Revised Final

Steps 3b and 4 of the Baseline Ecological Risk Assessment
SWMU 9 - Area B (Tanks 214 - 215)
Naval Activity Puerto Rico
RCRA/HSWA Permit No. PR2170027203
Ceiba, Puerto Rico

Prepared For

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Norfolk, Virginia

Under the
LANTDIV CLEAN Program

Contract No. N62470-95-D-6007
CTO-0271

January 10, 2006

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REVISED FINAL

STEPS 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT SWMU 9 - AREA B (TANKS 214 – 215)

NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT TASK ORDER 0271

JANUARY 10, 2006

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
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LIST OF ACRONYMS AND ABBREVIATIONS

AVGAS	Aviation Gasoline
AOC	Area of Concern
AVS	Acid Volatile Sulfide
Baker	Baker Environmental, Inc.
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
CERCLA	Comprehensive Environmental Recovery, Compensation, and Liabilities Act
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
CNO	Chief of Naval Operations
COC	Chemical of Concern
CRQL	Contract Required Quantitation Limits
CTO	Contract Task Order
DCQAP	Data Collection Quality Assurance Plan
DMP	Data Management Plan
DoN	Department of Navy
DRMO	Defense Reutilization and Marketing Office
DQO	Data Quality Objective
EM	Electomagnetic
ERA	Ecological Risk Assessment
EC_{50}	Effects Concentration (concentration at which 50 % of the population is affected)
FSAP	Field Sampling and Analysis Plan
GPR	Ground Penetrating Radar
GPS	Global Positioning System
HASP	Health and Safety Plan
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Amendments
ICM	Interim Corrective Measure
IDW	Investigation Derived Waste
IR	Installation Restoration
LOAEL	Lowest Observed Adverse Effect Level
mg/kg	milligrams per kilogram
mg/kg-BW/day	milligrams per kilogram body weight per day
mg/L	milligrams per liter
mm	millimeters
MS/MSD	Matrix Spike/Matrix Spike Duplicate

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

NAPR	Naval Activity Puerto Rico
NAVFAC	Naval Activity Puerto Rico, Atlantic
NFEC	Naval Facilities Engineering Command
NSRR	Naval Station Roosevelt Roads
NOAEL	No Observed Adverse Effect Level
OU	Operable Unit
PMP	Project Management Plan
ppt	parts per thousand
PRDNR	Puerto Rico Department of Natural Resources
PRG	Preliminary Remediation Goal
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SERA	Screening-level Ecological Risk Assessment
SEM	Simultaneously Extracted Metal
SOP	Standard Operating Procedure
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TEL	Threshold Effect Level
TOC	Total Organic Carbon
USGS	United States Geological Survey
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Survey
UST	Underground Storage Tank

1.0 INTRODUCTION

This document presents Step 3b (baseline risk assessment problem formulation) and Step 4 (baseline risk assessment study design/data quality objectives) for additional ecological investigations of estuarine wetland sediment located downgradient from Solid Waste Management Unit (SWMU) 9 (Area B; Tanks 214 – 215) at Naval Activity Puerto Rico (NAPR), Ceiba, Puerto Rico. This document is based upon previous investigations conducted at SWMU 9 and has been prepared under contract to the Naval Facilities Engineering Command (NAVFAC) Atlantic, Contract Number N62470-95-D-6007, Contract Task Order (CTO) 0271.

The primary purpose of this investigation is to provide additional data with which to refine previous ecological risk estimates from potential exposures to site-related chemicals in estuarine wetland sediment downgradient from SWMU 9 (Area B). Once the data outlined in this document are collected (Steps 5 and 6 of the ERA process), they will be evaluated, along with previously collected data, in order to develop refined ecological risk estimates (Step 7). If unacceptable risks are indicated following Step 7, these data will also be used to develop ecologically-based Preliminary Remediation Goals (PRGs) for estuarine wetland sediment to aid the risk management decision-making process.

The components of the Step 4 studies, as outlined in this document, will provide multiple lines of evidence on which to evaluate potential ecological risks or existing ecological impacts from exposure to chemicals present in sediment. These lines of evidence are facility-specific, direct measures of potential ecological effects and are thus preferable to the comparison of chemical concentrations in sediment to conservative, non-SWMU-specific screening values, and other overly conservative assumptions, which form the basis for screening-level ecological risk assessments (ERAs). The use of multiple lines of evidence reduces the dependence on any one type of data and thus reduces the uncertainty of the analysis, allowing more confident decisions to be made about the need for, and extent of, remedial actions.

1.1 Objectives

The objectives of this investigation are to:

- Provide additional data with which to refine previous ecological risk estimates from potential exposures to facility-related chemicals in estuarine wetland sediment downgradient from SWMU 9 (Area B); and

- Provide the necessary data with which to develop ecologically-based PRGs for sediment to aid the risk-management decision-making process should unacceptable ecological risks be identified in Step 7 of the baseline ERA.

2.0 SITE DESCRIPTION AND ENVIRONMENTAL SETTING

This section provides a description of the site and its history. The terrestrial and aquatic habitats occurring within and contiguous to SWMU 9, as well as the biota that may be present, are also described. A description of regional and, where applicable, area-specific physiographic features, including climate, topography, geology, and hydrology was previously presented in the USEPA-approved Revised Draft RCRA Facility Investigation Report for SWMU 9, Naval Station Roosevelt Roads, Ceiba, Puerto Rico (Baker, 2000).

2.1 Site Description and History

NAPR occupies over 8,600 acres on the East Coast of Puerto Rico, along Vieques Passage (see Figure 2-1), with Vieques Island lying approximately ten miles to the east. NAPR was commissioned in 1943 as a Naval Operations Base and re-designated a Naval Station in 1957. Naval Station Roosevelt Roads (NSRR) operated as a Naval Station until March 31, 2004 when NSRR underwent operational closure. On April 1, 2004 NSRR was re-designated as Naval Activity Puerto Rico (NAPR). The current primary mission of NAPR is to protect the physical assets remaining, comply with environmental regulations, and sustain the value of the property until final disposal of the property.

On October 20, 1994, a Final RCRA Part B permit was issued by the United States Environmental Protection Agency (EPA) Region II to NSRR. This permit contains requirements for RFI activities at 24 SWMUs and three areas of concern (AOC). Prior to 1993, environmental activities at NSRR, exclusive of underground storage tanks (USTs), were conducted in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations under the Department of the Navy's (DoN's) Installation Restoration (IR) Program. The RCRA Part B permit, issued for the Defense Reutilization and Marketing Office (DRMO) at NSRR, included provisions for corrective action under the Hazardous and Solid Waste Amendments (HSWA) provisions of RCRA.

The various SWMUs and AOCs at NSRR have been grouped together into Operable Units (OUs) based on similarity of investigation scope, geography, or similarity of contaminants potentially released (Figure 2-2). This report pertains to SWMU 9 Area B - Tanks 214-215, a fuel management area within OU 2. OU 2 consists of SWMU 7 and 8, Tow Way Fuel Farm and SWMU 9, Tanks 212-217.

SWMU 9 is comprised of six USTs, pipelines, and ancillary facilities. For investigation purposes, the SWMU has been divided into three separate areas:

- Area A – Tanks 212 to 213 (see Figure 2-3)
- Area B – Tanks 214 to 215 (see Figure 2-3)
- Area C – Tanks 216 and 217 (see Figure 2-4)

Areas A and B are located north of Forrestal Drive, along Manila Bay Street. Area C is located approximately 4,000 feet southwest of Areas A and B, north of Forrestal Drive along Antietam Road. The USTs were constructed in the 1940's for the storage of aviation gasoline (AVGAS) for piston-driven airplanes. Most recently, Tanks 212 and 213 (Area A) were used for the storage of diesel fuel and unleaded gasoline. Tanks 214 and 215 were changed from AVGAS storage to diesel fuel marine, while Tank 216 was most recently used for the storage of unleaded gasoline.

In addition to AVGAS, Tank 217 may have been used for the storage of diesel fuel marine and JP-5. All tanks were cleaned and put out of service in 2001.

Previous reports indicate that each UST was cleaned of petroleum-based sludge every five years. Sludge material collected during tank cleaning activities prior to 1978 was reportedly disposed of onsite in unlined earthen pits. Since 1978, any sludge materials generated during tank cleaning activities have been removed and disposed off-site by a licensed contractor. A geophysical investigation, using a combination of both electromagnetic (EM) terrain conductivity and ground penetrating radar (GPR), conducted during Phase I of the RCRA Facility Investigation (RFI), as well as test pits excavated during Phases I and II of RFI did not identify the presence of the suspected sludge disposal pits (Baker, 2000).

2.2 Terrestrial and Marine Habitats

A description of the terrestrial and aquatic habitats occurring within and contiguous to SWMU 9, is provided in the sections that follow. The description of habitats relies primarily on literature-based information for Puerto Rico and NAPR, and is supplemented by site-specific observations recorded during a field investigation conducted in July 2003.

2.2.1 Terrestrial Habitat

The upland habitat bounded by NAPR is classified as subtropical dry forest (Ewel and Witmore, 1973). Similar to other forested areas of Puerto Rico, this region was previously clear-cut in the early part of the 20th century, primarily for pastureland (Geo-Marine, Inc., 1998). After acquisition by the Navy, a secondary growth of thick scrub, dominated by lead tree (*Leucaena spp.*), Christmas tree (*Randia aculeate*), sweet acacia (*Acacia famesiana*), and Australian corkwood (*Sesbania grandiflora*) grew in the previously grazed sections (Geo-Marine, Inc., 1998). Secondary growth communities (upland coastal forest communities and coastal scrub forest communities) exist today throughout the station's undeveloped upland. The upland vegetative community within and contiguous to SWMU 9 is classified as a coastal scrub forest community (see Figure 2-3). Although the species composition of the upland community at SWMU 9 is not known, it likely resembles the coastal scrub forest communities encountered at SWMUs 1 and 45 during a habitat characterization conducted in May 2000 (Geo-Marine, Inc., 2000). Species encountered at SWMUs 1 and 45 included lead tree, Christmas tree, sweet acacia, oxhorn bucida [*Bucida buceras*], basket wiss [*Trichostigma octandrum*], and common guayaba [*Psidium guajava*]). Until recently, habitat located in the immediate vicinity of each UST area consisted of a maintained vegetative ground cover of unknown species composition. Without continued maintenance, the surrounding secondary growth vegetation will become established within each UST location.

Cobana negra (*Stahlia monosperma*), a federally threatened tree species, is known to occur between the boundary of black mangrove communities and coastal upland forest communities. This species is also known to occur in coastal forests of southeastern Puerto Rico (Little and Wadsworth, 1964). It is not known if this species is present within the coastal scrub forest community at SWMU 9. However, the occurrence of cobana negra is unlikely since this species has only been reported in one survey but its location was not given. NAPR personnel believe the only tree reported is located in the scrub forest behind the former Navy Exchange main store. A survey conducted in 2000, including habitat characterizations conducted at SWMUs 1, 2, and 45 (Geo-Marine, Inc, 2000) did not encounter any cobana negra trees.

2.2.2 Aquatic Habitat

The marine environment surrounding NAPR includes mudflats, mangroves (i.e., black mangrove [*Avicenia germinans*] and red mangrove [*Rhizophora mangle*] communities), and sea grass beds (turtle grass [*Thalassia testudium*] and manatee grass [*Syringodium filliforme*]). The total area of mudflats, mangroves, and sea grass beds in the offshore environment is approximately 161 acres, 2,700 acres, and 1,900 acres, respectively (Geo-Marine, Inc., 1998). The sea grass beds represent grazing areas for green sea turtles (*Chelonia mydas*) and West Indian manatees (*Trichechas manatus*). The green sea turtle is a federally threatened species, while the West Indian manatee is a federally endangered species. Although green sea turtles and West Indian manatees have been reported from the offshore marine environment surrounding NSRR, they are not likely to occur within the estuarine wetland system downgradient from SWMU 9. This can be attributed to the absence of foraging habitat (i.e., sea grass beds) and the presence of shallow water and extensive mangrove stands that inhibit their movement into the wetland (see description in the paragraph that follows). In addition to mudflats, mangroves, and sea grass beds, coral reefs are also located in the offshore marine environment.

Freshwater wetlands and open water marine habitat (e.g., sea grass beds and coral reefs) are not contiguous to SWMU 9 (Areas A, B, and C); however, the SWMU does border an extensive estuarine wetland system consisting of a red mangrove forest community interspersed with mudflats and shallow, unvegetated pools. A map showing the spatial relationship of SWMU 9 to the estuarine wetland system is provided on Figure 2-4. Included on this figure are specific wetland units identified by the Cowardian Wetland Classification System (Cowardian et al., 1979 [see Figure 2-5]). The wetlands depicted on Figure 2-4 were delineated by Geo-Marine, Inc. in December 1999 from 1993 color infrared and 1998 true color aerial photography. Twenty percent of the wetlands delineated by aerial photography were field checked to verify the accuracy of the delineations. Field verification was based on the 1987 Corps of Engineers wetland delineation manual (United States Army Corps of Engineers [USACE], 1987). The specific Cowardian wetland units present within the estuarine wetland unit adjacent to SWMU 9 include the following:

- Estuarine, intertidal, unconsolidated shore, mud (E2US3)
- Estuarine, intertidal, unconsolidated shore, organic (E2US4)
- Estuarine, intertidal, scrub-shrub, broad-leaved evergreen (E2SS3)
- Estuarine, subtidal, open water (E10W)

2.3 Biota

A description of the biota occurring within Puerto Rico and the landmass encompassed by NAPR is provided in the sections that follow. This description is supplemented by information specific to SWMU 9

2.3.1 Mammals

A total of 22 terrestrial mammal species are known historically from Puerto Rico; however, all mammals except bats (13 species) have been extirpated (United States Geological Society [USGS], 1999). None of the bats found on Puerto Rico are exclusive to the island. The West

Indian manatee is known to occur in the open water marine environment surrounding NAPR. As depicted on Figures 2-3 and 2-4, open water marine habitat and sea grass beds are not contiguous to SWMU 9. Several terrestrial mammals have been introduced into Puerto Rico, including the black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), and mongoose (*Herpestes javanicus*). These nonindigenous mammals have been implicated in the decline of native bird and reptile populations (USGS, 1999 and United States Fish and Wildlife Service [USFWS], 1996).

2.3.2 Birds

A total of 239 bird species are native to Puerto Rico (Raffaele, 1989). This total includes breeding permanent residents and non-breeding migrants. In addition, many nonindigenous bird species have been introduced to Puerto Rico, including the shiny cowbird (*Molothrus bonariensis*) and several parrot species, such as the budgerigar (*Melopsittacus undulates*), orange-fronted parrot (*Aratinga canicularis*), and monk parrot (*Myiopsitta monaqchus*). Of the 239 species native to Puerto Rico, 12 are endemic to the island (Raffaele, 1989).

