EG&G MOUND-30-01----9610010010

MOUND

Environmental
Restoration
Program

POTENTIAL RELEASE SITE PACKAGES

Reading and Understanding

VOLUME II

(PRELIMINARY)

August 7, 1996

POTENTIAL RELEASE SITE PACKAGES

READING AND UNDERSTANDING

VOLUME II

(PRELIMINARY)

AUGUST 8, 1996

TABLE OF CONTENTS

Volume I

Introduction 1

1. Purpose 2

2. What is a Potential Release Site (PRS)? 2

3. What is a PRS Package? 2

4. What are the elements of a PRS Package? 2

- *4.1. Cover* 2
- *4.2. Maps and Photographs* 3
- *4.3. PRS History* 3
- *4.4. Contamination Section* 3
- *4.5. References* 5
  - *4.5.1. Reading Room References* 5
  - *4.5.2. Other References* 5
- *4.6. Recommendation* 5
- *4.7. Reference Material Section* 6

5. Supplemental Information to Reading and Understanding a PRS 7

Example PRS 9

TABLE OF CONTENTS

Volume II

APPENDICES

Appendix A - Acronyms and Abbreviations
Appendix B - Glossary of PRS Terms
Appendix C - Sampling Methods, Analysis Methods, and Terminology
Appendix D - Guideline Criteria Documents

Attachment D1, PRS Comparison Values
Attachment D2, Background Concentrations for Chemicals in Soils
Attachment D3, Comparison of Actual Soil Gas Values with Calculated Acceptable Soil Gas Values
Attachment D4, Standardized Equations Based upon USEPA Soil Screening Guidance for the Soil to Ground Water Migration Pathway
Attachment D5, Response to OEPA Comments on Mound Plant Soil Screening Levels
Attachment D6, Guideline Criteria References

Appendix E - Public Comment Submittal Guidance

APPENDIX A

ACRONYMS AND ABBREVIATIONS

Appendix A - Acronyms and Abbreviations

A master PRS acronyms and abbreviations list covering all PRSs can be found in the CERCLA Reading Room.

+	Plus
>	Greater Than
%	Percent
#	Number
@	At
α	Alpha
β	Beta
'	Feet
"	Inches
μg/Kg	Micrograms per Kilogram
AEA	Atomic Energy Act
AKA	Also Known As
ALARA	As Low as Reasonably Achievable
ATSDR	Agency for Toxic Substances and Disease Registry
BUSTR	Bureau of Underground Storage Tank Regulations
BVA	Buried Valley Aquifer
C	Designates Core Sample Location
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH1-CH2	Instrument Channel #1 - #2
Ci	Curie
CLP	Contract Laboratory Program
cm	Centimeter
cm^2	Square Centimeter
Cont.	Continued
cpm	Counts per Minute
CWA	(Federal) Clean Water Act
D*	Daughter
D*	Absorbed Dose
D&D	Decontamination and Decommissioning
DAF	Dilution-Attenuation Factor
DDAGW	Ohio Environmental Protection Agency Division of Drinking and Groundwater
DOE/MB	Department of Energy/Miamisburg Office
DOE	United States (U.S.) Department of Energy
e.g.	For Example (Latin, exempli gratia)
EG&G MAT	EG&G Mound Applied Technologies
EM-453	United States (U.S.) Department of Energy - Environmental Management Office of Southwestern Area Programs
ER (Program)	Environmental Restoration (Program)
esp.	Especially
et al.	And Others (Latin, et alii)
etc.	Et Cetera (Latin, and other {things})
FA	Further Assessment
FFA	Federal Facilities Agreement
FIDLER	Field Instrument for the Detection of Low-energy Radiation
FR	Federal Register

* = multiple meanings for same acronym

Appendix A - Acronyms and Abbreviations

ft^2	Square Feet
g/Kg	Grams per Kilogram
g	Gram
Ga	Georgia
GV	Guideline Value
H	Dose Equivalent
HAZ	Hazardous Contaminant
HAZWRAP	Hazardous Waste Remedial Action Program
HBLS	Health-based Limits
HI	Hazard Index
HQ	Hazard Quotient
i.e.	id est (Latin, that is)
IATA	International Air Transport Association
ID	Identification
IDM	Investigative Derived Material
IX	Nine
kcpm	One Thousand Counts per Minute
Kd	Soil-Water Partition Coefficient (L/Kg)
Kg	Kilogram
Lab	Laboratory
LET	Linear Energy Transfer
m	Meter
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg	Milligram
mg/Kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
Misc.	Miscellaneous
mL/g	Milliliters per Gram
MO	Month
MRC	Monsanto Research Corporation
N	North
NA	Not Applicable
nCi	Nanocurie
ND	Not Detected
NFA	No Further Assessment
ng/mL	Nanograms per Milliliter
No.	Number
Non-AOC	Non-Area of Concern
NPDES	National Pollutant Discharge Elimination System
NR	No Result Given
NRC	Nuclear Regulatory Commission
OEPA	Ohio Environmental Protection Agency
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
OVA	Organic Vapor Analyzer
OVM	Organic Vapor Meter (Photoionizer Detector)
P.O.	Post Office
PAH	Polycyclic (Polynuclear) Aromatic Hydrocarbon

Appendix A - Acronyms and Abbreviations

PCB	Polychlorinated Biphenyl
pCi/mL	Picocuries per Milliliter
pCi/g	Picocuries per Gram
PETREX	Trade Name for a Type of Soil Sampling
pH	*Pouvoir hydrogene* (French, hydrogen power)
PP	Plutonium Processing
ppb	Parts per Billion
ppm	Parts per Million
PRG	Preliminary Remediation Goals
PRS	Potential Release Site
Pu	Plutonium
PXRF	Portable X-Ray Fluorimetry
Q	Quality Factor
Quanterra	Quanterra Environmental Services, Inc.
RA	Response Action
Rad	Radiation
RAGS	Risk Assessment Guidance for Superfund
RBE	Relative Biological Effectiveness
RCRA MCL	RCRA Maximum Concentration Limits
RCRA	Resource Conservation and Recovery Act
RCT	Radiation Control Technician
REM	Radiation Equivalent Man
Rev.	Revision
RI/FS	Remedial Investigation/Feasibility Study
RRE	Residual Risk Evaluation
S	Designates Surface Sample Location
SDWA	Safe Drinking Water Act
SM	Special Metallurgical
SS	Surface Sample
SSL	Soil Screening Level
SVOC	Semi-volatile Organic Compound
SWMU	Solid Waste Management Unit
TCLP	Toxic Characteristic Leaching Procedure
Th	Thorium
TLV	Threshold Limit Value
TMA	Thermo Analytical, Inc.
TR	Total Risk
TVOC	Total Volatile Organic Compounds
U	Undetermined Nature of the Data
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
Vol.	Volume
W	West
W.O. No.	Work Order Number
WD	Waste Disposal
XRF	X-Ray Fluorimetry
Yd^3	Cubic Yards
Yr.	Year

This page left intentionally blank

APPENDIX B

GLOSSARY OF PRS TERMS

Appendix B - Glossary of PRS Terms

The glossary was developed from terms found in this document (PRS Packages - Reading and Understanding) as well as from the PRS Packages.

Absorbed Dose (D) - the mean energy imparted by **ionizing radiation** to matter per unit mass.

Absorption - process by which the number and energy of particles or photons entering a body of matter are reduced by interaction with the matter.

ALARA - As Low As Reasonably Achievable - which is an approach to radiation protection to manage and control exposures (both individual and collective) to the work force and the general public, and releases of radioactive material to the environment at levels as low as is practicable, taking into account social, technical, economic, practical, and public policy considerations. The monitoring cleanup, and control of residual radioactive material are subject to the DOE ALARA policy of DOE 5400.5 and FR Vol. 58, No. 56, March 25, 1993.

Alpha Radiation - the least penetrating but most energetic of radiation types. The alpha particle is positively charged and relatively massive. Because of its size, it may easily be stopped in a few centimeters of air. Alpha-emitting nuclides can be dangerous when ingested or inhaled because the particle energy is transferred directly to adjacent cells.

Ambient - surrounding.

Analyte - constituent or parameter that is being analyzed.

Aquifer - saturated, permeable geological unit that can transmit significant quantities of water under ordinary hydraulic gradients.

Aromatic - having an odor.

ATSDR - Agency for Toxic Substances and Disease Registry. This agency is developing toxicity profiles for 275 hazardous substances found at Superfund sites. This agency may be involved in the study of a site if there is human monitoring to assess current or past **exposure**s. The agency assesses the current health status of the people near a site based on the monitoring results.

Appendix B - Glossary of PRS Terms

Background (level) - (average) value of a contaminant of concern in samples taken near the time and place of the sample of interest to demonstrate whether the site is contaminated or truly different from the norm. The estimated average level of radioactivity that would be present at a site if the facility on the site did not exist.

Beta Radiation - radiation from beta particles. Beta particles are charged electrons emitted from the **decay** of some radioactive elements and are more penetrating than alpha particles. Beta particles can penetrate skin and cause burns. They can travel several meters in air, but the principal hazard still comes from ingestion or inhalation of material that emits beta particles.

Bioremediation - remediating the environmental media by using living organisms.

Bitumen - any of various mixtures of hydrocarbons found in asphalt and tar and used for surfacing roads or waterproofing.

Blank - control sample that is identical, in principle, to the sample of interest, except the substance being analyzed is absent. In such cases, the measured value or signal for the substance being analyzed is believed to be due to artifacts. Under certain circumstances, that value may be subtracted from the measured value to give a net result reflecting the amount of the substance in the sample. The Environmental Protection Agency does not permit the subtraction of blank results in Environmental Protection Agency-regulated analyses.

Carcinogen - a chemical capable of inducing cancer.

Carcinogenic Risk - risk associated with developing an excess cancer incident. Risks are usually expressed as a probability of adverse effects associated with exposure to contaminants. For carcinogens, contaminants that are known to cause cancer, these probabilities are expressed as excess cancer incident over a human lifetime, which is the probability of an individual having one case of cancer above the normal background cancer rate observed in the general population.

Caustic - able to burn, corrode or dissolve.

Appendix B - Glossary of PRS Terms

Clean-up - actions taken to deal with release or potential release of hazardous substance. This may mean complete removal of the substance; it may mean stabilizing, containing, or otherwise treating the substance so that it does not adversely affect human health and the environment.

Closure - control of a hazardous waste management facility under Resource Conservation and Recovery Act (RCRA) requirements.

Commercial (Mound Office Worker) Scenario - This scenario characterizes risks from contaminant exposures to persons who work primarily indoors at the property 8 hours per day for 250 days per year for 25 years. These workers are assumed to ingest a small amount of soil on the property, inhale small amounts of dust from the soil, and be externally exposed to possible radiation from the soil only while they walk between buildings or take breaks outdoors. The worker is also assumed to drink about a quart (1 liter) of water per day from a groundwater well on the property. Worker exposures will vary depending on the type of work performed.

Concentration - amount of a substance contained in a unit volume or mass of a sample.

Confidence Coefficient - the chance or probability, usually expressed as a percentage, that a **confidence interval** includes some defined parameter of a population. The confidence coefficient usually associated with confidence intervals are 90%, 95%, and 99%. For a given sample size, the width of the **confidence interval** increases as the confidence coefficient increases.

Confidence Interval - a value interval that has a designated probability (the **confidence coefficient**) of including some defined parameter of the population.

Confirmatory Samples - samples whose results are to be used to verify or corroborate previous conclusions drawn from previous sample results.

Contract Laboratory Program (CLP) Methods - laboratory methods defined for the Contract Laboratory Program (CLP). The CLP is an analytical program developed for Superfund waste site samples to fill the need for legally defensible analytical results supported by a high level of quality assurance and documentation.

Appendix B - Glossary of PRS Terms

Core Sampling - subsurface sampling. Soil sampling at a depth greater than 15 cm.

Core Team - committee consisting of USEPA, OEPA, and DOE who make PRS recommendations.

Decay (radioactive) - spontaneous transformation of one radionuclide into a different radioactive or nonradioactive nuclide, or into a different energy state of the same radionuclide.

Detection Limit - the lowest amount of a chemical that can be "seen" above the normal, random noise of an analytical instrument or method. A chemical present below that level cannot be distinguished from noise. Detection Limits are chemical-specific and instrument-specific and are determined by statistical treatment of multiple analyses in which the ratio of the lowest amount observed to the electronic noise level is determined.

Dose Equivalent - the product of the **absorbed dose** (rad) in tissue and a **quality factor**. Dose equivalent is expressed in units of rem (or Sievert) (1 rem = 0.1 Sievert).

Downgradient - in the direction of decreasing hydrostatic head.

Exposure - contact of a living thing with a chemical or physical agent. Exposure is expressed as the amount of the agent available at the exchange boundaries of the living thing (e.g., skin, lungs, gut) and available for **absorption**.

Ferrous - of or containing iron.

Filtrate - the portion of filtered material that passes through the filter.

