

INTRODUCTION TO THE CLEAN WATER ACT¹

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 nor with water quantity issues.) The statute employs a variety of regulatory and nonregulatory tools to sharply reduce direct pollutant discharges into waterways, 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."

For many years following the passage of CWA in 1972, EPA, states, and Indian tribes focused mainly on the chemical aspects of the "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 focused on regulating discharges from traditional "point source" facilities, such as municipal sewage plants and industrial 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" runoff, 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 is being employed.

Evolution of CWA programs over the last decade has also included something of a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the 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. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining state water quality and other environmental goals is another hallmark of this approach.

HISTORY OF THE CLEAN WATER ACT

The Federal Water Pollution Control Act of 1948 was the first major U.S. law to address water pollution. Growing public awareness and concern for controlling water pollution led to sweeping amendments in 1972. As amended in 1977, the law became commonly known as the Clean Water Act (CWA).

The 1977 amendments:

- Established the basic structure for regulating pollutant discharges into the waters of the United States.
- Gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry.
- Maintained existing requirements to set water quality standards for all contaminants in surface waters.
- Made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions.
- Funded the construction of sewage treatment plants under the construction grants program.

1. <http://www.epa.gov/watertrain/cwa/>

- Recognized the need for planning to address the critical problems posed by nonpoint source pollution.

Subsequent amendments modified some of the earlier CWA provisions. Revisions in 1981 streamlined the municipal construction grants process, improving the capabilities of treatment plants built under the program. Changes in 1987 phased out the construction grants program, replacing it with the State Water Pollution Control Revolving Fund, more commonly known as the Clean Water State Revolving Fund. This new funding strategy addressed water quality needs by building on EPA-state partnerships.

Over the years, many other laws have changed parts of the Clean Water Act. Title I of the Great Lakes Critical Programs Act of 1990, for example, put into place parts of the Great Lakes Water Quality Agreement of 1978, signed by the U.S. and Canada, where the two nations agreed to reduce certain toxic pollutants in the Great Lakes. That law required EPA to establish water quality criteria for the Great Lakes addressing 29 toxic pollutants with maximum levels that are safe for humans, wildlife, and aquatic life. It also required EPA to help the States implement the criteria on a specific schedule.

SUMMARY OF THE CLEAN WATER ACT

The module goes through the major CWA programs in the following sequence: 1) water quality standards, 2) antidegradation policy, 3) waterbody monitoring and assessment, 4) reports on condition of the nation's waters, 5) total maximum daily loads (TMDLs), 6) NPDES permit program for point sources, 7) Section 319 program for nonpoint sources, 8) Section 404 program regulating filling of wetlands and other waters; 9) Section 401 state water quality certification; 10) state revolving loan fund (SRF).

Also, at any time, you can jump to the slides about a particular CWA program, by clicking on the "CWA Big Picture" link in the navigation tool bar -- at the top of the screen. For example, if you want to go to the unit on the Section 319 nonpoint source program, first click on "CWA Big Picture" in the tool bar, and then click on the brown box labeled "Section 319," in the lower left corner of the Big Picture slide.

Throughout the module, underlined terms are hyperlinked to the glossary (see also the "glossary" link at the upper right corner of your screen). If this is your first visit to a Watershed Academy module, click the "how to navigate Watershed Academy modules" link for other general browsing instructions.

This course may take several hours to complete. Students may vary the depth of the course by choosing to read only the left slides, the right side text, or both. Also, throughout the module, there are numerous links to other websites providing additional details on particular programs or topics. These are strictly optional, and 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.

Brief Overview of Key CWA Elements

First, [water quality standards \(WQS\)](#) consistent with the statutory goals of the CWA must be established. Then waterbodies are monitored to determine whether the WQS are met.

If all WQS are met, then [antidegradation](#) policies and programs are employed to keep the water quality at acceptable levels. [Ambient monitoring](#) is also needed to ensure that this is the case.

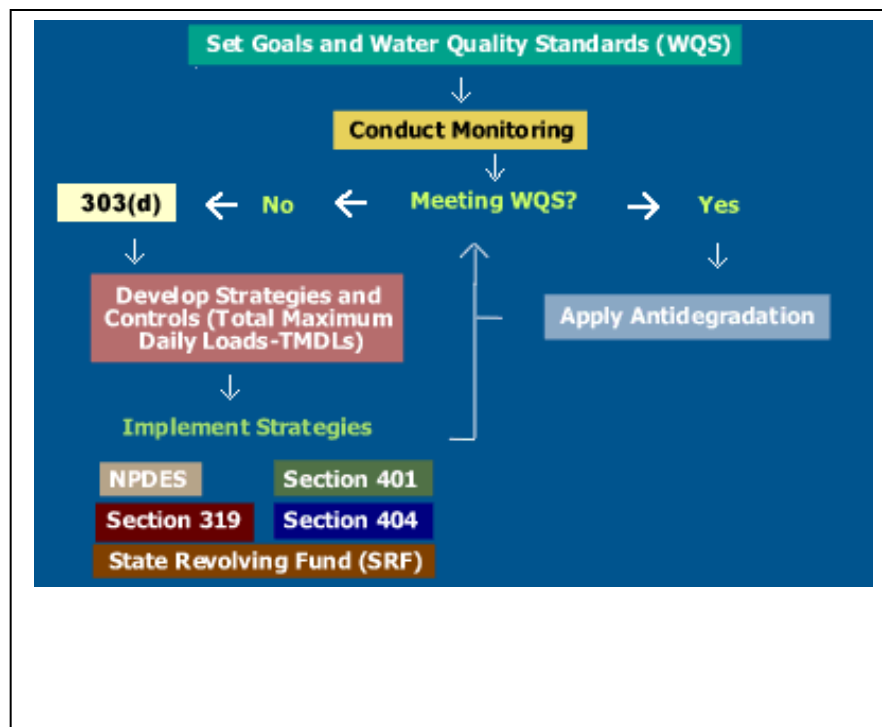
If the waterbody is not meeting WQS, a strategy for meeting these standards must be developed. The most common type of strategy is the development of a [Total Maximum Daily Load \(TMDL\)](#). TMDLs

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 pollution](#) discharging into a surface waterbody.
- **Section 319**
Addresses [nonpoint sources of pollution](#), such as most farming and forestry operations, largely through grants.
- **Section 404**
Regulates the placement 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 would result in increased pollutant loads to a waterbody. 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 in the form of loans for municipal point sources, nonpoint sources, and other activities.

