STATE OF MINNESOTA

MINNESOTA POLLUTION CONTROL AGENCY

IN THE MATTER OF PROPOSED REVISIONS
OF MINNESOTA RULES CHAPTER 7050,
RELATING TO THE CLASSIFICATION
AND STANDARDS FOR WATERS OF THE
STATE

STATEMENT OF NEED
AND REASONABLENESS

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I. INTRODUCTION

A. Minnesota Rules Chapter 7050

Minnesota Rules Chapter 7050 are the rules of the Minnesota Pollution Control Agency (hereinafter "Agency") that establish water quality standards and the beneficial use classifications for all the waters of the state. These rules define the water quality standards for all water bodies consistent with the goal of the federal Clean Water Act to provide fishable and swimmable waters wherever attainable. The standards in general include narrative requirements such as nondegradation, mixing zone requirements, and general provisions applicable to all dischargers or to all waters of the state. Specific numerical water quality standards* are established to protect fisheries and recreation, and other beneficial uses as well, such as water for drinking, industrial and agricultural uses. The numerical standards provide a measuring stick against which the Agency can assess the quality of the state's waters, determine the need for treatment or clean-up programs, measure the success of ongoing pollution abatement programs, and help establish priorities when planning for pollution control needs. Also, standards are the basis for effluent limitations in some permits.

* The term "standards" is used both in a broad sense to refer to all of Chapter 7050, and in a strict sense to refer to pollutant-specific numerical standards. The words "numerical standards" will be used when standards has the latter meaning, unless the meaning is clear from the context.

Chapter 7050 also defines the levels of wastewater treatment that are applicable to industrial and municipal point source dischargers. Secondary treatment and federal technology-based minimum treatment requirements are generally required, although more advanced water quality based effluent limitations may be required if the technology-based effluent limitations are not adequate to maintain water quality standards.

B. Scope of the Proposed Amendments

The major subjects of this hearing are the proposed amendment of Chapter 7050 as follows:

1. Add a detailed set of procedures to determine numerical standards applicable to surface waters. The standards will protect from the harmful effects of toxic substances 1) fish and other aquatic organisms, 2) the human consumers of fish and other edible aquatic life, and 3) the wildlife consumers of aquatic life.

2. Propose new numerical standards for 54 toxics in part 7050.0220, subp. 3.

3. Update five of the six existing numerical standards in part 7050.0220 for toxics. The five toxics being changed are chromium, copper, total cyanide, oil and total phenols. The sixth toxic, un-ionized ammonia, is not being changed.

The minor subjects of this hearing are the proposed amendment of Chapter 7050 as follows:

1. Update the reference to approved methods for preserving and analyzing water samples, part 7050.0150.

2. Indicate when the nondegradation provisions became effective for designated outstanding resource value waters, part 7050.0180.

3. Add three calcareous fens to the list of Outstanding Resource Value Waters, part 7050.0180.

4. Delete the word "unspecified" as used with toxic substances and make the definition of acute toxicity in parts 7050.0210, subp. 5, item D., 7050.0211, subp. 1, 7050.0212, subp. 6, and 7050.0214, subp. 1 more explicit and consistent throughout the rule.

5. Revise the citation to the definition of "toxic pollutant" in part 7050.0185, subp. 2.

6. Retain a portion of the last paragraph in part 7050.0220, subp. 3 and move it to part 7050.0210, subp. 13.

7. Make the reference to section 316 of the Clean Water Act consistent with proper citation procedures in part 7050.0180, subp. 10.

8. Remove part 7050.0210, subp. 14 because it will be replaced by the methods in part 7050.0218.

9. Modify the subp. and item titles in part 7050.0220 to correspond to how they are commonly referenced.

10. Remove the last sentence in the last paragraph in part 7050.0220, subp. 3 because the provision to develop additional standards will be specified in part 7050.0218, subp. 4.

11. Reclassify two Class 2C stream reaches as Class 7 Limited Resource Value Waters, part 7050.0470.

12. Incorporate by reference the new Department of Natural Resources Commissioner's Order 2294 for trout streams dated March 18, 1988, in part 7050.0420.

13. Miscellaneous changes to part 7050.0470.

C. Toxics Technical Advisory Committee

The major amendments the Agency is proposing are very technical and complex. Because of their technical nature, the Agency made a special effort to solicit the ideas and recommendations of experts outside the Agency. A Toxics Technical Advisory Committee (TTAC) was established to facilitate the review of pertinent issues related to criteria development. The committee was composed of people with expertise in aquatic toxicology, fisheries biology, health risk assessment, wildlife toxicology, and other relevant disciplines. The TTAC members

represented municipalities, industries, other governmental agencies, academia, and environmental groups. A list of the TTAC members is in Exhibit 8, Appendix A.

The TTAC met for 11 consecutive months beginning in March, 1988. To expedite the discussion of issues, three subcommittees were formed; 1) direct aquatic life toxicity, 2) human health effects, and 3) wildlife effects. The TTAC reviewed the major issues pertinent to developing criteria and made recommendations on most. Their findings are contained in a report. Exhibit 8. The Agency has adopted nearly all of the TTAC recommendations.

A member of the National Wildlife Federation was a member-at-large of the TTAC. The National Wildlife Federation submitted extensive comments on the procedures being evaluated by the TTAC. Exhibit 105.

The Agency also solicited outside public opinion on two occasions with notices in the State Register, December 27, 1988 and June 5, 1989. Exhibits 9 and 10. Several phone inquiries and four letters were received in response to these solicitations. Exhibits 11 through 14.

The Agency has kept the Region 5 office of the U.S. Environmental Protection Agency (EPA) informed during the formulation of these rules. A representative of Region 5 EPA was on the TTAC. The Agency has received draft comments on the proposed rule from Region 5. Exhibit 16. Region 5 EPA has asked the Agency, and the Agency has agreed, to consider including several issues during the next triennial review of the water quality rule. Exhibit 15.

The proposed amendments were brought before the Agency Board Water Quality Committee in November, 1988; March, 1989; and on consecutive months from July through November, 1989.

Because of the technical nature of these proposed rules, the Agency has included a glossary of terms at the end of this statement.

II. STATEMENT OF STATUTORY AUTHORITY

The Agency's statutory authority to adopt water quality standards and to classify waters of the state is found in Minn. Stat. § 115.03 (1988), particularly subdivisions 1(b) and 1(c). Subdivision 1(b) authorizes the Agency to classify waters, while subdivision 1(c) authorizes the Agency to establish water quality standards. Minn. Stat. § 115.44, subd. 2 (1988) authorizes the Agency to "group the designated waters of the state into classes, and adopt classifications and standards of purity and quality therefor."

III. NEED FOR AMENDMENTS

Minn. Stat. ch. 14 (1988) requires the Agency to make an affirmative presentation of facts establishing the need for and reasonableness of the rules as proposed. In general terms, this means that the Agency must present the reasons for its proposal, and the reasons must not be arbitrary or capricious. However, to the extent that need and reasonableness are separate, need has come to mean that a problem exists which requires administrative attention, and reasonableness means that the solution proposed by the Agency is appropriate. The need for the rules is discussed below.

It is the actions of the Federal government which establish the primary need for the proposed amendments. Section 303(c)(2)(B) of the Clean Water Act Amendments of 1987, 33 U.S.C. § 1313 (c)(2)(B), requires all states to adopt standards for toxic pollutants. This provision states that:

> "Whenever a State reviews water quality standards pursuant to paragraph (1) of this subsection, or revises or adopts new standards pursuant to this paragraph, such State shall adopt criteria for all toxic pollutants listed pursuant to section 307(a)(1) of this Act for which criteria have been published under section 304(a), the discharge or presence of which in the affected waters could reasonably be expected to interfere with those designated uses adopted by the State, as necessary to support such designated uses. Such criteria shall be specific numerical criteria for such toxic pollutants. Where such numerical criteria are not available, whenever a State reviews water quality standards pursuant to paragraph (1), or revises or adopts new standards pursuant to this paragraph, such State shall adopt criteria based on biological monitoring or assessment methods consistent with information published pursuant to section 304(a)(8). Nothing in this section shall be construed to limit or delay the use of effluent limitations or other permit conditions based on or involving biological monitoring or assessment methods or previously adopted numerical criteria."

The 303(c)(2)(B) requirement is a special obligation to the states to amend their toxics rules, and this requirement will be discussed further below. However, states are also obligated by the Clean Water Act under section 303(c)(1) to review and revise their water quality standards at

least once every three years. 33 U.S.C. § 1313(c). The agency last reviewed its water quality standards in 1987. The Agency is about six months ahead of the three year schedule, but another review is still appropriate. It is the intent of the Agency that these proposed amendments will satisfy both the federal 303(c)(2)(B) and the 303(c)(1) requirements.

The EPA has provided the states with guidance on how to review and amend their water quality standards in the Water Quality Standards Handbook, December, 1983. Exhibit 20. This document discusses the states obligation to review and amend their rules every three years. It also discusses the federal authority to review and approve the states' standards after they are promulgated.

It is the Clean Water Act section 303(c)(2)(B) requirement that is causing the Agency to proceed ahead of the triennial timing. The EPA, including the EPA Region 5 office in Chicago, which is the EPA region that includes Minnesota, has placed a very high priority on states meeting the Section 303(c)(2)(B) requirement. While the Clean Water Act did not establish an explicit date for compliance with the 303(c)(2)(B) requirement, the EPA headquarters and Region 5 has interpreted the deadline to be February 4, 1990. This date is the three year anniversary of the enactment of the 1987 Clean Water Act amendments. Region 5 has said in a letter to the Agency that if Minnesota missed the February deadline, they would begin promulgating national criteria in Minnesota under their authority in 40 CFR § 131.22. Exhibit 17.

The Agency has invested a substantial amount of time and effort into the development of these proposed amendments. The amendments reflect the Agency's strong commitment to control toxic pollutants in surface waters, and they are part of a larger Agency-wide program of toxics control. Also, the proposed amendments reflect advancements made to the national criteria development methods that will be explained later in this statement. The proposed amendments include standards for chemicals polluting Minnesota's waters, but for which no EPA criteria exist, and the amendments include the authority to adopt site-specific standards when scientific evidence supports a modification of the state-wide standard. The Agency wishes to meet its 303(c)(2)(B) requirements so that the EPA will not have to promulgate national standards in Minnesota.

The EPA has provided the states with guidance on how to comply with the 303(c)(2)(B) requirement. Exhibit 19. The guidance offers the states three options on how to comply. The first option is for the state to adopt standards for all the priority pollutants for which EPA has developed criteria. Exhibit 106 is a list of the EPA priority pollutants. The second option is for the state to adopt standards for those priority pollutants being discharged into its waters at levels interfering with beneficial uses. The third option is for the state to adopt a narrative procedure limiting toxics which can then be used by the state to establish numerical criteria for toxics as needed. The EPA recommends that states use option 2 because they believe that option 2 most directly reflects the Clean Water Act section 303(c)(2)(B) requirements.

The Agency's proposed amendments follow the EPA's options 2 and 3. The proposal includes both numerical standards for pollutants that the Agency

has identified as the most likely to need controlling plus the priority pollutants for which the EPA has criteria, and a procedure that can be used to determine standards for new toxicants as they emerge as problems. Exhibit 19, page 8.

Section 303(c)(2)(B) refers to pollutants listed as toxic under section 307(a) of the Clean Water Act. The list has been codified at 40 CFR § 401.15. Section 307(a) directs the EPA to develop and maintain a list of toxic pollutants. This list of "priority pollutants" currently contains 126 toxic substances. Section 304(a) is the part of the Clean Water Act that requires the EPA to develop numerical criteria for the priority pollutants. Both the list and the criteria established under section 304(a) are subject to change by EPA. Forty-eight of the 54 pollutants the Agency is proposing standards for are on the priority pollutant list.

In addition to the actions of the federal government that mandate these amendments, the Agency's overall program for regulating toxics needs to be expanded and updated. In the past the Agency has controlled toxics using the few numerical standards for toxics in part 7050.0220, and the authority, with its general guidance on how to set criteria, in part 7050.0210, subp. 14. Having numerical standards available in the water quality rule for many of the pollutants the Agency needs to control will facilitate the application of the correct standard in a consistent manner. Having the procedures specified in the rule will make it clear to all parties how the Agency has developed the standards in the rule, and how they will develop standards for additional pollutants as the need arises.

The regulated community, environmental groups, consulting firms, and the public in general, as well as the Agency staff, will benefit by having the procedures, and additional numerical standards, specified in the rule.

In summary, the Agency needs to amend Chapter 7050 for the following reasons:

1. The requirement in Section 303(c)(2)(B) of the Clean Water Act Amendments of 1987 that says states must adopt standards for toxics.

2. The requirement in Section 303(c)(1) of the Clean Water Act that says states must review their water quality standards every three years.

3. The need to update and make more explicit the procedures for developing standards.

4. The need to expand the number of numerical standards for the pollutants most often encountered in Minnesota's waters and provide for consistent application of toxics criteria throughout the Agency.

IV. REASONABLENESS OF THE AMENDMENTS

A. Agency's Burden of Reasonableness

Section IV describes the Agency's rationale for the proposed changes in the rule. The Agency is required by Minn. Stat. ch. 14 to make an affirmative presentation of facts establishing the reasonableness of the proposed rules. Reasonableness in this sense means that there is a

rational and factual basis for the Agency's proposed action. The reasonableness of the proposed rule is discussed below.

The major proposed change to the rule, the procedures for determining standards for toxic substances plus the addition of 54 new numerical or revised standards, is discussed first. Part 7050.0218 will contain the detailed procedures used to develop aquatic life standards for toxics. Each subp. of part 7050.0218 will be discussed separately. The remaining minor changes to the rule are discussed next, in the order they appear in the rule.

As stated in section III of this statement, the Agency currently derives the authority to use EPA criteria and to develop our own criteria from part 7050.0210, subp. 14. Under this authority, the Agency used procedures for criteria development very similar to those being proposed in these amendments. The criteria so derived are used in the same regulatory processes as the numerical standards in the current rule, including forming the basis for permit limitations. The promulgation of these procedures will not significantly change the way in which the Agency has established criteria and controlled toxics in the past. The proposed rule is, to a great extent, a codification of current procedures.

At the outset, it is important to differentiate between the terms "criterion" and "standard" (numerical standard). For the purpose of this statement the term "criterion" will be used when referring to the numbers derived under part 7050.0210, subp. 14 of the current rule, to the EPA national criteria, and to the numbers developed under the

proposed part 7050.0218 to protect aquatic life, human health or wildlife prior to the selection of the final standard. The term "standard" or "numerical standard" will be used when referring to the numerical standards in part 7050.0220 of the current and proposed rule, and the final applicable numbers selected under the proposed part 7050.0218, subp. 12.

The Agency has prepared a guidance document detailing how the proposed standards are derived. Exhibit 21. This document provides much of the technical rationale and justification for the methods selected for the proposed rule, and it will be frequently cited in this statement. Much of the detailed technical justifications will not be repeated in this statement. Exhibit 21 should be consulted for this information.

The Water Quality Division is not the only division within the Agency that is obligated to control toxic pollutants. All the divisions have their own toxic control programs. It is important that the various toxic control programs are coordinated so that the state is adequately and consistently protected whether the toxics are found in the air, ground water or surface water. The Water Quality Division staff met with the staff from the other divisions during the development of the proposed rules to insure consistency. The Agency is consistent in all the major assumptions and exposure values used in the calculation of the numerical standards. Particularly important issues involving coordination within the Agency will be mentioned in section IV. J. of this statement.

B. Part 7050.0218, Subpart 1, Purpose and Scope

This subp. defines the scope of the proposed part 7050.0218. Part 7050.0218 will describe in detail the procedures used to develop standards for toxic substances. As explained before, the authority to develop criteria has always been in Chapter 7050. Part 7050.0218 clearly defines and outlines the methods in much greater detail than the current rule does.

The standards from part 7050.0218 are designed to protect aquatic life and their uses by man, and they apply to all surface waters of the state. The actual standard that applies will depend on the classification of the surface water. Lakes and streams designated as a source of drinking water (Class 1B, 1C, or 1D), in addition to their fishing and recreation designation (Class 2), must have standards that protect both beneficial uses. Trout streams and trout lakes (Class 2A) may have lower (more stringent) standards if trout or salmon are particularly sensitive to a chemical. Finally, limited resource value waters (Class 7) are not provided protection for the maintenance of an aquatic community. However, the general narrative prohibition in Chapter 7050 against allowing toxic chemicals in acutely toxic amounts applies to all waters of the state.

As mentioned above, the protection of aquatic life is the primary purpose of the proposed standards. Protecting the aquatic community means protecting sensitive organisms in the community from the direct effects of toxic chemicals. Protecting the aquatic community also means protecting the users of the aquatic community, namely humans and

wildlife. An important use is recreational fishing for sport and food. To fully meet the fishable and swimmable goal in the Clean Water Act, fish and other edible aquatic organisms must be acceptable for human consumption and consumption by wildlife. Fish acceptable for consumption also means the flesh must be free from unacceptable tastes and odors. In summary, the proposed aquatic life standards can be based on the following three major beneficial uses.

1. Toxicity-based: direct toxicity effects on the aquatic community.

2. Human health-based: fish (and water) consumption by humans, and prevention of unacceptable tastes and odors.

3. Wildlife-based: consumption of aquatic organisms by wildlife.

C. Part 7050.0218, Subpart 2, Policy

1. General Protection Goals

In establishing standards it is important at the outset to state the level of protection the standards are intended to achieve. These "protection level goals" are stated in this subp. The goals are consistent with general goal statements in the current rule such as those in part 7050.0200, part 7050.0210, and part 7050.0220. The first paragraph establishes the general goal for aquatic life standards, and the subsequent paragraphs establish more specific goals.

The language in the first paragraph in this subp. has been taken from the last paragraph in part 7050.0220, subp. 3 in the current rule. This paragraph contains a general goal of protection for aquatic communities that the Agency feels accurately reflects the goal of the proposed rule. The goal is more appropriately moved to part 7050.0218, subp. 2. The current paragraph in 7050.0220, subp. 3 will be deleted.

2. Protection Goals for Toxicity-based Standards

The second paragraph of this subp. expresses the protection level goal for toxicity-based standards. Standards are called toxicity based when the standards protect aquatic life from the direct toxic effects of substances.

Toxicity-based standards are developed to ensure that the surface waters of Minnesota are of a quality satisfactory for aquatic life, and the aquatic community shall not be seriously impaired or endangered, the species composition shall not be altered materially, and propagation or migration of the fish and other biota normally present shall not be prevented or hindered (Minn. Rules part 7050.0220). The EPA has determined, and the Agency agrees, this goal can be achieved without trying to protect 100 percent of all species of aquatic life all of the time. This concept of protection is taken from the EPA guidance on the development of aquatic life criteria. Exhibit 22.

The EPA maintains that protecting 95 percent of the species in a given aquatic community provides adequate protection of the community. The goal is based on the premise that aquatic communities can accept some stress and not undergo appreciable change in species composition, or in the resident species' mode of living. Most, if not all, aquatic communities are subjected to stress from factors such as temperature extremes, rapid changes in flows, droughts or floods, runoff of sediments, and other natural events. Aquatic organisms have evolved over millions of generations coping with some stress. Standards designed to achieve 100 percent protection of all species all the time would probably be overprotective and unnecessarily costly to meet.

3. Protection Goals for Human Health-based Standards

The protection level goal for standards based on fish consumption, and drinking water where applicable, reflects the EPA's discussion on protection goals in Exhibit 23 (pages 79323 and 79347), and the discussion on cancer risk by the Minnesota Department of Health (MDH) in Exhibit 34. Human health-based aquatic life criteria are intended to provide the same level of protection to humans as the drinking water criteria established by the MDH. The protection goal for cancer causing chemicals is no more than one additional cancer case in a population of 100,000 after a lifetime of exposure. The protection goal for systemic toxicants (noncarcinogens) is exposure below levels expected to produce known adverse effects. The numerical standards themselves do not take

into account treatability, analytical detection limits, or other social and economic considerations (see page 127 of this statement).

Ideally, ambient water quality standards should represent levels for compounds in ambient water that do not pose a hazard to the human population. However, in any realistic assessment of human health hazard, a fundamental distinction must be made between absolute safety and the recognition of some risk. Criteria for absolute safety would have to be based on detailed knowledge of dose-response relationships in humans, including all sources of chemical exposure, the types of toxic effects elicited, the existence of thresholds for the toxic effects, and exposure levels within the human population. In practice, such absolute criteria cannot be established because of deficiencies in both the available data and the means of interpreting this information. Exhibit 23, page 79347.

4. Protection Goals for Wildlife-based Standards

The protection level goal for wildlife-based criteria is the protection of all wildlife species or populations, including the most sensitive species. Typically, wildlife-based criteria are not designed to protect sensitive individuals within wildlife populations. In this respect, wildlife criteria are analogous to aquatic life toxicity-based criteria but unlike human health-based aquatic life criteria.

The protection of individuals within a wildlife population will be the goal of wildlife criteria, however, if the species in question are on the state or federal endangered or threatened list. These species probably do not have the resiliency or, possibly, the reproductive potential to tolerate any additional stress.

D. Part 7050.0218, Subpart 3, Promulgation of New Standards

The authority to promulgate new or amended standards is well established in Minn. Stat. Chapter 115 and, indeed, is mandated by the Clean Water Act, as discussed in section III of this statement. Thus, this provision is not included in the rule to establish the authority to promulgate new standards, but it is in the rule to inform the public that the agency will be continuously updating the toxicity information upon which the standards are based. The Agency feels an obligation to the public to provide standards that reflect the latest toxicity data and data evaluation methods. Thus, this provision is included so that all parties are aware that the standards can change. Changes will be made at the time of the triennial review of the water quality standards.

Effluent limitations in National Pollutant Discharge Elimination System (NPDES) or State Disposal Permits based on a standard that changes will normally not be changed until the permit comes up for renewal in its normal five-year cycle. However, the Agency may exercise its authority to reopen a permit to change an effluent limitation if necessary. Such a determination would be made on a case-by-case basis in consultation with the permittee, probably in situations where the change in the

standard is substantial and the old effluent limitation based on the old standard is either not protective of the public health and welfare, or if substantial treatment costs of meeting the old limitation can be saved by changing the limitation. In the latter situation, however, the antibacksliding requirements of Section 402 (o) of the Clean Water Act, 33 U.S.C. § 1342 and part 7050.0212, subp. 3 of this rule, may not allow a lower effluent limitation.

