M E M O R A N D U M

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD • CENTRAL VALLEY REGION
3443 Routier Road, Suite A Phone: (916) 255-3000
Sacramento, California 95827-3098 CALNET: 8-494-3000

TO: Technical Staff
Sacramento, Fresno, & Redding Offices
and Other Interested Parties

FROM: Jon B. Marshack
Senior Environmental Specialist
Environmental/Technical Support

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SIGNATURE: [signature]

SUBJECT: ***THE ROLE OF RISK ASSESSMENT AND CHEMICAL TRANSPORT MODELING IN SITE ASSESSMENT AND CLEANUP LEVEL DETERMINATION***

Through my involvement in Department of Defense (DoD), CERCLA (Superfund), and other contaminated site cases, I have seen an increasing reliance, by responsible parties and their consultants, on risk assessments and chemical transport modeling to determine whether sites pose health or environmental threats and to determine the degree to which such sites must be remediated. In fact, the current approach of the Department of Toxic Substances Control (DTSC) and the U. S. Environmental Protection Agency (EPA) to assessing health and environmental risks at contaminated sites and for determining cleanup levels relies on these methods, as contained in the EPA's *Risk Assessment Guidelines for Superfund* (RAGS). Staff working on site assessment and cleanup cases will, likely, be asked to accept this type of analysis as sufficient to protect water quality. However, by their very nature, conventional risk assessments and chemical transport modeling methods are insufficient to protect existing and probable future beneficial uses of waters of the State, as required by the Porter-Cologne Water Quality Control Act. In order to safeguard water quality, site-specific, resource protective methods and criteria must form the basis for site assessments and cleanup levels.

The Limitations of Conventional Risk Assessment Methods

Within EPA and DTSC, the development of methods for site assessment and cleanup level determination has been dominated by a single branch of science, namely toxicology. Environmental toxicology is the study of the toxic effects of chemicals on the health of animals and humans, with the aim of better understanding the relationships between environmental chemicals and the health of human populations. For this reason, toxicologist-derived site assessment and cleanup level determination methods view risks to health and the environment largely through our knowledge of the health effects of chemicals on humans. More recently, attempts have been to broaden this conventional risk assessment dogma to encompass other "biological receptors", such as fish and wildlife; however, our database on the effects of chemical pollutants on these organisms is far smaller than that for humans and for the laboratory animals used as surrogates for humans in toxicological research. For this reason, this expanded risk assessment system has largely failed to adequately address potential impacts of environmental chemicals on non-human life forms. Because toxicology-dominated conventional risk assessment methods have been inadequate to address risks to other than human health, EPA's and DTSC's environmental protection mandates have been largely ignored by their site assessment and cleanup level determination methods. Procedures such as those contained in EPA's RAGS are sufficient only for the assessment of risk to human populations.

Because conventional risk assessment methods focus almost entirely on threats to human health, as opposed to threats to wildlife and other natural resources, such methods will not sufficiently protect water resources so as to comply with the mandates of Porter-Cologne and the regulations, water quality control plans and policies of the State and Regional Water Boards. The attached chart shows the main areas of dissimilarity between EPA and DTSC's risk assessment approach and the Water Boards' requirements for water resource protection.

Chemicals addressed by conventional risk assessment methods do not encompass all potential pollutants that are capable of causing adverse impacts on beneficial uses of surface and ground waters. This is because many beneficial uses of water do not involve potential human health impacts. An example is where a chemical causes adverse taste or odor at a concentration lower than it can cause toxicity. The impact of boron or dissolved solids on the ability of a body of ground water to be used for agricultural or industrial supply cannot be predicted by conventional risk assessment either.

The concept of antidegradation is also excluded by conventional risk assessment procedures. Antidegradation principles are critical to water quality protection under both the Porter-Cologne Act and the federal Clean Water Act. Multiple waste dischargers within an area and the contribution to water quality degradation potentially imposed by each must be considered. If one discharger (e.g., a single DoD site) is permitted to degrade a water resource to just below the level where beneficial uses are impaired, then no additional capacity exists for further degradation by other existing or future discharges of waste. If a discharger is allowed to degrade a water resource to just below a present-day standard of 10 ppb, then if the standard changes to 5 ppb, beneficial uses are lost. Our knowledge of the health and environmental effects of chemicals or combinations of chemicals is constantly evolving.

For these reasons, antidegradation forms a basis for Chapter 15, Article 5 and State Water Board Resolution No. 92-49 corrective action requirements. These requirements set background levels as the goal of cleanup actions unless this goal is technologically and/or economically infeasible to achieve. In those cases, cleanup levels must be "consistent with the maximum benefit to the people of the state", and must "not unreasonably affect present and probable future beneficial uses". In many cases, this involves the application of "best available technology" to the cleanup effort.

To be an effective tool for long-term water resource protection in site assessment and cleanup level determinations, conventional risk assessment methods must be substantially altered to consider the resources themselves, such as surface and ground water bodies, as the receptors of chemical pollutants, and not simply the nearest human populations. The State's water quality standards — the beneficial use designations, water quality objectives, and implementation programs contained in the State and Regional Water Boards' *Water Quality Control Plans* — which are applicable to the particular site in question must be used as indicators of impacts on the "health" of the water body. Staff should require that these adjustments be made, when requested by dischargers to consider that risk assessment methods be used to assess risks to beneficial uses of water resources.

The Uncertainties of Chemical Transport Modeling

Conventional risk assessment methods use chemical transport models to determine the availability of a chemical to cause an impact on a receptor. Models used to determining the potential for impacts of pollutants in soils on ground water quality involve pollutant transport in the unsaturated zone. The modeling of pollutant transport in unsaturated soils is not clear and exact science. Many unknowns exist in our knowledge of chemical transport and retardation mechanisms in the unsaturated zone. To be workable, these models are forced to greatly simplify a highly complex natural situation. In addition, most models are derived from knowledge of micro-scale environmental fate processes. Models often ignore larger scale factors, such as fracture flow in soils, which can have significant effects on chemical transport in the field.

Decisions that would be based on these models can be of great import. Acceptance of the results of a model that proves not to be valid could result in the pollution of ground waters beneath and adjacent to contaminated sites. Without rigorous laboratory and field verification, chemical transport models are not really science, but essentially computerized theory on the interaction between chemicals and the soil environment. Field verification of a model's output is critical to the reliability of site assessment and cleanup decisions that will be based on that model.

Few models have been rigorously field verified under the wide range of hydrogeologic conditions present in California. To be usable, all assumptions and boundary conditions of a model would have to be clearly demonstrated to be consistent with conditions present at the site being studied. The model(s) must also be justified as being appropriate for the types of attenuative mechanisms actually available for protection of ground water at the site. Specifically, a theoretical model should be developed based on site-specific properties and attenuative mechanisms that are known to be available. Only then should an existing computer model be selected, based on a good fit with the theoretical model. Unfortunately, consultants all too often simply select a computer model off the shelf, without a real understanding of its appropriateness to the site and the situation at hand.

JBM

Attachment

cc: Regional Board Assistant Executive Officers
Betsy Miller Jennings, Office of the Chief Counsel, State Water Resources Control Bd.
Frances McChesney, Office of the Chief Counsel, State Water Resources Control Bd.
James Cornelius, Div. of Clean Water Programs, State Water Resources Control Board