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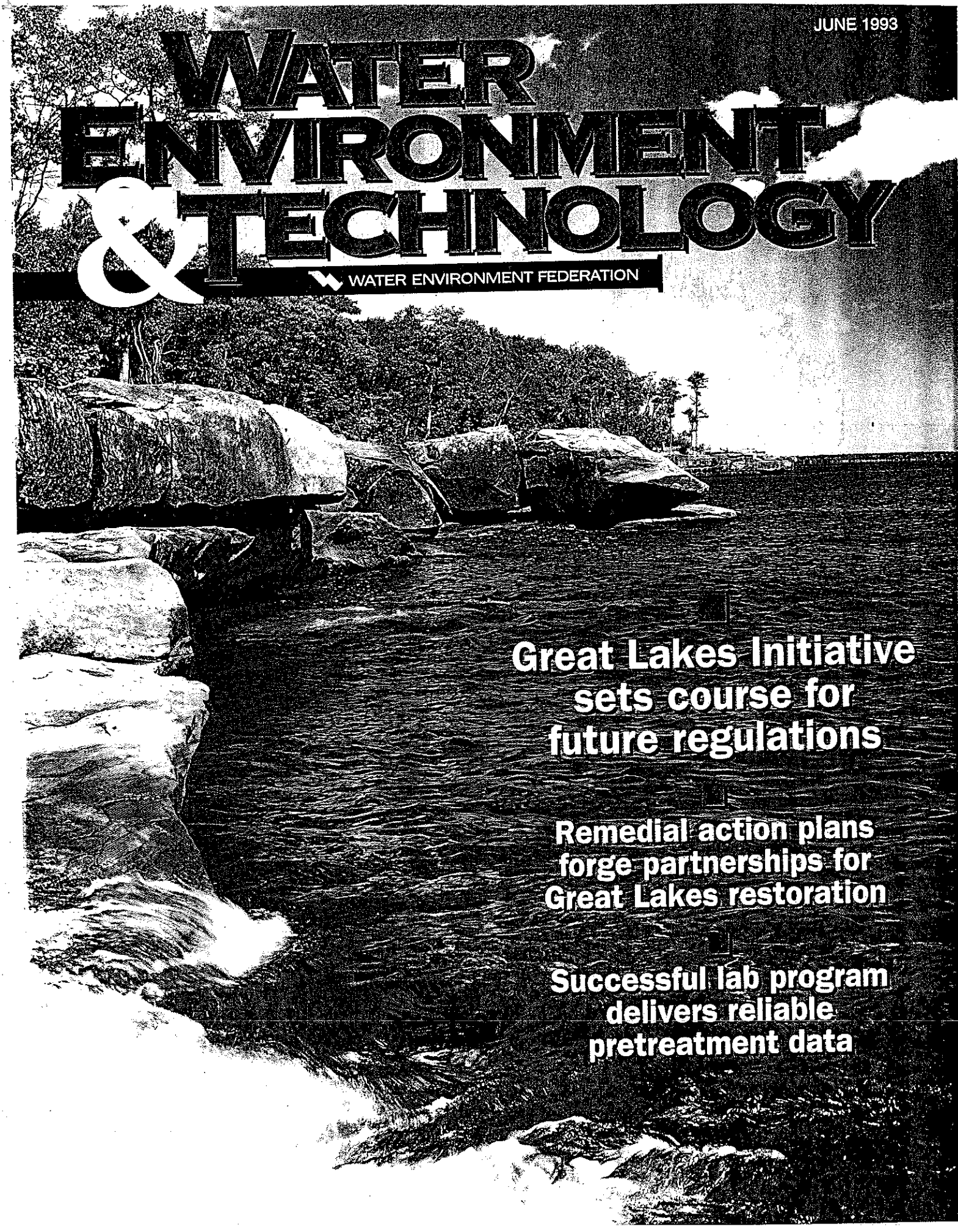

Great Lakes Initiative sets course for future regulations

Remedial action plans forge partnerships for Great Lakes restoration

Successful lab program delivers reliable pretreatment data

A Reflection on Metals Criteria

EPA's interim guidance for implementing aquatic life criteria for metals is analyzed

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EPA's recent publication of the *Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals* represents a significant advancement in the regulation of metals. Regulatory policy and science are now more aligned. EPA has acknowledged in the interim guidance that only toxic forms of bioavailable metals are intended to be regulated by EPA criteria. However, some critics argue that the interim guidance does not reflect the latest scientific knowledge, and that the regulatory alternatives are overprotective and discourage use of the dissolved metals approach.

