Minnesota Pollution Control Agency

Nondegradation Rulemaking

Issue Paper 6. What are the best ways to describe impacts on receiving waters?

Water Quality Rulemaking • September 2008

Contents

wq-rule3-15

Antidegradation provisions in water quality standards are a means of protecting water resources. Implementation procedures provide a process by which a state determines whether and to what extent water quality may be lowered.

Federal regulation[1] stipulates that existing uses[2] be protected (tier 1 protection) and that the quality of Outstanding National Resource Waters (ONRW; equivalent to Minnesota's Outstanding Resource Value Waters, ORVWs) be maintained and protected (tier 3 protection). Where water quality is better than the applicable standard (high quality waters), that quality must be maintained unless lowering of water quality is justified by social or economic need (tier 2 protection). The decision process to determine if lowering is justified, called an antidegradation review, includes public participation, intergovernmental cooperation and an analysis of alternatives to the proposed activity. When an alternative is not available that would maintain water quality, the benefits of the activity are weighed against the lowering of water quality.

In order to make this judgment it is necessary to understand how and to what extent the water quality will be lowered. If impacts are not well understood there are risks that permitted activities could cause undetected lowering of water quality or impairment of the waterbody.

How changes in water quality are described depends on our understanding of current and baseline conditions, and the nature, persistence and impacts of the pollutants or polluting activities at critical conditions. Some general criteria that may be used to describe impacts include:

- Dilution ratio (ratio of stream flow to discharge flow)
- Duration of discharge
- Use of assimilative capacity
- Expected change in concentration
- Expected change in mass loading
- Degree of change in ambient water quality
- Degree of confidence in evaluation procedures
- Background or baseline conditions

States vary on their approach to evaluating impact criteria, with some relying heavily on quantitative tests (i.e., establishing that a dilution ratio of greater than 100:1 may be considered sufficient to assimilate discharge without impact), while others use a more subjective approach on a case- by-case basis.

EPA Region 8 *Antidegradation Implementation*[3] guidance recommends that guidelines be established and that all relevant information (e.g. dilution ratio, duration, degree of change in instream quality, nature of pollutants — conservative vs. non-conservative vs. persistent, percentage of assimilative capacity taken, degree of confidence in evaluation procedures) be considered. This type of evaluation would be used as a tool to screen out minor discharges which would forgo full antidegradation reviews.

Whichever criteria are used to describe impacts, the review must address the scope of parameters that need to be evaluated, the difference in how parameters are measured and how to make judgments when there are no standards for the parameters in question.

Which parameters should be considered and how should "parameters of concern" be defined?

In order to identify which parameters should to be considered in antidegradation decisions, there must be an understanding of what is meant by "lowering of water quality" or water pollution. Minnesota Statute 115.01[4] provides the following definition:

> Subd. 13. **Pollution of water, water pollution, pollute the water.** "Pollution of water," "water pollution," or "pollute the water" means: (a) the discharge of any pollutant into any waters of the state or the contamination of any waters of the state so as to create a nuisance or render such waters unclean, or noxious, or impure so as to be actually or potentially harmful or detrimental or injurious to public health, safety or welfare, to domestic, agricultural, commercial, industrial, recreational or other legitimate uses, or to livestock, animals, birds, fish or other aquatic life; or (b) the alteration made or induced by human activity of the chemical, physical, biological, or radiological integrity of waters of the state.

Part (a) refers to the discharge of pollutants, where a *pollutant* is defined in Subdivision 12 of the same Statute as "…any 'sewage,' 'industrial waste,' or 'other wastes,' as defined in this chapter, discharged into a disposal system or to waters of the state."

"Other wastes" are further defined as:

> Subd. 9. **Other wastes**. "Other wastes" mean garbage, municipal refuse, decayed wood, sawdust, shavings, bark, lime, sand, ashes, offal, oil, tar, chemicals, dredged spoil, solid waste, incinerator residue, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, cellar dirt or municipal or agricultural waste, and all other substances not included within the definitions of sewage and industrial waste set forth in this chapter which may pollute or tend to pollute the waters of the state.

Part (b) of Subd. 13 addresses alterations to the integrity of waters as a result of human activities. An example of such an alteration, although not listed as a pollutant *per se*, is the degradation of water quality or habitat resulting from changes in flow or volume in a receiving water. This can be either a reduction, such as appropriated water withdrawals, or an increase in flow or volume, such as those resulting from stormwater runoff.