Fission Products - the large variety of smaller atoms, including cesium and strontium, left over by the splitting of uranium and plutonium. Most of the atoms are radioactive, and decay into their isotopes. There are more than 200 isotopes of 35 elements in this category. Most of the fission products produced in the United States are found in spent nuclear fuel and high-level waste.

Fission - the splitting of a heavy nucleus into two approximately equal parts, accompanied by the release of large amounts of energy and generally one or more neutrons.

Appendix B - Glossary of PRS Terms

Flashpoint - the lowest temperature at which the vapor of a combustible liquid can be made to ignite momentarily in air.

Gamma Ray - high-energy, short wavelength electromagnetic radiation emitted from the nucleus of an excited atom. Gamma rays are identical to X-rays except for the source of emission.

Gamma spectroscopy - system consisting of detector, associated electronics, and a multichannel analyzer that is used to analyze samples for gamma-emitting radionuclides.

Gamma-emitting radionuclide - radionuclide that emits gamma rays.

Gas Chromatography - a method for the separation and analysis of complex mixtures of volatile organic and inorganic compounds.

Guideline Values (GV) - risk-based media-specific contaminant concentrations derived for specific carcinogenic risk levels (i.e., 10^{-4}, 10^{-5}, 10^{-6}) and noncarcinogenic chronic and subchronic effect levels (i.e., hazard quotient of 1) that are applicable to land use/exposure scenarios likely to occur at a specific site. GVs are intended to be used as an internal site evaluation/prioritization decision-making tool for project managers, risk assessors, and others involved in making risk assessment and risk management decisions during site characterization and remediation. They are not final or stand-alone decision making-tools. Once accepted by the Core Team, GVs can be used as a screening tool (for sites with adequate characterization data) to rapidly assess the potential for "no further assessment" decisions. GVs are initial guidelines; they do not establish that cleanup is warranted to meet these goals.

Guideline Criteria - A phrase used in the PRS Recommendations. Guideline Criteria are the "standards" for which the PRS data are evaluated to reach a recommendation decision. They consist of Mound risk-based guideline values, regulatory limits, Mound ALARA goals, and protective soil screening levels.

Half-life - the time for a quantity of radionuclide, i.e., its activity, to diminish by a factor of a half (because of nuclear decay events, biological elimination of the material, or both).

Halogen - any of a group of five chemically related nonmetallic elements that includes fluorine, chlorine, bromine, iodine, and astatine.

Halogenated - to combine with or subject to the action of a halogen.

Hazard Quotient - the ratio of a single substance exposure level over a specified time period (e.g., subchronic) to a **reference dose** (see definition below) for that substance derived from a similar exposure period.

Hazard Index - the sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. The Hazard Index is calculated separately for chronic, subchronic, and shorter-duration exposures.

Hazardous Waste - as defined in 40 CFR 261, any solid waste; concentration; or physical, chemical, or infectious characteristics that may " (1) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible, illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed..."

Heavy Industry (Mound Construction Worker) Scenario - This scenario characterizes risks from contaminant exposures to persons who work outdoor construction at the property eight (8) hours per day for 250 days per year for 25 years. An outdoor construction worker may be assumed to ingest and inhale greater amounts of soil/sediment and dust than the **Mound Office Worker Scenario**. The construction worker may also bathe or shower daily in the water from a well on the property, and inhale small amounts of water vapor while showering. Occupational exposure to surface water by the outdoor worker may be infrequent and is estimated by the recreational exposure to surface water. The exposure duration will be 5 years rather then the default value of 25 years. This was agreed to by DOE, OEPA and Region V USEPA.

Hot Spot - area of radioactive contamination of higher than average concentration.

Inorganic - involving matter other than plant or animal.

Ionizing Radiation - any radiation capable of displacing electrons from atoms or molecules, thereby producing ions.

Appendix B - Glossary of PRS Terms

Isotope - a variation of an element that has the same atomic number but a different weight because of the number of neutrons it carries. Different isotopes of an element may exhibit distinctly different radioactive behaviors.

Linear Energy Transfer (LET) - a measure of the rate of energy absorption, defined as the average energy imparted to the absorbing medium by a charged particle per unit distance.

Liquid Scintillation - laboratory method used to determine the amount of radionuclides that emit low-energy beta radiation. It can be adapted to measure alpha radiation.

Low Level (Waste) - waste that contains radioactivity and is not classified as high-level waste, transuranic waste, spent nuclear fuel, or some by-product material.

Magazines - places for storage, esp. of ammunition.

Maximum Contaminant Levels (MCLs) - The National primary standards (40 CFR 142) consist of contaminant-specific standards known as maximum contaminant levels (MCLs). MCLs are enforceable drinking water standards that apply to specific contaminants that EPA has determined to have adverse effects on human health above a given level.

Medium - the solid, liquid, or gas that serves as a carrier of the **analytes** of interest.

Metallurgical - of or pertaining to the science or technology of extracting metals from their ores, of purifying metals, and of creating useful objects from metals.

Mound 2000 Process - Process consistent with CERCLA where emphasis is placed on evaluating small areas called **potential release sites**. This process focuses the environmental restoration efforts and results in a more rapid clean-up.

National Pollutant Discharge Elimination System (NPDES) - is the national program for issuing, monitoring, and enforcing permits for direct discharges. The Clean Water Act (CWA) established the NPDES permit program under Section 402 of the Act to implement the regulations, limitations, and standards promulgated pursuant to Section 301, 304, 306, 307, 308, and 403 of the CWA for point source (direct) discharged. The NPDES program is implemented

under 40 CFR 122-125. NPDES permits contain applicable effluent standards (i.e., technology-based and/or water quality-based), monitoring requirements, and standard and special conditions for discharge. The NPDES program is administered by EPA and by State agencies authorized by EPA to administer a State Program equivalent to the Federal NPDES program. Regardless of whether the States are authorized to administer the Program, they may establish more stringent requirements than those contained in the Federal Program.

Nuclide - atom specified by its atomic weight, atomic number, and energy state. A radionuclide is a radioactive nuclide.

Operable Unit - means a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site.

Overburden - the soil, rock, and other naturally occurring material overlying the bedrock.

Parts per million (ppm) - unit measure of concentration equivalent to the weight/volume ratio expressed as mg/L.

Percolate - to move slowly through a porous material.

PETREX - soil gas analysis method to determine if certain compound families are present underground in the tiny spaces between the soil.

pH - measure of the hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH from 0 - 6, basic solutions have a pH >7, and neutral solutions have a pH equal to 7.

Piezometer - instrument used to measure the potentiometric surface of the ground water. Also, a well designed for this purpose.

Appendix B - Glossary of PRS Terms

Polychlorinated Biphenyl (PCB) - any of several organic compounds that are commonly used in industrial applications. PCBs are environmental pollutants which tend to accumulate in animal tissues.

Polymeric - of or pertaining to any of the numerous natural and synthetic compounds of usually high molecular weight consisting of repeated linked units, each a relatively light and simple molecule.

Polynuclear aromatic hydrocarbons (PAHs) - highly reactive compounds consisting of hydrogen and carbon atoms arranged in multiple rings.

Potential Release Site (PRS) - An area where sampling data or knowledge of historic or current use indicates that the site may have had releases of radioactive and/or hazardous material.

Preliminary Remediation Goal (PRG) - chemical-specific concentration goals for specific media and selected land-use conditions at CERCLA sites. They provide remedial design staff with long-term targets to use during analysis and selection of remedial alternatives.

Quality Factor (Q) - the principle modifying factor that is used in deriving the **dose equivalent (H)** from **absorbed dose (D)**; chosen to account for the **relative biological effectiveness (RBE)** of the radiation in question, but to be independent of the tissue or organ under consideration, and the biological endpoint. For radiation protection purposes, the quality factor is determined by the **linear energy transfer (LET)** of the radiation.

Radioactivity - the property or characteristic of radioactive material to spontaneously "disintegrate" with the emission of energy in the form of radiation.

Radiochemistry - the aspects of chemistry connected with radionuclides and their properties, with the behavior of minute quantities of radioactive materials by means of their radioactivity, and the use of radionuclides in the study of chemical problems.

Radioisotopes - radioactive isotopes.

Radionuclide - unstable **nuclide** capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles. There are several hundred known radionuclides, both artificially produced and naturally occurring; radionuclides are characterized by the number of neutrons and protons in an atom's nucleus and their characteristic decay processes.

Raffinate - the portion of a liquid that remains after other compounds have been dissolved by a solvent.

Rare Earth Element - any of the series of very similar metals ranging in atomic number from 57 through 71.

Recreational Scenario - the recreational scenario characterizes potential exposure to someone who visits the property (e.g., the park) for 4 hours a day, 52 days per year (i.e., 1 day per week) for 30 years (including 6 years as a child). The person is assumed to ingest a small amount of soil/sediment in the park, inhale small amounts of dust from the soil/sediment, and be externally exposed to possible radiation from the soil/sediment. In addition, the park visitor is assumed to wade or play in surface water on the property 4 hours per day, 52 days per year for 30 years, and ingest (accidentally drink) small amounts of water while wading or playing.

Recreational Cleanup Guideline - a cleanup guideline developed using the **recreational scenario.**

Reference Dose - the Environmental Protection Agency's preferred **toxicity** value for evaluating noncarcinogenic effects result from exposures at Superfund sites.

Regulatory limit - a level or concentration that shall not be exceeded. Based on regulation.

Relative Biological Effectiveness (RBE) - a factor used to compare the biological effectiveness of absorbed radiation doses due to different types of ionizing radiation.

Release Block - A contiguous tract of the Mound property that is designated through the **Mound 2000 Process** for release at a specific point in time.

Appendix B - Glossary of PRS Terms

Removal Site Evaluation Process - The decision making process for the cleanup of Mound. Informally known as the **Mound 2000 Process**. It is consistent with the Federal Facilities Agreement (FFA) and CERCLA as defined in the National Contingency Plan (NCP). It uses the **Release Block** concept instead of the Operable Unit System, in which **Potential Release Sites** are identified and evaluated.

Removal Action - short-term immediate actions taken to address releases of hazardous substances that require expedient response.

Residual Risk Evaluation (RRE) - A risk evaluation of the health risks within a **Release Block** after all PRS have been declared to be NFA. A RRE will be conducted for each **Release Block** prior to transfer of the **Release Block** from DOE to another party, to ensure that future users of the land will not be exposed to contaminant levels that would pose unacceptable risks.

Risk Based Guideline Values - in developing GVs, target risks for chemicals and radionuclides of concern are identified. Risks are usually expressed as a probability of adverse effects associated with exposure to contaminants. For carcinogens, these probabilities are expressed as excess cancer incidence over a human lifetime, which is the probability of an individual having one case of cancer above the normal background cancer rate observed in the general population. In the development of the Mound Risk-Based Guideline Values, concentrations were calculated corresponding to incremental lifetime cancer risk of 10^{-4}, 10^{-5}, and 10^{-6}, which are within the EPA target risk range of 10^{-4} to 10^{-6}. A cancer risk of 10^{-4} to 10^{-6} indicates a probability of one chance in 10,000 to one chance in 1,000,000, respectively of an individual developing cancer. For noncarcinogenic effects, a concentration is calculated that corresponds to a **Hazard Quotient** of 1, which is the level of exposure to a chemical from significant exposure pathways in a given medium for the human population, including sensitive subpopulations, that are likely to be without an appreciable risk of deleterious effects during a lifetime or portion of a lifetime.

Risk - the probability or likelihood of an adverse effect.

Scenario - is a combination of exposure pathways used to model conceptually the potential conditions, events, and processes that result in exposure to individuals or groups of people.

Appendix B - Glossary of PRS Terms

Screening - rapid, qualitative, or semi-quantitative on-site measurements.

Seep - area, generally small, where water **percolates** slowly to the land surface.

Sluiceway - a man made channel for water with a gate to regulate flow.

Soil Screening Level (SSL) - A chemical concentration in soil below which there is no concern under CERCLA for ingestion, inhalation and migration to groundwater exposure pathways, provided certain conditions are met.

Solvent - a liquid capable of dissolving another substance.

Source - point or object from which radiation or contamination originates.

Spoils - disrupted or disturbed material such as soil.

Stable - not radioactive or not easily decomposed or otherwise modified.

Stakeholder - a shareholder or interested party in any enterprise.

Supernatant - portion of a liquid above settled material in a tank or other vessel.

Threshold Limit Value (TLV) - an allowable exposure concentration averaged over a normal 8-hour workday or 40-hour workweek.

Toxic - having the ability to injury or interfere with a life process when coming into contact with it.

Toxicity - the effect of a specific quantity or dose of a specific **toxin** (chemical) has on a living organism.

Toxin - a substance which can cause injury or interferes with a life process when one comes into contact with it.

Upper 95 Percent Confidence Interval - estimate of the standard deviation of the measurement or counting process taken to the 95% confidence limit (+2 standard deviations from the mean).

Appendix B - Glossary of PRS Terms

USEPA Target Risk Range - a cancer risk in the range of 10^{-4} to 10^{-6} is the target range that the United States Environmental Protection Agency (USEPA) has defined acceptable. This indicates a probability of one chance in 10,000 to one chance in 1,000,000, respectively, of an individual developing cancer.

