



Brian L. Murphy, Ph.D.
Principal Scientist

Professional Profile

Dr. Brian L. Murphy is a Principal Scientist in Exponent's Environmental Sciences practice. Trained as a physicist, he has more than 30 years of experience in data analysis and mathematical modeling of pollutant fate and transport in various media. He is the author of more than 30 journal publications. He is also coeditor of the Academic Press texts, *Introduction to Environmental Forensics*, and *Environmental Forensics: Contaminant Specific Guide* and is on the editorial board of the journal *Environmental Forensics*.

Dr. Murphy's practice focuses on:

- Application of environmental forensics methods to assess liability
- Dose reconstruction for toxic torts
- Historical reconstruction of contaminating events at former manufactured gas plants
- Air dispersion modeling, both indoors and outdoors, including soil vapor intrusion
- Use of risk assessment to set clean-up levels and as a cost allocation tool.

Dr. Murphy's projects often involve chlorinated solvents such as PCE, TCE, and TCA; gasoline and other petroleum compounds such as benzene and MTBE; dioxins; metals such as lead and arsenic; and a variety of other compounds, including PAHs, PCBs, radiological compounds, pathogenic compounds, nerve gas, and explosives. He serves as both a testifying and consulting expert in these areas, and his experience also includes formulating challenges to other experts' testimony.

Dr. Murphy has co-chaired several Environmental Forensics conferences and moderated a scientific symposium organized by a citizens group in Palmerton, Pennsylvania, regarding the significance of lead contamination in that town. He has also taught classes on Managing the Superfund Process, Requirements of the Clean Air Act, and Brownfields redevelopment. He has also been a Visiting Instructor at the Harvard School of Public Health and the University of South Florida.

In addition to numerous private-sector clients, Dr. Murphy has been a consultant to the Economic Development Administration of the Commonwealth of Puerto Rico, PEMEX, the North Atlantic Treaty Organization, U.S. Departments of Commerce and Defense, EPA, and the National Academy of Sciences.

Academic Credentials and Professional Honors

Ph.D., Theoretical Physics, Yale University, 1966

M.S., Theoretical Physics, Yale University, 1963

B.S., Physics, Brown University (honors), 1961

Publications

Murphy BL, Chan WR. Multi-compartment mass transfer model applied to building vapor intrusion. *Atmospheric Environment* 2011; doi: 10.1016/j.atmosenv.09.009.

Murphy BL, Mohsen FM. Reconstructed plume method for identifying sources of chlorinated solvents. *Environ Foren* 2010; 11(1):60–71.

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Murphy BL, Brown J. Environmental forensics aspects of PAHs from wood treatment with creosote compounds. *Environ Foren* 2005; 6(2):151–159.

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Bowers TS, Shifrin NS, Murphy BL. Applying hazardous waste site cleanup levels: A statistical approach to meeting soil cleanup goals on average. *Environ Sci Technol* 1996; 30:1437–1444.

Murphy BL, Sanborn PS. Technical issues in Superfund insurance litigation. *Environ Claims J* 1993; (5/4):573–592.

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Steele MJ, Beck BD, Murphy BL, Strauss HS. Assessing the contribution from lead in mining wastes to blood lead. *Regul Toxicol Pharmacol* 1990; 11:159–190.

Murphy BL, Beck BD, Toole AP, Bergstrom PD. Risk assessment studies for arsenic contaminated soil. *Society for Environmental Geochemistry and Health, 7th European Meeting, Egham, U.K. Environ Geochem Health* 1989; 11(3/4):163–169.

Murphy BL. Modeling the leaching and transport of 2,3,7,8-TCDD (TCDD) from incinerator ash from landfills. *Dioxin '88, 8th International Conference, Umea, Sweden, August 1988. Chemosphere* 1989; 19(1–6):433–438.

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Books

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Murphy BL. Forensic methods for chlorinated solvents. *Proceedings, International Network of Environmental Forensics 2009 Annual Conference, Calgary, Alberta, Royal Society of Chemistry, London, 2010.*

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Morrison RD, Murphy BL (eds). Environmental Forensics: Contaminant Specific Guide. Cowrote chapter chlorinated Solvents". Academic Press, San Diego, CA, 2006.

Ehrenfeld JR, Ong JH, Farino W, Spawn R, Jasinski M, Murphy BL. Controlling volatile emissions at hazardous waste sites. Noyes Data Corp, NJ, 1986.

Technical Reports

Murphy BL. Exposure model handbook for the screening of former manufactured gas sites. Prepared for the Gas Research Institute, Chicago, IL, 1988.

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Farino W, Spawn P, Jasinski M, Murphy BL, Nunno T. Evaluation and selection of models for estimating air emissions from hazardous waste treatment, storage and disposal facilities. GCA Corporation Report GCA-TR-82-83-G to U.S. EPA, 1982.

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Electromagnetic Wave Propagation, Wiesbaden, West Germany, April. AGARD-CP-115. North Atlantic Treaty Organization Report, 1972.

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Presentations

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Chan W, Brorby G, Murphy BL. Characterizing TCE exposure distributions for occupants of houses with basements. AWMA Vapor Intrusion Conference, Chicago, IL, September 29–30, 2010.

Murphy BL, Chan W. A Different Way of Looking at Soil Vapor Intrusion. Poster Presentation, AWMA Vapor Intrusion Conference, Chicago, IL, September 29–30, 2010.

Murphy BL. Manufactured Gas Plants (MGPs). International Network for Environmental Forensics Conference, Calgary, Alberta, Canada, August 31–September 2, 2009.

