REGULATORY APPROACHES TO COMPLYING WITH WATER QUALITY STANDARDS[1]

Jarvis Harper[2]

Abstract. Reported detections of elevated contaminates of concern (COC) are becoming more prevalent in industrial/mining discharges. Complying with Federal and State stream standard for COCs is becoming increasingly difficult for many dischargers. For example, EPA has proposed 5 Φg/l selenium as the chronic numerical criterion for receiving streams. Potential treatment options for waters contaminated with selenium include physical, biological, and chemical methodologies. However, treatment methodologies that will reduce selenium concentrations to levels below 5 Φg/l are expensive and have not been highly successful in field applications. An alternative approach to compliance with selenium, or COCs, may be to alter the regulatory aspects. Several options are discussed including permit modifications, mixing zones, maximizing stream assimilative capacities, modifications to the designated use of a water body, variances, Use Attainability Analyses, increasing the numeric criteria in receiving streams, site-specific numeric water quality criteria changes, and environmental improvement projects. Each discharge, receiving stream, permit, and locality has unique circumstances that preclude a "cookbook" approach to compliance with water quality standards but numerous options are available to assist dischargers with compliance issues.

Additional Key Words: mixing zone, assimilative capacity, designated use, attainable use, variance, use attainability analysis, environmental improvement project

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[2] Jarvis Harper Ph.D., C.P.Ag. is Project Manager, FTN Associates, Ltd., Little Rock, AR, 72211

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Introduction

Contaminates of Concern (COCs) in industrial/mining discharges are becoming more prevalent as demand for goods increases, methodology/practices are altered, sampling/analytical techniques improve, water quality criteria are modified, and for other reasons. Some of the more prevalent COCs include Al, B, Bo, Cd, Cr, Co, Cu, Hg, Fe, Mg, Mn, Ni, Ag, V, Pb, Zn, Se, sulfates, chlorides, and TSS.

One of the more commonly used treatment methods for waters impacted by mining/industrial activities is neutralization/precipitation (Ayres et al., 1994). Neutralization/precipitation is an active form of chemical treatment and typically removes metals to concentration values that are less than permit limits. For example, Fe is frequently removed from such waters by neutralization/precipitation treatment systems to concentrations that are well below best available technology driven NPDES permit limits of 0.5 mg/L. The cost of this form of treatment varies greatly and is dependent on the chemistry of the water being treated, metals being removed, type of chemicals used, labor costs, equipment costs, installation costs, and utility access.

Water treatment systems take on many forms other than neutralization/precipitation. Other forms of chemical treatment systems as well as biological and physical treatment systems have been employed to remove COCs from wastewaters. Many of these systems will remove COCs to concentrations that are much lower than those achievable when using neutralization/precipitation technology. Passive biologic systems such as bioreactors, wetlands, and permeable reactive walls have shown promise but are sometimes limited in terms of efficiency and can be expensive. Both efficiency and costs of these systems are a function of several factors such as site access, bacterial activity, composition of the reactive mixture, flow, constituent loading, constituent toxicity, and metal speciation. Frequently such systems will achieve concentrations that are below Federal and State water quality criteria.

Although water treatment systems can be used to treat to levels that achieve compliance with either permit limits and/or Federal/State water quality standards, they occasionally are limited in ways that preclude them being used to treat a specific discharge. Some of the limiting factors include, but are not limited to, flow, temperature, concentrations, acceptability, fouling/plugging, power requirements, remoteness, available space, and waste disposal. In addition, water treatment systems must not only be capable of removing the constituents of concern but must be capable of treating a volume of water that exceeds the anticipated annual generation at a reasonable cost. Some of the COCs (e.g. selenium) often exist in wastewater at relatively low concentrations before it is subjected to the treatment process. Depending on the treatment system selected, it may be difficult to remove COCs that exists in influents at low concentrations to values that meet water quality criteria. When water treatment options for a particular COC are not effective or are cost prohibitive regulatory approaches to complying with water quality standards may be a viable option.

Regulatory Approaches to Compliance

In the rare instances where treatment systems fail to perform adequately or are impractical for the application regulatory approaches to compliance are worthy of consideration. Typically there is sufficient regulatory flexibility in the form of permit modifications, mixing zones, maximizing stream assimilative capacities, modifications to the designated use of a water body, variances, Use Attainability Analyses, site-specific numeric water quality criteria changes, and Environmental Improvement Projects. Although numerous options are available to the discharger, each option has to be weighed against the conditions that exist at the particular site to determine which option is best suited to ensure compliance of a particular discharge or in a particular receiving stream. Regardless of the regulatory approach or approaches used, one should seek to alter the regulatory aspect on only that portion of the receiving stream needed to ensure compliance.

