



National Bridge Management, Inspection, and Preservation Conference

St. Louis, Missouri

Bridge Management – A Virginia Perspective

November 1, 2011

Jeff Milton

Bridge Preservation Specialist, Structure
and Bridge Division

Presentation Outline

- **About Virginia**
- **About the Virginia Department of Transportation (VDOT)**
- **The Virginia Highway System**
- **Background – Asset Management, Bridge Management, and Bridge Preservation**
- **Asset Management and Structure Needs in Virginia**
- **Virginia's Structure Inventory and Inspection Process**
- **Virginia's Bridge Management Process**
- **Approaches to Managing a Bridge Inventory**
- **Virginia's Approach to Bridge Management**
- **Accomplishing Bridge Work in Virginia**
- **Tracking Bridge Maintenance Work in Virginia**
- **Federal Funding for the Virginia Bridge Program**
- **Closing Remarks**

About Virginia



- **Nicknames:**
 - The Old Dominion
 - The Mother of Presidents
- **Virginia entered the union on June 25, 1788 (Tenth state to enter the union)**
- **The first permanent English settlement in North America was established at Jamestown, Virginia in 1607**
- **Population 2010 – 8,001,024**
- **95 Counties**
- **39 Independent Cities**

About the Virginia Department of Transportation (VDOT)

- **VDOT is responsible for building, maintaining, and operating the roads, bridges, and tunnels in the Commonwealth of Virginia.**

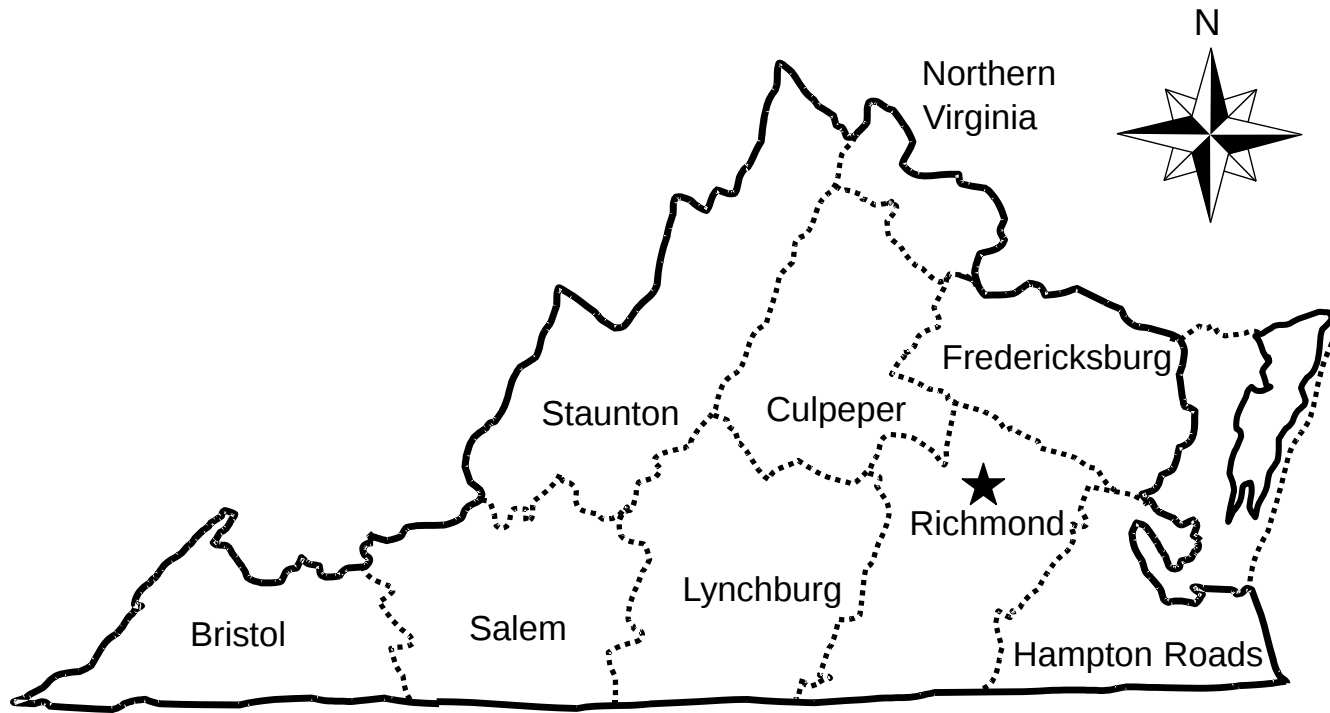
- **Virginia's highway network consists of approximately 58,000 centerline miles of highways and bridges, which is the third largest state-maintained highway system in the country, behind North Carolina and Texas.**