Murphy BL. Forensic techniques for chlorinated solvents. International Network for Environmental Forensics Conference, Calgary, Alberta, Canada, August 31–September 2, 2009.

Murphy BL. American Bar Association, Toxic Torts and Environmental Law Committee, Ethanol, Phoenix, AZ, March 29–31, 2007.

Boehm PD, Murphy BL. Environmental forensics: Winning strategies and tactics. Keystone, CO, March 9–12, 2006.

Murphy BL. Who spilled the chlorinated solvents? American Bar Association, Toxic Torts and Environmental Law Committee, April 8, 2006.

Murphy BL. Forensic methods for chlorinated solvents. SETAC, Baltimore, MD, November 2005.

Murphy BL. Intersol. Forensic methods for estimating the source and age of a chlorinated solvent release, Paris, France, April 19, 2005.

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Murphy BL. Forensic techniques for age dating and source identification of chlorinated solvents, Santa Fe, NM, September 24–25, 2003.

Murphy BL. Forensics techniques for age dating and source identification of chlorinated solvents. International Society for Environmental Forensics, Stresa, Italy, May 20, 2003.

Gauthier TD, Murphy BL. Edible plant bioconcentration factors for RDX. Presented at the 2000 Annual Meeting, Society for Risk Analysis, Arlington, VA, December 3–6, 2000.

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Murphy BL, Gauthier TD. RBCA and brownfields: Importance of the soil vapor migration pathway. IBC Symposium on Risk-Based Decision Making, Washington, DC, February 24–25, 1997.

Murphy BL. Dealing with uncertainty in risk assessment. Presented at the State of Practice of Risk Assessment in Human Health and Environmental Decision Making, Tallahassee, FL, December 13–14, 1995.

Murphy BL, Drivas PJ. Migration of volatile contaminants into buildings. Proceedings, 8th Annual Conference on Contaminated Soils, Amherst, MA, September 1993.

Murphy BL, Bowers TS. Risk assessment with lognormal distributions. Proceedings, HMC/Superfund, HMCRI's 13th Annual National Conference and Exhibition, Washington, DC, December 1992.

Murphy BL, Bowers TS. A model relating post remedial soil concentrations to exposure, p. 374. Proceedings, Annual New England Environmental Expo, May 21–23, 1991.

Murphy BL, Steele MJ, Drivas PJ, Daly LC. State-of-the-art Superfund insurance claim reviews, pp. 443–447. Proceedings, HMC-Northeast '91 Conference, July 10–12, 1991.

Drivas PJ, Bass DH, Murphy BL. Atmospheric emissions from buried hazardous waste. Paper 90-74.4. Presented at the 83rd Annual Air and Waste Management Association Meeting, Pittsburgh, PA, June 1990.

Murphy BL, Doherty JD, Shifrin NS. Determining the effectiveness of soil washing. Presented at the 6th HMCRI National Conference on Hazardous Wastes and Hazardous Materials, New Orleans, LA, 1989.

Murphy BL. Total exposure from contaminated tap water. Paper 87–98.2. Presented at the Air Pollution Control Association 80th Annual Meeting, New York, June 1987.

Murphy BL. Real estate development of contaminated sites. Presented at the Air Pollution Control Association Spring 1987 Hazardous Waste Conference, Sturbridge, MA, 1987.

Burmester DE, Wolff SK, Gushue JJ, Murphy BL, Menzie CA. Exposure and public health risk assessment for the Baird and McGuire Superfund site in Holbrook, MA. Presented at the Superfund '87 Conference, Washington, DC, November 1987.

Murphy BL. Mathematical modeling: Physical science issues in natural resource damage assessment. Presented at the Center for Energy and Environmental Management Conference on Damages to Natural Resources, Washington, DC, 1986.

Cole CF, Murphy BL, Evans JS. Quantification of errors in EPA's fugitive dust emissions and modeling methodology at Western Surface Coal Mines. Presented at the Air Pollution Control Association Conference on Particulate Matter and Fugitive Dust, Tucson, AZ, October 1986.

Murphy BL. Community risks from chemicals in contaminated groundwater entering basements. Paper 9-5. Presented at the Society for Risk Analysis Annual Meeting, Boston, MA, November 1986.

Murphy BL, J.E. Yocum. Migration factors for particulates entering the indoor environment. Proceedings, Air Pollution Control Association 79th Annual Meeting, Minneapolis, MN, 1986.

Brandwein DI, Murphy BL, Cowen BD, Halvorsen MS, Beck, Jr, WW, Elston HC. Auditing hazardous waste facilities. Proceedings, Air Pollution Control Association 77th Annual Meeting, San Francisco, CA, June 1984.

Murphy BL, Beck W, Unites D. Superfund: Mining sites on the National Priority List. Presented at the American Mining Congress Annual Meeting, San Francisco, CA, 1983.

Murphy BL. Indoor air pollution risk considerations in energy conservation programs. Paper 1B-2. Proceedings, Society for Risk Analysis Annual Meeting, New York, 1983.

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Ozkaynak H, Murphy BL, Watson J. A comparative risk assessment technique for tanker oil spills. Proceedings, 1979 Oil Spill Conference, 1979.

Murphy BL, Fitzroy S, Goldsmith BJ, and Ghelardi R. Impact on industry of upcoming potential visibility regulations. In: APCA Specialty Conference on Visibility, Denver. Air Pollution Control Association Report, 1979.

Egan BA, Murphy BL, Bendel WB, DePietro SA. Modeling and monitoring requirements implicit in the new PSD regulations. American Society of Mechanical Engineers Annual Meeting, San Francisco, CA, December 1978. ASME publication No. 78-WA/APC-14.

