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December 2013

CLEAN WATER ACT

Changes Needed If Key EPA Program Is to Help Fulfill the Nation's Water Quality Goals

GAO-14-80

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GAO Highlights

Highlights of GAO-14-80, a report to congressional requesters

Why GAO Did This Study

The 1972 Clean Water Act aimed to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." Under the act, states must establish water quality standards; for waters that do not meet these standards, states must develop TMDLs, which EPA approves. TMDLs set targeted limits for pollutants but are not self-implementing; EPA and states help reduce pollutants by issuing permits for point sources, whereas they provide voluntary incentives to reduce nonpoint source pollution.

GAO was asked to examine the TMDL program, specifically (1) EPA's and states' responsibilities in developing and implementing TMDLs, (2) what is known about the status of long-established TMDLs, (3) the extent to which such TMDLs contain features key to attaining water quality standards, and (4) the extent to which TMDLs exhibit factors that facilitate effective implementation. GAO asked water resource experts to review a random sample of 25 long-established TMDLs and surveyed state officials who are responsible for implementing a representative sample of 191 long-established TMDLs.

What GAO Recommends

GAO recommends that EPA issue new regulations for TMDL development, adding key features. Further, Congress should consider revising the Clean Water Act's approach to addressing nonpoint source pollution. EPA did not comment on the matter for Congress. The agency agreed with the need to add key features to TMDLs but did not agree to issue new regulations. GAO believes new regulations are needed.

View GAO-14-80. For more information, contact J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov.

What GAO Found

The Environmental Protection Agency (EPA) and the states each have responsibilities for developing and implementing pollution targets, known as total maximum daily loads (TMDL). EPA oversees states' TMDL efforts by establishing in regulations minimum requirements TMDLs need for approval, providing funding, and furnishing technical assistance. States develop TMDLs and generally take the lead in implementing them by identifying pollutants that impair water quality and taking actions to reduce them.

Of about 50,000 TMDLs developed and approved, nearly 35,000 were approved more than 5 years ago, long enough for GAO to consider them long established. State officials GAO surveyed in its representative sample of 191 TMDLs reported that pollutants had been reduced in many waters, but few impaired water bodies have fully attained water quality standards.

The sample of 25 TMDLs reviewed by water resource experts GAO contacted seldom contained all features key to attaining water quality standards. According to the National Research Council and EPA, these features—some that are beyond the scope of EPA's existing regulations—include identifying pollution-causing stressors and showing how addressing them would help attain such standards; specifying how and by whom TMDLs will be implemented; and ensuring periodic revisions as needed. The experts found, however, that 17 of 25 long-established TMDLs they reviewed did not show that addressing identified stressors would help attain water quality standards; 12 contained vague or no information on actions that need to be taken, or by whom, for implementation; and 15 did not contain features to help ensure that TMDLs are revised if need be. GAO's review showed that EPA's existing regulations do not explicitly require TMDLs to include these key features, and without such features in TMDLs—or in addition to TMDLs—impaired water bodies are unlikely to attain standards.

In response to GAO's survey, state officials reported that long-established TMDLs generally do not exhibit factors most helpful for attaining water quality standards, particularly for nonpoint source pollution (e.g., farms and storm water runoff). The officials reported that landowner participation and adequate funding—factors they viewed as among the most helpful in implementing TMDLs—were not present in the implementation activities of at least two-thirds of long-established TMDLs, particularly those of nonpoint source TMDLs. Because the Clean Water Act addresses nonpoint source pollution largely through voluntary means, EPA does not have direct authority to compel landowners to take prescribed actions to reduce such pollution. In GAO's survey, state officials knowledgeable about TMDLs reported that 83 percent of TMDLs have achieved their targets for point source pollution (e.g., factories) through permits but that 20 percent achieved their targets for nonpoint source pollution. In 1987, when the act was amended to cover such pollution, some Members of Congress indicated that this provision was a starting point, to be changed if reliance on voluntary approaches did not significantly improve water quality. More than 40 years after Congress passed the Clean Water Act, however, EPA reported that many of the nation's waters are still impaired, and the goals of the act are not being met. Without changes to the act's approach to nonpoint source pollution, the act's goals are likely to remain unfulfilled.

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Abbreviations

EPA	Environmental Protection Agency
GIS	Geographic Information Systems
TMDL	Total Maximum Daily Load
USDA	U.S. Department of Agriculture
NRC	National Research Council

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December 5, 2013

The Honorable Barbara Boxer
Chairman
Committee on Environment and Public Works
United States Senate

The Honorable Benjamin L. Cardin
United States Senate

The Clean Water Act was enacted more than 40 years ago to "restore and maintain the chemical, physical, and biological integrity of the nation's waters."[1] Toward this end, the act requires states to establish water quality standards protective of public health and the environment and considering aquatic wildlife and human consumption and recreation, among other uses; the act also requires the Environmental Protection Agency (EPA) to maintain and improve water quality by assisting and overseeing states' efforts, among other responsibilities. As of August 2013, EPA's assessment of national water quality, however, reported that more than half the nation's assessed waters do not meet these standards or their designated uses, such as fishing, swimming, or drinking.[2] For example, the assessment identified more than 12 million acres of lakes (or 67 percent of total assessed lake acres nationwide) and more than 500,000 miles of rivers (or 53 percent of assessed river miles nationwide) as impaired; in all, the report shows, more water bodies that have been assessed are not meeting water quality standards than at any time in the past.[3] Furthermore, the assessment cites pollutants from nonpoint sources, such as agricultural runoff and stormwater runoff from some

[1]The Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500, § 2, 86 Stat. 816, codified as amended at 33 U.S.C. §§ 1251-1387 (2013) (commonly referred to as the Clean Water Act). For consistency throughout this report, we refer to the statute and its amendments as the Clean Water Act.

[2]EPA, "National Summary of State Information" in *Water Quality Assessment and TMDL Information*, accessed August 19, 2013, http://ofmpub.epa.gov/waters10/attains_nation_cy.control.

[3]Under the Clean Water Act, states are to report every 2 years to EPA on the quality of the water bodies within their boundaries. In 2012, states assessed about 18 million lake acres, or 43 percent of lake acres nationwide, and almost 1 million river miles, or 28 percent of river miles nationwide.

urban and suburban areas, as leading causes of impairment of these water bodies. EPA has estimated that at historical funding levels and water body restoration rates, it would take longer than 1,000 years to restore all the water bodies that are now impaired by nonpoint source pollution.

To improve the condition of water bodies that states identify as impaired, the Clean Water Act requires states to develop pollutant budgets, known as "total maximum daily loads" (TMDL), generally for each pollutant impairing a water body. A TMDL is essentially the numeric target for a specific pollutant, reflecting the maximum amount of the pollutant that a water body can contain and still be considered in compliance with water quality standards, and is described in a report that may also provide a general plan for how this target is to be achieved in the water body. According to EPA documents and officials, the agency's regulations refer to a TMDL generally as a calculation or formula used to address one pollutant in one particular part of a water body, but as the program has evolved, the concept of a TMDL has become more expansive. Overall, the goal of developing a TMDL is to end up with a plan, including the actions needed, to meet water quality standards and restore impaired water bodies. After states develop TMDLs, they take the lead in implementing these plans, and it may take many years to see actual improvements in water quality.[4]

EPA oversees states' TMDL development and implementation efforts under its TMDL program, which is a primary part of EPA's efforts to restore impaired waters. In addition, several key responsibilities related to TMDL development and implementation are found in other EPA water quality-based programs. For the purposes of this report, we use the term "TMDL program" to include the TMDL-related responsibilities in other EPA water quality-based programs. To guide the development of TMDLs, EPA issued regulations in 1985, and revised them in 1992, which states are to use to this day. These regulations establish minimum requirements for establishing TMDLs and, according to EPA officials, should lead to TMDLs that, if implemented, enable water bodies to attain water quality standards. Under the regulations, TMDLs are to identify the applicable water body, pollutant of concern, and pollutant sources—as well as the

[4]The Clean Water Act does not expressly require implementation of a TMDL, but states are required to engage in a continuous planning process that includes TMDLs, among other things, and is to achieve water quality standards. 33 U.S.C. § 1313(e) (2013).

share of pollutant reduction to be achieved by point sources and nonpoint sources.[5]

According to EPA officials, states took little action under the Clean Water Act's requirement to develop TMDLs until the mid-1990s, when citizen groups sued EPA in several states for not doing so in the absence of state action. Since that time, states developed nearly 50,000 TMDLs, in part as a result of EPA efforts to meet the schedules in consent decrees stemming from the lawsuits, according to EPA officials.[6] EPA approved about 35,000 of these TMDLs more than 5 years ago, and, according to EPA officials, states should have implemented these TMDLs to some extent by the time of our review. For purposes of this report, we define TMDLs approved by EPA through December 31, 2007—that is, TMDLs developed more than 5 years ago—as long-established TMDLs.

Since EPA last revised its TMDL regulations in 1992, the agency and others have been asked to evaluate states' TMDL development and implementation. In 1996, EPA convened a Federal Advisory Committee to examine the lack of progress in TMDL development and implementation and the pervasiveness of nonpoint source pollution.[7] In 2001, the National Research Council (NRC) of the U.S. National Academies issued a report assessing the scientific basis of the TMDL program, which described a number of features to strengthen TMDL development and implementation.[8] For example, the report recommended that EPA's TMDL program focus on improving the condition of water bodies as

[5]A point source discharges pollutants from a discrete point, such as a pipe carrying effluent from a wastewater treatment plant or an industrial facility. Under Clean Water Act regulations, limits in TMDLs for pollutants from point sources are to be implemented through National Pollutant Discharge Elimination System permits. Under the Clean Water Act, the discharge of pollutants from a point source into U.S. waters is prohibited without a permit; facilities obtain permits from authorized states or else from the applicable EPA region. If TMDLs have been developed for these waters in question, the permitted limits for point sources must be consistent with the pollutant levels called for in the TMDLs.

[6]Consent decrees are settlement agreements signed by the parties and entered, or approved, by a court; they are therefore enforceable by the courts.

[7]EPA, *Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program*, EPA-100-R-98-006 (Washington, D.C.: July 1998).

[8]National Research Council, *Assessing the TMDL Approach to Water Quality Management* (Washington, D.C.: National Academies Press, 2001). The National Academies comprises four organizations: the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council.

measured by the attainment of designated uses, such as supporting fish populations or human recreation, rather than administrative outputs, such as numbers of permits issued or TMDLs developed. The report further recommended that TMDLs be implemented adaptively, that is, that periodic assessments should determine if water bodies are attaining water quality standards, and TMDLs should be revised if water quality is not improving. More recently, EPA published a series of papers in response to a 2007 EPA Office of Inspector General report, which found that the agency had limited data on TMDL implementation activities.[9] In these papers, EPA identified particular factors associated with TMDLs that have been effectively implemented—that is, factors having helped the water bodies to which they apply partially or fully attain water quality standards—including the targeting of certain federal and state funds toward specific practices, such as keeping cattle out of streams, in locations where TMDLs have been developed.[10]

Nearly 20 years after developing the first TMDLs, states have largely developed those TMDLs required by consent decree, according to EPA officials, but face the task of implementing the projects and activities described in these TMDLs to control pollution and developing TMDLs for other waters that states have identified as impaired.[11] EPA acknowledges that it must determine the extent to which the agency will encourage states to continue to direct their resources toward developing TMDLs for the tens of thousands of impaired water bodies that do not yet have them or focus on helping states implement the TMDLs that have already been developed. In this context, you asked us to study EPA's efforts to restore

[9]EPA, Office of Inspector General, *Total Maximum Daily Load Program Needs Better Data and Measures to Demonstrate Environmental Results*, Report No. 2007-P-00036 (Washington, D.C.: Sept. 19, 2007).

[10]EPA, *Developing Effective Nonpoint Source TMDLs: An Evaluation of the TMDL Development Process* (Washington, D.C.: January 2007); EPA, *Developing Effective TMDLs: An Evaluation of the TMDL Process* (Washington, D.C.: 2007); and Center for TMDL and Watershed Studies, *TMDL Implementation: Characteristics of Successful Projects*, Final Report, VT-BSE doc. no. 2006-0003 (Blacksburg, VA: 2006).

[11]*Projects* described in TMDLs may include implementing best management practices on agricultural land to reduce nutrient-laden runoff, such as planting riparian buffers, which are vegetative areas along stream banks that can absorb excess nutrients before they enter water bodies. *Activities* described in TMDLs may include efforts such as nutrient management planning, which describes a process to develop a coordinated combination of projects that help farmers manage the amount, form, placement, and timing of fertilizer to support crop production while also minimizing polluted runoff.

and maintain the nation's waters through its TMDL program. Our objectives were to examine (1) EPA's and states' responsibilities in the TMDL program, (2) what is known about the status of long-established TMDLs, (3) the extent to which long-established TMDLs contain key features that enable attainment of water quality standards, and (4) the extent to which such TMDLs exhibit factors that facilitate effective implementation.

To address each of these objectives, we reviewed EPA reports and independent, peer-reviewed reports on the status of TMDLs and assessments of TMDL implementation projects and activities. In addition, we visited a nonprobability sample of four states in two of EPA's 10 regions to review EPA's and states' responsibilities in developing and implementing TMDLs, as well as any challenges the states may have faced in doing so.[12] We selected these regions and states on the basis of the number of TMDLs each state had developed, types of water pollution, differences in state authorities to implement TMDLs, and extent of each state's TMDL implementation efforts. To examine what is known about the status of long-established TMDLs, we used an EPA database known as Assessment, TMDL Tracking and Implementation System. To assess the reliability of data from this database, we (1) electronically tested required data elements, (2) reviewed existing information about the data and the system that produced them, and (3) interviewed agency officials knowledgeable about the data. We found these data to be sufficiently reliable for purposes of this report. We also used the database to select a random, nationwide, representative sample of 191 long-established TMDLs, which we defined to be those approved by EPA through December 31, 2007. We used the sample of TMDLs in the following ways to assess TMDL development and implementation:

- To examine the extent to which long-established TMDLs contain key features needed to enable a water body to attain water quality standards, we selected water resource experts to review a random subsample of 25 TMDLs drawn from the nationwide sample of 191 long-established TMDLs.[13] This subsample of 25 TMDLs is too small

[12]Because the states we visited made up a nonprobability sample, the information we collected from those states is not generalizable to all states but provides examples of how the selected states developed and implemented TMDLs.

[13]These key features were identified in the 2001 NRC report on EPA's TMDL program and in various EPA studies and guidance documents.

to be representative of all TMDLs, but it is an unbiased set that provides detailed examples of TMDL development in specific states and regions and helps illustrate TMDL development challenges and successes. We selected three experts to review these 25 TMDLs from among the eight authors of the 2001 NRC report on EPA's TMDL program, which is the most recent effort undertaken by the National Academies to evaluate the TMDL approach to water quality management. To increase the reliability of our findings, each TMDL was independently reviewed by two experts.

- To examine the extent to which long-established TMDLs exhibit factors EPA identified that facilitate their implementation, we surveyed state TMDL coordinators responsible for implementing the 191 long-established TMDLs in our representative sample; we received 177 responses for a 93 percent response rate to our survey.[14] To perform this analysis, we first identified factors EPA has determined to be necessary for facilitating effective TMDL implementation. We then developed a survey on whether and to what extent these factors were present in the representative sample of 191 long-established TMDLs and whether and to what extent water quality had improved. We used the results of this survey to determine which factors were viewed by our survey respondents as helpful in TMDL implementation and, if so, to what extent TMDLs exhibited them. The estimates from our survey have a margin of error of no more than 10 percent at the 95 percent confidence level, unless otherwise noted.[15]

We also interviewed officials in each of EPA's 10 regional offices responsible for reviewing and approving TMDLs. We discussed with these officials the extent to which regional EPA officials encourage state programs to ensure the presence of factors facilitating effective TMDL implementation. We obtained information on the regional offices' review and approval of state-developed TMDLs, as well as on their oversight of state programs, including how the offices encourage state programs to ensure the presence of factors needed for effective TMDL

[14]The population of long-established TMDLs is 34,794.

[15]Survey results based on probability samples are subject to sampling error. The sample we drew for our survey is only one of a large number of samples we might have drawn. Because different samples could have provided different estimates, we express our confidence in the precision of our particular sample results as a 95 percent confidence interval. This interval would contain the actual population values for 95 percent of the samples we could have drawn. As a result, we are 95 percent confident that each of the confidence intervals in this report will include the true values in the target population, unless otherwise noted.

implementation. Appendix I describes our objectives, scope, and methodology in more detail.

We conducted this performance audit from July 2012 to December 2013 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

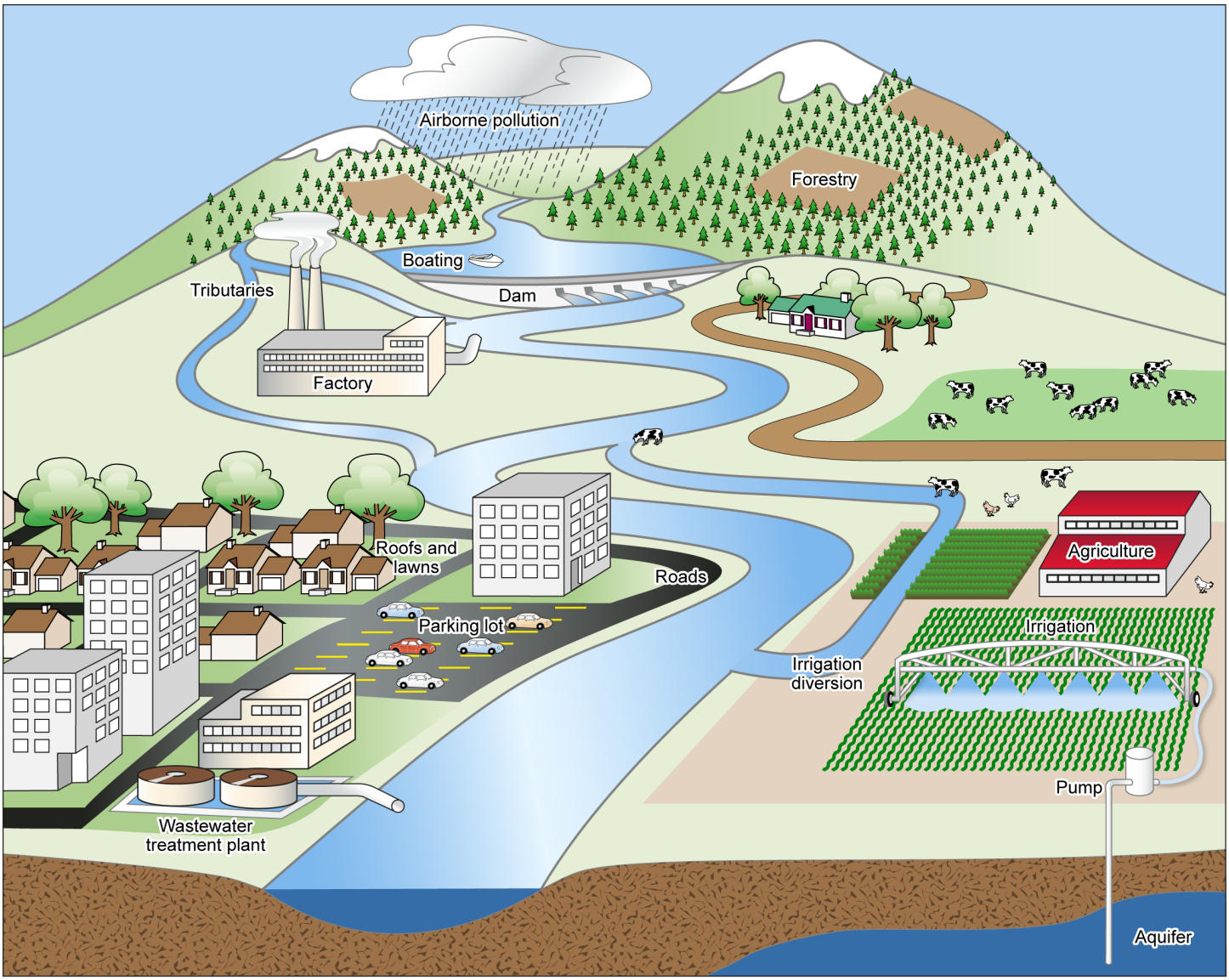
Background

The Clean Water Act establishes a nationwide approach to improve and maintain the quality of rivers, streams, lakes, and other water bodies, which involves different programs aimed at reducing pollution of the nation's waters. Under this approach, states are to set water quality standards, monitor water quality, and assess water quality against the applicable standards. Through the monitoring and assessment process, states are to identify water bodies that do not meet their standards, and these water bodies are considered to be impaired. Under the act, point source dischargers of pollutants must obtain permits, issued by authorized states or EPA regions. The permits limit the amount of pollutants according to specific guidelines set by EPA, as well as other considerations.[16] Under the act and implementing regulations, states must develop a TMDL for each of the pollutants affecting each water body identified as impaired; in so doing, states typically identify pollutant sources and the actions needed to control pollution and restore water bodies, according to EPA documents. In identifying pollutants and their sources—both point and nonpoint, where applicable—a TMDL is to specify the amount by which one or more pollutants needs to be reduced to meet water quality standards. EPA's TMDL program has evolved over the last several decades as nationwide efforts have shifted from a focus

[16]Section 502(6) of the Clean Water Act defines the term *pollutant* as "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water." Section 502(19) of the act defines *pollution* as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." According to the 2001 NRC report on EPA's TMDL program, pollution goes beyond pollutants; it includes pollutants and other stressors, such as habitat degradation, flow alteration, channelization, and loss of riparian areas.

on controlling point source pollutants to addressing nonpoint source pollution. Figure 1 shows some of the activities impairing water bodies.

Figure 1: Activities That Can Impair Water Bodies



Source: GAO.

Note: The figure shows that impairment of water bodies may stem from pollution by point sources—which include industrial facilities, such as factories and wastewater treatment plants, and other sources that discharge wastewater from pipes or other discrete points—or nonpoint sources such as airborne pollution; agricultural fields; forestry; and runoff from roofs, lawns, parking lots, and roads.

States Set Water Quality Standards, Assess Water Quality, and Identify Impaired Waters

Under the Clean Water Act, each state is to establish its own water quality standards and review and update these standards every 3 years.[17] Water quality standards consist of designated uses and water quality criteria.[18] Designated uses reflect the intended use and value of a water body, such as public drinking water supply; protection of fish, shellfish, and other wildlife; or recreational, agricultural, industrial, and navigational purposes. Water quality criteria generally describe the chemical, physical, and biological conditions necessary to achieve and protect designated uses, such as nitrogen concentrations, stream structure, and health of aquatic life, respectively.[19]

EPA approves states' water quality standards and establishes recommended national water quality criteria, which states can adopt, or states can develop their own criteria, subject to EPA approval. According to EPA documents, water quality standards should be comprehensive and strong enough to achieve the Clean Water Act's goal of "chemical, physical, and biological integrity" for the state's waters. According to the 2001 NRC report, it is not uncommon for water bodies to be largely free of chemical pollutants yet still vulnerable to other stressors, including stressors affecting habitat, stream morphology (structure), and streamflow, which are critical to supporting aquatic life. For example, a river or stream may be channelized, as when farmers straighten the waterway to maximize the amount of land that can be farmed and make it easier to move machinery across fields, thus altering the waterway's characteristics (see fig. 2). Even if stream channeling does not contribute

[17]According to EPA documents and officials, the triennial review is to consider all the scientific information EPA has issued for specific pollutants since the state last updated its standards, adding or revising standards as necessary. EPA is to review new or revised water quality standards consistent with Clean Water Act requirements in connection with its approval role. EPA can make a determination that new or revised water quality standards are necessary to meet the act's requirements. If EPA makes such a determination and the state fails to adopt such standards, EPA must promulgate the standards for the state.

[18]EPA's regulations provide that the minimum requirements for state water quality standards also include an antidegradation policy to maintain and protect the existing uses of water bodies.

[19]Water quality criteria are constituent concentrations, levels, or narrative statements representing a quality of water that supports a particular use. EPA-recommended criteria are to reflect the latest scientific information on the effect of the constituent on health and welfare, including aquatic life. States must use EPA-recommended values or other scientifically defensible methods for numeric criteria. Where numeric criteria cannot be established, states may establish narrative criteria.

many chemical pollutants to a waterway, it typically removes vegetation along stream banks, alters streambed structure and water flows, and limits the stream's capacity to support aquatic life, according to EPA documents; such effects may extend far downstream.

Figure 2: An Eastern Washington Stream Channelized to Maximize Crop Yield

Source: GAO.

After setting water quality standards, states are to monitor and assess water quality to determine the degree to which the standards are being met. According to EPA documents, states generally base their water quality assessments on three broad types of monitoring data: chemical,

physical, and biological.[20] States assess water bodies, often using each data type, and then integrate these data with other data types for an overall assessment. According to EPA documents, depending on the designated use for a given water body, one type of data may be more informative than others.

- *Chemical data* include measurements of specific chemical constituents in water, sediments, and fish tissue. Examples include measuring the concentrations of metals, oils, pesticides, and nutrients such as nitrogen and phosphorus. Monitoring for specific chemicals helps states identify specific pollutants and helps trace pollutants to their sources.
- *Physical data* include characteristics of water and water body configuration, such as temperature, flow, and physical structure. Physical attributes can be useful indicators of potential problems, often because they can modify the effects of chemicals.
- *Biological data* are objective measurements of living aquatic communities (usually aquatic insects, fish, or algae) used to evaluate the condition of an aquatic ecosystem. Biological data are often the most appropriate measures for assessing if waters can support aquatic life.