E. Part 7050.0218, Subpart 4, Standards for Substances Not Listed in Part 7050.0220.

The proposed part 7050.0218, subp. 4 will allow the Agency to use the procedures proposed in the rule to develop additional standards as the need arises. The Agency deals with or regulates many toxic substances, and "new" toxicants are always being discovered. To be effective in the control of toxics the Agency needs to more clearly define the methods used to develop standards for substances not listed in part 7050.0220. The Agency currently has the authority to develop and apply criteria for toxics under part 7050.0210 subp. 14, so the proposed new rule will not change this important basic authority to develop standards for chemicals in response to need. A major aspect of the proposed amendments will be to detail the process by which standards are developed in the rule.

The standards derived under proposed subp. 4 will have the same authority as standards in part 7050.0220, and they will be used for the same purpose. Both will be used to identify the existence of pollution problems, help assess the quality of the waters of the state, determine

the need for remedial actions, and provide the basis for an effluent limitation in permits. The Agency will maintain a list of current criteria developed under subp. 4. This list will be a public document and available to all. It will be used by the Agency staff, and it will be of interest to and made available to consulting firms, permittees, environmental groups, and the interested public.

When subp. 4 standards are used as the basis for a permit effluent limitation, the permittee, or any member of the public, will have an opportunity for a public hearing to review the standard. The NPDES permit process, with its public noticing requirements and opportunity for a hearing, will satisfy this requirement. Since the permittees will be the primary affected parties in such situations, and the noticing process identifies other interested or affected parties, the permit process provides an adequate means to involve the public without incurring substantial additional noticing costs to the Agency.

F. Part 7050.0218, Subpart 5, Definitions.

It is important when promulgating a complex and technical rule to define the technical terms or the terms that may have special meaning in the context of this rule. This subp. contains 28 definitions. Many have been taken from EPA documents. The definitions of aquatic toxicity and bioaccumulation have been taken from several sources, but most were taken from the "Technical Support Document for Water Quality-based Toxics Control." Exhibit 24. The definitions for human health terms have been taken from "National Primary and Secondary Drinking Water Regulations; Proposed Rule", EPA Office of Drinking

Water 54 Fed. Reg. 22,062-22,160, (May 22, 1989). Exhibit 25. The definitions for wildlife related terms are taken from the Wisconsin rule Chapter NR 105. Exhibit 26.

G. Part 7050.0218, Subpart 6, Adoption of EPA National Criteria.

1. EPA National Criteria Development Methods

The EPA has published national toxicity-based aquatic life criteria for 29 pollutants. The EPA has also published human health-based (drinking water plus fish consumption or fish consumption only) criteria for about 65 pollutants. It is the former, the aquatic life toxicity-based criteria, that is the subject of this subp.

EPA criteria do not have the force of law when published, but are made available to the states for promulgation into their water quality rules. The first federal water quality criteria document, the "Green Book" published in 1968, predates the major amendments to the Clean Water Act of 1972. The Green Book was followed by the "Blue Book" in 1972 and the "Red Book" in 1976. The current compilation of applicable EPA aquatic life criteria is contained in "Quality Criteria for Water 1986" (Yellow Book), published in 1986. Exhibit 27.

The methods the EPA used to develop aquatic life criteria were substantially changed and improved in the late 1970s. The staffs at the EPA Environmental Research Labs, particularly the laboratory in Duluth, developed a more quantitative and statistically-based

method to calculate aquatic life criteria. Public comments were solicited on the new methods in the Federal Register. The methods were modified slightly in response to these comments. The first 22 aquatic life criteria developed using the new method were published in 1980. Exhibit 23. Since 1980 the method has continued to undergo thorough scrutiny from the scientific and regulated community. The method has been modified only slightly since 1980. The current EPA national method is described in detail in "Guidelines for Developing Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses." Exhibit 22.

Many states have adopted the EPA national method as the basis for developing their own aquatic life criteria. All the EPA Region 5 states use this method. An example of the incorporation of the national method into rules is the recently completed amendments to Wisconsin's water quality rule, Chapter NR 105. Exhibit 26. (EPA Region 5 includes Minnesota, Wisconsin, Michigan, Illinois, Indiana, and Ohio.)

The EPA aquatic life criteria for 28 toxic substances are the basis for the proposed standards for the same substances. The EPA criterion for un-ionized ammonia is not being proposed for adoption at this time. Region 5 EPA has agreed to give the Agency additional time to evaluate the biological and economic impacts of adopting the national un-ionized ammonia criterion. Exhibit 15. The list of the 28 chemicals is shown in Table 1. The EPA has established a criterion for 2,4,6-trichlorophenol based on taste

and odor. The Agency is proposing to adopt the 2,4,6-trichlorophenol criterion, bringing the total of EPA based standards to 29.

Table 1. Pollutants for which EPA has Developed Aquatic Life Criteria

Aluminum
Arsenic
Cadmium
Chlordane
Chloride
Chlorine
Chlorpyrifos
Chromium (+3)
Chromium (+6)
Copper
Cyanide
DDT
Dieldrin
Dioxin (2,3,7,8-TCDD)
Endosulfan
Endrin
Heptachlor
Lead
Lindane
Mercury
Nickel
Parathion
Pentachlorophenol
Polychlorinated Biphenyls
Selenium
Silver
Toxaphene
Zinc

The procedure proposed in subp. 6 will allow the Agency to modify the EPA criteria before adoption in two ways. The first will allow the criteria to be adapted to Minnesota's surface water classification scheme that provides for different standards for waters containing trout or salmon and waters that don't contain trout or salmon. The second will allow the Agency to review the information supporting the criterion and update it, if necessary.

2. Trout Waters and Non-trout Waters Modification

Class 2 fisheries and recreational use waters in Minnesota are subdivided into three subclasses, 2A, 2B, and 2C. Class 2A waters are designated trout waters. Class 2B waters are designated as suitable for cool and warm water fisheries, and 2C waters are suitable for rough or forage fisheries. Another subclass, Class 2Bd is being proposed for these rule amendments to identify the Class 2B waters that are protected for domestic consumption, as well as fisheries and recreation (see page 98 of this statement). Most trout and salmon (family Salmonidae) are restricted to Class 2A waters. Several members of the family Salmonidae are resident to Minnesota, including the brook trout and lake trout which are native species. Introduced salmonid species include the rainbow trout, brown trout, coho salmon and pink salmon. Salmonids are often referred to as cold water fish because their preferred habitats are colder streams and the colder waters of lakes.

In Minnesota, most waters suitable for trout or salmon are listed on two Minnesota Department of Natural Resources (MDNR) Commissioner's Orders. One order lists the trout streams and the other lists the trout lakes. Chapter 7050 incorporates the waters on the two Commissioner's Orders by reference as Class 2A waters. In addition to the waters listed in these two Commissioner's orders, there are existing and potential lake trout lakes that have been identified and are classified 2A in part 7050.0470. Generally, these waters are managed by the MDNR to provide a cold water sport fishery. A new Commissioner's Order for trout streams

is being incorporated by reference in these amendments (see page 123 of this statement). Class 2A waters are protected as a source of drinking water in addition to being protected for a cold water fishery.

Waters not listed on the Commissioner's Orders, or not specifically listed as Class 2A waters in part 7050.0470, are not protected for trout or salmon. A group of fish in the family Salmonidae, the white fish (Coregoninae), live in both trout lakes and nontrout lakes. The white fish that live in Class 2B waters are not considered salmonids for the purposes of Chapter 7050.

Salmonids are often more sensitive to the effects of toxic chemicals than other aquatic organisms. Exhibit 21, page 22. When salmonid species are particularly sensitive to a chemical, the Agency proposes to have one standard for trout waters and a different, less restrictive, standard for nontrout waters. The intent of having two standards is to adequately protect salmonids in Class 2A waters when salmonids are more sensitive, but not to overprotect nonsalmonids in Class 2B/2C waters.

Under the proposed method for developing a separate standard for nonsalmonid (2Bd/2B/2C) waters, salmonid data will be deleted from the data used by the EPA to calculate the national criterion when salmonids are more sensitive to the toxicant than most other organisms tested. Salmonid data will be deleted only from among the lowest four acute values (LC50s) available to the EPA. The criterion is then recalculated without the salmonid data. It is

the lowest four acute values that determine the final acute value in the national procedure for calculating criteria. Exhibits 21 and 22.

When salmonids are not particularly sensitive to a chemical, salmonid data are not deleted, and Class 2A and Class 2B/2C waters will have the same (toxicity-based) standard. To delete the less sensitive salmonid data would unnecessarily reduce the amount of data upon which the standard is based. All other things being equal, the less data used to calculate the standard the more stringent the standard. In these amendments the Agency is proposing separate salmonid and nonsalmonid standards based on this method for only four chemicals (aluminum, cadmium maximum criterion and final acute value, endosulfan, and silver chronic criterion).

The calculation of a separate 2B/2C criterion for aluminum is shown to illustrate the process. Table 2. shows the data in the EPA criterion document for aluminum. Salmonid species are the second and third most sensitive species among the 14 species for which data are available. The acute values for the two salmonid species are deleted, and the nonsalmonid acute values above them in the rankings move down to replace them. The acute value for the chinook salmon is not deleted because it is not sensitive to aluminum, and deleting this value would unnecessarily reduce the size of the data base for the standard. In the aluminum example, the recalculation of the standard minus the two salmonid acute values results in a larger (less stringent) standard for nonsalmonids.

Table 2. Ranked Acute Values For Aluminum From the EPA Criterion Document

Test Organism	Including Salmonids Rank	Including Salmonids Acute Values ug/l	Excluding Sensitive Salmonids Rank	Excluding Sensitive Salmonids Acute Values ug/l
Midge (insect)	14	79,900	12	79,900
Green Sunfish	13	50,000	11	50,000
Yellow Perch	12	49,800	10	49,800
Channel Catfish	11	47,900	9	47,900
Chinook Salmon	10	40,000	8	40,000
Daphnia magna	9	38,200	7	38,200
Fathead Minnow	8	35,000	6	35,000
Snail	7	30,600	5	30,600
Planarian	6	23,000	4	23,000
Stonefly	5	22,600	3	22,600
Amphipod	4	22,000	2	22,000
Rainbow Trout	3	10,390		---
Brook Trout	2	3,600		---
Ceriodaphnia	1	2,648	1	2,648
Number of Acute Values		14		12
Final Acute Value ug/l		1,496		2,145
Acute to chronic ratio:		17.2		17.2
Chronic standard ug/l		87		125

EPA guidance recognizes the need for site-specific criteria including separate salmonid and nonsalmonid standards. Exhibit 20. One of the three methods the EPA guidance provides for determining site-specific criteria is called the recalculation procedure. The Agency has based its salmonid/nonsalmonid modification method on the EPA guidance. The concept underlying both is the same, i.e. if very sensitive species are not present in the water to which the standard is being applied, it is acceptable to delete these species from the data base before the standard is calculated.

EPA discusses two problems encountered with this procedure in Exhibit 20. The first is dropping below the minimum data requirements of eight acute values after the salmonids are deleted. Minnesota specifies in the proposed rule, as does the national guidance, that the minimum EPA data requirements must be met after any deletions, or the deletions can't be made. The second is the effect of reducing the number of acute values on the calculation of the standard. Exhibit 21, page 21. As mentioned before, other things being equal, the fewer acute values the standard is based on, the more stringent the standard becomes. The Agency proposes to mitigate this problem by deleting salmonids only when they are very sensitive (in the lowest 4 Genus Mean Acute Values [GMAVs]) and not deleting them if they are not sensitive.

The proposed method further states that if, following the deletion of salmonid acute values, the resulting standard is lower (more stringent) than the standard including the salmonids, the Agency

will use the standard including the salmonid data for both nontrout and trout waters. See example on page 24, Exhibit 21. The only exception to this would be if there was sound toxicological evidence that the lower nonsalmonid standard was justified. The type of information the Agency would consider in this evaluation includes the recreational, commercial, or ecological importance of the sensitive nonsalmonid species, the sensitivity of salmonids to the chemical compared to nonsalmonids in the data base, and the total number of acute values available.

3. Modification of EPA Criteria Through Updating Information

The second way the EPA criteria can be modified in the proposed rule is by updating the information the criteria are based on. Many of the current EPA criteria were issued in 1980. The data upon which they are based is from literature published through 1979. If new information available since 1979 indicates that a modification should be made to the national criteria, the Agency is proposing to make the appropriate changes consistent with the new information.

The Agency staff has reviewed all the EPA aquatic life criteria. A review sheet is used for this purpose. If an EPA criteria is modified, the changes are recorded on the review sheet and the rationale for the change is included. These review sheets are part of a notebook that summarizes the information upon which

all the proposed standards are based. Exhibit 48. The contents of Exhibit 48 will be explained further in sections IV. H. and I. in this statement.

Modification of the EPA criteria by the Agency staff has been most extensive when the EPA criteria are based on bioaccumulation and human health concerns because these EPA criteria date back to 1980. Ten of the 54 proposed standards are modifications of EPA human health-based criteria. These issues, listed below, are discussed in detail in section IV. J. of this statement and in several exhibits.

The Agency is proposing to use:

1. The latest human health toxicity information available from the EPA and Minnesota Department of Health in the form of reference doses and carcinogen potency factors (see page 54 of this statement);

2. updated bioconcentration and bioaccumulation data, available since 1979;

3. different percent lipid values in fish that affect bioaccumulation factors (Exhibit 21, Appendix G);

4. a bioaccumulation factor (BAF) to bioconcentration factor (BCF) conversion factor that will affect bioaccumulation factors (Exhibit 50); and

5. a different fish consumption amount than is used by the EPA (Exhibit 21, Appendix F).

H. Part 7050.0218, Subpart 7, Toxicity-based Criteria, the National and Advisory Methods for Standard Development

1. Introduction

This subp. includes the proposed methods to establish standards for substances when there is no EPA aquatic life criterion available. Two procedures are proposed, and the selection of the appropriate procedure to use depends on the amount of toxicity data available. When toxicity data is available for at least eight species in specified animal (taxonomic) groups, the procedure used by the EPA to determine criteria will be used to determine the standard (hereafter called the "national method"). Exhibit 22. When these minimum data requirements are not met, the EPA "advisory" method will be used to determine the standard (hereafter called the "advisory method").

As a general rule, the more data available, the more accurately the standard can be determined. When there is enough data available to use the national method, this method is preferred over the advisory method.

The discussion in this section will be divided into four parts. The first part will discuss the need to have a procedure in the rule to determine toxicity-based standards when there is no EPA

criterion. The second part will discuss the process used to select the toxic materials for which standards were developed. The third part will discuss the use of the national method, and the fourth part will discuss the use of the advisory method.

2. Need for a Criteria Development Method in the Absence of EPA Criteria

As mentioned in section IV G, the EPA has developed aquatic life criteria for a total of 29 pollutants. The EPA has a program of providing new criteria on a regular basis. For example, a draft criteria for tributyltin is the latest criterion to be made available for public comment. However, the EPA has not produced criteria for all the chemicals that the Agency needs to control. The EPA does not have enough resources to develop all the criteria needed, or the chemical may not be perceived as a high enough priority by the EPA. Also, there is simply not enough toxicity data available for many chemicals to derive a criterion using the national method.

The Agency has been called upon to regulate, in one way or another, well over one hundred chemicals for which no EPA criteria exist. Many of these chemicals are industrial solvents or cleaning agents. Some are by-products of manufacturing processes, some are agricultural pesticides or herbicides, and others include miscellaneous chemicals.

3. Selection of Toxic Substances Needing Standards

Recognizing the need for standards for many chemicals that have no EPA criterion, the Agency established a process to select the chemicals most needing standards.

The first step in developing the Agency's list of chemicals was to determine which chemicals are frequently detected in surface and ground waters in the state, and have required evaluation by the various divisions within the Agency. A list of chemicals requiring surface water criteria was complied by each section within the agency. The lists were combined and sorted. The chemicals on the combined list were divided into seven groups based upon the number of times a chemical appeared on the separate lists. Those pollutants appearing most often were given highest priority. A total of 69 chemicals, listed in groups one through four, were selected for criterion development. This prioritization method was intended to provide standards for chemicals that are most likely to be encountered in pollution problems. Exhibit 53.

The list of 69 includes all 29 of the pollutants that have EPA criteria for which the Agency is promulgating standards. The 40 remaining chemicals were further prioritized based on their potential to cause environmental harm. A scoring method modified from that used by the State of Michigan and the Province of Ontario was used. The ranking categories included, 1) toxicity, 2) carcinogenic and mutagenic effects, 3) bioaccumulation, 4) taste/odor problems, and 5) persistence. A score from one to five

was possible for each category. Exhibit 53. The scoring properties used are important in determining a chemical's potential harm to aquatic life, human health and the environment. The chemicals were ranked based on the highest total score from all five categories. Criteria were developed for those chemicals having the highest score that had the minimum data needed to calculate a criterion. Of the 40 chemicals, adequate data are available to develop standards for 25.

Section 313 of the federal Emergency Planning and Community Right-To-Know Act of 1986 (42 U.S.C. §§ 11001-11050) requires manufacturing facilities that meet certain criteria and use toxic chemicals, to report releases to the air, water, and land of any specified listed toxic chemicals. The Agency's priority list of 40 chemicals was compared to the 1988 Toxic Chemical Release Inventory (TRI) data for the State of Minnesota. Exhibit 32. The TRI is a record of the release of chemicals from Minnesota facilities. Seventeen chemicals on the Minnesota TRI are included in the Agency's list. Also on the list are 13 chemicals for which existing EPA or Agency criteria are available and for which the Agency proposes to adopt standards. Thirty chemicals, or more than half of the chemicals for which Minnesota numerical standards are proposed, are on the TRI.

4. Data Sources

In the development of water quality standards it is important to base standards on as much available data as possible in order to

derive a standard that will provide the appropriate level of protection to aquatic life and humans. The Agency staff examined the major sources of data available for standard development. The sources for calculating toxicity-based criteria included:

AQUIRE - Aquatic Toxicity Information Retrieval database, EPA's computer database of toxicity data.

CESARS - The State of Michigan's computer database of toxicity data.

QSAR - EPAs quantitative structure activity relationships database.

Other computer databases.

Annual summaries of toxicity data published in the "Journal of the Water Pollution Control Federation."

EPA aquatic life criteria documents.

EPA aquatic life and human health advisories.

Recent journal articles from:

- "Archives of Environmental Toxicology and Chemistry"
- "Bulletin of Environmental Toxicology and Chemistry"
- "Aquatic Toxicology"
- "Environmental Science and Technology"

American Society of Testing and Materials annual symposium proceedings.

Other journal articles acquired through the Agency library and borrowed from other libraries.

Data in AQUIRE are reviewed for acceptability and given a review code by the EPA staff. Data given an unacceptable review code were not used unless the original paper was reviewed for acceptability. The Agency staff made a particular effort to review all the original papers from which the lowest acute or chronic value, or the lowest four acute values, were obtained, since these

values are critical in determining the criterion. Exhibits 57 through 100. They were reviewed for acceptability based on the EPA methods. Exhibit 22. Unacceptable data were not used in calculating a final criterion. Articles containing bioconcentration data were also reviewed for acceptability based upon EPA requirements.

Agency staff attempted to search for all available sources of data to be used in criteria calculations. AQUIRE was used as the starting base for data since it is the largest source of data, containing over 100,000 individual test results. Other sources were compared to the data obtained through AQUIRE. Acceptable data were added to the AQUIRE data. The final database used in calculating a criterion for a chemical is believed to be as complete as is possible, and will result in the most accurate criteria possible at this time.

5. The EPA National Method

The proposed procedure in subp. 7 calls for the Agency to use the national method when there is enough data to meet the minimum requirements. Exhibit 22. To allow the use of the preferred national method as often as possible, the Agency is proposing to make the data requirements less restrictive than the national requirements specified in Exhibit 22. The Agency and the national minimum data requirements are listed on page 38.

Agency Requirements	EPA Requirements
1. fish species, fresh or saltwater	1. fish species, fresh water
2. fish species, fresh or saltwater	2. species in phylum Chordata
3. salmonid fish species	3. salmonid fish species
4. fresh or salt water crustacean	4. planktonic crustacean
5. fresh water cladoceran	5. benthic crustacean
6. species not in phylum Arthropoda or Chordata	6. insect species
7. species not in phylum Chordata	7. species not in phylum Arthropoda or Chordata
8. species not in phylum Chordata	8. insect or species in a phylum not already represented

Note: Crustaceans include crayfish, shrimp, scuds and related organisms.
Cladocera include the water fleas such as Daphnia. Arthropoda includes the crustaceans, insects, spiders, etc.
Chordata includes the animals with backbones, such as fish and amphibians.
Planktonic crustaceans are small crustaceans living in open water such as Daphnia.
Benthic crustaceans are crustaceans living on the bottom of lakes and streams.

The major difference between the Agency's and the EPA's minimum requirements is that the Agency accepts data from saltwater species with some restrictions, and insect data are not specifically required.

The EPA has determined that when data are scarce, it is acceptable to use data for saltwater organisms for non-ionizable organic chemicals to determine criteria for fresh waters. Exhibit 28. This allows the Agency to use more of the available toxicity information. The salinity of sea water may affect the toxicity of ionizable organic and inorganic chemicals; thus, saltwater data is not used for these chemicals. Phenol is an example of an ionizable organic chemical. The saltwater data was not used in the calculation of the phenol standard. The Agency is proposing, however, that no more than two of the lowest four acute values can

be for saltwater species; the other two must be for freshwater species. This requirement is added so standards applicable to Minnesota will not be determined entirely from saltwater data.

The Agency is proposing two additional data requirements for pesticides. Because pesticides have as their purpose the killing of specific plants or animals, the Agency wants to be assured that related nontarget organisms in aquatic communities are protected. Therefore, at least one of the acute values must be for an insect when the chemical in question is an insecticide. Similarly, for herbicides, two acute values for plant species are required in addition to the eight animal acute values. Two plant species are required (whereas only one insect species is required for insecticides) because the rest of the available data is usually all for animal species.

The Agency is proposing three standards calculated using the national method. The calculation of the standard for xylene in Table 3. illustrates the use of the national method.

