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Transportation Agency Practices Currently Employed for Bridge Maintenance Painting Operations: Findings from a National Survey

Introduction

Determining the extent of coating deterioration and prioritizing maintenance painting projects state-wide can be a daunting task, particularly in states with more severe or dynamic climates. An accurate, representative and thorough assessment of the coating conditions provides the necessary information for prioritizing bridge painting projects and for determining the most cost effective maintenance strategies on a bridge-specific basis. Selection of optimum coating materials and corresponding levels of surface preparation are of critical importance in protecting bridge and highway structures from corrosion and for addressing aesthetics. In addition, none of the results of the assessments are of value unless communicated effectively through a guidance document that can be used by agency personnel for maintenance painting planning and painting operations.

The first objective of this research was to conduct a Transportation Research Synthesis (TRS) on behalf of the Minnesota Department of Transportation to determine policies, guidance, and manuals related to best practices for bridge maintenance painting operations that can be performed by agency personnel that are currently employed by representative Transportation Agencies. A questionnaire was prepared and distributed to fifty-two Transportation Agencies via a survey tool to determine common practices used by the agencies for maintenance painting of steel bridges. The survey contained questions in five topic areas such as evaluation of existing coating system conditions, maintenance painting practices, surface preparation standards used and coating systems employed for repair to existing coatings or replacement of existing coatings. The final task area inquired about Agency use of in-house maintenance personnel and independent industrial painting companies for maintenance painting.

The second objective was to identify the best practices appropriate for MnDOT from the results of the synthesis in order to develop a state-wide bridge maintenance painting program. The principal areas of study included guidance for conducting coating condition assessments on existing structures and guidance for developing maintenance strategies based on the condition and characteristics of the existing coating systems. Among key decision points addressed were: prioritizing structures for maintenance painting, determining the scope of maintenance painting projects and establishing the necessary degree(s) of surface preparation, selecting coating systems, and compatibility with existing systems when overcoating.

Summary

The Minnesota Department of Transportation (MnDOT) desired to investigate current practices for maintenance painting of steel bridges employed by other Transportation Agencies throughout the United States. KTA-Tator, Inc., an independent consulting firm working with the MnDOT Technical Advisory Panel, prepared a survey and, following review by the MnDOT Technical Advisory Panel, the survey was distributed to fifty-two agencies. Forty-two agencies returned the survey. The findings from review of agency responses are provided in this TRS.

Survey questions were developed for each of five Topic Areas, including 1) Coating Condition Assessments; 2) Bridge Coating Maintenance Strategies; 3) Surface Preparation Methods; 4) Coating Systems; and 5) Use of In-house Painting Forces versus Contractors. A summary of the data for each of the topic areas, comparisons to the practices currently employed by MnDOT, and recommendations are provided in the Summary and Recommendations section of this TRS.

Resources used to develop a list of transportation agencies included the American Association of State Highway & Transportation Officials (AASHTO) Research Advisory Committee (RAC) Listserv, member states of the AASHTO National Transportation Product Evaluation Program (NTPEP), and various transportation agencies that are either past or present clients of KTA. Each potential responding agency was provided a letter (via e-mail) describing the purpose and scope of the survey. Fifty-two agencies were contacted to participate.

Participation required that each respondent access, via the internet, a program called "Surveygizmo" and respond to the survey questions. The questions were designed to allow participants to respond by selecting one or, in some cases, more than one listed response. Additionally, some questions included a "comments box" allowing respondents to clarify a response or provide a response not available in the list of possible answers. Follow-up contacts were also made to selected respondents to seek participation, answer questions, and clarify information.

Information within the five topic areas was collected from 42 agencies through the survey process. Forty-three (43) of fifty-two (52) surveys were actually returned. However, one of the surveys returned was blank, effectively making the number of responses 42 (an 81% response rate). The results of each topic area are presented in this TRS. In addition, all survey recipients were offered the opportunity to receive a summary of the data collected. Thirty-seven agencies (88%) requested a copy of the synthesis report while five (12%) were not interested in receiving a copy.

Topic Area 1: Coating Condition Assessments

Coating condition assessments are performed to evaluate the integrity of existing coating systems and to determine the degree of rusting (corrosion) present on steel bridges. The approach can include evaluation of physical properties (adhesion, thickness, substrate condition) and chemical properties (generic resin type, lead on other toxic metal content) of the existing coating as well as the distribution and nature of rust on bridge structural steel. Decisions regarding maintenance painting are made based upon the findings.

Some transportation agencies rely on consultants to perform the field evaluations, while other agencies may use internal personnel to perform this activity. A combination of consultants and internal personnel may be used on larger bridge structures. In addition, there are some agencies that do not perform coating condition assessments at all. In this study, agencies were questioned regarding their practices for conducting coating condition assessments. The questions focused on who performs a coating condition assessment, what triggers a coating condition assessment and how those assessments are performed.

Results of Survey Topic Area 1

All response distributions are indicated as the percent of respondents providing any given answer with the number of respondents in parentheses. It should be noted that the questions may allow any one respondent to select more than a single response. Thus the percent distribution can exceed 100%.

Question 1: Does your agency use in-house personnel or outside consultants to perform Coating Condition Assessments?

There were 42 respondents distributed as follows[1].

- Our Agency does not conduct coating condition assessments on bridges 9.5% (4)
- Agency personnel only 33.3% (14)
- Consultants only 11.9% (5)
- Combination of Agency personnel and Consultants 42.2% (19)

[1] All response distributions are indicated as the percent of respondents providing any given answer with the number of respondents in parentheses.

Question 2: What triggers your Agency to perform a coating condition assessment on a given structure? Select all that apply[2].

There were 40 respondents with respondents distributed as follows.

- Age of the structure 12.5% (5)
- Age of the coating on the structure 32.5% (13)
- The coating rating from the biennial bridge inspection 77.5% (31)
- Traffic/Vehicle Load 0.0% (0)
- Calendar-based 10.0% (4)
- Other (please describe)

Comments received are listed below. There were 31 respondents that offered no additional comments.

- Complaint (1)
- District Bridge Engineer Recommendation (1)
- Field Personnel Review (1)
- Other rehabilitation work being performed on the structure (1)
- Painting project planning (1)
- Rehabilitation Project (1)
- We do not use it on all structures. We will use it in special cases such as Major Bridges. (1)
- Lead based paint removal (1)
- Visual (1)
- All bridges are given a general visual coating assessment as part of the biennial Pontis Bridge Inspection Program. More detailed assessment of bridge coatings (ABC) are performed for specific projects coming up either definitely or under consideration in the near future. The data in Pontis does not automatically trigger in-depth ABC. (1)
- If a bridge is scheduled for other work (such as widening), then the overall condition of the bridge is evaluated and repainting the bridge might be an option at that time. (1)
- Visual assessments are conducted by bridge inspection staff during each general inspection. More in depth evaluations, including dry film thickness readings and adhesion testing, are conducted when considering overcoat/recoat options (primarily for rehab projects). (1)

[2] It should be noted that questions such as this allows any one respondent to select more than a single response. Thus the percent distribution can exceed 100%.

Question 3: What does the coating condition assessment entail? Select all that apply.

There were 40 respondents distributed as follows.

- A cursory visual only (i.e., for entry into Pontis) 52.5% (21)
  - *No. of respondents who selected this option only (6)*
- A detailed visual (i.e., percentage of deterioration, type of coating deterioration, etc.) 72.5% (29)
  - *No. of respondents who selected this option only (7)*
- Physical attributes (i.e., adhesion, thickness, substrate condition, etc.) 47.5% (19)
  - *No. of respondents who selected this option only (1*)
- Hazardous metals analysis 32.5% (13)
  - *No. of respondents who selected this option only (0)*
- Generic coating type analysis 20.0% (8)
  - *No. of respondents who selected this option only (1)*
- Other

Twenty-five (25) respondents indicated that they use a combination of assessment techniques.

Comments received are listed below. There were 39 respondents offering no additional comments

- Mill Scale (1)
- Priority for Repaint (1)
- Overcoat patches & test (1)
- The level of ABC depends on the nature of the bridge. For routine bridges (e.g. overpasses, small bridges, etc.) the ABC is performed visually by more-trained DOT folks, including DFT, X-cut adhesion, VIS-2 rust grade, etc. For large bridges the Department may use a consultant for an in-depth ABC including RCRA metal check, etc. (1).

Question 4: If your Agency performs coating condition assessments, what "tools" do you use? Select all that apply.

There were 37 respondents with responses distributed as follows

- SSPC-VIS 2, Standard Method for Evaluating Degree of Rusting of Painted Steel Surfaces 56.8% (21)
- Custom photographic standards of various conditions /levels of coating deterioration 38.7% (14)
- Tensile adhesion testers 18.9% (7)
- Tape/knife adhesion testing equipment 51.4% (19)
- Destructive coating thickness measurement gages (e.g., Tooke gage) 32.4% (12)
- Non-destructive coating thickness measurement gages 43.2% (16)
- Ultrasonic thickness gages (steel thickness) 10.8% (4)
- Pit depth gages 5.4% (2)
- Soluble salt testing equipment 21.6% (8)
- Other

Comments received are listed below. There were 34 respondents offering no further comments.

- Only visual (2)
- Standard Photographs (1)

Current MnDOT Practices Relating to Coating Condition Assessments

Currently, MnDOT uses only agency personnel to perform bridge coating condition assessments and uses the coating rating from the biennial or annual bridge inspection. The assessment entails a cursory visual evaluation only; a detailed evaluation is performed when there is failing coating. The percentage of failed coating is estimated and entered into the SIMS program. Hazardous metals analysis is performed but only during the scoping of a project. MnDOT uses primarily visual inspection and does not use a standard method or guide. Sometimes tape/knife adhesion is performed and/or non-destructive coating thickness measurements are obtained when needed, but not as a common practice.

MnDOT would like to develop a custom photographic standard to promote consistent inspection statewide, and may develop guidelines on which assessment methods are appropriate for additional analysis based on the maintenance strategy selected.

Topic Area 2: Bridge Coating Maintenance Strategies

There are several options or strategies available for performing coating maintenance on steel bridges, such as spot touch-up, zone painting, overcoating and removal and replacement of the existing coating on the entire structure. Apart from removal and replacement, these other maintenance painting options can serve to extend the service life of existing coating systems, postpone major painting projects and address aesthetic issues separate from rusting and corrosion.

Several factors must be considered to determine where and when any given approach is selected. The foremost consideration is the actual condition of the existing coating system which can be established by the coating condition assessment process. Through review of the assessment data, maintenance painting options can be classified as low, medium or high risk. In addition to the coating condition assessment, other factors are also important in establishing which maintenance painting strategy (or strategies) will meet the maintenance objective. These factors may include department policy (i.e. postpone or prioritized work on bridges with lead paint), budgetary limits, packaging coating maintenance with other bridge maintenance tasks (i.e., deck or steel replacement), appearance to the traveling public and others. This Topic Area was surveyed to determine which maintenance painting strategies are commonly employed, what the decision making processes include and any constraints that are encountered by transportation agencies.

Maintenance strategies typically include five options: **1) Do nothing** simply reflects that either no maintenance painting is necessary; the coating is in good to very good condition or the condition may be poor but there is a decision to delay maintenance activities. **2) Spot repair** entails preparing and coating discrete areas where the coating system is degraded but by addressing these areas further corrosion can be delayed for two years or more. Typically the strategy includes approaches designed to address the degree of breakdown (coating only or coating and exposed substrates). **3) Zone painting** includes removal and replacement of the coatings over a defined location or area. Such locations are in a discrete service environment that is more aggressive and requires more frequent maintenance painting. Total coating removal and replacement in such locations greatly increases service life. **4) Spot repair and overcoat** includes performing spot repairs as described above followed by the application of a full additional coat to improve or restore barrier protection while improving overall appearance. **5) Full removal and replacement** is used to address widespread corrosion and coating deterioration. It also provides the longest duration of service life since all corrosion is removed and a full, high performance replacement coating system is applied. Distinguishing between these five options should help to place the responses to Question 1 below in context.

Results of Survey Topic Area 2

Question 1: Which of the following bridge coating maintenance strategies does your Agency employ? Select all that apply.

There were 37 respondents distributed as follows.

- (A) Spot touch-up (repair) 54.8% (23)
- (B) Zone painting (e.g., beneath expansions; fascia) 66.7% (28)
- (C) Spot touch-up and overcoat (entire structure) 50.0% (21)
- (D) Remove and replace the coating on the entire structure 90.5% (38)
- (E) Don't know 2.4% (1)

Note that many respondents selected two or more strategies:

- A & B (1)
- C & D (2)
- A & D (2)
- B & D (7)
- A, B, D (5)
- A, C, D (3)
- B, C, D (1)
- A - D (13)

Question 2: What drives your decision to employ a certain maintenance strategy? Select all that apply.

There were 41 respondents with responses distributed as follows.

- (A) Visual condition of the coating/bridge structure 61.0% (25)
  - *No. of respondents who selected this option only (1)*
- (B) Visual condition & physical attributes of the existing coating system (% deterioration, adhesion, thickness, corrosion, etc.) 80.5% (33)
  - *No. of respondents who selected this option only (5)*
- (C) Presence of hazardous metals 36.6% (15)
  - *No. of respondents who selected this option only (0)*
- (D) Available funding 80.5% (33)
  - *No. of respondents who selected this option only (2)*
- Other (please describe in comment box below)

Note that many respondents selected two or more decision drivers:

- B & D (16)
- A & D (3)
- B & C (1)
- A, C, D (3)
- A - D (10)

Comments received are listed below. There were 37 respondents offering no additional comments.

- Agreements (Town, Railroad, Coast Guard, etc.) & Time constraints (1)
- Bid Prices (1)
- Environment (marine vs western vs eastern part of the state) (1)
- Rehabilitation Project (1)
- Funding is the key element. All but a tiny amount of work is done by contract. Given that scenario, we specify the best coating treatment. (1)
- Tend to do zone painting when the exterior, which is exposed more, deteriorates quicker than the interior. In that case, we would paint the exterior of the exterior girders and areas around joints and abutments. (1)

Question 3: If your Agency employs overcoating as a bridge coating maintenance strategy, how do you assess compatibility with the existing coating system on the structure? Select all that apply.

There were 35 respondents distributed as follows.

• Rely on historical records	34.3 (12)
• Laboratory testing of existing paint to determine generic type	28.6% (10)
• Test patches	34.3% (10)
• Rely on consultants	27.5% (9)
• Rely on contractors/manufacturers	14.3% (5)
• We do not take specific steps to assess compatibility	14.3% (5)
• Other (please describe in comment box below)	

Comments received are listed below. There were 34 respondents offering no additional comments.

- Do not overcoat (1)
- Normally do not overcoat (1)
- Not necessarily used (1)
- Results of dry film thickness reading and adhesion test results (1)
- We avoid overcoating. If needed we'd probably rely on manufacturer (1)
- We do not overcoat (1)
- Overcoating is not a strategy (1)
- We only use overcoating occasionally. The coating has to be in pretty good shape to be foundational for a new system. If this is the case, the issue of compatibility is addressed by the surface tolerant system we use, single component moisture cure urethane. (1)

Question 4: How does your Agency prioritize bridge painting projects? Select all that apply.

There were 41 respondents distributed as follows.

- Based on the coating condition assessment data 78.1% (32)
- Solely based on the availability of funding 19.5% (8)
- Based on years of service 12.2% (5)
- Based on complaints from Districts or customers 31.7% (13)
- Based on the presence of hazardous metals (i.e., if present, assign a higher priority than non-lead containing bridges in the same state of repair) 22.0% (9)
- When other work on the structure is scheduled (e.g., deck replacement) 61% (25)
- Other (please describe in comment box below)

Comments received are listed below. There were 34 respondents offering no additional comments.

- Agency practices on preservation work (1)
- Fracture Critical given priority (1)
- Importance of structure being maintained (1)
- Preservation beam ends & bearings (1)
- Spot repair projects are based on District's workload (1)
- Importance of member/structure (1)
- Priorities submitted from 10 districts are prioritized by a formula that considers paint condition, age of structure, deck and superstructure condition, ADT etc. (1)
- Condition of the Paint and the importance of the bridge. Bridges with higher percentage of trucks will be painted first. (1)
- There are a lot of factors, mostly related to funding, importance of the bridge, other work, etc. and not driven strictly by the ABC. (1)

Current MnDOT Practices Relating to Bridge Coating Maintenance Strategies

Currently, MnDOT removes and replaces the coating on existing structures as their coating maintenance strategy; however, they would like to employ more zone painting preservation strategies through the development of a bridge maintenance painting program. The visual condition of the coating and bridge structure (and the presence of hazardous metals in the existing coatings (e.g., lead) drives the decision to remove and replace the coating system. Currently, MnDOT does minimal overcoating of the existing coating system and when performed they primarily rely on historical records and secondarily on laboratory testing of the existing coating type to help ensure compatibility with the overcoating materials. Most of the comments provided for Question 3 would indicate that few agencies employ overcoating as a maintenance strategy. To this end, MnDOT is seeking guidance on when overcoating would be more beneficial than removal and replacement of the existing coating system. MnDOT prioritizes bridge maintenance painting projects primarily based on the coating condition assessment data and secondarily when other work such as deck replacement on the structure is scheduled.

Topic Area 3: Surface Preparation Methods

Surface preparation standards serve to provide uniform understanding of properly cleaned and prepared surfaces for coating application. With these standards, owners, coating manufacturers, supervisors and field personnel are provided with a common and consistent understanding of how to achieve an adequate surface for a variety of coating products and coating systems. Surface preparation standards published by The Society for Protective Coatings (SSPC)[3] are commonly used throughout the transportation industry.

With respect to maintenance painting, surface preparation methods and standards may be thought of as *degrees of cleanliness*. Some of the standards invoke a lower degree of cleanliness (less aggressive) such as hand and power tool cleaning (SSPC-SP 2 and SSPC-SP 3, respectively) while others invoke a more aggressive degree of cleaning (SSPC-SP 6/NACE No. 3 and SSPC-SP 11, Commercial Blast Cleaning and Power Tool Cleaning to Bare Metal, respectively). The degree of cleanliness is determined based on the maintenance strategy selected for any given structure, component or steel element to be painted. Information sought in Topic Area 3 included how the degree (level) of surface preparation is determined and which methods of surface preparation, including both wet and dry methods, are commonly used. If wet methods are used, the agencies were surveyed on handling and discharge to determine what water management considerations are considered. Another factor to consider when determining surface preparation methods is the issue of soluble salts which accelerates corrosion of exposed steel. This is a known problem where deicing materials are used in winter and/or where chlorides from [sea] coastal environments are a concern. To address this issue, agencies were surveyed regarding the implementation of a salt remediation program.

Results of Survey Topic Area 3

Question 1: How does your Agency determine the level/degree of surface preparation to specify for a given project? Select all that apply.

There were 42 respondents distributed as follows.

- Extent of steel deterioration 57.1% (24)
- Costs of containment, if needed 14.3% (6)
- Proximity to sensitive receptors 9.5% (4)
- Access 23.8% (10)
- Tools/Equipment Availability 9.5% (4)
- Coating manufacturer requirements 50.0% (21)
- Other (please describe in comment box below)

Comments received are listed below. There were 31 respondents offering no additional comments.

[3] SSPC and NACE International have many joint surface preparation standards which are designated as SSPC/NACE or NACE/SSPC standards depending on the source of the published standard.

- Agency practice on preservation work (1)
- Clean all steel to SP 10 (1)
- Dependent on the Paint System that will be used (1)
- For Contract painting we set the standard to SP10 (1)
- Pre-tested chloride levels (1)
- Specification requires SSPC-SP 10, SP 11 (1)
- Specifications (1)
- Surface is prepared to an SSPC-SP 2 or 3 standard for overcoat and SSPC-SP 10 standard for recoat (1)
- The extent of coating condition (1)
- We always specify an SP 10 near white surface preparation (1)
- Specification requirements for paint item - *see section 411 of the 2007 VDOT Specifications http://www.virginiadot.org/business/resources/const/2007SpecBook.pdf* (1)
- SSPC-SP 6 is almost always required. An option for power tool cleaning is offered, however abrasive blasting appears to be the overwhelming choice by the contractors. (1)

Question 2: Indicate which (if any) of the following wet methods of surface preparation your Agency employs for bridge coating maintenance? Select all that apply.

There were 40 respondents distributed as follows.

- Our Agency does not employ wet methods of surface preparation 45.0% (18)
- Low Pressure Water Cleaning (<5,000 psi) 50.0% (20)
- High Pressure Water Cleaning (5,000-10,000 psi) 20.0% (8)
- High Pressure Water Jetting (10,000-30,000 psi) 10.0% (4)
- Ultrahigh Pressure Water Jetting (>30,000 psi) 10.0% (4)
- Wet abrasive blast cleaning 10.0% (4)

Question 3: When wet methods of surface preparation are employed, does your Agency specify the use of rust inhibitors to prevent rust-back when bare steel is exposed?

There were 23 respondents distributed as follows.

- Yes 26.1% (6)
- No 73.9% (17)

Question 4: When wet methods of surface preparation are employed, does your Agency capture the water?

There were 24 respondents distributed as follows.

- Yes, always 50.0% (12)
- Yes, but only for coatings that contain lead 12.5% (3)
- Yes, but only when washing is performed on bridge structures over protected waters (4.2%) (1)
- Yes, but only when washing is performed on bridge structures over protected waters **AND** the coatings contain lead 12.5% (3)
- No 20.8% (5)
- Don't know 0.0% (0)

Question 5: Indicate which (if any) of the following dry methods of surface preparation your Agency employs for bridge coating maintenance. Select all that apply.

There were 40 respondents distributed as follows.

- Hand tool cleaning (SSPC-SP 2) 62.5% (25)
- Power tool cleaning (SSPC-SP 3) 77.5% (31)
- Commercial grade power tool cleaning (SSPC-SP 15) 22.5% (9)
- Power tool cleaning to bare metal (SSPC-SP 11) 57.5% (23)
- Brush-off abrasive blast cleaning (SSPC-SP 7) 17.5% (7)
- Commercial abrasive blast cleaning (SSPC-SP 6) 37.5% (15)
- Near-white metal abrasive blast cleaning (SSPC-SP 10) 80.0% (32)
- White metal abrasive blast cleaning (SSPC-SP 5) 12.5% (5)
- Chemical stripping 7.5% (3)

Question 6: What methods of salt remediation does your Agency use to remove deposits from bridge elements prior to maintenance painting?

There were 41 respondents distributed as follows.

- Our Agency does not have a salt remediation program 29.3% (12)
- Pressure washing (water only) 24.4% (10)
- Pressure washing with soluble salt remover (e.g., Chlor-Rid®, HoldTight®, etc.) 19.5% (8)
- Blast cleaning using a blend of fine & coarse abrasive 4.9% (2)
- Blast cleaning, allowing rust to reform, then re-blast cleaning 2.4% (1)
- Steam cleaning 2.4% (1)
- Other (please describe in comment box below)

Comments received are listed below.

- Low pressure, high volume washing (1)
- Blast cleaning, apply a soluble salt remover, allow structure to re-rust and then re-blast (1)
- We allow all of the options listed above (1)
- Do not have an overarching program; have used pressure washing or blast cleaning with requirement to test for salt contamination prior to coating on specific projects (1)
- Contractors option of chloride remover or additional blasting. Typically, additional blasting is used. (1)
- After all surface preparation is completed; in the area of greatest corrosion no area shall have quantities greater than 7 $\mu g/cm^2$ (1)
- Pressure washing with water is required and then if soluble salts are detected the contractor is required to propose a method to remove them. (1)

Question 7: If post-remediation testing is performed to verify a reduction in surface salt contamination, what soluble salts do you test for? Select all that apply.

There were 34 respondents distributed as follows.

• Our Agency does not perform post-remediation testing	23.5% (8)
• Chloride	67.7% (23)
• Sulfates	23.5% (8)
• Nitrates	14.7% (5)
• Ferrous Ion	8.8% (3)
• Conductivity (non-ion-specific)	8.8% (3)
• Other (please describe in comment box below)	14.7% (5)

Comments received are listed below. There were 29 respondents offering no additional comments.

- Chlor*Test (1)
- On specific projects have required surface to be less than 100µS/cm (1)
- Same as above (1)
- N/A (1)
- Typically the ARP (conductivity) salt meter unless additive used in abrasive for lead paint removal. (1)

Question 8: Using the drop-down lists below, indicate the limits your Agency imposes for each of the soluble salts selected in Question 7.

