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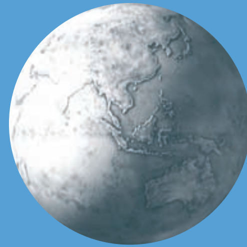
Environmental Perspectives

2nd QUARTER 2007



The Collision of MTBE and NRD in New Jersey

The Situation

The New Jersey Department of Environmental Protection (NJDEP) recently filed a complaint against a long list of petrochemical companies who previously provided the state's gasoline supply. The suit is specifically targeted at alleged releases of methyl tertiary butyl ether (MTBE), a fuel oxygenate approved by U.S. EPA in 1979 and added to gasoline to reduce combustion emissions. Though the suit is focused on groundwater and surface waters and aims to "restore such waters to their original condition, to compensate the citizens of New Jersey for the lost interim value and benefits of their natural resources…," the suit also has the flavor of product liability and public nuisance elements. The suit is aimed at the state's waters and water quality with respect to drinking water, it is not entirely clear that other environmental resources (e.g., ecological resources) would not be associated with injuries to surface waters.

For the first time, damages associated with MTBE releases are being claimed for injuries to surface waters and natural resources.

MTBE contamination primarily impacts groundwater after accidental releases. NJDEP has set a health-based primary maximum contaminant level (MCL) of 70 ppb for drinking water. Several states have previously sued suppliers of reformulated gasoline for exceedances of this standard.

Natural resource damage (NRD) claims have traditionally focused on both lost human use and ecological services. NRD groundwater claims usually focus only on human use services. This recent NRD claim, however, is not limited to injuries to groundwater resources. Now for the first time, damages associated with MTBE releases are a prominent focus, and are being claimed for injuries to surface waters. The state is claiming compensatory damages for the lost interim value of the water as well as other damages ostensibly related to the discharge of MTBE.

Background

MTBE in Groundwater

The presence of MTBE may significantly increase the footprint of the many alleged gasoline releases in New Jersey. A typical plume for a gasoline release from a service station is less than one acre, based on the area exceeding the groundwater criterion for benzene. However, when based on MTBE, the plume size may cover much larger areas because the concentration of MTBE in gasoline is higher than that of benzene, MTBE is much more soluble in groundwater, and MTBE has a slower degradation rate than benzene.

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For more information, contact:

Paul D. Boehm, Ph.D.

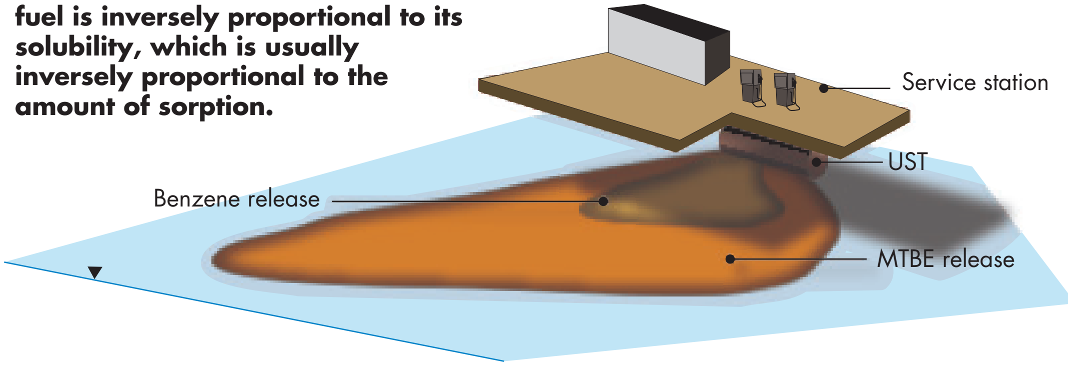
Principal Scientist and Group Vice President, Environmental Group

(978) 461-1220

pboehm@exponent.com

www.exponent.com

The rate of release of a chemical from fuel is inversely proportional to its solubility, which is usually inversely proportional to the amount of sorption.



New Jersey Groundwater NRD Formula

NJDEP has developed a formula (now commonly known as the "New Jersey formula") for determining damages to groundwater for settlement purposes. While the formula is simple, it may overestimate actual damages. To use a specific example, a TCE spill in 1986 created a 252-acre plume. Using the New Jersey formula, groundwater damage was calculated to be $765,000. Using more realistic methods to calculate the actual volume of water that flows through the plume, the volume affected was much smaller than predicted by NJDEP's formula, and potential damages were decreased to $496,000. If damages are based on actual service loss, as they should be in NRD, they are even lower. In this case, the TCE spill affected several water supply wells; however, the number of wells affected by the plume at any one time changed as the area of the plume grew and shrank. Using 178gallons/ day as the assumed household water use, tabulating the number of households affected each year, and calculating the present value of the volume of water that could not be used (the lost service), groundwater damage was $27,384, approximately 3.5 percent of what was calculated using the New Jersey formula.

Technical Challenges

While the mere presence of a listed contaminant in groundwater in excess of the drinking water standard had previously been the basis of most NRD groundwater claims, the scientific assessment of damages to groundwater is far more technically complicated. Extending the damage claims to surface water and possibly to other natural resources raises a number of important technical issues and questions that would need to be addressed.

