2. UNDERSTANDING THE GROUND RULES: AN INTRODUCTION TO WATER QUALITY STANDARDS, USE ATTAINABILITY ANALYSES, AND ANTIDEGRADATION REVIEWS

This chapter explains how the water quality goals and ecological integrity for a water body, termed its designated uses, are established as part of a WQS program. It discusses the circumstances under which designated uses can be changed with a focus on whether these changes are wanted by communities. Understanding these ground rules—determining what is allowable—is a prerequisite for the subject to be addressed in the following chapters—determining whether the changes are worth making (see U.S. EPA [1994] for more detail).

2.1. CLEAN WATER ACT GOALS AND THE ESTABLISHMENT OF WATER QUALITY STANDARDS

States adopt WQS in accordance with the Water Quality Standards Regulation (40 CFR 131) to protect public health and welfare, enhance the quality of water, and serve the purposes of the CWA. Section 101(a)(2) of the CWA identifies two overarching goals:

- Restore and maintain the chemical, physical, and biological integrity of the nation's waters, and
- Achieve a "fishable/swimmable" level of water quality: one that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water, wherever attainable.

The CWA recognizes other objectives when it requires states to consider the use and value of public water supplies, and agricultural, industrial, and other purposes, including navigation, in revising or adopting new WQS (Section 303(c)). Although the CWA does not present a hierarchy of uses, U.S. EPA's Water Quality Standards Regulation highlights the uses in the "fishable/swimmable" goal (U.S. EPA, 1994).

The WQS program is a partnership between U.S. EPA and states and authorized tribes to work toward achieving the goals of the CWA. The states and tribes have primary responsibility for setting, reviewing, revising, and enforcing WQS. U.S. EPA develops regulations, policies, and guidance to help states and tribes implement the program and oversees their activities to

ensure that standards are consistent with the requirements of the CWA and the WQS regulation. U.S. EPA has authority to review and approve or disapprove state standards and, where necessary, to promulgate federal WQS.

2.1.1. What are Water Quality Standards?

To comply with the provisions of the CWA, states and authorized tribes must establish WQS. According to U.S. EPA (1994) and 40 CFR 131, WQS are the foundation of the water quality-based control program mandated by the CWA. WQS define the goals for a water body by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants. A water quality standard consists of four basic elements:

(1) Designated uses of the water body (e.g., recreation, water supply, aquatic life, agriculture)

(2) Water quality criteria (numeric pollutant concentrations and narrative requirements) to protect designated uses

(3) An antidegradation policy to maintain and protect existing uses[1] and high-quality waters, and

(4) General policies addressing implementation issues (e.g., low flows, variances, mixing zones)

The following sections describe these elements in greater detail.

2.1.2. Designated Uses

States and authorized tribes are required to specify, for each water body, appropriate uses to be achieved and protected. The appropriate uses are determined by taking into consideration the use and value of the water body for a variety of purposes: public water supply; protection of fish, shellfish, and wildlife; and recreational, agricultural, industrial, and navigational purposes. In designating uses for a water body, states and tribes examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and economic considerations. Because each state considers its own set of water bodies, each state could have a unique set of designated uses (e.g.,

[1] 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)).

see Table 2-1). Designated uses must be at a minimum the uses actually attained, termed existing uses, at any time since November 28, 1975 (U.S. EPA, 1994). Existing uses are different from designated uses because, whereas a designated use can be removed, existing uses set a historical baseline that must be maintained. The inclusion of existing uses in WQS helps ensure that a temporary impairment does not become permanent.

If a state or tribe designates a use that does not include uses of aquatic life and contact recreation (the fishable/swimmable goal of the CWA), it must conduct a UAA. Such water bodies must be reexamined every 3 years to determine if new information has become available that would warrant a revision of the standard. If new information indicates that "fishable/swimmable" uses can be attained, those uses must be designated. In addition, states and tribes may remove a designated use that is not an existing use or establish subcategories of a use if the state can demonstrate through a UAA that attaining the designated use is not feasible. For example, to meet the deadline of submitting WQS (if states had not adopted WQS for intrastate waters) to the Administrator prior to 180 days after October 18, 1972, some states designated all waters as fishable/swimmable because they did not have time to evaluate the attainability before designating the use. Because no evaluation was done, some designations may not be attainable or some could actually be upgraded. The WQS regulation (40 CFR 131.10(g)) lists reasons why a designated use might not be feasible; they include physical, chemical, biological, and socioeconomic reasons (Section 2.2 describes these six factors in more detail).[2]