Table 4.1 Soluble Salt Remediation Requirements of Responding Agencies

Ion Level	Chloride		Sulfate		Nitrate		Ferrous Ion		Conductivity		
Non-detectable	1	2.3%	1	2.3%	0	0.0%	1	2.3%	Non-detectable	1	2.3%
< 5 µg/cm2	6	14.0%	1	2.3%	0	0.0%	0	0.0%	< 5 µS/cm	0	0.0%
6-10 µg/cm2	13	30.2%	1	2.3%	3	7.0%	3	7.0%	6-10 µS/cm	1	2.3%
11-15 µg/cm2	1	2.3%	0	0.0%	1	2.3%	0	0.0%	11-15 µS/cm	0	0.0%
16-25 µg/cm2	0	0.0%	5	11.6%	0	0.0%	0	0.0%	16-25 µS/cm	0	0.0%
26-50 µg/cm2	0	0.0%	0	0.0%	0	0.0%	0	0.0%	26-50 µS/cm	1	2.3%
Total Performing Salt Testing	21	48.8%	8	18.6%	4	9.3%	4	9.3%	Total Measuring Conductivity	3[a]	7.0%

[a] A fourth respondent reported a limit of < 70 µS/cm

Many respondents indicated they tested for more than one salt ion.

Current MnDOT Practices Relating to Surface Preparation

Currently MnDOT relies on the coating manufacturer's requirements for surface preparation. The Agency does not currently employ wet methods of surface preparation; however low pressure water cleaning has been performed by a few in-house crews. Hand tool cleaning (SSPC-SP 2), power tool cleaning (SSPC-SP 3) and abrasive blast cleaning to a near-white metal condition (SSPC-SP 10/NACE No. 2) are the primary methods used to prepare steel surfaces for coating. MnDOT specifies SSPC-SP 10/NACE No. 2 for all contract-type painting work. MnDOT bridge crews use hand tools, power tools and abrasive blast cleaning. The bridge crews have prepared the steel to a "near-white" condition in the past, but have also blast cleaned to remove loose material only. MnDOT wants to develop guidance as to what degree of surface preparation is necessary for a bridge repainting project based on the many factors.

MnDOT specifies abrasive blast cleaning to remediate chloride contamination for contract painting, but is concerned as to the effectiveness of this process and whether it drives the contaminants into the steel (versus removing them). The maximum allowable surface chloride level is 7 micrograms per square centimeter (µg/cm^2); the Chlor-Test Kit is used for extraction and analysis. Recommendations for salt remediation are provided in the *Recommendations* section of this TRS.

Topic Area 4: Coating Systems

A discussion of coating systems employed is significant with regard to anticipated service life in differing environments (e.g. Southwest vs. Midwest) and the maintenance strategies and surface preparation methods that are employed. There are coating products that are considered to be "surface tolerant" and appropriate for application to surfaces that are prepared to lesser degrees of cleanliness (e.g., epoxy mastic, alkyds). There are also some very effective coatings suited to (and limited to) high degrees of surface preparation (inorganic zinc, organic zinc, thermal spray coatings), which are typically used when the existing coatings are fully removed and replaced. Such systems are also appropriate for zone coating removal where the service environment is particularly aggressive (e.g., bridge expansions and beam ends where deicing materials collect). Topic Area 4 was developed to determine which maintenance painting coating products and coating systems are commonly used.

Since there are numerous coating types and coating manufacturers, the selection of specific coating products and systems requires that they be deemed acceptable for use for a particular maintenance strategy. Coating products are commonly selected from "qualified product lists" (QPLs) or "approved products lists" (APLs) indicating the products have undergone testing to establish they are suitable for use. Many states have developed their own QPLs/APLs while others have jointly established performance requirements and qualification, for example; the North East Protective Coating Committee (NEPCOAT) which includes ten States (CT, DE, ME, MA, NH, NJ, NY, PA, RI and VT).[4] Independently generated coating system performance data can also be obtained from the AASHTO National Transportation Product Evaluation Program (NTPEP) to use when selecting an appropriate coating system.

Results of Survey Topic Area 4

Question 1: What generic type(s) of coating systems does your Agency employ for corrosion protection, based on **spot touch-up (repair) and overcoating** of the existing system? Select all that apply.

There were 42 respondents with responses distributed as follows.

- Our Agency does not perform spot painting to maintain the existing bridge coating system 23.8% (10)
- Our Agency does not perform spot repair/overcoating to maintain the existing bridge coating system 16.7% (7)
- Epoxy mastic primer, polyurethane finish 28.6% (12)
- Epoxy mastic primer, waterborne acrylic finish 2.4% (1
- Epoxy mastic primer, polysiloxane finish 0.0% (0)
- Epoxy penetrating sealer, epoxy mastic, polyurethane finish 19.1% (8)
- Epoxy penetrating sealer, epoxy mastic, waterborne acrylic finish 9.5% (4)
- Epoxy penetrating sealer, epoxy mastic, polysiloxane finish 2.4% (1)
- Calcium sulfonate alkyd 11.9% (5)

[4] http://www.nepcoat.org

- Alkyd 9.5% (4)
- Waterborne acrylic 19.1% (8)
- Moisture cured urethane 35.7% (15)
- Other (please describe in comment box below)

Comments received are listed below. There were 38 respondents offering no additional comments.

- Dependent on the coating system being overcoated. (1)
- Don't spot paint (1)
- Epoxy primer and urethane finish (1)
- For Spot Painting only. We do not overcoat. (1)
- Please understand this point. The NHDOT no longer does maintenance painting, except a very tiny amount, which would be considered spot/zone painting at bearings and beam ends only. They use Rustoleum alkyd. All the rest of maintenance painting is done by the Bridge Design office via Contract. If suitable we use spot repair and overcoat using moisture cure urethane coatings. (1)

Question 2: What generic type(s) of coating systems does your Agency employ for corrosion protection, based on **removal and replacement of the existing system**? Select all that apply.

There were 42 respondents with responses distributed as follows.

- Inorganic zinc primer, epoxy mid-coat, polyurethane finish 31.0% (13)
- Inorganic zinc primer, epoxy mid-coat, polysiloxane finish 2.4% (1)
- Inorganic zinc primer, epoxy mid-coat, fluoropolymer finish 0.0% (0)
- Inorganic zinc primer, water borne acrylic finish 9.5% (4)
- Organic zinc primer, epoxy mid-coat, polyurethane finish 64.3% (27)
- Organic zinc primer, epoxy mid-coat, polysiloxane finish 9.5% (4)
- Organic zinc primer, epoxy mid-coat, fluoropolymer finish 0.0% (0)
- Organic zinc primer, water borne acrylic finish 11.9% (5)
- Multi-coat alkyd system 2.4% (1)
- Metalizing without seal coats 4.8% (2)
- Metalizing with seal coats 16.7% (7)
- Other (please describe in comment box below) 28.6% (12)

Comments received are listed below. There were 32 respondents offering no additional comments.

- MCU primer, mid, and finish (1)
- Metalize with seal coat - Pilot only (1)
- Moisture Cured Urethane (1)
- Moisture cured urethane (1)
- Organic zinc primer, epoxy or polyurethane mid-coat, polyurethane finish (1)
- Would also consider 2-coat zinc/polysiloxane systems (1)

- Zinc primer, Waterborne acrylic mid & top coat (1)
- Zinc-rich primer, MC polyurethane mid-coat, polyurethane finish (will be adopting NEPCOAT soon) (1)
- Waterborne acrylic latex system (1)
- Organic zinc moisture cured Polyurethane primer / moisture cured Polyurethane intermediate coat / moisture cured Polyurethane top coat (1)
- Our normal practice for total removal is to apply a three-coat moisture-cure urethane system. Sometimes we add a fourth clear coat on fascia beams for anti-graffiti and UV & color protection. There may be specialized bridges that receive a slightly different treatment, such as zinc/tar/tar moisture cure system if the bridge is in a marine setting low to the water. We painted a major bridge with metallizing and one seal coat and were very pleased. We would like to use TSC more often but the bridge has to be important enough to justify the cost (1)

Question 3: Does your Agency use a Qualified Products List (QPL) of approved bridge coating systems?

There were 42 respondents distributed as follows.

- Yes 57.1% (24)
- Yes, but for contract painting only 21.4% (9)
- No 21.4% (9)

Current MnDOT Practices Relating to Coating System Selection

Currently, MnDOT does not perform consistent spot painting to maintain the coating system but would like to set up a program using an epoxy mastic primer/polyurethane finish coating system for spot painting. Depending on the project or structure, an epoxy penetrating sealer may also be warranted. MnDOT primarily specifies an organic zinc-rich primer, epoxy mid-coat and polyurethane finish coat when the coating systems is removed and replaced by contract personnel. Currently, MnDOT's APL is specific to contract painting for removal and replacement of the coating system; however, the Agency desires to establish a maintenance coating system APL as part of the development of a bridge maintenance painting manual.

Topic Area 5: Use of In-house Painting Forces versus Contractors

MnDOT would like to develop a comprehensive in-house maintenance painting program administered by the Department's Districts. With respect to maintenance painting, there are several factors known to influence who will be executing the work. Examples include the presence of toxic metals (e.g., lead) in the existing coating system, capability of in-house crews, project size, etc. Additionally, in-house painting crews require guidance and training to properly perform their work. Therefore, Topic Area 5 focuses on whether other agencies employ in-house forces to perform maintenance painting, what factors are considered when allocating the work, what percent of the maintenance budget is allocated to maintenance painting, and what guidance and training are provided to the work force.

Results of Survey Topic Area 5

Question 1: Approximately what percentage of your annual bridge maintenance budget is allocated to painting?

There were 38 respondents with respondents distributed as follows.

- <1% 29.0% (11)
- 10% 42.1% (16)
- 25% 23.7% (9)
- 50% 2.1% (1)
- >50% 2.1% (1)

Question 2: Which of the following describes your Agency related to the use of in-house crews versus contracting to accomplish the bridge coating maintenance program?

There were 42 respondents with responses distributed as follows.

- Our Agency uses in-house crews exclusively, even when hazardous metals are present. 2.4% (1)
- Our Agency uses contractors exclusively; we do not use in-house crews. 64.3% (27)
- Our Agency uses a combination of in-house crews and industrial painting contractors to accomplish our bridge coating maintenance program. 33.3% (14)

Question 3: If hazardous metals are present on the structure, do you use in-house crews to perform maintenance painting?

There were 23 respondents distributed as follows.

- Yes 47.8% (11)
- No 52.2% (12)

Question 4: When you use a combination of in-house crews and contract painting for your painting program, what criteria do you employ to decide whether to use in-house crews or to bid the work to industrial painting contractors? Check all that apply.

There were 42 respondents distributed as follows.

- Presence of hazardous metals 37.5% (6)
- Square footage of area requiring maintenance 75.0% (12)
- Access to perform the work 25.0% (4)
- Cost 31.3% (5)
- Traffic 18.8 % (3)
- Capability of local crews 56.3% (9)
- Other (please describe in comment box below) 18.8% (3)

Comments received are listed below. There were 41 respondents offering no additional comments.

- If we are overcoating then we do it. If it is blast cleaned then by contract. (1)
- All the maintenance painting work is done by industrial painting contractors except for a very small amount of spot work done by the Department. (1)
- In-house crews will work even if there is existing lead-based paint (Q. 21) (1)

Question 5: What scope of work is performed by in-house crews? Select all that apply.

There were 17 respondents distributed as follows.

- Localized coating breakdown 41.2% (7)
- Bearings 47.1% (8)
- Beam Ends 52.9% (9)
- Fascia Beams 17.7% (3)
- Can be any amount of work depending on specific needs 41.2% (7)

Question 6: When you use in-house crews to perform bridge coating maintenance painting, what type of training do they receive?

There were 17 respondents distributed as follows.

- In-house instructor-led training 11.8% (2)
- On-line training 0.0% (0)
- Industry-based training (SSPC, NACE, other courses) 29.4% (5)
- On-the-job training 58.8% (10)
- None 0.0% (0)

Question 7: When performing bridge maintenance painting, which documents are used to ensure that the work is done properly? Select all that apply.

There were 42 respondents distributed as follows.

- Coating manufacturer's Product Data Sheets/Application Instructions 81.0% (34)
- Agency standard specification/technical special provisions 81.0% (34)
- Agency Best Practices Manual 9.5% (4)
- Other (please describe in comment box below) 16.7% (7)

Comments received are listed below. There were 36 respondents offering no additional comments.

- Data sheets by state forces/specs by contracted forces (1)
- NEPCOAT List (1)
- Remember, 99% of maintenance painting is by contract, governed by specification. (1)

- SSPC Manuals (1)
- SSPC QP 1 and 2 (1)
- Specification currently under revision (1)
- By maintenance painting, I assume you're talking about complete removal and recoat. For those applications, we'd use the first two choices: Coating Manufacturer's Data Sheets / Application Instructions and Agency standard specifications. (1)

Current MnDOT Practices Relating to Use of In-house Painting Forces versus Contractors

Currently, less than 1% of MnDOT's annual bridge maintenance budget is allocated to painting. Most of MnDOT's painting is done through contract. There is some maintenance painting performed by agency crews, but it is not consistent across the state. Further, MnDOT has typically focused on beam ends but would like to maintain other bridge elements using in-house forces with a more formalized maintenance painting program. In-house crews only perform maintenance painting on areas less than 500 square feet per bridge, per year when lead is present on the structure. MnDOT currently relies on "on-the-job" training to educate workers; however there is a desire to update instructor-led training and perhaps create training videos to supplement the on-the-job training. Finally, in-house crews typically rely on coating manufacturer product data sheets (PDS) to mix and apply the coatings properly, while the MnDOT Standard Specifications and Special Provisions (in conjunction with manufacturer's PDS) are used for contract painting.

Summary and Recommendations

Following is a summary of the information captured by the national survey for each of the five topic areas. Recommendations to MnDOT are also provided for each topic area.

Topic Area 1: Coating Condition Assessments

Summary: Responses to the questions about coating condition assessments revealed that most assessments are conducted using agency personnel (33%) or a combination of agency personnel and consultants (42%). When combined, this indicates agency personnel are engaged in 75% of the assessments. Less than 10% of the respondents do not conduct condition assessments. Similar to many of the other agencies that responded, MnDOT typically performs coating condition assessments using agency personnel, however there is consideration for using a combination of Agency personnel and Consultants on large bridge structures.

Biennial bridge examination findings are reported to be the primary trigger for performing coating condition assessments (77%) while the age of the existing coating on the structure accounted for 33% of coating assessment triggers. MnDOT currently uses the coating rating from the biennial or annual bridge inspection to trigger maintenance painting. In addition to the answer choices provided, there were twelve comments offered. These included performing coating condition assessments when the bridge is scheduled for other work, and more detailed assessments if the visual observations suggest overcoating may be a maintenance option.

The level of detail for coating condition assessments may vary depending on the project. Since more than one response was possible, the total number of responses was greater than the number of participants. For example, visual examinations (cursory and detailed) accounted for 50 responses from 40 agencies (125%). Physical attributes are used by 48% of the participants, 34% perform hazardous metals analysis and 20% test for the generic coating type applied. Comments provided indicated repainting priority may be established by the coating condition assessment. Overcoating test patches and the nature of the bridge influence how detailed the assessments become. One respondent indicated small bridges are evaluated by in-house personnel but large bridges are evaluated by consultants. In comparison, MnDOT primarily uses only visual inspection to assess coating condition; although, a hazardous metals analysis may be conducted to determine the scope of a specific project.

The tools employed for condition assessment also revealed multiple responses. SSPC-VIS 2, tape adhesion testing, dry film thickness measurements, and custom photographic standards were the most frequently selected tools. MnDOT again primarily uses only visual inspection to assess the existing coating condition; however there is a desire to develop custom photographic standards to enable consistent condition assessments state-wide.

Recommendations: Since the condition of the existing coating system drives the maintenance painting options (do nothing, spot repair, zone painting, spot repair and overcoat; remove and replace), an accurate assessment of the existing condition is paramount. KTA recommends developing a standard set of bridge element condition images (digital photographs) depicting condition state Categories 1 through 4 to follow the new AASHTO NBE guidance (Good, Fair, Poor, Severe) for BME Element 515 Steel Protective Coating. This includes steel elements such as beams (and beam ends), box girders, stringers, trusses, arches, floor beams, columns, piles, gusset plates, pin and hanger assemblies, pier caps, bearings and railings. In this manner, MnDOT will improve the consistency of the coating condition assessment data across the State. If spot repair and overcoat is a desirable maintenance option for a given structure, then it is recommended that additional testing (substrate examination, adhesion, coating thickness, surface salt concentrations lead or other toxic metals and identification of existing coating type) be undertaken to verify the integrity of the existing coating and compatibility with the new system. These additional tests are unnecessary if the coating is going to be completely removed and replaced (on a zone or structure basis). The use of more detailed coating condition assessments, when warranted is an important process for establishing condition thresholds for which maintenance painting strategies are appropriate and determining risk. Further, it aides in making priority planning in relation to condition options, and establishing bridge maintenance painting priorities.

Topic Area 2: Bridge Coating Maintenance Strategies

Summary: Bridge coating maintenance options elicited 111 responses from 37 participants. Clearly, multiple maintenance strategies are used by the majority of agencies. The distribution of maintenance painting strategies included removal and replacement (90%), zone painting (67%), spot touch-up (55%) and spot touch-up with full overcoat (50%). MnDOT also typically employs removal and replacement using contractor forces as well as some zone painting using agency forces.

The two most significant factors that drive decision making for selecting coating maintenance options were visual and physical condition of the coating and available funding for the responding agencies. In comparison, MnDOT typically relies on visual assessment alone to determine a maintenance strategy. Hazardous metals also need to be considered when determining whether a project can be completed by MnDOT forces. When overcoating is the strategy selected, respondents indicated that coating compatibility was determined through historical records, laboratory testing, test patches, and consultant recommendations. It should be noted that overcoating is not a strategy that is commonly employed by those agencies surveyed. MnDOT primarily relies on historical records and, in some instances, laboratory testing to determine the generic type of the existing coating system.

Setting high priorities for bridge painting projects relies most heavily on the coating condition assessment findings followed by complaints and funding. The priority for maintenance painting is increased when other maintenance work has been scheduled for the bridge (such as deck replacement). All things being equal, several agencies would place a bridge with lead paint present ahead of a bridge without lead paint present on the maintenance schedule.

Recommendations: Spot touch-up and overcoating can be a cost-effective maintenance strategy to prolong the life of the existing coating system. In this manner, the funding required to perform removal and replacement can be carefully budgeted (planned) 5-7 years ahead. However, the existing coating condition as well as the condition of the substrate beneath must be carefully assessed to reduce the risk of failure. And the existing coating should be analyzed (or historical records accessed) to determine the generic coating type for compatibility with the overcoat system. If the amount of coating deterioration is 10-20% of the total coated area, then removal and replacement of the coating system should be considered, as the amount of spot touch-up will likely not be economical. Further, MnDOT will need to establish an APL for overcoat systems, complete with surface preparation requirements, and pressure washing and surface soluble salt testing must be considered when overcoating an existing system. Spot-touch-up and overcoating can be performed by contract or using in-house forces.

Topic Area 3: Surface Preparation Methods

Summary: Selection of which surface preparation methods should be employed for any given project was most frequently based on the condition (deterioration) of the steel (57%). However, coating manufacturer requirements was nearly as frequent (50%). MnDOT also typically relies on coating manufacturer requirements when selecting surface preparation methods. As indicated by the percentage distribution, each respondent could provide more than one answer. However, it was not clear how the condition of the steel and coating manufacturer requirements are linked. The manufacturer may be involved in advocating certain products based on the surface preparation method chosen, or approved products may be selected for use and the surface preparation driven by manufacturer recommendations. Access (24%) was the third most common response while the cost of containment (14%), availability of tools and equipment and proximity to sensitive receptors (9.5% each) were three other factors identified when selecting a surface preparation method. Review of the comments provided by responders indicated that, in reality, surface preparation and coating products are mostly driven by specifications, perhaps with some project-specific modifications. Had one of the selected options been "Specification Requirements," the distribution of responses may have been quite different.

For the nine (9) north central states, 50% cite coating manufacturer requirements for surface preparation specifications, while the remaining base the decision on extent of steel deterioration, access or "other" (see comments).

With regard to using wet methods of surface preparation, slightly less than one-half of the responders (45%) indicated they do not use wet methods for surface preparation. However, one-half (50%) responded they use low pressure water cleaning (LPWC, < 5,000 psi) which may be seen by some agencies as cleaning or washing and not surface preparation per se. High pressure water cleaning (HPWC at 5,000-10,000 psi) was indicated by 20% of respondents while high pressure water jetting (HPWJ, 10,000-30,000 psi), ultra-high water jetting (UHPWJ,>30,000 psi) and wet abrasive blast cleaning (WAB) were each 10% of the total responses. Since multiple responses were available to each agency it is possible that HPWJ and UHPWJ are both selected by a given agency. There were 40 of 42 agencies that responded to this inquiry. MnDOT does not typically employ wet methods of surface preparation; however, some agency forces have used low pressure water cleaning. Seven of the same nine north centrally-located agencies do not use wet methods of surface preparation.

Of the agencies that responded, 74% (17) do not use rust inhibitors when using wet methods of surface preparation. Only 23 responses were received for this question, compared to 40 who responded to the previous question. This is most likely due to the fact that many agencies do not employ wet methods.

Agencies were also asked about the handling of [waste] water generated by wet surface preparation methods. One-half (12) of the 24 responders reported they always capture the water. Only 21% (5) responded that they do not capture the water. The remaining responders reported that water was collected when working over protected waters and the coating contains lead (3). Only 1 respondent reported that water was collected when working over protected waters whether lead was present or not.

There were 40 respondents that reported which dry methods of surface preparation their agency employs. Since multiple responses were allowed, there were 160 total responses. Simply stated, agencies use multiple surface preparation methods. Eighty percent (80%) of responders use abrasive blast cleaning per SSPC-SP 10/NACE No. 2 (Near White Abrasive Blast Cleaning). SSPC-SP 3 (Power Tool Cleaning) is used by 76% of the agencies followed by 63% using SSPC-SP 2 (Hand Tool Cleaning). Commercial Grade Power Tool Cleaning (SSPC-SP 15) and Commercial Blast Cleaning (SSPC-SP 6/NACE No. 3) are used by 23% and 38% of the agencies, respectively. The prevalence of SSPC-SP 10 probably coincides with the number of agencies that perform removal and replacement contracts. If looking solely at maintenance painting with in-house forces, the distribution may be different.

Hand tool cleaning (SSPC-SP 2), power tool cleaning (SSPC-SP 3) and abrasive blast cleaning to a near-white metal condition (SSPC-SP 10/NACE No. 2) are the primary methods used by MnDOT to prepare steel surfaces for coating. MnDOT specifies SSPC-SP 10/NACE No. 2 for all contract-type painting work. MnDOT bridge crews use hand tools, power tools and abrasive blast cleaning. These procedures appear similar to those used by the north central states

surveyed. Commercial abrasive blast cleaning (SSPC-SP 6/NACE No. 3) was also indicated as a method of surface preparation employed by the north central states.

Soluble salts, particularly chloride salts are a significant contributor to corrosion on steel bridges. Whether the source is from deicing materials or salt laden coastal environments some agencies use salt remediation methods. Forty-one agencies responded to the question about which salt remediation procedures they employ. Pressure washing with water (only) is the most common method (24%) while pressure washing with a soluble salt removal additive was the second most common method (20%). Interestingly, 29% of the agencies do not have a salt remediation program. The remaining agencies reported using abrasive blast cleaning (3) or steam cleaning (1). MnDOT specifies abrasive blast cleaning to remediate chloride contamination for contract painting, but is concerned as to the effectiveness of this process and whether it drives the contaminants into the steel (versus removing them). Only three of the nine north central states indicated that they have a salt remediation program and that they perform post-remediation testing.

The participating agencies were also asked about testing for soluble salts following remediation. There were 34 responders of which 8 reported they did not perform post remediation testing (24%). The remaining 26 respondents were asked to identify which testing they perform. The selection options ranged from a single salt ion, to any combination of up to three additional salt ions and testing for conductivity[5]. It was not surprising that the majority of agencies (68%) reported performing chloride ion testing. There are agencies that test for multiple ions and/or conductivity. The distribution is shown in the following table.

Post Remediation Testing

Agencies Testing for =>	One Soluble Salt	Two Soluble Salts	Three Soluble Salts	Four Soluble Salts
Number of Agencies	14	3	5	1
AND Conductivity	1	1	0	1

One respondent reported that they perform conductivity measurements exclusively. The most common soluble salt acceptance ranges, reported in micrograms per square centimeter ($\mu g/cm^2$) of surface were: chloride 6-10 $\mu g/cm^2$and sulfate 16-25 $\mu g/cm^2$; nitrate and ferrous ion were both 6-10 $\mu g/cm^2$. No conductivity range was selected more than once. The range was "less than detectable" to < 70 µS/cm. MnDOT invokes a maximum allowable surface chloride level of 7 $\mu g/cm^2$; the Chlor-Test Kit is used for extraction and analysis of surface soluble salts (chloride ion only).

Recommendations: Following are recommendations related to surface preparation methods and degrees of surface cleanliness; chloride remediation; and post chloride remediation testing for each of three maintenance strategies that may be employed by MnDOT.

[5] The test options ion specific tests include Cl-, SO4=, NO3- and Fe+2. Conductivity test values increase as soluble salt concentrations increase. However, conductivity testing does not provide the identity of the specific ion in solution.