CRITERIA THAT REFLECT AMBIENT CONDITIONS ARE CRITICAL

Since 1980, EPA has published aquatic life criteria for metals pursuant to Section 304(a) of the Clean Water Act (CWA), which gives EPA the responsibility to "develop and publish ... criteria for water quality accurately reflecting the latest scientific knowledge on the kind and extent of all identifiable effects on health and welfare ... which may be expected from the presence of pollutants in any body of water ... and on the effects of pollutants on biological community diversity, productivity, and stability ... ."

The criteria are not, by themselves, enforceable, but are available to states to assist in the development of water quality standards. Once adopted by a state, the water quality standard becomes an enforceable requirement of the CWA. From the water quality standard, EPA (or the state) calculates the total maximum daily loads for receiving waters as well as the wasteload allocations for each discharge into the receiving water and then establishes the permit effluent limitations.

Several metals criteria contain statements similar to the statement in the 1984 Ambient Water Quality

Impact of Municipal Effluent on Reported Water Effect Ratios

Data source	Metal	River	Water effect ratio[a]
Study 1[b]	Cu	Niagara	5.5[c]
	Cu	Cuyahoga	10[c]
	Cu	Naugatuck	5.8[c]
	Zn	Niagara	1.5-2.0[c]
	Zn	Cuyahoga	1.0[c]
	Cd	Cuyahoga	4.1[c]
Study 2[d]	Cu	Shayler Run	26[e]
Study 3[f]	Cu	South Ana River Tributary	64[e]
	Cd		38[e]
Study 4[g]	Cu	Rocky Creek	32[e]
	Zn		2.4[e]

[a]Water effect ratio equals the site-specific standard divided by the EPA criteria.

[b]Brungs, W.A., *et al.* (1992) *Synopsis of Water Effect Ratios for Heavy Metals as Derived for Site-Specific Water Quality Criteria*, draft, EPA contract 68-C0-0070.

[c]Water effect ratio with high dilution.

[d]Geckler, J.R., *et al.* (1976) *Validity of Laboratory Tests for Predicting Copper Toxicity In Streams*, Environmental Research Laboratory—Duluth, Cincinnati, Ohio.

[e]Water effect ratio with low dilution.

[f]Diamond, Jerry (1990) *Summary Data Report for Liberty Fabrics Inc., Woolwine, Va.*, Biological Monitoring, Inc.

[g]Diamond, Jerry (1992) *Draft Final Report: Site-Specific Copper and Zinc Effluent Limits Study for the City of Washington, Georgia Water Pollution Control Plant*, Biological Monitoring, Inc.

Criteria For Copper that "in many situations states may want to adjust water quality criteria developed under Section 304 to reflect local environmental conditions and human exposure patterns before incorporation into water quality standards." This statement indicates that the conditions under which EPA derived the criteria differ from conditions in ambient waters. However, in practice, few states have adjusted criteria before adoption as water quality standards, and the EPA criteria have become water quality standards without regard to whether the assumptions underlying the criteria reasonably reflect the conditions in ambient waters.

Many permit holders are concerned that metals criteria may be based on experiments whose objective was to determine the most toxic impact possible. The conditions under which these impacts occurred in the laboratory rarely, if ever, exist in ambient waters. This, when combined with the practice of "adoption without adjustment," often results in unnecessarily stringent effluent limitations regulating the discharge of metals. Estimates of the cost of complying with these limitations exceed tens of billion of dollars nationwide.

