1. INTRODUCTION

1.1. THE PURPOSE AND ROLE OF THIS REPORT

The goal of this report is to help states and authorized tribes—and the associated communities—to understand how the assessment of ecological benefits could inform decisions about their water bodies while complying with the provisions of the Clean Water Act (CWA). Although estimating the gains from these decisions is not required by the CWA and related regulations, understanding community preferences for water quality may aid in conducting a balanced analysis. The report is intended to assist water quality officials, watershed managers, members of stakeholder groups, and other interested individuals in fully evaluating the ecological and socioeconomic gains and losses that often are involved in these decisions. It also provides a framework and suggestions for eliciting input from stakeholders, assessing the preferences of the affected community, and incorporating these insights into the decision-making process.

The CWA includes two main approaches to improving water quality: effluent guidelines and water quality standards (WQS). This report focuses on WQS. Whereas effluent guidelines focus on specific industries and, depending on the available technology, set pollution limits to protect the receiving waters, Section 303(c) of the CWA requires states and tribes to adopt designated uses or goals for their water bodies. Designated uses, which are one component of the WQS program, are designed to protect the natural integrity of the nation's waters and the uses of these waters by people and aquatic organisms. The CWA also recognizes that, in some cases, states or tribes must evaluate changes to a designated use, for example, because naturally occurring, man-made, or socioeconomic factors inhibit its attainment.[1] Decisions related to changing or attaining designated uses sometimes require consideration and balancing of various health, ecological, institutional (e.g., organizational goals), and socioeconomic factors (herein called *gains and losses* or *benefits and costs*). States and tribes are provided limited latitude in adopting or revising designated uses and must balance these gains and losses carefully. For example, a significant reduction in the discharge of pollutants to a stream might restore a blue ribbon trout fishery and make the stream safe for full-contact recreation such as swimming, but it also may require a substantial increase in treatment costs. On the other hand, a modest reduction

[1] In some cases, these evaluations could establish that a higher use is attainable.

with a modest increase in treatment costs may allow the stream to support trout year round yet make the water only safe enough for incidental contact recreation such as fishing and boating.

To change designated uses, states and tribes are first required to conduct **use attainability analyses (UAAs)** or variance analyses. The purpose of these scientific assessments is to determine which designated uses are feasible and appropriate for a water body. A variance analysis, similar to a UAA, is for a temporary relaxation of the WQS. In other cases, states and tribes may consider permitting a reduction of water quality in high-quality waters if the reduced quality will not affect existing[2] or designated uses. Under these conditions, the CWA requires formal **antidegradation reviews (ARs)** to demonstrate that the reduction is necessary to accommodate important economic or social development in the area. Thus, the ultimate determination of water quality goals for a stream, lake, or estuary may require the evaluation of both ecological and socioeconomic objectives. Therefore, in the UAA case, a community may ask, what are the benefits of attaining a use that is not currently being attained? Or, in the AR case, the relevant question might be, if we allow the degradation being considered, what are the damages produced? The answers to these questions may lead to a community's reconsideration of whether a use change (and, in turn, the quality of their water) is needed.

Figures 1-1 through 1-5 outline some of the specific situations this report is intended to address.[3] They include, most importantly, decisions related to UAAs and ARs, but they also extend more broadly to watershed planning decisions. More specifically, the four situations are

1. Deciding whether to change a use in a UAA where there are substantial and widespread economic impacts from retaining existing use,

2. Deciding whether a source of impairment is better left in place because of the environmental damages that might be caused from corrective measures,

3. Deciding whether the damages from allowing the reduction in water quality that is necessary to accommodate important economic and social development (Tier 2: Antidegradation) are acceptable to the community, and

4. Deciding whether a potential watershed planning activity should be pursued.

[2] The WQS regulation defines existing uses as those uses "actually attained in the water body on or after November 28, 1975, whether or not they are actually included in the water quality standards" (40 CFR 131.3 (e)).
[3] The CWA elements and the WQS regulation process are not as distinct as the figures suggest. This simplification, however, is needed to clarify the purpose of the report.

The report describes an approach for integrating assessments of ecological quality with assessments of socioeconomic considerations, so that the relevant benefits and costs can be understood, communicated, and weighed in the standard-setting process. As shown in these figures, in many situations this approach requires evaluating community preferences.