Spot Touch-up

Surface preparation methods may include pressure washing, followed by degreasing (as necessary, per SSPC-SP 1) and hand or power tool cleaning (SSPC-SP 2/SSPC-SP 3). If a greater degree of surface cleanliness (and roughness) is desired SSPC-SP 15, Commercial Grade Power Tool Cleaning) may be performed (particularly when heavy rust, pitting and pack rust are present). The prepared areas should be transitioned (feathered) into the existing coatings. Chloride remediation may be performed during the pressure washing procedure (with or without a proprietary solution), followed by testing using currently employed methods (Chlor-Test); the current threshold of 7 $\mu g/cm^2$ is reasonable. Testing is particularly important where heavy rust and pitting exist and should be conducted independent of whether maintenance painting is being performed by in-house crews or by contract.

Spot Touch-up and Overcoat

Surface preparation methods should include pressure washing, followed by degreasing (as necessary, per SSPC-SP 1) and hand or power tool cleaning (SSPC-SP 2/SSPC-SP 3). The surface should be scrubbed during pressure washing to ensure the removal of dirt and chalking paint, etc. If a greater degree of surface cleanliness (and roughness) is desired in the spot touch-up areas, SSPC-SP 15, Commercial Grade Power Tool Cleaning) may be performed. The prepared areas should be transitioned (feathered) into the existing coatings. Chloride remediation may be performed during the pressure washing procedure (with or without a proprietary solution), followed by testing using currently employed methods (Chlor-Test); the current threshold of 7 $\mu g/cm^2$ is reasonable.

Total Removal & Replacement

Prior to abrasive blast cleaning, grease/oil contamination must be removed (as necessary, per SSPC-SP 1) followed by testing representative surfaces for chloride levels. If chloride levels exceed 7 $\mu g/cm^2$ chloride remediation should be performed prior to abrasive blast cleaning. Chloride remediation may be performed by pressure washing (with or without a proprietary solution), followed by testing using currently employed methods (Chlor-Test); the current threshold of 7 $\mu g/cm^2$ is reasonable. Abrasive blast cleaning according to SSPC-SP 10, Near-White Metal Blast Cleaning should then be performed and the specified surface profile depth should be achieved.

Topic Area 4: Coating Systems

Summary: Each respondent was asked to identify the generic coating systems used for maintenance painting when spot repair and overcoating are performed. Ten of the 42 responses (24%) reported that their agency does not perform spot repairs for maintenance painting. An additional 7 responders (17%) reported that their agency does not perform spot repair/over coating. The most common coating systems used by agencies that do perform spot repairs and/or spot repair and overcoating (in order) were moisture cure urethane (MCU), epoxy mastic (EM) and polyurethane (PU), epoxy penetrating sealer (EPS) with EM and PU, and waterborne acrylic (ACR). Calcium sulfonate alkyd and alkyd coatings are also used. Comments confirmed that selection of a coating system can be dependent on the existing coating system (for compatibility reasons), and one agency noted that they no longer do maintenance painting except for zone painting at bearings and beam ends. Based on the regional data, it appears that the Northeast

region (predominate region that conducts spot touch-up/overcoat) uses EM/PU system (with and without an EPS). MCU systems are also common.

Currently, MnDOT does not perform consistent spot painting to maintain the coating system but would like to set up a program using an epoxy mastic primer/polyurethane finish coating system for spot painting. Depending on the project or structure, an epoxy penetrating sealer may also be warranted.

Information was also requested regarding what generic coating systems are employed when existing coatings are removed and replaced. The most commonly used system consists of organic zinc rich primer (OZR) with epoxy (E) mid-coat and PU finish coat, which was selected by 64% of the 42 agencies. MnDOT also typically uses this coating system when existing coatings are removed and replaced. Inorganic zinc (IOZ), E mid-coat and PU finish coat was the second most common system selected (31%). Thermal spray coating (TSC) with a seal coat was identified by 17% of the respondents and 12% of respondents identified a system consisting of OZR primer with an ACR. Twelve comments were provided which included variations of the systems described above. More important were comments indicating MCU was employed by 12% of the respondents. Coating products from specific manufacturers are commonly used. However, rarely are sole source materials specified. Both the North Central and Northeast regions predominantly use OZR/E/PU systems; some states within these same regions also use IOZ with the same intermediate and finish coats.

The coating products (and systems) used by many agencies are typically required to be tested and meet specific physical and performance properties. Coatings that successfully demonstrate they meet the range of properties are said to be qualified products and added to the qualified products list (QPL). Of the agencies surveyed 57% of respondents use a QPL for coating systems, 22% do not use a QPL and 22% use a QPL for contract work only. Currently, MnDOT's approved products list (APL) is specific to contract painting for removal and replacement of the coating system; however, the Agency desires to establish a maintenance coating system APL as part of the development of a bridge maintenance painting manual.

Recommendations: Following are generic coating system recommendations for each of three maintenance strategies that may be employed by MnDOT, as well as recommendations regarding development of an APL for maintenance coatings.

<u>Spot Touch-up</u>

1. Epoxy penetrating sealer[6]/epoxy mastic/polyurethane finish
2. Epoxy mastic primer/polyurethane finish

<u>Spot Touch-up and Overcoat</u>[7]

1. Epoxy penetrating sealer/epoxy mastic/polyurethane finish
2. Epoxy mastic primer/polyurethane finish

[6] This coating is particularly useful in cleaned pitted steel, heavy rust and pack rust.
[7] Verify compatibility with the existing coating system prior to use.

Total Removal & Replacement

1. Organic (epoxy) zinc-rich primer/epoxy intermediate/polyurethane finish coat
2. Organic (epoxy) zinc-rich primer/epoxy intermediate/polysiloxane finish coat
3. Moisture cure urethane (MCU) zinc-rich primer/2-coat MCU

Currently, there is no known database of coating systems that have been tested for performance as overcoat (maintenance) materials, and to KTA's knowledge, there are no plans within AASHTO NTPEP to initiate such a program. While NEPCOAT conducted a study in the early 2000's (NEPOVERCOAT), the data are over 10 years old. As a result, MnDOT may need to rely on historical performance of coating systems used as overcoats on bridge structures in the north central regions to develop an APL (versus laboratory testing). Most major coating manufacturers can provide this type of historical information on request.

Topic Area 5: Use of In-house Painting Forces versus Contractors

Summary: Agencies were asked what percentage of their annual bridge maintenance budget was allocated to painting. The most frequent response was 10% of the budget which was reported by 16 of the 38 agencies that responded (42%). Eleven of the respondents (29%) reported that bridge maintenance painting received less than 1% of the annual maintenance and nine (24%) allocate 25% of the maintenance budget. Only two agencies reported that as much as 50% or more of funding was being used for bridge painting. Currently, MnDOT allocates less than 1% of its maintenance budget to painting.

The proportion of agencies using contractors exclusively was 64%. Agencies using both internal forces and industrial painting contractors were 33% (14%) One agency (NHDOT) reported that in-house crews are used exclusively, even when hazardous metals are present. Eleven of the twenty-three agencies responding (48%) reported that they use in-house crews to perform maintenance painting when lead is present. Twelve of the respondents (52%) do not use in-house crews when lead is present.

The vast majority of respondents (75%) indicated that the basis for deciding whether to use in-house crews or contractors is the square footage of the structure requiring maintenance painting. The capability of the in-house crews was also a basis for the decision for 56% of the respondents. One agency indicated that the decision is driven by the maintenance strategy (overcoating is done in-house; removal and replacement of the coating system is contracted). The current MnDOT criterion is based on square footage of the structure requiring maintenance painting.

The scope of work performed by in-house crews (for those agencies that have in-house crews) appears to be primarily on beam ends, bearings, and localized breakdown. Only three agencies indicated that they use in-house crews to repair coatings on the fascia beams.

The majority (59%) of the agencies who use in-house crews rely on "on-the-job" training; 29% use industry-based courses such as NACE, SSPC, or others). Coating manufacturer product data sheets (PDS) and/or agency standard specifications/technical special provisions are used as governing documents. MnDOT relies on PDS for painting work done by in-house crews and the standard specifications/technical special provisions for contract painting work.

Recommendations: Recommendations relating to the use of in-house crews versus contract painting are provided below based on bridges structures containing lead and/or other toxic metals and for bridge structures that do not contain coatings with toxic metals.

Structures Containing Lead and/or Other Toxic Metals

While in-house crews can be used for maintenance painting, they are best protected from toxic metal exposures when trained in lead health hazards, worker protection, environmental protection and waste management. The Agency may be required to maintain a lead compliance program, perform medical surveillance, and perform worker exposure monitoring to assess exposures and determine engineering controls, work practices and personal protective equipment required to reduce airborne concentrations to below the Permissible Exposure Limit (PEL) for the toxic metal(s) of concern. Beyond worker safety and environmental protection, in-house crews should receive formal training on proper surface preparation techniques as well as proper coating mixing, thinning and application procedures. While this training can be accomplished on-line, KTA recommends instructor-led training and assessments of comprehension. Assuming properly trained crews are available, the use of square footage and access as the criteria for whether to use in-house crews or contractors makes sense.

Structures Not Containing Lead and/or Other Toxic Metals

The use of in-house crews to perform maintenance painting is recommended and the use of square footage and access as the criteria for whether to use in-house crews or contractors makes sense. However, training is paramount to the success of maintenance painting operations. KTA recommends that in-house crews receive formal training on proper surface preparation techniques as well as proper coating mixing, thinning and application procedures. While this training can be on-line, KTA recommends instructor-led training and assessments of comprehension.

Additional Information

The following agencies attached documents to their survey response or provided them as separate email attachments. The items that were provided were either standard specifications or technical special provisions. None of the agencies surveyed provided a Bridge Maintenance Painting Manual.

Agency	Description of Attachment
Alaska	Standard Specification for Construction
Delaware	605522 (Urethane Paint System – Existing Steel)
Idaho	RW(1) Pine Creek Structural Steel Painting Spec (Standard Specification)
Maine	AugustaMemorial2011Rev2Clean (Special Provision)
Massachusetts	Longfellow Bridge (Standard Specification)
Metropolitan Transit Authority Bridge & Tunnel (NY)	Section 09930 MTA Bridges & Tunnels (standard specification)
Missouri	Sec1081 (Standard Specification)
New Hampshire	Wentworth 15908 556 based on Plym 15882 (Special Provision)
New York City DOT	Section 831 (September2007) Final (Standard Specification)
Ohio Turnpike Commission	SP 514A and SP 525A (Special Provisions)

Agency	Description of Attachment
Pennsylvania	PA Publication 408, Sections 1070 and 1071 (standard specifications)
Virginia	Section 411 of the 2007 Road and Bridge Specifications

Note that the Virginia Department of Transportation published a research project concerning bridge coatings in 2013. The title of the research report is "Preliminary Assessment of Procedures for Coating Steel Components on Virginia Bridges."
http://vtrc.virginiadot.org/PubDetails.aspx?PubNo=14-R1

Appendix A
Survey/Questionnaire

Minnesota Department of Transportation (MnDOT)
Transportation Research Synthesis (TRS)
Coating Condition Assessments, Maintenance Painting Strategies and
Best Practices for Bridge Maintenance Painting Performed by Agency Forces

You have been invited to participate in a survey sponsored by the Minnesota Department of Transportation (MnDOT) related to a Transportation Research Synthesis (TRS) for Coating Condition Assessments, Maintenance Painting Strategies and Best Practices for Bridge Maintenance Painting Performed by Agency Forces.

Purpose of the Questionnaire/Survey

The Minnesota Department of Transportation (MnDOT) has contracted with KTA-Tator, Inc. (a consulting engineering firm specializing in protective coatings) to conduct a Transportation Research Synthesis (TRS) related to coating condition assessments, maintenance painting strategies and best practices for bridge maintenance painting operations that can be performed by agency personnel. The study is focused on steel bridges. We are asking for your help in completing the enclosed questionnaire/survey.

Dissemination of Questionnaire/Survey Data

MnDOT anticipates that the information revealed by the questionnaire will be of great interest to other agencies that are facing similar bridge coating maintenance issues. To this end, a summary of the responses gathered from the survey will be shared with all participants who express interest.

The Questionnaire/Survey Process

The questionnaire is being issued electronically through "Survey Gizmo." The questionnaire is comprised of 26 questions over five Topic Areas:

1. Coating Condition Assessment (4 Questions);
2. Bridge Coating Maintenance Strategies (4 Questions);
3. Surface Preparation Methods (8 Questions);
4. Coating Systems (3 Questions); and
5. Use of In-House Painting Forces versus Contractors (7 Questions)

We are requesting that you complete the survey within a 2-week period (before December 20, 2013). We expect to have the results summarized and back to you in February 2014 (if you elected to receive a summary of the data). We are asking that you enter your name and agency on the survey response (at the end) so that we may contact you in the event that clarifications to your responses are necessary.

On behalf of the Minnesota Department of Transportation and KTA-Tator, Inc. thank you for agreeing to participate in this very important Transportation Research Synthesis. If you have questions, please contact:

Sarah Sondag, P.E., MnDOT Bridge Operations Support (sarah.sondag@state.mn.us)
Richard Burgess, Senior Coatings Consultant, KTA-Tator, Inc. (rburgess@kta.com)

Minnesota Department of Transportation (MnDOT)
Transportation Research Synthesis (TRS)
Coating Condition Assessments, Maintenance Painting Strategies and
Best Practices for Bridge Maintenance Painting Performed by Agency Forces

Draft Questionnaire/Survey

Topic Area 1: Coating Condition Assessments

1. Does your agency use in-house personnel or outside consultants to perform Coating Condition Assessments?

   O Our Agency does not conduct coating condition assessments on bridges (PROCEED TO **TOPIC AREA 2**)

   O Agency personnel only

   O Consultants only

   O Combination of Agency personnel and Consultants

2. What triggers your Agency to perform a coating condition assessment on a given structure? Select all that apply.

   O Age of the structure
   O Age of the coating on the structure
   O The coating rating from the biennial bridge inspection
   O Traffic/Vehicle Load
   O Calendar-based
   O Other (please describe in comment box below) ☐

3. Does the coating condition assessment entail (select all that apply):

   O A cursory visual only (i.e., for entry into Pontis)

   O A detailed visual (i.e., percentage of deterioration, type of coating deterioration, etc.)

   O Physical attributes (i.e., adhesion, thickness, substrate condition, etc.)

   O Hazardous metals analysis

   O Generic coating type analysis

   O Other (please describe in comment box below) ☐

4. If your Agency performs coating condition assessments, what "tools" do you use? Select all that apply.

   O SSPC-VIS 2, Standard Method for Evaluating Degree of Rusting of Painted Steel Surfaces

   O Custom photographic standards of various conditions /levels of coating deterioration

   O Tensile adhesion testers

   O Tape/knife adhesion testing equipment

   O Destructive coating thickness measurement gages (e.g., Tooke gage)

   O Non-destructive coating thickness measurement gages

   O Ultrasonic thickness gages (steel thickness)

   O Pit depth gages

O Soluble salt testing equipment

O Other (please describe in comment box below) ☐

Topic Area 2: Bridge Coating Maintenance Strategies

1. Which of the following bridge coating maintenance strategies does your Agency employ? Select all that apply.
   - O Spot touch-up (repair)
   - O Zone painting (e.g., beneath expansions; fascia)
   - O Spot touch-up and overcoat (entire structure)
   - O Remove and replace the coating on the entire structure
   - O Don't know (PLEASE PROCEED TO **TOPIC AREA 3)**

2. What drives your decision to employ a certain maintenance strategy? Select all that apply.
   - O Visual condition of the coating/bridge structure
   - O Visual condition & physical attributes of the existing coating system (% deterioration, adhesion, thickness, corrosion, etc.)
   - O Presence of hazardous metals
   - O Available funding
   - O Other (please describe in comment box below) ☐

3. If your Agency employs overcoating as a bridge coating maintenance strategy, how do you assess compatibility with the existing coating system on the structure? Select all that apply.
   - O Rely on historical records
   - O Laboratory testing of existing paint to determine generic type
   - O Test patches
   - O Rely on consultants
   - O Rely on contractors/manufacturers
   - O We do not take specific steps to assess compatibility
   - O Other (please describe in comment box below) ☐

4. How does your Agency prioritize bridge painting projects? Select all that apply.
   - O Based on the coating condition assessment data
   - O Solely based on the availability of funding
   - O Based on years of service
   - O Based on complaints from Districts or customers
   - O Based on the presence of hazardous metals (i.e., if present, assign a higher priority than non-lead containing bridges in the same state of repair)
   - O When other work on the structure is scheduled (e.g., deck replacement)
   - O Other (please describe in comment box below) ☐

Topic Area 3: Surface Preparation Methods

1. How does your Agency determine the level/degree of surface preparation to specify for a given project? Select all that apply.

   O Extent of steel deterioration

   O Costs of containment, if needed

   O Proximity to sensitive receptors

   O Access

   O Tools/Equipment Availability

   O Coating manufacturer requirements

   O Other (please describe in comment box below) ☐

2. Indicate which (if any) of the following wet methods of surface preparation your Agency employs for bridge coating maintenance? Select all that apply.

   O Our Agency does not employ wet methods of surface preparation

   PROCEED TO **QUESTION 5**

   O Low Pressure Water Cleaning (<5,000 psi)

   O High Pressure Water Cleaning (5,000-10,000 psi)

   O High Pressure Water Jetting (10,000-30,000 psi)

   O Ultrahigh Pressure Water Jetting (>30,000 psi)

   O Wet abrasive blast cleaning

3. When wet methods of surface preparation are employed, does your Agency specify the use of rust inhibitors to prevent rust-back when bare steel is exposed?

   O Yes

   O No

4. When wet methods of surface preparation are employed, does your Agency capture the water?

   O Yes, always

   O Yes, but only for coatings that contain lead

   O Yes, but only when washing is performed on bridge structures over protected waters

   O Yes, but only when washing is performed on bridge structures over protected waters **AND** the coatings contain lead

   O No

   O Don't know

5. Indicate which (if any) of the following dry methods of surface preparation your Agency employs for bridge coating maintenance? Select all that apply.

O Hand tool cleaning (SSPC-SP 2)

O Power tool cleaning (SSPC-SP 3)

O Commercial grade power tool cleaning (SSPC-SP 15)

O Power tool cleaning to bare metal (SSPC-SP 11)

O Brush-off abrasive blast cleaning (SSPC-SP 7)

O Commercial abrasive blast cleaning (SSPC-SP 6)

O Near-white metal abrasive blast cleaning (SSPC-SP 10)

O White metal abrasive blast cleaning (SSPC-SP 5)

O Chemical stripping

6. What methods of salt remediation does your Agency use to remove deposits from bridge elements prior to maintenance painting?

O Our Agency does not have a salt remediation program (PROCEED TO **TOPIC AREA 4**)
O Pressure washing (water only)
O Pressure washing with soluble salt remover (e.g., Chlor-Rid®, HoldTight®, etc.)
O Blast cleaning using a blend of fine & coarse abrasive
O Blast cleaning, allowing rust to reform, then re-blast cleaning
O Steam cleaning
O Other (please describe in comment box below)

7. If post-remediation testing is performed to verify a reduction in surface salt contamination, what soluble salts do you test for? Select all that apply.

O Our Agency does not perform post-remediation testing (PROCEED TO **TOPIC AREA 4**)
O Chloride
O Sulfates
O Nitrates
O Ferrous Ion
O Conductivity (non ion-specific)
O Other (please describe in comment box below)

8. Using the drop-down lists below, indicate the limits your Agency imposes for each of the soluble salts selected in Question 7.

Chlorides	**Sulfates**	**Nitrates**	**Ferrous Ions**	**Conductivity**
o Non-detectable	o Non-detectable	o Non-detectable	o Non-detectable	o Non-detectable
o < 5 µg/cm^2	o < 5 µg/cm^2	o < 5 µg/cm^2	o < 5 µg/cm^2	o < 5 µS/cm
o 6-10 µg/cm^2	o 6-10 µg/cm^2	o 6-10 µg/cm^2	o 6-10 µg/cm^2	o 6-10 µS/cm
o 11-15 µg/cm^2	o 11-15 µg/cm^2	o 11-15 µg/cm^2	o 11-15 µg/cm^2	o 11-15 µS/cm
o 16-25 µg/cm^2	o 16-25 µg/cm^2	o 16-25 µg/cm^2	o 16-25 µg/cm^2	o 16-25 µS/cm
o 26-50 µg/cm^2	o 26-50 µg/cm^2	o 26-50 µg/cm^2	o 26-50 µg/cm^2	o 26-50 µS/cm

Topic Area 4: Bridge Coating Systems

1. What generic type(s) of coating systems does your Agency employ for corrosion protection, based on **spot touch-up (repair) and overcoating** of the existing system? Select all that apply.
   - O Our Agency does not perform spot painting to maintain the existing bridge coating system
   - O Our Agency does not perform spot repair/overcoating to maintain the existing bridge coating system
   - O Epoxy mastic primer, polyurethane finish
   - O Epoxy mastic primer, waterborne acrylic finish
   - O Epoxy mastic primer, polysiloxane finish
   - O Epoxy penetrating sealer, epoxy mastic, polyurethane finish
   - O Epoxy penetrating sealer, epoxy mastic, waterborne acrylic finish
   - O Epoxy penetrating sealer, epoxy mastic, polysiloxane finish
   - O Calcium sulfonate alkyd
   - O Alkyd
   - O Waterborne acrylic
   - O Moisture cured urethane
   - O Other (please describe in comment box below) [ ]

2. What generic type(s) of coating systems does your Agency employ for corrosion protection, based on **removal and replacement of the existing system**? Select all that apply
   - O Inorganic zinc primer, epoxy mid-coat, polyurethane finish
   - O Inorganic zinc primer, epoxy mid-coat, polysiloxane finish
   - O Inorganic zinc primer, epoxy mid-coat, fluoropolymer finish
   - O Inorganic zinc primer, water borne acrylic finish
   - O Organic zinc primer, epoxy mid-coat, polyurethane finish
   - O Organic zinc primer, epoxy mid-coat, polysiloxane finish
   - O Organic zinc primer, epoxy mid-coat, fluoropolymer finish
   - O Organic zinc primer, water borne acrylic finish
   - O Multi-coat alkyd system
   - O Metalizing without seal coats
   - O Metalizing with seal coats
   - O Other (please describe in comment box below) [ ]

3. Does your Agency use a Qualified Products List (QPL) of approved bridge coating systems?
   - O Yes
   - O Yes, but for contract painting only
   - O No

Topic Area 5: Use of In-house Agency Forces verses Contracting for Bridge Maintenance Painting

1. Approximately what percentage of your annual bridge maintenance budget is allocated to painting?

   O <1%

   O 10%

   O 25%

   O 50%

   O >50%

2. Which of the following describes your Agency related to the use of in-house crews verses contracting to accomplish the bridge coating maintenance program?

   O Our Agency uses in-house crews exclusively, even when hazardous metals are present. PROCEED TO **QUESTION NO. 6**

   O Our Agency uses contractors exclusively; we do not use in-house crews. PROCEED TO **QUESTION NO. 7**

   O Our Agency uses a combination of in-house crews and industrial painting contractors to accomplish our bridge coating maintenance program. PROCEED TO **QUESTION NO. 3**

3. If hazardous metals are present on the structure, do you use in-house crews to perform maintenance painting?

   O Yes

   O No

4. When you use a combination of in-house crews and contract painting for your painting program, what criteria do you employ to decide whether to use in-house crews or to bid the work to industrial painting contractors? Check all that apply.

   O Presence of hazardous metals

   O Square footage of area requiring maintenance

   O Access to perform the work

   O Cost

   O Traffic

   O Capability of local crews

   O Other (please describe in comment box below) ☐

5. What scope of work is performed by in-house crews? Select all that apply.

   O Localized coating breakdown

   O Bearings

   O Beam Ends

   O Fascia Beams

   O Can be any amount of work depending on specific needs

6. When you use in-house crews to perform bridge coating maintenance painting, what type of training do they receive?

    O In-house instructor-led training

    O On-line training

    O Industry-based training (SSPC, NACE, other courses)

    O On-the-job training

    O None

7. When performing bridge maintenance painting, which documents are used to ensure that the work is done properly? Select all that apply.

    O Coating manufacturer's Product Data Sheets/Application Instructions

    O Agency standard specification/technical special provisions

    O Agency Best Practices Manual

    O Other (please describe in comment box below) [ ]

If your Agency has a Bridge Maintenance Painting Manual, best practices guidelines or specifications, please attach or send a link with your survey response.

Thank you for completing this questionnaire/survey. Please type your name and email address in the Comment Box below. We will only contact you if we require clarification to one or more of your responses. Also, please indicate whether you would like to receive a summary of the data.