Murphy BL, Henebry WM. Use of mathematical models in negotiating air quality permits. Proceedings, National Petroleum Refiners Association Annual Meeting, San Antonio, TX, 1978.

Egan BA, Murphy BL, Bendel WB, DePietro SA. Modeling and monitoring requirements implicit in the new PSD regulations. Paper 78-WA/APC-14. Presented at the American Society of Mechanical Engineers Annual Winter Meeting, San Francisco, CA, 1978.

Murphy BL. The Clean Air Act and the uncertainties surrounding the regulation of rare events. Presented at the American Bar Association Course of Study on Environmental Law, American Law Institute, Washington, DC, 1977.

Murphy BL. Plume rise from a row of chimneys. Paper 75-04.7. Proceedings, 68th Annual Air Pollution Control Association Meeting, Boston, MA, 1975.

Project Experience

Criteria Air Pollutants/Visibility

Critiqued the North Dakota State Ambient Air Quality Standards on behalf of the Lignite Energy Council. The State standards were more stringent than federal standards. In particular, the State had a one-hour standard to prevent sulfur dioxide exposure of asthmatics exercising outdoors. Analyzed ambient air monitoring data, air dispersion modeling results, and insurance claims data for the treatment of asthma to support the opinion that risks to asthmatics were extremely small. Made presentations to several State boards and legislative committees, resulting in the elimination of the State standards.

Reviewed a proposal to retrofit older North Dakota power plants to New Source Performance Standards for the Lignite Energy Council. The review focused on the actual contribution of older plants to statewide emissions and ambient air concentrations.

Analyzed regional United States population exposure and potential mortality due to airborne particulate exposure, including uncertainty analysis, in a program sponsored by the U.S. Department of Energy at the Harvard School of Public Health.

Developed a site-specific dispersion model for Proctor and Gamble for a factory in a deep valley, where monitoring showed high concentrations of sulfur dioxide to occur during stable, nighttime conditions.

Conducted dispersion modeling of all Duke Power and Carolina Power and Light facilities in North Carolina, and provided testimony in state hearings regarding a proposed change in particulate standards.

Conducted downwash modeling and dispersion analysis to determine causes and appropriate solutions to a mill odor problem.

Conducted a prevention-of-significant-deterioration (PSD) study for Chevron Chemical at an Iowa fertilizer plant.

Provided dispersion modeling and testimony for Union Camp Corporation for a particulate emission variance in Ohio. Also, assisted in PSD permitting for a new mill in Alabama.

Prepared an uncertainty analysis for particulate concentrations due to surface coal mines for the National Coal Association. Analyzed and combined uncertainties in fugitive dust emission factors, dispersion models, and activity factors to arrive at an overall prediction uncertainty.

Conducted a series of studies evaluating the effect of Amendments to the Clean Air Act on growth in various industrial sectors for the Utility Air Regulatory Group, the American Paper Institute, and the U.S. Department of Energy.

Developed a site location inventory for new power plants in the State of Ohio, through dispersion modeling and other considerations such as water availability, under proposed Clean Air Act Amendments. Work was sponsored by a group of Ohio utilities and was presented to members of Congress and staff.

Developed a modeling and screening procedure for the U.S. Department of Energy to identify visibility impairment—both visual range reduction and discoloration—from air pollutants due to industrial sources.

Evaluated whether or not a potential paper mill acquisition would be permitted by regulatory agencies to convert to coal. Issues related to Clean Air Act compliance and the necessity of installing control equipment.

Conducted plume dispersion and visibility modeling for a power plant near a national wilderness area as part of a lawsuit brought against Public Service of Colorado, Salt River Project, and PacifiCorp.

Retained by Steptoe and Johnson to conduct plume rise analysis for cooling towers at a Chevron Chemical plant in Texas. The purpose was to determine the potential contribution from cooling towers to fog formation along a nearby highway. Concluded that under the meteorological

conditions existing at the time, the plume would have risen vertically, rather than moving horizontally to obscure the highway. Deposited before the case settled.

Dioxins/Furans

Conducted a risk analysis for EPA at the dioxin- and pesticide-contaminated Baird and McGuire site in Holbrook, Massachusetts.

Retained by a citizens' group in Thomaston, Maine, to review environmental impacts due to burning hazardous waste in a rotary cement kiln. Dioxin formation in the kiln, lead contamination of surface waters, and transportation-related fires were examined.

Retained on behalf of Akzo Reliance at the Harvey Industries site in Athens, Texas. The issue was dioxin and furan formation from combusting spent solvents in a boiler and from open burning of solvents. Conducted dispersion modeling and analyzed soil contamination patterns to show that these processes were negligible contributors to the regional dioxin background.

Reviewed the OLM and VHS models used by EPA to develop regulations for leaching and transport of dioxins from burial of incinerator ash. The work was supported by Syntex chemical. Results were presented at an international dioxin conference in Sweden.

Retained by Strasburger and Price on behalf of General Motors to compile emissions inventories and conduct dispersion modeling for three General Motors plants in Matamoros, Mexico, as part of a toxic tort case in Brownsville, Texas. Also analyzed the downwind concentrations of dioxins and other combustion products that would result from open burning of plant wastes at a municipal dump. Compared model concentrations with concentrations of the same chemicals to which people elsewhere are normally exposed. Deposited before the case settled.

Estimated chemical emissions, including metals and dioxins, at a metals reclamation facility in Muskogee, Oklahoma, for the U.S. Department of Justice. Modeled air dispersion and deposition of contaminants into nearby lakes and streams as part of a NPDES suit.