Numerous native and migratory bird species have been reported at NSRR (Geo-Marine, Inc., 1998). A list of bird species reported at NAPR or having the potential to occur is provided in Table 2-1. The list, compiled from literature-based information pre-dating 1990, includes the great blue heron (*Ardea herodias*), snowy egret (*Egretta thula*), little blue heron (*Florida caerulea*), black-crowned night heron (*Nycticorax nycticorax*), belted kingfisher (*Ceryle alcyon*), spotted sandpiper (*Actitis macularia*), greater yellowlegs (*Tringa melanoleauca*), black-bellied plover (*Squatarola squatarola*), clapper rail (*Rallus longirostris*), Royal tern (*Thalasseus maximus*), sandwich tern (*Thalasseus sandvicensis*), least tern (*Stema albifrons*), yellow warbler (*Dendroica petechia*), palm warbler (*Dendroica palmarum*), prairie warbler (*Dendroica discolar*), magnolia warbler (*Dendrocia magnolia*), mourning dove (*Zenaida macroura*), red-legged thrush (*Mimocichla plumbea*), common nighthawk (*Chordeiles minor*), and red-tailed hawk (*Buteo jamaicensis*). Endemic species reported from NAPR include the Puerto Rican lizard cuckoo (*Saurothera vieilloti*), Puerto Rican flycatcher (*Myiarchus antillarum*), Puerto Rican woodpecker (*Malanerpes portoricensis*), Puerto Rican emerald (*Chlorostilbon maugaeus*), and yellow-shouldered blackbird (*Agelaius xanthomus*).

The yellow-shouldered blackbird is a federally endangered species. One of the principal reasons for the status of this species is attributed to parasitism by the nonindigenous shiny cowbird, which lays its eggs in blackbird nests and sometimes punctures the host's eggs (USFWS, 1983). Other factors contributing to the status of this species include nest predation by the introduced black rat, Norway rat, and mongoose, as well as habitat modification and destruction (USFWS 1996). The entire land area of NAPR was declared critical habitat for the yellow-shouldered blackbird in 1976; however, a 1980 agreement with the USFWS exempted certain areas from this categorization (Geo-Marine, Inc., 1998). A study conducted by the Naval Facilities Engineering Command (NFEC, 1996) reported that the mangrove forests surrounding NAPR should be considered the most important nesting habitats for the yellow-shouldered blackbird. Although SWMU 9 is outside the critical habitat designation for the yellow-shouldered blackbird, the red mangrove forest downgradient from the SWMU represents potential nesting habitat. A survey conducted in July 2002 (Puerto Rico Department of Natural Resources [PRDNR], 2002) reported fifteen yellow-shouldered blackbirds at NAPR. The birds were using structures at the NAPR airport for resting cover. Other federally-listed bird species that have been reported at NAPR or have the potential to occur are the brown pelican (*Pelecanus occidentalis occidentalis*), roseate tern (*Sterna dougallii dougallii*), and the piping plover (*Charadrius melodus*) (Geo-Marine, Inc., 1998). Given their habitat preferences for feeding (open water), the brown pelican and roseate

tern have little potential to occur in the estuarine wetland system downgradient from SWMU 9. However, the wetland system does represent potential foraging habitat for the piping plover.

2.3.3 Reptiles and Amphibians

A total of 23 amphibians and 47 reptiles are known from Puerto Rico and the adjacent waters (USGS, 1999). Fifteen of the amphibians and 29 of the reptiles are endemic, while four amphibian species and three reptilian species have been introduced (USGS, 1999). Puerto Rico's native amphibian species include 16 species of tiny frogs commonly called coquis. On the coastal lowlands, almost all coqui species are arboreal. The only amphibians listed under provisions of the Endangered Species Act of 1973 are the Puerto Rican crested toad (*Peltophryene lemur*) and the golden coqui (*Eleutherodactylus jasperi*). Both species are listed as threatened (USFWS, 2004). Distribution of the golden coqui is restricted to areas of dense bromeliad growth. All specimens to date have been collected from a small semicircular area of a 6-mile radius south of Cayey (approximately 30 miles southwest of NAPR), generally at elevations above 700 meters (USFWS, 1984). The Puerto Rican crested toad occurs at low elevations (below 200 meters) where there is exposed limestone or porous, well drained soil offering an abundance of fissures and cavities (USFWS, 1987). A single large population is known to exist from the southwest coast in Guánica Commonwealth Forest, and a small population is believed to survive on the north coast near Quebradillas, Arecibo, Barceloneta, Vega Baja, and Bayamón (USFWS, 1987). It has also been collected on the southeastern coastal plain near Coamo (USFWS, 1987). Given the habitat preferences and locations of known occurrences, these two species are not expected to occur at NAPR.

Puerto Rico's native reptilian species include 31 lizards, 8 snakes, 1 freshwater turtle, and 5 sea turtles (USGS, 1999). Of the five sea turtles, only the green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), and loggerhead sea turtle (*Dermochelys coriacea*) nest within Puerto Rico. These three sea turtles, as well as the leatherback sea turtle (*Caretta caretta*) and the Puerto Rican boa (*Epicrates inornatus*) represent the reptilian species listed under the provisions of the Endangered Species Act of 1973 (green sea turtle and loggerhead sea turtle are listed as threatened, while the hawksbill sea turtle, leatherback sea turtle, and Puerto Rican boa are listed as endangered [USFWS, 2004]). As discussed in Section 2.2.2, the esturaine wetland system downgradient from SWMU 9 does not provide suitable habitat for marine sea turtles. The Puerto Rican boa uses a variety of habitats but is most commonly found in karst forest habitat. Given the absence of karst forest habitat and the absence of any known occurrence of this species at or contiguous to SWMU 9 (Geo-marine, Inc. 1998), there is a low probability of occurrence for this species at the site.

2.3.4 Fish and Aquatic Invertebrates

A diverse fish and invertebrate community can be found in the marine environments surrounding NAPR. This can be attributed to the varied habitats that include open water habitat, mud flats, sea grass beds, and mangrove forests. Although too numerous to list individually by species, the fish community is represented by stingrays, herrings, groupers, needlefish, mullets, barracudas, jacks, snappers, grunts, snooks, lizardfishes, parrotfishes, gobies, filefishes, wrasses, damselfishes, and butterflyfish (Geo-Marine, Inc., 1998). The benthic invertebrate community includes sponges, corals, anemones, sea cucumbers, sea stars, urchins, and crabs.

3.0 PREVIOUS ECOLOGICAL INVESTIGATIONS

This section presents a summary of previous ecological investigations conducted at SWMU 9. Sources of relevant data used in the ecological investigations are also identified.

3.1 Sources of Available Analytical Data

Sampling activities at SWMU 9 have been conducted under three separate investigations:

- RCRA Facility Investigation (RFI): Phase I (April 1996), Phase II (September/October 1997), and Phase III (June 1999);
- Corrective Measures Study (CMS) in December 2000; and
- Additional Data Collection Field Investigation in July 2003.

The RFI field investigations and associated analytical data were presented and discussed in the Revised Draft RCRA Facility Investigation Report for SWMU 9, Naval Station Roosevelt Roads, Ceiba, Puerto Rico (Baker, 2000). The CMS field investigation and associated analytical data were presented and discussed in the Final Corrective Measures Study Investigation Report for SWMU 9, Naval Station Roosevelt Roads, Ceiba, Puerto Rico (Baker, 2003), while the additional data collection field investigation and associated analytical data were presented and discussed in the Final Additional Data Collection Investigation Report, SWMU 9, Naval Activity Puerto Rico, Ceiba, Puerto Rico (Baker, 2004). A summary of the ecologically relevant media (i.e., surface soil, surface water, and sediment) collected during these three investigations is presented in Tables 3-1 through 3-3, respectively.

3.2 Summary of Previous Ecological Investigations

A screening-level ERA and Step 3a of the baseline ERA was conducted at SWMU 9 using the process outlined in the Chief of Naval Operations (CNO) document entitled Navy Policy for conducting Ecological Risk Assessments (CNO, 1999). The screening-level ERA, presented in the Final CMS Investigation Report for SWMU 9 (Baker, 2003) used relevant data collected during the RFI and CMS field investigations. Based on the results of the assessment, no further evaluation of ecological risks was recommended for Areas A and C surface soil, Areas A/B surface water, and Area C sediment. However, lead and zinc were identified as ecological chemicals of concern (COCs) for SWMU 9 (Area B) surface soil (mean hazard quotient [HQ] = 4.59 for lead and 4.91 for zinc). These two metals also were identified as ecological COCs for terrestrial avian herbivore (mourning dove) and/or terrestrial avian omnivore (American robin) food web exposures (mean lead No Observed Adverse Effect Level [NOAEL)-based HQ = 3.77 for the American robin and 2.09 for the mourning dove; mean zinc NOAEL-based HQ = 1.95 for the American robin). In addition to potential ecological risks to terrestrial receptors, lead was identified as an ecological COC for SWMU 9 (Area B) sediment (mean HQ = 1.11 for aquatic invertebrates; mean NOAEL-based HQ = 2.43 for avian invertebrate consumer populations [spotted sandpiper]).

Given the limited surface soil and sediment data available for these two metals, the Final CMS Investigation Report for SWMU 9 (Baker, 2003) recommended the collection of additional surface soil samples at Area B (in the vicinity of Tank 214) for lead and zinc analysis, as well as the collection of additional sediment samples from the estuarine wetland system downgradient from Tank 214 for lead analysis prior to making a decision on whether the SWMU should move

forward in the ERA process (i.e., the baseline risk assessment problem formulation). A work plan (dated April 25, 2003), presenting the technical approach for conducting the additional data collection effort, was prepared and submitted to the USEPA. The Work Plan, approved in a letter from the USEPA dated June 3, 2003, was implemented in July 2003. Results of the Additional data Collection Field Investigation were presented in the Final Additional Data Collection Investigation Report for SWMU 9, Naval Activity Puerto Rico, Ceiba, Puerto Rico (Baker, 2004). This document also contained risk calculations and a risk characterization for the lead and zinc surface soil data and lead sediment data (unified data sets containing surface soil and sediment data from the RFI, CMS, and additional data collection field investigations). Based on the risk calculations and characterization, lead was retained as an ecological COC for surface soil (mean HQ = 4.59 for terrestrial plants) and terrestrial avian omnivore food web exposures (mean NAOEL-based HQ = 3.77). Lead also was retained as an ecological COC for aquatic invertebrates (mean HQ = 1.52) and avian invertebrate consumer populations (mean NOAEL-based HQ = 3.32). Based on the risk calculations and risk characterization summarized above, it was recommended that SWMU 9 (Area B) move forward in the ERA process (Step 3b baseline risk assessment problem formulation).

The results of the surface soil sampling at SWMU 9 (Area B) have identified levels of lead in surface soils in excess of the USEPA Action Level (residential soil screening level) of 400 mg/kg. Due to these exceedences, the Navy evaluated the option of performing an interim corrective measure for the removal of soils contaminated with lead in excess of the USEPA action level of 400 mg/kg. To determine if surface soil remediation to address human health would also address potential ecological risks at the SWMU, the Navy conducted an evaluation of ecological risks post remediation. The evaluation, presented in a letter to the USEPA dated November 3, 2004, concluded that remediation of surface soils in excess of 400 mg/kg lead would reduce the magnitude and spatial extent of potential risks to acceptable levels, thereby eliminating the need to perform a terrestrial baseline ERA at SWMU 9 (Area B). The USEPA agreed to the approach and conclusions presented in the November 3, 2004 letter via an email dated November 10, 2004. It is noted that terrestrial risk estimates will be recalculated following the interim corrective measure (ICM) using analytical data from confirmation samples and existing analytical data from locations undisturbed by the proposed remediation. The reevaluation of potential terrestrial risks will verify the effectiveness of the soil removal.

Based upon the ecological evaluations summarized in the preceding paragraphs and USEPA concurrence of the recommendations contained in the November 3, 2004 letter, further evaluation of ecological risks at SWMU 9 (Area B) will focus on the aquatic habitat downgradient from Tank 214. Specifically, the ERA will focus on lead in sediments of the estuarine wetland system downgradient from Tank 214.

4.0 BASELINE RISK ASSESSMENT PROBLEM FORMULATION

The baseline ERA problem formulation (Step 3b of the Navy ERA process) is a revision of the screening-level problem formulation developed in Step 1 of the ERA process (Baker, 2003), and is focused on defining the key pathways, chemicals, and receptors that may be driving potential risks for estuarine wetland sediment downgradient from SWMU 9 (Area B). The baseline ERA problem formulation refines the conceptual model and assessment endpoints from the screening-level ERA to reflect the results of the Step 3a evaluation.

4.1 Refined Conceptual Model

Information on the habitat features at the SWMU 9 (Area B), the fate and transport of potential ecological risk drivers, and the key exposure pathways and routes, and receptor groups are used to refine the preliminary conceptual model developed in Step 1 of the ERA. The refined conceptual model, depicted on Figure 4-1, uses the results of previous ecological investigations (see Section 3.2) and addresses complete transport and exposure pathways, key receptors, assessment endpoints, and risk hypotheses.

4.1.1 Transport Pathways

A transport pathway describes the mechanisms whereby chemicals may be transported from a source of contamination to ecologically relevant media. The primary mechanisms for lead transport from potential source areas at SWMU 9 (Area B) to estuarine wetland sediment are believed to include the following:

- Overland transport of chemicals with surface soil via surface runoff to downgradient sediment

- Leaching of chemicals from surface soil and/or subsurface soil by infiltrating precipitation and subsequent transport to sediment with groundwater

4.1.2 Exposure Pathways

An exposure pathway links a source of contamination with one or more receptors through exposure to one or more media. Exposure, and thus potential risk, can only occur if each of the following conditions are present (USEPA, 1998):

- A source of contamination must be present.

- Release and transport mechanisms must be available to move the contaminants from the source to an exposure point.

- An exposure point must exist where ecological receptors could contact the affected media.

- An exposure route must exist whereby the contaminant can be taken up by ecological receptors.

Figure 4-1 shows the critical exposure pathways for ecological receptors within the estuarine wetland system downgradient from SWMU 9 (Area B). Based upon the results of previous ecological evaluations, the critical exposure pathways are believed to include:

- Direct exposure of lower trophic level receptors to lead in estuarine wetland sediment.

- Indirect exposure (via the food web) of upper trophic level avian invertebrate consumers to lead in estuarine wetland sediment.

4.1.3 Assessment Endpoints and Risk Hypotheses

Assessment endpoints are intended to focus the risk assessment on particular components of the ecosystem that could be adversely affected by contaminants. The assessment endpoints selected for the baseline ERA at SWMU 9 (Area B) are:

- *Survival, growth, and reproduction of benthic invertebrate communities* - Benthic invertebrates serve as the prey base for many aquatic species. The estuarine wetland system downgradient from SWMU 9 (Area B) will support fewer fish and birds if site-related chemical contamination is limiting the survival, growth, or reproduction of the benthic macroinvertebrate community.

