Final Report

Inboard Area Focused Feasibility Study Report

BRAC Property
Hamilton Army Airfield

Volume I

Prepared for

U.S. Army Corps of Engineers

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Acronyms and Abbreviations

AMSF	Aircraft Maintenance and Storage Facility
ARAR	applicable or relevant and appropriate requirements
AST	aboveground storage tank
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERFA	Community Environmental Response Facilitation Act
CFR	Code of Federal Regulations
cm/s	centimeters per second
COC	chemical(s) of concern
COPC	chemical(s) of potential concern
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
ER-L	Effects Range-Low
ER-M	Effects Range-Medium
FFS	Focused Feasibility Study
FSTP	Former Sewage Treatment Plant
ft	foot (feet)
ft^2	square feet
GSA	General Services Administration
HAAF	Hamilton Army Airfield
HI	hazard index
HQ	hazard quotient

ILCR	incremental lifetime cancer risk
IT	IT Corporation
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
NCP	National Contingency Plan
NGVD	National Geodectic Vertical Datum
NHP	New Hamilton Partnership
ONSFL	Onshore Fuel Line
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDD	perimeter drainage ditch
ppt	parts per thousand
RAO	remedial action objective
RAP	Remedial Action Plan
RART	Regulatory Agencies and Resource Trustees
RI	remedial investigation
RIR	Remedial Investigation Report
RWQCB	Regional Water Quality Control Board
STLC	Soluble Threshold Limit Concentration
SVOC	semivolatile organic compound
TBC	to be considered
TCLP	toxicity characteristic teaching procedure
TDS	total dissolved solid
TPH	total petroleum hydrocarbon
TTLC	total threshold limit concentration
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
UST	underground storage tank
VOC	volatile organic compound
yd^3	cubic yards

Executive Summary

This Focused Feasibility Study (FFS) was originally prepared by IT Corporation (IT) for the U.S. Army Corps of Engineers (USACE), Sacramento District, under Contract No. DACW05-95-D-001, Delivery Order 0006, of the Total Environmental Restoration Contract. Based on comments received from regulatory agencies, the February 2001 version of the FFS prepared by IT was revised by CH2M HILL at the request of USACE. The feasibility study is focused in the sense that development of remedial alternatives was streamlined to consider only applications that are consistent with the future wetland land use scenario. This final FFS reflects the revisions made by CH2M HILL.

This FFS was prepared for the Hamilton Army Airfield (HAAF) Inboard Area. HAAF is a former military installation located on a diked and subsided bayfront parcel in the City of Novato, California. The Inboard Area sites and other portions of HAAF were identified for operational closure under the Base Realignment and Closure (BRAC) Act of 1988. For the purpose of environmental remediation under the Comprehensive, Environmental, Resource, Compensation and Liability Act (CERCLA), the Inboard Area sites are distinguished from other BRAC areas at the former HAAF.

Historically, the Inboard Area was part of a tidal wetland. The Inboard Area will be transferred to the California State Coastal Conservancy (SCC) through the BRAC process and become part of the Hamilton Wetland Restoration Project. The USACE, San Francisco District, will manage the project, and the SCC is the local sponsor.

The purpose of the FFS is to identify sites within the Inboard Area that require further action and to develop, evaluate, and recommend an alternative for each Inboard Area site that would be protective of human health and the environment during the development and maturation of the wetland. The following steps were conducted for the FFS effort:

- Develop a conceptual model for the FFS evaluation based on estuarine and human receptors at each of the Inboard Area sites (except the Northwest Runway Area which has only upland receptors) and additional freshwater receptors at Building 82/87/92/94 Area; Spoils Piles A, B, and N; and the PDD-Unlined Portion.
- Review data collected by remedial investigation (RI) activities and during previous and subsequent investigative activities.
- Analyze the results of the human health and ecological risk assessment (U.S. Army, 2001) provided in Appendix A to determine what sites proceed forward for further evaluation.
- Review hazard indexes (HI) for receptors at each site and determine if any HIs are greater than 1.0. If no HIs are greater than 1.0, no further action is required. If any HIs are greater than 1.0, determine if site-specific FFS chemicals of potential concern (COPCs) are present.

- Review ecological hazard quotient (HQ), human health HQ, and human health incremental lifetime cancer risk (ILCR) and determine if the HQ's are greater than 1.0 or the ILCR is greater than $1x10^{-6}$. If the HQs are less than 1.0 and the ILCR is less than $1x10^{-6}$, the chemical is not a site-specific FFS chemical of potential concern (COPC). If either HQ is greater than 1.0 or the ILCR is greater than $1x10^{-6}$, the chemical is a site-specific FFS COPC.
- Review comparator values developed through negotiations with the Regulatory Agencies and Resource Trustees.
- Compare the site-specific FFS COPCs to the comparator values.
  - If all 95 UCL (or maximum in some cases) COPC concentrations are less than the comparator values, the site does not require further action.
  - If all 95 UCL (or maximum in some cases) are greater than the comparator value, the site requires further evaluation, and the site-specific FFS COPC becomes a chemical of concern (COC).
- Develop remedial action objectives (RAO) and applicable or relevant and appropriate requirements (ARAR).
- Identify remedial alternatives.
  - Alternative 1 – No Further Action
  - Alternative 2 – Institutional Controls
  - Alternative 3 – Excavation and Offsite Disposal
  - Alternative 4 – Excavation and Onsite Disposal
- Conduct detailed and comparative analyses of the remedial alternatives for each Inboard Area site with COCs.
- Recommend the preferred alternative for each Inboard Area site.

The FFS evaluates 57 Inboard Area sites. However, during the FFS evaluation of alternatives, the number of sites was reduced to 56 when Building 86 was combined with the Building 82/87/92/94 Area. The FFS recommends No Further Action for 18 sites, Institutional Controls for 34 sites, and Excavation and Offsite Disposal for four sites. Table ES-1 provides a list of the preferred remedial alternatives recommended for each of the 56 Inboard Area sites.

TABLE ES-1
Preferred Remedial Alternative Summary
Focused Feasibility Study Evaluation

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation and Offsite Disposal	Alternative 4 – Excavation and Onsite Disposal
Former Sewage Treatment Plant		X		
Revetment 18/ Building 15	X[a]			
Building 20	X[b]			
Building 26		X		
Building 35/39 Area		X		
Building 41 Area			X	
Building 82/87/92/94 Area and Building 86		X		
Building 84/90 Area	X[b]			
Perimeter Drainage Ditch (PDD)		X		
PDD Spoils Pile A		X		
PDD Spoils Pile B		X		
PDD Spoils Pile C	X[b]			
PDD Spoils Pile D		X		
PDD Spoils Pile E		X		
PDD Spoils Pile F			X	
PDD Spoils Pile G		X		
PDD Spoils Pile H	X[b]			
PDD Spoils Pile I		X		
PDD Spoils Pile J		X		
PDD Spoils Pile K		X		
PDD Spoils Pile L	X[c]			
PDD Spoils Pile M		X		
PDD Spoils Pile N		X		
East Levee Generator Pad	X[b]			
Onshore Fuel Line (ONSFL)-54-inch Line		X		
ONSFL-Hangar Segment		X		
ONSFL-Northern Segment		X		

TABLE ES-1
Preferred Remedial Alternative Summary
Focused Feasibility Study Evaluation

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation and Offsite Disposal	Alternative 4 – Excavation and Onsite Disposal
Northwest Runway Area		X		
Tarmac East of Outparcel A-5	X[b]			
Revetment 1		X		
Revetment 2		X		
Revetment 3		X		
Revetment 4		X		
Revetment 5	X[a]			
Revetment 6			X	
Revetment 7			X	
Revetment 8	X[b]			
Revetment 9	X[b]			
Revetment 10	X[b]			
Revetment 11		X		
Revetment 12		X		
Revetment 13		X		
Revetment 14		X		
Revetment 15	X[c]			
Revetment 16		X		
Revetment 17	X[b]			
Revetment 19		X		
Revetment 20	X[c]			
Revetment 21		X		
Revetment 22		X		
Revetment 23		X		
Revetment 24	X[b]			
Revetment 25		X		
Revetment 26		X		
Revetment 27	X[b]			
Revetment 28	X[a]			

[a] Site did not have a site hazard index exceeding 1.0; therefore, it was screened out when compared to risk assessment results.
[b] Site did not have site-specific FFS chemical of potential concern 95 UCL (or maximum in some cases) concentrations exceeding the comparator value; therefore, it does not require remedial action.
[c] Site suitable for risk management considerations. COCs are at their comparator values.

SECTION 1

Introduction

This Focused Feasibility Study (FFS) was originally prepared by IT Corporation (IT) for the U.S. Army Corps of Engineers (USACE), Sacramento District, under Contract No. DACW05-95-D-001, Delivery Order 0006, of the Total Environmental Restoration Contract. Based on comments received from regulatory agencies, the February 2001 draft of the FFS prepared by IT was revised by CH2M HILL at the request of USACE. This final FFS reflects the revisions made by CH2M HILL.

1.1 Background

This FFS was prepared for the Hamilton Army Air Field (HAAF) Inboard Area. HAAF is a former military installation located on a diked and subsided bayfront parcel in the City of Novato, Marin County, California (Figure 1-1). The Inboard Area lies inboard of the perimeter levee and encompasses most of the former airfield (Figure 1-2). The Inboard Area sites and other portions of HAAF were identified for operational closure under the Base Realignment and Closure Act (BRAC) of 1988. For purposes of environmental remediation under the Comprehensive, Environmental, Resource, Compensation, and Liability Act (CERCLA), the Inboard Area sites are distinguished from other BRAC areas at the former HAAF.

Historically, the Inboard Area was part of a tidal wetland. Through the BRAC process, the Inboard Area will be transferred to the California State Coastal Conservancy (SCC) and become part of the Hamilton Wetland Restoration Project. The Hamilton Wetlands Restoration Project is a federal project authorized by the Water Resources Development Act of 1999. The USACE, San Francisco District, will manage the project, and the SCC is the local sponsor. Local and regional public, government, and resource agencies have expressed a desire for the wetlands to be restored.

Several issues related to residual contamination have been identified within the Inboard Area. These issues include residual installation-wide pesticides, and PAHs in soil near the runway. The Army has identified these issues as not being CERCLA releases. Therefore, these issues are not addressed in the comprehensive remedial investigation, interim removal actions, human health and ecological risk assessment and this FFS. DTSC believes that these issues are releases under CERCLA. The Army has agreed to develop options in the ROD/RAP to address potential threats to human health or the environment in future wetland.

1.2 Purpose and Scope

The purpose of the FFS is to identify sites within the Inboard Area that require further action and to develop, evaluate, and recommend alternatives for these Inboard Area sites to protect human health and the environment in the future wetland restoration. Each alternative considered in this FFS is consistent with the planned use of the property (wetland restoration). Specific aspects of the Hamilton Wetland Restoration Project were considered in identifying, evaluating, and selecting remedial alternatives for the Inboard Area sites.

This feasibility study is focused in the sense that development of remedial alternatives was streamlined to consider only applications that are consistent with the future wetland land use scenario. The following steps were conducted for the FFS effort:

- Develop a conceptual model for the FFS evaluation based on estuarine and human receptors at each of the Inboard Area sites (except the Northwest Runway Area which has only upland receptors) and additional freshwater receptors at Building 82/87/92/94 Area, Spoils Piles A, B, and N, and the PDD-Unlined Portion.
- Review data collected by remedial investigation (RI) activities and during previous and subsequent investigative activities.
- Analyze the results of the human health and ecological risk assessment (U.S. Army, 2001) provided in Appendix A to determine what sites proceed forward for further evaluation.
- Review hazard indexes (HI) for receptors at each site and determine if any HIs are greater than 1.0. If no HIs are greater than 1.0 then no further action is required. If any HIs are greater than 1.0 then determine if site-specific FFS chemicals of potential concern (COPCs) are present.
- Review ecological hazard quotient (HQ), human health HQ, and human health incremental lifetime cancer risk (ILCR) and determine if the HQs are greater than 1.0 or the ILCR is greater than $1x10^{-6}$. If the HQs are less than 1.0 and the ILCR is less than $1x10^{-6}$, the chemical is not a site-specific FFS COPC. If either HQ is greater than 1.0 or the ILCR is greater than $1x10^{-6}$, the chemical is a site-specific FFS COPC.
- Review comparator values developed through negotiations with the Regulatory Agencies and Resource Trustees.
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- Develop remedial action objectives (RAO) and applicable or relevant and appropriate requirements (ARAR).
- Identify remedial alternatives.
  - Alternative 1 – No Further Action
  - Alternative 2 – Institutional Controls (IC)
  - Alternative 3 – Excavation and Offsite Disposal
  - Alternative 4 – Excavation and Onsite Disposal

- Conduct detailed and comparative analyses of the remedial alternatives for each Inboard Area site with COCs.
- Recommend the preferred alternative for each Inboard Area site.

The FFS process is shown in Figure 1-3.

The objective of this FFS is to recommend appropriate remedies by developing and analyzing remedial alternatives for those sites that require further action. The FFS is based on the results of the human health and ecological risk assessment (U.S. Army, 2001), process knowledge, and best engineering judgement. The ultimate goal of this effort is to provide a rational basis for the selection and subsequent implementation of a proposed cost-effective remedial alternative for each Inboard Area site to protect public health and the environment. In conjunction with the FFS, a proposed plan in the form of a draft Record of Decision/Remedial Action Plan (ROD/RAP) has been developed and will be available for public comment. The final ROD/RAP will consider comments from the public and document the chosen remedies for each Inboard Area site.

1.3 Regulatory Framework

The Inboard Area is being transferred in accordance with the BRAC Act (U.S. Public Law 100-526). The process of transferring federal lands mandates a process of environmental investigations in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The process of transferring federal lands mandates a process of environmental investigations. The process includes identification, assessment, and, as needed, remediation and closure. The assessment of the environmental conditions was conducted through the Comprehensive Remedial Investigation Report (RI) (IT, 1999a), the Interim Removal Actions (IT, 1999b and IT, 2000), and the Human Health and Ecological Risk Assessment (IT, 2001). This FFS, which is a continuation of the process, is used to develop remedial actions where further action is needed to protect human health and the environment.

The HAAF is not regulated under the CERCLA as a Superfund site and is not on the National Priority List (NPL). The U.S. Army is using its lead agency status and authority under CERCLA to implement the environmental restoration activities at HAAF. The FFS has been prepared in accordance with CERCLA, as amended by the Superfund Amendments Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Guidance documents used in the preparation of this FFS report included the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) (40 Code of Federal Regulations [CFR] 300.430) and the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988a).

The regulatory agencies involved in the BRAC closure process for the Inboard Area include the:

- California Environmental Protection Agency, Department of Toxic Substances Control (DTSC); since HAAF is not on the NPL, the DTSC is the lead regulatory agency
- U.S. Environmental Protection Agency (EPA)

- California Regional Water Quality Control Board (RWQCB)

The agencies involved in the wetland restoration activities at HAAF include the:

- Bay Conservation and Development Commission (BCDC)
- State of California Coastal Conservancy (SCC)
- USACE, San Francisco District

There are also Resource Trustee agencies involved in the closure process for the Inboard Area, including the:

- U.S. Fish and Wildlife Service (USFWS)
- California Department of Fish and Game (CDFG)
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration (NOAA)

1.4 Installation History

Hamilton Army Airfield is located approximately 22 miles north of San Francisco, California, in Marin County, California, and encompasses an area of roughly 1,600 acres. As shown on Figure 1-2, the Inboard Area is located primarily within the northeastern portion of HAAF. HAAF was constructed on reclaimed tidal wetlands by the U.S. Army Air Corps in 1932. Prior to 1932, the area was known as Marin Meadows and had been used as ranch and farm land since the Mexican Land Grant (USACE, undated). Military operations began in December 1932. Bombers and, later, transport and fighter aircraft were based at the airfield. HAAF played a major role in World War II as a training field and staging area for Pacific Theater operations. During the war, the Base hospital served as an acute care and rehabilitation facility for thousands of war casualties each month. The Airfield was renamed Hamilton Air Force Base in 1947 when it was transferred to the newly created U.S. Air Force.

In the mid-1960s, the U.S. Air Force began to curtail Base operations due to increased complaints about aircraft noise and concerns for air traffic and public safety (ETC, 1994a). In 1974, the U.S. Air Force deactivated the Base and initiated disposal of the property. The residential portion of the installation was transferred to the U.S. Navy in 1975 and to the U.S. Coast Guard in 1998.

In 1976, the U.S. Army began using the runway and ancillary facilities and several other buildings for regular U.S. Army and U.S. Army Reserve operations. In 1976, the State of California determined that lands subject to tidal action belong to the State. Consequently, the State claimed a portion of the land outside the levees that encircle the site (i.e., North Antenna Field and the Coastal Salt Marsh). The Army continued to use portions of the Base on a permit basis until 1984. In 1984, when portions of the airfield were officially acquired by the Army, property management responsibilities were transferred to the Presidio of San Francisco, and the base was renamed Hamilton Army Airfield. Aircraft operations were again discontinued in 1994 when the Airfield was closed.

1.5 Hydrogeological Setting, Ecological Communities, and Land Uses

This section describes the hydrogeology, land use, and biological habitats and biota currently existing within the Inboard Area. This background information aids in the understanding of past work conducted at the Inboard Area sites and, in part, the basis for development of remedial alternatives.

1.5.1 Existing Hydrogeological Setting

Three shallow hydrogeologic units occur within the Inboard Area: fill, soft Bay Mud, and desiccated Bay Mud. The "fill" was originally used to reclaim the bay margin lowlands for agriculture and has very similar content and hydrogeological properties to the Bay Mud. A different type of "fill" referenced in the RI (IT, 1999a) is the imported construction material used for geotechnical applications and foundation and drainage properties and is not part of the hydrogeologic unit. This type of "fill" is found in pipeline trenches and as a bridging layer beneath some of the formerly developed areas. This fill will be referred to as "imported fill" when used. Permeabilities and groundwater flow characteristics are summarized below:

- Fill materials have moderate to low hydraulic conductivities. Preferential groundwater flow through the fill may be controlled by the distributions of different fill types.
- Soft Bay Mud generally has low hydraulic conductivity. Preferential flow, if existent, is probably horizontal and confined to peat layers or shell lenses which are discontinuous and limited in aerial extent.
- Desiccated Bay Mud has low hydraulic conductivity with some fracture permeability. The desiccation cracks are potentially transient in nature and may heal or infill during periods of saturation.

The developed airfield is located on the eastern side of the Novato Creek groundwater basin and is part of the regional San Pablo groundwater basin defined by the drainage entering San Pablo Bay. Existing and potential beneficial uses of groundwater within the Novato Creek basin include municipal and domestic water supply, rare and endangered species preservation, freshwater wildlife habitats, and recreational use (RWQCB, 1995). The BRAC property has a relatively low potential for beneficial groundwater use based on the San Francisco Bay Basin (Region 2) Water Quality Control Plan beneficial-use criteria.

Groundwater beneath the BRAC property is not now, nor is likely to be, used for drinking water. State Water Resources Control Board Policy 88-63 (1988) specifies the criteria for determining whether groundwater is a source of drinking water, that is, if it is suitable for municipal or domestic water supply. One of the criteria for suitability as drinking water is low total dissolved solids (TDS). The policy defines water with TDS in excess of 3,000 milligrams per liter (mg/L) as unsuitable for drinking. The TDS concentrations in groundwater from monitoring wells across the BRAC property range from one to 18 parts per thousand (ppt) (equivalent to 819 to 18,270 mg/L) (IT, 1999a). These findings indicate that groundwater beneath the BRAC property is generally unsuitable for drinking because the average TDS concentration (5 ppt or 4,898 mg/L) exceeds the 3,000-mg/L limit.

As part of the remedial assessment summary for the General Services Administration (GSA) Phase II Sale Area (IT, 1998), the available well records at the Department of Water Resources and Marin County Environmental Health were reviewed to evaluate the regional beneficial uses of groundwater within the vicinity of the HAAF. The review included all domestic, industrial, and irrigation supply wells within a two-mile radius of the airfield and included available Department of Water Resources well logs and Marin County Environmental Health records. There are 11 supply wells located within a two-mile radius of the HAAF. Most of the wells in the vicinity of the HAAF are used for domestic or irrigation supply, and all of these wells appear to be outside the influence of historical HAAF activities. Only one well is located within one-mile of the site boundaries, and the entire airfield is downgradient (east), isolated from all of the existing supply wells.

Groundwater is generally not extracted in the Bay plain east of Novato because of poor water quality, low well yield, and decreasing saturated aquifer thickness. Redevelopment plans for the HAAF include importing municipal water for residential and industrial uses and reducing the necessity of installing any groundwater extraction wells. Well-integrity criteria and potential rapid degradation of water quality from salinity generally preclude groundwater extraction.

In summary, high salinities and low yields from groundwater support the conclusion that groundwater beneath the HAAF is not beneficial for human use. In a decision consistent with this position, the San Francisco RWQCB set aside groundwater concerns about the airfield parcel and notified the Army by letter in 1991 that the Army need not further assess groundwater along the onshore fuel line due to the low permeability soils.

The other consideration of interest for potential significance to ecological receptors are the results obtained from monitoring efforts in 1993 and 1994 of the BRAC property. Although this study was somewhat troubled by laboratory contamination of samples, it was still sufficiently demonstrated that total recoverable petroleum hydrocarbon, diesel, JP-4, volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and other organic contaminants were not present in groundwater throughout the Airfield sites. In 1994 and 1995, the Army conducted further studies to address the issues of metals and background levels for inorganic compounds in BRAC property groundwater. Results reflected the brackish nature of BRAC property groundwater with high TDS levels in that numerous metals appeared in both background wells and site-specific wells. Metals concentrations (unfiltered only) for site-specific wells fell generally within the range of observed values from background wells. The lack of ability to distinguish between dissolved metals and metals that might be adsorbed upon soil particles presented a confounding factor for interpretation, but the broad consensus was that the BRAC property groundwater did not pose a threat due to inorganic compounds.

Based upon these findings, it is concluded that BRAC property groundwater was not adversely affected by Army activities at Hamilton. Therefore, groundwater is not evaluated further in this FFS report.

1.5.2 Hydrology

HAAF is in the southern portion of the Novato Creek Drainage Basin and Watershed (USACE, 1993). Historically, tidal marsh and mudflats covered the area. The main slough channel drainage system in the HAAF panhandle (the rectangular area to the east of Ammo Hill and to the northwest of the triangular pond will be referred to as the “panhandle” in this document) area drained to the northwest into the tidal reaches of Novato Creek (PWA, 1998), which then drained into San Pablo Bay. Using a system of levees and drainage ditches, the area that is now HAAF was reclaimed for agricultural use in the late 1800s. The surface water flow pattern was further modified through a series of Perimeter Drainage Ditches (PDDs), culverts, and levees on the property.

Today, regional surface water flow is generally from the upland areas in the west toward the San Pablo Bay in the east. From areas west of HAAF, surface water is carried by Pacheco Creek and Arroyo San Jose, which occur along the northwestern boundary of HAAF. Both Pacheco Creek and Arroyo San Jose discharge into the Ignacio Reservoir, which occupies approximately 120 acres and has a storage capacity of 480 acre-feet (Jones & Stokes Associates, Inc., 1998). The reservoir drains into Novato Creek through a leveed channel with a flap gate outlet, located at the Bel Marin Keys Boulevard bridge. This water is then conveyed through a network of drainage ditches and the PDD, which conveys drainage to three pump stations (Buildings 35, 39, and 41) on the margin of San Pablo Bay.

Stormwater drainage system conduits ranging in diameter from less than 12 inches to as large as 54 inches in diameter are distributed in several general areas of the HAAF. The component lines in each network span various distances and lie at various depths, usually no deeper than three to five feet below current grade. One network drains the mid-airfield just north of the revetment area. Another network drains the revetment area itself, while a third drains the aircraft maintenance area to the west of the revetments. The drains in the Aircraft Maintenance and Storage Facility Area (AMSF) convey water to discharge into the PDD to the west of the central portion of the airfield (CH2M HILL, 2001).

Runoff from the Landfill 26 area and 40 acres in the northern Reservoir Hill area enters the panhandle and drains into the PDD located parallel to the northern border of the airfield.

The runoff from the north side of Reservoir Hill enters the panhandle through a culvert in the south corner of the panhandle. Modified underground storm drains along the northwest and southwest sides of the panhandle convey Reservoir Hill runoff into the northern PDD. The northern PDD conveys stormwater to the eastern end of the airfield, where the aforementioned three pumps transport runoff from the airfield into San Pablo Bay (Jones & Stokes Associates, Inc., 1998).

Seasonal surface runoff from the Landfill 26 area is routed around the landfill in grass-lined swales and temporary ponds into a small depression north of the landfill. This pond releases runoff to the panhandle via a four-foot diameter tide-gated culvert which empties into a drainage ditch, and then enters a seasonal wetland mitigation site. When water in the wetland reaches an elevation of –3 feet NGVD, it spills over a constructed weir into the northern PDD (PWA, 1998). In 10-year and larger storm events, Pacheco Creek overtops its banks and overflows into the Landfill 26 drainage system.

A second PDD, located along the southern and eastern sides of the airfield, carries runoff from other parts of the airfield and from adjacent property west and south of the airfield to the HAAF pumps (PWA, 1998). Indeed, the southern PDD system receives drainage from several proximate areas:

- Drainage flows through a 42-inch gated culvert through the perimeter levee near the southwest corner of HAAF on the St. Vincent's property which carries flows from the western portion of the DoD housing and Long Point peninsula upland areas adjacent to the airfield and from a portion of the St. Vincent's property
- Drainage from the New Hamilton Partnership development, the eastern portion of the DoD housing area, and other areas adjacent to the west side of the airfield that are conveyed to the ditch in two outfalls: one near Reservoir Hill (west outfall) and one near the southwest corner of the airfield (east outfall) (Jones & Stokes Associates, Inc., 1998).

1.5.3 Existing/Future Land Use

The BRAC property has been inactive since the mid-1980s with the exception of infrequent runway use prior to 1994. There is no residential housing or developed recreational areas within the Inboard Area. However, adjacent properties that were part of the larger HAAF, particularly to the west, have been or are in the process of being developed for residential and/or commercial uses.

Wetlands restoration on the portion of the airfield parcel and the adjoining abandoned antenna field that together constitute the wetland project area is consistent with and helps implement applicable local, regional, and state plans, including the Hamilton Reuse Plan, the City of Novato General Plan, and the San Francisco Bay Conservation and Development Commission San Francisco Bay Plan. There are three wetland project objectives that satisfy the above mentioned plans: (1) to create a diverse array of wetland and wildlife habitats that benefit a number of threatened, endangered, and other species, (2) to reduce in-water disposal of cover material and beneficially reuse cover materials as feasible, and (3) to facilitate the base-closure and reuse process.

This FFS evaluates the need for remediation and the remedial alternatives based on beneficial use as a wetlands. Under the future wetlands end use, the existing levee surrounding the airfield will be breached, and water from San Pablo Bay would be allowed to reclaim the airfield, eventually returning the area to a wetlands state. Because much of the Inboard Area has subsided to elevations below that of a productive salt marsh, the restored wetlands must rise to a level that will sustain a permanent marsh habitat through the placement of imported fill material augmented by natural sedimentation. Main tidal channels will be constructed within the cover material and lower order channels will form naturally.

The initial construction phase of the wetlands restoration project is scheduled for approximately five to eight years. Following construction, the levee will be breached and the wetlands will be allowed to equilibrate and mature. The wetland is expected to reach maturity in approximately 50 years.

1.5.4 Existing Biological Communities

This section contains descriptions of habitats and biota currently existing within the Inboard Area and in the Coastal Salt Marsh (CSM) that borders the east BRAC property boundary. This summary is not intended to be an exhaustive compilation of plants and wildlife, but rather a list of potential ecological receptors.

Several studies since 1986 have characterized the biological resources (flora and fauna) in the vicinity of the Inboard Area and CSM. The surveys were conducted in support of environmental impact reports for Base closure and subsequent use of BRAC property. The discussions of biological resources in this section are based upon reports by EIP Associates (1986 and 1993) and USACE (1994). Information in these reports includes results of botanical field surveys conducted in August 1993 and May 1994 and wildlife surveys conducted in May 1994.

Additional wildlife investigations were conducted in 1997 and 1998 and include the following:

- A bat survey (LSA, 1997a)
- California Clapper Rail (*Rallus longirostris obsoletus*) and California black rail (*Laterallus jamaicensis coturniculus*) Survey (LSA, 1998)
- Burrowing Owl (*Athene cunicularia*) Study and Relocation (LSA, 1997b)
- Red Legged Frog (*Rana aurora*) Survey (LSA, 1997c).

There are some differences among the various HAAF BRAC project documents as to which special status species, of those not actually observed on the property or salt marsh areas, are likely to be present. The Hamilton Wetland Restoration Plan, Volume II: Final EIR/EIS (Jones & Stokes Associates, Inc., 1998) lists 56 special-status species and evaluates their potential for occurrence or reports documented observations. It is concluded from this information that after elimination of species for which habitat is lacking or species which may make only incidental use of the site, 12 species are known to occur or are assumed to use suitable habitat at the site. These species included:

- Longfin smelt (Spirinchus thaleichthys)
- Central California steelhead (Oncorhynchus mykiss)
- Chinook salmon (Oncorhynchus tshawytscha)
- Double-crested cormorant (Phalacrocorax auritus)
- California brown pelican (Pelicanus occidentalis californicus)
- California clapper rail
- California black rail
- Northern harrier (Circus cyaneus)
- Burrowing owl
- Salt marsh common yellowthroat (Geothrypis trichas sinuosa)
- San Pablo song sparrow (Melospiza melodia samuelis)
- Salt marsh harvest mouse (Reithrodontomys raviventris).

1.6 Historical Investigations

This FFS is primarily based on the information presented in the RI (initiated in 1996) (IT, 1999a), the 1998 Interim Removal Action Report (IT, 1999b), the 1999 Interim Removal Action Report (IT, 2000), the Foster Wheeler Remedial Design Investigation Report (FW, 2000), and the Human Health and Ecological Risk Assessment (U.S. Army, 2001) for which site-specific field investigations and interim removal actions at the Inboard Area is documented.

These primary documents include information from the investigative documents referenced below:

- Report of Findings, Survey of Toxic and Hazardous Materials on Excess Property (USADEH, 1985)
- GSA Sale Area Confirmation Study for Surface and Subsurface Hazardous Materials Contamination (WCC, 1985)
- Confirmation Study for Hazardous Waste (WCC, 1987)
- *Hamilton AFB Storage Tank Removal Project* (IT, 1987)
- Enhanced Preliminary Assessment (Weston, 1990)
- Final Engineering Report, Miscellaneous Contaminated Sites (IT, 1991)
- Final Environmental Investigation Report (ESI, 1993)
- Community Environmental Response Facilitation Act Plan (ETC, 1994a)
- Supplement to the Final Environmental Investigation Report (USACE, 1994)
- HAAF BRAC property, Site Description and Programmatic Approach (Army, 1994)
- Ground Geophysical Surveys of Hamilton Army Air Base (Terrasoft, 1994)
- Additional Environmental Investigation of the BRAC property (WCFS, 1996)
- Environmental Investigation Report, Onshore Fuel Line (IT, 1996)
- Comprehensive Remedial Investigation Report (IT, 1999a).

1.7 Nature and Extent of Contamination

As described in Section 1.3, the Inboard Area was used for a variety of military functions. These functions, which could have potentially impacted soil, were supported by underground storage tanks (UST), aboveground storage tanks (AST), transformers and transformer pads, storm drain and sanitary sewer systems, the Former Sewage Treatment Plant (FSTP) (including sludge drying beds), fuel lines, revetment areas, and the Perimeter Drainage Ditch (PDD) which collected runoff from the Base as well as the surrounding agricultural lands. Based on historical investigation, the contaminants detected at various sites include:

- Total petroleum hydrocarbons (TPH) measured as diesel, gasoline, JP-4, or motor oil
- Metals
- Dioxins and furans
- Volatile organic compounds (VOC)
- Semi-volatile organic compounds (SVOC) including Polynuclear aromatic hydrocarbons (PAH)

- Polychlorinated biphenyls (PCB)
- Pesticides

The chemicals were generally detected in surficial soils at trace concentrations. A detailed description of the site characterization activities is provided in the RI (IT, 1999a), the interim removal action reports (IT, 1999b and IT, 2000), and the Foster Wheeler (FW) remedial design report (FW, 2000).

1.8 Description of Inboard Area Sites

This section provides a brief description of each Inboard Area site evaluated in this FFS. Figure 1-2 shows the general location of each Inboard Area site. Additional information on these sites, including characterization results, can be found in the RI (IT, 1999a).

The baseline risk assessment for HAAF was prepared for 63 Inboard Area sites. The sites were divided into 58 Inboard Area sites and five CSM sites (not addressed by this FFS). The Seasonal Wetland was considered as an Inboard Area site in the Risk Assessment; however, it is not a part of the BRAC property and is not identified as a site in the final Community Environmental Response Facilitation Act (CERFA) report (ETC, 1994a). Hence, it was not considered in this FFS. Therefore, 57 Inboard Area sites were identified within the Inboard Area and carried through the FFS for evaluation as listed below.

- Former Sewage Treatment Plant (FSTP)
- Building 20
- Building 26
- Building 35/39 Area
- Building 41 Area
- Building 82/87/92/94 Area
- Building 84/90 Area
- Building 86
- PDD
- PDD Spoils Piles A, B, C, D, E, F, G, H, I, J, K, L, M, and N
- East Levee Generator Pad
- Onshore Fuel Line (ONSFL) – 54-inch Drain Line Segment
- ONSFL – Hangar Segment
- ONSFL – Northern Segment
- Northwest Runway Area
- Tarmac East of Outparcel A-5

- Revetments 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, and 28
- Revetment 18/Building 15

Building 86 is combined with the Building 82/87/92/94 Area in Section 4 for the purposes of evaluating remedial alternatives.

Each Inboard Area site was investigated during the RI. Following the RI, interim removal actions were conducted in 1998 and 1999. Interim removal action guidance levels were recommended by regulatory agencies and regulatory trustees for the interim removal actions at HAAF. Effects Range-Medium (ER-M) guidelines, a toxicity-based indicator of potential adverse impact on estuarine benthic invertebrate, were selected for the interim removal action guidance levels at the time the actions were conducted. The non-petroleum interim removal action guidance levels were ER-M guidelines derived from NOAA Technical Memoranda, "The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program" and "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." The petroleum interim removal action guidance levels were based on San Francisco Airport site cleanup levels and RWQCB, San Francisco Bay Region saltwater protection zone tier 1 standards. The interim removal action guidance levels were used to establish excavation limits; they were not used as strict cleanup goals.

Interim removal actions were conducted in 1998 and 1999 at sites where one or more samples contained a chemical at a concentration at or above its ER-M guideline (Long et al., 1995). The interim removal actions involved excavation of impacted soil with offsite disposal of the excavated soil (IT, 1999b and IT, 2000). Confirmation soil samples were collected after excavation to confirm the achievement of interim removal action guidance levels.

Interim removal actions were performed in 1998 at the following Inboard Area sites:

- Revetment 18/Building 15
- Building 20
- Building 82 (Transformer Pad)
- Building 92/94 (Transformer Pad)
- East Levee Generator Pad (Tank Pads)
- PDD-Unlined
- PDD Spoils Piles (A, B, C, D, E, G, H, I, J, K, L, M, and N)
- Revetment 10
- Building 35/39
- Building 41
- FSTP
- Building 86 (storm drains)

Additional removal activities were conducted in 1999 at sites where confirmation samples exceeded the interim removal action guidance levels at the 1998 interim removal action (IT, 1999b) excavation sites. The majority of the confirmation samples from the 1999 interim removal actions were analyzed only for the chemicals of interest based on the previous sampling. The 1999 interim removal actions were conducted at the following Inboard Area sites:

- Building 82
- PDD Spoils Piles (B, C, E, H, I, J, and L)
- Revetment 9
- Building 35/39
- Building 41
- FSTP

In some cases, the figures provided in Appendix B (area and volume calculations), include the 1998 excavation confirmation sample locations which exceed the comparator values even though a subsequent excavation (1999 interim removal action [IT, 2000]) was conducted.

The following sections give a description of each Inboard Area site.

1.8.1 Former Sewage Treatment Plant

The FSTP is located at the eastern edge of the Inboard Area, close to Perimeter Road and the PDD and immediately southwest of the Pump Station Area (PSA). The FSTP consisted of several buildings, a digester, and four sludge drying beds. The beds were unlined and contained within earthen berms. Sewage generated at the HAAF was processed by primary and secondary treatment at the plant. Treated effluent water was discharged into San Pablo Bay via an outfall pipe. Beginning in 1986, sewage from remaining operating areas of the HAAF was directed to the Novato Sanitation District.

The FSTP buildings were demolished (Jordan, 1990 and Weston, 1990) and the sludge, berms, and bed dikes were removed in 1987.

Investigations during the RI characterized the contamination present at the FSTP. The 1998 Interim Removal Actions (IT, 1999b) resulted in the removal of approximately 4,000 cubic yards (yd^3) of soil centered on the former sludge drying beds to a depth of 5 to 7 feet below ground surface (bgs). In the southeast corner of the excavation, removal continued to a depth of 10 feet bgs. A total of 37 confirmation samples were collected from the excavations and analyzed for TPH-E, PAHs, PCBs, pesticides, and metals. Confirmation sampling indicated detections of unknown extractable hydrocarbon (UHE), metals, and pesticides above the interim removal action guidance levels. A combination of sloping and backfilling was used following the confirmation sampling.

As part of the 1999 interim removal actions (IT, 2000), approximately 140 yd^3 of soil were excavated to a depth of 4 feet bgs to address a black sludge layer identified in 1998. The black sludge layer (which was the objective of the excavation) extended beyond the original anticipated boundary for the excavation. The layer was followed and removed until no longer visible. Four confirmation samples were collected following the excavation and sampled for TPH-E, metals, PAHs, pesticides, and PCBs. Confirmation sampling indicated detections of metals, pesticides, and TPH-diesel above the interim removal action guidance levels in one of the confirmation samples. The excavation was backfilled with onsite borrow material to ensure stability of the outboard levee.

1.8.2 Building 20

Building 20, the westernmost airfield building, is located along the northern Perimeter Road near the Landfill 26 borrow area. The building was used to provide electricity for runway lighting, radar, or other activities. A transformer pad is located adjacent to the east wall, and the former UST was buried on the southwest side of the building. The transformers and UST were removed.

Investigations during the RI characterized the contamination present at Building 20. The 1998 interim removal actions (IT, 1999b) resulted in the removal of approximately 150 yd^3 of soil at the former UST location to a depth of 10 feet bgs. Ten confirmation samples were collected at Building 20 and analyzed for TPH-E, TPH-P, BTEX, PAHs, and metals. Confirmation sampling indicated detections of metals only; lead was detected below its interim removal action guidance level. The excavation was backfilled.

1.8.3 Building 26

Building 26 is located along the northern Perimeter Road, approximately 500 feet southeast of Building 20. A transformer pad (with the transformers removed) is located on the west side of the building. A former UST was located adjacent to the south side of the transformer pad, and a former AST was located inside the building. A concrete pad on the south side of the building contains concrete pillars and steel structures that may have supported an antenna or tower.

During the RI, samples were collected around the transformer pad and potholes were excavated around the former UST location. Samples were analyzed for TPH-P, TPH-E, BTEX, PAHs, and lead. Sampling indicated detections of petroleum hydrocarbons and metals. TPH was detected at 5 feet bgs and lead did not exceed its soil baseline concentration in the pothole samples. The lateral impact of fuel contamination on soil located southwest of the former UST was not defined during the RI. The excavation was backfilled.

1.8.4 Building 35/39 Area

The Building 35/39 Area is located at the north end of the pump station near the northeast corner of the Inboard Area. Both buildings contain high-capacity pumps for the removal of water from the BRAC property via the Perimeter Drainage Ditch. The water is discharged via outfall pipes into the outfall drainage ditch, located immediately outside the perimeter levee which flows into San Pablo Bay. Features in this area include Building 35, which contains a large pump, and former AST 6. AST 6 was located at the northeast corner of Building 35. Former AST 5 was located southeast of Building 39. Three active transformers are located midway between the two buildings, and outfall pipes are located at each building to discharge water from the pumps through the levee into the outfall drainage ditch. There were no documented releases at this location.

Investigations during the RI characterized the contamination present at the Building 35/39 Area. The 1998 interim removal actions (IT, 1999b) resulted in the removal of approximately 50 yd^3 of soil impacted by elevated concentrations of diesel and PAH to a depth of 5 feet bgs. The excavation was located south of Building 39 and southeast of AST-5. The excavation was based on sample PS-SS-04 collected in 1991. The sample contained total recoverable petroleum hydrocarbons at 166,000 milligrams per kilogram (mg/kg) (ESI, 1993) in the surface soils. Four sidewall and one bottom confirmation samples were collected from the excavation and analyzed for TPH extractables, PAHs, and lead. Confirmation sampling indicated detections of UHE in the northern sidewall sample and the bottom sample above its interim removal action guidance level. Lead was detected below its interim removal action guidance level. The excavation was backfilled.

As a part of the 1999 interim removal actions (IT, 2000), AST-5 and -6 were removed and approximately 332 yd^3 of soil were excavated to a depth of 7.5 feet bgs from the area around former AST 6. Due to stability issues, the excavation was kept 5 feet from the footings of the concrete sump and discharge pipeline; therefore, the impacted soil was removed to the extent practicable. Ten confirmation samples were collected (two from each sidewall and the bottom) and analyzed for TPH-E, pesticides, PCBs, and lead. Confirmation sampling indicated detections of lead, TPH, pesticides, UHE, and PAHs. Pesticides and UHE were detected above their interim removal action guidance levels on the southeastern side of the excavation and UHE was also detected above its interim removal action guidance level on the west-southwestern side of the excavation. The excavation was backfilled.

1.8.5 Building 41 Area

The Building 41 Area is a former pump station and is located in the southern portion of the Pump Station Area. Two former 1,100-gallon diesel USTs located on the north western side of the building supplied fuel for the pumps at the building. Features in the vicinity of the Building 41 include:

- Four inoperable diesel powered pumps inside Building 41
- Two former ASTs east of Building 41
- Former Building 40
- A generator in former Building 40 for emergency power
- Three former transformers on a concrete pad three feet northeast of Building 40
- An outfall pipe that extends 80 feet southeast of Building 41, through the levee, to a discharge point in the outfall drainage ditch.

Investigations during the RI characterized the contamination present at the Building 41 area. The 1998 interim removal actions (IT, 1999b) resulted in the removal of approximately 250 yd^3 of soil located west of Building 40 at the former AST location to a depth of 5 feet bgs. Four sidewall and one bottom confirmation samples were collected from the excavation and analyzed for TPH-E, PAHs, and lead. Confirmation sampling indicated detections of UHE in the excavation from two sidewall samples and a bottom sample (620 mg/kg, 3,100 mg/kg, and 360 mg/kg, respectively). Lead was detected below its interim removal action guidance level. The excavation was backfilled.

