Developing Effective Nonpoint Source TMDLs: An Evaluation of the TMDL Development Process

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Acknowledgements

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Introduction

Developing and implementing Total Maximum Daily Loads (TMDLs) is an important step in achieving the water quality goals of the Clean Water Act (CWA). Over 40% of the nation's assessed waters still do not meet the water quality standards that States, Territories, and authorized Tribes have set for them. Section 303 (d) of the CWA requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. TMDLs are calculations that determine the maximum amount of pollutant allowed to be released into a water body without impairing its designated use (fishable, swimmable, habitat, etc.) and allocate the maximum amount among the various point sources (referred to as the waste load allocation (WLA)) and non-point sources (NPS) (referred to as the load allocation (LA)) in the watershed. Typically, draft TMDLs are developed by States and their contractors. The EPA Regional TMDL staff then approves these TMDLs. Sometimes, under consent decree deadlines, EPA Regional staff will develop and establish TMDLs for States.

TMDL implementation varies by pollutant source. For regulated point sources, once a TMDL is approved, EPA and delegated States must ensure that the permits issued through the National Pollutant discharge Elimination System (NPDES) program are consistent with the waste load allocation. Municipal storm water permits do not include specific effluent limits; instead they include certain best management practices to reduce stormwater pollution. For non-point sources (NPS), EPA and the States need to rely on a combination of voluntary source activities, state rules, and active watershed organizations that promote community action.

EPA's Office of Water manages the TMDL program through its Assessment and Watershed Protection Division, located in the Office of Wetlands, Oceans and Watersheds (OWOW). As part of ongoing efforts to evaluate the success of its programs and identify possible ways to improve them, OWOW has begun efforts to examine both the development and implementation of TMDLs. This report discusses the results of a study designed to examine how stakeholder participation and implementation planning that occurs during the development of a TMDL affect implementation and provide opportunities to leverage other watershed efforts to improve water quality. OWOW matched evaluation funding support from EPA's Office of Policy, Economics, and Innovation (OPEI) through its Improving Results Competition, and contracted with Industrial Economics, Inc. (IEc) to assist in the evaluation.

- How does variation in the availability, quality, and analysis of data influence the development of useful, high-quality TMDLs?
- How does variation in funding, guidance and leadership influence the development of useful, high-quality TMDLs?
- How do variations in stakeholder involvement influence the development of useful, high-quality TMDLs?

- How do variations in scale and scope of the TMDL influence active stakeholder involvement and the production of useful, high quality TMDLs?
- What elements of an implementation plan are most important for effective implementation?
- How might EPA refine its TMDLs to further increase water quality decision maker knowledge and commitment to water quality improvements?

Methodology

In supporting this evaluation, IEc collected and analyzed information by conducting:

- **a review of literature** related to TMDL development and associated stakeholder involvement;
- **two surveys**, one of EPA TMDL staff from EPA Regions and one of other EPA program staff from EPA Regions engaged in activities related to TMDLs. The surveys contain quantitative and qualitative questions designed to elicit insights into the nature and quality of stakeholder participation and implementation plans during the development of TMDLs.
- **case studies of seven TMDLs** to build on and potentially validate preliminary results obtained from the surveys, and further explore how elements contributing to the development and implementation of TMDLs - most notably stakeholder involvement and implementation planning – impact customer knowledge of and approaches to watershed protection. The table below describes the seven case studies.

EPA Region	State	TMDL	Year Approved	Pollutant(s)*	Source Type
I	ME	East Pond	2001	Phosphorus	NPS
V	MI	Grand River	2003	Fecal Coliform	PS*/NPS
VI	NM	Middle Rio Grande	2002	Fecal Coliform	PS/NPS
VII	KS	Turkey Creek	2002	Fecal Coliform	NPS
VIII	SD	Cottonwood Lake	2001	Phosphorus Sediments	NPS
IX	CA	Calleguas Creek	2003	Nitrogen	PS/NPS
X	WA	Nooksack River	2000	Fecal Coliform	NPS

*Point Source

Results

The report organizes the discussion of results by the six overarching evaluation questions. Details on all the responses received are included in Appendices to the report. Eighty-four percent of the TMDL personnel whom we contacted completed the survey (67 respondents out of 80 requested) while 46% of the non-TMDL personnel who were contacted completed the survey

(105 respondents out of 228 requested). In completing the seven case study analyses, we interviewed 36 stakeholders. In addition to the quantitative results we received from the survey participants, we also received 95 qualitative comments from the TMDL personnel and 184 comments from the other EPA program personnel.

I. How does variation in the availability, quality, and analysis of data influence the development of useful, high-quality TMDLs?

The TMDL survey and case study results confirm that the availability and quality of data is a key factor in determining the success of the TMDL development and implementation planning process. Only 34% of respondents indicated that quality data to support the development of TMDLs is *often* or *always* available and important types of data are frequently not available as well. Many TMDL staff also chose to comment on the need for more and better data as an area for improvement in the TMDL program. One staffer noted that "[g]ood non-point source and stormwater data is virtually non-existent. Data collection efforts need to be deployed to set the baseline reference levels or concentrations for the non-point source and stormwater runoff." This comment is confirmed by the 49% of respondents that reported data on runoff quality is *never* or *seldom* available. Only, 16% of respondents to the survey found that this type of data was *often* or *always* available.

Case study respondents for the Calleguas Creek, Cottonwood Lake, East Pond, and Turkey Creek studies also reported that the ability to gather data sufficient to adequately characterize source loading and linkages was compromised by time and resource constraints. In each of these case studies, the consent decree schedule for completion of the TMDL limited opportunities for comprehensive sampling and data analysis. For instance, in the Calleguas Creek case study, the consent decree schedule imposed constraints on the adoption of multi-pollutant approaches that had been proposed by stakeholders. EPA TMDL respondents supported this observation by noting that: "[t]he most limiting factor for the timely development of quality TMDLs is the existence of environmental data to help with source identification and other aspects of defining the problem and ultimately the solutions."

II. How does variation in funding, guidance and leadership influence the development of useful, high-quality TMDLs?

In general, survey and case study respondents indicated the need for greater and sustained funding to support better data quality and collection and TMDL implementation activities. Three funding sources including Clean Water Act (CWA) 319 funds to States for implementing approved NPS management programs, CWA 104(b)(3) or water quality cooperative agreements, and other EPA, Federal, state and local sources are the predominant sources of monies to support TMDL development. Twenty-five percent to 34% of respondents indicate that these funding sources are *often* or *always* available, and 30% to 34% of respondents have experience with these same sources being *sometimes* available. By contrast, 52% to 55% of respondents report that Great Water Body and the United States Department of Agriculture (USDA) or "Farm Bill" funding is *never* or *seldom* available for nonpoint source TMDLs.

With regard to the various guidance materials available, survey results show that 39% of overall respondents report that adequate guidance and information on TMDL development is *often* or *always* generally available and 25% of overall respondents have experience with such materials being *sometimes* available. The two top-ranked types of materials that EPA TMDL staff found *often* or *always* useful are: a) case studies; and b) regional guidance documents, methodologies, and analyses (51% of respondents and 49% of respondents, respectively). This same preference for case studies and regional guidance materials prevails for respondents who *seldom* or *never* believe that adequate guidance is available.

State environmental agencies *often* or *always* lead the TMDL development process according to 84% of TMDL survey respondents, and are regarded as *often* or *always* the most effective leaders by 78% of survey respondents. However, many case study interviewees and survey respondents emphasized the need for enhanced collaboration between federal, state, and local programs on water quality issues. One survey respondent noted the need for these agencies "to find shared goals and to translate them into program specific activities designed to identify, prioritize, and fix impairments."

III. How do variations in stakeholder involvement influence the development of useful, high-quality TMDLs?

Stakeholders are broadly defined in this evaluation to include EPA and State TMDL and non-TMDL staff engaged in water quality issues, other Federal agencies such as Natural Resources Conservation Service (NRCS), the United States Forestry Service (USFS), and the United States Fish and Wildlife Service (USFWS), local government environmental and planning agencies, pollutant sources, national and regional environmental advocacy groups, local NGOs and watershed organizations, universities and/or research institutions, and watershed residents. More than half of EPA TMDL respondents view stakeholder participation as *often* or *always* having a positive, substantive impact on TMDL development (52% of respondents). However, this overall generally affirmative response by EPA TMDL respondents to stakeholder involvement should be viewed in the context of only 24% of the same respondents *often* or *always* having experience with a *high* level of stakeholder participation.

EPA TMDL respondents *consistently* ranked state and local planning agencies, state agricultural agencies, and USDA programs as stakeholders/organizations with the least understanding of the TMDL program, lowest commitment to achieve water quality standards based on TMDLs, and fewest action(s) taken to improve water quality based on TMDLs. With regard to the timing of effective stakeholder participation, EPA TMDL staff view stakeholders as *often* or *always* helpful with public outreach and implementation (66% of respondents) and in developing implementation plans (63% of respondents). The percentage of positive respondents declines for more technical activities such as assembling data, monitoring, and analysis (48% of respondents), source assessments (37% of respondents), and assigning load allocations among sources (28% of respondents). However, case study interviewees indicated an interest in being involved earlier it the process, during data gathering, source assessment, and watershed characterization.

The case studies demonstrated the multiple benefits that accrue from an extensive and diverse representation of stakeholders in the TMDL development process. For example, stakeholders who participated in development of the Nooksack River TMDL gained a greater understanding of Tribal concerns, contributed to and enhanced their knowledge of the scientific basis for the established targets, and developed a communication network among the groups that would be important in facing the challenges of implementation in a very large and complex watershed.

IV. How do variations in scale and scope of the TMDL influence active stakeholder involvement and the production of useful, high quality TMDLs?

Respondents view watershed-wide TMDLs and the simultaneous development of all TMDLs in a watershed (i.e., multi-pollutant) as *often* or *always* more likely to lead to meaningful stakeholder involvement (51% of respondents and 42% of respondents) than TMDLs involving a high degree of impairment (28% of respondents), a stream segment specific TMDL (19% of respondents), or single pollutant TMDLs (10% of respondents). Developing watershed-wide TMDLs may be an efficient way to engage the appropriate stakeholders in TMDL development as well.

V. What elements of an implementation plan are most important for effective implementation?

"A well-thought out implementation plan with understandable and achievable targets is key. The TMDL needs to reflect real world conditions and include a more specific “road map” for implementation." This EPA TMDL respondent sums up the importance of implementation plans to achieving the actions necessary for addressing water quality impairments. Only 37% of EPA TMDL respondents report that TMDLs *often* or *always* have implementation plans, and 46% of respondents indicate that TMDLs *never* or *seldom* have detailed implementation plans. These results may suggest that EPA needs to provide more support for the development of implementation plans, despite the Agency’s lack of legal authority to require such plans.

Both TMDL staff and other EPA program staff were asked to rank the utility of various elements of a TMDL for effective implementation. The largest percentage of respondents from both groups considered the monitoring of water quality as *often* or *always* essential to effective TMDL implementation. One of the EPA TMDL staff echoed many sentiments commenting that “[f]ollow-up monitoring and water quality model refinements are typically necessary to develop effective plans.” The types of implementation plan elements that other EPA programs ranked as 2nd, 3rd, and 4th most important require adequate data to develop. These included the identification of necessary reductions targeted geographically, BMP recommendations by pollutant, and BMP recommendations targeted geographically, respectively. Their priorities differed from their TMDL program counterparts. The TMDL program should take note of this, since other EPA programs are the target audience/customer for TMDLs.

VI. How might EPA refine its TMDLs to further increase WQ decision maker knowledge and commitment to water quality improvements?

Through the surveys and case studies, we hoped to identify the extent to which decision makers currently use TMDL information in their decision making and how that might be improved. Overall, less than 50% of EPA TMDL respondents reported that water quality decision makers *often* or *always* had knowledge of TMDLs, with the exception of state NPS programs that were viewed by 60% of the respondents as *often* or *always* understanding the TMDL program.

In addition, data from the surveys indicate that only approximately one-third of EPA TMDL staff report that the behaviors of water quality decision makers are *often* or *always* influenced by TMDLs to take action to improve water quality. Factors other than TMDLs may be influencing water quality decision makers to take action, but TMDLs do not seem to be the predominant motivator according to EPA TMDL staff.

It is also important to note that the survey of non-TMDL staff indicated that, with the exception of the State Revolving Loan Fund (SRF) program, respondents from each of the other EPA programs surveyed noted that their program had been involved to some degree in the TMDL development and implementation plan process. Knowledge of and commitment to the TMDL process might be greater than the responses from the TMDL staff imply.

Recommendations

The report includes detailed recommendations intended to improve OWOW's efforts to facilitate access to the fiscal, informational, and communication resources necessary to develop high-quality TMDLs as well as enhance the processes by which they are developed, implemented, and applied. Of primary importance, in our estimation, are the recommendations calling for a more prominent EPA role in encouraging collaborative stakeholder involvement during TMDL development, improving the availability and quality of data used to establish load allocations, and brokering EPA and other Federal funding sources to support TMDLs. The recommendations, not listed in any priority order, are:

1. **Focus on improving the availability and quality of data directly related to non-point and storm-water-related sources**

2. **Help broker other sources of federal funds in support of non-point source and storm-water TMDLs**

3. **Determine "content gaps" in case study information and regional guidance and prioritize delivery of these materials**

4. **Engage additional stakeholders in TMDL development and implementation**

    - **Develop and implement a communications strategy for TMDL practitioners to utilize when developing TMDLs**

    - **Target outreach to state/local planning and agriculture agencies**

    - **Emphasize the development of watershed TMDLs**

5. **Encourage development of detailed TMDLs and support development of implementation plans and follow-up monitoring despite lack of legal authority**

6. **Make TMDL information more accessible and readily available to our stakeholders**

INTRODUCTION CHAPTER 1

Developing and implementing Total Maximum Daily Loads (TMDLs) is an important step in achieving the water quality goals of the Clean Water Act (CWA). Over 40% of the nation's assessed waters still do not meet the water quality standards States, Territories, and authorized Tribes have set for them. Section 303 (d) of the CWA requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. TMDLs are calculations that determine the maximum amount of pollutant allowed to be released into a water body without impairing its designated use (fishable, swimmable, habitat, etc.) and allocate the maximum amount among the various point sources (referred to as the waste load allocation (WLA)) and non-point sources (NPS) (referred to as the load allocation (LA)) in the watershed. Typically, draft TMDLs are developed by States and their contractors or by an interested third party – most often a local government. The EPA Regional TMDL staff then approves these TMDLs, and in some cases, EPA Regional staff develop TMDLs.

TMDL implementation varies by pollutant source. For regulated point sources, once a TMDL is approved, EPA and delegated States must ensure the permits issued through the National Pollutant Discharge Elimination System (NPDES) program are consistent with the waste load allocation. Municipal storm water permits do not include specific effluent limits and rather require that municipalities adopt certain management practices. For non-point sources (NPS), EPA and the States need to rely on a combination of voluntary source activities, state rules, and active watershed organizations that promote community action.

To illustrate the various components of the TMDL program, EPA has developed two logic models for the development and implementation of the TMDLs (see Tables 1-1 and 1-2). A logic model synthesizes the key activities of a program into a picture of how the program is expected to work. Often this model is displayed in a flow chart, map, or table format to portray the sequence of steps leading to program results. The model links inputs to activities and to expected outputs and outcomes. Using a program logic model helps determine the degree to which a program's activities and other related inputs affect the expected outcomes. In addition, it can help identify potential indicators or measures to help track performance. Key components of a logic model include the following:

- **Resources** are the basic inputs of funds, staffing, and knowledge dedicated to the program.

- **Activities/Outputs** are the specific actions taken to achieve program goals and the immediate products that result.

- **Customers/Stakeholders** are the users of the activities and outputs (fiscal, technical, administrative) provided.

