

# Performance-Based Rehabilitation and Maintenance for the District of Columbia's National Highway System

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## ABSTRACT

Local and state Departments of Transportation (DOTs) face a common challenge. The Federal Highway Administration (FHWA) will provide Federal-aid funds to construct transportation assets, and they will provide Federal-aid funds to re-construct transportation assets, but maintenance funds generally must come out of the local or state agency's budget. This situation provides little incentive for effective maintenance, which can result in an expedited decline in asset conditions, necessitating reconstruction sooner than it should be needed. The objective of using Federal-aid funds for performance-based asset preservation is to break this cycle, improve the condition of the assets to a specified level, maintain the assets at or above the specified level, and thus, lengthen the life-cycle of the asset while providing better service to the public.

Performance-based asset preservation aims to rehabilitate and maintain roadway, roadside, bridge, and tunnel assets, while reducing overall rehabilitation and maintenance costs by encouraging innovative, cost-effective, flexible preservation strategies. The DC Streets contract, an experimental performance-

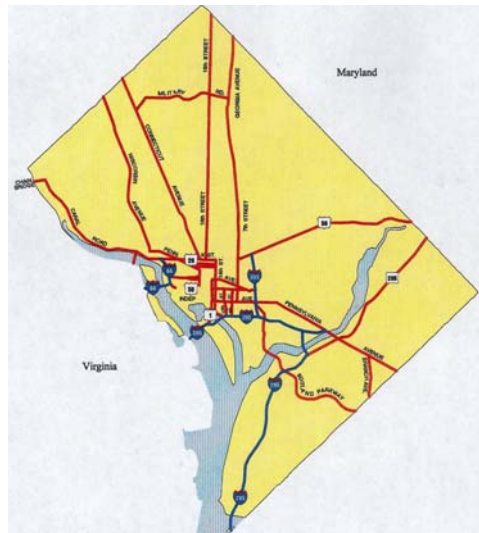
based asset preservation project undertaken by the District of Columbia Department of Transportation (DDOT) and FHWA over the past five years, entails a private contractor, VMS Inc., maintaining over 75 miles of the National Highway System (NHS) in the District.

With this type of innovative contracting, DDOT has attained system condition improvements on the NHS and currently plans to continue using performance-based asset preservation contracts after the conclusion of the DC Streets effort. This paper describes the DC Streets project's daily, monthly, and annual assessments, lessons learned, innovative technologies, and contract management methods.

**Key words: asset preservation—performance-based—urban**

## PROJECT INTRODUCTION

The DC Streets project, an experimental project undertaken by the District of Columbia Department of Transportation (DDOT) and the Federal Highway Administration (FHWA) over the past five years, entails a private contractor, VMS Inc., rehabilitating and maintaining over 75 miles of the National Highway System (NHS) in the District (Figure 1). This \$70 million Federal-aid project is the first urban, performance-based asset preservation effort of its kind in the United States. Performance-based asset preservation aims to rehabilitate and maintain roadway, roadside, bridge, and tunnel assets, while reducing overall rehabilitation and maintenance costs by encouraging innovative, cost-effective, and flexible preservation strategies.



**Figure 1. DC NHS roadways**

## PROJECT BACKGROUND

The 75 miles of the NHS in the District are heavily used by residents, commuters, businesses and tourists. The District's NHS infrastructure needs routine maintenance and timely preservation. The aging of the infrastructure and reduction in public sector staffing forced the District to look at alternatives, such as the DC Streets project, for timely preservation.

This project represents the first time that FHWA has teamed directly with a city government on a program to preserve their highway infrastructure. FHWA is providing management advice, engineering services for contract development, and annual evaluations of the asset preservation contractor with support from Science Applications International Corporation (SAIC), an employee-owned research and engineering company.