Antidegradation guidance from EPA Region 5[5] states that:

> Antidegradation is applicable to all chemical pollutants, even though there is a substantial variation in physical, chemical, and biological properties among chemical pollutants, because there are environmental benefits to be gained from water quality better than the minimum prescribed by water quality standards, for all categories of chemicals.

Given the wide range of pollutants or pollution to which antidegradation applies and limited resources of both the state and the regulated community, it would be prudent to define a process by which the scope of these "parameters of concern" are identified. It would seem logical that certain types of parameters would be closely associated with a given source or type of activity. For example, parameters such as total phosphorus (TP), biochemical oxygen demand (BOD), total ammonia-nitrogen (TAN) and total suspended solids (TSS) may be included in "parameters of concern" for a municipal wastewater treatment plant. On the other hand, BOD and TAN may not be considered as important, in general, for stormwater as TSS and flow. However, for industrial stormwater, sector-specific pollutants identified by U.S. EPA[6] could be used as a starting point for identifying which "parameters of concern" should be addressed in antidegradation review.

When determining which parameters should be addressed in antidegradation decisions, the nature, persistence and potential impact of the parameters need to be considered. Wherever possible, impacts should be evaluated in terms of:

- Toxicity
- Long-term chronic effects
- Carcinogenetic, mutagenic or teratogenic effects
- Persistency in the water column or sediments (conservative vs. non-conservative)
- Bioaccumulation
- Effects on reproduction or other population changes

- Effects on habitat
- Synergistic or additive effects
- Duration, frequency and magnitude
- Bioavailability
- Others?

Where it is not possible to obtain meaningful water quality data, surrogate measures may be useful in defining parameters that are of concern for different types of activities. For example, the type and percentage of various land covers, land use practices and slope may be considered as surrogates for estimating TSS and flow for some types of stormwater runoff. Where surrogates are used there must be a clear understanding of the relationship between the pollutant and the surrogate.

Identifying which parameters should be reviewed would benefit both the regulated community and the MPCA in that it would create consistency and efficiency. Procedures for identifying "parameters of concern" will likely be in implementation guidance to allow for flexibility in addressing the diversity of situations coming under antidegradation review.

Should impacts for chemical parameters be addressed in terms of concentration or mass?

Numeric water quality standards for pollutants are most often expressed in terms of concentration because this is how the chronic and acute biological effects of pollutants are described. Effluent limits, also expressed in terms of concentration, are then translated to mass loading in order to determine waste load allocations.

When a permit renewal for an existing activity has a projected discharge which would not cause mass loading to be increased, and therefore assumes the concentration in the receiving water would not increase, no further review would be required. On the other hand, a discharge that has an increase in mass loading resulting in a significant increase above a baseline concentration in the receiving water a review would be required. If, however, an expanding activity that has an increase in mass with a corresponding increase in discharge volume, but where the discharge concentration is less than the baseline concentration, would a review be required?

Regarding new discharges, any new mass loadings, assuming there is a resulting significant increase in concentration above baseline concentrations, would obviously require review. A full review would not be required where a new discharge effluent concentration is below baseline conditions.

EPA Region 8 *Antidegradation Implementation*[3] guidance addresses the question of using either mass or concentration for antidegradation decisions where the baseline in considered to be the background water quality. In a question and answer format, the questions posed are:

> For purposes of determining significant degradation, why does EPA recommend use of the projected pollutant loadings instead of projected effluent/ambient concentrations? For example, if the quality of a proposed new discharge to a high quality water is equal to or better than background water quality, when would an antidegradation review be necessary?

The response is:

> Information on both pollutant concentrations and loadings will be useful in judging significance. In some cases, a simple comparison of proposed versus existing effluent loadings will be sufficient basis to conclude that a significant change in water quality will result. In these cases, information on background water quality and modeling the potential change in water quality are not necessary to conclude significance. With regard to the cited example, where the quality of a proposed discharge is equal to or better than background water quality, the state would be correct in determining no significant degradation, except perhaps where a cumulative effect is of concern, such as may be the case with persistent toxics in fish or sediment.

Whether impacts are addressed in terms of mass or concentration also depends on the parameter in question. When dealing with non-conservation parameters (i.e., BOD) the answer would likely be based on concentration in the affected waterbody. For conservative pollutants, which remain in the environment for extended periods of time, both concentration (for localized toxic effects) and loadings (for downstream cumulative effects) would need to be addressed. Loadings would also need to be considered when dealing with parameters that exhibit changes in bioavailability. For example, relative to total mercury concentrations the percentage of down-stream toxic methyl mercury may increase under certain environmental conditions.

