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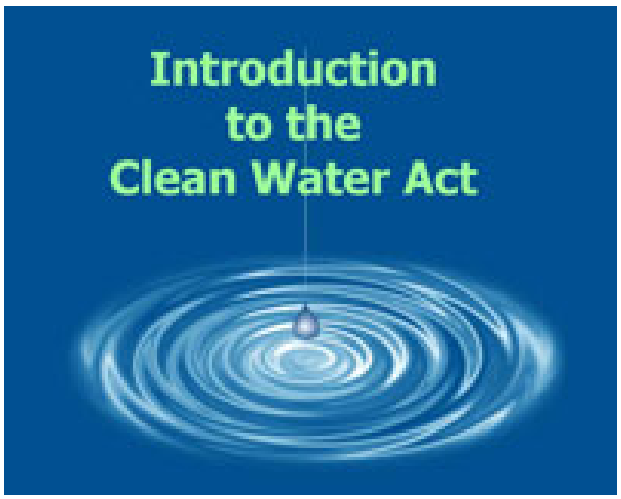
Introduction to the Clean Water Act



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Introduction to the Clean Water Act

Introduction

The Clean Water Act (CWA) is the cornerstone of surface water quality protection in the United States. The act does not deal directly with ground water or with water quantity issues. Some states have chosen to develop ground water quality standards (mentioned in the section entitled *Introduction to WQS*) or water quality standards that address streamflow specifically. The statute employs various regulatory and non-regulatory tools to sharply reduce direct pollutant discharges into waterways, establish ambient water quality standards, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water." The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the act was significantly reorganized and expanded in 1972. "Clean Water Act" became the act's common name with amendments in 1977.

The CWA made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit authorized under the CWA was obtained. EPA's National Pollutant Discharge Elimination System (NPDES) permit program (found at http://cfpub.epa.gov/npdes/) controls these "point source" discharges. Point sources are discrete conveyances, such as pipes or man-made ditches, that discharge into surface waters. Individual homes that are connected to a municipal system, use a subsurface discharging septic system, or do not have a surface discharge do not need an NPDES permit. Nevertheless, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.

For many years, following the passage of the CWA in 1972, EPA, states, and Indian tribes focused mainly on the chemical aspects of the water quality "integrity" goal. During the last decade, however, more attention has been given to physical and biological integrity. Also, in the early decades of the act's implementation, efforts were focused on regulating discharges from traditional point source facilities, such as municipal sewage treatment plants and industrial wastewater facilities, with little attention paid to runoff from streets, construction sites, farms, and other "wet-weather" sources. Starting in the late 1980s, efforts to address polluted runoff have increased significantly. For "nonpoint" pollutant runoff, education and voluntary programs, including cost-sharing with landowners, are the key tool. For "wet weather point sources" like urban storm sewer systems and construction sites, a regulatory approach under the NPDES permit program is being employed.

CWA programs, as they evolved over the last decade, have shifted from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under a watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority (e.g., stream channel erosion). Involving stakeholder groups with developing and

implementing strategies for achieving and maintaining state water quality standards and other environmental goals is another hallmark of this approach.

History of the Clean Water Act (CWA)

Figure 1

The Cuyahoga River was one of the most polluted rivers in the United States (Figure 1). The reach from Akron to Cleveland was devoid of fish throughout the 1950s and 60s. There were at least 13 fires on the Cuyahoga River, the first occurring in 1868. The largest river fire, in 1952, caused more than $1 million in damage to boats and a riverfront office building. Fires erupted on the river several more times before June 22, 1969; on that date a river fire captured the attention of Time magazine, which described the Cuyahoga as the river that "oozes rather than flows" and in which a person "does not drown but decays." The 1969 Cuyahoga River fire mobilized public concern across the nation and helped spur an avalanche of water pollution control activities resulting in the Clean Water Act, Great Lakes Water Quality Agreement, and the creation of the federal Environmental Protection Agency and the Ohio Environmental Protection Agency (OEPA).

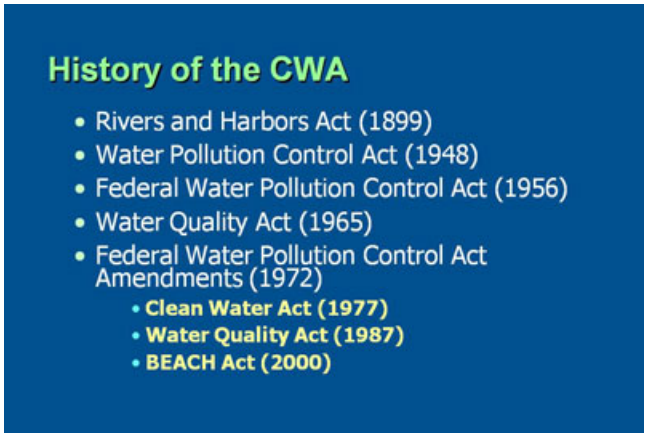


Figure 2

Although the Cuyahoga River fire(s) dramatically focused public opinion and motivated action, several federal laws had been in place to regulate activities in surface waters. The Rivers and Harbors Act (Figure 2) addressed projects and activities in navigable waters and harbor and river improvements, such as placing dredged or fill material in waterways, altering channels, and constructing dams, bulkheads, jetties, and other structures. In 1948, Congress enacted the Water Pollution Control Act to "enhance the quality and value of our water resources and to establish a national policy for the prevention, control and abatement of water pollution." This was an important step in establishing the basic legal authority for federal regulation of water quality. The act was amended in 1956 to strengthen enforcement provisions and again in 1965 to establish water quality standards for surface waters enforceable by state and federal authorities. Incremental adjustments through 1970 beefed-up reporting requirements, enforcement provisions, and added an antidegradation component.

Despite the improvements achieved by each amendment to the original act, the result of this sporadic legislation was a hodgepodge of law. Eleven reorganizations and restructurings of

federal agency responsibilities compounded the difficulty of effectively implementing the law. To solve these problems, the 1972 amendments to the act restructured the authority for water pollution control and consolidated authority in the Administrator of the Environmental Protection Agency, which was created by Executive Order of the President. Additional adjustments were enacted in 1977 to address long-term funding for wastewater treatment facilities, sludge management, toxic pollutants, and wetland protection; in 1987 to establish stormwater permitting, nonpoint source pollution control, and Great Lakes and Chesapeake Bay protection programs; and again in 2000 to support updated water quality standards and pathogen monitoring for recreational waters.

Throughout the many adjustments to federal clean water law, two major approaches are evident: (1) water quality protection rules based on establishing enforceable standards that apply to the chemical, physical, or biological condition of surface water bodies; and (2) protection measures based on treatment technology requirements for facilities that discharge effluent, pollutants, wastes, or other substances into water bodies.

Before 1972, many states had so-called "water quality standards" that attempted to limit pollutant concentrations in their lakes, rivers, streams, wetlands, and coastal waters. Yet the lack of efficient and effective monitoring and assessment tools and the sheer difficulty in identifying pollutant sources resulted in a cumbersome, slow, ineffective system that was unable to reverse growing pollution levels in the nation's waters. The strength of the 1972 amendments to federal law was the creation of the NPDES permitting system, which required authorization to discharge pollutants from a point source into the waters of the U.S. This approach—attacking pollution problems by focusing on the sources—was extremely successful, because it linked strong enforcement provisions with federal grants to construct wastewater treatment facilities. Regardless, as point source pollutant loads were addressed effectively by hundreds of new treatment plants, the problem with polluted runoff (i.e., nonpoint source pollution) became more evident.

Today, states, tribes, and federal agencies use a dual approach to address water quality: point sources are controlled by permit programs, effluent limits, monitoring, and enforcement, and water body integrity is supported by water quality standards that address all sources of impairment, including point source and nonpoint pollution (i.e., polluted runoff), habitat degradation caused by changes in runoff patterns, and other stressors (Figure 3). This approach allows NPDES discharge permits to be adjusted through the establishment of water quality based effluent limits—in addition to the usual technology-based limits—to ensure that the water body receiving the discharge can support its beneficial uses, such as aquatic life support, recreation, etc.

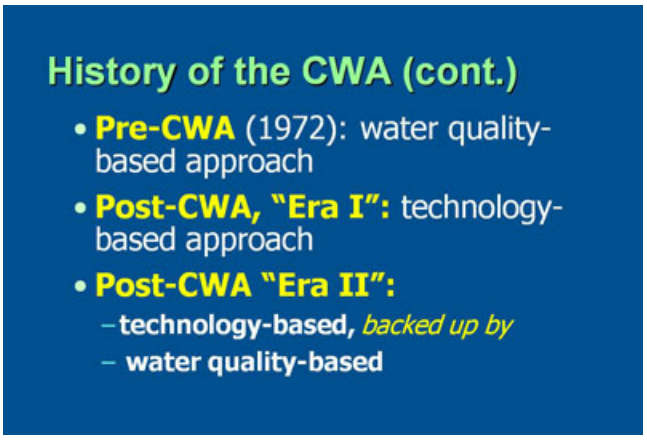
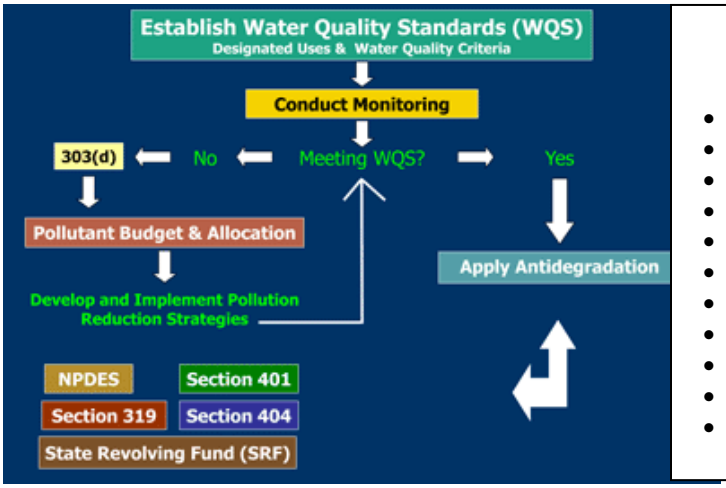


Figure 3

CWA: Water Quality Based Approach—The Big Picture

Figure 4, which is what this module refers to as the CWA Big Picture, provides further details on what will be discussed in this module. This module goes through the major CWA programs in the following sequence: (1) water quality standards; (2) antidegradation policy; (3) water body monitoring and assessment; (4) reports on condition of the nation's waters; (5) total maximum daily loads (TMDLs); 6) NPDES permit program for discharges from point sources; (7) section 319 program for nonpoint sources; (8) section 404 program regulating discharge of dredged or fill materials to wetlands and other waters; and (9) section 401 state water quality certification; state revolving loan fund (SRF).

Throughout the module, the terms in bold script can be found in the glossary. This module could take several hours to complete. Students can vary the depth of the course by choosing to focus on certain subsections of this module. Also, throughout the module, links to other websites are provided that cover particular programs or topics in detail. These are strictly optional and are not essential to understanding the basics of the CWA. Exploring these additional informational resources can easily double or triple the amount of time it takes to navigate this module.



The Big Picture
Topics covered in this module are:

- Establish Water Quality Standards
- Apply Antidegradation
- Conduct Monitoring
- 303(d): Threatened and Impaired Waters List
- Pollutant Budget and Allocation
- Develop and Implement Pollution Reduction Strategies
- NPDES
- Section 319
- Section 401
- Section 404
- State Revolving Loan Fund

Figure 4

Brief Overview of Key CWA Elements

First, **water quality standards** (WQS) consistent with the statutory goals of the CWA must be established. All waters must have designations for how they're used, and numeric and/or narrative criteria that support those uses. Antidegradation policies and implementation methods are also required, to ensure that high quality is not unnecessarily degraded and that all waters meet their minimum water quality criteria. Then water bodies are monitored to determine whether the WQS are met.

If all WQS are met, **antidegradation** policies and implementation methods are employed to keep the water quality at acceptable levels. **Ambient monitoring** is also needed to ensure that this is the case.

If the water body is not meeting WQS, a strategy for meeting these standards is needed. Key elements of a strategy include: (1) a **Total Maximum Daily Load** (TMDL); and (2) a **TMDL implementation plan**. TMDLs determine what level of pollutant load would be consistent with meeting WQS. TMDLs also allocate acceptable loads among sources of the relevant pollutants.

Necessary reductions in pollutant loading are achieved by implementing strategies authorized by the CWA, along with any other tools available from federal, state, and local governments and nongovernmental organizations. Key CWA tools include the following:

- NPDES permit program: Covers **point sources of pollutants** discharging into a surface water body.
- Section 319: Addresses **nonpoint sources of pollution**, such as most farming and forestry operations, largely through education and cost-share grants.
- Section 404: Regulates the discharge of dredged or fill materials into **wetlands** and other Waters of the United States.
- Section 401: Requires federal agencies to obtain certification from the state, territory, or Indian tribes before issuing permits that could result in increased pollutant loads to a water body. The certification is issued only if such increased loads would not cause or contribute to exceedances of water quality standards.
- State Revolving Funds (SRF): Provides large amounts of money through loans for municipal point sources, nonpoint sources, and other activities.

After implementing these strategies, water body conditions are again measured and compared to ambient water quality standards. If standards are now met, only occasional monitoring is needed. If standards are still not being met, then a revised strategy is developed and implemented, followed by more ambient monitoring. This iterative process must be repeated until standards are met.

Introduction to WQS

Figure 5

Water quality standards (WQS) are aimed at translating the broad goals of the CWA into water body-specific objectives (Figure 5). Ideally, WQS should be expressed in terms that allow quantifiable measurement. WQS, like the CWA overall, apply only to the waters of the United States. As defined in the CWA, "waters of the United States" include only surface waters—such as streams, rivers, lakes, estuaries, coastal waters, and wetlands. Not all surface waters are legally "waters of the United States." Generally, however, those waters include the following:

- All waters that are traditionally navigable
- All interstate waters

- Intrastate waters used in interstate and/or foreign commerce
- Tributaries of the above
- Territorial seas at the cyclical high tide mark
- Wetlands adjacent to all the above

The exact dividing line between "waters of the United States" protected by the CWA and other waters can be hard, especially regarding **ephemeral** water bodies and wetlands not adjacent to other "waters of the United States." In fact, the jurisdictional determination changes from time to time as new court rulings are handed down, new regulations are issued, or the act itself is modified. (For more information on this topic, visit the "Clean Water Act Definition of Waters of the United States" at http://water.epa.gov/lawsregs/guidance/wetlands/CWAwaters.cfm).

As indicated by the placement of WQS in all parts of the water body system illustrated in Figure 6, water quality standards should be established for all surface waters meeting the definition of "waters of the United States."

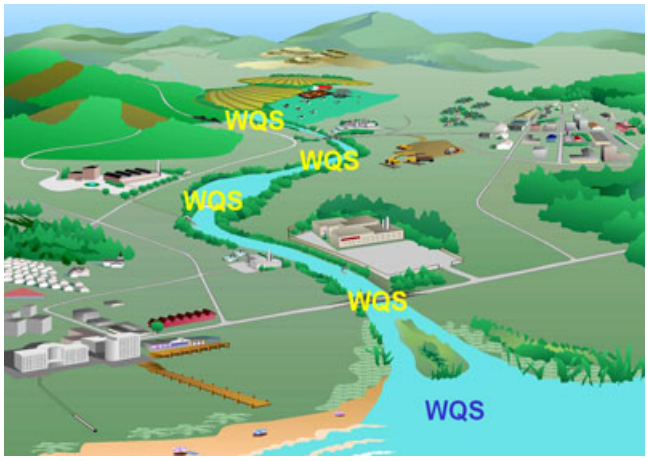


Figure 6

States, territories, and designated tribes, using their own authority, can adopt standards for additional surface waters. Though the CWA does not require WQS for ground water, states, tribes, and territories can use their own authority to set targets for ground water.

Designated uses, water quality criteria, and an antidegradation policy and implementation methods constitute the three major components of the Water Quality Standards Program (Figure 7). The designated uses (DUs) of a water body are those uses that states, territories, and authorized tribes determine the water body should be clean enough to fully support, regardless of its current condition. The DUs are the goals set for the water body. In some cases, these uses have already been attained; sometimes conditions in a water body do not support all the DUs.

Figure 7

Water quality criteria (WQC) are numeric and narrative descriptions of the conditions in a water body necessary to support the DUs. These can be expressed as concentrations of pollutants, temperature, pH, turbidity units, toxicity units, or other quantitative measures. WQC can also be narrative statements such as "no toxic chemicals in toxic amounts."

Antidegradation policies are a component of state/tribal WQS that establish a set of rules that should be followed when addressing proposed activities that could lower the quality of surface waters.

WQS: Key Definitions

To understand the regulations that apply to designating uses under WQS, several key terms must be defined (Figure 8). As noted previously, a **designated use** is a use specified in water quality standards for each water body whether or not conditions currently support that use. (It might be helpful to think of these as "desired" uses). For example, a water body may be designated by state regulations for "aquatic life support" even though it might not contain a healthy aquatic ecosystem now.

Figure 8

The term existing use has a somewhat different meaning, in the context of the CWA, than one might expect. Rather than actual or current uses, it refers not only to those uses the water body is capable of supporting at present but also any use to which the water body has actually attained since November 28, 1975. Even if the water body is currently not supporting a use attained since November 28, 1975, for purposes of the CWA, it is still an "existing use." Even if there has been no documentation that a use has occurred since November 28, 1975, evidence that water quality has been sufficient to support a given use at some time since November 28, 1975 can be the basis for defining an "existing use" for a water body.

The process of changing a use designation is called use reclassification. The terms downgrading and upgrading are sometimes used in this context. Removing a designated use and replacing it with a "lower" use is often referred to as "downgrading." "Upgrading" is just the reverse. It is important to note, however, that in the parlance of the CWA, the difference between a "higher" and "lower" use reflects the quality of water needed to support each use. Those uses needing cleaner water are considerably "higher." The terms "high" and "low" are not intended to suggest that one use of a water body (fishing, for example) is inherently more important than another (industrial water supply, for example). Hence, removing from the designated uses of a water body one that required an average daily concentration of pollutant "x" of 20 mg/L or less, so that the next highest use was one needing concentrations of 30 mg/L or less would be a "downgrading."

Designated Uses (DU)

Typically, the DUs assigned to a water body reflect the public's answer to the question, "What do we want to use this water body for?" Answers might include: swimming, boating, water skiing, wind surfing, recreational fishing, commercial fishing, subsistence fishing, supporting native aquatic life, supplying water for drinking, irrigating crops and landscaping, and industrial purposes (Figure 9).

Figure 9

The subcategories under water-based recreation refer to the proportion of time in which someone engaging in certain types of activities would come into direct contact with the water. Noncontact uses would include riding in a large boat, for example. Short-term contact (that is, "secondary contact" or "partial body contact") might include jet skiing, speed boating and canoeing. Long-term contact (that is, "primary contact" or "whole body contact") would include snorkeling, swimming, kayaking and wind surfing. Obviously, it can be difficult to draw distinct lines between these different activities, because the extent of exposure can be affected by factors such as the skill of the recreationist and weather conditions. Nevertheless, such distinctions can be very important, as concentrations of pathogens and other key pollutants need to be lower in waters used for long-term contact activities than for short-term activities, if the health of users is to be protected adequately.

Warm water aquatic habitat are those characterized by species of fish and other animals that can tolerate higher temperatures in the surrounding water than can species such as trout and salmon, whose body chemistry requires them to be in colder waters. Bass and perch are examples of warm water fish.

DU Classifications

In general, different water bodies and different portions of a given water body, are assigned various combinations of the DUs. A given segment will almost always be classified for more than one DU (Figure 10).

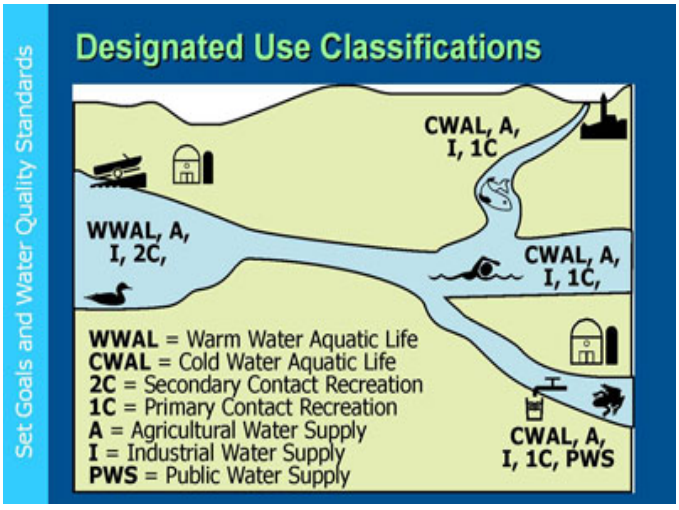


Figure 10

Economic factors can be considered when setting the DU for a water body. In contrast, economics cannot be factored in when developing the WQC applicable to a given or specific DU.

Use designations reflect the full range of water body uses including aquatic life support, recreation, drinking water, industrial and other uses (Figure 11).

Figure 11

Designating Uses for Waters

Figure 12 lists policies used in designating uses for water bodies. The first policy is that if current water quality supports a use, and/or the use is actually taking place, the water quality standards must include that use or those uses.

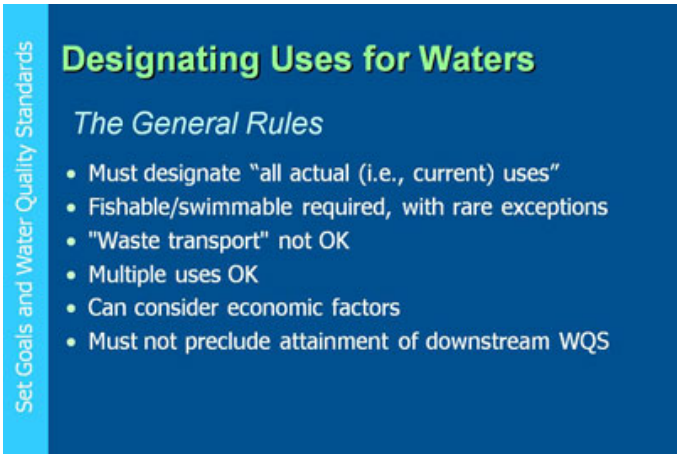


Figure 12

The second rule is simply a reflection of the CWA's "fishable/swimmable" goal (protection and propagation of fish, shellfish, and wildlife and recreation in and on the water), as articulated in EPA's regulations, which say that these uses should be designated for all waters, unless it is demonstrated that it is impractical to meet them. Only in those cases where the "downgrading" process has been followed can these uses be excluded from the set of DUs for a water body.

The third rule is that "waste transport" is not an acceptable DU, because in passing the 1972 CWA, Congress said that our nation's surface waters should no longer be used as waste conveyances.

The fourth rule states that a water body can be designated for more than one use. Details are provided in the sidebar box.

The fifth key rule regarding the setting of DUs is that economic and social factors can be

Typically, the DUs assigned to a waterbody reflect the public's answer to the question, "What do we want to use this waterbody for?" Answers might include: swimming, boating, water skiing, wind surfing, recreational fishing, commercial fishing, subsistence fishing, supporting native aquatic life, supplying water for drinking, irrigating crops and landscaping, and industrial purposes.

Commonly used use designations include the following:

- Drinking water supply
- Water-based recreation
- Full body contact; noncontact
- Fishing/fish consumption
- Aquatic life
- Warm water species/habitat
- Cold water species/habitat
- Agriculture water supply
- Industrial water supply
- Cultural/Spiritual Uses

considered, although this is not required. More specifics about this will be presented in the next slide, which deals with changing DUs. Finally, designated uses for waterbodies must not preclude the attainment of downstream WQS.

Reclassification of DUs

EPA regulations prohibit removing an "existing" or actual use from the DUs for a water body (Figure 13). A DU that has not been attained, however, may be removed under limited circumstances.

A key part of the process through which a state, territory, or tribe would enact a "downgrading" is called a use attainability analysis (UAA). In the UAA, the state would have to demonstrate that one or more of a limited set of situations exists.

Figure 13

First, it must be shown that the current DU cannot be achieved through implementation of: (1) applicable technology-based limits for point sources; and (2) cost-effective and reasonable best management practices (BMPs) for nonpoint sources.

If it has been shown that DUs can't be met with the measures above, then another set of factors should be considered. These factors are as follows:

- Natural background conditions prevent attainment;
- Irreversible human-caused conditions prevent attainment;
- What is needed to attain the DU would cause substantial environmental damage; and
- The cleanup needed to achieve the use would cause widespread social and economic costs.

