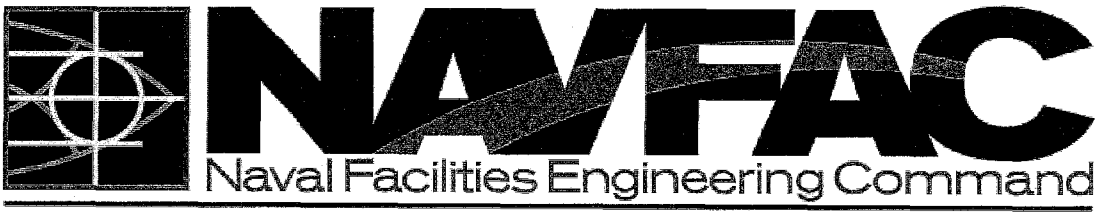
12/1/04-1323

Final

Step 4 Work Plan
Ecological Risk Assessment
Upper Reaches of Bousch Creek

Naval Station Norfolk
Norfolk, Virginia



Prepared for

Department of the Navy
Naval Facilities Engineering Command Atlantic

Contract No. N62470-02-D-3052
CTO-0066

December 2004

Prepared by

CH2MHILL

12/1/04-1323

Final

Step 4 Work Plan
Ecological Risk Assessment
Upper Reaches of Bousch Creek

Naval Station Norfolk
Norfolk, Virginia

Contract Task Order 066

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

LANTDIV CLEAN III Program
Contract No. N62470-02-D-3052

Prepared by

Herndon, Virginia

December 2004

Contents

Appendixes

Tables

Figures

Acronyms and Abbreviations

AVS/SEM	Acid Volatile Sulfide/Simultaneously Extracted Metal
BERA	Baseline Ecological Risk Assessment
BTAG	Biological Technical Assistance Group
CAL	Camp Allen Landfill
CAP	Corrective Action Plan
CASY	Camp Allen Salvage Yard
CLEAN	Comprehensive Long-Term Environmental Action - Navy
CLP	Contract Laboratory Program
COC	Chemical of Concern
COPC	Chemical of Potential Concern
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
ERA	Ecological Risk Assessment
FSP	Field Sampling Plan
ft	feet
GIS	Geographical Information Systems
GPS	Global Positioning System
HASP	Health and Safety Plan
HQ	Hazard Quotient
IDW	Investigation-Derived Waste
IR	Installation Restoration
IRI	Interim Remedial Investigation
LOAEL	Lowest Observed Adverse Effect Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NOAEL	No Observed Adverse Effect Level
NSN	Naval Station Norfolk
ORP	Oxidation Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation

SERA	Screening Ecological Risk Assessment
SOP	Standard Operating Procedure
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USEPA	U.S. Environmental Protection Agency
VPDES	Virginia Pollution Discharge Elimination System
WP	Work Plan

SECTION 1

Introduction

This Work Plan (WP) describes additional ecological risk investigations of the sediment and surface water in Bousch Creek, as associated with Site 1 (Camp Allen Landfill), located at Naval Station Norfolk (NSN), Norfolk, Virginia (Figure 1-1). The general background and physical setting of NSN is described in Sections 3 and 4 of the Master Project Plan (CH2M HILL 1997a, 1997b). This WP is based upon the previous investigations in Bousch Creek and presents the scope of work for an additional investigation as part of Navy Contract N62470-02-D-3052, Comprehensive Long-Term Environmental Action - Navy (CLEAN), District III, Contract Task Order - 0066. The approach for this WP was jointly scoped with the NSN Tier I Partnering Team and the Region III Biological Technical Assistance Group (BTAG) in April 2004.

The primary purpose of this investigation is to provide additional data with which to refine previous (Steps 1-3) ecological risk estimates (CH2M HILL 2004) from potential exposures to chemicals associated with Installation Restoration (IR) related activities in the sediment and surface water of designated areas (see Section 3.1) of Bousch Creek. This investigation focuses on Steps 4 through 7 of the ecological risk assessment (ERA) process for the upper reaches[1] of Bousch Creek as related to Site 1 (Camp Allen Landfill). This WP constitutes Step 4 of the ERA process. Once the data outlined in this WP 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 sediments to aid the risk management decision-making process.

The components of the Step 4 studies, as outlined in this WP, will provide multiple lines of evidence on which to evaluate potential ecological risks or existing ecological impacts from exposure to chemicals present in creek surface water and 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 these media to conservative, non-facility-specific screening values, and other overly conservative assumptions, which form the basis for screening 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 general objective of this investigation is to provide additional data with which to refine previous ecological risk estimates (CH2M HILL 2004) from potential exposures to chemicals from IR activities associated with Site 1, Camp Allen Landfill (CAL), in Bousch Creek sediment and surface water. The specific objectives of this investigation are to:

[1] The distinction between the upper and lower reaches of Bousch Creek was defined in the Step 3 BERA report (CH2M HILL 2004) and is shown in Section 2, Figures 2-4 and 2-5.

1. **Refine Step 3 Risk Estimates.** Collect additional data, as recommended following Step 3 of the ERA process (CH2M HILL 2004), with which to refine ecological exposure and risk estimates for the exposure pathways, receptors, areas, and chemicals of concern (COCs), as follows:

   a) **Surface Sediment**. Collect surface sediment samples throughout the Bousch Creek system (upgradient of the culvert to Willoughby Bay) to directly characterize exposure and bioavailability in the upper reaches of the creek and extending into the lower creek reaches to establish a concentration gradient.

   b) **Sediment Cores**. To help evaluate potential vertical transport, 2-foot cores will be collected to sample subsurface sediments at selected locations near the CAL.

   c) **Surface Water**. Collect a limited number of surface water samples from selected areas of the upper and lower creek reaches to evaluate current exposures as the existing data are historical (1997 or older).

   d) **Fish Tissue**. Determine body burdens of COCs in representative fish species to evaluate direct effects to fish communities as well as indirect effects to upper trophic level pisivorous wildlife receptors.

   e) **Reference Conditions**. To help evaluate source attribution and transport, reference conditions will be characterized by sampling areas that are minimally impacted by IR-related activities.

2. **Directly Assess Potential Sediment Toxicity.** Collect data with which to directly assess potential toxicity of creek sediments to representative ecological receptors.

3. **Assess Biological Communities.** Collect data to directly assess the biological communities present in the creek and to more quantitatively characterize the habitats present in and adjacent to the creek.

4. **Support Risk Management Decisions.** 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 ERA.

1.2 Work Plan Organization

This WP contains the following sections:

- Section 1 – Introduction
- Section 2 – Site Background
- Section 3 – Sampling Rationale
- Section 4 – Investigation Tasks
- Section 5 – Staff Organization
- Section 6 – Data Evaluation and Reporting
- Section 7 – Estimated Project Schedule
- Section 8 – References

As applicable, this WP references previous regulatory-approved work plans and related documents. Any addenda to referenced documents, including Standard Operating Procedures (SOPs), are included as appendices to this WP. This sampling program builds upon the results of previous sampling in Bousch Creek.

SECTION 2

Site Background

This section provides a description of the Bousch Creek system and summarizes relevant data from previous investigations.

2.1 Site Description

Bousch Creek is located entirely on NSN, however off-site runoff from Terminal Boulevard and the Glenwood Park Neighborhood, located to the southwest of the creek, drain into Bousch Creek. Additionally, groundwater discharges associated with the petroleum, oil, and lubricants remediation program also discharge into Bousch Creek. The creek channel has been significantly altered from historic conditions and most of the bordering vegetated wetlands have been filled as part of facility development. Currently, portions of the creek are lined or walled with concrete. The creek has been channelized over most of its length and it flows through underground culverts over part of its length. The headwaters of the creek consist of two branches, the eastern branch, which flows west past the northern edge of the CAL, and the western branch, which flows west and then north along the southern and western edges of the CAL (Figure 2-1). Several small tributaries enter the western branch from the west. The two branches merge near the northwestern edge of the CAL. The creek then flows north (the creek channel is lined with concrete in this reach), then west, and then north again for about 2,000 feet before entering an underground culvert that traverses the overrun portion of the airfield runway. Three principal tributaries enter the creek from the west and one enters (through an underground pipe) from the east within this reach (Figure 2-1). Just downgradient of where Bousch Creek emerges from the concrete culvert, a tributary enters the creek from the west. The creek then flows north, then east, and then south before entering a 3,900-foot underground culvert. Before the creek turns south, two tributaries that drain parking lots and commercial development enter the creek from the north. The downgradient end of the 3,900-foot culvert is the creek's outfall to Willoughby Bay (Outfall 115).

Twenty-nine outfalls discharge directly to Bousch Creek between its headwaters near the CAL and its confluence with Willoughby Bay. Most of these outfalls carry storm water runoff not associated with a regulated industrial activity. Some of these outfalls carry storm water runoff from airfield and vehicle maintenance activities. Only one of the 29 Bousch Creek outfalls is associated with industrial drainage, outfall 408 (Figure 2-1). Outfall 408 is permitted under the Virginia Pollution Discharge Elimination System (VPDES) program but monitoring is not required. This outfall is associated with storm water runoff and industrial drainage from the LP area of the facility. Principal activities associated with the LP area included aircraft maintenance hangers (Buildings LP-20 and LP-22), which are now vehicle maintenance facilities, and fuel storage facilities. Contaminated groundwater in this area is being addressed under several Corrective Action Plans (CAPs), which include free product recovery and monitoring.

Available data suggest that most of the complex of remnant tributaries that comprises the Bousch Creek system is influenced by the daily tides. Exceptions include most of the eastern branch of the creek, the extreme upper portions (east of Ingersoll Street) of the western creek branch, and the upper portions of the four tributaries that enter the main creek channel from the west. Salinity is highest in the lower portions of the creek complex (15 to 18 parts per thousand) with the headwater areas (not regularly influenced by daily tidal flow) generally consisting of fresh water. The salinity in the system also fluctuates based upon the point in the tidal cycle and the amount of freshwater input from precipitation events due to runoff.

Substrate type is somewhat variable within the creek system but most sediments are composed of silt-clay, are soft and dark, are rich in organic matter (especially in the wetland areas), and give off a sulfide odor when disturbed. A few areas near roads are composed of mostly sand and are low in organic matter. Sediments in some areas of the creek had strong petroleum odors and released a visible sheen when disturbed. This typically occurred only in samples taken near the runway and near roadways (e.g., I-564).

Periodically mowed grasses and other herbaceous plants cover most of the undeveloped area on and immediately surrounding the CAL (Area A). The surrounding upland areas support a variety of trees, shrubs, and a number of woody vines. Mixed coniferous/ deciduous woods are located on the western side of Bousch Creek and the adjacent wetlands (Figure 2-2). A wooded area, an open area, and a small pond border CAL Area B. The wooded area consists of a variety of trees with the ground layer dominated by several species of woody vine. The pond contains several aquatic plant species and is bordered by a mixture of shrubs and small trees. The U.S. Army Corp of Engineers has indicated that the pond is not classified as a jurisdictional wetland. The pond is very small and has minimal functions and values. Grasses dominate the open areas of CAL Area B.

In the drainage ditch to the west of CAL Area A and the surrounding wetlands, cordgrass and common reed are the dominant plant species. At elevations above the wetland (e.g., along the banks of the railroad right-of way), trees and shrubs are well mixed. Woody vines are common including Japanese honeysuckle, Virginia creeper, poison ivy, trumpet creeper, and common greenbrier. The edge of the mowed field atop the landfill includes common reed, along with grasses and other herbaceous plants. On the western side of Bousch Creek and the adjacent wetlands, a clear transition from open ground through woody edge to mixed coniferous/deciduous woods was observed. Residential development is the dominant land use south and west of the creek channel/wetlands near CAL Area A.

In the vicinity of CAL Area B, a wooded border occurs along most of the eastern creek branch and is dominated by a variety of tree species. Woody vines dominate the ground layer of this wooded border. Sweetgum, red mulberry, shining sumac, smooth sumac, and blackberry were found within the shrubby border of the pond. Black locust, black willow, and blackberry were found around the open border of the pond, but this area is dominated by grasses. Aquatic vegetation in the pond includes pondweed, spike rush, duckweed, and water pennywort. The Camp Allen Salvage Yard (CASY) currently consists of an open area covered with planted grasses.

North of the railroad tracks and west of the main creek channel is a fairly extensive area of forested and scrub-shrub wetland (Figure 2-3). This area is traversed by several small channels that connect to the creek. East of the creek in this area, habitats are mostly upland

forest. Areas north of the runway along the creek consist of a combination of open fields and early successional forested/shrubby areas. Further north are developed areas, mostly commercial buildings and parking lots. Along the I-564 corridor, the vegetation along the creek consists mostly of regularly mowed grass.

2.1.1 Biota

Data on the wildlife use of the area are mostly limited to surveys conducted during the 1994 Remedial Investigation (RI) for the CAL. Most of the species observed during these surveys are common to suburban settings. Small fish have been observed in the middle and lower reaches of Bousch Creek. The fish community in Bousch Creek is likely composed of species that feed on macroinvertebrates, detritus, and/or plankton. Resident species that might be expected in Bousch Creek include mummichogs and larger species such as bream and catfish. The presence of the 3,900-foot underground culvert connecting Bousch Creek to Willoughby Bay has likely discouraged the routine passage of the larger estuarine fish species like flounder and weakfish, as well as other marine biota such as blue crabs, into the upper reaches of Bousch Creek. In addition, most of the upper reaches of the creek lack water during low tide, limiting their use by fish.

Benthic macroinvertebrates were sampled in tidally and non-tidally influenced areas adjacent to the CAL in 1995. Two stations (BC01 [BC-SD92-B02] and BC02 [BC-SD92-B03]) were located within the CAL Area B pond (Figure 2-5), with a third station (BC03 [BC-SD92-A26]) located in the eastern branch of the creek downstream of the pond. At all three of these locations, the water had a negligible velocity, and the substrate was primarily sand covered with some silt and organic debris. Two stations (BC04 [BC-SD92-A05] and BC05 [BC-SD92-A11]) were located within the tidally influenced portion of the creek west of CAL Area A. The creek channel at one of the tidally influenced stations (BC04, located in the channel between CAL Area A and the emergent wetland area west of CAL Area A) was about four times wider than the station (BC05) that was located further upstream. Between each of these sampling locations, there were slight differences in the habitat, including sediment grain size, water depth, and water temperature. At each of the stations, the benthic macroinvertebrate community was dominated by freshwater oligochaetes (Tubificidae) and insects in the family Chironomidae. The presence of large numbers of tubicid worms is an indicator of organically enriched bottom sediments. Gastropods were reasonably common at the two pond stations. Other types of organisms, such as the nereid and spionid polychaete worms (which are typical estuarine species), were only observed at Stations BC04 and BC05, which is expected based upon the observed salinity at the five stations.

2.1.2 Site Hydrology

Shallow groundwater is typically encountered at depths of approximately 4 to 6 feet below ground surface in the area of the CAL. However, the groundwater extraction and treatment system currently operating at the CAL prevents this shallow groundwater from discharging directly to the creek.

2.2 Previous Investigations

2.2.1 Summary of Available Analytical Data

A number of sampling events have been conducted in the Bousch Creek system, which mostly center on the CAL and the CASY. The first known event for which analytical data are available is the Confirmation Study conducted by Malcom Pirnie in April 1987, during which four surface water samples were collected from Bousch Creek during each of four sampling events (December 1983, August 1984, April 1986, and June 1986).

An Interim Remedial Investigation (IRI) of the CAL was conducted in 1991. During these IRI studies, sediment and surface water samples were collected at each of 12 locations in Bousch Creek. The data from this event have not been validated. Three rounds of data (April, June, and December) were collected during 1992 as part of the RI for the CAL. Sixteen surface water and 34 sediment samples (27 shallow [0 to 6 inches] and 7 deep [6 to 12 inches]) were collected during Rounds 1 and 2, and five sediment samples (all shallow) were collected during Round 3. In August and September 1993, eight surface water, 13 surface (0 to 3 inches) sediment, and eight subsurface (24 to 30 inches) sediment samples were collected along tributaries of Bousch Creek adjacent to the CD Landfill as part of the RI for that site.

Data were collected in February and March 1997 to support a Screening ERA (SERA) for Bousch Creek, as related to the CAL. Data included 30 surface water samples (collected during low and high tides at each of 15 locations) and 15 shallow (0 to 4 inch) sediment samples. Similarly, data were collected in November 1999 to support the Step 3 Baseline ERA (BERA) for Bousch Creek. Data from this event were limited to sediments and included 25 shallow (0 to 6 inches) and 4 deep (6 to 18 inches) samples.

Several limited sampling events in Bousch Creek have also been conducted at the CASY, where a 36-inch underground storm line to Bousch Creek traverses the yard. Two surface water and two shallow (0 to 4 inches) sediment samples were collected in August 1996 from two catch basins located within the underground storm line. Four additional sediment samples were collected in June 1999 at four catch basins within the storm line; these 1999 data have not been validated. Finally, three shallow (0 to 4 inches) sediment samples were collected in and around the salvage yard pond in December 1998.

The location of previous surface water and sediment samples within the Bousch Creek system are shown on Figures 2-4 and 2-5, respectively.

2.2.2 Summary of Previous ERAs

Two previous ERAs have addressed part (Baker 1995) or most (CH2M HILL 1998) of the Bousch Creek system. These ERAs are briefly summarized in the following subsections.

2.2.2.1 1995 ERA

Baker (1995) prepared a baseline ERA in support of the RI at the CAL (both Areas A and B). The Baker ERA evaluated terrestrial habitats (soils) on and near the CAL and the portions of Bousch Creek (surface water and sediment) directly bordering CAL Area B and the northern portion of CAL Area A. The evaluation in Bousch Creek was limited to five locations, two in the CAL Area B pond, one in the eastern branch of the creek, and two on the western side of

the CAL Area A landfill. The evaluation included a comparison of chemical concentrations in surface water and sediment to literature-based screening values, and biological surveys. Benthic macroinvertebrate sampling was performed at each of the five locations. Observations of aquatic and terrestrial flora and fauna were performed adjacent to invertebrate sampling stations.

In surface water, exceedances of screening values occurred for several metals (chromium, copper, iron, lead, mercury, and zinc), pesticides (dieldrin, endrin, and gamma-chlordane), and polychlorinated biphenyls (PCBs) (Aroclor-1254). In sediment, exceedances of screening values occurred for nine metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), six pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endrin, and gamma-chlordane), two PCBs (Aroclor-1254 and Aroclor-1260), and fluoranthene. The ERA concluded that benthic macroinvertebrate communities may have been potentially impacted by both contaminants and physical factors.

2.2.2.2 1998 Screening ERA

In 1997, additional surface water and sediment data were collected from the Bousch Creek system. These data were evaluated in a draft 1998 SERA report. The 1997 sampling and 1998 draft SERA were designed to address comments received from the Region III BTAG on the 1995 ERA. The SERA focused on the conditions in Bousch Creek.

The general objective of the SERA was to evaluate the potential risks to ecological receptors from exposure to chemicals present in Bousch Creek that could be attributed to the CAL. The SERA built upon the results of the 1995 ERA but focused on the surface water and sediments of Bousch Creek. Terrestrial habitats and groundwater were not evaluated in the 1998 SERA.

The SERA described the site, the nature and extent of contamination, contaminant fate and transport mechanisms, mechanisms of toxicity, potential exposure pathways, exposure estimates (food web), and screening-level risk calculations. A discussion of the uncertainties associated with the SERA was also included in the draft SERA report as were site-specific conclusions based upon the results of the SERA.

The assessment was based upon data from 30 surface water and 15 sediment samples collected in 1997 from 15 locations within the Bousch Creek system. Data from these samples were compared to BTAG Region III screening values to identify Chemicals of Potential Concern (COPCs).

For sediment, 24 chemicals were identified as COPCs (28 additional chemicals did not have available screening values). There was at least one exceedance of a screening value at all 15 sampling locations. For surface water, eight chemicals (all metals) exceeded screening values and were retained as COPCs; 10 additional chemicals did not have available screening values. Food web modeling using nine receptor species was also conducted based upon the surface water and sediment data. Hazard quotients based upon maximum media concentrations exceeded one for at least one receptor and 18 inorganics, three pesticides, and nine semivolatile organic compounds (SVOCs).

The SERA recommended that additional sediment samples from Bousch Creek be collected and that the ERA process proceed to the first step (Step 3) of the BERA. Additional sediment data were collected from Bousch Creek in November 1999.

Both the 1997 and 1999 data were used in the Step 3 BERA (CH2M HILL 2004), which reiterated ERA Steps 1 and 2 (to reflect the 1999 data) and completed Step 3, to evaluate potential risks in Bousch Creek associated with the CAL.

2.2.3 Summary of the Step 3 BERA

2.2.3.1 Surface Water

The Step 3 BERA concluded that potential risks are possible in portions of the upper reaches of the Bousch Creek system. In these reaches, five metals (aluminum, copper, iron, manganese, and mercury) exceeded surface water screening values based upon mean detected dissolved concentrations. Cadmium, lead, nickel, and zinc also exceeded screening values based upon total, but not dissolved, concentrations. No organic chemical exceeded surface water screening values based upon a detected concentration. Surface water samples from the main creek channel were not available for the lower reaches.

2.2.3.2 Surface Sediment

In sediments from the upper reaches, 11 metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc), four pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin), Aroclor-1260, seven polycyclic aromatic hydrocarbons (PAHs), and two phthalates exceeded screening values based upon mean detected concentrations. The HQ for total PAHs (1.29) exceeded one based upon mean concentrations but was influenced by elevated reporting limits in several 1999 samples. Based only upon detections, the mean HQ for total PAHs was 0.39. The magnitude of the sediment exceedances was low (HQs of 1.5 or less) for barium, mercury, nickel, selenium, and several of the PAHs. The frequency of detection was five percent or less for dieldrin, acenaphthylene, and butylbenzylphthalate. A comparison of sediment concentrations for non-polar organic chemicals to equilibrium partitioning-based sediment values, which provide a measure of bioavailability, suggests that potential exposures and risks are limited for organic chemicals. Only mercury exceeded (based upon Lowest Observed Adverse Effect Levels [LOAELs]) ingestion screening values for mean food web exposures in the upper creek reaches. These exceedances were limited to the two piscivorous avian receptors (great blue heron and belted kingfisher); HQs were less than two.

The frequency and magnitude of sediment exceedances in the lower reaches of the Bousch Creek system were much lower relative to the upper reaches. Three metals (arsenic, cadmium, and selenium), five pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, and gamma-chlordane), two PAHs, and diethylphthalate exceeded screening values based upon mean detected concentrations. The HQ for total PAHs (1.13) exceeded one based upon mean concentrations but was influenced by elevated reporting limits in several 1999 samples. Based only upon detections, the mean HQ for total PAHs was 0.20. Data from four 1999 subsurface sediment samples collected from the lower reaches of the creek showed very similar exceedance magnitudes relative to surface sediment samples.

The magnitude of the sediment exceedances in the lower reaches was low (HQs of two or less) for arsenic, selenium, and the SVOCs. A comparison of sediment concentrations for non-polar organic chemicals to equilibrium partitioning-based sediment values, which provide a measure of bioavailability, suggests that potential exposures and risks are limited for these organic chemicals in the lower reaches. No chemical exceeded (based upon LOAELs) ingestion screening values for mean food web exposures.

The Bousch Creek system has been significantly altered (channelized) from its original state and currently provides limited habitat values for most ecological receptors. Most of the existing habitat values are provided by the few remaining vegetated wetland areas. Major remedial and removal projects have been completed, or are in progress, at major source areas (CAL, CASY, and the CD Landfill) in the upper portions of the Bousch Creek system. Therefore, potential contaminant migration pathways from these sources to Bousch Creek have been, or soon will be, eliminated. A qualitative analysis of spatial trends suggests that chemicals have not migrated far from source areas in the upper creek reaches in significant quantities and that the concentrations of chemicals generally decrease going downstream. In general, the highest sediment concentrations were associated with CASY and the portion of Bousch Creek immediately north of CAL, while the lowest concentrations were generally associated with the lower portions of Bousch Creek furthest from CASY and CAL. Generally, metal concentrations were similar in surface and subsurface sediment samples, concentrations of pesticides and PCBs tended to be higher in subsurface samples, and PAHs tended to be higher in surface samples.

2.2.3.3 Recommendations

The Step 3 BERA recommended that the ERA process continue and focus on the pathways, receptors, chemicals, and areas where the BERA indicated that potential risks are possible. Thus, the recommended focus was on metals in the sediments of the upper creek reaches.

2.3 Baseline Problem Formulation (Step 3B)

The baseline problem formulation (CH2M HILL 2004) is a revision of the screening problem formulation and is focused on better defining the key pathways, chemicals, and receptors that may be driving potential risks. This section summarizes the baseline problem formulation, which refines the conceptual model and endpoints from the SERA to reflect the results of the Step 3A evaluation.

2.3.1 Refined Conceptual Model

Information on the habitat features of the Bousch Creek system, the fate and transport mechanisms of the COCs, and the key exposure pathways and receptors were used to refine the conceptual model. The refined conceptual model used the results of the Step 3A evaluation and addresses complete transport and exposure pathways, key receptors, assessment endpoints, and risk hypotheses.

2.3.1.1 Transport Pathways

A transport pathway describes the mechanisms whereby chemicals may be transported from a source of contamination to ecologically relevant media. Source-related chemicals in

surface water and sediment may have been transported, historically, via surface runoff, seeps, and groundwater, although these are expected to be minor pathways, currently, due to past and on-going remedial actions at source areas.

2.3.1.2 Exposure Pathways

An exposure pathway links a source of contamination with one or more receptors through exposure via one or more media and exposure routes. Exposure, and thus potential risk, can only occur if complete exposure pathways exist. Based upon the results of the Step 3A evaluation, the critical exposure pathways include:

- Direct exposure of lower trophic level wetland receptors to metals (primarily cadmium), pesticides, and PAHs in the sediments of the lower creek reaches. Pesticide and PAH exposures and risks are likely to be minimal when bioavailability factors are considered.
- Direct exposure of lower trophic level wetland receptors to metals (particularly copper and manganese) in the surface waters of the upper creek reaches. These potential risks may no longer reflect current exposures given the historical nature (collected in 1997) of existing surface water samples.
- Direct exposure of lower trophic level wetland receptors to metals (particularly arsenic, cadmium, chromium, copper, lead, silver, and zinc), pesticides, and PAHs in the sediments of the upper creek reaches. Pesticide and PAH exposures and risks are likely to be minimal when bioavailability factors are considered.
- Indirect exposure (via food webs) of upper trophic level picivorous birds to mercury in the sediments of the upper creek reaches.

2.3.1.3 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. Proposed assessment and measurement endpoints for the Step 4 investigation are shown in Table 2-1. The assessment endpoints are as follows:

1. *Survival, growth, and reproduction of benthic invertebrate communities* - Benthic invertebrates serve as the prey base for many aquatic species. Bousch Creek will support fewer fish and other aquatic animals if chemical contamination is limiting the survival, growth, or reproduction of the benthic invertebrate community.
2. *Survival, growth, and reproduction of fish communities* - Fish may receive substantial exposure to chemicals in surface water and sediments, and are an important prey base for higher order predators.
3. *Survival, growth, and reproduction of piscivorous bird 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 source-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 are:

1. Are chemical concentrations in surface water and/or sediment high enough to impair the survival, growth, or reproduction of the benthic infaunal and epifaunal invertebrate communities to the extent that the prey base to support aquatic predators is affected?
2. Are chemical concentrations in surface water and/or sediment high enough to impair the survival, growth, or reproduction of fish communities to the extent that the prey base to support aquatic piscivores is affected?
3. Are chemical concentrations in surface water and/or sediment high enough to adversely effect the survival, growth, or reproduction of piscivorous bird populations?

SECTION 3

Sampling Rationale

Step 4 of the ERA process establishes the measurement endpoints, the study design, and data quality objectives (DQOs) for the additional investigations necessary to complete the ERA. The Step 4 studies are designed to address areas identified, in earlier steps of the ERA process, as having the highest degree of uncertainty, to fill identified data gaps, and to refine risk estimates.

The proposed components of the Step 4 studies, as outlined in this WP, will provide multiple lines of evidence on which to evaluate potential ecological risks or existing ecological impacts from exposure to chemicals present in Bousch Creek surface water and sediment, as related to the CAL. These lines of evidence are facility-specific, direct measures of potential ecological effects and are thus preferable to the comparison of chemical concentrations in these media to conservative, non-facility-specific screening values, and other overly conservative assumptions, which form the basis for screening 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.

The following field investigation tasks will be conducted as part of the Step 4 studies:

- Collection of surface water, sediment, and fish tissue samples.
- Conduct of semi-quantitative biological surveys in wetland/aquatic habitats.
- Collection of split sediment samples for laboratory-based toxicological testing.
- Selection of suitable aquatic reference areas, and collection of sediment samples (for toxicological testing) and conduct of biological surveys at these reference areas.
- Surveying of sampling locations.

This work plan describes the data collection activities associated with the Step 4 sampling.

3.1 Spatial Area

The principal IR-related potential source areas to Bousch Creek upgradient of the 3,900-foot underground culvert are the CAL (the focus of this ERA), the CASY, and the CD Landfill. Bousch Creek also receives runoff from a number of storm water outfalls that drain portions of the facility, such as the airfield, as well as off-base locations.

As discussed and agreed to at the March 2002 and April 2004 partnering meetings, the focus of the investigation will be on the upper portions of the creek system proximate to the CAL. Portions of the lower creek will be included to evaluate fate and transport and to provide a gradient of chemical concentrations in sediments (lines of evidence). Specifically, the spatial scope of the ERA will be limited as follows:

- The downgradient spatial extent of the Bousch Creek ERA, in terms of quantitative risk evaluation, will be the upgradient end of the 3,900-foot culvert connecting Bousch Creek to Willoughby Bay.
- The CASY remediation will address any potential ecological risks in the portion of Bousch Creek east of Ingersol Street. Thus, the portion of Bousch Creek located east of Ingersol Street will not be quantitatively addressed in the ERA.
- The CD Landfill remediation will address any potential ecological risks in the tributary channel leading from the CD Landfill to Bousch Creek. Thus, the ERA will only evaluate, quantitatively, the portion of this channel immediately adjacent to the main Bousch Creek channel.

The spatial extent of this investigation is reflected in the study objectives (see Section 1.1) as well as in the placement of the proposed sampling locations (Figure 2-6).

3.2 Sampling Rationale

Analyte selection was based upon the COCs identified in the Step 3 BERA (metals, PCBs, pesticides, and PAHs; Table 3-1), with the addition of bioavailability indicators (pH, total organic carbon [TOC], grain size, and acid volatile sulfide/simultaneously extracted metal [AVS/SEM] in sediment). Table 3-2 lists the proposed number of samples by medium and outlines the proposed analytes and analytical methods. Proposed sampling locations are shown on Figure 2-6. Table 3-3 summarizes the rationale for sample placement. In addition, a technical memorandum detailing the site visits wherein the sample locations were jointly-scoped with a BTAG representative is provided in Appendix A. Appendix A also provides a photograph and a table describing each sampling location. The precise number of samples, and their location, may be adjusted based upon conditions encountered in the field at the time sampling is conducted.

SECTION 4

Investigation Tasks

The tasks to be implemented for this investigation include existing data review, field investigation (sampling and analysis of sediment, surface water, and fish tissue; toxicity testing; and biological surveys), sample analysis and data validation, data evaluation, and report preparation. Specific procedures will be addressed in task-specific project instructions.

To simplify the process of developing site-specific project plans, a Master WP, Master Field Sampling Plan (FSP), Master Quality Assurance Project Plan (QAPP), and Master Health and Safety Plan (HASP) have been prepared for NSN (CH2M HILL 1997a, 1997b). The Master Project Plans provide the details for sampling and analysis protocols to be followed and general types of activities to be accomplished for implementing the field activities at NSN. This document will supplement the Master Plans with site-specific information for the Bousch Creek ERA. Table 4-1 lists the applicable SOPs for this WP. These SOPs are provided in Appendix B. In addition, a site-specific HASP (Appendix C) has been prepared to address activity-specific precautions related to this investigation.

4.1 Data Quality Objectives

As defined by USEPA, the DQO process is 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 tolerable 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 1994, 2000a, 2000b):

- Step 1 - State the problem
- Step 2 - Identify the decision
- Step 3 - Identify the inputs to the decision
- 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 DQO process is a tool used to determine the type, quantity, and quality of data needed to support project objectives. The purpose of the DQO process is to ensure that the type, quantity, and quality of data used in decision-making will be appropriate for estimating potential ecological risks. The DQO process was qualitatively applied to this study, with the general DQOs associated with the ERA outlined in Table 4-2. The DQO process has been compressed to fit project objectives. General DQOs for analytical methods are discussed in the Master QAPP.

4.2 Existing Data Review

This task includes the review of existing data from previous investigations (summarized in Section 2) and verification of their usability. Historical analytical results will be reviewed to assess data validity. Laboratory analytical methods, quantification limits and detection limits, and quality assurance protocols used in previous investigations will be reviewed to ensure appropriate data quality. Historic analytical data that do not meet the appropriate data quality objectives, as measured by the degree of precision, accuracy, representativeness, comparability, and completeness (as defined in the Master QAPP), will not be considered usable, quantitatively, but may be considered in a qualitative manner.

4.3 Field Investigation

The field investigation involves efforts related to field work support, the field investigation and sampling event, sample designation, surveying, and investigation-derived waste (IDW).

4.3.1 Field Work Support

Field work support includes subcontractor procurement, mobilization, and demobilization. (see Section 5.2 of the Master WP). As part of field work support, CH2M HILL will procure: (1) an analytical laboratory; (2) a third-party, independent validator; (3) a toxicology laboratory; (4) a taxonomic laboratory; and (5) IDW disposal services. Equipment and supplies will be brought to the site when the CH2M HILL field team mobilizes for field activities. Demobilization activities will consist of general site restoration prior to the return transport of field equipment and crew.

4.3.2 Field Investigation and Sampling Activities

Field investigation activities are discussed in Section 5.3 of the Master WP and in the Master FSP. Applicable SOPs are listed in Table 4-1. The media sampled, number of samples, sample placement, and analytes proposed for the investigation are based upon the results of previous analytical sampling, the results of the Step 3 BERA, discussions with the Tier I Partnering Team in January and April 2004, and a field reconnaissance with BTAG conducted on August 27, 2004.

4.3.2.1 Habitat Characterization

Habitat types in areas bordering the main creek channel, especially wetland areas, will be characterized in terms of the vegetation present and habitat structure. Habitat/channel characteristics within the main creek channel and main tributaries will also be characterized, including:

- The hydrology of Bousch Creek (e.g., channel volume, substrate, and flow)
- Water depth (to the nearest cm) using a meter stick or a weighted, graduated line
- Channel width, estimated visually
- Point in tidal cycle
- Depth of the redox boundary (sediment), estimated visually or using a redox probe

A visual description of the sediment samples, including sediment color, particle size distribution, and odors will be logged. Weather conditions and habitat characteristics at each sampling location will be noted in the field book, and digital photographs will be taken of each collection site.

Provided that sufficient water is present, the following field measurements will be taken at each sampling location in the creek:

- Water temperature
- Water pH
- Conductivity
- Salinity
- Turbidity
- Dissolved oxygen
- Oxidation reduction potential (ORP)

Readings will be taken at just below the water surface and again at just above the sediment surface (if water depth exceeds 0.5 m). If water depth exceeds 1 m, readings will also be taken at mid-depth. These parameters will be measured using a water quality meter or equivalent device following the SOP in Appendix B.

4.3.2.2 Sediment Sampling

Surface sediment samples (0 to 4 inches) will be collected at 20 primary locations (including three reference locations; Figure 2-6) and analyzed for Target Analyte List (TAL) metals, Target Compound List (TCL) pesticides/PCBs, PAHs, ammonia, pH, TOC, grain size analysis, and AVS/SEM. An additional set of eight surface sediment samples (secondary locations) will be analyzed for a select list of analytes (Aroclor-1260, 4,4'-DDE, silver, and chromium). To help evaluate potential vertical transport, sediment cores (2 feet long with samples collected every 6 inches) will be collected to sample subsurface sediments at five of the 28 primary and secondary sediment sampling locations (see Table 3-3) and analyzed for TAL metals, TCL pesticides/PCBs, and PAHs.

Sampling will be conducted starting with the most downgradient location and working upgradient (i.e., against the direction of tidal flow). All surface sediment samples (0 to 4 inches) will be collected using either a hand scoop, a Ponar dredge, or a hand corer with polyvinyl chloride (PVC) sampling tubes. The sampling device used will depend upon water depth and substrate composition with the general order of preference being the hand corer, hand scoop (locations without standing water), and Ponar dredge (locations with deep surface water). All subsurface sediment samples will be collected using a hand corer to allow depth intervals to be determined. A new coring tube will be used at each location sampled with this device. Sampling procedures will follow the general methodologies outlined in the Master FSP (CH2M HILL 1997b) and the SOP for Sediment Sampling (Appendix B). The collected samples (separated by depth interval, as appropriate) will be placed into a stainless steel bowl and thoroughly homogenized following removal of rocks and other debris per the SOP in Appendix B. A visual description (color, texture, etc.) of each sediment sample will also be entered into the field notebook. After homogenization, samples will be placed in the appropriate sample jars and labeled.

Proposed sampling locations are shown on Figure 2-6. These proposed locations may be adjusted, as needed, based upon the field conditions encountered at the time of sampling.

4.3.2.3 Sediment Toxicity Tests

Sediment toxicity tests will be conducted on split surface sediment samples collected for chemical analysis at the 20 primary sediment locations (which include three reference locations). *Leptocheirus plumulosus* (amphipod) will be used for the sediment tests. Test duration is 28 days. Test endpoints are survival, growth, and reproduction (described in more detail in the test SOP; Appendix B). Proposed locations are shown on Figure 2-6. At each sediment location, a large sample volume will be homogenized in the field prior to filling bottles for chemical and toxicological analyses. The SOP for this test is provided in Appendix B.

