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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION/REMEDIAL INVESTIGATION WORK PLAN FOR SITE 1, SITE 2, SITE 3, SITE 15 AND SITE 41 MCRD PARRIS ISLAND SC

3/9/1999

TETRA TECH NUS

Rev. 2
03/09/99

RCRA Facility Investigation/ Remedial Investigation Work Plan

for

Site/SWMU 1 - Incinerator Landfill
Site/SWMU 2 - Borrow Pit Landfill
Site/SWMU 3 - Causeway Landfill
Site/SWMU 15 - Dirt Roads and
SWMU 41 - Former Incinerator

Marine Corps Recruit Depot

Parris Island, South Carolina
U.S. EPA Identification Number
SC6 170 022 762

Southern Division
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888
Contract Task Order 0020

March 1999

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HEALTH AND SAFETY PLAN FOR SITES/SWMUS 1, 2, 3 AND 15, AND SWMU 41

Rev. 2
03/09/99

RCRA FACILITY INVESTIGATION/ REMEDIAL INVESTIGATION WORK PLAN FOR SITE/SWMU 1 - INCINERATOR LANDFILL SITE/SWMU 2 - BORROW PIT LANDFILL SITE/SWMU 3 - CAUSEWAY LANDFILL SITE/SWMU 15 - DIRT ROADS AND SWMU 41 - FORMER INCINERATOR

MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA
U.S. EPA IDENTIFICATION NUMBER
SC6 170 022 762

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0020

MARCH 1999

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Rev. 2
03/09/99

RCRA Facility Investigation/ Remedial Investigation Work Plan

for

Site/SWMU 1 - Incinerator Landfill and SWMU 41 - Former Incinerator

Marine Corps Recruit Depot

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Rev. 2
03/09/99

RCRA FACILITY INVESTIGATION/ REMEDIAL INVESTIGATION WORK PLAN FOR SITE/SWMU 1 - INCINERATOR LANDFILL AND SWMU 41 - FORMER INCINERATOR

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A Work Plan Addendum 1

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ACRONYMS

AOCs	Areas of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
B&R Environmental	Brown & Root Environmental
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COCs	Chemicals of Concern
CTO	Contract Task Order
DHEC	Department of Health and Environmental Control
DQO	Data Quality Objective
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EP	Extended Procedure
FID	Flameionization Detector
FOL	Field Operations Leader
FS	Feasibility Study
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HCL	Hydrochloric Acid
HDPE	High Density Polyethylene
HSWA	Hazardous and Solid Waste Amendments
IAS	Initial Assessment Study
IDW	Investigative-Derived Waste
K_h	Horizontal Hydraulic Conductivity
K_v	Vertical Hydraulic Conductivity
LQAP	Laboratory Quality Assurance Plan
MCLs	Maximum Contaminant Levels
MCRD	Marine Corps Recruit Depot
MSL	Mean Sea Level
NAVFAC	Naval Facilities Engineering Command
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NFA	No Further Action
NPL	National Priorities List

NSF	National Sanitation Foundation
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PR	Preliminary Review
QA	Quality Assurance
QAM	Quality Assurance Manual
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBCs	Risked-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SOPs	Standard Operating Procedures
SOUTHDIV	Southern Division
SSO	Site Safety Officer
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TOM	Task Order Manager
U.S. EPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
VS	Verification Step
VSI	Visual Site Inspection

FOREWORD

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act of 1986 (SARA) establishes a program for the cleanup of hazardous waste disposal and spill sites nationwide. This program contains provisions for the cleanup of contamination from past hazardous waste operations and past hazardous material spills and is the framework for installation restoration (IR) programs at numerous Navy and Marine Corps installations. The Resource Conservation and Recovery Act (RCRA), as amended, also establishes a cleanup program that provides for current and future hazardous waste management practices, as well as cleanup of past disposal sites at permitted or interim status Navy/Marine Corps installations.

Because of the past hazardous waste activities conducted at the Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina, the MCRD meets criteria for conducting IR activities under the CERCLA regulatory framework. To date, the MCRD has completed steps equivalent to the Preliminary Assessment/Site Inspection phases of the CERCLA remedial action process. The MCRD also meets the criteria for conducting IR activities under RCRA because in the late 1980's, the MCRD applied for a RCRA permit. Under RCRA, this action required the MCRD to conduct corrective action for the release of hazardous waste or hazardous constituents from solid waste management units. An interim RCRA Facility Assessment was conducted in 1990 as part of this requirement. Since this time, the MCRD has withdrawn its application for a RCRA permit.

Because of the circumstances surrounding the MCRD's IR program history, discussions have been held between representatives from the United States (U.S.) Marine Corps, U.S. Navy, South Carolina Department of Health and Environmental Control, and the U.S. Environmental Protection Agency, Region 4 to determine the appropriate regulatory framework for conducting IR activities at the MCRD. From these discussions, it has been decided that this site-specific work plan will encompass both CERCLA and RCRA requirements and will be dually titled as such. The success/lessons learned of this approach will used for subsequent IR activities as well as used to negotiate a Federal Facility Agreement for the MCRD.

RESPONSE TO REGULATORY COMMENTS TO THE

DRAFT AND DRAFT FINAL WORK PLAN FOR SITES/SWMUS 1/41

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLAN
SITE 1/41 - INCINERATOR LANDFILL AND FORMER INCINERATOR - COMMENTS ISSUED 11/21/96
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

(J. TAPAI, REVIEWER)

1. **Comment:** Section 2.2.3
   This section confirms the existence of a public water supply well within 1/4 of a mile radius of the MCRD. This public supply well should be identified on either Figure 2-1 or Figure 2-2.

   Response:
   Figure 2-1 will be revised to indicate the exact location of the public water supply well. However, it will be noted that the well is currently not in use but has not been abandoned.

2. **Comment:** Page 4-6, Table 4-2
   Footnote (4) says that three surface soil samples will be collected upgradient of Site 1 for background determination, and ten surface soil samples will be collected at specified soil boring locations. This footnote disagrees with what is shown on Table 4-2. This table proposes the collection of fourteen surface soil samples (including four for background determination). This table should be revised to clarify the discrepancy.

   Response:
   A total of four background soil samples will be collected. This footnote will be revised to read "Includes four surface soil samples for background determination upgradient of Site 1 ..." In the revised Work Plan, this table has been renumbered as Table 4-3.

3. **Comment:** Section 6.2, Site Restoration
   This paragraph states "The site will be restored to its original condition prior to investigation activities." It should be explained what "original condition" means, and why the site will be restored before to start investigation activities and then will be disturbed again to do the investigation. The paragraph is vague and should be more specific and/or correct the proposed approach.

   Response:
   Section 6.2 will be changed to read "If investigation activities (e.g., monitoring well installation) disturb or alter the landscape, vegetation, or other features of Site 1, the site may require restoration to conditions prior to the investigation. If vegetation is stressed or damaged as a result of investigation activities, the affected area will be reseeded. Portions of Site 1 will be regraded if investigative activities alter the natural contour of the site. Additionally, all equipment used during the investigation and investigative-derived waste will be removed from the site."

4. **Comment:** Table 7-1
   This comment makes reference to page 7-4, where the identification of all soil sampling and boring locations is described. It seems that soil boring #3 has been mislabeled as soil boring #2 sampling locations. For example, PAI-01-SB02 should be labeled PAI-01-SB03. Table 7-1 should be corrected accordingly.

   Response:
   As discussed in the response to U.S. EPA Region 4 Comment Number 16 for Site 1/41, subsurface soil samples have been removed from investigation activities.

(D. HARGROVE, REVIEWER)

1. **Comment:** Figure 1-1, Depot Location Map
   Remove "Site 1 - Incinerator Landfill" from title.

   Response:
   "Site 1 - Incinerator Landfill" will be removed from the title of Figure 1-1.

2. **Comment**: Section 2.2.1, Surficial Aquifer

   Typographical error: "Pamlico" should be "Pamplico".

   Response:
   This typographical error will be corrected.

3. **Comment**: Section 2.2.2, Confining Layer, fifth sentence

   This sentence is vague. It implies that the depth to the top of the Hawthorn Formation is 70' below ground level while a previous sentence describes the top of the Hawthorn at 30' below msl. Please clarify.

   Response:
   The third, fourth, and fifth sentences will be replaced with the following text. "The elevation at the top of the Hawthorn Formation is reported to be within the range of 30 to 60 feet below msl at Parris Island. The thickness of the Hawthorn Formation at Site 1 is anticipated to be between 20 to 40 feet. The actual depth of this formation at Site 1 will be determined during the field investigation."

4. **Comment**: Figure 7-1, Proposed SW/Sediment Sample Locations

   The approximate locations for the upgradient samples should be specified on this figure.

   Section 3.3 describes surficial groundwater flow in a radial pattern towards the tidal stream. If this is the case, the upgradient sample locations can be approximated.

   Section 4.2.3.4 Water-Level Measurements describes a plan to measure groundwater levels during low and high tides and determine groundwater flow directions in the surficial aquifer. If further groundwater investigation is necessary before choosing upgradient sample locations, then Section 6.0 Field Operations should be revised to include a methodology describing the chronology of events pertaining to the characterization of groundwater flow followed by the determination of upgradient sample locations.

   Please revise the text and figures for the appropriate scenario.

   Response:
   Tidal influences may affect the flow of groundwater. Although an estimation of upgradient could be made without taking into account this tidal effect, water-level measurements taken during the initial phase of field activities would help to better depict the location of the upgradient samples. As such, the following sentences will be inserted after the first sentence of the second paragraph of Section 6.0 Field Operations.

"Monitoring well installation will be a priority of the field effort followed by water-level measurements. The results of these measurements will be used to better characterize the depth, flow direction, and gradient of the groundwater. From this information, the location of background surface water and sediment will be determined in the field."

Additionally, the following sentence will be inserted into Section 7.2.1, Surface Water and Sediment Sampling. "The location of the four background samples for surface water and sediment will be determined in the field from the results of water-level measurements conducted during the initial portion of the investigation field effort."

The four background surface water and sediment samples taken for Site 1 will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

5. **Comment**: Figure 7-2 Proposed Soil Sample Locations

   See comment 4.

   Response:
   The location of the four background soil samples will be illustrated on a new figure in Section 7.0. The four background soil samples taken for Site 1 will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

6. **Comment**: General Comment
   All figures showing well locations or proposed well locations, proposed sample locations, or groundwater contamination plumes should include arrows indicating groundwater flow directions from the latest data. Please revise.

   Response:
   Figure 7-3, Proposed Groundwater Sample Locations, will be revised to include estimates of surficial groundwater flow directions in the vicinity of each monitoring well that is proposed to be sampled. In the revised version of the Work Plan, Figure 7-3 has been renumbered as Figure 7-4.

RESPONSE TO U.S. EPA REGION 4 COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLAN
SITE 1/41 - INCINERATOR LANDFILL AND FORMER INCINERATOR -
COMMENTS RECEIVED 2/20/97
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

1. **Comment:** Page 1-3, Figure 1-1
   Given the title and purpose of this figure, Site 1 (Incinerator Landfill) should be clearly depicted on the map.

   Response:
   The purpose of Figure 1-1 is to provide the general layout and features of MCRD Parris Island. As such, "Site 1 - Incinerator Landfill" will be removed from the title of this figure. However, to illustrate the location of Site 1 in relation to the other features of the Depot, Site 1 will be depicted on this figure.

2. **Comment:** Page 2-1, Section 2.1, Paragraph 2
   The text should also briefly describe the level and type (if applicable) of activity that took place at the site between 1965 and present.

   Response:
   No significant disposal or intrusive activity has taken place at Sites 1 and 41 since 1965. This statement will be included in Section 2.1.

3. **Comment:** Page 2-10, Section 2.3.2, Paragraph 1, Bullet 2
   This section recommends that action be taken to determine if chloroform is present at greater depths in the surficial aquifers. However, the text on page 2-6 states that no organic compounds were detected in the groundwater samples collected during the 1990 verification study. The text should present further rationale for determining the presence of chloroform at greater depths in the surficial aquifer.

   Response:
   This section summarizes the results of the Verification Study conducted by McClelland Consultants in 1990. In this study, chloroform was recommended for further evaluation in the surficial aquifers at Site 1. This evaluation was based on the presence of chloroform in sediment and the density and possible mobility of this compound. The text of the last paragraph of Section 2.3.2 will be revised to include the basis of McClelland Consultants recommendations.

4. **Comment:** Pages 3-1 through 3-2, Section 3.0
   This section repeatedly mentions Archers Creek as a potential receiving media for Site 1 contaminants. It may thus be helpful to modify the scale of all figures showing landfill boundaries (e.g. Figures 2-2 and 7-1) to include this surface water body.

   Response:
   The scale of all figures showing landfill boundaries will be modified to include Archers Creek.

5. **Comment:** Page 3-1, Section 3.3, Sentence 3
   The text states that the marsh deposits underlying the landfill are assumed to be a barrier to the deeper aquifer. This statement appears to contradict Figure 3-1 (Site Conceptual Model), which depicts these deposits as providing a partial barrier to the shallow aquifer. Please clarify and revise as needed.

Response:
During field activities, the presence of the marsh deposits will be confirmed during the installation of deep surficial monitoring wells. Additionally, the vertical conductivity of the deposits will be investigated. The last sentence of Section 3.3 Groundwater will be revised to "However, the marsh deposits underlying the landfill including the clay comprising the Hawthorn Formation may act as a partial barrier to the deeper aquifer and will be investigated during the investigation."

6. **Comment:** Page 4-1, Section 4.1
Given the relatively low numbers and concentrations of contaminants detected during previous investigations of this site, a primary sampling rationale for each media should be to characterize worst-case site conditions for that media. The text should be modified to include this objective.

Response:
Section 4.1 will be revised to include this sampling rationale.

7. **Comment:** Page 4-6, Table 4-2
The body of the table does not appear to include a reference to footnote number 1. Please check and revise as needed.

Response:
The column titled "Samples per Location" should be referenced with footnote number 1. This change will be made accordingly. In the revised version of the Work Plan, this table has been renumbered as Table 4-3.

8. **Comment:** Page 4-7, Section 4.2.2.2
Based on the site description provided in Section 2.1 of the SAP, this landfill appears to consist primarily of incinerated Municipal Landfill (MLF)-type wastes and cover an area in excess of 29,000 cubic yards. Given these site characteristics, wholesale excavation of Site 1 landfill contents would seem unlikely (see EPA/OSWER Quick Reference Fact Sheet: Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (June 27, 1995)). Toxicity Characteristic Leaching Procedure (TCLP) analyses of subsurface soil and sediment samples to determine if waste material/fill is a characteristic RCRA waste (presumably for purposes of off-site disposal) should therefore be delayed until a determination regarding the need to excavate these materials has to be made. For example, if hot spots are identified during the RI/RFI, these may require further characterization to determine if removal and/or treatment is warranted.

Also, depending on RI/RFI results, a second type of leach test which may prove helpful is RCRA Method 1312: Synthetic Precipitation Leach Test for Soils. This method is designed to determine the mobility of organic and inorganic contaminants in soils.

Response:
As will be discussed in Comment Number 16 for Site 1/41, the focus of the investigation will be changed to address 1) onsite exposure pathways for direct contact and 2) offsite exposure pathways. As such, characterization of landfill contents will not be addressed by investigation activities and TCLP analyses of subsurface soil and sediment samples will not be conducted. The text of the Work Plan will be revised to eliminate reference to TCLP analysis.

9. **Comment:** Page 4-7, Section 4.2.2.3
For use in assessing effects on ecological receptors, it is recommended that temperature and Secchi Disk readings also be collected for surface water.

Response:
The text of Section 4.2.2.3 will be revised to indicate that temperature and Secchi Disk readings will be collected for surface water.

10. **Comment:** Page 5-1, Section 5.0, Paragraph 4
Unless the groundwater beneath Parris Island is determined not to be potable, the following exposure routes must also be included under the "Future Resident" receptor group heading for groundwater: ingestion and inhalation. These exposure routes should also be considered for future construction workers, and/or maintenance workers.

Response:
For the Future Resident receptor groups, groundwater exposure through ingestion and inhalation will be evaluated in the human health risk assessment and will be added to the text of Section 5.1. However, if it is found from investigation activities that the groundwater beneath Parris Island is not potable, it will be removed as a pathway of concern from the human health risk assessment.

11. **Comment:** Page 6-1, Section 6.3:
The inner diameter of the augers should be at least 6.25 inches.

Response:
The fourth sentence of Section 6.3 will be replaced with the following text.

> *"For monitoring well construction, hollow stem augers of sufficient diameter will be used to produce a 2-inch annular space between the casing and the borehole wall."*

This complies with Section 6.4, "Borehole Construction", of the U.S. EPA Region 4 EISOPQAM.

12. **Comment:** Page 6-5, Section 6.4.1
The grout seal should be cored, not drilled, to prevent shattering.

Response:
As discussed in the response to Comment Number 16, the Work Plan will be revised to reflect an approach consistent with Presumptive Remedy for CERCLA Municipal Landfill Sites (Directive No. 9355.0-49FS, June 27, 1995). The investigation of the Floridan Aquifer will be delayed until characterization of the surficial aquifer. As such, a monitoring well to the Floridan Aquifer will not be installed at this time and Section 6.4.1 has been removed from the Work Plans.

13. **Comment:** Page 6-6, Section 6.8, Paragraph 2
The acronym FOL is not defined here. All acronyms should either be defined in text (first occurrence only), or in an acronym list to be included with the document.

Response:
The acronym FOL will be defined in Section 6-6 as Field Operations Leader. Additionally, an acronym list has been added to the document.

14. **Comment:** Page 7-1, Section 7.2.1
In order to ensure that the sediment samples collected reflect worst-case conditions, sediments should be collected from at least two depth intervals at each location. Recommend that samples be collected from the top few inches, to reflect recent off-site migration, and from some greater depth interval (suggest 1 foot) to reflect historical accumulations. Visual inspection, or other available information, should be used to ensure sample collection from the depth interval with the greatest potential for contamination.

Response:
Sediment samples will be collected at two sample depth intervals. At each site (1/41, 2/15, and 3), one sediment sample will be collected at a 6- to 12-inch sample depth to reflect historical accumulation. This sample will be collected at a downgradient location where preferentially accumulation of contaminants is likely to occur. The remainder of the sediment samples will be collected at a 0- to 6-inch sample depth to reflect recent offsite migration.

15. **Comment:** Page 7-1, Section 7.2.2
A. Surface soil samples should be collected from the depression observed during the October 15-17 1996 base tour and from any other areas where contaminants are likely to have preferentially accumulated (e.g. based on visual inspection of existing site conditions, aerial photographs, historical information, etc.). A reasonable effort should also be made to locate the former incinerator and collect samples near it.

Response:
The following sentence will be added to the text of Section 7.2. "If during field activities, the FOL deems that an area not contained in the Work Plan should be sampled because of surface features (e.g., depressions) that would cause accumulation of contaminants, the locations of samples as presented in the sampling plan will be altered to include such areas."

As presented in the Addendum to the Draft Remedial Investigation Work Plan for Site 1 - Incinerator Landfill submitted on October 7, 1996, surface soil sampling locations in the vicinity of the Former Incinerator have been included in the Work Plan.

B. Per Region 4 Supplemental Guidance to RAGS, all surface soil samples should also be collected from the 0-1 foot interval, or biased to reflect worst-case conditions. For example, if historical records, visual inspection or aerial photographs indicate that the soil/fill layer on top of the landfill is less than 1 foot thick in any area, a surface soil sample should be collected from the ash/waste layer contained within the top foot of the landfill.

Response:
The text of Section 7.2.2 will be revised to include that all surface soil samples will be collected from the 0-1 foot interval in accordance with this Region 4 guidance document. Additionally, the text of Section 7.2.2 will be revised to indicate that samples will be collected to bias the worst-case scenario.

16. **Comment:** Page 7-11, Section 7.2.3
Given the Site 1 characteristics mentioned previously (e.g. primarily incinerated MLF-type wastes, size: >29,000 cubic yards), engineering controls, such as containment, would appear to be a more likely remedy than treatment (see Section 300.430(a)(iii)(B) of the NCP and EPA/OSWER Quick Reference Fact Sheet: Presumptive Remedy for CERCLA Municipal Landfill Sites (Directive No. 9355.0-49FS, June 27, 1995)). For this reason, the RI should initially focus on characterizing (i) on-site exposure pathways for direct contact (e.g. surface soil contamination) and (ii) all off-site exposure pathways (e.g. off-site contamination of surface water, sediment and groundwater). EPA

recommends that a decision regarding the need to characterize landfill contents (i.e. source characterization) be delayed until this initial round of data becomes available. Evaluation of this data for purposes of determining whether source characterization is appropriate should include consideration of such factors as: (i) magnitude and risk-level of detected off-site contamination (ii) presence/absence and nature of any hot spots and (iii) length of time for which contaminants have been available for off-site transport (in this case between 32 and 76 years).

Use of the above approach makes it critical that the locations and numbers of samples collected during this first round of activities provide adequate characterization of worst-case site conditions. To this end, specific justification/rationale must be provided for each sample collected. Care should also be taken to ensure that the number of samples collected provides coverage of all areas where significant potential for off-site migration and/or concentration of contamination exists.

Response:
It is agreed that given the conditions of the site, containment would appear to be a more likely remedy than treatment. Therefore, an investigation approach is proposed that will initially characterize the extent of contamination in all areas where significant potential for offsite migration of contamination exists. Groundwater samples will be taken downgradient of groundwater flow at Sites 1/41 and 2/15, and below Site 3 due to the site-specific characteristics of the Causeway Landfill. Additionally, surface water and sediment samples will be taken downgradient of the path of surface water runoff at all sites. Lastly, surface soil (0-1 foot below ground surface) will be sampled throughout the sites as previously proposed in the Draft Work Plan.

If the results of these investigation activities indicate that offsite migration of contamination exceeds regulatory standards or poses unacceptable human and ecological risks, additional investigation may be considered to characterize the extent of contamination within the landfill. Additionally, if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill, further investigation of the competency of the Hawthorn Layer as an adequate confining layer and evaluation of potential impacts to the Floridan aquifer may be warranted.

17. **Comment:** Page 7-11, Section 7.2.4
Given that metals were the only contaminants detected in groundwater samples during earlier Site 1 investigations, it is important that the current RI use sampling methods which will facilitate the collection of clear ground water samples and reduce the likelihood of false positives. The Navy should use the ground water sampling techniques provided in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), May 1, 1996 and summarized in the final paragraph of Section 3.1.1 (Groundwater Sampling) of the Draft Volume II Master Work Plan.

Response:
It is agreed that the groundwater sampling techniques provided in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), May 1, 1996 and summarized in the final paragraph of Section 3.1.1 (Groundwater Sampling) of the Draft Volume II Master Work Plan should be used. The final paragraph of Section 3.1.1 is fully detailed in SOP SA-1.1, Section 5.7, "Low Flow Purging and Sampling." The text of section 7.2.4 will be revised accordingly.

18. **Comment:** Page 7-12, Section 7.3.2
This section stipulates that the last two digits of the sample number will specify the middle of the sample interval, yet the sample numbers in Table 7-1 specify the bottom of the sample interval. This discrepancy in sample nomenclature should be addressed.

Response:
The explanation of the sample depth portion of the sample identification number will be changed from "Middle of sample interval" to "Bottom of the sample interval or sample round."

19. **Comment:** Page 10-1, Section 10.2
A number of needed field QA/QC blanks are missing. Grout, sand, bentonite, and preservative blanks should also be collected.

Response:
Brown & Root Environmental recommends that material QA/QC blanks not be taken because the contractor will provide certified-clean well construction materials and false positive detections have not been a historical problem.

Additionally, it is recommended that preservative QA/QC blanks not be taken. In Section 10.2.1, trip blanks, field blanks, and rinsate blanks are proposed. Historically, such blanks very rarely shown positive detection of contaminants. Therefore, if the analytical results indicate that these samples are clean, the results indicate that preservatives used in such samples are pure.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLAN
SITE 1/41 - INCINERATOR LANDFILL AND FORMER INCINERATOR -
COMMENTS RECEIVED 7/18/97
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

(S. PETERSON, REVIEWER)

1. **Comment**:
   Please modify the title of this work plan to include RCRA terminology. As known, understood, and accepted by the MCRD Tier I technical and Tier II teams, the State of South Carolina has authorization under the Hazardous & Solid Waste Amendment to implement correction action activities.

   The Department reviewed this document to meet the requirements of an RCRA Facility Investigation (RFI) Work Plan. The Department is willing to recognize the following dually-titled document:

   Draft Final RCRA Facility Investigation/Draft Final Remedial Investigation Work Plan
   for
   SWMU/Site 1 - Incinerator Landfill and
   SWMU/Site 41 - Former Incinerator

   or

   Draft Final
   RCRA Facility Investigation/Remedial Investigation Work Plan
   for
   SWMU/Site 1 - Incinerator Landfill and
   SWMU/Site 41 - Former Incinerator

   Marine Corps Recruit Depot
   Parris Island, South Carolina
   SC6 170 022 762

   Response:
   The suggested title will be used. However, in accordance with Navy CLEAN format, the word "FINAL" will not be included in the title of the FINAL report.

2. **Comment**:
   According to the Region 4 RFI Work Plan Checklist, prepared by A.T. Kearney, dated 1989, an EPA Identification Number should be included on the cover page. The EPA identification number for MCRD Parris Island is SC6 170 022 762. Please include that identification number on the Final Work Plan.

   Response:
   The EPA Identification Number will be added to the cover page of the document.

(D. HARGROVE, REVIEWER)

1. **Comment**: The title should reflect whether this document is a "DRAFT" or a "FINAL" document. Please revise.

   Response:
   The last version of the site-specific sampling and analysis plan (SAP) for Site 1/41 was incorrectly missing the words "DRAFT FINAL" in the title and header of the document. However, Navy CLEAN format stipulates when a document is issued "FINAL", the words "DRAFT" or "DRAFT FINAL" are to be removed from the title and header of the report. As such, the title and header will not contain the "FINAL" designation.

2. **Comment**: Response to Comments

   Only the comments concerning the "DRAFT" version of this document should be included in this section. The Division of Hydrogeology understands that some comments made on other work plans have been incorporated into this document due to comparable applicability. Any additional comments that have been incorporated into this document should be included at the end of this section. Please revise.

   Response:
   Comments made to the "DRAFT" and "DRAFT FINAL" Work Plans for Site 1/41 will be included in the Response to Comments Section of the "FINAL" Work Plan. Additionally, applicable comments concerning the Work Plans for Site 2/15 and 3 will be added to the end of this section.

RESPONSE TO U.S. EPA REGION 4 COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLAN
SITE 1/41 - INCINERATOR LANDFILL AND FORMER INCINERATOR -
COMMENTS RECEIVED 7/22/97
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

1. **Comment:** Pages 3-1 through 3-2, Section 3.0:
According to the text, "This section presents a conceptual model and discussion of potential migration and human and ecological exposure pathways." However, the text does not indicate whether the identified pathways are applicable to human receptors, ecological receptors, or both. Nor does it indicate if any other aspects of the exposure pathways identified are unique to the receptor being considered. This information must be provided to ensure development of an adequate site conceptual model.

Response:
The text of Section 3.0 will be revised to indicate which exposure pathways are applicable to human or ecological receptors. Also, if aspects of the identified exposure pathways are unique to a receptor, the text will also be revised to indicate this information.

This comment is also relevant to the Draft Final Work Plans for Sites 2/15 and 3 and will be similarly addressed.

2. **Comment:** Page 4-12, Section 4.2.2.3:
As discussed and agreed to during the July 1997 Partnering Meeting, two surface water samples will be collected and analyzed for hexavalent chromium for risk assessment purposes. Verification of the hexavalent chromium content of surface water samples is appropriate, since chromium has been detected in previous sediment samples and surface water samples have never been collected at this site.

Response:
Per U.S. Fish & Wildlife Comments, 3 samples from each medium will be sampled for hexavalent chromium.

This comment is also relevant to the Draft Final Work Plans for Sites 2/15 and 3 and will be similarly addressed.

3. **Comment:** Page 4-1, Section 4.0:
Given that a presumptive remedy approach will be used to evaluate this site, appropriate steps should be taken to notify the public of this approach. It is important that all stakeholders understand completely how the presumptive remedy process varies from the usual cleanup process, and the benefits of using this process. Please refer to U.S. EPA Directive entitled *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills* (Directive No. 9355.0-67FS, December 1996) for information and documents to be provided to the public via mechanisms such as the Administrative Record, Fact Sheets, etc.

Response:
In accordance with the U.S. EPA Directive entitled Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills, the Administrative Record will include the necessary generic and site-specific information documenting the selection and non-selection of the containment presumptive remedy. The text of Section 4.0 will be revised to reflect this information.

This comment is also relevant to the Draft Final Work Plans for Sites 2/15 and 3 and will be similarly addressed.

4. **Comment:** Page 5-2, Section 5.2:
The description of the ecological risk assessment to be performed must be comparable, in level of detail, to that provided for the human health risk assessment. For example, information on potential COCs (e.g. results of previous investigations), exposure pathways and receptor groups should be provided. Site-specific approaches to completing the generic steps identified in the Volume III Master Work Plan should also be provided. If Work Plan/SAP addendums will be generated to complete the plans for conducting the Ecological Risk Assessment (ERA), these addendums should also be clearly identified and described (e.g. purpose, contents, submittal criteria) in the present SAP.

Response:
Section 5.2 will be rewritten to describe the Navy's approach for conducting the ERA portion of the baseline risk assessment. In summary, the Navy believes that the ERA should be performed at the screening level only (Steps 1 and 2 of the ERA process) with data obtained from the upcoming RI/RFI rather than evidence of exceedences.

This comment is also relevant to the Draft Final Work Plans for Sites 2/15 and will be similarly addressed.

For Site 3, the text of Section 5.2 will be revised to include the resolutions made during the September 8, 1997 conference call of the Tier I Partnering Team. During this conference call, the Team resolved to collect surface water and sediment samples at Site 3 at the onset of the field effort and to obtain analytical results from these samples within seven days. The need for biota sampling will be evaluated based on the results of this analysis. If necessary, biota sampling will be conducted before demobilization of the field effort.

Also for Site 3, a figure will be included in the SAP that overlays analytical data from the Verification Step onto the proposed surface water and sediment sampling points. This figure will be used as a check to ensure that Verification Step sample locations that exceeded U.S. EPA screening criteria are resampled and that areas not sampled during the Verification Step are sampled. Additionally, sampling points have been added within the Pond northeast of the Causeway and Ribbon Creek (southeast of the causeway) to evaluate the possible migration of contaminants from the site.

5. **Comment:** Page 7-1, Section 7.2:
Regarding the rationale for the proposed sampling, the SAP currently includes some good general criteria for selecting sampling locations (e.g. "..a primary sampling concern will be to characterize the worst-case site condition of each media investigated.." (p. 4-6, Section 4.1); "If during field activities, the FOL deems that a location not contained in the Work Plan should be sampled because of surface features (e.g. depressions) that would cause preferential accumulation of contaminants, the sampling plan will be altered to include these locations (p. 7-1, Section 7.2).

However, as discussed and agreed to during the July 1997 Partnering Meeting, in order to assure that these goals are accomplished on a sample-specific basis, the RI Report will briefly describe (e.g. 1-2 sentences) the justification for each sample collected.

Response:
If during field activities, a sampling location is altered, rationale will be provided in the RI/RFI report that justifies such deviation.

This comment is also relevant to the Draft Final Work Plans for Sites 2/15 and 3 and will be similarly addressed.

6. **Comment:** Page 7-13, Figure 7-4:
As discussed and agreed to during the July 1997 Partnering Meeting, one additional monitoring well pair will be installed on the western and eastern sides of the landfill (total of 4 additional wells). This

will result in the collection of a groundwater sample at least every 200-300' around the landfill perimeter, ensuring better characterization of potential offsite groundwater contaminant migration .

Response:
The monitoring wells will be added to the site-specific sampling plan for Site 1/41 as agreed to at the July 1997 Partnering Team Meeting.

7. **Comment:** Page 10-1, Section 10.2:
Section 5.13.10 (Estimating Variability) of the U.S. EPA Region 4 SOPQAM cites the need for collecting material and preservative blanks. The Navy's decision not to collect QA/QC blanks for grout, sand bentonite and a preservative blank is acceptable, so long as the Navy assumes the risk for false positive detections.

Response:
As indicated in the response to comments to the Draft RI Work Plan for Site 1/41, false positive detections have not been a historical problem. However, QA/QC blanks for grout, sand, and bentonite will be collected and held for analysis pending the analytical results of the field investigation. If it is suspected that inorganic contaminants have been introduced by well installation materials, the samples will be sent to the laboratory for analysis. For inorganics, holding times will not be exceeded because the holding time for inorganic analysis is considerably longer than the 3-week turn-around time anticipated for analytical results. For organics, material blank analysis is not anticipated because monitoring well purging and development activities should dissipate minor organic contamination if present.

This comment is also relevant to the Draft Final Work Plans for Sites 2/15 and 3 and will be similarly addressed.

RESPONSE TO U.S. EPA REGION 4 COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLANS
SITES 1/41, 2/15, and 3 - REVISED SECTION 5.2 - COMMENTS RECEIVED 9/9/97
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

1. **Comment:** Section 5.2 - Paragraph 1:
   The paragraph is OK, pending receipt of acceptable description of ecological risk methods/steps in MWP v. III.

   Response:
   Comments made to the ecological risk approach contained in Volume III of the Parris Island Master Work Plan have been incorporated.

2. Section 5.2 - Paragraph 3:
   a) **Comment:** Replace "Problem Formulation" w/ "Preliminary Problem Formulation."

      Response: *The text will be revised.*

   b) **Comment:** Include groundwater discharge to surface water as an exposure media.

      Response: *Groundwater discharge to surface water will be included as an exposure media.*

   c) **Comment:** Replace "soil organisms" and "terrestrial wildlife feeding on soil organisms" with "terrestrial invertebrates."

      Response: *"Soil organisms" will be replace with "terrestrial invertebrates." However, "terrestrial wildlife feeding on soil organisms" will be replaced with "terrestrial vertebrates."*

   d) **Comment:** Replace "sediment-dwelling organisms" with "benthic invertebrates."

      Response: *The text will be revised.*

3. **Comment:** Section 5.2 - Paragraph 4:
   Preliminary assessment should not consider/calculate midpoint concentrations or midpoint ingestion rates. The initial screening phase should use only the most conservative values. Delete all references to midpoint values.

   Response:
   Agree. The text will be revised accordingly.

4. **Comment:** Section 5.2 - Paragraph 5:
   Regarding "recommendations for further investigation", "additional field work" is the only truly appropriate means for verifying or disproving potential ecological effects identified during the screening step. Modeling results are likely to be inconclusive, and risk management comes into play only after site risks are adequately characterized. If the technical memorandum indicates the need for additional work, a work plan addendum would also need to be submitted.

   Response:
   Agree. The text will be revised accordingly.

RESPONSE TO SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES (SCDNR) COMMENTS TO THE DRAFT FINAL RFI/RI WORKPLAN FOR SITE 1 - INCINERATOR LANDFILL and SITE 41 - FORMER INCERATOR - COMMENTS RECEIVED 1/5/98 MCRD, PARRIS ISLAND, SOUTH CAROLINA

COMMENTS - Robert E. Duncan, Environmental Programs Director

1. **Comment**: Page 1-1, paragraph 4, line 2

Since the incinerator landfill projects into the marsh immediately adjacent to Class SA water (that portion of Archers Creek from Port Royal Sound to the Parris Island Bridge) which, by definition, is "suitable for primary and secondary contact recreation", it would seem appropriate to include "adult, adolescent, and child recreational users" among the list of potential receptors in the human health risk assessment.

Response: Adolescent recreational users will be considered as potential receptors at specific sites in addition to adult recreational users. However, the child recreational user will not be considered. Although a child (ages 1 to 6) could be exposed to surface water, it is unlikely that a receptor at this age is routinely exposed to surface water when one considers the recreational activities that are typical of this area (boating, swimming, fishing).

2. **Comment**: Page 2-1, paragraph 5, line 5

Please clarify whether or not any fill material (clean or otherwise) was used to cover the landfill after disposal activities were discontinued in 1965. If fill material was used, any information on its composition, volume, depth, or areal coverage should be included.

Response: To date, limited information is available concerning the composition, volume, depth, or areal coverage of fill material at Site 1. During the Verification Step (McClelland Consultants, 1990), a soil boring was taken outside of the perimeter of the southeast corner of the landfill. Fill was observed from 0 to 3.5 feet below ground surface. The fill material consisted of a silty sand (dark brown in color), gravel, and rubble. The report did not comment on the areal coverage of the fill layer. No other soil borings have been recorded for the site.

To determine the presence and extent of areal coverage of fill material at Site 1, surface soil samples (0-1 ft bgs) will be taken as proposed in the Draft Final RFI/RI SAP for Site 1. After the surface soil sample has been collected, field personnel will continue to bore into the soil with a hand auger until the top limit of waste is reached. From this information, an average depth of fill cover material will be determined. To determine the composition of the fill material, the lithology of all borings will be recorded and geotechnical tests (e.g., porosity and grain-size analysis) will be performed on one of the surface soil samples.

3. **Comment**: Page 5-1, paragraph 4, line 1

The removal of groundwater that is "not potable" from an assessment of human health risk may be inappropriate, if it is demonstrated that there is a connection between any such groundwater and surface waters that are used for primary and secondary recreation.

Response: Brown & Root Environmental and the US Navy maintain that removal of water that is "not potable" from a human health risk assessment is appropriate. Although groundwater may discharge to surface water, human health risk resulting from exposure to groundwater is still

unlikely if its general quality is deemed "not potable." However, it is important to note that exposure to surface water is not precluded because of removing the assessment of exposure to groundwater. Surface water will be sampled and appropriate exposure scenarios will be evaluated.

4. **Comment**: Page 5-2, after paragraph 2

Include "Adult, Adolescent and Child Recreational Users" as potential human receptors. Include ingestion of, and dermal contact with, sediment and surface water, and ingestion of finfish as pathways of concern in the human health risk assessment for this group.

Response: Adolescent recreational users will be considered as potential receptors at specific sites in addition to adult recreational users. However, the child recreational user will not be considered. Although a child (ages 1 to 6) could be exposed to surface water, it is unlikely that a receptor at this age is routinely exposed to surface water when one considers the recreational activities that are typical of this area (boating, swimming, fishing).

In accordance with the Master Work Plan, ingestion of and dermal contact with surface water will be evaluated, but ingestion of and dermal contact with sediment will not be evaluated. Exposure to surface water concurrent with exposure to sediment renders exposure to sediment negligible.

To be consistent with the Master Work Plan, ingestion of finfish/shellfish by the recreational users will be evaluated. However, ingestion of finfish/shellfish by offsite residents will not be considered for this specific site because sustenance fishing is unlikely to occur from this site.

RESPONSE TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) COMMENTS TO THE DRAFT FINAL RFI/RI WORKPLAN FOR SITE 1 - INCINERATOR LANDFILL and SITE 41 - FORMER INCERATOR - COMMENTS RECEIVED 12/17/97 MCRD, PARRIS ISLAND, SOUTH CAROLINA

COMMENTS - Tom Dillon, Ph.D.

1. **Comment**: General

Analytical detection limits must be below ecological screening values for water, sediment and soil. PAHs are especially problematic. Experience suggests that the standard SW846 method for extracting/analyzing PAHs does not provide sufficiently low detection limits. Liquid chromatography may be required. To evaluate this potential, recommend creation of a table listing analytical method, detection limit and ecological screening values for each analyte in each media.

Response: Media-specific tables that compare laboratory practical quantitation limits (PQLs) to relevant screening criteria have been prepared. These tables, which include analytical method references, also indicate whether there is an exceedance of the screening value and the resolution of the discrepancy, if required. In most cases, the best available approved technology or approved analytical method capable of achieving the lowest PQL is proposed to resolve the discrepancy. However, some PQLs may still exceed some screening levels. These tables have been included as Appendix D of the Master Work Plan, Volume III. Based on this information low level analysis of volatile organic compounds in soils is recommended. The site-specific work plan will be revised accordingly.

2. **Comment**: General

Collection of surface sediments (0"-6") should be biased toward depositional areas. Briefly state sediment collection method in Section 7.2.1.

Response: Agree. The text will be modified to include that collection of surface sediments will be biased towards depositional areas. Sediment samples will be collected in accordance with Brown & Root Environmental Standard Operating Procedure SA-1.2, "Surface Water and Sediment Sampling" and the text of Section 7.2.1. A complete version of this SOP will be included in the Final Volume II, MWP.

3. **Comment**: General

NOAA requests involvement in the decision-making process when locations for collecting background sediment samples are discussed (Section 7.2.1).

Response: NOAA and the other members of the Parris Island Tier I Partnering Team will be consulted on the planned locations of background sediment locations. The locations will be proposed after the results of water-level measurements are conducted during the initial phase of the investigation.

4. **Comment**: General

NOAA reserves comment on the number and location of proposed sample until after the January 98 site visit.

Response: Agree. (NOTE: After the January 1998 site visit, NOAA did not propose additional sampling).

RESPONSE TO U.S. FISH AND WILDLIFE SERVICE
COMMENTS TO RCRA FACILITY INVESTIGATION/REMEDIAL INVESTIGATION WORK PLAN
FOR SITE/SWMU 1 - INCINERATOR LANDFILL AND SWMU 41 - FORMER INCINERATOR -
COMMENTS RECEIVED 2/26/98
MCRD PARRIS ISLAND, SOUTH CAROLINA

COMMENTS - Catherine D. Duncan, Environmental Contaminants Specialist

1. **Comment**: General

As we discussed at the January 21, 1998, partnering team meeting, the Service's major problem with the proposed work plan for this site results from the proposed application of EPA's Presumptive Remedy for CERCLA Municipal Landfill Sites guidance which assumes containment (capping, hydraulic controls, institutional controls) rather than treatment (removal) is the remedy. We understand this approach was suggested in order to avoid wetland destruction via excavation of landfilled material. Under certain circumstances, the Service agrees that this presumptive remedy is appropriate. However, when incinerator wastes and combustible trash were disposed of in intertidal saltmarsh and paint thinners (mineral spirits), diesel fuels, kerosene, and strippers (methyl chloride) were poured onto the landfill(marsh) and burned, we do not believe it is appropriate to assume that the portion of the landfill where intertidal marsh now exists or any other portion of this landfill will not need treatment. Containment, such as capping, would prevent human and wildlife exposure; institutional controls could be utilized to prevent human exposure to site contaminants, but no such controls could be employed to prevent exposure and possible injury to fish and wildlife. The Service appreciates concern about destruction of intertidal saltmarsh such as would occur if this portion of the landfill were excavated and has no desire to excavate wetlands unless absolutely necessary. However, we must first determine the nature and extent of contamination within this area and the ecological risks associated with exposure to that contamination prior to making risk management decisions such as the type of remedy required at this site. In addition, the "presumptive remedy" itself could result in marsh destruction in that the containment remedy typically requires capping of the landfill. As we stated at the meeting, we believe the issue of presumptive remedy at this site is premature and should not dictate the sampling effort of the Remedial Investigation at this stage.

a) We therefore suggest that the objectives of this investigation as discussed on page 1-1 (and other locations in the document) be expanded to include characterization of the nature and extent of contamination within the landfill itself as well as potential contaminant migration from the site.

Response: If the results of field activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered if it is determined that the presumptive remedy would not be appropriate. Section 1.1 and 4.0 will be revised accordingly.

b) There was considerable confusion at the meeting regarding the figures showing sampling locations relative to the landfill boundary and existing marsh versus upland areas and it appeared that all proposed sediment sampling locations (Figure 7-1) were outside the landfill boundary which would be consistent with the proposed objective of identifying and characterizing offsite contaminant migration. However, a closer look at Figure 7-2, Proposed Soil Boring and Surface Soil Sample Locations, indicates that a number of "soil boring and surface soil" sample locations appear to be in the marsh as opposed to in the upland (e.g., SB01, SB02, SB03, SS12, SS14, and possibly SS05); these would thus be sediment as opposed to surface soil samples. The actual depiction of the upland/wetland boundary on these and all other figures in the document needs

clarification. However, there clearly needs to be sampling of the marsh portion of the landfill as we believe was agreed to at the partnering team meeting. The plan already proposes surface soil samples (and apparently sediments) within the landfill boundary which will provide a characterization of the nature and extent of surface soil contamination within the landfill and allow an assessment of ecological risks associated with exposure to those surface soils (and sediments).

Response: As mentioned during the last Partnering Team meeting, the upland/wetland boundary is not well defined and will be characterized during RI/RFI field activities. Actual sampling locations will be modified as appropriate during the investigation. Sediment samples will be taken in the marsh area during low tide. Surface soil samples will be taken in the upland area. Any deviation from the proposed locations will be noted in the field and documented in the RI/RFI report. Figures 7-1 and 7-2 will indicate that the sampling locations are approximate.

All soil borings presented on Figure 7-2 will be converted to monitoring wells for the purposes of monitoring offsite groundwater. The monitoring wells will be located at the edge of the landfill boundary during high tide. The surface sample taken at this location will be referred to as a soil sample within the RI/RFI report.

c) Our recommendation to expand the stated objectives of the investigation, therefore, does not appear inconsistent with the proposed sampling plan. References to only offsite migration throughout the document in terms of nature and extent characterization, exceedances of regulatory standards, and human and ecological risk should be modified.

Response: Please see the response to comment 1a.

2. **Comment**: General

As to the location of sediment and surface water sampling locations in the wetlands within and adjacent to the landfill, we suggest that samples be placed along a transect from the shoreline to the furthest sampling location (taking into consideration any obvious or suspected depositional areas recommended by NOAA). We believe this will provide a more accurate characterization of contaminant concentrations within and outside the landfill relative to offsite movement and the gradation of contaminant concentrations from the source.

Response: The proposed sampling will be conducted in phases. The first phase will determine if offsite migration of contaminants has occurred. This data will be evaluated by the Partnering Team to determine what actions should be taken next (e.g., preparation of a FS/CMS or additional sampling).

3. **Comment**: Page 2-8, Verification Step; Page 3-1, Sediment, Pages 3-1 and 3-2, Groundwater; Page 4-2, Sediments and Groundwater paragraphs

a) While no organic compounds were detected in the four groundwater samples, only one was located within the landfill boundary and that location recorded dissolved lead at a concentration an order of magnitude greater than locations outside the landfill boundary. Dissolved lead concentrations at all sampling locations exceeded the chronic State water quality standard for protection of saltwater aquatic life.

Response: This information will be added to the text Section 2.3.2 of the sampling and analysis plan.

b) Also, no information is provided on organic compound detection limits in the subject work plan or in the Verification Step report, so the significance of the fact that none were detected in the groundwater cannot be determined.

Response: Detection limits for the subject work plan are provided in the Master Work Plan, Volume II.

Concerning the Verification Step, there were no organic compounds were detected in groundwater based on detection limits which are unfortunately unknown. However, the current sampling strategy does not reflect this information and offsite groundwater will be characterized during investigation activities.

c) Both chloroform (352 ug/kg and 215 ug/kg) and benzene (16 ug/kg) were detected in sediment samples; arsenic, barium, and cadmium were also detected. Please revise these section accordingly.

Response: This information will be added to the text of Section 2.3.2, accordingly.

4. **Comment**: Pages 4-6 through 4-10, Analytical Parameter Rationale

The Service agrees with the propose analytical parameters per media, with the exception of hexavalent chromium (as discussed below) and dioxins and furans. Considering the historical use of the site, we believe it may be appropriate to sample at least a percentage of all media samples for dioxins and furans. Page 3 of 4 in Table 4-3 is missing; the table on page 4-9 is for Site 2 and is page 5 of 5. Please correct.

Response: Media will be analyzed for dioxin/furan precursors (Target Compound List [TCL] pesticides and TCL PCBs) to determine the potential presence of dioxin/furan compounds. The Partnering Team will evaluate analytical data and determine whether additional analysis for dioxins/furans are necessary. The missing pages will be corrected.

5. **Comment**: Page 4-12, Hexavalent Chromium

The hexavalent form of chromium has been shown to be more toxic than the trivalent form; the State water quality standard is based on the concentration of hexavalent chromium. Therefore, the Service recommends an increase in the number of samples to be analyzed for hexavalent chromium (preferably all, but at least three samples from each media). The statement that "This analysis will not be conducted on surface water samples because chromium was not detected in surface water during previous investigations" should be removed. First, previous investigations did not include surface water sampling, according to statements on page 4-1 and in Table 4-1 (page 4-3). Second, the water quality standard for the protection of saltwater aquatic life is based on hexavalent chromium. Third, the water quality for protection of human health is 673,0333 ug/L trivalent chromium and 50 ug/L hexavalent chromium. Surface water samples should be analyzed for hexavalent chromium.

Response: Three samples from each medium will be sampled for hexavalent chromium. The work plan will be revised accordingly.

6. **Comment**: Page 7-1, Surface Water and Sediment Sampling

There is no indication of how and to what depth the surface water samples will be taken. Please specify. Sediment sampling to a depth of 6 inches (with one exception to 12 inches) will not allow determination of the vertical extent of site contaminants either within or outside the landfill

boundary. While the 0-6-inch depth would sample the zone of highest biological activity and that most likely to affect most aquatic organisms, burrowers such as the fiddler crabs may dig as much as 2 to 3 feet into the sediment. Also, contaminated sediments may lie under 6 inches or more of depositional sediments but could still present exposure pathways to benthic and other aquatic organisms via burrowing and/or sediment erosion during storm events. The Service therefore recommends that sediment samples outside the landfill boundary include depths of 0-6 inches, 6-12 inches, 2 feet, and 3 feet. Sediment samples within the landfill boundary should include at a minimum depths of 0-6 inches and 6-12 inches. Depending upon the contaminant concentrations at these depths, additional sediment samples may bee needed. As requested by NOAA and SCDNR, the Service would like to assist in locating the background sampling locations.

Response: The Navy proposes to utilize surface sediment collection (outside the landfill boundary) as part of a first tier in the investigation. If the data from the surface sediment or other media indicate the need for subsurface sediment sampling, then it will be performed at a later time. Assistance with locating background samples is welcomed.

7. **Comment**: Pages 7-2 through 7-6, Table 7-1

This Table needs to be modified to reflect additional sediment sample depths. Also, "(Feet below ground surface)" should be removed from the Sample Depth column for Surface Water; water depth at which the samples will be taken should be shown.

Response: Please see response to #6. Table notations will be corrected.

8. **Comment**: Page 7-14, Surface Soil Sampling

Again, the 0-1 foot surface soil sample depth will not adequately characterize the vertical extent of site contaminants nor provide adequate data for an ecological risk assessment. We recognize this sampling is proposed to assess potential contaminant transport via surface runoff to surface water and sediment and potential pathways to human and ecological receptors, not specifically to characterize the nature and extent of contamination within the landfill itself in accordance with the "presumptive remedy" approach. Depending upon contaminant concentrations in sediments and surface waters adjacent to the upland portion of the landfill, this may be an appropriate approach to soil sampling within the upland. We are somewhat concerned however about those animals that may burrow below 1 foot and also about potential plant uptake via the roots and animal exposure via contaminants bioaccumulated in the plants. This is a topic we would like to discuss further with the team.

Response: The Navy looks forward to discussing the need for sampling below 1 foot in surface soil after results are evaluated from Phase I. This topic can be discussed at a Partnering Team meeting and recommendations can be made and incorporated into additional sampling if the Partnering Team determines it to be necessary.

9. **Comment**: Groundwater Sampling

With the exception of the existing surficial aquifer monitoring well (PAI-1-GW04), all proposed groundwater monitoring locations are outside the landfill boundary. Groundwater/interstitial water in marsh areas of the landfill proper should also be sampled. Depending upon the contaminant concentrations and ecological risk, groundwater sampling within the upland portion of the landfill may be necessary to determine the appropriate remedy (containment or treatment). Containment of contaminated groundwater may be difficult and/or infeasible where there is transport of contaminants to ecological receptors via tidal influence.

Response: Monitoring wells will be located in the upland area near the landfill boundary. If groundwater analytical results indicate that offsite groundwater exceed regulatory standards or pose unacceptable human and ecological risks, groundwater sampling of the upland area may be appropriate to determine treatment/containment methods.

RESPONSE TO REGULATORY COMMENTS TO THE DRAFT AND DRAFT FINAL WORKPLANS FOR SITES/SWMUS 2/15 AND 3 (COMMENTS APPLICABLE TO SITE/SWMU 1/41)

The comments included in this section were sent to MCRD Parris Island by SCDHEC and U.S. EPA Region 4. Although the comments were directed towards Sites 2/15 and 3, they are applicable to Site 1/41 and have been incorporated into this document. Comments not applicable to Site 1/41 have been removed. Please note, the numerical sequence of the comments as arranged in SCDHEC and U.S. EPA correspondence has not changed even though comments have been removed (i.e., comment #9 is still number as #9 although preceding comments have been deleted as they were not applicable to Site 1/41).

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLAN
SITE 2 - BORROW PIT LANDFILL AND SITE 15 - DIRT ROADS FOR -
COMMENTS RECEIVED 2/20/97
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

(S. PETERSON, REVIEWER)

1. **Comment:** Overall
   This document was reviewed to meet the requirements of an RFI Work Plan. Please change the title to reflect this.

   Response:
   As decided in the March 6, 1997 conference call of the MCRD Parris Island Partnering Team, this issue will be addressed in Tier II Partnering Team discussions.

2. **Comment:** Section 1.1, Scope and Objective
   a) The 1st sentence should be deleted. This is information already stated in Section 1.0 and has nothing to do with Scope and Objective; and

   b) The objective of this investigation is less specific than that of the Master Work Plan. The scope and objective should be specific since this is a site specific work plan. Please rewrite to give the reader a clear statement of the specific objectives of the investigation. In some cases, the objectives of the study may be to generate data to justify a "no-further action" decision. Describe fully the objectives of Site 2 and 15.

   Response:
   In accordance with this comment and the response to U.S. EPA Region 4 Comment Number 16 for Site 1/41, Section 1.1, Scope and Objective, will be rewritten as follows:

   "The preamble of the National Contingency Plan identifies a municipal landfill as a site where the treatment of wastes may be impracticable because of the size and heterogeneity of the landfill's contents (i.e., municipal waste co-disposed with industrial/hazardous waste). Because treatment usually is impracticable, the United States Environmental Protection Agency (U.S. EPA) generally considers containment to be the appropriate response action, or the "presumptive remedy" for the source areas of municipal landfill sites. Therefore, an investigation approach is proposed that will correspond with the approach outlined in U.S. EPA's Presumptive Remedy for CERCLA Municipal Landfill Sites and Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance).

   In following the presumptive remedy guidance, the objectives of this investigation are to characterize the nature and extent of potential contaminant migration from past landfilling operations at Site 1 and past incineration activities at Site 41. Media of concern that will be investigated consist of surface water and sediment located topographically downgradient of Sites 1 and 41 and groundwater located hydraulically downgradient of Sites 1 and 41. Data collected from this investigation will be used to assess the human health and ecological risks associated with potential migration of contaminants. Additionally, surface soils located within the boundaries of Sites 1 and 41 will be investigated to assess the human health and ecological risks associated with potential direct contact with contaminants.

   Human health risks to construction workers, site employees (maintenance and other), adolescent trespassers, and future residents, as well as ecological risks to the site's native flora and fauna, will be assessed. Also, sampling is proposed to determine whether media contain contaminants at

concentrations above applicable or relevant and appropriate requirements (ARARs). Based on this information, decisions for remedial action will be evaluated and determined."

9. **Comment:** Figure 2.1
This quadrangle is 18 years old. Is there anything that has changed that would warrant additions or deletions?

Response:
Variations in current surface features and those shown in Figure 2-1 are not believed to be significantly different and will not affect the investigation activities outlined in the Work Plans; however, differences will be noted during the field investigation and when the areas are surveyed, the differences will be incorporated into the Investigation Report.

(D. HARGROVE, REVIEWER)

2) **Comment:** Section 4.2.2.1, Target Compound List (TCL) and Target Analyte List (TAL) Parameters, page 4-6:

This work plan proposes using the TCL and TAL parameters specified under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The State has expressed its need to recognize and follow the Resource Conservation and Recovery Act (RCRA).

Given the ongoing CERCLA/RCRA discussions in the negotiation of a Federal Facilities Agreement (FFA) among Navy, Marine Corps, U.S. EPA, and SCDHEC representatives, the combination of the analytes identified under CERCLA and RCRA should be used as a starting point for investigation. This could eliminate the possibility of resampling depending on the outcome of the FFA negotiations. In order to accomplish this, R.61-79.261 Appendix VIII constituents should be studied for soils and R.61-79.264 Appendix IX constituents should be studied for groundwater. Please revise the text accordingly.

Response:
As agreed upon during the February 28, 1997 and March 6, 1997 conference calls of the MCRD Parris Island Tier I Partnering Team, the following decisions were made to satisfy RCRA requirements.

- *Four groundwater samples will be collected and analyzed for Appendix IX constituents. Of the four samples, one will be collected at each of the following three sites: Site 1 - Incinerator Landfill, Site 2 - Borrow Pit Landfill, and Site 3 - Causeway Landfill. The remaining sample will be a background sample collected from PAI-02-GW02. PAI-02-GW02 is an existing monitoring well located upgradient of Site 2. The four samples will be collected at locations previously proposed in the Draft Work Plans. The remaining proposed groundwater samples will be analyzed using SW-846 methodologies on the parameters specified by the TCL/TAL.*

- *Soil samples will not be analyzed for Appendix VIII constituents because there is a lack of established methodologies for analyzing these compounds.*

The additional groundwater analytical requirements will be incorporated into the text of Section 4.2.2.

3) **Comment:** Section 6.0, Field Operations, page 6-1:
Note: It is good you have specified that a state certified geologist will be present for the field operations. However, all monitoring wells must still be installed by a state-certified well driller. This includes direct push groundwater sampling activities.

