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FOCUSED FEASIBILITY STUDY SITE 2 NAS PENSACOLA FL
04/09/1997
ENSAFE

FOCUSED FEASIBILITY STUDY
NAS PENSACOLA SITE 2

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

CONTRACT NO. N62467-89-D-0318

CTO-059

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

April 9, 1997

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The Contractor, EnSafe/Allen & Hoshall, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0318 is complete, accurate, and complies with all requirements of the contract.

Date: April 9, 1997
Signature: Henry H. Beiro
Name: Henry Beiro
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EnSafe / Allen & Hoshall

a joint venture for professional services

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April 9, 1997

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RE: Site 2 Focused Feasibility Study for NAS Pensacola
Contract # N62467-89-D-0318/0059

Dear Mr. Joyner:

On behalf of the Navy, EnSafe/Allen & Hoshall is pleased to submit two copies of the Site 2 Focused Feasibility Study, at Naval Air Station Pensacola, Florida. If you should have any questions or need any additional information regarding this document, please do not hesitate to call me.

Sincerely,

EnSafe/Allen & Hoshall

Henry H. Beiro

Henry H. Beiro, P.G.
Task Order Manager

Enclosure

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Gena Townsend, USEPA – 1 copy
John Mitchell, FDEP – 1 copy
Denise Klimas, NOAA – 1 copy
Judeth Walker, NAS Pensacola – 1 copy
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EXECUTIVE SUMMARY

This Focused Feasibility Study (FFS) develops, evaluates, and compares four remedial action alternatives that may be used to mitigate hazards and threats to the environment (ecological) at Site 2 at Naval Air Station Pensacola. The FFS addresses sediment contamination only, as recommended in the *Remedial Investigation Report for Site 2, Naval Air Station Pensacola, Florida.*

The FFS evaluates the RI, the baseline risk assessment (BRA), and ecological risk assessment to develop preliminary remediation goals (PRGs) for Site 2. The BRA did not identify any risk to human health; no further action is required to protect human health under the current use scenario. However, contaminated sediment poses an unacceptable risk to the benthic organisms at Site 2. PRGs assembled for Site 2 are protective of the environment.

Four alternatives are developed and screened in this FFS:

- No action.

- Capping, consisting of design and construction of a sand-and-gravel subaqueous cap over the areas exceeding PRGs.

- Dredging with offsite disposal. This alternative involves dredging the contaminated sediment exceeding PRGs, processing the dredged material, and disposing of the residual at an approved offsite facility.

- Natural attenuation. This alternative is not the same as "no-action." Under this alternative, contaminated sediment is left in place. Physical controls would continue to be implemented at the site to limit access. A sampling and analysis program would be

conducted throughout the process to confirm that degradation proceeds at rates consistent with meeting cleanup objectives.

These alternatives are initially evaluated using the three screening criteria of implementability, effectiveness, and cost. Then, as per the *National Contingency Plan*, each alternative is analyzed in detail using the criteria of long-term effectiveness; short-term effectiveness; reduction of toxicity, mobility, or volume; implementability; cost; compliance with applicable or relevant and appropriate requirements; overall protection of human health and the environment; state acceptance; and community acceptance.

A comparative analysis of the four alternatives is discussed briefly below:

Threshold Criteria: As discussed in the BRA, no human health risks are expected at Site 2 due to sediment contamination. No further action is required to protect human health. Each alternative protects the environment in varying degrees. The no-action and natural attenuation alternatives are expected to meet the PRGs in time. Dredging immediately eliminates the source at Site 2, achieving PRGs immediately. The capping alternative reduces ecological risk by isolating the constituents and preventing the benthic organisms from burrowing into the contaminated sediment.

Balancing Criteria: Both the capping and dredging alternatives provide more long-term effectiveness than the no-action or natural attenuation controls, but have adverse short-term impacts to the ecology at Site 2. All alternatives are implementable, with capping having the highest cost and natural attenuation having the lowest cost among Alternatives 2, 3, and 4. "No-action" has the lowest cost of all the alternatives.

Modifying Criteria: These criteria will be addressed during the FFS review period and the public comment period for the Record of Decision.

1.0 INTRODUCTION

1.1 Purpose and Organization

The purpose of this Focused Feasibility Study (FFS) is to develop, evaluate, and compare remedial action alternatives that may be used to mitigate hazards and threats to the environment as a result of sediment contamination at Site 2 on the southeastern shoreline of Naval Air Station (NAS) Pensacola. The FFS is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 based upon findings reported in the *Final Remedial Investigation Report, Naval Air Station Pensacola, Site 2* (E/A&H, 1996).

This FFS report is organized in the format suggested in Office of Solid Waste and Emergency Response (OWSER) Directive 9355.3-01, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (Interim Final, October 1988). The only medium at Site 2 requiring attention is the near-shore sediment in Pensacola Bay. Because of this, the scope of work and alternatives for Site 2 are limited, and an abbreviated feasibility study format was adopted, as described below:

- **Section 1, Introduction:** This section presents background information regarding the Remedial Investigation (RI), baseline risk assessment (BRA), and preliminary remediation goals (PRGs). Remedial volumes identified using PRGs are presented.

- **Section 2, Identification and Screening of Technologies:** This section presents the remedial elements of each alternative, along with its implementability, effectiveness, and cost.

- **Section 3, Detailed Analysis of Alternatives:** This section presents the detailed analysis of alternatives as per the nine criteria outlined in the *National Oil and Hazardous*

Substances Pollution Contingency Plan; Final Rule (EPA/540/1-89/002, December 1989) (NCP) This analysis is the foundation of future decision-making for the site.

- **Section 4, Comparative Analysis of Alternatives:** This section compares the alternatives presented in the previous sections. The section provides decision-makers with a concise comparison that highlights differences between the alternatives.

1.2 Background Information

Site 2 is on the southeastern shoreline of NAS Pensacola, in Escambia County, Florida. The site consists of an area of near-shore sediments along Pensacola Bay's waterfront. Figure 1-1 is a location map of Site 2 and vicinity. A concrete seawall, approximately 3 to 4 feet high, dominates the shoreline. Fifty-six sewer and industrial wastewater outfalls, ranging from 1 to 42 inches in diameter, were previously identified along the seawall (E&E, 1991). The seawall also accommodates numerous scuppers to drain surface water runoff from the adjacent parking areas.

From 1939 to 1973, untreated industrial wastes from Naval Aviation Depot (NADEP) and Naval Air Rework Facilities (NARF) operations were routinely discharged into Pensacola Bay, near Site 2. Over 34 years, an estimated 83 million gallons of the following materials were disposed of in the bay: waste containing paint, paint solvents, thinners, ketones, trichloroethylene, Alodine, mercury, and concentrated plating wastes (primarily chromium, cadmium, lead, nickel, and cyanide) (G&M, 1984). Other potential impacts may have occurred from vessel operations at the pier and docking facilities in the immediate area. Additionally, because of transport mechanisms characteristic of open bay systems such as Pensacola Bay, offsite sources may have impacted the site. In 1973, NAS Pensacola's industrial wastestream was diverted to the Industrial Wastewater

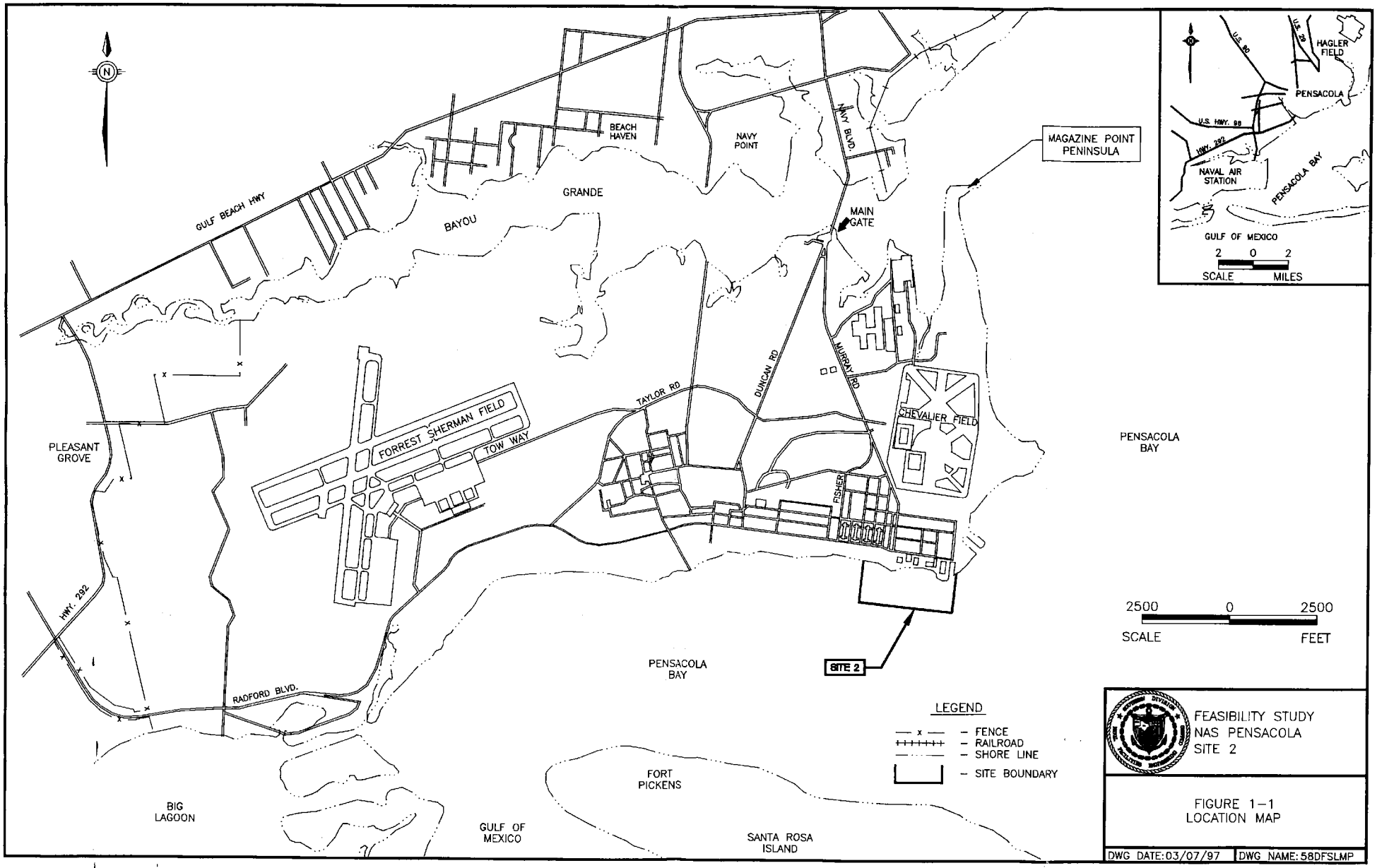
Treatment Plant (E&E, 1991, 1992a, 1992b). Since 1973, numerous environmental studies have been conducted at Site 2 to evaluate the extent of contamination. More detailed information regarding site use and history is presented in the final RI report.

