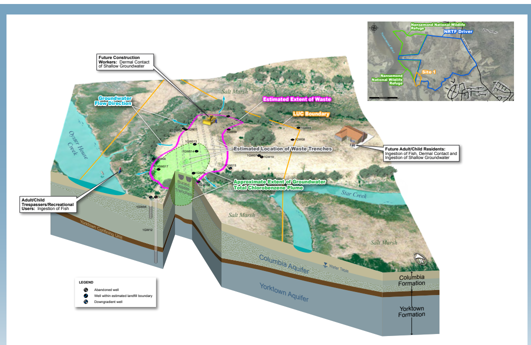
United States Environmental Protection Agency

TOOLKIT FOR PREPARING CERCLA RECORDS OF DECISION



SEPTEMBER 2011

United States
Environmental Protection
Agency

TOOLKIT FOR PREPARING CERCLA RECORDS OF DECISION

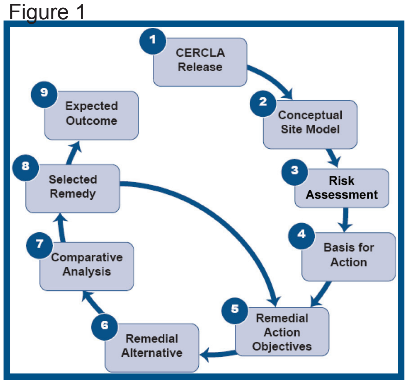
This effort is the culmination of a multi-year collaboration with the Department of the Navy (DoN) to investigate ways to produce higher quality and more user-friendly Records of Decisions. EPA wishes to acknowledge the DoN for its creative ideas, unflagging assistance, and technical support, especially the graphics production. This product has been significantly improved through those who have worked with EPA over the years and EPA gratefully acknowledges their contributions.

TOOLKIT INTRODUCTION

This toolkit consists of sixteen exhibits and each includes a "**Recommended Toolkit Tip** ▶▶▶" to help improve the quality and transparency of data presentation in a Record of Decision.

This document provides Remedial Project Managers (RPMs) with a resource to help improve the public transparency and understanding of Superfund Records of Decision (RODs) for remedy decisions developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)[1] using communication tools designed to enhance the decision document's presentation **(Exhibits 1-16)**. This document provides suggestions on means to convey information graphically and visually in a ROD or in a separate outreach document. By using these tools, RPMs may help clarify the selected remedy **(Figure 1)** and effectively convey information in a format that thoroughly yet concisely presents the full rationale for the remedy decision. These tools are meant to supplement the ROD decision document, not replace it. The suggestions or tools in this document do not substitute for the statutory or regulatory requirements for a ROD or for related guidance documents[2].

Figure 1



The ROD should be a defensible, stand-alone document that memorializes the remedy decision in an appropriate level of detail, as discussed in EPA's ROD Guidance. Sometimes, in attempts to be all inclusive or overly thorough, a ROD includes extraneous information or provides an excessive amount of detailed information from previous documents. This may inadvertently affect the public's ability to understand the ROD. RPMs may be able to summarize the key facts from prior site-related documents and use the tools described herein to enhance the decision document's presentation to provide a more succinct and understandable ROD. For example, by using summary graphics, figures, and tables, supported by appropriate text, an RPM may be able to better illustrate the data, analysis, and rationale to better explain the remedy selected in the ROD. Because there is no "one size fits all" template, it is generally important during development of a ROD to include the level of detail recommended by EPA's ROD Guidance and consider the use of streamlining and visualization tools for better site-specific data or information presentation.

The example exhibits presented in this document track the EPA ROD outline as provided in the "A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents" (OSWER 9200.1-23P) July 1999, on page 6-2. Each exhibit provides recommended tips that suggest how and where to consider including tools like tables and graphics in a ROD. These recommended streamlining and visualization tools may also be effective in the preparation of other documentation related to the CERCLA remedy selection process, such as Remedial Investigations and/or Feasibility Studies.

This document is designed to be viewed electronically. This format allows the reader to zoom into the detail presented in the color graphics. Please note that some reformatting may be required for printing.

EPA plans to create a web site that will provide additional information on available visualization and decision support tools (i.e., software packages). These support tools often can be used to present data/ information similar to the exhibits in this document. The web site is intended to provide a resource of available free-ware and commercial computer software. The data visualization tool listing will not provide endorsements or recommendations of specific resources but instead will provide potential users with examples of tools available and their stated applications. EPA also intends to provide a series of documents on Conceptual Site Models designed to discuss the context for potential use of visualization tools. The science supporting data visualization is advancing rapidly and we anticipate the web site will continue to capture these advances.

[1] This document provides guidance to Regional staff regarding how the Agency intends to interpret and implement the NCP which provides the blueprint for CERCLA implementation. However, this document does not substitute for those provisions or regulations, nor is it a regulation itself. Thus, it cannot impose legally binding requirements on EPA, sites, or the regulated community and may not apply to a particular situation based upon the circumstances. Any decisions regarding a particular situation will be made based on the statute and the regulations, and EPA decision-makers retain the discretion to adopt approaches on a case-by-case basis that differ from the guidance where appropriate.

[2] See for example 40 CFR 300.400 and the guidance document entitled: "A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents" (OSWER 9200.1-23P), July 1999.

TOOLKIT EXHIBITS

Exhibit 1: Road Map of the Key Elements of Remedy Selection

Exhibit 2: Data Certification Checklist for RODs with Multiple Operable Units/Sites

Exhibit 3: Site Layout and Photographs

Exhibit 4: History of Site Investigations and Actions

Exhibit 5: Nature and Extent of Contamination

Exhibit 6: Conceptual Site Model

Exhibit 7: Current and Potential Future Land and Resource Uses

Exhibit 8: Risk Assessment Summary Tables

Exhibit 9: Basis for Action

Exhibit 10: Remedial Action Objectives for Chemicals of Concern Requiring Action

Exhibit 11: Summary of Remedial Alternatives

Exhibit 12: Evaluating Monitored Natural Attenuation as a Remedial Alternative

Exhibit 13: Comparative Analysis of Alternatives

Exhibit 14: Description of Selected Remedy

Exhibit 15: Expected Outcomes of the Selected Remedy

Exhibit 16: Optional Reference CD

EXHIBIT 1. ROAD MAP OF SOME KEY ELEMENTS OF REMEDY SELECTION

Recommended Toolkit Tip

Exhibit 1 visually displays some of the possible graphic tools that should be considered for incorporation into a ROD; however, this Exhibit itself should not be included in the ROD. These tools can help explain the CERCLA remedy selection decision process, and help promote meaningful community involvement, which typically is a key component throughout that process. Similar to a directional road map, there is a starting point (CERCLA Release) and a finish line (Expected Outcomes) for the site, with many key stops along the way.

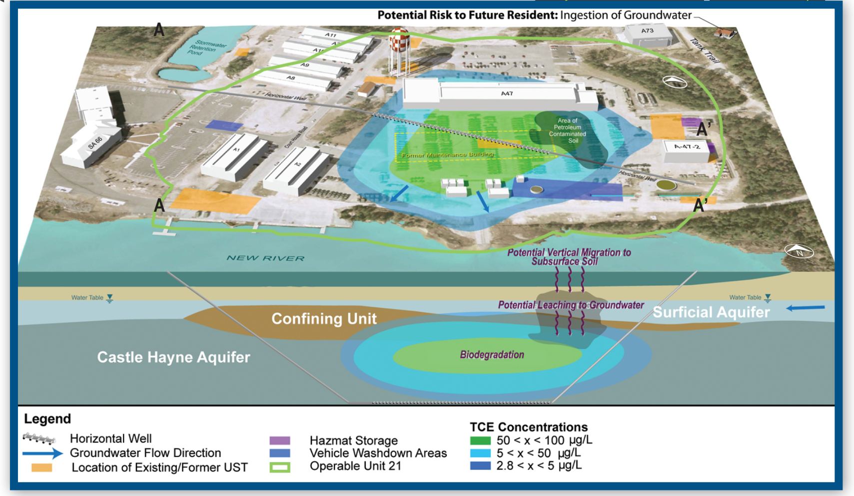
Community Involvement

1 CERCLA Release
2 Conceptual Site Model
3 Risk Assessment
4 Basis for Action
5 Remedial Action Objectives
6 Remedial Alternatives
7 Comparative Analysis
8 Selected Remedy
9 Expected Outcomes

1 CERCLA Release

Conduct site investigation activities to identify the CERCLA release, surface characteristics, hydrogeology, nature and extent, and fate and transport mechanisms to develop the conceptual site model (CSM).

2 Conceptual Site Model



Refine the CSM to identify the current and potential future land and resource uses and potential exposure pathways for risk evaluation.

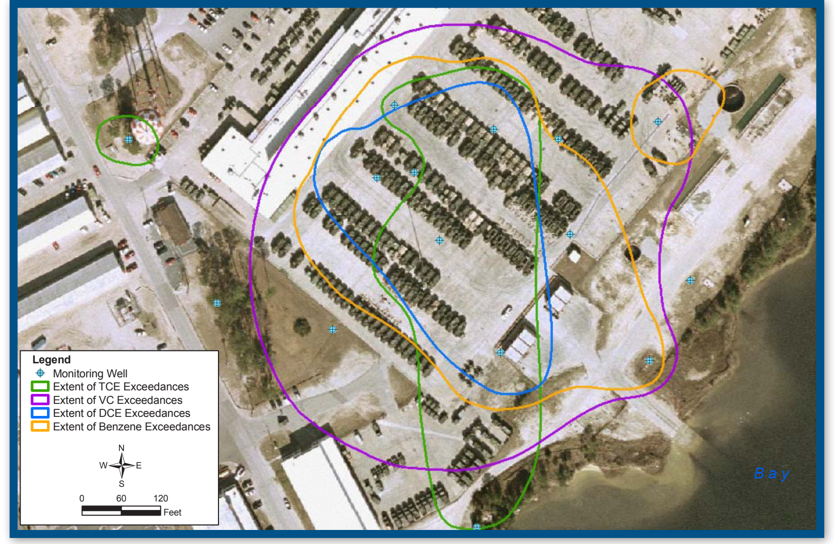
3 Risk Assessment

Receptor	Media†	Pathway	Chemical of Concern	Exposure Point Concentration	RME Cancer Risk	RME Non-Cancer Risk (HI)	CT Cancer Risk	CT Non-Cancer Risk (HI)	Cancer Toxicity Factor (CSF) mg/kg-day^{-1}	Non-Cancer Toxicity Factor (RfD) mg/kg-day^{-1}
Future Adult Resident	Subsurface Soil	Inhalation	C11-C22 Aromatic Hydrocarbon Fraction	3,062 mg/kg	NA	2.92	NA	0.711	Not carcinogenic	3×10^{-2}
	Groundwater	Ingestion	VC	6.52 µg/L	1.5E-04	0.0	2.0E-05	0.0	1.9	0.0
Future Child Resident	Subsurface Soil	Incidental Ingestion	C11-C22 Aromatic Hydrocarbon Fraction	3,062 mg/kg	NA	1.30	NA	0.159	Not carcinogenic	3×10^{-2}
		Inhalation			NA	2.92	NA	0.711		

Results of the risk assessment are used to identify media and chemicals of concern (COCs) warranting a response action based on current and potential future land and resource use.

4 Basis for Action

Receptor	Media	Reasonably Anticipated Land Use	Chemical of Concern Requiring Action	Basis for Action
Human Health	Surface soil	Residential	No unacceptable risks	Not applicable
	Subsurface soil	Residential	Arsenic	Non-cancer hazard index > 1
	Groundwater	Current or potential drinking water resource	Benzene	Cancer risk > 10^{-4}
			TCE	Cancer risk > 10^{-4}
			cis-1,2-DCE	MCL exceedance
			1,1-DCE	MCL exceedance
			Vinyl chloride	Cancer risk > 10^{-4}
	Sediment/Surface water	Recreational & Training	No unacceptable risks	Not applicable
Ecological	Surface soil	Habitat	No unacceptable risks	Not applicable
	Subsurface soil	No pathway	Not applicable	Not applicable
	Groundwater	Habitat	No unacceptable risks	Not applicable
	Sediment/Surface water	Habitat	No unacceptable risks	Not applicable



Develop Remedial Action Objectives (RAOs) and cleanup levels to address all media and COCs that warrant a response action.

5 Remedial Action Objectives

2 DECISION SUMMARY

2.7 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for Site 73 are based upon the potential of future residential receptors using groundwater as a potable water supply and having direct contact with subsurface soil. The RAOs for Site 73 are as follows:

- Restore groundwater quality at Site 73 to the NCGWQS and maximum contaminant level (MCL) standards based on the classification of the aquifer as a potential source of drinking water (Class GA or Class GSA) under 15A NCAC 02L.0201, and to prevent human ingestion of water containing COCs (benzene, TCE, cis-1,2-DCE, 1,1-DCE, and VC) at concentrations above NCGWQS or MCL standards, whichever is more stringent, until the cleanup levels have been obtained.
- Prevent future residential exposure to petroleum hydrocarbon-contaminated soils above the NC HWS SSL and minimize transport to groundwater.
- Minimize migration of COCs in groundwater to surface water.

Cleanup levels to meet the RAOs are identified in Table 5.