Response:
Section 6.0, Field Operations, will be revised to indicate that all well installation activities will be performed under the direction of a state-certified Professional Geologist and will be installed by a state-certified well driller.

4) **Comment:** Section 6.4, Monitoring Well Installation and Construction, page 6-3:
a) Note decision criteria for using different slot sizes at different depths. Is this assumed due to local geology or will this be determined upon drilling activities? Please revise to include the methodology used for making this determination.

Response::
There is sufficient history from existing wells to conclude that the upper wells would be screened in fine-grained material (silts and fine sand) and the deeper wells would be screened in more coarse-grained sands. Therefore, the anticipated well slot size is determined to be 0.010 and 0.020 inches accordingly.

This comment is also relevant to the Draft Work Plans for Sites 1/41 and 3 will be similarly addressed.

b) It is suggested that bentonite chips not be used for placement of the bentonite seal. Chips take longer to hydrate than pellets and full hydration is not guaranteed. If chips are used, hydration times greater than eight (8) hours are warranted.

Response:
Section 6.4 Monitoring Well Installation and Construction will be revised as follows. "A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate as per the manufacturer's recommendations."

6) **Comment:** Figure 6-1, Typical Monitoring Well Detail, page 6-5:
Include ID plate in monitoring well detail. Note that as per R.61-71.6(H), the information listed on the identification plate must include:

a) Well identification number
b) Date of construction
c) Driller name and certification number.
d) Screened interval
e) Static water level

Response:
The identification plate information listed above will be included in Figure 6-1.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLAN
SITE 3 - CAUSEWAY LANDFILL - COMMENTS RECEIVED 2/20/97
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

(D. HARGROVE, REVIEWER)

3) **Comment:** Section 4.1, Investigation Rationale, page 4-1:
a) Groundwater: Note that as per R.61-68 of the Water Classification and Standards, "...all South Carolina groundwater is classified GB effective on June 28, 1985." Groundwater classified as "GB" is considered a potential underground source of drinking water. The analysis proposed to determine if the groundwater is "...suitable for use as a drinking water source" is not necessary. All groundwater in the state is classified as a potential drinking water source. Please revise the text to either justify this analysis better or omit this analysis altogether.

Response:
To satisfy CERCLA requirements, all groundwater that is suitable for use as a drinking water source based on water quality parameters such as salinity and turbidity must undergo a risk assessment. The text of Section 4.1 will be revised to indicate that groundwater will be evaluated as a practical drinking water source according to CERCLA in the human health risk assessment. The text of Section 5.1 will also be revised accordingly.

4) **Comment:** Table 4-1, Investigation Rationale, text page 4-4:
The section discussing data gaps/needs for the groundwater proposes risk assessment. As stated in comment 3(a), all groundwater in the state is classified as a potential drinking water source. In accordance with R.61-68 Water Classification and Standards, all groundwater of the State is classified as Class GB. This classification requires that concentrations of inorganic and organic constituents must not exceed established MCLs. Completing a risk assessment of the concentrations of contaminants found in the groundwater is inappropriate when concentration limits are established by regulation. In addition, MCLs are established at concentrations that already account for risk to human health.

Response:
Please refer to the response to Comment 3 of this section.

5) **Comment:** Section 6.4, Monitoring Well Installation and Construction:
b) Page 6-4: The grout should not be installed to the ground surface. It should be installed to a point below the frost line. The concrete used to form the pad will fill the remaining annular space. Figure 6-1 of this work plan correctly depicts the relationship between the grouted interval and the concrete pad.

Response:
It is agreed that the grout should not be installed to the ground surface but to a point below the frost line. This change will be reflected in the text of Section 6.4 Monitoring Well Installation and Construction.

c) Page 6-4: This section is incomplete. The text and figures should also include:
i) Specifications for an identification plate that will be affixed to the well with information including: Well name, date drilled, depth of well, the driller's name and certification number.
ii) Specifications for the formation of the concrete pad.
iii) Specifications for the protective stickups to be installed around the completed concrete pad.

NOTE: These specifications are already listed in the Master Work Plan for MCRD. The text should be revised to either include complete specifications, or properly reference the Master Work Plan.

Response:
The text of Section 6.4 will be revised to include a reference to MCRD Parris Island South Carolina Master Work Plan, Volume II, Section 2.3 Monitoring Well Construction and Installation for the specifications of the well's concrete pad and protective casings. Additionally, the identification plate specifications will be included in the text of this section. Lastly, Figure 6-1 will be revised to include these specifications.

6) **Comment:** Figure 6-1, Typical Monitoring Well Detail:
This diagram should have the specifications for the protective stickups shown (see comment 5 above). Please revise the text accordingly.

Response:
Please refer to the response to comment 5.

7) **Comment:** Section 7.2.1, Surface Water Sampling, page 7-1:
a) The text does not specify if the surface water samples will be taken before, during, or after high tide. It is preferable that all the surface water samples be taken during like tidal conditions. Please revise the text to include a sample protocol that describes the timing of the sampling events.

Response:
As discussed during the July 9-10, 1997 Parris Island Partnering Team meeting, sediment samples will be collected at low tide and surface water samples will be collected at high tide as the surface water begins to recede. The text of Section 7.2.1 will be revised accordingly.

b) The text specifies that background samples collected for Site 2 will be used to determine background conditions at Site 3. Sites 1, 2, and 3 are all located close to each other. Please revise the text to include a comparison of the background samples taken from Site 1 as well.

Response:
One set of background samples for soil, surface water and sediment will be taken at Site 1. These samples will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLAN
SITE 3 - CAUSEWAY LANDFILL - COMMENTS RECEIVED 7/18/97
MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

(D. HARGROVE, REVIEWER)

3. **Comment**: Response to comment #3
   This response clarifies that the groundwater risk assessment will be performed according to CERCLA requirements. However, compliance with the State Primary Drinking Water Standards has not been specified. According to the National Oil and Hazardous Substances Contingency Plan (NCP), remedial alternatives should be evaluated against NCP threshold criteria for overall protection of human health, and compliance with applicable or relevant and appropriate requirements (ARARs). The State Primary Drinking Water Standards are ARAR and must be followed. This comment does not require a specific revision. This is for future reference to be acknowledged in the resulting report.

   Response:
   This comment is acknowledged.

1.0 INTRODUCTION

This Work Plan for Site/Solid Waste Management Unit (SWMU) 1 - Incinerator Landfill and SWMU 41 - Former Incinerator, Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina, has been prepared by Brown & Root Environmental, Inc., (B&R Environmental) for the Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC) under the Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0020. This Work Plan outlines the requirements and describes the procedures for performing a field investigation at Site/SWMU 1 and SWMU 41. It is intended for use in conjunction with the Master Work Plan, Volumes I, II, and III for the MCRD Parris Island (B&R Environmental, 1998c).

MCRD Parris Island is located along the southern coast of South Carolina approximately 1 mile south of the city of Port Royal and 3 miles south of the city of Beaufort within Beaufort County. MCRD Parris Island covers approximately 8,047 acres, consisting of dry land, salt marshes, saltwater creeks, and ponds, as shown in Figure 1-1. MCRD Parris Island is the reception and recruit training facility for the Marine Corps for enlisted men from states east of the Mississippi River and enlisted women nationwide.

For the remainder of this document, Site/SWMU 1 and SWMU 41 will be referred to as Sites 1 and 41; however, both sites are still recognized and designated as RCRA SWMUs by the State of South Carolina

1.1 SCOPE AND OBJECTIVE

The preamble of the National Contingency Plan (NCP) identifies a municipal landfill as a site where the treatment of wastes may be impracticable because of the size and heterogeneity of the landfill's contents (i.e., municipal waste co-disposed with industrial/hazardous waste). Because treatment usually is impractical, the United States Environmental Protection Agency (U.S. EPA) generally considers containment to be the appropriate response action, or the "presumptive remedy" for the source areas of municipal landfill sites (U.S. EPA, 1993). Therefore, an investigation approach is proposed that will correspond with the approach outlined in U.S. EPA's *Presumptive Remedy for CERCLA Municipal Landfill Sites* (U.S. EPA, 1993) and *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance)* (U.S. EPA, 1996a).

In following the presumptive remedy guidance, the objectives of this investigation are to characterize the nature and extent of potential contaminant migration from past landfilling operations at Site 1 and past incineration activities at Site 41. Media of concern that will be investigated consist of surface water and

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P:\GIS\APR\PARRIS.APR 8-SEP-97 DNP DEPOT LOCATION MAP

SOURCE: USGS 7.5 MINUTE PARRIS ISLAND QUADRANGLE, 1956. PHOTOREVISED 1979.

DEPOT LOCATION MAP

MCRD, PARRIS ISLAND, SOUTH CAROLINA

3000 0 3000 6000 Feet

FIGURE 1-1

Brown & Root Environmental

sediment located topographically downgradient of Sites 1 and 41 and groundwater located hydraulically downgradient of Sites 1 and 41. Data collected from this investigation will be used to assess the human health and ecological risks associated with potential migration of contaminants. Additionally, surface soils located within the boundaries of Sites 1 and 41 will be investigated.

Data collected from this investigation will be used to assess the human health and ecological risks associated with potential direct contact with contaminants. Human health risks to construction workers, site employees (maintenance and other), adolescent trespassers, adult and adolescent recreational users, and future residents, as well as ecological risks to the site's native flora and fauna, will be assessed. Also, sampling is proposed to determine whether media contain contaminants at concentrations above applicable or relevant and appropriate requirements (ARARs). Based on this information, decisions for remedial action will be evaluated and determined. If the results of field activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered if it is determined that the presumptive remedy is not appropriate.

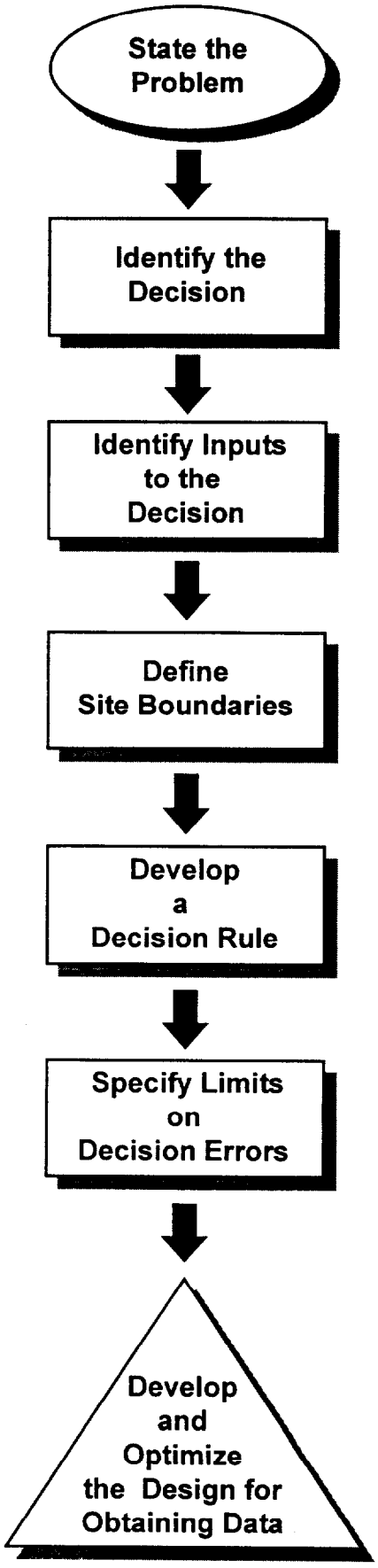
1.2 DATA QUALITY OBJECTIVES

This Work Plan has been developed using the Data Quality Objective (DQO) Process. The DQO Process is a focused, iterative process for developing data collection design to support decision-making. The goal of the process is to conduct investigations in an efficient and effective manner without unnecessary precision or redundancy of data. The process consists of seven steps, ordered in a downward decision flow. A flow diagram with descriptions of each step is provided in Figure 1-2. The DQO Process is further explained in Volume I, Section 1.2.2, of the Master Work Plan (B&R Environmental, 1998c).

1.3 PLANNING DOCUMENT ORGANIZATION

This Work Plan is intended to be used in conjunction with the Master Work Plan for MCRD Parris Island (Volumes I through III) and references the Master Work Plan where appropriate. This Work Plan includes the site-specific information to be used for sampling at Site 1 and Site 41, while the Master Field Sampling Plan (FSP) and the Master Quality Assurance Plan (QAP) provide general information that is applicable to all sites on MCRD Parris Island. Sections 1.0 through 4.0 of this site-specific Work Plan identify the project scope and objectives, summarize background information and existing data, and present the proposed sampling. Section 5.0 discusses the human health and ecological risk assessment. Sections 6.0 and 7.0 are the site-specific FSP. Sections 8.0 through 10.0 of this document describe the Quality Assurance and Quality Control (QA/QC) measures for ensuring usable data is obtained.

FIGURE 1-2
DATA QUALITY OBJECTIVES PROCESS



- Definition of problem for data collection (Section 2.4)
- Review of historical & background information (Section 2.0)
- Preliminary assessment of existing data (Section 3.0)

- Statement of the action-based decision to resolve problem (Section 4.0)

- Identification of measurable variables and action levels to support decisions (Section 5.0)

- Definition of sampling population, and spatial and temporal boundaries and limitations (Section 4.0)

- Single statement synthesizing previous steps and summarizing how data will be used to make a decision (Master Work Plan, Volume III)
- An "if...then" statement defining values for deciding between alternative actions (Master Work Plan, Volume III)

- Definition of acceptable limits of decision error and potential consequences of incorrect decisions (Decision Document; Master Work Plan, Volume III)

- Development of alternative sampling designs and selection of most effective design for sampling and analysis (Section 4.2)

2.0 SITE BACKGROUND

This section presents a brief history of Site 1 - Incinerator Landfill and Site 41 - Former Incinerator. It describes the existing site conditions and summarizes previous investigation results. Figure 2-1 illustrates the location of Sites 1 and 41 along with other sites (Sites 2, 3, and 15) at the MCRD Parris Island facility where remedial activities are scheduled to take place.

2.1 SITE DESCRIPTION AND HISTORY

Site 1 - Incinerator Landfill is located on the northeastern tip of Horse Island at MCRD Parris Island, as shown in Figure 2-1. The landfill extends approximately 670 feet into the marsh toward Archers Creek and is approximately 400 feet in width. The landfill occupies approximately 4 acres and is currently covered with mature pine trees as illustrated in Figure 2-2.

Historical records indicate that Site 41, Former Incinerator, was located in one of two possible locations, as indicated in Figure 2-3. The former incinerator unit consisted of a coal-fired brick chamber approximately 43 feet long, 34 feet tall, and 20 feet wide. Emissions were vented through a hole in the top of the chamber. A ramp was situated along one of the unit's sides to provide access to the top of the incinerator. Trucks carried wastes up the ramp and discharged them into the hole.

From 1921 to 1965, Site 1 served as the disposal site for combustion residues from the incinerator, formerly located adjacent to the landfill. The majority of wastes disposed of in the landfill during this time were nonhazardous, combustible domestic wastes (ash residues) and other noncombustible wastes (e.g., cans, bottles, and construction debris). Additionally, hazardous wastes generated from the MCRD from 1921 to 1959 were treated in the incinerator and disposed of in the landfill. Paint thinners (mineral spirits), diesel fuels, kerosene, and strippers (methylene chloride) were also poured onto the landfill and burned (NEESA, 1986). No auxiliary fuels were used for open burning.

Wastes were initially piled on the land or placed in trenches into the marsh, extending the edge of the landfill further into the marsh. Fill dirt was also used to build up the land at the edge of the marsh. The landfill progressively extended farther into the marsh as wastes were dumped on the edge of the fill. To date, limited information is available concerning the composition, volume depth, or areal coverage of fill material at Site 1.

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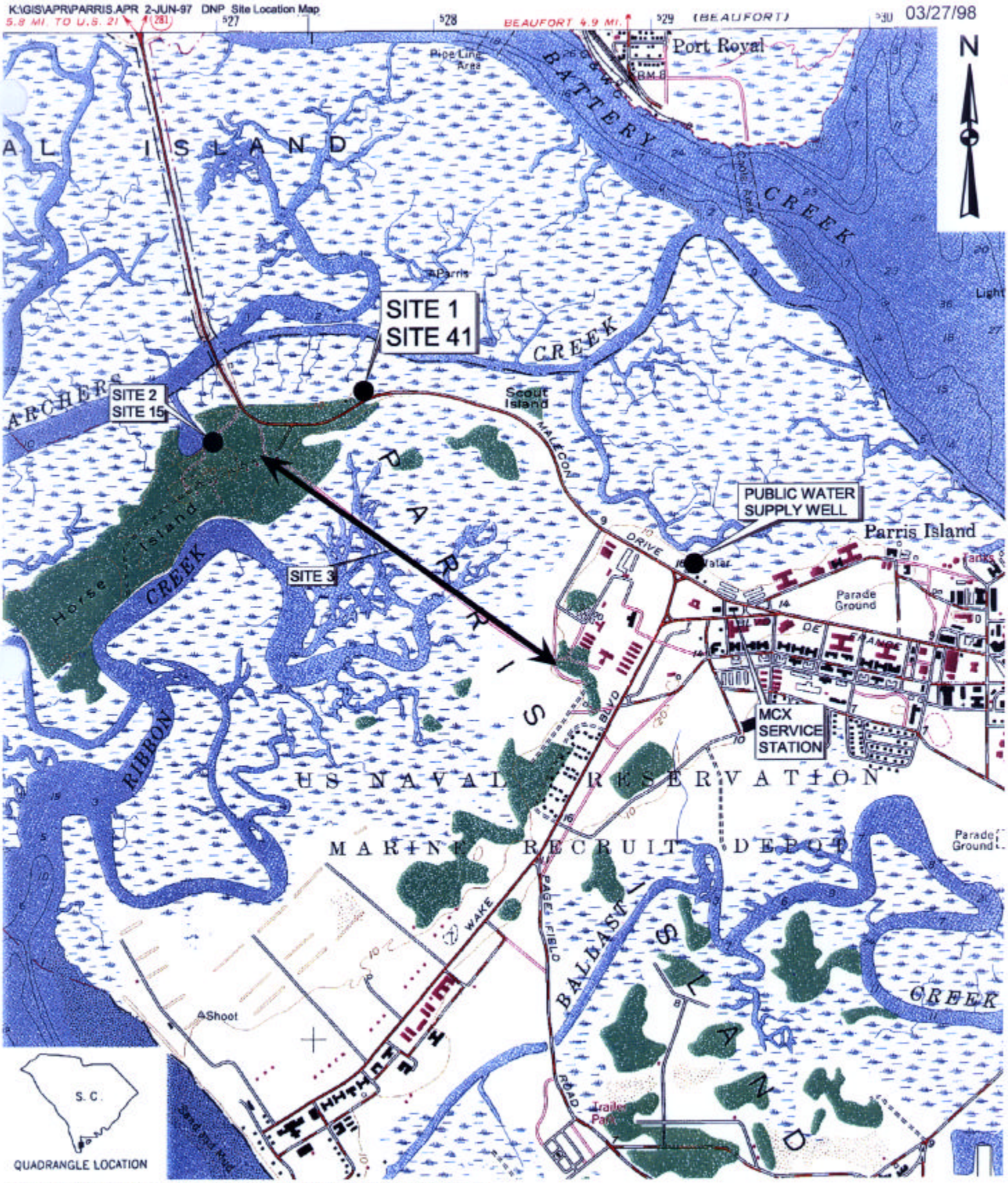

SOURCE: USGS 7.5 MINUTE PARRIS ISLAND QUADRANGLE, 1956. PHOTOREVISED 1979.

SITE LOCATION MAP

MCRD, PARRIS ISLAND, SOUTH CAROLINA

2000 0 2000 4000 Feet

FIGURE 2-1

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WEST SIDE OF INCINERATOR LANDFILL. LOOKING NORTHEAST FROM THE SOUTHWEST CORNER OF THE LANDFILL.

EAST SIDE OF INCINERATOR LANDFILL. LOOKING WEST NORTHWEST FROM MALECON DRIVE.

SITE PHOTOS
SITE 1 – INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2–2

Brown & Root Environmental

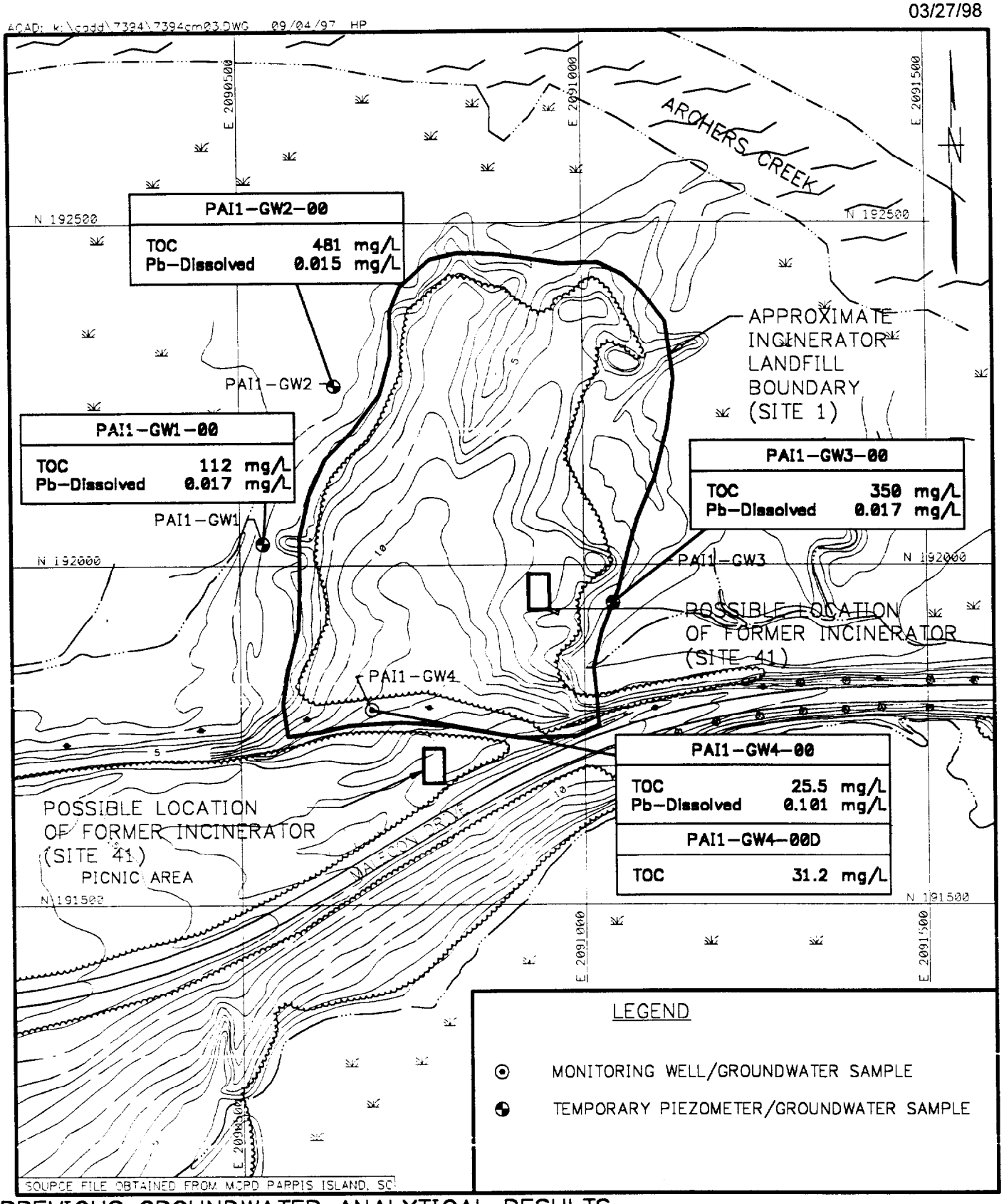
LOOKING ALONG SOUTHERN EDGE OF INCINERATOR LANDFILL
FROM THE SOUTHWEST CORNER OF THE LANDFILL.

LOOKING NORTH INTO THE INCINERATOR LANDFILL AREA
FROM THE SOUTHERN EDGE OF THE LANDFILL.

SITE PHOTOS
SITE 1 – INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2-2

Brown & Root Environmental



PREVIOUS GROUNDWATER ANALYTICAL RESULTS
SITE 1 – INCINERATOR LANDFILL
SITE 41–FORMER INCINERATOR
MCRD, PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2–3

0 200 400
SCALE IN FEET

Brown & Root Environmental

Site 41 remained in operation until 1959. Site 1 continued to be used for disposal of combustible trash and noncombustible waste until 1965. Since 1965, no significant disposal or intrusive activity has taken place within the boundaries of Sites 1 and 41.

2.2 SITE HYDROGEOLOGY

A summary of the site hydrogeology for Sites 1 and 41 is provided in this section.

2.2.1 Surficial Aquifer

The surficial, or water table aquifer at Sites 1 and 41 is unconsolidated and restricted to the shallow, Pleistocene- to Holocene-age, fine-grained, sedimentary deposits of the Pamplico and Waccamaw Formations (Hughes et al., 1989). Based upon previous investigations at the site, the upper 20 feet of sediment consists of very fine, yellow-brown sand with traces of clay and silt with thin (approximately 6 inches thick), discontinuous layers of greenish-gray silty clay. The surficial aquifer is estimated to be 30 feet thick in the area. An estimated transmissivity of 1,300 ft^2/day with a storage coefficient of 0.20 has been reported for sands within the shallow deposits (Hassen, 1985). Water table depths range from 0 to 10 feet, and seasonal changes can be as great as 6.5 feet (NEESA, 1986).

2.2.2 Confining Layer

The surficial aquifer is underlain by the unconsolidated, Miocene-age, Hawthorn Formation (Hughes et al., 1989). The Hawthorn Formation is a geological formation that hydraulically separates the unconfined surficial aquifer from the underlying, artesian Floridan Aquifer. The elevation at the top of the Hawthorn Formation is reported to be within the range of 30 to 60 feet below mean sea level (msl) at Parris Island. The thickness of the Hawthorn Formation at Site 1 and 41 is anticipated to be between 20 to 40 feet (NEESA, 1986). The actual depth of this formation at Site 1 will be determined during the field investigation. Hughes, et al. (1989) calculated the leakage through the Hawthorn Formation to be 0.0002 ft^3/day for every foot of head difference (using an average formation thickness of 30 feet and vertical hydraulic conductivity of 0.006 ft/day).

2.2.3 Floridan Aquifer

The principal source of groundwater used for consumption in the Beaufort County, South Carolina area is the Floridan Aquifer (Smith, 1987). This artesian aquifer system is contained within the Santee Limestone Formation, has a total depth of approximately 1,000 feet and is divided into the Upper Unit and the Lower Unit (NEESA, 1986).

The only public supply well identified within a 1/4-mile radius of MCRD is located approximately 600 feet northwest of the MCX Service Station and is illustrated on Figure 2-1. The MCX Service Station is located in the north central portion of the MCRD. The well was once used as a hot water source (Sirrine Environmental Consultants, Inc., 1991). It is currently not in use but has not been abandoned.

2.3 PREVIOUS INVESTIGATIONS

2.3.1 Initial Assessment Study

In 1986, the Naval Energy and Environmental Support Activity (NEESA) conducted an Initial Assessment Study (IAS) (NEESA, 1986) to identify potentially contaminated sites at MCRD Parris Island that may pose a threat to human health or the environment. NEESA reviewed historical records and conducted a site survey. The IAS identified Site 1 - Incinerator Landfill as a site requiring further characterization. Site 41-Former Incinerator was not distinguished as a site separate from Site 1, and no recommendations were made concerning this area. At Site 1, the study recommended the installation of one monitoring well and four piezometers. Sampling of the wells, plus sediment and surface water sampling along the edge of the landfill, was also recommended.

2.3.2 Verification Step

Based on the recommendations of the IAS, McClelland Consultants conducted a Verification Step (VS) at Site 1 (McClelland, 1990). McClelland installed one monitoring well south of Site 1 and three well points along the edge of the landfill in the marsh. McClelland collected four groundwater samples from the monitoring well and well points and three sediment samples along the landfill/marsh interface. Site 41 was not distinguished as a unique site in the VS; however, a southern monitoring well was installed approximately 150 feet northwest of the location of the former incinerator.

The groundwater samples were analyzed for Priority Pollutant List volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and dissolved metals (arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, and silver). The sediments were analyzed for Priority Pollutant VOCs, SVOCs, and metals and extended procedure (EP) toxic metals (arsenic, cadmium, chromium, lead, and mercury).

No organic compounds were detected in the groundwater samples; however only one groundwater sample was located within the landfill boundary. All groundwater samples contained dissolved lead at concentrations (0.017, 0.015, 0.017, and 0.101 mg/L) which exceeded or were equal to the current U.S.

EPA Safe Drinking Water Act Action Level of 0.015 mg/L. The detection of 0.101 mg/L was located within the landfill boundary. All lead detections in groundwater also exceeded the state chronic water quality standard for protection of saltwater aquatic life. At the time of sampling, the interim safe drinking water standard was 0.050 mg/L. Figure 2-3 shows groundwater results with associated sampling locations. Chloroform was identified in sediment samples PAI1-SS1 and PAI1-SS2 at concentrations of 352 µg/kg and 215 µg/kg. Benzene was detected at sediment sample PAI1-SS2 at a concentration of 16 µg/kg. Chromium, lead, arsenic, barium, and cadmium were also detected in the sediment samples. Figure 2-4 shows sediment results with associated sampling locations.

The VS recommended the following:

- Based on the presence of chloroform in sediment and the density and possible mobility of this compound, evaluate the depth and lateral extent of chloroform in subsurface soils and determine whether chloroform is present in the surficial aquifer.

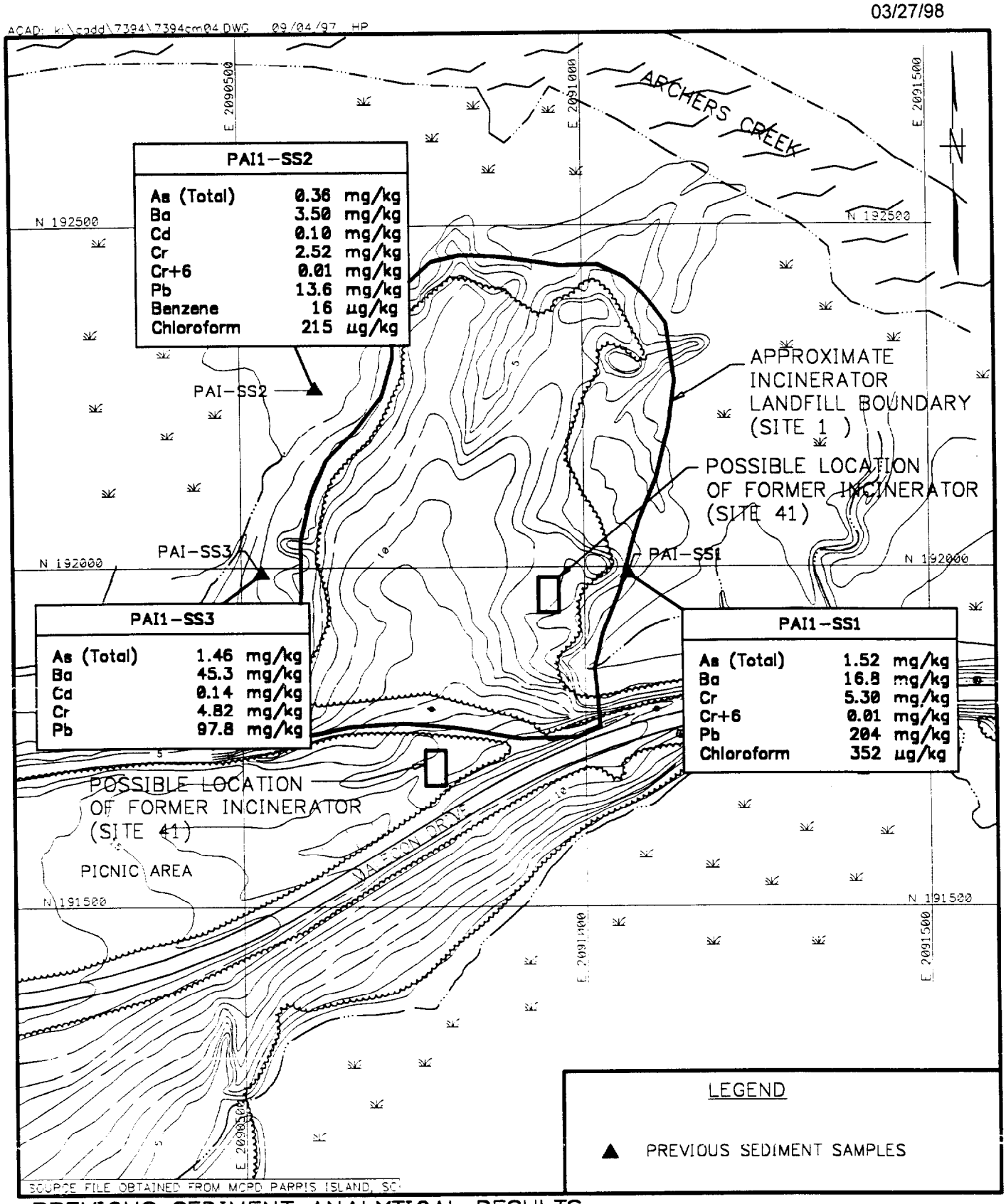
- Evaluate the nature and extent of heavy metals (lead and chromium).

2.3.3 RCRA Facility Assessment Report (Kearney, 1990)

The Hazardous and Solid Waste Amendments (HSWA) of 1984 expanded the scope of the U.S. EPA's authority under the Resource Conservation and Recovery Act (RCRA) to require corrective action for the release of hazardous waste or hazardous constituents from Solid Waste Management Units (SWMU) at those facilities which seek a RCRA permit. A RCRA Facility Assessment (RFA) was conducted to fulfill this requirement when the MCRD applied for a RCRA permit. It should be noted that the request for the RCRA permit has been subsequently withdrawn.

An Interim RFA was performed during January 1990 through March 1990 and a report (Kearney, 1990) submitted based on a Preliminary Review (PR) of U.S. EPA Region 4 and South Carolina Department of Health and Environmental Control (SCDHEC) files and a Visual Site Inspection (VSI).

The PR collected information concerning the facility and developed a preliminary list of SWMUs and Areas of Concern (AOCs). The PR was followed by the VSI, which consisted of a site visit where SWMUs and AOCs were assessed to determine the potential for release of hazardous wastes or hazardous constituents to the environment.



PREVIOUS SEDIMENT ANALYTICAL RESULTS
SITE 1 – INCINERATOR LANDFILL
SITE 41–FORMER INCINERATOR
MCRD, PARRIS ISLAND, SOUTH CAROLINA

0 200 400
SCALE IN FEET

FIGURE 2–4

Brown & Root Environmental

The RFA re-evaluated the IAS and VS conducted for Site 1 and indicated that a RCRA Facility Investigation (RFI) should be conducted. The RFA also identified and investigated Site 41. The report indicated that the former incinerator unit was designed to release to the air and was no longer in operation and, therefore, No Further Action (NFA) was appropriate at Site 41.

2.4 STATEMENT OF PROBLEM

Based on known disposal practices conducted at Site 1, the activities associated with Site 41, and the results of the previous investigations conducted, it has been determined that environmental media have been affected by the sites and that further evaluation is needed to determine potential risks to human health and ecological receptors.

3.0 PRELIMINARY ASSESSMENT

This section presents a conceptual model and discussion of potential migration and human and ecological exposure pathways of contaminants from Sites 1 and 41. Figure 3-1 presents a conceptual model of these sites. A detailed discussion of potential receptors, media of concern, and exposure routes is found in Section 5.0.

3.1 SURFACE WATER

Surface water flow from Sites 1 and 41 is generally radial to the north, east, and west into the adjacent marsh and then to Archers Creek (McClelland, 1990). Impacts to the surface water may be from direct runoff from the landfill and may also originate from groundwater beneath the landfill discharging (e.g., through seeps) to Archers Creek or the surrounding marsh.

No surface water samples were collected during the VS (McClelland, 1990). However, dissolved lead was detected in groundwater samples, and chloroform, lead, and chromium were detected in sediment samples. Therefore, the surface water surrounding the site may also be adversely impacted and be a pathway for further contaminant migration. If surface water is found to be adversely impacted, incidental ingestion and dermal contact with contaminants in surface water by human receptors would be possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors (aquatic organisms) would also be anticipated exposure pathways.

3.2 SEDIMENT

Chloroform, chromium, and lead were detected in sediments sampled during the VS (McClelland, 1990). Sediment contamination may have resulted from contaminants that are directly adsorbed to eroded soils or from contaminants adsorbing to sediment during transportation and deposition. Sediments are located in the marsh adjacent to the site and may be transported into Archers Creek. Incidental ingestion and dermal contact with contaminants in sediment by human receptors are possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors (organisms living and/or feeding on the water bottom) would also be anticipated exposure pathways.

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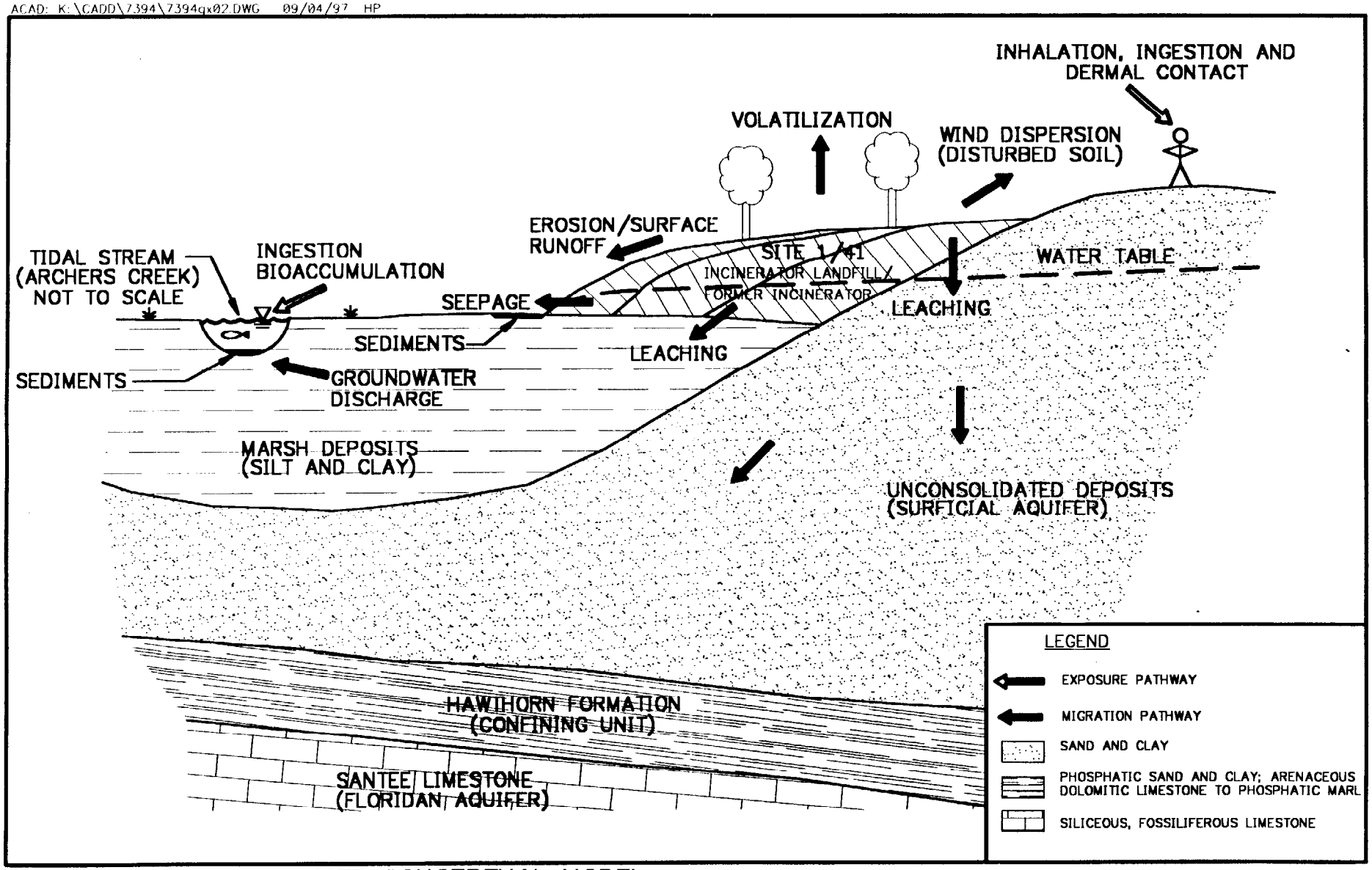


SITE CONCEPTUAL MODEL
SITE 1 – INCINERATOR LANDFILL
SITE 41–FORMER INCINERATOR
MCRD, PARRIS ISLAND, SOUTH CAROLINA
NOT TO SCALE

FIGURE 3–1

Brown & Root Environmental

3.3 GROUNDWATER

The VS (McClelland, 1990) determined surficial groundwater flow to be radial from the landfill toward the tidal stream (Archers Creek) north of the site. The VS also determined the surficial groundwater to be shallow and influenced by tidal changes. However, the marsh deposits underlying the landfill including the clay comprising the Hawthorn Formation may act as a partial barrier to the Floridan Aquifer and will be investigated.

No organic compounds were detected in the surficial groundwater; lead was detected in all well points at levels above the U.S. EPA Safe Drinking Water Act action levels. Ingestion, dermal contact, and inhalation (via showering) of contaminants in groundwater by human receptors are possible exposure pathways of concern. Exposure to ecological receptors is not anticipated. The deeper part of the surficial aquifer was not evaluated during the VS, so the vertical extent of contamination has not been identified.

3.4 SOIL

The surface soil at Sites 1 and 41 may be a contaminant source to surface water and sediment via leaching and surface runoff. Surface soils were not sampled during the VS (McClelland, 1990). If surface soil is found to be adversely impacted, incidental ingestion and dermal contact with contaminants within the soil by human receptors would be possible exposure pathways of concern. In addition, the surface soil, if disturbed, may serve as a source for airborne transport of contaminants. Contaminants in the soil may also be accumulated by natural or cultural vegetation which could be ingested by wildlife and/or human receptors. Additional exposure pathways involving direct ingestion or contact with contaminated soil by benthic invertebrates may also be of concern.

3.5 AIR

The site has been revegetated since cessation of landfill operations and the closure of the incinerator. Since vegetative cover reduces the potential for suspension of particulates and subsequent airborne transport, the air pathway is not considered to be significant to human or ecological risk other than the potential for particulate inhalation by human receptors if the soil is disturbed. The potential for suspension of particles and subsequent airborne transport will be evaluated during the risk assessment using the results from surface soil samples.

4.0 INVESTIGATION SCOPING

The scope of this investigation is consistent with the U.S. EPA guidance entitled Presumptive Remedy for *CERCLA Municipal Landfill Sites* (U.S. EPA, 1993) and *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance)* (U.S. EPA, 1996a). In summary, field activities will characterize the extent of contamination in all areas where potential for offsite migration of contamination exists. Groundwater samples will be collected downgradient of groundwater flow of Site 1 and 41, and surface water and sediment samples will be collected downgradient of the path of surface water runoff. Additionally, surface soil will be sampled throughout both sites.

If the results of these activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered. Additionally, if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill, further investigation to determine the competency of the Hawthorn Formation as an adequate confining layer may be warranted. If analytical results indicate that both the lower surficial aquifer has been adversely impacted by the landfill and the Hawthorn Formation does not adequately act as a confining layer, investigation activities to evaluate potential impacts to the underlying Floridan aquifer may also be warranted.

In accordance with U.S. EPA guidance, the Administrative Record will include the necessary generic and site-specific information documenting the selection or non-selection of the containment presumptive remedy (U.S. EPA, 1996a).

4.1 INVESTIGATION RATIONALE

Previous investigations indicated the presence of chloroform, lead, and chromium in the sediments adjacent to Site 1 - Incinerator Landfill. Additionally, dissolved lead was detected in the shallow surficial aquifer. Based on the information presented in Sections 2.0 and 3.0, the proposed investigation of Site 1 will include the following media. Table 4-1 summarizes the rationale for investigation of specific media at Site 1.

- Surface Water - Previous investigations did not include surface water sampling. Surface water sampling is proposed to determine whether contaminants are migrating to the surface water at levels above ARARs and risk-based criteria (ecological and human health).

TABLE 4-1

INVESTIGATION RATIONALE
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 2

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution Of Data Gaps/Needs
Surface Water	No previous sampling conducted	Surface water may be an exposure pathway of contaminants to human and ecological receptors. Contaminant migration to surface water may originate from soil, sediment, and/or groundwater.	RI/RFI • Nature and extent characterization • Risk assessment • Define background concentrations FS/CMS • Modeling • Site hydrology	• TCL, TAL (metals and cyanide, total and dissolved) parameters • Water quality parameters • Water-level measurements • Tidal influence study
Sediment	Organics: chloroform Inorganics: lead and chromium	Sediments may be an exposure pathway of contaminants for human and ecological receptors. Contaminant migration to sediment may originate from soil, surface water, and/or groundwater.	RI/RFI • Nature and extent characterization • Risk assessment • Define background concentrations FS/CMS • Modeling • Volume calculations	• TCL, TAL (metals and cyanide) parameters • Hexavalent chromium • TOC • Grain-size analysis • Bulk density • pH • Sediment sampling results

TABLE 4-1

INVESTIGATION RATIONALE
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 2

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution Of Data Gaps/Needs
Groundwater	Inorganics: dissolved lead, chloroform	Groundwater may be a pathway of contaminants from soils to surface water and sediment. Groundwater is a potential pathway of contaminants to human receptors.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Modeling • Site hydrogeology	• TCL, TAL (metals and cyanide, total and dissolved) parameters • Water quality parameters • Appendix IX parameters • Horizontal hydraulic conductivity • Vertical hydraulic conductivity • Groundwater modeling parameters • Water-level measurements • Tidal influence study
Soil	No previous sampling performed. Known depository of ash residue and solvents.	Soils may be a pathway of contaminants to surface water and sediment as a potential pathway to human and ecological receptors.	RI/RFI • Nature and extent characterization • Risk assessment • Define background concentrations FS/CMS • Geotechnical characterization • Determine presence and extent of cover (fill) material • Stratigraphy • Modeling	• TCL, TAL (metals and cyanide) parameters • Hexavalent chromium • Soil classification • Lithology • Groundwater modeling parameters

- Sediment - Previous investigations detected VOCs (chloroform) and metals (lead and chromium) in the sediments adjacent to the site. However, the extent of migration of contaminants from the site to adjacent sediments has not been evaluated. Sediment sampling is proposed to determine whether site-related constituents are present in sediments at levels above ARARs and risk-based criteria (ecological and human health).

- Groundwater - Dissolved lead was identified in the shallow groundwater; chloroform, lead, and chromium were detected in sediments surrounding the site. Therefore, sampling of the shallow and deep surficial aquifer downgradient of the site is proposed to determine whether site-related compounds are leaching from the landfill at concentrations above ARARs and risk-based criteria (ecological and human health). For use in the human health risk assessment, sampling and analysis will be conducted for evaluating the use of groundwater as a practical drinking water source according to CERCLA (U.S. EPA, 1991).

- Surface/Subsurface Soil - Previous investigations did not include soil sampling. Surface soil sampling is proposed to determine whether the surface soil is a source of contamination for the other migration pathways and to determine whether contamination exists at levels above ARARs and risk-based criteria (ecological and human health). Additionally, surface soil samples are proposed to determine the presence, composition, depth, and areal coverage of fill material at Site 1. Subsurface soil samples are proposed for groundwater modeling purposes to determine the extent of contaminant fate and transport.

- Air - Airborne contamination is not anticipated to pose a risk at this site and, therefore, will not be investigated directly. Airborne contamination will be investigated indirectly when evaluating potential surface soil transport in the risk assessment.

Also, the proposed investigation of Site 41 will include the following. Table 4-2 summarizes the rationale for investigation of media at Site 41.

- Surface Soil - Previous investigations did not include soil sampling within the vicinity of the Former Incinerator. Surface soil sampling is proposed to determine whether the soil is a source of contamination for the other migration pathways and to determine whether contamination exists at levels above ARARs and risk-based criteria (ecological and human health). Surface soil samples will be taken at both suspected locations of the former incinerator unit.

TABLE 4-2

INVESTIGATION RATIONALE
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution Of Data Gaps/Needs
Surface Soil	No previous sampling conducted. Suspected ash residue may be present in surface soil.	Surface soil may be a potential pathway of contaminants to human and ecological receptors.	RI/RFI • Nature and extent characterization • Risk Assessment FS/CMS • Volume calculation	• TCL, TAL (metals and cyanide) parameters • Soil samples

During past investigations, relatively low concentrations of contaminants were detected for only a few compounds. To provide sufficient data for conducting subsequent steps of the process, a primary sample concern will be to characterize the worst-case site condition under investigation.

4.2 INVESTIGATION SUMMARY

The following sections present the proposed investigation. All data will be collected in accordance with the Master FSP, the Master QAP (B&R Environmental, 1998c), and U.S. EPA Region 4 Environmental Investigations Standard Operating Procedures Quality Assurance Manual (IESOPQAM) (U.S. EPA, 1996b).

4.2.1 Sampling Activities

Table 4-3 summarizes the field investigation activities for Site 1 - Incinerator Landfill. Table 4-4 summarizes the field investigation activities at Site 41 - Former Incinerator.

4.2.2 Analytical Parameter Rationale

This section provides the rationale for the proposed analytical program to be conducted on the samples collected from Sites 1 and 41.

4.2.2.1 TCL and TAL Parameters

Based on the previous disposal practices conducted at Site 1 and incineration activities at Site 41, there exists a potential for both organic and inorganic contamination at these sites. To determine if contamination exists in the various media (surface water, sediment, groundwater, and surface soil), fixed base laboratory analysis will be conducted. Samples from each media will be analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics. These analyses are necessary to provide sufficient data within Sites 1 and 41 to determine the nature and extent of contamination and to conduct a human health and ecological risk assessment. The TCL organics analysis includes both volatile and semivolatile organics. Samples from each media at Site 1 and surface soil at Site 41 will also be analyzed for both TCL pesticides and TCL PCBs. Media will be analyzed for these parameters because pesticides and/or PCBs may have been disposed of or incinerated at Site 1 and 41. Additionally, these results will indicate the presence of dioxin/furan precursors (dioxin/furan-forming compounds). TAL metals (total) and cyanide will be analyzed because these constituents are potential components of the wastes disposed of at Site 1 and incinerated at Site 41. The results of these analyses will be compared

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Surface Water	• TCL, TAL parameters	• Collect surface water samples.	12[2]	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals and Cyanide (Total and Dissolved)
	• Water quality parameters	• Collect surface water samples.	12[2]	1	TOC pH Hardness ($CaCO_3$) Dissolved Oxygen Salinity
	• Ecological parameters	• Collect surface water samples.	12[2]	1	Temperature and Secchi Disk readings
	• Tidal influence study	• Collect water elevations during 24-hour period.	1	48	Field Analysis
	• Risk Assessment Assumptions	• Collect surface water samples.	3	1	Hexavalent chromium

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Sediment	• TCL, TAL parameters	• Collect shallow sediment samples.	12[2]	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals (Total) and Cyanide
	• TCL, TAL parameters	• Collect deep sediment sample.	1	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals (Total) and Cyanide
	• Ecological Parameters	• Collect sediment samples.	13[2]	1	TOC, pH
	• Ecological Parameters	• Collect sediment samples.	3	1	Grain-size analysis Bulk density
	• Risk Assessment Assumptions	• Collect sediment samples.	3	1	Hexavalent chromium

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 3 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Groundwater	• TCL, TAL parameters	• Collect shallow and deep groundwater samples.	10	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals and Cyanide (Total and Dissolved Metals)
	• RCRA	• Collect deep groundwater sample.	1	1	Appendix IX VOCs Appendix IX SVOCs Appendix IX Pesticides/ PCBs Appendix IX Organo-phosphorus Compounds Appendix IX Herbicides Appendix IX Metals (Total and Dissolved)
	• Water quality parameters	• Collect shallow and deep groundwater samples.	11	1	TOC pH Hardness ($CaCO_3$) Turbidity, Total Dissolved Solids, Total Suspended Solids, Chloride, Fluoride, Nitrate/Nitrite, Sulfate, Dissolved Oxygen, Salinity
	• Horizontal hydraulic conductivity	• Perform slug tests.	11	1	Evaluation of horizontal hydraulic conductivity

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 4 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Groundwater (Continued)	• Vertical hydraulic conductivity	• Collect Shelby tube at confining layer.	1	1	Permeability test
	• Groundwater flow direction and gradient	• Measure monitoring well groundwater levels.	11	2	Collect water levels at high and low tide. (Can be incorporated in tidal influence readings.)
		• Tidal influence study.	11	48	Collect water levels every 30 minutes over a 24-hour period during a full or new moon.
	• Risk assessment assumptions	• Collect groundwater sample	3	1	Hexavalent chromium
Soil	• TCL, TAL parameters	• Collect surface soil samples.	14[3]	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals (Total) and Cyanide
	• Soil Classification	• Collect surface soil sample.	1	1	Grain-size analysis, Atterberg Limits, and Natural moisture content
	• Soil Classification	• Collect subsurface soil samples.	5	2 samples/boring	Grain-size analysis, Atterberg Limits, and Natural moisture content
	• Risk Assessment Assumptions	• Collect surface soil samples.	3	1	Hexavalent Chromium

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 5 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Soil (Continued)	• Groundwater Modeling Parameters	• Collect subsurface soil samples in aquifer.	5	1	TOC pH Bulk density Specific gravity Porosity Grain-size analysis
	• Groundwater Modeling Parameters	• Collect ash material from surface.	2	1	TOC pH Bulk density Specific gravity Porosity Grain-size analysis
	• Soil Loggings	• Document soil characteristics during monitoring well installation.	10	1	Continuous soil logs
	• Soil Loggings	• After surface soil sample is collected, bore into the soil until the top limit of waste is reached. Document soil characteristics.	10	1	Continuous soil logs until the top limit of waste is encountered.

1 Does not include QA/QC samples.
2 Includes four samples upgradient of Site 1.
3 Includes four surface soil samples for background concentration determination upgradient of Site 1.

TABLE 4-4

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location(1)	Analysis
Soil	• TCL, TAL parameters	• Collect surface soil samples.	4	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals and Cyanide

1 Does not include QA/QC samples. QC sample frequency is provided in Table 10-1.

against the screening criteria established in the decision document (Volume III of the Master Work Plan, B&R Environmental, 1998c) to determine whether there is a potential risk to human or ecological receptors.

4.2.2.2 RCRA Appendix IX Constituents

One groundwater sample will be collected and analyzed for the inorganic (total and dissolved metals) and volatile, semivolatile, pesticide/PCB, organophosphorus, and herbicide organic constituents listed in Appendix IX of 40 CFR Part 264. The sample will be collected to satisfy RCRA requirements for the field investigation. The location of this sample will be discussed in Section 7.0.

4.2.2.3 Hexavalent Chromium

At Site 1, surface water, sediment, groundwater, and surface soil will be collected and analyzed for hexavalent chromium for risk assessment purposes. Three samples will be taken in each medium. Sampling locations are chosen based on the likelihood of contaminant migration/accumulation and/or the results of previous investigations.

4.2.2.4 Water Quality Parameters

In addition to determining contaminant concentrations in surface water and/or groundwater, water quality parameters such as Total Organic Carbon (TOC), pH, and hardness will be obtained. These parameters are necessary for modeling and risk assessment. Surface water measurements shall also include dissolved oxygen, temperature, Secchi Disk readings, and salinity to assist in the ecological risk assessment. If the surface water is not deep enough to provide valid Secchi Disk readings, turbidity meter readings will be used instead.

4.2.3 Groundwater and Ecological Modeling Parameter Rationale

Modeling will be conducted to evaluate contaminant fate and transport. General parameters which are required to perform modeling include:

Aquifer

- Horizontal Hydraulic Conductivity (K_h) of surficial aquifer
- Vertical Hydraulic Conductivity (K_v) of confining layer
- Total Organic Carbon (TOC)

- Porosity
- Bulk Density
- Grain-Size Analysis
- Specific Gravity
- pH

Ecological

- TOC
- Bulk Density
- Grain-Size Analysis
- pH
- Hardness
- Secchi Disk Readings

4.2.3.1 Soil Classification

Soil classification is used to determine the geotechnical and geochemical properties of the soil and includes grain-size analysis, Atterberg Limits, and moisture content. Grain-size analysis is useful for determining the heterogeneity of the soil and can be used to estimate seepage velocities. The moisture content of the soil is important in evaluating potential remedial actions and for contaminant transport through the vadose zone. The Atterberg Limits are used to determine engineering properties (water content boundaries) of the soil.

4.2.3.2 Horizontal Hydraulic Conductivity (K_h)

A slug test will be conducted at each monitoring well to determine the horizontal hydraulic conductivity of the aquifer in the immediate vicinity of the well. This information will be used to characterize the aquifer and in the groundwater modeling and during evaluation of an aquifer remediation alternative, if necessary.

4.2.3.3 Vertical Hydraulic Conductivity (K_v)

The Hawthorn Formation (confining unit), which underlies the surficial aquifer, will be evaluated to determine its vertical hydraulic conductivity by performing a permeability test on a core sample. ASTM Method D5084-90 and analysis Method SW-846-9100 will be utilized for the permeability testing. The sample will be collected using a Shelby Tube. A knowledge of the vertical hydraulic conductivity of the

confining unit is useful to evaluate the potential of the unit to impede the migration of contaminated groundwater into the underlying water supply system.