Retained by Hartline, Dacus, Dreyer and Kern on behalf of General Tire in a toxic tort in Odessa, Texas. Estimated chemical emissions and performed air dispersion modeling at a rubber manufacturing facility. Modeled dioxin emissions from an onsite incinerator and hydrogen sulfide emissions from solar evaporation ponds, as well as styrene and butadiene process emissions.

At an abandoned refinery that had leased space to a wood treating plant, analyzed how and when dioxins were transported off site.

Engineered Structures Risk Analysis

Performed a detailed analysis of the likelihood of oil spills, fires, and explosions associated with a proposed oil port in Puget Sound, including tanker and terrestrial and submarine pipeline components. Also conducted oil spill trajectory modeling studies. Provided more than a week

of testimony and cross-examination on behalf of Northern Tier Pipeline Company on these topics before the Washington State Energy Facility Siting Commission.

Helped develop a worldwide database for outer continental shelf activity related to oil spills for the U.S. Geological Survey. Collected accident data for oil ports, rigs, submarine pipelines, single-buoy moorings, and tankers, and developed statistical tests to determine the most appropriate exposure variables and to find evidence of trends.

Developed estimates for the Bureau of Land Management of the oil spill probability and probable magnitude of release associated with tanker traffic for the proposed SOHIO Oil Port in Long Beach. Special problems associated with tanker operations in Port Valdez, Alaska, were included. Predicted that one major spill would occur during the lifetime of the project, probably associated with icebergs in the shipping channel.

Examined the probability of a terrestrial pipeline failure and potential groundwater contamination for a proposed oil port in the state of Tabasco, as well as fire and explosion hazards associated with pipeline operations. Work was sponsored by Petroleos Mexicanos.

Carried out an assessment of the public risk involved in the operation of a liquid natural gas storage facility in Massachusetts. Estimated the probability of occurrence of various initiating events such as earthquake, hurricane, and sabotage; modeled the vapor cloud motion in the event of a release; and estimated the probability of ignition and subsequent damage that could occur.

Evaluated records of tank failures in a solvent storage facility in Massachusetts over a 50-year period, and then developed a model for probable tank lifetime and expected time to failure. This model was used to determine the consequences of replacing all the tanks in the farm, replacing the older tanks, or taking no action.

Explosive Compounds/Nerve Gas

Developed bioconcentration factors for the explosive compound RDX in garden vegetables based on a review of the literature. Work sponsored by The Ensign-Bickford Company and the Spanish Fork Technical Committee.

Conducted a multipathway risk assessment for explosive compounds (RDX, HMX, TNT, DNT, nitroglycerin, TEGDN, BTTN, PETN, DEGDN, and TMETN) in groundwater at a site in Utah on behalf of The Ensign-Bickford Company. Developed toxicity factors for a variety of endpoints where these were either absent or inappropriate.

Responded to an EPA request for information as part of listing PETN as a high-production-volume chemical on behalf of The Ensign-Bickford Company.

Assisted the law firms of Parsons Bailey and Latimer and Leboeuf, Lamb, Greene and MacRae in defense of a toxic tort involving possible exposure to RDX and other explosive compounds.

Retained by the Commissioner of Health and Hospitals of the City of Cambridge, Massachusetts, to analyze risks to the public from experiments with chemical warfare agents at a laboratory within the city. Conducted dispersion (puff) modeling to determine the maximum number of people that could be killed in an air release.

Soil Vapor Intrusion / Indoor Air Contaminants

Analyzed the source of, and recommended remedies for, methane found in soils and groundwater at a Florida housing development.

Estimated present and future indoor air concentrations and associated risks at a Connecticut factory where a groundwater plume of perchloroethylene from a neighboring facility had migrated beneath the building.

Estimated indoor air concentrations due to soil vapor intrusion for homes above a chlorinated solvent plume near Denver.

Conducted a study of indoor air pollutants and associated health effects for the Electric Power Research Institute. The purpose of the study was to determine whether meaningful risk analysis could be done for residential weatherization programs. Pollutants studied include formaldehyde, nitrogen dioxide, radon, and tobacco smoke.

Conducted several air modeling studies and prepared an affidavit for EPA relating to the Hyde Park hazardous waste landfill in Niagara Falls, New York. Topics included potential indoor air concentrations due to contaminated groundwater, air impacts of excavation, air concentrations due to flowing contaminated surface water, and emissions and concentrations resulting from incineration of waste.

Conducted a study of outdoor/indoor chemical migration factors for EPA. Migration pathways included transport of contaminants into basements and living spaces from ambient air, soil water, soil vapor, and surface dust.

Estimated inhalation, dermal, and ingestion exposure from showering, bathing, and general use of groundwater containing chlorinated solvents near a circuit board manufacturing site in Boulder, Colorado. Indoor air modeling and risk assessment were also conducted as part of this toxic tort. Deposed and testified in court regarding how EPA sets drinking water standards.

Determined the indoor air exposures that would occur to occupants if different types of buildings (i.e., office, parking garage) were constructed over a former manufactured gas plant site. Study conducted for a California utility.

Calculated employee exposure in a West Virginia factory where floors were washed with TCE.

Metals/Inorganics

Provided litigation support and courtroom testimony on behalf of one of the owners of a normal superphosphate plant in Charleston, South Carolina. The source of sulfuric acid used in fertilizer production was sulfur from burning pyrite. The pyrite contained both lead and arsenic, which entered the environment. Lead from the lead-lined chambers used in sulfuric acid production also entered the environment. Based on years of operation, changes in capacity, and other records, together with stoichiometry, we were able to allocate the lead and arsenic to successive owners. Based on aerial photography, we were also able to allocate filling of pyrite slag by successive owners to the remediation zone. Finally, based on statistical analysis, we were able to demonstrate that lead originating from the lead-chamber process was no longer on site, having been washed away in the gullies to which it had been disposed.