As a part of the 1999 interim removal actions (IT, 2000), approximately 490 yd^3 of soil were removed at the former tank locations to a depth of 9 feet bgs. Due to stability issues, the excavation remained at least five feet from the building footings and the wall of the lined PDD to protect the integrity of these foundations. Thirteen confirmation samples were collected from the excavation (5 bottom samples and 8 sidewall samples) and analyzed for TPH. Confirmation sampling indicated detections of TPH-D in seven of the samples (ranging from 110J mg/kg to 1,200J mg/kg), above the interim removal action guidance level.

1.8.6 Building 82/87/92/94 Area

Building 82

Building 82 is a single-story structure located south of former Building 86 and about 50 feet from Perimeter Road. Building 82 was built in the area of former Building 91; Building 91 was an air freight terminal. Building 82 was historically used for flight operations, aircraft rescue, and first aid. It is currently used by the BEC for office use. A transformer was previously located on a concrete pad northwest of Building 82.

Investigations during the RI characterized the contamination present at Building 82. The 1998 Interim Removal Actions (IT, 1999b) resulted in the removal of approximately 170 yd^3 of soil at the transformer pad to a depth of 4 feet bgs. Ten confirmation samples (seven sidewall and three bottom samples) were collected and analyzed for TPH-E, TPH-P, and PCBs. Confirmation sampling indicated detections of UHE, unknown purgeable hydrocarbon (UHP) and PCBs in one bottom and two sidewall samples above the interim removal action guidance levels. The excavation was backfilled.

As part of the 1999 Interim Removal Actions (IT, 2000), an additional removal action took place to address the TPH and UHE contamination detected at the Building 82 transformer pad area. Approximately 317 yd^3 of soil were excavated to depths ranging from 4.5 to 6.5 feet bgs. Four confirmation samples were collected from the excavation: one sidewall , two bottom samples, and one pothole soil sample. Confirmation sampling indicated detections of TPH-P, TPH-E, lead, and PCBs below interim removal action guidance levels.

Two additional pothole samples were excavated to a depth of 7 feet bgs to the south of the main excavation to investigate the extent of the TPH contamination along the sewer line (IT 2000). There was no visual evidence of contamination. The samples were analyzed for TPH-E, TPH-P, and PCBs. Sampling indicated detections of diesel in all samples below its interim removal action guidance level at depths ranging from 0.5 to 7 feet bgs. The excavation was backfilled.

Groundwater was observed in the potholes. Temporary wells were installed in each of the potholes, and a third well was installed in the southeast corner of the main excavation. The groundwater from the pothole wells was collected and sampled for PCBs and TPH-E. Sampling indicated detections of TPH-E below established water screening levels (IT 2000) in the well between the southmost pothole and the main excavation.

Building 87

Building 87 is located immediately south of the aircraft parking lot and was used for storage of unopened packaged products (five gallons or less) such as paint, oil, grease, antifreeze, and solvents. The area surrounding Building 87 was used to hold 55-gallon drums of solvent and cleaning compounds on horizontal dispensing racks. A metal CONEX container was located north of Building 87 and contained unleaded gasoline in five-gallon containers.

The racks and drums were occasionally moved to various locations surrounding the building (ESI, 1993). There were no documented releases of hazardous materials at this site.

No RI investigations were conducted at Building 87 because the results of previous investigations adequately characterized the site. In a 1993 investigation conducted by ESI, soil samples were collected from the test pits and storm drain sediment. Three soil borings and monitoring well AM-MW-104 were drilled. Soil sampling indicated detections of metals above their baseline concentrations. PAHs, metals, and VOCs were detected in the sediments; the concentrations of PAHs and metals were above soil baseline concentrations. TPH was not detected in soil or sediment samples. Metals also were detected in the groundwater.

Building 92/94

Buildings 92 and 94 are single-story structures located north of Building 82 and to the west of former Building 86. Their former use was for aircraft maintenance and storage and storage of supplies for aircraft rescue and offices; they are currently used for storage of sampling equipment and records storage. Three transformers were previously located on a concrete pad between Buildings 92 and 94, referred to as the Building 92/94 transformer pad. Asphalt on the south, west, and east sides of the pad is deteriorated. A storage area (Storage Area 3) was located on the eastern side of Building 94. The storage area consisted of five metal containers used to store maintenance related fluids, such as fuel, paint, and solvents. The area was not surrounded by curbing or other surface containment. There were no documented releases of hazardous materials at these buildings.

Investigations during the RI characterized the contamination present at Buildings 92 and 94. The Interim Removal Actions (IT, 1999b) resulting in the removal of approximately 125 yd^3 of soil at the transformer pad to a depth of 4 feet bgs. Eight confirmation samples were collected from the excavation area and analyzed for PCBs. Confirmation sampling indicated a detection of PCB below the interim removal action guidance level.

1.8.7 Building 84/90 Area

The Building 84/90 Area is located at the southeastern end of the Aircraft Maintenance Storage Facility (AMSF) area, northwest of Perimeter Road and south of the taxiways. The two buildings were constructed in 1961.

Building 84

Building 84 was used for repair of aircraft electronics equipment (WCFS, 1996). A fenced enclosure located just northeast of the building formerly contained a concrete slab and three transformers. The transformers were removed in 1995 (RCI, 1996). Three electrical units of unknown use are located on the north exterior wall beneath an awning.

During the RI, one surface soil sample was collected near the awning on the north side of Building 84 to assess potential impact near stained concrete and asphalt. The sample, collected beneath deteriorated asphalt near the former transformer pad, was analyzed for TPH-P, TPH-E, BTEX, VOCs, PAHs and metals. Sampling indicated detections of four metals and one PAH above of soil baseline concentrations. In addition, four surface soil samples were also collected from the soil in the area believed to adjoin the former location of the transformer pad. These samples were analyzed for PCBs. PCBs were not detected at the former transformer pad.

Building 90

Building 90 was used for aircraft maintenance activities (WCFS, 1996). These activities included aircraft equipment repair, oil changing, jet and propeller engine repair and service, aircraft bodywork, painting and washing, and fuel testing. The southern end of the building is a small utility/electrical room. Two wash racks adjoin the west side of the building. A small sump is on the southern side of the building. This sump was used as a receiving structure for a floor drain inside the southern shed of Building 90. A fence-enclosed transformer pad adjoins the south side of the building. The transformers were removed in February 1991 by the Navy Public Works Commission. Hazardous substances used and wastes generated during these activities reportedly included stripping and degreasing solvents, batteries, petroleum, oils, lubricants, antifreeze, and paints.

During the RI, five soil borings were drilled at various locations around Building 90. Samples were collected at three depths in each boring and analyzed for TPH-P, TPH-E, BTEX, VOCs, PAHs, and metals. Sampling indicated detections of PAHs below soil baseline concentrations and metals above soil baseline concentrations. UHE was also detected in one sample below the step-out criterion. Groundwater also was sampled from one of the soil borings drilled west of the building, adjacent to the edge of the wash racks. The groundwater sample was analyzed for TPH-P, TPH-E, BTEX, VOCs, PAHs, and lead. Lead was detected in the groundwater sample. Four surface soil samples were also collected at the Building 90 transformer pad and analyzed for PCBs. PCBs were detected at the former transformer pad.

1.8.8 Building 86

Building 86 was an aircraft maintenance hangar, located about 50 feet southeast of the New Hamilton Partnership (NHP) levee and used primarily for light maintenance of aircraft. A flammable materials locker and at least one recirculating solvent parts cleaner were located in Building 86. Substances used and waste generated at the hangar included stripping and degreasing solvents, oils, and paints. Waste material from activities at Building 86 were taken to a storage area located on the southwest corner of the building (Storage Area 2) (ESI, 1993) by Army personnel. Storage Area 2 consisted of 55-gallon drums and smaller containers, which stored waste oils, waste fuel, and other maintenance related fluids. The materials were stored within a metal container that rested on a gravel surface. Storage Area 1 was located near the northeast corner of Building 86 and was a drum storage area. Drums were placed horizontally on metal storage and dispensing racks.

Building 86 was demolished and removed in 1998. The remaining building pad is adjoined by concrete aircraft aprons on the north, east, and south and by a concrete slab on the west.

Investigations during the RI characterized the contamination present at Building 86. Removal activities were conducted in 1998. During the 1998 interim removal actions, a storm drain investigation was conducted at Building 86. Ten soil borings were drilled along storm drain line SD-1, located south of the building. Samples were collected at depths ranging from 1 to 5 feet below the bottom of the storm drain line. The samples were analyzed for TPH-E, TPH-P, PAHs, and metals. Sampling indicated a detection of nickel above its interim removal action guidance level at a depth of 11.5 feet bgs in a soil sample collected along the portion of SD-1 located southeast of Building 86. Sampling also indicated detections of several PAHs above their respective interim removal action guidance levels at a depth of 10 feet bgs in the soil sample collected along the portion of SD-1 located north of Building 87.

1.8.9 Perimeter Drainage Ditch

The PDD is a man made drainage channel that encircles all but the western margin of the Inboard Area. It was constructed to convey surface water runoff to the pump stations for lifting and discharge into the outfall drainage ditch and San Pablo Bay. The PDD conveys water from portions of the GSA properties and from privately owned agricultural lands adjoining the airfield. Further information about the PDD is presented in the Perimeter Drainage Ditch Engineering Evaluation Report (IT, 1997a).

Additionally, there is an open drainage ditch at the base of Reservoir Hill in the GSA Phase I Sale Area that connects to the north end of the PDD by an underground storm drain pipe (WCFS, 1996). The northern section of PDD is unlined from the western property boundary to the confluence with the 54-inch storm drain line.

Investigations during the RI characterized the contamination present at the unlined PDD. The 1998 interim removal actions (IT, 1999b) included dewatering of the ditch and sediment removal from the PDD. An estimated 2,800 yd^3 of sediment and vegetation were removed from the 17,500-foot-long PDD channel, including the lined and unlined portions. In the unlined portion, one sidewall sample and one bottom sample was collected every 200 linear feet for a total of 20 sidewall and 20 bottom samples.

Samples were analyzed for TPH-E, TPH-P, PAHs, pesticides, PCBs, and metals. A dioxin analysis was also performed on five confirmation samples collected from the bottom of the excavation. Confirmation sampling indicated detections of UHE, metals, and pesticides. UHE, nickel, DDE, and DDT were detected above their interim removal action guidance levels. UHE was detected above its interim removal action guidance level in one sample collected from the southern section of the unlined PDD; benzo(b)fluoranthene was also detected at its maximum concentration at this location. Nickel, DDE, and DDT were detected above interim removal action guidance levels in several locations. The maximum concentration of DDE and DDT were detected in the northern section of the unlined PDD. Nickel was detected above its interim removal action guidance level in the northern and southern sections of the unlined PDD. DDD was also detected in several confirmation samples; a guidance level was not provided for this constituent. The maximum concentration of DDD was detected in the northern section of the unlined PDD. Dioxins and furans were detected in the northern section of the unlined PDD. Dioxins were detected in two PDD samples and furan was detected in one of these samples.

Two surface soils samples were collected from cracks located on the northeastern side of the concrete-lined PDD during the remedial design investigation (FW, 2000). The samples were analyzed for pesticides, herbicides, metals, TPH-E, PCBs, and PAHs. Pesticides, herbicides, and metals were detected in both samples. PAHs were detected in the southern sample. PCBs and TPH-E were not detected in either sample.

1.8.10 Perimeter Drainage Ditch Spoils Piles

During the course of military operations at the airfield, periodic dredging of the PDD occurred. Fourteen dredge spoil stockpiles were identified based on previous investigation maps, review of aerial photographs, and field reconnaissance. The spoils piles are designated A through N. Locations were later verified (except for Spoils Pile F) by further field reconnaissance after mowing the vegetation. There is no physical evidence of the exact location of Spoils Pile F; however, previous investigations conducted by Woodward Clyde and Jordan documented the pile to be northeast of Building 41.

The 1998 interim removal actions (IT, 1999b) included removal of soil from 13 of the 14 PDD spoils piles (A through E and G through N). Material from the 13 spoils piles were removed down to the approximate original grade and the materials were transported to an offsite Class II disposal facility. Confirmation samples were collected at a total of 25 discrete locations within the 13 footprints of the spoils piles after removal and analyzed for TPH-E, PAHs, pesticides, PCBs, and metals. Samples were based on one sample approximately every 50-foot by 50-foot grid section.

During the 1999 Interim Removal Actions (IT, 2000), the footprints of seven spoils piles (B, C, E, H, I, J, and L), where the 1998 interim removal action (IT, 1999b) took place, were further excavated to a depth of 1.5 feet bgs based on chemicals of interest identified from the 1998 Interim Removal Action confirmation sample results. Following is a summary of the 1999 site-specific actions:

- Spoils Pile B – The chemicals of interest for Spoils Pile B were pesticides and metals. Approximately 591 yd^3 of soil were removed from the Spoils Pile B to a depth of 1.5 feet bgs to address contamination from lead, mercury, silver, DDE, and DDT. Four confirmation samples were collected from the bottom of the excavation and analyzed for the contamination of interest. Mercury and DDT were detected in all four samples. Silver and lead were detected in three of the samples. The following additional pesticides, DDD, DDE, endrin aldehyde, and endrin ketone, were also detected in one sample. The removal action guidance levels were not exceeded for the analytes with established interim removal action guidance levels.
- Spoils Pile C – The chemicals of interest for Spoils Pile C were pesticides. Approximately 17 yd^3 of soil were removed from the Spoils Pile C to a depth of 1.5 feet bgs to address contamination from DDE. One confirmation sample was collected from the bottom of the excavation and analyzed for pesticides. Confirmation sampling indicated detections of DDD, DDE, and DDT below the interim removal action guidance levels.
- Spoils Pile E – The chemicals of interest for Spoils Pile E were pesticides. Approximately 261 yd^3 of soil were removed from two separate excavation areas along the footprint of Spoils Pile E to address contamination from DDE. The excavation extended to a depth of 1.5 feet bgs. A confirmation sample was collected from each excavation and analyzed for pesticides. Confirmation sampling indicated detections of DDE and DDT in both confirmation samples below the interim removal action guidance levels.
- Spoils Pile H – The chemicals of interest for Spoils Pile H were pesticides and TPH. Approximately 290 yd^3 of soil were removed from the Spoil Pile H to a depth of 1.5 feet bgs to address contamination from DDE, DDT, and UHE. Two confirmation samples

and a duplicate were collected from the bottom of the excavation and analyzed for pesticides and TPH-E. Confirmation sampling indicated detections of TPH-D in one sample and in the duplicate of the other sample as well as DDE and DDT in both confirmation samples below the interim removal action guidance levels.

- Spoils Pile I – The chemicals of interest for Spoils Pile I were pesticides and TPH. Approximately 70 yd^3 of soil were removed from Spoils Pile I to a depth of 1.5 feet bgs to address contamination from UHE and DDT. One confirmation sample was collected and analyzed for pesticides and TPH-E. Confirmation sampling indicated no detections of pesticides or TPH.
- Spoils Pile J – The chemicals of interest for Spoils Pile J were pesticides and PAHs. Approximately 13 yd^3 of soil were removed from Spoils Pile J to a depth of 1.5 feet bgs to address contamination from benzo(a)pyrene, benzo(a)anthracene, DDE, and DDT. One confirmation sample and a duplicate were collected from the bottom of the excavation and analyzed for pesticides and PAHs. Confirmation sampling indicated detections of three pesticides (DDD, DDE, and DDT) and four PAHs below interim removal action guidance levels. DDT was detected in the duplicate sample above interim removal action guidance levels; the concentration was estimated with a high bias.
- Spoils Pile L – The chemical of interest for Spoils Pile L was nickel. Approximately 6 yd^3 of soil were removed from Spoils Pile L to a depth of 1.5 feet bgs to address nickel contamination. One confirmation sample was collected from the bottom of the excavation. Confirmation sampling indicated detections of nickel below its interim removal action guidance level.

The spoils piles excavations were sloped following the 1999 interim removal actions.

1.8.11 East Levee Generator Pad

A transformer pad and a generator pad were located adjacent to one another at a former AST site. The site is located just inboard of the east levee, midway between the FSTP and the south end of the runway. Although this site is located directly across the east levee from the southwest corner of the East Levee Construction Debris Disposal Area (a Coastal Salt Marsh site), it is not associated with the historic disposal area.

Investigations during the RI characterized the contamination present at the East Levee Generator Pad. The 1998 interim removal actions (IT, 1999b) resulted in the removal of the generator pad, the adjacent AST cradle and concrete slab, an empty 55-gallon drum, and approximately 380 yd^3 of impacted soil to a depth of 5 feet bgs. Fifteen confirmation samples were collected (nine sidewall and six bottom samples) from the excavation and analyzed for TPH-E, PAHs, and metals. Confirmation sampling indicated detections of lead and other metals below their interim removal action guidance levels. UHE and PAHs were not detected. A combination of sloping and backfilling was performed for the excavation.

1.8.12 Onshore Fuel Line

The onshore fuel line (ONSFL) originally conveyed aviation gasoline and, later, JP-4 liquid fuels from the Offshore Fuel System to several locations around the airfield, including fueling stations near the edge of the tarmac and the former tank farm on the Petroleum, Oil, and Lubricant Outparcel. The fuel line was constructed between 1935 and 1945 and was last used in 1975 (IT, 1997b). The fuel line included an offshore portion, between the unloading terminal in the Bay and the booster pump station just inside the east levee, and the onshore portion, which extended from the booster pump station to the airfield hangars. The offshore fuel system was closed under a separate action in 1998.

The ONSFL system was evaluated in the RI and risk assessment as three distinct segments:

- 54-inch Drain Line Segment
- Hangar Segment
- Northern Segment

The fuel lines were removed in 1995 except for the portion from the PDD to the levee which was removed in 1998. TPH-P, ethylbenzene, xylenes, PAHs, and lead were detected in the samples collected after removal of the fuel lines.

The soil beneath the board-mounted transformer, located at the booster pump station in the northeastern corner of the BRAC property, was investigated for PCBs during the RI. PCBs were not detected. Additional sampling also was conducted along previous sample areas of the fuel line to determine the extent of fuel contamination for locations with high concentrations of fuel contamination. Results of the sampling indicated that most of the contamination is within 20 feet of the trench; however, one location required stepouts to 50 feet beyond the trench.

1.8.13 Northwest Runway Area

The Northwest Runway Area is located at the extreme northern end of the Inboard Area. The site is located along the southeastern slope of the northern perimeter levee, between Ignacio Reservoir Marsh and an alkali marsh. Although investigated as part of the GSA Phase II Sale Area (IT, 1998), the Northwest Runway Area is primarily located within the Inboard Area. This site was originally identified as of potential concern as a result of geophysical survey anomalies. Subsequent soil and groundwater investigations that included installing three trenches and four test pits did encounter debris that is indicative of landfill activity.

This site has been investigated since 1985, and the methods have included geophysical, radiological, and explosive surveys and collection of soil and groundwater samples. Soil samples were collected from three test pits and three excavation trenches located along the northwestern runway area. Metals, DDD, TPH, and bis(2-ethylhexyl)phthalate (a common laboratory contaminant) were detected in the soil samples. Scrap metal was discovered; however, no evidence of landfill activity was identified. Metals were detected below baseline concentrations.

Four groundwater monitoring wells (MW-PVC-1, -2, -3, and -4) were installed in 1985. They were sampled for pesticides, petroleum hydrocarbons, VOCs, SVOCs, and metals during nine sampling events conducted between October 1985 and September 1986. A total of 36 groundwater samples were collected. Five VOCs, one pesticide, and 12 SVOCs were detected sporadically in the groundwater samples. Arsenic, barium, boron, copper, lead, nickel vanadium, and zinc were consistently detected above ambient levels in all four wells

(IT, 1998). In 1997, four additional direct-push soil samples were collected and temporary monitoring wells were installed in the boreholes. The soil samples were collected at depths of 5, 10, and 15 feet bgs and analyzed for metals, VOC, TPH-E, TPH-P, pesticides, and PAHs. Water samples collected from the temporary wells were analyzed for metals, TPH-P, and VOCs. The wells also were analyzed for pesticides, TPH-E, PAHs, and general chemistry parameters when sufficient water volume was available. The levels of metals in the soils appeared to be within ambient ranges and metals in groundwater appeared to be associated with the freshwater/saline water transition zone present at this site.

1.8.14 Tarmac East of Outparcel A-5

The tarmac east of Outparcel A-5 directly adjoins and includes a portion of the NHP levee constructed at the boundary between the GSA and BRAC properties. The tarmac area, located northwest of former Building 86, is a concrete-paved taxiway connecting the AMSF with the northwestern portion of the runway.

The tarmac was identified for further investigation when a petroleum hydrocarbon and PAH plume at Outparcel A-5 was found to extend northeast onto the BRAC property. During the RI, three potholes were excavated to a depth of 10 feet bgs and sampled at three depth intervals (0-4 feet bgs, 4 feet bgs, and below 9 feet bgs). The samples were analyzed for TPH-P, TPH-E, BTEX, lead, and PAHs. Sampling indicated detections of PAHs below soil baseline concentrations; lead above its soil baseline concentration (at a depth of 4.5 feet bgs), and UHP below the stepout criterion. BTEX and TPH-E were not detected.

1.8.15 Revetment Area

The revetment area, located east of the airfield, is transected by concrete-paved taxiways which connect 28 circular parking areas (revetment turnouts) and extensive undeveloped areas. All revetments were historically used for aircraft staging and refueling prior to 1974, except for Revetment 6 (Engine Test Pad) and Revetment 10 (firefighter training area) which were used as an engine test pad and firefighter training area respectively. Fuels, solvents, and vehicles were periodically ignited and doused at Revetment 10 from 1975 to 1987. Aircraft fueling via fuel trucks was also reported to have occurred in this area. Due to their close geographic proximity, Revetment 18 includes the Building 15 area. Building 15 is located south of the revetment along the northern perimeter of the Inboard Area. The building formerly contained a generator that provided electrical power for airfield activities, such as runway lighting. A concrete transformer pad is located adjacent to the west wall of the building. An AST, which stored fuel for the generator, was located north of Building 15 and was removed in 1997. Three transformers (removed in 1995) were also located on the concrete pad adjacent to the building.

Twenty-four of the revetment turnouts are paved with concrete, and four revetments (9, 11, 12 and 23) are "unpaved." The "unpaved" revetments are actually paved with a thin layer of asphalt that has been covered over with sedimentation. Each concrete revetment is approximately 120 feet in diameter, with the exception of Revetment 6, which is approximately 200 feet in diameter. Each of the turnouts is nearly encircled by an earthen berm approximately one foot high. A thin layer of sediment, grass, and weeds is now present at many of the turnouts.

The revetments discussions are grouped in this FFS to provide a clearer summary of the investigations conducted at each revetment and the results of these investigations. The following is the breakout of these groups:

- Revetments 1, 2, 3, 4, 7, 8, 13 through 17, 19, 20, 21, 22, and 24 through 28
- Revetment 5
- Revetment 6
- Revetments 9, 11, 12, and 23
- Revetment 10
- Revetment 18/Building 15

Revetments 1, 2, 3, 4, 7, 8, 13 through 22, and 24 through 28

During the 1993 Engineering-Science Inc. (ESI) investigation, the degree of surface soil contamination was determined by collecting surface soil samples from beneath the revetment pads. Five soil samples were collected from each area and composited at a laboratory. The samples were analyzed for SVOCs, TPH, and lead. TPH and lead were detected at Revetments 1, 2, 3, 4, 7, 8, 13 through 22, 24, and 28. Bis(2-ethylhexyl)phthalate (a common laboratory contaminant) was detected at Revetments 3 and 8. SVOCs were detected in the composite soil samples at Revetments 7, 15, 19 (only in the duplicate sample), 20, and 27.

Additional sampling was conducted at Revetments 17, 20, 26, and 27 in 1993. Four soil borings were drilled around each pad and soil samples were collected at 4 to 5 feet bgs. The soil samples were analyzed for TPH, BTEX, and lead. TPH was detected at Revetments 17, 26, and 27. Lead and one PAH were detected above baseline concentrations; however, BTEX was not detected.

ESI installed two additional wells, RV-MW-103 at Revetment 20 and RV-MW-102 at Revetment 26 in 1993. Two rounds of groundwater monitoring were conducted at RV-MW-103. Recharge was insufficient at RV-MW-102; therefore, the groundwater was not sampled. The groundwater samples were analyzed for TPH, BTEX, and lead. No constituents were detected in the groundwater.

RI activities were conducted at Revetments 17 and 27. Soil samples were collected from the revetments to obtain more accurate TPH results than previously reported. Two soil samples were collected at Revetment 17, and one soil sample was collected at Revetment 27. Lead was detected below its baseline concentration at Revetments 17 and 27.

During Phase 1 of the Design Data Summary investigation, soil samples were collected in the general areas of Revetments 1, 4, 14, 17, 21, and between Revetments 7 and 28. Herbicides were detected in surface soil samples collected southwest of Revetment 1, in the area of Revetments 4, 14 17, and 21, and between Revetments 7 and 28. Herbicides were also detected in two subsurface samples collected at depths ranging from 2 to 3 feet bgs (between Revetments 7 and 28) and 5 to 6 feet bgs (in the Revetment 21 area). Pesticides were detected in all of the surface soil samples collected from the revetment areas. Pesticides were also detected in two subsurface samples at depths ranging from 2 to 3 feet bgs (southwest of Revetment 1) and 10 to 11 feet bgs (in the Revetment 21 area). UHE and UHP were detected in a sample collected in the area of Revetment 14. UHP was detected in one soil sample collected in the Revetment 21 area.

During Phase 2 of the investigation, surface soil samples were collected at three locations surrounding Revetments 1, 2, 4, 7, 13, 15, and 19 and one sample was collected beneath the pavement at each location. In addition, thirteen (13) soil sample were collected (one sample from beneath the pavement at Revetments 3, 8, 14, 16, 17, 20, 21, 22, and 24 through 28). The soil samples were analyzed for TPH, PAHs, VOCs, and metals. UHE and UHP were detected in the surface soil samples collected from Revetments 1, 7, 13, 19, 21, 22, and 26. UHE also was detected in the surface soil samples at Revetments 2, 14, 24, 25, and 28, and UHP was detected at Revetments 3 and 4. TPH-D also was detected at Revetment 19. Metals were detected in the surface soil samples collected from all of the revetments. PAHs were detected in the surface soil samples collected from Revetments 1, 2, 4, 7, 13, 19, 21, 22, 24, and 25, and VOCs were detected in all of the surface samples collected from the revetments except Revetment 14.

Revetment 5

In 1993, ESI collected five surface soil samples from Revetment 5 and composited the samples at a laboratory. The samples were analyzed for SVOCs, TPH, and lead. TPH and lead were detected in the samples.

Woodward-Clyde installed monitoring wells RVT-MW1 through RVT-MW3 around a catch basin located next to Revetment 5 in 1996 (IT, 1999a). The groundwater samples collected from these wells were analyzed for TPH, oil and grease, PAHs, VOCs, BTEX, pesticides, herbicides, and metals. Ten (10) metals were detected in the groundwater, but no organics were detected (IT, 1999a).

During Phase 2 of the Design Data Summary investigation, a sample was collected beneath the pavement at Revetment 5. The sample was analyzed for TPH, PAHs, VOCs, and metals. UHP and VOCs were detected in the surface soil sample collected at Revetment 5.

Revetment 6

In 1990, monitoring well RV-MW-101 was installed adjacent to Revetment 6 by Jordan (IT, 1999a). One groundwater sample was collected and analyzed for VOCs, SVOCs, TPH, and lead. Cyanide and five metals were detected.

Two rounds of groundwater monitoring were conducted at RV-MW-101. The groundwater samples were analyzed for TPH, BTEX, and lead. Cyanide and five metals were the only constituents detected in groundwater.

In 1993, ESI collected surface and subsurface soil samples from the edge of Revetment 6. The samples were analyzed for VOCs, SVOCs, TPH, and lead. Lead, toluene, and bis(2-ethylhexyl)phthtalate (a common laboratory contaminant) were detected in the soil. Lead was detected below baseline concentrations. One boring was also completed as a monitoring well; no analytes were detected in the groundwater well (IT, 1999a).

Woodward-Clyde also collected two soil samples at depths ranging from 2.5 to 3 feet bgs and analyzed them for TRPH, oil and grease, BTEX, and PAHs in 1996; no analytes were detected (IT, 1999a).

One soil sample was collected from Revetment 6 during the RI to obtain more accurate TPH results than previously reported. Toluene and lead were detected in the samples. Lead was detected below its baseline concentration.

During Phase 1 of the Design Data Summary investigation, one surface soil sample was collected in the general area of Revetment 6. Pesticides and herbicides were detected in the soil sample.

During Phase 2 of the investigation, surface soil samples were collected at three locations surrounding the revetments, and one sample was collected from beneath the pavement. In addition, one sample was collected from beneath the pavement at revetments with no previous detection in the composite sample. The soil samples were analyzed for TPH, PAHs, VOCs, metals, and dioxins and furans. Dioxins were detected in three surface soil samples collected from the site. Metals, VOCs, PAHs, UHE, and UHP also were detected in the surface soil samples.

Revetments 9, 11, 12, and 23 (unpaved revetments)

Revetments 9, 11, 12, and 23 were investigated by Woodward-Clyde in 1996. Soil samples were collected from depths ranging from 0 to 6 inches bgs and 1 to 1.5 feet bgs; soil borings were also installed in two additional locations (IT, 1999a). The soil samples were analyzed for TPH-D, TPH-G, TPH-JP-4, TPH-motor oil, BTEX, PAHs, VOCs, metals, and oil and grease. Ten (10) metals were detected above baseline concentrations, and TPH, BTEX, and VOCs were not detected. Acenaphthene was detected above its baseline concentration at Revetment 9 at a depth of 6 inches bgs; it was not detected at 1.5 feet bgs. In 1996, eight temporary monitoring wells, RVT-TW1 through RVT-TW8, were installed in soil borings at the unpaved revetments. Groundwater samples were collected and analyzed for TPH-D, TPH-G, TPH-JP-4, BTEX, and PAHs. Xylene was detected in the groundwater at Revetment 9, and ethylbenzene was detected at Revetment 12.

RI activities were conducted at Revetments 11 and 23. Soil samples were collected from the revetments to obtain more accurate TPH results than previously reported. Three soil samples were collected from Revetment 11 and one soil sample was collected at Revetment 23. TPH-G and UHE were detected in the soil at Revetment 11. Five metals were detected at Revetment 23; vanadium, copper, and zinc were detected at or above their baseline concentrations.

An interim removal action was conducted at Revetment 9 in 1999. Approximately 144 yd^3 of soil were removed to a depth of 1 foot bgs from Revetment 9 based on elevated concentrations of lead detected in samples collected in 1995 (IT, 2000). Two confirmation soil samples and one duplicate soil sample were collected from the excavation. Lead was detected below its interim removal action guidance level. The excavation was sloped.

Revetment 10

In 1987, WC collected soil samples from three soil borings at Revetment 10 (the firefighter training area). One soil boring was located on the northwestern side of the firefighter training area, and the other two soil borings were located south and east of the training area. The samples were collected at depths ranging from 1 to 9 feet bgs and analyzed for TPH, PAHs, VOCs, and metals. Seven metals were detected at concentrations exceeding baseline concentrations, and the highest detection of TPH was detected at a depth of 1 foot bgs (IT, 1999). PAHs were not detected.

In 1993, ESI collected four new soil borings (15 feet bgs.) and two shallow test pits (approximately 6 feet bgs.) were excavated around the concrete pad (one excavation was also completed at the center of the pad) to address subsurface soil contamination. Surface soil samples were also collected around the concrete pad, in the bermed area, and at the former ground level surface exposed during excavation of the test pits. Four groundwater monitoring wells were also installed in the four new soil borings (BP-MW-101 through 104) located around the concrete pad. The soil and groundwater samples were analyzed for VOCs, SVOCs, TPH and lead. Toluene, anthracene, chrysene, bis(2-ethylhexyl)phthalate (a common laboratory contaminant), and lead were detected in the soil samples. Lead and four PAHs were detected above baseline concentrations. Ethylbenzene, toluene, xylene, and 1,3-dimethylbenzene were detected in subsurface soil samples. Methyl ethyl ketone (MEK) and TPH were found in the groundwater samples.

During the RI, a PCB investigation was conducted at Revetment 10. One soil sample was collected from outside the berm at a depth of 1 foot bgs and one soil sample was collected at a depth of 1.5 feet bgs from beneath the concrete pad. PCBs were not detected in the soil samples collected from the firefighter training area.

An interim removal action was conducted at Revetment 10 in 1998. The soil beneath Revetment 10 was excavated, and confirmation samples were collected from the initial excavation; the concrete pad and four monitoring wells, BP-MW-101 through BP-MW-104, were removed before the excavation activities began. Approximately 2,400 yd^3 of soil were removed from the initial excavation to a depth ranging from 5 to 7 feet bgs; the center of the excavation was excavated to a depth of 7 feet bgs. An additional 75 yd^3 soil were removed from three contingency excavations conducted within the initial excavation in December 1998 (IT, 2000). Sixty-four (64) confirmation samples were collected from within the excavation and at a few locations outside of the initial excavation. The confirmation samples were analyzed for TPH-E, TPH-P, BTEX, PAHs, and metals (CAM 17 and boron). Ten samples were also analyzed for PCBs, and 12 samples collected outside of the initial excavation were analyzed for dioxins and furans. UHE was detected above its interim removal action guidance level in one soil sample located in the northern part of the initial excavation at a depth of 6 feet bgs. This area was over-excavated to a depth of 8 feet bgs, and confirmation samples were analyzed for TPH-E. TPH-E was detected below interim removal action guidance levels. Nickel was detected above its interim removal action guidance level in a soil sample located in the southern section of the initial excavation at a depth of 7 feet bgs. This area was over-excavated to a depth of 9 feet bgs, and one confirmation sample was collected directly below the previous sample location and analyzed for nickel. Nickel was detected below the interim removal action guidance level. Two dioxins were detected in one shallow soil sample collected on the northeastern side of the initial excavation. Soil was over-excavated to a depth of 2 feet bgs and extended 10 feet east of the initial excavation. Three dioxins and one furan were detected at a depth of 1 foot bgs in the confirmation sample collected following the overexcavation. The excavation was sloped.

During Phase 1 of the Design Data Summary investigation, one surface sample was collected outside of the revetment area. Pesticides and herbicides were detected in the soil sample.

Revetment 18/Building 15 Area

Building 15 was investigated to determine environmental impacts from fuel storage and PCB contamination at the transformer location during the RI (IT, 1999). The AST and associated piping were removed. One soil sample was collected southeast of the AST at 1.5 feet bgs and analyzed for TPH-E, TPH-P, BTEX, lead, and PAHs. UHE was detected in the confirmation soil sample above the stepout criterion and lead was detected above its baseline concentration for soil. The excavation was extended to 10 feet bgs and two pothole samples were collected at 7 and 8.5 feet bgs east of the former AST. UHE was detected above the stepout criterion at 7 feet bgs, and TPH was not detected at 8.5 feet bgs. Four stepout potholes were also excavated to a depth of 10 feet bgs about 20 feet from each side of the excavation, and one groundwater sample was collected from the stepout pothole east of the concrete pad. The stepout pothole samples were collected at depths of 5 and 10 feet bgs. UHE was not detected in the stepout soil samples; however, it was detected in the groundwater sample.

An interim removal action was conducted in the Revetment 18/Building 15 Area in 1998. Approximately 170 yd^3 of soil were removed to a depth of 8.5 feet bgs from the former AST and transformer area at Building 15. Seven confirmation samples were collected (six sidewall and one bottom sample) and analyzed for TPH-E and lead. Lead and UHE were detected below interim removal action guidance levels at depths ranging from 5.5 to 9.5 feet bgs. The excavation was sloped.

During Phase 1 of the Design Data Summary investigation, one surface soil sample was collected in the general area of Revetment 18. Pesticides, UHP, and PAHs were detected in the soil sample.

During Phase 2 of the Design Data Summary investigation, one soil sample was collected from beneath the pavement of Revetment 18. The sample was analyzed for TPH, PAHs, VOCs, and metals. VOCs were detected in the soil sample.

Except for the few revetments previous described, investigations of the revetment area have been oriented to consider all of the individual revetments as a single site due to the same historical activities at each turnout. However, for the human health and ecological risk assessment (U.S. Army, 2001), the individual revetments have been considered separate sites; this is based on home range considerations for ecological receptors.

1.9 Summary of Human Health and Ecological Risk Assessment

The baseline risk assessment utilized a conservative approach to estimate the potential risk the Inboard Area sites could pose to human health and the environment during the development and maturation of the wetland. The conservative aspects of the assessment included assuming that exposure pathways were complete at all Inboard Area sites even where the exposure pathways are not complete or would not be complete once cover material is placed for the wetland restoration. For example, the baseline risk assessment assumed that human and ecological receptors were in direct contact with contaminants at a site even where existing contamination is currently covered or is planned to be covered in the future wetland restoration project. Exposure to human or ecological receptors would not occur in this case. As a result, the baseline risk assessment presents a conservative estimate of where and when remedial actions may be necessary to protect human health and the environment for the Inboard Area sites.

The overall objective of the combined human health and ecological risk assessment (U.S. Army, 2001) was to evaluate whether residual contaminants at each Inboard Area site would pose a risk to human health or the environment if exposure was not controlled or mitigated during the development and maturation of the wetland.

The risk assessment evaluated all of the following ecological and human health receptors for each site:

- Ten estuarine receptors (ecological) (high marsh [HM], intertidal marsh [IN], and subtidal marsh [SUB])
  - Algae (SUB)
  - Pickleweed (HM)
  - Amphipod (IN)
  - Bay Shrimp (SUB)
  - Northern Anchovy (SUB)
  - Juvenile salmonid (SUB)
  - California Clapper Rail (IN)
  - California black rail (IN)
  - Double-crested cormorant (SUB)
  - Salt marsh harvest mouse (HM)
- Five freshwater receptors (ecological)
  - Algae
  - Amphipods
  - Mosquitofish
  - Great Blue Heron
  - Snipe
- Six grassland habitat (ecological)
  - Terrestrial plants
  - Black-tailed deer
  - California vole
  - Raccoon
  - burrowing owl
  - northern harrier

- Three human health receptors (human health)
  - Marsh Recreational User – The exposure pathways considered for this receptor included incidental ingestion of impacted soil, direct skin contact with impacted soil, skin contact with surface water, and incidental ingestion of surface water
  - Recreational Angler – The exposure pathways considered for this receptor included ingestion of fish living in surface water and ingestion of shellfish living in the water at the sediment/surface water interface
  - Grassland Recreational User – The exposure pathways considered for this receptor included incidental ingestion of impacted soil, direct skin contact with impacted soil and inhalation of windborne soil

The results of the baseline risk assessment are evaluated in this FFS to determine how the potential risk should be addressed by proposed remedial actions. The conceptual model developed for the baseline risk assessment is refined for use in this FFS. The FFS conceptual model is based on potential exposure pathways and human and ecological receptors for a wetland end use. The FFS conceptual model identifies and evaluates receptors based on the general habitat types (upland, estuarine, freshwater, or recreational) that are expected to be developed at each Inboard Area site. These general habitat types are established by the preferred wetland configuration (Jones & Stokes Associates, Inc., 1998). Although the final design of the wetland restoration has not been finalized, the general habitat types and receptors at a specific location are not expected to change significantly due to the physical constraints of the Inboard Area site. For example, a planned upland area is not likely to become a subtidal channel, and vice versa.

The FFS conceptual model assumes estuarine and human recreational receptors at each Inboard Area site and additional freshwater receptors at the Building 82/87/92/94 Area; PDD Spoils Piles A, B and N; and the PDD-unlined portion (see Appendix A). Only grassland receptors are assumed for the Northwest Runway Area.

A summary of the human health and ecological risk assessment results for the Inboard Area site receptors is presented in Appendix A.

1.10 Summary of Sites to be Evaluated in this Focused Feasibility Study

The hazard indices (HI) developed in the baseline risk assessment were are used in the FFS to determine if a site requires remedial action. To require further action and evaluation, a site has to have at least one receptor with an HI greater than 1. The receptors evaluated included those identified in the FFS conceptual model described in the previous section. Table 1-1 shows the sites that do not have at least one receptor with an HI greater than 1.0.

Because these sites do not require further action to protect human health and the environment, they are not evaluated any further in this FFS.

For each remaining site that required further evaluation, site-specific FFS COPCs are established based on the receptors that were expected to be present during the development and maturation of the wetland and the potential risk posed by residual contaminants. The site-specific FFS COPCs were determined by reviewing the risk assessment COPCs at each site for the receptors identified by the FFS conceptual model. If the ecological HQ was greater than 1.0, or the human health HQ was greater than 1.0, or the ILCR was greater than $1x10^{-6}$, then the contaminant was considered a site-specific FFS COPC. The site-specific FFS COPCs are listed in Table 1-2.

The site-specific FFS COPCs were then compared to selected comparator values. These comparator values were based primarily on ambient soil and bay sediment levels and also included RWQCB surface sediment criteria, Regulatory Agencies and Resource Trustees values, and baseline risk assessment target concentration values (U.S. Army, 2001). These comparator values were developed through negotiations with the Regulatory Agencies and Resources Trustees.

Typically, clean up goals are based on risk evaluations and negotiations between regulators and responsible parties. However, the science of ecological risk estimation is not to the point where scientists can definitively determine whether specific chemical concentrations actually pose a risk to ecological receptors. Therefore, it is difficult to establish pre-use clean up goals for ecological receptors. At HAAF, where ecological receptors are the primary concern, comparator values were established in lieu of specific clean up goals. These comparator values were derived from ambient chemical concentrations and guidelines for placement of dredge materials in wetlands (also based primarily on ambient values). These levels are described in this document as comparator and were discussed and agreed upon by the U.S. Army, regulators and the RART. For the purposes of this document, comparator values can be thought of as clean up goals in the context that COC concentrations that are above their comparator values are considered for remedial action.

Table 1-3 presents the data evaluated for chemicals assessed in this FFS and the selected comparator (this includes values provided by the regulators and target concentrations from the risk assessment) value. Ambient soil concentrations for the BRAC property, HAAF upland soil ambient levels, and San Pablo Bay sediment ambient levels were used in selection of the comparators for selected metals (in some cases the recommended ambient values were superceded by the ER-L values). The ER-Ls (Long et al., 1995) and RWQCB Wetland Surface Sediment Guidelines were evaluated as possible comparators for the selected metals, as well as the selected PAHs, petroleum hydrocarbons, pesticides, and PCBs. Table 1-4 presents the source of the comparator values for both the inboard and upland environments.

Several analytes with HQs that exceeded the criteria for inclusion in this FFS did not have values presented by the regulators. In these cases, the target concentrations from the human health and ecological risk assessment (U.S. Army, 2001) were used to establish a comparator. The target concentrations do not include any type of site utilization factors. All of the analytes considered in this FFS that did not have regulator-presented comparators, were identified as non-bioaccumulators. Since the majority of the selected comparators were based on protection of benthos, non-wildlife receptors were used in selecting the target concentration to be used as the comparator value. The most appropriate target concentrations from the non-wildlife receptors were chosen as the comparator in these cases. Table 1-5 presents all of the analytes assessed in the FFS, and compares the comparators to the target concentrations for estuarine and freshwater receptors.