- **In addition to roads and bridges, the system also includes**
 - **4 underwater tunnels**
 - **2 mountain tunnels**
 - **3 ferries**
 - **41 rest areas**
 - **12 welcome centers**
 - **100 commuter parking lots**

About the Virginia Department of Transportation (VDOT)

- The governing body for VDOT is the Commonwealth Transportation Board which has 17 members who are appointed by the Governor.
- The CEO of VDOT is the Commissioner who is assisted by the executive staff (Chiefs).
- VDOT has 9 districts and a Central Office that is located in the state capitol of Richmond.

About the Virginia Department of Transportation (VDOT)



About the Virginia Department of Transportation (VDOT)

- The Central Office is composed of 28 divisions and the Virginia Center for Transportation Innovation and Research (located in Charlottesville).
- VDOT has approximately 7,500 employees.
- The total VDOT budget for fiscal year 2012 is \$4.764 Billion, which includes:
 - \$1.413 Billion for Highway System Maintenance
 - \$2.254 Billion for Highway System Acquisition and Construction
- The VDOT structure maintenance budget for fiscal year 2012 is \$165,862,596.

The Virginia Highway System

- **Virginia has 126,186 Lane Miles of Highways, distributed by system as follows:**
 - **Interstate System 5,400 miles**
 - **Primary System 21,666 miles**
 - **Secondary System 98,463 miles**
 - **Frontage System 647 miles**

- **Virginia has 20,908 structures in the inventory, distributed by system as follows:**
 - **Interstate System 2,391**
 - **Primary System 5,735**
 - **Secondary System 11,899**
 - **Urban System 883**

The Virginia Highway System

- The 20,908 structures have 115,337,077 square feet of deck area
 - 19,390 (93%) of the structures are maintained by VDOT, and 1,518 (7%) are maintained by localities and private owners
 - 12,926 of the structures (62%) are bridges, and 7,982 (38%) are culverts
 - 13,244 of the Structures (63%) are NBI structures, and 7,664 (37%) are non-NBI structures
 - There are 1,720 (8.2%) Structurally Deficient structures in the inventory
 - There are 3,247 (15.5%) Functionally Obsolete structures in the inventory
 - Therefore, there are 4,967 (23.8%) Deficient structures in the inventory
 - There are 4,611 (22.1%) structures in the inventory that have a low General Condition Rating of 5 – these structures are at risk of becoming Structurally Deficient

Background – Asset Management, Bridge Management, and Bridge Preservation

- The FHWA promotes and supports the concept of Transportation Asset Management by state highway agencies.
- AASHTO defines Transportation Asset Management as “a strategic and systematic process of operating, maintaining, upgrading and expanding physical assets effectively throughout their lifecycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well defined objectives”.
- Stated another way – Transportation Asset Management is
 - Knowing what you have
 - Knowing what you need
 - Making money go as far as possible

Background – Asset Management, Bridge Management, and Bridge Preservation

➤ Why Transportation Asset Management?

- Do the right thing
- At the right time
- In the right place
- At the right price

➤ Transportation system preservation is a key strategy for achieving the goals of effective asset management.

➤ Bridge management processes should be consistent with asset management principles and bridge preservation should be a key strategy of a comprehensive bridge program – bridge management and preservation is promoted and supported by FHWA.

Background – Asset Management, Bridge Management, and Bridge Preservation

➤ What is Bridge Management?

- Wikipedia defines a Bridge Management System as follows
 - A bridge management system or BMS is a means for managing bridges throughout design, construction, operation and maintenance of the bridges.
- The major tasks in bridge management are: collection of inventory data; inspection; assessment of condition and strength; repair, strengthening or replacement of components; and prioritizing the allocation of funds.
- A BMS includes four basic components: data storage, cost and deterioration models, optimization and analysis models, and updating functions.

Background – Asset Management, Bridge Management, and Bridge Preservation

➤ What is Bridge Preservation?