The data these standards, and all the proposed standards, are based on is tabulated in Exhibit 48. Exhibit 48 contains summaries of the information used to determine the standard and explanatory notes on any judgments made by the Agency staff on the data. Specifically, Exhibit 48 contains the following:

Table 3. Determination of the Standard for Xylene
Using the National Method All values in ug/l

Acute Data

Test Species	Genus Mean Acute Value* ug/l
Carp	780,000
Copepod	99,500
Guppy	34,730
Snail	>22,400
Dungeness crab (salt)	19,900
Goldfish	16,675
Bluegill sunfish	16,554
White sucker	16,100
Fathead minnow	16,100
Striped bass	9,200
Rainbow trout	8,050
Grass shrimp (salt)	7,400
Daphnia magna	3,820
Bay shrimp (salt)	3,700
Number of GMAVs	14
Final Acute Value	2,814
Maximum Criterion	1,407

Acute to Chronic Ratio

Test Species	Acute Value	Chronic Value	Ratio
Rainbow trout	15,282	1,300	11.8
Generic			20
Generic			20
Acute to Chronic Ratio		17	
Chronic Criterion		166	

* Note: The genus mean acute value (GMAV) is the geometric mean of the acute data available for all the species in a genus. The GMAVs are the acute values used in the national method to calculate the final acute value (FAV). The FAV is an estimate of the fifth percentile acute value at the sensitive end of the distribution of all the GMAVs available for a substance. Exhibits 22 and 21.

1. A summary of the criteria determinations on four pages.

   Page one is the general summary showing the final standard for the various use classes.

   Page two summarizes the criteria information when an EPA criterion is available.

   Page three summarizes the determination of a toxicity-based criterion using the national or advisory methods, when no EPA criterion is available.

   Page four summarizes the information for human health-based criteria.

2. All available acute data, table 1.
3. All available chronic data and the calculation of measured acute to chronic ratios, table 2.
4. A list of acceptable acute data, table 3a; and the ranked genus mean acute values, table 3.
5. A list of plant toxicity data, table 4.
6. A list of bioconcentration and bioaccumulation factors, table 5.

6. EPA Advisory Method

The EPA has recognized the limitations of the criteria development program and has begun issuing what they call "water quality advisories." EPA's water quality advisories are concentration values for specific pollutants that serve to protect the same beneficial uses as the national criteria. Advisories are based on less toxicity data than national criteria. The aquatic life advisory program is new, and at the time this statement was written, the advisory method had not been formally published in the

Federal Register. The method proposed for these rule amendments is based on a draft EPA document describing the advisory method. Exhibit 28. The EPA staff has informed the Agency staff that the method to be published in the Federal Register will be the same as the method in the draft.

The EPA draft advisory method has received important technical review. A subcommittee of EPA's Science Advisory Board (SAB) thoroughly reviewed the advisory method and issued a report. Exhibit 29. The SAB report endorses the advisory concept and makes no substantive recommendations for changes to EPA's proposed aquatic life advisory method.

The Agency is proposing to use the EPA advisory method for developing aquatic life standards when there is a shortage of data. The Agency and the Toxics Technical Advisory Committee evaluated another method to develop standards from limited data before selecting the advisory method. The other method was developed by the State of Michigan. The Toxics Technical Advisory Committee recommended the advisory method over the Michigan method. Appendix E in Exhibit 21 compares the two methods. The advisory method applies to aquatic life toxicity data and not human health data.

When developing standards with limited data, the goal is to have standards at least as protective as the national criteria would be if there were enough data to use the national method. To insure this goal is met, the advisory method includes steps to assure the resulting standards are adequately protective. Most standards

determined using the advisory method will be lower or more stringent than the standard would be if enough data were available to use the national method. A general rule of thumb that applies to the advisory method, and the national method as well, is that the less information available, the more conservative or protective the methods become.

The advisory method is quite simple and straight forward. The lowest acute value, in the form of a genus mean acute value, is selected from all the available approved acute values. At least three acute values must be available. The lowest acute value is divided by a "factor." The size of the factor depends on the number of acute values available. Varying the size of the factor directly with the number of acute values is analogous to the relationship between the final acute value and the number of GMAVs in the national method. (In the national method, other variables being equal, the smaller the number of GMAVs, the smaller the FAV.) The factors applied to the lowest LC50 in the advisory method are shown in Table 4.

In general, the Agency recognizes the restrictions placed on the use of the EPA advisory method by the EPA. Exhibit 28. The EPA recommends that the advisory method be applied to non-ionizable organic chemicals, most of which probably have a general or narcotic mode of toxic action. However, the mode of toxic action is not always known. The Agency has expanded the advisory method to include nonbioaccumulative chemicals that have specific modes of

Table 4. Advisory Method Adjustment Factors

Number of GMAVs	Factor	Number of GMAVs	Factor
3	11	12	3.6
4	10	13	3.4
5	9	14	3.2
6	8	15	3.0
7	7	16	2.8
8	6	17	2.6
9	5	18	2.4
10	4	19	2.2
11	3.8	20 or more	2.0

action, such as the modern day insecticides and herbicides. The advisory method does not address bioaccumulation, and it will not be used to develop standards for highly bioaccumulative pollutants. The comparisons of the Advisory and National methods made by the Agency staff show that the method is acceptable for the nonbioaccumulative substances but not bioaccumulative substances. Exhibit 21, Appendix E. The Agency proposes to limit the use of the advisory method to chemicals with bioaccumulation factors less than 5,000 (or with log Kow values of less than 5.19; see section IV. K. of this statement).

As proposed for the national method, the Agency is imposing additional data requirements when the advisory method is used to determine standards for insecticides and herbicides. Acute data for at least one insect species is required in addition to the

minimum three acute values required by the advisory method. Similarly, for herbicides, two acute values for plant species are needed in addition to the three required animal LC50s.

The calculation of the standard for acenaphthene in Table 5 illustrates the advisory method.

Table 5. Determination of the Standard For Acenaphthene Using the Advisory Method

Acute Data

Test Species	Genus Mean Acute Value* ug/l
Daphnia magna	11,893
Sheepshead minnow (salt)	2,230
Snail	>2,040
Channel catfish	1,720
Fathead minnow	1,189
Mysid shrimp (salt)	970
Salmo sp.	623
Midge (insect)	486
Number of GMAVs	8
Lowest GMAV	486
Advisory factor	6
Final Acute Value	81
Maximum criterion	41

Acute to Chronic Ratio (See section IV I of this statement)

	Acute Value	Chronic Value	Ratio
Sheepshead minnow	2230	710	3.1
Fathead minnow	608	325	1.87
Generic			55
Acute to Chronic Ratio	6.8		
Chronic criterion	11.9		

The Agency is proposing five standards calculated using the advisory method. Exhibit 48 contains the data upon which these standards are based. As mentioned previously, the Agency staff reviewed for acceptability the original papers from which the lowest acute values were taken that determine the advisory criteria. Exhibits 57 through 100.

I. Part 7050.0218, Subpart 7, Toxicity-Based Standards, Chronic Data and Acute to Chronic Ratios

1. Introduction

Section IV. H. of this statement describes how the national or advisory method selects the final acute value from available acute data. This section describes how the the chronic criterion is determined. Information on the sublethal toxic effects on aquatic organisms is obtained through chronic studies. Chronic or long-term effects are usually measured by reductions in growth and impairment of reproduction in the test animals. Most chronic studies last from one to several weeks. The EPA national method (Exhibit 22) contains guidance on how to judge the acceptability of chronic data. Chronic data should meet the EPA requirements or not be used. Chronic toxicity data is utilized in two ways. First, if chronic values and acute values are available for the same test organism from the same study, a measured acute to chronic ratio (ACR) can be determined. The second way chronic data is used is to compare the measured chronic values to the chronic criterion.

Typically, the measured chronic values should be larger than the chronic criterion.

2. Measured Acute to Chronic Ratios

The relationship between acute and chronic toxicity can be established directly for a given chemical if acute and chronic data are available for the same test species and the tests were conducted in the same laboratory under the same set of conditions. The acute LC50 is divided by the associated chronic value to derive the acute to chronic ratio (ACR) as follows:

$$ACR = \frac{LC50}{\text{Chronic value}}$$

ACRs generally range from two to 100. When more than one ACR is available, a final ACR is determined by taking the geometric mean of the available ACRs. The EPA guidance (Exhibit 22) does not specify a minimum number of measured ACRs needed to establish a final ACR. The relationship between acute and chronic toxicity varies depending on the sensitivity of the species being tested, the conditions of the test and other factors. Therefore, the Agency is proposing that at least three measured acute to chronic ratios from three different species be available to determine a final mean ACR. The minimum requirement will help assure that the acute to chronic ratio is representative of the chemical in question.

The chronic criterion is determined by dividing the final acute value by the ACR. This approach to setting chronic criteria dates back to the earliest days of aquatic life criteria development, and it is still widely used. It is based on the premise that the relationship between acute and chronic toxicity (the ACR) is transferable from one species to another for a particular chemical. The species upon which the ACR is based need not be sensitive. But once the ACR is established, it can be divided into acute values for sensitive species to determine a chronic criterion that is protective of sensitive species. The final acute value (national method) and the lowest genus mean acute value (advisory method) represent acute values for sensitive species.

3. Default Acute to Chronic Ratios

It is preferable to have the necessary measured acute and chronic data to establish a chemical-specific ACR. Unfortunately, these data are not available for many chemicals. The Agency is proposing, in the absence of acceptable acute and chronic data, two default ACRs. One default ACR of 20 is proposed for organic chemicals that are not bioaccumulative. A second default ACR of 55 is proposed for persistent organic chemicals, pesticides, and inorganic chemicals.

Exhibit 21, Appendix D describes in detail how the default ACRs were derived. Briefly, chemical-specific measured ACRs for 109 chemicals from several sources were evaluated. Initially the ACRs were

separated into four groups based on the type of chemical and the chemical's mode of toxic action. The modes of toxic action included general narcotic action and various specific modes of action typical of pesticides.

Statistical analysis showed that the ACRs in the four groups were not all significantly different from each other, but when combined into two groups, the ACRs are significantly different. The ACRs in each of the two groups were ranked from the smallest to the largest ACR. The Agency, with the concurrence of the Toxics Technical Advisory Committee, chose the eightieth percentile ACR from the ranked ACRs as the default ACRs. Eightieth percentile is a reasonable point at which to select a default ACR from the available ACRs. Plots of the ACRs (Exhibit 21, Appendix D) show that at percentile values higher than 80 percent, the ACRs increase dramatically, and selecting a higher percentile would probably result in many standards being unnecessarily stringent. The State of Michigan selected the eightieth percentile ACR in their analysis of ACR information. The eightieth percentile ACR will be protective when combined with other elements of the criterion development process for nearly all chemicals for which the acute to chronic ratio is unknown. Exhibit 21, Appendix D.

The EPA advisory method uses a default ACR of 25, which is slightly more protective than the ACR of 20 selected by the Agency, for a similar group of chemicals. The EPA ACR seems to based on the work of Kenaga (1985) who concludes that an ACR of 25 will be greater than nearly all the measured ACRs for "industrial" volatile

organics, Exhibit III. However, the Agency, in its analysis of the ACR data and the segregation of ACRs into two groups, feels it is preferable to be consistent in its selection of the 80th percentile ACR from the two groups.

The situation will arise when there is only one or two measured ACRs and a final measured ACR can not be determined. These ACRs represent valuable toxicological information on the chemical in question, and they should not be ignored simply because the minimum requirement of three ACRs has not been met. The Agency proposes to "supplement" the available measured ACRs with the appropriate default ACR in determining the final ACR as described in Exhibit 21, page 28. This approach is in keeping with the general philosophy that the more limited the available data, the more conservative (protective) the standard development process.

The following hypothetical example illustrates the process for a pesticide with two measured ACRs.

Measured ACR	7.9
Measured ACR	23.6
Default ACR	55
Final ACR	21.7

If the measured ACRs are larger than the appropriate default ACR, the Agency proposes to use the measured ACRs even though three measured ACRs are not available.

Exhibit 48 contains the ACR information used to determine the toxicity-based standards.

4. Comparison of Chronic Values to the Chronic Criterion

As stated above, the second way in which chronic data are used is to compare the measured chronic values to the chronic criterion. Normally, the chronic criterion will be lower than the lowest measured chronic value. In those instances where this is not the case, the chronic criterion will be adjusted downward to equal the lowest measured chronic value, unless an evaluation of the chronic value shows that it is not acceptable or that the bulk of the data suggest that a larger chronic criterion is justified. EPA chronic criteria are usually lower than measured chronic values, but not always. For example, there are EPA chronic criteria for metals that are greater than some measured chronic values. Exhibit 48. In these cases, however, there is ample data, so the criterion can be set at a level above some chronic values and the criterion will still meet the protection level goals.

J. Part 7050.0218, Subpart 8, Human Health-based Criteria

1. Introduction

As discussed in Section IV. B. of this statement, surface water standards must not only protect the aquatic community from the harmful effects of toxics, but humans must be protected from eating fish flesh containing excessive amounts of toxics. The human

health-based criteria will protect fish and other edible aquatic organisms for this use.

Human health-based aquatic life criteria are calculated by inserting a fish consumption value in the formulas commonly used to determine drinking water standards. The same method is used by the EPA and a number of states, including Michigan, Wisconsin, Ohio, Illinois and Indiana, to determine human health-based criteria. Exhibit 23. The Agency is proposing to use the same method.

To help understand how human health-based criteria are determined, it is helpful to start with the basic formula used to determine drinking water standards for noncarcinogenic chemicals. With the units removed, the basic formula is:

$$\text{Drinking water standard} = \frac{\text{acceptable dose} \times \text{human body weight}}{\text{water consumed}} \times \text{relative source}$$

To use this formula to determine human health-based aquatic life criteria (for surface waters not protected for drinking), the water consumption is replaced by a fish consumption amount times a bioaccumulation factor. The formula with the units is:

$$\text{Human health-based aquatic life criteria mg/l} = \frac{\text{RfD mg/kg/day} \times 70 \text{ kg} \times 0.2}{0.03 \text{ kg/day} \times \text{BAF l/kg}}$$

The variables in the formula will be described in this section of the statement. For purposes of discussion, the formula can be

divided into three basic elements. The three elements are: 1) the acceptable risk element, 2) the exposure element, and 3) the relative source element. Conceptually, the elements would appear as follows:

Criterion =	Acceptable Risk	X	Exposure	X	Relative Source	

The first element includes the reference doses and the cancer potency factors which are discussed in section 2 immediately below.

The second element includes the exposure assumptions listed below:

1. A drinking water consumption value of 2 liters per day (about one half gallon per day).
2. An average body size for adults of 70 kilograms (154 lbs).
3. Exposure over a lifetime (70 years).
4. A fish consumption amount of 30 grams per day (1.06 oz./day).
5. Incidental ingestion of 0.01 liters per day (10 milliliters per day or about one third fluid ounce per day).

These are explained in sections 3, 4, and 5. Finally, the third element is explained in section 6.

2. Reference Dose and Cancer Potency Factor

The acceptable risk element includes the reference dose (RfD) for noncarcinogenic chemicals and the cancer potency factor, or potency slope, (q1*) for carcinogenic chemicals. A full discussion of how RfDs and q1*s are developed is outside the scope of this document. See Exhibits 23 and 31. The EPA has also published guidance on five areas (carcinogenicity, mutagenicity, exposure, developmental effects, and chemical mixtures) relevant to setting human health-based standards. Exhibits 35 through 39.

In brief, the RfD is an estimate, with uncertainty perhaps spanning an order of magnitude, of the daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effect during a lifetime. The uncertainty has to do with the interpretation of animal toxicity studies, the extrapolation of animal data to human effects, the availability of human epidemiological data, and the overall quality and quantity of the data.

The q1* is a factor indicative of a chemical's human cancer-causing potential based on extrapolation from high doses of the chemical administered over a short period of time to low dose levels and a lifetime of exposure. The q1* is the upper 95 percent (one-sided) confidence limit of the slope of the linear dose response curve. This means there is only one chance in 20 that the material is a more potent carcinogen than predicted.

The EPA, MDH, and many health and environmental agencies assume that chemicals considered carcinogenic have no threshold of effect. Any exposure to the chemical, no matter how small, represents some risk to humans. After the EPA decides that a chemical has the potential to cause cancer in humans, a risk level must be assumed to set the standard. The Agency uses a risk level of one in 100,000 (10^{-5}). This risk level represents the incremental increase in cancer risk to humans of one case of cancer in a population of 100,000, after continuous exposure over a lifetime. Because the q1* is based on the upper 95 percent confidence limit of the dose response curve, the true risk should not be greater than 10^{-5} and is likely to be lower. The MDH has prepared a document explaining the rationale for selecting a risk level of 10^{-5}. Exhibit 34. Most of the states in EPA Region 5, including Michigan, Wisconsin, Illinois, and Indiana use a risk level of 10^{-5}.

The RfDs and q1*s that the Agency uses are the same as those used by the MDH to establish drinking water criteria. The MDH drinking water criteria, called recommended allowable limits, are commonly used by the Agency to protect Minnesota's ground water. Exhibit 33. Also, they are the same RfDs and q1*s used to establish the standards and intervention limits in Minnesota Rules part 7035.2815, subp. 4. These rules serve to protect Minnesota's ground water potentially impacted by landfills.

In summary, it is helpful to list out the aspects of the RfDs and q1*s that assure adequately protective standards.

Reference Doses

1. Include safety factors ranging from 10 to 1000 depending on the quality and quantity of human and animal data.

2. Assume a lifetime of exposure at the daily dose.

Cancer Potency Slope

1. Set at the upper 95 percent confidence limit.

2. Assume a lifetime of exposure at the standard concentration.

Note: Both reference doses and potency factors are obtained from the Integrated Risk Information System (IRIS) through the Minnesota Department of Health (MDH). IRIS is an on-line system maintained and updated by the EPA Office of Health and Environmental Assessment, Environmental Criteria and Assessment, Cincinnati, Ohio. All the reference doses and potency slopes in IRIS have been reviewed and agreed upon by intra-Agency review groups. Thus, the values selected represent EPA-wide consensus. The EPA guidance document EPA/600/6-86/032a provides information on the use of the system (IRIS User Support-FTS 684-7254). The Agency can access the IRIS system directly, but in practice, the Agency obtains the RfDs and q1*s needed from the MDH Division of Environmental Health, Health Risk Assessment Section. The

MDH has the expertise in human toxicology to provide their own review of the RfDs and q1*s in IRIS. The Agency relies on the experts in the EPA and the MDH to provide acceptable RfDs and q1*s.

3. Standard Exposure Assumptions

The second element of the human health-based criteria formula is the exposure element. As in the case of the RfDs and q1*s, the Agency must rely on the expertise of the EPA and MDH in the selection of some standard exposure assumptions.

The exposure element includes three standard exposure assumptions:

1. A drinking water consumption value of 2 liters per day.
2. An average body size for adults of 70 kilograms (154 pounds).
3. Exposure over a lifetime (70 years).

The Agency is accepting the position taken by the EPA and MDH for these three exposure assumptions in the proposed rule. Each of the three will be discussed below.

The daily drinking water amount of two liters per day has been widely accepted and used by many agencies for many years. The origin of the 2 liter amount is often attributed to EPA's National Interim Primary Drinking Water Regulations (EPA-570/9-76-003, Exhibit 40), but the use of two liters can be traced back to 1962

(Public Health Service Drinking Water Standards, U.S. Department of Health, Education, and Welfare, Public Health Service).

The mean adult male consumption cited in Exhibit 40 is 1.65 liters per day, and the mean consumption for an adult woman was 1.2 liters per day. The EPA in Exhibit 40 concludes: "considering all the information we have available, two liters per day drinking water consumption for the average man [person] should be a reasonable estimate. It is twice the amount listed by some authors and 30 percent higher than other authors list as an average figure and is therefore defensible as a reference standard."

The second exposure value is the average body weight for an adult person of 70 kg. Similar to the use of two l/day, the 70 kg weight has been used for years by many agencies to set human health standards. See Exhibits 23, 25, and 26 as examples. The origin of the 70 kg value is obscure, but it may be based on an evaluation of human body weights over the life span of humans done by the International Commission for Radiation Protection, 1975. Exhibit 41. A more recent EPA study, Development of Statistical Distribution for ranges of Standard Factors Used in Exposure Assessment, 1985 (EPA 600/8-85/010), showed the following results:

	Mean Weight	50th % Weight
Adult female (age 18-75)	65.4 kg	61.5 kg
Adult male (age 18-75)	78.1 kg	75.9 kg
Mean adult	71.8 kg	68.7 kg

Use of the 70 kg mean adult weight might be challenged on the grounds that children would not be adequately protected by the standards. This fact has been considered by the EPA when they set drinking water standards. Also, the EPA has established a 10 kg body weight and a one liter drinking water amount for children that can be used if considered necessary. Exhibit 25. The Agency would follow the EPA in the use of the children-specific exposure values. All of the health-based standards proposed by the Agency are based on adult exposure assumptions. The use of 70 kgs for standards applicable to children is not as underprotective as it may seem. This is because 1) the childhood years are about 20 percent of the 70 years of assumed exposure (see below), 2) children will eat and drink less than adults which reduces their exposure, and 3) if children are particularly sensitive, the reference dose will take this into account such as in the case of nitrite.

Below is a list of some of the agencies and states that use two liters of water and a 70 kilogram person in their criteria calculations.

1. EPA Office of Drinking Water
2. EPA Criteria and Standards Division
3. National Academy of Science
4. World Health Organization
5. Minnesota Department of Health
6. Province of Ontario

7. States of Wisconsin, Illinois, Michigan, Indiana, New York and Iowa

The third exposure assumption is that exposure to the chemical will occur over a lifetime of 70 years. This means the standards are set at a level that assumes people are exposed to the chemical every day for 70 years. If the standards were based on a shorter exposure period, they would be less stringent.

For surface waters protected for both drinking water and fish consumption, the lifetime exposure assumption means a person would drink the water and eat the fish from the same source over a lifetime and be protected. For example, consider a retired avid angler living in Minneapolis who, since boyhood, has regularly caught and eaten fish from the Mississippi River. Since Minneapolis gets its drinking water from the Mississippi River, this angler meets the exposure conditions assumed for everyone, most of whom will not eat fish and drink the water from the same source as consistently.

For surface waters not protected for drinking water, the standards will protect for the consumption of fish alone. An example would be a person living on a lake who regularly catches and eats fish from the lake over a lifetime, but whose water comes from a private well. In this example, the fish and the water are protected independently. Other things being equal, standards for waters protected for both drinking water and fish consumption may be slightly more conservative than standards for water protected for

fish consumption alone. This is because fewer people are likely to get their drinking water and eat fish from the same source over a lifetime than simply eat fish from one source, and drink water from another over a lifetime.

