

## A. Qualifications

### ChemRisk®, LLC

ChemRisk is a scientific consulting firm providing state-of-the-art toxicology, industrial hygiene, radiological health, epidemiology, and risk assessment services to a wide variety of organizations that confront public health, occupational health, and environmental challenges. Professionals on the ChemRisk team have a long-standing reputation for thorough scientific analyses and for sharing results in the peer-reviewed scientific literature. The 400 papers published by scientists in the firm are frequently referenced in scientific literature, regulatory decision-making, and litigation. Sharing our work in the peer-reviewed literature is a priority that we have found to be unique in the consulting field. Our staff has extensive experience with conducting original research (such as simulation studies to estimate workplace or environmental exposures), handling large data sets, interpreting complex toxicology and epidemiology related matters, and conducting effective public involvement programs.

In the way of advanced academic education, ChemRisk's staff of 55 scientists offers 12 consultants with Ph.D. degrees, one M.D., and 23 with Masters degrees. Major areas of study include toxicology (11 consultants), epidemiology (8), environmental health or environmental sciences (9), industrial hygiene (6), health physics/ radiological health (3), biology (3), mathematics (1), pharmaceutical sciences (1), kinesiology/physiology (1), and library and information sciences (1). Four ChemRisk consultants have engineering degrees. Three of our consultants are certified by the American Board of Toxicology (DABT), six by the American Board of Industrial Hygiene (CIH), one by the American Board of Health Physics (CHP), and one as a Certified Safety Professional (CSP).

ChemRisk currently has scientists and research associates working from offices in California, Colorado, Pennsylvania, and Ontario, Canada. ChemRisk offers skill sets in the following areas:

- Environmental Risk Assessment
- Health Physics / Radiological Health
- Retrospective Exposure Analysis (Dose Reconstruction)
- Occupational Risk Assessment
- Aquatic Toxicology
- Industrial Toxicology
- Cost/Benefit, Cost/Effectiveness Analysis
- Physiologically-Based Pharmacokinetic (PBPK) Modeling
- Industrial Hygiene
- National Security & Public Safety
- Human Health Risk Assessment
- Consumer Products and Foods
- Litigation Support
- Medical Devices
- Pharmaceuticals
- Risk Communication
- Toxicology
- Epidemiology
- Risk-Benefit, Comparative Risk Assessment

Since 1990, ChemRisk scientists have been the nation's leaders in the independent investigation of historical operations at U.S. nuclear weapons plants, radionuclides and toxic chemicals that they released, and potential exposures and health risks that could have resulted. ChemRisk conducted a Toxicologic Review and Dose Reconstruction of Rocky Flats Plant operations and releases for the Colorado Department of Public Health and Environment (1990-1994) and the Oak Ridge Health Studies for the Tennessee Department of Health. The latter project started with a Dose Reconstruction Feasibility Study (1992-1993) that formed the bases for the Oak Ridge Dose Reconstruction (1994-1999).

As stated in a newsletter issued by the Colorado Department of Health, ChemRisk was chosen to perform the Rocky Flats study because of "experience in doing risk assessments of large, controversial, complex facilities; capability of establishing credibility with the community; ability to collect extensive quantities of data quickly; educational training and experience in toxicology and health physics; experience in doing historical research and review of industrial operations; and experience in reviewing classified data."

Since 1999, ChemRisk has been conducting the Los Alamos Historical Document Retrieval and Assessment (LAHDRA) project for the U.S. Centers for Disease Control and Prevention (CDC). On the LAHDRA project, a team of scientists and engineers had unprecedented access to documents and interviewees at Los Alamos National Laboratory (LANL). Team members reviewed millions of classified and unclassified documents at LANL, collected those documents that were relevant to off-site releases of radionuclides and chemicals, prioritized past releases in terms of their potential public health significance, and recently published draft final findings regarding the historical operations and releases that warrant more detailed evaluation.

### **AMEC Earth and Environmental**

For this project, ChemRisk will team with consultants from AMEC Earth and Environmental who offer exceptional academic training and experience with the hydrology, hydrogeology, and geochemistry of New Mexico that will be invaluable for the peer review effort.

AMEC plc, an international capital project, services, and investments company, is the parent of the Socorro NM, and Denver CO offices of AMEC Earth and Environmental, Inc. AMEC plc and its subsidiaries employ more than 23,000 people in over 30 countries and have billings in excess of \$4.5 billion annually. AMEC provides services to US clients through a network of 153 offices. AMEC plc is the largest international design firm in the world, as ranked by Engineering News Record (ENR) magazine. In addition, our ability to achieve consensus among key groups of stakeholders was recognized and highlighted by Consensus Magazine.

Much of the technical capability of AMEC relevant to this project is due to strategic acquisitions. AMEC team members for the proposed effort come from the AMEC acquisition of Geomatrix, Inc., and Hydrosphere Resource Consultants, Inc., in the past few years. The reputation of these two firms in hydrogeology, contaminant transport, and groundwater meta-studies stands on its own. Geomatrix, Inc. is a diversified technical consulting firm with groundwater project experience in New Mexico and specific groundwater contamination project experience with numerous DOE facilities including LANL. The project team member from Geomatrix has broad experience with DOE groundwater contamination investigation, DOE document and

management systems, and dissemination of those results to the general public. This direct New Mexico DOE/LANL experience will be invaluable in minimizing any learning curve for the project team.

Ten years ago Hydrosphere opened a satellite office in Socorro, New Mexico. Staffed dominantly with graduates from the nationally known Hydrology Program at New Mexico Institute of Mining and Technology, the office's dominant focus has been New Mexico water resource problems. The two principals of the Socorro office are Ph.D.s from New Mexico Tech in Hydrology and Geochemistry. In addition to both having an intimate understanding of New Mexico hydrology, one has conducted work on groundwater contamination and radioactive waste disposal at Sandia and Los Alamos National Laboratories, the Hanford reservation, and the Nevada Test Site. The other has worked as a consultant regarding groundwater contamination at the Y-12, K-25, Mound, Portsmouth, and Pantex plants; and the Oak Ridge and Livermore National Laboratories. The project team's core experience for the hydrogeology of this project flows from the Socorro office of AMEC Earth and Environmental.

### **Samples of Relevant ChemRisk Project Experience**

**Los Alamos Historical Document Retrieval and Assessment (LAHDRA) Project.** From 1999 to 2009, ChemRisk has conducted the LAHDRA project for the Centers for Disease Control and Prevention. An independent team of 28 scientists and engineers from ChemRisk and several subcontractors had unprecedented access to classified documents, unclassified documents, and interviewees at LANL. The team reviewed millions of historical documents at Los Alamos in search of information that is relevant to estimating off-site releases of chemicals and radionuclides and assessing the potential for public health effects from those releases. Relevant records were cleared for public release, copied, and scanned. Off-site releases were identified and prioritized, and a database of related information is now publicly available. The DocSleuth database contains over 10,000 historical documents that are relevant to releases of radionuclides and chemicals from Los Alamos activities from 1943 to the present.

The LAHDRA project has included a significant public involvement and risk communication component. ChemRisk has conducted 18 public meetings in New Mexico over the course of the project, including several workshops on topics of particular interest to members of the public. These meetings were held in Santa Fe/Pojoaque (9 occasions), Los Alamos (5), Española (3), and Taos (1).

The unprecedented independent research done by the LAHDRA team over the past 10 years has developed within the ChemRisk team a broad yet thorough understanding of operations at LANL that can be matched by no other consulting group in the world. In addition, the database they have built—coupled with their familiarity with sources of information at LANL—make them uniquely qualified to identify and obtain information that is relevant to the BDD Independent Peer Review effort.

**Oak Ridge Dose Reconstruction Feasibility Study, followed by the Oak Ridge Dose Reconstruction for the Tennessee Department of Health.** This eight-year, two-phased public project led by ChemRisk included evaluation of historical exposures and health risks to off-site populations from past operations at the 58,000-acre Oak Ridge Reservation. The initial Feasibility Study focused detailed dose reconstruction efforts on radioiodine released during

separation of radioactive lanthanum, mercury discharged from lithium enrichment operations, PCBs in the environment near Oak Ridge, and radionuclides discharged from White Oak Creek.

Waterborne contamination addressed by detailed dose reconstruction on the Oak Ridge project included mercury in East Fork Poplar Creek (EFPC), radionuclides in White Oak Creek and the Clinch River, and PCBs in EFPC and the Clinch River. The assessment of radionuclide transport in the Clinch River included detailed modeling of sediment transport and accumulation using the HEC6R model supported by analysis of numerous historical sediment core samples.