USEPA Maximum Contaminant Level - under the Safe Drinking Water Act (SDWA) there are chemical-specific risk-based standards for 30 toxic compounds, including 14 compounds adopted as RCRA Maximum Concentration Limits, for which enforceable standards for public drinking water systems (40 CFR 141.11 - 141.16) have been adopted.

Verification Sampling - sampling performed to test the accuracy or certainty by comparison; sampling performed to substantiate.

Volatile Organic Compounds (VOCs) - broad range of organic compounds, commonly halogenated, that vaporize at **ambient**, or relative low, temperatures (e.g., acetone, benzene, chloroform, and methyl alcohol).

Waste Transfer System (WTS) - system at the Mound site that was used to transfer liquid wastes from the Special Metallurgical (SM) and Plutonium Processing (PP) Buildings to the Waste Disposal (WD) facility. This system consisted of two (2) underground transfer lines (approximately 5100 feet total) and a 350 square foot building (Building 41 containing two (2) 3500 gallon tanks and a pumping system.

X-ray Fluoroscope - laboratory instrument used to measure the characteristic x-rays to determine the amount of an x-ray emitting radionuclide. The instrument is used to detect metals.

This page left intentionally blank

APPENDIX C

SAMPLING METHODS, ANALYSIS METHODS, AND TERMINOLOGY

Appendix C - Sampling Methods, Analysis Methods, and Terminology

What one is trying to find out about a site, as well as how accurate one wants the results, the amount of money available for studying the site, and the applicable regulatory requirements all are factors which drive the type of sampling and analysis methods used.

Sampling and analysis methods are generally chosen based on the objective of the sampling, the required accuracy of the data, the cost of obtaining the data, and by regulatory requirement. Generally, there are three types of sampling: preliminary, characterization, and supplementary sampling. The objectives of environmental sampling are broadly divided into exploratory or monitoring goals. Exploratory sampling is designed to provide preliminary information about the site or material being analyzed. Monitoring is intended to provide information on the variation of specific analyte concentrations over a period of time or within a specific geographic area.

Preliminary sampling - screening or a preliminary assessment of the extent and magnitude of contamination. Preliminary sampling is a reference to either a strategy or methods that have restraints on their use through either less stringent quality assurance or less formal procedures like lack of survey locational data.

Preliminary sampling methods (sometimes referred to as screening or scoping) are desired to determine the extent and magnitude of contamination and the variations in contaminant levels within the affected areas. Preliminary sampling methods are simple, less expensive methods. They can be useful to indicate areas of concern which would be investigated by more complex and more expensive methods to characterize contamination. In other words, preliminary sampling methods provide preliminary assessments of site conditions, and provide information to classify the site into affected and unaffected areas.

Characterization sampling - a more detailed definition of the extent and magnitude of contamination.

Characterization sampling is a strategy performed to more precisely define the extent and magnitude of contamination. Characterization is typically concentrated on those portions of the site which are known to have been or are suspected of having been affected by site operations.

Supplementary sampling - confirms or provides more information about the extent or magnitude of contamination.

Sometimes, supplementary sampling or resampling also is desirable. It may confirm particularly critical findings and clarify any uncertainties that were discovered earlier.

The ability of an analytical method to measure a contaminant must be appropriate to the sampling objective. For certain contaminants, EPA requires the use of specific analytical methods sometimes referred to as "standard" methods.

Selecting the analytical methods is an important part of the planning process. For example, the sensitivity of an analytical method directly influences the volume of sample necessary to measure constituents (analytes) at a needed minimum detection or quantification level. EPA requires the use of specific analytical methods for characterizing certain contaminants. The methods applicable to various classes of contaminants as seen in the PRS evaluations are discussed briefly below.

Appendix C - Sampling Methods, Analysis Methods, and Terminology

PETREX is one type of screening tool that can tell you if contaminants are high relative to other areas but it cannot tell you quantitative results for specific chemicals. PETREX is measured in units of ion counts.

Organic Chemical Contaminants are materials such as alcohols, paint thinners, fuel oils, degreasers, and pesticides. A simple, sensitive and relatively inexpensive sampling method to determine the presence of these materials is called PETREX. It can determine if certain compound families are present underground in the tiny spaces between the soil particles. It uses a gas analyzer called a mass spectrometer to detect a large variety of organic chemicals and to indicate their presence by reporting numbers on a relative scale in ion counts. PETREX cannot determine how much (i.e., mg of contaminant per kilogram of soil gas) of a specific compound (i.e., trichloroethene) is present in the soil gas or in the soil. PETREX results can be used as a screen to identify areas where relatively elevated ion counts (concentrations) of compound families are located. These areas can then be further evaluated by more complex methods to provide information on which to base a decision.

Soil Gas Measurement is similar to PETREX, but it is a more complex method. Soil Gas Measurement is measured in units of part per million (ppm).

A more complex field sampling method is Soil Gas Measurement in which the nonadsorbed organic gases or compounds between the soil particles are collected and analyzed. The concentrations are reported as quantities of contaminant relative to the quantity of soil and contaminant mixture, usually parts of contaminant per million parts of mixture and reported in units of parts per million (ppm).

Laboratory sample analysis is more complex, accurate, time consuming and expensive. Samples are analyzed in an analytical laboratory. With soil sampling, the sampling depth can be from the surface to very deep depending on the depth of bedrock, physical obstructions, or the capability of the equipment to drill a hole into the earth and enable the intact removal of the sample.

X-ray Fluorimetry is a sampling method for measuring inorganic chemical contaminants (metals). X-ray induced emissions are measured in ppm.

Inorganic Chemical Contaminants are metals such as arsenic, beryllium, mercury, and lead in the environment. A field survey (sampling) method for these materials is X-ray Fluorimetry. It is a measure of X-ray induced emissions with a portable X-ray fluorescent emissions detector. Contaminant concentration is determined and reported in units of parts per million (ppm).

Sensitive analysis of inorganic chemical contaminants can be accomplished in the laboratory. Results can be obtained in the parts per billion (ppb) range.

Laboratory sample analysis is the most accurate method for inorganic chemical contaminant measurement. In the laboratory, contaminant concentrations can be determined and reported in units of parts per billion (ppb).

Appendix C - Sampling Methods, Analysis Methods, and Terminology

Each radionuclide emits a characteristic energy or series of energy levels or intensities.

Radiological Contaminants are materials, such as tritium, thorium, plutonium, polonium, radium, and uranium in the environment. These materials are also referred to as radionuclides. A radionuclide is an unstable form of an element which undergoes radioactive decay. The product nuclide may also be radioactive. The decays occur until a stable nuclide (non-radioactive) is the end-point. The rate at which a radioactive substance decays is a constant for each radionuclide. The fundamental law of radioactive decay is that each pure, radioactive species is characterized by the fraction and type of its particles decaying during a given unit of time.

Alpha, beta, and gamma radiation are measured at the Mound site. Each PRS may have one or more of these types of radiation present in varying amounts. It is dependent on the source of contamination present at the PRS.

Environmental radiation at the Mound includes X-rays, gamma rays, electrons, positrons, and alpha particles. Each radionuclide emits a characteristic energy or series of energy levels or intensities. For example, tritium is an electron emitter.

Gross radiation measurements cannot distinguish one radionuclide from another. Radionuclide specific analyses are used to characterize an area.

Gross radiation measurements should not be used for characterization as it cannot distinguish one radionuclide from another. Characterization should be done using radionuclide specific analyses. However, gross radiation measurements can be useful in determining the general activity levels. For example, a field survey (sampling) method to establish the presence of gamma emitting radioactive materials is the use of a portable gamma detector on the surface of soils. The presence and location of areas with gamma emitting radioactive materials can be established this way for further investigation and evaluation.

A FIDLER is used to detect low-energy gamma emitting radionuclides. A FIDLER soil survey is used as a screening mechanism to identify the distribution of surface deposits of low-energy gamma emitting radionuclides. It cannot identify what radionuclides are present.

A systematic survey of the surface soils throughout an area associated with contamination due to low-energy gamma emitting radionuclides can be conducted using a Field Instrument for Detection of Low Energy Radiation (FIDLER). This provides a screening mechanism for the distribution of surface deposits of radioactivity for lower energy gamma emitting radionuclides and indicates where soil samples should be collected. This type of survey cannot identify which radionuclides are present or the concentration of the contaminants. It can quantify the intensity of the low-energy radiation present.

At the Mound Soil Screening Laboratory gamma spectroscopy is performed. Although still considered a screening method or preliminary assessment, it

Radiological Soil Screening (alpha or gamma spectroscopy) is performed in the laboratory with weighed amounts of soil placed in a specific geometry and in a stable atmosphere. This screening provides indications of certain radionuclides such as plutonium-238 and thorium-232 only. Soil screening is usually done after field

provides indications of certain radionuclides such as plutonium-238 and thorium-232. Results are reported in pCi/g.

More precise measurement using gamma spectroscopy and alpha spectroscopy can be achieved using specific analytical measurement procedures. Specific radionuclides can be identified and measured with confidence. These are more complex, time consuming, and expensive analytical methods that are used for characterizing an area.

survey instrument data, such as FIDLER data or other data, indicate increased activity. PRS gamma spectroscopy data were also available for evaluation in many cases. Gamma emissions from gamma emitting radionuclides in the soil are counted directly using sodium iodide thallium activated crystals, lithium-drifted germanium diodes or hyper-pure germanium type detectors. Different analytical protocols will allow for the identification and quantification of radionuclide contaminants of concern.

PRS alpha spectroscopy data were also available for evaluation in some cases. Alpha spectroscopy can identify a wide variety of radionuclides in soil. This technique is most sensitive and can quantify alpha emitters at very low concentrations. However, laboratory preparation of soil samples is necessary, lengthy, and relatively expensive.

Units of Measurement

Concentrations of chemicals are reported in various units, depending on customary expressions, convention, or in some cases regulation.

Ion Counts = Number of responses to ions of a particular molecular weight range.

PETREX data are given in "ion counts," meaning that the gas analyzer recorded so many responses to ions of a particular molecular weight range. All organic chemicals in that weight range are counted so it cannot discriminate between specific organic chemicals but it can differentiate between different organic chemical classes. The numbers are non-specific and only indicate the relative magnitude of organic species.

Concentration = measured quantity of contaminant per amount of soil or water.

Laboratory analytical data are reported in concentrations of measured quantities per amount of soil or water. Most of these analyses are confidently reported in milligrams per kilogram of soil (mg/Kg) or milligrams per Liter of water (mg/L). A kilogram of soil or a liter of water is 2.2 pounds. A milligram is one one-thousandth part of a gram (a dime weighs a gram). The milligram per kilogram is usually simply called parts per million (ppm).

Frequently analytical methods are so accurate that they can report micrograms per kilogram (soil) or per liter (water), (i.e., µg/Kg). This is one one-millionth part of a gram per kilogram (1000 grams). This unit is parts per billion (ppb).

Appendix C - Sampling Methods, Analysis Methods, and Terminology

Ppm and ppb are concentrations. These units are commonly seen in PRS organic and inorganic characterization results used to precisely define the extent and magnitude of contamination.

1/100 = parts per hundred or percent, as in 10 g/Kg

1/1,000,000 = parts per million (ppm), as in mg/Kg

1/1,000,000,000 = parts per billion (ppb), as in µg/Kg

To aid the reader in understanding these units, ppm and ppb, are put into approximate money, time, length, and volume perspectives:

Units	ppm	ppb
Money	$0.01/$10,000	$0.01/$10,000,000
Time	1 min/2 yrs	1 sec/32 yrs
Length	1"/16 miles	1"/16,000 miles
Volume	1drop/65 quarts	1 drop/65,000 quarts

Standards are known concentrations of a contaminant or chemical substance. They are used to calibrate detectors or analytical equipment so that reliable sample results may be obtained.

Chemical or radiation detectors are calibrated to standards whose concentrations are known. Thus, the response of the detector can be associated with certainty to the concentration of the standard and the response can be extrapolated to express intermediate concentrations.

Radiation concentration results are expressed in terms of the Curie. This unit is unique to radiation.

pCi/g is a unit for radionuclide concentration; the measured quantity of radionuclide per amount of soil or water.

Radiation concentrations are expressed in unique terms. The important criterion is the amount of radiation emitted by the radionuclide. Each radionuclide emits radiation at a different rate (i.e., reference its half-life). The number of atoms of a nuclide in a gram is dependent on its atomic weight. The physical standard unit is the Curie. The Curie is defined, for any radionuclide as a source, as that quantity of radionuclide that is disintegrating at a rate of 37 billion disintegrations per second (3.7×10^{10} disintegrations per second). It is common in physics, chemistry, and medicine to use subunits or multiples of units to describe either very small quantities or very large quantities. In environmental assessment, the picocurie is most often used. One picocurie is one trillionth of a Curie. Another often seen unit is one thousand picocuries or nanocurie.