2.1.3. Water Quality Criteria

Under 40 CFR 131.11, states are to adopt numeric (e.g., pH measured from 6.0 to 9.0 to protect the cold-water fishery use) and/or narrative criteria (e.g., "aquatic life should be as it naturally occurs") with sufficient coverage and stringency to protect designated uses. States can choose to

- adopt the criteria that U.S. EPA publishes under 304(a) of the CWA,[3]
- modify the Section 304(a) criteria to reflect site-specific conditions, or
- develop other criteria based on scientifically defensible methods.

[2] These analyses could also establish that a higher use is attainable.
[3] Water quality criteria documents can be found at http://www.epa.gov/waterscience/criteria.

TABLE 2-1

Examples of States' Designated Uses

OREGON[a]		OHIO[b]	
Domestic water supply Industrial water supply Irrigation Livestock watering Fish and aquatic life Wildlife and hunting	Fishing Boating Water contact recreation Aesthetic quality Hydropower Commercial navigation and transportation	Warm-water habitat Limited warm-water habitat Exceptional warm-water habitat Modified warm-water habitat Seasonal salmonid habitat Cold-water habitat Limited resource waters	Bathing waters Primary contact recreation[c] Secondary contact recreation[d] Public water supply Agricultural water supply Industrial water supply

MAINE[e]	
Class AA: Must be of such quality that they are suitable for the designated uses of drinking water after disinfection, fishing, agriculture, recreation in and on the water, navigation and as habitat for fish and other aquatic life. The habitat must be characterized as free-flowing and natural. Class A: Must be of such quality that they are suitable for the designated uses of drinking water after disinfection; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The habitat must be characterized as natural.	Class B: Must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life. The habitat must be characterized as unimpaired. Class C: Must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as habitat for fish and other aquatic life.

[a]Accessed on March 26, 2007, at www.deq.state.or.us/wq/standards/uses.htm.
[b]Accessed on March 26, 2007, at www.epa.state.oh.us/dsw/wqs/designation_summary.pdf.
[c]Water depth allows full body immersion (e.g., swimming).
[d]Water depth precludes full body immersion (e.g., wading).
[e]All copyrights and other rights to statutory text are reserved by the State of Maine. The text included in this publication reflects changes made through the Second Regular Session of the 122nd Legislature, and is current through December 31, 2006, but is subject to change without notice. It is a version that has not been officially certified by the Secretary of State. Refer to the Maine Revised Statutes Annotated and supplements for certified text. Accessed on March 26, 2007, at http://janus.state.me.us/legis/statutes/38/title38sec465.html.

Criteria are developed to protect human health and aquatic life (both freshwater and saltwater) and to specify desirable biological characteristics (biocriteria) and nutrient levels (nutrient criteria). Criteria are science-based; as new information becomes available, criteria are revised to reflect it.

2.1.4. Antidegradation Policy

Antidegradation policy specifies a three-tier program. Tier 1 protects existing uses and the water quality conditions needed to protect those uses. Tier 2 maintains and protects "high-quality" waters—water bodies where water quality exceeds "fishable/swimmable." Tier 3 maintains and protects water quality in outstanding natural resource waters. Under Tier 2, water quality may be lowered as long as existing and "fishable/swimmable" uses are not impaired; however, U.S. EPA (1994) states, "This provision is intended to provide relief only in a few extraordinary circumstances…" (p. 4-7). For example, a proposed wastewater treatment plant discharge is expected to change pH, but because pH should remain in the range of 6.0 to 9.0, the cold-water fishery use should not be impaired. To justify lowering water quality in Tier 2 cases, an AR analysis must be performed (Section 2.2 provides more detail on ARs).

2.1.5. General Provisions

States and tribes may adopt policies and provisions regarding WQS implementation. For example, variances allow states and tribes to temporarily relax a water quality standard to progress toward attainment. Mixing zone policies allow numeric criteria to be exceeded for small areas near outfalls if the integrity of the water body as a whole is protected. Finally, a water quality standard may include procedures for critical low-flow conditions that differ from higher flows. Such policies are first subject to U.S. EPA review and approval.