TABLE 5
Cleanup Levels for Groundwater and Soil

Groundwater Chemical of Concern	NCGWQS (µg/L)
Benzene	1
TCE	2.8
cis-1,2-DCE	70
1,1-DCE	7
VC	0.015
Soil Chemical of Concern	**NC HWS SSL (mg/kg)**
Petroleum Aromatic Carbon Fraction Class C9-C22	33.6

Notes:
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
NCGWQS - North Carolina Ground Water Quality Standards are more stringent than MCLs for some COCs
NC HWS SSL - North Carolina Hazardous Waste Section Soil Screening Level

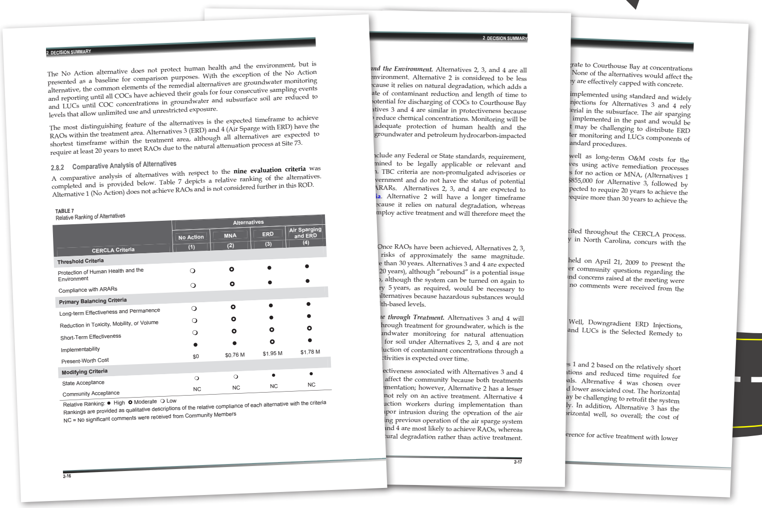
Remedial alternatives are developed for the media and COCs warranting a response action.

6 Remedial Alternatives

Alternative	Components	Details	Cost	
1—No Action	None	Allow the COCs to breakdown naturally over time	Capital Cost	$0
			Annual operation and maintenance (O&M)	$0
			Total Present-Worth	**$0**
			Timeframe	**30 years**
2 –MNA / LUCs	MNA	Groundwater monitoring and reporting to assess the progress of natural attenuation over time	Capital Cost	$13,500
			Annual O&M	$48,249
	LUCs	LUCs to prevent exposure to groundwater and petroleum hydrocarbon-impacted soil	**Total Present-Worth**	**$763,736**
			Timeframe	**30 years**
3 –ERD using existing Horizontal Well and Downgradient ERD Injections / Monitoring / LUCs	Enhanced Anaerobic Bioremediation through Horizontal Well	Injection of electron donors through existing horizontal well to stimulate anaerobic biodegradation of CVOC source by reductive dechlorination	Capital Cost	$854,751
			Annual O&M	$48,295
			Total Present-Worth	**$1,946,816**
	Enhanced Anaerobic Bioremediation via Downgradient Injections	Injection of electron donors in wells downgradient from horizontal well, upgradient of Courthouse Bay, to stimulate anaerobic biodegradation of CVOCs by reductive dechlorination and minimize migration of CVOCs to Courthouse Bay	**Timeframe**	**20 years**
	LUCs	LUCs to prevent exposure to groundwater and petroleum hydrocarbon-impacted soil		

Remedial alternatives are evaluated against the nine criteria and one another for a comparative analysis.

7 Comparative Analysis



8 Selected Remedy

Based on the comparative analysis, a remedy is proposed, then after opportunity for public comment, selected that meets the threshold criteria and achieves RAOs.

9 Expected Outcomes

Risk	RAO	Remedy Component	Expected Outcomes
Ingestion of VOCS in groundwater under potable use scenario	Restore groundwater quality based on the classification of the aquifer as a potential source of drinking water and to prevent human ingestion of water containing COCs at concentrations above NCGWQS or MCL standards, whichever is more stringent until cleanup levels have been obtained.	Air sparge system	Operate system until groundwater cleanup levels are met (expected 5 years) to achieve UU/UE.
		LTM	Maintain LUCs and LTM until groundwater COCs are at or below cleanup levels for four consecutive monitoring events to establish UU/UE.
		LUCs	
Direct exposure to petroleum hydrocarbons in soil under residential use scenario and leaching potential to groundwater	Prevent future residential exposure to petroleum hydrocarbon-contaminated soils above the NC HWS SSL and minimize transport to groundwater.	LUCs	Maintain LUCs on soil for continued industrial landuse.

The components of the Selected Remedy mitigate risk to achieve RAOs consistent with current and potential future land and resource uses.

EXHIBIT 2. DATA CERTIFICATION CHECKLIST FOR RODS WITH MULTIPLE OPERABLE UNITS/SITES

ROD Section
Declaration
Data Certification Checklist

Recommended Toolkit Tip
For RODs addressing multiple sites or Operable Units, a table may be used to help the reader locate important information in each individual ROD, such as information for each recommended element of the sample Data Certification Checklist.

Data	ROD Section Number		
	OU/Site 1A-1	OU/Site 1H	OU/Site 6A*
Chemicals of concern and their respective concentrations	1.2	2.2	3.2
Baseline risk represented by the chemicals of concern	1.4	2.4	3.4
Cleanup levels established for chemicals of concern and the basis for these levels	1.4	2.4	3.4
How source materials constituting principal threats are addressed	1.5	2.5	Not Applicable
Current and reasonably anticipated future land-use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD	1.3	2.3	3.3
Potential land and groundwater use that will be available at the site as a result of the Selected Remedy	1.8	2.8	Not Applicable
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	1.8	2.8	Not Applicable
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)	1.7	2.7	Not Applicable

*no action is required for OU/Site 6A

EXHIBIT 3. SITE LAYOUT AND PHOTOGRAPHS

ROD Section

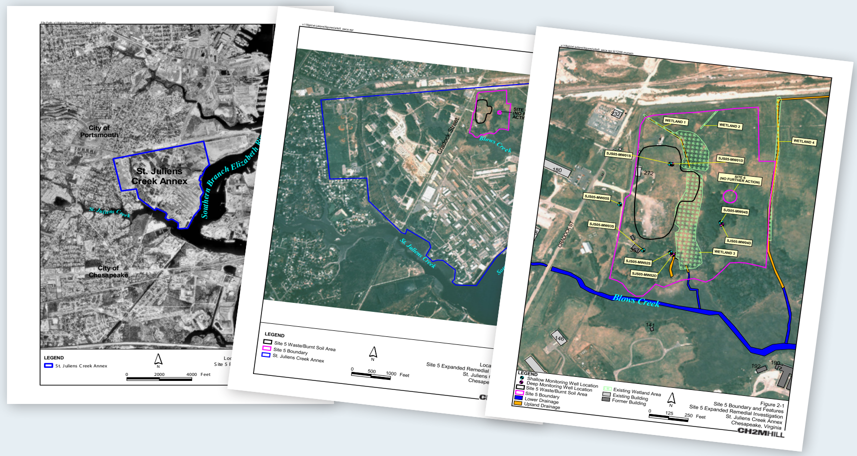
Decision Summary
Site Name, Location, and Brief Description

Recommended Toolkit Tip

Embedding regional and base location images as insets within a figure showing the detailed site layout often can effectively consolidate information previously displayed in several figures. This type of comprehensive graphic combined with historic and current site photographs, if available, can help provide the reader with a better understanding of the site.

The figure should present accurate information on the site boundary, current conditions that encompass the source(s), or release area(s) and the extent of contamination. As noted in the 40 CFR 300.4, CERCLA response actions include "where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located." Therefore, the extent of contamination should not be truncated by artificial/ physical boundaries (e.g., property line, roadways, water bodies).

Administrative Record Resources



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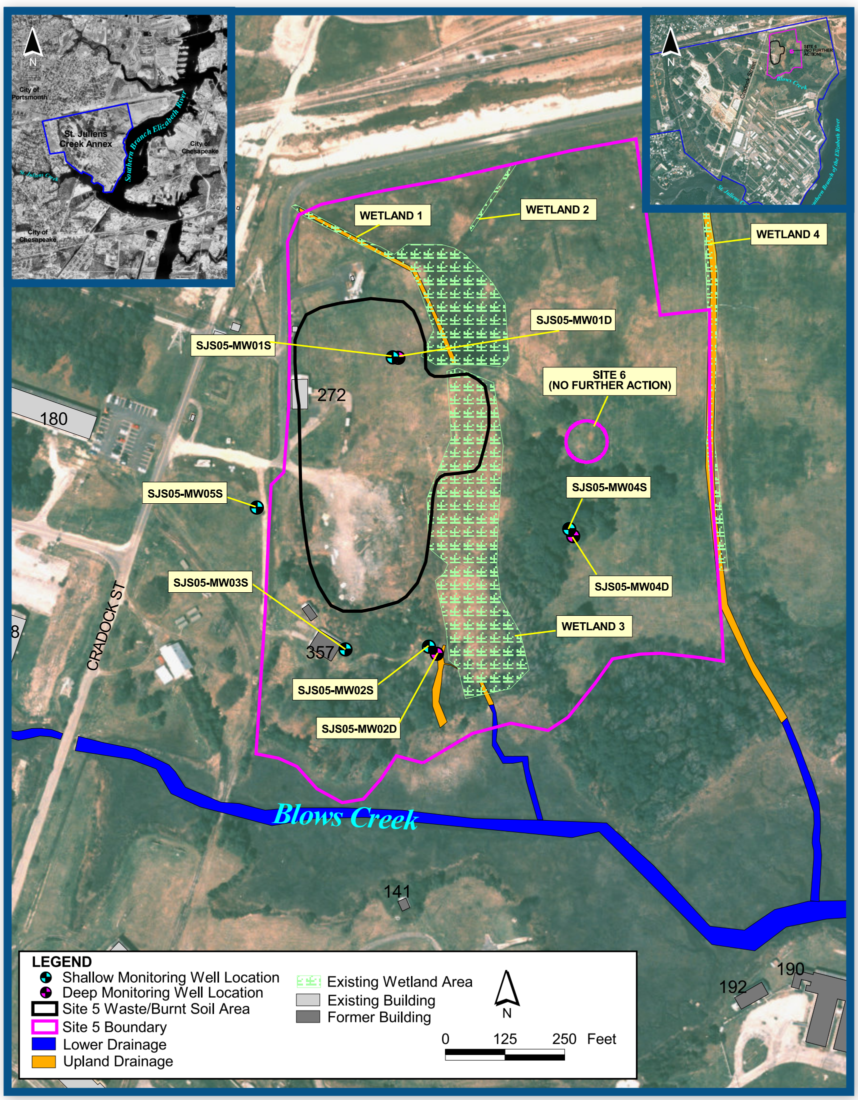

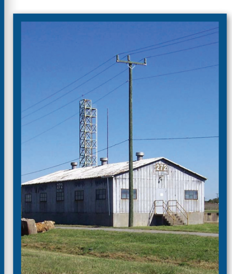

EXHIBIT 4. HISTORY OF SITE INVESTIGATIONS AND ACTIONS

ROD Section
Decision Summary
Site History & Enforcement Activities

Recommended Toolkit Tip
To enhance the presentation of the site history and enforcement activities discussion, a summary table and/or graphic depicting previous investigations/actions may be used to explain how the site has been adequately investigated utilizing an appropriate sampling strategy. The level of detail in a summary table should be adequate to meaningfully supplement the ROD's discussion of all pertinent investigation/action information as the site has gone through the CERCLA process.

Including a figure can be an effective way of illustrating the sample locations with good spatial coverage, appropriate medium, and relevant analysis groups based on the CERCLA release or threat of release. Emerging contaminants (e.g., perchlorate, 1,4-dioxane) should not be overlooked.

For extensive site histories where a text summary may be more appropriate, the use of a time-line can help present a graphic depiction of the CERCLA investigations/actions that have occurred.