The project also included an evaluation of the quality of historical uranium effluent monitoring, systematic searching of document repositories, and additional screening of the potential health significance of materials not evaluated in the earlier Feasibility Study (including arsenic, asbestos, beryllium, copper, hexavalent chromium, lead, lithium, Np-237, nickel, niobium, plutonium, Tc-99, tellurium, TMAB, tritium, and zirconium). This project included significant public involvement and risk communication, including over 15 public meetings.

**Rocky Flats Toxicologic Review and Dose Reconstruction for the Colorado Department of Public Health and Environment.** Phase I of the Health Studies on Rocky Flats, this public project led by ChemRisk addressed Rocky Flats nuclear weapons facility operations and emissions from 1952 to 1989. The study team identified 12 radionuclides and over 12,000 toxic chemicals that had been used at Rocky Flats, and used innovative screening processes to focus on fewer than 20 that warranted reconstruction of doses and health risks. These included routine and accident-related releases of plutonium, americium, uranium, tritium, beryllium, and carbon tetrachloride to the air, burial grounds, and Walnut Creek and Woman Creek, which drained to Great Western Reservoir (a source drinking water for Broomfield) and Standley Lake (a drinking water supply for the cities of Westminster, Thornton, Northglenn and Federal Heights). Like the Los Alamos and Oak Ridge projects, this project had a significant public involvement and risk communication component.

**Retrospective Residential Exposure Assessment for Perfluorooctanoic Acid (PFOA) Releases from a Fluoropolymer Manufacturing Facility.** ChemRisk conducted a 53-year retrospective exposure analysis in order to evaluate current and historical exposures to PFOA from fluoropolymer manufacturing releases to Ohio and West Virginia. For this project, a PFOA material balance model was developed to estimate the mass of PFOA released to air, water, landfills, and off-site disposal. Computer programming and fate and transport modeling was conducted to estimate concentrations in air, soil, groundwater, and surface water and to evaluate current and past residential exposures in the nearby communities over time, as well as the estimated future exposures.

**Risk Assessment for Chromium (VI) in Drinking Water.** ChemRisk conducted a large multipathway exposure and risk assessment to estimate the retrospective exposure history for persons with potentially exposed to hexavalent chromium in groundwater. A series of bench scale tests and human pharmacokinetic studies were designed and conducted to examine the fate of hexavalent chromium in humans after tap water ingestion

**Risk Assessment of Compounds Found in Drinking Water.** ChemRisk conducted a detailed quantitative assessment of the doses and health risks of several members of a community potentially exposed to tetrachloroethylene (TCE), perchlorate, and NDMA in drinking water. This work involved modeling several exposure pathways associated with the use of potable water, and customizing the models for each individual based on their personal consumption and hygiene habits. Annual average daily doses and lifetime average daily doses were computed and compared to both state and federal risk criteria to assess each individual's risk of cancer and non-cancerous health effects.

**Risk assessment of Contaminants in Ground Water.** ChemRisk conducted a detailed quantitative assessment of the doses and health risks to several members of a community potentially exposed to PCE, TCE, 1,1,1-TCA, 1,1-DCA, 1,1-DCE, and cis 1,2-DCE in ground water. This work involved modeling several exposure pathways including the exposure from the use of well water and as a result of soil vapor intrusion. Annual average daily doses and lifetime average daily doses were computed and compared to both state and federal risk criteria to assess each individual's risk of cancer and non-cancerous health effects.

**Drinking Water Risk Assessment for Water Treatment By-Products.** For this project, approximately 20 oral human health risk assessments were conducted for a variety of unregulated by-products from drinking water treatment chemicals and leachates from drinking water system components, including iodine, titanium, ethanolamines, and chlorinated isocyanurates. USEPA guidelines were used to characterize chemical exposures and risks, and to derive appropriate toxicity criteria values. The results of these evaluations were used by a third-party certification agency as "pass-fail" criteria for initial and recurrent product certifications.

**Drinking Water Risk Assessment for Drinking Water Treatment Chemicals.** For this project, over 500 product formulations and laboratory test results were evaluated for established and proposed drinking water treatment chemicals. Chemical toxicity and potential health effects were reviewed for products that are used during all facets of drinking water treatment, including coagulation/flocculation, disinfection, and filtration. The findings were used to assess the public health risk associated with introducing new chemicals available for long-term drinking water treatment.

**Human Health Risk Assessment for a Wastewater Treatment Landfill Site.** This project was prompted by a proposal for approximately 80 acres of Site land to be preserved as a natural habitat, with possible use as an environmental education center. A human health risk assessment was performed to determine potential exposure to wastewater treatment plant sludge. This assessment determined incorporated fugitive dust emission calculations to determine site-specific risk-based remediation goals for a dirt-bike trespasser, a teacher, and a student. The assessment was approved by USEPA Region 5, resulting in a no-action alternative.

**Review and Comment on Work Plans and Pathway Analysis Reports for Large Urban Watershed Estuary.** For this project, ChemRisk prepared technical comments for the risk assessment components of these reports with respect to current EPA guidance and scientific rigor. The risk assessment and related documents were used as a tool to determine preliminary remedial options ranging from \$0.9 billion to \$2.3 billion.

**Human Health Risk Assessment for Secondary Exposure Household Bleach Use.** For this project, ChemRisk identified chlorinated organic chemicals likely to be present in tap water subsequent to the cycle of residential bleach use, disposal to drainwater and wastewater treatment. Chlorinated organics, perchlorate, and mercury were among the chemicals of the most frequent or greatest concern. Upper-bound potential health risks were calculated using concentrations that were estimated using the “Down-the-Drain” module of USEPA’s E-FAST model. The possible adverse human health risks were determined to be virtually zero; which corroborated with the results of a similar assessment conducted by the European Union.

**Human Health and Ecological Risk Assessments for Cornell University.** ChemRisk managed activities and public interaction initiatives on a human health and ecological risk assessment project for Cornell University. The assessments were conducted to determine appropriate remedial actions for a radioactive waste disposal site that operated from 1956 to 1978.

**Research Facility Assessment for Chemicals and Radionuclides.** ChemRisk conducted a site characterization and review of the risk analysis activities that had been conducted for a 2,668-acre aeronautics, nuclear, and general research facility. This facility had experienced environmental contamination in the form of chemicals and radionuclides from operations that included rocket engine testing and nuclear reactor research.

**Technical Review of Proposed Perchlorate Drinking Water Guidelines.** ChemRisk prepared technical comments on the draft document entitled Public Health Goal for Perchlorate In Drinking Water prepared by the Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency. Specifically addressed the use of a 10-fold uncertainty factor to account for sensitive subpopulations, such as fetuses, infants, and pregnant women, to the effects of perchlorate. Evaluated several issues related to this topic: 1) iodide deficiency and dietary iodide intake in the U.S., 2) potential adverse health effects associated with iodide deficiency, 3) epidemiologic studies on thyroid function of infants or children exposed to perchlorate in drinking water, and 4) treatment of infants with congenital hypothyroidism or insufficient thyroid hormone levels

**Radioactive Effluent Assessment.** A ChemRisk scientist led a radioactive effluent assessment program for a two-unit boiling water reactor nuclear power plant in its construction, startup, and operational phases. Work included effluent monitoring procedures and controls, meteorological monitoring and dispersion modeling, emergency planning and response, training, routine and emergency dose assessment, off-site monitoring teams, and assistance with environmental monitoring. A unique dispersion modeling method was developed that reflected the effects of the complex terrain, a wind tunnel study of local dispersion patterns of plant effluents was conducted, and the capability to perform atmospheric tracer studies was evaluated. Surface water dispersion patterns in the Susquehanna River were also studied through the use of fluorescent tracer dyes.

**Human Health Risk Assessment of Residents Located Near a Former Manufactured Gas Plant (MGP) site.** For this project, ChemRisk evaluated the environmental data, including vapor emissions and air concentrations, related to the former site and residential areas and used the results to conduct human health risk assessments of individual properties, including environmental fate and transport modeling of soil and groundwater contaminants. As part of this evaluation, a risk assessment conducted by another consultant was reviewed and critiqued.

**Historical Exposure Reconstruction for Residential Groundwater Impacted by a Manufacturing Facility.** ChemRisk evaluated potential human health effects for residents who were potentially exposed to TCE in indoor air as a result of vapor intrusion from groundwater that was impacted by a manufacturing facility in New York. The retrospective exposure analysis involved modeling historical groundwater concentrations and subsequent indoor vapor intrusion. The result was a bounding estimate of likely TCE exposures over time.