- **Short-Term Outcomes (Knowledge/Attitude)** are changes in awareness, attitudes, understanding, knowledge, and skills resulting from program outputs.

- **Intermediate Outcomes (Behavior)** involve changes in behavior that are broader in scope than short-term outcomes. Intermediate outcomes often build upon the progress achieved in the short-term.

- **Long-Term Outcomes (Condition)** parallel the overarching goals of the program and are the environmental improvements and public health benefits that flow from the behavioral, procedural, and operational changes.

- **External Factors** are not directly controlled by the program or its entities, which may affect program performance.

Table 1- 1 NPS (and Stormwater) TMDL

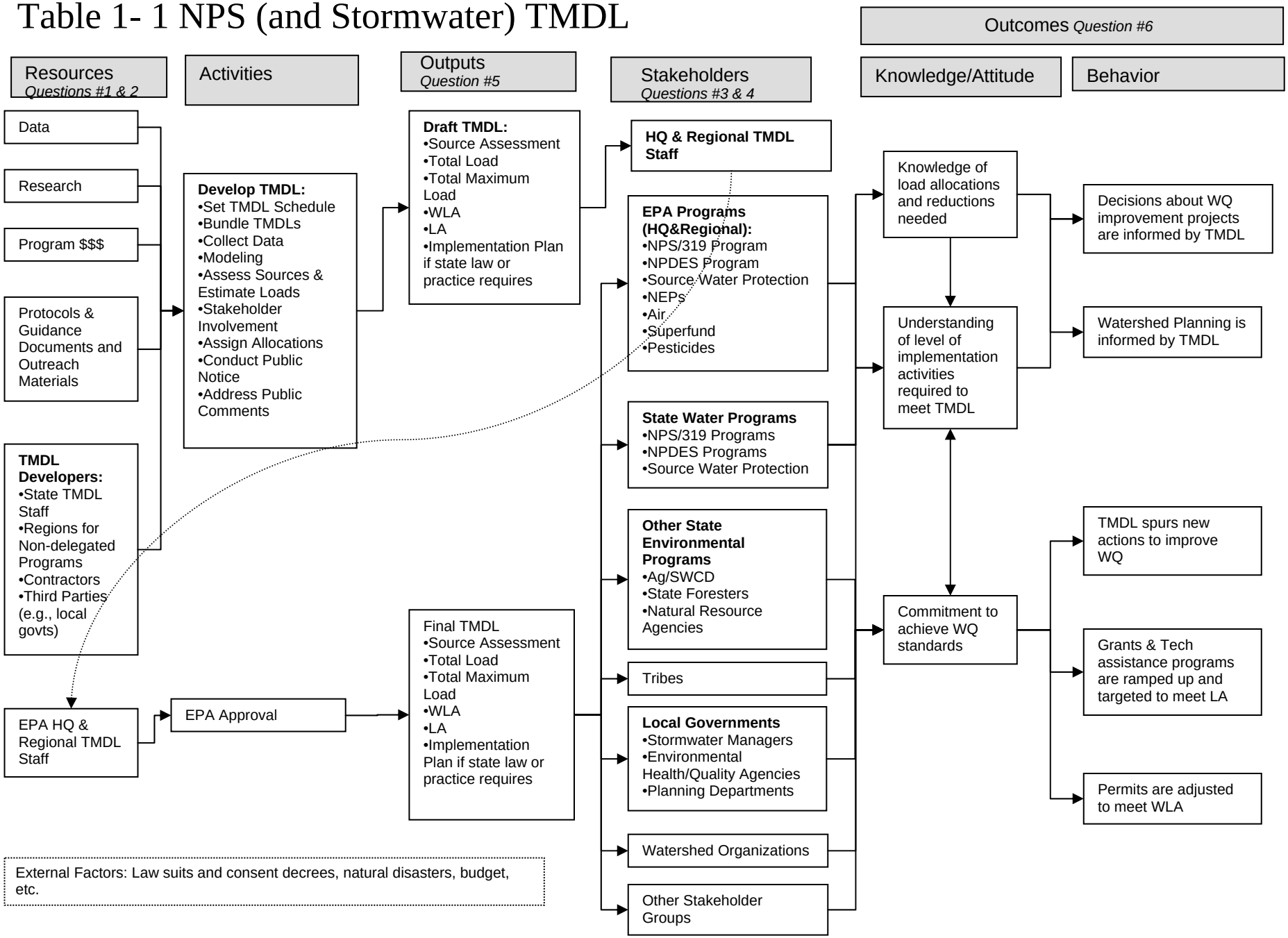
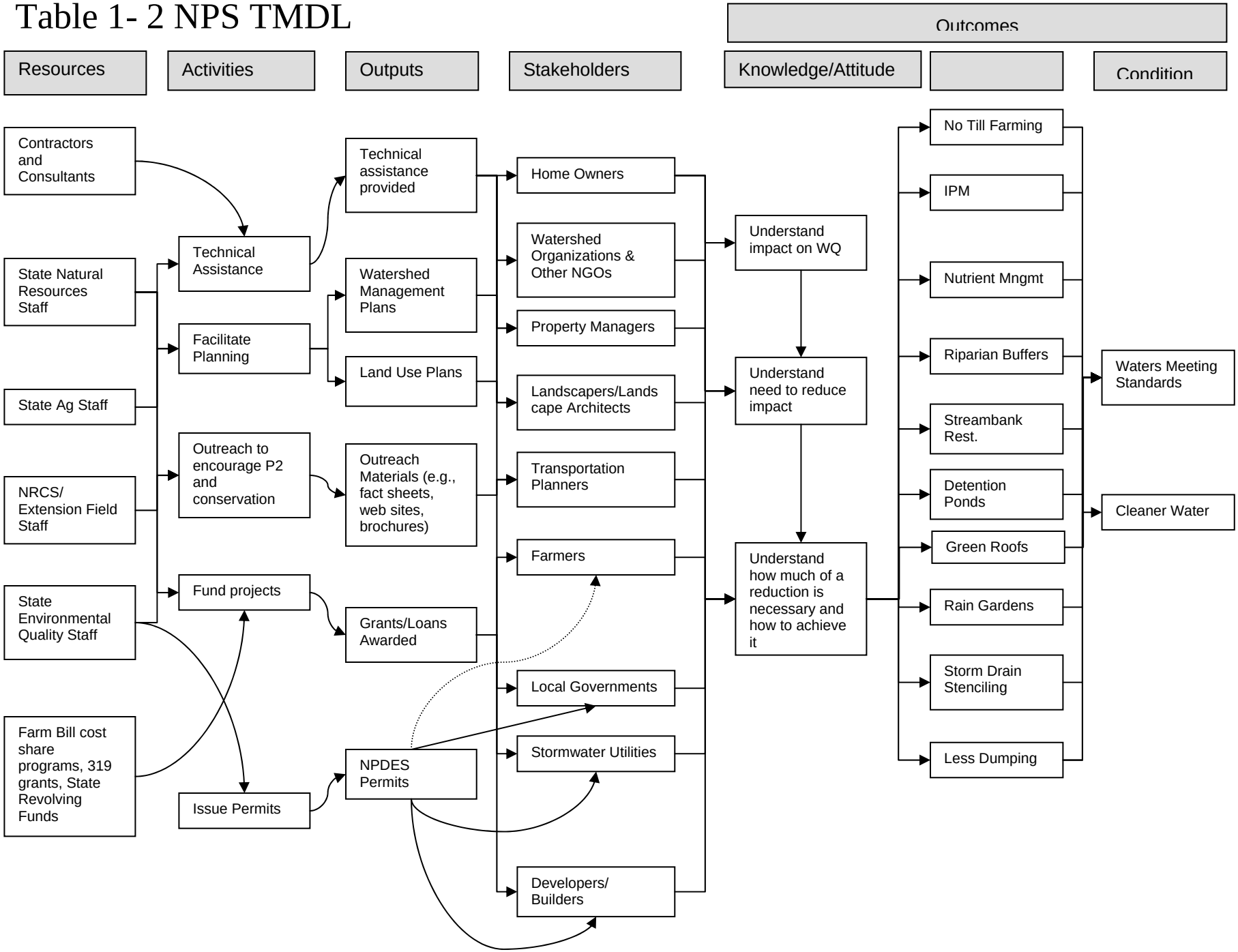


Table 1- 2 NPS TMDL



PURPOSE

As part of ongoing efforts to evaluate the success of its programs and identify possible ways to improve them, OWOW has begun efforts to examine both the development and implementation of TMDLs. The purpose of this evaluation was to identify how nonpoint source and municipal stormwater TMDLs can be developed in a manner that will facilitate implementation and lead to improved water quality. This evaluation is designed to focus on how the TMDL development process informs and changes the water quality decisions of federal, state, and local governments, and other involved stakeholders. By understanding better the role that TMDL development plays in a watershed, the Office of Wetlands, Oceans, and Watersheds (OWOW) management hopes to integrate other watershed activities supported by EPA, such as the nonpoint source 319 funding program, with the TMDL development process. EPA is engaged in other activities directed at assessing the implementation process. OWOW received evaluation funding support from EPA's Office of Policy, Economics, and Innovation (OPEI) through its Improving Results Competition, and contracted with Industrial Economics, Inc. (IEc or we) to assist in the evaluation.

The target audience for this evaluation are OWOW managers who seek to support a TMDL development and implementation process that enhances knowledge, increases awareness, and influences customer behavior. In addition, EPA Regional TMDL staff may be able to use the results of this evaluation to increase the effectiveness of their role in NPS TMDL development and implementation, focusing on volunteer programs and cooperative management among sources contributing to water quality impairments. Another important audience are the front-line state, contractor, or third-party local government or watershed organization that are interested in techniques to improve the TMDL development process.

EVALUATION QUESTIONS

As part of this analysis, IEc, on EPA's behalf, evaluated current nonpoint source and municipal stormwater TMDLs to determine the extent to which they currently inform water quality decisions by federal, state, and local governments and other stakeholders. Based on the logic model as well as the needs of the various audiences, OWOW and IEc identified the following questions to answer through the evaluation. At the end of each question we note which element of the logic model is addressed.

I. How does variation in the availability, quality, and analysis of data influence the development of useful, high-quality TMDLs? Are there variations in availability, quality, and use of existing research/data? How do variations in the data collection and modeling processes affect the TMDL? (*Resources)*

II. How does variation in funding, guidance and leadership influence the development of useful, high-quality TMDLs? Are TMDL developers tapping into all the available sources of funding? Are there variations in availability and use of EPA guidance and protocols? How do variations in responsibility amongst stakeholders (EPA, State, or third party, etc.) influence TMDL development? (*Resources)*

III. How do variations in stakeholder involvement influence the development of useful, high-quality TMDLs? Are there variations in number and type of stakeholders, including the public and "polluters"? Which stakeholders are most useful to have "at the table"? During which phases of TMDL development is the involvement of stakeholders most crucial? *(Stakeholders)*

IV. How do variations in scale and scope of the TMDL influence active stakeholder involvement and the production of useful, high quality TMDLs? How does the type of pollutant influence TMDL development? How does the geographic scope of the TMDL influence TMDL quality (i.e. segment or watershed TMDLs, single or multi-pollutant TMDLs)? Does it influence the ability to involve stakeholders? How does degree of impairment affect the TMDL development process and stakeholder buy-in? *(Stakeholders)*

V. What elements of an implementation plan are most important for effective implementation? Do most TMDLs include implementation plans? Are they detailed? What elements (BMP recommendations, funding source identification, schedule, designated management agencies, etc) are the most important for effective implementation? *(Outputs)*

VI. How might EPA refine its TMDLs to further increase WQ decision maker knowledge and commitment to water quality improvements*?* Are TMDL "customers" aware of TMDLs and their pollutant reduction recommendations? Do they understand TMDLs? Do they have ready access to TMDLs? How might EPA improve its TMDLs to meet their needs better? To what extent are water quality decisions informed by TMDLs? Watershed planning decisions? To what extent do TMDLs spur new actions to improve water quality? To what extent are grants and technical assistance strengthened and targeted to address load allocations based on TMDL information? To what extent are land use rules, regulations, and policies implemented to protect/improve water quality based on TMDL information? How might TMDLs be refined to create new knowledge and awareness that would better inform positive behavioral change? *(Outcomes)*

In supporting this evaluation, IEc reviewed background information provided by the EPA WAM and collected and analyzed information by conducting:

- a review of literature related to TMDL development and associated stakeholder involvement;
- a survey of EPA TMDL staff from EPA Regions identified by OWOW;
- a survey of other EPA program staff from EPA Regions who are engaged in activities related to TMDLs and national estuary staff, also identified by OWOW; and
- seven case studies examining in more detail specific TMDLs and their development.

The following discussions detail the specifics of our approach to data collection and analysis.

DATA COLLECTION

Literature Review

As an initial step in the process, IEc conducted a preliminary literature search to identify studies related to TMDL development and associated stakeholder involvement. First, we reviewed available internet and EPA resources. Second, IEc searched the available peer-reviewed literature to identify existing studies that critically examine TMDL development and stakeholder involvement. Using a variety of academic databases including ISI Web of Science, EBSCOHOST, and CSA Illumina, IEc conducted multiple searches using terms such as *TMDL, TMDL development, TMDL process, TMDL implementation plan, TMDL community,* and *TMDL stakeholder*. These databases were selected to ensure maximum coverage of peer-reviewed literature. ISI Web of Science provides access to journals, books, conference proceedings, and evaluated Web content. EBSCOHost's Science and Technology Collection contains over 800 full text scientific and technical journals in addition to indices and abstracts for more than 1,600 publications. CSA Illumina provides access to more than 100 full-text and bibliographic databases in four primary editorial areas: natural sciences, social sciences, arts & humanities, and technology. This research effort was conducted in June 2005 and yielded a wide variety of

sources, including both peer-reviewed and non-peer-reviewed articles, reports, and conference proceedings. The number of search results from each database is presented in Table 2-1.

Table 2-1

NUMBER OF DATABASE SEARCH RESULTS BY SEARCH TERM

Search Term / Database	TMDL	TMDL Development	TMDL Process	TMDL Implementation Plan	TMDL Community	TMDL Stakeholder
ISI Web of Science	107	9	11	1	5	3
EBSCOHost	94	3	5	2	3	6
CSA Illumina	337	42	27	3	10	6
Total	538	54	43	6	18	15

Note: Total search results represent raw numbers and do not account for overlap in entries among the databases.

IEc screened the results of these broad searches for articles that focus on the impact of stakeholder involvement in TMDL development and the role implementation plans play in facilitating attainment of water quality goals. In addition, we also sought articles that addressed non-point sources in rural and urban areas due to the significant water quality impairments from agricultural and municipal storm sewer sources. Of the 674 documents found in the academic databases and the innumerable TMDL references found through the generic internet search, IEc identified 50 that merited closer scrutiny. Appendix A presents the list of the 50 studies that IEc identified through its searches and preliminary screen. IEc carefully reviewed these articles to glean information to inform the development of the evaluation's surveys, interviews, case studies, and conclusions. Although we reference only those studies specifically used in the course of the evaluation, we include the full list for readers who are interested in additional sources of information.

Surveys

Development of the Survey Instruments

Using the six overarching questions as a guide, IEc, in collaboration with EPA, developed two separate surveys to gather information from EPA TMDL staff, other EPA Program staff, and national estuary staff on the TMDL development process. Both survey instruments are attached as Appendices B and C. The surveys contain quantitative and qualitative questions designed to elicit insights into the nature and quality of stakeholder participation during the development of TMDLs. For quantitative responses in the TMDL staff survey, we used a 6-point scale in an effort to capture the full range of the respondents' knowledge and experience; for quantitative responses in the other EPA program staff survey, we used a 7-point scale.