2.1.6. Review and Revision

After state or tribal WQS are officially adopted, a governor or designee submits the standards to the appropriate U.S. EPA Regional Administrator for review to determine whether any analyses performed are adequate. The Agency also evaluates whether the designated uses and criteria are compatible throughout all water bodies covered and whether downstream water

quality is protected. The CWA requires states to hold public hearings to review their WQS at least once every three years and to revise them if appropriate.

States may identify necessary additions or revisions to existing standards based on their 305(b) reports (i.e., biennial reports describing the quality of states' waters including the extent to which designated uses are supported and the impairments), other water quality monitoring data, etc. WQS reviews and revisions may include additions to and modifications of uses, criteria, the antidegradation policy or procedures, or the general policies.

2.2. CONDUCT OF USE ATTAINABILITY ANALYSES AND ANTIDEGRADATION REVIEWS

As described above, states or tribes that wish to designate a use for a water body that is not consistent with CWA Section 101(a)(2) (i.e., "fishable/swimmable"); remove a designated use for a water body that is specified in Section 101(a)(2); or adopt a subcategory of a use must conduct a UAA. A UAA is a structured scientific assessment of the factors affecting the attainment of a use. UAA is best understood as a means of determining which uses are feasible and appropriate for a water body, rather than as a process for downgrading uses. For example, in certain cases, initial use designations made by states and tribes were not actually attainable (see Section 2.1.2). UAA constitutes a process for recognizing and correcting these historical mistakes. The WQS regulation lists factors states can use to demonstrate that attaining a use is not feasible (40 CFR 131.10(g)):

(1) naturally occurring pollutant concentrations prevent the attainment of the use;

(2) natural, ephemeral, intermittent or low-flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating state water conservation requirements to enable uses to be met;

(3) human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place;

(4) dams, diversions, or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use;

(5) physical conditions related to the natural features of the water body, such as a lack of proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or

(6) controls more stringent than minimum technology requirements (as specified in Sections 301(b) and 306 of the CWA[4]) would result in substantial and widespread economic and social impact.

As the above list makes clear, economic and social impacts are only one of several reasons states may cite in a UAA for adopting a lower designated use or subcategorizing a use. Thus, the majority of UAAs rely on noneconomic arguments, but economics may play a determining role in some cases. In contrast, economics is more central in ARs. The WQS regulation (131.12 (a)(2)) provide that water quality in "high-quality" or Tier 2 waters may be lowered without changing the current uses of the water body if it is necessary to permit "important economic and social development." In addition to these provisions, the WQS regulation (131.13) allow states to grant a variance from WQS to specific dischargers, allowing them to exceed water quality-based permit limits for a certain pollutant for a limited period of time.

U.S. EPA provides guidance on the need for and conduct of UAAs and other economic analyses in the *Water Quality Standards Handbook* (U.S. EPA, 1994) and the *Interim Economic Guidance for Water Quality Standards: Workbook* (U.S. EPA, 1995). A short summary of existing economic guidance in the WQS program follows.

2.2.1. Economics in Use Attainability Analysis

When applying for a change in a designated use or a subcategory of use, or for a variance, specifically based on economic criteria (i.e., factor six in WQS regulation), the state must demonstrate that meeting WQS will cause substantial and widespread economic and social impacts. The *Interim Economic Guidance for Water Quality Standards: Workbook* (hereafter referred to as *Interim Economic Guidance*) defines a set of measures to determine whether impacts are substantial, including separate measures for private-sector and public-sector pollution sources (U.S. EPA, 1995). U.S. EPA notes that, to justify modifying a use or granting a variance, the state must demonstrate both substantial impacts on the discharger and widespread

[4] Sections 301(b) and 306 do not list any specific requirements.

impacts on the geographic area. The *Interim Economic Guidance* defines financial ratios (e.g., profitability, liquidity, solvency, and leverage) to determine whether impacts are substantial, and it identifies a group of socioeconomic indicators (see Section 2.2.4) that should be considered when assessing whether impacts are widespread. The financial ratios to determine substantial impacts are further explained in Appendix A.

