Water quality standards and water quality

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Public Law 92-500 has set as a goal—interim to attainment of zero pollutant discharge—the attainment wherever possible of what are generally referred to as fishable, swimmable waters by 1983. To carry out the purpose of this act, water quality standards shall be effected by the states. These standards—the designated uses of the waters and the water quality criteria for such waters based upon these uses—must meet the approval of the U. S. Environmental Protection Agency (EPA) administrator. Public Law 92-500 further mandates that EPA develop water quality criteria that accurately reflect the latest scientific knowledge on the effects of pollutants on water. EPA issued its "Quality Criteria for Water"[1] (Red Book) in July 1976 to meet this obligation. If the states fail to provide standards that the administrator feels are consistent with the applicable requirements of this act, EPA must publish proposed standards for that state. EPA's technical resource for proposing standards is the set of Red Book criteria. Indeed, according to EPA policy, standards can exceed EPA criteria only if the state "provides adequate technical justification for the deviation."[2]

The EPA July 1976 Red Book criteria are in most cases single numerical concentrations that were developed based on the results of chronic, lifetime bioassays or extrapolation equivalent of sensitive organisms exposed to contaminants in 100% available forms. They and the additional EPA criteria currently out for review therefore are "worst-case" criteria. Increasingly, there are individuals and groups who question the appropriateness of automatically, somewhat arbitrarily, setting water quality standards at concentration levels equal to or less than these worst-case criteria.[2] The zero pollutant discharge goal of PL 92-500 and EPA's approach for developing state water quality standards based on worst-case criteria was initiated in the "E-day" era of the early 1970s when the environmental conservation movement was at its peak. At that time there was a widespread belief, which continues to some extent today, that "contaminant" and "pollutant" were synonymous and that, if any contaminant entered a water body, degradation of water quality would result. Little regard was given to economic or other social impacts or consequences of fulfilling the "zero contaminant" goal. Although it seemed then that the American public would support and pay for the ultimate in contaminant control to achieve this goal, irrespective of the effect of contaminants on water quality, the growing realization that a contaminant is not necessarily a pollutant, combined with the recent energy crisis and inflation, have led many to question the practicality and desirability of achieving zero contaminant discharge or of treating wastes to meet worst-case exposure criteria-standards.

This ultraconservative approach, it should be noted, has still not been widely implemented within the U. S. The slow rate at which EPA promulgated the water quality criteria (they were due in October 1973 but not published until July 1976) has meant that, in general, states are only now beginning to adopt water quality standards based on these criteria. There have been few instances in which contaminant loads to water bodies have been adjusted based on achieving contaminant levels in the receiving waters at or below these criteria-standards levels. It is beginning to be realized that the control of contaminants from point as well as diffuse sources to meet water quality standards numerically equal to Red Book criteria will

- Require a massive expenditure of public funds, either through taxation or increased prices of goods;
- Aggravate the already short energy supply; and
- Contribute to the inflationary spiral.

As a result, many state pollution control agencies are encountering significant public opposition to the use of worst-case criteria as numeric values for state water quality standards. Further, use of this approach is also being met with increasing opposition from the technical water quality management community because it is well known that contaminants exist in aquatic systems in a variety of forms, only some of which are available to affect water quality/aquatic organisms. The response of aquatic organisms to available forms of contaminants may

To achieve desirable water quality, it is not always necessary to make the "worst-case" assumptions.

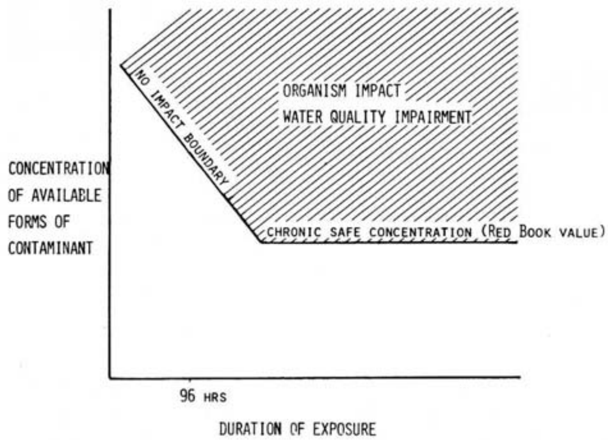

Figure 1—Generalized concentrations of available forms/duration of exposure/"no impact" relationships.[6]

depend on the duration of exposure of the organism.

