

Michael L. Raub, R.G., C.E.G.

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Education M.Phil., Geology, University of Auckland, New Zealand, 1985
B.A., Geology, University of California, Santa Barbara, 1979

Registration Registered Geologist, California, 1987, #4415
Certified Engineering Geologist, California, 1987, #1376

Experience

- 2001 on **Independent Consultant** **Irvine, California**
Independent consultant to environmental and geotechnical engineering companies in Southern California. Work includes field and office technical support and management of projects up to \$2 million and construction management of environmental remediation projects to \$13 million. In addition to geotechnical and environmental services, Mr. Raub has coordinated California Environmental Quality Act related studies and permitting.
- 1996 to 2001 **Golder Associates** **Irvine, California**
Group Leader and Senior Project Manager
Group Leader/Senior Project Manager specializing in engineering geology, environmental engineering, and geotechnical engineering. Mr. Raub has conducted and supervised site characterization, engineering design and construction quality assurance (CQA) programs for landfill liners, final covers, groundwater monitoring systems, landfill siting, and subsurface groundwater/leachate barriers.
- 1988 - 1996 **EARTH TECH, Inc.** **Irvine, California**
Project Geologist/Senior Geologist/Associate
Work included providing geological characterization, construction quality assurance (CQA), design, and engineering for landfills, liner and cover systems, subsurface barriers, and groundwater monitoring systems.
- 1985 - 1988 **Converse Consultants** **Irvine, California**
Project Geologist
Performed geotechnical explorations, engineering design and project management for foundation, hillside grading, reservoir and critical structure siting studies. Conducted field activities including logging of borings, trenches, geophysical studies, geologic mapping and surveying. Performed engineering calculations for seismic risk, settlement, pavement design, and slope stability.
- 1980 - 1982 **EARTH TECH, Inc. (formerly Fugro/Ertec) Laguna Hills, California**
Staff Geologist
Performed geological investigations for earthwork construction, dams, active fault, harbor extension and tunneling projects. First year performed construction testing and observation.
- 1976 - 1978 **Jack G. Raub Company**
Civil Designer and Land Surveyor
Drafted preliminary profile and plot plans for residential housing tracts and provided ground control surveying for aerial mapping project (Summer Intern).

Professional Experience

Mr. Michael Raub is a State of California Certified Engineering Geologist with over 30 years experience specializing in engineering geology, civil engineering, and geotechnical engineering. Mr. Raub has conducted and supervised site characterization, engineering design and construction quality assurance (CQA) programs for landfill liners, final covers, groundwater monitoring systems, landfill siting, and subsurface groundwater/leachate barriers and associated civil improvements at solid waste facilities. Mr. Raub has not only a diverse technical background, but also provides strong project management skills and an integrated technical approach to the project.

Mr. Raub has provided consulting services at over 50 landfills in California. He has provided site characterization studies at most landfill sites. These projects ranged from waste and contamination characterization at a former 4-acre burn dump to large geotechnical and geohydrological characterizations for a 300-acre expansion at Puente Hills Landfill. He has performed field mapping, drilling, trenching and geophysical surveys as routine elements of these projects. He has constructed monitoring wells, gas probes, sealed double ring infiltrometers and other specialized instruments for conducting field engineering evaluations in support of waste containment system designs. He has also performed engineering analyses, including stability, settlement, seismic hazard and dynamic response evaluations for landfill structures. He has also prepared design documents, plans, specifications and public works bid packages for landfill liners, final cover, surface drainage controls, borrow sites, building pads and operational fill and development plans, and final closure and post closure monitoring and maintenance plans.

He also has a successful track record in conducting Construction Quality Assurance programs for landfill liner, LCRS, final covers, low permeability liner material processing, civil construction inspection and testing, and groundwater monitoring systems. He has provided CQA management for 10 major landfill liner projects totaling over 200 acres of composite compacted clay/HDPE geomembrane, or geocomposite clay liner/HDPE geomembrane liner systems. He has also performed CQA management for over 300 acres of final cover as part of closure construction for 5 major landfills. These landfill liner and final closure projects were performed in accordance with Subtitle D and CCR Title 14, 23 and 27 regulations and were reviewed and approved by the California Regional Water Quality Control Boards and California Integrated Waste Management Board.

Engineering geology projects for heavy civil, commercial and residential developments have included fault studies, landslide and slope stability evaluations, regional mapping and groundwater seepage evaluations in Southern California. Overseas projects have included fault evaluations in support of a dam feasibility study in New Zealand and a 1-mile-square, active landslide that was moving an entire village in the Swiss Alps. He has constructed and monitored wells, survey networks, slope indicators and other specialized instrumentation. In his career he worked as a staff engineer performing field survey, plot plans, quantity, slope stability, settlement, seismic hazard and dynamic response evaluations for buildings, dams, landfills, and other civil structures. He has also prepared design documents, plans, specifications and bid packages for surface drainage controls, borrow sites, building pads, geotechnical remediation and more typical earthwork projects. He has provided CQA management for major drainage, earthwork and foundation projects. He performed or supervised field testing and monitoring for over 15 million cubic yards of earthwork in the Southern California area. Associated inspection and testing was provided for slope reinforcement, subdrains, concrete, asphalt, gabion and rip-rap.

LANDFILL EXPERIENCE

Naval Training Center Landfill Remediation

San Diego International Airport

San Diego County, California

Senior technical consultant for site evaluation and preparation of public works bid package for site remediation and landfill closure at San Diego International Airport. Expansion of taxiway and terminal buildings is proposed in area of contaminated soil, burn dump ash and municipal solid waste landfill. Estimated remediation cost between \$30 and \$40 million. Evaluated site characterization data to scope and plan remedial activities. Prepared plans and specifications for excavation, stockpiling, characterization and disposal of waste. Evaluating requirements for NPDES storm water and groundwater discharge permits and air quality permits required during site dewatering and excavation activities. Planning stresses segregation and reuse of soils from the excavation.

Closed Landfill Redevelopment

Gardena Valley No 5 Landfill

Carson, California

Provided technical support to the redevelopment of a closed landfill property into a commercial/retail park. Prepared a Post-Closure Land Use Plan to address proposed modifications to the vacant site, addressing improvements to existing containment systems and environmental controls. Lead technical reviewer for methane protection systems integrated with building foundations, consisting of HDPE geomembranes, gas collection piping, monitoring sensors and alarms. Evaluated alternatives for modifying landfill area to allow construction of building within landfill footprint.

55th Way Landfill

Long Beach, California

Design Support during design of an alternative final cover system, construction CQA, and regulatory coordination during construction of final cover and conversion of the former 55th Way landfill into a public park and recreational area.

Mountain View Landfill

Inspection and Cover Repair Design

Mountain View, California

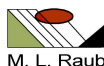
Performed detailed site inspection of a 40-acre closed landfill in an urban park. Mapped and surveyed areas of depressions, ponding, erosion, scour and blocked drainage devices impacting the performance of the landfill closure improvements. Unique issues included distress to asphalt pavement bike paths due to landfill settlement. The bike paths are a popular for roller blading, creating liability concerns for the City. Prepared designs, specifications and quality assurance plans for repair of the landfill cover, pavement and drainage systems. Conducted periodic reviews of repair construction progress.