Retained by Strasburger and Price on behalf of Norton Performance Plastics in a toxic tort in Odessa, Texas. Estimated indoor air concentrations of mercury in a laboratory as part of a worker exposure case.

Retained by Sagaser, Franson, and Jones on behalf of the Halliburton Company in a toxic tort at a California gold mine. Estimated mercury emissions and ambient air concentrations from blasting ore containing cinnabar. Dispersion was modeled as a puff released from within a pit. Also investigated the relative toxicity of different mercury species.

Acted as Newmont Mining Company's representative on a Technical Advisory Group, which developed risk-based cleanup levels for lead and arsenic in Leadville, Colorado.

Conducted a review of documented public health effects possibly attributable to various mining, milling, refining, and smelting operations for the American Mining Congress. Also provided a theoretical analysis of exposure and expected public health impacts from mining-related sources. This study was motivated by impending RCRA regulation.

Provided risk assessment support to ARCO Coal Corporation for several mining-related Superfund sites in the Western U.S. Lead and arsenic were the principal contaminants of concern.

Developed cost allocation information at the Lowry Landfill in Denver based on legal theories of separability of harm for Alumet Corporation and Shell Chemical. A risk-based analysis showed that these parties' contribution to risk, particularly for the foreseeable future, was minimal and permitted a favorable settlement with the other PRPs.

Retained by Honigman, Miller to identify whether the source of lead at a Michigan site was airborne or due to a nearby landfill. Analysis was based on statistical evidence of enhancement of building drip-line concentrations, characteristic of an airborne source.

Reviewed mining sites proposed for the National Priority List for the American Mining Congress and compared these with a group of non-mining sites also proposed. The purpose was

to determine whether there were biases associated with application of the Hazard Ranking System to mining sites. As part of the analysis, developed a risk-based ranking model.

Retained by Sherman and Howard to conduct a critical review of an EPA risk assessment for a tailings pile at the Colorado School of Mines Research Institute. Exposure routes included wind-blown particulate, direct gamma radiation, and tailings ingestion.

Determined how and when uranium tailings had been dispersed across a site with successive owners. The analysis combined aerial photographs, recent radiation measurements, and documentary evidence.

PAHs/PCBs

Reviewed historical documents, topographic maps, and aerial photographs as well as recent sampling data in order to determine when contamination occurred at an Alabama Manufactured Gas Plant.

Identified historical operations leading to contamination and assessed the potential for additional offsite migration at more than 25 former manufactured gas plant sites in New York and Massachusetts on behalf of the utility insurers. Deposed numerous times regarding the circumstances in which tar and other materials were placed in the environment.

Reviewed historical information and contaminant data for a manufactured gas plant in Florida as part of a cost allocation case. Deposed regarding the time periods when releases to the environment likely occurred.

Reviewed potential exposure routes and health effects for coal-tar-related compounds discharging to the Island End River site in Boston Harbor.

Conducted indoor air transport calculations for a western utility in order to estimate exposures that would result for different types of buildings if they were constructed over a former manufactured gas plant site.

Provided exposure and risk assessment information to EPA for the Hocomonco Pond Superfund site in Westborough, Massachusetts. Contaminants included creosote, coal tar, and related PAHs. Exposure scenarios included ingestion of groundwater, soils, or muck; ingestion of fish; and ingestion of water while swimming.

Developed a comprehensive multimedia exposure model handbook for the Gas Research Institute. The purpose of the handbook was to assist utilities in remediating former manufactured gas plant sites.

Provided litigation support for a wood-treating site in Georgia. Chemicals of concern included pentachlorophenol, creosote, and arsenic.

Determined the likelihood of imminent release through leaching of PCBs in pipeline liquids disposal pits. Work was conducted on behalf of the insurers of Texas Eastern Pipeline.

Estimated air toxics emissions from incineration of wood tar at the Kerry Chemical site for the New York State Department of Environmental Conservation. Also estimated odors that would result from site excavation.

Determined the source of creosote chemicals in groundwater at a site in Florida by analyzing the spatial distribution of contaminants. Candidate sources were a wood-treating facility and an unloading operation at a railroad spur.

Pesticides

Analyzed emissions, downwind dispersion, and resident exposures as part of a toxic tort based on application of methyl bromide, 1,3-dichloropropene, and chloropicrin to California strawberry fields.

Petroleum Compounds

Age-dated petroleum releases at approximately 30 Florida gasoline stations based on the record of equipment failures, plume development, and ratios of plume constituents.

Analyzed benzene exposure from ambient and indoor air for a resident living near a refinery.

Investigated the source and timing of gasoline storage-tank releases at 7-11 convenience stores located in Berkeley, California; Houston, Texas; and Windham, Maine; for Southland Corporation. Techniques included mass-balance checks against missing inventory, ratio analysis of BTEX compounds, presence of tracers such as lead or MTBE, and estimating release date from MTBE plume extent.

On behalf of the American Petroleum Institute, conducted a critical review of EPA's Liner Location Model. This model was used in development of regulations for groundwater releases from mud pits and reinjection wells.

Reviewed how the Hazard Ranking System was applied at a Bossier City, Louisiana, refinery site for Occidental Petroleum.

Conducted a study for the National Academy of Sciences of the cost/benefit relationships involved in regulations controlling the discharge of oil from offshore drilling platforms. This required an assessment of energy and natural resource depletion factors, as well as economic and environmental impacts.