Permit Modifications

Federal/State permits are typically written to cover a five-year time frame. However, should the situation dictate that a permit condition be altered before the permit expires, modifications can be made to the permit. This is accomplished by submitting a modification request to the regulatory entity stating the requested changes along with required justification. Once the regulatory entity approves the request, a public notice will be issued stating the proposed alterations to the permit. After the public comment period has expired the regulatory agency will then review the comments, if any, and issue a public response to the comments. If the regulatory entity deems changes to the draft permit amendments appropriate, the permit holder will be notified of the requested changes. The permit holder has the option of negotiating with the regulatory agency and resubmitting the changes for public comment or making the changes as requested. Once the permit holder and the regulatory agency agree on the proposed changes and public notice is successfully completed, a modified permit will be issued to the permit holder.

Upon completion of the permit cycle, permits are almost always modified during the renewal process. As part of the modified permit, it is not uncommon for the regulatory entity to include a compliance schedule that allows the operator up to three years to come into compliance with a new permit requirement. This approach is a good tool for permittees to use assuming that the permit condition can be met at the end of the compliance schedule. One should be cautious about signing a permit with a compliance schedule without a great deal of certainty that the condition can be met in the specified time frame.

Mixing Zones

Mixing zones can be a critical component of ensuring compliance associated with end-of-the-pipe discharges. Even after treatment, wastewater discharges sometimes result in low levels of contaminates of concern that are temporarily in excess of in-stream criteria. In many such cases, mixing zones have been effectively used by permittees.

CORMIX is a USEPA-supported mixing zone model. In their discussion of the model EPA states, "A mixing zone is the region in which the initial dilution of a discharge occurs. In contrast, the regulatory mixing zone is a definition that allows for the initial dilution of a discharge rather than imposing strict end-of-pipe concentration requirements for NPDES water quality permits for conventional and toxic discharges. They (mixing zones) can be used as long as the integrity of a water body as a whole is not impaired" (www.cormix.info/picgal/rmixingz.php).

EPA further states the (regulatory) mixing zone is defined as an "allocated impact zone" where numeric water quality criteria may be exceeded as long as acutely toxic conditions are prevent(ed). A (regulatory) mixing zone can be thought of as a limited area or volume where the initial dilution of a discharge occurs. Water quality criteria apply at the boundary of the (regulatory) mixing zone, not within the mixing zone itself. Figure 1 from USEPA (**www.cormix.info/picgal/rmixingz.php**) depicts this in a graphic format.

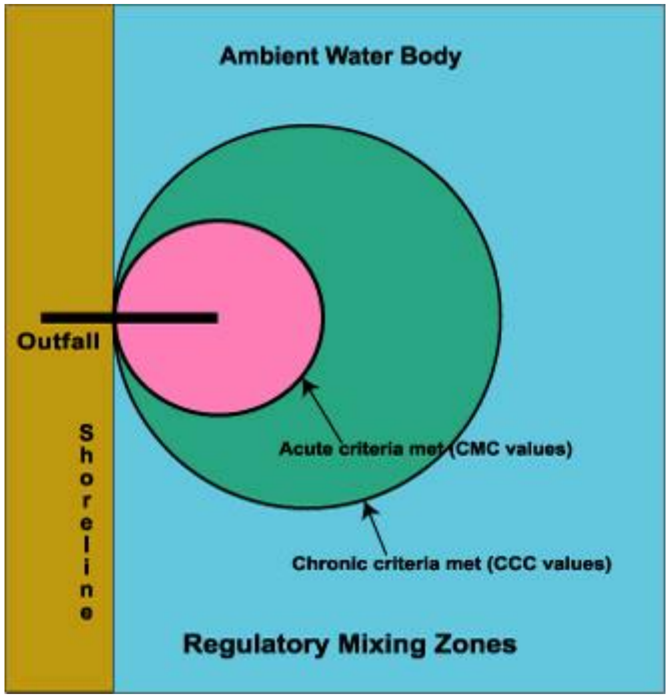

Figure 1: Regulatory Mixing Zones

USEPA also has identified Special Regulatory Mixing Zone Requirements for Toxic Discharges. In discussing the mixing zone requirements they state

"USEPA maintains two water quality criteria for allowable concentrations of toxic discharges:

- 1. Criterion Maximum Concentration (CMC) - Protective of acute or lethal effects.
- 2. Criterion Continuous Concentration (CCC) - Protective of chronic effects.