1.2.1 Nature and Extent of Contamination

According to the final RI report, most constituents were spatially distributed in the northeast portion of Site 2. In general, the metals arsenic, cadmium, chromium, copper, lead, mercury, and zinc, along with the organic constituents, polyaromatic hydrocarbons (PAHs), and pesticides, appeared to exceed background concentrations.

Surface Water: To assess potential impacts to the environment, observed water concentrations were compared to federal and state water-quality criteria. Consequently, analytical data indicate surface water is not contaminated at or near Site 2. According to the final RI report, few constituents in surface water exceeded established criteria. The only significant occurrence across the site was for silver. However, the reported concentrations for silver may be a result of laboratory matrix interference from the high salinity water.

Sediment: The metals present in sediment (cadmium, copper, lead, and zinc) appear elevated when compared to natural concentrations. Organic compounds including PAHs, pesticides, and polychlorinated biphenyls (PCBs) were present, but their limited distribution and overall concentrations do not indicate a measurable risk to receptors. Based on contaminant distribution, the final RI report indicates five locations where constituent concentrations exceed sediment screening values (SSVs).


N
GULF BEACH HWY
BEACH HAVEN
NAVY POINT
NAVY BLVD.
GRANDE
BAYOU
MAGAZINE POINT PENINSULA
MAIN GATE
DUNCAN RD
MURRAY RD
TAYLOR RD
FORREST SHERMAN FIELD
TOW WAY
CHEVALIER FIELD
FISHER
PLEASANT GROVE
HWY. 292
RADFORD BLVD.
PENSACOLA BAY
SITE 2
PENSACOLA BAY
FORT PICKENS
BIG LAGOON
GULF OF MEXICO
SANTA ROSA ISLAND
LEGEND
FENCE
RAILROAD
SHORE LINE
SITE BOUNDARY
2500 0 2500
SCALE FEET
U.S. 90
U.S. 29
HAGLER FIELD
PENSACOLA
U.S. HWY. 98
HWY. 292
NAVAL AIR STATION
PENSACOLA BAY
GULF OF MEXICO
2 0 2
SCALE MILES
FEASIBILITY STUDY
NAS PENSACOLA
SITE 2
FIGURE 1-1
LOCATION MAP
DWG DATE:03/07/97
DWG NAME:58DFSLMP

1.2.2 Contaminant Fate and Transport

Site 2 is a complex system which has many factors affecting the fate and transport of contaminants introduced to the site. The physical state of the system (saline surface waters, presence of humic substances and clay minerals, and nearby current and past sources for metals) provides a way for contaminants to be introduced into Site 2 media and accumulate there. The bay-gulf channel and intercoastal waterway strongly influence the hydraulic movement of sediment into and away from the site.

Listed below are various potential sources identified in the final RI report that are likely contributing to the sediment contamination at Site 2.

- Activities associated with Buildings 71 and 72
- Boat maintenance and refueling services in the vicinity
- Surface water runoff
- Routine application of pesticides draining to the Site 2 area

1.3 Remedial Action Objectives

In developing remedial objectives, the following items are typically reviewed:

- The spatial distribution of sediment contamination, as presented in the RI
- A BRA, including human health and ecological assessments
- Chemical-specific applicable or relevant and appropriate requirements (ARARs)

1.3.1 RI Assessment

As shown in the RI report, the spatial distribution of sediment contamination at Site 2 was in the northeast portion of the site. This distributional pattern moderately correlated with fine-grain sediments and shallow waters in that portion of the site. The RI characterized five sampling

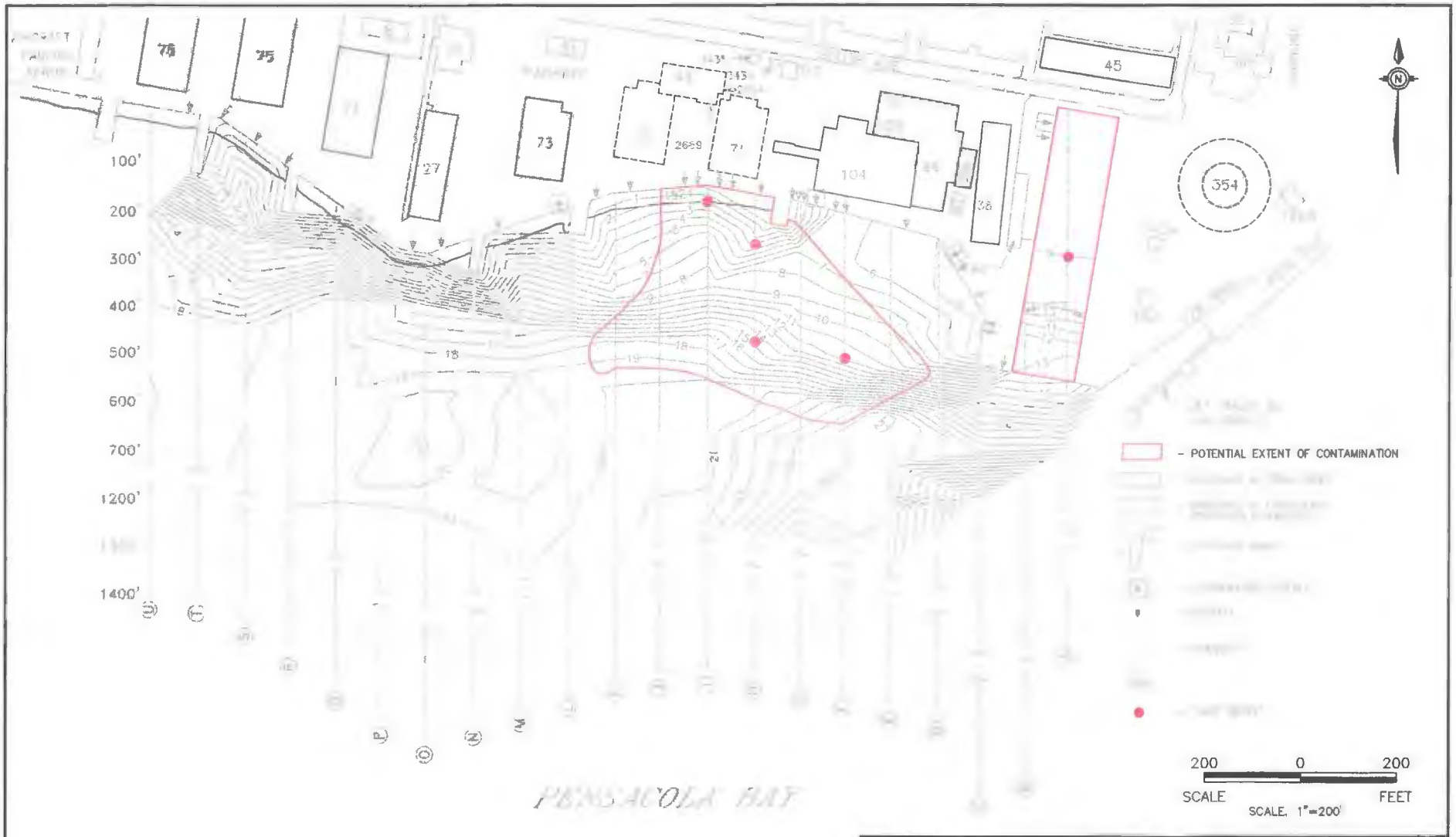
points (Stations I0, H1, H3, F3, and A2) as "hot spots," areas where concentrations of constituents exceed SSVs. Their locations are shown in Figure 1-2. A conservative aerial extent of contamination was estimated, based sediments surrounding the "hot spots" having a minimum of 60% fines.

Possible groundwater transport from Site 38 to Site 2 sediments was also assessed as a potential pathway. The investigation at Site 38 concluded that groundwater and soil had been impacted. According to data in the Site 38 RI, the greatest potential impact to Site 2 is from a volatile organic compound (VOC) plume underneath former Building 71. Sampling was directed near the shoreline of Site 38 and within the estimated outfall width for groundwater discharge offshore. Sediment and surface water samples collected at Site 2 did not detect the VOCs identified in the groundwater at Site 38. The absence of these VOCs suggests several attenuation possibilities. Primarily, complex transport and mixing processes occurring at the fresh-saline groundwater interface would tend to excaberate dispersion. Based on this assessment, groundwater discharge from Site 38 is not likely to be a continuous source of contaminants above risk-based action levels. This is mainly contributed to complex reactions of inorganics in groundwater, mixing at the fresh groundwater and saline groundwater interface, and tidal fluctuations.

The RI report recommends conducting a feasibility study to determine the most appropriate approach for dealing with the contaminated sediment.

1.3.2 Baseline Risk Assessment

The BRA was reviewed to identify site chemicals of potential concern (COPCs) in contaminated media posing a risk or hazard in current or future-use scenarios. Human health risk and ecological risk both were assessed. Potential receptors were identified and adverse effects associated with the site COPCs were qualitatively and quantitatively evaluated. Two media were assessed in this BRA, surface water and sediment.



FEASIBILITY STUDY
SITE 2
NAS-PENSACOLA
PENSACOLA, FLORIDA

FIGURE 1-2
EXTENT OF CONTAMINATION

DWG DATE.04/04/97 | DWG NAME.58DTHTSP

Ecological Risk Assessment: Effects to marine biota have occurred or are presently occurring due to sediment contaminant concentrations at some stations across Site 2. From a spatial perspective, the BRA determined five stations to have hazard indices (HIs) above 10 and thus negative impacts represent only 3.9% of the total area under investigation at Site 2.