Figure 1 illustrates general relationships among organism response, the contaminant concentration, and duration of exposure. It shows that organisms generally can tolerate, with no ill effects, concentrations of available forms of contaminants above chronic safe levels as long as the exposure time is sufficiently short. These factors are not taken into account in EPA's Red Book criteria. Consequently, the more-or-less mechanical adoption of Red Book water quality criteria numeric values as state water quality standards will sometimes result in large-scale expenditure of funds in the name of water pollution control with little or no improvement in water quality as measured by the water's swimmable-fishable characteristics.

The growing opposition to the EPA's worst-case approach is exemplified by a number of recent events. One of the most significant is the statement presented in 1979 by the president's Council on Wage and Price Stability[2] criticizing EPA's position with respect to the state of Ohio's water quality standards. It was recommended that EPA modify its Red Book policy or the Red Book itself to provide criteria in the form of a range of values corresponding to different levels of protection within the waterbody use level. This modification would permit states to consider localized conditions and the expected costs and benefits in choosing specific criteria for a given use level. As indicated by the president's council, issues similar to Ohio's also have arisen recently in connection with the review of water quality standards developed by Indiana, Kentucky, North Carolina, Pennsylvania, and Texas.

Another criticism of the approach taken by EPA and some states for setting water quality standards is exemplified by the actions of the city of Denver, Colo. Denver has asked the public, through a one-page advertisement-questionnaire in a Denver newspaper, what it wished to achieve in the way of water quality in the South Platte River downstream of the major wastewater discharges from the city, in light of the cost of achieving various degrees of contaminant control. Also in Colorado, the cities of Fort Collins, Windsor, and Greeley, and Kodak of Colorado have jointly filed suit against the State Water Quality Control Commission for the purpose of establishing more technically valid and appropriate water quality standards for the waters receiving their wastewater discharges. This group of municipalities and industry was prompted to this action because they felt that the State Water Quality Commission and EPA did not properly consider the ambient conditions of the receiving waters in developing their stream classifications and associated water quality standards. For example, because of irrigation diversions, the only water in the Poudre River below the Fort Collins wastewater discharge is domestic wastewater. When the city discharges to an irrigation ditch instead of to the river, as is frequently done, the river is at times essentially dry. It is doubtful that any type of sport fishery can be established under these conditions. To impose Red Book criteria as a basis for establishing waste load allocations under these conditions is technically invalid and inappropriate, and could easily result in expenditures by Fort Collins and other communities of large amounts of money in the name of water pollution control, with no associated improvement in fisheries, even though the communities achieve the Red Book criteria levels for ammonia and chlorine (which presently are the contaminants of greatest concern) in the river when the wastewater discharges are made to the river.

Congress is also becoming increasingly critical of EPA's approach toward requiring domestic wastewater treatment beyond normal secondary treatment. The Government Accounting Office (GAO)[3] critique of EPA's approach for advanced waste treatment has caused Congress to require that EPA conduct a critical review of the potential water quality benefits of constructing treatment plants categorized as advanced secondary treatment or advanced waste treatment and costing in excess of $3 million.

Part of the mounting resistance against EPA's approach is the completely arbitrary use of Red Book criteria for certain situations. One blatant example of inappropriate use of these criteria is in EPA regulations governing ocean dumping of dredged sediments. This subject is discussed in a subsequent portion.

WHAT IS WATER QUALITY?