Using existing and readily available water quality-related data and other information, states identify impaired waters that do not meet applicable water quality standards and need TMDLs. EPA's regulations require that states report biennially to EPA on the quality of their waters, and states generally fulfill this requirement by submitting integrated reports to EPA

[20]According to EPA documents, to supplement these three data types, states may also use habitat assessments and toxicity analyses. Habitat assessments include descriptions of sites and surrounding land uses; condition of streamside vegetation; and measurement of features such as stream width, depth, flow, and substrate (bottom). States can use habitat assessments to supplement and interpret other kinds of data. States can generate toxicity analyses by exposing selected organisms, such as fathead minnows or daphnia (water fleas), to known dilutions of water taken from a sampling location. These tests can help determine whether poor water quality stems from toxins or another cause, such as degraded habitat.

every 2 years.[21] In these reports, which list impaired water bodies, each water body is to be listed according to the following categories:

- Category 1: all designated uses are supported, no use is threatened.
- Category 2: available data and information indicate that some, but not all, designated uses are supported.
- Category 3: there is insufficient available data and information to determine whether designated uses are supported.
- Category 4a: a state developed TMDL has been approved by EPA or a TMDL has been established by EPA.
- Category 4b: other required control measures are expected to result in the attainment of an applicable water quality standard in a reasonable period of time.[22]
- Category 4c: water quality is impaired by something other than a pollutant, such as a dam.
- Category 5: available data and information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

Evolution of the TMDL Program

The TMDL program has evolved over the last several decades as nationwide efforts have shifted from a focus on controlling point source pollutants to addressing nonpoint source pollution, according to EPA documents. Few TMDLs were developed during the first two decades after the TMDL program was created under the Clean Water Act. Figure 3 shows the extent of state-identified impaired water bodies (in acres of

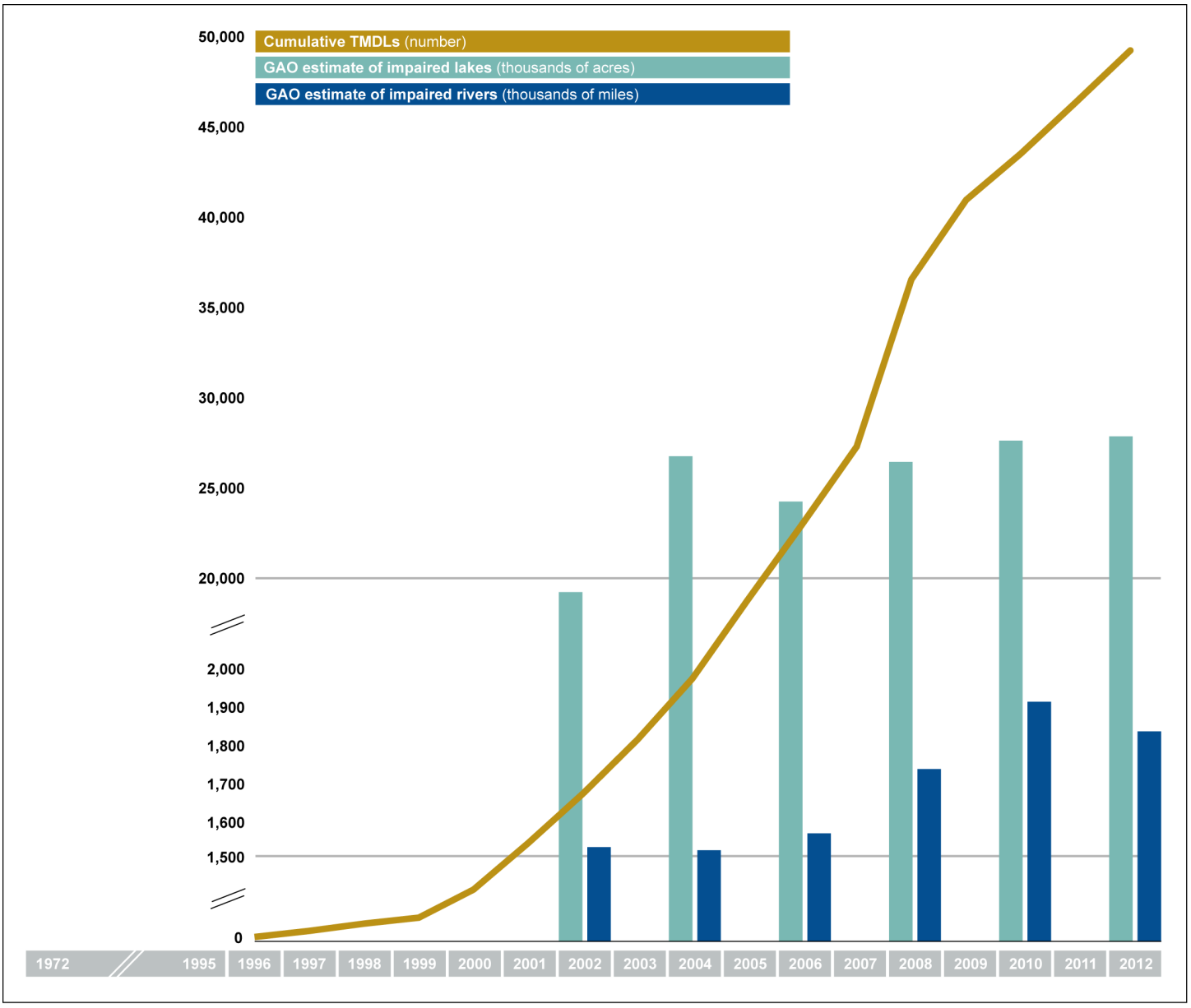
[21]Under the act, states are required to monitor and assess waters under section 305(b) of the Clean Water Act and to identify impaired waters under section 303(d). In 2002, EPA recommended that states submit "integrated reports," which include information gathered under each of these provisions. According to EPA, integrated reports result in a more comprehensive and consistent description of states' waters, including impaired waters. Not all states submit integrated reports, however, so the data EPA receives from all states are not uniform, according to EPA officials.

[22]According to EPA guidance, alternative measures are reviewed by EPA on a case-by-case basis and may include (1) permits that are stringent enough to meet water quality standards by the end of permit terms in water bodies impaired solely by point sources and (2) state regulations requiring nonpoint sources to implement certain projects, along with a demonstration that such projects will result in meeting water quality standards in a reasonable time.

lakes and miles of rivers) and the cumulative number of TMDLs developed since passage of the act.[23]

[23]The measures used by states and EPA for impaired water bodies and for water bodies attaining designated uses differ by water body type: specifically, acres of impaired lakes and miles of impaired rivers but numbers of water bodies attaining designated uses.

Figure 3: Extent of Impaired Freshwaters and TMDLs Developed since Passage of the Clean Water Act



Source: GAO analysis of EPA data.

Note: Before 2002, states identified impaired water bodies using varied methods and reported them to EPA in varied ways, making it difficult to reliably identify the number of impaired water bodies nationwide, according to EPA officials.

A number of major events have occurred over the last 40 years, which have shaped the program as it evolved. After the Clean Water Act was passed in 1972, EPA and the states focused primarily on, and made progress in, reducing pollutants discharged from point sources, but they made less progress in controlling nonpoint source pollution. In 1985, with minor amendments in 1992, EPA published regulations requiring the establishment of TMDLs and defining the minimum requirements TMDLs were to contain to qualify for approval, including the requirement that pollutant loads, or amounts, were to be set so as to attain water quality standards. Between these years, Congress in 1987 amended the Clean Water Act, adding section 319 to explicitly address nonpoint source pollution through a cooperative, grant-based program with states.[24] Among other provisions, the nonpoint source program was to fund voluntary projects aimed at curtailing nonpoint source pollution. In amending the act, Congress established the nonpoint source program to help states implement nonpoint source controls, largely through voluntary means and financial incentives, such as those set out in TMDLs. At the same time, some Members of Congress indicated that this provision was a starting point, to be changed if reliance on voluntary approaches did not significantly improve water quality.

In 1996, EPA determined that it needed a comprehensive evaluation of the TMDL program, in large part because of limited progress states had made in developing TMDLs. Moreover, environmental and public-interest organizations had started filing lawsuits alleging that EPA should be held accountable under the Clean Water Act for failure to oversee TMDL development efforts and should establish TMDLs where states had not done so. EPA convened a Federal Advisory Committee, which developed more than 170 separate recommendations to strengthen the TMDL program, ultimately reporting in 1998 that (1) restoring impaired waters should be a high priority; (2) implementing TMDLs, particularly those for nonpoint source pollution, should be the key to program success; and

[24]Water Quality Act of 1987, Pub. L. No. 100-4 § 316 (1987), adding § 319 to the Clean Water Act, codified at 33 U.S.C. § 1329 (2013).

(3) strengthening the federal government's capacity to carry out the TMDL program should be strengthened.[25]

Following on the heels of the Federal Advisory Committee's recommendations, EPA in 2000 promulgated significant revisions to the TMDL program in a rule published in the *Federal Register*. The preamble to the rule stated that although significant improvements had been made to water quality—particularly in stemming pollution from point sources—major challenges remained for addressing nonpoint source pollution. The rule specified elements that TMDLs needed to contain to be approved by EPA, including (1) implementation plans, which were to contain lists of specific actions to reduce pollution and schedules for reducing pollutant loads; (2) "reasonable assurances" that TMDLs for waters impaired by point and nonpoint source pollution show that nonpoint source pollution would actually be reduced; and (3) a plan for monitoring implementation projects and activities and TMDL revision procedures if such projects and activities did not have the anticipated effect on water quality. Finally, the rule also set a goal of 5 years to implement a given TMDL and 10 years for attaining water quality standards whenever practicable. In the preamble to the rule, EPA stated that the TMDL program needed new regulations because existing regulations had brought about insufficient improvement in water quality.

In 2000, however, Congress delayed EPA's implementation of the rule by prohibiting the agency from using funds made available for fiscal years 2000 and 2001 to make a final determination on, or implement, the 2000 rule.[26] Then, in association with the fiscal year 2001 appropriations bill, the congressional appropriations committee directed EPA to contract with NRC to evaluate the adequacy of scientific methods and approaches available to support development and implementation of TMDLs. NRC issued its report in April 2001, identifying features to strengthen TMDL development and implementation.

[25]The TMDL Federal Advisory Committee comprised 20 members with diverse geographic, policy, and professional perspectives, including state and local governments, tribal organizations, environmental groups, industry, agriculture, forestry, and academia. In addition, three federal agency officials—from EPA and the Department of Agriculture's Natural Resources Conservation Service and Forest Service—served as nonvoting members.

[26]EPA issued the final rule but delayed its effective date until after the spending prohibition would end.

In 2002, EPA withdrew its rule, stating that significant changes would be needed before the rule could serve as a blueprint for an efficient and effective TMDL program. EPA also stated that it needed more time to evaluate whether and how to revise then-current regulations, reporting that the agency was not sure how long this effort would take. EPA cited significant controversy, pending litigation, and lack of stakeholder consensus on key aspects of the rule as the main challenges that a new rule would need to overcome. [27] Since then, according to EPA officials, EPA has focused its efforts on implementing the TMDL program, including the review and approval of TMDLs submitted by states according to the 1985 regulations and 1992 amendments. EPA has also issued additional guidance to states on a range of topics, including on specific elements that a TMDL should contain.

In 2013, EPA drafted a long-term "vision" for its TMDL program, acknowledging that many TMDLs have been developed for impaired waters, although much remains to be done to restore water bodies to which TMDLs apply and to develop TMDLs for still more water bodies. EPA's vision seeks to help states set priorities for TMDLs to be developed and implemented, now that states are emerging from several decades of consent-decree-driven time frames for TMDL development and have more flexibility in addressing technical challenges, limited funding and other resources, state-specific legislative and regulatory frameworks, and public objectives. For example, by 2016, states are to review; systematically set priorities for; and, in their biennial integrated reports,

[27]According to the Congressional Research Service, EPA's proposal had few strong supporters, for varied reasons. States, which would have been directly affected by the rule, criticized the burdens that new requirements would place on them. They were concerned that they did not have resources to meet tight deadlines for developing and implementing TMDLs. Further, states said that TMDLs should not necessarily take higher priority over other elements of existing water quality management programs. Industry groups expressed concern about impacts of new pollution control requirements. For their part, municipal and industrial point source groups urged states and EPA to ensure that TMDL requirements did not fall disproportionately on their discharges, while possibly failing to address nonpoint source contributions to impaired waters. Farm groups and others with nonpoint discharges questioned EPA's authority to include nonpoint source pollution in the TMDL program. The forestry industry vigorously criticized potential impacts of the rule. Environmentalists, who supported the need for a stronger and more comprehensive TMDL program, objected to the long periods in the rule before water quality improvements were likely to occur. They criticized the lack of aggressive implementation of a program that has existed in law since 1972. Congressional Research Service, *Clean Water Act and Total Maximum Daily Loads (TMDLs) of Pollutants*, Order Code 97-831 (Washington, D.C.: August 2008).

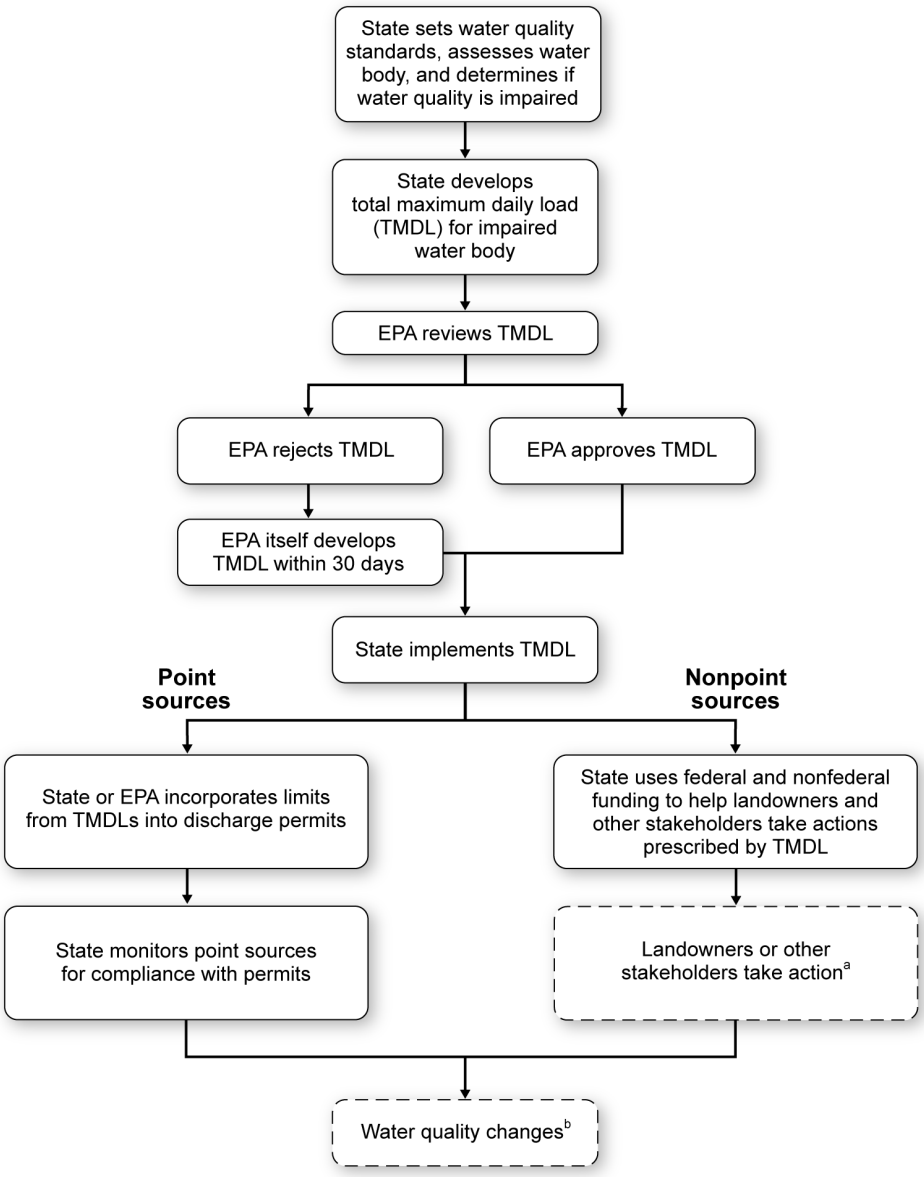
identify waters for restoration and protection. Also by 2016, states are to identify and coordinate implementation of the water quality efforts of other federal agencies, such as the U.S. Department of Agriculture (USDA), to achieve each state's water quality goals.

EPA and the States Have Certain Responsibilities for Developing and Implementing TMDLs

Under the Clean Water Act, EPA and the states each have certain responsibilities for developing and implementing TMDLs. EPA establishes elements for TMDLs for review and approval, funds some TMDL development and implementation, and provides technical assistance to states. States are responsible for developing TMDLs and implementing the pollution control actions prescribed by the plans for point sources, while they take the lead for implementing any actions for nonpoint sources.[28] Figure 4 shows the key steps and parties involved in developing and implementing TMDLs.

[28]According to EPA, "it is the responsibility of the states, through the exercise of state law, to implement TMDLs that establish load allocations for nonpoint sources." See Brief for Defendant-Appellants at 9, *Sierra Club v. Meiburg*, 296 F.3d 1021 (11th Cir. 2002) (No. 01-14587-G).

Figure 4: Key Steps in Developing and Implementing TMDLs



Source: GAO analysis of EPA information.

[a]The Clean Water Act's approach to curtailing nonpoint source pollution depends in large part on voluntary participation by private landowners; other actors may include state or local regulatory or nonregulatory programs.

[b]According to EPA officials, it may take years for changes to occur in water quality after implementation of best management practices or other projects and activities prescribed by TMDLs.

EPA's Responsibilities

EPA has three main responsibilities for developing and implementing TMDLs. First, EPA establishes regulations and guidance for TMDL development and reviews TMDL documents that states submit. Under guidance implementing the agency's regulations promulgated in 1985 and amended in 1992, EPA reviews the adequacy of TMDLs on the basis of 11 elements (see table 1). If EPA rejects a state's TMDL, EPA must itself develop one for the identified water body within 30 days. According to EPA program officials, its regional offices review TMDL documents and approve them when the information provided in those documents demonstrates that if the TMDL were implemented as written, it would enable an impaired water body to attain the relevant water quality standards.

Table 1: Elements for Approvable TMDLs

TMDL element	Description
1. Identification of water body, pollutant of concern, pollutant sources, and priority ranking	A TMDL should identify the water body and pollutant for which the TMDL is established; link between the pollutant of concern and applicable water quality standard; point and nonpoint sources of the pollutant of concern; and point source permits, if any.
2. Description of the applicable water quality standard and numeric water quality target	A TMDL must describe the applicable water quality standard. The TMDL must also identify the numeric water quality target and how meeting the target will allow designated uses to be attained.
3. Loading capacity—linking water quality and pollutant sources	A TMDL must identify the loading capacity of a water body for the applicable pollutant, that is, the greatest amount of a pollutant that the water body can receive and still attain the applicable water quality standard.
4. Load allocations	A TMDL must include load allocations, which identify the portion of the loading capacity assigned to existing and future nonpoint sources—in other words, the share of the pollutant limit that nonpoint sources must meet.
5. Wasteload allocations	A TMDL must include wasteload allocations, which identify the portion of the loading capacity assigned to each existing and future point source—in other words, the share of the pollutant limit that point sources must meet.
6. Margin of safety	A TMDL must include a margin of safety—such as conservative assumptions—to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality.
7. Seasonal variation	A TMDL must consider how seasonal variations affect loading capacity, and it must describe the method that accounts for seasonal variation.
8. Reasonable assurances	When a TMDL is developed for waters impaired by both point and nonpoint sources, a "TMDL should provide reasonable assurances that nonpoint source control measures will achieve the expected load reductions." This information is necessary for EPA to determine that the TMDL has been established at a level necessary to implement water quality standards.

TMDL element	Description
9. .Monitoring plan to track TMDL effectiveness	EPA recommends that TMDLs include a monitoring plan to track effectiveness of implementation, particularly when a TMDL involves both point and nonpoint sources (emphasis added). The monitoring plan should describe data to be collected to determine if load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.
10. Implementation	EPA encourages states to develop implementation plans that include reasonable assurances that nonpoint source pollution reductions will occur (emphasis added).
11. Public participation	EPA recommends full and meaningful public participation in the TMDL development process (emphasis added). States must subject TMDL calculations to public review. Inadequate public participation may be a basis for disapproving a TMDL.

Source: EPA.

EPA's second responsibility is to provide funding, which helps states develop and implement TMDLs. EPA has two grant programs under the Clean Water Act: grants for water pollution control programs (section 106) and grants for state nonpoint source management programs (section 319). Portions of grants from EPA for water pollution control give states funding to assist in administering programs for the prevention, reduction, and elimination of pollution, including, but not limited to, TMDLs. Similarly, portions of grants for state nonpoint source management programs fund state-selected projects to reduce nonpoint source pollution and restore impaired water bodies. These state grant programs generally fund implementation of TMDLs addressing nonpoint sources. In implementing section 319, EPA awards funds to states, provided they meet various minimum conditions, including targeting funds to geographic areas in need of restoration and demonstrating annual progress. EPA has discretion by statute to (1) add terms and conditions to grants; (2) require additional information on applications; and (3) request additional information, data, and reports that it considers necessary to determine continuing state eligibility for grants. For example, EPA's regional offices establish commitments from each state to develop a specific number of TMDLs each year, and each state is to report back to the relevant regional office how many it has developed. Under section 319, to receive funding, states must obtain a determination from EPA that they made satisfactory progress in meeting their nonpoint source program goals from the prior year.[29]

[29]Nonpoint source grant funding under section 319 is allocated to states using a formula established by EPA, which incorporates states' population, cropland, pasture, forest harvest acreage, and other factors, set when the grant program began.

For fiscal years 2008 to 2012, EPA budget was $432 million per year, on average, for its grants supporting state efforts under its water pollution and nonpoint source management programs, including for developing and implementing TMDLs. During this time, EPA's water pollution control program was budgeted at $235.5 million per year, on average, and the nonpoint source management program was budgeted at $196.5 million per year, on average. Less than half of these amounts, however, are applied toward TMDL development and implementation because of the many other state water quality efforts they also support. For example, EPA officials told us, a majority of the agency's grants under the water pollution control program support states' permitting, monitoring, and assessment activities, not TMDL development per se. Moreover, officials estimated that about one-third of grants through the nonpoint source management program are used to implement TMDLs, whereas the remaining two-thirds support other aspects of states' nonpoint source management programs.

EPA's third responsibility with regard to TMDLs is to provide technical assistance to help states restore water bodies through the TMDL process. For example, in addition to developing numerous models, monitoring methodologies, and databases over the past several decades, the agency has developed recent tools to assist states in (1) identifying the causes and effects of various impairments and (2) assessing different water bodies to identify those with the highest likelihood of successful restoration. Specifically, according to EPA documents, EPA has developed tools such as the Causal Analysis/Diagnosis Decision Information System and the Recovery Potential Screening tools. The first is a web-based system that helps scientists and engineers in EPA regions and states assess water bodies and identify causes of impairment, with a focus on biological assessments. Biological assessments can evaluate the cumulative impacts of chemicals for which no water quality standards exist, as well as of nonchemical stressors such as flow alteration (e.g., stream channeling) and invasive species, according to EPA documents. The second tool is also web based and, according to EPA documents, assists state officials in considering where to invest their water quality restoration efforts for greater likelihood of success, given specific traits of their own geographic area and communities. The tool is to help states compare the relative restoration and recovery potential of large numbers

of water bodies by measuring, for each water body or watershed, several indicators showing the likelihood that a restoration effort can succeed.[30]

States' Responsibilities

Under the Clean Water Act, states are responsible for developing TMDLs for waters they identify as impaired and, generally, for implementing the pollution control actions they prescribe for point sources; whereas for nonpoint sources, states take the lead in implementing projects and activities intended to achieve pollution reductions.[31] To develop TMDLs, states identify individual pollutants or pollution impairing water quality; point and nonpoint sources of the pollution; and, generally, the actions needed to reduce pollution to an amount that meets water quality standards. TMDL development generally consists of the following steps:

- identifying the pollutant responsible for listing a water body as impaired;
- estimating the water body's loading capacity for that pollutant;
- estimating pollutant loading in the water body from all sources;
- determining pollutant reductions to meet the loading capacity;
- allocating the allowable pollutant load among different pollutant sources—both point (i.e., wasteload allocation) and nonpoint (i.e., load allocation)—in a manner that achieves water quality; and
- describing a plan for the actions that should be implemented to reduce pollutants from entering the water body.

As part of the TMDL development process, states use different approaches for point source and nonpoint source pollution. EPA and the

[30]For example, according to EPA documents, ecological indicators measure natural watershed features, such as the relative abundance of aquatic animals or plants, and the tool assigns an "ecological index score" that reflects the watershed's restoration potential. Further, a "social context score" includes factors such as community involvement, local regulations, and whether any plans to improve water quality have already been developed, which often strongly influences how difficult restoration may be.

[31]*See, e.g., Sierra Club v. Meiburg*, 296 F.3d 1021, 1031 (11th Cir. 2002) (explaining that "… the national policy and objectives relating to clean water are most reliably embodied in the act itself which puts the responsibility for implementation of TMDLs on the states"). As we previously noted, the act does not expressly require implementation of a TMDL, but states are required to engage in a continuous planning process which includes TMDLs, among other things, and which will achieve water quality standards. With respect to state implementation of nonpoint source controls, the act "provides no direct mechanism to control nonpoint source pollution but rather uses the 'threat and promise' of federal grants to the states to accomplish this task." *Pronsolino v. Nastri*, 291 F.3d 1123, 1126-27 (9th Cir. 2002).

states regulate point source discharges of pollutants by means of National Pollutant Discharge Elimination System permits, which are to incorporate overall pollutant loads—wasteload allocations—established by TMDLs. Under the National Pollutant Discharge Elimination System, all facilities that discharge pollutants from any point source into U.S. waters must generally obtain a permit, typically from their state or EPA region. During TMDL development, a state identifies each point source discharging to the water body subject to a TMDL and determines specific limits for the pollutants addressed by the TMDL that would enable the water body to attain water quality standards. For example, in developing one California TMDL, the regional water quality control board determined that to meet water quality standards, point sources could discharge no more than 5.5 pounds of nitrogen per day into the water body subject to the TMDL. States who issue these permits are thus responsible for implementing the point source control component of TMDLs. Unlike point source pollutants, nonpoint source pollution is not regulated through permitting and discharge limits. A state or EPA identifies pollution caused by adjacent or upstream lands contributing polluted runoff or other pollution to a water body and sets load allocations for particular pollutants of concern. The California TMDL, for example, states that nonpoint sources, which discharged about 84 pounds of nitrogen per day all together, were to collectively discharge no more than 8.5 pounds per day.