Waste Pond Closure

Former Waste Facility

Lake County, California

Project Manager for Resident Engineering and Environmental Compliance during closure of 40 acres of waste disposal ponds and trenches in Lake County, California. Provided technical assistance, planning and contract administration support to 18 cooperating entities during execution of a \$13M design/build contract. Support during the bid period included review of proposals, conducting interviews, review of cost proposals, and contract negotiations with the successful contractor. Provided oversight of closure contractor activities, including contract administration, technical review of contractor design submittals, and monitored contractor compliance with permit conditions. Site closure, which began in 2003, was successfully completed in 3 years, in accordance with the schedule set by the Regional Water Quality Control Board. Principal activities include treatment of 30M gallons of pond water impacted by waste, excavation of buried solid wastes, and construction of a 15-acre solid waste landfill. Reviewed or



prepared associated permit applications to county, state, and federal agencies. Work required securing and compliance with NPDES storm water and discharge permits, air quality permits and CWA 404 and 401 permits. Currently providing postclosure monitoring and maintenance services.

Landfill Final Closure Redesign**Santiago Canyon Landfill****Orange County, California**

Lead Designer for optimization of final cover design to reduce the quantity of import soil. Due to loss of an onsite borrow source, expensive import soil was required to construct the designed final cover. Evaluated test pit exploration data on thickness of in-place soil cover. Excessively thick in-place cover areas were lowered to provide soil borrow for fill areas. By adjusting the final grades across approximately 80 acres resulted in the reduction of 80,000 cubic yards of import. Based on bid unit prices, this reduction of import resulted in the reduction of construction costs by approximately \$400,000.

Landfill Final Cover Evaluation**Palos Verdes Landfill****Palos Verdes, California**

Conducted field investigation of in-place final cover soils at the landfill. Logged 41 borings across the top deck of the landfill to evaluate soil types and thickness of cover. For 4 representative locations, drilled additional borings for the detailed logging and sampling for laboratory analysis.

Joint Technical Document**Antelope Valley Public Landfill****Palmdale, California**

Project Manager for preparation of a Joint Technical Document for the expansion of a 115-acre landfill. Developed conceptual designs for the landfill expansion. Technical challenges included seismic stability of the refuse mass and final cover system due to ground motions from the San Andreas Fault, located at the property boundary. Oversaw the development of ground motions for a M_w 8 earthquake and a finite element model for site. Evaluated acceleration time histories using TELDYN. Calculated permanent deformations for refuse fill and shallow failures of the landfill cover. Developed a preliminary closure plan utilizing a monolithic soil cover as an alternative to prescriptive designs, suitable for the arid site. Prepared updated Monitoring and Reporting Program for groundwater and surface water. A major challenge to the development of the site was related to potential flooding of a creek at the property boundary. Prepared floodplain limits and channel velocities for the Capital Flood and 100-year, 24-hour flood events, required to address both state landfill regulations and local flood control design standards. Developed alternative solutions for channel modifications and bank scour analyses to define project improvements or set backs. Supported the client in preparation of the Conditional Use Permit application.

Apple Valley Sanitary Landfill**San Bernardino County, California**

Lead Design Professional responsible for preparation of design details and construction documents for the final closure construction. The project work tasks included geotechnical investigation and testing of onsite borrow material and import sources for blending scenarios to attain cover permeability, final cover grading, drainage design and design of miscellaneous closure improvements, preparation of contract drawings and technical specifications.

Milliken Sanitary Landfill**San Bernardino County, California**

Backup Resident Engineer for the construction management and CQA services for the Phase 3 final closure construction. The closure included construction of 3-foot thick monocover for this 75-acre landfill including 50 acres of side slopes and 25 acres of deck areas.

Santiago Canyon Landfill**Orange County, California**

Backup Construction Manager and construction support for 130-acre moncover closure construction. Responsible for in situ cover characterization, limits of refuse delineation, and preparing design modifications to optimize existing cover thickness.

San Timoteo Landfill**San Bernardino County, California**

Lead Design Professional responsible for preparation of design details and construction documents for the landfill liner expansion construction. The project work tasks included geotechnical investigation for landfill expansion including slope stability evaluation, seismicity and faulting studies, materials resources evaluation, and preparation of geotechnical report for regulatory agency review. Prepared details and coordinated preparation of AutoCAD drawings showing grading, drainage and landfill liner, LCRS and operations layer elements.

Colton Sanitary Landfill**San Bernardino County, California**

Design Support for final cover design and preparation of closure and post-closure plans for Phase 2 closure including alternative cover design and infiltration modeling.

Mid-Valley Sanitary Landfill**San Bernardino County, California**

Construction Manager (Backup) for the Unit 3, Phase 5A composite liner construction involving 25,000 cu. yds. of clay liner and 1,200,000 sq. ft. of geosynthetics.

Phase 2 Expansion Design**Savage Canyon Sanitary Landfill****Whittier, California**

Project Manager for conceptual phasing plan for the incremental development of the back canyon of the landfill. Phasing design required addressing stability of a large landslide initiated during previous grading at the site and stability of the interim refuse fills. Developed construction drawings, specifications and technical design report for the first incremental phase of expansion of the composite lining system. Also prepared hydrology calculations and construction-level designs for a concrete-lined sediment control basin.

Phase IB Landfill Expansion Geotechnical Design**Otay Sanitary Landfill****Chula Vista, California**

Technical reviewer for the geotechnical evaluation of planned grading for 150-foot high slopes to support landfill lining system. Supervised field-mapping efforts to establish limits of landslides and weak rock features that formed potential slope instabilities. Reviewed development of geotechnical cross sections, soil and rock strength parameters, and stability analyses performed.

Landfill Master Plan Geotechnical Design**Otay Sanitary Landfill****Chula Vista, California**

Task leader for the geotechnical evaluation of planned conceptual grading for development of a major regional landfill. Compiled existing soil and rock strength data for selection of parameters for use in analyses. Evaluated planned liner subgrade slopes and refuse fill plans for stability. Work included updating seismic design parameters to current CCR Title 27 regulations. Developed remedial grading designs to achieve required factors of stability against failure. Analyses required use of deformation analyses to check for reasonable levels of deformation in a maximum probable earthquake event.

Ramona Landfill – Evaluation of Landfill Gas and Groundwater Extraction and Treatment Improvements**Ramona, California**

Lead investigator and project manager for a comprehensive evaluation of landfill gas (LFG), soil vapor and groundwater extraction and treatment improvements for a site with groundwater impacted by tetrachloroethene, trichloroethene, and associated chlorinated aliphatic compounds.