Survey Administration

IEc administered the surveys electronically, allowing respondents to access the survey instrument and submit responses via the internet. IEc determined that an online survey offered several key advantages over telephone or mail distribution. Responses were automatically

transferred into an Access database we had developed, as soon as the respondent had completed the survey. The online mechanism provided expediency and facilitated IEc's analysis of the data.

Survey Respondents

This section details how we identified participants from both TMDL and other EPA program staff. Survey respondents in each group were identified through discussions with the EPA WAM and other EPA personnel. Specifically, TMDL Innovation Workgroup participants identified EPA program staff and other Federal employees involved in TMDL development who would be able to provide insights into the process. Each respondent group offered a unique perspective on the TMDL process based on the nature of their involvement in the TMDL process.

EPA TMDL Staff

This group included all EPA Regional staff who work on TMDL issues. Members of the TMDL Innovation Workgroup served as test survey participants to help refine the survey. The Watershed Branch provided the names and email addresses of all of their regional TMDL staff counterparts. Eighty-four percent of the 80 survey recipients completed and submitted the EPA TMDL staff survey. The response rate among recipients from each EPA Region is as follows: 100% for Regions 1, 3, and 4; 91% for Region 10; 90% for Region 5; 75% for Region 6; 71% for Region 8; 67% for Regions 2 and 7; and 63% for Region 9.

EPA program and other Federal Staff

Other EPA program staff included EPA staff working on non-point sources, stormwater coordinators, ground water/drinking water/source water protection, smart growth, air deposition, national estuaries, clean water state revolving fund coordinators, and the remediation of Superfund sites that affect surface water quality, as well as nine, non-Federal staff responsible for the management of national estuaries. While the work of these respondents does not focus directly on TMDLs, their respective areas of expertise are important to the implementation of TMDLs. These respondents can provide perspective on how TMDLs might influence the knowledge and behavior of EPA staff supporting other water quality efforts. Forty-seven percent of the 224 survey recipients completed and submitted the other EPA program personnel survey. The other EPA program staff who responded to the survey were comprised of personnel from the following EPA program areas: approximately 29% from nonpoint source, 22% from the National Estuary Program (NEP), 13% from air, 13% from Superfund, 7% from ground water/drinking water, 6% from permitted stormwater, 4%, from smart growth, and 3% from the Clean Water State Revolving Fund. The remaining 3% of respondents did not identify themselves with a particular program area.

Survey Implementation

Each survey was implemented in several stages. First, an e-mail message was sent from EPA management to the identified survey recipients and their managers to describe the purpose and importance of the survey, and request their participation. The e-mail message for EPA

TMDL staff was sent by John Goodin, Chief of the Watershed Branch, to the water division directors in the regions (with a copy to all survey recipients) requesting them to encourage their staff participation in the survey. The e-mail message for other EPA program staff was sent by Mike Shapiro, Deputy Assistant Administrator for the Office of Water, to the identified recipients (with a copy to their managers) requesting their participation in the survey. This communication was an important step to provide advance notification and ensure that the relevant respondents' manager or supervisor was informed of this effort.

Second, IEc e-mailed individual TMDL and other EPA program respondents to solicit their participation and provide them with the link to the online surveys. Respondents were asked to complete the survey within two weeks of receipt. Finally, IEc sent non-responders a reminder email at the conclusion of this two-week period. Due to time constraints, other EPA program survey recipients only received one reminder email. All communications regarding this evaluation were personalized, using an automated email merge and distribution system.

Case Studies

IEc conducted case studies of seven TMDLs to: 1) build on and potentially validate preliminary results obtained from the surveys, and 2) further explore how elements contributing to the development and implementation of TMDLs - most notably stakeholder involvement and implementation planning – impact customer knowledge of and approaches to watershed protection.

In particular, IEc examined: 1) how the level and nature of stakeholder involvement in nonpoint source and stormwater TMDL development and implementation planning processes influence stakeholder knowledge of and participation in watershed protection decisions; and 2) how the development of TMDL implementation plans influence the implementation of nonpoint source and stormwater TMDLs. The case studies that formed the basis of our evaluation are listed in Table 2-2 below.

Table 2-2
Nonpoint Source/Stormwater TMDL Cases and Available Documents

EPA Region	State	TMDL	Year Approved	Pollutant(s)*	Source Type	TMDL Documents Available	
						Approved TMDL	Stakeholder Participation/ Implementation Plan**
I	ME	East Pond	2001	Phosphorus	NPS	http://mainegov-images.informe.org/dep/blwq/docmonitoring/tmdleastpondrep.pdf	SP - described in TMDL (p. 32); IP - included with TMDL (p. 26)
V	MI	Grand River	2003	Fecal Coliform	PS/NPS	http://www.deq.state.mi.us/documents/deq-swq-gleas-tmdlgrand.pdf	SP - no description; IP - referenced in TMDL (p. 6)
VI	NM	Middle Rio Grande	2002	Fecal Coliform	PS/NPS	http://www.nmenv.state.nm.us/swqb/Mid_Rio_Grande-Draft_TMDL.pdf	SP - illustrated in TMDL (p. 41) ; IP – included in TMDL (p. 31)

Table 2-2
Nonpoint Source/Stormwater TMDL Cases and Available Documents

EPA Region	State	TMDL	Year Approved	Pollutant(s)*	Source Type	TMDL Documents Available	
						Approved TMDL	Stakeholder Participation/ Implementation Plan**
VII	KS	Turkey Creek	2002	Fecal Coliform	NPS	http://www.kdhe.state.ks.us/tmdl/ne/TurkeyCr_FCB.pdf	SP - discussed in TMDL (p. 10); IP - referenced in TMDL (p. 8)
VIII	SD	Cottonwood Lake	2001	Phosphorus Sediments	NPS	http://www.state.sd.us/denr/DFTA/WatershedProtection/TMDL/TMDL_CottonwoodAll.pdf	SP - discussed in TMDL summary (p. 164); IP - referenced in TMDL summary (p. 165)
IX	CA	Calleguas Creek	2003	Nitrogen	PS/NPS	http://www.swrcb.ca.gov/rwqcb4/html/meetings/tmdl/calleguas_creek/02_1211/02_1211_Staff Report.pdf	SP - discussed in conjunction with IP (p. 81); IP - included with TMDL (p. 81)
X	WA	Nooksack River	2000	Fecal Coliform	NPS	http://www.ecy.wa.gov/pubs/0010036.pdf	SP - discussed in conjunction with IP (p. 31); IP - included with TMDL (p. 31)

*Some TMDLs bundle together multiple pollutants. Our case study analysis is limited to those pollutants most directly associated with nonpoint sources - pathogens, nutrients, and sediments.

**We reviewed the final TMDL documents for each case to ascertain the levels of stakeholder participation and to determine whether an implementation plan had been completed. SP = text that pertains to stakeholder participation; IP = text that refers to an implementation plan or outlines plan elements.

IEc attempted to characterize the level and qualities of stakeholder involvement for each of the TMDL cases studied. Previous reviews and evaluations of the TMDL process and other collaborative approaches to watershed management (Jarrell, 1999; Poole, 1999; National Academy of Public Administration, 2000; National Policy Consensus Center, 2002) cite broad collaborative involvement of stakeholders and the public as key factors affecting the overall success of TMDL development and attainment of watershed improvements.

IEc also investigated how the quality and specificity of implementation plans, legally required by some States and integrated into the TMDL development process in others, facilitate TMDLs. Washington State, which recently undertook an evaluation of its TMDL program, requires the development of detailed implementation plans following TMDL approval (U.S. EPA, 2005). These plans must document the methods by which pollution will be reduced, timeframes for meeting water quality standards, how monitoring will be conducted, as well as the parties with primary responsibility for implementing pollution control measures. The positive relationship between implementation plans and implementation outcomes was reported in a recent evaluation of TMDL implementation conducted for EPA by Virginia Polytechnic Institute (Virginia Tech, 2006, p. 10).

Case Study Selection and Design

In developing the case study design, IEc considered randomly sampling cases. However, we rejected this option in favor of a more strategic or purposive selection procedure. In our view, given the few cases to be studied and the very large population of TMDLs, a random sample of 10 cases would neither effectively comprise the range of variables impacting TMDLs, nor provide sufficient statistical power to make sound inferences. Furthermore, the purpose of the case studies is not to evaluate the universe of variables that could potentially influence TMDL outcomes but rather to focus on the few salient variables that have been previously associated with successful TMDL development and implementation.

IEc approached case selection systematically, beginning with a list of TMDLs compiled by staff from EPA Regions 1, 2, 4, 6, 7, 8, 9 and 10 during a series of conference calls on TMDL innovations. We chose these cases since we knew we would be able to collect information on them. From this broader list of TMDLs, we selected a preliminary list of potential cases representing all the regions, except Region 1. We also sought assistance from EPA to identify potential cases from the two regions (3 and 5) not represented among the preliminary set.

IEc applied screening criteria to the initial group of TMDLs to narrow the field to include only TMDLs established primarily to address nonpoint source and stormwater impairments. Table 2-3 presents the screening criteria for pollutant type, pollutant source, and implementation timeframe that IEc used to identify the subset of eligible cases. For each of these categories, we further delineated subcategories and category indicators to inform our TMDL selection. IEc's rationale for selecting these specific categories and indicators is multifold. In selecting these criteria, we considered the following:

- Selection of cases that represent the types of nonpoint source impairments most frequently associated with water quality degradation. According to the *National Water Quality Inventory: 2000 Report* (U.S. EPA, 2002), bacterial contamination from agricultural runoff constitutes the greatest threat to the nation's rivers and streams; agricultural runoff containing excessive nutrients is the leading contributor to eutrophication in lakes and reservoirs. The report also implicates urban stormwater as a chief source of both these pollutants. Nitrogen, phosphorus and fecal coliform are examples of specific nutrients and pathogens, respectively, for which TMDLs have been established.

- Selection of cases limited to those TMDLs developed and approved before 2004. We established this threshold on the basis that implementation planning and implementation activities are more likely to have been initiated for TMDLs approved more than two years ago.

Table 2-3 SCREENING CRITERIA FOR TMDL CASE SELECTION		
Primary Category	**Criteria**	**Potential Indicators**
Land Use Type	Urban; Rural	MS4 Phase I Status; CAFOs; Forest; Cropland; Pasture
Pollutant Type	Nutrients; Pathogens	Nitrogen; Phosphorus; Fecal coliform
Pollutant Source	Nonpoint Source	Agricultural runoff; Municipal stormwater
Implementation Timeframe	Approval Date of TMDL	Prior to 2004

IEc selected the final 10 cases from among the list of 14 TMDLs produced following the application of the initial screening criteria. To this list we then applied a set of selection criteria to identify cases demonstrating varying degrees of stakeholder participation during the TMDL development process as well as implementation plans of varying composition and specificity. We also attempted to achieve geographic diversity of TMDLs across the 10 EPA regions, balance among the number of urban versus rural TMDLs, and equal representation of nutrient and pathogenic impairments. Optimally, we sought to select five urban and five rural cases. Within these two groups of five cases, we assigned individual TMDLs to one of nine possible stakeholder participation/implementation plan combinations. Our ultimate objective was to generate, to the extent possible, a cross section of cases to inform the study findings.

We used a number of indicators to quickly categorize land use for TMDLs. For example, we used Phase I MS4 status as a proxy for designating urban TMDLs. Due to the variety of agricultural activities that take place in rural areas, we used a combination of indicators, including confined animal feeding operations (CAFOs) and/or pasture, forestry, and cropland land uses as proxies for designating rural TMDLs.

In order to define dimensions of stakeholder involvement to be applied in the case selection process, we relied on descriptions of stakeholders and the public participation process published in the approved TMDL reports. With often very few details provided, we established definitions of "high", "moderate", and "low" degrees of stakeholder involvement. We defined a "high" level of stakeholder participation as the most collaborative, comprised of a large and diverse group of stakeholders involved throughout the TMDL development process in various capacities. "Moderate" participation was defined as less collaborative, involving a smaller, more homogenous group of stakeholders who served in an advisory capacity on an infrequent basis. We defined a "low" degree of participation as being limited to the involvement of just a few key stakeholders, such as the convening agency, and one or two public hearings.

IEc followed a similar strategy when characterizing the composition and specificity of implementation plans. We reviewed the implementation plans and descriptions of implementation planning efforts included with the published TMDLs. We classified implementation plans as "detailed", if they included timelines, interim targets, monitoring strategies, lists of best management practices (BMPs), responsible parties, and budgets directed specifically at meeting the load allocations in the TMDL. Implementation plans that provided only brief descriptions of BMPs without specific references to targets, monitoring, funding, or

responsible parties were classified as "general". We classified TMDLs that did not include a plan, or which only referred to the future development of an implementation plan, as having "no plan".

IEc developed a matrix to facilitate comparisons across the TMDLs and aid the selection process. Our objective was to generate a final set of 10 cases evenly distributed across the selection criteria and dimensions of stakeholder participation and implementation plan detail. We found that the cases identified from the "innovations" list tended to be characterized by a moderate/high degree of stakeholder involvement and the inclusion of implementation plans with the TMDL. To counter this selection bias, we randomly selected from EPA's WATERS database, additional nonpoint/stormwater TMDLs with a low degree of stakeholder involvement and no implementation plan. The matrix, presented in Table 2-4**,** displays the final selection of 10 TMDLs, organized by land use, level of stakeholder involvement, and type of implementation plan. The matrix also lists the pollutant and predominant pollutant source for each TMDL.

Table 2-4 TMDL Final Case Selection Matrix
(shaded cells represent the seven case studies that IEc conducted)

Implementation Plan Type*	**Degree of Stakeholder Involvement***					
	High		Moderate		Low	
Detailed Plan Included	R10 - WA, Nooksack River; FC, NPS, CAFOs	R1 - ME, East Pond (U/R); Ph, NPS, Septic/Agri		R9 - CA, Calleguas Creek (U/R); N, PS/NPS, Storm/Agri		
General Plan Included	R2 - NJ, Lower Delaware Region; Ph, PS/NPS, Crops	R6 - NM, Middle Rio Grande; FC, PS/NPS, Storm	R4 - FL, Lake Okeechobee; Ph, NPS, Agri/Septic			R5 - IL, Cedar Creek (U/R); Nutr/Sed, NPS, Storm
No Plan Included**			R8 - SD, Cottonwood Lake; Ph/Sed, NPS, Range/Crops		R7 - KS, Turkey Creek; FC, NPS, CAFOs/Crops	R5 - MI, Grand River (U/R); FC, PS/NPS, Storm/Agri
Land Use***	Rural	Urban	Rural	Urban	Rural	Urban

*TMDLs with stakeholder involvement categorized as "High" documented broad and ongoing stakeholder involvement; those with "Moderate" involvement documented an advisory group and numerous public meetings; those with "Low" involvement documented public notices and hearings.

**TMDLs listed in the "No Plan/Moderate" categories reference plans; however, they were not available electronically and could not be otherwise categorized.

***TMDLs designated at R/U or U/R include both rural and urban land uses, however, they were ultimately categorized as urban or rural based on predominant land use and loading by land use.

Legend: FC = fecal coliform, Ph = phosphorus, N = nitrogen, Nutr = nutrients, Sed = sediments, PS = point source, NPS = nonpoint source, Septic = septic systems, Storm = stormwater, CAFOs = confined animal feeding operations, Agri = agriculture, Crops = cropland, Range = rangeland.

Case Study Data Collection and Analysis

The primary mode of data collection for each case involved conducting a series of semi-structured phone interviews with individuals representing various stakeholder groups in the TMDL development process augmented with a thorough review of the approved TMDL report, implementation plan (if available), and other published material about the TMDL. The primary purpose of the interviews was to: 1) to expand and validate preliminary data gathered for each

case from published sources; and more importantly, 2) to gain insight from stakeholders about the processes undertaken to develop and implement TMDLs, their participation in these processes, and the factors that influence the establishment of the TMDLs and their impact on water quality decisions. Due to the unavailability of a number of stakeholders for three of the cases selected for study, we conducted a total of seven case studies.