If a UAA indicated that conditions for authorizing a removal of one or more DU existed, the UAA and the accompanying proposal to downgrade a DU must go through the public review/participation process that is required for any change in a WQS and must be approved by EPA. EPA has provided some guidance on the meaning of key terms such as "substantial and widespread social and economic costs," particularly as it relates to "point source" dischargers such as municipal sewage treatment plants and industrial facilities.

Water Quality Criteria

Water Quality Criteria (WQC or criteria) can be chemical, physical, or biological. They are levels of individual pollutants or water quality characteristics, or other descriptions of conditions of a water body that, if met, will protect the designated use(s) of the water (Figure 14). For a given DU, there are likely to be numerous criteria dealing with different types of conditions, as well as levels of specific chemicals. Since most water bodies have multiple DUs, the number of criteria applicable to a given water body can be very substantial.

Figure 14

WQC must be scientifically consistent with attainment of DUs. This means that only scientific considerations can be taken into account when determining what water quality conditions are consistent with meeting a given DU. Economic and social impacts are not allowed to be considered when developing criteria.

Criteria can be categorized for descriptive purposes in many ways. For instance, numeric criteria (e.g., 7-day average of 5 mg/L dissolved oxygen) can be contrasted with narrative criteria (no putrescent bottom deposits). Criteria also can be categorized according to what portion of the aquatic system they can be applied to: the water itself (water column), the bottom sediments, or the bodies of aquatic organisms (fish tissue). The duration of time to which they apply is another way of categorizing water quality criteria, with those dealing with short-term exposures (acute) being distinguished from those addressing long-term exposure (chronic).

Criteria can also be categorized according to the types of organisms they are designed to protect. Aquatic life criteria are aimed at protecting entire communities of aquatic organisms, including a wide array of animals, various plants, and microorganisms. These can be expressed as parameter specific (e.g., daily average of 30 ug/L of copper) or in terms of various "metrics" that directly measure numbers, weight, and diversity of plants and animals in a water body (community indices).

Human health criteria can apply to three exposure routes: (1) drinking water; (2) consuming aquatic foodstuffs (i.e., fish consumption); and (3) body contact.

Wildlife criteria, like human health/fish consumption criteria, deal with the effects of pollutants with high bioaccumulation factors. To date, EPA has issued and adopted far fewer wildlife criteria than aquatic life or human health criteria. Such criteria are designed to protect terrestrial animals that feed upon aquatic species. Examples are ospreys, herons and other wading birds, and mink and otters.

Narrative Water Quality Criteria

Most state/tribal WQS require that all surface waters be free from the following:

- Putrescent or otherwise objectionable bottom deposits
- Oil, scum, and floating debris in amounts that are unsightly
- Nuisance levels of odor, color, and other conditions
- Undesirable or nuisance aquatic life
- Substances in amounts toxic to humans or aquatic life

It is not always easy to translate these rather subjective descriptions into quantitative measures. EPA guidance can be found in chapter 3, section 3.5.2, page 3-24, of the EPA Water Quality Standards Handbook at http://water.epa.gov/scitech/swguidance/standards/handbook/.

"No toxics in toxic amounts" does not lend itself to quantitative measurement. The Clean Water Act (since 1987) has required water quality standards to incorporate numeric criteria for any toxic for which EPA has developed a numeric criteria. Thus, "no toxics in toxic amounts" is no longer legally sufficient for those toxic pollutants. Toxicity testing, one way to translate this narrative into a quantitative measure, will be covered later in this module.

Narrative criteria (Figure 15) are usually applicable to all water bodies, regardless of their use designations.

Figure 15

Sources for Developing Water Quality Criteria

States, tribes, and EPA use various sources of information to develop water quality criteria, including literature reviews, laboratory studies, and other data. EPA's process for developing water quality criteria is illustrated in Figure 16.

Numeric Water Quality Criteria

Numeric criteria are usually parameter-specific; they express conditions for specific measures, such as dissolved oxygen, temperature, turbidity, nitrogen, phosphorus, heavy metals such as mercury and cadmium, and synthetic organic chemicals like dioxin and PCBs. They do not consist merely of stated levels/concentrations, such as 15 µg/L or a pH above 5.0. They also should specify the span of time over which conditions must be met. This is the "duration" component of a WQC. Combining the concentration/magnitude and duration components of a

WQC results in wording such as “the average 4-day concentration of pollutant X shall not surpass 50 µg/L."

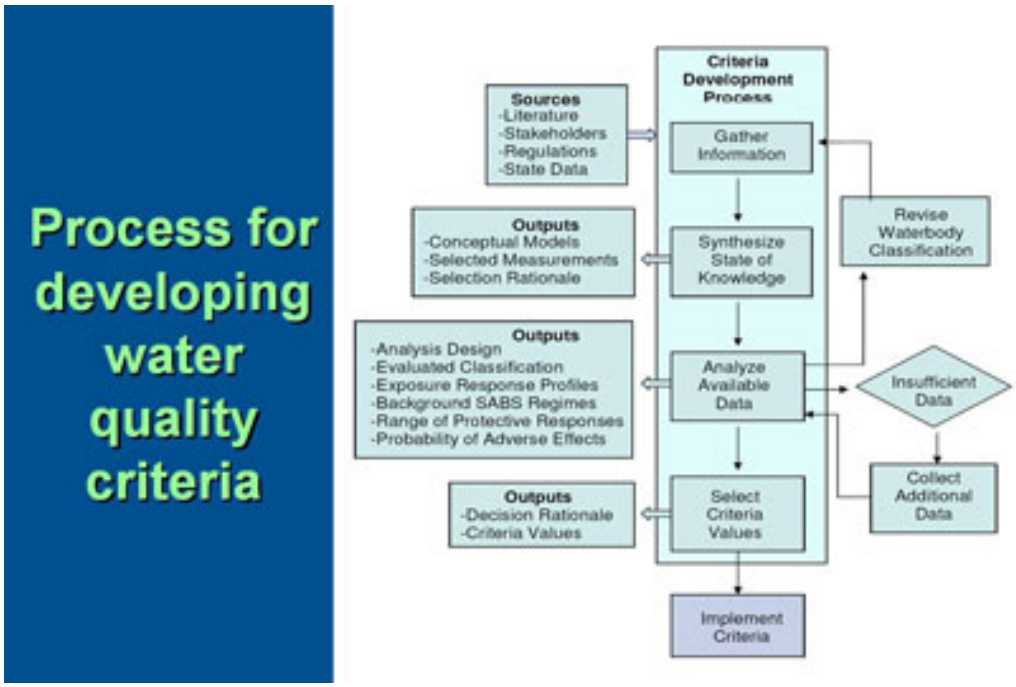


Figure 16

A numeric WQC also should indicate how often it would be acceptable to go beyond specified concentration/duration combinations. This is called the frequency or the recurrence interval component of the WQC. For instance, for protection of aquatic life, as a general rule, EPA recommends a recurrence interval of once in three years. The purpose of the criterion frequency in terval is to recognize that aquatic ecosystems can recover from impacts of exposure to harmful conditions, but to make such adverse conditions sufficiently rare as to keep the community of aquatic organism from being in a constant state of recovery.

Simply because one sample has a concentration higher than the concentration component of a WQC does not necessarily mean the WQC has been exceeded and a designated use affected. This is true only in the case of “instantaneous criteria,” levels that are never to be exceeded. But if there was a criterion of 50 mg/L of “x,” for a seven-day average, then having one sample at a concentration above 50 mg/L would not necessarily indicate that this criterion had actually been exceeded. Likewise, having just one or two samples below 50 mg/L is not a good basis for concluding a water body is indeed meeting the applicable WQC.

EPA publishes recommended water quality criteria corresponding to several key designated uses. For aquatic life uses, criteria for short-term (acute) and long-term (chronic) exposures are provided on the National Recommended Water Quality Criteria Web page at http://water.epa.gov/scitech/swguidance/standards/current/index.cfm. Different criteria for freshwater systems and marine (saline) systems are often provided. Most human health criteria, except certain pathogens, address chronic exposures. (NOTE: When elevated levels of human risk are indicated, e.g., in areas where consumption of locally caught fish could be high because

of cultural, economic, or other factors, criteria might need to be revised to reflect risk parameters more accurately, such as greater fish consumption (Figure 17). This is particularly important for highly bioaccumulative contaminants such as PCBs, mercury, dioxin, and other compounds.)

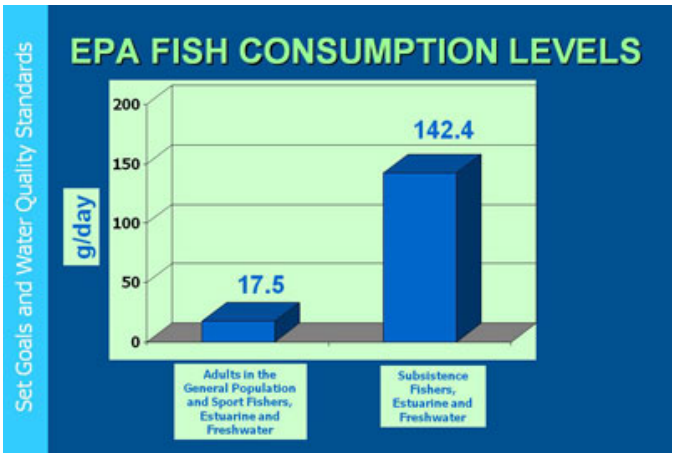


Figure 17

States, tribes, and territories are not required to adopt the exact numbers that EPA has published, but once EPA has issued a criterion for a pollutant, they must either adopt EPA's or develop a corresponding criterion based on a sound scientific rationale. State criteria must provide the same level of protection as EPA's, and a state/tribe must document that this is the case.

Figure 18 illustrates several basic principles regarding WQC. Note that the toxicity of pollutants differs depending on whether they are in fresh or salt water environments. There is no predictable pattern, however, whether a pollutant is more or less toxic in fresh versus salt water (copper is more toxic in marine water, cadmium in fresh water).

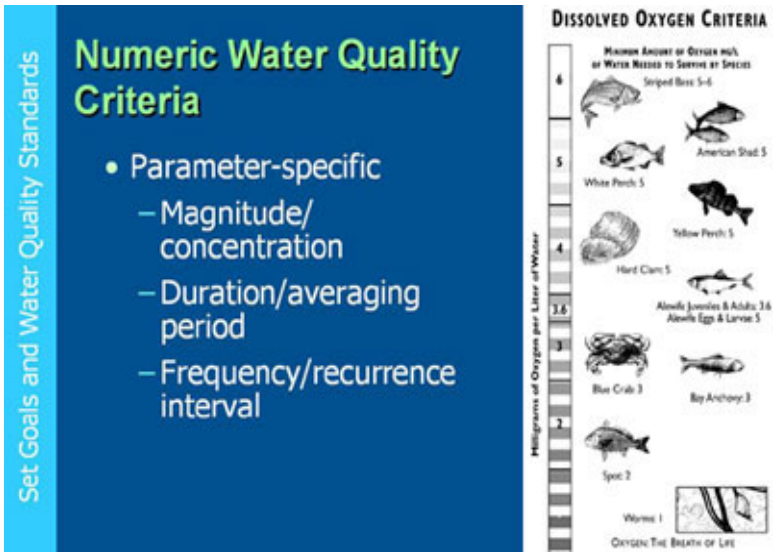
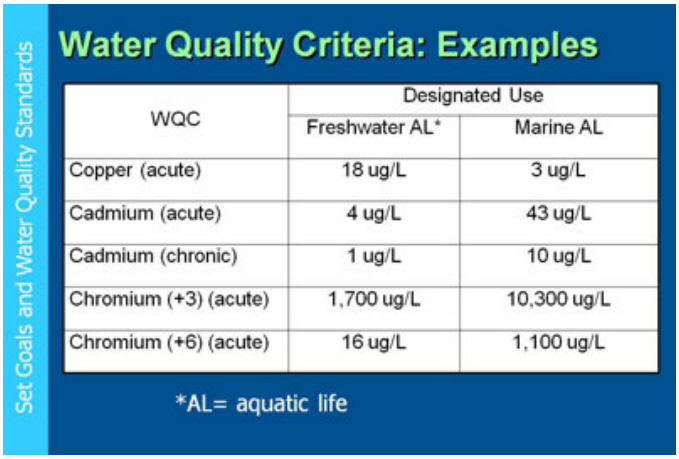


Figure 18

On the other hand, the chronic criterion concentration for a pollutant is always lower than the acute criterion, as shown by the cadmium numbers in Figure 19. As is well-known, long-term exposure to lower concentrations of contaminants can cause exactly the same negative effects as short-term exposure to much higher pollutant levels. The graph seen in Figure 20 is another illustration of how environmental conditions can affect the impact of a pollutant in aquatic life. As the temperature of the water increases, the toxicity of ammonia (NH3) also goes up; hence, the criterion concentration gets "lower." To further complicate matters, the



WQC	Designated Use	
	Freshwater AL*	Marine AL
Copper (acute)	18 ug/L	3 ug/L
Cadmium (acute)	4 ug/L	43 ug/L
Cadmium (chronic)	1 ug/L	10 ug/L
Chromium (+3) (acute)	1,700 ug/L	10,300 ug/L
Chromium (+6) (acute)	16 ug/L	1,100 ug/L

*AL= aquatic life

Figure 19

acidity (pH) of the water also affects the toxicity of ammonia.

EPA has issued technical guidance that can be used to help set WQC for nutrients (nitrogen, phosphorus) (Figure 21). For more information, see the Ecoregional Criteria Web page at http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/ecoregions/index.cfm.

Temperature also can affect the toxicity of some pollutants. For example, the numeric criteria for chronic exposure to ammonia (Figure 22) reflects the greater risk from this compound at higher temperatures.

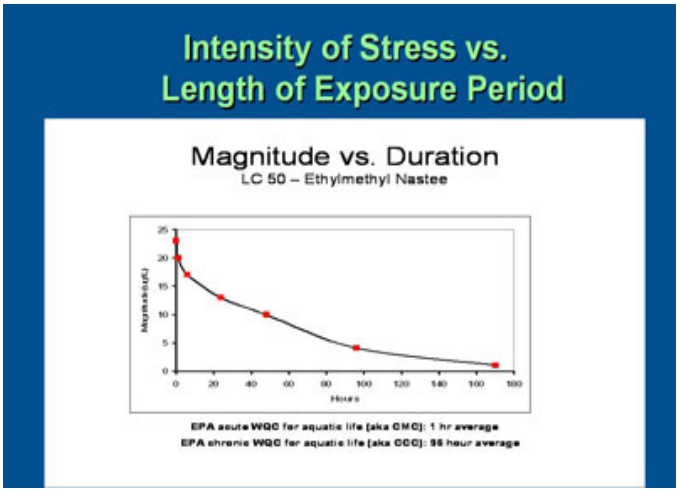


Figure 20

Biological Water Quality Criteria

Biological criteria apply only to aquatic life designated uses (see EPA's Biocriteria Web page at http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/biocriteria/index.cfm) (Figure 23). To establish biological criteria requires spending considerable time in the field collecting organisms and other data. Various techniques focus on different kinds of organisms, such as fish, large invertebrates, and plants. Biocriteria are derived from biological assessments involving integrated measures—indices—of the composition, diversity, and functional organization of a **reference** aquatic community.

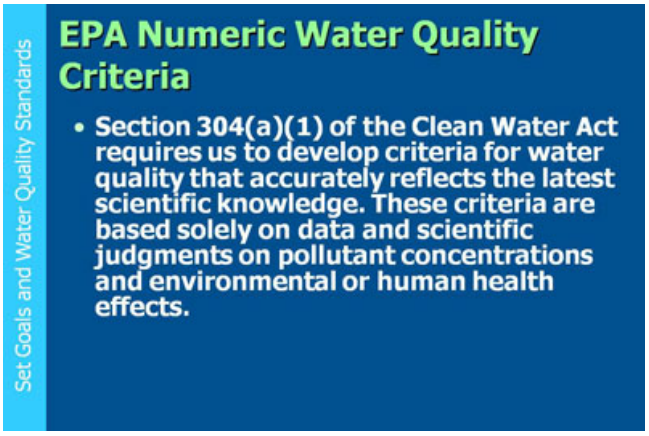


Figure 21

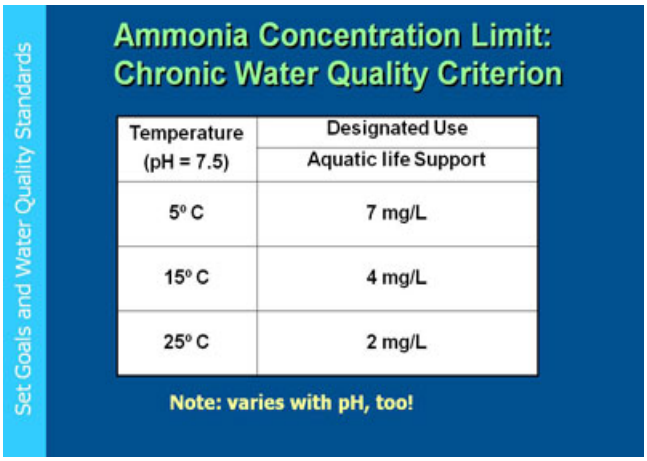


Figure 22

The **reference conditions** should be the foundation for biocriteria. They should represent unimpaired or **minimally impaired** conditions. Examples include **feeding guilds**, **trophic levels**, **generalists**, and **specialists**. As an example of how these metrics can be used as indicators of the health and integrity of an aquatic ecosystem, a water body that has mostly generalists is usually less healthy than those that have a substantial number of specialists. Likewise, a water body dominated

by species that can tolerate highly polluted conditions is generally less healthy than one dominated by pollution-intolerant species.

Symptoms of Impairment:

- Larger percent of tolerant species
- Lower proportion of predators
- Higher number of generalists
- Greater proportion of exotics
- More disease, malformations, and lesions

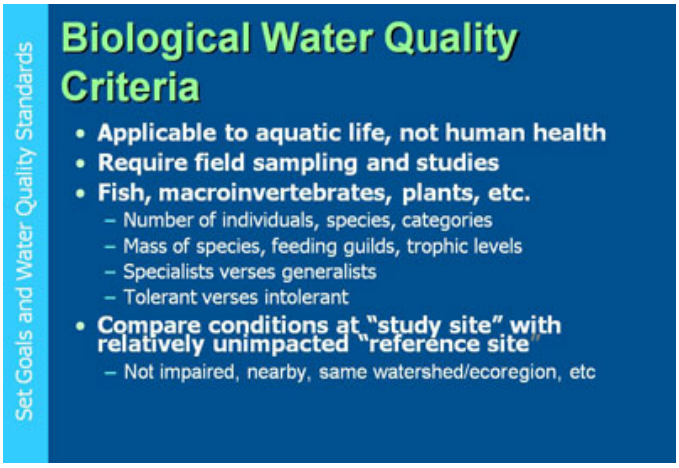


Figure 23

Water Quality Criteria Exemptions

EPA regulations give states, authorized tribes, and territories the flexibility to "waive" applicable WQC under certain circumstances (Figure 24). The two most common forms of such provisions are: (1) mixing zones; and (2) extreme flow conditions. Hence, mixing zones can be thought of as "spatial exemptions" and extreme flow conditions as "temporal exemptions."

Figure 24

Mixing zones exempt certain portions of a water body from meeting applicable designated uses and water quality criteria. Such exemptions are usually employed "downstream" of point source discharges.

Sometimes mixing zones are divided into subzones (Figure 25). In the innermost zone, which is the zone closest to the discharge pipe, exceedance of acute and chronic WQC may be allowed. In the outer zone, acute criteria must be met, but chronic criteria can be exceeded. EPA policy holds that mixing zones should never extend from bank to bank in a river. There should always be a "zone of passage" in which all WQS are met. Likewise, an entire lake or reservoir should not be encompassed by a mixing zone.

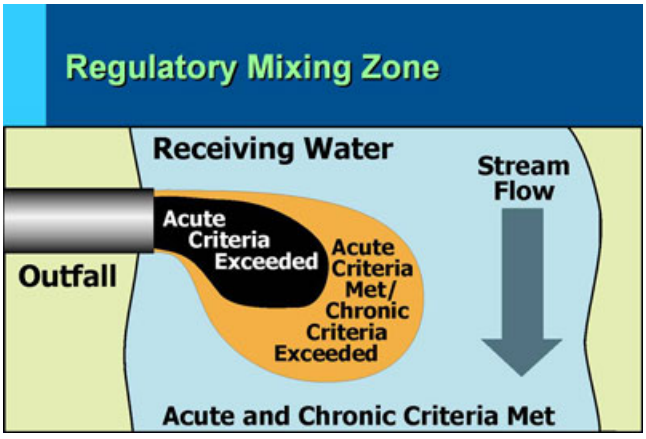


Figure 25

Often, mixing zones are not allowed to overlap with important areas, such as popular swimming beaches, shellfish beds, and critical habitat for commercially, recreationally, or ecologically important species.

Flow exemptions also have been employed primarily in the context of regulation of point sources. They waive applicability of WQS during certain periods, most commonly during extreme low flow events. Low flow exemptions are usually associated with regulation of relatively continuous discharges, e.g., wastewater treatment plant discharges. Waivers of WQS during extreme high flow events could be considered in association with municipal wet weather discharges—combined sewer overflows, for example.

The bell-shaped curve in Figure 26 illustrates the basic idea of temporal WQS exemptions. Note that water quality standards must be met in the vast majority of flow conditions. They are waived only during rare events, represented by the areas on the "outside" of the two dotted lines, each of which delineates one of the "tails" of the curve.

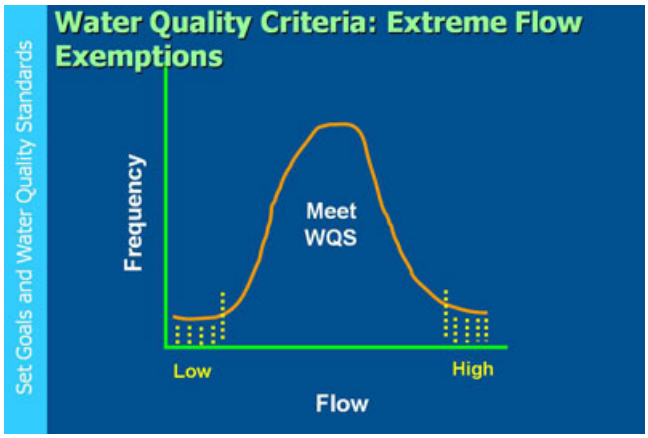


Figure 26

Such exemptions provide a means of avoiding the imposition of extremely high costs upon regulated discharges, as meeting WQS under any and all circumstances would likely be very expensive. Narrative WQC apply in all parts of the water body at all times.

Antidegradation

The third component of state/tribal water quality standards is Antidegradation (Figure 27). The "antideg" regulations help to ensure the following: (1) all waters continue to support their designated uses; (2) waters with higher quality than the minimum are protected, unless there are important benefits associated with carefully considered actions that could cause additional degradation; and (3) highly valued, high-quality waters are not degraded at all.

Figure 27

So let's see how the antidegradation component of the water quality standards program works to protect existing uses, to prevent deterioration of existing levels of good water quality, and to keep specially designated waters clean.

Antidegradation Regulation

Although the regulations don't use the "tier" terminology, they do describe the three levels of protection noted previously (Figure 28). Tier 1—protecting existing uses—is fairly straightforward, as is Tier 3—preventing degradation in "outstanding national resource waters," or ONRWs. Tier 2 is a bit more complex . . . . Let's start with Tier 3.

Figure 28

Antidegradation Tier 3

Tier 3 states that water quality must be maintained and protected without exception for those waters specially designated by a state, territory, or tribe (Figure 29). EPA regulations refer to such waters as Outstanding National Resource Waters (ONRW). States often use the term Outstanding Resource Waters. The "candidate" water body types (e.g., wild and scenic rivers, waters in national and state parks) are merely suggestions that EPA has provided regarding the kinds of water bodies that states, tribes, and territories might choose to designate for Tier 3 level protection. It is generally recognized that some minor, temporary degradation in ONRWs might occur—for example, during road paving work in a national park.

Figure 29

Nevertheless, Tier 3 requires that such degradation be minimized, and that water quality return to the previous level after the activity is completed. The ONRW designation process varies considerably among states. Some states have documented procedures for adding waters to the ONRW list—including those proposed by the public—but others do not.

