6.0 WRITING THE RECORD OF DECISION

6.1 INTRODUCTION

This chapter presents a recommended structure for preparing a ROD and is accompanied by an outline and checklist, which can be found at the end of the chapter. Sample language and summary tables are also provided to illustrate how information should be presented in the ROD and the suggested level of detail. This recommended structure can be modified, where appropriate, on a site-specific basis. However, it is recommended that RODs be consistent with the general format and content presented in this chapter. Since RODs serve as the primary data source for all parties interested in site cleanup, a consistent format enhances the predictability of where to find site information in the document.

This chapter applies specifically to decision documents prepared for final response actions that are planned either for a site or an operable unit. Chapter 8 outlines the modifications to the standard format (as outlined in this chapter) that should be made when documenting "no action," "interim action," or "contingency" response decisions. Other specific cases that may require modifications to this standard format are discussed in Chapter 9.

6.1.1 Purpose of the Record of Decision

The ROD documents the selected remedial action for a site or operable unit. It is prepared by the lead agency in consultation with the support agency. The ROD serves as:

- A legal document in that it certifies that the remedy selection process was carried out in accordance with CERCLA and, to the extent practicable, in accordance with the NCP.[1]

- A substantive summary of the technical rationale and background information contained in the Administrative Record file (*e.g.*, RI/FS including the baseline risk assessment).

- A technical document that provides information necessary for determining the conceptual engineering components, and which outlines the remedial action objectives and cleanup levels for the Selected Remedy.

- A key communication tool for the public that explains the contamination problems the remedy seeks to address and the rationale for its selection.

6.1.2 Regulatory Requirements for the Content of the Record of Decision

The NCP directs the lead agency to produce a ROD documenting all facts, analyses of facts, and site-specific policy determinations considered in the course of selecting a remedial action, and how the nine remedy selection criteria were used to select the remedy (NCP §300.430(f)(5)(i)).

The ROD also describes the following statutory requirements as they relate to the scope and objectives of the remedial action (NCP §300.430(f)(5)(ii)).

- How the selected remedy is protective of human health and the environment, explaining how the remedy eliminates, reduces, or controls exposures to human and environmental receptors.

- The federal and state requirements that are applicable or relevant and appropriate to the site that the remedy will attain.

- The applicable or relevant and appropriate requirements of other federal and state laws that the remedy will not meet, the waiver invoked, and the justification for invoking the waiver.

- How the remedy is cost-effective, (*i.e.*, explaining how the remedy provides overall effectiveness proportional to its costs).

- How the remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

[1] Section 121(a) of CERCLA provides that remedial actions should be carried out in accordance with §121 "and, to the extent practicable, the National Contingency Plan."

- Whether the preference for remedies employing treatment that permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants as a principal element is, or is not, satisfied by the selected remedy. If this preference is not satisfied, the ROD must explain why a remedial action involving such reductions in toxicity, mobility, or volume was not selected.

As stated in NCP §300.430(f)(5)(iii), the ROD also must:

- Indicate the remediation goals (*i.e.*, cleanup levels) that the remedy is expected to achieve. Remediation goals shall establish acceptable exposure levels that are protective of human health and the environment.

- Discuss significant changes and the response to public comments received on the Proposed Plan.

- Describe whether hazardous substances, pollutants, or contaminants will remain at the site above levels that allow for unlimited use and unrestricted exposure such that a five-year review will be required.

- When appropriate, provide a commitment for further analysis and selection of long-term response measures within an appropriate time frame.

6.1.3 Major Components of the Record of Decision

The three basic components of the ROD (see Highlight 6-1) are as follows:

- *The Declaration* functions as an abstract and data certification sheet for the key information in the ROD and is the formal authorizing signature page for the ROD.

- *The Decision Summary* provides an overview of the site characteristics, alternatives evaluated, and the analysis of those options. It also identifies the Selected Remedy and explains how the remedy fulfills statutory and regulatory requirements.

- *The Responsiveness Summary* serves the dual purposes of: (1) presenting stakeholder concerns about the site and preferences regarding the remedial alternatives; and (2) explaining how those concerns were addressed and the preferences were factored into the remedy selection process.

Highlight 6-1: Recommended Outline for Standard Recordof Decision*

PART 1: DECLARATION
- Site Name and Location
- Statement of Basis and Purpose
- Assessment of Site
- Description of Selected Remedy
- Statutory Determinations
- ROD Data Certification Checklist
- Authorizing Signatures

PART 2: DECISION SUMMARY
- Site Name, Location, and Brief Description
- Site History and Enforcement Activities
- Community Participation
- Scope and Role of Operable Unit or Response Action
- Site Characteristics
- Current and Potential Future Site and Resource Uses
- Summary of Site Risks
- Remedial Action Objectives
- Description of Alternatives
- Comparative Analysis of Alternatives
- Principal Threat Waste
- Selected Remedy
- Statutory Determinations
- Documentation of Significant Changes

PART 3: RESPONSIVENESS SUMMARY
- Stakeholder Comments and Lead Agency Responses
- Technical and Legal Issues

* See the expanded outline/checklist at the end of Chapter 6.

6.2 SECTION-BY-SECTION DESCRIPTION OF THE DECLARATION

The *Declaration* functions as an abstract and data certification sheet for the key information in the ROD and is the formal authorizing signature page for the ROD.

6.2.1 Site Name and Location

The proper site name (as it is listed on the NPL) and the town or county, Indian Reservation or Tribe, and State in which the site is located should be included in the *Declaration*. The National Superfund Database (*e.g.*, CERCLIS) identification number should also be provided. If the site is divided into operable units to facilitate site management, the name and number of the operable units addressed by the ROD should be provided.

6.2.2 Statement of Basis and Purpose

The lead agency must explain the factual and legal basis for selecting a particular remedy. The ROD serves as this statement of basis and purpose, and the *Declaration* formally certifies this information. In addition, this section of the *Declaration* should state that the information supporting the lead and support agencies' decisions on the Selected Remedy is contained in the Administrative Record file.

This section should also specify whether the State concurs or does not concur with the Selected Remedy. Highlight 6-2 provides standard language for the statement of basis and purpose.

Highlight 6-2: Standard Language for Statement of Basis and Purpose

This decision document presents the Selected Remedy for the (site name), in (location), which was chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the NCP. This decision is based on the Administrative Record file for this site.

The State/Commonwealth of _____ concurs/does not concur) with the Selected Remedy.

6.2.3 Assessment of the Site

The *Declaration* should include a statement that identifies the existence of a release or substantial threat of release of hazardous substances into the environment and that states that the response action selected in the ROD is necessary to protect public health or welfare or the environment (CERCLA §104(a)). Standard language for this section is presented in Highlight 6-3 and should be included in all RODs where a response action is planned.[2]

6.2.4 Description of the Selected Remedy

The Selected Remedy should be identified and briefly described in terms of the following:

- A brief explanation of the overall site cleanup strategy. If the action is one of several oper-

Highlight 6-3: Standard Language for Assessment of the Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

****

If the site is contaminated with only pollutants or contaminants (in accordance with the definitions contained in NCP §300.5), then the following standard language should be used:

The response action selected in this Record of Decision is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

****

If the response action will address both hazardous substances and pollutants or contaminants, a combination of the two examples of standard language may be necessary.

[2] When a No Action decision is made, the following language is recommended "The lead agency has determined that no action is necessary to protect public health or welfare or the environment."

able units, briefly explain how this action fits into the overall site management plan. Include the intended sequence and timing of the operable units and identify the selected performance standards.

- A brief description of how the selected response action addresses source materials constituting principal threats at the site (See Section 6.3.11 and Highlight 6-26 for definitions and examples of principal threat wastes).

- A brief description, in bullet form, of the major components of the Selected Remedy. This discussion should include the treatment technologies and/or engineering controls that will be used, as well as any institutional controls that will be used and the entities responsible for implementing and enforcing them (*e.g.*, land use zoning restrictions enforced by town planning board).[3]

6.2.5 Statutory Determinations

The ROD Declaration shall conclude with the finding that the Selected Remedy satisfies the statutory requirements of CERCLA. This can be accomplished by making confirmatory statements that the Selected Remedy attains the mandates of CERCLA §121, and, to the extent practicable, the NCP. Specifically, the remedy must do the following: (1) Be protective of human health and the environment; (2) Comply with ARARs (or justify a waiver); (3) Be cost-effective; (4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; (5) Satisfy the preference for treatment as a principal element of the remedy which permanently and significantly reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants.[4]

In addition, this section of the *Declaration* must also discuss the applicability of the five-year review. NCP §300.430(f)(4)(ii) requires a five-year review if the remedial action results in hazardous substances, pollutants or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. This review evaluates whether such a remedy is protective of human health and the environment and is required no less often than every five years after the date of such remedy.

Standard language is provided in Highlight 6-4. This standard language is provided in three main parts. Part 1 affirms that the Selected Remedy satisfies CERCLA §121 requirements. Part 2 indicates whether or not the remedy satisfies the statutory preference for treatment as a principal element. Part 3 indicates whether or not a five-year review is applicable.

6.2.6 ROD Data Certification Checklist

The *Declaration* should also contain a data certification checklist which certifies that the ROD contains certain key remedy selection information (see Highlight 6-5). This data certification checklist fulfills a commitment made by EPA to the General Accounting Office to ensure that RODs contain certain key remedy selection information. If the ROD Outline/Checklist recommended in this guidance document is used when preparing the ROD (including the information summary tables provided in this Chapter), the information on the ROD Data Certification Checklist will be captured in the document. References to page numbers where the information can be found in the body of the

[3] Engineering controls are physical barriers to exposure and do not include institutional controls, which are non-engineering methods intended to affect human activities in such a way as to prevent or reduce exposure to hazardous substances (*e.g.*, deed restrictions such as easements and covenants, deed notices, land use restrictions such as zoning and local permitting, ground-water use restrictions, and public health advisories).

[4] If the remedy does not meet the statutory preference for treatment, then the *Statutory Determinations* section of the *Declaration* must include a statement to this effect and summarize the rationale for choosing a remedy that does not contain treatment as a principal element (NCP §300.430(f)(5)(ii)(F)). This rationale could be based on: 1) the specific factors used to determine that the treatment is impracticable, such as technical infeasibility, inadequate short-term protection of human health and the environment, unavailability of necessary capacity, equipment, or specialists, or extraordinarily high costs; and 2) the fact that no source materials constituting principal threats will be addressed within the scope of this action. In addition, a brief statement asserting that past or future operable units have met or will meet the statutory preference for treatment should be included, when appropriate.

Highlight 6-4: Standard Language for Statutory Determinations

Part 1: Statutory Requirements

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action (unless justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

Part 2: Statutory Preference for Treatment

This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

OR

The remedy in this OU does not satisfy the statutory preference for treatment as a principal element of the remedy for the following reasons . . ..