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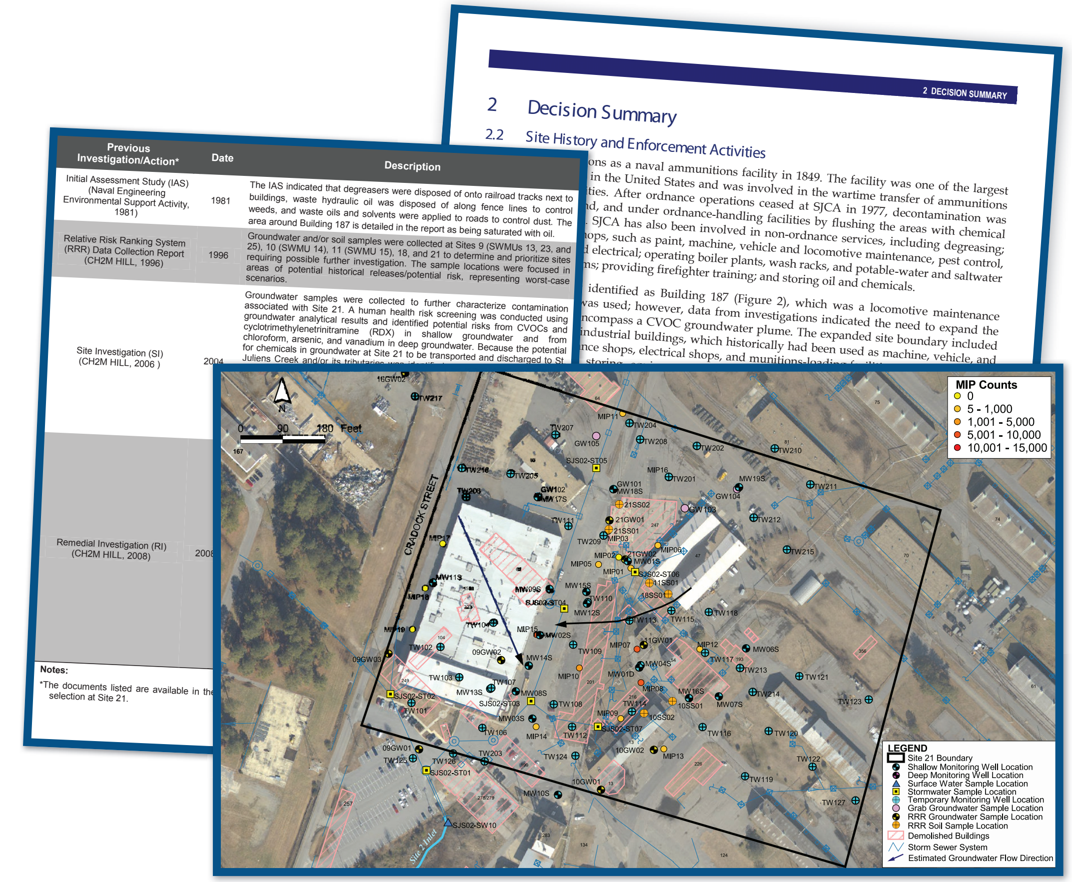
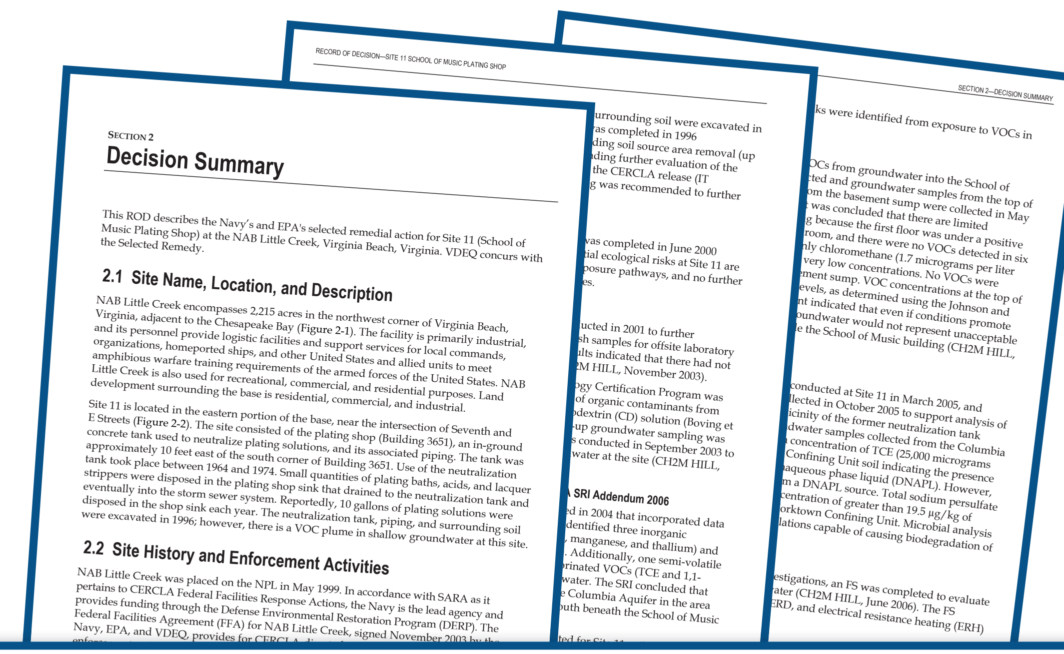




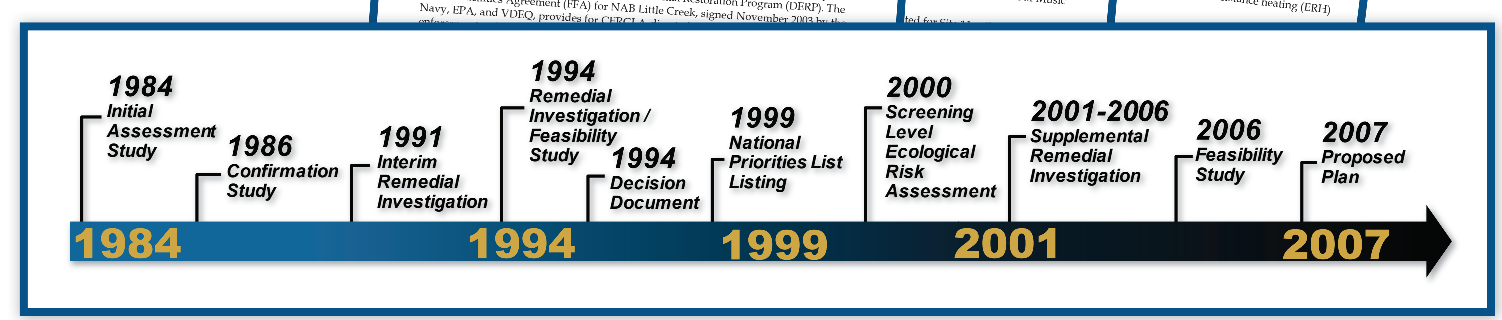


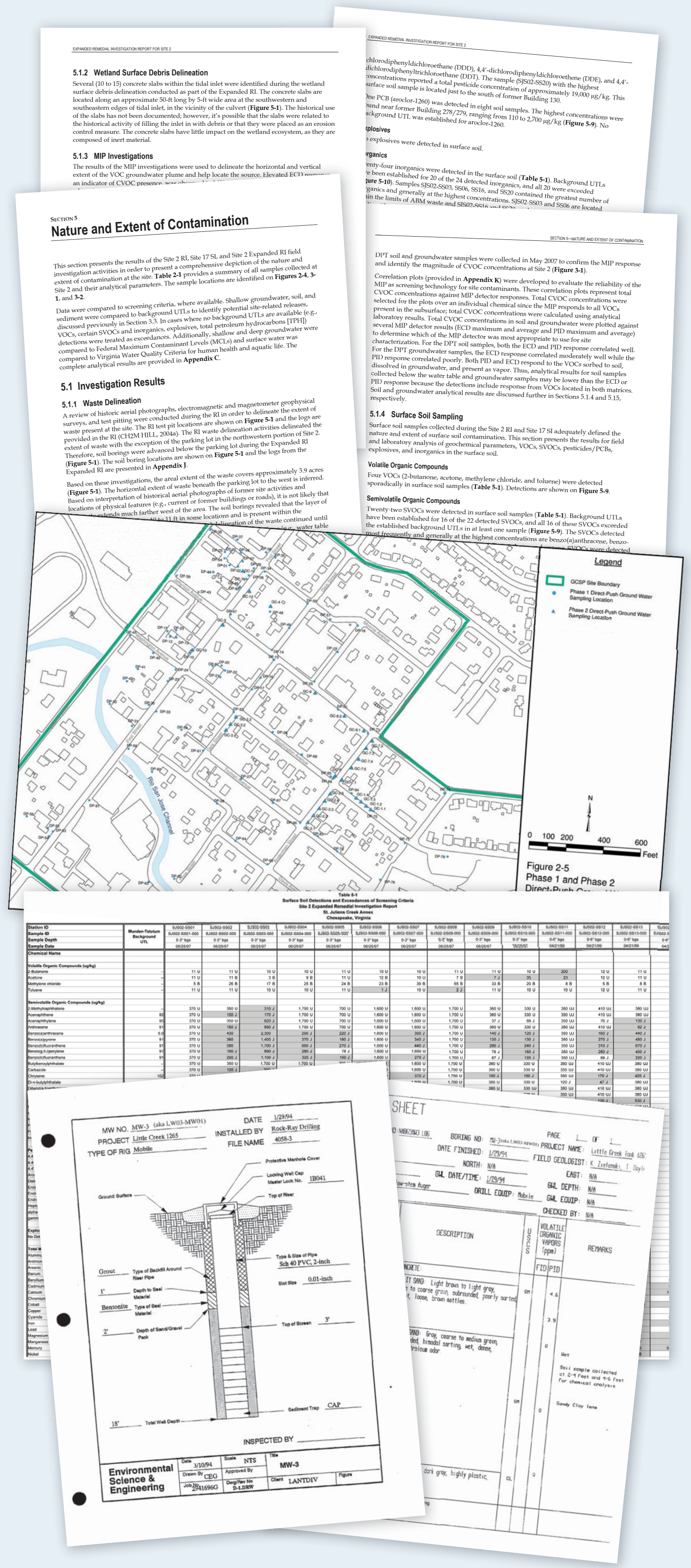
EXHIBIT 5. NATURE AND EXTENT OF CONTAMINATION

ROD Section
Decision Summary
Site Characteristics

Recommended Toolkit Tip
Comprehensive figures may be used to support the ROD's discussion concerning the current relationship between potential sources, subsurface geology and hydrogeology, and the lateral/vertical extent and magnitude of contamination. The figures should reflect any uncertainties in the data presentation.

For sites with groundwater plumes or subsurface contamination, a figure can help portray an accurate, detailed depiction of both the horizontal and vertical extent of contamination, which can also assist in better understanding the conceptual site model.

Administrative Record Resources



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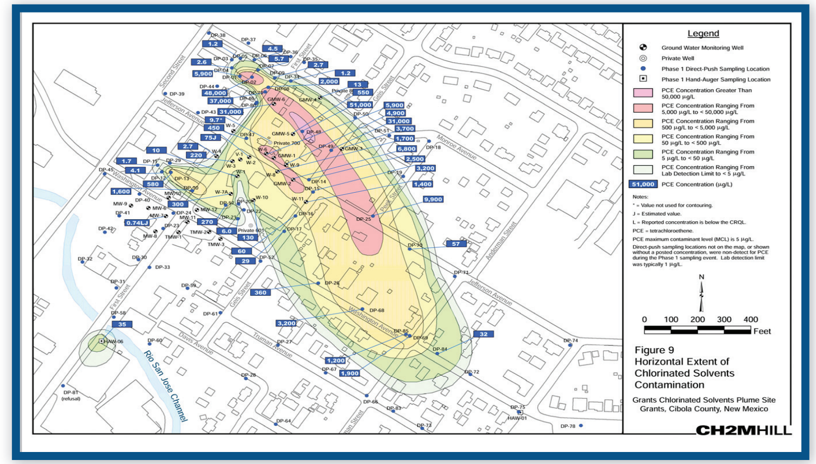
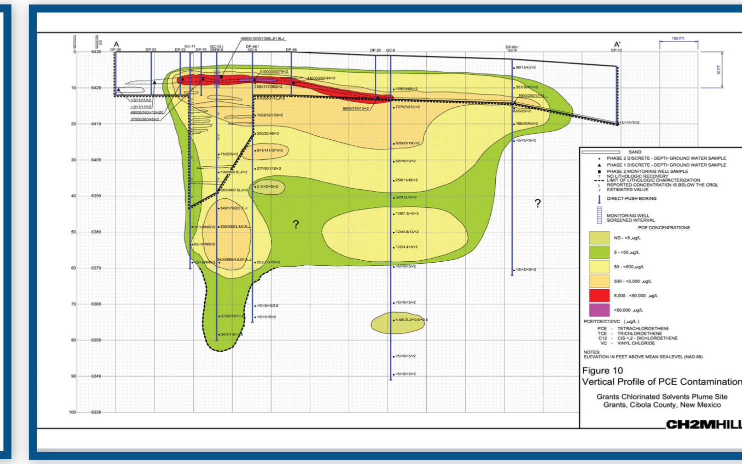
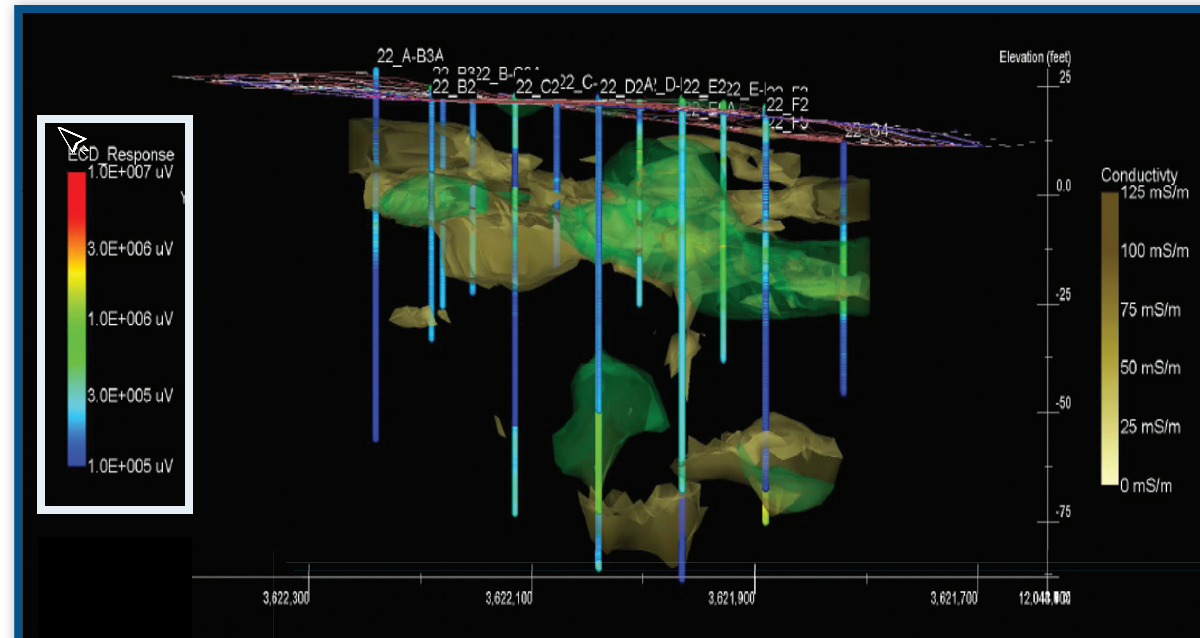