The influence of the Section 304(a) criteria is demonstrated through a comparison of EPA recommendations and the policies of many states. The first EPA criteria for metals recommended expression of the criteria and water quality standards as total recoverable metals. In response, many states, including Virginia, Georgia, and California, adopted water quality standards expressed as total recoverable metals. Then, when EPA modified its recommendation of the total recoverable metal procedure in 1984 and described an acid-soluble procedure as the more scientifically correct basis upon which to establish criteria for metals, many states promulgated acid-soluble-based water quality standards, even though no approved test procedure existed.

EPA currently promotes biological testing to translate the criteria into appropriate water quality standards, and several states, including Maryland, Pennsylvania, and Georgia, have proposed or have promulgated biological adjustment factors to the

Suggested Improvements to the Interim Metals Guidance

Although improved, the interim guidance needs clarification and modification in several critical respects. The following actions are suggested:

THE TOTAL RECOVERABLE METHOD SHOULD NOT BE RECOMMENDED BECAUSE IT IS NOT BASED ON THE LATEST SCIENTIFIC KNOWLEDGE

EPA acknowledges the weakness of this approach in the guidance in stating that "when used for ambient waters, total recoverable measurements may result in overestimating the toxicity."

EPA recently acknowledged that it does not possess data demonstrating a relationship between total recoverable metals and bioavailable and toxic metals in ambient waters. The lack of a correlation to "real world" impacts is why continued use of the total recoverable method to establish water quality standards is no longer justified and should be deleted from the Section 304(a) criteria for metals. The studies available to EPA and the public have uniformly concluded that the total recoverable metals measurement *cannot* be equated to toxic impacts in natural waters because of the prevalence of complex agents that render metals nontoxic.

THE GUIDANCE SHOULD CLARIFY AREAS THAT DISCOURAGE ADOPTION AND USE OF THE DISSOLVED METALS METHOD

The interim guidance states that "toxicity testing has shown dissolved measurements to be *better* predictors of toxicity than total recoverable measurements," but then outlines hypothetical circumstances under which the dissolved method could underestimate toxicity without citing a study or data from an ambient water (that is, pH greater than 6.0) in which any of its concerns about the dissolved metals method might be realized. For example, there is little scientific data to support the concern that "some metal that is in the particulate phase in the ambient water environment may become dissolved in the chemical environment associated with the gill or gut." However, available research confirms that particulate metals retain

numeric water quality standards in response to EPA's latest recommendations.

WATER EFFECT RATIOS ARE A USEFUL TOOL

The interim guidance is intended to present "recommendations on the best current approaches for implementing aquatic life criteria for metals and measuring attainment of such criteria." A key recommendation is that of the water effect ratio (WER) method—a biological method comparing the bioavailability and toxicity in receiving waters downstream of the discharge with the bioavailability and toxicity in laboratory test water. The WER provides a site-specific adjustment to the criteria to produce standards toxicologically equivalent to laboratory results (see Table, *Impact of Municipal Effluent on Reported Water Effect Ratios*). EPA defines a WER as "the acute (or chronic) value in site water divided by the acute (or chronic) value in laboratory waters." The interim guidance promotes use of the WER method because it "is affected not only by speciation among the various dissolved and particulate forms [of metals], but also by additive, synergistic, and antagonistic effects of other materials in the affected site waters. As such, the WER is a much more comprehensive measure than a ratio of total recoverable metal to dissolved metal."

The interim guidance recognizes that, for most ambient waters, the measure of dissolved metals provides an adequate indicator of toxicity and is a better indicator of toxicity than the measure of total recoverable metals.

Although the guidance states that the dissolved approach is a better indicator of bioavailable metals than the total recoverable approach, EPA raises several caveats about its use. The guidance recommends that states using a dissolved approach reduce the EPA criteria to reflect the percentage of metal in the laboratory that was dissolved. This reduction is generally less than 10%, and is essentially zero for several metals (for example, arsenic, chromium, and nickel). EPA also states that the dissolved approach may be underprotective in pristine waters (waters where organic levels are very low). There is also some concern about bioavailability and the ingestion or conversion of particulate metals into dissolved forms at the gill interface. No explanation of the significance of these concerns is provided.

