Jeffrey V. Dagdigian, Ph.D.

Managing Principal Environmental Scientist

Waterstone Environmental, Inc.

Dr. Jeffrey V. Dagdigian is the owner of Waterstone and is Waterstone's lead environmental scientist. Dr. Dagdigian holds a Ph.D. in chemistry and has over 33 years of experience in the evaluation, assessment, remediation, restoration and/or mitigation of real property with impact to the subsurface by chemical compounds. Based on his lengthy career as an environmental scientist, Dr. Dagdigian is frequently retained as an expert witness for litigated matters. He also performs other aspects of litigation support including release timing, responsible party identification, cost allocation and damage calculations. To perform complex calculations or evaluate probabilities, Dr. Dagdigian prepares his own models that are tailored to address specific issues in a litigated case or environmental problem and uses commercially-available models to evaluate contaminant transport in the subsurface. In addition, Dr. Dagdigian has decades of experience in performing site assessments, subsurface site characterizations, remedial planning and costing, evaluation of industrial processes, forensic chemical analysis of contaminants, environmental site restoration, waste minimization, remediation, and wastewater treatment process evaluation. Dr. Dagdigian's reputation as an experienced expert witness has caused him to be chosen as the testifying expert for the US government and by large corporations where millions to billions of dollars in claims or damages are at stake. For over 20 years, Dr. Dagdigian has been a part-time instructor for environmental programs at the University of California, Irvine. In this role, Dr. Dagdigian develops and teaches courses addressing environmental issues related to chemistry, environmental due diligence, site characterization, remediation and cleanup standards, regulatory compliance and innovative technologies related to site assessment and remediation primarily for the continuing education of currently employed environmental professionals.

Education

- Graduate Course Work for MBA Program, California State University – Fullerton, 1981-1985
- Ph.D., Chemistry, University of Southern California, 1980
- B.S., Biology, University of Southern California, 1975

Capabilities

- Expert Witness and Litigation Support Services
- Forensic Chemical Analysis and Chemical Fate and Transport
- CERCLA Cost Allocation
- Model Construction for Costing, Plume Migration, and Probability Analysis
- Site Assessment and Remediation
- Remedial Action and Damages Costing
- Clean up Level Calculation and Agency Negotiation
- Government Agency Liaison
- Industrial Process and Chemical Use Evaluation for RCRA and CERCLA Compliance
- Due Diligence and Phase I Environmental Assessments
- Hazardous Materials and Air Resources Management
- Environmental Compliance and Business Acquisition Audits
- Industrial Process and Chemical Use Evaluation for Waste Minimization
- Wastewater Treatment Systems

Key Projects

Expert Witness and Litigation Support Services

- Dr. Dagdigian was retained by counsel as an expert witness for two separate operators of a former circuit board manufacturing facility in Santa Ana, California. The former circuit board manufacturing facility, which had multiple operators, was responsible for a release of 1,1,1-TCA to soil and groundwater beneath the facility that was alleged to be threating an Orange County Water District production well. The 1,1,1-TCA release had degraded to 1,1-DCE and 1,1-DCA, and also contained a solvent stabilizer 1,4-dioxane. To complicate matters, the 1,1,1-TCA release was comingled with a separate 1,1,1-TCA and TCE release from an upgradient offsite source and a separate offsite downgradient TCE plume. Through in-depth evaluation of existing Site assessment and remediation data for the Site which were conducted at the direction of the California Regional Water Quality Control Board Santa Ana Region, and half-life calculations for abiotic degradation of 1,1,1-TCA, Dr. Dagdigian was able to prove that the 1,1,1-TCA release occurred during the operation by a third operator and that neither of the two defendants could have been responsible for the releases. By calculating the mass of the dissolved phase chlorinated solvent groundwater plume for multiple chemicals of concern over multiple time frames, Dr. Dagdigian was also able to demonstrate that the 1,1,1-TCA, 1,1-DCE, 1,1-DCA, and 1,4-Dioxane dissolved phase groundwater plumes were stable and naturally attenuated, and as such they were not a threat to the Orange County Water District production well in question. In addition, to determining the source and timing of contamination, Dr. Dagdigian prepared a cost allocation for the subject site distributing the Orange County Water District investigation costs among the PRPs.
- Dr. Dagdigian was retained by counsel to represent Union Oil regarding insurer coverage issues. Dr. Dagdigian determined through modeling and probabilistic analysis the time frame during which the Guadalupe Oil Field was impacted by diluent releases that occurred sometime during production activities. A careful review of the existing data established the ages of each potential source area of petroleum hydrocarbon compounds. This included documenting the date of installation and date of removal, abandonment, or mitigation of any possible source areas including but not limited to all aboveground storage tanks, sumps, wellheads, and piping including couplings and repaired lines. It also included reviewing any reported spills from trucking and reported leaks from any of the above or other source areas. Dr. Dagdigian prepared a detailed allocation of costs attributable to the numerous insurers based on the time of the policy, self-insured retentions, and maximum policy limits. The analysis included Monte Carlo probabilistic analysis of the release times to support the times of the releases and thus the effected insurer policies.
- Dr. Dagdigian was retained by a plaintiff property owner of 200+ acres against a tenant oil exploration and extraction company. The case was filed to enforce lease requirements that the oil company return the property to clean and safe conditions following oil production activities. The case involved evaluating over 100 areas of concern via the collection of soil samples, calculating costs associated with 1) remediating soil impacted as a result of oil exploration and storage (determined to be 180,000 tons); 2) the removal of oilfield infrastructure (roads, well pads, wells, well vaults, tanks, tank foundations, secondary containment berms, piping, heater treaters, etc.); 3) regrading the property to pre-lease grade; and 4) regulatory oversight, permitting, reporting

and closure. Based on Dr. Dagdigian's environmental assessment and remediation calculations, the defendant settled the case before trial and was compelled to perform the required cleanup.