- *Survival, growth, and reproduction of avian invertebrate consumer populations* - These receptors are top-level consumers and are susceptible to bioaccumulative chemicals, especially those that have the potential to biomagnify through aquatic food webs.

Risk hypotheses are questions about how the assessment endpoints could be affected by site-related conditions. Risk hypotheses clarify and articulate relationships that are possible through consideration of available data, information from the scientific literature, and the best professional judgement of risk assessors. They can also form the basis for developing a study design for subsequent steps of the ERA process. The risk hypotheses associated with the assessment endpoints identified above are listed below.

- Are lead concentrations in sediment high enough to impair the survival, growth, or reproduction of the benthic macroinvertebrate community to the extent that the prey base to support aquatic predators is adversely affected?

- Are lead concentrations in estuarine wetland sediment high enough to adversely effect the survival, growth, or reproduction of semi-aquatic avian invertebrate consumer populations?

5.0 STUDY DESIGN/DATA QUALITY OBJECTIVES

Step 4 of the ERA process (study design/data quality objectives) establishes the measurement endpoints, the study design, data quality objectives, and data analysis methods for the additional site investigations necessary to complete the ecological risk assessment (USEPA, 1997). The Step 4 investigations are designed to address areas identified in earlier steps of the ERA process as having the greatest degree of uncertainty, to fill identified data gaps, and to refine risk estimates.

The proposed components of the Step 4 investigations will provide multiple lines of evidence on which to evaluate potential ecological risks or existing ecological impacts from exposure to chemicals present in estuarine wetland sediment downgradient from SWMU 9 (Area B). These lines of evidence are site-specific, direct measures of potential ecological effects and are thus preferable to the comparison of chemical concentrations to conservative, non-site-specific screening values, and other conservative assumptions, which form the basis for screening-level ERAs. The use of multiple lines of evidence reduces the dependence on any one type of data and thus reduces the uncertainty of the analysis, allowing for more confident decisions to be made about the need for, and extent of, remedial actions.

5.1 Measurement Endpoints

The conceptual model for SWMU 9 (Area B), begun in Step 3b (see Section 4.0), is completed in Step 4 with the development of measurement endpoints. Measurement endpoints are measures of biological effects (e.g., laboratory toxicity test results) that are related to each respective assessment endpoint (USEPA, 1997). The measurement endpoints selected for the baseline ERA at SWMU 9 (Area B) are listed below:

Survival, growth, and reproduction of benthic invertebrate communities:

- Comparison of lead concentrations in sediment with medium-specific screening values.
- Comparison of simultaneously extracted metal (SEM) molar concentrations with acid volatile sulfide (AVS) molar concentrations.
- Comparison of results of 28-day sediment laboratory toxicity tests (survival, growth, and reproduction) with the amphipod *Leptocheirus plumulosus*, using site and reference sediment.
- Existence of significant correlations between laboratory toxicity test results and concentrations of lead or other chemical/physical characteristics of sediment (e.g., total organic carbon [TOC] and grain size distributions).

Survival, growth, and reproduction of avian invertebrate consumer populations:

- Comparison of modeled dietary intakes using field-collected fiddler crabs (tissue residuals) with literature-based ingestion screening values.

5.2 Baseline Risk Assessment Study Design

A detailed description of the proposed sampling and analytical program is presented in Section 6.0. Field activities conducted as part of the baseline ERA will include:

- Collection of SWMU-specific surface sediment for laboratory-based analytical and toxicological testing.

- Collection of fiddler crab tissue samples downgradient from SWMU 9 (Area B) for laboratory-based analytical testing.

- Identification of suitable reference areas, and the collection of surface sediment and fiddler crab tissue samples at these locations for laboratory-based analytical and/or toxicological testing.

Sediment samples will be collected during a preliminary sediment sampling event and a baseline ERA sediment sampling event. The preliminary sediment sampling event will be conducted to further define the distribution of lead concentrations in estuarine wetland sediment downgradient from SWMU 9 (Area B). Analytical data from the preliminary sediment samples also will be used to define specific locations that will be sampled during the baseline ERA sampling event for toxicity testing. The baseline ERA sampling event will involve the collection of split sediment samples for laboratory-based analytical and toxicological testing. Sediment submitted for laboratory-based toxicity testing will be collected from those preliminary sampling locations that most effectively span the lead concentration gradient at the site.

Direct toxicity to aquatic invertebrates will be evaluated using solid phase toxicity tests with *Leptocheirus plumulosus* (amphipod). This species was selected as the test organism for the reasons listed below.

- *Leptocheirus plumulosus* is an infaunal amphipod intimately associated with sediment due to its burrowing habits and sediment ingesting nature (USEPA, 2001).

- *Leptocheirus plumulosus* is tolerant of a wide range of total organic carbon (TOC), salinity, and grain size distributions (USEPA, 2001).

- *Leptocheirus plumulosis* has a high tolerance for ammonia, a naturally occurring compound in marine sediments that results from the degradation of organic debris (USEPA, 2001).

- A chronic test method has been developed by the United States Environmental Protection Agency (USEPA) 2001) using *Leptocheirus plumulosus* with two sublethal endpoints (i.e., growth and reproduction), allowing for population-level risk evaluations on benthic invertebrates.

Salinity values for surface water collected during the CMS field investigation ranged from 18.6 parts per thousand (ppt) to 19.6 ppt (Baker, 2003). Salinity concentrations are within the tolerance range of *Leptocheirus plumulosus* (>1.0 to 35 ppt; USEPA, 2001). TOC concentrations measured in SWMU 9 (Area B) sediment collected during the CMS field investigation ranged from 3.5 percent to 11 percent (Baker, 2003). Of the nine sediment samples analyzed for TOC, four samples had TOC concentrations greater than the known tolerance range for this species (>1

to 7.0 percent; USEPA, 2001). It is noted that no literature-based data is available for sediment with TOC concentrations greater than 7 percent. To account for this potential confounding factor, reference sediment samples collected for toxicity testing will have a range of TOC concentrations similar to the range found in SWMU 9 (Area B) sediment. Finally, grain size has not been measured in SWMU 9 (Area B) sediment. USEPA (2001) states that *Leptocheirus plumulosis* should be tested with sediment having greater than or equal to 5 percent silt-clay, but less than 85 percent clay. Identical to TOC, reference sediment submitted for toxicity testing will have grain size characteristics similar to grain size characteristics in SWMU 9 (Area B) sediment. Other potential confounding factors (i.e., ammonia and sulfide) also will be addressed through testing of reference sediments with similar concentration ranges.

To evaluate potential food web-based risks to avian invertebrate consumer populations, fiddler crabs (*Ucer* sp.) will be collected from the estuarine wetland system and submitted to the analytical laboratory for whole-body tissue analysis. Fiddler crabs are deemed an appropriate species for evaluating bioaccumulation and subsequent food web transfer to avian invertebrate consumers based on their burrowing activities, which expose them to sediment-derived contaminants, feeding habits, sedentary behavior, and presence in large numbers within estuarine wetland systems at NAPR.

5.3 Data Quality Objectives

The USEPA defines the Data Quality Objectives (DQO) process as a *"strategic approach based on the scientific method that is used to prepare for a data collection activity. It provides a systematic procedure for defining the criteria that a data collection design should satisfy, including when to collect samples, where to collect samples, the tolerance level of decision errors for the study, and how many samples to collect."* (Barnthouse and Suter, 1996). The DQO process is composed of seven steps (USEPA, 2000a, and 2000b):

- Step 1 - State the problem
- Step 2 - Identify the decision
- Step 3 - Identify the inputs
- Step 4 - Define the boundaries of the study
- Step 5 - Develop a decision rule
- Step 6 - Specify tolerable limits on decision errors
- Step 7 - Optimize the design for obtaining data

The purpose of the DQO process is to ensure that the type, quantity, and quality of data used in the decision-making process will be appropriate for estimating potential ecological risks. By employing the DQO process, data requirements and error levels acceptable to the investigation can be defined prior to the collection of data. The DQO process for the baseline ERA is outlined in Table 5-1.

Acceptable data requirements and error levels associated with the field and analytical portions of this investigation are presented in the Master Data Collection Quality Assurance Plan (DCQAP)

(Baker, 1995). Acceptable data requirements and error levels associated with the laboratory-based toxicity tests (i.e., test conditions, data, and data interpretation) are summarized in Table 5-2. It is noted that information specific to toxicity test conditions were taken from the USEPA document entitled Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-Associated Contaminants With the Amphipod Leptocheirus Plumulosus (USEPA, 2001). These criteria may vary from those specific by the procured laboratory's Standard Operating Procedure (SOP). Once a laboratory is procured, the SOP will be provided to NAPR, NAVFAC Atlantic, and USEPA for approval prior to implementation of field activities.

5.4 Data Evaluation and Interpretation

As discussed in Section 5.0, the proposed components of the Step 4 investigations will provide multiple lines of evidence on which to evaluate potential ecological risks or existing ecological impacts from exposure to chemical present in estuarine wetland sediment downgradient from SWMU 9 (Area B). The use of multiple lines of evidence reduces the dependence on any one type of data and thus reduces the uncertainty of the analysis, allowing for more confident decisions to be made about the need for, and extent of, remedial actions. The specific lines of evidence that will be employed in this investigation are identified and discussed below.

- *Comparison of the mean SWMU 9 (Area B) sediment lead concentration to an appropriate literature-based toxicological threshold* - Sediment analytical data generated as part of the baseline ERA and existing analytical data generated during the RFI, CMS and additional data collection field investigations (Baker, 2000, 2003 and 2004, respectively) will be combined into a unified data set. The mean lead concentration of the unified data set will be compared to a literature-based toxicological threshold (Threshold Effect Concentration [TEL] of 30.2 mg/kg developed by MacDonald, 1994).

- *Derivation of Acid Volatile Sulfide (AVS)-Simultaneously Extracted Metal (SEM) ratios to assess the bioavailability of bulk sediment lead concentrations* - The AVS/SEM model states that if the AVS concentration is greater than the concentration of SEM (cadmium, copper, lead, nickel, and zinc [baseline ERA sediment samples will include silver]), toxicity will not be observed. That is, if the ratio AVS/SEM is greater than 1.0, sufficient AVS is available to bind all the SEM and sediment-associated biota are not likely to be exposed to toxic concentrations of these metals in the sediment pore water. Conversely, if the ratio AVS/SEM is less than 1.0, insufficient AVS is present to bind all SEM. The AVS/SEM data will be evaluated on a sample by sample basis, allowing for the identification of spatially explicit areas where lead is or is not bioavailable.

- *Comparison of Leptocheirus plumulosus survival, growth, and reproduction data in SWMU 9 (Area B) sediment to survival, growth, and reproduction in reference sediment* - Statistical comparisons between site samples and their assigned reference sample (assigned prior to statistical analysis based on physical/chemical properties) will be conducted for survival, growth, and reproduction. The tests will determine whether organism performance is significantly different (at $\alpha = 0.05$) when exposed to sediment collected from the site relative to the reference area.

- *Existence of patterns in laboratory toxicity tests results with chemical burden and other chemical/physical characteristics of the sediments* - The data will be reviewed to determine whether there are relationships between biological response in the toxicity tests and lead content of the sediment. This will be done with the use of multiple regressions

or other appropriate statistical analyses. Other factors that may be considered in the analyses include ammonia, TOC, and sulfide concentrations, as well as grain size distributions. Analysis of correlations between chemical concentrations and toxicity test results (considering the most sensitive of survival, growth, and reproduction endpoints) will be used to determine effects levels for lead at the site.

- *Comparison of dietary intakes to No Observed Adverse Effect Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs)* - Mean contaminant concentrations in fiddler crabs collected from the site will be used in place of modeled values to estimate dietary lead intakes for avian invertebrate consumers. Exposure parameters (e.g., body weight and food ingestion rate) used in the estimation of dietary intakes will be those identified in Step 3a of baseline ERA (Baker, 2003). HQs will be calculated by dividing dietary intake estimates by literature-based NOAEL and LOAEL values (1.13 mg/kg-BW/day and 11.3 mg/kg-BW/day [Sample et al., 1996]).

The Table 5-3 summarizes the decision rules and criteria that will be used to outline potential recommendations and actions associated with these lines of evidence. In general, each of the lines of evidence will be weighted equally. However, the following considerations to weight will be given once analytical results are compiled and all statistical tests are completed:

- Exposure-Response - Data that demonstrates a clear, unconfounded dose-relationship between the response variable and the COC will be preferentially weighted at the decision point.

- Quality - Data sets that meet each the acceptable data requirements and error levels outlined in Table 5-2 will be preferentially weighted at the decision point.

- Power - Data sets of sufficient size and coverage to detect a statistical difference between groups of interest will be preferentially weighted at the decision point.

- Spatial coverage - Data sets that adequately characterized the concentration gradient of the COCs under consideration will be preferentially weighted at the decision point.

- Uncertainty - Data sets relating to the assessment endpoints with lower uncertainty will be preferentially weighted at the decision point.

If significant conflicts among the lines of evidence result in uncertain risk conclusions, the risk managers will need to decide if these uncertainties are too high. If so, additional data collection and evaluation beyond the proposed Step 4 sampling might be required to resolve the uncertainties.

6.0 FIELD SAMPLING AND ANALYSIS PLAN

This Field Sampling and Analysis Plan (FSAP) presents the proposed field and laboratory activities for the baseline ERA at SWMU 9 (Area B). Activities will include field work support (subcontractor procurement and mobilization/demobilization), field verification of the FSAP, field investigations (sediment sampling, toxicity testing, and fiddler crab tissue sampling), analytical testing and data validation, data evaluation, and report preparation. The primary purpose of the FSAP is to provide guidance for all the project field activities by describing in detail the methods and procedures to be used to implement various field tasks identified in Section 5.0.

To simplify the process of developing site-specific project plans, a Master Project Management Plan (PMP), Master Data Collection Quality Assurance Plan (DCQAP), Data Management Plan (DMP), and Master Health and Safety Plan (HSAP) have been prepared for NAPR (Baker, 1995). Together, these plans provide all details regarding field investigation techniques, laboratory analysis, data validation, and data evaluation required to fulfill the requirements of the RFI program. These plans provide the details for sampling and analysis protocols to be followed and general activities to be accomplished for the SWMU 9 baseline ERA. Addendums to the DCQAP and HSAP have been prepared to address specific issues related to this investigation (see Appendix A and Appendix B, respectively). This document will supplement the Master Plans with site-specific information for the SWMU 9 (Area B) baseline ERA.

6.1 Field Work Support

Field work support includes subcontractor procurement and mobilization/demobilization. Subcontractors procured for the baseline ERA will consist of: (1) an analytical laboratory; (2) a third party, independent data validator; and (3) a toxicology laboratory. Mobilization/demobilization activities will include procurement of equipment and supplies necessary for the field sampling program, and shipping or transporting those items to and from the field. Travel time to and from NAPR is also included under this task.

