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Engineering & Scientific Consulting

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Professional Profile

Mr. Mesard has extensive experience as a hydrogeologist, engineering geologist, and civil engineer. His expertise includes design and implementation of environmental investigations; remediation system design, evaluation, and failure analysis; geologic hazard analysis; and construction defect assessment.

Mr. Mesard's principal area of specialization is environmental release reconstruction and source identification (environmental forensics), including chemical-characteristic analysis (chemical fingerprinting), the dating of chemical releases, and chemical fate and transport.

Mr. Mesard has assisted his clients on various CERCLA, RCRA, and state-equivalent sites, to identify and quantify the contributions of specific sources, evaluate the technical appropriateness and costs associated with remedial actions, and assess the consistency with state and federal regulations — specifically the national contingency plan (NCP). Mr. Mesard also has expertise in quantifying the flux, timing, and extent of chemical releases for dose reconstruction estimates related to toxic tort claims. Mr. Mesard has written technical reports and/or testified as an expert in projects involving chlorinated solvents, solvent stabilizers, perchlorate, petroleum hydrocarbon compounds, MTBE and other oxygenates, polycyclic aromatic hydrocarbons (PAHs), PCBs, dioxins and furans, various pesticides, and metals.

Mr. Mesard's areas of interest include risk management and decision analysis in assisting financial, legal, insurance, and commercial clients in quantifying and assessing the risks and costs associated with environmentally distressed properties, and in allocating environmental responsibilities and costs among responsible parties in cost-contribution and cost-recovery efforts.

Academic Credentials & Professional Honors

M.A.Sc., Geological Engineering, University of British Columbia, 1979

B.S., Engineering and Geology, Fort Lewis College, 1976

Licenses and Certifications

Professional Engineer Civil, California, #47609

Professional Licensed Geologist, California, #4311

Professional Engineer, Colorado, #PE-0043158

Professional Engineer, Hawaii, #PE-12036

Professional Engineer, Mississippi, #28634

Professional Engineer Civil, Nevada, #018711

Professional Engineer, Utah, #7280580-2202

Professional Licensed Geologist, Utah, #7280580-2250

Professional Engineer Civil, Washington, #53451

40-Hour Hazardous Waste Operation and Emergency Response Certification (HAZWOPER)

8-Hour HAZWOPER Managers and Supervisor Training

Certified Environmental Manager (CEM) (NV)

Certified Engineering Geologist (CA)

Certified Hydrogeologist (CA)

OSHA #500 Trainer Course In Occupational Safety & Health Standards For Construction

Prior Experience

Vice President, Kennedy/Jenks Consulting Scientists and Engineers, 1986-1999

Senior Geological Engineer, Atlas Corporation, 1984-1986

Senior Geologist, Exxon Company USA, 1977 and 1980-1984

Geological Engineer, British Columbia Ministry of Mines & Petroleum Resources, 1977-1979

Geologist, U.S. Geological Survey (part-time), 1973-1977

Professional Affiliations

Geological Society of America

Association of Engineering Geologists

National Groundwater Association

California Groundwater Resources Association

Four Corners Geological Foundation: Director and Treasurer, 2024-2027

Publications

Publications & Presentations

Robrock KR and Mesard PM. Identifying and Delineating Hidden Sources Within a Larger Chlorinated Solvent Plume. Battelle Chlorinated Conference. Denver, CO. June 2024.

Robrock, K.R., and Mesard, P.M. Distinguishing between multiple dry cleaner sources in a comingled chlorinated solvent plume. Battelle Eleventh International Conference on the Remediation of Chlorinated and Recalcitrant Compounds. Palm Springs, CA. 2018.

Pietari J, Mesard P, Muelhoefer T. Evaluation of trichloroethylene attenuation rates and mechanisms in support of monitored natural attenuation. Battelle Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies, Miami, FL, May 22-25, 2017.

Paulsen SC, Mesard PM. Opportunity under our feet: Successfully managing groundwater basins to balance stakeholder interests. American Bar Association, 44th Spring Conference on Environmental Law, San Francisco, CA, 2015.

Mesard PM, Sparacio T, O'Reilly K. Criteria for allocation of responsibility under state law. Environmental Claims Journal 2015; 27(1):40-49.

Mesard PM, Robrock KR. Forensic evaluation of heavy metals in surface water runoff to an urban lake, and allocation among multiple sources. Battelle, Eighth International Conference on Remediation and Management of Contaminated Sediments, New Orleans, LA, 2015.

Mesard P, Murphy B, Graham D. Multi-pronged approach to establish the timing of releases from a UST system a decade after occurrence. Groundwater Resources Association of California, Symposium on Environmental Forensics in an Era of Emerging Diagnostic Methods, Irvine, CA, 2011.

Mesard PM, Deardorff TL. Stormwater management during construction—A technical perspective. American Bar Association- Toxic Tort Environmental Law Conference, Scottsdale, AZ, 2008.

Mesard PM. Physical and chemical constraints on chlorinated solvent distribution in the subsurface—For addressing investigation, remediation, and forensic questions. Association of Engineering and Environmental Geologists, Annual Meeting, Program, and Abstracts, Los Angeles, CA, 2007.

Mesard PM, Shock S. Assessing remedial investigations and remedial actions at DNAPL sites: The case for internally consistent conceptual site models. Groundwater Resources Association of California—Symposium DNAPL Source Zone Characterization and Remediation, San Francisco, CA, December 2005.

Mesard PM, McNab W. Anthropogenic perchlorate sources and associated groundwater chemistry. International Society of Environmental Forensics. Workshop—Focus on Perchlorate, Santa Fe, NM, September 2005.

Mesard PM, Martin R. Sources of perchlorate releases to the environment. In: Perchlorate, A Scientific, Legal, and Economic Assessment. Hagstrom E (ed), Lawyers & Judges Publishing Co., Inc., Tucson, AZ, 2004.

Hilton L, Mesard PM. Legal approaches and technical tools to assess water agency claims for damages. Groundwater Resources Association of California, Symposium on Perchlorate in California's Groundwater, Glendale, CA, 2004.

Mesard PM. Perchlorate: Source identification and release reconstruction techniques. International Society of Environmental Forensics. Overview and Applications of Environmental Forensics in Soil and Groundwater Workshop, San Diego, CA, 2003.

Mesard PM. Integrating geologic and hydrogeologic tools to develop a predicative conceptual model for contaminant transport in an anisotropic aquifer. Association of Engineering Geologists, Annual Meeting, Program and Abstracts, Reno, NV, 2002.

Mesard PM. Characterization analyses of complex chlorinated compounds—Examples of fingerprinting dioxins and pesticides. Groundwater Resource Association of California, Workshop on Environmental Forensics, Emeryville, CA, 2002.

Mesard PM, Meldrum J. Performance and reliability issues associated with regulatory control periods. 11th Annual Technology Information Exchange, Department of Energy, Las Vegas, NV, 1999.

Mesard PM. Unique groundwater protection and design considerations at the Lockwood regional landfill. Solid Waste Association North America, Reno, NV, 1998.

Mesard PM, Mudge AE. The Clean Water Act. The New Environmental Regulation Course. Business Development Associates, Inc., Las Vegas, NV, 1995.

Mesard PM. Engineering solutions to implementing the new EPA Subtitle D Requirements. Conference on EPA's New Landfill Regulations—Impacts on New Mexico, New Mexico Association of Commerce and Industry Meeting, Santa Fe, NM, 1992.

Mesard PM, Schroth BK. Groundwater chemistry associated with the Lockwood Regional Landfill. Nevada Groundwater Annual Association Meeting, Reno, NV, 1991.

Mesard PM, Godwin CI. Mineralization and alteration of the Poplar copper molybdenum porphyry deposit, West-Central British Columbia. Canadian Institute Mining and Metals. Special Volume on Mineral Deposits, 1985.

Mesard PM, Godwin CI. Geology, geochemistry and geostatistics of the Poplar copper molybdenum porphyry deposit, West-Central British Columbia. Geological Society of America Annual Meeting, Program and Abstracts, San Diego, CA, 1979.