- Dr. Dagdigian was retained by an electroplating company to evaluate of the nature, extent, and source of contamination of the Santa Anita Industrial Park located at 4923 to 4973 Santa Anita Avenue in Temple City, CA 91820. Dr. Dagdigian was asked to perform the following tasks: (i) review historical environmental reports and related information; (ii) identify the chemicals of potential concern; (iii) establish appropriate cleanup goals for soil, groundwater, and soil vapor; (iv) evaluate potential technologies and procedures for performing site remediation; (v) evaluate remediation costs provided by the environmental consultant; (vi) determine whether the remedial actions were consistent with the NCP; and prepare a CERCLA cost allocation between the involved past and current owners and a number of tenants. Dr. Dagdigian evaluated and used each of the six Gore factors to allocate responsibility among the parties.
- For a confidential client, Dr. Dagdigian was the lead expert witness for the plaintiffs in a case involving contamination of a 600 acre commercial/light industrial park by releases of jet fuel, leaded gasoline, unleaded gasoline, and various refinery intermediates. Three entities (two pipeline companies and large oil refinery) were involved in the releases of the above materials, which eventually resulted in six groundwater plumes, which were commingled in various locations on the property. Among other demands, the plaintiffs asked for cleanup costs and full indemnification from future liabilities. Dr. Dagdigian was responsible for reviewing existing site characterization data produced by a variety of consultants for various clients, integrating the all site characterization data into a single database, developing and implementing an expedited sampling program, which allowed for determination of the extent of contamination and an allocation to the responsible parties. In addition, Dr. Dagdigian was responsible for preparing and defending in court a remedial action plan and corresponding remedial cost estimates. As a result of Dr. Dagdigian's efforts, two of the defendants settled out of court meeting the plaintiff's demands and with respect to the third defendant, the jury found in favor of the plaintiff.
- Tricor Refining, LLC, etc. v. Crompton Corporation, etc.; Kern County Superior Court Case No. S-1500-CV-252296-SPC. In this case, Dr. Dagdigian served as the sole expert witness for Tricor Refining, LLC. Dr. Dagdigian provided opinions regarding the extent and nature of soil, soil gas, and groundwater contamination beneath the Golden Bear Refinery located in Oildale, California. These opinions were based on a multi-year investigation of the refinery Dr. Dagdigian directed which included hundreds of borings and samples collected in both soil and groundwater beneath the refinery. In addition, Dr. Dagdigian opined on the fate and transport of the various chemicals through various media using chemical, geological, and hydrogeological principles. This portion of his testimony was aimed at showing areas of contamination that needed remediation and the potential migratory paths for contaminants currently impacting the soil and groundwater. Finally, Dr. Dagdigian developed health-based cleanup levels for all of the chemicals of concern and provided the Court with his detailed engineering plans for the cleanup and remediation of contaminated soil beneath the refinery. Based on his remediation plans, Dr. Dagdigian testified that the cleanup cost for the entire refinery would be $29.5 million. This estimate was based on a detailed engineering cost estimate, prepared by me, which totaled remedial costs for every area of the refinery that was contaminated. The costs included installation of several vapor extraction systems to remove volatile vapors in the soil gas, excavation of contaminated soil beneath various operating units within the refinery, installation of various shoring systems and the removal of and re-installation of various operating units and tanks within the refinery.

- Dr. Dagdigian was retained by counsel for a Responsible Party in the Portland Harbor Superfund Site, evaluated factors potentially effecting incidental formation of polychlorinated dibenzo-p-dioxins (CDDs) and polychlorinated dibenzofurans (CDFs) in chlorate/chlorine reactors at a former manufacturing facility. Water and sediments along Portland Harbor are contaminated with many hazardous substances, including heavy metals, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAH), dioxin, and pesticides. The facility operated from 1941 to 2001 and manufactured chlorine, DDT, ammonia and orthosilicates. Dr. Dagdigian identified process variables and materials of construction of the chlorate cells which potentially may have impacted or promoted the formation of CDDs/CDFs. Dr. Dagdigian prepared an expert report that presented the potential mechanisms of CDD/CDF formation in both thermal (e.g. waste incineration) and wet chemistry settings. The evidence showed that based on the materials used, the construction of the chlorate cells, and the operating conditions would not have attributed to the formation of CDDs or CDFs.

- Dr. Dagdigian was retained as an expert witness by counsel for a machine shop that made airplane parts named as a potentially responsible party in the San Gabriel Valley Puente Valley Operable Unit. This is an area with groundwater impact by TCE, PCE, and 1,4-dioxane among other chemicals. Dr. Dagdigian performed a historical investigation and additional investigations he designed to show that the client did not contribute to the groundwater plume in the Superfund. Dr. Dagdigian presented his conclusions to the Puente Valley Superfund Group and the judge in charge showing: (i) the client never used the chemicals of concern, (ii) the chemicals of concern were not found in soil matrix on the client's property, (iii) groundwater contamination from up-gradient sites had impacted groundwater beneath client's property, (iv) groundwater contamination is responsible for low concentrations of halogenated volatile organic compounds in soil gas on the client's property, and (v) owners and operators of properties responsible for up-gradient groundwater contamination have not been named as potentially responsible parties (PRPs). This presentation resulted in the client receiving a *de minimus* settlement offer.

- Dr. Dagdigian was retained by counsel for a food manufacturer named as a responsible party (RP) for the Omega Chemical Superfund Site in Whittier, California. The Omega facility was a solvent and refrigerant recycler that operated from approximately 1976 to 1991. The facility was identified as a Superfund Site following the discovery of extensive soil and groundwater contamination of numerous chemicals including trichloroethene (TCE), tetrachloroethene (PCE), Freon and 1,4-dioxane with a groundwater plume approximately four miles in length. Dr. Dagdigian performed a comparative study of plume chemicals against his client's chemical use and storage history and prepared an expert report indicating that the chemicals were dissimilar and recommending that counsel request the client's removal from the RP Group or be provided a reasonable *de minimus* settlement amount. The client was named a PRP as a result of having shipped significant volumes of food-grade isopropyl alcohol (IPA) to the facility for disposal in the 1990s, even though IPA is not a chemical of concern in the Superfund and Superfund investigation and remediation did not address IPA. The report presented technical arguments for the client's removal from the RP group and results from Dr. Dagdigian's work are pending.
- Dr. Dagdigian was contracted by the United States Department of Justice (DOJ) to testify as the lead expert for a civil enforcement action against a United States Department of Energy (DOE) contractor pertaining to groundwater contamination. The subject facility, a now privatized nuclear enrichment facility formerly operated by the DOE. Dr. Dagdigian was tasked with identifying the specific sources of contamination and routes of migration that resulted in multiple

plumes of groundwater contamination that extend for several miles, eventually impacting the down-gradient surface waters of the Ohio River. Dr. Dagdigian prepared a chemical fate and transport model that demonstrated the release of chemicals from specific chemical process, the migration route of that release through a network of subsurface utilities and structures, and the continued subsurface migration, both free-phase and dissolved-phase, through the hydrogeologic environment. Dr. Dagdigian evaluated reports of chemical and geological data pertinent to the presence or absence of specific chemicals within the facility infrastructure, surface waters, soil, soil vapor, and groundwater; and other facility records (including unit operation and maintenance records), facility maps and plans (including a 50-year series of subsurface utility engineering as-builts), aerial photographs, and any other available records or data pertaining to the location and function of facilities that may have utilized or been a pathway for the migration of contaminants. .