**Human Health Risk Assessment for a Former Integrated Iron and Steel Facility in New York.** ChemRisk evaluated over 104 solid waste management units (SWMUs) and five water courses for various chemical constituents identified at the site. Health-protective remediation goals for chemicals of concern (benzene in groundwater, and PAHs related to various process waste streams and coal tars) were developed, and both site-wide and SWMU-specific human health risk assessments were conducted. Interaction with both USEPA Region 2 and the New York State Department of Environmental Conservation (NYSDEC) was part of this on-going project as progress was made in moving the site from closure in the RCRA Corrective Action Program to redevelopment within NYSDEC's Voluntary Cleanup Program.

**Human Health Risk Assessments for a Compressor Station and Ball Launching Station.** ChemRisk evaluated residual risks to on-site workers exposed to BTEX constituents (benzene, toluene, ethylbenzene, and xylenes) in soil and groundwater at two sites in West Virginia. Volatilization modeling was utilized to assess BTEX inhalation, and fate and transport modeling was conducted to determine potential migration of chemicals from groundwater to nearby surface water.

**Human Health Risk Assessment for a 1,400-Acre Historical Chemical Production Site in Painesville, Ohio.** ChemRisk performed a complex risk assessment involving multiple chemicals, media, and exposure scenarios. The assessment was conducted in accordance with the Ohio EPA Voluntary Action Program to determine end-use specific human health risks for each study. Human health impacts from and ecological impacts to the Grand River and Lake Erie were also evaluated.

**Evaluation, Review and Comment of Drinking Water Evaluations for Pesticide Reregistration.** ChemRisk is currently conducting a large-scale review of numerous risk assessments, exposure assessments, and supporting documentation for pesticides that are included in EPA's Reregistration program under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The purpose of this evaluation is to understand the drinking water exposures evaluated by the EPA; including the contribution of surface water and/or groundwater to community water systems, the monitoring data that has been collected, and modeling approaches that are used.

**Evaluation of Intervention Options for an Elementary School Impacted by Groundwater Contamination.** ChemRisk assessed the potential risk from vapor intrusion of TCE, TECE, cis-1,2-DCE and vinyl chloride into a school resulting from a contaminated groundwater plume that had migrated from an adjacent sheet metal production facility. The risk assessment included evaluation of indoor air monitoring data, analysis of TCE plume migration and modeling of groundwater and indoor air to predict TCE concentrations. Results of the risk assessment concluded that the in-place remedial interventions were sufficient.

**Imminent Hazard Evaluation of Vinyl Chloride in Onsite Surface Waters at Multiple SWMU RCRA Facilities in Northeastern Ohio.** ChemRisk evaluated the human health risks associated with onsite and offsite exposures to vinyl chloride in local surface water. Acute, subchronic, and chronic effects due to onsite recreational and offsite residential exposures via vapor inhalation were evaluated. USEPA methods were used to estimate vapor emissions from surface water in conjunction with the box and ISCST2 models to estimate onsite and offsite air concentrations, respectively.

**Chemical Manufacturing Plant Soil, Sediment and Groundwater Assessment.** ChemRisk conducted this risk assessment for a chemical production facility in the Virgin Islands. Exposures to chemicals in surface soil, groundwater and sediment were evaluated for industrial and construction workers, adult and juvenile trespassers, and adult and child residents (including a showering scenario). This assessment included the evaluation of various metals and organic chemicals.

**Contaminated Groundwater Assessment.** ChemRisk conducted an exposure assessment for an aquifer contaminated by former oil refinery and fuel storage operations at a facility located in Ohio. This project involved air monitoring inside residents' basements or crawlspaces, at homes located above the contamination plume and in homes located outside the bounds of the plume. Extensive risk communication was conducted during resident interviews, and results reports and toll-free hotlines were established in conjunction with the local health department.

**Human Health Evaluation for a Hazardous Waste Incinerator.** As part of the permitting application for a hazardous waste incinerator, ChemRisk® calculated public exposure doses for various chemicals via inhalation, dermal contact, as well as for ingestion of soil, plants, water, mother's milk, and meat and dairy products. Concentrations were estimated for heavy metals, dioxins, PCBs, and volatile organic solvents present in wastes received by the incinerator (including products of incomplete combustion) in air, soil, surface water, fish, and plants due to deposition and uptake. The risk assessment was reviewed by the public and approved by the Bay Area Air Quality Management District, California EPA, USEPA Region 9, and Environmental Toxicology International for the City of Martinez, CA. Numerous public meetings were conducted during the review process.

**Soil and Groundwater Modeling Following a Diesel Fuel Pipeline Rupture.** ChemRisk performed a fate and transport evaluation of No. 2 diesel fuel in soils and groundwater due to a pipeline rupture in northeast Indiana. A linear equilibrium partitioning approach was used to determine groundwater concentrations due to the leaching of No. 2 diesel fuel from soils and the GLEAMS model was used to predict the concentration of diesel fuel in surface runoff from impacted soils. The results of groundwater and surface runoff modeling were used to predict concentrations of No. 2 diesel fuel that would impact local streams in the future.

**Independent Third Party Risk Assessment Peer Review.** On behalf of the Pennsylvania Department of Environmental protection (PADEP), ChemRisk reviewed and critiqued various risk assessment reports that had been submitted to the Department for sites undergoing closure through the Pennsylvania Land Recycling Act (Act 2). The reviews involved the evaluation of the site-specific risk assessments for scientific validity and completeness. Examples of risk



assessments reviewed include those for a former steel slag landfill, former petroleum products storage facilities, gas stations, and miscellaneous manufacturing sites.

### **Samples of Relevant AMEC Earth and Environmental Project Experience**

#### **Independent Technical Review of the Los Alamos Hydrogeologic Characterization Program.**

In 2001, AMEC staff participated in an Independent Review of the Los Alamos Hydrogeologic Characterization Program being performed by LANL staff. The review, requested by Department of Energy Albuquerque Operations Office, was jointly sponsored by the DOE/AL Environmental Restoration Division, the Office of Environmental Management's Office of Project Management, and the National Nuclear Security Administration's Office of Defense Programs' Office of Project Management. The objective of the review was to convene a team of technical experts to review existing information and data in order to provide recommendation to improve the Hydrogeologic Characterization Program. The review team's recommended that LANL staff perform an analysis of all the data collected to date and prepare a comprehensive report that summarizes their understanding of the groundwater system beneath the Pajarito Plateau. The review team anticipated that the objective of the program could then be transitioned from that of characterization to establishment of a groundwater monitoring network that would consist of approximately 10 strategically placed single-screen monitoring wells. The team recommended ways to decrease the cost of wells, reduce the cost of chemical analyses, minimize the time drilling rigs are on-site, and optimize the suite of geophysical logs run in the boreholes. The team also recommended methods to further develop communications and collaboration with NMED, including jointly identifying deliverables and prioritizing data needs.

**Santa Fe Municipal Watershed Management Study.** AMEC was retained by the Santa Fe National Forest to perform a soil and water resource effects analysis in support of the EIS for treatment options designed to reduce the risk of catastrophic fire in the Watershed. The project considered effects of treatments (including No Action / catastrophic fire) on Santa Fe River peak flows / flooding potential, erosion, and Watershed water yield. Results of AMEC's analyses provided quantitative estimates of the volume of sediments likely to be washed into the City's water supply reservoirs in the watershed, as well as the expected extent of downtown flooding from heavy rains on the watershed following a catastrophic fire. Prior to this analysis, community leaders were warned of possibly dire consequences should the fuels buildup in the watershed be ignored, but no quantitative values were available upon which to plan watershed treatments.

**Two Mile Dam, Santa Fe, New Mexico.** AMEC performed geotechnical investigation and static and seismic analysis of a 70-foot high earthen dam built in 1892, considered the oldest "high" earthen dam built west of the Mississippi. AMEC also provided a remedial action and design plans for the dam, and eventually was involved in the planned breaching and de-commissioning of the dam.

**Pueblo Canyon/Diamond Drive Dam, Los Alamos, New Mexico.** AMEC staff performed geotechnical investigation, static and seismic testing and analysis of the 160-foot high highway embankment on Diamond Drive in Los Alamos, NM for conversion to a flood control dam in response to the increased stormwater runoff caused by the Cerro Grande Fire.

**Pajarito Canyon RCC Dam, Los Alamos, New Mexico.** AMEC performed emergency response services for Los Alamos National Laboratory in response to the Cerro Grande Fire. AMEC and other team members designed and built a Roller Compacted Concrete (RCC) dam in 45 days. AMEC provided dam foundation investigation and testing of tuff bedrock.

**Nichols Dam and McClure Dam, Santa Fe County, New Mexico.** AMEC performed seismic retrofit analysis and design on behalf of the City of Santa Fe water utility for the reservoir system in the Santa Fe municipal watershed. These reservoirs provide over 50% of the City's water supply and stability and safety of these dams is critical to maintaining the ability of the City to access these supplies.

