necessary to complete the work.