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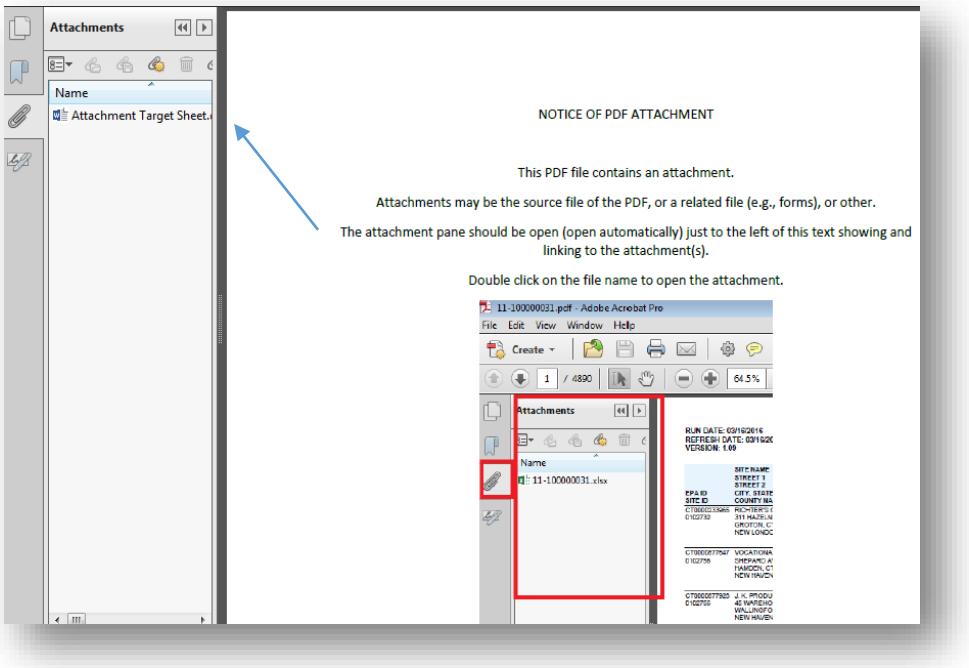

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Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments)

Final

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

NOTICE

This document provides guidance to EPA Regions concerning how the Agency intends to exercise its discretion in implementing one aspect of the CERCLA remedy selection process. The guidance is designed to implement national policy on these issues.

Some of the statutory provisions described in this document contain legally binding requirements. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. Any decisions regarding a particular remedy selection decision will be made based on the statute and regulations, and EPA decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate.

Interested parties are free to raise questions and objections about the substance of this guidance and the appropriateness of the application of this guidance to a particular situation, and the Agency welcomes public input on the document at any time. EPA may change this guidance in the future.

CONTENTS

CONTENTS (Continued)

Page

CONTENTS (Continued)

Page

EXHIBITS

Exhibit **Page**

DEFINITIONS

These definitions are provided for purposes of this guidance and are intended to be consistent with existing Agency guidance and regualtions.

Term	Definition
Applicable or Relevant and Appropriate Requirements (ARARs)	As defined in the NCP, "Applicable" requirements are those clean-up standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site. "Relevant and appropriate" requirements are those clean-up standards which, while not "applicable" at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. ARARs can be action-specific, location-specific, or chemical-specific.
Conceptual Site Model	A "model" of a site developed at scoping using readily available information. Used to identify all potential or suspected sources of contamination, types and concentrations of contaminants detected at the site, potentially contaminated media, and potential exposure pathways, including receptors. This model is also known as "conceptual evaluation model."
Deterministic Analysis	Calculation and expression of health risks as single numerical values or "single point" estimates of risk. In risk assessments, the uncertainty and variability are discussed in a qualitative manner.
EPA Risk Assessor	The risk assessor responsible for reviewing the risk assessment on behalf of EPA. The individual may be an EPA employee or contractor, a State employee, or some other party, as appropriate for an individual site.
Exposure Medium	The contaminated environmental medium to which an individual may be exposed. Includes the transfer of contaminants from one medium to another.

DEFINITIONS (Continued)

Term	Definition
Exposure Pathway	The course a chemical or radionuclide takes from the source to the exposed individual. An exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure. Within the Planning Tables, an Exposure Pathway is defined as each unique combination of Scenario Timeframe, Medium, Exposure Medium, Exposure Point, Receptor Population, Receptor Age, and Exposure Route.
Exposure Point	An exact location of potential contact between a person and a chemical or radionuclide within an Exposure Medium.
Exposure Point Concentration	The value, based on either a statistical derivation of measured data or modeled data, that represents an estimate of the chemical or radionuclide concentration available from a particular Medium or route of exposure.
Exposure Route	The way a chemical or radionuclide comes in contact with a person (e.g., by ingestion, inhalation, dermal contact).
Interim Deliverables	A series of Planning Tables, Worksheets, and Supporting Information, identified in the Workplan for each site, that should be developed by the risk assessment author, and evaluated by the EPA risk assessor, prior to development of the Draft Baseline Risk Assessment Report. After review and revision, as necessary, these documents should be included in the Baseline Risk Assessment Report. The Planning Tables should be prepared for each site to achieve standardization in risk assessment reporting. The Worksheets and Supporting Information should also be prepared to further improve transparency, clarity, consistency, and reasonableness of risk assessments.
Medium	The environmental substance (e.g, air, water, soil) that is a potential source of contaminants in the Exposure Medium. (The Medium will sometimes equal the Exposure Medium.) Usually the Medium is targeted for possible remediation.

DEFINITIONS (Continued)

Term	Definition
Preliminary Remediation Goals (PRGs)	Generally, initial cleanup goals that (1) are protective of human health and the environment and (2) comply with ARARs. Pursuant to the NCP, they are developed early in the remedy selection process based on readily available information and should be modified to reflect results of the baseline risk assessment. They also should be used during analysis of remedial alternatives in the remedial investigation/feasibility study (RI/FS). Remedial goals, selected as part of the risk management decision, normally replace PRGs in the Record of Decision.
Probabilistic Analysis	Calculation and expression of health risks using multiple risk descriptors to provide the likelihood of various risk levels. Probabilistic risk results approximate a full range of possible outcomes and the likelihood of each, which often are presented as a frequency distribution graph, thus allowing uncertainty or variability to be expressed quantitatively.
Risk Assessment Author	The risk assessor responsible for preparing the risk assessment. This individual may be an EPA employee or contractor, a State employee, a PRP employee or contractor, or some other party, as appropriate for an individual site.
Receptor Age	The description of the exposed individual as defined by the EPA Region or dictated by the site.
Receptor Population	The exposed individual relative to the Exposure Pathway considered.
Scenario Timeframe	The time period (current and/or future) being considered for the Exposure Pathway.

DEFINITIONS (Continued)

Term	Definition
Planning Tables	One of the Planning Tools under the RAGS Part D approach. The Planning Tables have been developed to clearly and consistently document important parameters, data, calculations, and conclusions from all stages of human health risk assessment development. Electronic templates for the Planning Tables have been developed in Lotus® and Excel® for ease of use by risk assessors. For each site-specific risk assessment, the Planning Tables, related Worksheets, and Supporting Information should first be prepared as Interim Deliverables for EPA risk assessor review, and should later be included in the Draft and Final Baseline Risk Assessment Reports. The Planning Tables may be found in Appendix A. Use of the Planning Tables will standardize the reporting of human health risk assessments. The Planning Table formats should not be altered (i.e., columns should not be added, deleted, or changed); however, rows and footnotes may be added as appropriate. Standardization of the Tables is needed to achieve Superfund program-wide reporting consistency.
Planning Tools	A basic element of the RAGS Part D approach. The Planning Tools have been developed to standardize the planning, reporting, and review of Superfund risk assessments. The three Planning Tools contained in the Part D approach include the Technical Approach for Risk Assessment (TARA), the Planning Tables, and Instructions for the Planning Tables.
Supporting Information	Information submissions that substantiate or summarize detailed data analysis, calculations, or modeling and associated parameters and assumptions. Examples of recommended Supporting Information include: derivations of background values, exposure point concentrations, modeled intakes, and chemical-specific parameters. Supporting Information should be provided as Interim Deliverables for EPA risk assessor review prior to the development of the Draft Baseline Risk Assessment Report.

DEFINITIONS (Continued)

Term	Definition
Technical Approach for Risk Assessment (TARA)	One of the Planning Tools under the RAGS Part D approach. The TARA is a road map for incorporating continuous involvement of the EPA risk assessor throughout the CERCLA remedial process. Risk-related activities, beginning with scoping and problem formulation, extending through collection and analysis of risk-related data, and supporting risk management decision making and remedial design/remedial action issues are addressed. The TARA should be customized for each site and the requirements identified should be included in project workplans so that risk assessment requirements and approaches are clearly defined. The TARA Schedule Worksheet may be found in Appendix C with the other worksheets. Chapters 2 through 5 of Part D present the TARA.
Worksheets	Formats for documenting assumptions, input parameters, and conclusions regarding complex risk assessment issues. Data Useability, TARA Schedule, Lead, Dermal, Radiation Dose Assessment, and ROD Risk Worksheets are found in Appendix C and should be developed as Interim Deliverables for all risk assessments, as applicable.

ACRONYMS/ABBREVIATIONS

Acronym/ Abbreviation	Definition
ARARs	Applicable or Relevant and Appropriate Requirements
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
COPCs	Chemicals of Potential Concern
CSF	Cancer Slope Factor
CT	Central Tendency
CWA	Clean Water Act
DQOs	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ESD	Explanation of Significant Differences
FS	Feasibility Study
FY	Fiscal Year
GAO	General Accounting Office
HEAST	Health Effects Assessment Summary Tables
HI	Hazard Index
HQ	Hazard Quotient
IEUBK	Integrated Exposure Uptake Biokinetic Model
IRIS	Integrated Risk Information System
MCLs	Maximum Contaminant Levels
NCEA	National Center for Environmental Assessment
NCP	National Contingency Plan
NPL	National Priorities List
non-TCL	non-Target Compound List
OSWER	Office of Solid Waste and Emergency Response
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PQLs	Procedure Quantitation Limits
PRGs	Preliminary Remediation Goals
PRP	Potentially Responsible Party
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RAGS	*Risk Assessment Guidance for Superfund*
RAGS/HHEM	*Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual*
RAOs	Remedial Action Objectives
RfC	Reference Concentration
RfD	Reference Dose
RI/FS	Remedial Investigation/Feasibility Study

ACRONYMS/ABBREVIATIONS (Continued)

Acronym/ Abbreviation	Definition
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
TARA	Technical Approach for Risk Assessment
UCL	Upper Confidence Level
URF	Unit Risk Factor
UTL	Upper Tolerance Limit

ACKNOWLEDGMENTS

This manual was developed by EPA's Office of Emergency and Remedial Response. A large number of EPA regional technical staff participated in the Workgroup that developed the final RAGS Part D approach presented in this manual.

CDM Federal Programs Corporation provided technical assistance to EPA in the development of this guidance, under contract No. 68-W5-0022.

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PREFACE

Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual (RAGS/HHEM) Part D is the fourth part in the five-part series of guidance manuals on Superfund human health risk assessment. Part A addresses the baseline risk assessment; Part B addresses the development of risk-based preliminary remediation goals; Part C addresses the human health risk evaluations of remedial alternatives; and Part E addresses dermal exposure. Part D provides guidance on risk assessment planning, reporting, and review throughout the CERCLA remedial process, from scoping through remedy selection and completion and periodic review of the remedial action. Thus, Part D strives for effective and efficient implementation of Superfund risk assessment practice described in Parts A, B, C, and E, and in supplemental Office of Solid Waste and Emergency Response (OSWER) directives and other Agency risk assessment guidance. The potential users of Part D are persons involved in the risk evaluation, remedy selection, and implementation process, including risk assessors, risk assessment reviewers, remedial project managers, and other decisionmakers.

Released in January 1998 as interim guidance, RAGS Part D Revision 0 underwent field testing and evaluation for a 3-year period. This Final guidance considers the comments received from users of the Revision 0 guidance and provides Planning Table format changes as appropriate.

Generally, changes were made to improve useability, transparency, clarity, and/or consistency with other risk guidance (e.g., RAGS Part E dermal guidance [U.S. EPA, 2001], adult lead exposures technical fact sheet [U.S. EPA, 1996d], and Record of Decision guidance [U.S. EPA, 1999a]). These changes may also increase the efficiency of the risk assessor by decreasing the number of versions of each Planning Tables associated with certain sites.

In addition to Planning Table format changes, the Final guidance provides planning formats to document radionuclide and lead risk evaluations, neither of which was addressed in the Revision 0 guidance. The Final guidance also provides more robust and diverse examples than were included in Revision 0. These examples address comments and questions received from users of the Revision 0 guidance and are provided as suggested approaches to address complex situations. In all cases, the EPA regional risk assessor should be consulted to discuss the appropriate approach for a site.

This guidance does not discuss standardization of ecological risk assessments. EPA will provide planning tables for ecological evaluation under separate cover. This guidance does not discuss the risk management decisions that are necessary at a CERCLA site (e.g., selection of final remediation goals).

Upon issuance, RAGS Part D Final will be effective for all new CERCLA risk assessments. Consult the EPA risk assessor for applicability of the final guidance to ongoing risk assessments and non-CERCLA risk assessments. Any updates to this guidance will be posted at the RAGS Part D website at http://www.epa.gov/superfund/programs/risk/ragsd/index.htm.

Comments addressing usefulness, changes, and additional areas where guidance is needed should be addressed to the RAGS Part D website or to:

Senior Process Manager for Risk (RAGS Part D)
U.S. Environmental Protection Agency
Office of Emergency and Remedial Response (5202G)
Ariel Rios Building
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Washington, DC 20460

CHAPTER 1

INTRODUCTION

This guidance has been developed by the U.S. Environmental Protection Agency (EPA) to assist remedial project managers (RPMs), risk assessors, site engineers, and others in conducting risk assessment planning, reporting, and review at Comprehensive Environmental Response Compensation and Liability Act (CERCLA) sites. This guidance could also be a useful tool for quantitative risk assessment for non-National Priorities List (Non-NPL), Base Realignment and Closure (BRAC), and Brownfields sites.

This guidance is the fourth part (Part D) in the five-part series *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual* (RAGS/HHEM) (U.S. EPA, 1989c). Part A of this guidance addresses how to conduct a site-specific baseline risk assessment: the information in Part A is important background for Part D. Part B provides guidance for calculating risk-based concentrations that may be used, along with applicable or relevant and appropriate requirements (ARARs) and other information, to develop preliminary remediation goals (PRGs) during project scoping. PRGs (and final remediation levels set in the Record of Decision [ROD]) can be used throughout the analyses in Part C to assist in evaluating the human health risks of remedial alternatives. Part E provides guidance for evaluation of dermal exposure. Part D complements the guidance provided in Parts A, B, C, and E and presents recommended approaches to standardize risk assessment planning, reporting, and review. Part D guidance spans the CERCLA remedial process from project scoping to periodic review of the implemented remedial action. Exhibit 1-1 illustrates the major correspondence of RAGS/HHEM activities with the steps in the CERCLA remedial process.

The remainder of this chapter:

- presents an overview of Part D, including the background and elements of the Part D approach
- describes the applicability of Part D
- presents the organization of the remainder of this document
- describes where to find additional information regarding Part D.

1.1 OVERVIEW OF PART D

1.1.1 BACKGROUND

The March 21, 1995, memorandum on Risk Characterization Policy and Guidance from former EPA Administrator Browner directed improvement in the transparency, clarity, consistency, and reasonableness of risk assessments at EPA. EPA, over the years, has identified opportunities for improvement in presentation of Superfund risk assessments. Furthermore, the General Accounting Office (GAO), members of Congress, and others have called for betterment of Superfund risk assessments. The October 1995 Superfund Administrative Reform #6A directed EPA to: Establish National Criteria to Plan, Report, and Review Superfund Risk Assessments. EPA has developed an approach to respond to these challenges, which is presented in RAGS Part D.

1.1.2 GUIDANCE CHANGES

Released in January 1998 as interim guidance, RAGS Part D Revision 0 underwent field testing and evaluation for a 3-year period. This Final guidance incorporates changes based on the comments received from users of the Revision 0 guidance and provides recommended Planning Table format changes as appropriate.

Generally, changes were made to improve useability, transparency, clarity, or consistency with other risk guidance (e.g., RAGS Part E dermal guidance [U.S. EPA, 2001] and ROD guidance [U.S. EPA, 1999a]). These changes may also increase the efficiency of the risk assessor by decreasing the number of versions of each Planning Table associated with certain sites.

EXHIBIT 1-1
RELATIONSHIP OF THE HUMAN HEALTH EVALUATION TO THE CERCLA PROCESS

In addition to Planning Table format changes, the Final guidance provides standard formats to document radionuclide and lead risk evaluations, neither of which was addressed in the Revision 0 guidance. This final guidance also provides more robust and diverse examples than were included in Revision 0. These examples address comments and questions received from users of the Revision 0 guidance and are provided as suggested approaches to address complex situations. In all cases, the EPA risk assessor and the RPM (when appropriate) should be consulted to discuss the appropriate approach for a site. Revisions associated with each Planning Table may be found in Exhibit 3-3.

1.1.3 ELEMENTS OF PART D APPROACH

The *Risk Assessment Guidance for Superfund* (RAGS) Part D approach consists of three basic elements: Use of Planning Tools, Continuous Involvement of EPA Risk Assessors, and Information Transfer to a National Superfund Risk Data Repository. Brief descriptions of the three components follow:

- **Use of Planning Tools** - The Planning Tools developed by the EPA RAGS Part D Workgroup and refined through regional review include a Technical Approach for Risk Assessment or TARA, Planning Tables, and Instructions for the Planning Tables.

  -- The Technical Approach for Risk Assessment (TARA) is a road map for incorporating continuous involvement of the EPA risk assessor throughout the CERCLA remedial process for a particular site. Risk-related activities, beginning with scoping and problem formulation, extending through collection and analysis of risk-related data, and supporting risk management decision making and remedial design/remedial action issues are addressed.

     Chapters 2 through 5 of this guidance document present the TARA in the four CERCLA remedial process phases: During Scoping, During the Remedial Investigation, During the Feasibility Study, and After the Feasibility Study. It is recommended that the elements identified in the TARA in Chapters 2 through 5 be customized for each site-specific human health risk assessment, as appropriate. These elements should be included in project workplans to better define that risk assessment and facilitate more standardized planning. A planning worksheet that can be used to summarize the TARA for a particular site (the TARA Schedule Worksheet) is found in Appendix C.

  -- The Planning Tables have been developed to more clearly and consistently document important parameters, data, calculations, and conclusions from all stages of human health risk assessment development. Electronic templates for the Planning Tables have been developed in Lotus® and Excel® for ease of use by risk assessors. For site-specific risk assessments, the Planning Tables, related Worksheets, and Supporting Information should first be prepared as Interim Deliverables for EPA risk assessor review, and should later be included in the Draft and Final Baseline Risk Assessment Reports. The Planning Tables, both a blank set and a fully completed example set, may be found in Appendix A. Additional example scenarios and selected Planning Tables are provided in Appendix D. Use of the Planning Tables will help standardize the reporting of human health risk assessments and improve communication with stakeholders.

  -- Instructions for the Planning Tables have been prepared corresponding to each row and column on each Planning Table. Definitions of each field are supplied in the Glossary and example data or selections for individual data fields are provided. The Instructions should be used to complete and/or review Planning Tables for each site-specific human health risk assessment, where appropriate. The Instructions may be found in Appendix B.

- **Continuous Involvement of EPA Risk Assessors** - The EPA risk assessor is a critical

participant in the CERCLA remedial process for any site, from scoping through completion and periodic review of the remedial action. EPA risk assessors support reasonable and consistent risk analysis and risk-based decision making. Early and continuous involvement by the EPA risk assessors should include scoping, workplan review, and customization of the TARA for each site to identify all risk-related requirements. The EPA risk assessors should review Interim Deliverables and identify corrections needed prior to preparation of the Draft and Final Baseline Risk Assessment Reports. Participation of the EPA risk assessors in all other phases of the CERCLA remedial process will help ensure human health risk issues are appropriately incorporated in the remedy selection and implementation processes.

- **Information Transfer to a Superfund Risk Data Collection -** Summary-level site-specific risk information should be contained in a Superfund Risk Data Repository to provide information access and evaluation capabilities to EPA staff.

1.2 APPLICABILITY OF PART D APPROACH

The approach contained in RAGS Part D is strongly recommended for all CERCLA human health risk assessments.

Exhibit 1-2 provides guidelines regarding RAGS Part D applicability as a function of site lead and site type, so that site-specific applicability may be defined by each region.

1.3 PROCESS IMPROVEMENTS RESULTING FROM PART D APPROACH

The RAGS Part D approach provides advantages over previous practices in the Superfund program at both the site level and the overall Superfund program level.

A brief discussion of the process improvements associated with each RAGS Part D element follows:

- **Use of Planning Tools** - Planning Tools facilitate planning with TARA, reporting with Planning Table formats, and reviewing with Interim Deliverables. The Planning Tools are designed to provide more consistent content and clarity of data, parameters, and assumptions. Transparency for the public and others to understand the risk assessment should be improved by the Planning Tables, and review is facilitated because the basis for conclusions should be more clear. Because Interim Deliverables are integral parts of the baseline risk assessment, their early review and resolution by EPA risk assessors should minimize rework and may reduce project schedules and budgets, while improving consistency.

- **Continuous Involvement of EPA Risk Assessor** - Involvement of the EPA risk assessor throughout the CERCLA remedial process should result in holistic consideration of risk issues during scoping and helps ensure that appropriate and adequate data are collected. Planning for special evaluations can also be conducted efficiently at project inception rather than at a later point with associated schedule delays and additional costs. Ongoing review of Interim Deliverables by the EPA risk assessor should provide direction regarding reasonable assumptions and should eliminate rework requirements, particularly for those deliverables that build on previous analyses (e.g., the Baseline Risk Assessment Report).

EXHIBIT 1- 2
GUIDELINES FOR PART D APPLICABILITY

SITE LEAD	PART D APPLICABLE
Fund Lead	✓
Federal Facility Lead	✓
PRP Lead	✓
State Lead	✓
SITE TYPE[1]	
Remedial: Scoping, RI/FS, Risk Assessment, Proposed Plan, ROD, RD/RA, Presumptive Remedy	✓
Post-Remedial: ESD, Amended ROD, Five-Year Review	✓
Removal: Non-time Critical, Time-Critical, Streamlined	--[2]
SACM[3]	✓
RCRA Corrective Action[4]	--[2]

Notes:

1 The RAGS Part D Workgroup also suggests that RAGS Part D could be a useful tool for quantitative risk assessment for non-NPL, BRAC, and Brownfields sites and encourages its use.

2 RAGS Part D use is encouraged as appropriate.

3 Superfund Accelerated Cleanup Model.

4 As described in the September 1996 EPA memorandum on Coordination Between Resource Conservation and Recovery Act (RCRA) Corrective Action and Closure and CERCLA Site Activities, EPA is "...committed to the principle of parity between the RCRA corrective action and CERCLA programs...".

At later stages of the project (e.g., after the feasibility study), continuous involvement of the EPA risk assessor promotes reasonableness and consistency in risk management decision-making by clearly providing risk managers with the information they need. Preparation of draft ROD risk information as an interim deliverable in the format specified in Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents (U.S. EPA, 1999a) will further support risk managers' efficiency. The ROD Risk Worksheets found in Appendix C match the ROD guidance formats.

- **Information Transfer to Superfund Risk Data Collection** - Submission of the electronic Planning Tables and Worksheets to the Superfund Risk Data Collection fulfills the review objectives of Superfund Administrative Reform #6A. Use of the information by EPA risk assessors will help improve consistency in future risk assessments.

1.4 ORGANIZATION OF DOCUMENT

The remainder of this guidance is organized into four additional chapters, references, and four appendices as follows:

- Chapter 2: Risk Considerations During Project Scoping;
- Chapter 3: Risk Assessment Data Needs and Tasks During the Remedial Investigation;
- Chapter 4 Risk Evaluations During the Feasibility Study;
- Chapter 5: Risk Evaluations After the Feasibility Study;
- References
- Appendix A: Planning Tables
- Appendix B: Instructions for Completion of Planning Tables
- Appendix C: Worksheets
- Appendix D: Example Scenarios.

In addition, other useful information has been presented in highlight boxes placed throughout the document.

Exhibit 1-3 depicts the continuous involvement of the EPA risk assessor during scoping, during the remedial investigation, and during and after the feasibility study. The various activities the risk assessor conducts are listed, as well as the Part D chapter that addresses that phase.

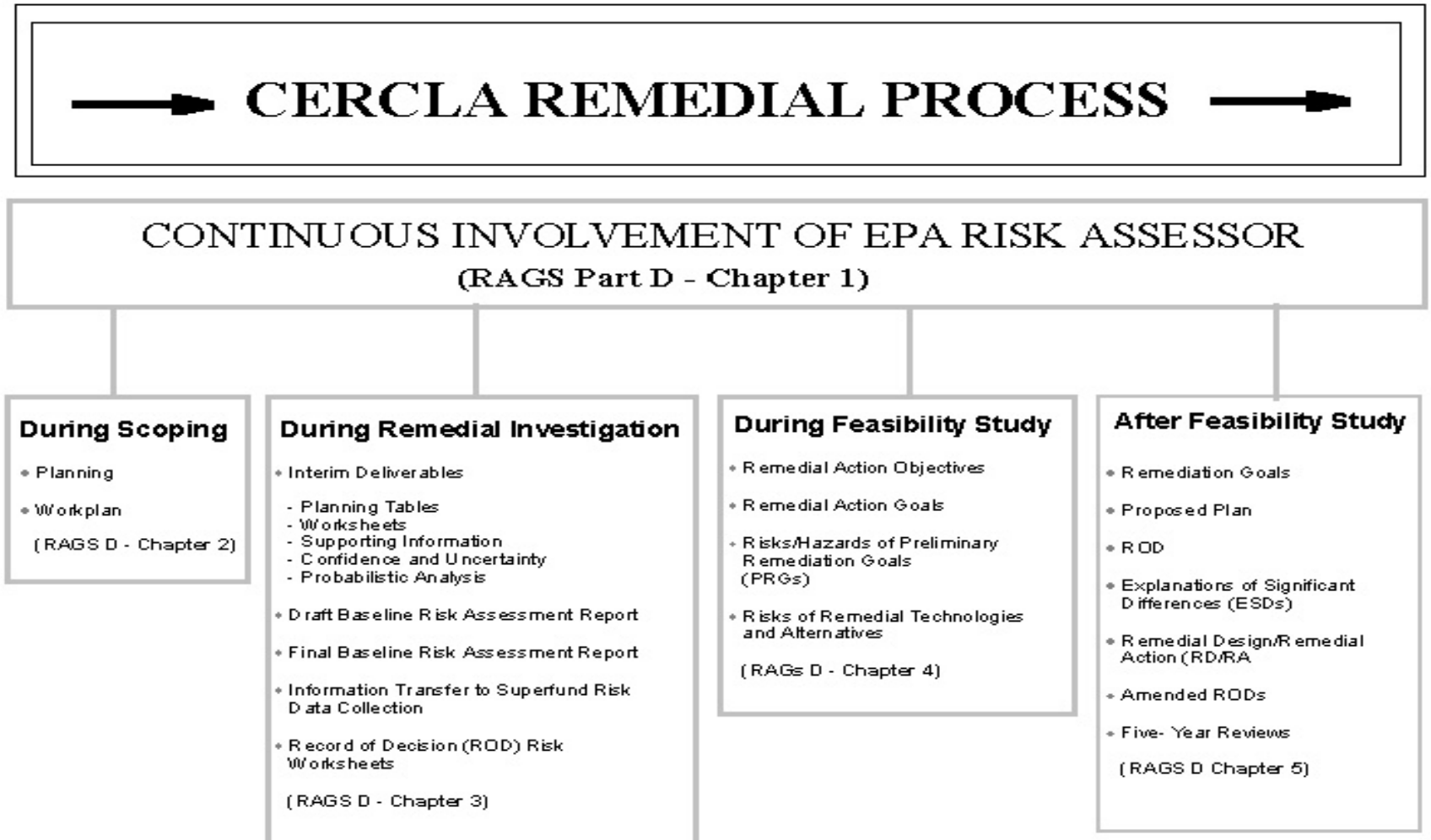
1.5 ADDITIONAL INFORMATION

This guidance will be updated periodically in response to user comments and suggestions and to address new human health risk assessment guidance as appropriate.

The Part D guidance and corresponding information may be accessed electronically on the RAGS Part D website, at http://www.epa.gov/superfund/programs/risk/ragsd/index.htm . Updates to Part D will also appear on the website along with an index of the current version of each Chapter or Appendix.

Questions or comments regarding Part D usage for a particular risk assessment should be directed to your EPA risk assessor. General Part D questions or comments should be directed to the RAGS Part D website. Questions or comments received through the website will be considered and a response will be developed and forwarded via telephone or email as appropriate. Frequently asked questions will be assembled and displayed on the website with corresponding responses to provide Part D user support.

EXHIBIT 1-3
ROLE OF RISK ASSESSOR IN THE CERCLA REMEDIAL PROCESS



CHAPTER 2

RISK CONSIDERATIONS DURING PROJECT SCOPING

The project scoping stage of the remedial investigation (RI) and baseline risk assessment is critical to the success of a Superfund project. The EPA risk assessor should be involved in the project scoping discussions and meetings to help ensure that the planning and workplan development tasks incorporate risk assessment data needs and achieve appropriate standardization in risk assessment planning.

2.1 PLANNING

The following planning activities should be performed at the beginning of the project. These activities should involve the EPA RPM and EPA risk assessor, as decisionmakers, and the risk assessment author and other resources tasked with preparing the Remedial Investigation Report, to support planning. The following pertinent information should be incorporated, as appropriate, into the Remedial Investigation Report or Site Characterization Report and the Baseline Risk Assessment Report:

- Provide site background information, site maps, sample location map; discuss historical site activity and chronology of land use.
- Discuss historical data and data useability, previous studies and actions, and an overview of the nature and extent of contamination.
- Discuss the purpose of the investigation.
- Prepare the preliminary site conceptual model which clearly identifies all known or potential sources of contamination (soil, groundwater, surface water, leachate, air, etc.), release mechanisms, and receptor routes and identifies all potential exposure pathways (including secondary pathways) and the media and receptors associated with each.
- Discuss PRGs and ARARs for the site.
- Discuss involvement by the risk assessor in discussions with stakeholders concerning land

WHEN PREPARING THE SITE CONCEPTUAL MODEL, CONSIDER THE FOLLOWING:

- Sensitive populations, including but not limited to the elderly, pregnant or nursing women, infants and children, and people suffering from chronic illnesses
- People exposed to particularly high levels of contaminants
- Circumstances where a disadvantaged population is exposed to hazardous materials (i.e., Environmental Justice situations)
- Significant contamination sources
- Potential contaminant release mechanisms (e.g., volatilization, fugitive dust emission, surface runoff/overland flow, leaching to groundwater, tracking by humans/animals, soil gas generation, biodegradation and radioactive decay)
- Contaminant transport pathways such as direct air transport downwind, diffusion in surface water, surface water flow, groundwater flow, soil gas migration, and biomagnification in the food chain
- Cross media transfer effects, such as volatilization to air, wet deposition, dry deposition, groundwater discharge to surface water, groundwater recharge from surface water, and bioaccumulation by aquatic species.

use, groundwater use, and exposure pathways and variables. If possible, the risk assessor should also visit the site.

- Identify interim deliverables for the risk assessment.

INTERIM DELIVERABLES SHOULD INCLUDE THE FOLLOWING:

- Planning Tables 0 through 10
- Worksheets on Data Useability, TARA Schedule, Dermal, Radiation Dose Assessment, and Lead (as applicable)
- Supporting Information (Section 3.1.1)
- Assessment of Confidence and Uncertainty (Section 3.1.2) and Probabilistic Analysis information, as applicable (Section 3.1.3).

- Identify Draft and Final deliverables for the risk assessment. Draft and Final deliverables include the Draft and Final Baseline Risk Assessment Reports, which also incorporate the Interim Deliverables.
- Prepare a preliminary version of Planning Table 1.
- During project scoping, the EPA RPM and EPA risk assessor may also meet to discuss the potential usefulness of including a Probabilistic Analysis (Monte Carlo) in the RI and the need for a separate Workplan. This preliminary discussion should address whether funds need to be allocated to carry out a Probabilistic Analysis. This decision should be revisited throughout Workplan development and the risk assessment process.

2.2 WORKPLAN DEVELOPMENT

Tasks to be conducted during the remedial investigation/feasibility study (RI/FS) should be identified and documented in several workplans. These usually include the RI/FS Workplan, a Sampling and Analysis Plan (SAP), and a Quality Assurance Project Plan (QAPP). Tasks related to development of the baseline risk assessment are sometimes presented in a separate Risk Assessment Workplan or incorporated into the RI/FS Workplan.

WHEN EVALUATING WHETHER TO CONDUCT PROBABILISTIC ANALYSIS, CONSIDER THE FOLLOWING:

- Extent of site remediation
- Potential costs of remediation
- Degree of uncertainty associated with the exposure information available for each portion of the site conceptual model

Risk assessment needs should be considered not only in tasks related to development of the baseline risk assessment but also in tasks related to sampling and analysis (i.e., those in the SAP and the QAPP) in the RI and tasks needing risk assessment input in the feasibility study(e.g., development of remedial goals and estimates of potential risk from remediation options).

2.2.1 RI/FS WORKPLAN/BASELINE RISK ASSESSMENT WORKPLAN

The RI/FS Workplan should summarize site background, the current and potential problems posed by site contaminants, and the objectives and scope of the RI/FS. It also should include a description of the tasks to be performed and the information and work products that should be produced from each task. Deliverables for specific tasks should be included. Tasks and deliverables for the baseline risk assessment may be included as a part of the RI/FS Workplan or in a separate Risk Assessment Workplan.

Within these Workplans, it should be clear that risk assessment needs are being considered in the RI/FS objectives. The site-specific objectives and scope of the risk assessment should be included in the Workplan.

This includes information to complete the baseline risk assessment in the RI as well as information for

the FS, such as that used to develop risk-based preliminary remedial goals (e.g., PRGs), and to assess risks from remediation (e.g., incineration).

These Workplans should also reference the methods (e.g., National guidance such as RAGS/HHEM [U.S. EPA, 1989c]; RAGS Probabilistic Guidance [U.S. EPA, 1997e and g and 2001d.]), used to prepare the Interim, Draft, and Final risk assessment deliverables and define the schedule for submission. These deliverables are described in more detail in Chapter 3. Deliverables related to development of risk-based remedial goals and assessment of risk from remediation should also be included in the Workplan (see Chapter 4).

The EPA risk assessor and EPA RPM may revisit the question of the potential value added by using Probabilistic Analyses in the risk assessment. If these analyses are to be used, the issues concerning the time, expense, and possible benefit associated with the collection of additional exposure information or sampling data should be considered to identify those exposure parameters with the greatest uncertainty, where collection of additional data and/or information may be warranted. A separate Probabilistic Analysis Workplan identifying associated deliverables should be prepared and approved by the EPA RPM and risk assessor.

2.2.2 SAP AND QAPP

Sampling and analysis activities undertaken during the RI should provide adequate data to evaluate all appropriate exposure pathways. Therefore, risk assessors should be involved in the development of the data quality objectives (DQOs) for sampling and analysis and in selecting the types of sampling and analyses that will be done. The DQOs should address the qualitative and quantitative nature of the sampling data in terms of relative quality and intent for use, to ensure that the data collected will be appropriate for the intended objectives. Note that the data quality evaluation should be recorded in the Data Useability Worksheet in Appendix C.

Sampling. The SAP should discuss how the types, numbers, and locations of samples to be collected will be adequate to evaluate each exposure pathway (both current and future) and medium. The SAP should be accompanied by detailed sampling maps showing the location and type of samples (e.g., grab, composite, or duplicate). It is important to consider how sample results will be used to estimate exposure point concentrations. Background samples should be collected from appropriate areas (e.g., areas proximate to the site, free of potential contamination by site chemicals and similar to the site in topography, geology, meteorology, and other characteristics).

If models will be used to evaluate exposure pathways and estimate exposure point concentrations, these models should be identified in the Workplan. Site-specific data collection needed for these models should also be discussed.