**Santa Fe Municipal Watershed Hydrologic Analysis, New Mexico.** AMEC served as lead hydrologists for Soil and Water effects analysis in support of an EIS that evaluated various management alternatives for the Santa Fe Municipal Watershed. As part of a multidisciplinary team of physical, chemical, and social scientists, AMEC provided quantitative estimates of hydrologic impacts of catastrophic fire and the various treatment alternatives. Hydrologic parameters evaluated included peak flows in the Santa Fe River, annual watershed water yield, erosion, and reservoir sedimentation.

**Surface Water-Groundwater Interactions, San Acacia to San Marcial Reach of the Rio Grande, NM.** On contract to the US Bureau of Reclamation, AMEC performed a comprehensive compilation and analysis of previous studies relevant to improving our understanding of surface water-groundwater interactions along the San Acacia to San Marcial Reach of the Rio Grande in central New Mexico. The initial project task involved compiling background historic and technical information on this reach of the Rio Grande and the adjacent Low Flow Conveyance Channel (LFCC), which was constructed in the 1950s to help ensure the state of New Mexico's ability to meet Rio Grande Compact delivery obligations. Included in the compilation were previous studies relevant to the LFCC and Rio Grande interactions with the underlying alluvial aquifer. Comparing the water elevations in the Rio Grande main channel, the Low Flow Channel, and the monitoring well networks provided snapshots of the surface water-groundwater interactions. Finally, seepage run data for the Rio Grande and the LFCC were compiled and analyzed. Integrating these independent data sets provides a state-of-the-art understanding of surface water-groundwater interactions along this critical reach of the middle Rio Grande where water allocation, scarcity, endangered species, and interstate delivery demands all collide. Results were synthesized into a summary of key conclusions and suggested directions for future research and data collection activities.

**Evapotranspiration Estimation (ET) for the State of New Mexico.** AMEC developed historical daily ET estimates for the State of New Mexico climate divisions. The work included the following four tasks: 1) assigning New Mexico climate divisions to hydrometeorological data grid, 2) identifying appropriate weather data for calculation of reference ET, 3) developing code, and 4) developing crop coefficients and potential ET.

**Groundwater Geochemistry as an Exploration Tool.** AMEC staff conducted research into the use of groundwater geochemistry as an exploration tool for uranium deposits in the Texas Gulf Coastal Plain. Two methods were tested to validate the hypothesis that groundwater geochemistry could be used to support a regional exploration program. Geochemical equilibrium modeling was performed using input data from groundwater samples collected in existing wells to identify areas where target mineral precipitates, such as uraninite and coffinite, could have formed. Two uranium isotopes, 234 and 238, were measured and plotted to identify areas of potential mineralization either in the past or in the present. Both methods were utilized to support a conceptual model and to target areas for further exploration.

**Groundwater Geochemistry for Aquifer Characterization.** AMEC staff participated as Principal Investigator for a multi-million-dollar, multi-year hydrogeologic and geochemical aquifer characterization research program involving more than eight principal aquifers across the 300-square mile Department of Energy Savannah River Site in South Carolina. AMEC staff lead the geochemical and mineralogical characterization of the principal aquifers, while working closely with staff hydrogeologists responsible for well installation and network design. The network was designed to provide baseline data for future studies and to provide a site-wide interpretation of the geology and geochemistry of the Atlantic Coastal Plain Hydrostratigraphic Province.

**Isotope Study, Powder River Basin.** AMEC helped develop an assessment of the potential mixing of water co-produced with the natural gas from coal beds in the Powder River Basin, Wyoming. The water produced from coal has a generally unique isotopic signature when compared to other groundwater and surface water sources, and thus an assessment of various chemical isotopes allows for an assessment of the origin and mixing of water within the watershed system.

**Evapotranspiration Calculations, Southwestern U.S.** AMEC provided services related to calculation of reference evapotranspiration (ET) for use in estimating crop consumptive use study. Calculations of ET were made using a physically-based equation, the ASCE Standardized Penman-Monteith equation. AMEC evaluated ground-based meteorological data for their adequacy in applying the Penman-Monteith equation, conducted comprehensive quality assurance on the existing data, assisted in acquiring additional weather monitoring equipment and evaluated the reliability of using gridded weather data as the basis for estimating reference ET. This work is being done in anticipation of water shortage situations and possible litigation.

**Rio Grande Alluvial Aquifer Testing in the Socorro Basin, NM ISC, Rio Grande Bureau Socorro County, New Mexico.** AMEC performed a series of pumping tests of irrigation wells completed in the Rio Grande shallow alluvial aquifer along the San Acacia to San Antonio reach of the Rio Grande for determination of aquifer parameters. Well test data were analyzed to estimate aquifer transmissivity and storage characteristics

**Rio Grande Low Flow Conveyance Channel Surface Water–Groundwater Interaction.** AMEC was contracted by the USBR to compile and analyze a variety of hydrologic data (both surface water and groundwater) collected over the past several decades with a goal of refining our understanding of surface water – groundwater interactions. The analyses ranged from development of water level maps to determine flow directions and rates, to computation of

shallow aquifer characteristics using complex analytical data inversion models. The results of these analysis have helped provide data and parameters for a physically based surface water – groundwater model currently under development by the New Mexico ISC.

**Rio Gallinas, Hydrologic Evaluation, New Mexico Interstate Stream Commission.** AMEC inventoried, evaluated operational capability and characterized over thirty Rio Gallinas irrigation diversions in the vicinity of Las Vegas. An evaluation of Rio Gallinas streamflow and diversion flow recording was also made. Site inspections resulted in recommendations for physical rehabilitation and enhanced flow measuring facilities. An initial result of this work was to retrofit an abandoned USGS gaging station on the Rio Gallinas to record flows in the lower reach of the river below Las Vegas. Selected improvements have been made to flow measuring and physical diversion facilities on an opportunistic basis. An interim program of flow measuring based on staff gages referenced to current meter measured flow rates has been implemented at many ditches.

**Pecos River Planning and Technical Support.** AMEC has been retained by the New Mexico ISC since 2001 as their lead water resource engineering and hydrology consultants on the Pecos River. In this role, AMEC has undertaken numerous technical investigations, analyses, and planning activities on behalf of the ISC. Included among the tasks are: 1) Development of a Pecos River Adjudication Model, 2) Participation in the Pecos River Re-operations NEPA team and leading the Hydrology Work Group, and 3) Development of a physically based model of bank storage and unidentified reservoir losses in the Brantley Reservoir.

**Pecos River Decision Support System and Data Processing Tools, New Mexico Interstate Stream Commission, Pecos River Basin, New Mexico.** AMEC developed a suite of surface and ground water models and associated tools to simulate hydrology and water operations in the Pecos River Basin for use in evaluating alternatives in the Pecos Adjudication Settlement and two EIS projects. Applications include: 1) Evaluation of alternatives for the Carlsbad Project Operations and Water Conservation EIS; 2) Support negotiations and evaluation of the Pecos River Adjudication Settlement Agreement; 3) Evaluation of impacts of potential water rights administration in the Carlsbad Basin; 4) Carlsbad Project system efficiency evaluations; and 4) Pecos River Accounting System.

**Pecos River Basin Groundwater Modeling, New Mexico.** The New Mexico Interstate Stream Commission (NM-ISC) retained AMEC to assist in the development and application of two groundwater models in the Pecos River Basin— the Roswell Artesian Basin Groundwater Model and the Carlsbad Area Groundwater Model— and contributed to linking these models with the Pecos River RiverWare water operations model. Analyses with these models have been performed in support of the Pecos Consensus Plan, the Lower Pecos Adjudication Settlement, the Carlsbad Project Water Operations and Water Supply Conservation EIS and the Carlsbad Project Miscellaneous Purposes Contract Re-operation EIS, and Pecos River Compact (“Compact”) issues.

**Water Rights Transfer Evaluations, New Mexico.** For various clients in several basins across New Mexico (including private parties and Indian tribes in the Pecos, Roswell, upper and middle Rio Grande, Tularosa, Mimbres, and Zuni Basins), AMEC has provided engineering assistance in evaluating proposed water rights transfers. AMEC has evaluated the validity of transfer-from

water rights according to the OSE criteria, has evaluated impacts at the transfer-to location, has evaluated impacts on intervening water rights, and has developed proposed terms and conditions for transfers. Details of clients and services are confidential.

