SCAN TEAM REPORT

Scan 08-03

Best Practices In Addressing NPDES And Other Water Quality Issues In Highway System Management

Supported by the

National Cooperative Highway Research Program

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SPECIAL NOTE: This report IS NOT an official publication of the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, or The National Academies.

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The purpose of each scan and of Project 20-68A as a whole is to accelerate beneficial innovation by facilitating information sharing and technology exchange among the states and other transportation agencies and identifying actionable items of common interest. Experience has shown that personal contact with new ideas and their application is a particularly valuable means for such sharing and exchange. A scan entails peer-to-peer discussions between practitioners who have implemented new practices and others who are able to disseminate knowledge of these new practices and their possible benefits to a broad audience of other users. Each scan addresses a single technical topic selected by AASHTO and the NCHRP 20-68A Project Panel. Further information on the NCHRP 20-68A U.S. Domestic Scan program is available at

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This report was prepared by the scan team for Scan 08-03, *Best Practices in Addressing NPDES and Other Water Quality Issues in Highway System Management,* whose members are listed below. Scan planning and logistics are managed by Arora and Associates, P.C.; Harry Capers is the Principal Investigator. NCHRP Project 20-68A is guided by a technical project panel and managed by Andrew C. Lemer, Ph.D., NCHRP Senior Program Officer.

Scott McGowen, *P.E., California DOT, AASHTO Co-Chair*

Brian Smith, *Federal Highway Administration, FHWA Co-Chair*

Scott Taylor, *P.E., RBF Consulting, Subject Matter Expert*

Frances Brindle, *Oregon DOT*

Patricia A. Cazenas, *P.E., L.S., Federal Highway Administration*

Vincent W. Davis, *P.E., Delaware DOT*

Mark Hemmerlein, *New Hampshire DOT*

Rachel Herbert, *U.S. EPA*

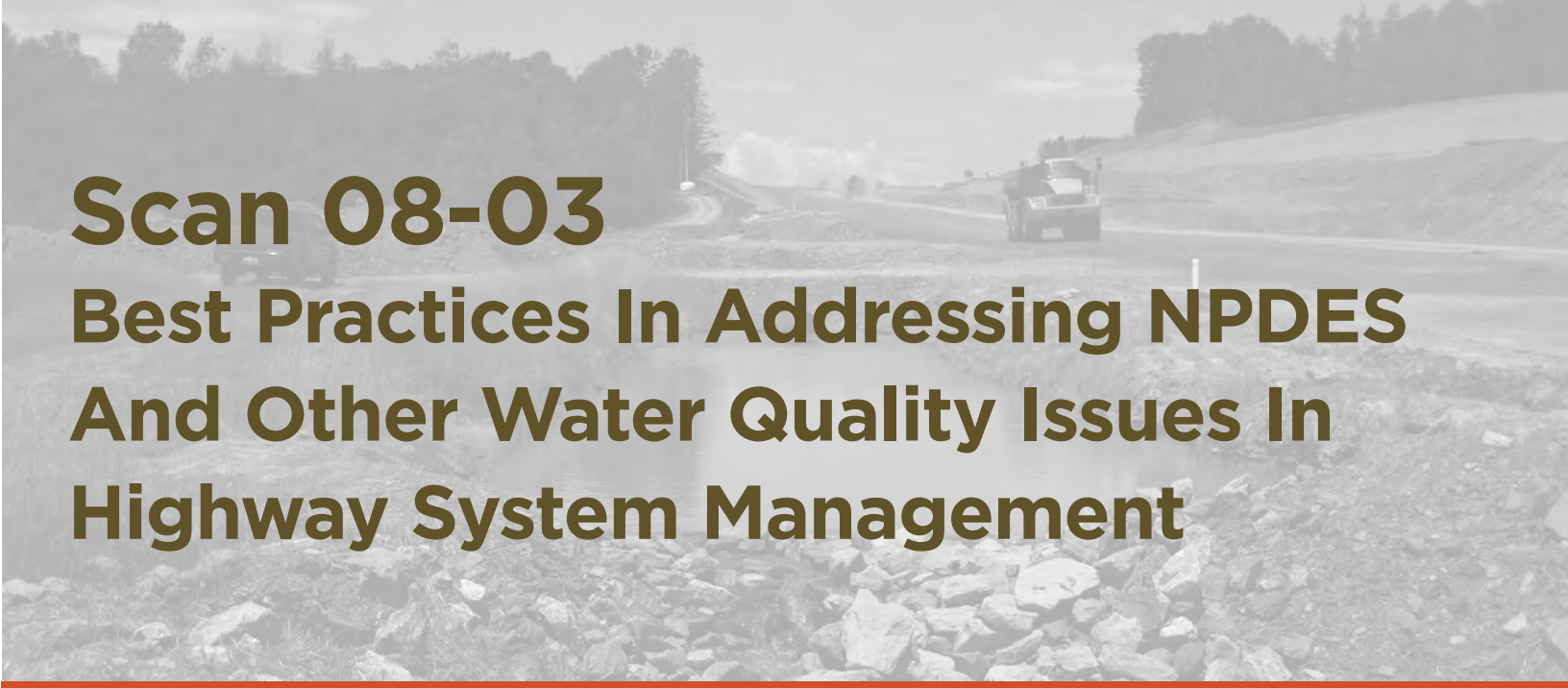
Matthew (Matt) S. Lauffer, *P.E., North Carolina DOT*

Jeff Lewis, *Federal Highway Administration*

Tom Ripka, *P.E., Illinois DOT*

Disclaimer

The information in this document was taken directly from the submission of the authors. The opinions and conclusions expressed or implied are those of the scan team and are not necessarily those of the Transportation Research Board, the National Research Council, or the program sponsors. The document has not been edited by the Transportation Research Board.



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REQUESTED BY THE

American Association of State Highway and Transportation Officials

PREPARED BY

Scott McGowen, P.E.,
California DOT, AASHTO Co-Chair

Brian Smith,
Federal Highway Administration, FHWA Co-Chair

Scott Taylor, P.E.,
RBF Consulting, Subject Matter Expert

Frances Brindle,
Oregon DOT

Patricia A. Cazenas, P.E.,
L.S., Federal Highway Administration

Vincent W. Davis, P.E.,
Delaware DOT

Mark Hemmerlein,
New Hampshire DOT

Rachel Herbert,
U.S. EPA

Matthew (Matt) S. Lauffer, P.E.,
North Carolina DOT

Jeff Lewis
Federal Highway Administration

Tom Ripka, P.E.,
Illinois DOT

SCAN MANAGEMENT

Arora and Associates, P.C.
Lawrenceville, NJ

December 2009

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Abbreviations and Acronyms

A&M	Agricultural and Mechanical (Texas A&M)
AASHTO	American Association of State Highway and Transportation Officials
AFB60	TRB Committee on Hydrology, Hydraulics and Water Quality
APL	Approved Products List
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ATS	Active Treatment System
BMAP	Basin Management Action Plan (Florida)
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
COC	Constituents of Concern
CPESC	Certified Professional in Erosion and Sediment Control
CPI	Continuous Process Improvement
CSO	Combined Sewer Outfall
CWA	Clean Water Act
DBOM	Design, Build, Operate, and Maintain
DC	District of Columbia
DDOE	District Department of the Environment (District of Columbia)
DDOT	District of Columbia Department of Transportation
DEC	Department of Conservation (New York State)
DENR	Department of Environment and Natural Resources (North Carolina)
DEP	Department of Environmental Protection (Florida)
DOT	Department of Transportation
DPW	Department of Public Works (District of Columbia)

ELG	Effluent Limitation Guidelines
EMS	Environmental Management System
EOP	End of Pipe
ERP	Environmental Resource Permit
ESA	Endangered Species Act
ESC	Erosion and Sediment Control
ESD	Environmental Site Design
FHWA	Federal Highway Administration
FTE	Florida Turnpike Enterprise
GIS	Geographic Information System
HSP	Highway Stormwater Program (North Carolina)
IDDE	Illicit Discharge Detection and Elimination
IDIC	Illegal Dumping and Illicit Connections
IDOT	Illinois Department of Transportation
LOS	Level of Service
MDE	Maryland Department of the Environment
MEP	Maximum Extent Practicable
mg/L	Milligrams per Liter
MOU	Memorandum of Understanding
MS4	Municipal Separate Storm Sewer System
MSHA	Maryland State Highway Administration
NCDA&CS	North Carolina Department of Agriculture and Consumer Services
NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NCSU	North Carolina State University
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units

NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOT	New York State Department of Transportation
O&M	Operation & Maintenance
PAM	Polyacrylamide
PEA	Program Effectiveness Assessment
PCB	Polychlorinated Biphenyl
PFC	Permeable Friction Course
PLC	Programmable Logic Controller
PS&E	Plans, Specifications, and Estimates
QA	Quality Assurance
ROW	Right-of-Way
SCMS	Stormwater Control Management System
SCOE	Standing Committee on the Environment (AASHTO)
SESC	Soil Erosion and Sediment Control
SME	Subject Matter Expert
SPPP	Stormwater Pollution Prevention Plan (North Carolina)
SR	State Route
SWPPP	Stormwater Pollution Prevention Plan
TCEQ	Texas Commission on Environmental Quality
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TRB	Transportation Research Board
TS4	Transportation Separate Storm Sewer System
TSS	Total Suspended Solids
TTI	Texas Transportation Institute
TxDOT	Texas Department of Transportation
U.S. EPA	United States Environmental Protection Agency

µm	Micrometer
UCF	University of Central Florida
UNCC	University of North Carolina at Charlotte
UT	University of Texas
WASA	Water and Sewer Authority (District of Columbia)
WLA	Waste Load Allocation
WMA	Water Management Administration (Maryland)
WQABI	Water Quality Ambient Benthic Index
WQV	Water Quality Volume

Executive Summary

Introduction/Overview

The Domestic Scan program was developed by the Federal Highway Administration (FHWA) and the American Association of State Transportation Highway Officials (AASHTO) to facilitate technology transfer between state Departments of Transportation (DOTs) to improve domestic highway programs by increasing their efficiency and effectiveness. The Domestic Scan program is administered through the National Cooperative Highway Research Program (NCHRP) using consultant contracts to assist in completing the identified scans.

Domestic scans are conducted by a team of specialists consisting of members of the FHWA and DOTs, with representatives from other agencies and consultants as appropriate. The scan team includes a chairman or chairwoman who guides the process and a subject matter expert (SME) who is responsible for completing most of the project deliverables. The scan format begins with a research phase where a desk scan is drafted, investigating the study questions and suggesting potential scan field locations. The scan continues through personal visits by the scan team to the selected field locations. Final scan documentation includes a summary report, a presentation file, and a final program report.

Scan Purpose and Scope

The purpose of this scan was to investigate issues surrounding the implementation of a DOT stormwater program. Compliance with state and federal stormwater regulations is complex, and DOTs must continually examine their approach to compliance with the goals of improving water quality and reducing implementation costs. DOT infrastructure improvements can be delayed if stormwater requirements are not well integrated early into the planning and project delivery process.

The scan team participated in an initial coordination meeting to discuss and refine the scan topics. The team concluded that it would investigate these four topic areas, each consisting of two subtopics:

- **Total Maximum Daily Load** (TMDL) implementation is an emerging issue for DOT stormwater programs, including how waste load allocations (WLAs) will be implemented in NPDES permits and what methods will be used to develop WLAs and compliance strategies. The scan team wanted to investigate water quality credit trading as a secondary topic to determine if this approach will be an important tool for DOT TMDL compliance.
- Traditional and innovative **Best Management Practices** (BMPs) are the cornerstone of a DOT stormwater program. BMPs also represent the single most resource-intensive portion of a DOT stormwater program. The scan team was especially interested in new BMP technologies that could operate passively in a highway environment and those that performed well for

the constituents of concern (COC) from highways, such as metals. Both construction and post-construction BMPs were of interest. Source control BMPs are the secondary element under this topic. The scan team recognized that source control approaches can be the most environmentally effective and least costly BMPs. Applied research in this area would also most likely be easily transferable to other agencies.

- **DOT Practices/Procedures**. DOT operation and maintenance (O&M) practices are an important element of the agency's stormwater program. The scan team was interested in how DOTs track the maintenance requirements of treatment BMPs, as well as the O&M BMPs being used to improve stormwater quality (such as reduction of DOT herbicide use). Overall, stormwater program reporting and compliance tracking are also important but consume staff time. The scan team investigated tools DOTs use to streamline agency reporting requirements as a secondary topic. The scan team members were interested in approaches to stormwater program effectiveness assessment (PEA), along with the performance measures that were being used. PEA is a required element under most NPDES permits; however, there is a lack of guidance to assist program managers, and existing assessment methods tend to be resource intensive.

- **Regulatory**. The relationship of the DOT with the regulatory agency charged with implementing the Clean Water Act (CWA) is complex. Typically, authority to implement the CWA is delegated to the state, so the DOT is regulated by a sister state agency, with federal oversight. The scan team believed that methods to improve communication with state and federal regulators would be highly valuable both in improving the effectiveness and proactively addressing issues of the DOT stormwater program, as well as in assisting the DOT to introduce more certainty into its stormwater budgeting process. The team was especially interested in the characteristics of DOTs that had a partnership-level relationship with their regulatory agency. There is a potential for overlap in the Act's stormwater regulation between Sections 401 (water quality certification) and 402 (regulation of discharge from the storm drain system). A secondary topic was to understand if this potential conflict was occurring in practice at the implementation level.

The scan team discussed potential scan field visit sites at its initial team meeting and reviewed a short list of sites based on findings from the desk scan report. The main consideration for selecting the field visit sites was each site's assessed compatibility with the final topics. The team determined that the best field visit candidate locations would be those DOTs with well-developed programs, including experience in several of the topic areas. Ultimately, the team selected six sites to visit based on Internet research and discussions with experts in the field of highway stormwater quality and with the NPDES coordinator at the candidate DOTs. The team visited the following sites for this scan (in order of the trip itinerary):

- **New York State DOT** (NYSDOT). NYSDOT has an established stormwater program that includes an advanced treatment system application for construction sites. The DOT also has experience with TMDLs, BMP research, and ultra-urban BMPs. The team was interested in viewing the database created by the DOT's Environmental Science Bureau to track

maintenance requirements and other data associated with treatment controls.

- **Washington D.C. DOT** (DDOT). DDOT is a leader in low-impact development (LID) BMP installation, particularly retrofits. DDOT has a unique structure in that it reports both to the City Council for the District of Columbia (DC) and to the other DC resource agencies. Many of the receiving waters within the District are on the 303(d) list for a variety of pollutants, and portions of the DDOT system are on a combined sewer outfall (CSO).
- **Maryland State Highway Authority** (MSHA). The scan team's literature review and personal communications with national experts indicated that MSHA is one of the leaders in beginning LID implementation and is a key state within the Chesapeake Bay watershed. MSHA faces many stormwater management challenges at the regional, state, and local levels and has a state-of-the-art tracking system for post-construction BMPs, maintenance, and operation. The scan team was also interested in its construction site stormwater compliance program and its design, build, operate, and maintain (DBOM) model for stormwater management BMPs. MSHA holds both Phase I and Phase II Municipal Separate Storm Sewer System (MS4) permits and has addressed individual permit requirements for impervious treatment accounting that will be integrated into the Chesapeake Bay modeling for the future Bay TMDL development.
- **North Carolina DOT** (NCDOT). NCDOT is actively involved in TMDL planning and participates on state workgroups for TMDLs. NCDOT partners with state universities to conduct water quality research, such as the use of soil binders for erosion control and BMP performance studies. NCDOT is also conducting a bridge stormwater project to assess the quality of runoff from bridge decks and the impact of runoff from bridge decks on receiving waters and aquatic life and to evaluate the cost of implementing effective bridge BMPs statewide. The DOT has improved stormwater compliance by basing a portion of employee performance reviews on metrics related to stormwater program performance.
- **Texas DOT** (TxDOT). TxDOT partners with public universities in Texas to implement an ongoing research program for highway BMPs and pioneered the use of sand filters in the Edwards Aquifer watershed. Texas Agricultural and Mechanical (A&M) University's erosion control laboratory tests erosion and sediment controls (ESCs) for use in the highway environment. The scan team was interested in the BMP research studies that TxDOT has funded and the results of those studies for potential technology transfer.
- **Florida DOT** (FDOT). The scan team was interested in Florida as a field visit site for several reasons. First, responsibility for the stormwater program resides with each of the DOT districts, rather than with a central office. NPDES permits are held by the DOT districts as a co-permittee with other MS4's, rather than through a single statewide DOT permit. FDOT also operates the Florida Turnpike Enterprise (FTE), which is a system of toll roads, and funds a BMP research program through the University of Central Florida (UCF).

Summary of Initial Findings

The scan team found a wide array of innovative practices at the field sites and was impressed with the dedication of the DOT staff at each location and their resolve to improve the effectiveness of their stormwater programs. The scan team developed some overall findings that are provided here as a basis for formulating improvements to DOT stormwater programs and for guiding future stormwater quality research.

- **DOTs are unique NPDES permittees.** DOTs have unique aspects that make them different from traditional municipalities for NPDES permitting. In some states, the unique attributes have been recognized at the regulatory level to the benefit of the highway stormwater program (HSP). The scan team isolated the unique characteristics of DOTs as NDPES permittees:
  - DOT facilities are passive and uniform.
  - DOT facilities are diffuse.
  - Safety is a primary objective.
  - DOTs have requirements to manage off-site stormwater runoff.

These unique characteristics offer an opportunity to craft DOT NPDES regulation and DOT approaches to stormwater programs to provide the maximum environmental benefit.

- **DOTs must develop new approaches to stormwater programs.** The scan team found that there are some aspects of stormwater program implementation that DOTs can perform exceptionally well and others that, due primarily to external factors, have high costs and fewer benefits. The scan team finds that it is logical for DOTs to focus on the areas of the stormwater program where they can expend public resources to achieve the highest beneficial outcome. Program areas that DOTs should invest in are:
  - Hydromodification
  - Particulate pollutant and metal removal
  - Sources of pollutants under DOT control (e.g., deicers)

  Program areas where traditional approaches should be reevaluated are:
  - Public education
  - Runoff characterization
  - Illicit discharge detection
- **DOTs should continue applied research.** Since DOTs have unique infrastructures and document stormwater discharge quality from their facilities, focused research will help to

achieve next-generation program improvements. The scan team found that research is needed in the following areas:

- Source control
- Pavement systems
- Trash control
- BMP effectiveness measurement

- **DOTs have a need for program changes.** The implementation of stormwater programs will continue to be an adaptive process. Regulations and technology have undergone continuous evolution since the inception of the NPDES program in the early 1990s. The scan team found a variety of areas that could strengthen DOT stormwater programs:
  - Investigate the benefits of a specific MS4 permit for transportation agencies (the concept of a Transportation Separate Storm Sewer System [TS4] permit) to optimize agency stormwater programs.
  - Investigate a TMDL credit-trading program for DOTs.
  - Strengthen the pooled-fund research program.
  - Invest in source control research.
  - Streamline and improve communication with regulatory agencies
  - Improve integration of the stormwater program into the DOT organization.

The scan team also found that a culture of environmental stewardship at the DOT is one of the single most important characteristics to support a successful stormwater program. DOTs need to create an agency culture that demonstrates a strong commitment to enhancing and preserving the environment. This requires strong upper management support and buy-in—words and actions that demonstrate commitment—and a similar high standard applied to all of the external partners, (e.g., consultants, contractors, and vendors) doing business with the DOT.

Recommendations

The scan team has developed a set of recommendations based on the field visits, team findings, and team discussions at the conclusion of the scan travel. Some of the recommendations can be implemented locally by DOTs; however, some will require a national discussion.

Create the Framework of a TS4 Permit

A TS4 permit can help focus DOTs on stormwater activities that will provide the most environmental benefit. The scan team recommends developing a model permit that state regulatory agencies can use as a guide for permitting their DOTs. The model permit would apply

to DOTs as an individual Phase I or Phase II permit, intended to cover all of the DOT's CWA activities, including construction. The model permit framework could initially be fashioned around the United States Environmental Protection Agency's (U.S. EPA's) six minimum measures:

- **Public Education and Outreach.** Focus this element on antilitter campaigns and integrate the program nationally.
- **Public Participation and Involvement**. Refocus this portion of the program on areas of specific interest to the public and benefit for DOT programs.
- **Illicit Discharge Detection and Elimination (IDDE).** This portion of the program should be centered on staff (i.e., maintenance personnel) training and enforcement (i.e., highway police departments).
- **Construction Site Runoff Control.** This program should be enhanced to promote both DOT-specific training for engineers and contractors and research into BMPs that are effective in the highway right-of-way (ROW). Sharing this information with the regulatory community will also be important.
- **Post-Construction Runoff Control.** Focus research and mitigation on controlling sources of pollutants from the existing highway system as well as on controlling hydromodification.
- **Pollution Prevention and Good Housekeeping.** This program element should be emphasized to reduce potential pollution from highway-specific maintenance activities (e.g., pavement rehabilitation) and to optimize current practices (e.g., sweeping). Pollution prevention techniques for maintenance yards, rest stops, and other similar locations under the DOTs control should also be examined.

Create National Guidance on TMDL Application for DOTs

303(d) listing of water bodies and TMDL development is increasing nationally as states collect more receiving water data. There is tremendous pressure on states (primarily from the threat of third-party litigation) to complete TMDLs and assign WLAs to stakeholders. DOTs may be overwhelmed by the volume of TMDLs they must track and implement.

National guidelines could assist states and DOTs by ensuring that DOTs are aware of and ready to participate in pollutant/water body listings for which there is a scientific nexus with highway stormwater quality. Those listings for which there is no scientific basis for the DOT to participate should be eliminated from consideration. The development of case studies and guidance on how DOTs are dealing with TMDLs within their permits would help all DOTs learn from experience. Open communication with regulators is important at all stages of TMDL development; expanded partnerships will be important for the effective implementation of TMDLs. The scan team recommends a panel or national discussion on the topic of allocating TMDL load distributions based on science, contributors, and cost-effective ways to implement the program on a watershed basis.

Refine the Approach to Expending Public Resources on Stormwater Quality

The cost to remove pollutants from stormwater varies from discharger to discharger, with the point of greatest control (usually at the source) being the most effective and economical location to expend water quality resources. Stormwater programs are entering a defining period where treatment control retrofit may be emphasized to meet numeric limits and TMDL WLA. What has not been adequately investigated, however, is the life-cycle cost of a treatment-emphasis type of approach for compliance as compared to a true source control approach through reduction of the pollutant in commercial use.

A flaw in current stormwater programs is that all point sources must reduce their discharge of a pollutant, regardless of its source. This type of approach is not the most efficient expenditure of limited stormwater program resources. Point source dischargers should focus their efforts on removing pollutants for which they have the tools and technical potential to reduce, rather than all constituents that are present in their runoff. For constituents that have a high marginal cost for the discharger to reduce or eliminate, alternatives such as credit trading may be more effective. The scan team recommends further study into credit trading programs for stormwater dischargers, with the objective of optimizing constituent control at the location that can obtain the greatest effectiveness per unit cost. Credit trading could provide needed flexibility, identify reliable benefits on a watershed scale, and would contribute to the de-listing of impaired waters.

Promote Environmental Stewardship

Overall, the scan team was impressed by the exceptional technical, strategic and practical approaches the DOT field sites were employing to meet their stormwater program objectives. An organization that has environmental stewardship as a core value can optimize these resources. Other benefits of environmental stewardship may include a reduction in both regulatory agency oversight of and reporting requirements for the DOT.

The scan team recommends that DOTs consider the following practices in guiding and structuring their organizations:

- Management commitment to environmental protection
- Accountability at all levels in the organization, promoted through education
- Communication and transparency of operations and environmental performance

Other Recommendations

The scan team assembled a collection of additional recommendations drawn from observing the operations at the scan field locations and assessing factors that would facilitate DOT stormwater program improvement. These recommendations are to:

- Hold an annual AASHTO Stormwater DOT Conference
- Integrate stormwater program responsibility within the DOT

- Invest in pooled-fund highway stormwater research
- Collect accurate and detailed cost data for stormwater program elements
- Develop a Transportation Research Board (TRB) initiative for source control of highway pollutants
- Invest in BMPs for maintenance activities

Implementation Activities

The scan identified important programs, strategies, and recommendations that would be beneficial to other DOTs. The team plans to initiate implementation activities such as the following immediately upon completion of the scan report. The implementation activities were developed specifically to support the scan's recommendations and will use methods such as:

- Publishing articles in journals and other industry-related publications, such as *ASCE Magazine* (published by the American Society of Civil Engineers), Stormwater *Solutions, and APWA Reporter* (published by the American Public Works Association)
- Making presentations at AASHTO committees, TRB conferences, ASCE conferences, and other venues as appropriate
- Using the project presentation file that the scan team members developed for the scan trip for in-house DOT presentations and presentations to local transportation organizations (see Appendix A)
- Integrating the team's findings into other associations and industry groups, such as the AASHTO Center for Excellence.
- Performing outreach with the assistance of the FHWA and U.S. EPA

Details on the implementation strategy for each of the recommendations made in this report are discussed in Chapter 8

CHAPTER 1

Introduction

Background

Section 402 of the CWA places requirements on Departments of Transportation (DOTs) for the discharge of stormwater from their storm sewer systems through the National Pollutant Discharge Elimination System (NPDES) program via a permitting framework. Noncompliance with NPDES permits can impact project design, engineering, and construction schedules and increase construction time and costs. Successful implementation and compliance with NPDES permits requires the appropriate transfer of information and accountability through multiple phases of project delivery. NPDES permits are issued for a five-year permit term; in practice, permit requirements have become increasingly more prescriptive through each permit cycle as stormwater programs become more mature.

State DOTs are anticipating TMDLs to be incorporated into their NPDES stormwater permits. DOTs are concerned about the method of implementation that will be chosen and the types of receiving water impairments that will be addressed. TMDLs may impose numeric effluent limits on DOTs, requiring specific measures for compliance that must be compatible with the restrictions of the highway ROW.

In some states, the CWA Section 404 and 401 permitting process appeared to be impacting project design and delivery. Section 404 and 401 permitting is required when fill or dredge material is deposited into waters of the U.S. Anecdotally, some DOTs have been experiencing permit requirements that vary from Section 402 programs. This divergence in stormwater program and individual project permit requirements can limit the benefit of programmatic planning and create uncertainty in project design and construction costs.

The dynamic nature of CWA Section 402 NPDES programs, coupled with the regulatory trend toward TMDL development and project-specific 401 permit requirements, creates a challenging environment for DOT project delivery. This domestic scan was conceived to observe some of the approaches DOTs are using to meet the challenges of CWA compliance and facilitate the implementation of cost-effective stormwater program strategies.

Objectives

Stormwater quality compliance is closely tied to and is a part of project environmental documentation and environmental permitting. Accordingly, there are a wide range of associated topics and external drivers. The initial list of scan topics proposed for this scan reflects the diversity of the subject matter:

- TMDL modeling
- Traditional and innovative BMPs for water quality

- Construction techniques and materials being used
- Agency maintenance and operations practices
- Coordination with local and federal regulators, specifically regarding agreements, processes, and tracking compliance
- Watershed land use management
- Water quality credit trading
- Management options other than structural BMPs (e.g., street sweeping, deicing chemicals, trash removal, and nutrient management plans)
- Handling of hazardous spills
- Agency compliance strategies
- Funding
- Program compliance reporting and tracking

Each of the proposed topics, while worthy of individual investigation, collectively represented a broader scope than could be effectively addressed through an individual scan. The scan team consolidated the original list by combining some topics and deferring others to arrive at four primary focus areas, each with two subtopics:

- TMDLs
  - TMDL Implementation
  - Water Quality Credit Trading
- BMPs
  - Traditional and Innovative BMPs
  - Nonstructural and Source Control Options
- DOT Practices/Procedures
  - Agency Maintenance and Operations Practices
  - Stormwater Program Compliance: Reporting and Tracking
- Regulatory
  - Coordination with Local and Federal Regulators
  - 401 Certifications

The team developed amplifying questions for the topics to further define the study questions and provide a vehicle for gathering information from the scan sites. The amplifying questions are provided in Appendix B, and responses to these questions (if available) are provided in Appendix C.

Scan Approach and Planning

A desk scan was prepared to assess the technical literature available on the primary scan topics and to discuss the topics with national experts to further refine the topic areas, confirm that the topic is of national importance, and determine potential scan sites.

The scan team reviewed the desk scan report and held a team meeting to discuss the selection of scan sites. The team wanted to focus the site visits on DOTs that had relatively advanced NPDES stormwater programs in areas of the U.S. that had mature regulatory requirements for construction site and post-construction runoff, had active stormwater BMP research programs, and/or were a named party in a TMDL.

The areas of the country with the most advanced regulations from a stormwater perspective generally coincide with highly urban areas near the coasts. These areas include the New England and Mid-Atlantic states and Florida. Texas emerged as a viable site due to the relatively sophisticated surface water quality regulation associated with protection of the Edwards Aquifer and the strong highway research program at the University of Texas (UT) and Texas Agricultural and Mechanical (A&M) University.

California and the Pacific Northwest have advanced stormwater regulation and an aggressive TMDL program. However, the scan co-chair is based in California, and he could facilitate information exchange with the team, making a visit to the DOT unnecessary. Similarly, Oregon has relatively advanced NPDES permits and emerging TMDL requirements, but a scan team member is based there. Washington DOT was contacted as a candidate for a scan site for reasons similar to those noted for California and Oregon, but was unable to accommodate the scan team request due to limited staff availability.

Because low-impact development (LID) techniques are emerging (via requirements in NPDES permits) as a tool for surface water management on highways, the team sought DOTs with leadership in LID technique development and implementation. The Maryland State Highway Administration (MSHA), the District of Columbia Department of Transportation (DDOT), and Florida DOT were each cited for program development in this area. Additionally, ultra-urban BMPs were of interest to the team given the relative scarcity of technologies available and the need for BMPs that are effective in areas with limited ROW availability.

Host Locations Visited

The scan team selected the following transportation agencies as scan sites based on their innovative approaches to the primary topic areas, leadership in program development, and/or their state regulatory environment:

- New York State (NYS)
- North Carolina (NC)
- District of Columbia (DC)
- Maryland (MD)
- Texas (TX)
- Florida (FL)

The scan team visited the host sites from July 12 through July 24, 2009. The travel itinerary was planned to be as efficient as possible, with most travel completed after normal business hours. (See Appendix D for the scan itinerary.) Multiple days were spent in North Carolina, Texas, and Florida due to the depth of the programs in those states, as well as for logistical reasons; all other sites consisted of a single-day visit. Figure 1.1 shows the states visited as a part of this scan.

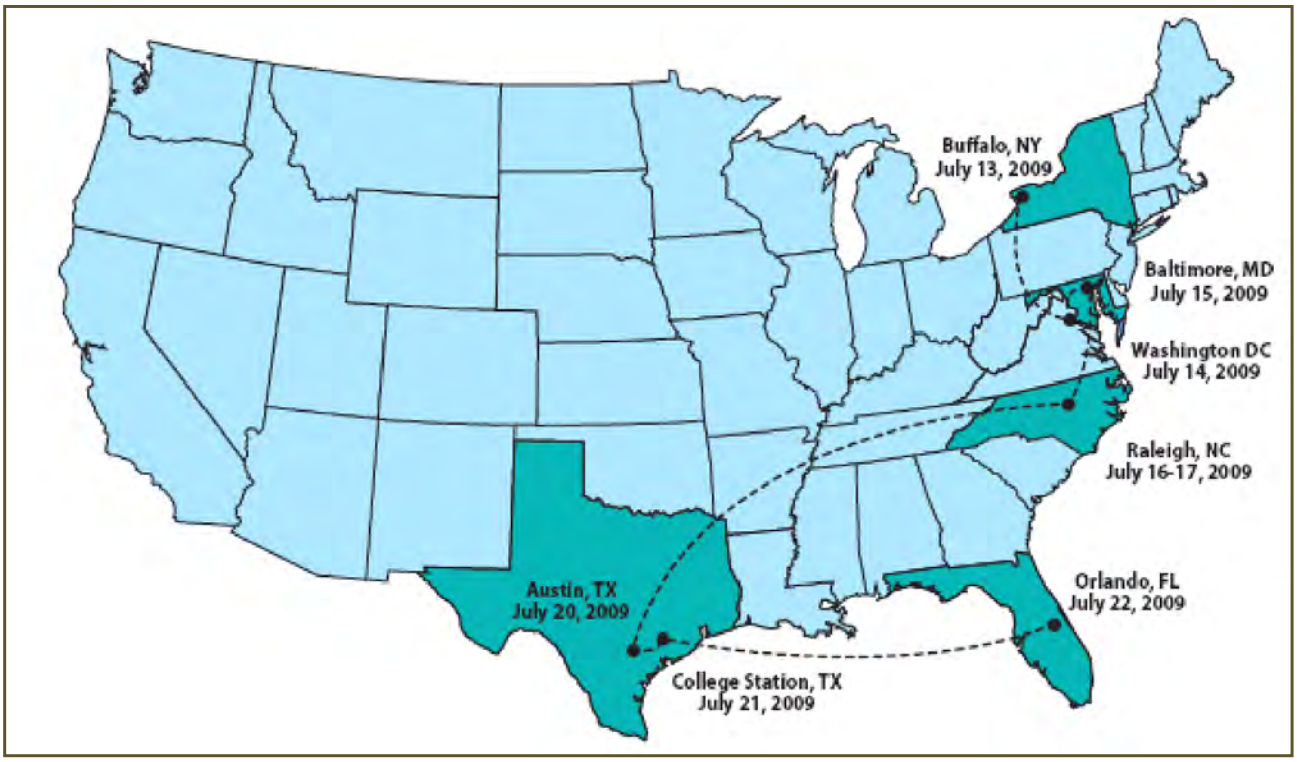


Figure 1.1 *Scan sites and visitation dates*

The selected scan sites represent programs under various permitting structures (Phase I and Phase II, individual and general permits, and the DOT as a co-permittee) and in parts of the U.S. with differing receiving water problems, resulting in a diverse sample set for the team's evaluation. Table 1.1 summarizes the number of lane miles and approximate annual stormwater program budget for each of the DOTs visited. See Appendix E for host agency contact information.

Scan Site – DOT	Total Lane Miles	NPDES Annual Program Budget
New York State	15,032	Unknown[a]
District of Columbia	3,625	$2.7M
North Carolina	79,000	$5.3M
Maryland	14,686	$5 to 7M
Texas	79,000	Unknown
Florida	42,432	N/A[b]

[a] The data is not tracked.
[b] The data was not available but may or may not be tracked.

Table 1.1 *Scan site lane and program data*

Scan Team Members

The members of the scan team were representatives from DOTs, AASHTO, FHWA, and the U.S. EPA, primarily specialists in stormwater, surface water quality, flood control, and environmental systems and permitting. Specifically, the team comprised 12 members, including three representatives from FHWA, one representative from the U.S. EPA, six representatives from various DOTs, and the SME. A representative from the NCHRP contractor, Arora and Associates P.C., accompanied the team. Table 1.2 provides the team members and their affiliations, team biographical information is contained in Appendix F, and contact information is contained in Appendix G.

Team Member	Affiliation
G. Scott McGowen, P.E., Co-chair	California Department of Transportation
Brian Smith, Co-chair	Federal Highway Administration
Patricia Cazenas, P.E.	Federal Highway Administration
Jeff Lewis	Federal Highway Administration
Rachel Herbert	U.S. Environmental Protection Agency
Vince Davis, P.E.	Delaware Department of Transportation
Mark Hemmerlein	New Hampshire Department of Transportation

Team Member	Affiliation
Tom Ripka, P.E.	Illinois Department of Transportation
Matt Lauffer, P.E.	North Carolina Department of Transportation
Frannie Brindle	Oregon Department of Transportation
Scott Taylor, P.E., SME	RBF Consulting

Table 1.2 *Scan Team Members*

The staff of Arora and Associates, P.C., of Lawrenceville, New Jersey, supported the team. Mandeep Singh, Arora, P.E., accompanied the team on the scan trip, and Harry Capers, P.E., provided general guidance and facilitation, and met with the team on the initial and concluding days of the trip. Melissa Jiang provided team technical and logistics support.

CHAPTER 2

Findings and Report Overview

The scan team's findings are organized around the four identified topic areas, each in a dedicated report chapter. The team was able to obtain information on exceptional practices at the scan sites that other DOTs can apply to enhance their stormwater program effectiveness and reduce their program implementation costs.

The field of stormwater quality is highly regulated and very dynamic, making it difficult for the stormwater program manager to allocate resources efficiently and effectively for maximum benefit. The scan team developed a progression of four basic principles that can be applied to help guide change in DOT stormwater programs. These principles are reinforced by examples from team observations at the scan sites throughout the remainder of this report.

DOTs as NPDES Permittees Are Unique

The states and the U.S. EPA regulate the state transportation systems within the traditional MS4 general permit framework, although DOTs do not fit well within this model. DOTs primarily operate facilities (highways, rail, and airports) that focus on providing a platform to allow for the efficient movement of people and goods. Municipalities have authority over the people who are using transportation infrastructure in the municipality and have the authority to control how those people conduct themselves through use and enforcement of regulation and ordinance. By comparison, DOT facilities are passive and uniform, diffuse (covering a wide geographic area), and include safety as a primary objective.

DOT Facilities Are Passive and Uniform

DOTs primarily operate single-purpose facilities (roads and highways), which can allow for a permit with more focused objectives as compared to a traditional MS4. For example, it is evident that additional characterization monitoring of roadway runoff has little value unless the monitoring is focused on new constituents that have not previously been assessed. There is a well-documented range of expected values (concentrations) for constituents in highway runoff. Although there may be some variation nationally, this information is not used in the implementation of DOT BMP programs. Further, there are not multiple pathways for potential stormwater contamination in the highway environment as there are with a traditional MS4, since access to most roadways is controlled and public activities are restricted.

A significant portion of pollution sources (i.e., atmospheric deposition and release from vehicles) is outside of the DOT's control. Accordingly, some of the requirements in a traditional MS4 permit will not result in significant or timely gains in water quality when applied to a DOT; they will, however, reduce the resources available to support more beneficial program elements. The attributes of DOT infrastructure (passive and uniform) must be used to their advantage in the DOT stormwater program to concentrate program resources on those areas where the DOT has the most potential to have a positive environmental benefit.

DOT Facilities Are Diffuse

DOT facilities occupy most watersheds within a state. DOTs are often issued multiple (or are co-permittees on) NPDES permits, resulting in varied program requirements throughout the state. DOT agencies cross many city and county jurisdictional boundaries and typically occupy a very small land area in any watershed, with limited ROW for improvements. Consequently, DOTs have the potential to be assigned stakeholder responsibility in a vast number of TMDLs for a variety of constituents. Physical improvements (e.g., treatment controls) or programmatic approaches (e.g., source controls) must be replicated over a wide geographic area when implemented by a DOT. The current NPDES permitting framework can be inconsistent with the structure of most DOTs that develop policy and provide technical guidance from a central office. A DOT permitting approach with multiple NPDES permits can result in a disproportionate expenditure of resources on stormwater program administration for multiple NPDES permits and TMDL implementation plans.