The CMC is spatially more restrictive than the CCC. The CCC is often treated like a water quality standard, it must be met at the edge of the same regulatory mixing zone specified for conventional or toxic pollutants" (www.cormix.info/picgal/rmixingz.php).

USEPA (www.cormix.info/picgal/rmixingz.php) allows a toxic dilution zone within the regulatory mixing zone, but it must comply with one of four of the following criteria:

1. Meet the CMC within the discharge pipe.
2. Exit velocity must exceed 3 m/s (10 ft/s).
3. Geometric Restrictions.
4. Show that a drifting organism will be exposed less than 1 hour to CMC no more than once in 3 years. (www.cormix.info/picgal/rmixingz.php).

Mixing zones allow a zone of passage for organisms that may be sensitive to a particular contaminate while allowing the assimilative capacity of the receiving stream to be utilized as appropriate. On the other hand sensitive organisms that cannot move quickly enough to escape the effects of the contaminate may be sacrificed. In order for the mixing zone to function properly the flow in the receiving streams must be equal to or larger than the discharge and the concentration of the contaminate of concern in the receiving stream must be less than that in the discharge.

Maximizing Stream Assimilative Capacities

Stream assimilative capacity has been defined as "the ability of a receiving water to accept a quantity of a water quality constituent and still meet water quality standards" (arcweb.sos.state.or.us/rules/OARs_300/OAR_340/340_056.html). EPA defines it as "The capacity of a natural body of water to receive wastewaters or toxic materials without deleterious effects and without damage to aquatic life or humans who consume the water" (http://www.epa.gov/OCEPAterms/aterms.html).

The assimilative capacity of a stream depends on the flow in the receiving water and the concentration of the pollutant upstream. As the upstream flow increases and the upstream concentration decreases the assimilative capacity is increased. In some cases assimilative capacity may represent dilution as in the allocations for metals. In other cases it is a function of the break-down of pollutants in the receiving water such as allocations for oxygen-demanding materials (http://chagrin.epa.ohio.gov/dsw/permits/districts/NEDO/3IE00016.fs.pdf).

Maximizing stream assimilative capacity is analogous to implementing a Total Maximum Daily Load (TMDL). A TMDL specifies the maximum amount of a pollutant that a water body can receive and still meet water quality standards. In doing so, the process allocates pollutant loadings among point and nonpoint pollutant sources. The TMDL calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality.

Streams are one of the few if not the only system that can recover when the assimilative capacity has been exceeded. This is due in large part to the fact that streams are typically being flushed over time and that they are dynamic in terms of species prevalent in the waterbody.

The advantage of implementing a TMDL is that the calculated loads are the result of a mathematical calculation and not a set of assumptions. The calculation allows one to use actual flow and water quality data where critical conditions are taken into consideration. Two disadvantages of implementing a TMDL are that nonpoint sources cannot always be identified and the calculated loads only apply to the point in the stream where the data is collected.

Modifications to the Designated Use of a Water Body

EPA requires that States and authorized Indian Tribes specify appropriate water uses to be achieved and protected. When identifying appropriate uses they are to take into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes. Before designating uses for a water body, States and Tribes are expected to examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting, its scenic qualities, and economic considerations. Where water quality standards specify designated uses less than those that are presently being attained, the State or Tribe is required to revise its standards to reflect the uses actually being attained (www.epa.gov/waterscience/standards/about/uses.htm).

In many cases a designated use was assigned by default to a water body by the regulators but the assigned use was not and could not be attained. In order for certain water quality criteria to become less stringent on such streams, it is often necessary that the designated use be removed or modified. For example, on a stream designated as a public water supply, in order for sulfate criteria to be increased to a value above 250 mg/l (drinking water standard) the public water supply use will need to be removed. Otherwise the standards will be conflicting.