For each site, the site-specific FFS COPC 95 UCL (or maximum in some cases) concentrations were compared to the comparator values. If the 95 UCL concentration was greater than the comparator value, then the contaminant was considered a COC. COCs are provided in Table 1-6. The site had to have at least one COC to be considered for further evaluation in this FFS. Table 1-7 shows the sites that did not have COCs.

The conceptual model developed for this FFS assumes that where COCs are present, a site would pose a potential human and/or ecological risk if the receptors were exposed to the residual contamination during the development and maturation of the wetland. For each of the remaining sites (Table 1-8), COCs were used to identify areas that require action, develop remedial action objectives, and identify remedial action alternatives.

TABLE 1-1
No Further Action Sites-HI Less than 1.0

Revetment 18/Building 15
Revetment 5
Revetment 28

TABLE 1-2

Summary of Site-Specific FFS Chemicals of Potential Concern

SITES	METALS																
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc
Former Sewage Treatment Plant																	
High Marsh			●		●		●		●			●					●
Subtidal																●	
Intertidal			●				●		●	●		●			●	●	
Building 15/Revetment 18																	
Building 20																	
High Marsh																	●
Intertidal				●													
Building 26																	
Intertidal																	
Building 35/39 Area																	
High Marsh							●										●
Subtidal																	
Intertidal						●	●										●
Building 41 Area																	
High Marsh																	
Subtidal																	
Intertidal																	
Building 82/87/92/94 Area																	
High Marsh			●		●		●										●
Intertidal			●	●	●		●										●
Freshwater			●	●	●		●										
Building 84/90 Area																	
High Marsh																	●
Intertidal															●		●
Building 86																	
High Marsh			●		●	●	●	●	●		●			●			●
Subtidal											●					●	
Intertidal			●	●		●	●		●	●	●			●			●
Perimeter Drainage Ditch (PDD)-Unlined																	
High Marsh									●					●			●
Subtidal																	
Intertidal				●					●					●	●		
Freshwater				●		●			●					●	●		
Perimeter Drainage Ditch Spoils Pile A																	
High Marsh																	●
Intertidal				●													●
Freshwater				●													
Perimeter Drainage Ditch Spoils Pile B																	
High Marsh									●			●					●
Subtidal									●							●	
Intertidal						●			●			●				●	●
Freshwater	●					●			●			●				●	

SITES	PESTICIDES									SVOCs[a]	PCBs[b]	TPH[c]			BTEX[d]	
	alpha-Chlordane	gamma-Chlordane	DDD[e]	DDE[f]	DDT[g]	Dieldrin	Endrin	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Aroclor - 1260	Gasoline[h]	Diesel[i]	JP4[j]	Ethylbenzene	Xylene
Former Sewage Treatment Plant																
High Marsh																
Subtidal		■				■					■□					
Intertidal	●	●■	●	●	●	●■		●	●		●■□					
Building 15/Revetment 18																
Building 20																
High Marsh																
Intertidal																
Building 26																
Intertidal													●			
Building 35/39 Area																
High Marsh																
Subtidal					●											
Intertidal			●	●	●		●									
Building 41 Area																
High Marsh																
Subtidal																
Intertidal													●			
Building 82/87/92/94 Area																
High Marsh																
Intertidal											■□					
Freshwater											■□					
Building 84/90 Area																
High Marsh																
Intertidal											■□					
Building 86																
High Marsh																
Subtidal																
Intertidal																
Perimeter Drainage Ditch (PDD)-Unlined																
High Marsh																
Subtidal					●	■										
Intertidal			●	●	●	●■										
Freshwater			●	●	●	●■										
Perimeter Drainage Ditch Spoils Pile A																
High Marsh																
Intertidal				●	●											
Freshwater				●	●											
Perimeter Drainage Ditch Spoils Pile B																
High Marsh																
Subtidal																
Intertidal			●		●			●								
Freshwater					●											

SITES	POLYNUCLEAR AROMATIC HYDROCARBONS														
	2-Methylnapthalene	Acenapthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo (g,h,i) perylene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Napthalene	Phenanthrene	Pyrene
Former Sewage Treatment Plant															
High Marsh					●■				■						
Subtidal															
Intertidal	●			●	●				●						
Building 15/Revetment 18															
Building 20															
High Marsh															
Intertidal															
Building 26															
Intertidal															
Building 35/39 Area															
High Marsh					●										
Subtidal															
Intertidal	●				●				●		●				
Building 41 Area															
High Marsh		●			●								●		
Subtidal													●		
Intertidal	●	●								●	●		●	●	●
Building 82/87/92/94 Area															
High Marsh															
Intertidal															
Freshwater															
Building 84/90 Area															
High Marsh					●										
Intertidal															
Building 86															
High Marsh				■	●■	■									
Subtidal															
Intertidal	●	●	●	●	●	●		●		●				●	●
Perimeter Drainage Ditch (PDD)-Unlined															
High Marsh															
Subtidal															
Intertidal															
Freshwater						●		●		●					
Perimeter Drainage Ditch Spoils Pile A															
High Marsh															
Intertidal															
Freshwater															
Perimeter Drainage Ditch Spoils Pile B															
High Marsh															
Subtidal															
Intertidal															
Freshwater								●							

TABLE 1-2

Summary of Site-Specific FFS Chemicals of Potential Concern

SITES	METALS																
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc
Perimeter Drainage Ditch Spoils Pile C																	
Intertidal																	
Perimeter Drainage Ditch Spoils Pile D																	
Intertidal																	
Perimeter Drainage Ditch Spoils Pile E																	
Intertidal																	
Perimeter Drainage Ditch Spoils Pile F																	
High Marsh		●■						●		●	●			●			●
Subtidal		■									●						
Intertidal		●■		●		●		●		●	●			●			●
Perimeter Drainage Ditch Spoils Pile G																	
Intertidal																	
Perimeter Drainage Ditch Spoils Pile H																	
Intertidal																	
High Marsh																	
Perimeter Drainage Ditch Spoils Pile I																	
High Marsh																	
Intertidal				●													
Perimeter Drainage Ditch Spoils Pile J																	
High Marsh																	
Intertidal																	
Perimeter Drainage Ditch Spoils Pile K																	
High Marsh																	●
Intertidal										●							
Perimeter Drainage Ditch Spoils Pile L																	
Intertidal			●					●		●							●
High Marsh								●		●							●
Perimeter Drainage Ditch Spoils Pile M																	
Intertidal																	
Freshwater																	
Perimeter Drainage Ditch Spoils Pile N																	
High Marsh										●							
Intertidal										●							
Freshwater										●							
East Levee Generator Pad																	
High Marsh									●								
Intertidal									●								
Onshore Fuel Line - 54-Inch Drain Line Segment																	
Intertidal										●							
Onshore Fuel Line - Hangar Segment																	
High Marsh																	
Intertidal										●							
Onshore Fuel Line - Northern Segment																	

SITES	PESTICIDES									SVOCs[a]	PCBs[b]	TPH[c]			BTEX[d]	
	alpha-Chlordane	gamma-Chlordane	DDD[e]	DDE[f]	DDT[g]	Dieldrin	Endrin	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Aroclor - 1260	Gasoline[h]	Diesel[i]	JP4[j]	Ethylbenzene	Xylene
Perimeter Drainage Ditch Spoils Pile C																
Intertidal				●	●											
Perimeter Drainage Ditch Spoils Pile D																
Intertidal				●	●											
Perimeter Drainage Ditch Spoils Pile E																
Intertidal				●	●											
Perimeter Drainage Ditch Spoils Pile F																
High Marsh																
Subtidal					●											
Intertidal			●	●	●					●						
Perimeter Drainage Ditch Spoils Pile G																
Intertidal				●	●											
Perimeter Drainage Ditch Spoils Pile H																
Intertidal					●											
High Marsh																
Perimeter Drainage Ditch Spoils Pile I																
High Marsh																
Intertidal				●	●											
Perimeter Drainage Ditch Spoils Pile J																
High Marsh																
Intertidal			●	●	●											
Perimeter Drainage Ditch Spoils Pile K																
High Marsh																
Intertidal				●	●											
Perimeter Drainage Ditch Spoils Pile L																
Intertidal				●	●											
High Marsh																
Perimeter Drainage Ditch Spoils Pile M																
Intertidal				●	●											
Freshwater				●	●											
Perimeter Drainage Ditch Spoils Pile N																
High Marsh																
Intertidal				●	●											
Freshwater				●	●											
East Levee Generator Pad																
High Marsh																
Intertidal																
Onshore Fuel Line - 54-Inch Drain Line Segment																
Intertidal												●				
Onshore Fuel Line - Hangar Segment																
High Marsh																
Intertidal												●		●	●	●
Onshore Fuel Line - Northern Segment																

SITES	POLYNUCLEAR AROMATIC HYDROCARBONS														
	2-Methylnapthalene	Acenapthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo (g,h,i) perylene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Napthalene	Phenanthrene	Pyrene
Perimeter Drainage Ditch Spoils Pile C															
Intertidal															
Perimeter Drainage Ditch Spoils Pile D															
Intertidal															
Perimeter Drainage Ditch Spoils Pile E															
Intertidal															
Perimeter Drainage Ditch Spoils Pile F															
High Marsh		●		■	●■	■									
Subtidal															
Intertidal		●	●	●	●	●	●	●		●	●	●		●	●
Perimeter Drainage Ditch Spoils Pile G															
Intertidal															
Perimeter Drainage Ditch Spoils Pile H															
Intertidal					●										
High Marsh					●										
Perimeter Drainage Ditch Spoils Pile I															
High Marsh					●										
Intertidal															
Perimeter Drainage Ditch Spoils Pile J															
High Marsh					●										
Intertidal															
Perimeter Drainage Ditch Spoils Pile K															
High Marsh															
Intertidal															
Perimeter Drainage Ditch Spoils Pile L															
Intertidal															
High Marsh															
Perimeter Drainage Ditch Spoils Pile M															
Intertidal															
Freshwater															
Perimeter Drainage Ditch Spoils Pile N															
High Marsh															
Intertidal															
Freshwater															
East Levee Generator Pad															
High Marsh															
Intertidal															
Onshore Fuel Line - 54-Inch Drain Line Segment															
Intertidal															
Onshore Fuel Line - Hangar Segment															
High Marsh				■	●■	■			■			■			
Intertidal		●	●	●	●			●	●	●	●		●	●	●
Onshore Fuel Line - Northern Segment															

TABLE 1-2

Summary of Site-Specific FFS Chemicals of Potential Concern

SITES	METALS																
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc
High Marsh																	
Intertidal																	
Northwest Runway Area																	
Intertidal		●■		●			●		●			●		●	●		●
High Marsh		■			●		●		●					●			●
Tarmac East of A-5																	
Intertidal																	
Revetment 1																	
High Marsh			●							●							
Subtidal																●	
Intertidal			●			●				●					●		
Revetment 2																	
High Marsh										●							
Intertidal						●				●					●		
Revetment 3																	
High Marsh			●						●		●						
Subtidal			●						●		●						
Intertidal			●						●		●						
Revetment 4																	
High Marsh										●			●				
Intertidal						●				●					●		
Subtidal													●			●	
Revetment 5																	
Revetment 6																	
Intertidal						●											
Revetment 7																	
Intertidal						●				●					●		
High Marsh										●							
Revetment 8																	
High Marsh									●								
Intertidal									●								
Revetment 9																	
High Marsh								●	●		●			●			
Subtidal											●						
Intertidal				●					●	●	●			●			
Revetment 10																	
High Marsh									●								
Intertidal									●						●		
Revetment 11																	
High Marsh									●								●
Intertidal				●		●			●	●							
Revetment 12																	
High Marsh									●								●

SITES	PESTICIDES									SVOCs[a]	PCBs[b]	TPH[c]			BTEX[d]	
	alpha-Chlordane	gamma-Chlordane	DDD[e]	DDE[f]	DDT[g]	Dieldrin	Endrin	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Aroclor - 1260	Gasoline[h]	Diesel[i]	JP4[j]	Ethylbenzene	Xylene
High Marsh																
Intertidal												●				
Northwest Runway Area																
Intertidal				●	●											
High Marsh																
Tarmac East of A-5																
Intertidal																
Revetment 1																
High Marsh																
Subtidal																
Intertidal																
Revetment 2																
High Marsh																
Intertidal																
Revetment 3																
High Marsh																
Subtidal																
Intertidal																
Revetment 4																
High Marsh																
Intertidal																
Subtidal																
Revetment 5																
Revetment 6																
Intertidal												●				
Revetment 7																
Intertidal																
High Marsh																
Revetment 8																
High Marsh																
Intertidal																
Revetment 9																
High Marsh																
Subtidal																
Intertidal																
Revetment 10																
High Marsh																
Intertidal																
Revetment 11																
High Marsh																
Intertidal																
Revetment 12																
High Marsh																

SITES	POLYNUCLEAR AROMATIC HYDROCARBONS														
	2-Methylnapthalene	Acenapthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo (g,h,i) perylene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Napthalene	Phenanthrene	Pyrene
High Marsh					●										
Intertidal	●														
Northwest Runway Area															
Intertidal									●						
High Marsh					●										
Tarmac East of A-5															
Intertidal										●				●	
Revetment 1															
High Marsh					●■										
Subtidal															
Intertidal	●	●	●	●	●			●	●	●	●			●	●
Revetment 2															
High Marsh					●■										
Intertidal		●		●	●			●	●	●	●			●	●
Revetment 3															
High Marsh															
Subtidal															
Intertidal															
Revetment 4															
High Marsh					●										
Intertidal	●	●	●	●	●			●	●	●	●		●	●	●
Subtidal															
Revetment 5															
Revetment 6															
Intertidal	●	●									●		●		
Revetment 7															
Intertidal	●	●	●	●	●			●	●	●	●		●	●	●
High Marsh					●■										
Revetment 8															
High Marsh															
Intertidal															
Revetment 9															
High Marsh															
Subtidal															
Intertidal															
Revetment 10															
High Marsh															
Intertidal															
Revetment 11															
High Marsh															
Intertidal															
Revetment 12															
High Marsh															

TABLE 1-2

Summary of Site-Specific FFS Chemicals of Potential Concern

SITES	METALS																	PESTICIDES								
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc	alpha-Chlordane	gamma-Chlordane	DDD[e]	DDE[f]	DDT[g]	Dieldrin	Endrin	Endrin Aldehyde	Endosulfan Sulfate
Intertidal									●																	
Revetment 13																										
High Marsh										●																
Subtidal										●																
Intertidal						●				●																
Revetment 14																										
High Marsh									●				●													
Subtidal													●													
Intertidal									●				●													
Revetment 15																										
High Marsh																										
Intertidal						●				●																
Revetment 16																										
High Marsh			●						●																	
Subtidal			●																							
Intertidal			●						●																	
Revetment 17																										
High Marsh									●																	
Intertidal									●																	
Revetment 19																										
High Marsh			●						●																	
Subtidal			●																							
Intertidal			●			●			●	●																
Revetment 20																										
Intertidal						●				●																
Revetment 21																										
High Marsh									●																	
Intertidal									●																	
Revetment 22																										
Intertidal																										
Revetment 23																										
High Marsh									●								●									
Intertidal									●	●																
Revetment 24																										
High Marsh																										
Intertidal																										
Revetment 25																										
High Marsh			●																							
Intertidal			●																							
Revetment 26																										
High Marsh			●		●				●		●															
Subtidal			●		●						●															
Intertidal			●						●		●															

SITES	SVOCs[a]	PCBs[b]	TPH[c]			BTEX[d]		POLYNUCLEAR AROMATIC HYDROCARBONS														
	Dibenzofuran	Aroclor - 1260	Gasoline[h]	Diesel[i]	JP4[j]	Ethylbenzene	Xylene	2-Methylnapthalene	Acenapthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo (g,h,i) perylene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Napthalene	Phenanthrene	Pyrene
Intertidal																						
Revetment 13																						
High Marsh												●■										
Subtidal																						
Intertidal									●	●	●	●			●	●	●	●			●	●
Revetment 14																						
High Marsh																						
Subtidal																						
Intertidal				●																		
Revetment 15																						
High Marsh												●										
Intertidal																						
Revetment 16																						
High Marsh																						
Subtidal																						
Intertidal																						
Revetment 17																						
High Marsh																						
Intertidal																						
Revetment 19																						
High Marsh												●■										
Subtidal			●																			
Intertidal			●	●				●	●	●	●	●			●	●	●	●			●	●
Revetment 20																						
Intertidal											●				●		●				●	●
Revetment 21																						
High Marsh																						
Intertidal			●	●				●										●				
Revetment 22																						
Intertidal			●	●				●	●									●				
Revetment 23																						
High Marsh																						
Intertidal																						
Revetment 24																						
High Marsh												●										
Intertidal											●					●	●				●	●
Revetment 25																						
High Marsh																						
Intertidal				●																		
Revetment 26																						
High Marsh																						
Subtidal																						
Intertidal			●	●																		

TABLE 1-2

Summary of Site-Specific FFS Chemicals of Potential Concern

SITES	METALS																	PESTICIDES									SVOCs[a]	PCBs[b]	TPH[c]			BTEX[d]		POLYNUCLEAR AROMATIC HYDROCARBONS														
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Zinc	alpha-Chlordane	gamma-Chlordane	DDD[e]	DDE[f]	DDT[g]	Dieldrin	Endrin	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Aroclor - 1260	Gasoline[h]	Diesel[i]	JP4[j]	Ethylbenzene	Xylene	2-Methylnapthalene	Acenapthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo (g,h,i) perylene	Chrysene	Dibenz (a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Napthalene	Phenanthrene	Pyrene
Revetment 27																																																
Intertidal										●																																	●				●	●
Revetment 28																																																

[a] Semivolatile organic compounds.
[b] Polychlorinated biphenyls.
[c] Total petroleum hydrocarbons.
[d] Benzene, toluene, ethylbenzene and xylenes.
[e] 4,4'-dichlorodiphenyldichloroethane.
[f] 4,4'-dichlorodiphenyldichloroethene.
[g] 4,4'-dichlorodiphenyltrichloroethane.
[h] Analytes within the gasoline range of total petroleum hydrocarbons.
[i] Analytes within the diesel range of total petroleum hydrocarbons.
[j] Analytes within the JP4 range of total petroleum hydrocarbons.

● Denotes site and constituent with ecological receptor(s) having one or more Hazard Quotient > 1.0.
■ Denotes site and constituent with human health carcinogenic risk > 1.0 E -06.
□ Denotes site and constituent with human health noncarcinogenic Hazard Quotient > 1.0.

TABLE 1-3
Selected Comparator Values
Focused Feasibility Study Evaluation

Contaminant	BRAC[a] Soil (mg/kg)[b]	Upland Soil (mg/kg)	Bay Sediment (mg/kg)	ERL[c] (mg/kg)	RWQCB[d] Wetland Surface Sediment Guidelines[e] (mg/kg)	RART[f] Values (mg/kg)	Selected Comparator: Inboard Sites (mg/kg)	Selected Comparator: Upland Sites (mg/kg)	Selected Comparator: Target Concentrations (mg/kg)
Metals									
Antimony	0.37	1.2					0.37	1.2	
Arsenic	16.7	4.7	15.7	8.2	15.3		16.7	15.3	
Barium	190	217	188 (i)				190	217	
Beryllium	1.0	0.72	1.68 (i)				1	0.72	
Boron	36.9	3.6	71.6 (i)				36.9	3.6	
Cadmium	0.64	(g)	0.33	1.2	0.33	1.2	1.2		
Chromium	107	40.2	129 (j)	81	112	112	112	112	
Cobalt	27.6	14.4	26.7 (i)				27.6	14.4	
Copper	48.8	12.4	67.45	34	68.1	68.1	68.1	68.1	
Lead	30.7	8.3	38.7	46.7	43.2	43.2	43.2	43.2	
Manganese	943	943 (h)	838				943	943	
Total Mercury	0.42	0.24	0.43	0.15	0.43	0.43	0.43	0.43	
Molybdenum	(g)	(g)							4.8
Nickel	113	37.2	116 (i)	20.9	112		113	112	
Selenium	(g)	(g),(h)	0.66 (i)		0.64		0.64		
Silver	0.21	(g)	0.42	1	0.58		1	1	
Zinc	92.0	47	160 (i)	150	158		158	158	
Polynuclear Aromatic Hydrocarbons (PAH)									
PAHs, total				4.022	3.39		4.022	4.022	
2-Methylnaphthalene					0.0194		0.0194	0.0194	
Acenaphthene				0.016	0.026		0.026	0.026	
Anthracene				0.0853	0.088		0.088	0.088	
Benz(a)anthracene				0.261	0.412		0.412	0.412	
Benzo(a)pyrene				0.43	0.371		0.43	0.43	
Benzo(b)fluoranthene					0.371		0.371	0.371	
Benzo(g,h,i)perylene					0.310		0.31	0.31	
Chrysene				0.384	0.289		0.384	0.384	
Dibenz(a,h)anthracene				0.0634	0.0327		0.0634	0.0634	
Fluoranthene				0.6	0.514		0.6	0.6	
Fluorene				0.019	0.0253		0.0253	0.0253	
Indeno(1,2,3-c,d)pyrene					0.382		0.382	0.382	
Naphthalene				0.16	0.0558		0.16	0.16	
Phenanthrene				0.24	0.237		0.24	0.24	
Pyrene				0.665	0.665		0.665	0.665	

TABLE 1-3
Selected Comparator Values
Focused Feasibility Study Evaluation

Contaminant	BRAC[a] Soil (mg/kg)[b]	Upland Soil (mg/kg)	Bay Sediment (mg/kg)	ERL[c] (mg/kg)	RWQCB[d] Wetland Surface Sediment Guidelines[e] (mg/kg)	RART[f] Values (mg/kg)	Selected Comparator: Inboard Sites (mg/kg)	Selected Comparator: Upland Sites (mg/kg)	Selected Comparator: Target Concentrations (mg/kg)
Petroleum Hydrocarbons									
Diesel/Motor Oil						144[k]	144	144	
Gasoline/JP-4						12[k]	12	12	
Pesticides/Polychlorinated Biphenyls (PCB)									
DDTs[l], sum				0.00158	0.007	0.086	0.007	0.007	
Chlordanes, sum				0.0005	0.0023 (TEL)[m]	0.0023	0.0023	0.0023	
Dieldrin				0.00002	0.00072 (TEL)		0.00072	0.00072	
PCBs, sum				0.0227	0.0227 (ER-L)[n]	0.36	0.36	0.36	0.36
Endrin									0.0215
Endrin Aldehyde									0.0215
Endosulfan Sulfate									0.00286
Volatile Organic Compounds									
Ethylbenzene									0.004
Xylenes (total)									0.04
Semivolatile Organic Compounds									
Dibenzofuran									0.11

[a] Base Realignment and Closure.
[b] Milligrams per kilogram.
[c] Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder, 1995, "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments," *Environmental Management*, 19:81-97.
[d] Regional Water Quality Control Board.
[e] Ambient values unless noted otherwise.
[f] Regulatory Agencies and Resource Trustees.
[g] Less than 10% of ambient samples had detectable concentrations of metal; therefore, the 95th quantile was not estimated and no ambient comparator was established. This metal is assumed to be above ambient levels if detected in more than 5% of samples at a site associated with this ambient dataset.
[h] No data available for metal from General Services Administration (upland) ambient dataset; soil ambient level from inboard BRAC sites used instead.
[i] No data available for metal from bay ambient dataset; high marsh sediment ambient values provided for risk management comparison.
[j] Values not used for this comparison; values maintained for subsequent risk management comparison.
[k] Based on cleanup values for sediment for the Saltwater Ecological Protection Zone at the Presidio of San Francisco.
[l] Dichlorodiphenyltrichloroethane.
[m] Threshold Effects Level.
[n] Effects range-low.

TABLE 1-4
Reference for Comparators in the FFS

	BRAC[a] Ambient Soil	Hamilton Ambient Upland Soil[b]	San Pablo Bay Sediment[c]	Effects Range-Low[d]	RWQCB[e] Wetland Surface Sediment Guidelines	RART[f] Values	Non-Wildlife Target Concentrations[b]
Metals							
Antimony	I	U					
Arsenic	I				U		
Barium	I	U					
Beryllium	I	U					
Boron	I	U					
Cadmium				I U		I	
Chromium						IU	
Cobalt	I	U					
Copper					IU	IU	
Lead					IU	IU	
Manganese	I U						
Mercury			IU			IU	
Molybdenum							I U
Nickel	I				U		
Selenium					I U[g]		
Silver				I U			
Zinc					IU		
Pesticides							
Chlordanes, sum					I U	I U	
DDTs[h], sum					I U		
Dieldrin					I U		
Endrin							I U
Endrin Aldehyde							I U
Endosulfan Sulfate							I U
PCBs[i], sum					I U		
Volatile Organic Compounds							
Ethylbenzene							I U
Xylenes (total)							I U
Semivolatile Organic Compounds (including PAHs[c,j])							
PAHs, total				I U			
2-Methylnaphthalene				I U			
Acenaphthene					I U		
Anthracene					I U		
Benz(a)anthracene					I U		
Benzo(a)pyrene				I U			
Benzo(b)fluoranthene					I U		
Benzo(g,h,i)perylene					I U		
Chrysene				I U			
Dibenz(a,h)anthracene				I U			
Dibenzofuran							I U

TABLE 1-4
Reference for Comparators in the FFS

	BRAC[a] Ambient Soil	Hamilton Ambient Upland Soil[b]	San Pablo Bay Sediment[c]	Effects Range-Low[d]	RWQCB[e] Wetland Surface Sediment Guidelines	RART[f] Values	Non-Wildlife Target Concentrations[b]
Fluoranthene				I U			
Fluorene					I U		
Indeno(1,2,3-cd)pyrene					I U		
Naphthalene				I U			
Phenanthrene				I U			
Pyrene				I U	I U		
Total Petroleum Hydrocarbons							
TPH[k] - gasoline range						I U	
TPH - diesel range						I U	
TPH - aviation fuel (JP4)						I U	

I = Used as inboard comparator
U = Used as upland comparator (Northwest Runway only)
[a] Base Realignment and Closure.
[b] IT Corporation (IT), 2001, *Human Health and Ecological Risk Assessment, BRAC Property, Hamilton Army Airfield, Novato, California,* Concord, California.
[c] San Francisco Estuary Institute
[d] Effects Range-Low; Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder, 1995, "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments," *Environmental Management*, 19:81-97.
[e] Regional Water Quality Control Board.
[f] Regulatory Agency and Resource Trustees.
[g] No upland comparator provided by RART, inboard comparator used.
[h] Dichlorodiphenyltrichloroethane.
[i] Polychlorinated biphenyls.
[j] Polynuclear aromatic hydrocarbons.
[k] Total petroleum hydrocarbons.

TABLE 1-5
Target Concentrations vs. Comparators
Focused Feasibility Study Evaluation

Chemical	Inboard/Upland Comparator Value[a] (mg/kg)	Effects Range-Low[b] (mg/kg)	RWQCB Wetland Surface Sediment Guidelines[c]	RART Values	ESTUARINE RECEPTORS: Subtidal Marsh: Green Algae (mg/kg in sediment, dry weight)	Bay Shrimp (mg/kg in sediment, dry weight)	Salmonid (mg/kg in sediment, dry weight)	Northern Anchovy (mg/kg in sediment, dry weight)	Double-Crested Cormorant (mg/kg in sediment, dry weight)	Intertidal Marsh: Amphipod (mg/kg in sediment, dry weight)	Black Rail (mg/kg in sediment, dry weight)	California Clapper Rail (mg/kg in sediment, dry weight)	High Marsh: Pickleweed (mg/kg[a] in sediment, dry weight)	Salt Marsh Harvest Mouse (mg/kg in sediment, dry weight)	FRESHWATER RECEPTORS: Algae (mg/kg in sediment, dry weight)	Benthic Invertebrate (mg/kg in sediment, dry weight)	Mosquitofish (mg/kg in sediment, dry weight)	Common Snipe (mg/kg in sediment, dry weight)	Great Blue Heron (mg/kg in sediment, dry weight)
METALS																			
Arsenic	1.7E+01 / 1.5E+01	8.2E+00	1.5E+01		**1.7E+02**	**1.7E+02**	**1.7E+02**	**5.0E+03**	**1.0E+04**	7.2E+00	**4.3E+01**	**1.3E+02**	1.0E+01	1.4E+01	**2.1E+02**	5.9E+00	**2.1E+02**	**2.7E+02**	**1.2E+04**
Barium	1.9E+02 / 2.2E+02				**3.1E+02**	**5.8E+03**	**5.8E+03**	**1.8E+05**	**4.3E+04**	1.4E+00	1.4E+02	**4.3E+02**	**5.0E+02**	8.8E+01	1.4E+00	6.7E+01	1.4E+00	**1.1E+03**	**4.9E+04**
Beryllium	1.0E+00 / 7.2E-01				no data	no data	**1.3E+01**	**3.9E+02**	no data	3.6E-01	no data	no data	**1.0E+01**	**9.9E+02**	3.7E-02	3.6E-01	3.7E-02	**no data**	no data
Boron	3.7E+01 / 3.6E+00				no data	**5.0E+01**	**1.5E+04**	**1.5E+04**	**5.9E+03**	no data	2.9E+01	**8.6E+01**	5.0E-01	9.6E+00	no data	1.9E+00	**no data**	**1.6E+02**	**7.1E+03**
Cadmium	1.2E+00 / NA	1.2E+00	3.3E-01	1.2E+00	**5.6E+00**	**5.6E+00**	**5.6E+00**	**1.7E+02**	**8.0E+02**	6.8E-01	**2.1E+00**	**6.3E+00**	**4.0E+00**	**2.6E+01**	4.0E-01	5.8E-01	4.0E-01	**4.0E+01**	**3.1E+01**
Chromium	1.1E+02 / 1.1E+02	8.1E+01	1.1E+02	1.1E+02	**6.5E+03**	**6.5E+03**	**6.5E+03**	**2.0E+05**	**1.1E+03**	5.2E+01	1.0E+01	3.1E+01	2.5E-02	**4.0E+04**	**1.4E+03**	3.6E+01	**1.4E+03**	2.8E+01	**1.3E+03**
Cobalt	2.8E+01 / 1.4E+01				**7.4E+01**	**1.8E+03**	**2.0E+04**	**6.0E+05**	no data	2.0E+01	no data	no data	2.0E+01	1.6E+01	**6.6E+02**	**6.6E+02**	**6.6E+02**	**no data**	no data
Copper	6.8E+01 / 6.8E+01	3.4E+01	6.8E+01	6.8E+01	**7.6E+01**	**7.6E+01**	**7.6E+01**	**2.3E+03**	**2.8E+03**	1.9E+01	5.8E+00	1.8E+01	**1.0E+02**	4.2E+00	6.7E+01	2.8E+01	6.7E+01	**7.5E+01**	**3.3E+03**
Lead	4.3E+01 / 4.3E+01	4.7E+01	4.3E+01	4.3E+01	**2.3E+03**	**2.3E+03**	**2.3E+03**	**6.9E+04**	**3.1E+02**	3.0E+01	2.3E+00	6.8E+00	**5.0E+01**	**2.0E+03**	**2.1E+02**	3.5E+01	**2.1E+02**	8.2E+00	**3.6E+02**
Manganese	9.4E+02 / 9.4E+02				5.5E+02	**7.3E+04**	**2.0E+04**	**6.1E+05**	**1.3E+06**	4.6E-01	**4.1E+03**	**1.2E+04**	5.0E+02	2.9E+02	1.6E+02	6.3E+02	**6.6E+03**	**3.7E+04**	**1.7E+06**
Mercury	4.3E-01 / 4.3E-01	1.5E-01	4.3E-01	4.3E-01	**4.7E+00**	**4.7E+00**	**4.7E+00**	**1.4E+02**	1.8E-01	1.3E-01	**5.5E-01**	**1.7E+00**	3.0E-01	**1.9E+00**	**1.2E+00**	1.7E-01	**1.2E+00**	6.3E-03	8.1E-02
Molybdenum	4.8E+00 / NA				**1.7E+01**	**1.7E+01**	4.9E-02	1.5E+00	**4.8E+03**	4.8E+00	**5.9E+01**	**1.8E+02**	2.0E+00	**6.0E+00**	**1.6E+01**	**1.6E+01**	**1.6E+01**	**1.2E+02**	**3.4E+03**
Nickel	1.1E+02 / 1.1E+02	2.1E+01	1.1E+02		**2.5E+02**	**2.5E+02**	**2.5E+02**	**7.6E+03**	**1.9E+04**	1.6E+01	**1.5E+02**	**4.6E+02**	3.0E+01	3.8E+01	**4.8E+02**	1.8E+01	**4.8E+02**	**5.2E+02**	**2.3E+04**
Silver	1.0E+00 / 1.0E+00	1.0E+00	5.8E-01		1.6E-01	1.6E-01	1.6E-01	**4.9E+00**	**2.5E+04**	7.3E-01	**4.1E+02**	**1.2E+03**	**2.0E+00**	**4.5E+02**	8.8E-02	**4.5E+00**	8.8E-02	**6.5E+02**	**2.3E+04**
Thallium	1.0E+00 / NA				**1.1E+02**	**1.1E+02**	**1.1E+02**	**3.2E+03**	no data	no data	no data	no data	1.0E+00	**1.6E+00**	**6.0E+00**	**6.0E+00**	**6.0E+00**	no data	no data
Vanadium	1.2E+02 / 3.9E+01				**2.3E+04**	**2.3E+03**	4.7E+00	**1.4E+02**	**2.5E+03**	2.7E+01	2.3E+01	7.0E+01	2.0E+00	7.8E+01	1.7E+01	1.7E+01	1.7E+01	6.8E+01	**3.0E+03**
Zinc	1.6E+02 / 1.6E+02	1.5E+02	1.6E+02		**3.8E+03**	**3.8E+03**	**3.8E+03**	**1.1E+05**	**1.4E+04**	1.2E+02	4.2E+01	1.3E+02	5.0E+01	**4.1E+02**	**1.7E+03**	**9.8E+02**	**1.7E+03**	**3.7E+02**	**9.9E+03**
PESTICIDES																			
Chlordanes, sum	2.3E-03 / 2.3E-03	5.0E-04	2.3E-03	2.3E-03															
alpha-Chlordane					**6.3E-01**	**6.3E-01**	**6.3E-01**	**1.9E+01**	**1.5E+01**	5.0E-04	**5.2E-01**	**1.6E+00**	no data	**1.9E+02**	**2.0E-01**	**4.5E-03**	**2.0E-01**	**1.0E+00**	**8.1E+00**
gamma-Chlordane					**1.2E-01**	**1.2E-01**	**1.2E-01**	**3.6E+00**	**2.8E-02**	5.0E-04	**1.4E-01**	**4.1E-01**	no data	**1.9E+02**	**3.9E-02**	**4.5E-03**	**3.9E-02**	**2.7E-01**	**3.1E-01**
DDTs, sum	7.0E-03 / 7.0E.03	1.6E-03	7.0E-03	8.6E-02															
4,4'-DDD					**2.5E+00**	**2.5E+00**	**2.5E+00**	**7.5E+01**	**1.3E-01**	1.2E-03	1.2E-03	3.7E-03	no data	**1.3E+02**	**1.9E-01**	3.5E-03	**1.9E-01**	2.4E-03	4.6E-03
4,4'-DDE					**6.1E+01**	**6.1E+01**	**6.1E+01**	**1.8E+03**	**1.4E-01**	2.1E-03	5.0E-04	1.5E-03	no data	**1.7E+02**	**1.4E+03**	1.4E-03	**1.4E+03**	2.9E-03	4.7E-03
4,4'-DDT					**2.6E-01**	**2.6E-01**	**2.6E-01**	**7.7E+00**	**3.9E-02**	1.2E-03	6.6E-03	**2.0E-02**	**1.0E+01**	**1.6E+02**	**7.7E-02**	7.0E-03	**7.7E-02**	**7.2E-03**	2.2E-03
Dieldrin	7.2E-04 / 7.2E-04	2.0E-05	7.2E-04		**3.6E-02**	**3.6E-02**	**3.6E-02**	**1.1E+00**	**1.6E-02**	2.0E-05	**8.5E-03**	**2.6E-02**	**1.0E+01**	**1.4E+00**	**3.2E-01**	**2.0E-03**	**3.2E-01**	**1.7E-02**	**1.5E-02**
Endrin Aldehyde	2.2E-02 / 2.2E-02				2.1E-02	2.1E-02	2.1E-02	**6.4E-01**	1.0E-02	**5.6E-02**	1.8E-04	5.4E-04	no data	**3.8E+00**	**1.0E-01**	2.7E-03	**1.0E-01**	3.5E-04	**2.2E-01**
Endosulfan Sulfate	2.9E-03 / 2.9E-03				**9.5E-03**	**9.5E-03**	**9.5E-03**	**2.9E-01**	**1.3E+04**	**2.9E-03**	**1.8E+02**	**5.4E+02**	no data	**4.6E+00**	**1.8E-02**	**1.8E-02**	**1.8E-02**	**3.0E+02**	**1.5E+04**
TOTAL PETROLEUM HYDROCARBONS																			
TPH - gasoline range	1.2E+01 / 1.2E+01			1.2E+01	**4.4E+02**	**4.4E+02**	**4.4E+02**	**1.3E+04**	no data	1.2E+01	no data	no data	no data	**9.5E+03**	**1.3E+02**	1.2E+01	**1.3E+02**	no data	no data
TPH - diesel range	1.4E+02 / 1.4E+02			1.4E+02	**8.1E+03**	**8.1E+03**	**8.1E+03**	**2.4E+05**	**3.1E+04**	1.4E+02	**1.5E+03**	**4.6E+03**	no data	**2.8E+04**	**2.4E+03**	1.4E+02	**2.4E+03**	**2.7E+03**	**6.9E+03**
TPH - aviation fuel (JP4)	1.2E+01 / 1.2E+01			1.2E+01	**4.4E+02**	**4.4E+02**	**4.4E+02**	**1.3E+04**	no data	1.2E+01	no data	no data	no data	**9.5E+03**	**1.3E+02**	1.2E+01	**1.3E+02**	no data	no data
VOLATILE ORGANIC COMPOUNDS																			
Ethylbenzene	4.0E-03 / 4.0E-03				**5.2E-01**	**5.2E-01**	**5.2E-01**	**1.6E+01**	no data	4.0E-03	no data	no data	no data	**9.2E+01**	**1.6E+01**	**2.6E-01**	**1.6E+01**	no data	no data
Xylenes (total)	4.0E-02 / 4.0E-02				**4.5E+02**	**3.3E+00**	**4.0E+01**	**1.2E+03**	**2.1E+05**	4.0E-02	**3.5E+03**	**1.1E+04**	**2.5E+01**	**8.7E+03**	**4.7E-01**	2.5E-02	**4.7E-01**	**5.2E+03**	**2.6E+02**
SEMIVOLATILE ORGANIC COMPOUNDS (Including PAHs)																			
PAHs, total	4.0E+00 / 4.0E+00	4.0E+00	3.4E+00																
2-Methylnaphthalene	7.0E-02 / 7.0E-02		1.9E-02		no data	no data	no data	no data	no data	2.0E-02	no data	no data	no data	**2.0E+03**	**1.6E+01**	1.5E-02	**1.6E+01**	no data	no data
Acenaphthene	2.6E-02 / 2.6E-02	1.6E-02	2.6E-02		**6.9E+00**	**6.9E+00**	**6.9E+00**	**2.1E+02**	**3.6E+03**	6.7E-03	**2.2E+03**	**6.7E+03**	**6.3E-01**	**3.9E+03**	**3.6E+00**	**6.2E-01**	**3.6E+00**	**3.8E+03**	**1.4E+02**
Anthracene	8.8E-02 / 8.8E-02	8.5E-02	8.8E-02		no data	no data	no data	no data	no data	4.7E-02	no data	no data	no data	**4.9E+04**	**6.1E-01**	1.0E-02	**1.5E+01**	no data	no data
Benzo(a)anthracene	4.1E-01 / 4.1E-01	2.6E-01	4.1E-01		no data	no data	no data	no data	no data	7.5E-02	no data	no data	no data	**1.2E+02**	no data	1.6E-02	no data	no data	no data
Benzo(a)pyrene	4.3E-01 / 4.3E-01	4.3E-01	3.7E-01		no data	no data	no data	no data	no data	8.9E-02	no data	no data	1.0E-02	**1.5E+02**	4.2E-01	3.2E-02	4.2E-01	no data	no data
Benzo(b)fluoranthene	3.7E-01 / 3.7E-01		3.7E-01		no data	no data	no data	no data	no data	**1.8E+00**	no data	no data	no data	**1.5E+02**	no data	3.2E-02	no data	no data	no data
Benzo(g,h,i)perylene	3.1E-01 / 3.1E-01		3.1E-01		no data	no data	no data	no data	no data	**7.2E-01**	no data	no data	no data	**1.9E+02**	no data	3.2E-02	no data	no data	no data
Chrysene	3.8E-01 / 3.8E-01	3.8E-01	2.9E-01		no data	no data	no data	no data	no data	1.1E-01	no data	no data	no data	**1.2E+02**	no data	2.7E-02	no data	no data	no data
Dibenz(a,h)anthracene	6.3E-02 / 6.3E-02	6.3E-02	3.3E-02		no data	no data	no data	no data	no data	6.2E-03	no data	no data	no data	**1.8E+02**	no data	3.2E-02	no data	no data	no data
Dibenzofuran	1.1E-01 / 1.1E-01				**4.7E+01**	**4.2E+01**	**2.3E+01**	**6.8E+02**	no data	1.1E-01	no data	no data	no data	**3.0E+02**	**1.4E+01**	**2.0E+00**	**6.7E+00**	no data	no data
Fluoranthene	6.0E-01 / 6.0E-01	6.0E-01	5.1E-01		**1.8E+01**	**1.8E+01**	**1.8E+01**	**5.3E+02**	no data	1.1E-01	no data	no data	no data	**9.6E+03**	**1.3E+02**	3.1E-02	**1.3E+02**	no data	no data
Fluorene	2.5E-02 / 2.5E-02	1.9E-02	2.5E-02		no data	no data	no data	no data	**3.1E+03**	1.9E-02	**1.5E+03**	**4.6E+03**	no data	**3.9E+03**	**5.0E+00**	1.0E-02	**5.0E+00**	**2.7E+03**	**6.2E+02**
Indeno(1,2,3-cd)pyrene	3.8E-01 / 3.8E-01		3.8E-01		no data	no data	no data	no data	no data	**6.9E-01**	no data	no data	no data	**1.7E+02**	no data	1.7E-02	no data	no data	no data

TABLE 1-5
Target Concentrations vs. Comparators
Focused Feasibility Study Evaluation

					ESTUARINE RECEPTORS										FRESHWATER RECEPTORS				
					Subtidal Marsh					Intertidal Marsh			High Marsh						
Chemical	Inboard/Upland Comparator Value[a] (mg/kg)	Effects Range-Low[b] (mg/kg)	RWQCB Wetland Surface Sediment Guidelines[c]	RART Values	Green Algae (mg/kg in sediment, dry weight)	Bay Shrimp (mg/kg in sediment, dry weight)	Salmonid (mg/kg in sediment, dry weight)	Northern Anchovy (mg/kg in sediment, dry weight)	Double-Crested Cormorant (mg/kg in sediment, dry weight)	Amphipod (mg/kg in sediment, dry weight)	Black Rail (mg/kg in sediment, dry weight)	California Clapper Rail (mg/kg in sediment, dry weight)	Pickleweed (mg/kg[a] in sediment, dry weight)	Salt Marsh Harvest Mouse (mg/kg in sediment, dry weight)	Algae (mg/kg in sediment, dry weight)	Benthic Invertebrate (mg/kg in sediment, dry weight)	Mosquitofish (mg/kg in sediment, dry weight)	Common Snipe (mg/kg in sediment, dry weight)	Great Blue Heron (mg/kg in sediment, dry weight)
Naphthalene	1.6E-01 / 1.6E-01	1.6E-01	5.6E-02		**4.7E+00**	**4.7E+00**	**4.7E+00**	**1.4E+02**	no data	3.5E-02	no data	no data	**2.5E+00**	**7.9E+02**	**3.7E+00**	1.5E-02	**3.7E+00**	no data	no data
Phenanthrene	2.4E-01 / 2.4E-01	2.4E-01	2.4E-01		no data	no data	no data	no data	no data	8.7E-02	no data	no data	no data	**4.9E+01**	no data	1.9E-02	no data	no data	no data
Pyrene	6.7E-01 / 6.7E-01	6.7E-01	6.7E-01		no data	no data	no data	no data	no data	1.5E-01	no data	no data	no data	**5.8E+03**	no data	4.4E-02	no data	no data	no data

[a] Upland value used for Northwest Runway, only.
[b] Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder, 1995, "Indcidence of Adverse Biological Effects Within Ranges of Chemicals Concentrations in Marin and Estuarine Sediment," *Environmental Management* , 19:81-97.
[c] Ambient values unless noted otherwise.
PAH = polynuclear aromatic hydrocarbons
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon
NA = Not applicable
RWQCB = Regional Water Quality Control Board
RART = Regulatory Agencies and Resource Trustees
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
Concentrations in **BOLD** indicate target concentrations that exceed comparator values.