The picocurie = $1/10^{-12}$ Curie

$$= \frac{1}{1{,}000{,}000{,}000{,}000} \textit{ Curie}$$

or 1 pCi: a source showing 3.7×10^{-2} disintegrations per second (0.037 disintegrations per second, or just over 2 per minute).

The nanocurie = $1/10^{-09}$ Curie

$$= \frac{1}{1{,}000{,}000{,}000} \textit{ Curie}$$

or 1 nCi: a source showing 3.7×10^{1} disintegrations per second (37 disintegrations per second).

Disintegrations either occur or they do not. They cannot be fractional. If the source strength is one picocurie, then there will be one disintegration every 27 (1/.037) seconds, on the average.

APPENDIX D

GUIDELINE CRITERIA DOCUMENTS

Appendix D - Guideline Criteria Documents

In order to consistently assess PRSs, PRS data must be evaluated against the same set of "standards." The set of "standards" that was used for all PRS assessments with potential soil contamination is known as Guideline Criteria.

Guideline Criteria are chemical or contaminant specific and environmental media (i.e., soil, water, air) specific concentration values. They are "standard" concentration values that are compared with PRS data. These "standard" concentration values fall into one of four categories:

1) Guideline Values (GVs),
2) Regulatory Limits,
3) ALARA goals, or
4) Screening Values for Soil as related to soil gas levels.

GVs, ALARA goals, and screening values are risk-based screening tools only. They are not cleanup values.

Some contaminants are known to cause cancer. These contaminants are called carcinogens. The risk associated with carcinogens was examined over an incremental range. A "standard" concentration value was obtained for each carcinogenic contaminant at each risk level for each applicable medium.

Some contaminants are not associated with cancer, but can cause harmful effects. These contaminants are called noncarcinogens.

A "standard" concentration value was obtained for each noncarcinogenic contaminant for each applicable medium.

Guideline criteria is a phrase used in the PRS Recommendations. Guideline criteria are the "standards" for which the PRS data are evaluated to reach a recommendation decision.

The guideline criteria are found in the PRS Comparison Values table (Attachment D1) and consist of Mound risk-based Guideline Values (GVs), regulatory limits, and Mound ALARA goals. Protective soil screening levels are also part of the guideline criteria, but do not appear in the PRS Comparison Values table (Attachment D1) because they are referred to only if soil GVs are exceeded. Protective soil screening levels are found in Attachment D4. Each of these components is explained below with reference to detailed information on how they were developed.

Risk-based Guidelines Values

Explosives, Inorganics, Organics, and Radionuclides in Different Media

PRS data are compared directly with risk-based GVs developed specifically for the DOE's Mound site. GVs are risk-based media-specific contaminant concentrations derived for specific carcinogenic risk levels (e.g., 10^{-4}, 10^{-5}, 10^{-6}) and noncarcinogenic risk (Hazard Quotient = 1). However, they do not establish that cleanup is warranted to meet these goals. Risks are expressed as probabilities of adverse effects associated with exposure to contaminants.

For carcinogens, these probabilities are expressed as excess cancer incidence over a human lifetime, which is the probability of an individual having one case of cancer above the normal background cancer rate observed in the general population. For Mound GVs, concentrations were calculated corresponding to incremental lifetime cancer risks of 10^{-4}, 10^{-5}, 10^{-6}. A cancer risk of 10^{-4} to 10^{-6} indicates a probability or likelihood of one chance in 10,000 to one chance in 1,000,000, respectively, of an individual developing cancer.

For noncarcinogenic effects, a concentration was calculated for a chemical contaminant that corresponds to a Hazard Quotient of 1. A Hazard Quotient of 1 is the level of exposure to a chemical from significant exposure pathways in a given medium for the human population, including sensitive subpopulations that are likely to be

without an appreciable risk of harmful effects during a lifetime or portion of a lifetime.

GVs were developed using an accepted EPA model called Risk Assessment Guidance for Superfund Methodology or RAGS for short. Mound data needed for the model was obtained from various Mound documents (see Reference List - Attachment D6).

For detailed information on how GVs were developed for the Mound, refer to the Risk-Based Guideline Value Report (see Attachment D6).

The GVs for the Mound site were developed by using Risk Assessment Guidance for Superfund (RAGS): Volume 1 - Human Health Evaluation Manual, Part - B, Development of Risk-Based Preliminary Remediation Goals (EPA, 1991). The development of the GVs required the following site specific data: (1) media of potential concern, (2) contaminants of potential concern, and (3) probable land use. This type of information was obtained from the RI/FS for Mound Operable Unit 9/Sitewide Work Plan (DOE, 1992a), the RI/FS for Mound Operable Unit/Sitewide Preliminary Baseline Risk Assessment (DOE, 1992b), the Draft Work Plan for Environmental Studies in the Vicinity of the Mound Plant (ASTDR, 1993), and the conceptual site model developed for the Mound Site.

The GV methodology is used for the development of risk-based media-specific contaminant concentrations that can be used as a risk-based screening tool to rapidly identify potential contaminants of concern, determine the need for future evaluation or to confirm that a site is a likely candidate for "NO FURTHER ASSESSMENT (NFA)." A detailed explanation of the development of the GVs for the Mound Site is found in Section 3.0 of the Risk-Based Guideline Values Report (DOE, 1995c).

The Core Team makes PRS recommendations. It is a multi-organizational team that reaches a joint recommendation concerning the status of a PRS.

Generally, the GVs are compared to media-specific (i.e., water, soil, air) maximum contaminant concentrations. Concentrations exceeding the GVs may verify that a site is a potential health concern requiring FURTHER ASSESSMENT (FA) or a RESPONSE ACTION (RA). Generally the Core Team, consisting of the EG&G MAT Environmental Restoration (ER) group, USEPA, OEPA and DOE consider sites that have no contaminant concentrations exceeding the GVs to be NO FURTHER ASSESSMENT (NFA) sites and further activities can be limited appropriately. Because the GVs can be used as a basis for proposing NO FURTHER ASSESSMENT (NFA), sites considered for NO FURTHER ASSESSMENT (NFA) based solely on the use of the GVs should have adequate site characterization data (historical or current).

GVs are risk-based for specific carcinogens and noncarcinogen effect levels that are appropriate to land use/exposure scenarios likely to occur at the Mound site. Likely exposure scenarios identified for the Mound site are Construction/Mound Employee and Commercial/Office Worker scenarios. Risk at different levels (10^{-4}, 10^{-5}, 10^{-6}) were considered for carcinogenic effects. One risk level (Hazard Quotient of 1) was considered for noncarcinogenic effects.

Specifically, GVs from the Construction/Mound Employee Exposure Scenario (Category 4) and the Commercial/Office Worker Exposure Scenario (Category 5), found in Appendix A of the Risk-Based Guideline Values Report (DOE, 1995c), were considered in the selection of specific GVs applicable to the PRS evaluations.

A scenario is a combination of exposure pathways used to model conceptually the potential conditions, events, and processes that result in exposure to individuals or groups of people. DOE, its regulators, and stakeholders agree that the future use of the Mound property will be commercial/industrial use. The above scenarios were selected because they represent reasonable exposures in a commercial/industrial setting.

The table of PRS Comparison Values (Attachment D1) contains the values representing the most conservative risk level (10^{-6}) for carcinogenic effects, the risk level equal to a Hazard Quotient of 1 for the noncarcinogenic effects, and where applicable, regulatory limits and ALARA goals.

For carcinogenic contaminants, GVs at the 10^{-4}, 10^{-5} 10^{-6} risk levels for different media (i.e, soil, water, etc.) were considered. For each contaminant, the applicable risk levels from each Exposure Scenario (Category 4 and 5) were compared with each other. The most conservative GV was selected and compiled in a table known as the PRS Comparison Values (see Attachment D1). There were some exceptions made for soil and groundwater. When there was a regulatory limit or an As Low As Reasonably Achievable (ALARA) Mound goal, then it took precedence. For example, the ALARA Mound goal for plutonium-238 in soil is 25 pCi/g. This value took precedence over the plutonium-238 GV of 5.5 pCi/g for soil. Based on the Mound ALARA Pu-238 soil evaluation, soil concentrations of less than 25 pCi/g cannot be reliably detected in the field with current technology. Exceptions are noted on the PRS Comparison Values table with specific regulatory explanation in the footnotes.

GVs, ALARA goals, and screening values were developed specifically for the Mound site. Regulatory limits are non-site specific values which cannot be exceeded. If Mound ALARA goals are established, then they take precedence because they take into consideration regulatory limits, technology, cost, etc. Otherwise, regulatory limits, if established, take precedence. They are the law.

For ground water Maximum Contaminant Levels (MCLs) were used in the PRS evaluation process for comparison with PRS ground water data. A MCL is a chemical specific drinking water limit with a concentration which the USEPA declares to be safe.

Background values were examined to put risk levels into perspective. Applicably background levels are found in Attachment D2.

PRS soil data are also compared against available soil background concentrations. Background data are used to put risk levels into perspective. Available soil background concentrations for radionuclides, anions, inorganics, and pesticides/PCBs were submitted to DOE/MB in July 1995 (see Attachment D2). These values were used in the PRS evaluation process as soil background

concentrations. These values were calculated from the data collected in the OU9 Soils Investigation from locations designated for background samples. Section 5, Appendix J, and Appendix K of the OU9 Background Soils Investigation Soil Chemistry Report (DOE, 1994d) provides a description of the calculations and the process used to develop these numbers. The specific background values used to compare PRS soil data with are also shown on the PRS Comparison Values table (see Attachment D1).

Soil Gas Data

Screening values for soil gas appear separately (see Attachment D3). They are applicable only when GVs are exceeded and are designed to protect groundwater resources.

Soil gas readings taken as part of the Reconnaissance Sampling Report - Soil Gas Survey and Geophysical Investigations, Mound Plant Main Hill and SM/PP Hill (DOE, 1993c) were used in the PRS screening process to identify potential release sites that may present a potential soil contamination problem from volatile organics. These soil gas values were compared with soil gas concentrations that are known to be below any regulatory or health-based level of concern.

Soil gas GVs were developed and compared with soil GVs. Similarities and differences can be identified in Attachment D3 and D4, respectively.

The applicable soil gas GVs were based on the Mound Plant Construction Worker exposure scenario at the 10^{-6} risk level (for carcinogens) of Hazard Quotient of 1 for noncarcinogens. However, Protective Soil Screening Levels were also developed because there is a potential for some of the organic contaminants to leach into the ground water. Potential ground water contaminants were considered in the development of Protective Soil Screening Levels. A "Mound Plant Soil Screening Level" paper, Attachment D4, identifies the applicable soil gas GVs and explains how they were calculated. Comments on the paper are found in Attachment D5.

For all of the chemicals identified in the soil gas survey, the calculated soil screening level soil concentrations were below the standard GVs. The calculated soil screening level soil concentrations are more conservative than the "standard" soil GVs and therefore they were used as the basis for PRS soil gas calculations.

The "Comparison of Actual Soil Gas Values with Calculated Acceptable Soil Gas Values" paper (EG&G MAT, 1996a), Attachment D3, contains details on how either the soil GVs or the Protective Soil Screening Levels can be used to convert soil concentrations to soil gas concentrations. Then these calculated soil gas concentrations can be compared to the actual observed soil gas values. For a PRS evaluation, if the soil gas readings are below the calculated soil gas readings values, then one can conclude that there is no threat to the ground water from the PRS. The "Comparison of Actual Soil Gas Values with Calculated Acceptable Soil Gas Values" paper (EG&G MAT, 1996a) also contains a table which identifies the typical chemicals that are detected with soil gas sampling, the calculated acceptable soil screening level value, and the calculated acceptable soil gas reading (see Attachment D3).

