THE ROLE OF RISK ASSESSMENT IN PROJECT PLANNING AT THE WELDON SPRING QUARRY, WELDON SPRING, MISSOURI*

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The Weldon Spring site is located near Weldon Spring, Missouri, about 48 km (30 mi) west of the city of St. Louis (Figure 1). It is surrounded by large tracts of land owned by the federal government and the state of Missouri. The site consists of two noncontiguous areas: (1) a raffinate pits and chemical plant area and (2) a quarry. The raffinate pits and chemical plant area are located about 3.2 km (2 mi) southwest of the junction of Missouri (State) Route 94 and U.S. Route 40/61. The quarry is located about 6.4 km (4 mi) south-southwest of the raffinate pits and chemical plant area and about 8 km (5 mi) southwest of the community of Weldon Spring in St. Charles County, Missouri. The raffinate pits and chemical plant area and the quarry are accessible from State Route 94. These areas are fenced and closed to the public.

The Weldon Spring site was used by the U.S. Department of the Army for the production of trinitrotoluene (TNT) and dinitrotoluene (DNT) from 1941 to 1944 and by the U.S. Atomic Energy Commission (AEC) for the processing of uranium and thorium concentrates from 1957 to 1966. The quarry, which had been used by the Army since the early 1940s for the disposal of chemically contaminated materials, was transferred to the AEC in July 1960 for use as a disposal site; it was last used for disposal in 1969. Wastes placed in the quarry include TNT and DNT residues and radioactively contaminated materials. As successor to the AEC, the U.S. Department of Energy (DOE) currently has responsibility for the Weldon Spring site, including the quarry.

This paper presents the methodology used to prepare a baseline risk evaluation of the bulk wastes at the quarry. The DOE is proposing to remove these bulk wastes and transport them approximately 6.4 km (4 mi) to a temporary storage facility at the chemical plant area of the Weldon Spring site. The DOE has responsibility for cleanup activities at the Weldon Spring site under its Surplus Facilities Management Program (SFMP).

A baseline risk evaluation is an evaluation of the potential impacts on human health and the environment that may result from exposure to releases of contaminants from a site in the absence of site remediation. This evaluation is a key component of the remedial investigation (RI) process, as identified in guidance from the U.S. Environmental Protection Agency (EPA) that addresses sites subject to the Comprehensive

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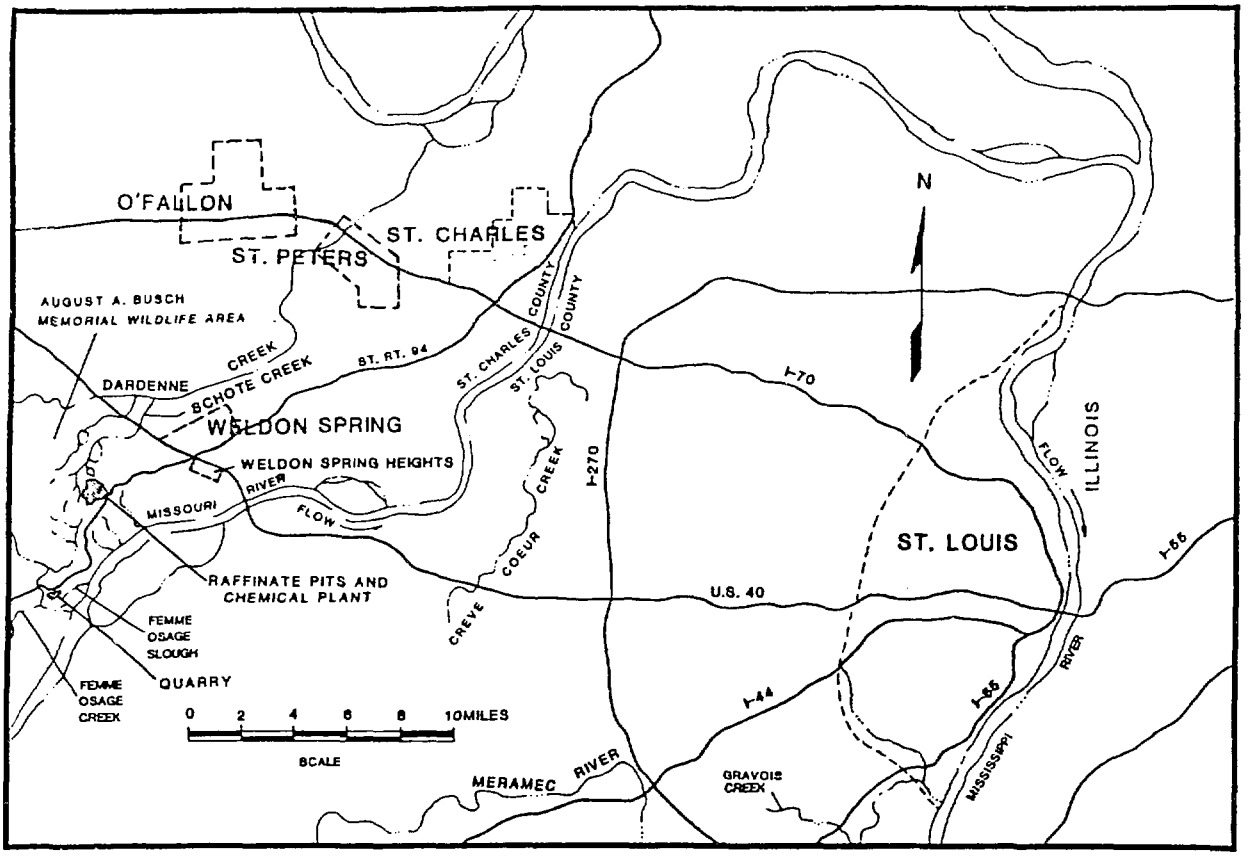