The first step in developing a plan for pollution control is to define the desired characteristics of water quality. According to PL 92-500, these are "chemical, physical, and biological integrity," and, intermittently, "the protection and propagation of fish, shellfish, and wildlife" and provision for "recreation in and on the water" (fishable, swimmable), wherever attainable. Because of the close tie made between these goals and water quality standards and criteria, water quality has unfortunately and inappropriately come to be defined in some states by the comparison of chemical concentrations in a water sample to equivalent Red Book water quality criteria or standards. As alluded to in the law (which requires inclusion of the designated uses of the waters as part of water quality standards), and as classically defined, "water quality" should be tied directly to the beneficial uses of a particular water body by man. Beneficial uses include domestic, industrial, and agricultural water supplies, sport and commercial fishing, recreation, and aesthetic quality as perceived by someone sitting on the bank or boating on the water.

Until substantially larger amounts of money are available for research and pollution control, and until techniques are available to judge much more subtle biological effects, man and his use of the water should be the focal point of all water quality consideration. During the late 1960s and early 1970s, the concept of aquatic "ecosystem quality" evolved; it is sometimes advocated that the focal point of pollution control programs should be to control contaminant input to the point that there is no effect on the numbers, types, and functions of the various aquatic organisms that live in a particular water body. Although this concept is in keeping with zero pollutant discharge, current scientific capability to detect many such changes is limited and costly. Also it is well known that the numbers and types of organisms in an aquatic system may be altered significantly—in some cases to the point of extinction of a species—with little or no impact on the functioning of the overall ecosystem. It is rare, even in situations not under the influence of contaminants, that the numbers and types of organisms are constant. Normal climatic changes may have a significant impact on ecosystems and specific species within them. The public does not presently seem to be willing to spend large amounts of money for water pollution control unless readily perceptible improvements in water quality will result. It is important to note that the term "water quality" is being used here in its broadest sense (which can include the numbers and types of organisms). It is doubtful that large amounts of public funds are going to become available to change the number of benthic worms in a particular aquatic system sediment; for example, unless there is a reasonably clear relationship between one type of worm and another in affecting the water quality components that man would perceive, such as the numbers and types of fish present in the water body. It is not now, nor will it likely be possible in the foreseeable future, to relate subtle changes in aquatic organism content, especially the lower forms, to the water quality components of the system that are of greatest importance to the general public. Frequently, the public wants to know number of and wholesomeness of fish that can be obtained from a particular water body.

The first step that must be taken to improve water quality in a particular water body is to define the problem; that is, how are the beneficial uses to man of a particular water being impaired, and what is the cause of this abuse? These decisions generally must be made on a local level and require case-by-case evaluation. The relationship between beneficial use and acceptable contaminant load is also site specific; each water body has its own assimilative capacity. Further, although the discharge of a contaminant to two different water bodies may result in the same total concentration in the waters, the impacts of the load could be considerably different because the forms of the contaminant in the waters may be different. Therefore, designing contaminant load allocations based on meeting a specific worst-case standard-criterion total concentration in the water is inappropriate. Highest priority for funding water pollution control should be given initially to those programs that focus on the most significant impairment of the beneficial uses by man.

It is now well recognized that unlimited amounts of money are not available to devote to water pollution control. In the 1970s, money spent was usually for the control of obvious, gross water-quality degradation. As these situations are abated, funds spent for water quality improvement have been directed toward eliminating more subtle adverse effects. The cost of controlling these effects generally will be much greater because of the low concentrations that must be reached. Likewise, the benefits derived will be more difficult to discern. There will have to be, therefore, a much more selective allocation of the financial resources available to ensure that the greatest amount of improvement in water quality results from the money spent in a particular control program. As the more perceivable water quality problems or those of most concern or most readily remedied are eliminated, additional funds should be used for control programs directed toward less readily identifiable problems. The broad brush, ultraconservative approach for contaminant control is inappropriate and must give way to a more carefully developed assessment of what the real water quality problems are in a particular water body, definition of the sources of contaminants that cause these problems, development of a contaminant-load/water-quality response relationship for a particular water body, and societal decisions regarding the amounts of money and other resources that should be spent locally to control the contaminant inputs to the degree necessary to achieve the desired water quality. The adoption of this approach will require a markedly different administrative framework than has existed thus far in the water quality control field. One reason states have adopted single numeric value water quality standards similar to those of EPA (July 1976) is that these standards are relatively simple to administer. EPA and some state pollution control agencies have opted for this administratively simple approach. However, when fully implemented into contaminant load allocations in the 1980s, the simplicity of the administrative approach will be paid for many times over by unnecessary contaminant control programs that will result in the control of contaminants not affecting water quality in a particular aquatic system.