Compiled data and performed original studies to characterize complex hydrogeological conditions. Site groundwater flows in both deeply weathered and fractured bedrock units. Evaluated performance of existing groundwater and vapor extraction systems and made recommendations for system improvements to control and remediate groundwater at the facility. The evaluations included assessment of the existing LFGs collection system and flare. LFG perimeter probe monitoring data was compiled to define areas of migration. Conceptual designs were prepared for upgrades to collection system to control offsite migration and remove VOCs from the unsaturated zone. Conducted original studies to support design of a final corrective action plan, including resistivity profiling to define extent of weathered bedrock and fracture zones. Conducted testing of gas extraction wells within refuse and the unsaturated zone to evaluate effectiveness of existing systems and to develop data for design of final gas extraction systems to control VOCs in the unsaturated zone. Installed a test well and observation wells and conducted pump test to provide supporting information for the design of a final groundwater extraction and treatment system.

Morongo Valley Landfill Human Health and Ecological Risk Assessment**Morongo Valley, California**

Project manager for a hydrogeologic and preliminary human health and ecological risk assessment. The project was the first of its kind in San Bernardino County to address closure of groundwater assessment activities at the closed site. The groundwater impacts attributed to the landfill included tetrachloroethene, trichloroethene, freons and to a lesser degree chloride. These impacts suggested a landfill gas as the principal source for contaminants. The site was situated at the margin of a groundwater basin that was utilized by groundwater well pumping as the source for residential drinking water. Downgradient of the landfill was a natural groundwater spring, which was suspected to be a unique water source for desert fauna. A probabilistic fate and transport study is being performed to quantify the concentrations of contaminants of concern considering ingestion pathways for humans drinking well water and animals visiting the spring. The risk assessment conformed with DTSC guidelines for a preliminary health and ecological risk assessment, and was successful in obtaining closure by the RWQCB of groundwater evaluations at the site.

Phelan Landfill Gas Migration Study**San Bernardino County, California**

Project manager for a comprehensive landfill gas migration characterization and numerical modeling project. Project included the design and installation of soil vapor and LFG probes within refuse and extending to depths of 500 feet below the landfill. A sophisticated testing program was developed to evaluate the physical and chemical properties of LFG and soil vapor and the physical properties of the alluvial soils at the site. Modeling was performed utilizing T2VOC, a thermodynamic numerical code to evaluate the mechanisms of VOC migration from the refuse down into the vadose zone. Design concepts for control of landfill gas migration and future monitoring systems were also evaluated.

Yucaipa Landfill Gas Monitoring**San Bernardino County, California**

Project manager for the design, construction and monitoring of a landfill gas migration probe network in conformance with SCAQMD regulations. Four multi-depth probes were designed and constructed around the perimeter of the landfill. Unique site setting and geological conditions were documented as an argument for limiting probes from portions of the site property where risk to LFG migration was not an issue. The alternative design was accepted and approved by the LEA.

Frank R. Bowerman Landfill -**Detection Monitoring Program Well Installation****Irvine, California**

Lead Geologist for the design and implementation of a groundwater detection monitoring program well system for a 320-acre composite lined municipal solid waste landfill. Work included evaluation of target well locations, well design, geologic logging and sampling, well development, and sampling for 6 wells constructed from 60 to 325 feet depth. Well were constructed in alluvial soils and soft sedimentary bedrock. Soil samples collected from rock cores were tested to determine physical properties of water containing formations.

Glennville Landfill and Burn Dump**Evaluation and Closure****Glennville, California**

Project Manager, conducted field exploration, evaluations and characterized waste for clean closure of a 4 acre former burn dump and solid waste landfill in the Southern Sierra Nevada Mountains. The landfill included burn dump ash capped by unburned municipal waste. Conducted field exploration including drilling and logging of 6 borings through unburned waste to evaluate and sample underlying burn dump ash and impacted geologic foundation materials. Work included 10 trenches to define the lateral extent of waste. Examined aerial photographs for location of former burn pits and past site operations. Compiled and evaluated analytical test results for VOCs, SVOCs, metals, and dioxins. Developed 5 closure scenarios from traditional final cover to removal of all waste, ash and impacted geologic medium. Prepared preliminary level closure construction and post-closure monitoring costs for the 5 scenarios, and gave recommendations for closure construction and waste disposal.

Provided CQA and engineering services during the Phase I closure activities consisting of removal and hauling of 55,000 cubic yards of unburned solid waste. Performed detailed sampling of uncovered ash and exposed granitic bedrock and surficial soils that formed the landfill foundation for analytical testing and ultimately recommendations for Phase II closure activities.

Feasibility Study for Closure Options**Operating Industries Inc. Landfill****Monterey Park, California**

Task Leader for evaluating closure options for an 8-acre landfill at a Federal Superfund site including clean closure and capping the waste in place. Work included review of previous geological, geotechnical, and environmental data to develop a model of the waste distribution and characterization. Prepared plans for calculation of waste quantities, removal sequencing and for two conceptual final cover systems. Prepared conceptual designs and detailed cost estimates for the relocation of 350,000 cubic yards of waste, alternative construction of a final cover system, environmental and aesthetic controls during waste relocation, and post-closure monitoring, maintenance and reporting.

Environmental Evaluation and Remediation**Feasibility Study for an Active, 82-Acre Landfill****Krakow, Poland**

Project Geologist/Geotechnical Engineer responsible for conducting field investigations including surface water quality sampling, audit of operational practices, and geotechnical mapping. Compiled and evaluated regional and site-specific data on geology, surface hydrology, subsurface hydrology, groundwater usage, and waste stream characterization studies. Evaluated surface water quality testing results and identified that leachate was impacting a perennial stream that passes the toe of the landfill.

Prepared conceptual plans for closure of existing waste cells, for landfill expansion areas and modifications to landfill operations. Provided preliminary level design including details, layout and specifications for final cover, slurry cutoff wall, leachate collection drains and wells, surface drainage, basal clay liner and leachate collection system, and a monitoring well system.

Developed operational plans for daily cell sizing and daily cover requirements and filling plans for 5 years and 20 years of operation.

Landfill Closure Design**Otay Mesa, California**

As Lead Engineering Geologist, prepared geotechnical report, final closure and post-closure maintenance plans, and construction level designs for closure of an abandoned 7-acre auto shredder and burn dump ash landfill. Conducted interim closure inspections of waste pile and drainage. Prepared a geotechnical report presenting the results of field explorations, laboratory testing, and engineering evaluations for static and dynamic slope stability, liquefaction, and settlement. Provided technical review of geohydrology and surface water hydrology studies at the site. Principal author and civil designer for final closure documentation consisting of a final closure plan, construction drawings and specifications, emergency response plan, post-closure monitoring and maintenance plan and construction quality assurance plan consistent with CCR Title 27 and Federal Subtitle D requirements. Provided designs for achieve regulatory compliance for endangered species and wetlands mitigation, including native plant salvage and site revegetation. Currently coordinating the efforts for closing the California Environmental Quality Act approval process, including wildlife surveys, archaeological studies, and habitat assessments. Negotiating mitigations for project impacts to jurisdictional waters, wetlands and sensitive riparian habitat with City of San Diego, U.S. Army Corps of Engineers, US Fish and Wildlife Service, and California Department of Fish and Game.

