Justification for Numeric Standards of Salinity and Sodicity of Water To Be Considered For Beneficial Use For Irrigation

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Currently there is considerable debate among industry proponents of coal bed methane development, regulatory agency personnel, political entities and representatives, landowner groups, and environmental protection entities regarding the value, appropriateness, and specificity of numeric and narrative standards specific to salinity and sodicity of waters to be considered for either irrigation or dispersal through land spreading. As of the writing of this document, the state of Montana Department of Environmental Quality (MT-DEQ), the Tribal Council of the Northern Cheyenne Tribe, the Tongue River Water Users Association, the T and Y Irrigation District, and the Buffalo Rapids Irrigation District have proposed various versions of numeric standards for salinity and sodicity of surface water resources with potential use for irrigation. In addition, the state of Wyoming Department of Environmental Quality (WY-DEQ) is also contemplating numeric standards for these parameters.

This paper addresses in general the issue of narrative and numeric standards and presents a rationale for the adoption of conjunctive numeric criteria and standards to compliment existing narrative standards. The rationale for **conjunctive numeric and narrative standards** applies to the complete spectrum of water quality constituents, parameters, and entities which may be considered either contaminants or pollutants. The information presented herein is intended to be reviewed from the perspective of water quality standards - although the information may have direct application to other fields of management and regulation.

The Purpose of Standards

Standards, whether narrative or numeric, are intended to provide guidance, goals, tools for monitoring and assessment, benchmarks, uniformity and consistency in management of resource - whether human, physical, biological, monetary, academic or other. Standards also serve as a benchmark for assessing compliance and trends. **Narrative standards provide broad-scale, general guidance of a qualitative nature whereas numeric standards provide specificity in a quantifiable manner. Narrative standards define the broad guidelines which serve as the basis for definition of numeric standards.**

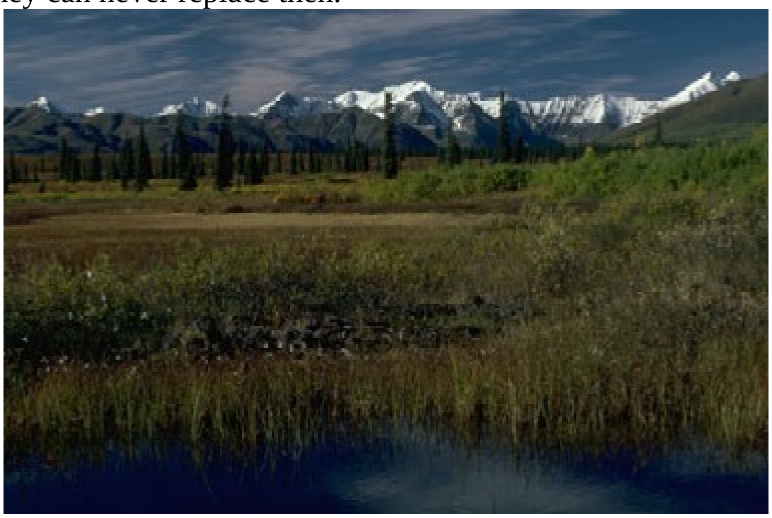
The basis for standards is multi-faceted: existing conditions, known cause-and-effect relationships, desired or expected future conditions, goals, designated uses of the resource, and achievability of specific circumstances. **Before any standard can be declared or adopted, whether narrative or numeric, it is necessary to complete background research, including the current status of the quality of water. The first step is then in the definition of narrative standards. Once narrative standards have been defined, the next logical step is numeric standards.** The designated uses will influence the specific parameters. Second, there should be a formal review of the guidelines. The narrative criteria must be specific enough that they may be translated into numeric criteria, permit limits and other control mechanisms.

Defining Narratives and Numerics

With respect to water quality, **narrative standards are general statements that establish water quality goals or outcomes and consequences that should result from maintaining a specified condition.** Narrative standards provide a mechanism for a qualitative framework for monitoring, protecting, and maintaining water quality. Narrative guidelines may also identify specific benchmarks that describe the quality of water needed to be able to use the water for a designated use. In as much as **narrative standards are for the most part guidelines,** presented as general descriptions, **narrative standards encompass significant latitude for interpretation. Narrative standards are typically established in the absence of scientifically based numeric standards or guidelines or as general framework within which numeric standards are defined. Narrative standards provide guidance to desired outcomes to be achieved by the imposition and compliance with numeric standards and criteria.**

Narrative standards serve as both the foundation and backstop for numeric standards. Narrative criteria should serve as the main guidelines and numeric values should enforce the narrative standards. Once narrative guidelines are established, efforts should be undertaken to set numeric values for the specific guidelines. Due to the rapid pace of technology, it should also be recognized that numeric standards may change over time but there is much less likelihood that narrative standards or goals will change significantly over time.