Then, depending on the state or EPA office that develops it, a TMDL may identify, in more or less detail, the actions needed to control or reduce runoff into the water body. Some states' TMDL documents prescribe specific actions to reduce runoff from fields; for example, they include the location and type of projects and activities that may be needed to reduce pollution from different parcels of land. Such projects and activities include agricultural best management practices, such as installing fences to exclude cattle from stream banks, planting strips of grass along a stream bank to absorb nitrogen and phosphorus runoff from fertilized fields, or building in-stream structures to prevent sediment from flowing downstream. For example, the TMDL for the South Santiam River in Oregon describes and locates soil conditions, vegetation, and human uses affecting the river and its tributaries. It also describes in detail specific steps to address elevated temperature in the river, including restoring stream channels, native vegetation, and natural streamflow, and it aligns such steps with the specific conditions and areas within the TMDL's geographic boundary. Other state TMDLs simply direct that runoff from all nonpoint sources is to fall below the overall load allocated among them. For example, the TMDL for Mariposa Lake in Iowa does not identify specific locations from which nonpoint source pollution comes or

the type and extent of actions needed to enable the lake to attain water quality standards. Runoff from 580 acres of nearby farmland flows into the lake, which is to support designated uses of swimming and aquatic wildlife, but the TMDL identifies a single maximum load of phosphorus to be collectively achieved from all these acres, without identifying the specific locations contributing the most polluted runoff or the extent to which actions are needed that could address polluted runoff.

Once a TMDL is developed for a water body, states have certain responsibilities for implementing it—that is, for taking the actions prescribed by the TMDL to reduce point source pollution. To implement TMDLs for waters impaired by point sources, states are to ensure that pollutant discharge levels specified in permits are consistent with the assumptions and requirements of any available wasteload allocation for the facility specified in TMDL documents.[32] Specifically, state staff determine whether the overall wasteload allocation for that pollutant can be met if each point source of that pollutant discharges no more than its permitted limit or whether a facility's permitted limit for the pollutant in question needs to be lower. If a TMDL has been developed for the receiving waters, the permitted limits for point sources must be consistent with the wasteload allocations in the TMDLs.

In contrast, states take the lead in implementing TMDLs for waters impaired by nonpoint source pollution by relying on projects funded through their nonpoint source management programs and through a mix of other federal and state funds.[33] In part because most land areas responsible for nonpoint source pollution are privately owned, EPA and the states use funding to try to secure voluntary landowner participation.

[32]Forty-six states are approved by EPA to issue permits setting pollutant limits for point sources. For the four states that do not have this approval—Idaho, Massachusetts, New Hampshire, and New Mexico—EPA is responsible for incorporating TMDL limits for point sources into their permits.

[33]States develop their own project selection processes and the criteria their nonpoint source management programs are to consider when determining what projects to fund. Annually, each state submits its list of selected projects to the applicable EPA regional office for incorporation into the state's work plan, which describes what projects will be funded through an EPA program established under section 319 of the Clean Water Act. Organizations that apply for funding through this program—often including conservation districts, local governments, and nonprofit organizations—submit project proposals to states' nonpoint source management programs and, if selected, are responsible for implementing their proposed nonpoint source pollution projects under an agreement with the state.

In particular, states are encouraged by EPA (under guidance implementing section 319 of the Clean Water Act) to coordinate with other agencies, particularly USDA, that fund projects that may help reduce nonpoint source pollution. Under the Farm Bill and other legislation, USDA administers agricultural conservation programs that fund best management practices on agricultural land, providing funding assistance to landowners for projects aimed at reducing soil erosion and air pollution, as well as nonpoint source water pollution. Such programs, including USDA's Environmental Quality Incentives Program, have in the past received more funding than EPA's nonpoint source management program, but not all such funding is specifically directed toward projects in impaired or threatened watersheds. For example, of the $1.4 billion in fiscal year 2012 that the Environmental Quality Incentives Program received, $33 million was specifically set aside to help farmers and ranchers implement conservation practices to protect water quality in impaired or threatened watersheds.

In addition, according to EPA documents, some states have taken steps through state law or guidance to further the implementation of TMDLs. Specifically, 10 states had taken steps to require formal TMDL implementation plans that specifically identified actions that could reduce nonpoint source pollution in a water body, according to a 2008 report.[34] Implementation plans may describe how nonpoint source load allocations are to be achieved for individual water bodies, for several water bodies within a watershed, or for all affected water bodies in the state, according to EPA. Moreover, a handful of states regulate nonpoint source pollution to some extent, according to the study.[35] For example, farms in Pennsylvania must have a conservation plan for sediment;[36] compliance with the plan can help farmers conserve soil. In Washington, dairies must have a nutrient management plan to prevent nutrients from entering nearby water bodies. Pennsylvania and Washington officials told us that

[34]"State Implementation Information," compiled by Virginia Polytechnic Institute and State University under EPA grant no. 83156301 (September 2008). The states include Arizona, California, Delaware, Hawaii, Idaho, Kansas, Minnesota, Oregon, Texas, and Virginia.

[35]These states include California, Florida, Hawaii, Oregon, Pennsylvania, Washington, and Wisconsin.

[36]Specifically, agricultural plowing or tilling activities and animal heavy use areas disturbing over 5,000 square feet are required to have a written erosion and sedimentation control plan, and to implement best management practices.

the mechanisms are generally limited in scope, and state and local officials reported that success or failure to implement TMDLs addressing significant nonpoint source pollution depends largely on voluntary initiatives.

EPA Has Limited Information about the Status of Long-Established TMDLs, but States Report That Few Water Bodies with Such TMDLs Have Attained Water Quality Standards

EPA tracks basic information on TMDL development, such as the number, location, and type of long-established TMDLs but, generally, does not have information on the extent to which the TMDLs have been implemented or have improved the quality of impaired water bodies. EPA's ability to track TMDL implementation is hindered by data system limitations and unavailable USDA data. In addition, results from our survey of state TMDL coordinators show that states have little information on TMDL implementation, and, where information exists, few water bodies to which long-established TMDLs apply have attained water quality standards.

EPA Systematically Tracks Basic Information on TMDL Development but Has Limited Information on TMDL Implementation and Water Quality

Through its national databases, EPA systematically tracks basic information related to TMDL development, but these databases contain limited information on the extent of TMDL implementation and associated changes in water quality. This basic information includes the number of TMDLs developed, the name of water bodies to which TMDLs apply, pollutants contributing to impairment, and probable sources of the impairments, as well as information on the extent to which states use nonpoint source management grant funds to support TMDL development and implementation. Generally, EPA has information related to TMDL development in its Assessment, TMDL Tracking and Implementation System, much of which is entered by EPA regional offices with data provided by states. From this database, the agency knows the following facts, as of August 2013:

- EPA has approved 50,184 TMDLs since fiscal year 1996, the year states generally began developing TMDLs; 34,794 of these, which we refer to as long-established TMDLs, were approved by December 31, 2007. The information that EPA tracks shows that states have developed TMDLs for many water bodies the states have identified as impaired and that the probable causes of impairment include chemical, physical, and biological stressors.

- The agency knows that 52 percent address only nonpoint source pollution, 5 percent address only point source pollution, and 41 percent address both point and nonpoint source pollution.[37]
- The states with the largest number of approved TMDLs include Pennsylvania (7,084 TMDLs), New Hampshire (6,006 TMDLs), West Virginia (3,819 TMDLs), and Kansas (2,982 TMDLs).[38]
- Pollutant groups addressed by the largest number of TMDLs include pathogens, such as bacteria from feces (addressed in 11,595 TMDLs); metals other than mercury, such as arsenic, cadmium, and zinc (9,010 TMDLs); mercury (7,046 TMDLs); nutrients such as nitrogen or phosphorus (5,466 TMDLs); and sediment (3,783 TMDLs).
- The probable sources of stressors contributing to impairments may vary by type of water body and include agricultural runoff, municipal discharges (sewage), and atmospheric deposition[39] into rivers, streams, lakes, ponds, bays, and estuaries. Other significant stressors include habitat alterations and physical modifications (e.g., altering water flow patterns by straightening streams or building dams).

EPA has two additional databases that contain information about TMDL implementation, but these databases contain limited information on the extent of TMDL implementation and associated changes in water quality. As a result, EPA cannot use its different databases to assess the extent to which most TMDLs have been implemented, and it does not have comprehensive, nationwide information on whether and to what extent TMDLs have led to improved water quality. In its Permit Compliance System or Integrated Compliance Information System, EPA tracks data on point sources, including permitted pollutant levels associated with

[37]Some TMDLs in the database did not have a TMDL type listed, so the percentages do not add to 100.

[38]These data do not necessarily mean that states with the most TMDLs have the most impaired waters. Pennsylvania's water body assessment units are relatively small, meaning that one stream may have dozens of assessment units and, if impaired, require dozens of TMDLs. In addition, New Hampshire was credited with thousands of TMDLs for completing one TMDL document—the New England Mercury TMDL—that applied to all water bodies in the state.

[39]Atmospheric deposition—a process that transfers pollutants from the air to the earth's surface—can significantly impair water quality in the nation's rivers, lakes, bays, and estuaries and harm human health and aquatic ecosystems. In particular, airborne pollutants can fall to the ground in precipitation or as a gas or particle and be deposited either directly onto the surface of a water body or onto land and then transported into a water body through runoff.

TMDLs.[40] In its Grants Reporting and Tracking System, EPA tracks data on EPA-funded projects and activities that may help reduce nonpoint source pollution to meet levels called for in TMDLs. To track TMDL implementation and any associated effect on water quality, EPA and states need to know what actions have been taken to reduce pollution in a watershed with a TMDL and how much pollution has been reduced as a result, according to program officials. Through several studies, EPA has integrated information in its databases, where available, to assess the status of pollution control actions prescribed in TMDLs and the extent to which water quality improved from these efforts. Specifically, EPA conducted several studies, most in response to the 2007 EPA Office of Inspector General report, which found that the agency had limited data on TMDL implementation activities; these studies examined the following issues:

- *Whether sufficient information existed in the databases to assess TMDL implementation status*. EPA determined that a limited number of TMDLs could be assessed for implementation status. For example, in a 2010 report, the agency found that 17 percent of point source TMDLs and 8 percent of nonpoint source TMDLs had all of the data elements needed for TMDL implementation status to be addressed.[41]
- *Whether point source permits had been revised to include TMDL limits.* EPA found in a 2009 study that wasteload allocations for point sources were generally incorporated into discharge permits. [42] The study showed that of 399 wasteload allocations set by 100 TMDLs, a majority (68 percent) was consistent with existing limits established in discharge permits, and no permit revisions were needed. Eleven percent required permit revisions and such revisions had been made, and 21 percent of wasteload allocations required permit revisions, but revisions had not been made. All the wasteload allocations for which permit revisions had not been made pertained to municipal stormwater or combined sewer overflows, for which permit revisions are not straightforward, according to EPA.

[40]EPA and the states are making a transition from the national database known as the Permit Compliance System to a database called Integrated Compliance Information System: NPDES. The states are divided in their use of the two databases.

[41]EPA, *FY2010 National Report on Implementing Total Maximum Daily Loads (TMDLs)*, Document No. EPA841-R-11-002 (Washington, D.C.: March 2011).

[42]EPA, *Analysis of TMDL Implementation Rates in EPA Region 5*, EPA841-R-09-005 (Washington, D.C.: Dec. 1, 2009).

- *Whether TMDLs have implementation plans for carrying out actions to control pollution.* In a 2007 study, EPA assessed how stakeholder participation and implementation planning, which may occur during TMDL development, affect implementation.[43] As part of this study, EPA surveyed regional officials responsible for TMDLs and found that 37 percent of TMDLs often or always have implementation plans, and 46 percent reported that TMDLs never or seldom have implementation plans.
- *Whether TMDLs have helped improve water quality.* A 2008 study funded by EPA on TMDL implementation status in Ohio and West Virginia,[44] that officials responsible for implementing TMDLs were not aware of some TMDLs developed for watersheds under their jurisdiction and that incremental improvements in water quality had occurred in less than 20 percent of watersheds. For example, for the 63 TMDLs sampled, the study found that agency officials did not know whether any TMDL implementation activities had occurred for 18 of them. The study found that implementation of pollution control actions had occurred in 29 of the 63 watersheds in the sample. Incremental improvements in water quality had occurred in 12 of the 63 watersheds, and full water body restoration had occurred in 2 of the 63 watersheds.[45]

EPA's Ability to Track TMDL Implementation Is Hindered by Data System Limitations and Unavailable USDA Data

EPA is hindered in its ability to track TMDL implementation results because of data system limitations, as well as the fact that data on water quality projects paid for by USDA are generally unavailable. First, EPA's databases, which contain information uploaded from states' databases, function independently of one another. Because information relevant to TMDL implementation is not consistently tagged with geographic information system (GIS) data (i.e., latitude-longitude coordinates on water body segments, permitted discharge locations, and the spatial extent of projects addressing nonpoint source pollution), as opposed to water body names and states, the information on TMDL implementation

[43]EPA, *Developing Effective Nonpoint Source TMDLs: An Evaluation of the TMDL Development Process*. (Washington, D.C.: January 2007).

[44]John Hoornbeek et al., *Implementing Total Maximum Daily Loads: Understanding and Fostering Successful Results* (Kent, Ohio: Kent State University, December 2008).

[45]In the watersheds where water quality improved, it was unclear whether the TMDLs caused these incremental improvements or whether the improvements would have occurred even in the absence of the TMDLs.

projects and impaired water bodies generally cannot be integrated across separate databases.[46] As a result, EPA cannot link (1) information on TMDL implementation projects and activities from its Grants Reporting and Tracking System with (2) information on impaired water bodies or the causes of their impairment from the Assessment, TMDL Tracking and Implementation System and can therefore not assess the extent to which TMDLs have been implemented in watersheds with impaired water bodies. According to TMDL program officials, to link TMDL information in several databases, the agency must have GIS data—not just the water body name—for the extent of waters addressed by each data point for each TMDL. Nevertheless, the data that states enter into their own systems and upload to EPA's databases do not consistently include this information, in part because EPA does not require the information and in part because state officials developed the majority of TMDLs before the widespread use of GIS, according to program officials. Without consistently obtaining from states GIS data in addition to water body names, EPA cannot integrate information on TMDL implementation projects and impaired water bodies across separate databases and cannot assess whether and to what extent water quality has been affected by TMDL implementation.

EPA's Office of Inspector General, in its 2007 report, recommended that EPA annually report on the progress of TMDL implementation activities and their effects on water quality. EPA officials explained to us that such an effort would be expensive (both to develop the system and to expand monitoring efforts to detect changes in water quality) and that limited funding should instead be invested in projects to control pollution. EPA program officials told us that in the present budget environment, they hesitate to ask states to invest additional resources or reallocate funding to track the water quality effects of TMDL implementation projects or update their databases. Nevertheless, EPA program officials told us, requiring states to report GIS data associated with TMDL implementation is more feasible than asking them to create new data systems or to merge existing ones with EPA's systems. EPA officials said that they are beginning to obtain GIS information associated with projects in the Grants Reporting and Tracking System for some nonpoint source TMDLs, but they acknowledged that this data-gathering effort will not provide

[46]GISs manipulate, analyze, and graphically present an array of information associated with geographic locations.

information on the specific type, amount, or location of projects that have been implemented for all the TMDLs in the database—information that would generally be needed to ascertain the effect of TMDL implementation on water quality.

A second reason that EPA has limited ability to track TMDL implementation results is that many USDA-funded projects undertaken on agricultural land adjacent to water bodies with TMDLs cannot be tracked by EPA or state water quality programs because of privacy provisions in the 2008 Farm Bill.[47] In more than one thousand watersheds across the country, USDA funds conservation projects to implement best management practices that reduce soil erosion, water pollution, and air pollution, and many of these projects help curb pollutants like nutrient runoff from agricultural fields. EPA officials told us that data on the location, type, and number of these projects could help identify whether and to what extent TMDLs have been implemented and whether water quality has improved as a result. Statutory provisions enacted as part of the 2008 Farm Bill, however, protect the identity and location of landowners and other agricultural producers who participate in USDA-funded conservation programs, including those implementing best management practices. Specifically, the provision prohibits USDA employees or contractors from sharing certain information concerning the land and operations of agricultural producers who participate in USDA conservation programs; the department also cannot share GIS information about agricultural land or operations.[48] The provision, however, does not prohibit landowners and agricultural producers from consenting to disclosure or disclosing information on the specific best management practices that USDA has funded on their land. As a practical matter, according to EPA program officials, the biggest single information gap that limits tracking of implementation of nonpoint source TMDLs is the lack of information on the location of USDA-funded best management practices.

According to EPA officials, USDA has collected data on projects that it funded, but these data are summarized and presented on fairly large geographic scales—scales too large to match to watersheds with TMDLs.

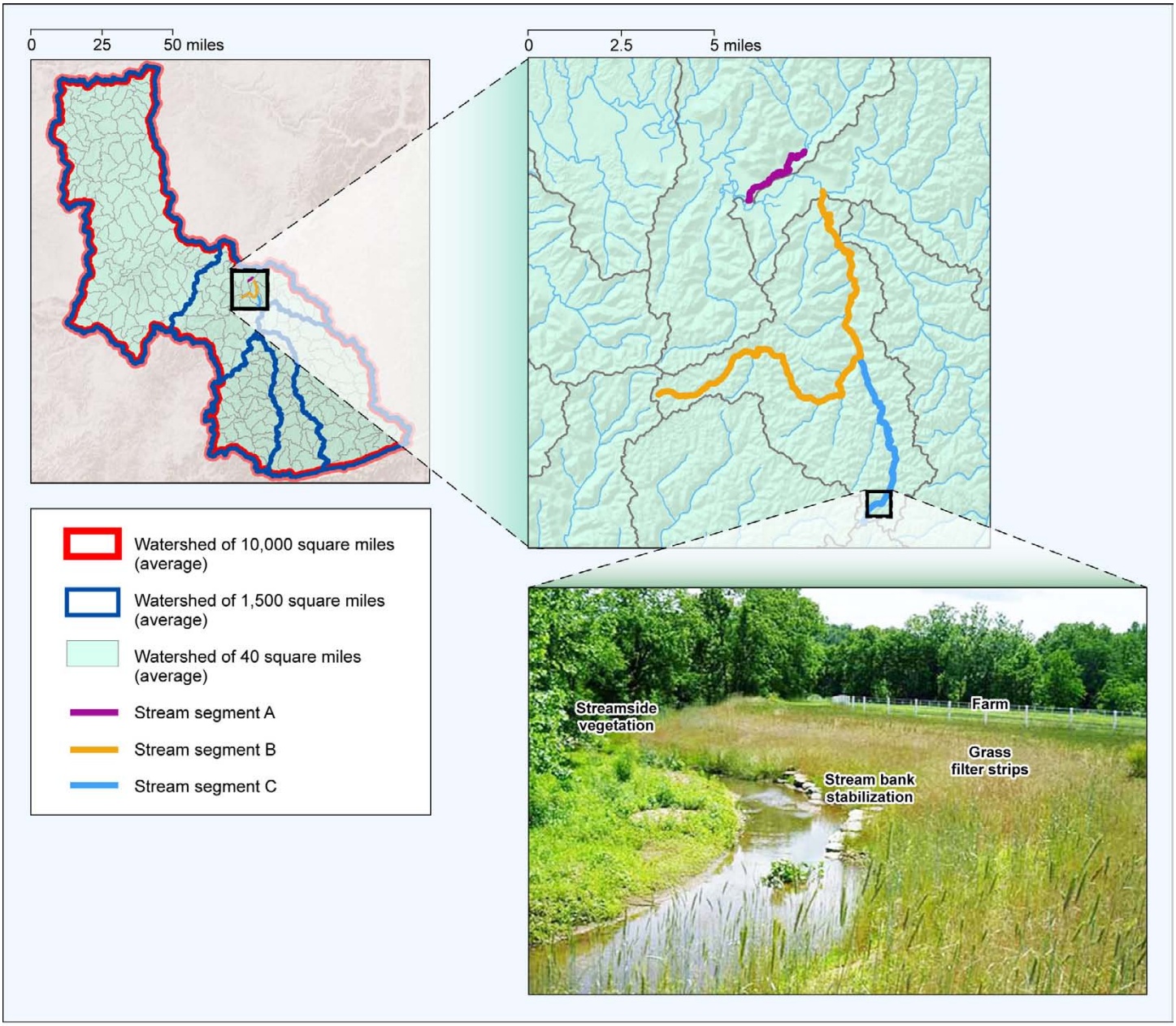
[47]Pub. L. No. 110-246 § 1619(b)(2), codified at 7 U.S.C. § 8791(b)(2) (2013).

[48]The provision has a limited exception for aggregated data and certain statistical information.

According to EPA program officials, such aggregated USDA data cannot be used to assess the effects of projects put in place to implement TMDLs because TMDLs typically apply to much smaller areas than represented by these data. To track the effectiveness of TMDL implementation, program officials told us, EPA generally needs data on specific best management practices implemented at specific sites on individual parts of a stream within a watershed. USDA's data, in contrast, are collected and aggregated for areas that cover, on average, 10,000 square miles, encompassing, for example, several rivers and their tributaries, according to EPA officials (see fig. 5).[49] EPA TMDL program officials told us that their senior managers have not formally discussed with USDA the availability of the department's data to EPA, primarily because of the sensitivity of this issue with USDA and its need to abide by the privacy provisions of the Farm Bill. Nevertheless, without access to data on the location, type, and number of projects implemented by landowners who participate in conservation programs funded by the USDA in areas subject to a TMDL, EPA cannot track actions taken to implement TMDLs and subsequent changes in water quality associated with a core EPA program and a substantial federal investment.

[49]In some cases, USDA has aggregated and shared with states data for areas that cover, on average, 1,500 square miles, according to EPA officials.

Figure 5: Scales at Which USDA Aggregates Watershed Data, States Implement TMDLs, and EPA Needs GIS Data to Track TMDL Implementation Projects



Sources: GAO, EPA, and USDA.

Note: USDA aggregates watershed data at the scales shown at top left; TMDLs are implemented at scales shown at top right (each of the colored stream segments A, B, and C is subject to a TMDL); and EPA needs data on the scale of TMDL implementation projects shown at bottom right. To track

USDA-funded projects implemented near and in impaired water bodies, EPA would need project information tagged with GIS data (i.e., latitude-longitude coordinates), in addition to water body names and states. According to EPA officials, however, data that USDA has on TMDL projects it funded, such as projects to plant or protect vegetation along stream banks (bottom right), are summarized and presented on fairly large geographic scales (top left), which are too large to match to watersheds with TMDLs (top right).

States Report Having Little Information on TMDL Implementation, as Well as Limited Improvement in Water Quality

Our survey of state TMDL coordinators responsible for implementing long-established TMDLs showed that state TMDL coordinators do not know the extent to which many long-established TMDLs have been implemented. For those TMDLs where information exists, state coordinators reported that pollutants had been reduced in many waters, but few TMDLs had helped water bodies attain water quality standards. State TMDL coordinators did not know the status of TMDL implementation for slightly less than half of the long-established TMDLs. Specifically state coordinators reported that they did not know (1) if wasteload allocations had been met for 36 percent of point source TMDLs,[50] or (2) whether load allocations had been met for 48 percent of nonpoint source TMDLs. Moreover, these coordinators did not know whether pollutant levels had changed in 35 percent of nonpoint source TMDLs.

Among state TMDL coordinators who had information on the extent of TMDL implementation, coordinators reported that a higher proportion of long-established point source TMDLs helped water bodies attain water quality standards than did nonpoint source TMDLs. When state TMDL coordinators were knowledgeable about TMDLs addressing point sources, they reported that for 83 percent of long-established TMDLs, wasteload allocations the TMDLs called for had been met.[51] When state TMDL coordinators were knowledgeable about TMDLs addressing nonpoint sources, however, they reported that 20 percent of load allocations had been met. According to state officials, this discrepancy exists primarily because actions called for in TMDLs for nonpoint source pollution either have not been implemented or have been implemented to a limited extent. Furthermore, state TMDL coordinators reported that they expected 13 percent of water bodies with TMDLs for nonpoint source pollution to attain water quality standards within the next 5 years.

[50]For certain survey questions, we received fewer than 100 responses. Where the margin of error for such responses is greater than 12 percent, we list the 95 confidence interval as (X, Y). For this estimate, the 95 percent confidence interval is (21, 50).

[51]The 95 percent confidence interval for this estimate is (70, 96).

Long-Established TMDLs Experts Reviewed Seldom Contained All Key Features, Some of Which Are Not Included in EPA's Guidance

Long-established TMDLs often do not contain key features that would help water bodies attain water quality standards, in part because EPA's regulations and guidance do not direct TMDLs to contain them. NRC and EPA have identified key features that TMDLs should contain to help impaired water bodies attain water quality standards. Water resource experts who reviewed a sample of 25 long-established TMDLs reported that these TMDLs do not contain many of these key features. In addition, in reviewing EPA's guidance on how regional offices are to apply EPA's 11 TMDL elements, we found that the guidance does not contain some of these key features and that some of these elements are vague, which has led EPA's regional offices to apply them in different ways and to approve TMDLs of variable quality.