Figure 1-1 depicts the key CWA elements. If a state/tribe determines that a water body is not meeting its WQS, it can place the water body on its listing of impaired waters—the 303(d) list—and develop management strategies and total maximum daily loads (TMDLs).[4] This strategy assumes that the use is attainable. However, if the state believes that attaining the use is not feasible, one alternative is changing the use, contingent on a UAA assessing the physical, chemical, biological, or socioeconomic factors (40 CFR 131.10 (g)). Decision-makers and analysts would have to evaluate conditions in the affected water body, define an initial set of options for addressing the WQS, and evaluate the options following existing guidance for UAAs.

Figure 1-2 illustrates how the socioeconomic factor is used in a UAA and how public preferences can enter the decision-making process. The socioeconomic factor specifically addresses whether the adverse economic and social impacts of actions necessary to eliminate an impairment at a particular site would be both *substantial and widespread*. With this factor, attainability is usually determined using financial impact and economic impact analyses; community preferences for water quality are not likely to play a role in examining this factor. However, following the determination of *substantial and widespread*, community preferences for water quality might be important if the UAA suggests that a designated use should be downgraded, as indicated by the box with the broken outline in Figure 1-2. The community may want to keep the long-term water quality goal even if doing so would have a substantial and widespread economic impact.

Current guidance allows, but does not require, the consideration of benefits in deciding whether to actually remove the designated use (U.S. EPA, 1995). For example, the community could decide to subsidize the pollution control costs. If the current use is removed, then a new

[4] U.S. EPA defines a TMDL as the “calculation of the maximum amount of a pollutant that a water body can receive and still meet WQS, and an allocation of that amount to the pollutant's sources.”

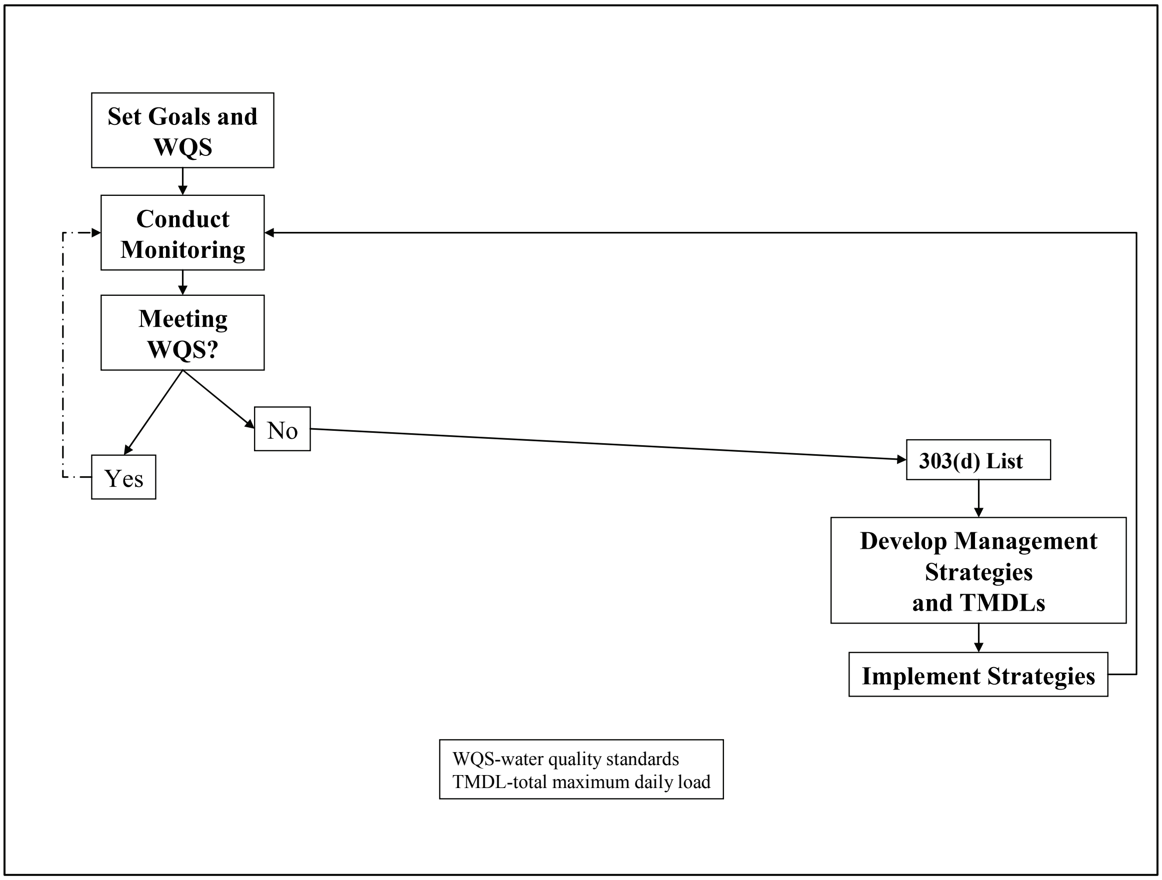

FIGURE 1-1

Key Clean Water Act Elements*

*CWA elements based on slides from: "Watersheds 101: CWA Tools for Watershed Protection. A Training Workshop." Additional information accessed at www.epa.gov/watertrain.

