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**ENVIRONMENTAL CONSULTING
QUALIFICATIONS OF
ENVIRONMENTAL RISK SCIENCES, INC.**

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ERS

**AN INTRODUCTION TO
ENVIRONMENTAL RISK SCIENCES, INC.**

Environmental Risk Sciences, Inc. (ERS) is an environmental health consulting firm providing services in the areas of health risk assessment, environmental fate and transport modeling, environmental toxicology, and hazardous waste risk management. Although our professional staff are experienced in many technical areas of environmental consulting, the preparation and review of health risk assessments is our primary business specialty.

Risk assessment is rapidly becoming the chosen method by which regulatory agencies evaluate the potential human health risks posed by environmental pollutants. Well established regulations such as TSCA, RCRA, and CERCLA (Superfund) and the recent requirements of The Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) demonstrate the importance of health risk assessment to the regulatory community. ERS has a long history of working closely with regulatory officials in evaluating contamination sources, including air, water and soil. We are dedicated to developing health risk assessments using state-of-the-art methodologies and our proven experience enables us to assist our clients in analyzing the potential health impacts resulting from a wide range of environmental contamination sources.

ERS is a full service risk assessment firm with staff trained in the many scientific disciplines relating to health risk assessment. These subject areas include environmental health science, chemistry, biology, ecology, ground water hydrology, statistics, toxicology, mathematics, public health, and environmental fate modeling. This complementary interdisciplinary training and experience enables us to provide consulting services of the highest technical quality over a wide range of subject areas. Our specific areas of consulting expertise relating to risk assessment include the following subject areas and topics:

- ecological risk assessment
- air dispersion modeling
- environmental toxicology
- expert witness testimony
- permit applications and licensing assistance
- agricultural development sites
- exposure assessment
- ground water modeling
- environmental statistics
- environmental audits

We are pleased to present this statement of qualifications which describes our experience and approach to health risk assessment.

APPROACH TO PREPARING HEALTH RISK ASSESSMENTS

Health risk assessments are designed to evaluate and quantify the potential adverse health effects posed by health hazards. ERS uses a two-tiered approach in conducting health risk assessments, involving screening and formal analyses. Screening analyses use a series of health conservative assumptions to provide a first approximation of potential health risks. If the estimated risks are negligible, the risk assessor will be assured that no further analyses are needed. If the screening analysis provides health risk estimates of significant concern, a formal analysis utilizing more detailed assumptions is required. Preparing health risk assessments using this methodology allows the risk assessor to focus on the more potentially hazardous pollution sources without discounting the health risks posed by less serious contamination.

ERS utilizes a health risk assessment model based on guidance supplied by the U.S. Environmental Protection Agency and the California Department of Health Services. These guidelines separate risk assessments into four sections: Hazard Identification, Dose-Response Assessment, Exposure Assessment, and Risk Characterization.

Hazard Identification

The first task in a health risk assessment is Hazard Identification. This task consists of two steps: 1) identification of the potentially hazardous compounds (both carcinogenic and noncarcinogenic) at an emission source, and 2) evaluating the geographic and demographic characteristics of the exposed human populations. The identification of potentially toxic substances is facilitated by constructing an emissions inventory of the specific pollution sources. Air emissions resulting from an industrial operation are estimated based on actual facility measurements or on published measurements of similar facilities. Chemical concentrations of pollutants released from soil/water sources are generally estimated based on samples obtained from the pollution source or environmental fate estimations developed from physical/chemical and environmental transport properties of the identified pollutants.

The second part of hazard identification evaluates the exposed population's location and proximity to the pollution source. This involves identifying the boundaries of the study area and defining the area's geographic and demographic patterns. The identification and description of human populations that are particularly sensitive to the proposed chemical emissions are also completed during this step. Sensitive receptors include pre-school and elementary school children and individuals residing in nursing homes and staying in hospitals.

Dose-Response Assessment

The second task in a health risk assessment is Dose-Response Assessment. In this task, the toxicology of the emitted pollutants is examined in order to derive the quantitative relationships between chemical exposure and potential adverse health effects. Toxicology data for most of the common environmental pollutants are supplied by regulatory agencies, such as the U.S. Environmental Protection Agency, the Occupational Safety and Health Administration (OSHA), and the California Department of Health Services. In addition, many pollutants have not received adequate evaluation and the experience of our staff is essential in reviewing the health effects literature in order to derive health criteria for chemicals less frequently encountered in the environment.

Approaches to dose-response assessment depend strongly on the individual toxic substances detected at the study site. The toxic effects of carcinogens are assumed to have no thresholds and, therefore, all levels of exposure, no matter how low, are assumed to contribute to the human health risk. The potential for a chemical to induce a carcinogenic effect is expressed as its cancer potency factor (also called "slope factor"). Chemicals thought to induce only noncarcinogenic effects are believed to possess thresholds, dose levels below which no adverse health effects are expected to occur. The level of exposure corresponding to this threshold is known as the reference dose (RfD), also called the acceptable daily intake (ADI). The toxicity values for both carcinogens and noncarcinogens are combined with estimates of exposure to estimate the magnitude of potential health risk to an exposed population.