Frequently States do not have sufficient time or resources to conduct the requisite Use Attainability Analyses to justify altering the designated uses and/or criteria. Consequently dischargers often are placed in the position of hiring consultants to complete the appropriate steps to effect a change in the designated uses. This is a perplexing dilemma with no easy solution. Industry is generally opposed to additional taxes being levied to cover the cost of removing uses designated by default. Even if taxes/fees were imposed the States would be hard pressed to prioritize the streams to be studied in an equitable fashion. Since State and Federal governments are not required to conduct elaborate studies to initiate water quality criteria/uses as is required to remove criteria/uses, perhaps a more judicious system of initiating water quality criteria would lessen this dilemma. In this manner the "polluter pays" concept would apply to the industry seeking to remove a particular criterion that was judiciously assigned.

According to EPA "setting water quality goals through assigning 'designated uses' is best viewed as a process for states and tribes to review and revise over time rather than as a one-time exercise. A key concept in assigning designated uses is "attainability," or the ability to achieve water quality goals under a given set of natural, human-caused, and economic conditions. The overall success of pollution control efforts depends on a reliable set of underlying designated uses in water quality "standards" (http://www.epa.gov/waterscience/standards/uaa/info.htm).

According to the Florida Department of Environmental Protection "designated uses establish the environmental goals for water resources. Typical uses include public water supply, primary contact recreation (such as swimming), and aquatic life support (including the propagation of fish and wildlife)" (www.floridadep.net/water/bioassess/docs/factshtz/fs3wqstan.pdf).

Variances

As an alternative to removing a designated use, a discharger may be able to utilize a variance as a water quality standard. Variances temporarily relax a water quality standard, are subject to public review every three years in most cases, and may be extended upon expiration. Variances can be helpful when progress toward improving water quality is being achieved but not within regulatory time frames (http://www.epa.gov/wqsdatabase/demo/intro/pol.htm).

The Preamble to the Federal water quality standards regulations discusses limiting the granting of a variance that"... based on a demonstration that meeting the standard would cause substantial and widespread economic and social impact, the same test as if the State were changing a use..." An interpretation by EPA's Office of General Counsel allows that any of the factors recognized in the regulation for justifying a stream use downgrade, not just the substantial and widespread economic and social impact test, may be used to support a variance (http://www.epa.gov/waterscience/library/wqstandards/wqsvariance.pdf).

State regulations generally reflect the Federal guidance. For example Section 33-16-02.1-05 of the North Dakota water quality standards states, "the department can permit a variance to the water quality standard for the affected segment. The department can set conditions and time limitations with the intent that progress toward improvements in water quality will be made. This can include interim criteria that must be reviewed at least once every three years. A variance will be granted only after fulfillment of public participation requirements and environmental protection agency approval. A variance will not preclude an existing use." (www.health.state.nd.us/wq/sw/Z7_Publications/B_NDCC_WQS.pdf).

Depending on the circumstances surrounding the variance it may be granted administratively or through a more formal process. Short term and single use variances typically are granted administratively. Regardless of the approach used the variance should be well documented in order to protect the discharger and the regulators.

Variances have the advantage of temporarily relaxing a water quality criterion to allow a particular effort to be completed without concern of enforcement action being taken on the discharger. They have the disadvantage of being less than three years in length. While a variance can theoretically be extended after the three-year time frame has expired an extension is not guaranteed.

Use Attainability Analysis

EPA’s definition of a Use Attainability Analysis (UAA) is “a structured scientific assessment of the factors affecting the attainment of uses specified in Section 101(a)(2) of the Clean Water Act (the so called "fishable/swimmable" uses). The factors to be considered in such an analysis include the physical, chemical, biological, and economic use removal criteria described in EPA' s water quality standards regulation (40 CFR 131.10(g)(1)-(6))” (www.epa.gov/waterscience/standards/uaa/about_uaas.htm).

Based on 40 CFR 131.10(g) “states may remove a designated use which is not an existing use, as defined in § 131.3, or establish sub-categories of a use if the State can demonstrate that attaining the designated use is not feasible because:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or
2. Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or
3. Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
4. Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or

5. Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
6. Controls more stringent than those required by sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact" (http://www.epa.gov/waterscience/standards/uaa/about_uaas.htm).

A UAA is an effective tool to consider when addressing compliance issues because the process critically evaluates the physical, chemical, biological, and economic use removal criteria. However, because they are comprehensive and are conducted over multiple seasons UAAs are typically time-consuming and consequently relatively expensive to conduct.

