



PROFESSIONAL PROFILE



Wai Kwan, PhD, PE

Principal Engineer

EXPERIENCE SUMMARY

More than twenty years of experience as a Principal, Senior, and Project Engineer at Roux.

TECHNICAL SPECIALTIES

Environmental chemistry, engineered natural systems, PCBs, chlorinated solvents, site remediation utilizing traditional and innovative techniques.

REPRESENTATIVE PROJECTS

Site Investigation/Remediation

- Principal Engineer and Engineer-of-Record for the implementation of in situ chemical treatment and SVE to remediate chlorinated volatile organic compounds (CVOCs) in groundwater at a car storage facility in Irvine, California. Oversaw performance of design verification tests to obtain site-specific data that was used to refine full-scale injection of proprietary zero-valent iron and design of carbon based permeable reactive barrier. Prepared and reviewed reports documenting findings and recommendations for full-scale implementation, completion of construction, and performance monitoring.
- Principal Engineer and Engineer-of-Record for site investigation and design of a soil vapor extraction (SVE) system in Santa Ana, California. Prepared and directed an investigation to delineate extent of soil vapor plume. Designed an SVE system to address soil vapor impacts underneath operating dry cleaner. Prepared a Remedial Action Plan for regulatory review and approval.
- Principal Engineer and Engineer-of-Record for the design and implementation of a vapor intrusion mitigation system (VIMS) for a self-storage facility in Tarzana, California. Remedial designs included retrofitting VIMS for an existing building and designed one for a new building. Prepared baseline investigation and response plan for regulatory review and approval.
- Principal Engineer for the remediation of soil and soil vapor impacted by the release of approximately 1,500 gallons of fuel at an operating gas station in San Bernardino County, California. Designed and involved in the operation of a soil vapor extraction (SVE) system consisting of five extraction wells focused on addressing the source area spanning 55 vertical feet.
- Principal Engineer for the remediation of soil and soil vapor impacted by the release of tetrachloroethene (PCE) from a former dry cleaner in Compton, California. Prepared a pilot study to evaluate the feasibility of expanding the current SVE system to treat impacted soil and soil vapor at shallow and deep intervals underneath an existing supermarket. Managed operation and maintenance (O&M) of the SVE system, including activities to comply with South Coast Air Quality Management District (SCAQMD) permit.
- Principal Engineer for the remediation of soil and soil vapor impacted by PCE in two shopping centers in Huntington Beach, California. Prepared a pilot study to evaluate the feasibility of using SVE technology in shallow groundwater aquifer. Designed SVE system. Managed O&M of the SVE system, including activities to comply with SCAQMD permit.
- Principal Engineer and Engineer-of-Record for the expansion of a SVE system in Oakland, California. Designed an expansion that reused components of the existing SVE system and integrated new elements to address areas of known contamination. Site is in an urban area with limited access and involves three different owners and affects multiple businesses.