FIGURE 1 Area and Vicinity Map of the Weldon Spring Site, Weldon Spring, Missouri (Source: Peterson et al. 1988)

Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986. Response actions at the Weldon Spring quarry are subject to CERCLA requirements because the quarry is listed on the EPA's National Priorities List (NPL).

DESCRIPTION OF THE ENVIRONMENTAL COMPLIANCE COMPONENTS FOR THE QUARRY

The Weldon Spring quarry can be divided into five separate components for the purpose of environmental response actions: (1) bulk wastes, (2) contaminated surface water from the quarry pond and other sources, (3) residual materials following removal of the quarry bulk wastes, (4) contaminated groundwater, and (5) contaminated vicinity properties. These five environmental compliance components associated with the quarry are shown in Figure 2.

The DOE is proposing to address quarry bulk waste removal as a separate operable unit of the overall remedial action at the Weldon Spring site under CERCLA. The bulk wastes are defined as various solid materials that can be removed from the quarry by standard excavation technologies; these wastes include contaminated soils and sludges, process wastes, rubble, drums, structural debris, and equipment. It is proposed

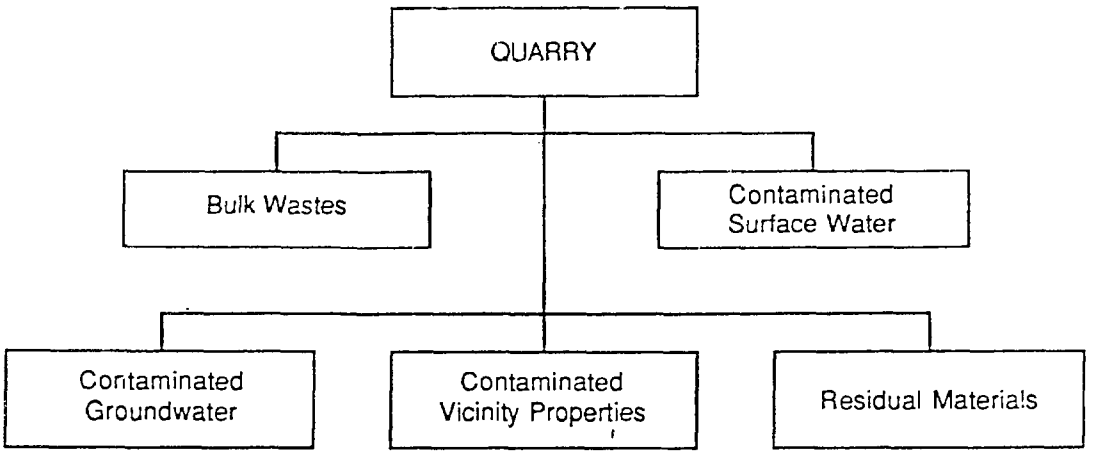

FIGURE 2 Environmental Compliance Components for the Weldon Spring Quarry

to remove the wastes from the quarry and transport them to the raffinate pits and chemical plant area for temporary storage prior to the Record of Decision for the overall remedial action at the Weldon Spring site. The decision on the final disposal of these bulk wastes will be included as part of the decision for the disposition of the contaminated materials currently located at the raffinate pits and chemical plant area.