Part 3: Five-Year Review Requirements

Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a five-year review will not be required for this remedial action.*

OR

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

* *If no statutory five-year review is required, but a policy five-year review is recommended pursuant to EPA five-year review guidance, the following standard language should be included in the declaration:* Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, but it will take more than five years to attain remedial action objectives and cleanup levels, a policy review may be conducted within five years of construction completion for the site to ensure that the remedy is, or will be, protective of human health and the environment.

document can also be added so that the checklist serves as a "roadmap" to key information in the ROD.

If these data elements are not included in the ROD, an explanation should be provided in the Declaration as well. This information may also be required for data entry into WasteLan (or the current Superfund electronic database). This guidance recommends the inclusion of this data verification form in the *Declaration*.[5]

6.2.7 Authorizing Signatures and Support Agency Acceptance of Remedy

The *Declaration* also serves as the formal authorizing signature page for the ROD. All CERCLA-funded or -authorized RODs are signed and dated by the Regional Administrator or the Assistant Administrator of OSWER at EPA Headquarters (or by those to whom this signature authority has been delegated). Where EPA is the lead agency, the support agency must also be given the opportunity to concur/nonconcur with the remedy selected in the ROD, and if appropriate, co-sign the ROD with EPA. Where a Federal agency other than EPA (*e.g.,* DOE or DOD) is the lead agency at an NPL site, that agency should co-sign the ROD with EPA as well. (See Highlight 6-6 and Chapter 5 for a more complete discussion of lead/support agency interactions in developing the ROD.)

[5] An alternative to including this information in the Declaration is to develop a one-page data certification sheet for the Waste Management Division Director's signature to be attached to the ROD and included in the Administrative Record file.

Highlight 6-5: Standard Language for ROD Data Certification Checklist

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this site.

- Chemicals of concern and their respective concentrations.
- Baseline risk represented by the chemicals of concern.
- Cleanup levels established for chemicals of concern and the basis for these levels.
- How source materials constituting principal threats are addressed.
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD.
- Potential land and ground-water use that will be available at the site as a result of the Selected Remedy.
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.
- Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision).

[Note: Add references to page numbers, if appropriate.]

Highlight 6-6: Notes on ROD Authorizing Signatures

When a State regulatory agency is the lead agency for developing and preparing the ROD for a Fund-financed or CERCLA enforcement-lead site, the director of the State regulatory agency or Chairman of the Indian Tribe or Nation should co-sign the ROD with EPA. In these cases, EPA must concur and adopt the ROD before a State can proceed with a Fund-financed remedial action (NCP Section 300.515(e)(2)(ii)) or use CERCLA authority to achieve a PRP-lead remedial action. When the State is the support agency, the State's signature on the ROD is optional (i.e., the SMOA may or may not provide for such a signature). At a minimum, a letter from the State specifying concurrence or nonconcurrence should always be included in the Administrative Record file.

Where a Federal agency other than EPA (e.g., DOE or DOD) is the lead agency at an NPL site, that agency should co-sign the ROD with EPA as well.

Although the goal of the interactions between the lead and support agencies is to reach mutual agreement on the ROD, there may be limited instances in which this is not achieved. In such an event, the procedures for selecting and implementing the remedy depend on who has the lead responsibility for the ROD. If EPA has the lead, and the State does not concur with the Selected Remedy, then EPA has the discretionary authority to sign the ROD and continue with the remedy using Fund monies or enforcement authority through the remedial design stage. EPA cannot proceed with a remedial action without the State's cost-share for Fund-financed remedial actions. However, where PRPs are conducting the RA, the RA can proceed.

If the State is the lead for an action using Fund monies or based on CERCLA enforcement authorities and EPA does not concur with the Selected Remedy, EPA can assume the lead for the ROD and proceed with an EPA-Selected Remedy (through the RD stage for Fund-financed remedial actions). In either case, all non-privileged information pertaining to the disagreement should be included in the Administrative Record file. Where the State has been designated as the lead agency for a non-Fund-financed State-lead enforcement response action (i.e., actions taken under State law) at an NPL site, the State may select a remedy without EPA's concurrence.

It should be noted that EPA retains the authority to sign RODs at NPL sites owned/operated by Federal agencies.

(See Chapter 5 for a more complete discussion of lead/support agency interactions in developing the ROD.)

6.3 SECTION-BY-SECTION DESCRIPTION OF THE DECISION SUMMARY

The *Decision Summary* provides an overview of the site characteristics, alternatives evaluated, and the analysis of those options. It also identifies the Selected Remedy and explains how the remedy fulfills statutory and regulatory requirements.

Although some of the information in the *Decision Summary* is similar to that in the *Declaration*, this section discusses the topics in greater detail and provides the rationale for those "summary declarations." The appropriate level of detail for the *Decision Summary* will depend on the complexity of the situation being addressed.

The *Decision Summary* should **provide a substantive summary** of information that is already available in the Administrative Record file for a site, particularly the RI/FS Report. However, when information is unavailable or is not satisfactorily addressed in the Administrative Record file, the discussion in the *Decision Summary* may need to be more thorough. The final section, which identifies and describes the Selected Remedy and explains how it satisfies the statutory and regulatory requirements, is information unique to the ROD that will not be contained elsewhere in the Administrative Record file, and thus should be presented in as much detail as possible given the information available at the time of the remedy selection decision.

6.3.1 Site Name, Location, and Description

This section should briefly describe basic information about the site. This section should include the following:

- Name and location.
- National Superfund electronic database identification number (*e.g.*, CERCLIS III, WasteLan).
- Lead and support agency (*e.g.*, EPA, State, Federal facility).
- Source of cleanup monies (*e.g.*, Superfund trust fund, enforcement/PRP settlement).
- Site type (*e.g.*, landfill, industrial facility).
- Brief site description (*i.e.*, one-paragraph abstract).

6.3.2 Site History and Enforcement Activities

This section should provide background information on the following:

- Activities that have led to the current problems, such as manufacturing or disposal of hazardous substances (*e.g.*, an important piece of information may be whether a site was in operation before or after the effective date of key RCRA regulations, such as those of November 19, 1980, or July 26, 1982).
- Federal, State, and local site investigations and removal, or remedial actions conducted to date under CERCLA, and under other environmental authorities (*e.g.,* RCRA, CWA, CAA, or State authorities). History of any cited violations under Federal or State environmental regulations or statutes.
- History of CERCLA enforcement activities (*e.g.*, RI/FS notice letter dates, results of RI/FS negotiations, whether special notice letters have been issued to PRPs (specific names need not be mentioned), and/or status of past or pending lawsuits pertaining to site cleanup).

6.3.3 Community Participation

This section should briefly note how the public participation requirements in CERCLA and the NCP were met in the remedy selection process. NCP Section 300.430(f)(3) establishes a number of public participation activities that the lead agency must conduct throughout this process (as described in Section 2.6).

The lead agency should also describe any other major public participation activities (*e.g.*, community relations plans, special activities related to environmental justice concerns). Efforts to solicit views on the assumptions about reasonably anticipated future land use and potential beneficial uses of ground water should also be described in this section of the *Decision Summary*.

A detailed summary of community responses to the Selected Remedy should not be included in this section of the *Decision Summary*; rather it should be addressed under the community acceptance criterion in the *Comparative Analysis of Alternatives* section. In addition, specific comments should be responded to in the *Responsiveness Summary*. Highlight 6-7 is an example of the length and type of information recommended for this section.

Highlight 6-7: Example Language for Community Participation Activities

The RI/FS Report and Proposed Plan for the EIO Industrial Site in Nameless, Tennessee, were made available to the public in March 1999. They can be found in the Administrative Record file and the information repository maintained at the EPA Docket Room in Region 4 and at the Nameless Public Library. The notice of the availability of these two documents was published in the Nameless Advocate on March 1, 1999. A public comment period was held from March 1 to March 30, 1999. An extension to the public comment period was requested. As a result, it was extended to April 30, 1999. In addition, a public meeting was held on March 13, 1999 to present the Proposed Plan to a broader community audience than those that had already been involved at the site. At this meeting, representatives from EPA and the Tennessee Department of Environment and Conservation answered questions about problems at the site and the remedial alternatives. EPA also used this meeting to solicit a wider cross-section of community input on the reasonably anticipated future land use and potential beneficial ground-water uses at the site. EPA's response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

6.3.4 Scope and Role of Operable Unit or Response Action

Due to the fact that many Superfund sites are complex and have multiple contamination problems or areas, they are generally divided into several operable units for the purposes of managing the site-wide response action.[6] When a ROD is written for an operable unit, and not an entire site, it is important to convey the scope and role of the operable unit within the overall site management plan. This section of the decision summary should discuss how the operable unit or response action addressed by the ROD fits into the overall site strategy. This discussion should describe the overall site cleanup strategy, including:

- The planned sequence of actions
- The scope of problems those actions will address.
- The authorities under which each action will be/has been implemented (*e.g.*, removal, remedial, State).

Highlight 6-8 provides tips for documenting the *Scope and Role* section for sites with more than one operable unit. Highlight 6-9 provides example language for describing the scope and role of an OU or response action.

[6] The NCP defines an operable unit (OU) as "a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site" (NCP Section 300.5).

Highlight 6-8: Tips for Documenting Scope and Role Section for Sites with More than One Operable Unit

- Clearly present an Overall Site Cleanup Plan in bullet format, and highlight or boldface the specific activities addressed by this ROD.
- Describe how past or planned removal actions fit into the overall site cleanup strategy.
- Organize the list into categories (e.g., past response, activities proposed in this ROD, future response plans).
- For Federal facility sites, the relationship between CERCLA and other remediation activities at the facility or base should be discussed (e.g., RCRA corrective action, long-term waste management).
- For interim RODs, state that the operable unit response action will be consistent with the final action selected for the site.

Highlight 6-9: Example Language for Scope and Role of Operable Unit Section

As with many Superfund sites, the problems at the [site name] Site are complex. As a result, EPA has organized the work into two operable units (OUs):

- Operable Unit 1: Contamination of the on-site soils
- Operable Unit 2: Contamination of the ground-water aquifer

EPA has already selected the remedy for Operable Unit 1 in a ROD signed on October 22, 1997. Operable Unit 1 will treat soils contaminated with high concentrations of Volatile Organic Compounds (VOCs) through a combination of a treatment technology (thermal desorption) and containment of residuals from that treatment unit. This action is in the remedial design stage. Actual construction is planned to begin in Fall 2000.

The second operable unit, the subject of this ROD, addresses the contamination of the ground-water aquifer. Ingestion of water extracted from this aquifer poses a current and potential risk to human health because EPA's acceptable risk range is exceeded and concentrations of contaminants are greater than the maximum contaminant levels for drinking water (as specified in the Safe Drinking Water Act). This second operable unit presents the final response action for this site and addresses a principal threat at the site through the removal and treatment of Non-Aqueous Phase Liquid (NAPL) source material in the aquifer.