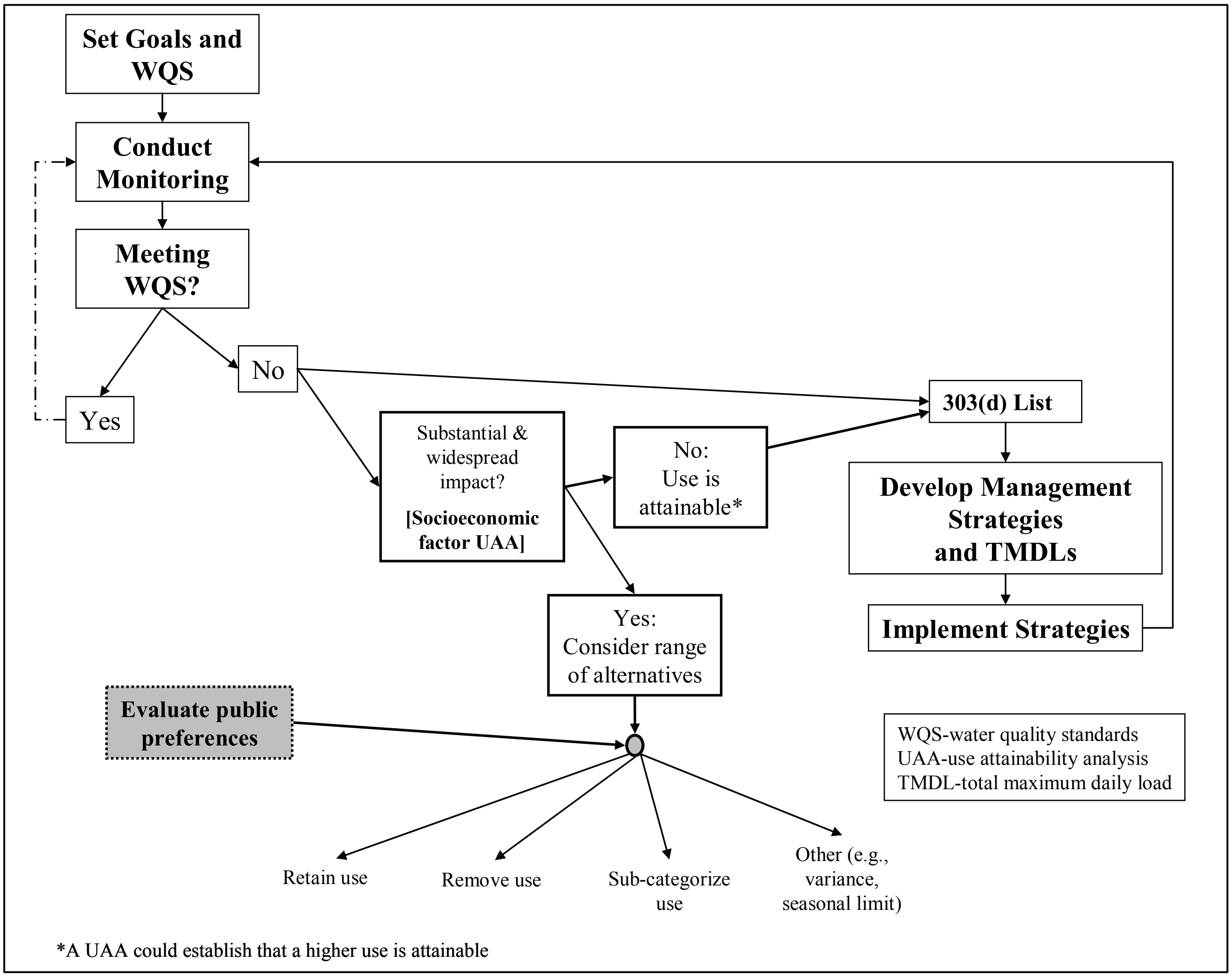

FIGURE 1-2

Use Attainability Analysis Using Socioeconomic Factor use may need to be determined. Community preferences for water quality improvements and the costs of achieving those improvements could play a role in identifying the appropriate new use.[5]

Figure 1-3 illustrates how the human-caused condition factor is used in a UAA and how public preferences can enter the decision-making process in this situation. A UAA may determine that human-caused conditions or sources of pollution prevent the attainment of the designated use and that these impairments cannot be remedied or that corrective measures would cause more environmental damage than leaving the source of impairment in place.[6] For example, in certain circumstances, removing contaminated sediments associated with historical pollution inputs would result in greater downstream environmental damage than leaving the sediments in place.