Conducted an assessment of the potential market for anthracite coal, under alternative formulations of New Sources Performance Standards for the U.S. Department of Energy.

Determined community exposure and risks at a municipal landfill where toxic chemicals were disposed and were being advected with the methane generated in the landfill. The analysis was performed for the City of New York at a Staten Island site.

Evaluated whether or not a potential acquisition would be permitted by regulatory agencies to convert to coal for a paper company.

Developed a national model for energy consumption due to environmental controls in the fossil-fuel-fired steam electric industry for the U.S. Department of Commerce.

Solvents

Using isotope analysis at Shaw Air Force Base to distinguish separate chlorinated solvent plumes.

Used carbon and chlorine isotope measurements to analyze whether chlorinated solvents in groundwater at a Florida facility originated entirely from a neighboring facility or there was evidence of additional onsite releases.

Determined how a release of perchloroethylene occurred at a California dry cleaning site. Estimated exposure of plaintiffs to ethylene dichloride, hydrogen chloride, and vinyl chloride monomer following an accidental release from a Louisiana facility. Used state-of-the-art meteorological analysis and the dispersion model CALMET/CALPUFF, and integrated real-time downwind measurements.

Used isotope and chemical concentration measurements to determine whether an offsite release was contributing to groundwater at a Texas oil-field equipment facility.

Determined exposure levels for nearby residents due to solvent wastes stored at a Texas site, as part of a toxic tort.

Analyzed how and when chlorinated solvents entered the environment at a Kansas manufacturing facility.

Retained as an expert witness and was deposed for a source determination case in the U.S. Virgin Islands. Analyzed chlorinated solvent biodegradation product ratios for perchloroethylene (PCE) and daughter products trichloroethylene (TCE) and 1,2-dichloroethylene (1,2-DCE). Both anaerobic and aerobic biodegradation were important. The purpose of the ratio analysis was to determine the relative contribution from a small release at a dry-cleaning facility to the total contamination observed in a large groundwater plume.

Estimated methylene chloride exposures near a manufacturing facility based on a variety of monitoring data and dispersion modeling results.

Deposed on how and when TCE and 1,1,1-trichloroethane (TCA) were released from a vapor degreasing operation at a manufacturing facility in Nebraska. The analysis was based on mass-

balance calculations and groundwater plume analysis, as well as solvent purchase records and inspection of the degreaser.

At the Salt River Project in Phoenix, Arizona, performed multimedia (three-phase) modeling to show that surface soils were being contaminated with TCE from a groundwater plume, rather than the contaminated soils being evidence of a spill that led to groundwater contamination.

Retained by U.S. Department of Justice to estimate indoor air exposures resulting from a solvent-contaminated groundwater plume in Colorado. Calibrated a soil vapor intrusion model for plaintiffs' homes with measurements made at nearby homes. Filed an affidavit reporting results.

Analyzed the spatial distribution of TCE and its biodegradation daughter products in groundwater, to help distinguish between residential septic tanks, a nearby landfill, and a manufacturing facility as sources of contamination at a site in Florida. This work involved a historical review of the use of septic tank cleaners containing chlorinated solvents.

Analyzed PCE data at a dry-cleaning facility in a Los Angeles-area strip mall. No biodegradation products were found in soils or groundwater. That, plus the operating history, led to the conclusion that the release had been of fresh PCE rather than spent. This helped to identify the responsible parties.

At a New Orleans dry cleaner, determined that soil and groundwater contamination had originated with a separator connected to a lateral line to the sanitary sewer. This determination was made based on the pattern of contamination and historical information about dry-cleaning operations.

Our client had operated a degreaser at a facility in the Denver area. However, there was no record of their using PCE. Based on their historical standard operating procedures, we determined that a previous tenant, a defense contractor, had operated a portable PCE degreaser for cleaning precious metals electronic parts. This enabled a settlement between the parties.

Retained by Grace Chemical Company and deposed as an expert witness in the Wells G and H toxic tort case in Woburn, Massachusetts. Examined groundwater data to determine possible sources of TCE contamination. Also analyzed the city water distribution system to determine exposures to TCE from drinking water and household water uses such as showering.

Conducted groundwater modeling to determine the time of plume origin and the time when solvent contamination reached site boundaries, at the Marotta Scientific Controls site in New Jersey.

Retained as an expert witness regarding the time of origin of a 1,1-dichloroethylene (1,1-DCE) plume in Palo Alto, California. The plume originated by hydrolysis of the degreasing agent TCA in relatively warm groundwater. The analysis was based on the fact that installation of a remediation well had left a "signature" in the plume, making a direct measurement of the

contaminant velocity possible in spite of a complex hydrogeologic setting. Was deposed and testified in court.

Determined the timing of releases to groundwater and the sources of solvent and chromium contamination leading to closure of drinking-water wells near Camden, New Jersey. To determine the sources of contamination, both mass-balance estimates and groundwater modeling were used.

Determined how long it would take to remove volatile organic compounds through *in situ* soil washing on behalf of a PRP group at the Liquid Disposal, Inc., Site in Michigan. These calculations were the basis for overturning a Record of Decision that had called for excavation and removal of soils.

Assessed risks due to offsite groundwater contamination by solvents and compounds related to chemical weapons manufacturing at the Rocky Mountain Arsenal in Colorado, for the State of Colorado.

Evaluated the public health significance of leachate measurements near the Cohasset Heights Landfill in Massachusetts and presented the results before two town boards.

Retained by Strasburger and Price to model chemical emissions from three General Motors automotive parts manufacturing plants and a waste dump in Matamoros, Mexico. Deposed regarding potential exposures of residents in nearby Brownsville, Texas, and how those exposures compared to everyday household exposures to the same chemicals, as part of a toxic tort anencephaly case.