6.3.5 Site Characteristics

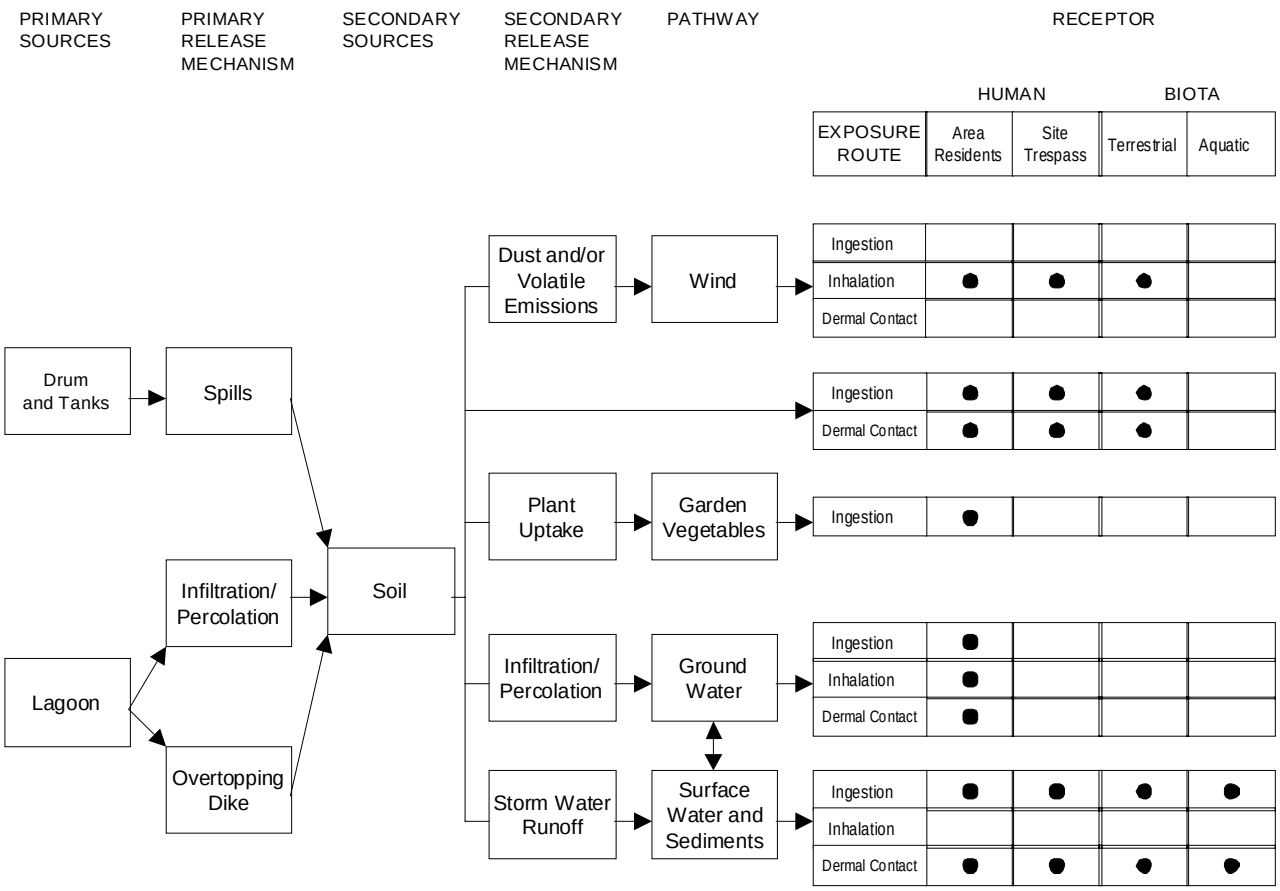
This section of the ROD should present a brief yet comprehensive overview of the site. The use of maps that highlight the location of sources and distribution of the detected contaminants and COCs is recommended.[7] In general, this section should satisfy the following:

- Describe the Conceptual Site Model (CSM)[8] on which the risk assessment and response action are based (see Highlight 6-10).
- Provide an overview of the site, including the following:
  - Size of site (*e.g.*, acres).
  - Geographical and topographical information (*e.g.*, surface waters, flood plains, wetlands).
- Surface and subsurface features (*e.g.*, number and volume of tanks, lagoons, structures, and drums on the site).
  - Areas of archaeological or historical importance.
- Describe the sampling strategy (*e.g.,* which media were investigated, what sampling approach was used, over what area, when was the sampling performed).
- Describe known or suspected sources of contamination.
- Describe types of contamination and the affected media (summarize in a table if appropriate), including the following:
  - Types and characteristics of COCs (*e.g.*, toxic, mobile, carcinogenic, non-carcinogenic).
  - Quantity/volume of waste.
  - Concentrations of COCs in each medium.
  - RCRA hazardous wastes and affected media.
- Describe location of contamination and known or potential routes of migration, including the following:
  - Lateral and vertical extent of contamination.
  - Current and potential future surface and subsurface routes of human or environmental exposure.
  - Likelihood for migration of COCs.
  - Human and ecological populations that could be affected.
- For sites with ground-water contamination, describe the following:
  - Aquifer(s) affected or threatened by site contamination, types of geologic materials, approximate depths, whether aquifer is confined or unconfined.
  - Surface and subsurface features (*e.g.*, number and volume of tanks, lagoons, structures, and drums at the site).
  - Ground-water flow directions within each aquifer and between aquifers and ground-water discharge locations (*e.g.*, surface waters, wetlands, other aquifers).

[7] Chemicals of Potential Concern (COPCs): Those chemicals that are identified as a potential threat to human health or the environment and are evaluated further in the baseline risk assessment. Chemicals of Concern (COCs): A subset of the COPCs that are identified in the RI/FS as needing to be addressed by the response action proposed in the ROD.

[8] Conceptual Site Model (CSM): A three-dimensional "picture" of site conditions that illustrates contaminant sources, release mechanisms, exposure pathways, migration routes, and potential human and ecological receptors. The CSM documents current and potential future site conditions and is supported by maps, cross sections, and site diagrams that illustrate what is known about human and environmental exposure through contaminant release and migration to potential receptors. The CSM is initially developed during the scoping phase of the RI/FS and should be modified as additional information becomes available. A graphical depiction of the CSM may be appropriate to include in the ROD as it provides a good presentation of the overall site conditions and basis for taking an action, and can be referenced when discussing the overall site management strategy and the specific remedial action objectives addressed by the Selected Remedy. Highlight 6-10 shows a sample CSM for contaminated soil. For additional information, refer to *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (EPA 540-G-89-004, October 1988) and *Soil Screening Guidance: User's Guide* (EPA 540-R-96-018, July 1996).

Highlight 6-10: Example Conceptual Site Model for Contaminated Soil



- Interconnection between surface contamination (*e.g.*, soils, surface water/sediments) and ground-water contamination.
- Confirmed or suspected presence and location of NAPLs.
- If ground-water models were used to define the fate and transport of COCs, identify the model used and major model assumptions.

- Note other site-specific factors that may affect response actions at the site.

Highlight 6-11 provides tips for documenting site characteristics in the ROD.

Highlight 6-11: Tips on Writing the "Site Characteristics" Section

- Use a simplified graphical depiction of the Conceptual Site Model (e.g., Highlight 6-10) to illustrate threats posed by the site.
- If the response action can be broken into distinct components (e.g., ground water, source control) or areas (e.g., Area A, Area B), clearly define this up front, and use the same terminology throughout the rest of the document.
- Use tables and figures to summarize and delineate types and extent of contamination, affected media, location of contamination, and potential routes of exposure.

6.3.6 Current and Potential Future Land and Resource Uses

This section of the ROD should discuss the **current and reasonably anticipated future land uses** and **current and potential beneficial ground-water uses** at the site, and discuss the basis for future use assumptions. It is important that this section precede the summary of the risk assessment as it forms the basis for reasonable exposure assessment assumptions and risk characterization conclusions. This section should include the following:

Land Uses:

- Current on-site land uses.
- Current adjacent/surrounding land uses.
- Reasonably anticipated future land uses, with expected time frames for such uses, and basis for future use assumptions (*e.g.*, zoning maps, nearby development, 20-year development plans, dialogue with local land use planning officials and citizens).

Ground and Surface Water Uses:

- Current ground/surface water uses on the site and in its vicinity.
- Potential beneficial ground/surface water uses (*e.g.*, potential drinking water, irrigation, recreational) and basis for future use assumptions (*e.g.*, Comprehensive State Ground Water Protection Plan (CSGWPP), promulgated State classification, EPA ground-water classification guidelines).
- If beneficial use is as a potential drinking water source, identify the approximate time frame of projected future drinking water use (*e.g.*, ground-water aquifer not currently used as a drinking water source but expected to be utilized in 30–50 years).
- Location of anticipated use in relation to location and anticipated migration of contamination.

The basis for assumptions about the reasonably anticipated future land use and potential beneficial use of ground water should be presented clearly in the ROD. The role that the community, and other site stakeholders, played in assisting the lead agency to develop these assumptions should be explained as well.

For additional information, please refer to *Land Use in the CERCLA Remedy Selection Process* (EPA 540-R-95-052, May 1995), *The Role of CSGWPPs in EPA Remediation Programs* (EPA 540-F-95-084, April 4, 1997), and *Rules of Thumb for Superfund Remedy Selection* (EPA 540-R-97-013, August 1997).

6.3.7 Summary of Site Risks

The *Summary of Site Risks* section of the ROD should: (1) state the basis for taking action at the site; (2) provide a brief summary of the relevant portions of the human health risk assessment for the site or operable unit; and (3) provide a brief summary of the ecological risk assessment.[9] This section should focus on the information that is driving the need for the specific response action described in the ROD. It is not necessarily a summary of the entire baseline risk assessment developed for the site as a whole. For example, the ROD should primarily discuss the Chemicals of Concern (COCs) identified in the risk assessment that are driving the need for a remedial action, not necessarily all of the Chemicals of Potential Concern (COPCs) originally identified in the risk assessment process.[10] These COCs are referred to as "risk drivers" in the *Risk Assessment Guidance for Superfund: Volume 1 Human Health Evaluation Manual, Part D* (EPA 540-R-97-033, January 1998), hereafter referred to as "*RAGS Part D*." In addition, the summary of the exposure assessment should focus on those exposure pathways and scenarios driving action at the site, not necessarily ALL of the exposure pathways and scenarios evaluated for the entire site. References to the Conceptual Site Model presented in the *Summary of Site Characteristics* section should be used to support the presentation of the risk assessment information as well.

[9] If an ecological risk assessment has not been performed, an explanation for when this will be performed or a justification for not performing it needs to be provided.

[10] In some circumstances (e.g. No Action RODs) a discussion of the contaminants detected that are not COCs and of exposures that do not exceed EPA's acceptable risk range is warranted.

The information presented in the *Summary of Site Risks* must support the decision to take the remedial action. **A clear statement regarding the basis for action at the site should be made at the conclusion of the risk assessment section of the ROD.**[11] See Highlight 6-12 for standard language.

Highlight 6-12: Standard Language - Basis for Action

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

****

If the site is contaminated with only pollutants or contaminants (in accordance with the definitions contained in NCP §300.5), then the following standard language should be used:

The response action selected in this Record of Decision is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

****

If the response action will address both hazardous substances and pollutants or contaminants, a combination of the two examples of standard language may be necessary.