2.2.2. Economics in Antidegradation Reviews

As with removing a use or granting a waiver, economic impacts are also considered as part of an AR. Where water quality exceeds "fishable/swimmable," states can allow reduction in water quality (as long as existing uses are protected) if the reduction is necessary to accommodate important economic or social development in the area of the water body. U.S. EPA's *Interim Economic Guidance* notes that ARs are in a sense the "flip side" of UAAs. Variances and use downgrades refer to situations where additional treatment to meet standards may result in substantial and widespread economic impacts, while antidegradation refers to situations where lowering water quality may result in improved social and economic development. Although the terminology associated with economic analyses for UAAs and ARs is different, the *Interim Economic Guidance* recommends using the same analytical tools for both.

In conducting an AR, the state must show both that the costs of treatment needed to maintain water quality would interfere with development and that the development is important to the region. These requirements are analogous to the UAA requirement that impacts show both substantial and widespread effects.

2.2.3. Evaluating Substantial Impacts or Costs Sufficient to Interfere with Development

Although U.S. EPA (1995) demonstrates that the same measures can be used for UAAs and ARs, it defines separate measures for public-sector and private-sector entities. For simplicity, the rest of this discussion will refer to these measures as demonstrating substantial impacts; however, the same measures are applicable for ARs as well.

2.2.3.1. *Measures for Private-Sector Entities*

Analyzing impacts on private-sector entities relies on the use of financial ratios that compare the costs of complying with the WQS with baseline company sales, profits, and other financial variables. U.S. EPA (1995) recommends the following process to assess whether impacts are substantial, which can be conducted for a single affected facility or a group of facilities that discharge pollutants to a water body:

(1) Verify project costs and calculate the annual cost of the pollution control project.

(2) Conduct financial impact analysis:

- Primary measure = Profit—How much will profits decline because of the pollution control expenditure?
- Secondary measures
  - Liquidity—How easily can an entity pay its short-term bills?
  - Solvency—How easily can an entity pay its fixed and long-term bills?
  - Leverage—How much money can the entity borrow?

U.S. EPA advises computing various ratios that measure profit, liquidity, solvency, and leverage both with and without the control costs. The *Interim Economic Guidance* states that the analysis should be conducted at the facility level and that the application should be accompanied by data to demonstrate it. U.S. EPA also notes that facility-level data may be unavailable or considered proprietary; in this case, U.S. EPA suggests estimating facility-level data based on data for the company that owns the facility. Appendix A describes in detail the ratios used for each measure and the values of each ratio that indicate when an impact is substantial.

2.2.3.2. *Measures for Public-Sector Entities*

If a facility is owned by a public-sector entity (such as a publicly owned treatment works [POTW] or public construction project), the indicators of impact are different. In this case, the process involves several steps:

(1) Verify project costs and calculate the annual cost of the pollution control project.

(2) Calculate the total annualized pollution control cost per household.

(3) Calculate and evaluate the municipal preliminary screener score, which compares the cost per household with the municipal median household income.

(4) Apply the secondary test, which characterizes community baseline financial and socioeconomic well-being based on measures such as debt indicators, unemployment rate, median household income, and measures of financial management.

(5) Determine where a municipality falls in the "substantial impacts matrix."

Appendix A provides the substantial impacts matrix for a public-sector entity. Overall, U.S. EPA states that socioeconomic conditions should be weighted more heavily than financial management indicators.

2.2.4. Determining if Impacts are Widespread

Determining that impacts are substantial is a necessary but not sufficient condition to remove a use or allow a waiver or to permit a reduction in water quality. The analyst must also demonstrate that the impacts are widespread. U.S. EPA's *Interim Economic Guidance* states that there are no definitive ratio measures to evaluate widespread impacts. Instead, the analyst must examine relative magnitudes of a variety of socioeconomic indicators.

The first step in examining whether economic impacts are widespread is to define the affected geographic area. For example, in the case of municipal pollution control projects, the affected community is most often the immediate municipality. In other circumstances, the geographic area may include adjacent or downstream communities too.

To evaluate whether costs incurred by a private-sector entity result in widespread impacts, U.S. EPA suggests that the criterion is whether the economy of the region is able to absorb reductions in employment and business activity resulting from them, which depends largely on the baseline strength or weakness of the local economy and on how important the affected facility is to the local economy. U.S. EPA again advises considering possible economic impacts on development opportunities if the need to install water pollution controls to comply with the standards discourages or delays investment.