In general, the first priority for pollution control programs must be toward establishing fishable water to provide at least a moderate quantity of desirable fish that are wholesome and nondamaging to man and animals that use the fish as food. If a water body will support at least a moderate game fish population, then the water usually will be suitable for domestic water supply purposes (normally the highest priority given to a particular water use). There are exceptions to this relationship, but these must be considered on a case-by-case basis.

In the opinion of the authors, after it is possible to establish at least moderate quality fisheries for a particular water body where the habitat is suitable to support the number and types of fish desired, consideration may be given to optimizing the fisheries through the additional control of contaminant input. It should be emphasized, however, that it may not always be in the best interest of the public to try to make all reaches of all water bodies suitable for at least moderate fisheries. The public may feel it is in its best interest to allow certain reaches of a particular stream to have contaminant concentrations outside of the classical mixing zones for point-source discharges to rivers or lakes higher than normally associated uninhibited fish reproduction. An example of this situation would be associated with the use of chlorine for disinfection in municipal wastewaters. Although chlorination is practiced to protect public health, it is being recognized that chlorine in levels present in chlorinated domestic wastewater treatment plant effluent is highly toxic to fish and other aquatic organisms. Granted, chlorine does tend to dissipate rapidly in aquatic systems; this dissipation rate is sufficiently slow, however, that chlorine will in many cases be present outside of the mixing zone typically allowed for municipal wastewater discharges. This means that if a pollution control agency utilizes appropriate analytical techniques, it can detect chlorine outside of the mixing zone in levels in excess of the Red Book criterion. Therefore, if the water quality standard adopted by the state is numerically equal to this criterion, the municipality would be in violation of this standard and would have to reduce the chlorine content of its effluent.

The authors and their associates are currently conducting a study of the persistence and impact of chlorine in the Poudre River downstream of the point of discharge of the domestic wastewaters from the city of Fort Collins, Colo. Fort Collins could be forced to spend over $100 000 for dechlorination equipment and several tens of thousands of dollars per year for dechlorination chemicals, to reduce its chlorine discharge to meet the Red Book criteria. Other nearby cities (such as Loveland, Colo.) have been forced to adopt such procedures, but few studies of the actual persistence and effect of chlorine in the receiving waters have been conducted. The authors' studies* have shown that the concentration of chlorine from the Fort Collins plant exceeds the Red Book criterion by several pg/1 for about 90 m downstream of the discharge. Caged fish (fathead minnows) placed about 100 m downstream of the discharge remained alive throughout their 1-week exposure to effluent chlorine, as well as any other contaminants present in the effluent. Survival was shorter at locations nearer the outfall, but it is clear that fish can readily pass through the region and spend several days in the area without any readily discernible adverse impacts.

Chlorination could also have an adverse effect on fish food organisms. The quantity of fish food present in the water downstream of the point of discharge of chlorinated effluent may be somewhat less than if no chlorine were added to the river. The difficulties in quantifying sublethal effects on fish, such as might be associated with a diminished food supply, are extreme, however; and it is doubtful in this instance that any change in the fishery would be perceptible. The nature of the reach of the Poudre River affected by the wastewater discharge is such that it is unlikely that a viable sport fishery could be developed without much more substantial management than simply decreasing the chlorine concentration in the effluent, as discussed earlier.

Further, it should be noted that if there is any public health benefit associated with the chlorination of the wastewaters (and there are those who question this assumption for many situations), then extending the contact time would enhance this benefit. In other words, the dechlorination step would tend to increase the public health risk of contracting a variety of enteric diseases from contact with the Poudre River water downstream of the input of the wastewater treatment plant effluent.