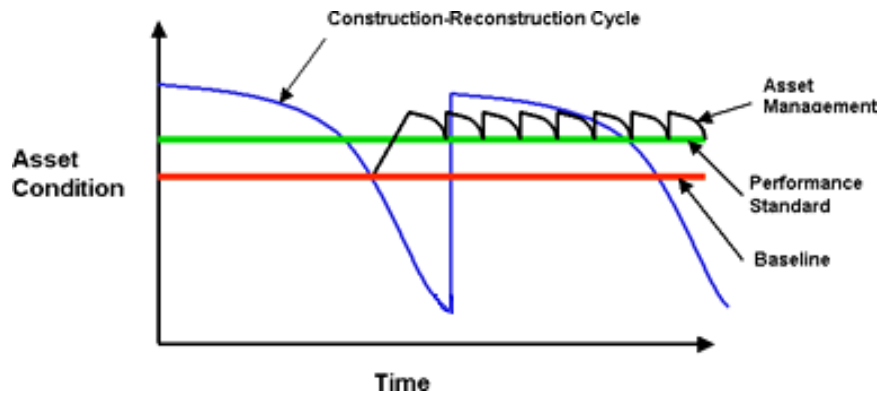
Asset preservation is the rehabilitation and maintenance of roadway and roadside infrastructure. Traditional asset preservation specifies what materials are used and what maintenance techniques and methods the contractor follows. This traditional method involves extensive engineering measurement and oversight, and the owner minimizes contractor risk. In performance-based asset preservation, the desired outcome is specified instead of the material or method. Thus, the contractor is instructed what to achieve, not how to achieve.

Assets covered by the project include tunnels, pavement, bridges, roadside assets (i.e., curbs, gutters, sidewalks, retaining walls), traffic safety assets (i.e., guardrails, barriers, attenuators, pavement markings, signs, lighting), roadway and roadside cleaning, drainage structures, roadside vegetation, pedestrian bridges, weigh-in-motion stations, and snow and ice control.

## Problem Statement

Currently, local and state Departments of Transportation (DOTs) face a common challenge with transportation infrastructure elements. The Federal Highway Administration (FHWA) provides Federal-aid funds to construct these transportation assets, and they provide Federal-aid funds to reconstruct transportation assets, but maintenance funds generally must come from the local or state agency's budget. This situation provides little incentive for effective maintenance of transportation assets, which may result in an expedited decline in asset conditions, necessitating reconstruction sooner than it should be needed.

The objective of using Federal-aid funds for performance-based asset preservation is to break this cycle, improve the condition of the assets to a specified level, maintain the assets at or above the specified level, and thus, lengthen the life-cycle of the assets while providing better service to the public (Figure 2).



**Figure 2. Traditional versus performance-based maintenance cycles**

With this type of innovative contracting, performance measures and standards are specified instead of maintenance techniques. While challenges existed with developing the performance measures for such a broad range of assets from scratch, the project team was able to develop a set of measures to evaluate the condition of all assets, as well as the timeliness of the contractor's performance. These measures, along with the lessons learned from the project, may be used by agencies across the country as a basis for new performance-based programs.

The DC Streets project has allowed DDOT to both improve the condition of the assets on the NHS and allocate their in-house maintenance resources to local neighborhood streets. The effort has also provided local small businesses and residents with increased opportunities for employment.

## PROJECT OBJECTIVES

Before the signing of the DC Streets contract, DDOT, FHWA, VMS, and SAIC determined that formal partnering would help to ensure the success of the project. The initial partnering session was held in 2000; the partners-to-be discussed personal views of owners, architects and engineers, the public, and

contractors. This frank conversation allowed the participants to understand the paradigms that they held of each other. Given this understanding, the group developed Bold, Hairy, Audacious Goals (BHAGs) for the DC Streets project. The resulting goals became the objectives for the contract. The goals include the following:

- Enhance the NHS infrastructure by meeting or exceeding performance standards
- Receive positive feedback from the public and the press
- Revitalize the community
- Institutionalize performance-based contracting
- Produce innovative methods, procedures, and processes for infrastructure maintenance

The partners hold periodic meetings to plot the course for a successful completion of the DC Streets project. Part of this process involves recognition of notable achievements and discussion on burning issues and contract concerns; actions to resolve differences in interpretation and areas of dissatisfaction are identified.

One key aspect of setting goals is to measure progress periodically against those goals. The progress of the goals is measured primarily through evaluations. Performance measurement methodologies are described in the next section.