- Dr. Dagdigian was retained by counsel to conduct a Potentially Responsible Party (PRP) search in a heavily industrialized area of Los Angeles. The first step was to conduct research to understand which industries and industrial activities presently or historically emitted the chemicals of concern (COCs). Using scientific articles, industry publications, regulatory publications, and other guidance documents 16 industrial operations were identified as potential emitters. The second step in the process involved a review of geocoded Sanborn maps from various decades viewed in a GIS viewing program (Arcviewer and Google Earth) to identify businesses as PRP. The effort resulted in the identification of 551 industrial facilities and/or operations within the approximately 2 mile radius evaluated.

- Provided litigation support to the Department of Justice (DOJ) in their case against a chemical manufacturing facility in Utah. A site visit was conducted to evaluate chemical manufacturing and solvent recycling equipment and to obtain process documents for review. It was determined and documented that the facility was not storing chemical manufacturing intermediates or recycling solvents in compliance with regulatory limitations but instead speculatively accumulating and over 3,000 drums of hazardous waste stored at the facility and in essence operating as an unpermitted RCRA hazardous waste storage facility. Using the expert report prepared by Dr. Dagdigian, the DOJ obtained a court order that required operations to cease, $100,000 in penalties for violations, and is entitled to collect up to $900,000 for the Superfund removal action conducted by the EPA.

- Dr. Dagdigian was retained by counsel for an electronics manufacturer in Santa Ana, CA who had been named as a defendant in the Orange County Water District vs. Radioshack Corporation and Universal Circuits, Inc. et al.; Case No. 30-2008-00078246-CU-TT-CXC; Superior Court of the State of California, Regarding Halogenated Hydrocarbon Groundwater Contamination in Orange County. Plaintiffs claimed that the client had contributed to groundwater contamination by one or more of the following volatile organic compounds: TCE, PCE, 1,1- DCE, 1,1,1-TCA, and 1,1-DCA. Dr. Dagdigian prepared a comprehensive study of the chemical use and history of the client and all prior tenants on the property, prepared an expert report, and provided deposition testimony indicating that the client did not contribute to the groundwater contamination. Subsequently, claims against the client were dropped by the plaintiff.

- Representing a steel manufacturer as defendant, Dr. Dagdigian was deposed regarding the storm water pollution prevention plan that was developed pursuant to federal regulations under his supervision. Stormwater from the client's plant had migrated to a neighboring chemical manufacturer's property. Dr. Dagdigian testified regarding the methodology of the storm water

plan he developed for the client and he provided detailed testimony regarding whether lead could be present in the client's stormwater, the migration properties of lead in general and whether it was possible for lead to migrate onto the plaintiff's property via stormwater. Dr. Dagdigian also provided expert testimony regarding the type of cleanup that would be required if remediation was necessary.

- Dr. Dagdigian was retained by counsel to represent a tire-to-energy generation plant where a lightening fire had caused melting of several million automobile and heavy equipment tires. Fire fighting was performed for months and fire fighting fluids mixed with the melted tires caused contamination of several storm water ponds at the site. Chemicals of concern included polynuclear aromatic hydrocarbons, petroleum hydrocarbons, metals, and solvents. The project involved the review of the environmental damage the fire had caused and the identification of the major source of potential contamination to groundwater. This project was overseen by the Department of Toxic Substances Control (lead agency), State of California Attorney General, the Regional Water Quality Control Board, and the Integrated Waste Management Board. Dr. Dagdigian directed and strategized the procedures for a Characterization Plan and Removal Action Workplan that was compliant with the National Contingency Plan and worked with counsel to interface with all oversight agencies to remove 7,000 tons of sludge material from the largest collection pond. A large number of confirmation sample analysis results were coordinated to ensure compliance with very low cleanup levels. Dr. Dagdigian directed all aspects of the project including characterization sampling, the removal action, confirmation sampling, data interpretation, compliance, and validation and preparation of the final report which was approved by the oversight agencies. Based on the work performed, no charges were brought against the client who later settled with the state for an undisclosed sum.

- Representing the plaintiff regarding litigation over a remediation technology, Dr. Dagdigian testified about the remediation method used to remove a variety of chemicals from impacted soil. Dr. Dagdigian's testimony provided detailed information regarding the use of low temperature thermal desorption including a discussion of the types of chemicals it can remove, how each chemical reacts with the low temperature, and the byproducts of the chemical reaction created by the low temperature method. Dr. Dagdigian's testimony included a discussion of the pilot tests run and an explanation of chemical boiling points and how boiling points are used to determine the efficiency of the low temperature remediation method with the types of chemicals that existed onsite.

- For a major aerospace client as defendant, Dr. Dagdigian was deposed regarding the client's management of Material Safety Data Sheet (MSDS) information system. Dr. Dagdigian provided an explanation of the MSDS system that was developed for the client under his supervision including an explanation regarding the type of chemical and technical information contained in the MSDS system. Dr. Dagdigian provided specific information regarding Proposition 65-listed chemicals and chemicals listed under AB2588 (Toxic Hot Spots). Dr. Dagdigian's testimony was used to provide a strong defense for the client which included a detailed explanation of how all mixtures of chemicals could be traced to individual chemical compounds in the client's MSDS system, how to use the MSDS system to trace all Proposition 65 chemicals automatically, and how the client uses the MSDS system to monitor manufacturing activities where Proposition 65 chemicals are used.