At the laboratory, sediment samples will be overlain with surface water for the tests. As salinity can affect the results of the test, all samples will be standardized to the same salinity. The target salinity is 10 parts per thousand, which represents a deviation from the standard test SOP to better reflect site conditions. A control will be run for test organisms to ensure that the population used in the toxicity testing is healthy. Good health is demonstrated when the organism's performance meets or exceeds some threshold (documented in the test method SOP). The toxicity testing laboratory will determine the appropriate substrate for control testing, which is documented in the SOP (Appendix B).

4.3.2.4 Surface Water Sampling

Surface water samples will be collected at five (see Table 3-3) of the 20 primary sediment locations and analyzed for TAL metals (total and dissolved), hardness, total suspended solids (TSS), and total dissolved solids (TDS). Surface water samples will be collected during an outgoing tide with downgradient locations sampled first to avoid disturbing the water column and sediment. Samples will be taken so to minimize turbidity and prevent foreign material from affecting the surface water sample. Samples will be taken at mid depth by immersing the sample bottle or, if the water is too deep, using a pump with an attached, weighted plastic tube or a device such as a Kemmerer bottle.

Table 3-2 lists the proposed number of surface water samples and outlines the proposed analytes and analytical methods. Proposed sampling locations are shown on Figure 2-6. These proposed locations may be adjusted, as needed, based upon the field conditions encountered at the time of sampling.

4.3.2.5 Biological Surveys

Although organisms may be exposed to chemicals in their natural environment, these exposures will not necessarily lead to adverse impacts. Direct measures of potential adverse impacts to biological communities are thus useful to quantify or confirm any risks that are predicted in an ERA. These data can also help interpret and confirm the results from laboratory-based toxicity testing.

For the Step 4 investigation, qualitative surveys of the benthic invertebrate community will be conducted at each of the 20 primary sediment sampling locations. Samples will be collected with a Ponar dredge and/or dip net and sieved using a No. 30 (500 micron) sieve bucket. Material retained by the sieve will be placed in wide-mouth plastic bottles and

preserved with 10 percent formalin. Borax (buffer), Rose Bengal (stain), and any other material specified by the taxonomy laboratory will be added to the preservation solution at concentrations to be specified by the taxonomy laboratory. Sample processing and identification will occur as follows:

- Samples will be picked to separate the organisms from any coarse material (e.g., leaf litter, twigs) present in the sample. Organisms will then be sorted by major taxa and identified. For samples with 100 or fewer organisms, all organisms will be identified and enumerated. For samples with more than 100 organisms, a 100-organism subsample will be randomly selected for identification and enumeration. If the taxonomist, using his best professional judgement, feels that a 100-organism subsample is too small to be representative, a higher number (up to 500 organisms) will be used to define the subsample.
- Organisms will be identified in the laboratory to the lowest practical taxon, generally species.
- Following identification, organisms will be enumerated by taxonomic group and the samples preserved in a 70 percent ethanol solution.

Data on habitat metrics will also be collected at each sampling location.

Concurrent with invertebrate surveys, qualitative surveys of fish will also be conducted from representative creek reaches that will encompass the entire study area (including reference areas). Fish will be collected using methods (nets, traps, etc.) appropriate to the habitat type present. The fish will be identified, enumerated, and measured (length and weight) and gross external morphological exams for lesions and other abnormalities will be conducted in the field. Gender will also be noted if it can be determined, for that particular species, by external examination. This information will be used to determine which species are most representative of the populations present in Bousch Creek.

For other vertebrate animal groups (such as birds, mammals, and reptiles), no quantitative field surveys are proposed. However, qualitative data (incidental observations) will be collected for these organisms during the field program.

4.3.2.6 Fish Tissue Sampling

Ten whole-body tissue samples of representative fish species (determined during the biological surveys) will be collected from the creek). To the degree practicable, the same fish species will be selected for tissue analysis throughout the creek system. Based upon the attributes of the Bousch Creek system, it is anticipated that mummichog (*Fundulus* spp.) will be the dominant fish species and will constitute most, if not all, of the fish tissue samples submitted. The tissue will be analyzed for select metals (arsenic, selenium, cadmium, chromium, copper, lead, zinc, and mercury), TCL pesticides, TCL PCBs, percent moisture, and percent lipids.

Table 3-2 summarizes the number of proposed tissue samples and lists the proposed analytes and analytical methods. The type of tissue samples, and the proposed analytes, were based upon the results of the Step 3 BERA and the refined conceptual model (see Section 2.3). Creek samples will be whole-body fish. The compositing of samples may be necessary to achieve the required tissue mass for analysis. The minimum required tissue

mass for the proposed analytes is 20 grams. However, if large numbers of fish are caught, the laboratory will be provided with several times this minimum mass to provide for any unexpected contingencies. If compositing is necessary, composite samples will be composed of the same species, gender, and age group whenever possible. All samples will be analyzed as whole-body samples; ingesta will not be purged prior to analysis. Species will be selected based upon abundance, with predators emphasized. Size classes will be targeted to those most likely to be consumed by representative upper trophic level receptors, generally 4 to 10 cm. Tissue samples will be frozen using dry ice prior to shipment and packed with dry ice to remain frozen during shipment.

4.3.2.7 Reference Areas

The biologically-based tests/surveys require that samples from areas not known to be impacted by identified contaminant sources, termed reference areas, be collected for comparison to potentially impacted areas. For sediment, no true reference areas exist in Bousch Creek due to tidal flow. Using analytical data from previous investigations at Bousch Creek, three potential reference locations within the Bousch Creek system have been chosen for this investigation (BC-SD04-18, BC-SD04-19, and BC-SD04-20; Figure 2-6). These locations were chosen due to the lack of suitable reference locations from nearby areas outside of the Bousch Creek system.

Reference areas will be used in the evaluation in several ways. For the aquatic biological surveys and the tissue residue analyses, they will serve as an "unimpacted" baseline for areas with similar habitat conditions. For toxicity tests, site samples will be statistically compared to the appropriate reference sample(s), as well as the sample controls, to determine if endpoint measurements (e.g., percent survival) differ significantly using the statistical tests outlined in the toxicity test SOP (Appendix B).

4.3.2.8 Sampling Equipment Decontamination

All non-disposable sampling equipment will be decontaminated immediately after each use in accordance with applicable SOPs included in Appendix B.

4.3.2.9 Sampling Shipping and Chain-of–Custody

Sample shipping and chain-of-custody will follow the procedures specified in Section 3.2 of the Master FSP and Section 6 of the Master QAPP.

4.3.3 Sample Designation

Sampling locations and sampled media collected during the investigation will be assigned unique designations to allow the sampling information and analytical data to be entered into the Geographic Information System (GIS) Data Management system for NSN. The following sections describe the sample designation specifications (also see Section 3.0 of the Master FSP).

4.3.3.1 Specifications for Field Location Data

Field station data consists of information assigned to a physical location in the field where a sample is collected. For example, a soil boring that has been installed will require a name that will uniquely identify it with respect to other soil boring locations, or other types of

sampling locations. The station name provides for a key in the database to which any samples collected from that location can be linked to form a relational database.

A listing of the location identification numbers will be maintained by the field team leader, who will be responsible for enforcing the use of the standardized numbering system during all field activities. Each station will be designated by an alphanumeric code that will identify the station location by facility, site type, site number, location type, and sequential location number. The scheme that will be used to identify the field station data is shown in Table 4-3. Station and sample IDs are provided in Table 3-2. Figure 2-6 shows the location of each station.

4.3.3.2 Specifications for Analytical Data

Analytical data will be generated for the sampled media (sediment, surface water, and fish tissue) at Bousch Creek. Each analytical sample that is collected will be assigned a unique sample identifier. The scheme used as a guide for labeling analytical samples in the field is documented in Section 4.3.3.3. The format that will be used for electronic deliverables from the analytical laboratory and the data validator is discussed in Section 4.3.3.4.

4.3.3.3 Sample Identification Scheme

A standardized numbering system will be used to identify all samples collected during sampling activities. The numbering system will provide a tracking procedure to ensure accurate data retrieval of all samples taken. A listing of the sample identification numbers will be maintained by the field team leader, who will be responsible for enforcing the use of the standardized numbering system during all sampling activities. Sample identification for all samples collected during the investigations will use the following format.

Each sample will be designated by an alphanumeric code that will identify the facility, site, and matrix sampled, and contains a sequential sample number. Quality Assurance/ Quality Control (QA/QC) samples will have a unique sample designation. A summary of the sample identification scheme is presented in Table 4-3.

4.3.3.4 Electronic Deliverable File Format

This effort includes checking the data from the laboratory and converting it into an electronic format that can be readily incorporated into the GIS Data Management system for NSN. An off-site laboratory will analyze the samples and tabulate the results in an electronic format specified by CH2M HILL (Table 4-4). The data validator will add data validation qualifiers to the table of analytical results. In addition to the hard copy data package deliverable, CH2M HILL will receive an electronic file from the data validator in a table format that will facilitate loading into a database (Table 4-4). A summary of the analytical data electronic deliverable format is contained in the Master Data Management Plan. Analytical data must be delivered in Microsoft Excel format.

4.3.4 Surveying

A Global Positioning System (GPS) receiver with 1-m resolution will be used to document the horizontal location of all sediment, surface water, and biological survey locations.

4.3.5 Project Documentation

Field data collection activities will be recorded in a project logbook. Entries will be described at an appropriate level of detail so that the situation can be reconstructed without relying on memory. All logbooks will be kept in the project files.

4.3.6 Investigation-Derived Waste (IDW)

IDW generated during field activities will be containerized in 55-gallon drums for storage. These drums will be properly labeled and stored at a location designated by the Navy prior to disposal. The IDW disposal method will be dependent on the characterization from the analytical results.

4.4 Sample Analysis and Data Validation

CH2M HILL will track sample analysis and obtain results from the laboratory. The analytical data generated during the investigation field program will be validated by an independent data validation subcontractor according to the United States Environmental Protection Agency (USEPA) standard procedures. A detailed discussion of quality control procedures for field investigations at NSN is presented in Section 5.4 of the Master WP.

An independent data validator, using the guidance in the project-specific QAPP, will validate all analytical data. The procedure follows Region III Modifications to the National Functional Guidelines. The QAPP establishes all of the general QA requirements for the investigations and analyses that will occur during the Investigation. The QAPP presents the specific policies, organization, functions and QA/QC activities associated with analytical data. The plan and validation are designed to ensure that the analytical-associated DQOs are achieved.

No data validation is required for the toxicity testing data.

4.4.1 Sample Analysis

All analyses will be conducted at a contracted laboratory that fulfills all requirements of the U.S. Navy's QA/QC Program Manual and USEPA's Contract Laboratory Program (CLP). A signed certificate of analysis will be provided with each laboratory data package, along with a certificate of compliance certifying that all work was performed in accordance with the applicable federal, state, and local regulations. All analyses will be performed following the highest level of Navy guidance. Analyses will include the proper ratio of field QC samples as presented in Table 4-5.

4.4.2 Field Quality Control Procedures

Quality control duplicate samples and blanks are used to provide a measure of the internal consistency of the samples and to provide an estimate of the components of variance and the bias in the analytical process. Quality control samples to be collected during the investigation are summarized in Table 4-5 for each medium.

4.4.3 Data Validation

An independent data validation subcontractor will validate all of the analytical data generated during the field program according to EPA standard procedures. Analytical results for samples requiring the highest level will be validated by CH2M HILL subcontractors approved by the EPA and the Navy. Data validators will use USEPA Region III guidance. Data validation subcontractors from the CH2M HILL BOA list will be secured to perform validation services. Data that should be qualified will be flagged appropriately. Results for QA/QC samples will be reviewed and the data will be qualified further, if necessary. Finally, the data set as a whole will be examined for consistency, anomalous results, reasonableness, and utility.

SECTION 5

Staff Organization

This project will be managed and staffed by CH2M HILL's Virginia Beach and Herndon offices. The CH2M HILL Activity Manager, Ms. Holly Rosnick, will assume primary responsibility for ensuring that the work is performed in a manner that is acceptable to LANTDIV, the Base, and government regulatory agencies. In addition, Mr. Ben Francisco will serve as the CH2M HILL project manager. Mr. Bill Kappleman will serve as the task lead for the ERA. The field work will be performed by CH2M HILL. Dennis Ballam will serve as the Field Team Leader and Site Safety Coordinator. Table 5-1 provides contact information for the key participants in this investigation.

SECTION 6

Data Evaluation and Reporting

6.1 Step 7 BERA Report

The results of the Step 4 investigation, along with the existing data used in the Step 3 BERA, will be evaluated in the Step 7 BERA report. These data will provide multiple lines of evidence which will be used to more fully evaluate the potential risks to ecological receptors in Bousch Creek. These multiple lines of evidence, which are reflected in the measurement endpoints, include:

- **Comparison of surface water and sediment concentrations to screening values** - The data from these samples will be compared to the medium-specific screening values outlined in the Step 3 BERA, updated as appropriate.
- **Comparison of fish tissue concentrations to screening values** - Fish tissue data will be compared to literature-derived tissue residue screening values.
- **Refined food web exposure estimates** - Measured fish tissue concentrations will be used in place of modeled values (from the Step 3 BERA) to refine the food web exposure estimates for the receptors/food web COCs.
- **Evaluation of bioavailability** - Collected data, which will help evaluate the potential chemical-specific bioavailability in abiotic media, include: (1) for sediment, TOC, pH, AVS/SEM, and grain size, and (2) for surface water, dissolved metals, pH, hardness, TDS, and TSS.
- **Toxicity testing** - The results of toxicity testing will help directly determine toxicity and bioavailability of chemicals in surface sediment samples and, if required, can be used to develop chemical- and medium-specific PRGs. Lines of evidence include:
  - *Comparison of biological response between site and reference samples* - Statistical comparison will be conducted for growth, survival, and reproduction endpoints as specified in the test SOP (Appendix B). The tests will determine whether organism performance is significantly different when exposed to sediment collected from the site relative to the reference area. Absence of a significant difference will be a line of evidence supporting minimal risk. Presence of a significant difference will trigger additional evaluation. If no significant different exists and survival is low, the potential reasons for the low survival will be investigated. The performance of reference and control samples will be compared to learn more about the suitability of the reference medium for the test organism. A table will be generated that will show the percent survival in each sample relative to the test-specific threshold level of toxicity. Statistical testing against both the reference and control will be conducted and considered in the risk and uncertainty evaluations.
  - *Existence of patterns in laboratory toxicity testing results with chemical burden and other chemical/physical characteristics of the medium* - If necessary, the data will be reviewed

to determine whether there are relationships between biological response in the toxicity tests and the chemical content of the sediment. This will be done with the use of multiple regressions or other appropriate statistical analyses. Other factors that may be used in the analyses include TOC and grain size adjustments.

- **Biological survey data** - The results of the biological surveys (benthic invertebrates and fish) will help directly determine if impacts are occurring. Data evaluation would consist of a comparison of the benthic invertebrate community present in potentially impacted areas relative to reference areas containing similar habitats. Comparison endpoints (metrics) would consist of parameters such as species diversity and relative abundance.

These multiple lines of evidence will be evaluated in Step 7 using a weight-of-evidence approach within the context of the refined conceptual model. If significant conflicts among these lines of evidence result in uncertain risk conclusions for particular areas or habitats, the risk managers will be provided with all of the lines of evidence and decide a path forward.

6.2 Step 8 Technical Memorandum

Medium- and chemical-specific PRGs, if needed, will be calculated based upon several methods, as appropriate to the specific area and medium: (1) using the results of the toxicity tests (Apparent Effect Threshold approach), and (2) back-calculated from a HQ of 0.99 (based upon the NOAEL-LOAEL range) using food web models. If the resulting PRG is less than a suitable background concentration, the background concentration will be used.

The decision to calculate PRGs for specific media and chemicals will be based upon the results of the Step 7 BERA (i.e., conclusion of unacceptable risk). The rationale, methods, and calculations will be documented in a Step 8 technical memorandum.

SECTION 7

Estimated Project Schedule

The estimated project schedule and due dates of deliverables are summarized in Table 7-1.

SECTION 8

References

Baker Environmental, Inc. 1995. *Revised final baseline risk assessment, Camp Allen Landfill, Norfolk Naval Base, Norfolk, VA.* Prepared for Department of the Navy Atlantic Division Naval Facilities Engineering Command (LANTDIV), Norfolk, VA.

Barnthouse, L.W. and G.W. Suter II. 1996. *Guide for developing data quality objectives for ecological risk assessment at DOE Oak Ridge operations facilities.* Environmental Restoration Division, ORNL Environmental Restoration Program. ES/ER/TM-185/R1.

CH2M HILL, Inc. 2004. *Ecological risk assessment - Upper Reaches of Bousch Creek.* Prepared for the Department of the Navy, Atlantic Division, Naval Facilities Engineering Command. Final. March.

CH2M HILL, Inc. 1998. *Draft ecological risk assessment for Bousch Creek and Camp Allen Landfill.* Prepared for the Department of the Navy, Atlantic Division, Naval Facilities Engineering Command. May.

CH2M HILL, Inc. 1997a. *Final Master Work Plan, Naval Base Norfolk, Norfolk, Virginia.* October.

CH2M HILL, Inc. 1997b. *Final Master Project Plan Volume 2, Naval Base Norfolk, Norfolk, Virginia.* October.

U.S. Environmental Protection Agency (USEPA). 2000a. *Guidance for the data quality objectives process. EPA QA/G-4.* EPA/600/R-96/055.

U.S. Environmental Protection Agency (USEPA). 2000b. *Data quality objectives process for hazardous waste site investigations. EPA QA/G-4HW.* EPA/600/R-00/007.

U.S. Environmental Protection Agency (USEPA). 1994. *Guidance for the data quality objectives process. EPA QA/G-4.* EPA/600/R-96/055.

Tables

Table 2-1 Proposed Endpoints for the Step 4 Investigation *Naval Station Norfolk, Norfolk, Virginia*	
Assessment Endpoint	**Measurement Endpoint**
Survival, growth, and reproduction of benthic invertebrate communities	Comparison of chemical concentrations in surface water and sediment with medium-specific screening values
	Comparison of results of 28-day sediment laboratory toxicity tests (growth, survival, and reproduction) with the amphipod, *Leptocheirus plumulosus*, using site and reference sediment
	Existence of significant correlations between laboratory toxicity test results and concentrations of COCs or other chemical/physical characteristics of sediment
	Comparison of results of invertebrate field surveys in areas proximate to source areas with areas distant from source areas and/or reference areas
Survival, growth, and reproduction of fish communities	Comparison of chemical concentrations in surface water and sediment with medium-specific screening values
	Comparison of results of fish field surveys in areas proximate to source areas with areas distant from source areas and/or reference areas
	Comparison of results of fish tissue residue analyses with literature-based tissue screening values
Survival, growth, and reproduction of piscivorous bird populations	Comparison of modeled dietary intakes using field-collected fish (tissue residues) with literature-based ingestion screening values; ratios >1 based upon the NOAEL-LOAEL range indicate an effect

Table 3-1
Summary of Chemicals of Concern From the Step 3 BERA Report
Naval Station Norfolk, Norfolk, Virginia

Chemical	Surface Water		Sediment		Food Web	
	Upper Reaches	Lower Reaches	Upper Reaches	Lower Reaches	Upper Reaches	Lower Reaches
Metals						
Aluminum	x					
Arsenic			X	x		
Barium			x			
Cadmium			X	x		
Chromium			X			
Copper	X		X			
Iron	x					
Lead			X			
Manganese	X					
Mercury	x		x		x	
Nickel			x			
Selenium			x	x		
Silver			X			
Zinc			X			
Pesticides/PCBs						
4,4'-DDD			x	x		
4,4'-DDE			x	x		
4,4'-DDT			x	x		
alpha-Chlordane				x		
Dieldrin			x			
gamma-Chlordane				x		
Aroclor-1260			x			
Semivolatile Organic Compounds						
PAHs			x	x		

Shaded cells indicate that exposures and risks are likely minimal when bioavailability factors are considered
X - Potential risk drivers
x - Other potential COCs

Table 3-2

Analytical Table for the Step 4 Investigation

Naval Station Norfolk, Norfolk, Virginia

Sample Type	Description	Study Objective (Section 1.1)	Station ID	Sample ID	Medium	Analysis/Method: TAL Metals Method CLP ILM04	TCL Pesticides and PCBs Method CLP OLM04	PAHs Method CLP OLM04	Ammonia Method 350.2	pH Method SW-846 9040B/9045C	Total Organic Carbon Method Lloyd Kahn	Grain Size Method ASTM D422	AVS/SEM Method AVS/SEM April 1991	Aroclor-1260 Method CLP OLM04	4,4'-DDE Method CLP OLM04	Silver Method CLP ILM04	Chromium Method CLP ILM04	TAL Metals (Aq) Total Method CLP ILM04	TAL Metals (Aq) Dissolved Method CLP ILM04	Hardness Method 130.2	Total Suspended Solids Method 160.2	Total Dissolved Solids Method 160.1	Select Metals[1] Method CLP ILM04	Pesticides and PCBs Method CLP OLM04	Percent Moisture Method Percent Moisture	Percent Lipids Method Percent Lipids	Taxonomic Identification N/A	Toxicity Testing 28 Day Bioassay using amphipod[2]
Surface Sediment Sampling	Primary Samples	1a, 1e, 4	NSN-BC-SD04-01	NSN-BC-SD04-01	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-02	NSN-BC-SD04-02	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-03	NSN-BC-SD04-03	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-04	NSN-BC-SD04-04	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-05	NSN-BC-SD04-05	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-06	NSN-BC-SD04-06	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-07	NSN-BC-SD04-07	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-08	NSN-BC-SD04-08	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-09	NSN-BC-SD04-09	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-10	NSN-BC-SD04-10	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-10	NSN-BC-SD04-10P[3]	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-11	NSN-BC-SD04-11	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-12	NSN-BC-SD04-12	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-13	NSN-BC-SD04-13	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-14	NSN-BC-SD04-14	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-15	NSN-BC-SD04-15	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-16	NSN-BC-SD04-16	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-17	NSN-BC-SD04-17	Sediment	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-18	NSN-BC-SD04-18	Sediment (Reference	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-19	NSN-BC-SD04-19	Sediment (Reference	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-20	NSN-BC-SD04-20	Sediment (Reference	X	X	X	X	X	X	X	X														
			NSN-BC-SD04-20	NSN-BC-SD04-20P[3]	Sediment (Reference	X	X	X	X	X	X	X	X														
	Secondary Samples	1a, 1e, 4	NSN-BC-SD04-A	NSN-BC-SD04-A	Sediment									X	X	X	X										
			NSN-BC-SD04-B	NSN-BC-SD04-B	Sediment (Reference									X	X	X	X										
			NSN-BC-SD04-C	NSN-BC-SD04-C	Sediment (Reference									X	X	X	X										
			NSN-BC-SD04-D	NSN-BC-SD04-D	Sediment									X	X	X	X										
			NSN-BC-SD04-D	NSN-BC-SD04-DP[3]	Sediment									X	X	X	X										
			NSN-BC-SD04-E	NSN-BC-SD04-E	Sediment									X	X	X	X										
			NSN-BC-SD04-F	NSN-BC-SD04-F	Sediment									X	X	X	X										
			NSN-BC-SD04-G	NSN-BC-SD04-G	Sediment									X	X	X	X										
			NSN-BC-SD04-H	NSN-BC-SD04-H	Sediment (Reference									X	X	X	X										
Surface and Subsurface Sediment Sampling	Sediment Cores	1b, 4	NSN-BC-SD04-06	NSN-BC-SD04-06-0006	Sediment	X	X	X																			
			NSN-BC-SD04-06	NSN-BC-SD04-06-0612	Sediment	X	X	X																			
			NSN-BC-SD04-06	NSN-BC-SD04-06-1218	Sediment	X	X	X																			
			NSN-BC-SD04-06	NSN-BC-SD04-06-1824	Sediment	X	X	X																			
			NSN-BC-SD04-08	NSN-BC-SD04-08-0006	Sediment	X	X	X																			
			NSN-BC-SD04-08	NSN-BC-SD04-08-0612	Sediment	X	X	X																			
			NSN-BC-SD04-08	NSN-BC-SD04-08-1218	Sediment	X	X	X																			
			NSN-BC-SD04-08	NSN-BC-SD04-08-1824	Sediment	X	X	X																			
			NSN-BC-SD04-10	NSN-BC-SD04-10-0006	Sediment	X	X	X																			
			NSN-BC-SD04-10	NSN-BC-SD04-10P-0006[3]	Sediment	X	X	X																			
			NSN-BC-SD04-10	NSN-BC-SD04-10-0612	Sediment	X	X	X																			
			NSN-BC-SD04-10	NSN-BC-SD04-10-1218	Sediment	X	X	X																			
			NSN-BC-SD04-10	NSN-BC-SD04-10-1824	Sediment	X	X	X																			
			NSN-BC-SD04-14	NSN-BC-SD04-14-0006	Sediment	X	X	X																			
			NSN-BC-SD04-14	NSN-BC-SD04-14-0612	Sediment	X	X	X																			
			NSN-BC-SD04-14	NSN-BC-SD04-14-1218	Sediment	X	X	X																			
			NSN-BC-SD04-14	NSN-BC-SD04-14-1824	Sediment	X	X	X																			
			NSN-BC-SD04-D	NSN-BC-SD04-D-0006	Sediment	X	X	X																			
			NSN-BC-SD04-D	NSN-BC-SD04-D-0612	Sediment	X	X	X																			
			NSN-BC-SD04-D	NSN-BC-SD04-DP-0612[3]	Sediment	X	X	X																			
			NSN-BC-SD04-D	NSN-BC-SD04-D-1218	Sediment	X	X	X																			
			NSN-BC-SD04-D	NSN-BC-SD04-D-1824	Sediment	X	X	X																			

A1373DB12

Table 3-2

Analytical Table for the Step 4 Investigation

Naval Station Norfolk, Norfolk, Virginia

Sample Type	Description	Study Objective (Section 1.1)	Station ID	Sample ID	Medium	Analysis/Method: TAL Metals; Method CLP ILM04	TCL Pesticides and PCBs; Method CLP OLM04	PAHs; Method CLP OLM04	Ammonia; Method 350.2	pH; Method SW-846 9040B/9045C	Total Organic Carbon; Method Lloyd Kahn	Grain Size; Method ASTM D422	AVS/SEM; Method AVS/SEM April 1991	Aroclor-1260; Method CLP OLM04	4,4'-DDE; Method CLP OLM04	Silver; Method CLP ILM04	Chromium; Method CLP ILM04	TAL Metals (Aq) Total; Method CLP ILM04	TAL Metals (Aq) Dissolved; Method CLP ILM04	Hardness; Method 130.2	Total Suspended Solids; Method 160.2	Total Dissolved Solids; Method 160.1	Select Metals[1]; Method CLP ILM04	Pesticides and PCBs; Method CLP OLM04	Percent Moisture; Method Percent Moisture	Percent Lipids; Method Percent Lipids	Taxonomic Identification; N/A	Toxicity Testing	28 Day Bioassay using amphipod[2]
Surface Water Sampling	Surface Water Samples	1c	NSN-BC-SD04-03	NSN-BC-SW04-03	Surface Water													X	X	X	X	X							
			NSN-BC-SD04-06	NSN-BC-SW04-06	Surface Water													X	X	X	X	X							
			NSN-BC-SD04-08	NSN-BC-SW04-08	Surface Water													X	X	X	X	X							
			NSN-BC-SD04-08	NSN-BC-SW04-08P[3]	Surface Water													X	X	X	X	X							
			NSN-BC-SD04-14	NSN-BC-SW04-14	Surface Water													X	X	X	X	X							
			NSN-BC-SD04-18	NSN-BC-SW04-18	Surface Water													X	X	X	X	X							
Sediment Toxicity Testing	Toxicity Test Samples	2, 4	NSN-BC-SD04-01	NSN-BC-TX04-01	Sediment																								
			NSN-BC-SD04-02	NSN-BC-TX04-02	Sediment																							X	
			NSN-BC-SD04-03	NSN-BC-TX04-03	Sediment																							X	
			NSN-BC-SD04-04	NSN-BC-TX04-04	Sediment																							X	
			NSN-BC-SD04-05	NSN-BC-TX04-05	Sediment																							X	
			NSN-BC-SD04-06	NSN-BC-TX04-06	Sediment																							X	
			NSN-BC-SD04-07	NSN-BC-TX04-07	Sediment																							X	
			NSN-BC-SD04-08	NSN-BC-TX04-08	Sediment																							X	
			NSN-BC-SD04-09	NSN-BC-TX04-09	Sediment																							X	
			NSN-BC-SD04-10	NSN-BC-TX04-10	Sediment																							X	
			NSN-BC-SD04-11	NSN-BC-TX04-11	Sediment																							X	
			NSN-BC-SD04-12	NSN-BC-TX04-12	Sediment																							X	
			NSN-BC-SD04-13	NSN-BC-TX04-13	Sediment																							X	
			NSN-BC-SD04-14	NSN-BC-TX04-14	Sediment																							X	
			NSN-BC-SD04-15	NSN-BC-TX04-15	Sediment																							X	
			NSN-BC-SD04-16	NSN-BC-TX04-16	Sediment																							X	
			NSN-BC-SD04-17	NSN-BC-TX04-17	Sediment																							X	
			NSN-BC-SD04-18	NSN-BC-TX04-18	Sediment (Reference																							X	
			NSN-BC-SD04-19	NSN-BC-TX04-19	Sediment (Reference																							X	
			NSN-BC-SD04-20	NSN-BC-TX04-20	Sediment (Reference																							X	
Fish Tissue and Macroinvertebrate Sampling	Fish Tissue Samples	1d, 3, 4	Throughout Creek	NSN-BC-FI04-01	Whole Body Fish																								
			Throughout Creek	NSN-BC-FI04-02	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-03	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-04	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-05	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-05P[3]	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-06	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-07	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-08	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-09	Whole Body Fish																		X	X	X	X			
			Throughout Creek	NSN-BC-FI04-10	Whole Body Fish																		X	X	X	X			
	Macroinvertebrate Samples	3	NSN-BC-SD04-01	NSN-BC-MC04-01	Macroinvertebrate																								
			NSN-BC-SD04-02	NSN-BC-MC04-02	Macroinvertebrate																							X	
			NSN-BC-SD04-03	NSN-BC-MC04-03	Macroinvertebrate																							X	
			NSN-BC-SD04-04	NSN-BC-MC04-04	Macroinvertebrate																							X	
			NSN-BC-SD04-05	NSN-BC-MC04-05	Macroinvertebrate																							X	
			NSN-BC-SD04-06	NSN-BC-MC04-06	Macroinvertebrate																							X	
			NSN-BC-SD04-07	NSN-BC-MC04-07	Macroinvertebrate																							X	
			NSN-BC-SD04-08	NSN-BC-MC04-08	Macroinvertebrate																							X	
			NSN-BC-SD04-09	NSN-BC-MC04-09	Macroinvertebrate																							X	
			NSN-BC-SD04-10	NSN-BC-MC04-10	Macroinvertebrate																							X	
			NSN-BC-SD04-11	NSN-BC-MC04-11	Macroinvertebrate																							X	
			NSN-BC-SD04-12	NSN-BC-MC04-12	Macroinvertebrate																							X	
			NSN-BC-SD04-13	NSN-BC-MC04-13	Macroinvertebrate																							X	
			NSN-BC-SD04-14	NSN-BC-MC04-14	Macroinvertebrate																							X	
			NSN-BC-SD04-15	NSN-BC-MC04-15	Macroinvertebrate																							X	
			NSN-BC-SD04-16	NSN-BC-MC04-16	Macroinvertebrate																							X	
			NSN-BC-SD04-17	NSN-BC-MC04-17	Macroinvertebrate																							X	
			NSN-BC-SD04-18	NSN-BC-MC04-18	Macroinvertebrate																							X	
			NSN-BC-SD04-19	NSN-BC-MC04-19	Macroinvertebrate																							X	
			NSN-BC-SD04-20	NSN-BC-MC04-20	Macroinvertebrate																							X	

Table 3-2

Analytical Table for the Step 4 Investigation

Naval Station Norfolk, Norfolk, Virginia

						Analysis/Method																																															
Sample Type	Description	Study Objective (Section 1.1)	Station ID	Sample ID	Medium	TAL Metals	Method CLP ILM04	TCL Pesticides and PCBs	Method CLP OLM04	PAHs	Method CLP OLM04	Ammonia	Method 350.2	pH	Method SW-846 9040B/9045C	Total Organic Carbon	Method Lloyd Kahn	Grain Size	Method ASTM D422	AVS/SEM	Method AVS/SEM April 1991	Aroclor-1260	Method CLP OLM04	4,4'-DDE	Method CLP OLM04	Silver	Method CLP ILM04	Chromium	Method CLP ILM04	TAL Metals (Aq) Total	Method CLP ILM04	TAL Metals (Aq) Dissolved	Method CLP ILM04	Hardness	Method 130.2	Total Suspended Solids	Method 160.2	Total Dissolved Solids	Method 160.1	Select Metals[1]	Method CLP ILM04	Pesticides and PCBs	Method CLP OLM04	Percent Moisture	Method Percent Moisture	Percent Lipids	Method Percent Lipids	Taxonomic Identification	N/A	Toxicity Testing	28 Day Bioassay using amphipod[2]
QA/QC	Field Duplicates	--	See note[3]			Same analysis as parent sample																																															
	Field Blank		NSN-BC-SD04-FB	NSN-BC-SD04-FB-MMDDYR	QA/QC	Same as analysis collected during that week																																															
	Equipment Blanks		NSN-BC-SD04-EB	NSN-BC-SD04-EB-MMDDYR	QA/QC	Same as analysis collected during that day																																															
	MS/MSD		MS/MSD samples collected l:20 ratio during sampling, or 1 per media unless otherwise noted. Sample ID is the same.			Same analysis as parent sample																																															

[1] Selected metals include: arsenic, selenium, cadmium, chromium, copper, lead, zinc, and mercury

[2] 28 Day bioassay amphipod will be *Leptocheirus plumulous*, test endpoints will be survival, growth and reproduction

[3] Station ID followed by the letter P designates a duplicate sample. Duplicate sample may be collected at alternate locations chosen by the Field Team Leader

Table 3-3
Sampling Rationale Matrix
Naval Station Norfolk, Norfolk, Virginia

Station ID	Medium					Toxicity Tests	Rationale
	Surface SD	Subsurface SD	SW	Macroinvertebrate MC	Fish FI		
NSN-BC-SD04-01	X			X		X	At major bend in creek channel; potential depositional area; downgradient end of assessment area
NSN-BC-SD04-02	X			X		X	At major bend in creek channel; potential depositional area; supplement exisiting samples
NSN-BC-SD04-03	X		X	X		X	At major bend in creek channel; potential depositional area
NSN-BC-SD04-04	X			X		X	Junction where tributary from CD Landfill enters the main creek channel
NSN-BC-SD04-05	X			X		X	At major bend in creek channel; potential depositional area
NSN-BC-SD04-06	X	X	X	X		X	At major bend in creek channel; potential depositional area; presence of storm water culvert; downgradient end of concrete portion of channel
NSN-BC-SD04-07	X			X		X	Evaluate existing exceedances; potential depositional area at boundary fence across channel
NSN-BC-SD04-08	X	X	X	X		X	Junction of east and west branches; evaluate existing exceedances
NSN-BC-SD04-09	X			X		X	Upgradient end of assessment area on east branch; evaluate potential past contributions from CASY; upgradient of WWTP outfall
NSN-BC-SD04-10	X	X		X		X	Junction of main wetland channel with main creek channel
NSN-BC-SD04-11	X			X		X	Junction of main wetland channel with main creek channel
NSN-BC-SD04-12	X			X		X	Evaluate potential transport to emergent wetland area; supplement existing samples
NSN-BC-SD04-13	X			X		X	Evaluate potential transport to emergent wetland area; supplement existing samples
NSN-BC-SD04-14	X	X	X	X		X	Junction of main wetland channel with main creek channel
NSN-BC-SD04-15	X			X		X	Evaluate upper portions of creek system (transport); supplement existing samples
NSN-BC-SD04-16	X			X		X	Evaluate upper portions of creek system (transport); supplement existing samples
NSN-BC-SD04-17	X			X		X	Evaluate upper portions of creek system (transport); supplement existing samples
NSN-BC-SD04-18	X		X	X		X	Potential Reference Sample; low concetrations of COCs determined during previous investigation; no other suitable location for reference samples found in the area
NSN-BC-SD04-19	X			X		X	Potential Reference Sample; low concetrations of COCs determined during previous investigation; no other suitable location for reference samples found in the area
NSN-BC-SD04-20	X			X		X	Potential Reference Sample; low concetrations of COCs determined during previous investigation; no other suitable location for reference samples found in the area
NSN-BC-SD04-A	X						Junction where unnamed tributary enters the main creek channel
NSN-BC-SD04-B	X						Wetland area not directly connected to Bousch Creek; potentially reflects reference conditions

Table 3-3
Sampling Rationale Matrix
Naval Station Norfolk, Norfolk, Virginia

Station ID	Medium					Toxicity Tests	Rationale
	Surface SD	Subsurface SD	SW	Macroinvertebrate MC	Fish FI		
NSN-BC-SD04-C	X						Wetland area not directly connected to Bousch Creek; potentially reflects reference conditions
NSN-BC-SD04-D	X	X					Area with non-tidal flow; evaluate potential past contributions from CASY; downgradient of WWTP outfall
NSN-BC-SD04-E	X						Evaluate potential transport up unnamed tributary
NSN-BC-SD04-F	X						Evaluate potential transport to emergent wetland area; supplement existing samples
NSN-BC-SD04-G	X						Evaluate upper portions of creek system (transport); supplement existing samples
NSN-BC-SD04-H	X						Upgradient of CAL
NSN-BC-FI04-01					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-02					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-03					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-04					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-05					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-06					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-07					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-08					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-09					X		Throughout Bousch Creek; representative of entire area
NSN-BC-FI04-10					X		Throughout Bousch Creek; representative of entire area

Table 4-1 List of Standard Operating Procedures *Naval Station Norfolk, Norfolk, Virginia*
Decontamination and Waste Management
Decontamination of Personnel and Equipment
Disposal of Waste Fluids and Solids
Ecological Sampling
Fish Population Sampling Using Seining Procedures
Fish Population Sampling Using Gill Net Procedures
Fish Sample Collection Procedures
Aquatic Macroinvertebrate Sampling
Qualitative Mammalian Species Survey
Avian Community Survey
Field Parameters
Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using the Horiba® U-22
Streamflow Measurements
Completing Field Log Books
Log Books
Sample Preparation
Preserving Non-VOC Aqueous Samples
Equipment and Field Rinse Blank Preparation
Homogenization of Soil and Sediment Samples
Packaging and Shipping Procedures for Low-Concentration Samples
Chain-of-Custody
Surface Water and Sediment Sampling
Surface Water Sampling
Sediment Sampling
Flat Bottom Boat Sampling Operations
Clean Sampling for Trace Metals in Surface Water
Toxicity Testing
Test Method (SED-Lp-152) - 28-Day Static-Renewal Toxicity Test With Estuarine Amphipods (*Leptocheirus plumulosus*) to Meet U.S. EPA Guidelines

Table 4-2 Summary of General Data Quality Objectives for the Step 4 Investigation *Naval Station Norfolk, Norfolk, Virginia*
STEP 1 - State the Problem
Define the degree and spatial extent of any ecological risks from exposure to source-related (CAL) chemicals in wetland and aquatic habitats in Bousch Creek.
STEP 2 - Identify the Decision
Is there evidence of unacceptable risks to ecological receptors? Are there sufficient data on which to base this decision?
STEP 3 - Identify Inputs to the Decision
Analytical chemistry data from relevant media, physical characteristics of exposure media, bioavailability estimates, biological survey data, and toxicological testing.
STEP 4 - Define the Study Boundaries
All portions of Bousch Creek upgradient of the 3,900-foot culvert to Willoughby Bay, except for actively remediated areas (i.e., areas above Ingersol Road [CASY] and the upper portion of the tributary to the CD Landfill).
STEP 5 - Develop a Decision Rule
Based upon the results of the multiple lines of evidence for which data will be available: (1) comparison of measured media concentrations against applicable risk-based screening values, (2) refined food web modeling using measured tissue concentrations, (3) bioavailability measures, (4) toxicological testing results, and (5) biological survey data.
STEP 6 - Evaluate Decision Errors
Tolerable limits for decision errors (analytical data) are specified in the Master QAPP. For toxicological testing, these are specified in the test-specific SOP (e.g., minimum acceptability criteria).
STEP 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.