Narrative (sometimes referred to as enumerative) **standards or criteria have been adopted nationally and state by state as acceptable criteria to base environmental decisions on when data to support, justify or serve as the foundation and basis for numeric standards are inadequate or unsubstantiated.** Narrative statements represent the quality of water required to meet a designated or beneficial use. Some narrative criteria describe a desirable biological condition, such as a balanced, healthy population of native aquatic life. Others are expressed as general statements or "free from statements" about other types of conditions that should or should not exist. For example, many states' narrative standards say water should be "free from substances that may cause adverse effects to aquatic life." Since no state can ever set chemical criteria for all conceivable pollutants and water quality parameters, these narrative criteria serve as an important backstop to numeric criteria. They should always supplement numeric criterion, but they can never replace then.



Narrative standards are usually established when specificity of numeric criteria regarding an identified water quality parameter or water quality goal are not known or are not clearly defined - yet the desired outcome of the standard or management is known. **Narrative standards would be used exclusively when numeric criteria cannot be established or to supplement numeric criteria.** It is important for narrative guidelines to be specific and when possible able to be translated into numeric data. In contrast, numeric standards are based on proven science and known cause-and-effect relationships, i.e., predictable outcomes.

With respect to numeric criteria, specific data to support, justify, and serve as the foundation for numeric standards for salinity and sodicity are available, substantiated and consistent from research finding to research finding.
Numeric standards set specific, quantitative limits and must be applied to specific conditions and sets of circumstances. In the case of water quality, numeric standards address chemical and physical parameters or biological conditions. With respect to water quality, numeric standards can provide a maximum concentration of pollutants, acceptable ranges of physical parameters, minimum thresholds of biological conditions, and minimum concentrations of desirable parameters, such as dissolved oxygen.

Numeric standards are measurable and easily quantifiable. In addition, assurance of satisfactory compliance or achievement of a specified water quality goal can not be assured with any degree of acceptable probability without knowledge of a numeric criteria. Numeric standards leave little room for interpretation and often lack flexibility in implementation or achievement, whereas the interpretation of narrative standards could change. Numeric criteria should be used to guide management to achieve goals set forth in narrative standards. Numeric criteria are in the form of concentrations, loads, values etc. and are usually only applied to waters that have been designated as being beneficial and have water year round.

Numeric criteria are specific numeric values for chemical constituents, physical parameters or biological conditions that are adopted in state standards. These may be values not to be exceeded (e.g., toxics), values that must be maintained or exceed (e.g., dissolved oxygen), or a combination of the two (e.g., pH). Unlike narrative standards, numeric criteria are very specific and more easily measurable. This makes numeric criteria easier for a regulating body to enforce. **Numeric standards are less useful for non-point sources and activities that affect physical and/or biological, rather than chemical, aspects of a body of water.**

Numeric standards as a consistent, repeatable, defendable, transferable mechanism for monitoring, assessment, enforcement, and compliance:

Numeric standards and criteria are essential to effective, consistent, repeatable, defendable monitoring. Monitoring is a crucial element of water quality-based decision making. Monitoring provides data for an independent evaluation of whether the imposed practice or activity and control actions that are based on the standards protect or improve the environment and are sufficient to meet changing waterbody protection requirements such as revised water quality standards or changing pollution sources.

It is not inconceivable that a regulatory agency administrator or individual responsible for issuing narrative standards (or for that matter numeric standards) has never actually witnessed the significance of standards or the consequence of violation of a standard. Similarly, individuals within the industry quite conceivably lack the knowledge, expertise, and experience to assess the situation or impact of a specific situation. **Numeric standards provide a mechanism for and a means of consistency in permitting, analyzing the consequences of permit situations, determining why particular cause-and-effect relationships occurred or resulted in the consequence we observe, and determining how we are going to change our actions so that the situation is not repeated. Numeric standards provide a mechanism for assessment, record keeping, and database generation that facilitates situation analyses.**

Numeric standards provide a equitable, consistent, and transferable means of assessment which does not require repeated interpretation. Nor does it allow for inconsistency in implementation or interpretation. Narrative standards - admittedly - provide flexibility in interpretation. However, numeric standards are based on science, interpretation is not necessary. Science is based on facts, scientific method, proven cause-and-effect relationships. If, on the basis of numeric standards, a particular situation is found to fall measurably outside the norm or distant from the standard, an opportunity should be taken to see how to improve the situation.

Without numeric standards, it makes it extremely difficult for anyone to be held accountable. Numeric standards provide a transferrable, assessable, real time mechanisms to insure and monitor accountability to the constituency.

Weighing Advantages and Disadvantages:

What are the advantages, disadvantages, strengths, weaknesses of narrative standards, numeric standards? The following is a summary comparison of the advantages and disadvantages of narrative and numeric standards. **The importance or significance of each advantage and disadvantage, relative to establishment of standards for salinity and sodicity of surface water for irrigation or beneficial use purposes, is identified as follows**: **none** - no significant role; **slight** - some but not significant role or importance; **moderate** - recognizable significance or importance; **high** - substantial importance or significance. A fifth category has been defined as **not recognizable,** i.e., no immediate importance or significance is evident at present time or circumstances where this condition would be preferred and is not recognizable at present.