To assess whether costs incurred by a public-sector entity result in widespread impacts, U.S. EPA recommends examining potential changes in such indicators as median household income, community unemployment, percentage of households below the poverty line, impacts on property values, and impaired development opportunities. Whether an impact is considered widespread according to the *Interim Economic Guidance* depends on its magnitude and on the current condition of the community.

Decreased employment, decreased personal income, and reductions in local expenditures by the entity or entities will generate additional indirect and induced effects throughout the rest of the economy as directly affected businesses and households reduce their spending on locally produced goods and services. U.S. EPA notes that these impacts can be evaluated using multipliers (such as the U.S. Department of Commerce's RIMS II Regional Multipliers, currently based on the 1997 Economic Census) (DoC, 1997). These multipliers capture the spending linkages between the directly affected entities and the rest of the economy and permit the analyst to trace the changes in spending throughout the economy (additional information can be found in Chapter 4, see Section 4.25).

2.2.5. Differences in Application for Antidegradation Reviews

If the quality of water (i.e., water quality criteria) exceeds "fishable/swimmable" (in other words, it is a "high-quality water"), some reduction of water quality may be permitted if an AR determines that the lowering is necessary to accommodate important economic or social development in the area where the waters are located. For the AR, the analyst first assesses whether the costs of control required to maintain the water quality would interfere with economic development (usually, a specific proposed project). If so, the next step is to determine whether the development would be important economically or socially to the area.[5] The *Interim Economic Guidance* identifies the following steps in an AR:

[5] U.S. EPA (1995) states that "the term important is intended to convey a general concept regarding the level of social and economic development," which is measured by geographical area and changes to socioeconomic indicators like unemployment, income, and tax revenue, for example.

(1) Verify project costs and calculate the annual cost of the pollution control project.

(2) Determine if requirements would interfere with development.

(3) Determine if the economic and social development that is at risk would be important.

2.3. OTHER PERSPECTIVES ON ECONOMIC ANALYSES AND USE ATTAINMENT DECISIONS

As described above, the U.S. EPA *Interim Economic Guidance* recommendation for UAAs based on the socioeconomic factor is to use **economic impact analysis** methods to assess both substantial and widespread impacts. Nevertheless, there are other perspectives on the appropriate methods to apply. In particular, the Water Environment Research Foundation (WERF, 1997), National Research Council (NRC, 2001), and Shabman (2005) are all examples of documents that use approaches other than economic impact analysis for evaluating the socioeconomic effects of changing designated uses. However, it is not clear if these other approaches are consistent with current WQS regulation. In this section, we present these other perspectives. The purpose is not to advocate for or against these other approaches, but rather to inform the reader about other viewpoints on applicable research related to economic UAAs.[6]

Benefit-cost analysis (BCA) is one of the main alternatives to economic impact analysis. BCA is a widely used economic analysis method for evaluating the overall effect of a policy on society's well-being; however, it is generally not part of the UAA process. As the name implies, BCA involves identifying, quantifying, and valuing the positive effects (benefits) and negative effects (costs) on society's well-being that result from a water quality change and then comparing these benefits and costs to assess whether the change improves society's well-being overall. This is different from economic impact analysis, which tends to focus on changes in financial and fiscal outcomes—profits, revenues, incomes—and employment measures. Although benefits analysis is described in U.S. EPA *Interim Economic Guidance*, the process

[6] This report, as described in Chapter 1, supports and presents the idea that community preferences can play a role in UAAs and ARs but still remain within the current regulatory framework. By following the recommendations within the *Interim Economic Guidance*, we suggest additional analyses to examine whether the community prefers the outcomes suggested by the *Interim Economic Guidance* (i.e., if substantial and widespread impacts are found, does the community still want to downgrade the use and lose the potential ecological benefits?).

described in the guidance focuses on measuring the costs and economic impacts of meeting water quality goals.

The WQS regulation (40 CFR 131) allows for the consideration of economic impacts on regulated entities and the economic health and development of the surrounding communities, in cases where either the state wishes to remove a use, obtain a pollutant-specific waiver, subcategorize a use, and require it when the state wishes to allow a reduction of water quality while still maintaining water quality that is "fishable/swimmable." The language in the regulation calls for economic impact analysis, including an assessment of impacts on regulated entities, communities, and economic development. It does not call specifically for a comparison of benefits and costs (for details, see Bruins and Heberling, 2005). This is consistent with other regulations under the CWA, which incorporate a criterion of "economic achievability" into consideration of point-source water pollution controls and best management practices for nonpoint sources.