Safety Is a Primary Objective

DOTs are also unique in that the safety of both the public and DOT personnel dominates the configuration of the infrastructure and constrains activities that can occur in the ROW. Stormwater BMPs must operate passively and cannot interfere with other state and federal safety requirements, such as clear recovery zones. BMPs that detain water, require frequent maintenance, or could cause flooding during a failure may not be practical in the DOT's limited ROW. Maintenance for BMPs within a DOT ROW that requires lane closure or other traffic control may have a higher cost compared to other locations in a traditional MS4. Passive controls with small footprints should be pursued for DOT applications.

DOTs Must Develop New Approaches to Allocate Stormwater Resources for Maximum Benefit

Stormwater program resources must be allocated where they will provide the most benefit for water quality. Program tasks, such as runoff characterization and illicit connection detection, are probably not nearly as beneficial for a DOT stormwater program as optimizing the configuration of the roadside element for water quality (passive BMPs) or implementing new pavement systems and source control measures. Scale is also an important issue for a DOT stormwater program. BMPs appropriate for a large urban freeway are most likely inappropriate for a rural two-lane road. Resource allocation and the development of program standards must be carefully studied since DOT program decisions will be implemented statewide. TMDLs are another emerging compliance issue; in some instances, it may be more effective for DOTs to comply with TMDLs through credit trading rather than with retrofit treatment controls. This is because DOTs have limited land area available for construction of treatment devices and usually contribute a relatively small constituent load, making their cost/mass to remove a potential pollutant relatively high.

Threats to water quality that DOTs can or should be effective in controlling include:

- Hydromodification [1]
- Particulates and metals in stormwater
- Sources under DOT control (e.g., deicers or traction aides)

Program mandates that may be modified to improve effectiveness for DOTs include:

- Public education
- Runoff characterization
- Illicit connection detection (cross-connections)

The Need for Applied Studies

Stormwater quality research has historically focused on traditional MS4s since they make up the majority of Phase I permittees and represent the vast majority of urban land area. DOT programs can benefit greatly from traditional MS4 research and self-auditing; however, they require focused studies to develop mitigation methods that are compatible with transportation infrastructure. DOT stormwater program research will usually be universally applicable to all DOT programs, demonstrating the value of technology transfer programs and pooled-fund studies. The scan team found that additional information and research is needed for DOT stormwater programs in the following areas:

- **Source control.** Because the highway infrastructure and ROW are essentially completed in the U.S., it may not be practical or economical to retrofit treatment controls into existing infrastructure. Preventing pollutants from coming into contact with stormwater via source control measures or eliminating the commercial use of pollutants should be given greater priority.
- **Pavement systems.** New pavement systems that infiltrate runoff or otherwise mitigate water quality from the roadway would appear to be an area that could provide a favorable cost-benefit application.
- **Trash control.** DOTs spend significant resources on trash control, yet receiving water problems persist and trash TMDLs are being developed nationwide. More effective controls and programs could reduce costs nationally.

The Need for Change

A universal finding of the scan team was that DOT stormwater programs and water quality from DOT facilities could benefit from changes to the permitting system. A TS4 NPDES permit that

[1] Changes to stormwater runoff (hydrology) caused by land use modifications, such as freeway and highway construction, are referred to as hydromodification. Hydromodification can cause channel erosion or sedimentation, as well as biologic impacts to stream systems. Impacts from erosion and sedimentation may be associated with impairment of beneficial uses and degradation of stream condition.

recognizes the unique aspects of a DOT stormwater program would assist DOTs in improving their program efficiency and effectiveness. Regulatory and organizational changes would also help reduce the resources DOTs are expending on legal actions and allow more meaningful advances in stormwater program effectiveness. Permit trends in some states (and at the federal level for construction sites) towards numeric limits underscore the need to develop DOT-specific approaches to improve runoff water quality.

DOTs can also be challenged by their own internal structures, which emphasize the historical goals of safety and mobility but are less accommodating to relatively new regulatory programs, such as stormwater quality. Communication with regulatory agencies may be improved if DOTs have a structure (i.e., personnel counterparts) similar to that of regulatory agencies and if the regulatory community acknowledges the DOT's unique mission. On their own initiative, many of the DOTs visited invited state regulators to participate in and provide input to this scan. Partnership between the regulatory and transportation agencies is a fundamental attribute of a high-performing DOT stormwater program.

Sprawl is a problem for transportation systems, creating demand for additional transportation infrastructure. Environmental regulations, implemented through local ordinances, can discourage brownfield development (due to cost and permitting issues) and indirectly trend toward reduced urban density (such as through stormwater infiltration requirements). Stormwater permitting should enhance sustainability and smart growth initiatives. Redevelopment of urban areas may require different approaches for stormwater quality than new development. Source control is one tool that may assist redevelopment projects to improve water quality economically. A higher value should be placed on land development that reduces the need for transportation infrastructure expansion.

The DOTs must provide the leadership in meeting stormwater program goals with innovation and BMPs that are compatible with their mission and physical and institutional constraints. The scan team finds that a national vision for DOT stormwater programs is needed:

- **Examine the benefits of a single TS4 permit for DOTs**. A TS4 permit could recognize the unique aspects of the DOT operation and mission and optimize regulatory requirements accordingly to assist in increasing program effectiveness.
- **Assess a TMDL trading program**. DOTs have the potential to be named in many TMDLs; however, due to the geographically dispersed nature of transportation facilities and their limited constituent load contribution, in many cases it may be more environmentally beneficial for DOT resources to apply as credits or pay in-lieu fees.
- **Support, utilize, and strengthen the pooled-fund research program.** DOTs are funding national applied research in stormwater programs with various academic institutions and consulting firms. Some of this research is repetitive and does not build on previous studies. Nearly all of the DOT stormwater program research is applicable to all DOTs; however, there is no structured, peer-reviewed clearinghouse to guide or disseminate research findings.

- **Invest in source control.** The primary source of stormwater runoff pollution for DOTs is vehicles. Little emphasis has been placed on reducing the constituent sources that contribute to stormwater pollution from vehicles. Examples are zinc from tires, copper from brake pads, and other metals and polycyclic aromatic hydrocarbons from vehicles and asphalt pavement manufacturing. Redesigning key vehicle components for stormwater source control could eliminate much of the pollution DOTs are tasked with cleaning up—at a greatly reduced cost to the public.
- **Streamline and improve communication.** DOTs are state agencies operating for the public benefit and are regulated (generally) by other state agencies through the NPDES permit system, which also operates for the public benefit. Environmental stewardship is a goal of both DOTs and state regulatory agencies. Improved communication and transfer of information between state agencies can replace cumbersome and expensive reporting and documentation requirements.
- **Integrate the stormwater program into the DOT organization.** DOT organizations are based on traditions that emphasize engineering and operations supporting a mission of safety and mobility. Stormwater programs may not be well integrated into the organization, since the regulatory requirements have primarily emerged over the previous few decades. Many DOTs can benefit from restructuring their organization to include the stormwater program as an integral part of their mission and through all phases of project delivery.

General Findings

The scan team developed some general findings that are not specifically associated with one of the four topic areas discussed in the following chapters. These general findings were developed through the team's observation of the commonalities of the high-performing stormwater programs and the common issues raised about program implementation.

Need for Environmental Stewardship

Each successful agency stormwater program has incorporated environmental stewardship into the organization's culture. A significant component of establishing environmental stewardship in the organization is support from the highest levels of management through both words and actions. Cultural change occurs when the agency stormwater program is not viewed as a regulatory requirement, but rather is embraced as an operational imperative. Agencies operating under this model have incorporated the stormwater program into all facets of the organization and place a high priority on ensuring that all agency actions protect surface and groundwater resources. As an example, most transportation agencies have this type of approach to safety in all aspects of their operations.

NCDOT exhibited many of the attributes of an agency that has a culture of environmental stewardship. Upper management at NCDOT is well versed in stormwater program requirements and understands its issues and challenges. There is also exceptional program transparency and

communication, both with regulatory agencies and the public. For example, the NCDOT Web site includes a dashboard that tracks various program metrics, such as the DOT's environmental compliance. This builds support for the program both internally and externally and allows for routine stakeholder input. NCDOT management is notified of any violations of the General Construction Permit, the North Carolina Sediment and Pollution Control Act, or NCDOT environmental policy. Environmental compliance is also part of every employee's performance rating. Similarly, contractors for NCDOT receive an environmental stewardship rating; poor ratings reduce contractor qualification scores for design-build projects.

Ultimately, a culture of environmental stewardship within the agency is one of the most important attributes for an effective and efficient stormwater program. Most other positive program attributes are dependent on the existence of this characteristic.

Need for a National Dialogue

Stormwater programs are being implemented through the NPDES permit system in each state. Transportation agencies as permittees are unique and operate infrastructure that is uniform, with generally consistent pollutant sources and BMP programs. A national dialogue is needed between DOTs to facilitate stormwater program improvements, and also between DOTS and regulatory authorities to refine the permitting process.

Based on discussions at the scan sites, transportation agencies are dedicating a significant portion of their resources to stormwater management. National costs can be reduced and program effectiveness can be improved through a continuous commitment to technology sharing and transfer between agencies. The effective dissemination of DOT-specific research information will improve performance uniformly while reducing duplication of effort. The scan team recommends that AASHTO establish a stormwater research database to serve as a clearinghouse for agency research. The database could possibly be managed by AASHTO under the Center for Environmental Excellence or work in collaboration with the ASCE BMP database.

The importance of a national dialogue relative to stormwater programs will become increasingly essential as more TMDLs are established with transportation agencies as named stakeholders. Transportation agency TMDL compliance strategies will likely have applicability for transfer to other agencies with a load allocation for the same constituent.

CHAPTER 3

TMDL Implementation and Compliance Strategies

TMDLs are prescribed in Section 303 of the CWA to ensure that jurisdictional waters that are impaired by one or more pollutants are brought into compliance with the standards set by states for the beneficial uses of those waters. Nationally, the number of water bodies listed as impaired doubled from 21,749 in 1998 to 43,446 in 2008[2]. According to the U.S. EPA[3], the leading causes of impairments are:

- Pathogens
- Mercury
- Metals
- Nutrients
- Sediment
- Polychlorinated biphenyls (PCBs)

Figure 3.1 illustrates the rate of increase in TMDL development by the states for impaired water bodies since about 1996. As more and better receiving water quality data becomes available, more water bodies will be listed as impaired, and subsequent TMDL development will become ever more important for DOT stormwater programs.

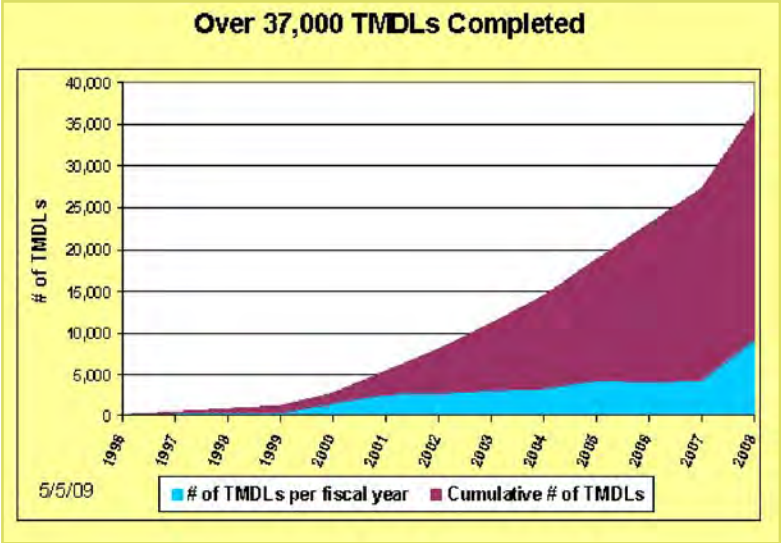


Figure 3.1 *TMDLs completed nationally by year*
Source: U.S. EPA, 2009

Not every DOT the scan team visited has been named as a stakeholder in a TMDL; however, given the rate of national TMDL listing growth, such an occurrence seems likely in the near term. For example, the State of Texas currently has 651 waters listed as impaired and 338 TMDLs are completed[4]; yet TxDOT is not named as a stakeholder for a completed TMDL. However, in North Carolina, 902 waters are listed as impaired and 44 TMDLs are completed, with the NCDOT as a named stakeholder in three of the TMDLs. Finally, a more dramatic example is California, where 937 water bodies are listed as impaired, 84 TMDLs are completed, and Caltrans is named as a

[2] Taylor, S. (2009), "Source Control as the Compliance End Game," In: Proceedings from 2009 StormCon, Anaheim, CA
[3] U.S. EPA, (2009a). See: http://iaspub.epa.gov/waters10/attains_nation_cy.control?p_report_Type=T
[4] Source: U.S. EPA

stakeholder in 52 of the completed TMDLs.

The scan team placed a high value on understanding the current and future impacts of TMDLs on DOTs and potential compliance strategies. The team focused on TMDL implementation strategies and, specifically, on water quality credit trading as a method for TMDL compliance.

TMDL Implementation

Several of the scan sites reported activity on TMDLs, and all agreed that TMDLs would command larger portions of their resources in the future. Table 3.1 provides an overview of the status of TMDLs at the sites visited.

Team Member	Total Number (Impairment)
NYSDOT	5 (including phosphorus, nitrogen, nitrogen/pathogens combined)
DDOT	350 (various)
NCDOT	3 (one for fecal coliform and two for biological integrity)
MSHA	Numerous (nutrients and sediment)
TxDOT	None
FDOT	Numerous (nutrients and fecal coliform are primary constituents/ indicators)

Table 3.1 *TMDLs with the DOT as a named stakeholder*

TMDL compliance and implementation strategies varied at the scan sites visited. It is clear that compliance and implementation plans are in the formative stages in most areas so there is not a great deal of implementation experience yet. A synopsis of the TMDL implementation approach for each scan site follows.

New York

In accordance with the current MS4 general permit, by 2013 the DOT must show a reduction of the listed pollutant loading within TMDL watersheds and show no net increase of loads to 303(d) list water bodies. Currently, 263 water bodies (160 of which receive drainage from state highways) are listed in the MS4 general permit. The DOT anticipates that compliance will be demonstrated through simple modeling to show that new projects do not increase constituent loading. Figure 3.2 shows the 303(d) listed water bodies in NYS.

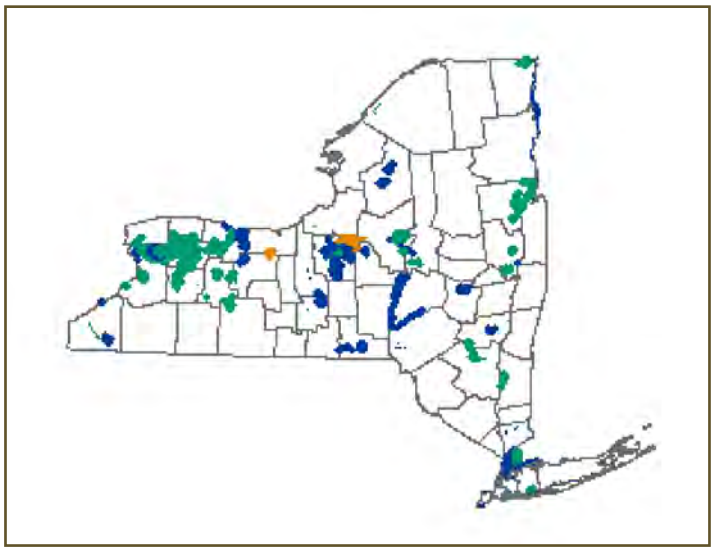


Figure 3.2 *303(d) listed water bodies in New York State*

The NYSDOT can also receive a WLA when it is a named stakeholder in a TMDL. Compliance with WLAs is generally achieved by mitigating stormwater impacts on construction projects and through a treatment BMP retrofit program. Currently NYSDOT is required to develop treatment BMP retrofit programs in five of the state's watersheds.

District of Columbia

Almost all of the receiving water bodies within the District of Columbia are impaired by at least one pollutant. This includes the Anacostia River, the Potomac River, and Rock Creek. Since the agencies in the District have one stormwater NPDES permit, DDOT is named in all TMDLs in the District. About 20% of the Anacostia River watershed is in the District of Columbia. TMDLs have been developed for bacteria, organics, and metals. There are more than 350 TMDLs (pollutant/water body combinations) for major water bodies and smaller tributaries in the District. The District of Columbia Department of the Environment (DDOE) develops the TMDLs and is currently working with the U.S. EPA's Chesapeake Bay Program for a Bay TMDL for nutrients and trash. Figure 3.3 shows a D.C. receiving water impaired by trash.

Figure 3.3 *D.C. receiving water impaired by trash*

The District of Columbia is atypical in that various agencies within the District government and the Water and Sewer Authority (WASA) are responsible for compliance with the NPDES MS4 permit issued by U.S. EPA Region 3, so the load allocation does not have to be divided among various jurisdictions. The District of Columbia government structure provides real-world insight to the benefits of a watershed approach, where a single authority has jurisdiction over all of the discharges to the receiving water and can more easily balance expenditures to achieve the required load reductions in the most economical and effective manner. For example, Blue Plains, the wastewater treatment plant in the District operated by WASA, can more economically reduce the load of some constituents as compared to the DOT, creating a very efficient quasi-credit trading system between the DC agencies.

Maryland

The Maryland State Highway Administration (MSHA) highway system traverses many impaired watersheds that are also tributary to highly visible impaired water bodies, such as the Chesapeake Bay. The Bay is a current priority for restoration. With the passage of Executive Order 13508 by President Obama on May 12, 2009, many initiatives and programs are under development to ensure compliance with current TMDLs and to develop a new Chesapeake Bay TMDL for nutrients and sediment. According to the 2008 Integrated Report of Surface Water Quality in

Maryland (Maryland Department of the Environment [MDE]), there are currently 412 Category 5 waters requiring TMDL development; 111 TMDLs have been approved by U.S. EPA. MSHA is named in a few of the latest TMDLs for sediment and nutrients.

The Stormwater Management Act of 2007 will play a significant role in TMDL compliance for MSHA projects with new impervious areas. The law implements Environmental Site Design (ESD) requirements. ESD requires management of the watershed (project) to predevelopment conditions for both water quality and discharge volume. This goal is accomplished using a combination of small-scale stormwater practices, site planning, and nonstructural practices. The state has put in place an enhanced review process for improvement projects that consists of three phases: concept, site, and final. SHA must implement ESD by May 4, 2010.

For projects that meet the 2007 ESD criteria, compliance will be presumptive for most TMDLs. For existing infrastructure, BMP retrofit may be required, depending on the phased load reduction requirements in the TMDL.

The MDE views the TMDL process as a planning tool rather than as a regulatory enforcement tool. The MDE recognizes that the precision of TMDL modeling is not, in many cases, appropriate for project-specific BMP implementation and load allocation. Rather, TMDLs are a method to ensure accountability in the performance of each discharger in the stormwater system. However, new MS4 permit renewals in Maryland require TMDL implementation plans, and MSHA anticipates that this requirement will be added to the next NPDES permit term. The current SHA Phase I permit expires in October 2010.

North Carolina

There are 809 pollutant/impaired water body combinations in North Carolina (see Figure 3.4). The state is unique for TMDL listings in that there is a category for biological integrity for receiving water impairment. The State Department of the Environment and Resources (DENR) develops the TMDLs. NCDOT, working as a partner in the TMDL process, recognizes the need for each stakeholder to bring data forward during TDML development to provide the best opportunity for developing a realistic TMDL goal and WLAs.

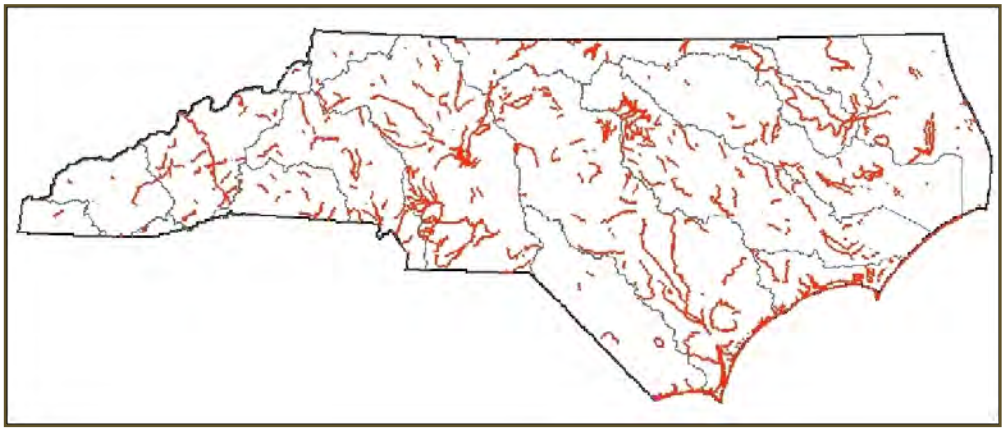


Figure 3.4 *Impaired waters in North Carolina*

NCDOT recognizes the need to take a leadership role in the TMDL development process to ensure a reasonable outcome for the DOT. NCDOT takes the approach that TMDL policy needs to be rooted in science. It is the responsibility of each stakeholder in the process to develop, manage, and distribute environmental data for education and outreach to the public and resource agencies. Some NCDOT education/outreach resources can be found at this Web site: http://www.ncdot.org/programs/environment/stormwater.

Some of the other elements that NCDOT believes are essential in the TMDL development process and ultimately must be incorporated into all NPDES permits include:

- Establish a clear, measurable pathway to TMDL compliance
- Define when specific language in the TMDL applies
- Ensure that compliance is directly tied to the WLA
- Ensure that there is a formalized process for identifying credits against the WLA
- Ensure that there is a quantifiable WLA compliance endpoint

The NCDOT NPDES permit requires the DOT to develop a TMDL assessment and monitoring plan, report monitoring data, prepare an implementation schedule, implement actions, and submit an annual report.

In North Carolina, the typical timeframe from 303(d) listing of a water body to an approved TMDL is from eight to 13 years. A third party can also develop a draft TMDL, with the state (DENR) finalizing and adopting it. The NCDOT believes that third-party TMDLs are very high quality from a technical standpoint.

In 2002, the U.S. EPA noted that NPDES sources must be included in the discharger's WLA; however, they do not have to be assigned a discrete load. The U.S. EPA also indicated its preference to have the WLA defined as narrowly as possible. The WLA and load allocation (for nonpoint sources) must be expressed in numeric form. However, effluent limits may be expressed in the form of BMPs, but in these cases should also include BMP performance monitoring.

According to NCDOT, some of the current and future challenges associated with TMDLs for DOTs are:

- Fair, reasonable, and proportionate TMDL implementation requirements
- The current lack of an appeal process for WLAs
- WLA credit using proprietary stormwater devices
- Treatment of comingled drainage (from several stakeholders) and WLA credit apportionment
- A potential increase in TMDL liability when NCDOT takes jurisdiction over private roads
- Undefined compliance (Impervious cover TMDLs are under development in North Carolina.

Impervious cover is an undefined proxy for biological integrity and may not be suitable for TMDL implementation.)

Dr. Bill Hunt of North Carolina State University (NCSU) is investigating an alternative to the maximum extent practicable (MEP) and U.S. EPA Gold Book criteria, the latter of which can be overprotective for some receiving waters. The suggested approach is to set water quality goals based on the ambient conditions in high-quality local streams. Toxicity goals can be set to meet the requirements of sensitive local species (e.g., mayflies) using an approach called the water quality ambient benthic index (WQABI). This is a practical approach to setting regulatory standards and addresses the problem of potentially over-conservative national standards. This type of approach may be a useful refinement to TMDL development. Figure 3.5 shows NCSU researchers gathering data to develop an ambient index for a stream in North Carolina.

Figure 3.5 *UNC researchers gather organisms for stream health assessment*

Texas

TxDOT actively monitors impaired water listings in the state and gathers data where the DOT may contribute to the receiving water impairment. Current causes of impairment in Texas are:

- Bacteria
- Dissolved oxygen
- Mercury
- PCBs
- pH
- Chloride
- Dioxin
- Sulfate
- Total dissolved solids
- Impaired fish community
- Impaired macrobenthic community
- Toxicity in water
- Toxicity in sediment
- Toxicity from lead, zinc, and aluminum

In total, there are 837 impaired water segments in the state; notable pollutant impairment absences include sediment, nutrients, turbidity, and copper. Water bodies are listed by comparing available in-stream monitoring data to U.S. EPA's *Quality Criteria for Water* (the Gold Book) standards. Currently, 302 TMDLs are under development by the state, 94 instances where the water quality standards are under review, and 441 cases where additional data are needed to determine if a TMDL for the water body is required.

The TMDL implementation plan is not created during the TMDL adoption process in Texas. To date, TxDOT has not been given a load allocation for any TMDL. The Texas Commission on Environmental Quality (TCEQ) does not view TxDOT as a primary contributor to any of the pollutants responsible for receiving water listings on the state 303(d) list.

TxDOT and UT have created an interactive map of the state's impaired streams (see Figure 3.6). The highest ranked COCs are pathogens and dissolved oxygen. Most TMDLs are for receiving waters located in east Texas. The Houston area also has pathogen TMDLs; this is probably due to the amount of receiving water monitoring that has been completed.

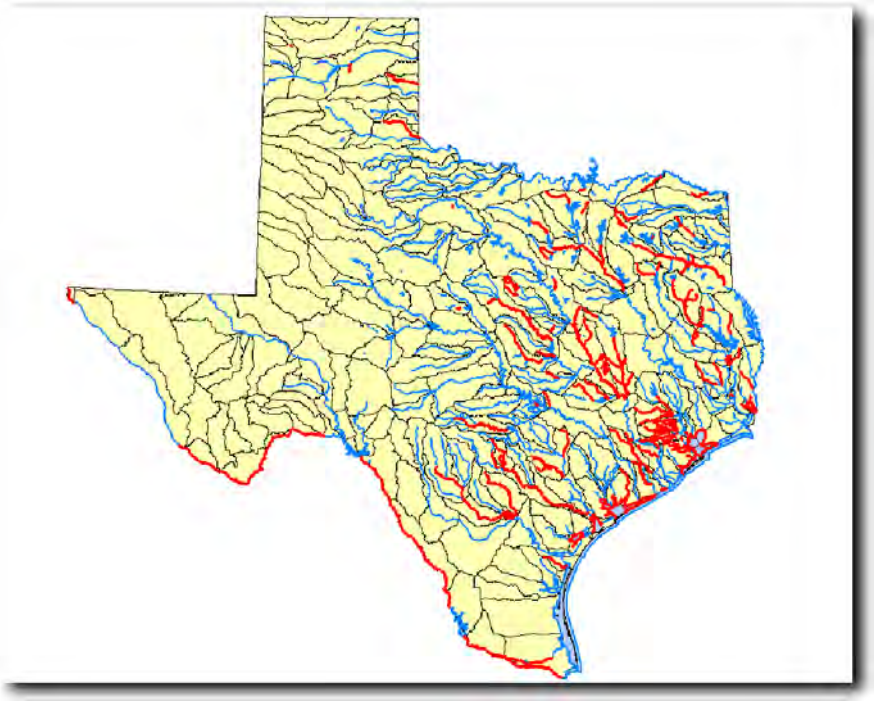


Figure 3.6 *Water bodies in Texas impaired by pathogens*

TxDOT is currently performing a research project that originated from 401 certification requirements for a bridge widening project. It is studying bacterial levels from highways, particularly from bridges, with the objective of identifying pathogen sources. Preliminary findings show that birds are a large pathogen source at bridges due to nesting. UT, on behalf of TxDOT, monitored the water upstream and downstream of a highway bridge to understand the contribution from nesting bids. The study found that when no birds are present (nesting),

the receiving water generally meets water quality standards upstream and downstream of the bridge. However, the project showed a substantial impact from birds when they are present (nesting), which can cause the receiving water to exceed sanitary standards. Changes to the bridge superstructure to eliminate nesting sites will be considered in this study. Figure 3.7 and Figure 3.8 show bird nests found on one of the two TxDOT bridge assessment sites.

Figure 3.7 *TxDOT bacteria assessment*

Figure 3.8 *Bird Nests*

Florida

An objective of FDOT and the FTE is to build the TMDL program to achieve TMDL compliance. TMDL compliance will be incorporated into current projects being delivered and will be completed under a retrofit-only program (if necessary). There is a no net increased loading requirement for the constituent of concern in areas where there is a TMDL in place, meaning that new impervious areas can have no net load of the pollutant.

The Florida Department of Environmental Protection (DEP) generates the 303(d) list with input from the waste management districts. There are two separate regulatory programs in Florida. Waste management districts issue permits for compliance with state water policy. The state environmental resource permit (ERP) program includes stormwater, wetland alteration, and wetland fill. Compliance with this policy is through application of controls to MEP. This criteria system presumes that, if the specified controls are used or installed, the criteria are satisfied and MEP is met.

The FDOT and the FTE hold monthly meetings with their internal NPDES coordinators to facilitate communication. They have also created a TMDL task force that employs a statewide consultant for TMDLs to coordinate the activities of each agency.

Florida has hundreds of water bodies on the 303d list, and TMDLs are a major issue for FDOT. The primary causes of impairment are phosphorus, fecal coliform, chlorophyll A, and nitrogen. A TMDL is developed through a stakeholder process, led by the DEP, typically through a Basin Management Action Plan (BMAP). A working group and a technical group guide the process in a collaborative manner. DEP develops the loading models, with input from the TMDL stakeholders.

TMDL implementation plans are self-implementing through general language in Phase II permits. When a TMDL is issued, an implementation plan is developed (through the BMAP process). For

areas under Phase I permit coverage, the DEP intends to insert permit language to make TMDLs self-implementing.

The TMDL program in Florida is emerging as a major issue, and it will require significant resources. The largest issue to face the TMDL program is the sheer number of stakeholders involved in all the various pollutant and water body impairment combinations. It is extremely difficult to assign responsibility for each of the loads, making solutions exceedingly complex. Developing consensus-based practical TMDL implementation plans will be very difficult to achieve. The DOT staff estimate that the TMDL program will begin to take a larger and larger portion of the DOT budget for TMDL program administration and the design, construction, operation, and maintenance of treatment controls to meet WLAs. Accordingly, FDOT will be developing a comprehensive approach to accommodate TMDL requirements.

Conclusions

The Scan Team has formulated several conclusions regarding TMDL implementation and compliance strategies for DOTs. DOTs do not have a broad base of experience in developing TMDLs or in participating in the development of implementation plans. DOTs stand to minimize costs associated with TMDL implementation if the following objectives are pursued.

Collaborative Approach

A collaborative approach for TMDL development and implementation with other stakeholders is highly recommended since many source and treatment reduction approaches will benefit from economies of scale, including shared costs for measures such as public education. Stormwater programs in general benefit from collaboration, sharing, and consensus building. It is not a field where proprietary development will be successful, since continual refinement and adaptation is necessary.

Participate Early

DOTs should participate early in the TMDL development process to avoid being assigned a WLA if the DOT is not a contributor of the pollutant and to ensure the allocations prescribed for the DOT are equitable. It is important to determine the level of participation, based largely on the WLA to be expected, since a DOT will most likely have many TMDL processes proceeding in parallel.

Provide Good Science

Some of the scan sites noted that the science behind TMDLs, particularly for WLAs, can be dubious, yet significant resources are expended based on these models. It is imperative that load modeling and WLAs are correct since reduction of a constituent from stormwater runoff becomes increasingly expensive as the concentration of the constituent in runoff becomes lower. Therefore, providing data that the DOT has collected early in the TMDL process is imperative. The researchers at the University of North Carolina at Charlotte (UNCC) noted that DOT-retrofit BMPs may be operating in a very high marginal cost removal range for constituents that do not have a direct source within the ROW.

Water Quality Credit Trading

Water quality credit trading for TMDL compliance was not being used at any of the scan sites visited. However, each of the scan sites working on TMDL issues indicated that some sort of credit trading program would be imperative to comply with TMDLs economically or, in some cases, to comply at all. DOTs have limited ROW to construct treatment controls for TMDL compliance. The DOT may have relatively low concentrations of the constituent of concern in its discharge, making removal costs relatively high. A credit trading program may ultimately be the most cost-effective method for a DOT to comply with TMDL requirements.

Two scan sites had some experience with credit trading programs for stormwater. A review of these programs is useful since a similar structure could be used for TMDL compliance.

Maryland

MSHA has aggressive standards for treatment control for new and widening highway projects, requiring that 100% of all new impervious areas and 20% of existing impervious surfaces be treated within the project limits. The latter number will increase to 50% with the implementation of new regulations in May 2010. One method to meet these requirements has been the allowance for the DOT to trade treatment credit (treated impervious surface) between watersheds. There is a 20% "charge" each time credit is withdrawn from the "bank" (stored treatment credit) used to offset treatment requirements for a project. Only MSHA is allowed to use this bank system; the MDE recognizes that the DOT faces ROW constraints in urban areas and allows the trading system to help the DOT manage compliance costs. There are maximum debit limits for any single project for which credit may be used, varying from two to five impervious acres. A water quality credit spreadsheet has been developed to serve as a tool for recording credits and debits to maintain an overall accounting system.

North Carolina

NCDOT is currently participating in the development of a credit trading system to comply with a nutrient TMDL for Jordan Lake. The program will be voluntary, but is being designed to allow TMDL stakeholders to meet water quality goals more efficiently. Highlights of the program include:

- The TMDL baseline sets nitrogen and phosphorus caps.
- Performance better than the baseline results in credit that can be sold.
- Agriculture is included as a WLA, as is urban stormwater and state and federal entities.
- The credit calculation, certification, reporting, and enforcement framework are under development.
- The program will allow for implementation using a phased approach.
- NCDOT potential credit trading partners include municipalities and the agricultural sector.

Conclusions

Transportation agencies may be named as stakeholders in TMDLs for constituents that are not generated within the ROW or are present at very low concentrations. This means that there are very limited options for constituent reduction (e.g., no source control options). An example is the TMDL for pathogens, the leading cause of impairment of water bodies in the U.S. Pathogens have few sources within the controlled-access environment of the highway. Highways may show high levels of bacteria indicators in runoff, but there is no documented correlation between the number of indicator organisms and pathogens in stormwater runoff [5]. Further, few BMPs that are effective in removing pathogens can be used in the highway environment. As a result, for a DOT named in a pathogen TMDL, compliance strategies are limited unless credit trading is available.

Credit trading may also be beneficial to help ensure that resources for environmental improvement are spent efficiently. For example, nitrogen is commonly found in highway runoff, albeit at relatively low levels (the mean value of Total Kjeldahl Nitrogen [TKN] in highway runoff in California is about 2.1 milligrams per liter [mg/L],[6]). Nitrogen is highly soluble and consequently difficult to remove from stormwater runoff.

A study in Atlantic Beach, FL, assessed strategies for meeting nutrient TMDL requirements. It found that the total cost for nitrogen removal at wastewater treatment plants (capital and O&M costs) ranged from $31 to $52 per kilogram, depending on the type of treatment plant [7]. Contrast these values with the estimated cost for removal of nitrogen from stormwater of from $12,000 to $16,500 per kilogram. Clearly, the cost advantage of treating the wastewater is exceptional, and ancillary environmental benefits, such as treating a perennial flow source instead of an episodic flow, may be desirable but harder to quantify. It was also interesting to note that, in this same study of the St. Johns River, municipal stormwater accounted for about 4% of the total nitrogen load to the receiving water.

The scan team also recognized that the listing of impaired water bodies could be driven by the availability of data rather than a comprehensive assessment of the receiving water health. The team further recognized that scale issues are important, but may not be understood prior to TMDL development. For impairments of which DOTs are only a minor or de minimus contributor, it would not appear an efficient expenditure of public resources to engage the DOT as a TMDL stakeholder.

It is clear that DOT facilities contribute to pollution in receiving waters and that they are obligated to control or reduce their pollutant discharges. However, DOTs have relatively consistent stormwater discharge water quality and uniform, diffuse systems; therefore, national guidelines

[5] Caltrans, (2002), "Management of Pathogens Associated with Stormwater Discharge," CTSW-RT-02-025.

[6] Caltrans, (2003), "Discharge Characterization Study Report," CTSW-RT-03-65.41.52.

[7] Kaluzniak D., R. Carper, and G. Misterly, (2007), "Meeting TMDL limits: A cost comparison for mid-sized communities," www.enviro-net.com, http://logicalecology.net/userfiles//Meeting%20TMDL%20limits.pdf

for pollutants of which DOTs are a significant source could be used to establish guidelines for DOTs as TMDL stakeholders. For some constituents, and for locations where DOT facilities make up a relatively small portion of the urbanized area, a standardized list of TMDL exclusions for DOTs would greatly reduce the resources otherwise expended in each state for DOTs working through the TMDL regulatory process. Further, facilitated approaches to developing site-specific objectives could also ensure that DOT program resources are expended efficiently.

CHAPTER 4

Source Control and Innovative Stormwater Best Management Practices

BMPs are the cornerstone of a DOT stormwater program and the single largest element influencing the quality of discharge leaving the DOT ROW. BMP research and development for stormwater applications has been underway with continuous support since the early 1980s, with steady technology improvement and advances during this time. Treatment BMPs remain modestly effective for most constituents but are land intensive. BMPs that have a relatively small footprint generally have increased maintenance requirements.

The cost for DOTs to implement BMPs in their infrastructure is significant. DOT systems are diffuse, meaning a BMP installation must be replicated over a wide area for comprehensive coverage, and BMPs must be consistent with the objective of user and DOT personnel safety, imposing BMP O&M restrictions.

The scan team recognized that the most economical and effective method for stormwater quality mitigation is by applying BMPs at the point of greatest control of the pollution. In most cases, for stormwater the point of greatest control is at the source of the constituent, not at the end of pipe (EOP). The scan team was interested in evaluating BMPs that represented an improvement in performance or that could be implemented at a reduced cost as compared to current industry-standard practices. Emerging BMPs and passive BMPs with low capital and O&M costs were reviewed at each of the scan sites, as were nonstructural, source control, and enhanced institutional controls. The results of the field investigation for this topic are divided into post-construction and construction BMPs for treatment controls and source controls.

Post-Construction BMPs

Some of the scan sites have collaborated with universities to fund ongoing BMP research programs. DOTs pursuing active BMP research are leaders in the development of highway-specific practices with potentially high value for technology transfer. Universities offer cutting-edge credentials, an objective approach, and moderate costs for DOTs to complete BMP research.