CONTACT INFORMATION

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EDUCATION

PhD, Environmental

Engineering, Massachusetts

Institute of Technology, 2003

MS, Environmental Engineering,

Massachusetts Institute of

Technology, 1999

BS, Chemistry, California

Institute of Technology, 1997

BS, Engineering & Applied

Science, California Institute of

Technology, 1997

PROFESSIONAL LICENSES

Professional Engineer – New

York, California

- Principal Engineer for the design and implementation of SVE pilot tests at multiple shopping centers and industrial sites across Southern California. Designed SVE well depths and layout, provided field support, evaluated data, and prepared technical memos to document the procedures and findings.
- Principal Engineer for the implementation of Phase II investigation at multiple shopping centers and industrial sites across Southern California. Prepared workplans and oversaw performance of soil, groundwater, soil vapor, sub-slab vapor indoor air and ambient air sampling.
- Operations Deputy for rapid mobilization and coordination of over 75 people to screen and sample for lead and other heavy metals in soil across 500 residences within 1.7 miles of the source in 10 days in the County of Los Angeles, California. Soil screening involved use of handheld x-ray fluorescence analyzer. Provided laboratory coordination, logistics and technical support, and QA/QC check of data.
- Engineer for the conceptual design of a two-acre engineered phyto cap for a site in Los Angeles County, California. The site is approximately seven acres and contains a waste dump and two abandoned oil production wells. The engineered phyto cap is designed to mitigate the potential for exposure of future residents to trash materials and is incorporated into the private, community-use park.
- Designed and oversaw construction of a full-scale in situ enhanced bioremediation treatment system for groundwater impacted with CVOCs at an 18-acre former electronics manufacturing facility in Taiwan. Evaluated the effectiveness of different substrates for in situ treatment from the results of two concurrent 6-month pilot studies, resulting in selection of enhanced bioremediation. The full-scale treatment system consists of over 9,000 feet of piping and 189 molasses injection wells. The technology decreased PCE concentrations by 99 percent, trichloroethene (TCE) concentrations by 98 percent, and total CVOC concentrations by 96 percent.
- Project Manager for the injection of 10,280 gallons of Fenton's reagent to address groundwater contaminated with PCE and its breakdown products associated with a former PCE reclamation facility in Brooklyn, New York. The design focused on the source area and two downgradient hot spots that exhibited concentrations of dissolved CVOCs in parts per million and used a proprietary method to activate the Fenton's reagent.
- Project Manager for the remediation and closure of a former dry cleaner site in Brooklyn, New York, under the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program. Managed field staff and provided engineering support during excavation and removal of 55 cubic yards of soil and concrete impacted by PCE and its breakdown products from a basement. Provided design and management of injection of 1,700 pounds of potassium permanganate solution to treat CVOCs in groundwater. Prepared Remedial Action Work Plan, permit application, daily construction reports, Final Engineering Report (FER) and Site Management Plan (SMP). Interacted with client, contractor, and regulatory agency project manager.
- Field Engineer for the remediation of a NYSDEC Brownfield Site in Staten Island, New York. Supervised the removal of soil and groundwater contaminated with hazardous levels of PCE and TCE released from a defunct dry cleaner. Evaluated the performance of molasses injections to enhance in situ bioremediation of impacted groundwater. Prepared the Final Engineering Report to document the remedial action.
- Prepared reports that evaluated bench scale and field scale results of using surfactant-enhanced subsurface remediation technology to enhance free-product recovery at an active railroad yard in Sunnyside, Queens, New York. Coordinated lab and field activities with a surfactant vendor, performed literature review, designed a multi-month field scale treatability study, and evaluated the findings for potential application during full scale remediation.
- Prepared a treatability study work plan to evaluate the feasibility of using surfactant-enhanced subsurface remediation technology to enhance free-product recovery at a former petroleum refinery and distribution terminal in Greenpoint, Brooklyn, New York. Corresponded with surfactant vendors, performing literature review, designed a bench scale treatability study, and assessed the feasibility of implementing enhanced recovery of residual free-product in the regional aquifer that is exhibiting decreases in recovery rates via dual-pump liquid extraction.
- Project Manager for an SVE and air sparge (AS) system to treat groundwater contaminated with VOCs and CVOCs at a 0.8-acre NYSDEC Voluntary Cleanup Site in Brooklyn, New York. Designed and performed two SVE/AS pilot studies. Designed the full-scale SVE/AS system. Provided oversight during installation of the full-scale SVE/AS system. Prepared the FER and SMP. Managed daily operations of the SVE/AS system and groundwater gauging and sampling personnel. Responsible for communications with the NYSDEC and reviewing progress reports.
- Project Manager for the performance of multiple soil, groundwater, and soil vapor investigations at a NYSDEC Voluntary Cleanup Site in Brooklyn, New York. Prepared reports, work plans and directed field staff in the collection of discrete soil, groundwater, and soil vapor samples to delineate the extent of CVOC contamination in groundwater, soil, and soil vapor. Used membrane interface probe (MIP) technology as a

screening tool to focus subsequent sample collection efforts and to reduce overall investigation costs.