4.2.3.4 Groundwater-Level Measurements

Groundwater-levels provide information that can be used to determine the depth, flow direction, and gradient of the groundwater. The levels are also useful for setting calibration targets for modeling purposes. Groundwater-level measurements will be collected in accordance with SOP GH-1.2, "Evaluation of Existing Monitoring Wells and Water-level Measurements," and the information obtained will be used to establish groundwater contour maps and provide information concerning the site hydrogeology. The groundwater-level measurements will be collected synoptically at high and low groundwater elevations as determined by the tidal study.

4.2.3.5 Tidal Influence Study

Site 1 is located in an area that is affected by tidal influences. To evaluate the effect of the tidal fluctuations on contaminant flushing, a tidal study will be conducted over a minimum period of 24 hours. The goal of the study will be to determine how the surface water tidal fluctuations and the groundwater elevations are related.

The tidal influence study will consist of collecting groundwater elevations and surface water elevations every 30 minutes over a minimum of a 24-hour period. Measurements will be collected until the high and low tide data are collected for the surface water verses the high and low groundwater elevations (i.e., the lag time between the surface water and groundwater will be determined). The length of the study will depend on the lag time between the high/low surface water elevation and the high/low groundwater elevations.

Groundwater-level measurements will be collected in accordance with SOP GH-1.2, "Evaluation of Existing Monitoring Wells and Water-Level Measurement." Surface water measurements will be obtained by installing a staff gauge in the surface water body and collecting measurements from a known reference point to the surface water elevation. Measurements will be collected during a full or new moon so that the extremes in water-level elevation can be determined.

Published local tide tables and precipitation data will also be obtained during the course of the field investigation from the nearest local resource. The information will be used to determine tidal cycle peaks and precipitation impacts on surface water and groundwater.

5.0 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

The following two sections briefly describe the human health and ecological risk assessment that will be conducted for Sites 1 and 41.

5.1 HUMAN HEALTH RISK

A human health risk assessment for the site will be performed. Analytical data generated under this Work Plan, as well as historical data for the site, will be used to determine whether measured chemical concentrations pose a significant threat to human receptors. The general methodologies which will be used to assess human health risks are contained in Appendix A of the Master Work Plan Volume III for MCRD, Parris Island (B&R Environmental, 1998c).

Potential chemicals of concern (COCs) for the site, based on the VS, are chloroform, lead, and chromium. Based on data collected under this Work Plan, the Region 3 RBCs screening levels (U.S. EPA, 1997) will be used to identify additional site-specific potential COCs for soil, sediment, surface water, and groundwater. Included in the groundwater analysis will be pH, turbidity, dissolved solids, TOC, chloride, fluoride, nitrate/nitrite, dissolved oxygen, salinity, and sulfate to aid in determining whether the groundwater at Site 1 is suitable for use as a drinking water source.

If it is determined that the groundwater is not potable, groundwater will be removed as a pathway of concern from the human health risk assessment. The following potential receptor groups will be evaluated in the human health risk assessment.

- Adolescent Trespassers
  - Soil: ingestion, dermal contact
  - Surface Water: ingestion, dermal contact
  - Sediment: ingestion, dermal contact

- Construction Workers
  - Soil: ingestion, dermal contact
  - Groundwater: ingestion, dermal contact
  - Surface Water: ingestion, dermal contact

- Future Residents
  - Soil: ingestion, dermal contact, vegetable consumption
  - Groundwater: ingestion, dermal contact, inhalation (showering)

- Workers (Maintenance, Other Employees)
  - Soil: ingestion, dermal contact
  - Groundwater: ingestion, dermal contact

- Adult and Adolescent Recreational Users
  - Surface Water: ingestion, dermal contact
  - Finfish/shellfish: ingestion

Additional details on receptors and complete exposure pathways to be considered in the development of the human health risk assessment are provided in Section 3.3 of the Human Health Risk Assessment Methodology provided in Appendix A of the Master Work Plan, Volume III.

5.2 ECOLOGICAL RISK

An ecological risk assessment for this site will be performed. Analytical data generated under this Work Plan, as well as historical data for the site, will be used to determine if measured chemical concentrations pose a significant threat to potential ecological receptors. The general methodologies which will be used to assess risks to ecological receptors are contained in Appendix B of the Master Work Plan Volume III for MCRD, Parris Island (B&R Environmental, 1998c).

Selection of contaminants of potential concern will be accomplished by the comparison of maximum detected site concentrations to U.S. EPA Region 4 screening values. Chromium, lead, and chloroform have been identified as potential contaminants in the VS.

The preliminary ecological risk assessment will begin with a "preliminary problem formulation" step, including review of historical documents, potential COCs, site characteristics, photographs, maps, and notes from a site visit. Media of concern include surface soil, sediment, and surface water. Additionally, groundwater discharge to surface water will be included as an exposure medium. Receptors may be exposed to such contaminants through direct contact, inhalation, ingestion of media, and ingestion of contaminated food. Preliminary receptors of concern at Sites 1 and 41 may be:

- Terrestrial invertebrates,
- Terrestrial vertebrates,
- Aquatic life, and
- Benthic invertebrates.

Others may be added, especially if sampling reveals bioaccumulating chemicals at concentrations above screening levels.

The latter part of the preliminary assessment will include an evaluation of ecological effects, which will establish preliminary threshold levels for contaminant concentrations in exposure media, and if needed, for contaminant ingestion rates. A preliminary exposure assessment will entail the compilation of maximum contaminant concentrations in exposure media. If necessary, maximum ingestion rates for indicator species will be calculated. The preliminary risk calculations will be in the form of ratios; the exposure levels to be divided by the threshold values.

The preliminary risk assessment will be initially documented in the form of a technical memorandum. The purpose of the memorandum is to provide results as quickly as possible in case more investigation may be required. The preliminary risk assessment will conclude with recommendations for further investigation. If more work is required, a work plan addendum would be submitted.

6.0 FIELD OPERATIONS

This section is the Site-Specific Field Sampling Plan (FSP) for the investigation at Site 1 - Incinerator Landfill and Site 41 - Former Incinerator. It outlines the project-specific field investigation activities to be performed at Sites 1 and 41 for this investigation. This section also describes the procedures for performing the field investigation activities. It is to be used in conjunction with the Master FSP, Volume II of the Master Work Plan for MCRD, Parris Island (B&R Environmental, 1998c) and references the Master FSP where appropriate.

Field operation activities to be performed at MCRD Parris Island for this investigation include mobilization of equipment, soil boring installation and soil sampling, monitoring well installation, hydraulic conductivity testing (slug tests), surface water and sediment sampling, groundwater sampling, water-level measurements, site surveying, equipment decontamination, waste handling, and site restoration. Monitoring well installation will be a priority of the field effort followed by water-level measurements. The results of these measurements will be used to better characterize the depth, flow direction, and gradient of the groundwater. From this information, the background surface water and sediment sample locations will be determined in the field.

All field operation activities will be performed as described in the Master FSP and subsequent B&R Environmental Standard Operating Procedures (SOPs) provided in Volume II of the Master Work Plan, except where noted. All well installation activities will be performed under the direction of a state-certified Professional Geologist familiar with all state, federal, and local laws, regulations, and requirements pertaining to the geologist's duties and responsibilities. Additionally, a state-certified driller will be used.

6.1 MOBILIZATION/DEMOBILIZATION

Mobilization activities will be performed in accordance with the procedures outlined in the Master FSP. If additional field investigations are occurring at other sites at MCRD, field activities at Sites 1 and 41 will be coordinated accordingly with the other field activities.

6.2 SITE RESTORATION

If investigation activities (e.g., monitoring well installation) disturb or alter the landscape, vegetation, or other features of Sites 1 or 41, the site may require restoration to conditions prior to the investigation. If vegetation is stressed or damaged as a result of investigation activities, the affected area will be reseeded. Portions of Sites 1 or 41 will be regarded if investigation activities alter the natural contour of

the sites. Additionally, all equipment used during the investigation and investigative-derived waste (IDW) will be removed from the sites.

6.3 SOIL BORING DRILLING

Ten soil borings will be drilled at Site 1 for the purpose of monitoring well installation. At high tide, monitoring wells will be placed as far from the landfill boundary, as possible, without entering surface water. From these borings, five will be converted to shallow surficial aquifer wells and five will be converted to deep surficial aquifer wells. Two samples will be collected at each of the deep well boring locations; in the vadose zone and within the aquifer. The mud-rotary drilling method will be used for advancing the soil borings. The mud-rotary drilling technique involves the downward advancement of 5 to 10 foot sections of hollow, heavy-gauge steel rods. Hollow rods of sufficient diameter will be used to produce a 2-inch annular space between the casing and the borehole wall. The drilling fluids used must be adequately thinned to allow proper installation of well materials

Split-spoon samples will be collected continuously from the ground surface to the termination depth of the borings in accordance with ASTM Standard Method D 1586-84. The split-spoon samplers will have a minimum inside diameter (I.D.) of 2 inches and a length of 2 feet to fulfill sample volume requirements for chemical analysis. Each split-spoon sample will be field screened with a flameionization detector (FID) or photoionization detector (PID) upon collection and head-space field analysis shall be performed to prejudice the selection of the sample to be submitted for fixed-base laboratory analysis. Split-spoon samples will be divided and placed in chemical sample jars and 8-oz. lithologic sample jars. Selected chemical sample jars will be labeled, packed, and shipped to the laboratory. Lithologic sample jars will be labeled as described in the Master FSP and retained on site until completion of the investigation, at which time all lithologic samples will be properly disposed. Lithologic samples will provide information relevant to contaminant fate and transport modeling.

At one soil boring location, a Shelby Tube sample will be collected within the Hawthorn Formation (confining layer) in accordance with the methodologies described in B&R Environmental SOP SA-1.3, "Soil Sampling." Because the thickness and consistency of the Hawthorn Formation has not been verified during previous investigations, the following events will take place to prevent the possibility of compromising the integrity of the confining layer. Initially, a soil boring will be installed as described previously. Once the top of the Hawthorn Formation is encountered, any material removed from the confining unit will be replaced with a bentonite/cement mixture. Then, an additional soil boring will be installed a few feet upgradient of the initial boring. The boring will be installed to the depth of the top of the Hawthorn Formation and from this depth, a Shelby Tube sample will be collected, and removed material

will be replaced with the bentonite/cement mixture. This procedure will ensure that no more than 2 feet of material will be removed from the confining layer, thus minimizing the potential to contaminate the underlying Floridan Aquifer.

A boring log will be maintained as described in the Master FSP for each soil boring by the state-certified field geologist. Field screening and head-space analysis results and a lithologic description of each split-spoon sample will be recorded on the boring log. At a minimum, the information outlined in the Master FSP will be recorded on the boring log for each boring.

6.4 MONITORING WELL INSTALLATION AND CONSTRUCTION

Monitoring wells will be installed and constructed in accordance with all applicable State of South Carolina regulations (e.g., Code of Laws of South Carolina 1976, Regulation 61-71 Well Standards) and Volume II of the Master Work Plan (B&R Environmental, 1998c). Prior to the construction of any monitoring well, a formal request will be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) for approval. The request will contain the following information:

- Proposed location(s) on a scaled map or plate
- Proposed construction detail
- Intended purpose of the monitoring well(s)

The state also requires a formal submission detailing the activity performed during the installation of the monitoring well(s). A monitoring well record form or other form provided and/or approved by the state shall be completed and submitted within 30 days after completion of each monitoring well. The form shall contain the following information:

(a) Name and address of facility/owner
(b) Location of monitoring well(s) on a scaled map or plate
(c) Driller and certification number
(d) Date drilled
(e) Driller's or geologist's log
(f) Total depth
(g) Screened interval
(h) Diameter and construction details
(i) Depth to water table with date and time measured

(j) Surveyed elevation of measuring point with respect to an established benchmark

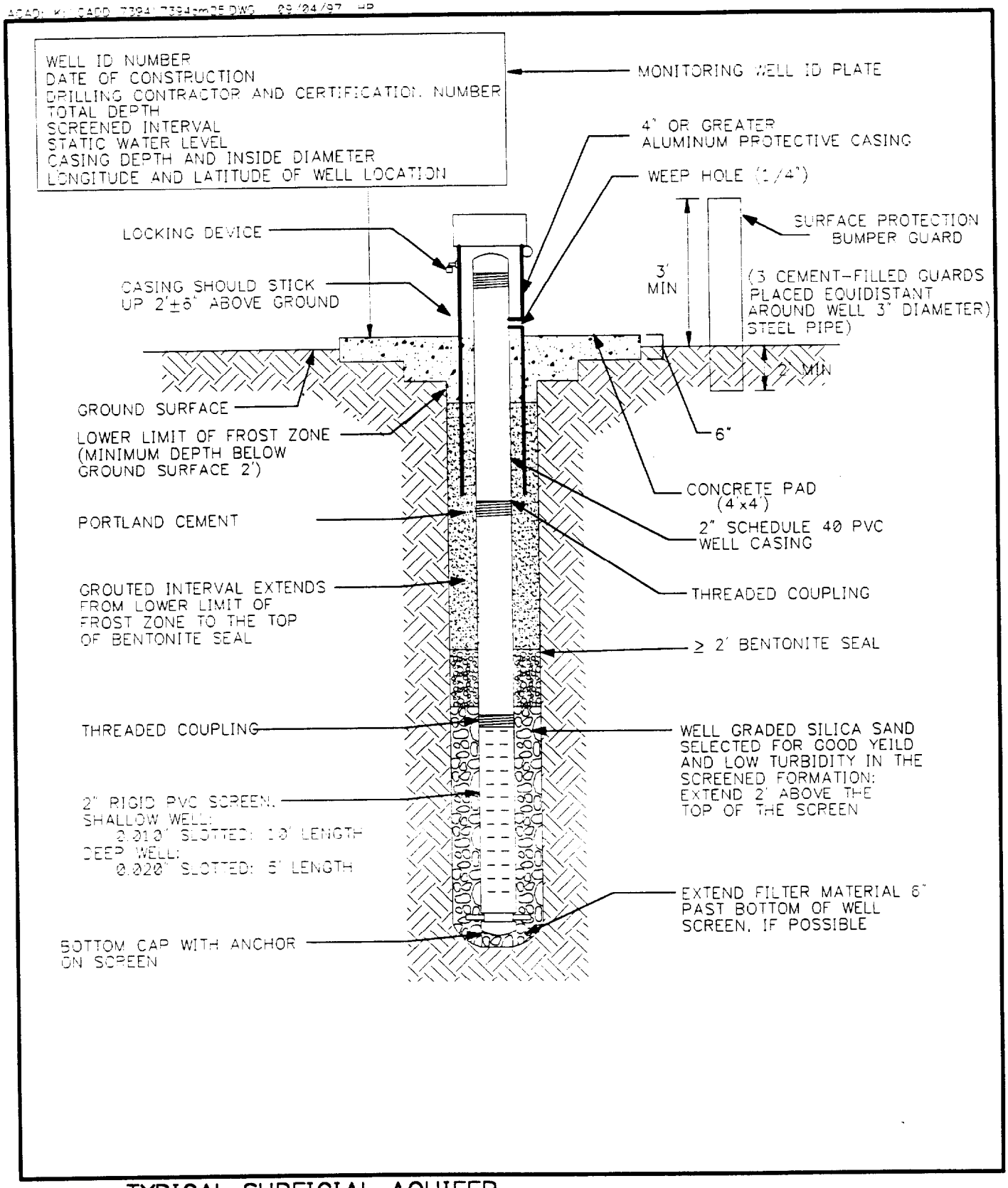
(k) State-certified professional geologist's seal and certification number

Five shallow monitoring wells and five deep monitoring wells will be installed downgradient of Site 1 in the surficial aquifer. All wells will be constructed with certified-clean well construction material. The shallow wells will monitor the top of the surficial aquifer, whereas the deep wells will monitor the bottom of the surficial aquifer. The top of the screened interval for the shallow monitoring wells will be placed approximately 2 feet above the high tide water table, assuming sufficient water remains in the well during low tide to obtain a groundwater sample. Shallow monitoring wells will be constructed of 2-inch I.D., flush-threaded PVC well screen and compatibly-threaded PVC well casing riser. PVC shall meet National Sanitation Foundation (NSF) Standard 14 as specified in U.S. EPA Region 4 Environmental Investigations Standard Operating Procedure and Quality Assurance Manual (EISOPQAM) (U.S. EPA, 1996b). PVC is appropriate for the application because sorption and leaching are not of sufficient impact to affect the pipe and is expected to function properly for the expected duration of this project.

Boreholes for deep monitoring wells will be advanced to the top of the confining unit (Hawthorn Formation) underlying the surficial aquifer. The bottom of the screened interval for the deep monitoring wells will be placed even with, or slightly below, the top of the confining unit. Deep monitoring wells will be constructed of 2-inch I.D., flush-threaded PVC well screen and PVC well casing riser. PVC well screens and well casing risers will be used and will meet the requirements as stated previously.

Well screens for shallow monitoring wells will be 10 feet long with 0.010-inch openings. Deep well screens will be 5 feet long with 0.020-inch openings. There is sufficient history from existing wells to conclude that the upper wells will be screened in fine-grained material (silt and fine sand) and the deeper wells will be screened in more coarse-grained sands. Therefore, the anticipated slot size for the shallow and deep well screens is determined to be 0.010 and 0.020 inches accordingly.

For both shallow and deep monitoring wells, a primary filter pack of clean, silica sand will be installed flush with the bottom of the well to a minimum of 2 feet above the top of the well screen. A sand passing U.S. Standard Sieve No. 20-30 will be used for finer formations (0.010 slot size), and sand passing U.S. Standard Sieve No. 10-20 will be used for coarser formations (0.020 slot size), as determined by the site geologist. A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate in accordance with the manufacturer's recommendations. The annular space above the bentonite seal will be grouted with neat cement or a bentonite/cement mixture from the top of the bentonite seal to a point below the frost line or at least 2 feet below ground surface.



TYPICAL SURFICIAL AQUIFER
MONITORING WELL DETAIL
MCRD
PARRIS ISLAND, SOUTH CAROLINA
NOT TO SCALE

FIGURE 6-1

Brown & Root Environmental

The concrete used to form the pad will fill the remaining annular space. Figure 6-1 illustrates a typical monitoring well construction.

All monitoring wells will be completed with a 4-inch diameter, protective aluminum casing with a locking cap, as described in the Master FSP. A 4-foot- by 4-foot-wide by 6-inch-thick concrete surface seal shall be placed flush with the ground surface. A minimum of three bumper guards consisting of steel pipes filled with cement slurry will be installed equidistant around each monitoring well. Additionally, a 4-inch by 4-inch aluminum tag identification plate will be affixed to each well and will contain the following information.

(a) Well identification number
(b) Date of construction
(c) Drilling contractor and certification number
(d) Depth of well
(e) Screened interval
(f) Static water level
(g) Casing depth and inside diameter
(h) Latitude and longitude of well location

Prior to sampling, all monitoring wells will be developed to remove formation cuttings (as well as any residual drilling fluids), as described in the Master FSP, Volume II (B&R Environmental, 1998c).

6.5 HYDRAULIC CONDUCTIVITY

Slug tests will be performed at each proposed and existing monitoring well to determine the hydraulic conductivity of the aquifer. The slug tests will be conducted according to the procedures described in Section 2.7.1 of the Master FSP, Volume II (B&R Environmental, 1998c).

6.6 SURVEYING

All proposed soil borings, groundwater monitoring wells, surface water and sediment, and staff gauge locations will be surveyed. A third-order survey will be conducted by a professional surveyor licensed in the State of South Carolina according to the requirements described in the Master FSP of the Master Work Plan, Volume II (B&R Environmental, 1998c).

6.7 WATER-LEVEL MEASUREMENTS

Two synoptic rounds of water-level measurements of proposed and existing monitoring wells at Site 1 will be conducted for this investigation. One round will be collected during high tide, and the second round will be collected during low tide, based on Naval tidal charts for MCRD Parris Island. This will be incorporated with the tidal influence study in which water levels are recorded every 30 minutes over a 24-hour period at each monitoring well (see Section 4.2.3.5). Surface water levels will also be collected over a 24-hour period to evaluate tidal influences. A standard USGS staff gauge (National Oceanic Survey) or permanent feature will be used as a reference point for measurements.

All instrumentation should be checked for damage, warpage, legibility, etc., before use. It must also be cleaned before and after use. The staff gauge and wells will be permanently marked by the Field Operations Leader (FOL) indicating the referenced points of measurement. The reference points will be subsequently surveyed for location and elevation.

Procedures for conducting surface water stage/tape downs will be conducted in accordance with the procedures identified in Section 15.5 of the U.S. EPA Region 4 EISOPQAM (U.S. EPA, 1996b).

All water-level measurements will be noted with the time and recorded to the nearest 0.01 foot.

6.8 DECONTAMINATION

Decontamination of major equipment and sampling equipment will be in accordance with the Master FSP and SOP SA-7.1, "Decontamination of Field Equipment and Waste Handling." An area for the decontamination pad for major equipment and a source of potable water for steam washing will be arranged by the FOL through MCRD personnel.

6.9 WASTE HANDLING

All solid and liquid wastes generated as a result of this investigation will be handled in accordance with the procedures described in Section 2.11 of the Master FSP and SOP SA-7.1, "Decontamination of Field Equipment and Waste Handling" (B&R Environmental, 1998c).

7.0 ENVIRONMENTAL SAMPLING

This section outlines the environmental sampling program and describes the sampling procedures for the field investigation at Site 1 - Incinerator Landfill and Site 41 - Former Incinerator.

7.1 SUMMARY OF ENVIRONMENTAL SAMPLING

Tables 7-1 and 7-2 summarize the sampling program for the field investigation at Sites 1 and 41, respectively. Figure 7-1 illustrates the proposed surface water and sediment sampling locations for Sites 1 and 41. Likewise, Figure 7-2 depicts the proposed soil sampling locations, and Figure 7-3 shows the proposed groundwater sampling locations. Proposed sampling locations are contingent upon utility location and clearance with MCRD personnel.

7.2 SAMPLING PROCEDURES

The following sections describe sampling procedures that will be followed during surface water, sediment, soil, and groundwater sample collection. Additionally, the following sections present the proposed sampling locations for field activities. If during field activities, the FOL deems that an area not contained in the Work Plan should be sampled because of surface features (e.g., depressions) that would cause preferential accumulation of contaminants, the location of samples presented in the sampling plan will be altered to include such areas. Additionally, the rationale for the deviation will be documented in the RI/RFI report.

Collection of surface water, sediment, and surface soil samples at Site 1 and surface soil samples at Site 41 will be a priority of the field effort. These results will indicate the presence of dioxin/furan precursors and the possible need for additional sampling for dioxin/furan analysis.

7.2.1 Surface Water and Sediment Sampling

Twelve surface water samples and thirteen sediment samples (which includes three background samples from each media) will be collected for this investigation at locations indicated on Figure 7-1. Based on consultation with the Parris Island Tier I Partnering Team, the three surface water and sediment background samples will be collected at Pickney Island. Two (2) background samples will be collected from the intertidal area and one (1) sample will be collected at a submerged low tide evaluation point. Background sediment samples will be collected at a 0- to 6-inch sample depth. Of the remaining nine sediment samples, eight samples will be collected at a 0- to 6-inch sampling depth to reflect recent offsite migration, and one sample (at PAI-01-SD02) will be collected from the 6- to 12-inch depth to reflect

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Filtered)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
SURFACE WATER											
PAI-01-SW01	PAI-01-SW-001-00	Surface	•	•	•	•	•	•		•	Ecological Parameters (1)
PAI-01-SW02	PAI-01-SW-002-00	Surface	•	•	•	•	•	•		•	Ecological Parameters (1)
PAI-01-SW03	PAI-01-SW-003-00	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW04	PAI-01-SW-004-00	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW05	PAI-01-SW-005-00	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW06	PAI-01-SW-006-00	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW07	PAI-01-SW-007-00	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW08	PAI-01-SW-008-00	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW09	PAI-01-SW-009-01	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW10	PAI-01-SW-010-01	Surface	•	•	•	•	•	•			Ecological Parameters (1)
PAI-01-SW11	PAI-01-SW-011-01	Surface	•	•	•	•	•	•		•	Ecological Parameters (1)
PAI-01-SW12	PAI-01-SW-012-01	Surface	•	•	•	•	•	•			Ecological Parameters (1)

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Filtered)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
SEDIMENT											
PAI-01-SD01	PAI-01-SD-001-01	0 - 0.5	•	•	•		•	•(2)		•	Ecological Parameters (3)
PAI-01-SD02	PAI-01-SD-002-01	0 - 0.5	•	•	•		•	•(2)		•	
PAI-01-SD02	PAI-01-SD-002-02	0.5 - 1	•	•	•		•	•(2)			Ecological Parameters (3)
PAI-01-SD03	PAI-01-SD-003-01	0 - 0.5	•	•	•		•	•(2)			Ecological Parameters (3)
PAI-01-SD04	PAI-01-SD-004-01	0 - 0.5	•	•	•		•	•(2)			
PAI-01-SD05	PAI-01-SD-005-01	0 - 0.5	•	•	•		•	•(2)			
PAI-01-SD06	PAI-01-SD-006-01	0 - 0.5	•	•	•		•	•(2)			
PAI-01-SD07	PAI-01-SD-007-01	0 - 0.5	•	•	•		•	•(2)			
PAI-01-SD08	PAI-01-SD-008-01	0 - 0.5	•	•	•		•	•(2)			
PAI-01-SD09	PAI-01-SD-009-01	0 - 0.5	•	•	•		•	•(2)			
PAI-01-SD10	PAI-01-SD-010-01	0 - 0.5	•	•	•		•	•(2)			
PAI-01-SD11	PAI-01-SD-011-01	0 - 0.5	•	•	•		•	•(2)		•	
PAI-01-SD12	PAI-01-SD-012-01	0 - 0.5	•	•	•		•	•(2)			

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 3 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Filtered)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
SOIL											
PAI-01-SS01	PAI-01-SS-001-01	0-1	•	•	•		•				
PAI-01-SS02	PAI-01-SS-002-01	0-1	•	•	•		•				
PAI-01-SS03	PAI-01-SS-003-01	0-1	•	•	•		•				
PAI-01-SS04	PAI-01-SS-004-01	0-1	•	•	•		•				
PAI-01-SS05	PAI-01-SS-005-01	0-1	•	•	•		•				
PAI-01-SS06	PAI-01-SS-006-01	0-1	•	•	•		•				
PAI-01-SS07	PAI-01-SS-007-01	0-1	•	•	•		•	TOC & pH only			•(10)
PAI-01-SS08	PAI-01-SS-008-01	0-1	•	•	•		•			•	
PAI-01-SS09	PAI-01-SS-009-01	0-1	•	•	•		•			•	
PAI-01-SS10	PAI-01-SS-010-01	0-1	•	•	•		•	TOC & pH only			•(4)(10)
PAI-01-SS11	PAI-01-SS-011-01	0-1	•	•	•		•				
PAI-01-SS12	PAI-01-SS-012-01	0-1	•	•	•		•				
PAI-01-SS13	PAI-01-SS-013-01	0-1	•	•	•		•				
PAI-01-SS14	PAI-01-SS-014-01	0-1	•	•	•		•			•	
PAI-01-SB01	PAI-01-SB-001-xx(5)	TBD(11)									•(4)

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 4 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Filtered)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
PAI-01-SB01	PAI-01-SB-001-xx(5)	TBD(7)						TOC & pH only			•(4)(10)
PAI-01-SB02	PAI-01-SB-002-xx(5)	TBD(11)									•(4)
PAI-01-SB02	PAI-01-SB-002-xx(5)	TBD(7)						TOC & pH only			•(4)(10)
PAI-01-SB03	PAI-01-SB-003-xx(5)	TBD(11)									•(4)
PAI-01-SB03	PAI-01-SB-003-xx(5)	TBD(7)						TOC & pH only			•(4)(10)
PAI-01-SB03	PAI-01-SB-003-xx(5)	TBD(12)									•(6)
PAI-01-SB04	PAI-01-SB-004-xx(5)	TBD(11)									•(4)
PAI-01-SB04	PAI-01-SB-004-xx(5)	TBD(7)						TOC & pH only			•(4)(10)
PAI-01-SB05	PAI-01-SB-005-xx(5)	TBD(11)									•(4)
PAI-01-SB05	PAI-01-SB-005-xx(5)	TBD(7)						TOC & pH only			•(4)(10)
GROUNDWATER											
PAI-01-GW04 (existing monitoring well)	PAI-01-GW-004-01	Shallow Surficial	•	•	•	•	•	•			•(8)(9)
PAI-01-GW05	PAI-01-GW-005-01	Shallow Surficial	•	•	•	•	•	•			•(8)(9)
PAI-01-GW06 (Converted from PAI-01-SB01)	PAI-01-GW-006-01	Deep Surficial	•	•	•	•	•	•			•(8)(9)

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 5 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Filtered)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
PAI-01-GW07	PAI-01-GW-007-01	Shallow Surficial	•	•	•	•	•	•		•	•(8)(9)
PAI-01-GW08 (Converted from PAI-01-SB02)	PAI-01-GW-008-01	Deep Surficial	•	•	•	•	•	•			•(8)(9)
PAI-01-GW09	PAI-01-GW-009-01	Shallow Surficial	•	•	•	•	•	•			•(8)(9)
PAI-01-GW10 (Converted from PAI-01-SB03)	PAI-01-GW-010-01	Deep Surficial							•	•	•(8)(9)
PAI-01-GW11	PAI-01-GW-011-01	Shallow Surficial	•	•	•	•	•	•		•	•(8)(9)
PAI-01-GW12 (Converted from PAI-01-SB04)	PAI-01-GW-012-01	Deep Surficial	•	•	•	•	•	•			•(8)(9)
PAI-01-GW13	PAI-01-GW-013-01	Shallow Surficial	•	•	•	•	•	•			•(8)(9)
PAI-01-GW14 (Converted from PAI-01-SB05)	PAI-01-GW-014-01	Deep Surficial	•	•	•	•	•	•			•(8)(9)

1 Dissolved oxygen, salinity, temperature, and Secchi Disk readings.
2 TOC and pH, only.
3 Grain-size analysis, and bulk density.
4 Natural moisture content, grain-size analysis, and Atterberg Limits.
5 XX = Sample depth determined in field.
6 A Shelby Tube will be collected from the Hawthorn Formation to determine vertical conductivity.
7 Sample to be collected from the saturated zone.
8 Turbidity, TDS, TSS, chloride, fluoride, nitrate/nitrite, sulfate, salinity, and dissolved oxygen.
9 Perform slug test, water-level measurements, and tidal influence study.

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 1 - INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 6 OF 6

10 Porosity, grain-size analysis, bulk density, and specific gravity.
11 Sample to be collected from the vadose zone.
12 Sample to be collected from the Hawthorn Formation.

TBD = To Be Determined.

TABLE 7-2

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA

Sample Location	Sample Designation	Sample Depth (feet below ground surface)	Sample Analysis					
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Additional Analysis
SOIL								
PAI-41-SS01	PAI-41-SS-001-01	0-1	•	•	•	•		
PAI-41-SS02	PAI-41-SS-002-01	0-1	•	•	•	•		
PAI-41-SS03	PAI-41-SS-003-01	0-1	•	•	•	•		
PAI-41-SS04	PAI-41-SS-004-01	0-1	•	•	•	•		

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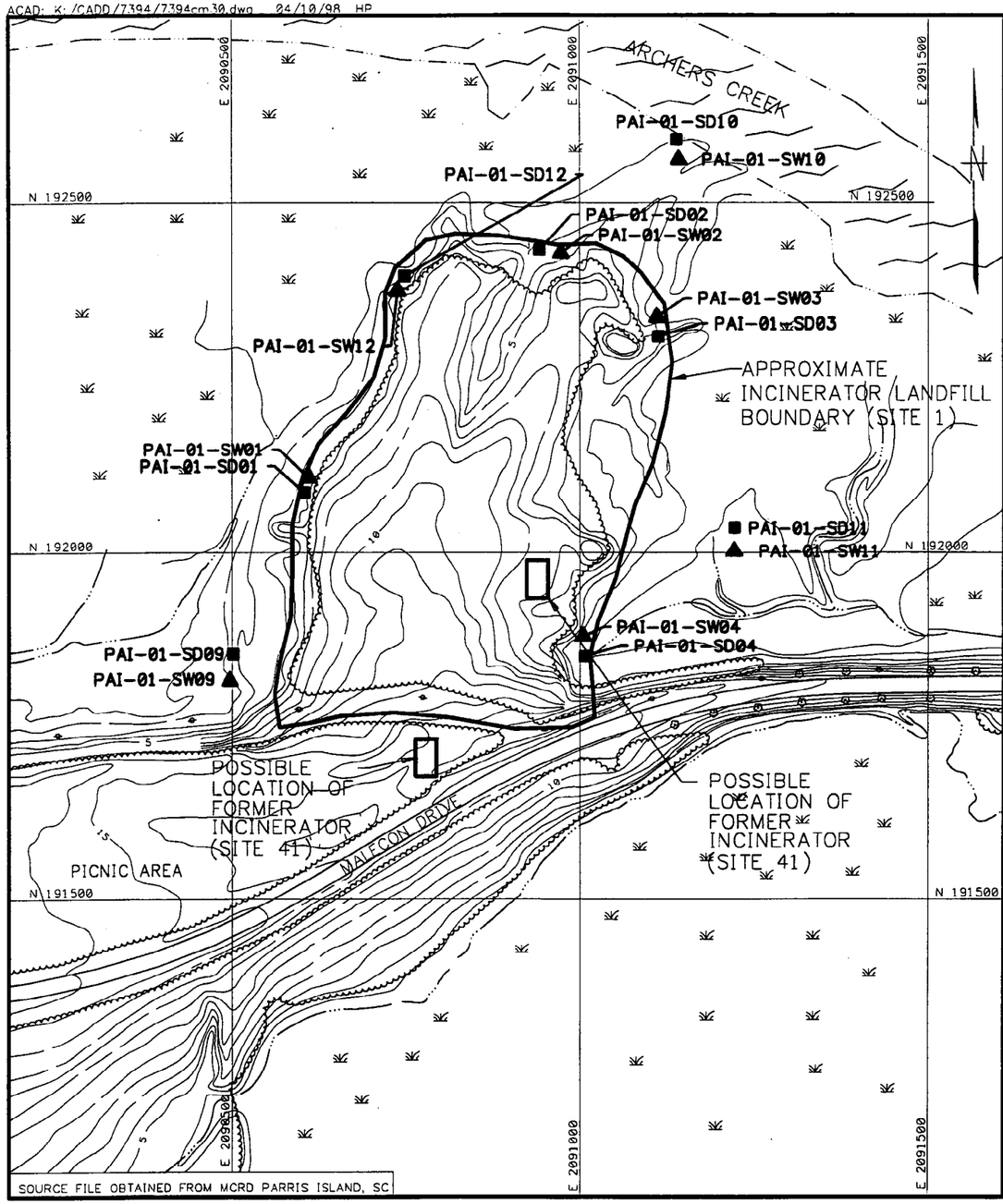

LEGEND

▲ PROPOSED SURFACE WATER SAMPLE LOCATION

■ PROPOSED SEDIMENT SAMPLE LOCATION

▭ POSSIBLE LOCATION OF FORMER INCINERATOR

NOTES:
1. SURFACE WATER AND SEDIMENT SAMPLES TO BE COLLECTED FROM THE SAME LOCATION.
2. AT PAI-01-SD02, ONE SHALLOW AND ONE DEEP SEDIMENT SAMPLE WILL BE TAKEN.
3. SAMPLING LOCATIONS ARE APPROXIMATE AND MAY BE REVISED AS INDICATED IN SECTION 7.2.1.
4. SURFACE WATER AND SEDIMENT SAMPLES PAI-01-SW01, 02, 03, 04, 12 AND PAI-01-SD01, 02, 03, 04, 12 TO BE COLLECTED IN THE INTERTIDAL AREA BETWEEN THE TREELINE AND LANDFILL BOUNDARY.
5. BASED ON CONSULTATION WITH THE PARRIS ISLAND PARTNERING TEAM, THE BACKGROUND SAMPLES PAI-01-SW05, 06, 07 AND PAI-01-SD05, 06, 07 WILL BE COLLECTED AT PICKNEY ISLAND. TWO (2) SAMPLES WILL BE COLLECTED FROM THE INTERTIDAL AREA AND ONE (1) SAMPLE WILL BE COLLECTED AT A SUBMERGED LOW TIDE ELEVATION POINT.
6. SURFACE WATER AND SEDIMENT SAMPLE PAI-01-SW08 AND PAI-01-SD08 WILL BE AN EXTRA SAMPLE TO BE USED AS NECESSARY.
7. SURFACE WATER AND SEDIMENT SAMPLES PAI-01-SW09, 10, 11 AND PAI-01-SD09, 10, 11 WILL BE COLLECTED IN A SUBMERGED LOW TIDE AREA OUTSIDE THE LANDFILL BOUNDARY.

PROPOSED SW/SEDIMENT SAMPLE LOCATIONS
SITE 1- INCINERATOR LANDFILL
SITE 41- FORMER INCINERATOR
MCRD, PARRIS ISLAND, SOUTH CAROLINA

0 200 400
SCALE IN FEET

FIGURE 7-1

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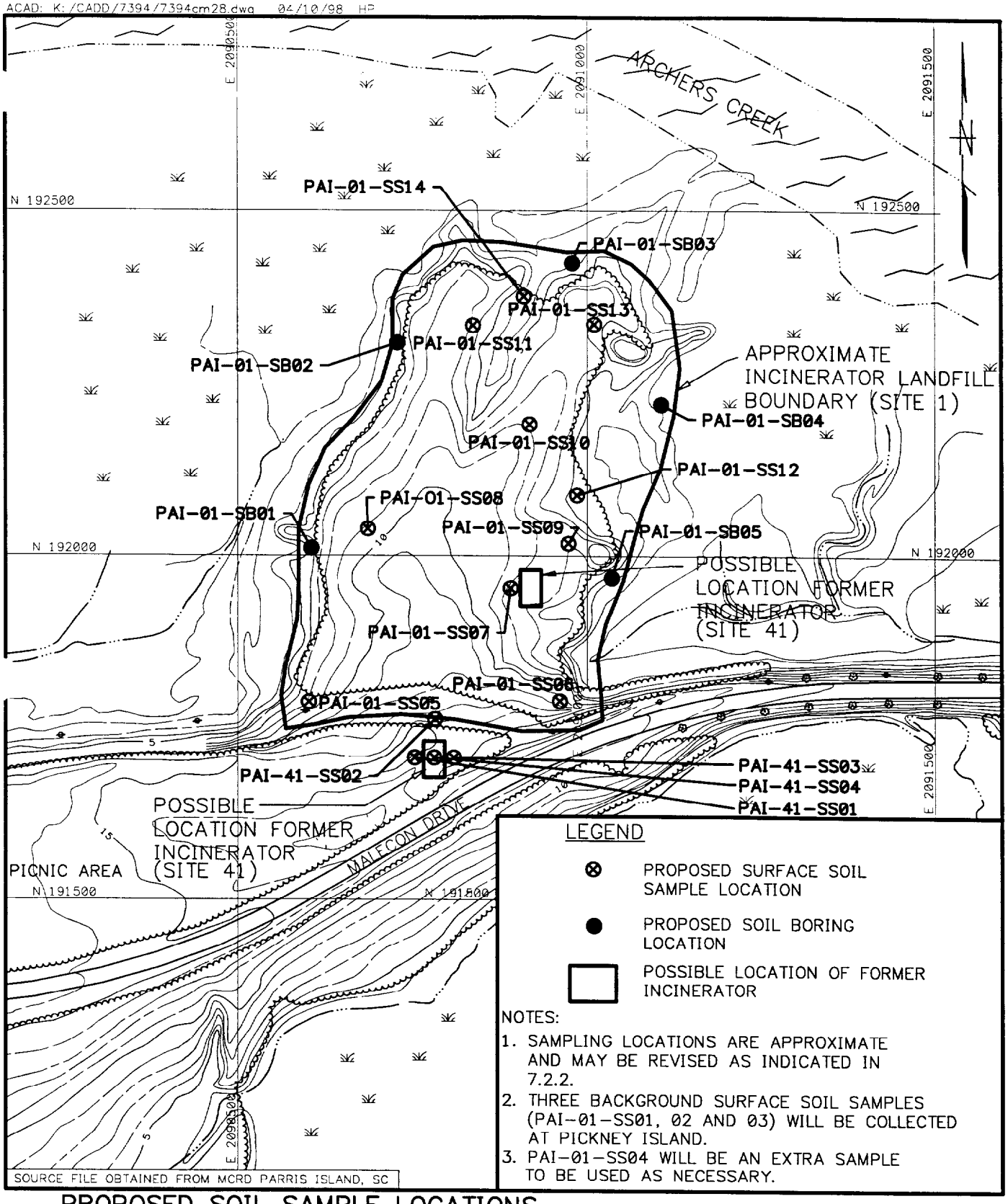

PROPOSED SOIL SAMPLE LOCATIONS
SITE 1 – INCINERATOR LANDFILL
SITE 41 – FORMER INCINERATOR
MCRD, PARRIS ISLAND, SOUTH CAROLINA

FIGURE 7-2

0 200 400
SCALE IN FEET

Brown & Root Environmental

069703/P

CTO 0020

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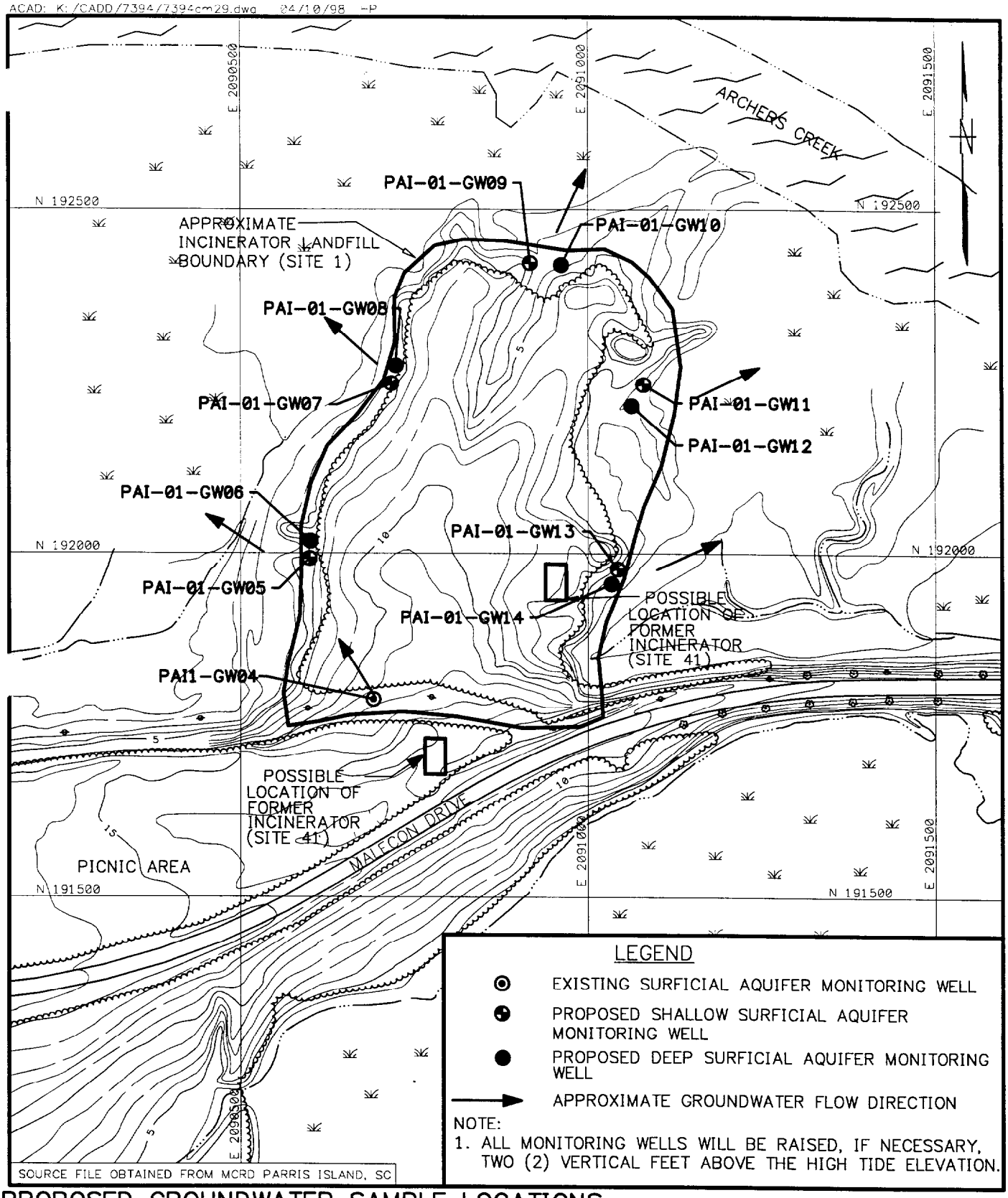


PROPOSED GROUNDWATER SAMPLE LOCATIONS
SITE 1 – INCINERATOR LANDFILL
SITE 41–FORMER INCINERATOR
MCRD, PARRIS ISLAND, SOUTH CAROLINA

0 200 400
SCALE IN FEET

FIGURE 7–3

Brown & Root Environmental

historical accumulation. Collection of surface sediments will be biased towards depositional areas. The surface water and sediment samples will be collected in accordance with sampling methodologies described in the Master FSP and B&R Environmental SOP Number SA-1.2, "Surface Water and Sediment Sampling." Each set of surface water and sediment samples will be collected at the same location. At low tide, the proposed surface water and sediment sampling locations are not covered with water. Sediment samples will be collected in the marsh area at low tide as U.S. EPA Region 4 considers exposure to sediments for only those periods that the sediment is not covered with surface water. Surface water samples will be collected at high tide as the surface water begins to recede. Surface water samples will be filtered in the field for dissolved metals analysis in addition to the unfiltered samples collected for total metals analysis.

The upland/wetland boundary is not well defined and will be characterized during field activities. Consequently, proposed sampling locations may be modified as appropriate during the investigation. Any deviation from the proposed locations will be noted in the field and documented in the RI/RFI report.

7.2.2 Surface Soil Sampling

Eighteen surface soil samples (which includes three background samples) will be collected for this investigation at locations shown on Figure 7-2. Ten surface soil samples will be collected from the 0-1 foot sampling interval at Site 1 within the upland portion of the landfill boundary. Once the sample is collected, field personnel will continue to bore into the soil with a hand auger until the top limit of waste is reached. The lithology of these borings will be recorded.

As mentioned previously, the upland/wetland boundary is not well defined and will be characterized during field activities. Consequently, proposed sampling locations may be modified as appropriate during the investigation. Any deviation from the proposed locations will be noted in the field and documented in the RI/RFI report.

In addition to the ten surface soil samples at Site 1, four surface soil samples will be collected at Site 41, and three background surface soil samples will be collected from the 0-1 foot interval at Pickney Island. All surface soil samples will be collected in accordance with the methodologies described in the Master FSP and B&R Environmental SOP Number SA-1.3, "Soil Sampling." Samples will be collected to bias the worst-case scenario based on visual and field instrumentation evaluation.

7.2.3 Subsurface Soil Sampling

Ten subsurface soil samples will be collected for this investigation in accordance with the methodologies described in the Master FSP and B&R Environmental SOP Numbers GH-1.5, "Borehole and Sample

Logging" and GH-1.3, "Soil and Rock Drilling Methods." Two subsurface soil samples will be collected from each proposed boring location that will be converted to a deep surficial aquifer monitoring well. Soil borings where subsurface soil samples will be taken are shown in Figure 7-2. The subsurface soil samples will include one from the vadose zone and one within the aquifer. Soil classification will be conducted on both samples. Groundwater modeling parameters will be determined for the sample taken within the aquifer. Also, a Shelby Tube sample will be collected during the installation of monitoring well PAI-01-GW10 in accordance with the methodologies described in B&R Environmental SOP SA-1.3, Section 5.2.3, "Procedure for Collecting Undisturbed Samples" and Section 6.3 of this Work Plan.

7.2.4 Groundwater Sampling

Eleven groundwater samples will be collected for this investigation at the locations shown in Figure 7-3. The one existing and ten proposed monitoring wells will be sampled during this investigation in accordance with the U.S. EPA Region 4 EISOPQAM and B&R Environmental Number SOP SA-1.1, Section 5.7, "Low Flow Purge and Sampling." Samples will be collected using disposable Teflon bailers at low tide when the dilution is anticipated to be minimized. A portion of each sample will be filtered in the field for dissolved metals analysis.

Background groundwater samples will not be taken at Sites 1 or 41. However, an upgradient groundwater sample will be collected during field activities associated with Site 2 (B&R Environmental, 1998a). The analytical results of this sample will be used to estimate representative upgradient conditions at Sites 1 and 41.

7.3 SAMPLE HANDLING

7.3.1 Sample Containers, Preservation, Holding Times, and Analyses

Sample handling includes proper selection of sample containers, preservation, allowable holding times, and analyses. The site-specific QAPP summarizes the sample handling requirements for this investigation.

7.3.2 Sample Nomenclature

Each sample will be assigned a unique codified sample identification number. The sample nomenclature format described in the Master FSP and B&R Environmental SOP Number CT-04, "Sample Nomenclature," will be used for this investigation. The unique label system established for this sampling event is as follows.

1		2		3		4
AAA-NN	-	AA	-	NNN	-	NN
Site Location and Site Number		Media		Sample Number		Sample Depth

1	PAI - Parris Island 01 - Site 1 41 - Site 41	3	An ascending sequential number of samples collected
2	SW - Surface Water SD - Sediment SS - Surface Soil SB - Soil Boring/Subsurface Soil GW - Groundwater	4	Bottom of sample interval or sample round.

7.3.3 Sample Documentation, Packaging, and Shipping

Matrix-specific sample logsheets will be maintained for each sample collected. In addition, sample collection information will be recorded in field notebooks and the Site Logbook. Further description of sample documentation is provided in the Master FSP and B&R Environmental SOP Number SA-6.3, "Field Documentation."

Samples will be packaged and shipped according the Master FSP and B&R Environmental SOP Number SA-6.1, "Non-Radiological Sample Handling."

7.3.4 Sample Custody

Sample custody will be maintained and documented at all times. Custody begins at the time of collection and ends at the time of disposal by the laboratory. The procedures for custody described in the Master FSP and B&R Environmental SOP Number SA-6.1 will be implemented for this investigation.

8.0 QUALITY ASSURANCE PLAN

A general discussion of the Data Quality Process is provided in the Master Work Plan (B&R Environmental, 1998c). Site-specific data quality objectives are provided in Section 4.0, and the laboratory DQOs are discussed in Section 10.0 of this document.

9.0 PROJECT MANAGEMENT ORGANIZATION

B&R Environmental will be responsible for management, implementation, and inspection of the field investigation for MCRD Parris Island Sites 1 and 41. B&R Environmental will coordinate activities with program personnel and MCRD Navy personnel when appropriate.

9.1 PROJECT ORGANIZATION

An organizational chart of the site-specific project personnel for this investigation is provided in Figure 9-1.

9.2 PROJECT PERSONNEL RESPONSIBILITIES

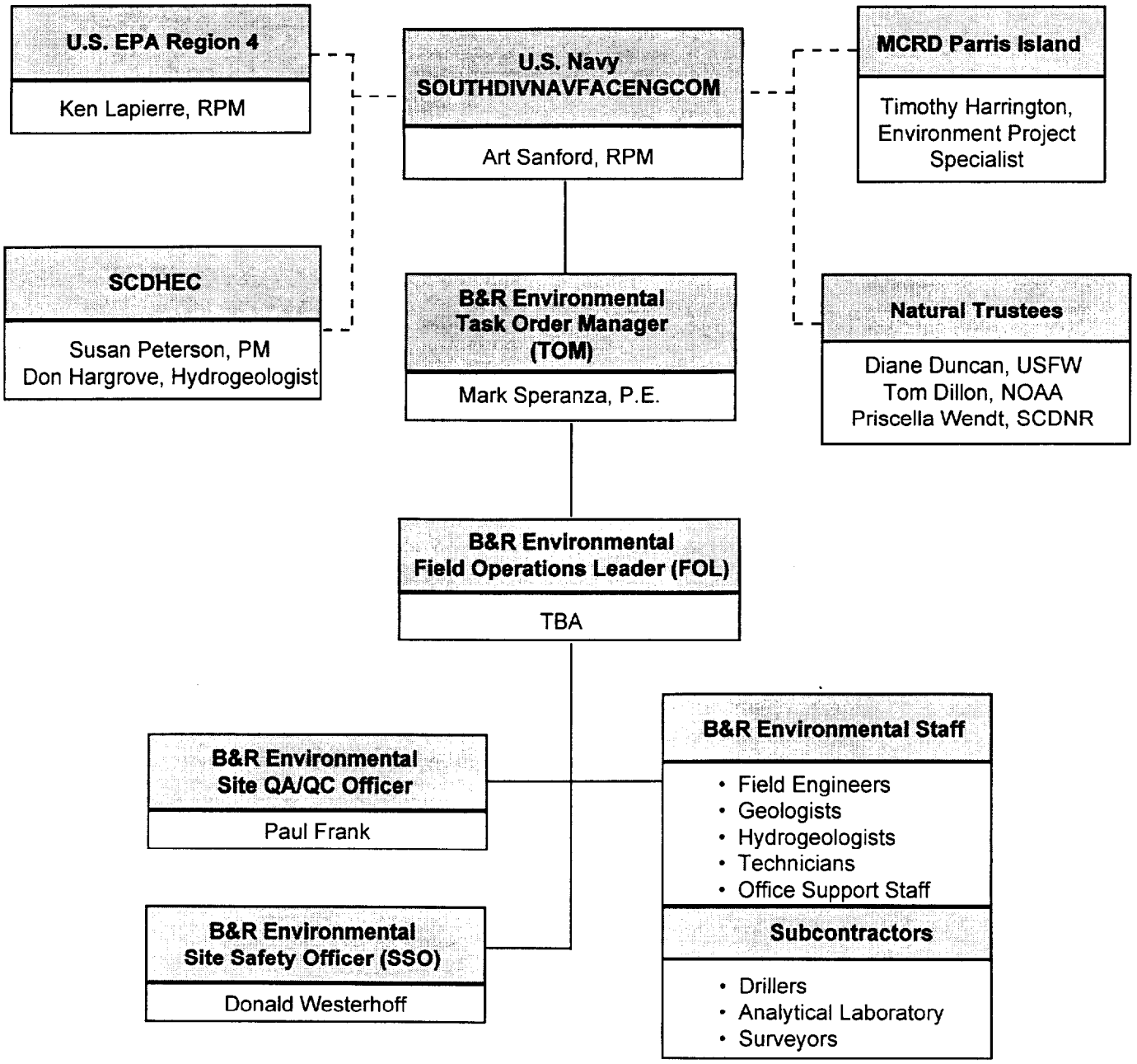
A description of responsibilities of individual project team members is provided below.

The responsibilities of the Task Order Manager (TOM) are provided in the Master Work Plan. The Field Operations Leader (FOL) will be responsible for coordinating all site personnel and field activities. The FOL will:

- Act as liaison between the TOM, field team members, Site Safety Officer (SSO), and Site Quality Assurance/Quality Control (QA/QC) officer.
- Supervise all subcontractors.
- Oversee the mobilization and demobilization of all equipment, personnel, and subcontractors, and ensure the availability and maintenance of all field sampling and monitoring equipment and materials.
- Oversee the completion of all site documentation.
- Assume custody of all samples and ensure the proper handling and shipment of all samples.
- Resolve all logistical, weather, personnel, and equipment problems that may arise and initiate field change requests after consultation with the TOM, when necessary.

FIGURE 9-1

PROJECT PERSONNEL ORGANIZATION
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA



NOAA: National Oceanic and Atmospheric Administration
PM: Project Manager
RPM: Remedial Project Manager
SCNDR: South Carolina Department of Natural Resources
TBA: To Be Assigned
USFW: U.S. Fish and Wildlife Service

A Professional Geologist certified in the State of South Carolina will provide direction for the well installation activities and review of boring logs. Mr. Stan Conti (License Number 242) or Ms. Adel Baker (License Number 103) of B&R Environmental have been tentatively identified as candidates.

The Site QA/QC Officer will be responsible for ensuring all site activities are performed according to the QA/QC guidelines outlined in the Master QAP. The Site QA/QC officer will:

- Act as liaison between the B&R Environmental Quality Assurance Manager (QAM), laboratory, and site personnel.
- Ensure that field duplicates and quality control blanks are collected at the proper frequency and volume.
- Ensure that all measuring and testing equipment is calibrated, used, and maintained in accordance with applicable procedures.
- Manage bottleware procurement and oversee field preservation and filtration activities.

The SSO will advise the FOL on issues of site health and safety. The duties of the SSO are described in the Master Health and Safety Plan (HASP) of the Master Work Plan, Volume II (B&R Environmental, 1998c).

10.0 DATA QUALITY REQUIREMENTS

The purpose of this section is to relate the site-specific laboratory analyses and field QA/QC samples to the DQO statements established for this investigation. The Master QAP of the Master Work Plan (Volume II) is referenced where appropriate.

10.1 LABORATORY ANALYSES

Section 5.0 of the Master QAP describes the laboratory and methodology requirements for the sample analyses for this investigation. Section 5.5 of the Master QAP describes the data reporting requirements for this investigation. Section 5.6 of the Master QAP describes the criteria for laboratory selection. The laboratory selected to perform work at this site must be South Carolina state certified.

10.2 EXTERNAL (FIELD) QC SAMPLES

Section 3.3 of the Master QAP contains a general description of external quality control measures.

10.2.1 Field QC Sample Types and Frequencies

Table 10-1 summarizes the frequency and type of QA/QC samples to be collected for this investigation.

TABLE 10-1

FREQUENCY OF FIELD QC SAMPLES
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA

Type Of Sample	Organics	Inorganics
Field Duplicate/ Split Samples	1/10 samples/media	1/10 samples/media
Source Water Blank	1/source/sampling event	1/source/sampling event
Trip Blank (VOCs only)	1/cooler containing VOCs samples	NA
Equipment Rinsate Blank	1/day/matrix	1/day/matrix
Field Blank	As needed; Depends on site conditions	As needed; Depends on site conditions

QA/QC blanks for grout, sand, and bentonite will be collected and held for analysis pending the analytical results of the field investigation. If it is suspected that inorganic contaminants have been introduced by well installation materials, the samples will be sent to the laboratory for analysis.