Table 4-3
Naming Scheme
Naval Station Norfolk, Norfolk Virginia

Field Station ID Scheme

First Segment	Second Segment	Third Segment	
Facility	Station Year	Station Number	
AAA	AANN	NN	

Notes: "A"= alphabetic "N"= numeric

Facility: NSN = Naval Station Norfolk

Station Type: SD = Station, 04= Year

Station Number: 01-20 and A-H

Sample ID Scheme

First Segment	Second Segment	Third Segment	Fourth Segment
Facility	Media Year	Station Number	Depth of Sample
AAA	AANN	NN	NNNN

Notes: "A"= alphabetic "N"= numeric

Facility: NSN = Naval Station Norfolk

Media Type: SD= Sediment, SW=Surface Water, TX= Toxicity, FI= Fish, MC= Macroinvertebrate, 04= Year

Station Number: 01-20 and A-H

Depth of Sample: 0006= 0-6", 0612= 6-12", 1218= 12-18", 1824= 18-24"

Table 4-4
CH2M HILL EDD Format
Naval Station Norfolk, Norfolk, Virginia

Field Name	Field Format	Req'd	Description
Sample_ID	A25	R	CH2M HILL sample ID (taken from the chain of custody).
Analysis_Group *	A9	R	The CH2M HILL code for the analysis performed on the sample.
DateTime_Collected	00/00/0000 00:00:00	R	The date the sample was collected (from the chain of custody). Use 24-hour clock
Date_Received	00/00/0000	R	The date the sample was received in the lab.
Date_Extracted	00/00/0000	RA	Extraction or preparation date.
Date_Analyzed	00/00/0000	R	The date the sample was analyzed.
Lab_Sample_ID	A15	R	The laboratory sample ID.
Dilution_Factor	N5	R	The dilution factor used. Use 1 if not diluted.
SDG_Number	A15	R	Laboratory code for the group of samples in a data deliverable package.
Chem_Code	A12	R	The ERPIMS parameter code.
Chem_Name *	A45	R	The compound being analyzed.
CAS_Number *	A6-A2-A1	R	CAS Number (Note dashes).
Ana_Value	N11	R	The analytical result. It should match the number of significant digits on the hard copy. Use detection limit when not detected.
Lab_Qual *	A5	RA	The lab qualifiers, if any (e.g., U, UJ, B); there may be a qualifier not on the valid value table in special cases.
DV_Qual	A5		Left blank for data validation qualifiers.
DV_Qual_Code*	A5		Left blank for data validation qualifier codes. Use valid values.
Units *	A15	R	The unit of the result (e.g., mg/L).
Detect_Limit	N5	R	The minimum available sample-specific detection limit for the compound, the laboratory reporting limit.
MDL	N10.3	R	Method detection limit.
Preparation	A15	R	ERPIMS code used for the preparation method of the sample fraction.
Analysis_Method	A15	R	Analytical method used to analyze the sample fraction. Use ERPIMS codes.
Result_Type *	A15	RA	The laboratory QC type for single compounds (e.g, SURR, IS) All surrogates and internal standard results are to be reported in % recovery units.
Lab_QC_Type *	A15	RA	Laboratory samples (lab blanks, dups, LCS, etc.).
PCT_Moisture	N3,3	RA	Percent moisture for soil samples; not applicable for aqueous samples.
Basis	A3	RA	Concentrations are reported on a wet or dry weight basis. Use ERPIMS codes.
Batch	A12	R	Laboratory code for the batch of samples analyzed together.
Lab_Code	A10	R	The ERPIMS code for the name of the laboratory.
ReRun*	A9	RA	To report dilutions, re-extractions, and/or re-analyses.
QC_Limits	AAA-AAA	RA	Laboratory QC limits in percent recovery for surrogates, internal standards, laboratory control spikes, calibration checks, interference check standards, serial dilutions, and MS/MSDs.
Comment	A 30	RA	For the laboratory to note exceptions.

Notes:
* - See valid value list
TICs are not reported on the EDD
R - Required field
NR - Not Required
RA - Required as Appropriate
EDD may be submitted in ASCII (comma delimited) or in Excel

Table 4-5
Summary of Samples for Submittal to the Offsite Laboratory with QA/QC
Naval Station Norfolk, Norfolk, Virginia

Laboratory Parameter	Samples	Field Duplicates[1]	Field Blanks[2]	Trip Blanks[3]	Matrix Spikes[4]	Equipment Blanks[5]	Matrix Total
Sediment Samples							
TCL Pesticides/PCB	40	4	1	0	2	5	52
TAL Metals	40	4	1	0	2	5	52
PAHs	40	4	1	0	2	5	52
Ammonia	20	2	1	0	1	5	29
pH	20	2	1	0	1	5	29
TOC	20	2	1	0	1	5	29
Grain Size	20	2	1	0	1	5	29
AVS/SEM	20	2	1	0	1	5	29
Aroclor 1260	8	1	1	0	1	5	16
4,4'-DDE	8	1	1	0	1	5	16
Silver	8	1	1	0	1	5	16
Chromium	8	1	1	0	1	5	16
Toxicity Test[6]	20	0	0	0	0	0	20
Aqueous Samples							
TAL Metals (total)	5	1	1	0	1	1	9
TAL Metals (dissolved)	5	1	1	0	1	1	9
Hardness	5	1	1	0	1	1	9
Total Suspended Solids (TSS)	5	1	1	0	1	1	9
Total Dissolved Solids (TDS)	5	1	1	0	1	1	9
Fish Tissue							
Selected Metals[7]	10	1	0	0	1	0	12
Pesticides and PCBs	10	1	0	0	1	0	12
Percent Moisture	10	1	0	0	1	0	12
Percent Lipids	10	1	0	0	1	0	12
Macroinvertebrates							
Taxonomic Identification	20	0	0	0	0	0	20

Notes:

[1]Field Duplicates are collected at a frequency of 1 per 10.

[2]Field blanks are collected at a frequency of 1 per source per event or 1 per week of sampling.

[3]Trip blanks are shipped with samples submitted for volatile analysis. Trip blanks are collected at a frequency of 1 per cooler of volatile samples.

[4]Matrix spike/matrix spike duplicates (MS/MSD) are collected at a frequency of 1 per 20.

[5]Equipment blanks are collected at a frequency of 1 per day.

[6]28-Day Bioassay using amphipod *Leptocherius plumulosus,* test endpoints will be survival, growth and reproduction.

[7]Selected Metals: arsenic, selenium, cadmium, chromium, copper, lead, zinc and mercury

Table 5-1
Contact Information and Management Structure

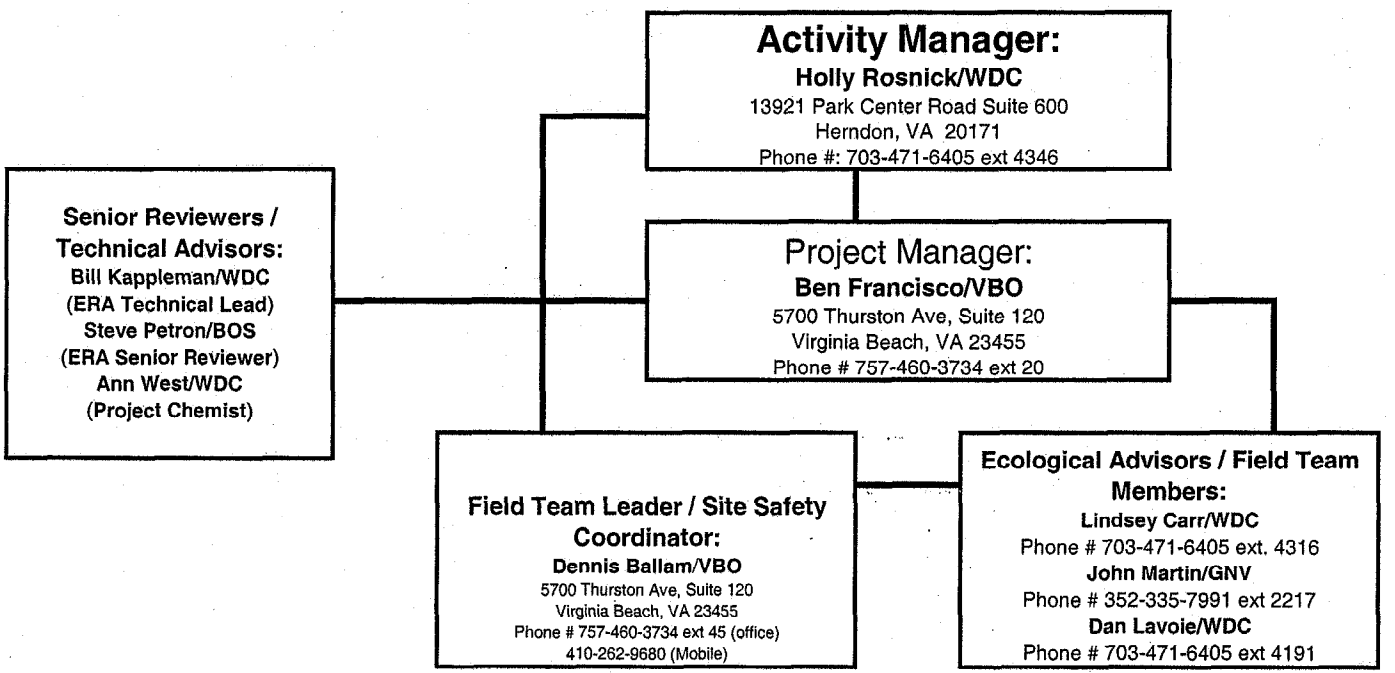


Table 7-1 Estimated Project Schedule *Naval Staton Norfolk, Norfolk, Virginia*	
WEEK OF	ACTIVITY
27-Sep-04	Submit Work Plan for review
18-Oct-04	Incorporate comments, finalize Work Plan
25-Oct-04	Mobilize for field event
1-Nov-04	Sediment and surface water sampling
8-Nov-04	Fish tissue and macroinvertebrate sampling

Figures

File Path: v:\18gis\nsn\figures\153013.apr

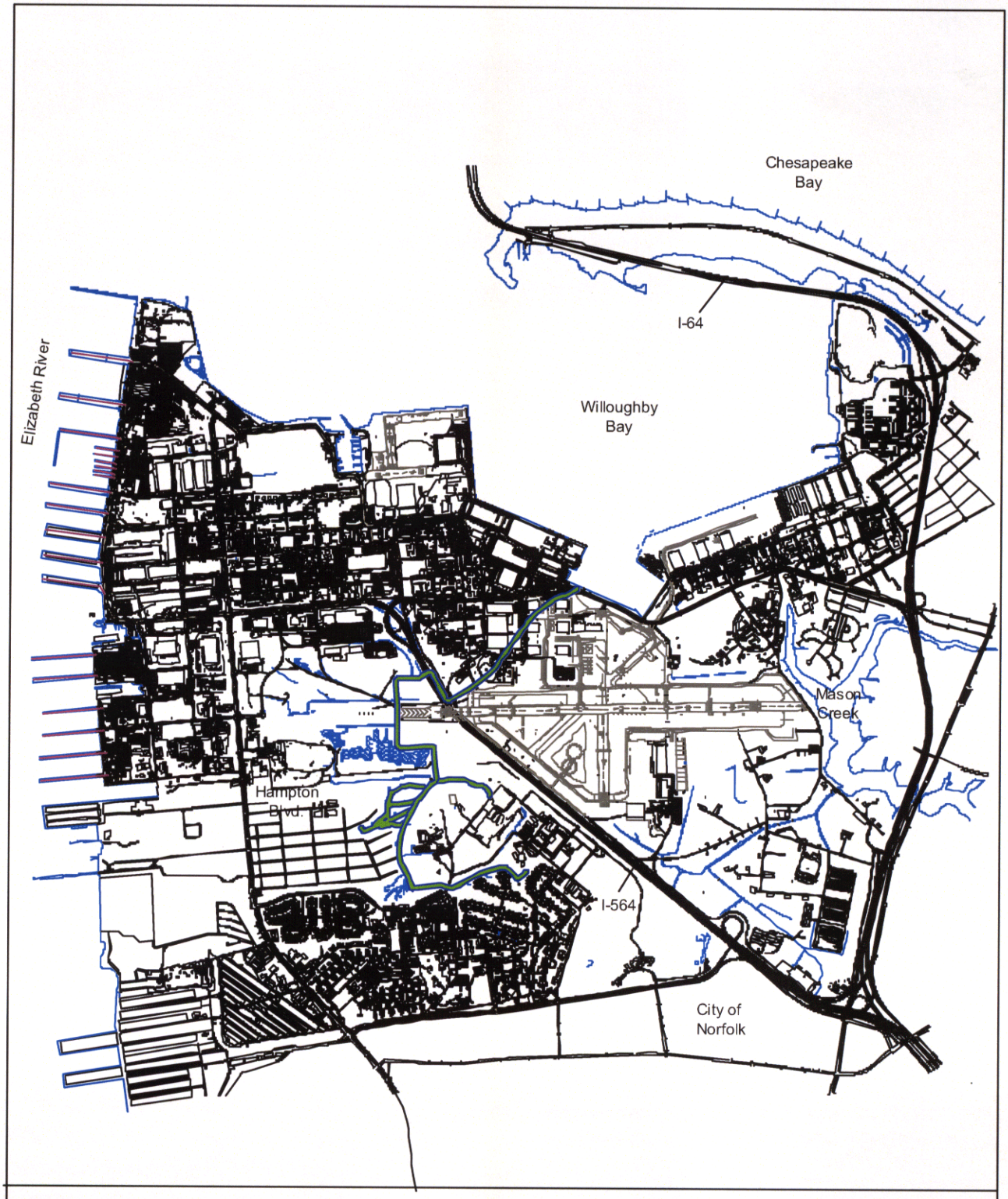
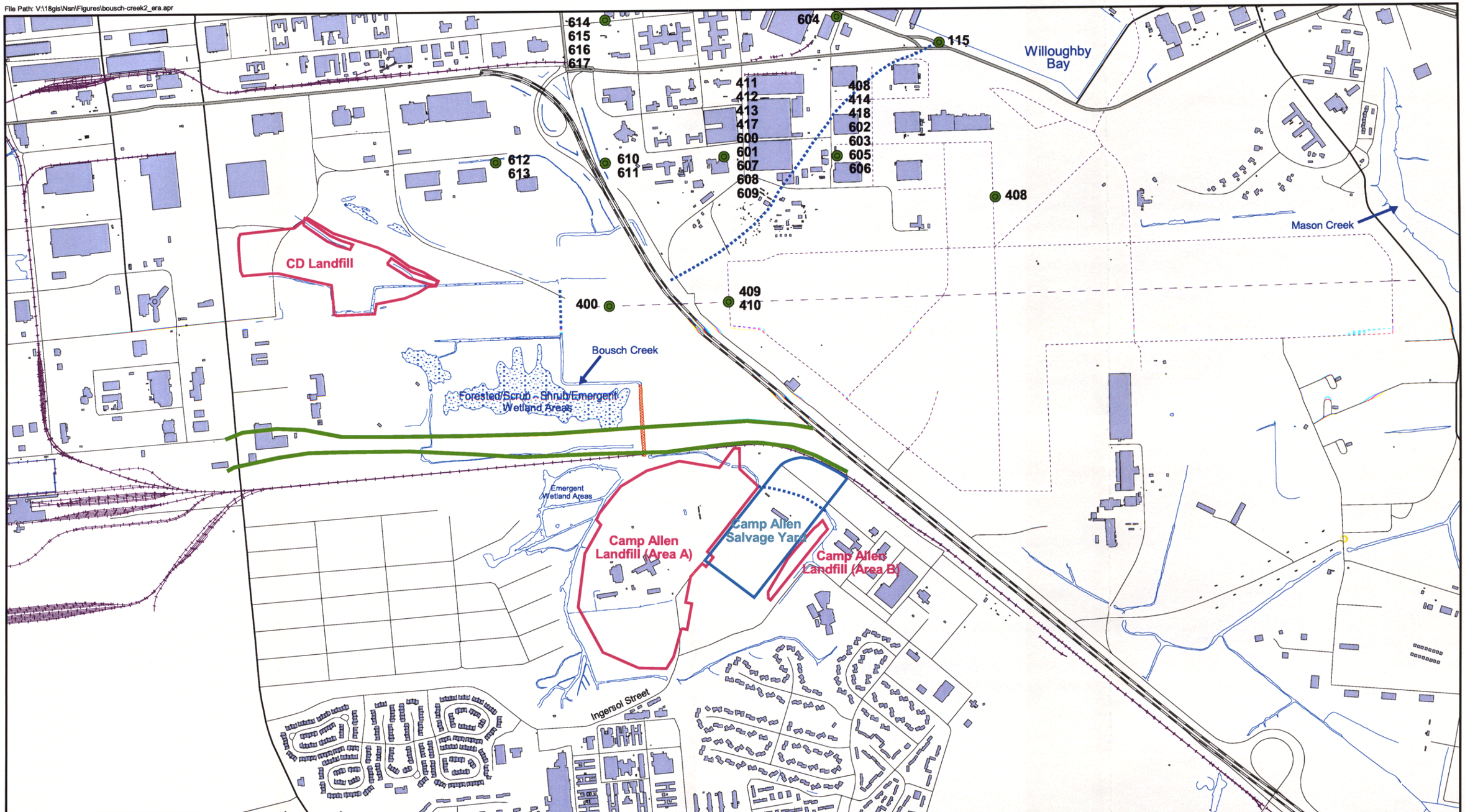


Figure 1-1
Bousch Creek
Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

File Path: V:\18gis\Nsn\Figures\bousch-creek2_era.apr



LEGEND

- Proposed I-564 Corridor (Approximate)
- Underground Culvert
- Concrete Lined
- Outfall 408

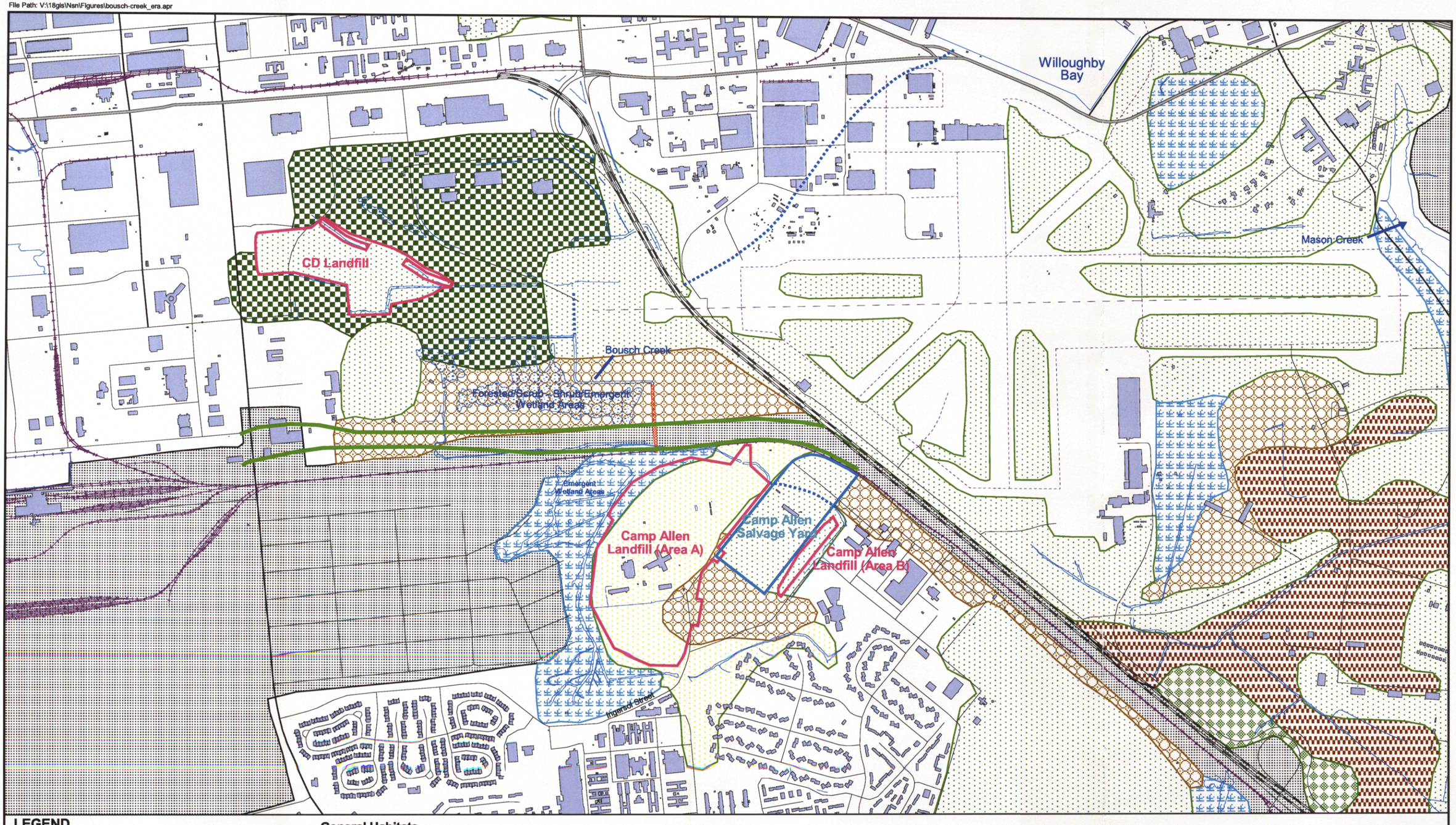
N

0 500 1000 1500 Feet

Figure 2-1
Location Map
Bousch Creek Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

File Path: V:\18gis\Nsn\Figures\bousch-creek_era.apr



LEGEND

- Proposed I-564 Corridor (Approximate)
- Underground Culvert
- Concrete Lined
- Buildings

General Habitats

- Improved Fields
- Mixed Woods
- Off Base
- Pine Woods
- Semi-Improved Fields
- Unimproved Fields
- Wetlands
- Urban Areas

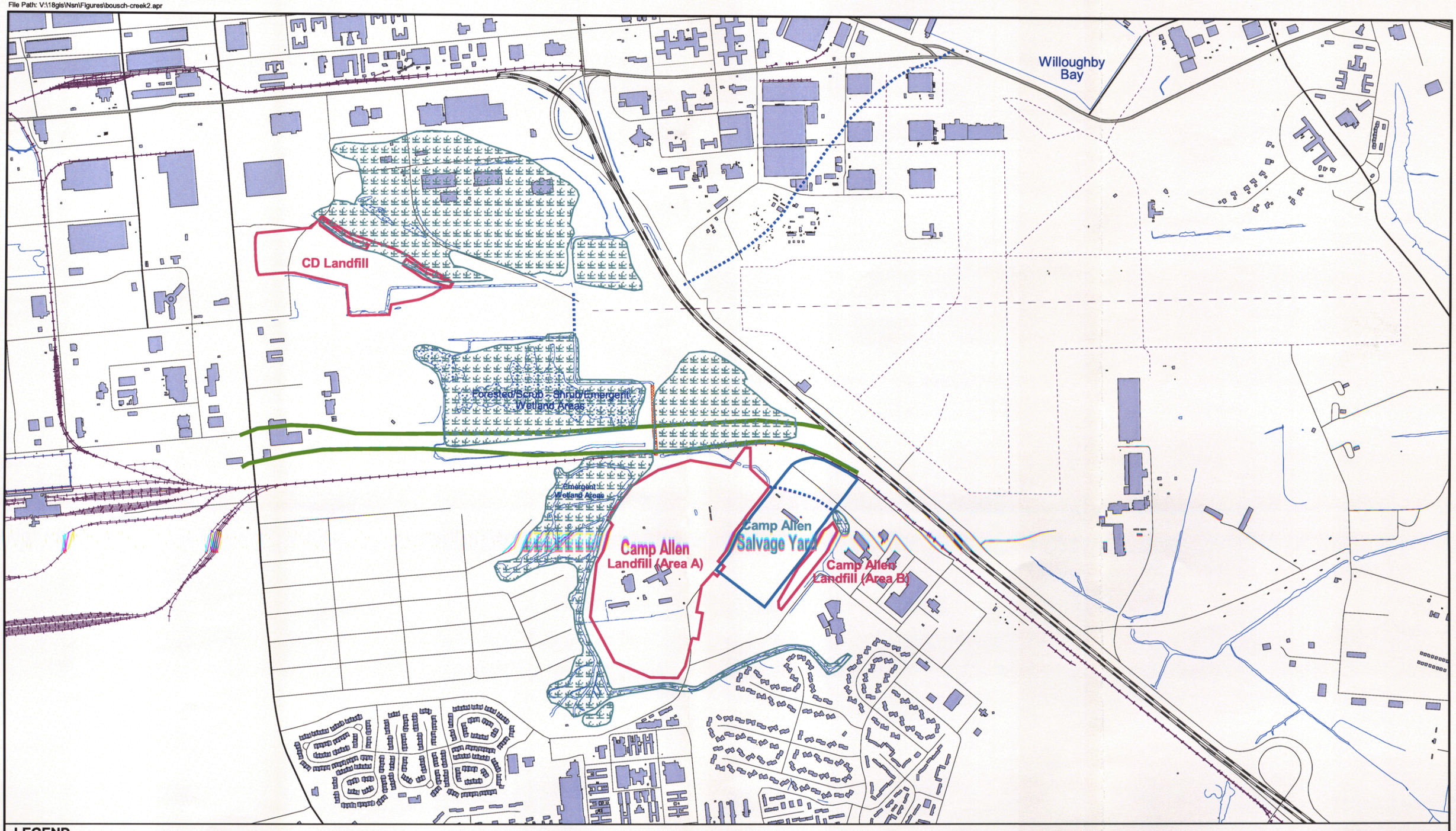
N

0 500 1000 1500 Feet

Figure 2-2
General Habitat Types
Bousch Creek Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

File Path: V:\18gis\Nsn\Figures\bousch-creek2.apr



LEGEND

- Proposed I-564 Corridor (Approximate)
- Underground Culvert
- Concrete Lined
- Wetlands

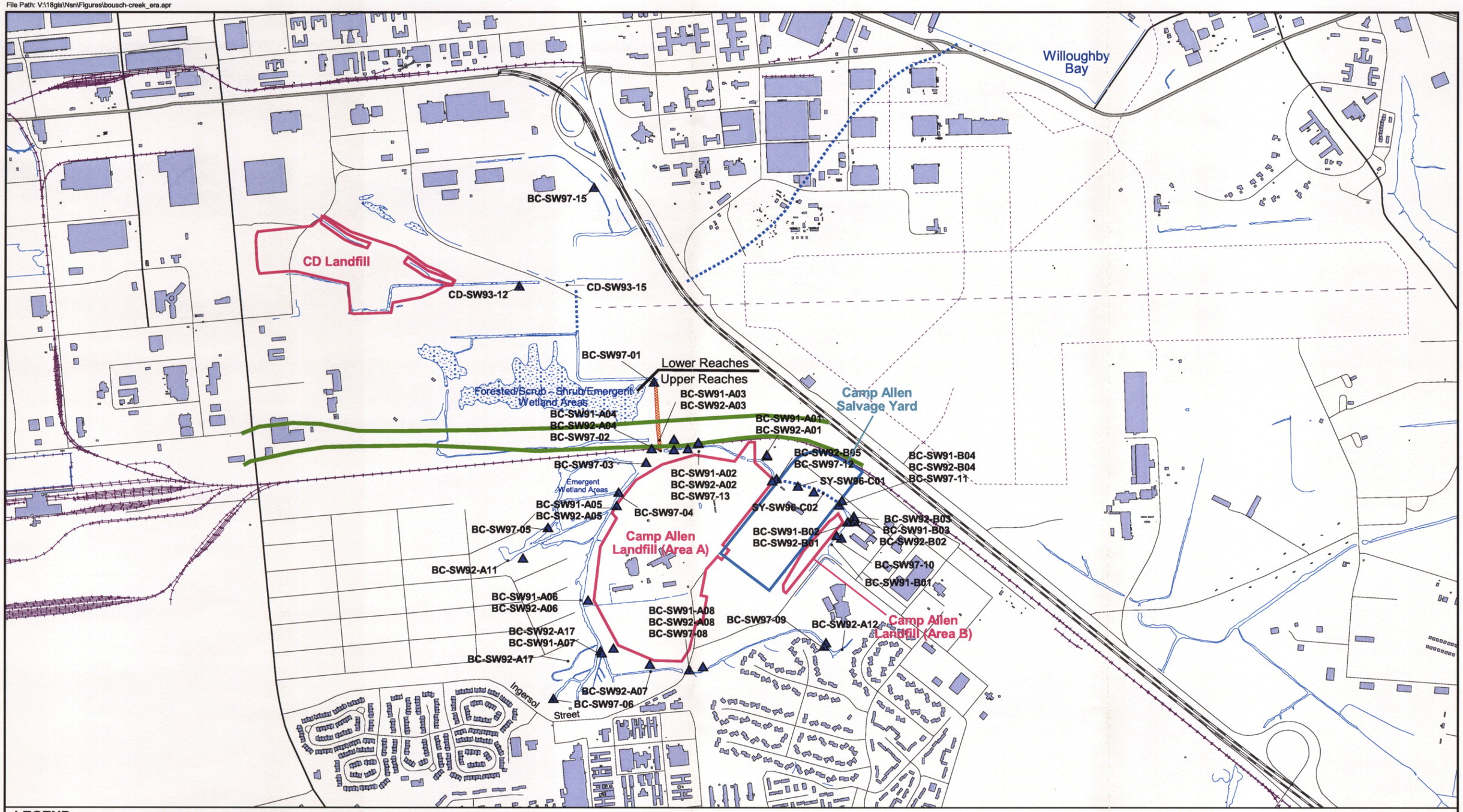
N

0 500 1000 1500 Feet

Figure 2-3
Wetlands Associated with Bousch Creek
Bousch Creek Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

File Path: V:\18gis\Nsn\Figures\bousch-creek_era.apr



LEGEND

- ▲ Surface Water Sample Locations
- Proposed I-564 Corridor (Approximate)
- Underground Culvert
- Concrete Lined

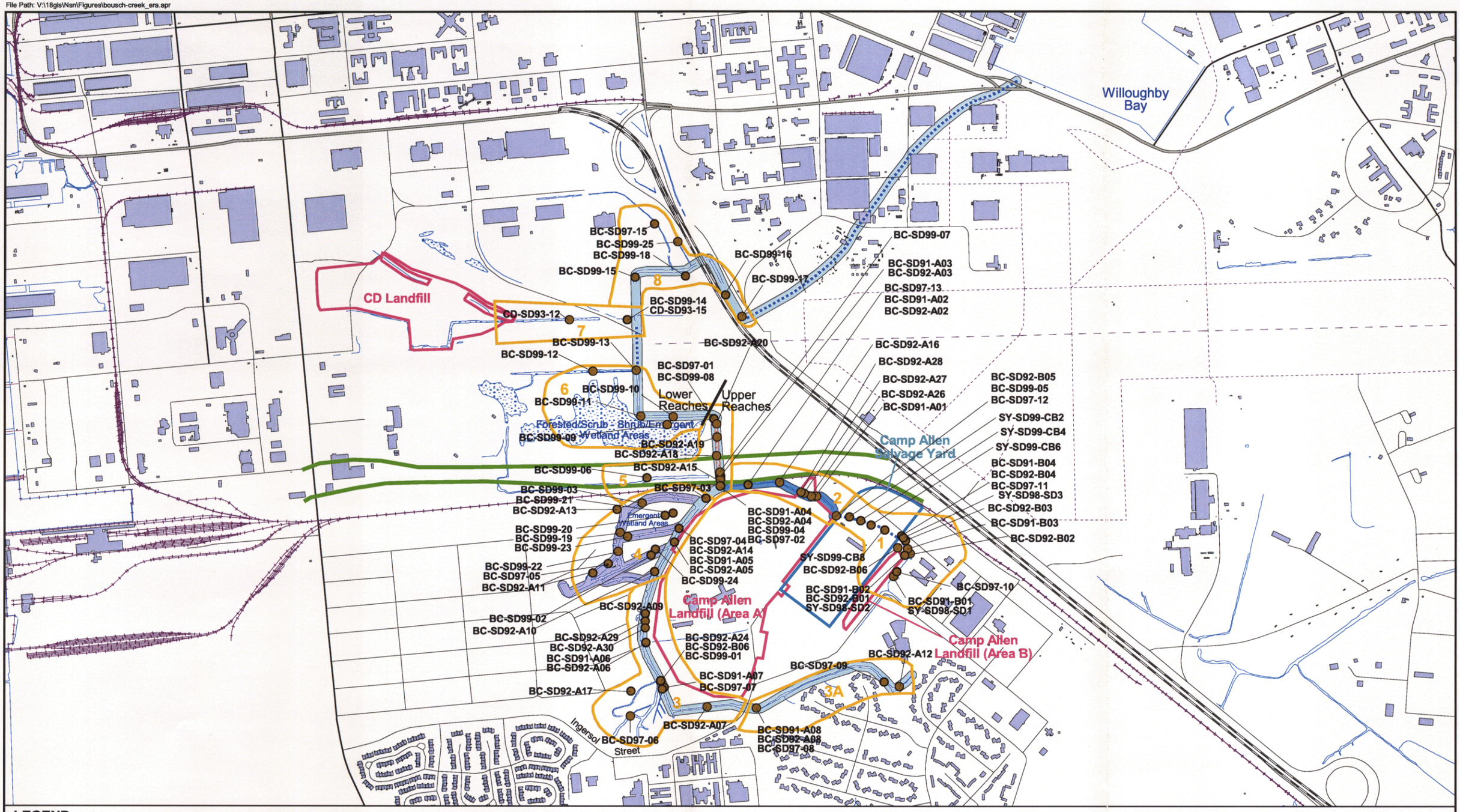
N

0 500 1000 1500 Feet

Figure 2-4
Previous Surface Water Sampling Locations
Bousch Creek Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

File Path: V:\18gis\Nsn\Figures\bousch-creek_era.apr



LEGEND

- Sediment Sample Locations
- Proposed I-564 Corridor (Approximate)
- Underground Culvert
- Concrete Lined
- Zones

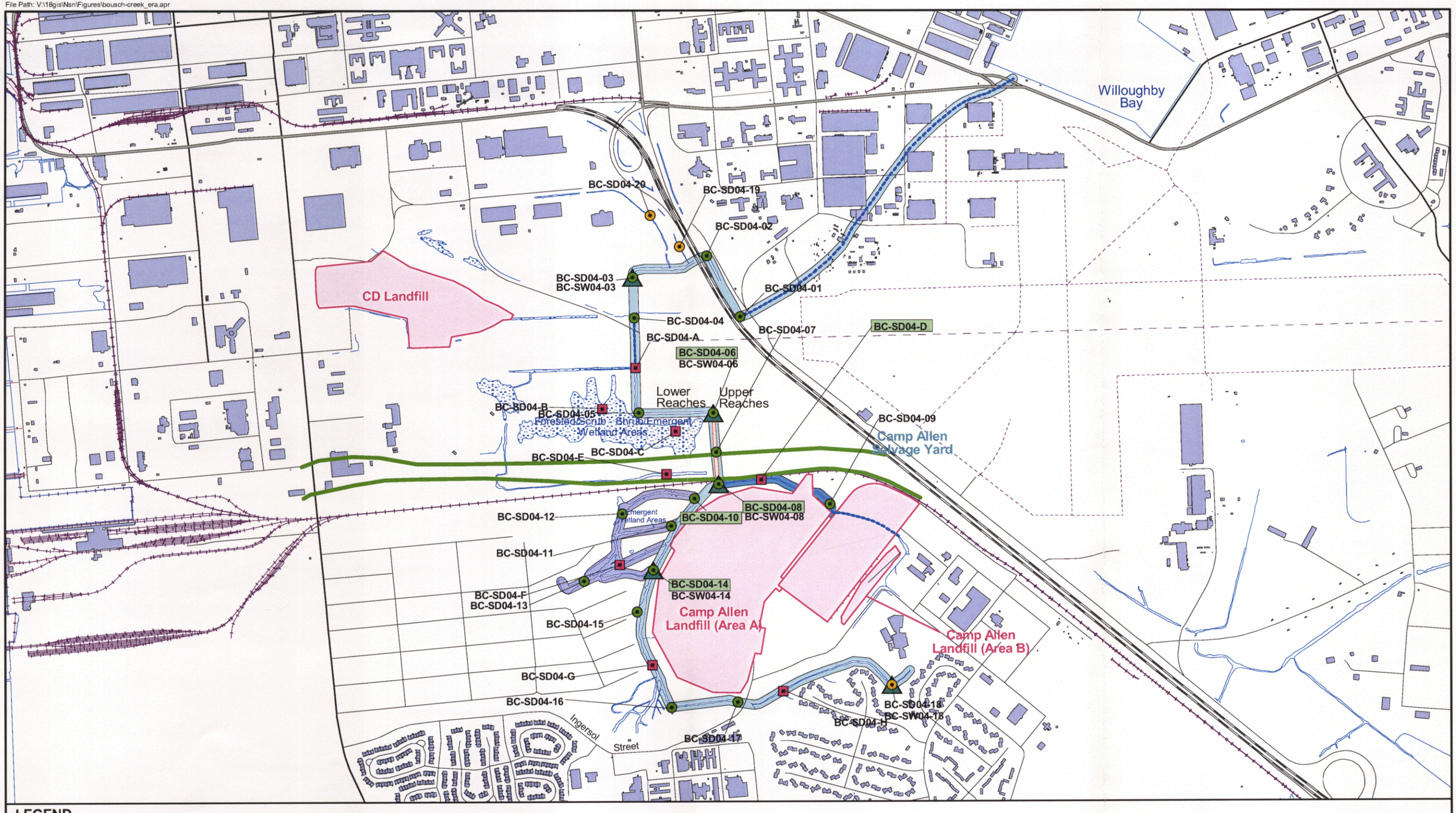
N

0 500 1000 1500 Feet

Figure 2-5
Previous Sediment Sampling Locations
Bousch Creek Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

File Path: V:\18gis\Nsn\Figures\bousch-creek_era.apr



LEGEND

- General Areas Where Remedial Actions Are On-going or Have Been Completed
- Proposed I-564 Corridor (Approximate)
- Underground Culvert
- Concrete Lined
- Primary Sediment Sample Locations
- Secondary Sediment Sample Locations
- Potential Reference Sediment Sample Locations
- Eastern Branch Bousch Creek
- Western Branch Bousch Creek
- Main Branch Bousch Creek
- Surface Water Sample Location
- Sediment Core Sample Location

N

0 500 1000 1500 Feet

Figure 2-6
Proposed Sampling Locations
Bousch Creek Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

Appendix A
Technical Memorandum - Field Reconnaissance of Sampling Locations

Bousch Creek Site Visits, Naval Station Norfolk, Norfolk, Virginia

PREPARED FOR: Naval Station Norfolk Tier I Partnering Team

PREPARED BY: Dennis Ballam/VBO

DATE: September 17, 2004

Introduction

This memorandum documents the site visits conducted at Bousch Creek located in the Camp Allen area at Naval Station Norfolk (NSN), Norfolk, Virginia. The objective of these site visits was to joint-scope sample locations for the Step 7 Ecological Risk Assessment (ERA). Rationale and objectives for the sampling locations was previously presented to the Partnering Team and will also be documented in the work plan. The sole purpose of this memo and attachments is to report on the specific locations selected as a result of the site visit.