Contaminated water in the quarry area will be removed and treated prior to, and as necessary, during bulk waste removal. The long-term remedial plan for contaminated groundwater, contaminated vicinity properties, and residual materials remaining after bulk waste removal will be developed after the bulk wastes have been removed and the extent of residual contamination in and around the quarry has been fully assessed.

DOCUMENTATION REQUIREMENTS

In accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and CERCLA, as amended, a remedial investigation/feasibility study (RI/FS) is being undertaken for the Weldon Spring quarry. Because removal of the bulk wastes from the quarry is an interim step in the overall remedial action, the RI report has focused on those data pertinent to that removal. Removal and treatment of contaminated water in the quarry pond has been addressed in an engineering evaluation/cost analysis report (MacDonell et al. 1989), and the appropriate documentation for other environmental compliance components will be developed following removal of the bulk wastes.

A key component of the RI is a baseline risk assessment. This assessment is conducted for the baseline (no-action) case to (1) determine potential impacts to human health and the environment, (2) help determine appropriate cleanup criteria, and (3) provide a basis for evaluating the effectiveness of proposed remedial action alternatives. However, consistent with the scope of the RI for the quarry bulk wastes, a modified baseline risk assessment, i.e., a baseline risk evaluation, is being prepared. Limitations on the availability of site characterization data with respect to the extent of

contamination and the pathways and mechanisms for contaminant migration from the quarry preclude the preparation of a comprehensive baseline risk assessment for the quarry. The detailed characterization data necessary to make such an assessment cannot be obtained until the bulk wastes have been removed from the quarry. The nature of these wastes (e.g. rubble, structural debris and heavy equipment) are not conducive to the use of conventional investigative techniques such as drilling or geophysics. Current data are considered sufficient to perform a limited baseline risk evaluation. A substantial amount of historical data is available on past disposal practices at the quarry, including analytical data regarding the composition of the bulk wastes. These studies have confirmed the presence of radioactive and chemical contaminants consistent with the types of materials known to have been placed in the quarry.

Following removal of the quarry bulk wastes, additional studies will be carried out to further characterize the geology, hydrology, and extent of residual contamination in and around the quarry. A comprehensive risk assessment will be prepared at that time to assess potential impacts to human health and the environment from residual materials and contaminated groundwater, to determine the need for additional cleanup, and to help establish cleanup criteria, as appropriate.

OVERVIEW OF THE BASELINE RISK EVALUATION PROCESS

During the baseline risk evaluation, all available physical, chemical, radiological, hydrological, geological, ecological, and demographic factors at the Weldon Spring quarry are evaluated. The objective is to describe and assess the extent, if any, of potential risk to human health and the environment resulting from contamination present at the quarry. The health evaluation is conducted according to guidance given in the *Superfund Public Health Evaluation Manual* (U.S. Environmental Protection Agency 1986) and the *Superfund Exposure Assessment Manual* (U.S. Environmental Protection Agency 1987). The health risk evaluation process is diagrammed in Figure 3, and each of its components is briefly described below.

Identification of Contaminants of Concern

The first step in the risk evaluation process is to select indicator radionuclides and chemicals at the site that pose the greatest potential risks to public health. In general, these contaminants are those that represent the most toxic, mobile, and/or persistent species, as well as those that are present in the largest quantities. Additional factors considered in the selection of indicator radionuclides are the components of the relevant decay series and the half-lives of the radionuclides.