Guidelines establishing how and when mass loading, concentration or both will be considered when assessing impacts will need to be developed. This includes the use of baseline conditions and cumulative impacts which will be covered in Issue Papers 7 and 10, respectively.

How should impacts be described when dealing with "unconventional" parameters (where the determination of concentration or mass loading is not possible or is impractical)?

Some parameters are either not expressed in terms of concentration or do not lend themselves well to being expressed in such terms. In some cases the parameters are not pollutants themselves, but rather are measures used to define water quality conditions.

An example is pH, which is a measure of hydrogen ions expressed on a logarithmic scale. Changes in pH are a result of interactions between biotic and abiotic components in the aquatic environment. Although pH itself is not a pollutant, shifts in pH away from normal conditions can result in lowering of water quality. Minnesota's water quality standards[7] for pH are either expressed as a range or have the requirement to "maintain background."

Dissolved oxygen (DO) is another example of an "unconventional" parameter which, like pH, is closely associated with biological, chemical and physical interactions in the environment. Standards for DO require that minimum concentrations be maintained to protect aquatic life.

Temperature changes may have detrimental affects on aquatic life. Federal regulation[1] require that antidegradation policy and implementation be consistent with Section 316 of the Clean Water Act where there is the potential for water quality impairment associated with thermal discharges. Minnesota's current standards, establish a standard of "no material increase" (i.e., Class 2A) or describes maximum increases above natural conditions based on average maximum daily temperatures and absolute limits based on average daily temperatures (i.e., Classes 2Bd and 2B). Although changes in temperature have are usually associated with wastewater treatment or other point sources where heat is a byproduct of some process (i.e., cooling water, boiler blowdown, exothermic process reactions), changes in temperature may result from overland runoff, especially from impervious surfaces.

The turbidity standard is expressed as Nephelometric Turbidity Units (NTU) and is a measure of how light is refracted off of particles in solution. The Class 2A turbidity standard is 10 NTU, while the standards for other aquatic life and recreation standards are 25 NTU.

Flow alterations and changes in volume may also be considered an "unconventional" parameter and a form of pollution in that it has the potential to impact the chemical, physical and biological integrity of the water. Minnesota's nondegradation provisions do not specifically address flow or changes in water volume. However, as a result of a 2003 Minnesota Court of Appeals decision[8], 30 cities were required to evaluate stormwater flow, along with TSS and phosphorus, as part of a nondegradation reporting requirement. Other states do include flow and volume changes in their antidegradation provisions. New Hampshire, for example, specifically includes flow alterations in its antidegradation regulation at Env-Ws 1708.02[9]. Pennsylvania, in its 2003 *Water Quality Antidegradation Implementation Guidance*[10], applies antidegradation requirements to activities that impact flow, including those involving water withdrawal permits.

EPA's *Questions and Answers on Antidegradation*[11] guidance addresses the relationship between antidegradation policy, state water rights use laws and section 101 (g) of the Clean Water Act which deals with state authority to allocate water quantities. The guidance reads:

> The exact limitations imposed by section 101 (g) are unclear; however, the legislative history and the courts interpreting it do indicate that is does not nullify water quality measures authorized by the CWA (such as water quality standards and their upgrading, and NPDES and 402 permits) even if such measures incidentally affect individual water rights; those authorities also indicate that if there is a way to reconcile water quality need and water quantity allocations, such accommodation should be pursued. In other words, where there are alternative ways to meet the water quality requirements of the Act, the one with least disruption to water quantity allocations should be chosen. Where a planned diversion would lead to a violation of water quality standards (either the antidegradation policy or criterion), a 404 permit associated with the diversion should be suitably conditioned if possible and/or

additional nonpoint and/or point source controls should be imposed to compensate.

The simplest way of expressing impacts when dealing with “unconventional” parameters is the net change expected as a result of a proposed activity. Tetra Tech, Inc., Technical Memorandum #2[12] describes Ohio’s approach to some of these “unconventional parameters”:

> Ohio goes further in defining a *net increase* for an existing source as:
> (i) The amount by which the sum of the following exceeds zero:
> (a) The increase in the mass discharge limit attributable to the activity subject to this rule; and
> (b) All other contemporaneous increases or decreases attributable to other pollutant source(s) affecting the surface water segment(s) under consideration and which are stipulated as a condition of the applicant's permit and which shall occur during the term of the applicant's permit;
> or
> (ii) For heat, bacteria and any other regulated pollutant which, though not measurable as a mass level is nonetheless susceptible to determinations of net increase, the amount by which the sum of the following exceeds zero:
> (a) The increase in an authorized discharge level attributable to the activity subject to this rule; and
> (b) All other contemporaneous increases or decreases attributable to other pollutant source(s) affecting the surface water segment(s) under consideration and which are stipulated as a condition of the applicant's permit and which shall occur during the term of the applicant's permit.