After implementation of these strategies, ambient 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.



Water quality standards (WQS) are aimed at translating the broad goals of the CWA into waterbody-specific objectives. 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" apply only to surface waters—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 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" according to the CWA and other waters can be hard to determine, especially with regard to smaller streams, [ephemeral](#) waterbodies, and wetlands not adjacent to other "waters of the United States." In fact, the delineation changes from time to time, as new court rulings are handed down, new regulations are issued, or the Act itself is modified.

As indicated by the placement of WQS in all parts of the waterbody system illustrated in the accompanying slide, water quality standards should be set for all surface waters meeting the definition of "waters of the United States."

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

Designated uses, water quality criteria, and an antidegradation policy constitute the three major components of Water Quality Standards Program.

The designated uses (DUs) of a waterbody are those uses that society, through various units of government, determines should be attained in the waterbody. The DUs are the goals set for the waterbody. In some cases, these uses have already been attained, but sometimes conditions in a waterbody do not support all the DUs.

Water quality criteria (WQC) are descriptions of the conditions in a waterbody 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 high quality waters, that is, those with conditions that exceed those necessary to meet the designated uses.

To understand the regulations that apply to designating uses under WQS, several key terms must be defined. As noted previously, a designated use is a use specified in water quality standards for each waterbody whether or not they are being attained (it might be helpful to think of these as desired uses).

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 waterbody is capable of supporting at present but also any use to which the waterbody has actually attained since November 28, 1975. Even if the waterbody 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 waterbody.)

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 is a reflection of 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 waterbody (fishing, for example) is inherently more important than another (industrial water supply, for example). Hence, removing from the designated uses of a waterbody 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."

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

Commonly used use designations include the following:

- Drinking water
 - **Treated/untreated**
- Water-based recreation
 - **Noncontact/short-term/long-term**
- Fishing/eating
- Aquatic life
 - **Warm water species/habitat**
 - **Cold water species/habitat**
- Agriculture water supply
- Industrial water supply

The terms listed in bold text are examples of subcategories of uses. For example, a water segment could be designated for "public drinking water supply (PWS)--no treatment before use." It could also be designated "PWS--treatment provided." If water from a river or lake goes through a filtration facility before being sent to a public water distribution system, then levels of certain pollutants in the raw water supply (river/lake) could be allowed to be higher than if no treatment occurred. The higher level in the raw water would be proportional to the degree to which the particular drinking water treatment plant removed that pollutant.

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 fisheries 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.

In general, different waterbodies, and different portions of a given waterbody, are assigned various combinations of the DUs. A given segment will almost always be classified for more than one DU.

Economic factors can be considered when setting the DU for a waterbody. In contrast, economics cannot be factored in when developing the WQC to protect a DU.

The first policy is that if a use is an "existing" use for a waterbody, then the waterbody must have that use in its designated uses (sometimes called use classifications). Remember, as noted previously, the term "existing use" has a special meaning in the context of water quality standards.

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 (see next slide) can these uses be excluded from the DUs for a waterbody.

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 or treatment systems.

The fourth rule has been covered in the [WQS: Use Classification slide](#). When a waterbody has been classified for more than one DU, as is usually the case, regulatory activities and other programs are "driven" by the DU that requires the cleanest water. This is simply because if one DU requires a concentration of pollutant "x" of 50 mg/L or less and a second DU requires 25 mg/L, then meeting the second DU (and the corresponding WQC of 25 mg/L) automatically results in meeting the first DU and its corresponding WQC.

The last key rule regarding the setting of DUs is that economic and social factors can be considered, although this is not required. More specifics about this will be presented in the next slide, which deals with changing DUs.

EPA regulations prohibit the removal of an "existing" or actual use from the DUs for a waterbody. However, a DU that has not been attained may be removed under limited circumstances (downgraded).

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.

First, it must be shown that the current DU cannot be achieved through implementation of: (1) applicable technology-based limits or 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 above measures, then another set of other 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.
- achieving the use would involve 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. (For more details on UAAs [click here](#))

Some indication of how EPA might interpret the language regarding nonpoint sources can be obtained by looking at the guidance it has issued with regard to the nonpoint source provisions of the Coastal Zone Management Act ([click for the federal web site on CZMA](#)). Additional, more recent, EPA guidance on management measures applicable to [forestry](#) and [agriculture](#) is also available.

However, one must remember that the U.S. EPA has no regulatory authority over nonpoint sources, so it could not force a state to require that these BMPs be applied by normal farming operations or other nonpoint sources.

Water Quality Criteria (WQC) are levels of individual pollutants or water quality characteristics, or descriptions of conditions of a waterbody that, if met, will generally protect the designated use of the water. For a given DU, there are likely to be a number of criteria dealing with different types of conditions, as well as levels of specific chemicals. Since most waterbodies have multiple DUs, the number of WQC applicable to a given waterbody can be very substantial.

Water quality criteria 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 considered when developing WQC.

WQC can be divided up for descriptive purposes in many ways. For instance, numeric criteria (weekly average of 5 mg/L dissolved oxygen) can be contrasted with narrative criteria (no putrescent bottom deposits). Criteria can also 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 dividing WQC, with those dealing with short-term exposures (acute) being distinguished from those addressing long-term exposure (chronic).

Criteria can also be distinguished 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 and various plants and microorganisms. These can be expressed as parameter specific (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 waterbody (community indices).

Human health criteria can apply to two exposure routes: (1) drinking water and (2) consuming aquatic foodstuffs.

Wildlife criteria, like human health/fish consumption criteria, deal with the effects of pollutants with high [bioaccumulation](#) factors. To date, EPA has issued and/or adopted 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.