Antidegradation Tier 2

Tier 2 (Figure 30) is aimed at preventing "freefall" of ambient water quality—that is, having the water quality decline, from being considerably better than the baseline water quality criteria down to just barely meeting those criteria. Note the stipulations required for allowing activities

that degrade water quality: you must ensure that point sources and nonpoint sources are appropriately controlled; you must accommodate public and governmental agency input; and you must assess potential alternatives that would prevent or preclude water quality degradation and perform a socioeconomic evaluation on the alternatives.

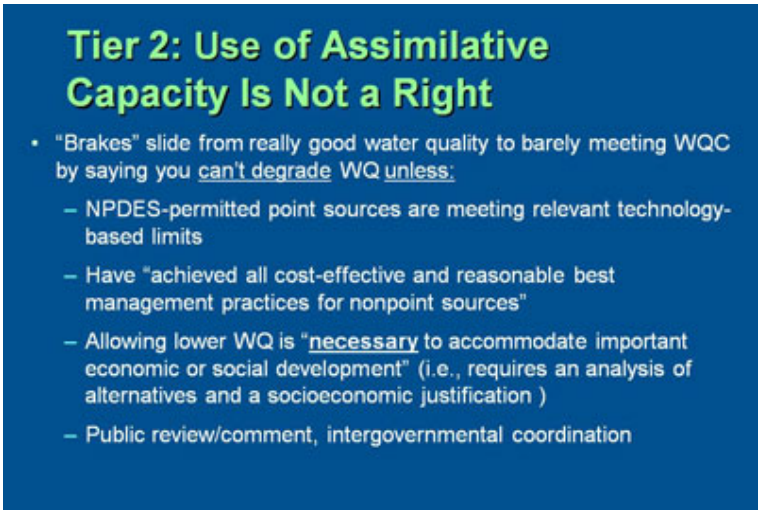


Figure 30

Antidegradation Tier 1

As noted previously, Tier 1 is the "bottom line" rule in antidegradation (Figure 31). Under no circumstances should the condition of any water body deteriorate to such a degree that one or more of the existing uses can no longer be supported. EPA, territories, authorized tribes, and state water agencies should not allow (e.g., by issuing an NPDES permit) any activity that would result in the loss of any existing use. This reflects an overall policy of "locking in" uses and the level of water quality necessary to meet those uses, once they have been attained.

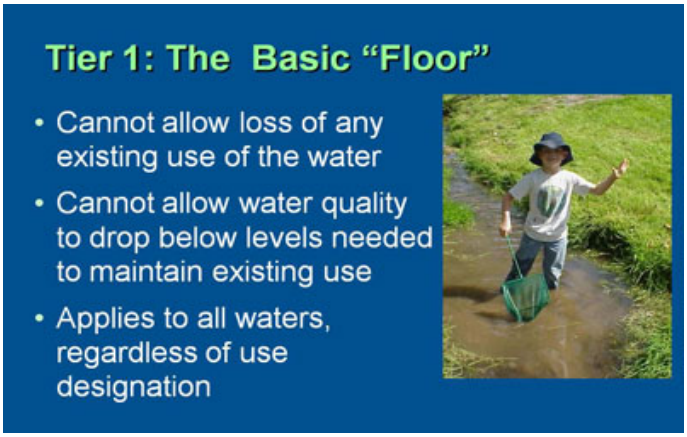


Figure 31

Applying Antidegradation

Antidegradation reviews apply to permits issued under the Clean Water Act and should be considered for other government-approved actions that affect water quality. The step-by-step process for assessing potential water quality impacts, considering alternatives, coordinating with other agencies, reviewing public input, and only allowing degradation for activities that cannot be avoided and that provide important benefits provides a simple framework for protecting water quality (Figure 32).

Figure 32

Antidegradation Overview

Figure 33 illustrates the overall antidegradation approach. Note that the vertical axis on the left side shows pollutant concentration, from low at the top (i.e., "good" water quality) to higher concentrations at the bottom. The circle-and-slash "NO" symbols show that water quality can't be degraded for "Tier 3" ONRWs, nor when the water is barely meeting the applicable criteria for "Tier 1" beneficial use support. Activities that would degrade high quality "Tier 2" waters must be justified, through alternatives analyses and a demonstration of "important" economic or social benefits in the area where the water is located.

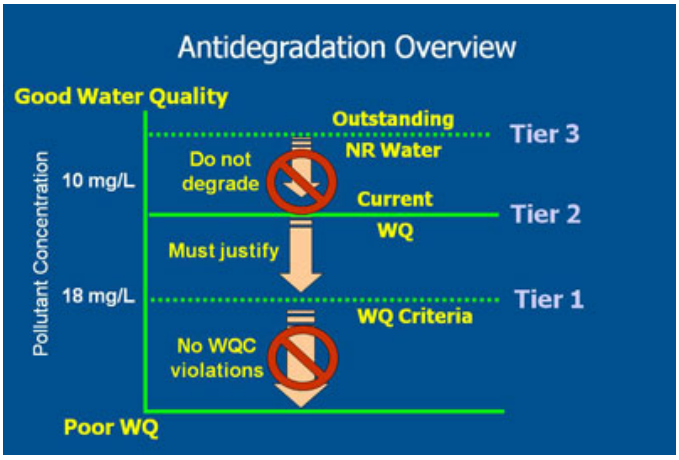


Figure 33

Process for Establishing WQS

EPA must approve the WQS adopted by states, authorized tribes, and territories. If EPA ultimately decides that it cannot reach agreement with a state, tribe, or territory, the Agency can promulgate substitute WQS by going through the formal federal rulemaking process. Opportunities for public comment on proposed WQS are provided at a minimum of two steps in the approval process. Figure 34 outlines the process for participation in the federal water quality standards program.

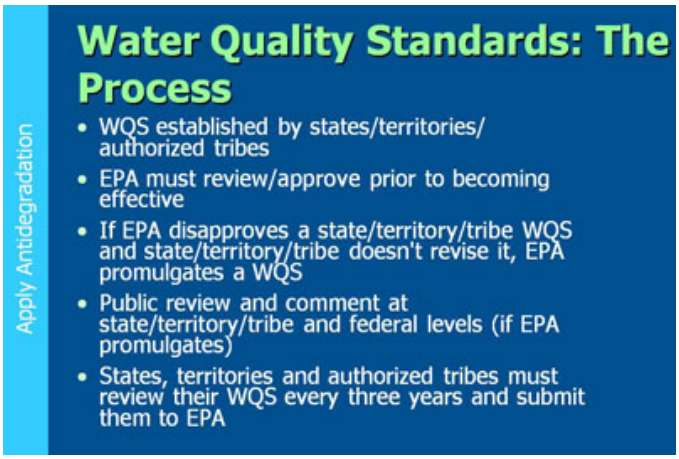


Figure 34

States and U. S. Territories are required to participate in the federal water quality standards program. Tribal participation is optional. Tribes must apply to EPA for "Treatment in a Manner Similar to a State" (TAS) status (Figure 35). Once EPA approves a Tribe's TAS application, the Tribe will then submit its water quality standards to EPA for approval. A Tribe may submit its water quality standards to EPA at the same time that it submits its TAS application. EPA will not approve, however,

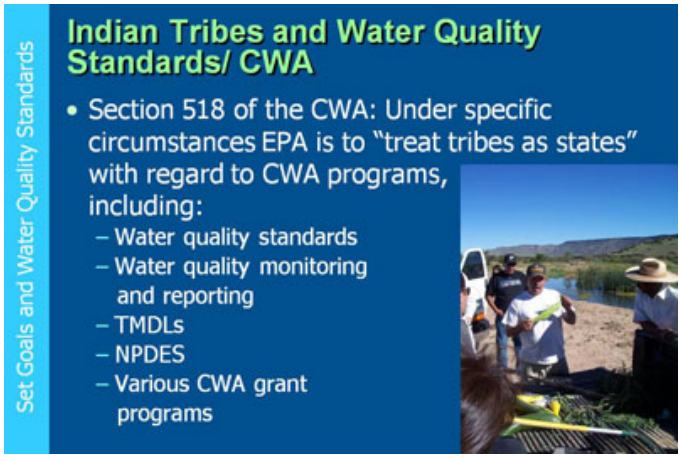


Figure 35

a Tribe's water quality standards until the TAS application has been approved. Approval of a Tribe's TAS application and approval of a Tribe's water quality standards consists of two separate approval actions. Once a Tribe has been approved for TAS for the water quality standards program, all of the regulations, guidance and policies that apply to States and U. S. Territories apply to the Tribe.

Water Quality Standards Rules (Recap)

- Fishable/swimmable are the "default" Dus (Figure 36).
- May not allow/permit impairment/elimination of existing use(s) (Antideg: Rule 1).
- Existing uses must be protected and designated.
- DU = EU ; DU > EU ; DU < EU…Not!!
- May degrade high-quality waters to WQC threshold, but not a "free ride"—must conduct alternatives/socioeconomic analysis and demonstrate benefits (Antideg: Rule 2).
- May downgrade an unmet DU, if certain conditions are met and processes followed.
- May not remove/downgrade an existing use.
- WQ criteria must support DUs.
- WQ criteria must be based on science, not economics or social impacts (Figure 37).
- "States" may use EPA's WQC, but not required if a scientific rationale for alternative is provided.
- May have spatial and/or temporal waivers of WQC (and DUs).
- WQS must not preclude ability to meet downstream WQS.

Figure 36

Figure 37

Enforceability of WQS

Water quality standards are not directly enforceable, despite commonly held beliefs (Figure 38). This means that when standards are not being met, there is no legal requirement for specific measures to be taken by any of the pollutant sources. States are obligated, however, to take certain actions:

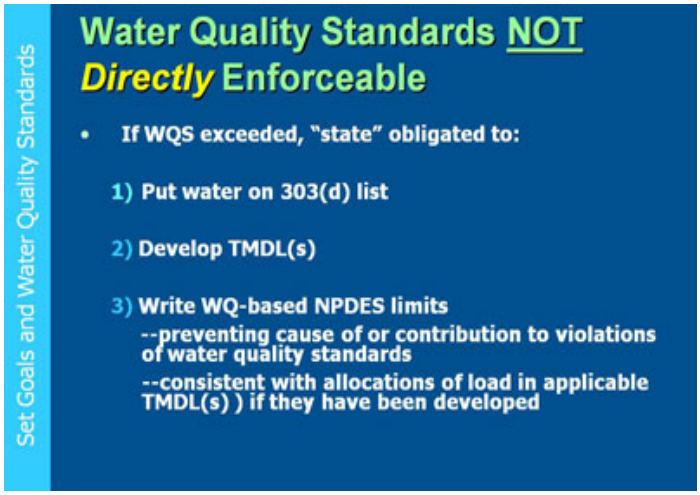


Figure 38

- Place the water body on the state's CWA Sec. 303(d) list
- Develop TMDL(s) for each pollutant exceeding WQC
- Reduce effluent limits in NPDES permits for regulated facilities and activities to the degree necessary to prevent any cause of or contribution to violations of WQS and to achieve wasteload allocations (WLAs) in any relevant TMDLs

NPDES permittees are required to meet their effluent limits. If they fail to do so, they are subject to enforcement actions, including fines and other penalties; but there are no specific federal requirements applicable to nonpoint sources. Consequently, nonpoint sources are not subject to enforcement action under federal law regardless of their contribution to failure to meet WQS.

Monitoring

First, water quality standards (WQS) consistent with the statutory goals of the CWA must be established. Then water bodies should be monitored to determine whether the WQS are being met. The responsibility for ambient monitoring of rivers, lakes, bays, wetlands, estuaries, and nearshore marine waters falls primarily on the states. Contrary to what many believe, EPA does not operate a large national network of water quality monitoring stations, though it could be involved in numerous monitoring projects across the country at any given time.

Unfortunately, most states do not have the funding required to carry out ambient monitoring on the scale needed to keep close track of the condition of our nation's surface waters. Most of the waters in the United States are not monitored several times a year or even once over a period of several years (Figure 39).

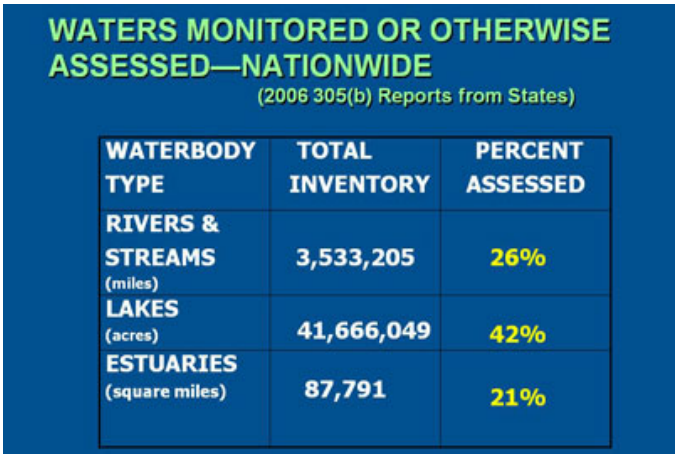


Figure 39

To be virtually certain that WQS are being met, instruments capable of performing continuous monitoring and analysis would need to be employed. Unfortunately, this is rarely the case, particularly for certain types of pollutants like synthetic organic chemicals. On the other hand, considerably less data is needed to have strong evidence that WQS are not being met (i.e., WQC are exceeded). This asymmetry in the amount of data needed is due simply to the severe harm that can come to aquatic ecosystems (and virtually all forms of life) from brief (minutes, hours) exposure to high levels of contaminants. Hence, proving that such short-term conditions occurred at no time over a given period of years requires essentially continuous monitoring.

On the other hand, if available data represent only a small fraction of the time period in question, and those limited data points include one or more exceedances of specified magnitude/duration and frequency combinations, then simple probability tells us that collecting a substantial number of additional samples will reveal additional exceedances. Therefore, we can be confident that WQS are being exceeded several times instream during the specified periods.

Monitoring answers these questions: Is the water safe for humans and fish? Can it be treated economically for domestic use? Is the treatment plant meeting its permit limits? Are the BMPs working as intended? The "why" of monitoring guides the type of program needed.

Decisions about what, where, and when to monitor are most important, and the answers to these questions can vary depending on the purpose of the monitoring program (Figure 40). For example, if the program is supposed to measure the effectiveness of the CWA's regulatory program dealing with "point sources," then monitoring should generally take place just above and just below the discharge pipes coming from such sources. In addition, it would usually make most sense to analyze for pollutants that are covered in the source's permit. A similar approach could be taken to assess the effectiveness of best management practices installed on farm land, logging sites, or other nonpoint pollutant source locations. Note that the monitoring above and below point sources is often a requirement for the point source in NPDES permits, not just the state.

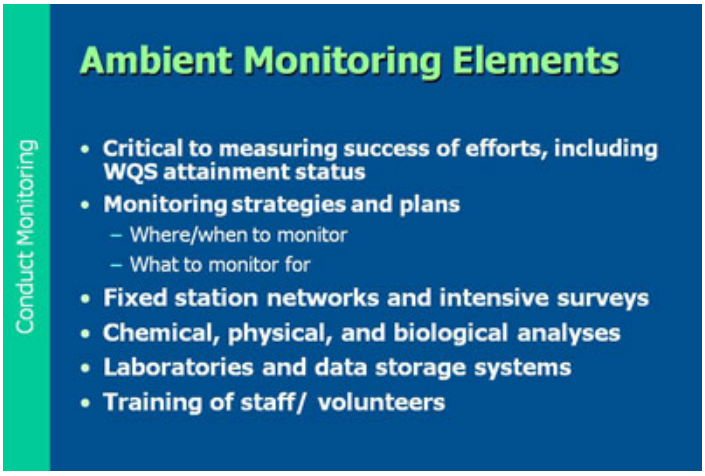


Figure 40

Monitoring efforts also can be organized to determine short- or long-term water quality trends. For example, monthly or quarterly sampling in an area experiencing rapid development can help to determine if post-construction stormwater design standards are indeed minimizing water quality impacts to the maximum extent practicable. Likewise, follow-up ambient monitoring can be used to determine whether or not load reductions called for in a TMDL are being met.

If the aim is to get an overall picture of water quality in a state (e.g., what percentage of all waters are meeting WQS), then a statistically chosen random set of sampling locations would usually be best. (See National Aquatic Resource Surveys at

http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm for more information on this topic.) Moreover, the types of pollutants to be tested for would need to be broader than just those known to be coming from a particular type of discharger. Currently, state **ambient monitoring** programs tend to be focused on waters that the state has declared impaired or suspects is polluted.

Water Quality Reports

Figure 41

States, tribes, and territories are required to provide the results of their monitoring efforts in the form of two reports, submitted to EPA and made available to the public (Figure 41). These reports are generally submitted on April 1 of every even-numbered year (i.e., biennially).

The first report is the "305(b) Report," after the requiring section of the CWA. It should include all that which the state, tribe, or territory knows about all its waters—healthy, threatened, and in poor condition. The second is the "303(d) List" and should include only those waters that are either threatened or already water quality limited (i.e., not meeting one or more applicable water quality standard).

In addition to 305(b) reports and 303(d) lists, states and tribes also submit other lists to EPA, such as the 303(e) continuous planning list and toxic hot spots under 304(l).

EPA's Assessment Total Maximum Daily Load (TMDL) Tracking And Implementation System (ATTAINS) provides information reported by the states to EPA about the conditions in their surface waters. This information is required every two years under Clean Water Act sections 305(b) and 303(d). For more information and to view findings reported by states and tribes, visit EPA's Watershed Assessment, Tracking & Environmental Results website at http://www.epa.gov/waters/ir/.

Since 2002, EPA has encouraged states, tribes, and territories to submit the information previously contained in separate 305(b) and 303(d) reports in one consolidated format. Under this new "Integrated Report" approach, all waters would be placed in one of five categories. These categories are defined by the amount of information available regarding a water body and the condition of the water body (For more information, see EPA's TMDL Guidance at http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm.)

Integrated 305(b)/303(d) Report

If monitoring and assessment indicate that for some uses and parameters, a water body or segment is not meeting WQS, then that water is considered "water quality limited" and goes on a special list called the "303(d) list," named after the section of the CWA that calls upon states,

approved tribes, and territories to create such lists. EPA has developed an integrated reporting format for water quality assessment information, using five categories as described in Figure 42. Note that Categories 2 and 3 are for waters that might lack sufficient information for determining whether or not all designated uses are currently being met. Category 5 contains the impaired and threatened waters "303(d) list." States are required under section 303(d) to identify those waters for which technology-based effluent limits are not adequate to achieve the state's water quality standards.

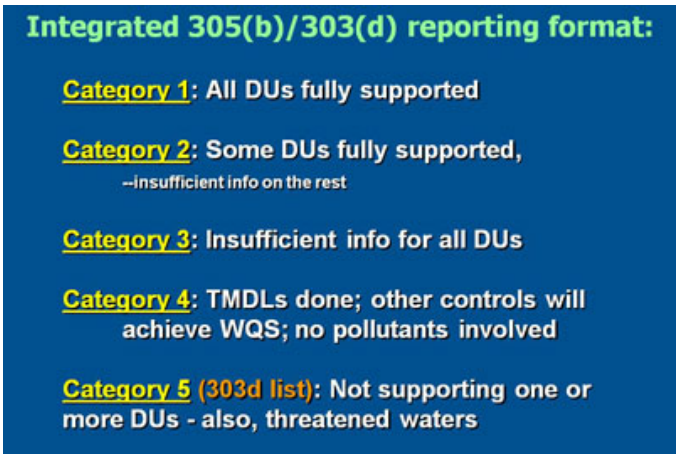


Figure 42

305(b) Reports

In addition to the information on the condition of all waters in the state, tribal land, or territory, the 305(b) report should also provide information (if available) on which pollutants (chemicals, sediments, nutrients, metals, temperature, pH) and other stressors (altered flows, modification of the stream channel, introduction of exotic invasive species) are the most common causes of impairment of water body uses and what are the most common sources (e.g., poorly managed development and agricultural operations) of those stressors (Figure 43). The report also should include a discussion of progress made toward meeting the CWA's goals since the time of the last 305(b) Report.

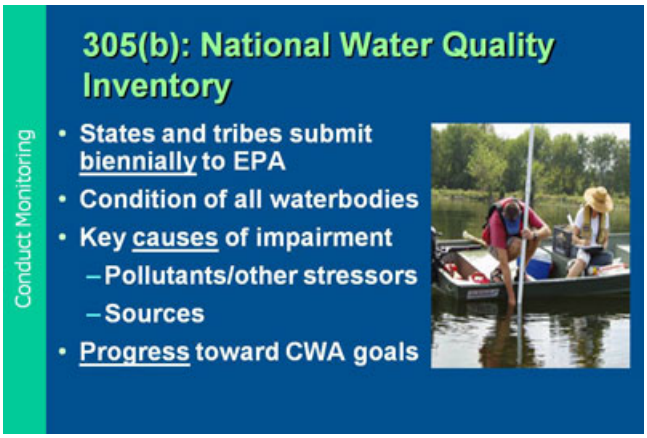


Figure 43

The CWA does not give EPA the authority to force states to do additional ambient monitoring. The agency does have some possible leverage with CWA 106 grantees, but it is difficult to leverage. Congress has not provided funding for data collection in states that have not collected sufficient information to assess their all their waters. For example, only about 16 percent of streams and rivers were assessed during the most recent reporting cycle, with approximately 44 percent impaired. For lakes and reservoirs, 39 percent of the total acres were assessed, with 66 percent impaired. For bays and estuaries, 29 percent was assessed, with 30% impaired (see EPA's National Water Quality Inventory Report to Congress at http://water.epa.gov/lawsregs/guidance/cwa/305b/index.cfm).

The table in Figure 44 shows a summary of the condition of assessed waters, nationwide. Unfortunately, because of resource limitations, only a portion of waters nationwide have been assessed.

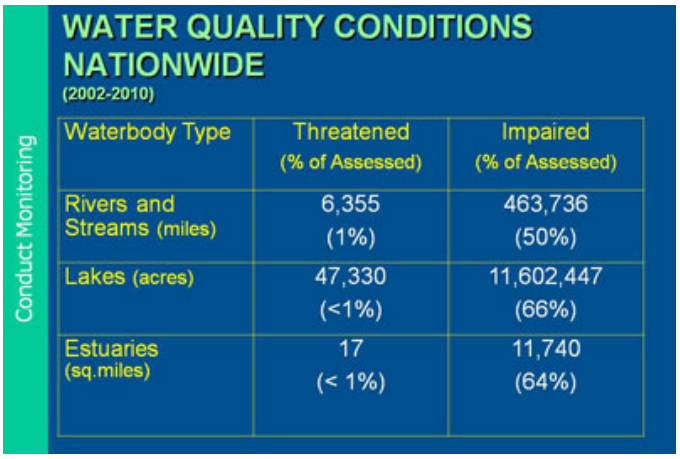


Figure 44

303(d) Reports

The 303(d) list (summarized in Figure 45) should include not only current water quality-limited water bodies but also waters believed to be threatened that are likely to become impaired for specific uses (i.e., not meeting WQS) by the time the next 303(d) list is due.

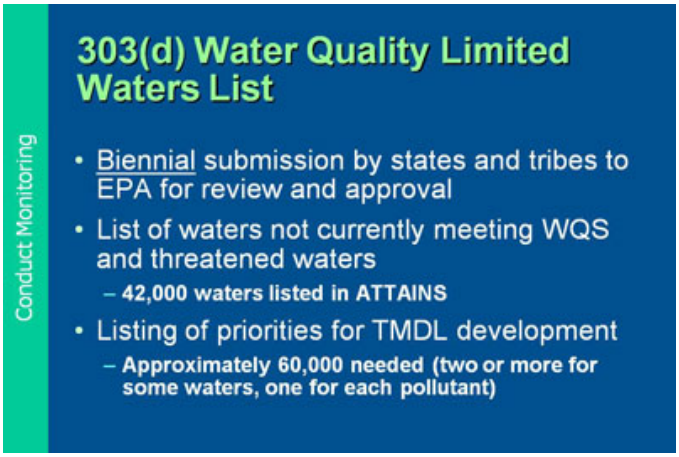


Figure 45

EPA regulations call for 303(d) lists to include only waters affected by "pollutants," not those affected by other types of "pollution" (altered flow or channel modification). If it is certain that a water body's poor condition is not caused by a "pollutant" but is due to another type of "pollution" such as flow, the water body does not need to be on the 303(d) list. If, however, biological monitoring indicates there is impairment of aquatic life uses, but it is not clear whether a pollutant is at least one of the reasons, the water should be on the 303(d) list, and further analysis to identify the causes are needed. Waters affected by "non-pollutant pollution" should be identified in category 4(c) of the Integrated Report.