Certain Features Are Key If TMDLS Are to Help Water Bodies Attain Water Quality Standards

A 2001 NRC report and several EPA studies and guidance documents have identified key features for TMDL development, which would help water bodies attain water quality standards if TMDLs were implemented.[52] We grouped these key features into three categories on the basis of the sequence of steps in the TMDL process: those that help ensure that (1) TMDLs accurately identify and address causes of impairment, (2) TMDLs can be implemented, and (3) TMDLs are revised if found to be ineffective in helping water bodies attain water quality standards. The steps in these three categories reflect a more expansive view of TMDLs than what EPA's existing regulations require TMDLs to include, according to EPA officials.

Accurately Identifying and Addressing Causes of Impairment

The 2001 NRC report identified key features that help ensure that TMDLs accurately identify and address the causes of water body impairment. These key features include (1) evidence that impairment is driven by the stressor or stressors for which a TMDL is being developed and (2) evidence that addressing the stressor or stressors in question will be sufficient for the water body to attain its designated use or uses, as follows:

- *Evidence that impairment is caused by the stressors a TMDL is developed to address.* The 2001 NRC report recommended that states conduct a thorough water body assessment before developing a TMDL to accurately and completely identify specific stressors or

[52]NRC and EPA identified key features in addition to the ones we discuss (see app. III).

causes of impairment. NRC reported that thousands of water bodies had been placed on states' impaired waters lists on the basis of limited data, rather than a thorough assessment. Evidence from a thorough water body assessment before TMDL development establishes whether and to what extent the stressor or stressors prompting a state to list a water body as impaired are indeed causing impairment.

- *Evidence that addressing these stressors will be sufficient for a water body to attain designated uses.* NRC recommended that TMDLs be developed to consider multiple stressors—be they pollutants entering a water body, such as sediment or nutrients, or other human-induced forms of pollution, such as stream straightening, altered flows, or removal of streamside vegetation—in large part because waters are often impaired by multiple stressors.[53]

Miami Gold

A total maximum daily load (TMDL) plan for the lower Little Miami River watershed, Ohio approved by EPA in 2010, includes several key features making it likely that implementing the TMDL will help lead to attainment of designated uses, according to the water resource experts we selected. By including evidence from a comprehensive chemical, physical, and biological assessment, this TMDL clearly shows that the river and its tributaries are impaired by the stressors for which the TMDL was developed. The stressors include bacteria, nutrients, oxygen demand, sediment, and habitat quality. A model based on mathematical equations and watershed characteristics links habitat quality, one of the stressors, to impairment with respect to the water body's designated use of supporting aquatic life. In addition, the TMDL identifies actors and actions needed to address both the point source and nonpoint source pollution impairing various sites in the watershed. For example, the TMDL identifies specific stream miles where buffers of native grasses and trees should be planted to help control nutrient and sediment runoff.

Source: Ohio Environmental Protection Agency.

Lower Little Miami River near a nature preserve.

[53]For example, a water body may no longer support native fish populations because of phosphorus runoff from nearby farms, the introduction of invasive species, and degraded streamside habitat. These stressors interact with one another, making it difficult to isolate and treat one stressor at a time. TMDLs that do not address the multiple stressors causing impairment of the water body in question—for example, a TMDL developed on the assumption that phosphorus alone is responsible for the absence of native fish—does not provide evidence that addressing the stressor or stressors in question will be sufficient for the water body to attain its designated use or uses.

Ensuring That Implementation Can Be Done

EPA studies and guidance documents have identified key features to help ensure that TMDLs can be implemented. These key features include (1) a plan for TMDL implementation that specifically identifies who must undertake what projects to control pollution (i.e., plan specifies actors) and on what land areas (i.e., plan specifies locations) and (2) a demonstration of reasonable assurances that projects to control nonpoint source pollution will actually be implemented, and to an extent that allows the water body to meet load allocations specified in the TMDL. These features may be described as follows:

- *Plan for TMDL implementation.* An EPA study recommended that states prepare and submit implementation plans for TMDLs to help ensure that TMDLs, once developed, actually help lead to attainment of water quality standards.[54] Other EPA studies have confirmed that effective TMDLs include or are accompanied by detailed plans for TMDL implementation that specify actors, as well as specific locations in need of remediation, to target efforts at those responsible for the problem, thus facilitating implementation.[55]
- *Reasonable assurances that implementation activities will occur.* EPA guidance states that when a TMDL is developed for waters impaired by both point and nonpoint sources, a TMDL should provide reasonable assurances that measures to control nonpoint source pollution will achieve the expected load reductions. According to an EPA study, such assurances may include identifying landowners who will actually implement necessary projects.[56] Without reasonable assurances, EPA cannot be certain that limits in a TMDL for both point and nonpoint source pollution have been established at levels sufficient to attain water quality standards, according to EPA guidance.

Revising TMDLs as Needed

Key features in the 2001 NRC report that help ensure that TMDLs are reviewed and revised if found to be ineffective in helping water bodies attain water quality standards include (1) a plan to monitor a TMDL's effect on water quality, including monitoring biological indicators, such as

[54]EPA, *Report of the Federal Advisory Committee*. (1998).

[55]Brian Benham et al., "TMDL Implementation: Lessons Learned," *Proceedings of the Water Environment Federation, TMDL 2007*, vol. 2007, pp. 428-442 (2007) and Center for TMDL and Watershed Studies, *TMDL Implementation: Characteristics of Successful Projects*, Final Report, VT-BSE doc. no. 2006-0003 (Blacksburg, Va: 2006).

[56]EPA, *Report of the Federal Advisory Committee* (1998).

the diversity and abundance of aquatic organisms, and (2) a description of an adaptive approach to implementing the TMDL, whereby monitoring data will be used to periodically assess progress toward attaining water quality standards and to adjust the TMDL if needed, as follows:

- *Plan to monitor a TMDL's effect on water quality.* The NRC report recommended that TMDLs include plans for post-implementation monitoring to ensure that actions taken as a result of a TMDL are effective at helping meet water quality standards. Further, according to the NRC report, such monitoring should include monitoring biological indicators, such as aquatic plants and animals, because such indicators provide a more accurate assessment of water body health with respect to designated uses, such as fishing or swimming, than chemical indicators alone. According to the report, aquatic plants and animals reflect the totality of their living conditions, including the chemical, physical, and biological stressors that impair specific water bodies.
- *Adaptive implementation approach.* The NRC report recommended that TMDLs follow an adaptive approach, in which monitoring data are used to revise and improve a TMDL over time. An adaptive approach allows states to implement pollution control actions, monitor the effects of those actions, and then revise the TMDL as needed. According to the NRC report, comparing results predicted during TMDL development against empirical data from the water body serves to verify that water quality is improving and that progress is in fact being made toward attaining designated uses.

Experts Reported That the 25 TMDLs They Reviewed Seldom Contained All Needed Key Features

Three water resource experts reviewed a sample of 25 long-established TMDLs and reported that many of them do not contain features identified as key if TMDLs are to help water bodies attain water quality standards.[57] The experts reported that many of the TMDLs they reviewed do not contain key features that accurately identify and address the causes of water body impairment, about half do not contain key features that help ensure that implementation can be done, and few contain key features that help ensure that TMDLs are revised if they are found to be ineffective in helping a water body attain water quality standards. As a result, they

[57]Each TMDL was independently reviewed by two experts to increase the reliability of our findings. The water resource experts reviewed a random subsample of 25 TMDLs that we drew from the nationwide sample of 191 of long-established TMDLs.

expressed little confidence that most of the TMDLs they reviewed would—if implemented—lead to attainment of water quality standards.

Many of the TMDLs Experts Reviewed Do Not Accurately Identify and Address Causes of Impairment

The three water resource experts reported that many of the 25 TMDLs they reviewed do not contain key features to help ensure that TMDLs accurately identify and address the causes of water body impairment. Experts also reported that the TMDLs that do not diagnose and aim to treat the true causes of water body impairment are unlikely to lead to attainment of designated uses.

- *Evidence that impairment is caused by the stressors a TMDL is developed to address.* Experts agreed that although 18 TMDLs they reviewed contain sufficient evidence that the water body in question was impaired by the stressor the TMDL was developed to address, 6 other TMDLs do not contain sufficient evidence linking stressor to impairment.[58] For example, the experts reported that a TMDL from an Alabama creek, approved by EPA in 2002, provides monitoring data showing that levels of the cause of impairment in question—dissolved oxygen—did not indicate impairment. The TMDL states that samples drawn from the creek did not identify any violation of the water quality standard for dissolved oxygen. Nonetheless, because the creek was placed on the state's impaired waters list as a result of low dissolved oxygen, the TMDL was developed to address dissolved oxygen levels. The TMDL also refers to physical stressors that could have contributed to impairment, such as low water flow, but does not thoroughly assess these stressors or seek to treat them, according to the experts. The experts said that by targeting an unsubstantiated stressor and potentially overlooking other causes of impairment, the TMDL is unlikely to help the water body attain its designated use of supporting fish and wildlife.
- *Evidence that addressing stated stressors will be sufficient for a water body to attain designated uses.* The experts agreed that 7 of the 25 TMDLs they reviewed demonstrate that addressing the identified stressor would be sufficient to attain the applicable designated use or

[58]Experts did not agree about whether the remaining TMDL contains sufficient evidence. In this section of our report, we generally present only the total number of TMDLs that experts agreed do and do not contain particular key features, with the remainder equaling the number of TMDLs for which experts (1) did not agree about whether a key feature is present or absent, (2) agreed that not enough information was contained in the TMDL to determine whether a key feature is present or absent, or (3) agreed that a key feature does not apply to the TMDL.

uses but that 17 other TMDLs do not demonstrate such a link.[59] The experts said that in the water bodies for which most of these 17 TMDLs were developed, stressors other than the stressor or stressors addressed by the TMDL were at play and that the TMDLs do not address these stressors. For example, the experts agreed that in 8 of the 17 TMDLs, biological stressors were probably contributing to water body impairment, but the TMDLs do not address these biological stressors; in 9 other TMDLs, the experts reported that physical stressors were probably contributing but that they are not addressed in the TMDLs.[60] For example, the experts reported that a TMDL approved by EPA in 2007 for a watershed in Maryland, which had active and abandoned mining operations, aims to treat low pH, indicating acidic water. According to the experts, however, mining is likely to result in stressors besides acidity, such as physical stressors including habitat degradation from stream channelization, and sedimentation caused by past and present land disturbances. The experts stated that the TMDL lays out a realistic approach for addressing the low pH caused by chemical pollutants and could thus likely help meet a numeric water quality target for pH. Nevertheless, they said, the TMDL would likely fall short of helping the water body attain its designated use—even if the numeric water quality target for pH were met—because the physical stressors they said are likely present, such as habitat degradation from stream channelization and other mining activities, would still be present. One expert said that the TMDL's narrow focus provides a false promise that addressing the chemical pollutants would solve the water quality problem.

About Half of TMDLs Reviewed by Experts Do Not Have Features Ensuring That Implementation Can Be Done

The water resource experts reported that about half of the TMDLs they reviewed do not contain key features helping to ensure that implementation can be done, which leads to TMDLs that may do little to actually improve water quality, as follows:

- *Plan for TMDL implementation.* The experts agreed that 13 of the 25 TMDLs they reviewed contain detailed information about

[59]Experts agreed that the remaining 1 of the 25 TMDLs does not contain enough information to determine whether this key feature is present or absent.

[60]Overall, 12 of the 17 TMDLs apply to water bodies that are subject to additional TMDLs the experts did not review, but most of these other TMDLs also address only chemical pollutants and therefore may not mitigate physical and biological stressors. The experts reported that the contribution of multiple, nonchemical stressors makes it highly unlikely that designated uses will be attained by addressing one or a few chemical pollutants.

Specify, Specify

One key feature that can help ensure the implementation of total maximum daily loads (TMDL) is the presence of a detailed implementation plan. Three water resource experts we selected reviewed six TMDLs that include formal TMDL implementation plans and found that the plans generally specify actors, actions, and locations to be involved in implementation. For example, a TMDL from California approved in 2006 contains an implementation plan identifying actors, such as wastewater treatment plants and agricultural landowners, responsible for various types of pollution; specific remedial actions that need to occur, such as development and implementation of a program to collect banned pesticides; locations, such as agricultural land and construction sites, where such actions should be implemented; and completion dates for particular actions. Experts said that such a detailed implementation plan will likely help the water body meet numeric water quality targets laid out in the TMDL.

Source: Bruce Perry, Department of Geological Sciences, California State University, Long Beach.

A California river runs through agricultural land before entering the Pacific Ocean.

implementation but that the other 12 TMDLs contain vague or no information about implementation.[61] Specifically, the experts agreed that 4 of these 12 TMDLs do not discuss how the TMDL is to be implemented: the TMDLs contain no references to implementation or a stand-alone implementation plan. The experts also agreed that the other 8 of the 12 TMDLs discuss implementation to some extent, but 6 of these 8 TMDLs do not identify specific actors who are to support implementation, and 7 of these 8 do not identify actions that need to occur to attain water quality standards.[62] For example, the experts reported that a South Dakota TMDL, approved by EPA in 2001, briefly discusses implementation but does not identify the actions or the actors needed to implement the TMDL. The experts told us that this brief discussion is unlikely to lead to attainment of water quality standards. A South Dakota water quality official who responded to our survey of states reported that as part of developing this TMDL, the state did not identify the landowners who needed to undertake projects to reduce nonpoint source pollution. The official added that nonpoint source load allocations have not been met and that nonpoint source loads are expected to stay the same over the next 5 years.

- *Reasonable assurances that implementation activities will occur.* The experts agreed that for a different group of 13 of the 25 TMDLs they reviewed, which involved both point and nonpoint source pollution—TMDLs that, according to the reasonable assurances element in EPA's guidance, are to provide reasonable assurances that projects to reduce nonpoint source pollution will achieve expected load reductions—5 TMDLs do not include a reasonable assurances element but were nevertheless approved. Of the 8 TMDLs that the experts agreed discuss reasonable assurances, the experts reported that 6 do not provide sufficient evidence that reductions in nonpoint source pollution will actually occur, such as identification of landowners willing to implement necessary projects to reduce

[61]Experts reviewed implementation information contained within the 25 TMDL documents as well as in accompanying implementation plans, where present, that were issued as separate documents.

[62]Of the 8 TMDLs that discuss implementation to some extent, the experts agreed that 2 of them identify actors who are to support implementation but are missing other key features related to implementation. They agreed that 1 of these 8 TMDLs identifies actions that need to occur to attain water quality standards but is missing another key feature related to implementation.

nonpoint source pollution.[63] For example, the experts reported that an Indiana TMDL, approved by EPA in 2006, does not identify specific projects to reduce nonpoint E. coli bacteria stemming from sources such as manure applications on farmland and leaking septic tanks. The TMDL instead includes a generic list of projects and activities related to implementation, such as educating homeowners who have septic systems. According to the experts, such a list does not provide reasonable assurances that the projects and activities will be put in place or that load reductions laid out in the TMDL will be achieved. An Indiana water quality official responding to our survey of states reported that although nonpoint pollutant loads in this water body have decreased to some degree, load allocations have not been met and are not expected to be met within the next 5 years.

Few TMDLs Have Features That Ensure They Will Be Revised as Needed

The three experts agreed that almost all of the 25 TMDLs they reviewed are missing one or more of the key features that help ensure that TMDLs are revised if they are found to be ineffective in helping a water body attain water quality standards. Experts said that without adequate monitoring plans and an adaptive implementation approach to verify the accuracy of the TMDL and the effectiveness of remediation efforts, resources may be wasted developing and implementing TMDLs that do little to improve the condition of water bodies.

- *Plan to monitor a TMDL's effect on water quality.* The experts agreed that 7 of the 25 TMDLs do not include a monitoring plan to track the TMDLs' effectiveness. Of the 18 TMDLs that include such a plan, the experts reported that 14 do not include indicators of biological outcomes, and 3 do.[64] For example, the experts said that an Oregon TMDL for water temperature, approved by EPA in 2007, does not include plans to monitor biological indicators, such as the number and condition of fish and other aquatic organisms. The experts gave the TMDL credit for its plans to monitor temperature changes that might result from implementing the TMDL but said that without tracking biological conditions affected by temperature, it would be impossible to assess whether progress were being made toward the water body's

[63]Experts did not agree on whether the remaining 2 of the 8 TMDLs that discuss reasonable assurances provide sufficient evidence that reductions from nonpoint sources will occur.

[64]The experts disagreed about whether the remaining 1 of the 18 TMDLs includes indicators of biological outcomes.

designated use of supporting salmon, trout, and other cold-water fish species.

- *Adaptive implementation approach.* The experts reported that of the 18 TMDLs that include a monitoring plan, 8 do not describe an adaptive approach to TMDL implementation—that is, an approach that uses monitoring and data analysis to periodically assess progress toward attaining water quality standards and adjust the TMDL as needed. The experts agreed that 9 TMDLs describe such an approach.[65] For example, experts reported that a Connecticut TMDL for phosphorus, approved by EPA in 2005, does not describe how monitoring data are to be used to assess progress toward water quality standards or to adjust the TMDL if implementation actions are found to be ineffective. Because the TMDL focuses only on phosphorus, a plant nutrient and chemical pollutant, one of the experts said that using monitoring data to assess progress toward the water body's designated uses is particularly important because such data could show that even while concentrations of phosphorus are declining, additional actions may be needed to attain the water body's designated uses of providing fish habitat and recreation. A Connecticut water quality official reported that for this TMDL, the official does not know whether point and nonpoint pollutant loads in the water body have changed or whether wasteload and load allocations have been met.

Sugar and Spice

According to the experts we selected, a total maximum daily load (TMDL) plan for 21 streams in the Sugar-Pecatonica River Basin, Wisconsin, contains several key features. It describes the 21 streams in detail, including evidence from physical and biological assessments that designated uses of supporting fish and other aquatic life are not being met. It explicitly links the effects of sediment, the targeted stressor, to the streams' ability to support aquatic life. By showing that certain agricultural practices have successfully reduced sediment in streams with similar natural characteristics in the same watershed and enabled these streams to meet their designated uses, the TMDL demonstrates that addressing sediment in the impaired streams will likely achieve a comparable effect. The TMDL includes assessment of biological indicators, such as counts of the number and type of fish and insect populations, which, according to the National Research Council and the experts, inherently reflect the cumulative effects of many impairments. In addition, the TMDL identifies actions needed to reduce sediment in the streams and the particular locations where such actions should be taken. For example, it identifies a specific best management practice that should be adopted where livestock graze to minimize sediment runoff.

Source: Wisconsin Department of Natural Resources.

A cattle crossing to reduce bank erosion; cattle were later fenced out of the stream corridor.

[65]Of the 18 TMDLs with a monitoring plan, experts disagreed about whether 1 of them describes an adaptive approach.

EPA's TMDL Guidance for Implementing Regulations Does Not Contain Some Key Features

In reviewing EPA's guidance on approvable TMDLs and how regional offices are to apply the 11 TMDL elements, we found that the guidance did not contain some key features and that some of these 11 elements are vague or optional, which has led EPA's regional offices to apply the elements in different ways and to approve TMDLs of variable quality. The 11 elements for approvable TMDLs described in EPA's guidance generally reflect the agency's interpretation of TMDL development requirements under existing regulations, according to EPA's guidance. In our review, we found that EPA's guidance does not include two key features—specifically, those that help ensure that TMDLs accurately identify and address causes of impairment with respect to a designated use or uses. First, the guidance does not specify that a TMDL should provide evidence that impairment is caused by a stressor or stressors for which the TMDL is being developed. Rather, according to the guidance, a TMDL need only identify a given pollutant. Second, although guidance states that a TMDL must provide evidence that pollutant reductions will meet numeric targets, it does not specify that a TMDL is to provide evidence that addressing the given stressor or stressors will be sufficient for a water body to attain its designated uses. Because these key features are not explicitly called for in EPA's guidance, chemical, physical, and biological stressors other than the pollutant identified in the TMDL may go unaddressed—unless additional TMDLs are developed for the water body—even if a numeric water quality target for the identified pollutant is met.[66]

EPA officials told us that the agency cannot include additional features in their guidance without issuing new regulations. Through its 2000 rule, EPA had planned to include additional features by conditioning TMDL approvals on more-rigorous requirements but withdrew the rule before its effective date. Instead, the agency developed guidance in 2002 for states

[66]EPA has a process to accommodate a nonchemical approach to water body assessment and listing, but it appears to be underused by states, according to our analysis. States may list water bodies impaired by nonchemical stressors as category 4c (water quality is impaired by something other than a pollutant, such as a dam), as opposed to category 5 (water quality is impaired, and the water body is waiting for a TMDL to be developed). Of water bodies nationwide, about 1,000 were listed as category 4c in recent integrated reports out of about 128,000 total assessed water bodies.

and EPA regions to apply in implementing its existing regulations.[67] According to EPA officials, the guidance contains weaker versions of many of the same elements included in the 2000 rule, and they have not reinitiated rulemaking, both because the agency wanted more time to assess the effectiveness of existing regulations and because rulemaking is costly and time-consuming. But because the guidance does not contain certain features, states may not always have clear direction to develop TMDLs containing key features that can help water bodies attain water quality standards. Moreover, guidance does not have the force of regulation, and states can choose which and how much information to include under the 11 elements as currently stated. All three of the experts commented that TMDL development is a complex and costly endeavor and that developing TMDLs that do not contain key features—such as accurately identifying the causes of water body impairment—can waste effort and the limited funds available for the task. Absent the force of regulations to direct states to develop TMDLs containing key features, TMDLs are likely to continue to do little to attain water quality standards. Yet neither EPA's existing guidance nor the agency's 2013 long-term vision for the TMDL program has the detail on key features that can provide such direction.

In addition, 3 of EPA's 11 elements in its TMDL guidance—those for (1) implementation, (2) reasonable assurances, and (3) a monitoring plan to track TMDL effectiveness—are either vague or stated as options (e.g., EPA encourages an implementation plan, EPA recommends inclusion of a monitoring plan) and are therefore subject to varying interpretation on the part of states developing a given TMDL and the regional offices applying the elements in approving TMDLs. Our analysis shows that EPA's regional offices do not apply the elements of the agency's existing guidance consistently. Specifically, several EPA regions have interpreted the guidance as calling for key features in state-developed TMDLs, while the remaining regions have not. The vagueness of certain elements in EPA's TMDL guidance—coupled with the absence of key features—

[67]After EPA withdrew the rule in 2002, it conducted dozens of studies evaluating and describing characteristics of TMDLs that enable water bodies to attain water quality standards. According to EPA officials, these studies were meant to provide information and guidance to states, and certain EPA regions applied study findings in their decisions to approve or disapprove TMDLs. EPA has also developed draft guidance, which was not final at the time of our review, outlining situations that may warrant TMDL revision, such as monitoring results showing that TMDL implementation is not achieving anticipated pollution reductions.

results in regional offices' inconsistently interpreting what a TMDL is to contain and approving TMDLs of variable quality. EPA headquarters, however, has not worked with the regions to apply existing guidance consistently or to develop specific criteria on which to base TMDL approvals, as some regions do. EPA headquarters officials told us they have not done so because of differences among states' programs, including that some states have been under pressure from consent decree schedules to develop a certain number of TMDLs by specific dates. Nevertheless, without specific criteria on which to base TMDL approvals, some EPA regions are likely to continue to approve TMDLs in which the quality or quantity of information is insufficient to help water bodies attain water quality standards.

Implementation

EPA's element for implementation encourages states to develop TMDL implementation plans but existing regulations do not require such plans or detail the information they should contain.[68] For example, the guidance describing the element does not specify that implementation plans should include information such as who must undertake what projects to reduce pollution and at what locations these projects are to be put in place. Our analysis showed that EPA's regional offices vary in how they interpret this implementation element. Officials at most regional offices (6 of 10) told us they give little scrutiny to whether states include formal implementation plans in TMDLs. For example, Region 3 officials told us they do not review or approve implementation plans since EPA regulations do not require them. They said that most states do not submit such plans. On the other hand, officials from 4 of the 10 regional offices told us they encourage states to produce implementation plans or ask that states do so, particularly for TMDLs involving nonpoint source pollution. Region 2 officials, for example, told us they have asked states to complete implementation plans and that the office reviews and comments on these plans. The officials said that information in implementation plans helps them determine whether projects to control nonpoint source pollution will be implemented.

Reasonable Assurances

When a TMDL is developed for waters impaired by both point and nonpoint sources, EPA guidance states that a TMDL should provide

[68]See 40 C.F.R. §§ 130.7(c), 130.2(i) (2013) (EPA's TMDL regulations). A court has held that neither the Clean Water Act nor EPA regulations define TMDLs as including an implementation plan. *Sierra Club v. Meiburg*, 296 F.3d 1021, 1030-31 (11th Cir. 2002). See also *Amigos Bravos v. Green*, 306 F. Supp. 2d 48, 57 (D.D.C. 2004).

reasonable assurances that actions to control nonpoint source pollution will achieve expected load reductions. This information is necessary for EPA to determine that TMDLs have been set at levels sufficient to attain water quality standards. Nevertheless, EPA's element for reasonable assurances does not describe the type of information needed to demonstrate that projects to reduce nonpoint source pollution will achieve expected load reductions. For example, the guidance describing the element does not state that a TMDL is to detail any available regulatory authority over nonpoint source pollution or identify landowners who are willing to implement needed projects. Without such specificity, EPA has little assurance that projects to reduce nonpoint source pollution will in fact be implemented.

We found that the regional offices vary in their review of the reasonable assurances element, with most regions (7 of 10) asking for little to no information on demonstrating that load reductions for nonpoint source pollution will occur. Officials from several regional offices told us they play a limited role in encouraging states to demonstrate reasonable assurances, although, according to EPA headquarters officials, EPA is beginning to put greater emphasis on demonstrating reasonable assurances in TMDLs. Officials from one regional office explained that many states lack data from which to develop reasonable assurances and that states without authority over nonpoint source pollution find it difficult to prove that sources of such pollution will take action to implement a TMDL. In the absence of specific guidance from EPA headquarters, officials from one regional office said that they encourage states to do the best they can to demonstrate reasonable assurances and that they do not reject TMDLs if reasonable assurances have not been demonstrated, in part because they do not have the resources to develop TMDL themselves.