WHEN DEVELOPING THE SAP, CONSIDER THE FOLLOWING:

- How will data from multiple groundwater wells collected over time be used to calculate exposure?
- At what depths will soil samples be taken and how will they be combined to describe exposures for different scenarios (e.g., industrial versus residential) or to characterize hotspots?
- What type of sampling design (e.g., random versus purposive) will be used?
- Are SAPs adequate to distinguish site contamination from background contamination for each medium and for organic and inorganic parameters?

Analysis. Development of the DQOs for analysis should not be limited to concern for the precision, accuracy, representativeness, completeness, and comparability of the data. DQOs that are important for risk assessment should consider: types of laboratory analyses used, sensitivity of detection limits of the analytical techniques (especially for non-Target Compound List [non-TCL] chemicals and non-standard matrices), resulting data quality, and the employment of adequate quality assurance/quality

control (QA/QC) measures.

In some cases, risk assessment data needs may be best supported by additional chemicals, different analytical methods, and/or lower detection limits than are being used for the RI. Based upon the values of the risk-based PRGs calculated during scoping, detection limits may need to be lower than those obtained by the standard Superfund methods. The adequacy of detection limits for conducting the baseline risk assessment and for comparing to PRGs should be evaluated in the Workplan (QAPP). For example, a table listing expected contaminants and comparing the method detection limit or quantitation limit for each compound with the appropriate risk-based goal for that chemical could be presented. This information along with issues of cost and other data uses should affect the methods and detection limits finally selected.

Analytical data should be evaluated and reviewed in accordance with the criteria to evaluate data (e.g., the National Functional Guidelines). Also refer to your regional Agency office for guidance on data validation and/or other chemical-specific guidance, as applicable.

The Workplan should also discuss how split samples, duplicates, blanks (trip, field, and laboratory), and qualified and rejected data can be used in assessing site risks. The Workplan should describe the analysis for each medium and how the types of analyses were selected based on site history.

CHAPTER 3

RISK ASSESSMENT DATA AND TASKS DURING THE REMEDIAL INVESTIGATION

Project Management Guidelines. Remedial project managers should establish the schedule of submission for the deliverables for the RI Reports and Baseline Risk Assessment Reports. The schedule may vary from site to site, as appropriate. Interested parties (States, Commonwealths, tribes and other stakeholders) may be involved in the scheduling and review process, as appropriate. Refer to your regional office for guidance regarding the order of the deliverables. These deliverables should also be defined in the Workplan.

General RI Guidelines. Generally, RI guidance should be followed in performing the remedial investigation. The following items are of particular importance to risk assessments. If the risk assessment is being prepared as a stand-alone document, the following items should be included. If, instead, the risk assessment is a section of the RI Report, the items which follow should be addressed in the RI Report and clearly referenced in the Baseline Risk Assessment Report.

- Present a general map of the site depicting boundaries and surface topography, which illustrates site features, such as fences, ponds, structures, as well as geographical relationships between potential receptors and the site.
- Discuss historical site activity.
- Discuss chronology of land use (specify agriculture, industry, recreation, waste deposition, and residential development at the site).
- Present an overview of the nature and extent of contamination, including when samples were collected and the kinds of contaminants and media potentially contaminated.

- Describe the analytical and data validation methods used.
- If modeling was used to estimate exposure point concentrations, document the parameters related to soil/sediment, hydrogeology, hydrology, and meteorology either in the risk assessment or the RI Report.

Risk Assessment Guidelines. The risk assessment should be conducted in accordance with all appropriate guidance and policies. Consult with your EPA risk assessor regarding the most appropriate guidance.

Interim Deliverables should be prepared as described in Section 3.1.1 and should ultimately be incorporated into the Baseline Risk Assessment Report. The Interim Deliverables prepared by the risk assessment author should be reviewed by the EPA risk assessor prior to submission of the Baseline Risk Assessment Report. Hazard identification and exposure parameters, among others, may require discussion, refinement, and revision. Review and modification of Interim Deliverables should greatly reduce the Baseline Risk Assessment Report preparation and review time. Discussions of the three categories of risk assessment deliverables (Interim Deliverables, Draft Baseline Risk Assessment Report, and Final Baseline Risk Assessment Report) follow.

3.1 INTERIM DELIVERABLES

This section presents an outline of the Planning Tables, Worksheets, and Supporting Recommended Information that should be prepared as Interim Deliverables for each site. The Workplan discussed in Section 2.2.1 should also describe the Planning Tables, Worksheets, and Supporting Recommended Information for a particular site. Exhibit 3-1 presents a list of recommended Interim Deliverables. Use of these deliverables for each site should improve standardization in risk assessment reporting and

should improve the transparency, clarity, and consistency of risk assessments.

3.1.1 PLANNING TABLES, WORKSHEETS, AND SUPPORTING INFORMATION

More standardized reporting of Superfund human health risk assessments can be achieved through the preparation of Planning Tables, Worksheets, and Supporting Information. These documents should be prepared as Interim Deliverables and reviewed by the EPA risk assessor prior to preparation of the Baseline Risk Assessment Report. After review and revision, as necessary, these documents should be included in the Baseline Risk Assessment Report.

This section describes the Planning Table formats that should be used in EPA CERCLA risk assessments. The Planning Table formats normally should not be altered (i.e., columns should not be added, deleted, or changed); however, rows and footnotes should be added as appropriate. Standardization of the Tables should help to achieve Superfund program-wide reporting consistency. Note that multiple versions of some Planning Tables may be used to address different Media, different Exposure Pathways, or different Exposures (i.e., reasonable maximum exposure [RME] versus central tendency [CT]). Exhibit 3-2 summarizes the relationship between five traditional risk assessment activities and the corresponding Planning Tables that should help standardize risk assessment reporting. The five risk assessment activities follow:

- Data collection
- Data evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization.

Copies of the blank Planning Tables are provided in both Lotus® and Excel® spreadsheet formats associated with the Part D guidance. Blank Planning Table templates and completed examples of typical Planning Tables are provided in Appendix A. Detailed Instructions for the completion of the Planning Tables are provided in Appendix B. Additional example scenarios and selected Planning Tables are provided in Appendix D.

In addition to the Planning Tables, six Planning Worksheets are provided in Appendix C. These include Worksheets for Data Useability, TARA Schedule, Dermal, Radiation Dose Assessment, Lead, and ROD Risk. Use of the Worksheets is strongly encouraged to improve transparency, clarity, and consistency.

The Planning Tables and Worksheets document the majority of the data and assumptions used to evaluate risk, as well as the risks and hazards calculated. In most cases, other data and rationale can be used to support the information presented in the Planning Tables. This additional Supporting Information should also be provided to the EPA risk assessor as an Interim Deliverable and later incorporated in the Baseline Risk Assessment Report.

Refer to Exhibit 3-3 for a brief summary of the Revision 1 improvements to the Planning Tables and Worksheets as compared to Revision 0. Descriptions of the RAGS Part D Revision 1 Planning Tables, Worksheets, and Supporting Information follow:

Planning TABLE 0: Site Risk Assessment Identification Information. The purposes of **Planning Table 0** are:

- To uniquely identify the risk assessment
- To identify the relevant contacts for the risk assessment.

The information documented in **Planning Table 0** should include:

- Site Information
- Contact information
- Risk assessment document information.

The data elements that should be presented in **Planning Table 0** are listed in the Planning Table 0 highlight box.

KEY DATA ELEMENTS IN PLANNING TABLE 0

Regions should provide the following information: Site Name/OU, Region, EPA ID Number, State, Status, Federal Facility (Y/N), EPA Project Manager, EPA Risk Assessor, Prepared by, Prepared for, Document Title, Document Date, Probabilistic Risk Assessment (Y/N), and Comments.

Regions should perform the following steps associated with the preparation of **Planning Table 0:**

1. Provide the identification information for the risk assessment.

2. Include Planning Table 0 with the other Planning Tables, Worksheets, and Supporting Information to facilitate tracking of the relevant contacts.

TARA SCHEDULE WORKSHEET. The **TARA Schedule of Risk-Related Activities Worksheet** (TARA Schedule Worksheet) is the first Worksheet that should be developed for each risk assessment to document the applicability, responsibility, and schedule for each risk-related activity. As the first interim deliverable, the Worksheet documents the plan for a particular site, identifying which Planning Tables, Worksheets, and Supporting Information should be provided as interim deliverables for EPA risk assessor review, and when they are expected to be available. The TARA Schedule Worksheet should be prepared in consultation with the EPA risk assessor assigned to the site.

Regions should perform the following steps associated with the preparation of the TARA Schedule Worksheet:

1. **Complete the TARA Schedule Worksheet** prior to initiation of any other Planning Tables, Worksheets, or Supporting Information.

2. **Obtain EPA risk assessor consensus** regarding which interim deliverables should be submitted and the schedules for each.

The recommended blank TARA Schedule Worksheet may be found in Appendix C. An example TARA Schedule Worksheet accompanies the Dean Company example in Appendix A.

PLANNING TABLE 1: Selection of Exposure Pathways. The purposes of **Planning Table 1** are:

- To assist in project planning
- To accompany the site conceptual model
- To present possible Receptors, Exposure Routes, and Exposure Pathways
- To present the rationale for selection or exclusion of each Exposure Pathway
- To communicate risk information to interested parties outside EPA
- To establish a framework for the generation of subsequent Planning Tables. All subsequent tables should be built from the information contained in Planning Table 1.

The information that should be documented in **Planning Table 1** includes:

- Exposure Pathways that were examined and excluded from analysis
- Exposure Pathways that are expected to be qualitatively or quantitatively evaluated in the risk assessment.

The data elements that should be presented in **Planning Table 1** are listed in the Planning Table 1 highlight box.

KEY DATA ELEMENTS IN PLANNING TABLE 1

Regions should provide the following information: Scenario Timeframe, Medium, Exposure Medium, Exposure Point, Receptor Population, Receptor Age, Exposure Route, Type of Analysis, Rationale for Selection or Exclusion of Exposure Pathway.

Region should perform the following steps associated with the preparation of **Planning Table 1**:

1. Refine site conceptual model which identifies all potential sources of contamination, all potential Exposure Pathways, the Medium associated with each, and the potentially exposed populations (Receptors).

2. Select realistic Exposure Pathways for detailed analyses.

3. Include rationale for exclusion of potential Exposure Pathways.

4. **Modify Planning Table 1, where appropriate .**

5. **Planning Table 1** should later be incorporated in the Baseline Risk Assessment Report.

DATA USEABILITY WORKSHEET. Data quality is an important component of the risk assessment and the evaluation of data quality should be documented. A recommended Data Useability Worksheet is included to address this need.

The Regional EPA risk assessor and the EPA document *Guidance for Data Useability in Risk Assessment (Part A,* U.S. EPA 1990a*),* should be consulted before completing the Data Useability Worksheet to define the appropriate level of detail to be reflected in the comment fields in the Worksheet. This Worksheet should be prepared as soon as all data validation reports have been completed for each medium. A medium-specific Data Useability Worksheet should be completed only after the project team (i.e., lead chemist, lead hydrogeologist, risk assessor, etc.) has collectively discussed the data useability criteria. The Worksheet should be used to record and identify the impact of data quality issues as they relate to data useability. For example, deviations from approved site Workplans which occurred during sample collection, laboratory analysis, or data review should be assessed. Also, the Worksheet preparer should refer to the Superfund regional office for guidance on data validation when preparing the Worksheet.

Regions should perform the following steps associated with the preparation of the **Data Useability Worksheet**:

1. **Complete the *Data Useability Worksheet*** for each Medium prior to screening of chemicals of potential concern (COPCs).

2. Incorporate the **Data Useability Worksheet** in the Baseline Risk Assessment Report.

A recommended blank Data Useability Worksheet may be found in Appendix C. An example Data Useability Worksheet accompanies the Dean Company example in Appendix A.

PLANNING TABLE 2: Occurrence, Distribution, and Selection of COPCs. The purposes of **Planning Table 2** are:

- To provide information useful for data evaluation of chemicals and radionuclides detected
- To provide adequate information so the user/reviewer gets a sense of the chemicals and radionuclides detected at the site and the potential magnitude of the potential problems at the site
- To provide chemical screening data and rationale for selection of COPCs.

The information documented in **Planning Table 2** should include:

- Statistical information about chemicals and radionuclides detected in each Medium
- The detection limits of chemicals and radionuclides analyzed
- The toxicity screening values for COPC selection
- The chemicals and radionuclides selected and deleted as COPCs.

The data elements presented in **Planning Table 2** are listed in the Planning Table 2 highlight box.

Regions should perform the following steps

associated with the preparation of **Planning Table 2**. Refer to the regional office for guidance when performing these steps.

KEY DATA ELEMENTS IN PLANNING TABLE 2

For each unique combination of Scenario Timeframe, Medium, and Exposure Medium, Regions should provide the following information: Exposure Point, CAS Number, Chemical, Minimum Concentration (Qualifier), Maximum Concentration (Qualifier), Units, Location of Maximum Concentration, Detection Frequency, Range of Detection Limits, Concentration Used for Screening, Background Value, Screening Toxicity Value (N/C), Potential ARAR/TBC Value, Potential ARAR/TBC Source, COPC Flag (Y/N), and Rationale for Selection or Deletion.

1. Discuss selection criteria for COPCs; including toxicity screening values, frequency of detection, and background comparison, as appropriate.

2. Perform screening; select COPCs that will be carried into the risk assessment (include comparison to regulatory standards and criteria where appropriate).

3. **Submit Supporting Information to substantiate the available Background Value shown for each chemical in Planning Table 2** and to enable verification of those values by EPA. The format of the summary should be determined by each region. The Supporting Information should provide relevant information for each chemical used to determine the background concentration, including (but not limited to) average, maximum, hypothesis testing of equality of the mean, and other information that may be required to fully describe the background selection process.

4. Incorporate the Background Supporting Information in the Baseline Risk Assessment Report.

5. **Complete Planning Table 2** for each combination of Scenario Timeframe, Medium, and Exposure Medium.

6. **Incorporate Planning Table 2** in the Baseline Risk Assessment Report.

PLANNING TABLE 3: Exposure Point Concentration Summary. The purposes of **Planning Table 3** are:

- To provide the EPCs for measured and modeled values
- To provide statistical information on the derivation of the EPCs.

The information documented in **Planning Table 3** should include:

- Statistical information which was used to calculate the EPCs for chemicals and radionuclides detected in each Medium
- EPCs (RME and/or CT)
- The statistics which were used to make the determinations as well as the rationale for the selection of the statistics for each chemical or radionuclide (i.e., discuss statistical derivation of measured data or approach for modeled data).

The data elements presented in **Planning Table 3** are listed in the Planning Table 3 highlight box.

KEY DATA ELEMENTS IN PLANNING TABLE 3

For each unique combination of Scenario Timeframe, Medium, and Exposure Medium, Regions should provide the following information: Exposure Point, Chemical of Potential Concern, Units, Arithmetic Mean, 95% upper confidence level (UCL), Maximum Concentration (Qualifier), EPC Value, EPC Units, EPC Statistic, and EPC Rationale.

Region should perform the following steps associated with the preparation **of Planning Table 3**.

1. Discuss how samples will be grouped (e.g., how hot spots in soil will be considered; how groundwater data will be combined; how temporal and chemical phases will be addressed; how upgradient, downgradient, and cross gradient samples will be addressed).

2. Discuss approach to determine how data are distributed (e.g., normal, log-normal).

3. Discuss evaluation of lead, total chromium and any other special chemicals.

4. **Submit Supporting Information to document the EPC summary presented in Planning Table 3** and to enable verification of those values by EPA. The format of the summary should be determined by each region. The Supporting Information should discuss EPCs statistically derived from measured data, including identification of the samples used in each calculation, results of distribution testing (Wilk-Shapiro, D'Agostino), mean (transformed if appropriate), maximum (transformed if appropriate), Planning deviation (transformed if appropriate), t- or H-statistic, 95% UCL (including non-parametric methods, where applicable), and other protocols as required. The Supporting Information should also present information for EPCs, including derivation of modeled values, assumptions and values used, statistical derivation of measured values and associated calculations, and other protocols as required.

5. Incorporate the **EPC Supporting Information** in the Baseline Risk Assessment Report.

6. **Complete Planning Table 3** for each combination of Scenario Timeframe, Medium, Exposure Medium, and Exposure Point. Create separate sets of Planning Table 3 for RME and CT, when appropriate.

7. Incorporate **Planning Table 3** in the Baseline Risk Assessment Report.

Planning TABLE 4: Values Used for Daily Intake Calculations. The purposes of **Planning Table 4** are:

- To provide the exposure parameters used for intake calculations for each Exposure Pathway (Scenario Timeframe, Medium, Exposure Medium, Exposure Point, Receptor Population, Receptor Age, and Exposure Route)
- To provide the intake equations or models used for each Exposure Route/Pathway.

The information documented in **Planning Table 4** should include:

- Values used for each intake equation for each Exposure Pathway and the reference/rationale for each
- Intake equation or model used to calculate the intake for each Exposure Pathway.

The data elements presented in **Planning Table 4** are listed in the Planning Table 4 highlight box.

KEY DATA ELEMENTS IN PLANNING TABLE 4

For each unique combination of Scenario Timeframe, Medium, and Exposure Medium, Regions should provide the following information: Exposure Route, Receptor Population, Receptor Age, Exposure Point, Parameter Code, Parameter (Definition, Value, and Units), Rationale/Reference, and Intake Equation/Model Name.

Regions should perform the following steps associated with the preparation of **Planning Table 4**.

1. Provide references for all exposure

parameters.

2. **Submit Supporting Information to summarize the Modeled Intake Methodology and Parameters used to calculate modeled intake values** and to enable verification of those values by EPA. The Supporting Information should be limited to summary level information. The format of the summary should be structured to accommodate the variability and complexity associated with different models.

3. Incorporate the **Modeled Intake Supporting Information** in the Baseline Risk Assessment Report.

4. **Submit Supporting Information on Chemical-Specific Parameters**, which apply to all Planning Tables to be completed for the risk assessment and to enable verification of those values by EPA. The summary should identify and display chemical parameters and constants that are used to calculate risks and hazards, but are not included on Planning Tables. The format of the summary should be determined by each region. The values and constants that are used to calculate risk and hazards, including molecular weight, vapor pressure, K_{oc}, K_{ow}, dermal permeability constant, Henry's Law constant, and other information that the reader would find useful for understanding the risk assessment discussion should be included.

5. Incorporate the **Chemical-Specific Parameter Supporting Information** summary into the Baseline Risk Assessment Report.

6. **Complete Planning Table 4** for each combination of Scenario Timeframe, Medium, and Exposure Medium. Create separate sets of Planning Table 4 for RME and CT, where appropriate.

7. Incorporate **Planning Table 4** into the Baseline Risk Assessment Report.

DERMAL WORKSHEET. The recommended Dermal Worksheet presents intermediate variables for calculating absorbed dose per event DA (event). A version of this Worksheet should be developed for each medium for which the dermal exposure route will be quantitatively assessed. Available data should be provided for each COPC under evaluation.

Regions should perform the following steps associated with preparation of the **Dermal Worksheet**:

1. **Complete the Dermal Worksheet** prior to calculation of risks and hazards.

2. Provide interim deliverables to the EPA risk assessor, as appropriate.

3. Incorporate the **Dermal Worksheet** in the Baseline Risk Assessment Report.

A recommended blank Dermal Worksheet may be found in Appendix C. An example Dermal Worksheet accompanies the Dean Company example in Appendix A.

PLANNING TABLES 5 AND 6: Non-Cancer and Cancer Toxicity Data. The purposes of **Planning Tables 5.1, 5.2, and 5.3** are:

- To provide information on reference doses (RfDs), reference concentrations (RfCs), Target organs, and adjustment factors for chemicals
- To provide oral to dermal adjustment factors
- To provide RfC to RfD adjustment factors
- To verify references for non-cancer toxicity data
- To provide non-cancer toxicity information for "special-case" chemicals.

KEY DATA ELEMENTS IN
PLANNING TABLE 5.1

Region should provide the following information: Chemical of Potential Concern, Chronic/Subchronic, Oral RfD Value and Units, Oral Absorption Efficiency for Dermal, Absorbed RfD for Dermal Value and Units, Primary Target Organ(s), Combined Uncertainty/Modifying Factors, Source(s) RfD: Target Organ(s), and Dates of RfD: Target Organ(s).

The information documented in **Planning Tables 5.1, 5.2, and 5.3** should include:

- The RfDs for each of the COPCs, as well as modifying factors and reference concentration (RfC) to RfD adjustments
- The organ effects of each of the COPCs
- References for RfCs and organ effects.

The data elements presented in **Planning Tables 5.1, 5.2, and 5.3** are listed in the Planning Tables 5.1, 5.2, and 5.3 highlight boxes.

KEY DATA ELEMENTS IN
PLANNING TABLE 5.2

Regions should provide the following information: Chemical of Potential Concern, Chronic/Subchronic, Inhalation RfC Value and Units, Extrapolated RfD Value and Units, Primary Target Organ(s), Combined Uncertainty/Modifying Factors, Source(s) of RfC: Target Organ(s), and Date(s) of RfC: Target Organ(s).

KEY DATA ELEMENTS IN
PLANNING TABLE 5.3

Regions should provide the following information: Chemical of Potential Concern, Chronic/Subchronic, Parameter Name, Value, and Units), Primary Target Organ(s), Combined Uncertainty/Modifying Factors, Source(s) of Parameter: Target Organ(s), and Date(s) of

The purposes of **Planning Tables 6.1, 6.2, 6.3, and 6.4** are:

- To provide the oral, dermal, and inhalation cancer toxicity information (values and sources of information) for chemicals and radionuclides of potential concern
- To provide the methodology and adjustment factors used to convert oral cancer toxicity values to dermal toxicity values and to convert inhalation unit risks to inhalation cancer slope factors
- To provide weight of evidence/cancer guideline descriptions for each chemical and radionuclide of potential concern
- To provide cancer toxicity information for "special case" chemicals.

The information documented in **Planning Tables 6.1, 6.2, 6.3, and 6.4** should include:

- Oral, dermal, and inhalation toxicity values for chemicals and radionuclides of potential concern

- Weight of evidence/cancer guidelines descriptions for chemicals of potential concern

- The source/reference for each toxicity value.

The data elements presented in **Planning Tables 6.1, 6.2, 6.3, and 6.4** are listed in the Planning Tables 6.1, 6.2, 6.3, and 6.4 highlight box.

KEY DATA ELEMENTS IN PLANNING TABLE 6.1

Regions should provide the following information: Chemical of Potential Concern, Oral Cancer Slope Factor Value and Units, Oral Absorption Efficiency for Dermal, Absorbed Cancer Slope Factor for Dermal Value and Units, Weight of Evidence/Cancer Guideline Description, Source(s) and Date(s) of Oral CSF.

KEY DATA ELEMENTS IN PLANNING TABLE 6.2

Regions should provide the following information: Chemical of Potential Concern, Unit Risk Value and Units, Inhalation Cancer Slope Factor Value and Units, Weight of Evidence/Cancer Guideline Description, Source(s) and Date(s) of Unit Risk: Inhalation CSF.

KEY DATA ELEMENTS IN PLANNING TABLE 6.3

Regions should p rovide the following information: Chemical of Potential Concern, Parameter (Name, Value, and Units), Source(s), and Dates(s).

KEY DATA ELEMENTS IN PLANNING TABLE 6.4

Regions should provide the following information: Chemical of Potential Concern, Cancer Slope Factor Value and Units, Source(s), and Dates(s).

Regions should perform the following steps associated with the preparation of **Planning Tables 5 and 6.**

1. Refer to the end of Section 3.1.1 for Lead Worksheets.

2. Ensure that chronic and subchronic toxicity values are applied correctly based on the duration of exposure. Provide rationale for selection of surrogate toxicity values not in IRIS or HEAST, or provided by NCEA. (EPA may require additional review.)

3. **Submit Supporting Information regarding Toxicity Data for Special Case Chemicals** (i.e., those chemicals with cancer risks and non-cancer hazards calculated using methods or toxicity parameters different from those presented on Planning Tables 5.1, 5.2, 6.1, or 6.2). The Supporting Information should be be used to enable verification of those values by EPA. Examples may include selection of potency factors for polychlorinated biphenyls (PCBs), use of relative potencies for polynuclear aromatic hydrocarbons (PAHs) and chlorinated dioxins and furans, and valence species assumptions for metals. Consult the EPA risk assessor regarding the use of these tables.

4. Incorporate the **Special Case Chemicals Supporting Information** in the Baseline Risk Assessment Report.

5. **Complete Planning Tables 5 and 6** for the exposure routes and chemicals under evaluation.
   Planning Table 5.1: Non-Cancer Toxicity Data - Oral/Dermal
   Planning Table 5.2: Non-Cancer Toxicity Data - Inhalation
   Planning Table 5.3: Non-Cancer Toxicity Data - Special Case Chemicals
   Planning Table 6.1: Cancer Toxicity Data - Oral/Dermal
   Planning Table 6.2: Cancer Toxicity Data - Inhalation
   Planning Table 6.3: Cancer Toxicity Data - Special Case Chemicals
   Planning Table 6.4: Cancer Toxicity Data -External (Radiation).

6. Incorporate **Planning Tables 5 and 6** in the Baseline Risk Assessment Report.

PLANNING TABLE 7: Calculation of

Chemical Cancer Risks and Non-Cancer Hazards. The purposes of **Planning Table 7** are:

- To provide a summary of the variables used to calculate chemical cancer risks and non-cancer hazards
- To show the EPC and intake used in the non-cancer hazard and cancer risk calculations
- To present the result of the calculation for each Exposure Route/Pathway for each COPC
- To provide the total hazard index and cancer risks for all Exposure Routes/Pathways for the Scenario Timeframe and Receptor presented in this table.

The information documented in **Planning Table 7** should include:

- The non-cancer hazard quotient (HQ) and cancer risk value for each COPC for each Exposure Route/Pathway
- The values used for EPC, non-cancer intake, cancer intake, reference doses and concentrations, and cancer slope factors for each COPC for each Exposure Route.

The data elements presented in **Planning Table 7** are listed in the Planning Table 7 highlight box.

KEY DATA ELEMENTS IN PLANNING TABLE 7

For each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age, Regions should provide the following information: Medium, Exposure Medium, Exposure Point, Exposure Route, Chemical of Potential Concern, EPC Value and Units, Cancer Risk Calculations (Intake/Exposure Concentration Value and Units, CSF/Unit Risk Value and Units, and Cancer Risk), and Non-Cancer Hazard Calculations (Intake/Exposure Concentration Value and Units, RfD/RfC Value and Units, and Hazard Quotient).

Regions should perform the following steps associated with the preparation of **Planning Table 7.**

1. Address non-cancer hazards and cancer risks including the calculations and supporting information by Exposure Route.

2. Include RME and CT results in separate tables. Ensure that risks and hazards from multiple chemicals are combined appropriately across Pathways that affect the same individual or population subgroup, for all site-related chemicals.

3. Discuss definitions of Planning Tables
   Planning Table 7.n.RME: Calculation of Chemical Cancer Risks and Non-Cancer Hazards (RME)
   Planning Table 7.n.CT: Calculation of Chemical Cancer Risks and Non-Cancer Hazards (CT)

4. If it is preferred to segregate cancer and non-cancer evaluations, see the blank Planning Tables 7.a.1 and 7.b.1 shown in Appendix A as well as Example Scenario 7 in Appendix D.

5. **Submit Supporting Information that summarizes the approach used to perform Special Chemical Risk and Hazard Calculations** and to enable verification of those values by EPA. This summary should address the calculation of non-cancer hazards and cancer risks for chemicals that do not use RfD or cancer slope factor (CSF) values, respectively. The format of the summary should be determined by each region.

6. Incorporate the **Special Chemical Risk and Hazard Calculations Supporting Information** in the Baseline Risk Assessment Report.

7. **Complete Planning Table 7** for each combination of Scenario Timeframe, Receptor Population, and Receptor Age.

8. Incorporate **Planning Table 7** in the Baseline Risk Assessment Report.

PLANNING TABLE 8: **Calculation of Radiation Cancer Risks.**
The purposes of **Planning Table 8** are:

- To provide a summary of the variables used to calculate radiation cancer risks
- To show the EPC used in the radiation cancer risk calculations
- To show, based on the documented risk calculation approach, the intake and cancer slope factors
- To present the result of the calculation for each Exposure Route/Pathway for each COPC
- To provide the radiation cancer risks for all Exposure Routes/Pathways for the Scenario Timeframe and Receptor presented in this table.

The information documented in **Planning Table 8** should include:

- The approach for calculating the radiation cancer risk for each COPC for each Exposure Route/Pathway
- The values used for EPC, intake, and cancer slope factor for each COPC for each Exposure Route
- The Cancer risk value for each COPC for each Exposure Route/Pathway
- Total cancer risk values by Exposure Route, Exposure Point, and across all media for the Scenario Timeframe and Receptor presented in this table.

KEY DATA ELEMENTS IN PLANNING TABLE 8

For each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age, Regions should provide the following information: Medium, Exposure Medium, Exposure Point, Exposure Route, Radionuclide of Potential Concern, EPC Value and Units, Risk Calculation Approach, and Cancer Risk Calculations (Intake/Activity Value and Units, CSF Value and Units, and Cancer Risk).

The data elements presented in **Planning Table 8** are listed in the Planning Table 8 highlight box.

Regions should perform the following steps associated with the preparation of **Planning Table 8**.

1. Address radiation cancer risks including the calculations and supporting information by Exposure Route.

2. Include RME and CT results in separate tables. Ensure that risks from multiple radionuclides are combined appropriately across pathways that affect the same individual or population subgroup, for all site-related radionuclides.

3. Discuss definitions of Planning Tables
   Planning Table 8.n.RME: Calculation of Cancer Radiation Risks (RME)
   Planning Table 8.n.CT: Calculation of Cancer Radiation Risks (CT)

4. **Complete Planning Table 8** for each combination of Scenario Timeframe, Receptor Population, and Receptor Age.

5. Incorporate **Planning Table 8** in the Baseline Risk Assessment Report.

RADIATION DOSE ASSESSMENT WORKSHEET. The recommended Radiation Dose Assessment Worksheet has been provided to document alternate radionuclide cancer risk calculations, performed using a dose approach rather than the standard CERCLA risk calculation method.

The Regions should perform the following steps associated with preparation of the **Radiation Dose Assessment Worksheet,** if applicable to the risk assessment:

1. Complete the **Radiation Dose Assessment Worksheet** for each Receptor.

2. Provide interim deliverables to the EPA risk assessor, as appropriate.

3. Incorporate the **Radiation Dose Assessment Worksheet** in the Baseline Risk Assessment Report.

A recommended blank Radiation Dose Assessment Worksheet may be found in Appendix C. An example Radiation Dose Assessment Worksheet is presented in Appendix D, Example Scenario 11.

PLANNING TABLE 9: Summary of Receptor Risk and Hazards for COPCs.

The purpose of **Planning Table 9** is:

- To provide a summary of cancer risks and non-cancer hazards for each Receptor, by Medium, Exposure Medium, Exposure Route, and Exposure Point.

The information documented in **Planning Table 9** should include:

- The cancer risk and non-cancer hazard to each Receptor for each COPC by Exposure Route and Exposure Point
- The total cancer risk and non-cancer hazard for each Exposure Point, Exposure Medium and Medium across all Exposure Routes
- The total cancer risk and non-cancer hazard for a Receptor across all media
- The primary target organs for non-carcinogenic hazard effects.

The data elements presented in **Planning Table 9** are listed in the Planning Table 9 highlight box.

Regions should perform the following steps associated with the preparation of **Planning Table 9.**

1. Address non-cancer hazards and cancer risks including the calculations and supporting information by Exposure Route.

2. Include RME and CT results. Ensure that risks and hazards from multiple chemicals are combined appropriately across Pathways that affect the same individual or population subgroup, for all site-related chemicals.

KEY DATA ELEMENTS IN PLANNING TABLE 9

For each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age, Regions should provide the following information: Medium, Exposure Medium, Exposure Point, Chemical of Potential Concern, Carcinogenic Risk (Ingestion, Inhalation, Dermal, External (Radiation) and Exposure Routes Total), and Non-Carcinogenic Hazard Quotient (Primary Target Organ(s), Ingestion, Inhalation, Dermal, and Exposure Routes Total).

3. Discuss definitions of Planning Tables
   Planning Table 9.n.RME: Summary of Receptor Risks and Hazards for COPCs (RME)
   Planning Table 9.n.CT: Summary of Receptor Risks and Hazards for COPCs (CT)

4. **Complete Planning Table 9** for each combination of Scenario Timeframe, Receptor Population, and Receptor Age.

5. Incorporate **Planning Table 9** in the Baseline Risk Assessment Report.

PLANNING TABLE 10: Risk Summary. The purpose of **Planning Table 10** is:

- To provide a summary of cancer risks and non-cancer hazards for each Receptor, by Medium, Exposure Medium, Exposure Route, and Exposure Point, that may trigger the need for remedial action.

The information documented in **Planning Table 10** should include:

- The cancer risk and non-cancer hazard to each Receptor for each chemical or radionuclide by Exposure Route and Exposure Point for risk drivers
- The total cancer risk and non-cancer hazard for each Exposure Point, Exposure Medium, and Medium across all Exposure Routes for

risk drivers
- The total cancer risk and non-cancer hazard for a Receptor across all media for risk drivers
- The primary target organs for non-carcinogenic hazard effects for risk drivers.

The data elements presented in **Planning Table 10** are listed in the Planning Table 10 highlight box.

KEY DATA ELEMENTS IN PLANNING TABLE 10

For each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age, Regions should provide the following information: Medium, Exposure Medium, Exposure Point, Chemical, Carcinogenic Risk (Ingestion, Inhalation, Dermal, External (Radiation) and Exposure Routes Total), and Non-Carcinogenic Hazard Quotient (Primary Target Organ(s), Ingestion, Inhalation, Dermal, and Exposure Routes Total).

Regions should perform the following steps associated with the preparation of **Planning Table 10**.

1. Address non-cancer hazards and cancer risks including the calculations and supporting information by Exposure Route.

2. Include RME and CT results. Ensure that risks and hazards from multiple chemicals are combined appropriately across Pathways that affect the same individual or population subgroup, for all site-related chemicals.

3. Discuss definitions of Planning Tables
   Planning Table 10.n.RME: Risk Summary (RME)
   Planning Table 10.n.CT: Risk Summary (CT)

4. **Complete Planning Table 10** for each combination of Scenario Timeframe, Receptor Population, and Receptor Age.

5. Incorporate **Planning Table 10** in the Baseline Risk Assessment Report.

LEAD WORKSHEETS. Two recommended Lead Worksheets have been provided to document lead risk evaluations performed for young children and adult receptors at a site.

Regions should perform the following steps associated with the preparation of **Lead Worksheets**:

1. **Complete the Lead Worksheets** for Child and Adult. Also attach the appropriate graphs and results from the Integrated Exposure Uptake Biokinetic Model (IEUBK) model (if used) to the Child Worksheet. Also attach results from the adult lead spreadsheet to the Adult Worksheet.

2. The **Lead Worksheets** should later be incorporated in the Baseline Risk Assessment Report.

Blank recommended Lead Worksheets may be found in Appendix C. Example Lead Worksheets are presented in Appendix D Example Scenario 10.

3.1.2 ASSESSMENT OF CONFIDENCE AND UNCERTAINTY

Uncertainty assessment is important in risk assessment. Although the risk assessment should indicate sources of variability and uncertainty throughout the process, it will generally be appropriate to include a separate section of the Baseline Risk Assessment Report that also focuses on the uncertainties associated with data evaluation, toxicity assessment, exposure assessment, and risk characterization, as well as overall uncertainty of the final risk numbers. The region may choose to defer presentation of this specific section to the Draft Baseline Risk Assessment Report.

Regions should perform the following steps associated with the **Assessment of Confidence and Uncertainty**:

1. **Summarize the Assessment of Confidence and Uncertainty.**

2. Incorporate the **Assessment of Confidence and Uncertainty** in the Baseline Risk Assessment Report.

3.1.3 PROBABILISTIC ANALYSIS INFORMATION

Based upon the results from a deterministic risk characterization calculation (Planning Table 7) a decision should be made if a Probabilistic Analysis will be performed to calculate cancer risks and non-cancer hazards in accordance with Agency policy.