EPA guidance documents (found at http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/guidance.cfm) mention numerous types of data and information that are considered "existing and readily available." EPA has stated that such data include: (1) evidence of exceedance of a numeric WQC; (2) direct evidence of beneficial use impairment; (3) evidence that narrative standards are not being met; and (4) results of computer modeling of the water bodies. EPA also requires that data from sources other than the state agency itself—federal agencies, universities, volunteer monitoring groups—must be considered, and used, if they meet the state's requirements for data quality. Some of the above actions might initially seem obvious, such as evidence of numeric WQC exceedances. But even this can be subject to debate.

For instance, suppose you are dealing with a WQC expressed as a 30-day average concentration of pollutant "x," and you have only two data points for the relevant 30-day period, each representing just one "grab sample." Suppose both were higher (more polluted) than the WQC. Should this water be listed as "impaired," or should more data be collected before putting the water on 303(d) list?

How would you measure impairment of a designated use directly? Using a biological assessment of aquatic life could be one method. Epidemiological studies showing a correlation between people swimming in the water and incidence of waterborne disease could be a direct measure of impairment of contact and recreation uses.

How should narrative WQC be interpreted? For example, how much "scum or floating debris" would constitute an exceedance? Would algal mats floating on a surface of the lake represent an exceedance of this narrative WQC, or perhaps of an "undesirable or nuisance aquatic life" narrative?

What if water quality computer modeling studies indicated that WQC would be exceeded at critical low flows, but actual monitoring data available from numerous samples from more typical flow conditions showed no exceedances of criteria. Should the water body be listed?

What level of training for volunteer monitors and what extent of quality assurance/quality control (QA/QC) measures should be required before data collected via volunteer monitoring efforts could be used as the basis of putting a water body on the 303(d) list?

The two most common causes of impairment, nutrients (nitrogen and phosphorus) and sediment, are parameters for which EPA and most states do not currently have numeric WQC. The sediment referred to here is clean sediment/silt, not toxics-laden bottom sediments. Nutrients are phosphorus and/or nitrogen. "Other habitat alterations" listed as sources of poor water quality means dams, channelization, bank destabilization, and removal of riparian vegetation, but usually not flow alteration. Organics refers to synthetic organics, not naturally occurring organic materials. Noxious aquatic plants includes blooms of blue-green algae and invasive species such as hydrilla.

Causes of Impairment

IMPORTANT NOTE: The precise numbers presented in these tables should not be assigned a great deal of significance. Even the exact order in which the different stressors are listed should not be considered definitive. What can be said with considerable confidence is that the three most frequently encountered causes of impaired uses are nutrients, pathogens and sediments (Figure 46). By contrast "toxic chemicals" such as metals, pesticides, synthetic organics, and ammonia are not as frequently encountered. (This is not to say that toxics need not be addressed in those water bodies where they are a problem.) Data years for the information presented in the table are 2002–2010 and vary by state. For more information, please see EPA's WATERS Web page (http://iaspub.epa.gov/waters10/attains_nation_cy.control#prob_source).

TOP FIVE CAUSES OF IMPAIRMENT

Cause of Pollution	River/Stream (Miles)	Lakes, Ponds, Reservoirs (Acres)	Estuaries and Bays (Sq. Mi)
Pathogens	141,789	445,619	3,042
Sediment	107,650	723,937	209
Nutrients	101,461	2,454,459	833
Org. Enrichment/ Oxygen Depletion	83,583	1,954,805	3,602
Habitat Alterations	82,510	443,640	273

Figure 46

Figure 47 shows that the most commonly cited causes of impaired water body uses vary from one major water body type to another. Of course, this does not mean that the key pollutants for a particular river, lake, or estuary would reflect the national picture shown here. The data presented in Figure 48 are drawn from years 2002–2010 and vary by state. See EPA's WATERS National Summary of State Information Web page (http://iaspub.epa.gov/waters10/attains_nation_cy.control#status_of_data) for details.

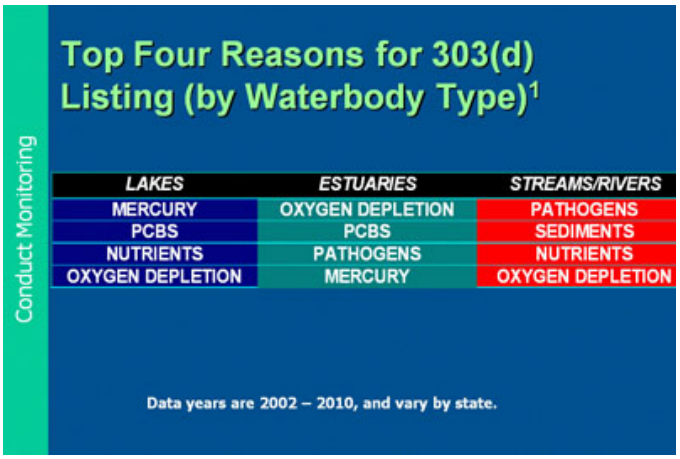


Figure 47

Because of the implementation of CWA regulatory programs controlling point sources of pollution over the last four decades, industrial facilities and municipal sewage treatment plants no longer are the major cause of use impairment of most of the nation's surface waters. On the other hand, diffuse sources of precipitation-induced runoff are the sole cause of impairment of nearly half of the waters that states, territories, and authorized tribes list in their 303(d) reports. Also likely is that in many of that 50 percent of the water quality-limited waters in which point and nonpoint sources are significant contributors, nonpoint sources contribute considerably more pollutant loads than do point sources.

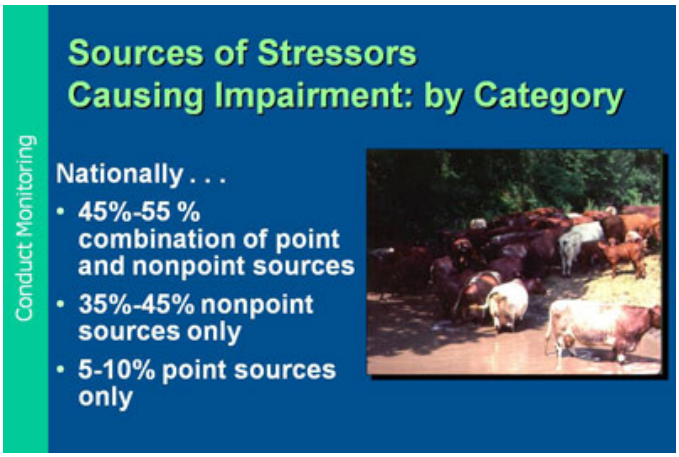


Figure 48

Total Maximum Daily Loads (TMDLs)

If monitoring and assessment indicate that a water body or segment fails to meet one or more water quality standard and it is, therefore, placed on the 303(d) list, then the relevant entity (state, territory, or authorized tribe) is required to assess and allocate pollutant loads in a manner that would lead to attainment of WQS. The process of quantifying existing pollutant loads and calculating the load reductions needed to meet WQS is required under section 303 of the CWA, which describes the result as the "Total Maximum Daily Load" (Figure 49).

Figure 49

The CWA requires that Total Maximum Daily Loads (TMDLs) be developed only for waters affected by pollutants where implementation of the technology-based controls imposed upon point sources by the CWA and EPA regulations would not result in achievement of WQC. At this point in the history of the CWA, most point sources have been issued NPDES permits with technology-based discharge limits. In addition, a substantial fraction of point sources also have more stringent water quality-based permit limits. But because nonpoint sources are major contributors of pollutant loads to many water bodies, even these more stringent limits on point sources have not resulted in attaining WQS.

Strategies that help to achieve WQS must consist of a TMDL or another comprehensive effort that includes the functional equivalent of a TMDL implementation plan. Some states have developed watershed management plans that address water bodies that are threatened or affected by pollution. The key point to remember is that TMDLs are "pollutant budgets" for a specific water body or segment that, if not exceeded, would result in attaining WQS.

One somewhat unique program that can address water quality impacts with or without a TMDL is authorized by section 320 of the CWA, the National Estuary Program (http://water.epa.gov/type/oceb/nep/index.cfm).

TMDLs are required for "pollutants," but not for all forms of "pollution" (Figure 50). The Clean Water Act regulates pollutants that are discharged to water, while "pollution" is a broader term that can be caused by actions involving discharges as well as those not involving discharges, such as removing stream cover or flow modification. "Pollutants" include substances such as clean sediments, nutrients (nitrogen and phosphorus), pathogens, acids/bases, heat, metals, cyanide, and synthetic organic chemicals. As noted previously, pollution includes all pollutants but also includes flow alterations and physical habitat modifications.

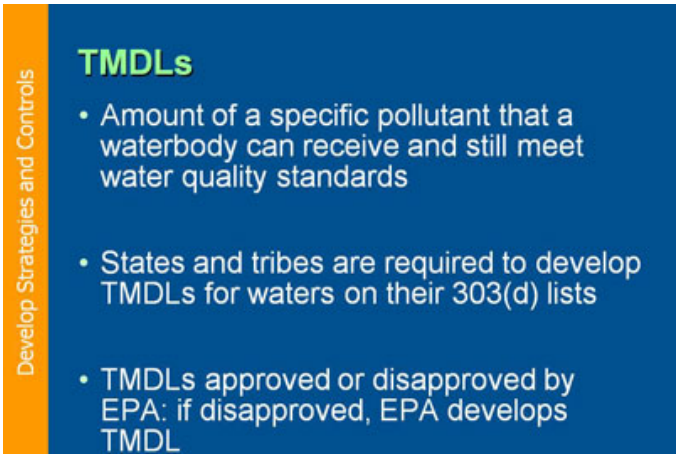


Figure 50

At least one TMDL must be done for every water body or segment impaired by one or more pollutants. TMDLs are done pollutant-by-pollutant. Although if a water body or segment were affected by two or more pollutants, the TMDLs for each pollutant could be done simultaneously.

EPA is encouraging states, tribes, and territories to do TMDLs on a "watershed basis" (e.g., to "bundle" TMDLs together) to realize program efficiencies and foster more holistic analysis. Ideally, TMDLs would be incorporated into comprehensive watershed strategies. Such strategies would address protection of high quality waters (antidegradation) as well as restoration of impaired segments (TMDLs). They would address the full array of activities affecting the water body. Finally, such strategies would be the product of collaborative efforts between a wide variety of stakeholders.

TMDLs must be submitted to EPA for review and approval/disapproval. If EPA ultimately decides that it cannot approve a TMDL that has been submitted, the Agency would need to develop and promulgate what it considers to be an acceptable TMDL. Doing so requires going through the formal federal rulemaking process.

Elements of a TMDL

The first element of a TMDL is "the acceptable load," also referred to as the pollutant "cap" (Figure 51). It is basically a budget for a particular pollutant in a particular body of water, or an expression of the "carrying capacity." This is the loading rate that would be consistent with meeting the WQC for the pollutant in question. The cap is usually derived by using mathematical models, which can be derived via simple calculations or through computer modeling (Figure 52).

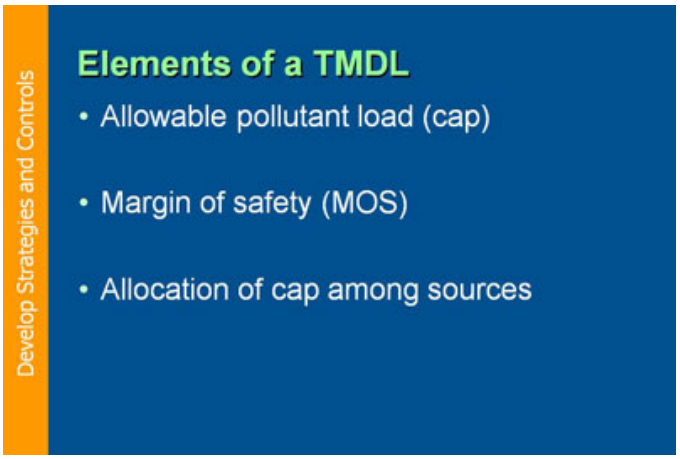


Figure 51

The CWA requires that all TMDLs include a safety factor as an extra measure of environmental protection, taking into account uncertainties associated with estimating the acceptable cap or load. This is referred to as the margin of safety (MOS).

Once the cap has been set (with the MOS factored in), the next step is to allocate that total pollutant load among various sources of the pollutant for which the TMDL has been done. This is, essentially, the "slicing of the pie."

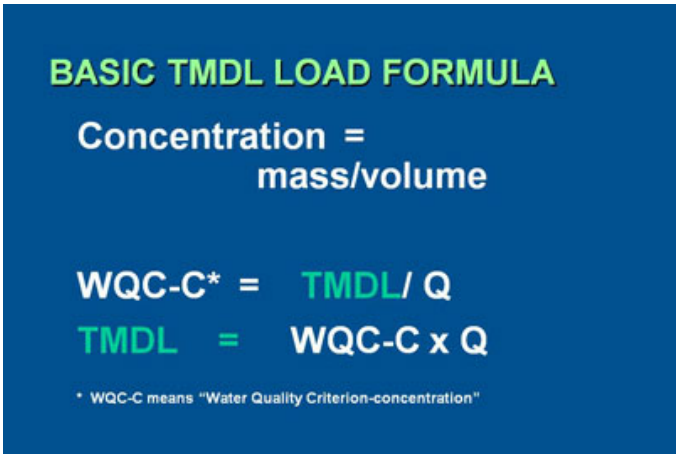


Figure 52

TMDL Caps

TMDLs are developed for several pollutants and water body types (Figure 53). TMDL developers use a wide variety of analytical approaches depending on available data, watershed and water body characteristics, and available budgets. EPA recommends that all TMDLs and associated load allocations and wasteload allocations be expressed in terms of daily time increments. In addition to daily time increments, TMDLs may also include non-daily pollutant load expressions to attain and maintain the applicable water quality standards. In an effort to fully understand the physical and chemical dynamics of a water body, many TMDLs are developed using methodologies that result in identified allocations of monthly or greater time

periods. TMDLs commonly include time steps ranging from daily to annual to express the loading capacity and associated allocations.

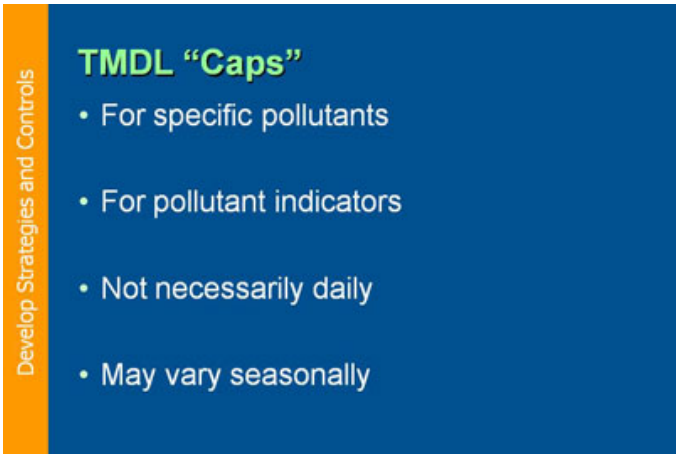


Figure 53

EPA encourages TMDL developers to apply accepted and reasonable methodologies when calculating TMDLs and to use the most appropriate averaging period for developing allocations based on factors such as available data, watershed and water body characteristics, pollutant loading considerations, applicable standards, and the TMDL development methodology, among other things. For example, in the case of a narrative criteria applicable to sediment, attaining WQS cannot always be judged daily. Assessing cumulative loading impacts is necessary to understand how to achieve WQS and to estimate the allowable loading capacity.

For more information on the technical approach related to TMDL averaging periods and methods, see "Options for Expressing Daily Loads in TMDLs" (www.epa.gov/owow/tmdl/draft_daily_loads_tech.pdf).

TMDL Allocations

EPA regulations use the terms Wasteload Allocations (WLA) and Load Allocations (LA) to describe loadings assigned to point and nonpoint sources, respectively (Figure 54).

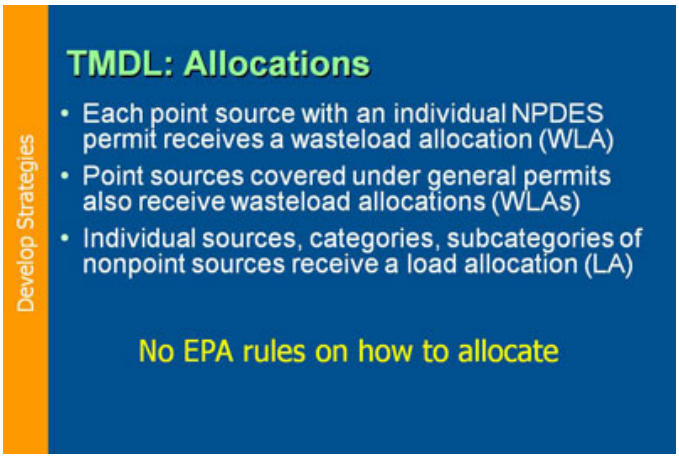


Figure 54

Generally, point sources that are required to have individual NPDES permits are required to be assigned individual WLAs. On the other hand, a group of sources covered under a "general" NPDES permit may be assigned one collective WLA.

Although ideally, load allocations should be assigned to individual nonpoint sources, this is often not practical or even scientifically feasible; hence, loads can be assigned to categories of nonpoint sources (all soybean fields in the watershed, for example) or to geographic groupings of nonpoint sources (all in a particular subwatershed).

Even though the CWA provides no federal authority for requiring nonpoint sources to reduce their loadings of pollutants to the nation's waters, the act does require states (and authorized

territories and tribes) to develop TMDLs for waters where nonpoint sources are significant sources of pollutants. TMDLs do not create any new federal regulatory authority over any type of sources. Rather, regarding nonpoint sources, TMDLs are a source of information that, for a given water body, should answer the following questions:

- Are nonpoint sources a significant contributor of pollutants to this water body?
- What are the approximate total current loads of a particular pollutant from all nonpoint sources in the watershed?
- What fraction of total loads of the pollutant of concern comes from nonpoint sources vs. point sources?
- What are the approximate loadings from the major categories of nonpoint sources in the watershed?
- How much do loads from nonpoint sources need to be reduced to achieve the water quality standards for the water body?

A common misconception about TMDLs is that EPA has issued regulations specifying how the pollutant cap in a TMDL should be allocated among sources—equal reductions for all or equal loadings from each, for example. EPA has no such regulations. States, territories, and tribes are free to allocate among sources in any way they see fit, so long as the sum of all the allocations is no greater than the overall loading cap. Nevertheless, when thinking about changing the share of allowed loads among sources, it is important to realize that in all but very small water body segments, load location matters. In many cases, the farther away from the zone of impact that a pollutant enters into the water body system, the less of an effect that load will have on the water quality limited zone. For example, studies of large watersheds, such as Long Island Sound, have indicated that one pound of pollutant (nitrogen, in the case of the Sound) discharged close to the impaired zone has the same impact on that zone as 10 pounds discharged substantially farther away. Furthermore, even after accounting for location-related relative impacts on a particular segment or zone, care must be taken to ensure that localized exceedances of WQS do not result from moving loads from one tributary/segment to another.

For more information on allocation of loads under TMDLs, check the Allocations: Definition and Options (http://water.epa.gov/scitech/datait/models/allocation/def.cfm) Web page.

Figure 55 shows a conceptual diagram showing how loads under a TMDL might be allocated to various kinds of sources and other factors.

Margin of Safety (MOS)— Obviously, the bigger the slice of the pie, the less load that can be "given" to current or future sources.

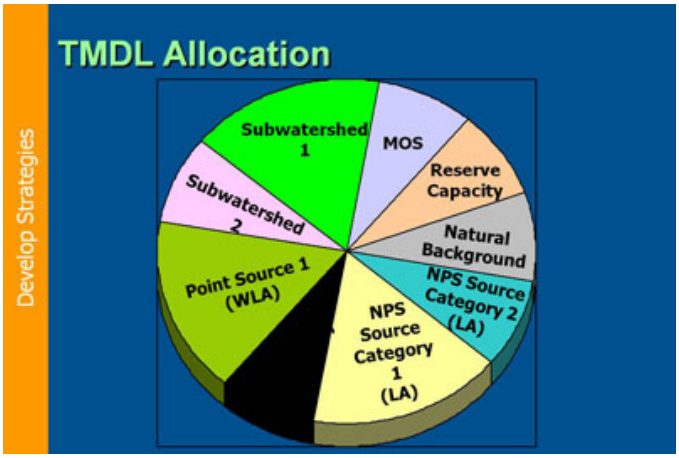


Figure 55

Reserve Capacity—Deciding how much of the allowed load to assign to future growth and development presents some very interesting issues. There is an inevitable tradeoff between the interests of existing sources and those of future sources. If a TMDL does not set aside anything for the future, it will be harder to accommodate development that generates new loads of the pollutant in question. But if a relatively large amount is set aside for growth, then existing sources will get lower allocations and, therefore, will have to achieve greater reductions. A reserve capacity is optional and at the state's discretion.

Natural Background—Allocation of the total allowed load must reflect the contribution from truly natural sources, such as areas where the soil is naturally high in a particular metal, for example.

Nonpoint Source Categories—The next two wedges illustrate that loads can be assigned to entire categories of nonpoint sources, such as all of a certain type of farming operation.

Individual Waste Load Allocations for Point Sources—A TMDL can assign different-size slices to each of these sources. These allocations in the TMDL would be the basis for each source's NPDES permit discharge limit for the pollutant addressed by the TMDL.

Load Allocation to Specific Subbasins—This could be an option in situations where there are no significant individual point sources and the subwatershed is not dominated by one or two categories of nonpoint sources.

TMDLs are not "self-implementing." Hence, other authorities and programs must be used to implement the pollutant reductions called for by a TMDL or other strategy to achieve water quality standards. The exact authorities and programs a state, territory, or authorized tribe uses will depend on the type of sources present, as well as on social, political, and economic factors. A variety of federal, state, local, and tribal authorities and programs can be brought to bear, together with initiatives from the private sector.

The CWA provides many regulatory and voluntary tools that can be useful in achieving needed reductions. (It is likely, however, that the CWA tools alone might not be sufficient to achieve needed reductions, especially in situations where nonpoint sources dominate loadings. Other tools might be available from other federal programs, state and local government programs, academic institutions, the business community, nongovernmental organizations such as land trusts, and other sources) (Figure 56).

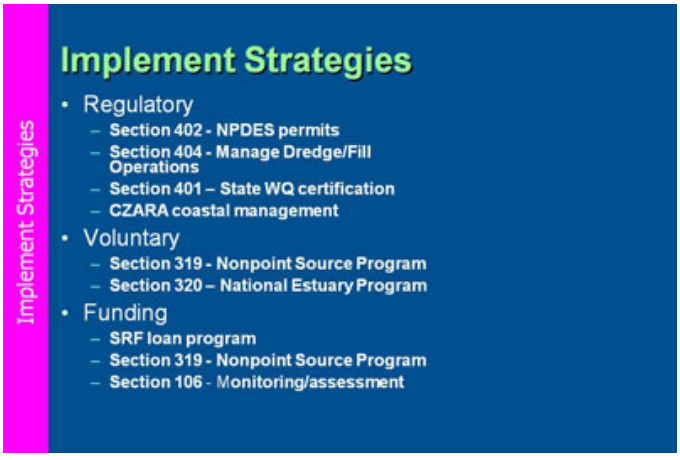


Figure 56

NPDES Program

The CWA makes it illegal to discharge **pollutants** from a **point source** (i.e., a manmade conveyance, such as a pipe, ditch, tank, vehicle, etc.) to the **waters of the United States** except in accordance with a permit. Section 402 of the act creates the National Pollutant Discharge Elimination System (NPDES) regulatory and permitting program. Point sources must obtain a discharge permit from the proper authority (usually a state, but sometimes the EPA, a tribe, or a territory). Though the CWA does contain a long-range goal of zero discharge of pollutants, these permits do not, as the name of this program might suggest, simply say "no discharge." Rather, they set limits on the amount of various pollutants that a source can discharge in a given time.

In most cases, the NPDES permitting program applies only to direct discharges to surface waters. Some cases in which discharges to ground water are hydrologically connected directly to a surface water have been incorporated into the NPDES program. A wide variety of conveyances are considered point sources, including pipes, ditches, channels, tunnels, certain kinds of ships, and offshore oil rigs.

NPDES permits cover industrial and municipal discharges, discharges from storm sewer systems in larger cities, stormwater associated with numerous kinds of industrial activity, runoff from construction sites disturbing more than one acre, mining operations, and animal feedlots and aquaculture facilities above certain thresholds (Figure 57).