This page intentionally left blank

ATTACHMENT D1

PRS COMPARISON VALUES

CHEMICAL	Guideline Value mg/kg	Soil BACKGROUND mg/kg	Soil OTHER mg/kg	Ground Water mcl mg/l
Explosives				
HMX	1.10E+04			
PETN				
RDX	270			
Inorganics				
Aluminum		19,000		
Antimony	85			0.006
Arsenic	64	8.6		0.05
Barium	1.50E+04	180		2
Beryllium	0.7	1.3		0.004
Bismuth				
Bromate				0.01
Cadmium (Diet)	210	2.1		0.005
Calcium		310,000		
Chloramine				4
Chloride		107		
Chlorine				4
Chlorine dioxide				0.8
Chlorite				1
Chromium III	2.10E+05	20		0.1
Chromium VI	1.10E+03	20		0.1
Cobalt		19		
Copper		26		1.3
Cyanide	4.30E+03	ND		0.2
Fluoride		6.7		4
Iron		35,000		
Lead		48	400	0.015
Lithium		26		
Magnesium		40,000		
Manganese (Diet)	2.70E+04	1,400		
Mercury	64			0.002
Molybdenum		27		
Nickel	4.30E+03	32		0.1
Nitrate		26		10
Nitrite		26		1
Potassium		1,900		
Selenium				0.05
Silver	1.10E+03	1.7		
Sodium		240		
Sulfate		150		500
Thallium		0.46		0.002
Tin		20		
Vanadium	1.50E+03	25		
Zinc	6.40E+04	140		

ANY VALUE IN THE SOIL OTHER COLUMN IS REGULATORY AND TAKES PRECEDENCE

*CFR 192.12 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)
**CFR 192.41 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)

PRS COMPARISON VALUES

CHEMICAL	Guideline Value mg/kg	Soil BACKGROUND mg/kg	Soil OTHER mg/kg	Ground Water mcl mg/l
Organics				
2,3,7,8-TCDD (Dioxin)			0.001	0.00000003
2,4,5-TP				0.05
2,4-D				0.07
4,4'-DDD		4.2		
4,4'-DDE	9	4.3		
4,4'-DDT	9	13		
Acenaphthylene				
Acetone	2.10E+04			
Adipate (diethylhexyl)				0.4
Alachlor		58		0.002
Aldicarb				0.007
Aldicarb sulfone				0.007
Aldicarb sulfoxide				0.007
Aldrin				
Alpha chlordane				
Alpha-BHC				
Anthracene	6.40E+04			
Aroclor 1248	0.38			
Aroclor 1254	4.3			
Aroclor 1260	3.85E-01			
Atrazine				0.003
Benzene	8.9			0.005
Benzo(a)anthracene	4.10E+00			
Benzo(a)pyrene	4.10E-01			0.002
Benzo(b)fluoranthene	4.1			
Benzo(g,h,i)perylene				
Benzo(k)fluoranthene	41			
Benzoic Acid	8.50E+05			
Beta-BHC	1.65			
bis(2-Ethylhexyl)phthalate	215			
Bromodichloromethane (THM)	4.30E+03			0.08
Bromoform (THM)				0.08
Butanone 2- (methylethylketone --MEK)	9.30E+03			
Butyl benzyl phthalate	4.30E+04			
Carbofuran				0.04
Carbon Disulfide	2.80E+02			0.005
Carbon tetrachloride	4.60E+00			0.005
Chloral hydrate				0.06
Chlordane				0.002
Chlorodibromomethane (THM)				0.08
Chloroethane	160			
Chrysene	410			
Cresols				
Dalapon				0.2
Di-n-butylphthalate	2.10E+04			
Di-n-octyphthalate	4.30E+03			
Dibenz(a,h)anthracene	4.10E-01			

ANY VALUE IN THE SOIL OTHER COLUMN IS REGULATORY AND TAKES PRECEDENCE

*CFR 192.12 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)
**CFR 192.41 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)

PRS COMPARISON VALUES

CHEMICAL	Guideline Value mg/kg	Soil BACKGROUND mg/kg	Soil OTHER mg/kg	Ground Water mcl mg/l
Dibromochloromethane	35.5			
Dichloroacetic acid				0.06
Dichlorobenzene m-				0.6
Dichlorobenzene o-				0.6
Dichlorobenzene p-				0.075
Dichloroethane 1,1- (1,1-DCA)	7.8			
Dichloroethane1,2- (1,2-DCA)	3.2			0.005
Dichloroethene 1,1- (1,1-DCE)				0.007
Dichloroethene 1,2-cis- (1,2-cis-DCE)				0.07
Dichloroethene 1,2-trans- (1,2-trans-DCE)	4.30E+03			0.1
Dichloromethane	395			0.005
Dichloropropane 1,2-				0.005
Dieldrin	1.85E-01			
Diethyl benzene, 1,4				
Diethylhexyl phthalate (PAE)				0.006
Dinoseb				0.007
Diobromochloropropane (DBCP)				0.0002
Diquat				0.02
Endosulfan I (alpha)		ND		
Endosulfan II (beta)				
Endosulfan Sulfate		ND		
Endothall				0.1
Endrin		ND		0.002
Endrin Aldehyde		ND		
Endrin Ketone		ND		
Ethyl benzene	4.80E-01			0.7
Ethylene dibromide (EDB)				0.00005
Fluoranthene	8.50E+03			
Gamma Chlordane		ND		
Gamma-BHC (Lindane)		ND		
Glyphosphate				0.7
Heptachlor		ND		0.0004
Heptachlor epoxide		ND		0.0002
Hexachlorobenzene				0.001
Hexachlorocyclopentadiene		ND		0.05
Hexane	91			
Hexanone 2-				
Ideno(1,2,3-cd)pyrene	4.1			
Isophorone	3.15E+03			
Lindane				0.0002
Methoxychlor		30		0.04
Methyl iodide				
Methyl-2-Pentanone 4-	7.00E+02			
Methylnaphthalene 2-				
Methylphenol 4-	1.10E+03			
Monochlorobenzene				0.1
N-nitroso-diphenylamine	600			
Oxamyl (Vydate)				0.2

*CFR 192.12 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)
**CFR 192.41 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)

ANY VALUE IN THE SOIL OTHER COLUMN IS REGULATORY AND TAKES PRECEDENCE

PRS COMPARISON VALUES

CHEMICAL	Guideline Value mg/kg	Soil BACKGROUND mg/kg	Soil OTHER mg/kg	Ground Water mcl mg/l
Pentachlorophenol	25			
Pentachlorophenol				0.001
Phenol	1.30E+05			
Picloram				0.5
Polychlorinated biphenyls			50	0.0005
Pyrene	6.40E+03			
Simazine				0.004
Styrene				0.1
Tetrachloroethene (PCE)	2.10E+03			0.005
Toluene	2.50E+02			1
Toxaphene		ND		0.003
Tribromomethane	3.75E+02			
Trichloroacetic acid				0.06
Trichlorobenzene 1,2,4-				0.07
Trichloroethane 1,1,1- (1,1,1-TCA)				0.2
Trichloroethane 1,1,2- (1,1,2-TCA)				0.005
Trichloroethene (TCE)	41			0.005
Trichlorofluoromethane	7.30E+02			
Tricholoromethane (Chloroform (THM))	3.1			0.08
Vinyl chloride				0.002
Xylene	4.30E+05			10
Radionuclides	pCi/g		pCi/g	PCi/L
Actinium-227+D	1			0.4
Americium-241	4.95			1.2
Bismuth-207	0.175			1200
Cesium-137+D	0.46	0.42		120
Cobalt-60	0.1			400
Plutonium-238	5.5	0.13		1.6
Plutonium-239	5.5	0.18		1.2
Plutonium-240	5.5	0.18		1.2
Radium-226+D*	0.14	2	5/15	4
Strontium-90+D	3	0.72		40
Thorium-228+D*	0.85	1.5	5/15	16
Thorium-230*	44	1.9	5/15	12
Thorium-232**	50	1.4	5/15	2
Tritium	2.35E+04	1.6		20000
Uranium-233	37			20
Uranium-234	37.5	1.1		20
Uranium-235+D	3.35	0.11		24
Uranium-238+D	11	1.2		24
Potassium-40		37		

ANY VALUE IN THE SOIL OTHER COLUMN IS REGULATORY AND TAKES PRECEDENCE

*CFR 192.12 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)
**CFR 192.41 (5 pCi/g to 15 cm, 15 pCi/g below 15 cm)

ATTACHMENT D2

Proposed Mound Background Concentrations for Chemicals in Soils

This page intentionally left blank

Radionuclide Background Values for Comparison to Mound Plant Soils

	Maximum Value (pCi/g)	Background* Value (pCi/g)
Americium-241	Not detected in any sample	Not detected in any sample
Bismuth-207	Not detected in any sample	Not detected in any sample
Bismuth-210	Not detected in any sample	Not detected in any sample
Cesium-137	0.73	0.42
Cobalt-60	1.01 Note 1	
Plutonium-238	0.25	0.13
Plutonium-239/240	0.32	0.18
Potassium-40	37.9	37
Radium-226	2.95	2
Strontium-90	21.9	0.72
Thorium-228	2.13	1.5
Thorium-230**	2.44	1.9
Thorium-232	1.69	1.4
Tritium	8.28	1.6
Uranium-234	1.16	1.1
Uranium-235/236	0.12	0.11
Uranium-238	1.29	1.2

Note 1: The background value could not be computed due to the large number of non-detects in the sample set.

* Upper 95% Sample Tolerance Limit

** From Regional Soils Investigation

Anion Background Values for Comparison to Mound Plant Soils

	Maximum Value (mg/kg)	Background* Value (mg/kg)
Chloride	116	107
Fluoride	18.3	6.7
Nitrate/Nitrite	30.9	26
Sulfate	196	150
TOC	40,300	28,000

Note 1: The background value could not be computed due to the large number of non-detects in the sample set.

* Upper 95% Sample Tolerance Limit

** From Regional Soils Investigation

Inorganic Background Values for Comparison to Mound Plant Soils

	Maximum Value (mg/kg)	Background* Value (mg/kg)
Aluminum	71,000	19,000
Antimony	Data Rejected	Data Rejected
Arsenic	11	8.6
Barium	250	180
Beryllium	2.4	1.3
Bismuth	38	Note1
Cadmium	3.2	2.1
Calcium	260,000	310,000
Chromium	32	20
Cobalt	29	19
Copper	43	26
Cyanide	Not detected in any sample	Not detected in any sample
Iron	53,000	35,000
Lead	85	48
Lithium	28	26
Magnesium	56,000	40,000
Manganese	1,700	1,400
Mercury	0.15	Note 1
Molybdenum	31	27
Nickel	50	32
Potassium	2,400	1,900
Selenium	0.59	Note 1
Silver	5.1	1.7
Sodium	400	240
Thallium	0.47	0.46
Tin	23	20
Vanadium	31	25
Zinc	740	140

Note 1: The background value could not be computed due to the large number of non-detects in the sample set.

* Upper 95% Sample Tolerance Limit

** From Regional Soils Investigation

Pesticides/PCB Background Values for Comparison to Mound Plant Soils

	Maximum Value (mg/kg)	Background* Value (mg/kg)
4,4-DDD	21	4.2
4,4-DDE	39	4.3
4,4-DDT	65	13
Aldrin	Not detected in any sample	Not detected in any sample
Alpha chlordane	Not detected in any sample	Not detected in any sample
Alpha-BHC	Not detected in any sample	Not detected in any sample
Arochlor-1016	Not detected in any sample	Not detected in any sample
Arochlor-1221	Not detected in any sample	Not detected in any sample
Arochlor-1232	Not detected in any sample	Not detected in any sample
Arochlor-1242	Not detected in any sample	Not detected in any sample
Arochlor-1248	Not detected in any sample	Not detected in any sample
Arochlor-1254	Not detected in any sample	Not detected in any sample
Arochlor-1260	Not detected in any sample	Not detected in any sample
Aroclor-1254	65	58
Beta-BHC	Not detected in any sample	Not detected in any sample
Delta-BHC	Not detected in any sample	Not detected in any sample
Dieldrin	Not detected in any sample	Not detected in any sample
Endosulfan I (alpha)	Not detected in any sample	Not detected in any sample
Endosulfan II (beta)	1.9	Note 1
Endosulfan Sulfate	Not detected in any sample	Not detected in any sample
Endrin	Not detected in any sample	Not detected in any sample
Endrin Aldehyde	Not detected in any sample	Not detected in any sample
Endrin Ketone	Not detected in any sample	Not detected in any sample
Gamma Chlordane	Not detected in any sample	Not detected in any sample
Gamma-BHC (Lindane)	Not detected in any sample	Not detected in any sample
Heptachlor	Not detected in any sample	Not detected in any sample
Heptachlor	Not detected in any sample	Not detected in any sample
Heptachlor Epoxide	Not detected in any sample	Not detected in any sample
Methoxychlor	50	30
Toxaphene	Not detected in any sample	Not detected in any sample

Note 1: The background value could not be computed due to the large number of non-detects in the sample set.

* Upper 95% Sample Tolerance Limit

** From Regional Soils Investigation

ATTACHMENT D3

COMPARISON OF ACTUAL SOIL GAS VALUES WITH CALCULATED ACCEPTABLE SOIL GAS VALUES

This page left intentionally blank

SCREENING POTENTIAL RELEASE SITES BASED ON SOIL GAS READINGS

Soil gas readings can be utilized in the PRS screening process to identify potential release sites that may present a potential soil contamination problem for volatile organics. The soil gas survey that was conducted at Mound as part of the "Reconnaissance Sampling Report--Soil Gas Survey and Geophysical Investigations, Mound Plant Main Hill and SM/PP Hill" investigated 8 volatile compounds. The concentrations of these compounds in the vapor phase within the pore spaces of the soil can be correlated to the actual soil contaminant concentrations by utilizing a method developed by ICF Kaiser Engineers. This technique has been used with US EPA Region IX approval at a large Superfund site contaminated with many of the same chemicals found at relatively low levels in soils at the Mound Plant.