6.2 Verification of the Field Sampling Design

Approximately one month prior to mobilization for the baseline ERA field investigation, the field sampling design will be verified in the field to ensure that the study design is appropriate and implementable at the site. The testable hypotheses, exposure pathway models, and measurement endpoints also will be evaluated for their appropriateness. By verifying the field sampling design prior to conducting the field investigation, well-considered alterations to the study design can be made if necessary. If the field verification indicates that the study design cannot be met, or that significant deviations from this FSAP are necessary, discussion will be held with representatives from NAPR, NAVFAC Atlantic, Baker Environmental, Inc. (Baker), and USEPA to determine appropriate actions. Additional activities conducted as part of this task is presented in Section 6.3.1.1 below.

6.3 Field Sampling Activities

Field sampling activities will involve the collection of SWMU-specific and reference sediments for analytical and toxicological testing. Fiddler crab tissue samples also will be collected from the estuarine wetland system downgradient from SWMU 9 (Area B) and from a reference area for analytical testing.

6.3.1 Sediment Sampling

Sediment sampling activities will be conducted during two separate sampling events: (1) a preliminary sediment sampling event; and (2) the baseline ERA sediment sampling event. The preliminary sediment sampling event will be performed to further define the distribution of lead concentrations in estuarine wetland sediment downgradient from SWMU 9 (Area B). Analytical data for the preliminary sediment samples also will be used to define specific locations that will be sampled during the baseline ERA sampling event for toxicity testing. Finally, the preliminary sediment analytical data will determine if sediment at the proposed reference area have physical/chemical properties similar to estuarine wetland sediment downgradient from SWMU 9. The baseline ERA sampling event will involve the collection of split sediment samples for laboratory-based analytical and toxicological testing. Sediment submitted for laboratory-based toxicological testing will be collected from those preliminary sampling locations that most effectively span the lead concentration gradient at the site.

6.3.1.1 Preliminary Sediment Samples

Concurrent with the field verification task discussed in Section 6.2 above, 45 preliminary sediment samples will be collected from the estuarine wetland system downgradient from SWMU 9 (Area B) and analyzed for lead (COC identified in previous ecological evaluations [see Section 3.0]). Each sediment sample also will be analyzed for ammonia, AVS/SEM, TOC, and grain size. Sediment samples will be collected using a systemic sampling scheme by establishing 25-foot by 25-foot sampling grids (see Figure 6-1) at locations that cover the range of lead concentrations detected during previous investigations (see Figure 6-2). A single sediment sample will be collected from the center point of each grid. If a given sampling grid overlaps with upland habitat, the sediment sample from that grid will be collected from the center point of the grid portion located within estuarine wetland habitat. Preliminary sediment sampling locations will be marked in the field using a stake labeled with the sample identification number (see Section 6.6). A Global Positioning System (GPS) receiver also will be used to document the location of each preliminary sediment sample. Proposed preliminary sediment sampling locations may be adjusted as needed, based upon field conditions encountered at the time of sample collection.

In addition to the SWMU-specific sediment samples discussed above, preliminary sediment samples will be collected from a reference area and analyzed for lead, ammonia, AVS/SEM, TOC, and grain size. The proposed reference area (see Figure 6-3) was previously identified as the base background sampling location for estuarine wetland sediment and is located within the same estuarine wetland system downgradient from SWMU 9 (Area B), but outside potentially impacted areas (as determined by analytical data for background sediment samples collected from this area during the SWMU 9 CMS field investigation [Baker, 2003]). Reference sediment sample locations will be chosen to be as similar as possible to the site with regard to habitat and visual sediment characteristics (e.g., color and texture). A maximum of 6 reference sediment samples will be collected for analytical testing. The variability in habitat and variability in visual sediment characteristics will dictate the actual number of reference sediment samples collected.

The procedure listed below will be used to collect the preliminary SWMU-specific and reference sediment samples.

1. Sample jars will be labeled prior to sample collection.

2. Sediment samples will be collected from the 0 to 6-inch depth interval and distributed directly into the sample jars using disposable, stainless steel spoons.
3. All pertinent sampling information such as sediment description, sample depth, sample number and location, surrounding vegetation, presence or absence of aquaitic invertebrates, and the date and time of sample collection will be recorded in the field logbook.

4. All sample jars for chemical analyses will be packed in ice and shipped to the analytical laboratory.

The preliminary sampling event will include the collection of Quality Assurance/Quality Control (QA/QC) samples (i.e., equipment rinsate blanks, field blanks, field duplicates and matrix spike/matrix spike duplicate [MS/MSD] samples). A description of the QA/QC samples is provided in Section 6.5.1.

6.3.1.2 Baseline Ecological Risk Assessment Sediment Samples

Analytical data for the preliminary sediment samples will be used to identify specific locations that will be sampled for laboratory-based toxicological testing. A maximum of twenty sediment samples will be collected from those preliminary sample locations that most effectively span the lead concentration gradient at the site (as determined by analytical results for the preliminary sediment samples). A sufficient volume of sediment will be collected at each location for chemical analyses (lead, ammonia, AVS/SEM, TOC, sulfide, pH, and grain size) and toxicity testing (including double the laboratory-required volume for toxicity testing). Identical to the preliminary sediment samples discussed in Section 6.3.1.1, a GPS receiver will be used to document the location of each baseline ERA sediment sample.

The baseline ERA sediment samples will be collected using the following procedure:

1. Sample jars will be labeled prior to sample collection.

2. Sediment samples will be collected from the 0 to 6-inch depth interval using disposable, stainless steel spoons. Samples will be obtained by placing the sediment in a disposable aluminum pan and thoroughly homogenized following the removal of debris (e.g., vegetation/mangrove roots).

3. All pertinent sampling information such as sediment description (e.g., color and texture), sample depth, sample number and location, surrounding vegetation, presence or absence of aquatic invertebrates, and the time of sample collection will be recorded in the field logbook.

4. After homogenization, the sediment samples will be placed into appropriate jars for laboratory-based chemical analysis and toxicological testing.

5. All sample jars will be packed in ice and shipped to the analytical laboratory or toxicity laboratory.

In addition to the SWMU-specific sediment samples, reference sediment samples will be collected for chemical analysis (lead, ammonia, TOC, AVS/SEM, sulfide, pH, and grain size) and toxicity testing using the method presented above. Reference sediment will be sampled at those preliminary reference sediment locations that are as similar as possible to the SWMU 9 (Area B)

preliminary sediment sample locations that are re-sampled for toxicity testing with regard to physical/chemical characteristics (ammonia, AVS, sulfide, pH, TOC, and grain size). The number of baseline ERA reference sediment samples submitted for analytical and toxicity testing will be dictated by the variability of these potential confounding factors.

Identical to the preliminary sediment sampling event, the baseline ERA sediment sampling event will include the collection of QA/QC samples (i.e., equipment rinsate blanks, field blanks, field duplicates and MS/MSD samples). A description of the QA/QC samples is provided in Section 6.5.1.

6.3.2 Fiddler Crab Tissue Samples

The coastline downgradient from SWMU 9 (Area B), between historical sample locations 9SD29 and 9SW/SD22, will be divided into four segments of approximate equal length based on linear feet of coastline (see Figure 6-4). These historical sampling locations (i.e., 9SD29 and 9SW/SD03) form the western and eastern boundary of potentially impacted wetland sediments downgradient from SWMU 9 (Area B) as determined by existing analytical data (see Figure 6-2). Two fiddler crab composite samples will be collected from each segment. Each composite sample will consist of six individual whole-body crabs (ingesta will not be purged). Fiddler crabs will be rinsed with laboratory-grade deionized water and frozen prior to shipment. Crab samples also will be packed with ice to ensure they remain frozen during shipment.

In addition to the SWMU-specific fiddler crab tissue sampling, a total of four reference fiddler crab composite samples will be collected from the reference area. Each composite sample will consist of six individual whole-body crabs (ingesta will not be purged). Fiddler crabs will be prepared as described previously.

6.4 Solid Phase Toxicity Testing

Direct toxicity to aquatic invertebrates will be evaluated using 28-day laboratory toxicity tests with *Leptocheirus plumulosus* (amphipod). A total of 10 baseline ecological risk assessment samples (7 site samples and 3 reference samples) will be submitted for toxicity testing. The sediment toxicity tests will be conducted using the SWMU-specific and reference surface sediment samples discussed in Section 6.3.1. Test endpoints for *Leptocheirus plumulosus* are survival, calculated as the percentage of neonates at test initiation that survive as adults at test termination; growth rate, calculated as the mean dry weight per adult amphipod at test termination; and reproduction; calculated as the number of offspring per surviving adult.

Sediment samples will be overlain with surface water specified by the procured laboratory with a target salinity of based on the salinity of pore water for the baseline ecological risk assessment sediment samples submitted for toxicity testing. A negative control will be run to ensure that the population of organisms used in the toxicity test is healthy. Good health is demonstrated when the organism's performance meets or exceeds the control performance acceptability criterion for survival, growth and reproduction (specified by the procured laboratory's SOP). The toxicity testing laboratory will determine the appropriate substrate for control testing. If control performance falls below the acceptability criteria, the results of the toxicity tests will be considered invalid and the tests will be rerun at the expense of the toxicity laboratory.

Acceptable error levels for the *Leptocheirus plumulosis* toxicity tests are summarized in Table 5-2. As discussed in Section 5.3, acceptable error levels for the *Leptochheirus plumulosus* toxicity tests were taken from the USEPA document entitled Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-Associated Contaminants With the Amphipod *Leptocheirus*

Plumulosus (USEPA, 2001). These criteria may vary from those specified by the procured laboratory's Standard Operating Procedure (SOP). Once a laboratory is procured, the laboratory's SOP will be provided to NAPR, NAVFAC Atlantic, and USEPA for approval prior to implementation of field activities.

6.5 Sample Analysis and Data Validation

All analyses (lead, ammonia, AVS/SEM, TOC, sulfide, pH, % lipids, and grain size) will be conducted at a contracted laboratory that fulfills all requirements of the Navy's QA/QC Program Manual and USEPA's Contract Laboratory program (CLP). All analytical data generated by this investigation will be subjected to independent, third party validation in accordance with the USEPA Region II Data Validation Operating Procedures. The DCQAP establishes all the general QA requirements for the analyses that will occur during the investigation. The DCQAP presents the specific policies, organization, functions, and QA/QC activities associated with the analytical data, and in conjunction with data validation, is designed to ensure that acceptable data requirements and error levels are achieved. A summary of the samples collected as part of the preliminary and baseline ERA sediment sampling events is presented in Table 6-1. Information regarding analytical methods and method detection limits are summarized in Table 6-2.

6.5.1 Quality Assurance/Quality Control Samples

The QA/QC requirements for biotic and abiotic samples collected during the preliminary field investigation and baseline ERA field investigation are presented in the Master DCQAP (Baker, 1995). The following QA/QC samples will be collected during field sampling activities to provide a measure of the internal consistency of samples, and to provide an estimate of the components of variance and the bias in the analytical process:

Equipment Rinsate Blanks - Equipment rinstae blanks are defined as samples that are obtained by running analyte-free water over/through sample collection equipment before its first use (new or dedicated sampling equipment) or after it has been cleaned. Equipment rinsates from stainless steel spoons will be collected once during each sampling event (see Table 6-1). An equipment rinsate blank also will be collected from the disposable aluminum pan used to homogenize sediment samples collected for split analytical and toxicological testing. The results from the rinsates will be used to evaluate the dedicated sampling equipment. This comparison is made during data validation and the rinsates are analyzed for the same parameters as the related samples.

Field Blanks - Field blanks are defined as samples that are obtained by pouring analyte-free water into appropriate sample containers at pre-designated field locations. This is done to determine if any contaminants present in the area may have an effect on sample integrity. Field blanks should not be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.

Field Duplicates - Field duplicates samples are collected concurrently with environmental samples. All samples are homogenized and split. Field duplicates will be collected at a frequency of 10 percent (1/10).

Matrix Spike/Matrix Spike Duplicates (MS/MSD) - MS/MSD samples are collected to evaluate the matrix effect of the sample upon the analytical methodology. MS/MSD samples will be collected at a frequency of 5 percent (1/20).

6.6 Sample Designations

In order to identify and accurately track the sediment and fiddler crab tissue samples, all samples collected during this investigation, including QA/QC samples, will be designated with a unique

number. The number will serve to identify the SWMU, the sample media, sampling location, the investigation, and QA/QC qualifiers. The sample designation format is as follows:

[Site #]-[Investigation]-[Media][Station #][QA/QC]

An explanation of each of these identifiers is given below.

Site #:	SWMU 9
Media:	SD = Sediment Sample FC = Fiddler Crab
Station #:	Each sediment and fiddler crab sample will be identified with a unique identification number. Sediment sampling stations will be distinct from fiddler crab sampling locations. Sediment sampling stations for the baseline ERA will correspond to the identification number utilized during the preliminary sampling event.
Investigation:	Sediment samples collected during the baseline ERA sampling event will be indicated by B.
QA/QC:	(FB) = Field Blank (D) = Duplicate Sample (ER) = Equipment Rinsate (MS/MSD) = Matrix Spike/Matrix Spike Duplicate

Under this sample designation format the sample number 9-BERA-SD01D refers to:

9SDXXBD	SWMU 9
9SDXXBD	Sediment sample
9SDXXBD	Sample Location # to be determined in the field
9SDXXBD	Baseline ERA Field Investigation
9SDXXBD	Duplicate (QA/QC) Sample

This sample designation format will be followed throughout the project. Required deviations to this format in response to field conditions will be documented.

6.7 Decontamination Procedures

Dedicated sampling equipment will be used during the field investigation. As such, no equipment or materials will require decontamination for the baseline ecological risk assessment (BERA) at SWMU 9.

6.8 Investigation Derived Waste

Field investigation activities often result in the generation and handling of potentially contaminated materials that must be properly managed to protect the public and the environment,

as well as to meet legal requirements. These wastes may be either hazardous or non-hazardous in nature. The nature of the waste (i.e., hazardous or non-hazardous) will determine how the wastes will be handled during the field investigation.

The sources of waste material depend on the site activities planned for the project. The following types of waste material may be generated during this investigation, which must be properly handled:

- Excess sediment
- Personal protective equipment (health and safety disposables)

6.8.1 Designation of Investigation Derived Wastes

Wastes generated during the field investigation can be categorized as either potentially hazardous or non-hazardous in nature. The designation of such wastes will determine how the wastes are handled. The anticipated investigative wastes generated during this project are sediment and personal protective equipment (health and safety disposables). These wastes will be handled as follows:

Sediment - Excess sediment will be placed at the sampling location from which they were generated.

Personal Protective Equipment and Disposable Sampling Equipment - All personal protective equipment (i.e., tyveks, gloves, and other health and safety disposables) and disposable sampling equipment (i.e., dedicated sampling equipment, disposable aluminum pans, sample jars), shall be placed in garbage bags and disposed of in trash dump boxes.