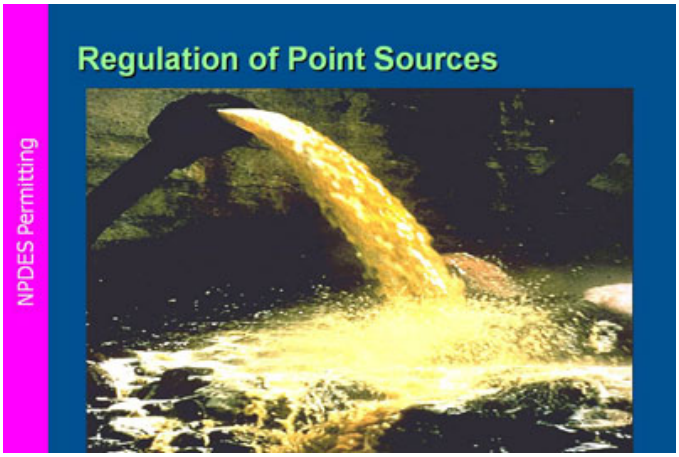


Figure 57

Special Exemptions

- A number of types of discharges that meet the definition of a "point" source are not required to obtain an NPDES permit because of either statutory (congressional) or administrative (EPA) exemptions. These include the following:
- Abandoned mines on nonfederal lands (state, local, private)
- Sewage (not other types of discharges) from ships covered by EPA's Vessel Sewage Discharge Program
- Return flows from irrigated agriculture
- Most drainage ditches associated with logging roads
- Some energy-related facilities
- Most smaller feedlots and aquaculture facilities

Also, all so-called "indirect" dischargers are not required to obtain NPDES permits. The drawing explains the difference between "direct" and "indirect" discharges. An indirect discharger is one that sends its wastewater into a city sewer system, so it eventually goes to municipal treatment plants, which are commonly called "publicly owned treatment works" (POTWs). Though not regulated under NPDES, "indirect" discharges are covered by another CWA program, called pretreatment (Figure 58). All permits state their issuance and expiration date. In accordance with the CWA, permit terms may not exceed five years. EPA's regulations require that permit applications be submitted to the permitting authority 180 days before discharge (if a new discharger) or permit expiration (if already an NPDES permit holder).

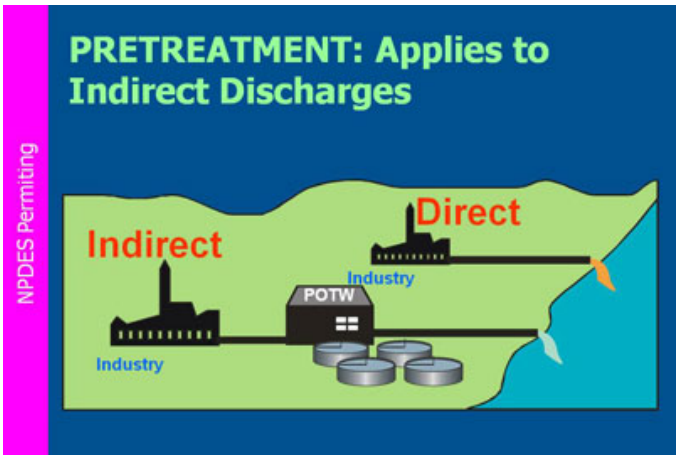


Figure 58

Who is responsible for drafting and issuing the permits?

The first thing to determine is whether the state is "authorized" to administer the NPDES program. This authorization (sometimes referred to as delegation or primacy) is granted by EPA to a state if it can demonstrate that it has a program at least as stringent as EPA's regulations. Nearly all states are authorized to manage the NPDES permitting program in their jurisdictions—for more information, see Web page on State and Tribal Program Authorization Status at http://cfpub.epa.gov/npdes/statestribes/astatus.cfm. As of 2010, 46 states are authorized to administer the NPDES program.

If the state does not have authorization to administer the NPDES program, then EPA will be the permitting authority. Therefore, the EPA regional office issues the permits, takes all the enforcement actions, and does the inspections and monitoring visits as necessary.

If a state, tribe, or territory has authorization, then it is the permitting authority and performs all of the day-to-day permit issuance and oversight activities (Figure 59). In this case, EPA acts in an oversight role, providing review and guidance for the state's program. Under certain circumstances (e.g., objection to a permit, failure to enforce, failure to include required permit provisions—such as effluent limits), EPA could determine that the state action is insufficient **and may issue its own permit.**

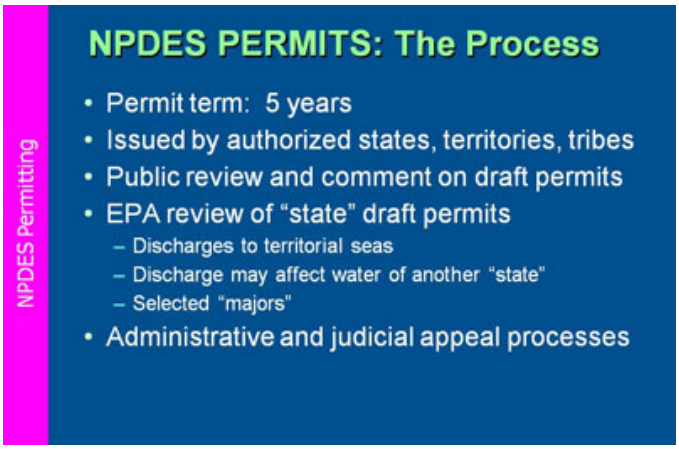


Figure 59

Regardless of who is the permitting authority, all draft permits must be made available for at least a 30-day public review and comment period. If the public expresses sufficient interest during the comment period or if issues require clarifications, a public hearing may be scheduled.

After a final permit has been issued, stakeholders still have access to administrative (state/EPA) or judicial (courts) appeal processes. Clean Water Act permit programs, including the NPDES permit program, are structured to provide permit coverage to point sources in one of two ways: developing a unique permit for each discharger or developing a single permit that covers a large number of similar dischargers. These types of coverages are called individual permits and general permits, respectively (Figure 60). The following examples demonstrate how individual and general permits function under the NPDES program.

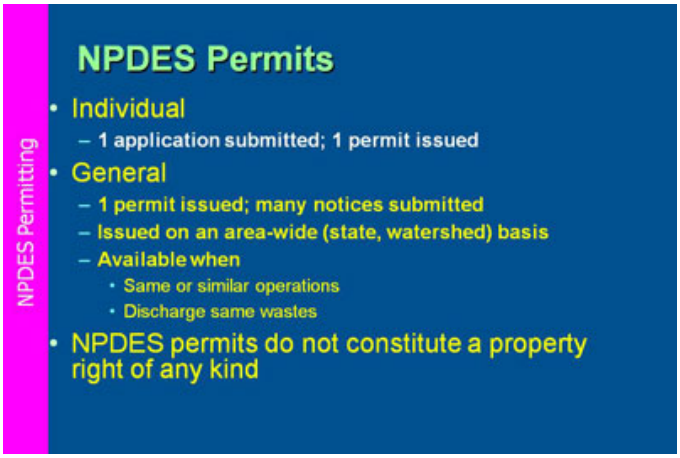


Figure 60

An individual permit is just what it sounds like. An individual facility gets its own unique permit designed for its specific discharge and situation. For example, ACME, Inc., has a process wastewater discharge to Pristine Creek. ACME completes an application that describes its operation and discharge and requests a permit to allow it to continue discharging. The permitting authority reviews the application and crafts and issues a permit that is unique to the ACME, Inc., facility and provides specific conditions that ACME must meet.

A general permit is a permit that covers a large number of similar facilities with a single permit document. In this case, the permitting authority identifies a large number of similar facilities and determines that the permit conditions that would apply to these facilities would be virtually identical. The permitting authority then crafts and issues a general permit that can be used to cover any discharger that meets criteria established by the permitting authority. Once the general permit is issued, any dischargers that think they meet the general permit criteria can submit a Notice of Intent (or other appropriate notification) to the permitting authority requesting coverage and promising to comply with the conditions in the permit. The permitting authority can then grant coverage or require the facility to apply for an individual permit.

General permits are limited by certain regulatory and practical constraints. The regulations at 40 CFR 122.28 require the permitting authority to define the geographical area and sources. Geographical area can be just about anything (e.g., watershed, county lines, state boundaries). Sources covered can include stormwater or a discharger category with similar operations, similar wastes, and needing similar limits. General permits appropriately control numerous small sources. The more complex the discharge, the more likely an individual permit will be required.

All individual NPDES permits include a certain set of basic elements (see Figure 61). The first is perhaps the most obvious—a specific, numeric, measurable set of limits on the amount of various pollutants that can appear in the wastewater discharged by the facility into the nation's waters. Such limits are often expressed as concentrations, combined with allowed volumes of discharge. Or, limits can be expressed as mass discharged per unit time (day, week, and so forth). Limits must be expressed in such a way that they cannot be met simply by diluting the facility's effluents with clean water just before they are released into the receiving water.

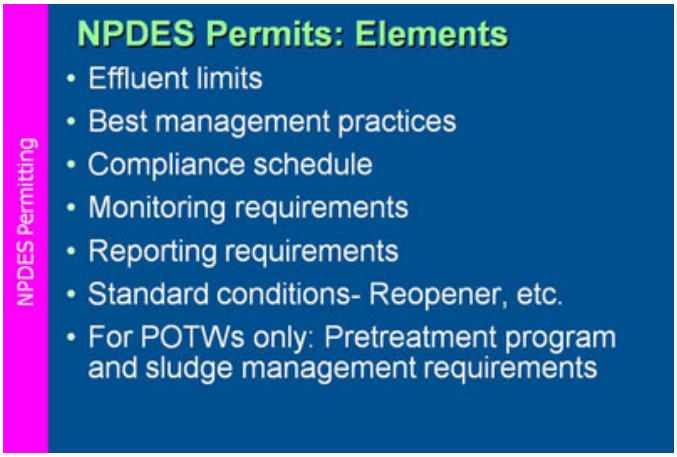


Figure 61

As explained in more detail later, such limits can be either technology-based or water quality-based. Regardless of how they are derived, effluent limits are performance standards; a permittee is free to use any combination of process modification, recycling, end-of-pipe treatment, or other strategies to meet them.

NPDES permits also can require the use of certain structural or non-structural BMPs. For "traditional" point sources, municipal wastewater plants and industrial facilities, BMPs are supplemental to end-of-pipe performance standards. For wet weather-related point sources, such as combined sewer overflows (CSOs) and municipal and industrial stormwater runoff, BMPs are often the only "control" requirements in the permit.

If meeting the effluent limits in a permit will require upgrading in-plant or wastewater treatment processes, it would not be reasonable to require compliance with such limits upon issuance of the permit (in the case of existing sources). Hence, permits for such sources can include a compliance schedule. Such schedules usually include not only a final date upon which effluent limits must be met but also interim milestones, such as dates for onset of needed construction. EPA guidance specifies that compliance schedules extend no longer than the term of the permit.

Most individual NPDES permits include detailed monitoring requirements that specify what pollutants the permittee must monitor for in their discharge, how frequently the monitoring should be done, and what sampling and analytic techniques should be used. Although EPA and states conduct some inspections and compliance monitoring, the vast majority of data about the contents of the discharges from NPDES facilities are collected by the permittees themselves. In the past, permits required only monitoring of the facility's discharges; but in recent years, some states have required some facilities to sample and analyze the waters into which they discharge as well.

If a permit contains monitoring requirements, it will include reporting requirements. Permittees are required to regularly submit the results of the monitoring required in their permit. Most commonly these Discharge Monitoring Reports must be submitted monthly; but in some cases they are less frequent. (Currently, general permits include few, if any, monitoring or reporting requirements.)

All NPDES permits include a standard set of clauses, including provisions for reopening the permit if new information or other specific circumstances justify possible changes, authority to revoke the permit for cause, and authority for the permitting authority to enter the facility and perform inspections. An NPDES permit also includes a cover page (permitting authority, permittee, statutory and regulatory authorities, and effective/expiration dates), special conditions (e.g., studies, compliance schedules), and standard conditions (basic provisions included in all permits). Along with a draft permit, the regulatory authority must include an explanation of how the discharge limits were derived.

Effluent Limits

Effluent limits can be calculated based on current treatment technologies (technology-based - TBEL) or on discharge levels consistent with meeting ambient WQS (water quality based - WQBEL) (Figure 62). This slide illustrates the differences between technology-based and water quality-based approaches to setting limits on loadings of pollutants. "Water body" is put in parenthesis to make the point that under the technology-based approach, success is measured primarily by reductions in discharges of pollutants, not effects on receiving waters. As a historical side-note, before 1972, water quality-based standards were too hard and slow to impose on individual dischargers, with little water quality improvement as the result. The 1972 amendments established the Effluent Limit Guideline (ELG) program as a first line of defense because they were relatively easy to set and were intended as the initial and uniformly imposed effluent control requirement. At the same time, Congress planned the Water Quality-Based Effluent Limits as the back-stop for the ELGs. The ELG program has been successful in the amount of nationally imposed limits on dischargers and the comparatively few (when compared to pre-1972) instances where the more analytically difficult WQBELs are required.

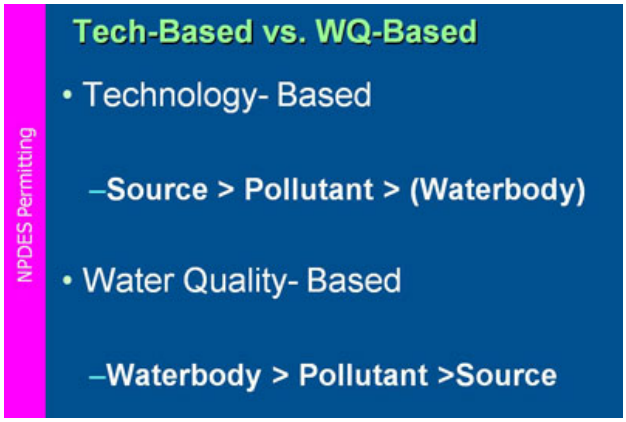


Figure 62

Technology-Based Effluent Limits

Technology-based effluent limits do not specify what technologies must be employed, but only the state levels of specific parameters that are allowed in the discharger's wastewater. Such limits are called "performance standards" (Figure 63).

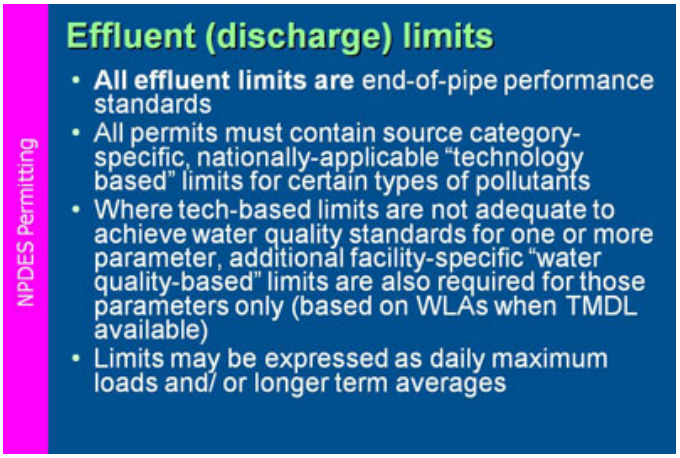


Figure 63

Technology-based limits are derived from studies of facilities within a specific industrial category aimed at determining what levels of discharge, pollutant by pollutant, can be achieved using the most cost-effective set of available pollution prevention and control techniques applicable to those types of facilities. EPA publishes packages of regulations, called "effluent guidelines," which lay out performance standards for different types of facilities within major industrial categories. All dischargers within each of these subcategories are required to meet these end-of-pipe limits, regardless of the condition of the water into which they discharge, their contribution of a pollutant relative to other sources or other "risk-based" factors.

For existing direct dischargers, effluent guidelines are referred to as best available technology economically achievable (BAT). An existing industrial direct discharger is subject to BAT if the pollutant being discharged is either a toxic or gray area pollutant. Nevertheless, "best conventional technology" (BCT) applies if the pollutant from an industrial direct discharger is a conventional pollutant such as TSS, pH, oil and grease, BOD, etc. Similarly, POTWs discharging conventional pollutants are subject to "best practicable technology" (BPT), essentially a 1972 version of BCT. For new sources, technology-based limits are called New Source Performance Standards. Limits for new sources are often more stringent than those for existing sources, because new facilities can employ more options for building pollution prevention systems into their in-plant processes.

(Note: EPA also includes in its effluent guidelines package for a specific industrial category technology-based limits for "indirect" dischargers. These are called "categorical pretreatment standards," and cover performance standards for existing and new sources.) Figure 64 is an example of technology-based effluent limits for an industrial category.

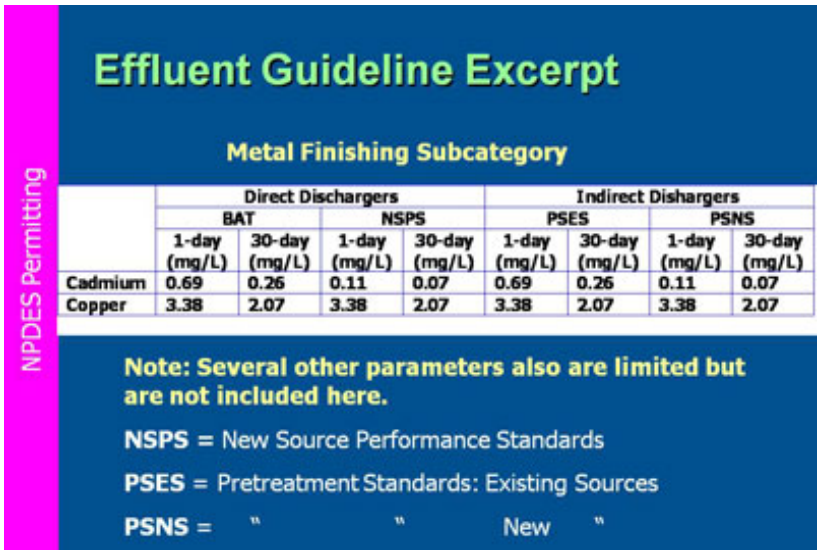


Figure 64. This is an excerpt from the Code of Federal Regulations, showing examples of technology-based limits.

Definitions:
BAT—Best Available Technology or Best Available Technology Economically Achievable (BATEA)
NSPS—New Source Performance Standards
PSES—Pretreatment Standards for Existing Sources
PSNS—Pretreatment Standards for New Sources

The limits that appear on the right side of the table (PSES and PSNS) apply to indirect discharges—those going into community sewer systems rather than a stream, lake, bay, estuary, and so forth. These technology-based requirements for indirect industrial discharges are often called "categorical" pretreatment requirements. (Note: The limits for direct and indirect dischargers are exactly the same.)

For cadmium, limits on new sources (NSPS, PSNS) are more than those for existing sources (BAT, PSES). New facilities can build pollution prevention and other techniques into their systems. This pattern does not always hold. For copper, for example, BAT, NSPS, PSES, and PSNS are all the same. Note that for both chemicals, BAT and PSES are the same, as are NSPS and PSNS.

For more information on EPA Effluent Guidelines, see EPA's Effluent Limitation Guidelines Web page (http://water.epa.gov/scitech/wastetech/guide/index.cfm).

Technology Based Effluent Limits Example

The technology-based limits for municipal sewage treatment plants publicly owned treatment works (POTWs) are, with some exceptions, the same everywhere. As with all technology-based limits, permit requirements are expressed as end-of-pipe conditions, rather than spelling out what particular technologies should be employed. This set of numbers reflects levels of three key parameters: (1) biochemical oxygen demand (BOD); (2) total suspended solids (TSS); and (3) pH acid/base balance (Figure 65). (Note: EPA's secondary treatment requirements do not address levels of nutrients—phosphorus and nitrogen.)

These levels can be achieved by well-operated sewage plants employing "secondary" treatment. Primary treatment involves screening and settling, while secondary treatment uses biological treatment in the form of "activated sludge."

Water Quality-Based Effluent Limits

Water Quality-Based Effluent Limits (WQBELs) are used when it has been determined that more stringent limits than technology-based effluent limits must be applied to a discharge to protect the designated use (DU) of the receiving waters. WQBELs are "back calculated" from ambient water quality standards, setting allowable pollutant levels in the effluent, which will meet WQS in the receiving water after accounting for available dilution (Figure 66).

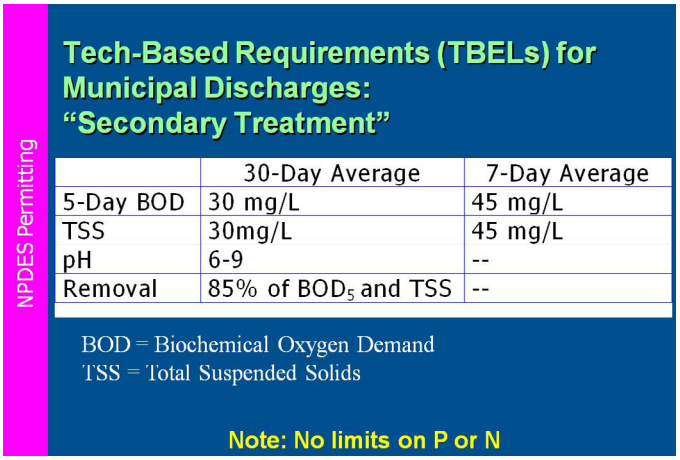


Figure 65

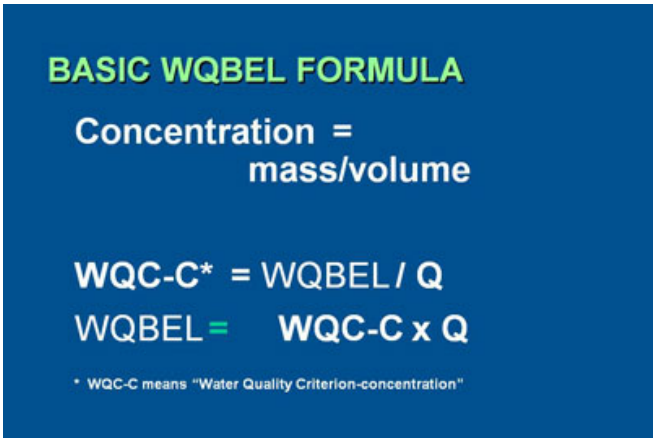


Figure 66

The permitting authority performs such calculations when a TMDL for the receiving water has not been established. When an EPA-approved TMDL is available, the effluent limits must be consistent with the wasteload allocation (WLA) assigned to the source by the TMDL. When numeric water quality criteria are available, dilution calculations or more sophisticated mathematical models are used to determine corresponding loading rates.

When only narrative standards are present, translator mechanisms can be employed. For instance, a translator for a "no toxics in toxics amount" narrative could be a limit on the overall toxicity of the discharge–a so-called Whole Effluent Toxicity (WET) limit. WQBELs are risk based and therefore generally place much less emphasis on economic and technological factors than do technology-based limits.

Effluent Monitoring

Beside effluent discharge limits, permits almost always include effluent monitoring requirements (Figure 67). Fundamentally, permitting authorities require monitoring of pollutants limited in the permit so that the permittee can demonstrate compliance with its limits. If the monitoring demonstrates noncompliance, then the data can be used as the basis for an enforcement action.

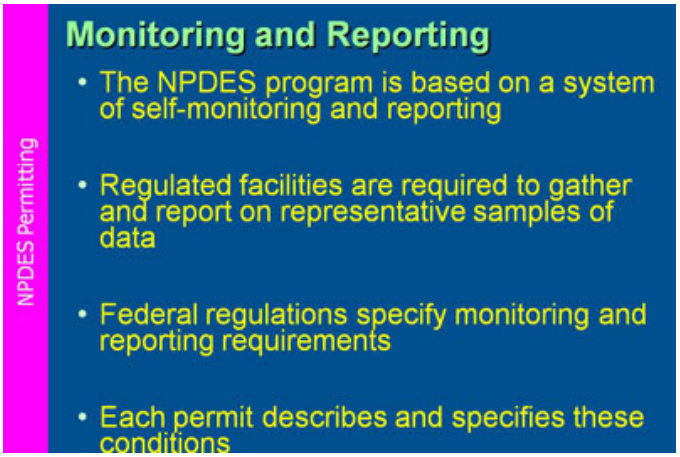


Figure 67

The permittee must retain records for all monitoring information, which includes maintenance and calibration records, strip charts, reports, etc., for at least three years from the date of sampling (sewage sludge data must be maintained for five years). Monitoring also can provide data about treatment efficiency and to characterize effluents for permit reissuance. Instream monitoring (above and below the outfall) can be useful to assess impacts of the discharge, but it is infrequently required.