Human Health Risk Assessment: The human health risk and hazard associated with exposure to Site 2 environmental media were assessed for hypothetical current and future (combined) child, and the hypothetical current and future (combined) adult recreationists crabbing exclusively at Site 2. The tissue ingestion exposure pathway was selected as an indicator of potential human health risk. According to the RI report, using maximum detected concentrations in crab tissue, no chemicals of concern (COCs) were identified for the tissue ingestion pathway. Based on the Site 2 exposure scenarios, no human health levels exceeding acceptable risks were calculated.

1.3.3 Chemical-Specific ARARs and TBCs

Where appropriate, chemical-specific ARARs will be considered in developing remedial objectives for the site. In accordance with the NCP, the BRA provides site-specific risk-based remedial cleanup goals which may be considered ARARs for the site. The leading agency, in consultation with the support agencies, decides which requirements are applicable or relevant and appropriate. Waivers must be obtained for alternatives which are selected but do not comply with established ARARs, in accordance with CERCLA 121(d)(4).

In the absence of established sediment criteria, the applicability of state and federal screening values to data collected at Site 2 was analyzed in depth. Site 2 sediment values were labeled as "exceeded" in the BRA based on comparison of concentrations to SSVs established by U.S. Environmental Protection Agency (USEPA) Region IV. USEPA Region IV SSVs (1994) were proposed after review of three studies (Long & Morgan 1990; MacDonald 1993; and Long et al., 1995) which evaluated effects-based concentrations. SSVs were selected based on

the lowest effects value from one of these studies, or placed at the contract laboratory program (CLP) practical quantitation limit (PQL). Although these proposed SSVs are not ARARs, and will not be considered as such, the lack of sediment criteria results in their being used for comparison and screening. These SSVs are used as benchmark values or To Be Considered (TBC) criteria, as appropriate, for the medium of concern.

1.3.4 Remedial Goals

Table 1-1 lists preliminary contaminant-specific remedial goals for site sediment. As explained in the final RI, sediment samples were collected on two separate occasions, once during Phase IIA and once during Phase IIB of the remedial investigation. The parameters and exceedances in Table 1-1 include both sampling events.

Table 1-1
Preliminary Contaminant Specific Remediation Goals for Site 2 Sediments

Parameters	PRG	Number of Exceedances	Basis
	Inorganics (mg/kg)		
Antimony	11.0	4	TEL
Arsenic	7.24	17	FDEP SQAG
Cadmium	0.676	7	FDEP SQAG
Chromium	52.3	6	FDEP SQAG
Copper	18.7	17	FDEP SQAG
Lead	30.2	18	FDEP SQAG
Mercury	0.13	10	FDEP SQAG
Nickel	15.9	2	FDEP SQAG
Silver	0.733	5	FDEP SQAG
Zinc	124.0	6	FDEP SQAG

Table 1-1
Preliminary Contaminant Specific Remediation Goals for Site 2 Sediments

Parameters	PRG	Number of Exceedances	Basis
Semivolatiles (μg/kg)			
2-Methylnaphthalene	20.2	3	FDEP SQAG
Acenaphthene	6.71	3	FDEP SQAG
Acenaphthylene	5.87	1	FDEP SQAG
Anthracene	46.9	5	FDEP SQAG
Benzo(a)anthracene	74.8	17	FDEP SQAG
Benzo(a)pyrene	88.8	13	FDEP SQAG
Chrysene	108.0	15	FDEP SQAG
Dibenz(a,h)anthracene	6.22	3	FDEP SQAG
Fluoranthene	113.0	22	FDEP SQAG
Fluorene	21.2	2	FDEP SQAG
Naphthalene	34.6	2	FDEP SQAG
Phenanthrene	86.7	8	FDEP SQAG
Pyrene	153.0	17	FDEP SQAG
bis(2-Ethylhexyl)phthalate	182.0	7	FDEP SQAG
Pesticides (μg/kg)			
4,4'-DDD	1.22	4	FDEP SQAG
4,4'-DDT	1.19	4	FDEP SQAG
Aroclor-1242	21.6	1	USEPA SSV
Aroclor-1260	21.6	1	USEPA SSV
gamma-BHC (Lindane)	0.32	2	FDEP SQAG

Notes:

mg/kg	=	Milligram per kilogram
μg/kg	=	Microgram per kilogram
FDEP SQAG	=	Florida Department of Environmental Protection Sediment Quality Assessment Guidelines
EPA SSV	=	Environmental Protection Agency Sediment Screening Value
TEL	=	Threshold Effects Level

1.3.5 Remedial Objectives

As mentioned previously, the sampling strategy developed for the RI generally characterized the site and subsequently identified five "hot spots" in the northeast region. Based on the information collected during this study, the remedial objectives for Site 2 sediments are presented in Table 1-2.

Table 1-2
Site 2 — Remedial Objectives

Media	Objective	Location [a]	Volume [b]	Rationale
Sediment	Protect ecological environment from adverse effects due to contaminant concentrations.	Northeast portion of Site 2.	10,000 yd^3	Sediments exceeding FDEP SQAG SSVs.

Notes:
yd^3 = Cubic yards
[a] = Refer to Figure 1-2 for location of Site 2.
[b] = Conservative volume was determined by calculating an area surrounding the hot spots containing at least 65% fines and contamination depth of 1 foot.

1.4 Preliminary Technology Screening

The following remedial process options were considered for Site 2, given site sediment conditions and Pensacola Bay characteristics.

- No Action
- Capping
- Natural Attenuation
- Dredging and Offsite Disposal
- Solidification/Stabilization
- Dredging and Confined Disposal Facilities (CDFs)

Implementability: The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required. Technical implementability was used to initially eliminate technology types and process options that are clearly ineffective or unworkable. The readily available information from the RI site characterization is used to eliminate technologies and process options. Administrative implementability emphasizes the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions; the availability of treatment, storage, and disposal services (including capacity); and the availability of necessary equipment and skilled workers to implement the technology.

Effectiveness: The effectiveness screening evaluation is based on how effective each technology would be in protecting human health and the environment. Each technology is evaluated according to its effectiveness in providing protection and reducing toxicity, mobility, or volume of contamination. Both shorterm and longterm components of effectiveness should be evaluated; short-term refers to the construction and implementation period and long-term refers to the period after the remedial action is complete.

Cost: Costs play a limited role in the screening process. Relative capital and operation and maintenance (O&M) costs are used rather than detailed estimates. At this stage in the process, the cost analysis is based on engineering judgment, and each process is evaluated as to whether costs are high, low, or medium relative to other process options.

Table 1-3 discusses the six treatment technologies and their objectives, along with implementability, effectiveness, and cost issues. The following table is consistent with technology screening techniques presented in the NCP and USEPA guidance because it includes containment, removal, disposal, and treatment technologies, along with implementability, effectiveness, and cost criteria as per USEPA guidance.

Table 1-3
Technology Screening for Site 2

Technology	Objectives	Implementability	Effectiveness	Cost
No Action	The no-action alternative leaves the contaminated sediment in place allowing natural sedimentation to cover and contain pollutants and/or natural biodegradation to occur.	This option may be appropriate at Site 2 because the pollutant discharge source has been halted; the burial process is naturally occurring; and the environmental effects of cleanup may be more damaging than allowing the sediment to remain in place.	It is expected that the contaminant concentrations are currently at their highest levels and will naturally degrade over time, therefore reducing the chronic effects to marine organisms. No acute effects were observed or measured.	N/A
Capping	Subaqueous capping consists of covering contaminated sediment with cleaner, less-contaminated sediments in an attempt to isolate them.	This technology is implementable at Site 2; however, some navigational and tidal conflicts may arise. Suitable capping is readily available.	This technology is effective in reducing chronic effects to the ecology. It also eliminates further resuspension of the contaminated sediment. Annual maintenance would be necessary to replace cap material that is eroded due to wave action, tidal influences, currents, and/or storms.	High capital cost, high O&M cost
Dredging and CDFs	CDFs are engineered structures designed to retain dredged material. They can be constructed away from the water, partially in water near shore, or surrounded by water. The primary goal of the CDF design is containment and solids retention.	This technology is implementable at Site 2 onshore only. It would not be practical to construct a CDF in the shallow water near Site 2 or in the bay where navigational conflicts could arise.	CDFs offer an attractive, cost-effective method of dredged material disposal. When properly located and constructed, they can isolate contaminated sediment from the environment fairly well.	Low capital cost, low O&M cost.

Table 1-3
Technology Screening for Site 2

Technology	Objectives	Implementability	Effectiveness	Cost
Dredging and Offsite Disposal	This alternative consists of dredging the contaminated sediments, dewatering, soil washing, separating waste streams, and transporting the remaining residual to an offsite approved landfill. Hydraulic equipment would be used for dredging and trucks would be used for transport.	This technology is implementable at Site 2. The hot spot locations are accessible, and the volumes will be relatively easy to manage. However, this technology adds an additional handling step due to transporting the sediment offsite. It is advantageous to avoid multiple handling steps.	This technology is effective at containing contaminated media in an approved landfill. Longterm risk to the ecological system and environment onsite is eliminated.	Low to moderate capital cost, no O&M cost.
Solidification and Stabilization	In-situ solidification/stabilization treatments immobilize sediment and contaminants by treating them with reagents to solidify them. These fixatives neutralize or bind the pollutants to reduce contaminant mobility. Another method covers sediment with barriers or sorbents to reduce transfer of the pollutants to water and biota. This technology satisfies the statutory preference for treatment.	This treatment technology is readily implementable onsite, considering the contaminants which are present. However, little is known about the large-scale treatments, their effectiveness, or their possible toxic by-products.	Although this technology is effective at rendering sediments and contaminants immobile, several problems are associated with solidification and stabilization. There are inaccuracies in reagent placement, erosion, longterm monitoring requirements, and the inability of the procedure to remove and detoxify contaminants. It is also difficult to adjust solidification mixtures and agents for subaqueous settings.	Moderate to high capital cost, low O&M cost.