Site Visits

The initial site visit was conducted on August 27, 2004 and consisted of Steve Petron/CH2M HILL, John McCloskey/USFWS, Ben Francisco/CH2M HILL, and Dennis Ballam/CH2M HILL. During the initial site visit, the participants evaluated the site characteristics and based on the proposed sampling strategy, joint-scoped the optimal depositional areas for sediment sampling locations.

Areas where samples are to be collected were visited and the type of depositional areas to be sampled were discussed. The onsite scientist will collect samples in areas where the depositional material is comprised of mainly silts and clays, areas with a high sand content will be avoided. At locations where samples are located on bends in the creek, samples will be collected on the inside of the bend, on the downstream side of the bend, where sediments are normally deposited. Samples collected in locations that were chosen in areas without bends in the creek will be located in the center of the channel. If the center of the channel is scoured or is comprised of mainly sands, the location will be moved closer to the shore line where the depositional material is more suitable for sampling. Samples that are to be collected in emergent wetland areas will be located in depressions in the wetland. These depressions will be located by finding standing water or by assessing the vegetation in the area to find locations that are lower than the area surrounding them. Sample locations that are found at the confluence of two branches of the creek will be located where sediments are deposited from both branches. These samples will be collected at the point where the two branches intersect. If the depositional material found in that area is unsuitable for sampling, the sample location will be moved to the closest point downstream of the confluence where suitable depositional material can be found. All of these locations can be adjusted during sampling to allow for the collection of the best-suited sediment.

Two follow-up site visits were conducted by Ben Francisco and Dennis Ballam on September 14 and 17 to verify, mark, photograph, and document descriptions of each sampling location. During these site visits, the logistics for conducting the ERA sampling were determined. Descriptions and photographs of each sampling location are provided in Table 1-1 and Attachment 1, respectively, of this appendix. Figure 2-6 of the work plan shows a map of the site detailing the planned sampling locations.

Site Visit Tech Memo

Table 1-1

BOUSCH CREEK SAMPLING LOCATIONS

SAMPLE ID	ANALYSIS	Picture #	SAMPLE LOCATION
NSN-BC-SD04-01	Full Suite	1	North side of I-564 at the inlet of the underground culvert leading to Willoughby Bay, center channel[1]
NSN-BC-SD04-02	Full Suite	2	North side of I-564 just above where creek flows beneath I-564, center channel[1]
NSN-BC-SD04-03	Full Suite	3	At the first bend below I-564, in man-made culvert on inside of bend[2]
NSN-BC-SD04-04	Full Suite	4	North of the flightline underground culvert, just below culvert outfall center channel[1]
NSN-BC-SD04-05	Full Suite	5	At the first upstream bend above the flightline culvert inside of bend[2]
NSN-BC-SD04-06	Full Suite	6	At the 90° bend just below the concrete culvert, inside of bend[2]
NSN-BC-SD04-07	Full Suite	7	50' downstream of the security gate crossing the concrete culvert, center channel[1]
NSN-BC-SD04-08	Full Suite	8	Directly above the railroad bridge crossing the concrete culvert, center channel[1]
NSN-BC-SD04-09	Full Suite	9	At a point midway between the treatment plant outfall and the road, center channel.[1] Location was relocated after initial site visit, was originally located below outfall, moved to present location to avoid contamination of the sample from treatment plant. This will allow for one sample located above the treatment plant to determine possible impacts from the treatment plant.
NSN-BC-SD04-10	Full Suite	10	West of the concrete culvert at the first upstream confluence of the main branch and the western branch of Bousch Creek[3]
NSN-BC-SD04-11	Full Suite	11	South of SD10 at the next western branch inlet into the main branch of the creek[1]
NSN-BC-SD04-12	Full Suite	12	In the western branch of the creek, where the stream bends away from the railroad tracks, impounded area with sunken canoe, center channel[1]
NSN-BC-SD04-13	Full Suite	13	A point near the beginning of the western branch approximately 100' from where it begins, center channel[1]
NSN-BC-SD04-14	Full Suite	14	At the first confluence, going downstream, of the main branch and the western portion of Bousch Creek. Just downstream of the 3-wire overhead powerlines[3]
NSN-BC-SD04-15	Full Suite	15	Below the powerlines upstream of the western branch marsh, wide area 100' downstream of oak tree that has fallen across the main branch[3]
NSN-BC-SD04-16	Full Suite	16	At the first hard bend below Ingersol Street, just below where the steam line crosses the main branch[3]
NSN-BC-SD04-17	Full Suite	17	At the outfall of the culvert going beneath Ingersol Street, center channel[1]
NSN-BC-SD04-18	Full Suite	18	Point farthest upstream in the area of impounded water behind the base housing area, accessed through the backyard of unit 1133, center channel[1]
NSN-BC-SD04-19	Full Suite	None	Located in the tributary found on the northern end of Bousch Creek just before the I-564 underpass. The location will be approximately 20 downstream of the beginning of the tributary. Near SD-99-25
NSN-BC-SD04-20	Full Suite	None	Located in the tributary found on the northern end of Bousch Creek. The location is east of where the movie theatre is currently located just before the security fence. Near SD-97-15
NSN-BC-SD04-A	Target Analytes	19	Just upstream of the flightline culvert inlet, center channel[1]
NSN-BC-SD04-B	Target Analytes	20	Approximately 300' west of point SD05, in a depression in the wetland. Exact location to be determined by the onsite scientist at time of sampling[4]
NSN-BC-SD04-C	Target Analytes	21	Approximately 100' south of the creek at a point midway between SD05 and SD06, in a depression in the wetland. Exact location to be determined by the onsite scientist at time of sampling[4]
NSN-BC-SD04-D	Target Analytes	22	Eastern Branch sample approximately 200' east of the railroad bridge, just below where the creek bends away from the railroad tracks
NSN-BC-SD04-E	Target Analytes	23	In the marsh area north of the railroad tracks in the portion of the creek feeding into the main stem between the railroad tracks and the security fence. The point is approximately 50' west of underground culvert feeding into the concrete culvert, center channel[1]
NSN-BC-SD04-F	Target Analytes	24	Western branch, beneath the overhead powerlines in a area almost completely surrounded by vegetation, center channel[1]
NSN-BC-SD04-G	Target Analytes	25	At a point midway between SD15 and SD16, center channel[1]
NSN-BC-SD04-H	Target Analytes	26	At the outlet of the grass swale near unit 1135 in the base housing area, the creek runs intermittent through this area the sample will be collected in a low-lying area[4]

[1] Center channel samples will be collected as close as possible the the center of the channel while avoiding any area that may have been scoured or have high sand content. This may require moving sample locations closer to the shoreline.

[2] Samples collected on the inside of bends will normally be just downstream of the bend on the inside and will be selected while in the field after texture content has been determined. Areas with high sand content will be avoided.

[3] Samples collected at confluences will be located at the point created where the two branches meet. Areas with high sand content will be avoided.

[4] Samples collected in marshes or in areas where Bousch Creek runs intermittently will be located in depressional/low-lying areas determined during sample collection.These areas will be determined using the presence of standing water or the type of vegetation present.

Note: **Full Suite Analytes will include**:TAL Metals,TCL pesticides and PCBs, PAHs, Ammonia, pH, TOC, grain size, and AVS/SEM. Five of these samples will be analyzed for vertical transport of TAL Metals, TCL pesticides and PCBs, and PAHs. This will be done using 2 foot sediment cores sampled at 6 inch intervals. **Target Analytes will include**: Aroclor-1260, 4,4'-DDE, chromium, and silver.

Attachment 1
Photographs

PICTURE 1 BC-SD04-01

PICTURE 2 BC-SD04-02

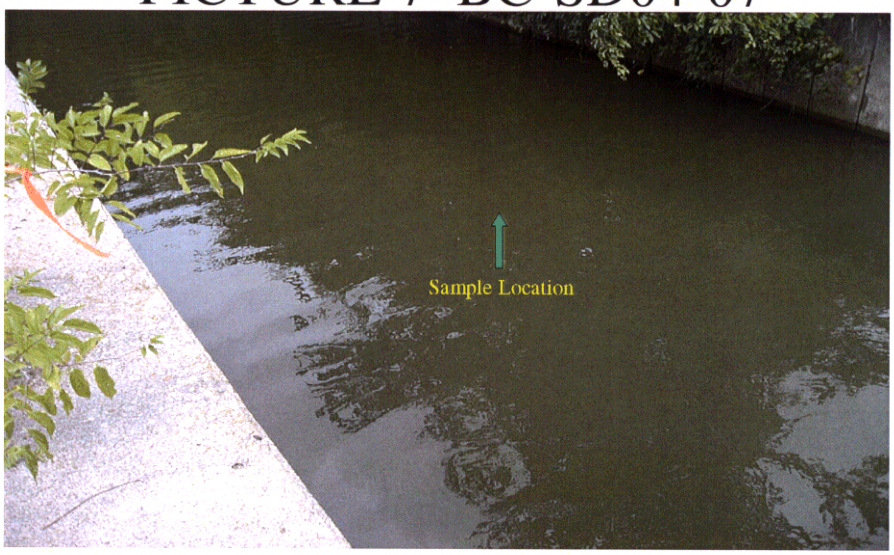
PICTURE 3 BC-SD04-03

PICTURE 4 BC-SD04-04

PICTURE 5 BC-SD04-05

PICTURE 6 BC-SD04-06

PICTURE 7 BC-SD04-07

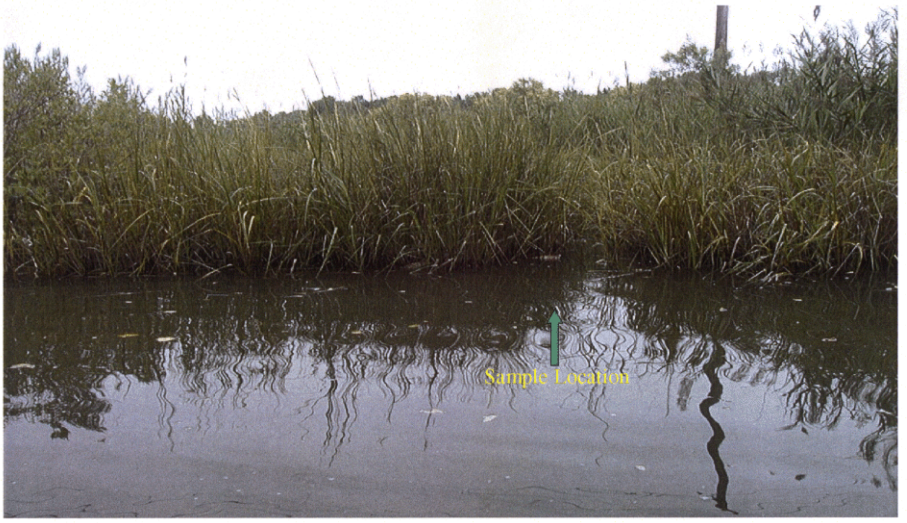


PICTURE 8 BC-SD04-08

PICTURE 9 BC-SD04-09

PICTURE 10 BC-SD04-10

PICTURE 11 BC-SD04-11

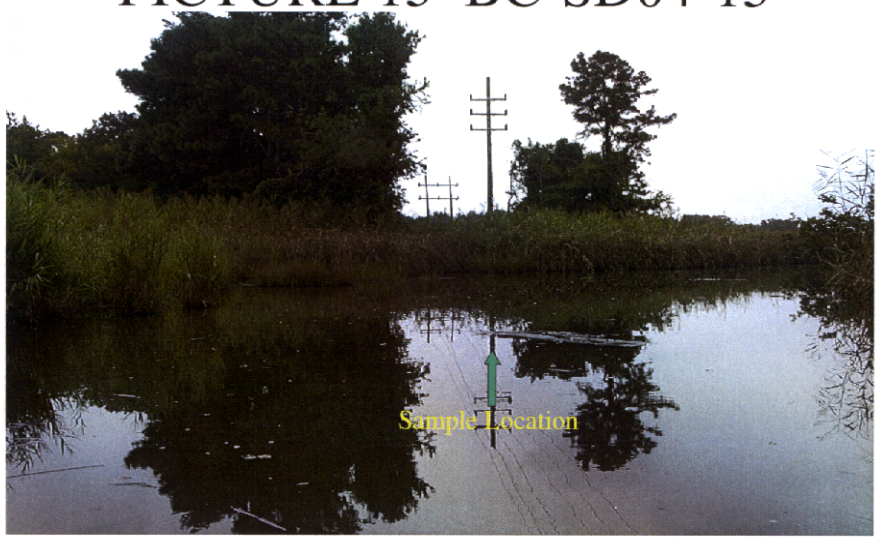


PICTURE 12 BC-SD04-12

PICTURE 13 BC-SD04-13

PICTURE 14 BC-SD04-14

PICTURE 15 BC-SD04-15



PICTURE 16 BC-SD04-16

PICTURE 17 BC-SD04-17

PICTURE 18 BC-SD04-18

PICTURE 19 BC-SD04-A

PICTURE 20 BC-SD04-B

PICTURE 21 BC-SD04-C

PICTURE 22 BC-SD04-D

PICTURE 23 BC-SD04-E

PICTURE 24 BC-SD04-F

PICTURE 25 BC-SD04-G

PICTURE 26 BC-SD04-H

Appendix B
Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water)
- Distilled water
- Potable water; must be from a municipal water supplier, otherwise an analysis must be run for appropriate volatile and semivolatile organic compounds and inorganic chemicals (e.g., Target Compound List and Target Analyte List chemicals)
- 2.5% (W/W) Liquinox® and water solution
- Concentrated (V/V) pesticide grade methanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Liquinox® and water, scrub brushes, squirt bottles for Liquinox® solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Powder-free, phthalate-free gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

1. Wash boots in Liquinox® solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Liquinox® solution, remove, and discard into DOT-approved 55-gallon drum.

2. Wash outer gloves in Liquinox® solution, rinse, remove, and discard into DOT-approved 55-gallon drum.

3. Remove disposable coveralls ("Tyveks") and discard into DOT-approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. At the end of the work day, shower entire body, including hair, either at the work site or at home.

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don powder-free, phthalate-free gloves.

2. Spread plastic on the ground to keep hoses from touching the ground

3. Turn off pump after sampling. Remove pump from well and place pump in decontamination tube, making sure that tubing does not touch the ground

4. Turn pump back on and pump 1 gallon of Liquinox® solution through the sampling pump.

5. Rinse with 1 gallon of 10% methanol solution pumped through the pump. (DO NOT USE ACETONE).

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.

9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

1. Don powder-free, phthalate-free gloves.
2. Before entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).
3. Rinse and scrub with potable water.
4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with Liquinox® solution.
5. Rinse with potable water.
6. Rinse with distilled or potable water and methanol solution (DO NOT USE ACETONE).
7. Air dry.
8. Rinse with deionized water.
9. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
10. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
11. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with Liquinox® solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

E. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with Liquinox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

F. HEAVY EQUIPMENT AND TOOLS

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1. Set up a decontamination pad in area designated by the Navy
2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

- Clean with solutions of Liquinox®, methanol, and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

STANDARD OPERATING PROCEDURE

Disposal of Waste Fluids and Solids

I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rolloffs
- Tools for securing drum lids
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rolloffs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they are filled in the field and labels indicating that the contents are potentially hazardous affixed.

The drum contents will be sampled to determine the disposal requirements of the drilling wastes. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Date that accumulation began
- Date that accumulation ended
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the amount of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used

during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to the fenced drum storage area by the drilling services subcontractor.

Waste solid materials that contain hazardous constituents will be disposed of at an offsite location in a manner consistent with applicable solid waste, hazardous waste, and water quality regulations. Transport and disposal will be performed by a commercial firm under subcontract.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. Prior to disposal to the sanitary sewer system, contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- Check that representative samples of the containerized materials are obtained.
- Be sure that all state and federal regulations are considered when classifying waste for disposal.

STANDARD OPERATING PROCEDURE

Fish Population Sampling Using Seining Procedures

I. Purpose

The purpose of this SOP is to provide general reference information and technical guidance on the procedure to sample and characterize fish communities using seining procedures. The collected samples provide information used in the determination of population statistics of the fish community and can be used to collect fish samples for chemical analysis of tissues. This information will be used in the assessment of risks to human health and the environment.

II. Scope

This guideline provides information on proper sampling equipment and techniques for the collection of fish in shallow streams, ponds, and near-shore areas of lakes, impoundments, bays, estuaries, and ocean shoreline. This technique is more suited for use in smooth-bottomed, low-sloped areas.

This procedure is not very effective when the seine is pulled over weeds and other obstructions as they may tend to roll up, and allow the fish to pass under the seine.

Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The technique described should be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methods.

III. Definitions

Abiotic	Non-biological components of the environment, including water body structure and natural or manmade disturbances.
Biotic	Biological components of the environment, including organisms and vegetation.
Bow	The front of the boat.
Reach	The designated portion of a stream or river.
Riffles	A stretch of water flowing over, rocks, debris, or shallow sediments causing a disturbance of the water.
Riparian	Along the bank of a river or lake.

Runs	A stretch of water flowing without any disturbances.
Stern	The back of the boat.

IV. Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures that deviate from those presented herein.

Field Team Leader - The Field Team Leader is responsible for selecting and detailing the specific sampling techniques and equipment to be used, and documenting these in the Sampling and Analysis Plan. It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sample Personnel - It is the responsibility of the field sampling personnel to follow these procedures, or to follow documented, project-specific procedures as directed by the Field Team Leader and/or the Project Manager.

V. Procedures

The primary considerations for collecting fish for population studies include identifying sampling locations, proper sampling techniques for the haul seine and proper documentation of samples. Detailed procedures for conducting fish populations utilizing the haul seine are described in the sections to follow.

A. Equipment

The following list is an example of the type of equipment that generally must be on hand when collecting fish samples with a haul seine:

Seine

- Fish Measuring Board
- 0-16 oz scale, 1-4 lb scale, 1-15 lb scale
- Appropriate sampling keys for species to be sampled, and any required instruments to aid in the identification
- Live Well (large tub) with overflow pipe to outside of boat
- Field sampling data sheets
- Glass jars for storage of fish
- Black Permanent Marker
- Camera
- Required Personal Protective Equipment
- Portable Air Pumps

B. Preliminary Activities

Collect and determine all information pertinent to the fish sampling project, including water depth, station locations, nearby boat access locations, known sediment contamination, any waterway obstructions or inconsistencies (e.g. shallow or grassy areas, low structures, pipe crossings), any other biological studies previously conducted on or near the site, species used locally for human consumption and the degree of such consumption, species most likely present, and the most appropriate sampling method for the species of interest that is permitted by law.

Before sampling occurs, conduct a site reconnaissance using a site map. The objective of this exercise is to categorize habitats, and map dividing lines and descriptors identifying the various types of habitats available. Make notations on the map depicting the "abiotic" characteristics of the reach including features such as pools, riffles, runs, substrate, water depth, channel shape, degree of bank erosion, tidal variations shade/sun exposure, and relative current velocity and direction. Also make notations on the site map to show "biotic" characteristics of the reach including fish species observed, evidence of fisherman use, and aquatic and riparian vegetation including wetlands. In addition, identify station locations at this point, along with the total area to be sampled. Choose the station locations, where possible, to represent ecologically similar aquatic environments.

Ensure adequate number of sample collection jars for entire trip.

Set up a continuous flow through water system using the live wells and the pumps. Place the overflow pipes about five inches from the top of the well. Attach a mesh/screen over the inlet of the overflow pipe to prevent loss of small fish species.

C. Operating Procedure

Determine the area to be sampled, and mark it with flagging, if possible. Stretch the seine across the area to be sampled, with a minimum of one field personnel on either side of the seine. Ensure that the weighted side of the seine is at the bottom. Best results are achieved when the water level is no deeper than two thirds the height of the slack net.

Rapidly walk through the water at the same speed, while keeping a constant distance apart. If sampling in a stream, walk upstream against the current. As the end of the sampling area approaches, pull the seine rapidly toward the shore, and lift the weighted end out of the water. Place the collected fish into the live wells.

If other field personnel are present, have them walk towards the seine to chase the fish in that direction. In addition, have them help to lift the seine when the sampling effort is complete.

Conduct sampling in areas that will ensure adequate qualitative and/or quantitative representation of the fish community, whichever is necessary. These areas should include riffles/runs, shorelines, snags, natural fish holding areas, vegetation beds and other habitats.

At the end of a sampling reach, identify, measure, weigh and release the specimens. Record the proportion of individuals as hybrids and the proportion of individuals with disease, tumors, fin damage, skeletal anomalies, and any other pertinent information on a field data sheet.

VI. Quality Assurance Records

Quality Assurance records will be maintained for each sample that is collected. The following information will be recorded in the Field Logbook:

- Sample identification (site name, location, project no.; sample name/number and location; sample type and matrix; time and date; sampler's identity).
- Field observations and measurements (sample setting, appearance of substrate, sampling method, and photograph descriptions).
- Additional remarks, as appropriate.

Record all observations in the Field Logbook. Complete field sheets for the collected samples.

VII. References

Brower, 1977. James E. Brower and H. Jerrold Zar. *Field and Laboratory Methods for General Ecology*. Wm. C. Brown Company Publishers. 1977.

Ricker, 1971. Ricker, W.E. *Methods for Assessment of Fish Production in Fresh Waters*. International Biological Programme Handbook No. 3. 1971.

U.S. EPA, 1987. U.S. Environmental Protection Agency. *A Compendium of Superfund Field Operations Methods*. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement. December 1987.

U.S. EPA, 1989. Warren-Hicks, William, Parkhurst, Benjamin R., Baker, Samuel S. Jr. *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference*. U.S. EPA, Environmental Research Laboratory, Corvallis, OR 97333. March 1989.

STANDARD OPERATING PROCEDURE

Fish Population Sampling Using Gill Net Procedures

I. Purpose

The purpose of this SOP is to provide general reference information and technical guidance on the procedure to sample and characterize fish communities using gill net procedures. The collected samples provide information used in the determination of population statistics of the fish community and can be used to collect fish samples for chemical analysis of tissues. This information will be used in the assessment of risks to human health and the environment.

II. Scope

This guideline provides information on proper sampling equipment and techniques for the collection of fish in streams, ponds, and near-shore areas of lakes, impoundments, bays, and estuaries, and the ocean shoreline. This technique is most effective in slow moving streams and rivers, and open areas in lakes and impoundments. Swift moving water bodies tend to tangle the nets.

Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The technique described should be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methods.

III. Definitions

Abiotic	Non-biological components of the environment, including water body structure and natural or manmade disturbances.
Bow	The front of a boat.
Biotic	Biological components of the environment, including organisms and vegetation.
Reach	The designated portion of a stream or river.
Riffles	A stretch of water flowing over, rocks, debris, or shallow sediments causing a disturbance of the water.
Riparian	Along the bank of a river or lake.
Stern	The back of a boat.
Runs	A stretch of water flowing without any disturbances.

IV. Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures that deviate from those presented herein.

Field Team Leader - The Field Team Leader is responsible for selecting and detailing the specific sampling techniques and equipment to be used, and documenting these in the Sampling and Analysis Plan. It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sampling Personnel - It is the responsibility of the field sampling personnel to follow these procedures, or to follow documented, project-specific procedures as directed by the Field Team Leader and/or the Project Manager.

V. Procedures

The primary consideration for collecting fish using gill nets is identifying sampling locations where there is a steady traffic of fish. Accurate and timely deployment and retrieval of the gill nets is a key variable in the success of the fish collection effort. Detailed procedures for conducting fish populations utilizing gill nets are described in the sections to follow.

A. Equipment

The following list is an example of the type of equipment that generally must be on hand when collecting fish samples with gill net:

- Sampling boat
- Gill nets (the size mesh is dependent on the size fish desired for collection)
- Flotation and weights to properly set the nets
- Fish Measuring Board
- 0-16 oz scale, 1-4 lb scale, 1-15 lb scale
- Live Well (large tub) with overflow pipe to outside of boat
- Appropriate sampling keys for species to be sampled, and any required instruments to aid in the identification
- Field sampling data sheets
- Glass jars for storage of fish
- Black Permanent Marker
- Camera
- Required Personal Protective Equipment
- Portable Air Pumps
- Field log book
- Fish scale envelopes

- Tweezers
- Additional line and couplings
- Tools (pliers, variable wrench, hammer)

B. Preliminary Activities

Collect and determine all information pertinent to the fish sampling project, including water depth, station locations, nearby boat access locations, known sediment contamination, tidal variation, any waterway obstructions or inconsistencies (e.g. shallow or grassy areas, low structures, pipe crossings), any other biological studies previously conducted on or near the site, species used locally for human consumption and the degree of such consumption species most likely present, and the most appropriate sampling method for the species of interest that is permitted by law.

Before sampling occurs, conduct a site reconnaissance using a site map. The objective of this exercise is to categorize habitats, and map dividing lines and descriptors identifying the various types of habitats available. Make notations on the map depicting the "abiotic" characteristics of the reach including features such as pools, riffles, runs, substrate, water depth, channel shape, degree of bank erosion, shade/sun exposure, and relative current velocity and direction. Also make notations on the site map to show "biotic" characteristics of the reach including fish species observed, evidence of fisherman use, and aquatic and riparian vegetation including wetlands. In addition, identify station locations at this point, along with the total area to be sampled. Choose the station locations, where possible, to represent ecologically similar aquatic environments.

Ensure adequate number of sample collection jars for entire trip.

Set up a continuous flow through water system using the live wells and the pumps. Place the overflow pipes about five inches from the top of the well. Attach a mesh/screen over the inlet of the overflow pipe to prevent loss of small fish species.

C. Operating Procedure

Determine the area to be sampled, and mark it with flagging, if possible. Field personnel that are setting the net should be standing on the platform on the bow of the boat. Place one end of the gill net with a weight attached to the bottom and a buoy attached to the top into the water, stretch the gill net (do not leave slack) across the area to be sampled by pulling it along with the boat. If there is a discernible flow, the net will be set in the upstream direction.

The net should remain in the sample location for 8 to 12 hours before retrieving. Field personnel that are collecting the fish should be standing on the platform on the bow of the boat. The net should be pulled slowly from the water and the collected fish removed as the net is being removed from the water. Place the collected fish into the live wells.

Conduct sampling in areas that will ensure adequate qualitative and/or quantitative representation of the fish community, whichever is necessary. These areas should

include riffles/runs, shorelines, snags, natural fish holding areas, vegetation beds and other habitats.

Upon retrieval of a gill net, identify, measure, weigh and release the specimens. Collect fish scales for aging. Record the proportion of individuals as hybrids and the proportion of individuals with disease, tumors, fm damage, skeletal anomalies, and any other pertinent information on a field data sheet.

To the extent possible, process all species in the field and return them to the stream alive. If specimens present taxonomic difficulties, or are too numerous for effective field processing, preserve them in 10% Formalin, and transport them to the office or lab for taxonomic work and measurements.

VI. Quality Assurance Records

Quality assurance records will be maintained for each sample that is collected. The following information will be recorded in the field logbook:

- Sample identification (site name, location, project no.; sample name/number and location; sample type and matrix; time and date; sampler's identity).
- Field observations and measurements (sample setting, appearance of substrate, sampling method, and photograph descriptions).
- Additional remarks, as appropriate.

Record all observations in the field logbook. Complete field sheets for the collected samples.

VII. References

Brower, 1977. James E. Brower and H. Jerrold Zar. *Field and Laboratory Methods for General Ecology*. Wm. C. Brown Company Publishers. 1977.

Ricker, 1971. Ricker, W.E. *Methods for Assessment of Fish Production in Fresh Waters*, International Biological Programme Handbook No. 3. 1971.

U.S. EPA, 1987. U.S. Environmental Protection Agency. *A Compendium of Superfund Field Operations Methods*. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement. December 1987.

U.S. EPA, 1989. Warren-Hicks, William, Parkhurst, Benjamin R., Baker, Samuel S. Jr. *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference*. U.S. EPA, Environmental Research Laboratory, Corvallis, OR 97333. March 1989.

STANDARD OPERATING PROCEDURE

Fish Sample Collection Procedures

I. Purpose and Scope

To provide general guidelines on collecting, preserving, and shipping fish samples for chemical analysis. Selected fish will be analyzed as whole fish for parameters of interest at the site.

II. Equipment and Materials

- Sample containers: teflon baggies, sample jars, aluminum foil
- Stainless steel knife
- Personal protective equipment
- Coolers
- Dry ice
- Buckets
- Labels
- Masking tape

III. Procedures and Guidelines

After being collected, fish will be placed in a live-well or equivalent until they can be processed. Processing of fish includes identification, measuring weight and length, and determining if they will be retained for analysis. Fish retained for analysis will be killed by suffocation.

Fish will be collected for whole fish tissue analysis. Samples will be placed in glass sampling jars. All of the samples will be stored and shipped to the analytical laboratories on dry ice.

IV. Attachments

None

V. Key Checks

- Samples should be stored on dry ice after they are killed.

STANDARD OPERATING PROCEDURE

Aquatic Macroinvertebrate Sampling

I. Purpose

To provide a general guideline for sampling benthic macroinvertebrate communities.

II. Scope

A standard benthic macroinvertebrate sampling procedure is described. Site-specific details are discussed in related sections of the field sampling plan.

III. Equipment and Materials

- Data sheets
- Ponar or Ekman grab sampler
- Benthic wash buckets or U.S Standard No. 30 screens
- Standard No. 30 dip net
- Outer and inner rubber gloves
- Plastic bottles or containers with labels
- Rinse bottles
- Cooler
- Water buckets
- Brushes
- Large wash tub
- Site Health and Safety Plan
- Alcohol solution
- Field log book
- Metered line
- Sampling boat

IV. Procedures and Guidelines

1. Identify appropriate sample station locations in ponds, wetlands, and rivers, estuaries, and map these locations.

2. Collect samples starting from downstream locations, when sampling in flowing systems.

3. Select the appropriate sampling device (i.e. petite Ponar, Ekman, Surber, etc.) and collect the number of replicate samples at each station specified in the Project Instructions/Work Plan.

4. Sieve the contents of the sampler through a U.S. Standard No. 30 (0.5 mm) mesh screen or bucket with screened bottom.

5. Characterize the contents of the sample by species, if possible, and relative abundance and record this information on a appropriate data sheet.

6. Transfer contents of the screen to a labeled sample container and fix with alcohol or formalin solution.

7. Areas of wetland or stream habitat may be sampled with a dip net (U.S. Standard No. 30 mesh). Sweep the net in a standardized motion through rooted vegetation or stream areas to collect a single composite invertebrate sample. Follow procedures for other methods described above.

8. Characterize substrate conditions including color, odor, relative organic content, and physical condition.

9. Wash and rinse sampling equipment between stations to avoid contamination.

10. Photograph sample stations to supplement written descriptions.

V. Attachments

None

VI. Key Checks and Items

- Wash and rinse sampling equipment between sample stations.

STANDARD OPERATING PROCEDURE

Qualitative Mammalian Species Survey

I. Purpose

To provide a general guideline for conducting a qualitative mammal community survey.

II. Scope

A standard procedure for conducting a qualitative terrestrial mammal community survey. Site specific details are discussed in related sections of the FSP.

III. Equipment and Materials

- Topographic and site area maps
- Aerial photographs
- Compass
- Data sheets
- Hand lens
- Field guides or keys
- Species list, if available
- Appropriate safety equipment
- Camera
- Binoculars
- Site Health and Safety Plan
- Field log book

IV. Procedures and Guidelines

1. Proceed along a series of pre-established sample transects over the site, being sure to include every major plant community or habitat type.

2. Search additional areas or locations that may provide areas of mammal concentration or opportunities for observation of mammal signs such as tracks.

3. Record direct observations of mammals and any signs of mammal activity on the site including but not limited to the following:

    - Tracks or foot prints
    - Scats, droppings or other fecal material

- Burrows or holes in stream banks, hill sides or den trees
- Leave, grass, or stick nests on the ground or in trees
- Ridges, mounds, or tunnels in the ground or in vegetation
- Trails or runways through the study area
- Signs of grazing, browsing, rubbing, or clawing on trees, shrubs, or other vegetation

4. Photograph representative signs of mammal activity and plot the location of nests, burrow, etc., on a map of the site.

V. Attachments

None

VI. Key Checks and Items

- Look for mammal signs on the ground, in trees and other vegetation, and along wetlands and water bodies.

STANDARD OPERATING PROCEDURE

Avian Community Survey

I. Purpose

To provide a general guideline for conducting a qualitative avian species community survey.

II. Scope

A standard avian community sampling procedure is provided. Site specific details are discussed in related sections of the FSP.

III. Equipment and Materials

- Topographic and site area maps
- Aerial photographs
- Binoculars
- Data sheets
- Species code list
- Compass
- Field guides or keys
- Species list, if available
- Appropriate safety equipment
- Camera
- Site Health and Safety Plan
- Field log book

IV. Procedures and Guidelines

1. Conduct avian surveys at pre-established sample points over the site. Sample points should be located in each major plant community or habitat type of the survey area and should be far enough apart to avoid counting the same birds twice.

2. Record all birds heard or seen from the sample point for a period of approximately 20 minutes. Shorter time intervals may be used under some circumstances.