Mesard PM, Godwin CI. Preliminary geology of the Poplar copper molybdenum porphyry deposit, West-Central British Columbia. British Columbia Ministry of Mines and Natural Resources, Fieldwork, 1978.

Project Experience

Environmental Investigation/Design/Environmental Forensics

Chlorinated Solvents and Dense Non-Aqueous-Phase Liquids (DNAPLs)

Evaluated the release histories, transport pathways, and contributions to a large, comingled groundwater plume of trichloroethylene (TCE), in part from a client’s 110-year-old manufacturing facility in the Midwest. While the historic releases from the plant were not in question, clearly delineating the lateral extent of that portion of the TCE plume that was due solely to the manufacturing facility was key in assessing liability and damages in a class action lawsuit. As part of this assignment, I identified numerous other, local, current and past industrial facilities that likely use or used TCE, and likely contributed to the co-mingled plume. Lines of evidence related to these other contributions were developed from the assessment of historical insurance (SanbornTM) maps, regulatory agency files, and environmental corrective action reports. In addition, Exponent evaluated patterns of chlorinated solvent degradation products throughout the entire comingled plume, and reconstructed historic groundwater flow from over 60 years of data from various sources. Results of our analysis indicated that the client’s manufacturing facility was responsible for TCE contamination for only a portion of the overall plume and, further, identified several other facilities that contributed to the plume.

Using historical construction and grading plans, record drawings, extensive soil, soil gas, and dissolved and separate-phase groundwater sampling of TCE, and other halogenated volatile organic compounds (HVOCs) through the vadose and multiple saturated zones, I reconstructed the timing and approximate location(s) of various releases from the two separate historical manufacturing operations that shared a common footprint but operated at different periods of time. The distinct HVOC chemical signatures and patterns (e.g., chemical “fingerprints”) that I established and assigned to each manufacturing operation at this San Francisco Bay Area location, and the documented timing of multiple construction events allowed me to distinguish the releases from the earlier operations (circa 1910-1958) from releases from the

subsequent operations (circa 1960-1999). I demonstrated that both historical operations contributed to significant environmental impacts.

Undertook study of TCE and its degradation products cis-1,2-dichlorethylene (cis-1,2-DCE) and vinyl chloride, in multiple aquifers at a former military installation in the Midwest to assess the locations and relative timing of releases of TCE to the environment. Extremely elevated concentrations of the halogenated volatile organic compounds (HVOCs) — up to low percentage levels in shallow soils — and the relatively aggressive degradation rates, were used in concert with an understanding of site history and operations to bracket the timing of the releases. Identified unusual anaerobic soil and groundwater conditions due to subsequent releases of petroleum and/or phenol compounds that commingled with the previously released TCE, which was the proximate cause of the intense degradation. Results of this work will be used in CERCLA §113 and state tort litigation, and subsequent allocation.

Conducted an analysis of an insurance claim that perchloroethylene (PCE) contamination in soils and groundwater beneath the footprint of a building that had been destroyed in a fire was exacerbated and remobilized due to the fire and associated fire suppression efforts. The claim was made years following the event and long after demolition of the ruins of the building and remediation of impacted soils. Relying on written and photographic records of the fire and subsequent environmental investigation and remediation reports, evaluated potential pathways of the fire and suppression waters to the source. Based on the geometry and condition of the foundation of the building, the likely temperatures and duration of the fire, and the locations, velocity and directions at which suppression water could have reached impacted soils, concluded that the contamination was not remobilized or spread further by the fire or the efforts to control it.

Evaluated historical and current RCRA closures compliance at a former electrical-components manufacturing facility in Indiana, as part of a RCRA Citizen’s suit. The evaluation included the review and analysis of numerous regulatory records to develop compliance ‘timelines’ from the promulgation of RCRA in 1980, to the present. Compliance, investigation, remediation, and regulatory records related to four waste management units (WMUs) were evaluated in detail to document that all four units are in compliance with both state and federal RCRA regulations, and are suitable for complete RCRA closure, pending cleanup of other, non-RCRA, portions of the facility. In addition, addressed allegations that a number of other chemical handling operations/locations, which were not designated WMUs, should have been so designated. Assessed the technical and regulatory each specific claim, and addressed each—presenting regulatory, technical and historical evidence to show that these areas appropriately were never designated WMUs.

Undertook detailed evaluation of the contemporaneous but evolving "state of knowledge" of the environmental understanding and regulatory status of a specific chlorinated solvent from the 1940s through the 1970s. The purpose of the evaluation was to assist a client in determining what was commonly understood by the industrial and scientific community related to the potential threat of the solvent to groundwater, including pathways, fate, and toxicology. Reviewed and tabulated the findings from over 400 technical and regulatory documents.

Assessed the timing of releases, migration velocity, extent, and cost of cleanup of a plume of mixed chlorinated solvents emanating from a former solvent recycling facility in the San Francisco Bay area. The site was undergoing RCRA corrective actions, and an adjacent building owner claimed diminution of property value due to the offsite footprint of the solvent plume, which was migrating beneath that property. Worked with counsel as well as financial and real estate experts to quantify potential damages due to alleged environmental “stigma,” and to separate such potential damages from losses due to real estate price declines unrelated to the claim of stigma. A significant complicating factor was the discovery of 1,4-dioxane contamination during the assessment. Because of the unique environmental behavior of 1,4-dioxane, the footprint of that plume was over twice the size of the previously-defined extent of solvent contamination. Remediation of the 1,4-dioaxne plume required a significantly different approach than that for the previously identified solvents, the risks and costs of which were incorporated into the estimated stigma damage estimate.

Evaluated the relative contributions of TCE to a large plume of commingled HVOCs at a site in southern California. Evaluated historical soils and groundwater data at client's site as well as adjacent properties. Used SESOIL™, a one dimensional unsaturated zone transport model, to estimate the amount of TCE and other HVOCs that potentially could have reached groundwater and contributed to the regional plume. Also evaluated the results of historical soil vapor extraction on soil and groundwater concentrations. Used the results of these analyses to determine the amount of TCE released from the Site, and compared that to a separate estimate of the total mass of HVOCs in the regional plume to develop an allocation of responsibility for client's site to a regional cleanup. As part of the 'causation' analysis, occurrences of perchlorate and 1,4-dioxane in deeper groundwater samples were determined to be from imported and recycled waste water used to replenish the basin.

Undertook an assessment of sources and pathways of releases of PCE from a dry cleaner in Monterey California that operated for over 50 years, Based on the requirements and limitations of various insurance policies, the nature, the timing, and the specific source of the releases was essential to determine which, if any, coverage would be applicable to cover the estimated $1.4 million cost of groundwater and soil remediation. Inspection details (including a sewer video survey), current and historical photographs, business records and regulatory communications were evaluated to understand the nature of historical operations, and type of equipment used (and changed) over the duration of the business, which included multiple "generations" of dry cleaning equipment and appurtenances (cookers, filters, water separators, etc.). Also, evaluated many years' worth of groundwater, soil, soil gas and subslab vapor data to conclude that the dry cleaning equipment was the principal sources of the releases, and the sanitary sewer was a relatively minor contributor of PCE to the environment.

Assisted a client in assessing the technical correctness and cost of the remediation of a former dry cleaning site in the San Francisco Bay area as part of a response cost recovery dispute. Evaluated pre-remediation soil vapor, soil, and groundwater conditions to assess the proposed remedy (sub-slab depressurization, soil vapor extraction, and groundwater natural attenuation). Identified areas for cost savings and schedule acceleration. Bracketed release dates and locations by staining locations and patterns in the proximity of various Site features.

Assessed the fate and transport of PCE from a former dry cleaner in a shallow aquifer in northern California as part of a CERCLA Section 107 action. Assessing potential sources of PCE and other HVOCs, and the timing and impact of the HVOCs on groundwater production wells at a manufacturing facility. MODFLOW-2000 was used to conduct inverse numerical modeling to establish approximate release dates. Detailed evaluation of degradation products (TCE, cis-1,2-DCE, vinyl chloride) led to the identification of at least one additional source on plaintiff's property (containing 1,1, DCE) that is distinct from other sources.