Biosolids

EPA has published national regulations dealing with municipal sludge. The focus of these regulations is on toxics, pathogens, and "vectors" (flies, mosquitoes, rodents, and other carriers of disease) (Figure 68).

Sewage sludge can be disposed of in landfills, lagoons, incinerated, or land applied to serve as a soil enhancer or fertilizer (Figure 69). Land application of sewage sludge is often done on parks, golf courses, abandoned mines, and construction site restoration. It also can be applied to crops, including crops for human consumption (Figure 70).

The sludge program is designed to encourage communities to keep levels of contaminants in their sludge as low as possible. The cleaner a city's sludge is, the fewer the federal limitations are on disposal and use.

Figure 68

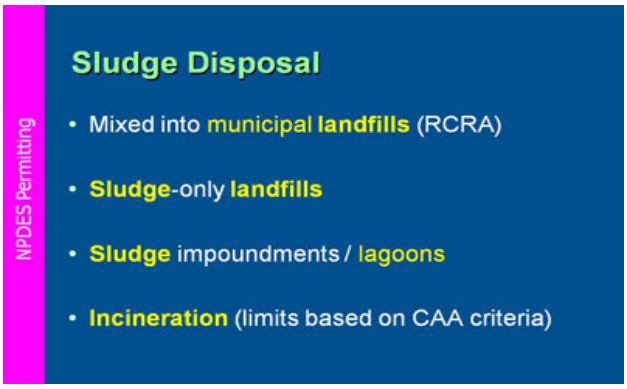


Figure 69

Municipal Wet Weather Flows

Initially, EPA and state water quality agencies focused on point source discharges that were essentially continuous, that is discharging at more or less the same rate year-round. In 1987, EPA amended the CWA to include the 402(p) stormwater program. Thus attention was directed to point source discharges that happened only during and after precipitation events—so-called "wet weather flows" (Figure 71). These included rainfall-induced runoff from industrial facilities, as well as two types of urban wet weather flows—combined sewer overflows and municipal separate storm sewers.

Figure 70

Combined sewer overflows, or CSOs, and certain municipal separate storm sewer systems, also called MS4s, are subject to regulatory control under the NPDES program (see Figure 72). A combined sewer system is one that, by design and by function, carries sanitary sewage (wastewater from homes, offices, factories) and stormwater. During dry weather these systems carry all sanitary flows to the wastewater treatment plant for treatment to levels specified in the NPDES permit. (EPA regulations prohibit untreated discharges from combined sewer systems during dry weather).

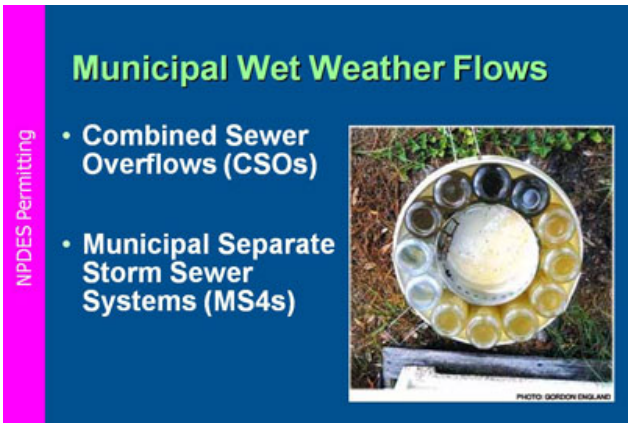


Figure 71

During periods of rainfall or snow melt, the carrying capacity of the sewer collection system could be exceeded, causing a combined sewer overflow (CSO) at relief points in the sewer system. These relief points are designed into the sewer system to prevent basement flooding, backup onto the streets, or overloading of the wastewater treatment facilities.

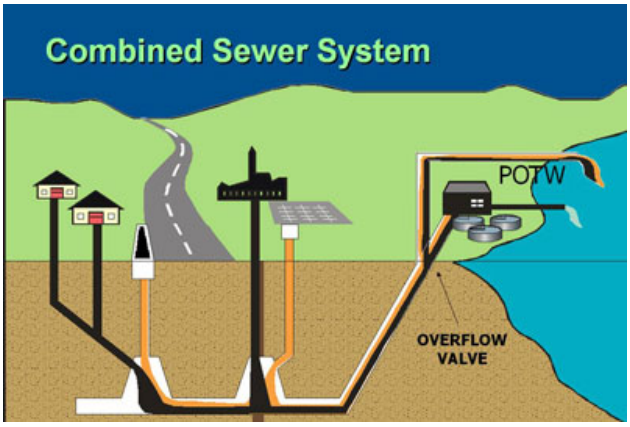


Figure 72

Overflow discharges from combined systems contain not only stormwater but also untreated human and industrial waste, oil and grease, metals, sediments, and floating debris. Untreated discharges from CSOs can necessitate beach closing and shellfish harvesting restrictions to avoid the spread of human pathogens and resulting illness.

Cities with CSOs tend to be older than those with MS4s. They are concentrated in the Northeast, the Great Lakes States, and the Pacific Northwest.

EPA requires CSO system owners to implement nine minimum control measures to address impacts from overflows:

1. Proper operation and regular maintenance programs for the sewer system and the CSOs
2. Maximum use of the collection system for storage
3. Review and modification of pretreatment requirements to assure CSO impacts are minimized
4. Maximization of flow to the publicly owned treatment works for treatment
5. Prohibition of CSOs during dry weather
6. Control of solid and floatable materials in CSOs
7. Pollution prevention

8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls

For more information, see EPA's Combined Sewer Overflows (http://cfpub.epa.gov/npdes/home.cfm?program_id=5) website.

Combined Sewer Overflows

Figure 73

The basic requirements applied to all CSO systems—often referred to as the "minimum measures"—do not include a statement of required or expected end-of-pipe concentrations of individual pollutants, as would be the case with technology-based limits on wastewater treatment plant or industrial process wastewater (Figure 73). Rather, the nine measures are a listing of key operating principles for CSOs, all aimed at reducing the volume of wastewater that is routed around the wastewater treatment plant and lowering the amount of pollutant loads associated with CSO events. These nine measures will be discussed later in this module. These principles are translated into greater detail on a CSO permit-by-permit basis. Regardless, most current CSO permits do not contain end-of-pipe limits.

Municipal Separate Storm Sewer Systems for Urbanized Areas

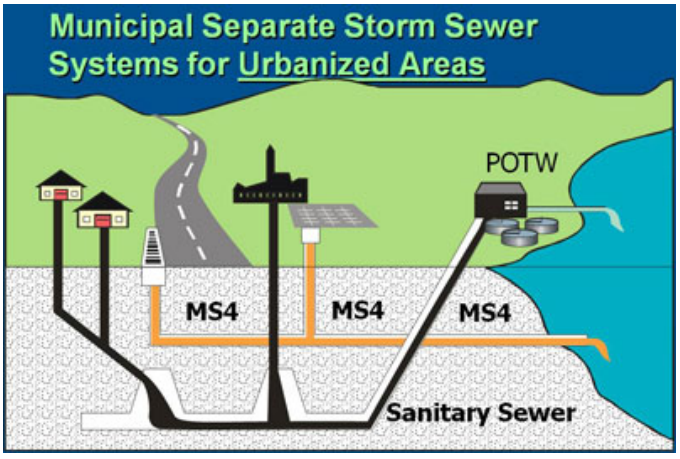


Figure 74

While combined sewer systems have one set of pipes to carry stormwater and wastewater, municipal separate storm sewer systems (MS4s) have separate lines, one set for the stormwater and another for sewage (Figure 74). MS4s that discharge to surface waters are also required to get NPDES permits, since they are, in effect, point source discharges of water mixed with various pollutants: oil and grease, metals, pesticides, pathogens, sediment and nutrients.

MS4/CSO Permits

Because they deal with systems that are quite different from the point source discharges covered by "traditional" NPDES permits, MS4/CSO permits take a different approach in several aspects (Figure 75). MS4/CSO systems often have large numbers of outfalls (discharge points), so permits for such systems do not usually address outfalls individually. Rather, one permit is issued covering all the outfalls in a city's CSO or MS4.

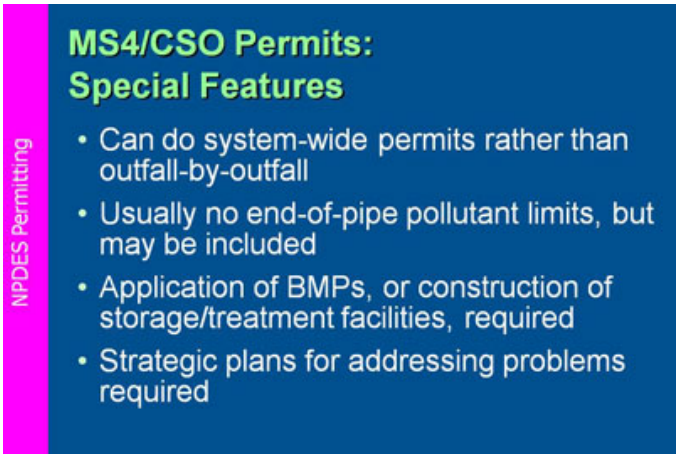


Figure 75

We have much less experience with treating pollutants in wet weather-dependent **urban discharges**, and the volume of wastewater being dealt with varies greatly. This makes it difficult to predict with any precision what treatment levels can be achieved regularly. Nevertheless, wet weather programs have been developing innovative, creative approaches for reducing impacts from urban runoff. Addressing existing stormwater discharges typically involves retrofitting stormwater basins, disconnecting impervious surfaces, and promoting infiltration of rainfall and snowmelt wherever possible via 'rain' gardens, pervious pavement, and other features. New development runoff often can be controlled through low impact development design, which couples infiltration and retention/approaches with preserving key site features (natural drainage systems, highly infiltrative soils), clustering built facilities, and other design elements (visit the Web page National Management Measures to Control Nonpoint Source Pollution from Urban Areas: Index (www.epa.gov/owow/nps/urbanmm/index.html).

Pollutant-by-pollutant end-of-pipe discharge limits are the exception rather than the rule in NPDES permits for MS4s and CSOs. NPDES permits designed to achieve wasteload allocations for stormwater sources included in a TMDL may incorporate a range of options, including BMPs and/or numeric effluent limits if necessary. See the following memorandum (www.epa.gov/npdes/pubs/final-wwtmdl.pdf) for more information.

Instead, requirements for installation of certain types of structural devices or employment of various management strategies are common. In addition, NPDES permits for urban wet weather discharges require cities to develop an overall strategic plan for addressing runoff of pollutants from various types of land use currently employed and expected in the future. Over the past 15 years, EPA and states have developed detailed NPDES permit programs to address discharges from municipal separate storm sewer systems (MS4s). MS4 operators must obtain a NPDES permit and develop a stormwater management program. The permit program has been implemented in two major phases:

- Phase I, issued in 1990, requires *medium* and *large* cities or certain counties with populations of 100,000 or more to obtain NPDES permit coverage for their stormwater discharges;

- Phase II, issued in 1999, requires regulated small MS4s in urbanized areas, as well as small MS4s outside the urbanized areas that are designated by the permitting authority, to obtain NPDES permit coverage for their stormwater discharges.

Generally, Phase I MS4s are covered by individual permits and Phase II MS4s are covered by a general permit. Each regulated MS4 is required to develop and implement a stormwater management program (SWMP) to reduce the contamination of stormwater runoff and prohibit illicit discharges. For more information on this permit program, visit EPA's Discharges From Municipal Separate Storm Sewer Systems (MS4s) (http://cfpub.epa.gov/npdes/stormwater/munic.cfm) Web page.

Phase I MS4 Application Requirements

To receive a permit, these "Phase I" communities were required to submit detailed application forms. These applications include a wide array of information, such as what was then known about separate storm sewer pipes underneath the city and where they emerged as outfalls (discharges to surface waters) (Figure 76).

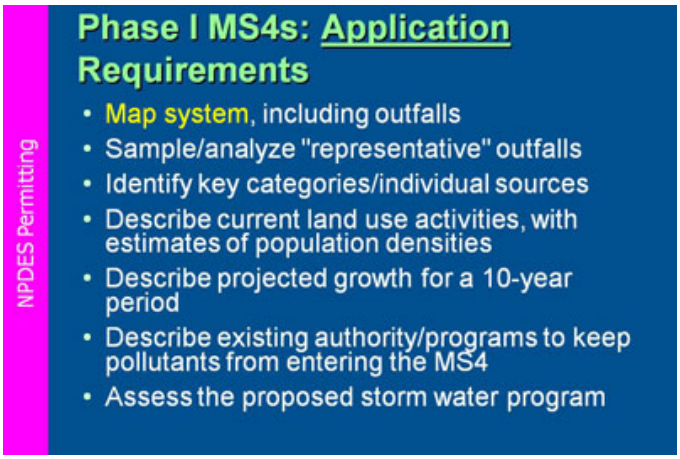


Figure 76

Because of the large number of outfalls associated with most MS4s, unlike "traditional" point sources, these systems were not required to sample and analyze discharges from every outfall. Only a subset of what were thought to be outfalls, representative of the system as a whole, had to be tested and reported upon.

Cities applying for Phase I NPDES permits for their MS4s were required to develop a plan for reducing pollutant loadings into the MS4 and remove what had gotten into the system regardless, to the "maximum extent practicable." They also had to provide an estimate of the degree of effectiveness of the overall program they proposed, in terms of reduction in pollutant discharges from MS4s and consequent changes in stream conditions.

Figure 77

One of the most basic requirements in permits for MS4s calls for elimination of all "non-stormwater" or "illicit" discharges (Figure 75). The reason for this provision is that if sewage coming from homes, businesses, industries, hospitals, and other facilities goes into a MS4, that sewage will be discharged to a receiving water without going through the municipal sewage

treatment plant (because of the basic design of an MS4). Once an illegal/illicit connection has been located—in itself no small task—one option is to dig down to the point where the pipe(s) from the home/business/other waste-generating facility connect with the MS4 and then move the connection over to the sanitary sewer line. Another option is to leave the connection in place, but treat it like a direct point source discharge and require the obtaining of an NPDES permit.

Another key requirement is implementation of a program to reduce loadings of pollutants in stormwater runoff from existing sources in all major urban land use categories to the "maximum extent practicable" (MEP). Because EPA has not issued detailed, precise regulations or guidance regarding what activities or levels of pollutant removal constitute MEP, this key term is being defined on a MS4-by-MS4 basis.

MS4 communities also are required to develop and implement a program aimed at controlling levels of polluted runoff generated by new development activity. Such controls should not only address runoff during the construction stage, but also post construction runoff. (For more information, see EPA's Stormwater Page for MS4s (http://cfpub.epa.gov/npdes/stormwater/munic.cfm).

Phase II MS4 Application Requirements

Figure 78 lists the Phase 2 MS4 permit requirements. The six minimum control measures that apply specifically to medium and small MS4s are:

Figure 78

- Public Education and Outreach
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post-Construction Stormwater Management for New and Re-Development
- Pollution Prevention/ Good Housekeeping for Municipal Operators

An ***urbanized area*** is a land area comprising one or more places—central place(s)—and the adjacent densely settled surrounding area—urban fringe—that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile (Figure 79). For more information, visit the Urbanized Area Maps (http://cfpub.epa.gov/npdes/stormwater/urbanmaps.cfm) on EPA's NPDES website.

MS4 Basic Permit Provisions

Basic permit provisions for MS4s are targeted at eliminating illicit discharges and controlling runoff from construction sites and newly developed areas (Figure 80).

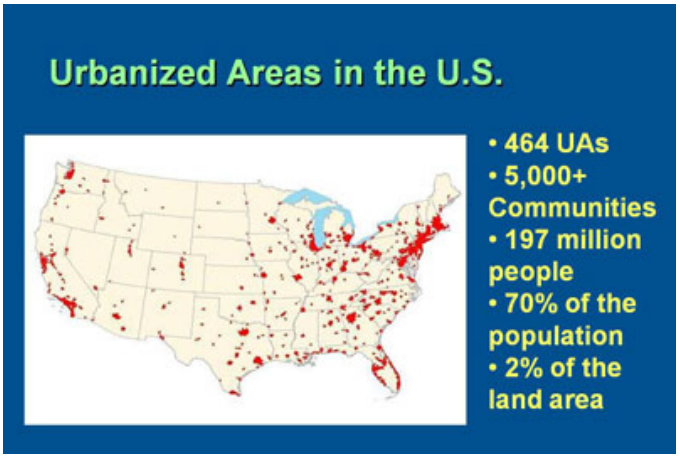


Figure 79

NPDES for CSOs

The basic requirements applied to all CSO systems—often referred to as the "minimum measures"—do not include a statement of required or expected end-of-pipe concentrations of individual pollutants, as would be the case with technology-based limits on a wastewater treatment plant or on industrial process wastewater. Rather, the nine measures (Figure 81) are a listing of key operating principles for CSOs, all aimed at reducing the volume of wastewater that is routed around the wastewater treatment plant and lowering the amount of pollutant loads associated with CSO events. These principles are translated into greater detail on a CSO permit-by-permit basis. Still, most current CSO permits do not contain end-of-pipe limits.

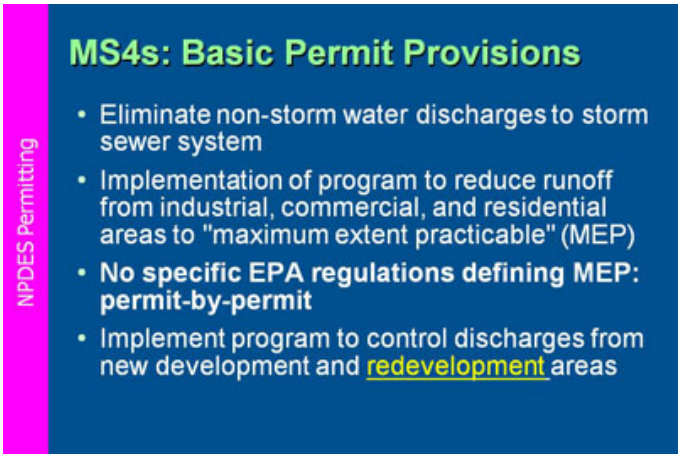


Figure 80

Because it is often impractical to eliminate CSO events entirely, especially in major storms, communities are required to notify the public that CSO events have occurred and that this will make it unsafe to swim in the receiving waters of CSO outfalls (discharges) for a certain period. Such notification can include signs posted at popular swimming areas, radio or television public service announcements, or other means of informing the public.

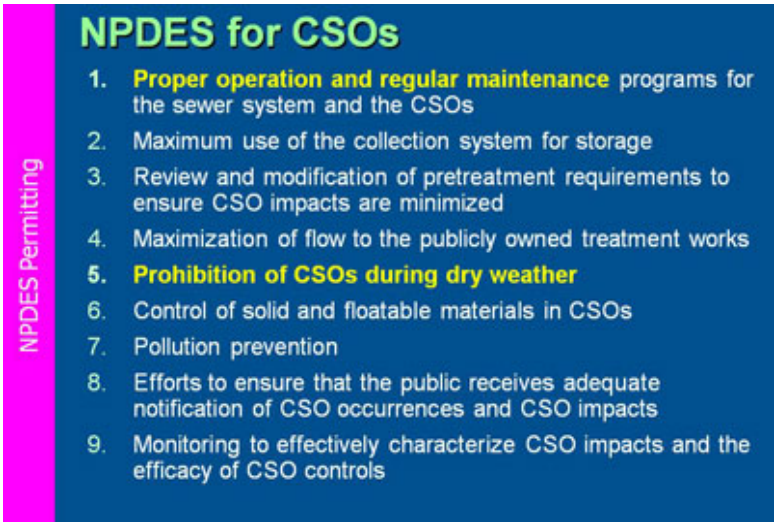


Figure 81

Communities with CSOs also are required to develop a long-term plan for dealing with water quality problems caused by CSOs. Among the provisions of such plans are strategies for eliminating, or at least minimizing, CSO discharges to sensitive areas such as locales with significant amounts of primary contact recreation (swimming), shellfish beds, drinking water supplies, and waters with threatened and endangered species and their habitats.

Industrial Stormwater

Figure 82

Operators of industrial facilities falling into one of 11 categories listed by EPA in its stormwater regulation (several of which are listed in Figure 82) need an NPDES permit if the stormwater is discharged directly to a surface water or goes into a municipal separate storm sewer system (MS4). Most such operations are likely to be covered under a general NPDES permit, but some might need an individual NPDES permit. EPA has included the category under "stormwater associated with industrial activity" runoff from construction sites. Construction activities disturbing one or more acres need NPDES permits (Figure 83). At a minimum, these permits require development of a site-specific stormwater pollution prevention plan, covering the construction and the post-construction phases of the project.

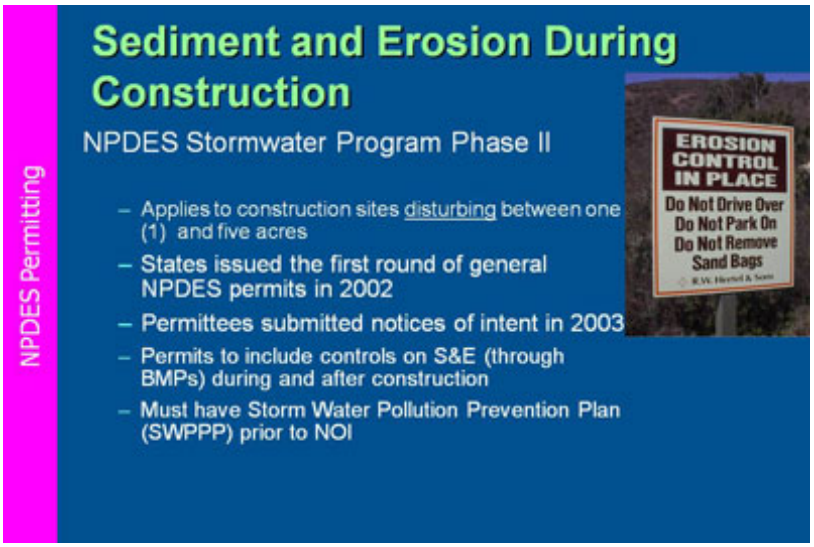


Figure 83

A Stormwater Pollution Prevention Plan (SWPPP) must include a site description, including a map that identifies sources of stormwater discharges on the site, anticipated drainage patterns after major grading, areas where major structural and nonstructural measures will be employed, surface waters, including wetlands, and locations of discharge points to surface waters. The SWPPP also describes measures that will be employed, including at least protection of existing vegetation wherever possible, plus stabilization of disturbed areas of the site as quickly as practicable, but no more than 14 days after construction activity has ceased.

Permit Violations

In addition to such obvious situations as discharging without having obtained an NPDES permit and exceeding the pollutant discharge levels set forth in the permit, NPDES permittees also are in violation if they fail to comply with monitoring and reporting requirements, or any other requirement, laid out in their permit (Figure 84).

Figure 84

Sometimes, permits for existing sources will not require attainment of more stringent effluent limits immediately upon receipt of a permit. Permittees will be given time to modify their operations and, if necessary, install new equipment. If the "compliance schedule" extends for longer than a year after permit issuance, interim milestones must be included. Examples of such interim steps include: (1) completion of detailed design drawings; (2) the letting of contracts to equipment installers; and (3) onset of construction. (Such compliance schedules should, as a general rule, not extend beyond the five-year term of the project.) Failure to meet such interim deadlines is a permit violation, just as exceedance of an effluent limit would be.

Permittees are required to notify the NPDES authority (usually a state) when they realize they have failed to comply with one or more of the permit conditions. EPA and state NPDES agencies also send inspectors to a permitted facility from time to time.

NPDES Enforcement

States, territories, and tribes are primarily responsible for enforcing NPDES permits when EPA has authorized them to administer the NPDES program (Figure 85). EPA takes enforcement action if these entities fail to do so. EPA must first inform the state, territory, or tribe of its belief that enforcement is necessary and give it time to take action.