Table 1-3
Technology Screening for Site 2

Technology	Objectives	Implementability	Effectiveness	Cost
Natural Attenuation	Natural attenuation is not a technology, but more of a management philosophy. Natural subsurface processes such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials are allowed to reduce contaminants to acceptable concentrations.	Natural attenuation is implementable at Site 2. This option may be appropriate because of the low-risk situation. The pollutant discharge source has been halted and there are no human health risks associated with the site. The environmental effects of cleanup may be more damaging than allowing the sediment to remain in place.	Natural attenuation could occur gradually, over time. Use restrictions already in place at Site 2 reduce the potential for human exposure. Monitoring would be conducted periodically to assess site sediment contaminant reduction.	Low capital cost, low O&M cost.

Using the implementability, effectiveness, and cost criteria discussed in this table to screen remedial technologies, neither the CDF nor the solidification/stabilization alternatives are very practical and/or efficient when compared to the other four proposed technologies. It would not be practical to construct a CDF onshore and continually have to maintain it, or to construct it in shallow water where the current and tidal fluctuations could cause erosion. The solidificaiton/stabilization technology is difficult to implement and involves many inaccuracies when operating on a largescale. These two technologies are not required or desired for either technical or regulatory reasons, and therefore, will not be retained for the assembly of alternatives.

1.5 Focused Feasibility Study Alternatives

As described in the NCP, the feasibility study's primary objective is to ensure that appropriate remedial alternatives are developed and evaluated so relevant information concerning the remedial action options can be presented to decision-makers, and the appropriate remedy selected.

To accomplish this objective, the feasibility study is tasked with addressing only remedial measures appropriate to the scope and complexity of the project.

Fewer remedial options are available for sediment contamination when compared to other media (i.e., soil, groundwater, air). Consequently, the available technologies for remediating contaminated sediment are all very similar. Because the remediation objectives for this site are clearly defined and sediment volumes are relatively small, the FFS format will be used to address the medium of concern. Four remedial alternatives will be discussed.

- **Alternative 1 — No Action:** Consideration of this alternative is required under the NCP. Under the no-action alternative, contaminated sediment would be left in place. This alternative poses no risk to current workers and site trespassers, and no additional

risk to the ecosystem. It is expected that current sediment conditions represent worst-case scenarios over the next 30 years.

- **Alternative 2 — Capping:** Subtidal capping involves placement of a clean sand layer to isolate contaminants and limit their vertical migration and release into the water column. In addition to limiting migration, a cap would also limit the potential for marine organisms to reach the contaminated sediment. Capping would cause an immediate acute adverse impact to the benthic organisms in that area, but would ultimately limit the chronic impacts.

- **Alternative 3 — Dredging and Offsite Disposal:** The areas identified in Figure 1-2, which include the five hot spots associated with the site, can be dredged to remove the contaminated sediment from the site, eliminating future adverse effects to the ecological system. Dredged sediment would be disposed of offsite in an approved Subtitle D facility. Although this alternative would result in an immediate acute adverse impact to the benthic organisms, it would ultimately limit the long-term effects to the ecological system in that area.

- **Alternative 4 — Natural Attenuation:** This alternative is not the same as "no action." Under this alternative, contaminated sediment is left in place. Currently the site is a natural area of deposition. Unless the shoreline is altered, natural coverage of the contaminated sediment will continue, reducing exposure to benthic organisms. This alternative poses no risk to current workers and site trespassers and no excess risk to the ecosystem. It is expected that current conditions represent worst-case scenarios and contaminant concentrations are gradually attenuating with time. A sampling and analysis program would be conducted throughout the process to confirm that degradation is proceeding at rates consistent with meeting cleanup objectives.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section describes the initial steps toward remedy selection: identification of remedial objectives, general response actions, applicable technologies, and regulatory constraints under which remediation is conducted.

2.1 Alternative 1: No Action

The NCP requires that a no-action alternative be considered as a "baseline" against which all other alternatives are evaluated. In the no-action alternative, no remedial actions are taken to contain, remove, or treat sediment contamination that exceeds risk- or leachability-based cleanup goals. Sediment will remain in place to attenuate according to natural biotic or abiotic processes.

2.1.1 Alternative 1 Remedial Elements

No remedial elements are associated with the no-action alternative.

2.1.2 Alternative 1 Implementability

This alternative is technically feasible. No construction, operation, or maintenance is required. No technology-specific regulations apply. This alternative is administratively feasible. The no-action alternative has no special technical or capacity requirements.

2.1.3 Alternative 1 Effectiveness

The no-action alternative does not provide any additional effectiveness for the current use scenario. However, current site access controls prohibit swimming, reducing the potential for direct human contact with the contaminated media. The site is also an area of deposition, and the contaminated sediment will continued to be naturally covered, reducing the risk to benthic organisms.

This alternative does not reduce the toxicity, mobility, or volume of contaminants. No risks are posed during the short term (implementation phase). Once the no-action alternative is implemented, the only risks remaining are those to the residing marine organisms.

2.1.4 Alternative 1 Cost

No cost is associated with the no-action alternative.

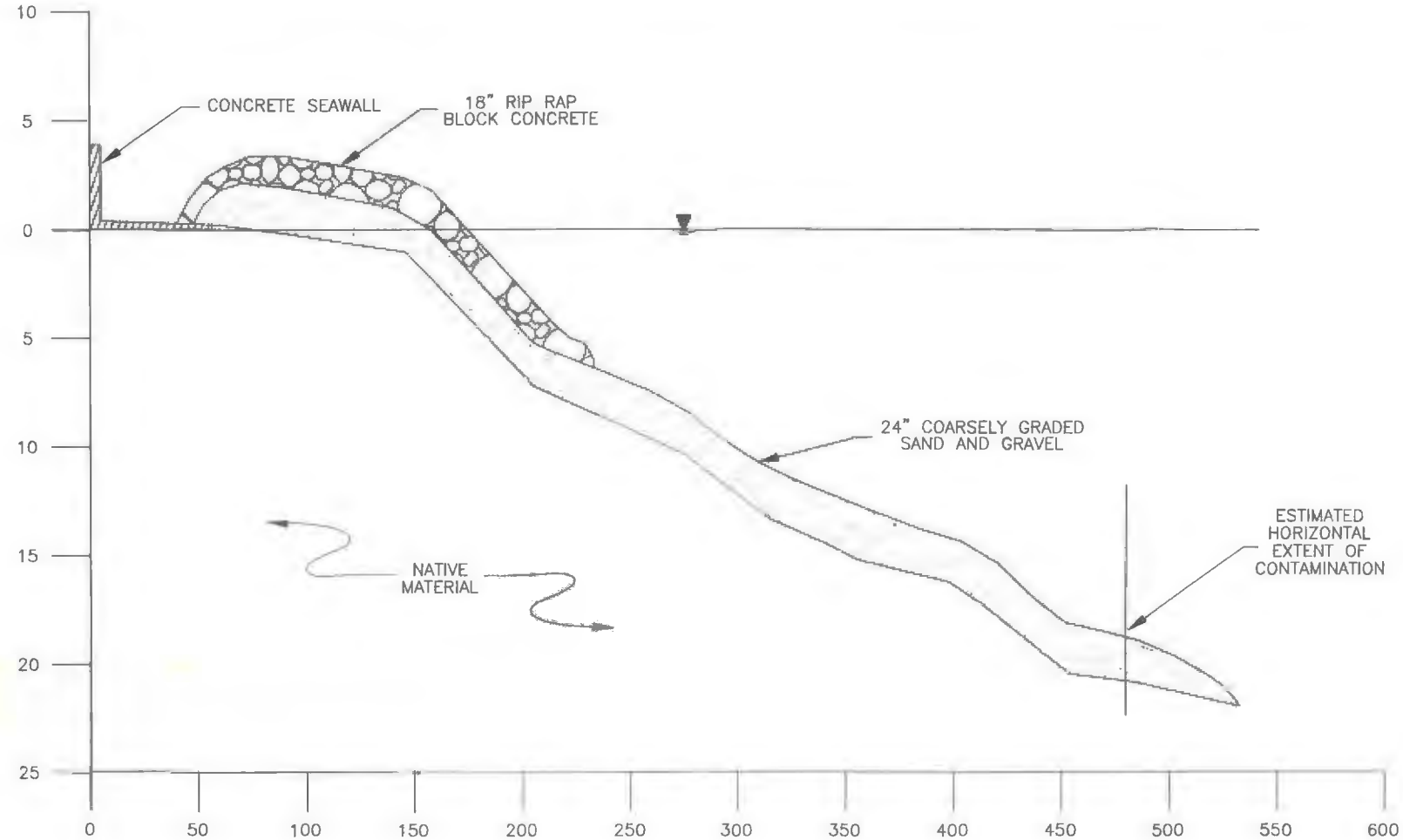
2.2 Alternative 2: Capping

Subaqueous capping consists of mechanically constructing a barrier between the contaminated sediments and biota to eliminate the possible transport of the contaminated material to other areas. Functionally, a subaqueous cap would consist of the construction of a 24-inch thick (USACOE, 1988) coarse sand and gravel layer to prevent migration of biota through to the contaminated material and to hold contaminated sediment in place. To protect the cap from erosion, adequate controls need to be constructed (i.e. riprap facing, breakwaters, groins, etc.). A conceptual design is shown in Figure 2-1.

2.2.1 Alternative 2 Remedial Elements

A remedial design investigation would be needed to further delineate the area of concern, determine actual current velocities and directions, and study wave action at the site to evaluate potential erosion controls.

The remedial action would consist of placing 24 inches of material over the contaminated sediments and placing appropriate erosion controls on the shoreline to protect against erosion. The cap would require annual monitoring to ensure its integrity. If the cap showed excessive erosion, an additional amount of material would be placed over the areas. Controls would be needed to prevent the USACOE from dredging near the cap and markers would be needed for boating safety due to the loss of navigational depths.



50 0 50
SCALE FEET
VERTICAL SCALE 1" = 5'

FEASIBILITY STUDY
NAS PENSACOLA
SITE 2

FIGURE 2-1
PROPOSED IN-PLACE
CAPPING DESIGN

DWG DATE:04/09/97 | DWG NAME:59CRSFSD

2.2.2 Alternative 2 Implementability

This alternative is administratively and technically feasible. Potential areas of concern would be the restrictions placed on dredging of the navigational channel close to the site and loss of use of the shoreline by the Navy. A remedial design investigation and associated engineering plans and specifications would need to be developed.