<u>Site-Specific Numeric Water Quality Criteria Changes</u>

Discharges may utilize site-specific criteria to achieve compliance with permit limitations. The EPA website (www.epa.gov/waterscience/library/wqcriteria/naturalback.pdf) states "Site specific criteria are allowed by regulation and are subject to EPA review and approval". The Federal water quality standards regulation at 40 CFR 131.11 (b)(1) requires States and authorized Tribes to adopt numeric water quality criteria that are based on section 304(a) criteria, section 304(a) criteria modified to reflect site-specific conditions, or other scientifically defensible methods. Currently, EPA guidance has specified three procedures for States and Tribes to follow in deriving site-specific criteria. These are the Recalculation Procedure, the Water-Effect Ratio Procedure and the Resident Species Procedure. These procedures can be found in the Water Quality Standards Handbook (EPA-823-B940005a, 1994). EPA also recognizes there may be naturally occurring concentrations of pollutants, which may exceed the national criteria, published under section 304(a) of the Clean Water Act.

For Se specifically, Adams et al. (2000) states "Bioaccumulation data leave little doubt that water Se concentrations protective of aquatic life and wildlife differ from site to site as a function of selenium's site-specific biogeochemical cycling. Consequently, from a regulatory perspective to avoid over-regulation with associated costs, there is a need for developing a site-specific water quality criteria methodology for Se. Existing methodologies for deriving site-specific water quality criteria such as water effect ratios are not applicable to Se because unlike most contaminants, for Se, the diet is the critical exposure pathway. Therefore, approaches for deriving site-specific water quality criteria must be based on the dietary exposure pathway to be appropriately protective for both birds and aquatic life.”

Altering numeric water quality criteria on a site-specific basis helps to ensure that the discharger is in compliance without making wholesale criteria changes to the entire water body. This is often a more acceptable change of water quality standards to the regulator and to the general public.

In the event that the water quality criterion of concern is a toxicant and/or bioaccumulator, such as Se, the criterion cannot be altered to a level that exceeds a toxic concentration. For example, EPA has determined that Se is toxic to aquatic life when stream concentrations exceed 5 Φg/L. EPA will not approve an increase in the Se water quality criterion unless 1) scientific documentation that aquatic life will not be impaired at the higher concentration is provided or 2) the segment of the receiving stream is designated as a mixing zone in which the criterion can be increased above 5 Φg/L assuming that the mixing zone regulations are met.

The federal water quality regulations allows for modification of water quality standards and many states employ this approach to develop more appropriate water quality standards for their waters. For example the state of Arkansas has approved numerous site-specific water quality criteria for parameters such as sulfate, chlorides, total dissolved solids, temperature, and selenium in various waters.

Environmental Improvement Projects

The General Assembly of Arkansas passed "an act to encourage long-term environmental projects”. This act is now part of Arkansas’ water regulations and states in part “that many areas of the state would benefit from long term environmental remediation projects that significantly improve the effects caused by industrial or extractive activities. However, commitments by private enterprise to remedy such damages are discouraged by the prospect of civil liability based upon rigid application of state water quality standards to the enterprises activities. The purpose of this act is to preserve the states approach to establishing water quality standards, while also encouraging private enterprises to make significant improvements to closed or abandoned sites that are of such magnitude that more than three (3) years will be required to complete the project”.

The act specifically allows a modification of water quality standards if that standard is not being maintained due to the implementation of the long-term environmental project. Furthermore, subcategories of use of the stream segment are allowed by the act.

The advantage of the Environmental Improvement Project (EIP) approach is that it allows dischargers involved in projects that will require more time for completion than is customarily allowed by variances, compliance schedules in permits, etc. sufficient time to complete the project with minimal concern about enforcement actions being taken or third-party lawsuits being filed. For example, mine operators are given incentive to reclaim lands that were mined prior to passage of mining/reclamation statutes requiring the land to be reclaimed but will more than three years to complete. One of the disadvantages to this approach is the time-frame for completing the project is far enough into the future that water quality criteria that were acceptable at the start of the project may be marginal or unacceptable to society at the end of the project.

Recommendations

It is recommended that dischargers

- Begin working with the regulators as soon as a potential noncompliance issue becomes apparent.
- Determine what alternatives exist to achieve compliance and thoroughly evaluate/document the evaluation.
- Involve the regulatory community in the decision making process to solicit their input and acceptance.
- Keep the community informed of any proposed changes to the water quality standards, the reasons that changes are necessary, and the reasons that changes are appropriate.
- If criteria changes are appropriate request modifications that can be scientifically justified and that State and Federal agencies can approve.