6.8.2 Investigation Derived Waste Sampling and Analysis

As dedicated equipment will be used during the field investigation, no equipment or materials will require decontamination for the baseline ERA at SWMU 9. As such, no Investigation Derived Waste (IDW) sampling or analysis will be required.

6.9 Specifications for Field Location Data

All sampling locations will be field located using a GPS receiver. Real-time corrections will be obtained from a local US Coast Guard beacon to give an accuracy of approximately +/- 1 foot. Elevations will not be required for this work and will not be collected. Post processing might provide additional accuracy.

6.10 Project Reporting

The methods, results, analyses, and risk characterization conclusions will be reported in a draft baseline ecological risk assessment report. The report will evaluate the potential risk to estuarine wetland ecological receptor populations at SWMU 9 Area B. If unacceptable risks are indicated following Step 7, ecologically based PRGs will be developed to aid the risk-management decision-making process.

7.0 SCHEDULE

The schedule of events included in this Work Plan is presented in Figure 7-1. It should be noted that this schedule is dependent upon USEPA review time. Many other factors can also extend the schedule such as, resampling if additional sampling is required, weather delays in the field, funding is delayed by the Navy, and consensus cannot be reached on how the USEPA's comments are incorporated.

8.0 REFERENCES

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TABLES

TABLE 2-1

LIST OF BIRDS REPORTED FROM NAVAL STATION ROOSEVELT ROADS
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 – AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Common Name [1]		
Pied-billed grebe	Red-billed tropicbird	Brown pelican [2]
Brown booby	Magnificent frigatebird	Great blue heron
Louisiana heron	Snowy egret	Great egret
Striated heron	Little blue heron	Cattle egret
Least bittern	Yellow-crowned night heron	Black-crowned night heron
White-cheeked pintail	Blue-winged teal	American widgeon
Red-tailed hawk	Osprey	Merlin
Clapper rail	American coot	Caribbean coot
Common gallinule	Piping plover [3]	Semipalmated plover
Black-bellied plover	Wilson's plover	Killdeer
Ruddy turnstone	Black-necked stilt	Whimbrel
Spotted sandpiper	Semipalmated sandpiper	Short-billed dowitcher
Greater yellowlegs	Lesser yellowlegs	Willet
Stilt sandpiper	Pectoral sandpiper	Laughing gull
Royal tern	Sandwich tern	Bridled tern
Least tern	Brown noddy	White-winged dove
Zenaida dove	White-crowned pigeon	Mourning dove
Red-necked pigeon	Common ground dove	Bridled quail dove
Ruddy quail dove	Caribbean parakeet	Smooth-billed ani
Yellow-billed cuckoo	Mangrove cockoo	Short-eared owl
Chuck-will's-widow	Common nighthawk	Antillean crested hummingbird
Green-throated carib	Antillean mango	Belted kingfisher

TABLE 2-1

LIST OF BIRDS REPORTED FROM NAVAL STATION ROOSEVELT ROADS
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 – AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO TABLE 4-1

Common Name [1]		
Gray kingbird	Loggerhead kingbird	Stolid flycatcher
Caribbean elaenia	Purple martin	Cave swallow
Barn swallow	Northern mockingbird	Pearly-eyed thrasher
Red-legged thrush	Black-whiskered vireo	American redstart
Parula warbler	Prairie warbler	Yellow warbler
Magnolia warbler	Cape May warbler	Black-throated blue warbler
Adelaide's warbler	Palm warbler	Black and white warbler
Ovenbird	Northern water thrush	Bananaquit
Striped-headed tanager	Shiny cowbird	Black-cowled oriole
Greater Antillean grackle	Yellow-shouldered blackbird [2]	Hooded mannikin
Yellow-faced grassquit	Black-faced grassquit	Least sandpiper
Western sandpiper	Puerto Rican woodpecker	Rock dove
Puerto Rican emerald	Puerto Rican flycatcher	Pin-tailed whydah
Spice finch	Ruddy duck	Peregrine falcon
Marbled godwit	Puerto Rican lizard cuckoo	Prothonotary warbler
Green-winged teal	Orange-cheeked waxbill	Roseate tern [3][4]
Least grebe	West Indian whistling duck	Puerto Rican screech owl
Puerto Rican tody		

Notes:

[1] List of birds taken from Geo-Marine, Inc. (1998).
[2] Federally-designated endangered species.
[3] Federally-designated threatened species.
[4] Species has the potential to occur at Naval Station Roosevelt Roads.

TABLE 3-1

SUMMARY OF SURFACE SOIL SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 (TANKS 212 - 217)
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Solid Samples Analysis Performed								
Area	Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	TPH-DRO/GRO(1)	Volatile Organic Compounds	Semivolatile Organic Compounds	PAH	RCRA Metals(2)	Appendix IX Inorganics	Lead	Zinc	Comments
SURFACE SOIL													
A	I	9SS01	0.0 -1.0	3/20/1996	X	X	X		X				
		9SS02	0.0 -1.0	3/20/1996	X	X	X		X				
		9MW01-00	0.0 -1.0	3/20/1996	X	X	X		X				
		9MW02-00	0.0 -1.0	3/20/1996	X	X	X		X				
B	I	9SS03	0.0 -1.0	3/20/1996	X	X	X		X				
		9SS04	0.0 -1.0	3/20/1996	X	X	X		X				
		9MW03-00	0.0 -1.0	3/20/1996	X	X	X		X				
	CMS	9SS07	0.0 - 0.5	12/16/2000	X			X		X			
		9SS07D	0.0 - 0.5	12/16/2000	X			X		X			Duplicate
		9SS08	0.0 - 0.5	12/16/2000	X			X		X			
		9SS08MS/MSD	0.0 - 0.5	12/16/2000	X			X		X			Matrix Spike/Matrix Spike Dulplicate
		9SS09	0.0 - 0.5	12/16/2000	X			X		X			
C	I	9SS05	0.0 -1.0	3/20/1996	X	X	X		X				
		9SS06	0.0 -1.0	3/20/1996	X	X	X		X				
		9MW04-00	0.0 -1.0	3/20/1996	X	X	X		X				
B	Additional Data Collection	9SS10	0.0 - 0.5	7/14/2003							X	X	
		9SS10D	0.0 - 0.5	7/14/2003							X	X	Duplicate
		9SS10MS/MSD	0.0 - 0.5	7/14/2003							X	X	Matrix Spike/Matrix Spike Dulplicate
		9SS11	0.0 - 0.5	7/14/2003							X	X	
		9SS12	0.0 - 0.5	7/14/2003							X	X	
		9SS13	0.0 - 0.5	7/14/2003							X	X	
		9SS14	0.0 - 0.5	7/14/2003							X	X	
		9SS15	0.0 - 0.5	7/14/2003							X	X	

TABLE 3-1

SUMMARY OF SURFACE SOIL SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 (TANKS 212 - 217)
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Solid Samples Analysis Performed								
Area	Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	TPH-DRO/GRO(1)	Volatile Organic Compounds	Semivolatile Organic Compounds	PAH	RCRA Metals(2)	Appendix IX Inorganics	Lead	Zinc	Comments
SURFACE SOIL													
B (Cont.)	Additional Data Collection (Cont.)	9SS16	0.0 - 0.5	7/14/2003							X	X	
		9SS17	0.0 - 0.5	7/14/2003							X	X	
		9SS18	0.0 - 0.5	7/14/2003							X	X	
		9SS19	0.0 - 0.5	7/14/2003							X	X	
		9SS20	0.0 - 0.5	7/14/2003							X	X	
		9SS20D	0.0 - 0.5	7/14/2003							X	X	Duplicate
		9SS21	0.0 - 0.5	7/14/2003							X	X	
		9SS22	0.0 - 0.5	7/14/2003							X	X	
		9SS23	0.0 - 0.5	7/15/2003							X	X	
		9SS24	0.0 - 0.5	7/15/2003							X	X	
		9SS25	0.0 - 0.5	7/15/2003							X	X	
		9SS28	0.0 - 0.5	7/14/2003							X	X	
		9SS29	0.0 - 0.5	7/14/2003							X	X	

Notes: bgs - below ground surface.
NA - Not Applicable.
(1) TPH DRO/GRO - Total Petroleum Hydrocarbon Diesel Range Organics/Gasoline Range Organics.
(2) RCRA Metals - Resource Conservation and Recovery Act Metals.

TABLE 3-2

SUMMARY OF SURFACE WATER SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 (TANKS 212 - 217)
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Aqueous Samples						
					Analysis Performed						
Area	Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	Volatile Organic Compounds	Semivolatile Organic Compounds	Benzene, Toluene, Ethylbenzene, Xylene	Total Metalloids *	Dissolved Appendix IX Inorganics	Total Appendix IX Inorganics	Comments
SURFACE WATER											
A	III	9SW02	NA	6/29/1999	X	X		X		X	
	CMS	9SW13	NA	12/17/2000			X		X	X	
		9SW13D	NA	12/17/2000			X		X	X	Duplicate
		9SW14	NA	12/17/2000			X		X	X	
		9SW15	NA	12/17/2000			X		X	X	
		9SW16	NA	12/17/2000			X		X	X	
		9SW16MS	NA	12/17/2000			X		X	X	Matrix Spike
		9SW16MSD	NA	12/17/2000			X		X	X	Matrix Spike Duplicate
		9SW17	NA	12/17/2000			X		X	X	
B	III	9SW01	NA	6/29/1999	X	X		X		X	
		9SW01D	NA	6/29/1999	X	X		X		X	Duplicate
		9SW03	NA	6/29/1999	X	X		X		X	
		9SW04	NA	6/29/1999	X	X		X		X	
	CMS	9SW18	NA	12/17/2000			X		X	X	
		9SW18D	NA	12/17/2000			X		X	X	Duplicate
		9SW19	NA	12/17/2000			X		X	X	
		9SW20	NA	12/17/2000			X		X	X	
		9SW21	NA	12/17/2000			X		X	X	
		9SW22	NA	12/17/2000			X		X	X	
		9SW22D	NA	12/17/2000			X		X	X	Duplicate
		9SW23	NA	12/17/2000			X		X	X	

TABLE 3-2

SUMMARY OF SURFACE WATER SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 (TANKS 212 - 217)
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Aqueous Samples						
					Analysis Performed						
Area	Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	Volatile Organic Compounds	Semivolatile Organic Compounds	Benzene, Toluene, Ethylbenzene, Xylene	Total Metalloids *	Dissolved Appendix IX Inorganics	Total Appendix IX Inorganics	Comments
SURFACE WATER											
C	III	9SW06	NA	6/29/1999	X	X		X		X	
		9SW07	NA	6/29/1999	X	X		X		X	
	CMS	9SW24	NA	12/20/2000			X		X	X	
		9SW24D	NA	12/20/2000			X		X	X	Duplicate
		9SW25	NA	12/20/2000			X		X	X	
		9SW26	NA	12/20/2000			X		X	X	
		9SW27	NA	12/20/2000			X		X	X	
		9SW28	NA	12/20/2000			X		X	X	

Notes: bgs - below ground surface.
* - Arsenic and Cyanide.
NA - Not Applicable.

TABLE 3-3

SUMMARY OF SEDIMENT SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 (TANKS 212 - 217)
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Solid Samples Analysis Performed									
Area	Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	Volatile Organic Compounds	Semivolatile Organic Compounds	Sulfide	Metalloids *	PAH	TOC	AVS/SEM	Appendix IX Inorganics	Lead	Comments
SEDIMENT														
A	III	9SD02	0.0 - 0.5	6/29/1999	X	X	X	X				X		
	CMS	9SD13	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD13D	0.0 - 0.5	12/17/2000					X			X		Duplicate
		9SD14	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD15	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD16	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD16MS/MSD	0.0 - 0.5	12/17/2000					X	X	X	X		Matrix Spike/Matrix Spike Duplicate
		9SD17	0.0 - 0.5	12/17/2000					X	X	X	X		
B	III	9SD01	0.0 - 0.5	6/29/1999	X	X	X	X				X		
		9SD01D	0.0 - 0.5	6/29/1999	X	X	X	X				X		Duplicate
		9SD03	0.0 - 0.5	6/29/1999	X	X	X	X				X		
		9SD04	0.0 - 0.5	6/29/1999	X	X	X	X				X		
	CMS	9SD18	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD18D	0.0 - 0.5	12/17/2000					X			X		Duplicate
		9SD19	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD20	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD21	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD22	0.0 - 0.5	12/17/2000					X	X	X	X		
		9SD22D	0.0 - 0.5	12/17/2000					X			X		Duplicate
		9SD23	0.0 - 0.5	12/17/2000					X	X	X	X		

TABLE 3-3

SUMMARY OF SEDIMENT SAMPLING AND ANALYTICAL PROGRAM
SWMU 9 (TANKS 212 - 217)
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

					Solid Samples Analysis Performed									
Area	Phase	Sample ID	Sample Depth (feet bgs)	Date Collected	Volatile Organic Compounds	Semivolatile Organic Compounds	Sulfide	Metalloids *	PAH	TOC	AVS/SEM	Appendix IX Inorganics	Lead	Comments
SEDIMENT														
C	III	9SD06	0.0 - 0.5	6/29/1999	X	X	X	X				X		
		9SD07	0.0 - 0.5	6/29/1999	X	X	X	X				X		
	CMS	9SD24	0.0 - 0.5	12/20/2000				X	X	X	X	X		
		9SD24D	0.0 - 0.5	12/20/2000				X	X			X		Duplicate
		9SD25	0.0 - 0.5	12/20/2000				X	X	X	X	X		
		9SD26	0.0 - 0.5	12/20/2000				X	X	X	X	X		
		9SD27	0.0 - 0.5	12/20/2000				X	X	X	X	X		
		9SD28	0.0 - 0.5	12/20/2000				X	X	X	X	X		
B	Additional Data Collection	9SD29	0.0 - 0.5	7/15/2003									X	
		9SD29D	0.0 - 0.5	7/15/2003									X	Duplicate
		9SD29MS/MSD	0.0 - 0.5	7/15/2003									X	Matrix Spike/Matrix Spike Duplicate
		9SD30	0.0 - 0.5	7/15/2003									X	
		9SD31	0.0 - 0.5	7/15/2003									X	
		9SD32	0.0 - 0.5	7/15/2003									X	
		9SD33	0.0 - 0.5	7/15/2003									X	
		9SD34	0.0 - 0.5	7/15/2003									X	

Notes: bgs - below ground surface.
* - Arsenic and Cyanide.