[11] Basis for Action: A response action is generally warranted if one or more of the following conditions is met: (1) the cumulative excess carcinogenic risk to an individual exceeds 10^{-4} (using reasonable maximum exposure (RME) assumptions for either the current or reasonably anticipated future land use or current or potential beneficial use of ground/surface water); (2) the non-carcinogenic hazard index is greater than one (using RME assumptions for either the current or reasonably anticipated future land use or current or potential use of ground/surface water); (3) site contaminants cause adverse environmental impacts; or (4) chemical-specific standards or other measures that define acceptable risk levels are exceeded and exposure to contaminants above these acceptable levels is predicted for the RME. Examples include drinking water standards that are exceeded in ground water when that ground water is a current or potential source of drinking water or water quality standards that are exceeded in surface waters that support the designated uses of these waters (*e.g.*, support aquatic life). For more information, see *Role of the Baseline Risk Assessment in Superfund Remedy Selection* (OSWER 9355.0-30, April 22, 1991).

The information necessary to write the *Summary of Site Risks* section of the *Decision Summary* should be available in the risk assessment chapter of the RI/FS report, or in a stand-alone human health or ecological risk assessment report. Appropriate sections of these reports should be cited as necessary.

6.3.7.1 Summary of Human Health Risk Assessment

A summary of the relevant information developed in the risk assessment should be presented in the ROD. A mixture of (1) text format (*e.g.*, for describing the toxicity assessment) and (2) table format (*e.g.*, for presenting COCs and risk values) should be used to summarize and communicate the results of the human health risk assessment. It is strongly recommended that the format for the tables presented in this section be used to summarize appropriate risk assessment information in the ROD. The information in these tables was drawn from the standardized tables in *RAGS Part D*. This guidance was developed and approved by a cross-Regional team of EPA risk assessors to standardize the planning, reporting, and review of Superfund risk assessments. The risk assessment information presented in the ROD should be a **relevant subset** of the information presented in the *RAGS Part D* standardized risk tables. This information will also be built into WasteLan (or the current national Superfund electronic database). Use of risk tables does not substitute for a text discussion of this information as well. See sample text provided in accompanying highlights.

The discussion of risks in this section of the ROD should parallel the major sections of the risk assessment: (1) Identification of Chemicals of Concern; (2) Exposure Assessment; (3) Toxicity Assessment; and (4) Risk Characterization (including the uncertainty analysis). Information should be presented so that the Selected Remedy will be supported and individuals unfamiliar with the site can understand the basis for undertaking remedial action. **The primary focus of this summary should be on those exposure pathways and chemicals found to pose actual or potential threats to human health.** Highlight 6-13 contains example language that can be used as an introduction for this section.

Highlight 6-13: Example Language for the Introduction to the HumanHealth Risks Summary

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this site.

Section 1: Identification of Chemicals of Concern

Information on chemicals of concern should include summaries of the following:

- COCs in each medium (*e.g.*, TCE in ground water, benzo(a)pyrene, dieldrin, and 4,4'-DDT in soil).
- The range of detected concentrations (minimum and maximum) and the frequency of detection for each COC in each medium investigated.
- Data quality as discussed in the data usability section of the risk assessment. For example, *RAGS Part D* suggests including a Data Usability Worksheet in the risk assessment to present this information.
- The exposure point concentration used to estimate the risk for each COC and the type of statistical measure it represents. Generally, the 95 percent upper confidence limit (UCL) on the arithmetic mean concentration for a chemical is used as the exposure point concentration. However, for sites with limited amounts of data or extreme variability in the data, the highest concentration (*i.e.,* the maximum value) is used commonly as a default exposure point concentration in the risk assessment. For further information, refer to *Supplemental Guidance to RAGS: Calculating the Concentration Term* (OSWER 9285.7-08I, Volume 1, Number 1, May 1992).

Highlight 6-15 presents the preferred table format for summarizing the COCs, their associated concentrations in each medium, and their frequency of detection. This table should be recreated in the ROD as many times as needed for each medium if addressed by the ROD. The information for this table can be found in Standard Table 3.1 of *RAGS Part D*. In addition to the summary table, the discussion should also include language summarizing the extent of contamination at the site; example language is provided in Highlight 6-15.

Section 2: Exposure Assessment

The exposure pathways that were quantitatively evaluated in the risk assessment should be summarized in the ROD. The appropriate section in the Human Health Risk Assessment should be referenced in this section. The information for this section can be found in Standard Table 1 of *RAGS Part D*.

The text should include a brief discussion of the following information:

- A reference to the Conceptual Site Model for the site and how it was used to determine reasonable exposure scenarios and pathways of concern. Include a brief discussion of scenarios and pathways that may have been considered, but not quantitatively addressed (*i.e.*, were considered but were not considered to be signifi-

Highlight 6-14: Tips on Writing the "Summary of Site Risks" Section

- Use the tables presented in this section to summarize the relevant information from the risk assessment.
- Explain the technical information presented in the tables in plain English that a layperson can understand. The guidance recommends attaching the explanation to the table itself.
- This section should primarily summarize the information from the baseline risk assessment relevant to the action proposed in the ROD.
- Clearly state the **basis for action** at the conclusion of the risk assessment section.

cant or realistic). Copies of the Standard Table 1 from *RAGS Part D* that includes all of the scenarios and pathways considered in the risk assessment may be useful to include as an appendix to the ROD as well.

- The potentially exposed populations in current and future scenarios (*e.g.*, worker currently working on-site, adults and children living on-site in the future).

- Any sensitive subpopulations (highly exposed and/or more susceptible) that may be exposed (*e.g.*, farm families, children, subsistence fishermen).

- The routes by which each population group or subpopulation group could reasonably be exposed to site contaminants (*e.g.*, ingestion of contaminated ground water for adults and children, inhalation of volatile contaminants for workers).

Major assumptions about exposure frequency, duration, and other exposure factors that were included in the exposure assessment (*e.g.*, exposure frequency (days/year), exposure duration (years), and body surface area (cm^2) for dermal exposure) could be included in an appendix.

Section 3: Toxicity Assessment

This section should summarize the salient points of the toxicity assessment section of the risk assessment. The information for this section can be found in Standard Tables 5 and 6 of risk assessments applying the *RAGS Part D* guidance.

The following information should be summarized in text format:

- A brief summary of the carcinogenic and non-carcinogenic toxicity data used to calculate the risk of each COC, differentiating between toxicity data for chronic, subchronic, and acute exposures.

- The source of the toxicity information (*e.g.*, Integrated Risk Information System (IRIS), Health Effects Assessment Summary Tables (HEAST), or provisional values provided by Superfund Technical Support Center in Cincinnati).

- Primary target organs and health effects of concern for non-carcinogenic COCs.[12] Example text for summarizing the toxicity assessment is provided with Highlights 6-16A and 6-16B.

Section 4: Risk Characterization

The risk characterization summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risks, both in quantitative expressions and qualitative statements (see Highlight 6-17 for introductory language for the Risk Characterization section). The summary of this section should include the following for all current and future land use scenarios that present unacceptable risks.

- Quantified carcinogenic risks for each COC in each exposure medium for each relevant exposure pathway.

- Combined carcinogenic risks reflecting total exposure to COCs in a given medium and pathway of exposure.

- Potential for non-carcinogenic impacts as quantified by the hazard quotient for each COC in each exposure medium for each exposure pathway, as appropriate.

- Potential for combined non-carcinogenic effects in each medium and pathway of exposure as expressed by hazard indices, which reflect the potential additive effects of COCs that affect the same target organ or system.

[12] The number and types of toxicity studies available varies from one chemical to another. Thus, EPA provides a qualitative analysis of the data supporting its toxicity criteria. For carcinogens, EPA provides a "weight of evidence" classification. Carcinogen guidelines recently proposed by EPA may replace this classification with other qualitative descriptions. For non-carcinogens, a high, medium, or low "level of confidence" is assigned. If particular values for a COC are unavailable in the acceptable references, this should be indicated, and the term "not available" should be used in subsequent tables to show that an evaluation was performed but information was not available. This information should be provided in the ROD as risk managers need to consider the impact of missing toxicity data in the decision making process.

- Combined carcinogenic risks and/or hazard indices for those exposure pathways to which the same individual or subpopulation could reasonably be exposed (*e.g.*, the carcinogenic risk to children living at a residence who may be exposed to contaminated soil and local ground water is 2.85×10^{-2}).

- Any qualitative descriptions of risk (*e.g.* special threats to pregnant women or hazards for which risk information can not be quantified.)[13]

- Brief explanation of the meaning of both the quantitative risk characterization and qualitative statements.

- Tabular summary of the carcinogenic risks and non-carcinogenic impacts by exposure pathway and by COCs per pathway. Highlights 6-16A and 6-16B present the preferred table format and sample language. Information for these tables can be found in Standard Table 10 of *RAGS Part D*.

The risk characterization should also include a brief discussion of the significant sources of uncertainty inherent in the risk assessment; indicating whether the uncertainties are expected to underestimate or overestimate the potential risk. The discussion may include the following:

- Uncertainty due to the number of samples collected or their location. Explain any concerns with data usability as a result of the QA/QC that was performed on the sampling/analysis data. For further information on evaluating data quality, refer to *Guidance for Data Usability in Risk Assessment, Parts A and B, Final* (OSWER 9285.7-09A and B, April and May 1992).

- Uncertainty due to the use of environmental fate and transport models.

- Uncertainty due to the use of default exposure assumptions in lieu of site-specific data for exposure factors.

- Uncertainty associated with available toxicity criteria or concerns regarding the lack of toxicity criteria to address potential exposure pathways.

Please note that in the examples provided in Highlights 6-18A and 6-18B, it is appropriate to sum the carcinogenic risks and hazard quotients (HQs). The summation of carcinogenic risks is appropriate because the same receptor (i.e,. child resident) is likely to be exposed to soil and ground water. Also, the summation of HQs is appropriate because 4,4'-DDT and dieldrin affected the same target organ (*i.e.,* the liver). However, it is not always appropriate to sum cancer risks and HQs, and questions should be directed to regional risk assessors. For written guidance on summing cancer risks or HQs, please refer to *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, Interim Final* (OSWER 9285.7-01B, December 1989) and the *Soil Screening Guidance: User's Guide* (EPA 540-R-96-018, April 1996).

6.3.7.2 Summary of Ecological Risk Assessment

The *Summary of Site Risks* section of the ROD should also address risks to potential ecological receptors. If this ROD addresses the final OU for the site and does not address ecological risks posed by the site, an explanation should be provided that explains when and how ecological risks were assessed and addressed or a justification should be provided for why no investigation was performed.

Procedures for addressing ecological risks are not as standardized as they are for human health risk assessment. Specific procedures and level of effort for an ecological risk assessment vary significantly depending on site-specific factors. If a significant level of effort has been put into an ecological risk assessment, the ROD should cover this information at an appropriate level of detail.