- Senior and Project Engineer for the evaluation of methods to treat petroleum impacted soils at a former petroleum refinery terminal in Buffalo, New York. Evaluated bench scale studies using organoclay, nitrate, RegenOx, cement/slag, and lime kiln dust. Designed, supervised, and evaluated the performance of favorable treatment agents based on results generated from pilot scale field tests. Also critiqued scanning electron microscopy photographs and energy dispersive x-ray spectroscopy absorption spectra that were used to identify and support the conclusion that multiple, unrelated lead species are present within one operable unit.
- Project Manager for the remedial investigation of a shopping center in Enfield, Connecticut. Designed a focused investigation using MIP technology to focus subsequent collection of groundwater and soil samples using a standard size and portable Geoprobe for interior locations, and installation of soil vapor pins for the collection of sub-slab samples. Managed field staff during the implementation of the remedial investigation and interacted with store proprietors to coordinate the work with minimal business interruptions.
- Field Engineer for the remediation of two 6.25-million-gallon process lagoons adjacent to the Hudson River at a former dye manufacturing facility in Rensselaer, New York. Supervised the excavation, staging, screening, and transport of riprap and soil contaminated with hazardous concentrations of arsenic. Interacted daily with the client and regulatory agency representatives during implementation of the remedial action.
- Project Engineer for a multi-element remedial design of a USEPA Superfund site in Nassau, New York. Prepared response letters, technical drawings, and 95 percent and 100 percent remedial design documents in accordance with the Record of Decision and Consent Judgment.
- Evaluated laboratory data packages of post-excavation soil samples generated during the interim remediation of a former storage and loading area of a pharmaceutical company in Brooklyn, New York. Initial site investigations concluded site contamination was limited to petroleum-related compounds. Supplemental site investigations conducted a few years after the conclusion of the interim remediation showed a dissolved CVOC plume was present site-wide. Reviewed chromatograms and concluded that CVOCs were detected but not reported, since the reporting scope was limited to petroleum-related compounds in many of the post-excavation soil samples, which would have provided earlier indications of the presence of the CVOC plume.

Landfills

- Project Manager for the redevelopment of 25 acres of a USEPA Superfund site in Santa Fe Springs, California. Redevelopment plans include construction of a new, state-of-the-art warehouse distribution center and associated trailer parking. Working as part of a multi-disciplinary team to address environmental, geotechnical, structural, and civil challenges. Prepared a workplan for procedures to penetrate and repair Resource Conservation and Recovery Act (RCRA) Subtitle-C and RCRA Subtitle-D cap. Managed environmental monitoring and oversight during geotechnical investigation. Preparing numerous plans for USEPA review and approval for soil management, air monitoring, removal and replacement of RCRA cap, and management of environmental monitoring points during construction.
- Project Manager for the remediation of a former petroleum refinery terminal in Buffalo, New York, under the NYSDEC Brownfield Cleanup Program. Prepared conceptual and final designs for stabilization of 1,400 linear feet of river embankment using tiered slopes, rip rap, and reinforced bioengineering as part of a landfill closure remedial action. The stabilized shoreline uses a variety of flora and land features to create multiple habitats for aquatic and terrestrial lifeforms, while also serving as a component of the vegetated landfill cover. Prepared Alternatives Analysis Report to document analysis of engineering options and remedy recommendation. Prepared permit application, Remedial Design and Bid Document for implementation of remedy. Reviewed contractor submittals. Provided oversight and engineering support during remedy construction. Prepared FER and SMP.
- Project Manager for the performance of a Corrective Measures Study (CMS) at a 30-acre land parcel undergoing RCRA Corrective Action in Williamsburg, Virginia. The site is a former fibers manufacturing facility, and a RCRA regulated landfill is located within the parcel. The CMS was conducted to identify, evaluate, and recommend a final remedy to address zinc-impacted groundwater discharging to a tributary. Managed multi-person field crew who installed multiple monitoring wells, gauged and sampled groundwater, and conducted slug tests. Analyzed the CMS data to show more than 96 percent of the zinc loading is attributed to groundwater discharge along approximately 20 percent of the shoreline. Proposed a final remedy consisting of a 6.5-acre phytotechnology cover and 960 linear feet of compost reactive barrier, at a significantly lower cost compared to conventional treatment approaches.

Litigation Support

- Principal Engineer for the preparation of a rebuttal report on the scope of soil vapor and groundwater remediation at a shopping center in Huntington Beach, California. Reviewed historical investigation findings and extent of contamination.

Opined on the reasonableness of the scope of remediation proposed by the opposing expert.