O Please send me a summary of the data collected from this survey
O I am not interested in receiving a summary of the data collected from this survey

NAME: EMAIL ADDRESS:

Appendix B
Summary of Responses by Geographical Region

States by Geographical Region

Region:	North Central (NC)	North East (NE)	North West (NW)	South Central (SC)	South East (SE)	South West (SW)
	Illinois	Chesapeake Bay Bridge Authority	Alaska	Arkansas	Florida	Caltrans
	Indiana	Connecticut	Idaho	Kansas	North Carolina	Golden Gate Bridge Authority
	Iowa	Delaware	Oregon		Virginia	
	Mackinac Bridge Authority	Kentucky	Washington			
	Michigan	Maine				
	Missouri	Maryland State Highway				
	Nebraska	Massachusetts				
	North Dakota	Metropolitan Transportation Authority - Bridge & Tunnel				
	South Dakota	New Hampshire				
		New Jersey Turnpike				
		New York City DOT				
		New York State Bridge Authority				
		Ohio				
		Ohio Turnpike				
		Pennsylvania				
		Pennsylvania Turnpike				
		Port Authority - New York & New Jersey				
		Rhode Island				
		Vermont				
		West Virginia				

Summary of Responses by Geographical Region

	Number of Responses By Region								Percent of Responses By Region								
Region	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk	Percent of All Regions	Percent of All Agencies
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
Topic Area 1																	
1. Does your agency use in-house personnel or outside consultants to perform Coating Condition Assessments?																	
O Our Agency does not conduct coating condition assessments on bridges	2	1	0	0	0	0	1	4	50.0%	25.0%	0.0%	0.0%	0.0%	0.0%	25.0%	100.0%	9.5%
O Agency personnel only	5	4	3	2	0	0	0	14	35.7%	28.6%	21.4%	14.3%	0.0%	0.0%	0.0%	100.0%	33.3%
O Consultants only	1	4	0	0	0	0	0	5	20.0%	80.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	11.9%
O Combination of Agency personnel and Consultants	1	11	1	0	3	2	1	19	5.3%	57.9%	5.3%	0.0%	15.8%	10.5%	5.3%	100.0%	45.2%
2. What triggers your Agency to perform a coating condition assessment on a given structure? Select all that apply.																	
O Age of the structure	1	2	1	0	1	1	0	6	16.7%	33.3%	16.7%	0.0%	16.7%	16.7%	0.0%	100.0%	14.3%
O Age of the coating on the structure	4	7	1	0	1	0	0	13	30.8%	53.8%	7.7%	0.0%	7.7%	0.0%	0.0%	100.0%	31.0%
O The coating rating from the biennial bridge inspection	2	17	4	2	2	1	2	30	6.7%	56.7%	13.3%	6.7%	6.7%	3.3%	6.7%	100.0%	71.4%
O Traffic/Vehicle Load	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
O Calendar-based	2	1	0	0	1	0	0	4	50.0%	25.0%	0.0%	0.0%	25.0%	0.0%	0.0%	100.0%	9.5%
O Other	4	5	1	0	0	2	0	12	33.3%	41.7%	8.3%	0.0%	0.0%	16.7%	0.0%	100.0%	28.6%
3. Does the coating condition assessment entail (select all that apply):																	
O A cursory visual only (i.e., for entry into Pontis)	3	10	2	2	1	1	2	21	14.3%	47.6%	9.5%	9.5%	4.8%	4.8%	9.5%	100.0%	50.0%
O A detailed visual (i.e., percentage of deterioration, type of coating deterioration, etc.)	4	17	4	1	2	1	0	29	13.8%	58.6%	13.8%	3.4%	6.9%	3.4%	0.0%	100.0%	69.0%
O Physical attributes (i.e., adhesion, thickness, substrate condition, etc.)	5	8	3	0	2	1	0	19	26.3%	42.1%	15.8%	0.0%	10.5%	5.3%	0.0%	100.0%	45.2%
O Hazardous metals analysis	1	7	3	1	1	1	0	14	7.1%	50.0%	21.4%	7.1%	7.1%	7.1%	0.0%	100.0%	33.3%
O Generic coating type analysis	2	2	1	0	2	0	0	7	28.6%	28.6%	14.3%	0.0%	28.6%	0.0%	0.0%	100.0%	16.7%
4. If your Agency performs coating condition assessments, what "tools" do you use? Select all that apply.																	
O SSPC-VIS 2, Standard Method for Evaluating Degree of Rusting of Painted Steel Surfaces	4	12	2	0	1	1	1	21	19.0%	57.1%	9.5%	0.0%	4.8%	4.8%	4.8%	100.0%	50.0%
O Custom photographic standards of various conditions /levels of coating deterioration	2	6	2	0	2	0	2	14	14.3%	42.9%	14.3%	0.0%	14.3%	0.0%	14.3%	100.0%	33.3%
O Tensile adhesion testers	0	2	3	0	1	1	0	7	0.0%	28.6%	42.9%	0.0%	14.3%	14.3%	0.0%	100.0%	16.7%
O Tape/knife adhesion testing equipment	3	10	3	0	2	1	0	19	15.8%	52.6%	15.8%	0.0%	10.5%	5.3%	0.0%	100.0%	45.2%
O Destructive coating thickness measurement gages (e.g., Tooke gage)	2	5	2	0	2	1	0	12	16.7%	41.7%	16.7%	0.0%	16.7%	8.3%	0.0%	100.0%	28.6%
O Non-destructive coating thickness measurement gages	2	7	3	1	2	1	0	16	12.5%	43.8%	18.8%	6.3%	12.5%	6.3%	0.0%	100.0%	38.1%
O Ultrasonic thickness gages (steel thickness)	0	1	1	0	2	0	0	4	0.0%	25.0%	25.0%	0.0%	50.0%	0.0%	0.0%	100.0%	9.5%
O Pit depth gages	0	1	1	0	0	0	0	2	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	100.0%	4.8%
O Soluble salt testing equipment	0	3	3	0	1	0	0	7	0.0%	42.9%	42.9%	0.0%	14.3%	0.0%	0.0%	100.0%	16.7%
Other	2	1	1	1	0	0	0	5	40.0%	20.0%	20.0%	20.0%	0.0%	0.0%	0.0%	100.0%	11.9%

Summary of Responses by Geographical Region

	Number of Responses By Region								Percent of Responses By Region								
Region	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk	Percent of All Regions	Percent of All Agencies
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
Topic Area 2																	
1. Which of the following bridge coating maintenance strategies does your Agency employ?																	
Select all that apply.	4	9	3	1	1	2	0	20	20.0%	45.0%	15.0%	5.0%	5.0%	10.0%	0.0%	100.0%	47.6%
O Spot touch-up (repair)	5	9	3	1	3	1	0	22	22.7%	40.9%	13.6%	4.5%	13.6%	4.5%	0.0%	100.0%	52.4%
O Zone painting (e.g., beneath expansions; fascia)	4	12	2	1	3	2	1	25	16.0%	48.0%	8.0%	4.0%	12.0%	8.0%	4.0%	100.0%	59.5%
O Spot touch-up and overcoat (entire structure)	8	12	3	2	2	2	1	30	26.7%	40.0%	10.0%	6.7%	6.7%	6.7%	3.3%	100.0%	71.4%
O Remove and replace the coating on the entire structure	3	7	1	0	2	0	1	14	21.4%	50.0%	7.1%	0.0%	14.3%	0.0%	7.1%	100.0%	33.3%
O Don't know	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	#DIV/0!	#DIV/0!
2. What drives your decision to employ a certain maintenance strategy? Select all that apply.																	
O Visual condition of the coating/bridge structure	7	13	2	2	0	2	2	28	25.0%	46.4%	7.1%	7.1%	0.0%	7.1%	7.1%	100.0%	65.1%
O Visual condition & physical attributes of the existing coating system (% deterioration, adhesion, thickness, corrosion, etc.)	6	15	3	1	3	2	1	31	19.4%	48.4%	9.7%	3.2%	9.7%	6.5%	3.2%	100.0%	72.1%
O Presence of hazardous metals	5	6	1	1	2	0	1	16	31.3%	37.5%	6.3%	6.3%	12.5%	0.0%	6.3%	100.0%	37.2%
O Available funding	5	13	4	2	2	0	1	27	18.5%	48.1%	14.8%	7.4%	7.4%	0.0%	3.7%	100.0%	62.8%
O Other (please describe in comment box below)	1	2	2	0	0	0	0	5	20.0%	40.0%	40.0%	0.0%	0.0%	0.0%	0.0%	100.0%	11.6%
3. If your Agency employs overcoating as a bridge coating maintenance strategy, how do you assess compatibility with the existing coating system on the structure? Select all that apply.																	
O Rely on historical records	2	6	3	0	0	1	1	13	15.4%	46.2%	23.1%	0.0%	0.0%	7.7%	7.7%	100.0%	31.0%
O Laboratory testing of existing paint to determine generic type	1	5	2	0	0	1	0	9	11.1%	55.6%	22.2%	0.0%	0.0%	11.1%	0.0%	100.0%	21.4%
O Test patches	2	5	3	0	1	1	0	12	16.7%	41.7%	25.0%	0.0%	8.3%	8.3%	0.0%	100.0%	27.9%
O Rely on consultants	1	6	1	0	1	0	0	9	11.1%	66.7%	11.1%	0.0%	11.1%	0.0%	0.0%	100.0%	20.9%
O Rely on contractors/manufacturers	0	3	1	1	0	0	0	5	0.0%	60.0%	20.0%	20.0%	0.0%	0.0%	0.0%	100.0%	11.6%
O We do not take specific steps to assess compatibility	1	2	0	1	0	0	1	5	20.0%	40.0%	0.0%	20.0%	0.0%	0.0%	20.0%	100.0%	11.6%
O Other (please describe in comment box below)	4	4	0	0	1	0	0	9	44.4%	44.4%	0.0%	0.0%	11.1%	0.0%	0.0%	100.0%	20.9%
4. How does your Agency prioritize bridge painting projects? Select all that apply.																	
O Based on the coating condition assessment data	6	17	3	1	3	1	1	32	18.8%	53.1%	9.4%	3.1%	9.4%	3.1%	3.1%	100.0%	74.4%
O Solely based on the availability of funding	2	5	0	0	1	0	0	8	25.0%	62.5%	0.0%	0.0%	12.5%	0.0%	0.0%	100.0%	18.6%
O Based on years of service	2	2	1	0	0	0	0	5	40.0%	40.0%	20.0%	0.0%	0.0%	0.0%	0.0%	100.0%	11.6%
O Based on complaints from Districts or customers	2	6	2	1	1	0	1	13	15.4%	46.2%	15.4%	7.7%	7.7%	0.0%	7.7%	100.0%	30.2%
O Based on the presence of hazardous metals (i.e., if present, assign a higher priority than non-lead containing bridges in the same state of repair)	1	5	2	0	1	0	0	9	11.1%	55.6%	22.2%	0.0%	11.1%	0.0%	0.0%	100.0%	20.9%
O When other work on the structure is scheduled (e.g., deck replacement)	8	11	3	0	2	1	0	25	32.0%	44.0%	12.0%	0.0%	8.0%	4.0%	0.0%	100.0%	59.5%

Summary of Responses by Geographical Region

	Number of Responses By Region								Percent of Responses By Region								
Region	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk	Percent of All Regions	Percent of All Agencies
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
Topic Area 3																	
1. How does your Agency determine the level/degree of surface preparation to specify for a given project? Select all that apply.																	
O Extent of steel deterioration	3	14	3	0	1	2	1	24	12.5%	58.3%	12.5%	0.0%	4.2%	8.3%	4.2%	100.0%	55.8%
O Costs of containment, if needed	0	2	2	0	0	1	1	7	0.0%	28.6%	28.6%	0.0%	0.0%	14.3%	14.3%	100.0%	16.3%
O Proximity to sensitive receptors	0	1	2	0	1	0	0	4	0.0%	25.0%	50.0%	0.0%	25.0%	0.0%	0.0%	100.0%	9.3%
O Access	1	4	2	1	1	1	0	10	10.0%	40.0%	20.0%	10.0%	10.0%	10.0%	0.0%	100.0%	23.3%
O Tools/Equipment Availability	0	2	1	0	0	1	0	4	0.0%	50.0%	25.0%	0.0%	0.0%	25.0%	0.0%	100.0%	9.3%
O Coating manufacturer requirements	5	11	2	0	2	0	0	20	25.0%	55.0%	10.0%	0.0%	10.0%	0.0%	0.0%	100.0%	46.5%
O Other (please describe in comment box below)	5	2	2	1	1	0	0	11	45.5%	18.2%	18.2%	9.1%	9.1%	0.0%	0.0%	100.0%	25.6%
2. Indicate which (if any) of the following wet methods of surface preparation your Agency employs for bridge coating maintenance? Select all that apply.																	
O Our Agency does not employ wet methods of surface preparation	7	10	1	1	0	0	0	19	36.8%	52.6%	5.3%	5.3%	0.0%	0.0%	0.0%	100.0%	44.2%
O Low Pressure Water Cleaning (<5,000 psi)	2	8	2	1	3	2	1	20	10.0%	40.0%	10.0%	5.0%	15.0%	10.0%	5.0%	100.0%	46.5%
O High Pressure Water Cleaning (5,000-10,000 psi)	0	3	3	0	1	1	0	8	0.0%	37.5%	37.5%	0.0%	12.5%	12.5%	0.0%	100.0%	18.6%
O High Pressure Water Jetting (10,000-30,000 psi)	0	2	1	0	1	0	0	4	0.0%	50.0%	25.0%	0.0%	25.0%	0.0%	0.0%	100.0%	9.3%
O Ultrahigh Pressure Water Jetting (>30,000 psi)	0	1	1	0	1	1	0	4	0.0%	25.0%	25.0%	0.0%	25.0%	25.0%	0.0%	100.0%	9.3%
O Wet abrasive blast cleaning	1	2	0	0	1	0	0	4	25.0%	50.0%	0.0%	0.0%	25.0%	0.0%	0.0%	100.0%	9.3%
3. When wet methods of surface preparation are employed, does your Agency specify the use of rust inhibitors to prevent rust-back when bare steel is exposed?																	
O Yes	1	2	1	0	0	1	1	6	9.5%	9.5%	25.0%	0.0%	0.0%	50.0%	100.0%	14.3%	28.6%
O No	1	8	2	2	2	1	1	17	38.1%	38.1%	50.0%	100.0%	66.7%	50.0%	100.0%	40.5%	81.0%
4. When wet methods of surface preparation are employed, does your Agency capture the water?																	
O Yes, always	1	4	2	0	3	2	0	12	8.3%	33.3%	16.7%	0.0%	25.0%	16.7%	0.0%	100.0%	27.9%
O Yes, but only for coatings that contain lead	1	2	0	0	0	0	0	3	33.3%	66.7%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	7.0%
O Yes, but only when washing is performed on bridge structures over protected waters	0	1	0	0	0	0	1	2	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	50.0%	100.0%	4.7%
O Yes, but only when washing is performed on bridge structures over protected waters AND the coatings contain lead	0	1	0	0	0	0	1	1	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	2.3%
O No	0	2	1	2	0	0	0	5	0.0%	40.0%	20.0%	40.0%	0.0%	0.0%	0.0%	100.0%	11.6%
O Don't know	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	#DIV/0!	#DIV/0!

Summary of Responses by Geographical Region

	Number of Responses By Region								Percent of Responses By Region								
Region	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk	Percent of All Regions	Percent of All Agencies
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
5. Indicate which (if any) of the following dry methods of surface preparation your Agency employs for bridge coating maintenance? Select all that apply.																	
O Hand tool cleaning (SSPC-SP 2)	4	11	3	0	3	2	1	25	16.0%	44.0%	12.0%	0.0%	12.0%	8.0%	4.0%	100.0%	58.1%
O Power tool cleaning (SSPC-SP 3)	6	15	3	0	3	2	1	31	19.4%	48.4%	9.7%	0.0%	9.7%	6.5%	3.2%	100.0%	72.1%
O Commercial grade power tool cleaning (SSPC-SP 15)	1	6	1	0	1	0	0	9	11.1%	66.7%	11.1%	0.0%	11.1%	0.0%	0.0%	100.0%	20.9%
O Power tool cleaning to bare metal (SSPC-SP 11)	3	12	3	0	3	2	0	23	13.0%	52.2%	13.0%	0.0%	13.0%	8.7%	0.0%	100.0%	53.5%
O Brush-off abrasive blast cleaning (SSPC-SP 7)	1	2	2	0	1	1	0	7	14.3%	28.6%	28.6%	0.0%	14.3%	14.3%	0.0%	100.0%	16.3%
O Commercial abrasive blast cleaning (SSPC-SP 6)	4	6	2	1	1	1	0	15	26.7%	40.0%	13.3%	6.7%	6.7%	6.7%	0.0%	100.0%	34.9%
O Near-white metal abrasive blast cleaning (SSPC-SP 10)	8	17	3	0	3	1	0	32	25.0%	53.1%	9.4%	0.0%	9.4%	3.1%	0.0%	100.0%	74.4%
O White metal abrasive blast cleaning (SSPC-SP 5)	1	2	0	0	2	0	0	5	20.0%	40.0%	0.0%	0.0%	40.0%	0.0%	0.0%	100.0%	11.6%
O Chemical stripping	0	1	1	0	1	0	0	3	0.0%	33.3%	33.3%	0.0%	33.3%	0.0%	0.0%	100.0%	7.0%
6. What methods of salt remediation does your Agency use to remove deposits from bridge elements prior to maintenance painting?																	
O Our Agency does not have a salt remediation program	5	3	1	2	1	0	0	12	41.7%	25.0%	8.3%	16.7%	8.3%	0.0%	0.0%	100.0%	27.9%
O Pressure washing (water only)	1	5	0	0	0	2	1	10	10.0%	50.0%	0.0%	0.0%	0.0%	20.0%	10.0%	100.0%	23.3%
O Pressure washing with soluble salt remover (e.g., Chlor-Rid®, HoldTight®, etc.)	1	4	2	0	1	0	0	8	12.5%	50.0%	25.0%	0.0%	12.5%	0.0%	0.0%	100.0%	18.6%
O Blast cleaning using a blend of fine & coarse abrasive	0	2	0	0	0	0	0	2	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	4.7%
O Blast cleaning, allowing rust to reform, then re-blast cleaning	0	1	0	0	0	0	0	1	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
O Steam cleaning	0	1	0	0	0	0	0	1	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
O Other (please describe in comment box below)	2	3	1	0	1	0	0	7	28.6%	42.9%	14.3%	0.0%	14.3%	0.0%	0.0%	100.0%	16.3%
7. If post-remediation testing is performed to verify a reduction in surface salt contamination, what soluble salts do you test for? Select all that apply.																	
O Our Agency does not perform post-remediation testing	2	5	0	1	0	0	0	8	25.0%	62.5%	0.0%	12.5%	0.0%	0.0%	0.0%	100.0%	18.6%
O Chloride	3	12	3	0	2	1	1	23	13.0%	52.2%	13.0%	0.0%	8.7%	4.3%	4.3%	100.0%	53.5%
O Sulfates	0	4	2	0	1	1	0	8	0.0%	50.0%	25.0%	0.0%	12.5%	12.5%	0.0%	100.0%	18.6%
O Nitrates	0	2	1	0	1	1	0	5	0.0%	40.0%	20.0%	0.0%	20.0%	20.0%	0.0%	100.0%	11.6%
O Ferrous Ion	0	2	1	0	0	0	0	3	0.0%	66.7%	33.3%	0.0%	0.0%	0.0%	0.0%	100.0%	7.0%
O Conductivity (non ion-specific)	0	1	1	0	1	0	0	3	0.0%	33.3%	33.3%	0.0%	33.3%	0.0%	0.0%	100.0%	7.0%
O Other (please describe in comment box below)	0	1	2	0	1	1	0	5	0.0%	20.0%	40.0%	0.0%	20.0%	20.0%	0.0%	100.0%	11.6%

Summary of Responses by Geographical Region

Region	Number of Responses By Region								Percent of Responses By Region							Percent of All Regions	Percent of All Agencies
	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk		
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
8. Using the drop-down lists below, indicate the limits your Agency imposes for each of the soluble salts selected in Question 7.																	
Chloride																	
o Non-detectable	0	0	1	0	0	0	0	1	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
o < 5 µg/cm2	0	2	2	0	0	0	1	6	0.0%	33.3%	33.3%	0.0%	0.0%	0.0%	16.7%	100.0%	14.0%
o 6-10 µg/cm2	2	9	0	0	2	0	0	13	15.4%	69.2%	0.0%	0.0%	15.4%	0.0%	0.0%	100.0%	30.2%
o 11-15 µg/cm2	1	0	0	0	0	0	0	1	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
o 16-25 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 26-50 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sulfate																	
o Non-detectable	0	0	1	0	0	0	0	1	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
o < 5 µg/cm2	0	1	0	0	0	0	0	1	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
o 6-10 µg/cm2	0	0	0	0	0	0	1	1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	2.3%
o 11-15 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 16-25 µg/cm2	0	3	1	0	1	0	0	5	0.0%	60.0%	20.0%	0.0%	20.0%	0.0%	0.0%	100.0%	11.6%
o 26-50 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Nitrate																	
o Non-detectable	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o < 5 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 6-10 µg/cm2	0	0	1	0	1	1	0	3	0.0%	0.0%	33.3%	0.0%	33.3%	33.3%	0.0%	100.0%	7.0%
o 11-15 µg/cm2	0	1	0	0	0	0	0	1	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
o 16-25 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 26-50 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ferrous Ion																	
o Non-detectable	0	0	1	0	0	0	0	1	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
o < 5 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 6-10 µg/cm2	0	2	0	0	1	0	0	3	0.0%	66.7%	0.0%	0.0%	33.3%	0.0%	0.0%	100.0%	7.0%
o 11-15 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 16-25 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 26-50 µg/cm2	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Conductivty																	
o Non-detectable	0	0	0	0	0	0	1	1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%	2.3%
o < 5 µS/cm	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 6-10 µS/cm	0	1	0	0	0	0	0	1	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
o 11-15 µS/cm	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 16-25 µS/cm	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
o 26-50 µS/cm	0	0	1	0	0	0	0	1	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%

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	Number of Responses By Region								Percent of Responses By Region								
Region	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk	Percent of All Regions	Percent of All Agencies
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
Topic Area 4																	
1. What generic type(s) of coating systems does your Agency employ for corrosion protection, based on spot touch-up (repair) and overcoating of the existing system? Select all that apply.																	
O Our Agency does not perform spot painting to maintain the existing bridge coating system	3	5	1	1	0	0	0	10	30.0%	50.0%	10.0%	10.0%	0.0%	0.0%	0.0%	100.0%	23.3%
O Our Agency does not perform spot repair/overcoating to maintain the existing bridge coating system	3	3	0	1	0	0	0	7	42.9%	42.9%	0.0%	14.3%	0.0%	0.0%	0.0%	100.0%	16.3%
O Epoxy mastic primer, polyurethane finish	1	9	0	0	2	0	0	12	8.3%	75.0%	0.0%	0.0%	16.7%	0.0%	0.0%	100.0%	27.9%
O Epoxy mastic primer, waterborne acrylic finish	0	0	0	0	1	0	0	1	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	2.3%
O Epoxy mastic primer, polysiloxane finish	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
O Epoxy penetrating sealer, epoxy mastic, polyurethane finish	1	6	0	0	1	0	0	8	12.5%	75.0%	0.0%	0.0%	12.5%	0.0%	0.0%	100.0%	18.6%
O Epoxy penetrating sealer, epoxy mastic, waterborne acrylic finish	1	2	0	0	1	0	0	4	25.0%	50.0%	0.0%	0.0%	25.0%	0.0%	0.0%	100.0%	9.3%
O Epoxy penetrating sealer, epoxy mastic, polysiloxane finish	0	0	0	0	1	0	0	1	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%	2.3%
O Calcium sulfonate alkyd	1	1	0	1	0	0	2	5	20.0%	20.0%	0.0%	20.0%	0.0%	0.0%	40.0%	100.0%	11.6%
O Alkyd	1	3	0	0	0	0	0	4	25.0%	75.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	9.3%
O Waterborne acrylic	0	3	0	0	2	2	1	8	0.0%	37.5%	0.0%	0.0%	25.0%	25.0%	12.5%	100.0%	18.6%
O Moisture cured urethane	2	6	3	0	0	2	1	15	13.3%	40.0%	20.0%	0.0%	0.0%	13.3%	6.7%	100.0%	34.9%
2. What generic type(s) of coating systems does your Agency employ for corrosion protection, based on removal and replacement of the existing system? Select all that apply																	
O Inorganic zinc primer, epoxy mid-coat, polyurethane finish	3	7	0	1	1	0	1	13	23.1%	53.8%	0.0%	7.7%	7.7%	0.0%	7.7%	100.0%	30.2%
O Inorganic zinc primer, epoxy mid-coat, polysiloxane finish	1	0	0	0	0	0	0	1	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
O Inorganic zinc primer, epoxy mid-coat, fluoropolymer finish	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
O Inorganic zinc primer, water borne acrylic finish	1	0	0	1	1	0	1	4	25.0%	0.0%	0.0%	25.0%	25.0%	0.0%	25.0%	100.0%	9.3%
O Organic zinc primer, epoxy mid-coat, polyurethane finish	5	16	2	1	2	0	1	27	18.5%	59.3%	7.4%	3.7%	7.4%	0.0%	3.7%	100.0%	62.8%
O Organic zinc primer, epoxy mid-coat, polysiloxane finish	0	3	0	0	1	0	0	4	0.0%	75.0%	0.0%	0.0%	25.0%	0.0%	0.0%	100.0%	9.3%
O Organic zinc primer, epoxy mid-coat, fluoropolymer finish	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
O Organic zinc primer, water borne acrylic finish	0	1	0	1	2	1	0	5	0.0%	20.0%	0.0%	20.0%	40.0%	20.0%	0.0%	100.0%	11.6%
O Multi-coat alkyd system	1	0	0	0	0	0	0	1	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	2.3%
O Metalizing without seal coats	0	1	0	0	1	0	0	2	0.0%	50.0%	0.0%	0.0%	50.0%	0.0%	0.0%	100.0%	4.7%
O Metalizing with seal coats	1	5	0	0	2	0	0	8	12.5%	62.5%	0.0%	0.0%	25.0%	0.0%	0.0%	100.0%	18.6%
O Other (please describe in comment box below)	3	3	4	0	0	1	0	11	27.3%	27.3%	36.4%	0.0%	0.0%	9.1%	0.0%	100.0%	25.6%
3. Does your Agency use a Qualified Products List (QPL) of approved bridge coating systems?																	
O Yes	5	9	4	1	3	1	1	24	20.8%	37.5%	16.7%	4.2%	12.5%	4.2%	4.2%	100.0%	55.8%
O Yes, but for contract painting only	2	5	0	1	0	0	1	9	22.2%	55.6%	0.0%	11.1%	0.0%	0.0%	11.1%	100.0%	20.9%
O No	2	6	0	0	0	1	0	9	22.2%	66.7%	0.0%	0.0%	0.0%	11.1%	0.0%	100.0%	20.9%