New York

NYSDOT has struggled with the specification of small footprint devices since most of these types of BMPs are proprietary. NYSDOT (similar to most DOTs) cannot specify a single proprietary device in construction documents and has developed a generic specification for stormwater quality vaults as a solution for one type of BMP. The current vault specification is based on flow; however, a more appropriate metric is constituent removal performance, and a specification for vaults based on constituent removal performance is currently under development.

Another issue that is difficult for DOTs is defining MEP for post-construction BMP implementation. NYSDOT has developed exceptions for the requirement of post-construction treatment BMPs for particular projects. The following are considerations that NYSDOT evaluates along with site-specific conditions and issues that may eliminate the treatment post-construction control from the project on an MEP basis:

- Pumping that is required to or from the BMP
- ROW acquisition that is required in sensitive areas
- "Large" vault structures, which are difficult to site and expensive both to construct and maintain
- ROW takings that change the environmental class of the project
- BMPs that exceed 5% of the total project cost
- BMPs that create significant social, economic, or environmental impacts
- Device maintenance that requires lane closure on high-volume highways
- Use of federal jurisdictional wetlands
- Encroachment into floodplains

Accepted post-construction stormwater management practices (all assumed to have 80% total suspended solids [TSS] and 40% phosphorus removal) at NYSDOT are:

- Stormwater ponds
- Wetlands (ponds/shallow wetlands)
- Infiltration (trenches, ponds, drywells)
- Filtering (sand filter, organic filter, bioretention)
- Open channels (dry swale, wet swale)

Nonproprietary BMPs are preferred over proprietary devices, which are only used in space-constrained areas and with approval from the NYS Department of Environmental Conservation (NYSDEC). Figure 4.1 and Figure 4.2 show a swale and a vault BMP in NYS, respectively.

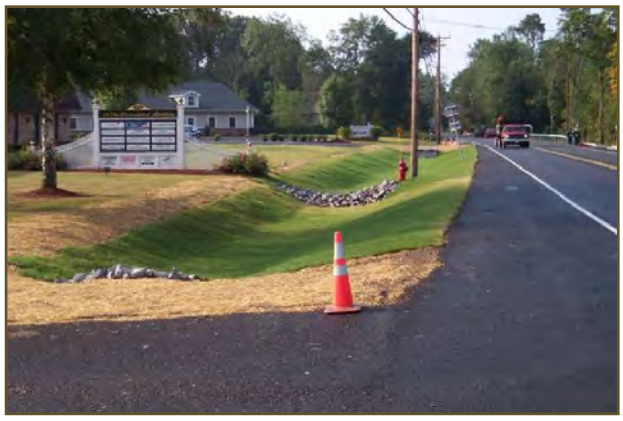


Figure 4.1 *Swale in New York State*

Figure 4.2 *Vault in New York State*

District of Columbia

DDOT uses minimum control requirements for stormwater management based on the *Stormwater Management Guidebook*, originally developed by the Center for Watershed Protection in Beltsville, Maryland.

BMPs that are approved for use by DDOT include:

- Bioretention
- Rain gardens
- Green roofs
- Infiltration systems
- Dry wells
- Planters
- Permeable pavers
- Hydrodynamic systems
- StormFilter®
- Stormceptor®
- Water quality inlets

Other BMPs may be used with specific DOT approval.

DDOT also uses an underground sand filter—the D.C. sand filter originated in the District, with a target of 85% TSS removal. The current regulatory trend in the District is for vegetated controls and on-site reuse of stormwater.

The major water quality problems in the District of Columbia are from stormwater runoff and CSOs; there are also some toxic legacy issues. The DC agencies have developed plans to show how each impaired water body can be restored, creating a long-term strategy for each water body/pollutant combination.

Trash control is an important issue in the District of Columbia. DDOT and DDOE have experimented with various trash control devices, including in-stream trash traps, drain inlet inserts, and inlet screens. In-stream controls used by DDOT include trash booms and screens. The Bandalong® Litter Trap developed in Australia has been installed on a pilot basis (see Figure 4.3).

Figure 4.3 *Bandalong® litter trap*

DDOT has been more aggressive with installing LID measures to manage road runoff. Retrofit projects have been

completed using bioretention, vegetated swales, strips, planter boxes, and rain gardens. These projects have an added benefit of reducing runoff volume, which is highly beneficial in areas tributary to the CSO. Figure 4.4 and Figure 4.5 show LID retrofits in the DC area.

Figure 4.4 *North Capitol and Irving Streets*

Figure 4.5 *Nebraska Avenue bioswale*

WASA developed a green build-out model to determine the impact on stormwater quality if green practices were implemented across the entire city. The model showed a 0% to 50% reduction in stormwater loading with a comprehensive retrofit. However, the model has not been field verified. A project is underway to verify the model in one of the District's sewersheds.

Maryland

The SHA uses the *2000 MDE Stormwater Design Manual* and follows unified sizing criteria for stormwater volume calculation. The water quality treatment volume is about 90% of average annual rainfall; the channel protection volume coincides with about a one-year storm.

Chapter 3 of the MDE manual specifies the accepted BMPs:

- Ponds
- Wetlands
- Infiltration
- Open channel practices
- Miscellaneous nonstructural controls

The new 2007 stormwater law implements ESD in the state, including the SHA, and requires management of the project drainage areas back to predevelopment conditions for water quality, time of concentration, and recharge volume. The ESD approach uses small-scale stormwater practices, site planning, and nonstructural practices.

There is a de-emphasis of traditional structural BMPs with the 2007 regulations. The SHA

anticipates that more ROW will be needed and construction costs will be higher with the implementation of the 2007 stormwater law. Figure 4.6 and Figure 4.7 show some stormwater BMPs along SHA facilities.

Figure 4.6 *Wet Pond*

Figure 4.7 *Wet Pond*

The SHA has also directed some BMP research studies. There is a chronic problem in Maryland with the failure of infiltration devices (Figure 4.8). The findings from a forensic research project found the primary problems contributing to failure included design (wrong soil), site conditions (excess sediment), and construction (wrong placement of geotextiles, etc.). The SHA has conducted effectiveness assessments for vegetated swales as shown in Figure 4.9.

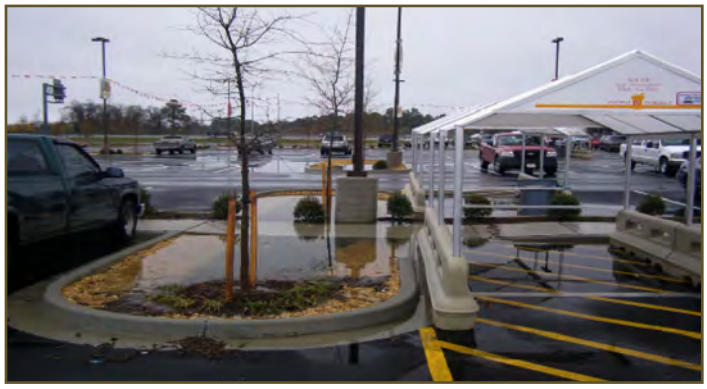


Figure 4.8 *Slow-draining infiltration area*

Figure 4.9 *Swale effectiveness research area*

North Carolina

North Carolina has a patchwork of regulations with special environmental protective rules and a stream corridor buffer rule. NCDOT is working with the North Carolina Department of Water Quality on a highway-specific MS4 permit for the 2010 permit renewal. The state has developed minimum standards for nutrient removal, which is driving the installation of certain types of BMPs. NCDOT has funded research to document nutrient loading rates from roadways as well as

nutrient removal effectiveness of BMPs used in highway projects.

The NCDOT NPDES permit requires the department to have a post-construction stormwater program that includes a BMP toolbox, a policy to implement treatment control retrofits, and a program to conduct BMP research. The publication *Stormwater Best Management Practices Toolbox* provides design guidance for seven structural BMPs that are approved for use statewide by the North Carolina DENR. NCDOT is currently assessing the addition of two BMPs, sand filtration and bioretention, to the approved toolbox.

NCDOT partnered with UNCC to assess the volume of runoff and peak flow as it is correlated to impervious surface coverage and nutrient export. The study found that secondary and tertiary roads should not be treated the same as major highways from a nutrient production standpoint because loading is substantially less than from major highways. Studies at UNCC completed for NCDOT are showing that there is clearly an irreducible minimum value for nitrogen from passive BMPs, which is about 1 mg/L.

The NCDOT funded a research study assessing the effectiveness of grass filter strips, shoulders, swales, and vehicular washing facilities. The first BMP studied was an infiltration swale, an under-drain in a grass swale. The research found that most water went right into the under-drain from the BMP forebay, short-circuiting the grass swale area and resulting in poor performance. These BMP assessments are used to improve design and construction techniques. The study confirmed that higher removals (load) are possible with higher influent concentration.

NCDOT is also assessing BMPs specifically for treating bridge deck runoff. The study is driven by a state legislative requirement for the DOT to perform 50 pilot studies for bridges over waterways. Water quality sampling, aquatic life assessments, and sediment sampling are being performed to determine the effect of bridge deck runoff on receiving waters. The cost of implementing effective controls on existing and new construction will be determined. Various types of treatment BMPs will be assessed as a part of the study, including sand filters, bioretention, dry detention, filter strips, infiltration basins, wetlands, swales, catch basin inserts, and LID systems.

Texas

TxDOT funds an approximate $20 million annual transportation research program conducted primarily by Texas public universities. There are about 150 active research projects at any time, and about 50 new projects start each year.

Research management committees guide all research under the TxDOT research program to ensure that the original study questions are answered and that the research can be applied in the field. The research committees are made up of TxDOT district engineers, division chiefs, the public transportation division chief, and the ROW division chief. Technical assistance panels are responsible for developing the research problem statements. TxDOT typically receives 200 to 300 proposed research project statements each year, which are then reduced to about 50 approved projects. Stormwater quality and sediment control are important parts of the TxDOT research program. Currently there are four to eight projects addressing stormwater research questions.

The objective of the research program is to provide TCEQ with information regarding stormwater environmental impacts and effectiveness information for highway stormwater BMPs.

To date, TxDOT has conducted research on the following BMPs:

- Sand filters
- Vegetated controls
- Small footprint devices
- Batch detention
- Permeable friction course overlays
- Bioretention

Some notable findings from the research program include the following.

Vegetated BMP Research

Length did not appear to correlate to constituent removal in the test area for a vegetated swale, which included lateral flow across vegetation to the longitudinal swale. The study found that the vegetated buffer strip leading to the swale, not the swale itself, did most of the removal from the highway runoff. The study found that an 8-meter width and slopes of up to 12% provided good constituent removal in the vegetated buffer strip area. The study also investigated the possibility of site soil contamination. It found that there is no issue with soil becoming contaminated from highway runoff over time; soil at the site was orders of magnitude less than hazardous threshold values. Figure 4.10 shows a sample test setup of highway vegetated strips.

Figure 4.10 *Sample test setup of highway vegetated strips*

Batch Detention

Batch detention is a very promising BMP for existing flood control facilities since the concept can be inexpensively retrofit to flood control basins. Batch detention automates the detention basin outlet to retain water with no outflow from the basin for a predetermined period. The early runoff into the basin (which tends to be more polluted) does not pass immediately through the basin, but it is retained for the longest time. The system is set up so the default position of the pond's outlet valve is closed. A float system notifies a programmable logic controller (PLC) to start a timer upon sensing runoff beginning to fill the basin. The PLC opens the outlet valve a predefined number of

hours after the start of direct runoff and the basin drains through a traditional orifice configuration. Figure 4.11 shows the batch detention automated valve and PLC.

Results of the batch detention study show that TSS went from 72 to 7 mg/L basin influent concentration (average); this far surpasses a conventional detention basin performance. Performance of the batch detention installation is comparable to that of a sand filter. The footprint of the device is smaller than that of a sand filter, has lower maintenance costs than many proprietary BMPs, is easily retrofit to an existing dry detention facility, and functions as a hazardous material trap. This is a promising technology for low-cost retrofit of existing dry detention ponds to improve their performance.

Figure 4.11 *Batch detention automated valve and PLC*

Permeable Friction Course

A permeable friction course (PFC) consists of an approximately 2-inch-thick permeable overlay placed over a conventional pavement section. Most of the fines are left out of a PFC mix to increase permeability in the section to about 22% porosity. Runoff moves laterally along the PFC/conventional asphaltic-concrete interface to the roadway shoulder. PFC benefits include a reduction in hydroplaning, vehicle spray, and road noise, improved braking and, most importantly, a significant improvement in runoff water quality. There are dramatic improvements (about 90% TSS reduction) with PFC in the particulate-associated pollutants from the roadway compared to runoff from a conventional dense graded asphalt section. This BMP is economical, performs well for highway constituents, and can be easily retrofit on an existing highway.

PFC is placed as a sacrificial wear layer and milled off for replacement at the end of its useful life. Milled PFC waste can be recycled into dense graded asphalt but cannot be reused for PFC. Figure 4.12 and Figure 4.13 show dense graded asphalt and PFC pavement sections, respectively, during a rainstorm.

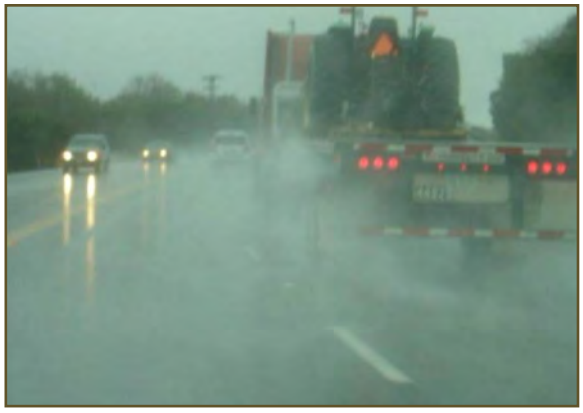


Figure 4.12 *Dense graded asphalt during a rainstorm*

Figure 4.13 *PFC asphalt during a rainstorm*

Nonproprietary Small Footprint Device

UT and Texas A&M University partnered to develop a small footprint treatment control BMP for TxDOT. The purpose of the device was to develop a tool for urban areas, to conserve surface use, and to avoid problems with the specification of proprietary products on public projects. A concrete vault was designed that ultimately achieved a 96% TSS removal rate (from a 200 mg/L influent TSS concentration). Figure 4.14 shows the vault design at the Texas Transportation Institute (TTI) test facility.

Florida

FDOT funds research at the UCF as a part of its post-construction stormwater research program. UCF's current projects include looking at stormwater harvesting (horizontal wells, in-pipe treatment) and porous pavements (longevity). The application of these BMPs to the highway environment remains in the planning stage; however, as the technology matures some elements may be incorporated into highway runoff control strategies.

Figure 4.14 *Nonproprietary stormwater vault prototype at TTI*

Stormwater Harvesting

Stormwater harvesting is emerging as a desirable BMP in some areas of the country. UCF has been researching applications of stormwater harvesting. Designs to date include storage volume in the BMP (pond) for water reuse, in addition to the treatment water quality volume (WQV) and flood control volume. The agronomic rate of application for water on vegetated areas in Florida is about 0.75 inches per week. Horizontal wells may also be used adjacent to stormwater ponds to capture water for irrigation use. This configuration helps to remove bacteria prior to applying stormwater for surface irrigation use. Figure 4.15 shows a stormwater harvesting cistern at UCF.

Figure 4.15 *Stormwater harvesting cistern at UCF*

Porous Pavement Studies

UCF has investigated the reuse of runoff stored in the rock layer below porous pavement sections and the infiltration rates of various pavement systems. Installation is a key parameter in the long-term performance of the pavement system. UCF has also had good results with the rejuvenation of clogged pavements using vacuum sweepers. Figure 4.16 shows a device developed at UCF for measuring the infiltration rate of permeable pavements.

Figure 4.16 *Device developed at UCF for measuring infiltration of permeable pavements*

Porous Asphalt

UCF research shows that porous asphalt binder tends to melt and move down into the pavement section. Once there, it can re-solidify, forming an impermeable layer and rendering the pavement section unusable for stormwater infiltration. This technology may need additional research in hot climates to develop a binder that will maintain its properties during periods of high temperatures.

Construction Period BMPs

This section provides an overview of innovative structural and nonstructural practices used during the construction period for highway projects.

New York

NYSDOT is in the process of constructing a segment of State Route (SR) 219 near Springville, NY. The segment is 4.2 miles long and consists of two lanes in each direction constructed with concrete pavement. The project has about 3 million cubic yards of export and a total construction value of about $120 million.

During excavation, significant groundwater was encountered, requiring dewatering before construction could continue. The groundwater flow, combined with the high silt/clay content of the site soils created compliance problems under the General Construction Permit with turbidity limits; conventional BMPs failed to control turbidity in the discharge. The DOT employed an active treatment system (ATS) to treat the discharge. Flow is collected in storage ponds, a

Figure 4.17 *SR 219 ATS*

coagulant is injected, and the discharge pumped through settling and filtration processes.

A private contractor operates the ATS system for NYSDOT on the SR 219 project using chitosan as the coagulant. The maximum pumping rate for the system is 500 gpm. The discharge standard is "no substantial visual contrast" with the receiving stream for turbidity. The system meets the discharge standard. The cost to date for ESC on the project (including operation of the ATS) is about $5 million. Figure 4.17 shows a portion of the SR 219 ATS system.

Maryland

MSHA is conducting research into the effectiveness of coagulants in an effort to reduce turbidity in construction site runoff from locations with high silt and clay content. The research program is structured as a literature search, followed by laboratory testing (of alum and polyacrylamide [PAM]), design of delivery methods, initial field trials, and implementation.

Preliminary results show that alum has good results over a range of storm events—up to 80% improvement compared to no chemical addition. PAM also has very good effectiveness—on par with alum. The SHA is continuing the study for health effects from the coagulants, looking at biology in the receiving creek and at the residual concentration in the discharge, and the maximum allowable threshold concentration for residual chemical.

The SHA has used ATS in the past on projects but found that the space and power required for these systems is excessive. The current research program is designed to find passive alternatives that will satisfy regulatory requirements.

North Carolina

NCDOT is conducting extensive testing relative to methods to reduce turbidity in runoff from construction sites since the state has many areas that have soils with high silt and clay content. NCDOT is contracting through the NCSU Soil Science Department for research into methods to reduce the turbidity of highway construction site runoff.

The current research focus is on the delivery mechanisms for PAM and hydraulically applied erosion control projects through a review of various products and of how they can most effectively be used for highway construction.

Research applications include:

- Wattles impregnated with PAM and wrapped rock measures (with PAM)
- Pit dewatering basins
- Hydraulically applied erosion control products
- PAM injection systems

The research questions postulated by NCSU: "What if PAM is used in conjunction with other erosion control practices? What are alternative delivery methods for PAM?"

When PAM is added to hydraulically applied mulches, researchers see reductions from 60 to 90%

compared to mulch with no PAM addition. Some other findings from field tests using PAM:

- PAM alone sprayed on bare soil usually reduces TSS by 50% compared to no application.
- The addition of PAM at 20 pounds per acre or more to straw mulch outperforms rolled erosion control blankets and hydromulch. (For optimum effectiveness, the contractor needs to broadcast the PAM in a liquid form with the mulch.)

Check-Dam Research Project

Fiber check dams were installed by NCSU researchers in a roadside ditch in lieu of a detention basin. PAM was applied (in powder form) to each of the fiber roll check dams that were installed at regular intervals in the earthen ditch. The results were compared to a ditch using rock check dams as a control. The standard rock check dam effluent was 4000 Nephelometric Turbidity Units (NTU); for the fiber roll system with PAM, the effluent was 19 NTU. PAM must be replenished when none visibly remains on the checks. The researchers found that it is very easy to monitor and maintain a fiber roll check dam system, and the cost per foot of ditch is very similar to rock (about $1.41 per foot). The researchers applied 3.5 ounces of dry granular PAM after 0.5 inch of rain to each fiber roll. This application rate maintained good performance without having excess PAM in the ditch effluent. The target dosing for PAM in stormwater runoff is about 1 mg/L for effective turbidity reduction. Figure 4.18 shows a rock check dam with PAM applied.

Figure 4.18 *Rock check dam with PAM visible*

Sediment Basin Research Project

The disadvantage of a conventional sediment basin is that dewatering occurs through the entire water column, resulting in about 50% sediment removal using traditional designs. An improved approach is to use a surface outlet. Up to 99% sediment removal can be achieved using a floating outlet (the design is patented), but turbidity can remain high in the effluent (2000 NTU) if the site soils have a high silt/clay content. To improve turbidity removal, PAM can be introduced in the sediment basin inlet, with particles flocculating and settling in the basin.

The NCSU researchers also addressed energy flux in sediment basins on reduced discrete particle settling with a porous baffle. Traditional baffle designs increase residence time in a pond, but they can also create areas of high flux. A better alternative is the use of a porous baffle, which helps to establish plug flow and reduces overall flux in the basin. NCSU uses a coir mat fabric on a support system as the baffle. A coir baffle lowers the average grain size leaving the sediment basin by

over half (from about 108 to 45 micrometers [µm]). Figure 4.19 shows a baffle system in a sedimentation basin on a NCDOT construction project.

Figure 4.19 *Sediment basin with baffles on a NCDOT project*

The NCSU researchers also reviewed advanced treatment systems. They found that a chitosan injection system could reach single digit turbidity values in the effluent, with treatment costs of 1 to 2 cents/gallon. Passive systems cannot routinely match the performance of an ATS.

NCSU has done extensive investigation into the toxicity of residual PAM in construction site effluent. PAM is known to be relatively nontoxic as measured by LD_{50} tests (The median lethal dose of a substance, or the amount required to kill 50% of a given test population). Acute toxicity is several orders of magnitude above chronic lethal levels. Chronic toxicity as measured by a *Ceriodaphnia* test shows mild toxicity at 3 to 5 mg/L, which is above the maximum expected dose for turbidity in practice, so residual toxicity should be below chronic levels. The NCSU researchers also note that sediment in the water column is much worse for aquatic life than any potential toxicity of PAM.

Texas

TTI tests erosion control products on behalf of TxDOT and others that participate in the FHWA Pooled Fund Project (TPF 5-015). The purpose of the testing is to develop an Approved Products List (APL) for erosion control products that meet minimum sediment retention and vegetation standards for use on TxDOT projects. The APL and test results are available on the TxDOT Web site (ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/bus/maintenance/approved_products_list_09.pdf).

TTI will begin testing sediment control products in 2010 to determine their effectiveness in reducing and/or controlling soil sediment. The tests will measure turbidity, ponding, and filtration. All approved erosion control products are tested for their index (physical) properties as well as for their erosion and/or channel protection performance. The TTI researchers have found that there is very little correlation between bench scale performance and performance of the product in the field. TTI continues to search for a bench testing protocol that will replicate (i.e., serve as a surrogate

Figure 4.20 *TTI rainfall simulator*

for) field performance in order to reduce the cost of product testing. Figure 4.20 shows the TTI tilting beds for testing erosion control products.

Nonstructural and Source Control Management Options

Nonstructural and source control management is an important emerging field for highway stormwater programs since source control will ultimately prove to be the most cost-effective approach for regulatory compliance with many constituents. Controlling a potential pollutant at the source, before it has an opportunity to come in contact with stormwater, is generally the point of greatest control, and as such will offer the greatest effectiveness at the lowest cost.

Most of the scan sites did not have formal initiatives or research programs for nonstructural and source controls. However, several projects for post-construction applications provide an example of this type of approach.

District of Columbia

Most of the DDOT roadways are not controlled access facilities as is the case with a conventional DOT. However, some of the source control measures DDOT is implementing may have applicability to state DOTs.

- **Increase tree canopy**. The District is currently working to increase tree canopy coverage from 35% to 40%. The increase in canopy area will reduce runoff and pollutant loads.
- **Reduce trash**. The District has noted that trash in the waterways comes from urban nonpoint sources. The District recently levied a fee on plastic bags; a portion of this fee will provide funding for receiving water trash cleanup projects. The Stormwater Management Division within DDOE, along with its partners (DDOT, Department of Public Works [DPW], and WASA), are working together to implement trash reduction strategies, such as end-of-pipe BMPs, catch basin retrofits, and installation of additional litter receptacles.

North Carolina

The NCDOT has an active Adopt-a-Highway program serving about 125,487 highway shoulder miles. The DOT estimates that this program saves about $6 million per year in litter pickup. The DOT has trained Adopt-a-Highway volunteers to recognize illegal dumping and illicit connections (IDIC) and report them to the DOT. This approach improves the IDIC program at little cost to the DOT. North Carolina also has a "no litter" license plate to support antilitter programs (see Figure 4.21). Finally, the DOT has a program to give away tarps to cover loads at local landfills and reduce fly-out litter from trucks on the highways.

Figure 4.21 *North Carolina no litter license plate*

Texas

TxDOT is investigating the use of compost on the roadside to enhance the moisture holding capacity for vegetation establishment and erosion control.

Nutrient export can be high from compost-amended soils. One study found that compost could germinate vegetation very quickly. Compost has a runoff coefficient that is about half that of bare soil. Compost also had lower TSS export by far compared to an untreated baseline soil plot and a hydromulch plot. The test plot used a 3-inch lift compost/wood mulch mixture. The bare soil plot had up to 80,000 mg/L of TSS export.

Florida

FDOT is funding a fertilizer wash-off study to assess the potential of fertilizer used in plant establishment on FDOT projects to cause pollution in receiving waters. The study is assessing the impact of application rate and its impact on the export of nutrients, with the goal of determining the optimum application rate for vegetation growth while minimizing export. Figure 4.22 shows a test bed used for the fertilizer wash-off study at the UCF.

Figure 4.22 *Test bed for fertilizer wash-off study*

Conclusions

The scan team found that significant progress is being made to improve the tools that DOTs use to comply with stormwater regulations. The scan team also believes that since DOT facilities are uniform and the quality of runoff from DOTs is fairly consistent nationally, that there is a substantial opportunity for BMP technology transfer from the research programs.

In addition to research that may be applicable for other agencies, the scan team developed several overarching conclusions relative to BMPs implementation and their application by DOTs:

- **Research programs help DOTs and regulators to collaborate to reach consensus.** DOT research programs, particularly in association with a university, provide a factual basis for discussion relative to the limits of technology, help in quantifying the DOT contribution to water quality problems, and provide a basis for capital and O&M costs projections.
- **There appears to be an exceptional potential for use of PAM on DOT construction sites to reduce turbidity in discharges.** Research at NCSU has shown several innovative ways to combine PAM with existing sediment control devices to significantly improve the quality of runoff at a very modest cost. However, research into the development of additional application methods and standardized specifications for DOTs should continue. In addition, training for the emerging practice should be developed since PAM must be applied in accordance with labeling instructions and state and U.S. EPA requirements to ensure the protection of water quality.
- **Source control has the potential to be the most effective approach for stormwater quality improvement with the lowest cost**. Treatment controls are and will remain a useful tool to assist DOTs in complying with water quality regulations. However, the scan

team found that there is a lack of emphasis on source control and source control applied research. Intervening at the point where a pollutant has the potential to come into contract with runoff is the point of greatest control for stormwater quality.

- **Highway stormwater research projects need to be synergistic rather than duplicative.** The scan team noted that there is duplication of effort in stormwater research, particularly in research of treatment controls. A coordinated national effort is needed, both as a repository for research completed, and to assist in managing a national stormwater research program; AASHTO should likely play a primary role in ensuring the synergy of these research projects. The challenges facing DOTs in the area of stormwater compliance are large, but the resources available to address them are limited.

CHAPTER 5

Agency Operation and Reporting Practices

Maintenance of treatment control BMPs and the development and implementation of institutional (for maintenance practices) BMPs are the primary elements of the DOT stormwater program. DOTs need standardized procedures to track treatment BMP maintenance requirements, and nonstructural or institutional BMPs can greatly enhance the DOT's source control program.

Each new generation of NDPES permits usually contains additional reporting requirements and place greater emphasis on PEA, adding to the stormwater program overhead that the DOT must support. Streamlining reporting allows more resources to be used for effort directly beneficial to the environment. Using advanced PEA approaches likewise can assist in eliminating program elements that are ineffective and focus resources on those with the highest demonstrated benefit.

Program-level procedures for operation and reporting practices are specific to the DOT since they reflect the agency structure and NPDES permit requirements. However, the principles demonstrated in the programs observed during the scan are applicable to and can be readily adopted by other DOTs.

Maintenance and Operations Practices

The scan team was interested in formalized methods for managing stormwater program assets, focusing on treatment BMPs and systems that included scheduling for maintenance BMPs. In addition, the scan team hoped to highlight institutional controls employed by DOTs that improved stormwater quality; examples of these types of practices are included in this section.

New York

The NYSDOT is developing tools for tracking the location and maintenance requirements of post-construction BMPs. The NYSDOT NPDES permit requires an inventory of post-construction BMPs installed since March 2003. The DOT has created a stormwater facility activation and inventory form that is used to enter the BMP into the database once the BMP is constructed. Once this database is implemented, each of the 11 NYSDOT regions will maintain a separate database; however, the main office can access each of the region databases.

The database contains project, practice, inspection, and maintenance information for each post-construction BMP, identified with a unique number. The database contains notes regarding the purpose and type of the BMP and the specific location coordinates (UTM [Universal Transverse Mercator] for geographic information system [GIS] use). The database can generate inspection forms and list the inspections performed by date. The maintenance information captures historical maintenance services (tasks), including quantities of materials used. The next step in the database development is to create maintenance and inspection schedules based on the historical

requirements for each site. Figure 5.1 shows a screenshot of the menu page for the NYSDOT BMP database.

The NYSDOT expects that this system will be effective because it will be integrated into the DOT's project delivery process. Information is entered in each DOT region as it is gathered for construction and maintenance. Real-time collection of information, coupled with the use of a structured database, will greatly streamline annual reporting on this aspect of the DOT's stormwater program.

Figure 5.1 *New York State DOT BMP maintenance tracking system*

District of Columbia

DDOT would like to develop an automated maintenance system for post-construction BMPs. The District is unique in that the private landowner may have responsibility for BMP maintenance via a covenant on the property in perpetuity. A DDOT water quality inspector reviews BMPs on private property to ensure that maintenance is completed. The District's long-term strategy is to integrate standard landscape maintenance with the maintenance required for BMPs.

Maryland

MSHA has developed several systems to track information related to stormwater compliance, including treatment BMPs and maintenance requirements. DOTs are generally required to have all storm drain systems mapped to comply with their NPDES permit. The SHA has completed mapping of its drainage system in a GIS database, which includes storm drains, outfalls, sub-watersheds, and attributes such as stormwater sampling data. Google Earth has a feature using .kmz (compressed keyhole markup language) files that can display GIS data on a Google Earth base map. The SHA is also using software called feature analyst that can recognize impervious surfaces.

Treatment control BMP tracking is done through the GIS database. There are two levels of performance rating recorded for each site, one for function and one for structural integrity. Sites are individually scored on a numeric scale.

The performance rating is used to assign priority for site maintenance and remediation. The numerical rating scale ranges from 1 though 6:

1 No action required

2 Routine maintenance needed

3 Major maintenance needed (one-third of sites fall into this category)

4 Retrofit design (the site needs a new design, and then reconstruction to become functional again, such as a site with a failed infiltration trench)

5 Immediate response needed (public safety issue)

6 Abandonment (facility is no longer maintainable)

The system includes a response table for tracking current maintenance activities.

MSHA also developed DBOM, an innovative project delivery and operation system for stormwater management BMPs. A DBOM contract is let for three years and is a method to deploy treatment controls in the field rapidly, while also ensuring their maintenance. A DBOM contract is extendable for three years; the SHA is currently allocating $1.8M annually to the program.

North Carolina

NCDOT also has a progressive BMP maintenance tracking system similar in structure to that used by MSHA. NCDOT records information about its stormwater treatment devices and posts it on its public Web site in the format of a performance dashboard (see Figure 5.2 for a screenshot). Public outreach is also a priority at NCDOT. One example is a compact disk available to the public that describes the DOTs highway beautification program. This transparency and effective communication about the stormwater program data and performance was pervasive for all aspects of the NCDOT program and undoubtedly assisted in providing both public and regulatory support.

The DOT has established metrics for performance and accountability of treatment BMPs:

- A maintenance condition assessment
- Established standards for O&M
- Level of service (LOS) ratings for:
  - Pavement
  - Shoulders
  - Ditches
  - Drainage
  - Traffic control devices
  - Rest areas
  - Roadside and post-construction BMPs (NCDOT maintains about 800 post-construction BMPs statewide.)

In addition, the assessment outcome is used as part of the review of the employee who is responsible for this infrastructure.

BMP assessment is completed annually through a field visit using the following rating system:

- A – Device is functioning
- B – Device needs minor maintenance but is working
- C – Device is functioning, but has moderate maintenance needs
- D – Device function is impaired and failure is imminent
- F – Device is nonfunctional

The LOS rating system for BMPs was originally put in place to maintain compliance with the DOT NPDES Permit, but it also helps with prioritization, accountability, and asset management.

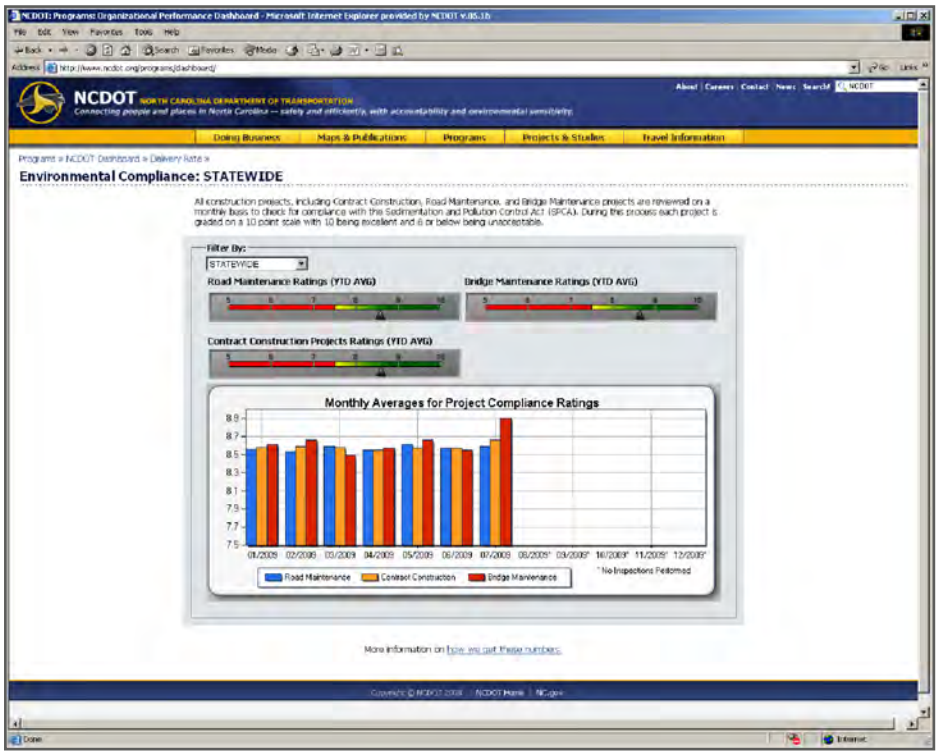


Figure 5.2 *NCDOT performance dashboard for environmental compliance*

The NCDOT is implementing a source control BMP through its turfgrass maintenance program. NCDOT maintains about 300,000 acres of turf, most of which is cool season grass, meaning that it is essentially perennial in North Carolina. Low-growing varieties are selected to reduce the number of annual mowing cycles. NCDOT does not apply maintenance fertilizer but does apply establishment fertilizer.

The DOT maintenance forces have developed a tool for use at the edge of pavement (see Figure 5.3) in and around guardrails to maintain sheet flow conditions off the pavement into the turf filter strip areas. This practice ensures that runoff will be more effectively treated by the roadside vegetation and reduces the possibility of rills or gullies forming where runoff concentrates.

Texas

TxDOT facility maintenance is relatively decentralized by district. However, statewide programs and specifications have been established for post-construction sediment control. The district environmental coordinator inspects the BMPs in the district routinely and following each stormwater runoff event to ensure that they are functional.

Figure 5.3 *NCDOT sheet flow maintenance tool*

TxDOT Environmental Division staff inspects maintenance facilities for general environmental compliance every two years; maintenance staff performs monthly inspections.

Annual environmental training occurs with selected maintenance section staff. These educational programs are used to keep maintenance section personnel knowledgeable of and current on environmental requirements.

Florida

FDOT has constructed a relatively extensive number of post-construction BMPs and has developed a system to track these assets. The data is recorded in a GIS database, including information on drainage structures, pipe connections, the receiving water, and the treatment device. FDOT has merged the DEP's data for TMDLs into the FDOT GIS system. When a new stormwater asset is added to the FDOT database, basic DEP data is automatically populated as well. Ultimately, FDOT hopes that the system will give it a better negotiating position when developing TMDL implementation plans, because it will be able to identify all of the existing stormwater mitigation measures in the watershed. Figure 5.4 shows a screenshot of FDOT's BMP tracking system.

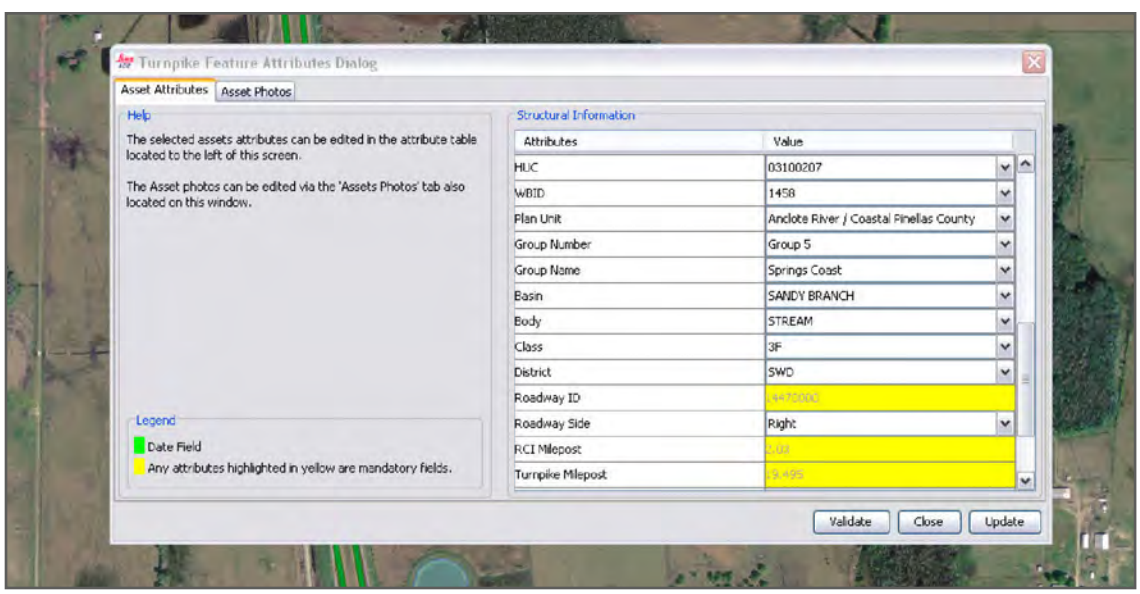


Figure 5.4 *FDOT's BMP tracking system*

Maintenance for newer BMP facilities is completed through maintenance contracts with private contractors. Maintenance of older BMPs is done either by FDOT or FTE personnel or through a private maintenance contract.