WERF's *A Comprehensive UAA Technical Reference,* which describes socioeconomic analysis in the context of a UAA (WERF, 1997, Chapter 10), argues that socioeconomic analysis can be accomplished through either financial impact analysis (FIA, a type of economic impact analysis) or BCA or both.[7] Although the U.S. EPA *Interim Economic Guidance* guidance clearly states that "benefit-cost analysis is not required to demonstrate substantial and widespread effects under the Federal Water Quality Standards regulation" (U.S. EPA, 1995, p. 4-6), WERF suggests that FIA is not a sufficient approach for a UAA proposal that involves large changes in WQS or water quality, changes that have widespread impact, changes that affect many people, and changes that require other financing mechanisms in addition to the investments provided by regulated dischargers. The WERF document then discusses the use of BCA for socioeconomic analysis. The document includes a discussion of benefits estimation and a discussion of social and financial costs of water quality improvements. WERF prefers BCA because it incorporates consideration of the values of water quality changes (improvements or reductions). WERF then describes, through the use of interrelated flow diagrams, the process of BCA for UAAs.

The financial analysis described in U.S. EPA's *Interim Economic Guidance* provides a detailed assessment of impacts on regulated entities and communities. Although the financial

[7] Whereas U.S. EPA distinguishes between UAAs, which are for removing, waiving, or subcategorizing uses, and ARs, in WERF's terminology there are two types of UAAs: one assessing nonattainment situations and one assessing antidegradation situations.

tests suggested are straightforward, WERF believes there are limitations: the data for these tests may need to be estimated, they do not incorporate likely behavioral responses by either the regulated entity or others indirectly affected, and their interpretation is somewhat arbitrary.

BCA, as noted by WERF, provides a more complete assessment of the effects of the change in water quality, including both costs and impacts to the regulated entity and the surrounding community, and changes in the value of the water body as a resource. It is, however, a more costly and complex process than economic impact analysis (involving first estimating changes in water quality, then quantifying the effects of those changes on the ecosystem and the services provided by the ecosystem, and then estimating the value of those changes). According to WERF, BCA may be warranted when changes in water quality are expected to be economically consequential, because of the magnitude of the change or the economic importance of the water body.

The NRC (2001) argues that a lack of clear guidance on what is an acceptable UAA and how to conduct economic analysis within the UAA decision leads to few states actually determining "substantial and widespread economic and social impact" (see Section 2.4). Therefore, one of NRC's recommendations is for U.S. EPA to provide "broadened socioeconomic evaluation and decision analysis guidelines for states to use during UAA." However, the NRC does not go into detail on what constitutes a "broadened socioeconomic evaluation."

Shabman (2005), providing some details omitted in the NRC (2001) report, describes an adaptive implementation (AI) process that refines uses and criteria over time. To bring economics into AI, he describes an analysis called "proximate knee of the cost curve," which allows the public to discover the gains and losses over time. It sets the starting point for the analysis at the current conditions and asks the public whether the additional costs of moving away from the current conditions to some goal are reasonable. The current U.S. EPA approach sets the WQS as the goal and requires the polluter to prove that costs are unreasonable. Shabman (2005) assumes that having the current conditions as the starting point reduces the uncertainty bounds around the benefits and costs of moving away from the current conditions.

2.4. EXAMPLES OF EXISTING USE ATTAINABILITY ANALYSES AND ANTIDEGRADATION REVIEWS USING ECONOMIC CONSIDERATIONS

To provide the reader with a resource for understanding the current practices, this section of the report identifies and describes several examples of existing UAAs and ARs. The WERF (1997) and the U.S. General Accounting Office (GAO, 2003) both surveyed the 50 states in order to gain an understanding of the UAA activity level and the number of designated uses that have been changed. No other sources of information could be found related to current practices. WERF found that approximately 3200 UAAs were undertaken between 1983 and the end of 1992. The GAO asked states how many designated use changes were adopted between 1997 and 2001. They found that approximately 3900 changes were identified.

In our search of the literature, we identified 13 UAAs and 4 ARs that incorporate economic arguments. The examples found in the search were initiated between 1983-2003. Documentation for the examples was obtained from materials that could be downloaded from state agency Web sites and reports submitted by the states to U.S. EPA Regional program offices. Tables 2-2 and 2-3 summarize select elements from each example, and Figure 2-1 shows their locations within states and watersheds (8-digit U.S. Geological Survey [USGS] cataloging units).