Groundwater-Surface Water Interactions

Groundwater-surface water interactions are complex. NRD claims may assume that if groundwater is injured then the nearby surface waters must also be injured. This assumption overlooks several important processes, especially in the case of MTBE. As a worst case, groundwater can be the sole source of water to wetlands, seepage lakes, and first order streams, emerging from the ground with MTBE undiluted. However, microorganisms that degrade MTBE are naturally abundant in sediments and aerated surface waters. In more realistic and typical cases involving larger streams, the flux of groundwater to overlying surface water is small compared to river flow. Considerable dilution is achieved quickly. MTBE also volatilizes from surface water to air. In tidal waters, the phenomenon of "tidal pumping" must be taken into account as this transport route may, in some cases, further dilute MTBE in groundwater before it influences surface waters.

Limited Data on Ecotoxicity of MTBE and Its Degradation Products

While the New Jersey claims do not directly address ecological injuries, the leap to such injury claims could conceivably occur in the future. However, while much has been written on potential human health effects of MTBE, far fewer reliable and applicable data are available on the potential toxicity of MTBE to specific ecological receptors (e.g., fish, birds, mammals). Available data indicate that appropriate acute and chronic aquatic toxicity thresholds are approximately 150 ppm and 50 ppm, respectively, values that are one thousand times higher than the drinking water MCL. Data are also limited on the ecotoxicity of MTBE's principal degradation product, tertiary butyl alcohol (TBA), which is included along with MTBE in the NRD complaint. However, it is known that the toxicity of TBA to ecological receptors is less than the toxicity of MTBE. Further, MTBE does not bioaccumulate and is rapidly excreted, unlike, for example, PCBs and mercury, whose persistence in fish tissue is a common NRD issue.

Available toxicity data suggest that, at commonly observed environmental concentrations, MTBE should not be toxic to aquatic life. Given the expected low concentrations of MTBE in surface water, its relatively low ecotoxicity, and lack of bioaccumulation, there is low potential for adverse ecological effects from exposure to MTBE.

Restoration Options

The preferred approach to settlement of NRD liability is to provide restoration of the injured resource rather than to pay monetary damages. In other NRD claims, restoration often takes the form of ecological restoration projects (e.g., wetlands creation, aquatic habitat enhancement, fish stocking programs, and other approaches that depend on the specific site). Restoration of damaged groundwater in New Jersey typically involves setting land aside in the same drainage basin to create recharge zones free from future development. Given the potential scope of the MTBE NRD claim and expected limited impact to surface waters, a lack of available land in the densely populated region may limit this restoration approach and other restoration approaches may need to be considered.

Causation and Baseline: Beware

Plaintiffs and regulators will often attribute alleged natural resource injuries to a contaminant regardless of a causal linkage. The rules of NRDA, however, require that a linkage (causation) between contaminant and alleged injury be demonstrated. The rules also require that the environment be considered on a "but for the release" basis. In other words, a defendant cannot be held responsible for a reduction in service of a natural resource if that reduction is likely the result of other natural or anthropogenic causes. In the highly industrial and commercially developed climate in most areas of New Jersey, many other factors and a host of other industrial chemicals unrelated to MTBE releases may greatly complicate the determination of the causality of injury from any single contaminant such as MTBE. The baseline factors are critical elements in a valid NRD claim.

Summary: Need for a Technically-Based Strategy

NRD claims need to be based on sound science and linkage between a source and the injured resources being claimed. While it may appear to be straight-forward to demonstrate the technical basis of an MTBE claim for NRD to groundwater based on exceedances of the MCL, the translation of injured resources to compensatory restoration is challenging. Furthermore, the translation of groundwater exceedances to surface water injuries and injuries to other resources require that a far stronger set of data be used and good science prevail. Therefore, it is challenging to develop a well-founded NRD claim for resources beyond groundwater and to mount a strong defense of such a claim. Ample data on the chemical baseline, hydrogeology, transport and fate elements related to linking groundwater and surface water, the use of defensible and realistic models to calculate damages, and perhaps the consideration of ecotoxicological benchmarks and/or fundamentals, all must be considered as part of a valid claim and/or a science-based defense of New Jersey's MTBE NRD complaints.

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Advancing Environmental Assessment and Communication Using GIS

"Knowing where you are is more than half the battle"

The increasing use of powerful analytical tools such as advanced event-specific projection models (e.g., oil spill models), multi-media transport and fate models, and spatially-explicit wildlife exposure models, generates large and complex data sets that decision-makers may not be able to interpret. Another tool, however, offers both analytical power and risk communication utility. A Geographic Information System (GIS) uses digital maps, photographs, satellite images, and other visual media to capture user-specified geographic data. Environmental stressors, once viewed in one flat and static dimension, are increasingly incorporated into and assessed with GIS tools. Conditions that affect these stressors change through time and across landscapes. Potential impacts may appear very different at one scale compared to another scale, depending on the assessment metric. As scientists, we are increasingly challenged to develop new ways to integrate and communicate our findings. Through GIS, which is now routinely applied to most of our projects, we can present our assessment findings (e.g., lines of evidence in a risk-based environmental review) within the larger spatial context of the study area. GIS offers another tool for emphasizing our conclusions from a range of scales. In our next issue, through a series of case studies, we will highlight the analytical applications of the powerful GIS tools.