Stormwater ponds that are permitted through the DEP pursuant to NPDES requirements have not historically included documentation of maintenance, whereas ponds permitted under the ERP system for new construction do require documentation of maintenance and a formal maintenance plan.

Conclusions

The scan team found that agency BMP maintenance and operation tracking practices were tailored for the agency structure and that some locations had well-developed, well-documented systems, while others had yet to focus on this effort. Institutional or O&M BMPs for water quality improvement need additional research; there could likely be further advances in agency practices, such as the reduction in the application of deicers, fertilizers, and herbicides. Some of the other scan team conclusions relative to O&M of stormwater devices and the use of innovative institutional controls are:

- **Need for a documented BMP maintenance tracking system.** DOTs need a formalized system to track post-construction BMP locations, types, and BMP maintenance to ensure that the systems are functioning as designed, to optimize maintenance operations, and to log accurate maintenance costs. Both MSHA and NCDOT had well-established tracking programs. Program requests for maintenance funding of stormwater devices will receive better support if the requirements are well documented.
- **Need for communication of program results.** Transparency of operations and communication to the public and the regulatory community are recurring themes in this study. Transparency is important for gaining support for agency stormwater program activities. The example provided by the NCDOT through its performance dashboard on the Internet detailing the state of O&M of highway environmental systems is one approach for good communication.
- **Need for strategic planning.** Treatment BMPs that are supported by a detailed maintenance and operation-tracking plan can help the DOT when applying for environmental permits, responding to agency requests for information, providing technical input to 303(d) listing, or developing TMDL implementation plans.

Stormwater Program Reporting, Tracking, and Effectiveness Assessment

Stormwater program reporting, tracking, and effectiveness assessment targets the administrative portion of the agency responsibility. Obligations for reporting and tracking incidents and operations can consume a considerable amount of staff time. Methods to streamline the collection and reduction of data not only reduce staff overhead, but can also position the agency for greater

public support, supplying the data necessary to justify resource requests for the stormwater portion of the agency's budget.

A PEA is required by NPDES permits and is the cornerstone of the adaptive management process that supports the stormwater program implementation and the MEP metric. A PEA can be difficult to implement, as the benefit of some stormwater program elements is not easily measured. More research is needed to support DOTs in this area.

District of Columbia

Several of the scan sites visited are starting an Environmental Management System (EMS) in part to assist in integrating, tracking, and implementing the MS4 NPDES permits. DDOE will work with DDOT to implement the EMS for DDOT's commitments under the MS4 permit. In the District, the MS4 NPDES permit covers about two-thirds of the District's area, as shown in Figure 5.5. The CSO area is covered under the Blue Plains Permit, which is managed by WASA. Presently, DDOT submits road reconstruction plans to DDOE, which in turn reviews and approves the plan in accordance with stormwater regulations. The projects are recorded in a BMP database.

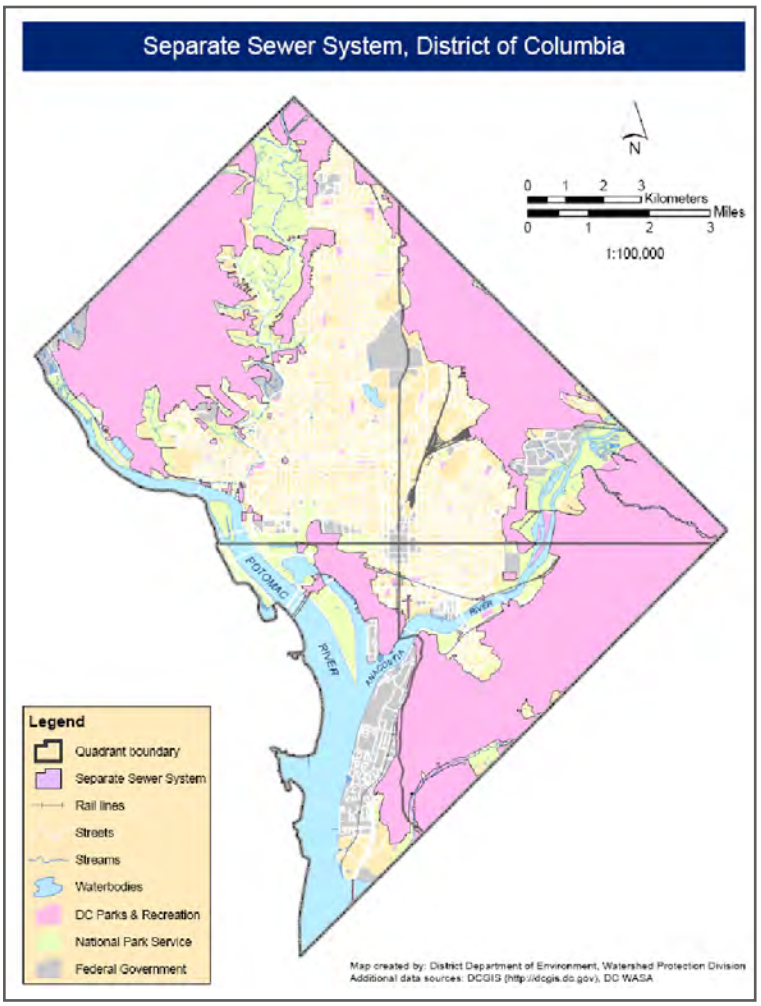


Figure 5.5 *Map of the DC separate sewer system area*

Maryland

The SHA has developed a business plan for the stormwater unit. The plan focuses on these key performance areas: impervious accounting, illicit connection, the stormwater management program, and ESC compliance. The plan requires quarterly reporting on these performance areas. The stormwater program also generates an annual report for each of the program's two phases.

The SHA has an advanced compliance tracking and reporting system for construction site compliance with the state ESC regulations. The program elements include:

- Construction inspection requirements
  - Daily contractor inspections
  - Weekly SHA inspections
  - Bi-weekly inspection for quality assurance (QA)
- Shutdown of projects not meeting requirements
- Compliance reporting

Independent QA inspectors have program oversight and rate each construction project using an objective scoring system during unannounced site visits. Seven inspectors are used statewide for oversight through the Office of Environmental Design, which is independent of the Office of Construction. The program goal is 100% compliance with all ESC regulations. The SHA has about 100 to 200 projects in process at any one time. The independent QA inspectors performed about 900 inspections in the previous quarter.

The SHA has also initiated efforts to improve collaboration between the state and contractors using these basic components: education, policy development, inspection, and research.

Education

The SHA has an SHA ESC Certification Training Program and developed an ESC field guide (hard stock pocket guide). Training for inspectors and contractors is required every three years. The course is one and a half days and includes instruction and a test on the following topics:

- Basic hydrology and hydraulics
- Erosion control
- Stabilization
- Nutrient management
- Control devices
- Review of specifications and protocols

- Preconstruction meeting
- Project closeout
- Design build issues
- Fines
- SHA organization structure

Policy Development

The SHA has introduced damages and incentives into the construction specifications for ESC compliance. The program allows incentives and damages to be prorated during the project (over quarterly and final assessments). If a project receives a D or F grade, the job is shut down and liquidated damages are applied. If a contractor receives two F ratings, the ESC certification issued by SHA is revoked for the site ESC manager and the construction superintendent; these personnel must be recertified before they can work on another SHA project. The SHA withdraws liquidated damages from the contract within 30 days to create a more immediate financial effect. Incentives are awarded if the contractor maintains a score of 85 or better during inspections over the life of the contract.

Inspection

If a construction contractor does not fix an inspection issue within 24 hours, they lose one point on the next report, per day, that the item is not resolved. (This is self-reported.) If they receive a C grade or lower, the next inspection will be within three days. Three problem items can result in immediate site noncompliance: lack of required permits and approvals, no demarcation of the limit of work or environmentally sensitive areas, or constructing the project out of sequence.

Research

The program includes a research component, currently focusing on the identification of new coagulants.

North Carolina

NCDOT has worked to streamline its compliance reporting and tracking for all aspects of its stormwater program. Consistent with the general practice of this DOT, reporting and tracking has been improved through exceptional communication and commitment to environmental stewardship at all levels of the organization. (See Figure 5.6 for the NCDOT environmental stewardship policy.)

The construction site compliance program includes monthly inspections, with a report and numerical grade for each site. The construction site inspections include DENR representatives to build relationships with the regulatory agency.

NCDOT management is notified of any violation of the General Construction Permit, the

North Carolina Sediment and Pollution Control Act, or NCDOT policy on a construction site. Environmental compliance is part of every NCDOT employee performance rating.

NCDOT has initiated a certification program for personnel working on NCDOT construction projects to improve permit compliance performance. Regulators assist in providing the training, which has four training levels (I, II, IIIA and IIIB).

The NCDOT program also has incentives and disincentives for construction site stormwater compliance similar to MSHA's program. The program is effective because it is applied without exception to each construction project. Violations can result in fines against the contractor.

Figure 5.6 *NCDOT environmental stewardship policy*

NCDOT has greatly simplified its annual report due to the large amount of information it provides over the course of each year and the level of participation the DENR representatives have in the implementation of the stormwater program. NCDOT's performance dashboard has previously been discussed (see page 5-3); this tool provides current information regarding the implementation of the agency's environmental program. DENR representatives routinely accompany NCDOT personnel on site inspections of both construction sites and post-construction BMP maintenance. This level of commitment to a continuous flow of information has reduced the need for NCDOT to report in detail each year, saving staff time for both the DOT and the DENR.

Texas

TxDOT is developing and implementing an EMS to improve environmental compliance (including stormwater regulation compliance) for road construction. The EMS is being initially implemented as a pilot program, which will extend through February 2010 in three TxDOT districts. TxDOT formulated its EMS approach based on a gap analysis of its program. Highlights from the TxDOT gap analysis included the following:

- TxDOT tended to form silos as an agency, with relatively poor communication between the various divisions, district offices, area offices, and field personnel.
- The agency has had a difficult time communicating environmental requirements in the plans, specifications, and estimates (PS&E), and it lacks procedures for assessing and

monitoring construction activities for environmental compliance.

- Interpretation and communication of environmental requirements is inconsistent through the organization and procedures were not well documented or were inconsistent.
- The agency has had an inadequate environmental training development process and an inadequate means of educating personnel about environmental requirements.

TxDOT is piloting a Stage Gate Checklist to document, track, and monitor environmental requirements throughout a project's development and delivery. To facilitate communication throughout the organization, the district environmental coordinator assembles the checklist of environmental requirements, and the Design Section must review the list to make sure that the requirements and specifications are placed in the PS&E. The contractor and TxDOT personnel then monitor the project's environmental requirements during construction and use an evaluation metric to document its environmental performance. The construction contractor superintendents are required to complete EMS awareness training and pass a proficiency exam.

The program includes a project in each pilot district with specific stormwater management criteria. Each of the projects includes additional contractor and TxDOT personnel stormwater training and more-frequent stormwater inspections.

TxDOT will be developing and implementing a statewide EMS by August 2010. The EMS pilot program will provide a basis for the statewide EMS process and procedures to manage environmental compliance for road construction.

TxDOT has an outfall inspection tracking database system to maintain outfall inspection data, as shown in Figure 5.7.

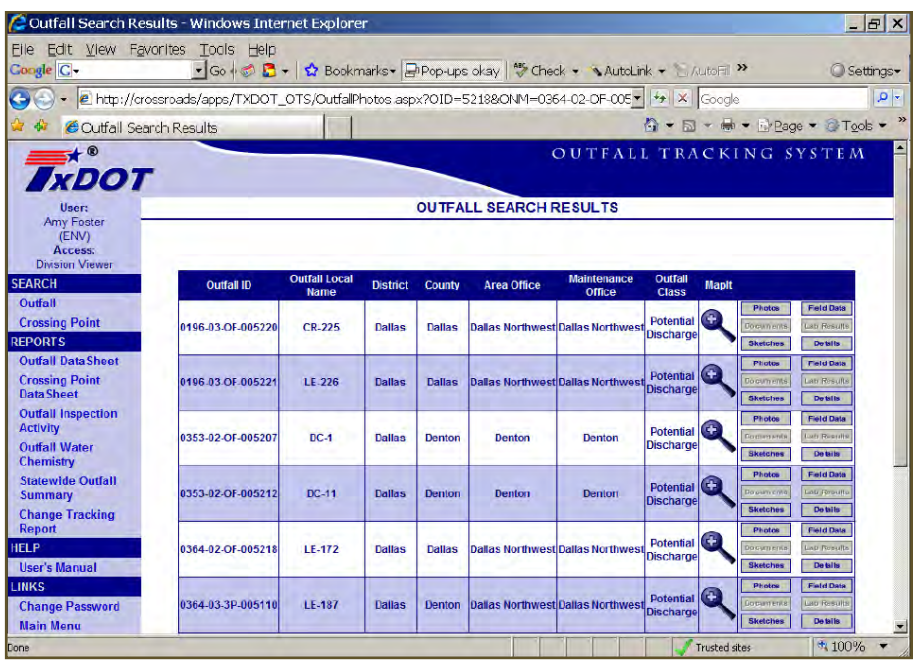


Figure 5.7 *TxDOT inspection database system*

Florida

FDOT is developing programs for construction site stormwater compliance tracking similar to the examples given for other scan sites. FDOT contracts out much of project design, a consultant develops the stormwater pollution prevention plan (SWPPP), and the contractor is responsible for implementing the plan. Construction engineering inspectors (CEIs) are independent of the contractor and are hired to inspect the site for compliance with stormwater regulations, providing a system of checks and balances.

Conclusions

The scan team found that program compliance tracking, reporting, and effectiveness assessment varied widely at the sites visited. Most sites have relatively sophisticated programs in specific program areas (such as construction) but have less-mature approaches for other program elements. PEA strategies are, in general, an area in which most DOTs could benefit from additional training and information. These strategies can be enhanced using technology transfer and national training materials. Some other specific conclusions are:

- **Program commitment**. It is clear that DOTs that have a commitment to the stormwater program and to those programs that have made stormwater compliance and environmental stewardship a part of the agency culture have more advanced reporting, incident tracking, and PEA programs. Top-down program commitment tends to strengthen the program in other areas, diminishing the need for extensive reporting. Examples of this type of approach are the NCDOT and MSHA programs.
- **Incentives and disincentives**. The carrot-and-stick idiom is applicable for progressive improvement through behavior change, particularly for contractors working on DOT construction projects. Incentive/disincentive programs were being used successfully at many of the scan locations. The most effective programs appeared to be those that used a balanced incentive and disincentive approach, rather than focusing on disincentives. Broad commitment throughout the organization is also a determining factor; for example, NCDOT includes environmental stewardship in its employee evaluations as well as in its contractor evaluations.
- **Communication.** A significant portion of stormwater program resources is expended on program reporting and tracking. The exchange of ideas between DOTs with the objective of streamlining reporting and tracking tasks would be beneficial.

CHAPTER 6

Regulatory Communication and Permitting

U.S. EPA has authorized most states to implement the NDPDES program, so most DOT stormwater programs are administered by the state environmental agency. The relationship between the regulatory authority and the DOT plays a decisive role in the success of the stormwater program. Positive and transparent working relationships enhance the effectiveness of the DOT stormwater program and reduce the expenditure of resources on administration and, potentially, litigation. The scan team was interested in finding program attributes, organizational structures, and reasoned approaches that supported a collaborative partnership with the regulatory agency, working toward the common goal of environmental stewardship.

The scan team was also interested in determining if DOTs were finding that CWA 401 certifications by the state in support of Section 404 permits were duplicative of the requirements, or were extending beyond the requirements, of the Section 402 DOT stormwater program. In general, the scan team concluded that it is important to identify 401 certification and 404 permit issues early in the project development process (ideally during the environmental document phase), but that there did not appear to be significant overlap or conflict between the administration of Section 401 and 402 activities at the sites visited.

Communication with Local and Federal Regulators

The relationship of the DOT with the regulatory agency is one of the most subjective program elements studied by the scan team, but also one of the most important. The scan team found that the goals of the DOT and the regulatory authority are consistent with respect to environmental protection, but that the DOT and resource agency structures and context for problem assessment differ. In practice, the differences between the agencies can dominate the relationship, creating inefficiencies that reduce the stormwater program's effectiveness and slow adaptive program advancement. The scan team sought to isolate and expose the behaviors of DOTs and regulatory agencies with truly collaborative relationships.

District of Columbia

The structure of the District of Columbia is unique in that the stakeholder agencies for stormwater all report to the mayor. The DDOE, WASA, DDOT, and DPW each have the same jurisdictional boundary. The relationship between the various D.C. agencies appears to be a distinct advantage for the District in developing coordinated approaches that emphasize the most economical and highest performing approach without the distraction of political boundaries and interagency cost-sharing negotiations.

Maryland

Maryland has some of the most aggressive stormwater quality mitigation requirements in the nation. The 2007 stormwater regulations place a very high stormwater mitigation standard on public works improvement projects with associated higher construction costs. Figure 6.1 shows some basic elements of the 2007 stormwater law, including the requirement for ESD.

Figure 6.1 *Elements of Maryland's 2007 stormwater law*

The SHA maintains a good working relationship with the MDE, which reviews all SHA administration plans. This reduces inconsistencies in policy application, since there is one central reviewer for SHA projects. SHA also funds positions at the MDE for stormwater review and wetland water body review. In general, DOTs report positive results and experiences from funding positions at the regulatory agency. The benefits are review by staff that has DOT experience and a reduced plan-check time.

During periods of high project volume, the SHA still experiences delay in MDE reviews. A potential solution to this problem is to provide consultant reviewers operating under MDE supervision. The SHA sets the project priorities for MDE reviews, which also provides a measure of flexibility to assist during periods of high work volume.

North Carolina

The high level of commitment to environmental stewardship practiced by NCDOT has been discussed previously in this report (see page 5-5). The level of communication between the NCDOT and its regulatory agencies operates at a partnership level. Another way NCDOT is working to maintain and improve communication with its regulatory agency is by providing funding for

Division of Water Quality staff, as well as at the U.S. EPA Region's office.

The NCDOT stormwater program has the stated objective of supporting the NCDOT mission statement. This statement includes a reference to environmental sensitivity, promoting a goal consistent with the state DENR mission: "Connecting people and places in North Carolina—safely and efficiently, with accountability and environmental sensitivity."

The state regulations in North Carolina allow the state DENR to apply regulations differently to linear (i.e., DOT) systems. It is also interesting to note that the fact sheet for the DOT permit acknowledges the difference between a traditional MS4 and the DOT, providing the potential for modifications to the permit as compared to the traditional MS4 model.

NCDOT creates a stormwater management plan for each capital improvement project. The plan is developed collaboratively with DENR, which recognizes that the DOT has limited ROW and consequently does not necessarily require land-intensive mitigation.

The NCDOT has the only Phase I permit at the scan sites visited that includes a retrofit program requirement. The NCDOT is required to complete 14 BMP retrofit projects per year. Figure 6.2 shows a planned retrofit project at an NCDOT facility. This permit provision is viewed, informally, as mitigation for instances where stormwater treatment cannot be accommodated in a new project. This is a very pragmatic approach to DOT permitting, demonstrating a balanced approach to development and natural resource protection.

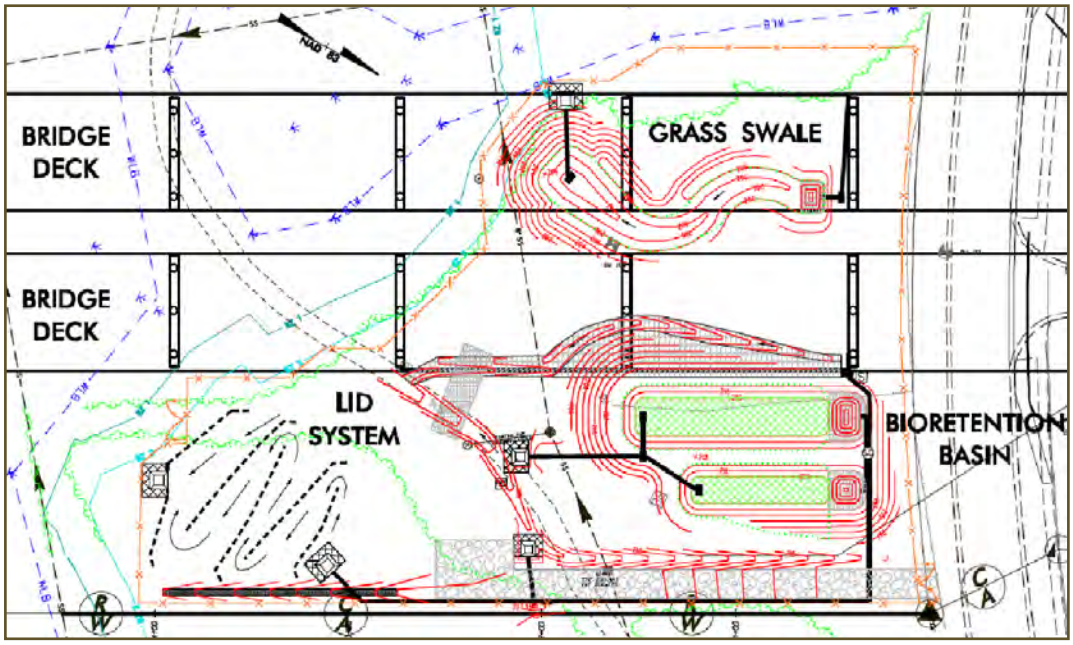


Figure 6.2 *NCDOT BMP retrofit schematic plan*

Texas

The sites the scan team visited use a variety of NPDES permitting approaches. DOTs can be covered under a single statewide individual NPDES permit, a statewide general NPDES permit (usually Phase II), or the DOT may be a co-permittee on Phase I and/or Phase II permits at various locations in the state. Scan sites in New York, the District of Columbia, North Carolina, and Maryland have coverage for activities under a single permit, which may be a general permit and under either Phase I or Phase II of the program. The scan sites at Texas and Florida do not have a single statewide MS4 permit. They are a co-permittee to a municipality in the Phase I or Phase II areas of the state, with co-permittee coverage by the TxDOT district. For TxDOT, 16 permits are under Phase I and 16 are under Phase II. (TxDOT is not a co-permittee for any of the Phase II permits; rather, these permits are individual).

The multiple permit model for DOTs results in a decentralized stormwater program, reflecting the unique requirements in each of the permit areas. For this approach to be successful, there must be good communication between each local DOT district and the corresponding state regulatory region (for Texas, it is with the TCEQ). There would also appear to be a duplication of staff resources (program staff being required in each DOT district), as well as permit administration (e.g., multiple annual reports to complete) with this type of permitting model. A multiple permit model also tends to result in DOT districts that are relatively autonomous, with the application of stormwater rules varying significantly from district to district.

One of the scan team's previously discussed findings is that DOT facilities are uniform, and the water quality issues associated with DOT infrastructure also tend to be uniform. The scan team discussed permitting approaches in light of the various models observed at the scan sites. It concluded that a single statewide permit for the DOT is the most effective permitting approach, allowing for economies of scale in the program administration, better and more consistent communication with the regulatory agency, and a more consistent approach to the state's water quality issues.

Conclusions

The scan team found that nationally, DOTs face similar regulatory issues: TMDL implementation, BMP retrofit, treatment control BMP integration, lack of source control tools and authority for implementation, and problems with construction site compliance. The findings section of this report has developed the concept that DOTs are unique: Their facilities are passive, uniform, and diffuse, and safety is the first priority. Each of these facts supports the need for DOTs to work on a national scale to help improve DOT stormwater program effectiveness. A more consistent national framework for both the DOT and the regulatory agency to work in would reduce conflict and promote partnerships. Specifically, the practice of placing a DOT program in a traditional MS4 permit framework should be reexamined. Other conclusions drawn by the team and attributes of high-performance programs observed during the scan for regulatory aspects of DOT stormwater programs include:

- **Watershed-based permits.** The U.S. EPA is moving toward a watershed-based permit system. National guidance needs to be formulated as to how a DOT would fit into this type of permitting approach. Multiple DOT permits within a state should be avoided when possible.
- **Standing meetings with regulatory agencies.** DOTs that hold standing meetings with the state or federal regulatory authority maintain generally good communication and improve the performance of the stormwater program.
- **Funded positions.** Regulatory agencies often have limited resources, so DOTs that provide funded positions at the regulatory agency receive improved service and more technically accurate reviews.
- **DOT structure.** DOTs that integrate the environmental and permit responsibilities create ownership throughout the organization for environmental compliance.
- **QA.** Some of the DOTs visited during the scan are in the process of developing and implementing an EMS, which facilitates interdisciplinary communication, providing a level of QA for the project's environmental elements throughout the project delivery process. Implementation of an EMS demonstrates DOT commitment to stormwater program elements to the regulatory agency.
- **Cost data.** The scan team found a general lack of detailed data on stormwater program costs. DOTs place themselves in a weak negotiating position to discuss the cost-benefit of stormwater program requirements if costs are unknown or if the basis for their cost computations are suspect.
- **Education and continuous process improvement (CPI).** Stormwater requirements and technology are rapidly evolving, making staff education necessary to have a functioning stormwater program and to improve the stormwater program. Education and improvement demonstrate the DOT's commitment to the regulatory agency and are fundamental to improving communication between the DOT and the regulator.
- **Provide consistent information**. Third parties and nongovernmental organizations regularly place pressure on regulatory agencies to increase program requirements and develop more prescriptive methods for program measurement (e.g., numeric effluent limits). These requirements and metrics may be developed more for ease of regulatory oversight than for providing the most effective assessment or environmental benefit for the resource expenditure. The DOT should provide its regulator with current information on program performance and process improvement initiatives, which the regulatory agency can provide to the third parties to help publicly champion the DOT program.

CHAPTER 7

Recommendations

The scan team found that a variety of challenges face DOTs in the implementation of their stormwater programs. State and federal regulations are the primary independent force shaping the priorities of DOT stormwater programs. Regulatory initiatives may be developed at any time, requiring the development of new programs with unknown schedules and costs. Existing water quality problems are a result of the built environment; but existing infrastructure does not usually accommodate water quality mitigation.

The scan developed recommendations that focus on improving the performance of DOT stormwater programs while reducing their implementation cost and budgetary uncertainty. The recommendations are divided into primary and secondary, or supporting, categories.

Primary Recommendations

TS4 Permit

Transportation agencies have been placed under the MS4 permitting structure largely for regulatory expediency. The scan team recognizes that there are benefits to developing a permit structure that accounts for the unique nature of transportation infrastructure, refining program areas that have limited benefit, and capitalizing on elements that DOTs can effectively implement. Stormwater NPDES permits are generally based on the six minimum measures developed by the U.S. EPA. The scan team believes that a model permit for transportation agencies would help states to customize their approach to DOT permitting.

As an initial step, the TS4 permit could be based on the current six minimum measures, with the following modifications:

- **Public Education and Outreach.** One area where DOTs can effectively reduce receiving water pollution through education is the reduction of litter. DOT anti-litter campaigns can be very successful; the TxDOT program's "Don't Mess with Texas" slogan is a notable example. Focusing DOT stormwater programs on this single element is appropriate, and developing a national framework of materials and suggested media approach and message would leverage the resources spent in each state to greater effect. DOTs could also partner with local municipalities on campaign efforts to be most effective. DOTs participating in the national program could have reduced reporting requirements on this portion of their program.
- **Public Participation and Involvement.** Primary DOT facilities are controlled access environments and pollution pathways are limited as compared to a traditional MS4. DOT resources in this area should be focused on sharing watershed information and education to reduce both the amount of trash entering waterways and the vehicle miles traveled.
- **Illicit Discharge Detection and Elimination (IDDE)**. DOT facilities are regularly

patrolled and maintained and many are fenced or have otherwise restricted access, with good surveillance of public dumping and very low potential for illegal connections to the DOT storm drain in nonurban areas. This program element should focus on staff training to assess and remediate illegally dumped materials and work with the state enforcement authority to improve policing of ROW.

- **Construction Site Runoff Control.** DOTs can be a significant contributor of pollution from construction sites if they are not managed properly. The scan team found that DOT stormwater construction programs could be sophisticated. However, the linear nature of DOT facilities, limited ROW area, and the primary need for public safety place unique constraints on DOT construction. Construction techniques, BMPs, slope stabilization, and post-construction controls can be different from those used with MS4 programs. Accordingly, this program element could be improved by including the construction site stormwater program in the TS4 permit, rather than requiring the DOT to enroll for coverage under a state general construction permit. A TS4 construction program element would ensure that designers, inspectors, and contractors receive specialized and relevant training for the techniques, products, and practices used in DOT construction.
- **Post-Construction Runoff Control.** A major portion of this report is dedicated to the discussion of post-construction BMPs and their application and efficacy in the highway environment. DOTs face exceptional challenges integrating BMPs into new highway construction and have even fewer options for existing roadways. A TS4 permit should capitalize on the known, constant runoff quality from DOT facilities by supporting pooled fund research into treatment controls that are viable for retrofit (e.g., PFC pavement) and source controls of national benefit (e.g., alternative deicers and approaches for particulates and metals reduction). For example, a national permit structure that supported the removal of copper from vehicle brake pads would be extremely effective from an environmental viewpoint as well as cost-effective. The DOT generally lacks control over some of the primary sources of pollution in the ROW; a TS4 permit could provide the regulatory basis to enable DOTs to work with vehicle manufacturers to reduce pollution sources from vehicles.

Pollution Prevention and Good Housekeeping Practices

The permit should emphasize pollution prevention and good housekeeping for DOTs. Advances in street-sweeping technology and application have the potential to further improve highway runoff water quality. The elimination of zinc-coated appurtenances and storm-drain conduit may be an important source control measure. As discussed previously, pollution prevention from vehicles is an important research priority. For example, trucks apply millions of pounds of grease to their hitch bearing plate each year, with most of this dropping off onto the highway. Most vehicles are required to pass an emissions test but are not required to fix fluid leaks. Tire wear and tire compound formulation have been the subjects of only modest investigation, and other potential pollutants, such as platinum and palladium (present in catalytic converters) have received virtually no investigation. A TS4 permit could focus highway stormwater program resources on

meaningful environmental priorities extracted from the vast database of highway runoff characterization studies.

National Guidance on TMDL Application for DOTs

DOTs cross most watersheds in a state, and the runoff from highways includes many of the constituents that are contributing to impairment of our nation's waters. As a result, DOTs are named as stakeholders and assigned a WLA for TMDLs. However, DOTs are not a source for some pollutants and DOT resources should not be expended participating in a TMDL process for which they have only a de minimus contribution. Chapter 3.0 lists the top six impairments identified by the U.S. EPA as pathogens, mercury, metals, nutrients, sediment, and PCBs. While diesel and car exhaust can be a very small source of mercury and nutrients, the highway ROW likely is not the source of receiving water impairment in most instances, or even a significant contributor of these pollutants. Similarly, operating highways are not a significant source of sediment, pathogens, or PCBs. National guidance should be established that defines the DOT role in TMDLs for these and other similar pollutants to reduce DOT resource expenditures in the TMDL development and compliance process. Accordingly, DOT responsibility would be necessary for pollutants such as metals. The flaw in the current application of TMDL regulations lies in the expectation that there must be some reduction from all dischargers of the constituent of concern, regardless of the cost and technical feasibility.

The Watershed Approach—Revisited

The U.S. EPA describes the foundation of the watershed approach as partnerships, with a geographic focus and using sound management techniques. The U.S. EPA also notes that the watershed approach makes good sense from a financial perspective, since it can reduce duplication of efforts and conflicting actions. The watershed approach is also an important element in determining the most cost-effective way to improve receiving water quality. Unfortunately, there are various definitions of the watershed approach; a first step will be to develop a common working definition of this concept. NPDES stormwater programs have been in place since the mid-1990s for most DOTs. Basic program elements have been established, and most of the lowest cost and highest return management techniques have been implemented. As permit requirements are ratcheted down and TMDL implementation plans are created, the disparity between each point source discharger's constituent removal costs will be increasingly important and apparent.

The most effective location to expend public resources should be investigated when attempting to meet a pollutant reduction target. In some cases, the cost per mass (or other indicator) to reduce a pollutant within the highway ROW will be orders of magnitude higher than at another location that is the best point of control. A watershed approach that allows credit trading would reduce costs for DOTs and bring environmental improvement more rapidly. The scan team recommends investigation into credit trading regulations that allow DOTs to focus on those constituents with available cost-effective controls and purchase or trade credits for pollutants that are comparatively costly for the DOT to mitigate.

Environmental Stewardship

A strength of DOT agencies is their people, who are highly skilled, specially trained, and oriented to solving technical problems. When environmental stewardship is part of the agency culture, protection of the environment becomes the benefactor of the highest levels of innovation and integration. NCDOT was an example of a DOT that has included environmental stewardship as a core agency value. The scan team isolated some of NCDOT's practices as attributes for other DOTs to assess:

- **Commitment from the top.** Commitment to implementing the stormwater program must come from the highest level of the agency, demonstrated with words and actions. Environmental stewardship must become a core agency value.
- **Accountability.** Accountability must be built into the system of check and balances to ensure that stormwater program requirements are fully implemented. Implementation of an EMS system can assist in this regard. Accountability requirements must include DOT employees and contractors.
- **Communication and transparency.** Good internal and external communication about the agency's goals and performance in meeting those goals is essential. Information about the stormwater program must be transparent—both easily available and comprehendible.

Other Recommendations

The scan team developed other recommendations supporting the primary recommendations discussed above. These recommendations will help improve the effectiveness of all aspects of the agency's stormwater program and help reduce implementation costs in the long term.

- **Annual AASHTO Stormwater Conference.** DOT stormwater programs can benefit from collaboration and technology transfer. Providing forums for staff to discuss implementation challenges and solutions is an effective way to reduce program costs and boost implementation effectiveness.
- **Integration of program responsibility.** Placing responsibility for stormwater program compliance with various divisions within the agency helps to create ownership and stewardship for the requirements as compared with tasking a single division to police the remainder of the agency and enforce compliance.
- **Pooling of fund studies.** One of this scan's findings was the similarity of DOT facilities and associated water quality issues on a national scale. The use of pooled fund studies to assess pressing areas of stormwater research will allow DOTs to leverage resources and reduce the duplication of research. More pooled-fund studies are recommended, and a central repository of catalogued highway stormwater research is needed.
- **Collecting accurate cost data.** DOTs do a relatively poor job of tracking stormwater program costs. The lack of cost data makes it difficult to assess program implementation

options and demonstrate the impact of regulatory actions on agency operations.

- **Researching source control**. DOTs should fund additional research into source control strategies. The scan team found that treatment controls are costly to DBOM. Reducing the source of pollutants within the ROW will ultimately be more effective and less costly than pursuing an approach that emphasizes treatment controls. The team recommends a TRB initiative in source control research.

CHAPTER 8

Planned Implementation Activities

Implementation Strategy

The team is committed to implementing the findings of this scan. The national dialogue on DOT stormwater programs remains one of the most important issues today. Many important programs, strategies, and BMPs were identified in the scan that would be of benefit if implemented at other DOTs. The team plans to initiate implementation activities such as the following immediately upon completion of this scan report:

- Publication of articles in journals and other industry-related publications, such as *ASCE Magazine, Stormwater Solutions,* and *APWA Reporter*
- Presentations at AASHTO committees, TRB sessions, ASCE, and other conferences
- Use of the project PowerPoint® developed for the scan trip by the scan team members for in-house DOT presentations and presentation to local transportation organizations
- Integration of the team's findings into other association and industry groups, such as the AASHTO Center for Excellence
- Outreach with the assistance of the FHWA and U.S. EPA

The above are general options the team will use as opportunities arise to disseminate the study information. Specific activities that will be completed, along with target dates, are provided in the following section.

Implementation Activities

The scan team has developed a roster of specific implementation activities to publicize the information from the scan. Each activity, a description, and a target completion date listed in chronological order are:

- **Technical paper presentation at the TRB Annual Meeting**. The scan summary report was used as the basis of a technical paper and has been accepted for the TRB Annual Meeting as an oral presentation. The TRB is one of six major divisions of the National Research Council—a private, nonprofit institution that is the principal operating agency of the National Academies in providing services to the government, the public, and the scientific and engineering communities.

  Target date: January 2010

- **Webcast through the Center for Transportation and the Environment (CTE) at NCSU, in cooperation with the Federal Highway Administration.** CTE is available to assist in the production of a webcast dedicated to the scan.

Target date: March 2010

- **AASHTO Annual Stormwater Conference**. AASHTO sponsored the first Stormwater conference in June 2008 in San Diego, CA. The conference convenes stormwater practitioners from each of the DOTs nationally in a forum designed to improve performance of DOT NPDES programs. The scan team recommends (with support from FHWA) that the 2010 Stormwater Conference, tentatively scheduled for April, focus on the findings of this scan and the further development and implementation of the findings.

  Target date: April 2010

- **NCHRP proposal development**. The NCHRP conducts research relative to highway planning, design, construction, operation, and maintenance nationwide. The NCHRP program is operated by the TRB. Potential research topics are provided in Chapter 7.0. They could include DOT NPDES permitting, pollutant source control, and national guidance on TMDLs for DOTs. The NCHRP proposal can also take the form of another domestic scan or an international scan.

  Target date: July 2010

- **Technical paper presentation at the National Hydraulics Engineering Conference.** The 2010 National Hydraulics Engineering Conference (NHEC) will be held near historic Park City, Utah, at the Canyons Resort Grand Summit Hotel from Tuesday, August 31, through Friday, September 3, 2010. The conference is being sponsored by the FHWA, Utah Department of Transportation, and AASHTO.

  Target date: August 2010

- **Technical paper presentation at StormCon.** StormCon is a national conference targeted to stormwater quality practitioners. An abstract has been submitted for the 2010 conference, which will be held in San Antonio Texas.

  Target date: August, 2010

- **Updates to existing National Highway Institute (NHI) Training Courses.** NHI is an organization within the FHWA that helps improve the performance of the transportation

industry through training. The training course options are instructor-led, Web conference, or Web-based training. Currently there are NHI water quality courses on the following topics:

- **Design and Implementation of Erosion and Sediment Control—NHI Course #142054.** This NHI course was developed as a joint effort between FHWA and the U.S. EPA Office of Water. It provides education and training on planning, design, implementation, enforcement, inspection, and maintenance strategies to control erosion and sediment on highway construction projects, as well as to ensure that regulatory issues are addressed accurately and uniformly. This course will be updated to reflect the new Construction and Development Industry Effluent Guidelines and reflect information and technologies gathered from the recent stormwater scan tour.