Summary of Responses by Geographical Region

	Number of Responses By Region								Percent of Responses By Region								
Region	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk	Percent of All Regions	Percent of All Agencies
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
Topic Area 5																	
1. Approximately what percentage of your annual bridge maintenance budget is allocated to painting?																	
O <1%	3	6	0	0	0	0	1	10	30.0%	60.0%	0.0%	0.0%	0.0%	0.0%	10.0%	100.0%	23.3%
O 10%	3	7	3	1	1	1	0	16	18.8%	43.8%	18.8%	6.3%	6.3%	6.3%	0.0%	100.0%	37.2%
O 25%	2	4	1	1	1	0	0	9	22.2%	44.4%	11.1%	11.1%	11.1%	0.0%	0.0%	100.0%	20.9%
O 50%	1	0	0	0	0	1	0	2	50.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	100.0%	4.7%
O >50%	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2. Which of the following describes your Agency related to the use of in-house crews verses contracting to accomplish the bridge coating maintenance program?																	0.0%
O Our Agency uses in-house crews exclusively, even when hazardous metals are present.	1	0	0	0	0	1	0	2	50.0%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	100.0%	4.7%
O Our Agency uses contractors exclusively; we do not use in-house crews.	5	13	3	1	2	0	1	25	20.0%	52.0%	12.0%	4.0%	8.0%	0.0%	4.0%	100.0%	58.1%
O Our Agency uses a combination of in-house crews and industrial painting contractors to accomplish our bridge coating maintenance program.	3	7	1	1	1	1	1	15	20.0%	46.7%	6.7%	6.7%	6.7%	6.7%	6.7%	100.0%	34.9%
	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
3. If hazardous metals are present on the structure, do you use in-house crews to perform maintenance painting?																	
O Yes	4	1	1	1	1	0	8	16	25.0%	6.3%	6.3%	6.3%	6.3%	0.0%	50.0%	100.0%	37.2%
O No	5	1	1	1	0	1	9	18	27.8%	5.6%	5.6%	5.6%	0.0%	5.6%	50.0%	100.0%	41.9%
4. When you use a combination of in-house crews and contract painting for your painting program, what criteria do you employ to decide whether to use in-house crews or to bid the work to industrial painting contractors? Check all that apply.																	0.0%
O Presence of hazardous metals	1	3	0	0	0	0	1	5	20.0%	60.0%	0.0%	0.0%	0.0%	0.0%	20.0%	100.0%	11.6%
O Square footage of area requiring maintenance	2	6	1	0	0	1	1	11	18.2%	54.5%	9.1%	0.0%	0.0%	9.1%	9.1%	100.0%	25.6%
O Access to perform the work	0	2	0	0	0	0	1	3	0.0%	66.7%	0.0%	0.0%	0.0%	0.0%	33.3%	100.0%	7.0%
O Cost	0	3	0	0	0	0	0	3	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	7.0%
O Traffic	0	1	0	0	0	0	1	2	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%	50.0%	100.0%	4.7%
O Capability of local crews	3	4	1	0	0	1	0	9	33.3%	44.4%	11.1%	0.0%	0.0%	11.1%	0.0%	100.0%	20.9%
O Other (please describe in comment box below)	0	1	0	1	1	0	0	3	0.0%	33.3%	0.0%	33.3%	33.3%	0.0%	0.0%	100.0%	7.0%
5. What scope of work is performed by in-house crews? Select all that apply.																	0.0%
O Localized coating breakdown	2	4	1	0	0	0	0	7	28.6%	57.1%	14.3%	0.0%	0.0%	0.0%	0.0%	100.0%	16.3%
O Bearings	2	3	1	0	0	0	1	7	28.6%	42.9%	14.3%	0.0%	0.0%	0.0%	14.3%	100.0%	16.3%
O Beam Ends	2	4	1	0	0	0	1	8	25.0%	50.0%	12.5%	0.0%	0.0%	0.0%	12.5%	100.0%	18.6%
O Fascia Beams	0	2	0	0	1	0	0	3	0.0%	66.7%	0.0%	0.0%	33.3%	0.0%	0.0%	100.0%	7.0%
O Can be any amount of work depending on specific needs	1	3	0	1	1	1	0	7	14.3%	42.9%	0.0%	14.3%	14.3%	14.3%	0.0%	100.0%	16.3%

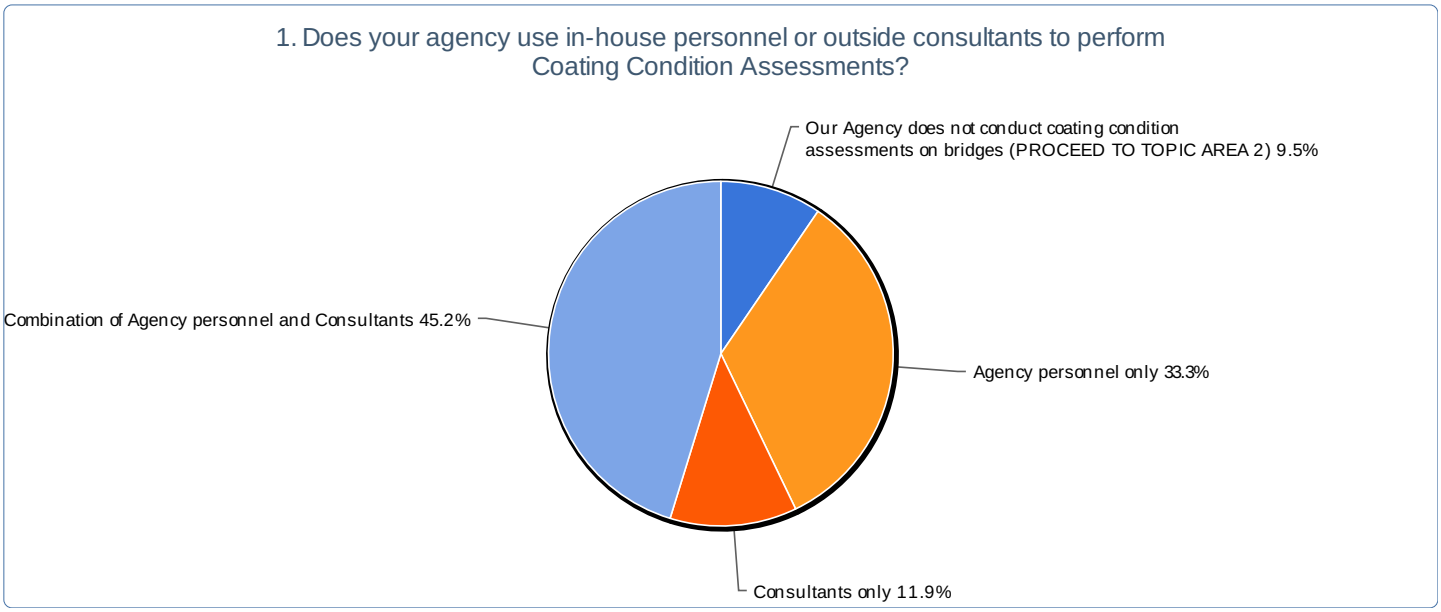
Summary of Responses by Geographical Region

Region	Number of Responses By Region								Percent of Responses By Region								
	NC	NE	NW	SC	SE	SW	Unk	Tot	NC	NE	NW	SC	SE	SW	Unk	Percent of All Regions	Percent of All Agencies
Respondants	9	21	4	2	3	2	1	42	48.8%	48.8%	9.3%	4.7%	7.0%	4.7%	4.7%	100.0%	100.0%
6. When you use in-house crews to perform bridge coating maintenance painting, what type of training do they receive?																	0.0%
O In-house instructor-led training	0	0	1	0	0	1	0	2	0.0%	0.0%	50.0%	0.0%	0.0%	50.0%	0.0%	100.0%	4.7%
O On-line training	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
O Industry-based training (SSPC, NACE, other courses)	1	3	0	0	0	1	0	5	20.0%	60.0%	0.0%	0.0%	0.0%	20.0%	0.0%	100.0%	11.6%
O On-the-job training	2	4	0	1	1	0	1	9	22.2%	44.4%	0.0%	11.1%	11.1%	0.0%	11.1%	100.0%	20.9%
O None	0	0	0	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
7. When performing bridge maintenance painting, which documents are used to ensure that the work is done properly? Select all that apply.																	
O Coating manufacturer's Product Data Sheets/Application Instructions	7	15	3	1	3	2	1	32	21.9%	46.9%	9.4%	3.1%	9.4%	6.3%	3.1%	100.0%	74.4%
O Agency standard specification/technical special provisions	7	17	4	1	3	2	0	34	20.6%	50.0%	11.8%	2.9%	8.8%	5.9%	0.0%	100.0%	79.1%
O Agency Best Practices Manual	0	3	1	0	0	0	0	4	0.0%	75.0%	25.0%	0.0%	0.0%	0.0%	0.0%	100.0%	9.3%
O Other (please describe in comment box below)	1	4	2	0	0	0	0	7	14.3%	57.1%	28.6%	0.0%	0.0%	0.0%	0.0%	100.0%	16.3%

Appendix C
SurveyGizmo Final Survey Report

Final Summary Report - Jan 10, 2014

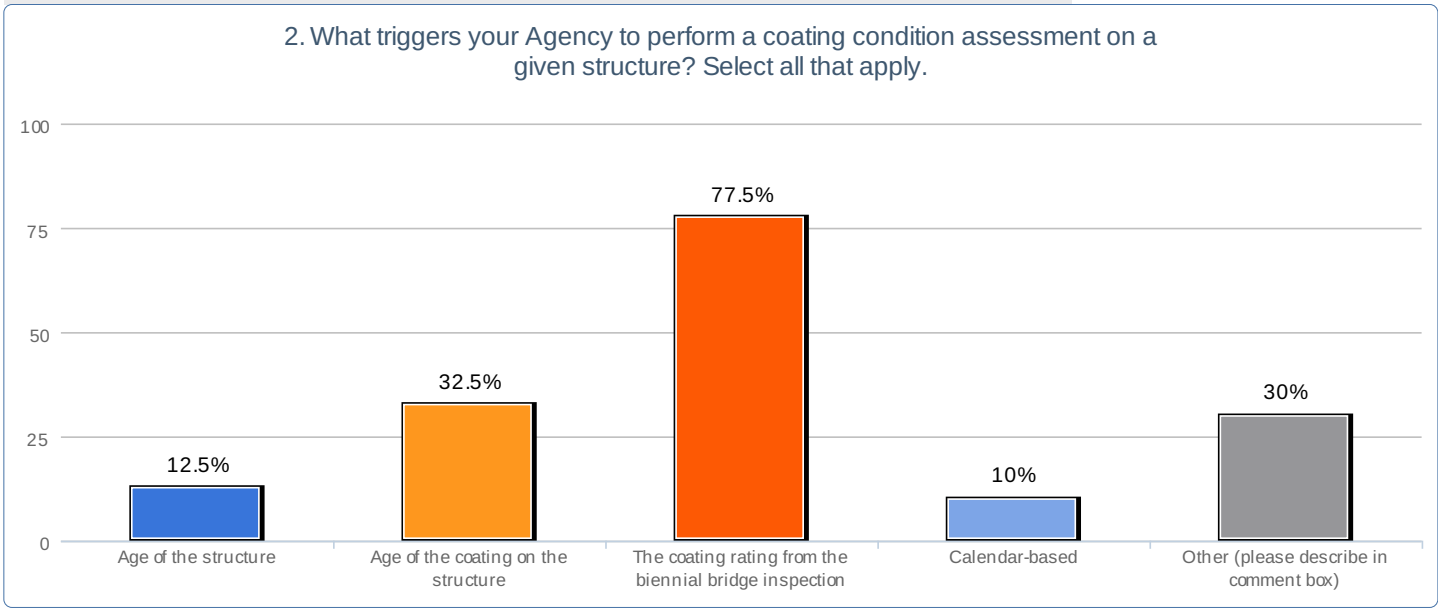
Survey: Minnesota Department of Transportation Transportation Research Synthesis Survey



1. Does your agency use in-house personnel or outside consultants to perform Coating Condition Assessments?

Value	Count	Percent %
Our Agency does not conduct coating condition assessments on bridges (PROCEED TO TOPIC AREA 2)	4	9.5%
Agency personnel only	14	33.3%
Consultants only	5	11.9%
Combination of Agency personnel and Consultants	19	45.2%

Statistics	
Total Responses	42

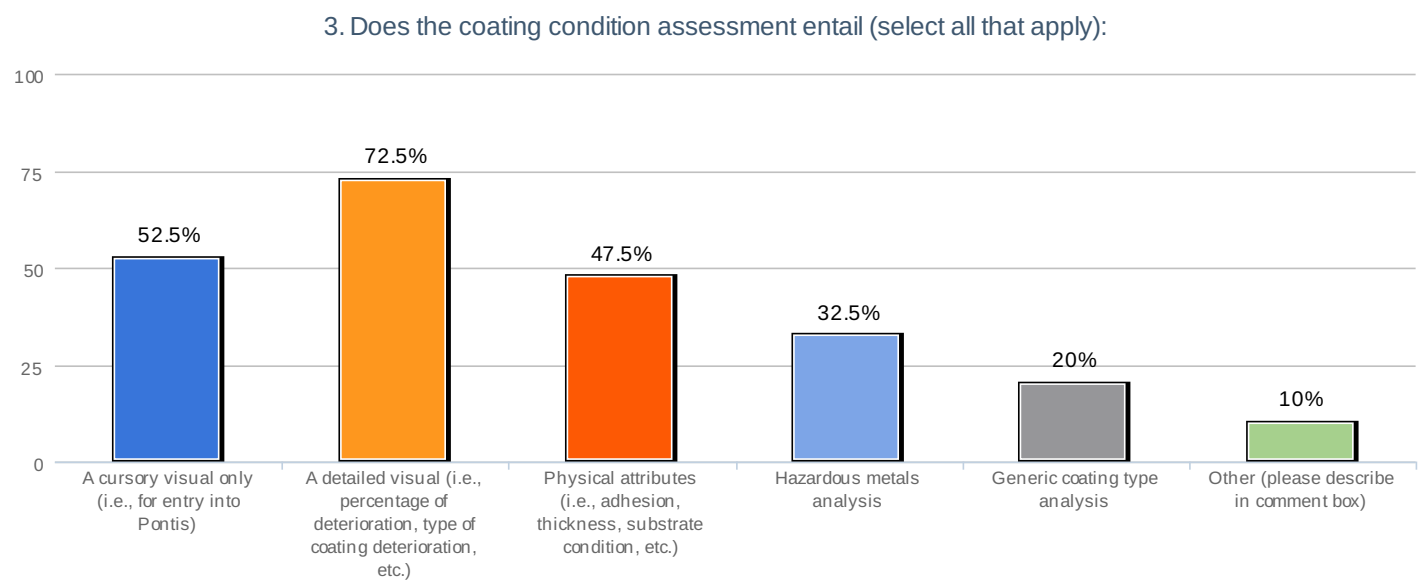


2. What triggers your Agency to perform a coating condition assessment on a given structure? Select all that apply.

Value	Count	Percent %
Age of the structure	5	12.5%
Age of the coating on the structure	13	32.5%
The coating rating from the biennial bridge inspection	31	77.5%
Traffic/Vehicle Load	0	0.0%
Calendar-based	4	10.0%
Other (please describe in comment box)	12	30.0%

Statistics	
Total Responses	40

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	31
Complaint	1
District Bridge Engineer Recommendation	1
Field Personnel Review	1
Other rehabilitation work being performed on the structure.	1
Painting project planning	1
Rehabilitation Project	1
We do not use it on all structures. We will use it in special cases such as Major Bridges.	1
lead based paint removal	1
visual	1
All bridges are given a general visual coating assessment as part of the bienneial Pontis Bridge Inspection Program. More detailed ABC (assessment of bridge coatings) are performed for specific projects coming up either definitely or under consideration in the near future. The data in Pontis does not automatically trigger in-depth ABC.	1
If a bridge is scheduled for other work (such as widening), then the overall condition of the bridge is evaluated and re-painting the bridge might be an option at that time.	1
Visual assessments are conducted by bridge inspection staff during each general inspection. More indepth evaluations, including dry film thickness readings and adhesion testing, are conducted when considering overcoat/recoat options (primarily for rehab projects).	1



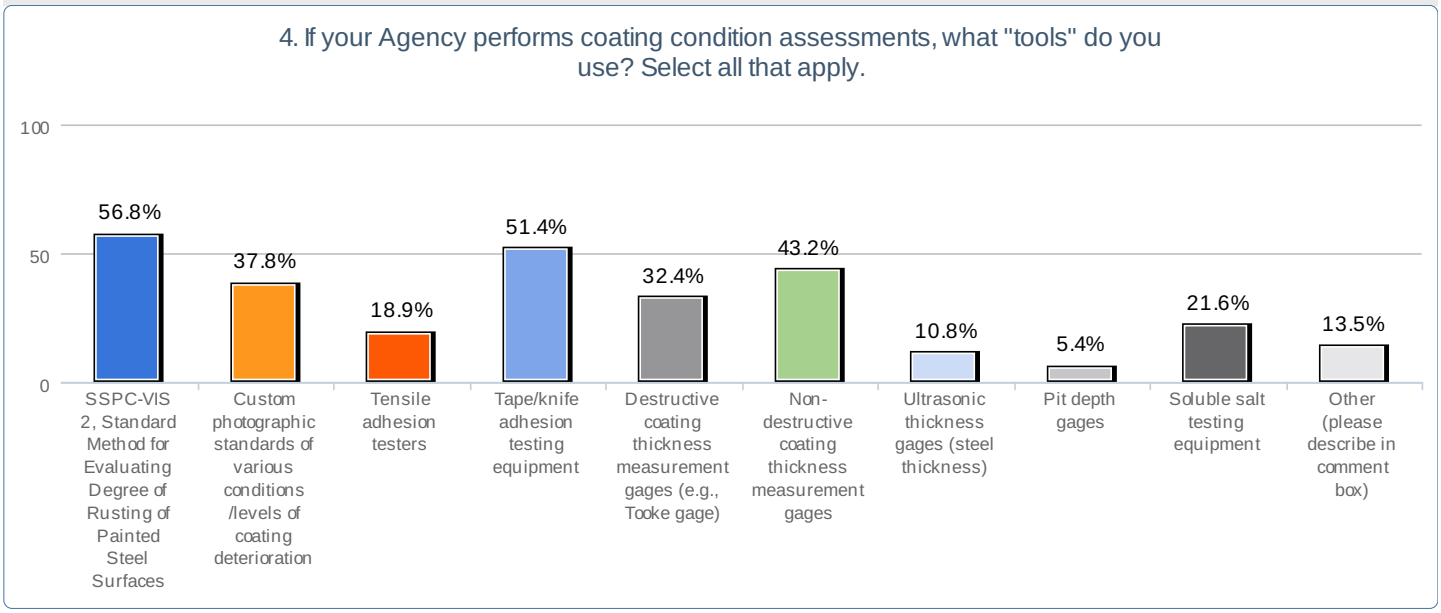
3. Does the coating condition assessment entail (select all that apply):

Value	Count	Percent %
A cursory visual only (i.e., for entry into Pontis)	21	52.5%
A detailed visual (i.e., percentage of deterioration, type of coating deterioration, etc.)	29	72.5%

Statistics	
Total Responses	40

Physical attributes (i.e., adhesion, thickness, substrate condition, etc.)	19	47.5%
Hazardous metals analysis	13	32.5%
Generic coating type analysis	8	20.0%
Other (please describe in comment box)	4	10.0%

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	39
Mill Scale	1
Priority for Repaint	1
overcoat patches & test	1
The level of ABC depends on the nature of the bridge. For routine bridges (e.g. overpasses, small bridges, etc.) the ABC is performed visually by more-trained DOT folks, including DFT, X-cut adhesion, VIS-2 rust grade, etc. For large bridges the Department may use a consultant for an in-depth ABC including RCRA metal check, etc.	1



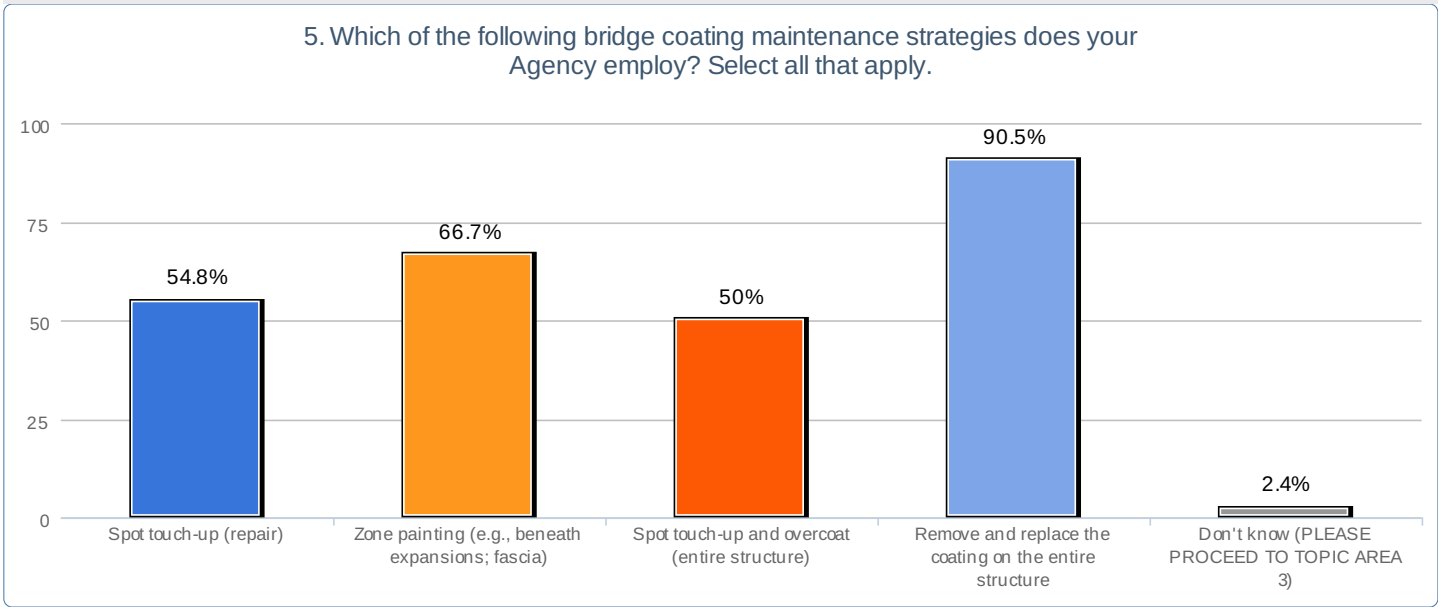
4. If your Agency performs coating condition assessments, what "tools" do you use? Select all that apply.