Exposure Assessment

The third task in a health risk assessment is Exposure Assessment. In this task, the amounts of the chemical pollutants that may come in contact with individuals in the exposed human population are estimated. Exposure assessment involves the application of pollutant transport models and an identification of the appropriate exposure routes for the exposed populations. The results of the exposure assessment provide a probable range of exposure estimates throughout the potentially exposed population since individuals of different ages, life-styles, and locations with respect to the pollution source account for real variations in long term exposure levels over an entire study population.

Exposure assessment consists of two steps. The first step describes how the individual pollutants are transported, partitioned, and eventually concentrated in various environmental media, including air, water, soil, sediment, human food, and biota. Dispersion models and transport models for air, ground water, and surface water are applied using local topographical and meteorological information to estimate chemical concentrations of pollutants at potential exposure point

locations throughout the study area. As a result of this exercise, the concentrations of the pollutants in different environmental media at the points of human contact can be estimated.

The second step of the exposure assessment analysis is designed to estimate the amount of chemical pollutants that may enter the bodies of exposed individuals. This task is completed by predicting how much of the various environmental media are contacted and eventually absorbed by each exposed individual. Rates of pollutant uptake, called exposure factors, are derived for all environmental media that may contribute to exposures, possibly including, for example, estimates of the amount of soil ingested each day, the volume of air breathed each day, and the amount of fish consumed from nearby surface water sources. Chronic exposures are then estimated as daily intakes averaged over a total lifetime of exposure in units of mg of contaminant per kg body weight per day. Acute, short-term exposures are estimated for exposure periods of shorter durations ranging from hours to weeks. The exposure assessment process determines the fraction of ingested and inhaled pollutants that are absorbed, distributed, and metabolized in the human body. Pollutants not absorbed into the metabolic processes of individuals are generally presumed not to contribute to adverse health effects in an exposed population.

Risk Characterization

The fourth, and last section of a health risk assessment is Risk Characterization. For this task, health risks directly attributable to exposures to both carcinogens and noncarcinogens are estimated. Health risk estimates to both the maximally exposed individual (MEI) and the average exposed individual (AEI) are generally derived. Risk due to exposure to carcinogens in all modeled environmental media is presented as the number of cases of cancer expected out of a given population size (usually expressed as the number of cancer cases per million potentially exposed individuals). Noncancer health risks are estimated by assuming that the health effects produced by these substances have thresholds (i.e., health effects only exist when contaminant exposures are greater than the levels assumed to be safe). Exposures to pollutants responsible for noncancer health effects are compared to the reference dose derived for each substance.

An essential component of risk characterization is the analysis of uncertainty in the risk estimates. Two types of uncertainty are commonly analyzed: emissions uncertainty and model uncertainty. Emissions uncertainty involves presenting the range of concentration estimates for the pollutants emitted to the environment. This step can be relatively straightforward as when emissions come from point sources, or can be extremely complicated such as the case for leachate from buried waste entering groundwater. Model uncertainty is the uncertainty due to the inaccuracies between the mathematical representation of a system and the system's actual physical behavior. Using a series of mathematical techniques ranging from error

propagation, Monte Carlo analysis, or sensitivity analysis, the relative uncertainties of the model can be evaluated to estimate both an overall uncertainty level in the total risk estimate and/or the relative contribution of uncertainty from each input into the total risk assessment model.

Following the completion of the health risk assessment, ERS staff support their work product throughout the entire risk management process. We have provided expert testimony in many public forums both in defending our work and in presenting reviews of risk assessments completed by other project teams. ERS staff have significant experience in negotiating and working with regulatory agency staff on a wide variety of project sites, including proposed Superfund sites, RCRA facilities, and proposed agricultural development property.

The next section of our statement of qualifications provides brief descriptions of the health risk assessments we have prepared on behalf of a wide range of clients.

HEALTH RISK ASSESSMENTS

ERS staff have completed health risk assessments for sources characterized by a wide variety of environmental contamination. Our project experience includes risk assessments for NPL hazardous waste (Superfund) sites, proposed real estate development sites from both agricultural and existing commercial properties, manufactured gas (coal gas) sites, pesticide contaminated sites, solid waste landfills, indoor air pollution, and estimation of health risks based on workplace exposures. ERS has also critically reviewed health risk assessments for many clients, the majority involving litigation related projects.

ERS has developed three specific areas of expertise in health risk assessment based on our extensive professional experience: pesticide contaminated sites, hazardous waste sites, and proposed real estate development property. We have an up-to-date library containing hundreds of research articles and publications on these particular subject areas. In addition, ERS has considerable expertise in the following health risk assessment subject areas: permitting projects involving airborne (outdoor and indoor) contaminants, cogeneration plants, and resource recovery facilities.

The following projects summarize the health risk assessments completed recently by ERS, Inc.:

U.S. EPA Superfund Site Endangerment Assessment:

Currently preparing an endangerment assessment for a former pole yard facility in the California Central Valley that is on the U.S. EPA National Priorities List. Analysis includes the evaluation of exposures and potential health risks for chemical contaminants including dioxins, creosote, and pentachlorophenol. Topics of concern included the impacts of the proposed remedial alternatives on human health risk and the extent of contamination at local drinking water sources. The potential exposures and health risks resulting from fugitive dust and excavation activities are of particular concern. In addition, a quantitative risk assessment of the nature and extent of potential ecosystem damage resulting from exposure to the site's contaminants will be prepared.