METALS BIOAVAILABILITY IS THE ISSUE

The interim guidance states that the criteria and water quality standards refer to acceptable levels of *bioavailable* metals in ambient waters, which is of vital importance to the regulated community. Before the interim guidance was issued, EPA assumed that the metal identified by the total recoverable metals method equated to the biologically available metal in ambient waters. Studies prove that this assumption is false. Metals chemistry is complex and subject to considerable variability from ambient water to ambient water and from discharge to discharge in different receiving waters. In recognition of toxicological variability, the interim guidance provides a framework for obtaining both statewide and site-specific adjustments to water quality standards that appropriately reflect the toxicity of various metal species in ambient waters.

EPA's recommendation of WERs should provide the opportunity for more reasonable regulation of the discharge of metals throughout the country. The procedure establishes a framework for development of toxicologically equivalent metals limitations for individual dis-

insignificant toxicity and that this route of exposure, should it exist, is not a significant water quality concern.

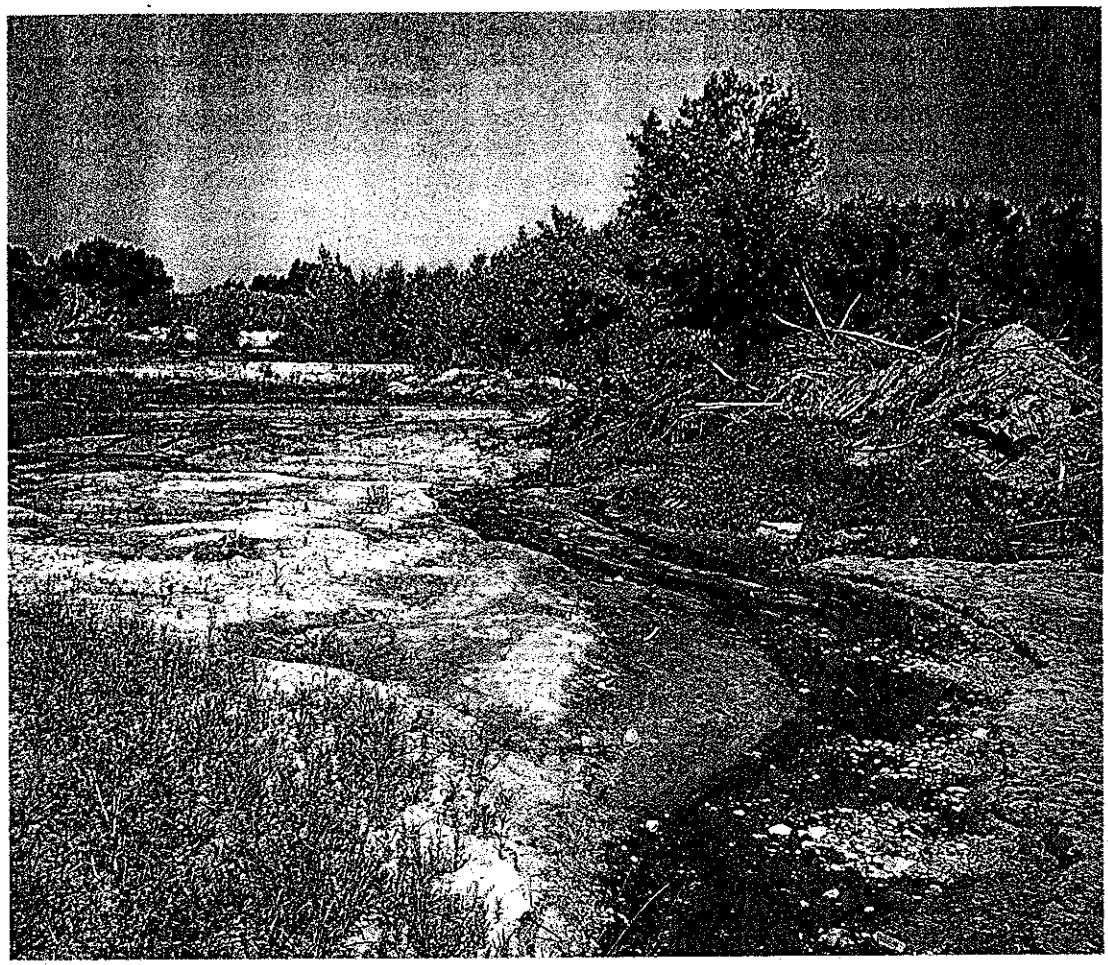
WARNINGS ABOUT DOWNWARD ADJUSTMENTS FOR CRITERIA BASED ON DISSOLVED STANDARDS SHOULD BE CLARIFIED