- Principal Engineer for the preparation of an expert report on the operation, closure, and pollution caused by a sanitary landfill adjacent to a creek in Indiana. The effort included reviewing historical site photographs; past regulations and practices for siting, operating, and closing of a sanitary landfill; and cost estimate to properly close the landfill.
- Principal Engineer for expert support on a former manufacturing facility in El Monte, California. Reviewed reports, workplans, and cost estimates and provided counsel with opinions on necessity and reasonableness.
- Senior Engineer for the analysis of expert reports and preparation of rebuttal for three superfund sites in New York and Massachusetts. The case involved assigning the percentage of polychlorinated biphenyls (PCBs) released over time during the operation of the facilities at the three sites for the purpose of remedial costs allocation to various insurance carriers. Reviewed information submitted by opposing experts, conducted independent research to verify methodologies, and provided technical calculations indicating flaws in positions advocated by the opposing experts.
- Senior Engineer and Project Manager for the analysis of the sources and fate and transport of dioxins and PCBs into Newark Bay in New Jersey. Reviewed sediment and water column data from existing investigations, performed independent review of third party publications, and worked with geochemical expert on principal component analysis to identify dioxin contributions from several nearby sources.
- Senior Engineer for the preparation of an expert report for a fuel oil release in Rochelle Park, New Jersey. The release was from a residential underground storage tank (UST). The expert report opined on the age of the release, the reliability of the estimation method used by the opposing expert, and the accuracy of the age dating of the perforations in the UST.
- Project Engineer for the preparation of an affidavit regarding a cesspool explosion on Long Island, New York. The affidavit was prepared for the defendant's counsel providing technical calculations and opining on the improbability that the defendant's use of a drain cleaner contributed to a flash fire that injured the plaintiff. Also prepared an expert rebuttal affidavit to demonstrate the fallacies in the plaintiff's expert's arguments. The judge dismissed the case after reviewing all admitted information.
- Senior Engineer for the evaluation of expected remedial costs for waste disposal sites as part of a large bankruptcy litigation. Reviewed over 70 site records to identify potential liabilities and appropriate statute of limitations. Developed present value

of remedial investigation and action costs and apportionment ranging from \$160,000 to \$1,200,000.

- Senior Engineer for the evaluation of gas chromatograms from multiple retail gasoline stations in Puerto Rico as part of a class action lawsuit. Responsibilities included reviewing for indicators of methyl tert-butyl ether (MTBE) and determining MTBE concentrations from historic laboratory data packages.

Insurance

- Evaluated claim for costs to remediate soil and groundwater contaminated with 1,4-dioxane and other VOCs at a site in Irvine, California. Reviewed cost estimates and workplans for necessity and reasonableness. Represented insurance carrier on calls with regulatory agency.
- Evaluated claim for costs to remediate oily water at a school in Beverly Hills, California. Reviewed cost estimates and timeline of events for necessity and reasonableness. Visited site to ascertain layout of school and adjacent oil well that was the source of impacts to water released from a fire suppression line during an earthquake.
- Evaluated claim for costs to address water damage at a residence in San Bernardino, California. Homeowner claimed water damage and mold were the result of water line break and inadequate emergency response by contractor. Determined necessity and reasonableness of invoices by visiting home to ascertain damage, evaluating photos for signs of water damage, and reviewing changes in moisture data during response.
- Evaluated claim for costs to investigate and remediate VOC, hexavalent chromium, and PFAS at a metal plating facility in Stanton, California. Reviewed cost estimates and workplans for necessity and reasonableness.
- Evaluated claim for costs to investigate VOC release from former dry cleaner in Mission Viejo, California. Reviewed invoices and cost estimates for necessity and reasonableness. Reviewed public records to formulate opinion that PCE releases to the subsurface occurred prior to policy coverage period.
- Evaluated claim for costs to design and implement a VIMS at a development in Los Angeles, California. Reviewed workplans, cost estimates, regulatory comments, and design for necessity and reasonableness.
- Evaluated claim for costs to remediate soil and USTs in support of redevelopment in San Diego, California. Reviewed workplans and invoices for necessity and reasonableness.
- Evaluated claim for costs from third party consultant for performance monitoring and litigation support for a former industrial site in Compton, California. Former operations at the site discharged waste that contaminated the underlying soil,

groundwater, and soil vapor. Reviewed invoices for necessity and reasonableness.