TABLE 5-1
SUMMARY OF GENERAL DATA QUALITY OBJECTIVES
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Step 1: State the Problem Define the degree and spatial extent of any ecological risks from exposure to site-related chemicals in esturaine wetland sediment downgradient from SWMU 9 (Area B)
Step 2: Identify the Decision Is there evidence of unacceptable risk to ecological receptors? Are there sufficient data on which to base this decision?
Step 3: Identify Inputs to the Decision Analytical chemicstry data from relevant media, physical/chemical characteristics of exposure media, bioavailability estimates, and toxicological testing
Step 4: Define the Study Boundaries Estuarine wetland system downgradient from SWMU 9 (Area B) - Tank 214
Step 5: Develop a Decision Rule Based upon the results of multiple lines of evidence for which data will be available: (1) comparison of measured media concentrations to applicable risk-based screening values; (2) refined food web modeling using measured tissue concentrations; (3) bioavailability measures; and (4) toxicological test results
Step 6: Evaluate Decision Errors Tolerable limits for decision errors (analytical data) are specified in the Master DCQAP. For toxicological testing, these tolerable limits for decision errors will be specified in the procured laboratory's SOP.
Stpe 7: Optimize the Design for Obtaining Data Compile and evaluate existing information and data to focus sampling efforts. Inherently optimized through the iterative nature of the 8-step ERA process.

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TABLE 5-2
ACCETABLE DATA REQUIREMENTS AND ERROR LEVELS
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analysis	Parameter	Acceptable Data Requirements and Error Levels	Action if Value is Not Acceptable (1)
28-Day *leptocheirus plumulosus* survival, growth, and reproduction test	Control quality	Adult mortality not to exceed 20% in control samples	Retest Samples
		Evidence of juvenile reproduction and growth	Retest Samples
	Water quality values (temperature, dissolved oxygen, salinity, and pH)	Specified by the procured laboratory's SOP	Laboratory will consult with Baker to determine if retesting is necessary
	Test conditions (e.g., photoperiod, light intensity, feeding regime)	Specified by the procured laboratory's SOP	Laboratory will consult with Baker to determine if retesting is necessary
	Total organic carbon of test material	Greater than or equal to 1% and less than or equal to 7%	Test reference sediment with similar TOC levels
	Grain size distribution of test material	Greater than or equal to 5% silt-clay, but less than 85% clay	Test reference sediment with similar grain size distribution
	Unionized ammonia concentration in sediment pore water at the start of the test	less than 0.8 mg/L	Laboratory will consult with Baker to determine if sediments are to be "washed" to reduce ammonia levels
	Sulfide and ammonia conentrations in pore water and overlying water during testing	Not specified	Monitor ammonia pore water and overlying water levels three times/week and monitor sulfide pore water and overlying water on a weekely basis to evaluate potetnial ammonia and sulfide effects during the test
	Presence of indigenous organisms in test sediment	No interference with test results due to predation or competition.	Laboratory will sieve sediment (1.0 mm openings)

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TABLE 5-2
ACCETABLE DATA REQUIREMENTS AND ERROR LEVELS
STEP 3B AND 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Analysis	Parameter	Acceptable Data Requirements and Error Levels	Action if Value is Not Acceptable [1]
Data Interpretation	Sampling design - identification of appropriate reference sediments	TOC, sulfide, pH and grainsize consistent between site and reference samples; reference area not impacted by SWMU 9 influences.	Confirm reference appropriatness via quick-turn analysis, redefine and sample new reference area if required.
	Results - use of appropriate measurement endpoint	Response appropriate and conclusive to decision criteria	Interpretation of data appropriateness Consider non-site-specific information (literature/screening values)
Data Interpretation (continued)	Sampling design - concentration gradient capture	Capture historic range of contaminant concentrations at the site	Consider non-site-specific information (literature/screening values); Consider potential for remaining isolated hot spots
		Response variable measured within concentration range	Consider maximum concentration not showing effect
	Statistics - confounding effects	Minimal influence of physical and chemical variables on response variable	Use of multiple regression statistics to address confounding affects
	Statistics - power	Sufficient power to detect significant result	Consider non-site-specific information (literature/screening values)

Notes:

[1] Field effort will include collection of double the required amount of material to support potential retesting due to data quality failure.

TABLE 5-3
DECISION RULES
STEP 3B AND STEP 4 OF THE BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Line of Evidence	Decision Based on	Uncertainties/ Limitations/ Factors to Consider	Decision Criteria	Decision Recommendations/ Actions
Comparison of mean lead sediment concentration to an appropriate toxicological threshold	Does the mean lead sediment concentration exceed an acceptable toxicological threshold?	Literature-based toxicological thresholds are not site-specific (do not take into consideration site-specific factors that can influence bioavailability)	HQ $\geq$ 1.0	Indication of unacceptable risk
			HQ $\leq$ 1.0	Indication of acceptable/minimal risk
Comparison of molar AVS concentrations to molar SEM concentrations	Does the molar concentration of AVS exceed the molar concentration of SEM metals (cadmium, copper, lead, nickel, and zinc(1))?	Predicition of the absence or presence of toxicity	AVS/SEM < 1.0	Indication of unacceptable risk
			AVS/SEM > 1.0	Indication of acceptable/minimal risk
Comparisons of toxic response to reference areas	Is a significant difference ($\alpha = 0.05$) detected in survival, growth, and/or reproduction of *Leptocheirus plumulosus* exposed to SWMU 9 (Area B) sediment and reference sediments?	Low control or reference survival, growth, or reproduction - potential inability to make decision; power of statistical test	$p < 0.05$, significant difference	Indication of unacceptable risk
			$p \geq 0.05$, non significant difference	Indication of acceptable/minimal risk
Demonstration of a dose-response relationship between lead concentrations and endpoint response variables	Does a dose-response relationship exists (indicated by multiple regression with a $p < 0.05$ and $r^2 > 0.50$) between lead and the most sensitive of three measured endpoints (survival, growth, and reproduction)?	Confounding influences may include the use of inappropriate reference samples, inability of field effort to capture known concentration gradient of lead, response variables outside of concentration ranges, and physical/chemical parameters (ammonia, sulfide, TOC, and grainsize impacting the response variable.	$p < 0.05$ and $r^2 \geq 0.50$, significant difference, low variability in response	Indication of unacceptable risk
			$p < 0.05$ and $r^2 < 0.50$ significant difference, high variability in response	Large variability in response variable caused by confounding variables; investigation into variable impact and weight to arrive at decision point
			$p \geq 0.05$, non significant difference	Indication of acceptable/minimal risk only after investigation of the limits and uncertainties associated with the potential for confounding influences
Comparison of dietary intake to literature-based toxicity reference values for lead	Do dietary dose estimates using fiddler crab tissue data exceed literature-based No Observed Adverse Effect Levels (NOAEL) and Lowest Observed Adverse Effect Levels (LOAELs)	Site-specific bioaccumulation	HQ $\geq$ 1.0	Indication of unacceptable risk
			HQ $\leq$ 1.0	Indication of acceptable/minimal risk

Notes:
AVS = Acid Volatile Sulfide
SEM = Simultaneously Estracted Metals
TOC = Total Organic Carbon
(1) - SEM for baseline ecological risk assessment sediment samples will include silver

TABLE 6-1

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SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Solid Samples - 14 Day Turn								Aqueous Samples - 14 Day Turn		
		Fixed Base Analytical Lab								Fixed Base Analytical Lab		
		Analysis Requested								Analysis Requested		
Sample ID	Sample Depth (ft bgs)	TAL Lead	% Lipids	TOC	AVS/SEM	Ammonia	Sulfide	pH	Grain Size	TAL Lead	AVS/SEM	Comments
PRELIMINARY SWMU-SPECIFIC SEDIMENT SAMPLES												
9SD35	0.0 - 0.6	X		X	X	X			X			
9SD36	0.0 - 0.6	X		X	X	X			X			
9SD37	0.0 - 0.6	X		X	X	X			X			
9SD38	0.0 - 0.6	X		X	X	X			X			
9SD39	0.0 - 0.6	X		X	X	X			X			
9SD40	0.0 - 0.6	X		X	X	X			X			
9SD41	0.0 - 0.6	X		X	X	X			X			
9SD42	0.0 - 0.6	X		X	X	X			X			
9SD43	0.0 - 0.6	X		X	X	X			X			
9SD44	0.0 - 0.6	X		X	X	X			X			
9SD44D	0.0 - 0.6	X										Duplicate
9SD45	0.0 - 0.6	X		X	X	X			X			
9SD46	0.0 - 0.6	X		X	X	X			X			
9SD47	0.0 - 0.6	X		X	X	X			X			
9SD48	0.0 - 0.6	X		X	X	X			X			
9SD49	0.0 - 0.6	X		X	X	X			X			
9SD50	0.0 - 0.6	X		X	X	X			X			
9SD51	0.0 - 0.6	X		X	X	X			X			
9SD52	0.0 - 0.6	X		X	X	X			X			
9SD53	0.0 - 0.6	X		X	X	X			X			
9SD54	0.0 - 0.6	X		X	X	X			X			
9SD54D	0.0 - 0.6	X										Duplicate
9SD54MS/MSD	0.0 - 0.6	X										Matrix Spike/Matrix Spike Duplicate
9SD55	0.0 - 0.6	X		X	X	X			X			
9SD56	0.0 - 0.6	X		X	X	X			X			
9SD57	0.0 - 0.6	X		X	X	X			X			

TABLE 6-1

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SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Solid Samples - 14 Day Turn								Aqueous Samples - 14 Day Turn		
		Fixed Base Analytical Lab								Fixed Base Analytical Lab		
		Analysis Requested								Analysis Requested		
Sample ID	Sample Depth (ft bgs)	TAL Lead	% Lipids	TOC	AVS/SEM	Ammonia	Sulfide	pH	Grain Size	TAL Lead	AVS/SEM	Comments
PRELIMINARY SWMU-SPECIFIC SEDIMENT SAMPLES (Continued)												
9SD58	0.0 - 0.6	X		X	X	X			X			
9SD59	0.0 - 0.6	X		X	X	X			X			
9SD60	0.0 - 0.6	X		X	X	X			X			
9SD61	0.0 - 0.6	X		X	X	X			X			
9SD62	0.0 - 0.6	X		X	X	X			X			
9SD63	0.0 - 0.6	X		X	X	X			X			
9SD64	0.0 - 0.6	X		X	X	X			X			
9SD64D	0.0 - 0.6	X										Duplicate
9SD65	0.0 - 0.6	X		X	X	X			X			
9SD66	0.0 - 0.6	X		X	X	X			X			
9SD67	0.0 - 0.6	X		X	X	X			X			
9SD68	0.0 - 0.6	X		X	X	X			X			
9SD69	0.0 - 0.6	X		X	X	X			X			
9SD70	0.0 - 0.6	X		X	X	X			X			
9SD71	0.0 - 0.6	X		X	X	X			X			
9SD72	0.0 - 0.6	X		X	X	X			X			
9SD73	0.0 - 0.6	X		X	X	X			X			
9SD74	0.0 - 0.6	X		X	X	X			X			
9SD74D	0.0 - 0.6	X										Duplicate
9SD74MS/MSD	0.0 - 0.6	X										Matrix Spike/Matrix Spike Duplicate
9SD75	0.0 - 0.6	X		X	X	X			X			
9SD76	0.0 - 0.6	X		X	X	X			X			
9SD77	0.0 - 0.6	X		X	X	X			X			
9SD78	0.0 - 0.6	X		X	X	X			X			
9SD79	0.0 - 0.6	X		X	X	X			X			

TABLE 6-1

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SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Solid Samples - 14 Day Turn								Aqueous Samples - 14 Day Turn		
		Fixed Base Analytical Lab								Fixed Base Analytical Lab		
		Analysis Requested								Analysis Requested		
Sample ID	Sample Depth (ft bgs)	TAL Lead	% Lipids	TOC	AVS/SEM	Ammonia	Sulfide	pH	Grain Size	TAL Lead	AVS/SEM	Comments
PRELIMINARY REFERENCE SEDIMENT SAMPLES (1)												
9SD80	0.0 - 0.6	X		X	X	X			X			
9SD81	0.0 - 0.6	X		X	X	X			X			
9SD82	0.0 - 0.6	X		X	X	X			X			
9SD83	0.0 - 0.6	X		X	X	X			X			
9SD84	0.0 - 0.6	X		X	X	X			X			
9SD84D	0.0 - 0.6	X										Duplicate
9SD84MS/MSD	0.0 - 0.6	X										Matrix Spike/Matrix Spike Duplicate
9SD85	0.0 - 0.6	X		X	X	X			X			
9SD85D	0.0 - 0.6	X										Duplicate
BASELINE ERA SWMU -SPECIFIC SEDIMENT SAMPLES (2)												
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXBD	0.0 - 0.6	X										Duplicate
9SDXXBMS/MSD	0.0 - 0.6	X										Matrix Spike/Matrix Spike Duplicate
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			

TABLE 6-1

Revised: January 10, 2006

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Solid Samples - 14 Day Turn								Aqueous Samples - 14 Day Turn		
		Fixed Base Analytical Lab								Fixed Base Analytical Lab		
		Analysis Requested								Analysis Requested		
Sample ID	Sample Depth (ft bgs)	TAL Lead	% Lipids	TOC	AVS/SEM	Ammonia	Sulfide	pH	Grain Size	TAL Lead	AVS/SEM	Comments
BASELINE ERA SWMU -SPECIFIC SEDIMENT SAMPLES [(2)] (Continued)												
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXBD	0.0 - 0.6	X										Duplicate
BASELINE ERA REFERENCE SEDIMENT SAMPLES [(2)(3)]												
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXB	0.0 - 0.6	X		X	X	X	X	X	X			
9SDXXBD	0.0 - 0.6	X										Duplicate
9SDXXBMS/MSD	0.0 - 0.6	X										Matrix Spike/Matrix Spike Duplicate
BASELINE ERA FIDDLER CRAB TISSUE SAMPLES												
9FC01	NA	X	X									
9FC02	NA	X	X									
9FC03	NA	X	X									
9FC04	NA	X	X									
9FC05	NA	X	X									
9FC06	NA	X	X									
9FC07	NA	X	X									
9FC08	NA	X	X									
9FC08D	NA	X										Duplicate
9FC08MS/MSD	NA	X										Matrix Spike/Matrix Spike Duplicate

TABLE 6-1

Revised: January 10, 2006

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAM
ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

		Solid Samples - 14 Day Turn								Aqueous Samples - 14 Day Turn		
		Fixed Base Analytical Lab								Fixed Base Analytical Lab		
		Analysis Requested								Analysis Requested		
Sample ID	Sample Depth (ft bgs)	TAL Lead	% Lipids	TOC	AVS/SEM	Ammonia	Sulfide	pH	Grain Size	TAL Lead	AVS/SEM	Comments
FIELD BLANKS												
9FB01PRE	NA									X		Lab Grade DI Water - Preliminary Investigation
9FB01BERA	NA									X		Lab Grade DI Water - BERA Investigation
EQUIPMENT RINSATE BLANKS												
9ER01PRE	NA									X		Stainless Steel Spoon - Preliminary Investigation
9ER01PBERA	NA									X		Stainless Steel Spoon - BERA Investigation
9ER02BERA	NA									X		Aluminum Pan - BERA Investigation

Notes:

ft bgs - feet below ground surface.

TOC - Total Organic Carbon

AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metal

XX - Site ID designation will be determined in the field and will match the number from the preliminary sampling event.