3. Scan for birds at all levels of vegetation and take care not to record the same bird more than once.

4. Record the species, number, sex, and age if possible for all birds observed. If birds occur in flocks to large to be counted estimate the number of birds by counting the number of birds in a portion of the group and estimating the number of portions in the entire flock.

5. Record the activity, habitat, and type of observation (i.e. seen, heard, or both) using the codes on the data sheet.

6. Birds flying over the site but not actually landing within a specific habitat type should be recorded as "flyovers." If, however, a bird flies through an area and never lands, but the observer feels it is using the particular habitat type, then record that type.

7. Surveys should be conducted between daybreak and 9:30 a.m., if possible. Surveys should not be conducted in high winds, heavy rains, or heavy fog. Weather conditions at the time of survey should be recorded on the data sheets.

8. Record other signs of bird use of the site such as stick nests, nest or roost cavities, droppings or pellets, tracks, and signs of foraging.

V. Attachments

None.

VI. Key Checks and Items

- Avoid counting the same bird more than once.
- Record all birds even those that cannot be identified accurately
- Record signs of bird use of the site such as nests in trees and cavities, droppings or pellets, and tracks.

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Salinity, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using the Horiba® U-22 with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using the Horiba® U-22 for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), salinity, and temperature of water samples. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Horiba® U-22 Water Quality Checker with flow-though cell
- Distilled water in squirt bottle
- Horiba® U-22 Auto-Calibration Standard Solution

III. Procedures and Guidelines

A. Parameters and Specifications:

Parameter	Range of measurement	Accuracy
pH	0 to 14 pH units	+/- 0.1 pH units
Specific conductance	0 to 9.99 S/m	+/- 3 % full scale
Turbidity	0 to 800 NTU	+/- 5 % full scale
Dissolved oxygen	0 to 19.99 mg/l	+/- 0.2 mg/l
Temperature	0 to 55 °C	+/- 1.0 °C
ORP	-999 to +999 mV	+/- 15 mV
Salinity	0 to 4 %	+/- 0.3 %

B. Calibration:

Prior to each day's use, clean the probe and flow-through cell using deionized water and calibrate using Horiba® Standard Solution. Calibration procedure:

1. Fill the calibration beaker to about 2/3 with the pH standard solution provided (pH 4).

2. Fit the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.

3. Turn power on.

4. Press CAL key to put the unit in the calibration mode.

5. Press the ENT key to start automatic calibration. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.

6. If the unit is calibrated properly, pH will read 4.0 +/- 3%, conductivity will read 4.49 +/- 3%, and turbidity will read 0 +/- 3%

C. Sample Measurement:

As water passes through the flow-through Cell, press MEAS to obtain reading; record in the field notebook.

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance
- Check batteries, and have a replacement set on hand
- Due to the importance of obtaining these parameters, the field team should have a spare unit readily available in case of an equipment malfunction.

STANDARD OPERATING PROCEDURE

Streamflow Measurements

I. Purpose

The purpose of this SOP is to provide general reference information for estimating the instantaneous discharge of flowing streams.

II. Scope

This SOP provides a description of field procedures, equipment, and calculations necessary to estimate the instantaneous discharge of streams using current meters to measure the velocity of flow. The SOP also covers constructing simple channel-control devices to expedite measuring the rate of flow with a current meter in a small shallow stream.

The SOP does not cover determining the stage-discharge relationships; therefore, methods to determine the stage or water level in streams are not covered. The SOP also does not cover instances where current-meter measurements must be made in deep water by suspending the meter from a bridge or other structure.

III. Procedures

A. Overview

Streamflow measurements are used to estimate the discharge of moving surface-water bodies. The simplest methods comprise using a current meter to measure the rate of flow in units such as feet per second and developing an estimate of the cross-sectional area in units such as square feet. Combined, they provide an estimate of the discharge, or volume rate of flow, of the stream.

The use of current meters to measure the flow velocity and the means of calculating the discharge are discussed below. There also is a discussion of the purpose and approach for modifying the channels of small streams in order to expedite measuring the flow velocity.

The information provided in this SOP primarily was derived from the USGS publication on measuring and computing streamflow (USGS 1982). Another good source of information is *Field Hydrogeology* (Brassington 1988).

B. Equipment

The following equipment is required:

- Current meter with wading rod and electronic counter (if available) to measure the relative velocity of the flow at different locations within the stream channel
- Stop watch to measure the increment of time over which meter rotations are counted
- Measuring tape or cable marked in even increments for determining the width of the stream and controlling the location where measurements are taken
- Waders (if necessary)

A current meter is an instrument used to measure the velocity of moving water in a surface stream. The current meter consists primarily of an impeller which, when placed in a moving stream of water, rotates at a rate that is proportional to the velocity of the flow of water passing by it. Current meters are available from the company equipment pool. Other types of meters are available but all serve the same purpose.

C. Taking Measurements

The current meter is used by suspending it in the stream and pointing it in the upstream direction. The assumption is that the stream to be measured is sufficiently shallow to wade in. The meter is attached to a special rod which is graduated in such units as centimeters and which allows the meter to be positioned in the stream at a known depth. The rate at which the impeller rotates is counted over a specified period of time, either by observing the rotations (for smaller meters and slow streams) or noting the number of rotations recorded by an electronic counter.

A Type AA Price current meter is standard for large streams. A Price pygmy meter should be used when the water depth is less than 1.5 feet. However, the two types of meters should not be used together in determining the total discharge of a stream at a single location in order to prevent inconsistencies in instrument operation from being introduced.

The tape or marked cable is stretched across the stream channel and anchored securely at each end. The total width of the stream is determined. Flow measurements are taken at known increments (even increments are best because it simplifies the subsequent calculations). There should be 10 to 20 measurements across a large stream, fewer across a small one. Preferably, no more than 5 percent of the total stream flow goes through an individual cross section. The data collected are used to calculate the discharge by the midsection method normally employed by the USGS.

Set the rod firmly on the stream bottom and hold it vertically at the desired mark on the tape. Point the meter upstream and stand to the side so that the flow around your legs does not affect the meter.

In theory, the average velocity of a stream occurs at a depth of 0.6 of the total stream depth measured downward from the surface. The velocity is measured here in the one-point method. If it is easier to set the meter at 0.5 of the total depth, a correction factor can be included in the subsequent calculations by multiplying the total flow by 0.95.

If the stream is more than 2.5 feet deep, then the two-point method is used. Measurements are taken at depths of 0.2 and 0.8 of the total stream depth. The measurements at 0.2 and 0.8 are averaged. Even if a pygmy meter is being used, the two-point method should be used unless the water depth is greater than 0.75 feet; otherwise, the velocity will be underestimated.

Allow the impeller rotation to settle down for a few seconds, then count the rotations over a 1-minute period. Do this twice so that a replicate number is available for averaging. Record the distance along the stream where the measurement was taken, the number of counts, the depth of the stream, and the depth of the meter. Record the data on a data form.

The velocity of flow for each set of measurements is determined using tables provided with the current meter used.

D. Stream-Channel Configuration

A straight stretch of stream with a fairly constant depth is preferred for conducting streamflow measurements. This will maximize the likelihood that the streamlines are parallel to one another. There should be few if any rocks, holes, or structures in the stream. Preferably the depth of the section to be measured is greater than 0.5 feet and the velocity is greater than 0.5 feet per second.

For small, very shallow streams, it may be necessary to modify the stream configuration to increase the tendency for horizontal flow and reduce turbulence. This may be done be installing two parallel rows of cinder blocks, pressure-treated lumber, or other materials along the stream channel in the direction of flow. The bottom of the channel also should be as smooth as possible. Flow is directed into this channel by damming the stream on either side of the upper end of the constructed channel. The rate of flow then is measured about two-thirds of the way down the constructed channel where the flow effects of the ends of the channel would be minimized. A pygmy current meter may still be needed to measure flow in the channel. Note that it may be necessary to reconstruct the channel periodically if stormflow has caused the construction to shift.

Note that in a constructed channel, there will be some effects on flow induced by the side walls. In this case, the velocities will need to be adjusted according to the following:

- At the wall, the velocity will be 0.65 percent of that measured (i./e., actual velocity = 0.65 x measured velocity)
- At a distance to the wall equal to 0.25 of the depth of the channel, the velocity will be 90 percent of that measured

- At a distance to the wall equal to 0.50 of the depth of the channel, the velocity will be 95 percent of that measured
- At a distance to the wall equal to 1.0 of the depth of the channel, the velocity will be 100 percent of that measured

E. Calculating the Discharge

Put simply, the discharge is estimated by multiplying the average velocity of flow through the individual cross sections by their areas and summing the individual totals. The calculations can be performed directly on the data sheet.

The individual cross section is defined by the depth d_2, d_3, ...d_n (Figure 3). The discharge for the individual sections then are calculated using the equation:

$$q_x = v_x ((b_{x+1} - b_{x-1}) / 2) d_x$$

where q_x = discharge through subsection x

v_x = mean velocity at vertical x

b_{x+1} = distance from initial point to preceding vertical

b_{x-1} = distance from initial point to next vertical

d_x = depth of water at vertical x

For example, the flow though the section with depth d_4 in Figure 3 is calculated by:

$$q_4 = v_4 ((b_5 - b_3) / 2) d_4$$

At the ends the discharge is calculated by:

$$q_1 = v_1 ((b_2 - b_1) / 2) d_1$$

$$q_n = v_n ((b_n - b_{n-1}) / 2) d_n$$

IV. Attachments

None.

V. Key Items

- Ensure that the stream channel is reasonably straight and is not disrupted with boulders, holes, etc.
- Be sure that the current meter is working properly. The date of calibration should be checked.
- Measure the impeller-rotation counts over two 60-second intervals and average the two values.

VI. References

Brassington, R. 1988. *Field Hydrogeology*. Geological Society of London Handbook Series. John Wiley and Sons, Inc. New York. 175 pp.

USGS. 1982. *Measurement and Computation of Streamflow. Volume I: Measurement of Stage and Discharge*. U.S. Geological Survey Water Supply Paper 2175. 284 pp.

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

To provide general guidelines for entering field data into log books during site investigation and remediation field activities.

II. Scope

This is a general description of data requirements and format for field log books. Log books are needed to properly document all field activities in support of data evaluation and possible legal activities.

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

Properly completed field log books are a requirement of much of the work we perform under the Navy CLEAN contract. Log books are legal documents and, as such, must be prepared following specific procedures and must contain required information to ensure their integrity and legitimacy. This SOP describes the basic requirements for field log book entries.

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

1. Field notes commonly are kept in bound, orange-covered logbooks used by surveyors and produced, for example, by Peninsular Publishing Company and Sesco, Inc. Pages should be water-resistant and notes should be taken only with water-proof, non-erasable permanent ink, such as that provided in Sanford Sharpie® permanent markers.

2. On the inside cover of the log book the following information should be included:

   - Company name and address
   - Log-holders name if log book was assigned specifically to that person

- Activity or location
- Project name
- Project manager's name
- Phone numbers of the company, supervisors, emergency response, etc.

3. All lines of all pages should be used to prevent later additions of text, which could later be questioned. Any line not used should be marked through with a line and initialed and dated. Any pages not used should be marked through with a line, the author's initials, the date, and the note "Intentionally Left Blank."

4. If errors are made in the log book, cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the personnel performing the correction. If possible, all corrections should be made by the individual who made the error.

5. Daily entries will be made chronologically.

6. Information will be recorded directly in the field log book during the work activity. Information will not be written on a separate sheet and then later transcribed into the log book.

7. Each page of the log book will have a the date of the work and the note takers initials.

8. The final page of each day's notes will include the note-takers signature as well as the date.

9. Only information relevant to the subject project will be added to the log book.

10. The field notes will be copied and the copies sent to the Project Manager or designee in a timely manner (at least by the end of each week of work being performed).

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

1. Entries into the log book should be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. Entries must be legible and complete.

2. General project information will be recorded at the beginning of each field project. This will include the project title, the project number, and project staff.

3. Scope: Describe the general scope of work to be performed each day.

4. Weather: Record the weather conditions and any significant changes in the weather during the day.

5. Tail Gate Safety Talks: Record time and location of meeting, who was

present, topics discussed, issues/problems/concerns identified, and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

6. Standard Health and Safety Procedures: Record level of personal protection being used (e.g., level D PPE), record air monitoring data on a regular basis and note where data were recording (e.g., reading in borehole, reading in breathing zone, etc). Also record other required health and safety procedures as specified in the project specific health and safety plan.

7. Instrument Calibration; Record calibration information for each piece of health and safety and field equipment.

8. Personnel: Record names of all personnel present during field activities and list their roles and their affiliation. Record when personnel and visitors enter and leave a project site and their level of personal protection.

9. Communications: Record communications with project manager, subcontractors, regulators, facility personnel, and others that impact performance of the project.

10. Time: Keep a running time log explaining field activities as they occur throughout the day.

11. Deviations from the Work Plan: Record any deviations from the work plan and document why these were required and any communications authorizing these deviations.

12. Heath and Safety Incidents: Record any health and safety incidents and immediately report any incidents to the Project Manager.

13. Subcontractor Information: Record name of company, record names and roles of subcontractor personnel, list type of equipment being used and general scope of work. List times of starting and stopping work and quantities of consumable equipment used if it is to be billed to the project.

14. Problems and Corrective Actions: Clearly describe any problems encountered during the field work and the corrective actions taken to address these problems.

15. Technical and Project Information: Describe the details of the work being performed. The technical information recorded will vary significantly between projects. The project work plan will describe the specific activities to be performed and may also list requirements for note taking. Discuss note-taking expectations with the Project Manager prior to beginning the field work.

16. Any conditions that might adversely affect the work or any data obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

17. Sampling Information; Specific information that will be relevant to most sampling jobs includes the following:

- Description of the general sampling area – site name, buildings and streets in the area, etc.
- Station/Location identifier
- Description of the sample location – estimate location in comparison to two fixed points – draw a diagram in the field log book indicating sample location relative to these fixed points – include distances in feet.
- Sample matrix and type
- Sample date and time
- Sample identifier
- Information on how the sample was collected – distinguish between "grab," "composite," and "discrete" samples
- Number and type of sample containers collected
- Record of any field measurements taken (i.e. pH, turbidity, dissolved oxygen, and temperature, and conductivity)
- Parameters to be analyzed for, if appropriate
- Descriptions of soil samples and drilling cuttings can be entered in depth sequence, along with PID readings and other observations. Include any unusual appearances of the samples.

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

1. Use the left side border to record times and the remainder of the page to record information.
2. Use tables to record sampling information and field data from multiple samples.
3. Sketch sampling locations and other pertinent information.
4. Sketch well construction diagrams.

V. Attachments

None.

STANDARD OPERATING PROCEDURE

Preserving Non-VOC Aqueous Samples

I. Purpose

To provide general guidelines for preserving aqueous samples.

II. Scope

Standard aqueous sample preservation procedures for non-VOC samples are provided.

III. Equipment and Materials

- Disposable eye droppers
- Clean beakers for transfer of small portions of chemical preservative
- pH paper strips (range 0 to 14)
- Chemical preservatives, as appropriate
- Personal protection, as appropriate
- Clean out door or vented indoor area

IV. Procedures and Guidelines

1. Remove caps from sample containers to be chemically preserved in designated area. Add appropriate amount of chemical preservative to opened container. To determine the approximate amount of preservative required, preserve a sample of potable water and calculate the volume of preservative required.

2. After adding the appropriate preservatives to the sample containers, cap containers tightly. Invert sample container a few times to mix.

3. After preserving all the sample containers and mixing, open the container and check the pH of the sample by pouring out a small quantity of the sample to a clean receptacle and dipping a pH indicating strip into the sample. Add more preservative to the sample to adjust the pH, if necessary repeating steps 1 and 2. When three times the amount of preservative used to preserve a sample of potable water has been added, record the pH and notify the sample manager that the sample could not be preserved.

V. Attachments

None.

VI. Key Check Items

Be sure appropriate preservatives are used.

STANDARD OPERATING PROCEDURE

Equipment Blank and Field Blank Preparation

I. Purpose

To prepare blanks to determine whether decontamination procedures are adequate and whether any cross-contamination is occurring during sampling due to contaminated air and dust.

II. Scope

The general protocols for preparing the blanks are outlined. The actual equipment to be rinsed will depend on the requirements of the specific sampling procedure.

III. Equipment and Materials

- Blank liquid (use ASTM Type II grade water)
- Millipore™ deionized water
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

IV. Procedures and Guidelines

A. Decontaminate all sampling equipment that has come in contact with sample according to SOP *Decontamination of Personnel and Equipment.*

B. To collect an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

For non-volatiles analyses, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces which contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles.

Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

C. When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling VOCs. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decon. When decon is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.

D. To collect a field blank, slowly pour ASTM Type II water directly into sample containers.

E. Document and ship samples in accordance with the procedures for other samples.

F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

- Wear gloves.
- Do not use any non-decontaminated equipment to prepare blank.
- Use ASTM-Type II grade water.

STANDARD OPERATING PROCEDURE

Homogenization of Soil and Sediment Samples

I. Purpose

The homogenization of soil and sediment samples is performed to minimize any bias of sample representativeness introduced by the natural stratification of constituents within the sample.

II. Scope

Standard techniques for soil and sediment homogenization and equipment are provided in this SOP. These procedures do not apply to aliquots collected for VOCs, AVS/SEM, or field GC screening; samples for these analyses should NOT be homogenized.

III. Equipment and Materials

Sample containers, stainless steel spoons or spatulas, and stainless steel pans.

IV. Procedures and Guidelines

Soil and sediment samples to be analyzed for semivolatiles, pesticides, PCBs, metals, cyanide, or field XRF screening should be homogenized in the field. After a sample is taken, a stainless steel spatula should be used to remove the sample from the split spoon or other sampling device. The sampler should not use fingers to do this, as gloves may introduce organic interferences into the sample.

Samples for VOCs and AVS/SEM should be taken immediately upon opening the spoon and should not be homogenized.

Prior to homogenizing the soil or sediment sample, any rocks, twigs, leaves, or other debris should be removed from the sample. The sample should be placed in a decontaminated stainless steel pan and thoroughly mixed using a stainless steel spoon. The soil or sediment material in the pan should be scraped from the sides, corners, and bottom, rolled into the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the pan and mixed with the entire sample again.

All stainless steel spoons, spatulas, and pans must be decontaminated following procedures specified in SOP *Decontamination of Personnel and Equipment* prior to homogenizing the sample. A composite equipment rinse blank of homogenization equipment should be taken each day it is used.

V. Attachments

None.

VI. Key Checks and Items

- Take VOC and AVS/SEM samples immediately and do not homogenize the soil or sediment.
- Homogenize soil for analyses other than VOCs in a clean, stainless steel bowl.

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

The purpose of this guideline is to describe the packaging and shipping of low-concentration samples of various media to a laboratory for analysis.

II. Scope

The guideline only discusses the packaging and shipping of samples that are anticipated to have low concentrations of chemical constituents. Whether or not samples should be classified as low-concentration or otherwise will depend upon the site history, observation of the samples in the field, odor, and photoionization-detector readings.

If the site is known to have produced high-concentration samples in the past or the sampler suspects that high concentrations of contaminants might be present in the samples, then the sampler should conservatively assume that the samples cannot be classified as low-concentration. Samples that are anticipated to have medium to high concentrations of constituents should be packaged and shipped following procedures for dangerous-goods shipping specified by the intended shipper (e.g., Federal Express).

III. Equipment and Materials

- Coolers
- Clear tape
- "This Side Up" labels
- "Fragile" labels
- Vermiculite
- Ziplock bags or bubble wrap
- Ice
- Chain-of-Custody form (completed)
- Custody seals

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

- Tape drains shut.
- Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.
- Place mailing label with laboratory address on top of coolers.
- Fill bottom of coolers with about 3 inches of vermiculite.

B. Arrange decontaminated sample containers in groups by sample number. Consolidate VOC samples into one cooler to minimize the need for trip blanks.

C. Affix appropriate adhesive sample labels to each container. Protect with clear label protection tape.

D. Seal each sample bottle within a separate ziplock plastic bag or bubble wrap, if available. Tape the bag around bottle. Sample label should be visible through the bag.

E. Arrange sample bottles in coolers so that they do not touch.

F. If ice is required to preserve the samples, cubes should be repackaged in zip-lock bags and placed on and around the containers.

G. Fill remaining spaces with vermiculite.

H. Complete and sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express or the courier.

J Close lid and latch.

K. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.

L. Tape cooler shut on both ends, making several complete revolutions with strapping tape. **Do not** cover custody seals.

M. Relinquish to Federal Express or to a courier arranged with the laboratory. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.

Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with several additional restrictions. The sample handler must refer to instructions associated with the shipping of dangerous goods for the necessary procedures for shipping by Federal Express or other overnight carrier.

V. Attachments

None.

VI. Key Checks and Items

- Be sure laboratory address is correct on the mailing label
- Pack sample bottles carefully, with adequate vermiculite or other packaging and without allowing bottles to touch
- Be sure there is adequate ice
- Include chain-of-custody form
- Include custody seals

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I. Purpose

The purpose of this SOP is to provide information on chain-of-custody procedures to be used under the CLEAN Program.

II. Scope

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities (except wellhead samples taken for measurement of field parameters). Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. This procedure identifies the necessary custody records and describes their completion. This procedure does not take precedence over region specific or site-specific requirements for chain-of-custody.

III. Definitions

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. One copy of the form must be retained in the project file.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under one's custody if:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and then he/she locked it up to prevent tampering.
- It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

IV. Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein. The Project Manager is responsible for ensuring that chain-of-custody procedures are implemented. The Project Manager also is responsible for determining that custody procedures have been met by the analytical laboratory.

Field Team Leader - The Field Team Leader is responsible for determining that chain-of-custody procedures are implemented up to and including release to the shipper or laboratory. It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sample Personnel - It is the responsibility of the field sampling personnel to initiate chain-of-custody procedures, and maintain custody of samples until they are relinquished to another custodian, the sample shipper, or to a common carrier.

V. Procedures

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is valid. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom, as well as providing security for the evidence as it is moved and/or passed from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain-of-possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

A. Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When *in situ* measurements are made, the data are recorded directly in bound logbooks or other field data records with identifying information.

Information which shall be recorded in the field logbook, when in-situ measurements or samples for laboratory analysis are collected, includes:

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,
- Date and time of sample collection and/or measurement,

- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

1) Sample Label

Samples, other than for *in situ* measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling and Analysis Plan. Each sample container is identified by a sample label (see Attachment A). Sample labels are provided, along with sample containers, by the analytical laboratory. The information recorded on the sample label includes:

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 12/21/85).
- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site).

B. Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed of.

1) Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.

- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once developed, the photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographs will be stored in the project files. It is good practice to identify sample locations in photographs by including an easily read sign with the appropriate sample/location number.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

2) Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. A Chain-of-Custody Record Form example is shown in Attachment B. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as given below:

- Enter header information (CTO number, samplers, and project name).

- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).

- Sign, date, and enter the time under "Relinquished by" entry.

- Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).

- If a carrier is used, enter the airbill number under "Remarks," in the bottom right corner;

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.

- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.

- Place the seal across the shipping container opening so that it would be broken if the container were to be opened.

- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

VI. Quality Assurance Records

Once samples have been packaged and shipped, the Chain-of-Custody copy and airbill receipt become part of the quality assurance record.

VII. Attachments

A. Sample Label
B. Chain of Custody Form
C. Custody Seal

VIII. References

USEPA. *User's Guide to the Contract Laboratory Program.* Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

QAL

Quality Analytical Laboratories, Inc.
2567 Fairlane Drive
Montgomery, Alabama 36116
PH. (334)271-2440

Client _____
Sample No. _____
Location _____
_____
Analysis _____
_____
Preservative HCL
Date _____ By _____

CEIMIC
CORPORATION
10 Dean Knauss Drive, Narragansett, R.I. 02882 • (401) 782-8900

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE

SAMPLE TYPE

☐ Grab ☐ Composite ☐ Other _____

COLLECTED BY:

CH2M HILL

APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project #

Purchase Order #

Project Name

Company Name CH2M HILL Office

Project Manager & Phone #
Mr. [ ]
Ms. [ ]
Dr. [ ]

Report Copy to:

Requested Completion Date:

Sampling Requirements: SDWA [ ] NPDES [ ] RCRA [ ] OTHER ____

Sample Disposal: Dispose [ ] Return [ ]

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	Matrix AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	LAB TEST CODES	ANALYSES REQUESTED	REMARKS	LAB 1 ID	LAB 2 ID

SHADED AREA – FOR LAB USE ONLY

Lab 1 #

Lab 2 #

Quote #

Kit Request #

Project #

No. of Samples

Page of

Login

LIMS Ver

Sampled By & Title (Please sign and print name)

Date/Time

Relinquished By (Please sign and print name)

Date/Time

Received By (Please sign and print name)

Date/Time

Relinquished By (Please sign and print name)

Date/Time

Received By (Please sign and print name)

Date/Time

Relinquished By (Please sign and print name)

Date/Time

Received By (Please sign and print name)

Date/Time

Shipped Via UPS BUS Fed-Ex Hand Other ____

Shipping #

Work Authorized By (Please sign and print name)

Remarks

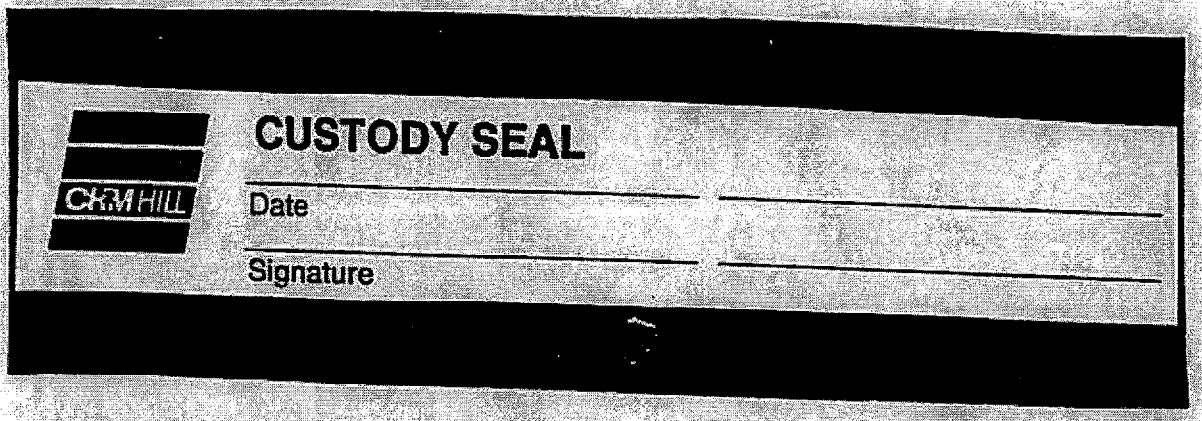
QC Level: 1 2 3 Other: ____

COC Rec	ICE
Ana Req	TEMP
Cust Seal	Ph

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client

REV 3/94 FORM 340


CH2MHILL
CUSTODY SEAL
Date
Signature

STANDARD OPERATING PROCEDURE

Surface Water Sampling

I. Purpose and Scope

This procedure presents the techniques used in collecting surface water samples. Materials, equipment, and procedures may vary; refer to the Field Sampling Plan and operators manuals for specific details.

II. Materials and Equipment

Materials and equipment vary depending on type of sampling; the Field Sampling Plan should be consulted for project-specific details. Typical equipment required includes:

- Open tube sampler
- Dip sampler
- Weighted bottle sampler
- Hand pump
- Kemmerer or Van Dorn sampler
- Depth-integrating sampler
- Sample containers
- Meters for specific conductance, temperature, pH, and dissolved oxygen

III. Procedures and Guidelines

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP *Decontamination of Personnel and Equipment*. Surface water samples collected from water bodies tidally influenced should be collected at low tide and under low flow conditions to minimize the dilution of potential contaminants. Methods for surface water sample collection are described below.

A. Manual Sampling

Surface water samples are collected manually by submerging a clean glass, stainless steel, or Teflon container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline. The most common sampler types are beakers, sealable bottles and jars, pond samplers, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler

assembly. Specific types of weighted bottle samplers include dissolved oxygen, Kemmerer, or Van Dorn, and are acceptable in most instances.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.
5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

IV. Attachments

None.

V. Key Checks and Items

- Start downstream, work upstream
- Log exact locations using permanent features
- Beware of hidden hazards

STANDARD OPERATING PROCEDURE

Sediment Sampling

I. Purpose

These general outlines describe the collection and handling of sediment samples during field operations.

II. Scope

The sediment sampling procedures generally describe the equipment and techniques needed to collect representative sediment samples. Operators manual , if available, should be consulted for specific details

III. Equipment and Materials

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device)
- Stainless steel spoon or spatula for media transfer
- Measuring tape
- Log book
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.)
- Materials for classifying soils, particularly the percentage of fines
- Sample jars, including jars for Total Organic Carbon and pH, as appropriate

IV. Procedures and Guidelines

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.

2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc).

3. Transfer sample into appropriate sample jars with a stainless steel utensil. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.

4. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.

5. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.

6. Sample sediment for TOC and pH also, to give context to organic and inorganic data during the risk assessment.

7. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.

8. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. Attachments

None.

VI. Key Checks and Items

- Start downstream, work upstream.
- Log exact locations using permanent features.
- Beware of hidden hazards.

STANDARD OPERATING PROCEDURE

Flat Bottom Boat Sampling Operations

I. Purpose

Flat bottom boat sampling operations are a non-standard practice of RCRA/CERCLA investigations. The objective of these operations is to access those sample locations inaccessible to larger, deeper draft, motorized water craft.

II. Scope

The provisions of this SOP apply to all program and project personnel engaged directly in technical boating operations, whether planning or executing those operations. These provisions apply whenever technical boating equipment or activities are used or included in project operations.

III. Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans for boating operations and federal and state boating safety regulations are in accordance with these procedures, where applicable, or that other approved procedures are developed.

Field Team Leader - The Field Team Leader is responsible for ensuring that these boating procedures are implemented in the field, and for ensuring that personnel performing these activities have been briefed and trained to execute these procedures.

Sampling Personnel - It is the responsibility of the sampling personnel to follow these procedures or to follow documented, project-specific procedures as directed by the Field Team Leader and/or the Project Manager. The sampling personnel are responsible for the proper sampling procedures, proper operation of the boat and adherence to waterborne health and safety procedures.

IV. Procedures

The following procedures outline the planning and execution of flat bottom boat sampling operations:

1. All operations involving technical boating will be directed by qualified and experienced boater as the team leader.
2. All persons participating in boating operations will be directed by the Team Leader.

3. All persons participating in boating operations will have been trained by the Team Leader or provide proof of experience in operating such water craft.
4. All water craft shall operate on a "line of sight" rule. No water craft will go out of sight of each other.
5. All personnel shall wear their Personnel Floatation Devices at all times while they are on the water.
6. The boating team will include at least one person qualified in First Aid/CPR for nonstandard conditions (for example: fire rescue, air/land/sea rescue).
7. All personnel shall wear bright colors (for example: hunter orange, yellow, etc.) to enhance their visibility to one another.
8. All personnel shall collect one sample at a time, and return that sample to the "mother ship," the dock, or other location as determined by site conditions and situation.
9. Team Leader has final authority on operations with regards to weather and water conditions.

STANDARD OPERATING PROCEDURE

Clean Sampling for Trace Metals in Surface Water

I. Purpose and Scope

This procedure presents the special techniques used in collecting surface water samples that will be analyzed for trace metals. Detection limits required are very low, and extra precautions must be taken both in the laboratory and in the field to avoid contaminating the samples. Materials, equipment, and procedures may vary depending upon the metals of concern and criteria levels; refer to the Field Sampling Plan and operator's manuals for specific details.

This method is not to be used for sampling for TAL analytes under normal conditions, but only in instances when selected metals with high toxicity (usually mercury or copper) have been detected in trace amounts at specific sites and an ecological or human health risk assessor has determined that the metals must be monitored at very low concentrations.

II. Materials and Equipment

Materials and equipment vary depending on type of sampling; the Field Sampling Plan should be consulted for project-specific details.

- Open tube sampler
- Dip sampler
- Weighted bottle sampler
- Peristaltic pump with in-line filter apparatus
- 0.45-micron filters
- Depth-integrating sampler
- Sample containers, furnished by the laboratory, cleaned and double-bagged
- Tubing, furnished by the laboratory, cleaned and double-bagged
- Non-talc gloves, multiple pairs for each sampling location
- Flat working area, such as a portable table
- Plastic drop-cloth or sheeting for a clean working surface
- Tyvek coveralls
- Storage coolers
- Meters for specific conductance, temperature, pH, and dissolved oxygen

III. General Clean Sampling Procedures

Clean sampling procedures minimize inadvertent contamination during the collection and handling of the sample in the field, as well as in the laboratory, by preventing contact of the sample with metal-containing materials and minimizing exposure to the air. The clean sampling procedures employed are based on EPA's *Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (July 1996). Clean sampling procedures are subject to field conditions and may be modified as necessary to ensure contamination-free sampling and worker safety.

Primary elements of clean sampling include the following:

- Metal-free sample apparatus, including sample containers, sampling devices, and all materials or equipment involved in the sample collection procedure. A clean working surface, such as a portable table covered with plastic sheeting, may be helpful.
- Advance planning and a dry-run practice session are highly recommended to prevent accidental decontamination while working. Review the EPA video, *Sampling Ambient and Effluent Water for Trace Metals* (17 minutes) for a demonstration of the techniques and equipment used. The video is available from the project chemist.
- Thorough decontamination and secure packaging of all apparatus before transportation to the site. Sample containers and tubing that will come into direct contact with the sample water are to be double-bagged.
- Field personnel trained in clean sampling techniques. One field worker is identified as the "clean-hands" worker, and another as the "dirty-hands" worker. All required contact with significant sources of contamination is made by the dirty-hands worker. In order to minimize sample contamination, the clean-hands worker contacts only the inner bags and sample containers and other items that are not expected to be significant sources of contamination.
- Special field clothing (Tyvek coveralls and non-talc latex gloves).
- QA/QC protocols to detect any source of contamination resulting from sample collection, handling, and analysis.

Clean sampling techniques address the potential for contamination by airborne sources. However, the EPA method does not address the potential for contamination from meteorological conditions like rain and wind, which have been shown to be airborne vectors for metal particulates and other contaminants. Field teams will make detailed notes regarding the weather and characterize any potential source of sample contamination that may result. Field and equipment blanks will be collected to assess possible contamination.

IV. Specific Procedures and Guidelines

All operations involving contact with the sample bottles, the inner plastic baggie, transfer of the sample, or any sample preparation are to be handled by the field worker designated as the "clean-hands" worker. The bottle caps are not to be set down on possibly contaminated surfaces while collecting the samples. The cap should not be held so that the inner side is exposed to the wind.

All operations involving opening of outer plastic containers must be performed by the individual assigned as the "dirty-hands" workers.

Field workers should avoid contact with any metal-containing objects during the sample collection period. In the case of unavoidable contact with metal-containing objects, the field workers must ensure that any objects which contact the collected sample, either directly or indirectly (including Tyvek coveralls, outer portion of gloves), are not contaminated from exposure. For example, if one worker is required to cover parts of a boat with plastic sheeting or contact a metal grid to prepare for the sample collection, clean Tyvek coveralls and appropriate gloves must be put on after this activity.

Other contamination which may occur during sample collection from airborne particulates, exhaust from nearby vehicles, and/or debris from disturbance of the sample collection location (such as removal of manhole cover) should be avoided. If possible, field workers should wait for the optimum time (low to zero winds, no nearby traffic, several minutes after the manhole lid is removed) before initiating the sample collection. If unavoidable during sample collection, the sample should be shielded from the source of contamination by the "clean hands" worker.

The procedure is subject to modification based on conditions encountered in the field. For example, if the dirty-hands person requires assistance from the clean-hands person, the clean-hands person will don a new set of clean sampling gear to become clean again. It is suggested that the team members begin with two pairs of gloves on, so that in case of accidental contamination, the outer gloves can be removed and the procedure continued without stopping to find a new pair of gloves.

All sample containers to be used should be labeled and positioned within easy reach of the sampling location. The outer bag that holds the clean sample bottles will be labeled with the sample ID, date collected, time collected, analyses to be performed, and the client name with an indelible sharpie (the clean sample bottle itself will not be labeled).

Mark the required information in the field notebook (workers' names, date, time of arrival at sample location, etc.). Both field workers must then put on "clean" sampling gear (includes Tyvek coveralls and non-talc gloves). The Tyvek coveralls contain metal parts (zipper). If these components have not been previously covered with Teflon tape in a clean environment, they must be put on prior to non-talc gloves.

The field workers start, by donning one pair of gloves from the "non-clean" bag of extra gloves. Making sure to cover metal rings and watches, they proceed by

applying the two pairs of "clean" non-talc gloves. This third pair of gloves is used to allow the workers to put on Tyvek without contamination of the "clean" gloves beneath. Next, the workers put on the Tyvek coveralls. After fully dressed, both workers remove the outer pair (3rd pair) of gloves. Each worker shall visually inspect the other to confirm the gear is properly covering all exposed sources of contamination.

Using a peristaltic pump to collect the sample will allow the least contact with the sample water. Attach the tubing to a notched metal-free pipe or wand to sample from shore. An in-line filter may be used with the pump for collecting samples for filtered metal analysis.

If the sample must be collected from a bridge, a weighted (plastic-lined weight) collection bottle may be used. If sample is collected from a boat, be aware of rust and fuel exhaust. The boat should be positioned down-wind from the sampling location.

Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

V. Attachments

None.

VI. Key Checks and Items

- Start downstream, work upstream.
- Avoid disturbance of bottom sediments as much as possible
- Log exact locations using permanent features
- Beware of hidden hazards
- Change gloves frequently as needed.