Value	Count	Percent %
SSPC-VIS 2, Standard Method for Evaluating Degree of Rusting of Painted Steel Surfaces	21	56.8%
Custom photographic standards of various conditions /levels of coating deterioration	14	37.8%
Tensile adhesion testers	7	18.9%
Tape/knife adhesion testing equipment	19	51.4%
Destructive coating thickness measurement gages (e.g., Tooke gage)	12	32.4%
Non-destructive coating thickness measurement gages	16	43.2%
Ultrasonic thickness gages (steel thickness)	4	10.8%
Pit depth gages	2	5.4%
Soluble salt testing equipment	8	21.6%
Other (please describe in comment box)	5	13.5%

Statistics	
Total Responses	37

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	39
N/A	1
Only visual	1

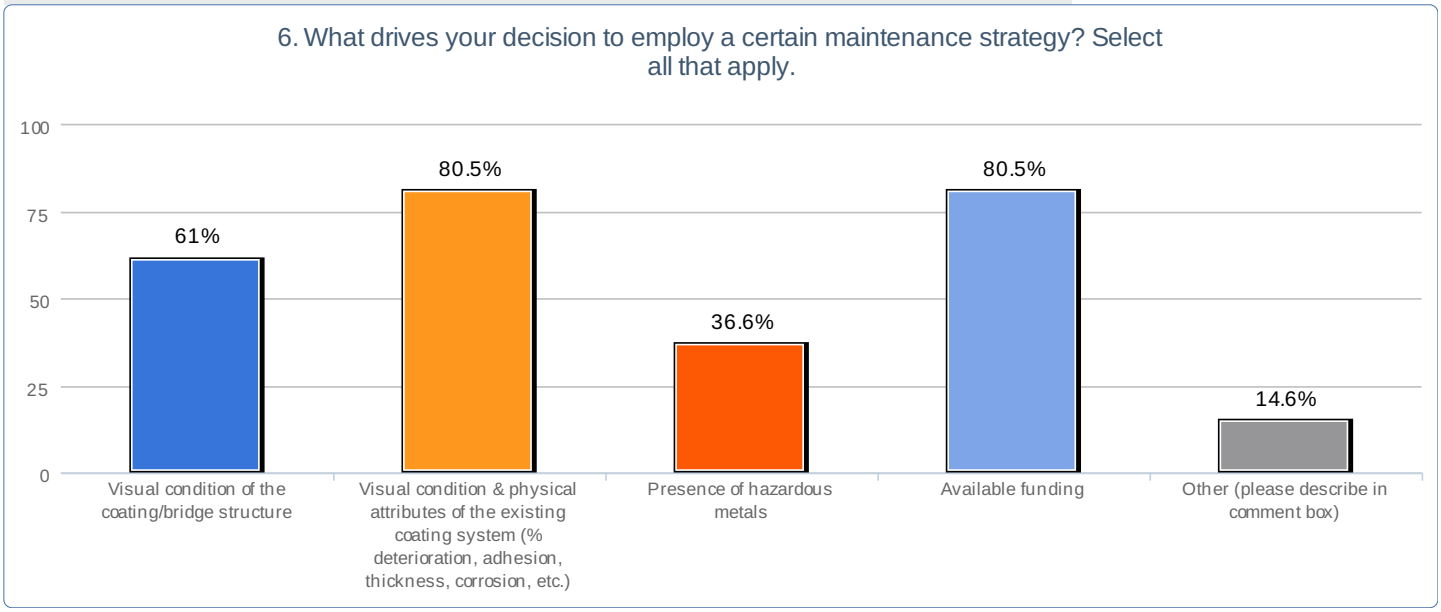
Standard Photos	1
Visual only	1



5. Which of the following bridge coating maintenance strategies does your Agency employ? Select all that apply.

Value	Count	Percent %
Spot touch-up (repair)	23	54.8%
Zone painting (e.g., beneath expansions; fascia)	28	66.7%
Spot touch-up and overcoat (entire structure)	21	50.0%
Remove and replace the coating on the entire structure	38	90.5%
Don't know (PLEASE PROCEED TO TOPIC AREA 3)	1	2.4%

Statistics	
Total Responses	42



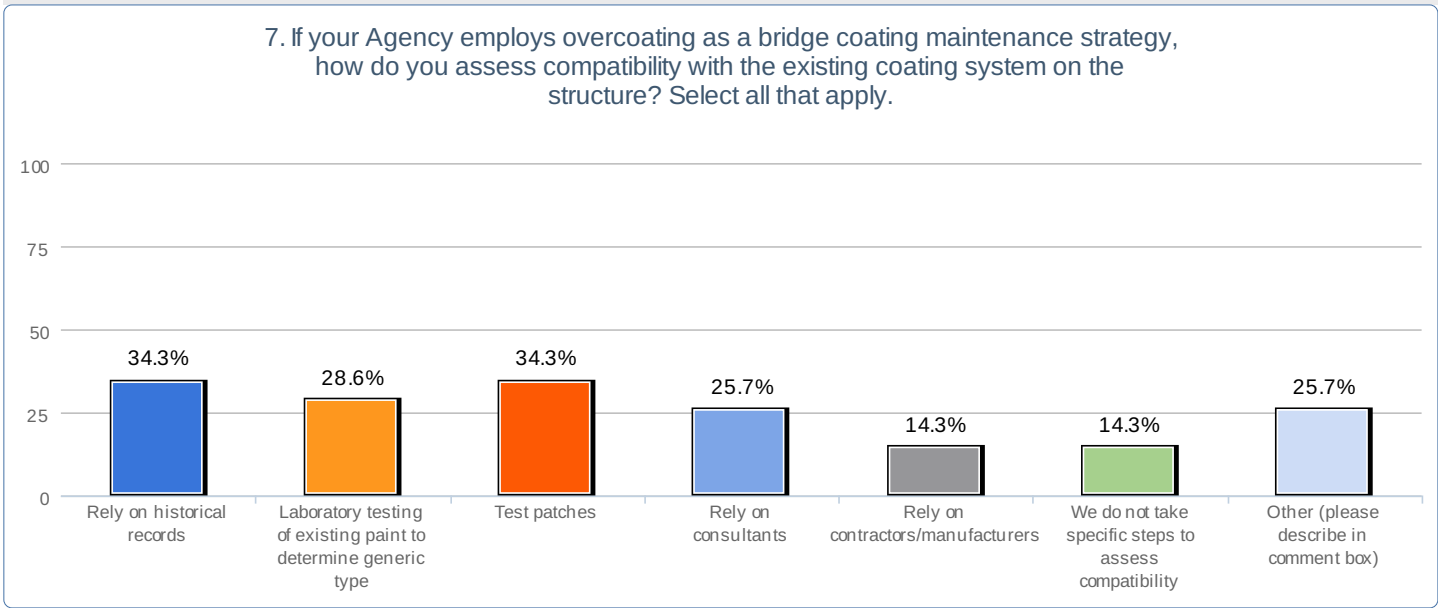
6. What drives your decision to employ a certain maintenance strategy? Select all that apply.

Value	Count	Percent %
Visual condition of the coating/bridge structure	25	61.0%
Visual condition & physical attributes of the existing coating system (%	33	80.5%

Statistics	
Total Responses	41

deterioration, adhesion, thickness, corrosion, etc.)	33	80.5%
Presence of hazardous metals	15	36.6%
Available funding	33	80.5%
Other (please describe in comment box)	6	14.6%

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	37
Agreements (Town, Railroad, Coast Guard, etc.) & Time contraints	1
Bid Prices	1
Environment (marine vs werstern vs eastern part of the state)	1
Rehabilitation Project	1
Funding is the key element. All but a tiny amount of work is done by contract. Given that scenario, we specify the best coating treatment.	1
Tend to do zone painting when the exterior, which is exposed more, deteriorates quicker then the interior. In that case, we would paint the exterior of the exterior girders and areas around joints and abutments.	1



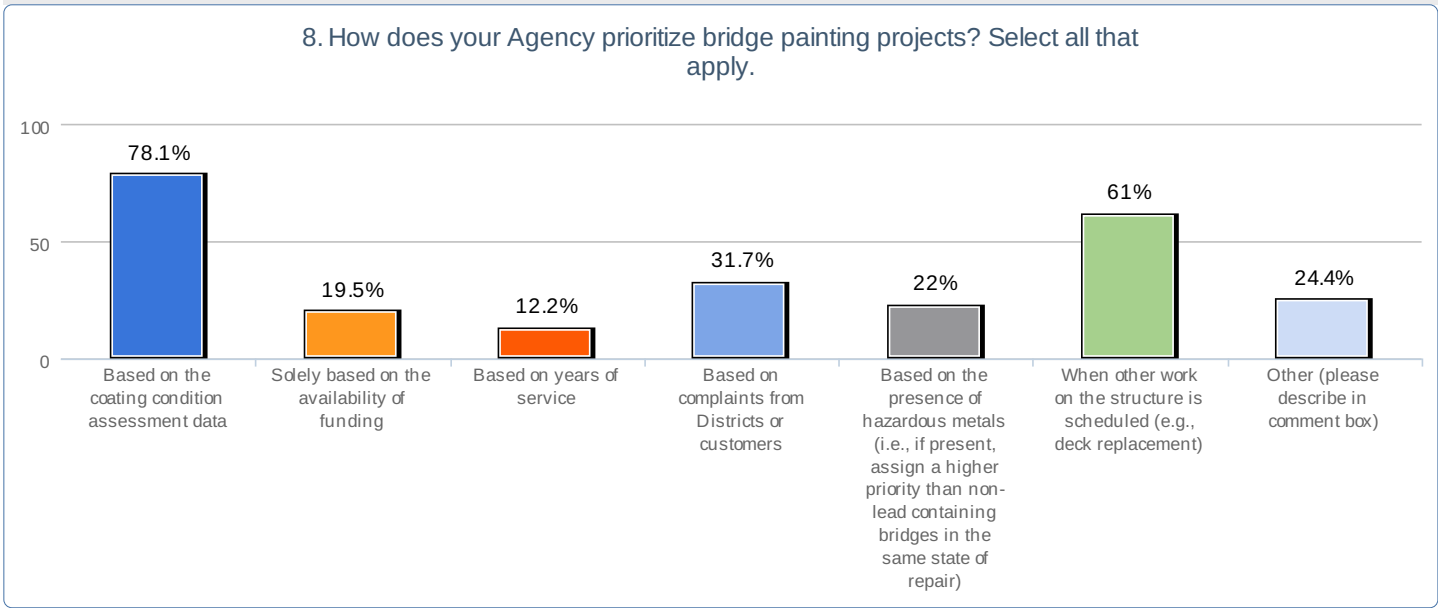
7. If your Agency employs overcoating as a bridge coating maintenance strategy, how do you assess compatibility with the existing coating system on the structure? Select all that apply.

Value	Count	Percent %
Rely on historical records	12	34.3%
Laboratory testing of existing paint to determine generic type	10	28.6%
Test patches	12	34.3%
Rely on consultants	9	25.7%
Rely on contractors/manufacturers	5	14.3%
We do not take specific steps to assess compatibility	5	14.3%
Other (please describe in comment box)	9	25.7%

Statistics	
Total Responses	35

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	34
Do not overcoat	1
N/A	1
Normally do not overcoat.	1
Not necessarily used	1

Results of dry film thickness reading and adhesion test results.	1
We avoid overcoating. If needed we'd probably rely on manufacturer.	1
We do not overcoat	1
overcoating is not a strategy	1
We only use overcoating occasionally. The coating has to be in pretty good shape to be foundational for a new system. If this is the case, the issue of compatibility is addressed by the surface tolerant system we use, single component moisture cure urethane.	1

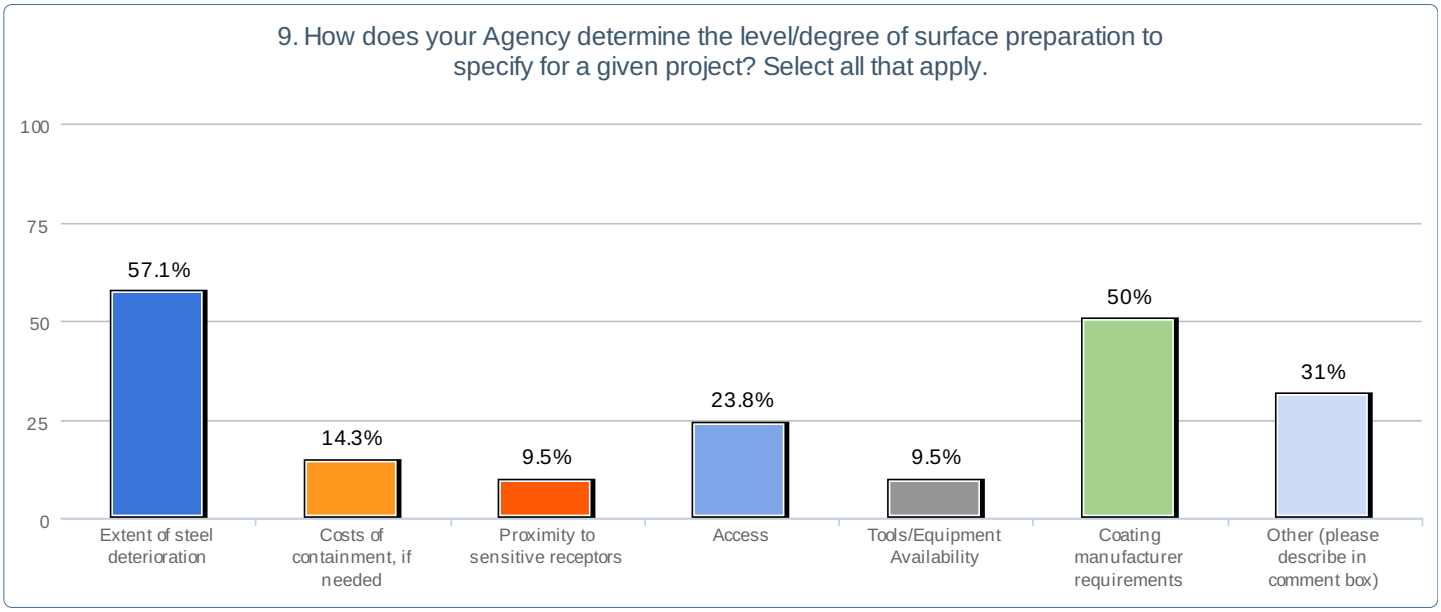


8. How does your Agency prioritize bridge painting projects? Select all that apply.

Value	Count	Percent %
Based on the coating condition assessment data	32	78.1%
Solely based on the availability of funding	8	19.5%
Based on years of service	5	12.2%
Based on complaints from Districts or customers	13	31.7%
Based on the presence of hazardous metals (i.e., if present, assign a higher priority than non-lead containing bridges in the same state of repair)	9	22.0%
When other work on the structure is scheduled (e.g., deck replacement)	25	61.0%
Other (please describe in comment box)	10	24.4%

Statistics	
Total Responses	41

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	34
Agency practices on preservation work.	1
Fracture Critical given priority	1
Importance of structure being maintained	1
Presevation beam ends & brgs	1
Spot repair projects are based on District's workload	1
importance of member/structure	1
Priorities submitted from 10 dristricts are prioritized by a formula that considers paint condition, age of structure, deck and superstructure condition, ADT etc.	1
Condition of the Paint and the importance of the bridge. Bridges with higher percentage of trucks will be painted first.	1
There are a lot of factors, mostly related to funding, importance of the bridge, other work, etc. and not driven strickly by the ABC.	1

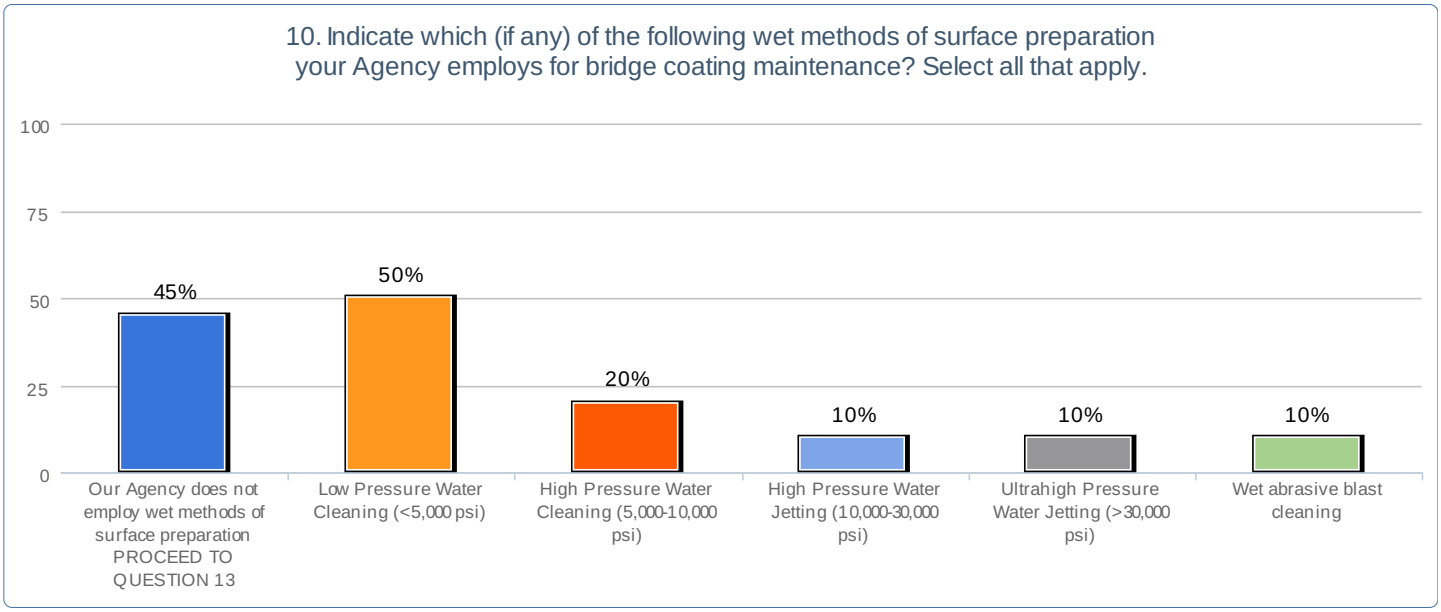


9. How does your Agency determine the level/degree of surface preparation to specify for a given project? Select all that apply.

Value	Count	Percent %
Extent of steel deterioration	24	57.1%
Costs of containment, if needed	6	14.3%
Proximity to sensitive receptors	4	9.5%
Access	10	23.8%
Tools/Equipment Availability	4	9.5%
Coating manufacturer requirements	21	50.0%
Other (please describe in comment box)	13	31.0%

Statistics	
Total Responses	42

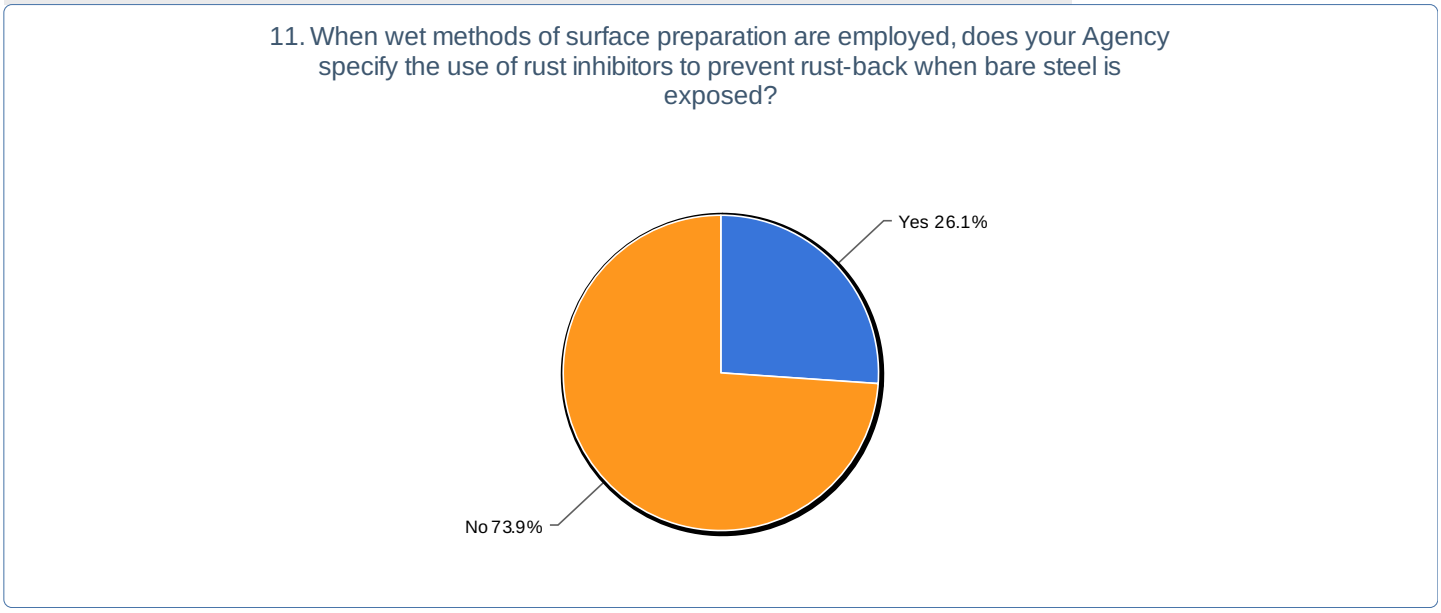
Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	31
Agency practice.	1
Clean all steel to SP-10	1
Dependent on the Paint System that will be used	1
For Contract painting we set the standard to SP10	1
Pre-tested chloride levels	1
Specification requires SSPC-SP 10, SP 11	1
Specifications	1
Surface is prepared to an SSPC-SP2 or 3 standard for overcoat and SSPC-SP10 standard for recoat.	1
The extent of coating condition.	1
We always specify an SP 10 near white surface preparation.	1
Specification requirements for paint item - see section 411 of the 2007 VDOT Specifications http://www.virginiadot.org/business/resources/const/2007SpecBook.pdf	1
SSPC-SP6 is almost always required. An option for power tool cleaning is offered, however abrasive blasting appears to be the overwhelming choice by the contractors.	1



10. Indicate which (if any) of the following wet methods of surface preparation your Agency employs for bridge coating maintenance? Select all that apply.

Value	Count	Percent %
Our Agency does not employ wet methods of surface preparation PROCEED TO QUESTION 13	18	45.0%
Low Pressure Water Cleaning (<5,000 psi)	20	50.0%
High Pressure Water Cleaning (5,000-10,000 psi)	8	20.0%
High Pressure Water Jetting (10,000-30,000 psi)	4	10.0%
Ultrahigh Pressure Water Jetting (>30,000 psi)	4	10.0%
Wet abrasive blast cleaning	4	10.0%

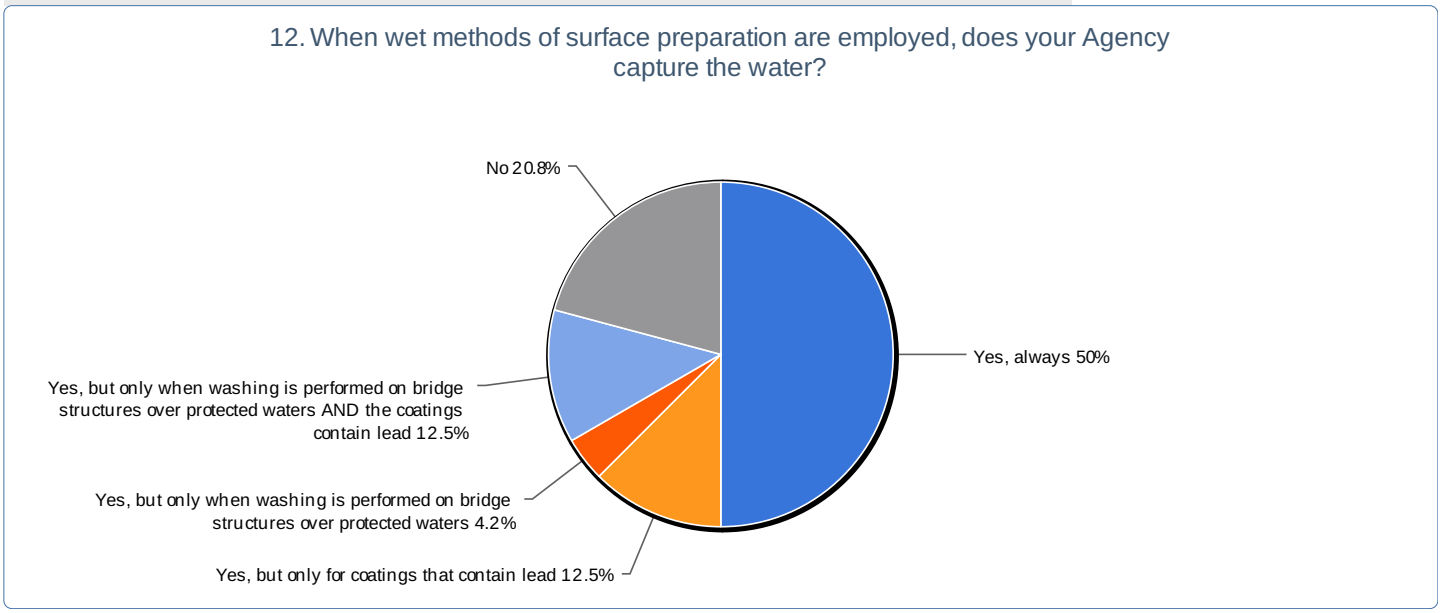
Statistics	
Total Responses	40



11. When wet methods of surface preparation are employed, does your Agency specify the use of rust inhibitors to prevent rust-back when bare steel is exposed?