Similar to the human health risk assessment summary, the major sections of the ecological risk assessment should be summarized in the ROD as well. The

[13] For sites where lead (Pb) is a COC, the *Summary of Site Risks* section of the ROD should document the use of models and the site-specific assumptions that were made to determine cleanup levels for lead in soil. (See Chapter 9, section 9.3, for more information on documenting remedy decisions at sites with lead contamination.)

major sections of ecological risk assessment usually include 1) Identification of Chemicals of Concern, 2) Exposure Assessment, 3) Ecological Effects Assessment, and 4) Ecological Risk Characterization. However, depending upon the type of assessment conducted, the sections of the ecological risk assessment may vary. Ecological risk data should be presented in the ROD in tabular form when sufficient data are available. RODs should include the following details to the extent they were discussed in the ecological assessment:

Section 1: Identification of Chemicals of Concern

- Summary of toxicity data used to screen COPCs as well as the background concentration for each chemical.
- COPCs in each medium (*e.g.*, TCE in ground water released to wetlands, and benzo(a)pyrene, 4,4'-DDT, and dieldrin in soil).
- The range of detected concentrations (minimum and maximum) and the frequency of detection for each COPC in each medium investigated.
- The mean concentrations (arithmetic mean) of the COPCs as well as the 95% upper confidence limit concentrations.
- The ecological Hazard Quotient and the contaminant of concern flag (Yes or No) for each COPC.
- Data quality, as discussed in the data usability section of the ecological risk assessment. For further information on evaluating data quality, refer to *Guidance for Data Usability in Risk Assessment, Parts A and B, Final* (OSWER 9285.7-09A and B, April and May 1992).
- Highlight 6-19 presents the preferred tabular format for summarizing the ecological COCs and their associated concentrations in each medium.

Section 2: Exposure Assessment

- Description of the ecological setting (*e.g.*, wetland, upland valley) on and near the site, including aquatic and terrestrial habitats, habitat maps, and related field survey information. Any ecologically sensitive areas should be identified.
- Description of the key species that are or could be exposed. Federal or State designated rare, endangered, or threatened species should be identified.
- Complete exposure pathways for receptor populations, communities, or selected species. Exposure point concentrations for each chemical within each relevant exposure pathway for a given population at risk.
- Monitoring or modeling data and assumptions used to characterize exposure point concentrations.
- Summary of any field studies conducted to establish exposures (*e.g.*, biomarkers, tissue analyses, food chain models).

A combination of text and tables is recommended for presenting this information. Highlight 6-20 presents the preferred tabular summary for the ecological exposure assessment.

Section 3: Ecological Effects Assessment

- Summary of any toxicity tests or field studies used to evaluate adverse ecological effects (*e.g.*, macroinvertebrate studies, aquatic, soil and/or sediment toxicity tests).
- A description of the assessment and measurement endpoints chosen for the assessment.

Section 4: Ecological Risk Characterization

- Brief summary of the environmental risks associated with the relevant media, the basis of these risks, how these risks were determined (*e.g.*, comparison of predicted exposure and toxicity, field studies), and COC concentrations that are expected to be protective of the ecological receptors. Highlight 6-21 presents the preferred tabular format for summarizing the protective levels for ecological receptors.

Highlight 6-15: Example Table Format

Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Soil On-site - Direct Contact	Benzo(a) pyrene	100	430	ppm	20/24	300	ppm	95% UCL
	4,4'-DDT	20	350	ppm	8/24	350	ppm	MAX
	Dieldrin	15	60	ppm	15/24	40	ppm	95% UCL

Key

ppm: Parts per million
95% UCL: 95% Upper Confidence Limit
MAX: Maximum Concentration

Example Language Describing Summary of Chemicals of Concern and Medium-Specific Exposure Point Concentrations

The table presents the chemicals of concern (COCs) and exposure point concentration for each of the COCs detected in soil (*i.e.*, the concentration that will be used to estimate the exposure and risk from each COC in the soil). The table includes the range of concentrations detected for each COC, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the site), the exposure point concentration (EPC), and how the EPC was derived. The table indicates that benzo(a)pyrene [B(a)P] is the most frequently detected COC in soil at the site. The 95%UCL on the arithmetic mean was used as the exposure point concentration for B(a)P and dieldrin. However, due to the limited amount of sample data available for 4,4'-DDT, the maximum concentration was used as the default exposure point concentration.

NOTE: In a ROD, this table would be expanded to include all Exposure Points that have significant routes of exposure for the soil. Additional versions of this table format would be presented to include other Media (e.g., Ground Water) or other Exposure Media (e.g., Dust) with significant routes of exposure.

Highlight 6-16A: Example Table Format

Sample Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal

Chemical of Concern	Oral Cancer Slope Factor	Dermal Cancer Slope Factor	Slope Factor Units	Weight of Evidence/Cancer Guideline Description	Source	Date (MM/DD/YYYY)
Benzo(a) pyrene	7.3	7.3	(mg/kg)/day	B2	IRIS	1998
4,4'-DDT	0.34	0.34	(mg/kg)/day	B2	IRIS	1998
Dieldrin	16	16	(mg/kg)/day	B2	IRIS	1998
TCE	0.011	0.011	(mg/kg)/day	B2	IRIS	1998

Pathway: Inhalation

Chemical of Concern	Unit Risk	Units	Inhalation Cancer Slope Factor	Units	Weight of Evidence/Cancer Guideline Description	Source	Date (MM/DD/YYYY)
Benzo(a)pyrene	—	—	—	—	B2	IRIS	1998
4,4'-DDT	9.7×10^{-5}	$\mu g/m^3$	—	—	B2	IRIS	1998
Dieldrin	4.6×10^{-3}	$\mu g/m^3$	—	—	B2	IRIS	1998
TCE	—	—	—	—	B2	IRIS	1998

Pathway: External (Radiation)[1]

Chemical of Concern	Cancer Slope or Conversion Factor	Exposure Route	Units	Weight of Evidence/Cancer Guideline Description	Source	Date (MM/DD/YYYY)
—	—	—	—	—	—	—
—	—	—	—	—	—	—

Key

— : No information available
IRIS: Integrated Risk Information System, U.S. EPA

1- This pathway would be used in the event that one of the contaminants of concern was a radionuclide. If there are no radionuclides associated with a particular site, then this column can be deleted.

EPA Group:

A - Human carcinogen
B1 - Probable human carcinogen - Indicates that limited human data are available
B2 - Probable human carcinogen - Indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

Example Language Describing Summary of Toxicity Assessment

This table provides carcinogenic risk information which is relevant to the contaminants of concern in both soil and ground water. At this time, slope factors are not available for the dermal route of exposure. Thus, the dermal slope factors used in the assessment have been extrapolated from oral values. An adjustment factor is sometimes applied, and is dependent upon how well the chemical is absorbed via the oral route. Adjustments are particularly important for chemicals with less than 50% absorption via the ingestion route. However, adjustment is not necessary for the chemicals evaluated at this site. Therefore, the same values presented above were used as the dermal carcinogenic slope factors for these contaminants.

Two of the COCs are also considered carcinogenic via the inhalation route. Dieldrin and 4,4'-DDT have inhalation unit risk factors of 4.6×10^{-3} $\mu g/m^3$ and 9.7×10^{-5} $\mu g/m^3$, respectively (Source: IRIS, USEPA 1998). TCE (found in the ground water) and benzo(a)pyrene lack sufficient toxicity information via the inhalation route to support the development of specific inhalation carcinogenic toxicity criteria.

Highlight 6-16B: Example Table Format

Sample Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal

Chemical of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Dermal RfD	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YYYY)
Benzo(a) pyrene	—	—	—	—	—	—	—	—	—
4,4'-DDT	Chronic	5.0×10^{-4}	mg/kg-day	5.0×10^{-4}	mg/kg-day	Liver	—	IRIS	1998
Dieldrin	Chronic	5.0×10^{-5}	mg/kg-day	5.0×10^{-5}	mg/kg-day	Liver	—	IRIS	1998
TCE	—	—	—	—	—	—	—	—	—

Pathway: Inhalation

Chemical of Concern	Chronic/ Subchronic	Inhalation RfC	Inhalation RfC Units	Inhalation RfD	Inhalation RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (MM/DD/YYYY)
Benzo(a) pyrene	—	—	—	—	—	—	—	—	—
4,4'-DDT	—	—	—	—	—	—	—	—	—
Dieldrin	—	—	—	—	—	—	—	—	—
TCE	—	—	—	—	—	—	—	—	—

Key

—: No information available
IRIS: Integrated Risk Information System, U.S. EPA

Example Language Describing Summary of Toxicity Assessment

This table provides non-carcinogenic risk information which is relevant to the contaminants of concern in both soil and ground water. Two of the COCs have toxicity data indicating their potential for adverse non-carcinogenic health effects in humans. The chronic toxicity data available for both 4,4'-DDT and dieldrin for oral exposures, have been used to develop oral reference doses (RfDs). The oral RfDs for 4,4'-DDT and dieldrin are 5.0×10^{-4}mg/kg/day, and 5.0×10^{-5} mg/kg/day, respectively (Source: IRIS, USEPA, 1998). The available toxicity data, from both chronic and subchronic animal studies, indicate that both dieldrin and 4,4'-DDT primarily affect the liver. Reference doses are not available for benzo(a)pyrene or TCE, neither are dermal RfDs or inhalation RfCs for any of the contaminants. As was the case for the carcinogenic data, dermal RfDs can be extrapolated from the oral RfDs applying an adjustment factor as appropriate. However, for dieldrin and 4,4'-DDT no adjustment is necessary, and the oral RfDs discussed were used as the dermal RfDs for these contaminants. At this time, inhalation reference concentrations are not available for any of the COCs.

Highlight 6-17: Example Language for Risk Characterization Summary

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as (mg/kg-day)-1.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where:
CDI = Chronic daily intake
RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Highlight 6-18A: Example Table Format

Risk Characterization Summary - Carcinogens

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

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk				
				Ingestion	Inhalation	Dermal	External (Radiation)[1]	Exposure Routes Total
Soil	Soil	Soil On-site-Direct Contact	Benzo (a) pyrene	1.2×10^{-2}	N/A	3.3×10^{-6}	—	1.2×10^{-2}
		Soil On-site-Direct Contact	4,4'-DDT	6.5×10^{-4}	N/A	4.5×10^{-7}	—	6.5×10^{-4}
		Soil On-site-Direct Contact	Dieldrin	3.5×10^{-3}	N/A	4.8×10^{-6}	—	3.5×10^{-3}
	Dust	Soil On-site-Inhalation of Soil as Dust	Benzo (a) pyrene	N/A	—	N/A	—	—
		Soil On-site-Inhalation of Soil as Dust	4,4'-DDT	N/A	9.7×10^{-4}	N/A	—	9.7×10^{-4}
		Soil On-site-Inhalation of Soil as Dust	Dieldrin	N/A	8.5×10^{-3}	N/A	—	8.5×10^{-3}
							Soil risk total=	**2.6×10^{-2}**
Ground Water	Ground Water	Aquifer X - Tap Water	TCE	2.5×10^{-3}	—	1.4×10^{-7}	—	2.5×10^{-3}
							Ground-water risk total=	**2.5×10^{-3}**
							Total Risk =	**2.9×10^{-2}**

Key

— : Toxicity criteria are not available to quantitatively address this route of exposure.
N/A: Route of exposure is not applicable to this medium.