4. Fish Consumption

The fourth assumption in the exposure element is a fish consumption amount. The amount of fish it is assumed people will eat each day has not been as widely standardized as the exposure assumptions discussed above, although the EPA has used 6.5 grams per day in the calculation of their human health-based criteria since 1980. Exhibit 23. The Agency is proposing to use a value of 30 grams per day. This equates to a single half pound meal per week. Again, the assumption is 30 grams per day every day for a lifetime.

"Fishing is great in the North Star State" proclaims a series of brochures promoting fishing in Minnesota put out by the Minnesota Department of Natural Resources. Fishing has been cited by tourists as the most important reason they come to Minnesota to vacation. Exhibit 107. There is no doubt that Minnesota, with its abundance of surface waters, offers the angler almost infinite opportunities to enjoy the sport. It is estimated that about two million of the 4.2 million people in Minnesota are anglers. The Agency feels it is important to protect this large segment of the population. Also, it is important to send the message to nonresidents that the fish in Minnesota will be safe to eat.

Therefore, the Agency proposes to base the fish consumption amount on the consumption habits of the angling population.

The Agency reviewed the survey information available on the consumption of fresh water fish by anglers and by the population as a whole. See Exhibit 21, Appendix F. Unfortunately, the fish consumption patterns of Minnesotans have not been determined (The Agency has presented several proposals to do fish consumption surveys in Minnesota to the Legislative Committee For Minnesota's Resources but they have not been funded). Surveys in Wisconsin and Ontario, however, provide good information on fish consumption that can be used in Minnesota. Exhibits 42 and 43. Both of these surveys included only individuals that had fishing licenses. A recent national survey provides information on the consumption patterns of the whole population. Exhibit 44. The results of these surveys show that, as one might expect, anglers eat more freshwater fish than the non-angling population.

Average, median, and various percentile consumption amounts ranging from the 75th to 95th percentile were determined from the survey results. See Table F-1, Exhibit 21. The Agency selected the 80th percentile as a reasonable point at which to select the consumption amount. An average of the 80th percentile values from the Wisconsin and Ontario surveys is about 30 grams per day. Based on the data of Rupp et al. (Exhibit 44), at least 95 percent of the whole population eats less than 30 grams of freshwater fish per day. Thus, use of the 80th percentile value from surveys of the

fishing population will provide a high level of protection to the population as a whole.

The proposed 30 grams per day value will be used to determine state-wide standards. However, if the Agency has specific information on fish consumption patterns of local populations, a site-specific consumption amount will be used to calculate the standard. For example, if a standard was to be applied in an area where native American communities rely on the local fishery for a substantial portion of their diet, a larger fish consumption amount would be used.

Since 1980 the EPA has used 6.5 grams per day in the calculation of their human health-based criteria. This amount is an average value, based on surveys of the general population nation-wide, and it includes the consumption of estuarine fish as well as freshwater fish. The Agency feels that the EPA value should not be used because it is more appropriate to use a value in Minnesota that includes only freshwater fish. Also, it seems more appropriate in Minnesota to use data from the angling population rather than the whole population.

Other states are using higher fish consumption values than the 6.5 grams per day as well. Some examples are listed below:

New York	33 g/day
Ohio (adults)	30 g/day
Illinois	20 g/day
Wisconsin	20 g/day

5. Incidental Ingestion

The last assumption in the exposure element is called incidental ingestion. Incidental ingestion refers to the small amount of water people may swallow while swimming or while engaged in other forms of water recreation. This could be a source of toxics to people if toxics are present in the water. Also, some toxics can be absorbed through the skin. The incidental exposure assumption takes these avenues of exposure into account. The Agency is proposing an amount of 10 milliliters (0.01 liters).

The Agency recognizes that exposure from this source is likely to be highly variable and very difficult to quantify. A mouthful of water is generally considered to be about 30 to 50 mls. The proposed amount of 10 mls, while smaller than this, is believed to be a conservative value because it assumes this amount of ingestion over a lifetime. Other states in EPA Region 5, including Michigan and Wisconsin, use 10 mls for incidental ingestion.

The incidental exposure assumption applies only to surface waters not protected for drinking. Standards for drinking water sources assume the consumption of 2 liters of water per day as already discussed, and adding 0.01 liters to this amount would have an inconsequential effect on the standard. The impact of including incidental ingestion in the standards depends on how bioaccumulative the chemical is. The more bioaccumulative the chemical, the less the impact, because the fish consumption amount dominates the the other exposure assumptions in the calculation of

the criterion. However, none of the standards will be substantially smaller (more stringent) by the inclusion of the incidental ingestion factor. A chemical with the lowest possible BAF of one will be 25 percent lower than it would be if the incidental ingestion factor was not used (see examples in Table 6). The Agency feels it is important to recognize this potential source by including the incidental exposure factor in the equation.

Table 6. Impact of Incidental Ingestion on the Criteria Calculations

	BAF	Chronic Criterion with inc. exp.		without inc. exp.	
Noncarcinogenic Chemicals					
1,1,1-Trichloroethane	9	1,750	ug/l	1,815	ug/l
Fluoranthene	615	4.6	ug/l	4.6	ug/l
Carcinogenic Chemicals					
1,2-Dichloroethane	1	190	ug/l	254	ug/l
1,1,2-Trichloroethylene	17	120	ug/l	123	ug/l
Carbon tetrachloride	30	5.9	ug/l	6.0	ug/l

Note: toxicity-based value of 263 ug/l determines the standard for 1,1,1-trichloroethane

6. Relative Source Contribution

The third and final major element in the criteria formula is the relative source element. This element addresses the fact that humans are exposed to toxic substances from many sources, not just drinking water and fish consumption. Other sources include inhalation from the air, ingestion from fruits, vegetables, and other foods. For example, the air is probably more important than water as a source of very volatile organic chemicals such as

tetrachloroethylene and dichloroethane. Vegetables may be a more important source than water for certain pesticides. On the other hand, fish consumption may be a very significant source for very bioaccumulative organics such as dioxins and PCBs.

The Illinois Department of Energy and Natural Resources (1987) compared human exposure from drinking water to exposure from inhalation and dermal absorption for nine volatile organic compounds. Exhibit 45. They conclude that intake of these organics through inhalation in the indoor environment (showering) can be as much as eight times the intake from drinking water. A report prepared for the Wisconsin Toxics Technical Advisory Committee (this committee had the same function as the Minnesota TTAC) concluded that food and air were often much more important sources of metals and organics than drinking water. Exhibit 46.

While there is enough information to indicate that other sources need to be accounted for in setting human health-based standards, specific exposure information is lacking for many chemicals. When there is insufficient information, a "default" relative exposure value must be used. The EPA has recognized this issue when developing the primary drinking water standards. In general, they have assumed that drinking water contributes 20 percent of a person's total daily exposure from all sources. Exhibits 25 and 30. The Minnesota Department of Health also assumes a 20 percent relative source contribution from drinking water, in lieu of chemical-specific data, when determining their drinking water criteria.

The Agency is proposing to use a relative source contribution, or "K" value, of 20 percent when no chemical-specific information is available. Conversely, this means that 80 percent of a person's exposure is assumed to come from other sources. This issue has been discussed with the Air Quality Division as part of the intra-Agency coordination of toxics issues. When chemical-specific information is available, it will be used to establish a chemical-specific exposure value.

The Agency's use of the same K value used by the Minnesota Department of Health (MDH) will mean a consistent level of protection for all drinking water in Minnesota. Thus, drinking water in Minnesota, whether coming from wells or surface waters, will receive the same level of protection. This will help greatly in the Agency's efforts to provide a consistent level of protection between the various Divisions in the Agency and between the Agency and MDH.

The K value, has a direct arithmetic effect on the criterion. A K value of 40 percent results in a criterion twice as large as a criterion calculated using a K value of 20 percent, or four times as large as a criterion calculated using a K value of 10 percent.

The K value is applied to health-based criteria for systemic (noncarcinogenic) chemicals. A K value is not used in the calculation of carcinogenic criteria. Carcinogenic criteria are based on a very small incremental increase in cancer risk from one source, and the process is considered adequately protective with out the use of a K value.

In summary, the Agency is selecting 20 percent for the following reasons:

1. The Minnesota Department of Health uses a default K value of 20 percent when calculating their drinking water criteria. The use of the same value by the Agency will provide a consistent level of protection for drinking water sources among the various divisions in the Agency and between the Agency and MDH.

2. The EPA uses a default K value of 20 percent, both for their primary drinking water standards and their drinking water advisories.

3. The studies on this question, while limited, indicate that a small K value for many chemicals is appropriate. Exhibits 45 and 46.

4. The Toxics Technical Advisory Committee recommended 20 percent.

7. Formulas for Determining Human Health-based Criteria

Four formulas are used to determine the human health-based aquatic life criteria as follows:

1. Noncarcinogenic chemicals
   a) drinking water plus fish consumption criterion (dfCC)
   b) fish consumption only criterion (fCC)

2. Carcinogenic chemicals

a) drinking water plus fish consumption criterion (dfCC)

b) fish consumption only criterion (fCC)

Formulas for Noncarcinogenic chemicals:

$$\text{dfCC mg/l} = \frac{\text{RfD mg/kg/day} \times 70\ \text{kg} \times 0.2}{2\ \text{l/day} + (0.03\ \text{kg/day} \times \text{BAF l/kg})}$$

$$\text{fCC mg/l} = \frac{\text{RfD mg/kg/day} \times 70\ \text{kg} \times 0.2}{0.01\ \text{l/day} + (0.03\ \text{kg/day} \times \text{BAF l/kg})}$$

Formulas for Carcinogenic chemicals

$$\text{dfCC mg/l} = \frac{70\ \text{kg} \times 0.00001}{\text{q1* day.kg/mg} \times [2\ \text{l/day} + (0.03\ \text{kg/day} \times \text{BAF l/kg})]}$$

$$\text{fCC mg/l} = \frac{70\ \text{kg} \times 0.00001}{\text{q1* day.kg/mg} \times [0.01\ \text{l/day} + (0.03\ \text{kg/day} \times \text{BAF l/kg})]}$$

Where: RfD = reference dose, see section IV J. 2.

q1* = cancer potency factor, see section J. 2.

70 kg = average adult body weight, see section J. 3.

0.2 = K factor, see section J. 6.

2 l/day = daily water consumption, see section J. 3.

0.03 kg/day = daily fish consumption, see section J. 4.

0.01 l/day = daily incidental ingestion of water, see section J.5.

BAF l/kg = bioaccumulation factor, see section IV K.

8. Data Sources for Determining Human Health-based Criteria

The Agency relies on the Minnesota Department of Health for most of the information on human health effects needed to develop the human

health-based standards. This includes the reference doses and cancer potency factors discussed previously. The Agency staff does, however, review the bioaccumulation literature to establish the bioaccumulation factors (see section IV K of this statement). Below is a list of the most important sources of information used by the Agency staff to develop the human health-based standards.

1. Minnesota Department of Health Recommended Allowable Limits (RALs) - reference doses (RfD) and carcinogen slopes (q1*).
2. EPA criteria documents.
3. EPA human health advisories.
4. IRIS - EPA integrated risk information system computer. database. This is the data base used by the EPA to communicate their latest recommended RfDs and q1*s.
5. AQUIRE (see page 36 of this statement) - bioconcentration data.
6. CESARS (see page 36 of this statement) - bioconcentration data.
7. QSAR - for estimated bioconcentration factors, parachors, and log Kows.
8. Journal articles including bioconcentration data.
9. Other database searches for bioconcentration data.

K. Part 7050.0218, Subpart 9, Bioaccumulation and Bioconcentration Factors

1. Measured Bioaccumulation and Bioconcentration Factors

When organisms are exposed to certain chemicals in the water, or in food or bottom sediments, they may accumulate the chemical in their body tissues. Some chemicals, based on physiochemical factors, are

highly bioaccumulative so that the concentration in aquatic organisms is many times the concentration in the surrounding water. Bioaccumulation factors (BAFs) and bioconcentration factors (BCFs) quantify the accumulation of a pollutant in an organism.

BAFs and BCFs are calculated by dividing the concentration of a substance in one or more tissues of an organism by the average concentration in the solution in which the organism had been living. Bioaccumulation refers to exposure to pollutants through the diet, sediments and the water. Bioconcentration refers to exposure of pollutants from the water only. The BAF is multiplied by the fish consumption amount, 30 g/day, to calculate the human health-based aquatic life criteria. This provides a criterion that protects human consumers of fish that are exposed to pollutants.

BCF and BAF data are obtained from several sources as mentioned in section IV. J. of this statement. Measured BAFs are preferred over BCFs because BAFs better represent the actual bioaccumulation that occurs in nature. Measured BAFs or BCFs are preferred over estimated BCFs. Measured values are compiled and reviewed to meet the EPA requirements. Exhibit 22. The geometric mean of all acceptable BAFs and BCFs is determined. The methodology described in this section is taken from the EPA guidance, and the same method is used by the EPA. Exhibit 22. Many states also use this methodology.

2. Adjustment to Bioaccumulation and Bioconcentration Factors Based on Percent Lipid

Most organic chemicals tend to accumulate in the fatty tissues (lipid) of organisms. These chemicals are called lipophilic. Different tissues of the body contain varying amounts of lipid. Typically, the internal organs and, of course, the body fat have a high lipid content. Muscle tissue is usually relatively low in lipid content. Most experimentally derived BCF and BAF values are for whole body fish and other whole organisms.

Since humans normally eat only the muscle tissue of freshwater fish, use of whole body BCFs could over estimate the amount of a lipophilic chemical ingested. The affinity most organic chemicals have for lipid means a whole body BCF can be adjusted to an edible portion BCF if the lipid content of the test organism was measured. It seems appropriate to use edible portion BCFs for a criterion that will be used to protect for human consumption of fish when this adjustment can be made. Edible portion BCFs can be estimated from whole body BCFs using percent lipid values as illustrated for the following hypothetical chemical:

Measured whole body BCF for fathead minnow	=	1000
Whole body percent lipid	=	7 %
BCF normalized to 1 % lipid (1000/7)	=	143

The normalized BCF can then be multiplied by the percent lipid in edible tissue to estimate the edible portion BCF. Because people

often eat a variety of game fish species and use different fish preparation methods, and because fish tissue varies in lipid content, average (default) percent lipid values for edible portions are usually used to make this adjustment. If site-specific lipid information is available based on creel surveys or other reliable information, this can be used to adjust the BCFs.

Default percent lipid values for the edible portions of cold water fish and cool and warm water fish were determined based upon measured values from four sources, including Minnesota and Wisconsin (See Exhibit 21 Appendix G). Most BCF or BAF data are for fish. Generally, warm water fish are less fatty than cold water fish (trout). Percent lipid values were listed by species, and mean values for each species were calculated. Mean percent lipid values for cold water fish and cool and warm water fish were separated, and an overall average (arithmetic mean) and median were determined for each group. A mean value of 6 percent lipid was calculated for cold water fisheries. The median, 1.5 percent lipid, was selected in place of the mean value of 2.5 for cool and warm water fish because most of the high percent lipid values are for nongame (rough) fish, and anglers typically eat far less nongame species than game species.

The example of a lipid adjusted BCF can now be completed by multiplying the normalized BCF by the percent lipid values as follows:

Normalized BCF	=	143
BCF applicable to a cold water fishery (143 x 6) (Class 2A)	=	858
BCF applicable to a warm water fishery (143 x 1.5) (Class 2B/2C)	=	215

Unfortunately, percent lipid data for the test species used in a BCF study are sometimes not reported. In this situation no adjustment for percent lipid can be made. The BCF or BAF is used as reported without adjustment.

3. Estimated Bioconcentration Factors

For some chemicals, no acceptable measured BCFs or BAFs are available. In those cases, a BCF will be estimated using an equation developed by Veith and Kosian (1983). Exhibit 49. The equation relates BCFs to a property called the octanol-water partition coefficient (Kow). The Kow simulates the partition of a chemical between the lipid of an organism and the water. Bioconcentration of lipophilic chemicals in aquatic organisms has been shown to be related to the log of the octanol-water partition coefficient (log Kow). The log Kow, up to a value of six, is highly correlated with BCFs for lipophilic chemicals. Chemicals with log Kow values greater than six do not bioconcentrate as much as the log Kow would predict because the size of the molecule starts to limit the chemical's ability to cross cell membranes.

The Agency proposes to use a value of six for the log Kow in the estimation of a BCF when the log Kow exceeds six. The equation of Veith and Kosian is used by the EPA for estimating BCFs. The same equation, or similar equations, are commonly used by many states. Estimated BCFs provide a credible means of estimating BCFs when measured values are not available. The Veith and Kosian equation is:

$$\text{Log}_{10}\ \text{BCF} = 0.79\ \log_{10}\ \text{Kow} - 0.40$$

Estimated BCFs are adjusted for percent lipid similar to the way measured BCFs are. The log Kow to BCF relationship was based, to a large extent, on fathead minnow data. Exhibit 49. The average percent lipid for fathead minnows was determined by the EPA to be 7.6. Exhibit 22. Thus, estimated BCFs are normalized by dividing the estimated BCF by 7.6 and multiplying the result by either 1.5 for cool and warm water fish, or by 6 for cold water fish.

4. Bioconcentration to Bioaccumulation Conversion Factor

BCFs may underestimate accumulation of a chemical in an organism, resulting in a criterion that may be underprotective for bioaccumulative chemicals. BAFs are more representative of accumulation of chemicals in the environment than are BCFs. The literature contains measured BAF to BCF ratios for very bioaccumulative chemicals as large as 220. BCFs are measured through laboratory experiments. BAFs are mainly determined from field experiments. The EPA recommends the use of BAF data over BCF data when BAFs are available. Exhibit 22. However, BAFs are often

not available for a chemical. Since BAFs are usually not available, a method for estimating BAFs from BCFs was needed. The use of a factor to convert BCFs to BAFs is a complex and somewhat new concept as applied to criteria development. However, the fact that a BCF may underestimate actual bioaccumulation of a chemical is well supported in the literature.

The Agency is proposing to include a BCF to BAF conversion factor in the rule. The factor is in the form of the following equation:

$$\log_{10} \text{BCF to BAF Factor} = 0.441 \log \text{Kow} - 0.0017 \text{ Parachor} - 0.686$$

The detailed justification for the conversion factor is contained in Exhibit 50, and it will be summarized here. BAFs and BCFs have been correlated with log Kow. However, BAFs are not as highly correlated with log Kow as are BCFs. Other physical and chemical properties of organic chemicals have been shown to affect how a chemical will accumulate in an organism. These properties are probably responsible for the difference between BCFs and BAFS. One of these properties is called the parachor. It is a number that estimates the molecular size and shape of a chemical. The parachor is important in that it indicates how readily a chemical can be transported across biological membranes.

A series of linear and multiple regressions were performed using the Statistical Analysis System (SAS). A statistically significant relationship was found between the BAF/BCF ratio and log Kow and parachor. Exhibit 50. A BCF is multiplied by the factor

calculated from the regression equation to estimate a BAF. This multiple regression equation provides a means to calculate a BAF from measured or estimated BCFs to better approximate the actual accumulation of a chemical in an organism that is occurring in the environment. Estimation of BAFs from BCFs using the factor will result in lower, more protective, human health-based standards.

The BCF to BAF conversion factor, obtained from the equation shown above, will only be used for chemicals having a log Kow greater than or equal to three, because the relationship of log Kow to BAFs and BCFs is strongest in the range of three to six. For those chemicals with any combination of log Kow and parachor that results in the calculated factor being greater than 15, a factor of 15 will be used. Thus, under this proposal, the factor can not exceed 15. Most factors will be in the range of 1 to 12. The determination of the final BAF for endrin illustrates the use of the factor.

Measured BCF for endrin, normalized to 1 % lipid	=	1490
Log Kow for endrin	=	5.34
Parachor for endrin	=	588
Factor from the BCF to BAF ratio equation	=	4.7
BCF adjusted to estimate a normalized BAF (1490 x 4.7)	=	7003
BAF for cold water fisheries (Class 2A) (7000 x 6)	=	42,000
BAF for warm water fisheries (Class 2B/2C) (7000 x 1.5)	=	10,500

If credible chemical specific information indicates that the application of the conversion factor is not appropriate, that information will be reviewed and a decision made regarding the use

of the conversion factor. For example, the factor has not been used to determine final BAFs for polynuclear aromatic hydrocarbons. This class of chemicals, while having large log Kow values, seem to readily metabolize in aquatic organisms and do not bioaccumulate as much as the log Kow models predict.

The EPA recognizes the need for a method to estimate BAFs. Factors for estimating BAFs from BCFs have been proposed in a draft EPA document. Exhibit 31. The Ontario Ministry of the Environment has also proposed the use of factors to estimate BAFs from BCFs. Exhibit 51. The BAF/BCF conversion factor approach received support from several researchers who have published articles on bioaccumulation and bioconcentration of chemicals (personal communication, A.J. Niimi, J.P. Connolly, G. Veith). Exhibit 52.

L. Part 7050.0218, Subpart 10, Taste and Odor Criteria

Fish not only must be free from harmful amounts of toxic substances, but they must be free from materials that impart unacceptable tastes or odors to the fish flesh. This aspect of aquatic life protection is in the current rule specifically under the total phenols standard in part 7050.0220, subp. 3, and it is broadly stated in the last paragraph in part 7050.0220, subp. 3. The proposed subp. 10 will serve to replace the latter. Subp. 10 will allow the Agency to use the EPA taste and odor criteria.

Among the criteria published by the EPA in 1980 are 20 criteria based on taste and odor (see list on page 47, Exhibit 21). For these twenty

chemicals, taste and odor problems will occur in fish at concentrations lower than the concentrations that would cause direct toxic effects or would cause the fish to be harmful to human consumers. The Agency is proposing to use these criteria without change as applicable standards, however, only one, 2,4,6-trichlorophenol, made the Agency's chemical priority list.

M. Part 7050.0218, Subpart 11, Wildlife-based Criteria

The protection of terrestrial wildlife whose diet includes aquatic organisms is the last of the three primary bases for aquatic life standards. The method proposed in the rule is taken from the Wisconsin water quality rule NR 105. The "Wisconsin" method was developed by the Wisconsin Department of Natural Resources staff for inclusion into their rule. The Minnesota Toxics Technical Advisory Committee reviewed this method and decided to make no changes to it. Exhibits 8, 21, 26, and 47.