Detailed descriptions of QC sample types are provided in Sections 3.3.1 through 3.3.5 of the Master QAP of the Master Work Plan (Volume II).

10.2.2 Matrix Spike/Duplicate Sample Aliquots

Laboratory duplicate and matrix spike samples will be analyzed as described in Section 3.4 of the Master QAP of the Master WP (Volume II). The field sampling team will provide the appropriate additional sample volume as prescribed by the laboratory requirements. The additional sample aliquots required for analysis of matrix spike/duplicates will be collected with a frequency of 1 per 20 samples per matrix.

10.3 BOTTLEWARE REQUIREMENTS

The bottleware and preservation requirements for the analyses proposed for this investigation are provided in Table 10-2. Pre-preserved, certified clean bottleware will be supplied by the laboratory subcontractor.

10.4 SAMPLE CUSTODY AND SHIPMENT

Sample custody procedures are designed to provide proper documentation of sample acquisition and integrity. Sample custody and shipment procedures for this investigation are described in Section 4.0 of the Master QAP of the Master Work Plan (Volume II).

10.5 INTERNAL (LABORATORY) QC CHECKS

Descriptions of the internal (laboratory) QC check types are provided in Section 6.0 of the Master QAP of the Master Work Plan (Volume II).

10.5.1 Laboratory Duplicate, Spike, and Method Blank Analyses

Table 10-3 summarizes the frequency and type of laboratory QC checks to be performed for this investigation.

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
AQUEOUS (SURFACE WATER & GROUNDWATER)					
TCL and Appendix IX Volatile Organic Compounds	SW-846 8260B	2 x 40 mL	Glass; Teflon-lined septum cap	HCl to pH<2; Cool to 4°C; zero headspace	14 days to analysis
TCL and Appendix IX Semivolatile Organic Compounds	SW-846 8270C	2 x1 L	Amber glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Total TAL and Appendix IX Metals	SW-846 6010B/ 7000A Series	1 L	High-Density Polyethylene (HDPE)	HNO_3 to pH<2	6 months, except Hg (28 days)
Dissolved TAL Metals	SW-846 6010B/ 7000A Series	1 L	HDPE	HNO_3 to pH<2	6 months, except Hg (28 days)
Cyanide	SW-864 9010B/9012A	500 mL	Glass or HDPE	NaOH to pH>12; Cool to 4°C	14 days to analysis
Hexavalent Chromium	SW-846 7196A	250 mL	Glass of HDPE	Cool to 4°C	24 hours to analysis
TCL and Appendix IX Pesticides	SW-846 8081A	2 x 1 L[4]	Amber glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
TCL and Appendix IX PCBs	SW-46 8082	2 x 1 L[4]	Amber glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Total Organic Carbon (TOC)	EPA 415.1	60 mL	Glass orHDPE	HCl or H_2SO_4 to pH <2; Cool to 4°C	28 days to analysis
pH	EPA 150.1	60 mL	Glass or HDPE	None Required	Analyze immediately
Turbidity	EPA 180.1	250 mL	Glass or HDPE	Cool to 4°C	48 hours to analysis
Total Dissolved Solids (TDS)	EPA 160.1	250 mL	Glass or HDPE	Cool to 4°C	7 days to analysis

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
AQUEOUS (SURFACE WATER & GROUNDWATER) (Continued)					
Total Suspended Solids (TSS)	EPA 160.2	250 mL	Glass or HDPE	Cool to 4°C	7 days to analysis
Chloride	EPA 325.2	250 mL	Glass or HDPE	None required	28 days to analysis
Fluoride	EPA 340.2	500 mL	HDPE	None required	28 days to analysis
Nitrate/Nitrite	EPA 353.3	250 mL	Glass or HDPE	H_2SO_4 to pH <2; Cool to 4°C	28 days to analysis
Sulfate	EPA 375.4	250 mL	Glass or HDPE	Cool to 4°C	28 days to analysis
Salinity	SM2520B	250 mL	Glass or HDPE	Cool to 4°C	Analyze immediately
Hardness	EPA 130.2	250 mL	Glass or HDPE	HNO_3 to pH<2;Cool to 4°C	6 months to analyze
Appendix IX Organophosphorous Pesticides	SW-846 8141A	2 x 1L	Amber Glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Appendix IX Herbicides	SW-846 8151A	2 x 1L	Amber Glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Appendix IX Nonhalogenated Organic Compounds (Isobutyl alcohol, propionitrile, Acetonitrile, 1,4-Dioxane, and Methacrylonitrile)	SW-846 8015B Modified	2 x 40 mL	Glass; Teflon-lined septum cap	HCl to pH <2; Cool to 4°C	14 days to analysis

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 3 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
SOLID (SURFACE & SUBSURFACE SOIL & SEDIMENT)					
TCL Volatile Organic Compounds	SW-846 8260B	5 X 5 g	Glass EnCore™ Samplers; Teflon-lined cap; volatiles vial	Cool to 4°C; At lab add sample to be preserved with either sodium bisulfate solution or by adding to 5 ml reagent water and then freezing at -10°C	Extract within 48 hours; 14 days to analysis
TCL Semivolatile Organic Compounds	SW-846 8270C	8 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Total TAL Metals and Cyanide	SW-846 6010B/7000A Series and 9010B/9012A	8 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	6 months, except Hg (28 days); cyanide 14 days
Hexavalent Chromium	SW-846 3060A/7196A	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	7 days to extraction; 24 hours from extraction to analysis
TCL Pesticides	SW-846 8081A	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
TCL PCBs	SW-846 8082	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Total Organic Content (TOC)	SW-846 9060	4 oz.	Glass; Wide-mouth	Cool to 4°C	28 days to analysis
Grain-Size Analysis	ASTM D 421/ 422	1 qt.	Glass; Wide-mouth	None	None
Atterberg Limits	ASTM D 4318	NA[5]	Shelby Tube	None	None

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 4 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
SOLID (SURFACE & SUBSURFACE SOIL & SEDIMENT (Continued)					
Permeability	ASTM Method D5084-90/ SW-846 9100	NA	Shelby Tube	None	None
pH	SW-846-9045C	4 oz.	Glass; Wide-mouth	Cool to 4°C	Analyze immediately
Bulk Density	MSA	NA	Shelby Tube	None	None
Specific Gravity	ASTM D854	NA	Shelby Tube	None	None
Porosity	Calculation	NA	NA	None	None

1 Sample volume may vary based on the laboratory.
2 HCl - Hydrochloric acid; HNO_3 - Nitric acid; NaOH - Sodium hydroxide; H_2SO_4 - Sulfuric acid.
3 Holding times are measured from the date of sample collection.
4 Two 1L bottles of samples are sufficient for pesticides and PCB analyses if both are performed for the same sample.
5 NA - Not applicable.

TABLE 10-3

**FREQUENCY OF LABORATORY QC CHECKS
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA**

Type Of Sample	Organics	Inorganics
Laboratory Duplicate	NA	1/20 samples/media
Matrix Spike	1/20 samples/media	1/20 samples/media
Matrix Spike Duplicate	1/20 samples/media	NA
Surrogate Spike	Each sample for chromatographic analyses	NA
Method Blank	Based on method requirements with a minimum of 1/batch of 20 samples	Based on method requirements with a minimum of 1/batch of 20 samples

10.5.2 Other Laboratory QC Checks

Calibration and preventive maintenance of laboratory instruments are described in Section 6.6 of the Master QAP of the Master Work Plan (Volume II). Handling and storage of samples, use of qualified technicians, and independent confirmation of data computations and deliverables are described in the Laboratory Quality Assurance Plan (LQAP).

10.6 PROJECT RECORDS

Record keeping and evidentiary file concerns are described in Section 7.0 of the Master QAP of the Master Work Plan (Volume II). All protocols described therein will be strictly observed.

10.7 DATA REDUCTION, VALIDATION, AND REPORTING

The data generated from this investigation shall be validated in accordance with the U.S. EPA National Functional Guidelines for Organic and Inorganic Data Review. The corresponding requirements as discussed in Section 8.0 of the Master QAP, Volume II, for data validation, data assessment, electronic deliverables, and data interpretation and reporting will be followed.

10.8 PERFORMANCE AND SYSTEM AUDITS

The protocol for conducting audits as outlined in Section 10.0 of the Master QAP, Volume II, shall be followed.

10.9 CORRECTIVE ACTIONS

In the event there are discrepancies in field activities from the established procedures and/or requirements or modifications to the proposed Work Plan, the procedures established in Section 10 of the Master QAP, Volume II, for documenting nonconformances shall be implemented and, if appropriate, a "Field Task Modification Request Form" completed.

10.10 TRAINING AND QUALITY PLANNING

Training requirements and pro-active management practices are provided in the Master Work Plan, Volume II (B&R Environmental, 1998c).

REFERENCES

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APPENDIX A

WORK PLAN ADDENDUM 1

WORK PLAN ADDENDUM 1
TO
RCRA FACILITY INVESTIGATION/
REMEDIAL INVESTIGATION WORK PLAN
FOR SITE/SWMU 1 – INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

OBJECTIVE: The objective of this addendum is to identify field work needed to better delineate the horizontal extent of chemicals of potential concern in sediments at Site/SWMU 1.

BACKGROUND: The intent of the original sediment investigation was to determine whether site chemicals have adversely impacted adjacent sediments. Based on a preliminary evaluation of sediment data collected in 1998, metals consistent with landfilling operations have been detected at concentrations exceeding potential human health and ecological screening levels in the adjacent sediments. Therefore, the horizontal extent of metal contamination has not been adequately defined.

In addition, pesticides and polynuclear aromatic hydrocarbons (PAHs) have been detected in the same sediments at concentrations that exceed human health and/or ecological screening values. These chemicals may be associated with Site 1 waste disposal activities. However, based on the prevalence of these chemicals throughout the area, these chemicals may also be associated with commercial application of these chemicals for beneficial use at the facility.

Carbon disulfide was detected in several sample locations, but with a maximum concentration of 18 ug/kg. Based on the frequency of detection, relatively low detected concentrations relative to the screening level (13 ug/kg), and chemical volatility, additional testing for VOCs is not proposed.

SAMPLING PLAN: To address the objectives described above, 5 sediment samples (plus 1 duplicate) and 2 surface soil samples will be collected. The sediment samples will be collected at a distance of approximately 200 to 400 feet beyond the approximate high water shoreline and the soil samples will be collected in the picnic area south and west of Site 1, (See Figure 1).

The intent of the sediment sampling effort is to identify the maximum horizontal extent of potential sediment contamination. To help identify these locations in the field, the sampling team will start at the high water shoreline at Site 1 and walk directly outward toward one of the sample points. Every 50 feet, the team will hand auger 6 to 12 inches, (and deeper if ash or other waste materials are encountered), into the sediments looking for visual evidence of incinerator ash or other waste materials. If ash/waste materials are observed, the thickness of the ash/waste material will be recorded, and the team will then

move out an additional 50 feet. The samples will be collected at the first location where ash/waste material is not observed. If ash is not observed at 50, 100, and 150 feet from the high water shoreline, then the sample will be collected at a distance of 200 feet from the high water shoreline. Five sediment plus one duplicate sample will collected an analyzed for PAHs (using HPLC), pesticides, and TAL metals.

Two soil samples will be collected in the picnic area within approximately 50 feet of a road and near a tree line. These locations represent areas that would normally be treated with pesticides at the facility. Also, if PAHs are found that are associated with road base material or dust control, then similar or higher PAH concentrations may be encountered at these locations. With the exception of the area nearest Site 1, this picnic area is not associated with any SWMUs or IR sites.

Specific addendum's to tables in the work plan are attached. These tables include the following.

Table 4-1 - Investigation Rationale Addendum
Table 4-3 – Investigation Summary Addendum
Table 7-1 – Summary of Environmental Sampling Addendum

All other aspects of the work plan will be followed.

TABLE 4-1

INVESTIGATION RATIONALE ADDENDUM
SITE/SWMU 1 – INCINERATOR LANDFILL
MCRD PARRIS ISLAND

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution of Data Gaps/Needs
Sediment	PAHs, metals, pesticides	Data indicates that these compounds may have migrated from the fill into the adjacent sediment.	• Further define the extent of potential sediment contamination.	• TAL metals, PAHs, pesticides.
Surface Soil	PAHs, pesticides	PAHs, and pesticides may be present in the area from non-site sources.	• Determine if PAHs and pesticides are common in the area.	• PAHs and pesticides.

TABLE 4-3

INVESTIGATION SUMMARY ADDENDUM
SITE/SWMU 1 – INCINERATOR LANDFILL
MCRD PARRIS ISLAND

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location	Analysis
Sediment	• TAL metals, PAHs, and pesticides.	Collect sediment samples.	5	1	TCL pesticides PAHs TAL metals
Surface Soil	• PAHs and pesticides.	Collect surface soil samples.	2	1	TCL pesticides PAHs

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING ADDENDUM
SITE/SWMU 1 – INCINERATOR LANDFILL
MCRD PARRIS ISLAND

Sample Location	Sample Designation	Sample Depth (feet below ground surface)	Sample Analysis		
			PAHs	TAL Metals	TCL pesticides
PAI-01-SD-13	PAI-01-SD-013	0 to 0.5	•	•	•
PAI-01-SD-13	PAI-01-SD-013-D	0 to 0.5	•	•	•
PAI-01-SD-14	PAI-01-SD-014	0 to 0.5	•	•	•
PAI-01-SD-15	PAI-01-SD-015	0 to 0.5	•	•	•
PAI-01-SD-16	PAI-01-SD-016	0 to 0.5	•	•	•
PAI-01-SD-17	PAI-01-SD-017	0 to 0.5	•	•	•
PAI-01-SS-15	PAI-01-SS-015	0 to 1	•		•
PAI-01-SS-16	PAI-01-SS-016	0 to 1	•		•

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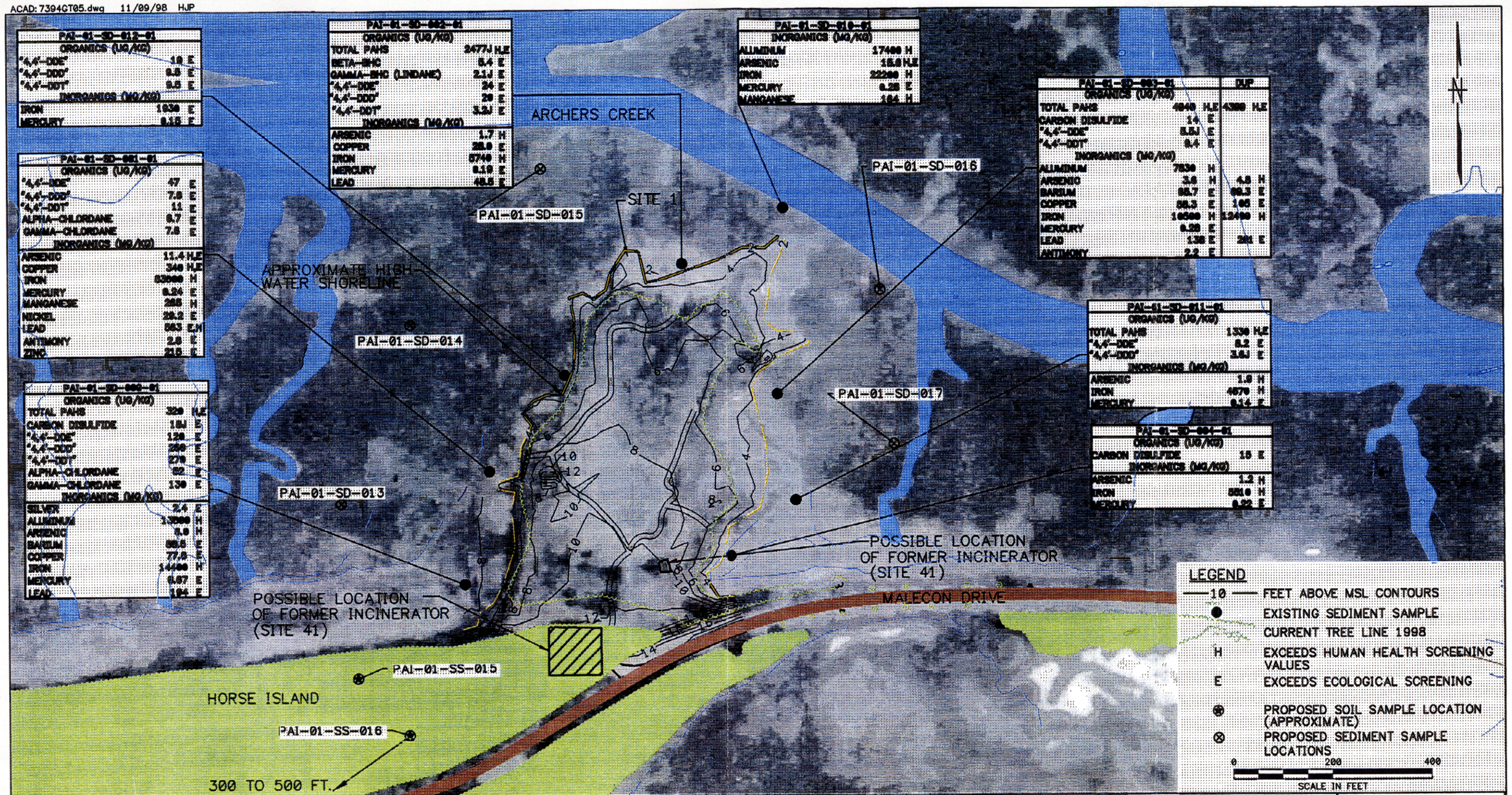

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 11/9/98
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PROPOSED SEDIMENT & SOIL SAMPLE LOCATION
SITE 1-INCINERATOR LANDFILL AND
SITE 41-FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO. 7540
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 1 REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

78A01Y

Response to Comments
SCDNR dated November 30, 1998

1. Comment: It is stated in the addendum that the maximum horizontal extent of potential sediment contamination will be determined by collecting sediments at 50-ft intervals extending outward from the high water shoreline at Site 1, and inspecting them for visual evidence of incinerator ash. It is then stated that "The samples will be collected at the first location where ash is not observed. However, the field samples for chemical testing will be collected at a minimum of 200 feet from the high water shoreline." First of all, it is unclear what the significance of the "200-ft" criterion is, and where sediments would be collected if the absence of ash suggests a horizontal extent of contamination *less* than 200 feet. This should be clarified.

   Response: There is no special significance to the distance of 200 feet, other than a mid-point between the distance of the previous sample points (20 to 50 feet from the high water shoreline) and the drainage channels.

   To clarify the sampling protocol, the following statement will be added to the work plan: "If ash is not observed at 50, 100 and 150 feet from the high water shoreline, then the sample will be collected at a distance of 200 feet from the high water shoreline. "

2. Comment: Secondly, it is our understanding that, in addition to incinerator ash, this landfill received a variety of solid and liquid waste materials, including "approximately 24,000 tons of domestic waste, and most notably, 40,000 gallons of paint thinners and 2,600 gallons of still bottoms" (SWMU Data Sheet). Given the nature of the waste materials disposed in the landfill (which extends several hundred feet into the marsh) and the likely influence of tidal excursions on their redistribution, it seems entirely possible that the extent of sediment contamination could extend beyond the area within which incinerator ash is detected.

   Response: The work plan will be revised to reference both ash and other waste materials. If each case that "ash" appears, it will be replaced with "ash or other waste materials". Also, please note that the results of chemical testing (not visual evidence) will be used to confirm the absence of contamination at these locations.

3. Comment: The addendum should clarify how the extent of sediment contamination will be determined if exceedances of ecological screening criteria are encountered at the farthest site sampled.

Response: The addendum is written specifically to address the collection of five additional sediment samples. After the analytical data is received and evaluated, then a decision will be made as to whether there is sufficient information to proceed to a FS/CMS. If additional testing is required, then another addendum will be prepared.

4, Comment: Finally, with respect to the soil samples, it is unclear how the PAH data obtained from the picnic area will be used. Although the picnic area is not associated with any SWMUs or IR sites, it seems inappropriate to use PAH levels associated with road base material or dust control as background concentrations to which levels in the landfill will be compared. The intent of this sampling should be clarified.

Response: The use of the data will be discussed with the partnering team once the results are received.

5. Comment: It should also be noted that the issue of sampling for dioxins and furans, as suggested by EPA, has still not been resolved, and should be discussed further at our next Partnering Team meeting.

Response: Agree.

Response to Comments
SCDHEC dated December 16, 1998

1. Comment: VOC analyses indicate carbon disulfide contamination exceeding ecological screening criteria, yet the nature and extent of contamination has not been delineated to date. Therefore, VOC analyses should be retained for every sample in every potentially affected media as was proposed in the RFI/RI work Plan. This will facilitate delineating nature and extent of contamination, as well as ensure that a more complete risk assessment has been performed.

   Response: The referenced carbon disulfide ecological screening criteria for sediment was 13 ug/kg. This screening value was obtained from a 1994 document prepared by Oak Ridge National Laboratory and developed based on a water quality bench mark and an assumption of equilibrium partitioning between sediment and surface water. This document was revised in 1997 and the revised document does not include an ecological screening value for carbon disulfide in sediment. In addition, USEPA Region IV has not established a screening value for carbon disulfide in sediment. As a result, the TAG site maps will not list detections of carbon disulfide as exceedances in sediments.

   Note that in the absence of a sediment screening value, the carbon disulfide is retained as a COPC and is evaluated in the ecological risk assessment. In the event that carbon disulfide is identified as a COC and a PRG is established, then addition delineation may be required in the future.

   Note also that carbon disulfide is a natural compound commonly found in marsh sediments. In addition, two of the six background sediment samples collected for Parris Island were found to contain carbon disulfide at concentrations of 2 and 7 ug/kg.

APPENDIX B

WORK PLAN ADDENDUM 2 - DIOXIN SAMPLING

WORK PLAN ADDENDUM 2 – DIOXIN TESTING
SITE/SWMU 1 – INCINERATOR LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Objective

The purpose of this work plan addendum is to identify sample locations and methodologies for collecting samples at Site/SWMU 1 for dioxin analysis. The sample locations are considered representative of the type of materials present at the site that may contain dioxins at site-related environmentally significant concentrations.

Background

The partnering team has discussed that because of the historic combustion of miscellaneous waste materials at Site/SWMU 1 – Incinerator Landfill, dioxins may have been formed at the site and accumulated in site waste, sediments, and/or groundwater. To resolve this concern, the Navy will sample representative media at the site to quantify potential risks. The data collected will be compared to human health and ecological screening values, and to a sample result collected at an offsite location.

Proposed Field Activities

Two sediment samples and one groundwater sample at Site/SWMU 1 will be collected and analyzed for dioxins. One sediment sample will be of exposed ash material and is expected to represent a reasonable worst case location. The second sediment sample is at a location where previous testing found only low level detections of metal and organic chemicals. In addition, one sediment sample from a southern area at Parris Island will be collected and analyzed to serve as a typical regional concentration for dioxins in sediments. The proposed sample locations are as follows.

- PAI-01-SD-02 - (sediment - ash)
- PAI-01-SD-11 - (sediment – non ash)
- PAI-10-SD-16 - (sediment – off site)
- PAI-01-MW-09(S) - (groundwater - shallow)

Sediment samples will be collected during low tide and will be placed directly into a sample container using a disposable trowel. The groundwater sample will be collected using low flow sample techniques as presented in the work plan. The analytical method will be SW846-8290 (high resolution – mass spec). A duplicate, matrix spike, and matrix spike duplicate will be collected at PAI-01-SD-11.

Rev. 0
03/27/98

RCRA Facility Investigation/ Remedial Investigation Work Plan for Site/SWMU 2 - Borrow Pit Landfill and Site/SWMU 15 - Dirt Roads

Marine Corps Recruit Depot

Parris Island, South Carolina
U.S. EPA Identification Number
SC6 170 022 762

Southern Division
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888
Contract Task Order 0020

March 1998

Rev. 0
03/27/98

RCRA FACILITY INVESTIGATION/ REMEDIAL INVESTIGATION WORK PLAN FOR SITE/SWMU 2 - BORROW PIT LANDFILL AND SITE/SWMU 15 - DIRT ROADS

MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA
U.S. EPA IDENTIFICATION NUMBER
SC6 170 022 762

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
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North Charleston, South Carolina 29406

Submitted by:
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CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0020

MARCH 1998

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ACRONYMS

AOCs	Areas of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
B&R Environmental	Brown & Root Environmental
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COCs	Chemicals of Concern
CTO	Contract Task Order
DHEC	Department of Health and Environmental Control
DQO	Data Quality Objective
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EP	Extended Procedure
FID	Flameionization Detector
FOL	Field Operations Leader
FS	Feasibility Study
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HCL	Hydrochloric Acid
HPPE	High Density Polyethylene
HSWA	Hazardous and Solid Waste Amendments
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
IAS	Initial Assessment Study
IDW	Investigative-Derived Waste
K_h	Horizontal Hydraulic Conductivity
K_v	Vertical Hydraulic Conductivity
LQAP	Laboratory Quality Assurance Plan
MCLs	Maximum Contaminant Levels
MCRD	Marine Corps Recruit Depot
MSL	Mean Sea Level
NAVFAC	Naval Facilities Engineering Command
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity

NFA	No Further Action
NPL	National Priorities List
NSF	National Sanitation Foundation
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PR	Preliminary Review
QA	Quality Assurance
QAM	Quality Assurance Manual
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBCs	Risked-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SCDHEC	South Carolina Department of Health and Environmental Controls
SOPs	Standard Operating Procedures
SOUTHDIV	Southern Division
SSO	Site Safety Officer
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TOM	Task Order Manager
U.S. EPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
VS	Verification Step
VSI	Visual Site Inspection

FOREWORD

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act of 1986 (SARA) establishes a program for the cleanup of hazardous waste disposal and spill sites nationwide. This program contains provisions for the cleanup of contamination from past hazardous waste operations and past hazardous material spills and is the framework for installation restoration (IR) programs at numerous Navy and Marine Corps installations. The Resource Conservation and Recovery Act (RCRA), as amended, also establishes a cleanup program that provides for current and future hazardous waste management practices, as well as cleanup of past disposal sites at permitted or interim status Navy/Marine Corps installations.

Because of the past hazardous waste activities conducted at the Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina, the MCRD meets criteria for conducting IR activities under the CERCLA regulatory framework. To date, the MCRD has completed steps equivalent to the Preliminary Assessment/Site Inspection phases of the CERCLA remedial action process. The MCRD also meets the criteria for conducting IR activities under RCRA because in the late 1980's, the MCRD applied for a RCRA permit. Under RCRA, this action required the MCRD to conduct corrective action for the release of hazardous waste or hazardous constituents from solid waste management units. An interim RCRA Facility Assessment was conducted in 1990 as part of this requirement. Since this time, the MCRD has withdrawn its application for a RCRA permit.

Because of the circumstances surrounding the MCRD's IR program history, discussions have been held between representatives from the United States (U.S.) Marine Corps, U.S. Navy, South Carolina Department of Health and Environmental Control, and the U.S. Environmental Protection Agency, Region 4 to determine the appropriate regulatory framework for conducting IR activities at the MCRD. From these discussions, it has been decided that this site-specific work plan will encompass both CERCLA and RCRA requirements and will be dually titled as such. The success/lessons learned of this approach will used for subsequent IR activities as well as used to negotiate a Federal Facility Agreement for the MCRD.

RESPONSE TO REGULATORY COMMENTS TO THE DRAFT AND DRAFT FINAL WORK PLAN FOR SITE 2/15

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 2 (BORROW PIT LANDFILL) AND (SITE 15 - DIRT ROADS) - COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(S. PETERSON, REVIEWER)

1. **Comment:** Overall
   This document was reviewed to meet the requirements of an RFI Work Plan. Please change the title to reflect this.

   Response:
   The title of the work plan will be changed to RCRA Facility Investigation/Remedial Investigation Work Plan for Site 2 - Borrow Pit Landfill and Site 15 - Dirt Roads.

2. **Comment:** Section 1.1, Scope and Objective
   a) The 1st sentence should be deleted. This is information already stated in Section 1.0 and has nothing to do with Scope and Objective; and

   b) The objective of this investigation is less specific than that of the Master Work Plan. The scope and objective should be specific since this is a site specific work plan. Please rewrite to give the reader a clear statement of the specific objectives of the investigation. In some cases, the objectives of the study may be to generate data to justify a "no-further action" decision. Describe fully the objectives of Site 2 and 15.

   Response:
   In accordance with this comment and the response to U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, the scope and objective has been rewritten to clearly state the objectives of the investigation and to reflect the presumptive remedy approach.

3. **Comment:** Section 2.0, SITE BACKGROUND
   Based on this sentence, it would be logical to either rename section 2.1 to Site Description and History or rename Section 2.1 to Site History and add a Section 2.2 named Existing Site Conditions (and of course renumbering the following sections).

   Response:
   Section 2.1 will be renamed to "Site Description and History."

4. **Comment:** Section 2.1, Site Description
   As mentioned above, you could consider renaming the section Site Description and History. Due to the status of the landfill, the description is history.

   Response:
   Section 2.1 will be renamed to "Site Description and History".

5. **Comment:** Section 2.1.1, Site 2 - Borrow Pit Landfill
   a) Only from verb tenses does the reader know that this landfill is no longer in operation. The reader's beliefs are confirmed with the last sentence of the 2nd paragraph. Consider replacing the first words "Site 2 is" with **"Borrow Pit Landfill is a former landfill that was in operation from 1965 to 1968. There is currently no activity in this area. It is located..."** This lets the reader know immediately that "there is currently no activity in this area," and the time frames of those activities.

Response:
The first words of Section 2.1.1 Site 2 - Borrow Pit Landfill, "Site 2", will be replaced with "Borrow Pit Landfill is a landfill that was in operation from 1965 to 1968. There is currently no activity in this area. It is located..."

b) The paragraphs are not in chronological order and should be corrected. You could combine the paragraphs (if you choose to not add a separate section for Site History). Suggested wording: **Borrow Pit Landfill began as a pit that had been dug...**

Response:
The second and third paragraphs will be combined and rearranged chronologically. The suggested wording will be incorporated into this revision of this section.

c) Suggested wording: From historical aerial photographs **taken in ____ and ____**, and

Response:
The reference to aerial photographs was taken from the 1986 NEESA Initial Assessment Study. This document does not include the photographs in question and the photographs can not be located at the base. This statement is referenced to the 1986 NEESA IAS in the text of Section 2.1.1.

d) Aerial photographs should be referenced in the text and therefore included in the REFERENCES section. Include a Xerox copy of the photographs in the work plan.

Response:
Please refer to the response to comment 5c of this section.

6. **Comment:** Section 2.1.2: Dirt Roads
Refer to Section 2.3.1.2: Site 15 - Dirt Roads. That section contains some information that is not included in Section 2.1.2. For clarification, include in this section the number of gallons of waste oils and other liquids the two roads accessing Elliott's Beach and the Borrow Pit Landfill received.

Response:
The following change will be made to the first paragraph of Section 2.1.2.

"...were paved in the 1940s. ***However, from the early 1940s to 1966 approximately 16,200 gallons of waste oils and hydraulic fluids continued to be applied to the two dirt roads accessing Elliott's Beach and the Borrow Pit Landfill.****"*

7. **Comment:** Section 2.2.3: Floridan Aquifer
This section confirms the existence of a public water supply well within 1/4 of a mile radius of the MCRD. This public supply well should be identified in Figure 2.1.

Response:
Figure 2-1 will be revised to indicate the exact location of the public water supply well. However, it will be noted that the well is currently not in use but has not been abandoned.

8. **Comment:** Section 2.3.1.2 Site 15 - Dirt Roads
Refer back to Section 2.1.2. That section contains some information that is not included in Section 2.3.1.2. For clarification, include in this section the estimated gallons sprayed from 1918-1940.

Response:
The following sentence will be included in Section 2.3.1.2. "From 1918 to 1940, the two roads accessing Elliott's Beach and the Borrow Landfill received an estimated 11,000 gallons of waste oils and other liquids, and from 1940 to 1966, the roads were coated with a total of 16,200 gallons of the mixture.

9. **Comment:** Figure 2.1
This quadrangle is 18 years old. Is there anything that has changed that would warrant additions or deletions?

Response:
Variations in current surface features and those shown in Figure 2-1 are not believed to be significantly different and will not affect the investigation activities outlined in the Work Plans; however, differences will be noted during the field investigation and when the areas are surveyed, the differences will be incorporated into the Investigation Report.

10. **Comment:** Section 6.2, Site Restoration
This paragraph states "the site will be restored to its original condition prior to investigation activities." It should be explained what "original condition" means, and why the site will be restored prior to the investigation activities and then will be disturbed again to do the investigation. The paragraph is vague and should be more specific and/or correct the proposed approach.

Response:
Section 6.2 will be changed to read "If investigation activities (e.g., monitoring well installation) disturb or alter the landscape, vegetation, or other features of Site 2 or 15, the site(s) may require restoration to conditions prior to the investigation. If vegetation is stressed or damaged as a result of investigation activities, the affected area will be reseeded. Portions of Site 2 and 15 will be regraded if investigation activities alter the natural contour of the site. Additionally, all equipment used during the investigation and investigation-derived waste will be removed from the site.

(D. HARGROVE, REVIEWER)

1) **Comment:** Section 4.1, Investigation Rationale, page 4-1:
Note that as per R.61-68.(H) of the Water Classifications and Standards, "...all South Carolina groundwater is classified GB effective on June 28, 1985." Groundwater classified as "GB" is considered a potential underground source of drinking water.

Response:
To satisfy CERCLA requirements, all groundwater that is suitable for use as a drinking water source based on water quality parameters such as salinity and turbidity must undergo a risk assessment. The text of Section 4.1 will be revised to indicate that groundwater will be evaluated as a practical drinking water source according to CERCLA in the human health risk assessment. The text of Section 5.1 will also be revised accordingly.

2) **Comment:** Section 4.2.2.1, Target Compound List (TCL) and Target Analyte List (TAL) Parameters, page 4-6:

This work plan proposes using the TCL and TAL parameters specified under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The State has expressed its need to recognize and follow the Resource Conservation and Recovery Act (RCRA).

Given the ongoing CERCLA/RCRA discussions in the negotiation of a Federal Facilities Agreement (FFA) among Navy, Marine Corps, U.S. EPA, and SCDHEC representatives, the combination of the analytes identified under CERCLA and RCRA should be used as a starting point for investigation.

This could eliminate the possibility of resampling depending on the outcome of the FFA negotiations. In order to accomplish this, R.61-79.261 Appendix VIII constituents should be studied for soils and R.61-79.264 Appendix IX constituents should be studied for groundwater. Please revise the text accordingly.

Response:
As agreed upon during the February 28, 1997 and March 6, 1997 conference calls of the MCRD Parris Island Tier I Partnering Team, the following decisions were made to satisfy RCRA requirements.

- *Four groundwater samples will be collected and analyzed for Appendix IX constituents. Of the four samples, one will be collected at each of the following three sites: Site 1 - Incinerator Landfill, Site 2 - Borrow Pit Landfill, and Site 3 - Causeway Landfill. The remaining sample will be a background sample collected from PAI-02-GW02. PAI-02-GW02 is an existing monitoring well located upgradient of Site 2. The four samples will be collected at locations previously proposed in the Draft Work Plans. The remaining proposed groundwater samples will be analyzed using SW-846 methodologies on the parameters specified by the TCL/TAL.*

- *Soil samples will not be analyzed for Appendix VIII constituents because there is a lack of established methodologies for analyzing these compounds.*

The additional groundwater analytical requirements will be incorporated into the text of Section 4.2.2.

3) **Comment:** Section 6.0, Field Operations, page 6-1:
Note: It is good you have specified that a state certified geologist will be present for the field operations. However, all monitoring wells must still be installed by a state-certified well driller. This includes direct push groundwater sampling activities.

Response:
Section 6.0, Field Operations, will be revised to indicate that all well installation activities will be performed under the direction of a state-certified Professional Geologist and will be installed by a state-certified well driller.

4) **Comment:** Section 6.4, Monitoring Well Installation and Construction, page 6-3:
a) Note decision criteria for using different slot sizes at different depths. Is this assumed due to local geology or will this be determined upon drilling activities? Please revise to include the methodology used for making this determination.

Response:
There is sufficient history from existing wells to conclude that the upper wells would be screened in fine-grained material (silts and fine sand) and the deeper wells would be screened in more coarse-grained sands. Therefore, the anticipated well slot size is determined to be 0.010 and 0.020 inches accordingly.

b) It is suggested that bentonite chips not be used for placement of the bentonite seal. Chips take longer to hydrate than pellets and full hydration is not guaranteed. If chips are used, hydration times greater than eight (8) hours are warranted.

Response:
Section 6.4 Monitoring Well Installation and Construction will be revised as follows. "A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate as per the manufacturer's recommendations."

6) **Comment:** Figure 6-1, Typical Monitoring Well Detail, page 6-5:
Include ID plate in monitoring well detail. Note that as per R.61-71.6(H), the information listed on the identification plate must include:

a) Well identification number
b) Date of construction
c) Driller name and certification number.
d) Screened interval
e) Static water level

Response:
The identification plate information listed above will be included in Figure 6-1.

7) **Comment:** Figure 7-2, Proposed Soil Sample Locations, page 7-9:
Additional sample points are needed in the area within the center of the landfill in order to get better coverage within the confines of the landfill. Please revise the work plan to include extra samples.

Response:
Two surface soil sample locations will be added in the center of the landfill. However, as discussed in the response to U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, subsurface soil samples within the landfill will not be a component of investigation activities.

8) **Comment:** Figure 7-3, Proposed Groundwater Sample Locations, page 7-10:
The well cluster containing PAI-02-GW04, PAI-02-GW05, and PAI-02-GW06 should be shifted to southeast in order to intercept groundwater flow from the central portion of the landfill rather than the edge.

Response:
The well cluster containing PAI-02-GW04 and PAI-02-GW05 will be shifted to the southeast as far as the surface features of the site will permit. The southwest border of the landfill is a marsh and it would not be feasible to construct a monitoring well in this area. In response to U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, PAI-02-GW06 has been removed. Figure 7-3 will be revised accordingly.

RESPONSE TO U.S. EPA COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 2 (BORROW PIT LANDFILL) AND SITE 15 (DIRT ROADS) - COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **Comment:** General Comment
   The following comments made for Sites 1 and 41 above are also generally applicable to the Draft RI Work Plan for Sites 2 and 15: comments 2, 8, 9, 11, 12, 13, 14, 15B, 16 and 19.

   Response:
   Please refer to the response to U.S. EPA comments to the Draft SAP for Site 1 (Incinerator Landfill) and Site 41 (Former Incinerator).

2. **Comment:** Page 2-11, Section 2.3.3:
   Comparison of the Region 4 Waste Management Division Saltwater Surface Water Screening Values and Sediment Screening Values with the values shown in Figure 2-5 revealed exceedences of chronic screening values for several metals, as listed below, in the one surface water and sediment sample collected:

Metal	SW Screening Value (ug/L)	Sediment Screening Value (ppm)
Arsenic	(NE)*	7.24
Cadmium	9.3	(NE)*
Chromium	103	(NE)*
Lead	8.5	(NE)*

* NE - Region 4 screening value not exceeded

   Please revise the text as needed. Region 4's surface water screening values are based on the chronic Ambient Water Quality Criteria (AWQC) for the protection of aquatic life. South Carolina State Water Quality Standards would be at least as stringent as AWQCs, and would likely be ARARs.

   Response:
   The information listed above will be included in the text of Section 2.3.3.

3. **Comment:** Figure 7-1, p. 7-8
   Surface water and sediment samples should be collected from the small marshy area nearest the landfill.

   Response:
   Sample locations PAI-02-SD02 and PAI-02-SW02 will be moved approximately 75 feet northeast to the small marshy area nearest the landfill.

4. **Comment:** Figure 7-3, p. 7-10
   One shallow well should be place on the southwest border of the landfill, nearest the marshy area.

   Response:
   The well cluster containing PAI-02-GW04 and PAI-02-GW05 will be shifted to the southeast as far as the surface features of the site will permit. The southwest border of the landfill is a marsh and it would not be feasible to construct a monitoring well in this area. Figure 7-3 will be revised accordingly. Monitoring well PAI-02-GW06 will be removed in accordance with U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLAN
SITE 2 (BORROW PIT LANDFILL) AND SITE 15 (DIRT ROADS) - COMMENTS RECEIVED 7/18/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(S. PETERSON, REVIEWER)

1. **Comment**:
   Please modify the title of this work plan to include RCRA terminology. As known, understood, and accepted by the MCRD Tier I technical and Tier II teams, the State of South Carolina has authorization under the Hazardous & Solid Waste Amendment to implement correction action activities.

   The Department reviewed this document to meet the requirements of an RCRA Facility Investigation (RFI) Work Plan. The Department is willing to recognize the following dually-titled document:

   Draft Final RCRA Facility Investigation/Draft Final Remedial Investigation Work Plan
   for
   SWMU/Site 2 - Borrow Pit Landfill and
   SWMU/Site 15 - Dirt Roads

   or

   Draft Final
   RCRA Facility Investigation/Remedial Investigation Work Plan
   for
   SWMU/Site 2 - Borrow Pit Landfill and
   SWMU/Site 15 - Dirt Roads

   Marine Corps Recruit Depot
   Parris Island, South Carolina
   SC6 170 022 762

   Response:
   The suggested title will be used. However, in accordance with Navy CLEAN format, the word "FINAL" will not be included in the title of the FINAL report.

2. **Comment**:
   According to the Region 4 RFI Work Plan Checklist, prepared by A.T. Kearney, dated 1989, an EPA Identification Number should be included on the cover page. The EPA Identification Number for MCRD Parris Island is SC6 170 022 762. Please include that Identification Number on the Final Work Plan.

   Response:
   The U.S. EPA Identification Number will be added to the cover page of the document.

(D. HARGROVE, REVIEWER)

1. **Comment**:
   The title should reflect whether this document is a DRAFT or a FINAL document. Please revise.

Response:
The last version of the site-specific SAP for Site 2/15 was incorrectly missing the words "DRAFT FINAL" in the title and header of the document. However, Navy CLEAN format stipulates when a document is issued "FINAL", the words "DRAFT" or "DRAFT FINAL" are to be removed from the title and header of the report. As such, the title and header will not contain the "FINAL" designation.

2. **Comment**: Response to Comments

Only the comments concerning the DRAFT version of this document should be included in this section. The Division of Hydrogeology understands that some comments made on other work plans have been incorporated into this document due to comparable applicability. Any additional comments that have been incorporated into this document should be included at the end of this section. Please revise.

Response:
Comments made to the "DRAFT" and "DRAFT FINAL" Work Plans for Site 2/15 will be included in the Response to Comments Section of the "FINAL" Work Plan. Additionally, applicable comments concerning the Work Plans for Site 1/41 and 3 will be added to the end of this section.

3. **Comment**: Response to comment #1

This response clarifies that the groundwater risk assessment will be performed according to CERCLA requirements. However, compliance with the State Primary Drinking Water Standards has not been specified. According to the National Oil and Hazardous Substances Contingency Plan (NCP), remedial alternatives should be evaluated against NCP threshold criteria for overall protection of human health, and compliance with applicable or relevant and appropriate requirements (ARARs). The State Primary Drinking Water Standards are ARARs and must be followed. This comment does not require a specific revision. This is for future reference to be acknowledged in the resulting report.

Response:
This comment is acknowledged.

4. **Comment**: Response to comment #8

The Division of Hydrogeology understands and accepts the reasoning behind removing Monitoring Well PAI-02-GW06 from the current investigative work. However, it should be noted that this well might be required at a future date to address the Floridan Aquifer.

Response:
As discussed in Section 4.0, further investigation to evaluate potential impacts to the Floridan aquifer may be warranted if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill and the competency of the Hawthorn Formation as a confining layer has not been established.

RESPONSE TO U.S. EPA COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLANS
SITE 2 (BORROW PIT LANDFILL) AND SITE 15 (DIRT ROADS) - COMMENTS RECEIVED 7/22/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **General Comment:**
   Comments 1, 3, 4, 5 and 7 on the Site 1/41 SAP are also applicable to the Site 2/15 SAP.

   Response:
   Please see the response to U.S. EPA comments to the Draft Final SAP for Site 1/41..

2. **Comment** - Page 7-6, Figure 7-1:
   As discussed and agreed to during the July 1997 Partnering Meeting, one additional sediment/ surface water pair will be collected from the portion of the inlet closest to the treeline and the bermed southwestern edge of the landfill. These samples will be biased to monitor for the maximum concentrations of contaminants migrating from the landfill into this adjacent marshy area.

   Response:
   One sediment/surface water sampling location will be added to the site-specific SAP for Site 2/15.

Supplemental Comments to Section 5.2 - Comments Received 9/9/97

1. **Comment:** Section 5.2 - Paragraph 1:
   The paragraph is OK, pending receipt of acceptable description of ecological risk methods/steps in MWP v. III.

   Response:
   Comments made to the ecological risk approach contained in Volume III of the Parris Island Master Work Plan have been incorporated.

2. Section 5.2 - Paragraph 3:
   a) **Comment:** Replace "Problem Formulation" w/ "Preliminary Problem Formulation."

      Response: *The text will be revised.*

   b) **Comment:** Include groundwater discharge to surface water as an exposure media.

      Response: *Groundwater discharge to surface water will be included as an exposure media.*

   c) **Comment:** Replace "soil organisms" and "terrestrial wildlife feeding on soil organisms" with "terrestrial invertebrates."

      Response: *"Soil organisms" will be replace with "terrestrial invertebrates." However, "terrestrial wildlife feeding on soil organisms" will be replaced with "terrestrial vertebrates."*

   d) **Comment:** Replace "sediment-dwelling organisms" with "benthic invertebrates."

      Response: *The text will be revised.*

3. **Comment:** Section 5.2 - Paragraph 4:
Preliminary assessment should not consider/calculate midpoint concentrations or midpoint ingestion rates. The initial screening phase should use only the most conservative values. Delete all references to midpoint values.

Response:
Agree. The text will be revised accordingly.

4. **Comment:** Section 5.2 - Paragraph 5:
Regarding "recommendations for further investigation", "additional field work" is the only truly appropriate means for verifying or disproving potential ecological effects identified during the screening step. Modeling results are likely to be inconclusive, and risk management comes into play only after site risks are adequately characterized. If the technical memorandum indicates the need for additional work, a work plan addendum would also need to be submitted.

Response:
Agree. The text will be revised accordingly.

RESPONSE TO SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES (SCDNR) COMMENTS TO THE DRAFT FINAL RFI/RI WORKPLAN FOR SITE 2- BORROW PIT LANDFILL and SITE 15 - DIRT ROADS - COMMENTS RECEIVED 1/5/98 MCRD, PARRIS ISLAND, SOUTH CAROLINA

COMMENTS - Robert E. Duncan, Environmental Programs Director

1. **Comment**: Page 1-1, paragraph 4, line 2

Since the unlined Borrow Pit landfill is located approximately 100 ft. from the marsh immediately adjacent to Class SFH water (that portion of Archers Creek from the Parris Island Bridge to the Broad River) which, by definition, is "protected for shellfish harvesting", in addition to other forms of primary and secondary contact recreation, it would seem appropriate to include "adult, adolescent, and child recreational users" among the list of potential receptors in the human health risk assessment.

Response: Adolescent recreational users will be considered as potential receptors at specific sites in addition to adult recreational users. However, the child recreational user will not be considered. Although a child (ages 1 to 6) could be exposed to surface water, it is unlikely that a receptor at this age is routinely exposed to surface water when one considers the recreational activities that are typical of this area (boating, swimming, fishing).

2. **Comment**: Page 2-1, paragraph 3, line 15

Please clarify whether or not any fill material (clean or otherwise) was used to cover the landfill after disposal activities were discontinued in 1968. If fill material was used, any information on its composition, volume, depth, or areal coverage should be included.

Response: To date, limited information is available concerning the composition, volume, depth, or areal coverage of fill material at Site 2. During the Verification Step (McClelland Consultants, 1990), three soil borings were taken outside the perimeter of the landfill. Fill material was not observed in the soil boring records; however, a silty sand (brown in color) was noted in the top two feet of all the soil borings.

To determine the presence and extent of areal coverage of fill material at Site 2, surface soil samples (0-1 ft bgs) will be taken as proposed in the Draft Final RFI/RI SAP for Site 2. After the surface soil sample has been collected, field personnel will continue to bore into the soil with a hand auger until the top limit of waste has been reached. From this information, an average depth of cover material will be determined. To determine the composition of the fill material, the lithology of all borings will be recorded and geotechnical tests (e.g., porosity and grain-size analysis) will be performed on one of the surface soil samples.

3. **Comment**: Page 2-16, Figure 2-7

Please indicate by shading (or other graphical device) which section(s) of dirt road remain unpaved.

Response: Agree. The remaining dirt sections of the road will be shaded.

4. **Comment**: Page 3-2, Figure 3-1

"Ribbon Creek" should be "Archers Creek".

Response: Agree. The figure will be revised accordingly.

5. **Comment**: Page 5-1, paragraph 3, line 8

The removal of groundwater that is "not potable" from an assessment of human health risk may be inappropriate, if it is demonstrated that there is a connection between any such groundwater and surface waters that are used for primary and secondary recreation.

Response: Brown & Root Environmental and the US Navy maintain that removal of water that is "not potable" from a human health risk assessment is appropriate. Although groundwater may discharge to surface water, human health risk resulting from exposure to groundwater is still unlikely if its general quality is deemed "not potable." However, it is important to note that exposure to surface water is not precluded because of removing the assessment of exposure to groundwater. Surface water will be sampled and appropriate exposure scenarios will be evaluated.

6. **Comment**: Page 5-2, after paragraph 2

Include "Adult, Adolescent and Child Recreational Users" as potential human receptors.. Include ingestion of, and dermal contact with, sediment and surface water, and ingestion of finfish/shellfish as pathways of concern in the human health risk assessment for this group.

Response: Adolescent recreational users will be considered as potential receptors at specific sites in addition to adult recreational users. However, the child recreational user will not be considered. Although a child (ages 1 to 6) could be exposed to surface water, it is unlikely that a receptor at this age is routinely exposed to surface water when one considers the recreational activities that are typical of this area (boating, swimming, fishing).

In accordance with the Master Work Plan, ingestion of and dermal contact with surface water will be evaluated, but ingestion of and dermal contact with sediment will not be evaluated. Exposure to surface water concurrent with exposure to sediment renders exposure to sediment negligible.

To be consistent with the Master Work Plan, ingestion of finfish/shellfish by the recreational users will be evaluated. However, ingestion of finfish/shellfish by offsite residents will not be considered for this specific site because sustenance fishing is unlikely to occur from this site.

7. **Comment**: Page 7-1, paragraph 4, line 1

Having visited these sites with Tim Harrington and Tom Dillon, I recommend that at least one surficial sediment sample be taken at each of three locations, as shown on the attached figure. In order to obtain a sample that is representative of depositional sediments in each location, I suggest that each of the three sample consist of a composite of several (e.g., five) "scoops" of sediment from the vegetated intertidal zone at each site. As we discussed at the last Partnering Team meeting, all sediment samples should be analyzed for the full suite of metals, SVOCs, and pesticides (in addition to lead and PCBs, as originally proposed). If sediment contaminant levels exceed EPA Region IV Screening Levels, the SCDNR may recommend that bioaccumulation and/or toxicity testing be done, as well.

Response: Agree. The proposed samples will be taken.

8. **Comment**: Page 7-10, Figure 7-5

Please indicate by shading (or other graphical device) which section(s) of dirt road remain unpaved.

Response: Agree. The remaining dirt sections of the road will be shaded.

RESPONSE TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) COMMENTS TO THE DRAFT FINAL RFI/RI WORKPLAN FOR SITE 2- BORROW PIT LANDFILL and SITE 15 - DIRT ROADS - COMMENTS RECEIVED 12/17/97 MCRD, PARRIS ISLAND, SOUTH CAROLINA

COMMENTS - Tom Dillon, Ph.D.

1. **Comment**: General

Analytical detection limits must be below ecological screening values for water, sediment and soil. PAHs are especially problematic. Experience suggests that the standard SW846 method for extracting/analyzing PAHs does not provide sufficiently low detection limits. Liquid chromatography may be required. To evaluate this potential, recommend creation of a table listing analytical method, detection limit and ecological screening values for each analyte in each media.

Response: Media-specific tables that compare laboratory practical quantitation limits (PQLs) to relevant screening criteria have been prepared. These tables, which include analytical method references, also indicate whether there is an exceedance of the screening value and the resolution of the discrepancy, if required. In most cases, the best available approved technology or approved analytical method capable of achieving the lowest PQL is proposed to resolve the discrepancy. However, some PQLs may still exceed some screening levels. These Tables have been included as Appendix D of the Master Work Plan, Volume III. Based on this information, low level analysis of volatile organic compounds in soils is recommended. The site-specific work plan will be revised accordingly.

2. **Comment**: General

Collection of surface sediments (0"-6") should be biased toward depositional areas. Briefly state sediment collection method in Section 7.2.1.

Response: Agree. The text will be modified to include that collection of surface sediments will be biased towards depositional areas. Sediment samples will be collected in accordance with Brown & Root Environmental Standard Operating Procedure SA-1.2, "Surface Water and Sediment Sampling" and the text of Section 7.2.1. A complete version of this SOP will be included in the Final MWP, Volume II.

3. **Comment**: General

NOAA requests involvement in the decision-making process when locations for collecting background sediment samples are discussed (Section 7.2.1). The WP states that background samples collected for Site 1 and Site 41 investigation, will be used as background for this site investigation also. This may or may not be appropriate.

Response: NOAA and the other members of the Parris Island Tier I Partnering Team will be consulted on the planned locations of background sediment locations. The locations will be proposed after the results of water-level measurements are conducted during the initial phase of the investigation. However, it should be noted that a decision will be required ASAP once the appropriate information is disseminated to the Partnering Team so the field activities are not delayed.

The background surface samples will be collected in a location that has not been impacted by the base (e.g., in a "pristine" environment). Such a background sample is viewed appropriate for all sites.

4. **Comment**: General

NOAA reserves comment on the number and location of proposed sample until after the January 98 site visit.

Response: Agree. (Note: No additional sampling was proposed by NOAA after the January 1998 Partnering Team Meeting.)

RESPONSE TO REGULATORY COMMENTS TO THE DRAFT AND DRAFT FINAL WORK PLANS FOR SITE 1/41 AND 3 (COMMENTS APPLICABLE TO SITE 2/15)

The comments included in this section were sent to MCRD Parris Island by SCDHEC and U.S. EPA Region 4. Although the comments were directed towards Sites 1/41 and 3, they are applicable to Site 2/15 and have been incorporated into this document. Comments not applicable to Site 2/15 have been removed. Please note, the numerical sequence of the comments as arranged in SCDHEC and U.S. EPA correspondence has not changed even though comments have been removed (i.e., comment #4 is still numbered as #4 although preceding comments may have been deleted).

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 1 (INCINERATOR LANDFILL) AND SITE 41 (FORMER INCINERATOR) -
COMMENTS RECEIVED 11/21/96
MCRD PARRIS ISLAND, SOUTH CAROLINA

(D. HARGROVE, REVIEWER)

1. **Comment:** Figure 1-1, Depot Location Map
   Remove "Site 1 - Incinerator Landfill" from title.

   Response:
   "Site 1 - Incinerator Landfill" will be removed from the title of Figure 1-1.

3. **Comment**: Section 2.2.2, Confining Layer, fifth sentence

   This sentence is vague. It implies that the depth to the top of the Hawthorn Formation is 70' below ground level while a previous sentence describes the top of the Hawthorn at 30' below msl. Please clarify.

   Response:
   The third, fourth, and fifth sentences will be replaced with the following text. "The elevation at the top of the Hawthorn Formation is reported to be within the range of 30 to 60 feet below msl at Parris Island. The thickness of the Hawthorn Formation at Site 1 is anticipated to be between 20 to 40 feet. The actual depth of this formation at Site 1 will be determined during the field investigation."

4. **Comment**: Figure 7-1, Proposed SW/Sediment Sample Locations

   The approximate locations for the upgradient samples should be specified on this figure.

   Section 3.3 describes surficial groundwater flow in a radial pattern towards the tidal stream. If this is the case, the upgradient sample locations can be approximated.

   Section 4.2.3.4 Water-Level Measurements describes a plan to measure groundwater levels during low and high tides and determine groundwater flow directions in the surficial aquifer. If further groundwater investigation is necessary before choosing upgradient sample locations, then Section 6.0 Field Operations should be revised to include a methodology describing the chronology of events pertaining to the characterization of groundwater flow followed by the determination of upgradient sample locations.

   Please revise the text and figures for the appropriate scenario.

   Response:
   Tidal influences may affect the flow of groundwater. Although an estimation of upgradient could be made without taking into account this tidal effect, water-level measurements taken during the initial phase of field activities would help to better depict the location of the upgradient samples. As such, the following sentences will be inserted after the first sentence of the second paragraph of Section 6.0 Field Operations.

   "Monitoring well installation will be a priority of the field effort followed by water-level measurements. The results of these measurements will be used to better characterize the depth, flow direction, and gradient of the groundwater. From this information, the location of background surface water and sediment will be determined in the field."

Additionally, the following sentence will be inserted into Section 7.2.1, Surface Water and Sediment Sampling. "The location of the four background samples for surface water and sediment will be determined in the field from the results of water-level measurements conducted during the initial portion of the investigation field effort."

The four background surface water and sediment samples taken for Site 1 will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

5. **Comment**: Figure 7-2 Proposed Soil Sample Locations

   See comment 4.