- A FHWA Bridge Preservation Expert Task Group has proposed the following formal definition of bridge preservation – *“Actions or strategies that prevent, delay or reduce deterioration of bridges or bridge elements, restore the function of existing bridges, keep bridges in good condition and extend their life. Preservation actions may be preventive or condition-driven.”*
- This definition has been endorsed by the AASHTO Subcommittee on Bridges and Structures, the AASHTO Subcommittee on Maintenance, and the AASHTO Standing Committee on Highways.

Asset Management and Structure Needs in Virginia

- Virginia state law requires the use of asset management processes and periodic reports on the conditions of transportation assets.
- Virginia's 2011 Biennial Needs Report includes the following needs for bridges and culverts:

Planned Preventive Maintenance	Restorative Maintenance	Replacement	Total Two Year Need
\$99,093,287	\$333,501,631	\$849,861,827	\$1,282,456,745

Virginia's Structure Inventory and Inspection Process

- The foundation for any Bridge Management Program is a complete and up to date structure inventory database, and a quality inspection program.
- Virginia utilizes the Inspection Module of the AASHTO Pontis software to maintain our structure inventory database.
- Virginia collects all of the data fields required by the FHWA in the NBI Coding Guide.
- In addition to the required federal data, Virginia also collects data for state specific data fields. The state specific data fields include, but are not limited to, the following:
 - VA Structure Number
 - Bridge Name
 - Plan Number
 - Types of Expansion Joints
 - Types of Substructure Units
 - Culvert Data
 - Load Rating and Posting Data for state Legal Loads

Virginia's Structure Inventory and Inspection Process

- Virginia inspects highway structures in accordance with the requirements of the National Bridge Inspection Standards (NBIS). In addition to the federal requirements, Virginia also inspects all bridges shorter than 20 feet, and all culverts having an opening of 36 square feet or more.
- Virginia assigns General Condition Ratings to the major structure components as required by the National Bridge Inspection Standards.
- Virginia also collects element level inspection data for all AASHTO Core Elements, and additional state specific elements.

Virginia's Bridge Management Process

- **The goals of the Virginia Bridge Management program are as follows:**
 - **Manage VDOT's structures using a life-cycle approach**
 - **Identify and prioritize statewide needs**
 - **Provide adequate processes to plan, budget, implement, and monitor work efforts**

- **Virginia uses the Bridge Management Modules of the AASHTO Pontis software as a tool in developing network level (statewide) needs for the structure maintenance and replacement programs, and for developing the bridge program budget allocations for each district.**

Virginia's Bridge Management Process

- Virginia has been collecting element level inspection data since 1995.
- In 2002, Virginia formed a Pontis Bridge Management Core Group consisting of three bridge engineers from the District Structure and Bridge Sections. The primary objective of this Core Group was to customize the Pontis 4.0 bridge management modules for use with the Virginia Bridge Program.
- The majority of the work performed by the Core Group involved modification of the Preservation and Programming Modules.

Virginia's Bridge Management Process

- **The Core Group's work with the Preservation Module included, but was not limited to, the following:**
 - Identification of the elements that account for the majority of the Virginia inventory – 54 elements that comprise approximately 98% of the element incidences in the inventory were selected
 - Modification of the feasible actions so that these actions conform to Virginia work activities – each state and feasible action for each selected element was evaluated and the actions were customized as needed to reflect Virginia practices
 - Modification of the deterioration and action effectiveness models to account for the conditions and climate in Virginia - these modifications were developed by expert elicitation
 - Modification of the preservation costs using Virginia work items and contract unit costs

Virginia's Bridge Management Process

- **The Core Group's work with the Programming Module included, but was not limited to, the following:**
 - **Revising advanced parameters**
 - **Development of a framework for the use of simulation rules**
 - **Development of scenario defaults**
 - **Development of flexible actions**
- **A small structure database was developed to evaluate the results of the modifications that were made.**
- **The Core Group prepared the specifications for the development of a companion software application known as the Post Pontis Optimizer (PPO).**

Virginia's Bridge Management Process

- The work of the Core Group provided the foundation for the use of the Pontis Bridge Management Software as a valuable tool for use with Virginia's Bridge Management Program.
- If a state is just beginning to explore the use of the Pontis Bridge Management Software as a tool for their Bridge Management Program, I would encourage you to form a group of experienced bridge maintenance engineers and specialists to customize the software for use in your state.