Inactive Landfill Closure Design**Edwards Air Force Base, California**

Task Leader, provided technical guidance and review for the final closure design of a 57-acre solid-waste landfill. Provided conceptual designs for final cover grades and drainage improvements to design team. Reviewed completed drafts and final drawings, details and technical specifications. Technical challenges included minimizing need for import foundation layer soil to meet CCR Chapter 15 grade requirements. The broad, flat site contained undocumented trenches and random piles of waste containing asbestos.

Double Butte Landfill - QA/QC**Services for Closure Activities****Winchester, California**

Project QA/QC Manager for construction quality assurance/quality control (QA/QC) services for the first phase of closure construction at the 100-acre landfill. Work includes implementation of QA/QC testing, observation and reporting during placement of the 2-foot thick foundation layer as part of final cover.

West Riverside Landfill**QA/QC Services for Closure Construction****Moreno Valley, California**

Project Manager for observation and testing for the 65-acre final cover system that meets Chapter 15 requirements, upgrading and installation of additional vertical wells for the landfill gas collection system, construction of concrete lined drainage channels and preparation of as-built report and construction plans. Project included stringent construction monitoring and testing for 104,000 cubic yards of compacted clay that forms the low-permeability layer of the final cover. The final cover consisted of 2 feet of foundation layer soil, 1 foot of compacted clay meeting a maximum permeability requirement of 1×10^{-6} cm/sec, and 1-1/2 feet of vegetative layer soil. Final grading of the site included waste relocation with air monitoring for landfill gas emissions following AQMD 1150 permit rules.

Puente Hills Landfill - Final Cover Evaluation**Whittier, California**

Project Manager for study covering 180 acres of the landfill front slope, and included performing 115 BAT™ field tests on low-permeability soils and collection of 48 samples for laboratory permeability, grain size, Atterberg limits, soil water content, and wilting point tests. Evaluated test

results for variability of placed cover soils, developing between the test parameters, and prepared graphical presentations of the test results to show spatial variations across the slope.

McFarland-Delano Landfill**QA/QC Services for Closure Construction****Delano, California**

Project Manager for the closure construction QA/QC services during closure of the 40-acre landfill in Kern County, California. The QA/QC services were provided for the final cover including a foundation layer, low-permeability barrier layer, and vegetative soil cover. The low-permeability soils were manufactured on site involving 74,000 cy of select onsite soil blended with 10 percent calcium bentonite. Mr. Raub prepared plans for implementation of QA/QC activities, including testing for material conformance, low-permeability material processing, and for the in-place final cover layers. These plans were reviewed and approved by the RWQCB and CIWMB. To evaluate a Contractor supplied alternative bentonite source, prepared a test pad program including the monitoring of low-permeable soils processing and test pad construction, and testing the completed test pad for in situ permeability using the BAT and Two-Stage Borehole permeability test methods. Supervised the implementation of the QA/QC program during construction of the final cover system, including review of daily progress, participation at progress meetings, evaluation of field and laboratory testing results. As part of the construction, also provided oversight for QA/QC activities during the modification of 12 groundwater monitoring wells and construction of 8 landfill gas monitoring probes.

San Diego County Solid Waste System Privatization**San Diego, California**

As Project Manager, supported a confidential client in their evaluation of the San Diego County solid waste system, to identify environmental, operational and engineering issues associated with the potential purchase of the system by a private operator. The system included 4 active landfills, a material recovery facility, a transfer station and 10 rural collection sites. Conducted extensive site walks and reviews of available data compiled by the County. Prepared environmental site assessments for each site to identify issues associated with the sites and neighboring properties that may result in an environmental liability for the client. Performed audits to evaluate compliance of the County facilities with permits and local, state and federal regulations. Prepared engineering evaluations of the landfill facilities to identify improvements to satisfy operational and permit requirements, remaining air space, and issues associated with future development of the sites. Cost estimates were prepared for potential groundwater remediation.

Solid Waste System Assessment**Nevada**

Project Manager and Lead Assessor for environmental and solid waste evaluation of a solid waste system for purchase. The system includes a large regional landfill, 2 smaller landfills, and 8 transfer stations. Conducting Phase I Environmental Site Assessments of each property. In addition, the permit status for each site was audited, along with compliance by the owner with permits and regulations. Engineering evaluations were prepared to develop costs for operation, monitoring, closure and groundwater remediation at the landfill facilities.

Solid Waste System Privatization**California**

Project Manager for an evaluation of 4 active landfill sites in Southern California for a confidential client. Compiled existing data for each site, including geologic and hydrogeologic conditions, landfill liner systems and other facility improvements. Prepared AutoCAD drawings and designs of the sites and future phasing for airspace and liner/cover estimates. Reviewed regulatory agency files to audit permit compliance. Prepared detailed cost estimates for capital improvements for liner, drainage, ancillary facilities, environmental monitoring and controls, and closure/post-closure activities.

Frank R. Bowerman Landfill - Phase II Geotechnical Design, Construction Coordination, and QA/QC Services**Irvine, California**

Project Manager, prepared and supervised geotechnical exploration program for the 55-acre area. Evaluated subsurface conditions of compressible surficial soils and stability of 20 landslides up to 8 acres in size, and provided stabilization and remedial grading plan recommendations. Supervised drilling of 23 borings, geologic and laboratory evaluations of 4 major clay borrow sources. Evaluations identified 2.8 million cubic yards of soil suitable for clay liner construction. Designed grading plans and construction sequencing for earthwork and the installation of clay and synthetic lining system. Coordinated design review, CQA, and earthwork direction activities. Supervised the stringent CQA program during construction of the Phase II lining, involving 2 million cubic yards of excavation, 78,000 cubic yards of clay lining and 1.4 million square feet of HDPE geomembrane, and associated drainage, roadway and infrastructure improvements. Prepared QA/QC reports, survey and construction record drawings that were approved by the RWQCB.

Puente Hills Landfill Hydrogeologic Evaluation**Whittier, California**

For County Sanitation Districts of Los Angeles County, compiled available geologic and hydrogeologic data. The project included preparing a composite geology map, detailed cross-section drawings showing existing geologic conditions and subsurface barriers, and compiling existing site and regional hydrologic and water quality data. Evaluated man-made and natural factors influencing fluid migration including stratigraphy; structure, physical properties, and geometries of bedrock; and refuse and subsurface leachate barriers. Assessed in-place barriers, leachate extraction systems, and geologic conditions for site suitability for the disposal of sewage sludge.

Puente Hills Landfill - Geotechnical Investigation for Proposed Expansion Area**Whittier, California**

Lead Field Geologist, supervised and coordinated the drilling, geotechnical logging and sampling of 13 borings ranging from 75 to 325 feet deep, and the construction of seven piezometers to depth of 325 feet. Compared surface geologic mapping data with stratigraphic and structural information obtained from the borings to develop a geotechnical model of the landfill expansion area. Conducted seven double packer tests on borings and three slug tests on wells and calculated average hydraulic conductivities. Prepared hydrogeologic section of site evaluation report.