The proposed method is similar to the method used to determine drinking water plus fish consumption human health-based standards. The wildlife criterion equation includes an acceptable risk element and an exposure element, but the relative source element is replaced with a species sensitivity factor. The formula is shown below:

$$WCC = \frac{NOAEL \times BWt \times SSF}{DW + (F \times BAF)}$$

where: WCC = wildlife chronic criterion mg/L

NOAEL = no observable adverse affect level, mg/kg/BWt/day

SSF = species sensitivity factor

BWt = body weight of test animal, kg

DW = drinking rate of test animal, L/day

F = feeding rate of test animal, kg/day

BAF = bioaccumulation factor, L/kg

The acceptable risk element is in the form of a no observable adverse effect level (NOAEL). The NOAEL is derived from studies on the effects of toxic substances on wildlife species, and is analogous to the RfD in the human health formula. See Exhibit 47.

The exposure element is composed of the body weight (BWt), the drinking rate (DW), and the feeding rate (F) for the test animal. These are analogous to the 70 kg body weight, 2 liters of drinking water per day, and the 30 grams of fish consumed per day in the human health criteria formulas. A lifetime of exposure is also assumed for the wildlife criteria. The Wisconsin method includes equations to estimate drinking and feeding rates for the test animals if this information is not reported in the original toxicological study. The Agency is proposing to include these in the rule.

The species sensitivity factor (SSF) will allow the Agency to adjust the standard based on the sensitivity of the test animal relative to other wildlife species. The SSF can vary between one and 0.1. If the evidence available indicates that the test animal is sensitive, then the factor will be one. An example is mink which are very sensitive to

the presence of PCBs in their fish diet. If the evidence indicates that the test animal is not as sensitive as other animals, then a sensitivity factor as small as 0.1 can be used.

A bioaccumulation factor (BAF) is used in the wildlife criteria formula much as it is used in the human health formula. The BAF for wildlife criteria is determined the same way it is for human health criteria, except for the percent lipid adjustment. Wildlife are likely to eat the whole fish, or at least a good share of it. Therefore, whole fish BAFs will be preferred over BAFs for muscle tissue. If percent lipid data is available, the adjustment for percent lipid will be based on the lipid content of whole fish rather than the lipid content of the edible portion. U.S. Fish and Wildlife Service data were used to determine average percent lipid for whole fish. U.S. Fish and Wildlife Service data were used because they have more whole fish lipid data than the Agency, especially for salmonid species. A mean value of 12 percent was determined for cold water fish (salmonids), and a mean value of 5 percent was determined for cool and warm water fish. Exhibit 21, Appendix H.

The Agency is not proposing any wildlife-based numerical standards in these rule amendments. The Agency staff has not had sufficient time to review the wildlife effects literature and process the information to determine the standards. However, the Agency feels it is important to establish the procedures in the rule. Based on Wisconsin's experience, the most likely candidates for wildlife-based standards are the very bioaccumulative chemicals. Wisconsin established three wildlife-based

standards in NR 105. They are for mercury, PCBs, and DDT. The standards are shown in Table 7 compared to the proposed Minnesota standards.

Table 7. Wisconsin Wildlife-based Standards Compared to the Proposed Minnesota Standards for the Same Chemicals

	WI Standard ng/l*	MN Proposed Standard (basis for standard) ng/l*
Mercury	2.0	7.0 (human health)
Polychlorinated Biphenols	3.0	0.014 (human health) 2A waters 0.029 (human health) 2B/2C waters
DDT and Metabolites	0.15	0.11 (human health) 2A waters 1.7 (human health) 2B/2C waters

* ng/l equals nanograms per liter or parts per quadrillion

It should be noted that Class 4B in the current rule protects wildlife and livestock from the harmful effects of drinking from the waters of the state, including protection from toxic materials. The proposed procedures to establish wildlife-based criteria will protect wildlife from the harmful effects of eating contaminated aquatic organisms.

N. Part 7050.0218, Subpart 12, Applicable Standards

1. Class 2 Waters

The final numerical aquatic life standards applicable to Class 2 waters will be the lowest of the three types of criteria; 1) the toxicity-based criteria, 2) human health-based criteria, and 3) wildlife-based criteria which may be developed in the future. This will insure protection of the most sensitive aspect of the aquatic community and the humans or terrestrial animals that make use of it.

The standard will have three parts: the chronic criterion (CC), which provides long term protection to the community or consumers of aquatic organisms; the maximum criterion (MC), which will prevent short-term excursions* of the CC that might cause mortality to sensitive organisms; and the final acute value (FAV), which applies as an end-of-pipe effluent limitation or a limitation in the mixing zone, to prevent acutely toxic conditions in waters of the state. The CC and MC are discussed in the EPA guidance documents (Exhibits 20 and 22), and they are the same as the EPA chronic criteria concentration (CCC) and the criteria maximum concentration (CMC).

* Excursion in this context means an ambient concentration greater than the standard. It means "violation" without the legal implications of that word.

The application of the FAV as an effluent limitation is consistent with the provisions in the current rule that prohibit the discharge of substances in acutely toxic amounts. The FAV will provide a more precise definition of acute toxicity in this context.

2. Class 7 Waters

Class 7 waters are protected for aesthetic qualities, secondary body contact such as wading, and for the potential recharge of surface water to the ground water which is protected as a source of drinking water. Class 7 waters are not protected for the maintenance of an aquatic community, nor are they protected for swimming. Thus, it is not appropriate for the Agency to apply chronic aquatic life standards to Class 7 waters. However, the Agency does not want the conditions in Class 7 waters to be acutely toxic, consistent with the general provisions in chapter 7050 that prohibit toxic materials in toxic amounts in any waters of the state. The Agency will apply the appropriate standards to Class 7 waters on a site-specific basis consistent with the uses for which they are protected.

3. Additivity of Effects

Some effluents may contain more than one toxic substance at or near acutely toxic levels. The combined effect of multiple toxicants may be an acutely toxic effluent even when no single toxicant is present in acutely toxic amounts. Many toxicity studies on the

effects of multiple toxicants on aquatic organisms have shown that linear additivity is a reasonably good model of their combined effect. If data are available for the group of chemicals in question that show the combined effect is less than or more than additive, this information will be used to model the combined effect for that effluent.

The following example illustrates how the additive formula works:

An effluent contains three toxics at the concentrations shown. The FAVs for the toxics are listed.

		FAV in ug/l	Effluent Concentration in ug/l
Toxic	A	75	50
Toxic	B	500	125
Toxic	C	45	20

The ratios of the effluent concentrations to their respective standards are added together.

$$\frac{50}{75} + \frac{125}{500} + \frac{20}{45} = 1.36$$

If the sum of the ratios is greater than one, the effluent is considered acutely toxic. In this example the effluent is acutely toxic.

The same additivity formula is applied to human health-based standards for carcinogenic chemicals. The additivity concept is applied to concentrations of carcinogens in ambient waters, rather than only to effluents as in the case of acute toxicity. Additivity is applied to mixtures of carcinogens to assure that the cancer risk does not exceed one in 100,000. As in the acute toxicity example above, if a stream contained several carcinogenic chemicals, the sum of the ratios of the stream concentrations over

their respective chronic criteria should not exceed one. If the sum is greater than one, the potential cancer risk would be greater than the acceptable risk level of 10^{-5}. The EPA has published guidance on how to address the issue of exposure to more than one carcinogen. Exhibit 39. This guidance suggests using the linear additivity equation in the absence of data supporting an alternative model. This is the position proposed by the Agency.

4. Averaging Period for Standards

The EPA aquatic life criteria published since 1984 have a suggested averaging period. The averaging period, or "duration", is the length of time over which the ambient concentration is averaged to compare to the standard. The EPA recommended durations for the maximum criterion and the chronic criterion are one hour and four days respectively. Exhibit 22. The Agency is proposing the following durations or averaging periods:

Chronic criterion based on aquatic life toxicity	4 days
Chronic criterion based on human health or wildlife	30 days
Maximum criterion	1 day
Final acute value	1 day

Durations associated with the standards should reflect the characteristics of what is being protected, and the practical limitations associated with monitoring and the ascertaining of compliance. Specifying the duration for standards is important so people know how to assess ambient or effluent data when they are

comparing concentrations to the standards. It is also important in the process of setting effluent limitations based on water quality standards using the new EPA guidance. Exhibit 24.

The four day duration proposed for the toxicity-based chronic criterion is the same as recommended by the EPA. Exhibit 22, page 10. A four day averaging period for a chronic criterion may seem short at first, but chronic effects may be based on a very sensitive stage in the life cycle of the test animal that lasts only a few days.

The proposed duration for human health-based criteria is 30 days. Criteria for both carcinogenic and noncarcinogenic chemicals assume a 70 year exposure period. Thus, it seems logical to use a longer duration period for human health-based criteria. The Agency is proposing a 30-day averaging period. Thirty days matches the averaging period for many permit limitations. It is a practical period of time over which monitoring results can be assessed; but it is not so long that major excursions of the criterion, which may be harmful over a shorter period of time, would be masked by data averaged over a much longer period.

The proposed duration for both the maximum criterion and the final acute value is one day rather than the one hour period recommended by EPA. The proposed change from one hour to one day is based primarily on the practicality of monitoring frequencies and the application of these criteria in the effluent limitation setting process. Monitoring is seldom, if ever, frequent enough to

determine hourly averages. It is not practical to determine compliance, either in the receiving stream or at the end of a pipe, over such a short duration. The models used in load allocation studies (studies to determine the degree of wastewater treatment needed to maintain water quality standards in the receiving stream) are based on one day average values. Because monitoring is seldom more frequent than once per day, a one-day average becomes the same as a daily maximum. A one hour average is an unrealistically short period of time, and changing the duration to one day will have little or no effect on the protectiveness of the standards. The EPA has recognized the same impracticalities of the one-hour duration and accepted a one day average for the maximum criterion in "most cases." Exhibit 24, pages 11 and D-2.

5. Maximum Criteria for Certain Human Health-based Standards

In subp. 12, item F the Agency is proposing to limit the maximum amounts of certain chemicals that can be introduced into waters of the state more stringently than the procedure discussed to this point allows. As already explained, the aquatic life standards can be based on toxicity to the aquatic community, the potential human health effects of ingesting fish, or the need to protect wildlife consumers of aquatic organisms. When the standard is based on toxicity to aquatic organisms, there is a direct relationship between the FAV, the MC and the CC. When the standard is based on human health (or wildlife) concerns, the direct relationship between the CC and the MC/FAV is absent, as shown below:

Toxicity-based

FAV = Final acute value; equivalent to an LC50 for a sensitive species.
MC = FAV divided by 2; equivalent to an LC1 - LC10 for a sensitive species.
CC = Chronic criterion; FAV divided by the acute to chronic ratio.

Human Health-based

FAV = Final acute value; equivalent to an LC50 for a sensitive species.
MC = FAV divided by 2; equivalent to an LC1 - LC10 for a sensitive species.
CC = Human health effects below threshold or at minimal risk.

The human health-based CC can be more than 4 orders of magnitude smaller than the FAV or MC. The standard for 1,2-dichloroethane (DCA) illustrates this situation:

FAV = 90,096 ug/l
MC = 45,048 ug/l
CC, if based on toxicity to aquatic life = 10,638 ug/l

dfCC, drinking water plus fish consumption criterion = 3.8 ug/l (Class 2Bd)
fCC, fish consumption only criterion = 190 ug/l (Class 2B/2C)
Ratio of FAV to dfCC = 23,700
Ratio of FAV to fCC = 474

In this example the FAV is either 23,700 or 474 times the CC, depending on whether or not the stream is protected for drinking water. This is a much greater difference between the CC and FAV than is typical for toxicity-based standards. The issue to consider when dealing with pollutants such as DCA is whether it is reasonable to use the relatively very large FAV as an end of pipe limitation, as is the normal procedure. By doing so, the Agency would be allowing a very high concentration, albeit a relatively low volume or mass, of a carcinogenic chemical into waters of the state. This situation would arise if a small volume discharge containing DCA was to be discharged to a large stream that provided

a great deal of dilution, or if ground water containing DCA was entering a surface water. Potentially, concentrations many times greater than the chronic criterion, could exist in the zone where the discharge mixes with the receiving stream resulting in fish accumulating unacceptable tissue concentrations in a short time. The Agency feels that the addition of carcinogenic or very bioaccumulative chemicals should be limited more stringently than the application of the FAV as an effluent limitation provides.

If the Commissioner finds that the application of the much larger FAV is not protective of public health and the beneficial uses, the Agency is proposing to use the calculated FAV or the CC times 200, whichever is lower, as the applicable FAV for human health-based standards for carcinogenic or very bioaccumulative chemicals. The value 200 was selected because it is in the range of the highest measured acute to chronic ratios available for bioaccumulative chemicals. See Exhibit 21, Appendix D. Similarly, the applicable MC would be the calculated MC or the CC times 100, whichever is lower. The intent is to provide a greater degree of protection to receiving streams, especially in the mixing zone, than the strict application of the FAV or MC provides.

This proposal is analogous to the minimum technology-based limitations which have been established for many industry categories by the EPA. No such minimum treatment requirements exist for many of the situations where these standards will be used, such as gas and oil spills, superfund sites, hazardous waste site cleanups, and the contamination of surface waters from landfill leachate.

The chemicals in the proposed rule that this provision would apply to, for Class 2B/2C waters, are listed below:

Acrylonitrile
Benzene
Carbon tetrachloride
Chlordane
DDT
1,2-Dichloroethane
Dieldrin
Heptachlor
Heptachlor epoxide
PCBs
Toxaphene
Mercury

All these chemicals are considered to be carcinogenic except mercury. Mercury, however, is highly bioaccumulative. It is proposed to list the full FAVs and MCs in the rule but place an asterisk by them which will refer the reader to part 7050.0218, subp. 12, item F.

An opportunity for public hearing, as granted through the permit process, will be available if a limitation is established through this process.

O. Part 7050.0218, Subpart 13, Site-specific Standards

The standards derived under part 7050.0218 apply state-wide. Because of their broad applicability, they incorporate some assumptions that represent general or "average" conditions. In some site-specific applications, sufficient local information may be available that could be used for one or more of the assumptions in place of the state-wide assumptions. The Agency feels that it is not only appropriate but necessary that the standards can be tailored to local conditions as much as possible while still providing adequate protection to the resource.

Proposed subp. 13 contains the authority to evaluate local data and information to determine whether a site-specific standard is warranted. Site-specific standards may be more or less stringent than the state-wide standards. The information supporting a change to the standard must be sufficient both in quality and quantity before the standard will be altered. Such information may be provided by any party outside the Agency or by the Agency itself.

Examples of the type of information that would support a change to the standard are shown below:

1. Studies showing the local consumption of fish is substantially greater than 30 grams per day. Use of a larger fish consumption amount will make the standard lower (more stringent).

2. Information showing that a local water quality characteristic or physical quality, such as the natural presence of high concentrations of dissolved organics, mitigates the toxicity of metals in the water. Consideration of such a factor will make the standard higher (less stringent).

3. Information showing that the bioaccumulation of the pollutant in the local fish is substantially less than is indicated in the general literature. Use of a smaller bioaccumulation factor will make the standard higher (less stringent).

All the information, whether submitted to the Agency by outside parties or obtained by the Agency, will be evaluated by the Agency staff. The

staff will make the initial determination as to whether or not the information is sufficient to support a site-specific standard. The staff may ask the Agency Board to approve the use of the site-specific standard if its use is challenged by an outside party, its use is potentially controversial, or its use would cause a large capital expenditure compared to the use of the state-wide standard.

If the site-specific standard is used as the basis for an effluent limitation in an NPDES or State Disposal System permit, or as the basis for cleanup operations, the Agency feels that the permittee, or any interested or affected member of the public, should have the opportunity for a public hearing. The hearing could be on any aspect of the development or application of the site-specific standard. The public noticing and opportunity for a hearing provisions of the permit process can meet this requirement.

P. Part 7050.0220, Subpart 3, Numerical Standards.

1. Introduction

Part 7050.0220 is the section of the rule that contains the numerical standards established to protect the various beneficial uses. Subp. 1 of this part contains introductory information about the numerical standards. The Agency is proposing minor changes to subp. 1 to replace the term "limiting conditions" with the term "standards." This will eliminate the duplicate terminology used in reference to numerical standards.

Subp. 2 contains the drinking water standards. These numerical standards are the EPA primary and secondary drinking water standards. They are taken from a 1962 document published by EPA's predecessor agency the U.S. Department of Health, Education, and Welfare, Public Health Service. The rule goes on to state that "any revisions, amendments or supplements" to the 1962 standards can be used. Thus, the Agency has applied the latest EPA drinking water standards under this authority. These standards apply both to underground waters and surface waters protected for drinking. However, they protect only the drinking water use. Drinking water standards applicable to surface waters need to address fish consumption as well as drinking water, as the standards proposed in these amendments will do. The Agency intends to amend its standards applicable to underground waters, including those in subp. 2 in a separate rulemaking sometime in the future.

2. Listing of the Numerical Standards

Subp. 3 contains the standards applicable to Class 2 waters of the state including the 54 new standards for toxic substances proposed in these amendments. The Agency has attempted to arrange the three part standards under the Class 2 subclass so they will be as easy to understand as possible. Table 8 lists the proposed numerical standards. Exhibit 108 is a table comparing the proposed standards to the numerical criteria currently being used by the Agency.

Table 8. Proposed Aquatic Life Standards for Class 2 Waters
all units are in micrograms per liter unless otherwise noted

	CHEMICAL	CLASS 2A CC	CLASS 2A MC	CLASS 2A FAV	CLASS 2Bd CC	CLASS 2B/2C CC	CLASS 2B/2C MC	CLASS 2B/2C FAV	BASIS
1	Acenapthene	12	41	81	12	12	41	81	PCA T2
2	Acrylonitrile (c)	0.38	1140	2281	0.38	0.69	1140	2281	PCA Hc
3	Aluminum, total	87	748	1496	125	125	1072	2145	EPA T1 m
4	Anthracene	0.029	0.78	1.6	0.029	0.029	0.78	1.6	PCA T2
5	Arsenic, total	50	360	720	50	70	360	720	EPA T1 m
6	Benzene (c)	5.9	4400	8800	6.9	111	4400	8800	PCA Hc T1
7	Bromoform	103	2900	5800	128	558	2900	5800	PCA Hs T2
8	Cadmium, total *	1.1	3.9	7.8	1.1	1.1	33	67	EPA T1 m
9	Carbon Tetrachloride (c)	1.9	1750	3500	1.9	5.9	1750	3500	PCA Hc
10	Chlordane (c)	0.000073	1.2	2.4	0.00029	0.00029	1.2	2.4	EPA Hc m
11	Chloride mg/l	230	860	1720	230	230	860	1720	EPA T1
12	Chlorine, total residual	6	19	38	6	6	19	38	EPA T1 m
13	Chlorobenzene (Monochlorobenzene)	10	423	846	10	10	423	846	PCA T2
14	Chloroform (c)	49	2235	4471	55	224	2235	4471	PCA Hc T2
15	Chloropyrifos	0.041	0.083	0.17	0.041	0.041	0.083	0.167	EPA T1
16	Chromium III, total *	207	1735	3469	207	207	1735	3469	EPA T1
17	Chromium VI, total *	11	16	32	11	11	16	32	EPA T1
18	Copper, total	9.8	18	35	10	10	18	35	EPA T1 m
19	Cyanide, free	5.2	22	45	5.2	5.2	22	45	EPA T1
20	DDT (c)	0.00011	0.55	1.1	0.0017	0.0017	0.55	1.1	EPA Hc m

Table 8. continued

	CHEMICAL	CLASS 2A CC	CLASS 2A MC	CLASS 2A FAV	CLASS 2Bd CC	CLASS 2B/2C CC	CLASS 2B/2C MC	CLASS 2B/2C FAV	BASIS
21	1,1-Dichloroethane (c)	3.5	45050	90100	3.8	190	45050	90100	PCA Hc
22	Dieldrin (c)	0.0000065	1.25	2.5	0.000026	0.000026	1.25	2.5	EPA Hc m
23	Di-2-ethylhexyl phthlate (c) (bis--)(DEHP)	1.94	none	none	1.94	2.1	none	none	PCA Hc
24	Di-n-octyl phthalate	30	825	1650	30	30	825	1650	PCA T1 other
25	Endosulfan	0.056	0.11	0.22	0.15	0.15	0.28	0.56	EPA T1 m
26	Endrin	0.0033	0.09	0.18	0.013	0.013	0.09	0.18	EPA Hs m
27	Ethylbenzene	68	1859	3717	68	68	1859	3717	PCA T1
28	Fluoranthene	1.1	199	398	4.1	4.6	199	398	PCA Hs
29	Heptachlor (c)	0.000088	0.26	0.52	0.00035	0.00035	0.26	0.52	EPA Hc m
30	Heptachlor Epoxide (c)	0.00012	0.27	0.53	0.00048	0.00048	0.27	0.53	PCA Hc
31	Hexachlorobenzene (c)	0.000056	none	none	0.00022	0.00022	none	none	PCA Hc
32	Lead, total *	3.2	82	164	3.2	3.2	82	164	EPA T1
33	Lindane (BHC-gamma) (c)	0.003	1	2	0.012	0.012	1	2	EPA Hc m
34	Mercury, total	0.007	2.4	4.9	0.007	0.007	2.4	4.9	EPA Hs m
35	Methylene Chloride (c) (Dichloromethane)	44.7	9600	19200	46	1561	9600	19200	PCA Hc T2
36	Nickel, total *	88	1418	2836	88	158	1418	2836	EPA Hs T2 m
37	Parathion	0.013	0.07	0.13	0.013	0.013	0.07	0.13	EPA T1
38	Pentachlorophenol (PCP) **	5.7	9.1	18	5.7	5.7	9.1	18	EPA T1
39	Phenanthrene	2.1	29	58	2.1	2.1	29	58	PCA T2
40	Phenol	123	2214	4428	123	123	2214	4428	PCA T1

Table 8. continued

	CHEMICAL	CLASS 2A CC	CLASS 2A MC	CLASS 2A FAV	CLASS 2Bd CC	CLASS 2B/2C CC	CLASS 2B/2C MC	CLASS 2B/2C FAV	BASIS
41	Polychlorinated biphenyls total (c)	0.000014	1	2	0.000029	0.000029	1	2	EPA Hc m
42	Selenium, total	5	20	40	5	5	20	40	EPA T1 other
43	Silver *	0.12	2	4.1	1	1	2	4.1	EPA T1 m
44	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) (c) pg/l	0.0003	none	none	0.0012	0.0012	none	none	EPA Hc m
45	1,1,2,2-Tetrachloroethane (c)	1.1	1127	2253	1.54	13	1127	2253	PCA Hc
46	Tetrachloroethylene (c)	2.9	428	857	2.9	5.3	428	857	PCA Hc
47	Toluene	253	1352	2703	253	253	1352	2703	PCA T1
48	Toxaphene (c)	0.00039	0.73	1.5	0.0016	0.0016	0.73	1.5	EPA Hc m
49	1,1,1-Trichloroethane	263	2628	5256	263	263	2628	5256	PCA T2
50	1,1,2-Trichloroethylene (c)	25	6988	13976	25	120	6988	13976	PCA Hc
51	2,4,6-Trichlorophenol	2	102	203	2	2	102	203	EPA 0
52	Vinyl Chloride (c)	0.14	none	none	0.15	7.6	none	none	PCA Hc
53	Xylene (total m,p and o)	166	1407	2814	166	166	1407	2814	PCA T1
54	Zinc, total	106	117	234	106	106	117	234	EPA T1

Chemical notes
- (c) = carcinogen
- * = Total hardness dependent standard, hardness equals 100 mg/l
- ** = pH dependent standard, pH equals 7.0

Basis codes for standards
- EPA = From EPA criterion
- PCA = Criterion developed by MPCA staff
- HC = Human health carcinogenic effects
- HS = Human health systemic effects
- T1 = Direct aquatic life toxicity, EPA national procedures used
- T2 = Direct aquatic life toxicity, EPA advisory procedures used
- m = modified
- 0 = Organoleptic
- other = Criterion based on other end point

The standards in subp. 3 can be divided into two categories. One category includes surface waters protected for drinking, and the other category includes surface waters not protected for drinking. The first category includes the Class 2A (trout) waters. All Class 2A waters also have a Class 1 domestic consumption use designation. The first category also includes certain Class 2B waters (cool/warm water fisheries) that are also assigned a Class 1 designation. In the proposed rule, these Class 2B waters which are also protected as a source of drinking water will be designated Class 2Bd waters in part 7050.0220, subp. 3, item B, and specifically identified as such in part 7050.0470. For example, the segment of the Mississippi River above St. Anthony Falls is presently classified as 1C, 2B, 3B in part 7050.0470, subp. 4. With the adoption of this new subclass of waters, Class 2Bd, this segment of the Mississippi River would be classed 1C, 2Bd, 3B in part 7050.0470, subp. 4.