Conversely, officials from Regions 1, 5, and 9 told us they ask for substantial information demonstrating that load reductions for nonpoint sources will actually occur. For example, in describing a decision to withdraw approval of a TMDL for Lake Champlain in Vermont, Region 1 officials explained that they expect reasonable assurances to show quantitative reductions anticipated from specific projects to reduce nonpoint source pollution and that they expect regulatory or other mechanisms to be in place to ensure compliance with the actions and reductions called for in the TMDL. In addition, Region 5 officials told us that, as part of providing reasonable assurances that nonpoint source pollution will be reduced, they ask states to document specific state and local regulatory authority over such pollution. By calling for this type of

information during TMDL development, the officials said that the region gains leverage it can call upon later in encouraging states to apply those authorities when a TMDL is implemented. EPA has acknowledged that the regional offices vary in how exacting they are when reviewing reasonable assurances.

Monitoring Plan

EPA's monitoring plan element recommends that TMDLs include plans for monitoring but does not specify that such plans should include indicators reflecting biological conditions or adaptive approaches for TMDL revision in light of monitoring results. We found that EPA's regional offices again vary in how they interpret and apply the monitoring plan element. Officials at most regional offices (7 of 10) told us they do not ask for TMDLs to include much, if any, information about monitoring. For example, Region 6 officials told us monitoring information is not a focus in their review of TMDLs and that only about 1 percent of TMDLs they review contain monitoring plans. On the other hand, officials in the other three regions ask for monitoring plans to provide assurance that TMDLs will lead to improved water quality as intended. For example, Region 8 officials told us that they ask for monitoring plans for a handful of TMDLs, particularly for those in which a high degree of uncertainty exists about proposed pollution limits or other elements. They said that asking for a monitoring plan gives some assurance that a state will examine whether projects to control pollution are working as predicted and will adjust a TMDL if needed.

Factors Reported as Facilitating the Implementation of Long-Established TMDLs, Particularly Those for Nonpoint Source Pollution, Are Often Not in Place

State TMDL coordinators reported that many factors EPA identified as helpful for effective TMDL implementation were often not in place in the long-established TMDLs they reviewed. EPA has identified a number of factors associated with effective TMDL implementation—that is, factors that help state TMDL coordinators and other stakeholders take actions, prescribed in TMDLs, that ultimately result in attainment of water quality standards. State TMDL coordinators reported that many factors, including those viewed as most helpful, were often not in place. Some factors are absent because EPA has not always asked states to make such factors a priority when funding TMDL implementation, and others—including those viewed as most helpful for implementation—are beyond EPA's and states' existing authorities to put in place, according to state TMDL coordinators.

A Number of Factors Facilitate Effective TMDL Implementation

Through its studies and state conferences on TMDLs, EPA and the states have identified numerous factors associated with effective TMDL implementation, particularly TMDLs for nonpoint source pollution (since point sources are subject to regulation through permits and discharge limits). These facilitating factors can be organized into the following three categories: (1) those securing landowners' and others' participation in implementing TMDLs, (2) those providing external assistance to implement TMDLs, and (3) those improving states' TMDL program functions. According to EPA documents, the agency expects some implementation actions to take place within 5 years of TMDL approval and all implementation actions to have taken place within 10 years of approval, and facilitating factors generally help states meet these goals. These facilitating factors—15 in all—can be organized as follows:

- Securing participation includes
  - landowners willing to implement projects[69]
  - landowners willing to implement projects in most-effective places
  - landowners willing to implement most-effective projects
  - citizen participation
  - supportive local government leaders
- Providing external assistance includes
  - funding enough or more than enough
  - assistance from state nonpoint source program
  - assistance from USDA
  - assistance from state agricultural program
  - assistance from EPA
  - assistance from state or local planning agency
  - assistance from state stormwater program
- Improving states' TMDL program functions includes
  - presence of TMDL implementation plan[70]
  - higher funding priority for water bodies with TMDLs
  - consolidation of TMDL responsibilities

[69]Projects prescribed in TMDLs may include landowners' implementation of best management practices on agricultural land to reduce nutrient-laden runoff.

[70]According to EPA studies, detailed implementation plans are associated with TMDLs that have been implemented effectively. Thus, detailed implementation plans are both a key feature in TMDL development *and* a factor facilitating effective TMDL implementation.

Securing Landowners' and Others' Participation in Implementing TMDLs

The first category of factors aims to secure participation by landowners and other stakeholders in implementing TMDLs. Without a federal regulatory framework similar to the one governing point source pollution, which requires that dischargers meet pollution limits or face penalties, most states generally must persuade landowners to implement best management practices to reduce nonpoint source pollution. For TMDL implementation to address nonpoint source pollution, an EPA study found, engaging owners of private land is crucial.[71] According to the study, without landowners' cooperation—including willingness to implement projects that are the most effective at reducing pollution in the places where they are most needed—projects to reduce such pollution may not be implemented.

In a 2007 study, EPA found that citizen-based groups, such as local watershed associations and supportive local governmental leaders, can have a positive effect on TMDL implementation.[72] Citizen-based groups often have strong local support, are well informed on watershed issues, and have knowledge and experience that enables them to aid implementation, according to the study. When present, these citizen-based groups may lead in implementing a TMDL, such as by pursuing funding for projects and monitoring changes in water quality. Without a citizen-based group involved in TMDL implementation efforts, no entity may be in charge of implementing a TMDL.

Providing External Assistance to Implement TMDLs

The second category of factors aims to provide states with external assistance to implement TMDLs. EPA found in the 2007 study that implementing TMDLs requires adequate funding to undertake projects that reduce pollution. For example, states may target funds received as grants under EPA's nonpoint source management program to implement best management practices on agricultural lands near water bodies subject to TMDLs, or states themselves may provide additional funding through other state water resource programs. According to a 2007 study, assistance from external agencies and programs (e.g., technical

[71]Center for TMDL and Watershed Studies, *TMDL Implementation: Characteristics of Successful Projects*, Final Report, VT-BSE doc. no. 2006-0003 (Blacksburg, Va: 2006).

[72]Center for TMDL and Watershed Studies and Biological Systems Engineering, *TMDL Implementation: Lessons Learned* (Blacksburg, Va: 2007).

assistance) can also be a critical factor in TMDL implementation.[73] Particularly important is the involvement of agencies and programs—such as state nonpoint source programs, USDA programs, state agricultural agencies, EPA, state and local planning agencies, and state stormwater programs—whose participation may be necessary to improve water quality.

Improving States' TMDL Program Functions

The third category of factors aims to improve states' TMDL program functions. In several recent conferences sponsored by EPA, state TMDL program managers identified ways to foster better TMDL implementation, including requiring or providing guidance for development of detailed implementation plans, administering funding to target water body restoration projects in areas where TMDLs have been developed, and consolidating TMDL development and implementation activities within the same state agency or program.

Five states have laws or regulations requiring development of TMDL implementation plans, and five others provide guidance for such plans, according to a 2008 study. In a 2009 conference sponsored by EPA, state water quality program officials said that formal implementation plans enhance TMDL implementation for nonpoint source pollution by providing explicit direction for implementation, such as specific information on existing water quality conditions, necessary load reductions for pollutants, land areas likely to be contributing to pollution, programs that may help provide technical or financial assistance, best management practices and where they are to be implemented, and an accurate timeline over which implementation will be accomplished and water quality would improve.

In a 2009 conference, state TMDL program managers supported putting a high priority on using federal and state funding for reducing nonpoint source pollution to support TMDL implementation. Some states have

[73]The 2007 EPA study found that external agency officials responsible for projects or activities related to TMDL implementation were generally unaware of the projects or activities identified in TMDLs that are needed to achieve water quality standards. The study noted that TMDLs are implemented by many stakeholders, but less than 50 percent of external agency stakeholders always or often had knowledge of TMDLs and the projects or activities needed to restore water bodies. These data underscore the importance of involving representatives from external agencies in the TMDL implementation process, to obtain their buy-in and encourage participants in their programs to implement best management practices or projects that can help improve water quality. EPA, *Developing Effective TMDLs* (2007).

revised funding criteria under their nonpoint source management programs to give higher priority to projects designed to implement best management practices where a water body was already identified by the state as impaired and had an associated TMDL.

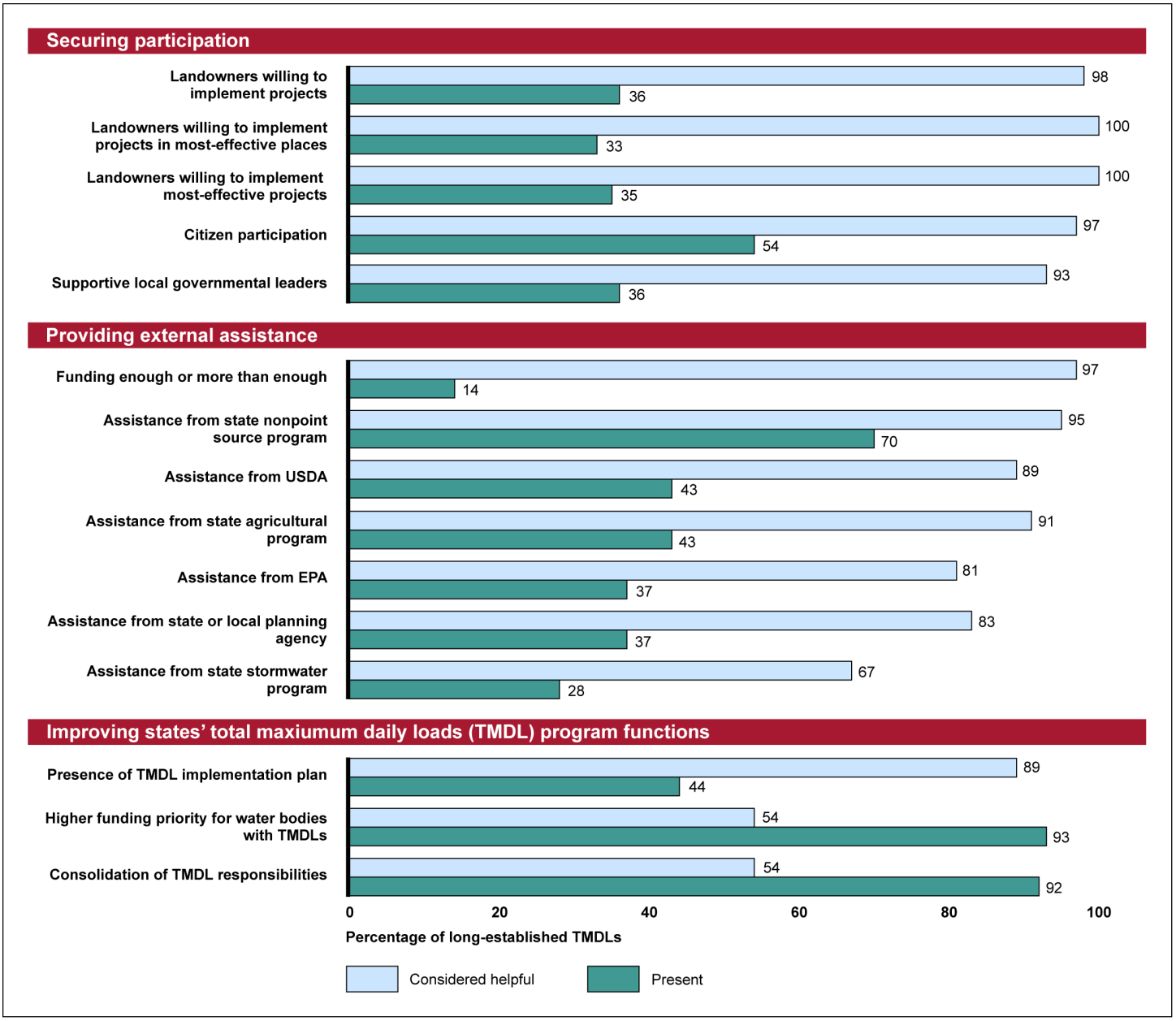
States have also identified the consolidation of their responsibilities for TMDL implementation and development activities as a factor that facilitates TMDL implementation. Some states have recently integrated their TMDL development and implementation responsibilities with their nonpoint source management programs, which fosters collaboration among staff working toward the same goal who have complementary knowledge and skills. Washington State, for example, merged its TMDL development and implementation programs into its Department of Ecology, and departmental staff reported that both programs are more effective. In Virginia, the state's general assembly recently passed legislation that consolidated the agencies responsible for developing and implementing TMDLs.

State TMDL Coordinators Reported That Many Factors, Including Those Viewed as Most Helpful, Were Often Not in Place for Long-Established TMDLs

In responding to our survey, state TMDL coordinators reported that the factors aiming to secure participation by landowners and other stakeholders are among the most helpful in implementing long-established TMDLs. They also reported that external assistance, such as financial or technical assistance from a state nonpoint source program, is also very helpful, whereas factors improving state TMDL program functions were sometimes helpful. The results of our survey, however, showed that many factors, including those viewed as most helpful, were often not in place for long-established TMDLs (see fig. 6).[74]

[74]Appendix IV presents the full results of our survey, including the helpfulness of two implementation factors—land development and land retirement—that state TMDL coordinators told us were less helpful than the implementation factors we discuss in the body of this report.

Figure 6: Factors Facilitating TMDL Implementation and Extent to Which They Were Present in and Considered Helpful for Long-Established TMDLs



Source: GAO survey of state TMDL coordinators responsible for implementing a nationally representative sample of long-established TMDLs.

Note: "Present" (light blue bars) denotes the percentage of long-established TMDLs in which the given factor on the y-axis was present during implementation of the TMDL in question. "Considered helpful" (teal bars) denotes the percentage of these long-established TMDLs in which the state TMDL

coordinators responding to our survey indicated that the factor either was helpful (if present) or (if factor was not present or TMDL was not yet implemented) would have been or would be helpful in implementing the TMDL in question. In general, estimates have a margin of error of no more than 12 percent. For reporting purposes, we describe a factor as helpful (or less helpful) on the basis of the percentages of long-established TMDLs for which state coordinators responding to our survey identified that factor as helpful or less helpful in TMDL implementation.

Factors Securing Landowners' and Others' Participation Are Always Helpful but Are Often Not in Place

Virtually all state TMDL coordinators reported that factors aiming to secure landowners' and others' participation in implementing long-established TMDLs are among the most helpful but, they reported, these factors were generally absent from about two-thirds of long-established TMDLs, and where they were present, they were not always present to an extent needed for effective TMDL implementation.[75] For example, state coordinators reported that landowner willingness to implement projects was considered helpful in TMDL implementation for 98 percent of long-established TMDLs. Similarly, according to state TMDL coordinators, assistance from other stakeholders was considered helpful: the coordinators reported that the assistance of citizen-based groups was considered helpful for 97 percent of long-established TMDLs and that the assistance of local government leaders was considered helpful for 93 percent of long-established TMDLs. Yet factors such as these were often not present.

Specifically, state TMDL coordinators told us that landowners were willing to implement projects, including practices most effective at reducing pollution and in the locations where they were most needed, for about one-third of long-established TMDLs.[76] For example, officials with Idaho's Department of Environmental Quality allocated nonpoint source funds to a restoration project to reduce stream bank erosion and sediment in a particular creek because the landowner was willing to install a gate to redirect water flow and alter the streambed to help reestablish the banks.

[75]Our survey asked if state TMDL coordinators found specific factors very helpful, somewhat helpful, not helpful, or not applicable for each of 191 TMDLs. For a given TMDL factor, "considered helpful" denotes the percentage of these long-established TMDLs in which a survey respondent indicated that the factor either was helpful (if present) or (if factor was not present or TMDL was not yet implemented) would have been or would be helpful in implementing the TMDL in question (see app. IV).

[76]State TMDL coordinators responding to our survey reported that landowners were willing to (1) implement best management practices for 36 percent of long-established TMDLs (the 95 percent confidence interval for this estimate is [24, 49]), (2) implement the most effective best management practices for 35 percent of long-established TMDLs, and (3) implement best management practices in the most-effective places for 33 percent of long-established TMDLs.

The creek where these actions were taken, however, contributed relatively little pollution to the larger impaired watershed. According to a local conservation district official, other projects the district wanted to pursue, which would have had a much greater benefit in the watershed, stalled because landowners at those locations that contributed pollution had not agreed to implement the proposed projects because they lacked agricultural value. Moreover, state TMDL coordinators reported that relatively small proportions of long-established TMDLs had enough landowners who were willing to implement projects to achieve load allocations called for in these TMDLs. For example, landowners had implemented all needed best management practices for 1 percent of long-established TMDLs, and landowners had implemented more than half of needed best management practices for 19 percent of long-established TMDLs. For 79 percent of long-established TMDLs, landowners had implemented half or less than half of needed best management practices.[77]

In addition, state TMDL coordinators reported that citizen-based groups assisted in implementing 54 percent of long-established TMDLs and that local government officials were supportive in implementing 36 percent of long-established TMDLs. For example, citizen-based groups are key to implementing many TMDLs in Pennsylvania, according to officials from the state's Department of Environmental Protection. Volunteers we met with from one stream restoration association—consisting of residents in a community directly affected by drainage from an abandoned mine—have helped establish and maintain treatment systems that remove metals and neutralize acidic water draining from the mine.[78] State officials told us, however, that if this organization had not been involved, they would not have put a high priority on funding implementation of this TMDL because they would have had little confidence that needed treatment systems would have been built or maintained.

[77]One state TMDL coordinator did not indicate in our survey the extent to which best management practices were installed. Other factors, such as limited funding, could also help explain the limited extent to which landowners had implemented all necessary best management practices.

[78]Treatment systems for drainage from abandoned mines, which usually consists of acidic water, channel the drainage into ponds, where the acidic water is neutralized through contact with limestone, and metal pollutants are removed.

Factors Providing External Assistance Are Almost Always Helpful but Are Often Not in Place

State TMDL coordinators responding to our survey reported that factors providing external assistance to implement projects to reduce nonpoint source pollution for long-established TMDLs are also helpful. Specifically, state TMDL coordinators reported that the provision of funding was considered helpful in implementing 97 percent of long-established TMDLs. Involvement of agencies other than the one responsible for implementing a particular TMDL was also considered helpful. For example, technical or financial assistance from state nonpoint source pollution programs was considered helpful in 95 percent of long-established TMDLs, according to our survey respondents, and the assistance of other external agencies ranged from 67 percent (for state stormwater programs)[79] to 91 percent (for state agriculture programs). With the exception of assistance from state nonpoint source pollution programs, however, such factors were present for less than half of long-established TMDLs.

Specifically, state TMDL coordinators told us that enough funding was available to implement best management practices for 14 percent of long-established TMDLs. The need for enough funding is shown by one project in Pennsylvania, where funding was available from two sources—grants under EPA's nonpoint source management program and the state's cleanup program for nonpoint source pollution—for projects aimed at reducing the amount of phosphorus entering a lake used primarily for recreation. During the first year after funding was received, best management practices that were implemented brought the lake within 25 percent of the load allocation for phosphorus established in the TMDL. With another year's funding received, Pennsylvania water quality officials expect other projects to be implemented that will enable the lake to meet its load allocation for phosphorus.

State TMDL coordinators also reported that involvement from external agencies or programs varied by agency or program. For example, according to these coordinators, state nonpoint source management programs helped with implementation for 70 percent of long-established TMDLs. State TMDL coordinators reported that other agencies or programs (e.g., EPA, USDA, state agricultural programs, state and local planning agencies, and state stormwater management programs) helped with the implementation of less than half of long-established TMDLs.

[79]The 95 percent confidence interval for this estimate is (52, 82).

Factors Improving State Program Functions Were Sometimes Helpful and More Often in Place than Other Factors

State TMDL coordinators reported that one factor aiming to improve program function was considered helpful in implementing projects to reduce pollution for nonpoint sources for most long-established TMDLs, and two others were considered helpful for about half of them. Specifically, according to state TMDL coordinators, a formal TMDL implementation plan was considered helpful for 89 percent of long-established TMDLs. Coordinators reported, however, that less than half (44 percent) of long-established TMDLs have implementation plans to identify who must undertake what actions to reduce pollution and on what land areas such actions are to be taken to restore impaired water bodies. For example, a TMDL for a largely rural watershed in Pennsylvania that we visited has an implementation plan that has, since 2007, resulted in implementation of best management practices at 130 different locations within the watershed, including one 300-acre farm that has terraced its land and implemented other best management practices to minimize soil loss into neighboring streams.

On the other hand, two factors—funding priority and consolidation of TMDL responsibilities in a single agency—were generally present, but state TMDL coordinators considered them helpful for about half of the long-established TMDLs. For example, in determining how to allocate grant funding from EPA's nonpoint source management programs to reduce nonpoint source pollution, state TMDL coordinators reported that, for 93 percent of long-established TMDLs, they assigned water bodies associated with a TMDL a higher priority for funding than water bodies without a TMDL. State TMDL coordinators reported that allocating grant funding in this way was helpful for about half (54 percent) of long-established TMDLs.[80] Similarly, state TMDL coordinators reported that for 92 percent of long-established TMDLs, TMDL development and implementation responsibilities were consolidated within a single state agency. State TMDL coordinators reported that the consolidation of TMDL programs within the same agency was considered helpful for about half (54 percent) of long-established TMDLs in improving water quality in the water body to which the TMDL applied.[81]

[80]The 95 percent confidence interval for this estimate is (41, 66).

[81]The 95 percent confidence interval for this estimate is (41, 67).

Some Factors Associated with Effective TMDL Implementation Are Often Not In Place

Some of the factors facilitating TMDL implementation are not often in place, either because (1) EPA has not always asked states to make such factors a priority when funding TMDL implementation projects or, according to state TMDL coordinators, (2) implementing certain TMDLs is a low priority. Two other factors, which are those viewed as most helpful, are generally beyond EPA's and states' existing authorities to put in place. Specifically, states (1) may find it difficult to convince landowners that actions need to be taken on their properties to reduce nonpoint source pollution and (2) may have limited ability to provide funding to implement more than a small fraction of TMDLs.

When making grants to states through its nonpoint source management or water pollution control programs, EPA has not always asked states to make various factors facilitating implementation a priority in selecting TMDL implementation projects for funding, particularly for the relatively older TMDLs in the scope of our review. Specifically, EPA headquarters officials said that in the past the agency rarely asked states to focus on more specific conditions, such as demonstrating local stakeholder involvement, gaining external assistance, or developing formal TMDL implementation plans. Recently, however, EPA has taken steps to target nonpoint source management grants toward projects demonstrating some of these factors—for example, encouraging states to fund projects that target nonpoint source management grant funds to water bodies with TMDLs. In 2013, EPA issued new guidance on the use of these grants, encouraging states to fund projects with local stakeholder involvement, external agency assistance, and formal TMDL implementation plans containing specific information on locations likely to be contributing to pollution and the projects needed to reduce such pollution.[82] For nonpoint source management grants, states must use 50 percent of their annual grant funding for implementing plans in watersheds with impaired waters; these plans may identify the presence of some of these factors. Although the guidance targets funding to where some of these factors may be present, the guidance does not require states to follow recommendations for selecting *projects* to fund or include these factors among programmatic conditions on annual nonpoint source grants. Without incorporating these factors as conditions into annual grants, regarding funding specific projects, rather than only plans, EPA may not be

[82]EPA, *Nonpoint Source Program and Grants Guidelines for States and Territories* (Washington, D.C.: April 2013).

targeting its limited funds toward TMDL implementation projects that exhibit factors facilitating effective TMDL implementation or ensuring that the funds are spent on a mix of projects likely to help attain water quality standards. Without such targeting, it is likely that the limited improvement in attaining water quality standards reported by state coordinators, especially for water bodies with associated TMDLs for nonpoint source pollution, will continue.

In addition, certain long-established TMDLs may not be a high priority for implementation, and circumstances may have discouraged EPA and states from focusing on factors facilitating successful TMDL implementation. EPA and state officials said that because many TMDLs were developed in response to schedules laid out in court-ordered consent decrees—not necessarily because they applied to water bodies at high priority for restoration—implementing many of these TMDLs is not a high priority and that states may therefore be reluctant to invest limited resources in drawing up implementation plans for TMDLs they do not plan to implement. For example, officials from Virginia's Department of Environmental Quality told us that about one-third of TMDLs developed in response to consent decrees have implementation plans, whereas a greater share of TMDLs developed without the pressure of a consent decree have implementation plans. On the other hand, where consent decrees did not drive TMDL development, TMDLs have sometimes reflected certain factors that facilitate implementation. For example, according to regional officials, states in EPA's Region 5 developed their TMDL programs without constraint from court-ordered schedules, and the region has placed strong emphasis on TMDLs that can be implemented. As a result, the region's TMDLs typically contain details that facilitate implementation, including identification of individual sources of nonpoint pollution and the specific actions that each needs to undertake to achieve required load allocations. According to agency officials, EPA's long-term vision, which the agency plans to implement in fiscal year 2014, seeks to allow states to rank TMDLs for development and implementation now that states are emerging from several decades of consent-decree-driven time frames and have more flexibility in allocating their limited resources.

Certain other factors, however, including those state TMDL coordinators considered most helpful, are beyond EPA's and states' existing authorities to put in place, particularly for nonpoint source pollution. Specifically, the Clean Water Act addresses nonpoint pollution through largely voluntary means and EPA does not have direct authority to require landowners to implement activities to reduce nonpoint source pollution. As such authority is absent and where additional effective state authority

is also limited, the inability to find enough landowners willing to implement projects to reduce nonpoint source pollution has resulted in limited improvements in water quality for waters impaired by such pollution, according to our survey results. The act does not provide states with the authority to require landowner implementation of projects to control nonpoint source pollution, and state TMDL coordinators cited a lack of authority as the main reason why nonpoint source TMDLs had not been implemented. For example, of the 67 state TMDL coordinators who submitted narrative responses to our survey, 46 (69 percent) said that long-established TMDLs faced implementation challenges because of the inability to secure landowners' and others' participation, such as by not having authority over nonpoint sources. One survey respondent stated that the state had no effective way to compel landowners to implement the best management practices called for in a TMDL, and as a result, no practices prescribed by that TMDL had been implemented in the 10 years since EPA approved it. EPA officials concurred with the state coordinator results, saying that the agency works within the authority it has to encourage landowners to carry out projects. The officials said that the Clean Water Act does not give the agency or states the authority to regulate nonpoint source pollution. As noted by some congressional members in 1987, when the act was amended to create the section 319 program, the program would be revisited if the voluntary approaches did not significantly address nonpoint source pollution.