- **Water Quality Management of Highway Runoff—NHI Course #142047.** This NHI course was developed with the U.S. EPA Office of Water and provides an overview of the basic water quality parameters and processes, along with the requirements of and guidance on BMPs the transportation community can use in mitigating highway runoff impacts and protecting water quality. This course shares approaches and technologies for the water quality management of highway runoff, including the effective maintenance, inspection, and evaluation of BMPs. This course will also be updated to reflect information and new technology gained from the stormwater scan tour.

  Target date: October 2010

Plan/Process for Implementation

The implementation activities are a good tool for disseminating the information developed from the scan. The plan/process for implementation describes specific mechanisms for applying the team's recommendations for DOT operations. The team recognizes that the recommendations developed from the scan will be implemented adaptively, but each recommendation should be pursued to realize the full benefit of the resources invested in the scan program.

TS4 Model Permit

Investigate the feasibility and benefit of developing a model permit for transportation agencies. The states could use a model permit to help focus DOT NPDES programs on areas that will have the most beneficial environmental impact and refine the elements of traditional MS4 NPDES programs that have historically not been as beneficial for a transportation agency. The Spring 2010 AASHTO Stormwater Conference is the appropriate forum to initiate discussion on this topic. Breakout sessions and speakers from the FHWA, U.S. EPA, DOTs, and private industry can help frame the discussion. Alternatively, the AASHTO Standing Committee on the Environment (SCOE) or the Standing Committee on Research (SCOR) could develop a panel to investigate this topic. The scan chairs will lead this effort.

National Guidance on TMDL Application for DOTs

DOTs cross most watersheds in a state, and the runoff from highways includes many of the

constituents that are contributing to impairment of our nations waters. As a result, DOTs are named as stakeholders and assigned a WLA for many TMDLs. However, DOTs are not a source for some pollutants and DOT resources should not be expended participating in a TMDL process for which they have only made a de minimus contribution. The implementation plan for this recommendation is identical to that suggested for the TS4 Model Permit.

The Watershed Approach

A watershed approach that allows credit trading would reduce costs for DOTs and bring environmental improvement more rapidly. The scan team recommends investigation into credit trading or stormwater banking options that allow DOTs to focus on those constituents with available cost-effective controls and purchase or trade credits for pollutants that are comparatively costly for the DOT to mitigate. The FHWA and the U.S. Geological Survey (USGS) are cooperating on a national project to evaluate the existing highway stormwater runoff model and update the model using new information and software. This work will incorporate the existing model in a new software platform and provide information on the probability distributions of:

- Precipitation characteristics
- Highway-runoff-volumes
- Highway-runoff concentrations
- Upstream flow
- Upstream receiving-water concentrations
- Structural BMP performance

This information is used to estimate the probability of concentration and loads in receiving waters downstream of the highway outfall; it will also estimate the probability of the outfall exceeding water quality standards. The model is in preparation. Information on this project can be found at http://ma.water.usgs.gov/fhwa/, along with the 1990 FHWA Pollutant Loadings Model for Highway Stormwater Runoff. The information from this study could be used to further the objectives of a watershed approach for DOTs.

Environmental Stewardship

Environmental stewardship must be made part of the transportation agency culture. The scan team has made specific recommendations to integrate stewardship into an organization. The implementation plan for this recommendation is through the AASHTO Stormwater Conference to be held in April 2010.

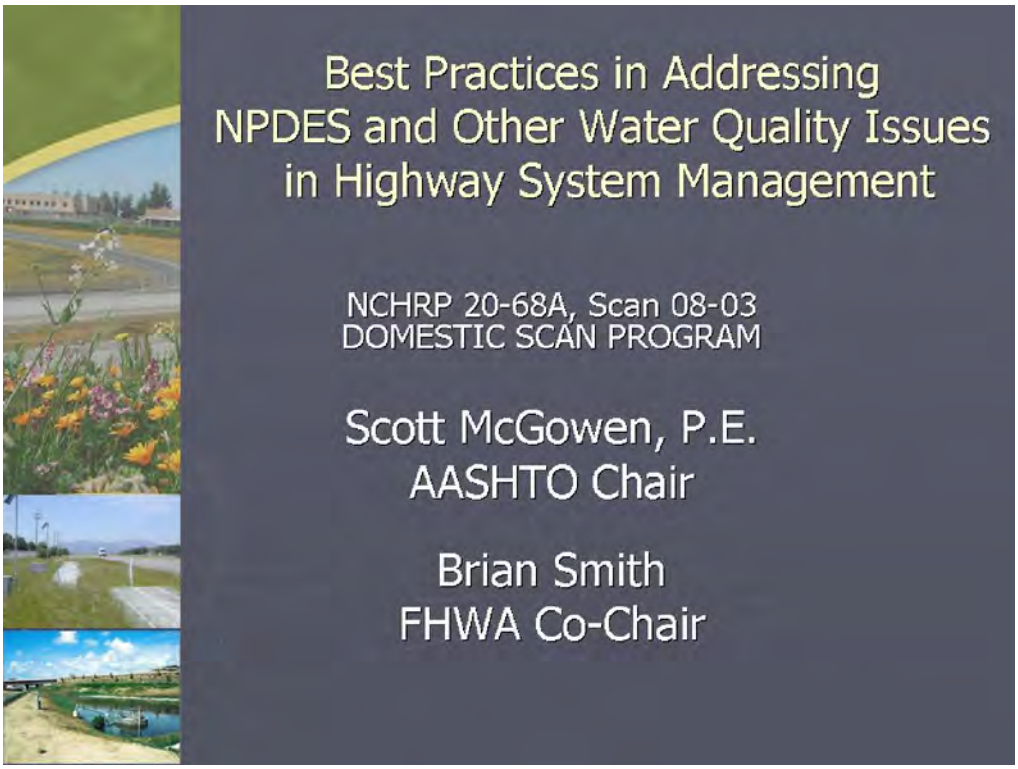
Support Activities

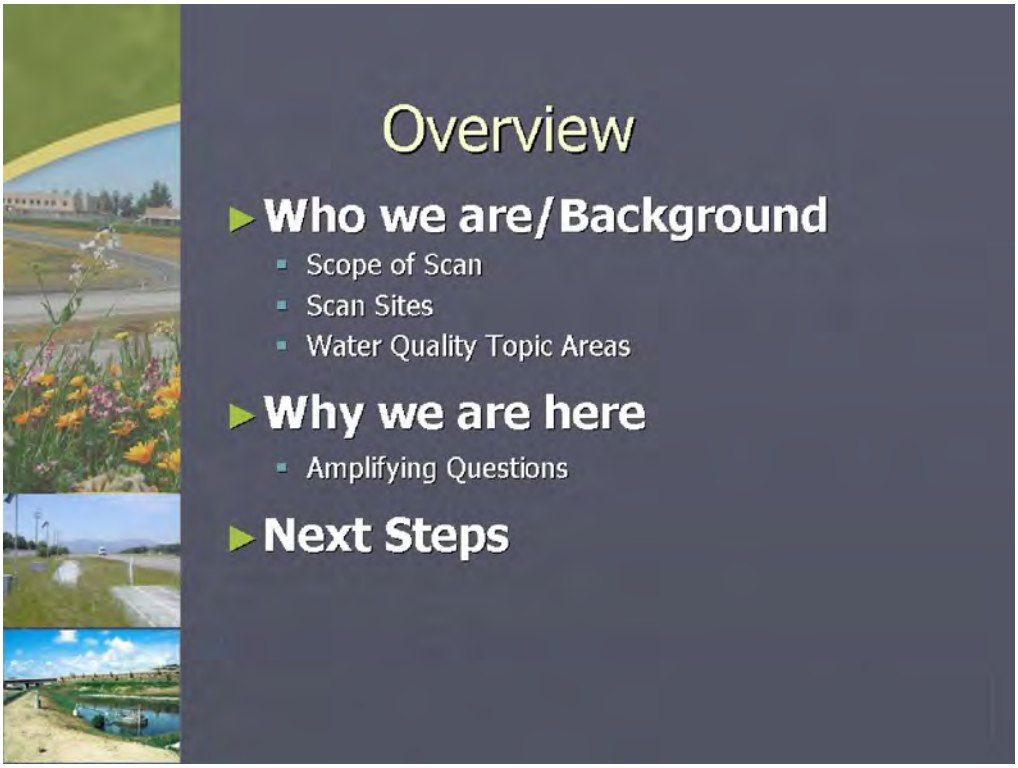
The scan team developed activities that support the implementation activities and the plan for implementation.

- **Integrate program responsibility.** The purpose of integrating NPDES program responsibility is to increase ownership throughout the agency. This concept will be highlighted in the technical presentations describing the scan and through the AASHTO Stormwater Conference. The scan SME will lead this effort.
- **Pooled fund studies.** The use of pooled fund studies to assess pressing areas of stormwater research will allow DOTs to leverage resources and reduce the duplication of research. The NCHRP is an example of this type of approach, but opportunity for further consolidation remains. The scan chairs will lead this effort.
- **Collect accurate cost data.** DOTs need accurate stormwater program cost data to effectively discuss program changes. This initiative will be put forward at the AASHTO Stormwater Conference in April 2010. The scan SME will lead this effort. There are efforts to establish performance measures for stormwater management. The scan team recommends that cost data and maintenance information data be collected along with the implementation of performance measures at DOTs.
- **Source control research.** DOTs should fund additional research into source control strategies as the most effective and least costly approach to surface water improvement. Future NCHRP studies in this area are recommended. The FHWA representatives on the scan will lead this effort.

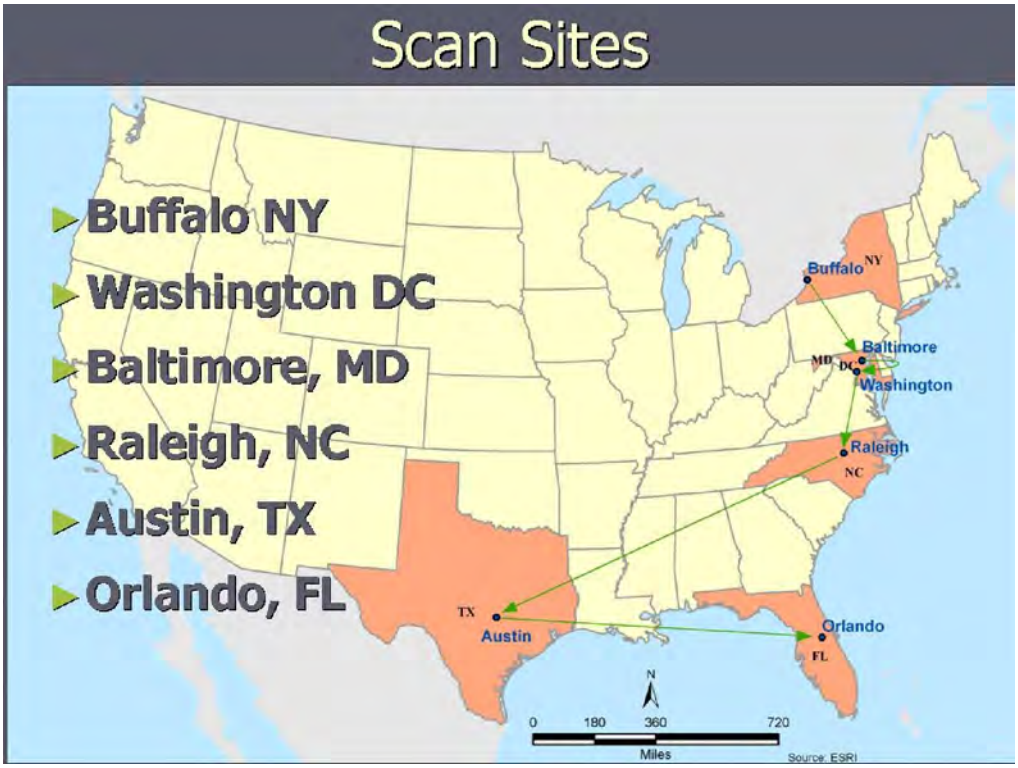
Appendix A:

Travel Introductory Presentation


Best Practices in Addressing
NPDES and Other Water Quality Issues
in Highway System Management
NCHRP 20-68A, Scan 08-03
DOMESTIC SCAN PROGRAM
Scott McGowen, P.E.
AASHTO Chair
Brian Smith
FHWA Co-Chair


Overview
Who we are/Background
Scope of Scan
Scan Sites
Water Quality Topic Areas
Why we are here
Amplifying Questions
Next Steps

Scan Team
Scott McGowen- AASHTO Chair, Caltrans
Brian Smith – Co-Chair, FHWA
Scott Taylor – Subject Matter Expert, RBF Consulting
Vince Davis, Delaware DOT
Frannie Brindle, Oregon DOT
Matt Lauffer, North Carolina DOT
Mark Hemmerlein, New Hampshire DOT
Pat Cazenas, FHWA
Rachel Herbert, EPA
Jeff Lewis, FHWA
Tom Ripka, Illinois DOT
Mandeep Arora, Arora & Associates Consulting


Scan Sites
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Baltimore, MD
Raleigh, NC
Austin, TX
Orlando, FL
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Orlando
FL
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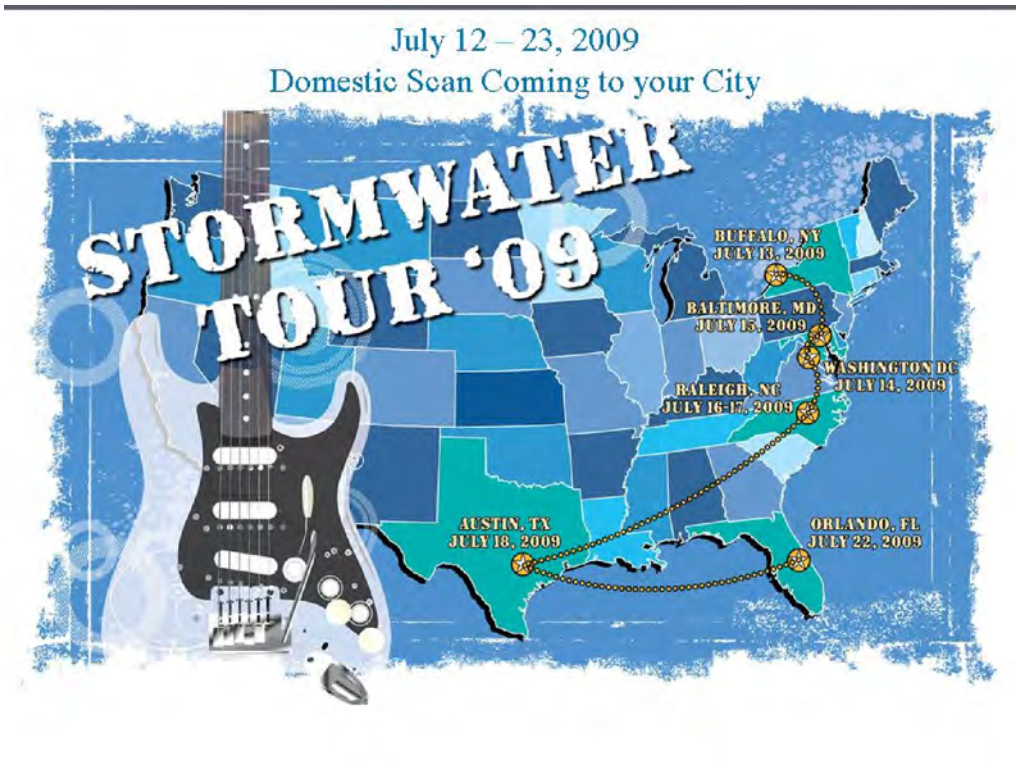
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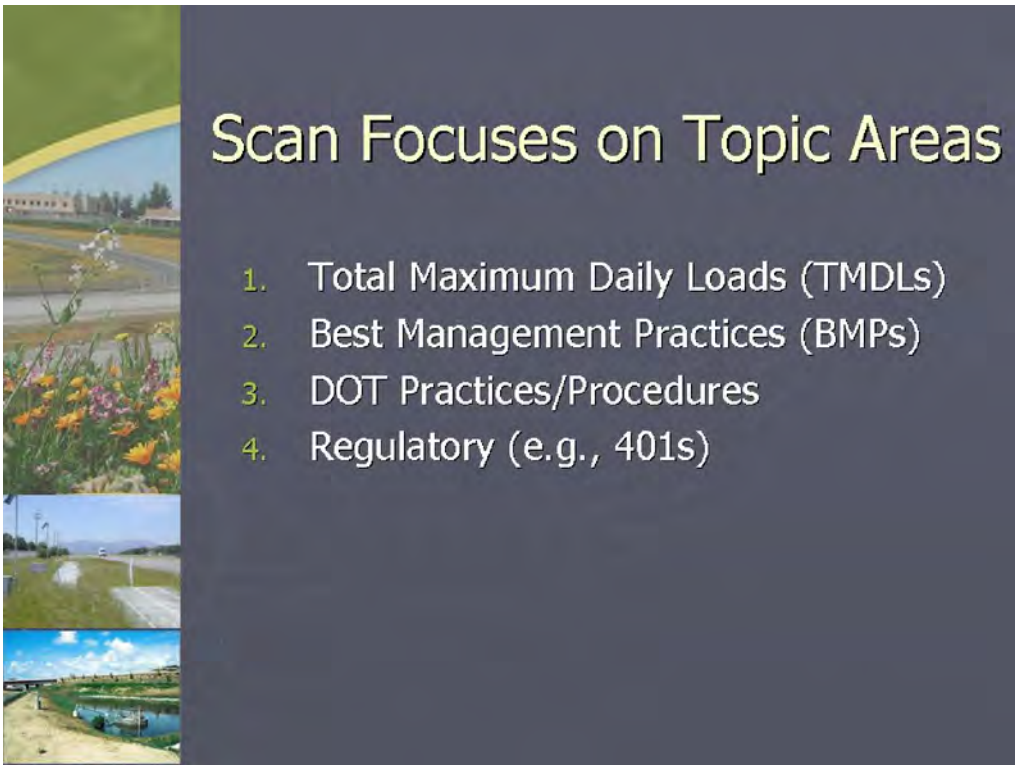
WASHINGTON DC JULY 14, 2009
RALEIGH, NC JULY 16-17, 2009
AUSTIN, TX JULY 18, 2009
ORLANDO, FL JULY 22, 2009

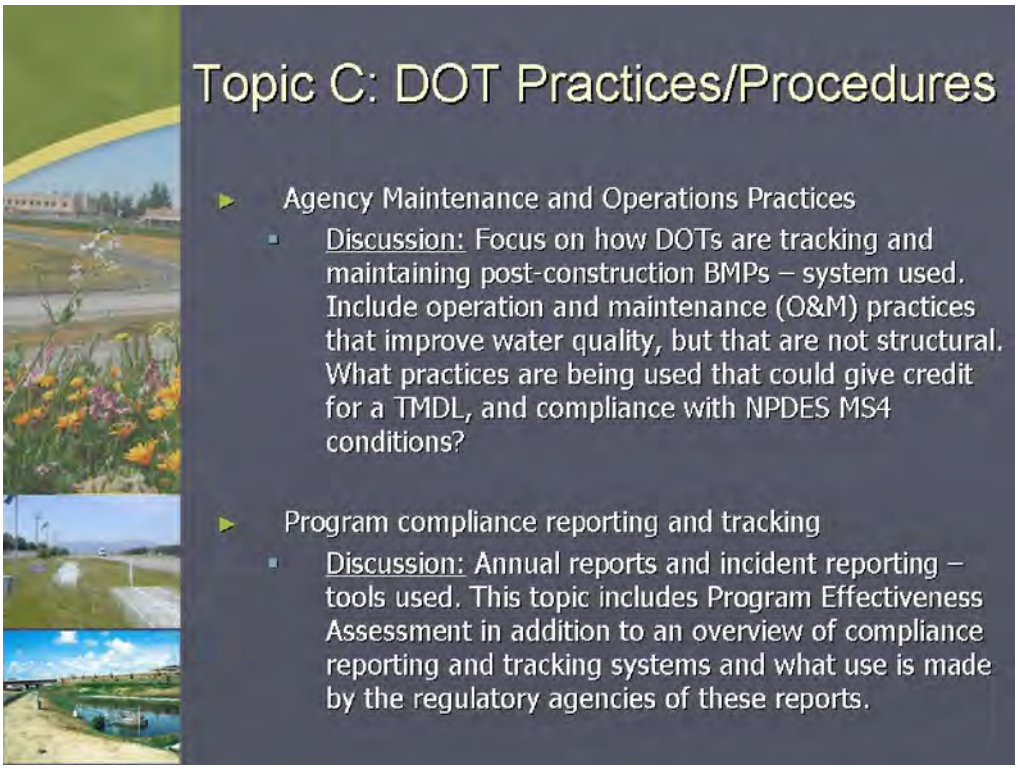
Why we are here?
Benefit from your expertise
Gain insight on your experience
Learn innovative practices that could be beneficially adopted by others
Opportunity for technology transfer with potentially significant benefits on a national scale


Scan Focuses on Topic Areas
1. Total Maximum Daily Loads (TMDLs)
2. Best Management Practices (BMPs)
3. DOT Practices/Procedures
4. Regulatory (e.g., 401s)

Expected Scan Results
Report/ catalogue of ready to implement technologies, methods and processes
Applied Studies to examine specific practices in greater depth
Possible influence on agency business practices
Possible national regulatory procedures development

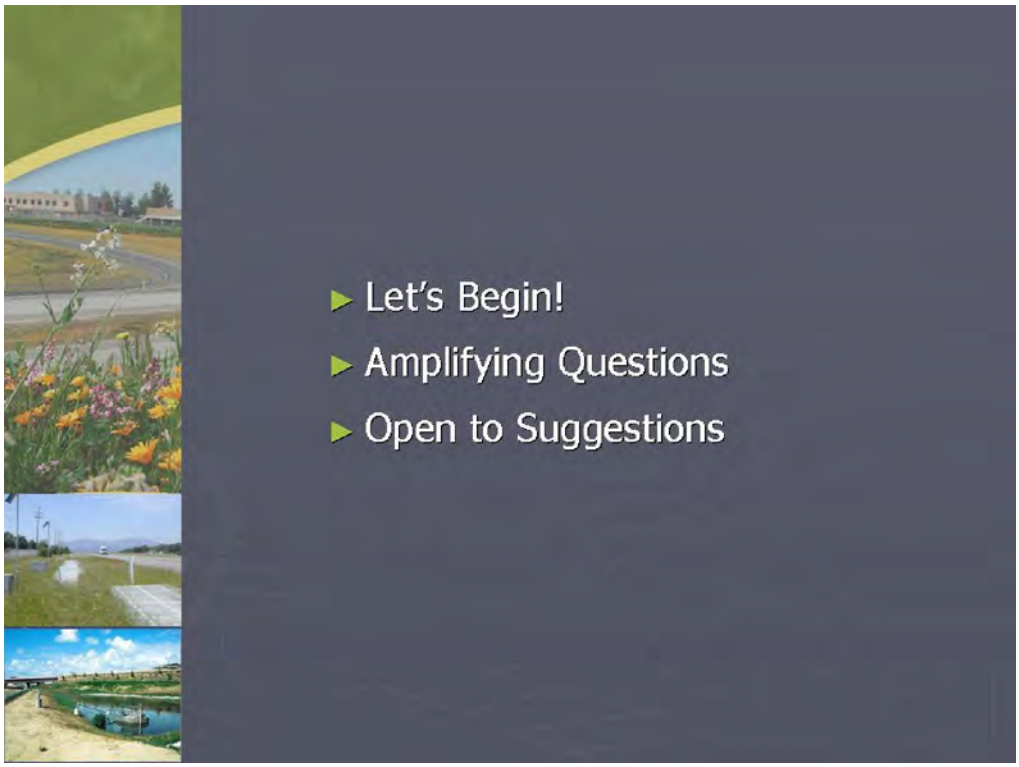
Topic A: TMDLs
TMDL Implementation
Discussion: TMDL inclusion in NPDES Permits, DOT load allocations and implementation strategies, including source control structural BMP retrofit to meet load allocations. This topic also includes compliance relative to Endangered Species Act (ESA) regulations.
Water Quality Credit Trading
Discussion: Credit trading may have significant value in TMDL implementation and may be especially applicable to DOTs that have TMDLs in locations with limited ROW or project scope changes during the project delivery process that prohibited treatment. This topic also includes impervious area and hydromodification – is there an opportunity to 'trade' impervious surface?

Topic B: BMPs
Water Quality Traditional and Innovative Best Management Practices (BMPs)
Discussion: Topic focus on construction and post-construction emerging BMPs in the highway environment. Low technology, Low Impact Development (LID), or green solutions (Principles vs. Opportunities). Include jurisdictional wetland issues for treatment (BMP) areas. Defining constructed wetlands relative to jurisdictional authority.
Non-structural and Source Control Management Options
Discussion: Topic to include research by DOTs relative to the source of pollutants within the ROW and source control programs for constituent control. Examples include: enhanced sweeping, Adopt a Highway, weed control, fire suppression, etc.


Topic C: DOT Practices/Procedures
Agency Maintenance and Operations Practices
Discussion: Focus on how DOTs are tracking and maintaining post-construction BMPs – system used. Include operation and maintenance (O&M) practices that improve water quality, but that are not structural. What practices are being used that could give credit for a TMDL, and compliance with NPDES MS4 conditions?
Program compliance reporting and tracking
Discussion: Annual reports and incident reporting – tools used. This topic includes Program Effectiveness Assessment in addition to an overview of compliance reporting and tracking systems and what use is made by the regulatory agencies of these reports.

Topic D: Regulatory
Coordination with Local and Federal Regulators
Discussion: Focus on communication with state and federal regulators. Are there better ways to structure staff at DOTs to better interface with regulatory agencies?
401 Certifications
Discussion: Determine if DOTs are finding that 401 certifications are being used as a tool to include requirements beyond or overlapping the NPDES permit requirements.

Next Steps
Summarize Scan Findings
Develop List of innovative initiatives
Document lessons learned and shared experiences
Assist in providing tools for DOTs
negotiating, developing, implementing and tracking TMDL programs as part of NPDES MS4 compliance
NPDES Implementation Tools (BMPs, etc.)
Develop policies that apply to DOTs on regulations


Let's Begin!
Amplifying Questions
Open to Suggestions

Appendix B:

Amplifying Questions

These amplifying questions establish a reference framework for activities that should be performed to capture the required information during the scan. The scan will focus on four topic areas relative to compliance with the CWA stormwater quality regulations. Each of the four topic areas has two sub-topics with amplifying questions. The four topic areas as they pertain to stormwater quality are:

- Topic A: TMDLs
- Topic B: BMPs
- Topic C: DOT Policies and Procedures
- Topic D: Regulatory

The purpose of the amplifying questions is to ensure productive interviews with the selected DOT sites by allowing for advance preparation through the assembly of information important to the scan's objectives. The questions in Topics A and B may also be suitable for researchers who collaborate with and provide support for DOT stormwater programs.

TMDLs

TMDL Implementation

1. Where and how do you characterize discharges from your ROW (i.e., location end of pipe [EOP], ROW, and load reduction between EOP and ROW)?
2. How do you address a TMDL (process)? Are you involved in the development?
3. How do you build an inventory of your storm drain system?
4. What source control strategies do you have in place for TMDL constituents, and what strategies are you researching?
5. How many TMDLs are you named in and have received a load allocation for?
6. What are the top pollutants of concern?
7. Do you have a policy for structural BMP retrofit and, if so, what is it?
8. Do you have any examples of how a load allocation for the highway system was derived?
9. Have you assessed cost for TMDL compliance? Do you have dedicated staff for TMDL compliance?

Water Quality Credit Trading

1. Do you have an established (or are you establishing) credit trading program for TMDL compliance? If so, in what regulatory framework/CWA or state authority?
2. Do you think this would be a valuable tool?
3. What pollutants of concern do you have a trading program for?

4. Do you think your regulatory agency would approve such a program? Give a brief outline of your credit-trading program.
5. Do you have to mitigate for impervious surface addition on a project?
6. Do you have or think it would be valuable to have an impervious surface-trading program?
7. How are water quality debits and credits determined?
8. Is there any mechanism for out-of-kind credit trading?

BMPs

Water Quality Traditional and Innovative BMPs

1. How do you define LID?
2. What structural BMPs are approved for use in the highway ROW?
3. What BMPs are conditionally accepted or are you considering for use?
4. What LID BMPs do you use?
5. What is your policy for requiring their use?
6. What innovative construction BMPs do you use?
7. What new BMPs do you think you will need to comply with the draft U.S. EPA Effluent Limitation Guidelines (ELGs)? What new BMPs will you need to comply with TMDLs?
8. How do you identify new BMPs?
9. How do you (or your state) vet and approve new BMPs?
10. When in the project development process do you identify what BMPs are needed (construction and post-construction BMPs)?
11. How do you select the appropriate BMP for the project?

Nonstructural and Source Control Management Options

1. What nonstructural and source control measures do you implement from the design process through construction and post-construction?
2. What have you determined to be the constituents of concern (COC) from highway runoff that originates within the ROW, and load percentages?
3. Have you developed any source control programs to control these COCs?
4. Do you have an enhanced sweeping program for water quality improvement?
5. Do you have an adopt-a-highway program?
6. Give a brief outline of your enhanced maintenance activities that would control pollutants

at the source.

7. Do you control pollutants associated with demolition?
8. How do you determine the effectiveness of these programs?

DOT PRACTICES AND PROCEDURES

Agency Maintenance and Operations Practices

1. What O&M practices do you use that improve water quality?
2. What O&M practices do you use that reduce the need for structural measures?
3. What practices do you use that could be used for credit against a TMDL?
4. What system do you use to track the location and maintenance requirements of structural and non-structural BMPs?
5. Do you contract out BMP maintenance?
6. Do you develop costs for BMP O&M during the project development process?

Program Compliance Analysis, Reporting, and Tracking

1. What specific tools do you use to report individual compliance issues as well as for annual reporting?
2. What are the components of your program effectiveness assessment?
3. Do you have measurable goals that you report on annually?
4. What system(s) do you have in place to track implementation of water quality requirements throughout the project development process?

REGULATORY

Program Compliance Analysis, Reporting, and Tracking

1. Characterize communication with your permitting agency. Does the permitting agency understand your transportation mission? Is it a cooperative relationship?
2. Do you routinely partner to find solutions to permitting and water quality issues? If so, provide an example.
3. Do you work cooperatively in the development of language for your NPDES permit?
4. What is your structure now, and is there a better way to organize or structure your staff to facilitate and improve communication with regulatory agencies?
5. Do you have interagency agreements that define communication protocols?
6. How are they functioning?
7. Do you have any joint training/certification programs?

7. Do you have any joint training/certification programs?

401 Certifications

1. What is your state's scope for a 401 certification, and does it expire/conclude?
2. Do you receive water quality requirements in 401 certifications that exceed NPDES requirements? What are some of the more onerous requirements you have seen?
3. Do you see this as a symptom of some other problem, such as inadequate water quality assessment during the National Environmental Policy Act (NEPA) process?
4. Is the regulatory agency's 401 certification program coordinated with its other water quality programs, including TMDLS and NPDES?
5. Are there clearly defined treatment expectations for 401 certifications (i.e., maximum extent practicable)?
6. Are there mutually agreed upon performance standards or goals and objectives for stormwater management? Are there ESA issues (such as a take)?

Appendix C:

Agency Responses to Amplifying Questions

NYSDOT Responses

TMDLs

TMDL Implementation

1. **Where and how do you characterize discharges from your ROW (i.e., location end of pipe [EOP], ROW, and load reduction between EOP and ROW)?**

   End of pipe.

2. **How do you address a TMDL (process)? Are you involved in the development?**

   TMDLs are addressed by increased WQV, retrofits, and heightened maintenance/asset management requirements. NYSDOT is only allowed to comment during the public review period.

3. **How do you build an inventory of your storm drain system?**

   Outfalls have been mapped with GPS. The entire system (including catch basins, pipes, etc.) is shown in record plans. NYSDOT does not have plans at this time to develop a database of the entire system.

4. **What source control strategies do you have in place for TMDL constituents, and what strategies are you researching?**

   Increase WQV in phosphorus TMDL watersheds, with emphasis on source control and reducing runoff volumes.

5. **How many TMDLs are you named in and have received a load allocation for?**

   Four of the five TMDLs in NYS that NYSDOT is subject to.

6. **What are the top pollutants of concern?**

   Phosphorus, sediment, nitrogen, pathogens, floatables

7. **Do you have a policy for structural BMP retrofit and, if so, what is it?**

   No official policy.

8. **Do you have any examples of how a load allocation for the highway system was derived?**

   Load allocation from highway system has not been derived and, based on permit requirements, is not needed.

9. **Have you assessed cost for TMDL compliance? Do you have dedicated staff for TMDL compliance?**

   No to both questions.

Water Quality Credit Trading

1. **Do you have an established (or are you establishing) a credit trading program for TMDL compliance? If so, in what regulatory framework/CWA or state authority?**

   NYSDOT plans to have a banking strategy, but not yet.

2. **Do you think this would be a valuable tool?**

   Yes. This will allow designers flexibility in developing SWPPPs.

3. **What pollutants of concern do you have a trading program for?**

   None. The program would be a credit/debit system based on WQV.

4. **Do you think your regulatory agency would approve such a program? Give a brief outline of your credit trading program.**

   Yes. NYSDOT has discussed such a system, and DEC has approved of the idea (wording was included in the last Memorandum of Understanding (MOU) to allow NYSDOT to develop a program). The system would allow DOT to get credit for additional WQV treated on one project and apply that credit to another project within the same watershed (probably 8- or 11-digit HUC watershed, similar to what DelDOT[8] uses). DEC also proposes language in the next MS4 general permit to allow any MS4 to develop and use a banking or credit system.

5. **Do you have to mitigate for impervious surface addition on a project?**

   Yes.

6. **Do you have or think it would be valuable to have an impervious surface trading program?**

   No.

7. **How are water quality debits and credits determined?**

   Based on WQV.

8. **Is there any mechanism for out-of-kind credit trading?**

   No. Rumor has it that PennDOT[9] does cross-category trading.

[8] Delaware Department of Transportation

[9] Pennsylvania Department of Transportation

BMPs

Water Quality Traditional and Innovative BMPs

1. **How do you define LID?**

   Defined as what is on NYSDEC's list.

2. **What structural BMPs are approved for use in the highway ROW?**

   In 5 major categories of stormwater wetlands, ponds, filtering systems, infiltration practices, and open channels. See Chapter 5 of the NYS Stormwater Management Design Manual (http://www.dec.ny.gov/chemical/29072.html).

3. **What BMPs are conditionally accepted or are you considering for use?**

   Hydrodynamic separators and permeable pavements are conditionally accepted.

4. **What LID BMPs do you use?**

   Bioretention, if that is considered LID (considered standard practice in NYS), permeable pavements.

5. **What is your policy for requiring their use?**

   No formal policy.

6. **What innovative construction BMPs do you use?**

   NYSDOT has a chitosan treatment system on one project.

7. **What new BMPs do you think you will need to comply with the draft EPA Effluent Limitation Guidelines (ELGs)? What new BMPs will you need to comply with TMDLs?**

   Chitosan treatment systems will be needed for compliance with Construction ELGs. Do not expect that new BMPs will be needed for TMDLs.

8. **How do you identify new BMPs?**

   NYSDOT has a New Product Evaluation Committee and gives provisional acceptance to some products intended to improve water quality, but does not necessarily integrate those products into the menu of practices available for use on highway projects.

9. **How do you (or your state) vet and approve new BMPs?**

   NYSDOT uses whatever DEC considers acceptable. Not sure what process that agency uses.

10. **When in the project development process do you identify what BMPs are needed (construction and post-construction BMPs)?**

Usually in preliminary design, but the choice may change when designs change or additional soils information is obtained.

11. **How do you select the appropriate BMP for the project?**

    There is a series of Feasibility Matrices in the DEC Design Manual.

Non-structural and Source Control Management Options

1. **What nonstructural and source control measures do you implement from the design process through construction and post-construction?**

   ESC, street sweeping, infiltration practices, reducing disturbed areas

2. **What have you determined to be the constituents of concern (COC) from highway runoff that originates within the ROW, and load percentages?**

   No such determination has been made.

3. **Have you developed any source control programs to control these COCs?**

   No.

4. **Do you have an enhanced sweeping program for water quality improvement?**

   NYSDOT does sweeping, but it is not what can be considered enhanced.

5. **Do you have an adopt-a-highway program?**

   Yes—5,000 miles have been adopted to date.

6. **Give a brief outline of your enhanced maintenance activities that would control pollutants at the source.**

   Drainage system cleaning, sweeping, litter pick-up.

7. **Do you control pollutants associated with demolition?**

   NYSDOT suppresses dust, controls water from hydro-demolition.

8. **How do you determine the effectiveness of these programs?**

   Effectiveness not determined.

DOT Practices/Procedures

Agency Maintenance and Operations Practices

1. **What O&M practices do you use that improve water quality?**

   Drainage system cleaning, sweeping, litter pick-up.

2. **What O&M practices do you use that reduce the need for structural measures?**

   None.

3. **What practices do you use that could be used for credit against a TMDL?**

   None.

4. **What system do you use to track the location and maintenance requirements of structural and nonstructural BMPs?**

   Access® database is used to track location, inspection, and maintenance history of structural practices only.

5. **Do you contract out BMP maintenance?**

   Some NYSDOT regions do, but not all.

6. **Do you develop costs for BMP O&M during the project development process?**

   No.

Program Compliance Analysis, Reporting, and Tracking

1. **What specific tools do you use to report individual compliance issues as well as for annual reporting?**

   Survey main office and regional staff. Also use a Maintenance Asset Management Information System.

2. **What are the components of your program effectiveness assessment?**

   Comparison of measurable goals to actual work accomplished.

3. **Do you have measurable goals that you report on annually?**

   Yes.

4. **What system(s) do you have in place to track implementation of water quality requirements throughout the project development process?**

   Review of SWPPPs.

Regulatory

Coordination with Local and Federal Regulators

1. **Characterize communication with your permitting agency. Does the permitting agency understand your transportation mission? Is it a cooperative relationship?**

   The regulatory agency does not fully appreciate the concerns of the regulated community in general because it does not have staff with experience as practitioners. The agency does appreciate the transportation mission to an extent, but also feels that money can overcome

limitations or constraints. Not necessarily a cooperative relationship, but enough to allow MOUs and agreements to be made.

2. **Do you routinely partner to find solutions to permitting and water quality issues? If so, provide an example.**

   No.

3. **Do you work cooperatively in the development of language for your NPDES permit?**

   No. NYSDOT offers comments during the public review process. Currently, NYSDOT is represented on a committee to discuss controversial issues in the permits and is allowed to comment on a pre-draft version of the construction and MS4 general permits.

4. **What is your structure now, and is there a better way to organize or structure your staff to facilitate and improve communication with regulatory agencies?**

   Currently, one person negotiates with DEC on water quality related policy issues. Perhaps communication would be improved if there was more staff to make more outreach efforts to DEC.