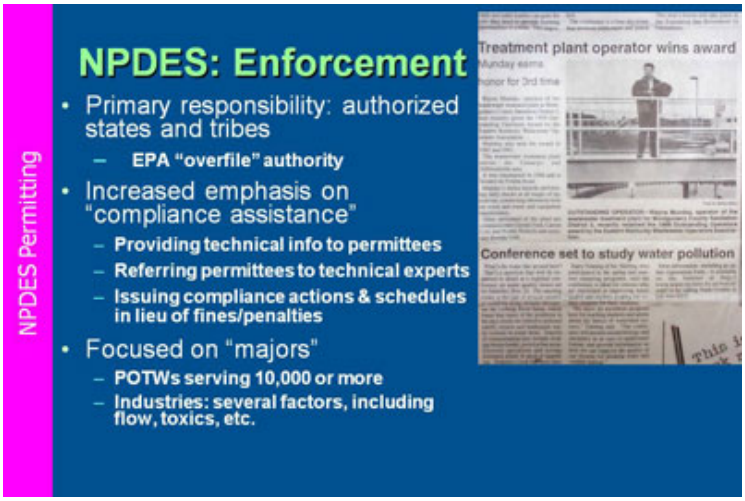


Figure 85

Enforcement actions include the following:

- Injunctions
- Fines for typical violations (exceed permit limits, failure to report)

- Imprisonment for criminal violations (http://www.epa.gov/fugitives/index.html) (repeated, willful violations)

With a SEP, instead of simply paying a fine to the federal or state treasury, the violator must spend more money than the amount of the fine on a relevant environmental project, such as wetlands restoration or abandoned mine cleanup. Citizens also can bring a lawsuit against a violator, but they must provide a 60-day notice to EPA and the state, territory, or tribe to give them time to take action against the violator.

Section 319: Nonpoint Source Program

Nonpoint source pollution (NPS) represents the most significant source of pollution overall in the country (Figure 86). According to states' 305(b) and 303(d) reports, more miles of rivers and acres of lakes are impaired by overland runoff from row crop farming, livestock pasturing, and other types of nonpoint sources than by industrial facilities, municipal sewage plants, and point source runoff from municipal storm sewer systems and stormwater associated with industrial activity. The most recent set of 303(d) reports (from 2002-2010, depending upon the state) indicated that more than 40 percent of all impaired waters were affected solely by nonpoint sources, while less than 10 percent of water quality criteria exceedances were caused by point source discharges alone.

Figure 86

The CWA does not provide a detailed definition of nonpoint sources. Rather, they are defined by exclusion—anything not considered a "point source" according to the act and EPA regulations. All nonpoint sources of pollution are caused by runoff of precipitation (rain and/or snow) over or through the ground. This includes stormwater associated with industrial activity, construction-related runoff, and discharges from municipal separate storm sewer systems (MS4s).

Atmospheric deposition also is a form of nonpoint source according to the CWA and EPA regulations: pollutants discharged into the air and returned directly or indirectly to surface waters in rainfall and snow, as well as so-called dry deposition between precipitation events. Of course, "smokestack industries" such as fossil-fueled electric generating plants could be considered "point sources of air pollution." But the diffuse deposition of pollutants emitted by such facilities is a form of nonpoint source in the context of water pollution. The reason that precipitation-induced runoff is treated as a point source rather than nonpoint has to do with channelization. Channelization is a key characteristic of a point source. Diffuse stormwater runoff, which is not channelized, is not regulated and is a nonpoint source.

Pollutants commonly associated with NPS include nutrients (phosphorus and nitrogen), pathogens, clean sediments, oil and grease, salt, and pesticides.

Congress chose not to address nonpoint sources through a regulatory approach, unlike its actions with "point" sources. Rather, when it added Section 319 to the CWA in 1987, it created a federal grant program that provides money to states, tribes, and territories for developing and implementing NPS management programs (Figure 87).

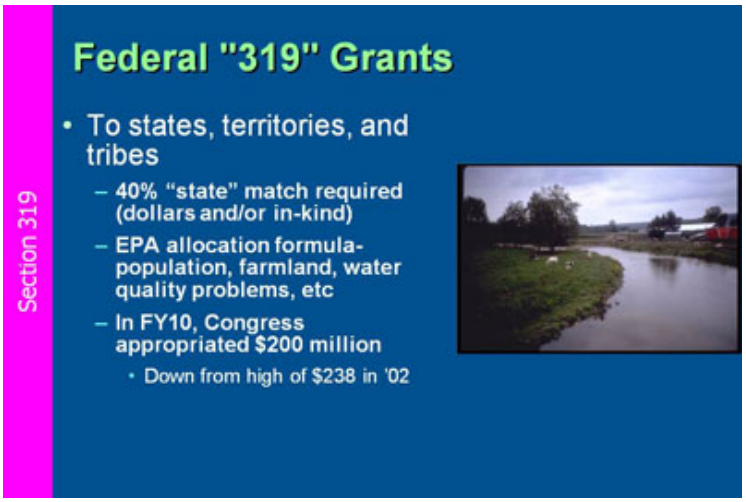


Figure 87

Under the Clean Water Act section 319, states, territories, and delegated tribes are required to develop nonpoint source pollution management programs (if they wish to receive 319 funds). Once it has approved a state's nonpoint source program, EPA provides grants to these entities to implement NPS management programs under section 319(h). Section 319 is a significant source of funding for implementing NPS management programs, but there are other federal (e.g., Farm Bill), state, local, and private programs.

Congressional appropriations for the CWA section 319 program peaked at $230 million in 2002, but have averaged about $200 million in recent years. Recipients of CWA section 319 grand funds must provide a 40 percent match, either in dollars or in-kind services. States and territories "pass on" a substantial fraction of the 319 funds they receive from EPA to support local nonpoint source pollution management efforts. Depending on the state or territory, a "local match" may be required.

Though there is no CWA federal regulatory authority over nonpoint sources of pollution and the act does not require states to develop their own regulatory programs to obtain 319 grants, states, territories, and tribes may, at their discretion, use 319 funds to develop their own NPS regulatory programs. To date, however, few have done so.

Section 319 funds can be used to conduct activities to ensure the use of Best Management Practices (BMPs), develop strategies for collaborating with other agencies and draft monitoring and evaluation plans (Figures 88 and 89).

Sec. 319 funds also can be used for developing and implementing TMDLs in watersheds where nonpoint sources are a substantial contributor of loadings of the pollutant(s) causing impairment. A state, tribe, or territory receiving section 319 funds must complete and update an NPS management plan every five years (Figure 90).

Section 319 Watershed Management Plans

A watershed management plan defines and addresses existing or future water quality problems from point sources and nonpoint sources of pollutants. Experience over the past decade has shown that effective watershed management includes participation from stakeholders, analysis and quantification of the specific causes and sources of water quality problems, identifying measurable water quality goals, and implementing specific actions needed to solve those problems. EPA has identified nine key elements needed for effective watershed management plans (Figures 91 and 92).

Section 404 Program

Section 404 deals with one broad type of pollution—discharge of dredged or fill material into "waters of the United States" (http://water.epa.gov/lawsregs/guidance/wetlands/CWAwaters.cfm). Wetlands are one component of "waters of the United States"; but there are numerous other types—intermittent streams, small perennial streams, rivers, lakes, bays, estuaries, and portions of the oceans.

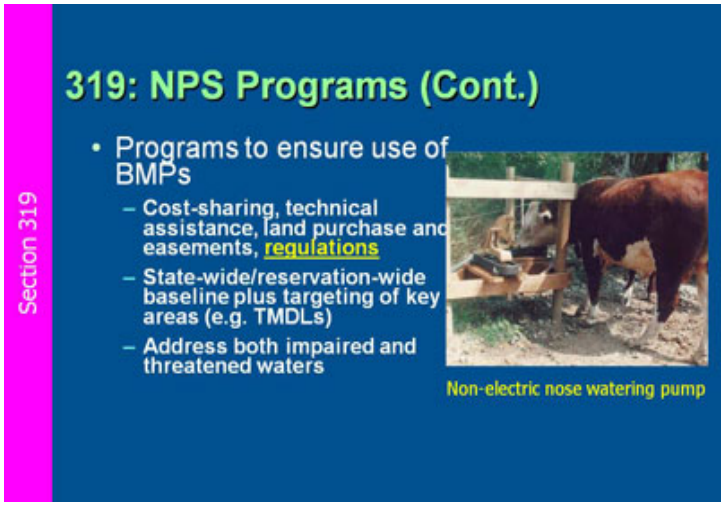


Figure 88

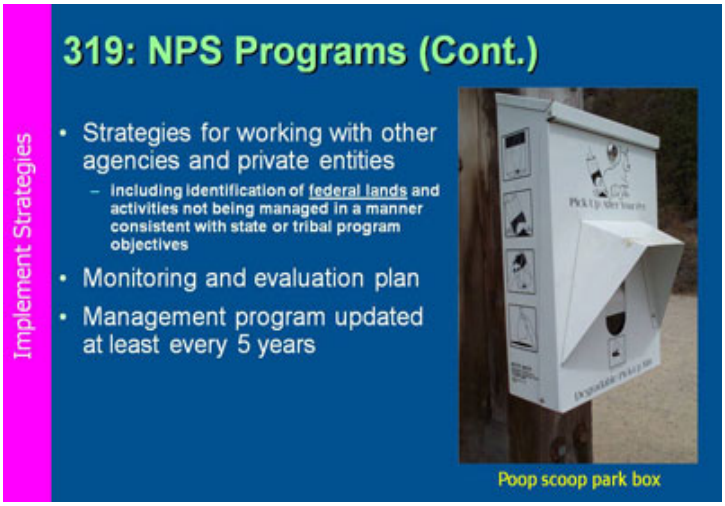


Figure 89

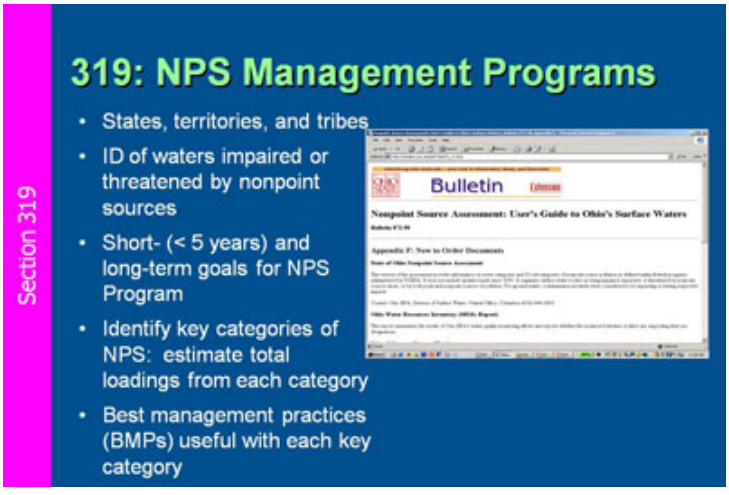


Figure 90

One of the controversial aspects of section 404 is determining exactly what is and isn't a wetland. Federal regulations define wetlands as: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of *vegetation* typically adapted for life in saturated *soil*" [33CFR328.3(b)].

For an area to be declared a wetland, it should exhibit all three of the key features—hydrology, wetland-dependent vegetation, and soil types associated with water-saturated conditions. Some kinds of wetlands, such as bottomland hardwood swamps, however, are dry during some periods. The absence of water or saturated soil at any given moment does not render a plot "not a wetland," if the vegetation and soils indicate that wet conditions often do occur and hydrological data support this conclusion.

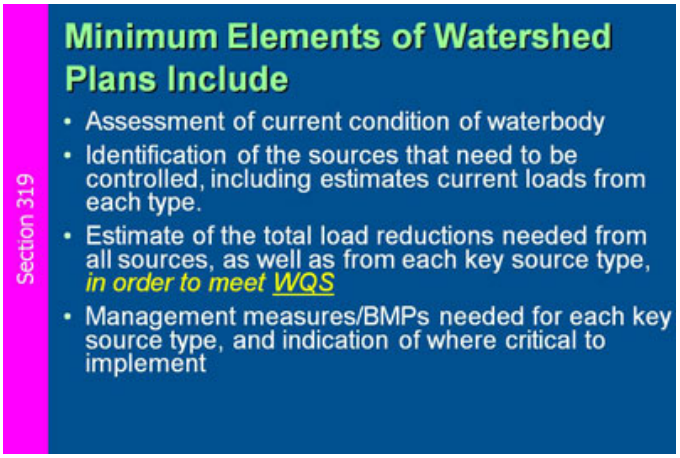


Figure 91

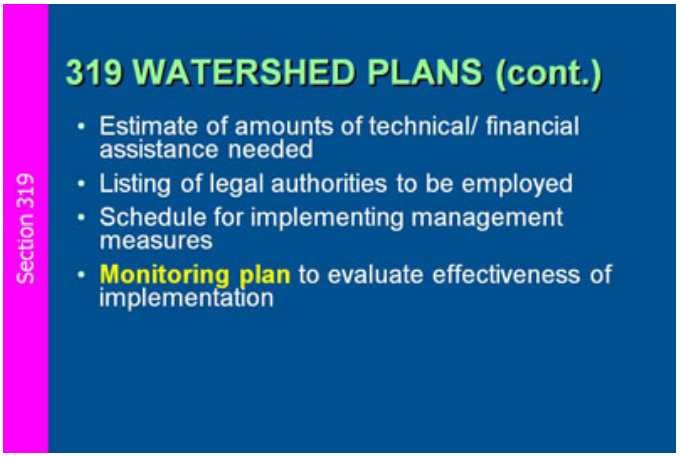


Figure 92

The 404 permit program is administered jointly by EPA and the U.S. Army Corps of Engineers in all but two states (Figure 93). The Corps handles the actual issuance of permits, individual and general. The program also determines whether a particular plot of land is a water of the United States. The Corps has primary responsibility for ensuring compliance with permit conditions, while EPA typically takes the enforcement lead for unpermitted discharges.

The U.S. Fish and Wildlife Service and National Marine Fisheries Service play special advisory roles because of their expertise regarding wildlife habitat.

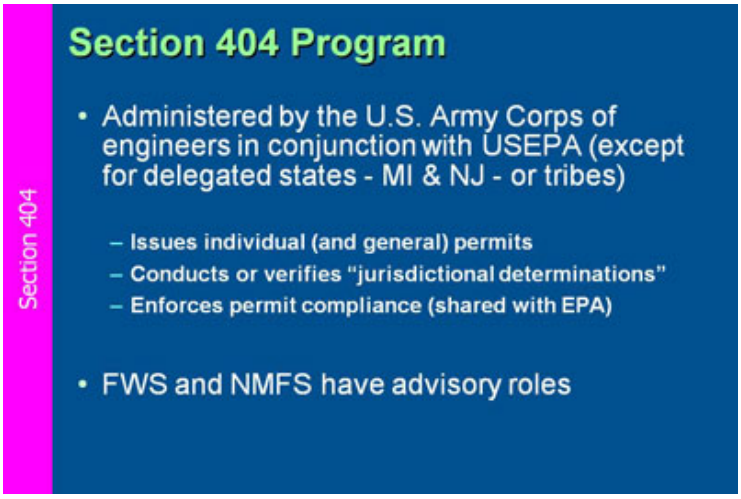


Figure 93

EPA develops the environmental guidelines the Corps uses to evaluate a permit application, has final authority to determine the scope of "waters of the United States," and can veto a Corps-issued permit (a step rarely taken). EPA also determines whether portions

of the 404 program should be turned over to a state, territory, or tribe. As of 2010, two states have assumed 404 responsibility for nontidal waters. When EPA has authorized a state to administer the section 404 program, EPA oversees implementation of the program. If necessary, EPA can "take back" the program.

The essence of section 404 policies is the concept of "sequencing." This is a step-wise process, in which one must go through one step before going on to the next.

Section 404 Program Implementation

Step 1 is called "avoidance" (Figure 94). Whenever practical, discharge of dredged or fill materials to waters of the United States should be avoided. A key issue in avoidance is whether the proposed activity is dependent on being located on or adjacent to a body of water. A marina, for example, would be water-dependent. A tennis court or shopping mall would not. Another issue is whether the plot of property on which the proposed project would be located contains sufficient amounts of dry land to accommodate the project. If an impact on wetlands or other water body cannot be avoided entirely, then attempts to minimize the impacts are required. Often, changes in the position or design of a project can significantly reduce the amount of wetland acreage affected.

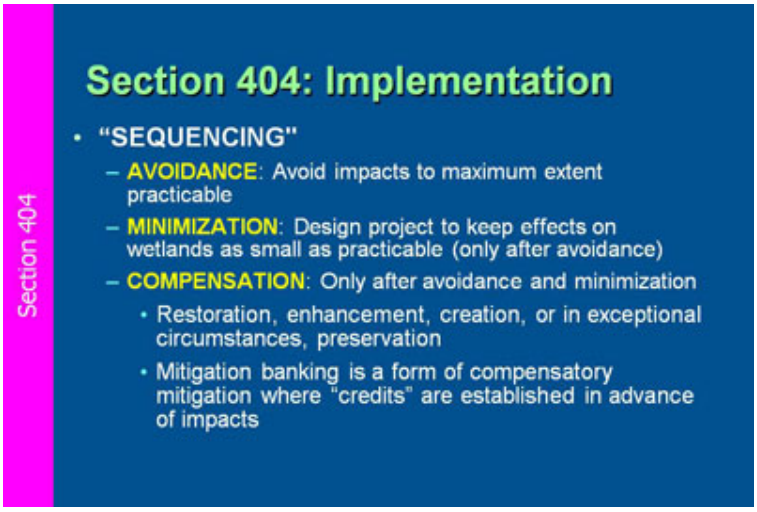


Figure 94

The final step in 404 sequencing is compensation. A long-standing federal policy called "no net loss" of wetlands drives compensation requirements under 404. The basic concept is that for every acre of wetland lost, at least one functionally equivalent acre of wetland must be restored. "Creation" of wetlands at sites where wetlands did not naturally occur is less acceptable than restoration of destroyed or degraded wetlands, because efforts to create wetlands have been deemed largely unsuccessful. Only in exceptional circumstances will preservation of existing healthy wetlands be accepted as mitigation for loss of wetlands permitted under section 404.

Water Quality Certification

Section 401(a) of the CWA requires that before issuing a license or permit that could result in any discharge to waters of the United States, an applicant for a federal permit or license must obtain from the state or authorized tribe where the proposed project is location, a certification that the discharge is consistent with the CWA, including attainment of applicable water quality standards (Figure 95). The CWA also provides a mechanism whereby downstream states whose

water quality could be affected by a federally permitted or licensed project can engage in the 401 process.

Figure 95

CWA provisions to which section 401 certification applies include 404 permits from the Corps of Engineers and EPA-issued NPDES permits. 401 certification also applies to non-CWA federal permits or licenses that could result in a discharge to waters of the United States. These typically have included discharge permits issued by the Army Corps of Engineers under the Rivers and Harbors Act section 10, and licenses for non-federal hydroelectric dams issued by the Federal Energy Regulatory Commission.

Section 401 certification has been a key issue in the relicensing of private hydropower dams by the Federal Energy Regulatory Commission (FERC). Section 401 certification requires FERC or any other federal agency to include all conditions on a state/tribal 401 cert in the resulting permit or license. The only alternative is to not issue the permit or license. In many cases, states have thus required FERC to include conditions in the new licenses for dams, requiring changes in dam management designed to prevent impairing uses designated for affected waters in state water quality standards.

Section 311 Program

Section 311 of the CWA addresses the discharge—including accidental spills—of oil and other hazardous substances into navigable and coastal waters (Figure 96). Under this section, "oil" means oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil. “Discharge" includes any spilling, leaking, pumping, pouring, emitting, emptying or dumping, but excludes permitted discharges (e.g., via an NPDES permit).

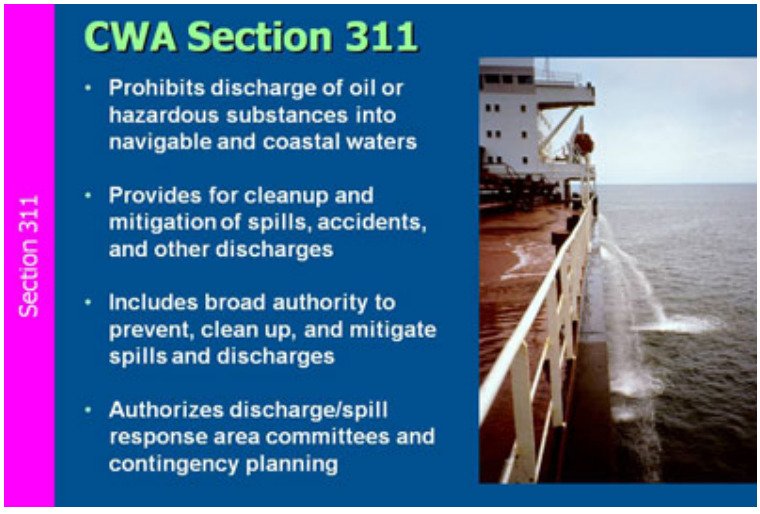


Figure 96

Section 311 prohibits discharging oil or hazardous substances into the navigable waters of the United States and adjoining shorelines, except where permitted under international protocol or under conditions that the President (i.e., through EPA regulations and authorities) determines not to be harmful. It also provides for the removal of an oil discharge and mitigation or prevention of

the threat of a discharge into navigable and coastal waters, and other waters that could affect U.S. natural resources. Other provisions include broad authority for the President to make any arrangements for removal or prevention, direct removal actions, and remove or destroy a vessel releasing or that has the threat of releasing.

The section authorizes the establishment of Area Committees, which prepare Area Contingency Plans that detail methods and procedures for responding to a worst case discharge, including the division of responsibilities among various authorities in a response.

State Revolving Loan Funds

In 1987, Congress voted to phase out the old construction grants program for funding of municipal sewer and wastewater treatment plant upgrades, replacing it with the Clean Water State Revolving Fund (CWSRF).

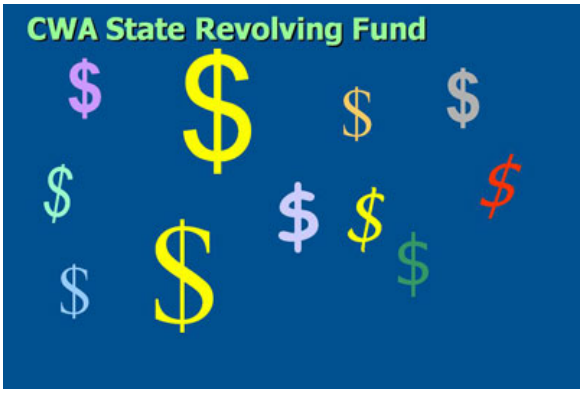


Figure 97

Under the CWSRF, EPA provides annual capitalization grants to states, who in turn provide low interest loans for a wide variety of water quality projects (Figure 97). States must match the federal funds with $1 for every $5 (a 20-percent match). As a result of federal capitalization grants, state match, loan repayments, and leverage bonds, the total amount of assets in all the CWSRFs is approaching $40 billion. Between $3 and $4 billion was loaned annually from CWSRFs nationwide through 2007. The CWSRFs have issued $70 billion in loans since the program was initiated in 1998. In 2008, $5.8 billion was appropriated.

Some funds also are provided to territories and tribes to be used as grants for municipal wastewater treatment projects. Territories must match the federal funds with a 20-percent match, while the tribes are not required to provide a match. Loans are usually made at low, sometimes no, interest. Although most loans have gone to local governments, they also can go to businesses or nonprofit organizations. Payback periods for loans extend to 20 years.

Most of the CWSRF dollars loaned to date have gone for construction expansion, repair, or upgrading of municipal sewage collection and treatment systems. But CWSRF loans can be made for the following: (1) NPS control projects consistent with a state, territorial, or tribal section 319 program; or (2) implementing a management plan developed under the National Estuary Program. CWSRFs have funded over $74 billion through early 2010, providing more than 24,688 low-interest loans to date.

CWSRFs can lend funds for nonpoint source projects (Figure 98). Such projects include loans to:

- Homeowners for repair and upgrade of septic systems
- Land trusts for purchase of sensitive lands/easements
- Purchase and restore degraded wetlands
- Dry cleaners to clean-up soil and ground water contamination on brownfields
- Farmers for equipment and structures to minimize runoff from fields

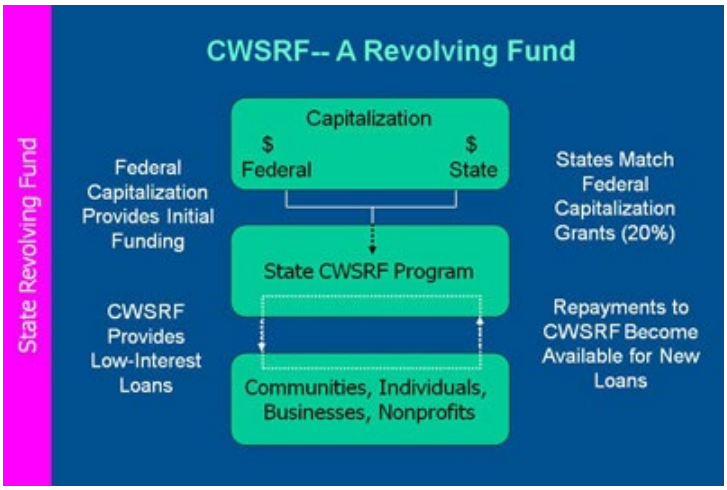


Figure 98

Managers of SRFs must comply with several basic requirements:

- Protect the capital (principle) in the fund—ensure funds circulating in the CWSRF do indeed "revolve" and not diminish over the long run.
- Develop "intended use plans"—develop project lists of upcoming loans in the next fiscal year.
- Provide for public participation and comment on intended use plans.
- Create a NEPA-like process, whereby the environmental impacts of projects getting loans are analyzed and options are considered.