For those states with some specific authority over nonpoint source pollution, according to state coordinators, the authority may be limited in scope or not routinely used. For example, nearly 1,000 Pennsylvania TMDLs identify sediment as impairing water quality, and runoff from farms is the source of sediment pollution for many of these TMDLs. Pennsylvania law requires that all farms have a plan to control or reduce sediment entering waterways from fields and animal use areas over a certain threshold. Nevertheless, officials said, the state's Department of Environmental Protection has never enforced this law and required farms to have, and implement, these plans, even though the law has been in effect for more than 40 years. The department's manager of conservation programs told us that the department has not been strict with the agricultural community over the years. Of the nearly 1,000 portions of water bodies identified as impaired by sediment, 2 have been restored, according to data from EPA's Assessment, TMDL Tracking and Implementation System.

EPA and states also are limited by their respective budgets, and, as a result, they cannot provide funding to ensure implementation of a

sufficient number of best management practices, according to state TMDL coordinators. Since section 319 was added to the Clean Water Act in 1987, EPA has awarded about $150 million per year, on average, in grants to the 50 states and others (the District of Columbia, U.S. territories, and Native American tribes) to address the primary cause of pollution in more than 33,000 water bodies. Most (86 percent) of long-established TMDLs addressing nonpoint source pollution did not have adequate funding, according to state TMDL coordinators, to implement the best management practices the TMDLs called for. State TMDL coordinators reported that although TMDL implementation is a priority for funding under the state's nonpoint source management grants, funding is typically not in proportion with the amount needed to implement projects in all areas or at all specific sites where they are needed to reduce nonpoint source pollution and enable water bodies to one day attain water quality standards. Moreover, 42 of 67 (63 percent) state TMDL coordinators reported in narrative responses that limited availability of funding impeded TMDL implementation. EPA officials said that they work with available funding to leverage funding from other agencies, such as USDA grants, for conservation projects in the areas subject to TMDLs and have begun to work with states under the 2013 long-term vision to prioritize TMDLs for development and implementation.

Conclusions

EPA has worked with the states to develop more than 50,000 TMDLs over the past two decades, and these TMDLs have proven useful in identifying and reducing pollutant loads in many waters impaired by pollutants from point sources. Yet progress toward the Clean Water Act's goals of restoring and maintaining "the chemical, physical, and biological integrity of the nation's waters"—including designated uses of fishing, swimming, and drinking—has stalled, largely because nonpoint source pollution has not been controlled. As our survey of state TMDL program coordinators indicates, few TMDLs have been implemented for nonpoint source pollution, and for those that have been implemented, progress has generally been incremental, in large part because of long-recognized limits to nonpoint source authority and funding. In 1987, when Congress amended the Clean Water Act to create a voluntary, incentive-based program to address nonpoint source pollution, Members of Congress also indicated that this provision was a starting point, subject to change if the reliance on voluntary participation did not significantly improve water quality. As reported by state TMDL coordinators, the absence of two key factors—specifically, legal authority and sufficient funding—has generally stymied the implementation of TMDLs meant to curtail nonpoint source pollution. The approach for abating nonpoint source pollution established

by the 1987 Clean Water Act amendments has not shown much progress toward achieving the goals of the act and likely will not do so in the foreseeable future. Consequently, more than 40 years after enactment of the Clean Water Act, and more than 25 years after Congress amended it to institute a program to control nonpoint source pollution, a majority of our nation's waters continue to be impaired. The preamble to EPA's 2000 rule recognized this fact, stating that although significant progress had been made—particularly in stemming pollution from point sources—major challenges remained for addressing nonpoint source pollution. EPA officials have said that they are working within existing authorities to make TMDL implementation a priority and to target and leverage funding; even so, many years will be needed to attain water quality standards. Without changes to the program's voluntary approach to implement projects in waters impaired by nonpoint source pollution, the act's goals are likely to remain unfulfilled.

Whether or not changes are made to the Clean Water Act, our review has uncovered several shortcomings in EPA's current implementation of the TMDL program, as follows:

- First, the experts' review shows that, where developed properly, TMDLs can be useful tools to identify impaired waters and plan actions to reduce water pollution. Yet the 11 elements in EPA's guidance, which generally reflect the agency's interpretation of TMDL development requirements in existing regulations, do not include certain features identified by the 2001 NRC report and several EPA studies as key for TMDLs to help water bodies attain water quality standards, such as comprehensive identification of impairment and plans to monitor water bodies to verify that water quality is improving. EPA officials said that the agency cannot require TMDLs to include additional features without issuing new regulations. Unless key features are incorporated into the agency's regulations—upon which future guidance can be based—states may include them in TMDLs only sporadically, if at all. Furthermore, without the force of regulations to direct states to develop TMDLs containing key features, TMDLs are likely to do little to attain water quality standards, particularly the designated uses of fishing, swimming, and drinking. EPA withdrew the 2000 rule before its effective date, and EPA officials have not taken action to reinitiate it, they said, both because the agency had wanted more time to assess the effectiveness of existing regulations and because rulemaking is costly and time-consuming. Nevertheless, TMDLs without certain key features may be unlikely to help water

bodies attain water quality standards and may potentially waste states' limited resources.

- Second, because some elements in the agency's existing 11-element guidance for TMDL development are either vague or stated as options, EPA's regional offices do not apply them consistently. A few regional offices have demonstrated, however, that asking states to provide more-detailed information about pollution causes and abatement actions provides greater assurance that TMDLs, if implemented, can achieve tangible water quality results. In the absence of clear guidance from headquarters directing all regional offices to review TMDLs on the basis of specific criteria, EPA's regional offices are unlikely to systematically ask states for more than the limited information described in the existing elements, including those that are vague or optional. As a result, some EPA regions may continue to approve TMDLs in which the quality or quantity of information is insufficient to help water bodies attain water quality standards, even if the TMDLs are implemented.
- Third, EPA has studied TMDL implementation and identified specific factors facilitating such implementation, but it has generally not placed on state grants conditions reflecting these factors for TMDL implementation plans and projects. In 2013, the agency issued guidance targeting nonpoint source management grant funds to states and projects that demonstrate some of these factors for effective TMDL implementation (e.g., targeting grant funds to projects where implementation plans have been developed and where external agency assistance is available). The guidance, however, neither requires states to follow these recommendations for selecting projects to fund, nor requires EPA regions to include these factors among programmatic conditions on annual nonpoint source grants. Without incorporating these factors as conditions into annual grants, the agency may neither target its limited funds toward effective TMDL implementation projects, nor ensure that the funds are spent on the mix of projects most likely to attain water quality standards or that they meet the purposes for which they are awarded.
- Fourth, the agency has little nationwide information to determine whether and to what extent TMDLs have been implemented or to what extent implemented TMDLs have helped impaired waters attain water quality standards. EPA recognizes that obtaining specific GIS data for TMDL implementation projects could help track the status of implementation efforts, and the agency has taken steps to gather some of these data. According to EPA officials, however, the agency has not required states to provide specific GIS data for TMDL projects funded in part by EPA that would enable it to link key pieces of such data in its own separate databases. Without consistently obtaining

from states GIS data in addition to water body names, EPA cannot integrate information on TMDL implementation projects and impaired water bodies across separate databases and cannot assess whether and to what extent water quality has been affected by TMDL implementation. Regardless, important data related to TMDL implementation are collected by USDA on conservation projects it funds and, under the 2008 Farm Bill, remain outside of EPA's authority to obtain from USDA without landowners' consent. Without access to data from landowners who participate in conservation programs funded by USDA in areas subject to a TMDL (e.g., on agricultural land adjacent to water bodies with TMDLs)—data including the location, type, and number of projects implemented under these programs—EPA cannot track actions taken to implement TMDLs or any subsequent changes in water quality associated with a core EPA program and a substantial federal investment.

Matter for Congressional Consideration

To help ensure effective TMDL implementation in water bodies impaired by nonpoint source pollution and to hasten progress toward the Clean Water Act's goals of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters, Congress should consider revising the act's largely voluntary approach to restoring waters impaired by such pollution. Specifically, Congress could consider ways to address factors, such as limited authority, which currently impede attainment of water quality standards, particularly the designated uses of fishing, swimming, and drinking.

Recommendations for Executive Action

To enhance the likelihood that TMDLs support the nation's waters' attainment of water quality standards and to strengthen water quality management, we recommend that the Administrator of EPA take the following four actions:

- Develop and issue new regulations requiring that TMDLs include *additional elements*—and consider requiring the elements that are now optional—specifically, elements reflecting key features identified by NRC as necessary for attaining water quality standards, such as comprehensive identification of impairment and plans to monitor water bodies to verify that water quality is improving.
- To ensure more consistent application of *existing TMDL elements* and to provide greater assurance that TMDLs, if implemented, can achieve tangible water quality results, identify regional offices with criteria for interpreting and applying such elements in reviewing and approving state-developed TMDLs and issue guidance with more

specificity, directing all regional offices to follow the same criteria, including requesting that states provide more-detailed information about pollution causes and abatement actions.

- Place conditions on states' annual use of nonpoint source management and water pollution control grants to ensure that the funds meet the purposes for which they are awarded and achieve greater reductions in nonpoint source pollution associated with TMDL implementation, such as by targeting funds to states and projects that incorporate factors needed for effective TMDL implementation (e.g., targeting grant funds to projects where implementation plans have been developed and where external agency assistance is available).
- Obtain missing data that currently impede EPA's efforts to determine whether and to what extent TMDLs have been implemented or to what extent implemented TMDLs have helped impaired waters attain water quality standards by
  - directing states to use and report specific GIS data when implementing projects to which TMDLs apply and
  - requesting that USDA ask landowners who participate in conservation programs funded by the department in areas subject to a TMDL to disclose information on the location, type, and number of projects implemented under these programs.

Agency Comments and Our Evaluation

We provided a draft of this report to the Administrator of the Environmental Protection Agency for review and comment. EPA provided written comments, reproduced in appendix V, in which the agency expressed general agreement with the report's findings and partial agreement with its conclusions and recommendations. Overall, the letter cited agreement with the report's characterization of the challenges facing EPA's water quality-based programs and agreement in principle with the kinds of changes that would be able to increase success under the Clean Water Act. EPA did not comment on the matter for congressional consideration, agreed with one recommendation, agreed with the findings of another recommendation but did not agree to take the recommended action, and partially agreed with two other recommendations. EPA also provided separate technical comments, which we incorporated in the report as appropriate.

In response to our recommendation that EPA develop and issue new regulations requiring that TMDLs include additional elements, EPA stated that it agrees that broader implementation and monitoring requirements would be helpful and pointed out that the agency attempted to revise the TMDL regulations to include such provisions in 2000. EPA stated that

since Congress prevented those regulations from going into effect, this recommendation might be better directed to Congress than to EPA. To help address the recommendation, EPA stated that it plans to continue its long-standing promotion of comprehensive watershed management well beyond the TMDL program. However, these plans do not include initiating a rulemaking. We note that while Congress temporarily prevented the 2000 rule from going into effect, EPA ultimately withdrew the rule in 2002, stating that it needed more time to evaluate the effectiveness of existing regulations. In withdrawing the rule, EPA stated that the rule would need significant changes before it could serve as a blueprint for an efficient and effective TMDL program. As we describe in the report, key events have transpired since development of the rule that provide EPA and state and other water quality managers with a wealth of information on the characteristics of effective TMDLs. In addition, and as we reported, ample time has passed for EPA to evaluate the effectiveness of existing regulations and substantial data shows that EPA's existing TMDL regulations—written nearly 30 years ago—do not go far enough to ensure they effectively support attainment of water quality standards. Specifically, the agency has gained new information on the characteristics of effective TMDLs. For these reasons, we continue to believe that EPA—with its expertise and decades of experience in water quality-based programs—should prepare updated regulations for the TMDL program and create a blueprint for an effective TMDL program for the future.

In response to our recommendation that EPA identify regional offices with criteria for interpreting and applying TMDL elements in reviewing and approving state-developed TMDLs and issue guidance with more specificity, directing all regional offices to follow the same criteria, EPA states that it will initiate a dialogue with its regional offices on overall TMDL review and approval guidance. EPA further stated that it would undertake this dialogue in 2014 and that this dialogue will consider the recommended changes in specificity and content that we raised.

In response to our recommendation that EPA place conditions on states' annual use of nonpoint source management and water pollution control grants to ensure that the funds meet the purposes for which they are awarded, EPA agreed with the recommendation as it relates to one of two grant programs, Section 106, saying that it will review the use of funds from one of two grant programs that we examined, and several others where our findings may be helpful, to address the recommendation. EPA stated that the agency is already implementing the recommendation for the second program, Section 319; however, we do not agree that this is the case. In particular, EPA stated that it has recently issued new

guidance for the nonpoint source program that substantially addresses much of GAO's recommendation and that there is no value added in revising the guidance for the program. We note, however, that the guidance targets funds to watersheds where comprehensive planning has taken place, whereas we recommend that EPA further target funds to specific on-the-ground TMDL *projects* for which certain factors—those that facilitate effective implementation—have been confirmed. We do not agree that these are the same actions, as the existence of a watershed based plan does not mean that the projects ultimately chosen to implement the plan and the TMDLs within the watershed will, in fact, reflect those factors that we and EPA have identified as necessary for helping to attain water quality standards. For this reason, we continue to believe that EPA should place conditions on grants to states to ensure the presence of such factors.

In response to our recommendation that EPA obtain missing data that currently impede its efforts to determine whether and to what extent TMDLs have been implemented or have helped impaired waters attain water quality standards, EPA stated that it generally agrees that it could direct states to use and report specific GIS data when implementing projects to which TMDLs apply. The agency disagreed with the second part of the recommendation, however, that it should request that USDA ask certain landowners—those participating in conservation programs funded by the department in areas subject to a TMDL—for permission to disclose information on the location, type, and number of projects implemented under these programs. EPA agreed that data on the location and type of USDA pollution control projects would be useful data for tracking implementation and evaluating water quality effects but urged GAO to direct this part of the recommendation to USDA. EPA stated that as currently written, the recommendation implies that EPA would use USDA data to assess individual actions to implement individual TMDLs. Recognizing that the state programs that develop TMDLs are partially funded by EPA and that many TMDL projects in waters impaired by agricultural runoff are also funded in part by EPA, we believe it is incumbent upon the agency to try to obtain data that it needs to evaluate the effectiveness of a key water quality program. The agency stated that it prefers to rely on states' oversight and tracking programs to assess states' collective progress in TMDL implementation, which may reflect data shared with the state by the department. We understand from our discussions with EPA and state officials, however, that this approach provides data aggregated at levels that are not precise enough to track actions taken to implement TMDLs. As we state in the report, without access to data on the location, type, and number of projects implemented

in areas subject to a TMDL, EPA cannot track possible changes in water quality associated with a core EPA program and a substantial federal investment. For these reasons, we continue to believe that—at the least—EPA should ask for these data from those who may be willing to provide it.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the Administrator of EPA, the appropriate congressional committees, and other interested parties. In addition, this report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or gomezj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VI.

J. Alfredo Gómez
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

The objectives of our work were to examine (1) the Environmental Protection Agency's (EPA) and states' responsibilities in the total maximum daily load (TMDL) program, (2) what is known about the status of long-established TMDLs, (3) the extent to which long-established TMDLs contain key features that enable attainment of water quality standards, and (4) the extent to which such TMDLs exhibit factors that facilitate effective implementation.

To conduct this work, we reviewed EPA reports and independent, peer-reviewed reports on the status of TMDLs and assessments of TMDL implementation projects and activities. We interviewed EPA officials in the agency's impaired waters and nonpoint source management programs. We also interviewed officials from the Association of Clean Water Administrators, National Association of Clean Water Agencies, and the Environmental Law Institute. In addition, we visited four states in two EPA regions to review the states' responsibilities in developing and implementing TMDLs, as well as any challenges the states may have faced in doing so. We selected these regions and states on the basis of the number of TMDLs each state had developed, types of water pollution, differences in state authorities to implement TMDLs, and the extent of each state's TMDL implementation efforts.

To examine EPA's and states' responsibilities in developing and implementing TMDLs, we reviewed documents and published reports to identify and describe the responsibilities of EPA and the states. Such documents and reports included relevant provisions of the Clean Water Act, including sections 303(d), 305(b), 319, and 402, which describe the responsibilities of EPA and the states with regard to identifying and restoring impaired waters. We reviewed EPA's 1985 regulations and 1992 amendments, which describe EPA's implementation of its Clean Water Act requirements, as well as the agency's 2002 "Guidelines for Reviewing TMDLs under Existing Regulations Issued in 1992." We also reviewed EPA's long-term vision for its impaired waters program under section 303(d) of the Clean Water Act. We reviewed other relevant reports addressing responsibilities within the TMDL program, including a 2001 report by the National Research Council (NRC) of the National Academies titled *Assessing the TMDL Approach to Water Quality Management*, which is the most recent effort undertaken by the National Academies to evaluate the TMDL approach to water quality management. We also reviewed a 2007 report by EPA's Office of Inspector General titled *Total Maximum Daily Load Program Needs Better Data and Measures to Demonstrate Environmental Results* and a 2008 report by

the Congressional Research Service titled *Clean Water Act and Total Maximum Daily Loads (TMDLs) of Pollutants*.

To examine what is known about the status of long-established TMDLs, we used information from the Assessment, TMDL Tracking and Implementation System on the number of impaired water bodies subject to TMDLs and the types of TMDLs by source (point, nonpoint, mixed), pollutant, and cause of impairment. To assess the reliability of the data from this system, we (1) electronically tested required data elements, (2) reviewed existing information about the data and the system that produced them, and (3) interviewed agency officials knowledgeable about the data. We found these data to be sufficiently reliable for purposes of this report. In addition, we reviewed EPA reports that examined the status of TMDLs, including the following:

- *FY2010 National Report on Implementing Total Maximum Daily Loads (TMDLs)*, EPA841-R-11-002 (March 2011)
- *Analysis of TMDL Implementation Rates in EPA Region 5*, EPA841-R-09-005 (December 2009)
- John Hoornbeek et al., *Implementing Total Maximum Daily Loads: Understanding and Fostering Successful Results* (Kent, Ohio: Kent State University, December 2008).
- *Developing Effective TMDLs: An Evaluation of the TMDL Process* (Washington, D.C.: 2007)
- *Developing Effective Nonpoint Source TMDLs: An Evaluation of the TMDL Development Process* (Washington, D.C.: January 2007).

To examine the extent to which long-established TMDLs contain key features needed to enable a water body to attain water quality standards, as well as to examine the extent to which long-established TMDLs exhibit factors facilitating effective implementation, we used the Assessment, TMDL Tracking and Implementation System database to select a generalizable, nationwide sample of 191 long-established TMDLs, which we defined to be those approved by EPA through December 31, 2007.[1] From this sample, we drew a random subsample of 25 TMDLs, which we asked three authors of the 2001 NRC report to review (see app. II). In addition, we used the whole sample of 191 long-established TMDLs in a survey of state TMDL coordinators on the water quality status associated with long-established TMDLs, such as whether and to what extent water

[1]The population of long-established TMDLs was 34,794.

quality had improved in the water body subject to the TMDL and whether water quality standards had been attained.

Experts' Review of Long-Established TMDLs

To examine the extent to which long-established TMDLs contain key features needed to enable a water body to attain water quality standards, we hired three water resource experts who had contributed to NRC's 2001 report. They reviewed our random subsample of 25 TMDLs drawn from our generalizable nationwide sample of 191 TMDLs. Unlike the sample as a whole, the subsample is not generalizable to all TMDLs, although it is an unbiased set that provides detailed examples of TMDL development in specific states and regions, which help illustrate challenges and successes in TMDL development. The 25 TMDLs in the subsample include TMDLs from all EPA regions except Region 2 and were approved by EPA from 1997 to 2007; see appendix III for additional information about these TMDLs.

We developed a questionnaire for the experts to use in examining the 25 TMDLs, and we charged them with identifying those features that are most important, or key, if a TMDL is to enable a water body to attain water quality standards. We began by reviewing the 2001 NRC report and EPA studies and guidance documents, such as the agency's 2002 guidelines for reviewing TMDLs, for features important to TMDL development and implementation (see app. III for results on features). We used the resulting list of features to then develop a total of 82 survey questions, which we pretested with the three experts to ensure that (1) the questions were clear and unambiguous, (2) the experts interpreted terms and questions similarly, (3) terminology was used correctly, (4) the information could feasibly be obtained from TMDL documents, and (5) the questionnaire was comprehensive and unbiased. We changed the questionnaire's content and format after the pretest according to the feedback we received. Independent GAO survey experts also reviewed a draft of the questionnaire, and we further revised the questionnaire to reflect that review.

To administer the questionnaire, we asked each expert to independently review 16 or 17 of the 25 TMDLs, fill out the questionnaire, and then compare and discuss responses with one another to reach consensus on as many questions as possible; we collected the questionnaire data from March through May 2013. We first randomly assigned each expert a set of TMDLs to review; we then assigned half of each expert's set to another expert to review, such that each half of one expert's assignment overlapped with half of another expert's assignments, and, thus, each

TMDL was ultimately reviewed by two experts. The experts reviewed their assigned TMDLs using a self-administered electronic version of the questionnaire posted on the World Wide Web. We e-mailed the experts unique usernames and passwords to ensure that only they could participate in the questionnaire. To minimize potential error, we facilitated a Microsoft Word-based process for the experts to compare and discuss questionnaire responses and to reach agreement on as many responses as possible. For each TMDL, we compiled the responses from the two experts who reviewed it and sent a copy of the compiled responses to the experts. We identified questions to which the experts provided substantially divergent responses, which we defined as responses where the experts disagreed about the presence or absence of a feature. We then asked the experts to exchange comments electronically and, if possible, to come to agreement on the best response. Once experts reached agreement, we coded their questionnaire responses to reflect changes, if any, and to enable us to tally the final responses to each of our questions. In the body of our report, we present only those questionnaire responses that experts reached agreement on. Two independent GAO analysts checked and verified that responses were compiled correctly and that any changes were coded correctly.

As a result of our steps to minimize survey error, experts reached agreement on 75 percent or more of the survey questions for 24 of the 25 TMDLs they reviewed.[2] The remaining TMDL had a lower agreement rate, in large part because the experts disagreed about whether this TMDL adequately demonstrates that sediment was the cause of biological impairment; their differing views on this issue affected their responses to many survey questions about this TMDL. Another source of divergent answers was the size and scope of some TMDLs. A few TMDLs in our sample are part of large TMDL documents encompassing numerous water bodies. The experts said that some of these large TMDL documents include little to no information about the specific water bodies to which the TMDLs in our sample apply, which made it difficult to ensure that each expert was basing his evaluations on the same portion of the documents.

For 73 out of 82 questions, experts reached agreement on 75 percent or more of the TMDLs they reviewed. The 9 questions with lower rates of

[2]Overall, experts agreed on 88 percent of the 1,917 questions they answered.

agreement were mostly of the same type: they asked whether the experts thought particular elements of a TMDL contain key features that, if the TMDL were fully implemented, would lead to attainment of a given numeric water quality target. One expert consistently expressed less confidence than the other experts that the models and other analytical methods used to develop most TMDLs would lead to attainment of numeric water quality targets. The experts generally agreed in their responses to a set of related questions: they responded that, for most TMDLs they reviewed, elements in the TMDLs do not contain key features that, if the TMDL were fully implemented, would lead to attainment of a designated use.

Survey of State TMDL Coordinators

To examine the extent to which long-established TMDLs exhibit factors that facilitate effective implementation, we surveyed state TMDL coordinators responsible for implementing the 191 long-established TMDLs in our generalizable sample. The purpose of this survey was to examine topics such as the extent of TMDL implementation, the extent of water quality improvement; factors that were helpful in implementing each TMDL; and factors that would have been helpful in implementing a given TMDL if they had been present or, if a given TMDL had not yet been implemented, would be helpful if it were present. To identify factors pertaining to TMDL implementation and to develop the survey questions, we reviewed EPA reports identifying particular factors associated with TMDLs that have been effectively implemented—that is, have helped the water bodies to which they apply partially or fully attain water quality standards (see app. IV for survey results).

We drew an initial simple random sample of TMDLs for state coordinators to examine from EPA's Assessment, TMDL Tracking and Implementation System database, out of a universe of 35,705 TMDLs approved by EPA from January 1, 1997, to December 31, 2007. To minimize the burden on prospective survey respondents, we drew a stratified random sample of 191 TMDLs—the smallest number we could have drawn for a nationally representative sample—to reflect their proportion in the universe of 35,075 TMDLs. Stratifying the sample in this way allowed us to reduce the number of TMDLs that any one state TMDL coordinator would receive for review. From this initial sample of 191 TMDLs, we removed TMDLs that were developed for entire states or multistate regions, such as those developed for atmospheric pollutants such as mercury or acid rain. We then drew a supplemental random sample to replace the TMDLs we had removed, so that we still had a representative sample of 191 TMDLs nationwide that applied to water bodies. The results of our survey are

generalizable to the population of TMDLs that were developed by December 31, 2007, which we defined as long-established TMDLs, and do not apply at statewide or regional scales.