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* [click here](#). (PDF format, 4.4MB, 46 pages)

"No toxics in toxic amounts" does lend itself to quantitative measurement. Toxicity testing, one way to translate this narrative into a quantitative measure, will be covered later in this module.

Narrative criteria are usually applicable to all waterbodies, regardless of their use designations.

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 ug/L or a pH above 5.0. They should also 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 exceed 50ug/L".

A numeric WQC should also indicate how often it would be acceptable to go beyond specified concentration/duration combinations. This is often 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 3 years. The purpose of the recurrence interval is to recognize that aquatic ecosystem can recover from impacts of exposure to harmful conditions, but to make such conditions sufficiently rare as to keep the community of aquatic organism from being in a constant state of recovery.

Simply because one sample has exceeded the concentration component of a WQC does not necessarily mean the WQC has been violated 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 7-day average, then having one sample at a concentration above 50 mg/L would not "prove" 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 waterbody is indeed meeting WQS.

EPA publishes recommended water quality criteria corresponding to a number of key designated uses. For aquatic life uses, criteria for both short-term (acute) and long-term (chronic) exposures are provided. Different criteria for freshwater systems and marine (saline) systems are often provided. Most human health criteria, except certain pathogens, address chronic exposures ([click for the OST WQS web site](#)).

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 parameter, they must adopt a corresponding criterion. Such criteria must provide the same level of protection as EPA's, and state/tribe must document that this is the case.

([Click for slide](#)) The table to the left illustrates several basic principles regarding WQC. Note that the toxicity of pollutants differs depending on whether they are in fresh or salt water environments. However, there is no predictable pattern as to whether a pollutant is more or less toxic in fresh vs. salt water (copper is more toxic in marine water, cadmium in fresh water).

On the other hand, the chronic criterion for a pollutant is always more stringent than the acute criterion, as shown by the cadmium numbers in the table to the left. This is because of the well-known fact that long-term exposure to lower concentrations of contaminants can cause exactly the same negative effects as short-term exposure to much higher pollutant levels.

Finally, the table illustrates the fact that the form (or species) a pollutant is in changes its toxicity. Hexavalent chromium is much more toxic than trivalent chromium.

The following table is another illustration of how environmental conditions can affect the impact of a pollutant in aquatic life. ([Click for slide](#)) As the temperature of the water increases, the toxicity of ammonia (NH₃) also goes up -- the criterion gets "lower." To further complicate matters, the acidity (pH) of the water also affects the toxicity of ammonia.

EPA is currently developing and issuing technical guidance that can be used to help set WQC for nutrients (nitrogen, phosphorus) ([click for the OST Nutrient Criteria Webpage](#)).

Biological criteria apply only to aquatic life designated uses. The use of biological or ecological assessments 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/or plants.

Once the target types of organisms have been collected, they are sorted into easily identifiable groups, usually to the family level, rather than genus or species. These are then quantified according to a variety of measures, each of which is used to indicate certain aspects of ecosystem health.

Examples of measures include [feeding guilds](#), [trophic levels](#), [generalists](#), and [specialists](#). As an example of how these metrics may be used as indicators of the health and integrity of an aquatic ecosystem, a waterbody that has mostly generalists is usually less healthy than those that have a substantial number of specialists. Likewise, a waterbody dominated by species that can tolerate very polluted conditions is generally less healthy than one dominated by pollution-intolerant species.

Symptoms of Impairment

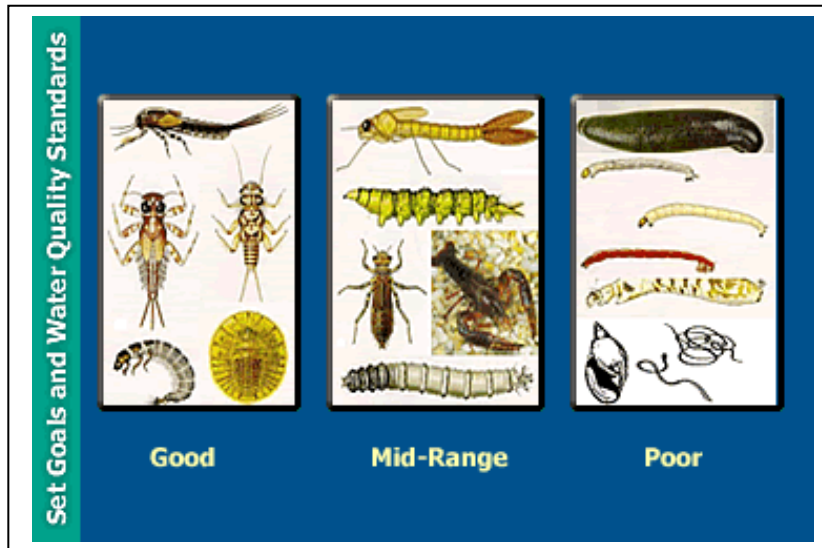
- Larger percent of tolerant species
- Lower proportion of predators
- Higher number of generalists
- Greater proportion of exotics
- More disease, malformations, and lesions

([Click for the OST Bioassessment and Biocriteria Webpage](#))

This series of photos shows how obvious the change in the mix of organisms can be as water quality goes from good to poor.

It is critical to recognize that bioassessments are not "absolute." The number of stonefly species that ecologists would say reflects "biological integrity" in one type of aquatic ecosystem would not necessarily be appropriate to apply to another type of waterbody. Hence, relatively unimpacted reference waterbodies for each major type of aquatic ecosystem in a state must be identified, and then the results of the biosurvey done in these waterbodies are compared with the results from surveys in other waterbodies of the same ecological category.

Around the country, citizen volunteers are collecting and interpreting biological data from streams and other waterbodies ([click for slide](#)).



EPA regulations give states, authorized tribes, and territories the flexibility to "waive" applicable WQS under certain circumstances. The two most common forms of exemptions are: (1) mixing zones and (2) stream design flows. Hence, mixing zones can be thought of as "spatial exemptions" and design flows as "temporal exemptions".

Mixing zones exempt certain portions of a waterbody 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 ([click for slide](#)). In the innermost zone, which is the zone closest to the discharge pipe, exceedance of both 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.