The use of surrogate parameters may be another tool that may be used to aide in the description of impacts resulting from changes in “unconventional” parameters. For example, TSS may be used as a surrogate parameter for turbidity under certain conditions and is often used in developing load and waste load allocations. The correlation between turbidity and TSS is dependant upon the properties of the particles such as shape, color, reflectivity and density. BOD typically has a strong inverse correlation with DO and may be used to assess projected impacts on receiving waters. Modeling done to predict changes in DO or BOD is extremely complex and requires extensive field data.

As mentioned previously, when considering the use of surrogates there must be a good understanding of the relationship between the standard and its surrogate parameter. Guidance on when and how surrogates are used in antidegradation review will need to be clearly established.

How should pollutants for which there are no standards be considered?

The lack of standards for pollutant parameters presents a number of challenges for antidegradation decisions. First is the determination of whether a water body is of high quality, which is defined as waters “(w)here the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water”[1]. If high quality waters are those whose quality exceeds designated uses or standards, does tier 2 protection apply to parameters for which there are no standards? In other words, where there are no numeric standards, does only tier 1 protection of existing uses apply? In such circumstances a broader approach could be employed where all waters are assumed to be of high quality and thus are afforded tier 2 protection. Using this approach would require the establishment of some type of baseline to ensure that the water quality is not degraded by future unjustified activities. The use of baselines will be covered in Issue Paper 7.

In addition, when a standard does not exist, an antidegradation decision based on the use assimilative capacity is not possible because the determination of assimilative capacity requires the existence of a numeric criterion.

The EPA Region 8 guidance[3], suggests that “(a)ntidegradation can and should apply to any parameter of concern, regardless of whether a numeric standard has been adopted. For a parameter such as phosphates, for which the narrative standards are likely to be the basis for control actions, antidegradation should still be applied.”

Minnesota takes a similar approach in that, although there are no phosphorus standards for rivers or TSS standards, effluent limits are used to control discharges from NPDES-permitted wastewater treatment facilities. Under current practice an applicant wanting to expand a discharge avoids nondegradation review if mass loadings are frozen at baseline conditions.

How are antidegradation provisions and Total Maximum Daily Load (TMDL) programs related?

To meet the objectives of the Clean Water Act, antidegradation provisions are used to maintain water quality, whereas TMDL programs are used to restore water quality. Theoretically, once a water is delisted for a particular parameter, it becomes a high quality water (for that parameter) and therefore eligible for tier 2 protection.

States' TMDL programs resources are typically much greater in terms of resources than those used to conduct antidegradation reviews. It would seem reasonable that some of the data, concepts, tools and methodology from TMDL programs could be used in an antidegradation review. For example, state TMDL procedures and monitoring data could be utilized to define existing ambient water quality conditions or assimilative capacity.

One major difference between antidegradation procedures and TMDL implementation is that the latter accounts for nonpoint sources. In many cases a waterbody may be delisted (becomes "high quality") as a result of significant pollutant reductions from nonpoint sources. If antidegradation provisions do not have procedures and a broader approach in place to maintain pollutant loadings, including those from nonpoint sources, the water may again become impaired.

What considerations can be taken when assessing waters containing either invasive species, or those with threatened or endangered species?

Introduction of invasive species represent a form of degradation that has the potential to diminish the health of the native aquatic communities. How and to what extent antidegradation review will be used to prevent introductions needs to be considered. One option would be to develop numeric biological standards that are protective of native aquatic communities. Another challenging situation is where invasive species have already been established and eradication is not a realistic option. What role does antidegradation have in requiring management measures to keep invasive populations under control?

On the other end of the spectrum, antidegradation provisions need to consider the maintenance of threatened or endangered species. One option for dealing with protecting such populations is applying a more rigorous form of tier 2 review on a case-by-case basis. Alternatively, waterbodies which have populations of threaten or endangered species could have a more protective designation such as Outstanding Resource Value Waters (ORVWs) or other recognized designations.