We conducted the survey by means of self-administered electronic questionnaires posted on the World Wide Web, and we collected survey data from February through May 2013. We pretested the survey questions with officials from four states—Illinois, Kansas, Minnesota, and North Carolina—to check that (1) the questions were clear and unambiguous, (2) terminology was used correctly, (3) the questionnaire did not place an undue burden on state agency officials, (4) the information could feasibly be obtained, and (5) the survey was comprehensive and unbiased. We made changes to the content or format of the questionnaire after each pretest according to the feedback we received. Independent GAO survey experts also reviewed a draft of the survey, and we further revised the survey to reflect that review. We contacted survey respondents by e-mail, and we gave each potential respondent a unique password and username to ensure that only members of the target population could participate in the survey. We sent follow-up e-mail messages to those who had not responded by the deadline, and, beginning in May 2013, we telephoned all remaining nonrespondents for whom contact information was available. We received a total of 177 survey responses, which, after certain adjustments needed to analyze the data, gave an overall response rate of 93 percent.

To analyze the results of our survey, we first weighted the TMDLs from each state coordinator in proportion to the number of TMDLs developed by each state; in other words, a TMDL from Pennsylvania, for example—which had developed roughly five times as many TMDLs as, say, Washington State—had more weight in our analyses than a TMDL from Washington.

Estimates produced from the sample of projects are subject to sampling error. We express our confidence in the precision of our results as a 95 percent confidence interval. This interval would contain the actual population value for 95 percent of the samples we could have drawn. As a result, we are 95 percent confident that each of the confidence intervals in this report includes the true values in the study population. The estimates from our survey generally have a margin of error of no more than 12 percent at the 95 percent confidence level, unless otherwise noted. Additionally, to encourage honest and open responses, we pledged in the introduction to the survey that we would report information in the aggregate and not report data that would identify a particular

respondent. This report does not contain all the results from the survey; the survey and a more complete tabulation of the results are provided in appendix IV. To eliminate data-processing errors, we independently verified the computer program that generated the survey results.

In addition to tabulating and analyzing the frequencies of survey responses, we conducted a content analysis of all of the open-ended narrative responses received to survey questions 7, 14, 24, 26B, 27, 36, 39G, 42, 48, and 49. We analyzed the content of the 111 responses to question 14, the 115 responses to question 24, the 33 responses to question 26B, the 72 responses to question 27, the 93 responses to question 36, the 51 responses to question 39G, the 52 responses to question 42, the 39 responses to question 45G, the 82 responses to question 48, and the 90 responses to question 49. Question 7 was coded using the following categories: additional data needed, EPA-developed TMDL, natural condition TMDL, new TMDLs are better, and TMDL no longer applies. Question 14 was coded using the following categories: additional data needed, legal authority lacking, limited verification data, low priority, and TMDL was not needed. Question 24 was coded using the following categories: additional priorities weighted, data available, lack of project sponsorship, not applicable, priority on listing, and too many impaired water bodies. Question 26B was coded using the following categories: authority rests with another agency, cumbersome or difficulty authority to use, improvements too costly, prefer voluntary approach, vague authority, and addressed point sources and municipal separate storm sewer systems first. Question 27 was coded using the following categories: forestry regulation, manure management, septic system, and wetland and riparian. Question 36 was coded using the following categories: additional data needed, consent decree TMDL, funding availability, low priority, more outreach needed, and poor targeting. Question 39G was coded using the following categories: discharge monitoring reports and geographic information system data. Question 48 was coded using the following categories: additional data needed, funding availability, more time needed, no change expected, no longer applies, low priority, and now a municipal separate storm sewer system. Question 49 was coded using the following categories: funding availability, legal authority lacking, stakeholders lacking, new TMDLs are better, resources misspent, and TMDL was not the appropriate tool. Coding was performed independently by two coders; team members then met to discuss the coding categories and reached consensus on the final coding category assignment for each response. Measures of reliability between GAO coders were calculated before codes were reconciled and found to be

sufficiently high for purposes of this analysis. The numbers of responses in each content category were then summarized and tallied.

Regional Office Review

We also interviewed officials in each of EPA's 10 regional offices responsible for reviewing and approving TMDLs. We discussed with these officials the extent to which they require states' TMDLs to demonstrate key features as conditions of approving TMDLs. Further, we discussed with them the extent to which they encourage state programs to ensure the presence of factors necessary for effective TMDL implementation. We obtained information on the offices' review and approval of state-developed TMDLs, as well as on their oversight of state programs, including whether and to what extent regional offices include in annual grants to states conditions that encourage presence of factors associated with effective TMDL implementation.

We conducted this performance audit from July 2012 to December 2013 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: National Research Council Experts GAO Selected to Review TMDLs

James R. Karr
Professor Emeritus, University of Washington, Seattle

Vladimir Novotny
Professor Emeritus, Marquette University, Milwaukee, Wisconsin, and Northeastern University, Boston, Massachusetts

Chris O. Yoder
Research Director, Midwest Biodiversity Institute, Columbus, Ohio

Appendix III: Experts' Review of Long-Established TMDLs

To examine the extent to which long-established TMDLs contain key features needed to enable a water body to attain water quality standards, we appointed water resource experts to review a random, non-generalizable subsample of 25 TMDLs drawn from a random, generalizable nationwide sample (see app. I). Table 2 gives more detail about these 25 TMDLs.

Table 2: Random Subsample of 25 TMDLs Reviewed by Water Resource Experts

State	Year EPA approved	Water body classification	Pollution source	Stressor
Alabama	1997	River or stream	Point and nonpoint	Ammonia (nitrogen)
Alabama	2002	River or stream	Point and nonpoint	Biochemical oxygen demand
Arkansas	2006	River or stream	Point and nonpoint	Copper
California	2006	River or stream	Point and nonpoint	Siltation
Colorado	2002	River or stream	Nonpoint	Lead
Connecticut	2005	Lake, reservoir, or pond	Point and nonpoint	Phosphorus
Georgia	2002	River or stream	Point and nonpoint	Sediment
Hawaii	2007	River or stream	Point and nonpoint	Nutrients (nitrogen and phosphorus)
Indiana	2006	River or stream	Point and nonpoint	E. coli bacteria
Iowa	2004	Lake, reservoir, or pond	Nonpoint	Algal growth
Kansas	2004	River or stream	Point and nonpoint	Sulfate
Maryland	2007	River or stream	Nonpoint	Sulfate
Massachusetts	2002	Lake, reservoir, or pond	Nonpoint	Phosphorus
Mississippi	2003	River or stream	Point and nonpoint	Biochemical oxygen demand
Mississippi	2007	River or stream	Nonpoint	Sediment
New Mexico	2006	River or stream	Nonpoint	Turbidity
Oregon	2006	River or stream	Point and nonpoint	Temperature
Oregon	2007	River or stream	Point and nonpoint	Temperature
Pennsylvania	2003	River or stream	Nonpoint	Phosphorus
South Dakota	2001	Lake, reservoir, or pond	Nonpoint	Eutrophication[a]
South Dakota	2003	River or stream	Point	Ammonia (nitrogen)
Utah	2002	River or stream	Nonpoint	Phosphorus
Washington	2007	River or stream	Point and nonpoint	Temperature
Wisconsin	2005	River or stream	Nonpoint	Sediment
Wyoming	2007	River or stream	Point	Chlorine

Source: GAO analysis of EPA data.

[a]Eutrophication is the natural process by which lakes and ponds age as minerals and organic matter accumulate in the water over thousands of years. These nutrients promote blooms of algae, which drop to the bottom when they die, in turn increasing oxygen-demanding decomposition rates and depleting oxygen needed by other forms of life in the lake. As a result, overall diversity of life in the

lake declines. Excess nutrients contributed by human activities, such as the application of nitrogen-rich fertilizers, hastens this process.

Table 3 shows the results of the experts' review of the TMDLs listed in table 2. These results are expressed as the number of TMDLs containing the feature listed in each table row.

Table 3: Number of Long-Established TMDLs in Which Experts Found Key Features Needed to Enable Water Bodies to Attain Water Quality Standards

		Experts agreed				
EPA element	TMDL key feature	Contain feature	Do not contain feature	Not enough information	Feature not applicable	Experts did not agree
1	Provides sufficient evidence that water quality is impaired by the selected pollutant of concern	18	6	0	0	1
	Addresses chemical stressors that may be affecting attainment of water quality standards	14	8	0	3	0
	Addresses biological stressors that may be affecting attainment of water quality standards	8	11	0	2	4
	Addresses physical stressors that may be affecting attainment of water quality standards	8	13	0	3	1
2	Demonstrates that achieving numeric water quality target for given pollutant will lead to attainment of designated use	7	17	1	0	0
	Describes scientific linkage between numeric water quality target and pollutant of concern	15	4	0	3	3
	Describes how numeric water quality target was calculated	22	3	0	0	0
	Represents numeric water quality target in terms of magnitude, or how much pollutant of concern can be present without loss of water's designated use	22	1	0	1	1
	Represents numeric water quality target in terms of duration, or time period over which pollutant levels are to be measured to determine how much pollutant can be present without loss of designated use	18	2	0	2	3

EPA element	TMDL key feature	Experts agreed: Contain feature	Experts agreed: Do not contain feature	Experts agreed: Not enough information	Experts agreed: Feature not applicable	Experts did not agree
	Represents numeric water quality target in terms of frequency, or how often numeric water quality target may be exceeded without loss of designated use	14	5	0	3	3
	Numeric water quality target is measurable with reasonably obtainable monitoring data	25	0	0	0	0
	Numeric water quality target accounts for pollutant loads flowing into or out of other water bodies or segments not part of geographic area of water body to which TMDL applies	15	2	5	0	3
3	Describes "critical conditions," or worst-case scenario of environmental conditions in water body under which relevant pollutant loading will still allow water body to attain water quality standards	17	4	1	0	3
	Model or other method used to calculate loading capacity includes natural processes taking place in the watershed	19	2	1	0	3
	Model or other method used to calculate loading capacity is appropriately complex	14	4	0	0	7
	Explains any assumptions in the TMDL analysis	22	1	0	0	2
	Describes strengths and weaknesses in analytical process used to calculate loading capacity	11	13	0	0	1
	Describes results from any water quality modeling used in the TMDL analysis	17	1	0	2	5
4	Demonstrates that meeting load allocations will have desired effect on water quality conditions needed to attain designated use	12	8	0	2	3
	Identifies the nonpoint sources contributing to impairment precisely enough for load allocations to be implemented	12	5	2	2	4
5	Specifies pollutant limits in individual permits for point source facilities[a]	15	1	1	6	2

EPA element	TMDL key feature	Experts agreed: Contain feature	Experts agreed: Do not contain feature	Experts agreed: Not enough information	Experts agreed: Feature not applicable	Experts did not agree
	Demonstrates that wasteload allocations for individual point source permit holders will not cause localized impairments	8	5	0	6	6
	Demonstrates that pollutant loads have not been reallocated from nonpoint sources to point sources	8	2	4	6	5
6	Refers to a margin of safety	23	1	0	0	1
	Includes an explicit uncertainty analysis as basis for determining margin of safety	2	19	0	2	2
	Margin of safety adequately accommodates variability that might impair attainment of numeric water quality target	9	7	5	2	2
7	Refers to seasonal variation	23	1	0	0	1
	Includes information about how seasonal variations in stressors influence water quality	17	3	0	4	1
	Describes method chosen for incorporating seasonal variation	18	1	1	4	1
8	Refers to reasonable assurances	8	5	0	12	0
	Provides sufficient evidence that reductions in nonpoint source pollution will occur	0	6	0	17	2
	Identifies specific actions that need to occur to attain a water quality standard	8	0	0	17	0
	Identifies land areas where actions need to occur to attain a water quality standard	6	1	0	17	1
9	Refers to a monitoring plan to track TMDL effectiveness	18	7	0	0	0
	Monitoring plan describes data to be collected to determine if TMDL's targeted load reductions are occurring	8	5	0	7	5
	Monitoring plan includes indicators reflecting biological responses, such as measures of biological diversity and relative abundance of particular groups of aquatic organisms	3	14	0	7	1
	Includes information about combining monitoring data and modeling so as to assess modeling error	0	13	0	8	4

EPA element	TMDL key feature	Experts agreed: Contain feature	Experts agreed: Do not contain feature	Experts agreed: Not enough information	Experts agreed: Feature not applicable	Experts did not agree
	Describes an adaptive approach to implementing the TMDL, whereby monitoring and data analysis will be used to periodically assess progress toward water quality standards and TMDL will be adjusted as needed	9	8	0	7	1
10	Refers to implementation	21	4	0	0	0
	Identifies actors to help support TMDL implementation	14	7	0	4	0
	Identifies actions that can help attain water quality standards	12	7	0	4	2
	Includes a formal TMDL implementation plan	6	19	0	0	0
	Implementation plan identifies actors to help support TMDL implementation	5	1	0	19	0
	Implementation plan identifies specific actions that need to occur to attain water quality standards	5	1	0	19	0
	Implementation plan identifies land areas where actions need to occur to attain water quality standards	3	2	0	19	1
	Implementation plan provides sufficient evidence that reductions in nonpoint source pollution will occur	0	5	0	19	1
11	Refers to public participation	21	4	0	0	0
	Describes extent of public participation, such as number or types of public meetings	8	10	0	4	3
	Includes a summary of significant public comments and state's response	3	17	0	4	1

Source: GAO.

Notes: Numbers in this table represent numbers of TMDLs in a random subsample of 25 TMDLs. Each TMDL was independently reviewed by two experts to increase the reliability of our findings. For each column under "Experts agreed," the two experts agreed that the given feature in a row was present in that number of TMDLs. For the TMDLs tallied in the last column at right, the two experts who reviewed them did not reach agreement on the presence or absence of the given feature.

[a]Permits are those issued to point source facilities under the National Pollutant Discharge Elimination system permit program.

Appendix IV: Survey of State TMDL Coordinators Responsible for Implementing Long-Established TMDLs

The questions we asked of state TMDL coordinators in a nationwide survey of long-established TMDLs are shown below. In our survey, we asked both closed and open-ended questions about specific TMDLs. For closed questions, we have included the frequency for each response option that state TMDL coordinators selected and a representative estimate for each response when it was generalizable. Generally, we considered a response to be generalizable when the bounds of the 95 percent confidence interval did not exceed 12 percent. For the open-ended questions in our survey, we have provided the three most prevalent response themes when we could identify them. For a more detailed discussion of our survey and sampling methodology see appendix I.

TMDL Development

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q1. Was the TMDL for [pollutant] in [water body] developed in response to a consent decree or other settlement order?	Yes	79	62.7	54-71.4
	No	89	36.0	27.4-44.5
	Don't know	6	1.3	0-2.7
Q2. Generally, were land use data available when developing the TMDL for [pollutant] in [water body]?	Yes	154	92.4	88.4-96.4
	No	10	4.9	1.5-8.3
	Don't know	9	2.7	0.5-4.9
Q2A. If yes, how helpful was the availability of land use data when developing the TMDL?	Very helpful	77	52.3	42-62.6
	Somewhat helpful	51	28.9	20-37.7
	Not helpful	23	18.8	9.4-28.3
Q2B. If no, how helpful would the availability of land use data have been when developing the TMDL?	Very helpful	2	.	Data not generalizable
	Somewhat helpful	5	.	Data not generalizable
	Not helpful	3	.	Data not generalizable
Q3. Generally, were land cover data available when developing the TMDL for [pollutant] in [water body]?	Yes	150	89.7	84.9-94.5
	No	12	6.4	2.5-10.4
	Don't know	11	3.9	1.2-6.6
Q3A. If yes, how helpful was the availability of land cover data when developing the TMDL?	Very helpful	71	49.8	39.3-60.3
	Somewhat helpful	51	30.5	21.3-39.7
	Not helpful	25	19.7	10-29.3
Q3B. If no, how helpful would the availability of land cover data have been when developing the TMDL?	Very helpful	6	.	Data not generalizable
	Somewhat helpful	4	.	Data not generalizable
	Not helpful	2	.	Data not generalizable
Q4. Generally, were ambient water quality data	Yes	150	89.8	84.5-95.2

Question	Response	Count	Estimated percentage	95 percent confidence interval
available when developing the TMDL for [pollutant] in [water body]?	No	11	5.8	2.2-9.3
	Don't know	11	4.4	0.2-8.6
Q4A. If yes, how helpful was the availability of ambient water quality data when developing the TMDL?	Very helpful	122	84.8	78.1-91.5
	Somewhat helpful	22	14.2	7.6-20.7
	Not helpful	3	1.1	0-2.5
Q4B. If no, how helpful would the availability of ambient water quality data have been when developing the TMDL?	Very helpful	3	.	Data not generalizable
	Somewhat helpful	6	.	Data not generalizable
	Not helpful	1	.	Data not generalizable
Q5. Generally, were source loading data available when developing the TMDL for [pollutant] in [water body]?	Yes	94	63.3	54.5-72.1
	No	63	33.5	24.9-42.2
	Don't know	15	3.2	1.2-5.2
Q5A. If yes, how helpful was the availability of source loading data when developing the TMDL?	Very helpful	72	79.5	70.2-88.9
	Somewhat helpful	20	20.5	11.1-29.8
Q5B. If no, how helpful would the availability of source loading data have been when developing the TMDL?	Very helpful	27	.	Data not generalizable
	Somewhat helpful	23	.	Data not generalizable
	Not helpful	4	3.5	0-7.8
Q6. Were runoff quality data available when developing the TMDL for [pollutant] in [water body]?	Yes	36	21.6	13.7-29.4
	No	110	68.7	60-77.4
	Don't know	25	9.7	4.8-14.6
Q6A. If yes, how helpful was the availability of runoff quality data in developing the TMDL?	Very helpful	29	95.6	91.6-99.6
	Somewhat helpful	3	2.2	0-4.9
	Not helpful	3	2.2	0-4.9
Q6B. If no, how helpful would the availability of runoff quality data have been when developing the TMDL?	Very helpful	31	23.8	14.4-33.1
	Somewhat helpful	47	.	Data not generalizable
	Not helpful	17	.	Data not generalizable

Q7. Is there anything further we should know about the development of the TMDL for [pollutant] in [water body]?

Open-ended response theme	Number of responses
Older TMDLs are not as comprehensive or as accurate as newer ones.	14
The state TMDL coordinator had limited information on the TMDL because EPA developed the TMDL.	12
Additional data or specificity would have made the TMDL more implementable.	10
Total coded responses	**54**

Status of TMDL Implementation

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q8. Was it necessary to revise National Pollutant Discharge Elimination System (NPDES) permits to meet the wasteload allocation in the TMDL for [pollutant] in [WATERBODY]?	Yes	36	20.7	12.7-28.7
	No	138	79.3	71.3-87.3
Q9. Since EPA approved the TMDL in [year], how many of the NPDES permits for [pollutant] discharge that needed revision has your state been able to revise?	All	24	.	Data not generalizable
	More than half	4	.	Data not generalizable
	About half	1	2.9	0-8.7
	Less than half	3	4.3	0-10.6
	None	4	2.9	0-6.1
Q10. How confident are you in the accuracy of your answer to question 9?	Extremely confident	20	.	Data not generalizable
	Very confident	11	.	Data not generalizable
	Moderately confident	2	5.1	0-14.1
	Somewhat confident	3	.	Data not generalizable
Q11. Was it necessary to install best management practices to meet the load allocation for [pollutant] in [WATERBODY]?	Yes	109	66.7	57.4-76.1
	No	52	33.3	23.9-42.6
Q12. Since EPA approved the TMDL in [year], about how many of the landowners who needed to install best management practices for [pollutant] had them installed?	Not checked	1	1.1	0-3.3
	All	1	1.1	0-3.3
	More than half	15	19.2	8.2-30.2
	About half	12	14.0	4.7-23.4
	Less than half	50	.	Data not generalizable
	None	17	10.2	4.1-16.4
Q13. How confident are you in the accuracy of your answer to question 12?	Extremely confident	11	9.8	3.2-16.5
	Very confident	19	18.3	8.5-28.1
	Moderately confident	27	.	Data not generalizable
	Somewhat confident	22	22.3	11.1-33.4
	Not confident	18	16.2	7.8-24.6

Q14. Is there anything else we should know about the implementation status of the TMDL for [pollutant] in [water body]?

Open-ended response theme	Number of responses
Limited data exist to verify implementation.	17
No legal authority to compel polluters or landowners to abate nonpoint source pollution.	14
Additional data or specificity would have made the TMDL more implementable.	9
Total coded responses	50

Factors That Helped or Could Have Helped Implementation

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q15. Since EPA approved the TMDL in [year], was your agency able to find enough landowners in the area covered by the TMDL who were willing to install best management practices on their properties?	Yes	31	.	Data not generalizable
	No	30	19.0	9.9-28.1
	Don't know	40	.	Data not generalizable
Q15A. If yes, how helpful was the willingness of landowners to install best management practices in implementing the TMDL?	Very helpful	17	.	Data not generalizable[a]
	Somewhat helpful	14	.	Data not generalizable
Q15B. If no, how helpful would the willingness of landowners to install best management practices have been in implementing the TMDL?	Very helpful	20	.	Data not generalizable
	Somewhat helpful	9	.	Data not generalizable
	Not helpful	1	5.2	0-15.9
Q16. Since EPA approved the TMDL in [year], were landowners in the area covered by the TMDL generally willing to install the types of best management practices that are most-effective at reducing [pollutant] loads?	Yes	35	.	Data not generalizable
	No	14	11.2	3.2-19.3
	Don't know	53	.	Data not generalizable
Q16A. If yes, how helpful was the willingness of landowners to install the most-effective types of best management practices in implementing the TMDL?	Very helpful	24	.	Data not generalizable
	Somewhat helpful	10	.	Data not generalizable
Q16B. If no, how helpful would the willingness of landowners to install the most-effective types of best management practices have been in implementing the TMDL?	Very helpful	11	.	Data not generalizable
	Somewhat helpful	2	.	Data not generalizable
Q17. Since EPA approved the TMDL in [year], were landowners generally willing to install best management practices in the area covered by the TMDL where they could most effectively reduce [pollutant] loads?	Yes	31	.	Data not generalizable
	No	15	10.7	2.9-18.6
	Don't know	56	.	Data not generalizable
Q17A. If yes, how helpful was the willingness of landowners to install best management practices in the places where they could most effectively reduce [pollutant] loads in implementing the TMDL?	Very helpful	24	.	Data not generalizable
	Somewhat helpful	7	.	Data not generalizable

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q17B. If no, how helpful would the willingness of landowners to install best management practices in places where they could most effectively reduce [pollutant] loads have been in implementing the TMDL?	Very helpful	11	.	Data not generalizable
	Somewhat helpful	4	.	Data not generalizable
Q18. Since EPA approved the TMDL in [year], was enough funding available to implement best management practices to reduce [pollutant] in [WATERBODY]?	Enough funding was available to implement best management practices	15	14.1	5.5-22.7
	Some funding was available to implement best management practices	40	.	Data not generalizable
	Not enough funding was available to implement best management practices	45	.	Data not generalizable
Q18A. If more than enough funding was available or enough funding was available to implement best management practices, how helpful was available funding in implementing the TMDL?	Very helpful	9	.	Data not generalizable
	Somewhat helpful	1	.	Data not generalizable
Q18B. If some funding was available or not enough funding was available, how helpful would the availability of additional funding have been in implementing the TMDL?	Very helpful	44	.	Data not generalizable
	Somewhat helpful	25	.	Data not generalizable
	Not helpful	4	4.1	0-9
Q19. Since EPA approved the TMDL in [year], was an implementation plan developed to reduce [pollutant] in [water body] that contained reasonable assurances with specific implementation activities and milestones?	Yes	43	.	Data not generalizable
	No	48	.	Data not generalizable
	Don’t know	13	14.9	5.1-24.7
Q19A. If yes, how helpful was an implementation plan in implementing the TMDL?	Very helpful	23	.	Data not generalizable
	Somewhat helpful	15	.	Data not generalizable
	Not helpful	5	7.4	0-15.8
Q19B. If no, how helpful would an implementation plan have been in implementing the TMDL?	Very helpful	16	.	Data not generalizable
	Somewhat helpful	23	.	Data not generalizable
	Not helpful	7	.	Data not generalizable
Q20. Since EPA approved the TMDL in [year], did land in the area covered by the TMDL for [pollutant] in [water body] become more developed?	Yes	32	32.8	21-44.6
	No	48	.	Data not generalizable
	Don’t know	25	20.3	10.3-30.2
Q20A. If yes, how helpful was land development in implementing the TMDL?	Very helpful	4	11.8	0-23.7
	Somewhat helpful	6	.	Data not generalizable
	Not helpful	22	.	Data not generalizable

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q20B. If no, how helpful would land development have been in implementing the TMDL?	Somewhat helpful	10	.	Data not generalizable
	Not helpful	35	.	Data not generalizable
Q21. Since EPA approved the TMDL in [year], has land in the area covered by the TMDL for [pollutant] in [water body] been retired?	Yes	16	15.2	6.6-23.8
	No	45	.	Data not generalizable
	Don't know	44	38.8	26.9-50.6
Q21A. If yes, how helpful was land retirement in implementing the TMDL?	Very helpful	5	.	Data not generalizable
	Somewhat helpful	8	.	Data not generalizable
	Not helpful	3	.	Data not generalizable
Q21B. If no, how helpful would land retirement have been in implementing the TMDL?	Very helpful	5	.	Data not generalizable
	Somewhat helpful	14	.	Data not generalizable
	Not helpful	23	.	Data not generalizable
Q22. Does your agency administer EPA's section 319 nonpoint source management Program in your state?	Yes	93	92.0	86.8-97.2
	No	12	8.0	2.8-13.2
Q22A. If yes, how helpful was your agency's administration of the section 319 program in implementing the TMDL for [pollutant] in [water body]?	Very helpful	34	32.1	20.3-43.9
	Somewhat helpful	21	18.8	9.6-28.1
	Not helpful	33	.	Data not generalizable
Q22B. If no, how helpful would administering the section 319 program have been in implementing the TMDL for [pollutant] in [water body]?	Very helpful	6	.	Data not generalizable
	Somewhat helpful	3	.	Data not generalizable
	Not helpful	3	.	Data not generalizable
Q23. When awarding section 319 funding, does your state a give a higher priority to water bodies with TMDLs, as compared with water bodies without TMDLs?	Yes	95	93.2	88.4-98
	No	9	6.5	1.8-11.3
	Don't know	1	0.2	0-0.7
Q23A. If yes, how helpful has giving a higher priority to water bodies with TMDLs, as compared with water bodies without TMDLs been in implementing the TMDL for [pollutant] in [water body]?	Very helpful	34	.	Data not generalizable
	Somewhat helpful	21	17.7	8.2-27.1
	Not helpful	39	.	Data not generalizable
Q23B. If no, how helpful would giving a higher priority to water bodies with TMDLs, as compared with water bodies without TMDLs have been in implementing the TMDL for [pollutant] in [water body]?	Very helpful	3	.	Data not generalizable
	Somewhat helpful	5	.	Data not generalizable
	Not helpful	1	.	Data not generalizable

[a]In the report, we combined the responses to those questions in which the state TMDL coordinators responding to our survey indicated that the factor either was helpful (if present) or (if factor was not present or TMDL was not yet implemented) would have been or would be helpful in implementing the TMDL in question. Unless otherwise noted, those combined estimates had margins of error of no more than 12 percent. When presented separately in this appendix, the questions had fewer responses and more often had margins of error that exceeded 12 percent, and we do report them as not generalizable.