Assisted a client in assessing its potential responsibility for alleged groundwater impact by TCE and 1,1,1-TCA at a major multi-party industrial area in the Midwest. Client had been allocated a significant proportion of cleanup costs by an oversight authority. Reviewed almost 30 years of groundwater and soils data regarding client's property and adjacent facilities and assessed the effect of large groundwater extraction and soil vapor extraction systems on systematic variations in that data. Detailed "fingerprinting" analysis of parent and daughter HVOCs indicated that biological degradation was not responsible for present paucity of HVOCs on client's site as claimed by oversight authority, but rather showed the source of the HVOCs was associated with an upgradient facility.

Evaluated the five-year performance of an in-situ chemical oxidation (ISCO) program to remediate a recalcitrant TCE plume at a site in Silicon Valley by injection of sodium permanganate. The TCE concentrations were not decreasing as planned, and we were asked by the lessee of the building to examine the ISCO program. The resulting investigation and analysis indicated that the ISCO remediation effort had been designed inappropriately and conducted ineffectively — the spacing of the ISCO injection points and the volume of permanganate injected were insufficient to contact all the TCE in the source area, given the porosity, depth, and thickness of the TCE-affected aquifer zones. Ironically, the solution was much too concentrated (based on mass-balance calculations) to be consumed by the TCE in the

limited areas in which it was injected, leading to a significant waste of the solution and its migration off site. Also, given the concentrations of dissolved TCE in the source area (greater than 200,000 µg/L), it was likely that the TCE existed in part as a dense non-aqueous-phase liquid (DNAPL), and the design of the system did not take the potential presence of DNAPL into account.

Provided a third-party review of a proposed enhanced reductive dechlorination (EDR) program to assess the feasibility of such a remediation effort to treat TCE in shallow groundwater at a site in northern California. The work plan included unsupported assumptions regarding background aquifer conditions (e.g., naturally occurring biological substrate, natural attenuation parameters, etc.) and relied on the remediation consultant's expertise at unspecified "similar" sites to determine the locations and density of injection points to augment the biological community, and the type of substrate to be used. Recommended that site-specific natural attenuation parameters be collected, and that bench-scale and, if justified, pilot-scale studies be conducted using site-specific soil and groundwater with actual contaminant concentrations (indicative of local DNAPL). These recommendations were accepted.

Evaluated the lateral and vertical extent of TCE and other HVOCs at a site in southern California (Orange County) as part of CERCLA Sections 107 and 113 actions. Used largely historical sampling results to assess potential sources and timing of releases. Was able to bracket the most likely dates of the release(s), and concluded that they were due to illicit dumping subsequent to client's vacating the Site. Reviewed and evaluated pilot tests and corrective actions by subsequent owner and plaintiff. Showed that costs associated with excavation and ex-situ soil venting were neither reasonable nor necessary, by demonstrating via mass balance calculations (based all on measurements and data collected by plaintiff), that the excavated soils contained no free product (DNAPL) and therefore, should not have been excavated. Concluded that in situ chemical oxidation by potassium permanganate injection was a preferable alternative (specifically, much more cost effective), which was subsequently demonstrated in the field.

Conducted an extensive geologic and hydrogeologic study of coupled fractured bedrock and alluvial aquifers to assess the location and movement of a TCE plume that had migrated beneath a residential community and high school. The driver of this dose-reconstruction study was to estimate potential historical (and cumulative) residential exposure to soil vapors emanating from the TCE plume. The evaluation consisted of creating a numerical groundwater model that would allow for estimation of TCE concentrations (and consequently, indoor air exposures) at specific residences at various times in the past. The lithologies of more than 450 borings and wells were re-examined for consistency and quality assurance purposes, and the resulting information was incorporated into a database to construct a three-dimensional groundwater model of the area, which consisted of three principal aquifer zones (deeper fractured bedrock, shallow fractured bedrock, and alluvium). The model was developed using the flow code MODFLOW-2000. However, while the amount of groundwater quality and piezometric data was voluminous, it went back in time only about five years. In addition, the plume had migrated from one groundwater basin into another that had significantly different characteristics. Therefore, to establish important groundwater flow parameters, such as dispersivity, the relative amounts and ratios of potassium and chloride ions (the concentrations of which occurred in groundwater in the two basins in inverse proportion), were used to establish a mixing model. This model calibrated well with observed conditions ($R^2=0.98$), providing a high degree of confidence in predicted concentrations of TCE over time.

Investigated damage to a major Central Valley (California) municipality's water-supply aquifer from releases of HVOCs. Evaluated field notes, work plans, regulatory communications, boring logs, as-built drawings, and soil and groundwater sampling results to determine the mechanism of the contamination. Used environmental event reconstruction techniques (inverse plume modeling, mass-balance analyses, advective transport estimates, and chemical partition modeling between groundwater and soil gas), and evaluation of the hydrostratigraphy. Assisted the City, in consultation with the California Department of Toxic Substances Control, in preparing the technical and regulatory elements of a proposed preliminary injunction directing the manner in which the PRPs were to conduct a National Contingency Plan (NCP)-compliant RI/FS/human health risk assessment (HHRA), and ecological risk assessment (ERA). Presented technical tutorial in Federal Court.

As part of a cost allocation effort, evaluated multiple HVOC groundwater plumes emanating from multiple source areas, including a former municipal and industrial dump located in the Central Valley of California. Focused on the sources of hazardous wastes that were disposed of in the former dump. Based on a very detailed review of documents, some more than 40 years old, determined that more than 98 percent of the specific hazardous constituents discovered in groundwater (TCE and its degradation products) came from one industrial source, and the remainder from two municipal sources. Prepared graphics that effectively communicated findings to the parties involved.

Provided technical support in a multi-party HVOC- and hydrocarbon-affected groundwater action in northern California. Technical work consisted of evaluating the technical feasibility, costs, schedule, and degree of regulatory compliance of past and present investigation and remediation technologies.

Provided technical and regulatory support to municipalities involved in a Superfund site in southern California that was a former landfill. Principal constituent of potential concern was a "soup" of various chlorinated and non-chlorinated solvents, and associated compounds including the solvent stabilizer, 1,4-dioxane. Major technical services included the compilation of waste manifests from more than 150 parties over a period of 20 years, categorizing the nature and amounts of wastes deposited at the site, characterizing the leachate and groundwater chemistry, comparing that chemistry to other municipal and industrial landfills, reviewing and commenting on the costs and design of remediation systems, and allocating responsibility among the parties.

Assisted a client in the acquisition of a "brownfields" property in southern California that was a former solvent recycling facility, operating under a RCRA Post-closure Permit. Prepared RCRA closure documents for the treatment, storage or disposal (TSD) facility. Assisted in valuation of the property's environmental liabilities, and developed cost estimates for long-term remediation of HVOC-affected soils and groundwater. Worked with the client and their business consultant to acquire environmental remediation insurance as part of the purchase, and developed alternatives for future investigation and remediation. Undertook a pilot study of the client's existing 22-well multi-depth groundwater extraction and treatment system to optimize the system operations. The variables examined included volumetric recovery, area of hydraulic containment, mass removal, and treatment and O&M costs. Using both numeric and analytical modeling of the hydraulic capture zones, and historical HVOC-mass removal rates and costs, five separate extraction-well configurations (consisting of various subsets of the entire well field) were operated consecutively in isolation for up to 90 days, while operating parameters were collected for each configuration. Based on the results of the pilot study, recommended that approximately one-third of the site's extraction wells be shut down, which resulted in substantial cost savings to the client while maintaining a hydraulic containment zone that is protective of downgradient receptors, with only a minor decrease in mass removal rates.

Managed remedial investigations/feasibility studies at two actively operating sites in northern California, owned by a major electronics manufacturer. At one of the sites, supervised the preparation of a remedial action plan (RAP) for cleanup of HVOC-containing soils and groundwater. The RAP included groundwater extraction and treatment by liquid-phase granular activated carbon (GAC), and extraction of soil vapor followed by vapor-phase GAC treatment to remediate soils at the source area.

Conducted periodic RCRA compliance audits for a semi-conductor manufacturing facility in Northern California. Assisted the client in the closure of various waste management units, including storage areas, sumps, and process lines.