2.2.3 Alternative 2 Effectiveness

Based on USACOE studies on capping of contaminated dredged material, this alternative would adequately protect Site 2 ecology. During remedial design, several studies would need to be done to ensure capping effectiveness. Current and velocity mapping would be needed for Site 2 to evaluate sediment transport and determine an erosion rate. The burrowing depths of bay biota would need to be evaluated to ensure they do not penetrate the cap. Changing the bottom type of the bay from sediment to sand would change the diversity and community types occupying the Site 2 area.

The main concern in regard to the effectiveness of the cap would be storm-induced erosion. Hurricanes and other strong storms occur annually in and around Pensacola. Forces induced by these storms are difficult to predict and could destroy even a well-designed system.

A possible cap design, shown in Figure 2-1, was evaluated for erosion potential using RI estimates of channel velocities. An assumed average channel velocity range from 3 to 8 knots (approximately 5.0 feet per second [ft/sec] to 13.4 ft/sec) was used to evaluate the cap's effectiveness. Channel velocity distribution is based on shoreline features, irregularity of the channel bottom, and depth of flow. Velocities at the bottom of a channel are theoretically zero; however, it is reasonable to assume that half the average velocity is acting on bed sediments. Taking half of the assumed average velocity range results in bed velocities of 1.5 to 4.0 knots (2.5 to 6.7 ft/sec). For channel design, several tables describe permissible water velocities for

specific channel-lining materials. Permissible water velocities are the maximum at which the channel lining material will remain in-place. Coarse gravel has a permissible velocity of 6.0 ft/sec (North Carolina Sedimentation Control Commission, 1988), which is inadequate for the upper end of the assumed velocities. Therefore, operation and maintenance of the cap would likely require renourishment of the cap material, either annually or biennial.

Ecological life within the 4.5-acre site would be buried if this alternative were implemented. Placement of the coarse-grained material in the bay could be very difficult. The cap, designed to keep organisms from burrowing into the contaminated sediment, would bury and destroy the organisms currently underneath it. Therefore, total loss of all biota in the area would be expected if a cap were constructed.

2.2.4 Alternative 2 Cost

The cost estimate for the capping alternative includes the following:

- Remedial design investigation
- Remedial design report
- Remedial design drawings and specifications
- Remedial action
- Development of an operations and maintenance plan
- Maintenance of the system

Table 2-1 presents the costs associated with capping.

Table 2-1
Estimated Costs Associated with Capping

Action	Quantity	Cost per Unit	Total Cost
Remedial Design Investigation	LS	$43,500	$43,500
Remedial Design Report	LS	$30,100	$30,100
Remedial Design Drawings and Specifications	LS	$32,900	$32,900
Remedial Action	LS	$577,000	$577,000
Development of Operation and Maintenance Plan	LS	$11,300	$11,300
Contingency	LS	30% of Direct Cost	$208,000
Total Cost			**$903,000**
Estimated Annual Operation and Maintenance Costs			
Annual Renourishment of Cap and Hydrographic Survey	2,250 tons of cap material[a]	LS	$98,500[b]

Notes:
a = Includes material and placement. Assumes 10% of material lost to erosion.
b = Does not include inflation.
LS = Lump Sum

2.3 Alternative 3: Dredging and Offsite Disposal

This alternative involves dredging the contaminated sediment from the two areas previously depicted as "hot spots" in Figure 1-2. The dredged spoils would be dewatered, separated, and transported by truck to an approved offsite Subtitle D facility. By dredging the contaminated sediment and removing it offsite, future risk would be eliminated.

2.3.1 Alternative 3 Remedial Elements

Before dredging can take place in the bay, a permit must be obtained from the USACOE. Pretreatment waste treatability studies would be conducted prior to project mobilization. The purpose of conducting these waste treatability studies are as follows:

- To simulate on a bench scale and in a controlled environment, actual operating conditions and operating parameters using representative in-situ wastestream samples collected from Site 2.

- To determine exact filtration/separation processing requirements for waste treatment purposes.

- To determine actual processing parameters.

Dredging would be performed by hydraulic equipment (e.g., Mudcats), and would consist of removing the top foot of sediment from the potentially contaminated areas determined in the RI. Silt curtains and possibly inflatable bladders would be used to recapture and isolate resuspended sediments. A protective netting could also be placed along the shoreline to prevent contaminated sediment from washing ashore.

Dredge spoils would be dewatered onshore through a filter press. Recovered solids would be transported by truck to a Subtitle D facility. Extracted water would be tested for possible contamination before being discharged back into the bay. If the water is contaminated, treatment alternatives would need to be evaluated.

2.3.2 Alternative 3 Implementability

This alternative is both technically and administratively feasible at Site 2.

Pensacola Bay and the boat slip near Pier 303 are now dredged on an as-needed basis. Dredging is a reliable option for removing contaminated sediment. The remedial option would involve excavating the top foot of sediment from the ocean floor. The areas to be dredged are relatively small (approximately 265,000 square feet combined) and would only take a minimal amount of

time to dredge. Hydraulic dredges proposed for this particular site have average production rates between 50 to 500 cubic yards per hour.

No remedial alternative can remove, contain, or treat contaminated sediment without some disturbance and consequent release of contaminants. The resuspension of sediments due to dredging could have an immediate negative impact on the benthic organisms, but would have a positive long-term effect.

Dredging is administratively feasible. A permit would be required before any dredging operations can take place. However, because the bay and boat slip are currently being dredged, it is assumed that a permit to dredge Site 2 could be obtained with little difficulty.

2.3.3 Alternative 3 Effectiveness

Dredging is effective at limiting the chronic impacts to the ecology, but immediate protection would not be provided. Initially, the benthic organisms would be destroyed due to the dredging operations. However, dredging and disposing of the contaminated sediment eliminates future risk. Gradually, the benthic organisms will reestablish themselves in the dredged areas.

2.3.4 Alternative 3 Cost

Table 2-2 shows capital costs associated with the dredging alternative.

Table 2-2
Estimated Costs Associated with Dredging and Offsite Disposal [a]

Action	Quantity	Cost per Unit	Total Cost
Pretreatment Waste Treatability Studies	1	LS	$7,200
Personnel and Equipment Mobilization	1	LS	$9,200
Sediment Dredging	1	LS	$171,000
Material Processing	1	LS	$201,000

Table 2-2
Estimated Costs Associated with Dredging and Offsite Disposal [a]

Action	Quantity	Cost per Unit	Total Cost
Equipment Decontamination/Demobilization	1	LS	$10,100
Transportation	50 trucks (assuming 20 yd^3 trucks) hauling 120 miles	$3.50/loaded mile	$105,000
Disposal	5,000 yd^3	$50/$yd^3$	$250,000
Contingency	LS	30% of Direct Cost	$226,000
Total Cost			**$980,000**

Notes:
LS = Lump Sum
[a] = Cost estimate provided by Industrial Cleanup, Inc.
* = No O&M costs are associated with this alternative.

2.4 Alternative 4: Natural Attenuation

Natural attenuation is not the same as "no action." Under this alternative, contaminated sediments would be left in place, controls would be implemented at the site to limit access, and the site would be monitored annually. This alternative poses no risk to human health. Natural attenuation relies on natural processes within the bay to naturally reduce the risk to benthic organisms.

2.4.1 Alternative 4 Remedial Elements

Natural attenuation at Site 2 would require annual site monitoring. Monitoring would be necessary to evaluate the effectiveness of natural processes.

Access controls are currently in place at Site 2. Access from shore to the contaminated sediments at Site 2 is controlled by the U.S. Navy and the area is not conducive to recreational activities. The shoreline is dominated by a 3- to 4-foot high concrete seawall. A major navigational channel between Site 2 and the opposing shore restricts site access to boat only. Crabbing occurs in the

Site 2 area. According to the RI report, no risk is expected to human health through consumption of Site 2 crab tissue.

The site would need to be monitored for sediment chemistry, general water chemistry, sediment toxicity, benthos that are not pollution indicators, and for any changes in the bathymetry. Using data from this monitoring, investigators could asess how much sediment toxicity is reduced through natural deposition in the area.

2.4.2 Alternative 4 Implementability

This alternative is technically and administratively feasible. No construction, operation, or maintenance is required. Developing and implementing a monitoring plan would be necessary.

2.4.3 Alternative 4 Effectiveness

Natural attenuation is an effective long-term alternative. Currently, physical and natural controls are in place (i.e., Navy control of shoreline and a major navigation channel between shores) to limit access to the site. The site is still accessible by boat and crabbing still takes place in the Site 2 area. As previously stated in the RI report, no risk to human health is expected via consumption of crab tissue from Site 2 (E/A&H, 1996). There is a risk to the ecological receptors in Site 2 based on the results of the Phase IIA and IIB investigations.

This alternative would not immediately protect area ecology; however, over time, natural attenuation would become more effective. Natural sedimentation taking place in the area of concern, over time, will bury the contaminated material. The RI identifies species as pollution indicator species in areas of contamination (E/A&H, December 1996). Natural attenuation would allow the organisms at Site 2 to possibly transform or degrade the organic constituents to less-toxic forms by bioprocesses (Bishop, 1996). "Intrinsic bioremediation (natural attenuation), even of these persistent compounds (speaking of organic compounds and metals), occurs naturally but slowly in sediments, and uses indigenous microorganisms and enzymatic pathways of both

aerobic and anaerobic processes." As the natural sedimentation and/or transformation of the chemicals at the site take place, other less opportunistic species within the bay will begin to move into the area naturally (Bishop, 1996).

A monitoring plan would be instituted to effectively monitor the site annually. The monitoring plan would describe sampling and analysis onsite and methods to perform the hydrographic survey. These analyses would demonstrate the natural capping in the area by sedimentation, reduction in ecological risk by comparison with chemistry and toxicity, and recovery of other marine species to the area. Furthermore, the monitoring plan would outline remedial goals, so when the site reaches levels of minimal ecological risk, annual monitoring would cease and the site would be closed to further investigation.