- Dr. Dagdigian testified in a bench trial on behalf of Defendant Kemira Water Solutions, Inc. ("KWS") (ECF Case: 11-cv-1686 (KBF) (KNF)) in US Federal Court. Dr. Dagdigian was retained by counsel for KWS to provide opinions regarding the response and clean-up actions taken by Plaintiff APL CO. PTE. LD. ("APL") with respect to two shipments of ferrous chloride crystals which leaked while on board trans-Pacific container ships and caused the need for a lengthy and costly cleanup at two sites in the Port of Los Angeles. Dr. Dagdigian was also asked to advise on regulatory issues pertaining to various environmental statutes and regulations, including the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") and the application of the National Contingency Plan ("NCP") for cost recovery under CERCLA.

- Dr. Dagdigian was retained by counsel for the property owner of a strip mall in Las Vegas, Nevada that had a dry cleaning tenant that caused PCE soil and groundwater contamination. Dr. Dagdigian designed the investigation, feasibility study and remedial action plan for the dry cleaner. The investigation was accelerated because the dry cleaner was situated immediately adjacent to a residential area. Investigation results showed a PCE plume in soil and groundwater extending from the strip mall to the residential area. A feasibility study was conducted and using the results of a cost benefit analysis, the Nevada Department of Environmental Protection (NDEP) approved a remedial action plan which was limited to onsite removal of impacted soil and groundwater.

- Dr. Dagdigian was retained by counsel for a bulk fuel shipping/distribution terminal in northern California. He served as expert witness for the defendant against claims by neighboring residents that concentrations of benzene were present in the indoor air of their homes as a result of vapor intrusion from impacted groundwater. Dr. Dagdigian designed and directed the evaluation of a commingled groundwater plume of petroleum hydrocarbons from the defendant's facility and chlorinated solvents (PCE and TCE) originating from a neighboring facility. Although PCE and TCE were present in the groundwater beneath the residential neighborhood, additional groundwater sampling was performed which showed that benzene was not. A study of historical records revealed an additional possible source in the form of a fuel UST in the former railroad right-of-way that other parties in the litigation had not discovered. The presence of the UST was confirmed by excavation. Dr. Dagdigian prepared an expert report and provided deposition testimony on behalf of the defendant which resulted in a favorable settlement.

- Dr. Dagdigian was retained as an expert witness by counsel for a retail shopping center in Cerritos, CA that was underlain by a large PCE/TCE groundwater plume that included elevated groundwater concentrations suggesting the presence of DNAPL. The property formerly housed an automobile repair facility and in recent years a tenant dry cleaning facility. Dr. Dagdigian evaluated all historical areas of concern to identify potential source areas that included video inspections of the public sewer system adjacent to the property. Dr. Dagdigian also developed a sampling plan to collect multi-depth groundwater samples in the immediate area of the sewer. This information together with the existing groundwater data was input into a GIS model and 3D animation was used to conclude the release point of PCE/TCE was from the public sewer. Dr. Dagdigian performed a forensic analysis of all potential sources onsite and offsite, evaluated chemical fate and transport and testified in court on behalf of the plaintiff to show that the solvents originated from the sewer within the public right-of-way that had migrated from offsite onto the property. Dr. Dagdigian prepared a summary of past and estimated future response

costs for assessment and remediation of the groundwater plume. Dr. Dagdigian's testimony resulted in a favorable settlement for the client.

- Dr. Dagdigian was retained by counsel for a former aerospace manufacturing facility in Redondo Beach to evaluate environmental liabilities associated with an existing groundwater plume. The site contained 4 groundwater plumes that were commingled and contaminated with TCE, PCE, TCA, DCE, and hexavalent chromium. The purpose of Dr. Dagdigian's evaluation was to facilitate the sale of the property and estimate the cost for future assessment/remediation for insurance purposes. The property was redeveloped in the 1990s as a retail shopping center, the responsible party was no longer financially viable and no environmental work had been performed for approximately five years. Dr. Dagdigian performed a study to identify historical source areas and areas of known contamination which was used to evaluate the effectiveness of previous remediation efforts including soil vapor extraction and groundwater pump and treat. Sampling of the existing groundwater well network was performed to assess the current conditions. A report was prepared which recommended a proposed scope of work, estimated schedule and costs to achieve site closure from the RWQCB. Work continued on behalf of the buyer, which included performing offsite groundwater sampling to further evaluate the extent of the groundwater plumes. A neighboring dry cleaning facility was identified as a likely contributing source of PCE to groundwater in a portion of the site forming a commingled plume together with petroleum hydrocarbons from a neighboring gasoline service station. Data indicate that closure can be achieved by monitored natural attenuation.
- Dr. Dagdigian was retained as an expert by a defendant oil production company to evaluate alleged chemical exposure to a resident leasing a house within an oil field. The plaintiff claimed health effects due to oil company operations. Dr. Dagdigian was retained to determine whether air contaminants alleged to be present and the source of health effects were i) from household or other products present at the residence; ii) present in concentrations which could result in acute or chronic health affects; iii) present in air from oil field extraction, storage and refining activities. Waterstone reviewed opposing expert depositions and provided counsel information related to errors in plaintiff's method of sample collection and data analysis that resulted in inaccurate conclusions. Waterstone collected air samples, performed a bench scale study, and showed that air contaminants inside the residential structure did not match air contaminants in the area of the oil field extraction activities, storage tanks, or refining activities. Dr. Dagdigian's conclusions indicated that there were no chemical concentrations inside the residence that were related to oil production activities.

Forensic Chemical Analysis

As a Ph.D. chemist, Dr. Dagdigian has been retained frequently to perform forensic chemical analysis. Dr. Dagdigian uses environmental forensics to develop a clearer understanding of the source(s) of the chemical contaminants, the time since chemical release, and how chemicals have moved through the environment. Dr. Dagdigian uses his understanding of chemistry and physics and how chemicals interact in the environment. Additionally, Dr. Dagdigian has used forensic analysis to support responsible party allocations in situations involving commingled plumes, track the fate and transport of the chemicals in the environment, and determine the extent to which remediation has successfully removed chemical mass from the environment.