1--This column would be used in the event that one of the contaminants of concern was a radionuclide. If there are no radionuclides associated with a particular site, then this column can be deleted.

Example Language Describing Risk Characterization

Highlight 6-18A provides risk estimates for the significant routes of exposure. These risk estimates are based on a reasonable maximum exposure and were developed by taking into account various conservative assumptions about the frequency and duration of a child's exposure to soil and ground water, as well as the toxicity of the COCs (benzo (a) pyrene, 4,4'-DDT, dieldrin, and TCE). The total risk from direct exposure to contaminated soil and ground water at this site to a current child resident is estimated to be 2.85×10^{-2}. The COCs contributing most to this risk level are benzo (a) pyrene and dieldrin in soil and TCE in ground water. This risk level indicates that if no clean-up action is taken, an individual would have an increased probability of 3 in 100 of developing cancer as a result of site-related exposure to the COCs.
NOTE: Additional versions of this table format would be presented to include other Receptors with significant exposure (Scenario Timeframe, Receptor Population, Receptor Age).

Highlight 6-18B: Example Table Format

Risk Characterization Summary - Non-Carcinogens

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

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Primary Target Organ	Non-Carcinogenic Hazard Quotient			
					Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	Soil On-site-Direct Contact	Benzo (a) pyrene	Liver	—	N/A	—	—
		Soil On-site-Direct Contact	4,4'-DDT	Liver	3.8	N/A	1.5×10^{-2}	3.9
		Soil On-site-Direct Contact	Dieldrin	Liver	4.4	N/A	2.7×10^{-4}	4.4
							Soil Hazard Index Total =	**8.3**
Ground Water	Ground Water	Aquifer X - Tap Water	TCE	—	—	—	—	—
							Ground-Water Hazard Index Total =	**—**
							Receptor Hazard Index =	**8.3**
							Liver Hazard Index =	**8.3**

Key

— : Toxicity criteria are not available to quantitatively address this route of exposure.
N/A: Route of exposure is not applicable to this medium.

Example Language Describing Risk Characterization

Highlight 6-18B provides hazard quotients (HQs) for each route of exposure and the hazard index (sum of hazard quotients) for all routes of exposure. The Risk Assessment Guidance (RAGS) for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse noncancer effects. The estimated HI of 8.3 indicates that the potential for adverse noncancer effects could occur from exposure to contaminated soil containing 4,4'-DDT, dieldrin and benzo(a)pyrene. The noncancer risk from exposure to contaminated ground water could not be evaluated due to the lack of noncarcinogenic toxicity criteria for TCE.

NOTE: Additional versions of this table format would be presented to include other Receptors with significant exposure (Scenario Timeframe (e.g., chronic versus subchronic exposures), Receptor Population, Receptor Age)

Highlight 6-19: Example Table Format

Occurrence, Distribution, and Selection of Chemicals of Concern (COC)

Exposure Medium: Sediment

Chemical of Potential Concern	Minimum Conc.[1] (ppm)	Maximum Conc.[1] (ppm)	Mean Conc. (ppm)	95 % UCL of the Mean [2] (ppm)	Background Conc. (ppm)	Screening Toxicity Value (ppm)	Screening Toxicity Value Source [3]	HQ Value [4]	COC Flag (Y or N)
Aluminum	2419	12,800	9808	10,400	3010	N/A	N/A	N/A	Y
Arsenic	3	69	12	21	3	6	ONT, LEL	11.5	Y
Dieldrin	0.01	0.01	0.01	0.01	N/A	0.052	EPA SQC	0.19	N
Lead	29	82	50	56	28	47	NOAA ER-L	1.75	Y
Methoxychlor	0.01	0.01	0.01	0.01	N/A	0.019	EPA SQB	0.53	N

Key
Conc. = Concentration
N/A = Not Applicable

Notes
[1] Minimum/ maximum detected concentration above the sample quantitation limit (SQL).
[2] The 95% Upper Confidence Limit (UCL) represents the RME concentration.
[3] Ont LEL = Ontario Lowest Effects Level: Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. D. Persaud, R. Jaagumagi, and A. Hayton. Ontario Ministry of the Environment, Ontario, August 1993.
NOAA ER-L = National Oceanic and Atmospheric Administration Effects Range- Low.
SQC= Sediment Quality Criteria.
[4] Hazard Quotient (HQ) is defined as Maximum Concentration/ Screening Toxicity Value.

Highlight 6-20: Example Table Format

Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Y or N)	Receptor	Endangered/ Threatened Species Flag (Y or N)	Exposure Routes	Assessment Endpoints	Measurement Endpoints
Sediment	N	Benthic organisms	N	Ingestion, respiration, and direct contact with chemicals in sediment	Benthic invertebrate community species diversity and abundance	- Toxicity of soil to *Hyallela* - Species diversity index
Surface Water	N	Fish	N	Ingestion, respiration, and direct contact with chemicals in surface water	Maintenance of an abundant and productive game fish population	- Toxicity of surface water to *Pimephales promelas* - Species diversity index
Soil	N	Terrestrial invertebrates	N	Ingestion and direct contact with chemicals in wetland soils	Survival of terrestrial invertebrate community	- Toxicity of sediments to *Lumbricus terrestris*
		Terrestrial plants	Y	Uptake of chemicals via root systems	Maintenance/ enhancement of native wetland vegetation	- Species diversity index - Survival of seedings
Surface Water (Vernal pools)	Y	Aquatic invertebrates	N	Ingestion, respiration, and direct contact with chemicals in surface water	Maintenance of a balanced, indigenous aquatic invertebrate community	- Species diversity index

Highlight 6-21: Example Table Format

COC Concentrations Expected to Provide Adequate Protection of Ecological Receptors

Habitat Type/ Name	Exposure Medium	COC	Protective Level [1]	Units	Basis[2]	Assessment Endpoint
Small Freshwater Stream/ West Branch Maple Creek	Sediment	Arsenic	6	mg/kg	Site-Specific LOAEL	Benthic invertebrate community species diversity and abundance
		Lead	15	mg/kg	Significant difference in Benthic Diversity Index between the site and the reference site	
		Total PCBs	0.03-0.05	mg/kg	LOAEL and NOAEL	
	Surface Water	Aluminum	123	ug/l	NOAEL	Maintenance of an abundant and productive game fish population
		Arsenic	208	ug/l	Mean of values between LOAEL and NOAEL	
		Total PCBs	0.1	ug/l	Bioaccumulation factor modeling	

Notes

[1] A range of levels may be provided.

[2] Provide Basis of Selection:
Mean of values between lowest observed adverse effect level (LOAEL) and no observed adverse effect level (NOAEL).

Bioaccumulation factor modeling.

LOAEL and NOAEL.

Significant difference in Benthic Diversity Index between site and reference site.

6.3.8 Remedial Action Objectives

A discussion of the *remedial action objectives (RAOs)* for the specific response action described in the ROD should be presented prior to the discussion of cleanup alternatives and remedy selection rationale.[14] RAOs provide a general description of what the cleanup will accomplish (*e.g.*, restoration of ground water to drinking water levels). These goals typically serve as the design basis for many of the remedial alternatives which will be presented in the next section. Presenting RAOs prior to the discussion of remedial alternatives provides the reader of the ROD with a basis for evaluating the cleanup options for the site and an understanding of how the risks identified in the previous section will be addressed by the response action. A clear statement of the RAOs also facilitates the five-year review determination of protectiveness of human health and the environment.

This section should include a discussion of the following:

- Clear statement of the specific RAOs for the operable unit or site (*e.g.*, treatment of contaminated soils above health-based action levels, restoration of ground-water plume to drinking water levels, and containment of DNAPL source areas). See Chapter 9 for additional information on documenting RAOs for OUs that address contaminated ground water.

- Basis and rationale for RAOs (*e.g.*, current and reasonably anticipated future land use and potential beneficial ground-water use).

- How the RAOs address risks identified in the risk assessment (*e.g.*, how will the risks driving the need for action be addressed by the response action?)

[14] If specific RAOs vary across alternatives, these differences should be described in general terms in this section and in more specific terms in the *Description of Alternatives section.*

6.3.9 Description of Alternatives

The objective of this section is to provide a brief explanation of the remedial alternatives developed for the site.

The description of each alternative in this section should contain enough information so that the comparative analysis of alternatives (the next section of the ROD) can focus on the differences or similarities among alternatives with respect to the nine evaluation criteria.

This discussion should be organized in three sections:

Description of Remedy Components

Provide a bulleted list of the major components of each alternative as they logically occur in the remediation process. This list should include the following:

- Treatment technologies and materials they will address (*e.g.*, source materials constituting principal threats).[15]

- Containment components of remedy (*e.g.*, engineering controls, cap, hydraulic barriers) and materials they will address (*e.g.*, low concentration source materials, treatment residuals).[16]

[15] Describe technologies in general terms that permit a number of "technological approaches" to be applied within a "technology category" (*e.g.,* use terms such as "ex-situ bioremediation" rather than "composting" or "soil slurry reactors"). This provides more flexibility to the design engineer and minimizes unnecessary ESDs and ROD Amendments. However, if the public's perception of the remedy is affected by the technology description, it may be appropriate to clarify which specific technology is being proposed (*e.g.,* use terms such as "incineration" and "thermal desorption" rather than "thermal treatment").

[16] "Engineering controls" are physical barriers to exposure and do not include "institutional controls," which are non-engineering methods intended to affect human activities in such a way as to prevent or reduce exposure to hazardous substances (*e.g.*, deed restrictions such as easements and covenants, deed notices, land use restrictions such as zoning and local permitting, ground-water use restrictions, and public health advisories).

- Institutional controls (and the entity responsible for implementing and maintaining them).[17]
- Operations and Maintenance (O&M) activities required to maintain integrity of remedy (*e.g.*, cap maintenance).
- Monitoring requirements.

Highlight 6-22 provides examples of the details that should be described for each alternative.

Common Elements and Distinguishing Features of Each Alternative

Describe common elements and distinguishing features unique to each response option. Examples of these elements include:

- Key ARARs (or ARAR waivers) associated with each alternative (*e.g.*, action- and/or location-specific ARARs, including the control of air, emissions from ground-water treatment units, manifesting of hazardous waste, and regulating solid waste landfills).[18]
- Long-term reliability of remedy (potential for remedy failure/replacement costs).
- Quantity of untreated waste and treatment residuals to be disposed off-site or managed on-site in a containment system and degree of hazard (*e.g.*, concentrations) remaining in such material.[19]
- Estimated time for design and construction (*i.e.*, implementation time frame).
- Estimated time to reach remediation goals (*i.e.*, time of operation, period of performance).
- Estimated capital, annual O&M, and total present worth costs; discount rate (current OSWER policy is 7%): and the number of years over which the remedy cost estimate is projected.
- Uses of presumptive remedies and/or innovative technologies.