Virginia's Bridge Management Process

- Virginia performs annual updates of the preservation and improvement cost models for the Pontis Bridge Management software.
- In 2011, Virginia contracted with a consultant to review historical element data and update the deterioration and action effectiveness models for the Pontis Bridge Management software.
- The Maintenance Section of the VDOT Central Office Structure and Bridge Division is currently in the process of preparing rules for use in the Pontis Bridge Management software.
- The updated models, costs, and rules will be used to improve the project level budgeting and planning capabilities of the Pontis Bridge Management software and the Post Pontis Optimizer application.
- Virginia is currently using version 4.4.4 of the Pontis software.

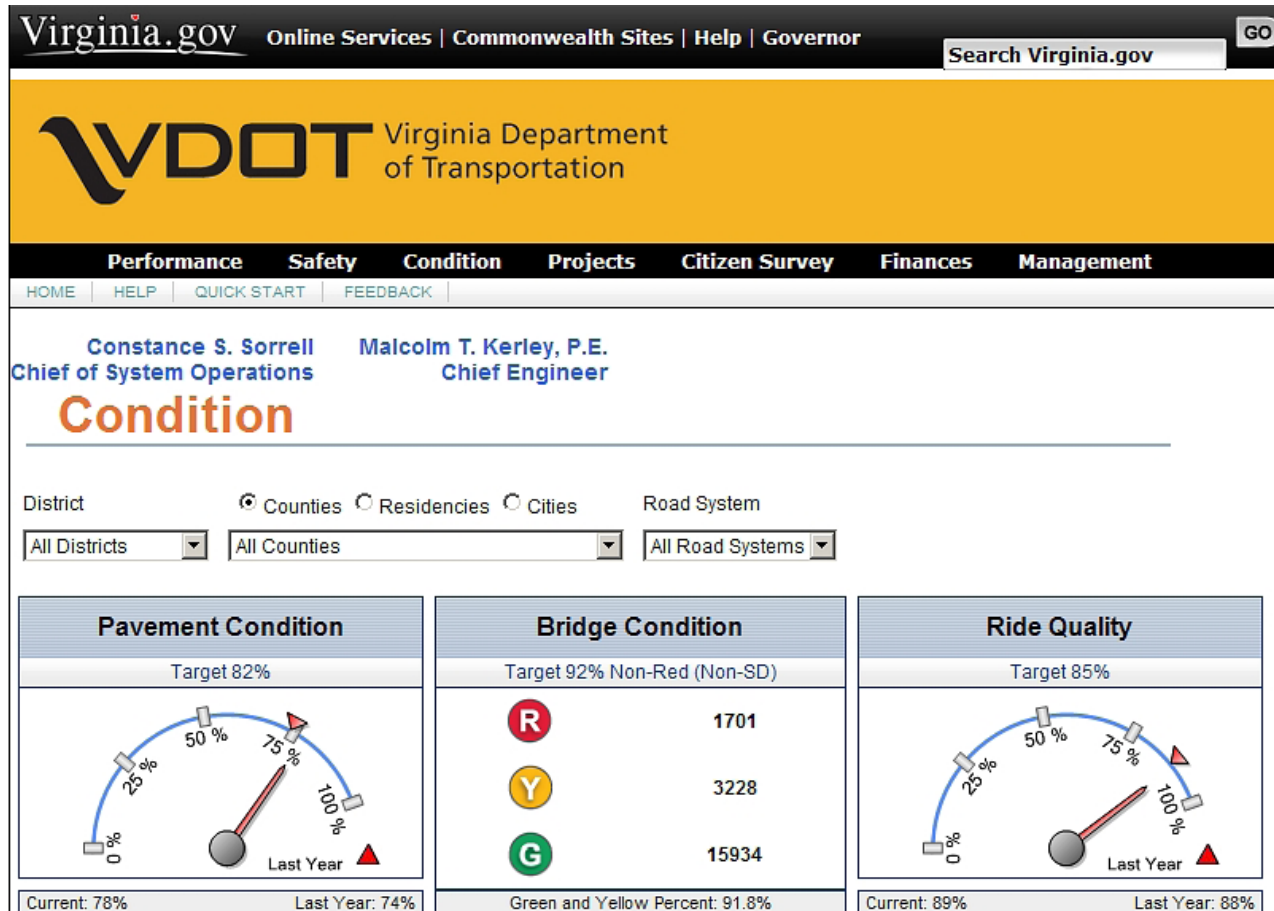
Virginia's Bridge Management Process

- The Central Office Structure and Bridge Division conducts annual statewide needs assessments and sets targets for the allocation of maintenance funds to the districts.
- The districts are responsible for the development of the district maintenance program budget and the selection of candidate structures for the program. During the development of the district program, bridge safety inspectors and bridge maintenance crew members are consulted for recommendations concerning specific structures that are selected for inclusion in the program.
- Virginia uses scenarios generated by the Pontis Bridge Management application, element level inspection data, and General Condition Rating (GCR) data as tools in selecting specific bridge preservation, rehabilitation, and replacement candidates.