   Response:
   The location of the four background soil samples will be illustrated on a new figure in Section 7.0. The four background soil samples taken for Site 1 will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

6. **Comment**: General Comment
   All figures showing well locations or proposed well locations, proposed sample locations, or groundwater contamination plumes should include arrows indicating groundwater flow directions from the latest data. Please revise.

   Response:
   Figure 7-3, Proposed Groundwater Sample Locations, will be revised to include estimates of surficial groundwater flow directions in the vicinity of each monitoring well that is proposed to be sampled. In the revised version of the Work Plan, Figure 7-3 has been renumbered as Figure 7-4.

RESPONSE TO U.S. EPA COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 1 (INCINERATOR LANDFILL) AND SITE 41 (FORMER INCINERATOR) -
COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **Comment:** Page 1-3, Figure 1-1
   Given the title and purpose of this figure, Site 1 (Incinerator Landfill) should be clearly depicted on the map.

   Response:
   The purpose of Figure 1-1 is to provide the general layout and features of MCRD Parris Island. As such, "Site 1 - Incinerator Landfill" will be removed from the title of this figure. However, to illustrate the location of Site 1 in relation to the other features of the Depot, Site 1 will be depicted on this figure.

2. **Comment:** Page 2-1, Section 2.1, Paragraph 2
   The text should also briefly describe the level and type (if applicable) of activity that took place at the site between 1965 and present.

   Response:
   No significant disposal or intrusive activity has taken place at Sites 1 and 41 since 1965. This statement will be included in Section 2.1.

5. **Comment:** Page 3-1, Section 3.3, Sentence 3
   The text states that the marsh deposits underlying the landfill are assumed to be a barrier to the deeper aquifer. This statement appears to contradict Figure 3-1 (Site Conceptual Model), which depicts these deposits as providing a partial barrier to the shallow aquifer. Please clarify and revise as needed.

   Response:
   During field activities, the presence of the marsh deposits will be confirmed during the installation of deep surficial monitoring wells. Additionally, the vertical conductivity of the deposits will be investigated. The last sentence of Section 3.3 Groundwater will be revised to "However, the marsh deposits underlying the landfill including the clay comprising the Hawthorne Formation may act as a partial barrier to the deeper aquifer and will be investigated during the investigation."

6. **Comment:** Page 4-1, Section 4.1
   Given the relatively low numbers and concentrations of contaminants detected during previous investigations of this site, a primary sampling rationale for each media should be to characterize worst-case site conditions for that media. The text should be modified to include this objective.

   Response:
   Section 4.1 will be revised to include this sampling rationale.

8. **Comment:** Page 4-7, Section 4.2.2.2
   Based on the site description provided in Section 2.1 of the SAP, this landfill appears to consist primarily of incinerated Municipal Landfill (MLF)-type wastes and cover an area in excess of 29,000 cubic yards. Given these site characteristics, wholesale excavation of Site 1 landfill contents would seem unlikely (see U.S. EPA/OSWER Quick Reference Fact Sheet: Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (June 27, 1995)). Toxicity Characteristic Leaching Procedure (TCLP) analyses of subsurface soil and sediment samples to determine if waste material/fill is a characteristic RCRA waste (presumably for purposes of off-site disposal) should therefore be delayed until a determination regarding the need to excavate these materials has to be

made. For example, if hot spots are identified during the RI/RFI, these may require further characterization to determine if removal and/or treatment is warranted.

Also, depending on RI/RFI results, a second type of leach test which may prove helpful is RCRA Method 1312: Synthetic Precipitation Leach Test for Soils. This method is designed to determine the mobility of organic and inorganic contaminants in soils.

Response:
As discussed in U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, the focus of the investigation will be changed to address 1) onsite exposure pathways for direct contact and 2) offsite exposure pathways. As such, characterization of landfill contents will not be addressed by investigation activities and TCLP analyses of subsurface soil and sediment samples will not be conducted. The text of the Work Plan will be revised to eliminate reference to TCLP analysis.

9. **Comment:** Page 4-7, Section 4.2.2.3
For use in assessing effects on ecological receptors, it is recommended that temperature and Secchi Disk readings also be collected for surface water.

Response:
The text of Section 4.2.2.3 will be revised to indicate that temperature and Secchi Disk readings will be collected for surface water.

10. **Comment:** Page 5-1, Section 5.0, Paragraph 4
Unless the groundwater beneath Parris Island is determined not to be potable, the following exposure routes must also be included under the "Future Resident" receptor group heading for groundwater: ingestion and inhalation. These exposure routes should also be considered for future construction workers, and/or maintenance workers.

Response:
For the Future Resident receptor groups, groundwater exposure through ingestion and inhalation will be evaluated in the human health risk assessment and will be added to the text of Section 5.1. However, if it is found from investigation activities that the groundwater beneath Parris Island is not potable, it will be removed as a pathway of concern from the human health risk assessment.

11. **Comment:** Page 6-1, Section 6.3:
The inner diameter of the augers should be at least 6.25 inches.

Response:
The fourth sentence of Section 6.3 will be replaced with the following text.

> *"For monitoring well construction, hollow stem augers of sufficient diameter will be used to produce a 2-inch annular space between the casing and the borehole wall."*

This complies with Section 6.4, "Borehole Construction", of the U.S. EPA Region 4 EISOPQAM.

12. **Comment:** Page 6-5, Section 6.4.1
The grout seal should be cored, not drilled, to prevent shattering.

Response:
As discussed in the response to U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, the scope of the investigation will be revised to reflect an approach consistent with Presumptive Remedy for CERCLA Municipal Landfill Sites (Directive No. 9355.0-49FS, September 1993). The investigation of the Floridan Aquifer will be delayed until characterization of the surficial aquifer. As such, a

monitoring well to the Floridan Aquifer will not be installed at this time and Section 6.4.1 has been removed from the Work Plans.

13. **Comment:** Page 6-6, Section 6.8, Paragraph 2
The acronym FOL is not defined here. All acronyms should either be defined in text (first occurrence only), or in an acronym list to be included with the document.

Response:
The acronym FOL will be defined in Section 6-6 as Field Operations Leader. Additionally, an acronym list has been added to the document.

14. **Comment:** Page 7-1, Section 7.2.1
In order to ensure that the sediment samples collected reflect worst-case conditions, sediments should be collected from at least two depth intervals at each location. Recommend that samples be collected from the top few inches, to reflect recent off-site migration, and from some greater depth interval (suggest 1 foot) to reflect historical accumulations. Visual inspection, or other available information, should be used to ensure sample collection from the depth interval with the greatest potential for contamination.

Response:
Sediment samples will be collected at two sample depth intervals. At each site (1/41, 2/15, and 3), one sediment sample will be collected at a 6- to 12-inch sample depth to reflect historical accumulation. This sample will be collected at a downgradient location where accumulation of contaminants is likely to occur. The remainder of the sediment samples will be collected at a 0- to 6-inch sample depth to reflect recent offsite migration.

15. **Comment:** Page 7-1, Section 7.2.2
A. Surface soil samples should be collected from the depression observed during the October 15-17 1996 base tour and from any other areas where contaminants are likely to have preferentially accumulated (e.g. based on visual inspection of existing site conditions, aerial photographs, historical information, etc.). A reasonable effort should also be made to locate the former incinerator and collect samples near it.

Response:
The following sentence will be added to the text of Section 7.2. "If during field activities, the FOL deems that an area not contained in the Work Plan should be sampled because of surface features (e.g., depressions) that would cause accumulation of contaminants, the location of samples presented in the sampling plan will be altered to include these locations."

As presented in the Addendum to the Draft Remedial Investigation Work Plan for Site 1 - Incinerator Landfill submitted on October 7, 1996, surface soil sampling locations in the vicinity of the Former Incinerator have been included in the Work Plan.

B. Per Region 4 Supplemental Guidance to RAGS, all surface soil samples should also be collected from the 0-1 foot interval, or biased to reflect worst-case conditions. For example, if historical records, visual inspection or aerial photographs indicate that the soil/fill layer on top of the landfill is less than 1 foot thick in any area, a surface soil sample should be collected from the ash/waste layer contained within the top foot of the landfill.

Response:
The text of Section 7.2.2 will be revised to include that all surface soil samples will be collected from the 0-1 foot interval in accordance with this Region 4 guidance document. Additionally, the text of Section 7.2.2 will be revised to indicate that samples will be collected to bias the worst-case scenario.

16. **Comment:** Page 7-11, Section 7.2.3
Given the Site 1 characteristics mentioned previously (e.g. primarily incinerated MLF-type wastes, size: >29,000 cubic yards), engineering controls, such as containment, would appear to be a more likely remedy than treatment (see Section 300.430(a)(iii)(B) of the NCP and EPA/OSWER Quick Reference Fact Sheet: Presumptive Remedy for CERCLA Municipal Landfill Sites (Directive No. 9355.0-49FS, June 27, 1995)). For this reason, the RI should initially focus on characterizing (i) on-site exposure pathways for direct contact (e.g. surface soil contamination) and (ii) all off-site exposure pathways (e.g. off-site contamination of surface water, sediment and groundwater). U.S. EPA recommends that a decision regarding the need to characterize landfill contents (i.e. source characterization) be delayed until this initial round of data becomes available. Evaluation of this data for purposes of determining whether source characterization is appropriate should include consideration of such factors as: (i) magnitude and risk-level of detected off-site contamination (ii) presence/absence and nature of any hot spots and (iii) length of time for which contaminants have been available for off-site transport (in this case between 32 and 76 years).

Use of the above approach makes it critical that the locations and numbers of samples collected during this first round of activities provide adequate characterization of worst-case site conditions. To this end, specific justification/rationale must be provided for each sample collected. Care should also be taken to ensure that the number of samples collected provides coverage of all areas where significant potential for off-site migration and/or concentration of contamination exists.

Response:
It is agreed that given the conditions of the site, containment would appear to be a more likely remedy than treatment. Therefore, an investigation approach is proposed that will initially characterize the extent of contamination in all areas where significant potential for offsite migration of contamination exists. Groundwater samples will be taken downgradient of groundwater flow at Sites 1/41 and 2/15, and below Site 3 due to the site-specific characteristics of the Causeway Landfill. Additionally, surface water and sediment samples will be taken downgradient of the path of surface water runoff at all sites. Lastly, surface soil (0-1 foot below ground surface) will be sampled throughout the sites as previously proposed in the Draft Work Plan.

If the results of these activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered. Additionally, if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill, further investigation to determine the competency of the Hawthorn Formation as an adequate confining layer may be warranted. If analytical results indicate that both the lower surficial aquifer has been adversely impacted by the landfill and the Hawthorn Layer does not adequately act as a confining layer, investigation activities to evaluate potential impacts to the Floridan aquifer may also be warranted.

18. **Comment:** Page 7-12, Section 7.3.2
This section stipulates that the last two digits of the sample number will specify the middle of the sample interval, yet the sample numbers in Table 7-1 specify the bottom of the sample interval. This discrepancy in sample nomenclature should be addressed.

Response:
The explanation of the sample depth portion of the sample identification number will be changed from "Middle of sample interval" to "Bottom of the sample interval or sample round."

19. **Comment:** Page 10-1, Section 10.2
A number of needed field QA/QC blanks are missing. Grout, sand, bentonite, and preservative blanks should also be collected.

Response:
Brown & Root Environmental recommends that material QA/QC blanks not be taken because the contractor will provide certified-clean well construction materials and false positive detections have not been a historical problem.

Additionally, it is recommended that preservative QA/QC blanks not be taken. In Section 10.2.1, trip blanks, field blanks, and rinsate blanks are proposed. Historically, such blanks very rarely shown positive detection of contaminants. Therefore, if the analytical results indicate that these samples are clean, the results indicate that preservatives used in such samples are pure.

RESPONSE TO U.S. EPA COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLANS
SITE 1 (INCINERATOR LANDFILL) AND SITE 41 (FORMER INCINERATOR) -
COMMENTS RECEIVED 7/22/970
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **Comment-** Pages 3-1 through 3-2, Section 3.0:
According to the text, "This section presents a conceptual model and discussion of potential migration and human and ecological exposure pathways." However, the text does not indicate whether the identified pathways are applicable to human receptors, ecological receptors, or both. Nor does it indicate if any other aspects of the exposure pathways identified are unique to the receptor being considered. This information must be provided to ensure development of an adequate site conceptual model.

Response:
The text of Section 3.0 will be revised to indicate which exposure pathways are applicable to human or ecological receptors. Also, if aspects of the identified exposure pathways are unique to a receptor, the text will also be revised to indicate this information.

2. **Comment** - Page 4-12, Section 4.2.2.3:
As discussed and agreed to during the July 1997 Partnering Meeting, two surface water samples will be collected and analyzed for hexavalent chromium for risk assessment purposes. Verification of the hexavalent chromium content of surface water samples is appropriate, since chromium has been detected in previous sediment samples and surface water samples have never been collected at this site.

Response:
Per comments made by the U.S. Fish & Wildlife Service, three samples per medium will be analyzed for hexavalent chromium.

3. **Comment** - Page 4-1, Section 4.0:
Given that a presumptive remedy approach will be used to evaluate this site, appropriate steps should be taken to notify the public of this approach. It is important that all stakeholders understand completely how the presumptive remedy process varies from the usual cleanup process, and the benefits of using this process. Please refer to U.S. EPA Directive entitled *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills* (Directive No. 9355.0-67FS, December 1996) for information and documents to be provided to the public via mechanisms such as the Administrative Record, Fact Sheets, etc.

Response:
In accordance with the U.S. EPA Directive entitled Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills, the Administrative Record will include the necessary generic and site-specific information documenting the selection and non-selection of the containment presumptive remedy. The text of Section 4.0 will be revised to reflect this information.

4. **Comment** - Page 5-2, Section 5.2:
The description of the ecological risk assessment to be performed must be comparable, in level of detail, to that provided for the human health risk assessment. For example, information on potential COCs (e.g. results of previous investigations), exposure pathways and receptor groups should be provided. Site-specific approaches to completing the generic steps identified in the Volume III Master Work Plan should also be provided. If Work Plan/SAP addendums will be generated to complete the plans for conducting the Ecological Risk Assessment (ERA), these addendums should also be clearly identified and described (e.g. purpose, contents, submittal criteria) in the present SAP.

Response:
Section 5.2 will be rewritten to describe the Navy's approach for conducting the ERA portion of the baseline risk assessment. In summary, the Navy believes that the ERA should be performed at the screening level only (Steps 1 and 2 of the ERA process) with data obtained from the upcoming RI/RFI rather than evidence of exceedences.

5. **Comment** - Page 7-1, Section 7.2:
Regarding the rationale for the proposed sampling, the SAP currently includes some good general criteria for selecting sampling locations (e.g. "..a primary sampling concern will be to characterize the worst-case site condition of each media investigated.." (p. 4-6, Section 4.1); "If during field activities, the FOL deems that a location not contained in the Work Plan should be sampled because of surface features (e.g. depressions) that would cause preferential accumulation of contaminants, the sampling plan will be altered to include these locations (p. 7-1, Section 7.2).

However, as discussed and agreed to during the July 1997 Partnering Meeting, in order to assure that these goals are accomplished on a sample-specific basis, the RI Report will briefly describe (e.g. 1-2 sentences) the justification for each sample collected.

Response:
If during field activities, a sampling location is altered, rationale will be provided in the RI/RFI report that justifies such deviation.

7. **Comment** - Page 10-1, Section 10.2:
Section 5.13.10 (Estimating Variability) of the U.S. EPA Region 4 SOPQAM cites the need for collecting material and preservative blanks. The Navy's decision not to collect QA/QC blanks for grout, sand bentonite and a preservative blank is acceptable, so long as the Navy assumes the risk for false positive detections.

Response:
As indicated in the response to comments to the Draft RI Work Plan for Site 1/41, false positive detections have not been a historical problem. However, QA/QC blanks for grout, sand, and bentonite will be collected and held for analysis pending the analytical results of the field investigation. If it is suspected that inorganic contaminants have been introduced by well installation materials, the samples will be sent to the laboratory for analysis. For inorganics, holding times will not be exceeded because the holding time for inorganic analysis is considerably longer than the 3-week turn-around time anticipated for analytical results. For organics, material blank analysis is not anticipated because monitoring well purging and development activities should dissipate minor organic contamination if present.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 3 (CAUSEWAY LANDFILL) - COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(D. HARGROVE, REVIEWER)

4) **Comment:** Table 4-1, Investigation Rationale, text page 4-4:
The section discussing data gaps/needs for the groundwater proposes risk assessment. As stated in comment 3(a), all groundwater in the state is classified as a potential drinking water source. In accordance with R.61-68 Water Classification and Standards, all groundwater of the State is classified as Class GB. This classification requires that concentrations of inorganic and organic constituents must not exceed established MCLs. Completing a risk assessment of the concentrations of contaminants found in the groundwater is inappropriate when concentration limits are established by regulation. In addition, MCLs are established at concentrations that already account for risk to human health.

Response:
To satisfy CERCLA requirements, all groundwater that is suitable for use as a drinking water source based on water quality parameters such as salinity and turbidity must undergo a risk assessment. The text of Section 4.1 will be revised to indicate that groundwater will be evaluated as a practical drinking water source according to CERCLA in the human health risk assessment. The text of Section 5.1 will also be revised accordingly.

5) **Comment:** Section 6.4, Monitoring Well Installation and Construction:
a) Page 6-3: The use of bentonite chips in the seal is not recommended. Bentonite chips have longer hydration times and complete hydration cannot be assured. Bentonite pellets are recommended due to faster/more complete hydration.

Response:
The third sentence of the fifth paragraph of Section 6.4, Monitoring Well Installation and Construction, will be revised as follows. "A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate as per the manufacturer's recommendations."

b) Page 6-4: The grout should not be installed to the ground surface. It should be installed to a point below the frost line. The concrete used to form the pad will fill the remaining annular space. Figure 6-1 of this work plan correctly depicts the relationship between the grouted interval and the concrete pad.

Response:
It is agreed that the grout should not be installed to the ground surface but to a point below the frost line. This change will be reflected in the text of Section 6.4 Monitoring Well Installation and Construction.

c) Page 6-4: This section is incomplete. The text and figures should also include:
i) Specifications for an identification plate that will be affixed to the well with information including: Well name, date drilled, depth of well, the driller's name and certification number.
ii) Specifications for the formation of the concrete pad.
iii) Specifications for the protective stickups to be installed around the completed concrete pad.

NOTE: These specifications are already listed in the Master Work Plan for MCRD. The text should be revised to either include complete specifications, or properly reference the Master Work Plan.

Response:
The text of Section 6.4 will be revised to include a reference to MCRD Parris Island South Carolina Master Work Plan, Volume II, Section 2.3 Monitoring Well Construction and Installation for the specifications of the well's concrete pad and protective casings. Additionally, the identification plate specifications will be included in the text of this section. Lastly, Figure 6-1 will be revised to include these specifications.

6) **Comment:** Figure 6-1, Typical Monitoring Well Detail:
This diagram should have the specifications for the protective stickups shown (see comment 5 above). Please revise the text accordingly.

Please refer to the response to comment 5.

7) **Comment:** Section 7.2.1, Surface Water Sampling, page 7-1:
a) The text does not specify if the surface water samples will be taken before, during, or after high tide. It is preferable that all the surface water samples be taken during like tidal conditions. Please revise the text to include a sample protocol that describes the timing of the sampling events.

Response:
As discussed during the July 9-10, 1997 Parris Island Partnering Team meeting, sediment samples will be collected at low tide and surface water samples will be collected at high tide as the surface water begins to recede. The text of Section 7.2.1 will be revised accordingly.

b) The text specifies that background samples collected for Site 2 will be used to determine background conditions at Site 3. Sites 1, 2, and 3 are all located close to each other. Please revise the text to include a comparison of the background samples taken from Site 1 as well.

Response:
One set of background samples for soil, surface water and sediment will be taken at Site 1. These samples will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLAN
SITE 3 (CAUSEWAY LANDFILL) - COMMENTS RECEIVED 7/18/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(D. HARGROVE, REVIEWER)

3. **Comment**: Response to comment #3

This response clarifies that the groundwater risk assessment will be performed according to CERCLA requirements. However, compliance with the State Primary Drinking Water Standards has not been specified. According to the National Oil and Hazardous Substances Contingency Plan (NCP), remedial alternatives should be evaluated against NCP threshold criteria for overall protection of human health, and compliance with applicable or relevant and appropriate requirements (ARARs). The State Primary Drinking Water Standards are ARAR and must be followed. This comment does not require a specific revision. This is for future reference to be acknowledged in the resulting report.

Response:
This comment is acknowledged

4. Response to Comment #4 to the Draft Work Plan for Site 3

The following restates the comment made to the Draft Work Plan by D. Hargrove and the response to this comment:

"**Comment:** Table 4-1, Investigation Rationale, text page 4-4:
The section discussing data gaps/needs for the groundwater proposes risk assessment. As stated in comment 3(a), all groundwater in the state is classified as a potential drinking water source. In accordance with R.61-68 Water Classification and Standards, all groundwater of the State is classified as Class GB. This classification requires that concentrations of inorganic and organic constituents must not exceed established MCLs. Completing a risk assessment of the concentrations of contaminants found in the groundwater is inappropriate when concentration limits are established by regulation. In addition, MCLs are established at concentrations that already account for risk to human health.

Response
Please refer to the response to Comment 2 of this section."

Comment:
a) This response should reference the response to Comment #3 (not #2).

Response:
The response will reference Comment #3.

Comment:
b) This response clarifies that the groundwater risk assessment will be performed according to CERCLA requirements. However, compliance with the State Primary Drinking Water Standards has not been specified. According to the National Oil and Hazardous Substances Contingency Plan (NCP), remedial alternatives should be evaluated against NCP threshold criteria for overall protection of human health, and compliance with applicable or relevant and appropriate requirements (ARARs). The State Primary Drinking Water Standards are ARAR and must be followed. This comment does not require a specific revision. This is for future reference to be acknowledged in the resulting report.

Response:
This comment is acknowledged

1.0 INTRODUCTION

This Work Plan for Site/SWMU 2 - Borrow Pit Landfill and Site/SWMU 15 - Dirt Roads, Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina, has been prepared by Brown & Root Environmental, Inc., (B&R Environmental) for the Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC) under the Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0020. This Work Plan outlines the requirements and describes the procedures for performing the field investigation at Site/SWMU 2 - Borrow Pit Landfill and Site/SWMU 15 - Dirt Roads. It is intended for use in conjunction with the Master Work Plan Volumes I, II, and III for MCRD Parris Island (B&R Environmental, 1998c).

MCRD Parris Island is located along the southern coast of South Carolina approximately 1 mile south of the city of Port Royal and 3 miles south of the city of Beaufort within Beaufort County. MCRD Parris Island covers approximately 8,047 acres, consisting of dry land, salt marshes, saltwater creeks, and ponds, as shown in Figure 1-1. MCRD Parris Island is the reception and recruit training facility for the Marine Corps for enlisted men from states east of the Mississippi River, and enlisted women nationwide.

For the remainder of this document, Site/SWMU 2 and Site/SWMU 15 will be referred to as Site 2 and Site 15; however, both sites are still recognized and designated as RCRA SWMUs by the State of South Carolina.

1.1 SCOPE AND OBJECTIVE

The preamble of the National Contingency Plan (NCP) identifies a municipal landfill as a site where the treatment of wastes may be impracticable because of the size and heterogeneity of the landfill's contents (i.e., municipal waste co-disposed with industrial/hazardous waste). Because treatment usually is impractical, the United States Environmental Protection Agency (U.S. EPA) generally considers containment to be the appropriate response action, or the "presumptive remedy" for the source areas of municipal landfill sites (U.S. EPA, 1993). Therefore, an investigation approach is proposed that will correspond with the approach outlined in U.S. EPA's *Presumptive Remedy for CERCLA Municipal Landfill Sites* (U.S. EPA, 1993) and *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance)* (U.S. EPA, 1996a).

In following the presumptive remedy guidance, the objectives of this investigation are to characterize the nature and extent of potential contaminant migration from past landfilling operations at Site 2 and past

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P:\GIS\APR\PARRIS.APR 8-SEP-97 DNP DEPOT LOCATION MAP

SOURCE: USGS 7.5 MINUTE PARRIS ISLAND QUADRANGLE, 1956. PHOTOREVISED 1979.

DEPOT LOCATION MAP

MCRD, PARRIS ISLAND, SOUTH CAROLINA

3000 0 3000 6000 Feet

FIGURE 1-1

Brown & Root Environmental

dust-suppression activities at site 15. media of concern that will be investigated consist of surface water and sediment located topographically downgradient of site 2 and groundwater located hydraulically downgradient of site 2. additionally, surface soils located within the boundaries of sites 2 and 15 will be investigated.

Data collected from this investigation will be used to assess the human health and ecological risks associated with potential migration of contaminants. Human health risks to construction workers, site employees (maintenance and other), adolescent trespassers, adult and adolscent recreational users, and future residents, as well as ecological risks to the site's native flora and fauna, will be assessed. Also, sampling is proposed to determine whether media contain contaminants at concentrations above applicable or relevant and appropriate requirements (ARARs). Based on this information, decisions for remedial action will be evaluated and determined. If the results of field activities indicate that areas of offsite contamination exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered if it is determined that the presumptive remedy is not appropriate.

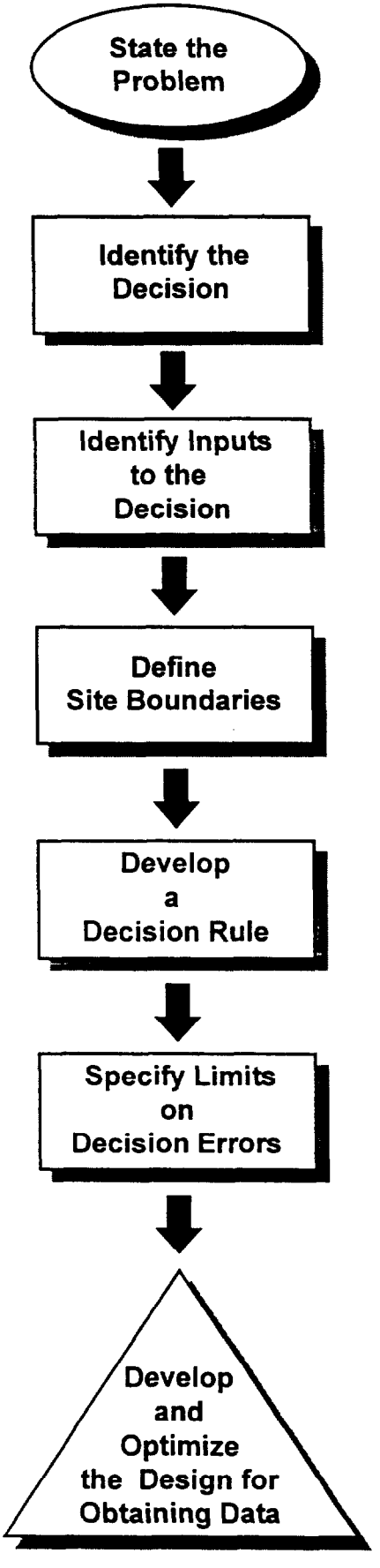
1.2 DATA QUALITY OBJECTIVES

This Work Plan has been developed using the Data Quality Objective (DQO) Process. The DQO Process is a focused, iterative process for developing the data collection strategy to support decision-making. The goal of the process is to conduct investigations in an efficient and effective manner without unnecessary precision or redundancy of data. The process consists of seven steps, ordered in a downward decision flow. A flow diagram with descriptions of each step is provided in Figure 1-2. The DQO Process is further explained in Volume I, Section 1.2.2, of the Master Work Plan (B&R Environmental, 1998c).

1.3 DOCUMENT ORGANIZATION

This Work Plan is intended to be used in conjunction with the Master Work Plan for MCRD Parris Island (Volumes I through III) and references the Master Work Plan where appropriate. This Work Plan includes the site-specific information to be used for sampling at Sites 2 and 15, while the Master Field Sampling Plan FSP and the Master Quality Assurance Plan (QAP) provide general information that is applicable to all sites at MCRD Parris Island. Sections 1.0 through 4.0 of this site-specific Work Plan identify the project scope and objectives, summarize background information and existing data, and present the proposed sampling plan. Section 5.0 discusses the human health and ecological risk assessment and Sections 6.0 and 7.0 are the site-specific FSP. Sections 8.0 through 10.0 of this document describe the Quality Assurance and Quality Control (QA/QC) measures for ensuring that usable data is obtained.

FIGURE 1-2
DATA QUALITY OBJECTIVES PROCESS



- Definition of problem for data collection (Section 2.4)
- Review of historical & background information (Section 2.0)
- Preliminary assessment of existing data (Section 3.0)

- Statement of the action-based decision to resolve problem (Section 4.0)

- Identification of measurable variables and action levels to support decisions (Section 5.0)

- Definition of sampling population, and spatial and temporal boundaries and limitations (Section 4.0)

- Single statement synthesizing previous steps and summarizing how data will be used to make a decision (Master Work Plan, Volume III)
- An "if...then" statement defining values for deciding between alternative actions (Master Work Plan, Volume III)

- Definition of acceptable limits of decision error and potential consequences of incorrect decisions (Decision Document; Master Work Plan, Volume III)

- Development of alternative sampling designs and selection of most effective design for sampling and analysis (Section 4.2)

2.0 SITE BACKGROUND

This section presents a brief history of Site 2 - Borrow Pit Landfill and Site 15 - Dirt Roads, and describes the existing site conditions. It also summarizes previous investigation results. Figure 2-1 illustrates the location of Sites 2 and 15 along with other sites (Sites 1, 3, and 41) at the MCRD Parris Island facility where remedial activities are schedule to take place.

2.1 SITE DESCRIPTION AND HISTORY

2.1.1 Site 2 - Borrow Pit Landfill

Site 2 - Borrow Pit Landfill is a landfill that was in operation from 1965 to 1968. It is located in the central portion of Horse Island, in the north section of MCRD Parris Island as shown in Figure 2-1. The southwest border of the landfill is located approximately 100 feet from a marsh area. The landfill occupies approximately 1.9 acres and is currently covered with mature pine trees. The water table is approximately 15 to 17 feet below ground surface. Photos of the site are provided in Figure 2-2.

In the 1960s, Site 2 consisted of a pit that had been dug to provide fill dirt for the base. When waste disposal at the Borrow Pit Landfill was initiated, the unlined pit consisted of a hole approximately 10 feet deep. The landfill served as the disposal site for domestic trash, construction debris, solid paint wastes, cleaning rags (contaminated with oil, mineral spirits, and kerosene), spent absorbent, solvent sludge (aliphatic petroleum and chlorinated solvent compounds), perchloroethylene still bottoms, metal shavings, PCB-contaminated oil, mercury amalgam, and beryllium wastes from the MCRD from 1966 to 1968. An estimated 33,000 tons of solid waste refuse and 16 tons of solid paint wastes were disposed in this landfill during the period of operation. Most of the wastes were located in the central and eastern portions of Site 2 (NEESA, September 1986). Liquid paint wastes including thinners (mineral spirits, kerosene, and diesel fuel) and a stripper (methylene chloride) were also brought to this landfill by paint shop personnel and burned. During the three year period, approximately 2,800 gallons of liquid paint wastes were burned annually in this landfill (NEESA, September 1986). The landfill was the facility's primary landfill after the termination of operations at the Site 1 - Incinerator Landfill and the temporary suspension of operations at the Site 3 - Causeway Landfill. When the landfill operations were terminated, the pit was approximately half filled with wastes, and approximately 6 feet deep. Limited information is available concerning the presence and extent of fill material used to cover the landfill after disposal activities were discontinued at Site 2. Since 1968, no significant disposal or intrusive activities have taken place at Site 2.

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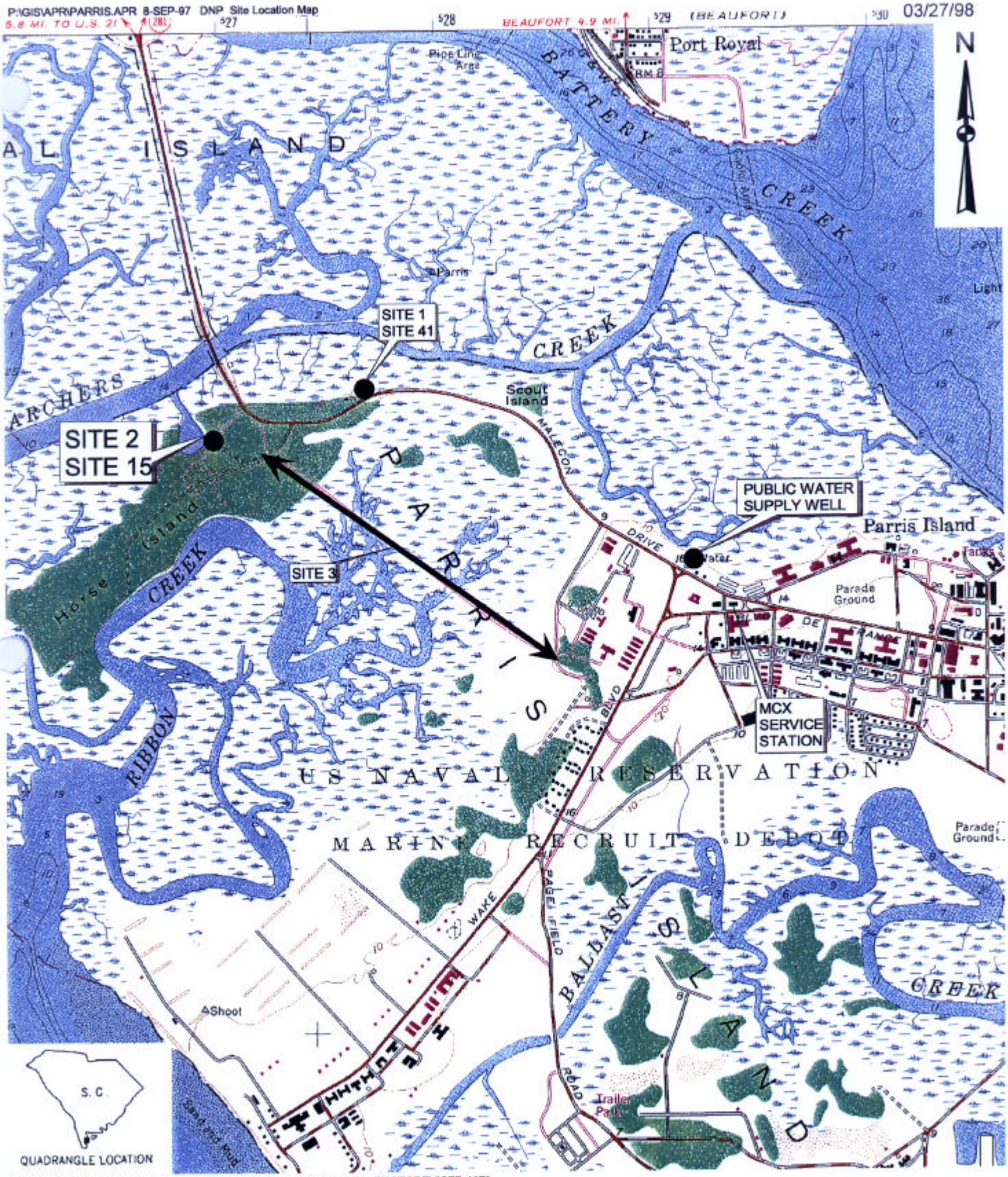

SOURCE: USGS 7.5 MINUTE PARRIS ISLAND QUADRANGLE, 1956. PHOTOREVISED 1979.

SITE LOCATION MAP

MCRD, PARRIS ISLAND, SOUTH CAROLINA

2000 0 2000 4000 Feet

FIGURE 2-1

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WEST SIDE OF BORROW PIT LANDFILL. LOOKING NORTHEAST FROM GUN CLUB LOCATED SOUTHWEST OF THE LANDFILL.

WEST SIDE OF BORROW PIT LANDFILL. LOOKING SOUTHEAST FROM THE NORTHWEST CORNER OF THE LANDFILL.

FIGURE 2-2
SHEET 1-2

SITE PHOTOS
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

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NORTH SIDE OF BORROW PIT LANDFILL. LOOKING EAST ALONG NORTHERN EDGE OF LANDFILL ALONG DIRT ROAD.

SOUTHERN CORNER OF BORROW PIT LANDFILL. LOOKING NORTH AT DIRT ROAD AND LANDFILL.

FIGURE 2-2
SHEET 2-2

SITE PHOTOS
SITE 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

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2.1.2 Site 15 - Dirt Roads

Site 15 is approximately 1.5 miles of dirt road accessing Elliott's Beach and 0.5 miles of road accessing the Borrow Pit Landfill (Figure 2-1). In the past, the MCRD routinely sprayed the Depot's dirt and gravel roads with oils to reduce dust. From about 1918 until 1966, waste lube oil, cutting oil, petroleum-based solvents (kerosene, gasoline, mineral spirits), hydraulic fluids, and water-based coolants were transported by roads and grounds personnel from various depot shops and sprayed on Depot roads for dust suppression. From 1918 to 1940, an estimated 11,000 gallons were sprayed on all Depot roads, the majority of which was applied during the 1930s. Most of the Depot roads were paved in the 1940s. However, from the early 1940s to 1966, approximately 16,200 gallons of waste oils and hydraulic fluids continued to be applied to the dirt roads accessing Elliott's Beach and the Borrow Pit Landfill. Photos of the dirt roads around Site 2 are provided in Figure 2-2. Most of the dirt road accessing Elliott's Beach was recently paved and only 0.25 miles of dirt road remains.

2.2 SITE HYDROGEOLOGY

A summary of the site hydrogeology for Sites 2 and 15 is provided in this section.

2.2.1 Surficial Aquifer

The surficial, or water table, aquifer at Sites 2 and 15 is unconsolidated and restricted to the shallow, Pleistocene to Holocene-age, fine-grained, sedimentary deposits of the Pamplico and Waccamaw Formations (Hughes et al., 1989). Based upon information obtained in the area, the upper 20 feet of sediment consists of very fine, yellow-brown sand with traces of clay and silt with thin (approximately 6 inches thick), discontinuous layers of greenish-gray silty clay. The surficial aquifer is estimated to be 30 feet thick in the area and usually ranges from a depth of 0 to 10 feet at MCRD Parris Island and is most commonly encountered at a depth of 3 feet. Seasonal changes can be as great as 6.5 feet (NEESA, 1986). An estimated transmissivity of 1,300 ft^2/day with a storage coefficient of 0.20 has been reported for sands within the shallow deposits (Hassen, 1985). Site-specific aquifer characteristics will be determined during the field investigation.

2.2.2 Confining Layer

The surficial aquifer is underlain by the unconsolidated, Miocene-age, Hawthorn Formation (Hughes et al., 1989). The Hawthorn Formation is a geological formation that hydraulically separates the unconfined surficial aquifer from the underlying, artesian Floridan Aquifer. The elevation at the top of the Hawthorn Formation is reported to be within the range of 30 to 60 feet below mean sea level (msl) at Parris Island.

The thickness of the Hawthorn Formation at Sites 2 and 15 is anticipated to be between 20 and 40 feet (NEESA, 1986). The actual depth of this formation at Site 2 will be determined during the field investigation. Hughes et al., (1989) calculated the leakage through the Hawthorn Formation to be 0.0002 ft^3/day for every foot of head difference (using an average formation thickness of 30 feet and vertical hydraulic conductivity of 0.006 ft/day). The Hawthorn Formation consists of miocene deposits that appear to be locally discontinuous and varying in lithologic features across most of coastal South Carolina. This formation consists of sandy, clayey materials that are frequently eroded in coastal Beaufort County.

2.2.3 Floridan Aquifer

The principal source of groundwater used for consumption in the Beaufort County, South Carolina area is the Floridan aquifer (Smith, 1987). This artesian aquifer system is contained within the Santee Limestone formation has a total thickness of approximately 1,000 feet and is divided into the Upper Unit and the Lower Unit (NEESA, 1986). In the Low Country (including the Beaufort area north of MCRD Parris Island), the aquifer occurs near land surface, and confining beds vary from essentially zero to more than 150 feet in thickness. Groundwater of this aquifer occurs mainly under artesian conditions at MCRD Parris Island.

The Floridan aquifer is the most important source of groundwater in the Low Country area, and wells generally less than 250 feet tap this aquifer system. The only public supply well identified within a 1/4-mile radius of MCRD is located approximately 600 feet northwest of the MCX Service Station and is illustrated on Figure 2-1. The MCX Service Station is located in the north-central portion of the MCRD (Figure 2-1). The well was once used as a hot water source (Sirrine Environmental Consultants, Inc., 1991). It is currently not in use but has not been abandoned.

2.3 PREVIOUS INVESTIGATIONS

2.3.1 Initial Assessment Study

In 1986 the Naval Energy and Environmental Support Activity (NEESA) conducted an Initial Assessment Study (IAS) (NEESA, 1986) to identify potentially contaminated sites at MCRD Parris Island that may pose a threat to human health or the environment. The IAS consisted of an investigation of activity records and a records search at various government agencies, an onsite survey to identify potentially contaminated areas, an evaluation of each site for its potential hazard to human health or to the environment, and a determination of the need for a confirmation study or an immediate mitigation action at each site.

2.3.1.1 Site 2 - Borrow Pit Landfill

The wastes placed in Site 2 were disposed of in unconfined, highly permeable, sandy soils less than 100 feet from a tidal inlet. It was determined that horizontal migration to the marsh was likely. Therefore, the IAS identified Site 2 as requiring further investigation to assess potential long-term impacts. The study recommended the installation of three groundwater monitoring wells. Sampling of the wells and surface water and sediment from the tidal stream was also recommended.

2.3.1.2 Site 15 - Dirt Roads

All dirt roads throughout the Depot received waste oil and other fluids from 1918-1940, although no single area was identified as having received a large quantity of liquid waste. From 1918 to 1940, the two roads accessing Elliott's Beach and the Borrow Pit Landfill received an estimated 11,000 gallons of waste oils and other liquids, and from 1940 to 1966, the roads were coated with a total of 16,200 gallons of the mixture. However, the area of distribution was large and the practice was discontinued in 1966. Evaporation and biodegradation would have been responsible for reducing the volume of contaminants migrating through the surface soils in these areas. The volume of soil required to immobilize the spilled material was estimated to be 300 cubic yards and 1,100 cubic yards on the Borrow Pit Road and Elliott's Beach Road, respectively (NEESA, 1986). Assuming uniform application and a road width of 12 feet, immobilization would have occurred within 4 inches along both roadways. The depth to the water table at high tide beneath Site 15 is 1 to 4 feet. This greatly exceeds the estimated required depth of less than 4 inches for containment immobilization, and percolation to the groundwater was therefore determined to be unlikely. Site 15 was not recommended for a confirmation study. Since Parris Island has been placed on the NPL, the regulatory agencies have determined that sampling for PCBs and lead should be conducted to evaluate potential concerns from spraying waste oils.

2.3.2 Interim RCRA Facility Assessment

An Interim RCRA Facility Assessment (RFA) was performed during January 1990 - March 1990. The RFA (Kearney, 1990) was based on the results of a Preliminary Review (PR) of the U.S. EPA Region 4 and South Carolina Department of Health and Environmental Control (SCDHEC) files and a Visual Site Inspection (VSI). The RFA resulted in the identification of 44 SWMUs and Areas of Concern (AOCs). There was documented soil contamination resulting from past management practices conducted at this facility. An RFI was suggested for Site 2, and RFA Phase II sampling was recommended at Site 15.

2.3.3 Verification Step

Based on the recommendations of the IAS, McClelland Consultants conducted a Verification Step (VS) (McClelland, 1990) at Site 2. The purpose of this investigation was to perform limited sampling and investigations at sites identified by the Navy for evaluation of potential environmental contamination. During this investigation (between February 1988 and March 1988), three soil borings and three monitoring wells were installed around the landfill, and one surface water/sediment sample was collected in the basin just west of the landfill. The sampling locations are shown on Figure 2-3.

The groundwater samples and the surface water sample were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and dissolved metals (arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, silver). The sediment sample collected at this site was analyzed for VOCs, SVOCs, pesticides, PCBs, total metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver), and EP toxic metals (arsenic, cadmium, chromium, lead, and mercury).

Chloroform was detected at a concentration of 12 ppb in the groundwater (PAI2-GW3) and 1,2-dichloroethane at a concentration of 20 ppb (PAI2-GW1). No other organic priority pollutants were identified in the groundwater samples. Dissolved chromium (0.10 ppm), lead (0.073 ppm), arsenic (0.007 ppm), and barium (0.14 ppm) were also detected in the groundwater (Figure 2-4).

Dissolved cadmium (0.083 ppm), chromium (0.14 ppm), and lead (0.025 ppm) were detected in the surface water sample collected at the site. The shallow sediment sample identified chloroform at a concentration of 81 ppb and arsenic (9.59 ppm), barium (3.0 ppm), chromium (3.11 ppm), and lead (4.81 ppm) (Figure 2-5). Although not discussed in the Verification Step, several of these results exceed U.S. EPA Region 4 Waste Management Division Saltwater Surface Water and Sediment Screening Values. These exceedances are listed as follows.

Metal	SW Screening Value (ug/L)	Sediment Screening Value (ppm)
Arsenic	(NE)*	7.24
Cadmium	9.3	(NE)*
Chromium	103	(NE)*
Lead	8.5	(NE)*

* NE - Region 4 screening value not exceeded

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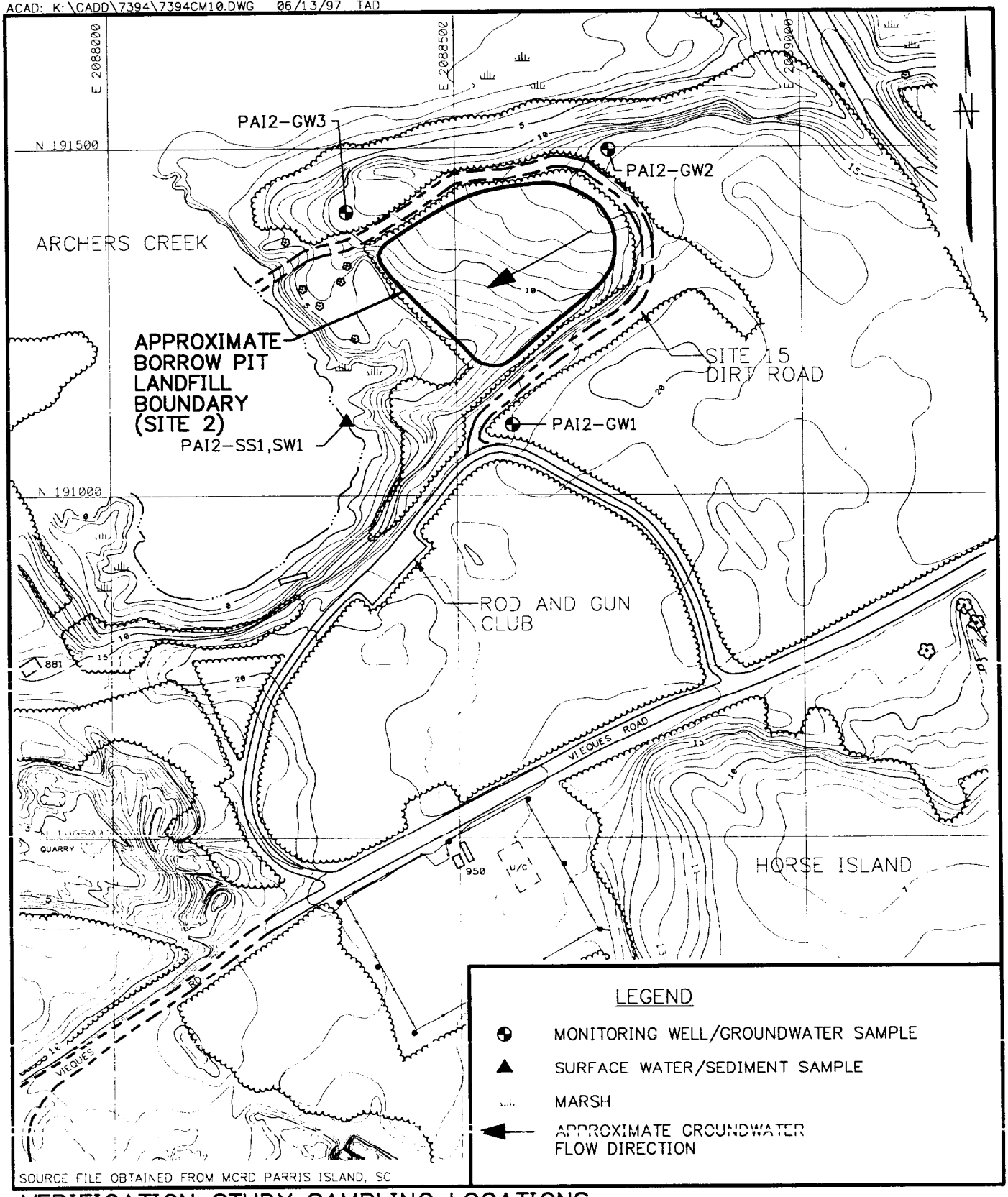

VERIFICATION STUDY SAMPLING LOCATIONS
SITE 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2-3

0 200 400
SCALE IN FEET

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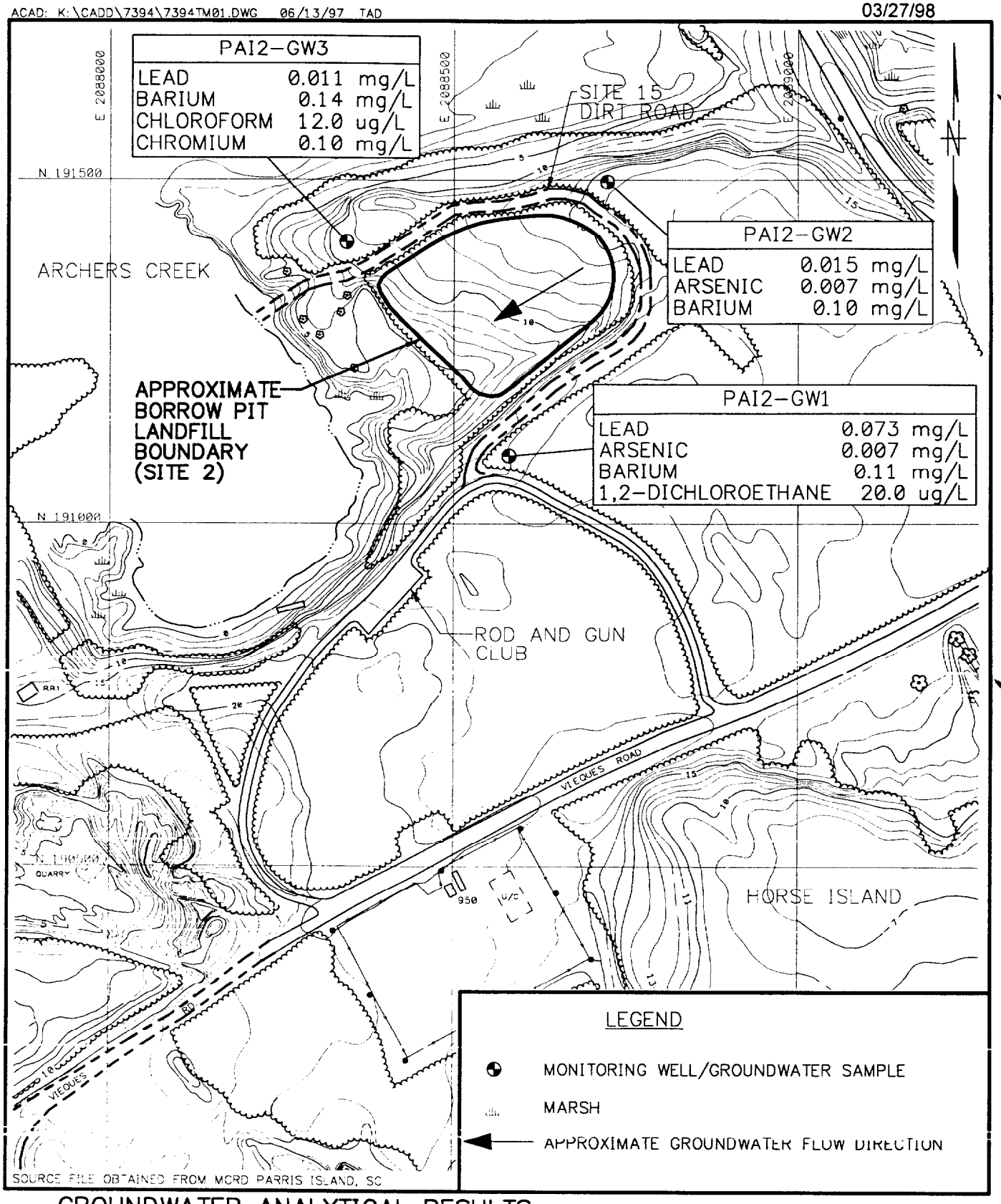

GROUNDWATER ANALYTICAL RESULTS
VERIFICATION STUDY
SITE 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2-4

0 200 400
SCALE IN FEET

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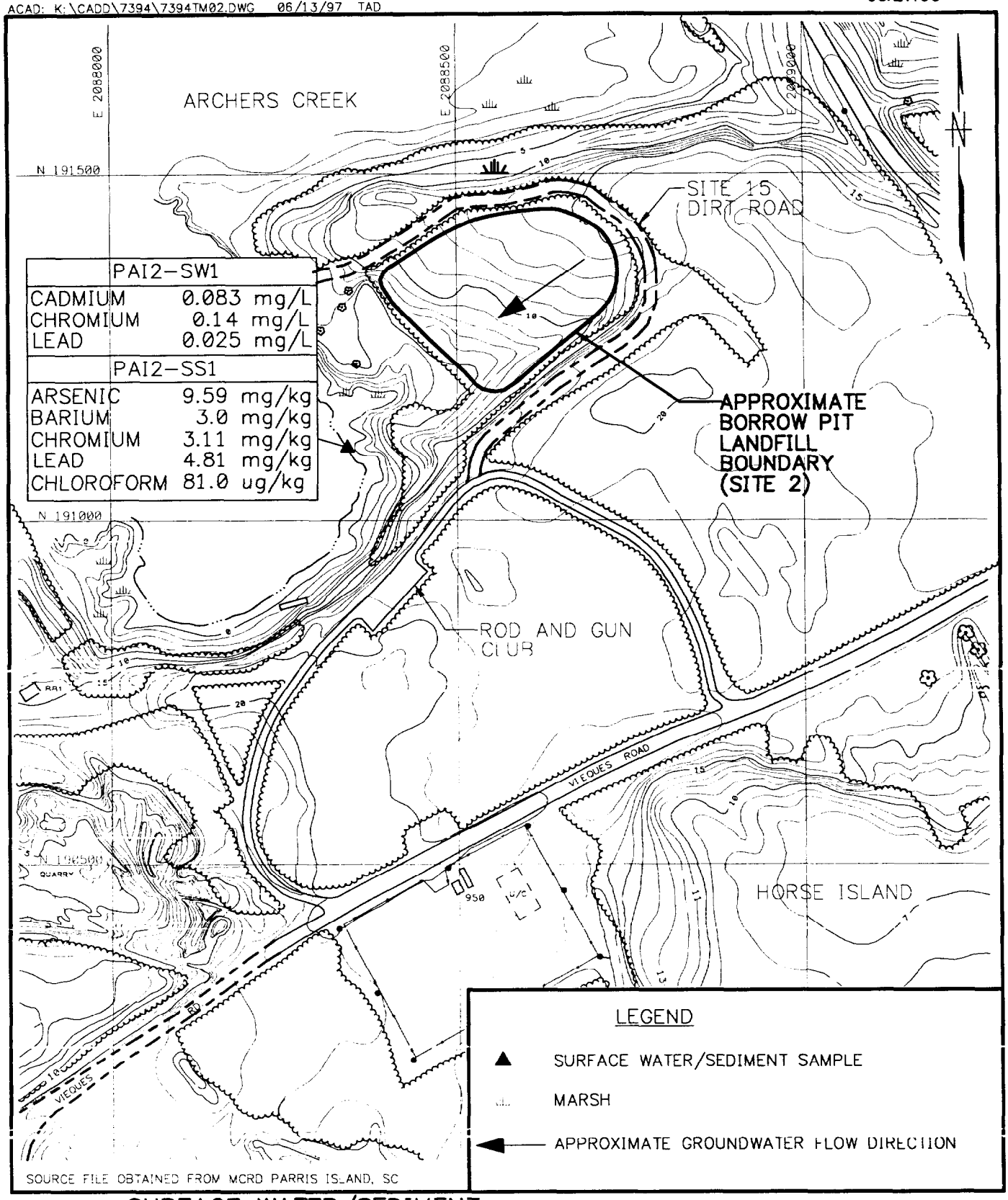

SURFACE WATER/SEDIMENT
ANALYTICAL RESULTS-VERIFICATION STUDY
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

0 200 400
SCALE IN FEET

FIGURE 2-5

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In the study, Site 2 was recommended for a detailed remedial investigation based on the presence of 1,2-dichloroethane above MCLs, chloroform in the groundwater, and chloroform in the sediment sample collected from the marsh west of the site. No federal standard existed for chloroform in sediment. Additional work was also recommended based on the presence of dissolved lead, chromium, and cadmium in the groundwater and surface water above their respective U.S. EPA Interim Primary Drinking Water Standards.

Site 15 was not addressed in the Verification Step.