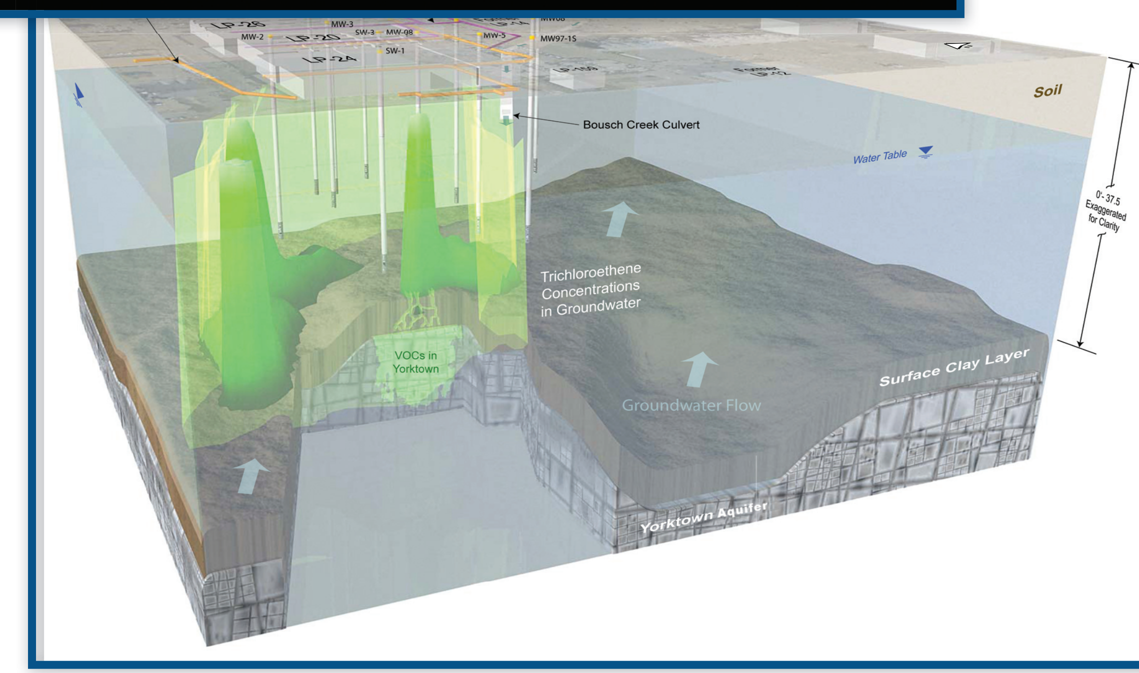


EXHIBIT 6. CONCEPTUAL SITE MODEL

ROD Section

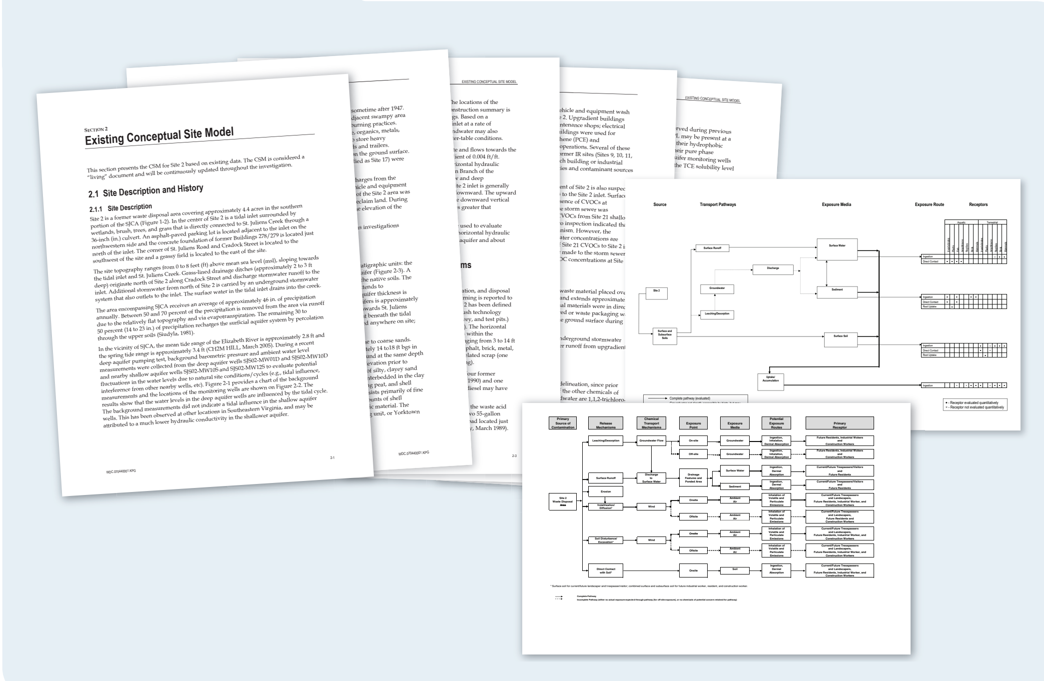
Decision Summary

Site Characteristics

Recommended Toolkit Tip

A comprehensive conceptual site model graphic generally helps illustrate the site layout, hydrogeologic setting, source area(s) and contaminated medium, fate and transport mechanisms, exposure pathways, and potential current and future receptors.

Administrative Record Resources



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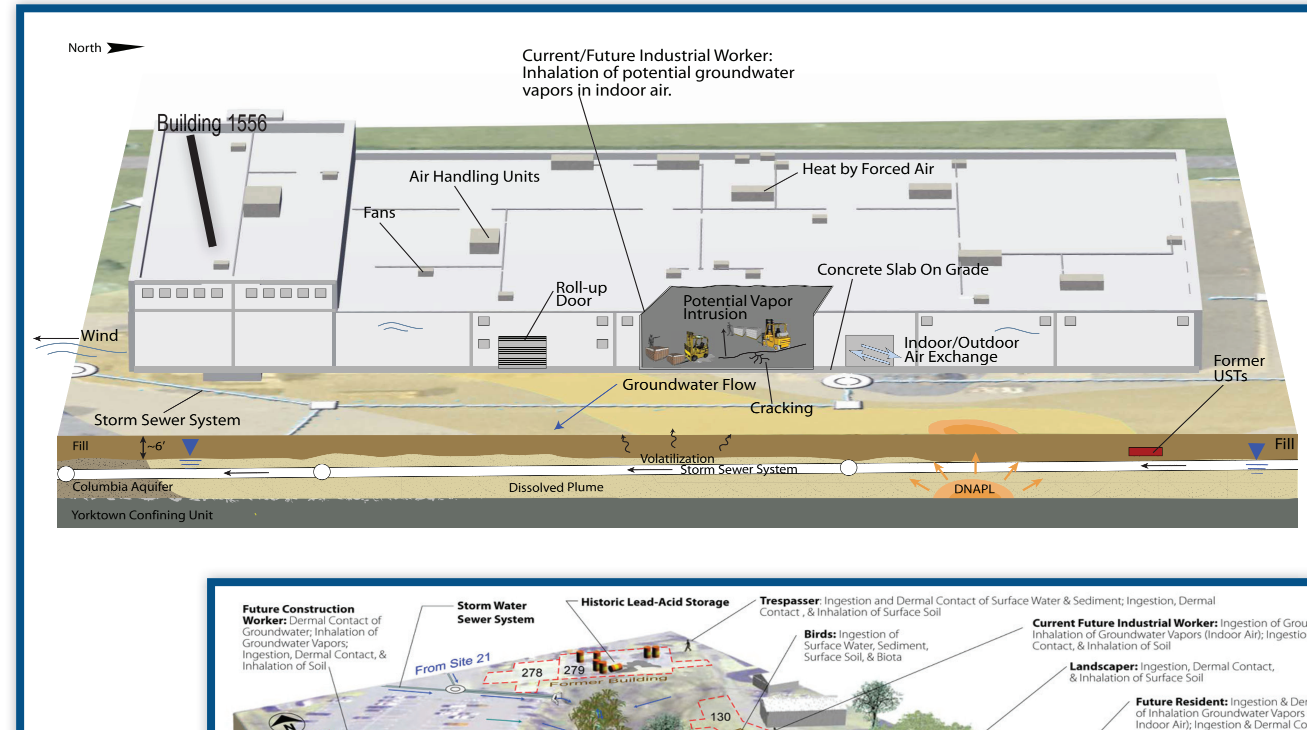