Managed a multi-site environmental investigation and feasibility study at an international airport. The project included Phase I site assessments, asbestos and lead paint abatement studies, human health and environmental endangerment assessments, and Phase II and subsequent soil and groundwater investigations for petroleum hydrocarbon compounds (PHCs), HVOCs, and metals. The results of the investigation were used to develop a multi-tiered containment zone for the management of affected groundwater.

Led the remedial investigation/feasibility study of a transportation facility in northern California that included both separate-phase petroleum and dissolved HVOC contamination. The project included preparation of a RAP for extracting and treating HVOC-containing groundwater. Following remedial design, remediation was implemented. Work also included soil excavation and onsite bioremediation of petroleum hydrocarbon-affected soils. Regulatory closure of seven areas was obtained by the Regional Water Quality Control Board. To assess potential contributions of HVOCs from offsite sources, used MODFLOW-2000 to conduct inverse plume modeling. Results indicated additional sources upgradient of client's site.

Designed a groundwater extraction system that utilized air stripping to remove HVOCs from groundwater at a site in the South San Francisco Bay area.

Planned and supervised a major investigation to evaluate the potential for deep aquifer contamination at a Superfund site in the South San Francisco Bay area. Principal CoPCs were chlorinated solvents. Used geophysical techniques, such as electromagnetic induction and ground-penetrating radar, to locate abandoned agricultural wells that were potential inter-aquifer conduits for contamination.

Conducted an investigation to assess the risk of inter-aquifer cross-contamination of HVOCs during the construction of deep foundation piers at a site in northern California.

Evaluated the completeness and technical correctness of a decade-old Phase I ESA, which was a critical issue in a due diligence dispute involving offsite migration of PCE in soil vapor and groundwater from a former dry cleaner to an apartment complex.

Provided on-call environmental risk-management services to a major insurance company that was evaluating large, complex remediation projects in North America, Asia, and Europe, to offer remediation cost-cap, and environmental indemnity and liability insurance policies to their clients seeking such coverage. Reviewed RI/FS documentation, interim remedial measure as-builts, HHRAs, and ERAs for a wide range of COIs in various media. Advised client on projects ranging up to $50 million in corrective action costs. Quantitatively assessed completeness and quality of investigations, and advised the client on the current and potential future physical, chemical, and regulatory risks posed by the COIs. Evaluated the costs, feasibility, and performance of existing and proposed remedial alternatives (including remedial technologies such as thermal desorption, in situ and ex situ fixation, catalytic oxidation, air sparging, reactive barrier treatment, and hydraulic containment). Also used statistical techniques (e.g., Monte Carlo simulations) to identify the most likely failure modes of the remedial systems.

Petroleum Hydrocarbon Compounds, Fuel Oxygenates, and Polycyclic Aromatic Hydrocarbons (PAHs)

Evaluated the timing and areal extent of a catastrophic release of petroleum condensate, due to a fatigue crack, in a shallowly buried high-pressure pipeline in northern Colorado. As part of a toxic tort exposure evaluation, Exponent’s analyses considered and incorporated specific documented events (e.g., routine helicopter vapor sampling, pressure readings, visual observations of condensate at the surface, etc.) immediately preceding and following the release, the physical and chemical properties of the condensate, the types and anticipated behavior of local soils, and the groundwater depth and flow direction. I undertook two separate methods to assess the migration of separate-phase and dissolved product in the vadose and saturated zones in the vicinity of the release. My analyses indicated that the “window” of time when the release could have occurred would have been approximately one to five weeks prior to when it was visually identified in a culvert.

Evaluated the migration and fate of a long-term release of unrefined petroleum to a complex series of fractured bedrock aquifers from a storage and distribution terminal that had been in operation since the 1930s. The objective of the assignment was to: (1) assess the completeness of remedial investigation efforts conducted by others, (2) evaluate the potential of alternative sources of contamination, (3) gauge the completeness and technical appropriateness of remedial alternatives, and (4) compare the duration of

response actions at the site to other, similar, sites to address claims of "foot dragging." The evaluation included physical and chemical attenuation studies such as petrophysical testing of cored bedrock to determine the saturation and relative mobility of non-aqueous phase liquid.

Evaluated the geologic and hydrogeologic setting and conducted a forensic analysis distribution of to determine the source or sources of a significant (approximately 50,000 gallons) free-product gasoline plume, and to allocate the plume among two principal suspected sources (several underground storage tanks [USTs]). The investigation included evaluating free-product geochemistry and fingerprinting the composition of the free product by conducting a PIANO (paraffins, isoparaffins, aromatics, naphthenes, and olefins) analysis. In addition, analyzed results of ROST (rapid optical screening tool) geophysical boring data, undertook a detailed review of UST inventory data, and studied the relative behavior of free product in different soils. The results of this study indicated that all of the free-product gasoline came from only one source area.

Assessed the fate and transport of methyl tertiary butyl ether (MTBE), and other fuel oxygenates (tert-butyl ether [TBA], tert-amyl methyl ether, diisopropyl ether, and tert-amyl alcohol) at a site in southern California. MTBE and TBA migration in groundwater at the site occurred in a direction different from that of other fuel constituents, including PHCs — gasoline and diesel, and benzene, toluene, ethylbenzene, and xylenes (BTEX). The fate-and-transport evaluation was undertaken to assess claims that the environmental impact of MTBE was exacerbated and the extent of the MTBE plume was increased due to the alleged failure of a groundwater pump and treat and soil vapor extraction system at the site. Evaluation found that the MTBE/TBA plume was not adversely affected by the remediation systems, but rather, was due to releases of MTBE from an adjacent property and was not related to historical onsite releases, and the remediation system was not designed or operated improperly.

Undertook historical and forensic evaluation of MTBE and BTEX releases from a service station in the Central Valley of California to assess the timing of multiple releases and the impact of those individual releases on nearby MTBE-affected domestic water wells as part of a dose reconstruction analysis in a toxic tort dispute. Based on the analyses of compound concentration trends, compound ratios, compound mass-fractions, concentration time-decay trends, historical groundwater elevations, and inverse plume modeling using MODFLOW-2000, concluded that at least two of the releases occurred after a change in ownership of the station. This finding was used in mediation among potentially responsible parties to settle part of a dispute, and was presented to the appropriate regulatory agency related to the modification of certain administrative orders.

Investigated technical and regulatory matters related to a release of Bunker C fuel oil mixed with diesel fuel from a tanker truck that was involved in a traffic accident adjacent to a protected salmon habitat in northern California. Initially met with five involved agencies (the Department of Transportation, the California Highway Patrol, the Regional Water Quality Control Board, the Department of Fish and Game, and the County Health Department) and developed an emergency response plan. The plan included actions to remove the free product, build temporary structures to protect the river from further migration during free-product removal, remove petroleum-affected soils and asphalt, replace a storm culvert, repave the highway, and regrade the shoulder. Provided advice regarding the methodologies and the final cleanup level, and the documentation required to demonstrate that residual free product, particularly in inaccessible areas, would not pose a threat to human health or to terrestrial and aquatic ecological receptors. Using leachate designed to reflect ambient rainwater conditions, and samples of affected rocks and soil, evaluated the effect of COIs on aquatic biota and demonstrated to the regulatory agencies that the effect was below harmful levels. Following a four-month monitoring period, the regulatory agencies issued a letter of no further action.

Reconstructed the record of a spill and release of 6,700 gal of gasoline, from an overturned tanker, in a vineyard in Napa, California. Retained by counsel to defendant insurer, which was sued over terms of coverage. Researched federal, state, and local regulations relating to spill and cleanup, delineated cleanup levels, and established environmental damages.

Assisted a client in the evaluation of appropriate regulatory requirements involving the handling of California non-RCRA hazardous wastes — involved large quantities of used machine oils, and lubricants (including sorbents), and metal-treating wastes that were abandoned at a former manufacturing facility that had abruptly entered bankruptcy proceedings. Part of the assignment included an assessment of allocation of damages among a number of parties.