2.3.4 Relative Risk Evaluation

During December 1995, two surface soil samples were collected at Site 15 - Dirt Roads in support of the Relative Risk Evaluation of potential sites at multiple Navy facilities. A Technical Memorandum was prepared to provide the sampling rationale and the analytical results of the sample collection conducted at the various Naval Activities throughout the SOUTHDIV Area of Responsibility (B&R Environmental, March 1996). All samples were analyzed for TAL metals, cyanide, TCL pesticides and PCBs, TCL volatiles, and TCL semivolatiles. One surface soil sample was collected at the dirt roads located near Site 2 Borrow Pit Landfill (Figure 2-6) where metals, di-n-butylphthalate, three volatiles, pesticides, and one PCB (Aroclor 1254) were detected. In addition, a surface soil sample was collected at the dirt road accessing Elliott's Beach (Figure 2-7) in which metals, di-n-butylphthalate, two volatiles, and two pesticides were detected. Of the compounds detected, arsenic, beryllium, and iron were detected in the soil above their respective U.S. EPA Region 3 risk-based concentrations (RBCs) for soil ingestion (residential).

2.4 STATEMENT OF PROBLEM

Based on the known disposal practices conducted at Site 2 and the results of the 1990 Verification Step, it has been determined that environmental media have been affected by Site 2 and that further evaluation is needed to assess potential risks to human and ecological receptors in the area of Site 2. Based on the previous activities conducted at Site 15 for dust suppression, Site 15 is recommended for further investigation to determine whether the site has adversely affected the environmental media.

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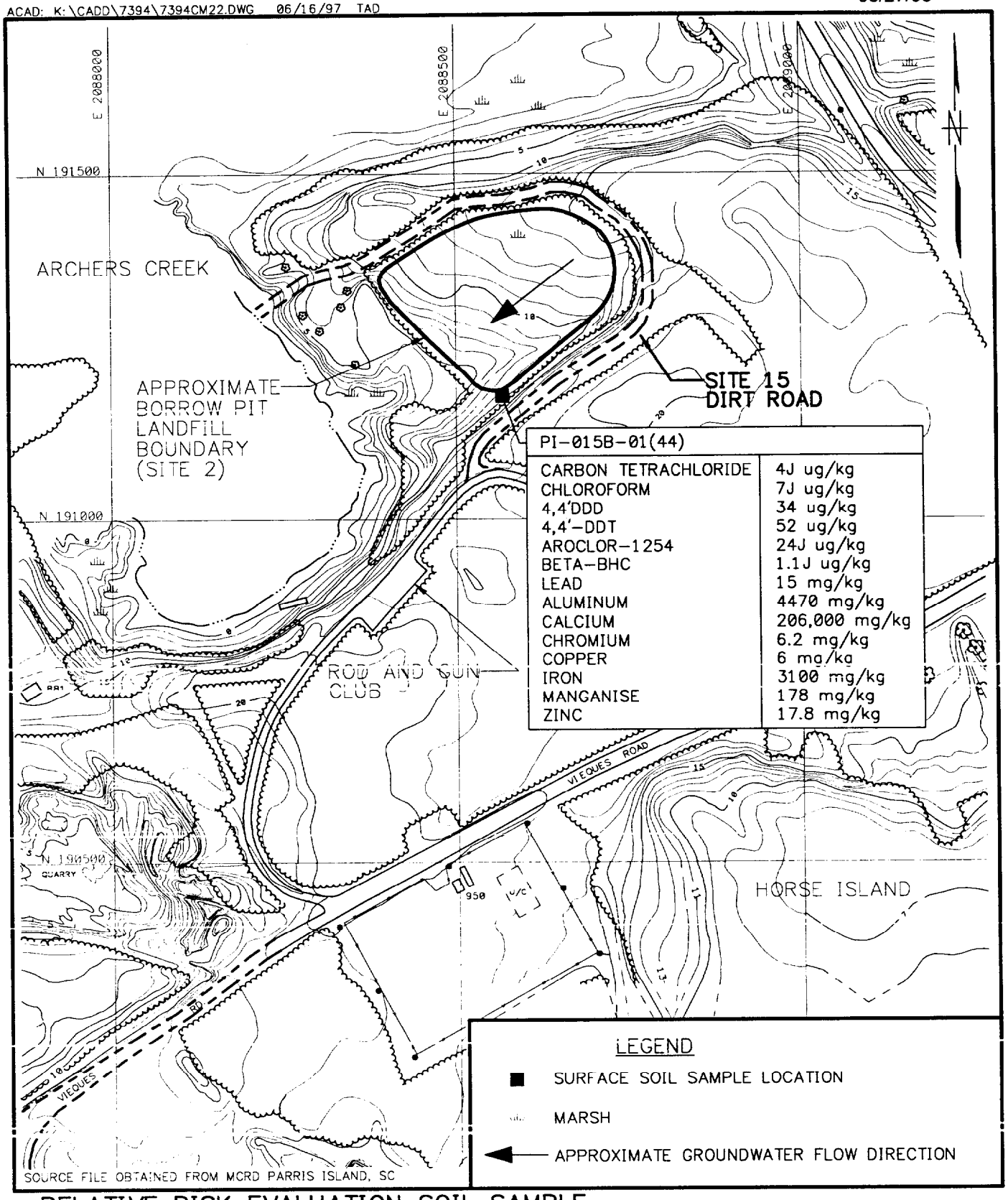

PI-015B-01(44)	
CARBON TETRACHLORIDE	4J ug/kg
CHLOROFORM	7J ug/kg
4,4'DDD	34 ug/kg
4,4'-DDT	52 ug/kg
AROCLOR-1254	24J ug/kg
BETA-BHC	1.1J ug/kg
LEAD	15 mg/kg
ALUMINUM	4470 mg/kg
CALCIUM	206,000 mg/kg
CHROMIUM	6.2 mg/kg
COPPER	6 mg/kg
IRON	3100 mg/kg
MANGANISE	178 mg/kg
ZINC	17.8 mg/kg

RELATIVE RISK EVALUATION SOIL SAMPLE LOCATIONS AND ANALYTICAL RESULTS
SITE 15-DIRT ROADS (BORROW PIT LANDFILL)
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2-6

0 200 400
SCALE IN FEET

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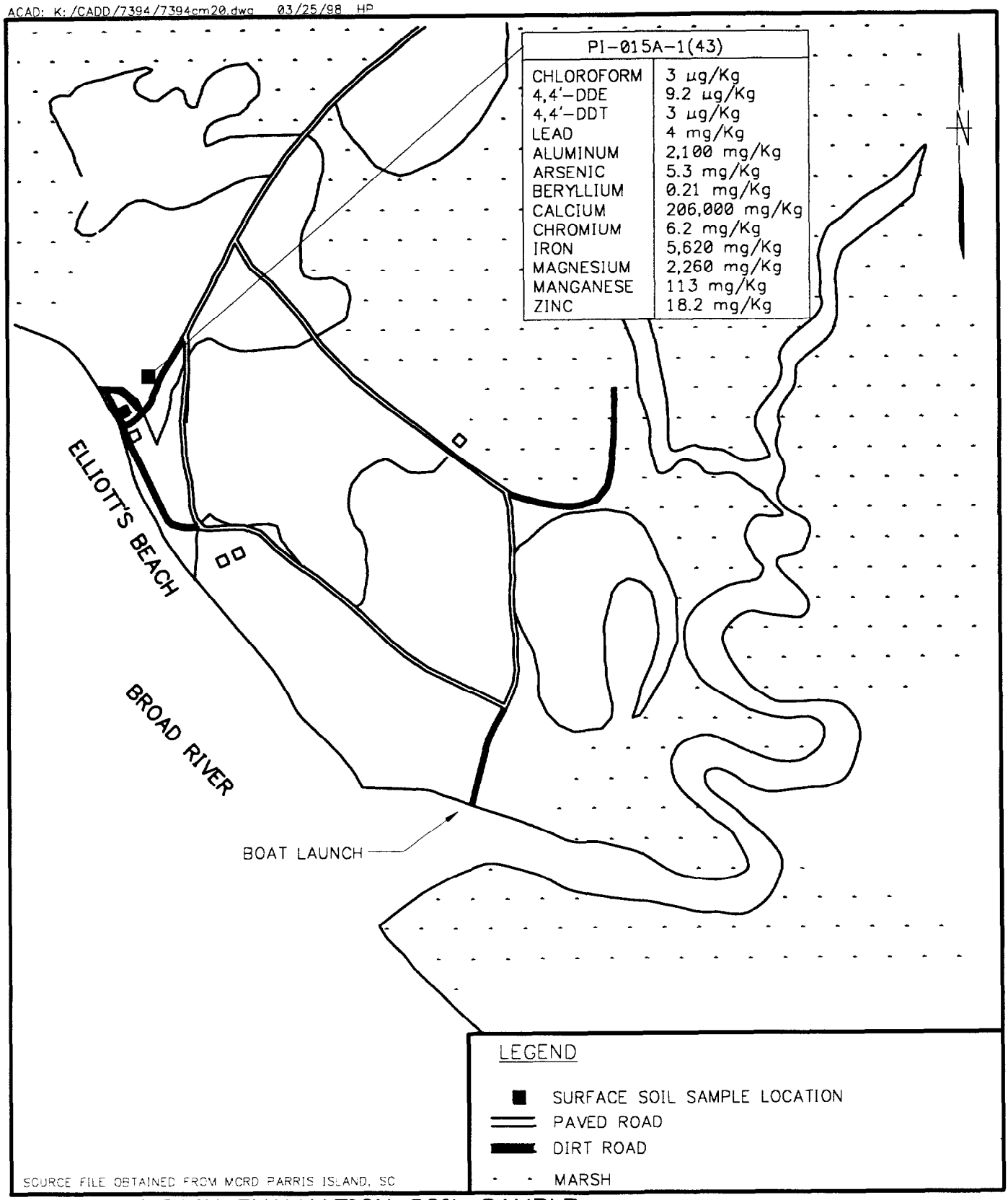

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RELATIVE RISK EVALUATION SOIL SAMPLE LOCATION AND ANALYTICAL RESULTS
SITE 15-DIRT ROADS (ELLIOTT'S BEACH)
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2-7

0 800 1600
SCALE IN FEET

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3.0 PRELIMINARY ASSESSMENT

This section presents a conceptual model and discussion of potential migration and human and ecological exposure pathways of contaminants from Sites 2 and 15. Figure 3-1 presents a conceptual model of the sites. A detailed discussion of potential receptors, media of concern, and exposure routes is presented in Section 5.0.

3.1 SURFACE WATER

Surface water flow from Sites 2 and 15 (near the landfill) is generally to the west into the adjacent marsh and then to Archers Creek. Surface water flow from Site 15 near Elliot's Beach is generally west into the adjacent marsh and then into Broad River. Impacts to the surface water from Site 2 may be from direct runoff from the landfill and may also originate from groundwater beneath the landfill discharging (e.g., through seeps) to Archers Creek or the surrounding marsh. Impacts to the surface water from Site 15 is not expected due to the low mobility of the potential contaminants of concern (PCBs and lead) that were sprayed on the dirt roads, however surface water samples collected for Site 2 will be used to assess Site 15.

A surface water sample collected in the basin just west of the landfill during the Verification Step (McClelland, 1990) indicated several metals (cadmium, chromium, and lead) were present in the surface water. The surface water surrounding the landfill may be adversely impacted and may also be a pathway for further contaminant migration. If surface water is found to be adversely impacted, incidental ingestion of and dermal contact with contaminants in surface water by human receptors would be possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors (aquatic organisms) would also be anticipated exposure pathways.

3.2 SEDIMENT

Chloroform, arsenic, barium, chromium, and lead were detected in sediments sampled during the Verification Step (McClelland, 1990). Sediment contamination may have resulted from contaminants that are directly adsorbed to eroded soils or from contaminants adsorbing to sediment during transportation and deposition. Sediments are located in the marsh and pond adjacent to the landfill and may be transported into Archers Creek. No sediment samples were previously collected to evaluate Site 15, although sediments are not anticipated to be impacted because the site contaminants (lead and PCBs) have low mobility. Incidental ingestion of and dermal contact with contaminants in sediment by human

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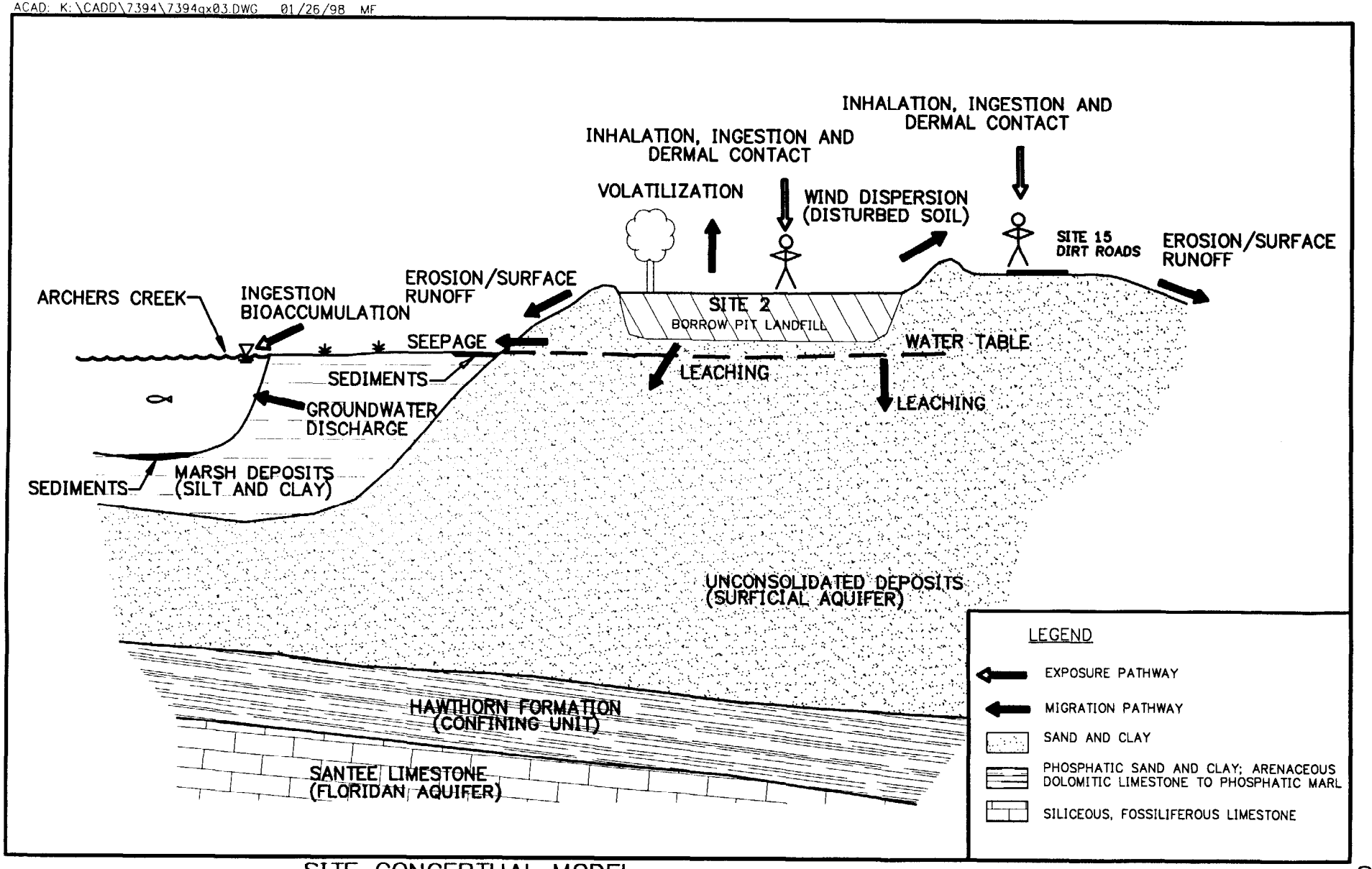


SITE CONCEPTUAL MODEL

SITE 2 – BORROW PIT LANDFILL AND SITE 15 – DIRT ROADS

MCRD PARRIS ISLAND, SOUTH CAROLINA

NOT TO SCALE

FIGURE 3-1

Brown & Root Environmental

receptors are possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors (organisms living and/or feeding on the water bottom) would also be anticipated exposure pathways.

3.3 GROUNDWATER

The Verification Step (McClelland, 1990) determined that shallow groundwater flows to the west from the landfill toward Archers Creek. The Verification Step also determined the gradient to be essentially flat (less than 0.01 ft/ft). In addition, the Verification Step determined the surficial groundwater to be shallow and influenced by tidal changes. However, the marsh deposits underlying the landfill including the Hawthorn Formation may act as a barrier to the Floridan Aquifer and will be investigated. No previous groundwater sampling has been conducted to evaluate Site 15.

Chloroform, 1,2-dichloroethane, and dissolved chromium and arsenic were detected in the groundwater in at least one location, and dissolved barium and lead were detected in all well points at the landfill. The deeper part of the surficial aquifer was not evaluated during the Verification Step, so the vertical extent of contamination has not been identified. Ingestion, dermal contact, and inhalation (via showering) of contaminants in groundwater by human receptors are possible exposure pathways of concern. Exposure to ecological receptors is not anticipated.

3.4 SOIL

The soil at Site 2 may be a contaminant source to surface water and sediment via leaching and surface runoff, and to groundwater via leaching. Neither surface soils nor subsurface soils were sampled during the Verification Step (McClelland, 1990) at Site 2.

The soil at Site 15 is a potential contaminant source to surface water via surface runoff. If surface soil at both sites is found to be adversely impacted, incidental ingestion of and dermal contact with contaminants in the soil by human receptors would be possible exposure pathways of concern. In addition, the surface soil, if disturbed, may serve as a source for airborne transport of contaminants. Contaminants in the soil may also be accumulated by natural or cultivated vegetation which could be ingested by wildlife and/or human receptors. Additional exposure pathways involving direct ingestion or contact with contaminated soil by benthic organisms may also be of concern.

3.5 AIR

Site 2 has been revegetated since cessation of landfill operations. Since vegetative cover reduces the potential for suspension of particulates and subsequent airborne transport, the air pathway is not considered to be significant to human or ecological risk provided that the surface cover is undisturbed. Site 15 is not an active source for air emissions, therefore, air samples will not be collected. The potential for suspension of particles and subsequent airborne transport to human receptors will be evaluated during the risk assessment using the results from surface soil samples.

4.0 INVESTIGATION SCOPING

The scope of this investigation is consistent with the U.S. EPA guidance entitled *Presumptive Remedy for CERCLA Municipal Landfill Sites* (U.S. EPA, 1993) and *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance)* (U.S. EPA, 1996a). In summary, field activities will characterize the nature and extent of contamination within Sites 2 and 15 where potential for offsite migration of contamination exists. Groundwater samples will be collected downgradient of Site 2 groundwater flow, and surface water and sediment samples will be collected downgradient of the path of surface water runoff from Site 2. Additionally, surface soil will be sampled at Sites 2 and 15.

If the results of these activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered. Additionally, if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill, further investigation to determine the competency of the Hawthorn Formation as an adequate confining layer may be warranted. If analytical results indicate that both the lower surficial aquifer has been adversely impacted by the landfill and the Hawthorn Formation does not adequately act as a confining layer, investigation activities to evaluate potential impacts to the underlying Floridan aquifer may also be warranted.

In accordance with U.S. EPA guidance, the Administrative Record will include the necessary generic and site-specific information documenting the selection or non-selection of the containment presumptive remedy (U.S. EPA, 1996a).

4.1 INVESTIGATION RATIONALE

Previous investigations indicated the presence of chloroform and several metals in the sediments adjacent to Site 2 - Borrow Pit Landfill. Metals were also detected in the surface water and groundwater, in addition to chloroform and 1,2-dichloroethane being detected in the surficial aquifer. Based on the information presented in Section 3.0 for the site media, the proposed investigation of Site 2 will include the following media.

- Surface Water - Previous investigations indicated the presence of cadmium, chromium, and lead in the surface water. Additional surface water sampling is proposed to determine whether contaminants are migrating to the surface water at levels above ARARs and risk-based criteria (ecological and human health).

- Sediment - Previous investigations detected VOCs (chloroform) and metals (arsenic, barium, chromium, and lead) in the sediments adjacent to the site. However, the extent of migration of contaminants from the site to adjacent sediments has not been evaluated. Sediment sampling is proposed to determine whether site-related constituents are present in sediments at levels above ARARs and risk-based criteria (ecological and human health).

- Groundwater - Previous investigations detected VOCs (chloroform and 1,2-dichloroethane) and dissolved metals (arsenic, barium, chromium, and lead) in the shallow groundwater. Therefore, sampling of the shallow and deep surficial aquifer is proposed to determine whether site-related compounds are leaching from the landfill at concentrations above ARARs and risk-based criteria (ecological and human health). For use in the human health risk assessment, sampling and analysis will be conducted for evaluating the use of groundwater as a practical drinking water source according to CERCLA (U.S. EPA, 1991).

- Surface/Subsurface Soil - Previous investigations did not include soil sampling. Surface soil sampling is proposed to determine whether the surface soil is a source of contamination for the other migration pathways and to determine whether contamination exists at levels above ARARs and risk-based criteria (ecological and human health). Additionally, surface soil samples are proposed to determine the presence, composition, depth, and areal coverage of fill material at Site 2. Subsurface soil samples are proposed for groundwater modeling purposes to determine the extent of contaminant fate and transport.

- Air - Airborne contamination is not anticipated to pose a risk at this site and therefore will not be investigated directly. Airborne contamination will be investigated indirectly when evaluating potential surface soil transport in the risk assessment.

Table 4-1 summarizes the rationale for investigation of specific media at Site 2.

Previous investigations indicate the presence of metals, volatiles, semivolatiles, pesticides and PCBs in the surface soil at Site 15 - Dirt Roads. Based on the information presented in Section 3.0, the proposed investigation of Site 15 will include the following.

TABLE 4-1

INVESTIGATION RATIONALE
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND
PAGE 1 OF 2

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution Of Data Gaps/Needs
Surface Water	Inorganics (dissolved): cadmium, chromium, and lead	Surface water may be an exposure pathway of contaminants to human and ecological receptors. Contaminant migration to surface water may originate from soil, sediment, and/or groundwater.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Modeling • Site hydrology	• TCL, TAL (metals and cyanide, total and dissolved) parameters • Water quality parameters • Hexavalent chromium • Water-level measurements • Tidal influence study
Sediment	Organics: chloroform Inorganics: arsenic, barium, chromium, and lead	Sediments may be an exposure pathway of contaminants for human and ecological receptors. Contaminant migration to sediment may originate from soil, surface water, and/or groundwater.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Modeling • Volume calculations	• TCL, TAL (metals and cyanide) parameters • Hexavalent chromium • TOC • Grain-size analysis • Bulk density • pH • Sediment sampling results

TABLE 4-1

INVESTIGATION RATIONALE
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND
PAGE 2 OF 2

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution Of Data Gaps/Needs
Groundwater	Organics: chloroform, 1,2-dichloroethane Inorganics (dissolved): chromium, lead, arsenic, and barium	Groundwater may be a pathway of contaminants from soils to surface water and sediment. Groundwater is a potential pathway of contaminants to human and ecological receptors.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Modeling • Site hydrogeology	• TCL, TAL (metals and cyanide, total and dissolved) parameters • Water quality parameters • Appendix IX parameters • Hexavalent chromium • Horizontal hydraulic conductivity • Vertical hydraulic conductivity • Groundwater modeling parameters • Water-level measurements • Tidal influence study
Soil	Historic soil samples collected for visual inspection, soil classification and headspace readings. No nonmethane peaks were identified with field instrumentation. No samples were analyzed by a fixed-based laboratory. Known depository of solid waste, liquid paint wastes, and other chemical constituents.	Soils may be a pathway of contaminants to surface water and sediment as a potential pathway to human and ecological receptors.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Geotechnical characterization • Determine presence and extent of fill (cover) material • Stratigraphy • Modeling	• TCL, TAL (metals and cyanide) parameters • Hexavalent chromium • Soil classification • Lithology • Groundwater modeling parameters

Surface Soil - Waste oils and hydraulic fluids which were suspected to contain PCBs and lead were sprayed on the surface of the dirt roads for dust suppression. Soil sampling is proposed to determine whether contamination exists in the soil at levels above ARARs and risk-based criteria (ecological and human health). No other media will be sampled at Site 15 due to the immobility of the potential site related contaminants.

Table 4-2 summarizes the rationale for investigation of specific media at Site 15.

During past investigations at both sites, relatively low concentrations of contaminants were detected for only a few compounds. To provide sufficient data for conducting subsequent steps of the CERCLA/RCRA cleanup process, a primary sample concern will be to characterize the worst-case site condition under investigation.

4.2 INVESTIGATION SUMMARY

The following sections present the proposed investigation at Sites 2 and 15. All data will be collected in accordance with the Master Field Sampling Plan, Master Quality Assurance Plan (QAP), and U.S. EPA Region 4 Environmental Investigations Standard Operating Procedures Quality Assurance Manual (EISOPQAM) (U.S. EPA, 1996b).

4.2.1 Sampling Activities

Table 4-3 summarizes the field investigation activities at Site 2 - Borrow Pit Landfill. Table 4-4 summarizes the field investigation activities at Site 15 - Dirt Roads.

4.2.2 Analytical Parameter Rationale

This section provides the rationale for the proposed analytical program to be conducted on the samples collected from Sites 2 and 15.

4.2.2.1 TCL and TAL Parameters

Based on the previous disposal practices at Site 2, there is a potential for both organic and inorganic contamination at this site. To determine if contamination exists in the various media (surface water, sediment, groundwater, and surface soils), fixed-base laboratory analysis will be conducted. Samples from each medium will be analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics. These analyses will provide data at Site 2 to determine the nature and extent of

TABLE 4-2

INVESTIGATION RATIONALE
SITE 15 - DIRT ROADS
MCRD PARRIS ISLAND

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution Of Data Gaps/Needs
Surface Soil	Inorganics: Arsenic, beryllium, and Iron Known depository of waste oils and hydraulic fluids.	Soils may be a potential pathway of contaminants to human and ecological receptors.	RI/RFI • Nature and extent characterization • Risk Assessment FS/CMS • Volume calculation	• TCL PCBs and Lead • Soil sample results
Sediment (Elloitt's Beach)	Sediment is downgradient of dirt roads which are known depositories of waste oils and hydraulic fluids.	Contaminants may have migrated from the dirt roads to nearby sediment.	RI/RFI • Nature and extent characterization • Risk Assessment FS/CMS • Volume calculation	• TCL SVOCs, Pesticides/PCBs, TAL metals • Sediment sample results

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND
PAGE 1 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Surface Water	• TCL, TAL parameters	• Collect surface water samples.	4	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals (Total and Dissolved) and Cyanide
	• Water quality parameters	• Collect surface water samples.	4	1	TOC pH Hardness ($CaCO_3$) Dissolved Oxygen and Salinity
	• Ecological parameters	• Collect surface water samples.	4	1	Temperature Secchi Disk readings
	• Risk assessment Assumptions	• Collect surface water sample	3	1	Hexavalent chromium
	• Tidal influence study	• Collect water elevations during 24-hour period	1	48	Field Analysis

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND
PAGE 2 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Sediment	• TCL, TAL parameters	• Collect shallow sediment samples.	4	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metal and Cyanide
	• TCL, TAL parameters	• Collect deep sediment sample.	1	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metal and Cyanide
	• Ecological parameters	• Collect sediment samples.	4	1	TOC Grain-size analysis Bulk Density pH
	• Risk Assessment assumptions	• Collect sediment sample	3	1	Hexavalent chromium

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND
PAGE 3 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Groundwater	• TCL, TAL parameters	• Collect shallow and deep groundwater samples	3	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals (Total and Dissolved) and Cyanide
	• TCL, TAL parameters • Water quality parameters	• Collect shallow and deep groundwater samples.	5	1	TOC pH Hardness ($CaCO_3$), Turbidity, Total Dissolved Solids, Total Suspended Solids, Chloride, Fluoride, Nitrate/Nitrite, Sulfate, Dissolved Oxygen, Salinity
	• Horizontal hydraulic conductivity	• Perform slug tests.	5	1	Evaluation of horizontal hydraulic conducitivity.
	• RCRA	• Collect deep groundwater samples.	2	1	Appendix IX VOCs Appendix IX SVOCs Appendix IX Pesticide/PCBs Appendix IX Organophosphorus Compounds Appendix IX Herbicides Appendix IX Metals (Total and Dissolved)

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND
PAGE 4 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Groundwater (Continued)	• Groundwater flow direction and gradient	• Measure monitoring well groundwater levels.	5	2	Collect water levels at high and low tide. (Can be incorporated in tidal study readings)
		• Tidal influence study.	5	48	Collect water levels every 30 minutes over a 24-hour period during a full or new moon.
	• Risk assessment assumptions	• Collect groundwater sample.	3	1	Hexavalent chromium
	• Vertical hydraulic conductivity	• Collect Shelby Tube at confining layer.	1	1	Permeability test
Soil	• TCL, TAL parameters	• Collect surface soil samples.	9[2]	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals and Cyanide
	• Risk assessment assumptions	• Collect surface soil sample.	3	1	Hexavalent chromium
	• Soil classification	• Collect surface soil sample.	1	1	Grain-size analysis, Atterberg Limits, and natural moisture content.

TABLE 4-3

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND
PAGE 5 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location[1]	Analysis
Soil (Continued)	• Soil classification	• Collect subsurface soil samples.	1	2	Grain-size analysis, Atterberg Limits, and natural moisture content.
	• Groundwater modeling parameters	• Collect subsurface soil sample in aquifer.	1	1	TOC pH Porosity Grain-size analysis Bulk density Specific gravity
	• Groundwater modeling parameters	• Collect surface soil sample.	1	1	TOC pH Porosity Grain-size analysis Bulk density Specific gravity
	• Soil Loggings	• Document soil characteristics during monitoring well installation	2	1	Continuous soil loggings
	• Soil Loggings	• After surface soil sample is collected, bore into the soil until the top limit of waste is reached. Document soil characteristics	8	1	Continuous soil loggings until top limit of waste is encountered.

1 Does not include QA/QC samples.
2 Includes one surface soil sample collected at soil boring PAI-02-SB01 and eight surface soil samples located atop the landfill.

TABLE 4-4

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 15 - DIRT ROADS
MCRD PARRIS ISLAND
PAGE 1 OF 1

Media	Data Gap/Need	Investigation Activity	Number of Locations(1)	Samples per Location	Analysis
Soil (Borrow Pit Landfill)	• TCL PCBs and Lead	• Collect surface soil samples.	4	1	TCL PCBs and Lead
Soil (Elliott's Beach)	• TCL PCBs and Lead	• Collect surface soil samples.	2	1	TCL PCBs and Lead
Sediment (Elliott's Beach)	• TCL Pesticides/PCBs, TCL SVOCs, and TAL Metals	• Collect composite sediment sample	3	1	TCL Pesticides/PCBs, TCL SVOCs, and TAL Metals

1 Does not include QA/QC samples.

contamination and to conduct a human health and ecological risk assessment. The TCL organics analysis includes both volatile and semivolatile organics. Samples from each media will also be analyzed for both TCL PCBs, and TCL pesticides. Media will be analyzed for these parameters because pesticides and/or PCBs may have been disposed of at Site 2. TAL metals (total and dissolved) and cyanide will be analyzed because these constituents are potential components of the wastes disposed of at Site 2.

Based on the previous activities conducted at Site 15 for dust suppression, there is a potential for PCB and lead contamination. To determine if contamination exists in the surface soil, fixed-base laboratory analysis will be conducted. Soil samples will be analyzed for TCL PCBs and lead. These analyses will provide data at Site 15 to determine the nature and extent of contamination and to conduct a human health and ecological risk assessment. TCL PCBs and lead will be analyzed because they are the primary waste constituents of the waste oil sprayed on Site 15.

The results of these analyses will be compared against the screening criteria established in the decision document (Volume III of the Master Work Plan) (B&R Environmental, 1998c) to determine whether there is a potential risk to human or ecological receptors.

4.2.2.2 RCRA Appendix IX Constituents

Two groundwater samples will be collected and analyzed for the inorganic (total and dissolved metals) and volatile, semivolatile, pesticide/PCB, organophosphorus, and herbicide organic constituents listed in Appendix IX of 40 CFR Part 264. The sample will be collected to satisfy RCRA requirements for the field investigation. The locations of these samples will be discussed in Section 7.0.

4.2.2.3 Hexavalent Chromium

At Site 2, samples will be collected from surface soil, groundwater, surface water, and sediment and analyzed for hexavalent chromium for risk assessment purposes. Three samples will be collected from each medium. Sampling locations are chosen based on the likelihood of contaminant migration/accumulation and the results of previous investigations. Hexavalent chromium analysis will not be conducted on samples taken at Site 15.

4.2.2.4 Water Quality Parameters

In addition to determining contaminant concentrations in surface water and/or groundwater, water quality parameters such as Total Organic Carbon (TOC), pH, and hardness will be obtained. These parameters are necessary for modeling and risk assessment. Surface water measurements shall also include

dissolved oxygen, temperature, Secchi Disk readings and salinity to assist in the ecological risk assessment. If surface water is not deep enough to provide valid Secchi Disk readings, turbidity meter readings will be used instead.

4.2.3 Groundwater and Ecological Modeling Parameter Rationale

Modeling will be conducted to evaluate the potential contaminant fate and transport. General parameters which are required to perform modeling include:

Aquifer

- Horizontal Hydraulic Conductivity (K_h) of surficial aquifer
- Vertical Hydraulic Conductivity (K_v) of confining layer
- Total Organic Carbon (TOC)
- Porosity
- Bulk Density
- Grain-Size Analysis
- Specific Gravity

Ecological

- TOC
- Bulk Density
- Grain-Size Analysis
- pH
- Hardness
- Secchi Disk Readiness

4.2.3.1 Soil Classification

Soil classification is used to determine the geotechnical and geochemical properties of the soil and includes grain-size analysis, Atterberg Limits, and moisture content. Grain-size analysis is useful for determining the heterogeneity of the soil and can be used to estimate seepage velocities. The moisture content of the soil is important in evaluating potential remedial actions and for contaminant transport through the vadose zone. The Atterberg Limits are used to determine engineering properties (water content boundaries) of the soil.

4.2.3.2 Horizontal Hydraulic Conductivity (K_h)

A slug test will be conducted at each monitoring well to determine the horizontal hydraulic conductivity of the aquifer in the immediate vicinity of the well. This information will be used to characterize the aquifer and in the groundwater modeling and during evaluation of aquifer remediation alternatives, if necessary.

4.2.3.3 Vertical Hydraulic Conductivity (K_v)

The Hawthorn Formation (confining unit), which underlies the surficial aquifer, will be evaluated to determine its vertical hydraulic conductivity by performing a permeability test on a core sample. ASTM Method D5084-90 and analysis Method SW-846-9100 will be utilized for the permeability testing. The sample will be collected using a Shelby Tube. A knowledge of the vertical hydraulic conductivity of the confining unit is useful in evaluating the potential of the unit to impede the migration of contaminated groundwater into the underlying water supply system.

4.2.3.4 Groundwater-Level Measurements

Groundwater-level data will be used to determine the depth, flow direction, and gradient of the groundwater. The water-level data is also useful for setting calibration targets for modeling. Groundwater level measurements will be collected in accordance with SOP GH-1.2, "Evaluation of Existing Monitoring Wells and Water-Level Measurements," and the information obtained will be used to prepare groundwater contour maps. The groundwater-level measurements will be collected synoptically at high and low groundwater elevations as determined by the tidal study.

4.2.3.5 Tidal Influence Study

Site 2 is in an area that is affected by tidal influences. To evaluate the effect of the tidal fluctuations on contaminant flushing, a tidal study will be conducted over a minimum period of 24 hours. The goal of the study will be to determine how the surface water tidal fluctuations and the groundwater elevations are related.

The tidal influence study will consist of collecting groundwater elevations and surface water elevations every 30 minutes over a minimum of a 24-hour period. Measurements will be collected until the high and low tide data are collected for the surface water verses the high and low groundwater elevations (i.e., the lag time between the surface water and groundwater will be determined). The length of the study will

depend on the lag time between the high/low surface water elevation and the high/low groundwater elevations.

Groundwater-level measurements will be collected in accordance with SOP GH-1.2, "Evaluation of Existing Monitoring Wells and Water-Level Measurement." Surface water measurements will be obtained by installing a staff gauge in the surface water body and collecting measurements from a known reference point to the surface water elevation. Measurements will be collected during a full or new moon so that the extremes in water-level elevation can be determined.

Published local tide tables and precipitation data will also be obtained during the course of the field investigation from the nearest local resource. The information will be used to determine tidal cycle peaks and precipitation impacts on surface water and groundwater.

5.0 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

The following two sections briefly describe the human health and ecological risk assessment that will be conducted for Sites 2 and 15.

5.1 HUMAN HEALTH RISK ASSESSMENT

A human health risk assessment for these sites will be performed. Analytical data generated during the investigation, as well as historical data for the site, will be used to determine whether measured chemical concentrations pose a significant threat to human receptors. The general methodologies which will be used to assess human health risks are contained in Appendix A of the Master Work Plan Volume III for MCRD Parris Island (B&R Environmental, 1998c).

Potential chemicals of concern (COCs) for Site 2, based on the Verification Step, are chloroform, 1,2-dichloroethane, arsenic, barium, cadmium, chromium, and lead. Potential COCs for Site 15, based on the use of waste oils and hydraulic fluids, are PCBs and lead. Based on data collected during the RI/RFI, the Region 3 RBC screening levels (U.S. EPA, 1997) will be used to identify additional site-specific COCs for soil, sediment, surface water, and groundwater at Site 2 and for soil at Site 15. Included in the groundwater analysis will be pH, turbidity, dissolved solids, TOC, chloride, fluoride, nitrate/nitrite, dissolved oxygen, salinity and sulfate to aid in determining whether the groundwater at the site is suitable for use as a drinking water source. If it is determined that the groundwater is not potable, groundwater will be removed as a pathway of concern from the human health risk assessment.

The following potential receptor groups will be evaluated in the human health risk assessment. Site 15 will only include the receptors that are associated with the soil exposure pathway.

- Adolescent Trespassers
  - Soil: ingestion, dermal contact
  - Surface Water: ingestion, dermal contact
  - Sediment: ingestion, dermal contact

- Construction Workers
  - Soil: ingestion, dermal contact
  - Groundwater: ingestion, dermal contact
  - Surface Water: ingestion, dermal contact

- Future Residents
  - Soil: ingestion, dermal contact, vegetable consumption
  - Groundwater: ingestion, dermal contact, inhalation (showering)

- Workers (Maintenance, Other Employees)
  - Soil: ingestion, dermal contact
  - Groundwater: ingestion, dermal contact

- Adult and Adolscent Recreational Users
  - Surface Water: ingestion, dermal contact
  - Finfish: ingestion

Additional details on receptors and complete exposure pathways to be considered in the development of the human health risk assessment are provided in Section 3.3 of the Human Health Risk Assessment Methodology provided in Appendix A of the Master Work Plan, Volume III (B&R Environmental, 1998c).

5.2 ECOLOGICAL RISK ASSESSMENT

An ecological risk assessment for this site will be performed. Analytical data generated under this Work Plan, as well as historical data for the site, will be used to determine if measured chemical concentrations pose a significant threat to potential ecological receptors. The general methodologies which will be used to assess risks to ecological receptors are contained in Appendix B of the Master Work Plan, Volume III for MCRD, Parris Island (B&R Environmental, 1998c).

Selection of contaminants of potential concern will be accomplished by the comparison of maximum detected site concentrations to U.S. EPA Region 4 screening values. Arsenic, cadmium, chromium, and lead have been identified as potential contaminants in the Verification Study.

The preliminary ecological risk assessment will begin with a "preliminary problem formulation" step, including review of historical documents, potential COCs, site characteristics, photographs, maps, and notes from a site visit. Media of concern include: surface soil, sediment, and surface water. Additionally, groundwater discharge to surface water will be included as an exposure medium. Receptors may be exposed to such contaminants through direct contact, inhalation, ingestion of media, and ingestion of contaminated food. Preliminary receptors of concern at Sites 2 and 15 may be:

- Terrestrial invertebrates,
- Terrestrial vertebrates,
- Aquatic life, and
- Benthic Invertebrates.

Others may be added, especially if sampling reveals bioaccumulating chemicals at concentrations above screening levels.

The latter part of the preliminary assessment will include an evaluation of ecological effects, which will establish preliminary threshold levels for contaminant concentrations in exposure media, and if needed, for contaminant ingestion rates. A preliminary exposure assessment will entail the compilation of maximum contaminant concentrations in exposure media. If necessary, maximum ingestion rates for indicator species will be calculated. The preliminary risk calculations will be in the form of ratios; the exposure levels to be divided by the threshold values.

The preliminary risk assessment will be initially documented in the form of a technical memorandum. The purpose of the memorandum is to provide results as quickly as possible in case more investigation may be required. The preliminary risk assessment will conclude with recommendations for further investigation. If more work is required, a work plan addendum would be submitted.

6.0 FIELD OPERATIONS

This section is the Site-Specific Field Sampling Plan (FSP) for the investigation at Site 2 - Borrow Pit Landfill and Site 15 - Dirt Roads. It outlines the project-specific field investigation activities to be performed at Sites 2 and 15 for this investigation. It is to be used in conjunction with the Master FSP, Volume II of the Master Work Plan for MCRD, Parris Island (B&R Environmental, 1998c) and references the Master FSP where appropriate.

Field operation activities to be performed at MCRD Parris Island for this investigation include mobilization of equipment, drilling of soil borings, soil sampling, monitoring well installation, hydraulic conductivity testing (slug tests), surface water and sediment sampling, groundwater sampling, water-level measurements, site surveying, equipment decontamination, waste handling, and site restoration. Monitoring well installation will be a priority of the field effort followed by water-level measurements. The results of these measurements will be used to better characterize the depth, flow direction, and gradient of the groundwater.

All field operation activities will be performed as described in the Master FSP and Standard Operating Procedures (SOPs) provided in Volume II of the Master Work Plan, except where noted. All well installation activities will be performed under the direction of a state-certified Professional Geologist familiar with all state, federal, and local laws, regulations, and requirements pertaining to the geologist's duties and responsibilities. Additionally, a state-certified driller will be used.

6.1 MOBILIZATION/DEMOBILIZATION

Mobilization activities will be performed in accordance with the procedures outlined in the Master FSP. If additional field investigations are occurring at other sites at MCRD Parris Island, field activities at Sites 2 and 15 will be coordinated accordingly with the other field activities.

6.2 SITE RESTORATION

If investigation activities (e.g., monitoring well installation) disturb or alter the landscape, vegetation, or other features of Site 2 or 15, the site may require restoration to conditions prior to the investigation. If vegetation is stressed or damaged as a result of investigation activities, the affected area will be reseeded. Portions of Sites 2 or 15 would be regraded if investigation activities alter the natural contour of the sites. Additionally, all equipment used during the investigation and investigation-derived waste (IDW) will be removed from the sites.

6.3 SOIL BORINGS

Two soil borings will be drilled at Site 2 for the purpose of monitoring well installation. At high tide monitoring wells will be placed as far from the landfill boundary, as possible, without entering surface water. From these borings, one boring will be converted to a shallow surficial aquifer well and one will be converted to a deep surficial aquifer well. Two samples will be collected at the deep well boring location; in the vadose zone and within the aquifer. The mud-rotary drilling method will be used for advancing the soil borings. The mud-rotary drilling technique involves the downward advancement of 5 to 10 feet long sections of hollow, heavy-gauge steel rods. Hollow rods of sufficient diameter will be used to produce a 2-inch annular space between the casing and the borehole wall. The drilling fluids must be adequately thinned to allow proper installation of well materials.

Split-spoon samples will be collected continuously from the ground surface to the termination depth of the borings in accordance with ASTM Standard Method D 1586-84. The split-spoon samplers will have a minimum inside diameter (I.D.) of 2 inches and a length of 2 feet to fulfill sample volume requirements for chemical analysis. Each split-spoon sample will be field screened with a Flameionization Detector (FID) or Photoionization Detector (PID) upon collection and head-space field analysis shall be performed to prejudice the selection of the sample to be submitted for fixed-base laboratory analysis. Split-spoon samples will be divided and placed in chemical sample jars and 8-oz. lithologic sample jars. Selected chemical sample jars will be labeled, packed, and shipped to the laboratory. Lithologic sample jars will be labeled as described in the Master FSP and retained on site until completion of the investigation, at which time all lithologic samples will be properly disposed. Lithologic sampling will provide information relevant to contaminant fate and transport modeling.

At one soil boring, a Shelby Tube sample will be collected within the Hawthorn Formation (confining layer) in accordance with the methodologies described in B&R Environmental SOP Number SA-1.3, "Soil Sampling." Because the thickness and consistency of the Hawthorn Formation has not been verified during previous investigations, the following events will take place to prevent the possibility of compromising the integrity of the confining layer. Initially, a soil boring will be installed as described previously. Once the top of the Hawthorn Formation is encountered, any material removed from the confining unit will be replaced with a bentonite/cement mixture. Then, an additional soil boring will be installed a few feet upgradient of the initial boring. The boring will be installed to the depth of the top of the Hawthorn Formation and from this depth, a Shelby Tube sample will be collected and removed material will be replaced with a bentonite/cement mixture. This procedure will ensure that no more than 2 feet of

material will be removed from the confining layer thus minimizing the potential to contaminate the underlying Floridan aquifer.

A boring log will be maintained as described in the Master FSP for each soil boring by the state-certified field geologist. Field screening and head-space analysis results and a lithologic description of each split-spoon sample will be recorded on the boring log. At a minimum, the information outlined in the Master FSP will be recorded on the boring log for each boring.

6.4 MONITORING WELL INSTALLATION AND CONSTRUCTION

Monitoring wells will be installed and constructed in accordance with all applicable State of South Carolina regulations (e.g., Code of Laws of South Carolina 1976, Regulation 61-71 Well Standards) and the Master FSP. Prior to the construction of any monitoring well, a request will be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) for approval. The request will contain the following information:

- Proposed location(s) on a scaled map or plate
- Proposed construction detail
- Intended purpose of the monitoring well(s)

The state also requires a formal submission detailing the activity performed during the installation of the monitoring well(s). A monitoring well record form or other form provided and/or approved by the state shall be completed and submitted within 30 days after completion of each monitoring well. The form shall contain the following information:

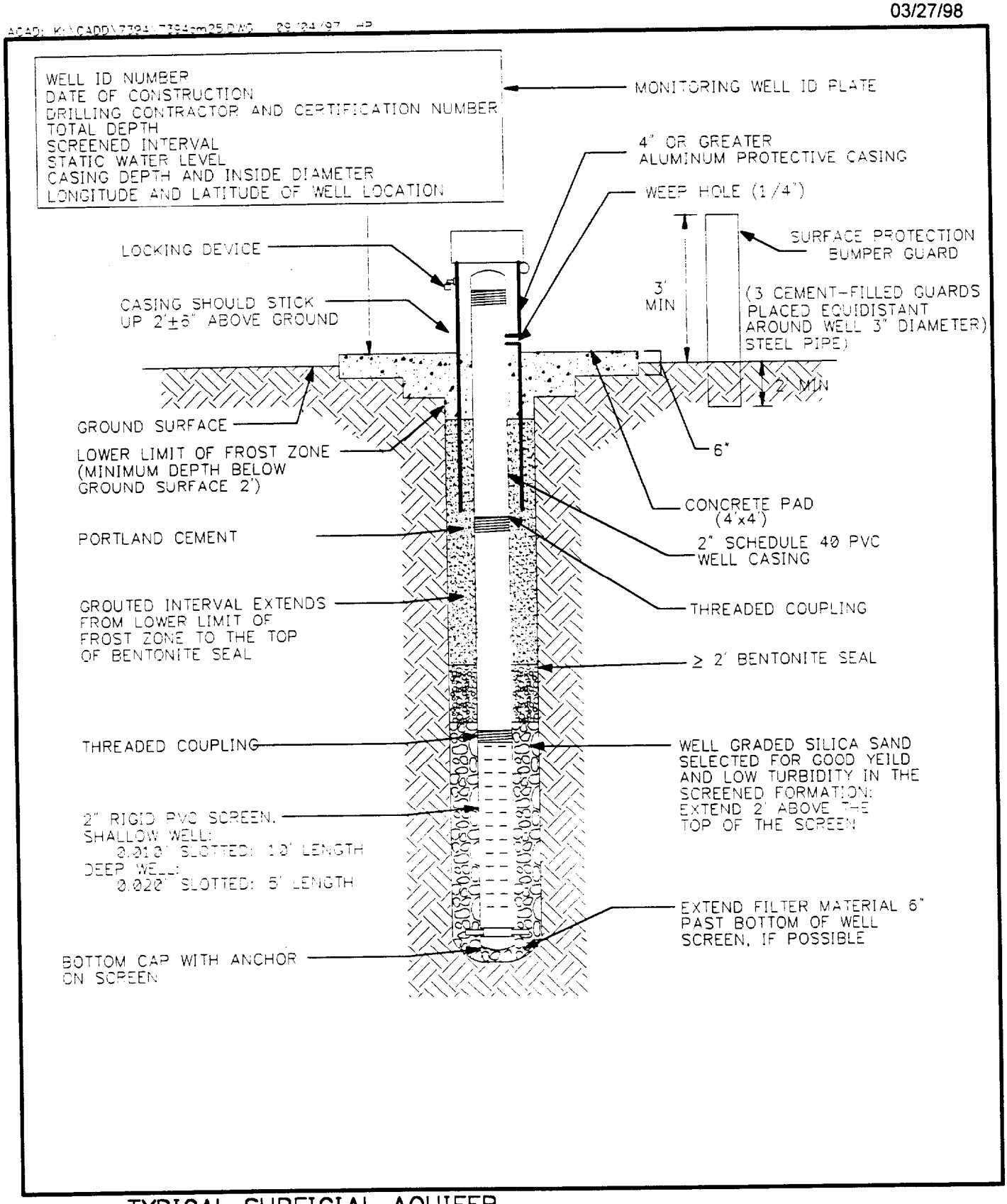
(a) Name and address of facility/owner
(b) Location of monitoring well(s) on a scaled map or plate
(c) Driller and certification number
(d) Date drilled
(e) Driller's or geologist's log
(f) Total depth
(g) Screened interval
(h) Diameter and construction details
(i) Depth to water table with date and time measured
(j) Surveyed elevation of measuring point with respect to an established benchmark
(k) State-certified professional geologist's seal and certification number

One shallow monitoring well (PAI-02-GW04) and one deep monitoring well (PAI-02-GW05) will be installed downgradient of Site 2 in the surficial aquifer. All wells will be constructed with certified-clean well construction material provided by the drilling subcontractor and will follow procedures outlined in the Master FSP. The shallow well will monitor the top of the surficial aquifer, whereas the deep well will monitor the bottom of the surficial aquifer. The top of the screened interval for the shallow monitoring well will be placed approximately 2 feet above the high tide water table, assuming sufficient water remains in the well during low tide to obtain a groundwater sample. The shallow monitoring well will be constructed of 2-inch I.D., flush-threaded rigid PVC well screen and compatibly-threaded PVC well casing riser. The PVC shall meet National Sanitation Foundation (NSF) Standard 14 as specified in U.S. EPA Region 4 Environmental Investigations Standard Operating Procedure and Quality Assurance Manual (EISOPQAM) (U.S. EPA, 1996b). PVC is appropriate for this application because sorption and leaching are not of sufficient impact and is expected to function properly for the expected duration of this project.

The borehole for the deep monitoring well will be advanced to the top of the confining unit (Hawthorn Formation) underlying the surficial aquifer. The bottom of the screened interval for the deep monitoring well will be placed even with, or slightly below, the top of the confining unit. The deep monitoring well will be constructed of a 2-inch I.D., flush-threaded rigid PVC well screen and a PVC well casing riser. The PVC shall meet NSF Standard 14 (NSF WC) as specified in U.S. EPA Region 4 EISOPQAM guidance. PVC is appropriate for this application because sorption and leaching is not of sufficient impact to affect the pipe and is expected to function properly for the expected duration of this project.

Well screens for shallow monitoring wells will be 10 feet long with 0.010-inch openings. Deep well screens will be 5 feet long with 0.020-inch openings. There is sufficient history from existing wells to conclude that the upper wells will be screened in fine-grained material (silt and fine sand) and the deeper wells will be screened in more coarse-grained sands. Therefore, the anticipated slot size for the shallow and deep well screens is determined to be 0.010 and 0.020 inches accordingly.

For both shallow and deep monitoring wells, a primary filter pack of clean, silica sand will be installed flush with the bottom of the well to a minimum of 2 feet above the top of the well screen. The filter pack will not be installed below the bottom of the well as to prevent the potential migration of chloroform below the well screen if chloroform is present in the groundwater. A sand passing U.S. Standard Sieve No. 20-30 will be used for finer formations (0.010 slot size), and sand passing U.S. Standard Sieve No. 10-20 will be used for coarser formations (0.020 slot size), as determined by the site geologist. A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate in accordance with the manufacturer's recommendations. The annular space above the bentonite



TYPICAL SURFICIAL AQUIFER
MONITORING WELL DETAIL
MCRD
PARRIS ISLAND, SOUTH CAROLINA
NOT TO SCALE

FIGURE 6-1

Brown & Root Environmental

seal will be grouted with neat cement or a bentonite/cement mixture from the top of the bentonite seal to a point below the frost line (at least two feet below ground surface). The concrete used to form the pad will fill the remaining annular space. Figure 6-1 illustrates a typical monitoring well construction.

All monitoring wells will be completed with a 4-inch diameter, protective aluminum casing with a locking cap, as described in the Master FSP. A 4-foot- by 4-foot-wide by 6-inch-thick concrete surface seal shall be placed flush with the ground surface. A minimum of three bumper guards consisting of steel pipes filled with cement slurry will be installed equidistant around each monitoring well. Additionally, a 4-inch by 4-inch aluminum tag identification plate will be affixed to each well and will contain the following information.

(a) Well identification number
(b) Date of construction
(c) Drilling contractor and certification number
(d) Depth of well
(e) Screen interval
(f) Static water level
(g) Casing depth and inside diameter
(h) Longitude and latitude of site

Prior to sampling, all monitoring wells will be developed to remove formation cuttings, (as well as any residual drilling fluids) as described in the Master FSP, Volume II (B&R Environmental, 1998c).

6.5 HYDRAULIC CONDUCTIVITY

Slug tests will be performed at each proposed and existing monitoring well to determine the hydraulic conductivity of the aquifer. The slug tests will be conducted according to the procedures described in Section 2.7.1 of the Master FSP, Volume II (B&R Environmental, 1998c).

6.6 SURVEYING

All groundwater monitoring wells, soil samples, surface water, and sediment locations will be surveyed. The staff gauge will also be surveyed. A third-order survey will be conducted by a professional surveyor licensed in the State of South Carolina according to the requirements described in the Master FSP (Section 2.7.1) of the Master Work Plan, Volume II (B&R Environmental, 1998c).

6.7 WATER-LEVEL MEASUREMENTS

Two synoptic rounds of water-level measurements of proposed and existing monitoring wells at Site 2 will be conducted for this investigation. One round will be collected during high tide, and the second round will be collected during low tide, based on Naval tidal charts for MCRD Parris Island. This will be incorporated with the tidal influence study in which water levels are recorded every 30 minutes over a 24-hour period at each monitoring well (see Section 4.2.3.5). Surface water levels will also be collected over a 24-hour period to evaluate tidal influences. A standard USGS staff gauge (National Oceanic Survey) or permanent feature will be used as a reference point for measurements.

All instrumentation should be checked for damage, warpage, legibility, etc., before use. It must also be cleaned before and after use. The staff gauge and wells will be permanently marked by the field operations leader (FOL) indicating the referenced points of measurement. The reference points will be subsequently surveyed for location and elevation.

Procedures for conducting surface water stage/tape downs will be conducted in accordance with the procedures identified in Section 15.5 of the U.S. EPA Region 4 EISOPQAM (U.S. EPA, 1996b).

All water-level measurements will be noted with the time and recorded to the nearest 0.01 foot.

6.8 DECONTAMINATION

Decontamination of major equipment and sampling equipment will be in accordance with the Master FSP and SOP Number SA-7.1, "Decontamination of Field Equipment and Waste Handling." An area for the decontamination pad for major equipment and a source of potable water for steam washing will be arranged by the FOL through MCRD personnel.

6.9 WASTE HANDLING

All solid and liquid wastes generated as a result of this investigation will be handled in accordance with the procedures described in Section 2.11 of the Master FSP and SOP Number SA-7.1, "Decontamination of Field Equipment and Waste Handling."

7.0 ENVIRONMENTAL SAMPLING

This section outlines the environmental sampling program and describes the sampling procedures for the field investigation at Site 2 - Borrow Pit Landfill and Site 15 - Dirt Roads.

7.1 SUMMARY OF ENVIRONMENTAL SAMPLING

Table 7-1 summarizes the sampling program for Site 2 and Table 7-2 summarizes the sampling program for Site 15. Figure 7-1 illustrates the proposed surface water and sediment sampling locations at Site 2. Figure 7-2 depicts the proposed soil sampling locations and Figure 7-3 shows the proposed groundwater sampling locations at Site 2. Figures 7-4 and 7-5 illustrate the proposed surface soil sample locations for Site 15. Proposed sampling locations are contingent upon utility location and clearance with MCRD personnel.

7.2 SAMPLING PROCEDURES

The following sections describe sampling procedures that will be followed for surface water and sediment, soil, and groundwater sample collection. Additionally, the following sections present the proposed sampling locations for field activities. If during field activities, the FOL deems that an area not contained in the Work Plan should be sampled because of surface features (e.g., depressions) that would cause preferential accumulation of contaminants, the location of samples presented in the sampling plan will be altered to include such areas. Additionally, the rationale for deviations will be documented in the RI/RFI report.

7.2.1 Surface Water and Sediment Sampling

At Site 2, four surface water samples and five sediment samples will be collected for this investigation at locations indicated on Figure 7-1. Four of the five sediment samples will be collected at a 0- to 6-inch sampling depth to reflect offsite migration, and at one location (at PAI-02-SD02), one sample will be collected from a 6- to 12-inch depth to reflect historical accumulation. Collection of surface sediments will be biased towards depositional areas. Due to the close proximity of Sites 1 and 41 to Sites 2 and 15, the background surface water and sediment samples taken for Site 1 - Incinerator Landfill and Site 41 - Former Incinerator will be used to assess the representative background concentration of constituents for Sites 2 and 15 (B&R Environmental, 1998a).