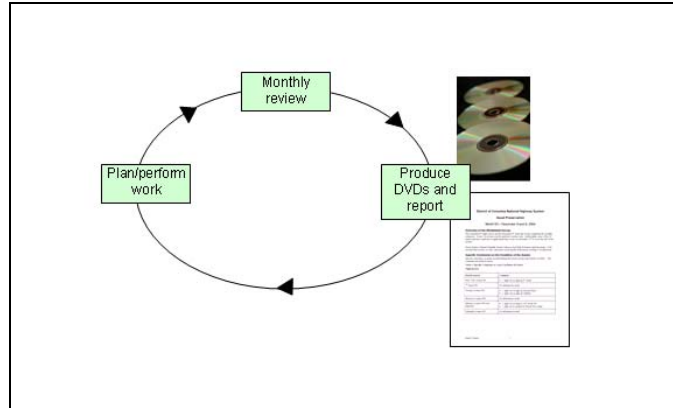
## **PERFORMANCE MEASUREMENT METHODOLOGIES**

### **Evaluations**

The project team measures performance using the performance standards on a daily, monthly and annual basis. On a daily basis, the project partners survey the system for deficiencies; the contractor maintains a daily log of activities as well. The monthly review is a subjective windshield survey, while the annual review is an objective engineering evaluation. Both time critical (i.e., timeliness of response) and condition-related performance measures are considered in the evaluations.

#### *Monthly Evaluation Methods*

Each month, members of the DC Streets team perform a subjective evaluation of the condition of the assets; Figure 3 shows the processes for the evaluations. The rating personnel are kept relatively consistent to help ensure comparability of the results from month to month. The monthly evaluations are video-recorded and distributed on DVD. A report for each evaluation is also generated. These deliverables help the contractor plan and perform work based on the deficiencies noted during the survey.

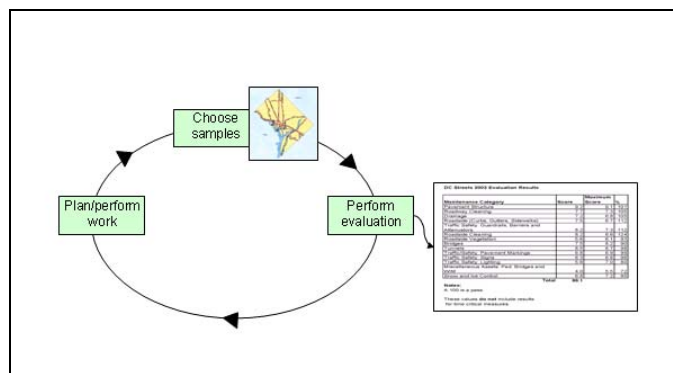


**Figure 3. Monthly evaluation process**

*Annual Evaluation Methods*

The purpose of the annual evaluation is to provide an evaluation of the condition of the assets and the timeliness of contractor response against the performance standards. Teams of subject matter experts perform this evaluation by rating the assets on randomly selected sample segments and rating time critical performance from DC NHS Tracker Database entries. Figure 4 shows the processes for the annual evaluations.

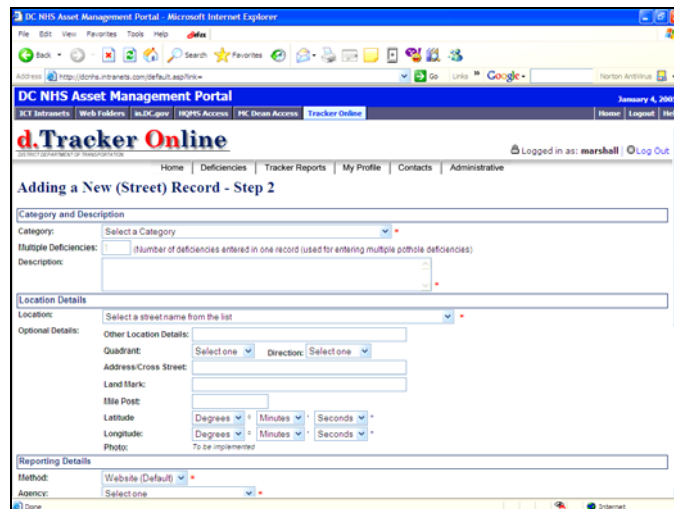
Most annual ratings are performed with an approximate 10% sampling rate. The SAIC team analyzes the data and uses the results to evaluate performance against the appropriate performance standards. For the final annual evaluation, a 20% sample may be used to provide a more comprehensive view of the project's status. A comprehensive report is provided to the project partners to present the results of each annual evaluation. Similar to the monthly deliverables, this annual deliverable helps the contractor to plan work.