5. **Do you have interagency agreements that define communication protocols?**

   NYSDOT has an MOU with the NYC Dept. of Environmental Protection that does discuss communication protocols.

6. **How are they functioning?**

   Apparently very well.

7. **Do you have any joint training/certification programs?**

   No.

401 Certifications

1. **What is your state's scope for a 401 certification, and does it expire/conclude?**

   Please clarify the question. What is meant by scope?

2. **Do you receive water quality requirements in 401 certifications that exceed NPDES requirements? What are some of the more onerous requirements you have seen?**

   401 certifications in NYS typically place conditions on activities in Waters of the U.S., not much on stormwater management issues.

3. **Do you see this as a symptom of some other problem, such as inadequate water quality assessment during the National Environmental Policy Act (NEPA) process?**

   No.

4. **Is the regulatory agency's 401 certification program coordinated with its other water**

quality programs, including TMDLS and NPDES?

No.

5. **Are there clearly defined treatment expectations for 401 certifications (i.e., maximum extent practicable)?**

   No. See previous question and answer.

6. **Are there mutually agreed upon performance standards or goals and objectives for stormwater management? Are there ESA issues (such as a take)?**

   Not mutually agreed upon, but the state SPDES permit is not applicable for activities that adversely affect an endangered or threatened species or habitat.

MSHA Responses

TMDLS

Questions concerning TMDLS can be directed to:

Ms. Karen Coffman
MSHA NPDES Program Manager
Maryland State Highway Administration
Highway Hydraulics Division, C-201
707 North Calvert Street
Baltimore, MD 21202
Phone: (410) 545-8407
E-mail: kcoffman@sha.state.md.us

TMDL Implementation

1. **Where and how do you characterize discharges from your ROW (i.e., location end of pipe [EOP], ROW, and load reduction between EOP and ROW)?**

   Discharge characterization efforts that occurred during our first MS4 Phase I permit term (1999 to 2004) were undertaken through both literature reviews and permit monitoring requirements. The MDE, Water Management Administration (WMA), which issues the NPDES MS4 permits, has developed a database of all discharge characterization for the Maryland NPDES jurisdictions. MDE WMA uses this data for determining discharge characterizations for the different land uses. Our current Phase I MS4 permit does not require that we manage for specific TMDLs, but rather contains this language concerning programmatic TMDL compliance:

   MDE has determined that the owners of storm drain systems that implement the requirements of this permit will be controlling stormwater pollution to the MEP. This current permit expires

October 2010 and we anticipate TMDL implementation in the next permit term that will require demonstration of waste load reductions. Newer permits, such as the permit issued to Montgomery County recently, has language requiring that TMDL implementation plans be submitted and approved upon the completion and approval of any TMDLs that name the county in the WLAs. MSHA anticipates similar language in our next permit.

A process for determining waste load reductions has not been defined for our land use by the Maryland Department of the Environment (MDE), the NPDES permitting authority in Maryland. Our understanding of the proposed MDE method will be a watershed modeling method rather than direct measurements at each pipe or flow leaving our ROW.

We had requested TMDL implementation as a domestic scan topic in November 2007 in a proposal titled *Readiness to Face Total Maximum Daily Loads (TMDLs) in National Pollutant Discharge Elimination System (NPDES)* Compliance. As such, we are interested in obtaining information from the team concerning TMDL implementation in other jurisdictions.

2. How do you address a TMDL (process)? Are you involved in the development?

TMDLs in Maryland are developed by the MDE Science Services Administration (SSA), while NPDES compliance is administered by the MDE WMA. We are not actively involved in the development of TMDLs; however; we are afforded the opportunity to comment on draft TMDLs as part of the public notice. We have recently provided the SSA with our impervious surface layer and anticipate our roadways being integrated into the waste load reductions in the future.

The MDE SSA TMDL page is located at this link:
http://www.mde.maryland.gov/Programs/WaterPrograms/TMDL/index_new.asp.

The *Maryland's TMDL Implementation Guidance for Local Governments* is also helpful in understanding the MDE perspective and background of TMDL development in Maryland. It can be found at this link:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/TMDL_implementation_2006_guidance_document.asp.

The exact method of demonstrating compliance with TMDL WLAs has not been determined by MDE. While the SSAs approach has been toward Tributary Strategies (http://www.dnr.state.md.us/bay/tribstrat/), the WMA has a different approach that would entail determining pre- and post-development waste loads at a project scale. Reductions would be demonstrated by utilizing efficiencies assigned to specific BMPs that can be utilized throughout the project site.

3. **How do you build an inventory of your storm drain system?**

There are nine Phase I and two Phase II NPDES counties in Maryland. We have recently completed the storm drain inventory of all the Phase I counties; the Phase II inventory will be completed later this year (October 2009). We try to update our MS4 inventory every three years, along with our stormwater BMP and outfall IDDE and stability inspections.

Our inventory is currently housed in an ArcGIS (ESRI) geodatabase, and we have developed draft standard procedures for data collection and input. The standard procedures include the chapters listed below. (Because they are in draft form, we prefer not to distribute PDF files at this time but will provide hard copies if requested.)

MSHA NPDES Standard Procedures:

- Chapter 1. Introduction
- Chapter 2. Source Identification and Inventory
- Chapter 3. BMP Field Inspections and Data Collection Procedures
- Chapter 4. Storm Drain Inspection Procedures
- Chapter 5. Illicit Discharge Detection and Elimination (IDDE) Procedures
- Chapter 6. Data Management, Quality Assurance and Quality Control
- Chapter 7. BMP Assessment Guidelines for Maintenance and Remediation

We update our inventory data a county at a time. Our process for updating the MS4 inventory and inspection information is described below.

Office Identification—For each county, an internal search will be conducted for new project files that were built since our last inventory. MSHA has scanned a good percentage of our roadway plan files and archived them on a server accessible to administration engineers. Some plans have not been scanned and may be filed with our district offices.

We employ a research consultant to develop and maintain a history of the state roadway development within each NPDES county. This includes reviewing our advertisement history, searching the archived scans, visiting our district offices, reviewing permit files and searching for plats. The research consultant produces a set of hard copy plans for the new roadway projects that include both storm drain and stormwater management design information. He will also compile electronic scans of the stormwater BMP design plan sheets that will be attached to the BMP records in the geodatabase. The GIS development consultants will be given this information to use in compiling the GIS updates for the county.

The same research consultant follows up with the MDE required Stormwater As-Built Certification package to ensure this information is archived.

GIS Development Consultant Initiation and Training—We hire consultants to perform the actual GIS development work. In order to ensure consistent and accurate data collection and development, we have developed the following (using consultants):

- Two training workshops (Source ID and Field Inspection)
- Standard procedures document (mentioned above)
- Office Editing Tool (OET)
- Field Editing Tool (FET)
- Versioned geodatabase check-out/check-in procedures (see Chapter 6 above)

Office Inventory—The GIS development team will be given a versioned personal geodatabase for the county of interest. The team will begin by reviewing the plans and inputting inventory information using the OET. Our data is organized into drainage systems, and the team will develop drainage system numbering using the plan sheets.

Field Spatial Data and Inspections—Once the inventory information is input into the geodatabase, field teams, using the FET will input spatial data (GPS) for each feature and verify the other attributes from the plan sheets to the actual constructed elements. Field inspections will also be performed at NPDES major outfalls for illicit discharges, at stormwater BMPs for functional assessments, and at outfalls for structural stability. Forms in the FET are filled out in the field using tough-book laptops.

Office Quality Checks—The GIS development team returns to the office and makes quality checks on the data.

Versioned Geodatabase Check-In—Once the GIS work is finished, the completed, versioned, personal geodatabase is returned for the check-in and the quality assurance/quality control process.

Initially, we were also developing (through consultants) an Internet-based viewer for sharing our NPDES data that was based on the ESRI ArcGIS Server. However, we are finding that the ability in ArcGIS 9.3 to develop Google Earth files (.kmz) for viewing is more effective for distributing and viewing data.

4. **What source control strategies do you have in place for TMDL constituents, and what strategies are you researching?**

We currently implement street sweeping, inlet cleaning and litter pick-up programs (including Adopt-a-Highway and Sponsor-a-Highway) that are not exclusive to the NPDES compliance program. We are investigating ways to compute the type and amount of pollutants removed from the waste stream through these efforts.

Winter Deicing Operations—MSHA is seeking to maintain LOS provided to motorists during winter storm events while also minimizing the impact of deicing operations on

the environment. Anti-icing is a method employed that increases the application of deicing materials prior to and in the early stages of a winter storm. This prevents snow and ice from bonding to roadway and bridge surfaces while leading to lower material usage at the conclusion of the storm event, thus lessening the overall usage of deicing materials. In addition, SHA provides sensible salting training to state and consultant equipment operators.

Herbicide and Pesticide Reduction—MSHA has developed vegetation management guidelines that standardize procedures, *Integrated Vegetation Management Manual for Maryland Highways*. Training is also required for pesticide applicators and includes:

- Pesticide applicator registration training
- SHA Vegetation Management Conference (recertification)
- Pesticide Core and ROW Pre-Test Certification
- Pesticide Aquatic Certification

Fertilizer Reduction—Maryland law requires that nutrient management plans be developed to ensure that no excess nutrients are being applied. We have implemented nutrient management in our project development process, and this has reduced the amount of fertilizers applied during vegetation establishment and maintenance of our ROW. We also utilize mowing reduction initiatives.

Sediment Reduction—Permanent vegetation stabilization is also important for controlling erosion and preventing sediment from becoming waterborne. SHA has a program to assess turf establishment success and require contractors to provide adequate turf cover prior to releasing the contract for acceptance for MSHA maintenance. This process is the Seeding Phase Acceptance and Final Phase Acceptance and entails MSHA assessing vegetation type and cover percentage.

We also inspect outfalls as part of the MS4 inventory and inspection process discussed in Question 3, above. This process identifies outfalls that are eroded and require stabilization. Outfall stabilization is accomplished either through open-ended maintenance/construction contracts or, if the project is extensive and requires environmental permitting, through advertised projects.

5. How many TMDLs are you named in and have received a load allocation for?

As stated above in Question 1, we have not been required to implement waste load reductions yet. The TMDL modeling has not isolated MSHA as a separate land user or supplied percentages of the NPDES stormwater WLAs to the various MS4 permit holders within the watershed.

According to the *2008 Integrated Report of Surface Water Quality in Maryland,* there are 393 impaired waters in need of TMDLs in Maryland. A fraction of those TMDLs has been produced. The 2008 IR can be found at this link:

http://www.mde.maryland.gov/Programs/WaterPrograms/TMDL/Maryland%20303%20dlist/2008_Final_303d_list.asp.

6. What are the top pollutants of concern?

Pollutants of concern for the state depend upon the designated uses and impairments of the particular streams. Water quality standards have been developed based upon the designated uses and impairments are assessed accordingly. Maryland designated uses are:

- Use I: Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life
- Use I-P: Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply
- Use II: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting
- Shellfish Harvesting Subcategory
- Seasonal Migratory Fish Spawning and Nursery Subcategory (Chesapeake Bay only)
- Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory (Chesapeake Bay only)
- Open-Water Fish and Shellfish Subcategory (Chesapeake Bay only)
- Seasonal Deep-Water Fish and Shellfish Subcategory (Chesapeake Bay only)
- Seasonal Deep-Channel Refuge Use (Chesapeake Bay only)
- **Use II-P**: Tidal Fresh Water Estuary—includes applicable Use II and Public Water Supply
- **Use III:** Nontidal Cold Water
- **Use III-P:** Nontidal Cold Water and Public Water Supply
- **Use IV:** Recreational Trout Waters
- **Use IV-P:** Recreational Trout Waters and Public Water Supply

Numerical Criteria for Toxic Substances in Surface Waters can be found at this link: http://www.dsd.state.md.us/comar/SubtitleSearch.aspx?search=26.08.02.03-2

The Water Quality Criteria Specific to Designated Uses can be found here: http://www.dsd.state.md.us/comar/SubtitleSearch.aspx?search=26.08.02.03-3

The TMDLs that have been developed to date are for sediment, nutrients (nitrogen, phosphorus), biological (fecal bacteria, biochemical oxygen demand [BOD]), metals (mercury), toxics (chlordane, PCBs) and pH. The approved TMDLs can be accessed at the following Web page: http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/ApprovedFinalTMDL/index.asp.

A Chesapeake Bay TMDL is also under development and, although not a TMDL, there is a Trash Treaty for the Anacostia Watershed that seeks to reduce trash significantly.

Currently, the pollutants selected by the MS4 Phase I permit for watershed assessment include:

- Biochemical Oxygen Demand (BOD5)
- TKN
- Nitrate plus Nitrite
- TSS
- Total Petroleum Hydrocarbons
- Fecal Coliform or E. Coli
- Total Lead
- Total Copper
- Total Zinc
- Total Phosphorus
- Oil and Grease

7. Do you have a policy for structural BMP retrofit and if so what is it?

Depends upon what you are asking concerning retrofits. If you are asking about upgrades to existing structural BMPs or if you are asking about retrofitting untreated impervious pavement with structural BMPs.

For upgrades to existing structural BMPs, we inspect structural BMPs based on our established criteria and rate them in terms of functionality. Depending upon the rating, the facility may be slated for routine maintenance, major maintenance, or complete retrofit. According to our Phase I MS4 permit, inspections are required to occur every three years, with required remediation efforts completed one year after that. We also have an internal business plan goal to have 90% stormwater management BMPs functionally adequate by 2010.

For retrofitting untreated impervious surfaces with structural BMPs, our NPDES MS4 permit requires us to address this. Here is the language from the permit.

The SHA shall continue to construct stormwater management retrofits for controlling pollutants associated with highway runoff and aiding in local watershed restoration activities. As part of this program, the SHA shall:

a. *Construct or fund 25 significant stormwater management retrofit projects during the course of this permit for impervious areas with poor or no runoff control infrastructure. These projects shall be implemented where water quality improvements can be achieved and shall not include typical stormwater management maintenance. Innovative alternatives to conventional stormwater management methods will be considered by MDE. Examples may include wetlands creation, stream buffer plantings, reforestation, or any other practices providing significant water quality benefits. Alternative practices shall be submitted to MDE for approval prior to implementation;*

b. *Contribute to local watershed restoration activities by constructing or funding stormwater management retrofits in watersheds targeted by local NPDES municipalities when feasible; and*

c. *Submit annual reports containing pertinent information on its watershed restoration activities such as stormwater management retrofit proposals, costs, schedules, implementation status and impervious acres proposed for management.*

Our phase I permit also requires us to develop impervious surface accounting. We have developed impervious layers and accounted for the amount of treatment we are providing through stormwater management practices. We have developed this accounting and will now be actively working to increase our treatment percentages. Overall, we are currently treating approximately 10% of our pavement.

8. **Do you have any examples of how a load allocation for the highway system was derived?**

While we have been named in several TMDLs as a NPDES Stormwater WLA contributor, there have not been breakdowns of the WLA to assign percentages to the various NPDES stormwater permit holders. An example of the development of a WLA that includes NPDES stormwater permit holders is the Conococheague Creek Watershed Sediment TMDL that was approved by U.S. EPA on November 24, 2008, and can be found at this link: http://www.mde.state.md.us/assets/document/Conoco_Sed_TMDL_011609_Final.pdf.

9. **Have you assessed cost for TMDL compliance? Do you have dedicated staff for TMDL compliance?**

One staff member is currently dedicated to TMDL compliance. We have not assessed cost if implementation involves tributary strategies that could entail a number of different activities depending upon the watershed. If a percent BMP treatment for the SHA impervious surfaces is required, we calculate it will cost approximately $500,000,000 for each 10% of SHA untreated impervious treated. The number is arrived at from past engineering, ROW, and construction costs that are approximately $200,000 per acre of treatment provided. Our current untreated impervious pavement is approximately 23,000 acres.

Water Quality Credit Trading

1. **Do you have an established (or are you establishing) credit trading program for TMDL compliance? If so, in what regulatory framework/CWA or state authority?**

   We see a distinction between water quality credit trading and banking. Trading would involve several distinct entities trading credit/debit among themselves when one exceeds its waste load reduction requirement and sells its over-management credit to another entity that has not managed to its required waste load reduction. Banking involves a single entity trading credit/debit between its projects only.

   Trading is in its infancy at MDE with current trading only being contemplated between traditional point source dischargers (wastewater treatment plants).

   However, we do have a banking agreement between MSHA and the MDE for water quality trading between SHA projects. This trading is based upon impervious acres and is exclusive to MSHA projects only. No credit is traded to other entities.

2. **Do you think this would be a valuable tool?**

   MDE thinks that this could possibly be valuable. Because the logistics of trading between point source and nonpoint sources is difficult and many years away, MDE will regulate primarily through stormwater management requirements for new development, redevelopment, and NPDES restoration permit conditions.

   MSHA thinks this could be a valuable tool, especially on a watershed management perspective. We could target retrofits and other types of watershed improvements outside of SHA ROW and potentially receive credit to trade in order to offset SHA projects.

3. **What pollutants of concern do you have a trading program for?**

   Current MDE credit trading program is with nutrients. The MDE/SHA water quality bank uses impervious surface as currency in acres by 6-digit watershed.

4. **Do you think your regulatory agency would approve such a program? Give a brief outline of your credit-trading program.**

   See MDE response to Question 2 above.

   SHA-MDE Water Quality Banking—Any time additional impervious surface is added in the watershed (of selected size), equivalent pavement plus some fee (20%) should be treated in the same watershed. Start with a bank deposit. Withdrawal only allowed if there is bank balance. Limits are placed on maximum debits, depending on needs and watershed condition. When maximum debit limits are exceeded, mitigation is required within the watershed.

5. **Do you have to mitigate for impervious surface addition on a project?**

   Yes, as required by Maryland stormwater management laws and regulations. The

requirement is to treat 100% of new pavement and, if the project is identified as redevelopment, the areas of existing pavement within the project limits that are impacted by the project should be reduced by 20% through either pavement removal or stormwater management. If all new impervious cannot be treated, we can treat additional existing impervious areas on-site. Off-site options are explored only if on-site options are not available. Use of the water quality bank to debit the bank is a last resort.

6. **Do you have, or do you think an impervious surface trading program would be valuable?**

   Yes. MSHA has had Water Quality Bank (agreement with MDE) in place since early 1990s. If banking could be extended to impervious trading within the county or NPDES jurisdiction, MSHA could treat county pavement if no opportunities are available.

7. **How are water quality debits and credits determined?**

   Based on acres of MSHA-owned pavement (impervious area) treated by structural or nonstructural BMPS.

8. **Is there any mechanism for out-of-kind credit trading?**

   Out-of-kind credit mechanisms do not exist in the MDE nutrient trading program. For the MSHA-MDE water quality banking agreement, water quality credit for stream restoration/stabilization projects can be obtained in lieu of traditional stormwater management BMPs.

BMPS

Questions concerning BMPS and DOT Practices and Procedures can be directed to:

Ms. Dana Havlik
MSHA
Stormwater Facility Program Manager
Phone: (410) 545-8418
E-mail: Dhavlik@sha.state.md.us

Or

Mr. Stephen Buckley
MSHA Erosion & Sediment Control Program Manager, Assistant Division Chief, Highway Hydraulics Division
Phone: (410) 545-8420
E-mail: sbuckley@sha.state.md.us

Water Quality Traditional and Innovative BMPs

1. **How do you define LID?**

   LID suggests methodology of development in a low impact to stormwater. It was intended for attention to site design. It has evolved into a stormwater concept where LID is an approach to manage stormwater runoff as close to its source as possible. LID includes preserving and incorporating natural landscape features to create functional and visually appealing stormwater water quality treatment. The commonly used practices are bioretention facilities, gutter filters, rain gardens, bio-inlets, vegetated rooftops, and pervious pavements.

2. **What structural BMPs are approved for use in the highway ROW?**

   MSHA has been using a variety of structural BMPs that have been approved by MDE in the *2000 Maryland Stormwater Design Manual*.

   - Stormwater Ponds Micropool Extended Detention Pond, Wet Pond, Wet Extended Detention Pond, Multiple Pond System, Pocket Pond
   - Stormwater Wetlands Shallow Wetland, Extended Detention Shallow Wetland, Pond/ Wetland System, Pocket Wetland
   - Infiltration Practices Infiltration Trench, Infiltration Basin
   - Filtering Practices Surface Sand Filter, Underground Sand Filter, Organic Filter, Pocket Sand Filter, Bioretention
   - Open Channel Practices Dry Swale, Wet Swale

3. **What BMPs are conditionally accepted or are you considering for use?**

   Stream restoration and stabilization projects, coastal plain outfalls, some LID (proprietary products)

4. **What LID BMPs do you use?**

   Bioretention, pervious pavers and pavements, bio-inlets, bioswales.

5. **What is your policy for requiring their use?**

   LID has not been used frequently because of its limitations, maintenance requirements, cost, and general issues with proprietary product. LID practices require drainage area size to be small. In linear highway application, that is typically a problem and required complex flow diversions resulting in additional drainage and ROW costs.

6. **What innovative construction BMPs do you use?**

   E&S measures and devices: flocculants, mobile water treatment stations.

7. **What new BMPs do you think you will need to comply with the draft U.S. EPA Effluent Limitation Guidelines (ELGs)? What new BMPs will you need to comply with TMDLs?**

   Flocculation will help to comply with proposed effluent limitations for turbidity. For TMDL compliance, more filtration or infiltration is needed. Eventually, approach of secondary and tertiary treatment methods may be necessary.

8. **How do you identify new BMPs?**

   MDE considers any of the BMPs listed in the Maryland 2007 Stormwater Management Act or ones that can meet these requirements. Revised Chapter 5 of the *2000 Maryland*

Stormwater Design Manual contains this guidance: http://www.mde.state.md.us/assets/document/Design%20Manual%20Chapter%205%2003%20 24%202009.pdf.

9. **How do you (or your state) vet and approve new BMPs?**

   According to MDE, Maryland state law requires that specific runoff volumes be managed by specific criteria in the *2000 Maryland Stormwater Design Manual*. New BMPs will need to follow these guidelines. For SHA, research studies support such proposals.

10. **When, in the project development process, do you identify what BMPs are needed (construction and post-construction BMPs)?**

    At 30% (post-construction needs) to 60% (construction needs) design completion of a highway project.

11. **How do you select the appropriate BMP for the project?**

    MDE requires that runoff volumes be met and allows the SHA flexibility in how to meet these volumes. Also, based on criteria and guidelines developed by MDE, site conditions, context or location, safety considerations, geotechnical conditions, and land value play roles in such decision making.

Nonstructural and Source Control Management Options

1. **What nonstructural and source control measures do you implement from the design process through construction and post-construction?**

   Swales, bioretention, porous pavement—all for post-construction. During construction phase, minimization of clearing is encouraged and detailed sequence of construction developed.

2. **What have you determined to be the constituents of concern (COC) from highway runoff that originates within the ROW, and load percentages?**

   From MSHA's perspective, highway COCs are trash, sediment, deicing chemicals, nutrients, metals, petroleum-based organic compounds, pH and biological affects. Thermal impacts are also of concern to MSHA. Load percentages have not been established.

3. **Have you developed any source control programs to control these COCs?**

   Litter pickup and trash removal. ESC QA inspection and training program. ESC incentive/disincentives for contractors. Turf acceptance standards.

4. **Do you have an enhanced sweeping program for water quality improvement?**

   Yes and no (not for water quality purpose exclusively).

5. **Do you have an adopt-a-highway program?**

   Yes.

6. **Give a brief outline of your enhanced maintenance activities that would control pollutants at the source.**

   Pollution prevention plans for shops, sediment control installation and QA program, stormwater management facilities program and routine maintenance.

7. **Do you control pollutants associated with demolition?**

   Yes.

8. **How do you determine the effectiveness of these programs?**

   BMP based. Not measured. Turbidity measured on occasion.

DOT PRACTICES/PROCEDURES

Agency Maintenance and Operations Practices

1. **What O&M practices do you use that improve water quality?**

   Routine and preventive maintenance of BMPs is the key element to the roadway runoff water quality improvement. Regular inspections provide performance rating and functionality level of stormwater management facilities and based on the collected data, level of maintenance is determined. Approved ESC plans, QA inspection (biweekly) of construction sites.

2. **What O&M practices do you use that reduce the need for structural measures?**

   Structural BMPs have been generally promoted by MDE until recently, especially since the latest design manual (2000) has been in effect. However, the most recent regulations are leaning towards nonstructural BMPs, ESD, and LIDs. SHA has increased a use of grass channels to provide water quality treatment along the open section highways. A variety of wetland facilities and shallow marshes are being created to serve the dual purpose of water quality treatment as well as wetland mitigation for impacts caused by roadway construction. Vegetated buffers and grass pretreatment areas are being incorporated in to stormwater management design and are being maintained under the Stormwater Management Maintenance Program. Limit grading areas, timely stabilization

3. **What practices do you use that could be used for credit against a TMDL?**

   Stream and flood plain restoration projects are initiated by MSHA in order to provide WQ at locations where unstable channel downstream of MSHA outfall is a major sediment and pollutant source.

4. What system do you use to track the location and maintenance requirements of structural and non-structural BMPs?

MSHA has developed a comprehensive program to locate, inspect, evaluate, maintain, and remediate BMPs to sustain their functionality, improve water quality, and protect sensitive water resources. The program's primary goal is to maintain MSHA's stormwater facilities to operate as designed and to strategically enhance their functions to meet today's stormwater standards. The Stormwater Management Facilities Program consists of four major components:

- Identification, inspection, and geodatabase development to manage SHA assets
- Maintenance and remediation of BMPs
- Visual and environmental quality enhancements, upgrades and retrofits
- Monitoring, research, and technology tools development

The program focuses on the remediation and enhancement of BMPs. This effort requires continuous improvement of the BMP inspection procedures, data management system, tools to track the performance and remediation actions. MSHA has developed a prioritization system for remedial activities and for developing new technologies for repairing or retrofitting BMPs, including visual and functional enhancement projects. A part of the Stormwater Management Facilities Program is research on performance and efficiency of commonly used BMPs.

The key to an efficient maintenance program is a detailed and consistent inspection assessment that is based on the *MSHA BMP Inspection Manual* that is part of NPDES Standard Procedures. Each facility is evaluated during a field inspection where individual parameters are scored (on scale 1 to 5) then used to establish an overall BMP performance rating:

A *No Issues*—BMP functioning as designed with no problem conditions identified. There are no signs of impending deterioration.

B *Minor Problems* are observed, however, BMP is functioning as designed.

C *Moderate Problems* are observed, however BMP is functioning as designed, but some parameters indicate the performance and functionality are compromised.

D *Major Problems* are observed, and facility is not functioning as designed. Several issues may exist that have compromised the BMP performance or indicate failure

E *Severe Problems* exist, and facility is not functioning as designed with several critical parameters having problem conditions. BMP facility shows signs of deterioration and/or failure. Remedial action should be performed immediately.

The inspection protocol is summarized in the guidance document *Best Management Practice Field Inspection & Collection Procedures*. The manual documents the methodologies used in the field for identifying, locating, and inspecting stormwater management facilities statewide. MSHA has expanded the protocol to include criteria for visual quality as well as inspection for potential water quality and visual enhancements.

After the field inspections, MSHA performs prioritization for maintenance and remediation by assigning the remedial rating. This is based on the overall initial inspection rating, performance, functionality, integrity and visual appearance; and also scope and complexity of the potential remedial work:

I *No Response Required*—schedule for multi-year inspection.

II *Minor Maintenance*—perform as necessary to sustain BMP performance. Upon remedial action and re-inspection, can be candidate for multi-year inspection.

III *Major Maintenance or Repair* is needed to return the site to original functionality within the existing footprint of the facility. Structural defects require repair and/or restoration.

IV *Retrofit Design*— is required on-site or at another location, since BMP cannot be returned to its original functionality within its existing footprint.

V *Immediate Response* is mandatory to address any public safety hazards regardless of the **functionality of the BMP.**

VI *Abandonment* of the BMP when the facility is not maintainable and will not provide sufficient benefits if retrofitted due to the lack of access for construction and maintenance, limited space or minimum impervious area treated.

5. Do you contract out BMP maintenance?

Yes. MSHA has several different approaches to stormwater management maintenance, depending on the BMP performance and required level of remediation. The majority of routine and major maintenance is performed by on-call contractors and managed by the design lead office. MSHA has advertised a number of open-ended (time and material) contracts to perform routine and preventive maintenance as well as major repairs. Typically, the contract duration is 24 or 36 months. MSHA also uses its own maintenance forces at some selected district in order to incorporate the BMP maintenance into the routine roadside maintenance.

In addition, MSHA has initiated innovative contracting and recently advertised its first Design-Build Operate Maintain (DBOM) countywide contract for stormwater management facilities maintenance.

Finally, BMP retrofits and enhancement that involve design and total reconstruction are usually advertised as regular highway projects.

6. Do you develop costs for BMP O&M during the project development process?

The practical aspects of maintenance are considered as part of the stormwater management type suitability and selection at each site during the design process, however, the maintenance cost is not necessarily evaluated at the project development stage.

Program Compliance Analysis, Reporting, and Tracking

1. **What specific tools do you use to report individual compliance issues as well as for annual reporting?**

   Reporting:

   - MDE Annual Report for Phase I and Phase II NPDES MS4 Permit
   - MSHA Business Plan—quarterly
   - Stormwater Management Inventory Database (Geodatabase) and Stormwater Management Maintenance Tracking Database (Access) are primary sources of data for reporting the current status of the stormwater management BMP program. ESC QA toolkit is an online database that site inspection reports are entered. Monthly and quarterly tabulations are reported.

2. **What are the components of your program effectiveness assessment?**

   Stormwater management BMP program:

   - Percentage of stormwater management facilities functioning as designed
   - Percentage of BMPs requiring minor/major maintenance or retrofit
   - Number of stormwater management facilities maintained/ reconstructed during the reporting period
   - Cost of maintenance
   - Cost of retrofit and enhancement project
   - Number of BMP facilities inventoried and inspected
   - Percentage of MSHA pavement being treated vs. untreated

3. **Do you have measurable goals that you report on annually?**

   - MS4—Permit Conditions
   - MSHA Business Plan Objectives, Goals and Measures
   - SB Response: Number of inspections, average ratings, percent inspections, percent projects in compliance, and numbers of inspectors trained

4. **What system(s) do you have in place to track implementation of water quality requirements throughout the project development process?**

   Water Quality Bank, Stormwater Management As-Built Certification, ESC QA Rating during construction

REGULATORY

Questions concerning Regulatory can be directed to:

Ms. Karuna Pujara, Chief
MSHA Highway Hydraulics Division
Phone: (410) 545-8390
kpujara@sha.state.md.us

Coordination with Local and Federal Regulators

1. **Characterize communication with your permitting agency. Does the permitting agency understand your transportation mission? Is it a cooperative relationship?**

   Yes they do. Yes.

2. **Do you routinely partner to find solutions to permitting and water quality issues? If so, provide an example.**

   Yes. MSHA recently delivered two mega projects, the Woodrow Wilson Bridge replacement project and the Inter-county Connector project. Coordination and meetings took place during early design stages at various levels of staffing. MDE clearly understood delivery needs to MSHA and MSHA made all attempts to deliver the regulatory intent of stormwater management /ESC. For both projects, a project-wide banking was established to facilitate flexibility and accountability on project base. This allowed flexibility among several phases of project while ensuring no net loss at the end of entire project.

3. **Do you work cooperatively in the development of language for your NPDES permit?**

   Yes.

4. **What is your structure now, and is there a better way to organize or structure your staff to facilitate and improve communication with regulatory agencies?**

   MSHA Highway Hydraulics Division responsible for design communicates with MDE Stormwater and NPDES staff and agrees on regulatory needs. Reconciliation of data occurs every few years. Because responsible staff is identified within each agency, this is working well.

5. **Do you have interagency agreements that define communication protocols?**

   WQ banking agreement, ESC quality inspection, self-certification MOU

6. **How are they functioning?**

   Both very well from MSHA stand point. We believe it works for MDE as well.

7. **Do you have any joint training/certification programs?**

   ESC-certified personnel training; it is a delegated training ability from MDE. MDE stays involved in training development, SHA delivers the training.

401 Certifications

1. **What is your state's scope for a 401 certification, and does it expire/conclude?**

   We do not have experience obtaining the 401 certifications specifically. Maryland permit process groups many permit applications into one, called the Joint Permit Application (JPA) and the 401 certification is part of that process. The NPDES permitting is not associated at this point with the JPA process. The JPA is typically associated with wetland and waterways, waterway construction and floodplain impacts. Current NPDES MS4, industrial and construction activity permitting does not require the applicant to submit for separate 401 certifications. The contact to obtain further information for this topic is the MDE Wetland and Waterways program at (410) 537-3745.

2. **Do you receive water quality requirements in 401 certifications that exceed NPDES requirements? What are some of the more onerous requirements you have seen?**

   Not that we are aware of.

3. **Do you see this as a symptom of some other problem such as inadequate water quality assessment during the National Environmental Policy Act (NEPA) process?**

   Cannot answer this question.

4. **Is the regulatory agency's 401 certification program coordinated with its other water quality programs, including TMDLS and NPDES?**

   See answer to Question 1, above.

5. **Are there clearly defined treatment expectations for 401 certifications (i.e., maximum extent practicable)?**

   Not that we are aware of.

6. **Are there mutually agreed upon performance standards or goals and objectives for stormwater management? Are there ESA issues (such as a take)?**

   What are ESA issues?

NCDOT Responses

TMDLs

TMDL Implementation

1. **Where and how do you characterize discharges from your ROW (i.e., location end of pipe], ROW, load reduction between EOP and ROW)?**

   In the context of TMDL development and implementation, NCDOT supports a variety of approaches to characterize discharges and pollutant loading from NCDOT areas. Through our research program, NCDOT has evaluated runoff characteristics as a function of road type (primary or secondary), road usage (ADT), and location (mountain, piedmont, and coastal physiographic regions). We have also evaluated runoff as a function of surface type (impervious and vegetated cover) within the ROW in an effort to better understand sources and develop source controls.

   The predominant approach used to characterize NCDOT in NC TMDLs has been aerial loading estimates from the entire ROW area rather than from specific outfall or discharge locations in an impaired watershed. In this context, NCDOT's pollutant contributions have been based on export coefficients, EMCs, application or accumulation/wash-off rates, and impervious area characteristics. NCDOT has been assessed as a unique source in TMDLs for which elevated nutrients, bacteria, and stormwater sources have contributed to chlorophyll a, turbidity, fecal coliform, and biological integrity impairments. The specific approach is largely dependent on the pollutant of concern, available data, watershed characteristics, and the modeling approach used in TMDL development.

   When named as a significant contributor to impairment, NCDOT's NPDES permit requires NCDOT to assess outfalls and develop a plan for future monitoring. These activities are designed to produce a much more detailed assessment and characterization (on an outfall-by-outfall basis) of pollutant contributions from NCDOT area.

2. **How do you address a TMDL (process)? Are you involved in the development?**

   The DOT is unique in that it is the only single entity in the state with NPDES permit coverage in virtually every 303(d)-listed watershed, thereby making the DOT a potential stakeholder in almost every TMDL developed in North Carolina. This unique situation emphasizes the importance of the DOT and the Division of Water Quality (DWQ) working together in partnership to develop a sustainable and mutually beneficial communication framework regarding TMDL matters. The goals of this framework include ensuring a smooth, efficient, and transparent TMDL development process; applying highway impact analysis methods rooted in science, and targeting implementation of management measures to achieve the most environmental benefit while controlling cost.

   The DOT and DWQ have proactively initiated steps to develop this communication framework, and they have partnered on a number of TMDL-related activities. In 2006, NCDOT and

NCDWQ's Modeling and TMDL Unit developed a flowchart outlining the steps by which the two agencies would communicate and collaborate in developing future TMDLs. To date, NCDOT's involvement has included active participation on technical advisory committees and in public stakeholder meetings, assistance to TMDL modelers with data needs and model inputs, partnering with other state, local, and nonprofit agencies to conduct monitoring and develop TMDLs, developing tools to evaluate pollutant contributions from NCDOT, and providing formal comments on draft TMDLs.

3. **How do you build an inventory of your storm drain system?**

   Project with Dewberry and Davis.

4. **What source control strategies do you have in place for TMDL constituents, and what strategies are you researching?**

   See section 1.4 of the Stormwater Mgmt Report

   Strategies for controlling bacteria loading from NCDOT areas have included:

   - Pet waste collection stations have been installed in highway rest areas. DOT has plans to implement pet waste stations at rest areas in 14 of the 17 river basins in North Carolina as part of BMP Retrofit Program. Pet waste stations control pollutants at the source by encouraging rest area visitors to collect and properly dispose of animal waste.
   - The HSP has been working closely with DENR's Shellfish Sanitation and Recreational Water Quality Section and the NC Coastal Federation to develop methods for enhancing the identification and distribution of information related to stormwater problem areas with the potential to affect shellfish harvesting waters.
   - Nutrients
   - Atmospheric Deposition Interagency Modeling Workshop
   - Nitrogen Deposition White Paper
   - Nitrogen Deposition Sources White Paper
   - Developed a literature database to be used as a foundation for future research
   - Developed Highway Runoff Screening Tool for nutrients

5. **How many TMDLs are you named in and have received a load allocation for?**

   NCDOT has been named as a significant contributor to impairment in two North Carolina TMDLs: Swift Creek in the Neuse River Basin (biological integrity impairment) and in Boathouse Creek and the White Oak River in the White Oak River Basin (fecal coliform impairment).

6. What are the top pollutants of concern?

Over the past decade, through research and monitoring studies, NCDOT has characterized a wide range of pollutants in runoff from primary and secondary roadway surfaces and ROW areas throughout North Carolina. NCDOT-sponsored research has also included in-depth evaluations of specific pollutants and the sources or origins of those pollutants in the highway environment. Based on this work, nutrients (primarily nitrogen) are at the top the list of pollutants of concern. Considerable effort has been placed on better understanding nutrient sources, both those that originate outside of NCDOT's ROW (e.g., atmospheric deposition or nutrient runoff from adjacent land uses) and those that originate within NCDOT's ROW (e.g., fertilizer usage). While significant amounts of nutrients are often not generated on the roadway or in the adjacent right-of-way, these areas often serve as a conduit for nutrient pass through by receiving them from adjacent, upslope lands or atmospheric sources and permitting their movement to downstream water bodies.

North Carolina Division of Water Quality's (NCDWQ's) initiatives and the NC 303(d) List have also played an important role in directing the focus of NCDOT research. NCDWQ initiatives over the past five years have included TMDLs for fecal coliform bacteria, turbidity, aquatic weeds, chlorophyll a (nutrients), and biological integrity. Of these, the highest priority pollutants of concern (from highest to lowest), include nutrients in lakes (particularly nitrogen), biological integrity, fecal coliform bacteria, turbidity, and aquatic weeds.