Value	Count	Percent %
Yes	6	26.1%
No	17	73.9%

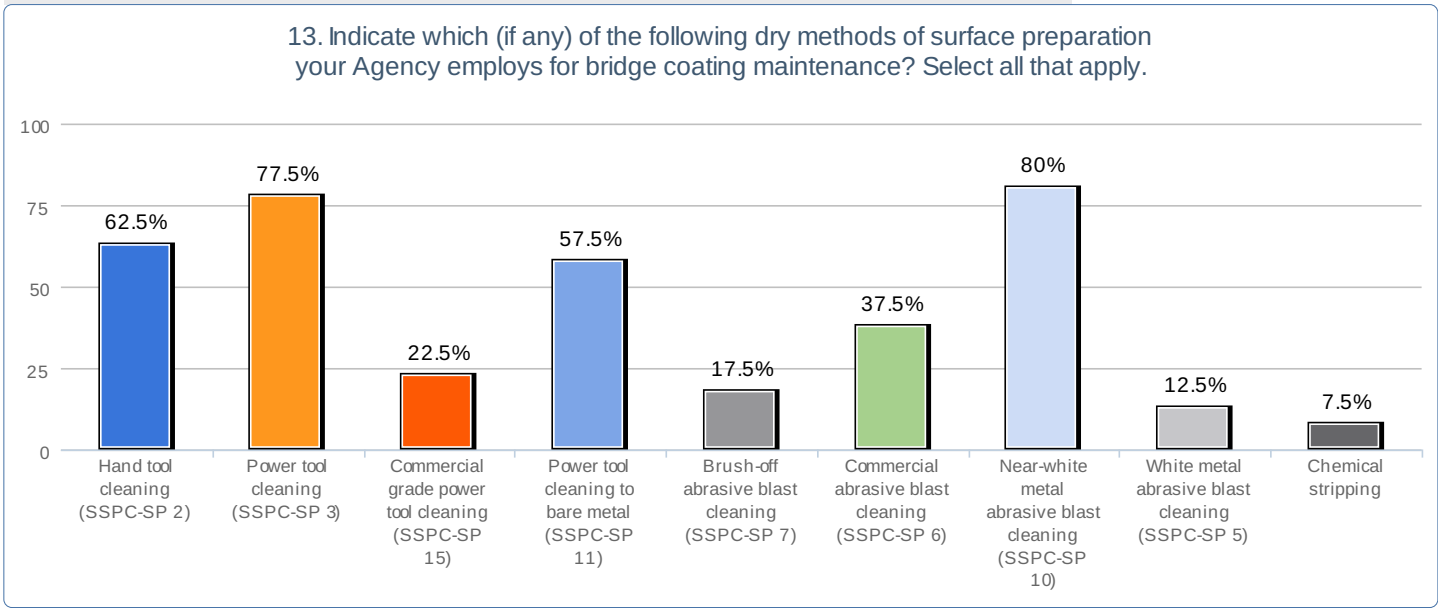
Statistics	
Total Responses	23



12. When wet methods of surface preparation are employed, does your Agency capture the water?

Value	Count	Percent %
Yes, always	12	50.0%
Yes, but only for coatings that contain lead	3	12.5%
Yes, but only when washing is performed on bridge structures over protected waters	1	4.2%
Yes, but only when washing is performed on bridge structures over protected waters AND the coatings contain lead	3	12.5%
No	5	20.8%
Don't know	0	0.0%

Statistics	
Total Responses	24

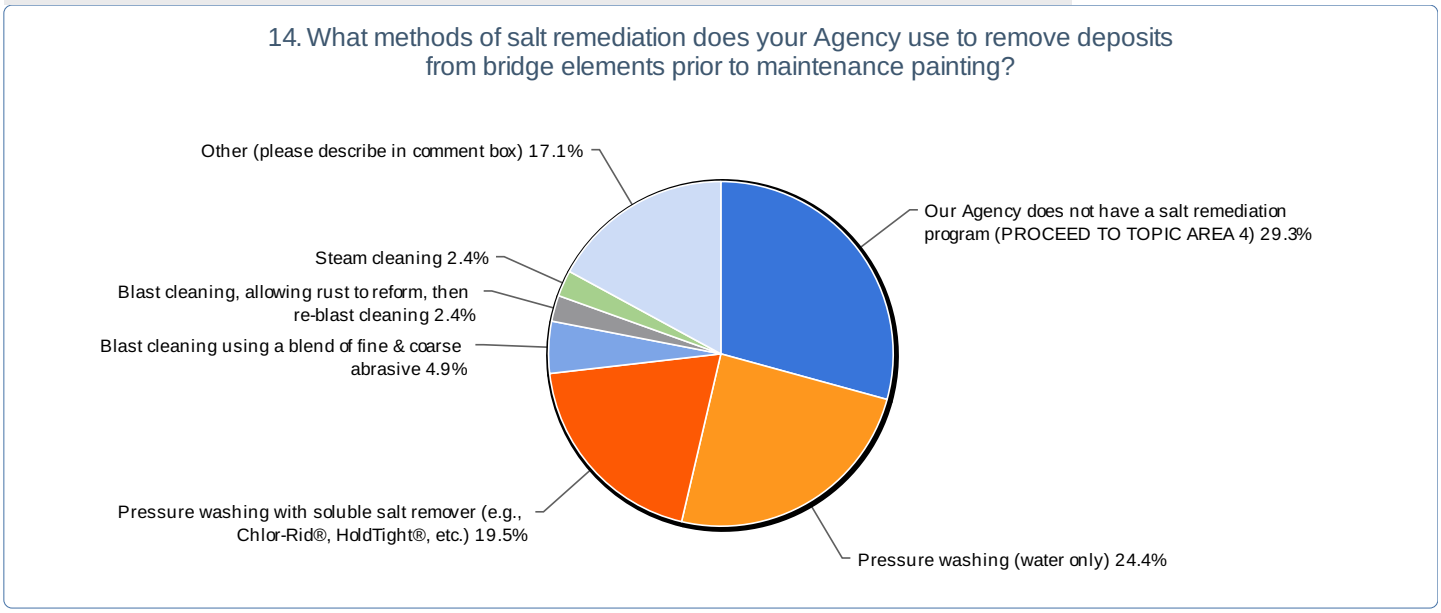


13. Indicate which (if any) of the following dry methods of surface preparation your Agency employs for bridge coating maintenance? Select all that apply.

Value	Count	Percent %
Hand tool cleaning (SSPC-SP 2)	25	62.5%
Power tool cleaning (SSPC-SP 3)	31	77.5%

Statistics	
Total Responses	40

Commercial grade power tool cleaning (SSPC-SP 15)	9	22.5%
Power tool cleaning to bare metal (SSPC-SP 11)	23	57.5%
Brush-off abrasive blast cleaning (SSPC-SP 7)	7	17.5%
Commercial abrasive blast cleaning (SSPC-SP 6)	15	37.5%
Near-white metal abrasive blast cleaning (SSPC-SP 10)	32	80.0%
White metal abrasive blast cleaning (SSPC-SP 5)	5	12.5%
Chemical stripping	3	7.5%

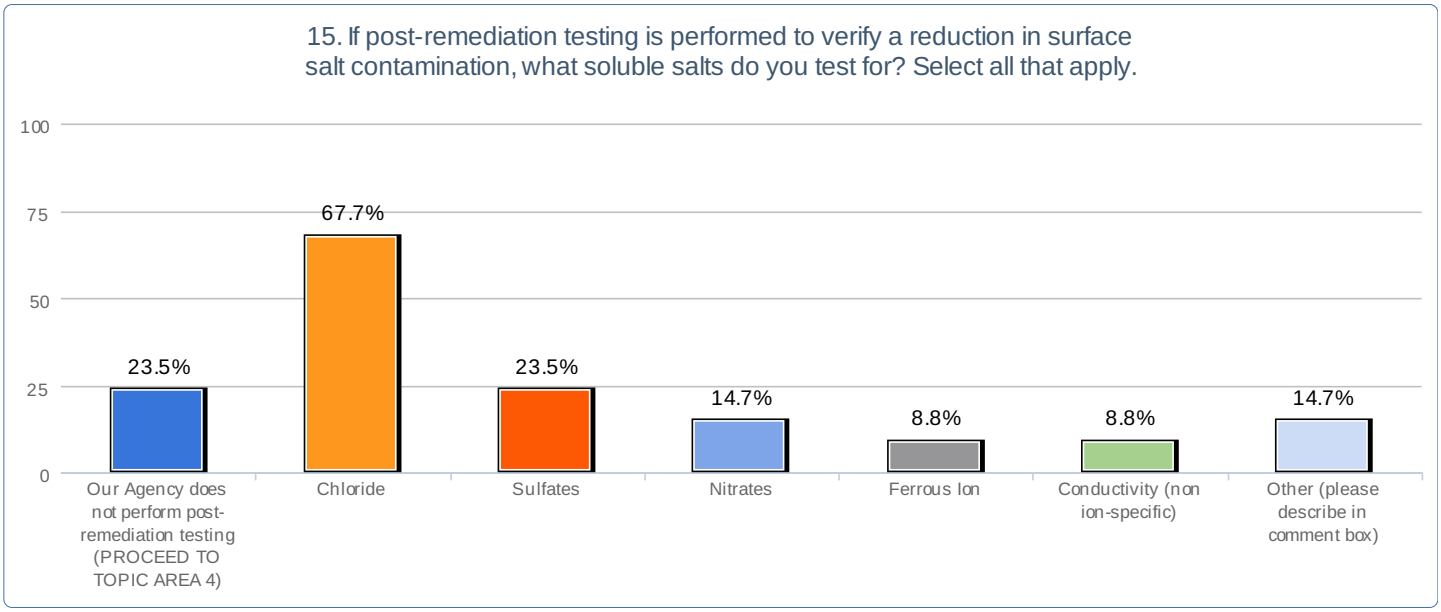


14. What methods of salt remediation does your Agency use to remove deposits from bridge elements prior to maintenance painting?

Value	Count	Percent %
Our Agency does not have a salt remediation program (PROCEED TO TOPIC AREA 4)	12	29.3%
Pressure washing (water only)	10	24.4%
Pressure washing with soluble salt remover (e.g., Chlor-Rid®, HoldTight®, etc.)	8	19.5%
Blast cleaning using a blend of fine & coarse abrasive	2	4.9%
Blast cleaning, allowing rust to reform, then re-blast cleaning	1	2.4%
Steam cleaning	1	2.4%
Other (please describe in comment box)	7	17.1%

Statistics	
Total Responses	41

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Low pressure, high volume washing	1
blast cleaning, apply a soulable salt remover, allow structure to rerust and then reblast.	1
we allow all of the options listed above	1
Do not have an overarching program, have used pressure washing or blast cleaning with requirement to test for salt contamination prior to coating on specific projects	1
Contractors option of chloride remover or additional blasting. Typically, additional blasting is used.	1
After all surface preparation is completed, in the area of greatest corrosion no area shall have quantities greater than 7 ug/cm2	1
pressure washing with water is required and then if soluble salts are detected the contractor is required to propose a method to remove them.	1



15. If post-remediation testing is performed to verify a reduction in surface salt contamination, what soluble salts do you test for? Select all that apply.

Value	Count	Percent %
Our Agency does not perform post-remediation testing (PROCEED TO TOPIC AREA 4)	8	23.5%
Chloride	23	67.7%
Sulfates	8	23.5%
Nitrates	5	14.7%
Ferrous Ion	3	8.8%
Conductivity (non ion-specific)	3	8.8%
Other (please describe in comment box)	5	14.7%

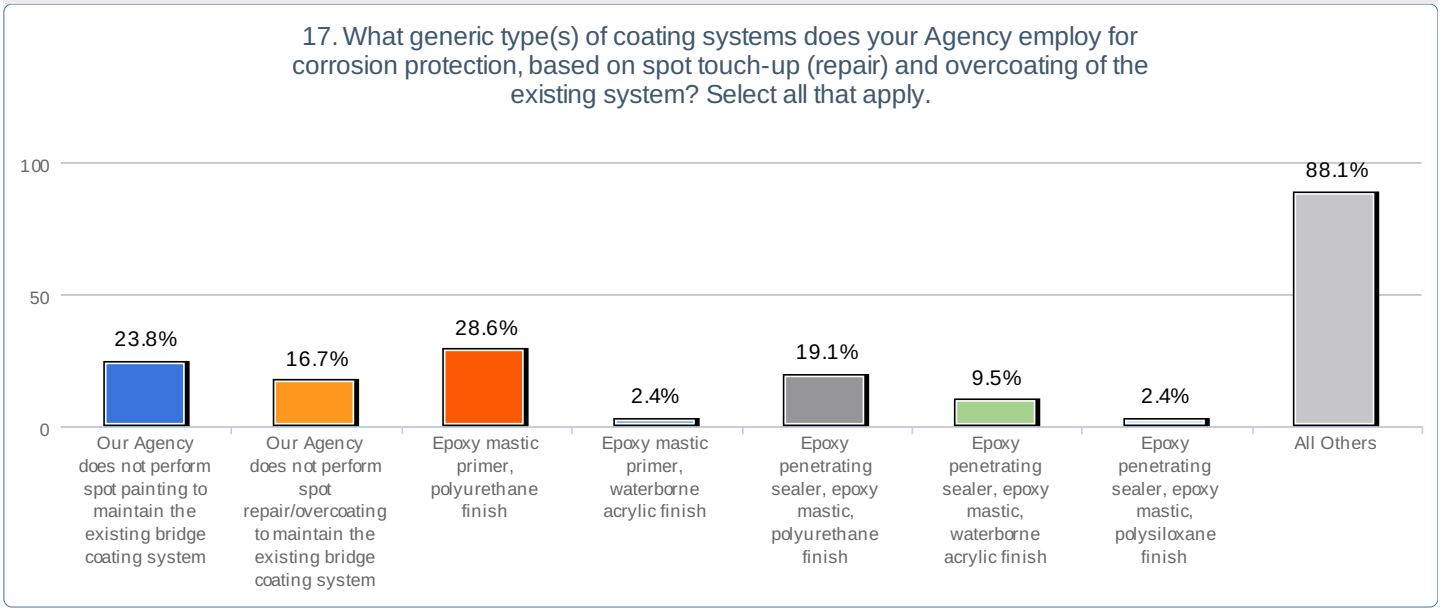
Statistics	
Total Responses	34

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	38
Clor*test	1
On specific projects have required surface to be less than 100uS/cm	1
Same as above	1
n/a	1
Typically the ARP (conductivity) salt meter unless additive used in abrasive for lead paint removal.	1

16. Using the table list below, indicate the limits your Agency imposes for each of the soluble salts selected in Question 15.

	Chlorides µg/cm²	Sulfates µg/cm²	Nitrates µg/cm²	Ferrous Ions µg/cm²	Conductivity µS/cm	Responses
Non-detectable	**50.0%** 1	**0.0%** 0	**0.0%** 0	**0.0%** 0	**50.0%** 1	**2**
< 5	**70.0%** 7	**10.0%** 1	**10.0%** 1	**0.0%** 0	**10.0%** 1	**10**
6-10	**70.6%** 12	**5.9%** 1	**11.8%** 2	**5.9%** 1	**5.9%** 1	**17**
11-15	**33.3%** 1	**0.0%** 0	**33.3%** 1	**33.3%** 1	**0.0%** 0	**3**
16-25	**0.0%** 0	**75.0%** 3	**0.0%** 0	**25.0%** 1	**0.0%** 0	**4**

26-50	0.0% 0	0.0% 0	0.0% 0	50.0% 1	50.0% 1	2

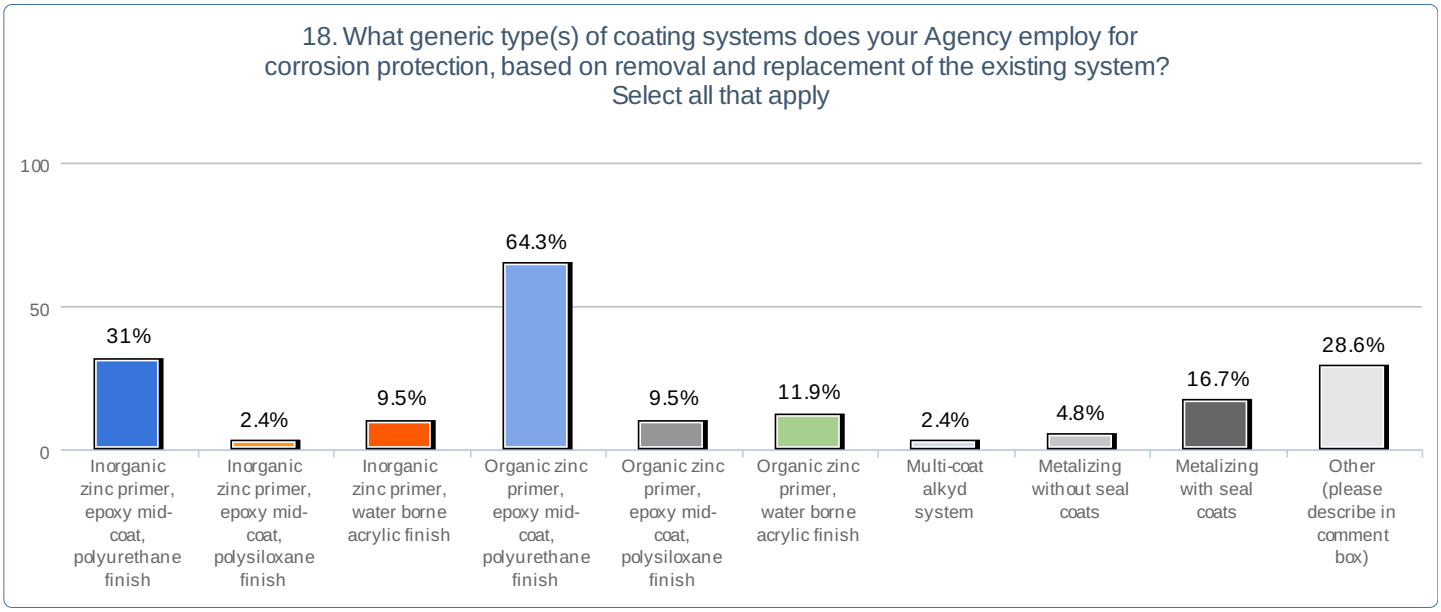


17. What generic type(s) of coating systems does your Agency employ for corrosion protection, based on spot touch-up (repair) and overcoating of the existing system? Select all that apply.

Value	Count	Percent %
Our Agency does not perform spot painting to maintain the existing bridge coating system	10	23.8%
Our Agency does not perform spot repair/overcoating to maintain the existing bridge coating system	7	16.7%
Epoxy mastic primer, polyurethane finish	12	28.6%
Epoxy mastic primer, waterborne acrylic finish	1	2.4%
Epoxy mastic primer, polysiloxane finish	0	0.0%
Epoxy penetrating sealer, epoxy mastic, polyurethane finish	8	19.1%
Epoxy penetrating sealer, epoxy mastic, waterborne acrylic finish	4	9.5%
Epoxy penetrating sealer, epoxy mastic, polysiloxane finish	1	2.4%
Calcium sulfonate alkyd	5	11.9%
Alkyd	4	9.5%
Waterborne acrylic	8	19.1%
Moisture cured urethane	15	35.7%
Other (please describe in comment box)	5	11.9%

Statistics	
Total Responses	42

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	38
Dependent on the coating system being overcoated.	1
Don't spot paint	1
Epoxy primer and urethane finish	1
For Spot Painting only. We do not overcoat.	1
Please understand this point. The NHDOT no longer does maintenance painting, except a very tiny amount, which would be considered spot/zone painting at bearings and beam ends only. They use Rustoleum alkyd. All the rest of maintenance painting is done by the Bridge Design office via Contract. If suitable we use spot repair and overcoat using moisture cure urethane coatings.	1



18. What generic type(s) of coating systems does your Agency employ for corrosion protection, based on removal and replacement of the existing system? Select all that apply

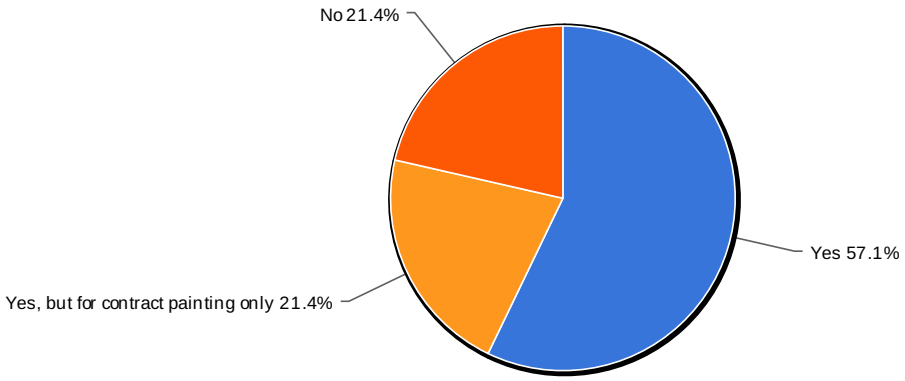
Value	Count	Percent %
Inorganic zinc primer, epoxy mid-coat, polyurethane finish	13	31.0%
Inorganic zinc primer, epoxy mid-coat, polysiloxane finish	1	2.4%
Inorganic zinc primer, epoxy mid-coat, fluoropolymer finish	0	0.0%
Inorganic zinc primer, water borne acrylic finish	4	9.5%
Organic zinc primer, epoxy mid-coat, polyurethane finish	27	64.3%
Organic zinc primer, epoxy mid-coat, polysiloxane finish	4	9.5%
Organic zinc primer, epoxy mid-coat, fluoropolymer finish	0	0.0%
Organic zinc primer, water borne acrylic finish	5	11.9%
Multi-coat alkyd system	1	2.4%
Metalizing without seal coats	2	4.8%
Metalizing with seal coats	7	16.7%
Other (please describe in comment box)	12	28.6%

Statistics	
Total Responses	42

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	32
MCU primer, mid, and finish	1
Metalize with seal coat - Pilot only	1
Moisture Cured Urethane	1
Moisture cured urethane	1
Organic zinc primer, epoxy or polyurethane mid-coat, polyurethane finish	1
Would also consider 2-coat zinc/polysiloxane systems	1
Zinc primer, Water bourn acrylic mid & top coat	1
Zinc-rich primer, MC polyurethane mid-coat, polyurethane finish (will be adopting NEPCOAT soon)	1
waterborne acrylic latex system	1
Organic zinc moisture cured Polyurethane primer / moisture cured PolyUrethane intermediate coate / moisture cured Polyurethane top coat	1
Our normal practice for total removal is to apply a three-coat moisture-cure urethane system. Sometimes we add a fourth clear coat on fascia beams for anti-graffiti and UV & color protection. There may be specialized bridges that receive a slightly different treatment, such as zinc/tar/tar moisture cure system if the bridge is in a marine setting low to the water. We painted a major bridge with metallizing and one seal coat and were very pleased. We would like to use	1

TSC more often but the bridge has to be important enough to justify the higher costs.