IEc first compiled a list of potential interview respondents for each case, working with the TMDL coordinators from each of the EPA Regions and States represented. State and regional coordinators were able to identify other stakeholder groups and key individuals involved in the development of specific TMDLs. Although no one TMDL or process exactly replicates another with regard to the roles and responsibilities of those involved, broad categories of stakeholders are likely to cut across all TMDLs. Table 2-5 lists examples of the kinds of stakeholders that IEc sought to interview.

Table 2-5
STAKEHOLDER CATEGORIES

Jurisdiction	Government	Non-Government
Federal/National	• USEPA Staff: – TMDL – NPS/319 Program – NPDES Program – Great Lakes/National Estuary Program – Superfund • USDA NRCS • US Fish and Wildlife Service • US Forest Service • USGS • NOAA	• Environmental Organizations • Research and Policy Institutes
State	• State Officials • State Environmental Agency Staff: – TMDL – Water Quality – Hazardous Waste – NPDES – NPS/319 Program • State Agriculture Agency • State Natural Resource Agency • State Extension Service • Public Utilities	• Universities/Research Institutes • Private Utilities • Environmental Organizations • Trade Associations
Local	• Local Officials • Drinking and Waste Water Treatment Plant Operators • Health Departments • Planning Departments • Public Works Departments • County Extension Service • Public Utilities • Public Schools	• Universities/Research Institutes • NPDES Permit Holders • Private Utilities • Farmers and Agricultural Cooperatives • Homeowner Associations • Watershed Associations • Student Groups

IEc developed a research guide as a template for organizing and framing the interview questions. We circulated this guide to the EPA Regional and state TMDL coordinators to provide background on the TMDL evaluation and a context for our request to identify stakeholders to participate in interviews. We adapted the basic set of research questions in the guide, listed below in Table 2-6, for each interview to reflect preliminary data obtained from the TMDL and other published sources, and information collected during previous interviews.

Nonpoint Source/Stormwater TMDL Case Study Research Guide
Table 2-6

I. Stakeholder Involvement
1. Representation: • How representative was stakeholder involvement? • Which constituencies were represented?
2. Participation, Duration and Timing: • How frequently were stakeholders involved in the TMDL development process? • At what points during the TMDL development process were stakeholders involved? • How did the scale/scope of the TMDL influence stakeholder development?
3. Leadership: • Which stakeholder(s) convened the TMDL development process? • How did leadership influence the TMDL development process?
4. Decision-Making: • How did stakeholders participate in decision-making during the TMDL development process?
5. Functions: • What functions did stakeholders perform during the development of the TMDL?
6. Influence on Stakeholder Knowledge and Decision-Making: • How has stakeholder involvement influenced stakeholder knowledge about TMDLs and watershed protection? • How has stakeholder involvement in the TMDL process influenced stakeholder watershed protection decisions?
II. Implementation Planning
1. Development of Implementation Plan: • What was the timeframe for developing an implementation plan relative to that for the development of the TMDL? • What prompted the development of a TMDL implementation plan? • What factors influenced the timing and completion of the TMDL implementation plan?
2. Stakeholder Involvement: • What aspects of stakeholder involvement in the TMDL development process also influenced the development of the TMDL implementation plan?
3. Implementation Elements: • What level of detail was included in the implementation plan? • What specific elements were included in the implementation plan? • Was the implementation plan subject to any external review or approval?

Nonpoint Source/Stormwater TMDL Case Study Research Guide Table 2-6
4. Implementation Status: • How has the plan been used to guide implementation of the TMDL? • Which parts of the plan have been implemented to date? • What factors have influenced the implementation of the TMDL? • How has the implementation planning process influenced stakeholder watershed protection decisions (if applicable)?

IEc TMDL team members conducted the interviews, which were designed to last approximately 45-60 minutes. IEc also scheduled any necessary follow-up phone calls with interviewees to clarify responses to interview questions or to fill in data gaps and reviewed any relevant documentation provided by respondents following the interviews. We conducted a total of 36 interviews, ranging in number from two to nine for each case, with an average of five respondents interviewed per case. The breakdown of interviews conducted by stakeholder category is as follows: 13 state government, nine local government, three Federal government, three Tribal government, three non-governmental organization, two watershed group, two consultant, and one agricultural. IEc oriented the interview guide around the two main independent variables discussed earlier in this section: stakeholder involvement and implementation planning. Although cases were initially selected on just two aspects of these variables, the characteristics of stakeholder participation and implementation planning are numerous and diverse. IEc designed questions that further explore these characteristics in more detail. Table 2-7 lists the additional dimensions of stakeholder involvement and implementation plans that may be associated with successful TMDL implementation. In addition to the level of activity and composition of stakeholders used to screen cases, IEc examined how the timing of stakeholder involvement, leadership roles, decision-making structures, and stakeholder functions contribute to successful TMDL development and whether these same elements also influence changes in attitudes and behavior among stakeholders and the implementation planning process.

Beyond the actual preparation of implementation plans, the composition and specificity of these plans may prove to be as influential to TMDL implementation as is stakeholder involvement. IEc compiled a list of plan elements in Table 2-7 that correspond to TMDL implementation activities and which may also be indicators of quality and/or sophistication in the plans that include them. The importance of stakeholder involvement notwithstanding, IEc hypothesized that plans which clearly specify the approaches to and timeframes for achieving water quality improvements, sustaining data collection activities, accessing necessary resources, and promoting public participation, will lead to increased involvement of TMDL customers in watershed protection activities and more expeditious and comprehensive TMDL implementation. IEc developed questions in the research guide to elucidate and verify indicators of implementation plan quality and sophistication as well as gauge their relative impact on implementation.

After each interview, members of IEc's TMDL team coded and input interview responses into an Access database designed specifically for the case study analysis. IEc developed a coding system that parallels the dimensions of stakeholder involvement and implementation plans in Table 2-7. In addition to describing the basic elements of each case, we sought to capture general impressions and identified broad themes within and among cases.

Table 2-7

DIMENSIONS OF TMDL STAKEHOLDER INVOLVEMENT AND IMPLEMENTATION PLANS IN TMDL DEVELOPMENT AND IMPLEMENTATION PLANNING

Stakeholder Involvement and Public Participation

Duration	Process Timing	Leadership	Decision-Making	Representation	Functions
- one-time - intermittent - consistent	- During 303(d) listing - Post 303(d) listing - Draft/final TMDL review - All phases of TMDL development - TMDL Implementation planning	- EPA convened - State convened - Local government convened - Third-party convened - Public/private partnership	- Consensus-based - Advisory role - Comment only - Formal collaborative - Informal collaborative	- Diverse (all interested parties) - Limited (most impacted parties) - Homogeneous (e.g., government agencies)	- Data collection and analysis - Funding - Advisory committees - Technical expertise - Public education and awareness - Administrative - Facilitation/coordination - Implementation

Implementation Plans

Included with TMDL	Required by State	State Practice	Stakeholder Involvement (Dimensions described above)	Implementation Elements Addressed in Plans
- Yes - No If no, describe timing of TMDL development	- Yes - No	- Yes - No	- Duration - Timing - Leadership - Decision-making - Representation - Function	- Identification of water quality goals - Approach to scheduling and adoption of interim targets - Identification of BMPs - Development of a continuous monitoring and data collection program - Identification of responsible parties - Identification of funding sources and detailed budget - Integration with existing water quality planning initiatives - Integration with ongoing watershed restoration activities

DATA ANALYSIS

IEc analyzed data from the two surveys and case studies on an individual and aggregate basis to identify emerging themes and highlight distinctions based on unique circumstances. As described above, we entered our web-based survey data automatically into an Access database. Data for simple, multiple-choice questions allowed for the computation of percentages and counts. In contrast, for the open-ended survey questions we coded responses to help categorize similar responses and conduct a qualitative analysis of the findings. This approach facilitated our comparative analysis of different groups of respondents, allowing us to identify patterns across respondent groups, for example, an analysis of how EPA employees who work on TMDLs view the value of different elements in TMDL development, as opposed to other EPA program employees or other Federal employees.

The case study analyses also consisted of organizing responses to the interview questions and supporting information from available case materials into categories for coding purposes. This allowed us to examine variations and similarities across cases to gather insights useful in interpreting other TMDL development processes.

DATA LIMITATIONS

To help OWOW consider the evaluation's findings, IEc worked with EPA Headquarters TMDL experts and OPEI personnel experienced in evaluations and survey methodology to interpret the study results. In doing so, we kept several data limitations in mind:

- Survey respondents included EPA staff and other Federal employees selected by EPA. While valuable insights were gained from the experience and knowledge of these respondents, state and non-point source participants were not included. State TMDL and other EPA program staff engaged in activities that impact water quality are key to understanding the TMDL development process since they are the primary implementers of the TMDL program. Seven case studies provided some information from state participants, but this information was limited, as discussed below.

- Study results generally reflect the views of a majority of the respondents. In certain instances, however, the survey attempts to identify the experience and knowledge of sub-groups of respondents (e.g., other EPA program staff in the smart growth program, etc.) through a limited number of respondents. This information may, therefore, not be representative of the experience of a larger group of smart growth personnel.

- The introduction of bias in the design and analysis of the case studies is of particular concern, given the few cases to be sampled, the limited number and representativeness of respondents, the narrow focus of the interview questions, and the tremendous variation in the approach from one TMDL process to another. While a worthy objective, complete elimination of bias under these circumstances is extremely difficult. As discussed above, IEc has designed its case selection process to control for land use, pollutant type, pollutant source, and the timeframe for TMDL approval. This design will prevent us

from extending our conclusions to all nonpoint source TMDLs in all States and EPA Regions; however, IEc attempted to both establish the limited representativeness of the results and identify potential confounding factors that could affect the relationship between independent and dependent variables. Examples of these extraneous factors include: restoration activities that pre-date the TMDL, the complexity of the waterbody and/or impairment, and bundling approaches.

Overall, this evaluation demonstrates the importance of engaging multiple stakeholders and water quality decision makers in a collaborative process to develop useful, high quality TMDLs. Achieving water quality standards in impaired water bodies requires a clarity of purpose, good data, knowledge of the issues, a commitment to nonpoint source and stormwater interventions that are likely to address pollutant sources, and the ability to take new actions and effect change.

The discussion of specific evaluation results is organized by the overarching six evaluation questions outlined in chapter 1:

I. How does variation in the availability, quality, and analysis of data influence the development of useful, high-quality TMDLs?

II. How does variation in funding, guidance and leadership influence the development of useful, high-quality TMDLs?

III. How do variations in stakeholder involvement influence the development of useful, high-quality TMDLs?

IV. How do variations in scale and scope of the TMDL influence active stakeholder involvement and the production of useful, high quality TMDLs?

V. What elements of an implementation plan are most important for effective implementation?

VI. How might EPA refine its TMDLs to further increase WQ decision maker knowledge and commitment to water quality improvements*?*

In addition, the evaluation questions explore which elements of an implementation plan are most important, and the extent to which water quality decision makers have knowledge of TMDLs, are committed to water quality improvements, and base their decisions on TMDLs. Detailed results of the two surveys and case studies are included in the Appendices to this report.

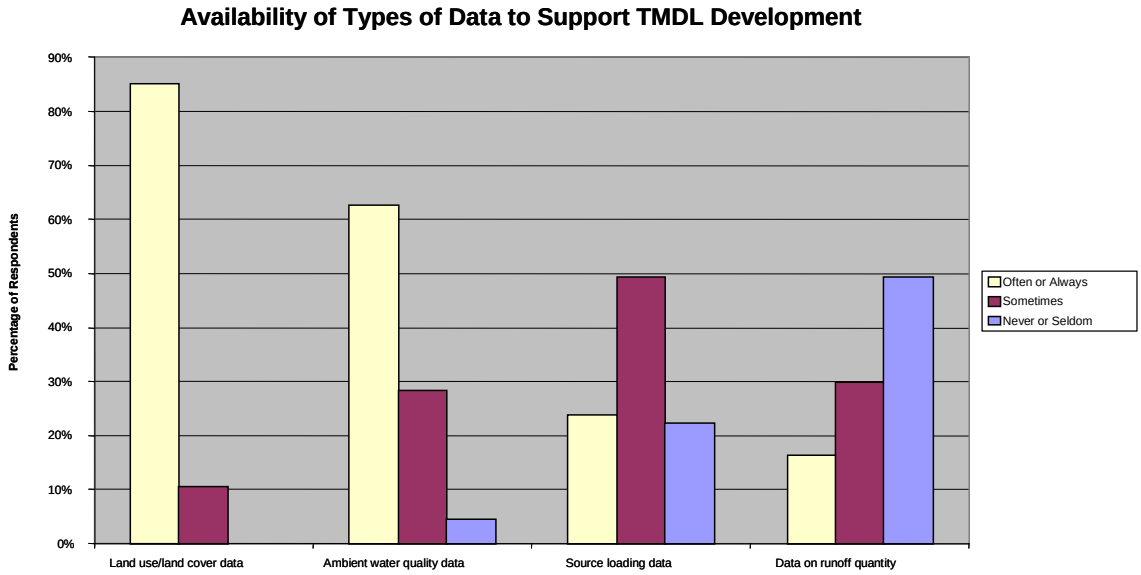
I. How does variation in the availability, quality, and analysis of data influence the development of useful, high-quality TMDLs?

DATA COLLECTION AND ANALYSIS

The development and implementation of useful, high quality nonpoint source and/or stormwater-related TMDLs depends on the availability, quality, and analysis of data pertinent to the water body. The survey designed for EPA TMDL staff asks respondents about their experience with the quality of data, different types of data needed to support TMDL development such as source loading and ambient water quality data, and the adequacy of data to support various activities including source assessments, loading capacity estimates and source allocations. In addition, the survey asks respondents to give their opinion regarding whether the following activities – new monitoring/data collection efforts, volunteer monitoring, strict QA/QC procedures, a technical advisory committee, and calibrated water quality models – are necessary to the development of a high quality TMDL. Case study respondents were also asked about the availability and quality of data, and the impact of time and resource constraints associated with data collection and analysis.

The TMDL survey and case study results confirm that the availability and quality of data is of paramount importance during the TMDL development and implementation planning process. Only 34% of respondents indicated that quality data is *often* or *always* available and important types of data are frequently not available as well. Many TMDL staff also provided qualitative responses regarding this need for more and better data. For example, one staffer noted that "[g]ood non-point source and stormwater data is virtually non-existent. Data collection efforts need to be deployed to set the baseline reference levels or concentrations for the non-point source and stormwater runoff." Forty-nine percent of respondents reported that data on runoff quality is *never* or *seldom* available and only 16% of respondents to the survey found that these data were *often* or *always* available. As noted above, this information is very important in the development of an effective nonpoint source and/or stormwater-related TMDL. Similarly, only 24% of respondents had *often* or *always* had source loading data available during the course of TMDL development. Data that were *often* or *always* more available includes land use/land cover data (85% of respondents) and ambient water quality data (63% of respondents). Another TMDL respondent summarized the challenge as follows: "[d]ata collection and analysis presents a significant challenge. Even when watershed groups or others collect the data, someone must coordinate the efforts and analyze the data." Figure 3-1 below provides a chart with survey responses regarding the availability of types of data.