Another example of a situation in which a water quality criterion is exceeded and yet a desirable fishery exists is provided by Lake Mendota, Wis., recognized as one of the better warm-water fisheries of the area. Extensive fishing pressure is made of this lake; yet routinely throughout the summer months, the photosynthetic activity of the water body is such that the pH is raised above the Red Book criterion. It is possible that otherwise there might be a better fishery, although this possibility is not at all clear because the only way to reduce the pH to acceptable levels is to reduce the nutrient inputs that could, in turn, reduce the fish yield. Lee and Jones[6] have discussed the relationship between phosphorus loads and fish yields in water bodies, and have shown a strong correlation between the two. The magnitude of the diel pH fluctuation would therefore also be correlated to phosphorus loads to Lake Mendota. It is certainly inappropriate to apply the Red Book pH criterion to this water body for purposes of improving the fisheries. In fact, the application of this criterion may be detrimental to the fisheries of the lake. It is important to note that Lake Mendota's situation is typical of that encountered in many water bodies considered to have a good sports fishery.

Many water quality control specialists can readily cite numerous examples of waters that have good sports fisheries, yet have concentrations of one or more contaminants that exceed Red Book criteria levels. Although these may not represent the optimum fisheries possible, there are many cases today where, owing to energy and financial constraints, achieving optimum fisheries or other beneficial uses may not be socially desirable. As noted above, this is causing some federal governmental agencies; state and local pollution control agencies; as well as municipalities, Industry, and agricultural interests vigorously to oppose the direct use of the worst-case water quality criteria values as water quality standards. Although achieving the optimum fishable waters should still be the ultimate goal, it should not necessarily be the immediate goal.

In summary, water quality should be judged based on the impacts of contaminants on beneficial uses of the water by man; it should not be assessed by the total concentrations of contaminants in a water sample. Because the concentration of a contaminant in a water sample exceeds worst-case water quality criteria like those in the EPA Red Book does not necessarily mean that water quality deterioration is occurring or that the water quality is unacceptable. Water quality control programs should be directed first toward improving gross water quality deterioration that is readily discernible by the public. Only after these problems have been eliminated in a particular region should control efforts and funding be directed toward the more subtle effects of contaminants such as impairment of reproduction, changes in fish behavior, and "ecosystem quality" impacts. These impacts should be controlled to the degree desired by the users of the water and should be in accord with funds made available to do so.

Because there may be very little relationship between water quality and exceeding water quality standards numerically equal to Red Book criteria, it is reasonable to ask how pollution control agencies and municipalities should proceed to achieve the goals of PL 92-500 for swimmable-fishable waters. The financial and resource constraints that exist today will most certainly become more severe in the future. Rather than arbitrarily assuming worst-case conditions exist (as when Red Book criteria values are used to judge water quality), it should be possible for governmental agencies, industry, and others responsible for the source of contaminants to determine the potential zones and magnitude of impact of a particular contaminant or combination of contaminants on given aspects of water quality. Basically, what is needed is an assessment of the contaminant load/ water quality response relationships that could inform the public of the water quality benefits that will be achieved as the result of providing certain degrees of contaminant control for certain amounts of their money. Such an assessment procedure, an "environmental hazard assessment approach," is being developed through the efforts of the authors.[7]

HAZARD ASSESSMENT APPROACH

As discussed by Cairns *et a1.*[8] and Lee *et al.*,[9] an environmental hazard assessment for an aquatic system utilizes the combination of aquatic toxicity and environmental chemistry-fate information to determine

- The forms and amounts of contaminants present in a particular water body that can affect water quality,
- The zone of potential impact for both acute and chronic toxicity, and
- The actual toxicity or other effects that occur in the region.

This hazard assessment is a tiered approach that enables the user to determine, at each level, the need for continued assessment to refine the estimate of the degree of hazard and the acceptability of the hazard that exists for a particular contaminant in a particular system. In some systems it is possible, through relatively simple calculations and without any field work, to determine that there is no hazard or that there may be a very substantial hazard associated with the discharge of a particular chemical. Under these conditions, there is little or no need to proceed with further work to define the hazard more precisely. It is in the in-between situations, where the expected environmental concentrations of available forms are near the critical concentrations that cause an adverse effect on water quality, that there is often need for further work beyond initial screening. Considerable emphasis is placed on the use of bioassays of selected reference organisms that can be related to the potential impact on organisms in the region of interest.