- Evaluated claim for costs to remediate VOCs in subsurface at two sites in Colorado. Reviewed workplans, reports, and cost estimates for necessity and reasonableness.
- Evaluated claim for costs to remediate cesspools encountered during construction in Honolulu, Hawaii. Reviewed invoices and cost estimates for necessity and reasonableness.
- Evaluated claim for costs to remediate cesspools encountered during construction in Honolulu, Hawaii. Reviewed invoices and cost estimates for necessity and reasonableness.
- Performed engineering evaluation of a Superfund site in Folsom, California in support of underwriting for \$25MM policy for site redevelopment. Reviewed thousands of pages of historical information and prepared GIS maps to understand known environmental conditions. Prepared report that evaluated multiple coverage exclusions.
- Performed tens of engineering evaluations of domestic and international sites in support of underwriting. Reviewed Phase I and Phase II environmental site assessment reports, evaluated risks, suggested exclusions to underwriters for multi-year, multi-million-dollar environmental insurance policies.

Stormwater Management

- Project Manager and Engineer for the design of a full-scale natural media filtration (NMF) system consisting of two stormwater storage basins (0.4 MM and 1.8 MM gallons) and four NMF cells (two 114,000-gallon aboveground cells and 0.15- and 0.25-acre in-ground cells) at a 172-acre active aluminum manufacturing facility in Lafayette, Indiana. The NMF cells treat up to 1,500 GPM of stormwater runoff and process water impacted by PCBs, dissolved and particulate aluminum, and suspended solids. Researched the fate and transport of PCBs, and assessed the treatability of PCBs in wetlands. Evaluated a compost treatability bench-scale experiment. Designed and coordinated groundwater percolation tests. Used HydroCAD to model treatment capacity for multiple storm events.
- Project Engineer for the design of a passive stormwater management system for a 3,500-acre aluminum manufacturing facility in Point Comfort, Texas. The passive stormwater management system uses sedimentation trenches and swales to manage and convey bauxite-laden runoff. Stormwater runoff is managed by a constructed treatment wetland (CTW) and is consumptively used by a phytotechnology tree plot. Completed a hydrologic analysis using USACE HEC-HMS modeling software. Prepared bid specifications and provided bid support.
- Project Manager for the design of a NMF system to reduce PCBs to non-detect levels in stormwater at an aluminum extrusion facility in Cressona, Pennsylvania. The NMF system treats the

first flush volume of 240,000 gallons containing residual PCBs. Conducted a detailed analysis of the site's constituents and runoff volumes during dry weather and wet weather to properly size the pump station and the NMF cell. Prepared bid document and provided bid support.

- Project Engineer for the design of a CTW to manage stormwater runoff generated from a scrap metal recycling facility in Sayreville, New Jersey. The CTW was designed to handle and treat runoff with elevated levels of suspended solids prior to discharge to adjacent coastal and freshwater jurisdictional wetlands.
- Evaluated the feasibility of using CTW to treat 110 GPM of groundwater containing elevated levels of cyanide at an aluminum manufacturing facility in Hannibal, Ohio. The CTW was designed to address the site's constituents and winter environment, and was modularized to facilitate the expansion and incorporation of the pilot-scale CTW into the full-scale CTW.
- Project Manager for a feasibility study to mitigate land subsidence at a golf course adjacent to Long Island Sound in Northport, New York. Completed a data review of existing reports from USGS and local municipality, previous soil investigation, and current stormwater drainage design. Directed a field investigation to obtain data in support of the conceptual model for land movement. Concluded that existing stormwater management measures accelerated the rate of land movement. Evaluated potential engineering remedies.