**Hydrology of Water Acquisition, New Mexico Interstate Stream Commission.** For the Rio Grande Bureau of the NMISC and the Middle Rio Grande Endangered Species Act Collaborative Program, AMEC investigated the effectiveness of water rights acquisition to provide either “wet water” or depletion offsets for supplemental flows in the Middle Rio Grande River to help meet the flow targets of the 2003 Biological Opinion regarding the Rio Grande silvery minnow.

**Southern Roswell Basin Water Resource Investigation, NM ISC, Pecos Bureau Roswell Basin/Pecos River, Chavez and Eddy County, New Mexico.** AMEC has supported the implementation of the NM ISC’s augmentation well field (as called in the Lower Pecos Adjudication Settlement) by providing services that have included acquisition and compilation of historical groundwater level and water quality data for the southern Roswell Basin in the vicinity of Seven Rivers; development and implementation of a regular water level and soil and water quality monitoring program for the Seven Rivers area; water quality equilibrium modeling; and development of a water quality trend prediction based on observed historical data and projections of future pumping in the area.

## B. Meeting the Buckman Direct Diversion Board's Needs

The main need of the BDD Board in procuring professional services for independent peer review is to obtain an overarching analysis and synthesis of available information regarding contaminants in tap water. As clearly stated in the associated RFP, the BDD Board needs knowledge to provide to the citizens of the Santa Fe region regarding exposures and health risks that could result through operation of the Buckman Direct Diversion system,

The BDD Board needs an efficient, effective, and transparent peer review. A peer review can be defined as in-depth critique of assumptions, calculations, extrapolations, alternate interpretations, methodology, and acceptance criteria employed, and of conclusions drawn in the original work.<sup>1</sup> Peer review will confirm or possibly call into question the adequacy of work that has been performed in the past. An effective peer review has the following characteristics:

- expert,
- independent,
- external, and
- technical.

Based on independent critical peer review and evaluation of existing studies and bodies of information, the BDD Board needs that synthesis of relevant information to be formed in a way that will add content and perspective above that provided by the discrete studies and bodies of information considered individually. Based on that synthesis of available information, the BDD Board needs an analysis of regulations and rules that apply to contamination in tap water, the amounts of contaminants that LANL has contributed to the Rio Grande, and amounts of the same contaminants present upstream of LANL's influences.

The BDD Board needs the risks to public health from radionuclides in tap water to be calculated for contamination present 1) at levels equal to Safe Drinking Water Act's Maximum Contaminant Levels (MCLs); 2) at levels recently measured in the Rio Grande; 3) at levels expected to be found in treated tap water after 95% removal of the plutonium, americium, uranium, and gross alpha-emitting radioactivity recently measured in the Rio Grande; and 4) at mean levels of gross alpha-emitting radioactivity and dissolved uranium produced by the Buckman well field as measured by the City of Santa Fe. Those calculated exposures and health risk must then be compared to applicable limits and toxicologic benchmarks and compared to exposures that occur from other sources of the same contaminants in the environment (including natural background radioactivity and fallout from atmospheric weapon testing) and via exposure pathways other than tap water ingestion.

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<sup>1</sup> Peer Review in Environmental Technology Development Programs, The Department of Energy's Office of Science and Technology Committee on the Department of Energy—Office of Science and Technology's Peer Review Program, Board on Radioactive Waste Management, Commission on Geosciences, Environment, and Resources, National Research Council. National Academy Press. Washington, D.C. 1998

The ChemRisk/AMEC peer review team will produce three sets of deliverables that will assist the BDD Board in communicating exposures and health risk information to members of the citizens of the Santa Fe region. The most comprehensive deliverable will be a report that will present the synthesis and analysis of relevant information, the exposure and health risk calculations, and a variety of summaries, comparisons, and graphical presentations to put those contaminant levels, exposures via the various pathways, and associated health risks in perspective. This report, which will serve as documentation of the peer review effort for the Board and technical audiences, will be supplemented with a summary for a lay audience, a Spanish translation of the summary, and a description to be presented to the BDD Board and one of their scheduled meetings.

The project deliverables will be prepared in preliminary draft, public review draft, and final forms, and presentation graphics will be prepared for display and distribution at the three public meetings that will be held during the course of the project.

## **C. Conduct of Work**

A team of scientists and engineers led by ChemRisk will perform the Independent Peer Review by completing the tasks outlined in the Professional Services Work Plan presented in Section E. As specified in RFP #’10/01/P, a detailed work plan and schedule will be issued within two weeks after execution of an agreement between ChemRisk and the City of Santa Fe.

Thomas Widner will serve as Principal Investigator for the Independent Peer Review project. Mr. Widner is a Certified Health Physicist and a Certified Industrial Hygienist with over 25 years of experience in radiological health, occupational health, and health risk assessment. Tom has been Principal Investigator on three of the nation’s largest dose reconstruction projects that have evaluated releases of radionuclides and toxic chemicals from nuclear weapons complex facilities. The project team from ChemRisk will include health physicist and health risk assessor Matthew Le, environmental statistician and health risk assessor Paul Scott, environmental scientist and health risk assessor Erin Shay, and toxicologists James Keenan and Kerry Thuett.

David Galbraith, M.D., will serve as an advisor to the project team for this assignment. Dr. Galbraith is a licensed physician who also has 12 years of life sciences consulting experience. Also serving as a senior advisor to the project team will be Dr. Dennis Paustenbach, the founder and president of ChemRisk. Dennis is a board-certified toxicologist and industrial hygienist with over 25 years of experience in risk assessment, environmental engineering, ecotoxicology, and occupational health. Resumes for ChemRisk team members are presented in Appendix A.

ChemRisk’s capabilities for the Independent Peer Review will be supplemented through a subcontract with AMEC Earth and Environmental (AMEC). AMEC will make available the services of a small group of local scientists with exceptional educational backgrounds and close familiarity with the surface water and ground water hydrology characteristics of a wide variety of settings in New Mexico. They have conducted extensive project work in and near Los Alamos and Santa Fe counties. Dr. Jim McCord has more than 28 years of professional experience in hydrology and water resource investigations, with emphasis on characterization of groundwater and surface water systems, vadose zone hydrology, contaminant hydrology, numerical modeling of hydrologic systems, surface water and groundwater interaction, water rights, river basin planning and management, and stochastic hydrology and geostatistics. Dr. Gregory P. Miller is a professional hydrogeologist with 21 years of practical experience and specialized training in aqueous geochemistry, geostatistics, surface water and ground water testing and modeling, and quality assurance. Dr. Dawn Kaback is a geochemist/geological scientist with more than 30 years of experience providing technical and management services for complex environmental and energy issues.

Also serving as a senior advisor to the Independent Peer Review team will be Dr. Sorab Panday, who has 20 years of experience in water resource modeling. Dr. Panday has developed and applied state-of-the-art models to address a variety of issues including conjunctive surface-water groundwater use and management; surface/subsurface interactions; stream-aquifer interactions in flow and solute transport; and hydraulic management for environmentally sensitive ecosystems.

Resumes for all AMEC Earth and Environmental team members are presented in Appendix B.

The ChemRisk/AMEC team does not see a need to offer alternative proposals for completion of the Independent Peer Review as described in RFP #’10/01/P.



## **D. Adequacy of Budget**

The ChemRisk/AMEC team will work with the BDD Board, staff, and consultants to accomplish a high quality, thorough, defensible, and well communicated Independent Peer Review within the stated budget of \$200,000.

Based on the information available to the members of the ChemRisk/AMEC team at this time, no scope changes or limitations are recognized as necessary to conduct the work within a budget of \$200,000.

## **E. Professional Services Work Plan**

This professional services work plan outlines the components of the professional services that will be performed by the ChemRisk/AMEC team acting as independent peer reviewers representing the Buckman Direct Diversion Board and the methods that are proposed to be used in completion of the work as outlined in RFP #10/01/P. This plan also documents the guaranteed minimum number of professional services hours that will be provided by each of the key individuals on the project team and the firm fixed price for provision of the services described herein.

Within two weeks of execution of a professional services agreement between ChemRisk and the City of Santa Fe, and after potential negotiations and discussions with the BDD project staff and consultants, a more detailed work plan will be prepared and submitted to the BDD Project Manager along with a schedule for completion of the work as described in that plan.

### **E.1 Plan for Provision of Professional Services**

The work to be performed on the Independent Peer Review Project can be divided into the following components:

1. Interactions with the BDD Board, Project Manager, and project staff
2. Review of BDD public communication materials
3. Identification and gathering of relevant information
4. Analysis and synthesis of information relevant to contamination in the tap water of the Santa Fe region
5. Analysis of human exposures and health risks
6. Preparation and refinement of project deliverables
7. Public meeting planning, conduct, and follow-up

Plans for completion of work for each of these components of the project are outlined below.