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.

Design flow exemptions have also 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 relatively continuous discharges. Increasingly, waivers of WQS during extreme high flow events are being employed in association with municipal wet weather discharges -- combined sewer overflows, for example.

([Click for slide](#)) This bell-shaped curve illustrates the basic idea of temporal WQS exemptions. 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.

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 waterbody at all times.

Antidegradation

To protect the existing uses of waters, and to protect waters with water quality levels better than necessary to support propagation of fish, shellfish and wildlife, and recreation in and on waters of the states, a set of policies called "antidegradation" comes into play. The purpose of these policies is to keep clean waters clean. States, tribes, and territories usually cover this program as part of their water quality standards regulations.

Antidegradation is generally considered to have three components, or "tiers" of protection: (1) protection and maintenance of existing uses of waters, (2) protection of high quality waters, and (3) outstanding national resource waters.

Antidegradation Policies

This component of water quality standards programs focuses on waters that are "better than standards" -- they have high water quality.

The high quality water component of antidegradation can be applied using one of two approaches. Each has its benefits for a state to consider. One approach is to identify and protect high quality waters based on consideration of the level of each parameter to the criteria necessary to support propagation of fish, shellfish and wildlife, and recreation in and on the water. The second approach is to use a variety of factors to judge a water body's overall quality. Regardless of the approach taken, states should apply their antidegradation policies in a way that requires a public review to determine whether proposed activities that might affect water quality should be authorized.

Antidegradation Policies

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Antidegradation can apply parameter-by-parameter or waterbody-by-waterbody, depending on the State's chosen method. With the parameter-specific method, a waterbody could have antidegradation apply to some criteria, whereas a cleanup strategy, such as a Total Maximum Daily Load (TMDL), could be needed for others. With the waterbody method, waters in need of a cleanup strategy would generally not have antidegradation apply.

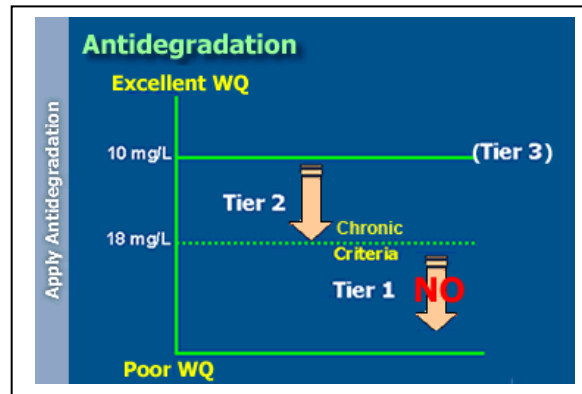
Antidegradation

This slide attempts to summarize all the key provisions of antidegradation. In this hypothetical example, the chronic criterion for toxic pollutant "x" is 18 mg/L and the concentration of "x" in the waterbody is 10 mg/L. Since the ambient concentration of "x" is lower than the criterion concentration, antidegradation applies.

Rule/Tier 1 of antidegradation means that under no circumstances can the state, authorized tribe, or territory allow regulated activities to increase the level of "x" beyond the criterion (18 mg/L). Allowing levels of "x" to go beyond the criterion would result in impairment of the existing uses that the criterion is designed to protect. Hence, "Tier 1" appears to the right of the arrow with "NO" superimposed, in the area of the graph where concentrations of "x" would be greater than 18 mg/L.

The broken arrow going from the existing concentration (10 mg/L) to the criterion (18 mg/L) is meant to indicate Rule/Tier 2 of antidegradation. Lowering of water quality from high levels down to ones barely better than applicable criteria is not prohibited, but it can take place only in very limited circumstances.

Tier 3 appears to the right of the line corresponding to the existing level of "x" in the waterbody (10 mg/L), to indicate that for Tier 3-designated waters, virtually no degradation of water quality would be allowed. (Tier 3 is placed in parentheses as a reminder that Tier 3 applies only to specially designated waters.)



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.

The responsibility for establishing WQS has always been vested in the states and territories, however EPA must assign WQS authority to tribes. Tribes must meet certain tests before they can assume WQS programs ([click for slide](#)). Before the tribes are given such authorization, EPA must set WQS on Indian lands.

For more information on water quality standards, please visit EPA-Office of Science and Technology's [Water Quality Criteria and Standards Program web site](#).

The diagram, titled "WQS: The Process", lists five key points regarding water quality standards. The vertical axis is labeled "Apply Antidegradation".

- WQS established by states/territories/authorized tribes
- EPA must review/approve prior to becoming effective
- If EPA disapproves a state/territory/tribe WQS and state/territory/tribe doesn't revise it, EPA promulgates a WQS
- Public review and comment at state/tribe/territory and federal levels (if EPA promulgates)
- States, territories, and authorized tribes must review its WQS every three years and submit to EPA

Monitoring

First, water quality standards (WQS) consistent with the statutory goals of the CWA must be established. Then waterbodies should be monitored to determine whether the WQS are being met.

The responsibility for 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 is involved in a number of 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 (Click [here](#) for slide). A high degree of uncertainty, therefore, is associated with what can be said about the condition of most rivers, lakes, bays, and other surface waters.

In order 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. Consequently agencies are usually able to make only statistical inferences -- often at high levels of uncertainty -- as to whether a waterbody *is* actually *meeting* WQS."

On the other hand, considerably less data is needed to have strong evidence that WQS is *not* being *met* (ie-WQC are exceeded.) This asymmetry in needed amounts of data is due simply to the fact that severe harm 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 represents only a small fraction of the time period in question, and those limited data points include one or more exceedances of specified magnitude/duration combinations, then simple probability tells us that collection of a substantial number of additional samples will reveal additional exceedances. Therefore, we can be very confident that WQC are being exceeded several times instream during the specified periods.

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.

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. On the other hand, if the aim is to get an overall picture of water quality in a state (e.g., what percentage of waters are meeting WQS), then a statistically chosen random set of sampling locations would usually be best. 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.

Click [here](#) for the EPA Monitoring and Assessing Water Quality home page.