Calabasas Landfill - Hydrogeologic Investigation for Subsurface Barrier No. 6**Calabasas, California**

Project Manager for an investigation to evaluate the geotechnical and hydrogeologic characteristics for design of a bentonite slurry cutoff wall and leachate extraction well system. Supervised 460 feet of seismic refraction survey and estimated depth of surficial soil and bedrock weathering profile. Supervised the logging and sampling of 4 borings drilled from 50 to 80 feet in depth by air rotary techniques. Conducted and supervised 8 packer tests using a double packer system to evaluate the hydraulic conductivities of highly fractured claystone. Compiled and evaluated geologic mapping, seismic refraction, geomechanical laboratory testing and drilling information to characterize subsurface conditions. Calculated hydraulic conductivity of bedrock from the packer test data.

Frank R. Bowerman Landfill - Phase I Geotechnical Design, Construction Coordination, and QA/QC of the Groundwater Protection System**Irvine, California**

Project Manager, reviewed exposed geologic conditions and grading design for their impact on the project constructability. Prepared design details and construction specifications for the composite compacted clay-flexible membrane lining and the leachate collection and removal system components of the groundwater protection system. Work was performed in a fast-track project to modify the landfill design to comply with Subtitle D regulations. Evaluated onsite clay sources, leading to the successful construction of a clay liner without requiring the import of clay. Developed and coordinated the construction QA/QC monitoring program for both clay and synthetic lining built at the site. Organized and coordinated compatibility testing and interface shear strength testing of geosynthetics. Phase I involved construction coordination and QA/QC for 75,000 cubic yards of clay lining and 1.5 million square feet of high-density polyethylene (HDPE). Designed a grading plan and construction sequencing for a 60-foot-deep subsurface barrier excavation.

Frank R. Bowerman Landfill - Clay Processing and CQA for Construction of the Phase IVC Subtitle D Composite Lining System**Irvine, California**

Project Manager, responsible for overall technical direction and QA monitoring for two clay processing contracts. Processing under the two contracts was provided for 190,000 cubic yards of clay borrowed from onsite bedrock excavations. Prepared technical specifications for the first contract and provided oversight of construction and quality assurance programs for both contracts. Supervised geotechnical exploration, laboratory testing and preparation of grading and surface drainage design for clay borrow excavations. Supervised and coordinated utilization of scrapers, dozers, rotomixer and power screening equipment procured under a rental contract. Managed the QC program for observation, sampling and testing during borrow and mechanical processing operations. During the second contract, supervised and supported construction of a Sealed Double Ring Infiltrometer (SDRI) test on a clay liner test pad constructed to evaluate clay borrowed from a new onsite source area.

Project Manager and Engineering Geologist of Record for the implementation of the construction QA/QC program and field engineering support during construction of the 17 acres of Subtitle D composite liner and leachate collection system. Supervised QA/QC observation and testing for 55,000 cy of compacted clay liner, 730,000 square feet of HDPE geomembrane, and 10,000 square feet of GCL as the primary liner system. Supervised QA/QC for the installation of 750,000 square feet of geotextile and 28,000 cubic yards of graded filter sand and piping forming the LCRS, and 56,000 cubic yards of overlying operations layer soil. Construction testing and inspection was provided for asphalt paving and concrete/steel for drainage structures. Complied survey as-built information and prepared pay quantity estimates and Construction Record Drawings. Provided the review of in-grade geologic mapping of the containment area and adjacent excavations. Also reviewed submittals and field changes, and developed plan modifications to suit field conditions.

Frank R. Bowerman, Prima Deshecha, Olinda Alpha, and Santiago Landfills - Geotechnical Services**Orange County, California**

Project Manager, performed and supervised geotechnical engineering services for the County of Orange's four active landfill sites. Work was continued under two separate contracts lasting over four years. The projects included geotechnical studies for roadways, drainage structures, building foundations, borrow areas, evaluations of unstable slopes or landslides, Subtitle D related evaluations, geohydrologic studies, and landfill liner and final cover design. Provided civil engineering designs for slope stabilization and drainage and erosion control facilities. Conducted

field explorations, laboratory testing, engineering analyses, and prepared reports, drawings, and public work bud packages (plans and specifications).

Prima Deshecha Landfill - conducted laboratory testing evaluation of onsite final cover soils; geotechnical evaluation and pavement design for an on site access road; and drilling and trenching programs for stability evaluations of three borrow sites. Supervised in-grading mapping of borrow slopes. In addition, data compilation, field mapping and a report were completed for the landfill to document unstable areas to satisfy Subtitle D requirements for landfill siting. Evaluated unstable slope conditions underlying high tension power line poles.

Frank R. Bowerman Landfill - supervised erosion control and drainage facilities design and construction QA/QC. Hydrology studies and drainage designs were prepared for terrace drains, down drains, energy reducers and drop structures for a borrow slope, a stockpile area, and for erosion that occurred downstream of the landfill. Prepared hydrologic calculations, designs and public works bid package for a gabion-lined stilling basin, channel lining and drop structures, designed to handle 1500 cfs flows during a design storm event. Also performed geotechnical and civil inspection during construction of the hydraulic structures. Supervised field mapping and data compilation and prepared an unstable areas report to the RWQCB. Designed and supervised construction of a 30-foot high, geosynthetic reinforced earth wall associated with the realignment of the primary onsite access road. Performed geologic mapping and drilling exploration, stability calculations and preliminary civil designs for stabilization of a steep, 270-foot high side slope.

Olinda/Olinda Alpha Landfill - supervised two separate studies of active landslides and unstable slopes onsite. These studies included field investigations (geologic mapping, trenching and drilling), stability analyses and providing recommendations for stabilization. For one large, failed slope, prepared preliminary and final civil designs and ultimately a public works bid package for a slope buttress fill and associated drainage improvements for the restoration of the 225-foot high slope. Performed geotechnical explorations and evaluations for an access road, a groundwater pipeline, and a sediment basin reconstruction. As QA Manager, supervised field QA/QC monitoring for construction of a seepage collection system, a groundwater pipeline, and for reconstruction of the sediment basin that included earthwork, concrete and steel inspection and testing. Prepared a geohydrologic report to evaluate the impacts of the landfilled waste and onsite grading to a natural spring located within close proximity to the northern limit of the landfill property.

Santiago Canyon Landfill - supervised drainage and erosion control improvement plans and details for the southeast borrow area. An erosion scarp potentially impacting improvements along the perimeter of the landfill was evaluated and recommendations provided for reducing the potential for further damage. Work also included the field exploration and engineering evaluation for alternatives for stabilization of an unstable slope supporting the waste fill and landfill gas header system. Prepared preliminary designs for gabion and geosynthetic reinforced slope alternatives for stabilizing the slope.