Expected Outcomes of Each Alternative

- Available uses of land upon achieving cleanup levels. Note time frame to achieve available use (*e.g.*, commercial or light industrial use available in 3 years when cleanup levels are achieved).
- Available uses of ground water upon achieving cleanup levels. Note time frame to achieve available use (*e.g.*, restricted use for industrial purposes in TI waiver zone, drinking water use in non-TI zone upon achieving cleanup levels in 100 years).
- Other impacts or benefits associated with each alternative.

[17] The term "deed restrictions" commonly appears in RODs, consent decrees, and other EPA materials (including the NCP). However, it is not a traditional real property term and does not have a precise legal meaning. The term "deed restrictions" should be understood as simply a catchall term for proprietary controls (such as easements and covenants) that are legally enforceable against subsequent property owners. Therefore, it is important to make sure that all those involved in evaluating remedies using proprietary controls understand that to establish legally enforceable restrictions, rather than merely informational notices (such as a deed notice), a conveyance or contract of some kind will likely be required. Where clarity of intent is important (such as in a ROD), a more precise term , such as easement or covenant, should generally be used (*Institutional Controls: A Reference Manual* (March 1998 draft)).

[18] Key ARARs that drive the remedial action objectives and response options should also be discussed. Key ARARs are generally considered to be those ARARs that provide a basis for developing an alternative (*e.g.*, cleanup levels such as state non-degradation standards for ground-water resources) or ARARs that help distinguish between alternatives. One approach to covering key ARARs in this section is to provide a table which cites the ARAR, identifies the alternative to which it applies, and clarifies how it will be applied at the site. The ROD must describe all ARARs for the selected remedy (NCP Section 300.430(f)(5)(ii)(B) and (C)). Therefore, a more extensive table of ARARs that apply to the Selected Remedy should be presented in the Statutory Determinations (see section 6.3.13 and Highlight 6-34).

[19] Off-site transfers of CERCLA wastes, residuals from CERCLA wastes treated on site, or wastewater containing CERCLA waste, should be compliant with the Off-Site Rule at 58 FR 49200, September 22, 1993, and 40 CFR Part 300.440. Regarding the off-site disposal of wastes, note that CERCLA §121(b)(1) states: "The offsite transport and disposal of hazardous substances or contaminated materials without such treatment should be the least favored alternative remedial action where practicable treatment technologies are available." NCP §300.430(f)(1)(ii)(E) also states: "The balancing shall also consider the preference for treatment as a principal element and the bias against off-site land disposal of untreated waste."

Highlight 6-22: Examples of Remedy Components for Each Alternative

Remedies Involving Soils and Surficial Contamination:

- **Treatment Components**
  - Treatment technologies (e.g., thermal destruction) to be used.
  - Type and estimated volume of waste treated (e.g., soils with high concentrations of VOCs composing the principal threat waste at the site).
  - Primary treatment levels (e.g., Best Demonstrated Available Technology, percentage, or order of magnitude of reductions expected) and basis (e.g., ARARs, risk-based levels) for selection of treatment level.
  - Type and estimated volume of emissions/residuals expected.
  - Any risks associated with emissions/residuals.
- **Containment (or Storage) Components**
  - Type of storage (e.g., landfill, tank, surface impoundment, containers).
  - Type of closure to be implemented (e.g., RCRA Subtitle C clean closure, landfill closure, Subtitle D solid waste closure).
  - Type and quantity of waste to be stored (e.g., treatment residuals, non-principal threat source material).
  - Type and quantity of untreated waste and/or treatment residuals to be disposed of off-site or managed on-site in a containment system (e.g., cap, RCRA Minimum Technology Unit).
- **Institutional Control Components**
  - Specific controls proposed (e.g., deed restrictions such as easements and covenants, deed notices, land use restrictions such as zoning and local permitting, ground-water use restrictions, and public health advisories).
  - Entities responsible for implementing and maintaining controls (e.g.,property owner, town zoning authority, State health agency)

Remedies Involving Ground-Water Contamination:

- **Ground-Water Extraction and Treatment Components**
  - Ground-water extraction method.
  - Whether ground water will be extracted over entire plume or portions of plume (e.g., hot spots)
  - Location for discharging treated ground water.
  - Technologies for treating extracted ground water.
  - Additional treatment and/or management for treatment residuals.
  - Other methods/technologies that will be used for aquifer remediation in addition to primary extraction and treatment components (e.g., air sparging, in-situ bioremediation, monitored natural attenuation).
  - Phased implementation stages of the remedy that will be used to optimize the remedy for site conditions and increase cost-effectiveness.
  - Remedy refinements that may be needed during the life of the remedy (e.g., adjusting the number of extraction wells, adjusting the pumping rate, pulsed pumping of some wells, etc.).
  - If applicable, provisions for ground-water monitoring once the system is shut off to ensure clean-up levels are maintained.
- **Ground-Water or Source Containment Components**
  - Containment technologies (e.g., subsurface barriers, hydraulic control).
  - Areas to be contained aerially and vertically.
  - Alternate performance standards.
  - Areas of ground-water plume to be contained.
  - Geologic stratum (if any) that will serve as a bottom for the containment system.
- **Monitored Natural Attenuation**
  - Portions of the plume that will be treated using natural attenuation.
  - Evidence that natural attenuation is likely to attain cleanup levels (or other remedial objectives) for the specific conditions of the site.
  - Contingency actions that will be used if natural attenuation can not attain aquifer cleanup levels.
  - Institutional controls that will restrict the use of ground water until cleanup levels are attained.
- **Institutional Control Components**
  - Specific controls proposed (e.g., deed restrictions such as easements and covenants, deed notices, land use restrictions such as zoning and local permitting, ground-water use restrictions, and public health advisories).
  - Entities responsible for implementing and maintaining controls (e.g.,property owner, town zoning authority, State health agency)

6.3.10 Summary of Comparative Analysis of Alternatives

The NCP provides that the ROD must explain how the nine criteria were used to select the remedy (NCP §300.430(f)(5)(i)). Thus, this section of the ROD should summarize the comparative analysis of alternatives presented in the detailed analysis section of the RI/FS Report. The major objective is to evaluate the relative performance of the alternatives with respect to the nine evaluation criteria so that the advantages and disadvantages of each are clearly understood. The most effective way of organizing this analysis is to present a series of paragraphs headed by each criterion. Each criterion should be described, and then the comparison of alternatives should be presented in decreasing order from the most to least advantageous. An example of this discussion can be found in Highlight 6-24. Highlight 3-6 (in Chapter 3) presents tips for discussing the nine criteria as well.

A summary table is also an effective way to communicate the salient points made from the text discussion. An example of a summary table that captures the entire Comparative Analysis can be found in Highlight 6-25.

Highlight 6-23: Tips on Presenting the Comparative Analysis of Alternatives

- First, develop a clear and descriptive summary of each of the nine criteria.
- Second, explain how each of the alternatives compare to each other relative to each criterion.
- Third, summarize the discussion of each criterion by presenting each of the alternatives in decreasing order from the most to least advantageous.
- Consider using a summary table to complement the text summary of the comparative analysis of alternative.
- Avoid a symbolic ranking method without an accompanying narrative, such as "+" for "best" alternative and a "-" for the lower-ranking alternative.

Highlight 6-24: Example Text Summary for the Comparative Analysis of Alternatives

Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

All of the alternatives, except the no-action alternative, are protective of human health and the environment by eliminating, reducing, or controlling risks posed by the site through treatment of soil contaminants, engineering controls, and/or institutional controls. Alternative 2 would provide adequate protection from exposure due to direct contact or soil ingestion. However, perpetual cap maintenance would be required to ensure total protectiveness. Any breach in the cap would potentially expose individuals to existing levels of contamination and allow leachate to contaminate the ground water. Alternative 3 would provide additional protection from possible exposure with the reduction of volatile organic concentrations by soil vapor extraction. Alternative 4 would provide greater protection than Alternative 3 due to the additional benefits of soil stabilization. Alternative 5 would provide the greatest degree of protection due to the total destruction of organic contaminants during the incineration process .

Alternatives 2 through 5 would provide adequate protection from exposure to ground-water contamination by providing an alternate water supply to area users. The protection from exposure to contaminated ground water afforded by Alternative 2 would be dependant on the enforcement of institutional controls. Alternative 2 would also allow currently uncontaminated areas to become contaminated as the plume migrates and dissipates, potentially exposing users currently outside the limits of the plume. Alternatives 3, 4, and 5 would provide adequate control of plume migration through pumping. The protection against future ground-water contamination increases as additional soil treatment processes decrease the potential for leachate generation.

Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as “ARARs,” unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance 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. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for a invoking waiver.

All alternatives, except the no action alternative, had common ARARs associated with the construction of a cap onsite and the drinking water standards for ground water. The use of soil vapor extraction would require consideration of emission standards for volatile organics. Alternative 5, which includes incineration, would be required to meet the performance standards of incinerators set in 40 CFR 264. Acquisition of permits would not be necessary for on-site treatment operations. A permit would be necessary for any surface discharge of treated water.

All alternatives will attain their respective Federal and State ARARs. However, drinking water standards will not be met through Alternative 2, natural attenuation, for approximately 100 years. These standards may be meet by the pump and treat alternatives in 25-40 years.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

Each alternative, except the No Action alternative, provides some degree of long-term protection. The alternatives increase in effectiveness of assuring protection against potential exposure and leachate generation as additional treatment components are included. The effectiveness and permanence of Alternative 2 is dependent entirely upon the adequacy of maintenance. Contaminated soil would remain as a potential source of ground-water contamination. Alternative 3 provides a greater degree of long-term effectiveness and permanence with the removal of contaminants from both soil and ground water though treatment. Alternative 3 also removes volatile organics as a potential source of ground-water contamination. However, metals-contaminated soil may remain unaddressed without treatment. (Continued)

Highlight 6-24: Example Text Summary for the Comparative Analysis of Alternatives (continued)

Long-Term Effectiveness and Permanence (continued)

Alternative 4 is more effective than Alternative 3 because it would also stabilize the lead contamination in soil. Alternative 5 provides the greatest long-term effectiveness and permanence of all the options because volatile organic compounds are destroyed in the incineration process. Ash from the incineration process is not expected to be hazardous. However, management of the ash on-site would not fully eliminate the potential for exposure to lead in the long-term.

The provision of an alternate water supply to prevent exposure of current ground-water users to contaminants is protective of human health for the duration that the alternative water supply exists. The effectiveness of monitored natural attenuation to control exposure of future users and reduce ground-water contamination at this site is highly questionable because of the uncertainties associated with attenuation and the enforceability of institutional controls. Alternatives 3, 4, and 5 are equally effective and permanent in restoring ground-water quality by attaining drinking water standards in a reasonable time frame.

Reviews at least every five years, as required, would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain on-site in concentrations above health-based levels.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 1 and 2 do not include treatment as a component of the remedy. Therefore, these alternatives would not reduce the toxicity, mobility, or volume of contamination at the site.