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. 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 impaired.

The second is the "303(d) List" and should include only those waters that are either threatened or impaired. (Waters attaining WQS should not be on the list).

Starting in 2002, EPA is asking 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 approach, all waters would be placed in one of five categories. These categories are defined by the amount of information available regarding a waterbody and the condition of the waterbody (Click [here](#) for more information.)

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 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 to waterbodies and what are the most common sources of those stressors.

The report should also include a discussion of progress made toward meeting the CWA's goals since the time of the last 305(b) Report

(Click [here](#) for a summary of the condition of assessed waters, nationwide).

If monitoring and assessment indicate that for some uses and/or parameters, a waterbody or segment is not meeting WQS, then that water is considered "impaired" 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.

The 303(d) list should include not only currently impaired waterbodies but also waters believed to be threatened that are likely to become impaired (i.e., not meet WQS) by the time the next 303(d) list is due.

Current EPA regulations call for 303(d) lists to include only waters impaired by "pollutants," not those impaired by other types of "pollution" (altered flow and/or channel modification). If it is certain that a waterbody's impairment is not caused by a "pollutant" but is due to another type of "pollution" such as flow, the waterbody 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 impaired by "non-pollutant pollution" should be identified in 305(b) reports.

EPA guidance documents mention a number of different 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 waterbodies. EPA also requires that data from sources other than the state agency itself -- federal agencies, universities, volunteer monitoring groups -- must be considered if they meet the state's requirements for data quality.

Some of the above actions may 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? Use of a biological assessment of aquatic life uses 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 waterbody 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 waterbody on the 303(d) list?

This table was compiled by EPA from information submitted in the states' 1998 and 2000 305(b) reports and represents the number of waterbodies for which the listed stressors or categories of stressors were cited as a cause of impairment.

The sediment referred to here is clean sediment/silt, not toxics-laden bottom sediments. Nutrients are phosphorus and/or nitrogen. "Other habitat alterations" 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.

The two most common causes of impairment, nutrients (nitrogen and phosphorus) and clean sediments, are parameters for which EPA and most states do not currently have numeric WQC. EPA is in the process of issuing criteria guidance for nutrients. Visit the EPA Office of Science and Technology's (OST) nutrient criteria homepage at <http://www.epa.gov/ost/standards/nutrient.html>.

Not all categories of stressors are mutually exclusive. For example, impaired biologic community is a condition that could result from any number of stressors (e.g., flow alteration, pH, temperature, and/or metals) listed in the table, but it could also mean impairments resulting from the introduction of exotic species. Fish consumption advisories would overlap with pesticides, metals, and/or organics.

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 impairment are nutrients, pathogens and sediments. 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 waterbodies where they are a problem.)

This graph shows that the most commonly cited causes of impairment vary from one major waterbody 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.

Top 15 Causes of Impairment 1998 and 2000	
Cause of Impairment	Count
Sediments	6,133
Pathogens	5,281
Nutrients	4,773
Metals	3,984
Dissolved Oxygen	3,772
Other Habitat Alterations	2,112
Temperature	1,884
pH	1,798
Impaired Biologic Community	1,440
Pesticides	1,432
Flow Alterations	1,099
Mercury	1,088
Organics	1,069
Noxious Aquatic Plants	831
Ammonia	752
Total	37,448

Because of the implementation of CWA regulatory programs controlling point sources of pollution over the last three decades, industrial facilities and municipal sewage treatment plants no longer are the major cause of impairment of most of the nation's surface waters. On the other hand, diffuse sources of precipitation-induced runoff (nonpoint sources under the CWA) are the sole cause of impairment of nearly half of the waters that states, territories, and authorized tribes list in their 303(d) reports. It is also likely that in many of the 50 percent of the impaired waters where both point and nonpoint sources are significant contributors, nonpoint sources contribute considerably more pollutant loads than do point sources ([click for slide](#)).

Top Four Reasons for 303(d) Listing (by Waterbody Type)			
	LAKES	ESTUARIES	STREAMRIVERS
NUTRIENTS		PATHOGENS	SEDIMENTS
SEDIMENTS		FCA²	METALS
DISSOLVED OXYGEN		METALS	PATHOGENS
pH		DISSOLVED OXYGEN	NUTRIENTS

TMDLs

If monitoring and assessment indicate that a waterbody or segment is impaired by one or more pollutants, and it is therefore placed on the 303(d) list, then the relevant entity (state, territory, or authorized tribe) is required to develop a strategy that would lead to attainment of WQS.

Note: 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 WQS. 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 waterbodies, even these more stringent limits on point sources have not resulted in attainment of WQS.

Such strategies must consist of a TMDL or another comprehensive strategy that includes a functional equivalent of a TMDL. In essence, TMDLs are "pollutant budgets" for a specific waterbody or segment, that if not exceeded, would result in attainment of WQS.

One somewhat unique program is authorized by Section 320 of the CWA, the National Estuary Program ([click for slide](#)).

TMDLs are required for "pollutants," but not for all forms of "pollution." Pollutants include 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.

At least one TMDL must be done for every waterbody or segment impaired by one or more pollutants. TMDLs are done pollutant by pollutant, although if a waterbody or segment were impaired 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) in order 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 also address the full array of activities affecting the waterbody. 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.

The first element of a TMDL is "the allowable load," also referred to as the pollutant "cap." 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 through use of mathematical models, probably computer based.

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 in essence the "slicing of the pie."

TMDLs set loading caps for individual pollutants such as clean sediments, nitrogen, phosphorus, coliform bacteria, temperature, copper, mercury, and PCBs. Indicators of a group of forms of pollution can also be used, such as biochemical oxygen demand (BOD), which is often used when doing TMDLs for waterbodies with low dissolved oxygen. (Again, TMDLs are not required for non pollutant forms of "pollution," such as streamflow patterns and stream channel modification.) States, territories, and authorized tribes are free to develop TMDLs for such pollutants, as they see fit. The CWA and EPA regulations put no limits on these other government entities going beyond what the Act requires.