Managed a major fast-track underground storage tank (UST)-related design, construction management, and environmental investigation project at a large airport in northern Nevada. The project involved the closure and replacement of six (up to 20,000-gallon capacity) USTs with upgraded USTs or aboveground storage tanks, to comply with pending federal and state regulations. Three of the USTs were located in areas of active airport operations. Specific challenges included designing and scheduling the replacement of two USTs that fed emergency generators, so that a continuous fuel supply was guaranteed throughout the project; scheduling removal and installation of the USTs; and undertaking UST integrity tests and environmental investigations around active airport operations. Releases from some USTs and associated piping were confirmed. However, due to the major disruption to airport operations and potential adverse impact on operational safety if the 20,000-gallon UST and affected soil had to be excavated, successfully negotiated a "closure in place" with the lead regulatory agency after conducting a risk-based corrective action risk assessment. The project was completed 2 weeks before the regulatory deadline.

Provided technical services regarding the environmental impact of, and the methods and costs for, remediating a 5-million-gallon plume of floating petroleum product on shallow groundwater at a site in northern Nevada. Also assisted with cost allocation among the parties. Specific responsibilities included evaluating the effectiveness and offsite impact of multiple remediation systems, assessing the relative contributions of multiple sources, and determining the physical and environmental impact of the plume on sensitive downgradient receiving waters.

As part of a large litigation support effort for a major municipality in northern California, estimated the amount of refined petroleum products that would reach a municipal reservoir from a release from a petroleum pipeline during a specific, but theoretical, seismic event. The estimate of product reaching the reservoir was based on site topography and drainage configuration, distance between the pipeline and the water, and the pressure in the pipeline and the estimated time it would take for the pipeline owner to recognize that a release was in progress and shut down the system. This assessment indicated that significant volumes of product could reach the reservoir and threaten water quality. The municipal client used the information to negotiate mitigation measures with the pipeline owner.

Assisted a county transportation agency located in northern California in developing stormwater monitoring plans and stormwater pollution prevention plans at three of their fueling facilities. Identified most likely release scenarios, and developed best management practices (BMPs) to protect against and mitigate any releases. At one fueling facility, undertook a two-year study, requiring automated sampling of three storm drains, which indicated that the BMPs and administrative actions substantially reduced the amount of PHCs and metals that entered the storm drains.

Provided technical and regulatory compliance assistance to a client seeking cost recovery from the Department of Defense (U.S. Navy), under a CERCLA Section 107 action. The southern California project site was a former Navy facility that had been turned over to a local municipality following cleanup and closure under the base realignment and closure program. During subsequent development, COIs, including lead and PAHs, interpreted to be associated with a former burn pit, were discovered in shallow soils, and were mitigated by the client's insured during a short-term removal action that cost over $7 million. Services included determination of the earliest date the COIs were released, tracing land ownership and development milestones over 80 years of site activity, assessment of NCP compliance during short-term removal actions, verification of removal-action costs, and review and assessment of technical correctness and completeness of previous remedial and removal actions.

Conducted fast-track Phase I and Phase II environmental investigations and directed the remediation of an automobile recycling facility in Honolulu, Hawaii, to meet State regulatory requirements and to assist in

cost-recovery efforts. COIs included light to heavy PHCs, BTEX, MTBE, and heavy metals in soil and groundwater. Determined that the COIs were unlikely to affect a local municipal well, or nearby ecological receptors. Following the investigations, developed a RAP, oversaw development of final design plans and specifications, and assisted with contract development and administration, contractor selection, and construction management to remediate the site. Remediation activities included removal of USTs, removal of chemically affected soil beneath a substantial portion of the property, closure of domestic and industrial waste collection and treatment systems, building demolition, regrading and paving, and construction of new stormwater runoff structures. Verified that the site met State regulatory standards and received a notification of no further action from the State. Assisted in cost-recovery efforts.

Assisted in planning the construction of a commercial facility at a brownfields redevelopment site in Honolulu, Hawaii. The site is part of a large and complex multi-party environmentally distressed area. Assisted with both technical and regulatory issues regarding the Site. Technical issues included the source, movement, and risk of relatively high levels of methane (locally exceeding the lower explosive limit of methane) — discovered in both air and soil gas in the area — as well as other COIs. The most likely source of methane was determined to be the large volumes of degrading PHCs, both in soil and — as a separate phase — floating on the groundwater. Recommended construction of methane mitigation measures in all proposed structures, reviewed the feasibility of proposed site-wide methane mitigation measures, and assisted in obtaining recompense from the property lessor for the additional cost of the mitigation systems. Also advised client (lessee) on the potential risks posed by COIs likely remaining on site following removal actions.

Developed, on a fast-track schedule, a characterization plan, remediation alternatives, and associated costs for addressing the environmental impact of residuals from a major fire at a tire-storage and recycling facility in the Central Valley of California. Approximately 6 million tires were consumed in the fire. Wastes consisted of metal- and VOC-containing ash, pyrolytic oils, and sludges in soil, groundwater, and surface water impoundments. Volume measurements of multiple waste piles, and collection and analysis of environmental samples were used to evaluate potential environmental impacts and to develop selected remediation alternatives and costs.

Provided technical assistance in a cost-recovery action for a site in northern Nevada affected by PAHs, BTEX, and metals. Conducted a two-phased investigation to identify the extent and magnitude of the contamination, and assisted in the review of a remediation plan. Monitored the cleanup of the site to ensure compliance with the terms of the cleanup agreement, and reviewed and provided advice on the adequacy of work plans, sampling and analysis plans, quality assurance project plans, design specifications, and other construction documents. Also provided second-party construction and remediation monitoring.

Provided technical assistance related to the purchase of a property in a historic district of a small town in the Sierra Nevada Mountains of California. During due diligence, significant petroleum hydrocarbon contamination of groundwater and soils was discovered. Two responsible parties were identified and undertook investigative and remediation activities. Assisted with technical review and advice regarding the work plans, regulatory agency liaison, and the results of the ongoing cleanup.

Performed a fast-track (3-week) due diligence review of a brownfields property in downtown Honolulu, Hawaii, that was still undergoing remediation for PAHs, PHCs, and BTEX. Evaluated past RI and corrective action performance data, discussed the status of the site with regulatory agency oversight personnel, and worked with the current owner's consultants to develop a schedule and cost estimate to complete remedial actions to the satisfaction of the State. Assisted in selection of a local long-term remediation contractor, and assisted in negotiating a contract with the contractor.

Provided geological/hydrogeological expertise in a $35 million environmental litigation on the Big Island of Hawaii. Managed expedited soil and groundwater investigation in a very sensitive habitat; conducted groundwater monitoring and modeling, which included assessing the influence of strong tidal fluctuations on separate and dissolved petroleum phases; used forensic chemistry to ascertain the age and nature of

degraded PHCs; and managed the development of remedial actions and their costs. Drafted the technical elements of the final settlement agreement between the parties.

Designed and supervised geological, surface geophysical, and geochemical evaluations of a residential area located on the site of a large former oil storage facility in the Central Valley of California.

Managed a fast-track site investigation to assess the potential for and extent of hydrocarbon and pesticide contamination of a shallow groundwater aquifer near Honolulu, Hawaii, for a $10 million property transaction.

Perchlorate

Conducted a forensic evaluation to assess the contribution of perchlorate-affected stormwater to currently impacted shallow groundwater due to releases from waste ponds in the 1960s and 1970s, long before perchlorate was recognized as a constituent of concern. Established a relationship between perchlorate and other constituents, for which analyses were conducted during the time frame of interest, to estimate a minimum concentration of perchlorate that would have been contained in the historical releases from a major CERCLA site. Used historical records and a mass balance approach to determine that perchlorate concentrations in the waste-containing storm waters were sufficiently high to impact groundwater at levels above the current California state MCL.

Assisted a client in evaluating alternative technologies for remediation of a perchlorate release to groundwater in Southern California.