Figure 3-1



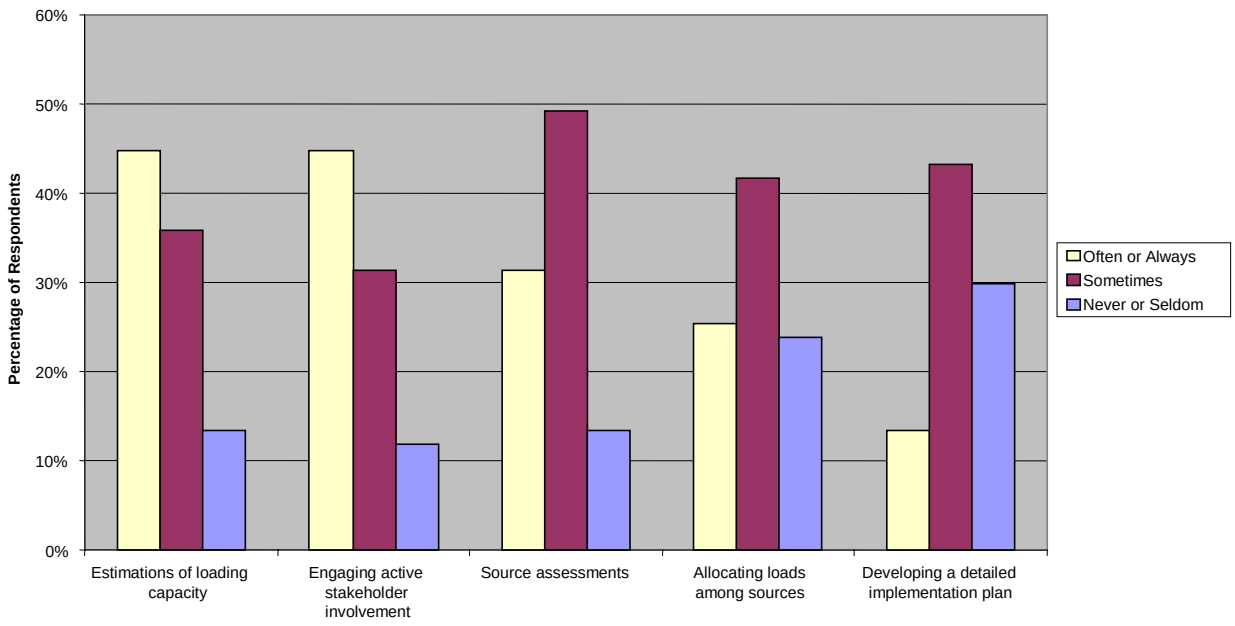
Data to support specific activities are also reported by less than half of survey respondents to be *often* or *always* available. Only 13% of respondents reported that adequate data were *often* or *always* available to support development of a detailed implementation plan; and only 25% of respondents *often* or *always* had adequate data to support an allocation of loads among sources. Interviewees for the Calleguas Creek, Cottonwood Lake, East Pond, and Turkey Creek studies also reported that the ability to gather data sufficient to adequately characterize source loading and linkages was compromised by time and resource constraints. In each of these case studies, the consent decree schedule for completion of the TMDL limited opportunities for comprehensive sampling and data analysis. For instance, in the Calleguas Creek case study, the consent decree schedule imposed constraints on the adoption of multi-pollutant approaches that had been proposed by stakeholders. EPA TMDL staff respondents supported this observation by noting that: "[t]he most limiting factor for the timely development of quality TMDLs is the existence of environmental data to help with source identification and other aspects of defining the problem and ultimately the solutions." This relates to the "lack of resources at the state level needed to collect the data;" and a recommendation that "more time for data collection and development" is needed.

The lack of adequate data led to concerns being raised about the TMDLs. Agricultural interests participating in the Calleguas Creek, East Pond and Nooksack River cases raised concerns about the load allocations established for agriculture and the scientific methods used to generate load allocations. In the Nooksack river basin, for example, the Whatcom Chapter Dairy Federation was not satisfied with the targets and load allocations established for dairy farms because they believed that a "zero discharge" limit was not realistic to accommodate accidents and malfunctions associated with their operations. Similarly, agricultural interests in the Calleguas Creek watershed disagreed with POTWs over the magnitude of the impairment and the source of nutrients at the outset of the TMDL development process. However, more refined technical data developed in the course of TMDL development facilitated a change in the

perspective of agricultural interests regarding their contribution to nitrogen loadings and a better understanding of the impacts of surface runoff on surface and groundwater quality. As a result, Calleguas Creek agricultural interests are engaged in identifying cost effective best management practices (BMPs), have secured grant funds to sponsor a BMP evaluation, and are considering making investments in new irrigation technologies. One stakeholder urged soliciting more input in general from agricultural sources to facilitate trust and foster this kind of active participation in implementation activities. Figure 3-2 below provides the experience of EPA TMDL staff respondents with respect to the adequacy of data to support specific activities.

Figure 3-2

Adequacy of Data to Support TMDL



Given the experience of EPA TMDL staff in often working with insufficient amounts of data, it is not surprising that 70% of these respondents *often* or *always* support the need for new monitoring and data collection to develop a useful, high-quality TMDL. They also favor strict quality assurance/quality control procedures and protocols (58% of respondents). By contrast, the availability of volunteer water quality monitoring and a technical advisory committee are reported by fewer respondents (24% and 19%, respectively) as *often* or *always* important activities to the development of a sound TMDL. Nonetheless, technical advisory committees can serve as effective sounding boards to evaluate sampling data and modeling results in establishing TMDL targets. For example, a major issue confronting the technical advisory committee for the Nooksack River involved establishing a TMDL target for the lower river basin that would protect shellfish in Portage Bay. The Lummi Indian Nation, the Nooksack Tribe, and the Washington Department of Health favored use of the more conservative marine fecal coliform criterion while the Whatcom County Dairy Federation and other stakeholders opposed it. The Washington Department of Ecology conducted a sophisticated simulation exercise with known and unknown variables that determined that the geometric mean for Class A waters would not be adequate to protect shellfish, and therefore a more stringent target would be needed. This approach

ultimately resulted in a target that was acceptable to all stakeholders in working closely with the technical advisory committee.

Survey and case study results point strongly to the need to focus resources on adequate and high quality data to support TMDL development. The involvement of stakeholders, as discussed in greater detail below, also plays a role in building support for the best available data and analyses to inform the setting of TMDL targets and implementation activities.

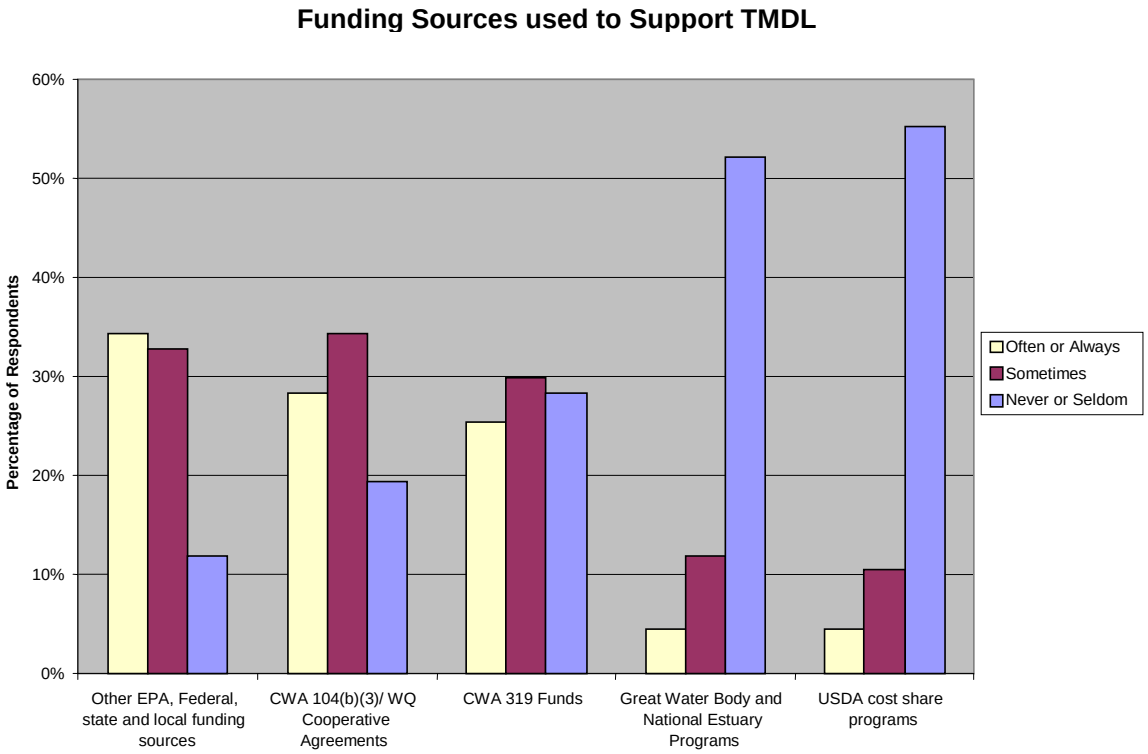
II. How does variation in funding, guidance and leadership influence the development of useful, high-quality TMDLs?

FUNDING RESOURCES

Supporting the development and implementation of TMDLs generally requires significant funding over many years. The survey queried EPA TMDL staff regarding the adequacy of funding for TMDL development purposes and their experience with particular funding sources. Approximately one third of respondents, or 30%, report that adequate funding is *often* or *always* available to support TMDL development, while 40% of respondents report that it is *sometimes* available. Three funding sources including Clean Water Act (CWA) 319 funds to States for implementing approved NPS management programs, CWA 104(b)(3) or water quality cooperative agreements, and other EPA, Federal, state and local sources are the predominant sources of monies to support TMDL development. Twenty-five percent to 34% of respondents indicate that these funding sources are *often* or *always* available, and 30% to 34% of respondents have experience with these same sources being *sometimes* available. By contrast, 52% and 55% of respondents report that Great Water Body and the United States Department of Agriculture (USDA) or "Farm Bill" funding, respectively, is *never* or *seldom* available for nonpoint source TMDLs.[1] Figure 3-3 below provides these results from EPA TMDL respondents.

[1] Great Water body funding refers to funding specifically allocated to the Great Lakes under Section 108(a) of the CWA. The "Farm Bill" is formally known as the "Farm Security and Rural Investment Act of 2002."

Figure 3-3



Section 319 monies provided funding for all of the case studies, regardless of which stakeholder group led the development process. In the cases where leadership was shared between state and local agencies (East Pond and Cottonwood Lake) or assumed by a third party (Calleguas Creek), the state distributed Section 319 grants to local groups. Funds were also contributed to the process either directly by stakeholders, as in Cottonwood Lake and Calleguas Creek, or as in-kind contributions (e.g., monitoring conducted by stakeholders but funded through separate grants or other funding sources). For example, the Calleguas Creek Watershed Management Plan which was formed by local wastewater dischargers and agricultural producers obtained a CWA Section 205(j) grant and hired a private consulting firm through the municipal water district to begin the process of developing a watershed-based TMDL for nitrogen.[2] Other funding sources mentioned by survey respondents include state and Tribal CWA 106 grant funding for the prevention and abatement of surface water pollution, local conservation districts, state funding such as the Clean Water Initiative funds in Michigan, CWA 604(b) monies to local governments for water quality management planning, and federal watershed contract dollars. Based on survey responses, it appears that many diverse sources contribute to support TMDL development, but Great Water body and USDA funds have been the least accessed for TMDL development. In the future, EPA may want to help broker these sources of federal funds for TMDL development and implementation.

[2] Section 205(j) of the Clean Water Act authorizes States to reserve up to one percent of their annual Title II CWA Construction Grant contribution for water quality management planning activities.

In general, survey and case study respondents indicated the need for greater and sustained funding to support better data quality and collection and TMDL implementation activities. However, our findings did not provide insights into how well stakeholders know about funding sources, the ease or difficulty in accessing such funds, and whether funding is being allocated to the highest priority water body impairments. EPA may want to examine these questions to develop a comprehensive strategy for funding TMDL development and implementation.

Guidance and Protocols

EPA is also interested in determining the extent to which adequate guidance materials and protocols are available to support the development of high-quality TMDLs. Survey results show that 39% of overall respondents report that adequate guidance and information on TMDL development is *often* or *always* generally available and 25% of overall respondents have experience with such materials being *sometimes* available. The two top-ranked types of materials that EPA TMDL staff found *often* or *always* useful are: a) case studies; and b) regional guidance documents, methodologies, and analyses (51% of respondents and 49% of respondents, respectively). This same preference for case studies and regional guidance materials prevails for respondents who *seldom* or *never* believe that adequate guidance is available.

Suggestions for additional guidance materials include help in interpreting narrative standards for nutrients, sediment, and temperature; determining what are adequate margins of safety or reasonable assurance; developing watershed TMDLs; resolving mercury issues; and modeling runoff from specific land uses in different types of geologic sites (i.e., wet/dry; low/high; and flat/steep).

Evaluation results demonstrate the relative importance of the types of guidance materials and also provide specific suggestions for additional materials. EPA may also want to inquire as to the value of existing guidance materials and conduct a prioritization exercise by Regional TMDL experts to identify the most important gaps in existing materials. With an inventory of available guidance and identification of the most pressing demand among TMDL developers, EPA will be positioned to improve its guidance materials.

Leadership

State environmental agencies *often* or *always* lead the TMDL development process according to 84% of TMDL survey respondents, and are regarded as *often* or *always* the most effective leaders by 78% of survey respondents. One survey respondent noted the need for leadership to integrate federal and state programs devoted to water quality issues "to find shared goals and to translate them into program specific activities designed to identify, prioritize, and fix impairments." This theme of enhanced collaboration between federal and state interests is supported by other respondents as well.

TMDL survey respondents urged EPA Headquarters and Regional staff to be more consistent in their direction to States and “to provide clear leadership on the details of TMDL development … so that state and local stakeholders … have a framework … and a schedule for

completion of the tasks." Additionally, one respondent urges a significant role for EPA in the process regardless of which stakeholder is "leading" the process. "EPA absolutely needs to provide a presence at community or stakeholder meetings. This elevates the importance of the TMDL in the watershed and gives the community confidence and support in moving forward with the TMDL development process." In addition, respondents urge EPA management to be "open and encourage new and innovative ways to address the backlog of impaired waterbody segments" by focusing more on "achievement" and less on "numbers."

In four of the case studies (Nooksack River, Middle Rio Grande, Turkey Creek, and Grand River), the TMDL development process was led exclusively by a state environmental agency. In two of the case studies (East Pond and Cottonwood Lake), leadership was shared by the state and local conservation agencies. In the last case (Calleguas Creek), the process was led by a third party. For East Pond and Cottonwood Lake, the state initiated TMDL development but turned over responsibility and funding for the process to local conservation districts. The districts, with input from the state, carried out all functions related to TMDL development including planning, data collection and analysis, stakeholder involvement, and TMDL report preparation.

III. How do variations in stakeholder involvement influence the development of useful, high-quality TMDLs?

Another important component of this evaluation focuses on how the variation in stakeholder involvement influences the development of nonpoint source and/or stormwater TMDLs. Stakeholders are broadly defined in this evaluation to include EPA and State TMDL and other EPA staff engaged in water quality issues, other Federal agencies such as Natural Resources Conservation Service (NRCS), the United States Forestry Service (USFS), and the United States Fish and Wildlife Service (USFWS), local government environmental and planning agencies, dischargers, national and regional environmental advocacy groups, local NGOs and watershed organizations, universities and/or research institutions, and watershed residents. Areas of inquiry include stakeholder characteristics such as the nature and type of stakeholder; and how stakeholder involvement varies based on the stage in the TMDL development process, the type of TMDL and the type of pollutant(s). Questions regarding stakeholder characteristics include the level of stakeholder involvement, the degree to which all interested parties are involved, and the impact of stakeholders to positively influence the development of a useful, high-quality TMDL.