In these situations, evaluating community preferences may have an appropriate role for weighing the damages vs. the improvement, particularly if the environmental damage to be caused by correcting the human-caused condition differs in kind from the environmental improvement that would result. For example, community preferences may help to weigh the creation of an upland disposal site vs. the alleviation of instream contamination.

Figure 1-4 illustrates the situation where a state is meeting its WQS, but an antidegradation policy is required. The antidegradation policy is a set of procedures for evaluating regulated activities that may affect water quality. It is a three-tier program that sets the minimum level of protection (Tier 1) and protects "high-quality" waters (Tier 2) and outstanding national resource waters (Tier 3).[7] Figure 1-4 specifically illustrates a Tier 2 decision node that could benefit from community input. Tier 2 water quality levels that exceed "fishable/ swimmable" must be protected unless the reduction is deemed necessary to accommodate important economic and social development in the area of the water body (as long as WQS are still met). U.S. Environmental Protection Agency (EPA) guidance suggests that the same analytic tools for the socioeconomic factor UAA be used for AR (U.S. EPA, 1995). Therefore, as

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[5] In this report, obtaining community or public preferences refers to something more than the mere solicitation of public comments. Although public comments can provide important information in the process, here we are discussing the use of preference elicitation or preference revelation methods (see Chapter 4 for more information).
[6] Related to this factor is EPA Region IX's guidance for effluent-dominated waters (U.S. EPA, 1992) describing the "net environmental benefit use attainability analysis." As stated in a Colorado Water Quality Control Division Discussion Paper (2003: p. vi), "[b]ecause a net environmental benefit approach inherently involves trade-offs and value judgments, the appropriate roles for both the states and the EPA in making these judgments need to be defined." This report suggests that public preferences should play a role in the value judgment as well.
[7] Chapter 2 provides more details on the Antidegradation Policy.