Natural attenuation does not require disturbance of the sediments, thereby eliminating the risk of releasing more contaminated sediments below the surface. The original Site 38 outfalls have not been used for at least 18 years. Site 2 sediment contamination may not be isolated to the upper foot of sediment. During the field investigation, sediment samples were generally collected from the zero to 1-foot interval, and therefore, vertical extent of contamination is unknown. The site may already be remediating itself through bioprocesses and capping through natural sedimentation. If the area is disturbed, contaminated sediments in deeper intervals may be encountered. If this is the case, further action may cause more harm than good.

Natural attenuation would be effective in reducing the risk to the ecology over time. The process is slow and would be monitored annually. Institutional controls would not need to be initiated, since current physical controls are sufficient.

2.4.4 Alternative 4 Cost

Cost components for natural attenuation include the following:

- Development of annual monitoring program
- Sediment and water sampling
- Benthic diversity and toxicity sampling
- Hydrographic survey
- Analysis and report compilation

Table 2-3 presents the costs associated with natural attenuation.

Table 2-3
Estimated Costs Associated with Natural Attenuation

Action	Quantity	Cost per Unit	Total Cost
Development of Annual Monitoring Plan	1	LS	$25,000[a]
Fieldwork (sampling)	labor	LS	$9,500
	equipment rental	LS	$4,500
	travel	LS	$3,000
Laboratory Analysis	sediment	10 @ 120	$1,200
		5 @240	$1,200
	water	10 @120	$1,200
		5 @ 120	$1,200
	toxicity (5)	625	$3,125
	benthic survey (5)	110	$550[b]
	labor	LS	$1,969
	shipping and handling	7% of analytical cost	$593
Reporting of Analytical Results	1	LS	$8,000
Hydrographic survey	1	LS	$10,000
Contingency	LS	30% of Direct Cost	$21,000
Total Cost			**$92,000**

Table 2-3
Estimated Costs Associated with Natural Attenuation

Action	Quantity	Cost per Unit	Total Cost
Estimated Biennial Operation and Maintenance Cost			
Field Work (sampling)	Once every 2 yrs. for 30 yrs., not including inflation	LS	$17,000
Laboratory Analysis	Once every 2 yrs. for 30 yrs., not including inflation	LS	$11,000
Hydrographic Survey	Once every 2 yrs. for 30 yrs., not including inflation	LS	$10,000

Notes:

a = Cost includes site visit for person preparing the plan.
b = Cost estimated by Barry Vittor and Associates.
LS = Lump Sum
* = Sampling, laboratory analysis, and hydrographic survey to occur once every 2 years.

3.0 DETAILED ANALYSIS OF ALTERNATIVES

In this section, the remedial alternatives discussed in Section 2 will be examined with respect to requirements stipulated in CERCLA as amended, the NCP, OSWER Directive No. 9355.9-19 (*Interim Guidance on Superfund Selection of Remedy,* December 24, 1986), and factors described in *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.*

3.1 Evaluation Process

The detailed analysis of alternatives consists of analyzing and presenting the relevant information needed to allow decision-makers to select a site remedy, but it does not replace the decision-making process. During the detailed analysis, each alternative will be assessed against the evaluation criteria and all other alternatives. The results of the assessment are arrayed to compare the alternatives and identify the key tradeoffs among them. This approach to analyzing alternatives is designed to provide decision-makers sufficient information to adequately compare the alternatives, select an appropriate remedy for the site, and demonstrate satisfaction of the CERCLA remedy-selection requirements.

Nine evaluation criteria have been developed to address the CERCLA requirements and considerations, and to address the additional technical and policy considerations that have proven to be important for selecting among remedial alternatives. These evaluation criteria serve as the basis for conducting the detailed analyses during the FFS and for subsequently selecting an appropriate remedial action. The evaluation criteria with the associated statutory considerations are:

- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume

- Implementability
- Cost
- Compliance with ARARs
- Overall protection of human health and the environment
- State acceptance
- Community acceptance

Each remedial alternative is evaluated with respect to the above criteria, as described in the following sections. In Section 4, the statutory factors and nine criteria listed above are compared for each alternative to assist in the remedy selection process.

3.1.1 Short-Term Effectiveness

The short-term effectiveness of a remedial alternative is evaluated relative to its effect on human health and the environment during implementation. The short-term effectiveness is based on four key factors:

- Risks to the community during implementation of the remedial action
- Risks to workers during implementation of the remedial action
- Potential for adverse environmental impact as a result of implementation
- Time until remedial response objectives are achieved

3.1.2 Long-Term Effectiveness and Permanence

The evaluation of alternatives under this criterion addresses the results of a remedial action in terms of the risk remaining at the site after response objectives 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 wastes. The following components of the criterion should be addressed for each alternative:

- **Magnitude of Residual Risk:** This factor assesses the residual risk from untreated waste or treatment residuals at the conclusion of remedial activities. This risk may be measured by numerical standards such as cancer risk levels or the volume or concentration of constituents in waste, media, or treatment residuals remaining onsite.

- **Adequacy and Reliability of Controls:** This factor assesses the adequacy and suitability of any controls used to manage treatment residuals or untreated wastes remaining onsite. It may include an assessment of containment systems and institutional controls to determine if they are sufficient to ensure that any exposure to human and environmental receptors is within protective levels.

3.1.3 Reduction of Toxicity, Mobility, or Volume

This evaluation criterion addresses the statutory preference for remedial actions employing treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances.

The evaluation should consider the following specific factors:

- The treatment processes, the remedies they will employ, and the materials they will treat.

- The amount of hazardous materials that will be destroyed or treated, including how principal threat(s) will be addressed.

- The degree of expected reduction in toxicity, mobility, or volume, measured as a percentage of reduction (or order of magnitude) when possible.

- The degree to which the treatment will be irreversible.

- The type and quantity of treatment residuals that will remain following treatment.

- Whether the alternative would satisfy the statutory preference for treatment as a principal element.

3.1.4 Implementability

The implementability criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. This criterion involves analysis of the following factors:

Technical Feasibility

- Construction and operation relating to the technical difficulties and unknowns associated with a technology.

- Reliability of technology, focusing on the likelihood that technical problems associated with implementation will lead to schedule delays.

- Ease of undertaking remedial action, discussing any future remedial actions that may be required and how difficult it would be to implement such additional actions.

- Monitoring considerations addressing the ability to monitor the effectiveness of the remedy, including an evaluation of the risks of exposure should monitoring be insufficient to detect a system failure.

Administrative Feasibility

- Activities needed to coordinate with other offices and agencies.

Availability of Services and Materials

- Availability of adequate offsite treatment, storage capacity, and disposal services.

- Availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources.

- Availability of services and materials, plus the potential to obtain competitive bids, which may be particularly important for innovative technologies.

- Availability of prospective technologies.

3.1.5 Cost

Detailed cost estimates for each remedial alternative are based on engineering analyses, suppliers' estimates of necessary technology and costs for similar actions (such as excavation) at other CERCLA and Resource Conservation and Recovery Act (RCRA) sites. Costs are expressed in 1996/1997 dollars. The cost estimate for a remedial alternative consists of four principal elements: capital cost, operation and maintenance cost, costs for five-year evaluation reports, and present-worth analysis.

Capital Costs

- ***Direct costs*** for equipment, labor, and materials used to develop, construct, and implement a remedial action.

- ***Indirect costs*** for engineering, financial, and other services that are not actually a part of construction, but are required to implement a remedial alternative. The percentage applied to the direct cost varies with the degree of difficulty associated with construction and/or implementation of the alternative. In this FFS, the indirect costs include health and safety

items, permitting and legal fees, bid and scope contingencies, and engineering design and services.

Annual O&M Costs

O&M costs refer to postconstruction costs necessary to ensure the continued effectiveness of a remedial action. They typically refer to long-term power and material costs (such as the operational cost of a water treatment facility), equipment replacement costs, and long-term monitoring costs.

Costs for Five-Year Evaluation Reports

This costs are associated with reports prepared every five years evaluating the results of monitoring activities.

Present-Worth Analysis

This analysis makes it possible to compare remedial alternatives on the basis of a single cost representing an amount that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action during its planned life. A 30-year performance period is assumed for present-worth analyses. Discount rates of 6% are assumed for base calculations. An increase in the discount rate decreases the present worth of the alternative.

The cost elements for each remedial alternative are summarized in the cost analysis section. The study estimate costs provided for the alternatives are intended to reflect actual costs with an accuracy of 30% to plus 50%, in accordance with USEPA guidelines.

3.1.6 Compliance with ARARs

This evaluation criterion is used to determine whether each alternative will meet all the federal and state ARARs that have been identified in previous stages of the remedial process. The detailed analysis should identify which requirements are applicable or relevant and appropriate to an alternative. The following should be addressed for each alternative during the detailed analysis of ARARs:

- Compliance with chemical-specific ARARs
- Compliance with location-specific ARARs
- Compliance with action-specific ARARs

The actual determination of which requirements are applicable or relevant and appropriate is made by the lead agency (the Navy) in consultation with the support agencies (USEPA and Florida Department of Environmental Protection [FDEP]).

3.1.7 Overall Protection of Human Health and the Environment

This evaluation criterion provides a final check to assess whether each alternative adequately protects human health and the environment. The overall assessment of protection draws on the assessments conducted under other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Evaluation of the overall protectiveness of an alternative should focus on whether an alternative achieves adequate protection by eliminating, reducing, or controlling the risks posed through each pathway through treatment, engineering, or institutional controls. This evaluation also allows for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

3.1.8 State Acceptance

This assessment evaluates the technical and administrative issues and concerns the state may have regarding each alternative. This criterion is largely satisfied through state involvement in the entire remedial process, including review of the FFS.

3.1.9 Community Acceptance

This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. As with state acceptance, this criterion will be addressed in the Record of Decision (ROD) when comments on the FFS have been received.

3.2 Evaluation of Selected Alternatives

The following sections present a detailed analysis of each alternative presented in Section 2.

3.2.1 No Action

The no-action alternative for Site 2 would involve no active remedial effort. No actions would be taken to contain, remove, or treat sediment contaminated above risk-based cleanup goals. Sediment would remain in place and will attenuate according to natural biotic or physical processes.

Short-Term Effectiveness

Short-term effectiveness assesses the effects of an alternative on human health and the environment while implementing the remedial alternative. There are no implementation concerns associated with the no-action alternative. This alternative may be implemented immediately.