The second category includes the other Class 2B waters and Class 2C (rough/forage fisheries) waters which are not designated for domestic consumption purposes. The fisheries and recreational use standards for the waters in these two classes are found in part 7050.0220, subp. 3, item C and item D respectively.

The standards are listed by pollutant, which are arranged alphabetically. The letter "(c)" in parentheses is included after the name of the chemicals that are both considered carcinogenic and have a human health-based standard. The additivity formula for

carcinogens given in subp. 12, item E applies to these chemicals. A carcinogenic chemical with a toxicity-based standard will not be designated with a (c). The units the standard is expressed in are included for each substance. Most standards are given in micrograms per liter (ug/l) (parts per billion).

The numerical standards in subp. 3 are listed in three columns, one column each for the chronic criteria (CC), the maximum criteria (MC), and the final acute value (FAV). If no MC or FAV exists for a substance, the word "none" is inserted. None in place of a number means that there is insufficient toxicity data to determine the criterion. When adequate data become available, the Agency could determine the FAV and MC under the authority in proposed part 7050.0218, subp. 4.

Some standards are in a narrative form, or have explanatory statements with them. These standards are inserted in their proper place alphabetically, and the numerical standards for the next chemical continue after the narrative standard.

Subp. 3, item A, lists the standards for trout waters. Class 2A waters include Lake Superior. Through the International Joint Commission, the governments of the United States and Canada have signed an agreement establishing numerical criteria for the Great Lakes. The EPA has recommended that these criteria be considered when states bordering the Great Lakes establish standards applicable to these lakes. The Agency has reviewed the IJC

criteria for the chemicals the Agency is proposing standards and the following IJC criteria are lower than the proposed standards for Class 2A waters:

Chemical	IJC Criterion ug/L	Proposed 2A Standard ug/L
Endrin	0.002	0.0033
Nickel	25	80
Parathion	0.008	0.013
Zinc	30	54

The standards proposed by the Agency reflect the more recent toxicity information on the five chemicals than the IJC criteria (the IJC agreement with the criteria was established in 1978). It is the opinion of the Agency staff that the proposed standards will be fully protective of Lake Superior waters and its resident fish, and that it is preferrable to adopt them in place of the lower IJC criteria.

Subp. 3, item B, lists the standards for Class 2Bd and refers back to other standards in item A because both sets of standards protect both drinking water and fish consumption.

Subp. 3, item C, lists the standards for Class 2B waters that are not protected for drinking. These standards apply to most of the surface waters in Minnesota.

Subp. 3, item D, lists the standards for Class 2C waters and refers back to other standards listed in item C.

3. Numerical Standards that Vary with a Water Quality Characteristic

The standards for eight substances, seven metals and pentachlorophenol, vary with a water quality characteristic. The metal standards vary with total hardness (calcium plus magnesium expressed as $CaCO_3$) in milligrams per liter (mg/l). The pentachlorophenol standard varies with pH. The standards for these eight substances are expressed as an equation. Example standards for representative hardness or pH values are included to assist the users of the rule.

When determining a metal standard for a particular water, the following apply:

1. The ambient total hardness in mg/l is determined. Usually average or median values are used.

2. A best fit regression line has been established by the EPA in the determination of the criterion that represents the relationship between toxicity and the water quality characteristic. Exhibits 22 and 23.

3. Normally hardness values above 400 mg/l are not used to calculate a hardness related standard. If the average ambient hardness is

greater than 400 mg/l, a value of 400 is used. This is because the relationships between hardness and toxicity upon which the standards are based are usually established at hardness values between 50 and 250 mg/l. It is not acceptable to extrapolate the relationship too far beyond the data used to develop the relationship.

4. The standard is calculated by taking the antilog (base e) of the results of the natural log hardness times the slope of the relationship plus the intercept.

5. Four decimal places are usually maintained for the calculation, but the standard is rounded to a reasonable value.

6. The results are always in ug/l.

Example: cadmium CC for a hardness of 275 mg/l

CC = exp.(0.7852 [ln(total hardness mg/l)] -3.49

CC = exp.(0.7852 [5.6168] -3.49

CC = exp.(0.9203)

CC = 2.5 ug/l

When determining a standard for pentachlorophenol for a particular water the following apply:

1. Median or mean (median is preferred) ambient pH in standard units is determined.

2. Values for pH outside the range of 6.0 to 9.0 normally will not be used to calculate a pentachlorophenol standard for the same reasons hardness values are limited to 400 mg/l as discussed above.

3. The remaining steps are similar to those for calculating the metals chronic criterion.

   Example: pentachlorophenol CC for a pH of 7.9

   CC = exp.[1.005 (pH) -5.29]

   CC = exp.[1.005 (7.9) -5.29]

   CC = exp.[2.6495]

   CC = 14 ug/l

   Most of the metal hardness dependent standards use the same slope (the same relationship between hardness and toxicity) for the FAV and CC. The copper and cadmium standards have different slopes for the FAVs and CCs. The silver standard has a hardness dependent FAV and MC, but the CC is not hardness dependent.

4. Standards Below Analytical Detection Limits

The Agency is proposing numerical standards that are below standard analytical detection limits for 17 substances.

The following is a list of those substances:

Chlorinated pesticides

- Chlordane
- DDT
- Dieldrin
- Endrin
- Heptachlor
- Heptachlor epoxide
- Lindane
- Toxaphene

Other chlorinated compounds

- PCBs
- TCDD (dioxin)
- Hexachlorobenzene

Volatile organics

- Vinyl chloride

Polynuclear organic hydrocarbons

- Anthracene

Other organics

- Acrylonitrile
- Chlorpyrifos
- Parathion

Metals

- Mercury

Most of the substances on the above list are the very persistent and bioaccumulative chlorinated organics. The standards for these chemicals are very low due to their bioaccumulative potential and because many are considered carcinogenic. Unfortunately, analytical techniques are not yet sophisticated enough to detect concentrations determined to cause a health risk for some

chemicals. However, ambient standards must be established at levels necessary to protect the beneficial uses independent of the detection limits.

Standards lower than detection limits does make ascertaining compliance with the standard more difficult. The Agency can, and has used in the past, various procedures to mitigate this problem such as monitoring the concentration, of the chemical in fish tissue where it bioconcentrates, or by monitoring the effluent before it is diluted by the receiving stream. The best means of dealing with the detection limit problem is as part of a case-specific evaluation.

5. Discussion of Certain Proposed Standards

Some of the proposed standards, or proposed changes to existing standards, require additional discussion.

Dissolved Oxygen

The current rule states the Class 2 dissolved oxygen standards as an "instantaneous minimum concentration." The Agency is proposing to replace "instantaneous minimum concentration" with "as a daily minimum." (The numerical part of the standard, 7 mg/L for Class 2A waters and 5 mg/L for Class 2Bd/2B/2C waters, is not being changed.) The Agency is proposing this change so that the standard will agree with the EPA dissolved oxygen criterion, Exhibit 27. The proposed change merely updates the dissolved oxygen standard

language, and it will have no impact on the environment or dischargers. The change will not affect the application of the dissolved oxygen standard in receiving streams, the determination of carbonaceous biochemical oxygen demand (CBOD) effluent limitations through the load allocation modeling process, or the determination of compliance with CBOD limitations in permits.

Oil

The current rule has a different oil standard for Classes 2A, 2B and Class 2C waters as follows:

Class 2A, 2B	.5 mg/l
Class 2C	10 mg/l, and none is such quantities as to (1) produce a visible color film on the surface, (2) impart an oil odor to water or an oil taste to fish and edible invertebrates, (3) coat the banks and bottom of the watercourse or taint any of the associated biota, or (4) become effective toxicants according to the criteria recommended.

The Agency is proposing the following oil standard to apply to all Class 2 waters:

CC = 0.5 mg/l (= 500 ug/l)

MC = 5 mg/l

FAV = 10 mg/l

The 0.5 mg/l standard, which is the current Class 2A, 2B standard is considered comparable to the narrative portion of the Class 2C standard. This value will protect aquatic life from tainting by petroleum products and prevent any visible oil films. The change in the standard is not considered an increase in the stringency of the 2C standard. The change is in keeping with the past and current practice of the Agency to apply the same standard for toxics to both Class 2B and 2C waters.

The proposed FAV for the four subclasses is the same as the numerical part of the current Class 2C standard. This value, 10 mg/l, has been used as an effluent limitation for oil for many years. Thus, the proposal to make it an FAV is consistent with the use of FAVs as end-of-pipe limitations. It is intended to prevent visible oil films in the receiving stream.

Nickel

The nickel standard is particularly complex because, in addition to being hardness dependent, it can be human health-based as well. At low ambient hardness values the toxicity of nickel to aquatic life controls the final standard. At higher ambient hardness values the standard is human health-based. For 2A and 2Bd waters the "change over" point is at a hardness of 50 mg/l. For 2B/2C waters the standard changes at a hardness of 143 mg/l. The Class 2B/2C standard has a cap at 213 ug/l which is the human health-based criterion. The toxicity-based standards for waters with hardness values less than 143 mg/L will be less than 213 ug/L.

Phenol

The current phenol standard of 10 ug/L (Class 2A and 2B) and 100 (Class 2C) is for total phenolic compounds. The standard includes a narrative statement that concentrations of total phenols must be below levels that would impart unacceptable tastes or odors to fish and other edible aquatic life. The proposed phenol standard of 123 ug/L (all Class 2 waters) is for the compound phenol only. The Agency believes that chemical-specific standards are preferable to standards for groups of chemicals, because the toxicity and other environmental impacts of chemicals, even within a group of related chemicals, can vary widely. The Agency is proposing the phenol standard now and will consider adding standards for other specific phenolic compounds in the future.

The Agency proposes to delete the narrative portion of the current total phenol standard. This will not leave aquatic organisms unprotected for taste and odor problems because of the provisions of proposed part 7050.0218, subp. 10.

Trace Metals

The Agency is proposing that the metal standards be specified as total metals. This means that when metals are analyzed in the waters of the state for comparison to the standard, the total analysis technique should be used. A water sample to be analyzed for total metals is acidified to a low pH and a subsample withdrawn

from the bottle for analysis. The analysis results may include the metals bound in some metal complexes that are not as toxic as the the free metal ion or weakly bound metals. The EPA has, since about 1984, been advocating using an acid soluble analytical procedure for metals. The intent is that this procedure will measure more accurately the fraction of the metal that is toxic to aquatic life. The Agency is proposing to retain the total metal analytical procedure because nearly all of the Agency's historical data for metals, both ambient and effluent, is in the form of total metals, and the acid soluble procedure has not yet been approved by the EPA. The Agency will consider adopting the acid soluble procedure for metals when the procedure has been approved by the EPA.

Q. Other Proposed Changes

1. Part 7050.0150, Reference to Analytical Methods

The change proposed to this part updates the reference that details the approved methods of sample preservation and analysis used in determining compliance with water quality standards. The existing rule states that samples shall be preserved and analyzed in accordance with the 1971 edition of Standard Methods for the Examination of Water and Wastewater and "any revisions or amendments thereto." This rule language essentially means that the latest edition of Standard Methods would automatically be the reference document for sample preservation and analytical methods. In the past, the Agency has been reluctant to modify this part by

citing an updated version of Standard Methods because such modification might have resulted in the deletion of the statement "and any revisions or amendments thereto."

There are, however, several problems with the language in part 7050.0150. First, the Agency's continued citation of the 1971 edition of Standard Methods has been a source of confusion, even with the reference to the latest revision or amendment. Second, and of greater importance, is the fact that by only referring to Standard Methods, the present rule language does not adequately define the references which contain the EPA approved methods for sample preservation and analysis.

Section 304(h) of the Clean Water Act, 33 U.S.C. § 1314 (h), authorizes the EPA to promulgate guidelines establishing test procedures for the analysis of pollutants regulated by the Section 401 Certification and the Section 402 National Pollutant Discharge Elimination System programs. Code of Federal Regulations, title 40, part 136 is the regulation containing these guidelines. 40 CFR 136 identifies the EPA approved sample preservation and test procedures. It also defines the application and approval process for alternative test procedures. 40 CFR 136 also provides for a mechanism whereby test procedures can be specified for other pollutants not already identified.

Standard Methods is one of many sources which are cited as references in the lists of EPA approved methods in 40 CFR 136. The change proposed to part 7050.0150 to cite this federal regulation

is a reasonable amendment in that it will clarify and make the reference citation to the approved sample preservation and test methods more complete.

There are no anticipated impacts to the regulated community as a result of the proposed change to part 7050.0150. Monitoring plans for permits issued through the NPDES permit program and the Section 401 Certification program already make reference to 40 CFR 136 with regard to matters of sample preservation and analysis.

2. Part 7050.0180, Subpart 2, Effective Dates for Outstanding Resource Value Waters.

In 1984, a nondegradation policy was adopted into the water quality standards and use classification rule which identified specific waters as Outstanding Resource Value Waters (ORVWs). As stated in part 7050.0180, waters assigned the ORVWs designation are waters of the state with high water quality, wilderness characteristics, unique scientific or ecological significance, exceptional recreational value or other special qualities which warrant stringent protection from pollution. The Agency recognized, at the time, that the list of waters originally proposed for ORVW designation would not be all inclusive and that additional waters would likely be added through future rulemaking proceedings. Since the first ORVWs were adopted, additional scientific and natural areas, certain existing or potential lake trout lakes, and calcareous fens have received this designation. Three additional

calcareous fens are being proposed as ORVWs during this rulemaking proceeding.

A change being proposed to part 7050.0180, subp. 2, is intended to identify the effective date when the particular waters were designated as ORVWs. The effective date of ORVW designation corresponds to the date a revised rule in which the ORVW was adopted becomes effective. Identifying when these waters receive the ORVW designation is necessary in determining whether a discharge is new or "grandfathered in," part 7050.0180, subp. 2, item B. For those discharges which have been grandfathered in, identification of the effective date of ORVW designation is necessary to determine the applicable permit limitations as of that date which will serve as the basis for determining whether a discharge is an expanded discharge in accordance with part 7050.0180, subp. 2, item C.

Identification of the effective dates of ORVWs will be accomplished through some minor changes to parts 7050.0460 and 7050.0470. Presently, part 7050.0460 states that ORVWs are identified in part 7050.0470 by an asterisk. The proposed rule change expands on this statement and indicates that an ORVW is identified by an asterisk and that the name of the water resource precedes the effective date of designation. Along with the effective date, a letter code will appear. This code letter identifies whether the specific ORVW is covered by the prohibited discharges category (7050.0180, subp. 3) or the restricted discharges category

(7050.0180, subp. 6). The letter P will represent the prohibited discharges category of subp. 3 and the letter R will represent the restricted discharges category of subp. 6.

3. Part 7050.0180, Subpart 6b, Designation of Three Calcareous Fens as Outstanding Resource Value Waters.

In the existing rule, there are 28 calcareous fens designated as Outstanding Resource Value Waters (ORVW). Three additional calcareous fens are being proposed for this designation. Calcareous fens are considered the rarest wetland plant community in Minnesota, and probably one of the rarest in North America. These fens are typically grass-sedge dominated peatlands which develop where ground water, rich in calcium and magnesium bicarbonates, and in some instances calcium and magnesium sulfates discharge at the ground surface. A harsh, alkaline soil condition is created as these calcium and magnesium bicarbonates and sulfates precipitate out at the surface. A distinct assemblage of plants, referred to as calcicoles, have adapted to these wet, calcareous peat soils. In general, calcareous fen communities have a disproportionate number of rare, threatened and endangered plant species as compared to other plant communities in the state.

In Minnesota, calcareous fens have a sporadic distribution throughout the prairie region of the state. The calcareous fens in Minnesota occur in three broad geomorphic areas: 1) at the base of terrace escarpments in the major river valleys of southern Minnesota; 2) on the sides of glacial hills in the morainic uplands

of western Minnesota; and 3) in areas adjacent to Glacial Lake Agassiz beach ridges in northwestern Minnesota. The three calcareous fens being proposed for ORVWs designation in this rulemaking proceeding have been identified by the Natural Heritage Program, Minnesota Department of Natural Resources. The Natural Heritage Program identifies and locates significant examples of Minnesota's plant and animal species, plant community types, special wildlife habitats and special geologic features.

The three calcareous fens proposed for ORVWs designation which are listed under the restricted discharges category (part 7050.0180, subp. 6b) are also listed below. The noted exhibits refer to site maps showing the locations of the calcareous fens.

1. Adrian fen, Nobles County; Exhibit 101.
2. Altona State Wildlife Management Area fen, Lincoln and Pipestone Counties; Exhibit 102.
3. Burke State Wildlife Management Area fen, Pipestone County; Exhibit 103.

Calcareous fens in this state vary greatly in size and quality. Since fens are fed by ground water and not dependent on seasonally fluctuating amounts of precipitation, a constant microenvironment can be maintained. This produces a climax vegetation type which has remained stable for thousands of years. For this reason, fens often harbor relic plant species that are uncharacteristic or absent from other vegetation types. Due to human activities, however, a number of these fens have been seriously degraded and

have lost much of their original character. In general, impacts to calcareous fens are evidenced by a loss of calcicoles which, in turn, are replaced by weedy opportunistic plant species that take advantage of the changed habitat conditions.

The major threats to calcareous fens come from ditching, drainage and filling operations related to agricultural activities, commercial development and highway construction. Water pollution impacts from those activities and from point source discharges have the potential to significantly alter the quality and quantities of the water upon which fen development and maintenance are so dependent. By placing the calcareous fens under the restricted discharges category of the nondegradation section of the rule, activities which do or could potentially contribute to the degradation of the waters of these fens can be prohibited or more stringently controlled, depending on the outcome of the prudent and feasible test referenced in part 7050.0180, subp. 6. These prohibitions and controls will apply to both point source discharges, as defined in Minn. Stat. § 115.01, subd. 15, and to nonpoint source impacts resulting from land management and land use activities.

Since calcareous fens are so dependent upon specific hydrological conditions, impacts to water quantities in these fens resulting from certain land use activities, and to lesser degree from point source discharges, become important considerations in their protection and preservation. Too much water or too little water

can disrupt the unique habitat and can lead to a shift in the plant species composition to one where common plant species become more abundant.

Under item (b) of Minn. Stat. § 115.01, subd. 5, pollution of waters is defined as, "the man-made or man-induced alteration of the chemical, physical, biological or radiological integrity of waters of the state." A change in the physical integrity of waters of the state, in this instance a change in the quantity of water present in the calcareous fen needed to maintain a suitable habitat for this plant community, will be construed as pollution of waters. Therefore, a land use activity, or a point source discharge (notwithstanding its chemical quality), upon which the Agency has permitting authority, which could potentially bring about a detrimental change in the water quantity present in these fens will trigger the need for the prudent and feasible test.

The proper hydrogeological conditions which allow for the formation of calcareous fens are uncommon occurrences throughout the state. The rare endangered plant species they support make these fens unique resources deserving of a high degree of protection. The Agency, therefore, believes that it is reasonable to designate these three calcareous fens as ORVWs. In doing so, it is hoped that an element of protection will be added to aid in the effort to preserve these unique wetland plant communities.

The Natural Heritage Program has an ongoing effort to determine the existence of additional calcareous fens in the state. In the

future, additional fens may be identified and inventoried. As new calcareous fens are identified, it is the Agency's intent, in cooperation with the MDNR, to include additional calcareous fens as ORVWs in subsequent rule revisions. In those instances where a newly identified calcareous fen is threatened by a potential discharger or certain land use activity, the Agency will consider the calcareous fen as an unlisted outstanding resource value water pursuant to the provisions of part 7050.0180, subp. 7.

4. Part 7050.0180, Subpart 10, Clean Water Act Citation.

The proposed change to this subp. adds the proper citation of section 316 of the Clean Water Act as codified by United States Code.

5. Part 7050.0185, Subpart 2, Citation Change to the Definition of Toxic Pollutant.

The change proposed to this subp. is intended to make the reference to the definition of toxic pollutant more direct. The definition of toxic pollutant in the Agency's permit rule, part 7001.1020, subp. 30, means "a pollutant listed as toxic under section 307 (a)(1) of the Clean Water Act, United States Code, title 33, section 1317 (b)(1), or as defined by Minnesota Statutes, section 115.01, subdivision 14." By referencing the federal and state citations directly, it eliminates an intermediate step in determining this definition.