TABLE 1-6

Summary of FFS Chemicals of Concern

SITES	METALS															PESTICIDES								SVOC[1]	TPH[2]			BTEX[3]		POLYNUCLEAR AROMATIC HYDROCARBONS															
	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc	alpha-Chlordane	**gamma-Chlordane**	DDD[4]	DDE[5]	DDT[6]	**Dieldrin**	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Gasoline[7]	Diesel[8]	JP4[9]	Ethylbenzene	Xylene	**Total PAHs[10]**	2-Methylnapthalene	Acenapthene	Anthracene	**Benz(a)anthracene**	**Benzo(a)pyrene**	**Benzo(b)fluoranthene**	Benzo(g,h,i)perylene	Chrysene	**Dibenz(a,h)anthracene**	Fluoranthene	Fluorene	**Indeno(1,2,3-cd)pyrene**	Napthalene	Phenanthrene	Pyrene
Former Sewage Treatment Plant																																													
High Marsh																																													
Subtidal																	■				■																								
Intertidal																◆	◆■	◆	◆	◆	■◆		◆																						
Building 20	No Chemicals of Concern																																												
Building 26																																													
Intertidal																										◆																			
Building 35/39 Area																																													
Subtidal																				◆																									
Intertidal																		◆	◆	◆																									
Building 41 Area																																													
High Marsh																														◆		◆			e			n					◆		
Subtidal																														◆													◆		
Intertidal																										◆				◆	◆	◆						n		◆	◆		◆	◆	e
Building 82/87/92/94 Area																																													
High Marsh		◆																																											
Intertidal		◆	◆																																										
Freshwater		◆	◆																																										
Building 84/90 Area	No Chemicals of Concern																																												
Building 86																																													
High Marsh					◆	◆																								◆				■	■◆	■									
Intertidal			◆		◆	◆			◆																					◆	e	◆	◆	◆	◆	◆		◆		◆				◆	◆
Perimeter Drainage Ditch (PDD)-Unlined																																													
Subtidal																				◆	■																								
Intertidal			◆															◆	◆	◆	◆■																								
Freshwater			◆															◆	◆	◆	◆■																								
Perimeter Drainage Ditch Spoils Pile A																																													
High Marsh															m◆																														
Intertidal			m◆												m◆				m◆	m◆																									
Freshwater			m◆																m◆	m◆																									
Perimeter Drainage Ditch Spoils Pile B																																													
High Marsh								◆			◆				◆																														
Subtidal								◆					m◆																																
Intertidal					◆			◆			◆		m◆		◆					◆		m◆																							
Freshwater					◆			◆			◆		m◆		◆					◆																									
Perimeter Drainage Ditch Spoils Pile C	No Chemicals of Concern																																												
Perimeter Drainage Ditch Spoils Pile D																																													
Intertidal																			m◆	m◆																									
Perimeter Drainage Ditch Spoils Pile E																																													
Intertidal																			◆	◆				m◆						◆		m◆	m◆	m◆	m◆	m◆	m◆	m◆		m◆	m◆	m◆		m◆	m◆

TABLE 1-6

Summary of FFS Chemicals of Concern

METALS

SITES	**Arsenic**	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc
Perimeter Drainage Ditch Spoils Pile F															
High Marsh	m◆						m◆		m◆	m◆		m◆			m◆
Subtidal	m■									m◆					
Intertidal	m◆■		m◆		m◆		m◆		m◆	m◆		m◆			m◆
Perimeter Drainage Ditch Spoils Pile G															
Intertidal															
Perimeter Drainage Ditch Spoils Pile H	**No Chemicals of Concern**														
Perimeter Drainage Ditch Spoils Pile I															
Intertidal			m◆												
Perimeter Drainage Ditch Spoils Pile J															
Intertidal															
Perimeter Drainage Ditch Spoils Pile K															
Intertidal															
Perimeter Drainage Ditch Spoils Pile L															
Intertidal		m◆					m◆		m◆						m◆
High Marsh							m◆		m◆						m◆
Perimeter Drainage Ditch Spoils Pile M															
Intertidal															
Perimeter Drainage Ditch Spoils Pile N															
High Marsh									m◆						
Intertidal									m◆						
Freshwater									m◆						
East Levee Generator Pad	**No Chemicals of Concern**														
Onshore Fuel Line - 54-Inch Drain Line Segment															
Intertidal															
Onshore Fuel Line - Hangar Segment															
High Marsh															
Intertidal															
Onshore Fuel Line - Northern Segment															
Intertidal															
Northwest Runway Area															
Intertidal			◆												
High Marsh				◆											
Tarmac East of Outparcel A-5	**No Chemicals of Concern**														
Revetment 1															
High Marsh		◆							m◆						
Intertidal		◆			m◆				m◆						
Revetment 2															
High Marsh									◆						
Intertidal					m◆				◆						
Revetment 3															
High Marsh		m◆						m◆		m◆					
Subtidal		m◆						m◆		m◆					
Intertidal		m◆						m◆		m◆					

PESTICIDES / SVOC[1] / TPH[2] / BTEX[3]

SITES	alpha-Chlordane	**gamma-Chlordane**	DDD[4]	DDE[5]	DDT[6]	**Dieldrin**	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Gasoline[7]	Diesel[8]	JP4[9]	Ethylbenzene	Xylene
Perimeter Drainage Ditch Spoils Pile F														
High Marsh														
Subtidal					m◆									
Intertidal			m◆	m◆	m◆				m◆					
Perimeter Drainage Ditch Spoils Pile G														
Intertidal				m◆	m◆									
Perimeter Drainage Ditch Spoils Pile H														
Perimeter Drainage Ditch Spoils Pile I														
Intertidal				◆	◆									
Perimeter Drainage Ditch Spoils Pile J														
Intertidal			m◆	m◆	m◆									
Perimeter Drainage Ditch Spoils Pile K														
Intertidal				m◆	m◆									
Perimeter Drainage Ditch Spoils Pile L														
Intertidal					◆									
High Marsh														
Perimeter Drainage Ditch Spoils Pile M														
Intertidal				◆	◆									
Perimeter Drainage Ditch Spoils Pile N														
High Marsh														
Intertidal				m◆	m◆									
Freshwater				m◆	m◆									
East Levee Generator Pad														
Onshore Fuel Line - 54-Inch Drain Line Segment														
Intertidal										◆				
Onshore Fuel Line - Hangar Segment														
High Marsh														
Intertidal										◆		◆	◆	◆
Onshore Fuel Line - Northern Segment														
Intertidal										◆				
Northwest Runway Area														
Intertidal				11	11									
High Marsh														
Tarmac East of Outparcel A-5														
Revetment 1														
High Marsh														
Intertidal														
Revetment 2														
High Marsh														
Intertidal														
Revetment 3														
High Marsh														
Subtidal														
Intertidal														

POLYNUCLEAR AROMATIC HYDROCARBONS

SITES	**Total PAHs[10]**	2-Methylnapthalene	Acenapthene	Anthracene	**Benz(a)anthracene**	**Benzo(a)pyrene**	**Benzo(b)fluoranthene**	Benzo(g,h,i)perylene	Chrysene	**Dibenz(a,h)anthracene**	Fluoranthene	Fluorene	**Indeno(1,2,3-cd)pyrene**	Napthalene	Phenanthrene	Pyrene
Perimeter Drainage Ditch Spoils Pile F																
High Marsh	◆		m◆		m■	m■	m■									
Subtidal																
Intertidal	◆		m◆	m◆	m◆	m◆	m◆	m◆	m◆		m◆	m◆	m◆		m◆	m◆
Perimeter Drainage Ditch Spoils Pile G																
Intertidal																
Perimeter Drainage Ditch Spoils Pile H																
Perimeter Drainage Ditch Spoils Pile I																
Intertidal																
Perimeter Drainage Ditch Spoils Pile J																
Intertidal																
Perimeter Drainage Ditch Spoils Pile K																
Intertidal																
Perimeter Drainage Ditch Spoils Pile L																
Intertidal																
High Marsh																
Perimeter Drainage Ditch Spoils Pile M																
Intertidal																
Perimeter Drainage Ditch Spoils Pile N																
High Marsh																
Intertidal																
Freshwater																
East Levee Generator Pad																
Onshore Fuel Line - 54-Inch Drain Line Segment																
Intertidal																
Onshore Fuel Line - Hangar Segment																
High Marsh	◆				■	■◆	■			■			■			
Intertidal	◆		◆	e	◆	◆			◆	◆	◆	◆		◆	e	◆
Onshore Fuel Line - Northern Segment																
Intertidal																
Northwest Runway Area																
Intertidal																
High Marsh																
Tarmac East of Outparcel A-5																
Revetment 1																
High Marsh	◆					e										
Intertidal	◆	e	◆	◆	e	e			◆	◆	◆	◆			◆	e
Revetment 2																
High Marsh																
Intertidal										◆						
Revetment 3																
High Marsh																
Subtidal																
Intertidal																

TABLE 1-6

Summary of FFS Chemicals of Concern

SITES	METALS																																												
																PESTICIDES								SVOC[1]	TPH[2]			BTEX[3]		POLYNUCLEAR AROMATIC HYDROCARBONS															
	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc	alpha-Chlordane	**gamma-Chlordane**	DDD[4]	DDE[5]	DDT[6]	**Dieldrin**	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Gasoline[7]	Diesel[8]	JP4[9]	Ethylbenzene	Xylene	**Total PAHs[10]**	2-Methylnapthalene	Acenapthene	Anthracene	**Benz(a)anthracene**	**Benzo(a)pyrene**	**Benzo(b)fluoranthene**	Benzo(g,h,i)perylene	Chrysene	**Dibenz(a,h)anthracene**	Fluoranthene	Fluorene	**Indeno(1,2,3-cd)pyrene**	Napthalene	Phenanthrene	Pyrene
Revetment 4																																													
High Marsh									◆																																				
Intertidal					◆				◆																							◆									◆			◆	
Subtidal																																													
Revetment 6																																													
Intertidal																									◆						◆	◆									m◆				
Revetment 7																																													
Intertidal									m◆																					◆	◆	◆	◆	m◆	m◆			m◆	m◆	m◆	◆		me	◆	m◆
High Marsh									m◆																					◆					m◆										
Revetment 8	No Chemicals of Concern																																												
Revetment 9	No Chemicals of Concern																																												
Revetment 10	No Chemicals of Concern																																												
Revetment 11																																													
High Marsh								◆																																					
Intertidal								◆																																					
Revetment 12																																													
High Marsh								◆																																					
Subtidal								◆																																					
Intertidal								◆																																					
Revetment 13																																													
High Marsh									◆																					◆					m■e										
Intertidal					◆				◆																					◆		◆	e	m◆e	m◆			m◆	m◆	m◆	◆			m◆	m◆
Revetment 14																																													
High Marsh																																													
Subtidal																																													
Intertidal																										m◆																			
Revetment 15																																													
Intertidal					◆				◆																																				
Revetment 16																																														
High Marsh		m◆																																											
Subtidal		m◆																																											
Intertidal		m◆																																											
Revetment 17	No Chemicals of Concern																																												
Revetment 19																																													
High Marsh		◆						◆																						◆					■◆								mn		
Subtidal		◆																							◆																				
Intertidal		◆			m◆			◆	◆																◆	◆				◆	◆	◆	◆	◆	◆			◆	◆	◆	◆		mn	◆	◆
Revetment 20																																													
Intertidal					m◆																																							m◆	m◆
Revetment 21																																													
High Marsh								m◆						m◆																															
Intertidal								m◆						m◆											m◆	m◆					m◆										m◆				
Revetment 22																																													
Intertidal																									m◆	m◆					m◆	m◆									m◆				

TABLE 1-6

Summary of FFS Chemicals of Concern

SITES	METALS														
	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc
Revetment 23															
High Marsh								◆							
Intertidal								◆							
Revetment 24	**No Chemicals of Concern**														
Revetment 25															
High Marsh		m◆													
Intertidal		m◆													
Revetment 26															
High Marsh		m◆		m◆						m◆					
Subtidal		m◆		m◆						m◆					
Intertidal		m◆								m◆					
Revetment 27	**No Chemicals of Concern**														

SITES	PESTICIDES								SVOC[1]	TPH[2]			BTEX[3]		
	alpha-Chlordane	**gamma-Chlordane**	DDD[4]	DDE[5]	DDT[6]	**Dieldrin**	Endrin Aldehyde	Endosulfan Sulfate	Dibenzofuran	Gasoline[7]	Diesel[8]	JP4[9]	Ethylbenzene	Xylene	**Total PAHs[10]**
Revetment 23															
High Marsh															
Intertidal															
Revetment 24															
Revetment 25															
High Marsh															
Intertidal											m◆				
Revetment 26															
High Marsh															
Subtidal															
Intertidal										m◆	m◆				
Revetment 27															

SITES	POLYNUCLEAR AROMATIC HYDROCARBONS														
	2-Methylnapthalene	Acenapthene	Anthracene	**Benz(a)anthracene**	**Benzo(a)pyrene**	**Benzo(b)fluoranthene**	Benzo(g,h,i)perylene	Chrysene	**Dibenz(a,h)anthracene**	Fluoranthene	Fluorene	**Indeno(1,2,3-cd)pyrene**	Napthalene	Phenanthrene	Pyrene
Revetment 23															
High Marsh															
Intertidal															
Revetment 24															
Revetment 25															
High Marsh															
Intertidal															
Revetment 26															
High Marsh															
Subtidal															
Intertidal															
Revetment 27															

1 Semivolatile organic compounds.
2 Total petroleum hydrocarbons.
3 Benzene, toluene, ethylbenzene and xylenes.
4 4,4'-dichlorodiphenyldichloroethane.
5 4,4'-dichlorodiphenyldichloroethene.
6 4,4'-dichlorodiphenyltrichloroethane.
7 Analytes within the gasoline range of total petroleum hydrocarbons.
8 Analytes within the diesel range of total petroleum hydrocarbons.
9 Analytes within the JP-4 range of total petroleum hydrocarbons.
10 Polynuclear aromatic hydrocarbons.
11 Pesticide is related to non-Comprehensive Environmental Response, Compensation, and Liability Act release and is not a constituent of concern.

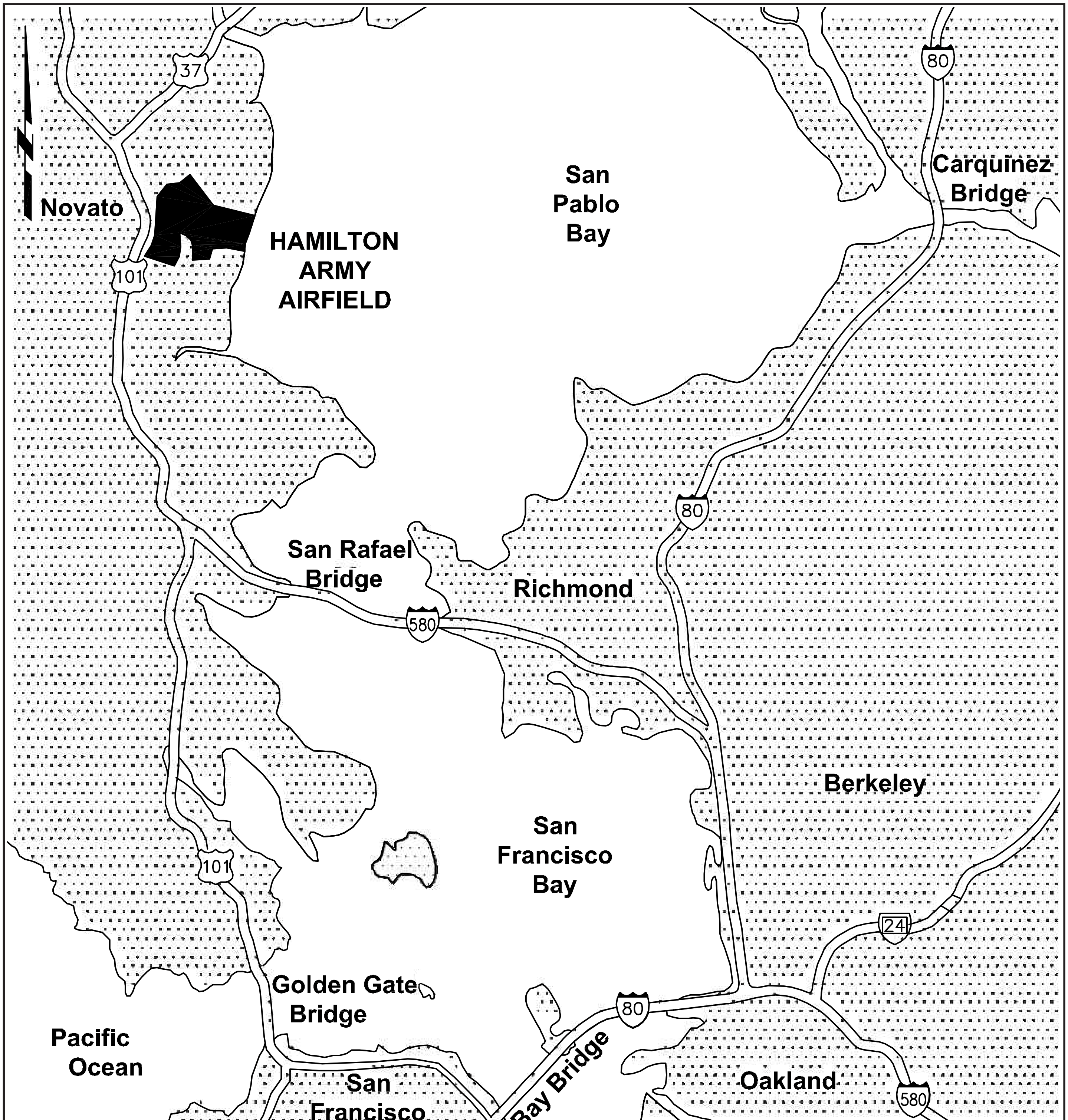
Notes:
- ◆ Denotes site and constituent with ecological receptor(s) having one or more Hazard Quotient > 1.0 and exceeds comparator value (upper confidence limit value used unless otherwise specified).
- ■ Denotes site and constituent with human health carcinogenic risk > 1.0 E -06.
- □ Denotes site and constituent with human health noncarcinogenic Hazard Quotient > 1.0.
- e Denotes PAHs that are included in the calculation of the Total PAHs for the site, did not exceed the comparator value (using the site statistical concentration [95% upper confidence level or maximum value]), and exceeded the hazard quotient of 1.0 in the Human Health and Ecological Risk Assessment (IT, 2000).
- m Denotes maximum value used for the statistical concentration to compare to target concentrations and comparators.
- n Denotes PAHs that are included in the calculation of the Total PAHs for the site, did not exceed the comparator value (using the site statistical concentration [95% upper confidence level or maximum value]), and **did not** exceed the hazard quotient of 1.0 in the Human Health and Ecological Risk Assessment (IT, 2000)

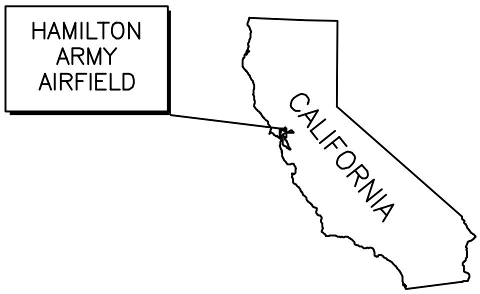
TABLE 1-7
No Further Action Sites – No COCs

Building 20
Building 84/90 Area
PDD Spoils Pile C
PDD Spoils Pile H
East Levee Generator Pad
Tarmac East of Outparcel A-5
Revetment 8
Revetment 9
Revetment 10
Revetment 17
Revetment 24
Revetment 27

TABLE 1-8
Inboard Area Sites Requiring Further Action

Sites	Sites
FSTP	Revetment 7
Building 26	Revetment 11
Building 35/39 Area	Revetment 12
Building 41 Area	Revetment 13
Building 82/87/92/94 Area	Revetment 14
Building 86	Revetment 15
PDD	Revetment 16
Spoils Pile A	Revetment 19
Spoils Pile B	Revetment 20
Spoils Pile D	Revetment 21
Spoils Pile E	
Spoils Pile F	Revetment 22
Spoils Pile G	Revetment 23
Spoils Pile J	Revetment 25
Spoils Pile K	Revetment 26
Spoils Pile L	
Spoils Pile M	
Spoils Pile N	
ONSFL – 54” line	
ONSFL – Hangar Segment	
ONSFL – Northern Segment	
Northwest Runway Area	
Revetment 1	
Revetment 2	
Revetment 3	
Revetment 4	
Revetment 6	





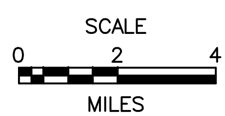


FIGURE 1-1

SITE LOCATION MAP

BRAC PROPERTY
HAMILTON ARMY AIRFIELD

Reference: IT Corporation Figure 1-1 Site Location Map

159892.08.RA Fig1-1 06-20-01 kjb

CH2MHILL

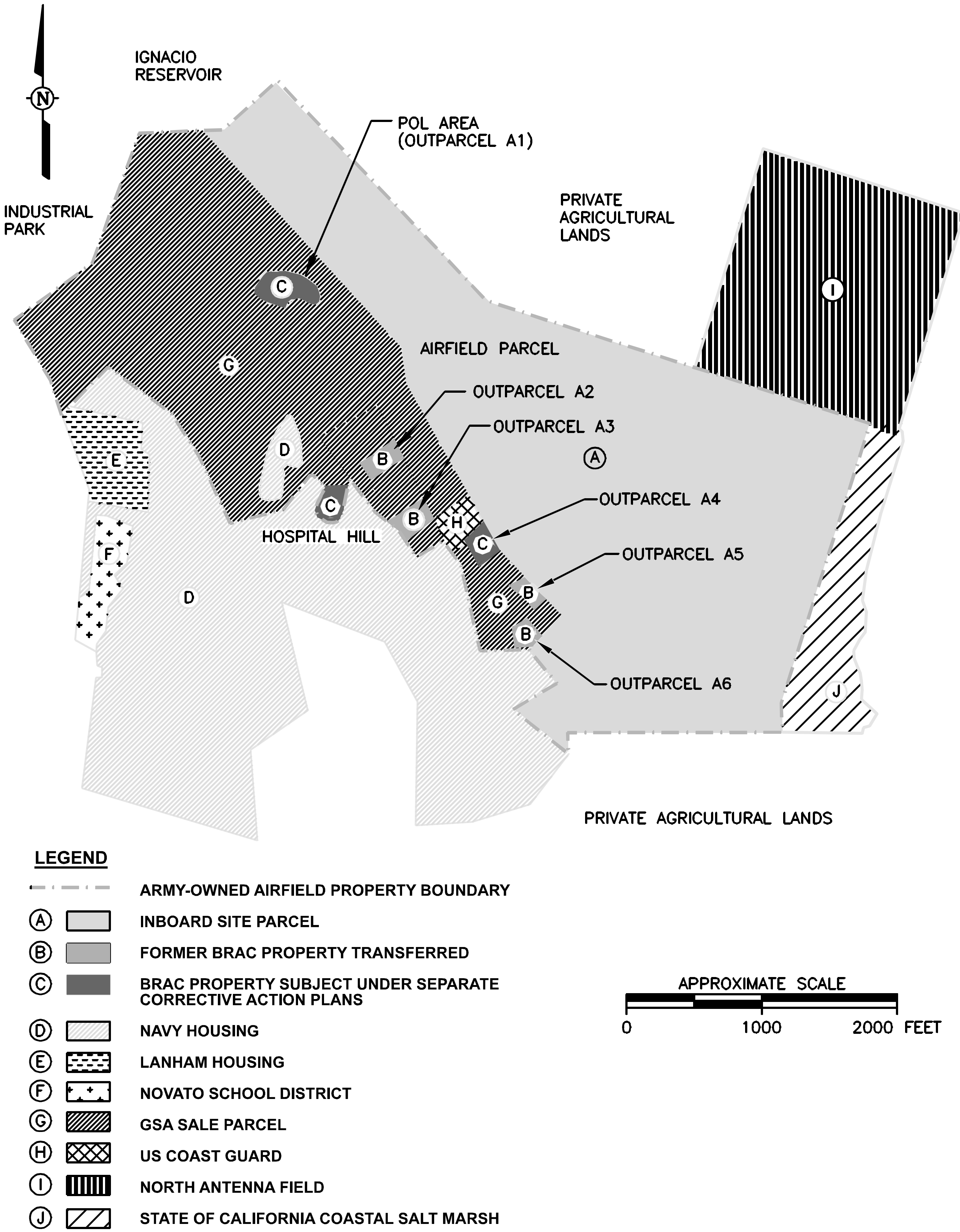


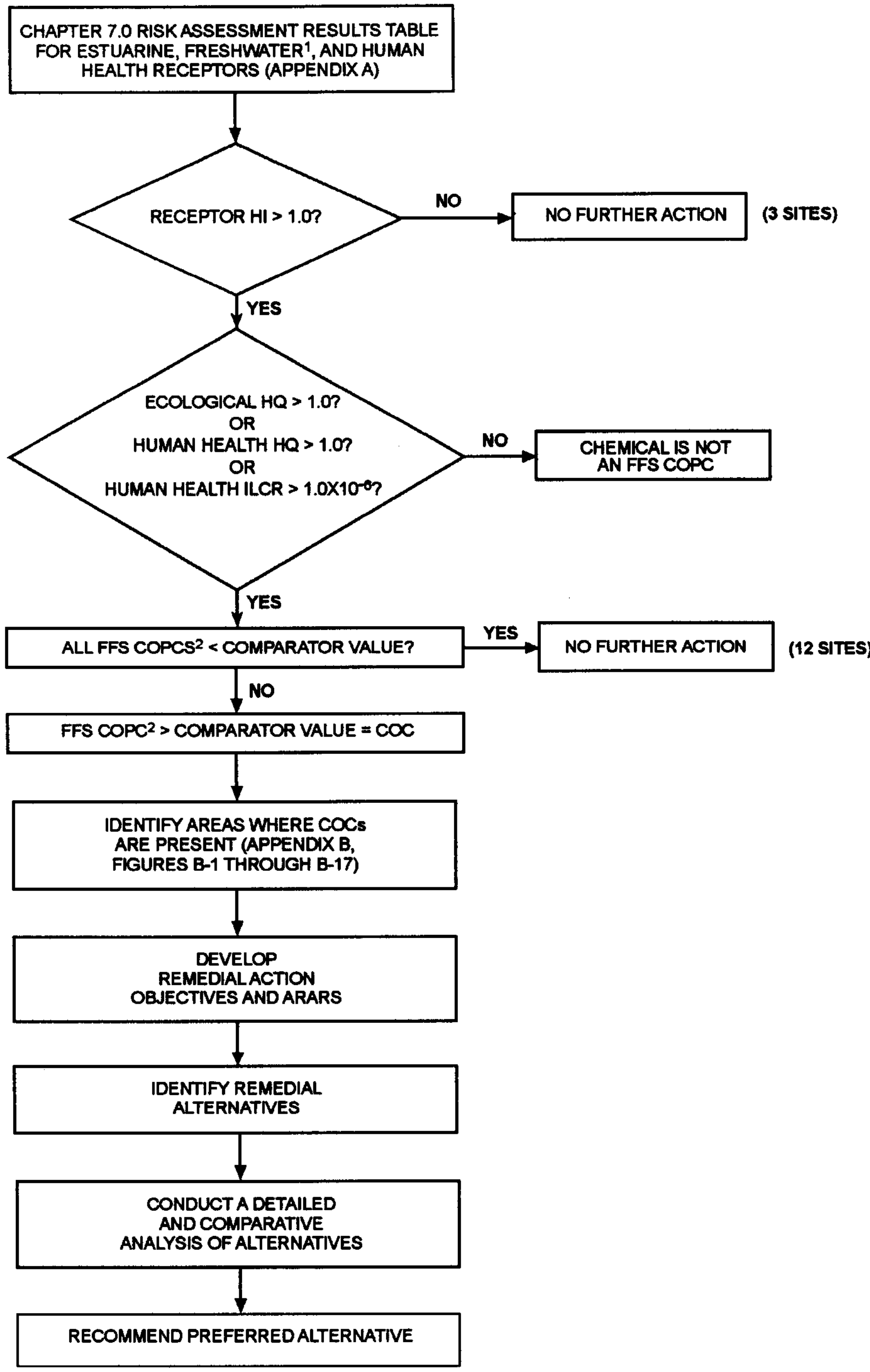
FIGURE 1-2
BRAC PROPERTY LOCATION MAP
HAMILTON ARMY AIRFIELD

Reference: IT Corporation Figure 2-1
BRAC Property Location Map (DWG No. 762538-A96)

CH2MHILL

159892.08.RA fig1-2.FH8 04-24-01 kyle

Figure 1-3
Focused Feasibility Study Site Screening and Alternative Selection Process



COC = CHEMICAL OF CONCERN   COPC = CHEMICAL OF POTENTIAL CONCERN   HI = HAZARD INDEX   HQ = HAZARD QUOTIENT

[1] Freshwater receptors were considered at Buildings 82/87/92/94 Area, Spoils Piles A, B, and N, and PDD.

[2] The 95 UCL concentrations (or maximum in some cases) of COPCs were compared to the comparator values.

SECTION 2

Development of Remedial Action Objectives

This section describes the RAO development process and establishes RAOs for the Inboard Area sites that require remedial action (i.e., have residual contaminants that are greater than their comparator values). The development of RAOs is the first phase of the feasibility study process and is, therefore, a critical prerequisite to the development of remedial alternatives. The RAOs are general descriptions of the goals the remedial actions are expected to accomplish, such as protecting human health and the environment by eliminating chemicals of concern and/or reducing or controlling exposures to human and ecological receptors during the development and maturation of the wetland.

2.1 RAO Development

The RAOs are developed in this FFS to provide a basis for evaluating the ability of the remedial alternatives, to comply with ARARs, and to achieve goals of protecting human health and the environment in the future wetland. The RAOs are quantitative and qualitative expressions of goals for protecting human health and the environment. Protection of human health and the environment in the future wetland can be accomplished by reducing the concentrations of residual contaminants that are greater than their comparator values or by controlling or eliminating the exposure of receptors to residual contaminants that are greater than their comparator values. Given these two primary methods for protecting human health and the environment at the Inboard Area sites, the RAOs establish both contaminant-specific and exposure-specific objectives. Together, the contaminants-specific and exposure-specific objectives consider the contaminants and media of interest, the possible future wetland receptors, and the exposure pathways.

Chemical-specific, location-specific, and action-specific ARARs and performance standards identified for this FFS are presented in Section 2.2. RAOs are identified in Section 2.3.

Analytical data and other information used to facilitate the development of RAOs for this FFS were obtained from the following references:

- RI (IT, 1999a)
- 1998 Interim Removal Action Data Report (IT, 1999b)
- 1999 Interim Removal Action Data Report (IT, 2000)
- Remedial Design Investigation (FW, 2000)
- Human Health and Ecological Risk Assessment (U.S. Army, 2001).

2.2 Applicable or Relevant and Appropriate Requirements

The ARARs listed in the following sections have been identified as potential ARARs; the determination of ARARs is an ongoing process, with a final determination of all ARARs to be presented in the BRAC Property RAP. Therefore, reference to the term “ARARs” in subsequent sections of this report should infer the ARARs are only potential in nature at this stage of the CERCLA process and will continue to evolve through the RAP. Applicable or relevant and appropriate requirements may be added, deleted, or have a revised status as the result of the document revision process.

Pursuant to Section 121(d)(1) of CERCLA, remedial actions must attain a degree of cleanup, which is protective of both human health and the environment, and they must comply with ARARs. Additionally, remedial actions that leave hazardous substances, pollutants, or contaminants onsite must meet standards, requirements, limitations, or criteria that are applicable or relevant and appropriate requirements. Federal ARARs include requirements under any federal environmental law, while state ARARs include promulgated requirements under state environmental or facility-siting laws that are more stringent than federal ARARs and that have been identified as ARARs by the State of California in a timely manner. To be an ARAR, the requirement must be either (EPA, 1988a):

- "Applicable" requirements, which are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

  Under CERCLA regulation, onsite actions need comply only with the substantive aspects of ARARs, not with corresponding administrative requirements (such as but not limited to permits, recordkeeping, and reporting). However, substantive components of apparently administrative requirements, such as recordkeeping, are potential ARARs. For example, a regulation that describes required reports can include specific measures of remediation performance that must be made. The report is not a potential ARAR, but the specific measures needed to document remediation performance are substantive requirements and may be ARARs.

- "Relevant and appropriate" requirements, which are those cleanup standards that are standard or other substantive environmental requirements promulgated under federal or state law that, while not specifically "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, nevertheless addresses problems or situations sufficiently similar to those encountered at the site to indicate their use. A requirement must be both relevant and appropriate to be designated an ARAR. Applicable or relevant and appropriate requirements are identified on a site-specific basis from information about site-specific chemicals, specific actions that are being considered, and specific features of the site location.

For a state requirement to be considered an ARAR, it must be:

- Legally enforceable
- Generally applicable to all circumstances covered by the requirement, not just Superfund sites
- More stringent than the federal regulation

Substantive requirements pertain directly to actions or conditions in the environment. They include restrictions for exposure to certain types of hazardous substances (e.g. chemical-specific ARAR), technology-based requirements for actions (e.g., action-specific ARARs), and restrictions on activities in certain locations (e.g., location-specific ARARs). For any onsite remedial activity, the administrative portions of the environmental standards criteria, or limitations are not ARARs because CERCLA, Section 121(e) exempts these actions from permitting requirements. This permit exemption applies to all administrative requirements, whether or not they are styled as "permits." Administrative requirements include the approval of or consultation with administrative bodies, issuance of permits, documentation, reporting, recordkeeping, and enforcement.

The three categories of ARARs are as follows:

- Chemical-Specific ARARs are numerical values that represent a health-based or risk-based standard or the results of methodologies which when applied to site-specific conditions are used to establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.
- Location-Specific ARARs are restrictions on the conduct of activities solely because the site occurs in certain environmentally sensitive areas. Examples are wetlands, floodplains, endangered species habitat, or historically significant resources.
- Action-Specific ARARs are technology-based or activity-based requirements or limitations on actions taken with respect to hazardous waste.

A requirement may not meet the definition of ARAR as defined above, but still be useful in determining whether to take action at a site or to what degree action is necessary. This can be particularly true when there are no ARARs for a site, action, or contaminant. Such requirements are called to-be-considered (TBC) criteria. TBC materials are nonpromulgated advisories or guidance issued by federal or state government that are not legally binding, but may provide useful information or recommended procedures for remedial action. Although TBCs do not have the status of ARARs, they are considered along with ARARs to establish the required level of cleanup for protection of health or the environment.

Section 121 (d)(4) of CERCLA provides six specific circumstances in which potential ARARs may be waived. These waivers apply only to meeting ARARs with respect to remedial actions onsite. Other statutory requirements, such as remedies being protective of human health and the environment, cannot be waived. Currently, it is not envisioned that any waivers will be requested for the BRAC Property sites; however, the following circumstances are summarized below for sake of completeness.

- Interim Measures: The remedial action selected is only part of a total remedial action that will attain such a level or standard of control when completed (Section 121 (d)(4)(A)).
- Greater Risk to Human Health and the Environment: Compliance with such requirement at the facility will result in greater risk to human health and the environment than alternative options (Section 121 (d)(4)(B)).
- Technical Impracticability: Compliance with such a requirement is technically impracticable from an engineering perspective (Section 121 (d)(4)(C)).

- Equivalent Standard of Performance: The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation, through use of another method or approach (Section 121 (d)(4)(D)).
- Inconsistent Application of State Requirements: With respect to a state standard, requirement, criterion, or limitation, the state has not consistently applied the standard, requirement, criterion, or limitation in similar circumstances at other remedial actions (Section 121 (d)(4)(E)).
- Fund Balancing: The Hazardous Substance Response Fund (Fund) waiver may apply when the selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration and the availability of amounts from the Fund to respond to other sites which present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats (Section 121 (d)(4)(F)). Since the U.S. Army is the lead agency for HAAF (i.e., remedial activities are not Fund financed), this waiver is not available to the HAAF remedial actions.

The ARARs and performance standards for this FFS were developed using the following guidelines and documents:

- *CERCLA Compliance with Other Laws Manual, Part I: Interim Final* (EPA, 1988b)
- *CERCLA Compliance with Other Laws Manual, Part II: Clean Air Act and Other Environmental Statutes and State Requirements* (EPA, 1989)
- *California State Water Resources Control Board ARARs Under CERCLA* (SWRCB, 1992).

2.2.1 Chemical-Specific ARARs and TBCs

The chemical-specific ARARs and TBCs for HAAF can divided be into two categories: those that affect cleanup goals and those that affect soil and sediment characterization and disposal.

Because there are no promulgated chemical-specific ARARs that can be applied as soil or sediment cleanup goals, a variety of TBC criteria have been considered. The chemical-specific TBCs for metals, pesticides, SVOCs, petroleum hydrocarbons, VOCs, and PAHs for both Inboard and Upland sites are presented in Table 2-1. These concentrations are not based on promulgated regulations, but are based on the following sources:

- Metals: Ambient concentrations for Hamilton, Effects Range Lows (Reference: Long, E.R, D.D. MacDonald, S.L. Smith, and F.D. Calder, 1995, "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments," Environmental Management, 19:81-97), and RWQCB Draft Staff Report "Beneficial Reuse of Dredge Materials: Sediment Screening and Testing Guidelines," May 2000
- Pesticides: RWQCB Draft Staff Report "Beneficial Reuse of Dredge Materials: Sediment Screening and Testing Guidelines," May 2000 and target concentrations (concentrations used to calculate risk during the risk assessment)

- SVOC (dibenzofuran): target concentration (concentration used to calculate risk during the risk assessment)
- Petroleum hydrocarbons: RART values
- VOC (xylenes); target concentration (concentration used to calculate risk during the risk assessment)
- PAHs: Effects Range Lows and RWQCB Draft Staff Report "Beneficial Reuse of Dredge Materials: Sediment Screening and Testing Guidelines," May 2000

The chemical-specific ARARs that affect soil and sediment characterization and disposal include the RCRA requirements for identification of hazardous waste found in Title 22 of the California Code of Regulations, Division 4.5, Chapter 11. A hazardous waste is a RCRA hazardous waste if it exhibits any of the characteristics of ignitability, corrosivity, reactivity, or toxicity identified in 22 66261.21, 66261.22(a)(1). 66261.22(a)(2), 66261.23, and 66261.24(a)(1) or if it is listed as a hazardous waste in article 4 of Chapter 11. Most of the waste determinations at HAAF will likely focus on whether the wastes generated at the site (e.g., excavated soil or sediment) could be classified as toxicity characteristic waste as defined by contaminant concentrations that exceed the toxicity characteristic leaching procedure (TCLP) limits. These limits are presented in 22 CCR 66261.24 (a)(1).

Under the California RCRA program, wastes can be classified as non-RCRA, State-only, hazardous wastes if they exceed the Soluble Threshold Limit Concentration (STLC) or the Total Threshold Limit Concentration (TTLC) values listed in 22 CCR 66261.24(a)(2). If remediation wastes generated at HAAF are characterized as hazardous waste, the regulations that govern the treatment, storage, and disposal of hazardous waste will be considered ARARs.

The numerical values presented in 22 CCR 66261.24 (a)(1) and (a)(2) are not considered cleanup goals but are compared to contaminant concentrations in excavated materials to determine how the material should be managed. In other words, the toxicity characteristic waste criteria should not be compared to in situ contaminant concentrations in soil or sediment but rather to the soil or sediment after it has been excavated (i.e., after the waste has been "generated").

If contaminant concentrations in excavated materials are less then the TCLP, TTLC, or STLC but still contain contaminants that could cause degradation of waters of the state, these materials may be considered a designated waste (See Table 2-3 for a more detailed discussion). Based on prior excavation and offsite disposal actions conducted in 1998 and 1999 at the HAAF site, it is anticipated that future excavated materials will not exceed the hazardous waste toxicity concentrations and therefore not be considered a hazardous waste. The waste may however be considered a designated waste and would require to be handled as such (e.g., disposed of in a Class II landfill - See Table 2-3).

2.2.2 Location-Specific ARARs

The location-specific ARARs for HAAF are summarized in Table 2-2.

2.2.3 Action-Specific ARARs

The action-specific ARARs for HAAF are summarized in Table 2-3.

2.3 Identification of Remedial Action Objectives

RAOs are developed in this section for each Inboard Area site where the FFS (Section 1.0) identifies COCs (i.e., sites where residual contamination was detected above comparator values). The RAOs constitute the basis for the development of remedial alternatives which are designed to be protective of human health and the environment during the development and maturation of the wetland.