Virginia's Bridge Management Process

- Virginia's current global performance measure is based on the number of non-structurally deficient (SD) structures in the inventory. The goal is to maintain a ninety two (92) percent non SD performance level statewide.
- Other performance measures that are considered in the overall management of the bridge program are functional obsolesce, General Condition Ratings greater than or equal to 5, load posting, and Health Index.
- Virginia has established a public, web based Structure Condition Dashboard application that provides real time structure condition data and trends in structure conditions over time.
- A screen shot of the Virginia Structure Condition Dashboard main screen follows -

Virginia's Bridge Management Process



Virginia's Bridge Management Process

- The Virginia Structure Condition Dashboard also provides data concerning the trends in structure conditions.
- Virginia is in the process of developing a Standard Operating Procedures Manual for Bridge Management.

Approaches to Managing a Bridge Inventory

➤ **There are two approaches that may be taken when managing a bridge inventory:**

- **Traditional or “Worst First” approach**
 - Needs are prioritized based on “worst bridges”
 - Good bridges are generally ignored
 - Corrective maintenance and repairs based on inspections
 - Needs grow, network conditions decline
 - Most agencies follow this approach due to HBP formula
- **Preservation approach**
 - Keeps good bridges in good condition
 - Balanced program
 - Applied asset mgmt. -Engineering, Business, Economics
 - Checks deterioration and reverses network decline
 - Eligible for HBP funds, incentive needed

Virginia's Approach to Bridge Management

- **The Virginia Bridge Program consists of the following five work actions:**
 - **Preventive Maintenance**
 - **Painting**
 - **Restorative Maintenance**
 - **Rehabilitation**
 - **Replacement**

Virginia's Approach to Bridge Management

➤ Examples of Preventive Maintenance –

- Bridge Cleaning
 - Deck Sealing
 - Sealing Joints
 - Thin Deck Overlays
 - Removing Large Debris in Channels
 - Spot and Zone Painting
 - Vegetation Removal
-
- Preventive maintenance can be condition based or non-condition based. Non-condition based preventive maintenance is typically referred to as Planned Preventive Maintenance (the Structure and Bridge Division recently developed a budget for a Planned Preventive Maintenance Program).

Virginia's Approach to Bridge Management

➤ Examples of Restorative Maintenance –

- Painting (Over Coating and Complete Removal and Re-Coating)
- Deck Patching
- Rigid Deck Overlays
- Reconstructing/Closing Joints
- Superstructure Repairs
- Substructure Repairs
- Fatigue Retrofitting
- Scour Repairs
- Cathodic Protection
- Electrochemical Chloride Extraction

➤ Examples of Rehabilitation –

- Superstructure Replacements
- Deck Replacements
- Culvert Rehabilitation

Virginia's Approach to Bridge Management

- Preventive Maintenance, Painting, and Restorative Maintenance are the components of Virginia's Bridge Preservation Program.
- Viewed from a high level -
 - Rehabilitation and replacement candidates are structures with a low General Condition Rating (GCR) of 4 or less
 - Restorative maintenance candidates are structures with a low GCR equal to 5
 - Preventive maintenance candidates are structures with a low GCR of 6 or greater
- Virginia also uses element condition data to determine preservation or rehabilitation needs -
 - Condition states 1 and 2 typically indicate no action or preventive maintenance activities
 - Condition states of 3 or greater typically indicate the need for restorative or rehabilitation activities

Virginia's Approach to Bridge Management

- Preventive Maintenance, Painting, Restorative Maintenance, and Rehabilitation activities are typically funded through the maintenance program.
- Replacement activities are typically funded by construction funds. Virginia has developed a Dedicated Bridge Fund as a part of the construction program – federal bridge replacement funds are allocated to this program, the majority of the bridge replacement projects are funded by this program.