Though the CWA itself uses the term Total Maximum Daily Loads, EPA has determined that loadings rates (caps) can be expressed as weekly, monthly, or even yearly loads. Which time period to use depends on the type of pollutant for which the TMDL is being done. Toxic chemicals that exhibit acute effects would probably call for daily or weekly loads, whereas nutrients and sediments could be expressed as monthly or yearly loading rates.

The CWA allows for seasonal TMDLs, that is, it allows different rates of loading at different times of the year. For example, colder waters can absorb more oxygen-demanding substances than can warm water, so allowable loadings could be higher in the winter than in the summer.

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

Generally, point sources that are required to have individual NPDES permits are also required to be assigned individual WLAs. On the other hand, a group of sources covered under a "general" NPDES permit would 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, with regard to nonpoint sources, TMDLs are simply a source of information that, for a given waterbody, should answer such questions as the following:

- Are nonpoint sources a significant contributor of pollutants to this impaired waterbody?
- What are the approximate total current loads of impairment - causing pollutants from all nonpoint sources in the watershed?
- What fraction of total loads of the pollutant(s) of concern come 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 in order to achieve the water quality standards for the waterbody?
- What kinds of management measures and practices would need to be applied to various types of nonpoint sources, in order to achieve the needed load reductions?

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. However, when thinking about changing the share of allowed loads among sources, it is important to realize that in all but very small waterbody segments, load **location matters**. In many cases, the farther away from the zone of impact that a loading enters into the waterbody system, the less of an effect that load will have on the impaired 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 exceedences of WQS do not result from moving loads from one tributary/segment to another.

For more information on allocation of loads under TMDLs, click [here](#).

This is 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.

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 will therefore have to achieve greater reductions.

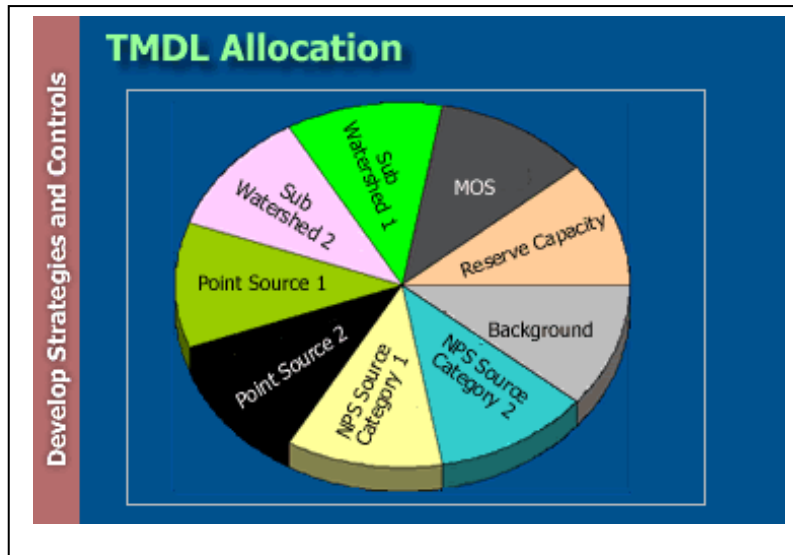
Background- Allocation of the total allowed load must reflect the contribution from uncontrollable sources. Of course, this would include loadings from truly natural sources. It would also include loadings from manmade sources that are essentially uncontrollable.

Nonpoint Source Categories- The next two wedges illustrate the fact 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.

For more information on TMDLs, click [here](#).



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 a number of regulatory and voluntary tools that can be useful in achieving needed reductions. (It is likely, however, that the CWA tools alone may not be sufficient to achieve needed reductions, especially in situations where nonpoint sources dominate loadings. Other tools may 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.)

Each of the CWA tools listed on the accompanying slide is covered in this module. The NPDES permit program, established in Section 402 of the Clean Water Act, regulates a wide array of discharges falling under the CWA's definition of "point" sources.

The permit program established by Section 404 of the CWA deals with the placement of dredged or fill materials into wetlands and other "waters of the United States."

Section 401 of the CWA requires that before a federal agency can issue a license or permit for construction or other activity, it must have received from the state in which the affected activity would take place a written certification that the activity will not cause or contribute to a violation of relevant state water quality standards. Downstream states whose WQS might be exceeded as a result of federal approval of the activity can also play a role in the 401 process.

CWA Section 319 created a federal program that provides money to states, tribes, and territories for the development and implementation of programs aimed at reducing pollution from "nonpoint" sources of pollution. The CWA provides no federal regulatory authority over nonpoint sources, in contrast to point sources.

By far, the largest federal source of money from the CWA comes through federal grants to states for the capitalization and operation of Clean Water State Revolving Loan programs. (In 1996, Congress created a Drinking Water State Revolving Loan Program under the Safe Drinking Water Act.)

CWA Section 106 authorizes federal grants to states, tribes, and territories to support the development and operation of state programs implementing the CWA.

NPDES Program

The CWA makes it illegal to discharge pollutants from a point source to the waters of the United States. Section 402 of the Act creates the National Pollutant Discharge Elimination System (NPDES) regulatory program. Point sources must obtain a discharge permit from the proper authority (usually a state, sometimes 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 directly hydrologically connected to a surface water have been incorporated into the NPDES program.

A wide variety of manmade 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, storm water 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.

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:

- Some 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.
- 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 ([click for slide](#)). An indirect discharger is one that sends its wastewater into a city sewer system, so it eventually goes to a sewage treatment plant (POTW). Though not regulated under NPDES, "indirect" discharges are covered by another CWA program, called pretreatment. "Indirect" dischargers send their wastewater into a city sewer system, which carries it to the municipal sewage treatment plant, through which it passes before entering a surface water.

All permits state their issuance and expiration date. In accordance with the CWA, permit terms may not exceed 5 years. EPA's regulations require that permit applications be submitted to the permitting authority 180 days prior to discharge (if a new discharger) or permit expiration (if already an NPDES permit holder).

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. [Click here](#) for current information about status of state authorization.

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. 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), EPA may determine that the state action is insufficient and may issue its own permit.

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.