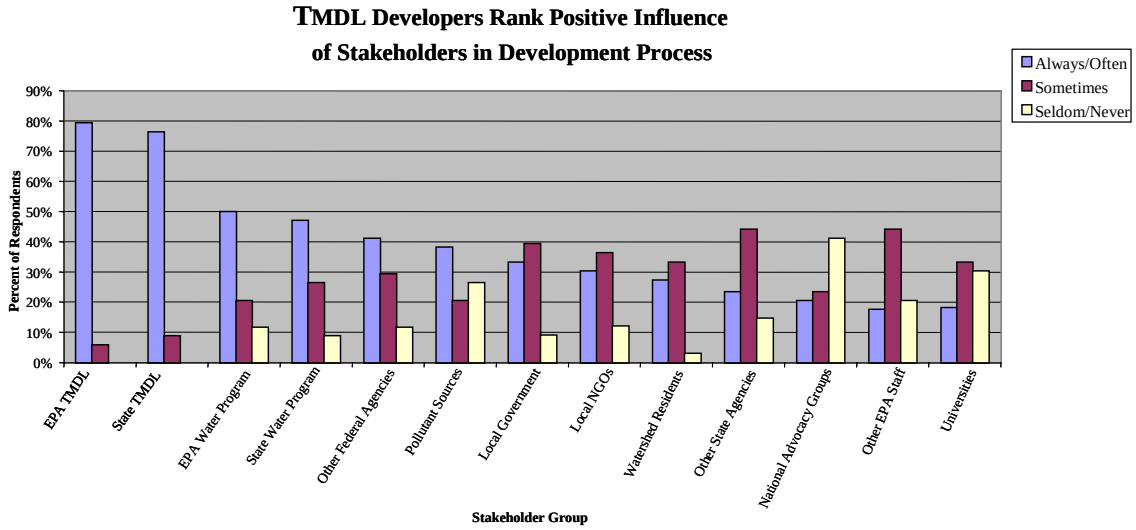
Character of Stakeholder Involvement

To assess the character of stakeholder involvement, the evaluation focused on three questions: 1) whether stakeholders have a positive impact on the TMDL development process; 2) what the level of stakeholder participation generally exists; and 3) the type of stakeholder who

has a positive impact.[3] More than half of EPA TMDL respondents view stakeholder participation as *often* or *always* having a positive, substantive impact on TMDL development (52% of respondents). However, this overall generally affirmative response by EPA TMDL respondents to stakeholder involvement should be viewed in the context of only 24% of the same respondents *often* or *always* having experience with a *high* level of stakeholder participation. There may be no correlation between these evaluation results, but it does raise additional questions. If the level of stakeholder participation were higher, what would the impact be on respondents' perception of impact - either positive or negative? Why is the level of stakeholder participation not higher, or is there a higher rate of participation among certain types of TMDLs (i.e., watershed-based versus single pollutant TMDLs)? Do the resource constraints of TMDL developers and consent decree schedules affect outreach efforts to engage more stakeholders?

We next examined which stakeholders are perceived by survey respondents as positively influencing the development process of the TMDL. Among EPA TMDL staff who engage in developing TMDLs and those who do not, State TMDL staff are rated highly overall as *always* or *often* having a positive influence (76% of developer respondents *and* 76% of non-developer respondents). EPA and state water program staff are also comparably rated with 47 to 50% of TMDL developers *often* or *always* considering the water programs to have a positive impact and 39% of TMDL respondents that do not develop TMDLs having the opinion that such water programs *often* or *always* have a positive impact. Figure 3-4 below presents the results from the ranking by TMDL developers, of stakeholder influence.

Figure 3-4



[3] For purposes of this evaluation, EPA TMDL staff are included as stakeholders. Thus, EPA TMDL staff respondents are also assessing their own role as stakeholders in the TMDL development process which may lead to bias.

At the lower end of the scale, however, EPA TMDL respondents *consistently* ranked state and local planning agencies, state agricultural agencies, and USDA programs as stakeholders/organizations with the least understanding of the TMDL program, lowest commitment to achieve water quality standards based on TMDLs, and fewest action(s) taken to improve water quality based on TMDLs. For example, USDA programs were ranked by only nine percent of the respondents as *often* or *always* having a commitment to achieve water quality standards and by only 12% of respondents as *often* or *always* taking new actions to improve water quality standards based on TMDLs. By comparison, state nonpoint source programs were ranked by 37% of respondents as *often* or *always* having a commitment to improve water quality standards and by 36% of the respondents as *often* or *always* taking new actions to achieve such water quality standards based on TMDLs. See Figures 3-10 and 3-11 for more details as to how EPA TMDL respondents ranked these stakeholders. This would suggest the need to target outreach and education efforts towards these stakeholders for TMDL purposes.

To be most effective, EPA may want to look for opportunities to create meaningful intersections between the TMDL program and state agricultural agencies and USDA programs through existing land grant cooperative extension networks that are supported by research-practitioners in universities. For example, two compliance assistance initiatives targeted at animal production facility operators include: 1) a California environmental stewardship certification program focused on dairy producers in California: and 2) a livestock and poultry environmental stewardship curriculum project that developed a comprehensive set of educational materials for local cooperative extension agencies to support their ongoing outreach activities. Both of these projects are just two examples of ongoing work that provide the agricultural community with best management practices to protect surface water. By integrating the knowledge gained from TMDL development and the implementation activities planned for a waterbody into existing agricultural learning networks, EPA stands a better chance of engaging agricultural stakeholders.

In four of the case studies (Calleguas Creek, East Pond, Middle Rio Grande, and the Nooksack River, the TMDL development process involved an extensive and diverse collection of stakeholders. Stakeholders included representatives from federal, state, local, and Tribal government agencies; consultants; agriculture; environmental groups; homeowner associations; academia; and other local interests. Regulators, impacted parties, and polluters were all represented. In the remaining three cases (Cottonwood Lake, Turkey Creek, and Grand River, stakeholder representation was more limited and homogeneous. Most of the stakeholders involved in the development of these TMDLs included state and local government agencies and few, if any, non-governmental local interests. Stakeholder involvement in the Cottonwood Lake TMDL development seems to have been limited by the fact that this was one of the first TMDLs to be completed in South Dakota and the Department of Environment and Natural Resources needed to "get it done" in response to a consent decree. Nonetheless, the NRCS recommended taking the time to identify everyone with an interest in the watershed and getting them involved early in the process for future efforts. Similarly, the compressed timetable due to the consent decree schedule and limited staffing levels impeded the Michigan Department of Environmental Quality from involving stakeholders in the Grand River TMDL development process in a meaningful way.

TMDL Characteristics and Stakeholder Involvement

We first examined how respondents view stakeholder involvement at various stages of TMDL development. EPA TMDL staff view stakeholders as *often* or *always* helpful with public outreach and implementation (66% of respondents) and in developing implementation plans (63% of respondents). The percentage of respondents that attribute helpfulness to stakeholders declines for more technical activities such as assembling data, monitoring, and analysis (48% of respondents), source assessments (37% of respondents), and assigning load allocations among sources (28% of respondents). Qualitative responses from EPA TMDL staff, however, encourage involvement of stakeholders early in the process for data gathering, source assessment, and watershed characterization. For example, one respondent opined that "involving decision makers early results in better information, greater awareness of water quality issues, and more informed decisions."

This approach of involving stakeholders earlier and more frequently throughout the TMDL development process occurred in the four cases with the most extensive and diverse stakeholder representation (Calleguas Creek, East Pond, Middle Rio Grande, and the Nooksack River). Stakeholders in these cases participated either as advisors to the process, as in the case of the Nooksack River, or collaborated formally and informally with the process leaders to provide comments and input on the draft TMDLs. For Calleguas Creek, Nooksack River, East Pond, and Cottonwood Lake, stakeholders also provided assistance with data collection, modeling activities, public education, and funding. Tribal representatives, who assisted sampling efforts for the Nooksack River TMDL, recommended that stakeholders participate in data collection during the planning stages as a means of streamlining the TMDL development process. Stakeholders not otherwise involved with leading the TMDL development process for Turkey Creek and Grand River were generally given opportunities to review and provide comments on the draft TMDLs prior to or during the public notice period. The case studies demonstrated the multiple benefits that accrue from an extensive and diverse representation of stakeholders in the TMDL development process. For example, stakeholders who participated in the development of the Nooksack River TMDL gained a greater understanding of Tribal concerns, contributed to and enhanced their knowledge of the scientific basis for the established targets, and developed a communication network among the groups that would be important in facing the challenges of implementation in a very large and complex watershed. The Ventura County Resource Conservation District, a participant in the Calleguas Creek TMDL, cited its involvement as a positive influence on other stakeholders' understanding and adoption of the watershed perspective. Early outreach to agriculture, in particular, was recommended by stakeholders who participated in the Cottonwood Lake and Calleguas Creek TMDLs, as a means of building trust and increasing knowledge in the agricultural community of its contribution to surface water contamination.

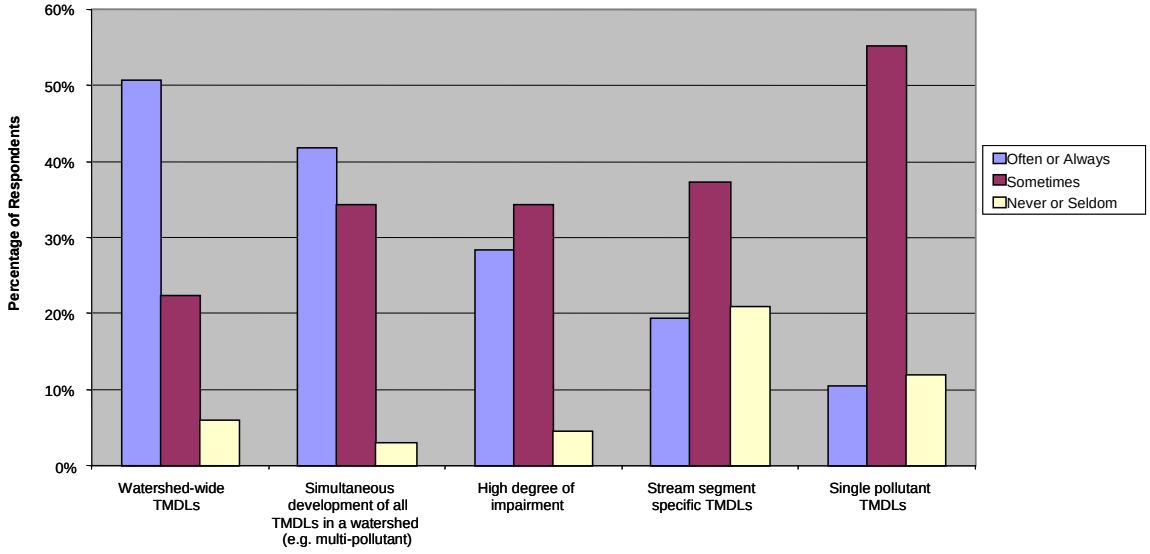
IV. How do variations in scale and scope of the TMDL influence active stakeholder involvement and the production of useful, high quality TMDLs?

We next analyzed how EPA TMDL staff viewed stakeholder involvement in different types of TMDLs ranging from watershed-based to single pollutant. Respondents view watershed-based TMDLs and the simultaneous development of all TMDLs in a watershed (i.e.,

multi-pollutant) as *often or always* more likely to lead to meaningful stakeholder involvement (51% of respondents and 42% of respondents) than TMDLs involving a high degree of impairment (28% of respondents), a stream segment specific TMDL (19% of respondents), or single pollutant TMDLs (10% of respondents). Research findings did not point to a reason for this result, but we might speculate that the grouping of TMDLs together allows TMDL staff more time to devote to stakeholder involvement. Additionally, the approach affords more stakeholders the opportunity to see how involvement in the TMDL process would be worth their time and might impact them directly since the impact of many TMDLs is greater than just one. Figure 3-5 below presents these results.

Figure 3-5

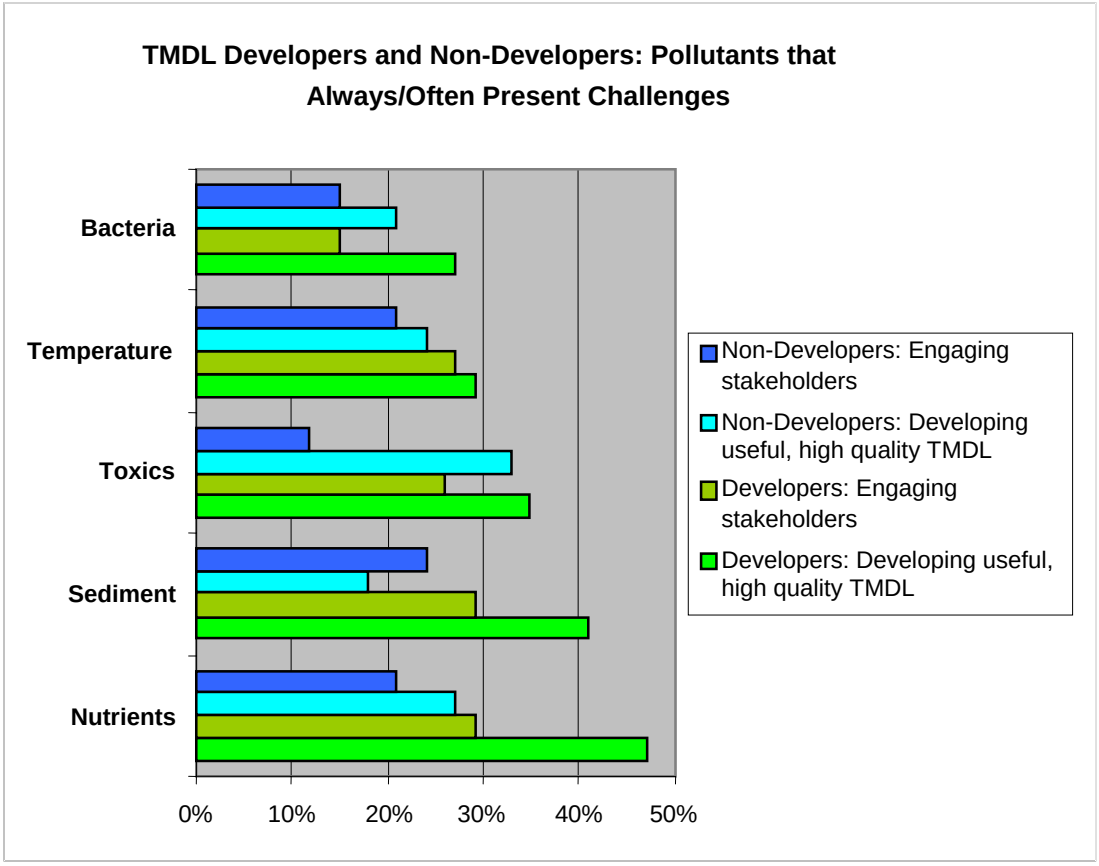
Extent to Which Different Types of TMDLs Lead to More Meaningful Stakeholder Involvement



Finally, we reviewed the various types of pollutants such as nutrients, sediment, toxics, temperature, and bacteria present different challenges to stakeholders. Based on EPA TMDL staff responses, different types of pollutants do not appear to present significantly more or less challenge for engaging stakeholders. Thirty one to 40% of the respondents report that *sometimes* each of the pollutants presents a challenge, whereas approximately a quarter of respondents view sediments, nutrients, and temperature as *often* or *always* presenting a challenge (27%, 25%, and 24% of respondents, respectively). When survey respondents are asked the same question *independent of stakeholder involvement* regarding the challenge presented by different pollutants on the development of useful, high quality TMDLs, opinions range from 24% of respondents for bacteria to 37% of respondents for nutrients often or always presenting a challenge. We conducted a further refinement of the survey results by distinguishing the responses of EPA TMDL staff who reported that their current position involves the development of nonpoint source and/or stormwater-related TMDLs versus those respondents whose functions do not involve the development of these TMDLs. Our analysis indicates that developers of NPS and stormwater-related TMDLs report that nutrients and sediments present greater challenges than

toxics, temperature, or bacteria to the development of a useful, high-quality TMDL than non-developers of TMDLs. These two types of pollutants, nutrient and sediments, do not typically have established numeric criteria which may be leading to the added difficulty with these TMDLs. The development of numeric criteria for these pollutants would ease the debate that often surfaces over the setting of the TMDL endpoint. Figure 3-6 below presents this analysis.