Glossary

10 C - (see Primary contact recreation)

1Q10 - Lowest (or highest) 1-day average stream flow that occurs once in 10 years, on average.

20 C - (see Secondary contact recreation)

303(d) list - A list of waters that fail to meet any applicable water quality standards, that states are required, under sec. 303(d) of the CWA, to assemble and update once every 2 years. EPA is required to determine the completeness of such lists.

305(b) report - State-prepared reports describing what is known about the condition of the waters within each state. Required under section 305(b) of the CWA, these reports, must be submitted to EPA on April 1st of even-numbered years.

319 program - Under section 319 of the CWA, EPA provides grants to states to enable them to develop and implement programs to address the effects of nonpoint source pollution.

401 Certification - According to section 401 of the CWA, a federal agency cannot issue a license or permit to an activity affecting a waterbody unless the state water quality agency certifies that the activity would not cause failure to meet any state water quality standard applicable to said waterbody.

404 Program - Established by section 404 of the CWA, this program regulates the placement of dredged and fill material in surface waters falling within the jurisdiction of the CWA.

7Q3 - Lowest (or highest) 7-day average stream flow that occurs once in 3 years, on average.

7Q10 - Lowest (or highest) 7-day average stream flow that occurs once in 10 years, on average.

Advanced wastewater treatment - Any treatment of sewage that goes beyond primary (see definition below) and secondary (see definition below), which may include treatment specifically designed to remove nitrogen and/or phosphorous.

Ambient monitoring - The systematic, long-term assessment of pollutant levels by measuring the quantity and types of certain pollutants in the water or surrounding environment.

Antibacksliding - A provision in EPA regulations specifying that a reissued NPDES permit must be no less stringent than the previous permit, except in certain limited conditions.

Antidegradation - Requirements established in the CWA and EPA regulations designed to prevent, or at least minimize, deterioration of water quality. States must adopt both an antidegradation policy and implementation methods. (Not to be confused with "antibacksliding," above)

Animal feeding operation (AFO) - Agricultural facilities where animals are confined and fed or maintained for a total of 45 days or more in any 12-month period, and crops, vegetation, forage growth, or post-harvest residues are not sustained in the normal growing season over any portion of the lot or facility. Unlike pasturing and grazing operations, AFOs confine animals at densities high enough that no vegetation of any type is sustained within the facility.

Background condition - Some aspect of the environment that is outside the temporal and/or spatial extent of a particular situation. Background conditions can be either natural (see also "natural background condition") or man-made (anthropogenic). With regard to anthropogenic conditions, "background" can be either controllable or essentially uncontrollable, in a technological or legal context.

Best available technology (BAT, BATEA) - One of several types of EPA-issued, technology-based regulations for controlling the direct discharges of pollutants to surface waters under jurisdiction of the CWA. BAT limits represent the best existing treatment technologies that are economically achievable within an industrial point source category or subcategory. BAT applies to older industrial facilities; newer facilities are covered by another set of EPA regulations new source performance standards (NSPS).

Best management practice (BMP) - Schedules of activities, prohibitions of practices, maintenances procedures, and other management practices other than traditional physical, chemical, or biological wastewater treatment. BMPs can be either nonstructural (good housekeeping practices, pollution prevention, contour plowing, cover crops) or structural (wet or dry detention ponds), and can include treatment requirements, operating procedures, and practices to control site runoff, spillage, or leaks. BMPs can be applied to both nonpoint and point sources of water pollution and can be employed as part of either regulatory or voluntary programs.

Bioaccumulation - Processes whereby the concentration of pollutants in living organisms are elevated to levels substantially higher than that in the aquatic environment.

Bioaccumulative pollutant of concern (BCC) - Contaminants that tend to bioaccumulate to a high degree. Examples include mercury, PCBs, and DDT.

Bioconcentration - A type of bioaccumulation that occurs directly across cell membranes that come in direct contact with contaminated water but is not further increased by passage of contaminants up a food chain.

Biomagnification - A type of bioaccumulation in which the level of a contaminant increases by a substantial amount as it is passed through each step in a food chain or web.

BOD - Biochemical oxygen demand. A measurement of the amount of oxygen consumed by the decomposition of organic material over a certain period of time. For instance, BOD5 is based on the amount of oxygen consumed over 5 days.

CFS - Cubic feet per second.

Chemical Oxygen Demand - A measure of the oxygen-consuming capacity of inorganic and organic matter present in wastewater. COD is expressed as the amount of oxygen consumed in a given period of time. (see also BOD)

Clean Water Act - Common name for the Federal Water Pollution Control Act of 1972, which restructured and expanded the federal government's authority for water pollution control and consolidated authority in the Administrator of the Environmental Protection Agency.

COD - Chemical oxygen demand.

Code of Federal Regulations **(CFR)** - A set of documents containing all regulations issued by federal agencies. Environmental regulations, including those issued by EPA pertaining to the CWA are found in Chapter 40 of the code.

Combined sewer overflow (CSO) - Precipitation-induced overflow from systems designed to collect domestic sewage, industrial wastewater and stormwater runoff in the same set of pipes. (See also "MS4s" and "sanitary sewer system.")

Concentrated animal feeding operation (CAFO) - An animal feeding operation defined as a point source of pollutants. CAFOs are generally larger AFOs, and categorized by the number of animals present, but they can also include smaller AFOs known to be discharging pollutants to surface waterbodies at levels of concern. CAFOs are covered under the NPDES permit program (see below), while AFOs are not.

Contiguous zone - The entire zone established by the United States under article 24 of the Convention of the Territorial Sea and the Contiguous Zone.

Criterion (see Water Quality Criteria).

Criterion-concentration - The component of a water quality criterion that specifies a maximum or minimum concentration of a water quality parameter. (see also criterion-magnitude)

Criterion-digression - A situation in which the level of a water quality parameter in a waterbody has risen for at least a moment, to a level above (or where relevant below) the level specified by an applicable water quality criterion.

Criterion-duration - The component of a water quality criterion that specifies a minimum time frame over which the average level of a water quality parameter should not surpass the criterion-magnitude (concentration). Criterion-durations are often referred to as criterion averaging periods.

Criterion-exceedance - A situation in which conditions in a waterbody are worse than those described by the criterion-magnitude (concentration), criterion-duration, and criterion-frequency of an applicable water quality criterion. For example, if a WQC for a certain pollutant is expressed as "the 30-day average waterbody concentration must not go above 25 µg/L more than once in 365 days," a criterion-exceedence would have occurred in a waterbody if the average ambient concentration of the pollutant to which the criterion applies went above 25 µg/L, for 2 or more 30-day periods in a given 365-day period.

Criterion-excursion - A situation in which conditions in a waterbody are worse than those described by the criterion-magnitude (concentration) and criterion-duration of an applicable water quality criterion. For example, if a WQC for a certain pollutant has a criterion-concentration of 25 µg/L and a criterion-duration of 30 days, any period in which the 30-day average concentration of that pollutant in a waterbody had gone above 25 µg/L would be a criterion-excursion.

Criterion-frequency - The component of a water quality criterion that specifies the maximum rate at which criterion-excursions can occur without having a criterion-exceedance. For example, a criterion-frequency might specify that the 30-day average concentration of a pollutant should not surpass 25 µg/L more than once in any 365-day period.

Criterion-magnitude - The component of a water quality criterion that specifies a maximum or minimum level of a water quality parameter. Usually expressed as a concentration (see criterion-concentration), but for some parameters (pH, temperature, turbidity, etc.) it is expressed in other terms.

Critical conditions - Those circumstances in which, because of a variety of factors, adverse effects on the environment and/or human health are likely to occur at a given site.

Cost-benefit analysis - A calculation of the monetary costs of a given action (e.g., regulation, infrastructure project) compared to the monetized benefits. In the environmental context, changes in environmental conditions and effects (aesthetics, populations of plants and animals, ecosystem functions, human health impacts) must be somehow converted to a monetary form.

Cost-effectiveness analysis - A calculation of the monetary cost of achieving a certain amount of a given desired outcome. In the environmental context, this involves estimating the cost of reducing loadings of a given unit of pollutants to the environment (e.g., dollars per pound). Technology-based effluent limits (see definition below) established under the CWA are based on cost-effectiveness analysis.

CWA - Abbreviation for the federal Clean Water Act, also known as the Federal Water Pollution Control Act of 1972, which restructured the authority for water pollution control and consolidated authority in the Administrator of the Environmental Protection Agency.

CWSRF - The Clean Water State Revolving Loan Fund, under which the federal government provides capitalization grants to states for establishment and expansion of revolving loan funds whereby municipalities and certain private entities can obtain funding for various types of clean water-related projects. (see also DWSRF)

Designated use (DU) - A use that state and federal governments have determined should be attained in a given waterbody, regardless of whether the waterbody could support the use at the time of designation. Examples include (1) support of aquatic life, (2) body contact recreation, (3) fish consumption, and (4) public drinking water supply.

Design conditions - A specific set of circumstances for which an NPDES permit, TMDL, set of best management practices, or some sort of watershed plan is designed to meet applicable water quality standards (WQS). For example, NPDES permit limits are often designed to result in attainment of WQS in a receiving stream whenever the stream flow is higher than a defined low flow (e.g., 7Q10 - see definition above).

Design flow - A type of design condition that refers to a specific stream flow.

Digression - (see criterion-digression)

DO - Dissolved oxygen. The concentration of oxygen dissolved in water, expressed in milligrams per liter or percent saturation.

DWSRF - The Drinking Water State Revolving Loan Fund created by the federal Safe Drinking Water Act (SDWA), under which the federal government provides capitalization grants to states for establishment and expansion of revolving loan funds whereby drinking water utilities can obtain funding for various types of clean drinking water-related projects. (see also CWSRF)

Effects-based water quality criterion - A WQC expressed in terms of effects on aquatic ecosystems or humans, as opposed to levels of pollutants or other stressors. Examples of response indicators for which effects-based WQC have been established include dissolved oxygen, pH, temperature, turbidity, chlorophyll *a*, and the structure or function of aquatic communities.

Effluent - Wastewater discharged from an industrial facility, sewage treatment plant, or other point source discharge (see definition below).

Effluent limit/limitation - A restriction on quantities, discharge rates, and concentrations of pollutants (chemical, physical, biological) discharged from a point source into surface waters under the jurisdiction of the CWA. Effluent limits are set forth as enforceable requirements in NPDES permits.

Ephemeral - A stream or portion of a stream that flows briefly in direct response to precipitation in the immediate vicinity, and whose channel is at all times above the groundwater reservoir.

Existing use - According to EPA regulations governing state water quality standards, any use that has been attained at any time since November 28, 1975. In this context, "attained" means that the use took place and/or water quality adequate to support the use occurred.

Feeding (trophic) guild - A group of organisms that is similar in its nutritional requirements and feeding habits, such as planktivores, piscivores, omnivores, etc.

"Fishable/swimmable" goal - An abbreviation of the language set forth in section 101(a) of the CWA, which states that where achievable, water quality sufficient to support protection and propagation of fish, shellfish, and wildlife and recreation in and on the water shall be attained by 1985.

Generalists - Organisms that are tolerant of variable environmental conditions. Generalists are typically able to accommodate multiple prey types and thrive under variable or unpredictable environmental conditions.

General permit - With regard to both the CWA 402 (NPDES) and 404 permit programs, a permit authorizing specified discharges of pollutants to waters of the United States from more than one source or activity. General permits apply to similar sorts of sources/activities taking place within a specified geographic area. Essentially the same requirements apply to all sources covered by a given general permit.

Indirect discharger - An facility that, instead of discharging pollutants or wastewater directly into a water of the United States, sends them into a municipal sewer system. Though not covered by the CWA's NPDES program, indirect discharges of toxic chemicals from industrial operations are subject to the CWA's pretreatment program (see below).

LC50 - Lethal concentration for 50 percent of organisms exposed to a chemical or other stressor over a specified period (e.g. 96 hour LC50).

Load allocation (LA) - That portion of a waterbody's loading capacity for a given pollutant established in a TMDL assigned to nonpoint sources. Anticipated future loads of pollutants from nonpoint sources can be included as a specific suballocation of under the LA, or can be included in separate "growth allocation" or "reserve capacity".

Loading capacity - For a given waterbody, the maximum pollutant-specific loading rate consistent with attainment of a particular water quality standard.

Margin of safety (MOS) - In the context of the TMDL program, a safety factor applied to a waterbody-pollutant specific loading capacity estimates, to ensure attainment of water quality standards.

Maximum contaminant level (MCL) - Limits on levels of contaminants in finished drinking water, set by EPA under the SDWA. (Contrary to their name, MCLs typically do not set limits on instantaneous maximum levels of contaminants/pollutants but are typically expressed as annual average maximum concentrations.)

Maximum extent practicable (MEP) - Technology-based NPDES permit limits applicable to municipal separate stormwater sewer systems (MS4s). EPA specifies that compliance with MEP can be attained by developing a stormwater management plan that addresses the six minimum control measures described in the stormwater regulations.

MCL - Maximum contaminant level (see definition above)

mgd - Million gallons per day

Minimally impaired - Describes the condition of the biota and habitat in an ecosystem having minimal influence from human activities. Minimally impaired habitats achieve biological integrity.

Mixing zone - An area in a receiving waterbody where effluents from a point source discharge undergoes initial dilution in which some, or all, otherwise applicable water quality criteria do not apply.

MS4 - Municipal separate storm sewer system. A system of pipes and other conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that collects and conveys only urban stormwater runoff and discharges it directly to one or more waters falling under the jurisdiction of the CWA. By definition, MS4s are owned or operated by a state, city, town, county, district, association, or other public body (see also "combined sewer system CSO" and "sanitary sewer system")

Municipal separate storm sewer system (see MS4, above).

Natural background condition - Characteristics of a waterbody in the absence of any pollutants or other anthropogenic stressors.

Narrative water quality criteria - A description of acceptable waterbody conditions contained in state water quality standards expressed without use of numbers. For example, "no excess plant growth" or "waterbodies must be free from floating scum or sludge".

Navigable waters - A term sometimes used to describe those surface waters falling under the jurisdiction of the CWA. (see also "traditional navigable waters")

NOI - Notice of intent that is typically sent to a regulatory authority to apply for coverage under a general permit. Most general NPDES (CWA section 402) and U.S. Army Corps of Engineers "dredge and fill" nationwide or regional permits (CWA section 404) permits require that discharges from a pollutant source must submit a written NOI to the relevant permitting authority.

Nonpoint source (NPS) - A diffuse source of water pollution that is not collected and discharged through a discrete man-made conveyance. (i.e, any source of pollutants not considered a point source under the CWA.) Atmospheric deposition and hydromodification are also nonpoint sources of pollution.

NPDES - National Pollutant Discharge Elimination System. A CWA-established national program regulating direct discharges of pollutants from point sources to the waters falling under the jurisdiction of the CWA.

Numeric water quality criteria - Descriptions of acceptable waterbody conditions contained in state water quality standards regulations that are expressed in numeric (as opposed to purely narrative) form. Numeric criteria consist of three basic elements: (1) a criterion-concentration (or magnitude in the case of parameters like temperature and pH); (2) a criterion-duration (sometimes called criterion-averaging period); and (3) a criterion-frequency (sometimes called a recurrence interval).

Ocean - Any portion of the high seas beyond the contiguous zone.

Outfall - A place where wastewater or stormwater, or a combination thereof, is discharged into a waterbody via a point source.

Point source - A discernable, discrete, confined man-made conveyance whereby pollutants are discharged directly to surface waters falling under the jurisdiction of the CWA. Such conveyances include pipes, ditches, channels, tunnels, conduits, wells, discrete fixtures, containers, rolling stock (wheeled vehicles),concentrated animal feeding operations, landfill leachate collection system, and vessels and other floating craft.

Pollutant - Industrial, municipal, and agricultural waste, including sewage, chemical wastes, dredged spoil, sand, sewage sludge, solid waste, garbage, rock, heat, filter backwash, discarded equipment, munitions, and radioactive and biological materials discharged into water.

Pollution - The man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.

Precipitation-dependent source - (see also "wet weather point source") A source of pollutants that loads pollutants into waterbodies only as a result of runoff resulting from precipitation events (rain, snow). Such sources can be considered, under the CWA, as either nonpoint or point sources, depending on whether the runoff and associated pollutants are collected into a man-made conveyance (point source) or enter the waterbody in a diffuse manner (nonpoint source). Row crop farming and livestock pasturing/grazing are examples of nonpoint sources. MS4s, CSOs, CAFOs, and some road systems and construction sites are examples of precipitation-dependent point sources.

Precipitation-independent source - A source that loads pollutants into waterbodies regardless of whether precipitation events have occurred. Examples include municipal sewage treatment plants and industrial process dischargers.

Pretreatment program - Applicable to indirect industrial dischargers (see definition above), this program sets technology-based limits on levels of toxic pollutants in wastewater from such facilities that are discharged into municipal sewer systems.

Primary contact recreation - Forms of water-based recreation in which the intake of pathogens and other contaminants found in ambient water is a reasonable possibility, due to ingestion of, and/or exposure of pervious membranes to, surrounding water.

Primary drinking water standard - A health-based limit on levels of contaminants in finished drinking water established under the federal Safe Drinking Water Act. (see also "maximum contaminant level-MCL")

Primary treatment - Treatment of wastewater by removing solids and organic matter, employing physical means such as screens, filters, and settling basins.

Process wastewater - Pollutant-carrying water resulting from contact with materials used in industrial manufacturing processes.

PS - Point source (See definition above)

Publicly owned treatment works (POTW) - A sewer collection and treatment system owned by a municipality or a state. Includes sewers, pipes, conveyances, and devices and systems used to store, treat, recycle, and reclaim sewage or industrial wastewater.

PWS - In the context of WQS established under the CWA, "public water supply," which refers to a waterbody used as a raw water source by a drinking water utility. In the context of the Safe Drinking Water Act, a "public water system.

Reference condition - Ideally, reference conditions represent the highest biological conditions found in waterbodies undisturbed by anthropogenic stressors. Acceptable reference conditions will differ between geographic regions and states. Reference conditions can be derived from reference sites, an empirical model of expectations that can include knowledge of historical conditions, or a model extrapolated from ecological principles. Usually, data from sites that represent best attainable conditions (i.e., least disturbed) of a waterbody are used.

Response indicator - A characteristic of a living system that reflects the effect of one or more stressors. Commonly used examples in the context of the CWA include depleted populations of aquatic organisms, unnaturally low or high pH, temperature, or dissolved oxygen, increased chlorophyll *a*, and increased turbidity.

Sanitary sewer system - A system of pipes and other conveyances that collects and carries waste from homes, offices, industrial facilities, and other kinds of buildings and operation to a municipal sewage treatment facility. Sanitary sewers to not carry urban stormwater runoff. (see also "MS4s" and "CSOs".)

Secondary contact recreation - Forms of water-based recreation in which contact with surrounding water is unlikely, such as fishing and motor boating.

Secondary drinking water standard - A limit on levels of contaminants in finished drinking water established under the federal Safe Drinking Water Act that addresses the aesthetic aspect of drinking water, such as color and odor.

Secondary treatment - Treatment of wastewater employing a combination of physical and biological processes, such as "activated sludge". Refers specifically to wastewater treatment requirements applying to discharges of BOD5, total suspended solids (TSS), and pH from municipal sewage treatment facilities.

Sewage treatment plant (STP) (see "Publicly owned treatment works")

Specialists - Organisms that have special nutritional needs or other physiological or physical requirements and live in a restricted habitat that provides those needs.

SRF - State revolving loan fund.(see CWSRF and DWSRF)

Standard - In the context of the Clean Water Act, a term used to refer to a number of different requirements and/or threshold levels, including water quality standards, water quality criteria, criterion-concentrations, effluent limitations, technology-based regulations applicable to point sources. It can also include primary and secondary drinking water standards established under SDWA.

TDS - Total dissolved solids. A measure of organic and inorganic substances suspended in water in molecular, ionized, or colloidal form.

Technology-based approach - An approach to environmental management whereby limits on releases of stressors into the environment are established according to cost-effectiveness analyses (see definition above). Examples of such requirements are BAT for industrial sources, secondary treatment for POTWs, and MEP for municipal separate storm sewers. Currently, best management practices applied to wet-weather point and nonpoint sources are typically based on the technology-based approach; although, they can be employed in a water quality-based approach.

Technology-based effluent limits (TBELs) - Technology-based limits on discharges of pollutants from point sources to waters of the United States set forth in NPDES permits, usually based on the capability of a treatment method to reduce pollutant levels to a certain concentration or mass loading level.

Territorial seas - The belt of the seas measured from the line of ordinary low water along that portion of the coast that is in direct contact with the open sea and extending seaward a distance of 3 miles.

TMDL Implementation Plan - Once a TMDL is developed and approved by EPA, measures described in the TMDL are taken to reduce pollution levels in the stream. Such measures are described in a TMDL Implementation Plan.

Total Maximum Daily Load (TMDL) - A calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

Traditional navigable waters - Waters defined as navigable before passage of the CWA and their tributaries, including interstate waters, intrastate lakes, rivers, and streams used for recreational or other purposes; and intrastate lakes, rivers, and streams from which fish or shellfish are taken and sold in interstate commerce.

Trophic level - An organism's position in a food chain. The levels are numbered according to how far organisms are along the chain from the primary producers (plants) at level 1, to herbivores (level 2), to predators (level 3), to carnivores or top carnivores (level 4 or 5).

TSS - Total suspended solids. A measure of filterable material suspended in water.

Urbanized area - A land area comprising one or more places - central place(s) - and the adjacent densely settled surrounding area - urban fringe - that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile.

Use attainability analysis (UAA) - A structured scientific analysis whereby states can determine whether an unattained waterbody use is technologically and economically achievable. To remove a designated use from application to a waterbody, a state must find that, according to a UAA, the unattained use is not attainable within the foreseeable future. Such findings, and the resulting change in designated uses, must be made available for public review and comments, and like any change in WQS regulations, must be approved by EPA to become effective under the CWA.

Wasteload allocation (WLA) - That portion of a waterbody's loading capacity for a given pollutant established in a TMDL assigned to point sources. Anticipated future loads of pollutants from point sources can be included as a specific suballocation under the WLA, or can be included in separate "growth allocation" or "reserve capacity".

Wastewater treatment plant (WWTP) - (see "Publicly owned treatment works")

Water quality-based approach - The application of the "risk-based approach" in the manner specified in the CWA. In particular, the water quality based approach requires setting regulatory limits and applying voluntary programs in a manner to ensure attainment of applicable WQS.

Water quality based effluent limit (WQBEL) - Limits on discharges of pollutants from point sources calculated to ensure attainment of water quality standards in the waterbodies receiving such discharges. Such limits must be included in NPDES permits, where necessary.

Water quality criteria (WQC) - The minimum conditions that a waterbody must attain or maintain to support a designated use. WQC describe physical, chemical, and biological attributes. WQC can be expressed in either numeric or narrative form.

Water quality criterion - The singular of water quality criteria.

Water quality limited segment - A waterbody that fails to meet one or more applicable water quality standards. The section 303(d) list is comprised of water quality limited segments (WQLS).

Water quality standard (WQS) - State-adopted and EPA-approved ambient standards for waterbodies. The standards prescribe the use of the waterbody and establish the water quality criteria and antidegradation measures that must be met to protect designated uses.

Waters of the United States - Waters used in or supporting interstate or foreign commerce or recreation, waters used for interstate or foreign industrial purposes, interstate waters and wetlands, the territorial sea, and the tributaries of and wetlands adjacent to those waters. This term is often used to describe those waters falling under the jurisdiction of the CWA.

Wet-weather point source - (see "precipitation-dependent source")

Wetland - For regulatory purposes under the Clean Water Act, the term wetlands means those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.