Exposure Evaluation

The second step in the risk evaluation process is to characterize potential exposure pathways and determine exposure point concentrations. The exposure evaluation consists of assessing (1) the sources and mechanisms of potential contaminant releases from the site, (2) the environmental fate of released contaminants -- including identification of both the media by which contaminants may be transported (e.g., air and/or water) and the possible physical, chemical, and biological mechanisms by which the contaminants may be transformed, (3) the potential human receptors and routes of

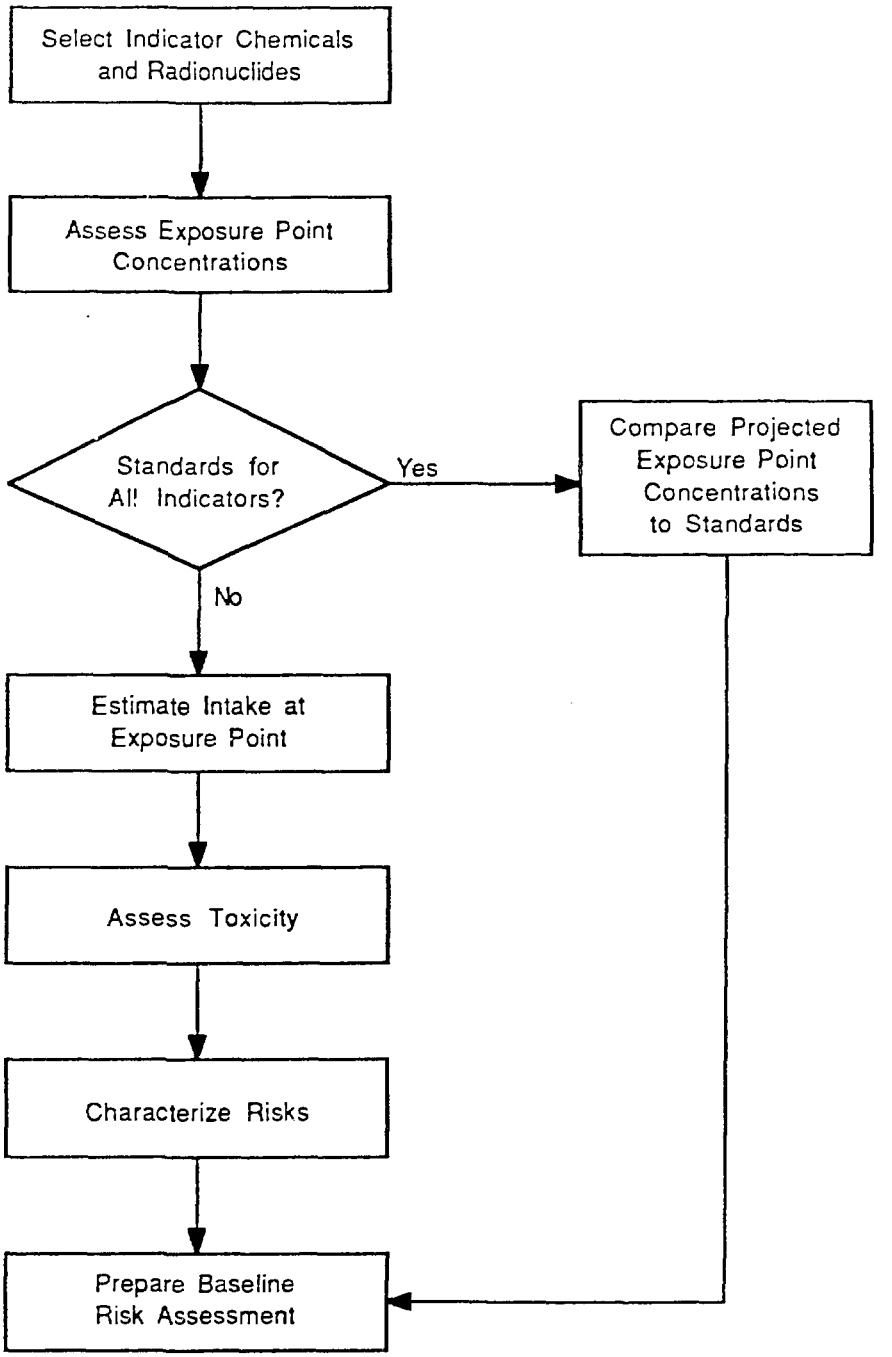

FIGURE 3 Diagram of the Public Health Risk Evaluation Process (Source: Modified from U.S. Department of Energy 1988)

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exposure (inhalation, ingestion, and dermal contact), (4) the exposure point concentrations, and (5) the uptake of contaminants by the exposed populations.