6. Part 7050.0210, Subpart 2, Visible Oil Film.

In addition to the specific narrative and numerical water quality standards in Chapter 7050, there are general standards that apply to discharges to waters of the state. Part 7050.0210, subp. 2 refers to general rule provisions regarding the prohibition of nuisance conditions in and on waters of the state. The change proposed for this subp. substitutes the phrase "visible oil film" for oil slicks as a specified nuisance condition. The proposed change is reasonable in that it is consistent with the prohibition on visible surface films noted in the narrative standard for oil in the existing rule under part 7050.0220, subp. 3, item D. However, proposed changes to subp. 3, item D. would delete this reference and the Agency believes that a similar statement should be included in part 7050.0210, subp. 2, since it provides for a qualitative analysis of oil pollution situations and does not necessarily require analytical testing to show that the standard is exceeded.

7. Parts 7050.0210, Subpart 5; 7050.0211, Subpart 1; 7050.0212, Subpart 6; 7050.0214, Subpart 1, Unspecified Toxic Substances References and Definition of Acute Toxicity.

The current rule prohibits acutely toxic concentrations of pollutants in mixing zones (part 7050.0210, subp. 5, item D) and in all municipal and industrial discharges (part 7050.0211, subp. 1; part 7050.0212, subp. 6; and part 7050.0214, subp. 1). The term "acute toxicity" is defined in part 7050.0210, subp. 5 of the current rule as "the 96 hour median tolerance limit for indigenous

fish and fish food organisms." Median tolerance limit means the same as "LC50" (see glossary in this statement). This definition establishes the commonly used and accepted concept of acute toxicity as the concentration that kills 50 percent of the test organisms in four days, but it does not define whether the LC50 is for a sensitive or tolerant species. Acute toxicity (LC50s) for a substance can vary widely depending on the organism being tested. For example, the least sensitive species tested with hexavalent chromium had an LC50 of 1,870 mg/L, and the most sensitive species tested (Daphnia magna or water flea) had an LC50 of 0.023 mg/L. These values are taken from the EPA criteria document for hexavalent chromium.

The Agency is proposing to more explicitly define acute toxicity as applied to mixing zones and effluents as the final acute value. The final acute value is defined by EPA (Exhibit 22) and in the proposed rule. Briefly, the final acute value is the fifth percentile LC50 at the sensitive or low end of the ranked (from high to low) LC50s for all the species tested for a chemical. Thus, assuming 100 species were tested, four species would have LC50s less than, and 95 would have LC50s greater than, the final acute value.

The adoption of the final acute value, applicable to mixing zones and effluents, will establish a consistent level of protection for aquatic organisms. Also, the use of the final acute value, because it simulates a sensitive LC50, will protect nearly all the organisms in the aquatic community from mortality.

The term unspecified toxic or corrosive substances has been used in the current rule. It is proposed to delete the word "unspecified" since numerical standards for toxics are either specified in the proposed rule or can be developed using the proposed procedures.

The removal of the term unspecified and the use of the final acute value as the definition of end-of-pipe acute toxicity limitations does not negate the authority of the Agency to require dischargers to perform whole effluent toxicity tests on their discharges and to require remedial action if whole effluent toxicity tests show acute toxicity.

8. Part 7050.0210, Subpart 13, Pollution Prohibited.

Part 7050.0210, subp. 13, refers to general rule provisions regarding prohibition of pollution resulting from either point or nonpoint discharges. The change proposed for this subp. contains a statement prohibiting discharges from causing any material change in any other substances or characteristics which may impair the beneficial uses of waters of the state as defined in part 7050.0200.

The new rule language in this subp. is similar to that which is being proposed for deletion at the end of part 7050.0220, subp. 3. By expanding on a portion of the rule language retained from this subp., and moving it to the part of the rule which contains the general standards, it would apply to all classes of waters. In addition to affirming that water quality standards must be

maintained, part 7050.0210 subp. 13 as amended, would reference the fact that any material change to the characteristics of a water resource which may impair beneficial uses as specified in part 7050.0200 would not be allowed. These characteristics would include the factors contributing to the chemical, physical, biological, or radiological integrity of waters of the state as referred to in Minn. Stat. § 115.01, subd. 5(b) (1988).

The Agency believes that the proposed amendment to this subp. is reasonable. This amendment is consistent with the intent of part 7050.0185, subp. 3, which specifies that, at a minimum, beneficial uses in the receiving water must be maintained. This amendment is also consistent with the stated intent for implementing the nondegradation provisions relating to water quality impacts to calcareous fens and other outstanding resource value waters specified in part 7050.0180, subps. 3 and 6.

9. Part 7050.0210, Subpart 14, Repealed.

As indicated earlier in this statement, under the existing rule, part 7050.0210, subp. 14, provides the Agency with the authority to use EPA criteria or develop its own criteria for the control of toxic substances. This subp. is being proposed for deletion and will be superseded by the more detailed set of procedures for establishing numerical standards for toxic substances contained in part 7050.0218.

10. Part 7050.0220, Changes to the Water Use Class Title Identifiers.

There are several minor changes proposed to the water use classification subp. and item titles of part 7050.0220. These changes add the word class to the subp. title of the use classifications and the use class number to the subp. items. For example, the domestic consumption use classification is amended to read Class 1 Domestic Consumption, and the subclasses within this use class are Class 1A, Class 1B, etc. These changes will clarify the manner of referencing the water use classifications.

11. Part 7050.0220, Subpart 3, Deletion of Last Paragraph.

Briefly stated, the last paragraph of part 7050.0220, subp. 3, restricts discharges from causing material changes in any substance or characteristic which may impair the quality of waters of the state or impair the aquatic biota so as to render them unsuitable or objectionable for fishing, fish culture or recreational uses. Also, the last sentence of this paragraph allows the Agency to develop additional standards as the need arises. While this rule language is being deleted from subp. 3, similar wording is proposed for inclusion in: part 7050.0210, subp. 13 (discussed on page 120 of this statement), part 7050.0218, subp. 2 (discussed on page 15), and part 7050.0218, subp. 4 (discussed on page 20).

12. Part 7050.0420, Incorporation of the Updated MDNR Commissioner's Order for Trout Streams.

Trout streams and certain trout lakes are identified by MDNR Commissioner's orders and are classified 1B, 2A, 3B, 3C, 4A, 4B, 5 and 6 by reference under the provisions of part 7050.0420. A new Commissioner's Order, No. 2294, designating trout streams, was issued on March 18, 1988. Exhibit 104. The new order supersedes Commissioner's Order No. 2089 which is cited in the current rule. The change proposed in part 7050.0420 will update the reference to the Commissioner's order to reflect the current list of designated trout streams.

13. Part 7050.0470, Class 7 Limited Resource Value Water Use Reclassifications.

Segments of two Class 2C watercourses are being proposed for reclassification as Class 7 Limited Resource Value waters. These waters are: Bogus Brook in Mille Lacs County at Bock Minnesota; and Chetomba Creek in Kandiyohi and Renville Counties at and downstream of Prinsburg, Minnesota.

Class 7 waters are waters of the state which are of limited value as a fisheries or recreational resource and are generally either intermittent or have a flow at the once in ten year, seven day low flow (7Q10) of less than one cubic foot per second. Class 7 waters are protected so as to allow secondary body contact use, to

preserve the ground water for use as a potable water supply and to protect aesthetic qualities of the water. Since the establishment of this use classification in 1981, 214 waters have been designated as Class 7 waters.

Waters which are assigned this use classification must meet the criteria set forth under part 7050.0200 for Class 7 waters. The Agency believes that portions of both Bogus Brook and Chetomba Creek meet these criteria. In the case of Bogus Brook, there are limited recreational opportunities (such as fishing, swimming, wading or boating) in and on this watercourse because of poor natural water quality characteristics, lack of habitat, and lack of water. For Chetomba Creek, the segment proposed for reclassification has limited fisheries and recreational opportunities as a result of extensive in-stream channel modifications, as well as limitations attributable to lack of water. Stream assessment worksheets for Bogus Brook at Bock (Exhibit 109) and Chetomba Creek at Prinsburg (Exhibit 110) serve to document the physical conditions which were cited to justify the reclassification of these waters.

A response to the Notice to Solicit Outside Opinion regarding Chetomba Creek was received from the Minnesota Department of Natural Resources area fisheries office at Spicer, Minnesota. This comment indicated that Chetomba Creek has no fishing or swimming value in and around Prinsburg (because of the channel alterations), but that the Class 7 reclassification was inappropriate because of the resource value of the downstream waters of Hawk Creek and the

Minnesota River. Exhibit 14. In response, Agency staff believe that the MDNR comment on the resource value of Chetomba Creek supports the contention that a portion of Chetomba Creek qualifies for reclassification as a Class 7 water. Staff feel that the concerns expressed about the downstream waters can be addressed by the Agency practice of setting effluent limitations that are protective of the water quality standards of waters downstream of the Class 7 reach (part 7050.0214, subp. 3). For Chetomba Creek, this means that the Class 2C water quality standards must be maintained at a point approximately six river miles upstream of its confluence with Hawk Creek.

In general, a Class 7 reclassification of Bogus Brook and Chetomba Creek could have the potential for cost savings to the respective cities in the form of reduced wastewater treatment plant construction costs, as well as operation and maintenance (O&M) expenses. At the present, neither community is meeting the minimum treatment limitations specified in 7050.0211 so system upgrades will be necessary to meet final effluent limits.

14. Part 7050.0470, Subpart 2, Miscellaneous Changes.

There are several changes proposed to the classifications section of the rule. These changes include: 1) the notation of the effective dates of outstanding resource value water (ORVW) designation, 2) use classification change for two watercourses in the Boundary Waters Canoe Area Wilderness (BWCAW), and 3) a legal description change for a listed scientific and natural area.

Effective Dates

Outstanding resource value waters are identified in part 7050.0470 with an asterisk. The effective date when the particular waterbody was designated as an ORVW follows its name. A letter code, accompanying this date, refers to either the restricted or prohibited discharge categories in part 7050.0180, subps. 3 and 6.

Classification Changes

Two watercourses, Lone Creek and the Stuart River, are listed in subp. 2 as Class 1B, 2C waters. Both of these watercourses are within the Boundary Waters Canoe Area Wilderness (BWCAW). All other waters within the BWCAW are designated as ORVWs and have either a Class 2A or Class 2B fisheries and recreational use designation. All waters within the BWCAW are also classified for domestic consumption, Class 1B. By deleting the specific listing of these two waters in subp. 2, they then fall under the narrative classification for non-trout waters in the BWCAW. This in effect would change their use classification to Class 1B, 2B, 3B. (The proposed changes to part 7050.0220, subp. 3, item B would classify these waters as Class 1B, 2Bd, 3B.) This change allows for a consistent approach to the use classification of waters within the boundaries of the BWCAW. However, since these waters are within this wilderness area, and are protected by the nondegradation provisions of part 7050.0180, subp. 3, from a practical sense, this change is of minor consequence.

Legal Description Correction

The legal description for the entry describing the location of the Purvis Lake - Ober Foundation Scientific and Natural Area should be corrected to read T.62, R.13.

V. ECONOMIC CONSIDERATIONS

A. Economic Impact of the Proposed Amendments

1. Introduction

In the exercise of its powers, the Agency is obligated by Minn. Stat. § 115.07, subd. 6 (1988) to give due consideration to economic factors. The statute provides:

> In exercising all its powers the pollution control agency shall give due consideration to the establishment, maintenance, operation and expansion of business, commerce, trade, industry, traffic, and other economic factors and other material matters affecting the feasibility and practicability of any proposed action, including, but not limited to, the burden on a municipality of any tax which may result therefrom, and shall take or provide for such action as may be reasonable, feasible, and practical under the circumstances.

In proposing these amendments, the Agency has considered their economic impact on industry, municipalities, and other regulated parties. But the Agency is not able to determine exactly what additional costs, if any, may be incurred because establishing numerical standards is only one of two major steps in the regulatory process that ultimately determines the cost of meeting the standards. The second step is the application of the standard to control pollution and establish effluent limitations. While it is impossible to determine the exact costs, it is the opinion of the Agency staff that these amendments will not substantially change the overall economic burden to the regulated community. Costs may be higher in one situation but lower in another situation. Some additional monitoring costs may be incurred as a result of the amendments (see below). In most situations, treatment costs are unlikely to change. The remainder of this section will discuss 1) why it is not possible to determine the exact costs, and 2) why the Agency staff thinks the overall costs will not change substantially.

2. Determination of Costs

These amendments deal with the establishment of numerical standards to provide protection of existing designated uses. Setting the standard is the first step of a two step regulatory process that ultimately determines treatment needs and costs. The second step is the determination of the effluent limitations for water quality permits or, in the case of superfund remedial actions, cleanup

requirements that will be required to meet the water quality standards. Water quality standards, rather than minimum technology-based treatment requirements, usually determine the need for treatment when receiving streams provide little or no dilution for discharges.

In practice, the "second step" process is always site-specific or discharge-specific, and it is carried out as part of the permit process or cleanup evaluation. Establishing effluent limitations or cleanup requirements must be completed before the treatment or cleanup costs to dischargers or responsible parties can be determined. The Agency is reviewing its effluent limitation setting procedures in light of recent guidance from the EPA. Exhibit 24. Future amendments to Chapter 7050 will deal with the application of standards to the effluent limitation setting process. Also, it is very difficult without a permit by permit review to predict the number of municipal, industrial, superfund, or other nonpoint source discharges that will require revision under the proposed amendments.

In summary, the exact costs can't be determined because the application of the standards on a case by case basis determines the costs, and the number of situations where these amendments would alter the treatment or cleanup needs cannot be determined. However, as discussed immediately below, the economic effects are likely to be minimal even where the proposed amendments would have an impact.

3. Overall Costs Unlikely to Change

As stated above, the Agency staff feels that the proposed rules will not change the overall costs of controlling toxics to regulated parties. The Agency has been using the numerical standards in part 7050.0220, or in the absence of numerical standards, criteria developed under the authority of the current rule, particularly part 7050.0210, subp. 14, to control toxics for many years. The methods presently being used to establish criteria are similar to those being proposed in these amendments. The proposed numerical standards reflect the same protection level goals as the criteria currently being used. The criteria have been used as the basis for effluent limitations in approximately 80 permits (out of a total of about 1200 municipal and industrial permits), to define treatment requirements, the need for cleanup and to establish the level of required treatment at hazardous waste sites. Thus, the proposed rules will not change the Agency's toxics control program or strategy.

The criteria used in the past and currently being used reflect the same protection level goals stated in the proposed rules. Thus, the proposed standards will not be more or less stringent as a matter of policy. However, many of the proposed standards are different than the criteria they will replace because the data used to determine the standards is more complete and current. Also, some toxicity-based standards may be different because the Advisory

method was not used prior to these amendments. Thus, some specific dischargers or parties responsible for a cleanup operation may incur greater or reduced costs, depending on the pollutants involved. Costs may increase if the proposed standards for the particular pollutants being controlled are lower, or less if the standards are greater. However, it is the opinion of the staff that despite having different standards for some pollutants, the need or lack of need, for treatment would have been triggered regardless in the majority of situations. (See the examples starting on page 135 of this statement.)

Of the 54 standards being proposed for Class 2B/2C waters, 15 are more stringent, 17 less stringent, and 17 are essentially unchanged, compared to the criteria currently being used by the Agency. Essentially unchanged means identical or a change of less than 20 percent. Exhibit 108. These figures total to only 49 because five proposed standards had no counterpart criterion.

It should be noted that independent of these proposed amendments, the Agency is implementing toxicity related programs that will mean additional cost to some permittees. For example, under current Chapter 7050 authority, nearly all municipalities that discharge to Class 2 waters and that disinfect with chlorine are being required to dechlorinate, and some dischargers are being required to perform bioassays in samples of their whole effluent. If the effluent is found to be acutely toxic they may be required to eliminate the toxic component. But these programs are going forward independent of these proposed rules.

4. Monitoring Costs

The proposed amendments have the potential to increase monitoring costs to some regulated parties. It is impossible to accurately estimate the overall increase in monitoring costs for the same reasons that overall treatment costs can't be determined, as discussed above. The proposed cyanide standard will mean additional monitoring costs to some dischargers (see page 134 of this statement).

The reason the Agency thinks monitoring costs may increase is that the presence of 54 numerical standards for toxic substances, rather than six in the current rule, may encourage the staff to require monitoring in the future when they might not have required it under the current rule. Without regard to whether or not the rule is amended, the Agency staff should exercise prudence when requiring monitoring. But, it may be assumed that the presence of a numerical standard in the rule could "tip the balance" toward a decision to require monitoring in some situations as the Agency staff evaluate individual sites.

As stated, the true additional monitoring costs can't be determined, but some indication of the magnitude of these costs can be estimated by looking at the costs of analyses charged by the Minnesota Department of Health (MDH) lab and the number of analyses it performed in a year. The MDH lab does most of the analytical work for the Agency staff, but they perform only a fraction of all the analyses related to pollution assessment performed in Minnesota.

The following analytical costs for various groups of chemicals are the amounts charged by the MDH lab. Private lab charges will be comparable.

Pollutants	Cost Per Analysis (Dollars)	No. of Analyses	Total cost (Dollars)
Volatile organics such as: Trichloroethylene Tetrachloroethylene Chloroform Vinyl chloride Benzene Toluene Xylene	140	770	107,800
Total hydrocarbons (oil and gasoline)	170	100	17,000
Polynuclear aromatic hydrocarbons	440	70	30,800
Metals (graphite furnace)	45 (each)	2,458	110,610
		Total	$266,210

At least half, and probably considerably more than half, of these analyses are the result of assessing ground water problems around the state. The proposed rules will impact the monitoring considerations on those assessments only when contaminated ground water affects surface waters. Also, most of the 54 chemicals the Agency is proposing standards for are on the EPA's list of 126 priority pollutants. Thus, monitoring for many of the 54 will already be required. However, for the sake of this illustration, it will be assumed that over the full period of time the impacts of the proposed rule will be felt, the number of analyses required will increase by five percent. Applied to the number of analyses done by MDH, total annual costs would increase by about $13,300.

The Minnesota Department of Health does not do all the analyses in Minnesota. They probably do far fewer analyses than all of the private labs in the state. Minnesota has several large private analytical labs that can perform all of the analyses listed above. There are additional labs that can do most of these analyses. It is not possible to estimate how many analyses these labs perform (information on the numbers of analyses performed by private labs is often not given out), so the total increased costs cannot be estimated.

The change from a total cyanide standard to the proposed free cyanide standard will mean an increase in monitoring costs. Free cyanide, the toxic form of cyanide, can be measured using the cyanide amenable to chlorination method (EPA method 335.1, method 412 F. in Standard Methods). Standard Methods states "Cyanides amenable to chlorination are free or are potentially dissociable, almost wholly or in large degree, and therefore, potentially toxic at low concentrations even in the dark."

The Agency believes that very few permittees will be impacted by this proposed change. Currently about 10 dischargers monitor for cyanide in their effluent. At least one discharger, the city of Northfield, already monitors for free cyanide using the cyanide amenable to chlorination method.

The following are the costs for total cyanide and cyanide amenable to chlorination charged by the Minnesota Department of Health analytical lab.

Total cyanide	$52
Cyanide amenable to chlorination	$84

Assuming the proposed change will impact 10 dischargers and twice monthly monitoring is required, the projected increased costs are:

$32 (difference in cost of the two methods) x 10 x 24 = $7,680

The Agency believes these costs are within reason, and that the advantages of measuring only the toxic form of cyanide, rather than the total, will be an advantage to the dischargers.

5. Hypothetical Examples

The following three examples serve to illustrate the potential cost impact of the proposed standards.

Example 1: A superfund site with ground water contaminated with volatile organics is located in a remote area near a small stream. The primary source of the contamination has been removed but a plume of contaminated ground water threatens the stream. The stream is a Class 2B water. The plan is to establish and pump barrier wells to intercept the plume, treat the water and either discharge it to the stream or spray irrigate it over adjacent land. Will the costs to clean up this site be different using the new standards compared to the current criteria?

Pollutants	current criteria (ug/l)	proposed standard (ug/l)	ground water conc. (ug/l)
1,1,2-Trichloroethylene	123	120	2000
Vinyl Chloride	3.3	7.6	25
1,2- Dichloroethane	128	190	200
Tetrachloroethylene	9	5.3	150
Chlorobenzene	109	10	75

Other pertinent information:

7Q10 of the stream = zero cubic feet per second

The projected pumping rate from all four barrier wells will be 25 gallons per minute.

Treatment Options and Estimated (Capital and O & M) Costs/day:

Passive air stripping (cascade)	($.08/1000 gal.)	$ 2.88
Air stripping without air filtration	($.20/1000 gal.)	$ 7.20
Carbon filtration	($.40/1000 gal.)	$14.40
Spray irrigation over vacant land	($.80/1000 gal.)	$28.80

Evaluation:

Since the receiving stream has a 7Q10 of zero, the discharge must meet the chronic criteria at the end of the pipe or be applied on land. Thus, treatment of the contaminated ground water would be required using either the current criteria or the proposed standards. The least expensive of the three treatment options, passive air stripping, is considered not adequate, but the use of air stripping without air filtration with discharge to the stream will provide adequate treatment.

Monitoring costs for this site will be unaffected by the proposed rules.

Conclusion:

The proposed standards will not increase treatment or monitoring costs for this site.

Example 2: A community of 1200 people has a small plating firm that provides employment for six persons. The firm pretreats about 2500 gallons per day of wastewater before discharging to the sanitary sewer. The town has an activated sludge wastewater treatment plant with a design flow of 120,000 gallons per day. The plant discharges to a small stream.

Pollutants	current criteria ug/l	proposed standards ug/l	Plating Firm Discharge conc. ug/l
Copper	10	10	500
Zinc	100	106	6000
Cadmium	0.8	1.1	300
Cyanide, total	20	none	120
Cyanide, free	none	5	unknown
Mercury	0.012	0.007	< 0.2

Treatment Costs:

The firm currently spends about $8,000 per year to operate and maintain their pretreatment system.

They currently spend about $450 per year for quarterly monitoring of their discharge:

4 metals x 4 x $15 (Flame AA)	= $240
total cyanide x 4 x $52	= $208

Future monitoring costs:

4 metals x 4 x $15 (Flame AA)	= $240
Cyanide amenable to chlorination 4 x $84	= $336

Evaluation:

Since the proposed standards are only slightly different from the currently used criteria, there will be no change in their treatment costs. The firm will, however, incur some additional monitoring costs because the new standard for cyanide is for free cyanide rather than total cyanide. The analytical procedure for total cyanide is less expensive than the procedure for free cyanide. The difference is about $32 per analysis. Assuming quarterly analyses, this represents a cost increase to this facility of $128 per year.