All individual NPDES permits include a certain set of basic elements.

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.

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 can also 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 storm water 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. (Though 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 also 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. (General permits often require 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 (boiler plate language 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

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."

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). 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 both existing and new sources. ([Click here](#) for EPA's effluent guidelines web site).

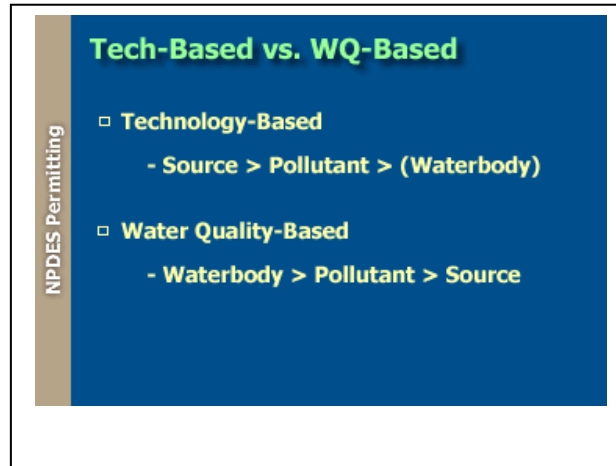
Water Quality-Based Effluent Limits (WQBELs) are used when it has been determined that more stringent limits than technology-based effluent limits must be applied to a discharge in order to protect the designated use (DU) of the receiving waters. WQBELs are "back calculated" from ambient water quality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

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.

Click [here](#) for slide illustrating the differences between technology-based and water quality-based approaches to setting limits on loadings of pollutants. "Waterbody" 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. Hence, ambient monitoring has often not been a high priority for states..



Effluent Monitoring

Besides effluent discharge limits, permits usually include effluent monitoring requirements. 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.

The permittee must retain records for all monitoring information (which includes maintenance and calibration records, strip charts, reports, etc.) for at least 3 years from the date of sampling (sewage sludge data must be maintained for 5 years).

Monitoring may also serve to provide data about treatment efficiency and to characterize effluents for permit reissuance. Instream monitoring (above and below the outfall) may also be useful to assess impacts of the discharge, but is infrequently required.

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.

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."

	30-Day Average	7-Day Average
5-Day BOD	30 mg/L	45 mg/L
TSS	30 mg/L	45 mg/L
pH	6-9	--
Removal	85% of BOD ⁵ and TSS	--

This is an actual 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: 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.

Effluent Guideline Excerpt

Metal Finishing Subcategory

NPDES Permitting

	Direct Dischargers				Indirect Dischargers			
	BAT		NSPS		PSES		PSNS	
	1-day (mg/L)	30-day (mg/L)	1-day (mg/L)	30-day (mg/L)	1-day (mg/L)	30-day (mg/L)	1-day (mg/L)	30-day (mg/L)
Cadmium	0.69	0.26	0.11	0.07	0.69	0.26	0.11	0.07
Copper	3.38	2.07	3.38	2.07	3.38	2.07	3.38	2.07

Note: Several other parameters also are limited, but are not included here.

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).

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

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 are the federal limitations on disposal and use.

[EPA Biosolids homepage](#)

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. Starting in the mid-1980s, attention was also directed to point source discharges that happened only during and after precipitation events—so called "wet weather flows." 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.

Combined sewer overflows, or CSOs, and municipal separate storm sewer systems, also called MS4s, are subject to regulatory control under the NPDES program.

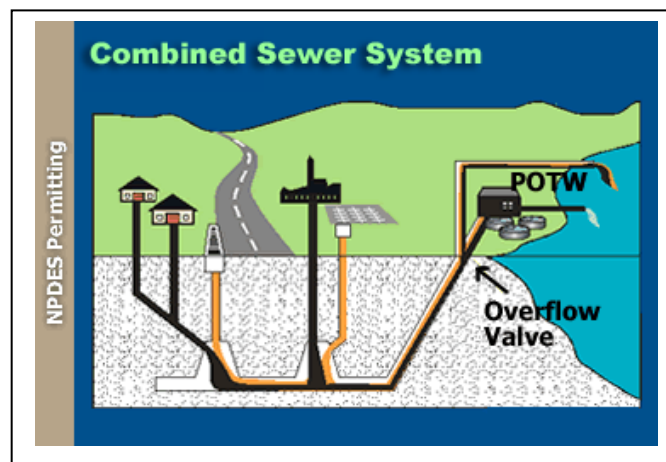
A combined sewer system is one that, by design and by function, carries both sanitary sewage (wastewater from homes, offices, factories) and storm water. During dry weather these systems carry all

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.)

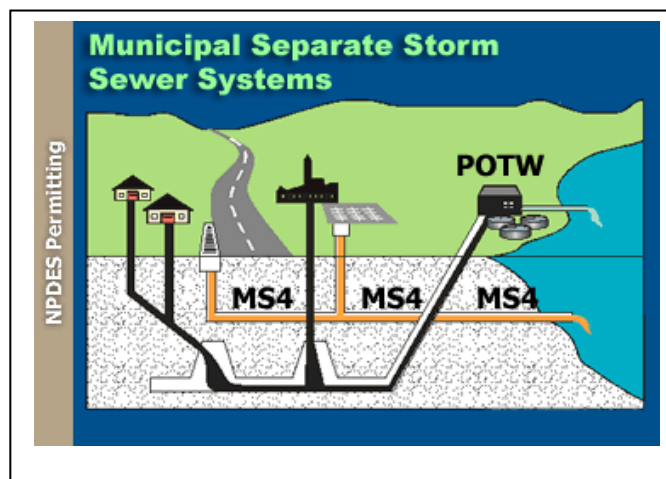
During periods of rainfall or snow melt, the carrying capacity of the sewer collection system may be exceeded, causing a combined sewer overflow (CSO) at relief points in the sewer system. These relief points are designed into the sewer system to prevent basement flooding, backup onto the streets or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

Overflow discharges from combined systems contain not only storm water but also untreated human and industrial waste, oil and grease, metals, sediments, and floating debris. Untreated discharges from CSOs can necessitate beach closing and shell fishing 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 ([click for slide](#)).