This increased use of bioassays will eliminate the need to analyze water samples for the hundreds to thousands of potentially significant contaminants that could be present in the effluents of chemical manufacturing plants, other industries, urban stormwater drainage, and

Table 1—Environmental hazard assessment for aquatic systems.[6]

Tier 1	B—Bioassay—96-hr LC_{50} C—Dilution—worst case based on rate of use and input
Tier 2A	B—Short term bioassay at other times C—Measure existing concentrations in environment
Tier 2B	B—Egg-fry, *Daphnia* C—Bioconcentration—octanol/water partition FDA limit
Tier 3	B—None C—Develop environmental chemistry-fate model
Tier 4	B—Conduct field studies, evaluate actual impact C—Determine chemical species
Tier 5	Evaluate significance of impact on water quality; compare to cost of control program. Submit results for societal review and decision.

B = biological testing
C = chemical testing

municipal wastewater treatment plants. Actually, probably the greatest use of bioassays will be to determine what part of the total concentration of many conaminants is available to affect water quality. As with chemical analyses, many difficulties are encountered in properly interpreting bioassay data with respect to their water quality implications. To provide guidance on the approaches that should be used for interpretation and appropriate application of bioassay results in water pollution control programs, the Water Pollution Control Federation "Standard Methods"[10] Bioassay Section Committee has organized a new subcommittee. Further information on the activities of this subcommittee may be obtained from the authors. It is anticipated that a hazard assessment approach of the type described by Cairns *et al.*[8] and Lee *et al:*[7,9] will be used as a basis for this subcommittee's activities.

Table 1 briefly summarizes the testing that should be done in a tiered hazard assessment for interpretation of effluent or stream bioassays, or chemical analysis of a contaminant input source or aquatic system. Further details on each component within this approach are discussed by Lee *et a1.*[9] *(a* copy of the discussion is available from the authors).

The approach that has been used over the years to develop control programs for gross pollution of waters has been based on the measurement of the total contaminant content. This approach is completely unsatisfactory as a means of assessing potential environmental-degradation/water-quality-impairment when the subtle effects of contaminants are the focal point (chronic toxicity, for example). Under such conditions, it is absolutely essential that available (in addition to total) forms of contaminants be measured. The total content of contaminants is useful as an indicator of potential problems; however, it should never be used as an indicator of real problems or as a basis for infliction of contaminant load allocations on either point or diffuse sources, or both. This is especially true, for example, for materials associated with deposited or suspended sediments. The work of Lee *et al.*[11] and Jones and Lee[12] has clearly demonstrated that there is no relationship between the total content of contaminants associated with dredged sediments and their impact on water quality when dumped in open water. Further, these works and others have shown that the total concentrations of contaminants in deposited sediments cannot be used to judge in any way the potential impact that those sediments will have on organisms contained within the sediments.

A prime example of the need for a hazard assessment approach for developing control programs for chemical contaminants in aquatic systems is provided by the regulations governing ocean dumping of dredged sediment. Public Law 92-532, EPA,[13] and EPA and the Corps of Engineers[14] specify that the contaminant concentrations at the edge of a mixing zone of a dredged sediment dump site are to be assessed for their implications for water quality by comparison with Red Book criteria. As discussed by Jones and Lee,[12] because of the intermittent nature of ocean dumping operations and the characteristics of ocean water dumping procedures, it is extremely unlikely that organisms in the water column at a dump site can sustain a chronic exposure sufficient to justify the use of the Red Book criterion for a particular contaminant. Further, as discussed above, dredged sediment-associated contaminants are largely in unavailable forms. Red Book criteria should not be used to judge the potential environmental impact of dredged sediment disposal; yet EPA and some states are using these values for this purpose. This situation is resulting in a significant increase in the cost of maintenance of waterway navigability (because alternate, more expensive disposal techniques must be used) with little or no improvement in water quality. In some instances, alternate disposal techniques present a significant increased potential for deteriorated water quality. Instead of dumping the sediments in the open waters where they can be readily dispersed below concentrations that can be harmful to aquatic life, these techniques cause the release of contaminants to the nearshore waters where there is limited mixing and where sensitive life forms of aquatic organisms are present.[11,12]