### **E.1.a Interactions with the BDD Board, Project Manager, and Project Staff**

The ChemRisk/AMEC Peer Review Team will work with the BDD project management and public communications staff initially and at appropriate intervals during the Independent Peer Review so that the BDD Board will be able to accurately and effectively describe and publicize the Independent Peer Review team's engagement, work processes, work products, and conclusions.

ChemRisk proposes to initially meet with BDD Board representatives in person near the outset of work of the project, and meet periodically thereafter in person (when key parties are present in or near Santa Fe) or by teleconference if there are any extended periods when key participants are not in the Santa Fe area. ChemRisk personnel are quite proficient in use of GoToMeeting.com to conduct status meetings via the Internet that effectively integrate visual and audio content and discussion. We propose that brief update meetings with BDD Board representative occur once each month. The purpose of these meetings will be to ensure that all parties are aware of concerns or questions that have arisen, new information that has been gained, recommendations or conclusions that can be offered, and advice that can be shared that will facilitate successful completion of the Independent Peer Review.

It is our experience that it is very hard for a consultant to communicate too much with his or her clients. This frequency can be modified once experience is gained, at the discretion of the BDD representatives. ChemRisk will work with the BDD Board representatives early in the project to determine if a regularly scheduled day each month (such as the second Wednesday of every month at 2 p.m.) would be advisable, or whether the brief meetings will have to be specifically scheduled each month. ChemRisk will ensure that these update meetings are scheduled and that meeting materials, agenda, and summary notes are prepared and distributed.

The ChemRisk/AMEC team will submit a detailed work plan and schedule to the BDD Project Manager within two weeks of execution of the professional services agreement.

Meetings and telephone conferences will also be held with BDD Project staff and consultants in coordination with work plan milestones. These milestones will include completion of the detailed work plan and schedule, completion of the preliminary draft deliverables, completion of public review draft deliverables (including responses to comments from the BDD Board and DOE/LANL), and completion of final deliverables (including responses to public comments). ChemRisk will ensure that these update meetings are scheduled and that meeting materials, agenda, and summary notes are prepared and distributed.

The ChemRisk/AMEC team will make several presentations to the BDD Board at scheduled public meetings of the Board. We understand that the BDD Board meets monthly, usually on the first Thursday of every month at 4:00 p.m. at the Santa Fe County Commission Chambers at 102 Grant Avenue in Santa Fe. In accordance with the information presented in RFP #'10/01/P, the Independent Peer Review team will address will address the BDD Board at its public meetings to present the proposed professional services agreement (possibly on 3 December 2009), to present the public review draft set of

deliverables (possibly on 11 August 2010), and to present the response to public comments and the final deliverables (possibly on 10 November 2010). The ChemRisk/AMEC team will also provide a letter response to any remaining questions from the BDD Board regarding the final set of deliverables.

One item of possible confusion from RFP # '10/01/P regards the timing of the team's addressing of the BDD Board when draft deliverables are completed. Page 15 of the RFP states that the peer reviewer will address the BDD Board at its public meetings to "... present the public review draft set of deliverables..." However, Page 12 of the RFP states that "...the BDD Board wishes to obtain DOE/LANL's review comments regarding the peer reviewer's preliminary draft deliverables and to provide the BDD Board's review comments." If that latter statement means that the BDD Board will comment on the preliminary draft deliverables, ChemRisk will want to clarify whether the Independent Peer Review team will address the BDD Board to present those preliminary draft deliverables, which will be one iteration prior to the public review draft deliverables that are referred to on Page 15.

### **E.1.b Review of BDD Public Communication Materials**

Early on in the Independent Peer Review project, the ChemRisk/AMEC team will meet with the BDD public communications staff and obtain copies of all public communication materials that have been drafted, finalized, and/or distributed regarding contaminants of LANL origin for which peer review is desired.

Based on the review of those materials and discussions with the BDD public communications staff, the Independent Peer Review team will identify any recommendations for correction or improvement of the existing BDD public communications. Items for consideration in those reviews will include (but not be limited to) technical accuracy, timeliness of the included information, suitability of terminology and concepts to the intended audience(s), avoidance of unnecessary complexities, appropriateness of any risk comparisons that are presented, degree of referencing of external sources of information that are utilized, effectiveness of use of graphical presentations of information, and the extent to which relevant but potentially opposing viewpoints are recognized and reflected.

The communication between the BDD public communications staff and the ChemRisk/AMEC team should be open, two-way communication in which the Independent Peer Review team will offer comments and recommendations based on their education and experiences, while the BDD public communications staff should feel free to offer community and project-specific perspective for the Independent Peer Review team to consider as they are drafting risk communication deliverables in the course of the Peer Review.

The recommendation of the ChemRisk/AMEC team members will be documented and discussed with the BDD Project Manager and staff as soon as possible within the schedule of the Independent Peer Review effort.

**E.1.c Identification and Gathering of Relevant Information**

The ChemRisk/AMEC team will identify and obtain the information that they will analyze, critique, and utilize to prepare the meta-level synthesis described in RFP #'10/01/P. While many of the relevant information sources are familiar to the team members, they will not limit their consideration of potentially useful information sources without a thorough review of key reports, their reference lists, databases, and information gained through discussions with recognized data owners. The identification will also include a searching of the 10,000+ documents relevant to LANL releases that are searchable via the DocSleuth database that was build by ChemRisk in CDC's LAHDRA project.

ChemRisk understands that DOE/LANL has agreed to provide relevant studies, reports, and data for use by the Independent Peer Review team's use. ChemRisk will request relevant studies, reports, and data from DOE/LANL and NMED, as appropriate. The team will obtain other relevant information that is available data from its owners. Sources of information that will be examined include the LANL Water Quality Database, the RACER system, and the U.S. Geological Survey, to name a few.

All communication from the ChemRisk/AMEC team to DOE/LANL will be in writing, and will be submitted through the BDD Project Manager. The conduct and communications of Independent Peer Review Team members with the BDD Board and third parties regarding the peer review work will be conducted so as to preserve the independence and credibility of the team's work products. ChemRisk has obtained information that describes the processes used by the National Academy of Sciences in conducting independent peer reviews, and will work with the BDD Project Manager and staff to ensure that no selective or private access by individuals or organizations to the team occurs.

Because the primary focus of the Independent Peer Review effort is to characterize potential doses and health risk from contaminants found in water obtained from the Rio Grande and the Buckman well fields, the information of primary importance to be gathered and evaluated will be measurements of contaminants in those sources of water. The team will collect all relevant measurements and information that will support critiques of the methods and practices used for sample site selection, sampling, sample processing, sample analysis (radiological or chemical), data processing, and data reporting.

An important consideration in characterizing doses and health risk that can be expected from use of tap water from the Rio Grande and/or the Buckman well field is the recognition of any significant changes in concentrations that might be measured in those water sources in the future due to the migration of contaminants of LANL origin in the ground water and/or surface water drainages that have been identified. If contamination might be projected to migrate to those water withdrawal points in the future, it is important to know whether that might occur in 10 years or not for 10,000 years. The ChemRisk/AMEC team will collect and analyze information regarding recognized sources of groundwater contamination from LANL operations and inventories of contaminants that reside in surface water drainage channels.

It is recognized that the following contaminants are among those that have been observed in deep groundwater around LANL:

- Tritium
- Perchlorate
- Chromium
- Nitrate
- High explosives

Modeling done by others that has projected travel times of known contaminants to the Rio Grande and/or the Buckman well fields will be examined and critiqued by the ChemRisk/AMEC team. Based upon that review, information about the extent to which concentrations of contaminants in those water sources might change in the future due to the migration of known contamination will be included in the synthesis of relevant information to the extent supported by the models and modeling approached that were used.

#### **E.1.d Analysis and Synthesis of Collected Information**

The ChemRisk/AMEC team will prepare and present deliverable products that will describe, for technical and non-technical audiences, a critiqued synthesis of existing data, information, studies, and published risk assessment analyses regarding exposure and risk to residents of the Santa Fe region from environmental radionuclide, toxic, and hazardous contaminants known to be of LANL-origin and from other sources of the same contaminants.

The synthesis of available information will emphasize the tap water pathway, including the contaminants in Rio Grande water diverted into the BDD and removed by water treatment processes. The report by Dr. Kerry Howe that characterizes the effectiveness of the proposed water treatment plant in removing radiological contaminants and other materials of interest from water will be a key reference in that regard.

The deliverables prepared by the ChemRisk/AMEC team will illustrate doses and health risks via the tap water pathway in comparison to other pathways and risks. The deliverables will quantify, from existing data, information, and studies, and compare, the tap water pathway exposure risk to other pathways of public exposure to LANL-origin contaminants and other natural and man-made radiation exposures.