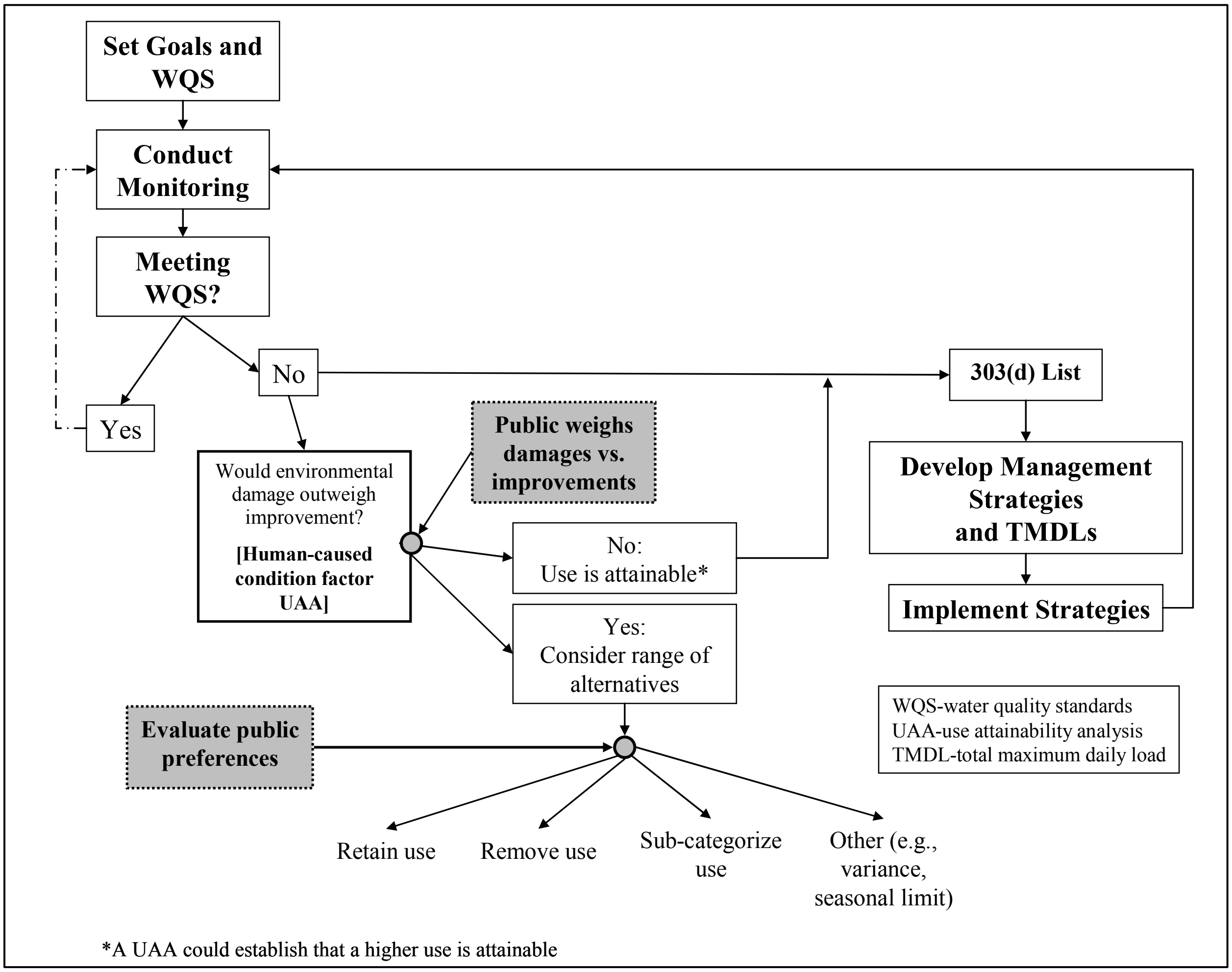

FIGURE 1-3

Use Attainability Analysis Using Human-Caused Condition Factor

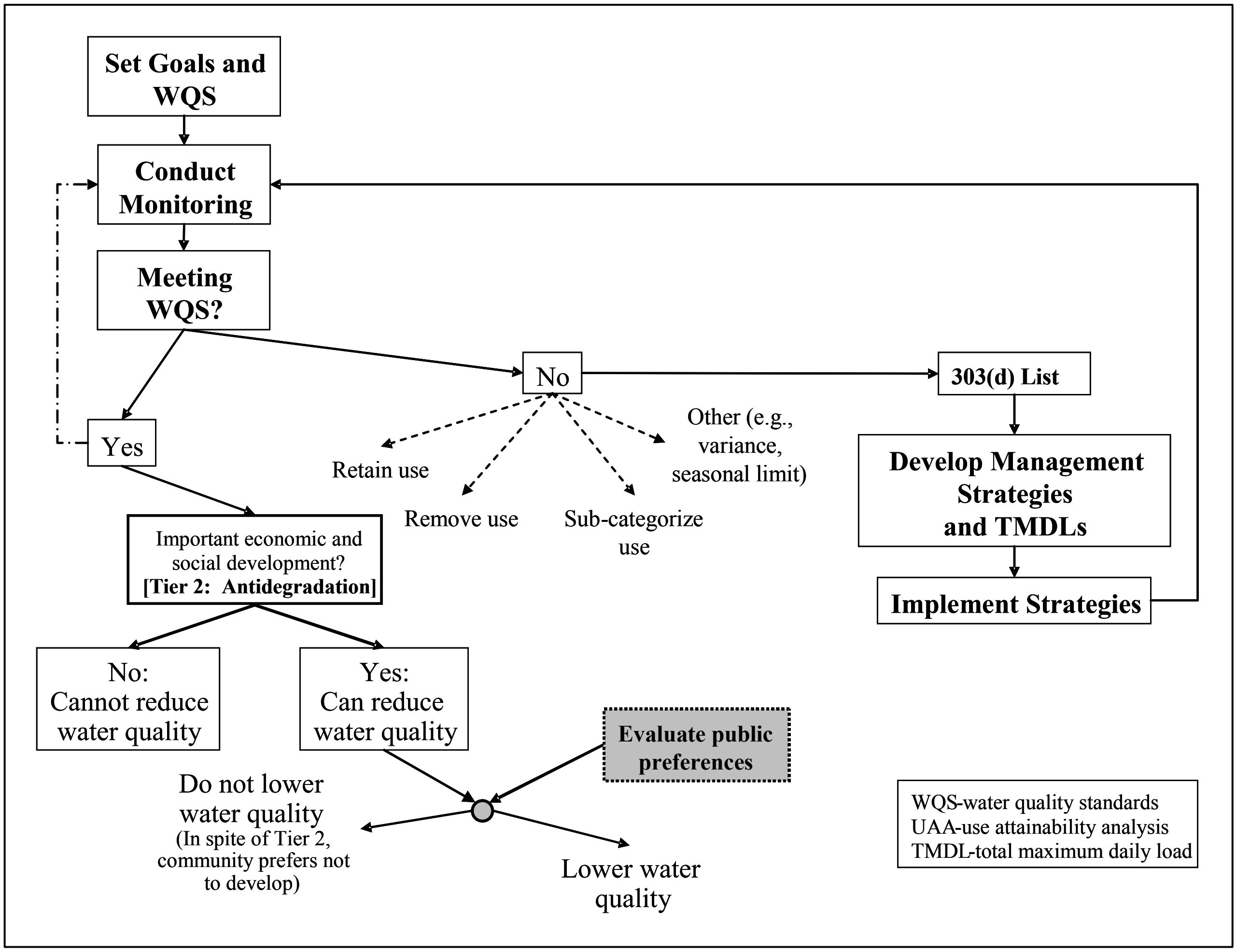

FIGURE 1-4

Antidegradation Review for High-Quality Waters
(exceeds fishable/swimmable goal)

with the socioeconomic factor (Figure 1-2), the fact that a lowering of water quality is allowable does not necessarily mean that the community would prefer it.

Figure 1-5 addresses watershed-wide planning activities that may identify water quality improvement strategies, which include regulatory (e.g., TMDL), nonregulatory (e.g., Section 319 nonpoint source grants), and other, non-CWA mechanisms or authorities. Through these activities, community development or other land management decisions may influence WQS attainment. In this broader context, community preferences play a critical or even determining role. For example, a community group may want to justify spending money to improve downstream water quality or coastal recreational activities.