Brown Road Landfill Design

Santa Maria, California

Engineering Task Leader for preparation of development plans and details for 115-acre composite-lined municipal solid waste landfill. Developed staged sequencing for landfill bottom liner grades, soil stockpiles and drainage improvements. Special considerations were provided for ultimate slope heights of up to 600 feet in the steep canyon site. Grading plans considered remedial grades for stabilization of unfavorable geologic conditions and elimination or stabilization of significant landslides. Designs included phased drainage channels, and a stormwater detention basin and outlet works in a confined area at the toe of the waste containment area. Stability of the waste fill in the area of high potential for strong ground shaking due to earthquake required a significant toe berm.

Badlands Landfill**Alternative Subtitle D Sideslope Liner Design****Moreno Valley, California**

Project Manager, supervised and prepared an engineering evaluation of a Subtitle D alternative design for the lining of steep sideslopes. Prepared demonstration report, plans, details and technical specifications for construction of a HDPE/geotextile lining system for a 100-foot high, 1½:1 (horizontal:vertical) sideslope. Presented concept and final evaluation and plans to the Regional Water Quality Control Board. Completed report and construction documents, and secured approvals from the Regional Water Quality Control Board in 2 months.

Coyote Canyon Landfill**Newport Beach, California**

Project Geologist for the geotechnical exploration for design of a subsurface leachate barrier below the existing landfill. Conducted field exploration to characterize geologic condition at the site of proposed leachate barrier. Mapped surface and bedrock geology, conducted exploratory trenching, coordinated drilling activities, and provided survey control of boring, trench, and well locations. Performed geologic analyses used in aquifer characterization and leachate barrier design.

Frank R. Bowerman Landfill - Construction QA/QC of the Phase IVA and IVB Landfill Liner and LCRS**Irvine, California**

Project Manager and Engineering Geologist of Record for the landfill liner expansion covering 25 acres and consisting of a composite 2-foot compacted clay liner and 80-mil HDPE geomembrane. Construction included 1 million cubic yards of excavation, stockpile grading, subdrain installation, the liner and overlying leachate collection gravel layers with piping, protective soil cover, and about 2 miles of reinforced concrete-lined drainage channels. Mr. Raub supervised all aspects of the construction QA/QC program, including for earthwork, 85,000 cubic yards of clay liner, 1.1 million square feet of HDPE, geotextiles, LCRS, soil cover and concrete, steel and asphalt. Provided field engineering for construction including plan clarifications, submittal review, plan modifications for changed conditions, and review of contract change orders for technical compliance. Compiled as-built survey data for development of pay quantities and Construction Record Drawings.

Frank R. Bowerman Landfill**Phase IVA and B Clay Processing****Irvine, California**

Project Manager, responsible for overall technical direction and QA monitoring of mechanical processing of 207,000 cubic yards of clay liner material. Established grading design for onsite clay borrow using bedrock sources. Provided guidance of earthwork contractor's equipment and operations, including haul roads, borrow cut sequencing, equipment specifications, and processing plant staging. Implemented the QA plan includes QC testing of clay quality and construction and testing of a clay liner test pad fill.

Badlands Landfill Canyon 1 Expansion**CQA Monitoring Program****Moreno Valley, California**

Project Manager for construction QA/QC program including earthwork, 48,000 cubic yards of clay liner and LCRS placement covering 10 acres. Provided QA/QC monitoring and testing for clay borrow operations, production pad construction and during placement of clay liner within the expansion area. Testing included geotechnical index tests, triaxial laboratory permeability, and BAT™ field permeability tests to verify that the 1×10^{-7} cm/sec maximum permeability standard had been achieved. The CQA program was conducted in conformance with CCR Title 23, Chapter 15 construction and design requirements in force at the time, and was reviewed and approved by the Santa Ana RWQCB.

Badlands Landfill Canyon 2 Expansion**Subtitle D Liner CQA Monitoring Program****Moreno Valley, California**

As Project Director, supervised the CQA program for the construction of a Subtitle D composite liner and LCRS for the 5-acre expansion. The bottom liner system consisted of 2 feet of compacted clay with a maximum permeability of 1×10^{-7} cm/sec, overlain by 60-mil HDPE geomembrane. Side slopes were lined with GCL overlain by the geomembrane. CQA services were provided for earthworks, compacted clay liner, GCL, geomembrane, geotextile, filter sand, operations layer, subdrainage and perimeter surface water drainage improvements.

Landfill Foundation Study**Carson, California**

Project Geologist, conducted exploration of subsurface geotechnical conditions at a site containing buried refuse to develop foundation design for nine commercial/industrial buildings. Conducted subsurface exploration consisting of 23 borings to define limits of buried refuse and evaluate subsurface soil conditions. Along with standard geotechnical logging, nine borings through refuse were completed. Installed gas monitoring wells to evaluate combustible landfill gas anticipated at the site. Evaluated remedial measures for buried refuse including removals to depth of 30 feet and the construction of a soil cover.

Double Butte Landfill - Subtitle D Clay**Test Pad Evaluation and SDRI****Winchester, California**

Project Director for the QA/QC testing and evaluation of a compacted clay test pad. Work included supervision of QA/QC monitoring for clay borrow operations, stockpiling, processing and test pad construction. After completing construction of the test pad, field permeability tests by the BAT™ method and a Sealed Double Ring Infiltrometer (SDRI) test were performed. The field testing was compared to laboratory permeability tests using the flexible wall permeameter. The results of the test pad proved the suitability of the clay for use in construction of a Subtitle D, compacted clay liner with a permeability of 1×10^{-7} cm/sec or less.

Edom Hills Landfill**Riverside County, California**

Field Geologist during a preliminary geotechnical investigation to evaluate the suitability of a proposed transfer station site located in close proximity of the south branch of the San Andreas fault. Conducted geologic logging of a 415 foot-long trench to investigate faulting potential and to establish structure setbacks.

LANDFILL GAS PROJECTS

Santos Landfill

San Jose, California

Project manager for the technical direction and design of methane barrier and extraction systems for three office buildings and supporting parking areas being constructed over closed landfill. Designs included active and passive landfill gas extraction systems, geomembrane methane barriers under building foundations, methane detection and alarm systems, and migration monitoring to protect adjacent residences.

West Riverside Landfill

Moreno Valley, California

Project Manager for observation and testing for the 65-acre final cover system and installation of vertical wells and header for the landfill gas collection system. Final grading of the site included waste relocation with air monitoring for landfill gas emissions following AQMD 1150 permit rules.

Landfill Foundation Study

Carson, California

Project Geologist, conducted exploration of subsurface conditions at a site containing buried refuse to develop foundation design for nine commercial/industrial buildings. Installed gas monitoring wells to evaluate combustible landfill gas anticipated at the site. Evaluated remedial measures for buried refuse.

Ramona Landfill Gas Collection System

San Diego County, California

Project manager and technical lead for evaluation of existing landfill gas collection system and flare. Evaluated LFG perimeter probes monitoring data to define areas of migration. Supervised design efforts for upgrades to collection system to control offsite migration.

Phelan Landfill Gas Migration Study

San Bernardino County, California

Project manager for a comprehensive landfill gas migration characterization and numerical modeling project. Design concepts for control of landfill gas migration will be prepared.

Yucaipa Landfill Gas Monitoring

San Bernardino County, California

Project manager for the design, construction and monitoring of landfill gas migration probe network in conformance with SCAQMD regulations.