Health Risk Assessment for Diesel Fuel Soil Contamination:

Prepared a health risk assessment for a site containing approximately 600 yd³ of soil contaminated with diesel fuel at an approximate 20 foot depth. Topics of concern included estimating the potential migration rates of diesel fuel via volatilization that could reach the soil surface and impact individuals on-site using both equilibrium and non-equilibrium conditions. Prepared for private client.

U.S. EPA Superfund Site Health Risk Assessment:

Currently evaluating the health risks attributable to ground water contamination at the Sacramento Army Depot, a National Priorities List (NPL) site. Analysis prepared as a part of the ground water treatment system Operable Unit Feasibility Study (OUFS) that focused on evaluating the baseline risks via ground water ingestion and the proposed remedial alternatives for ground water contamination. Ground water contains a variety of volatile organic solvents including trichloroethylene, tetrachloroethylene, 1,2-dichloroethylene, and 1,1-dichloroethane. Inhalation was the primary exposure pathway of concern for the ground water remedial alternatives. Analysis followed specifically the methodology presented in the Superfund Public Health Evaluation Manual and the Superfund Exposure Assessment Manual.

Manufactured Gas Plant Site Health Risk Assessment:

Analyzed the potential human health risks due to polycyclic aromatic hydrocarbon (PAH) volatilization and fugitive dust emissions of coal tar compounds, emphasizing exposures to workers during site excavation, exposures to the surrounding community during site excavation and steady state conditions, emissions through an asphalt cover placed on top of the site, and the health risks due to diffusion and pressure driven flow of volatilized contaminants that would migrate through the concrete foundation of a proposed office building proposed for the excavated site. Also, developed a back calculation analysis to estimate the soil concentrations of carcinogenic PAH compounds necessary to produce a lifetime cancer risk of one in a million in exposed building workers, excavation workers, and nearby residents. Prepared for Southern California Edison and the Southern California Gas Company, under subcontract to Alanova, Incorporated.

U.S. EPA Superfund Site Health Risk Assessment:

Prepared a health risk assessment for dioxin, heavy metal, and pesticide contamination at the Baird & McGuire hazardous waste site in Holbrook, MA. At the time of the completion of the risk assessment, the Baird & McGuire site was ranked #14 on the U.S. EPA National Priorities List. The study area was divided into 11 separate zones to allow risk managers to choose area specific remedial technologies for different locations at the site. The analysis focused on the potential health risks to individuals coming in contact with soil, groundwater, and surface water located in the study area. Submitted to the U.S. EPA Region I as part of a remedial investigation study. Prepared for GHR Engineering, Inc. under contract to NUS Corporation.

Health Risk Assessment for Solid Waste Landfill:

Currently preparing a health risk assessment for the Gardenia Valley 1 & 2 landfill in Carson, California. The property, listed on the State of California Expenditure Plan List (State Superfund List), has been proposed for residential development. Exposure routes of primary concern included inhalation of soil gas in ambient air and fugitive dust, ingestion of surface soil and ground water, and the dermal absorption of soil-bound organics. Health risks following the installation of a soil gas collection system estimated the risk reduction contributed by the remedial alternatives. Prepared under contract to Bryan A. Stirrat and Associates and reviewed by the Department of Health Services, Toxic Substances Control Program, Sacramento, CA.

Health Risk Assessment for Commercial Facility Property Transfer:

Prepared a health risk assessment for a commercial property in Alameda County, California, as part of an underground tank closure and a property transfer assessment. Over 40 organic compounds have been detected in soil and ground water at the property requiring the selection of a subset of indicator chemicals. Ground water and air transport modeling estimated contaminant concentrations at the potential points of human exposure throughout the study area. Direct contact of contaminated soil was a concern for the onsite workers. Analysis prepared following U.S. EPA Superfund and DHS risk assessment guidance and submitted to the Alameda County Health Department and the Regional Water Quality Control Board.

Health Risk Assessment for Phenols and Sulfates in Soil:

Currently evaluating the potential human health risks and ecological effects resulting from the migration and transport of phenols and sulfates from onsite salt cake and solar pond impoundments. Pathways analyzed in the HRA included direct contact, fugitive dust migration, ground water and surface water transport. A primary concern to the regulatory agencies is the potential impacts that sulfates and phenols may have on local ground water municipal wells that may be used in the case of severe drought. Soil and ground water clean-up levels derived based on a risk assessment approach for use in the Feasibility Study. Analysis was prepared to follow U.S. EPA risk assessment and ecological assessment Superfund guidance, and submitted to the local Regional Water Quality Control Board.