Regions should perform the following steps associated with the **Probabilistic Analysis:**

1. **Summarize the Probabilistic Analysis** (if performed) in a non-standard format. (Planning formats have not been developed to document probalistic analysis.) Refer to probabilistic analysis guidance (U.S. EPA 1997e, 1997g and 2001d) to determine the information to be documented.

2. Incorporate the **Probabilistic Analysis** summary in the Baseline Risk Assessment Report.

3.2 DRAFT BASELINE RISK ASSESSMENT REPORT

Regions should Submit the Draft Baseline Risk Assessment Report after the completion and acceptance of the Interim Deliverables described above. EPA guidance should be consulted in preparing the Draft Baseline Risk Assessment Report. EPA anticipates that this report preparation will be greatly expedited, since it should incorporate the following Interim Deliverables:

- Planning Tables 0 through 10
- Worksheets on Data Useability, Dermal, Radiation Dose Assessments, and Lead, as applicable
- Supporting Information
- The Assessment of Confidence and Uncertainty
- Probabilistic Analysis information (if applicable).

However, the report should not consist exclusively of the Interim Deliverables, because additional narrative should be necessary for a clear and comprehensible Baseline Risk Assessment Report. For example, information such as definition of hazard indices and cancer slope factors, toxicological profiles for COPCs, and other information indicated by risk assessment guidance should be incorporated.

Every risk assessment should contain a Risk Characterization appropriate to the assessment. Risk assessments submitted to the Agency or performed by the Agency should incorporate any current Agency guidance applicable on Risk Characterization (e.g., RAGS/HHEM, EPA 1989c; Memorandum from Carol Browner on Risk Characterization, EPA 1995b).

3.3 FINAL BASELINE RISK ASSESSMENT REPORT

Regions should submit the Final Baseline Risk Assessment Report as a revision of the draft, incorporating review comments as necessary and appropriate.

Regions should Prepare Draft ROD Risk Worksheet (ROD Risk Highlights) as directed by the EPA RPM and EPA risk assessor, upon completion of the Final Baseline Risk Assessment Report. Refer to the ROD guidance (U.S. EPA, 1999a) for human health risk data needs. The draft ROD Risk Worksheets present the Exposure Pathways and Chemicals that help justify the need for remedial action. Regions should prepare these recommended Worksheets when the Final

Baseline Risk Assessment Report is completed, in order to facilitate the EPA risk manager's preparation of the ROD at a later date.

Exhibit 3-4 identifies the RAGS Part D

information sources (Planning Table and column) for ROD Risk Worksheets (Highlights) 6-15, 6-16A, 6-16B, 6-18A, and 6-18B. Blank templates for the five ROD Risk Worksheets (Highlights) may be found in Appendix C

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3.4 INFORMATION TRANSFER TO SUPERFUND RISK DATA COLLECTION

Upon the completion of the Final Baseline Risk Assessment Report, provide the Lotus® or Excel® version of the Planning Tables and Worksheets to the EPA risk assessor, who should submit them to the EPA Headquarters Risk Information Manager responsible for the Superfund Risk Data Collection.

EXHIBIT 3-1

INTERIM DELIVERABLES FOR EACH SITE

Interim Deliverable	Scope of Deliverable
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLE 0	
TARA Schedule Worksheet	One Worksheet for each Risk Assessment.
Planning Table 0 - Site Risk Assessment Identification Information	One Planning Table for each Risk Assessment.
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLE 1	
Planning Table 1 - Selection of Exposure Pathways	One Planning Table for each Risk Assessment.
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLE 2	
Data Useability Worksheet	One Worksheet for each Medium.
Supporting Information on Background Values	Information for all Chemicals listed in Planning Table 2.
Planning Table 2 - Occurrence, Distribution, and Selection of Chemicals of Potential Concern (COPCs)	One Planning Table for each unique combination of Scenario Timeframe, Medium, and Exposure Medium.
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLE 3	
Supporting Information on EPCs	Information for all EPCs presented in Planning Table 3.
Planning Table 3 - Exposure Point Concentration (EPC) Summary	One Planning Table for each unique combination of Scenario Timeframe, Medium, and Exposure Medium.
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLE 4	
Supporting Information on Modeled Intake Methodology and Parameters	Information for all Modeled Intake calculations that are not presented in Planning Table 4.
Supporting Information on Chemical-Specific Parameters	Information for all Chemical-Specific Parameters used.
Dermal Worksheet	Information for calculation of DA(event).
Planning Table 4 - Values Used for Daily Intake Calculations	One Planning Table for each unique combination of Scenario Timeframe, Medium, and Exposure Medium.
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLES 5 AND 6	
Supporting Information on Toxicity Data for Special Case Chemicals	Information for each Special Case Chemical.
Planning Table 5 - Non-Cancer Toxicity Data	Three Planning Tables - 5.1 for Oral/Dermal, 5.2 for Inhalation, and 5.3 for Special Case Chemicals.

EXHIBIT 3-1

INTERIM DELIVERABLES FOR EACH SITE (continued)

Interim Deliverable	Scope of Deliverable
Planning Table 6 - Cancer Toxicity Data	Four Planning Tables - 6.1 for Oral/Dermal, 6.2 for Inhalation, 6.3 for Special Case Chemicals, and 6.4 for External (Radiation).
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLES 7 AND 8	
Supporting Information on Special Chemical Risk and Hazard Calculations	Information for each Special Case Chemical.
Planning Table 7 - Calculation of Chemical Cancer Risks and Non-Cancer Hazards	One Planning Table for each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age, for RME and for CT.
Radiation Dose Assessment Worksheet	One Worksheet for each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age (as appropriate).
Planning Table 8 - Calculation of Radiation Cancer Risks	One Planning Table for each unique combination of Scenario Timeframe, Receptor Population and Receptor Age.
INTERIM DELIVERABLES ASSOCIATED WITH PLANNING TABLES 9 AND 10	
Planning Table 9 - Summary of Receptor Risks and Hazards for COPCs	One Planning Table for each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age, for RME and CT.
Planning Table 10 - Risk Summary	One Planning Table for each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age, for RME and CT.
INTERIM DELIVERABLES ASSOCIATED WITH LEAD	
Lead Worksheets (if applicable)	Separate Worksheets for Residential and Non-Residential Scenarios for each unique combination of Scenario Timeframe, Receptor Population, and Receptor Age.
INTERIM DELIVERABLES ASSOCIATED WITH UNCERTAINTY ASSESSMENT	
Assessment of Confidence and Uncertainty	One Assessment for each Risk Assessment.
INTERIM DELIVERABLES ASSOCIATED WITH PROBABILISTIC ANALYSIS	
Summary of Probabilistic Analysis (if applicable)	One Summary for each Risk Assessment.

EXHIBIT 3-1

INTERIM DELIVERABLES FOR EACH SITE (continued)

Interim Deliverable	Scope of Deliverable
INTERIM DELIVERABLES ASSOCIATED WITH THE ROD	
ROD Risk Worksheets	As appropriate to document (in draft form) the need for remedial action.

Notes:
1. Each Interim Deliverable should be reviewed and verified by EPA prior to submission of the Draft Baseline Risk Assessment Report.
2. Each Interim Deliverable should later be incorporated in the Draft and Final Baseline Risk Assessment Reports.
3. The Interim Deliverables are needed for each risk assessment to achieve standardization in risk assessment reporting.

EXHIBIT 3-2

STANDARDIZED RISK ASSESSMENT REPORTING

Risk Assessment Activity	Corresponding Planning Table/Worksheet
Data Collection	
Provide identification information for the risk assessment	Planning Table 0 - Site Risk Assessment Identification Information
Plan the risk assessment review process	TARA Schedule Worksheet
Develop a conceptual site model	Planning Table 1 - Selection of Exposure Pathways
Gather and report appropriate data	Planning Table 2 - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Data Evaluation	
Evaluate detection frequency, background data, and site data	Data Useability Worksheet Planning Table 2 - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Identify chemicals of potential concern and provide rationale for selection and deletion	Planning Table 2 - Occurrence, Distribution, and Selection of Chemicals of Potential Concern
Exposure Assessment	
Characterize physical setting, identify potential pathways and exposed population	Planning Table 1 - Selection of Exposure Pathways
Identify exposure assumptions	Planning Table 4 - Values Used for Daily Intake Calculations Dermal Worksheet
Estimate exposure point concentrations	Planning Table 3 - Exposure Point Concentration Summary
Estimate exposure intakes	Planning Table 7 - Calculation of Chemical Cancer Risks and Non-Cancer Hazards Planning Table 8 - Calculation of Radiation Cancer Risks
Toxicity Assessment	
Determine toxicity values for carcinogenic and non-carcinogenic effects and provide source information	Planning Table 5 - Non-Cancer Toxicity Data Planning Table 6 - Cancer Toxicity Data

EXHIBIT 3-2

STANDARDIZED RISK ASSESSMENT REPORTING (continued)

Risk Assessment Activity	Corresponding Planning Table/Worksheet
Risk Characterization	
Quantify cancer and non-cancer risk by pathway	Planning Table 7 - Calculation of Chemical Cancer Risks and Non-Cancer Hazards Planning Table 8 - Calculation of Radiation Cancer Risks Radiation Dose Assessment Worksheet
Combine risks by media for different receptors	Planning Table 9 - Summary of Receptor Risks and Hazards for COPCs
Summarize risk drivers for different receptors	Planning Table 10 - Risk Summary
Prepare draft risk documentation for ROD	ROD Risk Worksheets

EXHIBIT 3-3

SUMMARY OF RAGS PART D
REVISION 1 CHANGES

PLANNING TABLE/WORKSHEET	REVISION 1 CHANGES
Planning Table 0	This is a new Planning Table.
TARA Schedule Worksheet	This is a new Worksheet.
Planning Table 1	Revision 1 does not include the On-Site/Off-Site field from Revision 0.
Data Useability Worksheet	The Revision 1 Worksheet is the same as the Revision 0 Worksheet.
Planning Table 2	Exposure Point was moved from the last row of the Summary Box (Revision 0) to the first column of the table (Revision 1). This may reduce the number of versions of Planning Table 2 needed for some sites. The Qualifier information for Minimum and Maximum Concentrations has been moved to the corresponding Concentration fields.
Planning Table 3	In Revision 1, separate versions of this table should be prepared for RME and CT. Exposure Point was moved from the last row of the Summary Box (Revision 0) to the first column of the table (Revision 1). This may reduce the number of versions of Planning Table 3 needed for some sites. The Qualifier information has been moved to the corresponding Maximum Concentration field.
Planning Table 4	In Revision 1, separate versions of this table should be prepared for RME and CT. Receptor Population, Receptor Age, and Exposure Point were moved from the Summary Box (Revision 0) to columns in Revision 1. This may reduce the number of versions of Planning Table 4 needed for some sites.
Planning Tables 5.1, 5.2, and 5.3	The Revision 1 Planning Tables are essentially the same as Revision 0. Some column headings have been slightly reworded, but the data needs are the same.
Planning Table 6.1, 6.2, 6.3, and 6.4	The Revision 1 Planning Tables 6.1, 6.2, and 6.3 are essentially the same as Revision 0. Some column headings have been slightly reworded, but the data needs are the same. Revision 1 Planning Table 6.4 for radionuclides was not included in Revision 0.

EXHIBIT 3-3

SUMMARY OF RAGS PART D
REVISION 1 CHANGES (continued)

PLANNING TABLE/WORKSHEET	REVISION 1 CHANGES
Planning Table 7	Medium, Exposure Medium, and Exposure Point were moved from the Summary Box (Revision 0) to columns in the table (Revision 1). This may reduce the number of versions of Planning Table 7 needed for some sites. Planning Table 7, which previously contained only non-cancer information (Revision 0), now presents cancer and non-cancer information for chemicals.
Planning Table 8	Planning Table 8 (Revision 1) focuses exclusively on the calculation of radiation cancer risks. Planning Table 8 (Revision 0) focused on cancer risk calculations for all chemicals. Medium, Exposure Medium, and Exposure Point were moved from the Summary Box (Revision 0) to columns in the table (Revision 1). This may reduce the number of versions of Planning Table 8 needed for some sites. Medium EPC and Route EPC information (Revision 0) was replaced by EPC information (Revision 1).
Radiation Dose Assessment Worksheet	This is a new Worksheet.
Planning Tables 9 and 10	A column for Exposure Route External (Radiation) has been added to the cancer calculations in Revision 1. The second COPC (Planning Table 9) or Chemical (Planning Table 10) column from Revision 0 has been deleted in Revision 1. Accommodations have been made for summing risks and hazards at the Exposure Point, Exposure Medium, Medium, and Receptor Levels.
Lead Worksheets	These are new Worksheets.
ROD Risk Worksheets (ROD Risk Highlights)	These are new Worksheets that copy the ROD Guidance (U.S. EPA, 1999a) Risk Highlights.

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-15	Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations	Scenario Timeframe	Planning Tables 2 & 3	Scenario Timeframe
		Medium	Planning Tables 2 & 3	Medium
		Exposure Medium	Planning Tables 2 & 3	Exposure Medium
		Exposure Point	Planning Tables 2 & 3	Exposure Point
		Chemical of Concern	Significant Chemicals from Planning Table 2 (site specific definition)	Chemical
		Concentration Detected - Min	Planning Table 2	Minimum Concentration
		Concentration Detected - Max	Planning Table 2	Maximum Concentration
		Units	Planning Table 2	Units
		Frequency of Detection	Planning Table 2	Detection Frequency
		Exposure Point Concentration	Planning Table 3	Exposure Point Concentration Value
		Exposure Point Concentration Units	Planning Table 3	Exposure Point Concentration Units
		Statistical Measure	Planning Table 3	Exposure Point Concentration Statistic

Notes:
-A version of ROD Highlight 6-15 is to be prepared for each combination of Scenario Timeframe, Medium, and Exposure Medium with "significant routes of exposure". The definition of "significant" will be site specific.
-Only Exposure Points with "Significant Routes of Exposure" are to be included.

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS (continued)

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-16A	Cancer Toxicity Data Summary	Pathway: Ingestion, Dermal	Planning Table 6.1 (Cancer Toxicity Data-Oral/Dermal)	
		Chemical of Concern	Chemicals of Concern from Planning Table 6.1 (site specific definition)	Chemical of Potential Concern
		Oral Cancer Slope Factor	Planning Table 6.1	Oral Cancer Slope Factor
		Dermal Cancer Slope Factor	Planning Table 6.1	Absorbed Cancer Slope Factor for Dermal Value
		Slope Factor Units	Planning Table 6.1	Oral Cancer Slope Factor Units and Absorbed Cancer Slope Factor for Dermal Units
		Weight of Evidence/ Cancer Guideline Description	Planning Table 6.1	Weight of Evidence/Cancer Guideline Description
		Source	Planning Table 6.1	Oral CSF Source(s)
		Date	Planning Table 6.1	Oral CSF Date(s)
		Pathway: Inhalation	Planning Table 6.2 (Cancer Toxicity Data - Inhalation)	
		Chemical of Concern	Chemicals of Concern from Planning Table 6.2 (site specific definition)	Chemical of Potential Concern
		Unit Risk	Planning Table 6.2	Unit Risk Value
		Units	Planning Table 6.2	Unit Risk Units

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS (continued)

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-16A (continued)	Cancer Toxicity Data Summary (continued)	Inhalation Cancer Slope Factor	Planning Table 6.2	Inhalation Cancer Slope Factor Value
		Units	Planning Table 6.2	Inhalation Cancer Slope Factor Units
		Weight of Evidence/ Cancer Guideline Description	Planning Table 6.2	Weight of Evidence/Cancer Guideline Description
		Source	Planning Table 6.2	Unit Risk : Inhalation CSF Source(s)
		Date	Planning Table 6.2	Unit Risk : Inhalation CSF Date(s)
		Pathway: External (Radiation)	Planning Table 6.4 (Cancer Toxicity Data - Radiation)	
		COC	Chemicals of Concern from Planning Table 6.4 (site specific definition)	Chemical of Potential Concern
		Cancer Slope or Conversion Factor	Planning Table 6.4	Cancer Slope Factor Value
		Exposure Route	Planning Table 1	Exposure Route
		Units	Planning Table 6.4	Cancer Slope Factor Units
		Weight of Evidence/ Cancer Guideline Description	Not Available	Not Available
		Source	Planning Table 6.4	Source(s)
		Date	Planning Table 6.4	Date(s)

Note:
-A version of ROD Highlight 6-16A is to be prepared for the Chemicals of Concern. This definition will be site specific.

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS (continued)

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-16B	Non-Cancer Toxicity Data Summary	Pathway: Ingestion, Dermal	Planning Table 5.1 (Non-Cancer Toxicity Data - Oral/Dermal)	
		Chemical of Concern	Chemicals of Concern from Planning Table 5.1 (site specific definition)	Chemical of Potential Concern
		Chronic/ Subchronic	Planning Table 5.1	Chronic/Subchronic
		Oral RfD Value	Planning Table 5.1	Oral RfD Value
		Oral RfD Units	Planning Table 5.1	Oral RfD Units
		Dermal RfD	Planning Table 5.1	Absorbed RfD for Dermal Value
		Dermal RfD Units	Planning Table 5.1	Absorbed RfD for Dermal Units
		Primary Target Organ	Planning Table 5.1	Primary Target Organ(s)
		Combined Uncertainty/ Modifying Factors	Planning Table 5.1	Combined Uncertainty/ Modifying Factors
		Sources of RfD:Target Organ	Planning Table 5.1	RfD:Target Organ(s) Source(s)
		Dates of RfD:Target Organ	Planning Table 5.1	RfD:Target Organ(s) Date(s)
		Pathway: Inhalation	Planning Table 5.2 (Non-Cancer Toxicity Data - Inhalation)	
		Chemical of Concern	Chemicals of Concern from Planning Table 5.2 (site specific definition)	Chemical of Potential Concern

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS (continued)

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-16B (continued)	Non-Cancer Toxicity Data Summary (continued)	Chronic/ Subchronic	Planning Table 5.2	Chronic/ Subchronic
		Inhalation RfC	Planning Table 5.2	Inhalation RfC Value
		Inhalation RfC Units	Planning Table 5.2	Inhalation RfC Units
		Inhalation RfD	Planning Table 5.2	Extrapolated RfD Value
		Inhalation RfD Units	Planning Table 5.2	Extrapolated RfD Units
		Primary Target Organ	Planning Table 5.2	Primary Target Organ(s)
		Combined Uncertainty/ Modifying Factors	Planning Table 5.2	Combined Uncertainty/ Modifying Factors
		Sources of RfC:RfD: Target Organ	Planning Table 5.2	RfC:Target Organ(s) Source(s)
		Dates	Planning Table 5.2	RfC:Target Organ(s) Date(s)

Notes:
-A version of ROD Highlight 6-16B is to be prepared for the Chemicals of Concern. This definition will be site specific.

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS (continued)

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-18A	Risk Characterization Summary - Carcinogens	Scenario Timeframe	Planning Table 9 or 10	Scenario Timeframe
		Receptor Population	Planning Table 9 or 10	Receptor Population
		Receptor Age	Planning Table 9 or 10	Receptor Age
		Medium	Planning Table 9 or 10	Medium
		Exposure Medium	Planning Table 9 or 10	Exposure Medium
		Exposure Point	Planning Table 9 or 10	Exposure Point
		Chemical of Concern	Chemicals of Concern from Planning Table 9 or 10 (site specific definition)	Chemical
		Carcinogenic Risk–Ingestion	Planning Table 9 or 10	Carcinogenic Risk–Ingestion
		Carcinogenic Risk–Inhalation	Planning Table 9 or 10	Carcinogenic Risk–Inhalation
		Carcinogenic Risk–Dermal	Planning Table 9 or 10	Carcinogenic Risk–Dermal
		Carcinogenic Risk–External (Radiation)	Planning Table 9 or 10	Carcinogenic Risk–External (Radiation)
		Carcinogenic Risk Exposure Routes Total	Planning Table 9 or 10	Carcinogenic Risk - Exposure Routes Total
		Medium Risk Total	Planning Table 9 or 10	Medium Total (Risk)
		Total Risk	Planning Table 9 or 10	Receptor Risk Total

Notes:
-A version of Highlight 6-18A is to be prepared for each Receptor (combination of Scenario Timeframe, Receptor Population, and Receptor Age) with "Significant Exposure". The definition of "Significant Exposure" will be site specific.

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS (continued)

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-18B	Risk Characterization Summary - Non-Carcinogens	Scenario Timeframe	Planning Table 9 or 10	Scenario Timeframe
		Receptor Population	Planning Table 9 or 10	Receptor Population
		Receptor Age	Planning Table 9 or 10	Receptor Age
		Medium	Planning Table 9 or 10	Medium
		Exposure Medium	Planning Table 9 or 10	Exposure Medium
		Exposure Point	Planning Table 9 or 10	Exposure Point
		Chemical of Concern	Chemicals of Concern from Planning Table 9 or 10 (site specific definition)	Chemical
		Primary Target Organ	Planning Table 9 or 10	Non-Carcinogenic Hazard Quotient - Primary Target Organ(s)
		Non-Carcinogenic Hazard Quotient - Ingestion	Planning Table 9 or 10	Non-Carcinogenic Hazard Quotient - Ingestion
		Non-Carcinogenic Hazard Quotient - Inhalation	Planning Table 9 or 10	Non-Carcinogenic Hazard Quotient - Inhalation
		Non-Carcinogenic Hazard Quotient - Dermal	Planning Table 9 or 10	Non-Carcinogenic Hazard Quotient - Dermal
		Non-Carcinogenic Hazard Quotient - Exposure Routes Total	Planning Table 9 or 10	Non-Carcinogenic Hazard Quotient - Exposuse Routes Total

EXHIBIT 3-4

RAGS PART D INFORMATION SOURCES FOR ROD RISK GUIDANCE HIGHLIGHTS (continued)

ROD RISK HIGHLIGHT	PURPOSE OF ROD RISK HIGHLIGHT	ROD FIELDS	ASSOCIATED RAGS D TABLE	ASSOCIATED RAGS D FIELDS
Highlight 6-18B (continued)	Risk Characterization Summary - Non-Carcinogens (continued)	Medium Hazard Index Total	Planning Table 9 or 10	Medium Total (Hazard)
		Receptor Hazard Index	Planning Table 9 or 10	Receptor HI Total
		Organ Hazard Index	Planning Table 9 or 10	Total Organ HI Across All Media

Notes:
-A version of Highlight 6-18B is to be prepared for each Receptor (combination of Scenario Timeframe, Receptor Population, and Receptor Age) with "Significant Exposure". The definition of "Significant Exposure" will be site specific.

CHAPTER 4

RISK EVALUATIONS DURING THE FEASIBILITY STUDY

Continuous involvement of the EPA risk assessor during the FS has numerous the benefits including: 1) supporting the development of remedial action objectives (RAOs) and PRGs, 2) identifying risks and hazards associated with PRGS, and 3) supporting comparison of risks associated with various remedial alternatives. For these reasons, EPA risk assessor involvement in FS preparation and review is strongly encouraged.

4.1 INTRODUCTION

The purpose of the FS generally is to evaluate waste management remedial alternatives. The *National Oil and Hazardous Substances Pollution Contingency Plan (NCP)* (U.S. EPA, 1990c) provides that a detailed analysis should be performed. The NCP indicates that for screening of remedial alternatives, the long-term and short-term aspects of three criteria - effectiveness, implementability, and cost - should be used to guide the development and screening of remedial alternatives. Consideration of effectiveness involves evaluating the long-term and short-term human health risks. Long-term risks associated with a remedial alternative are those risks that will remain after the remedy is complete; short-term risks associated with a remedial alternative are generally those risks that occur during implementation of the remedial alternative.

Evaluating long-term risks ideally includes an assessment of the risks associated with treatment of residuals and untreated wastes for a treatment-based remedy, or an evaluation of the remedy's ability to provide protectiveness over time for a containment-based remedy. For short-term human health risks associated with a remedial alternative, a risk assessor may need to evaluate the risks that occur during implementation of the remedial alternative (e.g., risks associated with emissions from an onsite air stripper). Because some remedies may take many years to complete, some "short-term" risks may actually occur over a period of many years. Populations that may be exposed to chemicals during remedy implementation include people who live and work in the vicinity of the site.

The NCP also provides that RAOs and remediation goals should be developed. These serve as objectives and goals that can be used to identify and assess remedial alternatives at Superfund sites. The remainder of this chapter discusses RAOs and remediation goals. As also discussed in the NCP, final remediation goals are generally not determined until a final remedy for the site is selected in the ROD (see Chapter 5).

4.1.1 REMEDIAL ACTION OBJECTIVES

As discussed in the NCP, RAOs should describe, in general terms, what a remedial action should accomplish in order to be protective of human health and the environment. RAOs are typically narrative statements that specify the contaminants and environmental media of concern, the potential exposure pathways to be addressed by remedial actions, the exposed populations and environmental receptors to be protected, and the acceptable contaminant concentrations or concentration ranges (remediation goals) in each environmental medium.

4.1.2 REMEDIATION GOALS

Remediation goals are normally a subset of the RAOs. They generally provide the acceptable contaminant concentrations in each medium for remedial actions to meet.

As explained in the preamble to the final NCP that remediation goals are generally based on ARARs unless ARARs are not available or are not protective. ARARs do not always exist for all

SELECTION OF REMEDIATION GOALS

The NCP [U.S. EPA, 1990c; Section 300.430(e) (2)(I)] states that the selection of remediation goals should consider the following:

"...remediation goals shall establish acceptable exposure levels that are protective of human health and the environment and shall be developed considering the following...

ARARs under Federal environmental or State environmental or facility siting laws, if available, and the following factors:

1. For systemic toxicants, acceptable exposure levels shall represent concentration levels to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety;

2. For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure;

3. Factors related to technical limitations such as detection/quantification limits for contaminants;

4. Factors related to uncertainty; and

5. Other pertinent information."

chemicals and all environmental media.

Therefore, according to the NCP, there are two major sources for determining the acceptable exposure levels used for developing remediation goals: a) concentrations found in Federal and State ARARs and, if these are not available or not protective, (b) risk-based concentrations that are determined to be protective of human health and the environment. These risk-based concentrations should be calculated using, at a minimum, the criteria sited in numbers 1 and 2 in the Remediation Goals highlight box. Other factors mentioned in the highlight box [i.e., limits of detection (number 3), uncertainty (number 4), and background concentration levels (number 5)] also should be considered.

Risk-based concentrations may need to be developed even if ARARs are available to ensure that these ARARs are protective of human health and the environment.

ARAR-Based Remediation Goals. Potential chemical-specific ARARs include concentration limits set by Federal environmental regulations such as Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA), ambient water quality criteria established under the Clean Water Act (CWA), and State regulations (e.g., State drinking water laws). Action-specific and location-specific ARARs must also be complied with or waived according to the NCP.

Risk-Based Remediation Goals. In general, remediation goals based on risk-based calculations should be determined using cancer or non-cancer toxicity values with specific exposure assumptions. For chemicals with carcinogenic effects, the NCP has described the development of remediation goals, as a practical matter, as a two-step process [U.S. EPA, 1990c, Section 300.430(e)(2)(I)(D)]. A concentration equivalent to a lifetime cancer risk of 10^{-6} is first established as a point of departure. Then, other factors are taken into account to determine where within the acceptable range the remediation goals for a given contaminant at a specific site should be established.

The NCP discusses a generally acceptable risk range of 10^{-4} to 10^{-6}. EPA has further clarified the extent of the acceptable risk range by stating that the upper boundary generally is not a discrete line at $1x10^{-4}$. Risks slightly greater than $1x10^{-4}$ may be considered to be acceptable (i.e., protective) if justified based on site-specific conditions, including any uncertainties about the nature and extent of contamination and associated

risks. [See *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991d)].

For non-cancer effects, the NCP states that an acceptable exposure level should be defined. (See "Selection of Remediation Goals" highlight box in this section.) According to EPA guidance, generally if the Hazard Index (HI) (Intake/RfD) is above 1 (i.e., the site exposure is estimated to be above the RfD) there may be a concern for potential non-cancer effects [see *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions* (U.S. EPA, 1991d)]. Therefore, in calculating remediation goals at a site to protect for non-cancer effects, remediation goals are generally set at a Hazard Index at or below 1.

4.1.3 PRELIMINARY REMEDIATION GOALS

PRGs for a site are usually established as early in the RI/FS process as possible during project scoping (see Chapter 2). These initial PRGs can then be modified as necessary during the FS, based on site-specific information from the baseline risk assessment. The PRGs should then be used to establish the goals to be met by the remedial alternatives in the FS. The PRGs also should guide the development of the Proposed Plan for remedial action and the selection of remediation levels in the Record of Decision. During the FS, both risk-based and ARAR-based PRGs should be considered. (See Section 4.1.2 for more discussion on ARAR-based PRGs).

Risk-based PRGs (non-ARARs) may be modified within the acceptable risk range during the remedy selection process based on a balancing of the major trade-offs among the alternatives as well as the public and Agency comments on the Proposed Plan (RAGS Part B, U.S. EPA, 1991a). Such balancing among alternatives and consideration of community and State acceptance should establish the specific level of protection the remedy will achieve (i.e., the final remediation levels).

The dialogue begun during Scoping between the EPA risk assessor and the EPA RPM should continue during the FS and beyond to ensure that risk assessment information is used appropriately in the risk management decision process.

The primary guidance on development of the FS is available in *"Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (U.S. EPA, 1988). RAGS Part B (U.S. EPA, 1991a) also presents guidance for the role of risk assessment in the FS. Consult the EPA RPM for guidance.

4.2 DEVELOP REMEDIAL ACTION OBJECTIVES

The risk assessor should be involved in the preparation or review of the following:

- A narrative description of the Medium, Exposure Point and Exposure Routes, and chemicals and radionuclides that will be the focus of the remedial action

- A narrative identifying the remedial action objectives for prevention of exposure and restoration, where appropriate of each contaminated Medium (e.g., restoring groundwater to a potable water source)

A format such as Example Table 1 in Exhibit 4-1 may be a useful approach to present these data for each Medium.

4.3 DEVELOP REMEDIATION GOALS

The risk assessor should be involved in the preparation or review of a short narrative or tables which provide the goals of the remediation. First, all values considered as PRGs should be identified. Then the PRGs selected for each chemical to be used in the FS should be presented.

4.3.1 IDENTIFY VALUES CONSIDERED AS PRELIMINARY REMEDIATION GOALS

The risk assessor should be involved in the following activities:

- Identify which chemicals and/or radionuclides will have PRGs developed.

- Identify ARAR-based PRGs and associated

risks/hazards.

- If ARAR-based PRGs are not protective, risk-based PRGs using EPA methods should be calculated.

- Identify other values to consider as PRGs [e.g., background, detection limits, Procedure Quantitation Limits (PQLs)].

A format such as Example Table 2 in Exhibit 4-1 may be a useful approach to present these values, for each Medium and Receptor Population combination.

4.3.2 SELECT PRELIMINARY REMEDIATION GOALS

The risk assessor should be involved in the following activities:

- Select PRG(s) for each chemical from among the values considered (e.g., risk-based for cancer and non-cancer, ARAR-based, other), modifying values as appropriate. Note that the PRG should be ARAR-based unless there is no ARAR available or the ARAR is not protective.

- Provide the rationale for the selected PRG. Include the source of the value.

A format such as Example Table 3 in Exhibit 4-1 may be a useful approach to present these values for each Medium and Receptor Population combination.

4.4 SUMMARIZE RISKS AND HAZARDS ASSOCIATED WITH PRELIMINARY REMEDIATION GOALS

The risk assessor should be involved in the preparation or review of a short narrative or tables which summarize the risks and hazards associated with the PRGs. The risk assessor should be involved in the following activities:

- Identify the chemical and/or radionuclide of concern, maximum concentration, PRG, basis of PRG, and calculated risks and hazards associated with the PRG for each Medium and Receptor Population.

- Summarize the total risk and total hazard among all chemicals for each Medium and Receptor Population combination.

A format such as Example Table 3 in Exhibit 4-1 may be a useful approach to present these values for each Medium and Receptor Population combination.

4.5 EVALUATE REMEDIAL TECHNOLOGIES AND ALTERNATIVES FOR RISK CONSIDERATIONS

The risk assessor may provide input in the process of evaluating remedial technologies and alternatives for risk considerations beginning in the development and screening stage of the FS and extending into the detailed analysis stage. The major goal for the risk evaluation during these steps is to provide the FS team and the EPA RPM with specific long-term and short-term human health risk information to consider when identifying and screening technologies and alternatives and performing detailed analysis of alternatives.

Generally, the long-term human health risks associated with a remedial technology or alternative are those risks that are expected to remain after the remedy is complete (i.e., residual risks). The risk issues to be considered may include an assessment of the risks associated with treatment residuals, untreated wastes, or contained wastes.

Generally, the short-term human health risks associated with a remedial technology or alternative are those risks that are expected to occur during implementation of the technology or alternative, which may occur over a period of years. Populations to be considered include people who live and work in the vicinity of the site and workers involved in site remediation.

4.5.1 IDENTIFICATION AND

SCREENING OF TECHNOLOGIES AND ALTERNATIVES

The risk assessor may contribute to the identification and screening of technologies and alternatives and focus on evaluating associated short-term and long-term human health risks to ensure that they meet RAOs and PRGs. The goal of the risk assessor is to assist in identifying, and eliminating from further consideration, technologies and/or alternatives with clearly unacceptable risks. This evaluation is typically qualitative, based on simplifying assumptions and professional judgment rather than detailed analysis. The risk assessor's evaluation should be associated with the consideration of effectiveness, one of the NCP's three screening criteria. (Implementability and cost are the other two criteria evaluated at this screening stage, but they do not typically involve risk assessor participation.)

4.5.2 DETAILED ANALYSIS OF ALTERNATIVES

The overall objective of the risk assessor's role in the detailed analysis of alternatives is to support the preparation and evaluation of the risk information needed for RPMs to select a remedial alternative for a site. See the highlight box for the NCP's nine remedial alternatives. The risk assessor should contribute to the analysis of at least three of the nine criteria specified by the NCP:

- Overall Protection of Human Health and the Environment
- Long-term Effectiveness and Permanence
- Short-term Effectiveness.

The detailed analysis of short-term and long-term risks may be qualitative or quantitative depending on the "perceived risk" associated with the alternative based on both professional judgment and community concerns. The risk analysis should follow the same general steps as the baseline risk assessment; however, the steps

will typically not be conducted in the same level of detail for the FS.

NCP CRITERIA FOR EVALUATING REMEDIAL ALTERNATIVES

1. Overall Protection of Human Health and Environment
2. Compliance with ARARs
3. Long-term Effectiveness and Permanence
4. Reductions in Toxicity, Mobility, and Volume Through Treatment
5. Short-term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance.

The detailed analysis of short-term risks should include the following components for each alternative:

- Evaluate short-term exposure
- Evaluate short-term toxicity
- Characterize short-term risks to the community (including people who live or work on or near the site)
- Characterize short-term risks to remediation workers (a qualitative assessment may be appropriate if the risks to remediation workers are addressed adequately in the site-specific Health and Safety Plan).

The detailed analysis of long-term risks includes the following components for each alternative.

- Evaluate residual risk
- Evaluate protectiveness over time.

EXHIBIT 4-1
EXAMPLE TABLES TO STANDARDIZE REPORTING OF FS RISK EVALUATIONS

Example Table 1
REMEDIAL ACTION OBJECTIVES

Medium:

Exposure Point	Chemical	Exposure Route	Receptor Population	Remedial Action Objectives

Example Table 2
VALUES CONSIDERED AS PRGs

Medium:
Receptor Population:

Chemical	Most Restrictive ARAR	Most Restrictive ARAR Source	Risk/Hazard at ARAR	Risk-Based PRG Cancer*	Risk-Based PRG Non-Cancer*	Other Value**	Other Value** Source

*Provide the associated risk and hazard levels in the footnotes.
**(e.g., detection limits, background)

Example Table 3
RISKS AND HAZARDS ASSOCIATED WITH PRGs

Medium:
Receptor Population:

Chemical	Site Concentration	PRG	Basis for PRG*	Risk at PRG: Cancer	Hazard at PRG: Non-Cancer	Target Endpoint
			Totals			

*TBC (Federal ARARs, State ARARs), Risk-based.
Background Concentrations, method detection limits

CHAPTER 5

RISK EVALUATIONS AFTER THE FEASIBILITY STUDY

After completion of the FS, EPA risk assessor involvement in risk evaluations should support the EPA RPM in ensuring that the remedy is protective. While these risk evaluations may not always require a significant level of quantitation, continuous involvement of EPA risk assessors is importantl to ensure consistency in risk evaluation and risk communication. Post-FS activities benefitting from EPA risk assessor involvement typically include the Proposed Plan, the Record of Decision (ROD), the Remedial Design/Remedial Action, and Five-Year Reviews.