Assisted a client in southern California in identifying, prioritizing, and evaluating potential sources of perchlorate to a municipal well field as part of a CERCLA Section 113 action. Services included historical and regulatory records research, field investigations, assessment of selected industrial production practices, and development of an offsite sources groundwater investigation workplan to verify potential releases. Identified a number of potential offsite sources of perchlorate. As part of this assignment, a previous groundwater model of the basin was evaluated and refined using MODFLOW-2000 and MT3D. The groundwater model was used to evaluate the future migration of perchlorate, as well as to optimize the locations and number of extraction and treatment wells. Evaluated state-of-the-art perchlorate treatment technologies and conducted an alternatives analysis of a number of technologies to treat perchlorate-affected groundwater at a large municipal water supply system. Technologies evaluated include biological fluidized bed reactors, reverse osmosis, various types of ion exchange, and GAC. Evaluation criteria included implementability, cost effectiveness (including both capital and operations and maintenance costs), and technical effectiveness. The systems evaluated were sized and developed to treat groundwater containing perchlorate in concentrations of up to 3000 µg/L to levels below current analytical detection limits. Results of our analysis indicated that biological fluidized bed reactor is a significantly superior technology over the other alternatives for the 30-year life of the system.

Assisted a major insurance company who was seeking to quantify technical, financial, and regulatory risks associated with a former manufacturing site in northern Oregon, in order to provide environmental cost-cap and third-party liability insurance as part of a property transaction. Specifically, Exponent evaluated potential source areas and developed an assessment of the risk of perchlorate migration to both surface water and groundwater. In addition, we contacted relevant state agencies to assess their understanding of the "emerging" issues related to perchlorate and what standards they propose to implement with regard to perchlorate cleanup (e.g., federal, another state's, such as California, or develop their own). The information provided allowed the client to make informed, risk-based decisions on the types and structures of the insurance policies they were willing to offer to their client.

Polychlorinated Biphenyls (PCBs), Dioxins, Furans

Providing multiple environmental, regulatory, and litigation support services regarding a CERCLA Section 107 cost recovery litigation on the Island of Oahu, Hawaii. The site is a former wood treatment facility, and COIs include chromium, arsenic, copper, pentachlorophenol (PCP), and polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDDs/Fs). Reviewed NCP compliance of previously performed remedial investigations, and evaluated the feasibility and cost of recommended preliminary remedial alternatives and previously completed removal actions. Performed chemical characteristic analysis (fingerprinting) using the 17 most common congeners of PCDD/F to evaluate potential multiple sources of those COIs. Used an optimization process to better estimate the volume of soils that would require corrective actions, depending on a range of potential cleanup levels, site uses, and land-use restrictions, and remedial alternatives to minimize the cost of final remediation. Prepared a condensed alternatives analysis (the State equivalent of a feasibility study under CERCLA).

Conducted a forensic evaluation of PCB contamination to determine whether the extent and distribution of PCBs on the floor and walls of a building were solely due to releases from damaged transformers. An assessment of the types and distribution of the aroclors indicated that only a relatively small amount of the building material was associated with releases from the transformers, and that other sources of PCBs better explained the pattern of contamination.

Managed the development of a RAP for the closure and remediation of a former natural gas production and transport facility in southern California affected by PCBs. The RAP included the completion of an initial study under the California Environmental Quality Act, which successfully led to a mitigated negative declaration. On completion of the RAP, the project continued with the final remedial design action.

Supervised field work and reviewed technical data, including shallow seismic geophysics, for an in-situ bedrock permeability testing program for the design of a slurry-wall containment system as a final remedial measure at an operating lumber site in northern California. COIs were PCP, dioxins, hexavalent chromium, copper, and arsenic. Dioxins were the drivers for corrective action.

Supervised a fast-track groundwater investigation of a PCB-contaminated Superfund site in northern California using cone penetrometer and BAT-probe sampling techniques to verify site conditions during Record of Decision negotiations between the client and EPA.

Supervised the remedial investigation of an electronics production facility site in the southeastern U.S., where PCBs were the major chemicals of concern. Of particular interest at this site was the occurrence of chlorinated HVOCs, which greatly enhanced the mobility of the PCBs. Defined the lateral and vertical extent of PCB and HVOC migration. Results indicated that HVOCs had reached local municipal wells. Interim remedial measures were implemented to mitigate erosion of PCB-affected soils.

Pesticides

Completed a fate and transport study of an endosulfan-related pesticide associated with a claim of damage to livestock on an adjacent property. Compiled meteorological information, results of soil, vegetation and surface water sampling, and specific information related to the equipment used and manner in which the pesticide was applied. Estimated droplet size and velocity from manufacturer's equipment specifications, calculated maximum distance the median droplet would travel, and determined that aerial deposition of measurable quantities on the adjacent property was not possible. Used a fugacity approach and a range of degradation rates to estimate the concentration of pesticide in runoff. Determined that surface water transport was also not a viable mechanism for the pesticide to reach the adjacent property at measurable concentrations.

Evaluated potential sources of 1,2,3-Trichloropropane (1,2,3-TCP) at a site in the Central Valley of California. Evaluation focused on the number and location of 1,2,3-TCP detections in municipal wells. Conducted a detailed hydrogeologic assessment and a statistical analysis comparing site-specific data to

1,2,3-TCP detections throughout the Central Valley. Demonstrated that the municipal wells in question at the Site were strongly anomalous in 1,2,3-TCP detections - both temporally and spatially- when compared to the pattern of detections in other wells, indicating a previously unrecognized potential source area on the Site.

Managed a fast-track project that included the characterization of shallow soils on a 13-acre site for pesticide contamination (DDT, DDD, DDE) that exceeded state hazardous waste criteria, and developed a plan for expedited excavation and disposition of contaminated soils. Working closely with four government agencies, the project team was able to meet the client's aggressive schedule to transfer the property and begin construction of a freeway interchange.

Metals

Evaluated the long-term, as well as proximate, causes of an approximate 3-million-gallon release of acid mine drainage (AMD), from a former gold mine in southwest Colorado, to a tributary to the Colorado River. The release contained elevated concentrations of several heavy metals. A number of hydraulic bulkheads were constructed and installed in several nearby abandoned or inactive mines, which created a “mine pool” of groundwater in the abandoned mine workings. The work included a review of the construction details of the bulkheads, an evaluation of pre- and post-bulkheading water levels in the mine pool, an assessment of major geologic structures that acted as groundwater pathways (or groundwater dams), a review of changing flow regime in local seeps and springs, and review and assessment of pre-bulkheading hydrogeologic studies. Determined that pre-bulkheading hydrogeologic studies were flawed both in execution and interpretation, and that long-term post-bulkhead monitoring of the mine pool and changes in seep and spring flow was not undertaken in a comprehensive fashion. Finally, when predictions of specific groundwater conditions were not realized, the mine owner responsible for the bulkheading did not investigate the cause\s of the deviations. Found that these actions, and non-actions, contributed to the uncontrolled release that occurred in 2015.

Led a team that evaluated the presence, concentrations, and distribution of various metals (specifically, lead and arsenic), polychlorinated dibenzo-p-dioxins and furans (collectively, dioxins) and polycyclic aromatic hydrocarbons (PAHs) at a K-12 school site in southern California. The purpose of the evaluation was to determine the age(s) and source(s) of these constituents of concern (COCs) at the school site. Using metal concentrations and their distribution, I determined the majority of elevated Pb and As at the Site was due to historical burn dump activities that occurred in the late 19th and early 20th century, well before the school district acquired the site. I found that minor detections of Pb and As were due to the school district’s use of lead-based paint and arsenical pesticides. Given the detailed historical documentation and photography of Site activities, the co-location of elevated As and Pb with burnt artifacts and debris (many artifacts dated by archeologists to the late 19th century), and the pattern of Pb and As concentrations, I concluded that the uncontrolled and unregulated burning of trash (e.g., a burn dump), was the most significant contributor to elevated metals concentrations at the Site. Forensic “fingerprints” of multiple dioxin congeners also supported identification of the burn dump as the primary source of metals. Forensic fingerprints of the PAHs indicated that a former manufactured gas plant located at the Site was responsible for elevated PAH concentrations.

As principal investigator, developed a protocol in estimating historical concentrations of chromium VI in groundwater from the 1960s through the 1990s. The work was conducted as part of a dose reconstruction assessment in southern California related to claims of exposure by numerous individuals. Challenges included the compilation of voluminous but intermittent historical data (with considerably varying analytical quality) from widely spaced wells to assess potential exposures from water supply wells, tanks, cooling towers, and spray irrigators.