The mercury standards, both proposed and current, present a special monitoring problem because both are below the detection limit of the atomic absorption cold vapor procedure (detection limit = 0.2 ug/l). In this example, the mercury discharge concentration is below detection. Considering the dilution provided by the domestic waste water and the receiving stream (which is not specified in this example for purposes of simplicity), the standard may be met. If the Agency thought the mercury from this facility was contaminating the fish in the receiving stream, monitoring of the fish would be undertaken by the Agency.

Conclusion:

The new standards will increase the firm's monitoring costs by $128 per year. Treatment costs will remain the same.

Example 3:

A former trucking operation has left soil on their property contaminated with petroleum products. The site is adjacent to the Mississippi River in Fridley, Minnesota. A plume of contaminated ground water is moving toward the river. The Mississippi River is protected for drinking water in this reach.

Pollutants	current criteria (ug/l)	proposed standard (ug/l)	ground water conc. (ug/l)
Oil (total hydrocarbons)	500	500	25,000
Benzene	6.1	6.9	175
Toluene	68	253	350
Xylene	42	166	200

Evaluation:

Because all the proposed standards are the same or higher than the currently used criteria, the treatment option selected to meet the current criteria would also meet the proposed standards. It is possible that under some situations, involving these toxics, that treatment costs might be less under the proposed standards.

Conclusion:

The proposed standards would not increase treatment costs, and it is possible that in some situations they may be less.

B. Public Bodies

Under Minn. Stat. § 14.11, subd. 1 (1988), the Agency must provide an estimate of the public monies associated with implementing the proposed amendments if it is estimated that the total cost to all local public bodies exceeds $100,000 in either of the first two years following adoption of the rules.

The proposed amendments which may directly or indirectly increase costs to public bodies are 1) the procedures to determine standards, and 2) the new numerical standards.

The exact costs of the proposed procedures and the proposed numerical standards is impossible to determine as discussed on page 128 of this statement. Because the Agency has used a similar procedure to establish criteria in the past, and because, for most waters, only 15 out of 49 of the proposed standards are lower than the currently used criteria, the Agency staff feels that the financial impact on local public bodies will be small or none over the next two years (no comparison can be made for 5 of the proposed standards because they have no counterpart criteria). The same potential for increased monitoring discussed on page 132 applies to public bodies, but the Agency staff estimates the total costs will be less than $100,000 over the next two years. The large municipalities in Minnesota incur a substantial portion of the total monitoring costs for all public bodies. The effluents of the large municipalities have already been evaluated for toxics under the current rule. (Because of their size they are given a higher priority.) Thus, they will incur very little, if any, increased monitoring costs as a result of the proposed rule. Also, as indicated before, much of the monitoring required is for superfund or other hazardous waste site analysis which are not usually the responsibility of public bodies. Public bodies with superfund responsibility have a liability cap under the 1989 amendments to the state superfund law, Minn. Stat. § 115B.04, subd. 4 (1989 Supp.). Most superfund cleanups will exceed the $400,000 cap, thus, incremental monitoring costs will have no impact on public bodies.

It is very unlikely that the proposed rule will produce a sudden increase in monitoring requirements. It is anticipated that, if

monitoring costs increase at all, the increase will take place gradually over time as permits expire and are reissued, and as new hazardous waste sites are evaluated.

In summary, the chief effects are on monitoring; treatment costs may increase or decrease, but the cumulative impact will be less than $100,000 in either of the two years.

C. Small Business

Minn. Stat. § 14.115, subd. 2 (1988) requires the Agency to consider several factors that may reduce the potential impacts on small business when promulgating new rules. The factors are:

1. the establishment of less stringent compliance or reporting requirements for small businesses;

2. the establishment of less stringent schedules or deadlines for compliance or reporting requirements for small businesses;

3. the consolidation or simplification of compliance or reporting requirements for small businesses;

4. the establishment of performance standards for small businesses to replace design or operational standards required in the rule; and

5. the exemption of small businesses from any or all requirements of the rule.

The proposed rules may affect small business as defined in Minn. Stat. § 14.115 (1988). The discussion of projected cost impacts in section V. A. of this statement applies to small business. An assumed increase in monitoring is the cost increase most likely to occur as a result of the proposed rule (see example no. 2 on page 136 of this statement).

The Agency staff has considered the above listed methods for reducing costs to small businesses, but they can most effectively be implemented at the time the standards are applied in a case-specific situation. The proposed procedures and numerical standards are generally applicable state-wide. Their first function is to be protective of the beneficial uses. At the time they are used to establish permit limitations or cleanup requirements, these factors can and are being applied to reduce costs whenever possible. When the Agency addresses the water quality-based permit limitation setting procedures as planned for the next Chapter 7050 revision, these factors can be more fully addressed.

D. Agricultural Lands

Minn. Stat. § 17.83 (1988) requires the Agency to notice and describe in the statement of need and reasonableness any direct or substantial adverse effect the proposed rule might have on agricultural land. The Agency does not believe the proposed rule will have such an impact on

agricultural land. The proposed procedures are likely to be used in the future to develop standards for the modern herbicides and insecticides, but this action will not impact agricultural land.

E. Fiscal Note Requirement

Minn. Stat. § 14.131 (1988) incorporates into the rulemaking process the fiscal note requirements of Minn. Stat. §§ 3.981-3.983. Prior to the amendments to Minn. Stat. §§ 3.981-3.983 in the special session of the 1989 Minnesota Legislature, section 3.982 required fiscal notes for legislative bills and for proposed rules, subject to certain exceptions. The proposed revisions to chapter 7050 would have come under one of the exceptions to the fiscal note requirements.

The amendments to sections 3.981-3.983 enacted in the 1989 special legislative session have deleted all requirements for a fiscal note for state rules, leaving the requirements only for legislative bills. 1989 Minn. laws, 1st Spec. Sess., ch. 1, art. 1, §§ 10, 13. Therefore, no fiscal note for the revisions to chapter 7050 is required under Minn. Stat. §§ 3.982 and 14.131.

VI. TECHNICAL ADVISORY COMMITTEE

As required by Minn. Stat. § 115.54 (1988), the Agency must consider the advice of the Technical Advisory Committee (TAC) when adopting or revising its rules concerning wastewater treatment. The Agency staff met with the TAC on a total of six occasions, most recently on October 19, 1989. The

committee has provided a letter indicating their approval of proceeding with a public hearing on these rule amendments.

The TAC should not be confused with the Toxics Technical Advisory Committee (TTAC). The latter was a special committee formed by the Agency and its role in these amendments is discuss in Section I of this statement.

VII. LIST OF WITNESSES AND EXHIBITS

A. Witnesses

In support of the need and reasonableness of the proposed amendments to the rule, the following Agency staff helped prepare this statement of need and reasonableness and will be available to explain the proposed amendments and answer questions at the rulemaking hearing.

1. David Maschwitz: methods for determining aquatic life standards, specific proposed numerical standards, and certain of the minor amendments.

2. Gerald Blaha: outstanding resource value water designation for calcareous fens, limited resource value water reclassification of two streams, and certain of the minor amendments.

3. Carolyn Dindorf: bioaccumulation and the bioconcentration to bioaccumulation adjustment factor.

4. Curtis Sparks: amendments in general

The following outside experts will be available, if needed, to provide expert testimony:

1. David Gray, Minnesota Department of Health, Division of Environmental Health: standard exposure assumptions used in human health-based criteria, reference doses and cancer potency factors, and the one in 100,000 risk level for carcinogenic chemicals.

2. Gilman Veith, Director, EPA Environmental Research Laboratory-Duluth: bioaccumulation and the bioconcentration to bioaccumulation adjustment factor.

3. Ira Adelman, Head, Department of Fisheries and Wildlife, University of Minnesota: Toxicity-based criteria and the activities of the Toxics Technical Advisory Committee

B. Exhibits

In support of the need for and reasonableness of the proposed rules, the following exhibits will be entered into the hearing record by the Agency.

Exhibit Number	Document
1.	Order of Hearing.
2.	Certificate of Board's Authorizing Resolution.
3.	Notice of Hearing.
4.	Notice of Hearing as published in State Register.
5.	Mailing list certificates.
6.	Affidavit of Mailing.
7.	Rules with Revisor's Certificate of Approval.
8.	Toxics Technical Advisory Committee Final Report to the Minnesota Pollution Control Agency. March 1989.
9.	Notice of Intent to Solicit Outside Opinion published in the December 27, 1988 State Register, pp. 1655-1656.
10.	Notice of Intent to Solicit Outside Opinion published in the June 5, 1989 State Register, pp. 2900-2901.
11.	Letter to MPCA from the Michigan Department of Natural Resources dated February 23, 1989.
12.	Letter to MPCA from Buffalo Ridge Railroad, Inc. dated July 6, 1989.
13.	Letter to MPCA from the City of St. Michael dated November 9, 1989.
14.	Office memorandum with attachment to MPCA from Minnesota Department of Natural Resources, Division of Fisheries, Spicer Area dated July 12, 1989 and forwarded through Minnesota Department of Natural Resources, Ecological Services dated July 25, 1989.
15.	Letter from MPCA to Region V, EPA with draft Rule, dated October 16, 1989.
16.	Letter and comments (draft) to MPCA from Region V, EPA dated November 11, 1989 concerning draft water quality standards.
17.	Letter to MPCA from Region V, EPA dated August 15, 1989 with attached memorandum from USEPA dated June 19, 1989 concerning deadline for adopting toxics standards, and 40 CFR 131.
18.	Letter from MPCA to Region V, EPA explaining delay, dated December 5, 1989.
19.	Memorandum to MPCA from USEPA dated December 12, 1988 transmitting Guidance For State Implementation of Water Quality Standards For CWA Section 303(c)(2)(B). USEPA. December 1988.

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28. USEPA. (1987) (Draft) Guidelines for deriving ambient aquatic life advisory concentrations. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. and Office of Research and Development, Environmental Research Lab, Duluth, MN. June 1987.

29. USEPA. (1988) Review of the guidelines for preparing water quality advisories. Report of the Water Quality Advisories Subcommittee, USEPA Science Advisory Board. SAB-EETFC-88. April 1988.

30. USEPA. (1985) 40 CFR Part 141. National primary drinking water regulations; synthetic organic chemicals, inorganic chemicals and microorganisms; proposed rule. Federal Register, Vol 50, No. 219. November 13, 1985. pages 46936-47022. (1986) Proposed rule; correction. Federal Register, Vol 51, No. 25. February 6, 1986. pp. 4618-4619.

31. Memorandum to MPCA from USEPA dated June 12, 1989 transmitting (Draft) Guidance on Assessment, Criteria Development, and Control of Bioconcentratable Contaminants In Surface Waters. June 1989.

32. Minnesota Department of Public Safety. (1989) 1988 toxic chemical release inventory. Emergency Response Commission. November 1989.

33. Memorandum from Minnesota Department of Health dated November 16, 1988 transmitting Recommended Allowable Limits for Drinking Water Contaminants. Minnesota Department of Health, Section of Health Risk Assessment. Release No. 2, November 1988.

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52. Letters from A.J. Niimi, J.P. Connolly, G. Veith in support of the BCF to BAF adjustment factor.

53. Tables showing chemical prioritization process used to select chemicals needing standards.

54. Table showing the determination of final BAFs.

55. Table showing the determination of the toxicity-based criteria.

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101. Adrian fen, Nobles County, site map.

102. Altona State Wildlife Management Area fen, Lincoln and Pipestone Counties, site map.

103. Burke State Wildlife Management Area fen, Pipestone County, site map.

104. Minnesota Department of Natural Resources Commissioner's Order No. 2294, Regulations Designating Trout Streams, March 1988.

105. Letter and comments to MPCA from the National Wildlife Federation dated January 25, 1989.

106. List of the 126 Clean Water Act Section 307(a) priority pollutants.

107. Lime, D.W. (1969) Wilderness-like recreation opportunities adjacent to the Boundary Waters Canoe Area. Naturalist. 20:36-39.

108. Table comparing the proposed standards to the criteria currently being used by the Agency.

109. Stream assessment worksheet for Bogus Brook at Bock.

110. Stream assessment worksheet for Chetomba Creek at Prinsburg.

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VIII. CONCLUSIONS

Based on the information in this statement and the exhibits, the proposed amendments to Minnesota Rules Chapter 7050 are both needed and reasonable.

Dated: December 8, 1989

Barbara Lindsay Sims
for Gerald L. Willet
Commissioner

GLOSSARY

Definition of selected terms contained in Minn. Rules ch. 7050 as proposed and the supporting Statement of Need and Reasonableness.

Activated Sludge	A biological treatment process involving an aeration tank in which micro-organisms metabolize organic wastes.
Acute-Chronic Ration (ACR)	The ratio of the acute toxicity, expressed as an LC50 or EC50, of a toxicant to its chronic toxicity expressed as the chronic value. The ACR is used as a factor for estimating chronic toxicity on the basis of acute toxicity.
Acute Toxicity	A stimulus severe enough to rapidly induce a response. In toxicity tests, a response is normally observed in 96 hours or less. Acute effects are often measured in terms of equilibrium loss, immobilization, mortality or other debilitating effects.
Aerobic	In the presence of free oxygen.
Anaerobic	In the absence of free oxygen.
Arithmetic Mean	The sum of n numbers divided by n.
Average Concentration	The average concentration is the average level of a water quality characteristic over a specified period of time usually determined by making a number of measurements spaced throughout the time interval of interest, summing the values of these measurements and dividing by the total number of measurements.
BOD5	A five-day Biochemical Oxygen Demand (BOD5) determination is an empirical test which measures the oxygen utilized during a five-day incubation period for: 1) the biochemical degradation of organic material (carbonaceous demand); 2) the oxidation of inorganic materials; and 3) the oxidation of reduced forms of nitrogen (nitrogenous demand).
Bioaccumulation Factor (BAF)	The concentration of a substance in one or more tissues of an aquatic organism, exposed from any source of the substance but primarily from the diet and bottom sediments in addition to the water column, divided by the average concentration in the solution in which the organism had been living.
Bioconcentration Factor (BCF)	The concentration of a substance in one or more tissues of an aquatic organism, exposed only to the water as the source of the substance, divided by the average concentration in the solution in which the organism had been living.

CBOD5	Five-day Carbonaceous Biochemical Oxygen Demand (CBOD5) refers to the biochemical oxygen demand from a BOD5 test in which oxidation of the reduced forms of nitrogen is prevented by an inhibiting chemical.
Bioassay	A test determination of the biological effect of a substance, factor or condition utilizing living organisms or cells as the indicator.
Calcareous Fens	A rare wetland plant community typically composed of grass-sedge dominated peatlands which develop under specific hydrogeological conditions where surface discharges occur of ground water rich in calcium and magnesium bicarbonates.
Cancer Potency Factor (q1*)	A factor indicative of a chemical's human cancer causing potential. The q1* is the upper 95 percent confidence limit (one sided) of the slope from a linear nonthreshold dose-response model used by the USEPA to provide an upper bound estimate of incremental cancer risk. The q1* assumes a lifetime exposure and is expressed in days per milligram toxicant per kilogram body weight (d x kg/mg).
CFS	Cubic feet per second.
Chronic Toxicity	A stimulus that lingers or continues for a long period of time, often one-tenth the life span or more. A chronic effect can be mortality, reduced growth, reproduction impairment, harmful changes in behavior, and other nonlethal effects.
Chronic Criterion (CC)	The highest water concentration of a toxicant to which organisms can be exposed indefinitely without causing chronic toxicity.
Chronic Value	The geometric mean of the highest tested concentration which did not cause an unacceptable adverse effect and the lowest tested concentration which did cause an unacceptable adverse effect (and all higher test values cause an effect) in a approved chronic test.
Cold Water Fisheries	A community of fish including species of trout and salmon (family Salmonidae) that inhabit trout waters as defined in part 7050.0420.
Criterion	A number (or numbers) established for a substance to protect aquatic life, humans, or wildlife.
Cumulative Probability Function (cpf)	A function which gives the probability that the random variable x will assume a value less than or equal to a specific given value of x. For instance, if x = height of MPCA staff, the cpf for 68 inches is the probability that an MPCA staff member will be less than or equal to 68 inches.

DO	Dissolved oxygen; may be expressed in milligrams per liter (mg/l), or in percent saturation.
Discharger	Individual, municipality, industry or agency which discharges wastewater.
Duration	The period of time over which the instream concentration of a substance is averaged for comparison with the standard.
EC50 (Effect Concentration)	The toxicant concentration that causes equilibrium loss, immobilization, mortality, or other debilitating effects in 50 percent of the exposed organisms during a specific time of observation.
Effluent Limitation	Standard of purity associated with a wastewater discharge.
Final Acute Value (FAV)	An estimate of the concentration of a material corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute toxicity tests conducted on a substance.
Fecal Coliform	A group of micro-organisms (bacteria) found in the intestines of warm-blooded animals, including humans.
Geometric Mean	The nth root of the product of n numbers; equivalent to the logarithmic mean.
Gavage	Administration of fluids into an animal by a stomach tube, forced feeding.
Genus	A group of closely related species in the taxonomic classification of plants and animals. Genera is the plural of genus.
Genus Mean Acute Value (GMAV)	The geometric mean of the species mean acute values available for the genus.
K Value	The fraction of the total allowable daily dose of a toxic substance that is attributed to drinking water and fish consumption relative to other sources of the substance to humans, such as air or food, in the calculation of criteria. In the absence of sufficient data to establish a chemical-specific K value, the K value will be 0.2.
LC50 (Lethal Concentration)	The toxicant concentration killing 50 percent of the exposed organisms in a specific time of observation.
Linear Regression	A statistical method which allows you to express response in one variable (the dependent variable) as a function of unit changes in one or more other variables (independent variables).

Lipid	Any of a group of organic compounds consisting of fats and other substances of similar properties, insoluble in water but soluble in alcohol and other fat solvents.
Lipophilic	A lipophilic substance has a strong attraction to fats. Lipophilic substances bioaccumulate or are stored in fat tissue.
Logarithmic Mean	The antilogarithm of the sum of n logarithms divided by n; equivalent to the geometric mean.
Lowest Observable Adverse Effect Level (LOAEL)	The lowest tested concentration that caused a statistically significant occurrence of an adverse effect in comparison with a control when all higher test concentrations caused adverse effects. In a chronic test, the lowest tested concentration that showed an effect is similar to the LOAEL concentration.
Low Flow/Intermittent Streams	Rivers which have very little or no flow during certain periods of time.
Maximum Criterion (MC)	The highest concentration of a toxicant in water to which aquatic organisms can be exposed for a brief period of time with zero to slight mortality. The MC equals the FAV divided by two.
Multiple Linear Regression	A linear regression which involves more than one independent variable.
National Methods	The methods the USEPA uses to develop aquatic life criteria as described in Stephan, C.E., D.J. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman, and W.A. Brungs. 1985. Guidelines for deriving numerical national water quality criteria for the protection of aquatic organisms and their uses. U.S. Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratories, Duluth, Minnesota; Narragansett. RI, Corvalis, OR. 98 p; available through the National Technical Information Service (NTIS), Springfield, VA.
Non-threshold Toxic	A non-threshold toxic chemical has the potential to cause harmful or deleterious effects at any level or concentration.
No Observable Adverse Effect Level (NOAEL)	The highest tested concentration that did not cause a statistically significant occurrence of an adverse effect in comparison with a control when no lower test concentration caused an injurious or adverse effect. In a chronic test, the highest tested concentration that did not show any adverse effect is similar to the NOAEL concentration.
NPDES/SDS Permit	National Pollutant Discharge Elimination System/State Disposal Systems Permit.

Octanol To Water Partition Coefficient (Kow)	The ratio of the concentration of a substance in the octanol phase to its concentration in the aqueous phase of a two-phase octanol to water system after equilibrium of the substance between the two phases has been achieved.
Order of Magnitude	An approximation to the nearest power of ten. Often used to indicate a significantly large difference in quantities.
Parachor	Parachor relates to the physical properties of a molecule that affect its potential to bioaccumulate in aquatic organisms. It is a number that estimates the molecular size and shape of a chemical and indicates how readily a chemical can be transported across biological membranes. It is expressed as the molecular weight of a liquid times the fourth root of its surface tension, divided by the difference between the density of the liquid and the density of the vapor in equilibrium with it; essentially constant over wide ranges of temperature. All things being equal, the larger the parachor number, the less bioaccumulative the substance would be.
pH	A measure of the "acidity" or "basicity" of a solution, a pH greater than seven is basic, less than seven is acidic, and a pH of seven is neutral.
Phylum	A primary division in taxonomic classification and consists of a group of plants or animals constructed on a similar general plan.
7Q10	The seven consecutive day low flow with a recurrence interval of 10 years.
q1*	The cancer potency factor expressed in days times milligram toxicant per kilogram body weight.
Reference Dose (RfD)	An estimate of a daily exposure to the human population (including sensitive subpopulations) that is likely to be without appreciable risk or deleterious effects over a lifetime (70 years). The RfD is expressed in units of daily dose and was formerly known as the "Acceptable daily intake."
RAL	Recommended Allowable Limit for Drinking Water. Generally, a RAL for a systemic toxicant is an estimate of a daily exposure to the human population that is unlikely to result in deleterious effects during long-term exposure. Most frequently applied to the ground water sources of drinking water.
SAS	Statistical Analysis System is a computer program package which is capable of performing various statistical operations and analyses.

Salmonid	Any member of the fish family Salmonidae, including the trouts, salmon, ciscos, whitefish and others.
Species	A group of interbreeding individuals not interbreeding with another such group.
Species Mean Acute Value (SMAV)	The geometric mean of all the available and acceptable acute values for a species.
Standard	A number or numbers established for a substance to protect a specified beneficial use. The standard for a toxic substance includes the lowest of the chronic criteria established to protect aquatic life, humans, or wildlife, the maximum criterion, and the final acute value. Some substances do not have a maximum criterion or final acute value due to insufficient data, in which case the chronic criterion alone is the standard.
Systemic	Affecting or impacting the entire organism or bodily system.
Taxonomic Classification	A systemic classification and naming of organisms organized under the following taxonomic units: Kingdom Phylum Class Order Family Genus Species
Toxic Pollutant	A pollutant listed as toxic under section 307(a)(1) of the Clean Water Act, United States Code, title 33, section 1317(b)(1), or as defined by Minn. Stat. § 115.01, subd. 14.
USEPA	The United States Environmental Protection Agency.
Water Quality Characteristic	A characteristic of natural waters such as total hardness or pH, that can affect the toxicity of a substance to aquatic organisms.