5.1 RISK EVALUATION FOR THE PROPOSED PLAN

The Proposed Plan should include sufficient risk assessment information to support the basis for the proposed remedial action. EPA risk assessor support is recommended during the preparation of the Proposed Plan to ensure the consistency of risk information with the Baseline Risk Assessment Report and the FS Report. The level of detail in the Proposed Plan should be appropriate to the needs of the public. Additional EPA risk assessor support at this time may be qualitative or quantitative, typically focusing on refinement of previous analyses, based on newly developed information.

5.2 RISK EVALUATION ASSOCIATED WITH THE RECORD OF DECISION

EPA risk assessor involvement in preparation of the risk evaluation in the ROD is strongly recommended. A summary of the relevant information from the Baseline Risk Assessment Report should be presented in a mixture of text format and table format. In addition, the risks

(short-term and residual) associated with each alternative should be discussed.

5.2.1 BASELINE RISK SUMMARY IN THE RECORD OF DECISION

To support the preparation of the Record of Decision, the EPA risk assessor should prepare or review a summary of the Baseline Risk Assessment Report which supports the basis for the remedial action. The primary focus should be on those exposure pathways and chemicals of concern found to pose actual or potential threats to human health or the environment. Chemicals included in the risk assessment but determined not to contribute significantly to an unacceptable risk need not be included in the Risk Characterization Summary in the ROD (e.g., chemicals with risk levels less than $1x10^{-6}$ or HQ less than 0.1) unless they are needed to justify a No Action ROD.

Refer to *Interim Final Guidance on Preparing Superfund Decision Documents* (U.S. EPA, 1989b) and *Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (U.S. EPA, 1999a) for a recommended format for summarizing human health risk assessment information in the ROD.

Other risk information may also be included in the ROD depending upon the level of detail preferred. Information related to values used for intake calculations and non-cancer and cancer toxicity data and exposure point concentrations are summarized on Planning Tables 4, 5, 6, 7, and 8, which could be placed in appendices to the ROD. Section 3.3 provides recommended ROD Risk Worksheets that correspond to ROD guidance highlights 6-15, 6-16A, 6-16B, 6-18A and 6.18B. Preparation of these recommended

Worksheets previously, as interim deliverables (see Section 3.3), is strongly recommended

because it should greatly facilitates risk evaluation in the ROD. If these recommended Worksheets were not previously prepared, refer to Exhibit 3-4 for RAGS Part D Planning Table sources for this information.

5.2.2 RISKS ASSOCIATED WITH CLEANUP LEVELS IN THE RECORD OF DECISION

The ROD (except for no-action RODs) should describe how remedial alternatives will reduce risks by achieving cleanup levels through treatment or by eliminating exposures through engineering controls for the contaminated media.

In addition, the risk assessor should prepare/review the following information related to the selected alternative:

- Document short-term risks that may occur during remedy implementation
- Document risks that may remain after completion of the remedy (including residual risk from untreated waste remaining at the site)
- Evaluate the need for five-year reviews.

Refer to the ROD guidance (U.S. EPA, 1999a) for suggestions regarding presentation of risks associated with cleanup levels in the ROD.

5.3 RISK EVALUATION DURING REMEDIAL DESIGN AND REMEDIAL ACTION

The EPA risk assessor's role during remedial design and remedial action may be qualitative or quantitative depending on the site and phase of the project. During the remedial design, short-term and long-term risks may be assessed through refinement of previous analyses and identification of the need for engineering controls or other measures to mitigate risk.

During the remedial action, the EPA risk assessor is more likely to provide quantitative risk evaluation support. Short-term risk evaluation may address impacts to remediation workers and neighboring communities.
Long-term risk evaluations typically focus on the following:

- Whether cleanup levels specified in the ROD have been attained
- Whether residual risk after completion of the remedy ensures protectiveness.

5.4 RISK EVALUATION ASSOCIATED WITH EXPLANATIONS OF SIGNIFICANT DIFFERENCES (ESDs) AND AMENDED RODs

This may occur when conditions relevant to a site change following the signing of a ROD. It is sometimes necessary to prepare an ESD or amended ROD. Examples of conditions causing this situation may include, but are not limited to, the following:

- Toxicity values change
- Additional technology performance information becomes available
- ARARs change (e.g., Land Disposal Restrictions).

EPA risk assessor involvement with RPM evaluations of ESDs and Amended RODs should focuses on evaluating: whether cleanup levels are still protective when considering new ARARs; new parameters for risk and hazard calculations; new technology information; and, other new information. Any new information and revised risk evaluations should be thoroughly documented.

5.5 RISK EVALUATION DURING FIVE-YEAR REVIEWS

CERCLA provides for reviews of certain remedies at least every five years to assure that human health and the environment are being protected by the remedial alternative implemented. EPA risk assessor involvement with RPM evaluations during Five-Year Reviews are generally quantitative and should focus on the following three goals:

- Confirm that the remedy remains protective (including any engineering or institutional controls)

- Evaluate whether cleanup levels are still protective by considering new ARARs, new parameters for risk and hazard calculations, and other new information
- Evaluate whether cleanup has reduced risks to levels no longer requiring restricted site use and five-year reviews (U.S. EPA, 2001b).

REFERENCES*

U.S. EPA. 1986. "Risk Assessment Guidelines for Mutagenicity Risk Assessment." 51 *Federal Register,* Page 34006, September 24, 1986.

U.S. EPA. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under* CERCLA, Interim Final. Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/G-89/004. OSWER Directive 9355.3-01.

U.S. EPA. 1989a. *Exposure Factors Handbook*. Office of Research and Development, Washington, DC. EPA/600/8-89/043.

U.S. EPA. 1989b. *Interim Final Guidance on Preparing Superfund Decision Documents.* Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9355.3-02.

U.S. EPA. 1989c. *Risk Assessment Guidance for Superfund* (RAGS): *Volume I - Human Health Evaluation Manual* (HHEM) *(Part A, Baseline Risk Assessment).* Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-89/002. NTIS PB90-155581.

U.S. EPA. 1990a. *Guidance for Data Useability in Risk Assessment (Part A), Final.* Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-09A. PB92-963356.

U.S. EPA. 1990b. *Guidance for Data Useability in Risk Assessment (Part B), Final.* Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-09B. PB92-963362.

U.S. EPA. 1990c. "National Oil and Hazardous Substances Pollution Contingency Plan." 40 CFR 300.

U.S. EPA. 1991a. *Risk Assessment Guidance for Superfund* (RAGS): *Volume I - Human Health Evaluation Manual* (HHEM) *(Part B, Development of Risk-Based Preliminary Remediation Goals).* Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-92/003. OSWER Directive 9285.7-01B. NTIS PB92-963333.

U.S. EPA. 1991b. *Risk Assessment Guidance for Superfund* (RAGS) *Volume I: Human Health Evaluation Manual* (HHEM) (*Part C, Risk Evaluation of Remedial Alternatives).* Interim. Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-92/004. OSWER Directive 9285.7-01C. NTIS PB92-963334.

U.S. EPA. 1991c. *Risk Assessment Guidance for Superfund (RAGS): Volume I - Human Health Evaluation Manual Supplemental Guidance: "Standard Default Exposure Factors."* Interim Final. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.6-03.

U.S. EPA. 1991d. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions.* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9355.0-30.

U.S. EPA. 1992a. *Data Quality Objectives Process for Superfund, Interim Final Guidance.* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9355.9-01. EPA/540/R-93/071.

REFERENCES* (Continued)

U.S. EPA. 1992b. *Dermal Exposure Assessment: Principles and Applications.* Office of Health and Environmental Assessment, Washington, DC. EPA/600/8-91/011B.

U.S. EPA. 1992c. *Human Health Evaluation Manual: Supplemental Guidance: Interim Dermal Risk Assessment Guidance*. OSWER Directive 9285.7-10.

U.S. EPA. 1992d. *Final Guidance on Data Useability in Risk Assessment (Part A).* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-09A.

U.S. EPA. 1992e. *Final Guidance on Data Useability in Risk Assessment (Part B).* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-09B.

U.S. EPA. 1992f. *Supplemental Guidance to RAGS: Calculating the Concentration Term.* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-081.

U.S. EPA. 1993a. *Guidance for Conducting Non-Time Critical Removal Actions Under CERCLA.* Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/R-93/057.

U.S. EPA. 1993b. *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons.* Office of Research and Development, Washington, DC. EPA/600/R-93/C89.

U.S. EPA. 1993c. *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9355.4-12.

U.S. EPA. 1995a. *EPA Risk Characterization Program.* Memorandum from Administrator Carol Browner. Office of the Administrator, Washington, DC. March 21, 1995.

U.S. EPA. 1995b. *Memorandum from Carol Browner on Risk Characterization.* Office of the Administrator, Washington, DC. February 22, 1995.

U.S. EPA. 1995c. *Soil Screening Guidance: Technical Background Document.* Office of Solid Waste and Emergency Response, Washington, DC. EPA 540/R-95/126.

U.S. EPA. 1996a. *Exposure Factors Handbook - SAB Review Document.* Office of Health and Environmental Assessment, Washington, D.C.

U.S. EPA. 1996b. *Final Soil Screening Guidance, May 17, 1996. Soil Screening Guidance User's Guide.* Office of Solid Waste and Emergency Response, Washington, DC. EPA 540/R-96/018.

U.S. EPA. 1996c. *PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures.* Office of Research and Development, Washington, DC. EPA/600/P-96/001A.

U.S. EPA. 1996d. *Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil.* Office of Solid Waste and Emergency Response, Washington, DC.

U.S. EPA. 1997a. *EPA Guidance for Data Assessment.* Office of Research and Development, Washington, DC. EPA/600/R-96/084.

REFERENCES* (Continued)

U.S. EPA. 1997b. *Exposure Factors Handbook, Volume 1.* Office of Research and Development, Washington, DC. EPA/600/P-95/002Fa.

U.S. EPA. 1997c. *Exposure Factors Handbook, Volume 2.* Office of Research and Development, Washington, DC. EPA/600/P-95/002Fb.

U.S. EPA. 1997d. *Exposure Factors Handbook, Volume 3.* Office of Research and Development, Washington, DC. EPA/600/P-95/002Fc.

U.S. EPA. 1997e. *Guiding Principles for Monte Carlo Analysis*. Office of Research and Development, Washington, DC. EPA/630/R-97/001.

U.S. EPA. 1997f. *Health Effects Assessment Summary Tables (HEAST), Annual FY 1997.* Office of Solid Waste and Emergency Response, Washington, DC. EPA/540/R-97/036.

U.S. EPA. 1997g. *Policy for Use of Probabilistic Analysis in Risk Assessment.* Office of Research and Development, Washington, DC. EPA/630/R-97/001.

U.S. EPA. 1997h. Integrated Risk Information System (IRIS) Data Base. Office of Research and Development/National Center for Environmental Assessment. Also see www.epa.gov/.iris/prototype/index.htm.

U.S. EPA. 1999a. *Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*. Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-98/031.

U.S. EPA. 2001a. *Risk Assessment Guidance for Superfund* (RAGS): *Volume I - Human Health Evaluation Manual* (HHEM) *(Part E, Supplemental Guidance for Dermal Risk Assessment) Interim Review Draft - For Public Comment.* Office of Emergency and Remedial Response, Washington, DC. EPA/540/R-99/005. OSWER Directive 9285.7-02EP.

U.S. EPA. 2001b. *Comprehensive Five-Year Review Guidance.* Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9355.7-03B-P.

U.S. EPA. 2001c. *Guidance for Characterizing Background Chemicals in Soil at Superfund Sites.* Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-41.

U.S. EPA. 2001d. *Risk Assessment Guidance for Superfund: Volume III - Part A, Process for Conducting Probabilistic Risk Assessments*. Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-45.

* This Reference Section is designed to not only give bibliographic information for documents referred to in the RAGS Part D text, but also to be a source of bibliographic information for documents that are relevant to risk assessment in general.

APPENDIX A

PLANNING TABLES

-Blank Planning Tables
-Example Planning Tables

Blank Planning Tables

The Planning Table formats may not be altered (i.e., columns may be added, deleted, or changed, and rows and footnotes may be added) as appropriate to reflect site-specific conditions.

Example Worksheets

Example Planning Tables

APPENDIX B

INSTRUCTIONS FOR COMPLETION OF THE PLANNING TABLES

– Instructions

–Glossary

Instructions

Glossary

APPENDIX C

PLANNING WORKSHEETS

- **Data Useability Worksheet**
- **TARA Schedule Worksheet**
- **Dermal Worksheet**
- **Radiation Dose Assessment Worksheet**
- **Lead Worksheets**
- **ROD Risk Worksheets**

BLANK PLANNING WORKSHEETS

–Data Useability Worksheet
–TARA Schedule Worksheet
–Dermal Worksheet
–Radiation Dose Assessment Worksheet
–Lead Worksheets
–ROD Risk Worksheets

EXAMPLE PLANNING WORKSHEETS

–Data Useability Worksheet
–TARA Schedule Worksheet
–Dermal Worksheet
–Radiation Dose Assessment Worksheet (not included)
–Lead Worksheets
–ROD Risk Worksheets (not included)

APPENDIX D

EXAMPLE SCENARIOS

TABLE 0

SITE RISK ASSESSMENT IDENTIFICATION INFORMATION

The Dean Company

Site Name/OU: The Dean Company
Region: III
EPA ID Number: PAD123456789
State: PA
Status: Fund Lead Remedial Investigation
Federal Facility (Y/N): N
EPA Project Manager: John Smith
EPA Risk Assessor: Jane Doe
Prepared by (Organization): Eris Consulting Engineers
Prepared for (Organization): EPA
Document Title: Human Health Risk Assessment for the Dean Company Site
Document Date: August 8, 2001
Probabilistic Risk Assessment (Y/N): N
Comments: This site is contaminated with volatile organic compounds, pesticides, and metals. Lead evaluation was conducted.

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site Name

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Aquifer 1 - Tap Water	117817	Bis(2-ethylhexyl)phthalate	2 J	5 J	ug/l	GW3D	4 / 12	3 - 4	5	NA	4.8 C	6	MCL	Y	ASL
	67663	Chloroform	0.6 J	9	ug/l	GW3D	3 / 12	1 - 1	9	NA	0.063 C	100	MCL	Y	ASL
	75150	Carbon Disulfide	0.3 J	4.5	ug/l	GW3D	3 / 12	1 - 1	4.5	NA	100 N	NA	NA	N	BSL
	76448	Heptachlor	2 J	33 J	ug/l	GW4D	6 / 12	0.01 - 0.01	33	NA	0.015 C	0.4	MCL	Y	ASL
	108883	Toluene	0.1 J	0.2 J	ug/l	GW3D	3 / 12	1 - 1	0.2	NA	75 N	1000	MCL	N	BSL
	7429905	Aluminum	134 J	1340	ug/l	GW3D	2 / 12	29 - 38.2	1340	NA	3700 N	50 - 200	SMCL	N	BSL
	7440393	Barium	65 J	489	ug/l	GW1D	6 / 12	0.2 - 1	489	NA	260 N	2000	MCL	Y	ASL
	7440417	Beryllium	0.2 K	1.5 K	ug/l	GW2D	3 / 12	0.1 - 1	1.5	NA	7.3 N	4	MCL	N	BSL
	7439921	Lead	6 J	35 J	ug/l	GW3D	4 / 12	0.1 - 1	35	NA	15	15	MCL	Y	ASL
	7439965	Manganese	1900	12500	ug/l	GW1D	6 / 12	0.3 - 1	12500	NA	73 N	50	SMCL	Y	ASL
	7440020	Nickel	0.9 J	1.5 J	ug/l	GW4D	3 / 12	0.9 - 7	1.5	NA	73 N	NA	NA	N	BSL

(1) Maximum concentration used for screening.

(2) To date, no background study has been completed.

(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for tap water (cancer benchmark = 1E-06; HQ = 0.1). Lead was screened against the action level of 15 ug/l.

(4) Rationale Codes:

Selection Reason: Above Screening Level (ASL)

Deletion Reason: Below Screening Level (BSL)

Definitions: NA = Not Applicable
MCL = Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
K = Estimated Value - Biased High
C = Carcinogen
N = Noncarcinogen

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Water Vapors from Showerhead	117817	Bis(2-ethylhexyl)phthalate	2 J	5 J	ug/l	GW3D	4 / 12	3 - 4	5	NA	4.8 C	6	MCL	Y	ASL
	67663	Chloroform	0.6 J	9	ug/l	GW3D	3 / 12	1 - 1	9	NA	0.063 C	100	MCL	Y	ASL
	75150	Carbon Disulfide	0.3 J	4.5	ug/l	GW3D	3 / 12	1 - 1	4.5	NA	100 N	NA	NA	N	BSL
	76448	Heptachlor	2 J	33 J	ug/l	GW4D	6 / 12	0.01 - 0.01	33	NA	0.015 C	0.4	MCL	Y	ASL
	108883	Toluene	0.1 J	0.2 J	ug/l	GW3D	3 / 12	1 - 1	0.2	NA	75 N	1000	MCL	N	BSL
	7429905	Aluminum	134 J	1340	ug/l	GW3D	2 / 12	29 - 38.2	1340	NA	3700 N	50 - 200	SMCL	N	BSL
	7440393	Barium	65 J	489	ug/l	GW1D	6 / 12	0.2 - 1	489	NA	260 N	2000	MCL	Y	ASL
	7440417	Beryllium	0.2 K	1.5 K	ug/l	GW2D	3 / 12	0.1 - 1	1.5	NA	7.3 N	4	MCL	N	BSL
	7439921	Lead	6 J	35 J	ug/l	GW3D	4 / 12	0.1 - 1	35	NA	15	15	MCL	Y	ASL
	7439965	Manganese	1900	12500	ug/l	GW1D	6 / 12	0.3 - 1	12500	NA	73 N	50	SMCL	Y	ASL
	7440020	Nickel	0.9 J	1.5 J	ug/l	GW4D	3 / 12	0.9 - 7	1.5	NA	73 N	NA	NA	N	BSL

(1) Maximum concentration used for screening.

(2) To date, no background study has been completed.

(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for tap water (cancer benchmark = 1E-06; HQ = 0.1). Lead was screened against the action level of 15 ug/l.

(4) Rationale Codes:

Selection Reason: Above Screening Level (ASL)

Deletion Reason: Below Screening Level (BSL)

Definitions: NA = Not Applicable
MCL = Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
K = Estimated Value - Biased High
C = Carcinogen
N = Noncarcinogen

TABLE 2.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Soil at Site 1	11096825	Aroclor-1260	15 J	110 J	ug/kg	SS03	6 / 29	33 - 300	110	NA	320 C	NA	NA	N	BSL
	56553	Benzo(a)anthracene	120 J	230 J	ug/kg	SS03	16 / 29	330 - 700	230	NA	870 C	NA	NA	N	BSL
	50328	Benzo(a)pyrene	48 J	70 J	ug/kg	SS03	17 / 29	30 - 70	70	NA	87 C	NA	NA	N	BSL
	75150	Carbon Disulfide	2 J	33	ug/kg	SB07	4 / 29	10 - 16	33	NA	780000 N	NA	NA	N	BSL
	72548	4,4'-DDD	1 J	4200	ug/kg	SS09	22 / 29	3.3 - 1900	4200	NA	2700 C	NA	NA	Y	ASL
	72559	4,4'-DDE	0.44 J	7200 J	ug/kg	SS09	28 / 29	2.2 - 700	7200	NA	1900 C	NA	NA	Y	ASL
	50293	4,4'-DDT	0.69 J	290000 J	ug/kg	SB08	29 / 29	3.3 - 700	290000	NA	1900 C	NA	NA	Y	ASL
	108883	Toluene	1 J	2 J	ug/kg	SS08	2 / 29	10 - 16	2	NA	1600000 N	NA	NA	N	BSL
	7429905	Aluminum	1960	21700	mg/kg	SB07	29 / 29	6.3 - 11	21700	NA	7800 N	NA	NA	Y	ASL
	7440417	Beryllium	0.1 J	13.4	mg/kg	SS06	23 / 29	0.02 - 0.21	13.4	NA	16 N	NA	NA	N	BSL
	7439921	Lead	56 J	750 J	mg/kg	SS03	16 / 29	10 - 16	750	NA	400	NA	NA	Y	ASL
	7439965	Manganese	5.9	688	mg/kg	SS03	29 / 29	0.05 - 0.5	688	NA	160 N	NA	NA	Y	ASL
	7782492	Selenium	0.53 J	1	mg/kg	SS02	9 / 29	0.43 - 0.75	1	NA	39 N	NA	NA	N	BSL
Soil at Site 2	67641	Acetone	9 J	170	ug/kg	SB01	16 / 40	10 - 22	170	NA	780000 N	NA	NA	N	BSL
	56553	Benzo(a)anthracene	48 J	100 J	ug/kg	SS26	31 / 40	340 - 700	100	NA	870 C	NA	NA	N	BSL
	50328	Benzo(a)pyrene	47 J	60 J	ug/kg	SS26	29 / 40	34 - 70	60	NA	87 C	NA	NA	N	BSL
	75150	Carbon Disulfide	2 J	17 J	ug/kg	SB07	13 / 40	10 - 22	17	NA	780000 N	NA	NA	N	BSL
	72559	4,4'-DDE	0.14 J	4700 J	ug/kg	SS35	28 / 40	3.3 - 600	4700	NA	1900 C	NA	NA	Y	ASL
	50293	4,4'-DDT	0.11 J	3100 J	ug/kg	SS32	27 / 40	3.3 - 600	3100	NA	1900 C	NA	NA	Y	ASL
	84662	Diethylphthalate	30 J	170 J	ug/kg	SS12	10 / 40	340 - 3400	170	NA	6300000 N	NA	NA	N	BSL
	7440417	Beryllium	0.08 J	1.5 J	mg/kg	SB07	34 / 40	0.02 - 0.36	1.5	NA	16 N	NA	NA	N	BSL
	7440484	Cobalt	0.31 J	36	mg/kg	SB02	28 / 40	0.08 - 2.9	36	NA	160 N	NA	NA	N	BSL
	7440508	Copper	0.9 J	6470	mg/kg	SS01	26 / 40	0.17 - 2.2	6470	NA	310 N	NA	NA	Y	ASL
	7439896	Iron	371	120000	mg/kg	SS01	24 / 40	2.7 - 13.5	120000	NA	2300 N	NA	NA	Y	ASL
	7782492	Selenium	0.49 J	1.6 J	mg/kg	SS23	12 / 40	0.4 - 1.1	1.6	NA	39 N	NA	NA	N	BSL

(1) Maximum concentration used for screening.
(2) To date, no background study has been completed.
(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for residential soil (cancer benchmark = 1E-06; HQ = 0.1). Lead was screened against the U.S. EPA screening value of 400 mg/kg.
(4) Rationale Codes:
Selection Reason: Above Screening Level (ASL)
Deletion Reason: Below Screening Level (BSL)

Definitions: NA = Not Applicable
J = Estimated Value
C = Carcinogen
N = Noncarcinogen

TABLE 3.1.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	ug/l	4	5.5 (T)	5 J	5	ug/l	Max	W-Test (1)
	Chloroform	ug/l	1.9	14.9 (T)	9	9	ug/l	Max	W-Test (1)
	Heptachlor	ug/l	27	30 (T)	33 J	30	ug/l	95% UCL - T	W - Test (2)
	Barium	ug/l	224	2835 (T)	489	489	ug/l	Max	W-Test (1)
	Lead	ug/l	21	32 (T)	35 J	32	ug/l	95% UCL - T	W - Test (2)
	Manganese	ug/l	6052	33449 (T)	12500	12500	ug/l	Max	W-Test (1)

Statistics: Maximum Detected Value (Max); 95% UCL of Transformed Data (95% UCL - T)

T = Transformed

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

J = Estimated Value

(2) Shapiro-Wilk W Test indicates data are log-normally distributed.

TABLE 3.2.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Water Vapors from Showerhead	Bis(2-ethylhexyl)phthalate	ug/l	4	5.5 (T)	5 J	5	ug/l	Max	W-Test (1)
	Chloroform	ug/l	1.9	14.9 (T)	9	9	ug/l	Max	W-Test (1)
	Heptachlor	ug/l	27	30 (T)	33 J	30	ug/l	95% UCL - T	W - Test (2)

Statistics: Maximum Detected Value (Max); 95% UCL of Transformed Data (95% UCL - T)

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(2) Shapiro-Wilk W Test indicates data are log-normally distributed.

T = Transformed

J = Estimated Value

TABLE 3.3.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Soil at Site 1	4,4'-DDD	ug/kg	239	452 (T)	4200	452	ug/kg	95 % UCL -T	W - Test (2)
	4,4'-DDE	ug/kg	596	6793 (T)	7200 J	6793	ug/kg	95% UCL - T	W - Test (2)
	4,4'-DDT	ug/kg	11007	28619 (N)	290000 J	28619	ug/kg	95% UCL - N	W - Test (1)
	Aluminum	mg/kg	7450	9964 (T)	21700	9964	mg/kg	95% UCL - T	W - Test (2)
	Lead	mg/kg	210	345 (T)	750 J	345	mg/kg	95% UCL - T	W - Test (2)
	Manganese	mg/kg	116	201 (T)	688	201	mg/kg	95% UCL - T	W - Test (2)
Soil at Site 2	4,4'-DDE	ug/kg	230	496	4700 J	496	ug/kg	95 % UCL - T	W - Test (2)
	4,4'-DDT	ug/kg	183	322 (T)	3100 J	322	ug/kg	95% UCL - T	W - Test (2)
	Copper	mg/kg	173	245 (T)	6470	245	mg/kg	95% UCL - T	W - Test (2)
	Iron	mg/kg	19518	32230 (T)	120000	32230	mg/kg	95% UCL - T	W - Test (2)

Statistics: 95% UCL of Normal Data (95% UCL - N); 95% UCL of Transformed Data (95% UCL - T)

(1) Shapiro-Wilk W Test indicates data are normally distributed.

(2) Shapiro-Wilk W Test indicates data are log-normally distributed.

N = Normal

T = Transformed

J = Estimated Value

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg/day) =
				IR-W	Ingestion Rate of Water	2	l/day	EPA, 1991	CW x IR-W x EF x ED x 1/BW x 1/AT
				EF	Exposure frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989a	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989a	
		Child	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	CDI (mg/kg/day) =
				IR-W	Ingestion Rate of Water	1	l/day	EPA, 1989b	CW x IR-W x EF x ED x 1/BW x 1/AT
				EF	Exposure frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989a	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989a	
Dermal	Resident	Adult	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				FA	Fraction Absorbed Water	Chemical Specific		EPA, 2001	DA-event x EV x ED x EF x SA x 1/BW x 1/AT
				Kp	Permeability Constant	Chemical Specific	cm/hr	EPA, 2001	where for organic compounds,
				SA	Skin Surface Area	18,000	cm2	EPA, 2001	Absorbed Dose per Event (DA-event) (mg/cm2-event) =
				tau-event	Lag time per event	Chemical Specific	hours/event	EPA, 2001	2 FA x Kp x CW x CF x SQRT{(6 x tau-event x t-event)/pi}
				t-event	Event Duration	0.58	hours/event	EPA, 2001	or
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	Chemical Specific		EPA, 2001	DA-event = FA x Kp x CW x {(t-event/(1 + B)) + 2 x tau-event x ((1 + (3 x B) + (3 x B x B))/(1 + B)2)} and where for inorganic compounds, DA-event = Kp x CW x CF x t-event
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 1991	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident (continued	Adult (continued)	Aquifer 1 - Tap Water	CF	Volumetric Conversion Factor for Water	0.001	l/cm3		
				BW	Body Weight	70	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 2001	
		Child	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	DAD (mg/kg-day) =
				FA	Fraction Absorbed Water	Chemical Specific		EPA, 2001	DA-event x EV x ED x EF x SA x 1/BW x 1/AT
				Kp	Permeability Constant	Chemical Specific	cm/hr	EPA, 2001	where for organic compounds,
				SA	Skin Surface Area	6,600	cm2	EPA, 2001	DA-event (mg/cm2-event) =
				tau-event	Lag time per event	Chemical Specific	hours/event	EPA, 2001	2 FA x Kp x CW x CF x SQRT{(6 x tau-event x t-event)/pi}
				t-event	Event Duration	1	hours/event	EPA, 2001	or
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	Chemical Specific		EPA, 2001	DA-event = FA x Kp x CW x {(t-event/(1 + B)) + 2 x tau-event x ((1 + (3 x B) + (3 x B x B))/(1 + B)2)} and where for inorganic compounds, DA-event = Kp x CW x CF x t-event
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	6	years	EPA, 2001	
				CF	Volumetric Conversion Factor for Water	0.001	l/cm3		
				BW	Body Weight	15	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 2001	

EPA 1989a: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1989b: Exposure Factors Handbook, July 1989, EPA/600/8-89/043.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 1992: Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B.

EPA 1997: Exposure Factors Handbook, Volume 1. EPA/600/P-95/002Fa.

EPA 2001: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation (1)	Resident	Adult	Water Vapors from Showerhead	(1)	(1)	(1)	(1)	(1)	Foster and Chrostowski Model

(1) Refer to the Risk Assessment text for details on the modeled intake methodology and parameters used to calculate modeled intake values for the Foster and Chrostowski Shower Model.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
			Soil at Site 2	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion (continued)	Resident (continued)	Child (continued)	Soil at Site 2	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989	
Dermal	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	Dermal Absorbed Dose (DAD) (mg/kg-day) =
				CF	Conversion Factor	1E-06	kg/mg		DA-event x EF x ED x EV x SA X 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,700	cm2	EPA, 2001	where
				AF	Soil to Skin Adherence Factor	0.07	mg/cm2-event	EPA, 2001	Absorbed Dose per Event (DA-event) (mg/cm2-event) =
				ABS-d	Dermal Absorption Factor	chemical-specific	unitless	EPA, 2001	CS x CF x AF x ABS-d
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 2001	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident (continued)	Adult (continued)	Soil at Site 2	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	DAD (mg/kg-day) =
				CF	Conversion Factor	1E-06	kg/mg		DA-event x EF x ED x EV x SA X 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,700	cm2	EPA, 2001	where
				AF	Soil to Skin Adherence Factor	0.07	mg/cm2-event	EPA, 2001	DA-event (mg/cm2-event) =
				ABS-d	Dermal Absorption Factor	chemical-specific	unitless	EPA, 2001	CS x CF x AF x ABS-d
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 2001	
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	DAD (mg/kg-day) =
				CF	Conversion Factor	1E-06	kg/mg		DA-event x EF x ED x EV x SA X 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	2,800	cm2	EPA, 2001	where
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2-event	EPA, 2001	DA-event (mg/cm2-event) =
				ABS-d	Dermal Absorption Factor	chemical-specific	unitless	EPA, 2001	CS x CF x AF x ABS-d
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	6	years	EPA, 2001	
				BW	Body Weight	15	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 2001	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident (continued)	Child (continued)	Soil at Site 2	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	DAD (mg/kg-day) =
				CF	Conversion Factor	1E-06	kg/mg		DA-event x EF x ED x EV x SA X 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	2,800	cm2	EPA, 2001	where
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2-event	EPA, 2001	DA-event (mg/cm2-event) =
				ABS-d	Dermal Absorption Factor	chemical-specific	unitless	EPA, 2001	CS x CF x AF x ABS-d
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	6	years	EPA, 2001	
				BW	Body Weight	15	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 2001	

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 1995: Assessing Dermal Exposure from Soil, Technical Guidance Manual, Region III, EPA/903-K-95-003.

EPA 1997: Exposure Factors Handbook, Volume 1. EPA/600/P-95/002Fa.

EPA 2001: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

The Dean Company

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absoprtion Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	NA	NA	NA	1	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	1	NA	NA	NA	NA	NA	NA
4,4'-DDT	Chronic	5.0E-004	mg/kg/day	1	5.0E-004	mg/kg/day	Liver	100	IRIS	06/21/2001
4,4'-DDT	Subchronic	5.0E-004	mg/kg/day	1	5.0E-004	mg/kg/day	Liver	100	HEAST	07/01/1997
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000	IRIS	06/21/2001
Bis(2-ethylhexyl)phthalate	Subchronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000	HEAST	07/01/1997
Chloroform	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000	IRIS	06/21/2001
Chloroform	Subchronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000	HEAST	07/01/1997
Heptachlor	Chronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	300	IRIS	06/21/2001
Heptachlor	Subchronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	300	HEAST	07/01/1997
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	Central Nervous System	100	NCEA	06/21/2001
Barium	Chronic	7.0E-02	mg/kg/day	0.07	4.9E-03	mg/kg/day	Heart	3	IRIS	02/02/2001
Barium	Subchronic	7.0E-02	mg/kg/day	0.07	4.9E-03	mg/kg/day	Heart	3	HEAST	07/01/1997
Copper	Chronic	3.7E-02	mg/kg/day	1	3.7E-02	mg/kg/day	Gastrointestinal	NA	HEAST	07/01/1997
Copper	Subchronic	3.7E-02	mg/kg/day	1	3.7E-02	mg/kg/day	Gastrointestinal	NA	HEAST	07/01/1997
Iron	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	Gastrointestinal	1	NCEA	06/21/2001
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	Chronic	2.0E-02	mg/kg/day	0.04	8.0E-04	mg/kg/day	Central Nervous System	1	IRIS	06/21/2001

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. Section 4.2 and Exhibit 4-1.

(2) See Risk Assessment text for the derivation of the "Absorbed RfD for Dermal".

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Table, July 1997

NCEA = National Center for Environmental Assessment

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

The Dean Company

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	Chronic	3.0E-04	mg/m3	8.6E-05	mg/kg/day	Nasal	1000	NCEA	06/21/2001
Chloroform	Subchronic	3.0E-03	mg/m3	8.6E-4	mg/kg/day	Nasal	100	NCEA	06/21/2001
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	Chronic	5.0E-03	mg/m3	1.4E-03	mg/kg/day	Central Nervous System	300	NCEA	06/21/2001
Barium	Chronic	5.0E-04	mg/m3	1.4E-04	mg/kg/day	Fetus	1000	HEAST	07/01/1997
Barium	Subchronic	5.0E-03	mg/m3	1.4E-03	mg/kg/day	Fetus	100	HEAST	07/01/1997
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	Chronic	5.0E-05	mg/m3	1.4E-05	mg/kg/day	Central Nervous System	1000	IRIS	06/21/2001

(1) See Risk Assessment text for the derivation of the "Extrapolated RfD".

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Table, July 1997

NCEA = National Center for Environmental Assessment

TABLE 5.3

NON-CANCER TOXICITY DATA -- SPECIAL CASE CHEMICALS

The Dean Company

Chemical of Potential Concern	Chronic/ Subchronic	Parameter			Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	Parameter:Target Organ(s)	
		Name	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Not Applicable								

There are no special case chemicals in this risk assessment. As a result, the table is blank.

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

The Dean Company

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	2.4E-01	1/mg/kg/day	1	2.4E-01	1/mg/kg/day	B2	IRIS	06/21/2001
4,4'-DDE	3.4E-01	1/mg/kg/day	1	3.4E-01	1/mg/kg/day	B2	IRIS	06/21/2001
4,4'-DDT	3.4E-001	1/mg/kg/day	1	3.4E-001	1/mg/kg/day	B2	IRIS	06/21/2001
Bis(2-ethylhexyl)phthalate	1.4E-02	1/mg/kg/day	1	1.4E-02	1/mg/kg/day	B2	IRIS	06/21/2001
Chloroform	6.1E-03	1/mg/kg/day	1	6.1E-03	1/mg/kg/day	B2	IRIS	06/21/2001
Heptachlor	4.5E+00	1/mg/kg/day	1	4.5E+00	1/mg/kg/day	B2	IRIS	06/21/2001
Aluminum	NA	NA	1	NA	NA	NA	NA	NA
Barium	NA	NA	0.07	NA	NA	NA	NA	NA
Copper	NA	NA	1	NA	NA	NA	NA	NA
Iron	NA	NA	1	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	NA	NA	0.04	NA	NA	NA	NA	NA

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. Section 4.2 and Exhibit 4-1.