While combined sewer systems have one set of pipes to carry both storm water and wastewater, municipal separate storm sewer systems (MS4s) have separate lines—one set for the storm water and another set for sewage. 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.



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.

Because MS4/CSO systems often have large numbers of outfalls (discharge points), 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.

Because we have much less experience with treating pollutants in wet weather-dependent urban discharges, and because the volume of wastewater being dealt with varies greatly, relatively few reliable and cost-effective treatment methods are available. Hence, it is difficult to predict with any precision what treatment levels can be achieved on a regular basis. Consequently, pollutant-by-pollutant end-of-pipe discharge limits are the exception rather than the rule in NPDES permits for MS4s and CSOs.

Instead, requirements for installation of certain types of structural devices or employment of various management strategies are ([Click here](#) for information on urban storm water BMPs.)

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.

NPDES permits have already been issued MS4s serving more than 100,000 people.

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).

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.

One of the most basic requirements in permits for MS4s calls for elimination of all "non-storm water" discharges. 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 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 it to obtain 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 possible" (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 are also 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.

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 POTWs or industrial process wastewater. 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 POTW 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.

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 take the form of signs posted at popular swimming areas, radio or television public service announcements, or other means of informing the public.

Communities with CSOs are also 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 area 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. Click [here](#) to visit EPA's CSO web site.

Operators of industrial facilities falling into 1 of 11 categories listed by EPA in its storm water regulation (several of which are listed in the accompanying slide) need an NPDES permit if the storm water 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 may need an individual NPDES permit.

EPA has included the category under "storm water associated with industrial activity" runoff from construction sites. As of March 10, 2003, Construction activities disturbing 1 or more acres need NPDES permits. At a minimum, these permits require development of a site-specific storm water pollution prevention plan, covering both the construction and the postconstruction phases of the project.

Industrial Storm Water		
NPDES Permitting	Facilities with effluent limits	Transportation
	Manufacturing	Treatment works
	Mineral, metal, oil, gas	Landfills
	Hazardous waste facilities	Light industry
	Stream electric plants	Construction > 1 ac.
	Recycling facilities	

A Storm Water Pollution Prevention Plan (SWPPP) must include a site description, including a map that identifies sources of storm water 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 site as quickly as practicable, but no more than 14 days after construction activity has ceased.

(For more information on regulation of construction activities, click [here](#).)

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 are also in violation if they fail to comply with or falsify monitoring and reporting requirements laid out in their permit.

Often, permits will not require attainment of effluent limits immediately upon receipt of a permit. Permittees will be given time to modify their operations and/or 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 are (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 5-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.

Enforcement

States, territories, and tribes are primarily responsible for enforcing NPDES permits when given responsibility by EPA. 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.

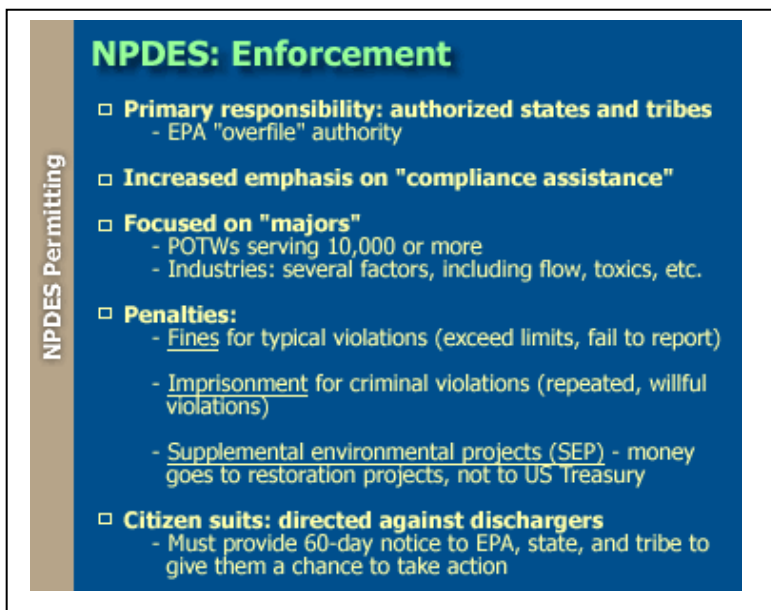
The NPDES program promotes compliance assistance, which helps permittees come into, and remain, in compliance with their permit, rather than going immediately to enforcement actions.

Enforcement actions include the following:

- Injunctions
- Fines for typical violations (exceed permit limits, failure to report)
- Imprisonment for criminal violations (repeated, willful violations)
- Supplemental environmental projects (SEP)

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 can also 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.



The slide is titled "NPDES: Enforcement" in green text on a blue background. On the left side, there is a vertical brown bar with the text "NPDES Permitting" written vertically. The main content is a list of enforcement details:

- **Primary responsibility: authorized states and tribes**
 - EPA "overfile" authority
- **Increased emphasis on "compliance assistance"**
- **Focused on "majors"**
 - POTWs serving 10,000 or more
 - Industries: several factors, including flow, toxics, etc.
- **Penalties:**
 - Fines for typical violations (exceed limits, fail to report)
 - Imprisonment for criminal violations (repeated, willful violations)
 - Supplemental environmental projects (SEP) - money goes to restoration projects, not to US Treasury
- **Citizen suits: directed against dischargers**
 - Must provide 60-day notice to EPA, state, and tribe to give them a chance to take action

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).

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. States must match the federal funds with \$1 for every \$5 (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 is loaned annually from CWSRFs nationwide.

Some funds are also 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.

State Revolving Loan Funds

Loans are usually made at low (sometimes even no) interest. Although most loans have gone to local governments, they can also 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 also be made for (1) NPS control projects consistent with a state, territorial, or tribal Section 319 program, or (2) implementation of a management plan developed under the National Estuary Program.

As of the end of 2001, over 30 CWSRFs had lent over \$1.4 billion for nonpoint source projects. Such projects include loans to:

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

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.

([Click here](#) for more information about the CWSRF)