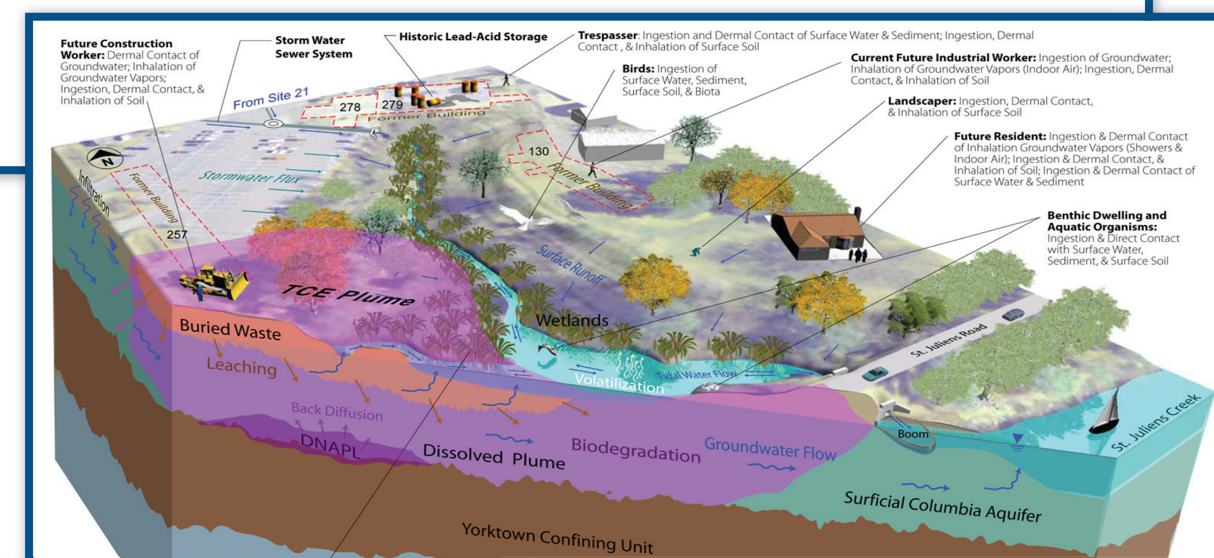

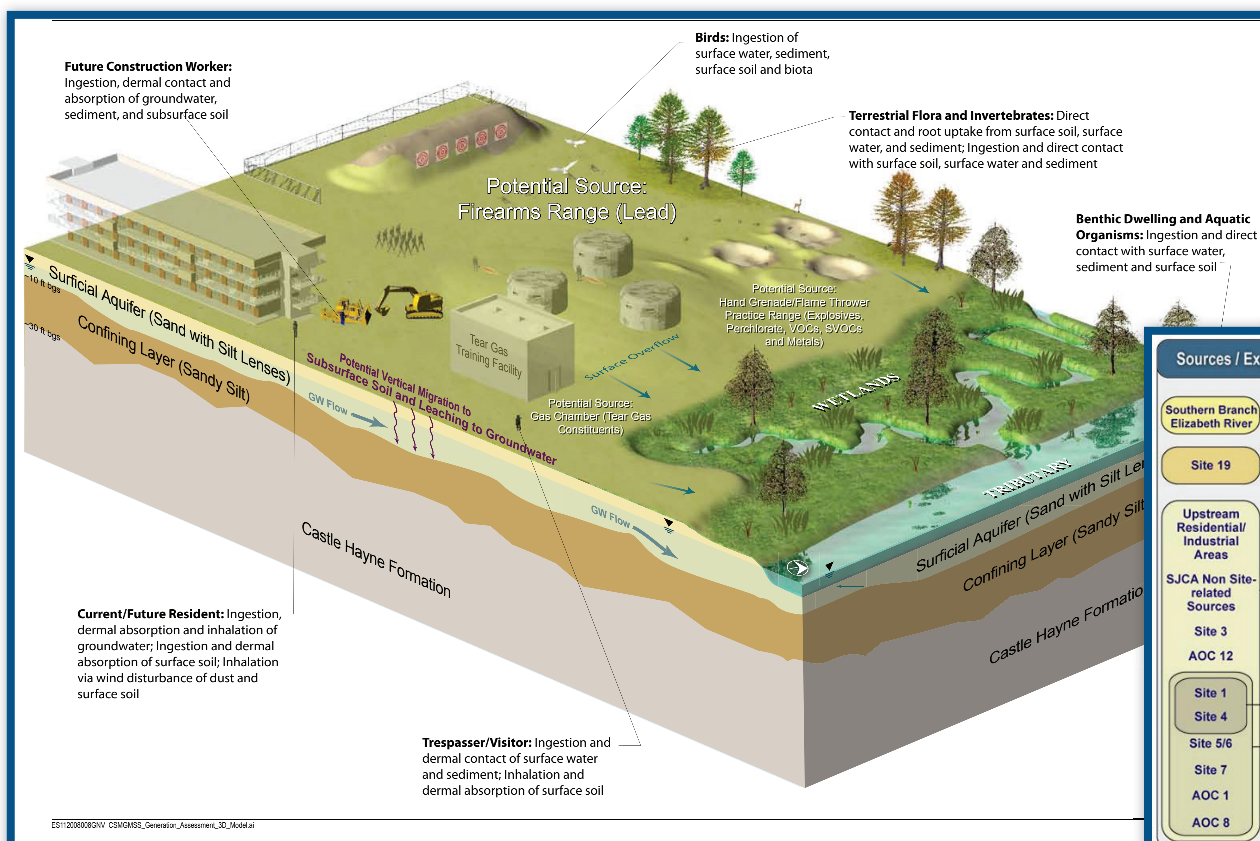

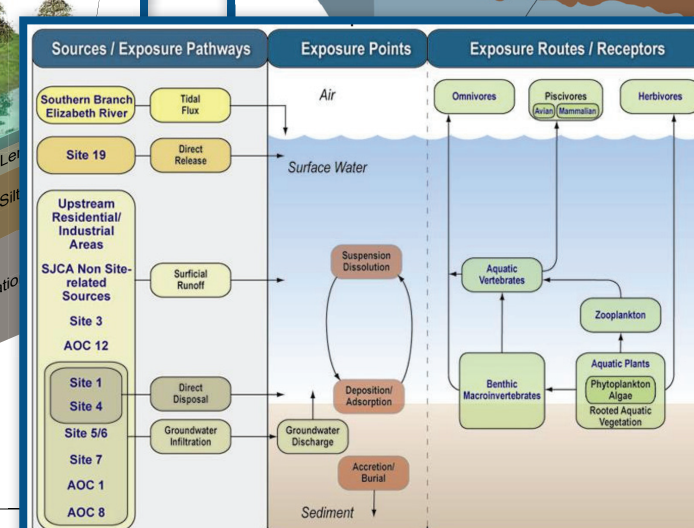

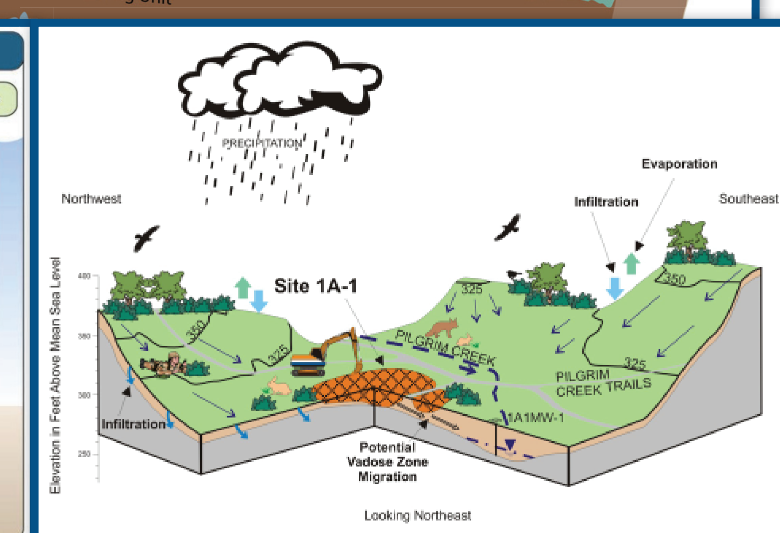

EXHIBIT 7. CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

ROD Section

Decision Summary
Current and Potential Future Land and Resource Uses

Recommended Toolkit Tip

A map can be an extremely effective tool for depicting all onsite and adjacent land/ resource uses, including recreational use of adjacent surface waters and groundwater classification for current and potential future use. Refer to page 7 of "Summary of Key Existing EPA CERCLA Policies for Groundwater Restoration" (OSWER Directive 9283.1-33, June 26, 2009.) The map can also help ensure appropriate remedial action objectives are identified for the potential receptors. Maps also can help show consideration of land use assumptions, relevant land and resource management plans, zoning maps, 20-year development plans, reuse assessments, and nearby development activity. The site layout figure or additional figures/photographs/ planning documents also may be useful for depicting current and potential future land and resource uses.

Refer to page 2 of "Land Use in the CERCLA Remedy Selection process" (OSWER 9355.7-04, May 25, 1995.)

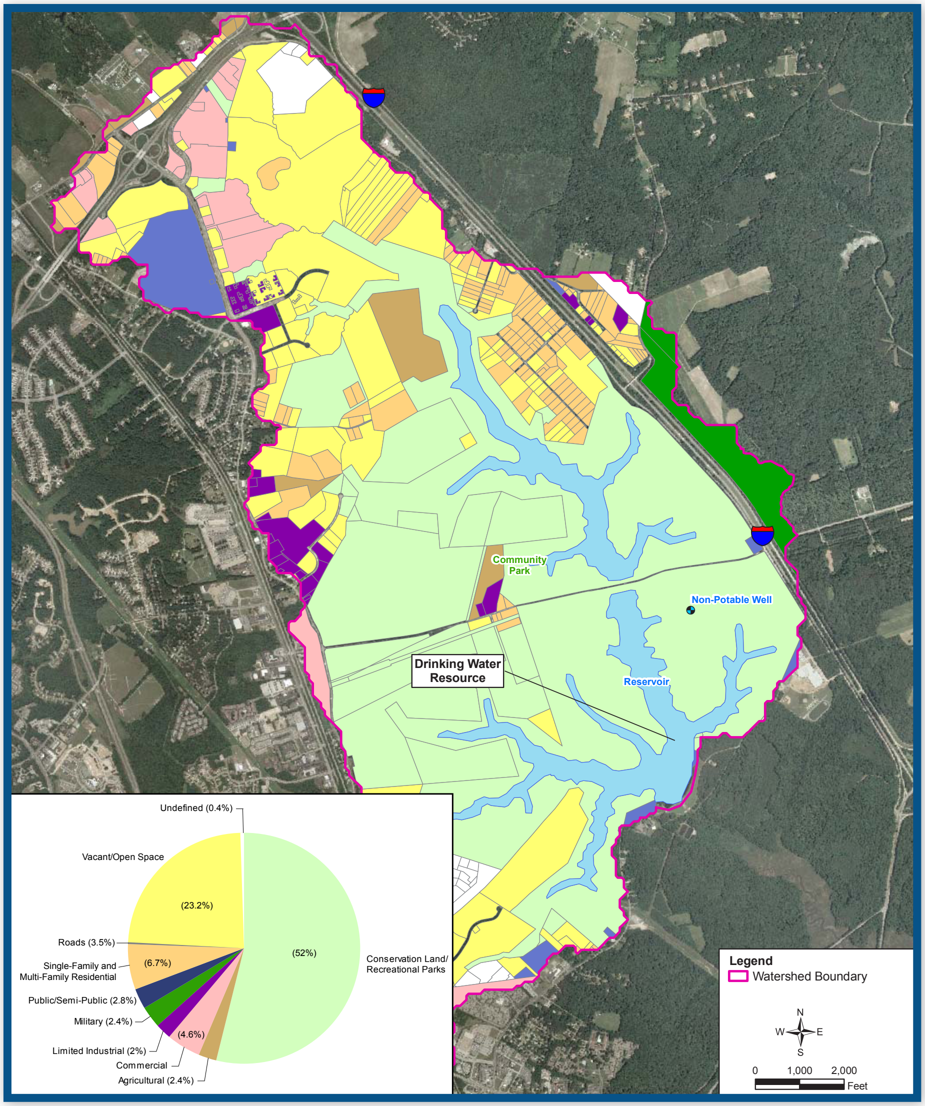

EXHIBIT 8. RISK ASSESSMENT SUMMARY TABLES

ROD Section
Decision Summary
Summary of Site Risks

Recommended Toolkit Tip
Summary tables may be used to help explain the ROD's discussion describing the risk assessment procedures and to help summarize the unacceptable risks; the summary tables can include information on receptor scenarios, medium, exposure pathways, chemicals of concern, exposure point concentrations, and toxicity values. These tables should be supplemented with cumulative risk summary tables to help ensure all risk assessment considerations discussed in EPA's ROD Guidance (1999) are addressed.

Summary tables can help explain how the risk assessment reflects current toxicity values, risk assessment methodologies and guidance, and site conditions (e.g., current residual risk if interim actions were taken). The tables also can help explain how all appropriate exposure pathways have been evaluated in a manner that considers current and potential future use (e.g., indoor air exposure, risk to future on-site workers).

Administrative Record Resources

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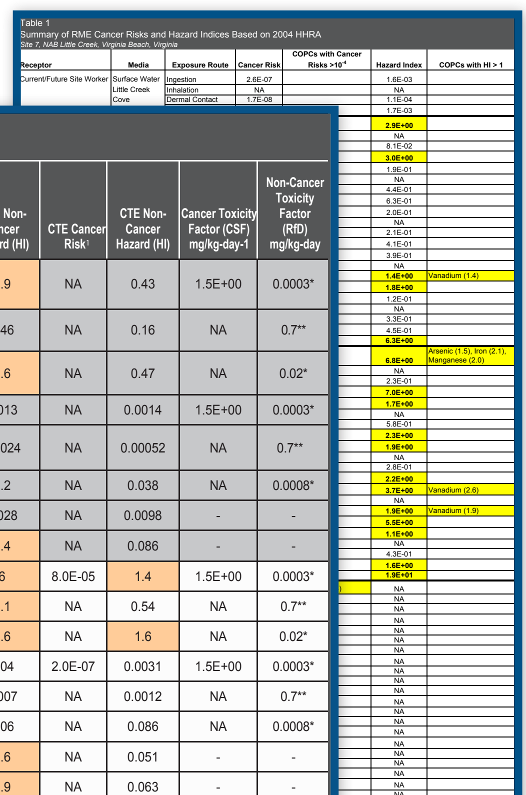


TABLE 2
Summary of Human Health Risks Above USEPA Threshold Levels

Receptor	Media	Pathway	Chemical of Concern	EPC[1]	RME Cancer Risk[1]	RME Non-Cancer Hazard (HI)	CTE Cancer Risk[1]	CTE Non-Cancer Hazard (HI)	Cancer Toxicity Factor (CSF) mg/kg-day-1	Non-Cancer Toxicity Factor (RfD) mg/kg-day
Future Resident Adult	Groundwater	Ingestion	Arsenic	2.8	NA	2.9	NA	0.43	1.5E+00	0.0003*
			Iron	12,000	NA	0.46	NA	0.16	NA	0.7**
			Manganese	1,100	NA	1.6	NA	0.47	NA	0.02*
		Dermal	Arsenic	28	NA	0.013	NA	0.0014	1.5E+00	0.0003*
			Iron	12,000	NA	0.0024	NA	0.00052	NA	0.7**
			Manganese	1,100	NA	0.2	NA	0.038	NA	0.0008*
	Site Perimeter Soil	Ingestion	Vanadium	202	NA	0.028	NA	0.0098	-	-
		Dermal			NA	1.4	NA	0.086	-	-
Future Resident Child	Groundwater	Ingestion	Arsenic	28	6.3E-04	6	8.0E-05	1.4	1.5E+00	0.0003*
			Iron	12,000	NA	1.1	NA	0.54	NA	0.7**
			Manganese	1,100	NA	3.6	NA	1.6	NA	0.02*
		Dermal	Arsenic	28	3.6E-06	0.04	2.0E-07	0.0031	1.5E+00	0.0003*
			Iron	12,000	NA	0.007	NA	0.0012	NA	0.7**
			Manganese	1,100	NA	0.06	NA	0.086	NA	0.0008*
	Site Perimeter Soil	Ingestion	Vanadium	202	0.0E-00	2.6	NA	0.051	-	-
		Dermal			0.0E-00	1.9	NA	0.063	-	-
Future Industrial Worker	Groundwater	Ingestion	Arsenic	28	1.5E-04	0.92	9.2E-06	0.29	1.5E+00	0.0003*
	Site Perimeter Soil	Ingestion	Vanadium	202	0.0E-00	0.2	NA	0.0091	-	-
		Dermal			0.0E-00	1.3	NA	0.045	-	-