In any environmental hazard assessment, the levels of protection must be established with public participation. It is the public, through taxes and the price of goods, that pays for water quality improvement. It is therefore imperative that water quality control programs focus on benefits of public concern. Failure to do so will erode the already limited public faith in the ability of elected officials and governmental agency personnel to improve water quality with available funds.

CONCLUSIONS

Some states are proposing water quality standards numerically equal to EPA July 1976 Red Book water quality criteria. This has been the administratively simple approach for the states to meet their obligations according to PL 92-500 and EPA policy, the latter being that unless the state provides adequate justification, its standards can be no less stringent than the Red Book criteria. However, the Red Book criteria are typically single values that indicate the level of available forms of contaminant to which an aquatic organism may be exposed for chronic lifetime durations without being harmed. Water quality standards and contaminant load allocations should be based on the preservation of the beneficial uses of the water body in question to the extent that the users believe is appropriate based on financial, energy, and other pertinent constraints. To maintain or restore desirable water quality, it is not always necessary to make the worst-case assumptions associated with the Red Book criteria. An environmental hazard assessment approach may be followed to assess the hazard to water quality associated with a given contaminant source. The decision about what constitutes an acceptable environmental risk is a societal one.

SUPPLEMENTAL DISCUSSION

Subsequent to the completion of this paper in 1979, EPA[15] in 1980 released its criteria for 64 of the 65 contaminants named in the consent decree.[16] Although the discussion presented above generally is applicable to these criteria as well, EPA has also made two important policy changes[15] that may significantly impact the implementation of all of its criteria into state water quality standards.

First, EPA has dropped its policy of "presumptive applicability" of its criteria. Prior to the November 1980 legislation, as discussed in this paper, EPA policy required that if a state adopted a numeric standard for a contaminant, the standard must be at least as stringent as the EPA criterion; that is, the policy presumed the criteria were applicable to essentially all waters. Although PL 92-500 nominally gave states the opportunity to adopt standards less stringent than those of EPA after providing acceptable justification, actual EPA policy was to hold the states to adopting its criteria. Because many state pollution control agencies did not feel that this approach was appropriate, they chose not to adopt numeric standards for many of the parameters for which EPA had developed criteria.

The second major change made by EPA in standards development policy is the requirement that states adopt standards for all parameters for which EPA has criteria. This requirement will have a significant impact on some states' water quality standards because few states adopted standards for all EPA criteria. Even though the states are now free to develop site-specific standards, there are many, including the authors, who question the wisdom of this requirement, especially as it relates to many of the exotic contaminants that were cited in the Consent Decree "List of 65." T his list of contaminants did not receive proper technical review. Many of the parameters may belong on a list of contaminants of potential concern; they do not, however, belong on a list of parameters for which water quality criteria must be developed. This is especially true in light of EPA's decision to require that water quality standards be developed for all parameters having EPA criteria.[15] The development of water quality standards for all of the contaminants in the EPA July 1976 Red Book and on the "List of 65" would require a substantial effort on the part of the states, an effort that is certainly not justified for many of the contaminants on the EPA toxic chemical lists.

EPA should, in cooperation with the states, develop a proposed list of contaminants for which standards must be developed. The selection of contaminants for inclusion on this list should be based on factors like potential toxicity and general occurrence in the nation's waters. There is no justification for developing a state water quality standard for a contaminant that was put on the "List of 65" because someone thought it might be important but for which subsequent studies have not confirmed the potential importance of the contaminant. The inclusion of a contaminant on such a list should be done very carefully because a massive expenditure of taxpayers' funds will be required for analyses of point-source discharges and natural waters, as well as for site-specific studies. A much more effective approach should be found for selecting contaminants that deserve the expenditure of public funds for the development of national water quality criteria and state water quality standards.

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