Test Method (SED - Lp - 152) - 28-Day Static-Renewal Toxicity Test with Estuarine Amphipods (*Leptocheirus plumlosus*)to Meet U.S. EPA Guidelines

1.0 OBJECTIVE

The objective of this study is to determine the chronic toxicity of sediment to estuarine amphipods (*Leptocheirus plumulosus*) during a 28-day exposure. Amphipods are exposed to the sediment sample to assess survival, growth, number of young per surviving female and percent gravid females on test day 28 (test termination). The methods (Springborn Smithers Laboratories test method #: SED-Lp-152) described in this test method generally meet the standard procedures described in 'Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-Associated Contaminants with the Amphipod *Leptocheirus plumulosus*' (U.S. EPA, 2001).

2.0 MATERIALS AND METHODS

2.1. TEST ORGANISMS

2.1.1. **Species** - The estuarine amphipod, *Leptocheirus plumulosus*, is used to conduct the 28-day toxicity test. The neonate amphipods used to initiate the 28-day test are the same size and age and are those amphipods that pass through a 0.5 mm sieve and retained on a 0.25 mm sieve.

2.1.2. **Source** - The neonate amphipods are obtained from a reliable commercial supplier. The neonate amphipods will be held under the same conditions as testing (i.e., salinity 20 ± 2 ‰, temperature 25 ± 2 °C).

2.1.3. **Feeding** - While being maintained in the culture prior to the test, neonate amphipods are fed a flaked fish food suspension (100 mg/mL) *ad libitum* each day. During the test, each exposure vessels is fed a flaked fish food suspension (10 mg/mL) three times per week (following renewal of overlying water). On test day 0 through 13, 2.0 mL of the flaked fish food suspension (10 mg/mL) is added to each exposure vessel. On days 14 through 27, 4.0 mL of the flaked fish food suspension (10 mg/mL) is added to each exposure vessel.

2.1.4. **Handling** - Wide-bore pipets and 0.25 mm mesh sieves are used to transfer the neonate amphipods to the test vessels, taking care to minimize possible stress due to handling. Amphipods that are damaged or dropped during transfer are not used.

2.1.5. **Reference Test** - A 96-hour reference test, water-only exposure, using cadmium is conducted on a sub-population of organisms (from the same population used to initiate the test) within 30 days of the study. The health of the test population is assessed using the LC50 from the reference test..

2.2. PHYSICAL SYSTEM

2.2.1. Sediment Samples - Sediment samples (both test and reference sites) should be shipped overnight to Springborn Smithers Laboratories. Upon receipt at Springborn, sample containers are inspected for leakage or damage and the sample identity is recorded. If storage is required, the samples are refrigerated at approximately 4 °C. Prior to use, all sediment samples are pressed through a 0.25 mm sieve to remove debris, large clumps of sediment, large predators, indigenous amphipods and to facilitate removal of offspring at termination of the test. A control sediment, collected by Springborn Smithers Laboratories, will be included in the test to evaluate performance of the test organisms and exposure system. The test is initiated within 14 days of sediment collection.

2.2.2. Test Chambers - The test chambers used in the static acute bioassay are 1000 mL glass jars which are chemically clean. Each jar contains 2 cm of sediment (approximately 120 mL) and 750 mL of overlying water. Test vessels will be covered with plastic during the test minimize evaporation of the overlying water. Each test vessel is labeled with the appropriate test concentration and replicate. Test vessels are cleaned by an appropriate method to remove residue of test material previously used (i.e., acid to remove metals and bases; detergents and organic solvents to remove organic compounds) and rinsed several times using dilution water.

2.2.3. Overlying Water - Natural, filtered seawater from the Cape Cod Canal is used as dilution water for the test. The water is filtered through a 20-Φm and 5-Φm polypropylene core filter and heated to the required test temperature. Salinity and pH of each new batch of seawater is measured and recorded to ensure that these parameters are within acceptable ranges. Natural values for seawater, generally, are a pH range of 7.5 - 8.2 and salinity 29 - 35 $^{o}/_{oo}$. Prior to use in the cultures or test system, the seawater used in diluted, with deionized water, to a salinity of 20 ‰. Periodic analysis of representative samples of seawater are conducted to ensure the absence of potential toxicants, including pesticides, PCBs and selected toxic metals, at concentrations which may be harmful to the amphipods.

2.2.4. Control Sediment - The laboratory control sediment, will be collected from a site, known to be free of contamination and supports a local population of amphipods. Sediment will be consistent with estuarine sediment and contain a high content of silt and clay (i.e., > 90% fines).

2.3. TEST PROCEDURES

2.3.1. Test Concentration - Each sediment sample is tested in five replicates, as 100% whole sediment (no dilutions). Sediment from one or more uncontaminated reference sites are usually included in the test to evaluate the survival, growth (dry weight) and sexual maturation potential of the test organisms in a non-contaminated sediment. The laboratory control sediment is also tested in five replicates. Twenty amphipods per replicate (100 per sediment sample or reference control) are used to initiate the test.

2.3.2. Test Initiation - The day before test initiation (day -1) test sediment, reference control sediment and laboratory control sediment are added to the test vessels. The overlying water is added gently to prevent resuspension of the sediment layer in the

water column. This allows the sediment and water to equilibrate prior to addition of the test organisms.

Neonate amphipods are removed from the cultures vessels and twenty amphipods are impartially selected and pipeted into each replicate test or control vessel. This procedure is repeated until all vessels contain twenty amphipods. Test vessels are inspected within 2 hours after amphipods are introduced to ensure organisms are not trapped in the surface tension. Organisms trapped in the surface tension are removed and replaced with new amphipods.

2.3.3. **Renewal of Overlying Water** - During the 28-day study, the overlying water is renewed by siphoning 400 mL of the overlying water and replacing it with fresh overlying water three times per week. The siphoning and replacement of overlying water is done carefully so as to not disturb the sediment layer. The 400 mL of fresh overlying water contains the food ration for that test day (i.e., either 3.0 mL or 6.0 mL of a 10 mg/mL flaked fish food suspension, see Section 2.1.3).

2.3.4. **Photoperiod** - The test vessels are illuminated at a light intensity of 20 to 100 footcandles using a combination of fluorescent bulbs. A 16-hour light, 8-hour dark photoperiod is maintained with an automatic timer. Sudden transitions from light to dark and vice versa are avoided.

2.3.5. **Measurement of Water Quality Variables** - At test initiation and test termination, temperature, pH, dissolved oxygen (DO) concentration and salinity in the overlying water are measured in each replicate test vessel. Temperature, DO, pH and salinity are measured two additional times per week (at each renewal interval) in one replicate test vessel of each treatment and control. These additional measurements are alternated between replicates at each interval. Ammonia concentrations are measured at test initiation and at test termination in a composite sample overlying water from each replciate vessel of each treatment and control. Temperature is monitored continuously in the waterbath using a minimum-maximum thermometer. Temperature extremes are recorded daily.

2.3.6. **Dissolved Oxygen** - To prevent total dissolved oxygen from dropping below 4.0 mg/L, aeration (with oil-free air) is maintained throughout the exposure at a rate of 1 to 3 bubbles per second with a 1 mL glass pipette.

2.3.7. **Temperature** - Water temperature of the test solutions is maintained at 25 ± 2°C by conducting the study in a temperature controlled waterbath.

2.3.8. **Biological Data** - Survival of the adult amphipods is determined in each test vessel at test termination by sieving the sediment, through a 0.75 mm and 0.25 mm sieve, to remove all surviving adult amphipods (retained on the 0.75 mm sieve) and young produced (retained on the 0.25 mm sieve). All surviving adult amphipods for each replicate vessel are then to a tared weigh boat and dried overnight at 70°C. Following drying, the samples are cooled to room temperature and weighed on an analytical balance to the nearest 0.01 mg.

Young amphipods are removed from the 0.25 mm sieve and transferred to a labeled sample jar. Sufficient alcohol is added to the sample jar to preserve the offspring and 3.0 milliliters of concentrated Rose Bengal solution (1 mg/mL) is then preserved

in 70% ethanol solution until young can be counted. Reproduction is reported as number of young per surviving female in each replicate vessel.

2.3.9 **Acceptability Criteria** - The percent survival of adult amphipods in the control must be ≥ 80 % after 28 days of exposure.

3.0 CALCULATIONS

Mean survival, growth, number of young per surviving adult amphipod for each sediment sample is compared to the mean survival, growth, number of young per surviving adult amphipod of the appropriate reference sediment sample for determination of significant adverse effects.

The mean survival, growth, number of young per surviving adult amphipod of each sediment sample will be tested for normality and homogeneity of variance using Shapiro-Wilks Test and Bartlett's Test. If the data set passes these two tests, then a parametric method (e.g., Dunnett's Test) will be used to evaluate the results of the mean survival of each test sample for significant adverse effects. If the data set fails the test for normality and homogeneity of variance, then a non-parametric method (e.g., Steel's Many-One Rank Test will be used to determine significant adverse effects. If necessary, mean values (i.e., percent survival) will be transformed (e.g., arcsine square root).

4.0 REPORTING

The raw data and summary report are reviewed by the Study Director. The test results will be presented in an outline format on a per sample basis.

5.0 REFERENCES

U.S. EPA. 2001. Methods for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-Associated Contaminants with the Amphipod *Leptocheirus plumulosus*. Office of Research and Development. Washington, DC EPA/600/R-01/020.

Appendix C
Site Specific Health and Safety Plan

CH2M HILL HEALTH AND SAFETY PLAN

This Health and Safety Plan (HSP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual,* as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must sign **Attachment 1.**

Project Information and Description

PROJECT NO:	314926.FI.BC
CLIENT:	US Navy
PROJECT/SITE NAME:	Bousch Creek
SITE ADDRESS:	Naval Station Norfolk, Norfolk, VA
CH2M HILL PROJECT MANAGER:	Ben Francisco/VBO
CH2M HILL OFFICE:	5700 Thurston Ave, Suite 116A Virginia Beach, VA 23455
DATE HSP PREPARED:	September 13, 2004
DATE(S) OF SITE WORK:	September 13, 2004 -Dec 1 2004
SITE ACCESS: I	Identification Badges - Navy issued
SITE SIZE:	Refer to work plan.
SITE TOPOGRAPHY:	Mid-Atlantic Coastal Region, Marsh Area
PREVAILING WEATHER:	For the month of September temperature ranges between 80□F and 56□F, with an average precipitation of 4.44 inches.
DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED:	• Sediment collection for toxicity testing • Ecological survey • Collection of tissue samples by trapping fish • Surface water sampling

SITE DESCRIPTION AND HISTORY:

Bousch Creek is located entirely on NSN. The creek channel has been significantly altered from historic conditions and most of the bordering vegetated wetlands have been filled as part of facility development. Currently, portions of the creek are lined or walled with concrete, it has been channelized over most of its length, and the creek flows through underground culverts over part of its length. The headwaters of the creek consist of two branches, the eastern branch, which flows west past the northern edge of the Camp Allen Landfill (CAL), and the western branch, which flows west and then north along the southern and western edges of the CAL. Several small tributaries enter the western branch from the west. The two branches merge near the northwestern edge of the CAL. The creek then flows north and then west for about 2,000 feet before entering an underground culvert that traverses the overrun portion of the air field runway. Three principal tributaries enter the creek from the west and one enters (as an outfall) from the east within this stretch. Just downstream of where Bousch Creek emerges from the concrete culvert, a tributary that drains the area around the CD Landfill enters the creek from the west. The creek then flows north, then west, and then south before entering a 3,900-foot underground culvert. Just before tuning south, a tributary that drains parking lots and commercial development enters the creek from the north. The downstream end of the 3,900-foot culvert is the creek's outfall to Willoughby Bay.

Twenty-nine outfalls discharge directly to Bousch Creek between its headwaters near the CAL and its confluence with Willoughby Bay. Most of these outfalls carry storm water runoff not associated with a regulated industrial activity. Some of these outfalls carry storm water runoff from airfield and vehicle maintenance activities; only one of these 29 outfalls is associated with industrial drainage. Available data suggest that most of the complex of remnant tributaries that comprises the Bousch Creek system is influenced by the daily tides. Exceptions include most of the eastern branch of the creek, the extreme upper portions of the western creek branch, and the upper portions of the four tributaries (including the ditches near the CD Landfill) that enter the main creek channel from the west. Salinity is highest in the lower portions of the creek complex (15 to 18 parts per thousand) with the headwater areas (not influenced by daily tidal flow) generally consisting of freshwater. The salinity in the system also fluctuates regularly

based upon the point in the tidal cycle and the amount of freshwater input from precipitation events due to runoff. Substrate type is somewhat variable within the creek system but most sediments are composed of silt-clay, are soft and dark, rich in organic matter (especially in the wetland areas), and give off a sulfide odor when disturbed. A few areas near roads are composed of mostly sand and are low in organic matter. Sediments in some areas had strong petroleum odors and released a visible sheen when disturbed. This typically occurred only in samples taken near the runway and near major roads.

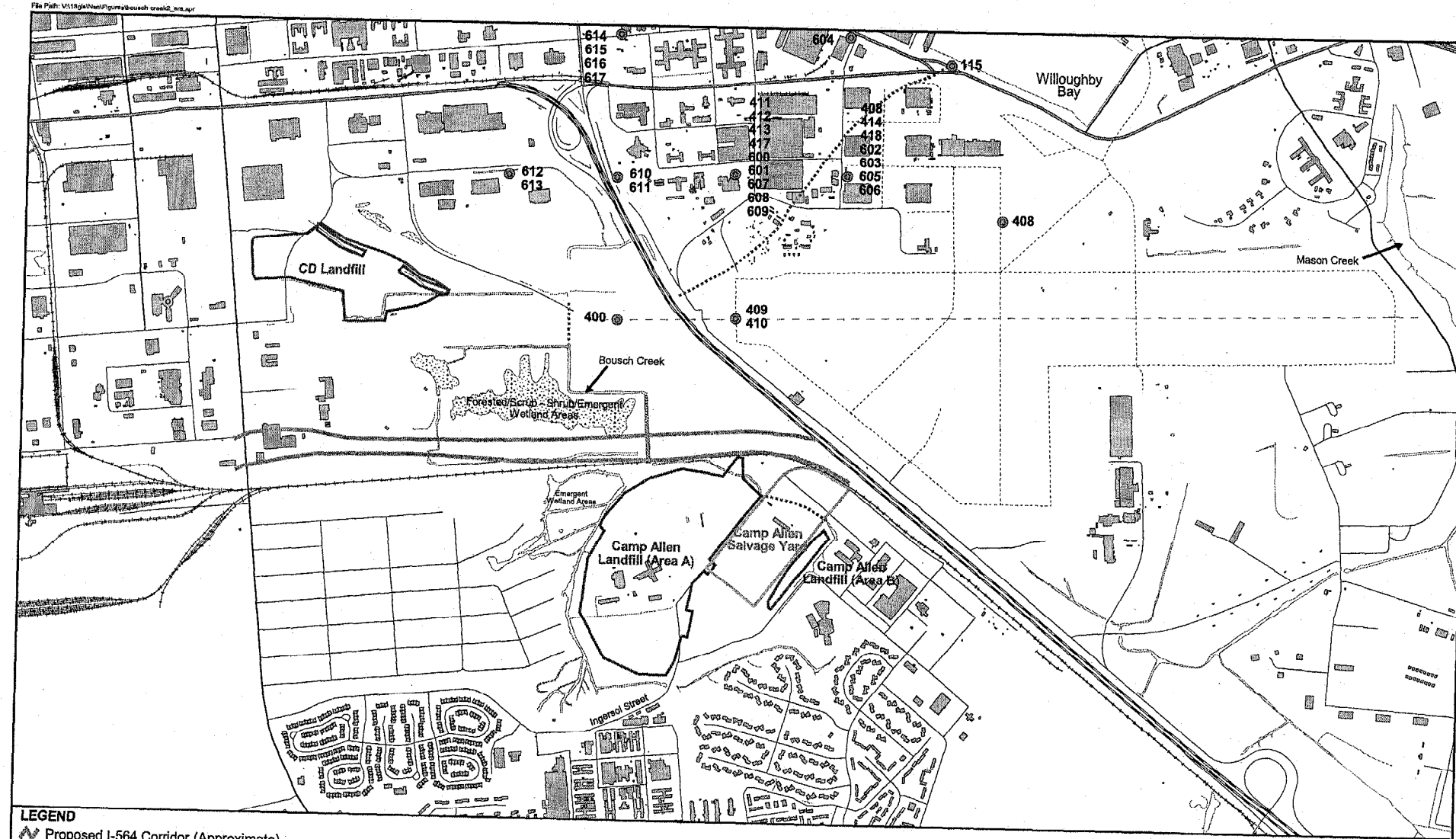


Figure 2-1
Location Map
Bousch Creek Ecological Risk Assessment
Naval Station Norfolk
Norfolk, Virginia

CH2MHILL

1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

Refer to project documents (i.e., Work Plan) for detailed task information. A health and safety risk analysis (Section 1.2) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

- Sediment sampling

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Health and Safety Manager (HSM) is required before these tasks are conducted on regulated hazardous waste sites.**

TASKS	CONTROLS
• Ecological Survey	• Brief on hazards, limits of access, and emergency procedures
• Fish Trapping	• Post contaminant areas as appropriate (refer to Section 8.2 for details)
• Tissue sampling fish	• Sample and monitor as appropriate (refer to Section 5.0)

1.2 Task Hazard Analysis

(Refer to Section 2 for hazard controls)

POTENTIAL HAZARDS	TASKS	
	Sediment & Surface Water sampling using a boat	Sediment & Surface Water sampling from the shore or water
Flying debris/objects	X	X
Noise > 85dBA	X	
Electrical	X	
Suspended loads	X	
Slip, trip, fall	X	X
Back injury	X	X
Visible lightning	X	X
Elevated work areas/falls		X
Fires		X
Heavy equipment	X	
Working near water		X
Working from boat	X	

2 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SSC for clarification.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in **Attachment 6.** These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments: **Initially before operating boat.**

2.1 Project-Specific Hazards

2.1.1 Field Vehicle

- Review driving directions prior to departure.
- Always wear seatbelt while operating vehicle.
- Tie down loose items if utilizing a van.
- Pull off the road, put the car in park and tun on flashers before talking on a mobile phone.
- Maintain both a First Aid kit and Fire Extinguisher in the field vehicle at all times.
- Close car doors slowly and carefully.
  - Fingers can get pinched in doors or the truck.
- Park vehicle in a location where it can be accessed easily in the event of an emergency.
  - If not possible, carry a cellular phone.
- Verify directions to Hospital by driving from site to medical facility. See **Attachment 4**

2.1.2 Inclement Weather

- Work may proceed in light rain- wear rain gear.
- Exposure to slips, trips and falls is increased during rainy and snowing conditions.
- Take cover in field vehicle during adverse weather conditions (High winds, heavy rain, lightning).
- Work shall cease and cover sought in the event of lightning or tornado warnings.
  - Identify "Take Shelter" areas before starting project.
  - Work may proceed in light rain- wear rain gear.
- Notify the Project Manager and Client Representative after shelter has been sought.

2.1.3 Wading/Walking in Water

- Traversing lakes & streams presents significant hazards, including drowning, hypothermia, and abrasions.
- Be cautious of areas where there are submerged or partially submerged trees/tree branches – these can create entanglement hazards.
- Streams should be crossed while facing upstream, stepping side to side, and using a sturdy walking stick.
- If streams are crossed that are deeper than "crotch deep", staff must wear chest waders.
- Streams that are deeper than mid-chest deep should not be assessed – move to a section that is less deep.

- Creeks and river areas will be wadeble in places, however there may be deep spots. Care must be taken when wading not to proceed beyond waist deep without a buddy nearby.
- It is imperative that all employees be instructed in and follow safety precautions when using equipment and hazardous materials. Waders will not be worn when personnel are in the boat.
- The sediments in the creek/river may be soft and there is a possibility of sinking.
- When wading, team members are cautioned to be careful of footing.

2.1.4 Boating

(Reference CH2M HILL SOP HS-404, *In-Water, Wetlands, and Coastal Areas*)

- All operations involving boating will be directed by qualified and experienced boater.
- All persons participating in boating operations will be directed by the SSC.
- Safe means of boarding or leaving the boat or platform must be provided to prevent slipping and falling.
- The Safe Boating Checklist found in **Attachment 5** of this safety plan will be completed at the frequency specified in Section 2 of this plan.
- All personnel shall wear their Personnel Floatation Devices (PFD) at all times while they are on the water.
- The boating team will include at least one person qualified in First Aid.
- All personnel shall wear bright colors (for example: hunter orange, yellow, etc.) to enhance their visibility to one another.
- Team Leader has final authority on operations with regards to weather and water conditions
- Boat must be equipped with adequate railing.
- Never stand on the gunwales of a boat except when needed for embarking or disembarking.
- Employees should be instructed on safe use of the boat.
- Work requiring the use of a boat will not take place at night or during inclement weather.
- The boat must be operated according to U.S. Coast Guard regulations (speed, lighting, right-of-way, etc).
- The engine should be shut off before refueling.
- Do not smoke while refueling.

2.1.5 Steep Slopes

- Always avoid these areas whenever possible.
- "Climbing" in these areas should be minimized and limited to that which does not require the use of climbing equipment.
- Exercise caution in relying on rocks and trees/tree stumps to support yourself – many times they are loose.
- Whenever possible, switchback your way up/down steep areas.
- Maintain a slow pace with firm footing.

2.1.6 Lightning

- Avoid working during thunderstorms.
- If caught in one, seek shelter among densely wooded areas.
- Avoid lone trees as shelter.
- Avoid open, bare areas.
- Do not cross water bodies.
- If caught in open area, place feet close together and crouch down as small as possible, without lying on the ground.
- Ground strikes are know to be initiated by "leaders", or charges, from the earth making a connection to the charge in the clouds. This may cause your hair to stand up, and since you do not want to be

part of a leader the makes the connection to form a cloud-to-ground strike, immediately crouch as described above.

2.2 General Hazards

General Practices and Housekeeping

(Reference CH2M HILL SOP HS-209, *General Practices*)

- Site work should be performed during daylight hours whenever possible..
- Maintain good housekeeping in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.

Hazard Communication

(Reference CH2M HILL SOP HS-107, *Hazard Communication)*

The SSC is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using **Attachment 2.**
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using **Attachment 3**.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL SOP HS-403, *Hazardous Materials Handling*, & CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods)*

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

2.2.4 Lifting

(Reference CH2M HILL SOP HS-112, *Lifting (Manual)*)

- Proper lifting techniques must be used when lifting any object.
  - Plan storage and staging to minimize lifting or carrying distances.
  - Split heavy loads into smaller loads.
  - Use mechanical lifting aids whenever possible.
  - Have someone assist with the lift -- especially for heavy or awkward loads.
  - Make sure the path of travel is clear prior to the lift.

2.2.5 Fire Prevention

(Reference CH2M HILL SOP HS-208, *Fire Prevention & Control*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - be maintained in a fully charged and operable condition,
  - be visually inspected each month, and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.6 Procedures for Locating Buried Utilities

Local Utility Mark-Out Service

Name: **Miss Utility of Virginia**
Phone: **1-800-552-7001**

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.
- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually

- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change n advancement of auger or split spoon).

When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SSC should confirm that arrangement.

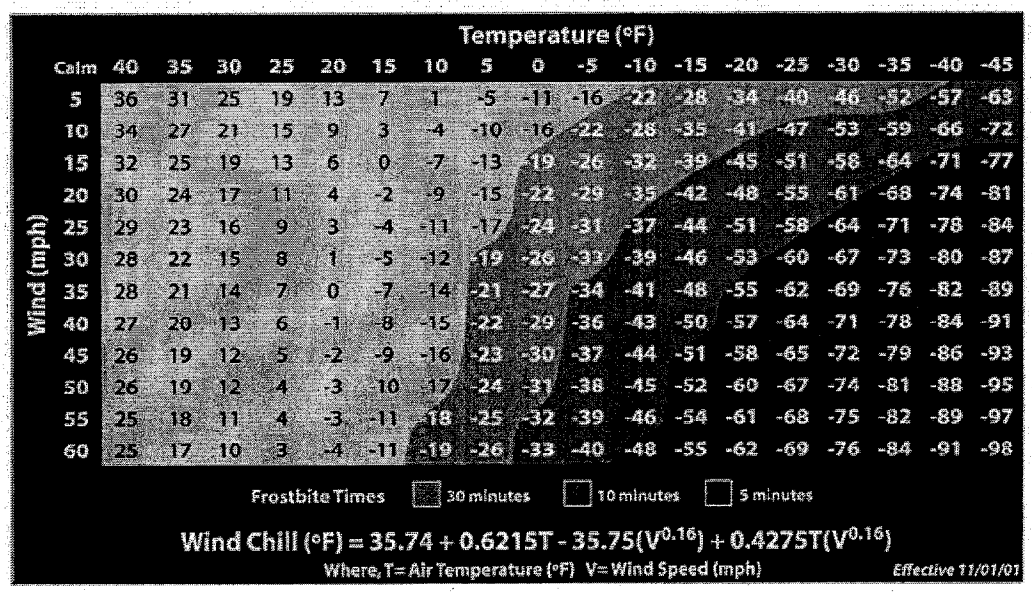
2.2.7 Cold Stress

(Reference CH2M HILL SOP HS-211, *Heat and Cold Stress*)

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SSC/DSC to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench) Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

Wind Chill Chart



Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T = Air Temperature (°F) V = Wind Speed (mph)

Effective 11/01/01

2.3 Biological Hazards and Controls

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.3.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention. **Refer to Attachment 8-Biological hazards**

2.3.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention. **Refer to Attachment 8- Biological Hazards.**

2.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.5 Bloodborne Pathogens

(Reference CH2M HILL SOP HS-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

2.3.6 West Nile

The following information is taken from the Centers for Disease Control and Prevention (CDC) Website:

Human illness from West Nile virus is rare, even in areas where the virus has been reported. The chance that any one person is going to become ill from a mosquito bite is low. On rare occasions, West Nile virus infection can result in a severe and sometimes fatal illness known as West Nile encephalitis (an inflammation of the brain). The risk of severe disease is higher for persons 50 years of age and older. There is no evidence to suggest that West Nile virus can be spread from person to person or from animal to person.

Most infections of West Nile encephalitis are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and rarely, death. The incubation period in humans (i.e., time from infection to onset of disease symptoms) for West Nile encephalitis is usually 3 to 15 days. If symptoms occur, see your doctor immediately.

You can reduce your chances of becoming ill by protecting yourself from mosquito bites. To avoid mosquito bites:

- Apply insect repellent containing DEET (N,N-diethyl-meta-toluamide) when you're outdoors. Apply sparingly to exposed skin. DEET in high concentrations (greater than 35%) provides no additional protection.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing.
- Read and follow the product directions whenever you use insect repellent.
- Wear long-sleeved clothes and long pants treated with repellent and stay indoors during peak mosquito feeding hours (dusk until dawn) to further reduce your risk.
- Limit the number of places available for mosquitoes to lay their eggs by eliminating standing water sources.

2.4 Radiological Hazards and Controls

Refer to CH2M HILL's *Corporate Health and Safety Program, Program and Training Manual,* and *Corporate Health and Safety Program, Radiation Protection Program Manual,* for standards of practice in contaminated areas.

Hazards	Controls
None Known	None Required

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Acenapthene	SS: 0.170 (NNB-BCM-SD97-13)	NL	NL	NL	NL
Acenapthylene	SS: 0.089 (NNB-BCM-SD97-08)	NL	NL	NL	NL
Acetone	SS: 0.460 (NNB-BCM-SD97-05)	NIOSH 590 mg/m^3	2500 ppm	Irrit. Eyes, nose, throat; head, dizz, CNS depress; derm.	9.69
Aluminum	SW: 6.6 (NNB-BCM-SW97-06L)	0.5 mg/m^3 (resp)	UK	Irritant to eyes, skin, respiratory system	NA
Anthracene	SS :0.210 (NNB-BCM-SD97-08)	NIOSH Ca 0.1 mg/m^3	Ca 80 mg/m^3	Derm, bron, [carc]	NA
Aroclor-1260	SS: 0.54 (NNB-BCM-SD-99-07)	0.5 mg/m^3	5 Ca	Eye and skin irritation, acne-form dermatitis, liver damage, reproductive effects	UK
Arsenic	SS: 142 (NNB-BCM-SD97-13)	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Barium	SS: 96.5 (NNB-BCM-SD-99-07)	NIOSH/ OSHA 0.5 mg/m^3	50 mg/m^3	Irrit eyes, skin, upper resp sys, skin burns, gastroenteritis, musc spasm, slow pulse, extrasystoles, hypokalemia	NA
Benzo(a)anthracene	SS: 0.7 (NNB-BCM-SD97-08)	0.1 mg/m^3	80 mg/m^3	Dermatitis, bronchitis, carcinogen	NA
Beryllium	SS: 10.9 (NNB-BCM-SD-99-15A)	NIOSH Ca 0.0005 mg/m^3	Ca 4 mg/m^3	Berylliosis (chronic exposure), anorexia, low-wgt, weak, chest pain, cough, clubbing of fingers, cyan, pulm insufficiency, irrit eyes, derm, [carc]	NA
2-Butanone (Methyl Ethyl Ketone, MEK)	SS: 0.071 (NNB-BCM-SD97-01)	200 ppm	3,000	Eye, skin, and nose irritation; headache; dizziness; vomiting; dermatitis	9.54
Butylbenzylphthalate	SS: 0.099 (NNB-BCM-SD-99-01)	NL	NL	NL	NA
Cadmium	SW: 0.00225 (NNB-BCM-SW97-15L) SS: 159 (NNB-BCM-SD-99-07)	0.005 mg/m^3	9 Ca	Pulmonary edema, coughing, chest tightness/pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, difficulty breathing, loss of sense of smell, emphysema, mild anemia	NA
Carbon Disulfide	SS: 0.059 (NNB-BCM-SD97-05)	1 ppm	500	Dizz, head, poor sleep, ftg, ner, anor, low-wgt; psychosis; polyneur; Parkinson-like syndrome; ocular changes; coron. heart disease; gastritis; kidney and liver injury; eye and skin burn; derm; repro effects.	10.08

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Alpha-Chlordane	SS: 0.200 (NNB-BCM-SD-99-09)	0.5 mg/m³	100 Ca	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors anuria	UK
gamma-Chlordane	SS: 0.250 (NNB-BCM-SD-99-09)	0.5 mg/m³	100 Ca	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors anuria	UK
Chromium (as Cr(II) & Cr(III))	SS: 1480 (NNB-BCM-SD-99-07)	0.5 mg/m³	25	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Copper	SW: 0.0782 (NNB-BCM-SW97-08H) SS: 246 (NNB-BCM-SD97-03)	0.01 mg/m³	100 mg/m³	Irritation eyes, upper respiratory system; metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough, lassitude (weakness, exhaustion); metallic or sweet taste; discoloration skin, hair	UK
DDD	SS: 0.13 (NNB-BCM-SD-99-01)	0.5 mg/m³	500 Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsion; eye and skin irritation; vomiting	UK
DDE	SS: 0.7 (NNB-BCM-SD-99-07)	0.5 mg/m³	500 Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsion; eye and skin irritation; vomiting	UK
DDT	SS: 0.14 (NNB-BCM-SD-99-07)	0.5 mg/m³	500 Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsion; eye and skin irritation; vomiting	UK
Dibenz(a,h)anthracene	SS: 0.11 (NNB-BCM-SD-99-04)	UK	UK	Redness, swelling, itching, eye irritant	UK
Diethylphthalate	SS: 3.70 (NNB-BCM-SD-99-22)	5 mg/m³	4,000	Eye, upper respiratory system, and stomach irritant	UK
1,2-Dichloroethene (total)	SS: 0.010 (NNB-BCM-SD97-12)	200 ppm	1000	Eyes and respiratory system irritant. CNS depres.	9.65
Dieldrin	SS: 0.0069 (NNB-BCM-SD-99-19)	250 µg/m3	50 mg/m 3	Headache, dizziness, vomiting, nausea, convulsions	NA
Fluorene	SS: 0.078 (NNB-BCM-SD97-08)	NL	NL	NL	NL
Iron	SW: 17. 6 (NNB-BCM-SW97-15L)	5 mg/m³ (Dust)	2500 mg/m³	Benign pneumoconiosis with X-Ray shadows indistinguishable from fibrotic pneumoconiosis (siderosis)	NA
Lead	SW: 0.127 (NNB-BCM-SW97-15L) SS: 3190 (NNB-BCM-SD97-02)	0.05 mg/m³	100	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Manganese	SW:.412 (NNB-BCM-SW97-06H)	1 mg/m³	500 mg/m³	Parkinson's, asthenia, insomnia, mental confusion, metal fume fever, dry throat, cough, chest tight, dysp, rales, flu-like fever, low-back pain, vomit, kidney damage.	12.88

2.5 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Mercury	SW:.0093 (NNB-BCM-SW97-08H) SS: 0.89 (NNB-BCM-SD-99-07)	0.05 mg/m³	10	Skin and eye irritation, cough, chest pain, difficult breathing, bronchitis, pneumontitis, tremors, insomnia, irritability, indecision, headache, fatigue, weakness, GI disturbance	NA
2-Methylnapthalene	SS: 0.094 (NNB-BCM-SD-99-15A)	NL	NL	NL	NL
Methylene Chloride	SS: 0.210 (NNB-BCM-SD97-04)	OSHA 25 ppm	Ca 2300 ppm	Irrit. Eyes, nose, throat, resp sens, cough, pulm secretions, chest pain, dysp, asthma	11.32
Nickel	SW: 0.0418 (NNB-BCM-SW97-03L) SS: 70.9 (NNB-BCM-SD97-03)	NIOSH Ca 0.015 mg/m³	Ca 10 mg/m³	Sens derm, allergic asthma, pneuitis, [carc]	NA
PAH (total)	SS: 9.656 (NNB-BCM-SD97-08)	NL	NL	NL	NL
Phenanthrene	SS: 1.2 (NNB-BCM-SD97-08)	0.1 mg/m³	80 mg/m³	Dermatitis, bronchitis, carcinogen	NA
Selenium	SS: 3.40 (NNB-BCM-SD-99-12A)	NIOSH/ OSHA 0.2 mg/m³	1 mg/m³	Irrit eyes, skin, resp sys	NA
Silver	SS: 45.9 (NNB-BCM-SD-99-07)	NIOSH/ OSHA 0.01 mg/m³	10 mg/m³	Blue-gray eyes, nasal septum, throat, skin, irrit, ulceration skin, GI dist	NA
Vinyl Chloride	SS: 0.032 (NNB-BCM-SD97-09)	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99
Zinc	SW: 0.572 (NNB-BCM-SW97-15L) SS: 652 (NNB-BCM-SD97-03)	5 mg/m³	500 mg/m³	Metal fume fever, chills, muscle ache, nausea, fever, dry throat, cough, weak, lassitude, metallic taste, headache, blurred vision, low back pain, vomit, tight chest, dysp, rales, decreased pulmonary function.	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of PEL, REL, or TLV listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

2.6 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HS-113, *Medical Monitoring*, and HS-110, *Health, Safety, and Environment Training)*

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP HS-04, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Ben Francisco	VBO	Project Manager	Level C SSC/FA-CPR
Dennis Ballam	VBO	Field Team Leader; Site Safety Coordinator	Level B SSC/FA-CPR
Lindsey Carr	WDC	Field Team Member	Level C SSC/FA-CPR
John Martin	GNV	Field Team Member	FA-CPR

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Contact Name:	**Winoma Johnson/LANTDIV**
Phone:	**757-322-4587**
Facility Contact Name:	**Channing Blackwell/CNRMA**
Phone:	**757-887-4086**

3.2.2 CH2M HILL

Project Manager:	**Ben Francisco**
Health and Safety Manager:	**Steve Beck**
Field Team Leader:	**Dennis Ballam**
Site Safety Coordinator:	**Dennis Ballam**

The SSC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The Health and Safety Manager should be contacted as appropriate.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-117, *Personal Protective Equipment*, HS-121, *Respiratory Protection*)

PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
• **General Site Entry** • **Ecological Survey** • **Tissue Sampling**	D	**Coveralls:** Work clothes; Bug suits-available from warehouse if desired. **Boots:** Steel-toe, leather work boots; **Gloves:** work glove if material hanlding.	Hardhat [c] Safety glasses Ear protection [d]	None required
• **Fish Trapping** (Wading) • **Surface Water Sampling** (Wading) • **Sediment Sampling** (Wading)	D	**Coveralls:** Work clothes **Boots:** Hip or Chest Waders **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves when handling sediment.	Hardhat [c] Safety glasses Ear protection [d]	None required
• **Fish Trapping** (Boat/Canoe) • **Surface Water Sampling** (Boat/Canoe) • **Sediment Sampling** (Boat/Canoe)	Modified D	**Coveralls:** Personal Floatation Devices (PDF). **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers when handling sediment. **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves when handling sediment.	Hardhat [c] Safety glasses Ear protection [d]	None required

Reasons for Upgrading or Downgrading Level of Protection

Upgrade [f]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

[c] Hardhat and splash-shield areas are to be determined by the SSC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HS-401, *Air Pollution Sources)*

5.1 Air Monitoring Specifications

- None required for tasks specified in Section 1.1

6 Decontamination

(Reference CH2M HILL SOP HS-13, *Decontamination*)

The SSC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SSC. The SSC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

Personnel

- Boot wash/rinse
- Glove wash/rinse
- Outer-glove removal
- Body-suit removal
- Inner-glove removal
- Respirator removal
- Hand wash/rinse
- Face wash/rinse
- Shower ASAP
- Dispose of PPE in municipal trash, or contain for disposal
- Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- Contain solvent waste for offsite disposal

Heavy Equipment

- Power wash
- Steam clean
- Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SSC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 6-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SSC to accommodate task-specific requirements.