Q24. If not addressed by question 23, how, if at all, does your state prioritize funding for water bodies with TMDLs?

Open-ended response theme	Number of responses
The state considers additional or other priorities when prioritizing funding.	22
Lack of a sponsor, such as a citizen-based group, prevents the awarding of 319 funds.	15
Funding is prioritized according to whether a water body is on the state's 303(d) list, rather than if there's a TMDL to address the listing.	10
Total coded responses	**48**

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q25. Does your state have legal authority to compel landowners to reduce nonpoint source [pollutant] discharge from their properties?	Yes	43	.	Data not generalizable
	No	61	.	Data not generalizable
Q26. If you answered yes to question 25, since EPA approved the TMDL in [year], has your state exercised its legal authority to compel landowners to reduce nonpoint source pollution from their properties?	Yes	10	.	Data not generalizable
	No	16	.	Data not generalizable
	Don't know	14	.	Data not generalizable

Q26A. If yes, how many times has your state exercised its legal authority to compel landowners to reduce nonpoint source pollution from their properties in the TMDL for [pollutant] in [water body]?

Respondents reported that they used their state legal authority 7 times in the long-established TMDLs in our sample.

26b. If no, why did your state choose not to use its legal authority to compel landowners to reduce nonpoint source pollution from their properties?

Open-ended response theme	Number of responses
The state prefers to use a voluntary approach.	15
Using the state's legal authority is cumbersome or difficult because it requires identification of specific violators.	6
The state's legal authority to address nonpoint source pollution is vague.	5
Total coded responses	**29**

Q27. If local government agencies in your state have legal authority to compel landowners to reduce nonpoint source pollution from their properties, please describe this authority and how it applied to the TMDL for [pollutant] in [water body], if at all.

Open-ended response theme	Number of responses
Livestock management act, county manure management laws, or local waste storage laws	6
Septic system enforcement, typically through county health departments	5
Wetland protection and riparian buffers	4

Open-ended response theme	Number of responses
Total coded responses	14

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q28. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has the U.S. Department of Agriculture assisted your agency in implementing the TMDL?	Yes	45	.	Data not generalizable
	No	27	21.5	12-31
	No assistance was necessary	21	.	Data not generalizable
	Don't know	11	7.9	2.1-13.7
Q28A. If yes, how helpful was the assistance of the U.S. Department of Agriculture in implementing the TMDL?	Very helpful	23	.	Data not generalizable
	Somewhat helpful	20	.	Data not generalizable
	Not helpful	2	6.9	0-16.6
Q28B. If no, how helpful would the assistance of the U.S. Department of Agriculture have been in implementing the TMDL?	Very helpful	8	.	Data not generalizable
	Somewhat helpful	12	.	Data not generalizable
	Not helpful	6	.	Data not generalizable
Q29. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has the U.S. Environmental Protection Agency assisted your agency to implementing the TMDL?	Not checked	1	1.0	0-2.9
	Yes	43	37.1	25.6-48.6
	No	43	.	Data not generalizable
	No assistance was necessary	13	9.3	3.3-15.2
	Don't know	5	5.3	0-11.9
Q29A. If yes, how helpful was the assistance of the U.S. Environmental Protection Agency in implementing the TMDL?	Very helpful	28	.	Data not generalizable
	Somewhat helpful	13	.	Data not generalizable
	Not helpful	2	6.6	0-15.9
Q29B. If no, how helpful would the assistance of the U.S. Environmental Protection Agency have been in implementing the TMDL?	Very helpful	4	9.7	0-20.6
	Somewhat helpful	20	.	Data not generalizable
	Not helpful	13	.	Data not generalizable
Q30. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has a state government agricultural program assisted your agency to implementing the TMDL?	Yes	43	.	Data not generalizable
	No	28	17.6	9.6-25.5
	No assistance was necessary	24	.	Data not generalizable
	Don't know	10	8.5	1.1-15.9
Q30A. If yes, how helpful was the assistance of a state government agricultural program in implementing the TMDL?	Very helpful	24	.	Data not generalizable
	Somewhat helpful	18	.	Data not generalizable
	Not helpful	1	0.6	0-1.8
Q30B. If no, how helpful would the assistance of a state government agricultural program have been in implementing the TMDL?	Very helpful	5	.	Data not generalizable

Question	Response	Count	Estimated percentage	95 percent confidence interval
	Somewhat helpful	13	.	Data not generalizable
	Not helpful	10	.	Data not generalizable
Q31. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has a state government stormwater program assisted your agency in implementing the TMDL?	Yes	32	28.2	18.1-38.3
	No	32	23.7	13.3-34.1
	No assistance was necessary	37	.	Data not generalizable
	Don't know	4	4.6	0-10.8
Q31A. If yes, how helpful was the assistance of a state government stormwater program in implementing the TMDL?	Very helpful	15	.	Data not generalizable
	Somewhat helpful	14	.	Data not generalizable
	Not helpful	3	7.7	0-17.6
Q31B. If no, how helpful would the assistance of a state government stormwater program have been in implementing the TMDL?	Very helpful	1	4.2	0-13
	Somewhat helpful	8	.	Data not generalizable
	Not helpful	22	.	Data not generalizable
Q32. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has a state government nonpoint source program assisted your agency in implementing the TMDL?	Yes	65	69.6	58.2-81
	No	28	22.8	12.1-33.5
	No assistance was necessary	9	7.0	1.6-12.5
	Don't know	2	0.5	0-1.2
Q32A. If yes, how helpful was the assistance of a state government nonpoint source program in implementing the TMDL?	Very helpful	43	.	Data not generalizable
	Somewhat helpful	20	.	Data not generalizable
	Not helpful	1	2.3	0-6.8
Q32B. If no, how helpful would the assistance of a state government nonpoint source program have been in implementing the TMDL?	Very helpful	6	.	Data not generalizable
	Somewhat helpful	14	.	Data not generalizable
	Not helpful	6	.	Data not generalizable
Q33. Since EPA approved the TMDL in [year] for [pollutant] in [water body], has a state or local government planning agency assisted your agency in implementing the TMDL?	Yes	34	37.0	25.1-49
	No	53	.	Data not generalizable
	Don't know	17	19.5	8.9-30.1
Q33A. If yes, how helpful was the assistance of a state or local government planning agency in implementing the TMDL?	Very helpful	23	.	Data not generalizable
	Somewhat helpful	10	.	Data not generalizable
Q33B. If no, how helpful would the assistance of a state or local government planning agency have been in implementing the TMDL?	Very helpful	7	14.3	2.6-26
	Somewhat helpful	26	.	Data not generalizable
	Not helpful	17	.	Data not generalizable
Q34. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has a citizen-based group such as a watershed organization or other nongovernmental organization assisted your agency in implementing the TMDL?	Yes	51	.	Data not generalizable
	No	34	28.6	17.8-39.4
	No assistance was necessary	4	3.0	0-6.7
	Don't know	15	14.6	6.6-22.6

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q34A. If yes, how helpful was the assistance of a citizen-based group in implementing the TMDL?	Very helpful	34	.	Data not generalizable
	Somewhat helpful	15	.	Data not generalizable
	Not helpful	1	0.5	0-1.5
Q34B. If no, how helpful would the assistance of a citizen-based group have been in implementing the TMDL?	Very helpful	10	.	Data not generalizable
	Somewhat helpful	16	.	Data not generalizable
	Not helpful	4	.	Data not generalizable
Q35. Since EPA approved the TMDL for [pollutant] in [water body] in [year], have local governmental leaders generally been supportive of implementing the TMDL?	Yes	37	.	Data not generalizable
	No	20	18.7	8.6-28.8
	Don't know	47	.	Data not generalizable
Q35A. If yes, how helpful was the support of local governmental leaders in implementing the TMDL?	Very helpful	23	.	Data not generalizable
	Somewhat helpful	11	.	Data not generalizable
	Not helpful	1	0.8	0-2.3
Q35B. If no, how helpful would the support of local governmental leaders have been in implementing the TMDL?	Very helpful	7	.	Data not generalizable
	Somewhat helpful	6	.	Data not generalizable
	Not helpful	5	.	Data not generalizable

Q36. Is there anything else we should know about the factors that helped or could have helped in implementing the TMDL for [pollutant] in [water body]?

Open-ended response theme	Number of responses
The availability of funding was an obstacle to implementing the TMDL.	18
The TMDL was not a priority for implementation.	10
More public outreach is needed to implement the TMDL successfully.	9
Total coded responses	**44**

Pollutant Loads from Point Sources

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q37. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has the pollutant load from point sources decreased, stayed the same, or increased?	Decreased	18	22.3	11.6-32.9
	Stayed the same	19	.	Data not generalizable
	Don't know	23	24.7	14.1-35.2
	There were no point sources.	19	.	Data not generalizable
Q38. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has the wasteload allocation for point sources been met?	Yes	31	.	Data not generalizable
	No	7	10.9	2.5-19.2
	Don't know	21	.	Data not generalizable
	There was no wasteload allocation for point sources in the TMDL.	1	0.4	0-1.3

Q39. What is the basis for your response in question 38?

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q39A. Water quality monitoring	Yes	18	.	Data not generalizable
	No	16	.	Data not generalizable
Q39B. Visual inspection	Yes	4	.	Data not generalizable
	No	27	.	Data not generalizable
Q39C. Revised NPDES permits	Yes	17	.	Data not generalizable
	No	19	.	Data not generalizable
Q39D. Model estimates	Yes	4	.	Data not generalizable
	No	25	.	Data not generalizable
Q39E. Land use changes	Yes	4	.	Data not generalizable
	No	26	.	Data not generalizable
Q39F. Discharge changes	Yes	15	.	Data not generalizable
	No	19	.	Data not generalizable
Q39G. Other. Please specify below	Yes	28	.	Data not generalizable
	No	7	.	Data not generalizable

If you checked “Other” above, what was the other source?

Open-ended response theme	Number of responses
Discharge monitoring reports	11
Geographic information system data	3
Total coded responses	**15**

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q40. Within the next 5 years, do you expect the pollutant load to decrease, stay the same, or increase as a result of actions that have already been taken for point sources in the TMDL for [pollutant] in [water body]?	Decrease	15	.	Data not generalizable
	Stay the same	23	.	Data not generalizable
	Increase	1	1.7	0-5.2
	Don’t know	20	.	Data not generalizable
Q41. Within the next 5 years, do you expect the wasteload allocation for [pollutant] in [water body] to be met?	Yes	31	.	Data not generalizable
	No	5	7.4	0.5-14.4
	Don’t know	23	.	Data not generalizable

Q42. Is there anything else that you think we should know about point source pollutant loads in the TMDL for [pollutant] in [water body]?

State TMDL coordinators offered no substantive responses to this question.

Pollutant Loads from Nonpoint Sources

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q43. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has the pollutant load from nonpoint sources decreased, stayed the same, or increased?	Decreased	42	32.4	22.7-42.2
	Stayed the same	38	25.4	16.5-34.2
	Increased	1	0.6	0-1.9
	Don’t know	67	34.7	25.6-43.8
	There were no nonpoint sources.	11	6.8	2.4-11.3
Q44. Since EPA approved the TMDL for [pollutant] in [water body] in [year], has the load allocation for nonpoint sources been met?	Yes	15	9.1	3.9-14.3
	No	51	36.6	26.3-47
	Don’t know	71	48.2	37.7-58.7
	There was no load allocation for nonpoint sources in the TMDL.	9	6.0	1.6-10.5

Q45. What is the basis for your response in 44?

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q45A. Water quality monitoring	Yes	65	.	Data not generalizable
	No	35	.	Data not generalizable
Q45B. Visual inspection	Yes	33	.	Data not generalizable
	No	49	.	Data not generalizable
Q45C. Implemented best management practices	Yes	52	.	Data not generalizable
	No	39	.	Data not generalizable
Q45D. Model estimates	Yes	16	15.9	5.3-26.4
	No	63	84.1	73.6-94.7
Q45E. Land use changes	Yes	28	.	Data not generalizable
	No	56	.	Data not generalizable
Q45F. Discharge changes	Yes	12	14.5	5.8-23.2
	No	68	85.5	76.8-94.2
Q45G. Other. Please specify below	Yes	28	.	Data not generalizable
	No	51	.	Data not generalizable

If you checked “Other” above, what was the other source?

State TMDL coordinators offered no substantive responses to this question.

Question	Response	Count	Estimated percentage	95 percent confidence interval
Q46. Within the next 5 years, do you expect that the pollutant load for nonpoint sources will decrease, stay the same, or increase as a result of actions that have already been taken for nonpoint sources in the TMDL for [pollutant] in [water body]?	Decrease	41	39.9	28.8-50.9
	Stay the same	45	30.1	20.4-39.8
	Increase	2	0.9	0-2.4
	Don’t know	50	29.1	19.7-38.5
Q47. Within the next 5 years, do you expect the load allocation for [pollutant] in [water body] to be met?	Yes	18	13.0	5.7-20.4
	No	43	30.1	20-40.2
	Don’t know	77	56.9	46-67.7

Q48. Is there anything else that you think we should know about nonpoint source pollutant loads in the TMDL for [pollutant] in [water body]?

Open-ended response theme	Number of responses
No changes were expected in the water body.	16
It will take more time to see changes in water quality.	11
The TMDL was not a priority for implementation.	10
Total coded responses	**49**

Additional Comments

Q49. Thank you for answering these questions. Please use the following space to share with us any additional thoughts you have about the challenges and opportunities that face your state's TMDL program.

Open-ended response theme	Number of responses
The availability of funding was an obstacle to implementing the TMDL.	42
No legal authority to compel polluters or landowners to abate nonpoint source pollution.	25
A lack of stakeholders prevents the TMDL being implemented.	21
Total coded responses	**67**

Appendix V: Comments from the Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 15 2013

OFFICE OF WATER

Mr. Alfredo Gomez
Acting Director
Natural Resources and Environment
U.S. Government Accountability Office
Washington, DC 20548

Dear Mr. Gomez:

Thank you for the opportunity to review and comment on the Government Accountability Office's draft report GAO-14-80, *"Changes Needed if Key EPA Program is to Help Fulfill the Nation's Water Quality Goals."* The purpose of this letter is to provide the Environmental Protection Agency's response to your findings, conclusions and recommendations.

The EPA generally agrees with the GAO's findings and partially agrees with your conclusions and recommendations. To a great extent, we agree with the report's characterization of the challenges facing the EPA's water quality-based programs (i.e., the much broader context within which the TMDL program operates) under the Clean Water Act. The GAO thoroughly analyzed and understands the abundance and complexity of impaired waters across the Nation, the limited funding and authorities for the CWA programs of the EPA and our state partners, and the limited achievement of CWA goals to date. Further, we agree in principle on the kinds of changes that would be able to increase CWA success. We wish to use this response letter to help clarify, to the extent possible, how the scope of the EPA's TMDL program figures into GAO's otherwise well-compiled findings, conclusions and recommendations. We provide our primary responses within this letter and offer technical details via the enclosed draft document file copy with embedded comments. In addition, we respond to the report's individual recommendations below.

GAO Review Findings Are Consistent with the EPA Understanding of Water Quality Issues and Needs

The draft report adequately recognizes the magnitude of the impairment problems addressed by the EPA and the states, and the general status of nationwide water quality. The description of the broader context of CWA programs, interacting programmatic components, and the EPA and states' respective roles is generally accurate. The EPA commends the GAO's substantial investment of effort in designing and carrying out a statistical survey of state water quality managers that has contributed new empirical data and insights into state TMDL development and implementation, including some findings on impaired waters restoration status and outcomes.

On the whole, the GAO's analysis identified key issues and driving factors as well as logical options for solutions. Although these issues include long-term challenges that remain unresolved, they have been and continue to be addressed as high priorities by our programs within the limits of our resources and

statutory authorities. Specifically, the GAO found that whereas in a high proportion (83%) of TMDLs the required point source load reduction is accomplished, a minority (20%) of TMDLs needing nonpoint load reduction achieve this goal. These findings are consistent with our experience that the regulatory permitting approach addressing point sources is more effective at meeting water quality targets than the voluntary nonpoint source approach – even though over 70% of the EPA's Section 319 nonpoint pollution control projects achieve all objectives. Further, the draft opines that achievement of the CWA goals might be improved by more comprehensive assessment; better causal association of stressor reduction and designated use support; greater implementation, particularly involving landowner participation; more post-TMDL monitoring and adaptive revision where needed; higher funding commensurate with restoration needs; and consideration of regulatory, guidance, or statutory changes as they relate to accomplishing these needed improvements. The EPA agrees in general with these potential options for action, but many require actions by Congress or other entities other than the EPA.

GAO Recommendations and EPA Responses

To enhance the likelihood that the TMDL program will enable the nation's waters to attain water quality standards and to strengthen water quality management; the GAO recommended that the Administrator of the EPA takes the following four actions:

Recommendation 1: ***Develop and issue new regulations requiring that TMDLs include additional elements—and considering the elements that are now optional—specifically, elements reflecting key features identified by the National Research Council as necessary for attaining water quality standards, such as comprehensive identification of impairment and plans to monitor water bodies to verify that water quality is improving.***

EPA Response: The EPA agrees that broader implementation and monitoring requirements would be helpful and, in fact, attempted to revise the TMDL regulations to include such strengthening provisions in 2000. Since Congress prevented those regulations from going into effect, this recommendation might be better directed to Congress than to the EPA.

To help address this recommendation, the EPA plans to continue its long-standing promotion of comprehensive watershed management well beyond just the TMDL program. Within the bounds of 40 CFR 130.7 as currently written, implementation is not a required component for TMDL approval. However, the State Water Quality Management Plan (WQMP), required at 40 CFR 130.6, is the existing mechanism providing the authority for the State to implement TMDLs. 40 CFR 130.6(b) and 130.6(c)(1), read together, clearly establish that TMDLs are "elements" of the Water Quality Management (WQM) Plan and that "WQM plans are used to direct implementation." TMDLs should be the piece of these watershed management plans that identifies the load reductions necessary to achieve water quality standards. The watershed management plan should manage point and nonpoint control implementation, identify controls such as BMPs, develop a schedule for implementation of controls, water quality assessment monitoring, and post-TMDL monitoring of the effectiveness of point and nonpoint source controls, and adjust the implementation plan and/or TMDL accordingly (adaptive implementation).

Recommendation 2: ***To ensure more consistent application of existing TMDL elements and to provide greater assurance that TMDLs, if implemented, can achieve tangible water quality results, identify regional offices with criteria for interpreting and applying such elements in reviewing and***

approving state-developed TMDLs and issue guidance with more specificity, directing all regional offices to follow the same criteria, including requesting states provide more-detailed information about pollution causes and abatement actions.

EPA Response: The EPA generally agrees with this recommendation. The EPA appreciates the GAO's effort to interact with all the EPA Regions and compile their findings on a national, comprehensive basis that reveals consistencies as well as differences. We see national coordination and guidance on procedures for the EPA Regional TMDL review and approval as an ongoing responsibility. Informally, we consistently maintain dialogue across the Regional TMDL programs via monthly conference calls that frequently include specific case studies or TMDL approval issues in practice. In recent years, our approach to Regional coordination on TMDL guidance has focused on clarifying specific elements as needs arise, rather than an overall relook. For example, recently the EPA Headquarters has invested substantially in analyzing issues pertaining to reasonable assurance and coordination with the EPA Regions on their ramifications for state partnerships and TMDL approvals. We will plan to initiate a dialogue with our Regional offices on overall TMDL review and approval guidance during 2014, and this dialogue will be able to consider the recommended changes in specificity and content raised by the GAO.

Recommendation 3: ***Place conditions on states' annual use of nonpoint source management and water pollution control grants to ensure that the funds meet the purposes for which they are awarded and achieve greater reductions in nonpoint source pollution associated with TMDL implementation, such as by targeting funds to states and projects that incorporate factors needed for effective TMDL implementation (e.g., targeting grant funds to projects where implementation plans have been developed and where external agency assistance is available).***

EPA Response: We agree with this recommendation and are doing this already in the Section 319 program by requiring nine-element watershed plans before 319 funds are spent on watershed restoration projects, including those that implement TMDLs. We will share this recommendation with other sources of funding, including geographic programs such as the Great Lakes Restoration Initiative and the Chesapeake Bay Program where much of the program funding resides.

The TMDL program agrees to review the possible uses of Section 106 funding to address this recommendation. Section 106 funds frequently support the development of TMDLs, and thus may have some capability to increase the detail of within-TMDL implementation sections and/or plans. We note, however, that although this Section might be able to increase implementation planning, it is not appropriately used to support on-the-ground implementation activities.

Both implementation planning and on-the-ground support are within the scope of Section 319 funding. In April 2013 Section 319 guidance was reissued by the EPA's Non-Point Source Control Program, with several modifications that strengthen TMDL-related implementation and on-the-ground control actions. Among the provisions in the new guidance were several elements related to the GAO's recommendation, including in particular "an increased emphasis on watershed project implementation in watersheds with impaired waters, and greater accountability measures." More emphasis is placed on

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watershed implementation by requiring a full 50 percent of 319 funds to go for that purpose. The guidance also requires supplemental information for TMDLs developed with 319 funds, including detailed identification of causes/sources, existing loads and load reductions needed by source, and management measures to achieve load reduction. These improvements are already in the form of a Section 319 grant condition, not a new TMDL element, and are structured to make TMDLs more useful to watershed based plans and vice versa. In summary, we believe that the recently revised Section 319 guidance substantially addresses much of what this GAO recommendation seeks to accomplish, and further revision may not be value-added under the current funding picture.

Recommendation 4: ***Obtain missing data that currently impede EPA's efforts to determine whether and to what extent TMDLs have been implemented or to what extent implemented TMDLs have helped impaired waters attain water quality standards by***

- ***directing states to use and report specific GIS data when implementing projects to which TMDLs apply and***
- ***requesting that USDA ask landowners who participate in conservation programs funded by the department in areas subject to a TMDL to disclose information on the location, type, and number of projects implemented under these programs.***

EPA Response: The EPA generally agrees with the first part of this recommendation and suggests that the GAO direct its second part to the USDA. Understanding TMDL implementation rates and patterns and their related driving factors is at once essential to effective program management while also cost-prohibitively complex to accomplish fully and nationally. The practical question is, what specifics of implementation tracking and data are feasible and essential to program success? The TMDL program has an established track record of nearly ten years of analyzing implementation, within our limited resources and against a backdrop of continually changing implementation activity among a wide slate of restoration participants, and with no EPA authority to centrally track all these actions. The TMDL program earlier estimated an annual cost of over $10 million to attempt to track all implementation actions (likely with limited success) for all TMDLs when about 30,000 TMDLs existed – not to mention the higher costs of relating these actions definitively to all water quality effects. We emphasize that a complete inventory of implementation actions and their influence on impaired waters recoveries will remain infeasible as a course of action, but share the GAO's keen interest in obtaining key data and developing more insightful analyses.

We agree that, due to its gradual but continued emergence as a routinely available element in environmental programs, geospatial data provides a highly valuable basis for data integration from multiple information sources. Although far from enabling complete inventory, geospatial data on NPDES permits and Section 319 projects enabled the EPA to summarize some basic implementation activities for thousands of TMDLs nationwide in 2011. Permits and Section 319 tracking continues to accumulate georeferenced information for newer permits and projects. In 2013, the EPA is actively engaging with states on a geospatial data requirements and applications study that seeks to exploit greater efficiencies in impaired waters and TMDL reporting and data management. Although we are uncertain as to the breadth of project types for which state implementation reporting could be required, we are actively engaging with states to develop a productive consensus on geospatial data requirements

and uses. We expect this project and a broader effort on an improved national EPA geospatial framework, including a significant investment of effort in catchment-level data management, to remain a priority activity during 2014 and beyond.

Regarding the second element of the GAO's recommendation, we agree that location and type of USDA pollution control projects would be useful data for tracking implementation and evaluating water quality effects, and urge GAO to direct this recommendation to USDA. As currently written, the recommendation implies that the EPA would use the USDA data to assess individual actions to implement individual TMDLs. Instead, we envision using the EPA's state oversight and tracking to assess states' collective progress in TMDL implementation, which may in turn reflect data shared with the state by USDA through conservation cooperator agreements.

Again, thank you for the opportunity to comment. The EPA expresses its appreciation for the thoughtful work of the GAO staff members throughout this review and their engagement with the EPA headquarters, the EPA Regional, and State water program staff.

Sincerely,

Nancy K. Stoner
Acting Assistant Administrator

Enclosure

cc: EPA GAO Liaison Team

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Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the individual named above, Susan Iott (Assistant Director), Nathan Anderson, Elizabeth Beardsley, Mark Braza, Ellen W. Chu, Catherine Hurley, Justin Fisher, Paul Kazemersky, Katherine Killebrew, Dan C. Royer, Kelly Rubin, and Kiki Theodoropoulos made key contributions to this report.