Figure 3-6



Based on the case study findings, bacterial impairments appear to present the most challenges for TMDL development and implementation, contrary to the focus of EPA TMDL staff on nutrients and sediments. However, it should be noted that the case studies are limited in number and only addressed bacteria and nutrient impairments. Three of the four cases that addressed fecal coliform bacteria (Middle Rio Grande, Nooksack River, and Turkey Creek) experienced difficulty fully characterizing the degree of impairment and the relationship between bacterial contamination and non-point sources, particularly urban storm water and agricultural runoff. The stringent fecal coliform standards established for the watersheds and the types of BMPs and controls proposed to achieve the standards, particularly for storm water, were criticized by certain stakeholders. With respect to implementation of nutrient load allocations developed for the Calleguas Creek TMDL, the Los Angeles Regional Water Quality Control Board expressed concern that the "jury is still out" as to whether the BMPs established for agricultural runoff and urban stormwater will be implemented and will be effective in reducing NPS loads. The Board and other stakeholders agree that, if met, the load allocations are

sufficient to achieve the numeric water quality standard for nitrogen. They are not convinced, however, that these allocations will also achieve the narrative criteria (i.e., nutrient levels that do not cause algae blooms) because the TMDL was drafted without a clear definition of what constitutes impairment due to algae.

As indicated above, results are mixed as to whether different pollutants present greater challenges to TMDL development. The unique circumstances associated with each water body and level of stakeholder interest appear to have a greater impact on "difficulty" than do the specific pollutants.

V. What elements of an implementation plan are most important for effective implementation?

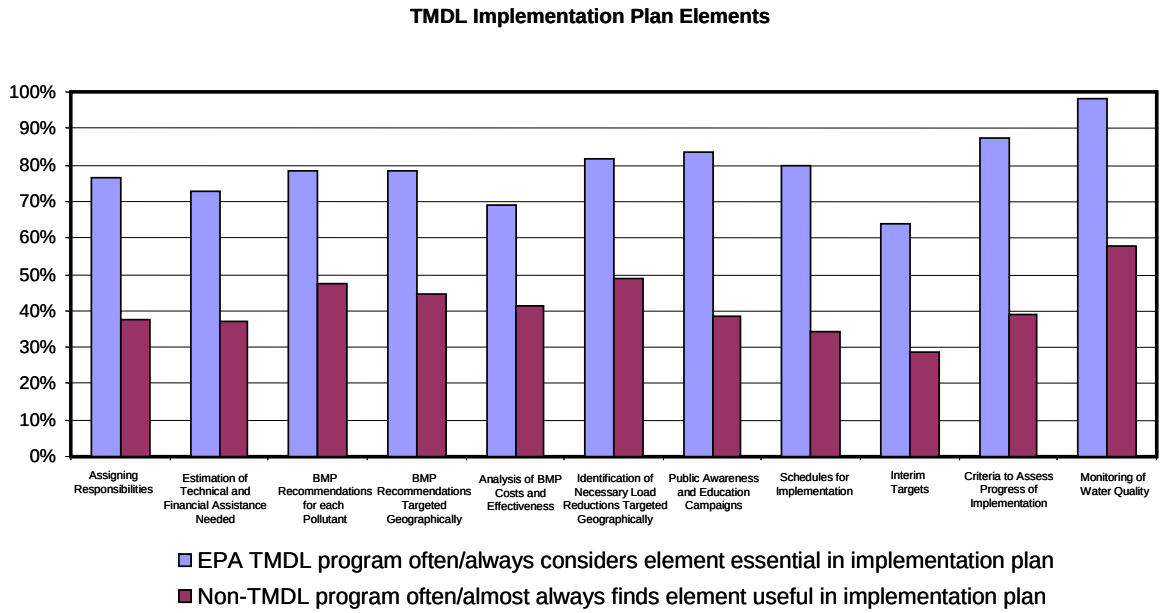
"A well-thought out implementation plan with understandable and achievable targets is key. The TMDL needs to reflect real world conditions and include a more specific "road map" for implementation." This EPA TMDL respondent sums up the importance of implementation plans to achieving the actions necessary for addressing water quality impairments. Only 37% of EPA TMDL staff respondents report that TMDLs *often* or *always* have implementation plans, and 46% of respondents indicate that TMDLs *never* or *seldom* have detailed implementation plans. For three of the case studies (Calleguas Creek, East Pond, and the Nooksack River), the States of California, Maine, and Washington, respectively, require the development of an implementation plan.

Both TMDL staff and other EPA program staff were asked to rank the utility of various elements of a TMDL for effective implementation. The largest percentage of respondents from both groups considered the monitoring of water quality as *often* or *always* essential to effective TMDL implementation. One of the EPA TMDL staff commented that "[f]ollow-up monitoring and water quality model refinements are typically necessary to develop effective plans." This finding supports the significant support described earlier for good data during the development of the TMDL. The chart below in Figure 3-7 below presents the elements of an implementation plan considered *often* or *always* essential to effective TMDL implementation by EPA TMDL staff as contrasted by the elements considered useful by other EPA program staff. In contrast to the TMDL staff, other EPA programs ranked identification of necessary reductions targeted geographically, BMP recommendations by pollutant and BMP recommendations targeted geographically higher (2^{nd}, 3^{rd} and 4^{th} respectively) than their TMDL program counterparts. More than 50% of respondents from the NEP, NPS, SRF, and permitted storm water programs found the compilation of source loads, reductions needed to meet water quality standards (WQS), and source allocations to be very useful to their programs. The TMDL program should take note of this, since other EPA programs are the target audience/customer for TMDLs. These results may suggest therefore that EPA needs to provide more support for the development of implementation plans, despite the Agency's lack of legal authority to require such plans.

Where they exist, final and draft implementation plans in our case studies include descriptions of agricultural and/or storm water BMPs. Other than BMPs, the specific elements contained in each plan vary considerably. Some of the more important elements found in the plans include: follow-up monitoring strategies (Calleguas Creek, Cottonwood Lake, East Pond, and the Nooksack River); identification of responsible parties (Calleguas Creek, Cottonwood

Lake, East Pond, and the Nooksack River); funding sources (Cottonwood Lake, East Pond, and the Nooksack River); a detailed budget (Cottonwood Lake and the Nooksack River); and implementation milestones (Calleguas Creek and Cottonwood Lake). Implementation plans developed for Calleguas Creek, East Pond, and the Nooksack River incorporate existing BMPs and projects being conducted independently of the TMDL.

Figure 3-7



VI. How might EPA refine its TMDLs to further increase WQ decision maker knowledge and commitment to water quality improvements?

Organizational research indicates that behavioral changes in the way individuals work within their own organization and with external constituencies and organizations require:

- identification of existing communication networks;
- clarity of purpose and identification of the problem (i.e., achieving water quality standards through reductions in nutrient impairments);
- understanding the means to achieve the common goal (i.e. documentation of the problem in the TMDL and development of an implementation plan that recommends support for new actions);
- commitment to work collaboratively internally and externally and if necessary, modify existing patterns of communication to enhance effectiveness; and

- the ability to sustain ongoing activities and undertake new actions designed to yield positive results.

To understand how knowledge leads to changes in attitude to new actions, the survey administered to EPA TMDL staff asked questions about organizational knowledge, commitment, and action or behavior change. We first explore the evaluation's findings with respect to the knowledge of water quality decision makers; followed by an examination of the relationship between an organization's knowledge or understanding of TMDLs and their commitment to improve water quality standards; and finally an analysis of the relationship between knowledge of recommended activities and the organization's ability to pursue new actions to improve water quality based on TMDLs.

The survey administered to other EPA program staff examined the accessibility of TMDL information and whether such stakeholders are routinely notified of relevant TMDLs and implementation plans. Notification of various phases in the TMDL process, the opportunity to participate, and access to information are the first steps in enhancing the knowledge of water quality decision makers. Finally, we provide results obtained from interviews with case study stakeholders regarding the knowledge and behavior of water quality decision makers.

Knowledge of Water Quality Decision Makers

The survey of EPA TMDL staff asked respondents to characterize the knowledge of water quality decision makers with respect to the draft or final TMDL document, an understanding of the program's purpose, load allocations and pollutant reductions, and recommended activities for meeting water quality standards. Water quality decision makers include other EPA program staff, state stormwater and NPS staff, permitted stormwater dischargers, and state/local government planning departments. Overall, less than 50% of EPA TMDL staff respondents reported that water quality decision makers *often* or *always* had knowledge of TMDLs, with the exception of state NPS programs that were viewed by 60% of the respondents as *often* or *always* understanding the TMDL program. The next ranked organization to understand the TMDL program – state stormwater staff – garnered 46% of responses, 14% below the top-ranked state NPS program staff. This finding is not surprising in that state NPS staff are primarily responsible for implementing nonpoint source TMDLs. Survey respondents also ranked state NPS staff as most likely to *always* or *often* commit to achieving water quality standards based on TMDLs.

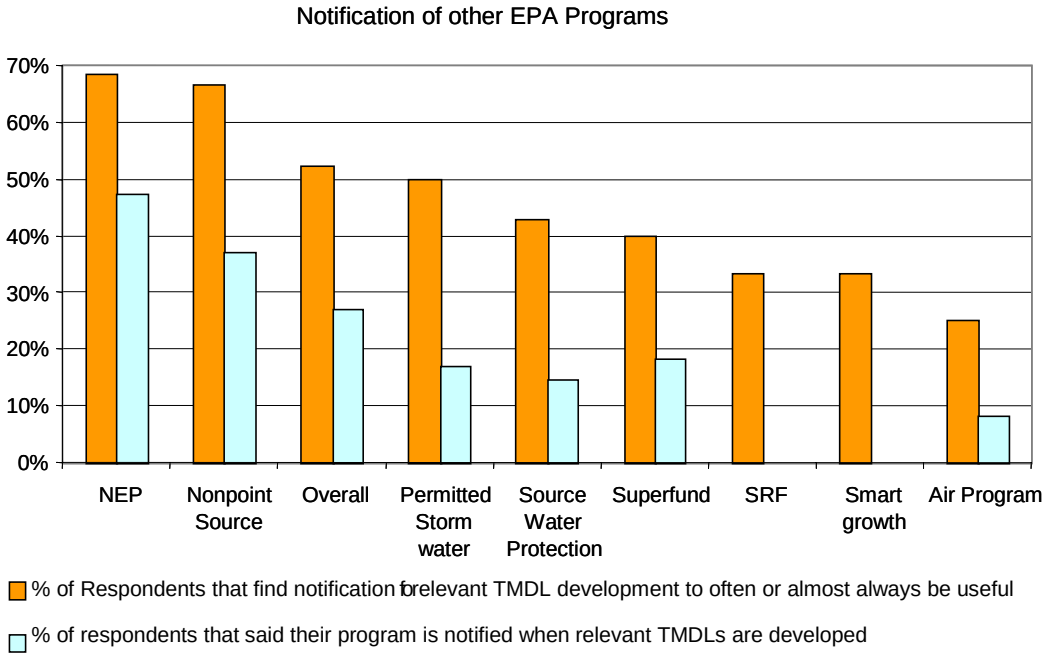
More specifically, less than half of all respondents reported that the various types of water quality decision makers *often* or *always* received notification of draft or final TMDLs (47% of respondents); have knowledge of load allocations and pollutant reductions (37% of respondents); and have knowledge of recommended activities (38% of respondents). Although water quality decision makers may not be informed of the issuance of a draft or final TMDL or have knowledge of the specifics of that TMDL, somewhat more respondents report that the following water quality decision makers' *often* or *always* understand TMDLs (state NPS programs - 60% of respondents; state stormwater programs - 46% of respondents; and other EPA program staff - 40% of respondents). Of the other EPA programs surveyed, all except for the SRF program noted they had been involved in TMDL development and implementation plan

development. Of special significance, more than 70% responses from the national estuary program note that their programs and their state counterparts have a policy of including TMDL implementation into program activities.

Permitted stormwater dischargers and state stormwater and NPS programs *often* rank highest on the knowledge scale according to EPA TMDL staff. This finding is not surprising in that stormwater permitting is a required component of the knowledge of stormwater dischargers and their relevant regulators; and the NPS program has money specifically designated for funding TMDL implementation. Nonetheless, it would be interesting to assess how these water quality decision makers viewed themselves with respect to their knowledge and understanding of the program. Are their permitting decisions informed by the TMDL or do they rely primarily on sector-specific stormwater BMPs such as those developed for the construction industry?

In discussing the extent to which their programs are notified when a relevant TMDL is developed, less than half of the respondents from other EPA programs noted they had been notified and respondents from each program indicated that they would like to be notified more often when relevant TMDLs are developed. The TMDL program should consider establishing a communications strategy that incorporated greater notification of relevant stakeholders. However, identification of "relevant" stakeholders for each TMDL by the TMDL developer will take additional time and resources. In addition, respondents also noted they were interested in getting notification about TMDL implementation. Figure 3-8 below presents these results.

Figure 3-8



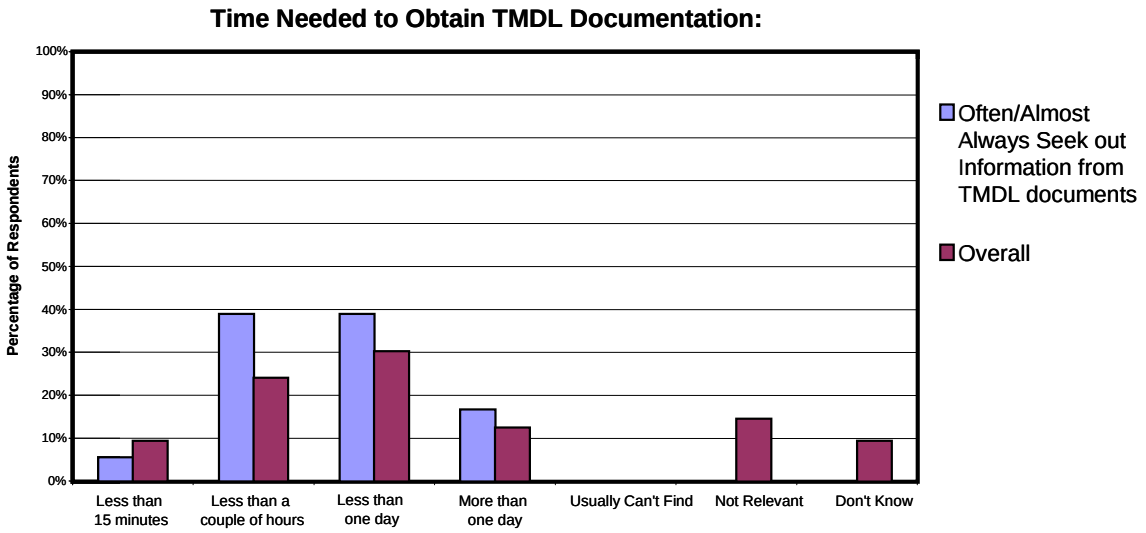
Overall, the case study interviewees report that the TMDL development process helped to generate new data and a more complete understanding of the watersheds, particularly linkages between water quality, impairment, and the sources of contamination. Since many of the TMDLs were some of the very first to be completed in their States, the TMDL development process also increased participants' understanding of TMDLs and the steps and inputs required to successfully complete them. Gains in knowledge were not uniform across all stakeholder groups, however. Local watershed groups and conservation districts tended to have a more comprehensive understanding of their watersheds which they shared with other stakeholders during the development of the TMDL. Generally, participation in the implementation planning process did not influence knowledge among stakeholders with the exception of Calleguas Creek, where agricultural producers gained an awareness of the impact of agricultural runoff on groundwater quality; and Middle Rio Grande, in which the state gained an understanding of how the dynamics of fecal coliform-contaminated storm water can affect implementation.