**Figure 4. Annual evaluation process**

## Innovations

Practical solutions have been designed to address the challenges on the DC Streets project. The project partners use numerous innovative products and technologies, namely the Web Portal for project coordination and the Tracker Database for asset deficiency tracking and innovative sampling and data collection (Figure 5).



The screenshot shows a web browser window displaying the 'DC NHS Asset Management Portal'. The page title is 'Adding a New (Street) Record - Step 2'. The form is divided into three main sections: 'Category and Description', 'Location Details', and 'Reporting Details'. The 'Category and Description' section includes a 'Category' dropdown menu, a 'Multiple Deficiencies' input field, and a 'Description' text area. The 'Location Details' section includes a 'Location' dropdown menu, 'Other Location Details' text input, 'Quadrant' and 'Direction' dropdown menus, 'Address/Cross Street', 'Land Mark', 'Mile Post', 'Latitude' and 'Longitude' dropdown menus with 'Degrees', 'Minutes', and 'Seconds' sub-selects, and a 'Photos' field. The 'Reporting Details' section includes a 'Method' dropdown menu and an 'Agency' dropdown menu. The browser's address bar shows the URL 'http://dohh.mntrains.com/default.asp?view=...'. The browser's status bar shows 'Done' and 'Internet'.

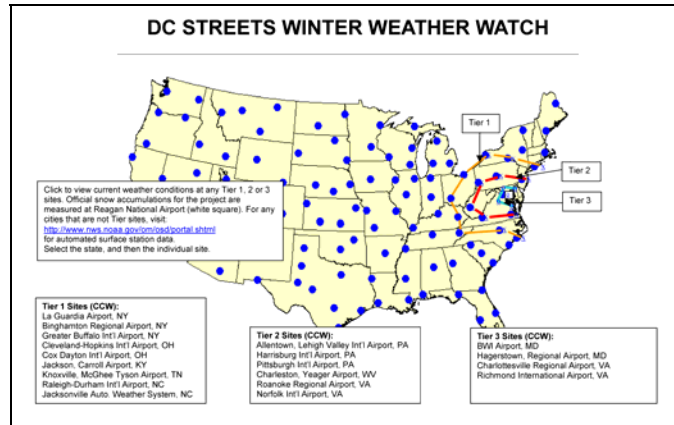
Figure 5. Tracker database

VMS began using a spray patch technology for potholes; this innovation provides a departure from the conventional cold mix operation that generally requires several people and more traditional lane closures to complete the patching safely. The innovative technique was tested by the Strategic Highway Research Program (SHRP); the technique has been used on the project with no failures to date. Previous uses of this method have lasted for several years.

VMS also introduced a new way to clean tunnel walls; it uses a three-step process, which includes a preliminary wash, sealing and an additional wash. Tunnel walls are washed a couple of times before they are sealed. Deionized water mixed with a detergent is sprayed onto the walls; this substance sticks to the walls for a specific dwelling period. A hot water rinse is the next phase. Next, the walls are sealed with a siliconized mineral, which is sprayed onto the clean wall. The primary purpose of the mineral is to remove the electrostatic charge that holds the dirt to the wall. After the walls are sealed, they are washed with a mixture of detergent and water again, but this mixture does not stick to the walls. The walls are then rinsed with plain water.

In early 2005, VMS presented a new material and method of replacing neoprene joint seals on bridges; the new material is a malleable two-part silicone. There are three main advantages of this new material. It can accommodate any joint up to 3", including irregular widths. The same material can be used for all surfaces, crack widths, and shapes. The silicone bonds to itself; thus, there is no need to replace large areas as needed with neoprene seals.

The effort also has produced multiple visual tools (i.e., video dissemination of the infrastructure condition, snowfall tracking via interactive map) that communicate the results of the project to the various internal and external stakeholders. The interactive snowfall-tracking map is shown in Figure 6.