Preliminary Health Risk Assessment for Abandoned Dry Cleaning Facility:
Derived air and water Applied Action Levels (AALs) for 11 organic compounds identified in ground water and soil at an abandoned dry cleaning facility in the Central Valley. Prepared a 3-4 page toxicity and environmental fate profile for each of the identified compounds. AALs utilized in a preliminary health risk assessment prepared for the Central Valley DHS office using The California Site Mitigation Decision Tree Manual. Health risks were estimated for potentially exposed adults and children.

Health Risk Assessment for Pesticide Contaminated Site:

Under subcontract to an engineering consulting firm, ERS prepared a health risk assessment analysis for a pesticide containment structure located in central California. Analysis focused on the potential for pesticides to enter the underlying unsaturated and saturated zones, the preparation of a water balance model for the site, estimation of pesticide concentrations entering the aquifer using a physical analytical model, and the modeling of pesticide ground water levels at the nearest drinking water well. Toxicity and environmental fate profiles were prepared for the 23 pesticides identified at the site. Analysis submitted to the DHS and the regional Water Quality Control Board.

Health Risk Assessment for Aeration of Gasoline Contaminated Soil:

Estimated health risks attributed to vaporized gasoline compounds during aeration of contaminated soil at a LUST site in Sacramento. Application of PTDIS, a U.S. EPA UNAMAP model, to estimate ambient contaminations during aeration period. Risk assessment analyzed potential health risks for the maximally exposed individual (MEI) in the study area. Submitted to the Sacramento County Air Pollution Control District (APCD). Private client.

Health Risk Assessment for Municipal Waste Landfill Gas Emissions:

Under subcontract to an engineering firm, evaluated the gaseous emissions from the Bailard landfill in Ventura County, California for their potential to pose a health risk to nearby residents. Ambient air concentrations and subsequent inhalation exposures at the maximum impact point were estimated using the ISCST ambient air dispersion model. Analysis was submitted to the Ventura County APCD which permitted the construction of a gas ventilation system at the landfill following review of the health risk assessment.

Health Risk Assessment for Solid Waste Landfill:

Prepared a health risk assessment screening analysis for a proposed solid waste landfill in Douglas, MA. Analysis was conducted prior to landfill construction to assess the potential human health risks that may result from the formation and release of leachate and airborne volatilization taking into account the hydrogeology, topography, ground water usage, and demographics of the particular area. Extensive review of the literature provided estimates of contaminant formation rates in landfill leachate and air. Prepared for private client.

Review of U.S. EPA Health and Environmental Risk Assessment:

Critical review of a U.S. EPA Draft Report regarding the potential health and environmental risks resulting from exposures to wastes produced by onshore oil, gas, and geothermal energy exploration. Specific topics covered in the review included a critique of the specified vadose and saturated zone groundwater models, verifying the carcinogenic and noncarcinogenic risks derived in the report, and preparing an analysis describing the comparative perspective of the health risks. Prepared for the American Petroleum Institute.

Health Risk Assessment for Aeration of Gasoline Contaminated Soil:

Prepared a health risk assessment analyzing the cancer risk resulting from inhalation exposure to gasoline vapor emissions during aeration of contaminated soil at a Sacramento County LUST site. Applied a U.S. EPA UNAMAP dispersion model (PTDIS) to estimate the ambient concentrations of benzene. Maximum exposed individual (MEI) and average concentrations across the study area were estimated. Prepared under subcontract to an engineering firm.

Screening Analysis of the Health Risks of a Cogeneration Plant:

Under subcontract to Alanova, Incorporated, the potential health risks resulting from the formation of nitrosamines in the emissions of a cogeneration plant were evaluated in a screening level analysis. Prepared a summary of the environmental fate properties of diethylamine and provided risk calculations for the appropriate human exposure pathways.

Review of Hazardous Waste Site Risk Assessment:

Critically reviewed a health risk assessment prepared by an environmental consulting firm for a private client in New England. Comments submitted to the client recommended that the risk assessment be reanalyzed to incorporate a series of innovative analytical techniques not present in the initial submission. The reanalyzed risk assessment has recently been accepted by the appropriate state environmental agency, and remediation is underway.

Shoe Manufacturer Risk Assessment:

Prepared a health risk assessment to estimate the potential cancer risk to shoe factory workers exposed to a variety of organic solvents, including trichloroethylene. Report prepared as part of an environmental audit. Private client.

Endangerment Assessment Review:

As part of a research team, prepared a critical review of an endangerment assessment for a former smelter site prepared by a large environmental consulting firm for the U.S. EPA Region VIII. The review included an evaluation of the influence of arsenic speciation on absorption, physiological distribution and metabolism, toxicity, and the presence of arsenic in food products. Prepared for Anaconda Minerals Company.

Review of Environmental Audit Risk Assessment:

Review of a screening analysis for a health risk assessment that estimated the potential health risks experienced by employees handling large quantities of several organic solvents at a chemical supply facility. Analysis included an estimation of the quantity of compounds that will volatilize in the workplace and the incidental ingestion of the critical compounds. Risk assessment prepared as part of an environmental audit. Private client.

Health Risk Assessment for Property with Surface Soil Lead:

Retained by a northern California law firm to prepare an analysis for a property with high levels of lead in surface soil. The potentially exposed populations of concern include the onsite construction workers involved in soil moving activities and a residential population located near the site. Exposure assessment required estimating the airborne fraction of soil particles that could be inhaled (<10 μm) during the various soil moving and transport operations conducted at the property. Health risk assessment prepared following U.S. EPA Superfund and Department of Health Services guidance documents.