The soil concentration can be estimated from the soil gas values by the following equation:

$$Ct = (Cg/Pb)*[[Pb * Kd / H] + [pw / H] + [pt - pw]]$$

where

Cg	concentration of volatile chemical concentrations as soil vapor in ng/ml
Pb	Bulk density of the soil in g/ml
Kd	soil/water partition coefficient in ml/g
H	Dimensionless Henry's Law Constant
pw	water filled porosity
pt	total porosity
Ct	target soil concentration in ng/g or ug/kg (ppb)

The technique that Mound Plant will use for screening a PRS is to compare the soil gas values obtained at a PRS with soil gas concentrations that are known to be below any regulatory or health based level of concern. The risk based guideline values for the Mound Plant (DOE, December 1995) soils are based upon 10^{-6} risk levels or a hazard index of 1. These values correspond to direct soil exposure to persons whose activities place them at the highest risk, in particular inhalation and ingestion by a Mound Plant construction worker.

Another potential exposure path must be considered, however. The potential for some of the organic contaminants to leach into ground water must be considered in developing protective soil screening levels. A "Mound Plant Soil Screening Level" paper explains the calculation of soil screening levels. For all of the chemicals that the soil gas survey identified, the calculated soil screening level soil concentrations are below the standard guideline values, therefore they are more conservative and are appropriate to be used as the basis for the soil gas calculations.

By re-arranging the equation, and using either the soil guideline values or the soil screening levels as the target soil concentration, a soil gas concentration can be calculated; this calculated soil gas concentration can be compared to the actual observed soil gas values:

$$Cg = (Pb*Ct)/[[Pb*Kd/H] + [pw/H] + [pt-pw]]$$

The values of the soil specific and chemical parameters for this equation are summarized as follows:

Pb	1.6	Bulk density of the soil in g/ml
pw	0.15	water filled porosity
pt	0.43	total porosity
foc	0.02	fraction organic material in soil (used in developing the SSL values)

5/20/96

Typical chemicals that are detected with soil gas sampling are:					
NAME	H	Kd	Calculated Acceptable	Calculated Acceptable	Calculated Acceptable
			Soil Screening Level Value	Soil Gas Reading	Soil Gas Reading
		ml/g	mg/kg (ppm)	ng/ml	ppb
Toluene	2.52E-01	3.42	22.06	1.56E+03	414600
1,1 Dicholorethane (DCA)	2.36E-01	0.7	5.70	1.61E+03	398000
Trichloroethene (TCE)	4.35E-01	2.24	0.07	1.26E+01	2400
111 Trichloroethane (TCA)	7.63E-01	2.2	3.01	9.46E+02	173400
Trans-1,2 Dichloroethene (DCE)	2.29E-01	1	0.70	1.41E+02	35700
cis-1,2 Dichloroethene (DCE)	1.85E-01	2.78	0.31	1.97E+01	5000
Freon 11	NA	NA			
Freon 113	NA	NA			
Tetrachloroethene (PCE)	7.09E-01	2.78	0.09	2.13E+01	3100

na--not available

IF THE SOIL GAS READING IS BELOW THE VALUES IN THE CALCULATED SOIL GAS READING COLUMN (SHADED), THEN THERE IS NO THREAT TO GROUNDWATER FROM THIS PRS.

The soil screening level values are calculated using the Soil Screening Methodology. The Potential Release Site is assumed to be more than 100 meters from a potential drinking water source with an aquifer thickness of 15 meters and a source size of 10 meters. The hydraulic gradient is assumed to be 0.01 which is conservative for most of the Mound Plant PRSs. In special instances where the PRS lies less than 100 meters from a potential drinking water source, or the hydraulic gradient is much less than 0.01, new SSL values and new acceptable soil gas values will be calculated for that particular PRS.

ATTACHMENT D4

STANDARDIZED EQUATIONS BASED UPON USEPA SOIL SCREENING GUIDANCE FOR THE SOIL TO GROUND WATER MIGRATION PATHWAY

A CONSERVATIVE FATE AND TRANSPORT MODEL WHICH IS DEPENDENT UPON SOURCE TERM SIZE, AQUIFER THICKNESS, GRADIENT, AND DISTANCE TO POTENTIAL RECEPTOR TO DETERMINE DILUTION WITHIN GROUNDWATER. NO CHEMICAL ADSORPTION WITHIN THE AQUIFER IS CONSIDERED.

PURPOSE OF SOIL SCREENING LEVELS (SSL) FOR MOUND

The primary purpose of SSLs is to define a level in soil below which no further study or action would be required. Soil screening level calculations are a necessary part of evaluating potential release sites (PRS) to determine whether residual soil contamination poses a threat to ground water. This method is a screening method which will identify any PRS that exceeds a soil screening level concentration. Due to the conservative assumptions, any PRS that does not exceed the SSLs can be considered a non-problem with regard for potential leaching of contaminants into ground water. This method is designed to be a conservative method and is not a full contaminant fate and transport analysis. The assumptions involved are conservative, but site specific. If soil concentrations exceed the calculated levels, additional more detailed site-specific contaminant fate and transport models will be used to determine whether remedial action is needed.

The Mound plant is assumed to continue in an industrial/office park type of land use. Bedrock ground water within the Mound Plant property boundaries will be evaluated to residential standards and MCLs where it migrates across the property boundary towards credible potential receptors or where it may flow into the Buried Valley Aquifer (BVA). It is assumed that there will be no production of bedrock ground water within the site boundaries due to relatively low well specific capacities that would not support industrial activities.

DEVELOPMENT OF SOIL SCREENING LEVELS (SSL) FOR MOUND

The soil screening equations for the migration to the ground water pathway are developed to identify chemical concentrations in soil that have the potential to contaminate ground water. Migration of contaminants from soil to ground water can be thought of as a two-stage process: (1) the release of contaminants in soil leachate and (2) the transport of the contaminant through the underlying soil and aquifer to a receptor well. The equations consider both of these fate and transport mechanisms in developing SSLs that are protective of human health through the migration to ground water pathway. To be used for early PRS evaluation, the methodology needs to be easily applied.

Soil Screening Level (SSL): a chemical concentration in soil below which there is no concern under CERCLA for ingestion, inhalation, and migration to ground water exposure pathways, provided certain conditions are met.

Simple Site-Specific Method: standardized equations to calculate SSLs with easily obtained site-specific data.

Direct ingestion and inhalation of soil volatiles and fugitive dusts:
The Soil Screening framework differs from a site-specific estimate of risk in that the exposure equations and models are run in reverse to back-calculate to an "acceptable level" of contaminant in soil. Toxicity criteria are used to define the acceptable level: a level corresponding to a 10^{-6} risk for carcinogens and a hazard quotient (HQ) of 1 for non-carcinogens. The concept of back-calculating to an acceptable level in soil was presented in RAGS Part B (US EPA, 1991). This is the method utilized to obtain the current Mound Plant PRGs (DOE, 1994).

Migration to ground water:
For the migration to the ground water pathway, SSLs are back-calculated from acceptable ground water concentrations which are maximum contaminant levels (MCLs), or health-based limits (HBLs) calculated at the target risk levels. There are two parts to the ground water migration pathway:

1. Leaching from the soil into the ground water immediately below the source term.

2. Contaminant fate and transport to the potential receptor. Depending upon site-specific conditions the receptor may be considered to be at the source term or at some distance down gradient. The results of the model will be a dilution factor which will be used to modify the back-calculated soil concentrations.

ASSUMPTIONS FOR SOIL TO WATER LEACHING

1. There is no allowance for chemical degradation or volatilization. The source does not decrease in concentration over time. This assumption is conservative, especially for the small sites at Mound.

2. Adsorption is linear with concentration. This is valid for low concentrations (e.g. in the low ppb range) of most chemicals and for halogenated hydrocarbons, polynuclear aromatic hydrocarbons, benzene and chlorinated benzenes at higher concentrations.

3. The soil and pore water concentrations are at equilibrium with respect to adsorption. This assumption is conservative. The concentration in the pore water will be less than predicted by the calculations if equilibrium conditions are not met.

4. Adsorption is reversible and instantaneous. This is conservative as desorption is usually a slower process than adsorption and some chemicals may never completely desorb.

5. Soil contamination extends from the surface to the water table. In reality the source often does not extend to the water table. This is a conservative assumption

6. The potential receptor well is within the plume.

ASSUMPTIONS FOR GROUND WATER MIGRATION AND DILUTION

1. No chemical dispersion is accounted for. This is conservative in that chemical concentrations will be over estimated by these equations.

2. No adsorption within the aquifer in accounted for. This is conservative as the chemical concentrations will be over estimated.

3. Mixing is due only to horizontal trasnport and dilution by infiltrating rain water. Flow is assumed to by laminar and follows Darcy's Law. If Darcy assumptions are incorrect and flow becomes turbulent, the mixing is more complete than would be predicted by the equations.

4. The aquifer is assumed to act as an equivalent porous media. On the scale of transport at Mound, the fractured bedrock will not have preferential fracture transport pathways.

The equations incorporate a standard linear equilibrium soil/water partition equation to estimate contaminant release in soil leachate (equations 1 & 2) and a simple water-balance equation that calculates a dilution factor to account for dilution of soil leachate in an aquifer (equations 2 & 3). The dilution factor represents the reduction in soil leachate contaminant concentrations by mixing in the aquifer, expressed as the ratio of leachate concentration to the concentration in ground water at the receptor point (receptor well or point of compliance).

Simple PRS or Release Block SSLs are back calculated from acceptable ground water concentrations (i.e. non-zero MCLs). First the acceptable ground water concentration is multiplied by the dilution/attenuation factor (DAF) to obtain a target leachate concentration. For example, if the DAF is 10 and the acceptable ground water concentration is 0.05 mg/L, the target soil leachate concentration would be 0.5 mg/L. The partition equation (equation 1) is then used to calculate the total soil concentration or soil screening level (SSL) corresponding to this soil leachate concentration.

1.0 SOIL LEACHING

Utilizing the calculated guideline values for ground water (acceptable water concentration) from HAZWRAP, a corresponding soil concentration or soil screening level (SSL) can be calculated from:

$$SSL = C_w\{K_d + (\theta_w + (\theta_a H'))/\rho_b\} \qquad \textbf{(Equation 1)}$$

$$K_d = K_{oc} * f_{oc} \qquad \textbf{(Equation 2)}$$

where

Parameter	Definition	Units
C_w	target soil leachate. Acceptable water concentration • DAF	mg/L
K_d	soil-water partition coefficient (K_{oc} • f_{oc} for organic chemicals)	L/kg
θw	saturated porosity	
θa	air filled porosity	
H	Henry's Law constant * 41 (0 for metals and radionuclides)	
ρ_b	dry soil bulk density	kg/L
K_{oc}	soil organic carbon/water partition coefficient	L/kg
f_{oc}	fraction organic carbon in soil	

2.0 DILUTION/ATTENUATION

As contaminants in soil leachate move through the soil and ground water, they are subjected to physical, chemical, and biological processes that tend to reduce the eventual contaminant concentration at the receptor point. The processes include adsorption onto soil and aquifer media, chemical transformation, biological degradation, and dilution due to mixing of the leachate with ambient ground water. The reduction in concentration can be expressed by the DAF, which is defined as the ratio of contaminant concentration in soil leachate to the concentration in ground water at the receptor point. The DAF is used to back-calculate the target soil leachate concentration from an acceptable ground water concentration.

This simple site-specific model addresses only one of these dilution-attenuation processes: contaminant dilution in ground water. A simple equation, broken into two parts for ease of use, derived from geohydrologic water-balance relationships is used. This simplifying use of only ground water dilution is used for several reasons.

First, the assumption that the source will last infinitely, results in all subsurface adsorption sites being eventually filled and no longer available to attenuate contaminants. Second, soil contamination is assumed to extend to the water table, eliminating attenuation processes in the unsaturated zone. Finally, chemical specific biological and chemical degradation rates are not known for many chemicals and where they are known there is a wide range in values.

MIXING ZONE DEPTH (d)

One aspect of the model is the determination of the depth that a contaminant leachate will mix in the aquifer. This is called the mixing zone depth and it is dependent upon the rainfall infiltration rate, the length of the source term parallel to the ground water flow direction, the horizontal distance to a potential ground water receptor, and the hydraulic gradient. The mixing zone depth equals the thickness of the saturated portion of the aquifer if mixing is completely effective. This can occur if the aquifer is relatively thin and the distance to the potential receptor is relatively great.

$$d = (0.0112(L+x_r)^2)^{0.5} + d_a\{1 - \exp[(-in(L+x_r))/Kid_a]\} \qquad \text{(Equation 3)}$$

where

Parameter	Definition	Units
L	source length parallel to ground water flow	m
d_a	aquifer thickness	m
K	hydraulic conductivity	m/y
i	hydraulic gradient at the source	m/m
x_r	horizontal distance to receptor	m
in	infiltration rate	m/y

Equation 2 assumes that the mixing depth cannot exceed the thickness of the aquifer. The equation is composed of two terms. The first term relates vertical mixing due to horizontal ground water flow, the second term relates the downward infiltration component due to rainfall recharge.

For Mound we assume that ground water contaminants from potential release sites that overlie the bedrock will be governed by this equation. This mixing zone depth equation is appropriate for use at PRSs that directly overlie the BVA, however the distance to the receptor must be assumed to be 0 m.