Virginia's Approach to Bridge Management

➤ As stated previously, Virginia recently completed preparation of a planned preventive maintenance program budget. This program includes the following work actions:

- Bridge Deck Washing – 1 year cycle
- Bridge Deck Sweeping – 1 year cycle
- Seats & Beam Ends Washing – 2 year cycle
- Cutting & Removing Vegetation – 2 year cycle
- Routine Maintenance of Timber Structures – 2 year cycle
- Scheduled Replacement of Compression Seal Joints – 10 year cycle
- Scheduled Replacement of Pourable Joints – 6 year cycle
- Cleaning and Lubricating Bearing Devices – 4 year cycle
- Scheduled Installation of Thin Epoxy Concrete Overlay – 15 year cycle
- Beam Ends Painting – 10 year cycle
- Removing Debris from Culverts – 5 year cycle

Virginia's Approach to Bridge Management

- Virginia utilizes a preservation approach to managing the structure inventory that includes performing preventive, painting, and restorative work actions that address structures while they are still in good or fair condition and before the onset of serious deterioration.
- This balanced approach to structure management provides for preservation, rehabilitation, and replacement actions, and we believe that this is the most efficient and effective way to maintain the health of the structure inventory.
- A suggested breakdown for structure maintenance allocations follows:
 - Preventive Maintenance ⇒ 15%
 - Painting ⇒ 10%
 - Restoration ⇒ 25%
 - Rehabilitation ⇒ 50%
 - The breakdown of maintenance allocations for a specific geographic area will depend on the condition and needs of the structures in that area.

Virginia's Approach to Bridge Management

- **Virginia uses the following measures to extend the service life of newly constructed bridges:**
 - Requiring the elimination of deck expansion joints to the greatest extent possible.
 - Discontinuing the use of epoxy coated and galvanized reinforcing bars, and requiring the use of corrosion resistant reinforcing bars.
 - Requiring a minimum concrete cover of 2 ½" over all top mat reinforcing bars in deck slabs.
 - Requiring the use of low permeability concrete.
 - Allowing the use of self consolidating concrete.
 - Allowing the use of high performance structural steel and concrete.

Accomplishing Bridge Work in Virginia

- Virginia executes the bridge program through a combination of state force bridge crew activities, administrative contracts, and construction contracts.
- The state force bridge crews typically perform work on secondary (rural local) routes. Activities performed by state force bridge crews include:
 - bridge cleaning
 - debris removal
 - concrete deck, superstructure, and substructure patching
 - joint replacement
 - timber deck replacement
 - superstructure replacements
 - total replacements for short span (less than approximately 60 feet) bridges
- By state law, the value of work performed by state forces cannot exceed \$600,000 for an individual project.

Accomplishing Bridge Work in Virginia

- Virginia has 32 state force bridge crews consisting of 235 employees.
- Major bridge preservation, bridge rehabilitation, and bridge replacement projects are performed by construction contracts for all types of activities.
- Design, plan, and contract development for bridge preservation, bridge rehabilitation, and bridge replacement projects is performed by a combination of in-house design teams and consultant design firms.
- Virginia has historically used Design/Bid/Build contracts; however, in recent years greater use is being made of Design-Build contracts for rehabilitation and replacement projects.

Tracking Bridge Maintenance Work in Virginia

- Virginia utilizes the Work Accomplishments Module of the Asset Management System to track work accomplishments and costs of the bridge work performed by state force crews.
- Virginia utilizes the Site Manager Plug-In Tool to track work accomplishments and costs of the bridge work performed by contractors.
- The data recorded for work accomplishments in both of the systems referenced above include individual structure identification information and five digit bridge maintenance activity codes.
- A listing of the bridge maintenance activity codes follows:

Tracking Bridge Maintenance Work in Virginia

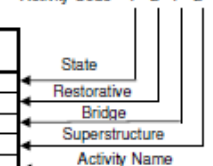
Bridge Maintenance Activities									
Bridge Deck		Bridge Superstructure		Bridge Substructure		Culvert (> 36SF)		Bridge Misc.	
Code	Name	Code	Name	Code	Name	Code	Name	Code	Name
70700	Ordinary Maintenance	70720	Ordinary Maintenance	70740	Ordinary Maintenance	70750	Ordinary Maintenance	70760	Ordinary Maintenance
71701	Deck Patching	721		741		751		761	
71702	Seal Cracks	722		742		752		762	
71703	Thin Overlay	723		743		753		763	
71704	Joint Rehabilitation	724		744		754		764	
72705	Rigid Overlay	72725	Conc. Superstr Repair	72745	Substr Surface Repair	72755	Surface Repair	72765	Approach Slab
72706	Rail Repair	72726	Steel Superstr Repair	72746	Repair Undermining	72756	Repair Undermining	766	
72707	Timber Rehabilitation	72727	Bearing Repair	747		757		767	
72708	Asphalt Overlay	72728	Paint	748		74758	Major Rehabilitation	768	
709		729		74749	Major Rehabilitation	74759	Culvert Replacement	769	
710		730						770	
711		731						771	
712		732						772	
713		733						773	
714		734						774	
715		735						775	
716		736						776	
717		737						777	
718		738						778	
74719	Deck Replacement	74739	Superstr Replacement					74779	Bridge Replacement
								75790	Bridge Rating - Interstate
								75791	Bridge Rating - Primary
								75792	Bridge Rating - Secondary
								799	
								794	
								795	
								796	
								797	
								75798	Bridge Management
								75799	Preliminary Engineering

Legend			
Service/Investment	Bridge Program		
Service/Investment	PM / Insp	70XXX / 75XXX Series	
Investment	Engineering	75XXX Series	
Investment	PM	71XXX Series	
Investment	Restorative / Paint	72XXX Series	
Investment	Rehabilitation	74XXX Series	
Investment	Replacement	74XXX Series	

Code Digit	Meaning	Legend
1	State / Federal	7 - State; 6* - Federal
2	Program	0, 1 - PM; 2 - Restorative / Paint; 4 - Rehabilitation / Replacement
3	Asset	7 - Bridge
4	Asset Group	0, 1 - Deck; 2, 3 - Superstructure; 4 - Substructure; 5 - Culvert; 6, 7 - Bridge; 8, 9 - Inspection & Engineering
5	Action	Activity Name

* 6XXXX activities can only be used if the work to be performed qualifies for federal reimbursement.

Example of Activity Code Generation
Activity Code = 7 2 7 2 5



When washing a bridge you will use one of the Ordinary Maintenance (routine preventive maintenance) activities associated with bridges. Depending on what portion of the bridge is being washed, one of the following activities is to be used:

- When only the deck is washed use 70700 (Ordinary Maintenance – Deck)
- When only the superstructure is washed use 70720 (Ordinary Maintenance – Superstructure)
- When only the substructure is washed use 70740 (Ordinary Maintenance – Substructure)
- When more than one portion of the bridge is washed use 70760 (Ordinary Maintenance – Bridge)

Federal Funding for the Virginia Bridge Program

- **Rehabilitation and Replacement work actions are eligible for funding under the “traditional” provisions of the federal Highway Bridge Program -**
 - **Sufficiency Rating less than 80 and deficient for rehabilitation**
 - **Sufficiency Rating less than 50 and deficient for Replacement**

- **Preventive Maintenance, Painting, and Restorative Maintenance (Bridge Preservation) work actions are eligible for funding under the Preventive Maintenance and System Preservation provisions of the federal Highway Bridge Program, as outlined in the FHWA/VDOT letter agreement dated November 8, 2010.**

Closing Remarks

- **In summary, the Virginia Bridge Management Program includes the following components:**
 - A complete and up-to-date structure inventory database
 - A quality structure inspection program
 - Computer software that provides a tool to staff to develop network level optimization models which minimize the long term maintenance funding requirements while keeping bridge elements and components out of risk of failure
 - A work candidate and project selection process that includes the use of bridge management software, analysis of element level inspection data, analysis of general condition data, and analysis of other data by bridge managers at both the Central Office and the District level
 - Performance Targets based on the number of structurally deficient structures

Closing Remarks

- A preservation approach to managing the structure inventory that includes work actions for preservation, rehabilitation, and replacement
 - Design and construction policies that will reduce the future maintenance needs of structures constructed today
 - A project delivery program that includes both state force activities and contract activities
 - A system for tracking work accomplishments
 - A letter agreement with the Division FHWA office for performing preventive maintenance and system preservation activities utilizing Federal Highway Bridge Program funds
- The Virginia Bridge Management Program is executed by a staff of bridge engineers, bridge managers, bridge specialists, bridge safety inspectors, and bridge maintenance crew members who are dedicated to protecting the safety of the traveling public and protecting and preserving the public's investment in the highway infrastructure.



Thank you for your time and attention

Questions??

National Bridge Management, Inspection,
and Preservation Conference

November 1, 2011

Jeff Milton

Bridge Preservation Specialist, Structure
and Bridge Division