- Dr. Dagdigian was the lead expert witness in a case involving petroleum hydrocarbon contamination of commercial/industrial park from an inter-refinery pipeline used by one oil refinery versus contamination from a second oil refinery located adjacent to the commercial/industrial park. Dr. Dagdigian performed an exhaustive forensic analysis using soil, soil vapor, groundwater and free product data to demonstrate the source of soil and groundwater contamination on the property. In addition to the traditional environmental analyses typically performed on these media, a more focused forensic analysis was performed. For the contaminated soil and free product media, this additional forensic analysis included full PIANO fingerprinting, stable isotope analysis, GC/FID analysis, full fuel oxygenate analysis, and lead alkyl analysis. For the vapor phase media, forensic chemical analysis included vapor flux rate studies and full GC/MS characterization of the vapors. The types and concentrations of the fuel oxygenates and lead alkyls allowed Dr. Dagdigian to demonstrate that the contamination was caused by a release of leaded gasoline and aviation fuel which had been produced between 1960 to 1980. In addition, several marker chemicals were identified in the groundwater, which confirmed the source as the inter-refinery pipeline and not the adjacent oil refinery.
- Dr. Dagdigian was retained as the environmental expert in a case involving a commingled gasoline plume from two nearby gasoline stations. The case involved determining whether the gasoline plumes were in fact commingled and, if they were commingled, allocation of remediation costs to each responsible party. Dr. Dagdigian performed a forensic analysis on the free product to determine whether the free product found on the subject gasoline station came from the nearby gasoline station. This forensic evaluation included full PIANO fingerprinting, stable isotope analysis, GC/FID analysis, full fuel oxygenate analysis, and lead alkyl analysis. Evaluation of the rate of evaporation of the volatile components and water washing and biodegradation of selected components were incorporated into the forensic analysis to demonstrate that the plume from the nearby gasoline station had indeed impacted the subject gasoline station. The analysis also showed that approximately 80% of the groundwater contamination on the subject gasoline was the result of a release from the neighboring gasoline station.
- Dr. Dagdigian has successfully used his extensive knowledge of chemistry to negotiate innovative and cost-effective remediation measures with the Regional Water Quality Control Board regarding Freon and acetone impact in groundwater at a former paint manufacturing company. By developing a conceptual model describing how different chemicals are retained by soils, chemical vapor pressures, and the chemical behavior of acetone and Freon in vapor, soil, and groundwater, Dr. Dagdigian negotiated a single episode of groundwater extraction in place of a lengthy pump and treat or air sparging system for the client.

Chemical Fate and Transport

- Dr. Dagdigian proposed a conceptual model for the movement of various metals through soil including Chromium VI, nickel, lead, zinc, and copper to support closure of a facility leased by a major chemical manufacturer. He explained the nature of the molecular size and properties of the metals and how they migrate in soil and groundwater. The presentation of this conceptual model to the California EPA Department of Toxic Substances Control proved that deep groundwater was not affected by metals and the site received closure under the Department's Voluntary Cleanup Program.

- Dr. Dagdigian used his conceptual modeling experience and understanding of chemical behavior in the subsurface to provide evidence that polynuclear aromatic hydrocarbons (PAHs) had not been fully addressed by a prior gas utility site owner. Dr. Dagdigian presented a conceptual model illustrating the migration of PAHs in soil and groundwater and provided a prediction of where the PAHs migrated by providing an explanation of PAH migration rates, solubility, volatility and methods of PAH movement in the environment. The results of Dr. Dagdigian's presentation caused the prior owner to expand its characterization of the site, increase the remedation efforts, and perform a more complete cleanup. The original remediation estimate, which included the removal of 7,000 tons of soil, was revised to the removal of 17,000 tons of soil based on the conceptual model.

Site Assessment and Remediation

- Dr. Dagdigian was retained to complete soil and groundwater investigations associated with a former plating facility in Carson, California. The soil and groundwater at the facility were impacted with tetrachloroethene (PCE) from operation of a former metals degreasing unit (solvent degreaser). Groundwater beneath the site was impacted by PCE and hexavalent chromium (Cr+6) from an unknown release associated with shop operations. Dr. Dagdigian supervised soil remediation via excavation to remove impacted soil beneath the former solvent degreaser area. Groundwater investigations included vertical characterization of PCE and other contaminants within the first aquifer utilizing a cone penetration testing rig and multi-depth Hydropunch sampling. Additionally, discrete sampling was conducted throughout a 50-foot thick shallow water bearing zone and collection of the groundwater from a deeper regional aquifer (Gardena Aquifer). Subsequent groundwater investigations included offsite installation of triple nested groundwater monitoring wells to monitor water quality in the top, middle and bottom portions of the impacted shallow water bearing zone. An interim remedial action plan was submitted to the LARWQCB, which contained a containment/barrier approach to limit further migration of the PCE plume utilizing in-well air-stripping wells and in situ chemical oxidation to reduce the chemical mass in the highest concentrations portion of the plume. Site pilot testing of remedial technologies and additional plume characterization will be conducted prior to implementation of a full scale multi-approach remedial system(s) on and offsite in the near future.

- Dr. Dagdigian was retained to perform a groundwater investigation of a former nuclear testing site in Goleta, California under the oversight of the Central Coast Regional Water Quality Control Board. TCE-contaminated groundwater was discovered in shallow groundwater beneath the property. Dr. Dagdigian performed historical research using several sources and implemented an intensive groundwater sampling program. The results indicated that a neighboring property owner was wholly responsible for the TCE plume.
- Dr. Dagdigian was retained to perform a groundwater investigation in the City of Commerce under the oversight of the Department of Toxic Substances Control (DTSC). PCE and TCE contaminated soil and groundwater was discovered beneath a former vapor degreaser area (VDA) on the property which was a former pipe and tube manufacturing facility. Following the removal of the VDA and subsequent remediation by excavation of the shallow soil, a "No Further Action" letter was issued regarding the soil issues. Dr. Dagdigian was able to successfully establish, through historical research, evaluation of previously collected subsurface data, and an intensive soil and groundwater sampling program, both the extent of impacted groundwater and the geometry of the underlying perched aquifer and aquiclude. This lead to a series of meetings with

DTSC project managers, as well as geologists from the Geological Services Unit (GSU), to establish both a revised conceptual site model of the complex subsurface geology and a final approach towards site closure which included monitored natural attenuation (MNA) coupled with groundwater monitoring activities utilizing low-flow purging and sampling techniques.