GEOTECHNICAL PROJECT EXPERIENCE**Sunset Cove Landslide Evaluation****Palos Verdes Estates, California**

As Lead Geologist, conducted geotechnical exploration and evaluation of a large landslide along the coastal bluff of the Palos Verdes Peninsula. The landslide was progressively retreating landward, and had progressed to the point that the city roadways were being significantly impacted. The project included the drilling and sampling of four large-diameter borings to 175 feet below the ground surface. The borings were logged down-hole to identify potential landslide slip surfaces, site stratigraphy, and to photographically log the subsurface conditions. One borehole was fitted with a slope inclinometer to evaluate potential subsurface movements. Also conducted detailed mapping of landslide features, surrounding geology, and groundwater conditions. Developed detailed cross sections, identifying the clay-rich, altered volcanic ash units that contributed to the instability of the slope. Developed alternatives for the stabilization of the site, including bluff grading, buttress fills, dewatering and caisson solutions.

Litigation Support**Southern California**

As court-identified expert, provided engineering geology services to private and public clients. Projects have included building and roadway distress, and major landslides impacting private and public improvements. Conducted fieldwork, analysis and preparation of exhibits. Participated in settlement conferences to settle claims for geologic-related impacts to property and structures.

Various Foundation and Seismicity Studies**Southern California**

Project Geologist, performed studies for foundation and structural design projects in Southern California. Structures included several high-rise buildings to 16 stories, a linear accelerator foundation at a hospital in coastal Orange County, a 1 million-gallon reservoir in the Anaheim Hills, and buildings housing sensitive electronic equipment at George Air Force Base in San Bernardino County. Conducted field investigations including drilling, test pit, geophysical and CPT methods. Compiled field and laboratory data for engineering evaluations. Performed settlement, stability, pavement and pile design calculations. Calculated deterministic maximum probable and maximum credible earthquakes and probabilistic design ground motions and associated peak horizontal ground accelerations from earthquake data and geologic models using microcomputers. Provided ground response spectra, and evaluated liquefaction potential and other seismically induced ground failure. Prepared engineering reports on the results of field investigations and engineering evaluations.

Geotechnical Exploration, Planning Area 18 East**Mission Viejo, California**

Lead Field Geologist for subsurface exploration of an 80-acre residential development in hillside terrain. Performed geological mapping and sampled and logged 15 borings and 12 trenches. Logging techniques included downhole inspection of large diameter borings, and recorded lithology and structural data. Identified surface and subsurface geometries and geotechnical conditions for five major landslides up to 31 acres in area and 100 feet deep. Prepared geologic report with maps and sections used in design of remedial grading measures.

Orchard Estates Project**Preliminary Geotechnical Study****Irvine, California**

As Project Geologist, performed geology mapping and aerial photograph analysis; supervised the drilling and logging of 57 borings and 147 exploratory trenches; and prepared geotechnical maps, cross sections, geological analyses, and reports documenting the findings. Supervised percolation testing for 63 sites and analyzed feasibility of onsite effluent disposal systems. Significant issues addressed by the study were the reclamation of an old quarry, the potential for an active fault crossing the site, and the potential for liquefaction of alluvial soils in an area of high groundwater beneath an existing earth dam located on the property.

**Preliminary Geotechnical Exploration
Planning Area 21****Aliso Viejo, California**

Performed and managed the preliminary geotechnical exploration for a 120-acre hillside residential development near Laguna Hills, California. Performed aerial photograph analysis and field mapping, and supervised the backhoe test pits, trenches, and drilling program. Supervised the preparation of the geotechnical map and cross sections. Prepared engineering analysis including compactability of onsite diatomaceous geologic units with unusually high moisture contents (to 105 percent), and compiled geologic and geotechnical engineering data and analyses into a final report. Established guidelines for characterization of soil and rock units at the site and implemented the procedures for use with a computer-based boring log editor and database.

Building Distress Evaluations**Southern California**

As project engineering geologist, conducted field, laboratory and engineering evaluations of distressed single family residences, multi-family residential units, and commercial buildings in Orange, San Diego, and Los Angeles counties. Evaluated potential geotechnical causes of distress including fill settlement, expansive soils, corrosive soils, surficial slope instability, landslides and fault activity. Conducted drilling, test pits, manometer surveys, distress mapping and characterization, crack strain monitoring, survey data gathering and reduction to document earth movement. Performed engineering calculations for settlement of fills up to 100 feet deep, slope stability for surficial and deep bedrock landslides, expansion potential and bearing capacity. Prepared reports documenting studies, calculations, conclusions and recommendations, including preparation of large exhibits for presentations.

Reservoir Tank Siting Study**Anaheim Hills, California**

Investigated subsurface soil and geologic conditions for proposed 1- and 3-million-gallon steel reservoir tanks. Assessed faulting potential and foundation design. Responsibilities included aerial photo analysis and the logging of seven trenches and one boring. Performed seismic refraction study and mapping of exposed geologic conditions. Special geological problems at the site included a potentially active fault crossing the site, strong volcanic rock units posing excavation difficulties, and a highly deformed rock in the area of a proposed 60-foot-high cut slope. Analyzed geologic conditions proposed for foundation design of tank site. Identified a fault traversing the site that required setback of tank pad.

Reservoir Geotechnical Study**Trabuco, California**

As Staff Geologist, conducted a field exploration for the siting of 1-1/2 and 3 million gallon steel domestic water reservoir tanks in hillside terrain. The tanks were to be sited on a cut and fill pad graded with adjacent slopes to 61 feet high. The geotechnical exploration included aerial photograph review, seismic refraction survey, geologic mapping, and the logging and sampling of 9 trenches. Prepared geologic analyses for development of the site, including evaluation of the excavability of the andesitic (volcanic) bedrock, rock slope stability, and grading recommendations.

**Leaking Underground
Tank Investigation****Long Beach and Norwalk, California**

Project Geologist, conducted subsurface drilling and soil gas survey exploration to define extent of contamination from leaking underground diesel tanks at two sites. Developed exploration and health and safety plans. Developed estimate of hydrocarbon plume from analytical laboratory and soil-gas survey data.

Active Fault Study, Cabrillo Fault**San Pedro, California**

Conducted a field exploration including a surface rupture hazard study of possible active fault crossing a proposed housing development crossed by the Cabrillo Fault. Trenches across the site exposed complex fault relationships and offsets of Pleistocene terrace deposits and Miocene bedrock. Analyzed potential for future rupture and developed setbacks from the located fault trace for proposed structures.

**Geotechnical Exploration and Foundation Study
for Office Building and Hotel****Carson, California**

Project Geologist, conducted geotechnical exploration of subsurface conditions for six story office building and eight-story hotel site to develop foundation design. Drilled eight borings to 80 feet to characterize subsurface geotechnical conditions. Developed laboratory testing program for foundation design and analyses. Analyzed local and regional seismicity and faults, and developed design accelerations for structural design.