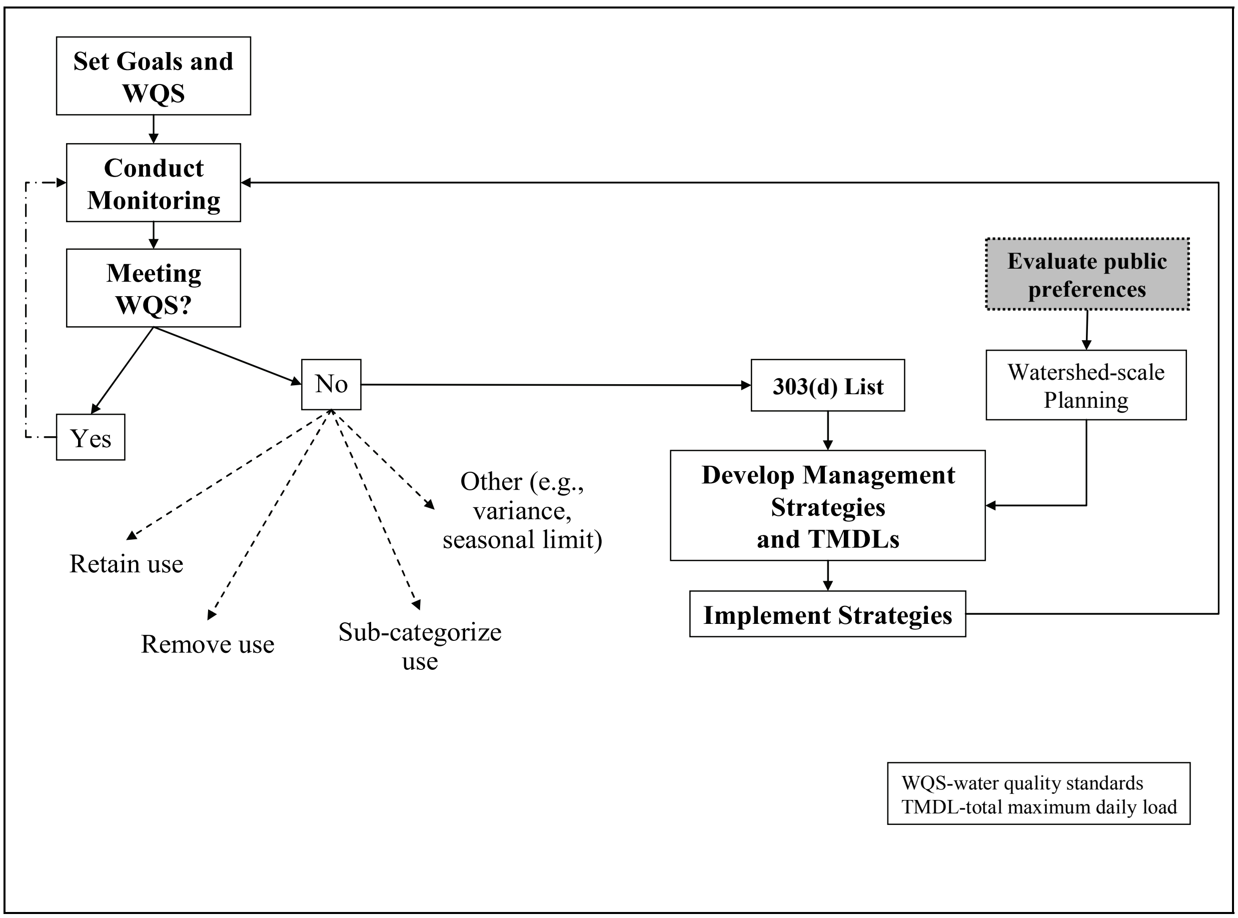

FIGURE 1-5

Watershed Planning Activities

As shown in these five figures, community preferences can contribute to WQS decisions in a number of ways. The main objective of this report is to propose a general decision framework and a corresponding set of methods for incorporating community input and preferences into decisions affecting the quality of local rivers and streams. Although the framework and methods are potentially applicable to a wide range of WQS decisions (e.g., prioritizing restoration activities, establishing variances, conducting watershed planning), the report focuses mainly on UAA and AR decisions. It uses and references methods from ecological risk assessment, causal analysis, economics, and other social sciences to explain how this information can be used in these types of water quality management decisions. More broadly, this document serves as

- an introduction to the CWA, WQS, UAAs, and ARs (Chapter 2);
- a basis for understanding the relationship between use-attainment decisions and the effects on ecosystems, ecosystem services, and ecological benefits (Chapter 3);
- a reference for methods that ascertain preferences related to attaining uses (Chapter 4); and
- a guide for incorporating new approaches in water quality decisions (Chapter 5).

This report should not be misconstrued as a new regulation or setting aside current regulatory requirements. It works within the boundaries set by the CWA and does not supersede any existing regulations or guidance.

Figure 1-6 depicts the general decision framework that this report proposes for addressing WQS and use-attainment issues. It also serves as an organizing structure for the report. The first few elements of the framework—from setting water quality goals and standards to developing initial management options—have already been touched on in this chapter. The next chapter (Chapter 2) expands on these topics by specifying the ground rules for WQS decisions. It defines the goals of the CWA, describes how WQS are used in implementing the CWA, and explains how WQS are established and occasionally modified through UAAs and ARs. It discusses the main factors that are evaluated in UAAs to determine whether use attainment is feasible. It specifically examines the “widespread economic and social impact” factor and describes the alternative economic methods that are or could be used in UAAs and ARs. It also presents examples of actual UAAs and ARs that have included economic analyses.