Advantages of Narrative Standards	
Advantages	**Significance**
Easy to establish	none
Give monitors flexibility	not recognizable at present time
Broader in definition - allow prohibition of certain activities	high
Provide wide range of protections to designated water use	high
Wide spectrum of effects are considered	high
Inexpensive to implement	moderate
Sites can be quickly monitored on qualitative basis	high (validity of advantage

	questionable)
Can be adjusted to fit variations in watershed characteristics	moderate
Disadvantages of Narrative Standards	
Disadvantages	**Significance**
Difficult to measure	high
Interpretations are not consistent; interpretation of compliance subjective	high
Do not insure consistency, continuity, or transferability of enforcement or transferability	high
Easily subject to dispute and disagreement - subject to individual interpretation	high
May not be specific enough for enforcement	high
Offer no standard or benchmark for degree of exceedance, necessity of enforcement	high
May not be applied correctly and intended protections are nullified	high
Some effects may be improperly attributed to point sources	none
May be more difficult for monitorers to understand	none
May lack depth of data	none (extensive data present to support numeric standards)

Advantages of Numeric Standards	
Disadvantages	**Significance**
Easily measured; exact; concrete; absolute assessment	high
Provide regulatory consistency; equity of management and regulation among all parties	high
Serve as a basis for enforcement and implementation of TMDL	high
Specific in definition - easier to regulate	high
Facilitate interpretation and analysis of measurements/observations	high
Expedite permitting of processes likely to impact resource	high
Standards are common and consistent - easily applied	high
Quantifiable and comparable test results	high
Provide quantifiable basis for assessment of extent of deviation	high
Easily understood, no ambiguity	high
Data are easy to handle and historical databases can be created	high
Provide specific, transferable, cross boundary tools for management, assessment	high
Provide mechanism for uniformity of management among agencies, entities, states	high
Facilitate communication	high

Insure continuity within agency	high
Independent of tenure, political motivation	high
There is little room for misinterpretation and skewing of data	high
Provide a mechanism for integration, accountability, and equitable apportioning of multiple sources, entities, discharges	high

Disdvantages of Numeric Standards	
Disadvantages	**Significance**
Difficult to establish	irrelevant
Remove flexibility/creativity	moderate
May be too narrow to holistically protect watershed - not good for non-point sources	high
Do not address the unique environment of individual watersheds	moderate
Ignore post discharge effects like alluvial interaction	none
Can be time consuming	moderate, but possibly irrelevant with respect to situation
May not be measurable across all bodies of water due to differences in characteristics and designated uses	moderate
The team creating the numeric can skew it to fit their intended outcome	irrelevant
Numeric standards imply and impose regulation rather than management	none
Eliminate flexibility in managing outside the standards	moderate

Objective of Establishing Water Quality Standards

The determination and definition of water quality standards and criteria is founded on intended attainment of one or more of a number of the following specific objectives:

1. Protection or preservation of existing uses associated with the water body, i.e., in the case of irrigation, livestock watering, fisheries, native wetland plant communities of cultural or historic significance.
2. Protection or preservation of the existing water quality with the intent of sustaining currently existing conditions, for example, in the case of fisheries or macro invertebrate populations. This objective essentially constitutes no new impairments or additions to existing impairments.
3. Preservation of the water resource for future or intended uses, i.e., in the case of future irrigation, recreational, or fisheries development.
4. Establishment of goals or target water quality characteristics that may be achieved through changes in watershed management.

The acceptable or allowable standards also need to be considered for adoption on the basis of: 1) the willingness or legality of some imposed impairment, 2) the level of impairment acceptable, i.e., % above some threshold, 3) the known thresholds with respect to the impacted entities, 4) the degree of attenuation, dilution, or assimilation due to loading/mixing rates, 5) economic burden that may be imposed as a consequence of adoption of specific standards. Certainly numerous other factors, yet to be identified, need to be taken into account when adopting standards.

The challenge of defining or designating a specific water quality threshold or criteria is complicated by the fact that waters of unique or regulated characteristic cannot be partitioned within the irrigation systems or stream channels once water is entered into the channel. Designating a specific water quality standard tailored to a unique set of soil criteria is further and more critically complicated by the fact that individual land resource conditions seldom occur as unique, isolated entities within the landscape, but rather as aggregated units within a more broad land form, which may be comprised of many competing land uses.

Rationale for numeric standards for salinity and sodicity of interstate surface waters intended for either irrigation or land spreading as a means of disposal:
The establishment of water quality standards and criteria for land spreading and/or irrigation suitability is supportable by more than 50 years of research elucidating the specific interactions between irrigation water quality, crop performance, soil physical and chemical characteristics, and groundwater. Water suitable for irrigation is a designated beneficial use. Irrigation water quality suitability is based on water quality and quantity characteristics, plant species and plant growth stage, soil and climate conditions, management practices, surface proximity to groundwater, geology and geomorphology, and physical infrastructure associated with water conveyances and deliveries. In order to protect the integrity of irrigable waters, insure rigor in management, and establish consistency and continuity among the multiple parties involved in both irrigation development and coalbed methane development, numeric standards appear essential.

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