7. Do you have a policy for structural BMP retrofit and if so what is it?

Not aware of a specific policy for retrofits.

8. Do you have any examples of how a load allocation for the highway system was derived?

NCDOT has received waste load allocations in two North Carolina TMDLs: Swift Creek and White Oak River. In Swift Creek, the TMDL was stated in terms of a watershed-wide percent reduction in effective impervious cover. This reduction was assigned to all NPDES permittees in the watershed. In Swift Creek, unique sources of biological impairment were not quantified. Rather, all known or potential stressors or sources of impairment were grouped and assigned the same percent reduction.

` In the White Oak River TMDL, a watershed model was used to assess bacteria loading from unique point and nonpoint sources. Load reductions from NCDOT lands were determined by comparing current pollutant loading conditions to scenarios in which the modeled bacteria accumulation rate on NCDOT land was set at zero. The difference between these two model runs represented the load from NCDOT land. The existing load was multiplied by the overall percent reduction determined to meet fecal coliform water quality standards in the receiving water to establish the final NCDOT WLA.

9. **Have you assessed cost for TMDL compliance? Do you have dedicated staff for TMDL compliance?**

   NCDOT has dedicated both staff and resources to ensuring that TMDL compliance through the NPDES permit is maintained. Costs are routinely updated as TMDLs are developed and the need for NCDOT involvement changes. NCDOT's NPDES permit states that NCDOT and NCDWR will work together to develop strategies for the protection of water quality and that they will develop a process by which discharges from NCDOT can be assessed during the preparation of a TMDL. Thus, compliance with TMDL NPDES requirements involves a wide spectrum of activities, such as participation in ongoing TMDLs, supporting NCDWQ in the characterization of NCDOT in TMDLs, and developing plans to address specific WLAs assigned to NCDOT in impaired water bodies.

10. **Is the Endangered Species Act (ESA) a consideration in the TMDL program?**

    The ESA has not been specifically considered in any of the TMDLS in which NCDOT has been involved.

Water Quality Credit Trading

1. **Do you have an established (or are you establishing) credit trading program for TMDL compliance? If so, in what regulatory framework/CWA or state authority?**

   Historic approaches to trading in North Carolina have not adequately addressed many of the complex legal requirements that NCDOT faces.

2. **Do you think this would be a valuable tool?**

   Water quality credit trading has the potential to be a valuable tool in North Carolina. NCDOT supports the use of approaches that assist in targeting management measures that achieve the most environmental benefit while controlling cost.

3. **What pollutants of concern do you have a trading program for?**

   None at this time.

4. **Do you think your regulatory agency would approve such a program? Give a brief outline of your credit trading program.**

5. **Do you have to mitigate for impervious surface addition on a project?**

   TMDLs: At this time NCDOT is not required to implement specific mitigation measures for impervious areas. In 2009, NCDWQ developed a TMDL for biological impairment in which impervious surface was used as the basis for defining WLAs and LAs. However, compliance with this TMDL is intended to be met through stormwater BMPs that result in hydrologic improvements. Specific impervious cover reduction measures were not defined in the TMDL.

   Because project mitigating is tied to capturing runoff from a specified rainfall event, indirectly, the level of mitigation measures required for a project will increase as the impervious area of

that project increases.

6. **Do you have, or do you think an impervious surface trading program would be valuable?**

   Not really… Andy, it seems that DOT would only be in the position of buying and not selling credits. Perhaps it depends on the details.

7. **How are water quality debits and credits determined?**

8. **Is there any mechanism for out-of-kind credit trading?**

BMPs

Water Quality Traditional and Innovative BMPs

1. **How do you define LID?**

   Construction: LID. TS

   Construction: Systems that mimic water quality and quantity typical for undisturbed, wooded sites as closely as possible. RM

   Post-Construction: Currently, NCDOT does not have an official definition of LID with regard to post-construction stormwater BMPs for the highway environment. However, it is generally accepted in the program that LID signifies approaches that are based on opportunistic land planning, emphasizes conservation and use of onsite natural features, offers pollution prevention, and/or manages stormwater as close to the source as possible. At this point in the program, specific practices are not labeled as LID, nor are they given preference over other practices for being more LID-like.

   NCDOT is interested in investigating several LID practices as part of the HSP Retrofit Program. Practices of interest include soil amendments for median areas, increasing filtration/infiltration in embankments, and permeable pavement overlays. LID practices that are not currently listed in the NCDOT BMP Toolbox are investigated through the Retrofit or Research Programs. Once they have been adequately vetted, they are included for widespread use in the NCDOT BMP Toolbox.

2. **What structural BMPs are approved for use in the highway ROW?**

   Post-Construction: The NCDOT Stormwater BMP Toolbox is the technical design manual that provides a list of BMPs that may be used in both retrofit and new roadway construction. At this time, these BMPs include swales, preformed scour holes, dry detention basins, level spreaders, forebays, hazardous spill basins, and infiltration basins. A design chapter on filtration basins/bioretention basins is planned for 2009.

3. **What BMPs are conditionally accepted or are you considering for use?**

   Post-Construction: Several bridge-related BMPs have been conceptualized or are being

considered for the Bridge Stormwater Project. These BMPs include natural LID basins, cisterns, and overbank practices. During site visits to select bridge sites for inclusion in the bridge stormwater project, it was noted that stormwater near the bridge deck tended to pool in preexisting depressed areas. If these areas are able to accommodate the 1-inch storm event and to nonerosively release the 1-inch storm, an existing site feature could be used to treat stormwater runoff and dampen the peak flow. These areas have been dubbed the Natural LID Basins. It was also observed that the overbank area underneath bridge decks, from the bank of the receiving stream to the bridge abutment, have historically not been used as areas for stormwater treatment. In addition, lack of vegetation and erosion protection has resulted in rills and gullies. The BSP team is considering the use of dense vegetation and various stabilization techniques in the overbank to provide vegetative treatment and prevent erosion. Finally, cisterns are being considered for use as part of the BSP to collect and reuse bridge deck runoff at nearby rest areas.

NCDOT may also conditionally consider traditional BMPs that have significant deviations from the design criteria posted in the toolbox. These BMPs are typically evaluated through the NCDOT Retrofit Program. BMP retrofits within the highway environment may require creative approaches due to lack of ROW, steep slopes, and set elevations. Therefore, allowances for deviations from the design criteria in the BMP Toolbox are possible. In addition, the Retrofit Program serves as a vehicle for installation of alternative BMP designs or innovative BMPs. If a BMP retrofit performs well and is feasible statewide, the BMP Toolbox may be amended to include the alternative design. Currently, the HSP is investigating the impact of bioretention basin sizing on performance and filtration basin media. BMP retrofits and their design criteria must be approved on a case-by-case basis by the NCDOT Hydraulic Unit.

Finally, in the HSP Research Program, researchers from NC State are evaluating the performance and feasibility of two innovative treatments. The first project, in Kure Beach, investigates subsurface infiltration basins installed in dune areas of the coastline. The second project investigates potential improvements in nutrient removal of roadside swales that have become inundated with stormwater, and therefore exhibit wetland vegetation.

4. **What LID BMPs do you use?**

Construction: Grass swales; bioretention basins; permeable pavement; cistern. TS

Post-Construction: BMPs listed in the NCDOT BMP Toolbox (i.e., appropriate for statewide use) that could be considered LID practices include the level spreader, the infiltration basin, and the swale. A design chapter on filtration basins/bioretention basins, which can be considered an LID practice, is planned for 2009. LID BMPs that are being conditionally considered and evaluated through the Bridge Stormwater Project include the natural LID basin, overbank practices, and cisterns.

5. **What is your policy for requiring their use?**

TMDLs: I am not aware of any specific policy or requirements related to water quality BMPs.

Post-Construction: NCDOT does not have a specific policy for the use of LID practices. Only BMPs provided in the NCDOT BMP Toolbox may be used statewide. Otherwise, innovative or experimental BMP may be evaluated through the Retrofit or Research programs.

Construction: Driven by riparian buffer rules and coastal stormwater requirements.

6. **What innovative construction BMPs do you use?**

Construction: Baffled skimmer basins; fiber check dams; compost berms; compost seeding.

Construction: Basin baffles, surface outlets, fiber check dams, PAM for enhanced erosion control, chemical treatments for turbidity control (pumped and gravity systems).

Post-Construction: Currently, to my knowledge, we do not use any innovative construction techniques for post-construction BMPs. However, with the number of retrofits being installed for the bridge stormwater project, it is anticipated that lessons learned from construction of post-construction BMPs will be collected. One construction technique that will be used for the BSP was conceptualized by Dr. Bill Hunt with NCSU. Dr. Hunt recommends when grading a basin, especially in clayey soils, that the backhoe bucket teeth be used to keep a rough surface of the final in-situ grade and to avoid smoothing the soil. Hypothetically, this technique should prevent the reduction of infiltration capacity of the soil.

7. **What new BMPs do you think you will need to comply with the draft U.S. EPA Effluent Limitation Guidelines (ELGs)? What new BMPs will you need to comply with TMDLs?**

Construction: Portable filtration devices and polymer-enhanced BMPs; land application; flocculation compounds: aluminum sulfate and gypsum; well pointing systems.

Construction: All of the above.

Post Construction: The draft U.S. EPA ELGs pertain to construction runoff and temporary controls and treatment of construction-related runoff. Team members more familiar with design requirements and BMPs in NCDOT's erosion and sedimentation program would be better suited to answer the first part of this question.

With regard to TMDLs, NCDOT has been named as a significant contributor in a biological integrity TMDL and a fecal coliform TMDL. The biological integrity TMDL limits all significant contributors to a maximum impervious cover in the watershed. NCDOT will likely implement hydromodification BMPs to meet the requirement of this TMDL. No new BMPs should be required.

However, there are not as many available options for cost-effective treatment of pathogens in stormwater. The program would greatly benefit from low-maintenance BMPs that could be used inline with the stormwater collection and conveyance system to treat pathogens.

8. **How do you identify new BMPs?**

Construction: Trade shows; journals; word of mouth.

Construction: Identify the problems and issues, look for answers in the market, put a BMP together if the market doesn't have one.

Post-Construction: In the past, new BMPs or creative approaches to BMP component design have been identified through one of two ways:

- The constraints (surface water classification, space-limitations, etc.) of a particular project may require an innovative approach to stormwater treatment
- A researcher may approach NCDOT with a new BMP idea through the HSP Research Program.

New BMPs are investigated through the Research or Retrofit programs before being allowed statewide.

9. **How do you (or your state) vet and approve new BMPs?**

Construction: NCDOT testing; university testing.

Construction: We do replicated testing in controlled (laboratory, field) situations and on actual construction sites.

Post-Construction: The North Carolina Department of the Environment and Natural Resources (NCDENR) DWQ has a policy for vetting innovative and proprietary BMPs not included in the NCDOT BMP Toolbox. Per NCDOT's NPDES permit, NCDOT is required to evaluate innovative and proprietary practices in keeping with this policy.

The monitoring requirements for innovative and proprietary practices are conducted through the HSP Research Program. Innovative BMPs conceptualized for the Bridge Stormwater Project will be visually observed throughout that project. If any are deemed potentially successful from visual inspection, they may be monitored as part of a research effort.

10. **When, in the project development process, do you identify what BMPs are needed (construction and post-construction BMPs)?**

Construction: Preliminary and final field inspections.

Post-Construction: For projects that go through the Merger process (i.e., projects that receive federal funding), all collaboration on avoidance and minimization of environmental impacts occurs at Concurrence Points 4A, 4B, and 4C. The use of hydraulic structures, appropriate construction techniques, prevention of ditching and filling in wetlands, and the need for stormwater BMPs is confirmed through discussions with the relevant permitting agencies. For smaller projects that are permitted on a regional basis, Hydraulics Engineers and occasionally staff from the Project Development and Environmental Analysis (PDEA) discuss stormwater BMP needs with regional NCDWQ staff. The point at which BMP needs are determined during these smaller projects varies from project to project.

For more information on the Merger process, please refer to http://www.ncdot.org/doh/preconstruct/pe/MERGER01/.

11. How do you select the appropriate BMP for the project?

Construction: Drainage area; environmentally sensitive areas; design storm.

Post-Construction: BMPs are currently selected on a project-by-project basis via agency collaboration between NCDOT and NCDENR representatives. For projects that drain to Outstanding Resource Waters, High Quality Waters, and in the 20 coastal counties, NCDOT attempts to apply stormwater BMPs as required for high-density projects, as defined in 15A NCAC[10] 2H .1002(4).

12. Define constructed wetlands relative to jurisdictional authority.

Construction: Handled by the Ecosystem Enhancement Program. Constructed wetlands are under jurisdictional authority, generally a 5-year observation period is required.

Post-Construction: To my knowledge, stormwater wetlands designed specifically for the purpose of stormwater treatment are not considered jurisdictional wetlands. I am not aware of a written policy by NCDWQ, USACE, or NCDOT that discusses this topic, however.

Nonstructural and Source Control Management Options

1. What nonstructural and source control measures do you implement from the design process through construction and post-construction?

General: NCDOT implements avoidance, minimization, and mitigation practices throughout its work efforts, including corridor selection, design, construction, and post-construction.

Chemical Applications: NCDOT works cooperatively with scientists at NC State University to determine what products we utilize in our Integrated Roadside Vegetation Management Program. The U.S. EPA requires that environmental fate and water toxicity information be on all labels. The label is the law in North Carolina. The North Carolina Department of Agriculture and Consumer Services (NCDA&CS) is the regulatory authority in North Carolina. Each application crew has at least one person on site who has a valid NCDA&CS Pesticide Applicator License. These licensed employees (many with multiple subclassifications) are required by law to attend recertification classes and receive ongoing training in content must be preapproved by NCDA&CS.

Construction: Level spreaders; vegetative strips/buffers; detention basins; preformed sour holes; plunge pool.

Construction: NCDOT and NC State University have developed a program to certify three levels of professionals involved in ESC. Level I is for Installers, Level II is for Project Supervisors, and Level III is for Erosion and Sediment Plan Designers. NCDOT also has specifications that compensate contractors for quick establishment of vegetation. Other

[10] North Carolina Administrative Code

specifications that are more punitive will encourage the proper implementation and maintenance of the ESC plan.

Post-Construction: Temporary nonstructural or source control practices implemented during or shortly following construction include stabilization with mulch and seeding, asphalt tacking, and erosion control matting, Nonstructural or source control practices permanently implemented following construction include roadway sweeping, installation of catch basins with fish logos, pet waste stations, and buffers. Other post-construction nonstructural practices being considered as part of the Bridge Stormwater Project include shoulder restoration to re-establish sheet flow and minimize erosion, bridge stormwater collection and conveyance assessments (to detect and minimize erosion around bridges), and dispersion of stormwater runoff via bridge drainage systems.

Industrial Activities: NCDOT develops Stormwater Pollution Prevention Plans for all industrial facilities; these plans address nonstructural and source control measures for pollutants that would impact stormwater quality. In addition, NCDOT is developing a BMP Guidance Manual for Industrial Activities and Road Maintenance Activities.

2. **What have you determined to be the constituents of concern (COC) from highway runoff that originates within the ROW, and load percentages?**

Construction: Sediment; nitrogen; phosphorus; bacteria; hydrocarbons.

Construction: Turbidity/TSS/Total Dissolved Solids.

Post-Construction: Research studies have been conducted by NCDOT to estimate COC and load percentages for site-specific areas, but, to my knowledge, no statewide assessments have been made. Many federally funded research studies have established COCs from highway runoff, and our program usually defers to the various guidance documents that report results from these studies (e.g., NCHRP Report 474 and 565). In general, COCs in highway runoff primarily include metals, solids and sediment, petroleum hydrocarbons, and nutrients. NCDOT is currently implementing an extensive bridge deck stormwater monitoring effort, which will help in further identifying COCs in stormwater runoff from highways as well as establishing load percentages.

Industrial Activities: For Industrial Facilities, COC are sediment and materials stored onsite such as CRS-2, diesel fuel, gasoline, salt and brine. Because NCDOT provides secondary containment for all hazardous materials, and for many nonhazardous, losses to stormwater runoff are rare and unlikely. NCDOT utilizes numerous BMPs to ensure that material losses do not occur. More information can be found in the Stormwater Pollution Prevention Plans (SPPPs).

3. **Have you developed any source control programs to control these COCs?**

Construction: Level spreaders; vegetative buffers; pet waste containment.

Construction: NCDOT has developed an extensive ESC Program that utilizes the current

technologies to minimize impacts associated with the COCs.

Post-Construction: COCs are addressed in highway runoff based on site-specific regulatory requirements, which include, but are not limited to, nutrient control programs implemented by the state for new development. The nonstructural and source control practices discussed under question 1 do target some of the COCs discussed under question 2, but to my knowledge, are not part of any specific source control programs. However, programs have been established as part of the permit that implements source controls to control COCs from a general perspective. For example, the stabilization measures utilized under the ESC program do target solids, sediment, and other contaminants that adsorb to sediment. In addition, the ESC Program establishes requirements for contractors to control waste that may cause adverse impacts to water quality. Additional programs associated with source control include the following:

1) The Vegetation Management Program institutes practices to responsibly apply and control pesticides and fertilizers.

2) The IDDE Program implements practices to prevent illicit spills, discharges, and dumping in NCDOT ROW.

3) Stormwater Pollution Prevention Plans are prepared for Industrial Activities, which include preparation of spill prevention plans and control of vehicle and equipment cleaning areas.

4) The Education and Involvement Program has informed and educated the public regarding the use of Pet Waste Stations that have been installed at rest areas.

Industrial Activities: The SPPPs for industrial facilities address source control programs (i.e., BMPs) in detail. See attached example SPPP.

4. **Do you have an enhanced sweeping program for water quality improvement?**

Construction: Enhanced Sweeping Program? Define Enhanced Sweeping.

Post-Construction: Sweeping activities on roadways and bridges are being conducted in every river basin in the State of North Carolina. To my knowledge, these activities are being implemented for various reasons, including removal of debris on coastal bridges primarily for aesthetic reasons, and removal of accumulated sediment on roadways following the winter season and application of deicing materials. A preliminary map showing known sweeping activities in cities in the State of North Carolina has been uploaded to the SharePoint site. To my knowledge, water quality benefits of these sweeping activities have not been assessed.

Industrial Activities: This topic will be addressed in detail when the chapters on Street Sweeping are written for the Industrial Activities and Road Maintenance BMP Guidance Manual.

5. **Do you have an adopt-a-highway program?**

6. **Give a brief outline of your enhanced maintenance activities that would control pollutants at the source.**

Post-Construction:

Current maintenance activities that could control pollutants at the source include:

1) BMP inspection (performed under the Inspection and Maintenance Program)

2) Stormwater inspection of industrial activities (performed as part of Stormwater Pollution Prevention Plan under Industrial Activities Program)

3) Roadway and Bridge Sweeping

4) Borrow Pit and Waste Pile Activities (under Construction)

Maintenance activities under development that could control pollutants at the source:

1) Shoulder restoration to re-establish sheet flow.

2) Bridge Stormwater Conveyance and Collection System Assessment (BSCCA)

Industrial Activities: The industrial facilities strive to control all pollutants at the source and are constantly evaluating and optimizing their approaches. A good example of an enhanced maintenance activity that controls a pollutant source is the use of brine for roadway ice control. The use of brine has reduced the amount of salt/sand and calcium chloride used during roadway ice control operations. In addition, NCDOT has implemented source control BMPs for roadway ice control materials stored at maintenance yards such as covered storage, secondary containment, and good housekeeping.

NCDOT has designed and installed numerous wash racks at maintenance yards to minimize stormwater pollution. These standard wash racks typically include containment pads with sediment chambers and oil/water separators that discharge to the sanitary sewer system where available.

NCDOT fuel stations are typically equipped with overhead covering; double-walled fuel tanks with leak detectors; pump islands that have key-coded dispensers; fuel dispensers with deadman switches, breakaway hoses, and automatic shutoff valves; and spill kits.

7. Do you control pollutants associated with demolition?

Construction: Asbestos abatement; hydro-demolition.

Post-Construction: I am not aware of current programs that control pollutants specifically associated with demolition. However, the ESC Program is intended to address activities and control pollutants associated with construction, which should include demolition or redevelopment activities.

8. How do you determine the effectiveness of these programs?

Construction: Analytical monitoring to measure COCs on selected projects.

Post-Construction: While I am not aware of the determination of effectiveness for source

control practices, the Research Program is implemented to assess pollutant loads and provide feedback on performance of BMPs. The most recent Research Plan (a requirement of the permit) has been uploaded to the SharePoint site. Several research projects have recently completed that have evaluated the pollutant removal capacity of structural BMPs. These include:

- Research Project No. 2001-07, Evaluating BMPs for Treating Stormwater and Wastewater From NCDOT's Highways, Industrial Facilities and Borrow Pits
- Research Project No. 2003-19, Evaluation and Implementation of BMPs for NCDOT's Highways and Industrial Facilities
- Research Project No. 2006-04, Evaluation of Manufactured Best Management Practices
- NCDOT's Highways and Industrial Facilities
- Research Project No. 2006-04, Evaluation of Manufactured Best Management Practices

As part of the Bridge Stormwater Project, the definition of stormwater BMP effectiveness is currently being explored. *For more information, see Session Law 2008-107: Stormwater Runoff from Bridges Interim Report July 1, 2009.* ARR/AJN

Industrial Activities: There has been discussion around conducting internal NCDOT audits of Industrial Facilities. To date, the inspections required by the SPPPs and documentation on the SPPP Web site are used to track the effectiveness. When the IA/Road Maintenance BMP Guidance Manual is distributed, there will be tests for understanding associated with each chapter that will aid in making that training more effective.

Training workshops are conducted for facility personnel each year to review stormwater pollution prevention measures, to discuss innovative BMPs, and to train new employees. In addition, HSP staff has conducted brainstorming sessions to communicate program goals and accomplishments. See the attached example HSP Industrial Activities PowerPoint.

DOT PRACTICES/PROCEDURES

Agency Maintenance and Operations Practices

1. **What O&M practices do you use that improve water quality?**

Construction: During the construction phase, we implement physical and chemical treatments to reduce erosion, sediment, and turbidity.

Inspection & Maintenance (or Stormwater Control Management System [SCMS]): NCDOT is finalizing a Stormwater Control Inspection and Maintenance Manual that details inspection and maintenance needs for the different types of stormwater controls. By following this manual and using the SCMS Web site to document and track information, NCDOT has the tools to improve water quality by ensuring that stormwater controls function well.

2. **What O&M practices do you use that reduce the need for structural measures?**

3. **What practices do you use that could be used for credit against a TMDL?**

TMDLs: DOT's stormwater management approach is built upon DOT environmental programs that perform the following four Core Practices:

1. Avoidance and Minimization Practices
2. Implementation of Stormwater Control Practices
3. Post-Construction Stormwater Management Practices
4. CPI Practices

These Core Practices are based on a foundation of Regulations, Guiding Principles, DOT Business Units, Partnerships, and Environmental Programs.

Avoidance and Minimization Practices are executed in many ways, such as pre-project planning and design, by reconfiguring an existing project design, relocating the project to a different site, or potentially adopting a no-build alternative. Project planning and design measures to avoid adverse effects to water resources may include arrangement of facilities, operation, and construction to avoid sensitive features by reducing the project footprint, locating the project in the least environmentally sensitive area, timing construction to avoid certain sensitive fish spawning periods, and creating buffer zones.

Implementation of Stormwater Control Practices is the process that DOT uses to develop stormwater controls to offset impacts from stormwater runoff. Stormwater controls or BMPs may be nonstructural or structural. Nonstructural controls include techniques or measures that remove pollutants through process change, while structural controls are engineered devices that physically remove pollutants. The implementation of stormwater controls includes the development of resources and processes to support these practices as they are integrated into DOT operations.

Post-construction stormwater management practices maintain existing DOT facilities to minimize the impacts of stormwater runoff. Existing roadways and associated stormwater controls must be managed and maintained in order to operate correctly over their planned functional lifespan. Many of these managing activities are performed by business units in Operations, a business organization that coordinates numerous units involved in the construction and maintenance of DOT's roadways and facilities. Operations seeks and implements environmentally sensitive solutions to their core business practices, resulting in positive benefits to stormwater quality.

CPI is the fourth Core Practice. DOT is committed to developing and improving its processes and programs, including those associated with environmental concerns, through CPI. DOT staff members seek and identify ways to improve the action of the Department through its programs and daily work efforts. In addition to improvements made by individuals, DOT

promotes several organized programs to facilitate CPI, including but not limited to the CPI Program, the Office of Environmental Quality, and the HSP Research Program.

In addition to DOT's efforts to protect water quality, DOT's approach to stormwater management includes a decision-making process by which the DWQ, DOT, and other agencies meet water quality objectives through cooperation, understanding, and application of scientifically based approaches. With this foundation of collaborative efforts and DOT's independent pledge of stewardship for the environment, the Department is committed to continue and expand its role in protecting stormwater quality.

4. **What system do you use to track the location and maintenance requirements of structural and nonstructural BMPs?**

   Construction: During construction, structural and nonstructural BMPs are reviewed weekly onsite or after a 0.5-inch rainfall. Weekly inspection reports and maintenance activities are recorded. A database is utilized to compile location of maintenance requirements by a third party as well as for all post construction BMPs.

   Inspection & Maintenance (or Stormwater Control Management System [SCMS]): For structural (and some nonstructural) stormwater controls, NCDOT maintains an inventory of all controls and is developing a Web site called the SCMS where inventories, inspections, maintenance, research and the design of certain controls (typically retrofits) will be tracked. The development of SCMS is based on a protocol-tracking database that was piloted by one NCDOT Division. In addition to the Web site, NCDOT is finalizing a Stormwater Control Inspection and Maintenance Manual for detailed guidance on inspecting and maintaining the various types of stormwater controls that NCDOT utilizes.

5. **Do you contract out BMP maintenance?**

6. **Do you develop costs for BMP O&M during the project development process?**

Program Compliance Analysis, Reporting, and Tracking

1. **What specific tools do you use to report individual compliance issues as well as for annual reporting?**

   General: IDDEP Web site: Staff at the resource agency (NCDENR) is notified via e-mail of illicit discharges or dumping identified and verified by NCDOT staff. Eventually, NCDENR will be able to review and track the notifications online at this custom Web site.

   Annual Report: The annual report required by our NPDES permit provides a concise description of highlighted projects performed in each area of the permit. Additional information is available to NCDENR upon request. See the 2007 Annual Report provided.

   Regular Staff-level Meetings: NCDOT and NCDENR hold regular meetings of staff that directly implement and manage the HSP and the ESC Program. Meetings often include site visits and detailed discussion of practices at NCDOT. Typically, each meeting will focus on one

portion of the permit.

Periodic High-level Meetings: As needed, higher-level managers who oversee the Operations and Preconstruction sections of the Division of Highways and NCDENR meet to discuss compliance concerns and interaction between the agencies.

Construction: Erosion control database; post construction database.

Approach? NCDOT utilizes a web-based analysis, reporting, and tracking site referred to as IDDE. This site was developed to ensure that illicit discharges, spills, and illegal dumping into NCDOT municipal separate storm sewer system are detected and eliminated. Occurrence of these events are identified by DOT staff and motoring public. Once a report is submitted, the IDDE program manager reviews the information and determines whether a response can be handled within NCDOT or forwarded to the appropriate Division of Water Quality (DWQ) - Regional Office for enforcement of the regulations. IDDE report statistics are summarized and submitted with the Annual Stormwater Report to DWQ as part of the requirements of NCDOT's NPDES Stormwater Permit.

2. What are the components of your program effectiveness assessment?

General:

Internal project evaluations:

- Regular meetings of staff and consultants to review activities under the HSP and how they relate to the measurable goals of the permit.
- Informal interviews and surveys of staff in the field (i.e., Division forces) to evaluate the maintenance of roadsides and BMPs in the ROW.
- Tracking the number of structural and nonstructural BMPs implemented and inspected at Industrial Facilities using the Stormwater Pollution Prevention Plan (SWPPP)/ Spill Prevention, Control and Countermeasures Web site.
- Tracking the number of retrofit (structural) BMPs implemented using a spreadsheet and regular staff meetings.
- Tracking the number of structural roadside BMPs inspected and maintenance requirements using the SCMS Web site currently in beta testing.
- Tracking the number of public education brochures distributed and opportunities for public display or distribution of stormwater materials, such as at the North Carolina State Fair.

External project evaluations:

See discussion of regular staff-level meetings and periodic high-level meetings between NCDOT and NCDENR staff.

Construction: ESC grading system based on installation, maintenance, implementation, effectiveness, and an overall grade.

3. **Do you have measurable goals that you report on annually?**

   General: Yes. Measurable Goals are included in our NPDES permit (see provided NPDES permit) and are discussed in our annual report (see provided 2007 Annual Report). Other WQ concerns that are reported on annually include the number of minimum criteria projects performed by NCDOT. These projects are exempt from formal 401 review per regulation.

   Construction: ESC grading system.

4. **What system(s) do you have in place to track implementation of water quality requirements throughout the project development process?**

   General:

   Green Sheets: These pages document the controls (stormwater and other such as threatened and endangered species, wetlands, etc.) that were agreed upon between resource agencies and NCDOT during the planning phases. The Green Sheets are tracked with the project through the design phase.

   Stormwater Management Plan: NCDOT requires a narrative stormwater management plan to be developed for TIP construction projects. The Plan documents the stormwater controls put in place and their dependence on regulations or practices. Currently, NCDOT is developing an update to the Stormwater Management Plan process that will be applied to BMPs implemented within the DOT realm (including nonstructural BMPs) and be integrated with an online database (to be known as the SCMS Database) which will track the implementation, inspection, and maintenance for BMPs.

   Construction: Green sheets - environmentally sensitive commitments.

REGULATORY

Coordination with Local and Federal Regulators

1. **Characterize communication with your permitting agency. Does the permitting agency understand your transportation mission? Is it a cooperative relationship?**

   Construction: Very proactive and generally cooperative relationship with regulators.

2. **Do you routinely partner to find solutions to permitting and water quality issues? If so, provide an example.**

   Construction: Yes. Monthly agency site meeting, quarterly inter-agency meetings, onsite calibrations.

3. **Do you work cooperatively in the development of language for your NPDES permit?**

4. **What is your structure now, and is there a better way to organize or structure your**

staff to facilitate and improve communication with regulatory agencies?

Construction: Calibration is a component of employees' work plan. Building relationships and trust.

5. **Do you have interagency agreements that define communication protocols?**

6. **How are they functioning?**

8. **Do you have any joint training/certification programs?**

   Construction: Work force training with agencies. 4,000 people certified in training program that includes private engineering firms, contractors and state agencies.

401 Certifications

1. **What is your state's scope for a 401 certification, and does it expire/conclude?**

2. **Do you receive water quality requirements in 401 certifications that exceed NPDES requirements? What are some of the more onerous requirements you have seen?**

3. **Do you see this as a symptom of some other problem, such as inadequate water quality assessment during the National Environmental Policy Act (NEPA) process?**

4. **Is the regulatory agency's 401 certification program coordinated with its other water quality programs, including TMDLS and NPDES?**

5. **Are there clearly defined treatment expectations for 401 certifications (i.e., maximum extent practicable)?**

6. **Are there mutually agreed upon performance standards or goals and objectives for stormwater management? Are there ESA issues (such as a take)?**

Appendix D:

Scan Itinerary

Domestic Scan 08-03 Best Practices Addressing NPDES and Other Water Quality Issues in Highway System Management Draft Scan Itinerary (7/12/2009 - 7/23/2009)

DATE	DAY	TIME	ACTIVITIES	LODGING
07/11/09	Sat		Team members fly to Buffalo, NY	Springville, NY
07/12/09	Sun		Team members fly to Buffalo, NY	Springville, NY
		Evening	Team meeting	
07/13/09		AM	Meetings with NYSDOT in Buffalo, NY	Washington DC
	Mon	PM	Meetings with NYSDOT in Buffalo, NY	
		Evening	Fly from Buffalo, NY to BWI	
07/14/09		AM	Meetings with DDOT in Washington DC	Baltimore, MD
	Tue	PM	Meetings with DDOT in Washington DC	
		Evening	Drive from Washington DC to Baltimore, MD?	
07/15/09		AM	Meetings with MDSHA in Baltimore, MD	Raleigh, NC
	Wed	PM	Meetings with MDSHA in Baltimore, MD	
		Evening	Fly from BWI to Raleigh, NC	
07/16/09	Thur	AM	Meetings with NCDOT in Raleigh, NC	Raleigh, NC
		PM	Meetings with NCDOT in Raleigh, NC	
07/17/09	Fri	AM	Meetings with NCDOT in Raleigh, NC	Raleigh, NC
		PM	Meetings with NCDOT in Raleigh, NC	
07/18/09	Sat	AM	Fly form Raleigh, NC to Austin, TX	Austin, TX
		PM	Team meeting	
07/19/09	Sun	AM	No Assignment	Austin, TX
		PM	No Assignment	
07/20/09	Mon	AM	Meetings with TxDOT in Austin, TX	Austin, TX
		PM	Meetings with TxDOT in Austin, TX	
07/21/09	Tue	AM	Meetings with TxDOT in Austin, TX	Orlando, FL
		PM	Fly from Austin, TX to Orlando, FL	
07/22/09	Wed	AM	Meetings with Florida DOT, Turnpike in Orlando, FL	Orlando, FL
		PM	Meetings with Florida DOT, Turnpike in Orlando, FL	
07/23/09	Thur	AM	Meetings with Florida DOT, Turnpike in Orlando, FL	Orlando, FL
		Evening	Meetings with Florida DOT, Turnpike in Orlando, FL	
07/24/09		AM	Final team meeting	Orlando, FL
	Fri	PM	Final team meeting	
		Evening	Team members fly back home	

Appendix E:

Host Agency Contact Information

Texas DOT Environmental Affairs Division

Amy Foster, CPESC
Water Team Leader
TxDOT Environmental Affairs Division
125 East 11th St., Austin, TX 78701
Phone: (512) 416-2649
E-mail: afoster@dot.state.tx.us

Maryland State Highway Administration

Karen Coffman
MSHA NPDES Program Manager
Maryland State Highway Administration
Highway Hydraulics Division, C-201
707 North Calvert St., Baltimore, MD 21202
Phone: (410) 545-8407
E-mail: kcoffman@sha.state.md.us

New York State Department of Transportation

David Graves, CPESC, CPSWQ
Stormwater Program Coordinator
Senior Environmental Specialist
Environmental Science Bureau
New York State Department of Transportation
50 Wolf Road, 4th Floor, P.O.D. #41
Albany, NY 12232
Phone: (518) 457-9608
E-mail: dgraves@dot.state.ny.us

Florida's Turnpike Enterprise

Jeremiah Marek
NPDES Coordinator
Florida's Turnpike Enterprise
Pompano Operations Building
Florida Turnpike Milepost 65
Phone: (954)-934-1213
E-mail: Jeremiah.Marek@dot.state.fl.us

District of Columbia Department of Transportation

Jeff Seltzer, P.E.
Program Manager
Infrastructure Project Management Administration
District Department of Transportation
64 New York Avenue, N.E., Washington, D.C. 20002
Phone: (202) 671 4607
E-mail: Jeffrey.Seltzer@dc.gov

North Carolina Department of Transportation

Matthew (Matt) S. Lauffer, P.E.
Project Engineer
Hydraulics Unit, Stormwater Management
North Carolina Department of Transportation
Raleigh, NC 27699
Mail: 1590 Mail Service Center Delivery:
1020 Birch Ridge Dr., Raleigh, NC 27610
Phone: (919) 250-4100
Fax: (919) 250-4108
E-mail: mslauffer@ncdot.gov

Appendix F:

Scan Team Biographical Information

SCOTT MCGOWEN (AASHTO CO-CHAIR) is the Chief Environmental Engineer and Assistant Division Chief for Environmental Analysis for the California Department of Transportation (Caltrans). He is responsible for all Environmental Engineering activities and statewide policies, including hazardous waste, noise, air quality, and the integrated stormwater quality management program. He has been with the department for more than 24 years, working in several areas, including Design, Traffic Operations, and Finance (Programming), and serving as Office Engineer. He currently serves on the Board of Directors of the California Stormwater Quality Association, is a member of the State Water Resources Control Board (SWRCB) Stormwater Management Task Force, and is a member of the AASHTO Natural Systems and Ecological Communities subcommittee. He was responsible for spearheading the first AASHTO Stormwater conference in June 2008, which brought together 41 DOTs to collaborate on current and future stormwater perspectives and challenges. McGowen is a licensed Professional Engineer.

BRIAN SMITH (FHWA CO-CHAIR) serves as Ecologist on the FHWA Resource Center Environment Technical Service Team and provides technical assistance, training, and technology deployment in soil ESC (SESC) and other environmental areas. Smith participated in a SESC peer exchange in September 2008 and observed the SESC programs and practices of Minnesota and Wisconsin DOTs. His experience includes stream bank and trail stabilization work with the U.S. Department of Agriculture Forest Service in Park Falls, Wisconsin, and construction inspection with U.S. Army Corps of Engineers, Chicago District, where he managed an Interagency Coordination Agreement (ICA) with local Soil and Water Conservation Districts to review SESC plans submitted under Section 404 permit applications. He also has five years of construction field experience with the Illinois DOT as an engineering technician. Smith earned a bachelor's degree in Biological Sciences from Illinois State University and a graduate degree in Geology from Northern Illinois University. He is a Certified Professional in SESC (CPSESC) and a Certified Professional in Stormwater Quality (CPSWQ) and serves on Transportation Research Board Committee AFP40 – Physicochemical and Biological Processes in Soils.

SCOTT TAYLOR (Subject Matter Expert) is a Senior Vice President with RBF Consulting headquartered in Irvine, California. Taylor earned a bachelor's degree in Civil Engineering from California State Polytechnic University at Pomona, and a master's degree in Civil Engineering from California State University at Long Beach, both with an emphasis in water resources engineering. He has more than 24 years of experience in flood control engineering and surface water quality. He has taught undergraduate courses in hydrology and hydraulic design at the University of California at Irvine and California State University at Long Beach as well as continuing education courses in BMP design for the American Society of Civil Engineers. He is a Professional Engineer and serves as an instructor and course coordinator for a Professional Engineer license review course. Taylor has completed stormwater research projects for municipalities, counties, and DOTs. He has completed flood control and stormwater quality infrastructure design projects throughout the Southwest and specializes in highway drainage and stormwater quality design. He has completed stormwater quality design projects throughout the Southwest for land development projects, roadways, toll ways, freeways, and other public works infrastructure. Taylor is an ASCE Fellow and a Registered Civil Engineer in California,

Nevada, Arizona, Utah, and Tennessee. He provided a short course in construction and post-construction stormwater quality for the Government of Hong Kong. He has also provided stormwater training courses for states, municipalities, and private companies in California, Nevada, Arizona, and Tennessee. Taylor is Vice Chair and a member of the Board of Directors for the California Stormwater Quality Association.