Retained as an expert witness by McKenna and Cuneo and the U.S. Department of Justice on behalf of Thiokol Corporation and the U.S. Army. Performed critical review of worker and public exposure estimates from vapor degreasing operations at the Longhorn Army Ammunition Plant, in Texas. The case involved deposition testimony and participation in a Daubert hearing.

Retained by Woodard, Hall and Primm on behalf of Monsanto to model emissions from chemicals buried in pits and other sources at the Brio Superfund Site in Texas. Other technical analysis has varied during the course of involvement in about half a dozen separate toxic torts involving worker as well as public health claims. Deposed on numerous occasions and, on one occasion, testified in court. The primary substances of concern have been 1,1,2-trichloroethane, 1,2-dichloroethane, and vinyl chloride.

Conducted a literature review and developed air emission models for volatile organic compounds, using a consistent mass transfer theory approach for lagoons, landfills, landfarms, and holding facilities. This work was sponsored by EPA and was published in book form by Noyes Data Publishing.

Retained by the New York State Department of Health to analyze emissions and risks from operation of an air stripper. Key compounds were tetrachloroethylene and byproducts from disinfection by chlorine.

Combined monitoring data and dispersion modeling to determine solvent and petroleum compound exposures for civilian workers at a wastewater treatment plant at the Pensacola Naval Air Station in Florida. Retained by the U.S. Navy and testified before an arbiter.

Estimated volatile and semivolatile compound emissions from a proposed groundwater air stripper system and from landfill gas flares, as part of a Minnesota landfill expansion for Browning Ferris Industries. Dispersion modeling was used to determine nearby population exposure. Testified before an Administrative Law Judge.

Provided risk assessment consulting for submittal of a RCRA corrective action report at a hazardous waste incinerator site in Ohio.

Retained by Sherman and Howard and Davis Graham and Stubbs in connection with the Redfield Rifle site in Denver, Colorado. Estimated the health risks from exposure to 1,1-dichloroethylene in indoor air at residences located above a groundwater plume. Risks from 1,1-dichloroethylene were compared to risks from radon and chloroform. Determined appropriate action levels and attended public meetings to communicate results to potentially affected residents. Subsequently was deposed regarding U.S. EPA revisions to the toxicity profile for 1,1-dichloroethylene as part of a toxic tort case at this site. As part of an allocation issue, also determined which chlorinated solvents had been used during which time periods of different site occupancy.

Miscellaneous

Used a statistical technique—Principal Component Analysis—to analyze the effect of spreading poultry litter on growers' land and determine whether it was having a discernible effect on downstream waters in the Illinois River Basin.

Determined the origin and transport of hydrogen sulfide gas as part of an injury case at a paper mill in Maine.

Determined carbon monoxide plume trajectory for an RV generator parked next to a fifth-wheel trailer as part of a carbon monoxide death case.

Developed an objective screening criterion for rank ordering potential hazardous waste disposers for an electronics manufacturer. Physical criteria, which accompanied financial and management criteria, were based on chemical release and fire/explosion risk models.

Surveyed applications of meteorology in energy conservation programs. Results were intended to help guide National Science Foundation meteorology research and development.

Reviewed environmental studies at two educational institutions and a museum, in connection with a loan from Barclays Bank, PLC. Also made recommendations for an amount to be escrowed.

Interpreted chemical data at a Chelsea, Massachusetts, archeological site in terms of worker exposures and risks.

Calculated fugitive dust emissions from a salt storage pile, estimated downwind concentrations, and interpreted these in terms of potential materials damage for the City of Chelsea, Massachusetts.

Prior Experience

Brian L. Murphy Associates, 2002

Sciences International, Vice President, 1999–2002

IT Corporation (purchased Gradient), 1995–1999

Gradient Corporation, President, 1985–1995

ENSR (formerly ERT), 1975–1985

Chief Scientist: Environmental Operations and Research

Manager: Air Quality Studies Division

General Manager: Policy, Planning, and Earth Resources Center

Mount Auburn Research Associates, 1965–1975

Professional Affiliations

- Air and Waste Management Association
- International Society for Environmental Forensics
- American Chemical Society

Testimony

Depositions

Ruth B. Finn, Trustee of the Ruth B. Finn Revocable Trust and Ruth Finn Gray v. Haydon Switch & Instrument, Inc. et al., Connecticut Superior Court, Judicial District of Waterbury, UWY-CV-08-5007826S, March 17, 2010.

W.A. Drew Edmonson, Attorney General, State of Oklahoma et al. v. Tyson Foods Inc., et al., United States District Court for the Northern District of Oklahoma, 4:95-CV-003290-TCK-SAJ, March 25, 2009.

Ashley II of Charleston, LLC v. PCS Nitrogen, Inc. v. Ross Development Corporation, Koninklijke NV, DSM Chemicals of North America, Inc. James H. Holcombe, J. Holcombe Enterprises, LP, J. Henry Fair, Jr., Allwaste Tank Cleaning LLC, Robin Hood Container Express, Inc. and the City of Charleston, South Carolina. Civil Action No. 2:05-CV-2782-CWH US District Court, District of South Carolina, Charleston Division, November 4, 2008.

Charles W. Hoffman and Terry Susan Hoffmann v. Monsanto Company et al., US District Court for the Southern District of West Virginia, Civil Action No. 2:05-cv-00418, June 19, 2007.

Massachusetts Electric Company, et al. v. Travelers Casualty & Surety Company et al., Commonwealth of Massachusetts, Worcester Superior Court, December 9 and 10, 2004; May 12, 2005.