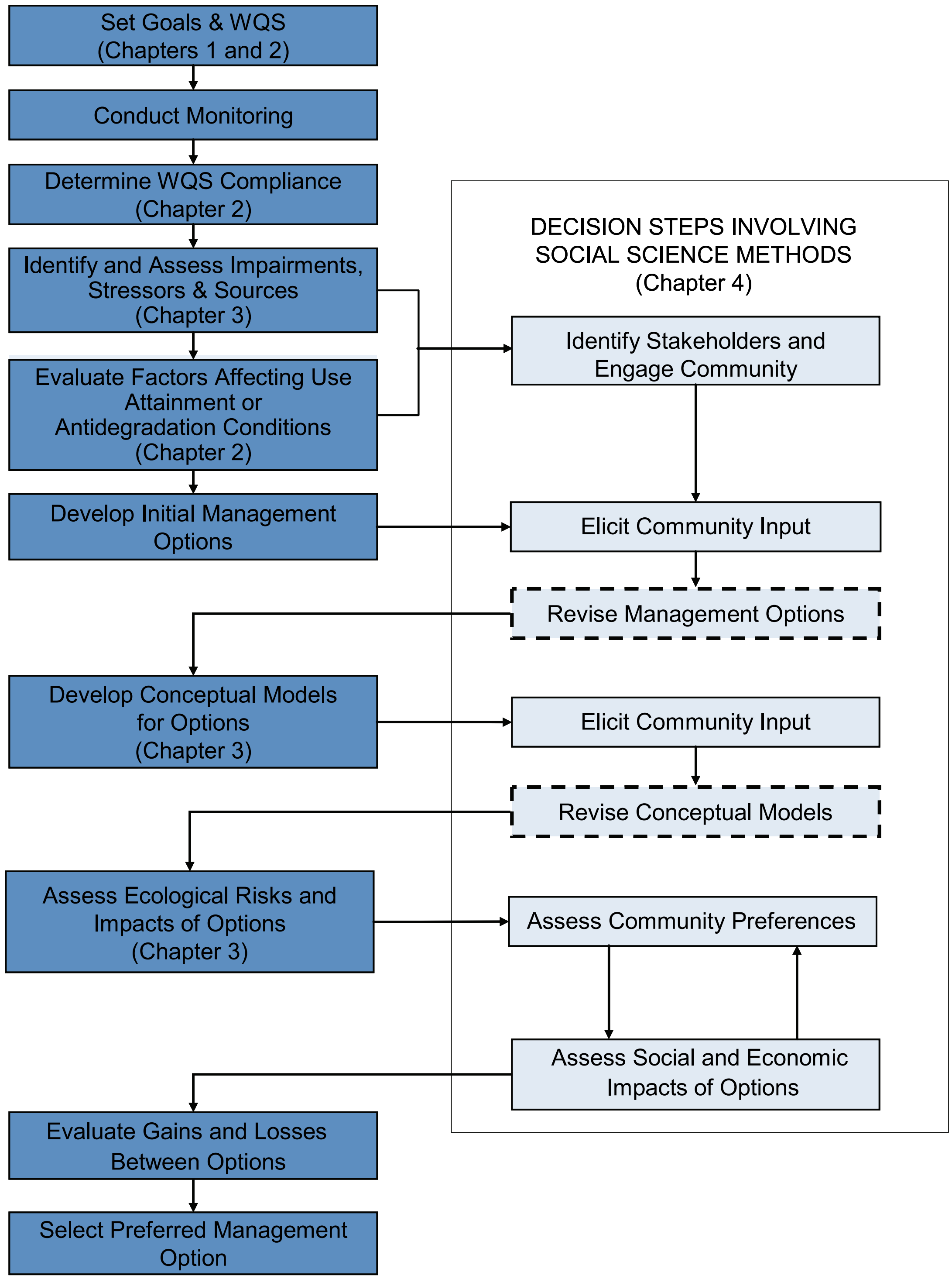

FIGURE 1-6

Framework for Incorporating Community Input and Preferences and Evaluating Ecological and Socioeconomic Gains and Losses in WQS Decisions
(chapter listed provides details of decision step)

Chapter 3 discusses methods for identifying and characterizing the relevant water quality problem(s) and the gains and losses associated with alternative management options. It characterizes impairments and their causes; it summarizes approaches for assessing ecological risks, including the identification of ecological risk assessment endpoints; and it defines ecosystem services and how they are affected by setting WQS. It then describes how flow diagrams can be used as conceptual models for representing the WQS management decisions. These diagrams depict the linkages between sources, stressors, ecological impacts, ecosystem services, and human welfare and the ecological and socioeconomic changes associated with different management options. The development of these conceptual models is illustrated through a series of hypothetical case studies involving complex management issues such as acid mine drainage affecting a river and its main tributary, combined sewer overflows, intermittent streams, commercial development and antidegradation, and effluent-dominated streams.

Chapter 4 presents a variety of social science methods that can be used to support and strengthen the WQS decision-making process. In particular, they can be used in a variety of ways to address the steps highlighted on the right hand side of Figure 1-6 (i.e., identify and engage stakeholders, elicit community input, assess community preferences, and assess socioeconomic impacts). Chapter 4 divides these methods into two main categories: sociocultural and economic methods. The main distinguishing feature of economic assessment methods is that they are based on a common conceptual paradigm for evaluating the human welfare effects and the benefit-cost trade-offs involved in policy decisions. Sociocultural methods, in contrast, provide a number of alternative perspectives and approaches for eliciting stakeholder input, assessing community preferences, and evaluating gains and losses as part of the decision-making process. In essence, Chapter 4 provides the reader with a toolkit of potentially useful social science methods. It briefly describes and compares the different techniques, highlighting some of their main advantages and disadvantages, and it provides references for more in-depth descriptions and illustrations of the methods.

Finally, Chapter 5 illustrates how the proposed decision framework can be implemented in practice, with particular emphasis on how social science methods can be applied. It divides the decision process outlined in Figure 1-6 into three main phases: (1) framing the WQS decision, (2) comparing the advantages and disadvantages of the different management options and (3) making the decision (selecting the most preferred option). For each phase, it describes the main components of the decision process and the techniques that can be used to address each component. It also uses two of the UAA case studies described in Chapter 3—one involving acid mine drainage and the other combined sewer overflows—to illustrate how the methods and tools described in the previous chapters can be applied to inform and strengthen each stage of the decision-making process.

1.2. REFERENCES

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