HEALTH RISK ASSESSMENTS FOR REAL ESTATE DEVELOPMENT SITES

Health Risk Assessment for Border Zone Determination:

Under subcontract to an engineering consulting firm, prepared a health risk assessment for a 100 acre parcel posed for a future development that abuts the Sharpe Army Depot in Lathrop, California, a Superfund site in northern California. Critical concern focused on evaluating the exposures and health risks to the future residents resulting from the migration of volatile organic compounds originating at the Superfund site. Exposure pathways included the inhalation of organics from soil gas from both on-site and off-site sources and the inhalation of organics from an air stripper currently in operation. Analysis submitted to the California Department of Health Services, who designated the parcel as a non-border zone property based on the results of the health risk assessment.

Health Risk Assessment for a Residential Development:

Under contract with the Plymouth Group to prepare a health risk assessment for a real estate development property in Mountain View, California. Primarily used as a nursery, the site is the location of a proposed townhouse development. On-site characterization of contaminants detected several other organochlorine pesticides. Soil cleanup levels for these compounds were estimated using The California Site Mitigation Decision Tree Manual.

Health Risk Assessment for an Agricultural Development Site:

Under subcontract to Kleinfelder, Inc., prepared a health risk assessment for a 900 acre property in Riverside County, California. Site characterization studies detected the organochlorine pesticides, DDD, DDE, DDT, endosulfan I, and endrin aldehyde in residual concentrations around the property which had been used to grow citrus fruits and other products. Risk assessment analyzed potential health risks to the maximally exposed individual (MEI) and the average exposed individual (AEI) via several exposure routes including soil ingestion, dermal absorption and garden produce ingestion. Analysis prepared to follow the guidance of the Superfund Public Health Evaluation Manual and other U.S. EPA guidance documents.

Health Risk Assessment for Proposed Real Estate Development Site:

Under subcontract to Kleinfelder, the potential human health risk resulting from direct and indirect contact with soil containing detectable levels of DDT and DDE was evaluated for a potential real estate development site in Imperial Valley, California. Analysis included the potential risks via soil ingestion and wind blown dust as a baseline calculation for the future residents of the site. The potential health risks following development of the property were also estimated for a variety of remedial action conditions.

Health Risk Assessment for Pesticide and PAH Contaminated Property:

Under subcontract to an engineering firm, prepared a health risk assessment for a property having organochlorine pesticides in surface soils and polycyclic aromatic hydrocarbons (PAHs) in deeper soils. The objective of the HRA was to assess the relative levels of human health risk to individuals having access to the property following construction of a proposed residential housing development. In addition, the impacts of the lower molecular weight PAHs to ground water is a concern to the regulatory agencies. Risk estimates prepared for both a hypothetical maximum exposed individual (MEI) and an average exposed individual (AEI). Analysis submitted to the Department of Health Services, Region I.

Health Risk Assessment for a Residential Development:

Prepared a health risk assessment for a proposed housing development property, the site of a former nursery. Health risk analysis of the property detected levels of delta-BHC, gamma-BHC, chlordane, dieldrin, DDT, DDD, DDE and endosulfan in surface soils. With the direct exposure routes of concern consisting of ingestion and dermal absorption of soil, the HRA estimated cleanup levels for the soil-bound pesticides. The remedial alternative risk assessment concluded that the residents of the future housing units would be subjected to an insignificant health risk.

Health Risk Assessment for Proposed Residential Development Site:

Retained by The Plymouth Group to prepare a health risk assessment for the Sunnyside Commons Project in Hayward, California; a proposed residential development site. The property, used primarily as the site of a nursery, indicated the presence of several pesticides in surface soil, including DDE, DDT, dieldrin, endosulfan, and endrin. The objective of the HRA was to evaluate the magnitude of potential health risk to the future residents of the housing development. To present a health conservative analysis, the HRA analysis estimated pesticide exposures to both a Maximum Exposed Individual (MEI) and an Average Exposed Individual (AEI). Pesticide levels corresponding to a maximum cancer risk of $<1.0E-06$ were presumed to pose a negligible health risk and soil clean-up levels were derived based on these criteria.

Health Risk Assessment for a Border Zone Determination:

Estimated the potential health effects to individuals exposed to volatile organic compound (VOC) emissions from a nearby Superfund site in northern California, the Sharpe Army Depot. The site studied was a proposed residential housing development that abuts the Depot on the eastern side. The compounds form soil gas and from the air stripper located south of the site. Modeling analysis derived health risk estimates for the Maximum Exposed Individual (MEI) and the Average Exposed Individual (AEI).

Health Risk Assessment for Proposed Development Site:

Prepared a health risk assessment for an agricultural property in Brentwood, California, Contra Costa County, having detectable surface soil levels of DDT, DDE, dieldrin, chlordane, endosulfan and toxaphene. Analysis focused on estimating health risks to the future residents of the proposed residential housing development. Soil pesticide clean-up levels were derived for three lifetime cancer risk levels: 1.0E-06, 5.0E-05 and 1.0E-05. The analysis concluded that the toxaphene surface soil residue was the primary pesticide of concern.