(1) - The actual number of preliminary sediment samples will be dictated by field observations (habitat variability and visual characteristics of sediment).

(2) - The extact location of this sample will be based on the analytical results of the preliminary sediment samples.

(3) - The actual number of baseline ERA reference sediment samples will be dictated by the variability of the physical/chemical characteristics of the preliminary SWMU-specific sediment samples.

TABLE 6-2 Revised: January 10, 2006

METHOD PERFORMANCE LIMITS
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)
SWMU 9 - AREA B (TANK 214)
NAVAL ACTIVITY PUERTO RICO, CEIBA, PUERTO RICO

Inorganics	Method Number	Quantitation Limits* Water (µg/L)	Quantitation Limits* Low Soil (mg/kg)	Method Description
Lead	6020	1.5	0.3	Inductively Coupled Plasma - Mass Spectrometry

AVS/SEM (1)	Method Number	Quantitation Limits* Water (µg/L)	Quantitation Limits* Low Soil (mg/kg)	Method Description
AVS	SL-SOP	N/A	2.5	Laboratory Procedure
Cadmium	SL-SOP	N/A	0.073	Laboratory Procedure
Copper	SL-SOP	N/A	0.29	Laboratory Procedure
Nickel	SL-SOP	N/A	0.58	Laboratory Procedure
Zinc	SL-SOP	N/A	0.29	Laboratory Procedure
Lead	SL-SOP	N/A	0.073	Laboratory Procedure
Silver	SL-SOP	N/A	0.15	Laboratory Procedure

Organic Analysis	Quantitation Limits* Water (µg/L)	Quantitation Limits* Low Soil (mg/kg)	Method Description
Total Organic Carbon (TOC)	N/A	1,000	Lloyd Kahn

Miscellaneous Analysis	Quantitation Limits* Water (mg/L)	Quantitation Limits* Low Soil (mg/kg)	Method Description
Ammonia	NA	0.15	350.1/CE:3-140
Sulfide	NA	25	SW-846 9030/9034
pH	NA	NA	SW-846 9045C
% Lipids	NA	NA	EPA Region IV Method 0B 10.90
Grain Size	NA	NA	ASTM D422

Notes:

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, will be higher.

(1) - AVS/SEM - Acid Volatile Sulfide/Simultaneously Extracted Metals.

ug/L - micrograms per liter.

mg/L - milligrams per liter.

mg/kg - milligrams per kilogram.

N/A - Not Available.

FIGURES

APPENDIX A
DATA COLLECTION QUALITY ASSURANCE PLAN ADDENDUM

DRAFT

DATA COLLECTION QUALITY ASSURANCE PLAN ADDENDUM

STEP 3B AND 4 OF THE
BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANKS 214 – 215)

NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT TASK ORDER 0271

DECEMBER 1, 2004

Prepared For:

DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
ATLANTIC DIVISION
Norfolk, Virginia

Under the:

LANTDIV CLEAN Program
Contract N62470-95-D-6007

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PREFACE

This Data Collection Quality Assurance Plan (DCQAP) Addendum provides specific quality assurance information for the Estuarine Wetland Baseline Ecological Risk Assessment at Solid Waste Management Unit (SWMU) 9 Area B (Tanks 214 – 215) at Naval Activity Puerto Rico, Ceiba, Puerto Rico. This DCQAP is designed to be used in conjunction with the DCQAP presented within the Final Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for Naval Station Roosevelt Roads, Ceiba, Puerto Rico (Baker Environmental, Inc. [Baker], 1995). General information that is required for this DCQAP can be found within the Final RFI mentioned above. Site personnel are required to review the information presented in both the DCQAP presented in the Final RFI (Baker, 1995), as well as this DCQAP Addendum prior to conducting field activities.

* Italicized print indicates that information in that section is presented in the Master QAPP and not in this QAPP Addendum.

6.0 PROJECT DESCRIPTION AND ORGANIZATION

Solid Waste Management Unit (SWMU) 9 is located within the property boundary of Naval Activity Puerto Rico (NAPR), and is comprised of six fuel storage tanks, pipelines, and ancillary facilities. The SWMU was divided into three separate areas for investigation purposes. Area A, located along Forrestal Drive, consists of Tanks 212 and 213. Area B, also located along Forrestal Drive, consists of Tanks 214 and 215. Area C, located along Antietam Road, consists of Tanks 216 and 217. This facility was included as a Solid Waste Management Unit (SWMU) in the Resource Conservation and Recovery Act (RCRA) Part B Permit (United States Environmental Protection Agency [USEPA], 1994), as a result of petroleum sludge generated and disposed of onsite in unlined earthen pits.

Previous reports indicate that the tanks were constructed in 1948 for the storage of fuel including aviation gasoline, diesel fuel, and Bunker C to name a few. According to base personnel, all six tanks were cleaned and placed out of service as part of a fuels contract in 2001, and are currently empty.

The RCRA Facility Investigation (RFI) conducted at the site indicated that various environmental media were impacted by past site operations. The additional data collection field investigation was designed to fill identified data gaps necessary to select corrective measures to mitigate human health and ecological risks associated with contamination related to site operations as presented in the Draft Additional Data Collection Work Plan (Baker, 2003a). The work plan was written and submitted based on recommendations made in the Final Corrective Measures Study (CMS) Investigation Report (Baker, 2003b), as well as concurrence of these recommendations by the USEPA (USEPA, 2003).

As part of the Step 3B and 4 of the Baseline Ecological Risk Assessment at SWMU 9 Area B (Baker, 2004), collection and analysis of sediment and fiddler crab (if applicable) samples will be conducted. The specific samples and analyses are presented in the Field Sampling and Analysis Plan (FSAP) portion of the report mentioned above.

The objective of this project is to define the requirements necessary to implement the Steps 3B and 4 of the Baseline Ecological Risk Assessment at SWMU 9 Area B, and to complete the necessary sampling and reporting which will document the estuarine wetland ecological risk assessment activities.

Baker's primary participants for this project include:

- Mr. John W. Mentz, Baker – Program Manager
- Mr. Mark E. Kimes, P.E., Baker – NAPR Activity Manager/Project Manager
- Mr. John Malinowski, Baker – Senior Ecological Risk Specialist/QA/QC/Field Team Leader
- Ms. Mary Smith, Baker – Ecological Risk Specialist/Environmental Scientist
- Mrs. Heather Govenor Wojdak, Baker – Ecological Risk Specialist/Environmental Scientist
- Mr. Jon Edel, Baker – Site Manager/Environmental Scientist/ Site Health and Safety Officer

Mr. Kimes will be responsible for monitoring the budget and schedule of individual tasks and will have the overall responsibility of completing the work plan, overseeing field activities, and completing the reports for this project. Mr. Malinowski will be technically responsible for ecological risk assessments, with technical input from both Ms. Smith and Mrs. Wojdak. He will

also assume the responsibility of team leader while in the field. Mr. Edel will serve as the Site Manager and Site Health and Safety Officer. Geologists, engineers, scientists, biologists, and clerical personnel will support the primary participants as needed.

Overall Quality Assurance/Quality Control (QA/QC) will be the responsibility of Mr. Kimes, while providing senior consulting support and coordination of subcontractor procurement for the project.

Subcontractors will be used to perform laboratory analysis, and data validation. Specific subcontractors have not yet been identified. Baker will perform this investigation with support from the Navy and NAPR.

References:

Baker Environmental, Inc. (Baker), 1995. Final RCRA Facility Investigation, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. September 14, 1995.

Baker, 2003a. Draft Additional Data Collection Work Plan for SWMU 9, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. April 25, 2003.

Baker, 2003b. Final Corrective Measures Study Investigation Report for SWMU 9, Naval Station Roosevelt Roads, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. April 25, 2003.

Baker, 2004. Final Additional Data Collection Report for SWMU 9, Naval Activity Puerto Rico, Ceiba, Puerto Rico. Coraopolis, Pennsylvania. June 14, 2004.

U. S. Environmental Protection Agency, (USEPA). 1994. Notice of Issuance of a Final Resource Conservation and Recovery Act as Amended by the Hazardous and Solid Waste Amendments of 1984 Permit to U.S. Naval Station Roosevelt Roads Ceiba, Puerto Rico. October 20, 1994.

USEPA. 2003. Comment letter to Mr. Kevin Cloe on Navy's December 23, 2002 Responses to EPA's Comments on the CMS Investigation Report for SWMU 9. February 19, 2003.

APPENDIX B
HEALTH AND SAFETY PLAN ADDENDUM

DRAFT

HEALTH AND SAFETY PLAN ADDENDUM

STEPS 3B AND 4 OF THE
BASELINE ECOLOGICAL RISK ASSESSMENT
SWMU 9 - AREA B (TANKS 214 – 215)

NAVAL ACTIVITY PUERTO RICO
CEIBA, PUERTO RICO

CONTRACT TASK ORDER 0271

DECEMBER 1, 2004

Prepared For:

DEPARTMENT OF THE NAVY
NAVAL FACILITIES
ENGINEERING COMMAND
ATLANTIC DIVISION
Norfolk, Virginia

Under the:

LANTDIV CLEAN Program
Contract N62470-95-D-6007

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

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Herndon, Virginia

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* Italicized print indicates that information in that section is presented in the Master Site HASP and not in this HASP Addendum.

EXECUTIVE SUMMARY

SWMU 9 is located at NAPR, and is comprised of six fuel storage tanks, pipelines, and ancillary facilities. The SWMU was divided into three separate areas for investigation purposes. Area A, located along Forrestal Drive, consists of Tanks 212 and 213. Area B, also located along Forrestal Drive, consists of Tanks 214 and 215. Area C, located along Antietam Road, consists of Tanks 216 and 217. This facility was included as a Solid Waste Management Unit in the RCRA Part B Permit, as a result of petroleum sludge generated and disposed of onsite in unlined earthen pits.

Previous reports indicate that the tanks were constructed in 1948 for the storage of fuel including aviation gasoline, diesel fuel, and Bunker C to name a few. According to base personnel, all six tanks were cleaned and placed out of service as part of a fuels contract in 2001, and are currently empty.

The chemical exposure potential for personnel working at SWMU 9 Area B at NAPR is expected to be similar to the chemicals identified by analytical analyses from previous sampling investigations at similar sites. The physical hazards that are potential concerns for work to be conducted at SWMU 9 Area B include thermal stress and fall hazards. The environmental hazardous include potentially hazardous flora and fauna at NAPR.

The chemical and physical/environmental hazards associated with the tasks to be conducted at SWMU 9 Area B (Tanks 214 – 215) include:

<u>Task 1 - Sediment Sampling</u>

Chemical

- Potential for contaminated material to be splashed onto body or in eyes.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of volatile constituents or volatile fraction of semi-volatile constituents within the sediments or surface water.
- Absorption of constituents through the skin.

Physical/Environmental

- Muscle strain from boring with hand auger.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral (i.e., wild) animal life.

<u>Task 2 – Fiddler Crab Sampling</u>

Chemical

- Potential for contaminated material to be splashed onto body or in eyes.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of volatile constituents or volatile fraction of semi-volatile constituents within the sediments or surface water.
- Absorption of constituents through the skin.

Physical/Environmental

- Muscle strain from boring with hand auger.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral (i.e., wild) animal life.

Task 3 - Land Surveying through a GPS Unit

Chemical

- Skin contact with potentially-contaminated material.
- Ingestion of contaminated material from hand-to-mouth contact.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.

Levels of protection outlined in Section 6.0 were selected based on site-specific and task-specific hazard identification, information obtained from previous investigations and site visits, and previous experience with similar investigations or activities.

Also included within this addendum are current emergency procedures, emergency telephone numbers, and hospital route.

2.0 PROJECT PERSONNEL AND RESPONSIBILITIES

The following personnel are designated to carry out the stated job functions for both project and site activities (Note: One person may carry out more than one job function; personnel identified are subject to change). The responsibilities that correspond with each job function are outlined below.

PROJECT MANAGER: Mark Kimes

The project manager will be responsible for assuring that all activities are conducted in accordance with the HASP. The Project Manager has the authority to suspend field activities if employees are in danger of injury or exposure to harmful agents. In addition, the Project Manager is responsible for:

- Assisting the Project Health and Safety Officer (PHSO), as designated below, in Site-Specific HASP development for all phases of the project.
- Designating a SHSO and other site personnel who will assure compliance with the HASP.
- Reviewing and approving the information presented in this HASP.

PROJECT HEALTH AND SAFETY OFFICER: Warren Lehew, CIH, CSP

The PHSO will be responsible for general development of the HASP and will be the primary contact for inquiries as to the contents of the HASP. The PHSO will be consulted before changes to the HASP can be approved or implemented. The PHSO will also:

- Develop new protocols or modify the HASP as appropriate and issue amendments.
- Resolve issues that arise in the field with respect to interpretation or implementation of the HASP.
- Monitor the field program through a regular review of field health and safety records, on-site activity audits, or a combination of both.
- Determine that all Baker personnel have received the required training and medical surveillance prior to entry onto a site.
- Coordinate the review, evaluation, and approval of the HASP.

SITE MANAGER: Jon Edel

The Site Manager will be responsible for assuring that all day-to-day activities are conducted in accordance with the HASP. The Site Manager has the immediate authority to suspend field activities if employees are subjected to a situation that can be immediately dangerous to life or health. The Site Manager's responsibilities include:

- Assuring that the appropriate health and safety equipment and personal protective equipment (PPE) has arrived on site and that it is properly maintained.
- Coordinating overall site access and security measures, including documenting all personnel arriving or departing the site (e.g., name, company and time).
- Approving all on site activities, and coordinating site safety and health issues with the SHSO.

- Assisting the SHSO in coordinating emergency procedures with the Naval Activity, emergency medical responders, etc., prior to or during site mobilization activities.

- Assuring compliance with site sanitation procedures and site precautions.

- Coordinating activities with Baker and subcontractor personnel.

- Overseeing the decontamination of field sampling equipment.

- Assuming the responsibilities as indicated under "Field Team Leader," in their absence.

SITE HEALTH AND SAFETY OFFICER: Jon Edel

The SHSO will be responsible for the on-site implementation of the HASP. The SHSO also has the immediate authority to suspend field activities if the health or safety of site personnel is endangered, and to audit the subcontractor training, fit testing, and medical surveillance records to verify compliance. These records will be maintained at the Baker Command Post. The SHSO will also:

- Coordinate the pre-entry briefing and subsequent briefings.

- Assure that monitoring equipment is properly calibrated and properly operated.

- Assure compliance with the Standard Operating Procedures (SOPs) in Attachment A.

- Inform personnel of the material safety data sheets (MSDSs) located in Attachments B and C and emergency procedures for exposure to hazardous materials/waste presented in Attachment D.

- Manage health and safety equipment, including instruments, respirators, PPE, etc., that is used during field activities.

- Confirm emergency response provisions, as necessary, in cooperation with Naval Activity, emergency medical care, etc., prior to or during site mobilization activities.

