FACTORS TO CONSIDER IN DRAFTING STANDARDS TO PROTECT GROUNDWATERS IN ARIZONA

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ABSTRACT

A summary of factors which need to be addressed when drafting standards to protect groundwater is presented based on research of existing and proposed groundwater quality standards in several states. Options available for each factor are offered as possible choices.

INTRODUCTION

The Water Quality Control Council, the entity responsible for water quality management in Arizona, has been mandated by the statutes (A.R.S. Section 36-1857) and a recent Attorney General's Opinion (No. 77-102, 1977) to develop standards to protect groundwaters of the state.

What are standards? This question first needs to be addressed before a groundwater protection program in Arizona can proceed. Standards should not be viewed narrowly as only numerical limits but in a broader sense as constraints necessary to impose for attaining identified management objectives. Maximizing the effectiveness of Arizona's future groundwater pollution control program is dependent on using as broad a definition of standards as possible in order to enhance the number of options.

The drafting of standards to protect groundwater is complex because a number of important issues or factors need to be resolved. The purpose of this paper is to identify these major factors to facilitate the process of drafting standards in Arizona. To be applicable to conditions in Arizona, elements in several options may have to be combined.

Eight major factors have been identified (See Figure 1):

1. Management Scale For Applying Standards
2. Management Objective
3. Management Policy
4. Focus of Standards
5. Type of Criteria
6. Protected Uses
7. Time Reference
8. Parametric Coverage

A DISCUSSION OF THE FACTORS

One factor which needs to be decided in drafting standards to protect groundwaters is the management scale for applying the standards. Many possibilities exist ranging from site-specific to statewide scales.

A site-specific scale would apply to an identified well or pollution source. For example, in New Mexico if the groundwater quality at a well is worse than defined limits, the existing water quality at the well is used as the standard.

A larger scale for applying standards is to use hydrographic subunits that are based on topographic features, geologic formations, hydrologic features (recharge areas), or groundwater classes. Groundwater objectives in the San Diego Basin apply to hydrographic subunits which are based on watershed boundaries. Maryland utilizes management boundaries based on aquifer transmissivity and permeability. Under this type of approach, management boundaries can be delineated for areas within aquifers with high transmissivity/permeability (recharge areas) which require stricter controls. Wyoming's proposed standards set management boundaries based on groundwater quality classes ranging from Class I (domestic use), for high quality groundwaters having a TDS

FACTORS	OPTIONS		
1. MANAGEMENT SCALE FOR APPLYING STANDARDS	Site Specific		Subaquifer Units a. Topographic Features b. Geologic Features c. Hydrologic Features d. GW Quality Classes
	Aquifer Basins	Aquifer Regions	All Groundwaters
2. MANAGEMENT OBJECTIVE	Improve Ambient Groundwater Quality	Maintain Ambient Groundwater Quality	Allow Degradation a. Controlled b. Uncontrolled
3. MANAGEMENT POLICY	Zero Discharge	Nondegradation	Planned Degradation
4. FOCUS OF STANDARDS	Waste Discharge		Ambient Groundwater
5. TYPE OF CRITERIA	Numeric a. Absolute b. Range		Descriptive
6. PROTECTED USES	Human Health	Domestic Industrial	Agricultural
7. TIME REFERENCE	Past	Present	Future
8. PARAMETRIC COVERAGE	Choose parameters associated with selected protected uses.		

FIGURE 1

FACTORS AND SOME AVAILABLE OPTIONS WHICH NEED TO BE ADDRESSED WHEN DRAFTING STANDARDS TO PROTECT GROUNDWATER

less than 500 mg/l, to Class VI (industrial use) for groundwaters having a TDS greater than 5,000 mg/l and do not have the potential of being beneficially used.

A third type of management scale that can be used is aquifer basins. In Arizona, these basins have been delineated in the Arizona Water Plan (Arizona Water Commission, 1975) by the Arizona Water Commission and the U.S. Geological Survey.

A fourth type of management scale which can be used is hydrogeologic regions. In Arizona, such geologic regions as the Basin/Range, Central Mountain Highland and Northern Plateau Provinces could be used.

Finally, standards can be applied to all groundwaters of the State without any differentiation.

A second factor which needs to be decided is the management objective within each designated management area. Three basic management objective choices are available: improve the groundwater quality, maintain its quality or allow degradation to its quality. Degradation can be allowed in a controlled or uncontrolled manner.