The following subsections contain summaries of the RAOs for each Inboard Area site requiring remedial action. Exposure-specific RAOs represent the receptor that is most sensitive to the listed COC within the habitats and subhabitats that are evaluated for each site. These habitats include estuarine subhabitats (high marsh, subtidal, and intertidal) and the applicable human health scenario (recreational uses). For the Building 82/87/92/94 Area, PDD-Unlined, and Spoil Piles A, B, and N freshwater receptors are also considered. The most sensitive receptor was determined by:

- Identifying COCs at the site,
- Determining which receptors have HQs greater than 1.0 (or ILCR greater than $1x10^{-6}$) for each habitat and subhabitat, and
- Determining which receptor in a habitat or subhabitat had the lowest target concentration (i.e., is the most sensitive to the COC in that habitat)

2.3.1 Former Sewage Treatment Plant

The FFS identifies pesticides as the COCs at the FSTP, which would pose a risk to human health or ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the FSTP are to prevent or mitigate the potential ecological and/or human health risks associated with soil containing pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of black rail to soil containing DDE and DDD
- Exposure of the amphipod to soil containing alpha-chlordane, gamma-chlordane, DDD, DDT, dieldrin, and endosulfan sulfate
- Human ingestion of fish containing gamma-chlordane and dieldrin

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-4.

2.3.2 Building 26

The FFS identifies total petroleum hydrocarbon measured as diesel as the COC at Building 26, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Building 26 are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing petroleum hydrocarbons as diesel during the development and maturation of the wetland. If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-5.

2.3.3 Building 35/39 Area

The FFS identifies pesticides as the COCs at the Building 35/39 Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the Building 35/39 Area are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDD and DDT
- Exposure of the algae and bay shrimp to soil containing DDT
- Exposure of the black rail to soil containing DDD and DDE

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-6.

2.3.4 Building 41 Area

The FFS identifies TPH measured as diesel and PAHs as the COCs at the Building 41 Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Building 41 Area are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing TPH measured as diesel, 2-methylnaphthalene, acenaphthene, fluoranthene, fluorene, naphthalene, and phenanthrene

- Exposure of the pickleweed to soil containing acenaphthalene and naphthalene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-7.

2.3.5 Building 82/87/92/94 Area

The FFS identifies metals as the COCs at the Building 82/87/92/94 Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Building 82/87/92/94 Area are to prevent or mitigate potential ecological risk associated with metals.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing barium
- Exposure of the amphipod to soil containing barium and beryllium
- Exposure of the algae and mosquitofish to water containing barium and beryllium

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-8.

2.3.6 Building 86

The FFS identifies metals and PAHs as the COCs at the Building 86 Area, which would pose a risk to ecological or human receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for Building 86 are to prevent or mitigate potential ecological or human risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing beryllium, cadmium, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, benzo(b)fluoranthene, fluoranthene, phenanthrene, and pyrene
- Exposure of black rail to soil containing chromium and lead
- Exposure of the pickleweed to soil containing cadmium, chromium, and benzo(a)pyrene
- Human exposure to benz(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-9.

2.3.7 Perimeter Drainage Ditch

The FFS identifies metals and pesticides as the COCs at the perimeter drainage ditch, which would pose a risk to human health or ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the PDD are to prevent or mitigate potential ecological and/or human health risks associated with metals and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing beryllium, DDD, DDT, and dieldrin

- Exposure of the black rail to soil containing DDD and DDE
- Exposure of bay shrimp and algae to soil containing DDT
- Exposure of the algae, sediment invertebrate, and mosquitofish to soil containing beryllium
- Exposure of the snipe to soil containing DDD
- Exposure of the sediment invertebrate to soil containing DDE, DDT, and dieldrin
- Human ingestion of fish containing dieldrin

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-10.

2.3.8 Perimeter Drainage Ditch Spoils Pile A

The FFS identifies metals as the COCs at PDD Spoils Pile A, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile A are to prevent or mitigate potential ecological risk associated with metals and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the pickleweed to soil containing zinc
- Exposure of the amphipod to soil containing beryllium, zinc, DDE, and DDT
- Exposure of the algae to water containing beryllium
- Exposure of the sediment invertebrate to water containing DDE and DDT

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-11.

2.3.9 Perimeter Drainage Ditch Spoils Pile B

The FFS identifies metals as the COCs at the PDD Spoils Pile B, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile B are to prevent or mitigate potential ecological risk associated with metals and DDT.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing copper
- Exposure of the pickleweed to soil containing mercury and zinc
- Exposure of the amphipod to soil containing cadmium, copper, mercury, silver, zinc, and DDT
- Exposure of the black rail to soil containing copper

- Exposure of the bay shrimp and algae to soil containing copper and silver
- Exposure of the snipe to water containing mercury
- Exposure of the algae to water containing cadmium and silver
- Exposure of the sediment invertebrate to water containing copper

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-12.

2.3.10 Perimeter Drainage Ditch Spoils Pile D

The FFS identifies pesticides as the COCs at the PDD Spoils Pile D, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile D are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDE and DDT
- Exposure of sediment invertebrate to water containing DDE and DDT

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-13.

2.3.11 Perimeter Drainage Ditch Spoils Pile E

The FFS identifies pesticides as the COCs at the PDD Spoils Pile E, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile E are to prevent or mitigate ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDE, and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-14.

2.3.12 Perimeter Drainage Ditch Spoils Pile F

The FFS identifies metals and PAHs as the COCs at the PDD Spoils Pile F, which would pose a risk to human health and ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the PDD Spoils Pile F are to prevent or mitigate potential human health and ecological risk associated with metals, PAHs, and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of bay shrimp and algae to soil containing DDT
- Exposure of the salt marsh harvest mouse to soil containing cobalt and manganese
- Exposure of the pickleweed to soil containing arsenic, lead, nickel, zinc, benzo(a)pyrene, and acenaphthene
- Exposure of the algae to soil containing manganese
- Exposure of the black rail to soil containing lead, DDD, and DDE
- Exposure of the amphipod to soil containing arsenic, beryllium, cadmium, cobalt, lead, manganese, nickel, zinc, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, DDD, and DDT
- Human exposure to arsenic, benz(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-15.

2.3.13 Perimeter Drainage Ditch Spoils Pile G

The FFS identifies pesticides as the COCs at the PDD Spoils Pile G, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile G are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDT
- Exposure of the black rail to soil containing DDE

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-16.

2.3.14 Perimeter Drainage Ditch Spoils Pile I

The FFS identifies beryllium as the COC at PDD Spoils Pile I, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile I are to prevent or mitigate potential ecological risk associated with beryllium and pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing beryllium, DDD, and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-17.

2.3.15 Perimeter Drainage Ditch Spoils Pile J

The FFS identifies pesticides as the COCs at PDD Spoils Pile J, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile J are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDD, DDE, and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, then contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-18.

2.3.16 Perimeter Drainage Ditch Spoils Pile K

The FFS identifies pesticides as the COCs at PDD Spoils Pile K, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile K are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDE and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-19.

2.3.17 Perimeter Drainage Ditch Spoils Pile L

The FFS identifies metals as the COCs at PDD Spoils Pile L, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile L are to prevent or mitigate potential ecological risk associated with metals and DDT.

Exposure-specific RAOs are to prevent:

- Exposure of the pickleweed to soil containing cobalt
- Exposure of the amphipod to soil containing barium, cobalt, lead, and zinc

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-20.

2.3.18 Perimeter Drainage Ditch Spoils Pile M

The FFS identifies pesticides as the COCs at PDD Spoils Pile M, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile M are to prevent or mitigate potential ecological risk associated with pesticides.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing DDE and DDT.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-21.

2.3.19 Perimeter Drainage Ditch Spoils Pile N

The FFS identifies lead and pesticides as the COCs at PDD Spoils Pile N, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the PDD Spoils Pile N are to prevent or mitigate potential ecological risk associated with lead and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing DDT
- Exposure of the black rail to soil containing DDE
- Exposure of the sediment invertebrate to water containing lead, DDE, and DDT

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-22.

2.3.20 Onshore Fuel Line – 54-Inch Line

The FFS identifies gasoline as the COC at the ONSFL 54-Inch Line, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the ONSFL 54-Inch Line are to prevent or mitigate potential ecological risk associated with gasoline.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as gasoline.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-23.

2.3.21 Onshore Fuel Line – Hangar Segment

The FFS identifies petroleum hydrocarbons and PAHs as the COCs at the ONSFL Hangar Segment, which would pose a risk to human health and ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for the ONSFL Hangar Segment are to prevent or mitigate potential human health and ecological risk associated with petroleum hydrocarbons and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing TPH measured as JP-4 and gasoline, acenaphthene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, benzo(b)fluoranthene, fluoranthene, fluorene, naphthalene, pyrene, ethylbenzene, indeno(1,2,3-cd)pyrene, and xylenes
- Exposure of Salmonid to soil containing ethylbenzene
- Exposure of algae to soil containing ethylbenzene
- Exposure of bay shrimp to soil containing ethylbenzene and xylenes
- Human exposure to benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene, debenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-24.

2.3.22 Onshore Fuel Line – Northern Segment

The FFS identifies petroleum hydrocarbons (gasoline) as the COCs at the ONSFL Northern Segment, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the ONSFL Northern Segment are to prevent or mitigate potential ecological risk associated with gasoline.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as gasoline.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-25.

2.3.23 Northwest Runway Area

The FFS identifies metals as the COCs at the Northwest Runway Area, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for the Northwest Runway Area are to prevent or mitigate potential ecological risk associated with metals and pesticides.

Exposure-specific RAOs are to prevent:

- Exposure of the pickleweed to soil containing boron
- Exposure of the amphipod to soil containing beryllium

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-26.

2.3.24 Revetment 1

The FFS identifies metals and PAHs as the COCs at Revetment 1, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 1 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead
- Exposure of the amphipod to soil containing barium, cadmium, acenaphthene, anthracene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, and phenanthrene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-27.

2.3.25 Revetment 2

The FFS identifies metals and PAHs as the COCs at Revetment 2, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 2 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead
- Exposure of the amphipod to soil containing cadmium and dibenz(a,h)anthracene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 28.

2.3.26 Revetment 3

The FFS identifies metals as the COCs at Revetment 3, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 3 are to prevent or mitigate potential ecological risk associated with metals.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing copper and manganese
- Exposure of amphipod and algae to soil containing barium and manganese

- Exposure of the pickleweed to soil containing manganese
- Exposure of bay shrimp and algae to soil containing copper

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-29.

2.3.27 Revetment 4

The FFS identifies metals and PAHs as the COCs at Revetment 4, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 4 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing cadmium, acenaphthene, fluorene, and phenanthrene
- Exposure of the black rail to soil containing lead

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-30.

2.3.28 Revetment 6

The FFS identifies PAHs and petroleum hydrocarbons as the COCs at Revetment 6, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 6 are to prevent or mitigate potential ecological risk associated with PAHs and petroleum hydrocarbons.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as gasoline, 2-methylnaphthalene, acenaphthene, and flourene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-31.

2.3.29 Revetment 7

The FFS identifies metals and PAHs as the COCs at Revetment 7, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 7 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead

- Exposure of the amphipod to soil containing 2-methylnaphthalene, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-32.

2.3.30 Revetment 11

The FFS identifies copper as the COC at Revetment 11, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 11 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the salt marsh harvest mouse to soil containing copper.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-33.

2.3.31 Revetment 12

The FFS identifies copper as the COC at Revetment 12, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 12 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the salt marsh harvest mouse, bay shrimp, and algae to soil containing copper.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-34.

2.3.32 Revetment 13

The FFS identifies metals and PAHs as the COCs at Revetment 13, which would pose a risk to human health and ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for Revetment 13 are to prevent or mitigate potential human health and ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the black rail to soil containing lead

- Exposure of the amphipod to soil containing cadmium, acenaphthene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene
- Human exposure to soil containing benzo(a)pyrene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-35.

2.3.33 Revetment 14

The FFS identifies TPH measured as diesel as the COC at Revetment 14, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 14 are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons (diesel).

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as diesel.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-36.

2.3.34 Revetment 15

The FFS identifies metals as the COCs at Revetment 15, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 15 are to prevent or mitigate potential ecological risk associated with metals.

Exposure-specific RAOs are to prevent:

- Exposure of the amphipod to soil containing cadmium
- Exposure of the black rail to soil containing lead

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-37.

2.3.35 Revetment 16

The FFS identifies barium as the COC at Revetment 16, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 16 are to prevent or mitigate potential ecological risk associated with barium.

Exposure-specific RAOs are to prevent exposure of the amphipod and algae to soil containing barium.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-38.

2.3.36 Revetment 19

The FFS identifies metals, petroleum hydrocarbons, and PAHs as the COCs at Revetment 19, which would pose a risk to human health and ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. The RAOs for Revetment 19 are to prevent or mitigate potential human health and ecological risk associated with metals, petroleum hydrocarbons, and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of algae to soil containing barium
- Exposure of the salt marsh harvest mouse to soil containing copper
- Exposure of the black rail to soil containing lead
- Exposure of the amphipod to soil containing barium, cadmium, TPH measured as diesel and gasoline, 2-methylnaphthalene, acenaphthene, anthracene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, phenanthrene, and pyrene
- Human exposure to soil containing benzo(a)pyrene from marsh recreation

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-39.

2.3.37 Revetment 20

The FFS identifies metals and PAHs as the COCs at Revetment 20, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 20 are to prevent or mitigate potential ecological risk associated with metals and PAHs.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing cadmium, phenanthrene, and pyrene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-40.

2.3.38 Revetment 21

The FFS identifies metals, petroleum hydrocarbons, and PAHs as the COCs at Revetment 21, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 21 are to prevent or mitigate potential ecological risk associated with metals, petroleum hydrocarbons, and PAHs.

Exposure-specific RAOs are to prevent:

- Exposure of the salt marsh harvest mouse to soil containing copper
- Exposure of the pickleweed to soil containing vanadium
- Exposure of the amphipod to soil containing TPH measured as diesel and gasoline, 2-methylnaphthalene, and fluorene

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-40.

2.3.39 Revetment 22

The FFS identifies petroleum hydrocarbons and PAHs as the COCs at Revetment 22, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 22 are to prevent or mitigate potential ecological risk associated with petroleum hydrocarbons and PAHs.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing TPH measured as diesel and gasoline, 2-methylnaphthalene, acenaphthene, and fluorene.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-42.

2.3.40 Revetment 23

The FFS identifies copper as the COC at Revetment 23, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 23 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the salt marsh harvest mouse to soil containing copper.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-43.

2.3.41 Revetment 25

The FFS identifies barium and petroleum hydrocarbons (diesel) as the COCs at Revetment 25, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 25 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent exposure of the amphipod to soil containing barium and TPH measured as diesel.

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-44.

2.3.42 Revetment 26

The FFS identifies metals and petroleum hydrocarbons as the COCs at Revetment 26, which would pose a risk to ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. No COCs were identified for human receptors at this site. The RAOs for Revetment 26 are to prevent or mitigate potential ecological risk associated with copper.

Exposure-specific RAOs are to prevent:

- Exposure of algae to soil containing barium and manganese
- Exposure of bay shrimp to soil containing boron
- Exposure of the pickleweed to soil containing boron
- Exposure of the amphipod to soil containing barium, manganese, and TPH measured as diesel and gasoline

If exposure-specific RAOs are not expected to be sufficient to protect human health and the environment, contaminant-specific RAOs would apply. These RAOs are expressed as comparator values and are shown in Table 2-45.

TABLE 2-1
Chemical-Specific To-Be-Considered (TBC) Criteria for Soil

	Chemical-Specific TBCs		
Contaminants	**Inboard Sites (mg/kg)**	**Upland Sites (mg/kg)**	**Applicable Target Concentrations (mg/kg)**
Metals			
Arsenic	16.7	15.3	N/A
Barium	190	217	N/A
Beryllium	1	0.72	N/A
Boron	36.9	3.6	N/A
Cadmium	1.2	N/A[b]	N/A
Chromium	112	112	N/A
Cobalt	27.6	14.4	N/A
Copper	68.1	68.1	N/A
Lead	43.2	43.2	N/A
Manganese	943	943	N/A
Total Mercury	0.43	0.43	N/A
Nickel	113	112	N/A
Silver	1	1	N/A
Vanadium	118	38.9	N/A
Zinc	158	158	N/A
Pesticides			
Total Chlordanes	0.0023	0.0023	N/A
Total DDTs	0.007	0.007	N/A
Dieldrin	0.00072	0.00072	N/A
Endrin Aldehyde	N/A	N/A	0.0215
Endosulfan Sulfate	N/A	N/A	0.00286
Semivolatile Organic Compounds			
Dibenzofuran	N/A	N/A	0.11
Petroleum Hydrocarbons			
Diesel/Motor Oil	144	144	N/A
Gasoline/JP-4	12	12	N/A
Volatile Organic Compounds			
Xylenes	N/A	N/A	0.04

TABLE 2-1
Chemical-Specific To-Be-Considered (TBC) Criteria for Soil

	Chemical-Specific TBCs		
Contaminants	**Inboard Sites (mg/kg)**	**Upland Sites (mg/kg)**	**Applicable Target Concentrations (mg/kg)**
Polynuclear Aromatic Hydrocarbons			
Total PAHs	4.02	4.02	N/A
2-Methylnaphthalene	0.0194	0.0194	N/A
Acenaphthene	0.026	0.026	N/A
Anthracene	0.088	0.088	N/A
Benz(a)anthracene	0.412	0.412	N/A
Benzo(a)pyrene	0.430	0.430	N/A
Benzo(b)fluoranthene	0.371	0.371	N/A
Benzo(g,h,i)perylene	0.310	0.310	N/A
Chrysene	0.384	0.384	N/A
Dibenz(a,h)anthracene	0.0634	0.0634	N/A
Fluoranthene	0.600	0.600	N/A
Fluorene	0.0253	0.0253	N/A
Indeno(1,2,3-cd)pyrene	0.382	0.382	N/A
Naphthalene	0.160	0.160	N/A
Phenanthrene	0.240	0.240	N/A
Pyrene	0.665	0.665	N/A

mg/kg Milligrams per kilogram
N/A Not applicable
DDT Dichlorodiphenyltrichloroethane
JP Polynuclear aromatic hydrocarbons
TBC To-be-considered

TABLE 2-2
Location-Specific ARAR and Performance Standards

Source	Citation	ARAR Status	Description of ARARs
California Endangered Species Act	50 Code of Federal Regulation 402	Applicable	Contains standards for the identification and protection of listed or proposed threatened or endangered plants or animals.
California Fish and Game Code	Section 1900 - California Native Plant Protection Act	Applicable	Contains standards for the identification and protection of plants by the act.
	Sections 3511, 4700, and 5050		Identify and protect certain birds, mammals, reptiles, and amphibians.
Federal Endangered Species Act		Applicable	Contains standards for the identification and protection of current or possible future-listed threatened or endangered plants or animals. Section 7 requires federal agencies to consult the U.S. Fish and Wildlife Service to ensure that actions do not jeopardize listed species or adversely modify their critical habitat. Section 9 prohibits taking of endangered species, while Section 10 permits incidental takes.
Federal Clean Water Act	40 CFR 230.3, Section 404 - Definition of Wetlands	Relevant and Appropriate	Authorized the U.S. Army Corps of Engineers (USACE) to delineate wetlands.
	USACE, Public Notice 92-7: Interim Testing Procedures for Evaluating Dredged Material Disposed in San Francisco Bay	Relevant and Appropriate	Reassures that all wetland creation, uplands disposal, or dredging projects complete certain notifications and listings.
			Provides the USACE to permit discharges of dredged materials or fill materials into navigable waters.
Coastal Zone Management Act	16 USCc 1456	Relevant and Appropriate	Establishes the authority of the Bay Conservation and Development commission to regulate construction and other activities within 100 feet inland from highest tidal action.
Rivers and Harbors Act	33 CFR 323.1, Parts 320, 325, and 328	Relevant and Appropriate	Gives the USACE permitting authority over the discharge of dredged materials into the waters of the United States. In addition, the USACE must permit any work within historically navigable waters, including behind levees.

TABLE 2-2
Location-Specific ARAR and Performance Standards

Source	Citation	ARAR Status	Description of ARARs
Fish and Game Code	Section 1603	Relevant and Appropriate	It is unlawful for any person to substantially direct or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake designated by the department or use any material from the streambeds, without first notifying the department of the activity.
Fish and Game Code	Section 5650 and 5652	Relevant and Appropriate	It is unlawful to deposit in, permit to pass into, or place where it can pass into the waters of the state any material listed in the Code.

ARAR Applicable or relevant and appropriate requirements
CFR Code of Federal Regulations
USACE U.S. Army Corps of Engineers
USC United States Code

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
Federal ARARs			
Federal Clean Water Act	40 Code of Federal Regulation (CFR) 122 – EPA Administered Permit Programs: The National Discharge Elimination System	Subsection(s) as Listed Below	Requirements to ensure storm water discharges from remedial action activities do not contribute to a violation of surface water quality standards. All reasonable steps must be taken to minimize or prevent discharges which have a reasonable likelihood of causing adverse impacts on surface water quality (40 CFR 122.41(d)). Discharges into surface water must achieve federal and state water quality standards (40 CFR 122.44(d)).
	40 CFR 122.26	Relevant and Appropriate	
	40 CFR 122.41(d)	Relevant and Appropriate	
	40 CFR 122.41(e)	Relevant and Appropriate	
	40 CFR 122.44(d)	Relevant and Appropriate	
State of California Hazardous Waste ARARs (Federal ARARs)			
California Hazardous Waste Control Law	22 CCR[d] 66261.1 through 22 CCR 66261.7	Relevant and Appropriate	The chemicals recovered from the sediments, surface soil, or subsurface soil may need to be managed as either a Resource Conservation and Recovery Act (RCRA) or non-RCRA hazardous waste. The treatment, storage, and disposal requirements for these wastes are either applicable or relevant and appropriate (depending upon the classification of the waste material) and they include: using containers to store the recovered product that are compatible with this material (22 CCR 66264.172); using containers that are in good condition (22 CCR 66264.171); segregating the waste from incompatible wastes (22 CCR 66264.177); inspecting the containers (22 CCR 66264.176); and providing adequate secondary containment for the water stored (22 CCR 66264.175); containers must be closed during transfer (22 CCR 66264.173); and all hazardous material must be removed at closure (22 CCR 66264.178).
	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 14 (Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities), Article 9 (Use and Management of Containers)	Subsection(s) as Listed Below	
	22 CCR 66264.171 through 22 CCR 66264.178	Relevant and Appropriate	If during excavation or cleanup activities hazardous waste is identified throughout the waste characterization process, the hazardous waste will be managed in accordance with what the standards state. It is anticipated that the contaminated sediments and soil at the Inboard Areas would not be characterized as hazardous waste, therefore these requirements would be considered relevant and appropriate.

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
California Hazardous Waste Control Law	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 12 (Standards Applicable to Generators of Hazardous Waste), Article 1 (Applicability)	Subsection(s) as Listed Below	These standards are only applicable to those sites where excavated wastes are classified as hazardous or non-RCRA hazardous waste. These standards establish requirements for generators of hazardous waste located in California. It is anticipated that the contaminated sediments and soil at the Inboard Areas would not be characterized as hazardous waste, therefore these requirements would be considered relevant and appropriate.
	22 CCR 66262.10 through 22 CCR 66262.12	Relevant and Appropriate	
	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 14 (Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities), Article 1 (General)	Subsection(s) as Listed Below	These standards are only applicable to those sites where excavated material is classified as hazardous waste. These standards establish minimum requirements, which define the acceptable management of hazardous waste. It is anticipated that the contaminated sediments and soil at the Inboard Areas would not be characterized as hazardous waste, therefore these requirements would be considered relevant and appropriate.
	22 CCR 66264.1 through 22 CCR 66264.4	Relevant and Appropriate	
	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 14 (Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities), Article 4 (Contingency Plan and Emergency Procedures)	Subsection(s) as Listed Below	These standards are only applicable to those sites where excavated material is classified as hazardous waste. These standards require the development of a set of contingency and emergency procedures. It is anticipated that the contaminated sediments and soil at the Inboard Areas would not be characterized as hazardous waste, therefore these requirements would be considered relevant and appropriate.
	22 CCR 66264.50 through 22 CCR 66264.56	Relevant and Appropriate	

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
California Hazardous Waste Control Law	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 14 (Standards for Owners and Operators of Hazardous Waste Transfer, Treatment, Storage, and Disposal Facilities), Article 12 (Waste Piles)	Subsection(s) as Listed below	Delineates requirements for the management of waste piles for hazardous waste. This regulation is applicable to sites where excavated materials are classified as hazardous wastes and managed in waste piles. These regulations include 22 CCR 66264.251 - Design and Operating Requirements; 22 CCR 66264.254 - Monitoring and Inspection; 22 CCR 66264.256 - Special Requirements for Ignitable or Reactive Waste; 22 CCR 66264.257 - Special Requirements for Incompatible Wastes; 22 CCR 66264.258 - Closure and Post-Closure Care; and 22 CCR 66264.259 - Special Requirements for Hazardous Wastes F020, F021, F022, F023, F026, and F027.
	22 CCR 66264.250 through 22 CCR 66264.259	Relevant and Appropriate	If during excavation or cleanup activities, hazardous waste is identified through the proper characterization process and the hazardous waste will be managed in accordance with the standards stated in these sections of the regulation. It is anticipated that the contaminated sediments and soil at the Inboard Areas would not be characterized as hazardous waste, therefore these requirements would be considered relevant and appropriate.
California Hazardous Waste Control Law	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 18 (Land Disposal Restrictions), Article 1 (General)	Subsection(s) as Listed Below	Provides the purpose, scope, and applicability of LDRs. The title of the sections of the regulations are; 22 CCR 66268.3 - Dilution Prohibited As a Substitute for Treatment; 22 CCR 66268.7 - Waste Analysis and Record keeping; and 22 CCR 66268.9 - Special Rules Regarding Wastes That Exhibit a Characteristic.
	22 CCR 66268.1 through 22 CCR 66268.9	Applicable only if waste is characterized as hazardous waste	If during excavation or cleanup activities hazardous waste is identified through the proper characterization process and will be land disposed within the meaning of the LDRs, the hazardous waste will be managed in accordance with the standards stated in applicable sections of the regulation. Only applicable if hazardous wastes are disposed of or treated in an area not designated as a CAMU or disposed of or treated beyond the area of contamination. These requirements are not ARARs if the waste is not characterizes as hazardous waste.

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
California Hazardous Waste Control Law	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 18 (Land Disposal Restrictions), Article 3 (Prohibitions on Land Disposal)	Subsection (s) as Listed Below	These standards are applicable to sites where excavated material is classified as hazardous waste and is disposed of or treated in an area not designated as a CAMU. Provides waste-specific LDRs for 22 CCR 66268.30 - Waste Specific Prohibitions--Solvent Wastes; 22 CCR 66268.31 - Waste Specific Prohibitions -- Dioxin-Containing Wastes; 22 CCR 66268.32 - Waste Specific Prohibitions--California List Wastes; 22 CCR 66268.33 - Waste Specific Prohibitions--First Third Wastes; 22 CCR 66268.34 - Waste Specific Prohibitions--Second Third Waste; and 22 CCR 66268.35 - Waste Specific Prohibitions--Third Waste.
	22 CCR 66268.30 through 22 CCR 66268.35	Applicable only if waste is characterized as hazardous waste	If during excavation, treatment processes, or cleanup activities hazardous waste is identified through the proper characterization process and will be land disposed within the meaning of the LDRs, the hazardous waste will be managed in accordance with the standards stated in these sections of the regulation. These requirements are not ARARs if the waste is not characterizes as hazardous waste.
California Hazardous Waste Control Law	Title 22, Division 4.5 (Environmental Health Standards for Management of Hazardous Waste), Chapter 18 (Land Disposal Restrictions), Article 5 (Prohibitions on Storage)	Subsection(s) as Listed Below	This standard is applicable to sites where excavated material is classified as hazardous waste. The standard provides prohibitions on storage of restricted wastes.
	22 CCR 66268.50	Applicable only if waste is characterized as hazardous waste	If during excavation, treatment processes, or cleanup activities hazardous waste is identified through the proper characterization process and will be land disposed within the meaning of the LDRs, the hazardous waste will be managed in accordance with the standards stated in these sections of the regulation. These requirements are not ARARs if the waste is not characterizes as hazardous waste.
California Hazardous Waste Control Law	Title 22, Division 4, Chapter 30	Subsection(s) as Listed Below	Prescribes the leachate test methods which are to be used in evaluating materials for proposed wetlands creation.
	22 CCR 66700 (Waste Extraction Test Procedure)	Relevant and Appropriate	

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
State of California Air ARARs			
California Clean Air Act	Bay Area Air Quality Management District (BAAQMD), Regulation 6 (Particulate Matter and Visible Emissions)	Applicable	This regulation limits visible emissions, particulate emissions by weight, and emissions from sulfuric acid plants and sulfur recovery units. This regulation is applicable to any remedial action activity, which may discharge air contaminants as defined by the rule.
	BAAQMD, Regulation 7 (Odorous Substances)	Applicable	This regulation limits odorous emissions per complaints received from persons on properties where the emissions did not occur and places maximum concentration limits on certain organic emissions.
	BAAQMD, Regulation 8, Rule 40 (Aeration of Contaminated Soil and Removal of Underground Storage Tanks)	Applicable	This rule limits the emissions of organic compounds with organic chemicals or petroleums and provides procedures for controlling emissions during underground storage tank removal and soil stockpiling. Exemptions are provided for soil which contains non-volatile hydrocarbons and for soil, which is in-situ.
	BAAQMD, Regulation 11 (Hazardous Pollutants, Rule 1 (Lead)	Relevant and Appropriate	This regulation limits the emission of lead to the atmosphere based upon ground-level concentrations of lead in air.
State of California Groundwater and Soil ARARs			
California Water Code	State Water Resources Control Board (SWRCB) Order 92-08-DWQ (General order for storm water management at construction sites)	Relevant and Appropriate	Must identify the sources of sediment and other pollutants that affect the quality of storm water discharges and implement practices to reduce these discharges. Storm water discharges from construction sites must meet pollutant limits and standards. The narrative effluent standard includes the requirements to implement BMPs and/or appropriate pollution prevention control practices. Inspections of the construction site prior to anticipated storm events and after actual storm events need to be conducted to identify areas contributing to storm water discharge and evaluated for the effectiveness of best management practices and other control practices. Applies to construction sites five acres or greater in size. It also applies to smaller sites that are part of a larger common plan of development or sale. Administrative portions of this permit are not applicable in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13240)	San Francisco Bay Basin (Region 2) Water Quality Control Plan	Relevant and Appropriate	Establishes water quality objectives, including narrative and numerical standards that protect the beneficial uses of surface waters and groundwaters in the region. The uses are municipal, domestic, agricultural, and industrial service supply. Specific applicable portions of the Basin Plan include beneficial uses of affected water bodies water quality objectives to protect those uses.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13240)	SWRCB Resolution 68-16	Relevant and Appropriate	The resolution establishes requirements for activities involving discharges of contamination directly into surface waters or groundwater. According to the RWQCB, this resolution requires that high quality surface and groundwater to be maintained to the maximum extent possible.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13000, 13140, 13240)	SWRCB Resolution 88-63	Relevant and Appropriate	Specifies that with certain exceptions all ground and surface waters have the beneficial use of municipal or domestic water supply. Applies in determining beneficial uses for waters that may be affected by discharges of waste. State Water Resources Control Board Resolution 88-63 applies to all sites that may be affected by discharges of waste to groundwater or surface water. The resolution specifies that with certain exceptions all groundwater and surface waters have beneficial use of municipal or domestic water supply. These exceptions include, among others, if 1) the total dissolved solids (TDS) exceed 3,000 mg/L or 2) the water source does not provide sufficient water to supply a single well capable of producing an average sustained yield of 200 gallons per day. In the case of HAAF, both these exceptions apply, therefore, groundwater below the site may not be considered suitable for municipal or domestic water supplies.

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140, 13240, 13260, 13263, 13267, 13300, 13304, 13307)	SWRCB Resolution 92-49 (as amended April 12, 1994 and October 2, 1996) Subparagraph IIIG	Relevant and Appropriate	Section IIIG directs the Water Boards to ensure dischargers clean up and abate the “effects” of discharges in a manner promoting attainment of either background water quality or the best reasonable water quality if background quality is not feasible. (Feasibility is determined by the factors listed in Section IIIG and 23 CCR, Chapter 15, Section 2550.4.) Minimum water standards must be protective of the beneficial use(s). Section IIIG directs the Water Boards to apply 23 CCR, Chapter 15, Section 2550.4 in approving any alternative cleanup levels less stringent than background quality. The requirement to obtain the Water Board’s approval is not a substantive requirement (ARAR); however, the Army will consult with the Water Board in applying the State’s criteria to establish alternative cleanup level(s).
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140-13147, 13172, 13260, 13263, 13267, 13304)	Title 27/Title 23 (Waters), Division 3 (State Water Resources Control Board), Chapter 15 (Discharges of Waste to Land), Article 1 (General) 27 CCR 20090(d)/23 CCR 2511(d)	Subsection(s) as Listed Below Relevant and Appropriate	Actions taken by or at the direction of public agencies to clean up from unauthorized releases are exempt from Title 27/Title 23. Except that wastes removed from the immediate place of release and discharged to land must be managed in accordance with classification (Title 27CCR, Section 20200/Title 23CCR, Section 2520) and siting requirements of Title 27 or 23. Wastes contained or left in place must comply with Title 27 or 23 to the extent feasible.
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140-13147, 13172, 13260, 13263, 13267, 13304)	Title 27/Title 23 (Waters), Division 3 (State Water Resources Control Board), Chapter 15 (Discharges of Waste to Land), Article 2 (Waste Classification and Management) 27 CCR, 20200, 20210, 20220, and 20230	Applicable or Relevant and Appropriate Applicable or Relevant and Appropriate	Waste Classification: Wastes must be classified as: hazardous waste (23 CCR 2521), designated waste (23 CCR 2522), nonhazardous solid waste (23 CCR 2523), or inert waste (23 CCR 2524). A hazardous waste can only be discharged to a Class I facility (unless a variance is applicable under Title 22 regulations). A designated waste can be discharged to a Class I or Class II facility. A nonhazardous solid waste can be discharged to a Class I, II, or III facility. Inert wastes do not need to be sent to a classified facility.

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
Porter-Cologne Water Quality Control Act (California Water Code Sections 13140-13147, 13172, 13260, 13263, 13267, 13304)	Title 27(Environmental Protection), Division 2 (Solid Waste), Chapter 3 (Criteria for All Waste Management Units, Facilities, and Disposal Sites), Subchapter 2 (Siting and Design) also Title 23 Division 23 (State Water Resources Control Board), Chapter 15 (Discharges of Waste to Land), Article 3 (Waste Management Unit Classification and Siting) and Article 5	Subsection(s) as Listed Below 27 CCR 20240 (c) (also 23 CCR 2530 (c)): Applicable 27 CCR 20240 (d) (also 23 CCR 2530 (d)): Applicable 27 CCR 20250: Relevant and Appropriate 27 CCR 20320 (also 23 CCR 2541): Relevant and Appropriate	Classification and Siting Criteria 27 CCR 20210/23 CCR 2522: Designated wastes are nonhazardous wastes that consist of pollutants which, under ambient environmental conditions at the waste management unit, could be released at concentrations in excess of applicable water quality objectives, or which could cause degradation of waters of the state. Wastes in this category shall be discharged only at Class I waste management units or at Class II waste management units. The Base Realignment and Closure Property soil proposed for onsite consolidation are nonhazardous but may potentially release concentrations that could cause degradation of waters of the state. Therefore, the soil is classified as designated waste. The onsite consolidation unit shall comply with requirements for Class II waste management units. 27 CCR 20240 (c): New waste piles shall be designed, constructed, and operated to ensure that wastes will be a minimum of five feet above the highest groundwater elevation. 27 CCR 20240 (d): All containment structures at the unit shall have a foundation or base capable of supporting the structures and capable of withstanding hydraulic pressure gradients. The unit needs to be able to withstand flooding without washout, ground rupture, and rapid geological change.
	27 CCR 20250 (also 23 CCR 2532)	Relevant and Appropriate	
	27 CCR 20320 (also 23 CCR 2541)		

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
	27 CCR 20250 (also 23 CCR 2532) 27 CCR 20320 (also 23 CCR 2541) 27 CCR 20330 (also CCR 2542) 27 CCR 20340 (also CCR 2543)	Relevant and Appropriate	27 CCR 20250: Class II waste management units shall be located where site characteristics and containment structures isolate waste from waters of the state. Requires that new Class II landfills shall be immediately underlain by either natural geologic materials or a liner system with permeabilities of not more than 1×10^{-6} cm/sec. Additionally, Class II units shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return period. 27 CCR 20320: Construction standards for waste management units are provided for Class II non-municipal solid waste landfills. Requires a clay liner and leachate collection and removal system for Class II landfills. 27 CCR 20330: Sets forth specific standards for liners. Clay liners for a Class II unit shall be a minimum of 2 feet thick and shall be installed at a relative compaction of at least 90 percent. 27 CCR 20340: Sets forth specific standards for leachate collection and removal systems. Class II landfills and waste piles which contain only dry wastes may be allowed to operate without an LCRS if the discharger demonstrates, based on climatic and hydrogeologic conditions, that leachate will not be formed in or migrate from the unit
	27 CCR 20410 (also 23 CCR 2550.6)	Relevant and Appropriate	Requires monitoring for compliance with cleanup standards for three years from the date of achieving cleanup levels (23 CCR 2550.6) at waste management units.
	27 CCR 20415 (also 23 CCR 2550.7)	Relevant and Appropriate	Requires general soil, surface water, and groundwater monitoring (23 CCR 2550.7) which states: - there is a sufficient number of monitoring points, including background points - the monitoring points should be located at appropriate locations and screened in the zones of concern
	27 CCR 20420 (also 23 CCR 2550.8)	Relevant and Appropriate	Detection Monitoring Program Requirements. Requires establishment of a water quality monitoring system that is appropriate for detecting at the earliest possible time a release from the unit.

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
	27 CCR 20425 (also 23 CCR 2550.9)	Relevant and Appropriate	Evaluation Monitoring Program Requirements. Requirements under this subsection are triggered if results of the Detection Monitoring Program indicate that there is a “measurably significant” evidence of a release or if there is significant physical evidence of a release. Requires an assessment of the nature and extent of the release, including a determination of the spatial distribution and concentration of each constituent.
	27 CCR 20430 (also 23 CCR 2550.10)	Relevant and Appropriate	Corrective Action Program Requirements. Requires implementation of corrective action measures that ensure that cleanup levels are achieved throughout the zone affected by the release by removing the waste constituents or treating them in place. Source control may be required. Also requires monitoring to determine the effectiveness of corrective actions. To demonstrate cleanup, the concentration of each COC in the groundwater must be equal to, or less than, the cleanup goal for at least one year following suspension of the corrective action.
	27 CCR 20950 (also 23 CCR 2580)	Relevant and Appropriate	Provides Closure and Post-Closure Maintenance requirements for disposal sites and landfills. Requires that Class II landfills shall be closed in accordance with 27 CCR 21090.
	27 CCR 21090 (also 23 CCR 2581)	Relevant and Appropriate	Provides final cover requirements for Class II landfills including specifications for final cover slopes, foundation layer, low-hydraulic-conductivity layer, and erosion resistance layer.
	27 CCR 21769 (also 23 CCR 2597)	Relevant and Appropriate	Requirements promulgated in this section set forth the requirements for the discharger’s development and implementation of the preliminary and final closure and post-closure maintenance plans and for the RWQCB’s review and approval of such plans. The purpose of the closure and post-closure plans is to ensure that the discharger meets performance standards set forth in the regulatory closure requirements and that sufficient funds are available to achieve these goals.

TABLE 2-3
State and Federal Action-Specific Applicable or Relevant and Appropriate Requirements

Source	Standard, Requirement, Criterion, or Limitation	ARAR Status	Description of ARARs
Other State of California TBCs			
Resolution 92-145	Interim Final Sediment Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Reuse dated December 1992, Resolution No. 92-145 (referenced in the San Francisco Bay Region Water Quality Control Plan, approved in 1995).	TBC	In this Resolution, the Regional Board established screening criteria to be used to evaluate the appropriateness of using dredged material for beneficial purposes. This document is not an ARAR because the HAAF is not reusing dredged sediments from the San Francisco Bay area. This document is, however, a TBC because the screening criteria presented in this Resolution were considered as guidelines.
	Draft Staff Report entitled Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines dated May 2000.	TBC	This document is an update of the December 1992 document described above. These guidelines fall into the category of “to be considered” (TBC). The screening values presented in this document were considered as guidelines.