EPA cautions the states unnecessarily that water quality criteria are generally based on the reported total recoverable concentrations in the toxicity tests, and that, if the criteria are used for dissolved standards, the criteria values need to be adjusted to account for the typical dissolved fraction in test dilution water. Although the recommendation for a downward adjustment is stated strongly, EPA adds that "preliminary analysis does not indicate that these dissolved adjustment factors are of significant magnitude to be of great concern."

In contrast to the recommendation to make dissolved standards more stringent, the interim guidance recognizes that the dissolved metals method typically *overestimates* the toxicity of metals in ambient water. This will occur "[b]ecause of the greater fraction of particulate metals in ambient waters, as well as the higher levels of dissolved organic binding agents in ambient waters." This situation, in which elevated organic levels are present (for example, effluent-dominated streams) is precisely the situation in which proper criteria application is most critical and *increased* dissolved standards, not decreased standards, are justified.

THE PERMIT RULE SHOULD ALLOW THE USE OF THE LATEST SCIENTIFIC INFORMATION TO MEASURE TOXICITY IN AMBIENT WATERS

The interim guidance refers to "technical and legal requirements" as to why states may wish to express standards as total recoverable metals. The only citation in the interim guidance is 40 *CFR* Part 122.45(c), which is a longstanding permit rule requiring effluent limitations for metals to be expressed as total recoverable metals. Because Section 304(a) criteria are required to be based on the "latest science," an outdated permit rule may not serve as a basis to define criteria.



EPA metals criteria are not enforceable, but exist to assist states in developing water quality standards.

Annapolis Conference Participants Favor Dissolved Metals Approach

In late January 1993, EPA convened a workshop on aquatic life criteria for metals in Annapolis, Md. Participants included university researchers; consultants; representatives from the regulated community and the states; and staff from EPA laboratories, regional offices, and headquarters. The participants concluded that the dissolved metal concentration better approximates the bioavailable fraction of waterborne metals than the total recoverable concentration of metals.

The participants further recommended that metals criteria be applied on a dissolved basis unless there is a demonstration that "food sources for organisms are shown to be contaminated and represent a significant exposure pathway."

Conference participants pointed out that a dissolved metals approach may be overprotective when metals are strongly complexed to ligands, which occurs generally in municipal and textile effluents.

These recommendations are the positions of the participants, and while they do not constitute EPA policy, they will be considered in the preparation of the guidance.

charges. This method will be of critical importance to dischargers who have assembled or can assemble data indicating that their discharge causes little or no toxicity in ambient waters. More stringent regulation and implementation of additional treatment technologies in these cases is generally not appropriate.

IMPROVING THE PROCESS

Updated and scientifically precise standards are essential for ensuring that pollution control resources are expended wisely. Because state agencies do not have resources to conduct independent scientific research, it is important for EPA to provide updated information on pollutant impacts.

The interim guidance is a much-needed improvement to the regulation of heavy metals. However, the interim guidance needs to abandon outdated positions. In addition, the recommendation of the total recoverable method should be replaced by either WERs or the dissolved metals method. The data available to EPA demonstrate that these approaches provide an accurate and reasonable measure of metals that are biologically available in ambient waters. ■