Once the mixing zone depth has been calculated, the actual dilution-attenuation factor (DAF) is calculated from the following equation:

$$\mathbf{DAF = 1 + Kid/inL} \qquad \textbf{(Equation 4)}$$

where the parameters are the same as in equation 2 and d = the mixing zone depth (equation 3).

Equation 3 incorporates the result of the calculated mixing zone depth with the volume of water that is traversing beneath the contaminant site. This is the effective dilution that occurs in the aquifer. This dilution could be as low as a factor of 1 if it is assumed that a receptor well is located within the leachate at the source term.

The calculated DAF shall be multiplied by the acceptable soil leachate concentration (back calculated from MCLs or risk derived concentrations) to obtain the target soil leachate concentration (C_w). The target soil leachate concentration is utilized in equation 1 to obtain the site specific SSL.

Additional dilution takes place when the migrating contaminant joins the BVA. It is reasonable to assume that any well that a resident installs for drinking water in the BVA is unlikely to located exactly at the edge of the BVA. This additional mixing that will take place is **not** accounted for in this SSL model. The assumption that the potential receptor is at the exact edge of the BVA, where the aquifer is too thin for a productive well is conservative.

SITE SPECIFIC DATA VALUES

These equations require site specific data for:

Parameter	Definition	SM/PP Hill top soil	Main Hill top soil	Units
L	source length parallel to ground water flow	45	45	m
d_a	aquifer thickness (DOE 1994)	10	15	m
K	hydraulic conductivity (DOE 1994)	52	52	m/y
i	hydraulic gradient at the source	site specific	site specific	m/m
x_r	horizontal distance to receptor	site specific	site specific	m
in	infiltration rate (Schairbaum & Frost 1988)	0.15	0.15	m/y
K_d	soil-water partition coefficient (K_{oc} * f_{oc} for organic chemicals)	chemical specific	chemical specific	L/kg
θ_w	saturated porosity	0.15	0.15	
θ_a	air filled porosity	0.28	0.28	
H	Henry's Law constant * 41 (0 for metals and radionuclides)	chemical specific	chemical specific	
ρ_b	dry soil bulk density	1.5	1.5	kg/L
K_{oc}	soil organic carbon/water partition coefficient	chemical specific	chemical specific	L/kg
f_{oc}	fraction organic carbon in soil (DOE Mound Plant Database)	0.02	0.02	

SOIL POROSITY AND DENSITY DETERMINATION

Although the soils at Mound rarely extends completely to the aquifer, a conservative assumption is that the soils do extend to the aquifer, providing a larger potential source that can desorb contaminants into the ground water.

The determination of the average soil pH is 7.45 from the Mound Plant site specific soil database.

The Mount Plant surface soils are typical of loam type soils. The f_{oc} from the Mound Plant soil database is 2.0%. There are no site specific values obtained for the soil bulk density or porosity. The default values that USEPA (USEPA, 1994) provides will be used in these equations.

HYDRAULIC GRADIENT DETERMINATION

The hydraulic gradient for a given PRS will be determined from nearby wells, or will be determined to be the same as the slope of the topography (or bedrock in fill areas) at the PRS location.

DISTANCE TO A POTENTIAL RECEPTOR

The distance to a potential receptor will be determined to be along the ground water flow direction until ground water encounters the edge of the BVA. The Mound Facility Boundary may be determined to define the distance to a potential receptor if it is deemed possible that a down gradient potential receptor well may be installed at or near the site boundary.

SOURCE LENGTH PARALLEL TO THE GROUND WATER FLOW DIRECTION

The size of the potential source can be quite variable. For PRS evaluation purposes, a length of 45 meters will be used which corresponds to a 1/2 acre potential source area. Soil chemical concentrations for this half acre area will be averaged. For some PRS's, the size is known to be substantially less, and the corresponding smaller value will be used in the equations.

CHEMICAL SPECIFIC PARAMETERS (H and K_{oc})

The values of H and K_{oc} are from the Technical Background Document for Soil Screening Guidance (USEPA. 1994). Although this draft document states that this document should not be cited or quoted, personal communication with Robert Truesdale of RTI indicates that these values may be used in the equations.

CHEMICAL NAME	H	Koc L/kg		Kd L/kg	MCL mg/L	10-6 Guideline Value mg/L		
Acenapthene	7.54E-03	5846	0.2	1169.2	—			
Acetone	1.18E-03	0.46	0.2	0.092	—	3.6		
Aldrin	4.22E-03	94623	0.2	18924.6	—			
Anthracene	4.55E-03	18162	0.2	3632.4	0.007			
Arochlor 1016	—	147410	0.2	29482	—			
Arochlor 1254	—	892520	0.2	178504	—	0.00073		
Arochlor 1260	—	4425557	0.2	885111.4	—	0.00001[illegible]		
Benzene	2.24E-01	66	0.2	13.2	0.005			
Benzo(a)anthracene	1.48E-04	272847	0.2	54569.4	0.007			
Benzo(b)flouranthene	2.53E-04	882588	0.2	176517.6	0.007			
Benzoic Acid	1.37E-05	—	0.2		—	140		
Benzo(a)pyrene	3.43E-05	749569	0.2	149913.8	0.0002			
Bis(2-chlorethyl)ether	8.77E-04	76	0.2	15.2	—			
Bis(2-ethylhexyl)phthalate	3.43E-04	94361	0.2	18872.2	—			
Bromodichloromethane	1.30E-01	54	0.2	10.8	0.08			
Bromoform	2.52E-02	97	0.2	19.4	0.08			
Butanol	3.50E-04	5	0.2	1	—			
Butyl benzyl phthalate	7.83E-05	15975	0.2	3195	—	7.3		
Carbazole	8.12E-05	2441	0.2	488.2	—			
Carbon disulfide	5.21E-01	52	0.2	10.4	—	0.033		
Carbon tetrachloride	1.18E+00	187	0.2	37.4	0.005			
Chlordane	2.73E-03	61155	0.2	12231	0.002			
p-Chloroaniline	4.80E-05	41	0.2	8.2	—			
Chlorobenzene	1.79E-01	213	0.2	42.6	—			
Chlorodibromomethane	1.02E-01	72	0.2	14.4	0.08			
Chloroform	1.65E-01	47	0.2	9.4	0.08			
2-Chlorphenol	6.81E-04	—	0.2		—			
Chyrsene	4.96E-05	312425	0.2	62485	—	0.0046		
DDD	2.03E-04	84937	0.2	16987.4				
DDE	5.08E-03	108469	0.2	21693.8		0.00017		
DDT	2.20E-03	77577	0.2	15515.4		0.001		
Dibenzo(a,h)anthracene	4.59E-07	1914389	0.2	382877.8	—			
Di-n-butyl phthalate	5.86E-05	16851	0.2	3370.2	—	3		
1,2-Dichlorobenzene (o)	8.61E-02	693	0.2	138.6	0.6			
1,2-Dichlorobenzene (p)	1.15E-01	653	0.2	130.6	0.075			
3,3-Dichlorobenzidene	8.53E-07	2441	0.2	488.2	—			
1,1-Dichloroethane	2.36E-01	35	0.2	7	—	1.1		
1,2-Dichloroethane	5.25E-02	20	0.2	4	0.005			
1,1-Dichloroethylene	1.04E+01	64	0.2	12.8	0.007			
cis-1,2 Dichloroethylene	1.85E-01	29	0.2	5.8	0.07			
trans-1,2-Dichloroethylene	2.29E-01	50	0.2	10	0.1			
1,2-Dichloropropane	1.15E-01	59	0.2	11.8	0.005			
1,3-Dichloropropene	1.21E-01	33	0.2	6.6	—			
2,4-Dichlorophenol	9.76E-06	—	0.2		—			
Dieldrin	1.09E-04	18388	0.2	3677.6	—	0.0018		
Diethyl phthalate	2.24E-05	152	0.2	30.4	—			
2,4-Dimethylphenol	1.33E-04	—	0.2					
Dimethyl phthalate	2.37E-05	32	0.2	6.4				

CHEMICAL NAME	H	Koc		Kd	MCL	10-6 Guideline Value		
2,4-Dinotrotoluiene	6.03E-06	51	0.2	10.2	—			
2,6-Dinotrotoluiene	5.33E-06	42	0.2	8.4	—			
Di-n-octyl phthalate	3.14E-05	9.8E+08	0.2	1.96E+08		0.73		
Endosulfan	9.47E-04	738	0.2	147.6				
Endrin	4.88E-05	9335	0.2	1867	0.002			
Ethylbenzene	3.18E-01	388	0.2	77.6	0.7			
Fluoranthene	3.83E-04	72025	0.2	14405		0.87		
Fluorene	2.99E-03	9226	0.2	1845.2	—			
Heptachlor	2.41E-02	11651	0.2	2330.2	0.0004			
Heptachlor epoxide	3.40E-04	7236	0.2	1447.2	0.0002			
Hexachlorobenzene	2.19E-02	27996	0.2	5599.2	0.001			
Hexachloro-1,3-butadiene	9.80E-01	6992	0.2	1398.4	—			
alpha-HCH (alpha-BHC)	2.78E-04	1310	0.2	262				
beta-HCH (beta-BHC)	1.42E-05	1392	0.2	278.4		0.000047		
gamma-HCH (lindane)	1.39E-04	1085	0.2	217	0.0002			
Hexachlorocyclopentadien	7.05E-01	9589	0.2	1917.8	0.05			
Hexachloroethane	1.48E-01	1829	0.2	365.8	—			
Indeno(1,2,3-c,d)pyrene	1.99E-07	4364700	0.2	872940	—	0.000026		
Isophorone	2.54E-04	30	0.2	6	—	7.2		
Mercury	4.67E-01	—	0.2		0.002			
Methoxychlor	2.60E-04	77936	0.2	15587.2	0.04			
Methyl bromide	5.82E-01	11	0.2	2.2				
Methyl chloride	1.85E+00	7	0.2	1.4				
Methylene chloride	9.72E-02	13	0.2	2.6				
2-Methylphenol	6.72E-05	—	0.2					
Napthalene	1.98E-02	1549	0.2	309.8	—			
Nitrobenzene	8.45E-04	—	0.2					
N-Nitrosodiphenylamine	2.86E-02	327	0.2	65.4				
N-Nitrosodi-n-propiyamine	1.70E-03	17	0.2	3.4				
Pentachlorobenzene	—	13274	0.2	2654.8				
Pentachlorophenol	5.82E-04	—	0.2		0.001			
Phenol	2.44E-05	—	0.2		—	22		
Pyrene	3.39E-04	59865	0.2	11973	—	0.68		
Styrene	1.37E-01	573	0.2	114.6	0.1			
1;1,2,2-Tetrachloroethane	1.53E-02	104	0.2	20.8	—			
Tetrachloroethylene	7.09E-01	139	0.2	27.8	0.005			
Toluiene	2.52E-01	171	0.2	34.2	1			
Toxaphene	1.38E-04	501	0.2	100.2	0.003			
1,2,4-Trichlorobenzene	1.07E-01	1840	0.2	368	0.07			
1,1,1-Trichloroethane	7.63E-01	110	0.2	22	0.2			
1,1,2-Trichloroethane	4.10E-02	61	0.2	12.2	0.005			
Trichloroethylene	4.35E-01	112	0.2	22.4	0.005			
2,4,5-Trichlorophenol	1.80E-04	—	0.2					
2,4,6-Trichlorophenol	1.66E-04	—	0.2		—			
Vinyl acetate	2.26E-02	5	0.2	1				
Vinyl chloride	3.45E+00	11	0.2	2.2	0.002			
Xylenes (total)	2.48E-01	381	0.2	76.2	10			

CHEMICAL NAME	H	Koc		Kd	MCL	10-6 Guideline Value		
Antimony			0.2		0.006			
Arsenic			0.2		0.05			
Barium			0.2		2			
Beryllium			0.2		0.004			
Bromate			0.2		0.01			
Cadmium			0.2		0.005			
Chloramine			0.2		4			
Chlorine			0.2		4			
Chlorine Dioxide			0.2		0.8			
Chromium (total)			0.2		0.1			
Cyanide			0.2		0.2			
Fluoride			0.2		4			
Mercury			0.2		0.002			
Nickel			0.2		0.1			
Nitrate			0.2		10			
Nitrite			0.2		1			
Selenium			0.2		0.05			
Sulfate			0.2		500			
Thallium			0.2		0.002			
			0.2					
Radium 226			0.2		20			
Radon			0.2		300			
Tritium			0.2		20			
			0.2		20,000			
Actinium 227			0.2			0.076		
Americium 241			0.2			0.15		
Bismuth 207			0.2			9.4		
Cesium 137			0.2			1.5		
Cobalt 60			0.2			2.5		
Plutonium 238			0.2			0.16		
Plutonium 239			0.2			0.15		
Plutonium 240			0.2			0.15		
Strontium 90			0.2			0.85		
Thorium 228			0.2			0.21		
Thorium 230			0.2			1.3		
Thorium 232			0.2			1.5		

EXAMPLE SSL CALCULATION FOR THE B-BUILDING SOLVENT SHED

B-Building Solvent Shed SSL Calculations

B-Building Solvent Shed

Definition	Parameter	Main Hilltop soil
source length parallel to ground water flow	L	10
aquifer thickness (DOE 1994)	da	15
hydraulic conductivity (DOE 1994)	K	52
hydraulic gradient at the source	i	0.008
horizontal distance to receptor	xr	150
infiltration rate (Schairbaum & Frost 1988)	in	0.15
soil-water partition coefficient (Koc * foc for organic chemicals)	Kd	chemical specific
saturated porosity	Ow	0.15
air filled porosity	Oa	0.28
Henry's Law constant * 41 (0 for metals and radionuclides)	H	chemical specific
dry soil bulk density	B	1.6
soil organic carbon/water partition coefficient	Koc	chemical specific
fraction organic carbon in soil (DOE Mound Plant Data Base)	foc	0.02

CALCULATED SOIL SCREENING LEVELS (acceptable concentrations to remain in soils)	
CHEMCIAL	SSL
	mg/kg
Trichoroethene	0.0621748
Toluene	18.358506
1,1,1-TCA	2.5049478
cis,1-2DCE	0.2550524
Freon 113*	—

* TLV in air is 1000ppm

CACULATED 95% UCL FROM VERIFICATION SAMPLES	95% UCL
CHEMICAL	mg/kg
Trichoroethene	0.045
Toluene	0.014
1,1,1-TCA	0.011
cis,1-2DCE	0.03
Freon 113*	0.008
* TLV in air is 1000ppm	

CONCLUSION
Since acceptable soil screening level concentrations exceed
the 95% UCL from the verification sampling, there is no need
for additional remediation.