ARAR	Applicable or relevant and appropriate requirements
BAAQMD	Bay Area Air Quality Management
BMP	Best management practice
CAMU	Corrective action management unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CCR	California Code of Regulations
CFR	Code of Federal Regulation
cm/sec	centimeter per second
COC	Contaminant of Concern
DWQ	Department of Water Quality
ERA	U.S. Environmental Protection Agency
HAAF	Hamilton Army Airfield
LDR	Land disposal restriction
mg/L	milligram per liter
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resource Control Board
TBC	To-be-considered
TDS	Total dissolved solids
USC	United States Code

TABLE 2-4
Comparator Values – Former Sewage Treatment Plant

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Alpha-chlordane	1	0.0023[a]
Gamma-chlordane	1,2	0.0023[a]
DDD	1	0.007[b]
DDE	1	0.007[b]
DDT	1	0.007[b]
Dieldrin	1,2	0.00072
Endosulfan sulfate	1	0.00286

[a] Based on total chlordanes
[b] Based on total DDTs

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk

COC = chemical of concern
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram

TABLE 2-5
Comparator Values – Building 26

Chemical of Concern	COC Basis	Comparator value (mg/kg)
TPH measured as diesel	1	144

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk

COC = chemical of concern
TPH = total petroleum hydrocarbon
mg/kg = milligrams per kilogram

TABLE 2-6
Comparator Values – Building 35/39 Area

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
DDD	1	0.007[a]
DDE	1	0.007[a]
DDT	1	0.007[a]

[a] Based on total DDTs

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram

TABLE 2-7
Comparator Values – Building 41 Area

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
TPH measured as diesel	1	144
2-methylnaphthalene	1	0.0194
Acenaphthene	1	0.026
Fluoranthene	1	0.6
Fluorene	1	0.0253
Naphthalene	1	0.382
Phenanthrene	1	0.24

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = micrograms per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-8
Comparator Values – Building 82/87/92/94 Area

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190
Beryllium	1	1

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-9
Comparator Values – Building 86

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Beryllium	1	1.0
Cadmium	1	1.2
Chromium	1	112
Lead	1	43.2
Acenaphthene	1	0.026
Anthracene	1	0.088
Benz(a)anthracene	1,2	0.412
Benzo(b)fluoranthene	1,2	0.371
Benzo(a)pyrene	1,2	0.43
Chrysene	1	0.384
Fluoranthene	1	0.6
Phenanthrene	1	0.24
Pyrene	1	0.665

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-10
Comparator Values – Perimeter Drainage Ditch

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Beryllium	1	1.0
DDD	1	0.007[a]
DDE	1	0.007[a]
DDT	1	0.007[a]
Dieldrin	1,2	0.00072

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram

TABLE 2-11
Comparator Values – Perimeter Drainage Ditch Spoils Pile A

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Beryllium	1	1.0
Zinc	1	158
DDE	1	0.007[a]
DDT	1	0.007[a]

[a] Based on total DDTs

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDT = dichlorodiphenyltrichloroethan
DDE = dichlorodiphenyldichloroethylene
mg/kg = milligrams per kilogram

TABLE 2-12
Comparator Values – Perimeter Drainage Ditch Spoils Pile B

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Cadmium	1	1.2
Copper	1	68.1
DDT	1	0.007[a]
Mercury	1	0.43
Silver	1	1.0
Zinc	1	158

[a] Based on total DDTs

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDT = dichlorodiphenyltrichloroethan
mg/kg = milligrams per kilogram

TABLE 2-13
Comparator Values – Perimeter Drainage Ditch Spoils Pile D

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
DDE	1	0.007[a]
DDT	1	0.007[a]

[a] Based on total DDTs

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram

TABLE 2-14
Comparator Values – Perimeter Drainage Ditch Spoils Pile E

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
DDE	1	0.007 [a]
DDT	1	0.007 [a]

[a] Based on total DDTs

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram

TABLE 2-15
Comparator Values – Perimeter Drainage Ditch Spoils Pile F

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Arsenic	1	16.7
Beryllium	1	1
Cadmium	1	1.2
Cobalt	1	27.6
Lead	1	43.2
Manganese	1	943
Nickel	1	113
Zinc	1	158
Acenaphthene	1	0.026
Anthracene	1	0.088
Benz(a)anthracene	1,2	0.412
Benzo(a)pyrene	1,2	0.43
Benzo(b)fluoranthene	1,2	0.371
Benzo(g,h,i)perylene	1	0.31
Chrysene	1	0.384
Dibenzofuran	1	0.11
Fluoranthene	1	0.6
Fluorene	1	0.0253
Indeno(1,2,3-cd)pyrene	1	0.16
Phenanthrene	1	0.24
Pyrene	1	0.665
DDD	1	0.007[a]
DDE	1	0.007[a]
DDT	1	0.007 [a]

[a] Based on total DDTs

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram

TABLE 2-16
Comparator Values – Perimeter Drainage Ditch Spoils Pile G

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
DDE	1	0.007[a]
DDT	1	0.007[a]

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDT = dichlorodiphenyltrichloroethan
DDE = dichlorodiphenyldichloroethylene
mg/kg = milligrams per kilogram

TABLE 2-17
Comparator Values – Perimeter Drainage Ditch Spoils Pile I

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Beryllium	1	1.0
DDD	1	0.007[a]
DDT	1	0.007[a]

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDD = dichlorodiphenyldichloroethane
DDT = dichlorodiphenyltrichloroethane
mg/kg = milligrams per kilogram

TABLE 2-18
Comparator Values – Perimeter Drainage Ditch Spoils Pile J

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
DDD	1	0.007 [a]
DDE	1	0.007 [a]
DDT	1	0.007 [a]

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDD = dichlorodiphenyldichloroethane
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethan
mg/kg = milligrams per kilogram

TABLE 2-19
Comparator Values – Perimeter Drainage Ditch Spoils Pile K

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
DDE	1	0.007 [a]
DDT	1	0.007 [a]

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDT = dichlorodiphenyltrichloroethan
DDE = dichlorodiphenyldichloroethylene
mg/kg = milligrams per kilogram

TABLE 2-20
Comparator Values – Perimeter Drainage Ditch Spoils Pile L

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190
DDT	1	0.007[a]
Cobalt	1	27.6
Lead	1	43.2
Zinc	1	158

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDT = dichlorodiphenyltrichloroethan
mg/kg = milligrams per kilogram

TABLE 2-21
Comparator Values – Perimeter Drainage Ditch Spoils Pile M

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
DDE	1	0.007[a]
DDT	1	0.007[a]

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDT = dichlorodiphenyltrichloroethan
DDE = dichlorodiphenyldichloroethylene
mg/kg = milligrams per kilogram

TABLE 2-22
Comparator Values – Perimeter Drainage Ditch Spoils Pile N

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Lead	1	43.2
DDE	1	0.007[a]
DDT	1	0.007[a]

[a] Based on total DDTs.

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
DDT = dichlorodiphenyltrichloroethan
DDE = dichlorodiphenyldichloroethylene
mg/kg = milligrams per kilogram

TABLE 2-23
Comparator Values – Onshore Fuel Line – 54 Inch Drain Line Segment

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
TPH measured as gasoline	1	12

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-24
Comparator Values – Onshore Fuel Line – Hangar Segment

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
TPH measured as JP-4	1	12
TPH measured as gasoline	1	12
Ethylbenzene	1	0.004
Xylenes	1	0.04
Acenaphthene	1	0.026
Benz(a)anthracene	1,2	0.412
Benzo(a)pyrene	1,2	0.43
Benzo(b)fluoranthene	2	0.371
Chrysene	1	0.384
Dibenz(a,h)anthracene	1,2	0.0634
Fluoranthene	1	0.6
Fluorene	1	0.0253
Indeno(1,2,3-cd)pyrene	2	0.382
Naphthalene	1	0.16
Pyrene	1	0.665

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-25
Comparator Values – Onshore Fuel Line – Northern Segment

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
TPH measured as gasoline	1	12

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-26
Comparator Values – Northwest Runway Area

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Beryllium	1	0.72
Boron	1	3.6

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-27
Comparator Values – Revetment 1

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190
Cadmium	1	1.2
Lead	1	43.2
Acenaphthene	1	0.026
Anthracene	1	0.088
Chrysene	1	0.384
Dibenz(a,h)anthracene	1	0.0634
Fluoranthene	1	0.6
Fluorene	1	0.0253
Phenanthrene	1	0.24

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-28
Comparator Values – Revetment 2

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Cadmium	1	1.2
Lead	1	43.2
Dibenz(a,h)anthracene	1	0.0634

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-29
Comparator Values – Revetment 3

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190
Copper	1	68.1
Manganese	1	943

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-30
Comparator Values – Revetment 4

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Cadmium	1	1.2
Lead	1	43.2
Acenaphthene	1	0.026
Fluorene	1	0.0253
Phenanthrene	1	0.24

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-31
Comparator Values – Revetment 6

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
TPH measured as gasoline	1	12
2-methylnaphthalene	1	0.0194
Acenaphthene	1	0.026
Fluorene	1	0.0253

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-32
Comparator Values – Revetment 7

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Lead	1	43.2
2-methylnaphthalene	1	0.0194
Acenaphthene	1	0.026
Anthracene	1	0.088
Benz(a)anthracene	1	0.412
Benzo(a)pyrene	1	0.43
Chrysene	1	0.384
Dibenz(a,h)anthracene	1	0.0634
Fluoranthene	1	0.6
Fluorene	1	0.0253
Phenanthrene	1	0.24
Pyrene	1	0.665

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-33
Comparator Values – Revetment 11

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Copper	1	68.1

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-34
Comparator Values – Revetment 12

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Copper	1	68.1

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-35
Comparator Values – Revetment 13

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Cadmium	1	1.2
Lead	1	43.2
Acenaphthene	1	0.026
Benz(a)anthracene	1	0.412
Benzo(a)pyrene	1,2	0.43
Chrysene	1	0.384
Dibenz(a,h)anthracene	1	0.0634
Fluoranthene	1	0.6
Fluorene	1	0.0253
Phenanthrene	1	0.24
Pyrene	1	0.665

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-36
Comparator Values – Revetment 14

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
TPH measured as diesel	1	144

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-37
Comparator Values – Revetment 15

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Cadmium	1	1.2
Lead	1	43.2

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-38
Comparator Values – Revetment 16

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-39
Comparator Values – Revetment 19

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190
Cadmium	1	1.2
Copper	1	68.1
Lead	1	43.2
TPH measured as diesel	1	144
TPH measured as gasoline	1	12
2-methylnaphthalene	1	0.0194
Acenaphthene	1	0.026
Anthracene	1	0.088
Benz(a)anthracene	1	0.412
Benzo(a)pyrene	1,2	0.43
Chrysene	1	0.384
Dibenz(a,h)anthracene	1	0.0634
Fluoranthene	1	0.6
Fluorene	1	0.0253
Phenanthrene	1	0.24
Pyrene	1	0.665

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-40
Comparator Values – Revetment 20

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Cadmium	1	1.2
Phenanthrene	1	0.24
Pyrene	1	0.665

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-41
Comparator Values – Revetment 21

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Copper	1	68.1
Vanadium	1	118
TPH measured as diesel	1	144
TPH measured as gasoline	1	12
2-methylnaphthalene	1	0.0194
Fluorene	1	0.0253

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-42
Comparator Values – Revetment 22

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
TPH measured as diesel	1	144
TPH measured as gasoline	1	12
2-methylnaphthalene	1	0.0194
Acenaphthene	1	0.026
Fluorene	1	0.0253

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-43
Comparator Values – Revetment 23

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Copper	1	68.1

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram

TABLE 2-44
Comparator Values – Revetment 25

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190
TPH measured as diesel	1	144

COC Basis
1 – Potential ecological hazard
2 – Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

TABLE 2-45
Comparator Values – Revetment 26

Chemical of Concern	COC Basis	Comparator Values (mg/kg)
Barium	1	190
Boron	1	36.9
Manganese	1	943
TPH measured as diesel	1	144
TPH measured as gasoline	1	12

COC Basis
1 - Potential ecological hazard
2 - Potential human health risk/hazard

COC = chemical of concern
mg/kg = milligrams per kilogram
TPH = total petroleum hydrocarbon

SECTION 3

Remedial Alternatives

This section presents the remedial alternatives developed for this FFS. The remedial alternatives were developed for each Inboard Area site that requires further action. These Inboard Area sites include sites where COCs were identified. The following remedial alternatives were developed by assembling remedial technologies compatible with a wetland end-use scenario into treatment options that address COCs and meet RAOs:

- Alternative 1 – No Further Action
- Alternative 2 – Institutional Controls
- Alternative 3 – Excavation with Offsite Disposal
- Alternative 4 – Excavation with Onsite Disposal

These remedial alternatives emphasize, to the extent practicable, the application of proven treatment technologies which are capable of restoring affected media to a degree compatible with future wetland reuse. Below is a detailed description of each remedial alternative.

3.1 Alternative 1 – No Further Action

In accordance with the National Contingency Plan (NCP) (40 Code of Federal Regulation [CFR] 300) and CERCLA guidance (EPA, 1988a), a No Further Action alternative was developed for evaluation at each site. The No Further Action alternative reflects current site conditions and provides a baseline against which the other alternatives are evaluated. This alternative allows the incremental value of other alternatives to be evaluated. In the case of HAAF, soil removal actions have made considerable progress toward cleanup. These actions are considered part of the No Further Action alternative.

This alternative would include maintaining the property and providing controls for a prescribed time frame (if necessary) to prevent access to the area. It would include maintaining and operating the PDD pump station and drainage system and monitoring the levees until the wetlands restoration is initiated.

3.2 Alternative 2 – Institutional Controls

The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual contaminants of concern and future wetland receptors. Institutional controls are non-engineering, legal measures that limit exposure to hazardous substances by restricting land and/or water use. Institutional controls are generally implemented in one of two ways. *Governmental controls* are implemented through state or local authorities and restrict property use. Examples include zoning restrictions and permit requirements for well drilling. *Proprietary controls* are placed in the chain of title to real property for the purpose of imposing restrictions on land or water use. Proprietary controls take the form of easements, covenants, restrictions, and servitudes. Proprietary controls include provisions that they "run with the land" (i.e., they are binding on subsequent property owners). Examples of proprietary controls used to support environmental remediation may include reservations of rights for access and requirements to receive permission from the U.S. Army or regulatory agencies before making significant changes in land use.

For the Inboard Area sites, the U.S. Army would establish institutional controls using both proprietary and governmental controls. These controls would be applied to areas where, under a wetland scenario, residual soil contamination is present at concentrations that could pose a potential risk to human health or the environment. The controls would protect receptors within the wetland environment by preventing receptor exposure to residual contamination above comparator values once the wetland is constructed.

The institutional controls would establish performance criteria requiring the final design for the wetland construction to provide for the placement and monitoring of cover material in specified areas and/or restrict excavation and erosion in specified areas. Cover may consist of dredge material and/or borrow material from onsite. Specified areas are shown in Figures B-1 through B-17 in Appendix B.

Based on fate and transport studies (see Appendix E) and consensus of the regulators and resources trustees, the performance criteria would specify that the final wetland design must provide for three feet of stable cover material during the development and maturation of the wetland over areas that have residual contamination at levels above comparator values. The mathematical model presented in the fate and transport study determined that one (1) foot of cover would be a sufficient barrier to prevent exposure of receptors to residual contamination that might migrate by diffusion in groundwater. The model used the following assumptions: diffusion is the dominant transport mechanism, the sources of contamination are constant in time, and there is no degradation of contaminants in transit. While one foot of cover could protect against diffusion migration, discussions between the U.S. Army and the regulators and resources trustees concluded that a total of three (3) feet of stable cover should be provided to protect receptors whose habitat or feeding ranges include subsurface sediment or soil.

The regulators and resources trustees agreed that a stable depth of 3 feet of cover would be sufficient to ensure that there will be no exposure to future wetland receptors. The performance criteria would also specify that the stable presence of cover must be adequately monitored and that excavation and erosion of cover would be prohibited throughout the development and maturation of the wetland.

If the performance criteria for the stable depth of three feet of cover can not be met by the final wetland design, then excavation and offsite disposal as described in Alternative 3 would be required. The final wetland design would be prepared by the USACE, San Francisco District. The U.S. Army would ensure that the final wetland design and the grading plans for the final wetland design meet the specified performance criteria and are protective of the future wetland receptors. Through a formal process, the regulator agencies would review the final wetland design and grading plan.

As part of the wetland restoration project, the wetland design team (in consultation with the U.S. Army) would develop a comprehensive wetland project monitoring program. This program would monitor both the natural development of the wetland system and the long-term compliance with the performance criteria specified for placement of cover and/or prevention of erosion and excavation.

The details of the monitoring plan (such as monitoring frequency, specific monitoring activities, and monitoring locations) will be developed in conjunction with the final wetland design to ensure maximum effectiveness of the monitoring program. The plan will consider activities such as chemical, physical and/or biological monitoring. The types of monitoring activities that will be considered in the monitoring plan include:

- Measurements to determine subtle changes in topography including: pin studies, visual observation, and/or aerial topographic surveys.
- Monitoring of sediment and water quality at several locations within the wetland project.
- Monitoring of flora and fauna for contaminant uptake.

The objective of monitoring will be to ensure that the performance criteria specified in this alternative are met during the development and maturation of the wetland. The goals of the monitoring will be to verify the physical barrier is present and to distinguish between the presence and potential effects of residual contaminants onsite from the presence and potential effects of contaminants that may be brought onsite as part of the wetland restoration project or natural processes. Once a site is physically mature (stable), the determination as to whether monitoring should be continued will be made on a site by site basis.

An final wetland design plan would be prepared describing the specific activity that will be conducted. The plan will include a map showing features of the final wetland design overlying areas that require institutional controls. The map will specifically show where cover material and/or prohibition of excavation and erosion would be required.

The authorizing legislation for the Hamilton Wetland Restoration Project (Water Resources Development Act of 1999) requires the preparation of an Adaptive Management Plan. The purpose of this plan is primarily to address actions that could be taken to preserve habitat values and resources in the event that the wetland does not develop and mature as planned. The Adaptive Management Plan will also address actions that could be taken if the performance criteria specified in the ROD/RAP are not met during the development and maturation of the wetland. The Adaptive Management Plan will be prepared by the Army Corps of Engineers San Francisco District following completion of the final wetland design.

3.3 Alternative 3 – Excavation and Offsite Disposal

Under this alternative, areas where remedial action is proposed (COCs are greater than chemical-specific RAOs and sufficient stable cover is not practical) would require removal through excavation. Confirmation samples would be collected to verify RAOs are met. These samples could be collected as pre-design investigation borings that would be drilled prior to excavation to determine the extent of the excavation geometry. Alternatively, confirmation samples could be collected following excavation activities from the bottom and sidewalls of the excavation. Contaminated material would be excavated using standard construction equipment. Excavation would continue until RAOs were achieved to ensure protection of human health and the environment. The excavated area would be backfilled with certified clean fill as necessary and recontoured to eliminate topographic depressions.

Institutional controls in the form of land-use restrictions are not required because contamination does not remain above levels considered acceptable for a wetlands end use.

This alternative would require any contaminated soils removed to be shipped offsite. It would require disposal in an approved landfill or treatment at a recycling facility. Landfill disposal sites for nonhazardous and hazardous wastes are located throughout the United States. This remedial technology is generally accepted and is commonly used in industry. Offsite disposal costs are dependent on the distance to the disposal facility and the classification of the waste; therefore, waste profiling would be required. A few waste recycling facilities exist where the contaminated soils could be treated and combined with other materials to create an asphalt base for roadways.

3.4 Alternative 4 – Excavation and Onsite Disposal

Under this alternative, areas where remedial action is required (COCs are greater than chemical-specific RAOs) and sufficient stable cover is not practical, would require removal through excavation. Prior to initiating excavation activities, pre-design investigation borings would be drilled where necessary to determine the excavation geometry. Impacted material would be excavated using standard construction equipment. Excavation would continue until RAOs are achieved to ensure protection of human health and the environment. The excavated area would be backfilled with certified clean fill as necessary and recontoured to eliminate topographic depressions.

Institutional controls in the form of land-use restrictions are not required because contamination does not remain above levels considered unacceptable for a wetlands end-use. The excavated soils would be transported to an onsite consolidation/disposal area located in the general vicinity of the seasonal wetlands.

The consolidation site would require conformance to the substantive requirements of the RWQCB regulations. It is assumed that the excavated material would be considered a designated waste and would require Class II management; the waste would be characterized before determining the type of waste management unit. The consolidation site would be designed as a Class II non-municipal solid waste landfill, which would require a 2-foot clay liner or a synthetic liner and a leachate collection and removal system.

Following consolidation of the site materials, the consolidation site would require closure through installation of an engineered cap. The engineered cap would consist of an upper vegetation layer, a low permeability layer, and a foundation layer. The vegetative layer would consist of a clean top soil seeded with native grasses. This layer prevents contact with the consolidated materials, minimizes the impact of cracking and weathering, and provides a zone of evapotranspiration for precipitation. The low permeability layer typically consists of fine-grained soils such as low permeability clays (possibly Bay Mud) and would provide a more “impenetrable” barrier to infiltration as compared to overburden soils. Synthetic materials could also be used as a barrier or in conjunction with other natural materials to provide increased protection against infiltration. The foundation layer would consist of reworked and compacted existing consolidated soils. Details regarding the actual design of the engineered cap would be finalized during the remedial design phase.

The cover serves three purposes, as follows:

- To prevent contact with the consolidated material (i.e., cover acts as a barrier)
- To provide protection from wind and rain erosion
- To provide a zone of evapotranspiration to reduce precipitation infiltration

Passive gas vent wells would be included with the engineered cap to relieve gases which may otherwise build up beneath the engineered cap and to abate potential lateral migration of gases.

An engineered cap is a well-developed technology commonly used to cover waste disposal sites to prevent contact with landfill refuse and reduce precipitation infiltration. In many cases, engineered caps may be constructed of native materials. Alternately, if synthetic materials are used in the low permeability layer, specialized installation methods are necessary. The combined effects of low permeability and vegetation layers provide a highly impenetrable barrier that is weather resistant and impervious to freeze/thaw and shrink/swell cycles.

After completion of the capping activities, it would be necessary to maintain the property and provide institutional controls (e.g., fencing, security patrols) for a prescribed time frame to prevent access to the area. Additionally, post-closure maintenance would be required and would consist of cover-integrity monitoring, cover maintenance, and leachate collection and removal system maintenance.

SECTION 4

Detailed Analysis of Alternatives

This section presents a detailed analysis of the alternatives developed and described in Section 3. The purpose of the detailed analysis is to provide decision-makers with sufficient information to adequately compare the alternatives, select an appropriate remedy for each site, and demonstrate achievement of RAOs and statutory requirements in the ARARs. The four alternatives developed in Section 3 are analyzed for each of the Inboard Area sites listed in Table 1-8.

4.1 Introduction

The NCP sets forth nine evaluation criteria to address the statutory requirements and the additional technical and policy considerations proven to be important for selection of remedial alternatives. These evaluation criteria serve as the basis for conducting the detailed analysis during this FFS and for subsequently selecting appropriate remedial actions.

The first two criteria overall protection of human health and the environment and compliance with ARARs are termed threshold criteria. Alternatives that do not protect human health and the environment or do not comply with ARARs (or justify a waiver) will not meet statutory requirements for selection of a remedy and therefore, will be eliminated from further consideration. The next five criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost) are balancing criteria upon which the remedy selection will be primarily based. CERCLA guidance for conducting feasibility studies lists appropriate questions to be addressed when evaluating an alternative against the balancing criteria (EPA, 1988a). These questions were addressed during the detailed analysis process to provide a consistent basis for evaluation of each of the alternatives. The final two criteria (state [support agency] acceptance and community acceptance) will be evaluated in the Final ROD/RAP.

The U.S. Army is using its lead agency status and authority under CERCLA to implement the environmental restoration activities at HAAF. This FFS is being prepared in accordance with the statutory requirements of the CERCLA, as amended, in an effort to provide protectiveness of human health and the environment.

4.2 Assessment Criteria

The first seven of the nine CERCLA evaluation criteria were evaluated in this FFS and include:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, and volume
- Short-term effectiveness

- Implementability
- Cost

The remaining two criteria (state and community acceptance) will be evaluated following public comment on the Draft Final ROD/RAP.

The following sections describe the elements of the nine evaluation criteria used for detailed analysis of the remedial alternatives.

Overall Protection of Human Health and the Environment

This evaluation criterion assesses whether each alternative provides adequate protection of human health and the environment. Protection encompasses such concepts as reduction of risk to acceptable levels, either by concentration reduction or by elimination of potential for exposure, and minimization of threats introduced by actions during remediation, if any. There is substantial overlap between the protection evaluation criterion and the criteria of compliance with ARARs, long-term effectiveness and permanence, and short-term effectiveness. This criterion is a threshold requirement and the primary objective of the remedial program.

Compliance with Applicable or Relevant and Appropriate Requirements

Each alternative is assessed for attainment of federal and state ARARs. When an ARAR can not be met, the basis for justifying an allowed waiver must be presented. Each of the following is addressed for each alternative during the detailed analysis of ARARs:

- Compliance with chemical-specific ARARs, such as maximum contaminant levels
- Compliance with location-specific ARARs, such as wetland regulations
- Compliance with action-specific ARARs, such as closure and post-closure requirements

Long-Term Effectiveness and Permanence

This criterion addresses the results of a remedial action in terms of risk remaining at the site after RAOs have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated residual contamination. The following components of the criterion are addressed for each alternative.

- Magnitude of residual risk: This factor assesses the risk remaining from residual COCs at the conclusion of the proposed activities. The characteristics of the residual COCs will be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and reliability of controls: This factor assesses the adequacy and suitability of controls, if any, that are used to manage COCs that remain at the site. It also assesses the long-term reliability of management controls for providing continued protection from residuals and includes an assessment of potential needs for replacement of technical components of the alternative.

Reduction of Toxicity, Mobility, or Volume

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies, which permanently and significantly reduce toxicity, mobility, or volume of the contaminants. Permanent and significant reduction can be achieved through destruction of toxic contaminants, reduction of total mass, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media. This evaluation focuses on the following specific factors for each of the alternatives:

- Treatment processes the remedy will employ, and the materials they will treat
- Amount of hazardous materials that will be destroyed or treated, including how the principal threat(s) will be addressed
- Degree of expected reduction in toxicity, mobility, or volume through treatment as measured as a percentage of reduction
- Degree to which the treatment will be irreversible
- Type and quantity of treatment residuals that will remain following treatment
- Whether the alternative will satisfy the statutory preference for treatment as a principal element.

Short-Term Effectiveness

Under this criterion, alternatives are evaluated with respect to their effects on human health and the environment during the construction and implementation phases of the remedial action. The following factors are addressed for each alternative.

- Protection of the community during remedial actions to address any risk that results from implementation such as fugitive dusts, transportation of hazardous materials, or air-quality impacts from emissions.
- Protection of workers during construction and implementation.
- Environmental impacts that may result from the construction and implementation of the remedial action.
- The amount of time until the RAOs are achieved.
- Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of the required services and materials. Implementability refers to the technical, administrative, and environmental feasibility of implementing an alternative, and the availability of various materials and services required during implementation.

Cost

The detailed cost analysis of alternatives involves estimating the expenditures required to complete each measure in terms of both capital costs and annual operation and maintenance costs. Once these values have been identified and a present worth calculated for each alternative, a comparative evaluation can be made.

Cost estimates for each alternative are based on site-specific conceptual designs and are expressed in terms of year 2001 dollars. An estimate of this type, according to EPA guidance document (1988a), is usually expected to be accurate within plus 50 percent and minus 30 percent.

Estimates of the area and volume of the potentially contaminated soil are presented in Table 4-1 (located at the end of this section). Computational methodologies and detailed estimates for each Inboard Area Site are presented in Appendix B.

For cost estimation purposes, it was assumed that the upper 2 feet of consolidated site soil would be recontoured to minimize surface depressions, provide final grade, and provide an adequate foundation for the engineered cap. The engineered cap would consist of a 1-foot layer of refuse-free soil seeded with native grasses underlain by a 1-foot low permeability soil layer and a 2-ft foundation layer of reworked and compacted consolidated material.

State Acceptance

This criterion presents the technical and administrative issues and concerns that the state may have regarding each of the alternatives and will be evaluated in the Final ROD/RAP.

Community Acceptance

This criterion presents the issues and concerns the public may have regarding each of the alternatives and will be evaluated in the final ROD/RAP.

4.3 Detailed Analysis of Alternatives

The following presents an evaluation of the site-specific remedial action alternatives:

- Alternative 1 – No Further Action
- Alternative 2 – Institutional Controls
- Alternative 3 – Excavation with Offsite Disposal
- Alternative 4 – Excavation with Onsite Disposal

The evaluation of the alternatives for the first seven of the nine evaluation criteria is based on a conceptual future wetland land-use scenario. The remaining two criteria, state (support agency) acceptance and community acceptance, will be evaluated following receipt of comments on the Draft Final ROD/RAP.

Former Sewage Treatment Plant

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the FSTP. Pesticides (alpha-chlordane, gamma-chlordane, DDD, DDE, DDT, dieldrin, and endosulfan sulfate) were the COCs identified in the soil which would pose a potential risk to human and ecological receptors if these receptors were exposed to COCs during the development and maturation of the wetland. Figure B-1 identifies the areas where remedial action is proposed (i.e., the area where residual concentrations of COCs are detected above their chemical-specific RAOs) at the FSTP.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of human health and the environment in the short- or long-term. Although residual COCs are currently located at depths ranging from 2.5 to 10.5 feet bgs, under this alternative potential risks to human health and the environment would exist. The potential risks would exist because throughout the development and maturation of the wetland the potential for erosion or excavation would not be controlled, and the presence of cover would not be monitored. Potential ecological risks would exist for amphipods and the black rail because exposure to pesticides in soil would not be controlled or mitigated. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would also exist from ingestion of fish (recreational fishing scenario) containing pesticides (gamma-chlordane and dieldrin). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential human health and ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 259 yd^3 of soil containing pesticides would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above their chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above their chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short-term and long-term. Pesticides are currently located at depths ranging from 2.5 to 10.5 feet bgs. The institutional controls would detail performance criteria specifying that the final design for the wetland: must provide a minimum of 3 feet of cover, restrict excavation and erosion, and monitor the depth of cover in areas where COCs are detected above their chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above their chemical-specific RAOs.

Under this alternative, potential ecological risks would not exist for amphipods and the black rail because exposure to chlordanes (amphipods only), total DDTs, dieldrin (amphipods only), and endosulfan sulfate (amphipods only) would be eliminated though implementation of the wetland final design performance criteria (monitoring of cover and protection against erosion and/or excavation). Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would not exist from ingestion of fish (recreational fishing scenario) because potential fish exposure to pesticides (gamma-chlordane and dieldrin) would be controlled and monitored. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to the concentrations of pesticides detected above their chemical-specific RAOs. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure that a minimum of 3 feet of cover would be provided and restrictions would be implemented on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 259 yd^3 of soil containing pesticides would remain in place. However, performance criteria for monitoring of cover and prevention of erosion or excavation of cover at the site would eliminate exposure to the residual COCs.

Short-Term Effectiveness. The RAOs to prevent exposure of amphipods and the black rail to pesticides and human ingestion of fish contaminated from pesticides would be achieved by maintaining at least 3 feet of cover in the areas where concentrations of COCs are detected above chemical-specific RAOs (see Figure B-1). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of a final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed of at an approved offsite landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing pesticides and therefore, would be protective of human health and the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for amphipods and the black rail because soil containing concentrations of pesticides above chemical-specific RAOs would be removed to meet RAOs. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would not exist from ingestion of fish (recreational fishing scenario) because potential fish exposure to pesticides (gamma-chlordane and dieldrin) would be eliminated.

Operations associated with the excavations would introduce some potential short-term human health risk due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing pesticides would be physically removed from the site. This would immediately reduce the site risk and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations of pesticides detected above chemical-specific RAOs would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because soil containing COCs would be removed from the site. Excavation would achieve the RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as the Perimeter Levee and PDD, may complicate excavation and removal activities. During the 1999 Interim Removal Actions (IT, 2000), excavation activities were conducted to the extent practicable in relation to the location of the levee. It was necessary to backfill that portion of the excavation immediately to ensure stability of the levee. Special shoring may be needed during excavation activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $61,217.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Onsite Disposal alternative would remove soil containing pesticides and therefore, would be protective of human health and the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for amphipods and black rail because soil containing pesticides detected above chemical-specific RAOs would be removed to meet RAOs. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would not exist from ingestion of fish (recreational fishing scenario) because the potential for fish exposure to pesticides (gamma-chlordane and dieldrin) would be eliminated.

Operations associated with the excavations would introduce some potential short-term human health risk due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective at the site in the long-term because the soil containing pesticides would be physically removed from the site. This would immediately reduce the site risk. Removal of soil containing COCs would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because soil containing COCs would removed from the site. However, the soil are disposed of at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

At the onsite Class II consolidation landfill, post-closure care of the engineered cap would be performed in accordance with appropriate regulations as long as groundwater and/or soil vapor monitoring are in effect. The effectiveness of the landfill cap would be determined through water quality, soil gas, and leachate collection. Monitoring would continue for a minimum of 5 years. At the end of every 5-year period (up to year 30), an evaluation would be performed to determine if a change in monitoring frequency would be appropriate.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the FSTP because the soil containing the COCs would be removed from the site and disposed at an approved onsite location. Excavation would achieve the

RAOs and reduce the site risks. However, the soil containing the COC would remain on the BRAC Property. There would not be a reduction, but rather a transfer of the contaminant toxicity and volume from the FSTP to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is implementable both technically and administratively. This alternative may encounter opposition to obtaining a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be non-hazardous, but would be considered designated waste and would require Class II management. The presence of site-specific obstacles, such as the Perimeter Levee and PDD, may complicate excavation and removal activities. During the 1999 Interim Removal Actions (IT, 2000), excavation activities were conducted to the extent practicable in relation to the location of the levee. It was necessary to backfill that portion of the excavation immediately to ensure stability of the levee. Special shoring may be needed during excavation activities.

At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from Inboard Area sites for disposal. Following consolidation of all the onsite excavated soil, the consolidation site landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $17,752. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Building 26

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for Building 26. TPH measured as diesel was the COC identified in the soil which would pose a potential risk to ecological receptors if these receptors were exposed to contaminants of concern during the development and maturation of the wetland. Figure B-3 identifies the area where remedial action is proposed (i.e., the area where residual concentrations of COCs are detected above chemical-specific RAOs) at Building 26.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of the environment in the short- or long-term. Although the residual COC (TPH measured as diesel) is currently located at depths ranging from 5 to 5.5 feet bgs, under this alternative potential risks to the environment would exist. The potential risk would exist because throughout the development and maturation of the wetland the potential for erosion or excavation would not be controlled and the presence of cover would not be monitored. Under this alternative, potential ecological risks would exist for amphipods because exposure to TPH measured as diesel in soil would not be controlled or mitigated. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COC would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential ecological risks have been identified because the COC would remain in place. Potential exposure to the COC would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest approximately 46 yd^3 of soil containing TPH measured as diesel would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of the environment in the short- and long-term. TPH measured as diesel is currently located at depths ranging from 5 to 5.5 feet bgs. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where TPH measured as diesel is detected above chemical–specific RAO. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Under this alternative, potential ecological risks would not exist for amphipods because exposure to TPH measured as diesel would be eliminated through implementation of the wetland final design performance criteria (monitoring of cover and protection against erosion and/or excavation). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of TPH measured as diesel detected above chemical-specific RAO. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure implementation of restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest approximately 46 yd^3 of soil containing the residual COC would remain in place. However, performance criteria for monitoring of cover and prevention of erosion or excavation of cover at the site would eliminate exposure to the residual COC.

Short-Term Effectiveness. The RAO to prevent exposure of amphipods to TPH measured as diesel would be achieved by maintaining at least 3 feet of cover in the area concentrations are above the chemical-specific RAO (see Figure B-3). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal Description

Alternative 3 is Excavation with Offsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil with concentrations of COCs detected above chemical-specific RAOs would be excavated, transported, and disposed at an approved offsite landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as diesel and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods because soil containing concentrations of TPH-measured as diesel detected above chemical-specific RAO would be removed to meet the RAO.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing the COC would be physically removed from the site. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations of TPH measured as diesel detected above chemical-specific RAOs would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing the COC would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site specific obstacles, such as having to remove the backfill material used to fill UST excavation prior to conducting proposed excavation activities, may complicate excavation and removal activities. Also, the location of Building 26 would limit the extent of excavation to the northeast. There are no other site-specific obstacles that should complicate excavation and removal activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $23,610.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above their chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Onsite Disposal alternative would remove soil containing TPH measured as diesel and therefore would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods because soil containing concentrations of TPH measured as diesel detected above chemical-specific RAO would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants

by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing TPH measured as diesel would be physically removed from the site, which would immediately reduce the site risk. Removal of soil containing COCs would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COC would be removed from the site. However, the soil would be disposed at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

At the onsite Class II consolidation landfill, post-closure care of the engineered cap would be performed in accordance with appropriate regulations as long as groundwater and/or soil vapor monitoring are in effect. The effectiveness of the landfill cap would be determined through water quality, soil gas, and leachate collection. Monitoring would continue for a minimum of 5 years. At the end of every 5-year period (up to year 30) an evaluation would be performed to determine if a change in monitoring frequency would be appropriate.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at Building 26 because the soil containing the COC would be removed from the site and disposed at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COC would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from Building 26 to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is implementable both technically and administratively. This alternative may encounter opposition to obtaining a permit for installation of a Class II landfill on the BRAC property. The excavated materials are expected to be nonhazardous but would be considered designated waste and would require Class II management. The presence of site specific obstacles, such as having to remove the backfill material used to fill UST excavation prior to conducting proposed excavation activities. Also, the location of Building 26 would limit the extent of excavation to the northeast.

At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting soil from Inboard Area site for disposal. Following consolidation of all the onsite excavated soil, the consolidation site landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $9,696. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Building 35/39 Area

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the Building 35/39 Area. Pesticides (DDD, DDE, and DDT) were the COCs identified in the soil which would pose a potential risk ecological receptors if these receptors were exposed to residual COCs during the development and maturation of the wetland. Figure B-4 identifies the areas where remedial action is proposed (i.e., the areas where residual concentrations of COCs are above chemical-specific RAOs) at the Building 35/39 Area.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of the environment in the short- or long-term. Although residual COCs are currently located at depths ranging from 3 to 4.5 feet bgs, under this alternative potential risks to the environment would exist. The potential risk would exist because throughout the development and maturation of the wetland the potential for erosion or excavation would not be controlled and the presence of cover would not be monitored. Under this alternative, potential ecological risks would exist for amphipods, bay shrimp, algae, and black rail because exposure to pesticides in soil would not be controlled or mitigated. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential human health and ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 25 yd^3 of soil containing pesticides would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above their chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above their chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of the environment in the short-term and long-term. Pesticides are currently located at depths ranging from 3 to 4.5 feet bgs. The institutional controls would detail performance criteria specifying that the final design for the wetlands must: restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above their chemical-specific RAOs.

Under this alternative, potential ecological risks would not exist for amphipods, bay shrimp, algae, and black rail because exposure to pesticides in soil would be eliminated through implementation of the wetland final design performance criteria (monitoring of cover and protection against erosion and/or excavation). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of COCs detected above chemical-specific RAOs. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure implementation of restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 25 yd^3 of soil containing pesticides would remain in place. However, performance criteria for monitoring of cover and prevention of erosion or excavation of cover at the site would eliminate exposure to pesticides detected above chemical-specific RAOs.

Short-Term Effectiveness. The RAO to prevent exposure of amphipods, bay shrimp, algae and black rail to pesticides would be achieved by maintaining at least 3 feet of cover in the area concentrations are above the chemical specific RAO (see Figure B-4). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing pesticides and therefore would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods, bay shrimp, algae and black rail because soil containing concentrations pesticides detected above their chemical-specific RAOs would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing pesticides would be physically removed from the site. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations of pesticides detected above chemical-specific RAOs would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing COCs would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as the discharge pipe and concrete sump, may complicate excavation and removal activities. During the 1999 Interim Removal Actions (IT, 2000), excavation activities were conducted to the extent practicable in relation to the location of these structures. It was necessary to backfill that portion of the excavation immediately to ensure stability. Special shoring may be needed during excavation activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $17,384.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing pesticides and therefore, would be protective of the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for amphipods, bay shrimp, algae and the black rail because soil containing concentrations pesticides detected above chemical-specific ARARs would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing pesticides would be physically removed from the site. This would immediately reduce the site risk. Removal of soil containing COCs would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COCs would be removed from the site. However, the soil would be disposed at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

At the onsite Class II consolidation landfill, post-closure care of the engineered cap would be performed in accordance with appropriate regulations as long as groundwater and/or soil vapor monitoring are in effect. The effectiveness of the landfill cap would be determined through water quality, soil gas, and leachate collection. Monitoring would continue for a minimum of 5 years. At the end of every 5-year period (up to year 30) an evaluation would be performed to determine if a change in monitoring frequency would be appropriate.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the Building 35/39 Area because the soil containing the COCs would be removed from the site and disposed at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COCs would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the Building 35/39 Area to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtaining a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management. The presence of site-specific obstacles, such as the outfall pipe and concrete sump, may complicate excavation and removal activities. During the 1999 Interim Removal Actions (IT, 2000), excavation activities were conducted to the extent practicable in relation to the location of these structures. It was necessary to backfill that portion of the excavation immediately to ensure stability. Special shoring may be needed during excavation activities.

At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting soil from the Inboard Area site for disposal. Following consolidation of all the onsite excavated soil, the landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $9,947. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Building 41 Area

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the Building 41 Area. TPH measured as diesel and PAHs were the COCs identified in the soil which would pose a potential risk to ecological receptors if these receptors were exposed to contaminants of concern during the development and maturation of the wetland. Figure B-5 identifies the areas where remedial action is proposed (i.e., the areas where residual concentrations of COCs are above chemical-specific RAOs) at the Building 41 area.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of the environment in the short-term or long-term. Although residual COCs are currently located at depths ranging from 2.5 to 18.5 feet bgs, under this alternative potential risk to the environment would exist. The potential risk would exist because Building 41 would be removed during wetland construction activities and throughout the development and maturation of the wetland the potential for erosion or excavation would not be controlled and the presence of cover would not be monitored. Under this alternative, potential ecological risks would exist for pickleweed and amphipods because exposure to TPH measured as diesel (amphipod only) and PAHs in soil would not be controlled or mitigated. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 907 yd^3 of soil containing TPH measured as diesel and PAHs would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above their chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short- and long-term. TPH measured as diesel and PAHs are currently located at depths ranging from 2.5 to 18.5 feet bgs. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor depth of cover in areas where COCs are detected above chemical-specific RAO's. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Under this alternative, potential ecological risks would not exist for pickleweed and amphipods because exposure to TPH measured as diesel and PAHs in soil would be eliminated through implementation of the wetland final design performance criteria (monitoring of cover and protection against erosion and/or excavation). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of TPH measured as diesel and PAHs detected above chemical-specific RAOs. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls.

The performance criteria specified in the wetland final design would ensure implementation of restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 907 yd^3 of soil containing TPH measured as diesel and PAHs would remain in place. However, performance criteria for monitoring of cover and prevention of erosion or excavation of cover at the site would eliminate exposure to pesticides detected above chemical-specific RAOs.

Short-Term Effectiveness. The RAO to prevent exposure of pickleweed and amphipods to TPH measured as diesel and PAHs would be achieved by maintaining at least 3 feet of cover in the areas where concentrations are detected above chemical-specific RAOs (see Figure B-5). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above their chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as diesel and PAHs and therefore, would be protective of the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for pickleweed and amphipods because soil containing concentrations TPH measured as diesel and PAHs detected above chemical-specific RAOs would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants

by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing TPH measured as diesel and PAHs would be physically removed from the site. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations of TPH measured as diesel and PAHs detected above their chemical-specific RAOs would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing COCs would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as the Perimeter Levee, concrete and asphalt, a power pole, the PDD, and Building 41 may complicate excavation and removal activities. There are no other site-specific obstacles that should complicate excavation and removal activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $297,018.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above their chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as diesel and PAHs and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for pickleweed and amphipods because soil containing concentrations TPH measured as diesel and PAHs detected above chemical-specific RAOs would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing TPH measured as diesel and PAHs would be physically removed from the site. This would immediately reduce the site risk. Removal of soil containing COCs would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COCs would be removed from the site. However, the soil would be disposed at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

At the onsite Class II consolidation landfill, post-closure care of the engineered cap would be performed in accordance with appropriate regulations as long as groundwater and/or soil vapor monitoring are in effect. The effectiveness of the landfill cap would be determined through water quality, soil gas, and leachate collection. Monitoring would continue for a minimum of 5 years. At the end of every 5-year period (up to year 30) an

evaluation would be performed to determine if a change in monitoring frequency would be appropriate.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the Building 41 Area because the soil containing the COCs would be removed from the site and disposed at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COCs would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the Building 41 Area to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtaining a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management. Additionally, the presence of site-specific obstacles, such as the Perimeter Levee, asphalt and concrete, a power pole, the PDD, and Building 41 may complicate excavation and removal activities.