EXHIBIT 9. BASIS FOR ACTION

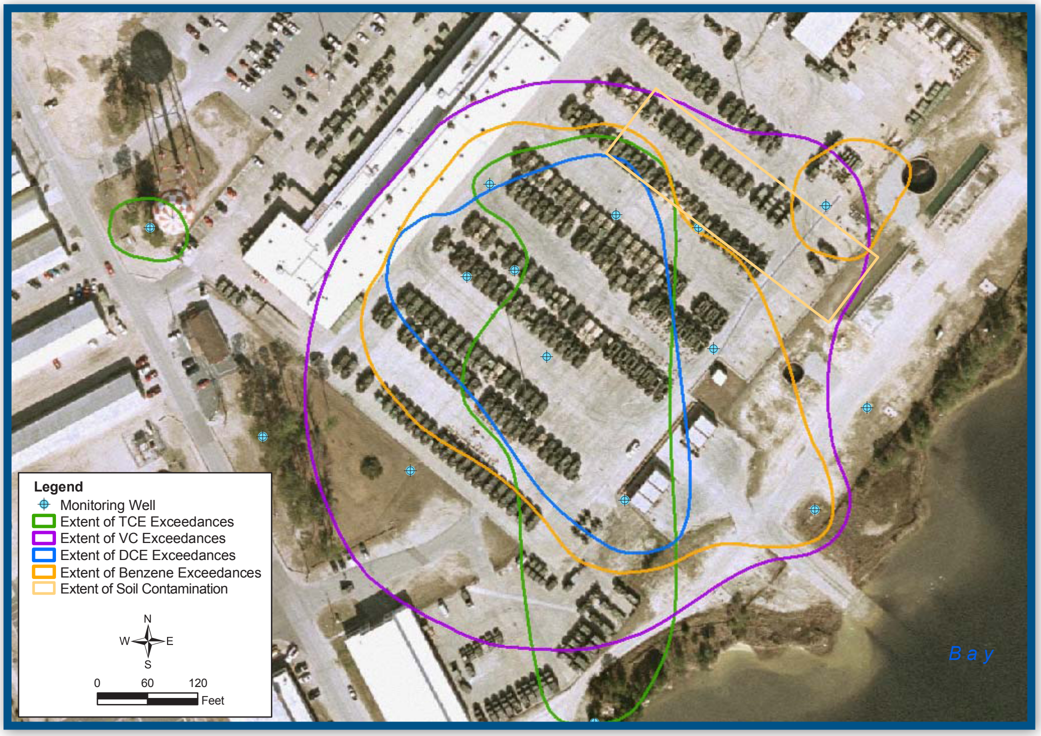
ROD Section

Decision Summary

Summary of Site Risks

Recommended Toolkit Tip

Maps and tables can help explain the results of the risk assessment and to help identify medium and chemicals of concern (COC) warranting a response action, considering current and potential future land use. These tools can help document the appropriate risk management decisions for risks exceeding threshold criteria and for chemicals of potential concern identified in screening-level risk assessments (e.g., comparison to background, slight exceedance of threshold criteria). A summary table with supporting text may be useful in identifying the potential receptors, impacted medium, land and resource uses, and COCs warranting response action under CERCLA. A summary table can help present the concentrations of COCs in each medium and associated risk factors may also be included to illustrate the magnitude of the threat to human health and the environment posed by the site. Graphics to help explain the Basis for Action can also assist in the ROD's discussion of the Remedial Action Objectives (RAOs) and the cleanup levels (see Exhibit 10).



Receptor	Media	Reasonably Anticipated Land Use	Chemical of Concern Requiring Action	Basis for Action
Human Health	Surface soil	Residential	No unacceptable risks	Not applicable
	Subsurface soil	Residential	Arsenic	Non-cancer hazard index of 1.4
	Groundwater	Current or potential drinking water resource	Benzene	Cancer risk of 1.2 x 10^{-4}
			TCE	Cancer risk of 2.3 x 10^{-3}
			cis-1,2-DCE	Max concentration = 136 µg/L (exceeding MCL of 70 µg/L)
			1,1-DCE	Max concentration = 34 µg/L (exceeding MCL of 7 µg/L)
			Vinyl chloride	Cancer risk of 1.7 x 10^{-4}
	Sediment/Surface water	Recreational & Training	No unacceptable risks	Not applicable
Ecological	Surface soil	Habitat	No unacceptable risks	Not applicable
	Subsurface soil	No pathway	Not applicable	Not applicable
	Groundwater	Habitat	No unacceptable risks	Not applicable
	Sediment/Surface water	Habitat	No unacceptable risks	Not applicable

EXHIBIT 10. REMEDIAL ACTION OBJECTIVES FOR CHEMICALS OF CONCERN WARRANTING RESPONSE ACTION

ROD Section

Decision Summary

Remedial Action Objectives

Recommended Toolkit Tip

Where appropriate, it may be helpful to use a bullet format to present the remedial action objectives (RAOs) that are established to address all unacceptable current and reasonably anticipated future risks at the site. A bullet format for the RAOs can effectively present qualitative statements. To present the quantitative site-specific cleanup levels that need to be met for each medium in order to achieve the RAOs, it may be useful to include tables to list the chemicals of concern (COCs) in each medium warranting a response action, their respective cleanup levels, and the basis for the cleanup levels. A figure also can be effective to help illustrate the areas within the site where concentrations of COCs exceed cleanup levels and warrant action.

2.7 Remedial Action Objectives

The Navy, EPA, and VDEQ concluded that remedial action is necessary to protect public health, welfare, and the environment from actual or threatened releases of hazardous substances in soil, shallow groundwater, sediment, and surface water at Site 2. Site-specific Remedial Action Objectives (RAOs) are as follows:

Waste, soil, and sediment (including sediment pore water):

- Prevent direct media contact with human and ecological receptors at concentrations that pose unacceptable risks
- Prevent migration of contaminants through surface water runoff and erosion pathways
- Prevent or minimize transport of COCs from waste to site media

Shallow groundwater (including residual DNAPL):

- Reduce contaminant source mass to the maximum extent practicable
- Prevent activities that might cause migration of chlorinated VOCs in the Columbia aquifer to the underlying Yorktown aquifer
- Prevent chlorinated VOC migration from the shallow groundwater to surface water and sediment
- Reduce chlorinated VOC concentrations in shallow groundwater to the maximum extent practicable and prevent exposure until concentrations allow for unlimited use and unrestricted exposure (beneficial use scenario)

Surface water:

- Minimize degradation of surface water

The quantitative cleanup levels that need to be met to achieve the RAOs are presented in Table 2-2 below.

TABLE 2-2
COCs and Cleanup Levels

Chemical of Concern	Cleanup Level	Basis for Cleanup Level
Surface soil (mg/kg)		
Antimony	26.4	Calculated risk-based value
Lead	400*	Action Level
Vanadium	72	Background
Groundwater (µg/L)		
1,1-DCE	7	MCL
cis-1,2-DCE	70	MCL
Napthalene	170	Cacluated risk-based value
TCE	5	MCL
Sediment (mg/kg)		
Chromium	53	Background

*average site-wide concentration

EXHIBIT 11. SUMMARY OF REMEDIAL ALTERNATIVES

ROD Section

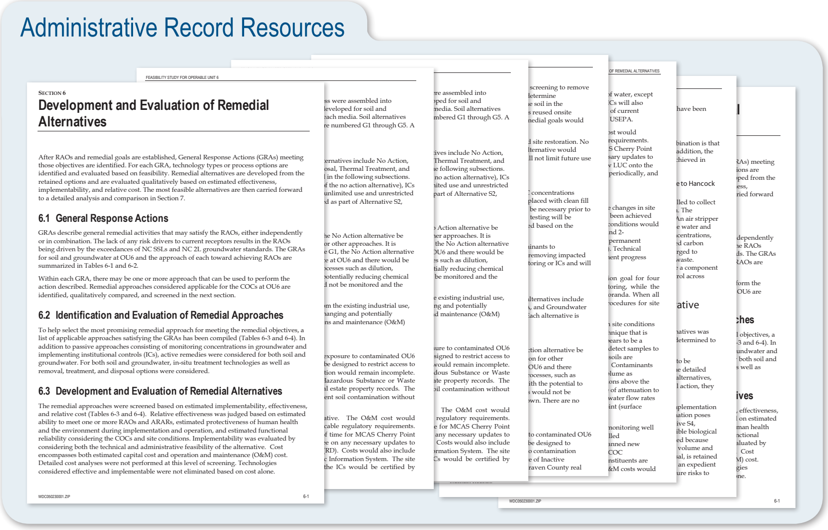
Decision Summary

Description of Alternatives

Recommended Toolkit Tip

Remedial alternatives discussed in a ROD also may be presented in a summary table identifying the alternatives, major components, description (e.g., estimated volume of excavation), costs (capital, operation and maintenance, present worth, and discount rate), and estimated time frame to achieve remedial action objectives (RAOs). Such a table can help show how the alternatives considered would each address the risks at the site, consistent with the basis for action and RAOs. To accurately present the "no action" alternative, land use controls (LUCs)/ institutional controls (ICs) should not be included, for example. The tables can also include text that presents the common elements and distinguishing features that are unique to the alternatives and that may directly affect the implementation, operation, or outcome if selected as the remedy.

Refer to *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites* (EPA, 2010). A summary table should include appropriate use of terminology for LUCs/ICs, if applicable.



Synthesize **Summarize**

TABLE 5 - REMEDIAL ALTERNATIVES

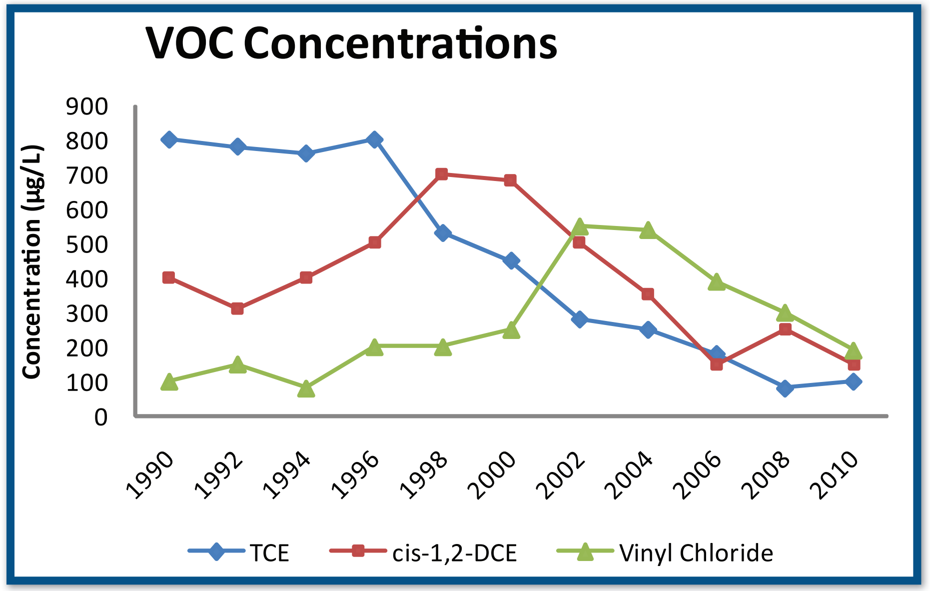
Alternative	Components	Description	Cost
Soil			
No Action *No action for contaminated soil with no restriction on activities.*	-Existing soil	-No action	No cost
Biostimulation and Off-Site Disposal *Excavation and stockpiling of contaminated soil for on-site ex-situ treatment followed by backfilling and site restoration.*	-Excavation of soil -On-site ex-situ biostimulation followed by off-site disposal -Site restoration -Engineering Controls	-Excavation of an estimated 1,333 yd^3 of soil. On-site material will be evaluated for potential re-use for backfill (it is estimated that only 1/3 of excavated material is contaminated based on existing sample data) -Collection of confirmation samples from the excavation and of the uncontaminated soil for analysis of COCs to verify performance standards are met -Stockpiling of contaminated site soil and placement on a treatment pad with physical controls (fencing and signs) to prevent access and erosion and sediment controls (silt fencing) to prevent contaminant transport -Mixing stockpiled soil with amendments (e.g.,commercial fertilizer) and bi-weekly aeration to stimulate biological degradation -Periodic sampling of stockpiled soil until performance standards are met followed by off-site disposal -Mixing clean fill and uncontaminated site soil for backfill and site restoration (repaving)	Capital Cost: $291,600 Annual O&M Cost: $0 Present-Worth Cost: $291,600 Federal Discount Rate: 3.5% Timeframe: 2 years
Excavation and Off-Site Disposal *Excavation of contaminated soil followed by off-site disposal, backfilling, and site restoration.*	-Excavation of soil -Off-site disposal -Site restoration -Engineering Controls	-Excavation of an estimated 1,333 yd^3 of soil. On-site material will be evaluated for potential re-use for backfill (it is estimated that only 1/3 of excavated material is contaminated based on existing sample data) -Collection of confirmation samples from the excavation and of the uncontaminated soil for analysis of COCs to verify performance standards are met -Stockpiling of contaminated site soil with physical controls (signs) to prevent access and erosion and sediment controls (silt fencing) to prevent contaminant transport during waste characterization -Waste characterization testing to classify the contaminated soil for proper off-site disposal -Mixing clean fill and uncontaminated site soil for backfill and site restoration (repaving)	Capital Cost: $229,300 Annual O&M Cost: $0 Present-Worth Cost: $229,300 Federal Discount Rate: 3.5% Timeframe: 1 month
Groundwater			
No Action *No action for contaminated groundwater with no restriction on activities.*	-Existing groundwater	-No action	No cost
MNA and LUC/ICs *Groundwater monitoring to access concentrations of COCs until performance standards have been achieved via natural attenuation*	-MNA groundwater monitoring -LUC/ICs	-Periodic groundwater monitoring (three existing wells and one newly installed well) for natural attenuation indicator parameters and reporting -LUC/ICs to restrict access to the Surficial Aquifer so that the potential exposure pathway to contamination would remain incomplete until performance standards have been achieved -O&M of monitoring wells	Capital Cost: $73,400 Annual O&M Cost: $24,900 Present-Worth Cost: $194,300 Federal Discount Rate: 3.5% Timeframe: 5 years