Health Risk Assessment for Citrus Orchard Property:

Evaluated the potential risks to human health resulting from organochlorine pesticides in soil at a site currently used for growing lemons and oranges, but is the proposed location of a residential housing development. Soil characterization studies detected DDT, DDD and DDE at elevated surface soil levels compared to background concentrations. Exposure pathways considered in the HRA were soil ingestion, dermal absorption and the ingestion of garden produce. In addition, the potential health risks to construction workers, who will be working at the site, were evaluated. Prepared for Kleinfelder for Eadington and Stuhley.

Health Risk Assessment for PAH Contaminated Site:

Prepared a health risk assessment to evaluate the potential exposures and resulting cancer risks for a site contaminated with PAHs in soils. The site is the proposed location of an office building. Analysis focused on estimating the concentrations of the soil-bound PAH compounds that would be expected to volatilize through the concrete foundation and enter indoors based on the contaminants' physical/chemical properties. Analysis concluded that the employees of the future businesses in the proposed office building would be subjected to an insignificant health risk via this migration pathway. Analysis prepared to follow guidance from the Superfund Public Health Evaluation Manual. Prepared for private client.

Health Risk Assessment for Agriculture Property:

Estimated the potential human health risks to the future residents of a property proposed for residential housing construction that was used predominantly as an apple orchard. Detected organochlorine pesticides at the 20 acre site included DDT, DDE, dieldrin, alpha, beta and gamma-BHC, and endosulfan. Exposures were estimated based on the soil levels for the entire property and also for a subset of the parcel having a pesticide mixing area. Soil clean-up levels for these soil-bound pesticides were estimated for the upper-bound exposure scenario. Prepared for Sunrise Development Company.

Health Risk Assessment for a Proposed Recreation Park Facility:

Prepared a health risk assessment for a proposed recreational park in Chandler, Arizona to be constructed on agricultural land recently used for crop production. Site assessment studies completed for the HRA detected DDE/DDT and toxaphene in surface soils located throughout the property. Arsenic soil contaminants, both on-site and background, were a primary issue of concern for the analysis. The HRA was approved by the local and state regulatory agencies prior to construction of the recreational facilities.

Health Risk Assessment for Lead Contaminated Site:

Under subcontract to an engineering firm, prepared a health risk assessment for a lead contaminated property in the lower Sacramento Valley proposed for commercial development. HRA focused on evaluating the potential noncarcinogenic risks attributable to soil-bound lead compounds that could impact employees of the proposed on-site businesses. Analysis submitted to the Yolo County Health Department. Prepared for private client.

Health Risk Assessment for Proposed Real Estate Development Site:

Under subcontract to an engineering firm, the potential human health risk resulting from direct and indirect contact with soil containing detectable levels of DDT and DDE was evaluated for a potential real estate development site in Imperial Valley, California. Analysis included the potential risks via soil ingestion and wind blown dust as a baseline calculation for the future residents of the site. The potential health risks following development of the property were also estimated for a variety of remedial action conditions.

Health Risk Assessment for Agricultural Development Site:

Prepared a health risk assessment for a 20 acre parcel in southern California proposed for residential housing construction. Site characterization studies identified DDT, DDD and DDE, dieldrin and toxaphene at concentrations greater than background. Analysis focused on estimating the level of pesticides that would impact the property's future residents via soil ingestion, dermal absorption, inhalation of windblown dust and the volatilization of soil-bound pesticides. Prepared for Lewis Homes of California.

Preliminary Health Risk Assessment for Abandoned Dry Cleaning Facility:

Derived air and water Applied Action Levels (AALs) for 11 organic compounds identified in ground water and soil at an abandoned dry cleaning facility in the Central Valley. Prepared a 3-4 page toxicity and environmental fate profile for each of the identified compounds. AALs utilized in a preliminary health risk assessment prepared for the Central Valley DHS office using The California Site Mitigation Decision Tree Manual. Health risks were estimated for potentially exposed adults and children.

Health Risk Assessment for Proposed Residential Development:

Under subcontract to Kleinfelder, prepared a health risk assessment for a 4-unit property development located within the Schneider Macadamia Grove in Oceanside, California. Soil characterization studies indicated that surface soils at the specific on-site location of the proposed housing development had elevated levels of chlordane and DDT. The HRA derived site-specific soil clean-up levels for these compounds based on a health conservative methodology that provides a negligible health risk to the maximum exposed individual residing at the site.

Health Risk Assessment for Lead Contaminated Site:

Prepared a health risk assessment for a lead-contaminated property proposed for commercial development in northern California. A review of the EPA's historical lead health criteria and human dose-response data was required to derive an Applied Action Level for lead in soil. Risk assessment addressed the direct contact exposure routes. Environmental fate transport modeling estimated the levels of lead expected to migrate through cracks in the asphalt/cement and potentially impact future workers at the site. Prepared for private client.