Assessed historical and current site conditions at a former alumina production facility in the U.S. Virgin Islands, which was the focus of CERCLA Sections 106, 107 and 113 cost recovery and cost contribution claims. Over 3,000 documents were reviewed to develop a sound conceptual site model for the facility. Principal COIs associated with "red mud" releases include metals (arsenic, cadmium) and high pH, which

are all associated with the Bayer alumina extraction process. Determined that adequate site information existed to support a finding of divisibility of harm to the environment and consequently, response costs could be apportioned and reasonably allocated among the parties. The six "Gore Factors" were applied at the site. Amount of waste generated and cooperation with regulatory agencies were the two principal differentiating Gore Factors. Used historical production records, as a surrogate for the amount of hazardous material generated by each party, and reviewed regulatory enforcement records to develop a quantitative record of regulatory infractions during the tenure of each party, to allocate response costs among those parties. Specific tasks included review of both soil and groundwater RI/FS reports, development of cost estimates for alternative remedial actions, review and assessment of the Bayer process for determining various waste streams, and quantification of site information to support a defensible allocation among the parties.

Subsequent to the allocation work at the Virgin Islands facility discussed above, retained by client to assist in evaluating alleged injury and damages related to a Natural Resource Damages claim. As part of this effort, evaluated allegations of injury to groundwater, which were subsequently used by plaintiff to establish damages. Upon a detailed assessment of historical environmental monitoring data, found that the assessment of baseline conditions was flawed, and the claims were not supportable.
On the same Virgin island site, was retained to assist evaluating the technical issues involving claims of negligence in a subsequent contractual dispute. Evaluated historical operations of the site and compared them to similar alumina refinery sites elsewhere in the Caribbean and worldwide. Concluded that the siting, design and operation of the facility was consistent with the standards in the late-1960s to the 1990s.

Managed a project for Naval Facilities Engineering Command (NAVFAC) in which maintenance and repair facilities at a number of naval bases were audited for compliance with RCRA.

Assisted a client in evaluating the conditions of a heavy manufacturing facility after it was shuttered with little to no preparation during a bankruptcy. The focus of the evaluation was to identify and rectify issues related to RCRA and non-RCRA (California) hazardous wastes left onsite when the operations immediately ceased. This involved evaluating the operations, documenting the then-current conditions of the production lines, assessing the type, quantity and storage age of various waste units, assisting the client in properly managing the wastes for offsite disposal, and verifying the completeness of removal and cleanup.

Assessed the response actions and costs of a cement kiln dust (CKD) and battery debris at a site near Seattle, WA. Various metals and pH were the principal drivers for cleanup. The assessment included the reconstruction of potential release events, and the resulting impact to groundwater and soils. Evaluated the technical appropriateness and costs of remediation, and the degree to which the response action was compliant with regulatory agency standards and practice.

As principal investigator, managed a project to quantify the mass of metals and various salts released from multiple settlement and evaporation waste ponds to shallow groundwater at a site in the arid southwestern U.S. In that the ponds were used by different parties, the estimate of mass was used in allocating responsibility between the parties. Also used chemical fingerprinting and statistical techniques to assess the contribution of specific ponds to various portions of the plume, and demonstrated divisibility. Using the 3-D groundwater model, MODFLOW™, assessed the long-term transport potential of the solutes, and in particular, the potential impact to a major surface water resource.

Consulted on a port authority in California in a CERCLA Section 107 cost recovery action related to a $5-million time-critical removal action. Used various analytical techniques to determine when dredged fill material containing elevated concentrations of lead was deposited. Historical aerial photographs were enhanced electronically, and then, by obtaining historical tidal and celestial information (going back to the 1940s), and compiling consecutive structural changes to facilities and the waterfront, was able to determine conclusively when a significant portion, if not all, of the lead-affected material was placed. Also

reviewed the corrective actions undertaken to ascertain the degree to which they were consistent with the NCP.

As project engineer, assisted with the RCRA closure of a number of process waste units at a former electronics manufacturing facility in Silicon Valley. The units including a plating line, metal working areas, waste sumps, settling basins, conveyance systems, and a laboratory.

Led an investigation of alleged metals impact from a highway to an urban Lake in San Francisco, CA. Lead, copper and zinc were the principal COIs. The investigation included a detailed evaluation of historical activities in the watershed to the Lake; identification of various metal sources, estimation of runoff patterns and historical flow rates based on precipitation records going back almost 100 years. Researched pre- and post-lead ban emission and deposition levels from a number of studies to estimate the historical (since the late 1930s) relative contributions of these metals from the highway and from nearby residential, military, and industrial land uses. Quantified the amount of lead present in the lake and annual and total contributions from other sources to establish an allocation based on the amount of hazardous substances released to the Lake. Also, conducted an NCP compliance evaluation of the RI/FS, and evaluated the technical correctness and costs associated with the proposed remedy, and developed alternative remedies that were lower in cost and more readily implemented than the proposed remedy.

Led an investigation to evaluate the causes of a release of selenium-containing particulate matter in furnace gasses from a glass-manufacturing facility. Also inspected, collected, and tested external finishes of automobiles to assess the degree and type of damages to the cars' finishes due to the release. Inspected the baghouse, plenum, and stack of the facility to ascertain whether the release was due to design, operations, and/or maintenance failure. Based on a detailed review of maintenance and operating records, determined that the most probable failure mode was poor performance of the coating of filter bags (in turn, most likely due to operating the furnace at levels below the dewpoint of the flue gas). An inspection of the automobile finishes indicated that the damage to the paint was surficial (i.e., did not penetrate through the paint to the metal), and was readily ameliorated by standard body-shop buffing practices.

Solid Waste

Evaluated the potential contribution of metals to municipal solid waste (MSW) landfill leachate from hospital incinerator ash at a CERCLA site in northern California. The study included comparing leachate results from samples collected in wells within and downgradient of the landfill to metals concentrations associated with hospital incinerator ash, MSW incineration ash, and typical MSW leachate from an extensive literature review. In addition, evaluated the effect of the hospital incinerator ash on the pH of the leachate, and the effect of the incinerator ash on the activity of dechlorinating bacteria and consequently on the presence of vinyl chloride in the leachate.

Closed a soil treatment unit at a landfill in Nevada following RCRA guidelines. Obtained clean closure after removing the treatment unit and verifying underlying soils and groundwater had not been impacted.

Designed and implemented RCRA Subtitle D-compliant groundwater detection and compliance monitoring systems at municipal solid waste landfills (MSWLFs) in California and Nevada.

Managed a major expansion of a solid waste landfill utilizing draft requirements of RCRA's Subtitle D and new state and local waste management plans. The project included conducting siting studies; performing groundwater, surface water, and air quality studies; developing operating and design plans; and preparing closure and post-closure maintenance plans for acceptance by the enforcement agency.

Managed the detailed compliance, operations, and siting review for a client (lessor) to assess the performance of an operator (lessee) in operating and maintaining a municipal solid waste landfill in

northern California. Compliance issues include the recently promulgated Title 23, Article 5, groundwater monitoring requirements by the California State Water Quality Control Board.

Supervised a project team that developed the conceptual design of a liquid waste treatment facility to solidify and treat waste streams that were disposed of at a client's municipal solid waste landfill. The project included statistically sampling numerous local liquid waste sources, characterizing the wastes into treatability groups, and performing bench-scale tests to develop final treatability options.

Provided regulatory compliance and permitting assistance to a client who operated three municipal solid waste landfills. Current emphasis involved liquids and sludge management issues in light of then-recent changes in state and federal regulations.

Led a team that rewrote a county's solid waste and hazardous waste management regulations. A detailed process for issuance and approval of both special use permits and waste management facilities permits was developed. As part of the submittal, the regulatory process was flow-charted, which indicated permitting milestones, review and submittal deadlines, and fee requirements.

Prepared a county waste management plan for approval by the state and local enforcement agencies.

Managed a project to close, fill, and grade five sewage treatment ponds in accordance with state and local regulations. An innovative component of the project, accepted by the state, was to use the sludge as a soil amendment during concurrent construction activities. The final use of the land is as a golf course.