**Figure 6. Interactive snowfall-tracking map**

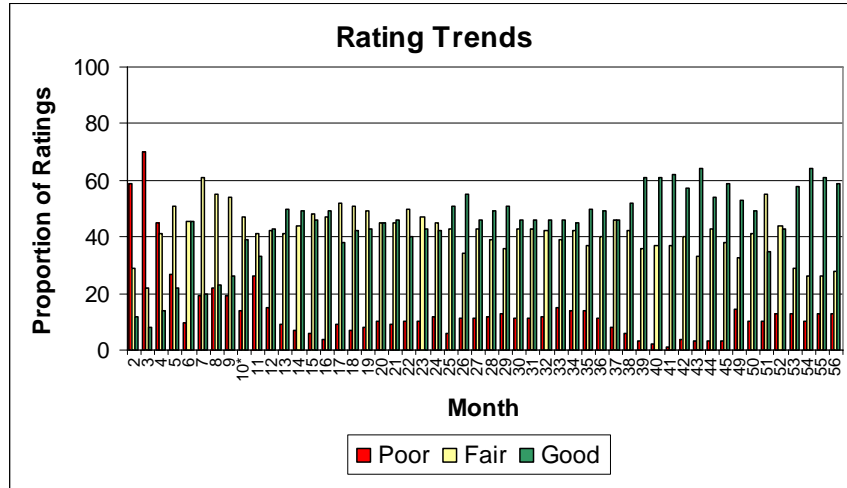
## KEY FINDINGS

### Results to Date

#### *Monthly Results*

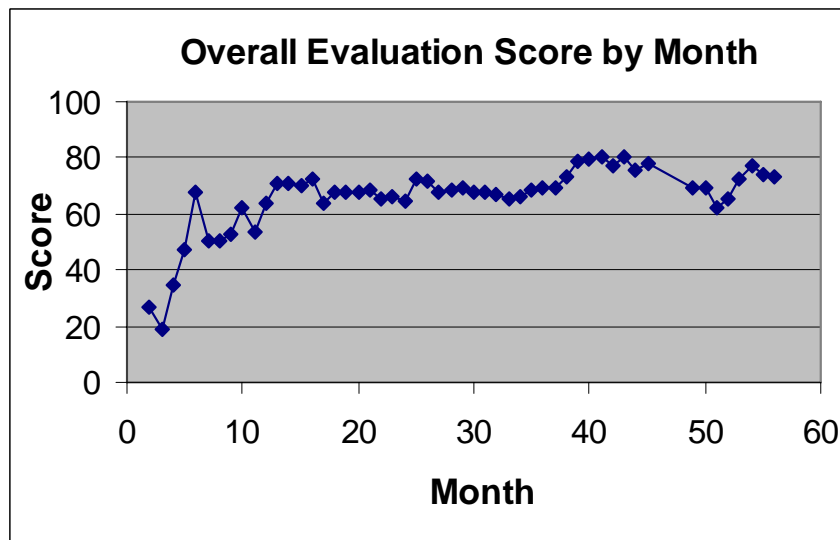
In an effort to enhance the NHS infrastructure by meeting or exceeding the performance standards, the project partners track the results of the project to date. For example, an overall and well-informed subjective score is computed monthly so the project team may adjust strategies or methodologies as needed. The raters assign subjective ratings of good, fair, and poor at the maintenance element level. A rating of good is assigned if the rater felt that the maintenance element appears to meet the performance standards; fair is assigned when the maintenance element may not meet the performance standards. A rating of poor is assigned when the condition of the maintenance element is clearly below the performance standards.

A summary of the results through Month 56 shows that there has been substantial subjective improvement over the course of time (Figure 7). The worst month was Month 3 with approximately 70% poor ratings. The best month was Month 41, when 99% of the ratings fell in either the good or the fair categories. The first month covered only Interstate 295 and is not shown.



**Figure 7. Monthly evaluation results**

The rating trends chart is useful, but the project team desired a means of tracking monthly performance with a single measure. In response to this desire, a monthly score was computed from the proportions of subjective good, fair, and poor ratings assigned by the evaluation team (Figure 8). The proportion of good ratings is multiplied by a factor of 100, the proportion of fair ratings by 50, and the proportion of poor ratings by 0. The resulting values are added together to obtain the score out of 100.