Compliance

- Prepared multiple applications for permit to construct/ operate SVE systems that were submitted to SCAQMD or Bay Area Air Quality Management District. Reviewed site information, air quality data, vendor supplied equipment cut sheets, and performed required calculations.
- Project Manager for the preparation of multiple Spill Prevention, Control, and Countermeasure (SPCC) plans for an international transport courier client. Visited three shipping facilities in the Phoenix, Arizona area to record site conditions, understand stormwater flow patterns, existing infrastructure, and planned improvements. SPCC plans were prepared under the direction of an Arizona-licensed professional engineer.
- Project Manager for the redevelopment of 25 acres of a USEPA Superfund site in Santa Fe Springs, California. Redevelopment plans include construction of a new, state-of-the-art warehouse distribution center and associated trailer parking. Working as part of a multi-disciplinary team to address environmental, geotechnical, structural, and civil challenges. Prepared a workplan for procedures to penetrate and repair Resource Conservation and Recovery Act (RCRA) Subtitle-C and RCRA

Subtitle-D cap. Managed environmental monitoring and oversight during geotechnical investigation. Preparing numerous plans for USEPA review and approval for soil management, air monitoring, removal and replacement of RCRA cap, and management of environmental monitoring points during construction. All plans must comply with the Site's Record of Decision and other governing plans for operation, maintenance, and monitoring of the remedy.

- Project Engineer for the evaluation of air emissions data from a steel mill melt shop in Sayreville, New Jersey. Prepared annual emissions statement in accordance with permit requirements using RADIUS software and emissions factors from AP-42 and CEMS data. Evaluated and summarized trends and anomalies observed in over one year's worth of air monitoring data on particulates and metals from monitors set up in the surrounding community.
- Project Engineer for the preparation of Title V emissions statement for two major hospitals in Nassau County, New York. Responsibilities included reviewing annual fuel usage data, calculating air emissions using emissions factors from AP-42, and preparing the emissions statement.
- Project Manager for the coordination, preparation, and submission of PCB total maximum daily loads (TMDL) reporting requirements for multiple sites in Virginia. Responsibilities included managing subcontractors, preparing submission forms in accordance with state guidelines, and preparing the first Pollutant Minimization Plan (PMP) in the state for PCBs.

PROFESSIONAL AFFILIATIONS

American Chemical Society

American Society of Civil Engineers

PRESENTATIONS AND PUBLICATIONS

Multi-Pronged Approach to Remediate and Mitigate Chlorinated Solvent Impacts. Kwan, W. P., McGuire, A., and Escobar, M. H., AEHS West 32nd Annual International Conference on Soil, Water, Energy, and Air, March 2023.

Proactive Evaluation of PRP Status at Hazardous Waste Disposal Sites. Sullivan, D., Kwan, W. P., Gerbig, C. A., and Moore, C., Environmental Claims Journal, 27(2), 2015.

Extricating Membership as a PRP at Hazardous Waste Disposal Sites. Ram, N. M., Kwan, W. P., Gerbig, C. A., and Moore, C., Remediation Journal. Spring 2014.

Long-Term Performance of a Phytoremediation Cap. Kwan, W. P., USEPA Engineering Forum, August 2012.

Long-Term Performance of an Integrated CTW/Phyto Cap System. Kwan, W. P., and W. Eifert, 8th International Phytotechnology Society Conference, 2011.

Large-Scale Enhanced Reductive Dechlorination for the Remediation of Chlorinated Volatile Organic Compounds. Kwan, W. P., Senh, S., and Netuschil, G., Proceedings of The Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Paper F-036, 2010.

Predicting Oxidation Rates of Dissolved Contaminants During In Situ Remediation Using Fenton's Reaction. Kwan, W. P., and B. M. Voelker, Abstracts of Papers of the American Chemical Society, 228 (352 ENVR), 2004.

Influence of Electrostatics on the Oxidation Rates of Organic Compounds in Heterogeneous Fenton Systems. Kwan, W. P. and B. M. Voelker, Environmental Science & Technology, 38(12), 2004.

Rates of Hydroxyl Radical Generation and Organic Compound Oxidation in Mineral-Catalyzed Fenton Like Systems. Kwan, W. P. and B. M. Voelker, Environmental Science & Technology, 37(6), 2003.

Decomposition of Hydrogen Peroxide and Organic Compounds in the Presence of Dissolved Iron and Ferrihydrite. Kwan, W. P. and B. M. Voelker, Environmental Science & Technology, 36(7), 2002.

Heterogeneous Fenton-Like Chain Reactions Initiated by Iron Oxides. Kwan, W. P. and B. M. Voelker, Abstracts of Papers of the American Chemical Society, 200 (283 ENVR), 2000.