FRANCES BRINDLE is the Natural Resource Manager for the Oregon Department of Transportation (since 2004), where she manages a staff of program managers responsible for ESA compliance, removal-fill permitting, erosion control, terrestrial and aquatic biology, water resources, and fish passage. She has more than 15 years of environmental management and permitting experience with the Oregon Military Department and the Department of Transportation. Brindle is the co-chair of the AASHTO Standing Committee on the Environment Steering Committee's Natural Systems and Ecological Communities Subcommittee. She is the Oregon DOT representative on the Tribal – State Government to Government Natural Resource Cluster. Brindle has a bachelor of science degree in Natural Resources and Environmental Science from Purdue University and a master of science degree in Environmental Soil Science from Oregon State University. In 2000 she was designated a Certified ESC Professional by the International Erosion Control Association since 2000.

PATRICIA A. CAZENAS is a Highway Engineer with the FHWA's Office of Project Development and Environmental Review in Washington, D.C. Cazenas develops agency policy, provides training, and deals with environmental regulations, concepts, practices, and procedures as they relate to highway water quality issues. She serves as the national advisor on water quality control, water resources, stormwater management, and water resources coordination in connection with federal-aid highway programs. She has more than 25 years of experience in both government and consulting engineering firms. She received her bachelor of science degree in civil engineering from Virginia Tech and is a registered professional engineer and licensed land surveyor in Virginia. She serves on technical panels for the Transportation Research Board's National Cooperative Highway Research Program and is a member of the TRB's Hydrology, Hydraulics, and Water Quality Committee.

VINCENT W. DAVIS serves as the Stormwater Engineer at the Delaware Department of Transportation (DelDOT). His position functions as an engineering expert in stormwater management for transportation construction projects. He is also responsible for the management and all technical decisions made in DelDOT's statewide stormwater management program. His position ensures that projects within DelDOT rights-of-way fulfill the obligations as set forth by the NPDES permit. Davis has been involved with many of the NPDES issues since their implementation at DelDOT. Davis received bachelor of science degrees in Civil Engineering and Environmental Engineering from North Carolina State University. He is a member of the International Erosion Control Association and is a registered Professional Engineer.

MARK HEMMERLEIN serves as the Water Quality Program Manager in the Bureau of Environment at the New Hampshire DOT; he has 14 years of experience with the department. His duties presently involve managing many aspects of stormwater runoff from state highways during

design, construction, and operations and maintenance. Hemmerlein is also actively involved as a panel member in several NCHRP projects focusing on Stormwater Treatment with Vegetated Buffers and Asset Management of Environmental Mitigation Features. He earned his bachelor of science degree in Forestry from the University of Vermont and a master of science degree in Botany from the University of Wyoming. He also has been closely involved in the developing methodology and practices for stormwater management and treatment on the I-93 Salem to Manchester project, as well as many others.

MATTHEW (MATT) LAUFFER is a Project Manger for the North Carolina DOT Hydraulics Unit. Lauffer manages the NCDOT HSP, which complies with the department's NPDES Statewide Stormwater Permit. The HSP manages stormwater runoff from 78,000 miles of highway through 14 program areas. Lauffer is a committee member of the TRB Committee on Hydrology, Hydraulics, and Water Quality (AFB60). He holds a bachelor of science in Civil Engineering from The Ohio State University and has done graduate work in Remote Sensing and Geoinformation Systems atthe University of Michigan. Before joining NCDOT in 1998, Lauffer worked with the U.S. Geological Survey Water Resources Division and a private engineering firm. Lauffer is a registered Professional Engineer in North Carolina.

JEFFERY S. LEWIS has been a Project Management Engineer with the FHWA Resource Center's Construction Program Management technical service team since July 2007. Prior to this position, Lewis was a Team Leader in the FHWA California Division for 20 years, overseeing the office's South 3 environmental specialists, who covered all of Southern California. He was also the Field Operations engineer responsible for federal-aid projects from the San Diego/San Bernardino to Arizona/Mexico border area. As the FOE, he was responsible for overseeing the development of projects, including planning, environmental, design, right-of-way, construction, maintenance, and operations. In doing so, he helped the state evaluate and improve a number of environmental processes, including a Mitigation Monitoring Reporting Record, which was developed as part of NEPA approval and used to track inclusion of environmental commitments into the PS&E and final construction project); mitigation banking efforts; requirements for environmental input into the engineer's project initiation document; and the state's Noise Protocol. Lewis is a graduate of the University of Missouri-Rolla with a bachelor of science degree in Civil Engineering and has been with FHWA 30 years. He has received the FHWA's Administrators Award for Excellence in Streamlining the Environment, FHWA Superior Achievement for Assisting Border Improvements, AASHTO Quality in Stewardship. He serves as secretary on the AASHTO Subcommittee of Construction Environmental and Human Resources section and is participating in various NCHRP reports.

THOMAS E. (TOM) RIPKA is a Project Review Engineer for the Illinois Department of Transportation (IDOT) Central Bureau of Construction. Ripka has 26 years of experience with the department in construction and materials (geotechnical). His duties primarily involve contract administration issues arising during construction. Ripka is Chairman of IDOT's Stormwater Committee, which is responsible for improving compliance with the department's Phase II NPDES Statewide Stormwater Permit. He has been involved the many NPDES issues implemented at

IDOT since formation of the Stormwater Committee. This committee develops policy, provides training, and incorporates regulations and concepts related to highway water quality issues into design, construction, and operations practices and procedures. Ripka holds a bachelor of science degree in Geology from the University of Illinois in Urbana and is a registered Professional Engineer.

RACHEL HERBERT is a physical scientist in the U.S. EPA's Office of Wastewater Management in Washington, D.C. She is currently a member of the National Pollutant Discharge Elimination System (NPDES) stormwater permitting team and focuses on stormwater issues pertaining to municipal and transportation facilities. She previously worked for the United States Department of Agriculture at the Beltsville Agriculture Research Center, where she participated in various projects examining best management practices to control agricultural runoff. She has a bachelor of science degree in Natural Resources Management and a master of science degree in Marine Estuarine Environmental Science, both from the University of Maryland at College Park.

Appendix G:

Scan Team Contact Information

Scott McGowen, P.E.
AASHTO Chair Chief Environmental Engineer
Division of Environmental Analysis
California Department of Transportation
1120 N Street, Sacramento, CA 95814
Phone: (916) 653-4446
E-mail: scott_mcgowen@dot.ca.gov

Brian Smith
FHWA Chair Ecologist
FHWA – Resource Center,
Environment Technical Services Team
4749 Lincoln Mall Drive, 600, Matteson, IL 60443
Phone: (708) 283-3553
E-mail: brian.smith@fhwa.dot.gov

Scott Taylor, P.E., SME
RBF Consulting
5050 Avenida Encinas, Ste. 260, Carlsbad, CA 92008
Phone: (760) 603-6242
Fax: (760) 476-9198
E-mail: staylor@rbf.com

Frances Brindle
Natural Resources Unit Manager
Oregon Department of Transportation
355 Capitol Street NE, Salem, OR 97301
Phone: (503) 986-3370
E-mail: frances.brindle@odot.state.or.us

Patricia A. Cazenas, P.E., L.S.
Highway Engineer
Federal Highway Administration
Office of Project Development & Environmental Review
HEPE-30, 1200 New Jersey Avenue SE
Washington, DC 20590
Phone: (202) 366-4085
Fax: (202) 366-3409
E-mail: patricia.cazenas@dot.gov

Vincent W. Davis, P.E.
Stormwater Engineer
Delaware DOT
PO Box 778, Dover, DE 19903
Phone: (302) 760-2180
E-mail: vince.davis@state.de.us

Mark Hemmerlein
Water Quality Program Manager
New Hampshire Department of Transportation
7 Hazen Drive, Concord, NH 03302
Phone: (603) 271 1550
E-mail: mhemmerlein@dot.state.nh.us

Rachel Herbert
U.S. EPA Water Permits Division
Mail Code: 4203M
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460
Phone: (202) 564-2649
E-mail: herbert.rachel@epa.gov

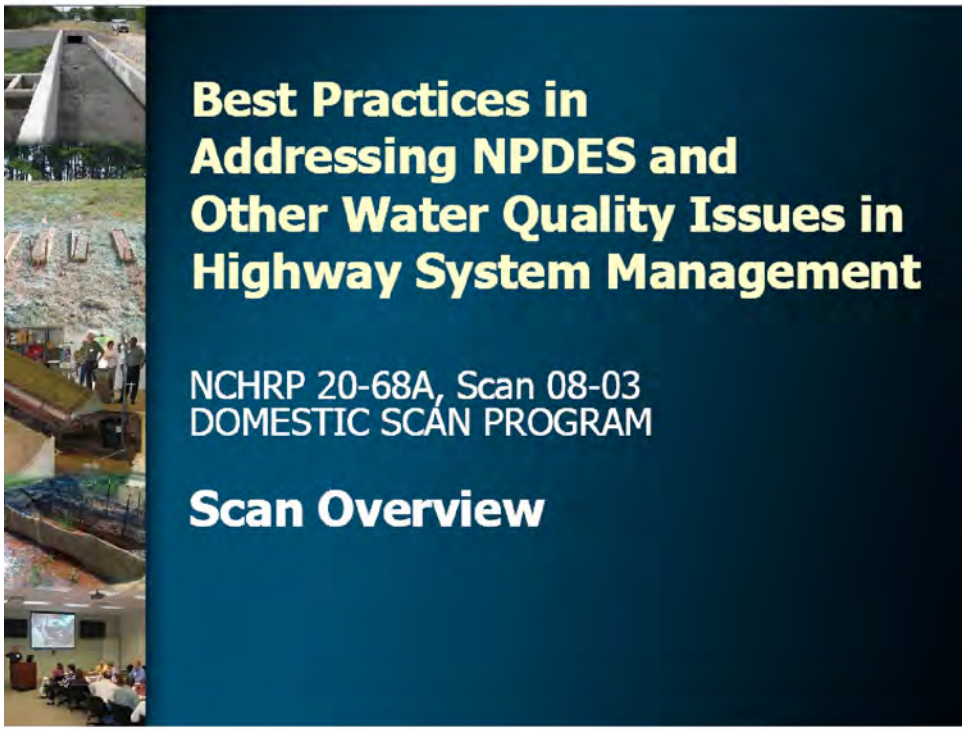
Matthew (Matt) S. Lauffer, P.E.
Project Engineer
Hydraulics Unit, Stormwater Management North Carolina Department of Transportation
Raleigh, NC 27699
Mail: 1590 Mail Service Center
Delivery: 1020 Birch Ridge Dr., Raleigh, NC 27610
Phone: (919) 250-4100
Fax: (919) 250-4108
E-mail: mslauffer@ncdot.gov

Jeff Lewis
Project Management Engineer
Resource Center
Federal Highway Administration
650 Capitol Mall, Ste 4-100, Sacramento, CA 95814
Phone: 916) 498-5035
Fax: (916) 498-5008
E-mail: jeff.lewis@dot.gov

Tom Ripka P.E.
Project Review Engineer
Illinois Department of Transportation
Bureau of Construction
2300 S. Dirksen Parkway, Springfield, IL 62764
Phone: (217) 785-4602
E-mail: thomas.ripka@illinois.gov

Appendix H:

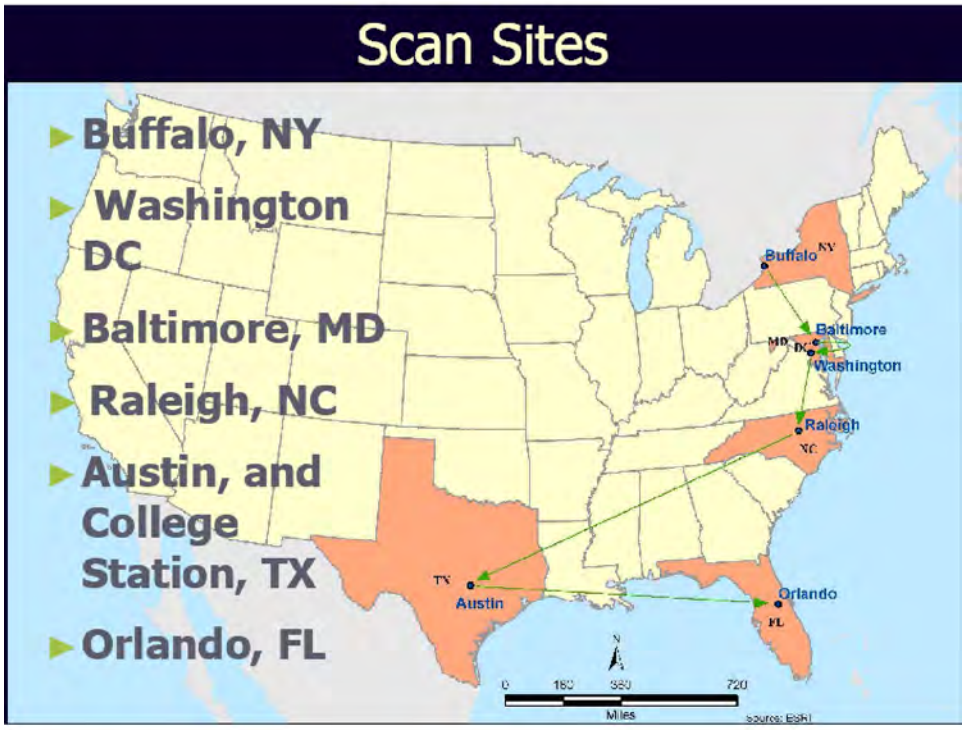
Scan Results Presentation

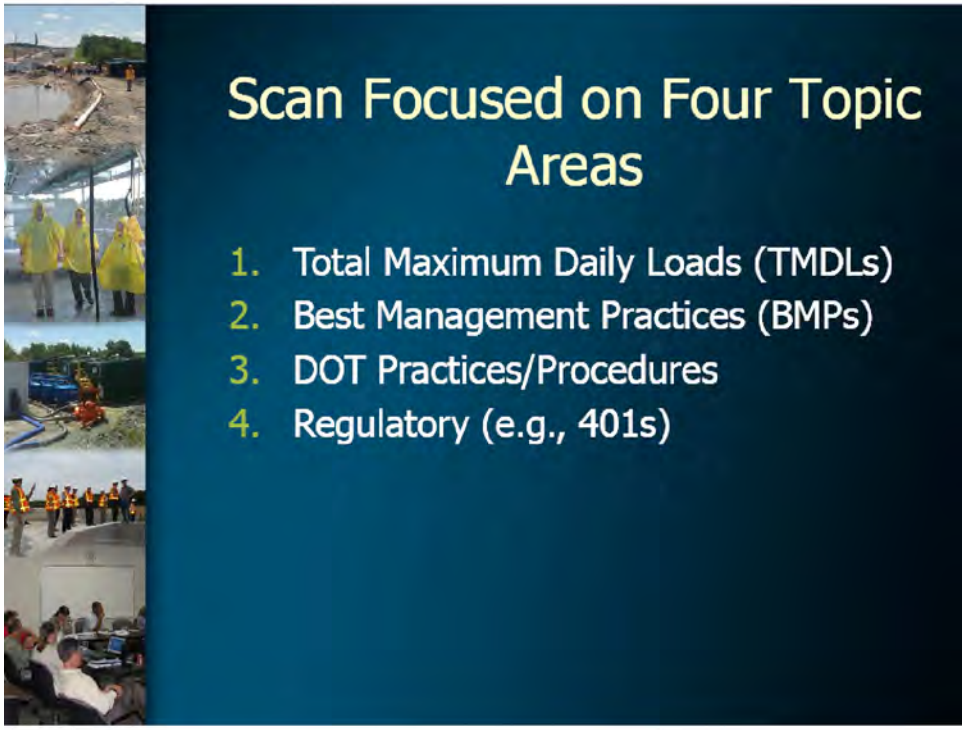

Best Practices in Addressing NPDES and Other Water Quality Issues in Highway System Management
NCHRP 20-68A, Scan 08-03
DOMESTIC SCAN PROGRAM
Scan Overview

Domestic Scan Program
Purpose: Technology transfer
Approach
Develop 'study' questions and review the programs at high-performing agencies
Develop education materials for public dissemination
Summary Report
Presentation
Scan Report
Implementation

Implementation Outcomes
Report/ catalogue of ready to implement technologies, methods and processes
Applied Studies to examine specific practices in greater depth
Influence on agency business practices
Suggestions for national regulatory procedures development

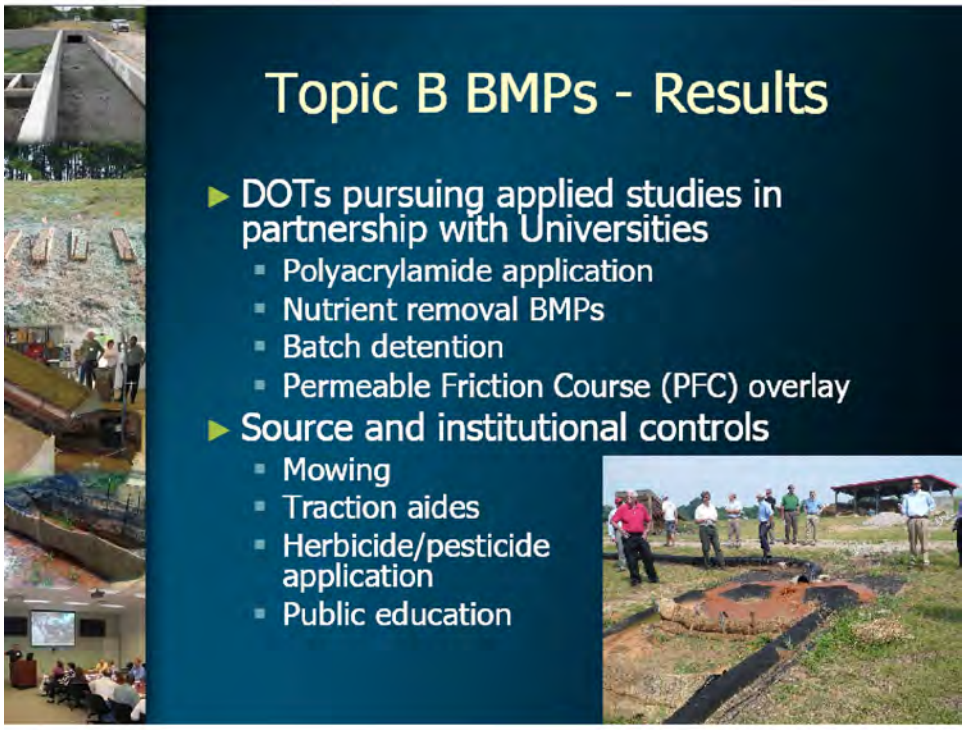
Scan 08-03 Team
Scott McGowen- AASHTO Chair, Caltrans
Brian Smith – Co-Chair, FHWA
Scott Taylor – Subject Matter Expert, RBF Consulting
Vince Davis, Delaware DOT
Frannie Brindle, Oregon DOT
Matt Lauffer, North Carolina DOT
Mark Hemmerlein, New Hampshire DOT
Patricia Cazenas, FHWA
Rachel Herbert, EPA
Jeff Lewis, FHWA
Tom Ripka, Illinois DOT
Mandeep Arora, Arora & Associates

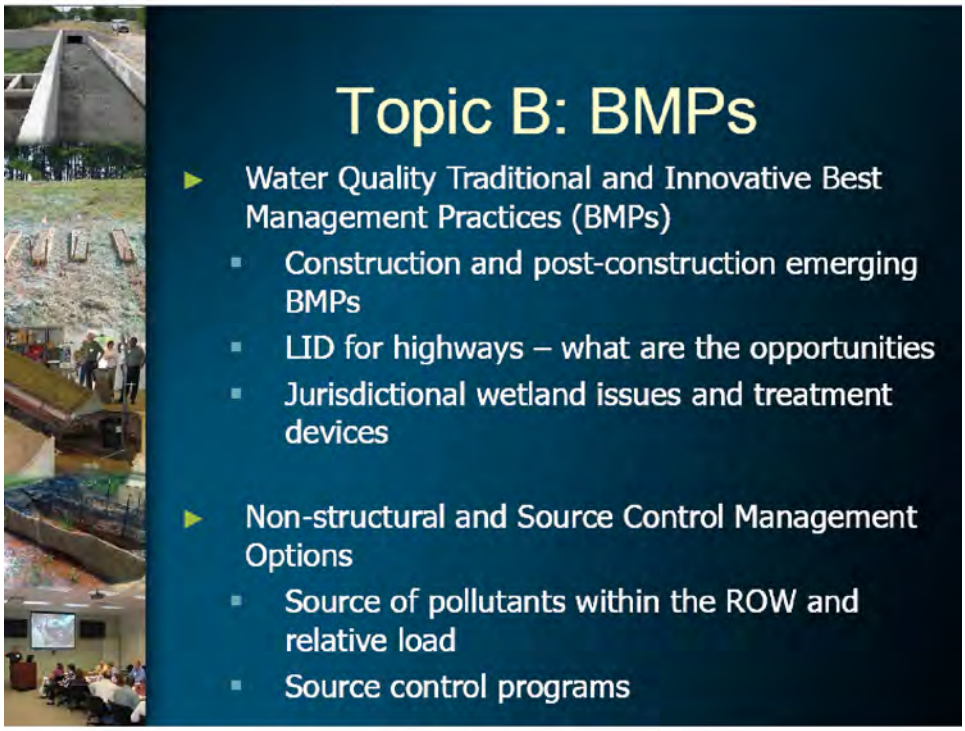

Scan Sites
Buffalo, NY
Washington DC
Baltimore, MD
Raleigh, NC
Austin, and College Station, TX
Orlando, FL
Buffalo
NY
Baltimore
MD
DC
Washington
Raleigh
NC
TX
Austin
Orlando
FL
N
0
180
360
720
Miles
Source: ESRI

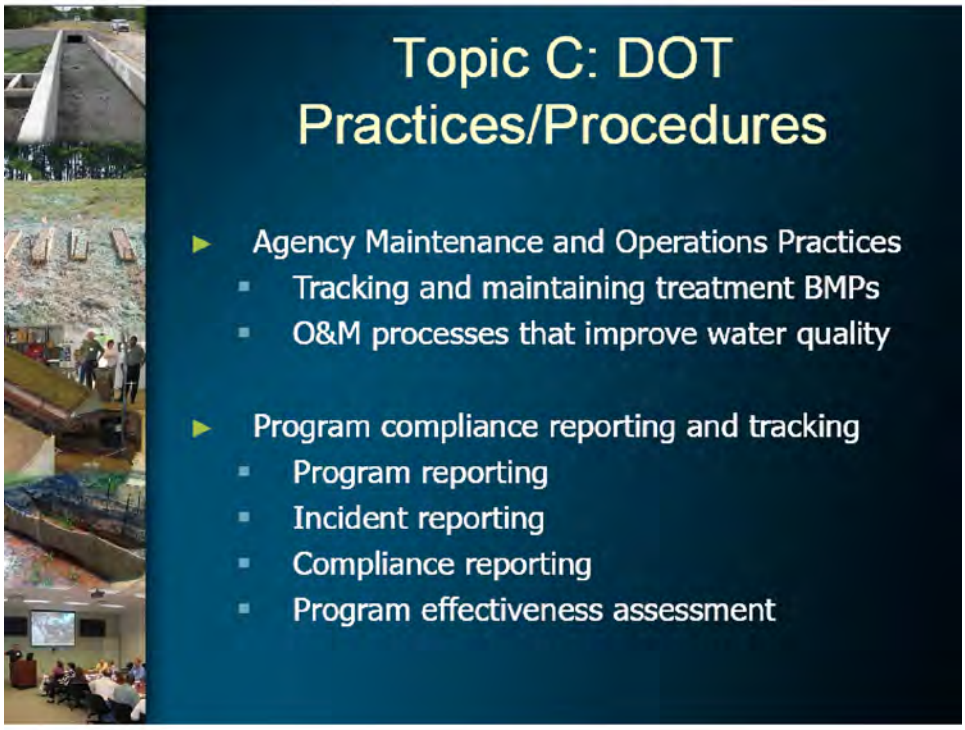

Scan Focused on Four Topic Areas
1. Total Maximum Daily Loads (TMDLs)
2. Best Management Practices (BMPs)
3. DOT Practices/Procedures
4. Regulatory (e.g., 401s)

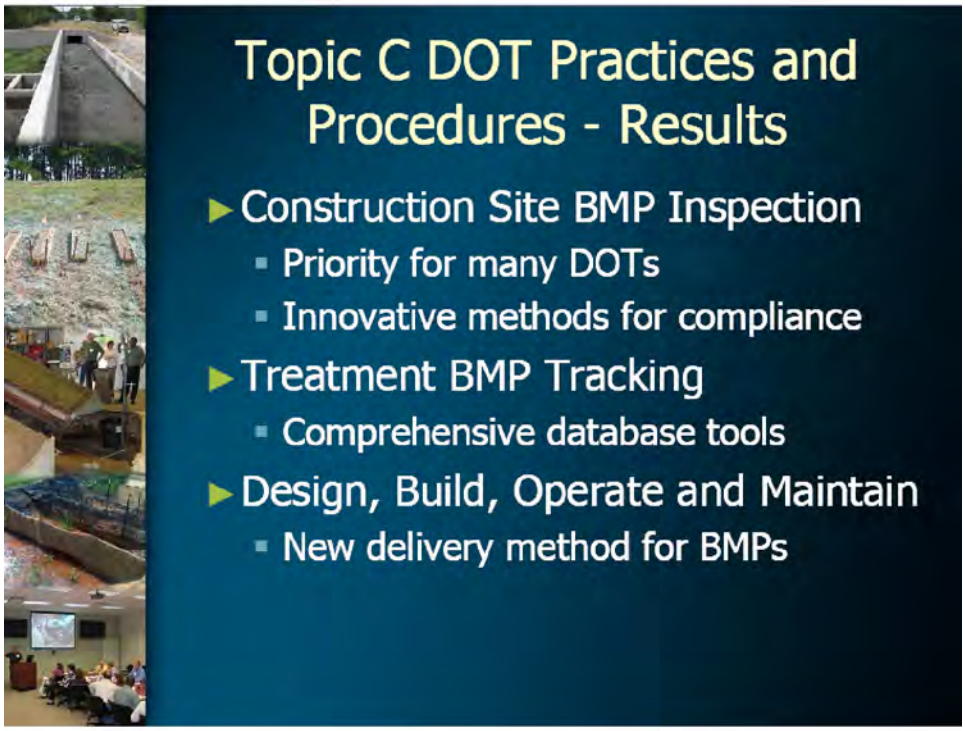
Topic A: TMDLs
TMDL Implementation
TMDLs in MS4 Permits
DOT implementation strategies
Source control
BMP retrofit
Water Quality Credit Trading
Credit trading for TMDL compliance
Impervious area credit trading

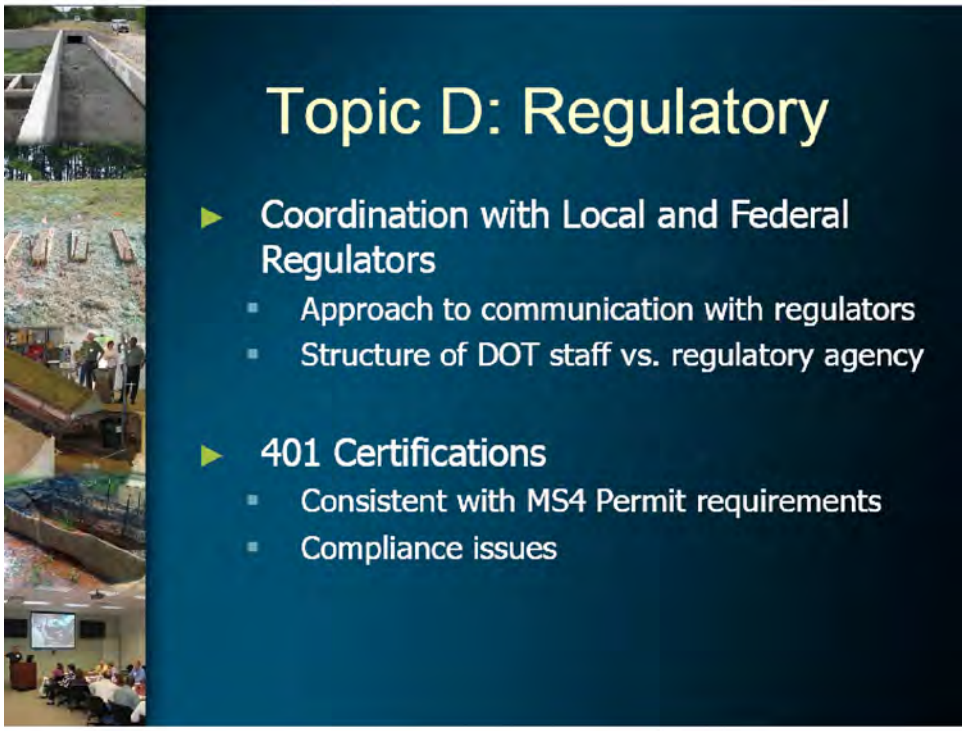
Topic A TMDLs - Results
Currently no credit trading programs but they will be important as a compliance strategy
DOTs are uniquely impacted by TMDLs
DOTs must support the TMDL process with good science and data
A clear TMDL compliance pathway is essential
TMDLs must be integrated


Topic B BMPs - Results
DOTs pursuing applied studies in partnership with Universities
Polyacrylamide application
Nutrient removal BMPs
Batch detention
Permeable Friction Course (PFC) overlay
Source and institutional controls
Mowing
Traction aides
Herbicide/pesticide application
Public education

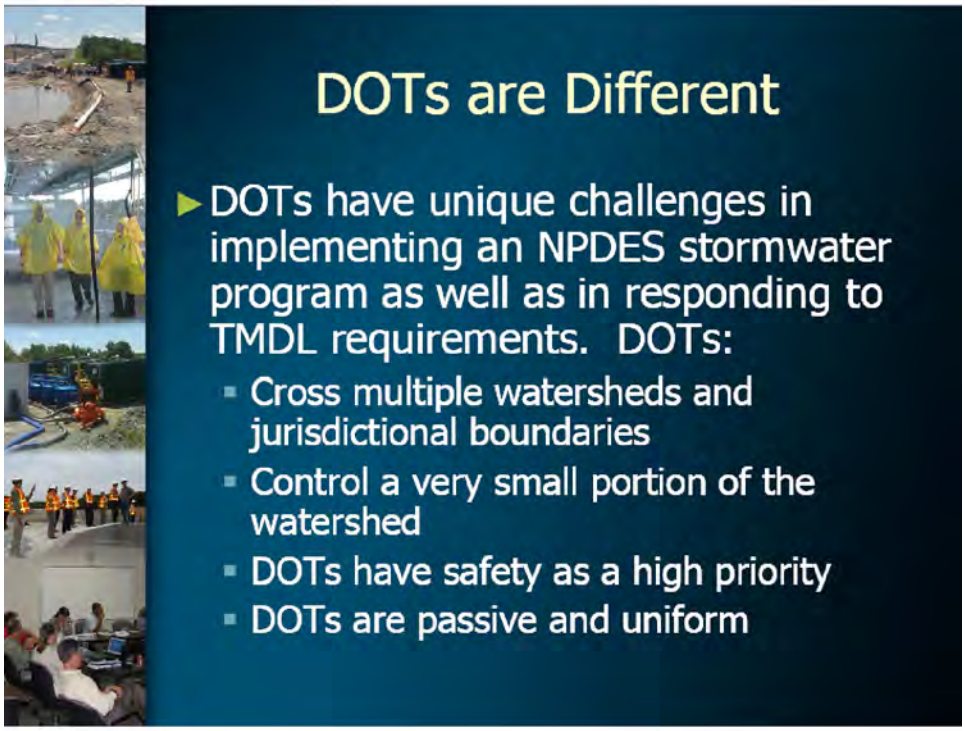

Topic B: BMPs
Water Quality Traditional and Innovative Best Management Practices (BMPs)
Construction and post-construction emerging BMPs
LID for highways – what are the opportunities
Jurisdictional wetland issues and treatment devices
Non-structural and Source Control Management Options
Source of pollutants within the ROW and relative load
Source control programs

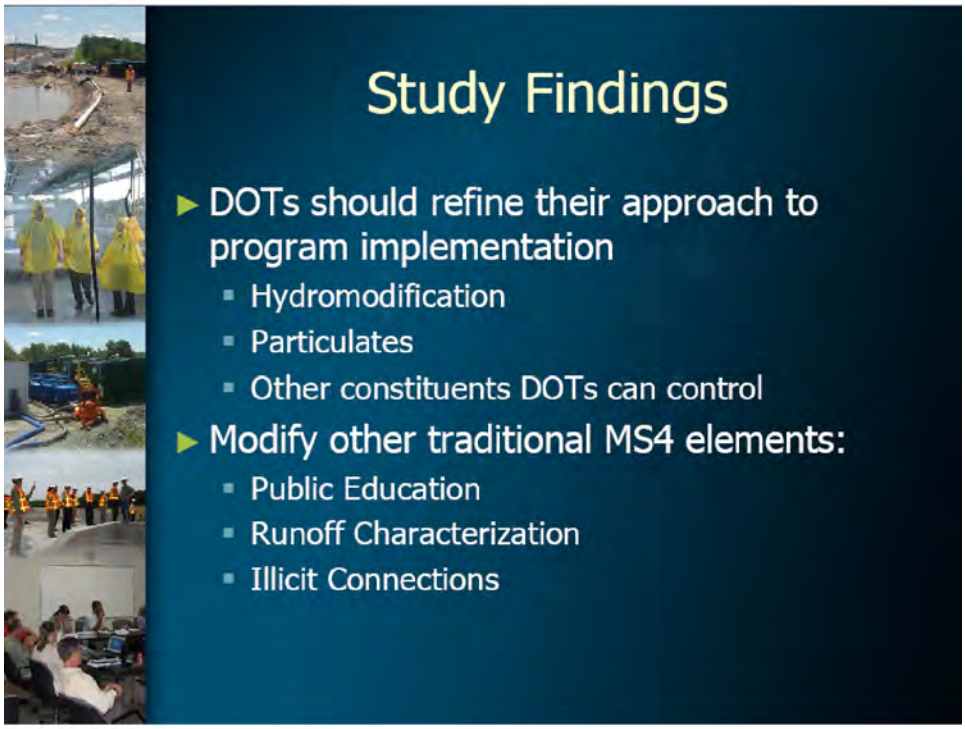

Topic C: DOT Practices/Procedures
Agency Maintenance and Operations Practices
Tracking and maintaining treatment BMPs
O&M processes that improve water quality
Program compliance reporting and tracking
Program reporting
Incident reporting
Compliance reporting
Program effectiveness assessment


Topic C DOT Practices and Procedures - Results
Construction Site BMP Inspection
Priority for many DOTs
Innovative methods for compliance
Treatment BMP Tracking
Comprehensive database tools
Design, Build, Operate and Maintain
New delivery method for BMPs

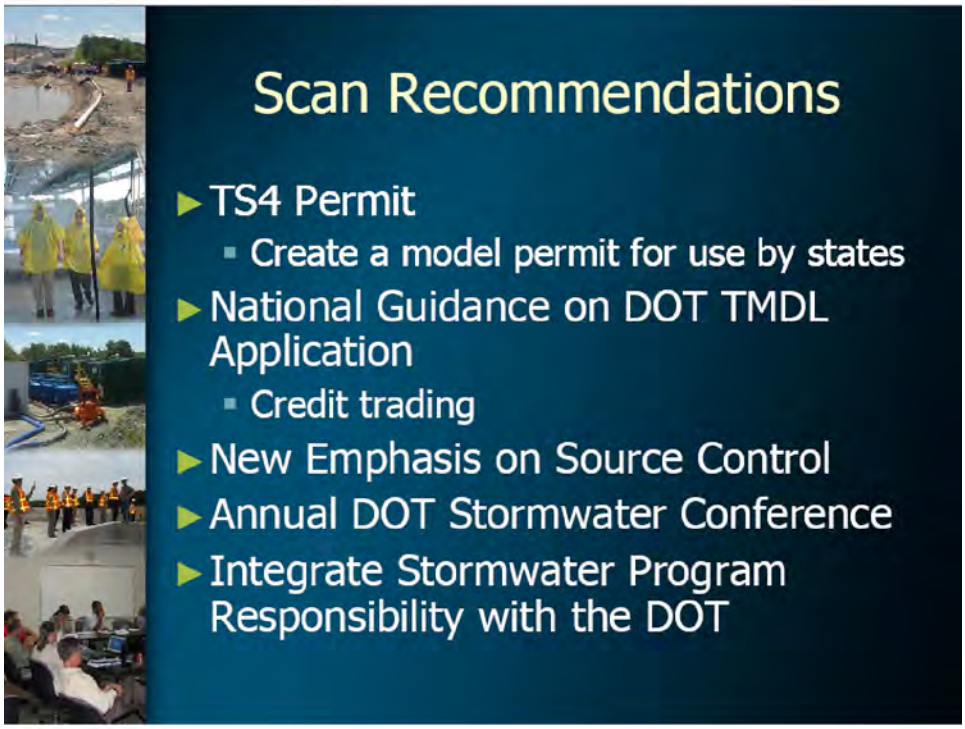

Topic D: Regulatory
Coordination with Local and Federal Regulators
Approach to communication with regulators
Structure of DOT staff vs. regulatory agency
401 Certifications
Consistent with MS4 Permit requirements
Compliance issues

Topic D Regulatory - Results
Partnerships
Culture of environmental stewardship within the DOT
Structure of DOT
DOT funded positions
Program flexibility
Program costs
Outreach


DOTs are Different
DOTs have unique challenges in implementing an NPDES stormwater program as well as in responding to TMDL requirements. DOTs:
Cross multiple watersheds and jurisdictional boundaries
Control a very small portion of the watershed
DOTs have safety as a high priority
DOTs are passive and uniform


Study Findings
DOTs should refine their approach to program implementation
Hydromodification
Particulates
Other constituents DOTs can control
Modify other traditional MS4 elements:
Public Education
Runoff Characterization
Illicit Connections

Other Findings
DOT Business Practices
Commitment from the top
Continued dialogue
Partnerships and communication
Evaluate programs based on cost/benefit
Incorporate stormwater early in project delivery process


Scan Recommendations
TS4 Permit
Create a model permit for use by states
National Guidance on DOT TMDL Application
Credit trading
New Emphasis on Source Control
Annual DOT Stormwater Conference
Integrate Stormwater Program Responsibility with the DOT

Scan Recommendations – Con't
Invest in pooled-fund studies
Collect Cost Data for Program Elements
Invest in BMPs for Highway Maintenance Activities
Develop a Stormwater Track for TRB