- Dr. Dagdigian directed a site investigation which included the collection and analysis of the following soil vapor, soil, and groundwater samples:
  - Collection and analysis of 127 soil vapor samples
  - Collection and analysis of 126 soil samples from 79 locations
  - Collection and analysis of 189 water samples from 113 locations; of these, 94 samples were collected from deeper saturated zones beneath the Property
  - Interpretation of subsurface geology and identification of six discrete groundwater flow zones within 60 feet of surface from the installation and description of 30 deep borings, seven of which were continuously cored.

  Dr. Dagdigian's Phase II investigation led to the identification of two areas of concern on the site. One area consisted of soil and groundwater contamination was clearly the result of onsite sources. This area was remediated by excavation. The second area was the result of offsite sources. Waterstone prepared a document clearly showing the path of migration from offsite sources and supported all hypotheses with information from several flow zones from beneath the property. Following remediation of the onsite area, the RWQCB closed the site without further remediation, prepared letters ordering additional work from offsite sources, and permitted our client to abandon all groundwater monitoring wells on the site.

  As a result of the investigation, remediation, and negotiation of closure directed by Dr. Dagdigian, our client was able to sell the property at full market price less than 1.5 years following the initiation of the original investigation. Waterstone has performed litigation support services that allowed the client to recoup 50% of the costs of performing the Phase II investigation and remediation from the responsible parties of the offsite source of contamination.
- Dr. Dagdigian was retained to evaluate environmental issues associated with a large paint manufacturing facility included a spray paint canning operation. Freon, chloroform, and carbon tetrachloride were contaminants of concern in vapor. Dr. Dagdigian studied the movement and pattern of contaminant transport and provided evidence that these compounds in soil vapor would naturally attenuate. The oversight agency agreed and no further action was required for Freon.

Wastewater Treatment Systems

- Designed a wastewater treatment facility for treating metal plating wastes at a major southern California aerospace facility.
- Managed the design and start-up of five wastewater treatment facilities for a large U.S. battery manufacturer to remove lead, copper, and zinc metals.
- Managed the design and start-up of three wastewater treatment facilities for plating operations of several aerospace fastener manufacturers. These wastewater treatment facilities included heavy metal removal, chrome reduction, cyanide oxidation chemistry, and process engineering.

- Managed the environmental audit, facility design, and facility start-up of two wastewater treatment facilities for an electrical connector manufacturer. These wastewater treatment facilities included heavy metal removal, chrome reduction, cyanide oxidation chemistry and process engineering.
- Modified cyanide treatment systems for several electroplaters from single-phase chlorine systems to dual-phase hypochlorite treatment systems.

Property Transaction Environmental Assessments

- Principal-in-Charge of the Phase I environmental assessment and site characterization of a chemical facility in southern California undergoing closure. Previous site uses included the production of clay adsorbent for petroleum refining, the manufacture of acid-leached clays used for purifying cooking oils, fuels, and other similar materials, and the production of fluid cracking catalyst and zeolites. Elements of the project include identification of historical chemical use/storage areas; site inspection; soil and groundwater investigation to determine any chemical impact to the site; and evaluation of remedial options.
- Principal-in-Charge of a fast-track environmental assessment program conducted under attorney-client privilege. Oversaw a team of assessors who reviewed over 90 Phase I assessments, conducted 48 neighboring property assessments and nine Phase I assessments, and assessed potential remediation costs within a six-week period. Tabular summaries of results were successfully used by the client in negotiations with the property seller.
- Provided oversight for the review of a Phase I environmental assessment of three ski areas for a potential buyer. Provided comments and recommendations, developed potential cleanup costs, and evaluated landslide and mining waste reports.
- Principal-in-Charge of a due diligence investigation of 215 Alpha Beta grocery store facilities. The project involved site inspections, underground tank research, groundwater data research, ranking the potential impact from neighboring "listed" sites, and soil sampling at facilities with potential hazardous materials impact. Created a database for managing the information collected during the investigation. The database produced issue-specific (i.e., underground storage tanks, historical property usage, etc.) and site-specific reports. The client received bi-weekly status reports, and a final report, which was issued eight weeks following commencement of the project.
- Principal-in-Charge of multi-site environmental assessment of industrial, retail, and undeveloped properties located in California, Arizona, Colorado, and Oregon on behalf of a national real estate corporation. The 72 properties, ranging in size from two to 300-acres, and buildings on the properties, up to 400,000 square feet in size, were assessed in a five-week period for evidence of potential on-site soil and groundwater contamination and asbestos-containing materials (ACM). The assessments combined review of regulatory agency files, field inspections, and site specific soil sampling programs, and proposed to evaluate the presence of contamination at 25 of the properties.
- Developed the methodology for performing assessments of 419 retail, commercial, industrial, research & development, office, and residential properties in the midwest and western United States for a major California developer. Orchestrated the activities of a 3-office team to complete property file reviews, agency research, and site inspections for 275 of the properties. Final

deliverable included a 15-volume, 3-inch binder set of reports, and three volumes of summaries and matrices.

- Project Director for a property transaction environmental assessment of 15 properties for Young's Market, a food and liquor distributor. Provided both Phase I and Phase II services.
- Project Director for the environmental assessment of 25 light industrial and warehouse facilities in a business park that is located within a National Priorities List (NPL) Superfund area. The purpose of the investigation was to evaluate the impact of the regional groundwater contamination on the subject site, and to assess the likelihood that activities currently or formerly conducted at the subject facilities and/or neighboring facilities impacted soil or groundwater underlying the subject property.
- Project Manager for a property transaction environmental assessment for Trammell Crow, a major national development company. Provided Phase I, Phase II, and asbestos sampling services for 66 properties located in the Western United States. The project was completed within six weeks, in conjunction of Jones, Day, Reavis & Pogue, a national law firm.
- Project Manager for a property transaction environmental assessment of a 900-acre oil and gas field located in southern California. The site originated in the 1920's, and included a natural gas plant, a wastewater treatment facility, a facility support yard, 300 oil wells, 95 tank farms, 51 sumps/pits, 17 catch basins, and 57 potential disposal sites. The project entailed the visual inspection and documentation of the condition of each well, tank farm, and sump; verification of the presence of each potential disposal site; inspection of the gas plant, support yard and wastewater treatment facilities; a historical records search; review of aerial photographs and company files; plotting of site observations on area maps; and preparation of final report.