At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from the Inboard Area site for disposal. Following consolidation of all the onsite excavated soil, the landfill would required the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $25,024. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Building 82/87/92/94 Area and Building 86

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the Building 82/87/92/94 Area and Building 86. These areas were combined for the purposes of this evaluation due to their close proximity and general process history. Metals (barium and beryllium) were the COCs identified in the soil at the Building 82/87/92/94 Area which would pose a potential risk to ecological receptors if the receptors were exposed to these COCs during the development and maturation of the wetland. Metals (beryllium, cadmium, chromium, and lead) and PAHs were the COCs identified in the soil at Building 86 which would pose a potential risk to human and ecological receptors if the receptors were exposed to these COCs during the development and maturation of the wetland. Figure B-6 identifies the areas where remedial action is proposed (i.e., the areas where residual concentrations of COCs are above chemical-specific RAOs) at the Building 82/87/92/94 Area and Building 86.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of human health and the environment in the short- or long-term. Although residual COCs are currently located at depths ranging from 0.5 to 11.5 feet bgs, under this alternative potential risks to human health and the environment would exist. The potential risk would exist because throughout the development and maturation of the wetland the potential for erosion or excavation would not be controlled and the presence of cover would not be monitored. Potential ecological risks would exist for amphipods, pickleweed, salt marsh harvest mouse, black rail, algae, and mosquitofish because exposure to metals and PAHs (amphipod and pickleweed only) would not be mitigated. Similarly, potential human health risk would also exist at Building 86 from exposure (marsh recreational scenario) to PAHs (i.e. benz(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential human health and ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 4,103 yd^3 of soil containing metals and PAHs would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above their chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short- and long-term. The COCs are currently located at depths ranging from 0.5 to 11.5 feet bgs. The institutional control alternative would detail performance criteria that specify the final design for the wetland must restrict excavation and erosion, and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs were detected above chemical specific RAOs.

Under this alternative, potential ecological risks would not exist for amphipods, pickleweed, salt marsh harvest mouse, black rail, algae, or mosquitofish because exposure to metals and PAHs (amphipod and pickleweed only) would be eliminated through implementation of the wetland final design performance criteria (monitoring of cover and protection against erosion and/or excavation). Similarly, potential human health risks would not exist at Building 86 because exposure (marsh recreation) to PAHs would be controlled and monitored. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of metals and PAHs detected above their chemical-specific RAOs. There are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure implementation of restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest approximately 4,103 yd^3 of soil containing metals and PAHs would remain in place. However, performance criteria for monitoring of cover and prevention of erosion or excavation of cover at the site would eliminate exposure to concentrations of metals and PAHs detected above their chemical-specific RAOs.

Short-Term Effectiveness. The RAO to prevent exposure of amphipods, pickleweed, salt marsh harvest mouse, black rail, algae, and mosquitofish to metals and PAHs and human receptors to PAHs would be achieved by maintaining at least 3 feet of cover in the areas where concentrations of COCs are detected above chemical specific RAOs (see Figure B-6). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed at an approved offsite landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing metals and PAHs and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods, pickleweed, salt marsh harvest mouse, black rail, algae, or mosquitofish because soil containing concentrations metals and PAHs detected above chemical-specific RAOs would be removed to meet RAOs. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would not exist because exposure (marsh recreational scenario) to soil containing PAHs would be removed to meet the RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants

by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing metals and PAHs would be physically removed from the site. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations of metals and PAHs detected above chemical-specific RAOs would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing metals and PAHs would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as the NHP Levee, buildings, and asphalt pavement, may complicate excavation and removal activities. There are no other site-specific obstacles that complicate excavation and removal activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility for which the cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $1,298,674.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above their chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing metals and PAHs and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods, pickleweed, salt marsh harvest mouse, black rail, algae, or mosquitofish because soil containing concentrations of metals and PAHs detected above chemical-specific RAOs would be removed to meet RAOs. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would not exist because exposure (marsh recreational scenario) to soil containing PAHs would be removed to meet the RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing metals and PAHs would be physically removed from the site. This would immediately reduce the site risks. Removal of contaminated soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COC would be removed from the site. However, the soil would be disposed of at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

At the onsite Class II consolidation landfill, post-closure care of the engineered cap would be performed in accordance with appropriate regulations as long as groundwater and/or soil vapor monitoring are in effect. The effectiveness of the landfill cap would be determined through water quality, soil gas, and leachate collection. Monitoring would continue for a minimum of 5 years. At the end of every 5-year period (up to year 30) an

evaluation would be performed to determine if a change in monitoring frequency would be appropriate.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the Building 82/87/92/94 Area and Building 86 Inboard Area sites because the soil containing the COCs would be removed from the site and disposed of at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COCs would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the Building 82/87/92/94 Area and Building 86 Inboard Area sites to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtain a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management. The presence of site-specific obstacles, such as the NHP Levee, buildings, and asphalt pavement, may complicate excavation and removal activities.

At the Onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from the Inboard Area sites for disposal. Following consolidation of all the onsite excavated soil, the landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $68,254. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Perimeter Drainage Ditch

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the PDD. Beryllium and pesticides (DDD, DDE, DDT, and dieldrin) were the

COCs identified in the soil which would pose a potential risk to ecological and human health receptors if these receptors were exposed to these COCs during the development and maturation of the wetland. Figures B-8a and B-8b identify the areas where remedial action is proposed (i.e., the areas where residual concentrations of COCs are above their chemical-specific RAOs) at the PDD.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of human health and the environment in the short- or long-term. Although residual COCs are currently located at depths ranging from 1 to 1.5 feet bgs, under this alternative potential risks to human health and the environment would exist. The potential risk would exist because: a minimum of 3 feet of cover is not provided, the potential for erosion or excavation would not be controlled, and the presence of cover would not be monitored. Potential ecological risks would exist for amphipods, black rail, snipe, bay shrimp, algae, sediment invertebrate, and mosquitofish because exposure to beryllium (amphipod, sediment invertebrate, algae, and mosquito fish only) and pesticides in soil would not be controlled or mitigated. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would exist from ingestion of fish (recreational fishing scenario) containing dieldrin. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential human health and ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 14,296 yd^3 of soil containing pesticides and beryllium would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short-term and long-term. COCs are currently located at depths ranging from 1 to 1.5 feet bgs. The PDD will be backfilled during wetland construction, therefore, the institutional control alternative would detail performance criteria specifying that the final design for the wetland must: provide a minimum of 3 feet of cover, restrict excavation and erosion, and monitor the depth of cover in the areas where COCs were detected above chemical-specific RAOs.

Under this alternative, potential ecological risks would not exist for amphipods, black rail, snipe, bay shrimp, algae, sediment invertebrate, and mosquitofish because exposure to beryllium (amphipod, sediment invertebrate, algae, and mosquito fish only) and pesticides would be eliminated through implementation of the wetland final design performance criteria (providing cover, monitoring of cover, and protection against erosion and/or excavation). Similarly, potential human health risks would not exist from ingestion of fish (recreational fishing scenario) because potential fish exposure to dieldrin would be controlled and monitored. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of COCs detected above chemical-specific RAOs. There are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure a minimum of 3 feet of cover would be provided, and would implement restriction on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 14,296 yd^3 of soil containing beryllium and pesticides would remain in place. However, performance criteria for applying cover, monitoring cover, and prevention of erosion or excavation of cover at the site would eliminate exposure to concentrations of beryllium and pesticides detected above chemical-specific RAOs.

Short-Term Effectiveness. The RAOs to prevent exposure of amphipods, black rail, snipe, bay shrimp, algae, sediment invertebrates, and mosquitofish to beryllium and pesticides and human ingestion of fish contaminated by dieldrin would be achieved by maintaining at least 3 feet of cover in areas where concentrations of COCs are detected above chemical-specific RAOs (see Figures B-8a and B-8b). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed at an approved offsite landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing beryllium and pesticides and therefore, would be protective of the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for amphipods, black rail, snipe, bay shrimp, sediment invertebrate, and mosquitofish because soil containing concentrations of beryllium and pesticides detected above their chemical-specific RAOs would be removed to meet RAOs. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would not exist from ingestion of fish (recreational fishing scenario) because the potential for fish exposure to pesticides would be eliminated.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing COCs would be physically removed from the site. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations COCs requiring further action would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing COCs would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of water in the ditch and the moisture of the excavated sediment may complicate excavation, removal, and disposal activities.

Prior to removal of the sediments, specified lengths of the channel would need to be dewatered through pumping or installation of diversion or coffer dams. After removal of the sediments, the excavated material may need to be dried or blended with dry soil prior to disposal, to meet landfill acceptance criteria of moisture content.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with the EPA requirements for a feasibility study that the cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $4,502,006.

The cost estimates have been prepared for guidance in project evaluation and implementation from the best available data at the time of the estimate. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing beryllium and pesticides and therefore would be protective of the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for amphipods, black rail, snipe, bay shrimp, sediment invertebrate, and mosquitofish because soil containing concentrations of beryllium and pesticides detected above chemical-specific RAOs would be removed to meet RAOs. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would not exist from ingestion of fish (recreational fishing scenario) because the potential for fish exposure to pesticides would be eliminated.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing beryllium and pesticides would be physically removed from the site. This would immediately reduce the site risk. Removal of impacted soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COCs would be removed from the site. However, the soil would be disposed at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

At the onsite Class II consolidation landfill, post-closure care of the engineered cap would be performed in accordance with appropriate regulations as long as groundwater and/or soil vapor monitoring are in effect. The effectiveness of the landfill cap would be determined through water quality, soil gas, and leachate collection. Monitoring would continue for a minimum of 5 years. At the end of every 5-year period (up to year 30) an

evaluation would be performed to determine if a change in monitoring frequency would be appropriate.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at PDD because the soil containing the COCs would be removed from the site and disposed at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COCs would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the PDD to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is implementable both technically and administratively. This alternative may encounter opposition to obtain a permitting for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management. The presence of water in the ditch and the moisture of the excavated sediments may complicate excavation, removal, and disposal activities. Prior to removal of the sediments, specified lengths of the channel would need to be dewatered through pumping or installation of diversion or coffer dams. After removal of the sediments, the excavated material may need to be dried or blended with dry soil prior to disposal, to meet landfill acceptance criteria of moisture content.

At the Onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from the Inboard Area sites for disposal. Following consolidation of all the onsite excavated soil, the landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $214,879. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Perimeter Drainage Ditch Spoils Piles (A, B, D, E, F, G, I, J, K, L, M and N)

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for PDD Spoils Piles A, B, D, E, F, G, I, J, K, L, M and N. The following COCs were identified for each spoils pile:

- Spoils Pile A – Beryllium, zinc, DDE, and DDT
- Spoils Pile B – Cadmium, copper, mercury, silver, zinc, DDE, and DDT
- Spoils Pile D – DDE and DDT
- Spoils Pile E – DDE and DDT
- Spoils Pile F – Dibenzofuran, DDD, DDE, and DDT 8 Metals, and 12 PAHs,
- Spoils Pile G – DDE and DDT
- Spoils Pile I – Beryllium, DDE, and DDT
- Spoils Pile J – DDD, DDE, and DDT
- Spoils Pile K – DDE and DDT
- Spoils Pile L – Barium, cobalt, lead, zinc, and DDT
- Spoils Pile M – DDE and DDT
- Spoils Pile N – Lead, DDE, and DDT

The COCs identified in the soil at the PDD spoils piles would pose a potential risk to ecological receptors if these receptors were exposed to COCs during development and maturation of the wetland. The COCs identified at Spoils Pile F would also pose a potential risk to human receptors if these receptors were exposed to COCs during the development and maturation of the wetland. Figures B-9 and B-10 identifies the areas where remedial action is proposed (i.e., the area where residual concentrations of COCs are detected above their chemical-specific RAOs) at the PDD spoils piles.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment.

The No Further Action alternative would not be protective of human health and the environment in the short- or long-term. Although residual COCs are currently located at depths ranging from zero to 1 foot bgs, potential risks to human health and the environment would exist. The potential risk would exist because: a minimum of 3 feet of cover is not provided, the potential for erosion or excavation would not be controlled, and the presence of cover would not be monitored. Under this alternative, potential ecological risks would exist for the following receptors because exposure to COCs would not be controlled or mitigated:

Spoils Pile A – Exposure of pickleweed and amphipods to soil containing zinc and pesticides (amphipod only). Exposure of sediment invertebrate to water containing pesticides, and algae to water containing beryllium.

Spoils Pile B – Exposure of salt marsh harvest mouse, pickleweed, amphipods, black rail, bay shrimp, and algae to soil containing metals. Exposure of algae and sediment invertebrate to water containing copper.

Spoils Pile D – Exposure of amphipods to soil containing DDE and DDT. Exposure of sediment invertebrate to water containing DDE and DDT.

Spoils Piles E, K and M – Exposure of amphipods to soil containing DDE and DDT.

Spoils Piles F – Exposure of salt marsh harvest mouse, pickleweed, black rail, algae, and amphipods to soil containing metals and PAHs (pickleweed and amphipods). Exposure of bay shrimp, algae, black rail, and amphipods to pesticides. Exposure of humans to metals and PAHs from marsh recreation.

Spoils Pile G – Exposure of amphipods and black rails to soil containing pesticides.

Spoils Pile I – Exposure of amphipods to soil containing beryllium, DDD, and DDT.

Spoils Pile J – Exposure of amphipod to soil containing DDD, DDE, and DDT.

Spoils Pile L – Exposure of pickleweed and amphipods to soil containing DDD, DDE, and DDT.

Spoils Pile N – Exposure of amphipods and black rail to soil containing pesticides. Exposure of sediment invertebrate to water containing lead and pesticides.

Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would exist at Spoils Pile F from exposure (marsh recreational scenario) to soil containing benz(a)anthracene, benzo(a)pyrene, and benzo(b)flouranthene. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential human health and ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 4,180 yd^3 of soil containing metals, pesticides, PAHs, and dibenzofuran would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above their chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short- and long-term. COCs are currently located at depths ranging from zero to 1 foot bgs. The institutional control alternative would detail performance criteria specifying that the final design for the wetland must: provide a minimum of 3 feet of cover, restrict excavation and erosion, and monitor the depth of cover in the areas where COCs were detected above chemical-specific RAOs.

Under this alternative, potential ecological risks would not exist for ecological receptors because exposure to metals, PAHs dibenzofuran, and pesticides would be eliminated though implementation of the wetland final design criteria (providing cover, monitoring of cover, and protection against erosion and/or excavation). Similarly, potential human health risk would not exist from ingestion of fish (recreational fishing scenarios) because the potential for fish to be exposed to PAHs would be controlled and monitored. No additional threats would be introduced by this alternative.

<u>Spoils Pile A</u> – During the 1998 Interim Removal Actions (IT, 1999b), soil was removed from the footprint of the spoils pile down to the approximate original grade. One confirmation sample was taken at 1 foot bgs. Metals (zinc and beryllium) and total DDTs were detected above their comparator values in the confirmation sample.

<u>Spoils Pile B</u> – This spoils pile was removed to the approximate original grade in 1998. During the 1999 Interim Removal Actions (IT, 2000), the footprint of the spoils pile was excavated to a depth of 1.5 feet bgs (approximately 591 yd^3). Metals (cadmium, mercury, zinc, and sliver) and pesticides were detected above their comparator values in confirmation samples.

<u>Spoils Pile D</u> – The spoils pile was removed to the approximate original grade in 1998. Pesticides (total DDTs) were detected above the comparator value at a depth of 1 foot bgs.

Spoils Pile E – The spoils pile was removed to the approximate original grade in 1998. In 1999, an additional interim removal action was conducted at the site. Pesticides (total DDTs) were detected above chemical-specific ROAs in one sample collected at a depth of 1 foot bgs.

Spoils Pile F – There is no physical evidence to pinpoint the location of spoils pile F. Therefore, risks from Spoils Pile F are hypothetical at this time. The estimated location of the spoils pile is within the designed channel cut; thus all soil would be removed during wetland construction. In 1995, metals, PAHs, and pesticides were detected above chemical-specific RAOs at a depth of 0.5 foot bgs.

Spoils Pile G– The spoils pile was removed to the approximate original grade in 1998. Pesticides (total DDTs) were detected above chemical-special RAOs at a depth of 1 foot bgs.

Spoils Pile I – This spoils pile was removed to the approximate original grade in 1998. During the 1999 Interim Removal Actions (IT, 2000), the footprint of the spoils pile was excavated to a depth of 1.5 feet bgs (approximately 230 yd^3). Beryllium (1.1 mg/kg), was detected at its comparator value (1 mg/kg), and total DDTs were detected above chemical-specific RAOs.

Spoils Pile J – The spoils pile was removed to the approximate original grade in 1998. In 1999, an additional interim removal action was conducted at the site. Pesticides (total DDTs) were detected above chemical-specific RAOs at a depth of 0.5 foot bgs.

Spoils Pile K – The spoils pile was removed to the approximate original grade in 1998. Pesticides (total DDTs) were detected above chemical-specific RAOs at a depth of 1 foot bgs.

Spoils Pile L – This spoils pile was removed to the approximate original grade in 1998. During the 1999 Interim Removal Actions (IT, 2000), the footprint of the spoils pile was excavated to a depth of 1.5 feet bgs (approximately 100 yd^3). The potential ecological risks at this spoils pile were based on the confirmation sample collected from the 1998 excavation. The 1998 confirmation sample point was removed during the 1999 interim removal action. The confirmation sample collected from the 1999 interim removal excavation did not detect analytes above chemical-specific RAOs.

Spoils Pile M – The spoils pile was removed to the approximate original grade in 1998. Pesticides (total DDTs) were detected above chemical-specific RAOs at a depth of 1 foot bgs.

Spoils Pile N – This spoils pile was removed to the approximate original grade in 1998. Three confirmation samples were collected. Pesticides (total DDTs) were detected above chemical-specific RAOs in two samples collected at a depth of 0.5 foot bgs, and lead was detected above chemical-specific RAOs one sample collected at a depth of 0.5 foot bgs.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of COCs detected above chemical-specific RAOs. There are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls.

The performance criteria specified in the wetland final design would ensure a minimum of 3 feet of cover would be provided and would implement restrictions on excavation and/or erosion and of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 4,180 yd^3 (for all spoils piles) of soil containing metals, pesticides, PAHs, and dibenzofuran would remain in place. However, performance criteria for applying cover, monitoring cover, and prevention of erosion or excavation of cover at the site would eliminate exposure to concentrations of COCs detected above the chemical-specific RAOs.

Short-Term Effectiveness. The RAOs to prevent exposure of ecological receptors to COCs and human ingestion of fish contaminated by PAHs by maintaining at least 3 feet of cover in areas where concentrations of COCs are detected above chemical-specific RAOs (see Figures B-8 though B-10). The workers would be adequately protected.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above their chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing the COCs detected at each spoils pile and therefore, would be protective of the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for the human and ecological receptors because soil containing concentrations the COCs detected above chemical-specific RAOs at each spoils pile would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants

by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing COCs would be physically removed from each spoils pile. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations COCs requiring further action would be removed from the site and disposed at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing COCs would be removed from each spoils pile. Excavation would achieve RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as the PDD, may complicate excavation and removal activities. Additionally, the location of Spoils Pile F is not apparent since there is no physical evidence as to its existence. There are no other site-specific obstacles that should complicate excavation an removal activities.

Cost. Cost estimates for the individual spoils piles are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative for each spoils pile is as follows:

- Spoils Pile A - $55,892
- Spoils Pile B - $123,374
- Spoils Pile D - $60,244
- Spoils Pile E - $56,507

- Spoils Pile F - $182,305
- Spoils Pile G - $68,213
- Spoils Pile I - $41,202
- Spoils Pile J - $16,915
- Spoils Pile K - $32,852
- Spoils Pile L - $9,811
- Spoils Pile M - $126,722
- Spoils Pile N - $72,078.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing the COCs detected at each spoils pile and therefore, would be protective of human health and the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for the human and ecological receptors because soil containing concentrations the COCs detected above chemical-specific RAOs at each spoils pile would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing the COCs would be physically removed from each spoils pile. This would immediately reduce the site risk. Removal of soil containing COCs would be confirmed with confirmation samples at each spoils pile. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COCs would be removed from each spoils pile. However, the soil would be disposed of at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

At the onsite Class II consolidation landfill, post-closure care of the engineered cap would be performed in accordance with appropriate regulations as long as groundwater and/or soil vapor monitoring are in effect. The effectiveness of the landfill cap would be determined through water quality, soil gas, and leachate collection. Monitoring would continue for a minimum of 5 years. At the end of every 5-year period (up to year 30) an evaluation would be performed to determine if a change in monitoring frequency would be appropriate.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the PDD spoils piles because the soil containing the COCs would be removed from each spoils pile site and disposed of at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COCs would remain on the BRAC Property. There would not be a reduction but rather a transfer of toxicity and volume from the PDD spoils piles to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtain a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management. The presence of site-specific obstacles, such as the PDD may complicate excavation and removal activities. Additionally, the location of Spoils Pile F is not apparent since there is no physical evidence as to its existence.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative for each of the spoils piles is as follows:

- Spoils Pile A - $9,350
- Spoils Pile B - $11,817
- Spoils Pile D - $9,144

- Spoils Pile E - $7,697
- Spoils Pile F - $17,729
- Spoils Pile G - $9,436
- Spoils Pile I - $8,814
- Spoils Pile J - $7,559
- Spoils Pile K - $8,142
- Spoils Pile L - $8,611
- Spoils Pile M - $11,806
- Spoils Pile N - $9,942

This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Onshore Fuel Line – 54-inch Drain Line Segment

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the ONSFL–54-inch Drain Line Segment. TPH measured as gasoline is the COC identified in the soil which would pose a potential to ecological receptors if these receptors were exposed to COCs during the development and maturation of the wetland. Figure B-12 identifies the areas where remedial action is proposed (i.e., the areas where residual concentrations of COCs are detected above their chemical-specific RAOs) at the ONSFL-54-inch Drain Line Segment.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of the environment in the short-term or long-term. Although the residual COC (TPH measured as gasoline) is currently located at depths ranging from 3 to 11.5 feet bgs, under this alternative potential risks to the environment would exist. The potential risk would exist because throughout the development and maturation of the wetland the potential for erosion or excavation would not be controlled and the presence of cover would not be monitored. Potential ecological risks would exist for amphipods because exposure to TPH measured as gasoline in soil would not be controlled or mitigated. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COC would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential ecological risks have been identified because the COC would remain in place. Potential exposure to the COC would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 2,026 yd^3 of soil containing TPH measured as gasoline would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect and the environment by eliminating the exposure pathway between the residual COC and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above their chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where the COC is detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of the environment in the short- and long-term. TPH measures as gasoline is currently located at depths ranging from 3 to 11.5 feet bgs. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where the COC is detected above its chemical-specific RAO.

Under this alternative, potential ecological risks would not exist for amphipods because exposure to TPH measured as gasoline would be eliminated through implementation of the final wetland design performance criteria (monitoring of cover and protection against erosion and/or excavation). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of TPH measured as gasoline detected above its chemical-specific RAO. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure implementation of restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 2,026 yd^3 of soil containing TPH measured as gasoline would remain in place. However, restrictions placed on the site should reduce exposure to the constituents left in place.

Short-Term Effectiveness. The RAOs to prevent exposure of amphipods TPH measured as gasoline would be achieved by maintaining at least 3 feet of cover in areas where concentrations of the COC are detected above the chemical-specific RAO (see Figure B-12). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as gasoline and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods because soil containing concentrations TPH measured as gasoline detected above the chemical-specific RAO would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing TPH measured as gasoline would be physically removed from the site. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations of the TPH measured as gasoline detected above the chemical-specific RAO would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing TPH measured as gasoline would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as the 54-inch concrete line, may complicate excavation and removal activities. There are no other site-specific obstacles that should complicate excavation and removal activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $625,306.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as gasoline and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods because soil containing concentrations of TPH measured as gasoline detected above the chemical-specific RAO would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing TPH measured as gasoline would be physically removed from the site. This would immediately reduce the site risk. Removal of soil containing the COC would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COC would be removed from the site. However, the soil would be disposed of at an approved onsite consolidation/disposal location; therefore, the contaminants remain would on the BRAC Property.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the ONSFL-54 inch drain line segment because the soil containing the COC would be removed from the site and disposed of at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COC would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the ONSFL-54 inch drain line segment to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtaining permitting for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management. The presence of site-specific obstacles, such as the 54-inch drain line segment, may complicate excavation and removal activities.

At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from the Inboard Area site for disposal. Following consolidation of all the onsite excavated soil, the landfill would required the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost of the excavation and onsite disposal alternative is $17,623. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Onshore Fuel Line – Hangar Segment

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the ONSFL–Hangar Segment. TPH measured as gasoline and JP-4, ethylbenzene, xylenes, and PAHs were the COCs identified in the soil which would pose a potential risk to human and ecological receptors if these receptors were exposed to COCs during the development and maturation of the wetland. Figure B-13 identifies the areas where remedial action is proposed (i.e., the areas where residual concentrations of COCs detected above chemical-specific RAOs) at the ONSFL-Hangar Segment.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of human health and the environment in the short-term or long-term. Although residual COCs are currently located at depths ranging from 0.5 to 8 feet bgs, under this alternative potential risks to human health and the environment would exist. The potential risk would exist because a minimum of 3 feet of cover is not provided, the potential for erosion or excavation would not be controlled, and the presence of cover would not be monitored. Under this alternative, potential ecological risks would exist for amphipods, Salmonid, algae, and bay shrimp because of exposure to petroleum hydrocarbons (amphipods only), ethylbenzene, xylenes (amphipods and bay shrimp only), and PAHs (amphipods only) in soil would not be controlled or mitigated. Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would also exist from exposure (marsh recreational scenario) to PAHs (i.e. benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd pyrene). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential human health and ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 2,150 yd^3 of soil containing TPH measured as gasoline and JP-4, ethylbenzene, xylenes, and PAHs would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short-term and long-term. Residual COCs are currently located at depths ranging from 0.5 to 8 feet bgs. The institutional would detail performance criteria specifying that the final design for the wetland must provide a minimum of 3 feet of cover, restrict excavation and erosion, and monitor the depth of cover in the areas where COCs were detected above chemical-specific RAOs. No additional threats would be introduced by this alternative.

Under this alternative, potential ecological risks would not exist for amphipods, algae, salmonid, and bay shrimp because exposure to COCs would be eliminated through implementation of the wetland final design performance criteria (provide cover, monitoring of cover, and protection against erosion and/or excavation). Similarly, potential human health risks would not exist from exposure (marsh recreational scenario) to PAHs.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of COCs detected above chemical-specific RAOs. There are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure a minimum of 3 feet of cover would be provided, and would implement restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest approximately 2,150 yd^3 of soil containing TPH measured as gasoline and JP-4, VOCs, and PAHs would remain in place. However, performance criteria for applying cover, monitoring cover, and prevention of erosion or excavation of cover at the site would eliminate exposure to concentrations TPH measured as gasoline and JP-4 detected above chemical-specific RAOs.

Short-Term Effectiveness. The RAOs to prevent exposure of amphipods, algae, salmonid, bay shrimp, and humans to COCs would be achieved by maintaining at least 3 feet of cover in areas where concentrations of COCs are detected above chemical-specific RAOs (see

Figure B-13). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as gasoline and JP-4 VOCs and PAHs and therefore would be protective of the environment in the short-term and long-term.

Under this alternative, potential human and ecological risks would not exist for amphipods because soil containing concentrations of TPH measured as gasoline and JP-4 VOCs, and PAHs detected above chemical-specific RAOs would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing COCs would be physically removed from the site, which would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations COCs detected above chemical-specific RAOs would be removed from the site and disposed at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing COCs would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as asphalt, may complicate excavation and removal activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $701,748.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Onsite Disposal alternative would remove soil containing TPH measured as gasoline and JP-4

VOCs, and PAHs and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential human and ecological risks would not exist for amphipods because soil containing concentrations TPH measured as gasoline and JP-4 VOCs, and PAHs detected above chemical-specific RAOs would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing petroleum hydrocarbons, VOCs, and PAHs would be physically removed from the site. This would immediately reduce the site risk. Removal of impacted soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COCs would be removed from the site. However, the soil would be disposed of at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the ONSFL-Hangar segment because the soil containing the COCs would be removed from the site and disposed of at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COCs would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the ONSFL-Hangar segment to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition in obtaining a permit a for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management.

The presence of site-specific obstacles, such as asphalt, may complicate excavation and removal activities. At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil for disposal. Following consolidation of all the Onsite excavated soil, the landfill would required the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $52,976. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Onshore Fuel Line – Northern Segment

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the ONSFL–Northern Segment. TPH measured as gasoline was the only COC identified, to pose a potential risk to ecological receptors if these receptors were exposed to the COC during the development and maturation of the wetland. Figure B-14 identifies the areas where remedial action is proposed (i.e., the areas where residual concentrations of COCs are detected above chemical-specific RAOs) at the ONSFL-Northern Segment.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of the environment in the short- or long-term. Although the residual COC (TPH measured as gasoline) is currently located at depths ranging from 0.5 to 5.5 feet bgs, under this alternative, potential risks to the environment would exist. The potential risk would exist because a minimum of 3 feet of cover is not provided, the potential for erosion or excavation would not be controlled, and the presence of cover would not be monitored. Under this alternative, potential ecological risks would exist for amphipods because exposure to TPH measured as gasoline in soil would not be controlled or mitigated. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COC would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential ecological risks have been identified because the COC would remain in place. Potential exposure to the COC would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 1,807 yd^3 of soil containing TPH measured as gasoline would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect the environment by eliminating the exposure pathway between the residual COC and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where the COC is detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of the environment in the short-term and long-term. The COC is currently located at depths ranging from 0.5 to 5.5 feet bgs. The institutional controls alternative would detail performance criteria specifying that the final design for the wetland must: provide a minimum of 3 feet of cover, restrict excavation and erosion, and monitor the depth of cover in areas where TPH measured as gasoline is detected above chemical-specified RAO.

Under this alternative, potential ecological risks would not exist for amphipods because exposure to TPH measured as gasoline would be eliminated through implementation of the wetland final design performance criteria (providing cover, monitoring of cover, and protection against erosion and/or excavation). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of the COC detected above chemical-specific RAOs. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure a minimum of 3 feet of cover would be provided, and would implement of restrictions on excavation and/or erosion and monitor the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 1,807 yd^3 of soil containing TPH-measured as gasoline would remain in place. However, performance criteria for applying cover, monitoring cover, and prevention of erosion or excavation of cover at the site would eliminate exposure to concentrations of TPH measured as gasoline detected above the chemical-specific RAO.

Short-Term Effectiveness. The RAO to prevent exposure of amphipods to TPH measured as gasoline would be achieved by maintaining at least 3 feet of cover in areas where the COC is detected above the chemical-specific RAO. The workers would be adequately protected.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above their chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as gasoline and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods because soil containing concentrations TPH measured as gasoline detected above chemical-specific RAO would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing TPH measured as gasoline would be physically removed from the site, which would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations TPH measured as gasoline detected above the chemical-specific RAO requiring further action would be removed from the site and disposed at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing the COC would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is implementable both technically and administratively. There are no site-specific obstacles that would complicate excavation and removal activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative is $571,294.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above their chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing TPH measured as gasoline and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods because soil containing concentrations TPH measured as gasoline detected above the chemical-specific RAO would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing TPH measured as gasoline would be physically removed from the site, which would immediately reduce the site risk. Removal of impacted soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COC would be removed from the site. However, the soil would be disposed of at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the ONSFL-Northern segment because the soil containing the COC would be removed from the site and disposed at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COC would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the ONSFL-Northern segment to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtaining a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management.

At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from the Inboard Area site for disposal. Following consolidation of all the onsite excavated soil, the landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $29,346. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Northwest Runway Area

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for the Northwest Runway Area. Metals (beryllium and boron) were the COCs identified in the soil which would pose a potential risk to ecological receptors if these receptors were exposed to COCs during the development and maturation of the wetland. Figure B-15 identifies the area where remedial action is proposed (i.e., the area where residual concentrations of COCs are detected above chemical-specific RAOs) at the Northwest Runway Area.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of the environment in the short-term or long-term. Although residual COCs are currently located at depths ranging from 5 to 15 feet bgs, potential risks to the environment would exist. The potential risk would exist because throughout the development and maturation of the wetland the potential for erosion or excavation would not be controlled and the presence of cover would not be monitored. Under this alternative, potential ecological risks would exist for amphipods and pickleweed because exposure to beryllium (amphipod only) and boron (pickleweed only) in soil would not be controlled or mitigated. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest approximately 222 yd^3 of soil containing metals would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short-term and long-term. COCs are present at depths ranging from 5 to 15 feet bgs. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs.

Under this alternative potential ecological risks would not exist for amphipods and pickleweed because exposure to metals would be eliminated through implementation of the final design performance criteria (monitoring of cover and protection against erosion and/or excavation). No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of COCs detected above chemical-specific RAOs. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the wetland final design would ensure implementation of restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 222 yd^3 of soil containing metals would remain in place. However, performance criteria for monitoring of cover and prevention of erosion or excavation of cover at the site would eliminate exposure to concentrations of metals detected above chemical-specific RAOs.

Short-Term Effectiveness. The RAOs to prevent exposure of amphipods and pickleweed to metals would be achieved by maintaining at least 3 feet of cover in the areas where concentrations of COCs are detected above chemical-specific RAOs (see Figure B-15). Potential risks can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing metals and therefore, would be protective of the environment in the short- and long-term.

Under this alternative, potential ecological risks would not exist for amphipods and pickleweed because soil containing concentrations of metals detected above chemical-specific RAOs would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil would be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing metals would be physically removed from the site. This would immediately reduce the site risks and achieve RAOs. Removal of the soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations metals detected above their chemical-specific RAOs would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing metals would be removed from the site. Excavation would achieve RAOs. Although the soil would be disposed of at an offsite facility, toxicity and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. There are no site-specific obstacles that would complicate excavation and removal activities.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost estimate for the excavation and offsite disposal alternative is $76,566.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Onsite Disposal alternative would remove soil containing metals and therefore, would be protective of the environment in the short-term and long-term.

Under this alternative, potential ecological risks would not exist for amphipods because soil containing concentrations metals requiring further action would be removed to meet RAOs.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs would be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil would be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil would be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because the soil containing metals would be physically removed from the site. This would immediately reduce the site risks. Removal of contaminated soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COCs would be removed from the site. However, the soil would be disposed of at an approved onsite consolidation/disposal location; therefore, the contaminants would remain on the BRAC Property.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the Northwest Runway Area because the soil containing the COCs would be removed from the site and disposed of at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, soil containing the COCs would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the Northwest Runway Area to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of soil.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtain a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management.

At the Onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from the Inboard Area site for disposal. Following consolidation of all the onsite excavated soil, the landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative is $9,872. This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Revetment Area

The following presents the detailed evaluation for the No Further Action, Institutional Control, Excavation with Offsite Disposal, and Excavation with Onsite Disposal remedial alternatives for Revetments 1, 2, 3, 4, 6, 7, 11, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, and 26. The following COCs were identified for each revetment:

- Revetment 1 – Barium, cadmium, lead, and PAHs
- Revetment 2 – Cadmium, lead, and dibenz(a,h)anthracene
- Revetment 3 – Barium, copper, and manganese
- Revetment 4 – Cadmium, lead, acenaphthene, fluorene, and phenanthrene
- Revetment 6 – TPH measured as gasoline, 2-methylnaphthalene, acenaphthen, and fluorene
- Revetment 7 – Lead and 11 PAHs
- Revetment 11 – Copper
- Revetment 12 - Copper
- Revetment 13 – Cadmium, lead, and 9 PAHs
- Revetment 14 – TPH measured as diesel
- Revetment 15 – Cadmium and lead
- Revetment 16 – Barium
- Revetment 19 – Barium, cadmium, copper, lead, TPH measures as diesel and gasoline, and 11 PAHs
- Revetment 20 – Cadmium, phenanthrene, and pyrene
- Revetment 21 – Copper, vanadium, TPH measured as diesel and gasoline, 2-methylnaphthalene, and fluorene

- Revetment 22 – TPH measured as diesel and gasoline, 2-methylnaphthalene, acenaphthene, and fluorene
- Revetment 23 – Copper
- Revetment 25 – Barium and TPH measured as diesel
- Revetment 26 – Barium, boron, manganese, and TPH measures as diesel and gasoline

The COCs identified in the soil at the revetments would pose a potential risk to ecological receptors if these receptors were exposed to COCs during development and maturation of the wetland. The COCs identified at Revetments 13 and 19 would also pose a potential risk to human receptors if these receptors were exposed to COCs during the development and maturation of the wetland. Figures B-16 identifies the area where remedial action is proposed (i.e., the area where residual concentrations of COCs are detected above chemical-specific RAOs) at the Revetments.

Alternative 1 – No Further Action

Description

Alternative 1 is No Further Action. No actions would be initiated to control potential site-related risks.

Assessment

Overall Protection of Human Health and the Environment. The No Further Action alternative would not be protective of human health and the environment in the short- or long-term. Although some of the residual COCs are currently located beneath concrete, potential risks to human health and the environment would exist. The potential risk would exist because a minimum of 3 feet of cover is not provided for the revetments with surface contamination, the potential for erosion or excavation would not be controlled, and the presence of cover would not be monitored. The potential ecological risks for each revetment would exist because exposure to the COCs would not be controlled or mitigated.

<u>Revetments 1, 2, and 4</u> – Exposure of black rail and amphipods to soil containing metals and PAHs (amphipod only).

<u>Revetment 3</u> – Exposure of amphipods, salt marsh harvest mouse, algae, pickleweed, and bay shrimp to soil containing metals.

<u>Revetment 6</u> – Exposure of amphipod to soil containing TPH measured as gasoline, 2-methylnaphthalene, acenaphthene, and fluorene.

<u>Revetment 7</u> – Exposure of black rail to soil containing lead, and amphipod to soil containing PAHs.

<u>Revetments 11 and 23</u> – Exposure of salt marsh harvest mouse to soil containing copper.

<u>Revetment 12</u> – Exposure of salt marsh harvest mouse, bay shrimp, and algae to soil containing copper.

<u>Revetment 13</u> – Exposure of the black rail to soil containing lead, amphipod to soil containing PAHs, and human exposure to soil containing benzo(a)pyrene from marsh recreation.

Revetment 14 – Exposure of amphipods to soil containing TPH measured as diesel.

Revetment 15 – Exposure to amphipods and black rail to soil containing metals.

Revetment 16 – Exposure of amphipod and algae to soil containing barium.

Revetment 19 – Exposure of algae, salt marsh harvest mouse, and black rail to soil containing metals, and human exposure to benzo(a)pyrene.

Revetment 20 – Exposure of amphipods to soil containing cadmium, phenanthrene, and pyrene.

Revetment 21 – Exposure of salt marsh harvest mouse and pickleweed to soil containing metals, amphipods to soil containing TPH measures as diesel and gasoline, 2-methylnaphthalene, and fluorene.

Revetment 22 – Exposure of amphipods to soil containing TPH measured as diesel and gasoline, 2- methylnaphthalene, acenaphthene, and flourene.

Revetment 25 – Exposure of amphipod to soil containing barium and TPH measured as diesel.

Revetment 26 – Exposure of algae, bay shrimp, and pickleweed to soil containing metals, amphipods to soil containing metals, and TPH measured as diesel and gasoline.

Similarly, potential human health risk (ILCR greater than $1x10^{-6}$) would exist at Revetments 13 and 19 from exposure (marsh recreational scenario) to benzo(a)pyrene. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The No Further Action alternative does not achieve the chemical-specific TBC criteria. The COCs would remain in place, and exposure would not be controlled or monitored. Since action is not proposed, there are no action- or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The No Further Action alternative is not expected to be effective in the long-term because no remedial actions are proposed. Potential human health and ecological risks have been identified because COCs would remain in place. Potential exposure to COCs would not be controlled or monitored.

Reduction of Toxicity, Mobility, or Volume. The No Further Action alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 8,448 yd^3 of soil containing metals, petroleum hydrocarbons, and PAHs would remain in place.

Short-Term Effectiveness. No remedial actions are proposed; therefore, the RAOs would not be achieved. Since no remedial actions are proposed, there would not be any short-term risks to the public, worker, and/or environment.

Implementability. The No Further Action alternative would not have implementation obstacles because remedial actions are not proposed. Implementation of this alternative does not introduce additional risks.

Cost. No costs would be associated with implementing the No Further Action alternative.

Alternative 2 – Institutional Controls

Description

Alternative 2 is Institutional Controls. The goal of this alternative is to protect human health and the environment by eliminating the exposure pathway between residual COCs and future wetland receptors. The institutional controls would detail performance criteria specifying that the final design for the wetland must restrict excavation and erosion and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs. The final design must maintain at least 3 feet of cover in the areas where COCs are detected above chemical-specific RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Institutional Controls alternative would be protective of human health and the environment in the short- and long-term. COCs are currently present beneath the concrete revetment pads and in surface soil surrounding the concrete revetment. The institutional controls alternative would detail performance criteria specifying that the final design for the wetland must provide a minimum of 3 feet of cover, restrict excavation and erosion, and monitor the depth of cover in areas where COCs are detected above chemical-specific RAOs.

Under this alternative, potential ecological risks would not exist for ecological receptors because exposure to metals, PAHs, and petroleum hydrocarbons would be eliminated through implementation of the final wetland design criteria (providing cover for surface soil contamination, monitoring of cover, and protection against erosion and/or excavation). Similarly, potential human health risk would not exist at Revetments 13 and 19 from exposure (marsh recreation scenario) to benzo(a)pyrene. No additional threats would be introduced by this alternative.

Compliance with Applicable or Relevant and Appropriate Requirements. The performance criteria specified for the Institutional Controls alternative will meet chemical-specific TBC criteria when 3 feet of stable cover cannot be provided. The alternative would prevent and monitor exposure of receptors to concentrations of COCs detected above chemical-specific RAOs. There are no action-specific or location-specific ARARs identified for this alternative.

Long-Term Effectiveness and Permanence. The Institutional Controls alternative is expected to be effective in the long-term through the use of proprietary and governmental controls. The performance criteria specified in the final wetland design would ensure a minimum of 3 feet of cover would be provided (where necessary) and implementation of restrictions on excavation and/or erosion and monitoring of the level of cover throughout the development and maturation of the wetland.

Reduction of Toxicity, Mobility, or Volume. The Institutional Controls alternative does not include any treatment to reduce toxicity, mobility, or volume. Current estimates suggest that approximately 8,448 yd^3 of soil containing COCs would remain in place. However, performance criteria for applying cover, monitoring cover, and prevention of erosion or excavation of cover at the site would eliminate exposure to concentrations of COCs detected above chemical-specific RAOs.

Short-Term Effectiveness. The RAOs to prevent exposure of ecological receptors to COCs and humans to benzo(a)pyrene during marsh recreation (at Revetments 13 and 19) would be achieved by maintaining at least 3 feet of cover in areas where concentrations of COCs are detected above chemical-specific RAOs in surface soil (see Figure B-16). Potential risks to workers can be controlled and minimized through proper health and safety procedures.

Implementability. The Institutional Controls alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. The performance criteria and monitoring requirements are easily implementable. Enforcement and verification of the recommendations should be a priority.