The concentrations of indicator chemicals and radionuclides in environmental media at exposure points are estimated using characterization and monitoring data and environmental fate and transport models, if necessary. Available information regarding environmental chemistry and contaminant fate are incorporated, where applicable. The exposure point concentrations are compared to health-based applicable or relevant and appropriate requirements (ARARs). If ARARs are not available for all indicator contaminants, a toxicity and risk assessment is performed. Scenarios of human activity that give rise to exposure are developed, and the uptake of contaminants by the receptors is determined.

Toxicity and Risk Evaluation

Potential health effects from exposure to noncarcinogenic chemicals are assessed by comparing the estimated average daily exposure estimates (intakes) to established reference doses. A reference dose is the average daily dose that can be incurred by individuals without likely adverse health effects. Potential chemical carcinogenic risks are estimated as probabilities, based on the average daily lifetime dose and on compound-specific potency factors (expressed as the lifetime cancer risk per milligram per day of the carcinogen per kilogram body weight). The risk of radiation exposure is expressed in terms of the increased likelihood for induction of a fatal cancer or serious genetic defects in the offspring of exposed individuals. In this risk evaluation, the radiological and chemical risks are reported separately for clarity of presentation.

Environmental Assessment

The baseline risk evaluation includes an environmental assessment in addition to an evaluation of potential public health impacts. This environmental assessment utilizes site-specific information from characterization studies and the environmental monitoring program at the quarry. Data on water and soil resources, air quality, and vegetation and wildlife -- including threatened and endangered species -- are used to evaluate potential adverse environmental impacts that could result from the presence of contaminated materials in the quarry. Sources of additional information used in the assessment include available literature and consultations with state and federal agencies (e.g., the Missouri Department of Conservation and the U.S. Fish and Wildlife Service). The assessment of potential impacts incorporates much of the information utilized in the public health evaluation portion of the baseline risk evaluation, including sources and mechanisms of contaminant release and transport from the quarry, environmental fates and concentrations of released contaminants, and potential environmental receptors. Potential environmental impacts associated with the presence of contaminated materials in the quarry are addressed qualitatively because comprehensive environmental data are not available, e.g., for the specific contaminants and biota present in the quarry area.

PRELIMINARY RESULTS

Two exposure scenarios are being evaluated to assess the potential risks associated with the quarry bulk wastes: (1) a passerby scenario, in which an individual is

assumed to walk past the quarry along State Route 94, and (2) a trespasser scenario, in which an individual is assumed to enter the quarry. These scenarios are evaluated to determine potential risks to the nearby population under existing land-use conditions. The quarry is currently fenced and its access is controlled by DOE. Although levels of radon gas and gamma exposure rates within the quarry and at the fence line are elevated above background levels, the potential health risks associated with the radioactive contamination are expected to remain low as long as access to the quarry is restricted. The radiation doses and associated risks estimated for the two exposure scenarios addressed in the risk evaluation are considerably less than those resulting from exposure to natural sources of radiation. Similarly, the carcinogenic and noncarcinogenic risks associated with exposure to chemical contaminants from the quarry do not present a risk to public health under current land-use conditions. In addition, no adverse effects on vegetation or wildlife as a result of exposure to quarry contaminants have been observed to date. Finally, in the short term, no incremental adverse impacts to air quality or soil and water resources are expected to result from the presence of contaminated bulk wastes in the quarry.

The risk evaluation being conducted for the quarry bulk wastes indicates that these materials do not pose a short-term risk. However, this conclusion cannot be extrapolated to long-term risk because access control cannot be guaranteed and contaminants are currently migrating from the quarry into groundwater. The potential extent of contaminant migration in the long term cannot be assessed until the bulk wastes are removed and the hydrogeologic regime is better characterized. This risk evaluation provides a measure of the extent of the immediate hazard associated with these materials and gives an indication of the potential long-term risks. This information is very valuable for planning remedial action activities at the Weldon Spring quarry.

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