Long-Term Effectiveness and Permanence

The long-term effectiveness criterion evaluates the results of a remedial action relative to the risk remaining onsite, particularly any residual risk and the adequacy and reliability of controls.

Current contaminant levels at Site 2 would attenuate slowly, decreasing the volume and concentrations of contaminated sediment. With time, the adverse effects to the benthic organisms would diminish.

Any controls which are currently in place at the site — which include military security and limited access to the site — would remain. These controls are considered reliable for protecting human health, given the current and projected use of the site.

Reduction of Toxicity, Mobility, and Volume

The no-action alternative does not reduce the mobility or volume of contaminants at Site 2. Toxicity would be reduced slowly through natural attenuation. Contaminants would remain onsite; no treatment would be effected during remedial actions. However, intrinsic remediation processes (either biotic or abiotic degradation) would continue. Intrinsic remediation is considered irreversible.

Implementability

The no-action alternative is technically feasible and easily implemented. No construction, operation, or reliability issues are associated with this alternative. Current site controls — including military security and limited access — have been reliable in the past. No administrative coordination is required for implementation of the no-action alternative. The no-action alternative will not require offsite services, materials, specialists, or innovative technologies.

Cost

No costs are associated with the no-action alternative.

Compliance with ARARs

The no-action alternative does not comply with the TBC criteria set forth in the BRA. It does not reduce the sediment contaminant concentrations to the proposed PRGs for the protection of the ecological system. The no-action alternative does not trigger any location- or action-specific ARARs.

Overall Protection of Human Health and the Environment

This criterion is used to assess the overall protectiveness of the alternative, particularly with respect to long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. The no-action alternative does not afford any long-term effectiveness and permanence beyond natural degradation of constituents. No short-term impacts are associated with this alternative. The alternative does not comply with TBC criteria.

However, as stated in the BRA, no human health risks are associated with contaminated sediment in the bay. The physical controls presently in place at Site 2 adequately restrict human contact with contaminated sediment. In addition, the volumes associated with sediment exceeding SSVs are relatively small. Hot spots are being capped naturally through continual deposition due to constant wave action.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process. FDEP will have the opportunity to review and comment on this FFS.

Community Acceptance

The community acceptance will be determined following the public-comment period.

3.2.2 Capping

The in-place capping alternative for Site 2 would involve constructing a physical barrier between the contaminated sediments and the biota in Pensacola Bay. Soil would remain in place and be covered with a layer of coarse-grained sand and gravel. In areas where waves may cause excessive erosion, riprap or other suitable material would be placed to stabilize it.

Short-Term Effectiveness

Effectiveness for this design will be measured in its ability to prevent biota from migrating through it and contacting sediment, and whether contaminated sediments are kept in place. If these two properties are maintained, risk to human health and the environment will not be expected. In the short-term, implementing this alternative will eliminate all marine life within the immediate area of Site 2. When construction is complete, there would be no expected risk to any species inhabiting the area.

Long-Term Effectiveness

Over time, it is expected that biota would recolonize the area; it is unknown to what extent. This cap would be affected by wave action, high-velocity currents, prop wash, etc., which are conducive to excessive erosion. Sufficient controls could be designed to prevent catastrophic erosion; however, it is assumed that there will be a net loss over the site. The exact amount would be determined in the remedial design. For cost comparison, it is assumed that 10% of the capping material will be lost in a year. Precise information on currents and wave action in the Site 2 area was unavailable to EnSafe/Allen & Hoshall at the time of this report. If this alternative is selected, a portion of the remedial design investigation will be allocated to mapping the currents and velocities at Site 2, so that the erosive nature of the environment could be adequately assessed.

Reduction of Toxicity, Mobility, and Volume

Capping sediments at Site 2 does not remove, treat, or remediate the contaminated sediments. In-place capping would restrict movement of sediments and contact with the biota at Site 2. Movement of the contaminated sediments would be prevented by the 24-inch layer of material above it. No reduction in volume is expected, except reduction from natural attenuation of the constituents.

Implementability

This alternative is technically and administratively feasible. The in-place capping alternative will require a remedial design phase, remedial action, O&M, and site monitoring. Remedial design will consist of further site investigation, report preparation, design drawings, specifications, an O&M plan, and a 30-year monitoring plan. Remedial action will consist of all activities necessary to construct the cap. The O&M and monitoring plans would need to be implemented. Site access controls would be necessary to restrict navigational dredging and a warning system (i.e., buoys) to identify the new shallow water depth.

Cost

The cost breakdown associated with the capping alternative is detailed in Section 2.2.4. Direct capital costs associated with cap construction are $903,000, including an additional 30% for contingencies. Annual maintenance costs are expected to be $98,500 per year.

Compliance with ARARs

According to the Clean Water Act, a permit must be obtained before dredged or fill material is discharged into navigable waters. This is an applicable and relevant location-specific ARAR. This alternative does address the TBC criteria (proposed USEPA Region IV SSVs), as identified in the BRA and proposed as PRGs for protection of the benthic species.

Overall Protection of Human Health and the Environment

The in-place capping alternative would temporarily destroy all the bottom-dwelling life at Site 2, but would adequately protect the environment, including bottom-dwelling life, after construction is completed. After implementation, marine life in the area should recolonize over time. According to the BRA, no human health risks are associated with Site 2 due to the contaminated sediment. The ecological risk from the contaminated sediments would be reduced after this alternative is implemented. However, a trade-off is involved. Implementing the alternative would require the initial elimination of the marine life the action is designed to protect.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process at Site 2 and it will have the opportunity to comment on this FFS.

Community Acceptance

Community acceptance will be determined following the public-comment period.

3.2.3 Dredging with Offsite Disposal

The primary element of this alternative is the dredging of sediment contaminated above the PRGs from the site with disposal in an approved landfill, thus eliminating risk to the marine environment.

Short-Term Effectiveness

Dredging Site 2 with the small hydraulic dredges recommended in this study would have no impact on the community. The dredging operation would be sufficiently removed from the public to minimize health and safety concerns associated with sediment removal. Dredge operators would have to take appropriate protective measures to prevent direct contact with the contaminated

sediment, particularly during maintenance of dredging equipment. The filter press and soil washing would be located onshore and would require restrictions to prevent access by the public.

Although dredging would remove contaminated sediment from the site and eliminate chronic risk to the environment, the ecology in the dredged areas would initially be destroyed. Given time, the ecology should reestablish in those areas.

Long-Term Effectiveness

Dredging would eliminate the chronic adverse impacts to the benthic organisms and to the overall ecology at Site 2 through removal and offsite disposal of the contaminated sediment. Dredging would continue until sediment remaining onsite would not threaten human health or the environment.

Dredging with offsite disposal is a particularly reliable option, as sediment is removed from the site. Onsite risks would be eliminated. Future liability will be incurred through disposal at a landfill.

Reduction of Toxicity, Mobility, or Volume

This criterion evaluates adherence to statutory preference for reducing toxicity, mobility, or volume through treatment. The dredging with offsite disposal alternative does not entirely satisfy this preference for treatment. Soil washing, which was proposed to be combined with the dredging alternative, is a treatment technique. It serves as a cost-effective pretreatment step in reducing the quantity of material to be disposed of offsite.

Dredging will eliminate the contaminated area and, therefore, eliminate risk to the surrounding ecology. This alternative includes the removal of approximately 10,000 cubic yards of sediment from the site; this sediment will be isolated in a secure landfill. Dredging is an irreversible

method of treatment. This alternative does not reduce toxicity or mobility through treatment, but when combined with soil washing, it does reduce volume through treatment. However, this alternative does not satisfy the statutory preference for treatment as a principal element.

Implementability

The dredging with offsite disposal alternative is implementable at Site 2; both the boat slip and the channel are dredged periodically.

Dredging is a common remediation technique for contaminated sediments. The only potential technical problems that may slow removal activities are materials handling and disposal (standby time between confirmatory sampling and disposal), management of removed sediment and drained water, and tidal fluctuations. Administrative coordination would involve the acquisition of a permit from the USACOE before dredging could begin. Coordination with the public owned treatment works (POTW) may be necessary if the wastewater from the soil washing process requires treatment before being discharged. Independent contractors capable of performing dredging operations for this alternative are located in the area.

Cost

Detailed costs associated with Alternative 3 are presented in Section 2.3.4. Total direct costs are estimated to be $754,000. Assuming a 30% contingency, total direct and indirect costs are $980,000.

No O&M costs are associated with this alternative.

Compliance with ARARs

A permit must be obtained from the USACOE before any dredging operations could take place in the bay. Dredging activities and soil-washing operations onsite may require compliance with

federal, state, and local air emissions and storm water control regulations. Transportation offsite will trigger U.S. Department of Transportation regulations. Land disposal restrictions will not be triggered because the contaminated sediment is nonhazardous. Occupational Safety and Health Administration (OSHA) regulations apply to any remedial activities on a CERCLA site.

This alternative does address the TBC criteria (proposed USEPA Region IV SSVs), as identified in the BRA and proposed as PRGs to protect the benthic species.

Overall Protection of Human Health and the Environment

This criterion evaluates the adequacy of an alternative with respect to the following three criteria: long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

The dredging with offsite disposal alternative addresses the long-term effectiveness and permanence criterion by removing contaminated sediment from the site. Risks to the environment would be eliminated. However, this alternative does not meet the short-term effectiveness criterion. Short-term risks include initial destruction of the marine environment in the areas being dredged. Short-term risks from inhalation and dermal contact exposures during implementation would be minimal, and can be controlled using common engineering techniques and personal protective equipment. This alternative complies with TBCs outlined above.

The dredging with offsite disposal alternative is the most aggressive remedial action proposed in this FFS. This alternative could be implemented at Site 2, and would be effective in eliminating the chronic adverse effects to the ecology.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process at Site 2 and it will have the opportunity to comment on this FFS.

Community Acceptance

Community acceptance will be determined following the public-comment period.

3.2.4 Natural Attenuation

Natural attenuation is not the same as no-action. Under this alternative, contaminated sediments would be left in place, site access controls would continue to be implemented at the site, and the site would be monitored annually. This alternative poses no risk to human health. Natural attenuation would rely on natural processes within the bay to remediate sediment over time.