Cost. Placement of cover and monitoring of the physical development of the wetland are necessary components of the wetland restoration program regardless of the need for remedial action. The performance criteria are designed to provide flexibility in the development and selection of final design and are expected to have only a minor impact on design details. Accordingly, there is no significant incremental cost associated with this alternative.

Alternative 3 – Excavation with Offsite Disposal

Description

Alternative 3 is Excavation with Offsite Disposal remedial alternative. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil concentrations of COCs above chemical-specific RAOs would be excavated, transported, and disposed at an approved off site landfill. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Offsite Disposal alternative would remove soil containing PAHs, metals, and petroleum hydrocarbon and therefore, would be protective of human health and the environment in the short-term and long-term.

Operations associated with the excavations would introduce some potential short-term human health risks due to the potential for direct contact or inhalation of the contaminants by workers during excavation activities. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Offsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs will be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the offsite disposal option, excavated soil will be characterized and compared to land ban restrictions prior to transport and disposal. All excavated soil will be managed, handled, and characterized using an approved plan prior to transporting offsite.

Long-Term Effectiveness and Permanence. The Excavation and Offsite Disposal alternative is expected to be effective in the long-term because soil containing COCs would be physically removed from the site. This would immediately reduce the site risk. Removal of the soil will be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence because the concentrations of COCs detected above chemical-specific RAOs would be removed from the site and disposed of at an appropriate offsite facility.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Offsite Disposal alternative would provide a high degree of mobility reduction because the soil containing the COCs would be removed from the site. Excavation would achieve the RAOs. Although the soil would be disposed of at an offsite facility, toxicity, and volume would not be reduced since no treatment of the soil is proposed.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the contaminated materials.

Implementability. The Excavation and Offsite Disposal alternative technology is well established and is technically and administratively implementable. However, the presence of site-specific obstacles, such as concrete revetment pads, may complicate excavation and removal activities.

Cost. Cost estimates for each of the revetments are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and offsite disposal alternative for each of the revetments is as follows:

- Revetment 1 - $211,033
- Revetment 2 - $142,096
- Revetment 3 - $160,424
- Revetment 4 - $227,718
- Revetment 6 - $112,184
- Revetment 7 - $55,992
- Revetment 11 - $21,516
- Revetment 12 - $14,006
- Revetment 13 - $142,596
- Revetment 14 - $164,622
- Revetment 15 - $94,973
- Revetment 16 - $162,415
- Revetment 19 - $242,280
- Revetment 20 - $170,446
- Revetment 21 - $167,867
- Revetment 22 - $156,872
- Revetment 23 - $226,934
- Revetment 25 - $164,373
- Revetment 26 - $156,810.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

Alternative 4 – Excavation with Onsite Disposal

Description

Alternative 4 is Excavation with Onsite Disposal. Actions to control site-related risks would consist of conducting a pre-design investigation that would include installation of soil borings to determine the excavation geometry. Following the pre-design investigation, soil containing COCs detected above chemical-specific RAOs would be excavated and transported to an onsite location for consolidation and disposal. Confirmation samples would be collected to verify that the site achieves RAOs.

Assessment

Overall Protection of Human Health and the Environment. The Excavation and Onsite Disposal alternative would be effective in removing the PAH-, metals-, and petroleum hydrocarbon-impacted soil and therefore reducing the potential unacceptable ecological risks that were identified for amphipods, pickleweed, black rail, salmonid, salt marsh harvest mouse, bay shrimp, and algae and unacceptable human health risks identified for marsh recreational receptors to acceptable levels (i.e., less than comparator values).

Operations associated with the excavations would afford a lesser overall short-term protection of human health and the environment due to the potential risks associated with direct contact or inhalation of the contaminants by workers. However, these risks can be controlled and minimized through proper health and safety procedures.

Compliance with Applicable or Relevant and Appropriate Requirements. The Excavation and Onsite Disposal alternative is expected to satisfy chemical-specific TBC criteria and location- and action-specific ARARs. The action-specific ARARs will be achieved through implementation of appropriate procedures, management practices, dust suppression, and air monitoring during remedial activities. In conjunction with the onsite disposal option, excavated soil will be characterized prior to transport to the onsite consolidation area for disposal. All excavated soil will be managed, handled, and characterized using an approved plan prior to transporting and consolidating onsite.

Long-Term Effectiveness and Permanence. The Excavation and Onsite Disposal alternative is expected to be effective in the long-term because soil contaminating COCs will be physically removed from the site. This would immediately reduce the site risk. Removal of contaminated soil would be confirmed with confirmation samples. Excavation would provide the greatest degree of effectiveness and permanence at the site because the soil containing the COCs would be removed from the site. However, the soil would be disposed of at an approved onsite consolidation/disposal location; therefore the contaminates would remain on the BRAC property.

Reduction of Toxicity, Mobility, or Volume. The Excavation and Onsite Disposal alternative would reduce mobility at the Revetment Area because the soil containing COCs would be removed from the site and disposed of at an approved onsite location. Excavation would achieve the RAOs and reduce the site risks. However, the soil containing COCs would remain on the BRAC Property. There would not be a reduction, but rather a transfer of toxicity and volume from the Revetment Area to the onsite consolidation site. The engineered cap would reduce infiltration of precipitation and potential contaminant migration. Landfill gases (if present) would be passively vented above the breathing zone.

Short-Term Effectiveness. Excavation would achieve the RAOs at the completion of the removal and disposal activities. There is a potential for release of fugitive dusts during the remedial action activities; however, this would be mitigated by developing and implementing appropriate health and safety procedures. Additionally, there may be short-term risks to the public and/or workers during excavation activities through exposure, handling, and transport of the impacted materials.

Implementability. The Excavation and Onsite Disposal technology is well established and is technically and administratively implementable. This alternative may encounter opposition to obtain a permit for installation of a Class II landfill on the BRAC Property. The excavated materials are expected to be nonhazardous, but would be considered designated waste and would require Class II management. The presence of site-specific obstacles, such as the presence of the concrete revetment pads, may complicate excavation and removal activities.

At the onsite consolidation site, a Class II non-municipal solid waste landfill would have to be designed, permitted, and installed prior to excavating and transporting site soil from the Inboard Area sites for disposal. Following consolidation of all the onsite excavated soil, the landfill would require the installation of an engineered cap for closure.

Cost. Cost estimates are provided in Appendix C. These costs are order-of-magnitude level estimates consistent with EPA requirements for a feasibility study for which cost estimates have an accuracy of plus 50 percent to minus 30 percent. The estimated cost for the excavation and onsite disposal alternative for each of the revetments is as follows:

- Revetment 1 - $19,348
- Revetment 2 - $14,226
- Revetment 3 - $16,240
- Revetment 4 - $19,959
- Revetment 6 - $1,227
- Revetment 7 - $814
- Revetment 11 - $8,561
- Revetment 12 - $10,887
- Revetment 13 - $14,246
- Revetment 14 - $17,080
- Revetment 15 - $11,246
- Revetment 16 - $16,312
- Revetment 19 - $21,806
- Revetment 20 - $17,866
- Revetment 21 - $16,486
- Revetment 22 - $18,686
- Revetment 23 - $16,347

- Revetment 25 - $17,070
- Revetment 26 - $17,424.

This does not include the cost for construction and capping of the consolidation site.

The cost estimates have been prepared from the best available data at the time of the estimate for guidance in project evaluation and implementation. The final cost of the project would depend on the actual labor and material costs, actual site conditions, final project scope and design, productivity, competitive market conditions, final project schedule, and other variable factors. As a result, the final project costs may vary from those presented in this FFS.

4.4 Comparative Analysis

The comparative analysis of remedial alternatives evaluated the relative performance of each alternative with respect to seven of the nine specific evaluation criteria presented in Section 4.2. The last two criteria, state (support agency) acceptance and community acceptance, would be addressed in the ROD/RAP. The purpose of the comparative analysis was to identify the advantages and disadvantages of each alternative so that key tradeoffs can be identified.

The first two criteria (overall protectiveness of human health and the environment and compliance with ARARs) serve as threshold determinations in that they must be met by any alternative for it to be eligible for selection. The next five criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, and volume; short-term effectiveness; implementability; and cost), are compared such that major tradeoffs among the alternatives are realized and weighed in the decision-making process. Table 4-2 presents a summary of the comparative analysis.

TABLE 4-1
Estimated Area and Volume Calculations for Proposed Remedial Action Areas
Focused Feasibility Study Evaluation

Reference Sample within Excavation Area	Area (square feet)	Depth (feet below ground surface)	Volume (cubic feet)	Volume (cubic yards)
Former Sewage Treatment Plant				
FSTP-CS-001	580	4	2,320	86
FSTP-CS-003	740	4	2,960	110
CS-FSTP-B03	100	10.5	1,050	39
SB-FSTP-015	100	6.5	650	24
		Total	**6,980**	**259**
Building 26				
PH-B026-004	250	5	1,250	46
		Total	**1,250**	**46**
Building 35/39 Area				
B35E-CS-005 and 006	96	3.5	336	12
B-35E-CS-002	75	4.5	338	13
		Total	**674**	**25**
Building 41 Area				
CS-PSA4-S04	2,520	6.5	16,380	607
B41E-CS-003	750	9	6,750	250
SB-UST41-01	150	9	1,350	50
		Total	**24,480**	**907**
Building 82/87/92/94 Area and Building 86				
AM-MW-101	2,612	2.5	6,530	242
AM-MW-102	100	2	200	7
SB-SD1-01	6,100	12.5	76,250	2,824
AM-TP-03	1,500	5.5	8,250	306
SB-SD1-08	1,500	10	15,000	556
AM-TP-05	600	4	2,400	89
AM-MW-104	300	4	1,200	44
AM-SD-03	100	1	100	4
AM-SD-02	100	2.5	250	9
PH-AMSD-05Q	100	6	600	22

TABLE 4-1
Estimated Area and Volume Calculations for Proposed Remedial Action Areas
Focused Feasibility Study Evaluation

Reference Sample within Excavation Area	Area (square feet)	Depth (feet below ground surface)	Volume (cubic feet)	Volume (cubic yards)
		Total	**110,780**	**4,103**
Perimeter Drainage Ditch (PDD)				
PDD-SD01	72,000	1.5	108,000	4,000
SS-PDUL-B01	6,000	3	18,000	667
HB-99-SD-29 and 29	260,000	1	260,000	9,630
		Total	**386,000**	**14,296**
PDD Spoils Piles				
Spoils Pile A	4,172	1	4,172	155
Spoils Pile B	57,674	1	57,674	2,136
Spoils Pile D	4,609	1	4,609	171
Spoils Pile E	4,273	1	4,273	158
Spoils Pile F	14,822	1	14,822	549
Spoils Pile G	5,302	1	5,302	196
Spoils Pile I	2,905	1	2,905	108
Spoils Pile J	833	1	833	31
Spoils Pile K	2,222	1	2,222	82
Spoils Pile L	100	1	100	4
Spoils Pile M	10,354	1	10,354	383
Spoils Pile N	5,590	1	5,590	207
		Total	**112,856**	**4,180**
Onshore Fuel Line - 54-Inch Line				
54-SD-12	1,650	10	16,500	611
54-SD-14	1,800	11.5	20,700	767
54-SD-20	1,600	10	16,000	593
54-SD-17	500	3	1,500	56
		Total	**54,700**	**2,026**
Onshore Fuel Line - Hangar Segrnent				
ATG(B)-051	400	4	1,600	59
ATG(B)-067	400	7.5	3,000	111
ATG(G)-277	150	0.58	87	3

TABLE 4-1
Estimated Area and Volume Calculations for Proposed Remedial Action Areas
Focused Feasibility Study Evaluation

Reference Sample within Excavation Area	Area (square feet)	Depth (feet below ground surface)	Volume (cubic feet)	Volume (cubic yards)
ATG(G)-280	200	3	600	22
ATG(G)-288	500	8	4,000	148
ATG(R)-044	900	4	3,600	133
ATG(R)-056	350	7.5	2,625	97
ATG(R)-059	250	3.5	875	32
ATG(R)-067	400	3	1,200	44
ATG(R)-072	800	7.5	6,000	222
ATG(R)-106	300	1.5	450	17
ATG(R)-114	500	7.5	3,750	139
ATG(R)-118	600	7.5	4,500	167
ATG-027	450	4.17	1,877	70
ATG-370	100	5	500	19
ATG-375	650	7.5	4,875	181
ATG-379	700	7.5	5,250	194
ATG-386	1,100	7.5	8,250	306
IT-003	400	7.5	3,000	111
ITLAT-04F	400	4	1,600	59
ITLAT-04B	100	4	400	15
		Total	**58,039**	**2,150**
Onshore Fuel Line - Northern Segment				
PRL-0305 to 325	5,000	4	20,000	741
PRL-0337	250	4	1,000	37
PRL-0471	300	4	1,200	44
PRL-0481	350	4	1,400	52
PRL-0491	350	4.5	1,575	58
PRL-0501	350	4	1,400	52
PRL-0511	250	3.5	875	32
PRL-0521	350	4	1,400	52
PRL-0531	400	4	1,600	59
PRL-0541	350	4	1,400	52

TABLE 4-1
Estimated Area and Volume Calculations for Proposed Remedial Action Areas
Focused Feasibility Study Evaluation

Reference Sample within Excavation Area	Area (square feet)	Depth (feet below ground surface)	Volume (cubic feet)	Volume (cubic yards)
PRL-0550	350	4	1,400	52
PRL-0559	400	4	1,600	59
PRL-0568	350	4	1,400	52
PRL-0577	500	3.5	1,750	65
PRL-0586	500	3.5	1,750	65
PRL-0595	500	3.5	1,750	65
PRL-0604	200	4	800	30
PRL-0616	250	4	1,000	37
PRL-0617	500	4	2,000	74
PRL-0630	350	4.5	1,575	58
PRL-0639	350	4.5	1,575	58
PH-SEG1-00D	60	5.5	330	12
		Total	**48,780**	**1,807**
Northwest Runway Area				
SL23-TW-004	400	15	6,000	222
		Total	**6,000**	**222**
Revetment Areas				
Revetment 1	17,259	1	17,259	639
Revetment 2	11,490	1	11,490	426
Revetment 3	12,985	1	12,985	481
Revetment 4	18,721	1	18,721	693
Revetment 6	10,000	1	10,000	370
Revetment 7	4,967	1	4,967	184
Revetment 11 - RVT-11-AS1	100	1.5	150	6
Revetment 11 - RVT-11-AS2	100	1.5	150	6
Revetment 11 - RVT-11-AS4	556	1	556	21
Revetment 12 - RVT-12-AS2	100	1.5	150	6
Revetment 12 - RVT-12-AS3	100	1	100	4
Revetment 13	11,544	1	11,544	428
Revetment 14	13,274	1	13,274	492

TABLE 4-1
Estimated Area and Volume Calculations for Proposed Remedial Action Areas
Focused Feasibility Study Evaluation

Reference Sample within Excavation Area	Area (square feet)	Depth (feet below ground surface)	Volume (cubic feet)	Volume (cubic yards)
Revetment 15	7,526	1	7,526	279
Revetment 16	13,154	1	13,154	487
Revetment 19	19,842	1	19,842	735
Revetment 20	13,746	1	13,746	509
Revetment 21	13,630	1	13,630	505
Revetment 22	12,458	1	12,458	461
Revetment 23	20,570	1	20,570	762
Revetment 25	13,269	1	13,269	491
Revetment 26	12,549	1	12,549	465
		Total	**228,090**	**8,448**
TOTAL EXCAVATION VOLUME			**1,038,628**	**38,468**

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Former Sewage Treatment Plant	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would provide a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, the proximity of the excavation to the Perimeter Levee and PDD may complicate excavation activities. Excavation was to the extent practicable in the vicinity of the PDD during the interim removal actions. Special shoring may be required. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, the proximity of the excavation to the Perimeter Levee and PDD may complicate excavation activities. Excavation was to the extent practicable in the vicinity of the PDD during the interim removal actions. Special shoring may be required. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Building 26	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would maintain a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, the proximity of Building 26 in relation to the excavation boundary could complicate excavation activities. Additionally, the area requiring further remedial action is at the bottom of a former UST excavation that has been backfilled; this backfill material would need to be removed to access the contaminated material. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. Proximity of Building 26 in relation to the excavation boundary may complicate excavation activities. Additionally, the elevated samples are at the bottom of the previous excavation that has been backfilled with gravel that would have to be removed prior to excavation of the impacted soil. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Building 35/39 Area	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would maintain a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, the proximity of the excavation to the discharge pipe and concrete sump may complicate excavation activities. Excavation was to the extent practicable in the vicinity of the discharge pipe during the interim removal actions. Due to stability issues at the pipe and concrete sump, the excavation was kept 5 feet from the footings of both structures. Special shoring may be required. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. Excavation was to the extent practicable in the vicinity of the discharge pipe during the interim removal actions. Due to stability issues at the pipe and concrete sump, the excavation was kept 5 feet from the footings of both structures. Special shoring may be required. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Building 41 Area	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would maintain a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. However, contamination exists beneath Building 41 and this building is planned for removal during wetland construction. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, the proximity to the Perimeter Levee and PDD may complicate excavation activities. Excavation was to the extent practicable in the vicinity of the PDD during the interim removal actions. Contamination exists beneath Building 41. Excavation of the material would not occur until Building 41 is demolished during wetland construction.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. Proximity to the Perimeter Levee and PDD may complicate excavation activities. Excavation was to the extent practicable in the vicinity of the PDD during the interim removal actions. Contamination exists beneath Building 41. Excavation of the material could not occur until demolition and removal of the building is conducted during wetland construction. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Building 82/87/92/94 Area and Building 86	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would maintain a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. Proximity to the New Hamilton Partnership Levee and the presence of asphalt and concrete may complicate excavation activities. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. Proximity to the New Hamilton Partnership Levee and the presence of asphalt and concrete may complicate excavation activities. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Perimeter Drainage Ditch	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would provide a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, prior to removal of the impacted sediments, specified portions of the channel would need to be dewatered through pumping or installation of coffer or diversion dams. After removal, the sediments may need to be dried or blended with dry soil prior to disposal, to meet landfill acceptance criteria. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. Prior to removal of the impacted sediments, specified portions of the channel would need to be dewatered through pumping or installation of coffer or diversion dams. After removal, the sediments may need to be dried or blended with dry soil prior to disposal, to meet consolidation acceptance criteria. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Perimeter Drainage Ditch Spoils Piles	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. However, Spoils Pile L is an exception. The risk associated with this site was based on a sample point that was removed; therefore this alternative would be protective of human health and the environment for this Inboard Area site. This alternative, offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would provide a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. The majority of the spoils piles have had soil removed to original grade during the interim removal actions. Spoils pile F is the only pile where there is no physical evidence indicating the location of the pile. However, the assumed location would be removed during installation of the main channel cut during wetland construction. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, the proximity to the PDD may complicate excavation activities. The majority of the spoils piles have had soil removed to original grade during the interim removal actions. Spoils pile F is the only pile where there is no physical evidence indicating the location of the pile; therefore a removal action will occur at this spoils pile. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. The majority of the spoils piles have had soil removed to original grade during the interim removal actions. Spoils pile F is the only pile where there is no physical evidence indicating the location of the pile. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Onshore Fuel Line – 54" Line	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would maintain a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Additionally, known sources of contamination (i.e., fuel line) have been removed. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, site obstacles, such as the concrete 54-inch drain line and asphalt which overlays the surface, may complicate excavation. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. Site obstacles, such as the concrete 54-inch drain line and asphalt which overlays the surface, may complicate excavation. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Onshore Fuel Line – northern segment	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would provide minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Additionally, known sources of contamination (i.e., fuel lines) have been removed. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Northwest Runway Area	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would provide a minimum of three feet of cover, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Offers a high degree of implementability since excavation is a widely used and accepted technology. The costs associated with this alternative are greater than Alternatives 1 and 2.

TABLE 4-2
Comparative Analysis

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation And Offsite Disposal	Alternative 4 – Excavation And Onsite Disposal
Revetments	Least effective of all alternatives because it would not be protective of human health and the environment throughout the development and maturation of the wetland. However, Revetments 15 and 20 are exceptions. The concentrations of cadmium and lead detected in the surface sample at Revetment 15 was detected at the comparator value; this alternative would be protective of human health and the environment. The concentrations of cadmium, phenanthrene, and pyrene were detected at their comparator values at Revetment 20 in one sample collected beneath the concrete; this alternative would be protective of human health and the environment. Offers a high degree of implementability since actions are not taken and there are no associated costs.	Offers a high degree of effectiveness in achieving RAOs. Potential risks to human health and ecological receptors would not exist because exposure to COCs would be eliminated through implementation of the final wetland design performance criteria. The alternative would provide a minimum of three feet of cover in those areas where contamination is at the surface, prevent and monitor exposure of receptors to the concentrations of COCs detected above their chemical-specific RAOs. Revetments 6 and 7 are in the path of the proposed main wetland channel; therefore these areas will require excavation. Less effective in reducing the site-specific contaminant mobility than Alternatives 3 and 4. This alternative would have minimal implementation obstacles because the controls would be fully considered and incorporated in preparation of the final wetland design. In addition, there are minimal associated costs.	This alternative would be protective of human health and the environment. Offers the highest degree of effectiveness in achieving RAOs and reducing contaminant mobility since the materials would be removed from the Inboard Area and from the BRAC Property. Offers a high degree of implementability since excavation is a widely used and accepted technology. However, the presence of the site-specific concrete revetment pads may complicate excavation activities. Revetments 6 and 7 are in the direct path of the proposed wetland channel. The concrete pad and underlying material would need to be removed during wetland construction. Underlying contamination would be addressed at that time. This alternative is the most expensive.	This alternative would be protective of human health and the environment. Offers the higher degree of effectiveness in achieving RAOs and reducing site contaminant mobility, and than Alternatives 1 and 2 but not as effective as Alternative 3. Excavation of the contaminated material immediately removes the contaminants from the site; however, they remain onsite at a consolidation/disposal location. Also, the process of obtaining permits to build an Onsite Class II landfill may be complicated and time-consuming. Revetments 6 and 7 are in the direct path of the proposed wetland channel. The concrete pad and underlying material would need to be removed during wetland construction. Underlying contamination would be addressed at that time. Offers a high degree of implementability since excavation is a widely used and accepted technology. Presence of the site-specific concrete revetment pads may complicate excavation activities. The costs associated with this alternative are greater than Alternatives 1 and 2.

SECTION 5

Conclusions

The FFS developed a conceptual model and evaluated the results of the baseline risk assessment to determine how potential risks should be addressed by the proposed remedial actions. The FFS conceptual model is based on potential exposure pathways and human and ecological receptors for the wetland end use. The conceptual model assumes that estuarine and human recreational receptors exist at each Inboard Area site, and additional freshwater receptors exist at the Building 82/87/92/94 Area; the PDD Spoils Piles A, B, and N; and the PDD-unlined portion (see Appendix A). The need for remedial action was determined by evaluating whether or not the HI for a particular receptor exceeded 1.0. Three sites were excluded from evaluation in this FFS because they lacked at least one receptor having an HI greater than 1.0 and therefore did not require remedial action (see Table 5-1).

For each remaining site that required further evaluation, site-specific FFS COPCs were established based on the receptors that were expected to be present during the development and maturation of the wetland. A COPC is defined as a chemical with a human health or ecological HQ (hazard quotient) greater than 1.0 or a human health incremental lifetime cancer risk (ILCR) greater than $1x10^{-6}$.

COCs were then identified from the list of site-specific FFS COPCs. All site-specific COPCs with 95 percent UCL concentrations that are greater than their comparator values were designated COCs, and the sites were identified for further analysis. The results of the analysis identified thirteen sites that did not have COCs (see Table 5-2).

These sites were designated for no further action.

The remaining 41 sites had at least one COC and were identified as requiring further remedial action. The remedial alternatives listed below were evaluated against the nine criteria set forth by the NCP to determine the appropriate remedial alternative for each site.

- Alternative 1 – No Further Action
- Alternative 2 – Institutional Controls
- Alternative 3 – Excavation and Offsite Disposal
- Alternative 4 – Excavation and Onsite Disposal

The remaining text of this section provides a summary of the rationale utilized to select the preferred remedial alternative for each site analyzed in Section 4.3.

5.1 Former Sewage Treatment Plant

Alternative 2 (Institutional Controls) is the preferred alternative for the FSTP. The institutional controls would protect the wetland environment by preventing exposure of human and ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- In 1998, the source area was removed from the former digester area and sludge drying beds to a depth ranging from 5 to 7 feet bgs (centered along the sludge drying beds).
- In 1998, the southeastern corner of this excavation was further excavated to a depth of 10 feet bgs.
- In 1999, a visible black sludge layer was removed to a depth of 4 feet bgs from the eastern side of the 1998 excavation.
- In 1998 and 1999, pesticides were detected above their comparator values at depths ranging from 2.5 to 10.5 feet bgs.
- The interim removal actions have been backfilled with clean material.
- COCs are present depths ranging from 2.5 to 10.5 feet bgs (beneath the backfill); therefore, there is no direct exposure pathway.
- The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.2 Building 26

Alternative 2 (Institutional Controls) is the preferred alternative for Building 26. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- The source of the contamination, a diesel UST, has been removed.
- Petroleum hydrocarbon measured as diesel has been detected above its comparator value at a depth ranging from 5 to 5.5 feet bgs on the southern and northeastern sides of the former UST excavation.
- The former UST excavation has been backfilled with clean material.
- COCs are present at depths ranging from 5 to 5.5 feet bgs (beneath the backfill); therefore, there is no direct exposure pathway.
- The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.3 Building 35/39 Area

Alternative 2 (Institutional Controls) is the preferred alternative for the Building 35/39 Area. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- Two potential sources of contamination, ASTs 5 and 6, have been removed.
- In 1998, approximately 50 yd^3 of soil were removed downslope of former AST 5 to a depth of 5 feet bgs.
- In 1999, approximately 444 yd^3 of soil were removed near former ASTs 5 and 6 to a depth of 7.5 feet bgs.
- In 1999, total DDT concentration was detected above the comparator value in one sample located southeast of AST 6 at depths ranging from 3 to 4.5 feet bgs.
- The interim removal action excavations were backfilled with clean material.
- COCs are present at depths ranging from 3 to 4.5 feet bgs (beneath the backfill); therefore, there is no direct exposure pathway.
- The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.4 Building 41 Area

Alternative 3 (Excavation and Offsite Disposal) is the preferred alternative for the Building 41 Area. Wetland restoration plans call for this building to be demolished during wetland construction; therefore, removal of contamination beneath Building 41 is necessary to protect future receptors. The following information was considered during the selection process:

- Two potential sources of contamination, diesel USTs northeast of Building 41, have been removed.
- Diesel has been detected above its comparator value west of Building 41 at depths ranging from 4 to 7.5 feet bgs.
- Diesel range hydrocarbons have been detected above the comparator value southwest of Building 40 at depths ranging from 2.5 to 6 feet bgs.
- The lateral extent of contamination has not been determined for diesel range hydrocarbons detected in confirmation sample CS-PSA4-03. The sample was collected at

a depth of 2.5 feet bgs on the east side excavation during the 1998 interim removal actions.

- PAH have been detected above their comparator values in samples collected beneath Building 41 at depths ranging from 14.5 to 18.5 feet bgs. Diesel range hydrocarbons have been detected above the comparator value beneath the building at 18.5 feet bgs.
- The demolition of Building 41 during wetland construction would potentially create a complete exposure pathway to the contaminants detected beneath the building.

5.5 Building 82/87/92/94 Area and Building 86

Alternative 2 (Institutional Controls) is the preferred alternative for the Building 82/87/92/94 Area and Building 86. The institutional controls would protect the wetland environment by preventing exposure of human and ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- Barium, beryllium, chromium, and PAH have been detected above their comparator values in various locations throughout the Building 82/87/92/94 Area and at Building 86.
- Residual contamination is present beneath concrete and asphalt.
- COCs are present at depths ranging from 0.5 to 11.5 feet bgs.
- The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.6 Perimeter Drainage Ditch

Alternative 2 (Institutional Controls) is the preferred alternative for the PDD. The institutional controls would protect the wetland environment by preventing exposure of human and ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- Total DDT concentration and beryllium have been detected above their comparator values in various locations along the unlined portion of the PDD at depths ranging from 0 to 1.5 feet bgs; dieldrin has been detected above its comparator value in one sample (PDD-SD02) at a depth of 1 to 1.5 feet bgs.
- COCs are present at depths ranging from 0 to 1.5 feet bgs.
- The PDD would be backfilled during wetland construction.

- Performance criteria for the final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.7 Perimeter Drainage Ditch Spoils Piles

The following alternatives are recommended for the PDD spoils piles for the following reasons:

- Spoils Pile A – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - In 1998, soil was removed from the footprint of the spoils pile to the approximate original grade during the removal actions.
  - Beryllium, zinc, and total DDT concentration have been detected above their comparator values in the confirmation sample (SS-PDSP-A01) at a depth of 1 foot bgs.
  - COCs are present at a depth of 1 foot bgs.
  - The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Spoils Pile B – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - In 1998 and 1999, soil was excavated during two separate removal actions (IT, 1999b and IT, 2000).
  - In 1998, cadmium, mercury, and zinc were detected above their comparator values in samples collected during the removal actions at a depth of 1 foot bgs.
  - In 1999, silver, endrin aldehyde, and total DDTs were detected above their comparator values in samples collected during the removal actions at depths ranging from 0 to 0.5 foot bgs.
  - COCs are present at depths ranging from 0 to 1 foot bgs.

  - Performance criteria for the final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

- Spoils Pile D – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - In 1998, soil was removed from the footprint of the spoils pile to the approximate original grade during interim removal actions.
  - Total DDT concentration has been detected above the comparator value at a depth of 1 foot bgs.
  - COCs are present at a depth of 1 foot bgs.
  - The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Spoils Pile E – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - In 1998 and 1999, soil was excavated during two separate removal actions.
  - In 1998, the total DDT concentration was detected above the comparator value at a depth of 1 foot bgs.
  - The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Spoils Pile F – Alternative 3 (Excavation and Offsite Disposal) is the preferred alternative. The exact location of the spoils pile is unknown; therefore, a removal action would be conducted to protect human health and the environment. The following information was considered during the selection process:

  - In 1995, metals, PAHs, and pesticides (total DDTs) were detected above their comparator values at a depth of 0.5 foot bgs during sampling.
  - The exact location of the samples collected in 1995 is unknown.
  - The estimated location of the spoils pile is within the designed channel cut; thus, all soils in the vicinity would ultimately be removed during wetland construction.
- Spoils Pile G – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - In 1998, soil was removed from the footprint of the spoils pile to the approximate original grade during the removal actions.
  - In 1998, the total DDT concentration was detected above the comparator value at a depth of 1 foot bgs.
  - COCs are present at a depth of 1 foot bgs.
  - The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Spoils Pile I – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - In 1998 and 1999, soil was excavated during two separate removal actions.
  - In 1998, beryllium was detected at its comparator value in one sample (SS-PDSP-I01) collected at a depth of 1 foot bgs. The concentration of beryllium was 1.1 mg/kg, and its comparator value is 1.0 mg/kg.
  - In 1998, the total DDT concentration was detected above the comparator value at a depth of 1 foot bgs.
  - The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Spoils Pile J – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of

ecological receptors to COCs above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- In 1998 and 1999, soil was excavated during two separate removal actions.
- In 1999, the total DDT concentration was detected above the comparator value at a depth of 0.5 foot bgs.
- COCs are present at depths ranging from 0.5 foot bgs.
- The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

• Spoils Pile K – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

  - In 1998, soil was removed from the footprint of the spoils pile to the approximate original grade during the removal actions.
  - In 1998, the total DDT concentration was detected above the comparator value at a depth of 1 foot bgs.
  - COCs are present at a depth of 1 foot bgs.
  - Performance criteria for the final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

• Spoils Pile L – Alternative 1 (No Further Action) is the preferred alternative. The following information was considered during the selection process:

  - In 1998 and 1999, soil was excavated during two separate removal actions.
  - Potential ecological risk was based on the confirmation sample SS-PDSP-L01 (collected during the 1998 interim removal actions), which detected metals above their comparator values; the sample area was excavated during the 1999 interim removal actions.
  - The 1999 confirmation sample did not detect analytes above their comparator values.

• Spoils Pile M – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- In 1998, soil was removed from the footprint of the spoils pile to the approximate original grade during the removal actions.
- In 1998, the total DDT concentration was detected above the comparator value in two samples at a depth of 1 foot bgs.
- The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

- Spoils Pile N – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - In 1998, soil was removed from the footprint of the spoils pile to the approximate original grade during the removal actions.
  - In 1998, the total DDT concentration was detected above the comparator value in two samples at a depth of 0.5 foot bgs. Lead was also detected above its comparator value in one sample at a depth of 0.5 foot bgs.
  - The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.8 Onshore Fuel Line – 54-Inch Line

Alternative 2 (Institutional Controls) is the preferred alternative for ONSFL – 54-Inch Line. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- The source of the contamination, the fuel line, has been removed.
- TPH measured as gasoline have been detected above the comparator value in samples at depths ranging from 3 to 11.5 ft bgs.

- COCs are present at a depth ranging from 3 to 11.5 ft bgs; therefore, there is no direct exposure pathway.
- The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.9 Onshore Fuel Line – Hangar Segment

Alternative 2 (Institutional Controls) is the preferred alternative for ONSFL – Hangar Segment. The institutional controls would protect the wetland environment by preventing exposure of human and ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- The source of the contamination, the fuel line, has been removed.
- TPH measured as gasoline, ethylbenzene, xylenes, and PAHs have been detected above their comparator values in various locations along the hangar segment at depths ranging from 0.5 to 8.0 feet bgs.
- COCs are present at a depth of 0.5 to 8.0 feet bgs.
- The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.10 Onshore Fuel Line – Northern Segment

Alternative 2 (Institutional Controls) is the preferred alternative for ONSFL – Northern Segment. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- The source of contamination, the fuel line, has been removed.
- TPH measured as gasoline have been detected above their comparator values at depths ranging from 0.5 to 6.5 ft bgs along the entire length of the former fuel line.
- COCs are present at a depth of 0.5 to 6.5 feet bgs.
- The final wetland design would provide a minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.

- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.11 Northwest Runway Area

Alternative 2 (Institutional Controls) is the preferred alternative for the Northwest Runway Area. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

- Beryllium and boron were detected above their comparator values at depths ranging from 5 to 15 feet bgs in soil samples collected from borings drilled to install temporary wells.
- This area would be a saline/freshwater transition zone, and the associated comparator values may be conservative.
- Beryllium and boron have been detected above their comparator values in a surface soil sample (Sample 23) collected from the southwest end of the runway.
- COCs are present at depths ranging from 0 to 15 feet bgs (beneath the backfill); therefore, there is no direct exposure pathway.
- The final wetland design would provide at minimum of 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

5.12 Revetment Area

The following preferred alternatives and reasons for selection are presented below for each of the revetments.

- Revetment 1 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Surface soil contamination has been detected alongside the revetment pad and beneath the concrete revetment.
  - Cadmium, lead, and PAH have been detected above their comparator values in surface soil samples REVT 1C and 1A.

- Barium has been detected above its comparator value in the sample collected beneath the revetment pad.
- The current exposure pathway is incomplete for contamination beneath the concrete pad.
- Performance criteria for the final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

• Revetment 2 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

  - Surface soil contamination has been detected alongside the revetment pad and beneath the concrete revetment.
  - Cadmium, lead, and PAH have been detected above their comparator values in surface soil samples collected alongside the revetment pad.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

• Revetment 3 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:

  - Barium, copper, and manganese have been detected above their comparator values in one soil sample (REVT 3A) collected beneath the concrete revetment pad.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.

  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

- Revetment 4 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Cadmium, lead, and PAH have been detected above their comparator values in soil samples collected beneath the concrete revetment pad.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - One sample (REVT4C) detected COCs above comparator values.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Revetment 6 – Alternative 3 (Excavation and Offsite Disposal) is the preferred alternative because the revetment is in the path of the proposed channel cut. The following information was considered during the selection process:
  - Gasoline range hydrocarbons and PAH have been detected above their comparator values in one soil sample collected beneath the concrete revetment pad.
  - Removal of the concrete or digging of the underlying soil would be prohibited until wetlands construction activities start.
- Revetment 7 – Alternative 3 (Excavation and Offsite Disposal) is the preferred alternative because the revetment is in the path of the proposed channel cut. The following information was considered during the selection process:
  - Lead and PAH have been detected above their comparator values in surface soil samples collected alongside the revetment pad.
  - Removal of the concrete or digging of the underlying soil would be prohibited until wetlands construction activities start.
- Revetment 11 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - This revetment is unpaved.

  - Copper was detected in soil above its comparator value at depths ranging from 0.5 to 1.5 feet bgs.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

- Revetment 12 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - This revetment is unpaved.
  - Copper was detected in soil above its comparator value at depths ranging from 0.5 to 1.5 feet bgs.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Revetment 13 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of human and ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Cadmium, lead, and PAH were detected above their comparator values in surface soils surrounding the revetment.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Revetment 14 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - TPH measured as diesel have been detected above their comparator values in one sample collected beneath the concrete revetment pad.

  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

- Revetment 15 – Alternative 1 (No Further Action) is the preferred alternative. The following information was considered during the selection process:
  - The concentrations of cadmium (1.5 mg/kg) and lead (48.6 mg/kg) were detected at their comparator values of 1.2 mg/kg and 43.2 mg/kg, respectively, in only one of four samples; the detection was in a surface soil sample.
- Revetment 16 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Barium was detected above its comparator value in a soil sample collected beneath the concrete pad.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Revetment 19 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of human and ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Barium, copper, cadmium, lead, diesel, gasoline range hydrocarbons, and PAH have been detected above their comparator values alongside, beneath, and surrounding the concrete revetment.
  - COCs are present in surface soil.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.

  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

- Revetment 20 – Alternative 1 (No Further Action) is the preferred alternative. The following information was considered during the selection process:
  - Only one of seven samples detected COCs; the detections were beneath the concrete revetment.
  - The concentration of cadmium (1.5 mg/kg), phenanthrene (0.44 mg/kg), and pyrene (0.78 mg/kg) were detected at their comparator values, 1.2 mg/kg, 0.24 mg/kg, and 0.662 mg/kg, respectively.
- Revetment 21 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Copper, vanadium, PAH, and diesel and gasoline range hydrocarbons have been detected above their comparator values in one soil sample collected beneath the concrete pad.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Revetment 22 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - PAH and diesel and gasoline range hydrocarbons have been detected above their comparator values in one soil sample collected beneath the concrete pad.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.

  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

- Revetment 23 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - The revetment is unpaved.
  - Copper has been detected above its comparator value at depths ranging from 0.5 to 1.5 feet bgs.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Revetment 25 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Barium and diesel range hydrocarbons have been detected above their comparator values in one soil sample collected beneath the concrete pad.
  - The current exposure pathway is incomplete for contamination beneath the concrete pad.
  - The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
  - Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.
- Revetment 26 – Alternative 2 (Institutional Controls) is the preferred alternative. The institutional controls would protect the wetland environment by preventing exposure of ecological receptors to COCs detected above chemical-specific RAOs during the development and maturation of the wetland. The following information was considered during the selection process:
  - Barium, boron, manganese, and diesel and gasoline range hydrocarbons have been detected above their comparator values in one soil sample collected beneath the concrete pad.

- The current exposure pathway is incomplete for contamination beneath the concrete pad.
- The final wetland design would maintain at least 3 feet of cover in areas where COCs are greater than chemical-specific RAOs.
- Performance criteria for the final wetland design would restrict excavation and erosion and monitor the depth of cover in areas where COCs are greater than chemical-specific RAOs.

Table 5-3 identifies the recommended alternatives for each of the Inboard Area sites. A total of 57 sites were considered in this FFS. During the evaluation of remedial alternatives, Building 86 was combined with the Building 82/87/92/94 Area to make the total number of sites 56. Results of the FFS screening process and comparative analysis resulted in the recommendation of 18 sites for no further action, 34 sites for institutional controls and management in-place, and four sites for excavation with offsite disposal.

TABLE 5-1
No Further Action Sites-HI Less than 1.0

Revetment 18/Building 15
Revetment 5
Revetment 28

TABLE 5-2
No Further Action Sites – No COCs

Building 20
Building 84/90 Area
PDD Spoils Pile C
PDD Spoils Pile H
East Levee Generator Pad
Tarmac East of Outparcel A-5
Revetment 8
Revetment 9
Revetment 10
Revetment 17
Revetment 24
Revetment 27

TABLE 5-3
Inboard Area Sites Preferred Remedial Alternative Summary

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation and Offsite Disposal	Alternative 4 – Excavation and Onsite Disposal
Former Sewage Treatment Plant		X		
Revetment 18/Building 15	X[a]			
Building 20	X[b]			
Building 26		X		
Building 35/39 Area		X		
Building 41 Area			X	
Building 82/87/92/94 Area and Building 86		X		
Building 84/90 Area	X[b]			
Perimeter Drainage Ditch (PDD)		X		
PDD Spoils Pile A		X		
PDD Spoils Pile B		X		
PDD Spoils Pile C	X[b]			
PDD Spoils Pile D		X		
PDD Spoils Pile E		X		
PDD Spoils Pile F			X	
PDD Spoils Pile G		X		
PDD Spoils Pile H	X[b]			
PDD Spoils Pile I		X		
PDD Spoils Pile J		X		
PDD Spoils Pile K		X		
PDD Spoils Pile L	X[c]			
PDD Spoils Pile M		X		
PDD Spoils Pile N		X		
East Levee Generator Pad	X[b]			
Onshore Fuel Line (ONSFL)-54-inch Line		X		
ONSFL-Hangar Segment		X		
ONSFL-Northern Segment		X		
Northwest Runway Area		X		
Tarmac East of Outparcel A-5	X[b]			
Revetment 1		X		
Revetment 2		X		
Revetment 3		X		
Revetment 4		X		

TABLE 5-3
Inboard Area Sites Preferred Remedial Alternative Summary

Site	Alternative 1 – No Further Action	Alternative 2 – Institutional Controls	Alternative 3 – Excavation and Offsite Disposal	Alternative 4 – Excavation and Onsite Disposal
Revetment 5	X[a]			
Revetment 6			X	
Revetment 7			X	
Revetment 8	X[b]			
Revetment 9	X[b]			
Revetment 10	X[b]			
Revetment 11		X		
Revetment 12		X		
Revetment 13		X		
Revetment 14		X		
Revetment 15	X[c]			
Revetment 16		X		
Revetment 17	X[b]			
Revetment 19		X		
Revetment 20	X[c]			
Revetment 21		X		
Revetment 22		X		
Revetment 23		X		
Revetment 24	X[b]			
Revetment 25		X		
Revetment 26		X		
Revetment 27	X[b]			
Revetment 28	X[a]			

[a] Site did not have a site-hazard index greater than 1.0.
[b] Site did not have site-specific FFS chemical of potential concern 95 UCL (or maximum in some cases) concentration greater than the comparator value; therefore, it does not require remedial action.
[c] Site suitable for risk management considerations. COCs are at their comparator values.

SECTION 6

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