EXHIBIT 12. EVALUATING MONITORED NATURAL ATTENUATION AS A REMEDIAL ALTERNATIVE

ROD Section
Decision Summary
Description of Alternatives

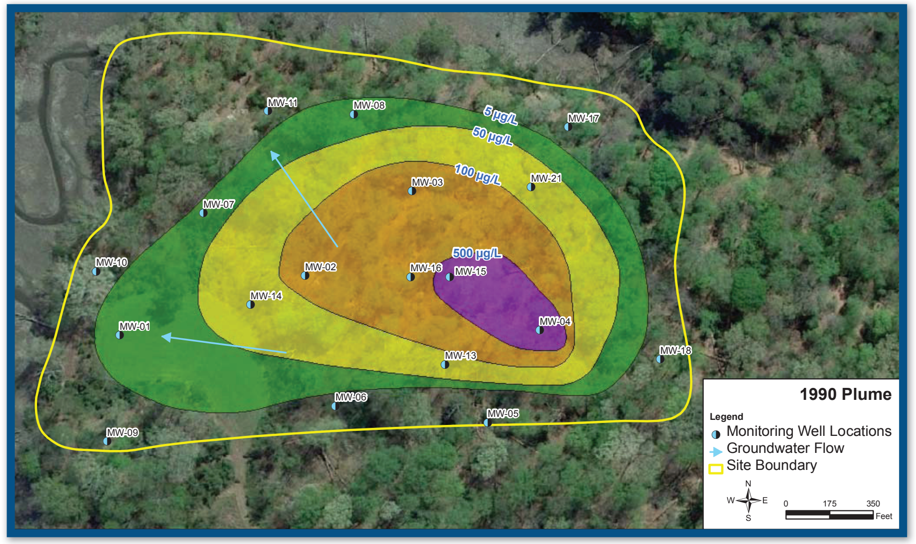
Recommended Toolkit Tip
A diagram may be a useful tool if Monitored Natural Attenuation (MNA) is considered as a potential remedial alternative or component of an alternative for groundwater; the diagram can present the lines of evidence contained in the administrative record and discussed in the ROD which support an MNA approach at the site. The diagram also can be an effective tool for depicting a clear and meaningful trend of concentrations, figures of groundwater concentrations over time, and tables of geochemical data. Other graphics can help explain the estimated time frame for MNA to achieve cleanup levels, as well as comparable time frames which could be achieved with active restoration.

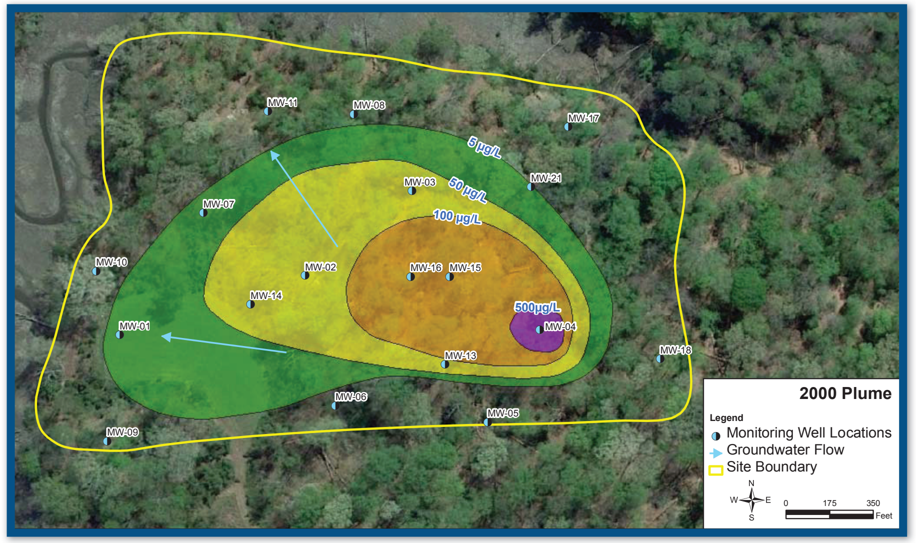
Tables and diagrams also can be used to portray site-specific data, such as the lines of evidence for MNA, and summarize the key points discussed in the ROD's evaluation contained in the Decision Summary: Description of Alternatives and Comparative Analysis of Alternatives.

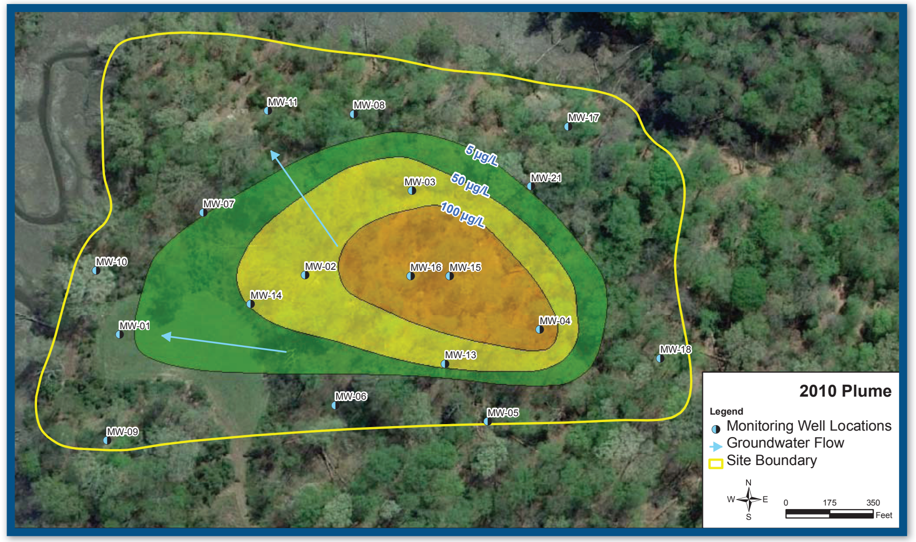


Natural Attenuation Indicator Parameters	Upgradient	Source Area	Downgradient
	MW-05	MW-04	MW-14
Geochemical Parameters			
Temperature (°C)	18.7	17.4	17.2
DO (mg/L)	1.2	0.25	0.3
pH (SU)	8.2	7.5	8.1
ORP (mV)	31	-170	-123
Ferrous Iron (mg/L)	0.5	8.2	2.1
Nitrate (mg/L)	Not Detected	Not Detected	Not Detected
Nitrite (mg/L)	1.2	0.8	0.7
Alkalinity (mg/L)	600	1,500	1,400
Chloride (mg/L)	57	254	195
Sulfate (mg/L)	12	1.8	8.4
Sulfide (mg/L)	0.8	Not Detected	0.1
TOC (mg/L)	4.5	260	48
Methane (µg/L)	24	780	342
Ethane (µg/L)	Not Detected	125	97
Ethene (µg/L)	Not Detected	12.8	5.4
Microbial Analysis (cells/mL)			
Dehalococcoides	Not Detected	350,000	5,000
Desulfuromonas	Not Detected	23.6	1.54
Dehalobacter	2.81	45.1	6.45

TCE Concentrations Over Time







Performance monitoring to evaluate biodegradation over time should be included as part of an MNA alternative.

Lines of evidence for MNA:

1. Historical groundwater and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. (In the case of a groundwater plume, decreasing concentrations should not be solely the result of plume migration. In the case of inorganic contaminants, the primary attenuating mechanism should also be understood.)
2. Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels. For example, characterization data may be used to quantify the rates of contaminant sorption, dilution, or volatilization, or to demonstrate and quantify the rates of biological degradation processes occurring at the site.
3. Data from field or microcosm studies (conducted in or with actual contaminated site medium) which directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern (typically used to demonstrate biological degradation processes only).

Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (EPA, 1999)

EXHIBIT 13. COMPARATIVE ANALYSIS OF ALTERNATIVES

ROD Section

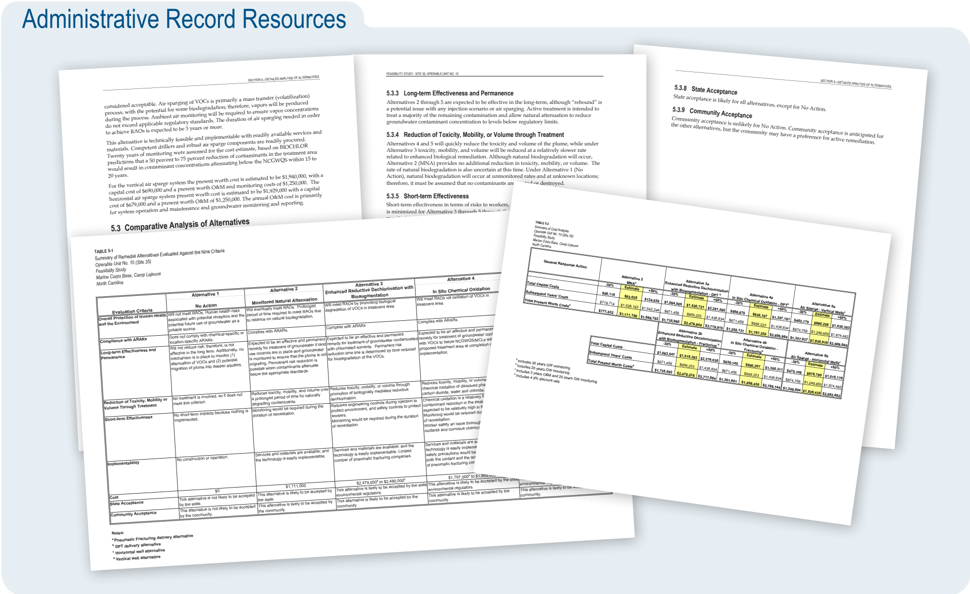
Decision Summary

Comparative Analysis of Alternatives

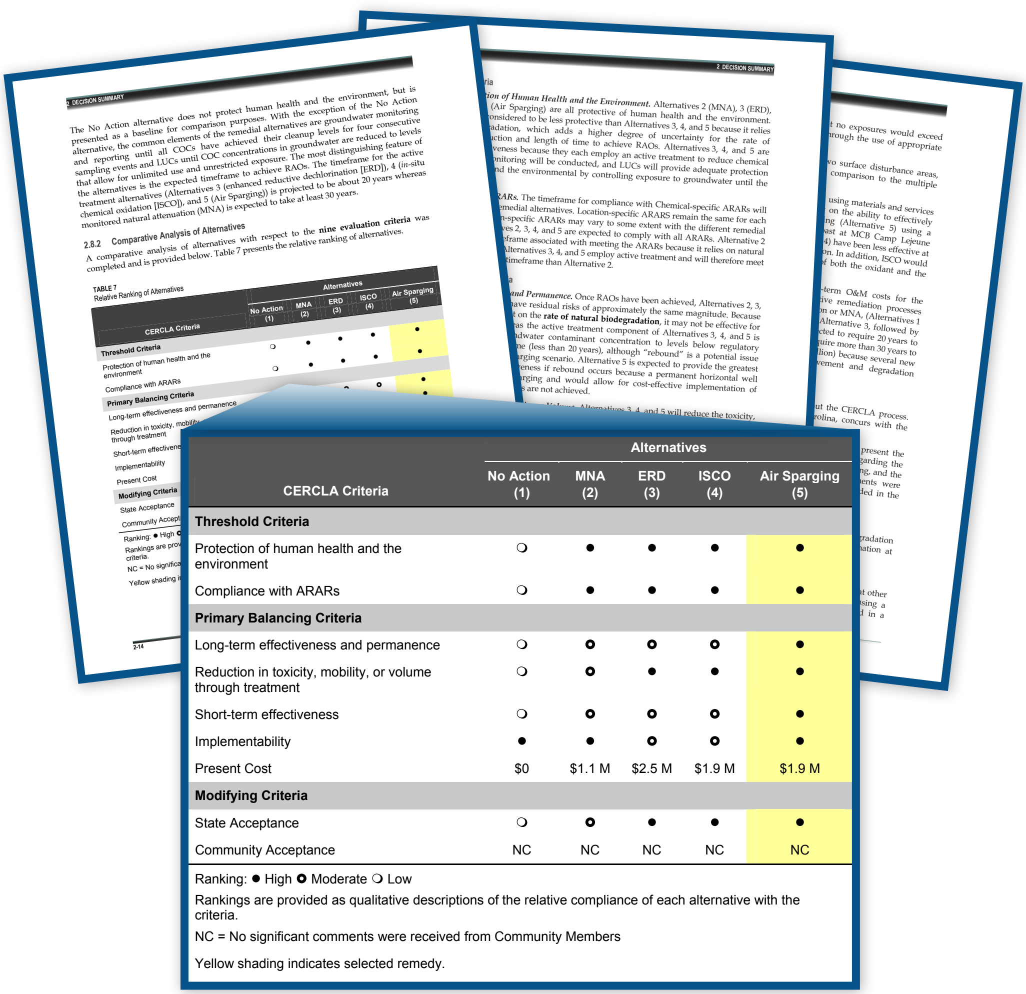
Recommended Toolkit Tip

Various table formats using summary text can be effective in complementing the ROD's detailed discussion of how each alternative compares with the other alternatives and with respect to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) nine criteria. Tables can help identify the distinguishing element or factor that favors one alternative above the others and that supports the rationale for selection of the remedy explained in the ROD. A graphic "consumer report" style table may be used to present the relative ranking in support of the ROD's text.