This collection of examples is not meant to be exhaustive, and the methods used in these cases are not necessarily recommended. The main goal in compiling them is to provide examples from different parts of the country that used economic analyses of varying sophistication or different methods in presenting socioeconomic arguments.

It should be noted that the vast majority of UAAs do not involve economic arguments. For ARs, many states are still defining their methodologies. This means that ARs involving socioeconomic arguments are not plentiful, and finding examples was difficult. The "record of decision" process does not usually involve publishing materials in the *Federal Register* or other readily available national dockets. Also, states tend to submit materials to their U.S. EPA Regional offices to initiate a potentially lengthy series of negotiations. In many cases, technical alternatives to an actual UAA (e.g., site-specific adjustments to criteria for existing uses) are employed to avoid actual changes in the designated uses. The status of the review process as of the end of 2003 is noted in Table 2-2, but a large number are best viewed as still in process or even as draft submissions.

TABLE 2-2

Use Attainability Analysis Examples

Example ID	State	Name	Reason for Analysis	Type of Economic Analysis	Status
1	CA	Ballona Creek	TMDL process	Narrative discussion of costs and benefits	Under review by U.S. EPA Region
2	ID	Blackbird Creek	Impacts from inactive mine lands and mine tailings	Narrative discussion of costs and benefits	Under review by U.S. EPA Region
3	VA	Blacks Run Creek	TMDL process	Narrative discussion of costs and benefits	Unclear
4	MA	Boston Harbor Area	Combined sewer overflow (CSO) issues	Narrative discussion of costs	Approved by U.S. EPA Region
5	OR	Burnt River	TMDL process	Narrative discussion of costs	Under review by U.S. EPA Region
6	NY	Cayadutta Creek	National Pollutant Discharge Elimination System (NPDES) discharge permit issue	Cost data for alternatives	Approved by U.S. EPA Region
7	DE/ PA/ NJ	Delaware Estuary	National Estuary Program recommendation	Narrative discussion of benefits	National Estuary Program recommendation approved by U.S. EPA Regions
8	ME	Gulf Island Pond	NPDES discharge permit issue involving pollution effects in a reservoir	Cost data for alternatives, narrative discussion of benefits	Under review by U.S. EPA Region
9	CO	Lower French Gulch/Blue River	Acid mine drainage from abandoned mine lands	Narrative discussion of costs and benefits, some valuation	Under review by U.S. EPA Region
10	NY	Lower Hudson/East River	Long Island Sound Study recommendations	Narrative discussion of costs and benefits	Analysis shared with U.S. EPA Region
11	ME	Lower Salmon Falls River	NPDES discharge permit issue	Cost data for alternatives, quantified assessment of water quality impacts, socioeconomic analysis	Under review by U.S. EPA Region
12	CA	Santa Ana River	NPDES discharge permit issues on an effluent-dominated system	Cost data for alternatives, quantified assessment of water quality impacts, socioeconomic analysis	Approved by U.S. EPA Region
13	IN	White River	CSO issues	Cost data for alternatives, quantified assessment of water quality impacts, socioeconomic analysis	Approved by U.S. EPA Region

TABLE 2-3

Antidegradation Examples

Example ID	State	Name	Reason for Analysis	Type of Economic Analysis	Status
14	ND	Devils Lake	Impacts of lake/wetland drainage on water quality	Cost data for alternatives, qualitative discussion of water quality and ecological impacts	Under review by U.S. EPA Region
15	WY	Northwest Basins	Coal bed methane operations general discharge permits	Cost data for alternatives, qualitative assessment of environmental impacts	Approved by U.S. EPA Region
16	OK	Snake Creek	Concentrated animal feeding operations (CAFO) issues (poultry wastes)	Narrative discussion of costs and benefits	Approved by U.S. EPA Region
17	OH	Sycamore Creek	NPDES discharge permit issue	Cost data for alternatives, qualitative comparison of benefits	Under review by U.S. EPA Region