- Monitor conditions during field activities to ensure worker compliance with the HASP and evaluate if more stringent procedures or a higher level of PPE should be implemented, and informing the PHSO and Project Manager.

- Document, as necessary, pertinent information such as accident investigation and reporting, designated safety inspections, a record of site conditions, personnel involved in field activities, and any other relevant health and safety issues. This information will become part of the official site records.

- Oversee the decontamination of personnel and determine safe boundary procedures for activities requiring Level C or higher protection levels.

- Act as the Emergency Coordinator.

FIELD TEAM LEADER: John Malinowski

The Field Team Leader will be responsible for:

- Safety issues relevant to the tasks under their direction.
- Determining safe boundary procedures for activities requiring Level D or D+ protection levels.
- Assuring that PPE is properly maintained.
- Complying with the conditions as outlined under Field Team Members.
- Assuming the responsibilities as indicated under "Site Manager" in their absence.

SUBCONTRACTOR COMPANIES:

Analytical Services: (To Be Determined)

LANTDIV REPRESENTATIVES:
Mr. Kevin Cloe (757) 322-4736

ACTIVITY/STATION/BASE REPRESENTATIVES:
Ms. Madeline Rivera, Public Works Environmental Eng. Div. (787) 865-4429

FEDERAL/STATE/LOCAL REPRESENTATIVES:
Not assigned

3.2 Facility HASP Objective

This "Facility" Health and Safety Plan (HASP) addresses the ecological investigation that is required at SWMU 9 Area B, with a detailed description of this site in the section that follows.

3.3 Description of SWMU 9 Area B (Tanks 214 – 215)

SWMU 9 is located at NAPR and is comprised of six fuel storage tanks, pipelines, and ancillary facilities. The SWMU was divided into three separate areas for investigation purposes. Area A, located along Forrestal Drive, consists of Tanks 212 and 213. Area B, also located along Forrestal Drive, consists of Tanks 214 and 215. Area C, located along Antietam Road, consists of Tanks 216 and 217. This facility was included as a Solid Waste Management Unit in the RCRA Part B Permit, as a result of petroleum sludge generated and disposed of onsite in unlined earthen pits.

Previous reports indicate that the tanks were constructed in 1948 for the storage of fuel including aviation gasoline, diesel fuel, and Bunker C to name a few. According to base personnel, all six tanks were cleaned and placed out of service as part of a fuels contract in 2001, and are currently empty.

3.4.5 Task-Specific Hazards

Listed below are summaries for the hazards associated with each task for the investigation to be conducted at SWMU 9 Area B. Levels of protection outlined in Section 6.0 were selected based on this task-specific hazard identification, information obtained from previous investigations and site visits, and previous experience with similar investigations or activities.

3.4.5.1 Task 1 - Sediment Sampling

Chemical

- Potential for contaminated material to be splashed onto body or in eyes.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of volatile constituents or volatile fraction of semi-volatile constituents within the sediments or surface water.
- Absorption of constituents through the skin.

Physical/Environmental

- Muscle strain from boring with hand auger.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral (i.e., wild) animal life.

3.4.5.2 Task 2 – Fiddler Crab Sampling

Chemical

- Potential for contaminated material to be splashed onto body or in eyes.
- Ingestion of contaminated material from hand-to-mouth contact.
- Inhalation of volatile constituents or volatile fraction of semi-volatile constituents within the sediments or surface water.

- Absorption of constituents through the skin.

Physical/Environmental

- Muscle strain from boring with hand auger.
- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral (i.e., wild) animal life.

3.4.5.3 Task 3 - Land Surveying through a GPS Unit

Chemical

- Skin contact with potentially-contaminated material.
- Ingestion of contaminated material from hand-to-mouth contact.

Physical/Environmental

- Slips/trips/falls - sloped, uneven terrain; crawling over and under obstacles.
- Skin irritation from contact with insects and vegetation.
- Interaction with native and feral animal life.

6.2 Site-Specific Levels of Protection

Based on the information provided in Section 3.0, Site Characterization, the levels of protection and corresponding personal protective equipment have been designated for the following field activities. Upgrading or downgrading the level of protection will be based on real time monitoring, working conditions, and the discretion of the SHSO. Items listed in parentheses are at the discretion of the SHSO, depending on specific site conditions.

Note: No single combination of protective equipment and clothing is capable of protection against all hazards. PPE should be used in conjunction with safe work practices, effective decontamination, and good personal hygiene.

Field Activity	Level of Protection					PPE (Item No.)
	B	C	D +	D	Other	
Sediment Sampling				X		4, 13, 20, 25
GPS Surveying				X		4
Fiddler Crab Sampling				X		4, 13, 18, 20, 25

EXCEPT IN EMERGENCY SITUATIONS, CHANGES TO THE SPECIFIED LEVELS OF PROTECTION SHALL ONLY BE MADE WITH THE APPROVAL OF THE SHSO AND THE SITE MANAGER, IN CONSULTATION WITH THE PHSO AND PROJECT MANAGER.

8.6 Emergency Hospital Route

An emergency hospital route map (Figure 8-2) showing the location of the local hospital will be posted in the Baker Field Trailer and maintained in the Baker Field Vehicle. Personnel will be informed of the location of the map during the pre-entry briefing. Since the Base Hospital is closed, the hospital to be used for this project is Hospital San Pablo Del Este, located at Avenida General Valero #404, in Fajardo. To get to the hospital, exit the base and take Route 3 north to Fajardo. After passing the Del Este Shopping Center, turn right onto Avenida El Conquistador. Turn Right onto Avenida General Valero (Route 194). The hospital will be on your right.

11.0 HEALTH AND SAFETY PLAN APPROVAL

This HASP has been reviewed by the following personnel prior to submission to LANTDIV.

Warren Lehew	PHSO	_____
Name (print)	Title (print)	Signature
Mark Kimes	Project Manager	_____
Name (print)	Title (print)	Signature
Jon Edel	Site Manager	_____
Name (print)	Title (print)	Signature

TABLES

TABLE 9-1

OSHA TRAINING HISTORY OF BAKER PROJECT PERSONNEL*

Personnel	Title/Role	Training Status	
Mark Kimes	• Project Manager	• 40-hr. training completed:	7/91
		• Supervisory training:	9/91
		• 8-hr. refresher completed:	4/03
		• First Aid Training:	4/03
		• CPR Training:	4/03
		• Medical Surveillance:	4/04
Warren Lehew	• Project Health and Safety Officer	• 40-hr. training completed:	9/99
		• First Aid Training:	8/00
		• CPR Training:	8/00
		• Medical Surveillance:	9/03
Jon Edel	• Site Manager/Site Health and Safety Officer	• 40-hr. training completed:	1/98
		• Supervisory training:	3/04
		• 8-hr. refresher completed:	3/04
		• First Aid Training:	4/03
		• CPR Training:	4/03
		• Medical Surveillance:	4/03

* Training history for contractor personnel will be maintained at the Command Post.
N/A – Not Applicable

FIGURES

FIGURE 8-1

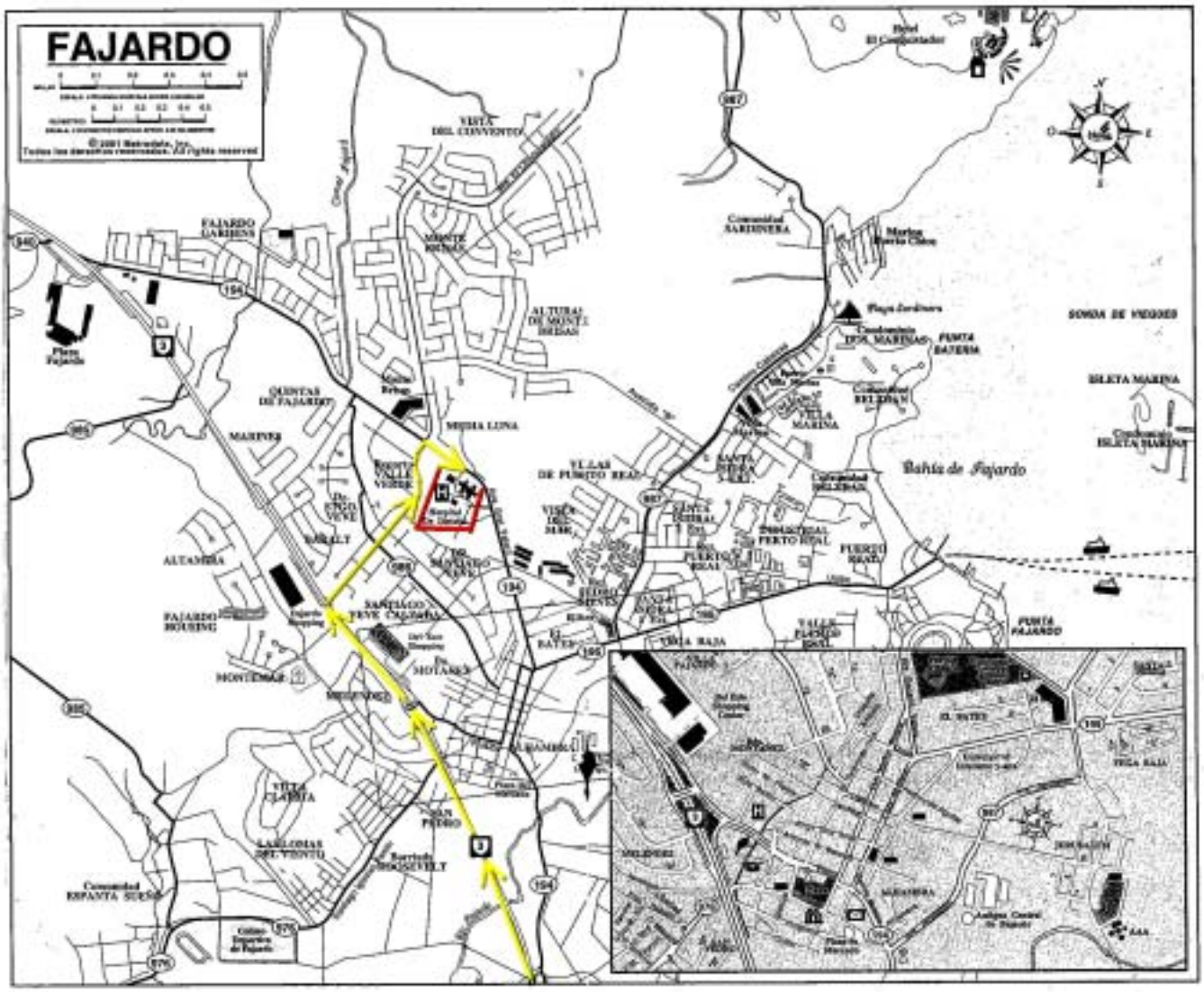
EMERGENCY TELEPHONE NUMBERS

NSRR	Telephone Number On-Base Phone	Telephone Number Off-Base Phone	Contact*
Security (Police)	4106	(787) 865-4106	Response Operator
Fire (On-Scene Commander)	4100	(787) 865-4100	Response Operator
Hospital (Fajardo)	(9) 787-863-0505	(787) 863-0505	Response Operator
General Base Information	2000	(787) 865-2000	Response Operator
Public Works	4429	(787) 865-4429	Ms. Madeline Rivera
Florida Poison Information Center	(9) 800-222-1222	(800) 222-1222	Response Operator
Federal Maritime Commission	(9) 954-963-5362 (9) 954-963-5284	(954) 963-5362 (954) 963-5284	Andrew Margolis Eric O. Mintz
CHEMTREC	(9) 1-800-424-9300	1-800-424-9300	Response Operator
EPA National Response Center	(9) (800) 424-8802	(800) 424-8802	Response Operator
Baker Project Manager	(9) 412-269-2009	(412)269-2009	Mr. Mark Kimes
Baker PHSO	(9) 412-269-6068	(412)269-6068	Mr. Warren Lehew
LANTDIV Navy Representative	(9) 757-322-4780	(757)322-4736	Mr. Kevin Cloe
USCG Marine Safety Office, Miami	(9) 305-535-8705	(305) 535-8705	Response Operator

- Remaining points of contact will be identified prior to the start of activities.

FIGURE 8-2

HOSPITAL ROUTE



Directions to Hospital San Pablo Del Este:

Exit the base and drive North on Route 3 toward Fajardo. After entering town, you will pass the Del Este Shopping Center on your right. After that, turn right onto Avenida El Conquistador. Proceed approximately 1/2 mile and turn right onto Avenida General Valero. The Hospital will be on your right.

FIGURE 8-3

EMERGENCY MEDICAL SERVICES

Chemical and Nonchemical Exposure Incidents

The nearest hospital is:

Name	Hospital San Pablo Del Este
Address	La Avenida General Valero #404, Fajardo, PR 00738
On-Base Telephone No.	
Off-Base Telephone No.	(787) 863-0505

Local ambulance service is available from:

Name	Hospital San Pablo Del Este
On-Base Telephone No.	
Off-Base Telephone No.	(787) 863-0505

Extreme Emergency

In instances of extreme emergency, or for "stable patient transfer" to nearby public hospitals or those located in the continental United States, contact will be made with Advanced Air Ambulance Service of Miami, Florida. The SHSO and Site Manager will serve as the primary contacts, however, site personnel will be permitted to make contact in extreme emergencies.

Emergency Telephone Numbers:	Advanced Air Ambulance (305) 232-7700 (Miami Headquarters) (800) 633-3590 (Miami Headquarters)

APPENDIX D
Emergency Procedures for Exposure to Hazardous Materials/Waste

ATTACHMENT D

EMERGENCY PROCEDURES FOR EXPOSURE TO HAZARDOUS MATERIALS/WASTE

1. Call ambulance or transport individual to hospital/clinic immediately. Don't forget to take the HASP with you; it contains information on the contaminants expected to be found on site and will assist the physician in his/her assessment of the exposure.

2. Fill in Potential Exposure Report, answering each of the questions to the best of your ability.

3. Contact our physician(s) at EMR as soon as possible. The procedure is as follows:

    a. **Call EMR at 1-800-229-3674**

    b. Ask to speak with:

    Dr. David L. Barnes;
    Dr. Elaine Theriault; or
    Ms. T.J. Wolff, R.N.

Note: During non-business hours (after 6 p.m.) call 1-800-229-3674 and follow directions for paging the aforementioned individuals.

4. Once in contact with any of these individuals, explain what has happened (they will review the information on the form with you and may ask you to fax the form to them, if possible), and allow either of them to speak with the attending physician.

5. When asked about payment (and they will ask), inform the Hospital/Clinic/Physician that this is a "work related injury" and have them contact Ms. Patty Anderson at (412) 269-4658. Have invoices sent to:

    Michael Baker Jr. Inc.
    Attn: Benefits Coordinator
    Airside Business Park
    100 Airside Drive
    Moon Township, PA 15108

6. Contact the Project Manager and the Project Health and Safety Officer as soon as it is feasible, but wait no longer than 24 hours.