7 Spill-Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

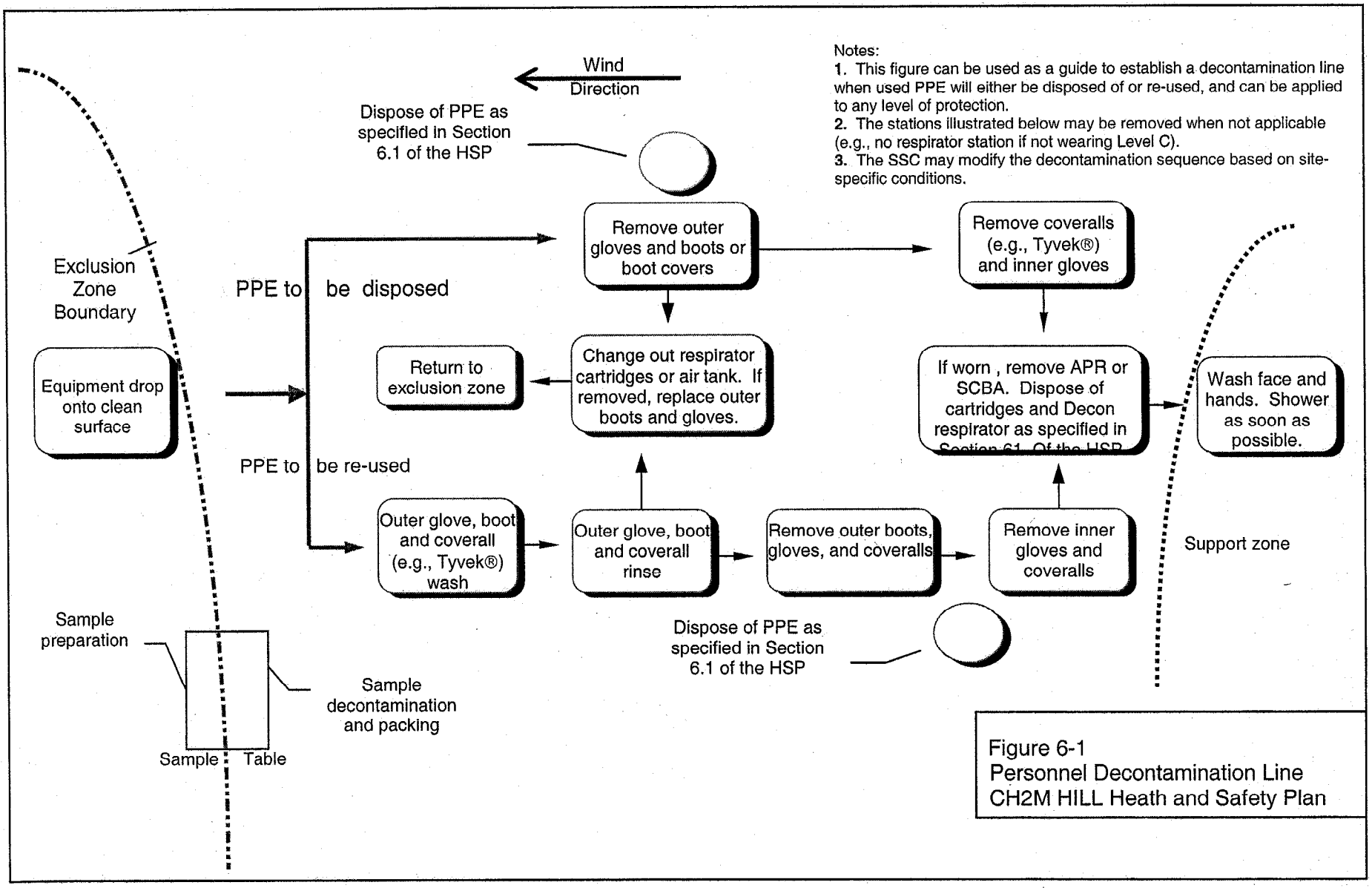


Figure 6-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

8 Site-Control Plan

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HS-11, *Site Control)*

- The SSC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SSC records attendance at safety briefings in a logbook and documents the topics discussed.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- The SCC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

8.2 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HS-19, *Site-Specific Written Safety Plans)*

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SSC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - nature of the existing contamination and its locations
  - limitations of their access
  - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.

- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hour of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

9 Emergency Response Plan

(Reference CH2M HILL, SOP HS-12, *Emergency Response*)

9.1 Pre-Emergency Planning

The SSC performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital.
- Brief new workers on the emergency response plan.
- The SSC will evaluate emergency response actions and initiate appropriate follow-up actions.

9.2 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	Field Vehicle
First aid kit	Field Vehicle
Eye Wash	Field Vehicle
Potable water	Field Vehicle
Bloodborne-pathogen kit	Field Vehicle
Additional equipment (specify): Cell Phone	On Site Safety Coordinator (SSC)

9.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate work area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

Instead of implementing a work-area evacuation, note that small fires or spills posing minimal safety or health hazards may be controlled.

9.4 Emergency Medical Treatment

The procedures listed below may also be applied to non-emergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During non-emergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Section 9.8 (e.g., 911).
- The SCC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Get medical attention immediately.
- Perform decontamination where feasible; lifesaving and first aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 9.7.

9.5 Evacuation

- Evacuation routes and assembly areas (and alternative routes and assembly areas) are specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the SSC before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SSC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The SSC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The SSC will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

9.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.

Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

9.7 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). IRF must be completed within 24 hours of incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.
- Notify and submit reports to client as required in contract.

10 Approval

This site-specific Health and Safety Plan has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

10.1 Original Plan

Written By: Ben Francisco/VBO **Date:** 09/13/2004

Approved By: Steve Beck/MKE **Date:** 09/15/2004

Steven J. Beck

10.2 Revisions

Revisions Made By: **Date:**

Revisions to Plan:

Revisions Approved By: **Date:**

11 Attachments

Attachment 1: Employee Signoff Form – Field Safety Instructions

Attachment 2: Project-Specific Chemical Product Hazard Communication Form

Attachment 3: Chemical-Specific Training Form

Attachment 4: Emergency Contacts

Attachment 5: Project H&S Forms/Permits

Attachment 6: Project Activity Self-Assessment Checklists

Attachment 7: Applicable Material Safety Data Sheets

EMPLOYEE SIGNOFF FORM

CH2MHILL

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this FSI, have read and understood it, and agree to abide by its provisions.

Project Name: Bousch Creek **Project Number:** 314926.FI.BC

EMPLOYEE NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

Health and Safety Plan
Attachment 2

Project-Specific Chemical Product Hazard Communication Form

CH2MHILL

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: Bousch Creek **Project Number:** 314926.FI.BC

MSDSs will be maintained at the following Location(s):
Field Vehicle

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Alconox	< gallon				
Gasoline	< 5 gallons	Boat			
Motor Oil	< liter	Boat/Field vehicle			
Methanol	< gallon				

Refer to SOP HS-05 *Hazard Communication* for more detailed information.

CHEMICAL-SPECIFIC TRAINING FORM

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Location:	Project # : 314926.FI.BC
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

APPLICABLE MATERIAL SAFETY DATA SHEETS

GASOLINE

SINCLAIR OIL -- GASOLINE - GASOLINE,UNLEADED
MATERIAL SAFETY DATA SHEET
NSN: 9130012720983
Manufacturer's CAGE: 2X948
Part No. Indicator: A
Part Number/Trade Name: GASOLINE

==========

General Information

==========

Item Name: GASOLINE,UNLEADED
Company's Name: SINCLAIR OIL CORP
Company's Street: 550 E SOUTH TEMPLE
Company's P. O. Box: 30825
Company's City: SALT LAKE CITY
Company's State: UT
Company's Country: US
Company's Zip Code: 84130-0825
Company's Emerg Ph #: 801-524-2700/800-424-9300(CHEMTREC)
Company's Info Ph #: 801-524-2853/307-324-3404 MEDICAL
Record No. For Safety Entry: 037
Tot Safety Entries This Stk#: 072
Status: SE
Date MSDS Prepared: 01JAN92
Safety Data Review Date: 04DEC92
Supply Item Manager: KY
MSDS Serial Number: BPKZJ
Hazard Characteristic Code: F2
Unit Of Issue: GL

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: CYCLOHEXANE (SARA III)
Ingredient Sequence Number: 01
Percent: 0.9-1.8
NIOSH (RTECS) Number: GU6300000
CAS Number: 110-82-7
OSHA PEL: 300 PPM
ACGIH TLV: 300 PPM, 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: BENZENE (SARA III)
Ingredient Sequence Number: 02
Percent: 0.8-4.8
NIOSH (RTECS) Number: CY1400000
CAS Number: 71-43-2
OSHA PEL: 1PPM/5STEL;1910.1028
ACGIH TLV: 10 PPM; A2; 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO

Ingredient: TOLUENE (SARA III)
Ingredient Sequence Number: 03
Percent: 6.6-7.8
NIOSH (RTECS) Number: XS5250000
CAS Number: 108-88-3
OSHA PEL: 200 PPM/150 STEL
ACGIH TLV: 50 PPM; 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: XYLENES (O-,M-,P- ISOMERS) (SARA III)
Ingredient Sequence Number: 04
Percent: 6- 10.4
NIOSH (RTECS) Number: ZE2100000
CAS Number: 1330-20-7
OSHA PEL: 100 PPM/150 STEL
ACGIH TLV: 100 PPM/150STEL;9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: NAPHTHALENE (SARA III)
Ingredient Sequence Number: 05
Percent: 0.1-1.2
NIOSH (RTECS) Number: QJ0525000
CAS Number: 91-20-3
OSHA PEL: 10 PPM/15 STEL
ACGIH TLV: 10 PPM/15 STEL; 9293
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: METHYL TERT-BUTYL ETHER (SARA III)
Ingredient Sequence Number: 06
Percent: 0 - 15
NIOSH (RTECS) Number: KN5250000
CAS Number: 1634-04-4
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: ETHYL ALCOHOL (ETHANOL)
Ingredient Sequence Number: 07
Percent: 0 - 10
NIOSH (RTECS) Number: KQ6300000
CAS Number: 64-17-5
OSHA PEL: 1000 PPM
ACGIH TLV: 1000 PPM; 9293
Other Recommended Limit: NONE RECOMMENDED

==========

Physical/Chemical Characteristics

==========

Appearance And Odor: CLEAR, BRONZE, RED OR PURPLE COLOR LIQUID - STRONG HYDROCARBON ODOR
Boiling Point: UNKNOWN
Melting Point: <-76F,<-60C
Vapor Pressure (MM Hg/70 F): 466 - 776
Specific Gravity: 0.7
Decomposition Temperature: UNKNOWN
Solubility In Water: NEGLIGIBLE
Corrosion Rate (IPY): UNKNOWN
Autoignition Temperature: >500F

==========

Fire and Explosion Hazard Data

==========

Flash Point: -45F,-43C
Lower Explosive Limit: 1.4%
Upper Explosive Limit: 7.6%
Extinguishing Media: USE WATER FOG, CARBON DIOXIDE, FOAM, DRY CHEMICAL OR HALON. WATER MAY BE INEFFECTIVE.
Special Fire Fighting Proc: WEAR FIRE FIGHTING PROTECTIVE EQUIPMENT & A FULL FACED SELF CONTAINED BREATHING APPARATUS/SUPPLIED-AIR RESPIRATOR.COOL
FIRE EXPOSED CONTAINERS WITH WATER SPRAY.
Unusual Fire And Expl Hazrds: EXTREMELY FLAMMABLE LIQUID. VAPOR ACCUMULATION COULD FLASH AND/OR EXPLODE IF IT COMES IN CONTACT WITH OPEN
FLAME.

==========

Reactivity Data

==========

Stability: YES
Cond To Avoid (Stability): HEAT, SPARKS, OPEN FLAMES, STATIC ELECTRICITY AND OTHER SOURCES OF IGNITION
Materials To Avoid: STRONG OXIDIZING AGENTS, HALOGENS, STRONG ACIDS, ALKALIES
Hazardous Decomp Products: CARBON MONOXIDE, CARBON DIOXIDE
Hazardous Poly Occur: NO

==========

Health Hazard Data

==========

LD50-LC50 Mixture: ORAL LD50 (RAT) IS UNKNOWN
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE/CHRONIC-HIGH VAPOR CONCENTRATIONS ARE
IRRITATING TO THE EYES & THE RESPIRATORY TRACT.MAY CAUSE DIZZINESS, HEADACHE,ARE ANESTHETIC,MAY CAUSE
UNCONSCIOUSNESS.PROLONGED/REPEATED LIQUID

CONTACT WITH SKIN WILL DRY & DEFAT SKIN,LEADING TO IRRITATION & DERMATITIS.
CONTAINS BENZENE WHICH CAUSES BLOOD DISEASE,LEUKEMIA.
Carcinogenicity - NTP: YES
Carcinogenicity - IARC: YES
Carcinogenicity - OSHA: YES
Explanation Carcinogenicity: CONTAINS BENZENE.MAY CAUSE BLOOD DISEASES INCLUDING LEUKEMIA.VAPORS MAY CAUSE KIDNEY CANCER IN MALE RATS.
Signs/Symptoms Of Overexp: HIGH VAPOR CONCENTRATIONS ARE IRRITATING TO THE
EYES & THE RESPIRATORY TRACT. MAY CAUSE DIZZINESS, HEADACHE, ARE ANESTHETIC, MAY CAUSE UNCONSCIOUSNESS & EVEN DEATH.
PROLONGED/REPEATED
LIQUID CONTACT WITH SKIN WILL DRY & DEFAT SKIN, LEADING TO IRRITATION & DERMATITIS. CONTAINS BENZENE WHICH CAUSES BLOOD DISEASE,LEUKEMIA
Med Cond Aggravated By Exp: BENZENE-INDIVIDUALS WITH LIVER DISEASE MAY BE MORE SUSCEPTIBLE TO TOXIC EFFECTS.HEXANE-INDIVIDUALS WITH NEUROLOGICAL DISEASE SHOULD AVOID EXPOSURE.PETROLEUM SOLVENT-THOSE WITH EXISTING DERMATITIS.
Emergency/First Aid Proc: CALL A PHYSICIAN IN ALL CASES.EYES: IMMEDIATELY FLUSH WITH WATER FOR 15 MINUTES,HOLDING EYELIDS OPEN.SKIN:WASH WITH SOAP &
WATER.INHALED:REMOVE TO FRESH AIR & PROVIDE CPR/OXYGEN IF NECESSARY.ORAL:DO
NOT INDUCE VOMITING.CALL A PHYSICIAN IMMEDIATELY.

==========

Precautions for Safe Handling and Use

==========

Steps If Matl Released/Spill: WEAR PROTECTIVE EQUIPMENTS.ELIMINATE ALL SOURCES OF IGNITION.USE EXPLOSION-PROOF TOOLS.SHUT OFF FUEL SOURCE.DIKE SPILL.PREVENT LIQUID FROM ENTERING SEWERS/WATERWAYS.RECOVER FREE LIQUID.ADD
SAND,EARTH OR OTHER ABSORBENT MATERIAL.TRANSFER TO CONTAINER.
Neutralizing Agent: NOT APPLICABLE
Waste Disposal Method: TREATMENT, STORAGE, TRANSPORTATION AND DISPOSAL MUST BE IN ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE AND FEDERAL LAWS AND
REGULATIONS.
Precautions-Handling/Storing: STORAGE-STORE IN ACCORDANCE WITH NATIONAL FIRE PROTECTION ASSOCIATION REGULATIONS.KEEP CONTAINERS CLOSED.
Other Precautions: "EMPTY" CONTAINERS RETAIN RESIDUE AND CAN BE DANGEROUS. DO NOT PRESSURIZE,CUT,WELD,BRAZE,SOLDER,DRILL,GRIND OR EXPOSE SUCH CONTAINERS TO HEAT,FLAME,SPARKS.THEY MAY EXPLODE AND CAUSE INJURY/DEATH.
AVOID REPEATED OR PROLONGED CONTACT WITH SKIN.

==========

Control Measures

==========

Respiratory Protection: NIOSH-APPROVED SELF-CONTAINED BREATHING APPARATUS OR ORGANIC VAPOR RESPIRATOR OR SUPPLIED-AIR RESPIRATOR, IF NEEDED.
Ventilation: LOCAL/MECHANICAL (GENERAL) VENTILATION - EXPLOSION PROOF, WELL GROUNDED EQUIPMENTS

Protective Gloves: RUBBER
Eye Protection: CHEMICAL SPLASH GOGGLES & FACE SHIELD
Other Protective Equipment: IMPERVIOUS CLOTHING TO AVOID SKIN AND EYE CONTACT. EYE WASH STATION & SAFETY SHOWER.
Work Hygienic Practices: AVOID CONTACT WITH EYES, SKIN OR CLOTHING. WASH HANDS AFTER USING PRODUCT. AVOID BREATHING VAPORS OR MISTS.
==========

Transportation Data

==========
Trans Data Review Date: 92339
DOT PSN Code: GTN
DOT Proper Shipping Name: GASOLINE
DOT Class: 3
DOT ID Number: UN1203
DOT Pack Group: II
DOT Label: FLAMMABLE LIQUID
IMO PSN Code: HRV
IMO Proper Shipping Name: GASOLINE
IMO Regulations Page Number: 3141
IMO UN Number: 1203
IMO UN Class: 3.1
IMO Subsidiary Risk Label: -
IATA PSN Code: RMF
IATA UN ID Number: 1203
IATA Proper Shipping Name: MOTOR SPIRIT
IATA UN Class: 3
IATA Label: FLAMMABLE LIQUID
AFI PSN Code: MUC
AFI Prop. Shipping Name: GASOLINE
AFI Class: 3
AFI ID Number: UN1203
AFI Pack Group: II
AFI Label: FLAMMABLE LIQUID
AFI Basic Pac Ref: 7-7
==========

Disposal Data

==========
==========

Label Data

==========L
abel Required: YES
Technical Review Date: 04DEC92
MFR Label Number: UNKNOWN
Label Status: F
Common Name: GASOLINE
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Severe: X
Fire Hazard-Severe: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE/CHRONIC-HIGH VAPOR CONCENTRATIONS ARE IRRITATING TO THE EYES & THE RESPIRATORY TRACT.MAY CAUSE DIZZINESS,

HEADACHE,ARE ANESTHETIC,MAY CAUSE
UNCONSCIOUSNESS.PROLONGED/REPEATED LIQUID
CONTACT WITH SKIN WILL DRY & DEFAT SKIN,LEADING TO IRRITATION &
DERMATITIS.
CONTAINS BENZENE WHICH CAUSES BLOOD DISEASE,LEUKEMIA.STORAGE-STORE IN
ACCORDANCE WITH NATIONAL FIRE PROTECTION ASSOCIATION
REGULATIONS.FIRST AID-
CALL A PHYSICIAN IN ALL CASES.EYES:IMMEDIATELY FLUSH WITH WATER FOR 15
MINUTES,HOLDING EYELIDS OPEN.SKIN:WASH WITH SOAP &
WATER.INHALED:REMOVE TO
FRESH AIR & PROVIDE CPR/OXYGEN IF NEEDED.ORAL:DO NOT INDUCE
VOMITING.CALL A
PHYSICIAN IMMEDIATELY
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: SINCLAIR OIL CORP
Label Street: 550 E SOUTH TEMPLE
Label P.O. Box: 30825
Label City: SALT LAKE CITY
Label State: UT
Label Zip Code: 84130-0825
Label Country: US
Label Emergency Number: 801-524-2700/800-424-9300(CHEMTREC)
==========
URL for this msds http://siri.org. If you wish to change, add to, or
delete information in this archive please sent updates to dan@siri.org.GASOLINE

==========
Physical/Chemical Characteristics
==========
Appearance And Odor: CLEAR, BRONZE, RED OR PURPLE COLOR LIQUID - STRONG
HYDROCARBON ODOR
Boiling Point: UNKNOWN
Melting Point: <-76F,<-60C
Vapor Pressure (MM Hg/70 F): 466 - 776
Specific Gravity: 0.7
Decomposition Temperature: UNKNOWN
Solubility In Water: NEGLIGIBLE
Corrosion Rate (IPY): UNKNOWN
Autoignition Temperature: >500F
==========
Fire and Explosion Hazard Data
==========
Flash Point: -45F,-43C
Lower Explosive Limit: 1.4%
Upper Explosive Limit: 7.6%
Extinguishing Media: USE WATER FOG, CARBON DIOXIDE, FOAM, DRY CHEMICAL OR
HALON. WATER MAY BE INEFFECTIVE.
Special Fire Fighting Proc: WEAR FIRE FIGHTING PROTECTIVE EQUIPMENT & A
FULL FACED SELF CONTAINED BREATHING APPARATUS/SUPPLIED-AIR
RESPIRATOR.COOL

FIRE EXPOSED CONTAINERS WITH WATER SPRAY.
Unusual Fire And Expl Hazrds: EXTREMELY FLAMMABLE LIQUID. VAPOR ACCUMULATION COULD FLASH AND/OR EXPLODE IF IT COMES IN CONTACT WITH OPEN
FLAME.

==========

Reactivity Data

==========

Stability: YES
Cond To Avoid (Stability): HEAT, SPARKS, OPEN FLAMES, STATIC ELECTRICITY AND OTHER SOURCES OF IGNITION
Materials To Avoid: STRONG OXIDIZING AGENTS, HALOGENS, STRONG ACIDS, ALKALIES
Hazardous Decomp Products: CARBON MONOXIDE, CARBON DIOXIDE
Hazardous Poly Occur: NO

==========

Health Hazard Data

==========

LD50-LC50 Mixture: ORAL LD50 (RAT) IS UNKNOWN
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE/CHRONIC-HIGH VAPOR CONCENTRATIONS ARE
IRRITATING TO THE EYES & THE RESPIRATORY TRACT.MAY CAUSE DIZZINESS, HEADACHE,ARE ANESTHETIC,MAY CAUSE
UNCONSCIOUSNESS.PROLONGED/REPEATED LIQUID
CONTACT WITH SKIN WILL DRY & DEFAT SKIN,LEADING TO IRRITATION & DERMATITIS.
CONTAINS BENZENE WHICH CAUSES BLOOD DISEASE,LEUKEMIA.
Carcinogenicity - NTP: YES
Carcinogenicity - IARC: YES
Carcinogenicity - OSHA: YES
Explanation Carcinogenicity: CONTAINS BENZENE.MAY CAUSE BLOOD DISEASES INCLUDING LEUKEMIA.VAPORS MAY CAUSE KIDNEY CANCER IN MALE RATS.
Signs/Symptoms Of Overexp: HIGH VAPOR CONCENTRATIONS ARE IRRITATING TO THE
EYES & THE RESPIRATORY TRACT. MAY CAUSE DIZZINESS, HEADACHE, ARE ANESTHETIC, MAY CAUSE UNCONSCIOUSNESS & EVEN DEATH.
PROLONGED/REPEATED
LIQUID CONTACT WITH SKIN WILL DRY & DEFAT SKIN, LEADING TO IRRITATION & DERMATITIS. CONTAINS BENZENE WHICH CAUSES BLOOD DISEASE,LEUKEMIA
Med Cond Aggravated By Exp: BENZENE-INDIVIDUALS WITH LIVER DISEASE MAY BE MORE SUSCEPTIBLE TO TOXIC EFFECTS.HEXANE-INDIVIDUALS WITH NEUROLOGICAL DISEASE SHOULD AVOID EXPOSURE.PETROLEUM SOLVENT-THOSE WITH EXISTING DERMATITIS.
Emergency/First Aid Proc: CALL A PHYSICIAN IN ALL CASES.EYES: IMMEDIATELY FLUSH WITH WATER FOR 15 MINUTES,HOLDING EYELIDS OPEN.SKIN:WASH WITH SOAP &
WATER.INHALED:REMOVE TO FRESH AIR & PROVIDE CPR/OXYGEN IF NECESSARY.ORAL:DO
NOT INDUCE VOMITING.CALL A PHYSICIAN IMMEDIATELY.

==========

Precautions for Safe Handling and Use

==========

Steps If Matl Released/Spill: WEAR PROTECTIVE EQUIPMENTS.ELIMINATE ALL SOURCES OF IGNITION.USE EXPLOSION-PROOF TOOLS.SHUT OFF FUEL SOURCE.DIKE SPILL.PREVENT LIQUID FROM ENTERING SEWERS/WATERWAYS.RECOVER FREE LIQUID.ADD
SAND,EARTH OR OTHER ABSORBENT MATERIAL.TRANSFER TO CONTAINER.
Neutralizing Agent: NOT APPLICABLE
Waste Disposal Method: TREATMENT, STORAGE, TRANSPORTATION AND DISPOSAL MUST BE IN ACCORDANCE WITH ALL APPLICABLE LOCAL, STATE AND FEDERAL LAWS AND
REGULATIONS.
Precautions-Handling/Storing: STORAGE-STORE IN ACCORDANCE WITH NATIONAL FIRE PROTECTION ASSOCIATION REGULATIONS.KEEP CONTAINERS CLOSED.
Other Precautions: "EMPTY" CONTAINERS RETAIN RESIDUE AND CAN BE DANGEROUS. DO NOT PRESSURIZE,CUT,WELD,BRAZE,SOLDER,DRILL,GRIND OR EXPOSE SUCH CONTAINERS TO HEAT,FLAME,SPARKS.THEY MAY EXPLODE AND CAUSE INJURY/DEATH.
AVOID REPEATED OR PROLONGED CONTACT WITH SKIN.

==========

Control Measures

==========

Respiratory Protection: NIOSH-APPROVED SELF-CONTAINED BREATHING APPARATUS OR ORGANIC VAPOR RESPIRATOR OR SUPPLIED-AIR RESPIRATOR, IF NEEDED.
Ventilation: LOCAL/MECHANICAL (GENERAL) VENTILATION - EXPLOSION PROOF, WELL GROUNDED EQUIPMENTS
Protective Gloves: RUBBER
Eye Protection: CHEMICAL SPLASH GOGGLES & FACE SHIELD
Other Protective Equipment: IMPERVIOUS CLOTHING TO AVOID SKIN AND EYE CONTACT. EYE WASH STATION & SAFETY SHOWER.
Work Hygienic Practices: AVOID CONTACT WITH EYES, SKIN OR CLOTHING. WASH HANDS AFTER USING PRODUCT. AVOID BREATHING VAPORS OR MISTS.

==========

Transportation Data

==========

Trans Data Review Date: 92339
DOT PSN Code: GTN
DOT Proper Shipping Name: GASOLINE
DOT Class: 3
DOT ID Number: UN1203
DOT Pack Group: II
DOT Label: FLAMMABLE LIQUID
IMO PSN Code: HRV
IMO Proper Shipping Name: GASOLINE
IMO Regulations Page Number: 3141
IMO UN Number: 1203
IMO UN Class: 3.1
IMO Subsidiary Risk Label: -
IATA PSN Code: RMF
IATA UN ID Number: 1203
IATA Proper Shipping Name: MOTOR SPIRIT
IATA UN Class: 3
IATA Label: FLAMMABLE LIQUID
AFI PSN Code: MUC
AFI Prop. Shipping Name: GASOLINE
AFI Class: 3
AFI ID Number: UN1203
AFI Pack Group: II
AFI Label: FLAMMABLE LIQUID
AFI Basic Pac Ref: 7-7

==========

Disposal Data

==========

==========

Label Data

==========L

abel Required: YES
Technical Review Date: 04DEC92
MFR Label Number: UNKNOWN
Label Status: F
Common Name: GASOLINE
Signal Word: DANGER!
Acute Health Hazard-Severe: X
Contact Hazard-Severe: X
Fire Hazard-Severe: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE/CHRONIC-HIGH VAPOR CONCENTRATIONS ARE IRRITATING TO THE EYES & THE RESPIRATORY TRACT.MAY CAUSE DIZZINESS, HEADACHE,ARE ANESTHETIC,MAY CAUSE UNCONSCIOUSNESS.PROLONGED/REPEATED LIQUID CONTACT WITH SKIN WILL DRY & DEFAT SKIN,LEADING TO IRRITATION & DERMATITIS.
CONTAINS BENZENE WHICH CAUSES BLOOD DISEASE,LEUKEMIA.STORAGE-STORE IN ACCORDANCE WITH NATIONAL FIRE PROTECTION ASSOCIATION REGULATIONS.FIRST AID-
CALL A PHYSICIAN IN ALL CASES.EYES:IMMEDIATELY FLUSH WITH WATER FOR 15 MINUTES,HOLDING EYELIDS OPEN.SKIN:WASH WITH SOAP & WATER.INHALED:REMOVE TO FRESH AIR & PROVIDE CPR/OXYGEN IF NEEDED.ORAL:DO NOT INDUCE VOMITING.CALL A PHYSICIAN IMMEDIATELY
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: SINCLAIR OIL CORP
Label Street: 550 E SOUTH TEMPLE
Label P.O. Box: 30825
Label City: SALT LAKE CITY
Label State: UT
Label Zip Code: 84130-0825
Label Country: US
Label Emergency Number: 801-524-2700/800-424-9300(CHEMTREC)

==========

URL for this msds http://siri.org. If you wish to change, add to, or delete information in this archive please sent updates to dan@siri.org.

Motor Oil

CHEVRON U S A -- CHEVRON 2-CYCLE OIL - OIL,2-CYCLE
MATERIAL SAFETY DATA SHEET
NSN: 915000F005683
Manufacturer's CAGE: 81230
Part No. Indicator: A
Part Number/Trade Name: CHEVRON 2-CYCLE OIL

==========

General Information

==========

Item Name: OIL,2-CYCLE
Company's Name: CHEVRON U S A INC
Company's Street: 575 MARKET ST
Company's P. O. Box: 7643
Company's City: SAN FRANCISCO
Company's State: CA
Company's Country: US
Company's Zip Code: 94120-2856
Company's Emerg Ph #: 800-231-0623 800-424-9300(CHEMTREC)
Company's Info Ph #: 800-582-3835 800-582-3835
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 002
Status: SE
Date MSDS Prepared: 14APR93
Safety Data Review Date: 16JUN94
Supply Item Manager: CX
MSDS Preparer's Name: UNKNOWN
MSDS Serial Number: BTJYT
Specification Number: NONE
Spec Type, Grade, Class: NONE
Hazard Characteristic Code: N1
Unit Of Issue: NK
Unit Of Issue Container Qty: UNKNOWN
Type Of Container: UNKNOWN
Net Unit Weight: UNKNOWN

==========

Ingredients/Identity Information

==========

Proprietary: NO
Ingredient: SOLVENT,DEWAXED RESIDUAL OIL (PETROLEUM)
Ingredient Sequence Number: 01
Percent: UNKNOWN
NIOSH (RTECS) Number: 1004315SD
CAS Number: 64742-62-7
OSHA PEL: 5 MG/M3 (OIL MIST)
ACGIH TLV: 5 MG/M3 (OIL MIST)
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: RESIDUAL OILS, HYDROTREATED
Ingredient Sequence Number: 02
Percent: UNKNOWN

NIOSH (RTECS) Number: 1003242SR
CAS Number: 64742-57-0
OSHA PEL: 5 MG/M3 (OIL MIST)
ACGIH TLV: 5 MG/M3 (OIL MIST)
Proprietary: NO
Ingredient: DISTILLATES, HYDROTREATED HEAVY PARAFFINIC
Ingredient Sequence Number: 03
Percent: UNKNOWN
NIOSH (RTECS) Number: PY8035500
CAS Number: 64742-54-7
OSHA PEL: 5 MG/M3 (OIL MIST)
ACGIH TLV: 5 MG/M3 (OIL MIST)
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: MINERAL OIL, PETROLEUM DISTILLATES, SOLVENT-DEWAXED HEAVY PARAFFINIC
Ingredient Sequence Number: 04
Percent: UNKNOWN
NIOSH (RTECS) Number: PY8038500
CAS Number: 64742-65-0
OSHA PEL: 5 MG/M3 (OIL MIST)
ACGIH TLV: 5 MG/M3 (OIL MIST)
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: HYDROTREATED LIGHT PETROLEUM DISTILLATE
Ingredient Sequence Number: 05
Percent: 1
Specific Gravity: 0.891
Decomposition Temperature: UNKNOWN
Evaporation Rate And Ref: UNKNOWN
Solubility In Water: NEGLIGIBLE
Percent Volatiles By Volume: NIL
Corrosion Rate (IPY): UNKNOWN
==========

Fire and Explosion Hazard Data

==========
Flash Point: NONE
Lower Explosive Limit: UNKNOWN
Upper Explosive Limit: UNKNOWN
Extinguishing Media: USE WATER FOG, CARBON DIOXIDE, FOAM, OR DRY CHEMICAL. WATER OR FOAM MAY CAUSE FROTHING.
Special Fire Fighting Proc: WEAR FIRE FIGHTING PROTECTIVE EQUIPMENT AND A FULL FACED SELF CONTAINED BREATHING APPARATUS. COOL FIRE EXPOSED CONTAINERS
WITH WATER SPRAY.
Unusual Fire And Expl Hazrds: COMBUSTION OR HEAT OF FIRE MAY PRODUCE HAZARDOUS DECOMPOSITION PRODUCTS AND VAPORS.

==========

Reactivity Data

==========

Stability: YES
Cond To Avoid (Stability): HIGH HEAT, OPEN FLAMES AND OTHER SOURCES OF IGNITION
Materials To Avoid: STRONG OXIDIZING AGENTS
Hazardous Decomp Products: AIRBORNE SOLID AND LIQUID PARTICULATES, CARBON MONOXIDE, OTHER UNIDENTIFIED HYDROCARBON PRODUCTS.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT APPLICABLE

==========

Health Hazard Data

==========L

D50-LC50 Mixture: LD 50 ORAL RAT IS UNKNOWN
Route Of Entry - Inhalation: NO
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: EYES:MAY CAUSE IRRITATION.SKIN:MAY CAUSE IRRITATION.INGEST:MAY CAUSE GI TRACT IRRITATION.INHAL:MAY CAUSE RESPIRATORY
IRRITATION,CNS EFFETS.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NONE OF THE INGREDIENTS IN THIS PRODUCT IS LISTED BY NTP, IARC OR OSHA AS A CARCINOGEN.
Signs/Symptoms Of Overexp: EYES: PAIN,TEARING,SWELLING,REDNESS,BLURRED VISION.
Med Cond Aggravated By Exp: BECAUSE OF ITS DEFATTING PROPERTIES, PROLONGED AND REPEATED SKIN CONTACT MAY AGGRAVATE AN EXISTING DERMATITIS.
Emergency/First Aid Proc: EYES: FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. IF IRRITATION PERSISTS, SEE DOCTOR. SKIN: WASH WITH SOAP. IF IRRITATION PERSISTS, SEE DOCTOR. INHALATION: REMOVE VICTIM TO FRESH AIR. GIVE OXYGEN/CPR IF NEEDED. SEE DOCTOR. INGESTION: DO NOT INDUCE VOMITING.
SEE DOCTOR. INJECTION: THIS IS A MEDICAL EMERGENCY. SEE DOCTOR IMMEDIATELY.

==========

Precautions for Safe Handling and Use

==========

Steps If Matl Released/Spill: REMOVE PERSONNEL. ELIMINATE IGNITION SOURCES. VENTILATE AREA. WEAR PROTECTIVE CLOTHING AND EQUIPMENT. DIKE AND
CONTAIN. ABSORB IN INERT MATERIAL AND PLACE IN APPROPIATE DISPOSAL CONTAINER AND COVER. WASH AREA WITH SOAP AND WATER.
Neutralizing Agent: NONE
Waste Disposal Method: CONTACT YOUR LOCAL ENVIRONMENTAL OFFICER. DISPOSE OF IN ACCORDANCE WITH ALL FEDERAL, STATE AND LOCAL REGULATIONS.
Precautions-Handling/Storing: STORE IN A COOL, DRY PLACE WITH ADEQUATE VENTILATION. KEEP AWAY FROM HEAT, OPEN FLAMES AND STRONG OXIDANTS. KEEP

CONTAINERS TIGHTLY CLOSED.
Other Precautions: AVOID EYE AND SKIN CONTACT. DO NOT BREATHE VAPORS.