Short-Term Effectiveness

No implementation concerns are associated with natural attenuation. Access to the site is controlled by the U.S. Navy from land and a navigational channel. The site is not conducive to recreation; therefore, human contact with sediments are not expected. Crabbing in the area is currently ongoing. Human health risks via the consumption of crab tissue from Site 2 is not expected (E/A&H, December, 1996). Development and implementation of a monitoring plan for Site 2 would be necessary.

In the short-term, this plan would not change current risks to the ecology. All industrial discharges from Site 38 have been eliminated. Sewer outfalls have been out of service for at least 18 years. Natural attenuation is taking place within the Site 2 sediments. Further construction at the site (i.e., dredging, capping) would eliminate the existing ecology in the area.

Long-Term Effectiveness and Permanence

The natural attenuation alternative would eliminate risk to the ecological environment via two mechanisms: (1) transformation/degradation of the chemicals of concern to less toxic forms by bioprocesses and (2) containment of the contaminated sediments through natural sedimentation over the area. Natural attenuation of sediments, in which organic and inorganic contaminants are

present, occurs slowly using indigenous microorganisms and enzymatic pathways. These processes are assumed to remediate the site over time. Velocity and current data in the immediate area of Site 2 are unavailable and would need to be part of a remedial design phase to determine the extent and rate of deposition in this area. It is assumed that an eddy current is formed by Pier 303 and the current coastline, thereby creating an area of lower velocities that allow finer materials to fall out of suspension and cover the shallow bottom. The area affected by the lower velocities is shown in Figure 7-1 of the RI. Areas with high percentages of fine material are indicative of slow-moving water, while coarser-grained materials (i.e., sand and gravels) are indicative of fast-moving currents or high-energy environments. If studies show a slow rate of deposition, it may be possible to construct a groin or breakwater that would promote a higher rate of deposition over the area. This possibility would be contingent on the potential of obstructing navigational channels.

Reduction of Toxicity, Mobility, or Volume

The natural attenuation alternative does not reduce the mobility or volume through treatment, and does not satisfy the statutory preference for treatment as a principal element. Contaminants would remain in place; no treatment would be effected during remedial actions. However, intrinsic remediation processes (either biotic or abiotic degradation) would continue and toxicity would be expected to reduce slowly with time. Intrinsic remediation is considered irreversible. Contaminated sediments that are not being contained and remediated would be monitored and would reach remedial goals with time.

Implementability

The natural attenuation alternative is technically feasible and easily implemented. A monitoring program would need to be developed. Institutional controls that are presently implemented at the site, including military security and the navigational channel, adequately restrict human access. No administrative coordination would be required to implement the natural attenuation

alternative. Natural attenuation is most likely taking place at Site 2. The only addition would be periodic site monitoring.

Cost

Cost components for the natural attenuation alternative include the following:

- Development of a monitoring plan
- Sampling: water, sediment, benthic diversity, and toxicity
- Institutional controls
- Analysis and report compilation

Costs associated with natural attenuation are detailed in Section 2. Direct capital costs for the alternative are approximately $71,000. Assuming a 30% contingency, total capital costs are $92,000. Biannual operating and maintenance costs for natural attenuation are $38,000. The total present value for Alternative 4, therefore, is $354,000 (assuming a 6% discount rate over 30 years).

Compliance with ARARs

The natural attenuation alternative complies with the TBC criteria developed in the BRA. Sediment would be expected to reach remedial goals with time through natural processes.

Overall Protection of Human Health and the Environment

Under current conditions there is no expected risk to human health from the contaminated sediment. Access to the site is controlled by land by the U.S. Navy, and the site is not conducive to recreational activities. There is a risk to the benthic ecology at the site. Over time, the site would remediate itself via bioprocesses and natural sedimentation, gradually reducing the risk to

the environment. If any construction activity were to take place in the area (i.e., dredging, capping) all existing ecology would be destroyed.

State Acceptance

FDEP has been involved with the USEPA in the entire remedial process. FDEP will have the opportunity to review and comment on this FFS.

Community Acceptance

Community acceptance for Alternative 4 will be established after the public-comment period for the FFS.

4.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section provides a comparative analysis of alternatives, examining potential advantages and disadvantages of each according to the nine criteria.

4.1 Threshold Criteria

All alternatives considered for selection must comply with the threshold criteria, overall protection of human health and the environment, and compliance with ARARs.

4.1.1 Overall Protection of Human Health and the Environment

This criterion evaluates the overall degree of protectiveness afforded to human health and the environment. It assesses the overall adequacy of each alternative.

Protection of Human Health

As discussed in Section 1, no human health risks are expected at Site 2 due to contamination of sediment. Access controls are currently enforced at the site and there is no direct contact between workers and/or residents and the contaminated sediment. Therefore, compliance with this criterion for each alternative does not have to be demonstrated.

Protection of the Environment

The ecological risk assessment employed the use of the hazard index approach (USEPA, 1989) to evaluate risk to potential receptors in the marine environment. An HI of 10 was selected as a screening level; USEPA suggests that levels above 10 may indicate a moderately high potential risk. At an HI of 10, minimal changes to the benthic assemblage at Site 2 were observed. Five stations had an HI above 10 (the five hot spots depicted in Figure 1-2) and thus from a spatial perspective, negative impacts represent only 3.9% of the total area under investigation at Site 2.

Each of the four alternatives protects the environment in varying degrees. The no-action alternative does not address sediment in excess of USEPA Region IV SSVs (1994). Alternative 4, natural attenuation, seeks to quantify threats to the environment from the Site 2 area. Natural attenuation involves annual monitoring.

Alternatives 2 and 3 afford long-term protection of the environment, but will initially destroy the ecology in those areas where the alternatives are being implemented.

4.1.2 Compliance with ARARs

As discussed in Section 1, no threats to human health are present at Site 2. If institutional controls continue to be implemented at the site, no further action will be required at Site 2 to protect human health.

Alternative 1 does not comply with ARARs. Alternatives 2 and 3 incur restrictions for dredge and fill material in navigable waters. USEPA Region IV SSVs are considered applicable to the site, therefore only Alternatives 2 and 3 comply with chemical-specific TBCs. Both Alternatives 2 and 3 protect the environment against chronic effects. Alternative 2 removes the risk to the benthic organisms by capping the site, thus preventing organisms from burrowing into the contaminated sediment layer. Alternative 3 eliminates risk to the environment identified by TBCs through dredging contaminated sediment and disposing of it offsite. Alternative 4, as a management alternative, attempts to monitor the site and assess natural attenuation rates to determine whether degradation is in fact occurring at a rate consistent with risk management goals.

Compliance with action- and location-specific ARARs for Alternatives 2 and 3 is anticipated and easily attainable.

As outlined in the NCP, onsite remedial actions selected in the ROD must attain those ARARs that are identified at the time of the ROD signature or provide grounds for invoking a waiver under 300.430(f)(1)(ii)(C) (or CERCLA 121[d][4]).

4.2 Primary Balancing Criteria

Five primary balancing criteria typically highlight the major differences between alternatives. These criteria include: long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost.

4.2.1 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion assesses the results of a remedial action in risk remaining at the site, particularly the magnitude of residual risk and the adequacy and reliability of controls.

Magnitude of Residual Risk

As stated in the BRA, no risk is posed to human health at Site 2. Alternative 1 has no long-term effectiveness, as no remedial actions are taken onsite. Alternative 4's long-term effectiveness is based on natural processes and can only be estimated as more effective than Alternative 1 but less effective than Alternatives 2 or 3. Alternative 2 isolates the contaminated sediment, reducing contact with biota. However, continually repairing the sand-and-gravel cap will be necessary due to erosion. Risk to the environment is eliminated in Alternative 3 by dredging and removing sediment contamination that exceeds established SSVs.

Adequacy and Reliability of Controls

Controls inherent to Site 2 include a concrete seawall, limited access, and restrictions on recreational use. No further actions are required to protect human health at Site 2 under the current-use scenario.

Alternative 2 provides slightly more reliable controls than the no-action and natural attenuation alternatives. The completed cap will reduce the threat to future biota in that area of the bay. However, the cap will require annual maintenance to ensure that contact with the contaminated sediment is restricted.

Alternative 3 provides the most reliability from environmental risks, because sediment is removed from the site. Long-term liability will be incurred through disposal at a landfill.

4.2.2 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives 1, 2, and 4 do not reduce toxicity, mobility, or volume of contaminants through treatment. Alternative 3 is the only alternative which includes a treatment technology to reduce the volume of contaminated sediment. A soil-washing process follows dredging to reduce the quantity of material being transported for offsite disposal. Alternative 2 reduces the accessibility to benthos and resuspension of constituents through containment.

4.2.3 Short-Term Effectiveness

No short-term effectiveness issues are associated with Alternatives 1 or 4. Both Alternative 2 and 3 have short-term issues associated with implementation. In both alternatives, all marine life would initially be destroyed in areas where the remedial actions are being implemented. In these alternatives, exposures to workers and the Site 2 environs can be controlled using engineering controls and proper personal protective equipment during dredging and capping. Duration of field activities for both Alternatives 2 and 3 is relatively short.

4.2.4 Implementability

All four alternatives are implementable at Site 2. Each alternative is technically and administratively feasible. The capping alternative would require a remedial design investigation before implementation. Current velocities and directions, and the potential for possible erosion

of the cap need to be evaluated. The dredging alternative requires multiple handling of the contaminated sediment, dewatering, soil washing, and transportation to an offsite facility. However, these alternatives do not require extraordinary services or materials. Permits need to be obtained for both the dredging and capping alternatives before implementation can take place. The natural attenuation alternative would require monitoring and a management plan for making decisions regarding monitoring parameters and objectives of sampling.

4.2.5 Cost

Capital (direct and indirect), O&M, and net present-worth costs for all four alternatives are presented in Table 4-1.

Table 4-1
Cost Comparison for Alternatives

Alternative	Direct and Indirect Costs	Annual O&M Costs	Total Net Present Worth
Alternative 1[a]	------	------	------
Alternative 2	$903,000	$98,500	$2,300,000
Alternative 3	$980,000	------	$980,000
Alternative 4	$92,000	$19,000	$354,000

Note:
[a] = Alternative 1 has no associated costs.

4.3 Modifying Criteria

These criteria will be evaluated in detail following comments on the FFS report and the proposed plan, and will be addressed once a final decision is made and the ROD is prepared.

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