Consolidated Edison Company of New York, Inc. v. American Home Assurance Company et al., Supreme Court of the State of New York, County of New York, September 29–30 and December 14, 2004.

The United States of America v. Dravo Corporation et al. v. Bruckman Rubber and the City of Hastings, Nebraska, United States District Court for the District of Nebraska No. 8:01cv500, November 16, 2004.

Steven Woods et al. v. Trico Mechanical, Oxford County Superior Court, Docket Number CV-03-82, October 11, 2004.

Atlanta Gas Light v. UGI Utilities et al., United States District Court, Middle District of Florida Jacksonville Division, Case No. 3:03-CV-614-J-20 MMH, Case No. 01-600527, September 21, 2004.

Carol Antolovich, et al. v. Brown Group Retail, Incorporated, et al.; District Court, City and County of Denver, CO, January 25, 2001.

LILCO v Allianz Underwriters Insurance Company et al., Supreme Court of the State of New York, December 19 and 20, 2000.

James E. Barnett, Sr. et al. v. Monsanto Company et al., NO. 92-34865. 80th Judicial District Court of Harris County, Texas, March 15, 2000.

Frank Theo Scott, Sr. et al. v. Thiokol Corporation et al. Civil Action No. 2:97-CV-151, US District Court for the Eastern District of Texas, Marshall Division, January 10, 2000.

In re: Tutu Wells CERCLA Litigation, District Court of the Virgin Islands, Division of St. Croix, Master Docket No. 1989-107-1227, October 22, 1999.

Janette L. Linck, et al. vs. Enterprise Products Company, et al., District Court, Harris County, Texas, No. 97-27238, 334 Judicial District, October 1998.

Anita Michelle Allen, et al. v. Akzo Nobel Coatings, Inc., et al.; 60th Judicial District Court of Jefferson County Texas, October 24, 1996.

Dravo Corporation v. Liberty Mutual Insurance Co. at al., United States District Court for the Southern District of Alabama, Southern Division, Civil Action No. 92-0674-P-C, May 15 and 16, 1996.

Sierra Club vs. Public Service Company of Colorado, Inc., Salt River Project Agricultural Improvement and Power District and Pacificorp, Civil Action No. 93-B-1749, U.S. District Court for the District of Colorado, January 16, 1996.

Juan and Alma Alvear, et al. vs. Leonard Electric Products Company, et al., Cameron County, 107th Judicial District, June 27 and 28, 1995.

Brown et al. v. Centerline Circuits, Inc., et al. Boulder County District Court, Consolidated Civil Action No. 93-CV-223-2, October 19, 1994.

Aydin Corporation v. American Empire Insurance Company et al., Superior Court, County of San Francisco, No. 867826, April 8, 1993.

Consolidated Edison Company of New York, Inc. vs. Allianz Insurance Company, Allstate Insurance Company, etc., et al., Superior Court of New Jersey, Docket No. BER-L-7519-91, September 8, 1992.

In re: Texas Eastern Transmission Corporation PCB Contamination Insurance Coverage Litigation, United States District Court for Eastern District of Pennsylvania, MDL Docket No. 764, May 31, 1991.

James Slaughter, et ux, Marilyn S. Slaughter et al vs. Farm and Home Savings Association. No. 86-42853, District Court of Harris County, Texas 151st District, June 2, July 6–7, 1989.

Remington Arms Company v. Liberty Mutual Insurance Company, United States District Court for the District of Delaware, C.A. No. 89-0420-JLL, September 12, 1989.

Anne Anderson et al. v. W.R. Grace & Co. et al., United States District Court, District of Massachusetts, Civil Action No. 82-1672-5, 1986.

United States of America et al. v. Hooker Chemicals and Plastics Corporation, United States District Court for the Western District of New York, Civil Action No. 79–989, Submitted Affidavit, December 13, 1985.

Trials and Arbitrations

Ashley II of Charleston, LLC v. PCS Nitrogen, Inc. v. Ross Development Corporation, Koninklijke NV, DSM Chemicals of North America, Inc. James H. Holcombe, J. Holcombe Enterprises, LP, J. Henry Fair, Jr., Allwaste Tank Cleaning LLC, Robin Hood Container Express, Inc. and the City of Charleston, South Carolina. Civil Action No. 2:05-CV-2782-CWH, US District Court, District of South Carolina, Charleston Division, testimony at trial November 6, 2009, and January 19–20, 2010.

Frank Theo Scott, Sr. et al. v. Thiokol Corporation et al. Civil Action No. 2:97-CV-151, US District Court for the Eastern District of Texas, Marshall Division, testimony at Daubert hearing, February 10, 2000.

Brown et al. v. Centerline Circuits, Inc., et al. Boulder County District Court, Consolidated Civil Action No. 93-CV-223-2, October 19, 1994, testimony at trial May 10, 1995.

Aydin Corporation v. American Empire Insurance Company et al, Superior Court, County of San Francisco, No. 867826, testimony at trial July 19, 1993.

Testified before an Administrative Law Judge regarding expansion of the Flying Cloud Landfill in Eden Prairie, MN, testimony at hearing June 27 and 29, 1990.

James Slaughter, et ux, Marilyn S. Slaughter et al vs. Farm and Home Savings Association, No. 86-42853, District Court of Harris County, Texas 151st District, testimony at trial January 18, 1990.

Washington State Energy Facility Siting Commission, Application 76-2. Testified before an Administrative Law Judge regarding risks from explosions and oil spills due to development of the Northern Tier oil port in Puget Sound, 1981.