The ChemRisk/AMEC team will review pertinent existing studies and bodies of evidence, including evaluating strengths and weaknesses. This review will be followed by the team's synthesis and description of the meta-level risk perspective. The analysis of available information and data will include synthesis of the team's best estimate of the total amounts of contaminants of LANL-origin in the Rio Grande, the distribution of those contributions over time of, comparisons to amounts of those same contaminants in the Rio Grande upstream from LANL influences, comparisons to applicable exposure standards, and comparisons to other pathways of public exposure in the Santa Fe region. For the evaluation of LANL's contributions of plutonium to the Rio Grande, the analyses documented by William L. Graf in his 1994 book "Plutonium and the Rio Grande:

Environmental Change and Contamination in the Nuclear Age” (and the reports on which that publication was based) likely be important information sources.

Because it is not certain if the radionuclide and chemical concentration data will be sufficiently robust to support a probabilistic exposure assessment using Monte Carlo analysis, it is proposed that the uncertainty and variability associated with exposure to contaminants of LANL origin from the Rio Grande be characterized by calculating a central tendency and reasonable upper bound estimate of cancer risk and non-cancer hazard. For the central tendency estimates of exposure, the distribution appropriate mean concentration will be used along with median or average values for the various exposure parameters (drinking water ingestion rate, exposure duration, etc.). For the reasonable upper bound estimates of exposure, the appropriate 95% upper confidence limit (UCL) of the mean will be used along with upper bound values for selected exposure parameters (for example, drinking water ingestion rate and exposure duration).

To characterize the exposure point concentrations for the radionuclides and chemicals of interest for this assessment, the USEPA software package ProUCL will be used. ProUCL is a computer program developed by the USEPA to assist with the estimation of exposure point concentrations and is capable of testing the distribution of the data, applying various statistical method for handling measurements that are below the limit of detection, and estimating mean and 95% UCL concentrations based on the method that is appropriate for the data distribution, sample size, and variance of the data set.

To determine which contaminants of LANL origin may be affecting the Rio Grande surface water, a statistical comparison of the concentrations upstream of Los Alamos canyon and downstream of the canyon will be performed. As a first step the upstream and downstream data will be tested using the Shapiro-Wilks goodness-of-fit test to determine if the data have a normal distribution, lognormal distribution, or neither distribution using ProUCL. For data with concentrations below the limit of detection, the regression on order statistic (ROS) method will be used. For the ROS method, values below the limit of detection are replaced with values consistent with the expected distribution of the data values greater than the limit of detection. Because of the skewed nature of environmental data, the lognormal ROS method was used if the data tested as neither normal nor lognormal.

Depending on the distribution of the data, one of the following methods will be used to determine if downstream concentrations are greater than the upstream concentrations:

- If the upstream and downstream data both have a normal distribution, the Student's two sample t test for comparison of means will be used.
- If the upstream and downstream data both have a lognormal distribution, the Student's two sample t test for comparison of means will be applied to the log transformed data.
- If the upstream and downstream data have neither a normal or lognormal distribution or the data distributions for the two data sets are different, the Wilcoxon rank sum test will be used. The Wilcoxon rank sum test is a

nonparametric test that is used to compare the central tendency of two data sets when the distribution cannot be defined.

### E.1.e Analysis of Human Exposures and Health Risks

The exposure assessment for the Santa Fe Region drinking water assessment will be focused on one primary population of interest: a residential user of publicly-supplied drinking water (i.e., tap water). Residential exposure to contaminant in tap water can occur through household use of tap water via food and drink, showering and bathing, laundering, dishwashing and swimming. Direct exposure to tap water can occur via ingestion, dermal contact, and inhalation, while indirect exposures can include consumption of homegrown produce from gardens watered with tap water, or swimming in a tap water-filled pool.

When showering, inhalation of chemicals in tap water can occur from vapors of volatile chemicals or from aerosolized water particles of non-volatile chemicals. When taking a bath, one is less likely to inhale non-volatile chemicals. Based on our current understanding of the current and potential future drinking water sources for publically-supplied water, the preliminary potential chemicals of interest include non-volatile chemicals such as PCBs, perchlorate, chromium, nitrate, fluorine (soluble fluoride). However, other non-specific chemicals are also of potential interest (e.g. explosives, pharmaceuticals, personal care products, and endocrine disruptors), and it is possible that the final list of chemicals of interest may include volatile chemicals.

The table below identifies some exposure pathways that are typically evaluated for contaminants in tap water. It may be determined that not all these pathways are relevant or represent complete exposure pathways for this assessment. As such, exposure pathways to be included will be evaluated subsequent to a review of available and relevant site-specific information.

**Potential Exposure Pathways for Contaminants in Tap Water**

Household Use of Tap Water	Potential Exposure Pathway	Volatile Contaminant	Non-Volatile Contaminant
Drinking Water	Ingestion via food and water	x	x
Home or Locally Grown Produce	Ingestion of produce	x	x
Showering	Inhalation	x	x
	Dermal contact	x	x
Taking a Bath	Inhalation	x	
	Dermal contact	x	x
Hand Washing	Dermal contact	x	x
Swimming/Hot Tub Use	Inhalation	x	
	Dermal contact	x	

x Indicates that the pathway is potentially complete in many settings.



*Exposure and Dose Estimates*

Exposures will be evaluated for adult and child residents. Because chemicals with known mutagenic modes of action may pose higher risks during early life stages, children's age groupings will be determined once the chemicals of interest have been established and a toxicity assessment has been performed (USEPA, 2005a,b, 2006). Based on necessary adjustments to the toxicity criteria, the USEPA guidance currently recommends that the following age groups are evaluated for mutagenic chemicals: 0-2 years, 2-16 years, 16-18 years. If no chemicals of interest are found to have mutagenic modes of action, a child between the ages of 0-6 years will be evaluated in addition to the adult (USEPA, 1989).

As previously mentioned, exposures will be quantified for central tendency and upper bound scenarios in order to provide a range of potential exposure estimates. For each age group, central tendency and upper bound exposure parameters will also be determined for factors such as body weight, residential tenure, tap water ingestion rates, shower duration and frequency, swimming duration and frequency and home grown produce ingestion rates. *Exposure Factors Handbook* (USEPA, 1997) and *Children's Exposure Factors Handbook* (USEPA, 2008) will be used as the primary sources of exposure parameters, and peer-reviewed literature may also be utilized, as appropriate.

Standard USEPA equations will be used to estimate the doses [mass of chemical per mass of body weight per day (mg/kg-day)] for all chemicals and pathways of exposure determined to be of potential concern. Consistent with USEPA's Risk Assessment Guidance for Superfund, lifetime average daily doses (LADDs) will be calculated for carcinogenic chemicals, and average daily doses (ADDs) will be calculated for non-carcinogenic chemicals, by integrating the exposure parameters and exposure concentrations (USEPA, 1989).

Default USEPA guidance that will be used to conduct the exposure assessment includes:

- USEPA, 1989. Risk assessment guidance for Superfund. Volume I: Human health evaluation manual (Part A). Interim Final. Office of Emergency and Remedial Response. EPA/540/1-89/002. <http://www.epa.gov/superfund/programs/risk/ragsa/>
- USEPA, 1997. Exposure Factors Handbook (EFH). U.S. Environmental Protection Agency, Office of Research and Development: Washington, D.C. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=12464>
- USEPA, 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. <http://www.epa.gov/oswer/riskassessment/ragse/index.htm>
- USEPA, 2005a. Supplemental Guidance for Assessing Cancer Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, Washington, DC. EPA/630/R-30/003F. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=160003>
- USEPA, 2005b. Guidance on Selecting Age Groups for Monitoring and Assessing Childhood Exposures to Environmental Contaminants. Risk Assessment Forum, Washington, DC. EPA/630/P-03/003F. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=146583>

- USEPA, 2006. A Framework for Assessing Health Risks of Environmental Exposures to Children. National Center for Environmental Assessment, Washington, DC. EPA/600/R05/093F. <http://cfpub.epa.gov/ncea/cfm/recorddisplay.cfm?deid=158363>
- USEPA, 2008. Child-Specific Exposure Factors Handbook (Final Report). Washington, DC. EPA/600/R-06/096F. <http://cfpub.epa.gov/ncea/CFM/recorddisplay.cfm?deid=199243>
- USEPA, 2009. USEPA, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Washington, DC. EPA-540-R-070-002. [http://rais.ornl.gov/homepage/RAGS\\_F\\_EPA540R070002.pdf](http://rais.ornl.gov/homepage/RAGS_F_EPA540R070002.pdf)

The ChemRisk/AMEC team will calculate the risk to public health from exposure to hypothetical amounts of radionuclides in tap water using the methodology of Federal Guidance Report No. 13 (EPA 402-R-99-001 (1999 and Suppl. 2002)) for the following four hypothetical, life-long, age-adjusted drinking water exposure scenarios:

- a. For drinking water with contaminant concentrations equal to current federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs);
- b. For drinking water with contaminant concentrations equivalent to actual recent water quality in the Rio Grande;
- c. For drinking water with average exposures to the water contaminants of hypothetical exposure b, above, but with water treatment that removes 95% of plutonium, americium, uranium, and gross alpha; and
- d. For drinking water that contains mean values of gross alpha-emitting radioactivity and dissolved uranium produced by the Buckman well field as measured by the City of Santa Fe at the point-of-entry to the public water distribution system. Associated data are reported for federal Safe Drinking Water Act compliance purposes.