==========

Control Measures

==========

Respiratory Protection: NONE NORMALLY REQUIRED. NIOSH/MSHA-APPROVED RESPIRATOR OR SCBA AS APPROPIATE FOR EXPOSURE OF CONCERN.
Ventilation: MECHANICAL (GENERAL) VENTILATION.
Protective Gloves: NITRILE GLOVES.
Eye Protection: SPLASH GOGGLES IF MISTING.
Other Protective Equipment: PROTECTIVE CLOTHING AS REQUIRED TO MINIMIZE EXPOSURE FROM PROLONGED OR REPEATED CONTACT. EYE BATH AND SAFETY SHOWER.
Work Hygienic Practices: WASH THOROUGHLY AFTER HANDLING AND BEFORE EATING.
LAUNDER CONTAMINATED CLOTHING BEFORE REUSE. DISCARD CONTAMINATED SHOES
Suppl. Safety & Health Data: NONE

==========

Transportation Data

==========

Trans Data Review Date: 94167
DOT PSN Code: ZZZ
DOT Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
IMO PSN Code: ZZZ
IMO Proper Shipping Name: NOT REGULATED FOR THIS MODE OF TRANSPORTATION
IATA PSN Code: ZZZ
IATA Proper Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
AFI PSN Code: ZZZ
AFI Prop. Shipping Name: NOT REGULATED BY THIS MODE OF TRANSPORTATION
MMAC Code: NR
Additional Trans Data: NONE

==========

Disposal Data

==========

==========

Label Data

==========

Label Required: YES
Technical Review Date: 16JUN94
MFR Label Number: UNKNOWN
Label Status: F
Common Name: CHEVRON 2-CYCLE OIL
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-Slight: X
Reactivity Hazard-None: X
Special Hazard Precautions: EYES:MAY CAUSE IRRITATION.SKIN:MAY CAUSE IRRITATION.INGEST:MAY CAUSE GI TRACT IRRITATION.INHAL:MAY CAUSE RESPIRATORY
IRRITATION,CNS EFFETS. STORE IN A COOL, DRY PLACE WITH ADEQUATE

VENTILATION. KEEP AWAY FROM HEAT, OPEN FLAMES AND STRONG OXIDANTS. KEEP
CONTAINERS TIGHTLY CLOSED. FIRST AID: EYES: FLUSH WITH PLENTY OF WATER FOR
AT LEAST 15 MINUTES. IF IRRITATION PERSISTS, SEE DOCTOR. SKIN: WASH WITH SOAP. IF IRRITATION PERSISTS, SEE DOCTOR. INHALATION: REMOVE VICTIM TO FRESH AIR. GIVE OXYGEN/CPR IF NEEDED. SEE DOCTOR. INGESTION: DO NOT INDUCE
VOMITING. SEE DOCTOR. INJECTION: THIS IS A MEDICAL EMERGENCY. SEE DOCTOR IMMEDIATELY.
Protect Skin: Y
Label Name: CHEVRON U S A INC
Label Street: 575 MARKET ST
Label P.O. Box: 7643
Label City: SAN FRANCISCO
Label State: CA
Label Zip Code: 94120-2856
Label Country: US
Label Emergency Number: 800-231-0623 800-424-9300(CHEMTREC)
==========

PCB's

(FACT SHEET)

ToxFAQsTM for

Polychlorinated Biphenyls (PCBs)

February 2001

This fact sheet answers the most frequently asked health questions about polychlorinated biphenyls (PCBs). For more information, you may call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls (PCBs)?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to polychlorinated biphenyls (PCBs) when they enter the environment?

PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.

PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.

PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.

PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to polychlorinated biphenyls (PCBs)?

PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.

PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.

PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.

PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How can polychlorinated biphenyls (PCBs) affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are polychlorinated biphenyls (PCBs) to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

How do polychlorinated biphenyls (PCBs) affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risk of exposure to polychlorinated biphenyls (PCBs)?

You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.

Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.

Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.

If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to polychlorinated biphenyls (PCBs)?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

For more information, contact:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road NE, Mailstop E-29
Atlanta, GA 30333
Phone: 1-888-422-8737
FAX: (404)498-0057

ALCONOX

ALCONOX®

1. Product Identification

Synonyms: Proprietary blend of sodium linear alkylaryl sulfonate, alcohol sulfate, phosphates, and carbonates.
CAS No.: Not applicable.
Molecular Weight: Not applicable to mixtures.
Chemical Formula: Not applicable to mixtures.
Product Codes: A461

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Alconox®	N/A	90 - 100%	Yes

proprietary detergent mixture

3. Hazards Identification

Emergency Overview

CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO EYES AND RESPIRATORY TRACT.

J.T. Baker SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 1 - Slight
Flammability Rating: 0 - None
Reactivity Rating: 1 - Slight
Contact Rating: 2 - Moderate
Lab Protective Equip: GOGGLES; LAB COAT
Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:
May cause irritation to the respiratory tract. Symptoms may include coughing and shortness of breath.
Ingestion:
May cause irritation to the gastrointestinal tract. Symptoms may include nausea, vomiting and diarrhea.
Skin Contact:
No adverse effects expected.
Eye Contact:
May cause irritation, redness and pain.
Chronic Exposure:
No information found.
Aggravation of Pre-existing Conditions:
No information found.

4. First Aid Measures

Inhalation:
Remove to fresh air. Get medical attention for any breathing difficulty.
Ingestion:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention.
Skin Contact:
Wash exposed area with soap and water. Get medical advice if irritation develops.
Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Not expected to be a fire hazard.
Explosion:
No information found.
Fire Extinguishing Media:
Dry chemical, foam, water or carbon dioxide.
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Spills: Pick up and place in a suitable container for reclamation or disposal, using a method that does not generate dust. When mixed with water, material foams profusely. Small amounts of residue may be flushed to sewer with plenty of water.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Moisture may cause material to cake. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
- OSHA Permissible Exposure Limit (PEL):
15 mg/m3 total dust, 5 mg/m3 respirable fraction for nuisance dusts.
- ACGIH Threshold Limit Value (TLV):
10 mg/m3 total dust containing no asbestos and < 1% crystalline silica for Particulates Not Otherwise Classified (PNOC).

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded, a half-face dust/mist respirator may be worn for up to ten times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. A full-face piece dust/mist respirator may be worn up to 50 times the exposure limit, or the maximum use concentration specified by the appropriate regulatory agency, or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. WARNING: Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:
Wear protective gloves and clean body-covering clothing.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
White powder interspersed with cream colored flakes.
Odor:
No information found.
Solubility:
Moderate (1-10%)
Specific Gravity:
No information found.
pH:
No information found.
% Volatiles by volume @ 21C (70F):
0
Boiling Point:
No information found.
Melting Point:
No information found.
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
No information found.
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
Carbon dioxide and carbon monoxide may form when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
No information found.
Conditions to Avoid:
No information found.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Alconox® proprietary detergent mixture	No	No	None

12. Ecological Information

Environmental Fate:
This product is biodegradable.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Alconox® proprietary detergent mixture	Yes	No	No	No

--------\Chemical Inventory Status - Part 2\--------

Ingredient	Korea	--Canada-- DSL	NDSL	Phil.
Alconox® proprietary detergent mixture	No	No	Yes	No

--------\Federal, State & International Regulations - Part 1\--------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313----- List	Chemical Catg.
Alconox® proprietary detergent mixture	No	No	No	No

--------\Federal, State & International Regulations - Part 2\--------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Alconox® proprietary detergent mixture	No	No	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: No Fire: No Pressure: No

Reactivity: No (Pure / Solid)

16. Other Information

NFPA Ratings: Health: **0** Flammability: **0** Reactivity: **0**
Label Hazard Warning:
CAUTION! MAY BE HARMFUL IF SWALLOWED OR INHALED. MAY CAUSE IRRITATION TO EYES AND RESPIRATORY TRACT.
Label Precautions:
Avoid contact with eyes.
Keep container closed.
Use with adequate ventilation.
Avoid breathing dust.
Wash thoroughly after handling.
Label First Aid:
If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. In all cases, get medical attention.
Product Use:
Laboratory Reagent.
Revision Information:
MSDS Section(s) changed since last revision of document include: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16.

Disclaimer:
****
Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.
****
Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

METHANOL

METHYL ALCOHOL

1. Product Identification

Synonyms: Wood alcohol; methanol; carbinol
CAS No.: 67-56-1
Molecular Weight: 32.04
Chemical Formula: CH3OH
Product Codes:
J.T. Baker: 5217, 5370, 5794, 5807, 5811, 5842, 5869, 9049, 9063, 9065, 9066, 9067, 9069, 9070, 9071, 9073, 9075, 9076, 9077, 9091, 9093, 9096, 9097, 9098, 9263, 9822, 9893, V654
Mallinckrodt: 3004, 3006, 3016, 3017, 3018, 3024, 3041, 3701, 4295, 5160, 8814, H080, H488, H603, H985, V079, V571

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Methyl Alcohol	67-56-1	100%	Yes

3. Hazards Identification

Emergency Overview

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

SAF-T-DATA(tm) Ratings (Provided here for your convenience)

Health Rating: 3 - Severe (Poison)
Flammability Rating: 3 - Severe (Flammable)
Reactivity Rating: 1 - Slight
Contact Rating: 3 - Severe (Life)
Lab Protective Equip: GOGGLES & SHIELD; LAB COAT & APRON; VENT HOOD; PROPER GLOVES; CLASS B EXTINGUISHER

Storage Color Code: Red (Flammable)

Potential Health Effects

Inhalation:
A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Once absorbed into the body, it is very slowly eliminated. Symptoms of overexposure may include headache, drowsiness, nausea, vomiting, blurred vision, blindness, coma, and death. A person may get better but then worse again up to 30 hours later.

Ingestion:
Toxic. Symptoms parallel inhalation. Can intoxicate and cause blindness. Usual fatal dose: 100-125 milliliters.

Skin Contact:
Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure.

Eye Contact:
Irritant. Continued exposure may cause eye lesions.

Chronic Exposure:
Marked impairment of vision has been reported. Repeated or prolonged exposure may cause skin irritation.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired liver or kidney function may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:
Induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:
Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:
Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

5. Fire Fighting Measures

Fire:
Flash point: 12C (54F) CC
Autoignition temperature: 464C (867F)
Flammable limits in air % by volume:
lel: 6.0; uel: 36
Flammable Liquid and Vapor!
Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Moderate explosion hazard and dangerous fire hazard when exposed to heat, sparks or flames. Sensitive to static discharge.
Fire Extinguishing Media:
Use alcohol foam, dry chemical or carbon dioxide. (Water may be ineffective.)
Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Use water spray to blanket fire, cool fire exposed containers, and to flush non-ignited spills or vapors away from fire. Vapors can flow along surfaces to distant ignition source and flash back.

6. Accidental Release Measures

Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures. US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking

type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product. Do Not attempt to clean empty containers since residue is difficult to remove. Do not pressurize, cut, weld, braze, solder, drill, grind or expose such containers to heat, sparks, flame, static electricity or other sources of ignition: they may explode and cause injury or death.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:
For Methyl Alcohol:
- OSHA Permissible Exposure Limit (PEL):
200 ppm (TWA)
- ACGIH Threshold Limit Value (TLV):
200 ppm (TWA), 250 ppm (STEL) skin

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details. Use explosion-proof equipment.

Personal Respirators (NIOSH Approved):
If the exposure limit is exceeded and engineering controls are not feasible, wear a supplied air, full-facepiece respirator, airlined hood, or full-facepiece self-contained breathing apparatus. Breathing air quality must meet the requirements of the OSHA respiratory protection standard (29CFR1910.134). This substance has poor warning properties.

Skin Protection:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure.

Eye Protection:
Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Clear, colorless liquid.

Odor:
Characteristic odor.

Solubility:
Miscible in water.

Specific Gravity:
0.8

pH:
No information found.

% Volatiles by volume @ 21C (70F):
100

Boiling Point:
64.5C (147F)

Melting Point:
-98C (-144F)
Vapor Density (Air=1):
1.1
Vapor Pressure (mm Hg):
97 @ 20C (68F)
Evaporation Rate (BuAc=1):
5.9

10. Stability and Reactivity

Stability:
Stable under ordinary conditions of use and storage.
Hazardous Decomposition Products:
May form carbon dioxide, carbon monoxide, and formaldehyde when heated to decomposition.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Strong oxidizing agents such as nitrates, perchlorates or sulfuric acid. Will attack some forms of plastics, rubber, and coatings. May react with metallic aluminum and generate hydrogen gas.
Conditions to Avoid:
Heat, flames, ignition sources and incompatibles.

11. Toxicological Information

Methyl Alcohol (Methanol) Oral rat LD50: 5628 mg/kg; inhalation rat LC50: 64000 ppm/4H; skin rabbit LD50: 15800 mg/kg; Irritation data-standard Draize test: skin, rabbit: 20mg/24 hr. Moderate; eye, rabbit: 100 mg/24 hr. Moderate. Investigated as a mutagen, reproductive effector.

--------\Cancer Lists\----------

Ingredient	---NTP Carcinogen--- Known	Anticipated	IARC Category
Methyl Alcohol (67-56-1)	No	No	None

12. Ecological Information

Environmental Fate:
When released into the soil, this material is expected to readily biodegrade. When released into the soil, this material is expected to leach into groundwater. When released into the soil, this material is expected to quickly evaporate. When released into the water, this material is expected to have a half-life between 1 and 10 days. When released into water, this material is expected to readily biodegrade. When released into the air, this material is expected to exist in the aerosol phase with a short half-life. When released into the air, this material is expected to be readily degraded by reaction with photochemically produced hydroxyl radicals. When released into air, this material is expected to have a half-life between 10 and

30 days. When released into the air, this material is expected to be readily removed from the atmosphere by wet deposition.

Environmental Toxicity:

This material is expected to be slightly toxic to aquatic life.

13. Disposal Considerations

Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Domestic (Land, D.O.T.)

Proper Shipping Name: METHANOL
Hazard Class: 3
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 350LB

International (Water, I.M.O.)

Proper Shipping Name: METHANOL
Hazard Class: 3, 6.1
UN/NA: UN1230
Packing Group: II
Information reported for product/size: 350LB

15. Regulatory Information

--------\Chemical Inventory Status - Part 1\--------

Ingredient	TSCA	EC	Japan	Australia
Methyl Alcohol (67-56-1)	Yes	Yes	Yes	Yes

--------\Chemical Inventory Status - Part 2\--------

		--Canada--		
Ingredient	Korea	DSL	NDSL	Phil.
Methyl Alcohol (67-56-1)	Yes	Yes	No	Yes

--------\Federal, State & International Regulations - Part 1\----------

Ingredient	-SARA 302- RQ	TPQ	------SARA 313------ List	Chemical Catg.
Methyl Alcohol (67-56-1)	No	No	Yes	No

--------\Federal, State & International Regulations - Part 2\----------

Ingredient	CERCLA	-RCRA- 261.33	-TSCA- 8(d)
Methyl Alcohol (67-56-1)	5000	U154	No

Chemical Weapons Convention: No TSCA 12(b): No CDTA: No
SARA 311/312: Acute: Yes Chronic: Yes Fire: Yes Pressure: No
Reactivity: No (Pure / Liquid)

16. Other Information

NFPA Ratings: Health: **1** Flammability: **3** Reactivity: **0**

Label Hazard Warning:

POISON! DANGER! VAPOR HARMFUL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CANNOT BE MADE NONPOISONOUS. FLAMMABLE LIQUID AND VAPOR. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. AFFECTS CENTRAL NERVOUS SYSTEM AND LIVER.

Label Precautions:

Avoid breathing vapor.
Avoid contact with eyes, skin and clothing.
Wash thoroughly after handling.
Keep container closed.
Use only with adequate ventilation.
Keep away from heat, sparks and flame.

Label First Aid:

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. If swallowed, induce vomiting immediately as directed by medical personnel. Never give anything by mouth to an unconscious person. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 3, 8.

Disclaimer:

****
*****

Mallinckrodt Baker, Inc. provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by

a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose. MALLINCKRODT BAKER, INC. MAKES NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO THE INFORMATION SET FORTH HEREIN OR THE PRODUCT TO WHICH THE INFORMATION REFERS. ACCORDINGLY, MALLINCKRODT BAKER, INC. WILL NOT BE RESPONSIBLE FOR DAMAGES RESULTING FROM USE OF OR RELIANCE UPON THIS INFORMATION.

****

Prepared by: Environmental Health & Safety
Phone Number: (314) 654-1600 (U.S.A.)

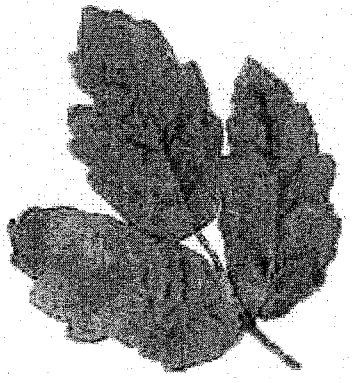
BIOLOGICAL FACT SHEETS

Poison Oak (Ivy and Sumac too)

Reaction to Poison Oak is an allergic response and ranges from no reaction to a severe "rhus" dermatitis. Rhus is the class of poisonous plants which also includes poison ivy and poison sumac, mango, and other urushiol containing plants. 3 of 4 people will develop dermatitis on contact with urushiol.

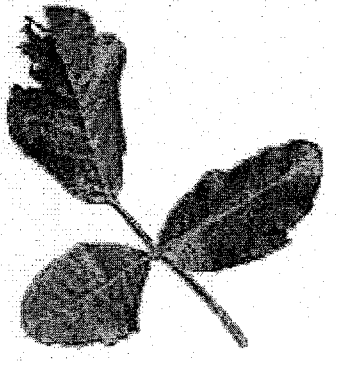
Shrubs are usually 12" to 30" high, or a tree-climbing vine, with triple leaflets and short, smooth hair underneath. A project site in Portland had 8' tall poison oak bushes. Early berries are fuzzy and white; later, dun-colored. Plants are red and dark green in Spring and Summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in Fall, but the plant loses its (yellowed, then brown) leaves in Winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons.

Spring Growth



Summer Colors

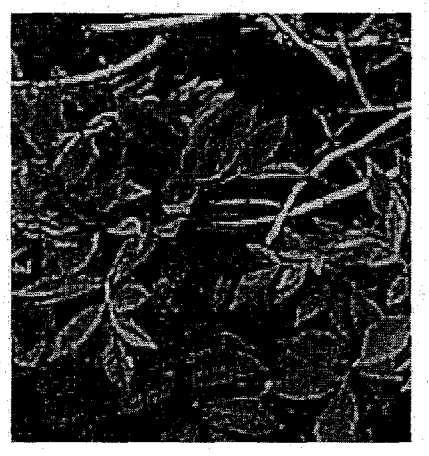
Fall Colors



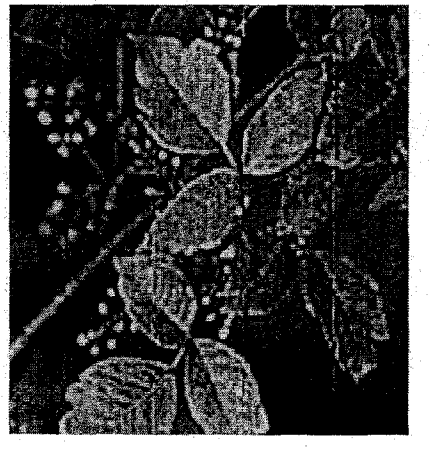
Primary contamination results from contact with bruised or broken plant parts that release "toxicodendrol", an oily resin containing the toxic chemical "urushiol".

Poison Ivy

Poison Sumac



Poison Oak



Exposure to Poison Oak is Preventable

Exposure to poison oak often becomes an OSHA recordable illness. The dermatitis is so severe that many people seek medical care and get prescription cortisone creams to reduce the suffering caused by the itch.

Exposure to Poison Oak is not an unavoidable part of working outdoors!

Identify Poison Oak – The best way to prevent exposure is to recognize the plant and avoid working in areas where poison oak is present.

If you must work in areas with poison oak, contact you project manager and health and safety manager to determine the best procedures to prevent contamination.

Contamination with poison oak can happen through several pathways. These include

Direct skin contact with any part of the plant.
Contact with clothing that has been contaminated
Contact from removing shoes that have been contaminated. (your shoes are coated with oil)
Sitting in a vehicle that has become contaminated
Contact with any objects or tools that have become contaminated.

If you must work on a site with poison oak the following precautions are necessary:

Do not drive vehicles onto the site where it will come into contact with poison oak. Vehicles which need to work in the area, such as drill rigs or heavy equipment must be washed as soon as possible after leaving the site.

All tools used in the poison oak area, including those used to cut back poison oak, surveying instruments used in the area, air monitoring equipment or other test apparatus must be decontaminated before they are placed back into the site vehicle. If on-site decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.

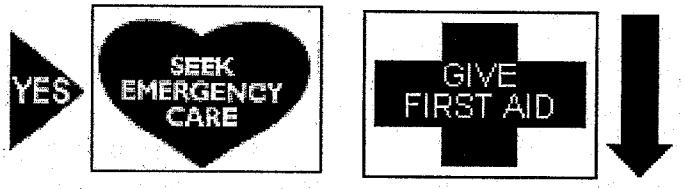
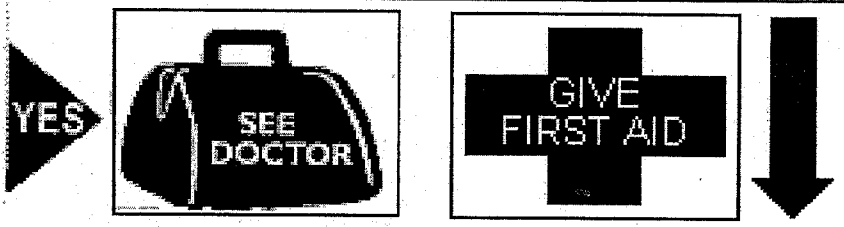
Personal protective equipment, including tyvek coveralls, gloves, and boot covers must be worn. PPE must be placed into plastic bags and sealed if they are not disposed immediately into a trash receptacle.

As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with "Tecnu" or other product designed for removing urushiol. If you do not have Tecnu wash with cold water. Do not take a bath, as the oils can form and invisible film on top of the water and contaminate your entire body upon exiting the bath.

Tecnu may also be used to decontaminate equipment.

If there is exposure use the following first aid procedures, or others you may find to alleviate the pain and itch.

Poison Oak First Aid

Are there any of these problems? Swelling in the throat, tongue and/or lips A hard time breathing or swallowing Weakness, dizziness Bluish lips and mouth Unconsciousness	
	Use emergency kit with adrenalin, if available, and Get Emergency Care.
Do you have any of these problems? Skin that is very bright red. Pus. Rash that has spread to the mouth, eyes or genitals. Rash on large areas of the body or the face.	
	See Doctor and Give first aid before seeing doctor: Take a hot shower (only after rash develops), put the rash area in hot water or pour hot water over it. Make sure the water is not too hot to burn the skin. The hot water causes itching at first, but brings relief later. Do not use soap. Take an over-the-counter antihistamine, such as Benadryl, as stated on the label. For weeping blisters: Mix 2 teaspoons of baking soda in 1 quarter (4 cups) of water. Dip squares of gauze in this mixture. Cover the blisters with the wet gauze for 10 minutes, four times a day. (Do not apply this to the eyes.)
	

Self-Care/First Aid

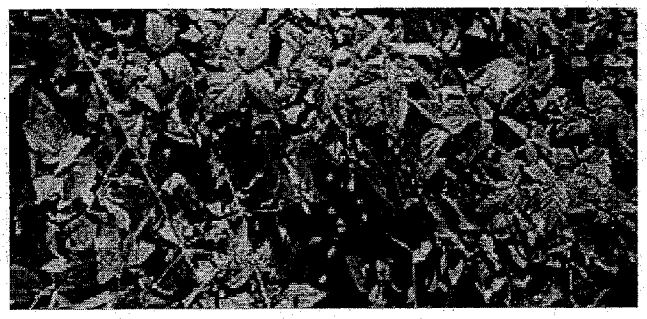
Make sure you wash all clothes and shoes with hot water and a strong soap. Also, bathe pets who have come in contact with poison ivy, oak or sumac. The sap can stay on pets for many days.
Keep your hands away from your eyes, mouth and face.
Do not scratch or rub the rash.
Apply any of these to the skin rash:
Calamine (not Caladryl) lotion
Zinc oxide ointment
Paste made with baking soda - mix 3 teaspoons of baking soda with 1 teaspoon of water
Take an over-the-counter antihistamine such as Benadryl, as stated on the label
If self-care/first aid measures don't bring relief, call your doctor.

Poison Oak Facts

Urushiol Oil is Potent

Only 1 nanogram (billionth of a gram) needed to cause rash
Average is 100 nanograms for most people
1/4 ounce of urushiol is all that is needed to cause a rash in every person on earth
500 people could itch from the amount covering the head of a pin
Specimens of urushiol several centuries old have found to cause dermatitis in sensitive people.
1 to 5 years is normal for urushiol oil to stay active on any surface including dead plants
Derived from **urushi**, Japanese name for lacquer

Myth ..	**Fact**
Poison Oak is contagious	Rubbing the rashes won't spread poison ivy to other parts of your body (or to another person). You spread the rash only if **urushiol oil** -- the sticky, resinlike substance that causes the rash -- has been left on your hands.
You can catch poison ivy simply by being near the plants	Direct contact is needed to release **urushiol oil**. Stay away from forest fires, direct burning, or anything else that can cause the oil to become airborne such as a lawnmower, trimmer, etc.
Leaves of three, let them be	Poison sumac has 7 to 13 leaves on a branch, although poison ivy and oak have 3 leaves per cluster
Do not worry about dead plants	**Urushiol** oil stays active on any surface, including dead plants, for up to 5 years.
Breaking the blisters releases **urushiol** oil that can spread	Not true. But your wounds can become infected and you may make the scarring worse. In very extreme cases, excessive fluid may need to be withdrawn by a doctor.

Tick-Borne Pathogens

There are 6 notifiable tick-borne pathogens that present a significant field hazard, and in some areas account for more than half of our serious field incidents. These procedures should be applied during any field activity – even those field efforts that are predominantly paved but with bordering vegetation.

Hazard Control

The methods for controlling exposure to ticks include, in order of most-preferred to least:

Avoiding tick habitats and ceasing operations in heavily infested areas
Reducing tick abundance through habitat disruption or application of acracide
Personal protection through use of repellants and protective clothing
Frequent tick inspections and proper hygiene

Vaccinations are not available and preventative antibiotic treatment after a bite is generally not recommended.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants – tickborne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced between 72 and 100% when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant, or licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

Personal Protection

After other prevention and controls are implemented, personal protection is still necessary in controlling exposure to ticks. Personal protection must include all of the following steps:

So that ticks may be seen on your clothing wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used.
To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots.
Wear long-sleeved shirts, a hat, and high boots.
Apply DEET repellent to exposed skin or clothing per product label.
Apply permethrin repellent to the outside of boots and clothing before wearing, per product label.
Frequently check for ticks and remove from clothing.

At the end of the day search your entire body for ticks (particularly groin, armpits, neck and head) and shower.

To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves anytime ticks are handled.

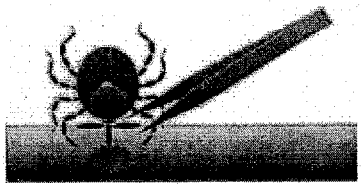
Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid hand-to-face contact, eating, drinking, smoking, etc. when applying or using repellents. Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

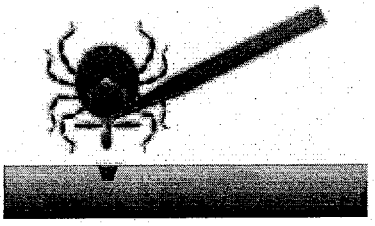
Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only.

Tick Removal

1. Use fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.

2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.)





3. Do not squeeze, crush, or puncture the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.

4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.

5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

6. You may wish to save the tick for identification in case you become ill. Your doctor can use the information to assist in making an accurate diagnosis. Place the tick in a plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.

Note: Folklore remedies such as petroleum jelly or hot matches do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be

avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

First-Aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Consult a healthcare professional if infection or symptoms and effects of tick-borne illnesses are develop.

Medical treatment for tick-borne infections include antibiotics and other medical interventions. Diagnosis of specific illness involves both clinical and laboratory confirmations. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only.

Previously infected individuals are not conferred immunity – re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs & symptoms of tick-borne illnesses.

Tick Identification

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These tick varieties include:

Deer (Black Legged) Tick (eastern and pacific varieties)
Lone Star Tick
Dog Tick
Rocky Mountain Wood Tick

These varieties and their geographical locations are illustrated on the following page.

Tick Habitat

In eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture. On the Pacific Coast, the bacteria are transmitted to humans by the western black-legged (deer) tick and habitats are more diverse. Here, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

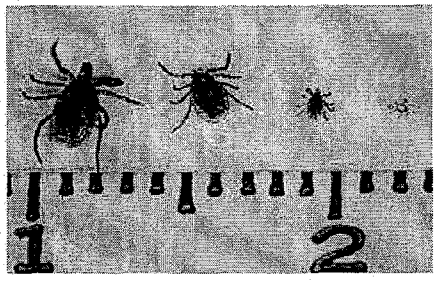
Illnesses and Signs & Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite – normally hours after attachment. The illnesses, presented in approximate order of most common to least, include:

Lyme (bacteria)
RMSF (bacteria)
Ehrlichiosis (bacteria)
STARI (Southern Tick-Associated Rash Illness) (bacteria)
Tularemia (Rabbit Fever) (bacteria)
Babesia (protozoan parasite)

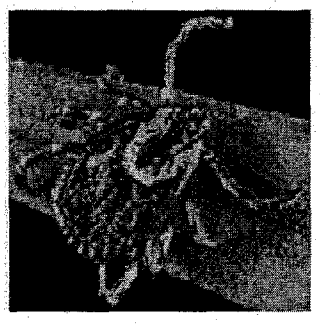
Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. A variety of long-term symptoms may result when untreated, including debilitating effects and death.

Deer Tick

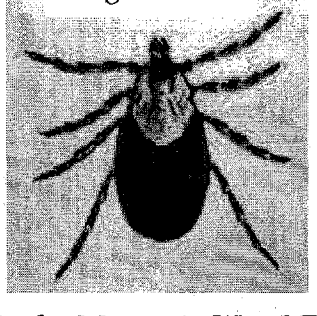


From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)

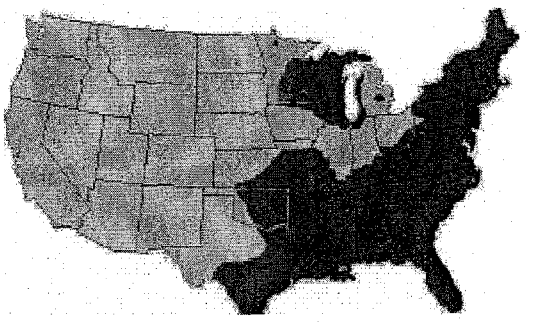
Lone Star Tick



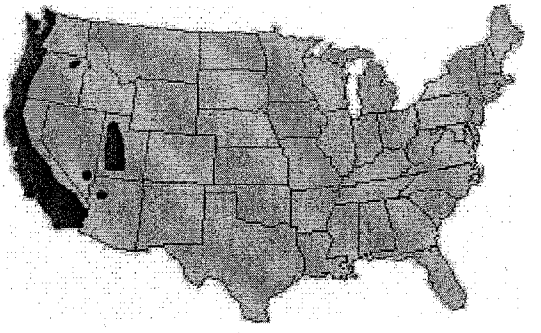
Dog Tick



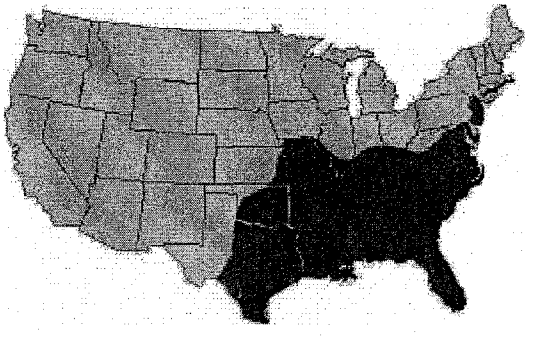
Rocky Mountain Wood Tick



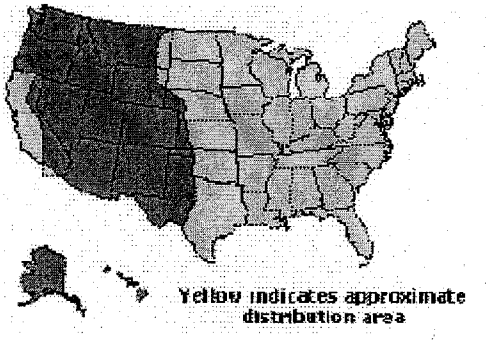
Distribution of Deer Tick (dark green)

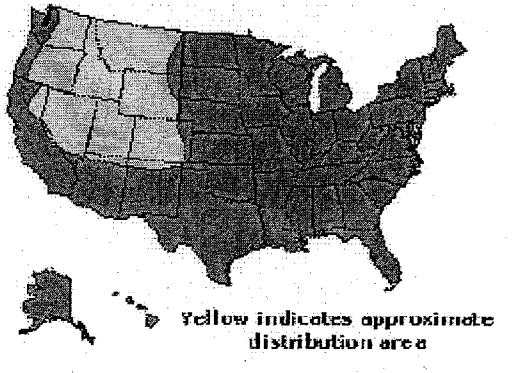


Distribution of Pacific Deer Tick (dark green)



Distribution of Lone Star Tick (Green)





CH2MHILL

Health and Safety Plan
Attachment 6

SELF-ASSESSMENT CHECKLISTS

Health and Safety Self Assessment Checklist-BOATS

This self assessment is only to be used at locations where CH2M HILL controls the work. It is not to be used at locations where others control the work.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

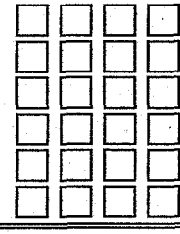
Auditor: _____ Title: _____ Date: _____

If an assessment item is complete/correct the "Yes" box should be checked. If an item is incomplete or deficient the "No" box should be checked. Items that are considered to be imminently dangerous must be corrected immediately or all exposed personnel must be removed from the hazard. All deficiencies shall be brought to the attention of the appropriate party that is responsible for correcting the deficiency. If an item is not applicable, the "N/A" box should be checked. If an item is applicable but was not observed during the assessment, the "N/O" box should be checked.

	Yes	No	N/A	N/O
GENERAL				
Weather forecast checked.	☐	☐	☐	☐
At Least one Team Member is trained in First Aid/CPR.	☐	☐	☐	☐
Lights, horn, battery, fuel, steering, bilge pump, anchor & propeller checked.	☐	☐	☐	☐
Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
5. Personal Floatation Devices (PFD's) inspected daily.	☐	☐	☐	☐
6. Fire extinguisher available, charged and accessible.	☐	☐	☐	☐
First aid kit available	☐	☐		
Project Instructions and H&S Plan available	☐	☐	☐	☐
Potable water available	☐	☐	☐	☐
Sunscreen & Bug Spray available	☐	☐	☐	☐
Distress communications available (flare gun, air horn, Cell phone, CB)	☐	☐	☐	☐
An oar is available on board the boat in the event of mechanical failure	☐	☐	☐	☐
BOAT TRANSPORT				
13. Boat motor secured prior to boat transport	☐	☐	☐	☐
14. Turn signals and brake lights verified as operable.	☐	☐	☐	☐
15. Safety chains available on trailer and secured in a criss-cross fashion	☐	☐	☐	☐
16. Trailer winch engaged	☐	☐	☐	☐
17. Ball hitch seated and latch pin installed	☐	☐	☐	☐
18 Tools and equipment secured prior to boat movement	☐	☐	☐	☐
19 Personnel not allowed ride on boat as it is being towed	☐	☐	☐	☐
20. Safe distance is maintained with traveling around power lines	☐	☐	☐	☐
21. Backup alarm or spotter used when backing boat	☐	☐	☐	☐
22. Boat is unhitched on a level and stabile surface	☐	☐	☐	☐

BOAT OPERATION

23. Boat holds appropriate size load
24. Personnel cleared during boat start-up
Kill switch clearly identified and operational
26. Personnel wearing appropriate PPE
27. All personnel wearing PFD's
28. Boat will not be used for recreational purposes



CH2MHILL

Health and Safety Plan
Attachment 7

EMERGENCY CONTACTS PAGE

Emergency Contacts

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical Emergency – 911

Fire/Spill Emergency -- 911

Police – 911

Utilities Emergency
Water: 757-444-6414
Gas: 757-444-6414
Electric: 757-444-6414

Designated Safety Coordinator (DSC)
Name: Ben Francisco/VBO
Phone: (757) 460-3734 x20

Project Manager
Name: Ben Francisco/VBO
Phone: (757) 460-3734 x20

Federal Express Dangerous Goods Shipping
Phone: (800) 238-5355

CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: (800) 255-3924

CH2M HILL Medical Consultant
Health Resources
Dr. Jerry Berke, MD, M.P.H.
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
(781) 938-4653; (800) 350-4511
(After hours calls will be returned within 20 minutes)

Local Occupational Physician
I&O Medical Center- Virginia Beach
1290 Diamond Springs Road
Virginia Beach, VA 23455
(757) 460-0700

Corporate Director Health and Safety
Name: Mollie Netherland/SEA
Phone: (206) 453-5005
24-hour emergency beeper: 888-444-1226

Health and Safety Manager (HSM)
Name: Steve Beck/MKE
Phone: (414) 272-2426 ext. 277

Regional Human Resources Department
Name: Cindy Bauder/WDC
Phone: (703) 471-1441 ext. 4243

Corporate Human Resources Department
Name: Pete Hannan/COR
Phone: (303) 771-0900

Worker's Compensation and Auto Claims
Contact Regional HR Department to have an Incident Report Form (IRF) completed or contact Julie Zimmerman after hours (303) 664-3304

Auto Claims/Rental: Carol Dietz/DEN (303) 713-2757
CH2M HILL owned vehicles: Zurich Insurance Company (800) 987-3373
Phone: (800) 420-8926 After hours: 800/497-4566

Report fatalities AND report vehicular accidents involving pedestrians, motorcycles, or more than two cars.

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms: Sound Field Vehicle horn **Evacuation Assembly Area(s):** Field Vehicle 3X

Facility/Site Evacuation Route(s): To be determined prior to activity

Hospital

Hospital Name/Address: Bon Secours Dc Paul Medical Center
150 Kingsley Lane
Norfolk, Virginia 23505

Hospital Phone #: (757) 889-5000

Directions to Hospital

1: Start out going North on 3RD AVE toward BELLINGER BLVD. <0.1 miles
2: Turn LEFT onto BELLINGER BLVD. 0.3 miles
3: Merge onto ADMIRAL TAUSSIG BLVD/I-564 E. 2.0 miles
4: Take the US-460/GRANBY ST exit. 0.6 miles
5: Turn RIGHT onto US-460 W/GRANBY ST. 1.4 miles
6: Turn RIGHT onto KINGSLEY LN. 0.1 miles
7: End at 150 Kingsley Ln Norfolk VA