19. Does your Agency use a Qualified Products List (QPL) of approved bridge coating systems?

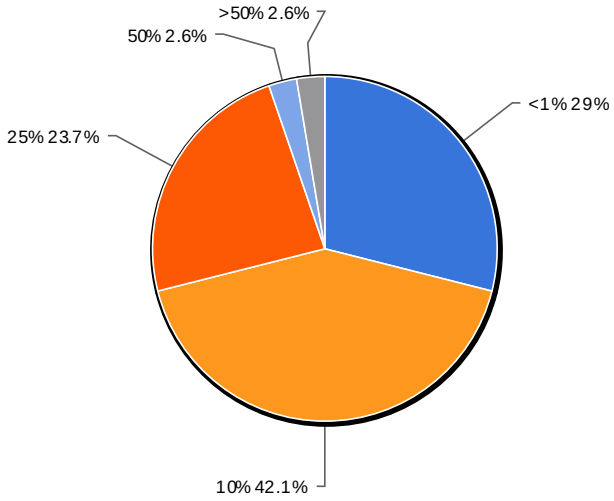


19. Does your Agency use a Qualified Products List (QPL) of approved bridge coating systems?

Value	Count	Percent %
Yes	24	57.1%
Yes, but for contract painting only	9	21.4%
No	9	21.4%

Statistics	
Total Responses	42

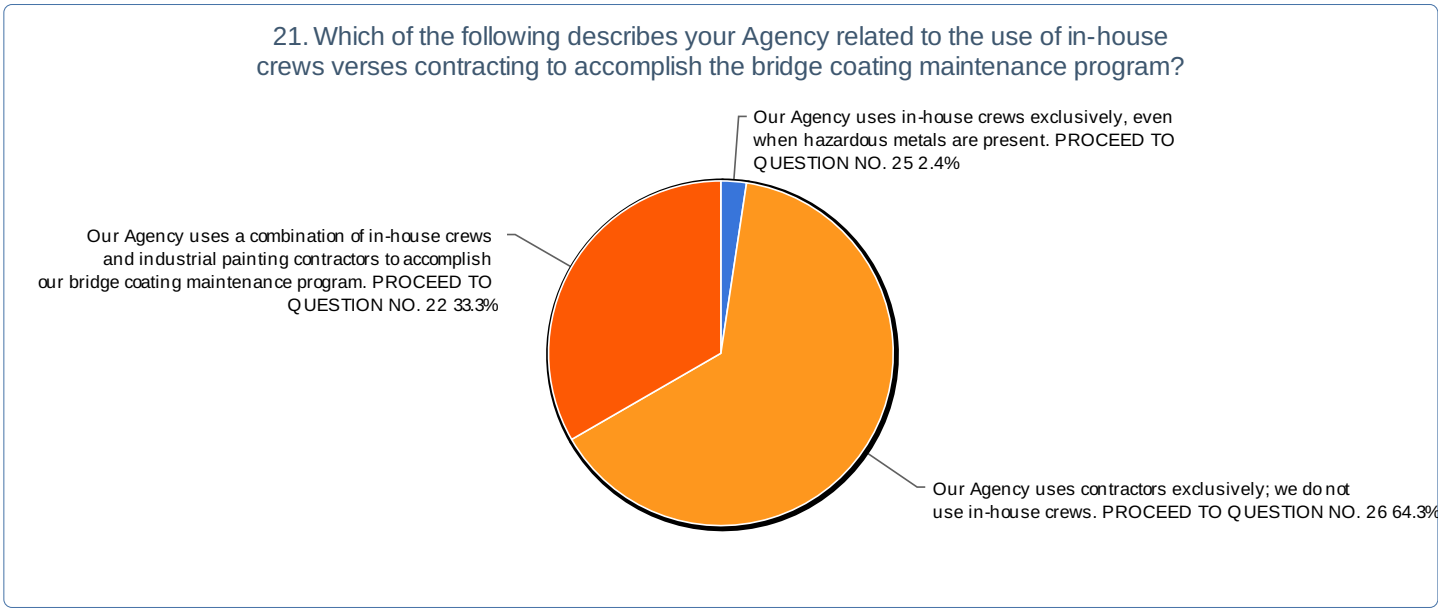
20. Approximately what percentage of your annual bridge maintenance budget is allocated to painting?



20. Approximately what percentage of your annual bridge maintenance budget is allocated to painting?

Value	Count	Percent %
<1%	11	29.0%
10%	16	42.1%
25%	9	23.7%
50%	1	2.6%
>50%	1	2.6%

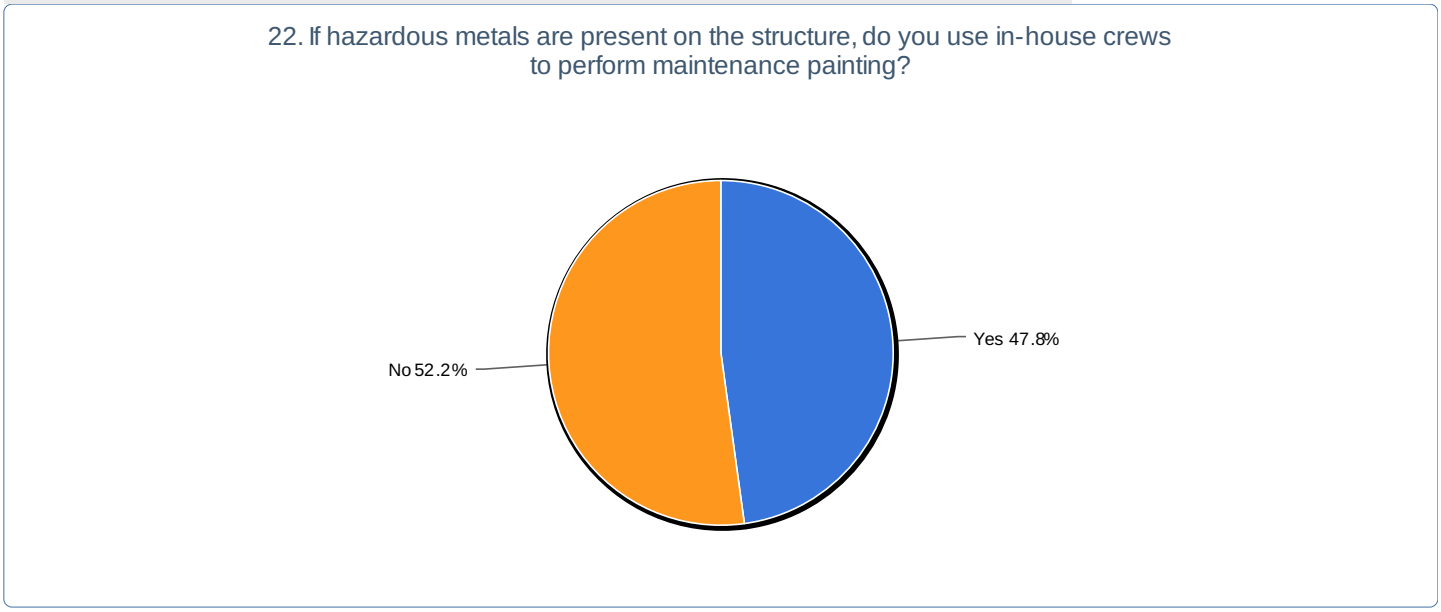
Statistics	
Total Responses	38
Sum	435.0
Avg.	16.7
StdDev	9.7
Max	50.0



21. Which of the following describes your Agency related to the use of in-house crews verses contracting to accomplish the bridge coating maintenance program?

Value	Count	Percent %
Our Agency uses in-house crews exclusively, even when hazardous metals are present. PROCEED TO QUESTION NO. 25	1	2.4%
Our Agency uses contractors exclusively; we do not use in-house crews. PROCEED TO QUESTION NO. 26	27	64.3%
Our Agency uses a combination of in-house crews and industrial painting contractors to accomplish our bridge coating maintenance program. PROCEED TO QUESTION NO. 22	14	33.3%

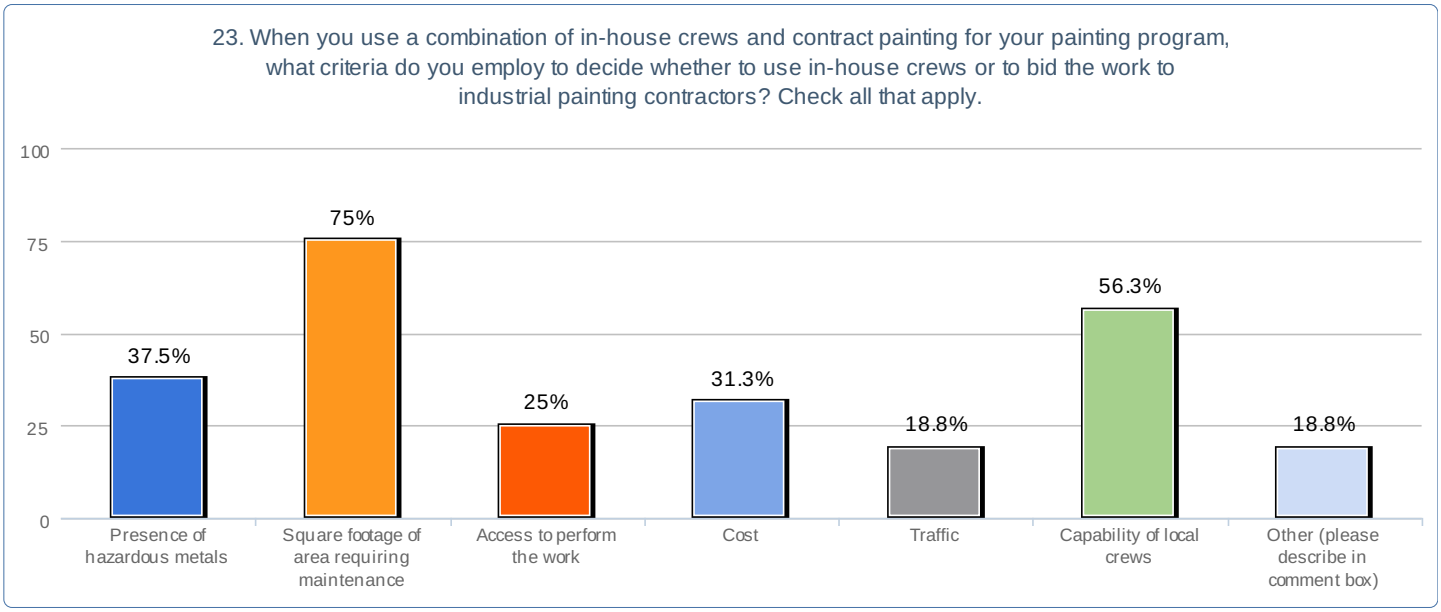
Statistics	
Total Responses	42



22. If hazardous metals are present on the structure, do you use in-house crews to perform maintenance painting?

Value	Count	Percent %
Yes	11	47.8%
No	12	52.2%

Statistics	
Total Responses	23

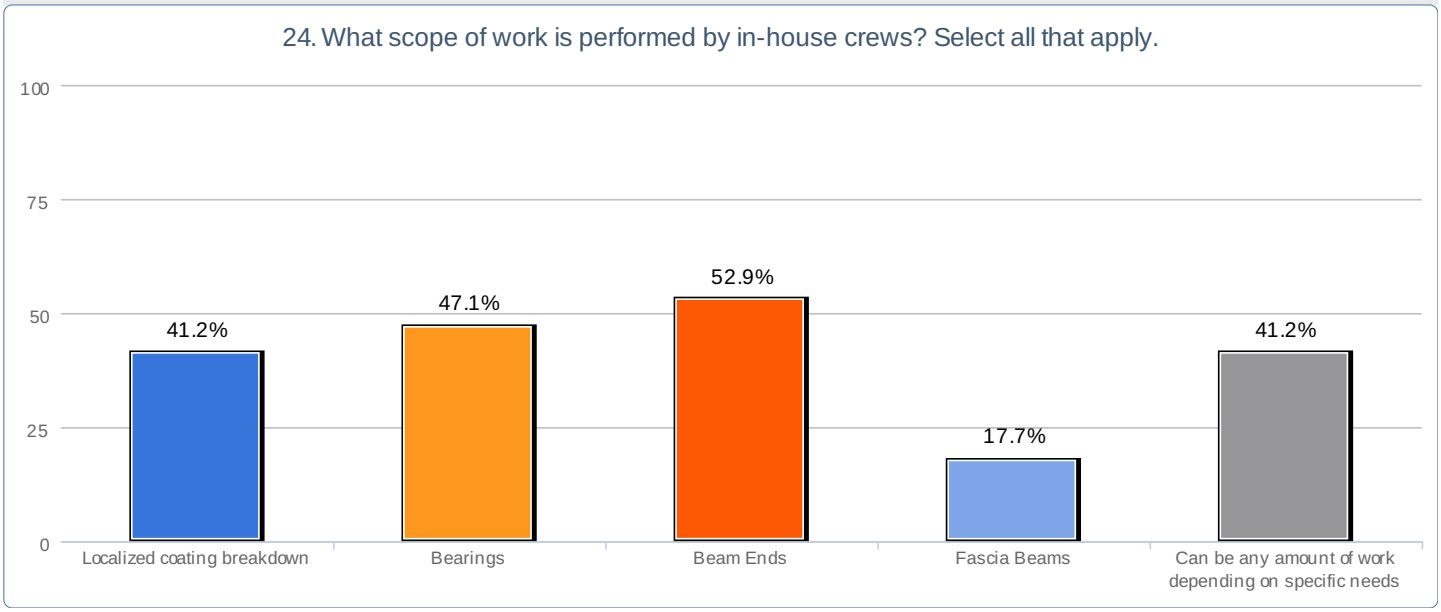


23. When you use a combination of in-house crews and contract painting for your painting program, what criteria do you employ to decide whether to use in-house crews or to bid the work to industrial painting contractors? Check all that apply.

Value	Count	Percent %
Presence of hazardous metals	6	37.5%
Square footage of area requiring maintenance	12	75.0%
Access to perform the work	4	25.0%
Cost	5	31.3%
Traffic	3	18.8%
Capability of local crews	9	56.3%
Other (please describe in comment box)	3	18.8%

Statistics	
Total Responses	16

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	41
If we are overcoating then we do it. If it is blast cleaned then by contract.	1
All the maintenance painting work is done by industrial painting contractors except for a very small amount of spot work done by the Department. In-house crews will work even if there is existing lead-base paint (Qn 21)	1

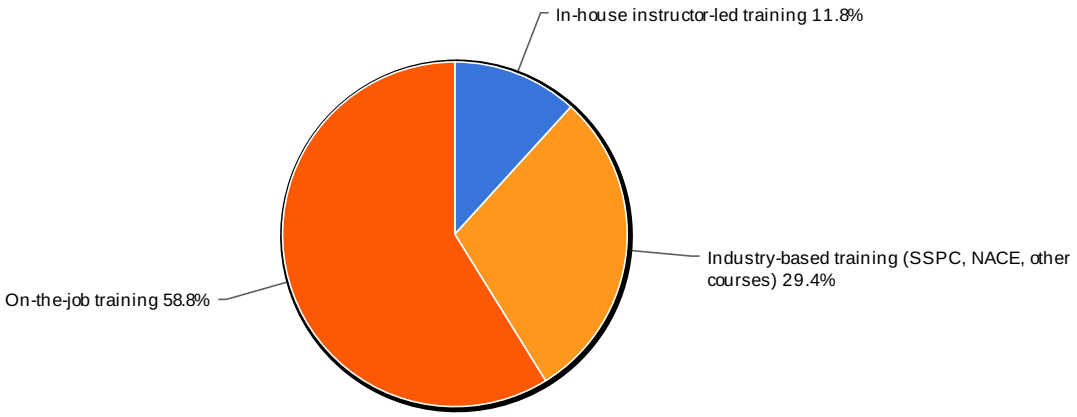


24. What scope of work is performed by in-house crews? Select all that apply.

Value	Count	Percent %
Localized coating breakdown	7	41.2%
Bearings	8	47.1%
Beam Ends	9	52.9%
Fascia Beams	3	17.7%
Can be any amount of work depending on specific needs	7	41.2%

Statistics	
Total Responses	17

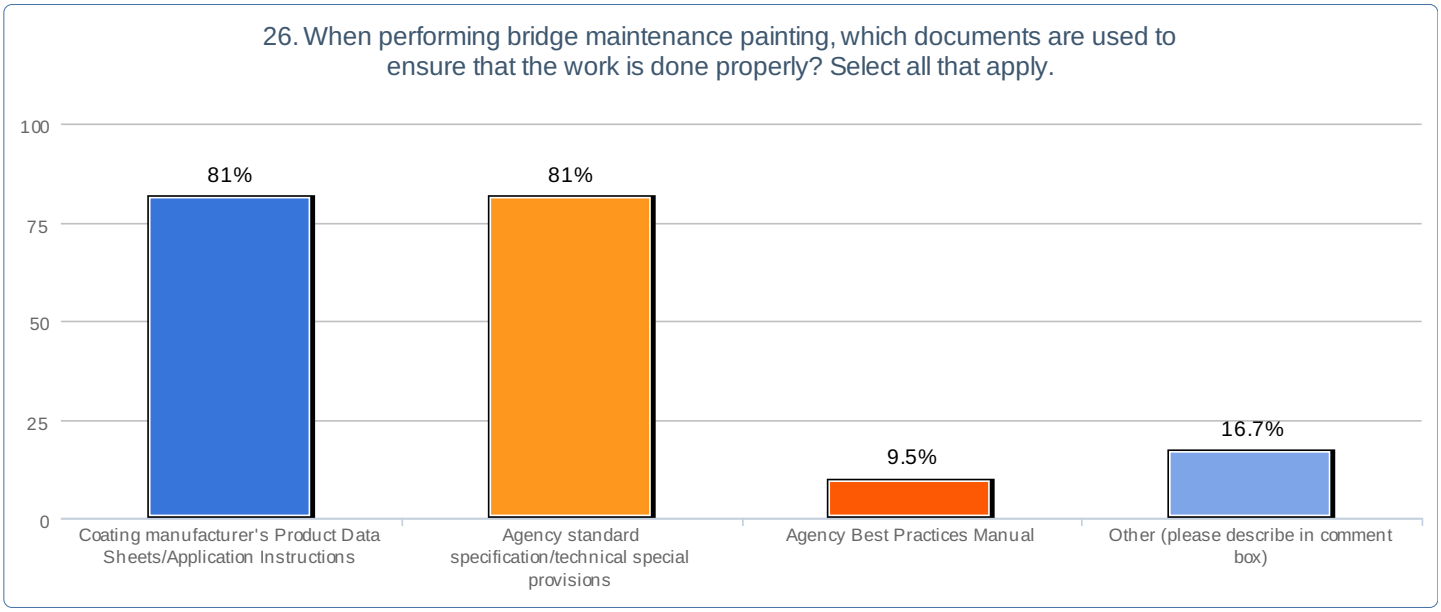
25. When you use in-house crews to perform bridge coating maintenance painting, what type of training do they receive?



25. When you use in-house crews to perform bridge coating maintenance painting, what type of training do they receive?

Value	Count	Percent %
In-house instructor-led training	2	11.8%
On-line training	0	0.0%
Industry-based training (SSPC, NACE, other courses)	5	29.4%
On-the-job training	10	58.8%
None	0	0.0%

Statistics	
Total Responses	17



26. When performing bridge maintenance painting, which documents are used to ensure that the work is done properly? Select all that apply.

Value	Count	Percent %
Coating manufacturer's Product Data Sheets/Application Instructions	34	81.0%
Agency standard specification/technical special provisions	34	81.0%
Agency Best Practices Manual	4	9.5%
Other (please describe in comment box)	7	16.7%

Statistics	
Total Responses	42

Open-Text Response Breakdown for "Other (please describe in comment box)"	Count
Left Blank	36
Data sheets by state forces/specs by contractional forces	1
NEPCOAT List	1
Remember, 99% of maintenance painting is by contract, governed by specification.	1
SSPC Manuals	1
SSPC QP 1 and 2	1
specification currently under revision	1
By maintenance painting, I assume you're talking about complete removal and recoat. For those applications, we'd use the first two choices: Coating Manufacturer's Data Sheets & Application Instructions, and Agency standard specifications.	1

28. First Name

Count	Response
1	Aaron
1	Beck
3	David
1	DeWayne
1	Deborah
1	Derrick
1	Douglas
1	Eric
1	Gary

1	Ivan
3	Jeff
1	Jerry
1	Jim
2	John
1	Kim
1	Llsa
1	Larry
1	Mark
3	Matthew
3	Michael
1	Pete
1	Richard
1	Robert
1	Ron
1	Ryan
1	Scott
1	Tom
1	William
1	lev
1	noel
1	paul

28. Last Name

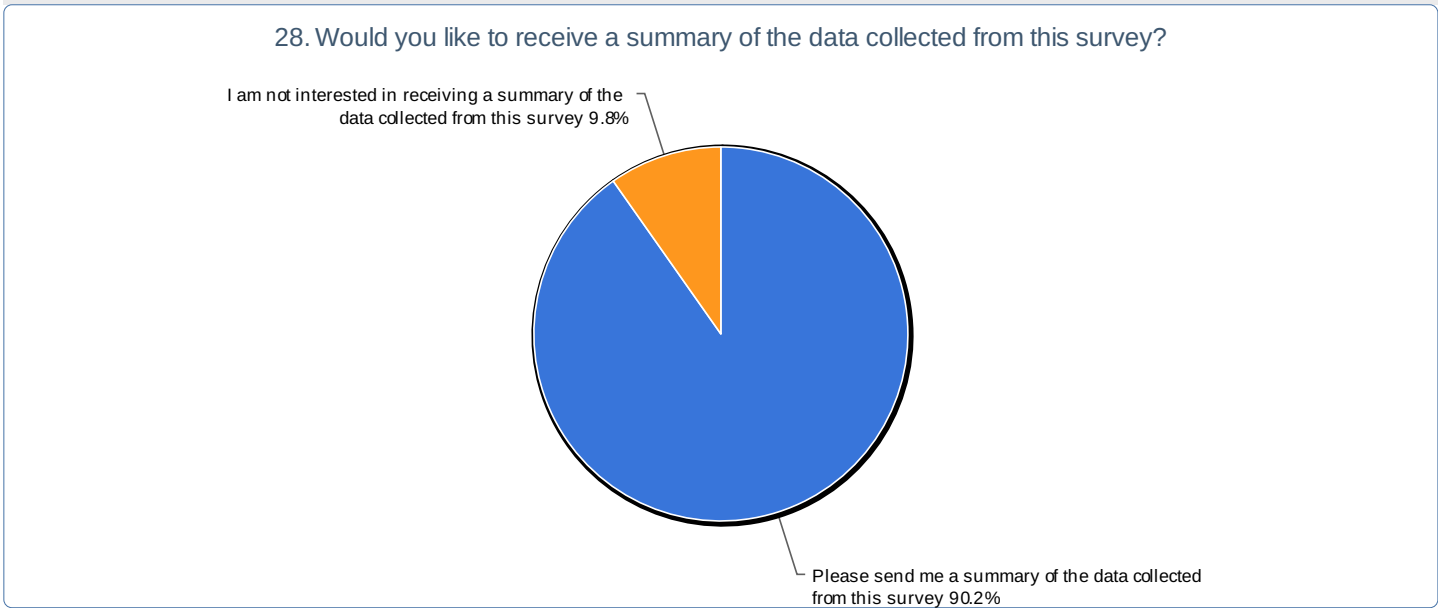
Count	Response
1	Bernard
1	Bryon
1	Bullard
1	Castle
1	Clark
1	Dacey
1	Gilsrud
1	Handeland
1	Hedrick
1	Hewins
1	Hill
1	Hughes
1	Jensen
1	Johnson
1	Kowalski
1	Kuniega
1	Luger
1	McDonagh
1	Milton
1	Moreau
1	Munroe

1	Nowack
1	Owen
1	Popp
1	Reilman
1	Rogers
1	Schlitter
1	Shepherd
1	Silbernagel
1	Stotlemeyer
1	Van Allen
1	Wagner
1	Whited
1	Wilson
1	Wright
1	Zigmund
1	Zoller
1	mezhburd
1	stampfli
1	vinik

28. Email Address

Count	Response
1	Derrick.Castle@ky.gov
1	Gary.Kowalski@Illinois.gov
1	Jeffrey.Milton@VDOT.Virginia.gov
1	Larry.Owen@alaska.gov
1	ahdacey@ncdot.gov
1	beckb@michigan.gov
1	bernard@turnpike.state.nj.us
1	bmoreau@nysba.ny.gov
1	david.jensen@dot.iowa.gov
1	david.w.whited@wv.gov
1	deborah.munroe@dot.ri.gov
1	dkuniega@pa.gov
1	doug.hedrick@ohioturnpike.org
1	eric.shepherd@maine.gov
1	ivan.p.silbernagel@odot.state.or.us
1	jbullard@panynj.gov
1	jeff.clark@state.vt.us
1	jeff.handeland@nebraska.gov
1	john.c.rogers@dot.ca.gov
1	jreilman@indot.IN.gov
1	jzoller@dot.state.nh.us
1	lmezhburd@dot.nyc.gov
1	lzigmund@dot.state.oh.us
1	matt.schlitter@state.de.us

1	michael.hewins@state.ma.us
1	michaelp@ksdot.org
1	mike.hill@ahtd.ar.gov
1	mmluger@nd.gov
1	mwagner@paturnpike.com
1	nowackk@michigan.gov
1	nstampfli@goldengate.org
1	paul.vinik@dot.state.fl.us
1	pmcdonag@mtabt.org
1	rhughes1@sha.state.md.us
1	richard.vanallen@ct.gov
1	rjohnson@cbbt.com
1	ron.wright@itd.idaho.gov
1	scott.stotlemeyer@modot.mo.gov
1	tom.gilsrud@state.sd.us
1	wilsond@wsdot.wa.gov



28. Would you like to receive a summary of the data collected from this survey?

Value	Count	Percent %
Please send me a summary of the data collected from this survey	37	90.2%
I am not interested in receiving a summary of the data collected from this survey	4	9.8%

Statistics	
Total Responses	41