(2) See Risk Assessment text for the derivation of the "Absorbed Cancer Slope Factor for Dermal".

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

B2 = Probable Human Carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

The Dean Company

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA
4,4-DDE	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	9.7E-005	1/ug/m3	3.4E-001	1/mg/kg/day	B2	IRIS	06/21/2001
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA
Chloroform	2.3E-05	1/ug/m3	8.1E-02	1/mg/kg/day	B2	IRIS	06/21/2001
Heptachlor	1.3E-03	1/ug/m3	4.5E+00	1/mg/kg/day	B2	IRIS	06/21/2001
Aluminum	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

B2 = Probable Human Carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

TABLE 6.3

CANCER TOXICITY DATA -- SPECIAL CASE CHEMICALS

The Dean Company

Chemical of Potential Concern	Parameters			Source(s)	Date(s) (MM/DD/YYYY)
	Name	Value	Units		
	Not Applicable				

There are no special case chemicals in this risk assessment. As a result, this table is blank.

TABLE 6.4

CANCER TOXICITY DATA -- EXTERNAL (RADIATION)

The Dean Company

Chemical of Potential Concern	Cancer Slope Factor		Source(s)	Date(s) (MM/DD/YYYY)
	Value	Units		
Not Applicable				

There are no radionuclides in this risk assessment. As a result, this table is blank.

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Aquifer 1 - Tap Water	Ingestion	Bis(2-ethylhexyl)phthalate	0.005	mg/l	4.7E-05	mg/kg/day	1.4E-02	1/mg/kg/day	7E-07	1.4E-04	mg/kg/day	2.0E-02	mg/kg/day	0.007
				Chloroform	0.009	mg/l	8.5E-05	mg/kg/day	6.1E-03	1/mg/kg/day	5E-07	2.5E-04	mg/kg/day	1.0E-02	mg/kg/day	0.03
				Heptachlor	0.03	mg/l	2.8E-04	mg/kg/day	4.5E-00	1/mg/kg/day	1E-03	8.1E-04	mg/kg/day	5.0E-04	mg/kg/day	2
				Barium	0.489	mg/l	4.6E-03	mg/kg/day	NA	NA	NA	1.3E-02	mg/kg/day	7.0E-02	mg/kg/day	0.2
				Lead (1)												
				Manganese	12.5	mg/l	1.2E-01	mg/kg/day	NA	NA	NA	3.4E-01	mg/kg/day	2.0E-02	mg/kg/day	17
			Exp. Route Total								1E-03					19
			Dermal	Bis(2-ethylhexyl)phthalate	0.005	mg/l	7.2E-05	mg/kg/day	1.4E-02	1/mg/kg/day	1E-06	2.1E-04	mg/kg/day	2.2E-02	mg/kg/day	0.01
				Chloroform	0.009	mg/l	1.7E-04	mg/kg/day	6.1E-03	1/mg/kg/day	1E-06	4.9E-04	mg/kg/day	1.0E-02	mg/kg/day	0.05
				Heptachlor	0.03	mg/l	1.3E-04	mg/kg/day	4.5E-00	1/mg/kg/day	6E-04	3.9E-04	mg/kg/day	5.0E-04	mg/kg/day	0.8
				Barium	0.489	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	12.5	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								6E-04					0.9
		Exposure Point Total									2E-03					20
	Exposure Medium Total										2E-03					20
	Air	Water Vapors from	Inhalation	Bis(2-ethylhexyl)phthalate	0.005	mg/l	2.3E-06	mg/kg/day	NA	NA	NA	3.6E-06	mg/kg/day	NA	NA	NA
		Showerhead		Chloroform	0.009	mg/l	1.3E-04	mg/kg/day	8.1E-02	1/mg/kg/day	1E-05	3.9E-04	mg/kg/day	8.6E-05	mg/kg/day	5
				Heptachlor	0.03	mg/l	2.6E-04	mg/kg/day	4.5E-00	1/mg/kg/day	1E-03	7.7E-04	mg/kg/day	NA	NA	NA
			Exp. Route Total								1E-03					5
		Exposure Point Total									1E-03					5
	Exposure Medium Total										1E-03					5
Groundwater Total											3E-03					25
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	2.1E-07	mg/kg/day	2.4E-01	1/mg/kg/day	5E-08	6.2E-07	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	3.2E-06	mg/kg/day	3.4E-01	1/mg/kg/day	1E-06	9.3E-06	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.3E-05	mg/kg/day	3.4E-01	1/mg/kg/day	5E-06	3.9E-05	mg/kg/day	5.0E-04	mg/kg/day	0.08
				Aluminum	9964	mg/kg	4.7E-03	mg/kg/day	NA	NA	NA	1.4E-02	mg/kg/day	1.0E+00	mg/kg/day	0.01
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	9.5E-05	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	1.4E-01	mg/kg/day	0.002
			Exp. Route Total								6E-06					0.09
			Dermal	4,4'-DDD	0.452	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.6E-06	mg/kg/day	3.4E-01	1/mg/kg/day	5E-07	4.7E-06	mg/kg/day	5.0E-04	mg/kg/day	0.009
				Aluminum	9964	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								5E-07					0.009
		Exposure Point Total									7E-06					0.1

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil (continued)	Soil (continued)	Soil at Site 2	Ingestion	4,4'-DDE	0.496	mg/kg	2.3E-07	mg/kg/day	3.4E-01	1/mg/kg/day	8E-08	6.8E-07	mg/kg/day	NA	NA	NA
				4,4'-DDT	0.322	mg/kg	1.5E-07	mg/kg/day	3.4E-01	1/mg/kg/day	5E-08	4.4E-07	mg/kg/day	5.0E-04	mg/kg/day	0.0009
				Copper	245	mg/kg	1.2E-04	mg/kg/day	NA	NA	NA	3.4E-04	mg/kg/day	3.7E-02	mg/kg/day	0.009
				Iron	32230	mg/kg	1.5E-02	mg/kg/day	NA	NA	NA	4.4E-02	mg/kg/day	3.0E-01	mg/kg/day	0.1
			Exp. Route Total								1E-07					0.1
			Dermal	4,4'-DDE	0.496	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDT	0.322	mg/kg	1.8E-08	mg/kg/day	3.4E-01	1/mg/kg/day	6E-09	5.3E-08	mg/kg/day	5.0E-04	mg/kg/day	0.0001
				Copper	245	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	32230	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								6E-09					0.0001
		Exposure Point Total									1E-07					0.1
	Exposure Medium Total										7E-06					0.2
Soil Total											7E-06					0.2
										Total of Receptor Risks Across All Media	3E-03				Total of Receptor Hazards Across All Media	25

(1) Lead is evaluated for the resident using the IEUBK model. See Risk Assessment text for discussion of results and appendix for the lead modeling run results.

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Aquifer 1 - Tap Water	Ingestion	Bis(2-ethylhexyl)phthalate	0.005	mg/l	2.7E-05	mg/kg/day	1.4E-02	1/mg/kg/day	4E-07	3.2E-04	mg/kg/day	2.0E-02	mg/kg/day	0.02
				Chloroform	0.009	mg/l	4.9E-05	mg/kg/day	6.1E-03	1/mg/kg/day	3E-07	5.8E-04	mg/kg/day	1.0E-02	mg/kg/day	0.06
				Heptachlor	0.03	mg/l	1.6E-04	mg/kg/day	4.5E-00	1/mg/kg/day	7E-04	1.9E-03	mg/kg/day	5.0E-04	mg/kg/day	4
				Barium	0.489	mg/l	2.7E-03	mg/kg/day	NA	NA	NA	3.1E-02	mg/kg/day	7.0E-02	mg/kg/day	0.4
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	12.5	mg/l	6.8E-02	mg/kg/day	NA	NA	NA	8.0E-01	mg/kg/day	2.0E-02	mg/kg/day	40
			Exp. Route Total								7E-04					44
			Dermal	Bis(2-ethylhexyl)phthalate	0.005	mg/l	3.1E-05	mg/kg/day	1.4E-02	1/mg/kg/day	4E-07	3.6E-04	mg/kg/day	2.2E-02	mg/kg/day	0.02
				Chloroform	0.009	mg/l	7.2E-05	mg/kg/day	6.1E-03	1/mg/kg/day	4E-07	8.4E-04	mg/kg/day	1.0E-02	mg/kg/day	0.08
				Heptachlor	0.03	mg/l	5.7E-05	mg/kg/day	4.5E-00	1/mg/kg/day	3E-04	6.7E-04	mg/kg/day	5.0E-04	mg/kg/day	1
				Barium	0.489	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	12.5	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3E-04					1
		Exposure Point Total									1E-03					45
	Exposure Medium Total										1E-03					45
Groundwater Total											1E-03					45
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	5.0E-07	mg/kg/day	2.4E-01	1/mg/kg/day	1E-07	5.8E-06	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	7.4E-06	mg/kg/day	3.4E-01	1/mg/kg/day	3E-06	8.7E-05	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	3.1E-05	mg/kg/day	3.4E-01	1/mg/kg/day	1E-05	3.7E-04	mg/kg/day	5.0E-04	mg/kg/day	0.7
				Aluminum	9964	mg/kg	1.1E-02	mg/kg/day	NA	NA	NA	1.3E-01	mg/kg/day	1.0E-00	mg/kg/day	0.1
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	2.2E-04	mg/kg/day	NA	NA	NA	2.6E-03	mg/kg/day	1.4E-01	mg/kg/day	0.02
			Exp. Route Total								1E-05					0.8
			Dermal	4,4'-DDD	0.452	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	2.6E-06	mg/kg/day	3.4E-01	1/mg/kg/day	9E-07	3.1E-05	mg/kg/day	5.0E-04	mg/kg/day	0.06
				Aluminum	9964	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	NA	NA	NA	NA	NA	NA	NA	MA	NA	NA
			Exp. Route Total								9E-07					0.06
		Exposure Point Total									1E-05					0.9

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil (continued)	Soil (continued)	Soil at Site 2	Ingestion	4,4'-DDE	0.496	mg/kg	5.4E-07	mg/kg/day	3.4E-01	1/mg/kg/day	2E-07	6.3E-06	mg/kg/day	NA	NA	NA
				4,4'-DDT	0.322	mg/kg	3.5E-07	mg/kg/day	3.4E-01	1/mg/kg/day	1E-07	4.1E-06	mg/kg/day	5.0E-04	mg/kg/day	0.008
				Copper	245	mg/kg	2.7E-04	mg/kg/day	NA	NA	NA	3.1E-03	mg/kg/day	3.7E-02	mg/kg/day	0.08
				Iron	32230	mg/kg	3.5E-02	mg/kg/day	NA	NA	NA	4.1E-01	mg/kg/day	3.0E-01	mg/kg/day	1
			Exp. Route Total								3E-07					1
			Dermal	4,4'-DDE	0.496	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDT	0.322	mg/kg	3.0E-08	mg/kg/day	3.4E-04	1/mg/kg/day	1E-08	3.5E-007	mg/kg/day	5.0E-004	mg/kg/day	0.0007
				Copper	245	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	32230	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								1E-08					0.0007
		Exposure Point Total									3E-07					1
	Exposure Medium Total										1E-05					2
Soil Total											1E-05					2
									Total of Receptor Risks Across All Media		1E-03			Total of Receptor Hazards Across All Media		47

(1) Lead is evaluated for the resident using the IEUBK model. See Risk Assessment text for discussion of results and appendix for the lead modeling run results.

TABLE 8.1.RME

CALCULATION OF RADIATION CANCER RISKS

The Dean Company

Scenario Timeframe:	
Receptor Population:	
Receptor Age:	

Medium	Exposure Medium	Exposure Point	Exposure Route	Radionuclide of Potential Concern	EPC		Risk Calculation Approach	Cancer Risk Calculations				
					Value	Units		Intake/Activity		CSF		Cancer Risk
								Value	Units	Value	Units	
			Exp. Route Total									
			Exp. Route Total									
		Exposure Point Total										
				Not Applicable								
			Exp. Route Total									
		Exposure Point Total										
			Exp. Route Total									
			Exp. Route Total									
		Exposure Point Total										
												Total of Receptor Risks Across All Media

There are no radionuclides in this risk assessment. As a result, this table is blank.

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	7E-07		1E-06		2E-06	Liver	0.007		0.01	0.02
			Chloroform	5E-07		1E-06		2E-06	Liver	0.03		0.05	0.08
			Heptachlor	1E-03		6E-04		2E-03	Liver	2		0.8	3
			Barium						Heart	0.2			0.2
			Lead (1)										
			Manganese						Central Nervous System	17			17
			Chemical Total	1E-03		6E-04		2E-03		19		0.9	20
			Radionuclide Total										
		Exposure Point Total						2E-03					20
	Exposure Medium Total							2E-03					20
	Air	Water Vapors from	Bis(2-ethylhexyl)phthalate										
		Showerhead	Chloroform		1E-05			1E-05	Liver		5		5
			Heptachlor		1E-03			1E-03					
			Barium										
			Lead (1)										
			Manganese										
			Chemical Total		1E-03			1E-03			5		5
			Radionuclide Total										
		Exposure Point Total						1E-03					5
	Exposure Medium Total							1E-03					5
Groundwater Total								3E-03					25

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	5E-08				5E-08					
			4,4'-DDE	1E-06				1E-06					
			4,4'-DDT	5E-06		5E-07		6E-06	Liver	0.08		0.009	0.09
			Aluminum						Central Nervous System	0.01			0.01
			Lead (1)										
			Manganese						Central Nervous System	0.002			0.002
			Chemical Total	6E-06		5E-07		7E-06		0.09		0.009	0.1
			Radionuclide Total										
		Exposure Point Total						7E-06					0.1
		Soil at Site 2	4,4'-DDE	8E-08				8E-08					
			4,4'-DDT	5E-08		6E-09		6E-08	Liver	0.0009		0.0001	0.001
			Copper						Gastrointestinal	0.009			0.009
			Iron						Gastrointestinal	0.1			0.1
			Chemical Total	1E-07		6E-09		1E-07		0.1		0.0001	0.1
			Radionuclide Total										
		Exposure Point Total						1E-07					0.1
	Exposure Medium Total							7E-06					0.2
Soil Total								7E-06					0.2
Receptor Total								3E-03					26

Total Risk Across All Media = 3E-03

Total Hazard Across All Media 26

Total Liver HI Across All Media = 8

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

(1) Lead is evaluated for the resident using the IEUBK model. See Risk Assessment text for discussion of results and appendix for the lead modleing run results.

Total Central Nervous System HI Across All Media = 17

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	4E-07		4E-07		8E-07	Liver	0.02		0.02	0.04
			Chloroform	3E-07		4E-07		7E-07	Liver	0.06		0.08	0.1
			Heptachlor	7E-04		3E-04		1E-03	Liver	4		1	5
			Barium						Heart	0.4			0.4
			Lead (1)										
			Manganese						Central Nervous System	40			40
			Chemical Total	7E-04		3E-04		1E-03		44		1	45
			Radionuclide Total										
		Exposure Point Total						1E-03					45
	Exposure Medium Total							1E-03					45
Groundwater Total								1E-03					45
Soil	Soil	Soil at Site 1	4,4'-DDD	1E-07				1E-07					
			4,4'-DDE	3E-06				3E-06					
			4,4'-DDT	1E-05		9E-07		1E-05	Liver	0.7		0.06	0.8
			Aluminum						Central Nervous System	0.1			0.1
			Lead (1)										
			Manganese						Central Nervous System	0.02			0.02
			Chemical Total	1E-05		9E-07		1E-05		0.8		0.06	0.9
			Radionuclide Total										
		Exposure Point Total						1E-05					0.9

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil (continued)	Soil (continued)	Soil at Site 2	4,4'-DDE	2E-07				2E-07					
			4,4'-DDT	1E-07		1E-08		1E-07	Liver	0.008		0.0007	0.008
			Copper						Gastrointestinal	0.08			0.08
			Iron						Gastrointestinal	1			1
			Chemical Total	3E-07		1E-08		3E-07		1		0.0007	1
			Radionuclide Total										
		Exposure Point Total						3E-07					1
	Exposure Medium Total							1E-05					2
Soil Total								1E-05					2
Receptor Total								1E-03					47

Total Risk Across All Media = 1E-03

Total Hazard Across All Media 47

Total Liver HI Across All Media = 6

Total Central Nervous System HI Across All Media = 40

Total Gastrointestinal HI Across All Media = 1

TABLE 10.1.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	7E-07	- -	1E-06	- -	2E-06	Liver	0.007	- -	0.01	0.02
			Chloroform	5E-07		1E-06		2E-06	Liver	0.03		0.05	0.08
			Heptachlor	1E-03		6E-04		2E-03	Liver	2		0.8	3
			Manganese						Central Nervous System	17			17
			Chemical Total	1E-03		6E-04		2E-03		19		0.8	20
		Exposure Point Total						2E-03					20
	Exposure Medium Total							2E-03					20
	Air	Water Vapors from Showerhead	Chloroform		1E-05			1E-05	Liver		5		5
			Heptachlor		1E-03			1E-03					
			Chemical Total		1E-03			1E-03			5		5
		Exposure Point Total						1E-03					5
	Exposure Medium Total							1E-03					5
Groundwater Total								3E-03					25
Soil	Soil	Soil at Site 1	4,4'-DDE	1E-06				1E-06					
			4,4'-DDT	5E-06		5E-07		6E-06					
			Chemical Total	6E-06		5E-07		7E-06					
		Exposure Point Total						7E-06					
	Exposure Medium Total							7E-06					
Soil Total								7E-06					
Receptor Total								3E-03					25
							Total Risk Across All Media	3E-03				Total Hazard Across All Media	25

The information in this example table is for illustration only. The site screening threshold was determined by the RPM.

Total Liver HI Across All Media =	8
Total Central Nervous System HI Across All Media =	17

TABLE 10.2.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Heptachlor	7E-04		3E-04		1E-03	Liver	4		1	5
			Manganese						Central Nervous System	40			40
			Chemical Total	7E-04		3E-04		1E-03		44		1	45
		Exposure Point Total						1E-03					45
	Exposure Medium Total							1E-03					45
Groundwater Total								1E-03					45
Soil	Soil	Soil at Site 1	4,4'-DDE	3E-06				3E-06					
			4,4'-DDT	1E-05		9E-07		1E-05					
			Chemical Total	1E-05		9E-07		1E-05					
		Exposure Point Total						1E-05					
		Soil at Site 2	Iron						Gastrointestinal	1			1
			Chemical Total							1			1
		Exposure Point Total											1
	Exposure Medium Total							1E-05					1
Soil Total								1E-05					1
Receptor Total								1E-03					46
				Total Risk Across All Media				1E-03		Total Hazard Across All Media			46

Total Liver HI Across All Media =	5
Total Central Nervous System HI Across All Media =	40
Total Gastrointestinal HI Across All Media =	1

The information in this example table is for illustration only. The site screening threshold was determined by the RPM.

DATA USEABILITY WORKSHEET
The Dean Company
Medium: Groundwater

Activity	Comment
Field Sampling	
Discuss sampling problems and field conditions that affect data useability.	Groundwater samples were collected from 12 monitoring wells located onsite. There were no apparent problems reported from the field collection program that could affect data useability.
Are samples representative of receptor exposure for this medium (e.g. sample depth, grab vs composite, filtered vs unfiltered, low flow, etc.)?	Groundwater samples submitted for organic and inorganic analyses were non-filtered samples collected using low flow purging and sampling techniques. These samples are representative of receptor exposure.
Assess the effect of field QC results on data useability.	A few of the metals in the samples were qualified "B" due to the presence of the metals in blank samples.
Summarize the effect of field sampling issues on the risk assessment, if applicable.	There are no field sampling issues that should affect the risk assessment.
Analytical Techniques	
Were the analytical methods appropriate for quantitative risk assessment?	Yes. Groundwater samples were analyzed for organic compounds according to Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis, Multi-Media, Multi-Concentration, OLM04.2. Inorganic groundwater samples were analyzed according to CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration, ILM04.1.
Were detection limits adequate?	Yes. The method detection and quantitation limit were less than the associated risk-based concentration (RBC) values, except for chloroform and thallium. For these two compounds, no available methods can achieve the RBC as a quantitation limit. For all non-detected chemicals in groundwater, the method detection and quantitation limits were less than the associated RBC values. Recommend no changes to the data set.
Summarize the effect of analytical technique issues on the risk assessment, if applicable.	There are no analytical technique issues that should affect the risk assessment.

DATA USEABILITY WORKSHEET (cont.)
The Dean Company
Medium: Groundwater

Activity	Comment
Data Quality Objectives	
Precision - How were duplicates handled?	Relative percent differences (RPDs) were calculated for one pair of duplicate samples. The RPDs were less than the EPA-approved RPD of 20%. The highest concentration of a compound detected in the samples was used in the risk assessment.
Accuracy - How were split samples handled?	Split samples were not collected.
Representativeness - Indicate any problems associated with data representativeness (e.g., trip blank or rinsate blank contamination, chain of custody problems, etc.).	Analytes qualified with a "B" due to blank contamination will be considered as non-detects during the risk assessment.
Completeness - Indicate any problems associated with data completeness (e.g., incorrect sample analysis, incomplete sample records, problems with field procedures, etc.).	No problems were associated with data completeness.
Comparability - Indicate any problems associated with data comparability.	No problems have been associated with data comparability.
Were the DQOs specified in the QAPP satisfied?	Yes, the DQOs identified in the Sampling and Analysis Plan were satisfied.
Summarize the effect of DQO issues on the risk assessment, if applicable.	There are no DQO issues that should affect the risk assessment.

DATA USEABILITY WORKSHEET (cont.)
The Dean Company
Medium: Groundwater

Activity	Comment
Data Validation and Interpretation	
What are the data validation requirements?	For organic samples, validators were required to check the following items: holding times, instrument performance checks, initial and continuing calibrations, blanks, system monitoring compounds, matrix spike/matrix spike duplicates, regional QA/QC, internal standards, target compound identification, contract required quantitation limits, tentatively identified compounds, system performance, and overall assessment of data. For inorganic samples, validators were required to check holding times, calibration, blanks, interference checks, laboratory control samples, duplicate samples, matrix spike samples, furnace atomic absorption QC, ICP Serial Dilution, sample result verification, field duplicates, and perform an overall assessment of the data.
What method or guidance was used to validate the data?	Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic (and Inorganic) Analyses", USEPA 9/94 (and 4/93).
Was the data validation method consistent with guidance? Discuss any discrepancies.	Yes. The data validation method was consistent with regional guidance.
Were all data qualifiers defined? Discuss those which were not.	Yes. All data qualifiers were defined.
Which qualifiers represent useable data?	B, J, L, U, UJ, and UL
Which qualifiers represent unuseable data?	R
How are tentatively identified compounds handled?	Only TICs that were determined not to be laboratory or field artifacts were reported. All TICs were reported with an "N" and/or a "J" qualifier. "N" qualified data indicates that the analyte is tentatively identified. "J" qualified data indicates that the analyte is present but reported value is estimated. TICs will be evaluated qualitatively in the risk assessment.

DATA USEABILITY WORKSHEET (cont.)
The Dean Company
Medium: Groundwater

Activity	Comment
Summarize the effect of data validation and interpretation issues on the risk assessment, if applicable.	Unusable data qualified with an "R" will not be used in the risk assessment. All other data, both qualified and unqualified, will be used in the risk assessment.
Additional notes:	None.

DATA USEABILITY WORKSHEET
The Dean Company
Medium: Soil

Activity	Comment
Field Sampling	
Discuss sampling problems and field conditions that affect data useability.	There were no apparent problems that could affect data useability.
Are samples representative of receptor exposure for this medium (e.g. sample depth, grab vs composite, filtered vs unfiltered, low flow, etc.)?	Yes. Soil samples are representative of receptor exposure for this medium.
Assess the effect of field QC results on data useability.	Overall, the trip, field, and rinsate blanks were generally non-detect for VOCs and SVOCs with the exception of low levels of commonly reported laboratory contaminants. Several of the metals in the samples were qualified "B" due to the presence of the metals in blank samples.
Summarize the effect of field sampling issues on the risk assessment, if applicable.	There are no field sampling issues that should affect the risk assessment.
Analytical Techniques	
Were the analytical methods appropriate for quantitative risk assessment?	Yes. Samples were analyzed for organic compounds according to Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis, Multi-Media, Multi-Concentration, OLM04.2. Inorganic soil samples were analyzed according to CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration, ILM04.1.
Were detection limits adequate?	Yes. The method detection and quantitation limit were less than the associated risk-based concentration (RBC) values.
Summarize the effect of analytical technique issues on the risk assessment, if applicable.	There are no analytical technique issues that should affect the risk assessment.

DATA USEABILITY WORKSHEET (cont.)
The Dean Company
Medium: Soil

Activity	Comment
Data Quality Objectives	
Precision - How were duplicates handled?	Relative percent differences (RPDs) were calculated for one pair of duplicate samples. The RPDs were less than the EPA-approved RPD of 35%. The highest concentration of a compound detected in the samples was used in the risk assessment.
Accuracy - How were split samples handled?	Split samples were not collected.
Representativeness - Indicate any problems associated with data representativeness (e.g., trip blank or rinsate blank contamination, chain of custody problems, etc.).	Analytes qualified with a "B" due to blank contamination will be considered as non-detects during the risk assessment.
Completeness - Indicate any problems associated with data completeness (e.g., incorrect sample analysis, incomplete sample records, problems with field procedures, etc.).	No problems were associated with data completeness.
Comparability - Indicate any problems associated with data comparability.	No problems have been associated with data comparability.
Were the DQOs specified in the QAPP satisfied?	Yes, the DQOs identified in the Sampling and Analysis Plan were satisfied.
Summarize the effect of DQO issues on the risk assessment, if applicable.	There are no DQO issues that should affect the risk assessment.

DATA USEABILITY WORKSHEET (cont.)
The Dean Company
Medium: Soil

Activity	Comment
Data Validation and Interpretation	
What are the data validation requirements?	For organic samples, validators were required to check the following items: holding times, instrument performance checks, initial and continuing calibrations, blanks, system monitoring compounds, matrix spike/matrix spike duplicates, regional QA/QC, internal standards, target compound identification, contract required quantitation limits, tentatively identified compounds, system performance, and overall assessment of data. For inorganic samples, validators were required to check holding times, calibration, blanks, interference checks, laboratory control samples, duplicate samples, matrix spike samples, furnace atomic absorption QC, ICP serial dilution, sample result verification, field duplicates, and perform an overall assessment of the data.
What method or guidance was used to validate the data?	Region III modifications to "Laboratory Data Validation Functional Guidelines for Validating Organic (and Inorganic) Analyses", USEPA 9/94 (and 4/93).
Was the data validation method consistent with guidance? Discuss any discrepancies.	Yes. The data validation method was consistent with regional guidance.
Were all data qualifiers defined? Discuss those which were not.	Yes. All data qualifiers were defined.
Which qualifiers represent useable data?	B, J, K, L, U, UJ, and UL
Which qualifiers represent unuseable data?	R
How are tentatively identified compounds handled?	Only TICs that were determined not to be laboratory or field artifacts were reported. All TICs were reported with an "N" and/or a "J" qualifier. "N" qualified data indicates that the analyte is tentatively identified. "J" qualified data indicates that the analyte is present but the reported value is estimated. TICs will be evaluated qualitatively in the risk assessment.

DATA USEABILITY WORKSHEET (cont.)
The Dean Company
Medium: Soil

Activity	Comment
Summarize the effect of data validation and interpretation issues on the risk assessment, if applicable.	Unusable data qualified with an "R" will not be used in the risk assessment. All other data, both qualified and unqualified, will be used in the risk assessment.
Additional notes:	None.

EXAMPLE TECHNICAL APPROACH TO RISK ASSESSMENT (TARA) SCHEDULE WORKSHEET

The Dean Company

Activity - *RAGS Part D Reference*[1]	Comments[2]
PROJECT SCOPING	
Preliminary site conceptual model - *Section 2.1*	November 30, 2000
Site visit - *Sec 2.1*	November 4, 2000
Scoping meeting - *Sec 2.1*	November 2, 2000
PRGs and ARARs (initial discussion) - *Sec 2.1*	November 2, 2000
Identification of deliverables - *Sec 2.1*	November 30, 2000
Planning Table 1 (preliminary version) - *Sec 2.1*	November 30, 2000
Probabilistic Analysis (preliminary consideration) - *Sec 2.1*	November 30, 2000
RI/FS Workplan (consideration of risk assessment objectives) - *Sec 2.2*	November 30, 2000
Baseline Risk Assessment Workplan (consideration of risk assessment objectives) - *Sec 2.2*	November 30, 2000
Probabilistic Analysis (additional consideration and Workplan as appropriate) - *Sec 2.2.1*	November 30, 2000
REMEDIAL INVESTIGATION	
Planning Table 0 - *Sec. 3.1.1*	August 30, 2001
TARA Schedule Worksheet - *Sec. 3.1.1 and Appendix C*	August 30, 2001
Planning Table 1 - *Sec 3.1.1*	August 30, 2001
Data Useability Worksheet - *Sec 3.1.1 and Appendix C*	August 30, 2001
Supporting information for background value for Planning Table 2 - *Sec 3.1.1*	August 30, 2001
Planning Table 2 - *Sec 3.1.1*	August 30, 2001
Supporting information for EPC for Planning Table 3 - *Sec 3.1.1*	August 30, 2001
Planning Table 3 -*Sec 3.1.1*	August 30, 2001

Notes:

[1]Add other activities as appropriate for the site.

[2]Use this column to identify the applicability, schedule, and responsibility for each activity. Activities that are not required for a particular site can be noted as NA (not applicable). It is recommended that the responsibility and schedule for both the preparation and review of each activity be noted.

EXAMPLE TECHNICAL APPROACH TO RISK ASSESSMENT (TARA) SCHEDULE WORKSHEET

The Dean Company

Activity - *RAGS Part D Reference*[1]	Comments[2]
REMEDIAL INVESTIGATION (continued)	
Supporting information on modeled intake methodology and parameters for Planning Table 4 - *Sec 3.1.1*	August 30, 2001
Supporting information on chemical-specific parameters for Planning Table 4 - *Sec 3.1.1*	August 30, 2001
Dermal Worksheet - *Sec 3.1.1 and Appendix C*	August 30, 2001
Planning Table 4 - *Sec 3.1.1*	August 30, 2001
Supporting information on toxicity data for special case chemicals on Planning Tables 5/6 - *Sec 3.1.1*	August 30, 2001
Planning Table 5 - *Sec 3.1.1*	August 30, 2001
Planning Table 6 - *Sec 3.1.1*	August 30, 2001
Supporting information on special chemical risk and hazard calculations for Planning Tables 7/8 - *Sec 3.1.1*	October 21, 2001
Planning Table 7 - *Sec 3.1.1*	October 21, 2001
Planning Table 8 - *Sec. 3.1.1*	October 21, 2001
Radiation Dose Assessment Worksheet - *Sec 3.1.1 and Appendix C*	October 21, 2001
Planning Table 9 - *Sec 3.1.1*	October 21, 2001
Planning Table 10 - *Sec 3.1.1*	October 21, 2001
Lead Worksheets - *Sec 3.1.1 and Appendix C*	October 21, 2001
Assessment of Confidence and Uncertainty - *Sec 3.1.2*	October 21, 2001
Summary of Probabilistic Analysis - *Sec 3.1.3*	October 21, 2001
Draft Baseline Risk Assessment - *Sec 3.2*	October 21, 2001
Final Baseline Risk Assessment - *Sec 3.3*	January 15, 2001

Notes:
[1]Add other activities as appropriate for the site.
[2]Use this column to identify the applicability, schedule, and responsibility for each activity. Activities that are not required for a particular site can be noted as NA (not applicable). It is recommended that the responsibility and schedule for both the preparation and review of each activity be noted.

EXAMPLE TECHNICAL APPROACH TO RISK ASSESSMENT (TARA) SCHEDULE WORKSHEET

The Dean Company

Activity - *RAGS Part D Reference*[1]	Comments[2]
REMEDIAL INVESTIGATION (continued)	
Draft ROD Risk Worksheets - *Sec 3.3 and Appendix C*	January 15, 2001
FEASIBILITY STUDY	
Remedial Action Objectives - *Sec 4.2*	January 15, 2001
Remediation Goals - *Sec 4.2*	January 15, 2001
Risks and hazards associated with PRGs - *Sec 4.4*	January 15, 2001
Risk considerations of remedial technologies and alternatives - *Sec 4.5*	January 15, 2001
AFTER THE FEASIBILITY STUDY	
Risk evaluation for the Proposed Plan - *Sec 5.1*	To be determined
Documentation of risks in the Record of Decision - *Sec 5.2*	To be determined
Revise ROD Risk Worksheets - *Sec 5.2 and Appendix C*	To be determined
Risk evaluation during remedial design and remedial action - *Sec 5.3*	To be determined
Risk evaluation associated with explanations of significant differences - *Sec 5.4*	To be determined
Risk evaluations during five-year review - *Sec 5.5*	To be determined
Public meeting participation	To be determined

Notes:

[1]Add other activities as appropriate for the site.

[2]Use this column to identify the applicability, schedule, and responsibility for each activity. Activities that are not required for a particular site can be noted as NA (not applicable). It is recommended that the responsibility and schedule for both the preparation and review of each activity be noted.

Dermal Worksheet
Intermediate Variables for Calculating DA(event)
The Dean Company

Chemical of Potential Concern	Medium	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
phthalate	Groundwater	- -	0.8	2.50E-002	cm/hour	0.58	hour/event	16.27	hour	39.05	hour	0.2
Chloroform	Groundwater	- -	1	1.50E-001	cm/hour	0.58	hour/event	0.49	hour	1.18	hour	0
Heptachlor	Groundwater	- -	0.8	8.70E-003	cm/hour	0.58	hour/event	12.99	hour	31.16	hour	0.1
Barium *	Groundwater	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Manganese *	Groundwater	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Thallium *	Groundwater		- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
4,4'-DDD *	Soil	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
4,4'-DDE *	Soil	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
4,4-DDT	Soil	0.03	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
Aluminum *	Soil	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Copper *	Soil	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Iron *	Soil	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Manganese *	Soil	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Thallium *	Soil	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

FA = Fraction Absorbed Water
Kp = Dermal Permeability Coefficient of Compound in Water

T(event) = Event Duration
Tau = Lag Time

T* = Time to Reach Steady-State
B = Dimensionless Ratio of the Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis

* = Dermal assessment not recommended based on RAGS Part E, Appendix B-3 screening table.

TABLE X (RAGS D IEUBK LEAD WORKSHEET)
Site Name: <SITE and OU>
Receptor: <Receptor> (Age <X> Months) Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration Used in Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Soil	<X>	mg/kg	Average Detected Value	400	mg/kg	Recommended Soil Screening Level
Water	<X>	ug/L	Average Detected Value	15	ug/L	Recommended Drinking Water Action Level

2. Lead Model Questions

Question	Response for Residential Lead Model
What lead model (version and date) was used?	<model> <version and date>
Where are the input values located in the risk assessment report?	Located in Appendix <X> <IEUBKwin OUTPUT>
What range of media concentrations were used for the model?	<Refer to sampling data table>
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	<Statistic used> Data are Located in Appendix <X>
Was soil sample taken from top 2 cm? If not, why?	<Yes/No>
Was soil sample sieved? What size screen was used? If not sieved, provide rationale.	<Yes/No> Mesh size <X> um
What was the point of exposure/location?	<describe>
Where are the output values located in the risk assessment report?	Located in Appendix X <IEUBKwin OUTPUT>
Was the model run using default values only?	<Yes/No>
Was the default soil bioavailability used?	<Yes/No> Default is 30%
Was the default soil ingestion rate used?	<Yes/No> Default values for 7 age groups are 85, 135, 135, 100, 090, and 85 mg/day
If non-default values were used, where are the rationale for the values located in the risk assessment report?	Located in Appendix X <IEUBKwin OUTPUT>

3. Final Result

Medium	Result	Comment/PRG [1]
<MEDIUM>	Input value of <X> (units) in <MEDIUM> results in YYY% of <receptor> above a blood lead level of 10 ug/dL. Geometric mean blood lead = ZZZ ug/dL. This exceeds the blood lead goal as described in the 1994 OSWER Directive of no more than 5% of children exceeding 10 ug/dL blood lead.	Based on site conditions, a PRG of X (units) is indicated for <MEDIUM>.