Accessibility of TMDL Information

When other EPA program staff seek out information from TMDL documents on their own initiative, the top three sources of information include EPA TMDL staff, State TMDL staff, and state TMDL websites. Overall, the case study interviewees report that the TMDL development process helped to generate new data and a more complete understanding of the watersheds, particularly linkages between water quality, impairment, and the sources of contamination. Since many of the TMDLs were some of the very first to be completed in their States, the TMDL development process also increased participants' understanding of TMDLs and the steps and inputs required to successfully complete them. Gains in knowledge were not uniform across all stakeholder groups, however. Local watershed groups and conservation districts tended to have a more comprehensive understanding of their watersheds which they shared with other stakeholders during the development of the TMDL. Generally, participation in the implementation planning process did not influence knowledge among stakeholders with the exception of Calleguas Creek, where agricultural producers gained an awareness of the impact of agricultural runoff on groundwater quality; and Middle Rio Grande, in which the state gained an understanding of how the dynamics of fecal coliform-contaminated storm water can affect implementation.

The resources that were least utilized include the EPA national and Regional TMDL websites. These findings suggest that EPA should focus additional resources on upgrading the national TMDL website to increase its utility. Eighty-five percent of the respondents who seek out this type of information receive it in less than one day, with upgrades to the website more people could find the relevant TMDL they seek in less than 15 minutes. Figure 3-9 below provides this information regarding the accessibility of TMDL information.

Figure 3-9



The case studies that involved a larger number and diversity of stakeholders also afforded stakeholders more opportunities to access the draft TMDLs and have their concerns addressed. Stakeholder involvement for Calleguas Creek, Nooksack River, and East Pond occurred both informally (e.g., via phone conversations and in-person discussions) and at more structured, formal assemblies. The Middle Rio Grande process involved stakeholders during a series of five, formal public meetings at which information on the TMDL was presented. At a minimum, all cases convened public meetings in conjunction with the 30-day public notice period.

These results suggest that EPA may wish to consider making greater outreach efforts to inform and engage additional water quality decision makers in a more complete understanding of the TMDL program. Various qualitative responses from EPA TMDL staff suggest ways to accomplish this goal. One respondent noted that "it is more realistic to identify percentage reductions in pollutants to achieve water quality standards, rather than assigning a precise daily loading capacity." By including elements into TMDLs that are more accessible and less technical (i.e., percent reductions), it may be possible to enhance understanding and subsequent action to effect the TMDL's recommendations. Another respondent suggested that TMDLs be displayed in a geographical context with information about impairment, pollutants, sources, reductions, and BMPs. This approach would allow state and local planning departments to better target their efforts to reduce NPS pollution and help the public visualize the impairments and the solution. The challenge will be to make the TMDLs legal and technical documents, while also ensuring they are accessible to the public.

Attitudes of Water Quality Decision Makers: Commitment to Achieve Water Quality Standards

EPA is interested in examining the relationship between an understanding of TMDLs and a greater commitment to achieving water quality standards. Data from the case study interviews suggest that the degree to which stakeholders participated in the TMDL development process and the means by which they gained access to the draft TMDL influenced their perceptions about

the TMDL, awareness of their contribution to water quality impairment (in the case of dischargers), and commitment to the implementation process. However, EPA TMDL survey respondents did not necessarily rank organizations that understood TMDLs as having the greatest commitment to achieving water quality standards based on those TMDLs. Most noteworthy among the findings is the low percentage of respondents who positively assessed the commitment/action orientation of USDA and state agricultural agencies. Figure 3-10 below presents this ranking graphically.

Figure 3-10
Comparison of Organizations that have an Understanding of TMDLs to Organizations with Commitment to Achieve WQS based on TMDLs
(Respondents that answered often/always to each question.
Highlighting represents where organizations matched in ranking.)

Organizations that understand TMDLS	State NPS 60% 1st	State Stormwater 46% 2nd	EPA Non-TMDL 40% 3rd	Watershed and NGOs 39% 4th	Permitted Stormwater Discharges 35% 5th	State/Local Planning 30% 6th	USDA Programs 28% 7th	State Agriculture 24% 8th
Organizations with greater commitment to achieving WQS based on TMDLs	State NPS 37% 1st	Watershed and NGOs 34% 2nd	EPA Non-TMDL 33% 3rd	Permitted Stormwater Discharges 27% 4th	State Stormwater 25% 5th	State/Local Planning 19% 6th	State Agriculture 12% 7th	USDA Programs 8% 8th

Behaviors of Water Quality Decision Makers

Whether water quality decision makers use their knowledge of impaired water bodies and TMDLs to take new actions, target outreach, funding and/or technical assistance, and make watershed and land use planning decisions intended to improve water quality is very important to EPA's understanding of the effectiveness of the TMDL program. The percentage of respondents that indicated organizations *often* or *always* take new actions or target outreach, funding and/or technical assistance to improve water quality based on TMDLs never exceeds 36 percent; and the proportion that indicated organizations *often* or *always* make watershed planning decisions based on TMDLs never exceeds 33 percent. This indicates that only approximately one-third of EPA TMDL staff report that the behaviors of water quality decision makers are *often* or *always* influenced by TMDLs to take action to improve water quality. EPA TMDL staff note that factors other than TMDLs may be influencing water quality decision makers to take action, but TMDLs do not seem to be the predominant motivator.

EPA TMDL staff report that the three organizations that *often* or *always* take new actions to improve water quality based on TMDLs include state NPS programs (36% of respondents), state stormwater programs (31% of respondents), and permitted stormwater discharges (26% of respondents). Those organizations that *often* or *always* target outreach, funding and/or technical assistance include other EPA program staff (36% of respondents), state NPS programs (34% of respondents), and state stormwater programs (22% of respondents). Finally, the top three organizations that often or always make watershed planning decisions based on TMDLs include

state NPS programs (33% of respondents), other EPA program staff (27% of respondents), and state stormwater programs (25% of respondents). Figure 3-11 presents these results.

Figure 3-11
Comparison of Organizations with Knowledge of Recommended Activities to meet WQS to Organizations that take new Actions to improve WQ based on TMDLs
(Respondents that answered often/always to each question.
Highlighting represents where organizations matched in ranking.)

Organizations that have knowledge of recommended activities to meet WQS	State Stormwater Programs 37% 1st	Permitted Stormwater Dischargers 36% 2nd	State NPS 31% 3rd	Watershed and NGOs 28% 4th	EPA Non-TMDL 25% 5th	USDA Programs 25% 5th	State/Local Planning 22% 6th	State Agriculture 19% 7th
Organizations that take new actions to improve WQ based on TMDLs	State NPS 36% 1st	State Stormwater 31% 2nd	Permitted Stormwater Discharges 26% 3rd	Watershed and NGOs 24% 4th	EPA Non-TMDL 24% 4th	State/Local Planning 14% 5th	USDA Programs 12% 6th	State Agriculture 8% 7th

Based on the case study interviews, the TMDL development process influenced the behavior or actions of water quality decision makers in two main ways: 1) it helped to establish priorities for state allocations of Section 319 funding and facilitated the acquisition of funding for local projects (Calleguas Creek, East Pond, Grand River, and Nooksack River); and 2) it influenced the processes undertaken to develop subsequent TMDLs. Among cases with high levels of stakeholder involvement (Calleguas Creek and Nooksack River), the TMDL development process improved the interactions among stakeholders and led to more productive deliberations between stakeholders and process leaders, particularly where these relationships had historically been contentious. An additional impact is on the interest and participation of the agricultural community. For Cottonwood Lake, the implementation planning process prompted more direct outreach to farmers during the TMDL development and implementation phases. For Calleguas Creek, the process helped to generate more active involvement and investment in implementation projects.

OWOW's TMDL program seeks to coordinate efforts across Federal, State, and local jurisdictions to achieve water quality standards in impaired water bodies. OWOW's challenge involves working with a variety of partners at different levels of government and engaging nonpoint and stormwater-related sources to take action to improve water quality.

We offer recommendations intended to improve OWOW's efforts to facilitate access to the fiscal, informational, and communication resources necessary to develop high-quality TMDLs as well as enhance the processes by which they are developed, implemented, and applied. Of primary importance, in our estimation, are the recommendations calling for a more prominent EPA role in encouraging collaborative stakeholder involvement during TMDL development, improving the availability and quality of data used to establish load allocations, and brokering EPA and other Federal funding sources to support TMDLs. The remaining five recommendations pertaining to guidance materials, collaborative leadership, communication strategies, and implementation plans constitute different, but related aspects of these recommendations.

DATA COLLECTION AND ANALYSIS

Recommendation 1: Focus on Improving the Availability and Quality of Data Directly Related to Non-Point and Stormwater-Related Sources

The persistent need for available, quality data is confirmed by survey respondents and case study interviewees. To ensure that useful, high quality non-point source and/or stormwater-related TMDLs are developed and embraced by interested parties, OWOW should consider strategies to increase the availability of data on runoff quality and non-point source loadings and to facilitate more comprehensive non-point source and stormwater monitoring activities by States. By focusing, for example, on the scientific methods used to generate load allocations for agricultural and other NPS sources and developing accompanying educational materials to educate stakeholders, OWOW may have an opportunity to influence the commitment and actions of such sources to improve water quality.

FUNDING RESOURCES

Recommendation 2: Help Broker Other Sources of Federal Funds in Support of Non-Point Source and Stormwater TMDLs

Approximately one-third of EPA TMDL staff experience adequate funding for the development of TMDLs and a multitude of sources of funds are cited, including federal, state, and local governmental and non-profit organizations. Great Waterbody and USDA funding, however, are never or seldom available according to more than half of the respondents. All of the cases studied demonstrated a direct reliance on Section 319 funds (or state grants supported in part with 319 money) for the development of TMDLs and implementation of best management practices for non-point sources.

The EPA TMDL program should help broker other federal funds to support TMDL development and implementation as 319 monies are limited. While OWOW could encourage use of funds from NEP and the great water body program for TMDL implementation, more significant resources reside with the USDA and Farm Bill agriculture money. In addition to attempting to broker other federal funds for TMDL development and implementation, EPA Regional offices may also wish to conduct an analysis of the degree to which other state and local funding sources are available to support TMDLs and broker these sources.

GUIDANCE PROTOCOLS

Recommendation 3: Determine "Content Gaps" in Case Study Information and Regional Guidance and Prioritize Delivery of these Materials

Overall, Regional TMDL staff report that adequate guidance is not available to support the development of high-quality TMDLs and provide examples of specific areas that need attention (e.g., narrative standards for nutrients, sediment, and temperature, modeling runoff from specific land uses in different types of geologic sites, etc.). Respondents note their strong preference for regional guidance materials and case studies of successful TMDLs. OWOW may wish to consider identifying the areas of greatest need for guidance materials; engaging Regional TMDL staff and ORD personnel, if appropriate, in workgroups to address these needs; and preparing materials within established timeframes. Case study highlights from the recently published evaluation of TMDL implementation conducted by Virginia Tech (Virginia Tech, 2006) could be repackaged into stand-alone documents or integrated into other guidance materials to serve as examples of best practices or showcase lessons learned.

STAKEHOLDER INVOLVEMENT

Recommendation 4: Engage Additional Stakeholders in TMDL Development and Implementation

Develop and Implement a Communications Strategy for TMDL Practitioners to Utilize When Developing TMDLs

Overall, stakeholder involvement at various stages in the TMDL development process is viewed as helpful, particularly with public outreach and implementation, and in developing implementation plans. Case study data support direct outreach to water quality decision makers at the state and local level as an important means of effecting behavioral changes and soliciting more investment in the implementation of water quality improvement projects. Only about one-third of EPA TMDL staff, however, report that water quality decision makers are committed to achieving water quality standards based on TMDLs or will take new actions to improve water quality. This low level of confidence in the impact of TMDLs suggests that OWOW needs to develop a communications strategy for both internal and external stakeholders to facilitate TMDL development and specific implementation activities. Due to the degree of variation among TMDLs, this strategy would require targeted communication between EPA Regional TMDL staff, other EPA program staff, their state counterparts, watershed groups and other stakeholders on a TMDL-specific basis. This approach would have the advantage of raising awareness of TMDLs among water quality decision makers as well as encouraging their direct involvement in activities being implemented to improve water quality.

Target Outreach to State/Local Planning and Agriculture Organizations

Some stakeholders, however, were not viewed as active participants in the process. These include state and local planning agencies, state agricultural agencies, and USDA programs. These organizations are consistently ranked at the lower end of the scale for their knowledge of recommended activities to meet water quality standards and a demonstrated commitment to achieve water quality standards based on TMDLs. Data from the case studies, however, underscore the importance of involving representatives from the agricultural community in the TMDL development and implementation planning process to obtain their buy-in and encourage their implementation of BMPs. In the Cottonwood Lake, Calleguas Creek, and Middle Rio Grande TMDLs, the participation of the National Resource Conservation Service proved useful in establishing communication with agricultural producers. In the Nooksack River TMDL, the local chapter of the Washington State Dairy Federation served as a liaison with dairy farmers. OWOW should make a concerted effort to engage agricultural organizations and producers in TMDL development and implementation given the significant impact of pathogen, nutrient, and sediment runoff from agricultural lands on water quality degradation.

Emphasize the Development of Watershed TMDLs

Survey respondents indicated that simultaneous development of all TMDLs in a watershed (i.e. “Watershed TMDLs”) and development of multi-pollutant TMDLs most often led to high stakeholder involvement. OWOW should emphasize this type of TMDL development and encourage TMDL practitioners to engage stakeholders during the development process. With these broader scale TMDLs there are more resources available that can be applied to outreach. It is both an efficient way of developing TMDLs but a good way of engaging stakeholders since the project as a whole, and their involvement, will lead to a more meaningful and large scale result.

IMPLEMENTATION PLANS

Recommendation 5: Encourage Development of Detailed TMDLs and Support Development of Implementation Plans and Follow-Up Monitoring Despite Lack of Legal Authority

As noted in the results section, both TMDL and other EPA program staff would like to see more detailed TMDLs; specifically identifying necessary reductions targeted geographically, and targeting BMP recommendations by pollutant and geographically. These detailed TMDLs will facilitate implementation assuming sufficient funds and a responsible agency are available. In addition, OWOW should encourage the completion of implementation plans and follow-up monitoring. Survey respondents from TMDL and other programs ranked the monitoring of water quality to be the most important element in an effective implementation plan. Case study interviewees also point to the lack of funding available to support the implementation of follow-up monitoring. Although EPA cannot mandate water quality monitoring, it may wish to strategically target its funding resources and outreach efforts to facilitate long-term, high-quality monitoring by States. Guidance materials developed by OWOW could offer instructions on how to prepare an implementation plan and recommendations on the essential elements to include in the plan.

KNOWLEDGE OF WATER QUALITY DECISION MAKERS

Recommendation 6: Make TMDL information more accessible and readily available to our stakeholders

OWOW should consider devoting additional resources to enhance its ability to promote an understanding of TMDLs by water quality decision makers and engage them in the TMDL development and implantation efforts. The communications strategy discussed above should be an important element of this effort. OWOW should place a greater focus on user-friendly TMDLs that are easy to understand by relevant stakeholders important to implementation (e.g. watetshed groups, local government, affected home owners, etc). Additionally, OWOW is currently redesigning its website to make TMDL information easier to access and this will supplement the outreach strategy. The top three sources of information about TMDLs that other EPA staff most often turn to include EPA TMDL staff, State TMDL staff, and State TMDL websites, but **not** EPA's own website. Improving the content and awareness of EPA's TMDL website could be a first step in developing a broader communications strategy focused on disseminating information on TMDLs.