The ChemRisk/AMEC team will compare the exposures and health risks estimated for these hypothetical exposures to exposures from other sources of exposure to ionizing radiation in the Santa Fe region, including other pathways of exposure to contaminants of LANL-origin.

#### **E.1.f Preparation and Refinement of Project Deliverables**

The ChemRisk/AMEC team will prepare, present, and revise written and graphic risk communication deliverables that will meet potential readers' needs and interests at four levels:

1. Summary for a lay audience,
2. Spanish translation of the summary,
3. Description for the BDD Board, and
4. Documentation for the Board and a technical audience.

ChemRisk/AMEC will provide preliminary draft and public review sets of draft risk communication deliverables, formally respond to draft comments, and produce the final set

of deliverables in accordance with the proposed schedule depicted graphically in Section F and shown below in text form:

<b>Milestones and Deliverables</b>	<b>Proposed Date</b>
Executed agreement	12/4/2009
Detailed work plan and schedule	12/18/2009
Recommendations on improvement of BDD public communications	2/12/2010
Preliminary draft set of deliverables	5/15/2010
Public draft deliverables with responses to BDD and LANL comments	8/5/2010
Final set of deliverables with responses to comments	11/4/2010
Letter response to the BDD Board re: questions on the final deliverables	12/31/2010

The preparation of these deliverable products will be compensated by lump sum payments, in accordance with this proposal and subsequent professional services agreement negotiations with BDD staff.

The BDD Board wishes to obtain DOE/LANL's review comments regarding the peer reviewer's preliminary draft deliverables and to provide their own review comments. The ChemRisk/AMEC team will include responses to each DOE/LANL and BDD Board comment in the subsequent draft deliverables that are distributed for public review and comment. Those draft deliverables will clearly identify all changes to the preliminary drafts that LANL and the BDD Board reviewed and why the changes were made.

#### **E.1.g Public Meeting Planning, Conduct, and Follow-up**

The ChemRisk/AMEC team will conduct three public meetings, and will provide all arrangements and logistics for these meetings. The first meeting is to introduce this professional services effort to the Santa Fe community in order to elicit, understand, and respond to public questions and concerns regarding LANL-origin environmental contamination and the Buckman tap water pathway. The second meeting is to provide an overview of peer reviewer's work and draft reports. The third is to present the final reports and the responses to comments received on the drafts.

RFP #10/01/P states that the initial public meeting shall be conducted prior to December 10, 2009 and the final public meeting shall be conducted no later than November 2010. With those desires in mind, a proposed schedule for public meetings is shown graphically in Section F and in text form below:

<b>Public Meetings of the Independent Peer Review Project</b>	<b>Proposed Date</b>
Public Meeting 1: Introduction of the professional services effort	1/13/2010
Public Meeting 2: Overview of the peer review and the public draft deliverables	8/11/2010
Public Meeting 3: Presentation of the final deliverables	11/10/2010

## E.2 Minimum Hours of Work to be Performed by Key Project Personnel

In accordance with the specifications of RFP #’10/01/P, the following table identifies the **minimum** number of hours that each member of the ChemRisk/AMEC project team will fork on the Independent Peer Review project.

Section G identifies the number of hours that each team member *is anticipated to work* on the project. ChemRisk has no reason to expect that the hours worked by each key individual on the project team will be less than those stated in Section G.

Name	Specialty or Role on Project	Hours
James Keenan	Toxicologist	12
David Galbraith	Medical Doctor (advisor)	4
Mathew Le	Health Physicist, Health Risk Assessor	90
Dennis Paustenbach	Toxicologist, Health Risk Assessor (senior advisor)	4
Paul Scott	Mathematician, Statistician, Health Risk Assessor	90
Erin Shay	Health Risk Assessor	80
Kerry Thuett	Toxicologist	10
Thomas Widner	Principal Investigator, Health Physicist, Health Risk Assessor	140
Dawn Kaback	Geochemist	40
Jim McCord	Hydrologist, Water Resource Investigator	70
Gregory Miller	Hydrogeologist, Geochemist	70
Sorab Panday	Surface Water / Groundwater Modeler (senior advisor)	6
Maria Milla	Certified translator, English to Spanish	~30

### **E.3 Proposed Firm Fixed Price**

ChemRisk offers to provide the Independent Peer Review services on behalf of the BDD Board, supplemented by the services of AMEC Earth and Environmental, for the firm fixed price of \$200,000.00.

Under this offer, it will be necessary for the City of Santa Fe to provide a Non Taxable Transaction Certificate to AMEC Earth and Environmental so that ChemRisk will not be charged New Mexico gross receipts tax.

## **F. Schedule Graphic**

## G. Key Team Members' Levels of Effort

The table below identifies the number of hours that each ChemRisk/AMEC team member is *anticipated to work* on the Independent Peer Review project.

Name	Specialty or Role on Project	Hours
James Keenan	Toxicologist	24
David Galbraith	Medical Doctor (advisor)	9
Mathew Le	Health Physicist, Health Risk Assessor	125
Dennis Paustenbach	Toxicologist, Health Risk Assessor (senior advisor)	9
Paul Scott	Mathematician, Statistician, Health Risk Assessor	125
Erin Shay	Health Risk Assessor	112
Kerry Thuett	Toxicologist	24
Thomas Widner	Principal Investigator, Health Physicist, Health Risk Assessor	195
Dawn Kaback	Geochemist	55
Jim McCord	Hydrologist, Water Resource Investigator	93
Gregory Miller	Hydrogeologist, Geochemist	94
Sorab Panday	Surface Water / Groundwater Modeler (senior advisor)	12
Maria Milla	Certified translator, English to Spanish	~ 60

## H. Client Meetings

As described in Section E.1.a of this proposal, the ChemRisk/AMEC Peer Review Team will address the BDD Board at scheduled public meetings of the Board. We understand that the BDD Board meets monthly, usually on the first Thursday of every month at 4:00 p.m. at the Santa Fe County Commission Chambers at 102 Grant Avenue in Santa Fe.

In accordance with the information presented in RFP #’10/01/P, the Independent Peer Review team will address the BDD Board at its public meetings to present the proposed professional services agreement (possibly on 3 December 2009), to present the public review draft set of deliverables (possibly on 11 August 2010), and to present the response to public comments and the final deliverables (possibly on 10 November 2010).

The ChemRisk/AMEC team will also provide a letter response to any remaining questions from the BDD Board regarding the final set of deliverables.

As described in Section E.1.a of this proposal, one item of possible confusion from RFP # ’10/01/P regards the timing of the team’s addressing of the BDD Board when draft deliverables are completed. Page 15 of the RFP states that the peer reviewer will address the BDD Board at its public meetings to “... present the public review draft set of deliverables...” However, Page 12 of the RFP states that “...the BDD Board wishes to obtain DOE/LANL’s review comments regarding the peer reviewer’s preliminary draft deliverables and to provide the BDD Board’s review comments.” If that latter statement means that the BDD Board will comment on the preliminary draft deliverables, ChemRisk will want to clarify whether the Independent Peer Review team will address the BDD Board to present those preliminary draft deliverables, which will be one iteration prior to the public review draft deliverables that are referred to on Page 15.



## H. Schedule of Payments

ChemRisk proposes that the following schedule of payments be adopted for payments based on achievement of contract deliverables and milestones:

<b>Milestones or Deliverable</b>	<b>Expected Date</b>	<b>Percentage of Firm Fixed Price to be Paid</b>
Recommendations on improvement of BDD public communications	2/12/2010	10
Preliminary draft set of deliverables	5/15/2010	30
Public draft deliverables with responses to BDD and LANL comments	8/5/2010	25
Final set of deliverables with responses to comments	11/4/2010	25
Letter response to the BDD Board re: questions on the final deliverables	12/31/2010	10