1. Attach the IEUBK text output file and graph upon which the PRG was based as an appendix. For additional information, see www.epa.gov/superfund/programs/lead

TABLE Y (RAGS D ADULT LEAD WORKSHEET)
Site Name: Example Site, Slag Pile 2
Receptor: Adult Worker, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration used in Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Soil	2000	mg/kg	Average Detected Value	750	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	EPA Interim Adult Lead Model (1996)
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	n/a
Where are the input values located in the risk assessment report?	Located in Appendix 5
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean soil concentration. Data are Located in Appendix 2
What was the point of exposure and location?	OU 3 Slag pile area
Where are the output values located in the risk assessment report?	Located in Appendix 5
What GSD value was used? If this is outside the recommended range of 1.8-2.1, provide rationale in Appendix <Y>.	1.8
What baseline blood lead concentration (PbB_0) value was used? If this is outside the default range of 1.7 to 2.2 provide rationale in Appendix <Y>.	2.0
Was the default exposure frequency (EF; 219 days/year) used?	Yes
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	Yes
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Located in Appendix 5

3. Final Result

Medium	Result	Comment/RBRG [1]
Soil	2000 ppm lead in soil results in >5% of receptors above a blood lead level of 10 ug/d and geometric mean blood lead = 11.6 ug/dL. This exceeds the blood lead goal as described in the 1994 OSWER Directive of no more than 5% of children (fetuses of exposed women) exceeding 10 ug/dL blood lead.	1500 ppm

1. Attach the ALM spreadsheet output file upon which the Risk Based Remediation Goal (RBRG) was based and description of rationale for parameters used. For additional information, see www.epa.gov/superfund/programs/lead

APPENDIX D

EXAMPLE SCENARIOS

1. **Duplicate Exposure Information for Different Exposure Points**
2. **Modeled Inhalation from Showering**
3. **Measured Data and Subsequent Ingestion**
4. **Modeled Data and Subsequent Ingestion**
5. **Modeled Data**
6. **Multiple Source Exposures**
7. **Possible Summing Options on Planning Tables 9 and 10**
8. **Child/Adult Lifetime Cancer Risk**
9. **Transfer of Contaminants Through Multiple Media**
10. **Lead Data Example**
11. **Radiation Data Example**

Example Scenario No. 1
Duplicate Exposure Information for Different Exposure Points
(with Planning Tables 1 and 4)

Scenario Description: Data are available for several exposure points that are to be evaluated separately in the risk assessment. In this risk assessment, data will be evaluated separately for ingestion and dermal contact from three different slag piles (Slag Piles 1, 2, and 3) for the same scenario timeframe, medium, and exposure medium.

Planning Table Issues Associated with this Scenario:

The primary issue with this scenario is whether or how to show the exposure points on Planning Tables 1 and 4. Note that the exposure parameter values used for daily intake calculations are identical for each individual pathway, i.e. the values presented on Planning Table 4 are the same for all exposure points for each type of exposure route.

1. How will Planning Table 1 show the three separate exposure points?

Planning Table 1 will need to show the three separate exposure points since each data set will be evaluated separately in the risk assessment. Planning Table 1 needs to show:

Medium: Solid Waste
Exposure Medium: Solid Waste
Exposure Point: Slag Pile 1

Medium: Solid Waste
Exposure Medium: Solid Waste
Exposure Point: Slag Pile 2

Medium: Solid Waste
Exposure Medium: Solid Waste
Exposure Point: Slag Pile 3

2. Do the values used for daily intake calculations need to be shown three separate times on Planning Table 4 for each exposure point even though the values and intake equations are identical?

There are two options that can be followed:

Option 1: Complete Planning Table 4 according to the RAGS Part D instructions. For this example, Planning Table 4 would have three sets of identical values and intake equations, one for each exposure point.

Option 2: Complete Planning Table 4 using only one set of values and intake equations and indicate on the table that these values are identical for all three different exposure points. This can be accomplished by including "Slag Piles 1, 2, and 3" in the Exposure

Example Scenario No. 1 (continued)
Duplicate Exposure Information for Different Exposure Points
(with Planning Tables 1 and 4)

Point column and footnoting that these values and intake equations are the same for all three exposure points.

Option 1 is provided in the Example Tables in Appendix A. Option 2, consisting of a revised example Planning Table 4, is illustrated in the accompanying table.

Example Scenario No. 2
Modeled Inhalation from Showering (with Planning Tables 1, 2, 3, 4, and 7)

Scenario Description: Individuals may be exposed to chemicals of potential concern in air by inhalation of chemicals through showering. The inhalation pathway is modeled using an EPA-accepted inhalation model. For this example scenario, a model accepted by EPA regions, such as the Foster and Chrostowski Shower Model, is used to evaluate *future adult resident inhalation exposure to groundwater*. See Example Scenario 4 for illustrations of how to present modeled data.

Planning Table Issues Associated with this Scenario:

1. How will use of an inhalation model affect Planning Table 1?
   Planning Table 1 can accommodate this easily. Planning Table 1 can be completed to include an exposure medium (e.g., Water Vapors at Showerhead) and include the inhalation exposure route for all applicable scenarios. For this scenario example, Planning Table 1 would include a row that would describe this inhalation exposure pathway.

2. What data will be included in Planning Table 2 -- modeled air concentrations or measured groundwater concentrations?
   In this example, Planning Table 2 will show measured groundwater concentrations. The data will be screened against tap water screening values.

3. What data will be included in Planning Table 3?
   In this example, Planning Table 3 will show measured groundwater statistics.

4. How will the inhalation model parameters be shown on Planning Table 4?
   For this example, the upper left hand corner Summary Box and the exposure route, receptor population, receptor age, and exposure point fields should be completed. However, exposure parameters and intake equations do not need to be entered into the table if there are space limitations. In the exposure route column, enter "Inhalation" with a footnote. Include the footnote explanation beneath the table that describes the model to be used and the section of the risk assessment text where information regarding modeled intake development can be found. Supporting information that summarizes the modeled intake methodology and parameters used to calculate modeled intake values should be included in the Baseline Risk Assessment Report as an attachment. Non-standard tables may also be used to display modeled information. Refer to the Risk Assessment text for details on the modeled intake methodology, the parameters used to calculate modeled intake values, and the modeled air concentrations predicted by the model.

Example Scenario No. 2
Modeled Inhalation from Showering (with Planning Tables 1, 2, 3, 4, and 7)

5. How are the modeled results displayed on Planning Table 7?

   For this example, EPC values are calculated using measured groundwater data. They can be found on Planning Table 3. Intake/Exposure concentration values are values that are generated using the inhalation model. These values need to be included on this table. The risks and hazards will be calculated using the "Intake / Exposure concentration values" based on modeling and appropriate toxicity information.

Example Scenario No. 3
Measured Data and Subsequent Ingestion (Planning Tables 1, 2 and 3)

Scenario Description: Measured fish tissue data are available for evaluation in the risk assessment. The data are available for a specific species: trout. The measured data will be used in the risk assessment to determine the potential for adverse effects from ingestion of fish. This scenario is based upon fish tissue to show how to include measured data in the tables, but it can be applied to other exposure media.

Planning Table Issues Associated with this Scenario:

1. How will Planning Table 1 show fish tissue exposure?
   In this situation, it is assumed that the source of exposure for the fish was the sediment, Planning Table 1 will need to show a specific exposure point for the trout as follows:

   Medium: Sediment
   Exposure Medium: Fish Tissue
   Exposure Point: Trout

2. What data will be included in Planning Table 2 - measured fish tissue data or sediment data?
   Planning Table 2 will show measured trout analytical data. The data will be screened against fish tissue screening values.

3. What data will be included in Planning Table 3?
   Planning Table 3 will show measured fish tissue statistics for the trout.

Example Scenario No. 4
Modeled Data and Subsequent Ingestion (Planning Tables 1 and 2)

Scenario Description: Modeled fish tissue data are available for evaluation in the risk assessment based on concentrations of contaminants in the sediment. The modeled data will be used in the risk assessment to determine the potential for adverse effects from ingestion of the fish. This scenario is based upon fish tissue to show how to include modeled data in the tables, but it can be applied to other exposure media.

Planning Table Issues Associated with this Scenario:

The primary issue with this scenario is what data to show on Planning Table 2 and subsequent tables (modeled fish tissue or measured sediment data). There are two options for data presentation.

> Option 1 (Modeled Fish Tissue Concentrations): The modeled fish tissue concentrations could appear on Planning Table 2 in the Concentration Used for Screening column. These modeled concentrations would be screened against fish tissue screening values. The methodology used to develop the modeled concentrations should be referenced on the tables. This option should be used when screening on fish tissue concentrations.
>
> Option 2 (Measured Sediment Concentrations): Measured sediment concentrations could be presented on Planning Table 2. The measured concentrations are the values used as input in the model to determine predicted fish tissue concentrations. The modeling methodology could be discussed in the text and referenced on Planning Table 4. The model results would be used for intake calculations in Planning Table 7. This option should be used when screening on sediment concentrations.

1. How will Planning Table 1 show fish tissue exposure?

   Assuming the source of exposure for the fish is sediment, Planning Table 1 will need to show a specific exposure point for the fish as follows:

   Medium: Sediment
   Exposure Medium: Fish Tissue
   Exposure Point: Trout

2. What data will be included in Planning Table 2 - measured sediment data or modeled fish tissue data?

   See discussion of options, above, and footnotes on Planning Table 2.

Example Scenario No. 5
Modeled Data (Planning Table 1)

Scenario Description: The risk assessment uses data that have been modeled to evaluate potential risks. The modeling results are for spatial changes, temporal changes, and transfer between media.

Planning Table Issues Associated with this Scenario:

The issue associated with this scenario is how to identify and evaluate each different modeled data set. In this temporal change example, groundwater data have been modeled to represent concentrations in future years (1 year, 2 years, and 5 years in the future). This evaluation can be accommodated by assigning a separate exposure point to each future year.

1. How will Planning Table 1 be completed?

   Planning Table 1 could show temporal changes using the exposure point column, as shown on the accompanying table.

Example Scenario No. 6
Multiple Source Exposures (Planning Table 1)

Scenario Description: The risk assessment is evaluating the ingestion of fish tissue affected by both contaminated surface water and sediment.

Planning Table Issues Associated with this Scenario:

1. How will the medium, exposure medium, and exposure point be represented in Planning Table 1 for fish tissue?

The exposure point for fish tissue ingestion can be presented in two different ways, as described in the options below:

Option 1

Medium: Surface Water/Sediment
Exposure Medium: Fish Tissue
Exposure Point: Trout - contaminant uptake from surface water and sediment

This option should be used if screening will be performed against measured or modeled fish tissue data.

Option 2

Medium: Surface Water
Exposure Medium: Fish Tissue
Exposure Point: Trout - contaminant uptake from surface water

AND

Medium: Sediment
Exposure Medium: Fish Tissue
Exposure Point: Trout - contaminant uptake from sediment

This option should be used if screening will be performed against measured surface water or sediment data.

Example Scenario No. 7
Possible Summing Options (Planning Tables 9 and 10)

Scenario Description: The risk assessment is evaluating several different exposure points for a particular set of media and exposure media. The EPA risk assessor for the site may allow the risk assessor to use abridged versions of Planning Tables 9 and 10 which do not require the same level of summation as the version of Planning Tables 9 and 10 shown in Appendix A.

Planning Table Issues Associated with this Scenario:

1. How will the risk data be summed on Planning Tables 9 and 10 for medium, exposure medium, exposure point, and receptor (combination of scenario timeframe, receptor population, and receptor age)?

The summing of risk for these exposure pathway elements can be presented in two different ways, as described in the options below. The EPA risk assessor will determine the type of summing that is appropriate for a particular site.

Option 1

Summing will occur in the standard fashion at four levels: medium, exposure medium, exposure point, and receptor.

Option 1 is shown in the accompanying tables and in Appendix A

Option 2

Summing will occur at fewer levels only: e.g., for exposure point and receptor only. Consult the EPA risk assessor to determine the appropriate procedure to follow.

Option 2 is shown in the accompanying tables.

Example Scenario No. 8
Child/Adult Lifetime Cancer Risk (Planning Tables 1, 4, 7, 9)

Scenario Description: For this risk assessment the lifetime risk will be evaluated. Lifetime risk evaluates the combined risk from childhood through adulthood.

Planning Table Issues Associated with this Scenario:
In some regions, lifetime cancer risks are calculated by adding child and adult risk estimates together. In other regions, age-adjusted exposure factors are used to calculate lifetime cancer risk.

1. How should lifetime cancer risk be presented on Planning Table 1?
   For the "receptor age" column, choose from the picklist and enter "Adult", "Child", and "Child/Adult"

2. How should the other Planning Tables be completed?
   Two options are presented:

   Option 1–Child/Adult calculated through summing cancer risks for separate Child and Adult receptors

   Planning Tables 1, 4, and 7 would have separate Child and Adult receptor ages. Planning Table 1 would also show a Child/Adult receptor to indicate that the Child/Adult analyses will be performed. Planning Table 4s would be developed for Child and Adult receptors with appropriate exposure factor values. A Planning Table 4 would also be shown for the Child/Adult receptor with no exposure factor values provided. Instead, a note would indicate that Child/Adult cancer risks will be calculated based upon the sum of Child cancer risk and Adult cancer risk.

   Planning Table 7s and 9s would then be developed for three receptor ages: Child, Adult, and Child/Adult (a version of Planning Tables 7 and 9 combining the Child and the Adult cancer risk data into a single Child/Adult table with a note that the data on the table was derived from summing the Child and Adult data).

   Option 2–Child/Adult calculated using age-adjusted exposure factors

   As in Option 1, Planning Tables 1, 4, and 7 in Option 2 would show separate Child and Adult receptor ages as well as the Child/Adult receptor age. For the Option 2 Planning Table 4, the Child/Adult receptor age would be shown with age-adjusted exposure factor values. For the Option 2 Planning Tables 7 and 9, the Child/Adult cancer risks would be calculated using age-adjusted exposure factor values.

Example Scenario No. 9
Transfer of Contaminants Through Multiple Media (Planning Table 1)

Scenario Description: The risk assessment evaluates the potential adverse effects from contaminants in soil that is taken up by plants and then taken up by an animal that is then ingested by human receptors.

Planning Table Issues Associated with this Scenario:

1. How can Planning Table 1 accommodate this three-way transfer?
   Planning Table 1 can accommodate this scenario as follows:

   Medium: Soil
   Exposure Medium: Animal Tissue
   Exposure Point: Beef from cattle grazing in field

This example scenario assumes that only the first and last media are of interest and no evaluation is needed for intermediate media. Consult with the EPA Risk Assessor to determine if screening is to be conducted on intermediate media (e.g., in an exposure scenario in which a contaminant moves from soil to plant tissue to animal tissue, whether an evaluation should be conducted for the intermediate plant tissue step).

Example Scenario No. 10
Lead Data Example (Lead Worksheets)

Scenario Description: Lead is present in site soil and the child and adult lead models were used to evaluate blood lead levels. The standard tables do not accommodate lead model results.

Planning Table Issues Associated with this Scenario:

1. Since there are no standard tables that accommodate lead, how should lead results be presented?
   The Lead Worksheets should be completed to demonstrate the evaluation performed and the results of analysis.

Examples of completed Lead Worksheets follow.

Example Scenario No. 11
Radiation Data Example

Scenario Description: The site has radiological and chemical waste associated with it and radiological and chemical analyses were performed as part of the investigation. Potential adverse health effects will be evaluated in the risk assessment.

Planning Table Issues Associated with this Scenario:

Since radiological risk assessment uses different methodologies and terminologies than chemical risk assessment, how can the radiological risk assessment data be shown in the Planning Tables?

Planning Table 6.4 (Cancer Toxicity Data - External (Radiation)) and Planning Table 8 (Calculation of Radiation Cancer Risks) were developed by the Workgroup. The carcinogenic risk sections of Planning Tables 9 and 10 were expanded to include an External (Radiation) column. The following radiological risk example includes these Planning Tables.

Note: Many of the Example Planning Tables (i.e., those Example Planning Tables that do not specifically address radionuclides) provided for this Example Scenario are identical to those from Appendix A.

EXAMPLE SCENARIO 1

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Solid Waste	Solid Waste	Slag Pile 1	Receptor Population	Age 1	Ingestion	Quant	Rationale
						Dermal	Quant	Rationale
			Slag Pile 2	Receptor Population	Age 1	Ingestion	Quant	Rationale
						Dermal	Quant	Rationale
			Slag Pile 3	Receptor Population	Age 1	Ingestion	Quant	Rationale
						Dermal	Quant	Rationale

EXAMPLE SCENARIO 1
Option 2

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
The Dean Company

Scenario Timeframe: Future
Medium: Solid Waste
Exposure Medium: Solid Waste

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Receptor Population	Age 1	Slag Piles 1, 2, 3 (1)	CS	Chemical Concentration in Slag	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR	Ingestion Rate of Slag	100	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
Dermal	Receptor Population	Age 1	Slag Piles 1, 2, 3 (1)	CS	Chemical Concentration in Slag	See Table 3.1	mg/kg	See Table 3.1	Dermal Absorbed Dose (DAD) (mg/kg-day) =
				CF1	Conversion Factor	1E-06	kg/mg		DA-event x EF x ED x EV x SA X 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,700	cm2	EPA, 2001	where
				AF	Soil to Skin Adherence Factor	0.19	mg/cm2-event	EPA, 2001	Absorbed Dose per Event (DA-event) (mg/cm2-event) =
				ABS-d	Absorption Factor	chemical-specific	unitless	EPA, 2001	CS x CF1 x AF x ABS-d
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 2001	

(1) Parameters for Slag Piles 2 and 3 are identical to Slag Pile 1, and are therefore not repeated.

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 1995: Assessing Dermal Exposure from Soil, Technical Guidance Manual, Region III, EPA/903-K-95-003.

EPA 1997: Exposure Factors Handbook, Volume 1. EPA/600/P-95/002Fa.

EPA 2001: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.

NA = Not Available

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Aquifer 1 - Tap Water	Resident	Adult	Dermal	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
						Ingestion	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
					Child	Dermal	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
						Ingestion	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
		Air	Water Vapors at Showerhead	Resident	Adult	Inhalation	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
					Child	Inhalation	None	Children are assumed not to shower.

EXAMPLE SCENARIO 2

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)	Maximum (1) Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Water Vapors at Showerhead	117817	Bis(2-ethylhexyl)phthalate	2 J	5 J	ug/l	GW3D	4 / 12	7 - 11	5	NA	4.8 C	6	MCL	Y	ASL
	67663	Chloroform	0.6 J	9	ug/l	GW3D	3 / 12	1 - 1	9	NA	0.063 C	100	MCL	Y	ASL
	75150	Carbon Disulfide	0.3 J	4.5	ug/l	GW3D	3 / 12	1 - 1	4.5	NA	100 N	NA	NA	N	BSL
	76448	Heptachlor	2 J	33 J	ug/l	GW4D	6 / 12	0.05 - 0.05	33	NA	0.015 C	0.4	MCL	Y	ASL
	108883	Toluene	0.1 J	0.2 J	ug/l	GW3D	3 / 12	1 - 1	0.2	NA	75 N	1000	MCL	N	BSL

(1) Measured groundwater concentrations.

(2) Maximum concentration used for screening.

(3) To date, no background study has been completed.

(4) All compounds are screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, October 5, 2000 for tap water (cancer benchmark = 1E-06; HQ = 0.1).

(5) Rationale Codes:

Selection Reason: Above Screening Level (ASL)

Deletion Reason: Below Screening Level (BSL)

Definitions: NA = Not Applicable

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

MCL = Maximum Contaminant Level

J = Estimated Value

C = Carcinogen

N = Noncarcinogen

EXAMPLE SCENARIO 2

TABLE 3.2.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Water Vapors at Showerhead	Bis(2-ethylhexyl)phthalate	ug/l	4	5.5 T	5 J	5	ug/l	Max	W-Test (1)
	Chloroform	ug/l	1.9	14.9 T	9	9	ug/l	Max	W-Test (1)
	Heptachlor	ug/l	27	30 T	33 J	30	ug/l	95% UCL - T	W - Test (2)

Note: Measured groundwater concentrations used to calculate EPC values.

Statistics: Maximum Detected Value (Max); 95% UCL of Transformed Data (95% UCL - T)

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(2) Shapiro-Wilk W Test indicates data are lognormally transformed.

N = Normal

T = Transformed

J = Estimated Value

EXAMPLE SCENARIO 2

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation (1)	Resident	Adult	Water Vapors at Showerhead	(1)	(1)	(1)	(1)	(1)	Foster and Chrostowski Model

(1) Refer to the Risk Assessment text for details on the modeled intake methodology, the parameters used to calculate modeled intake values, and the modeled air concentrations predicted by the Foster and Chrostowski Shower Model.

EXAMPLE SCENARIO 2

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Aquifer 1 - Tap Water	Ingestion	Bis(2-ethylhexyl)phthalate	0.005	mg/l	4.7E-005	mg/kg/day	1.4E-002	1/mg/kg/day	7E-007	1.4E-004	mg/kg/day	2.0E-002	mg/kg/day	0.007
				Chloroform	0.009	mg/l	8.5E-005	mg/kg/day	6.1E-003	1/mg/kg/day	5E-007	2.5E-004	mg/kg/day	1.0E-002	mg/kg/day	0.03
				Heptachlor	0.03	mg/l	2.8E-004	mg/kg/day	4.5E+000	1/mg/kg/day	1E-003	8.1E-004	mg/kg/day	5.0E-004	mg/kg/day	2
			Exp. Route Total								1E-003					2
			Dermal	Bis(2-ethylhexyl)phthalate	0.005	mg/l	3.9E-006	mg/kg/day	2.5E-002	1/mg/kg/day	1E-007	1.1E-005	mg/kg/day	1.1E-002	mg/kg/day	0.001
				Chloroform	0.009	mg/l	1.9E-006	mg/kg/day	6.1E-003	1/mg/kg/day	1E-008	5.5E-006	mg/kg/day	1.0E-002	mg/kg/day	0.0006
				Heptachlor	0.03	mg/l	7.6E-006	mg/kg/day	9.0E+000	1/mg/kg/day	7E-005	2.2E-005	mg/kg/day	2.5E-004	mg/kg/day	0.09
			Exp. Route Total								7E-005					0.09
		Exposure Point Total									1E-003					2
	Air	Water Vapors at Showerhead	Inhalation	Bis(2-ethylhexyl)phthalate	0.005	mg/l (1)	2.3E-006	mg/kg/day	NA	NA	NA	3.6E-006	mg/kg/day	NA	NA	NA
				Chloroform	0.009	mg/l (1)	1.3E-004	mg/kg/day	8.1E-002	1/mg/kg/day	1E-005	3.9E-004	mg/kg/day	8.6E-005	mg/kg/day	5
				Heptachlor	0.03	mg/l (1)	2.6E-004	mg/kg/day	4.5E+000	1/mg/kg/day	1E-003	7.7E-004	mg/kg/day	NA	NA	NA
			Exp. Route Total								1E-003					5
		Exposure Point Total									1E-003					5
											Total of Receptor Risks Across All Media					Total of Receptor Hazards Across All Media
											2E-003					7

(1) EPC values are shown as measured groundwater values and are found on Table 3.2.RME.

EXAMPLE SCENARIO 3

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Sediment	Sediment	Pond 1	Receptor Population	Age 1	Route 1	Quant	Rationale
						Route 2	Quant	Rationale
					Age 2	Route 1	Quant	Rationale
						Route 2	Quant	Rationale
		Fish Tissue	Trout	Receptor Population	Age 1	Route 1	Quant	Rationale
					Age 2	Route 1	Quant	Rationale

EXAMPLE SCENARIO 3

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Fish Tissue

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)	Maximum (1) Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Trout	11096825	Arochlor 1260	0.0002 J	0.005 J	mg/kg	Trout - 1	3 / 10	0.0001 - 0.0001	0.005	NA	0.0016 C	NA	NA	Y	ASL
	7439921	Lead	0.004 J	0.007 J	mg/kg	Trout - 3	5 / 10	0.001 - 0.001	0.007	NA	NA	NA	NA	Y	NTX
	1746016	2,3,7,8-Tetrachlorodibenzodioxin	0.00000001 J	0.00000005 J	mg/kg	Trout - 1	4 / 10	0.00000001 - 0.00000001	0.00000005	NA	0.000000021 C	NA	NA	Y	ASL

(1) Measured fish tissue concentrations. Maximum measured fish tissue concentrations used for screening.

(2) Background values are not available.

(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for fish tissue (cancer benchmark = 1E-06; HQ = 0.1).

(4) Rationale Codes:

Selection Reason: Above Screening Level (ASL)
No Toxicity Infomation (NTX)

Definitions: NA = Not Applicable
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated Value
C = Carcinogen
N = Noncarcinogen

EXAMPLE SCENARIO 3

TABLE 3.1.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Sediment

Exposure Medium: Fish Tissue

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Trout	Arochlor 1260	mg/kg	0.003	0.0035 (T)	0.005 J	0.0035	mg/kg	95% UCL - T	W - Test (1)
	Lead	mg/kg	0.005	0.0063 (T)	0.007 J	0.0063	mg/kg	95% UCL - T	W - Test (1)
	2,3,7,8-Tetrachlorodibenzodioxin	mg/kg	0.00000002	0.000000047 (T)	0.00000005 J	0.000000047	mg/kg	95% UCL -T	W - Test (1)

Statistics: 95% UCL of Transformed Data (95% UCL - T)

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.

Note: Measured fish tissue concentrations used to calculate EPC values.

N = Normal

T = Transformed

J = Estimated Value

EXAMPLE SCENARIO 4

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Timeframe	Sediment	Fish Tissue	Trout	Population 1	Age 1	Route 1	Quant	Rationale
					Age 2	Route 1	Quant	Rationale
				Population 2	Age 1	Route 1	Quant	Rationale
					Age 2	Route 1	Quant	Rationale

EXAMPLE SCENARIO 4
Option 1

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Fish Tissue

Exposure Point	CAS Number	Chemical	Minimum Concentration (1) (Qualifier)	Maximum Concentration (1) (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value (3)	Screening Toxicity Value (4) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (5)
Trout	11096825	Arochlor 1260	0.6 J	5.5 J	mg/kg	SD01	3 / 10	0.1 - 0.2	0.005	NA	0.0016 (C)	NA	NA	Y	ASL
	7439921	Lead	210 J	500 J	mg/kg	SD03	5 / 10	10 - 16	0.007	NA	NA	NA	NA	Y	NTX
	1746016	2,3,7,8-Tetrachlorodibenzodioxin	0.000001 J	0.00005 J	mg/kg	SD01	4 / 10	0.000001 - 0.000001	0.00000005	NA	0.000000021 (C)	NA	NA	Y	ASL

(1) Measured sediment concentrations.

(2) Concentrations used for screening are fish tissue values derived from the X model. Refer to the risk assessment text for details on the model methodology.

(3) To date, no background study has been completed.

(4) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for fish tissue (cancer benchmark = 1E-06; HQ = 0.1).

(5) Rationale Codes:

Selection Reason: Above Screening Level (ASL)
No Toxicity Infomation (NTX)

EXAMPLE SCENARIO 4
Option 2

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Sediment
Exposure Medium: Fish Tissue

Exposure Point	CAS Number	Chemical	Minimum Concentration (1) (Qualifier)	Maximum Concentration (1) (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Trout	11096825	Arochlor 1260	0.6 J	5.5 J	mg/kg	SD01	3 / 10	0.1 - 0.2	5.5	NA	3.2 (C)	NA	NA	Y	ASL
	7439921	Lead	210 J	500 J	mg/kg	SD03	5 / 10	10 - 16	500	NA	400	NA	NA	Y	ASL
	1746016	2,3,7,8-Tetrachlorodibenzodioxin	0.000001 J	0.00005 J	mg/kg	SD01	4 / 10	0.000001 - 0.000001	0.00005	NA	0.000043 (C)	NA	NA	Y	ASL

(1) Measured sediment concentrations are shown and maximum concentrations are used for screening. These data will be used as input in the X model to predict fish tissue concentrations. Refer to the risk assessment text for details on the model methodology.

(2) To date, no background study has been completed.

(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for 10 times the residential soil value (cancer benchmark = 10 x 1E-06; HQ = 10 x 0.1). Lead was screened against the U.S. EPA screening value of 400 mg/kg.

(4) Rationale Codes:

Selection Reason: Above Screening Level (ASL)

Definitions:

NA = Not Applicable
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
J = Estimated Value
C = Carcinogen
N = Noncarcinogen

EXAMPLE SCENARIO 5

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

Site Name

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Groundwater - Modeled 1 year into the future	Resident	Adult	Ingestion	Quant	Rationale
						Dermal	Quant	Rationale
			Groundwater - Modeled 2 Years into the Future	Resident	Adult	Ingestion	Quant	Rationale
						Dermal	Quant	Rationale
			Groundwater - Modeled 5 Years into the Future	Resident	Adult	Ingestion	Quant	Rationale
						Dermal	Quant	Rationale

EXAMPLE SCENARIO 6
OPTION 1

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Water/Sediment	Fish Tissue	Trout--Contaminant Uptake from Surface Water and Sediment	Receptor Population	Age 1	Ingestion	Quant	Rationale
					Age 2	Ingestion	Quant	Rationale

EXAMPLE SCENARIO 6
OPTION 2

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Water	Fish Tissue	Trout--Contaminant Uptake from Surface Water	Receptor Population	Age 1	Ingestion	Quant	Rationale
					Age 2	Ingestion	Quant	Rationale
	Sediment	Fish Tissue	Trout--Contaminant Uptake from Sediment	Receptor Population	Age 1	Ingestion	Quant	Rationale
					Age 2	Ingestion	Quant	Rationale

EXAMPLE SCENARIO 7

Option 1

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	7E-07		1E-07		8E-07	Liver	0.007		0.001	0.008
			Chloroform	5E-07		1E-08		5E-07	Liver	0.03		0.0006	0.03
			Chemical Total	1E-06		1E-07		1E-06		0.03		0.002	0.04
			Radionuclide Total										
		Exposure Point Total						1E-06					0.04
	Exposure Medium Total							1E-06					0.04
	Air	Water Vapors from Showerhead	Bis(2-ethylhexyl)phthalate		3E-08			3E-08					
			Chloroform		1E-05			1E-05	Liver		5		5
			Chemical Total		1E-05			1E-05			5		5
			Radionuclide Total										
		Exposure Point Total						1E-05					5
	Exposure Medium Total							1E-05					5
Groundwater Total								1E-05					5

EXAMPLE SCENARIO 7

Option 1

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDE	1E-06		1E-06		2E-06					
			4,4'-DDT	5E-06		5E-006		1E-005	Liver	0.08		0.08	0.2
			Chemical Total	6E-06		6E-06		1E-05		0.08		0.08	0.2
			Radionuclide Total										
		Exposure Point Total						1E-05					0.2
		Soil at Site 2	4,4'-DDE	8E-08		8E-08		2E-07					
			4,4'-DDT	5E-08		5E-08		1E-07	Liver	0.0009		0.0009	0.002
			Chemical Total	1E-07		1E-07		3E-07		0.0009		0.0009	0.002
			Radionuclide Total										
		Exposure Point Total						3E-07					0.002
	Exposure Medium Total							1E-05					0.002
Soil Total								1E-05					0.002
Receptor Total								2E-05					5

Total Risk Across All Media: 2E-05

Total Hazard Across All Media: 5

Total Liver HI Across All Media = 5

EXAMPLE SCENARIO 7
Option 2

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	7E-07	- -	1E-07	- -	8E-07	Liver	0.007	- -	0.001	0.008
			Chloroform	5E-07	- -	1E-08	- -	5E-07	Liver	0.03	- -	0.0006	0.03
			Chemical Total	1E-06	- -	1E-07	- -	1E-06		0.03	- -	0.002	0.04
			Radionuclide Total										
		Exposure Point Total						1E-06					0.04
	Air	Water Vapors from Showerhead	Bis(2-ethylhexyl)phthalate	- -	3E-08	- -	- -	3E-08	- -	- -	- -	- -	- -
			Chloroform	- -	1E-05	- -	- -	1E-05	Liver	- -	5	- -	5
			Chemical Total	- -	1E-05	- -	- -	1E-05		- -	5	- -	5
			Radionuclide Total										
		Exposure Point Total						1E-05					5
Soil	Soil	Soil at Site 1	4,4'-DDE	1E-06	- -	1E-06	- -	2E-06	- -	- -	- -	- -	- -
			4,4'-DDT	5E-06	- -	5E-006	- -	1E-005	Liver	0.08	- -	0.08	0.2
			Chemical Total	6E-06	- -	6E-06	- -	1E-05		0.08		0.08	0.2
			Radionuclide Total										
		Exposure Point Total						1E-05					0.2
		Soil at Site 2	4,4'-DDE	8E-08	- -	8E-08	- -	2E-07	- -	- -	- -	- -	- -
			4,4'-DDT	5E-08	- -	5E-08	- -	1E-07	Liver	0.0009	- -	0.0009	0.002
			Chemical Total	1E-07	- -	1E-07	- -	3E-07		0.0009		0.0009	0.002
			Radionuclide Total										
		Exposure Point Total						3E-07					0.002

Total Risk Across All Media: 2E-05

Total Hazard Across All Media = 5

Total Liver HI Across All Media = 5

EXAMPLE SCENARIO 7

Option 1

TABLE 10.1.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Water Vapors from Showerhead	Chloroform		1E-05			1E-05	Liver		5		5
			Chemical Total		1E-05			1E-05			5		5
			Radionuclide Total										
		Exposure Point Total						1E-05					5
	Exposure Medium Total							1E-05					5
Groundwater Total								1E-05					5
Soil	Soil	Soil at Site 1	4,4'-DDE	1E-06		1E-06		2E-06					
			4,4'-DDT	5E-06		5E-06		1E-05					
			Chemical Total	6E-06		6E-06		1E-05					
			Radionuclide Total										
		Exposure Point Total						1E-05					
	Exposure Medium Total							1E-05					
Soil Total								1E-05					
Receptor Total								2E-05					5

Total Risk Across All Media: 2E-05

Total Hazard Across All Media: 5

Cancer risks presented are those greater than 1E-06; Non-cancer risks presented are those greater than 1.

Total Liver HI Across All Media = 5

EXAMPLE SCENARIO 7

Option 2

TABLE 10.1.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Air	Water Vapors from Showerhead	Chloroform	- -	1E-05	- -	- -	1E-05	Liver	- -	5	- -	5
			Chemical Total	- -	1E-05	- -	- -	1E-05		- -	5	- -	5
			Radionuclide Total										
		Exposure Point Total						1E-05					5
Soil	Soil	Soil at Site 1	4,4'-DDE	1E-06	- -	1E-06	- -	2E-06	- -	- -	- -	- -	- -
			4,4'-DDT	5E-06	- -	5E-006	- -	1E-005	- -	- -	- -	- -	- -
			Chemical Total	6E-06	- -	6E-06	- -	1E-05		- -		- -	- -
			Radionuclide Total										
		Exposure Point Total						1E-05					- -

Total Risk Across All Media: 2E-05

Total Hazard Across All Media = 5

Cancer risks presented are those greater than 1E-06; Non-cancer risks presented are those greater than 1.

Total Liver HI Across All Media = 5

EXAMPLE SCENARIO 8

Option 1

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil	Soil	Soil at Site 1	Resident	Adult	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.
					Child	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.
					Child/Adult	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.

EXAMPLE SCENARIO 8

Option 2

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Soil	Soil	Soil at Site 1	Resident	Adult	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.
					Child	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.
					Child/Adult	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.

EXAMPLE SCENARIO 8
Option 1

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				IR	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989	
		Child/Adult	Soil at Site 1						Child/Adult cancer risks will be calculated as the sum of the Child cancer risk and the Adult cancer risk.