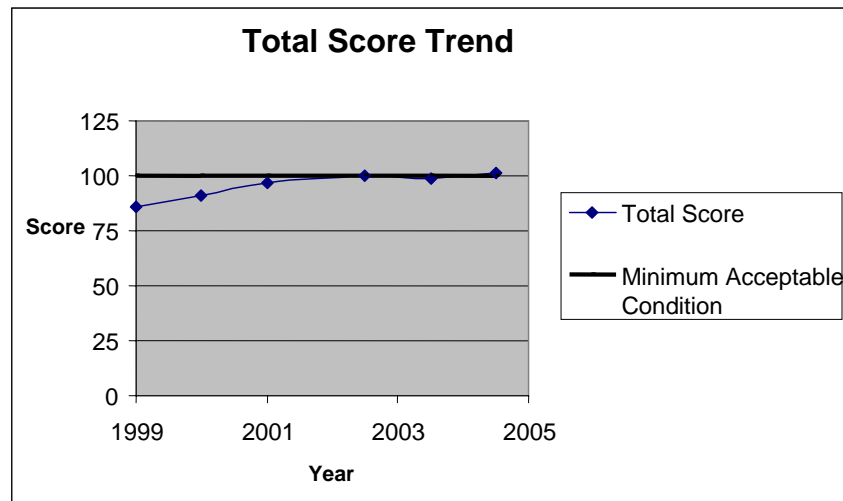
**Figure 8. Overall monthly score**

The overall evaluation score chart shows that the subjective score decreased between Months 44 and 53, and then increased in Month 54. It has decreased slightly in the last two months. The project partners are currently developing action plans to continually move towards exceeding the performance standards.

*Annual Results*

For the annual evaluation, the team enters resulting scores into a complex scoring spreadsheet, and an overall score, as well as a score for each maintenance category, is computed (Figure 9). A score of 100

indicates that, on average, the performance standards were met. For fair comparison purposes with pre-DC Streets conditions, time critical performance data are excluded in these scores.



**Figure 9. Overall annual score**

#### *Further Goal Results*

The project partners also strive to reach the other BHAGs they developed. For example, the editor-in-chief of FHWA’s Better Roads magazine attended the annual TRB conference in January 2004. She was impressed with the improvements and conditions of the District’s streets and thus contacted VMS’ corporate office. She wrote a four-page story in the April 2004 issue of the magazine.

In performing the DC Streets effort, VMS made a number of efforts to revitalize the community in which they work. VMS supported the Metropolitan Police Department’s “Operation Fight Back” on numerous occasions. Operation Fight Back involves a number of different approaches, including carrying out building and business inspections, towing abandoned vehicles, cleaning up trash, and reaching out to residents in the community. VMS supported this operation by performing street sweeping, mulching, graffiti removal, tree trimming, and sidewalk repair.

The main project factors that will help to institutionalize performance-based contracting will be the success in meeting and exceeding the performance standards and in providing a noticeable aesthetic improvement to the transportation network. For transportation professionals and politicians to find out about the good things happening in the DC Streets project, it is helpful to present at conferences and to publish in transportation journals.

#### **Lessons Learned**

A number of lessons have been learned over the first 4.5 years of the contract. For example, formal partnering is important for keeping good relationships between partners, solving problems not easily resolved at the daily project level, and avoiding claims. Additionally, a contract cannot cover every conceivable issue; project partners must work together within the spirit of the contract to make the project work.

The urban environment is dynamic and challenging to work in due to heavy traffic, limited right-of-way space, and the large number of people/organizations to work with.

Regular team meetings help keep outstanding issues in focus until they are solved. Assigning action items to specific individuals and then following up on the items at the next meeting improves the proportion of action items accomplished.

It is helpful to choose the monthly evaluation route randomly from a set of established routes. Doing so avoids focusing solely on problem areas and includes all sections of the system. It is easier on the driver as well. Performing routes in the reverse direction provides a different and useful perspective. A videographic or photographic record of the system should be captured on the day before the project starts.

It is important to keep multiple people from each partner organization involved in and informed about the project. This activity greatly eases the transition when a key person leaves.

Management IT tools are necessary. It is also useful to have different tools, such as the DC NHS Web Portal and Tracker Database, communicate directly with each other.

## **CONCLUSION**

DDOT plans to continue using performance-based asset preservation contracts after the conclusion of the DC Streets effort. The agency currently is expanding the application of the concept District-wide for assets, such as lighting and tunnels. DC Streets II, a follow-on contract that will include several DC NHS asset categories, also is being developed.