Environmental Compliance Audits

- Principal-in-Charge of an environmental health and safety compliance audit of a major airline jet engine refurbishing facility in southern California. Facility operations included metal plating and machining, parts cleaning, abrasive blasting, welding, engine testing, and painting and dye penetration testing. The facility was evaluated through inspection, review of files, and personnel interviews. A single report was prepared that documented the facility's environmental compliance status with federal, state, and local regulations regarding hazardous waste and hazardous substance management, water quality and air emissions control, underground storage tank management, and health and safety compliance.
- Principal-in-Charge of a property acquisition environmental compliance audit of five corrugated manufacturing facilities in southern California. Project involved the evaluation of potential chemical impact to the property from operations conducted at each facility, and the environmental compliance status of each facility. Documented findings and provided recommendations and associated costs for each facility to achieve compliance.
- Project Manager for an environmental audit for a major cement manufacturer. The facility audited contained cement quarry, cement kiln, and cement packaging operations. Performed audit of environmental record keeping to ensure completion of proper reports, and designed a system for continued compliance.

Waste Minimization

- Principal-in-Charge of Hazardous Waste Source Reduction and Management Review Act of 1989 (SB14) compliance project for a major oil corporation's lube plant and terminal facility in southern California. Evaluated the hazardous waste generating processes at the lube plant and terminal, and prepared a Hazardous Waste Management Performance Report and Report Summary, and Source Reduction Evaluation Review, Plan, and Plan Summary within a six-week period. Tasks included performing facility inspections and document review to estimate the total quantity of hazardous waste generated for the reporting year; identifying, evaluating, and selecting source reduction measures for each routinely generated hazardous waste stream; addressing the effectiveness of each selected measure in reducing hazardous waste and releases to all media; and preparing a timetable for implementing selected measures.
- Principal-in-Charge of SB14 project for an aluminum can manufacturing and aluminum extrusion facility. Project required the completion of a source reduction evaluation plan, waste management report, and related summaries. Oversaw data collection and review; identification and documentation of waste generating operations and past source reduction measures; and identification, evaluation, selection, and documentation of source reduction measures.
- Conducted a waste minimization audit of an aerospace plating facility, which reduced dragout by 40 percent and water usage by 50 percent with no impact on product quality or major capital expense.
- Conducted a source reduction program at a southern California aerospace metal finishing facility to meet pre-treatment requirements.
- Performed water and chemical mass balance studies for numerous plating shops to investigate wastewater treatment problems and waste minimization opportunities.

Air Resources Management

- Project Manager on several AB 2588 Toxics "Hot Spots" Emission inventory plans and reports throughout southern California.
- Project Manager for an Emission Inventory Plan for a circuit board manufacturer. Prepared Emission Inventory Plan; inventoried all chemicals emitted from the plant, which came under jurisdiction of AB 2588; developed methods to calculate emissions of those chemicals; designed and completed flow diagrams to describe how the chemicals were used and emitted.
- Managed the "Hot Spots" (AB 2588) evaluation of regulated chemicals for large semi-conductor electronics manufacturing firm within a 5 week time frame. Facility evaluation involved emissions from five buildings.
- Project Manager for review of an Emission Inventory Plan provided by another consultant for a major aerospace client. Reviewed the plan and prepared a critique for review by the client.
- Project Manager for an Emission Inventory Plan for a major aerospace manufacturing facility. Prepared an Emission Inventory Plan; inventoried all chemicals emitted from the plant, which came under jurisdiction of AB 2588; developed methods to calculate emissions of those chemicals; designed and completed flow diagrams to describe how the chemicals were used and emitted.

Accelerated Site Investigation and Closure

- Principal-In-Charge for a comprehensive Phase II investigation associated with potential environmental issues created by the historical use of approximately 20 properties as retail paint stores. The goal of the environmental work performed on these sites was to evaluate all potential environmental issues to prepare each parcel for sale as part of liquidation proceedings for a large portfolio. An additional stipulation was to minimize the future liability of the client by performing comprehensive, exhaustive investigation of all potential environmental issues for each property.

  Investigations were performed by collecting samples of soil vapor, soil, and groundwater using hand auger, hollow stem auger, geoprobe, dual wall casing, and cone penetrometer methods. Dr. Dagdigian negotiated closure with several different agencies including the California Regional Water Quality Control Board, the California Department of Toxic Substances Control, the County of San Diego Hazardous Materials Management Division, the Alameda County Department of Environmental Health, and various local oversight agencies such as city Fire Departments.

- As Principal-In-Charge, supervised Phase II sampling on a 33 acre oil field parcel where gas plant operations, oil production, and crude oil storage have been performed since 1902. Used Phase II data to prepare remediation cost calculations for the purposes of transferring the property to a new owner.

- As Principal-In-Charge for a southern California oil production company, oversaw the Phase II investigation, risk assessment activities, and preparation and implementation of a remedial action plan to remove 1100 cubic yards of soil from a site where oil production activities had been performed since the 1920's. First sampling through final closure report was performed in less than 3 months to meet a client-mandated deadline for marketing the property.

- For a Southern California home builder, participated in the design and implementation of an accelerated remediation of a former oilfield property where the discovery of sump materials stopped construction of homes in three different areas. Disposal of thousands of cubic yards of soil to the former oil operator's bioremediation cell was required within a one week timeframe to allow the building schedule to resume as planned. After all visible contamination was removed and confirmation samples were collected, the resultant data was used in a risk assessment for the site. Dr. Dagdigian then negotiated the accelerated issuance of a site closure letter with the Los Angeles Region of the Regional Water Quality Control Board.