Alternative 3 includes treatment of volatile organics in both soil and ground water as components of the remedy. Volatile organic contamination would be reduced by 99.9% in approximately 20,000 cubic yards of soil. This reduction is irreversible because the volatile organics would be removed from the soil by the extraction process and the organics would be destroyed in the carbon regeneration process. However, an additional 25,000 cubic yards of lead-contaminated soil on-site would remain untreated. Alternative 4 provides a greater degree of treatment by including the stabilization of the lead-contaminated soil. Stabilization would reduce the mobility of lead by approximately 40% while increasing the volume of stabilized material 20%.

Alternative 5 would provide the greatest reduction in the toxicity and volume of contaminated soil through the permanent destruction of volatile organics. Ash from the incinerator is not expected to be hazardous and would therefore not impact ground water.

Alternatives 3, 4, and 5 would provide comparable reductions in the mobility, volume, and toxicity of ground-water contamination at the site. Volatile organic concentrations in ground water would be reduced to drinking water standards through treatment of ground water by air stripping. The organics would eventually be destroyed by the carbon regeneration. The potential for recontamination of the ground water decreases from Alternative 3 to Alternative 5 as the degree of source treatment increases.

Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternative 2 would be completed in approximately one year. During this time, construction activities associated with installation of the alternate water supply would take place in the community. However, no exposure to hazardous substance would occur in the community during installation of the water supply. The source control components of Alternatives 3 and 4 would require up to six years to complete, depending on the time necessary for the soil vapor extraction to reach cleanup levels. Source control would be achieved in three years with Alternative 5.

Alternative 1, No Action, would not be an effective alternative because current risks from direct contact would continue to exist; current ground-water users would be exposed to contamination within one to three years. There would be potential risks to construction workers during excavation and treatment of soils and construction of the cap in Alternatives 2 though 5, primarily associated with equipment movement and exposure to contaminated dust and volatile organic emissions. However, air monitoring, on-site and at the site boundary, and engineering controls would control the potential for exposure. Workers would be required to wear appropriate levels of protection to avoid exposure during excavation and treatment activities.

Air emissions from the ground-water treatment process (air stripping) and the incinerator would be addressed by engineering controls to ensure that the emissions meet applicable Federal or State air emission standards, mitigating any adverse on- or off-site impacts.

Highlight 6-24: Example Text Summary for the Comparative Analysis of Alternatives (continued)

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Construction of the cap and installation of the alternate water supply in Alternative 2 is relatively straightforward. Materials and equipment necessary for cap construction are readily available. Installation of the water supply would require coordination with local authorities for the construction of water lines within existing right-of-ways. However, the ability to impose institutional controls to restrict ground-water use is uncertain because of the nature of county zoning laws.

All of the treatment alternatives are easily implemented. All materials and services needed for implementation are readily, commercially available. The site logistics of implementation increase in difficulty as more treatment components are added in each alternative. Incineration would require more available area on-site for equipment setup and stockpiling of soil and ash. However, logistical considerations would be addressed in design of the overall site remedy.

The components necessary for the ground-water remedy are also readily available and would not require any special engineering modification prior to use at the site. Operation and maintenance of the air strippers would include cleaning and replacement of well components, regeneration of activated carbon, and maintenance of blower equipment.

Cost

The estimated present worth costs for the alternatives, not including the No Action alternative, range from $4.8 million for Alternative 2 to $16.0 million for Alternative 5. The cost of each alternative increases as the degree of soil treatment increases. Cost summaries can be found in Table ___.

State/Support Agency Acceptance

The State has expressed its support for Alternatives 3, 4, and 5. The State does not believe that Alternative 1 provides adequate protection of human health and the environment. The State does not support Alternative 2 because it does not use treatment as a permanent solution.

Community Acceptance

During the public comment period, the community expressed its support for either Alternative 3 or 4. The community did not consider Alternatives 1 and 2 to be adequately protective and opposed the use of incineration technology.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Highlight 6-25: EXAMPLE COMPARATIVE ANALYSIS OF ALTERNATIVES

Criteria	Alternative 1 No Action	Alternative 2 Cap, Alternate Water Supply, Natural Attenuation of Ground Water	Alternative 3 In-situ Soil Vapor Extraction, Cap, Ground Water Pump and Treat	Alternative 4 In-situ Soil Vapor Extraction, In-situ Soil Stabilization, Cap, Ground Water Pump and Treat	Alternative 5 In-situ Soil Stabilization, Cap, Incineration, Ground Water Pump and Treat
OVERALL PROTECTIVENESS					
Human Health Protection					
• Direct Contact/ Soil Ingestion	No reduction in risk.	Cap reduces direct contact risk and soil ingestion risk to less than 1×10^{-6}.	Cap and vapor extraction reduce direct contact/soil ingestion risk to less than 1×10^{-6}.	Cap, stabilization, vapor extraction reduce direct contact/soil ingestion risk to less than 1×10^{-6}.	Cap, stabilization, incineration reduce direct contact/soil ingestion risk to less than 1×10^{-6}.
• Ground Water Ingestion for Current Users	No reduction in risk.	Alternate water supply provides protection against risk from ground water ingestion.	Greater degree of leachate protection than Alt. 2 from removal of volatile organics in soil. Controls migration of plume to unaffected current users.	Increased protection of ground water from stabilization of metals, in addition to removal of organics and cap.	Highest degree of ground-water protection due to destruction of organics in source.
• Ground Water Ingestion for Potential Future Users	No reduction in risk. Increases risk to new users as plume moves to uncontaminated areas.	Requires future users to hook up to alternate water supply. COC levels in aquifer estimated to achieve MCLs by natural attenuation in 100 years.	Area beyond existing plume available for use. Plume migration controlled by pumping. COC levels in aquifer estimated to achieve MCLs by pump and treat in 25-40 years.	Same as Alternative 3.	Same as Alternative 3.
Environmental Protection	Allows continued contamination of the ground water.	Migration of COCs by runoff and leaching is eliminated by use of cap. Continued migration of existing contaminated ground water is allowed.	Contaminant concentrations are reduced by soil vapor extraction. Migration of low level threat eliminated by the cap. Migration of contaminated ground water is controlled by pumping.	Contaminant concentrations reduced by soil vapor extraction. Migration of remaining soil contaminants decreased by soil stabilization and cap. Migration of contaminated ground water is controlled by pumping.	Highest degree of protection due to destruction of organic contaminants by incineration. Potential for migration to ground water is minimized by stabilization and cap. Ground-water contaminant migration controlled by pumping.

Criteria	Alternative 1 No Action	Alternative 2 Cap, Alternate Water Supply, Natural Attenuation of Ground Water	Alternative 3 In-situ Soil Vapor Extraction, Cap, Ground Water Pump and Treat	Alternative 4 In-situ Soil Vapor Extraction, In-situ Soil Stabilization, Cap, Ground Water Pump and Treat	Alternative 5 In-situ Soil Stabilization, Cap, Incineration, Ground Water Pump and Treat
COMPLIANCE WITH ARARs					
Chemical-Specific ARARs	Ground water will always exceed MCLs.	Would meet MCLs at the waste boundary in over 100 years.	Would meet MCLs at the waste boundary in 25-40 years.	Same as Alternative 3.	Same as Alternative 3.
Location-Specific ARARs	No location-specific ARARs.	No location-specific ARARs.	No location-specific ARARs.	No location-specific ARARs.	No location-specific ARARs.
Action-Specific ARARs	No action-specific ARARs.	Will meet RCRA minimum technology requirements for caps.	Will meet air release standards from the vapor extraction & air stripper; NPDES discharge requirements; RCRA minimum technology requirements for caps.	Same as Alternative 3.	Will meet performance and air release standards for incinerators & air strippers; NPDES discharge requirements; RCRA minimum technology requirements for caps.
Other Criteria and Guidance	Would allow ingestion of ground water exceeding MCLs. Would not protect against Pb levels above 600 mg/kg in soil.	Protects against soil ingestion to 1×10^{-6} level. Alternate water supply and institutional controls protect against ground-water ingestion at levels greater than MCLs. Covers soil with Pb above 600 mg/kg.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of Residual Risk					
• Direct Contact/Soil Ingestion	Source has not been addressed. Existing risk will remain.	Risk reduced as long as cap is maintained. Risk from potential exposure to lead from cap failure remains.	Risk from exposure to organics minimized through vapor extraction and cap. Minimal hazard remains from exposure to lead if cap fails.	Risk from exposure to both organics and lead minimized due to treatment. Decreased potential for leaching into ground water.	Risk from exposure to organics eliminated through incineration, minimized by stabilization of lead in remaining soil.
• Ground Water Ingestion for Current Users	Risk remains as plume continues to affect users. Ability for natural attenuation and dilution questionable since source is not removed.	Risk eliminated by providing alternate water supply. Some risk would remain for over 100 years if the ground water is used.	Current risk eliminated by providing alternate water supply. Future risk reduced by achieving MCLs in 25-40 years.	Same as Alternative 3.	Same as Alternative 3.
• Ground Water Ingestion for Potential Future Users	Risk from exposure increases to currently unaffected ground-water users increases as area of contamination increases. Ability for natural attenuation and dilution questionable since source is not removed.	Institutional controls used to control use of contaminated ground water. Ability to enforce controls is questionable. Unauthorized use of ground water would increase risk to user.	Risk minimized by extracting ground water and controlling plume migration. Drinking water quality restored in 25-40 years with source control.	Same as Alternative 3.	Same as Alternative 3.

Criteria	Alternative 1 No Action	Alternative 2 Cap, Alternate Water Supply, Natural Attenuation of Ground Water	Alternative 3 In-situ Soil Vapor Extraction, Cap, Ground Water Pump and Treat	Alternative 4 In-situ Soil Vapor Extraction, In-situ Soil Stabilization, Cap, Ground Water Pump and Treat	Alternative 5 In-situ Soil Stabilization, Cap, Incineration, Ground Water Pump and Treat
Adequacy and Reliability of Controls	No controls over remaining contamination. No reliability.	Risk to current users from ground-water exposure controlled by alternate water supply. Soil/clay cap controls contaminated soil. Institutional controls are limited in effectiveness due to enforceability.	Cap controls migration of and exposure to contaminated soil. Ground water extraction controls ground-water plume. Both are adequate.	Same as Alternative 3.	Similar to Alternative 3. Incinerator ash disposed in municipal landfill not hazardous. If high metals concentrations are present, incinerator ash would be disposed in RCRA landfill.
		Reliability of cap can be high if maintained. Failure to maintain cap can increase potential for direct contact and future ground-water contamination.	Reliability of vapor extraction high. Cap reliable if maintained. Ground-water pump and treat is reliable.	Reliability of stabilization with cap high, as are vapor extraction and ground- water pump and treat.	Incineration very reliable because material is destroyed. Stabilization with cap and ground-water pump and treat are reliable.
	Contaminants would remain on-site above health-based levels.	TCE and lead soil would remain on-site above health-based levels.	Lead-contaminated soil would remain on-site above health-based levels.	Fixed lead residuals would remain on-site above health-based levels.	Fixed lead residuals would remain on-site above health-based levels.