Discussion points

1) Given the wide range of parameters to which antidegradation applies, is there a need to determine selected parameters to be addressed in antidegradation decisions? If no, go to Question 2. If yes (I bet you're sorry you answered yes.):
    a. How are these decisions made? In other words, is there a way of prioritizing or ranking types of parameters or specific parameters to be addressed in antidegradation review? Some considerations include the probability that the parameter will impact water quality, level of risk associated with the parameter, type of pollutant, prevention or treatment costs, etc.
    b. When should 'parameters of concern" be defined? For example, on a case-by-case basis at the time of permit application, predetermined based on activity type, or a hybrid approach where some parameters are predetermined, but some discretion is left to the state.
    c. Where should these parameters be identified? For examples include in rule, guidance, permit, etc.

2) For chemical pollutants, under what circumstances (i.e., conditions, pollutants, receiving waters, etc.) would:
    a. only concentration be used to describe impacts?
    b. only mass loading be used to describe impacts?
    c. both concentration and mass loading be used?

3) Should flow alterations or changes in water volume of a receiving water be addressed in antidegradation decisions? If not, why not? If so, give some examples of specific situations where these parameters should be addressed.

4) For the purpose of antidegradation decisions, is the use of surrogates to describe impacts to receiving waters where it is not possible to obtain direct

measurements of pollutant parameters a good idea? Why or why not?

5) Should a designated use receive tier 2 protection for a given parameter where there is no standard for that parameter? Why or why not?

6) What concepts, tools or methodology from TMDL programs could be used to evaluate proposed activities for the purpose of antidegradation review?

7) Should numeric biological standards be developed to reflect native aquatic communities?

8) Should waters containing invasive species have some special designation indicating a biological impairment?

9) Should waters currently supporting threatened or endangered species have some special designation similar to designating waters as ORVWs? What other approaches could be used?

References and links

[1]40 CFR § 131.12, Antidegradation policy
http://edocket.access.gpo.gov/cfr_2007/julqtr/40cfr131.12.htm

[2]40 CFR § 131.3, Definitions
http://edocket.access.gpo.gov/cfr_2007/julqtr/pdf/40cfr131.3.pdf

[3]EPA Region VIII Guidance: Antidegradation Implementation
www.epa.gov/region8/water/wqs/wqsdocs.html

[4]Minnesota Statute 115.01, Water Pollution Control; Sanitary Districts — Definitions
www.revisor.leg.state.mn.us/statutes/?id=115.01

[5]EPA Region V Guidance for Antidegradation Policy Implementation for High Quality Waters, 1986.

[6]EPA's Multi-Sector General Permit (MSGP) for (This web page provides general information on the MSGP including facility-specific requirements for many types of industrial facilities).
http://cfpub.epa.gov/npdes/stormwater/msgp.cfm

[7]Minnesota Administrative Rules Chapter 7050, Waters of the State
www.revisor.leg.state.mn.us/rules/?id=7050

[8]Minnesota Center for Environmental Advocacy, Relator, vs. Minnesota Pollution Control Agency, Respondent, C6-02-1243
www.elr.info/litigation/vol33/33.20191.doc

[9]Env-Ws 1708.02 New Hampshire Code of Administrative Rules, Surface Water Regulations, Antidegradation, Applicability
www.des.nh.gov/rules/env-wq1700.pdf

[10]Pennsylvania Water Quality Antidegradation Implementation Guidance, 2003
http://164.156.71.80/VWRQ.asp?docid=2087d8407c0e0000000003bc000003bc&context=2&backlink=WXOD.aspx%3ffs%3d2087d8407c0e0000800003b9000003b9%26ft%3d1

[11]Questions and Answers on Antidegradation (This document was originally designated as Appendix A to Chapter 2 — General Program Guidance (antidegradation) of the Water Quality Standards Handbook, December 1983)
www.epa.gov/waterscience/standards/library/antidegqa.pdf

[12]Tetra Tech, Inc., Technical Memorandum #2, "Overview of State, Federal, and Judicial Guidance on Antidegradation", August 20, 2007
www.pca.state.mn.us/publications/snap-techmemo2.pdf

Please keep in mind that these issue papers are to generate discussion and are not to be taken as representing MPCA decisions or recommendations at this time. Your participation and input in this rule revision is much appreciated.

Contacts

For additional information regarding the stakeholder or rulemaking process contact Carol Nankivel at 651-279-8371 or carol.nankivel@pca.state.mn.us. The technical contact, Bill Cole, may be reached at 651-297-5237 or bill.cole@pca.state.mn.us.