EXAMPLE SCENARIO 8
Option 1

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				CF1	Conversion Factor	1E-06	kg/mg		CS x CF1 x SA x AF x AB x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,000	cm2	EPA, 1997	
				AF	Soil to Skin Adherence Factor	0.19	mg/cm2	EPA, 1997	
				AB	Absorption Factor	chemical-specific	unitless	EPA, 1995	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				CF1	Conversion Factor	1E-06	kg/mg		CS x CF1 x SA x AF x AB x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	3,600	cm2	EPA, 1997	
				AF	Soil to Skin Adherence Factor	0.11	mg/cm2	EPA, 1997	
				AB	Absorption Factor	chemical-specific	unitless	EPA, 1995	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989	
		Child/Adult	Soil at Site 1						Child/Adult cancer risks will be calculated as the sum of the Child cancer risk and the Adult cancer risk.

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 1995: Assessing Dermal Exposure from Soil, Technical Guidance Manual, Region III, EPA/903-K-95-003.

EPA 1997: Exposure Factors Handbook, Volume 1. EPA/600/P-95/002Fa.

EXAMPLE SCENARIO 8
Option 2

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor	1.0E-06	kg/mg		
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				IR	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor	1.0E-06	kg/mg		
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989	
		Child/Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg/day) =
				IF	Ingestion Factor	114	mg-year/kg-day	EPA 1991b	CS x IF x CF x FI x EF x 1/AT
				BW-C	Body Weight, Child	15	kg	EPA, 1991a	where
				BW-A	Body Weight, Adult	70	kg	EPA, 1991a	IF = (ED-C x IR-C / BW-C) + (ED-TOT - ED-C) x
				IR-C	Ingestion Rate, Child	200	mg/day	EPA, 1991a	(IR-A / BW-A)
				IR-A	Ingestion Rate, Adult	100	mg/day	EPA, 1991a	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991a	
				ED-TOT	Exposure Duration, Total	30	years	EPA, 1991a	
				CF	Conversion Factor	1.0E-06	kg/mg		
				FI	Fraction Ingested	1	unitless	Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991a	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	

EXAMPLE SCENARIO 8
Option 2

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				CF1	Conversion Factor	1.0E-06	kg/mg		CS x CF1 x SA x AF x AB x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,000	cm2	EPA, 1997	
				AF	Soil to Skin Adherence Factor	0.19	mg/cm2	EPA, 1997	
				AB	Absorption Factor	chemical-specific	unitless	EPA, 1995	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				CF1	Conversion Factor	1.0E-06	kg/mg		CS x CF1 x SA x AF x AB x EF x ED x 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	3,600	cm2	EPA, 1997	
				AF	Soil to Skin Adherence Factor	0.11	mg/cm2	EPA, 1997	
				AB	Absorption Factor	chemical-specific	unitless	EPA, 1995	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989	

EXAMPLE SCENARIO 8
Option 2

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident (continued)	Child/Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				DF	Dermal Factor	3,154	cm2-year/kg-day	EPA 1991b	CS x CF1 x DF x AF x AB x EF x 1/AT
				BW-C	Body Weight, Child	15	kg	EPA, 1991a	where
				BW-A	Body Weight, Adult	70	kg	EPA, 1991a	DF = (ED-C x SA-C / BW-C) + (ED-TOT - ED-C) x
				SA-C	Surface Area, Child	3,600	cm2	EPA, 1997	(SA-A / BW-A)
				SA-A	Surface Area, Adult	5,000	cm2	EPA, 1997	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991a	
				ED-TOT	Exposure Duration, Total	30	years	EPA, 1991a	
				AF	Soil to Skin Adherence Factor	0.15	mg/cm2	Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA 1991a	
				AB	Absorption Factor	chemical-specific	unitless	EPA, 1995	
				CF1	Conversion Factor	1.0E-06	kg/mg		
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1991a: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 1991b: Human Health Evaluation Manual, Part B: Development of Risk-Based Preliminary Remediation Goals. OSWER Directive 9285.7-01B

EPA 1997: Exposure Factors Handbook, Volume 1. EPA/600/P-95/002Fa.

EPA 1995: Assessing Dermal Exposure from Soil, Technical Guidance Manual, Region III, EPA/903-K-95-003.

EXAMPLE SCENARIO 8
Option 1

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	2.1E-07	mg/kg/day	2.4E-01	1/mg/kg/day	5E-08	6.2E-07	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	3.2E-06	mg/kg/day	3.4E-01	1/mg/kg/day	1E-06	9.3E-06	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.3E-005	mg/kg/day	3.4E-01	1/mg/kg/day	5E-06	3.9E-05	mg/kg/day	5.0E-04	mg/kg/day	0.08
				Aluminum	9964	mg/kg	4.7E-003	mg/kg/day	NA	NA	NA	1.4E-02	mg/kg/day	1.0E+00	mg/kg/day	0.01
				Manganese	201	mg/kg	9.5E-005	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	1.4E-01	mg/kg/day	0.002
				Thallium	1.2	mg/kg	5.6E-007	mg/kg/day	NA	NA	NA	1.6E-06	mg/kg/day	NA	NA	NA
			Exp. Route Total								6E-06					0.09
			Dermal	4,4'-DDD	0.452	mg/kg	2.0E-007	mg/kg/day	2.7E-01	1/mg/kg/day	5E-08	5.9E-07	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	3.0E-06	mg/kg/day	3.8E-01	1/mg/kg/day	1E-06	8.8E-06	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.3E-005	mg/kg/day	3.8E-01	1/mg/kg/day	5E-06	3.7E-005	mg/kg/day	4.5E-004	mg/kg/day	0.08
				Aluminum	9964	mg/kg	4.5E-004	mg/kg/day	NA	NA	NA	1.3E-003	mg/kg/day	2.7E-001	mg/kg/day	0.005
				Manganese	201	mg/kg	9.0E-006	mg/kg/day	NA	NA	NA	2.6E-005	mg/kg/day	7.0E-03	mg/kg/day	0.004
				Thallium	1.2	mg/kg	5.3E-008	mg/kg/day	NA	NA	NA	1.5E-007	mg/kg/day	NA	NA	NA
			Exp. Route Total								6E-06					0.09
		Exposure Point Total									1E-05					0.2
	Expsoure Medium Total										1E-05					0.2
Soil Total											1E-05					0.2
									Total of Receptor Risks Across All Media		1E-05			Total of Receptor Hazards Across All Media		0.2

EXAMPLE SCENARIO 8
Option 1

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	5.0E-07	mg/kg/day	2.4E-01	1/mg/kg/day	1E-07	5.8E-06	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	7.4E-06	mg/kg/day	3.4E-01	1/mg/kg/day	3E-06	8.7E-05	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	3.1E-005	mg/kg/day	3.4E-01	1/mg/kg/day	1E-05	3.7E-004	mg/kg/day	5.0E-04	mg/kg/day	0.7
				Aluminum	9964	mg/kg	1.1E-002	mg/kg/day	NA	NA	NA	1.3E-001	mg/kg/day	1.0E+00	mg/kg/day	0.1
				Manganese	201	mg/kg	2.2E-004	mg/kg/day	NA	NA	NA	2.6E-003	mg/kg/day	1.4E-01	mg/kg/day	0.02
				Thallium	1.2	mg/kg	1.3E-006	mg/kg/day	NA	NA	NA	1.5E-005	mg/kg/day	NA	NA	NA
			Exp. Route Total								1E-05					0.8
			Dermal	4,4'-DDD	0.452	mg/kg	9.8E-08	mg/kg/day	2.7E-01	1/mg/kg/day	3E-08	1.1E-06	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	1.5E-06	mg/kg/day	3.8E-01	1/mg/kg/day	6E-07	1.7E-05	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	6.2E-006	mg/kg/day	3.8E-01	1/mg/kg/day	2E-06	7.2E-005	mg/kg/day	4.5E-004	mg/kg/day	0.2
				Aluminum	9964	mg/kg	2.2E-004	mg/kg/day	NA	NA	NA	2.5E-003	mg/kg/day	2.7E-001	mg/kg/day	0.009
				Manganese	201	mg/kg	4.4E-006	mg/kg/day	NA	NA	NA	5.1E-005	mg/kg/day	7.0E-003	mg/kg/day	0.007
				Thallium	1.2	mg/kg	2.6E-008	mg/kg/day	NA	NA	NA	3.0E-007	mg/kg/day	NA	NA	NA
			Exp. Route Total								3E-06					0.2
		Exposure Point Total									1E-05					1
	Exposure Medium Total										1E-05					1
Medium											1E-05					1
									Total of Receptor Risks Across All Media		1E-05			Total of Receptor Hazards Across All Media		1

EXAMPLE SCENARIO 8
Option 1

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	7.1E-07	mg/kg/day	2.4E-01	1/mg/kg/day	2E-07	- -	- -	- -	- -	- -
				4,4'-DDE	6.8	mg/kg	1.1E-05	mg/kg/day	3.4E-01	1/mg/kg/day	4E-06	- -	- -	- -	- -	- -
				4,4'-DDT	28.6	mg/kg	4.4E-05	mg/kg/day	3.4E-01	1/mg/kg/day	2E-05	- -	- -	- -	- -	- -
				Aluminum	9964	mg/kg	1.6E-02	mg/kg/day	NA	NA	NA	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	3.2E-05	mg/kg/day	NA	NA	NA	- -	- -	- -	- -	- -
				Thallium	1.2	mg/kg	1.9E-06	mg/kg/day	NA	NA	NA	- -	- -	- -	- -	- -
			Exp. Route Total								2E-05					- -
			Dermal	4,4'-DDD	0.452	mg/kg	3.0E-07	mg/kg/day	2.7E-01	1/mg/kg/day	8E-08	- -	- -	- -	- -	- -
				4,4'-DDE	6.8	mg/kg	4.5E-06	mg/kg/day	3.8E-01	1/mg/kg/day	2E-06	- -	- -	- -	- -	- -
				4,4'-DDT	28.6	mg/kg	1.9E-05	mg/kg/day	3.8E-01	1/mg/kg/day	7E-06	- -	- -	- -	- -	- -
				Aluminum	9964	mg/kg	6.7E-04	mg/kg/day	NA	NA	NA	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	1.3E-05	mg/kg/day	NA	NA	NA	- -	- -	- -	- -	- -
				Thallium	1.2	mg/kg	7.9E-08	mg/kg/day	NA	NA	NA	- -	- -	- -	- -	- -
			Exp. Route Total								9E-06	- -	- -	- -	- -	- -
		Exposure Point Total									3E-05					- -
	Exposure Medium Total										3E-05					- -
Medium											3E-05					- -
											Total of Receptor Risks Across All Media					Total of Receptor Hazards Across All Media

Note: Child/Adult cancer risk was calculated as the sum of the Child cancer risk (Table 7.2.RME) and the Adult cancer risk (Table 7.1.RME).

EXAMPLE SCENARIO 8
Option 2

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	2.1E-07	mg/kg/day	2.4E-01	1/mg/kg/day	5E-08	6.2E-07	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	3.2E-06	mg/kg/day	3.4E-01	1/mg/kg/day	1E-06	9.3E-06	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.3E-005	mg/kg/day	3.4E-01	1/mg/kg/day	5E-06	3.9E-05	mg/kg/day	5.0E-04	mg/kg/day	0.08
				Aluminum	9964	mg/kg	4.7E-003	mg/kg/day	NA	NA	NA	1.4E-02	mg/kg/day	1.0E+00	mg/kg/day	0.01
				Manganese	201	mg/kg	9.5E-005	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	1.4E-01	mg/kg/day	0.002
				Thallium	1.2	mg/kg	5.6E-007	mg/kg/day	NA	NA	NA	1.6E-06	mg/kg/day	NA	NA	NA
			Exp. Route Total								6E-06					0.09
			Dermal	4,4'-DDD	0.452	mg/kg	2.0E-007	mg/kg/day	2.7E-01	1/mg/kg/day	5E-08	5.9E-07	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	3.0E-06	mg/kg/day	3.8E-01	1/mg/kg/day	1E-06	8.8E-06	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.3E-005	mg/kg/day	3.8E-01	1/mg/kg/day	5E-06	3.7E-005	mg/kg/day	4.5E-004	mg/kg/day	0.08
				Aluminum	9964	mg/kg	4.5E-004	mg/kg/day	NA	NA	NA	1.3E-003	mg/kg/day	2.7E-001	mg/kg/day	0.005
				Manganese	201	mg/kg	9.0E-006	mg/kg/day	NA	NA	NA	2.6E-005	mg/kg/day	7.0E-03	mg/kg/day	0.004
				Thallium	1.2	mg/kg	5.3E-008	mg/kg/day	NA	NA	NA	1.5E-007	mg/kg/day	NA	NA	NA
			Exp. Route Total								6E-06					0.09
		Exposure Point Total									1E-05					0.2
	Exposure Medium Total										1E-05					0.2
Soil Total											1E-05					0.2
											Total of Receptor Risks Across All Media					
											1E-05					0.2
																Total of Receptor Hazards Across All Media

EXAMPLE SCENARIO 8
Option 2

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	5.0E-07	mg/kg/day	2.4E-01	1/mg/kg/day	1E-07	5.8E-06	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	7.4E-06	mg/kg/day	3.4E-01	1/mg/kg/day	3E-06	8.7E-05	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	3.1E-005	mg/kg/day	3.4E-01	1/mg/kg/day	1E-05	3.7E-004	mg/kg/day	5.0E-04	mg/kg/day	0.7
				Aluminum	9964	mg/kg	1.1E-002	mg/kg/day	NA	NA	NA	1.3E-001	mg/kg/day	1.0E+00	mg/kg/day	0.1
				Manganese	201	mg/kg	2.2E-004	mg/kg/day	NA	NA	NA	2.6E-003	mg/kg/day	1.4E-01	mg/kg/day	0.02
				Thallium	1.2	mg/kg	1.3E-006	mg/kg/day	NA	NA	NA	1.5E-005	mg/kg/day	NA	NA	NA
			Exp. Route Total								1E-05					0.8
			Dermal	4,4'-DDD	0.452	mg/kg	9.8E-08	mg/kg/day	2.7E-01	1/mg/kg/day	3E-08	1.1E-06	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	1.5E-06	mg/kg/day	3.8E-01	1/mg/kg/day	6E-07	1.7E-05	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	6.2E-006	mg/kg/day	3.8E-01	1/mg/kg/day	2E-06	7.2E-005	mg/kg/day	4.5E-004	mg/kg/day	0.2
				Aluminum	9964	mg/kg	2.2E-004	mg/kg/day	NA	NA	NA	2.5E-003	mg/kg/day	2.7E-001	mg/kg/day	0.009
				Manganese	201	mg/kg	4.4E-006	mg/kg/day	NA	NA	NA	5.1E-005	mg/kg/day	7.0E-003	mg/kg/day	0.007
				Thallium	1.2	mg/kg	2.6E-008	mg/kg/day	NA	NA	NA	3.0E-007	mg/kg/day	NA	NA	NA
			Exp. Route Total								3E-06					0.2
		Exposure Point Total									1E-05					1
	Exposure Medium Total										1E-05					1
Soil Total											1E-05					1
										Total of Receptor Risks Across All Media	1E-05				Total of Receptor Hazards Across All Media		1

EXAMPLE SCENARIO 8
Option 1

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	5E-08	- -	5E-08	- -	1E-07	- -	- -	- -	- -	- -
			4,4'-DDE	1E-06	- -	1E-06	- -	2E-06	- -	- -	- -	- -	- -
			4,4'-DDT	5E-06	- -	5E-06	- -	1E-05	Liver	0.08	- -	0.08	0.2
			Aluminum	- -	- -	- -	- -	- -	Central Nervous System	0.01	- -	0.005	0.02
			Manganese	- -	- -	- -	- -	- -	Central Nervous System	0.002	- -	0.004	0.006
			Thallium	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Chemical Total	6E-06	- -	6E-06	- -	1E-05		0.09	- -	0.09	0.2
			Radionuclide Total										
		Exposure Point Total						1E-05					0.2
	Exposure Medium Total							1E-05					0.2
Soil Total								1E-05					0.2
Receptor Total								1E-05					0.2

Total Risk Across All Media 1E-05

Total Hazard Across All Media 0.2

EXAMPLE SCENARIO 8
Option 2

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	5E-08	- -	5E-08	- -	1E-07	- -	- -	- -	- -	- -
			4,4'-DDE	1E-06	- -	1E-06	- -	2E-06	- -	- -	- -	- -	- -
			4,4'-DDT	5E-06	- -	5E-06	- -	1E-05	Liver	0.08	- -	0.08	0.2
			Aluminum	- -	- -	- -	- -	- -	Central Nervous System	0.01	- -	0.005	0.02
			Manganese	- -	- -	- -	- -	- -	Central Nervous System	0.002	- -	0.004	0.006
			Thallium	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Chemical Total	6E-06	- -	6E-06	- -	1E-05		0.09	- -	0.09	0.2
			Radionuclide Total										
		Exposure Point Total						1E-05					0.2
	Exposure Medium Total							1E-05					0.2
Soil Total								1E-05					0.2
Receptor Total								1E-05					0.2

Total Risk Across All Media 1E-05

Total Hazard Across All Media 0.2

EXAMPLE SCENARIO 8
Option 1

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	1E-07	- -	3E-08	- -	1E-07	- -	- -	- -	- -	- -
			4,4'-DDE	3E-06	- -	6E-07	- -	3E-06	- -	- -	- -	- -	- -
			4,4'-DDT	1E-05	- -	2E-06	- -	1E-05	Liver	0.7	- -	0.2	0.9
			Aluminum	- -	- -	- -	- -	- -	Central Nervous System	0.1	- -	0.009	0.1
			Manganese	- -	- -	- -	- -	- -	Central Nervous System	0.02	- -	0.007	0.03
			Thallium	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Chemical Total	1E-05	- -	3E-06	- -	1E-05		0.8	- -	0.2	1
			Radionuclide Total										
		Exposure Point Total						1E-05					1
	Exposure Medium Total							1E-05					1
Soil Total								1E-05					1
Receptor Total								1E-05					1

Total Risk Across All Media: 1E-05

Total Hazard Across All Media: 1

EXAMPLE SCENARIO 8
Option 2

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	1E-07	- -	3E-08	- -	1E-07	- -	- -	- -	- -	- -
			4,4'-DDE	3E-06	- -	6E-07	- -	3E-06	- -	- -	- -	- -	- -
			4,4'-DDT	1E-05	- -	2E-06	- -	1E-05	Liver	0.7	- -	0.2	0.9
			Aluminum	- -	- -	- -	- -	- -	Central Nervous System	0.1	- -	0.009	0.1
			Manganese	- -	- -	- -	- -	- -	Central Nervous System	0.02	- -	0.007	0.03
			Thallium	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Chemical Total	1E-05	- -	3E-06	- -	1E-05		0.8	- -	0.2	1
			Radionuclide Total										
		Exposure Point Total						1E-05					1
	Exposure Medium Total							1E-05					1
Soil Total								1E-05					1
Receptor Total								1E-05					1

Total Risk Across All Media: 1E-05

Total Hazard Across All Media: 1

EXAMPLE SCENARIO 8
Option 1

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	2E-07	- -	8E-08	- -	3E-07	- -	- -	- -	- -	- -
			4,4'-DDE	4E-06	- -	2E-06	- -	6E-06	- -	- -	- -	- -	- -
			4,4'-DDT	2E-05	- -	7E-06	- -	3E-05	- -	- -	- -	- -	- -
			Aluminum	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Manganese	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Thallium	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Chemical Total	2E-05	- -	9E-06	- -	3E-05		- -	- -	- -	- -
			Radionuclide Total										
		Exposure Point Total						3E-05					- -
	Exposure Medium Total							3E-05					- -
Soil Total								3E-05					- -
Receptor Total								3E-05					- -

Total Risk Across All Media: 3E-05

Total Hazard Across All Media: - -

Note: This table represents the residential lifetime cancer risk and was derived by combining the adult residential risks and the child residential risks.

EXAMPLE SCENARIO 8
Option 2

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	2E-07	- -	8E-08	- -	3E-07	- -	- -	- -	- -	- -
			4,4'-DDE	4E-06	- -	2E-06	- -	6E-06	- -	- -	- -	- -	- -
			4,4'-DDT	2E-05	- -	7E-06	- -	3E-05	- -	- -	- -	- -	- -
			Aluminum	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Manganese	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Thallium	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			Chemical Total	2E-05	- -	9E-06	- -	3E-05		- -	- -	- -	- -
			Radionuclide Total										
		Exposure Point Total						3E-05					- -
	Exposure Medium Total							3E-05					- -
Soil Total								3E-05					- -
Receptor Total								3E-05					- -

Total Risk Across All Media: 3E-05

Total Hazard Across All Media: - -

Note: Child/Adult cancer risk was calculated using age-adjusted exposure factor values.

EXAMPLE SCENARIO 9

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Timeframe	Soil	Animal Tissue (1)	Beef from cattle grazing in field	Population 1	Age 1	Route 1	Quant	Rationale
					Age 2	Route 1	Quant	Rationale
				Population 2	Age 1	Route 1	Quant	Rationale
					Age 2	Route 1	Quant	Rationale

(1) Modeled via plant uptake from soil and beef cattle ingestion of plants. See Appendix x for full details of modeling.

TABLE Y (RAGS D ADULT LEAD WORKSHEET)
Site Name: Example Site, Slag Pile 2
Receptor: Adult Worker, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration used in Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Soil	2000	mg/kg	Average Detected Value	750	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	EPA Interim Adult Lead Model (1996)
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	n/a
Where are the input values located in the risk assessment report?	Located in Appendix 5
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean soil concentration. Data are Located in Appendix 2
What was the point of exposure and location?	OU 3 Slag pile area
Where are the output values located in the risk assessment report?	Located in Appendix 5
What GSD value was used? If this is outside the recommended range of 1.8-2.1, provide rationale in Appendix <Y>.	1.8
What baseline blood lead concentration (PbB_0) value was used? If this is outside the default range of 1.7 to 2.2 provide rationale in Appendix <Y>.	2.0
Was the default exposure frequency (EF; 219 days/year) used?	Yes
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	Yes
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Located in Appendix 5

3. Final Result

Medium	Result	Comment/RBRG [1]
Soil	2000 ppm lead in soil results in >5% of receptors above a blood lead level of 10 ug/d and geometric mean blood lead = 11.6 ug/dL. This exceeds the blood lead goal as described in the 1994 OSWER Directive of no more than 5% of children (fetuses of exposed women) exceeding 10 ug/dL blood lead.	1500 ppm

1. Attach the ALM spreadsheet output file upon which the Risk Based Remediation Goal (RBRG) was based and description of rationale for parameters used. For additional information, see www.epa.gov/superfund/programs/lead

TABLE X (RAGS D IEUBK LEAD WORKSHEET)
Site Name: Example Site, Neighborhood 2
Receptor: Future Residential Child (Age 0 to 84 Months) Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration used in Model Run		Basis for Lead Concentration Used for Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Soil	1000	mg/kg	Average Detected Value	400	mg/kg	Recommended Soil Screening Level
Water	4	ug/L	Average Detected Value	15	ug/L	Recommended Drinking Water Action Level

2. Lead Model Questions

Question	**Response for Residential Lead Model**
What lead model (version and date) was used?	IEUBK version 0.99d, 1994
Where are the input values located in the risk assessment report?	Located in Appendix 3
What range of media concentrations were used for the model?	Refer to sampling data table 2
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean value of backyard and side yard. Data presented in Appendix 3.
Was soil sample taken from top 2 cm? If not, why?	Yes
Was soil sample sieved? What size screen was used? If not sieved, provide rationale.	Yes, 250 um
What was the point of exposure/location?	Residential yard in Neighborhood 2: back yard and side yard composite.
Where are the output values located in the risk assessment report?	Located in Appendix 3
Was the model run using default values only?	Yes, except for soil and dust concentration data.
Was the default soil bioavailability used?	Yes. Default is 30%
Was the default soil ingestion rate used?	Yes. Default values for 7 age groups are 85, 135, 135, 100, 090, and 85 mg/day
If non-default values were used, where are the rationale for the values located in the risk assessment report?	Located in Appendix 3

3. Final Result

Medium	**Result**	**Comment/PRG [1]**
Soil	Input value of 1000 ppm in soil (and MSA derived dust of 710 ppm) results in 42.7% of children 0-84 months above a blood lead level of 10 ug/dL. Geometric mean blood lead = 9.5 ug/dL. This exceeds the blood lead goal as described in the 1994 OSWER Directive of no more than 5% of children exceeding 10 ug/dL blood lead.	Based on site conditions, a PRG of 354 ppm in soil is indicated. This PRG is typically rounded to 400 ppm.

1. Attach the IEUBK text output file and graph upon which the PRG was based as an appendix. For additional information, see www.epa.gov/superfund/programs/lead

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

The Dean Company

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Aquifer 1--Tap Water	Resident	Adult	Dermal	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
						Ingestion	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
					Child	Dermal	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
						Ingestion	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
		Air	Water Vapors from Showerhead	Resident	Adult	Inhalation	Quant	Future onsite residents may rely on domestic wells drawing from Aquifer 1.
					Child	Inhalation	None	Children are assumed not to shower.
	Soil	Soil	Soil at Site 1	Resident	Adult	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.
						External (Radiation)	Quant	Future onsite residents may come into contact with soil.
					Child	Dermal	Quant	Future onsite residents may come into contact with soil.
						Ingestion	Quant	Future onsite residents may ingest soil.
						External (Radiation)	Quant	Future onsite residents may come into contact with soil.

EXAMPLE SCENARIO 11

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Aquifer 1 - Tap Water	117817	Bis(2-ethylhexyl)phthalate	2 J	5 J	ug/l	GW3D	4 / 12	3 - 4	5	NA	4.8 C	6	MCL	Y	ASL
	67663	Chloroform	0.6 J	9	ug/l	GW3D	3 / 12	1 - 1	9	NA	0.063 C	100	MCL	Y	ASL
	75150	Carbon Disulfide	0.3 J	4.5	ug/l	GW3D	3 / 12	1 - 1	4.5	NA	100 N	NA	NA	N	BSL
	76448	Heptachlor	2 J	33 J	ug/l	GW4D	6 / 12	0.01 - 0.01	33	NA	0.015 C	0.4	MCL	Y	ASL
	108883	Toluene	0.1 J	0.2 J	ug/l	GW3D	3 / 12	1 - 1	0.2	NA	75 N	1000	MCL	N	BSL
	7429905	Aluminum	134 J	1340	ug/l	GW3D	2 / 12	29 - 38.2	1340	NA	3700 N	50 - 200	SMCL	N	BSL
	7440393	Barium	65 J	489	ug/l	GW1D	6 / 12	0.2 - 1	489	NA	260 N	2000	MCL	Y	ASL
	7440417	Beryllium	0.2 K	1.5 K	ug/l	GW2D	3 / 12	0.1 - 1	1.5	NA	7.3 N	4	MCL	N	BSL
	7439921	Lead	6 J	35 J	ug/l	GW3D	4 / 12	0.1 - 1	35	NA	15	15	MCL	Y	ASL
	7439965	Manganese	1900	12500	ug/l	GW1D	6 / 12	0.3 - 1	12500	NA	73 N	50	SMCL	Y	ASL
	7440020	Nickel	0.9 J	1.5 J	ug/l	GW4D	3 / 12	0.9 - 7	1.5	NA	73 N	NA	NA	N	BSL
	7440611	Uranium	50	500	ug/l	GW1D	12 / 12	1 - 2	500	NA	11 N	NA	NA	Y	ASL
	7440611	Uranium 238	0.23	80	pCi/l	GW1D	12 / 12	NA	NA	NA	NA	NA	NA	Y	DET
	13982-63-3	Radium 226	0.2	11	pCi/l	GW1D	12 / 12	NA	NA	NA	NA	5	MCL	Y	DET

(1) Maximum concentration used for screening chemicals. No screening was conducted for radionuclides; all radionuclides detected are selected as COPCs.

(2) To date, no background study has been completed.

(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for tap water (cancer benchmark = 1E-06; HQ = 0.1). Lead was screened against the action level of 15 ug/l.

(4) Rationale Codes:

Selection Reason: Above Screening Level (ASL)
Detected at Site (DET)

Deletion Reason: Below Screening Level (BSL)

Definitions: NA = Not Applicable
MCL = Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
K = Estimated Value - Biased High
C = Carcinogen
N = Noncarcinogen

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Water Vapors	117817	Bis(2-ethylhexyl)phthalate	2 J	5 J	ug/l	GW3D	4 / 12	3 - 4	5	NA	4.8 C	6	MCL	Y	ASL
from SHowerhead	67663	Chloroform	0.6 J	9	ug/l	GW3D	3 / 12	1 - 1	9	NA	0.063 C	100	MCL	Y	ASL
	75150	Carbon Disulfide	0.3 J	4.5	ug/l	GW3D	3 / 12	1 - 1	4.5	NA	100 N	NA	NA	N	BSL
	76448	Heptachlor	2 J	33 J	ug/l	GW4D	6 / 12	0.01 - 0.01	33	NA	0.015 C	0.4	MCL	Y	ASL
	108883	Toluene	0.1 J	0.2 J	ug/l	GW3D	3 / 12	1 - 1	0.2	NA	75 N	1000	MCL	N	BSL
	7429905	Aluminum	134 J	1340	ug/l	GW3D	2 / 12	29 - 38.2	1340	NA	3700 N	50 - 200	SMCL	N	BSL
	7440393	Barium	65 J	489	ug/l	GW1D	6 / 12	0.2 - 1	489	NA	260 N	2000	MCL	Y	ASL
	7440417	Beryllium	0.2 K	1.5 K	ug/l	GW2D	3 / 12	0.1 - 1	1.5	NA	7.3 N	4	MCL	N	BSL
	7439921	Lead	6 J	35 J	ug/l	GW3D	4 / 12	0.1 - 1	35	NA	15	15	MCL	Y	ASL
	7439965	Manganese	1900	12500	ug/l	GW1D	6 / 12	0.3 - 1	12500	NA	73 N	50	SMCL	Y	ASL
	7440020	Nickel	0.9 J	1.5 J	ug/l	GW4D	3 / 12	0.9 - 7	1.5	NA	73 N	NA	NA	N	BSL
	7440611	Uranium	50	500	ug/l	GW1D	12 / 12	1 - 2	500	NA	11 N	NA	NA	Y	ASL
	7440611	Uranium 238	0.23	80	pCi/l	GW1D	12 / 12	NA	NA	NA	NA	NA	NA	Y	DET
	13982-63-3	Radium 226	0.2	11	pCi/l	GW1D	12 / 12	NA	NA	NA	NA	5	MCL	Y	DET

(1) Maximum concentration used for screening chemicals. No screening was conducted for radionuclides; all radionuclides detected are selected as COPCs.

(2) To date, no background study has been completed.

(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for tap water (cancer benchmark = 1E-06; HQ = 0.1). Lead was screened against the action level of 15 ug/l.

(4) Rationale Codes:

Selection Reason: Above Screening Level (ASL)
Detected at Site (DET)

Deletion Reason: Below Screening Level (BSL)

Definitions: NA = Not Applicable
MCL = Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
K = Estimated Value - Biased High
C = Carcinogen
N = Noncarcinogen

TABLE 2.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Soil at Site 1	11096825	Aroclor-1260	15 J	110 J	ug/kg	SS03	6 / 29	33 - 300	110	NA	320 C	NA	NA	N	BSL
	56553	Benzo(a)anthracene	120 J	230 J	ug/kg	SS03	16 / 29	330 - 700	230	NA	870 C	NA	NA	N	BSL
	50328	Benzo(a)pyrene	48 J	70 J	ug/kg	SS03	17 / 29	30 - 70	70	NA	87 C	NA	NA	N	BSL
	75150	Carbon Disulfide	2 J	33	ug/kg	SB07	4 / 29	10 - 16	33	NA	780000 N	NA	NA	N	BSL
	72548	4,4'-DDD	1 J	4200	ug/kg	SS09	22 / 29	3.3 - 1900	4200	NA	2700 C	NA	NA	Y	ASL
	72559	4,4'-DDE	0.44 J	7200 J	ug/kg	SS09	28 / 29	2.2 - 700	7200	NA	1900 C	NA	NA	Y	ASL
	50293	4,4'-DDT	0.69 J	290000 J	ug/kg	SB08	29 / 29	3.3 - 700	290000	NA	1900 C	NA	NA	Y	ASL
	108883	Toluene	1 J	2 J	ug/kg	SS08	2 / 29	10 - 16	2	NA	1600000 N	NA	NA	N	BSL
	7429905	Aluminum	1960	21700	mg/kg	SB07	29 / 29	6.3 - 11	21700	NA	7800 N	NA	NA	Y	ASL
	7440417	Beryllium	0.1 J	13.4	mg/kg	SS06	23 / 29	0.02 - 0.21	13.4	NA	16 N	NA	NA	N	BSL
	7439921	Lead	56 J	750 J	mg/kg	SS03	16 / 29	10 - 16	750	NA	400	NA	NA	Y	ASL
	7439965	Manganese	5.9	688	mg/kg	SS03	29 / 29	0.05 - 0.5	688	NA	160 N	NA	NA	Y	ASL
	7782492	Selenium	0.53 J	1	mg/kg	SS02	9 / 29	0.43 - 0.75	1	NA	39 N	NA	NA	N	BSL
	7440611	Uranium	50	700	mg/kg	SS03	17 / 29	1 - 2	700	NA	610 N	NA	NA	Y	ASL
	7440611	Uranium 238	0.3	110	pCi/g	SS03	29 / 29	0.2 - 0.3	NA	NA	NA	NA	NA	Y	DET
	13982-63-3	Radium 226	0.36	41	pCi/g	SS02	29 / 29	0.2 - 0.3	NA	NA	NA	NA	NA	Y	DET

(1) Maximum concentration used for screening chemicals. No screening was conducted for radionuclides; all radionuclides detected are selected as COPCs.

(2) To date, no background study has been completed.

(3) All compounds were screened against the Risk-Based Concentration (RBC) Table, U.S. EPA Region III, May 8, 2001 for residential soil (cancer benchmark = 1E-06; HQ = 0.1). Lead was screened against the U.S. EPA screening value of 400 mg/kg.

(4) Rationale Codes:

Selection Reason: Above Screening Level (ASL)
Detected at Site (DET)

Deletion Reason: Below Screening Level (BSL)

Definitions: NA = Not Applicable
J = Estimated Value
C = Carcinogen
N = Noncarcinogen

TABLE 3.1.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	ug/l	4	5.5 (T)	5 J	5	ug/l	Max	W-Test (1)
	Chloroform	ug/l	1.9	14.9 (T)	9	9	ug/l	Max	W-Test (1)
	Heptachlor	ug/l	27	30 (T)	33 J	30	ug/l	95% UCL - T	W - Test (2)
	Barium	ug/l	224	2835 (T)	489	489	ug/l	Max	W-Test (1)
	Lead	ug/l	21	32 (T)	35 J	32	ug/l	95% UCL - T	W - Test (2)
	Manganese	ug/l	6052	33449 (T)	12500	12500	ug/l	Max	W-Test (1)
	Uranium	ug/l	62	375 (T)	500	375	ug/l	95% UCL - T	W - Test (2)
	Uranium 238	pCi/l	3.2	8.3 (T)	80	8.3	pCi/l	95% UCL - T	W - Test (2)
	Radium 226	pCi/l	3.5	4 (T)	11	4	pCi/l	95% UCL - T	W - Test (2)

Statistics: Maximum Detected Value (Max); 95% UCL of Transformed Data (95% UCL - T)

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(2) Shapiro-Wilk W Test indicates data are lognormally transformed.

T = Transformed

J = Estimated Value

EXAMPLE SCENARIO 11

TABLE 3.2.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Water Vapors from Showerhead	Bis(2-ethylhexyl)phthalate	ug/l	4	5.5 (T)	5 J	5	ug/l	Max	W-Test (1)
	Chloroform	ug/l	1.9	14.9 (T)	9	9	ug/l	Max	W-Test (1)
	Heptachlor	ug/l	27	30 (T)	33 J	30	ug/l	95% UCL - T	W - Test (2)

Statistics: Maximum Detected Value (Max); 95% UCL of Transformed Data (95% UCL - T)

(1) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

(2) Shapiro-Wilk W Test indicates data are log-normally distributed.