The third factor that needs to be decided is the management policy within management area. Three policies have been used in other state programs: zero discharge, nondegradation, and planned degradation. Zero discharge is zero migration of waste beyond the boundaries of the waste facility or "solid waste boundary" as defined in the RCRA regulations: "the outermost perimeter of the solid waste as it would exist at completion of the disposal activity" (Federal Register, 1979). Nondegradation is prevention of degradation to the groundwater in the management area. Nondegradation allows for attenuation and treatment of leachate in the vadose zone while zero discharge doesn't allow for any migration of leachate beyond the waste facility.

The third type of management policy is planned degradation which is the allowance of water quality degradation up to certain specified limits. These limits can be based on effect levels for chosen protected uses or on any other management objectives. New Mexico has a planned degradation policy for its groundwater standards because degradation is allowed up to the protected use limits for human health, domestic, or agricultural uses.

California has modified the theoretical definition of nondegradation in its policy by allowing degradation of groundwater quality up to a defined protected use limit (groundwater objective), in special circumstances, if "it has been demonstrated to the State that any change (in groundwater quality) will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies" (State Water Resources Control Board, 1968).

Selection of the most appropriate management policy is dependent on the adapted management objective, and the type of pollutants discharged from the waste facility. For example, if the management objective is to maintain the groundwater quality for a given management area and the pollutants that are discharged are toxic and soluble, a zero discharge policy would be warranted. However, if the pollutants discharged from the waste facility are not harmful and undergo attenuation in the vadose zone, a nondegradation policy for the management area may be appropriate.

The fourth factor which needs to be addressed is the focus of the standards to protect groundwater: should they be applied to the waste being discharged or to the ambient groundwater quality? Waste discharge standards would set limits on the quality of waste being discharged from a surface activity while groundwater quality standards would set limits on the ambient groundwater quality.

California uses the waste discharge approach where limits are set on the quality of waste being discharged into groundwater systems. The standards are set to meet groundwater (management) objectives. On the other hand, New Mexico has groundwater standards focused on the quality of the ambient groundwater. Discharge plans are filed with the State proving compliance with the groundwater standards.

The difference between the two approaches is subtle but significant. With waste discharge standards emphasis is placed on the quality of the waste discharge or leachate which eventually reaches groundwater while groundwater standards places emphasis in monitored changes in the quality of the ambient groundwater. Of course, once the pollutant has reached the groundwater and is monitored, the damage has occurred and may be irreversible.

The fifth factor which needs to be addressed is the type of criteria to use in the standards. Two types of criteria can be used: numeric and descriptive. Numerical criteria are expressed as numerical limits in the standard...i.e. 500 mg/l TDS. Relative numerical limits can also be used to express the range of error inherent in measuring different parameters.

Another option is to use descriptive criteria in the standards. Descriptive criteria can be worded very generally to have the flexibility necessary for regulating the release of pollutants whose harmful thresholds are not fully understood: "Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life, nor that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life" (State Water Resources Control Board, 1975).

Descriptive criteria can also be written in specific language as with locational criteria. For example, in California, hazardous waste disposal sites and landfills containing toxic materials are prohibited from being located above groundwaters of the State unless their integrity can be proven.

If a limited degradation management policy is chosen, a sixth factor that needs to be decided for the management area: the establishment of protected uses. Protected uses can be assigned for human health, municipal, agricultural, and industrial activities.

The seventh factor which needs to be decided is the time reference for the protected uses. Should past, present, or future protected uses be preserved? For example, New Mexico assigns protected uses to present and future groundwater uses - past uses are not considered.

For standards using numeric criteria, an eighth factor needs to be considered: parametric coverage. The parameters that are selected should be a function of the protected uses chosen for a given management area. For example, if the protected use is for human health, the EPA primary Drinking Water Standards would be appropriate. For domestic protected uses, the aesthetic properties of the water are important--thus the EPA secondary Drinking Water parameters can be utilized. For agricultural protected uses, parameters for constituents harmful to agricultural production should be included: sodium, fluoride, boron, and heavy metals.

CONCLUSION

In the coming months, Arizona Department of Health Services will begin formulating a groundwater pollution control program for Arizona. An integral part of this program is the development of standards. The eight factors summarized in this paper can be a catalyst to start this process. It is necessary to use as broad a definition of standards as possible to make this process fruitful.

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