Pumped Storage Hydroelectric Project**Geotechnical Study****San Bernardino Mountains, California**

Field geologist for a geotechnical study to support a Federal Energy Regulatory Commission (FERC) application for a pumped storage hydroelectric project on the northern flank of the San Bernardino Mountains. The project included a forebay at elevation 7600 feet and two dams with powerhouse alternatives at elevations 5200 and 5600 feet. Conducted geologic mapping for over 4 square miles of the range front, including detailed tracing of three active thrust fault systems that crossed the study areas and proposed water tunnels. Mapping included Quaternary and bedrock geologic units, bedrock structure, and geomorphic and structural features associated with the active faults. Supported evaluation of geotechnical issues, including potential seismicity and fault rupture, slope stability, and tunnel, forebay and dam construction.

Geotechnical Feasibility of Underground Mine**New Zealand**

As a geotechnical consultant for State Coal Mines for the Ministry of Energy in New Zealand, investigated the feasibility of an underground mine in the Buller Coalfield. Conducted surface and underground mapping, provided core evaluation and structural geology analysis, evaluated data, and prepared a report.

Seismotectonic Hazard Evaluation, Mohaka Fault**Hawkes Bay, New Zealand**

Conducted a field and office study of faulting potential for a major fault on the North Island of New Zealand. Analyzed aerial photos and mapped an 83-square-kilometer area along the fault trace. Conducted measurements of offset geologic features such as river terraces, soils, and volcanic ashes. Developed geologic and soil stratigraphy, including dating of features to determine rate and movement and earthquake recurrence intervals. Study used in regional analysis for a major hydroelectric dam project.

Ganesh Boulevard Widening**Pomona, California**

Project Geologist for the exploration of subsurface soils and bedrock for widening of a 1-mile segment of roadway in Pomona, California. Provided project planning, negotiated contract, conducted field exploration, and prepared report. Conducted field mapping and drilling program to assess local geologic conditions, rock slope stability, roadway foundation design, and adverse groundwater conditions. Prepared remedial design for stabilization of rock slopes 10-to 45-feet-high and roadway dewatering system, including 3,000 feet of subdrain.

Construction Monitoring of Pipeline and Soquel Canyon Roads, Chino Hills**San Bernardino County, California**

Project Geologist for 2 miles of Pipeline and Soquel Canyon Roads in hillside terrain 100-foot high cut slopes and a major fault crossing. Provided construction monitoring in accordance with Caltrans specifications and performed as-graded geologic mapping and analysis and mapped exposed conditions in canyon cleanout and cut operations. Reviewed geologic conditions in cut slopes up to 100 feet high, slope buttress fill excavations, and documented exposure of the main trace of the Chino fault. Performed geologic analyses for slope stability calculations. Geologic units encountered included Quaternary surficial deposits of colluvium, alluvium, terrace deposits and landslide debris, and Tertiary bedrock units of the Puente Formation.

Preliminary Geotechnical Study San Joaquin Hills Transportation Corridor and Planning Area 10**Mission Viejo, California**

As project geologist, conducted geotechnical exploration and performed engineering analyses for one-mile segment of a proposed freeway in hillside terrain and an adjacent 280-acre residential development. Mapped geology of the site; supervised and logged 52 borings up to 235 feet deep and 74 backhoe test pits to define subsurface geologic conditions. Prepared geotechnical map and cross sections. Calculated stability of proposed cut slopes and evaluated liquefaction potential of saturated alluvial soils. Evaluated excavability of hard rock in cuts planned to 220 feet by use of seismic refraction techniques and rock core analysis. The study results provided key information for development of the project, including estimated quantities of rock requiring blasting for excavation of the transportation corridor (about 1 million cubic yards).

East Loop Road - Geotechnical Exploration**Aliso Viejo, California**

Conducted a geotechnical exploration for 1.5-mile roadway in hillside terrain near Laguna Hills, California. The proposed roadway construction included cut slopes up to 85 feet high and fills to 110 feet deep. Field activities included geological mapping and logging of 12 borings and 21 trenches. Prepared cross sections through proposed slope areas and performed slope stability analyses using microcomputers. Prepared report documenting geologic conditions and recommendation for roadway construction.

Active Landslide Study**Italian Alps, Switzerland**

As lead geologist, conducted exploration of a major active landslide in the Italian Alps in southern Switzerland. The landslide occupied about 5 square kilometers and encompasses two mountain villages. About 30 meters of lateral movement had documented since 1892, when surveys of churches within the two villages were initially performed. The study conducted was to evaluate recent activity on the landslide and accelerating rates of erosion in the area of the toe of the landslide. Conducted detailed geologic mapping of rock types and structure in the 300-meter high slope forming the toe of the landslide above the river. Mapped active cracking and scarps within the body of the landslide where the villages were situated. Documented nature and orientations of distress in buildings impacted by internal movement of the landslide mass. Compiled geologic mapping and subsurface borehole information and supervised the development of a three-dimensional database. Calculated volumetrics for mass wasting, erosion and slope retreat in the area of the toe of the landslide.

Landfill Foundation Study**Carson, California**

Project Geologist, conducted exploration of subsurface geotechnical conditions at a site containing buried refuse to develop foundation design for nine commercial/industrial buildings. Conducted subsurface exploration consisting of 23 borings to define limits of buried refuse and evaluate subsurface soil conditions. Along with standard geotechnical logging, nine borings through refuse were completed. Installed gas monitoring wells to evaluate combustible landfill

gas anticipated at the site. Evaluated remedial measures for buried refuse including removals to depth of 30 feet and the construction of a soil cover.

PUBLICATIONS AND PRESENTATIONS

Raub, M. L., Morell, D. J., Aronson, E., Finegan, J. M., Keenan, R. J., Rivera, A. L., 2000. Mechanisms of Landfill Gas Migration in the Vadose Zone at an Arid Region Landfill. Proceedings from the 3rd Annual Arid Climate Symposium, Solid Waste Association of America, p2-1 – 2-11.

Raub, M. L., 1997. Geotechnical Aspects of Landfill Operations, presentation for Basic Engineers Training Course, County of Orange Integrated Waste Management Department.

Raub, M. L., 1995. Landfill Design, guest lecturer for Environmental Engineering Course, Department of Civil Engineering, California State University, Fullerton.

Raub, M. L., 1995. Technology, Regulations and the Learned Experience at Municipal Solid Waste Landfills in Southern California; presentation at The Greening of Southern California: Strategies for the 21st Century, California State University, Fullerton.

Raub, M. L., H.N. Cutten, and A.G. Hull, 1987. Seismotectonic Hazard Analysis of the Mohaka Fault, North Island, New Zealand; Proceedings from the Pacific Conference on Earthquake Engineering, August, Vol. 3, p. 219-230.

Bryant, M. E., and M. L. Raub, 1986. The Cabrillo Fault - A Structural Problem, Palos Verdes Peninsula: in Baldwin, E.J. (Ed.) Geology and Landslides of Palos Verdes Hills, California; Guidebook, National Association of Geology Teachers, Far Western Section, Spring 1986, p. 64-68.