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New Faces

Dr. Waverly A. Thorsen
Senior Scientist, Environmental, Bellevue, WA

Dr. Waverly A. Thorsen has expertise in the bioavailability of hydrophobic organic contaminants, particularly PAHs. She also has designed and conducted toxicokinetic studies to measure uptake and elimination rate constants of PAHs in bivalves. She has experience working in both laboratory and field settings and is interested in the fate and effects of contaminants in the environment, and the potential for human exposure and health effects.

Dr. Thorsen has conducted field studies in Maine, North Carolina, and Virginia to measure PAH concentrations in multiple environmental compartments (soil, sediment, water, particulate organic carbon). She has also measured biota-sediment accumulation factors in the laboratory and field to better understand hydrophobic organic contaminant partitioning. She has evaluated the effect of varying levels of soot carbon and organic carbon on PAH transport and fate in the environment. Dr. Thorsen's toxicokinetic work has been used to better inform environmental regulators, managers, and scientists, and her soot carbon and PAH partitioning work is applicable to address environmental remediation issues related to contaminant bioavailability.

Prior to joining Exponent, Dr. Thorsen worked as a consultant at the Bill and Melinda Gates Foundation with the Agricultural Development Program.

Recent/Upcoming Publications

Boehm, P.D., and D.S. Page. 2007. Exposure elements in oil spill risk and natural resource damage assessments: A review. Hum. Ecol. Risk Assess. 13:418–448.

Chan, W., W. Nazaroff, P. Price, and A. Gadgil. 2007. Effectiveness of urban shelter-in-place–I: Idealized conditions. Atmos. Environ. 41:4962–4976.

Kane Driscoll, S.B., and R.M. Burgess. 2007. An overview of the development, status, and application of equilibrium partitioning sediment benchmarks for PAH mixtures. Hum. Ecol. Risk Assess. 13(2):286–301.

Menzie, C.A., and A.J. Coleman. 2007. Debate and commentary. Polycyclic aromatic hydrocarbons in sediments: An overview of risk-related issues. Hum. Ecol. Risk Assess. 13:269–275.

Menzie, C.A., M.M. MacDonell, and M. Mumtaz. 2007. A phased approach for evaluating the combined effects from multiple stressors. Environ. Health Perspect. 115(5):807–816.

Johnson, M.S., **W.T. Wickwire**, M.J. Quinn, D.J. Ziolkowski, D. Burmistrov, **C.A. Menzie**, C. Geraghty, M. Minnich, and P.J. Parsons. In press. Are songbirds at risk from lead at small arms ranges? An application of the spatially explicit exposure model. Environ. Toxicol. Chem.

Recent/Upcoming Presentations

U.S. EPA Science to Achieve Results Workshop on Valuation of Ecological Benefits
Washington, DC
April 23–24, 2007

Use of Stated Preference Methods to Value the Benefits of Ecological Risk Reductions: A Case Study of Exposure to Polychlorinated Biphenyls. **K. von Stackelberg** and J. Hammitt. Invited paper.

SETAC Europe 17th Annual Meeting
Porto, Portugal
May 20–24, 2007

The Iraqi Wetlands: Ecological Stress and Hydrological Potential for Restoration. **A. Cattarossi**, J. Lecollinet, **D. Hamilton**, and **T. Deardorff**.

The Feasibility of Using a Microcosm-scaled Wetland for Treating Wastewater from a Pulp and Paper Mill. **T. Deardorff**.

Development of a Constructed Wetland in Southern Iraq. **T. Deardorff**, **T. Flowers**, **D. Hamilton**, **A. Cattarossi**, and J. Lecollinet.

North American Advancement of Integrated Gasification Combined Cycle (IGCC), Coal to Liquids (CTL), and Synthetic Natural Gas (SNG) Workshop
Houston, TX
May 24, 2007

CO_2 Utilization Technologies. **D. Mueller** and **S. Saraf**.

SETAC Pellston Workshop: The Tissue Residue Approach
Leavenworth, WA
June 7–12, 2007

S. Kane Driscoll, participant

Air & Waste Management Association Annual Meeting
Pittsburgh, PA
June 26–29, 2007

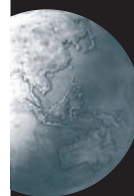
RCRA: The Past Quarter Century and the Next, **D. Mueller**, Panel Chair.

Environmental Forensics, **D. Mueller**, Panel Chair.

Texas State Bar Association's 19th Annual Texas Environmental Superconference
Austin, TX
August 1–3, 2007

Global Climate Change Modeling. **J. Levy**.

Environmental 101—Solid Waste/Superfund. **D. Mueller**.



About Exponent

Exponent is a leading engineering and scientific consulting firm dedicated to providing solutions to complex problems.

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(888) 656-EXPO
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