Stray Current

Undertook a detailed geologic, hydrogeologic, and geophysical study of a major basin in Utah to ascertain the subsurface behavior of direct current (DC) from a major power plant and to assess allegations of stray current. The study included an extensive literature review, verified by field observations, of specific geologic units and lithologies to depths up to 11,000 ft below ground surface, groundwater chemistry and the distribution of aquifer zones, and the resistivity and induced polarization characteristics of local soils and rock. Results of the evaluation indicated that there was no preferential geologic or hydrogeologic pathway for current to flow from the power plant to distant farms. Separately, using resistivity and current-density relationships, also demonstrated that the levels of stray current allegedly measured at distant farms could not be associated with the power plant.

Water Resources and Geologic Hazards

Currently evaluating the contribution of precipitation as the principal causative agent of periodic movement of a series of landslides in a residential neighborhood on the Island of Oahu, Hawaii. Local homeowners have asserted that leaks from local water and sewer utilities are the principal aggravating cause of soil movement. However, taking into account relevant hydrologic and hydrogeologic conditions, including local precipitation, transpiration, infiltration into and sorption by soil, runoff, and storage, preliminarily determined that a significant correlation exists between the amount of estimated infiltrated precipitation and periodic increases in soil movement. No such correlation had been established for alleged releases from water mains or the local sanitary sewers.

Conducted an evaluation of a number of historical flooding events in a residential neighborhood in Northern California on behalf of a county agency. Flooding occurred during relatively modest storm events. Reviewed meteorological records, photographic records, and testimony of public works employees and affected residents. The site was complicated by two separate storm water conveyance systems, two railroads, wetlands and tidal influences from San Pablo Bay. Detailed evaluation of historical aerial photographs, topographic site survey, and hydraulic and hydrologic calculations indicated that the proximate cause for the recurring flooding was backwater conditions created on the downstream

property during certain tidal conditions, combined with the lack of maintenance and clearing of a drainage channel on the downstream property owner's property.

As part of a CERCLA case, conducted a detailed evaluation of two deep, high capacity-industrial water supply wells at a manufacturing facility in Sacramento, California, to assess the timing and potential pathways of alleged chlorinated solvent (perchloroethylene, or PCE) contamination, which caused the wells to be shut down. Evaluation of historic concentration trends and inverse groundwater modeling were used to identify the sources and the relative contributions of the PCE from those sources. A preliminary evaluation of the well design was conducted to develop various mitigation measures to inhibit or prevent further PCE migration to other wells.

Evaluated the hydrogeologic and geologic characteristics of a residential area within a small city in northern California to assess the technical appropriateness of both setback requirements of individual wastewater treatment systems (IWTSs or septic systems) from tributaries that drain into a major drinking-water reservoir. Assessed surface and subsurface flow conditions, reviewed current literature regarding the fate of pathogens (particularly viruses) in the subsurface, and regional guidelines from other county and local agencies, as well as the state. Researched and tabulated failures of IWTSs in the area, which supported a moratorium on construction of new systems, in addition to the setback requirements.

Conducted a geologic and hydrogeologic assessment of a proposed new well field in the Southern Central Valley of California, which included aquifer pumping tests, to assess the optimum and maximum well yields from the proposed new field. Developed preliminary designs of wells to extract groundwater from at least three aquifer zones at depths up the 250 ft below ground surface. Also assisted the client in assessing various conveyance routing options.

Conducted an evaluation of an existing well field, owned and operated by a municipal utility in the San Francisco Bay area. Findings from the evaluation indicated additional wells could be added to the field, in selected areas, to increase overall yield without significant impact to existing wells. Prepared preliminary-level designs for two new wells.

Conducted a basin-wide assessment of the occurrence and transport of perchlorate contamination in a major well field in Southern California. The well field covered about 50 square miles and included dozens of wells. A number of wells in one part of the basin had been shut down to prevent serving impacted groundwater to customers, and to minimize continued spreading of the perchlorate plume. Our assessment identified the likely sources, the hydrologic pathways, and the long-term behavior of the plume under various pumping scenarios.

Conducted a historical hydrologic and hydrogeologic review of a property in the East San Francisco Bay Area to ascertain whether stormwater runoff that crosses the property was exacerbated by county-owned public works, and also to determine whether a retaining wall, installed to mitigate a landslide, affected the hydraulics of a major creek in such a way that a variance to a county setback requirement should be granted for development. The study involved review of historical aerial photographs (back to 1928) and topographic maps (back to 1897), review of county public works ordinances, and geologic and hydrogeologic studies. Then results of the study showed that the retaining wall had only a negligible effect on creek hydraulics, that the property was the concentration point for a 20-acre drainage area going back to at least the late 19th century, and that no county activities had affected that surface flow.

As part of an inverse condemnation claim, studied the surface and subsurface hydraulics of a major drainage basin in northern California, particularly during flooding events in 2002 and 2005. The purpose of the study was to ascertain whether the failure of a privately owned floodwall was due to deficiencies in the design of a retention basin and its discharge structure (flap-gates), and whether the floodwall was designed and built in accordance with county requirements. The study included a detailed survey of the floodwall and retention basin; excavation of the floodwall's foundation in a number of locations; testing the density, spacing, and orientation of rebar within the wall; and examination of historical photographs during and after the wall failures; and interviewing a number of witnesses to the floodwall failure. Results of the

evaluation indicated that the retention basin and discharge structures behaved as designed, and that the floodwall was not designed as required by the county, nor was it built as designed. Both of those deficiencies resulted in failure of the floodwall.

Evaluated a rural groundwater supply, conveyance, and treatment system on behalf of a client who was a defendant in an action related to the conditions of the system at the time that a property, located in San Benito County, California, was purchased. The system served 13 properties, and consisted of two wells, three equalization tanks, and more than 10,000 ft of conveyance. Services were related largely to the causes of, and mitigation measures (and costs) to address, periodic bacteriological blooms in the system. Tasks included a site inspection of the system, evaluation of as-built drawings, assessment of the system's compliance with local and state permits and regulations, and determination of the most likely sources and causes of the biological growths (e.g., E. coli). Developed mitigation measures and costs, developed estimates of damages, and evaluated plaintiff's expert's findings and conclusions.

Evaluated the water conveyance system and the water quality of an agricultural well at a large winery near Santa Barbara, California. The winery was experiencing significant clogging problems in their irrigation system. Our evaluation concluded that the agricultural well was affected by certain types of bacteria (iron-related, sulfate-reducing, and slim-forming), but that the most proximate cause of the clogging is from a combination of carbonate and iron hydroxide precipitation in certain portions of the irrigation system. Recommended mitigating the problem by relocating and/or deepening the well, and treating the water by ion exchange.

Evaluated and assessed construction procedures and documentation to assist a client in evaluating the failure of a containment system designed and installed to prevent mobility of certain COIs during the remediation of affected soils at a former wood-preserving site in western Washington. The soils are located within the inter-tidal zone, and the containment system was to prevent migration of metals, and both light and dense non-aqueous phase liquids (light, nonaqueous-phase liquids and DNAPLs, respectively) into the bay, and to prevent migrating marine organisms from entering the site.

Assessed claims that construction dewatering of a trench used to install a 96-inch force main near Sacramento, California, led to soil consolidation and settlement that resulted in alleged damages to residential structures along the alignment of the excavation. Using construction records — including well logs, pumping records, survey elevation data, and geotechnical characteristics of the relevant soils — determined that, while the groundwater drawdown created by the dewatering wells did affect nearby soils, the maximum extent of soil consolidation was less than 0.1 inch over the extent of the property, which would not have led to any structural impact, even at the residences closest to the excavation.

Investigated and analyzed a $7-million construction claim on a new $190 million high-rise office building in downtown Honolulu. Provided technical review and analysis related to the effects of, and potential mitigation measures against, artesian groundwater flow conditions during the installation of rock anchors used to prevent hydraulic uplift of a five-level underground parking garage.

When a slope failure in a residential neighborhood destroyed and damaged a number of homes, conducted a hydrogeologic analysis of the potential effects of seepage from a municipal reservoir, and the potential role of the seepage in the slope failure.

Managed a project to ascertain the degree of environmental impact to a municipal drinking-water reservoir from a hypothetical release from a fuel transmission pipeline due to a potential seismic failure. The results of the study identified the most likely routes of surface transport, degree of infiltration and runoff, and effects on surface water from the release.