Mixing Zone Depth Calculation

MIXING ZONE DEPTH (d)

$d = (0.0112(L+xr)^2)^{0.5} + da\{1 - \exp[(\ln(L+xr))/Kida)]\}$ (Equation 3)

DILUTION FACTOR (df) (Equation 4)

$df = 1 + Kid/\ln L$

CALCULATED PARAMETERS

d	15	mixing zone thickness (m)
df=	5.16	dilution factor

SOIL SCREENING LEVEL CALCULATION

$SSL = Cw\{Kd + (Ow + (OaH))/B\}$ (Equation 1)

$Kd = Koc * foc$ (Equation 2)

INPUT PARAMETER DEFINITION

MCL	mg/L	
Cw	mg/L	target soil leachate. Acceptable water concentration * df
Kd	L/kg	soil-water partition coefficient
Ow		saturated porosity
Oa		air filled porosity
H		Henry's Law constant * 41 to make dimensionless
B	kg/L	dry soil bulk density
Koc	L/kg	soil organic carbon/water partition coefficient
foc	g/g	fraction organic carbon in soil

CALCULATED SOIL SCREENING LEVELS

CHEMCIAL	MCL/Guide Value	Cw	H	Koc	Kd	SSL
	mg/L	mg/L		L/kg	L/kg	mg/kg
Trichoroethene	0.005	0.0258	0.435	112	2.24	**0.062175**
Toluene	1	5.16	0.252	171	3.42	**18.35851**
1,1,1-TCA	0.2	1.032	0.763	110	2.2	**2.504948**
cis,1-2DCE	0.07	0.3612	0.185	29	0.58	**0.255052**
Freon 113*	1.9	9.804	—	—	—	—

* TLV in air is 1000ppm

Gradient Calculation between wells 113 and 114

Date	Well 114	Well 113	Hirizontal	Gradient
	Water elevation	gw elev.	Distance	
5/5/93	821.6	824.3	575	0.004696
5/19/93	821.62	824.11	575	0.00433
6/2/93	821.59	823.47	575	0.00327
9/2/93	821.54	821.09	575	-0.00078
10/6/93	821.62	821.54	575	-0.00014
11/2/93	821.63	823.67	575	0.003548
12/14/93	821.64	823.75	575	0.00367
2/15/94	821.62	851.59	575	0.052122
4/28/94	821.6	824.24	575	0.004591
			Average =	**0.008367**

REFERENCES

Schairbaum, J.R. and Frost, J.P. 1988. "The Hydrology of Sicamore Farm - A Preliminary Report." Center for Ground water Management, Wright State University. September 20, 1988.

DOE. 1994. "Operable Unit 9, Hydrogeologic Investigation: Bedrock Report." U.S. Department of Energy, Albuquerque Field Office, Albuquerque, New Mexico. January, 1994.

USEPA. 1994. "Technical Background Document for soil Screening Guidance - Review Draft." U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA/540/R-94/106 December, 1994

This page intentionally left blank

ATTACHMENT D5

RESPONSE TO OEPA COMMENTS ON MOUND PLANT SOIL SCREENING LEVELS

Comment 1. Proposed Model. Page 1

The equation proposed for determining the SSL is dependent upon determination of a distribution coefficient (K_d) for each contaminant of concern. The Proposed definition submitted for K_d apparently assumes that K_d values can be found for organic compounds using:

$$K_d = K_{oc} \times f_{oc}$$

This equation assumes that partitioning is almost exclusively in the organic carbon fraction (f_{oc}) and that the organic carbon fraction is at least one percent of the soil or aquifer (Fetter, 1993). However, most aquifers contain less than 0.1 percent carbon content and the rate of adsorption is minimal (Testa et al. 1991). For those soils that contain less than one percent organic carbon, it is not automatic that the soil or organic carbon will be the primary surface onto which the organic compounds will partition. In these cases the above equation may not be valid. Therefore site specific values for f_{oc} for all areas where these equations are proposed for use should be determined. If the f_{oc} is found to be less than one percent, one approach to determining the above equations validity is to compare the determined f_{oc} to its corresponding critical value of organic carbon ($^*f_{oc}$).

The equation for solving the critical value is based on the surface area of the soil and the contaminant's K_{oc} value: it is the minimum value of organic carbon that need be present for sorption to occur primarily on the soils organic matter (Fetter, 1993). If the critical value is found to be above the f_{oc} then the above equation is probably valid. However, if the critical value is found to be below the foc then an alternate method for choosing K_d should be reviewed.

For organic, hydrophobic, non-ionizing compounds the determination of K_d is dependent upon selection of the proper method for determining a K_{oc} value. A number of contaminant specific equations are available for determining K_{oc} values. The selected methods for determining the Koc values of organic compounds should be made subject to reviewal by the DDAGW.

Determination of K_d for metals will be much more complicated than for organic compounds. Unlike organic compounds, for which K_d values are largely controlled by soil organic carbon, K_d values for metals are significantly affected by a variety of soil conditions (pH, redox, iron oxide content, soil organic matter content, cation exchange capacity, and major ion chemistry). The values determined for these parameters should be site-specific. Values for these parameters and the methods chosen for determining Kd values for metals should be submitted to the DDAGW for reviewal.

Response to comment 1.

While it is true that most aquifers contain less than 0.1 percent carbon content, the soil leaching equation is for use in the unsaturated soils above an aquifer. The surface soils at the Mound Plant average 2.2% organic carbon content, considerably above the critical one percent organic carbon so the equation is valid. The top 10 feet of the interbedded limestones and shales which we call "bedrock" averages 3.6% f_{oc}. In addition, research has demonstrated that, for volatile halogenated hydrocarbons, $^*f_{oc}$ is about 0.1 percent which is considerably below the one percent $^*f_{oc}$ quoted above. One of the conservative assumptions of the soil screening level equations is that there will be no adsorption or chemical decay (attenuation) accounted for within the saturated portion of the aquifer. If soil organic carbon content is below the critical level of 0.1 percent and the soils contain significant quantities of fine-grained materials, the equation will under predict sorption and over predict contaminant concentrations in soil pore water.

The purpose of this report is not to re-evaluate the methodologies of selected methods for determining Koc values, but rather to use generally available values for use in the SSL equations. Please see the references at the end of the document.

Comment 2. Proposed Model. Page 1.

The DDAGW tested the proposed calculations using parameter values to simulate conditions at OU1 for TCE. Calculations were run for conditions where the receptor was assumed to be within the contaminant plume, and for conditions where the receptor well was outside the contaminant plume: an apparent assumption of the equation is that the receptor be within the plume (p. 2-22, Technical Background Document for Soil Screening Guidance, Review Draft, 1994). In both cases, the solution for the Mixing Zone Depth equation computed a (d) value in excess of the aquifer thickness. The apparent reason for failure was that a relatively large source length was used in comparison to the chosen aquifer thickness. This is the case at OU-1. Failure of this equation indicates that the aquifer's thickness is insufficient to sorb a contaminant plume with the dimensions reported. In these cases the determination of an SSL may be inappropriate since the acceptable water concentration may already be in access of acceptable drinking water standards.

Response to Comment 2.

The purpose of the SSL equations is to determine a soil concentration that will result in ground water concentrations of chemicals that meet MCLs at a potential receptor location. By default, the receptor is therefore always assumed to be within the plume.

It is possible to calculate a mixing zone depth that is in excess of the actual aquifer thickness. This can occur when the aquifer is relatively thin and the flow length to the receptor is relatively long. The equation calculates the theoretical mixing effects and is not constrained by the aquifer thickness. In cases where the mixing zone depth exceeds the thickness of the aquifer, the actual aquifer thickness is used instead.

Comment 3. Proposed Model. Page 1.

Comment Deleted by OEPA request.

Comment 4. Proposed Model. Page 1.

Clarification is requested regarding the values of porosity and dry bulk density to be used. The DDAGW recommends that site specific values for these parameters be used.

Response to Comment 4.

Soil porosity values are not available for the specific Mound Plant soils. Dry bulk density values are also not available for the specific Mound Plant soils. The soils are a loam type soil, similar to the soil that the USEPA soil screening level guidance document (USEPA, 1994) uses. The default parameters are listed in the parameter definition table.

Comment 5. Proposed Model. Page 1.

In the equation used to calculate the SSL, the SSL is back calculated from an "acceptable ground water concentration". Clarification will be needed to verify if the "acceptable ground water concentration will be based on MCL's or MCLG's.

Response to Comment 5.

MCLs will be used for the SSL back-calculations where MCLs exist. Guideline values corresponding to 10^{-6} risk for residential ground water use will be used for compounds without an MCL.

Comment 6. Proposed Model. Page 1.

There are some questions concerning units in the equation for determining the SSL. First it appears that concentration units cancel out leaving a unitless SSL value. Secondly a factor of 41 is multiplied by Henry's law constant. Clarification regarding these issues is requested.

Response to Comment 6.

The SSL calculation should result in units of mg/kg or ug/kg.

The units in the equation should be as follows:

mg/kg=mg/L[L/kg+1/(kg/L)]

Henry s law constants are in atm-m3/mol. In order to get a dimensionless form of the Henry s law constant. 41 mol/atm-m3 are multiplied by the Henry s law constant.

This page intentionally left blank

ATTACHMENT D6

Guideline Criteria References

ATSDR 1993. *Draft Work Plan for Environmental Studies in the Vicinity of the Mound Plant.* Agency for Toxic Substances and Disease Registry. Atlanta, Ga. August 11, 1993.

DOE 1992a. *Remedial Investigation/Feasibility Study for Operable Unit 9, Sitewide Work Plan, Mound Plant, Miamisburg, Ohio.* Department of Energy, Albuquerque Field Office. April 1992.

DOE 1992b. *Remedial Investigation/Feasibility Study for Operable Unit 9, Sitewide Preliminary Baseline Risk Assessment, Mound Plant, Miamisburg, Ohio.* Department of Energy, Albuquerque Field Office. June 1992.

DOE 1993c. *Reconnaissance Sampling Report - Soil Gas Survey and Geophysical Investigations, Mound Plant Main Hill and SM/PP Hill (FINAL).* U.S. Department of Energy, Albuquerque Operations Office. February 1993.

DOE 1994d. *Operable Unit 9 Background Soils Investigation Soil Chemistry Report.* Environmental Restoration Program Department of Energy, Albuquerque Operations Office. December 1994.

DOE 1995e. *Risk-Based Guideline Values, Mound Plant, Miamisburg, Ohio.* Department of Energy, Miamisburg Area Office, Final (revision 3). December 1995.

EG&G MAT 1996a. *Comparison of Actual Soil Gas Values with Calculated Acceptable Soil Gas Values.*

EG&G MAT 1996b. *Standardized Equations Based upon USEPA Soil Screening Guidance for the Soil to Groundwater Migration Pathway.*

EG&G MAT 1996c. *PRS Comparison Values.*

EG&G MAT 1996d. *Response to OEPA Comments on Mound Plant Soil Screening Levels.*

Guideline Criteria References (Continued)

EPA 1991. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B - Development of Risk-based Preliminary Remediation Goals).* Office of Emergency and Remedial Response. OSWER Directive 9285.7-01B. December 13, 1991.

APPENDIX E

PUBLIC COMMENT SUBMITTAL GUIDANCE

Appendix E - Public Comment Submittal Guidance

Each PRS Package is issued for a thirty-day public review and comment period. This review and comment period is advertised in the local newspaper. Comments may be submitted during the advertised period to:

Mound Community Relations
P.O. Box 3000
Miamisburg, Ohio 45343-3000

This page intentionally left blank