T = Transformed

J = Estimated Value

TABLE 3.3.RME

EXPOSURE POINT CONCENTRATION SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Soil

Exposure Medium: Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Soil at Site 1	4,4'-DDD	ug/kg	239	452 (T)	4200	452	ug/kg	95 % UCL -T	W - Test (2)
	4,4'-DDE	ug/kg	596	6793 (T)	7200 J	6793	ug/kg	95% UCL - T	W - Test (2)
	4,4'-DDT	ug/kg	11007	28619 (N)	290000 J	28619	ug/kg	95% UCL - N	W - Test (1)
	Aluminum	mg/kg	7450	9964 (T)	21700	9964	mg/kg	95% UCL - T	W - Test (2)
	Lead	mg/kg	210	345 (T)	750 J	345	mg/kg	95% UCL - T	W - Test (2)
	Manganese	mg/kg	116	201 (T)	688	201	mg/kg	95% UCL - T	W - Test (2)
	Uranium	mg/kg	125	675 (T)	700	675	mg/kg	95% UCL - T	W - Test (2)
	Uranium 238	pCi/g	2.5	3.4 (T)	110	3.4	pCi/g	95% UCL - T	W - Test (2)
	Radium 226	pCi/g	3.1	3.9 (T)	41	3.9	pCi/g	95 % UCL - T	W- Test (2)

Statistics: 95% UCL of Normal Data (95% UCL - N); 95% UCL of Transformed Data (95% UCL - T)

(1) Shapiro-Wilk W Test indicates data are normally distributed.

(2) Shapiro-Wilk W Test indicates data are lognormally transformed.

N = Normal

T = Transformed

J = Estimated Value

EXAMPLE SCENARIO 11

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg/day) = CW x IR-W x EF x ED x 1/BW x 1/AT
				IR-W	Ingestion Rate of Water	2	l/day	EPA, 1991	
				EF	Exposure frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989a	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989a	
				CWR	Radionuclide Concentration in Water	See Table 3.1	pCi/l	See Table 3.1	Intake (pCi) = CWR x IR x EF x ED
				IR-W	Ingestion Rate of Water	2	l/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
		Child	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	CDI (mg/kg/day) = CW x IR-W x EF x ED x 1/BW x 1/AT
				IR-W	Ingestion Rate of Water	1	l/day	EPA, 1989b	
				EF	Exposure frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989a	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989a	
				CWR	Radionuclide Concentration in Water	See Table 3.1	pCi/l	See Table 3.1	Intake (pCi) = CWR x IR x EF x ED
				IR-W	Ingestion Rate of Water	1	l/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	

EXAMPLE SCENARIO 11

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				FA	Fraction Absorbed Water	Chemical Specific		EPA, 2001	DA-event x EV x ED x EF x SA x 1/BW x 1/AT
				Kp	Permeability Constant	Chemical Specific	cm/hr	EPA, 2001	where for organic compounds,
				SA	Skin Surface Area	18,000	cm2	EPA, 2001	Absorbed Dose per Event (DA-event) (mg/cm2-event) =
				tau-event	Lag time per event	Chemical Specific	hours/event	EPA, 2001	2 FA x Kp x CW x CF x SQRT{(6 x tau-event x t-event)/pi}
				t-event	Event Duration	0.58	hours/event	EPA, 2001	or
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	Chemical Specific		EPA, 2001	DA-event = FA x Kp x CW x {(t-event/(1 + B)) + 2 x tau-event x ((1 + (3 x B) + (3 x B x B))/(1 + B)2)} and where for inorganic compounds, DA-event = Kp x CW x CF x t-event
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Volumetric Conversion Factor for Water	0.001	l/cm3		
				BW	Body Weight	70	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 2001	

EXAMPLE SCENARIO 11

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident (continued)	Child	Aquifer 1 - Tap Water	CW	Chemical Concentration in Water	See Table 3.1	mg/l	See Table 3.1	DAD (mg/kg-day) =
				FA	Fraction Absorbed Water	Chemical Specific		EPA, 2001	DA-event x EV x ED x EF x SA x 1/BW x 1/AT
				Kp	Permeability Constant	Chemical Specific	cm/hr	EPA, 2001	where for organic compounds,
				SA	Skin Surface Area	6,600	cm2	EPA, 2001	DA-event (mg/cm2-event) =
				tau-event	Lag time per event	Chemical Specific	hours/event	EPA, 2001	2 FA x Kp x CW x CF x SQRT{(6 x tau-event x t-event)/pi}
				t-event	Event Duration	1	hours/event	EPA, 2001	or
				B	Ratio of permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	Chemical Specific		EPA, 2001	DA-event = FA x Kp x CW x {(t-event/(1 + B)) + 2 x tau-event x ((1 + (3 x B) + (3 x B x B))/(1 + B)2)} and where for inorganic compounds, DA-event = Kp x CW x CF x t-event
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	6	years	EPA, 2001	
				CF	Volumetric Conversion Factor for Water	0.001	l/cm3		
				BW	Body Weight	15	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 2001	

EPA 1989a: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1989b: Exposure Factors Handbook, July 1989, EPA/600/8-89/043.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 1992: Dermal Exposure Assessment: Principles and Applications. EPA/600/8-91/011B.

EPA 1997: Exposure Factors Handbook, Volume 1. EPA/600/P-95/002Fa.

EPA 2001: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.

EXAMPLE SCENARIO 11

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Medium: Groundwater

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation (1)	Resident	Adult	Water Vapors from Showerhead	(1)	(1)	(1)	(1)	(1)	Foster and Chrostowski Model

(1) Refer to the Risk Assessment text for details on the modeled intake methodology and parameters used to calculate modeled intake values for the Foster and Chrostowski Shower Model.

EXAMPLE SCENARIO 11

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 1989	
				CSR	Radionuclide Concentration in Soil	See Table 3.3	pCi/g	See Table 3.3	Intake (pCi) = CSR x IR x CF x EF X ED
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor	1.00E-03	g/mg		
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR x FI x EF x ED x CF1 x 1/BW x 1/AT
				FI	Fraction Ingested	1		Professional Judgment	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor	1E-06	kg/mg		
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 1989	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion (continued)	Resident (continued)	Child (continued)	Soil at Site 1 (continued)	CSR	Radionuclide Concentration in Soil	See Table 3.3	pCi/g	See Table 3.3	Intake (pCi) = CSR x IR x CF x EF X ED
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor	1.00E-03	g/mg		
Dermal	Resident	Adult	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	Dermal Absorbed Dose (DAD) (mg/kg-day) =
				CF	Conversion Factor	1E-06	kg/mg		DA-event x EF x ED x EV x SA X 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	5,700	cm2	EPA, 2001	where
				AF	Soil to Skin Adherence Factor	0.07	mg/cm2-event	EPA, 2001	Absorbed Dose per Event (DA-event) (mg/cm2-event) =
				ABS-d	Dermal Absorption Factor	chemical-specific	unitless	EPA, 2001	CS x CF x AF x ABS-d
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	8,760	days	EPA, 2001	
		Child	Soil at Site 1	CS	Chemical Concentration in Soil	See Table 3.3	mg/kg	See Table 3.3	DAD (mg/kg-day) =
				CF	Conversion Factor	1E-06	kg/mg		DA-event x EF x ED x EV x SA X 1/BW x 1/AT
				SA	Skin Surface Area Available for Contact	2,800	cm2	EPA, 2001	where
				AF	Soil to Skin Adherence Factor	0.2	mg/cm2-event	EPA, 2001	DA-event (mg/cm2-event) =
				ABS-d	Dermal Absorption Factor	chemical-specific	unitless	EPA, 2001	CS x CF x AF x ABS-d
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	6	years	EPA, 2001	
				BW	Body Weight	15	kg	EPA, 2001	
				AT-C	Averaging Time - Cancer	25,550	days	EPA, 2001	
				AT-N	Averaging Time - Non-Cancer	2,190	days	EPA, 2001	

EXAMPLE SCENARIO 11

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
External (Radiation)	Resident	Adult	Soil at Site 1	CSR	Radionuclide Concentration in Soil	See Table 3.3	pCi/g	See Table 3.3	External Exposure (pCi-year/g) =
				ET	Exposure Time	17	hrs/day		CSR x ET x EF x {(Fi x GSFi) + (Fo x GSFo)] x ED x CF
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				Fi	Time Fraction Indoors	0.75			
				Fo	Time Fraction Outdoors	0.25			
				GSFi	Gamma Shielding Factor Indoors	0.8			
				GSFo	Gamma Shielding Factor Outdoors	1			
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000114	years/hr		
		Child	Soil at Site 1	CSR	Radionuclide Concentration in Soil	See Table 3.3	pCi/g	See Table 3.3	External Exposure (pCi-year/g) =
				ET	Exposure Time	17	hrs/day		CSR x ET x EF x {(Fi x GSFi) + (Fo x GSFo)] x ED x CF
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				Fi	Time Fraction Indoors	0.875			
				Fo	Time Fraction Outdoors	0.125			
				GSFi	Gamma Shielding Factor Indoors	0.8			
				GSFo	Gamma Shielding Factor Outdoors	1			
				ED	Exposure Duration	6	years	EPA, 1991	
				CF	Conversion Factor	0.000114	years/hr		

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 1991: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

EPA 1995: Assessing Dermal Exposure from Soil, Technical Guidance Manual, Region III, EPA/903-K-95-003.

EPA 1997: Exposure Factors Handbook, Volume 1. EPA/600/P-95/002Fa.

EPA 2001: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.

NA = Not Available

EXAMPLE SCENARIO 11

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

The Dean Company

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absoprtion Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	NA	NA	NA	1	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	1	NA	NA	NA	NA	NA	NA
4,4'-DDT	Chronic	5.0E-004	mg/kg/day	1	5.0E-004	mg/kg/day	Liver	100	IRIS	06/21/2001
4,4'-DDT	Subchronic	5.0E-004	mg/kg/day	1	5.0E-004	mg/kg/day	Liver	100	HEAST	07/01/1997
Bis(2-ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000	IRIS	06/21/2001
Bis(2-ethylhexyl)phthalate	Subchronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000	HEAST	07/01/1997
Chloroform	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000	IRIS	06/21/2001
Chloroform	Subchronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000	HEAST	07/01/1997
Heptachlor	Chronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	300	IRIS	06/21/2001
Heptachlor	Subchronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	300	HEAST	07/01/1997
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	Central Nervous System	100	NCEA	06/21/2001
Barium	Chronic	7.0E-02	mg/kg/day	0.07	4.9E-03	mg/kg/day	Heart	3	IRIS	02/02/2001
Barium	Subchronic	7.0E-02	mg/kg/day	0.07	4.9E-03	mg/kg/day	Heart	3	HEAST	07/01/1997
Copper	Chronic	3.7E-02	mg/kg/day	1	3.7E-02	mg/kg/day	Gastrointestinal	NA	HEAST	07/01/1997
Copper	Subchronic	3.7E-02	mg/kg/day	1	3.7E-02	mg/kg/day	Gastrointestinal	NA	HEAST	07/01/1997
Iron	Chronic	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	Gastrointestinal	1	NCEA	06/21/2001
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	Chronic	2.0E-02	mg/kg/day	0.04	8.0E-04	mg/kg/day	Central Nervous System	1	IRIS	06/21/2001
Uranium	Chronic	3.0E-03	mg/kg/day	1	3E-003	mg/kg/day	Kidney	1000	IRIS	06/21/2001

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. Section 4.2 and Exhibit 4-1.

(2) See Risk Assessment text for the derivation of the "Absorbed RfD for Dermal".

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Table, July 1997

NCEA = National Center for Environmental Assessment

EXAMPLE SCENARIO 11

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

The Dean Company

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	Chronic	3.0E-04	mg/m3	8.6E-05	mg/kg/day	Nasal	1000	NCEA	06/21/2001
Chloroform	Subchronic	3.0E-03	mg/m3	8.6E-4	mg/kg/day	Nasal	100	NCEA	06/21/2001
Heptachlor	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	Chronic	5.0E-03	mg/m3	1.4E-03	mg/kg/day	Central Nervous System	300	NCEA	06/21/2001
Barium	Chronic	5.0E-04	mg/m3	1.4E-04	mg/kg/day	Fetus	1000	HEAST	07/01/1997
Barium	Subchronic	5.0E-03	mg/m3	1.4E-03	mg/kg/day	Fetus	100	HEAST	07/01/1997
Copper	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	Chronic	5.0E-05	mg/m3	1.4E-05	mg/kg/day	Central Nervous System	1000	IRIS	06/21/2001
Uranium	NA	NA	NA	NA	NA	NA	NA	NA	NA

(1) See Risk Assessment text for the derivation of the "Extrapolated RfD".

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Table, July 1997

NCEA = National Center for Environmental Assessment

EXAMPLE SCENARIO 11

TABLE 0

SITE RISK ASSESSMENT IDENTIFICATION INFORMATION

The Dean Company

Site Name/OU: The Dean Company
Region: III
EPA ID Number: PAD999999999
State: PA
Status: Fund Lead Remedial Investigation
Federal Facility (Y/N): N
EPA Project Manager: John Smith
EPA Risk Assessor: Jane Doe
Document Author: Mary Smith-Johnson
Document Title: Human Health Risk Assessment for the Dean Company Site
Document Date: August 8, 2001
Comments: This site is contaminated with both chemical and radioactive compounds.

EXAMPLE SCENARIO 11

TABLE 5.3

NON-CANCER TOXICITY DATA -- SPECIAL CASE CHEMICALS

The Dean Company

Chemical of Potential Concern	Chronic/ Subchronic	Parameter			Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	Parameter:Target Organ(s)	
		Name	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)

Not Applicable

There are no special case chemicals in this risk assessment. As a result, the table is blank.

EXAMPLE SCENARIO 11

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

The Dean Company

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	2.4E-01	1/mg/kg/day	1	2.4E-01	1/mg/kg/day	B2	IRIS	06/21/2001
4,4'-DDE	3.4E-01	1/mg/kg/day	1	3.4E-01	1/mg/kg/day	B2	IRIS	06/21/2001
4,4'-DDT	3.4E-001	1/mg/kg/day	1	3.4E-001	1/mg/kg/day	B2	IRIS	06/21/2001
Bis(2-ethylhexyl)phthalate	1.4E-02	1/mg/kg/day	1	1.4E-02	1/mg/kg/day	B2	IRIS	06/21/2001
Chloroform	6.1E-03	1/mg/kg/day	1	6.1E-03	1/mg/kg/day	B2	IRIS	06/21/2001
Heptachlor	4.5E+00	1/mg/kg/day	1	4.5E+00	1/mg/kg/day	B2	IRIS	06/21/2001
Aluminum	NA	NA	1	NA	NA	NA	NA	NA
Barium	NA	NA	0.07	NA	NA	NA	NA	NA
Copper	NA	NA	1	NA	NA	NA	NA	NA
Iron	NA	NA	1	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	NA	NA	0.04	NA	NA	NA	NA	NA
Uranium	NA	NA	NA	NA	NA	NA	NA	NA

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. Section 4.2 and Exhibit 4-1.

(2) See Risk Assessment text for the derivation of the "Absorbed Cancer Slope Factor for Dermal".

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

B2 = Probable Human Carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

TABLE 6.3

CANCER TOXICITY DATA -- SPECIAL CASE CHEMICALS

The Dean Company

Chemical of Potential Concern	Parameters			Source(s)	Date(s) (MM/DD/YYYY)
	Name	Value	Units		
Not Applicable					

There are no special case chemicals in this risk assessment. As a result, this table is blank.

EXAMPLE SCENARIO 11

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

The Dean Company

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA
4,4-DDE	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	9.7E-005	1/ug/m3	3.4E-001	1/mg/kg/day	B2	IRIS	06/21/2001
Bis(2-ethylhexyl)phthalate	NA	NA	NA	NA	NA	NA	NA
Chloroform	2.3E-05	1/ug/m3	8.1E-02	1/mg/kg/day	B2	IRIS	06/21/2001
Heptachlor	1.3E-03	1/ug/m3	4.5E+00	1/mg/kg/day	B2	IRIS	06/21/2001
Aluminum	NA	NA	NA	NA	NA	NA	NA
Barium	NA	NA	NA	NA	NA	NA	NA
Copper	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA
Lead	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	NA	NA	NA	NA	NA	NA	NA
Uranium	NA	NA	NA	NA	NA	NA	NA

Definitions: NA = Not Available

IRIS = Integrated Risk Information System

B2 = Probable Human Carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

EXAMPLE SCENARIO 11

TABLE 6.4

CANCER TOXICITY DATA -- EXTERNAL (RADIATION)

The Dean Company

Chemical of Potential Concern	Cancer Slope Factor		Source(s)	Date(s) (MM/DD/YYYY)
	Value	Units		
Uranium 238	6.2E-011	Risk/pCi	HEAST	07/01/1997
	5.3E-008	Risk/year per pCi/g soil	HEAST	07/01/1997
Radium 226	3.0E-010	Risk/pCi	HEAST	07/01/1997
	6.7E-006	Risk/year per pCi/g soil	HEAST	07/01/1997

HEAST = Health Effects Assessment Summary Table, July 1997

EXAMPLE SCENARIO 11

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Aquifer 1 - Tap Water	Ingestion	Bis(2-ethylhexyl)phthalate	0.005	mg/l	4.7E-005	mg/kg/day	1.4E-002	1/mg/kg/day	7E-007	1.4E-004	mg/kg/day	2.0E-002	mg/kg/day	0.007
				Chloroform	0.009	mg/l	8.5E-005	mg/kg/day	6.1E-003	1/mg/kg/day	5E-007	2.5E-004	mg/kg/day	1.0E-002	mg/kg/day	0.03
				Heptachlor	0.03	mg/l	2.8E-004	mg/kg/day	4.5E+000	1/mg/kg/day	1E-003	8.1E-004	mg/kg/day	5.0E-004	mg/kg/day	2
				Barium	0.489	mg/l	4.6E-003	mg/kg/day	NA	NA	NA	1.3E-002	mg/kg/day	7.0E-002	mg/kg/day	0.2
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	12.5	mg/l	1.2E-001	mg/kg/day	NA	NA	NA	3.4E-001	mg/kg/day	2.0E-002	mg/kg/day	17
				Uranium	0.375	mg/l	3.8E-05	mg/kg/day	NA	NA	NA	1.0E-02	mg/kg/day	3.0E-03	mg/kg/day	3
			Exp. Route Total								1E-003					22
			Dermal	Bis(2-ethylhexyl)phthalate	0.005	mg/l	7.2E-005	mg/kg/day	1.4E-002	1/mg/kg/day	1E-006	2.1E-004	mg/kg/day	2.2E-002	mg/kg/day	0.01
				Chloroform	0.009	mg/l	1.7E-004	mg/kg/day	6.1E-003	1/mg/kg/day	1E-006	4.9E-004	mg/kg/day	1.0E-002	mg/kg/day	0.05
				Heptachlor	0.03	mg/l	1.3E-004	mg/kg/day	4.5E+000	1/mg/kg/day	6E-004	3.9E-004	mg/kg/day	5.0E-004	mg/kg/day	0.8
				Barium	0.489	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	12.5	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Uranium	0.375	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								6E-004					0.9
		Exposure Point Total									2E-003					23
	Exposure Medium Total										2E-003					23
	Air	Water Vapors from	Inhalation	Bis(2-ethylhexyl)phthalate	0.005	mg/l	2.3E-006	mg/kg/day	NA	NA	NA	3.6E-006	mg/kg/day	NA	NA	NA
		Showerhead		Chloroform	0.009	mg/l	1.3E-004	mg/kg/day	8.1E-002	1/mg/kg/day	1E-005	3.9E-004	mg/kg/day	8.6E-005	mg/kg/day	5
				Heptachlor	0.03	mg/l	2.6E-004	mg/kg/day	4.5E+000	1/mg/kg/day	1E-003	7.7E-004	mg/kg/day	NA	NA	NA
			Exp. Route Total								1E-003					5
		Exposure Point Total									1E-003					5
	Exposure Medium Total										1E-003					5
Groundwater Total											3E-003					28

EXAMPLE SCENARIO 11

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future

Receptor Population: Resident

Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	2.1E-07	mg/kg/day	2.4E-01	1/mg/kg/day	5E-08	6.2E-07	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	3.2E-06	mg/kg/day	3.4E-001	1/mg/kg/day	1E-06	9.3E-06	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.3E-005	mg/kg/day	3.4E-001	1/mg/kg/day	5E-06	3.9E-05	mg/kg/day	5.0E-04	mg/kg/day	0.08
				Aluminum	9964	mg/kg	4.7E-003	mg/kg/day	NA	NA	NA	1.4E-02	mg/kg/day	1.0E+00	mg/kg/day	0.01
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	9.5E-005	mg/kg/day	NA	NA	NA	2.8E-04	mg/kg/day	1.4E-01	mg/kg/day	0.002
				Uranium	675	mg/kg	3.2E-004	mg/kg/day	NA	NA	NA	9.2E-04	mg/kg/day	3.0E-03	mg/kg/day	0.3
			Exp. Route Total								6E-06					0.4
			Dermal	4,4'-DDD	0.452	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	1.6E-006	mg/kg/day	3.4E-001	1/mg/kg/day	5E-007	4.7E-06	mg/kg/day	5.0E-04	mg/kg/day	0.009
				Aluminum	9964	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Uranium	675	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								5E-07					0.009
		Exposure Point Total									7E-006					0.4
	Exposure Medium Total										7E-006					0.4
Soil Total											7E-006					0.4
										Total of Receptor Risks Across All Media	3E-003				Total of Receptor Hazards Across All Media	28

(1) Lead is evaluated for the resident using the IEUBK model. See Risk Assessment text for discussion of results and appendix for the lead modeling run results.

EXAMPLE SCENARIO 11

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	Aquifer 1 - Tap Water	Ingestion	Bis(2-ethylhexyl)phthalate	0.005	mg/l	2.7E-005	mg/kg/day	1.4E-002	1/mg/kg/day	4E-007	3.2E-004	mg/kg/day	2.0E-002	mg/kg/day	0.02
				Chloroform	0.009	mg/l	4.9E-005	mg/kg/day	6.1E-003	1/mg/kg/day	3E-007	5.8E-004	mg/kg/day	1.0E-002	mg/kg/day	0.06
				Heptachlor	0.03	mg/l	1.6E-004	mg/kg/day	4.5E+000	1/mg/kg/day	7E-004	1.9E-003	mg/kg/day	5.0E-004	mg/kg/day	4
				Barium	0.489	mg/l	2.7E-003	mg/kg/day	NA	NA	NA	3.1E-002	mg/kg/day	7.0E-002	mg/kg/day	0.4
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	12.5	mg/l	6.8E-002	mg/kg/day	NA	NA	NA	8.0E-001	mg/kg/day	2.0E-002	mg/kg/day	40
				Uranium		mg/l	2.1E-003	mg/kg/day	NA	NA	NA	2.4E-002	mg/kg/day	3.0E-003	mg/kg/day	8
			Exp. Route Total								7E-004					52
			Dermal	Bis(2-ethylhexyl)phthalate	0.005	mg/l	3.1E-005	mg/kg/day	1.4E-002	1/mg/kg/day	4E-007	3.6E-004	mg/kg/day	2.2E-002	mg/kg/day	0.02
				Chloroform	0.009	mg/l	7.2E-005	mg/kg/day	6.1E-003	1/mg/kg/day	4E-007	8.4E-004	mg/kg/day	1.0E-002	mg/kg/day	0.08
				Heptachlor	0.03	mg/l	5.7E-005	mg/kg/day	4.5E+000	1/mg/kg/day	3E-004	6.7E-004	mg/kg/day	5.0E-004	mg/kg/day	1
				Barium	0.489	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	12.5	mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Uranium		mg/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								3E-004					1
		Exposure Point Total									1E-003					1
	Exposure Medium Total										1E-003					53
Groundwater Total											1E-003					53
Soil	Soil	Soil at Site 1	Ingestion	4,4'-DDD	0.452	mg/kg	5.0E-07	mg/kg/day	2.4E-01	1/mg/kg/day	1E-07	5.8E-06	mg/kg/day	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	7.4E-06	mg/kg/day	3.4E-001	1/mg/kg/day	3E-06	8.7E-05	mg/kg/day	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	3.1E-005	mg/kg/day	3.4E-001	1/mg/kg/day	1E-005	3.7E-004	mg/kg/day	5.0E-04	mg/kg/day	0.7
				Aluminum	9964	mg/kg	1.1E-002	mg/kg/day	NA	NA	NA	1.3E-001	mg/kg/day	1.0E+00	mg/kg/day	0.1
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	2.2E-004	mg/kg/day	NA	NA	NA	2.6E-003	mg/kg/day	1.4E-01	mg/kg/day	0.02
				Uranium		mg/kg	7.4E-004	mg/kg/day	NA	NA	NA	8.6E-003	mg/kg/day	3.0E-003	mg/kg/day	3
			Exp. Route Total								1E-005					4

EXAMPLE SCENARIO 11

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
Soil (continued)	Soil (continued)	Soil at Site 1 (continued)	Dermal	4,4'-DDD	0.452	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDE	6.8	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				4,4'-DDT	28.6	mg/kg	2.6E-006	mg/kg/day	3.4E-001	1/mg/kg/day	9E-007	3.1E-005	mg/kg/day	5.0E-004	mg/kg/day	0.06
				Aluminum	9964	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
				Lead (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
				Manganese	201	mg/kg	NA	NA	NA	NA	NA	NA	NA	MA	NA	NA
				Uranium		mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								9E-07					0.06
		Exposure Point Total									1E-005					4
	Exposure Medium Total										1E-005					4
Soil Total											1E-005					4
											Total of Receptor Risks Across All Media	1E-03				Total of Receptor Hazards Across All Media	57

(1) Lead is evaluated for the resident using the IEUBK model. See Risk Assessment text for discussion of results and appendix for the lead modeling run results.

TABLE 8.2

CALCULATION OF RADIATION CANCER RISKS

The Smith Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Radionuclide of Potential Concern	EPC		Risk Calculation Approach	Cancer Risk Calculations				
					Value	Units		Intake/External Dose		CSF/Conversion Factor		Cancer Risk
								Value	Units	Value	Units	
Groundwater	Groundwater	Aquifer 1 - Tap Water	Ingestion	Uranium 238	8.3E+000	pCi/l	USEPA RAGS	1.7E+004	pCi	6.2E-011	Risk/pCi	1E-006
				Radium 226	4.0E+000	pCi/l	USEPA RAGS	8.4E+003	pCi	3.0E-010	Risk/pCi	3E-006
			Exp. Route Total									4E-006
		Exposure Point Total										4E-006
	Exposure Medium Total											4E-006
Groundwater Total												4E-006
Soil	Soil	Soil at Site 1	Ingestion	Uranium 238	3.4E+000	pCi/g	USEPA RAGS	1.4E+003	pCi	6.2E-011	Risk/pCi	9E-008
				Radium 226	3.9E+000	pCi/g	USEPA RAGS	1.6E+003	pCi	3.0E-010	Risk/pCi	5E-007
			Exp. Route Total									6E-007
			External (Radiation)	Uranium 238	3.4E+000	pCi/g	USEPA RAGS	1.1E+001	pCi-yr/g	5.3E-008	Risk/yr per pCi/g soil	6E-007
				Radium 226	3.9E+000	pCi/g	USEPA RAGS	1.3E+001	pCi-yr/g	6.7E-006	Risk/yr per pCi/g soil	9E-005
			Exp. Route Total									9E-005
		Exposure Point Total										9E-005
	Exposure Medium Total											9E-005
Soil Total												9E-005
							Total of Receptor Risks Across All Media =					9E-005

EXAMPLE SCENARIO 11

RADIATION DOSE ASSESSMENT WORKSHEET

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Radionuclide of Potential Concern	EPC		Dose Approach	Internal/External Dose		Standard for	Conversion Factor			Risk
					Value	Units		Value	Units	Comparison(1)	Value	Units	Source	
Groundwater	Groundwater	Aquifer 1 -- Tap Water	Ingestion	Uranium 238	8.3E+000	pCi/l	NA	NA	NA	NA	NA	NA	NA	NA
				Radium 226	4.0E+000	pCi/l	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total					NA	NA					NA
		Exposure Point Total						NA	NA					NA
Soil	Soil	Soil at Site 1	Ingestion	Uranium 238	3.4E+000	pCi/g	NA	NA	NA	NA	NA	NA	NA	NA
				Radium 226	3.9E+000	pCi/g	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total											
			External (Radiation)	Uranium 238	3.4E+000	pCi/g	NA	NA	NA	NA	NA	NA	NA	NA
				Radium 226	3.9E+000	pCi/g	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total					NA	NA					NA
		Exposure Point Total						NA	NA					NA

NA = Not Applicable

Total of Receptor Dose Across All Media: NA NA

Total of Receptor Risks Across All Media: NA

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	7E-07		1E-06		2E-06	Liver	0.007		0.01	0.02
			Chloroform	5E-07		1E-06		2E-06	Liver	0.03		0.05	0.08
			Heptachlor	1E-03		6E-04		2E-03	Liver	2		0.8	3
			Barium						Heart	0.2			0.2
			Lead (1)										
			Manganese						Central Nervous System	17			17
			Uranium						Kidneys	3			3
			Chemical Total	1E-03		6E-04		2E-03		22		0.9	23
			Uranium 238	9E-06				9E-06					
			Radium 226	2E-05				2E-05					
			Radionuclide Total	3E-05				3E-05					
		Exposure Point Total						2E-03					23
	Exposure Medium Total							2E-03					23
	Air	Water Vapors from	Bis(2-ethylhexyl)phthalate										
		Showerhead	Chloroform		1E-05			1E-05	Liver		5		5
			Heptachlor		1E-03			1E-03					
			Barium										
			Lead (1)										
			Manganese										
			Uranium										
			Chemical Total		1E-03			1E-03			5		5
			Radionuclide Total										
		Exposure Point Total						1E-03					5
	Exposure Medium Total							1E-03					5

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater Total								3E-03					28

EXAMPLE SCENARIO 11

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	5E-08				5E-08					
			4,4'-DDE	1E-06				1E-06					
			4,4'-DDT	5E-06		5E-07		6E-06	Liver	0.08		0.009	0.09
			Aluminum						Central Nervous System	0.01			0.01
			Lead (1)										
			Manganese						Central Nervous System	0.002			0.002
			Uranium						Kidney	0.3			0.3
			Chemical Total	6E-06		5E-07		7E-06		0.4		0.009	0.4
			Uranium 238	2E-07			2E-06	2E-06					
			Radium 226	1E-006			4E-04	4E-04					
			Radionuclide Total	1E-06			4E-04	4E-04					
		Exposure Point Total						4E-04					0.4
	Exposure Medium Total							4E-04					0.4
Soil Total								4E-04					0.4
Receptor Total								3E-03					28

Total Risk Across All Media: 3E-03

Total Hazard Across All Media: 28

(1) Lead is evaluated for the resident using the IEUBK model. See Risk Assessment text for discussion of results and appendix for the lead modeling run results.

Total Liver HI Across All Media = 8
Total Kidney HI Across All Media = 3
Total Central Nervous System HI Across All Media = 17

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	4E-07		4E-07		8E-07	Liver	0.02		0.02	0.04
			Chloroform	3E-07		4E-07		7E-07	Liver	0.06		0.08	0.1
			Heptachlor	7E-04		3E-04		1E-03	Liver	4		1	5
			Barium						Heart	0.4			0.4
			Lead (1)										
			Manganese						Central Nervous System	40			40
			Uranium						Kidney	8			8
			Chemical Total	7E-04		3E-04		1E-03		52		1	53
			Uranium 238	1E-06				1E-06					
			Radium 226	3E-06				3E-06					
			Radionuclide Total	4E-06				4E-06					
		Exposure Point Total						1E-03					53
	Exposure Medium Total							1E-03					53
Groundwater Total								1E-03					53

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil at Site 1	4,4'-DDD	1E-07				1E-07					
			4,4'-DDE	3E-06				3E-06					
			4,4'-DDT	1E-05		9E-07		1E-05	Liver	0.7		0.06	0.8
			Aluminum						Central Nervous System	0.1			0.1
			Lead (1)										
			Manganese						Central Nervous System	0.02			0.02
			Uranium						Kidney	3			3
			Chemical Total	1E-05		9E-07		1E-05		4		0.06	4
			Uranium 238	9E-08			6E-07	7E-07					
			Radium 226	5E-07			9E-05	9E-05					
			Radionuclide Total	6E-07			9E-05	9E-05					
		Exposure Point Total						1E-04					4
	Exposure Medium Total							1E-04					4
Soil Total								1E-04					4
Receptor Total								1E-03					57

Total Risk Across All Media 1E-03

Total Hazard Across All Media 57

(1) Lead is evaluated for the resident using the IEUBK model. See Risk Assessment text for discussion of results and appendix for the lead modeling run results.

Total Liver HI Across All Media = 6
Total Kidney HI Across All Media = 11
Total Central Nervous System HI Across All Media = 40

EXAMPLE SCENARIO 11

TABLE 10.1.RME

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Bis(2-ethylhexyl)phthalate	7E-07		1E-06		2E-06					
			Chloroform	5E-07		1E-06		2E-06					
			Heptachlor	1E-03		6E-04		2E-03	Liver	2		0.8	3
			Manganese						Central Nervous System	17			17
			Uranium						Kidney	3			3
			Chemical Total	1E-03		6E-04		2E-03		22		0.8	23
			Uranium 238	9E-06				9E-06					
			Radium 226	2E-05				2E-05					
			Radionuclide Total	3E-05				3E-05					
		Exposure Point Total						2E-03					23
	Exposure Medium Total							2E-03					23
	Air	Water Vapors from Showerhead	Chloroform		1E-05			1E-05	Liver		5		5
			Heptachlor		1E-03			1E-03					
			Chemical Total		1E-03			1E-03			5		5
			Radionuclide Total										
		Exposure Point Total						1E-03					5
	Exposure Medium Total							1E-03					5
Groundwater Total								3E-03					28

EXAMPLE SCENARIO 11

TABLE 10.1.RME

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External	Exposure	Primary	Ingestion	Inhalation	Dermal	Exposure
Soil	Soil	Soil at Site 1	4,4'-DDE	1E-06		'- -		1E-06					
			4,4'-DDT	5E-06		5E-007		6E-06					
			Chemical Total	6E-06		5E-07		7E-06					
			Uranium 238	2E-07			2E-06	2E-06					
			Radium 226	1E-006			4E-04	4E-04					
			Radionuclide Total	1E-06			4E-04	4E-04					
		Exposure Point Total						4E-04					
	Exposure Medium Total							4E-04					
Soil Total								4E-04					
Receptor Total								3E-03					28

Total Risk Across All Media: 3E-03

Total Hazard Across All Media: 28

Total Liver HI Across All Media = 8

Total Kidney HI Across All Media = 3

Total Central Nervous System HI Across All Media = 17

Cancer risks presented are those greater than 1E-06; Non-cancer risks presented are those greater than 1.

EXAMPLE SCENARIO 11

TABLE 10.2.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
The Dean Company

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Aquifer 1 - Tap Water	Heptachlor	7E-04	--	3E-04	--	1E-03	Liver	4	--	1	5
			Manganese	--	--	--	--	--	Central Nervous System	40	--	--	40
			Uranium	--	--	--	--	--	Kidney	8	--	--	8
			Chemical Total	7E-04	--	3E-04	--	1E-03		52	--	1	53
			Uranium 238	1E-06	--	--	--	1E-06					
			Radium 226	3E-06	--	--	--	3E-06					
			Radionuclide Total	4E-06	--	--	--	4E-06					
		Exposure Point Total						1E-03					53
	Exposure Medium Total							1E-03					53
Groundwater Total								1E-03					53
Soil	Soil	Soil at Site 1	4,4'-DDE	3E-006	--	--	--	3E-06	--	--	--	--	--
			4,4'-DDT	1E-05	--	9E-07	--	1E-05	--	--	--	--	--
			Uranium	--	--	--	--	--	Kidney	3	--	--	3
			Chemical Total	1E-05	--	9E-07	--	1E-05		3	--	--	3
			Radium 226	5E-07	--	--	9E-05	9E-05					
			Radionuclide Total	6E-07	--	--	9E-05	9E-05					
		Exposure Point Total						1E-04					3
	Exposure Medium Total							1E-04					3
Soil Total								1E-04					3
Receptor Total								1E-03					56

Total Risk Across All Media: 1E-03

Total Hazard Across All Media: 56

Total Liver HI Across All Media = 5
Total Kidney HI Across All Media = 11
Total Central Nervous System HI Across All Media = 40

Cancer risks presented are those greater than 1E-06; Non-cancer risks presented are those greater than 1.