HEALTH RISK ASSESSMENTS FOR RESOURCE RECOVERY FACILITIES

Environmental Risk Sciences, Inc. has extensive expertise and experience in analyzing the potential human health risks resulting from the burning of solid waste in resource recovery facilities. ERS staff have completed two health risk assessments for proposed RRFs in California under jurisdiction of the California Energy Commission, arguably the most stringent RRF regulatory agency in the United States. Health risk assessments for RRFs pose particular difficulties, and a high level of sophistication is needed to present multimedia exposure assessments, in-depth toxicological evaluations for the many known contaminants, and an analysis of the potential uncertainties.

In addition to preparing analyses, ERS has helped several cities review health risk assessments and environmental impact reports for RRFs proposed for construction within their respective city limits. For all of these specific cases, ERS staff provided both a thorough review of all portions of the risk assessment, expert testimony, and worked with city attorneys and staff to develop strategies for presenting the results to the public.

Our experience in both preparing and reviewing RRF health risk assessments has provided our clients with the multidisciplinary expertise needed to analyze the complex risks associated with these facilities. The following projects summarize our experience in health risk assessment for resource recovery facilities.

Review of Proposed Resource Recovery Facility Risk Assessment:

Retained by the City of Ontario, CA as a subcontractor to Alanova Incorporated to review the health risk assessment prepared in support of a resource recovery facility proposed to be sited within the city limits. The review focused on the assumptions employed in: 1) the air dispersion model, 2) the presented emissions inventory, and 3) preparation of a critique of the exposure assessment. Results will be presented as a written report and as subsequent oral testimony before City of Ontario officials.

Resource Recovery Facility Health Risk Assessment:

Prepared a health risk assessment in support of a proposed resource recovery facility in Irwindale, CA. The analysis emphasized dioxin and furan contamination entering a nearby brewery, evaluation of background risks to the general population (both carcinogenic and noncarcinogenic end points), development of a detailed exposure assessment and uncertainty analysis, and a screening analysis of the potential health risks associated with alternative refuse disposal options, including landfilling.

Review of Proposed Resource Recovery Facility Risk Assessment:

Retained by the Town of Kirkwood, NY as a subcontractor to Alanova, Incorporated to review the health risk assessment prepared in support of a resource recovery facility proposed to be sited within the city limits. The review for these reports focused on the choice of the appropriate air dispersion models, the emissions inventory, dose-response assessment assumptions, exposure assessment assumptions, and a toxicological discussion of the quantitative public health risks calculated for the proposed facility. Results will be presented as a written report with subsequent oral testimony before the Town of Kirkwood Board of Supervisors.

Resource Recovery Facility Health Risk Assessment:

Prepared a health risk assessment for Signal Environmental Systems' proposed SANDER resource recovery facility in San Diego, California. Analysis included the evaluation of health risks to residents living and workers employed within the study area, development of a detailed set of exposure factors for the study population, and a quantitative analysis of the potential exposure uncertainties. Submitted two sets of data responses to the California Energy Commission (CEC) in support of the client's Application for Certification. Data responses critically summarized the potential toxicity at low exposure levels and the environmental fate and persistence of the compounds released into the atmosphere by the proposed facility. Testified before CEC staff at a data response hearing.

Review of Proposed Resource Recovery Facility Risk Assessment:

Retained by the City of Ontario, CA as a subcontractor to Alanova Incorporated to review the health risk assessment prepared in support of a resource recovery facility proposed to be sited within the city limits. The review focused on the assumptions employed in 1) the air dispersion model, 2) the presented emissions inventory, and 3) preparation of a critique of the exposure assessment. Results presented as a written report and as subsequent oral testimony before City of Ontario officials.

Review of Resource Recovery Facility Environmental Impact Report:

Retained by the City of Haverhill, MA as a subcontractor to Tech Environmental, Inc. to review an environmental impact report prepared in support of a proposed resource recovery facility. Review focused on the potential health and environmental risks that may result from atmospheric emissions and the disposal of ash produced by the daily operation of the proposed facility. Prepared written responses on these issues to the City's Board of Health and their attorneys.

Hazard Assessment to Hospital Waste Incinerator Emissions:

Estimated the potential health effects to individuals exposed to chemical and bacterial emissions from a proposed hospital waste incinerator in upstate New York. Special concern addressed the potential effects of the emissions to a subclass of sensitive individuals having a variety of neurological disorders. Prepared for the New York State Association for Retarded Children.

EXPOSURE ASSESSMENTS

Exposure assessment is the specific portion of a health risk assessment designed to estimate the amount of chemical contaminants humans are exposed to via the various routes of exposure (inhalation, ingestion, and dermal absorption). The estimation of exposure involves the application of environmental fate models with exposure factors that are influenced by the specific properties of the potentially exposed populations. ERS has considerable expertise in applying soil, air, ground water, and surface water exposure models to estimate human exposures to environmental contaminants. Our staff is skilled in using and selecting the appropriate fate models to estimate human exposures. In addition, ERS has developed many applications of U.S. EPA-accepted computer models in order to provide innovative techniques to the estimation of human exposures.

The specific projects below represent our project experience in exposure assessment.