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References

Adams, W. J., J. E. Toll, K. V. Brix, L. M. Tear and D. K. DeForest. 2000. Site-specific approach for setting water quality criteria for selenium: differences between lotic and lentic systems. Proceedings Mine Reclamation Symposium: Selenium Session; Sponsored by Ministry of Energy and Mines, Williams Lake, British Columbia, Canada, June 21-22, 2000.

Arkansas Pollution Control and Ecology Commission. Regulation No. 2. Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas. October 26, 2007.

Ayres, D. M., A. P. Davis, P. M. Gietka.1994. Removing Heavy Metals from Wastewater. University of Maryland. Engineering Research Center Report.

Florida Department of Environmental Protection; Division of Water Resource Management. Bioassessment Program Fact Sheet Water Quality Standards. 2003. [Online]. Available at www.floridadep.net/water/bioassess/docs/factshtz/fs3wqstan.pdf. (verified Dec. 2007).

North Dakota Century Code. 2001. Chapter 33-16-02.1 Standards Of Quality For Waters of the State. [Online]. Available at www.health.state.nd.us/wq/sw/Z7_Publications/ B_NDCC_WQS.pdf. (verified Jan 11, 2008)

Oregon Department of Transportation. 1996. Discussion Paper No. 3. Variances. [Online]. Available at www.oregon.gov/ODOT/HWY/ACCESSMGT/docs/ Variances.pdf. (verified Jan 10, 2008).

Oregon State Archives. 2007. Department Of Environmental Quality. Division 56. Instream Water Rights. 340-056-0005. [Online] Available at arcweb.sos.state.or.us/rules/OARs_300/ OAR_340/340_056.html. (verified Jan 10, 2008).

Portland State University. 2007. Oregon University System. [Online]. Available at www.cormix.info/picgal/rmixingz.php. (verified Jan 10, 2008).

United States Environmental Protection Agency. 1986. Office of Water. Memorandum. [Online]. USEPA, Washington, DC. Available at http://www.epa.gov/waterscience/library/ wqstandards/wqsvariance.pdf. (verified Dec. 2007).

United States Environmental Protection Agency. 1994. Water Quality Standards Handbook (EPA-823-B940005a, 1994).

United States Environmental Protection Agency. Office of Water. Memorandum. Establishing Site Specific Aquatic Life Criteria Equal to Natural Background. 1997. [Online]. USEPA, Washington, DC. Available at www.epa.gov/waterscience/library/wqcriteria/ naturalback.pdf (verified Dec. 2007).

United States Environmental Protection Agency. Federal Register: December 17, 2004. (Volume 69, Number 242). Notice of Draft Aquatic Life Criteria for Selenium and Request for Scientific Information, Data, and Views.

United States Environmental Protection Agency. National Pollutant Discharge Elimination System (NPDES) Permit Program. Factsheet 2006. [Online]. USEPA, Washington, DC. Available at http://chagrin.epa.ohio.gov/dsw/permits/districts/NEDO/3IE00016.fs.pdf. (verified Dec. 2007).

United States Environmental Protection Agency. 2006. Basic Information: Introduction to UAAs [Online]. USEPA, Washington, DC. Available at www.epa.gov/waterscience/ standards/uaa/info.htm (verified Dec. 2007).

United States Environmental Protection Agency. 2006. Draft Selenium Aquatic Life Criterion: Questions and Answers [Online]. USEPA, Washington, DC. Available at http://www.epa.gov/seleniumcriteria/questions.htm (verified Jan. 10, 2008)

United States Environmental Protection Agency. 2007. Idaho Water Quality Standards. [Online]. USEPA, Washington, DC. Available at yosemite.epa.gov/R10/WATER.NSF/ webpage/Idaho+Water+Quality+Standards. (verified Dec. 2007)

United States Environmental Protection Agency. 2007.What are Water Quality Standards? [Online]. USEPA, Washington, DC. Available at www.epa.gov/waterscience/standards/ about/uses.htm (verified Dec 2007).

United States Environmental Protection Agency. 2007. Basic Information: Introduction to UAAs. [Online]. USEPA, Washington, DC. Available at http://www.epa.gov/waterscience/ standards/uaa/info.htm. (verified Dec. 2007).

United States Environmental Protection Agency. 2007. What is a UAA? [Online]. USEPA, Washington, DC. Available at www.epa.gov/waterscience/standards/uaa/about_uaas.htm. (verified Dec. 2007).