- Principal-In-Charge for the Phase I Environmental Assessment of a warehouse property formerly owned by a large oil company. Air photo review revealed that a large ponded area had existed on the property for many years during the time it was owned by the oil company. Subsequent sampling of this potential environmental issue indicated that diesel range hydrocarbons existed in this area. Dr. Dagdigian oversaw the lateral and vertical extent sampling and oversaw a risk assessment, which indicated that the area posed no threat to human health and the environment or groundwater. Dr. Dagdigian's personnel determined that the Voluntary Cleanup Program administered by the California Department of Toxic Substances Control was the appropriate route to the timeliest environmental closure of the site.

- Due to a very strict escrow deadline on this property, Waterstone personnel involved local city officials to assist in negotiations with the Department of Toxic Substances Control to speed closure. Waterstone personnel were successful in negotiating a full site closure from the

Department of Toxic Substances Control in 12 business days, allowing the sale to be consummated. According to Department of Toxic Substances Control personnel, this was the most accelerated timeline for closure under its Voluntary Cleanup Program to date at that time.

The client retained Dr. Dagdigian to provide environmental assessment, remedial investigation, remediation, and supervision of risk assessment activities to negotiate environmental closure of the site so that the property could be returned to the owner without future liability to the client. An accelerated investigation/remediation was performed to allow the client to return the property to its owners in 10 months, far ahead of the 1.5 to 2 years customarily required by agency guidelines. After submittal of this site closure report to the Department of Toxic Substances Control under its Voluntary Cleanup Program, a 'No Further Action' decision was received for metals-impacted soil at the facility.

- As Principal-In-Charge, Dr. Dagdigian conducted a remedial investigation of soil and groundwater and remediation cost estimate for a bankrupt paint manufacturing facility. In the 1950s and 1960s this facility was the largest paint producer in the western United States. A large tank farm of raw materials was located on the facility and consisted of over 50 aboveground tanks, and approximately 12 former underground storage tank locations along with hundreds of linear feet of associated product lines leading into manufacturing areas. Manufacturing areas included solvent-based paint production, water-based paint production, aerosol paint packaging, and the manufacture of lacquers and thinners.
- Dr. Dagdigian supervised the collection and analysis of approximately 100 soil vapor samples, and 50 soil samples from over 120 sampling locations on the property. Areas of chemical impact identified through this investigation were further investigated to provide lateral and vertical extent characterization. Dr. Dagdigian is in the process of completing a Preliminary Endangerment Assessment (which includes risk assessment) for the property prior to submittal of this case into the Voluntary Cleanup Program with the California Department of Toxic Substances Control.

Computer Programming and Modeling

- Designed and wrote a chemical mass balance model to demonstrate that oil field wastewater had contaminated three aquifers used for drinking and agricultural irrigation water. The model was presented in deposition and jury trial testimony and the client was awarded damages based on Dr. Dagdigian's testimony.
- Designed and wrote a computer program to model wastewater treatment facility operations. The program took wastewater stream input data and performed mass balance type calculations; performed engineering design basis calculations; determined future chemical use rates; and determined capital and O&M costs.
- Designed and co-wrote a database software system to manage MSDS's, associated chemical manufacturers and contacts, associated CAS chemical components, and physical properties of chemicals and MSDS's. The software system also performed air emission calculations and was able to receive input into a laws database and determine which MSDS's were affected by various environmental legislation. The program tracked the locations of all chemicals used, as well as the source points at which air emissions left the facility. The program utilized chemical emission locations and chemical physical properties to calculate air emissions using various models that are pre-programmed into the system. Users are able to easily create reports that manipulate all of the above information.

Professional Affiliations

American Electroplaters and Surface Finishers Society
American Chemical Society

Specialized Training and Certifications

Certified Electroplater/Finisher

Publications

A. M. Holbrow, A. Keller, J. V. Dagdigian, C. Amantea, "Identifying Potential Liabilities Associated with Business Transactions," Journal of Environmental Law. May/June 1994.

M. McCullough, J. Dagdigian, A. Holbrow, R. Seguy, and R. Currie, "Implementing a Regulatory Compliance Program for Air Toxics, " in Proceedings of A&WMA Specialty Conference on New Hazardous Air Pollutant Laws and Regulations: Their Impact on Industry. Government and the Public, Air & Waste Management Association, 1992.

M. L. McCullough, J. V. Dagdigian, R. A. Seguy, and C. V. Vukmanic, "An Essay on Waste Source Reduction through Conservation of Process Power and Water," in Proceedings of Minimization and Recycling of Industrial and Hazardous Waste '92, Hazardous Materials Control Research Institute, 1992.

M. L. McCullough, J.V. Dagdigian, and M.L. Walker, "Responding to Findings of Violation and Orders Pursuant to the Clean Water Act," in Proceedings of the 1992 Industrial Environmental Association Annual Conference," Industrial Environmental Association, 1992.

M.L. McCullough, J.V. Dagdigian, and A.M. Holbrow, "Developing Air Compliance Programs," in Proceedings of the 1992 Industrial Environmental Association Annual Conference," Industrial Environmental Association, 1992.

M. L. McCullough, J. V. Dagdigian, and C. N. Parris, "Evaluating Soil Washing for Removing Petroleum Hydrocarbon and Metals Contamination," in Proceedings of Superfund '92, Hazardous Materials Control Research Institute, 1992.

M. L. McCullough and J. V. Dagdigian, "Evaluating Regulatory Issues and Emission Control Equipment for Air Toxics Applications, "Remediation, Vol. 2, No. 4: 15-38.

M. L. McCullough, and J. V. Dagdigian, "Evaluation of Remedial Options for Treatment of Heavy Metal and Petroleum Hydrocarbon Contaminated Soil, "Remediation, Vol. 3, No. 2: 1-30.

M. L. McCullough, J. V. Dagdigian, and M. L. Walker, "Responding to a Finding of Violation of Order Under the Clean Water Act," Environmental Regulation, Vol. 3, No. 3: 1-12.

M. L. McCullough, J. V. Dagdigian, A. M. Holbrow, "Developing Air Compliance Plans," presented at the Eighth Annual EA Environmental Compliance Conference, San Diego, CA, August 1992.

Professional Instruction

Between 1992 and 2017, Dr. Dagdigian taught classes for the University of California, Irvine, Extension Program for Environmental Management including:

- *Introduction to Site Characterization and Environmental Auditing*
- *Introductory Chemistry of Hazardous Materials*
- *Environmental Management.*