Expert Judgment of Formaldehyde Carcinogenic Mechanisms:

Participated in a research study designed to elicit and evaluate the probability density functions of opinions of cancer biology scientists regarding the importance of benign tumors observed in several formaldehyde cancer animal bioassays. Of critical importance were the expert opinions regarding the significance that benign tumors should have in estimating cancer potency factors. Study funded by the Mellon Foundation and the Risk Science Institute.

Contaminant Concentrations in Background Ambient Air:

Prepared a detailed summary of the measured concentrations of organic chemical concentrations in urban, rural, and isolated ambient air in support of an environmental risk assessment prepared for U.S. EPA Region I. As a first approximation, only data found in U.S. EPA documents were used to compile the tables. A second research phase required a computerized data base search to provide the appropriate primary research articles in the literature. Results were presented for selected volatile and base neutral organic compounds on the U.S. EPA Priority Pollutant List.

Source Assessment Manual Comments:

Prepared a set of technical comments for a review draft of the Air Toxics Source Assessment Manual For California Air Pollution Control Districts for a private client. Comments centered on the relevance of applying the risk assessment methodology described in the manual to obtain adequate measures of health risk in an exposed population. Recommendations addressed how the source assessment manual could be revised to provide better estimates of potential health risk.

Indoor Migration Exposure Assessment:

Developed, for a private client, a computer model designed for a desktop PC that estimates the potential indoor concentrations of outdoor airborne and soil contaminants that may migrate indoors as a result of air infiltration and the tracking of outdoor soil indoors. Model is being used by the client to estimate chemical concentrations of indoor air and deposited dust inside homes.

Exposure Assessment Risk Factors:

Developed an extensive manual documenting the potential quantities of air, water, soil, volatilized chemicals, and non volatile chemicals to which humans may be exposed via breathing under various conditions, ingestion, dermal absorption during different human activities, and other exposure pathways. Manual is currently being used by the client to assist in preparing in-house risk assessments. Private client.

Outdoor-Indoor Environment Migration Factors:

Prepared two case studies describing the migration of airborne outdoor contaminants indoors included as an appendix in a U.S. EPA report for the Athens Laboratory. Case studies involved the potential indoor exposures to contaminants in a cloud of toxic gas passing over a house and an evaluation of the indoor exposures resulting from the release of a radioactive gas near a group of homes.

Landfill Excavation Air Concentrations:

Developed an analysis of the exposure factors and potential downwind chemical concentrations that would result from proposed excavation activities at the Hyde Park hazardous waste landfill in Niagara Falls, NY. A review of the published dust emission factors resulting from the operation of excavation equipment on top of the landfill was also prepared. Report was submitted as part of an affidavit to the U.S. EPA, Office of Waste Programs Enforcement.

Toxicity Review of Trichloroethylene and Tetrachloroethylene:

Under subcontract to an engineering firm, prepared a review of the potential human toxicity responses to low doses of aqueous trichloroethylene and tetrachloroethylene. Review was included as part of a risk assessment prepared for a former dry cleaning operation in New England. Private client.

Environmental Audit Review:

Review of an environmental audit prepared by a consulting firm for a pesticide formulating facility in the Northeast. Analysis focused on the potential worker exposures that may result from handling pesticides during the daily operation of the facility. Developed a computer data base package designed to present current on-site chemical inventories. Private client.

PROJECTS SUPPORTING ENVIRONMENTAL LITIGATION

ERS staff has assisted both plaintiffs and defendants in many toxic tort lawsuits and environmental litigation. Our involvement with environmental lawsuits generally includes a technical review of the studies designed to estimate contaminant exposures at the point of human contact. This important relationship between contaminant release and environmental exposure is essential in toxic tort cases and ERS has extensive experience in presenting transport and fate models in litigation proceedings.

Although many of our projects involve assisting attorneys and their experts, the following projects represent the specific cases involving toxic tort litigation involving ERS staff.

Project Experience Supporting Litigation

Indoor Air Exposures:

Prepared a detailed evaluation of the physical/chemical parameters that influence chemical transport in groundwater and soil. Reviewed the current available methods for estimating these parameters for trichloroethylene and tetrachloroethylene. Developed an analysis for potential human exposures via showering, running hot water, and using dishwashers to organic contaminants in drinking water. Analyses provided in support of a toxic tort lawsuit in New England. Also, critically reviewed deposition submitted by plaintiff's scientific expert in this subject area.

Settlement Agreement Negotiations for Hazardous Waste Landfill:

Prepared review of an assessment of chemical contamination at and near the S-Area hazardous waste landfill in Niagara Falls, NY. Developed a computerized database for analyzing the extent of contamination at the city's Drinking Water Treatment Plant located next door to the landfill. Compiled fate and toxicological information on critical contaminants. Study for the U.S. EPA, Office of Waste Programs Enforcement.

Lung Carcinogen Exposure Analysis:

Developed an analysis of the retrospective exposures to potential lung carcinogens that an individual would experience living in an urban area in northern Massachusetts. Reviewed the available toxicological and epidemiological evidence for known and suspected human and animal lung carcinogens. Analysis completed for defendants as part of a tobacco product liability lawsuit.