The NCP's two threshold criteria must be met for all alternatives except "no action". If contingency remedies are a component of a remedial alternative, be sure to evaluate them with respect to the NCP criteria. Refer to "Guide to Preparing Superfund Proposed Plans, Record of Decisions, or Other Remedy Selection Decision Documents" (OSWER 9200.1-23P, July 1, 1999), Highlight 8-8, p. 8.10.



Synthesize **Summarize**



CERCLA Criteria	No Action (1)	MNA (2)	ERD (3)	ISCO (4)	Air Sparging (5)
Threshold Criteria					
Protection of human health and the environment	❍	●	●	●	●
Compliance with ARARs	❍	●	●	●	●
Primary Balancing Criteria					
Long-term effectiveness and permanence	❍	⭘	⭘	⭘	●
Reduction in toxicity, mobility, or volume through treatment	❍	⭘	●	●	●
Short-term effectiveness	❍	⭘	⭘	⭘	●
Implementability	●	●	⭘	⭘	●
Present Cost	$0	$1.1 M	$2.5 M	$1.9 M	$1.9 M
Modifying Criteria					
State Acceptance	❍	⭘	●	●	●
Community Acceptance	NC	NC	NC	NC	NC

Ranking: ● High ⭘ Moderate ❍ Low

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria.

NC = No significant comments were received from Community Members

Yellow shading indicates selected remedy.

EXHIBIT 14. DESCRIPTION OF SELECTED REMEDY

ROD Section

Decision Summary

Selected Remedy

Recommended Toolkit Tip

A figure typically is an effective way to help describe the Selected Remedy discussion in the ROD; a figure can be useful to illustrate the remedy components that address all chemicals of concern and medium requiring action. For example, the figures in this exhibit show the groundwater treatment area/soil removal area, proposed injections points for treatment, performance and long-term monitoring locations as well as the estimated aquifer use control boundary that will be in-place until groundwater cleanup levels are achieved.

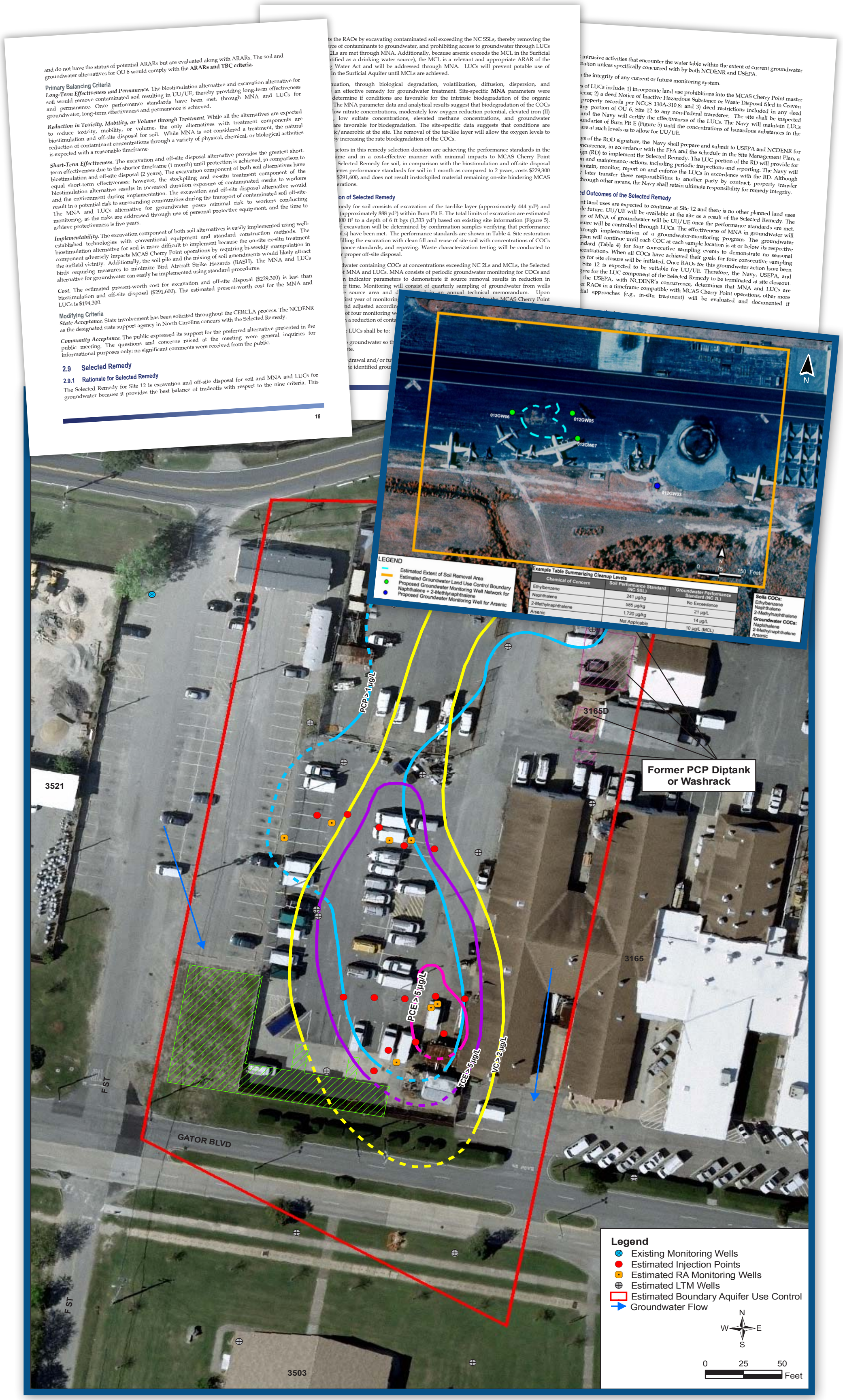


EXHIBIT 15. EXPECTED OUTCOMES OF THE SELECTED REMEDY

ROD Section

Decision Summary

Selected Remedy

Recommended Toolkit Tip

A summary table can be a useful tool to supplement ROD text by highlighting how the key components of the Selected Remedy are designed to mitigate risk to achieve remedial action objectives consistent with current and potential future land and resource uses.

2.9.3 Expected Outcomes of the Selected Remedy

Current industrial land uses are expected to continue at Site 73 and there are no other planned land uses in the foreseeable future, or for development of adjacent lands. Cleanup levels for the Selected Remedy are based on unlimited use and unrestricted exposure. Exposure will be controlled through land use controls/industrial controls (LUCs/ICs) until chemicals of concern (COCs) in groundwater and soil are reduced to the cleanup levels. **Table 2-5** summarizes the unacceptable risk (media, pathway, receptor), the remedial action objectives (RAOs) identified to address the risk, the remedy component intended to achieve the RAO, the metric that measures the remedial action progress, and the expected outcome that the remedy will achieve.

TABLE 2-5
Expected Outcomes of the Selected Remedy

Risk	Remedial Action Objective	Remedy Component	Metric	Expected Outcomes
Ingestion of VOCS in groundwater under potable use scenario	Restore groundwater quality based on the classification of the aquifer as a potential source of drinking water and to prevent human ingestion of water containing chemicals of concern at concentrations above NCGWQS or MCL standards, whichever is more stringent until cleanup levels have been obtained.	Air sparge system	Operate system for up to 5 years or until groundwater cleanup levels within the radius of influence are met, whichever is the shortest period.	Achieve unlimited use and unrestricted exposure
		LTM for MNA	Implement until each groundwater chemical of concern is at or below its respective cleanup level for four consecutive monitoring events.	
		LUCs/ICs		
Direct exposure to arsenic in soil under residential use scenario and leaching potential to groundwater	Prevent future residential exposure to arsenic-contaminated soils above the NC HWS SSL and minimize transport to groundwater.	LUCs/ICs	Maintain LUCs/ICs until chemicals of concern in the soil are at such levels that allow for unlimited use and unrestricted exposure.	Maintain industrial use
Transport of VOCs in groundwater to surface water	Minimize migration of chemicals of concern in groundwater to surface water.	ERD biobarrier	Maintain until chemicals of concern in groundwater meet cleanup levels	Minimize migration of chemicals of concern in groundwater to surface water
		LTM	Implement until each groundwater chemical of concern is at or below its respective cleanup level for four consecutive monitoring events.	
		LUCs/ICs		

The air sparge system will be operated for up to 5 years or until the cleanup levels within the radius of influence were met, whichever is the shortest period. System effectiveness will be evaluated annually by comparison of current concentrations of COCs in treatment area monitoring wells to pretreatment concentrations and the cleanup levels. The enhanced reductive dechlorination (ERD) biobarrier wall will be maintained until groundwater COCs concentrations have met the cleanup levels.

In accordance with LUC/IC objectives, groundwater use will be restricted to monitoring or remedial purposes. Long-term monitoring (LTM) for Monitored Natural Attenuation (MNA) will be conducted until each COC in groundwater is at or below its respective cleanup level for four consecutive monitoring events. The Navy and Marine Corps, in partnership with USEPA and the State, will evaluate the discontinuation of monitoring of individual COCs that have met the cleanup levels after four rounds based on site conditions. The results of LTM will be documented in an annual monitoring report. When all COCs have achieved their cleanup levels for four consecutive sampling events, site closure will be initiated. Once RAOs for this groundwater action have been achieved, the Site 73 area is expected to be suitable for unlimited use and unrestricted exposure for groundwater. Therefore, the Navy, USEPA, and NCDENR may agree for the groundwater LUC/IC component of the Selected Remedy to be terminated at site closeout.

LUCs/ICs, restricting any potential future residential exposure to impacted soils, will be maintained until the concentration of COCs in the soil are at such levels that allow for unrestricted use and unlimited exposure.

EXHIBIT 16. OPTIONAL REFERENCE CD

Recommended Toolkit Tip

A hard copy ROD is the official ROD and should be placed in the Administrative Record. An optional CD reference tool can be included as a supplemental tool in order to provide the reader with immediate access to Administrative Record files referenced within the ROD. A detailed reference table, highlighting the key words identified in the ROD text, should be provided. Prior to developing a reference CD, stakeholder input and community involvement should be considered.

Administrative Record File

Hyperlinked Administrative Record Information

Item	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
1	**Site 12 is the crash-crew training area**	Section 2.1	Final Remedial Investigation Report, Operable Unit 6, Site 12, Crash Crew Training Area, MCAS Cherry Point, North Carolina. Attachment 2, Section 2.2, Pages 2-1 through 2-3. CH2M HILL, December 2005.
2	**hydrogeologic setting**	Section 2.2	Final Remedial Investigation Report, Operable Unit 6, Site 12, Crash Crew Training Area, MCAS Cherry Point, North Carolina. Section 4.3.4.1, Pages 4-10 through 4-13. CH2M HILL.

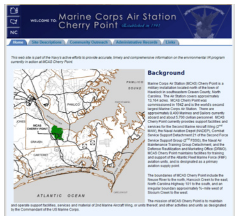
4.3.4.1 Site 12 Geology and Hydrogeology

The USGS has conducted several studies of the hydrogeology at MCAS Cherry Point. A description of MCAS Cherry Point geology and hydrogeology as described by the USGS is presented to provide an overview of available information and characteristics of the hydrostratigraphic units at the MCAS.

While developing a quasi three-dimensional finite-difference groundwater-flow model and while analyzing the hydrogeologic framework of MCAS Cherry Point, the USGS evaluated geophysical and lithologic well log data from 30 wells and water-level data from oil test wells, water supply wells, and observation wells. The subsurface materials evaluated by the USGS investigations and supported by site borings are separated into the following aquifers and respective confining units: Surficial Aquifer, Yorktown Aquifer, Pungo River Aquifer, upper Castle Hayne Aquifer, and lower Castle Hayne Aquifer. Deeper aquifers are not addressed in this site-specific discussion because the depth and separation of these aquifers from contaminant sources by a series of confining units, as well as the brackish water quality of the deeper aquifers, preclude the potential for significant impacts to these deeper aquifers.

Other Optional Electronic Enhancements

The public information repository is located at the library, Havelock, NC 28532, Phone 252-447-7509 remedy section process will be available the **IR Program website**



ROD with Optional Reference CD

United States
Environmental Protection
Agency

Office of Solid Waste
and Emergency Response

OSWER 9355.6-10
September 2011