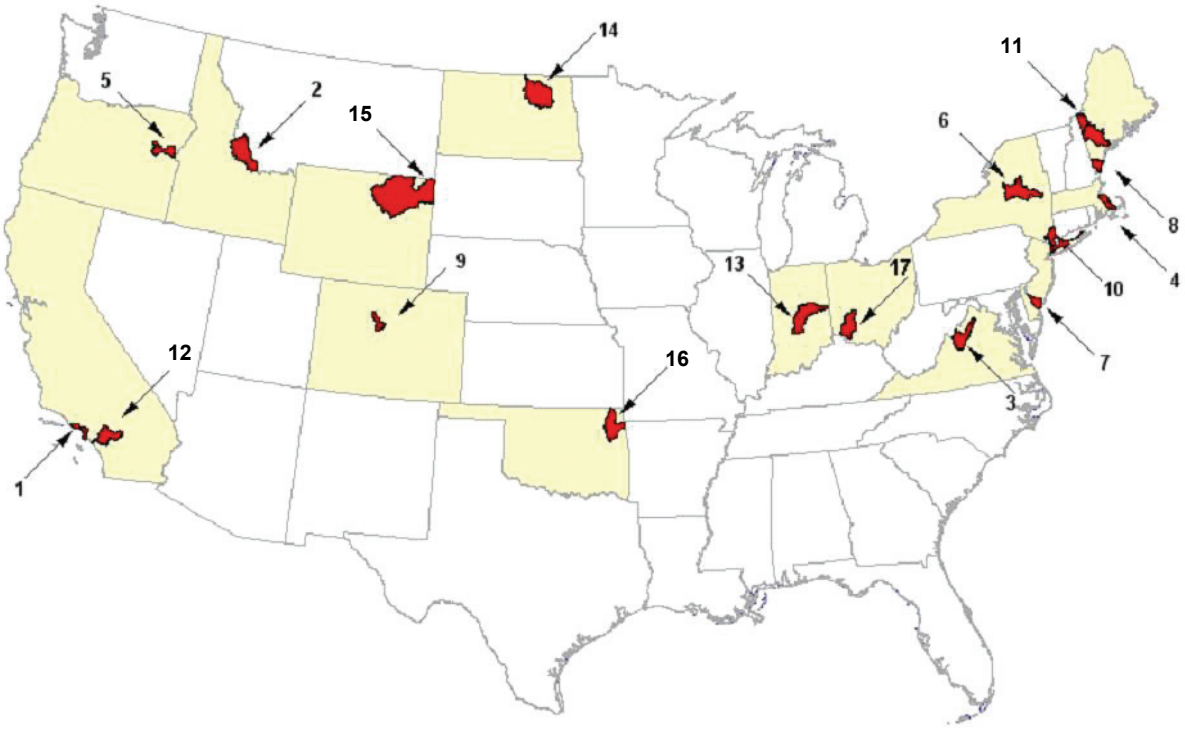

FIGURE 2-1

States and Watersheds Containing UAAs or Antidegradation Reviews that Incorporate Economic Arguments. Numbers correspond with the "Example ID" column in Tables 2-2, 2-3, and with the "Example" column in Table B-1.

Although somewhat limited in number, these examples offer a good illustration of the types of socioeconomic methods and techniques that states have applied. Appendix B provides more detailed summaries that include information on the location of the water bodies, the designated uses and pollution stressors of concern, the primary reasons for undertaking the studies, the types of analyses considered, and alternatives proposed to address the WQS issues. The different stakeholders involved are noted along with the year when the UAAs or ARs were initiated and the current status of the process.

2.5. LESSON

An important lesson that emerges from even a cursory review of the examples listed above is, to the extent that an economic analysis is conducted, most attention is given to the cost data of attaining designated uses or of maintaining high water quality. Very little attention is given to the kinds or amounts of economic benefits that would be obtained in the process. Therefore, the current approach used in the economic analysis, although useful for regulatory determinations, may not fully inform affected communities about the effects these decisions will have on their well-being. No UAA or AR was based on collecting community preferences suggesting that those UAAs and ARs did not provide the local community all the information it could have considered. A broader analysis, one that makes the preparation of UAAs and ARs more informed, may help a community decide that a use change or degradation is not warranted. On the other hand, it may reveal that a higher use is preferred. The subsequent sections of this report introduce a set of approaches that can be used to obtain a broader perspective on ecological and economic changes, including both qualitative and quantitative methods that result from decisions about WQS.

2.6. REFERENCES

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