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 3

Sample Location	Sample Designation	Sample Depth (feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
SURFACE WATER											
PAI-02-SW01	PAI-02-SW-001-00	Surface	•	•	•	•	•	•			Ecological Parameters(1)
PAI-02-SW02	PAI-02-SW-002-00	Surface	•	•	•	•	•	•		•	Ecological Parameters(1)
PAI-02-SW03	PAI-02-SW-003-00	Surface	•	•	•	•	•	•		•	Ecological Parameters(1)
PAI-02-SW04	PAI-02-SW-004-00	Surface	•	•	•	•	•	•		•	Ecological Parameters(1)
SEDIMENT											
PAI-02-SD01	PAI-02-SD-001-01	0 - 0.5	•	•	•		•	TOC and pH, only			Ecological Parameters(2)
PAI-02-SD02	PAI-02-SD-002-01	0 - 0.5	•	•	•		•	TOC and pH, only		•	Ecological Parameters(2)
PAI-02-SD02	PAI-02-SD-002-02	0.5 - 1	•	•	•		•	TOC and pH, only			
PAI-02-SD03	PAI-02-SD-003-01	0 - 0.5	•	•	•		•	TOC and pH, only		•	Ecological Parameters(2)
PAI-02-SD04	PAI-02-SD-004-01	0 - 0.5	•	•	•		•	TOC and pH, only		•	Ecological Parameters(2)
SOIL											
PAI-02-SS01	PAI-02-SS-001-01	0-1	•	•	•		•			•	Soil Log

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 3

Sample Location	Sample Designation	Sample Depth (feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
SOIL (Continued)											
PAI-02-SS02	PAI-02-SS-002-01	0-1	•	•	•		•				Soil Log
PAI-02-SS03	PAI-02-SS-003-01	0-1	•	•	•		•				Soil Log
PAI-02-SS04	PAI-02-SS-004-01	0-1	•	•	•		•				Soil Log
PAI-02-SS05	PAI-02-SS-005-01	0-1	•	•	•		•				Soil Log
PAI-02-SS06	PAI-02-SS-006-01	0-1	•	•	•		•			•	Soil Log
PAI-02-SS07	PAI-02-SS-007-01	0-1	•	•	•		•	TOC and pH only			•(6)(7)
PAI-02-SS08	PAI-02-SS-008-01	0-1	•	•	•		•			•	Soil Log
PAI-02-SB01	PAI-02-SB-001-01	0-1	•	•	•		•				Soil Log
PAI-02-SB01 (from well location GW05)	PAI-02-SB-001-XX(3)	TBD(10)									•(7)
PAI-02-SB01 (from well location GW05)	PAI-02-SB-001-XX(3)	TBD(5)						TOC and pH only			•(6)(7)
PAI-02-SB01 (from well location GW05)	PAI-02-SB-001-XX(3)	TBD(11)									•(4)

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 3 OF 3

Sample Location	Sample Designation	Sample Depth (feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	Appendix IX	Hexavalent Chromium	Additional Analysis
GROUNDWATER (Continued)											
PAI-02-GW01 (existing monitoring well)	PAI-02-GW-001-01	Shallow Surficial	•	•	•	•	•	•			•(8)(9)
PAI-02-GW02 (existing monitoring well)	PAI-02-GW-002-01	Deep Surficial						•	•	•	•(8)(9)
PAI-02-GW03 (existing monitoring well)	PAI-02-GW-003-01	Deep Surficial	•	•	•	•	•	•			•(8)(9)
PAI-02-GW04	PAI-02-GW-004-01	Shallow Surficial	•	•	•	•	•	•		•	•(8)(9)
PAI-02-GW05 (converted from PAI-02-SB01)	PAI-02-GW-005-01	Deep Surficial						•	•	•	•(8)(9)

(1) Dissolved oxygen, salinity, temperature, and Secchi Disk readings.
(2) Grain-size analysis and bulk density.
(3) XX = Sample depth determined in field.
(4) A Shelby Tube will be collected from the Hawthorn Formation to determine vertical conductivity.
(5) Sample to be collected from the saturated zone.
(6) Porosity, grain-size analysis, bulk density, and specific gravity.
(7) Natural moisture content, grain-size analysis, and Atterberg Limits.
(8) Turbidity, TDS, TSS, chloride, fluoride, nitrate/nitrite, sulfate, salinity, and dissolved oxygen.
(9) Perform slug test, water-level measurements, and tidal influence study.
(10) Sample to be collected from the vadose zone.
(11) Sample to be collected from the Hawthorn Formation.

TBD To be determined

TABLE 7-2

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 15 - DIRT ROADS
MCRD PARRIS ISLAND, SOUTH CAROLINA

Sample Location	Sample Designation	Sample Depth (feet below ground surface)	Sample Analysis				
			TCL PCBs	Lead	TAL Metals (Total)	TCL SVOCs	TCL Pesticides
SOIL							
PAI-15-SS01	PAI-15-SS-001-01	0 - 1	•	•			
PAI-15-SS02	PAI-15-SS-002-01	0 - 1	•	•			
PAI-15-SS03	PAI-15-SS-003-01	0 - 1	•	•			
PAI 15-SS04	PAI-15-SS-004-01	0 - 1	•	•			
PAI-15-SS05	PAI-15-SS-005-01	0 - 1	•	•			
PAI-15-SS06	PAI-15-SS-006-01	0 - 1	•	•			
SEDIMENT							
PAI-15-SD01	PAI-15-SD-001-01	0 - 0.5	•		•	•	•
PAI-15-SD02	PAI-15-SD-002-01	0 - 0.5	•		•	•	•
PAI-15-SD03	PAI-15-SD-003-01	0 - 0.5	•		•	•	•

(1) Soil sample to be collected in an area determined to be a low spot or drainage area.

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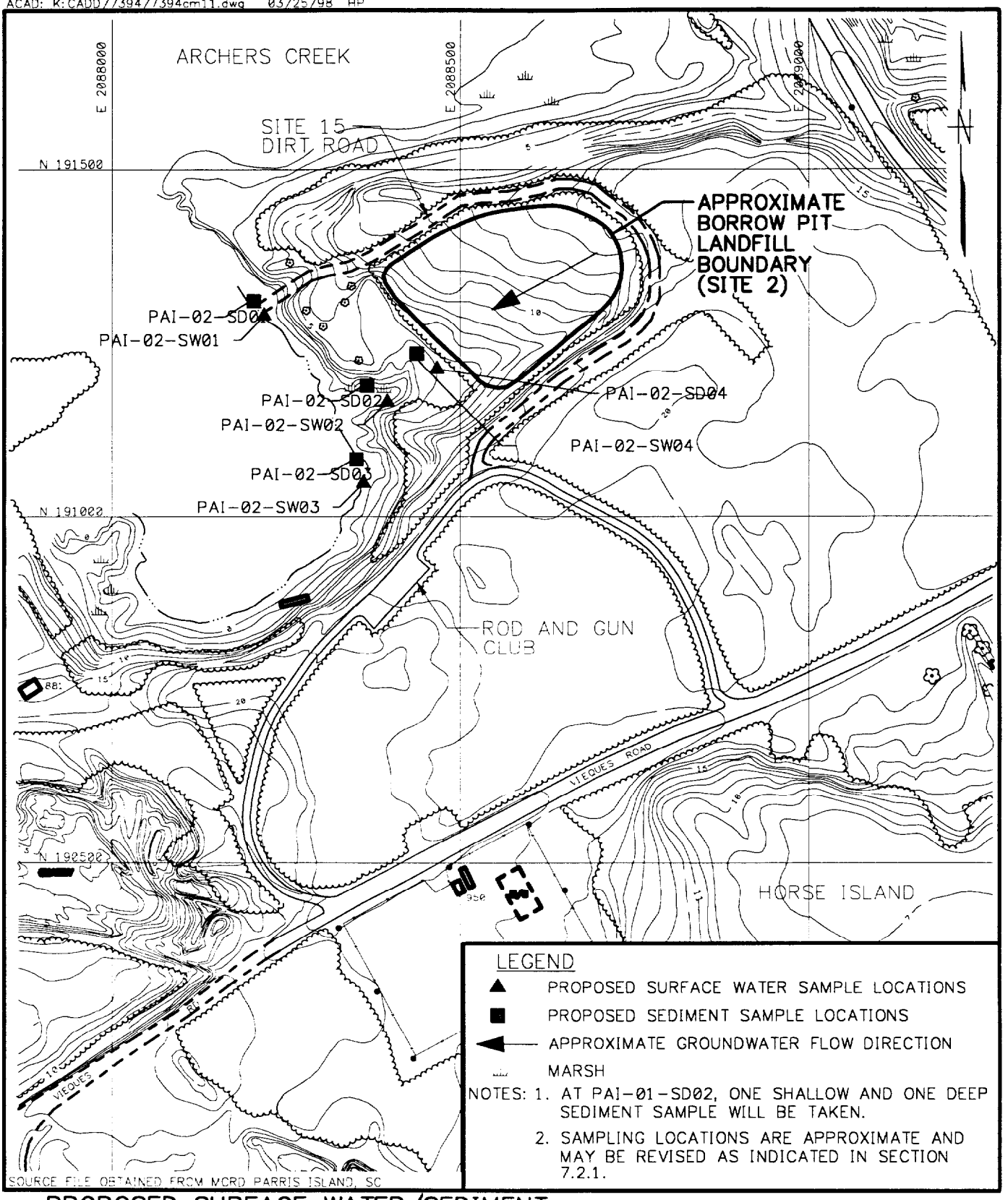

PROPOSED SURFACE WATER/SEDIMENT SAMPLE LOCATIONS
SITE 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 7-1

0 200 400
SCALE IN FEET

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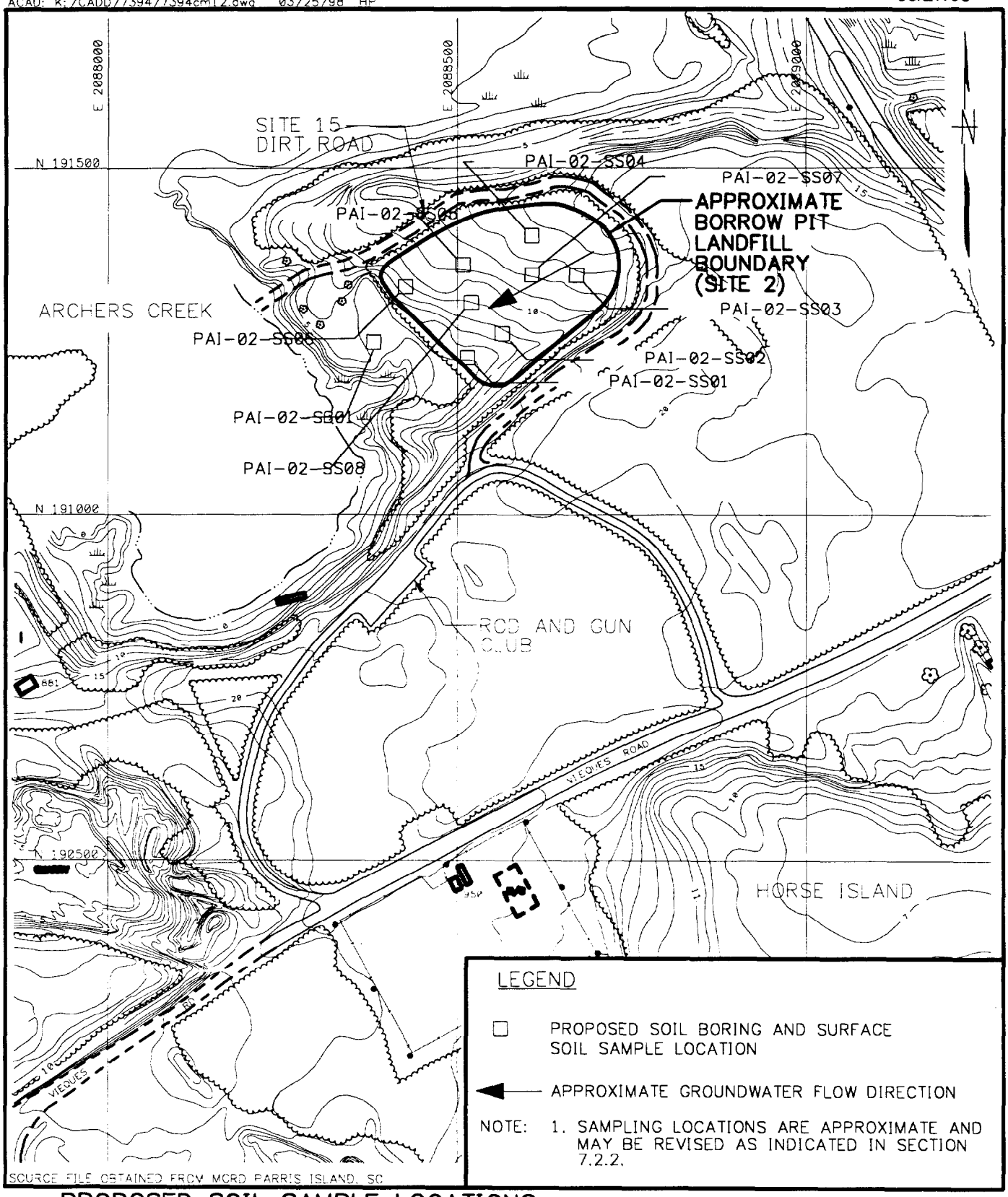

PROPOSED SOIL SAMPLE LOCATIONS
SITE 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 7-2

2 200 400
SCALE IN FEET

Brown & Root Environmental

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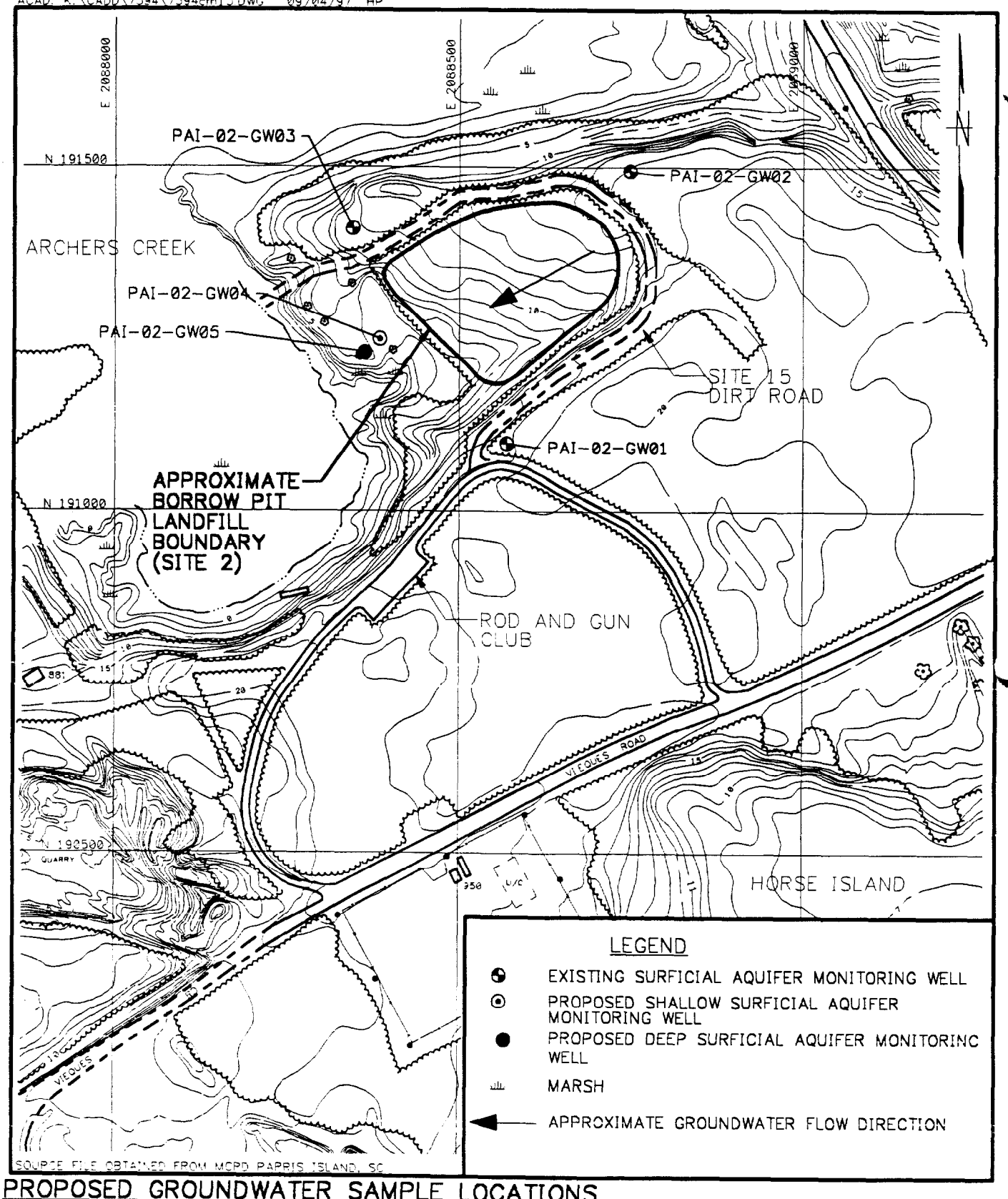

PROPOSED GROUNDWATER SAMPLE LOCATIONS
SITE 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

0 200 400
SCALE IN FEET

FIGURE 7-3

Brown & Root Environmental

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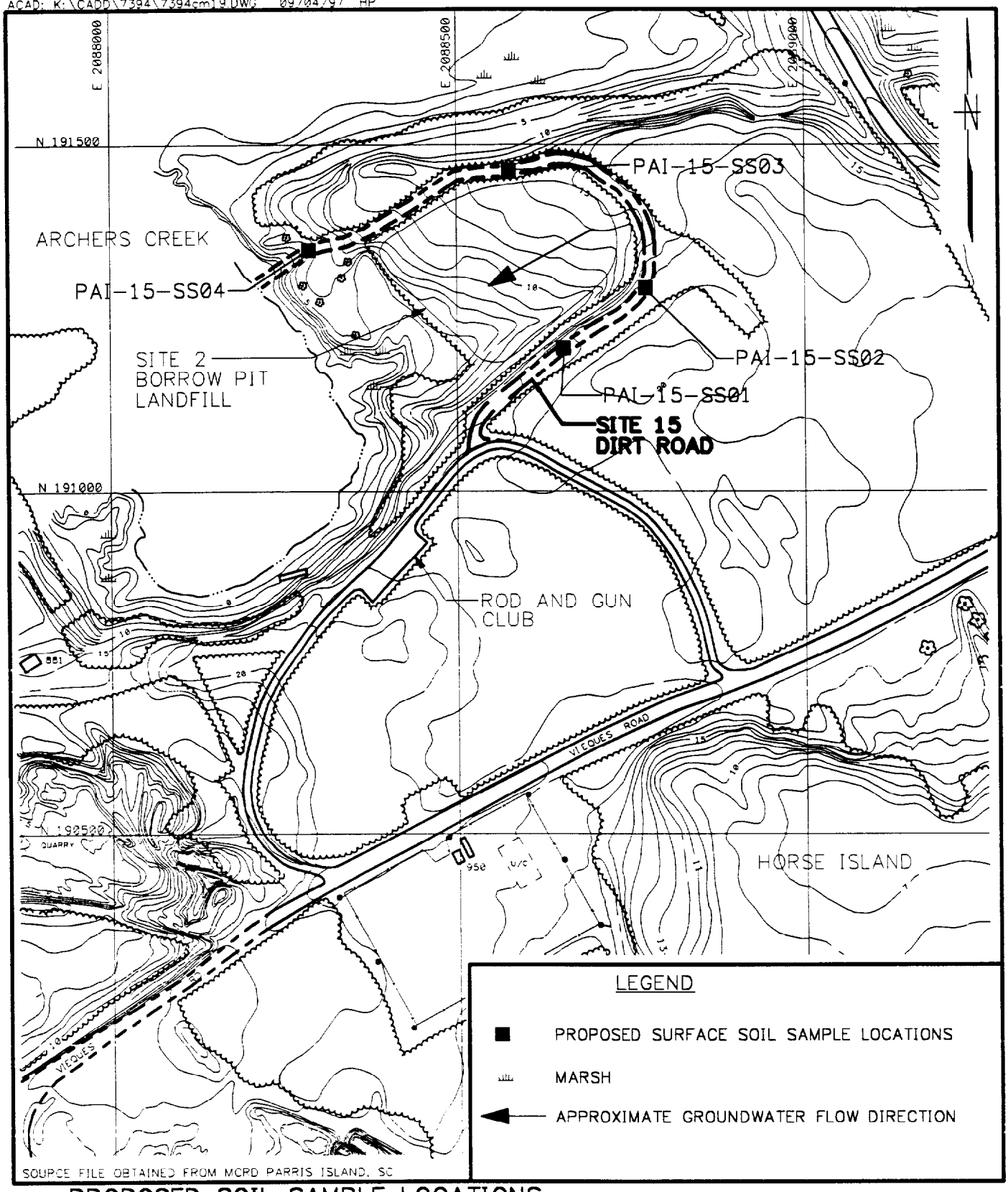

PROPOSED SOIL SAMPLE LOCATIONS
SITE 15-DIRT ROADS (BORROW PIT LANDFILL)
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 7-4

0 200 400
SCALE IN FEET

Brown & Root Environmental

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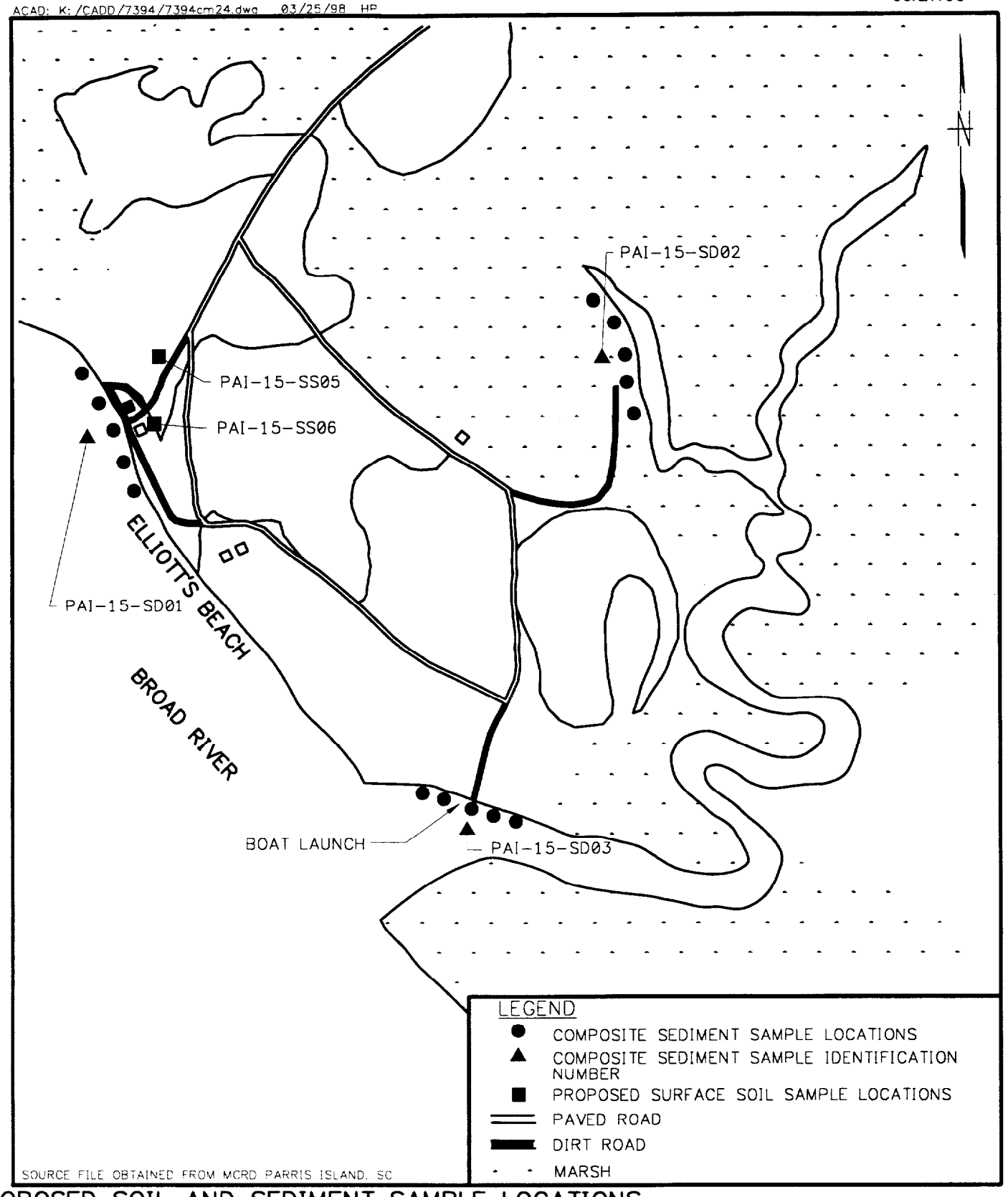

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PROPOSED SOIL AND SEDIMENT SAMPLE LOCATIONS
SITE 15-DIRT ROADS (ELLIOTT'S BEACH)
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 7-5

0 800 1600
SCALE IN FEET

Brown & Root Environmental

The surface water and sediment samples will be collected in accordance with sampling methodologies described in the Master FSP and B&R Environmental SOP Number SA-1.2, "Surface Water and Sediment Sampling." Each set of surface water and sediment samples will be collected at the same location. At low tide, the proposed surface water and sediment sampling locations are not covered with water. Sediment samples will be collected at low tide in the marsh area as U.S. EPA Region 4 considers exposure to sediments for only those periods that the sediment is not covered with surface water. Surface water samples will be collected at high tide as the surface water begins to recede. Surface water samples will be filtered in the field for dissolved metals analysis in addition to the unfiltered samples collected for total metals analysis.

The upland/wetland boundary is not well defined and will be characterized during field activities. Consequently, proposed sampling locations may be modified as appropriate during the investigation. Any deviation from the proposed locations will be noted in the field and documented in the RI/RFI report.

At the Elliott's Beach portion of Site 15, three composite sediment samples will be collected. At each sediment sample location, sediment from five areas (as shown on Figure 7-5) will be composited into a single sediment sample in accordance with B&R Environmental SOP Number 1.2, "Surface Water and Sediment Sampling." Each sample will be collected from the vegetated intertidal zone at each area (0 to 0.5 feet below ground surface).

7.2.2 Surface Soil Sampling

At Site 2, nine surface soil samples will be collected for this investigation at locations shown on Figure 7-2. Eight surface soil samples will be collected from the 0-1 foot sampling interval within the upland portion of the boundary of the Borrow Pit Landfill. Once a sample is collected, field personnel will continue to bore into the soil with a hand auger until the top limit of waste is reached. The lithology of these borings will be recorded. One surface soil sample will also be collected during the installation of monitoring well PAI-02-GW05. The background samples taken for the field activities at Site 1 - Incinerator Landfill and Site 41 - Former Incinerator will be used to assess the representative background concentration of constituents for Sites 2 and 15 (B&R Environmental, 1998a).

As mentioned previously, the upland/wetland boundary is not well defined and will be characterized during field activities. Consequently, proposed sampling locations may be modified as appropriate during the investigation. Any deviation from the proposed locations will be noted in the field and documented in the RI/RFI report.

At Site 15, six surface soil samples will be collected from the 0-1 foot interval at the locations shown on Figures 7-4 and 7-5. Four surface soil samples will be collected along the 0.5 miles of unpaved road accessing the Borrow Pit Landfill and two surface soil samples will be collected along the 0.25 miles of unpaved road accessing Elliott's Beach. The samples will be collected in areas of low spots or drainage due to the potential impacts of regrading activities at Site 15 pushing potential contaminants to these areas.

Surface soil samples will be collected in accordance with the methodologies described in the Master FSP and SOP Number SA-1.3, "Soil Sampling." Samples will be collected to bias the worst-case scenario based on visual and field instrumentation evaluation.

7.2.3 Subsurface Soil Sampling

Two subsurface soil samples will be collected during the installation of monitoring well PAI-02-GW05. The subsurface soil samples will be collected in accordance with the methodologies described in the Master FSP and SOP Numbers GH-1.5, "Borehole and Sample Logging" and GH-1.3, "Soil and Rock Drilling Methods." The subsurface soil samples will include one from the vadose zone and one within the aquifer. Soil classification will be conducted on both samples and groundwater modeling parameters will be determined for the sample taken within the aquifer. Also, a Shelby Tube sample will be collected during the installation of this monitoring well in accordance with the methodologies described in SOP SA-1.3, Section 5.2.3, "Procedure for Collecting Undisturbed Samples" and Section 6.3 of this Work Plan.

7.2.4 Groundwater Sampling

Five groundwater samples will be collected for this investigation at the locations shown in Figure 7-3. The three existing and two proposed monitoring wells will be sampled during this investigation in accordance with the Master FSP and SOP Number SA-1.1 "Groundwater Sample Acquisition and Onsite Water Quality Testing." Groundwater samples will be collected using low-flow sampling techniques in accordance with the U.S. EPA Region 4 EISOPQAM and SOP SA-1.1, Section 5.7, "Low Flow Purging and Sampling." Sampling shall be conducted at low tide when the dilution is anticipated to be minimized. A portion of each sample will be filtered in the field for dissolved metals analysis.

Of the five groundwater samples, one (PAI-02-GW02) will be used to estimate representative upgradient conditions. This sample will also be used to represent upgradient conditions for other nearby installation restoration sites (Sites 1, 2, 15, and 41).

7.2.5 Redevelopment of Existing Wells

Older monitoring wells that have not been recently purged require redevelopment to maintain and/or improve their original specific capacity. Regaining high specific capacity is critical in approximating natural aquifer flow conditions and the subsequent collection of representative groundwater samples. Therefore, the three existing wells at the site should be redeveloped prior to purging and sampling.

An evaluation of the groundwater monitoring well's condition will be performed prior to the initiation of well development and sampling. This evaluation will examine for the presence of a silted screen, a damaged surface casing or a damaged concrete surface pad. Water-levels and monitoring well evaluations will be performed following procedures outlined in SOP GH-1.2, "Evaluation of Existing Monitoring Wells and Water-Level Measurements."

In order to remove any fine-grained material that has likely accumulated in the stagnant wells, overpumping is the recommended method of redevelopment. Overpumping is the process where a well is pumped at a higher rate than it will be subsequently purged and sampled. The objective is to remove fine-grained material at higher flow rates such that it will not be entrained in the sample collected at lower flow rates. Although it is anticipated that this aquifer can sustain a sufficient yield, if the well does pump dry during the one hour period, the well will be allowed to recharge back to a level greater than or equal to the height of the screened section and alternately pumped a second time. The total pumping time should equal one hour per well. Prior to and upon completion of redevelopment, the sediment thickness within the well will be measured and recorded on the development form.

Monitoring well redevelopment will be completed at least 24 hours before well purging and sampling. The intent of this hiatus is to provide time for the well and surrounding sand pack and aquifer material to sufficiently equilibrate to natural conditions.

7.3 SAMPLE HANDLING

7.3.1 Sample Containers, Preservation, Holding Times, and Analyses

Sample handling includes the proper selection of sample containers and the preservation and allowable holding times for the required analyses. The site-specific QAPP summarizes the sample handling requirements for this investigation.

7.3.2 Sample Nomenclature

Each sample will be assigned a unique codified sample identification number. The sample nomenclature format described in the Master FSP and SOP Number CT-04, "Sample Nomenclature," will be used for this investigation. The unique nomenclature established for this sampling event is as follows:

1		2		3		4
AAA-NN	-	AA	-	NNN	-	NN
Site Location and Site Number		Media		Sample Number		Sample Depth

1	PAI - Parris Island 02 - Site 2 15 - Site 15	3	An ascending sequential number of samples collected.
2	SW - Surface Water SD - Sediment SS - Surface Soil SB - Soil Boring/Subsurface Soil GW - Groundwater TW - Temporary Well	4	Bottom of sample interval or sample round.

7.3.3 Sample Documentation, Packaging, and Shipping

Matrix-specific sample logsheets will be maintained for each sample collected. In addition, sample collection information will be recorded in field notebooks and the Site Logbook. Further description of sample documentation is provided in the Master FSP and SOP Number SA-6.3, "Field Documentation."

Samples will be packaged and shipped according to the Master FSP and SOP Number SA-6.1, "Non-Radiological Sample Handling" (B&R Environmental, 1998c).

7.3.4 Sample Custody and Shipment

Sample custody procedures are designed to provide proper documentation of sample acquisition and integrity. Sample custody will be maintained and documented at all times. Custody begins at the time of collection and ends at the time of disposal by the laboratory. The procedures for custody and shipment are described in Section 4.0 of the Master QAP and SOP Number SA-6.1 (B&R Environmental, 1998c).

8.0 QUALITY ASSURANCE PLAN

A general discussion of the Data Quality Process is provided in the Master Work Plan (B&R Environmental, 1998c). Site-specific data quality objectives are provided in Section 4.0, and the laboratory DQOs are discussed in Section 10.0 of this document.

9.0 PROJECT MANAGEMENT ORGANIZATION

B&R Environmental will be responsible for management, implementation, and inspection of the field investigation for MCRD Parris Island Sites 2 and 15. B&R Environmental will coordinate activities with program personnel and MCRD Navy personnel when appropriate.

9.1 PROJECT ORGANIZATION

An organizational chart of the site-specific project personnel for this investigation is provided in Figure 9-1.

9.2 PROJECT PERSONNEL RESPONSIBILITIES

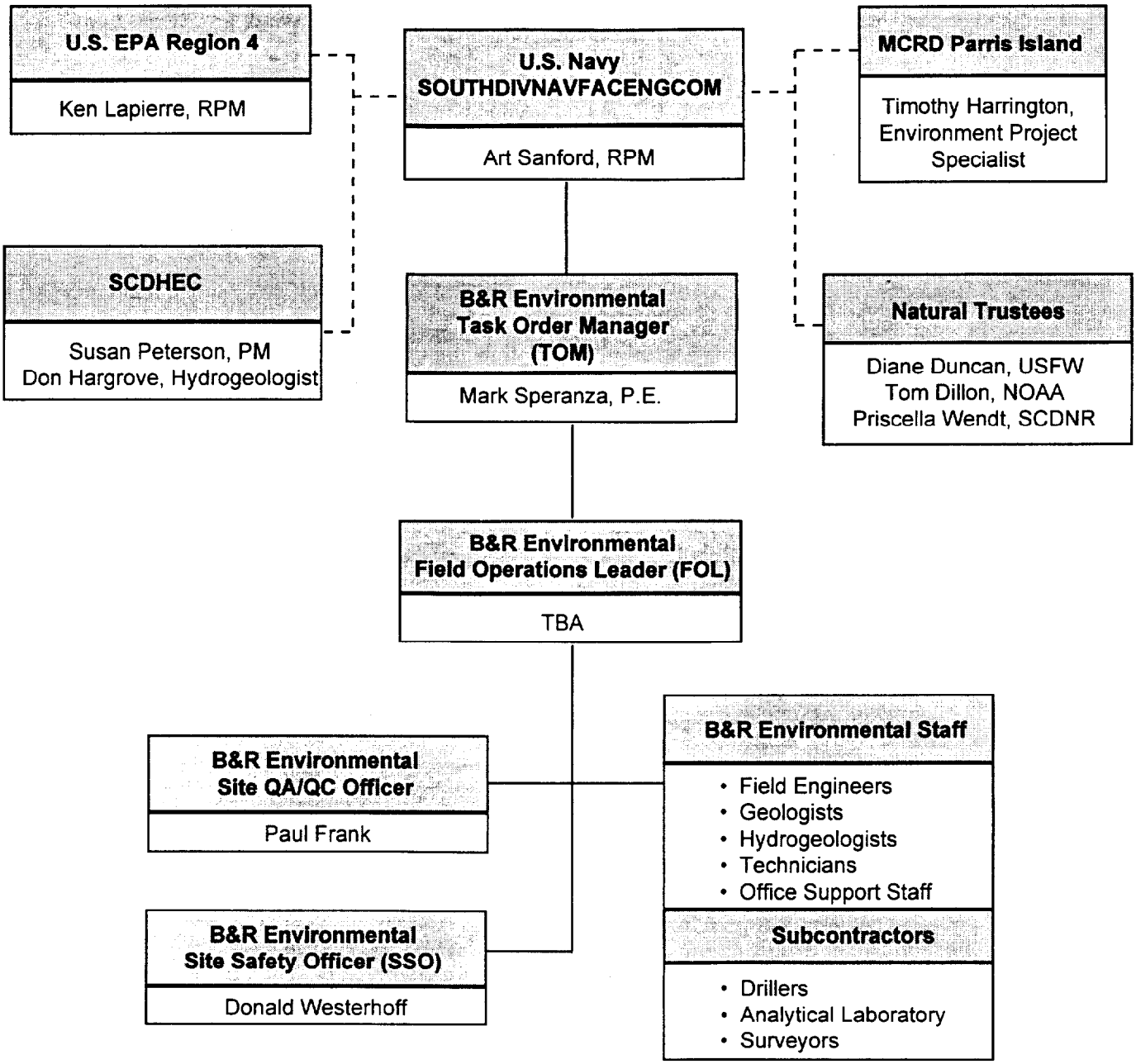
A description of responsibilities of individual project team members is provided below.

The responsibilities of the Task Order Manager (TOM) are provided in the Master Work Plan. The Field Operations Leader (FOL) will be responsible for coordinating all site personnel and field activities. The FOL will:

- Act as liaison between the TOM, field team members, Site Safety Officer (SSO), and Site Quality Assurance/Quality Control (QA/QC) Officer.
- Supervise all subcontractors.
- Oversee the mobilization and demobilization of all equipment, personnel, and subcontractors, and ensure the availability and maintenance of all field sampling and monitoring equipment and materials.
- Oversee the completion of all site documentation.
- Assume custody of all samples and ensure the proper handling and shipment of all samples.
- Resolve all logistical, weather, personnel, and equipment problems that may arise and initiate field change requests after consultation with the TOM, when necessary.

FIGURE 9-1

PROJECT PERSONNEL ORGANIZATION
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA



NOAA: National Oceanic and Atmospheric Administration
PM: Project Manager
RPM: Remedial Project Manager
SCNDR: South Carolina Department of Natural Resources
TBA: To Be Assigned
USFW: U.S. Fish and Wildlife Service

A Professional Geologist certified in the State of South Carolina will provide direction for the well installation activities and review of boring logs. Mr. Stan Conti (License Number 242) or Ms. Adel Baker (License Number 103) of B&R Environmental have been tentatively identified as candidates.

The Site QA/QC Officer will be responsible for ensuring all site activities are performed according to the QA/QC guidelines outlined in the Master QAP. The Site QA/QC officer will:

- Act as liaison between the B&R Environmental Quality Assurance Manager (QAM), laboratory, and site personnel.
- Ensure that field duplicates and quality control blanks are collected at the proper frequency and volume.
- Ensure that all measuring and testing equipment is calibrated, used, and maintained in accordance with applicable procedures.
- Manage bottleware procurement and oversee field preservation and filtration activities.

The SSO will advise the FOL on issues of site health and safety. The duties of the SSO are described in the Project Health and Safety Plan (HASP) of the Master Work Plan, Volume II (B&R Environmental, 1998c).

10.0 DATA QUALITY REQUIREMENTS

The purpose of this section is to relate the site-specific laboratory analyses and field QA/QC samples to the DQO statements established for this investigation. The Master QAP of the Master Work Plan (Volume II) is referenced where appropriate.

10.1 LABORATORY ANALYSES

Section 5.0 of the Master QAP describes the laboratory and methodology requirements for the sample analyses for this investigation. Section 5.5 of the Master QAP describes the data reporting requirements for this investigation. Section 5.6 of the Master QAP describes the criteria for laboratory selection. The laboratory selected to perform work at this site must be South Carolina state certified.

10.2 EXTERNAL (FIELD) QC SAMPLES

Section 3.3 of the Master QAP contains a general description of external quality control measures.

10.2.1 Field QC Sample Types and Frequencies

Table 10-1 summarizes the frequency and type of QA/QC samples to be collected for this investigation.

TABLE 10-1

FREQUENCY OF FIELD QC SAMPLES
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA

Type Of Sample	Organics	Inorganics
Field Duplicate/ Split Samples	1/10 samples/media	1/10 samples/media
Source Water Blank	1/source/sampling event	1/source/sampling event
Trip Blank (VOCs only)	1/cooler containing VOCs samples	NA
Equipment Rinsate Blank	1/day/matrix	1/day/matrix
Field Blank	As needed; Depends on site conditions	As needed; Depends on site conditions

QA/QC blanks for grout, sand, and bentonite will be collected and held for analysis pending the analytical results of the field investigation. If it is suspected that inorganic contaminants have been introduced by well installation materials, the samples will be sent to the laboratory for analysis.

Detailed descriptions of QC sample types are provided in Sections 3.3.1 through 3.3.5 of the Master QAP of the Master Work Plan (Volume II).

10.2.2 Matrix Spike/Duplicate Sample Aliquots

Laboratory duplicate and matrix spike samples will be analyzed as described in Section 3.4 of the Master QAP of the Master Work Plan (Volume II). The field sampling team will provide the appropriate additional sample volume as prescribed by the laboratory requirements. The additional sample aliquots required for analysis of matrix spike/duplicates will be collected with a frequency of 1 per 20 samples per matrix.

10.3 BOTTLEWARE REQUIREMENTS

The bottleware and preservation requirements for the analyses proposed for the investigation to be conducted at Site 2 are provided in Table 10-2 and for the investigation at Site 15 are provided in Table 10-3. Pre-preserved, certified clean bottleware will be supplied by the laboratory subcontractor.

10.4 SAMPLE CUSTODY AND SHIPMENT

Sample custody procedures are designed to provide proper documentation of sample acquisition and integrity. Sample custody and shipment procedures for this investigation are described in Section 4.0 of the Master QAP of the Master Work Plan (Volume II).

10.5 INTERNAL (LABORATORY) QC CHECKS

Descriptions of the internal (laboratory) QC check types are provided in Section 6.0 of the Master QAP of the Master Work Plan (Volume II).

10.5.1 Laboratory Duplicate, Spike, and Method Blank Analyses

Table 10-4 summarizes the frequency and type of laboratory QC checks to be performed for this investigation.

10.5.2 Other Laboratory QC Checks

Calibration and preventive maintenance of laboratory instruments are described in Section 6.6 of the Master QAP of the Master Work Plan (Volume II). Handling and storage of samples, use of qualified

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
AQUEOUS (SURFACE WATER & GROUNDWATER)					
TCL and Appendix IX Volatile Organic Compounds	SW-846 8260B	2 x 40 mL	Glass; Teflon-lined septum cap	HCl to pH<2; Cool to 4°C; Zero headspace	14 days to analysis
TCL and Appendix IX Semivolatile Organic Compounds	SW-846 8270C	2 x 1 L	Amber glass	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Total TAL and Appendix IX Metals	SW-846 6010B/ 7000A series	1 L	High-Density Polyethylene (HDPE)	HNO_3 to pH<2	6 months, except Hg (28 days)
Dissolved TAL and Appendix IX Metals	SW-846 6010B/ 7000A series	1 L	HDPE	HNO_3 to pH<2	6 months, except Hg (28 days)
Cyanide	SW-846 9010B/9012A	500 mL	Glass or HDPE	NaOH to pH>12; Cool to 4°C	14 day to analysis
Hexavalent chromium	SW-846-7196A	250 mL	Glass or HDPE	Cool to 4°C	24 hours to analysis
TCL and Appendix IX Pesticides	SW-846 8081A	2 x 1 L[4]	Amber glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
TCL and Appendix IX PCBs	SW-846 8082	2 x 1 L[4]	Amber glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Total Organic Carbon (TOC)	EPA 415.1	60 mL	Glass or HDPE	HCl or H_2SO_4 to pH <2; Cool to 4°C	28 days to analysis
pH	EPA 150.1	60 mL	Glass or HDPE	None Required	Analyze immediately
Turbidity	EPA 180.1	250 mL	Glass or HDPE	Cool to 4°C	48 hours to analysis
Total Dissolved Solids (TDS)	EPA 160.1	250 mL	Glass or HDPE	Cool to 4°C	7 days to analysis

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
AQUEOUS (SURFACE WATER & GROUNDWATER) (Continued)					
Total Suspended Solids (TSS)	EPA 160.2	250 mL	Glass or HDPE	Cool to 4°C	7 days to analysis
Chloride	EPA 325.2	250 mL	Glass or HDPE	None required	28 days to analysis
Appendix IX Organophosphorus Pesticides	SW-846 8141A	2 x 1 L	Amber Glass; Teflon-lined cap	Cool to 4°C ; dark	7 days to extraction; 40 days from extraction to analysis
Appendix IX Herbicides	SW-846 8151A	1 L	Amber Glass; Teflon-lined cap	Cool to 4°C ; dark	7 days to extraction; 40 days from extraction to analysis
Appendix IX Nonhalogenated Volatile Organic Compounds (Isobutyl alcohol, propionitrile acetonitrile, 1,4-Dioxane, Methacrylonitrile)	SW-846 8015B Modified	2 x 40 L	Glass; Teflon-lined septum cap	HCl to pH<2; Cool to 4°C	14 days to analysis
Fluoride	EPA 340.2	500 mL	HDPE	None required	28 days to analysis
Nitrate/Nitrite	EPA 353.3	250 mL	Glass or HDPE	H_2SO_4 to pH <2; Cool to 4°C	28 days to analysis
Sulfate	EPA 375.4	250 mL	Glass or HDPE	Cool to 4°C	28 days to analysis
Salinity	SM2520B	250 mL	Glass or HDPE	Cool to 4°C	Analyze immediately
Hardness	EPA 130.2	250 mL	Glass or HDPE	HNO_3 to pH<2;Cool to 4°C	6 months to analysis

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 3 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
SOLID (SURFACE & SUBSURFACE SOIL & SEDIMENT)					
TCL Volatile Organic Compounds	SW-846 8260B	5 x 5 g	EnCore Sampler™	Cool to 4°C; At lab add sample to be preserved with either sodium bisulfate solution or by adding to 5 ml reagent water and then freezing at -10°C.	Extract within 48 hours; 14 days to analysis
TCL Semivolatile Organic Compounds	SW-846 8270C	8 oz.	Glass; Wide-mouth; Teflon-line cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Total TAL Metals and Cyanide	SW-846 6010B/ 7000A series and 9010B/9012A	8 oz.	Glass; Wide-mouth; Teflon-line cap	Cool to 4°C	6 months, except Hg (28 days); cyanide 14 days
Hexavalent Chromium	SW-846 3060A/7196A	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	7 days to extraction; 24 hours from extraction to analysis
TCL Pesticides	SW-846 8081A	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
TCL PCBs	SW-846 8082	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Total Organic Content (TOC)	SW-846 9060	4 oz.	Glass; Wide-mouth	Cool to 4°C	28 days to analysis
Natural Mositrue and Grain-Size Analysis	ASTM D 421/ 422	1 qt.	Glass; Wide-mouth	None	None

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 4 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
Atterberg Limits	ASTM D 4318	NA[5]	Shelby Tube	None	None

SOLID (SURFACE & SUBSURFACE SOIL & SEDIMENT) (Continued)

Permeability	ASTM Method D5084-90/ SW-846 9100	NA	Shelby Tube	None	None
pH	SW-846-9045C	4 oz.	Glass; Wide-mouth	Cool to 4°C	Analyze immediately
Bulk Density	MSA	NA	Shelby Tube	None	None
Specific Gravity	ASTM D854	NA	Shelby Tube	None	None
Porosity	Calculation	NA	NA	None	None

1 Sample volume may vary based on the laboratory.
2 HCl - Hydrochloric acid; HNO_3 - Nitric acid; NaOH - Sodium hydroxide; H_2SO_4 - Sulfuric acid.
3 Holding times are measured from the date of sample collection.
4 Two 1L bottles of samples are sufficient for pesticides and PCB analyses if both are performed for the same sample.
5 NA - Not applicable.

TABLE 10-3

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 15 - DIRT ROADS
MCRD PARRIS ISLAND, SOUTH CAROLINA

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation	Holding Time[2]
SOLID (SURFACE SOIL)					
TCL PCBs	SW-846 8082	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Lead	SW-846 7421	8 oz.	Glass; Wide-mouth	Cool to 4°C	6 months
TCL Semivolatile Organic Compounds	SW-846 8270C	8 oz.	Glass; Wide-mouth; Teflon-line cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Total TAL Metals and Cyanide	SW-846 6010B/ 7000A series and 9010B/9012A	8 oz.	Glass; Wide-mouth; Teflon-line cap	Cool to 4°C	6 months, except Hg (28 days); cyanide 14 days
TCL Pesticides	SW-846 8081A	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days form extraction to analysis

1 Sample volume may vary based on the laboratory.
2 Holding times are measured from the date of sample collection.

technicians, and independent confirmation of data computations and deliverables are described in the Laboratory Quality Assurance Plan (LQAP).

TABLE 10-4

**FREQUENCY OF LABORATORY QC CHECKS
SITE 2 - BORROW PIT LANDFILL AND SITE 15 - DIRT ROADS
MCRD PARRIS ISLAND, SOUTH CAROLINA**

Type Of Sample	Organics	Inorganics
Laboratory Duplicate	NA	1/20 samples/media
Matrix Spike	1/20 samples/media	1/20 samples/media
Matrix Spike Duplicate	1/20 samples/media	NA
Surrogate Spike	Each sample for chromatographic analyses	NA
Method Blank	Based on method requirements with a minimum of 1/batch of 20 samples	Based on method requirements with a minimum of 1/batch of 20 samples

10.6 PROJECT RECORDS

Recordkeeping and evidentiary file concerns are described in Section 7.0 of the Master QAP of the Master Work Plan (Volume II). All protocols described therein will be strictly observed.

10.7 DATA REDUCTION, VALIDATION, AND REPORTING

The data generated from this investigation shall be validated in accordance with the U.S. EPA National Functional Guidelines for Organic and Inorganic Data Review. The corresponding requirements as discussed in Section 8.0 of the Master QAP, Volume II, for data validation, data assessment, electronic deliverables, and data interpretation and reporting will be followed.

10.8 PERFORMANCE AND SYSTEM AUDITS

The protocol for conducting audits as outlined in Section 10.0 of the Master QAP, Volume II shall be followed.

10.9 CORRECTIVE ACTIONS

In the event there are discrepancies in field activities from the established procedures and/or requirements or modifications to the proposed Work Plan, the procedures established in Section 10 of the Master QAP, Volume II, for documenting nonconformances shall be implemented and, if appropriate, a "Field Task Modification Request Form" completed.

10.10 TRAINING AND QUALITY PLANNING

Training requirements and pro-active management practices are provided in the Master Work Plan, Volume II.

REFERENCES

Brown & Root Environmental, 1998a. RI/RFI Work Plan for Site/SWMU 1 - Incinerator Landfill and SWMU 41 - Former Incinerator (069703/P), March.

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APPENDIX A

WORK PLAN ADDENDUM 3 – TEST PITTING

WORK PLAN ADDENDUM 3
TEST PITTING OPERATIONS AT SITE/SWMU 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Objective

The purpose of this Work Plan Addendum is to propose field activities to further investigate whether waste material is present at Site/SWMU 2 (Borrow Pit Landfill) at MCRD Parris Island, South Carolina and to collect information to support a No Further Action decision.

Background

A RI/RFI was conducted at Site/SWMU 2 from May to September 1998. During the 1998 RI/RFI, surface soil samples were collected from Site/SWMU 2 at eight locations and analyzed for TCL VOCs, SVOCs, and PCBs/pesticides and TAL inorganics. Also, as part of the investigation, soil borings were performed at five of the surface soil sample locations to determine the presence and depth of waste material. At these surface soil sample locations, field personnel advanced the borings using a hand auger until the top of waste was observed. Attachment 1 presents the general lithology observed in these soil borings.

RI/RFI Soil Results

Surface soils at Site/SWMU 2 were not found to contain chemicals in excess of those found in background media and the most stringent of human health RBCs (residential) and ecological screening values. In addition, soil borings in the area of the alleged fill material did not find evidence of waste in the borrow pit area. The only evidence of waste remaining at Site/SWMU 2 was the presence of visually stained soils near the water table.

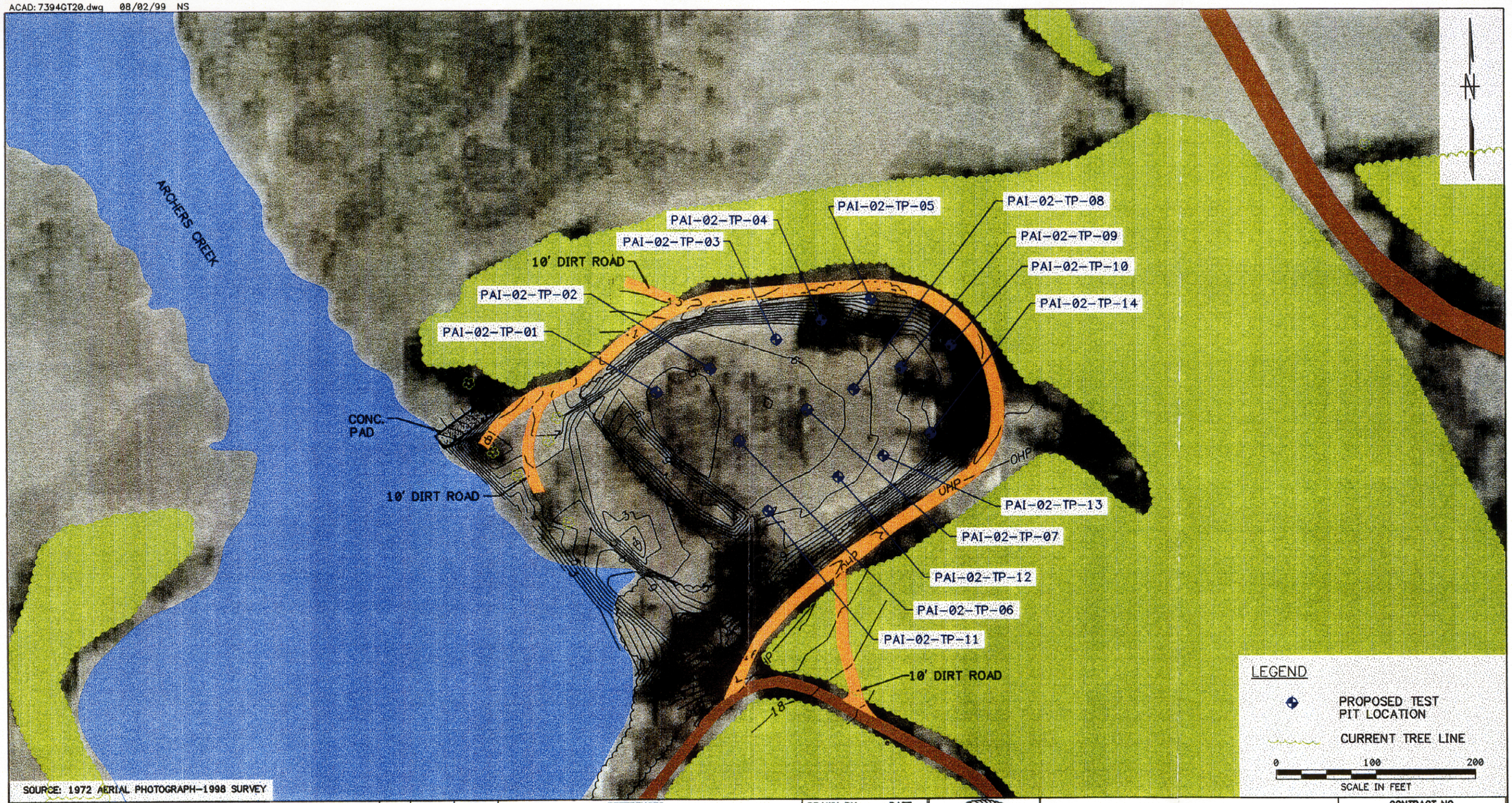
Proposed Field Activities

Because waste material was not observed during the RI/RFI, test pit operations are proposed to further investigate whether waste is present at Site/SWMU 2. Test pitting would be conducted at the 14 locations illustrated on Figure 1 and would be performed in accordance with SOP SA-1.3, Section 5.7, "Excavation and Sampling of Test Pits and Trenches." Excavated soils would not be considered a waste and would be placed back into the excavation.

WORK PLAN ADDENDUM 3
TEST PITTING OPERATIONS AT SITE/SWMU 2 – BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Subsurface soil samples are proposed at 3 of the test pit locations. Selection of the subsurface soil sample locations would take place based on field observations. One subsurface soil would be collected near the water table at a location where visually stained soils are observed. Two subsurface soil samples would be collected within the vadose zone. Subsurface samples would be analyzed for TCL VOCs, SVOCs, and PCBs/pesticides and TAL inorganics to determine whether contaminants are present at depth.

ACAD: 7394GT20.dwg 08/02/99 NS



SOURCE: 1972 AERIAL PHOTOGRAPH-1998 SURVEY

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY NS DATE 8/2/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

PROPOSED TEST PIT LOCATIONS
SITE 2 - BORROW PIT LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO. 7394
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 1
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

3

78A02Y

Attachment 1

BORING LOG

PROJECT NAME: MCRD - Parris Island
PROJECT NUMBER: 7394
DRILLING COMPANY: Parratt Wolff
DRILLING RIG: NA
BORING NUMBER: PAI-02-SS02
DATE: 07-22-98
GEOLOGIST: S. Pelcake / S. Barton
DRILLER: NA

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole	Drill BZ*
			4"			dk. brn	litter / humus		damp / organic rich				
			1			lt brn tan	f.g. sand, trace silt		moist, roots				
			2			lt. brn tan	as above						
			3			lt. brn tan	as above						
				▽4'									
			4			tan lt gray	f.g.-m.g. sand		saturated lt. brn mottling				
			5			tan lt gray	as above						
			6			tan lt gray	as above						
			6.5			tan lt gray	as above		lt. brn mottling / staining				
				T.D= 6.5'									

*When rock coring, enter rock brokeness.

Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: no conclusive evidence of trash encountered
boring was backfilled using soil that was originally removed
samples collected at 0-1'
drilling method: hand auger

Converted to Well: Yes ____ No ✓ Well I.D. #: ____

BORING LOG

PROJECT NAME: MCRD - Parris Island
BORING NUMBER: PAI-02-SS03
PROJECT NUMBER: 7394
DATE: 07-22-98
DRILLING COMPANY: Parratt Wolff
GEOLOGIST: S. Pelepko / S. Burton
DRILLING RIG: NA
DRILLER: NA

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	4"					dk. brn	litter / humus		damp				
	1					lt. brn tan	f.g. - m.g. sand		damp				
	2					tan lt. gray	f.g. sand		moist, roots				
	2.5					tan lt. gray	f.g. - m.g. sand		light brown mottling musty odor				
	3.0					tan lt. gray	f.g. - m.g. sand some c.g. clasts						
				▽ 4'									
	4.0					tan - lt. gray	as above		saturated				
	5.0					lt. brn tan	f.g. - m.g. sand		saturated brown mottling				
	6.0					lt. brn tan	as above		saturated				
				T.D. = 6'									

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: no conclusive evidence of trash encountered. boring was backfilled using soil that was originally removed. Samples collected at 0-1'. drilling method: hand auger

Converted to Well: Yes ____ No ✓ Well I.D. #: ____

BORING LOG

PROJECT NAME: MCRD - Parris Island
PROJECT NUMBER: 7394
DRILLING COMPANY: Parratt Wolff
DRILLING RIG: NA
BORING NUMBER: PAI-02-SS04
DATE: 07-22-98
GEOLOGIST: S. Pelczka / S. Barton
DRILLER: NA

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistancy or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Drilling Area
	4"					dk. brn	litter / humus		damp				
	1					H. brn tan	f.g. sand, trace silt		damp, roots				
	1.5					tan H.gray	f.g. sand		damp				
	3.0					tan H.gray	f.g. - m.g. sand		moist brown mottling				
	3.5			▽4'		red brn	m.g. - c.g. sand		moist				
	4.0					tan H.gray	f.g. - m.g. sand, trace c.g. sand		saturated				
	5.0					tan H.gray	f.g. - m.g. sand		brown mottling saturated				
	6.0					tan H.gray	as above						
	6.5					H. brn tan	f.g. - m.g. sand		brown mottling saturated				
				T.D.=6.5'									

* When rock coring, enter rock brokeness.

**Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: no conclusive evidence of trash encountered
boring was backfilled using soil that was originally removed
sample collected at 0-1'
drilling method: hand auger

Converted to Well: Yes ____ No ✓ Well I.D. #: ____

BORING LOG

PROJECT NAME: MCRD - Parris Island
BORING NUMBER: PAI-02-SS05
PROJECT NUMBER: 7394
DATE: 07-22-98
DRILLING COMPANY: Parratt Wolff
GEOLOGIST: S. Pekpka / S. Barton
DRILLING RIG: NA
DRILLER: NA

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler	Borehole	Drill Stem
	4"					dk. brn	litter / humus		damp/organic rich				
	1					lt brn tan	f.g. sand, trace silt						
	2					lt brn tan	as above						
				▽ 3'									
	3					tan lt. gray	f.g - m.g. sand		saturated				
	4					tan lt. gray	f.g. - m.g sand		slight musty odor gw infiltrating boring				
	5					lt. brn	f.g. - m.g. sand		saturated				
	6					lt. brn	as above		saturated				
				T.D.=6'									

* When rock coring, enter rock brokeness.

Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: no conclusive evidence of trash encountered
boring was backfilled using soil that was originally removed
samples collected at 0-1' drilling method: hand auger

Converted to Well: Yes ____ No ✓ Well I.D. #: ____

BORING LOG

PROJECT NAME: MCRD - Parris Island
PROJECT NUMBER: 7394
DRILLING COMPANY: Parratt Wolff
DRILLING RIG: NA
BORING NUMBER: PAI-02-SS07
DATE: 07-22-98
GEOLOGIST: S. Pekpke / S. Barton
DRILLER: NA

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm) Sample	Sampler BZ	Borehole	Ambient BZ
	4"					dk. brn	litter / humus		damp				
	1					lt. brn tan	f.g.-m.g. sand		roots, moist				
	2					tan lt. gray	as above		moist				
	2.5					tan lt. gray	as above		brown mottling moist				
	3.0					tan lt. gray	as above		very moist				
				▽ 4'									
	4.0					tan lt. gray	as above		saturated				
	5.0				dense				very compacted hard to auger				
	5.5				v. dense	tan lt. gray	as above		discrete volume of rust-colored staining at 5.5'				
				T.D. = 5.5									

* When rock coring, enter rock brokeness.

Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm):

Remarks: no conclusive evidence of trash encountered
boring was backfilled using soil that was originally removed
samples collected at 0-1' drilling method: hand auger

Converted to Well: Yes ____ No ✓ Well I.D. #: ____

Rev. 0
03/27/98

RCRA Facility Investigation/ Remedial Investigation Work Plan

for

Site/SWMU 3 - Causeway Landfill

Marine Corps Recruit Depot

Parris Island, South Carolina
U.S. EPA Identification Number
SC6 170 022 762

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0020

March 1998

Rev. 0
03/27/98

RCRA FACILITY INVESTIGATION/ REMEDIAL INVESTIGATION WORK PLAN FOR SITE/SWMU 3 - CAUSEWAY LANDFILL

MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA
U.S. EPA IDENTIFICATION NUMBER
SC6 170 022 762

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Brown & Root Environmental
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0020

MARCH 1998

PREPARED BY:

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PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

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PROGRAM MANAGER
BROWN & ROOT ENVIRONMENTAL
PITTSBURGH, PENNSYLVANIA

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ACRONYMS

AOCs	Areas of Concern
ARARs	Applicable or Relevant and Appropriate Requirements
B&R Environmental	Brown & Root Environmental
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COCs	Chemicals of Concern
CTO	Contract Task Order
DHEC	Department of Health and Environmental Control
DQO	Data Quality Objective
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EP	Extended Procedure
FID	Flameionization Detector
FOL	Field Operations Leader
FS	Feasibility Study
FSP	Field Sampling Plan
HSWA	Hazardous and Solid Waste Amendments
HASP	Health and Safety Plan
HCL	Hydrochloric Acid
HDPE	High Density Polyethylene
IAS	Initial Assessment Study
IDW	Investigative-Derived Waste
K_h	Horizontal Hydraulic Conductivity
K_v	Vertical Hydraulic Conductivity
LQAP	Laboratory Quality Assurance Plan
MCLs	Maximum Contaminant Levels
MCRD	Marine Corps Recruit Depot
MSL	Mean Sea Level
NAVFAC	Naval Facilities Engineering Command
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NFA	No Further Action
NPL	National Priorities List

NSF	National Sanitation Foundation
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PR	Preliminary Review
QA	Quality Assurance
QAM	Quality Assurance Manual
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBCs	Risked-Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SOPs	Standard Operating Procedures
SOUTHDIV	Southern Division
SSO	Site Safety Officer
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TOM	Task Order Manager
U.S. EPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
VS	Verification Step
VSI	Visual Site Inspection

FOREWORD

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act of 1986 (SARA) establishes a program for the cleanup of hazardous waste disposal and spill sites nationwide. This program contains provisions for the cleanup of contamination from past hazardous waste operations and past hazardous material spills and is the framework for installation restoration (IR) programs at numerous Navy and Marine Corps installations. The Resource Conservation and Recovery Act (RCRA), as amended, also establishes a cleanup program that provides for current and future hazardous waste management practices, as well as cleanup of past disposal sites at permitted or interim status Navy/Marine Corps installations.

Because of the past hazardous waste activities conducted at the Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina, the MCRD meets criteria for conducting IR activities under the CERCLA regulatory framework. To date, the MCRD has completed steps equivalent to the Preliminary Assessment/Site Inspection phases of the CERCLA remedial action process. The MCRD also meets the criteria for conducting IR activities under RCRA because in the late 1980's, the MCRD applied for a RCRA permit. Under RCRA, this action required the MCRD to conduct corrective action for the release of hazardous waste or hazardous constituents from solid waste management units. An interim RCRA Facility Assessment was conducted in 1990 as part of this requirement. Since this time, the MCRD has withdrawn its application for a RCRA permit.

Because of the circumstances surrounding the MCRD's IR program history, discussions have been held between representatives from the United States (U.S.) Marine Corps, U.S. Navy, South Carolina Department of Health and Environmental Control, and the U.S. Environmental Protection Agency, Region 4 to determine the appropriate regulatory framework for conducting IR activities at the MCRD. From these discussions, it has been decided that this site-specific work plan will encompass both CERCLA and RCRA requirements and will be dually titled as such. The success/lessons learned of this approach will used for subsequent IR activities as well as used to negotiate a Federal Facility Agreement for the MCRD.

RESPONSE TO REGULATORY COMMENTS TO THE DRAFT AND DRAFT FINAL WORK PLAN FOR SITE/SWMU 3

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 3 (CAUSEWAY LANDFILL) - COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(S. PETERSON, REVIEWER)

1. **Comment:** Overall
   This document was reviewed to meet the requirements of an RFI Work Plan. Please change the title to reflect this.

   Response:
   The title of the work plan will be changed to RCRA Facility Investigation/Remedial Investigation Work Plan for Site 3 - Causeway Landfill.

2. **Comment:** Section 1.1, Scope and Objective
   a) The 1st sentence should be deleted. This is information already stated in Section 1.0 and it has nothing to do with Scope and Objective; and

   b) The objective of this investigation is less specific than that of the Master Work Plan. The scope and objective should be specific since this is a site specific work plan. Please rewrite to give the reader a clear statement of the specific objectives of the investigation. In some cases, the objectives of the study may be to generate data to justify a "no-further action" decision. Describe fully the objectives of Site 3.

   Response:
   In accordance with this comment and the response to U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, the scope and objective has been rewritten to clearly state the objectives of the investigation and to reflect the presumptive remedy approach.

3. **Comment:** Section 2.0, Site Background
   Based on this sentence, it would be logical to either rename Section 2.1 to Site Description and History or rename Section 2.1 to Site History and add a Section 2.2 named Existing Site Conditions (and of course renumbering the following sections).

   Response:
   Section 2.1 will be renamed to "Site Description and History."

4. **Comment:** Section 2.1, Site Description
   a) As mentioned above, you could consider renaming the section Site Description and History. Due to the status of the landfill, the description is history.

   Response:
   Section 2.1 will be renamed to "Site Description and History."

   b) Section 2.1, Site Description
   The paragraphs are not in chronological order and should be corrected. This could be accomplished by making the 1st paragraph the 3rd, the 2nd the 1st, and the 3rd the 2nd (if you choose not to add a separate section for Site History).

   Response:
   The paragraphs will be chronologically arranged as suggested.

c) Paragraph 1 (existing)
State what year the former landfill began functioning as a causeway.

Response:
The causeway was completed in 1972. This information will be incorporated into Section 2.1.

d) Paragraph 1 (existing)
State the year of the causeway's completion (4th line). This sentence gives the impression that work (therefore time) was necessary to complete the construction of the causeway after the 2 sections met (supposedly in 1972).

Response:
The causeway was completed in 1972. This information will be incorporated into Section 2.1.

e) Paragraph 1 (existing)
Clarify the material of the road surface at the time of its completion. You describe it as dirt in this section however in Section 3.5 it is described as gravel.

Response:
The cover of the road surface will be described as gravel in all appropriate sections.

f) Paragraph 1 (existing)
State the existing road covering material. Is it dirt, gravel, or pavement as it appears in the enclosed photographs. This is a present tense paragraph and this information needs to be included.

Response:
The existing road cover is gravel and will be described as such in Section 2.1.

g) Paragraph 2 (existing)
Consider this wording: The Causeway Landfill (Site 3) functioned as the major Depot disposal area...

Response:
The above wording will be incorporated into Section 2.1.

h) Paragraph 2 (existing)
Inform the reader as to when Site 3 ceased to function as a landfill. Clarify with a sentence if operations stopped after 1972.

Response:
Landfill activities ceased in 1972. This will be incorporated into Section 2.1.

I) Paragraph 2 (existing)
"Also between 1969 and 1972, other solid and hazardous constituents..." If what is bolded is not the case, clarify. If so, include.

Response:
The following change has been made to the text in question.

> *"Between 1960 and 1965, this landfill received approximately 75 percent of the solid waste generated by the Depot. The remainder was disposed at Site 1, Incinerator Landfill, which was also in operation during that period. The site was inactive between 1966 and 1968. Between 1969 and 1972, the site received all of the Depot's solid waste. The solid waste disposed at the site included ...."*

j) Questions:
During its years operating as a landfill, was it ever used as a causeway?
Was this an excavated pit that was slowly filled up and tamped down until solid enough to support traffic?

Response:
The causeway serves as an alternative traffic route to Malecon Drive. Because the two sections of the causeway did not come together until 1972, traffic would not have been able to traverse the distance from the southern end of Talasea Street to Horse Island. The causeway was constructed over existing marsh deposits.

k) Paragraph 3 (existing)
Is your only means of determining when the 2 sections of causeway met the aerial photographs? This raises some doubts in the mind of the reader as to the actual (or general) date.

Response:
Aerial photographs from 1972 illustrate that the sections of the causeway had met although the exact date of the completion of the causeway can not be stated for certain.

l) Paragraph 3 (existing)
Be more explicit with the years of the aerial photographs. For example, **Examination of aerial photos taken in 1959, 1963, 1969, and 1972 showed...**

Response:
The years that the aerial photographs were taken will be specified in Section 2.1 and reproductions included in Appendix A.

m) Paragraph 3 (existing)
Aerial photograph should be referenced in the text and therefore included in the REFERENCES section. Include a Xerox copy of the photographs in the work plan.

Response:
The aerial photographs will be included in the References section. Additionally, copies of the aerial photographs will be included in Appendix A.

5. **Comment:** Figure 2.1
This quadrangle is 18 years old. Is there anything that has changed that would warrant additions or deletions?

Response:
Variations in current surface features and those shown in Figure 2-1 are not believed to be significantly different and will not affect the investigation activities outlined in the Work Plans; however, differences will be noted during the field investigation and when the areas are surveyed, the differences will be incorporated into the Investigation Report.

6. **Comment:** Section 6.2, Site Restoration
This paragraph states "the site will be restored to its original condition prior to investigation activities." It should be explained what "original condition" means, and why the site will be restored prior to the investigation activities and then will be disturbed again to do the investigation. The paragraph is vague and should be more specific and/or correct the proposed approach.

Response:
Section 6.2 will be changed to read "If investigation activities (e.g., monitoring well installation) disturb or alter the landscape, vegetation, or other features of Site 3, the site may require restoration to

conditions prior to the investigation. If vegetation is stressed or damaged as a result of investigation activities, the affected area will be reseeded. Portions of Site 3 will be regraded if investigation activities alter the natural contour of the site. Additionally, all equipment used during the investigation and investigation-derived waste will be removed from the site.

(D. HARGROVE, REVIEWER)

1) **Comment:** Section 2.1, Site Description:
The text describes the pipes installed through the causeway for tidal flow as "two corrugated metal pipes". During a site tour, I recall seeing two separate tidal culverts each with two concrete pipes. Please verify and revise as necessary.

Response:
The text of Section 2.1 will be revised to indicate that there are two culverts along the causeway. Each culvert contains three concrete pipes as verified with MCRD Parris Island.

2) **Comment:** Section 3.3, Groundwater:
This section states that "The causeway was constructed across a tidal marsh and the surficial groundwater is anticipated to be shallow and tidally influenced. However, the marsh deposits underlying the landfill [causeway] are anticipated to be a barrier to the deeper aquifer." The marsh deposits discussed are not previously described. There is no discussion about the thickness of the marsh deposits or evidence showing that the marsh deposits are continuous and have not been adversely impacted during installation of the causeway. These deposits cannot be anticipated as a barrier if thickness, continuity, and hydrologic characteristics have not been assessed. Please revise the text to address this data gap.

Response:
At the present time, there is a lack of data characterizing the layer of marsh deposits; however, the thickness, continuity, and hydrologic characteristics of this layer will be verified during the remedial investigation. The last sentence of Section 3.3 Groundwater will be revised to "However, the marsh deposits underlying the landfill including the clay comprising the Hawthorn Formation may act as a partial barrier to the deeper aquifer and will be investigated during the field investigation."

3) **Comment:** Section 4.1, Investigation Rationale, page 4-1:
a) Groundwater: Note that as per R.61-68 of the Water Classification and Standards, "...all South Carolina groundwater is classified GB effective on June 28, 1985." Groundwater classified as "GB" is considered a potential underground source of drinking water. The analysis proposed to determine if the groundwater is "...suitable for use as a drinking water source" is not necessary. All groundwater in the state is classified as a potential drinking water source. Please revise the text to either justify this analysis better or omit this analysis altogether.

Response:
To satisfy CERCLA requirements, all groundwater that is suitable for use as a drinking water source based on water quality parameters such as salinity and turbidity must undergo a risk assessment. The text of Section 4.1 will be revised to indicate that groundwater will be evaluated as a practical drinking water source according to CERCLA in the human health risk assessment. The text of Section 5.1 will also be revised accordingly.

b) Air: It should not be assumed that airborne contamination poses no risk since the surface of the causeway is a dirt road that is periodically graded. Please revise the text to include address the issue of airborne contamination risk and the dirt road.

Response:
Risk from dermal contact will be evaluated in the risk assessment. However, the causeway is not believed to be a source of fugitive emissions which would require collecting air samples. After review of existing data and field observations made from monitoring equipment, a decision to collect air samples would be determined.

4) **Comment:** Table 4-1, Investigation Rationale, text page 4-4:
The section discussing data gaps/needs for the groundwater proposes risk assessment. As stated in comment 3(a), all groundwater in the state is classified as a potential drinking water source. In accordance with R.61-68 Water Classification and Standards, all groundwater of the State is classified as Class GB. This classification requires that concentrations of inorganic and organic constituents must not exceed established MCLs. Completing a risk assessment of the concentrations of contaminants found in the groundwater is inappropriate when concentration limits are established by regulation. In addition, MCLs are established at concentrations that already account for risk to human health.

Response
Please refer to the response to Comment 3 of this section.

5) **Comment:** Section 6.4, Monitoring Well Installation and Construction:
a) Page 6-3: The use of bentonite chips in the seal is not recommended. Bentonite chips have longer hydration times and complete hydration cannot be assured. Bentonite pellets are recommended due to faster/more complete hydration.

Response:
The third sentence of the fifth paragraph of Section 6.4, Monitoring Well Installation and Construction, will be revised as follows. "A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate as per the manufacturer's recommendations."

b) Page 6-4: The grout should not be installed to the ground surface. It should be installed to a point below the frost line. The concrete used to form the pad will fill the remaining annular space. Figure 6-1 of this work plan correctly depicts the relationship between the grouted interval and the concrete pad.

Response:
It is agreed that the grout should not be installed to the ground surface but to a point below the frost line. This change will be reflected in the text of Section 6.4 Monitoring Well Installation and Construction.

c) Page 6-4: This section is incomplete. The text and figures should also include:
i) Specifications for an identification plate that will be affixed to the well with information including: Well name, date drilled, depth of well, the driller's name and certification number.
ii) Specifications for the formation of the concrete pad.
iii) Specifications for the protective stickups to be installed around the completed concrete pad.

NOTE: These specifications are already listed in the Master Work Plan for MCRD. The text should be revised to either include complete specifications, or properly reference the Master Work Plan.

Response:
The text of Section 6.4 will be revised to include a reference to MCRD Parris Island South Carolina Master Work Plan, Volume II, Section 2.3 Monitoring Well Construction and Installation for the specifications of the well's concrete pad and protective casings. Additionally, the identification plate

specifications will be included in the text of this section. Lastly, Figure 6-1 will be revised to include these specifications.

6) **Comment:** Figure 6-1, Typical Monitoring Well Detail:
This diagram should have the specifications for the protective stickups shown (see comment 5 above). Please revise the text accordingly.

Please refer to the response to comment 5.

7) **Comment:** Section 7.2.1, Surface Water Sampling, page 7-1:
a) The text does not specify if the surface water samples will be taken before, during, or after high tide. It is preferable that all the surface water samples be taken during like tidal conditions. Please revise the text to include a sample protocol that describes the timing of the sampling events.

Response:
As discussed during the July 9-10, 1997 Parris Island Partnering Team meeting, sediment samples will be collected at low tide and surface water samples will be collected at high tide as the surface water begins to recede. The text of Section 7.2.1 will be revised accordingly.

This comment is also relevant to the Draft Work Plans for Sites 1/41 and 2/15 and will be similarly addressed.

b) The text specifies that background samples collected for Site 2 will be used to determine background conditions at Site 3. Sites 1, 2, and 3 are all located close to each other. Please revise the text to include a comparison of the background samples taken from Site 1 as well.

Response:
One set of background samples for soil, surface water and sediment will be taken at Site 1. These samples will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

RESPONSE TO U.S. EPA COMMENTS TO THE
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 3 (CAUSEWAY LANDFILL) - COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **Comment:** General Comment
   The following comments made for Sites 1 and 41 above are also generally applicable to the Draft Work Plan for Site 3: comments 2, 5, 8, 9, 11, 12, 13, 14 and 19.

   Response:
   Please refer to the response to U.S. EPA comments to the Draft SAP for Site 1 (Incinerator Landfill) and Site 41 (Former Incinerator).

2. **Comment:** Page 2-11, Section 2.3.3
   Comparison of the Region 4 Waste Management Division Saltwater Surface Water Screening Values and Sediment Screening Values with the values shown in Figure 2-4 revealed exceedences of chronic screening values for several metals, as listed below:

	SW Screening	Number of	Sediment Screening	Number of
Metal	Value (ug/L)	Exceedences	Value (ppm)	Exceedences
Cadmium	9.3	2	1	-
Chromium	103	-	52.3	-
Lead	8.5	5	30.2	-
Mercury	0.025	2	0.13	8
Selenium	71	-	-	-

   Please revise the text as needed. Region 4's surface water screening values are based on the chronic Ambient Water Quality Criteria (AWQC) for the protection of aquatic life. South Carolina State Water Quality Standards would be at least as stringent as AWQCs, and would likely be ARARs.

   Response:
   The information listed above will be included in the text of Section 2.3.3

3. **Comment:** Page 2-11, Section 2.3.4
   The document should be expanded to include the results of this fish/shellfish study. In addition to providing detected contaminant concentrations, information on the types of tissues sampled (e.g. whole body vs. fillet/edible tissue) and basic parameters on the specimens collected (e.g. weight, length) should also be provided.

   Response:
   The fish/shellfish study data will be used to develop work plans for ecological sampling which will be developed, as needed, after the initial sampling results are evaluated. Additionally, the fish/shellfish data will be incorporated into the ecological risk assessment.

4. **Comment:** Page 2-15, Section 2.4
   The existing data and information for this site (e.g. fish/shellfish data, magnitude and exceedences of Region 4 screening values) should be used to revise and expand this section. As discussed in the Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment Bulletin No. 1 - Preliminary Risk Evaluation, after comparing available data with screening values, a Preliminary Problem Formulation should be conducted to "identify categories of potential ecological receptors that may exist in the site area, to identify contaminants which may pose unacceptable risks to those receptors, and to determine contaminant fate/transport and toxicity mechanisms."

Response:
Please refer to the response to comment 3.

5. **Comment:** Pages 3-1 through 4-1, Sections 3.0 and 4.1
The results of the Preliminary Problem Formulation should be used to revise and expand the information provided in these sections, particularly the general rationale for the proposed Site 3 sampling.

Response:
Please refer to the response to comment 3.

6. **Comment:** Page 5-2, Section 5.2
This section should also be expanded to include the results of the Site 3 Preliminary Problem Formulation and to further identify, in a more site-specific manner, the approach that will be used to assess ecological risk for this site.

Response:
Please refer to the response to comment 3.

7. **Comment:** Pages 7-1 through 7-15 , Section 7.2
More specific justification for the numbers and locations of samples proposed should be presented. In general, it may be appropriate to bias samples towards the southeastern end of the causeway, where "both solid waste and fill dirt" (p. 2-1) were deposited.

Response:
During a site visit, it was determined that waste materials (garbage) was present along the entire length of the causeway. Therefore, it is believed to be necessary to sample along the entire length of the causeway. The text of Section 7.2 will be modified to include the observation of landfill debris along the entire causeway.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLAN
SITE 3 (CAUSEWAY LANDFILL) - COMMENTS RECEIVED 7/22/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(S. PETERSON, REVIEWER)

1. **Comment**:
   Please modify the title of this work plan to include RCRA terminology. As known, understood, and accepted by the MCRD Tier I technical and Tier II teams, the State of South Carolina has authorization under the Hazardous & Solid Waste Amendment to implement correction action activities.

   The Department reviewed this document to meet the requirements of an RCRA Facility Investigation (RFI) Work Plan. The Department is willing to recognize the following dually-titled document:

   Draft Final RCRA Facility Investigation/Draft Final Remedial Investigation Work Plan
   for
   SWMU/Site 3 - Causeway Landfill

   or

   Draft Final
   RCRA Facility Investigation/Remedial Investigation Work Plan
   for
   SWMU/Site 3 - Causeway Landfill

   Marine Corps Recruit Depot
   Parris Island, South Carolina
   SC6 170 022 762

   Response:
   The suggested title will be used. However, in accordance with Navy CLEAN format, the word "FINAL" will not be included in the title of the FINAL report.

2. **Comment**:
   According to the Region 4 RFI Work Plan Checklist, prepared by A.T. Kearney, dated 1989, an EPA Identification Number should be included on the cover page. The EPA Identification Number for MCRD Parris Island is SC6 170 022 762. Please include that Identification Number on the Final Work Plan.

   Response:
   The U.S. EPA Identification Number will be added to the cover page of the document.

(D. HARGROVE, REVIEWER)

1. **Comment**:
   The title should reflect whether this document is a DRAFT or a FINAL document. Please revise.

Response:
The last version of the site-specific SAP for Site 3 was incorrectly missing the words "DRAFT FINAL" in the title and header of the document. However, Navy CLEAN format stipulates when a document is issued "FINAL", the words "DRAFT" or "DRAFT FINAL" are to be removed from the title and header of the report. As such, the title and header will not contain the "FINAL" designation.

2. **Comment**: Response to Comments

Only the comments concerning the DRAFT version of this document should be included in this section. The Division of Hydrogeology understands that some comments made on other work plans have been incorporated into this document due to comparable applicability. Any additional comments that have been incorporated into this document should be included at the end of this section. Please revise.

Response:
Comments made to the "DRAFT" and "DRAFT FINAL" Work Plans for Site 3 will be included in the Response to Comments Section of the "FINAL" Work Plan. Additionally, applicable comments concerning the Work Plans for Site 1/41 and 2/15 will be added to the end of this section.

3. **Comment**: Response to comment #3

This response clarifies that the groundwater risk assessment will be performed according to CERCLA requirements. However, compliance with the State Primary Drinking Water Standards has not been specified. According to the National Oil and Hazardous Substances Contingency Plan (NCP), remedial alternatives should be evaluated against NCP threshold criteria for overall protection of human health, and compliance with applicable or relevant and appropriate requirements (ARARs). The State Primary Drinking Water Standards are ARAR and must be followed. This comment does not require a specific revision. This is for future reference to be acknowledged in the resulting report.

Response:
This comment is acknowledged.

4. Response to Comment #4 to the Draft Work Plan for Site 3

The following restates the comment made to the Draft Work Plan by D. Hargrove and the response to this comment:

> "**Comment:** Table 4-1, Investigation Rationale, text page 4-4:
> The section discussing data gaps/needs for the groundwater proposes risk assessment. As stated in comment 3(a), all groundwater in the state is classified as a potential drinking water source. In accordance with R.61-68 Water Classification and Standards, all groundwater of the State is classified as Class GB. This classification requires that concentrations of inorganic and organic constituents must not exceed established MCLs. Completing a risk assessment of the concentrations of contaminants found in the groundwater is inappropriate when concentration limits are established by regulation. In addition, MCLs are established at concentrations that already account for risk to human health.
>
> **Response**
> *Please refer to the response to Comment 2 of this section."*

Comment:
a) This response should reference the response to Comment #3 (not #2).

Response:
The response will reference Comment #3.

Comment:
b) This response clarifies that the groundwater risk assessment will be performed according to CERCLA requirements. However, compliance with the State Primary Drinking Water Standards has not been specified. According to the National Oil and Hazardous Substances Contingency Plan (NCP), remedial alternatives should be evaluated against NCP threshold criteria for overall protection of human health, and compliance with applicable or relevant and appropriate requirements (ARARs). The State Primary Drinking Water Standards are ARAR and must be followed. This comment does not require a specific revision. This is for future reference to be acknowledged in the resulting report.

Response:
This comment is acknowledged.

RESPONSE TO U.S. EPA COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLANS
SITE 3 (CAUSEWAY LANDFILL) - COMMENTS RECEIVED 7/22/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **General Comment:**
   Comments 1, 3, 4, 5 and 7 on the Site 1/41 SAP are also applicable to the Site 3 SAP.

   Response:
   Please see the response to U.S. EPA comments to the Draft Final SAP for Site 1/41.

2. **Comment** - Pages 2-8 through 2-13, Section 2.3:
   The results of previous investigations (Verification Study and Extended Site Inspection) indicate that Site 3 contaminants may have adversely impacted ecological receptors. Several surface water and sediment samples contained metal concentrations which exceed Region 4 ecological screening values. Biological tissue samples contained pesticide and PCB concentrations which need to be evaluated for their effects on ecological receptors. Other sections of the present Work Plan (in particular, Sections 4 and 7) fail to acknowledge these findings, or specify how the proposed sampling will produce adequate information to address and resolve these concerns. In order for U.S. EPA to consider the RI for this site complete, it must include an adequate evaluation and assessment of this earlier data. The Work Plan must therefore be revised to address this information.

   Response:
   Please see the response to U.S. EPA Comment Number 4 made to the Draft Final SAP for Site 1/41.

3. **Comment** - Page 4-1, Section 4.0, Paragraph 3:
   Please revise the second sentence to read "Additionally, if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill....".

   Response:
   This change will be made.

4. **Comment** - Page 7-9, Figure 7-3:
   It is unclear why two of the three shallow wells proposed will be located at the northwestern end of the causeway, when "historical records indicate that more solid waste debris may have been disposed in the southeastern portion of the causeway" (p. 7-1). The RI Report submitted must clearly describe how the groundwater samples collected address the "primary sampling concern to characterize the worst-case site condition of each media investigated.." (p. 4-6, Section 4.1).

   Response:
   As discussed in the Tier I Partnering Meeting on July 10, 1997, surface water and sediment samples will be collected during the initial portion of the field investigation. The analytical results of these samples will indicate whether contaminant migration has occurred. Based on these results, the locations of the proposed monitoring wells will be moved, if necessary, to areas where contaminant migration has been observed.

   The text of Sections 6.4, and 7.2.1 will be revised accordingly to reflect the Partnering Team discussion.

Supplemental Comments to Section 5.2 - Comments Received 9/9/97

1. **Comment:** Section 5.2 - Paragraph 1:
   The paragraph is OK, pending receipt of acceptable description of ecological risk methods/steps in MWP v. III.

   Response:
   Comments made to the ecological risk approach contained in Volume III of the Parris Island Master Work Plan have been incorporated.

2. Section 5.2 - Paragraph 3:
   a) **Comment:** Replace "Problem Formulation" w/ "Preliminary Problem Formulation."

      Response: *The text will be revised.*

   b) **Comment:** Include groundwater discharge to surface water as an exposure media.

      Response: *Groundwater discharge to surface water will be included as an exposure media.*

   c) **Comment:** Replace "soil organisms" and "terrestrial wildlife feeding on soil organisms" with "terrestrial invertebrates."

      Response: *"Soil organisms" will be replace with "terrestrial invertebrates." However, "terrestrial wildlife feeding on soil organisms" will be replaced with "terrestrial vertebrates."*

   d) **Comment:** Replace "sediment-dwelling organisms" with "benthic invertebrates."

      Response: *The text will be revised.*

   e) **Comment:** Replace "fish-eating birds" with "avian piscivores."

      Response: *The text will be revised.*

   f) **Comment:** Replace "shellfish-eating mammals" with "mammalian piscivores."

      Response: *The text will be revised.*

3. **Comment:** Section 5.2 - Paragraph 4:
   Preliminary assessment should not consider/calculate midpoint concentrations or midpoint ingestion rates. The initial screening phase should use only the most conservative values. Delete all references to midpoint values.

   Response:
   Agree. The text will be revised accordingly.

4. **Comment:** Section 5.2 - Paragraph 5:
   Regarding "recommendations for further investigation", "additional field work" is the only truly appropriate means for verifying or disproving potential ecological effects identified during the screening step. Modeling results are likely to be inconclusive, and risk management comes into play only after site risks are adequately characterized. If the technical memorandum indicates the need for additional work, a work plan addendum would also need to be submitted.

   Response:
   Agree. The text will be revised accordingly.

RESPONSE TO SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES (SCDNR) COMMENTS TO THE DRAFT FINAL RFI/RI WORKPLAN FOR SITE 3 -CAUSEWAY LANDFILL - COMMENTS RECEIVED 1/5/98 MCRD, PARRIS ISLAND, SOUTH CAROLINA

COMMENTS - Robert E. Duncan, Environmental Programs Director

1. **Comment**: Page 1-1, paragraph 4, line 2

Since the Causeway Landfill was constructed directly through tidal marshes and across a tidal creek (Ribbon Creek) that is tributary to Class SFH water (The Broad River) which is, by definition, "protected for shellfish harvesting" in addition to other forms of primary and secondary contact recreation, it would seem appropriate to include "adult, adolescent, and child recreational users" among the list of potential receptors in the human health risk assessment.

Response: Adolescent recreational users will be considered as potential receptors at specific sites in addition to adult recreational users. However, the child recreational user will not be considered. Although a child (ages 1 to 6) could be exposed to surface water, it is unlikely that a receptor at this age is routinely exposed to surface water when one considers the recreational activities that are typical of this area (boating, swimming, fishing).

2. **Comment**: Page 2-1, paragraph 3, line 9

Please clarify whether or not any fill material (clean or otherwise) was used to cover the unpaved portions of the landfill (i.e., the shoulders and banks of the causeway) after disposal activities were discontinued in 1972. If fill material wa used, any information on its composition, volume, depth, or areal coverage should be included.

Response: To date, limited information is available concerning the composition, volume, depth, or areal coverage of fill material existing within the unpaved sections of Site 3. To determine the presence and extent of areal coverage of fill material, surface soil samples (0-1 ft bgs) will be taken as proposed in the Draft Final RFI/RI SAP for Site 3. After the surface soil sample has been collected, field personnel will continue to bore into the soil with a hand auger until the top limit of waste has been reached. From this information, an average depth and volume of fill material will be estimated. To determine the composition of the fill material, the lithology of all borings will be recorded and geotechnical tests (e.g., porosity and grain-size analysis) will be performed on one of the surface soil samples. The text of Table 4-2 and 7.2.2 will be revised accordingly.

3. **Comment**: Page 2-9, Section 2.3.4

Include a table summarizing the analytical results of the ABB (1993) Extended Site Inspection Report; include species analyzed, location (pond vs. tidal creek), contaminant concentrations measured, and appropriate USFDA action levels.

Response: This table will be included as Table 2-1.

4. **Comment**: Page 5-1, paragraph 3, line 7

The removal of groundwater that is "not potable" from an assessment of human health risk may be inappropriate, if it is demonstrated that there is a connection between any such groundwater and surface waters that are used for primary and secondary recreation.

Response: Brown & Root Environmental and the US Navy maintain that removal of water that is "not potable" from a human health risk assessment is appropriate. Although groundwater may discharge to surface water, human health risk resulting from exposure to groundwater is still unlikely if its general quality is deemed "unusable." However, it is important to note that exposure to surface water is not precluded because of removing the assessment of exposure to groundwater. Surface water will be sampled and appropriate exposure scenarios will be evaluated.

5. **Comment**: Page 5-2, paragraph 1

For the sake of consistency with our recommended changes to the workplans for Sites 1 and 2, replace "Recreational Users" with "Adult, Adolescent and Recreational Users". Also for consistency, replace "Fish: consumption" with "Finfish/Shellfish: ingestion". Include ingestion of, and dermal contact with, sediment and surface water as additional pathways of concern in the human health risk assessment for this group.

Response: Adolescent recreational users will be considered as potential receptors at specific sites in addition to adult recreational users.

In accordance with the Master Work Plan, ingestion of and dermal contact with surface water will be evaluated, but ingestion of and dermal contact with sediment will not be evaluated. Exposure to surface water concurrent with exposure to sediment renders exposure to sediment negligible.

To be consistent with the Master Work Plan, ingestion of finfish/shellfish by the recreational users will be evaluated. However, ingestion of finfish/shellfish by offsite residents will not be considered for this specific site because sustenance fishing is unlikely to occur from this site.

6. **Comment**: Page 5-2, paragraph 6, line 2

Replace "could warrant further consideration during..." with "will be considered within the context of...".

Response: This comment will be incorporated.

RESPONSE TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) COMMENTS TO THE DRAFT FINAL RFI/RI WORKPLAN FOR SITE 3 -CAUSEWAY LANDFILL - COMMENTS RECEIVED 12/17/98 MCRD, PARRIS ISLAND, SOUTH CAROLINA

COMMENTS - Tom Dillon, Ph.D.

1. **Comment**: General

Analytical detection limits must be below ecological screening values for water, sediment and soil. PAHs are especially problematic. Experience suggests that the standard SW846 method for extracting/analyzing PAHs does not provide sufficiently low detection limits. Liquid chromatography may be required. To evaluate this potential, recommend creation of a table listing analytical method, detection limit and ecological screening values for each analyte in each media.

Response: Media-specific tables that compare laboratory practical quantitation limits (PQLs) to relevant screening criteria have been prepared. These tables, which include analytical method references, also indicate whether there is an exceedance of the screening value and the resolution of the discrepancy, if required. In most cases, the best available approved technology or approved analytical method capable of achieving the lowest PQL is proposed to resolve the discrepancy. However, some PQLs may still exceed some screening levels. These tables have been included as Appendix D of the Master Work Plan, Volume III. Based on this information, low level analysis of volatile organic compounds in soils is recommended. The site-specific work plan will be revised accordingly.

2. **Comment**: General

Collection of surface sediments (0"-6") should be biased toward depositional areas. Briefly state sediment collection method in Section 7.2.1.

Response: Agree. The text will be modified to include that collection of surface sediments will be biased towards depositional areas. Sediment samples will be collected in accordance with Brown & Root Environmental Standard Operating Procedure SA-1.2, "Surface Water and Sediment Sampling" and the text of Section 7.2.1. A complete version of this SOP will be included in the Final MWP, Volume II.

3. **Comment**: General

NOAA requests involvement in the decision-making process when locations for collecting background sediment samples are discussed (Section 7.2.1).

Response: NOAA and the other members of the Parris Island Tier I Partnering Team will be consulted on the planned locations of background sediment locations. The locations will be proposed after the results of water-level measurements are conducted during the initial phase of the investigation. However, it should be noted that a decision will be required ASAP once the appropriate information is disseminated to the Partnering Team so the field activities are not delayed.

4. **Comment**: General

NOAA reserves comment on the number and location of proposed sample until after the January 98 site visit.

Response: Agree. (Note: No additional samples were proposed by NOAA after the January 1998 site visit.)

RESPONSE TO REGULATORY COMMENTS TO THE
DRAFT AND DRAFT FINAL WORK PLANS FOR SITE/SWMU 1/41 AND 2/15
(COMMENTS APPLICABLE TO SITE/SWMU 3)

The comments included in this section were sent to MCRD Parris Island by SCDHEC and U.S. EPA Region 4. Although the comments were directed towards Sites 1/41 and 2/15, they are applicable to Site 3 and have been incorporated into this document. Comments not applicable to Site 3 have been removed. Please note, the numerical sequence of the comments as arranged in SCDHEC and U.S. EPA correspondence has not changed even though comments have been removed (i.e., comment #4 is still numbered as #4 although preceding comments may have been deleted as they were not applicable to Site 3).

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 1 (INCINERATOR LANDFILL) AND SITE 41 (FORMER INCINERATOR) -
COMMENTS RECEIVED 11/21/96
MCRD PARRIS ISLAND, SOUTH CAROLINA

(J. TAPIA, REVIEWER)

1. **Comment:** Section 2.2.3
   This section confirms the existence of a public water supply well within 1/4 of a mile radius of the MCRD. This public supply well should be identified on either Figure 2-1 or Figure 2-2.

   Response:
   Figure 2-1 will be revised to indicate the exact location of the public water supply well. However, it will be noted that the well is currently not in use but has not been abandoned.

(D. HARGROVE, REVIEWER)

1. **Comment:** Figure 1-1, Depot Location Map
   Remove "Site 1 - Incinerator Landfill" from title.

   Response:
   "Site 1 - Incinerator Landfill" will be removed from the title of Figure 1-1.

4. **Comment**: Figure 7-1, Proposed SW/Sediment Sample Locations

   The approximate locations for the upgradient samples should be specified on this figure.

   Section 3.3 describes surficial groundwater flow in a radial pattern towards the tidal stream. If this is the case, the upgradient sample locations can be approximated.

   Section 4.2.3.4 Water-Level Measurements describes a plan to measure groundwater levels during low and high tides and determine groundwater flow directions in the surficial aquifer. If further groundwater investigation is necessary before choosing upgradient sample locations, then Section 6.0 Field Operations should be revised to include a methodology describing the chronology of events pertaining to the characterization of groundwater flow followed by the determination of upgradient sample locations.

   Please revise the text and figures for the appropriate scenario.

   Response:
   Tidal influences may affect the flow of groundwater. Although an estimation of upgradient could be made without taking into account this tidal effect, water-level measurements taken during the initial phase of field activities would help to better depict the location of the upgradient samples. As such, the following sentences will be inserted after the first sentence of the second paragraph of Section 6.0 Field Operations.

   "Monitoring well installation will be a priority of the field effort followed by water-level measurements. The results of these measurements will be used to better characterize the depth, flow direction, and gradient of the groundwater. From this information, the location of background surface water and sediment will be determined in the field."

   Additionally, the following sentence will be inserted into Section 7.2.1, Surface Water and Sediment Sampling. "The location of the four background samples for surface water and sediment will be

determined in the field from the results of water-level measurements conducted during the initial portion of the investigation field effort."

The four background surface water and sediment samples taken for Site 1 will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

5. **Comment**: Figure 7-2 Proposed Soil Sample Locations

   See comment 4.

   Response:
   The location of the four background soil samples will be illustrated on a new figure in Section 7.0. The four background soil samples taken for Site 1 will also be used as background for Sites 2/15 and 3. The text of the Work Plans for these sites will reflect this statement.

6. **Comment**: General Comment
   All figures showing well locations or proposed well locations, proposed sample locations, or groundwater contamination plumes should include arrows indicating groundwater flow directions from the latest data. Please revise.

   Response:
   Figure 7-3, Proposed Groundwater Sample Locations, will be revised to include estimates of surficial groundwater flow directions in the vicinity of each monitoring well that is proposed to be sampled. In the revised version of the Work Plan, Figure 7-3 has been renumbered as Figure 7-4.

   This comment is also relevant to the Draft Work Plan for Sites 2/15 and will be similarly addressed.

   Previous studies have not characterized the groundwater flow direction of Site 3. Additionally, it is anticipated that surficial groundwater at this site is significantly affected by tidal influences. As such, an estimate will not be provided in the relevant figures of this document.

RESPONSE TO U.S. EPA COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 1 (INCINERATOR LANDFILL) AND SITE 41 (FORMER INCINERATOR) -
COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **Comment:** Page 1-3, Figure 1-1
   Given the title and purpose of this figure, Site 1 (Incinerator Landfill) should be clearly depicted on the map.

   Response:
   The purpose of Figure 1-1 is to provide the general layout and features of MCRD Parris Island. As such, "Site 1 - Incinerator Landfill" will be removed from the title of this figure. However, to illustrate the location of Site 1 in relation to the other features of the Depot, Site 1 will be depicted on this figure.

2. **Comment:** Page 2-1, Section 2.1, Paragraph 2
   The text should also briefly describe the level and type (if applicable) of activity that took place at the site between 1965 and present.

   Response:
   No significant disposal or intrusive activity has taken place at Sites 1 and 41 since 1965. This statement will be included in Section 2.1.

5. **Comment:** Page 3-1, Section 3.3, Sentence 3
   The text states that the marsh deposits underlying the landfill are assumed to be a barrier to the deeper aquifer. This statement appears to contradict Figure 3-1 (Site Conceptual Model), which depicts these deposits as providing a partial barrier to the shallow aquifer. Please clarify and revise as needed.

   Response:
   During field activities, the presence of the marsh deposits will be confirmed during the installation of deep surficial monitoring wells. Additionally, the vertical conductivity of the deposits will be investigated. The last sentence of Section 3.3 Groundwater will be revised to "However, the marsh deposits underlying the landfill may act as a partial barrier to the deeper aquifer and will be investigated during the investigation."

6. **Comment:** Page 4-1, Section 4.1
   Given the relatively low numbers and concentrations of contaminants detected during previous investigations of this site, a primary sampling rationale for each media should be to characterize worst-case site conditions for that media. The text should be modified to include this objective.

   Response:
   Section 4.1 will be revised to include this sampling rationale.

8. **Comment:** Page 4-7, Section 4.2.2.2
   Based on the site description provided in Section 2.1 of the SAP, this landfill appears to consist primarily of incinerated Municipal Landfill (MLF)-type wastes and cover an area in excess of 29,000 cubic yards. Given these site characteristics, wholesale excavation of Site 1 landfill contents would seem unlikely (see U.S. EPA/OSWER Quick Reference Fact Sheet: Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (June 27, 1995)). Toxicity Characteristic Leaching Procedure (TCLP) analyses of subsurface soil and sediment samples to determine if waste material/fill is a characteristic RCRA waste (presumably for purposes of off-site disposal) should therefore be delayed until a determination regarding the need to excavate these materials has to be

made. For example, if hot spots are identified during the RI/RFI, these may require further characterization to determine if removal and/or treatment is warranted.

Also, depending on RI/RFI results, a second type of leach test which may prove helpful is RCRA Method 1312: Synthetic Precipitation Leach Test for Soils. This method is designed to determine the mobility of organic and inorganic contaminants in soils.

Response:
As discussed in U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, the focus of the investigation will be changed to address 1) onsite exposure pathways for direct contact and 2) offsite exposure pathways. As such, characterization of landfill contents will not be addressed by investigation activities and TCLP analyses of subsurface soil and sediment samples will not be conducted. The text of the Work Plan will be revised to eliminate reference to TCLP analysis.

9. **Comment:** Page 4-7, Section 4.2.2.3
For use in assessing effects on ecological receptors, it is recommended that temperature and Secchi Disk readings also be collected for surface water.

Response:
The text of Section 4.2.2.3 will be revised to indicate that temperature and Secchi Disk readings will be collected for surface water.

10. **Comment:** Page 5-1, Section 5.0, Paragraph 4
Unless the groundwater beneath Parris Island is determined not to be potable, the following exposure routes must also be included under the "Future Resident" receptor group heading for groundwater: ingestion and inhalation. These exposure routes should also be considered for future construction workers, and/or maintenance workers.

Response:
For the Future Resident receptor groups, groundwater exposure through ingestion and inhalation will be evaluated in the human health risk assessment and will be added to the text of Section 5.1. However, if it is found from investigation activities that the groundwater beneath Parris Island is not potable, it will be removed as a pathway of concern from the human health risk assessment.

11. **Comment:** Page 6-1, Section 6.3:
The inner diameter of the augers should be at least 6.25 inches.

Response:
The fourth sentence of Section 6.3 will be replaced with the following text.

> *"For monitoring well construction, hollow stem augers of sufficient diameter will be used to produce a 2-inch annular space between the casing and the borehole wall."*

This complies with Section 6.4, "Borehole Construction", of the U.S. EPA Region 4 EISOPQAM.

12. **Comment:** Page 6-5, Section 6.4.1
The grout seal should be cored, not drilled, to prevent shattering.

Response:
As discussed in the response to U.S. EPA Comment Number 16 to the Draft SAP for Site 1/41, the scope of the investigation will be revised to reflect an approach consistent with Presumptive Remedy for CERCLA Municipal Landfill Sites (Directive No. 9355.0-49FS, September 1993). The investigation of the Floridan Aquifer will be delayed until characterization of the surficial aquifer. As such, a

monitoring well to the Floridan Aquifer will not be installed at this time and Section 6.4.1 has been removed from the Work Plans.

13. **Comment:** Page 6-6, Section 6.8, Paragraph 2
The acronym FOL is not defined here. All acronyms should either be defined in text (first occurrence only), or in an acronym list to be included with the document.

Response:
The acronym FOL will be defined in Section 6-6 as Field Operations Leader. Additionally, an acronym list has been added to the document.

14. **Comment:** Page 7-1, Section 7.2.1
In order to ensure that the sediment samples collected reflect worst-case conditions, sediments should be collected from at least two depth intervals at each location. Recommend that samples be collected from the top few inches, to reflect recent off-site migration, and from some greater depth interval (suggest 1 foot) to reflect historical accumulations. Visual inspection, or other available information, should be used to ensure sample collection from the depth interval with the greatest potential for contamination.

Response:
Sediment samples will be collected at two sample depth intervals. At each site (1/41, 2/15, and 3), one sediment sample will be collected at a 6- to 12-inch sample depth to reflect historical accumulation. This sample will be collected at a downgradient location where accumulation of contaminants is likely to occur. The remainder of the sediment samples will be collected at a 0- to 6-inch sample depth to reflect recent offsite migration.

15. **Comment:** Page 7-1, Section 7.2.2
A. Surface soil samples should be collected from the depression observed during the October 15-17 1996 base tour and from any other areas where contaminants are likely to have preferentially accumulated (e.g. based on visual inspection of existing site conditions, aerial photographs, historical information, etc.). A reasonable effort should also be made to locate the former incinerator and collect samples near it.

Response:
The following sentence will be added to the text of Section 7.2. "If during field activities, the FOL deems that an area not contained in the Work Plan should be sampled because of surface features (e.g., depressions) that would cause accumulation of contaminants, the locations of samples presented in the sampling plan will be altered to include these locations."

As presented in the Addendum to the Draft Remedial Investigation Work Plan for Site 1 - Incinerator Landfill submitted on October 7, 1996, surface soil sampling locations in the vicinity of the Former Incinerator have been included in the Work Plan.

B. Per Region 4 Supplemental Guidance to RAGS, all surface soil samples should also be collected from the 0-1 foot interval, or biased to reflect worst-case conditions. For example, if historical records, visual inspection or aerial photographs indicate that the soil/fill layer on top of the landfill is less than 1 foot thick in any area, a surface soil sample should be collected from the ash/waste layer contained within the top foot of the landfill.

Response:
The text of Section 7.2.2 will be revised to include that all surface soil samples will be collected from the 0-1 foot interval in accordance with this Region 4 guidance document. Additionally, the text of Section 7.2.2 will be revised to indicate that samples will be collected to bias the worst-case scenario.

16. **Comment:** Page 7-11, Section 7.2.3
Given the Site 1 characteristics mentioned previously (e.g. primarily incinerated MLF-type wastes, size: >29,000 cubic yards), engineering controls, such as containment, would appear to be a more likely remedy than treatment (see Section 300.430(a)(iii)(B) of the NCP and EPA/OSWER Quick Reference Fact Sheet: Presumptive Remedy for CERCLA Municipal Landfill Sites (Directive No. 9355.0-49FS, June 27, 1995)). For this reason, the RI should initially focus on characterizing (i) on-site exposure pathways for direct contact (e.g. surface soil contamination) and (ii) all off-site exposure pathways (e.g. off-site contamination of surface water, sediment and groundwater). U.S. EPA recommends that a decision regarding the need to characterize landfill contents (i.e. source characterization) be delayed until this initial round of data becomes available. Evaluation of this data for purposes of determining whether source characterization is appropriate should include consideration of such factors as: (i) magnitude and risk-level of detected off-site contamination (ii) presence/absence and nature of any hot spots and (iii) length of time for which contaminants have been available for off-site transport (in this case between 32 and 76 years).

Use of the above approach makes it critical that the locations and numbers of samples collected during this first round of activities provide adequate characterization of worst-case site conditions. To this end, specific justification/rationale must be provided for each sample collected. Care should also be taken to ensure that the number of samples collected provides coverage of all areas where significant potential for off-site migration and/or concentration of contamination exists.

Response:
It is agreed that given the conditions of the site, containment would appear to be a more likely remedy than treatment. Therefore, an investigation approach is proposed that will initially characterize the extent of contamination in all areas where significant potential for offsite migration of contamination exists. Groundwater samples will be taken downgradient of groundwater flow at Sites 1/41 and 2/15, and below Site 3 due to the site-specific characteristics of the Causeway Landfill. Additionally, surface water and sediment samples will be taken downgradient of the path of surface water runoff at all sites. Lastly, surface soil (0-1 foot below ground surface) will be sampled throughout the sites as previously proposed in the Draft Work Plan.

If the results of these activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered. Additionally, if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill, further investigation to determine the competency of the Hawthorn Formation as an adequate confining layer may be warranted. If analytical results indicate that both the lower surficial aquifer has been adversely impacted by the landfill and the Hawthorn Layer does not adequately act as a confining layer, investigation activities to evaluate potential impacts to the Floridan aquifer may also be warranted.

17. **Comment:** Page 7-11, Section 7.2.4
Given that metals were the only contaminants detected in groundwater samples during earlier Site 1 investigations, it is important that the current RI use sampling methods which will facilitate the collection of clear ground water samples and reduce the likelihood of false positives. The Navy should use the ground water sampling techniques provided in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), May 1, 1996 and summarized in the final paragraph of Section 3.1.1 (Groundwater Sampling) of the Draft Volume II Master Work Plan.

Response:
It is agreed that the groundwater sampling techniques provided in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), May 1, 1996 and summarized in the final paragraph of Section 3.1.1 (Groundwater Sampling) of the Draft Volume II Master Work Plan should be used. The final paragraph of Section 3.1.1 is fully detailed in SOP

SA-1.1, Section 5.7, "Low Flow Purging and Sampling." The text of section 7.2.4 will be revised accordingly.

18. **Comment:** Page 7-12, Section 7.3.2
This section stipulates that the last two digits of the sample number will specify the middle of the sample interval, yet the sample numbers in Table 7-1 specify the bottom of the sample interval. This discrepancy in sample nomenclature should be addressed.

Response:
The explanation of the sample depth portion of the sample identification number will be changed from "Middle of sample interval" to "Bottom of the sample interval or sample round."

19. **Comment:** Page 10-1, Section 10.2
A number of needed field QA/QC blanks are missing. Grout, sand, bentonite, and preservative blanks should also be collected.

Response:
Brown & Root Environmental recommends that material QA/QC blanks not be taken because the contractor will provide certified-clean well construction materials and false positive detections have not been a historical problem.

Additionally, it is recommended that preservative QA/QC blanks not be taken. In Section 10.2.1, trip blanks, field blanks, and rinsate blanks are proposed. Historically, such blanks very rarely shown positive detection of contaminants. Therefore, if the analytical results indicate that these samples are clean, the results indicate that preservatives used in such samples are pure.

RESPONSE TO U.S. EPA COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLANS
SITE 1 (INCINERATOR LANDFILL) AND SITE 41 (FORMER INCINERATOR) -
COMMENTS RECEIVED 7/22/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

1. **Comment-** Pages 3-1 through 3-2, Section 3.0:
According to the text, "This section presents a conceptual model and discussion of potential migration and human and ecological exposure pathways." However, the text does not indicate whether the identified pathways are applicable to human receptors, ecological receptors, or both. Nor does it indicate if any other aspects of the exposure pathways identified are unique to the receptor being considered. This information must be provided to ensure development of an adequate site conceptual model.

Response:
The text of Section 3.0 will be revised to indicate which exposure pathways are applicable to human or ecological receptors. Also, if aspects of the identified exposure pathways are unique to a receptor, the text will also be revised to indicate this information.

2. **Comment** - Page 4-12, Section 4.2.2.3:
As discussed and agreed to during the July 1997 Partnering Meeting, two surface water samples will be collected and analyzed for hexavalent chromium for risk assessment purposes. Verification of the hexavalent chromium content of surface water samples is appropriate, since chromium has been detected in previous sediment samples and surface water samples have never been collected at this site.

Response:
Per U.S. Fish & Wildlife Service comments, three samples will be collected and analyzed for hexavalent chromium in each medium.

3. **Comment** - Page 4-1, Section 4.0:
Given that a presumptive remedy approach will be used to evaluate this site, appropriate steps should be taken to notify the public of this approach. It is important that all stakeholders understand completely how the presumptive remedy process varies from the usual cleanup process, and the benefits of using this process. Please refer to U.S. EPA Directive entitled *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills* (Directive No. 9355.0-67FS, December 1996) for information and documents to be provided to the public via mechanisms such as the Administrative Record, Fact Sheets, etc.

Response:
In accordance with the U.S. EPA Directive entitled Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills, the Administrative Record will include the necessary generic and site-specific information documenting the selection and non-selection of the containment presumptive remedy. The text of Section 4.0 will be revised to reflect this information.

4. **Comment** - Page 5-2, Section 5.2:
The description of the ecological risk assessment to be performed must be comparable, in level of detail, to that provided for the human health risk assessment. For example, information on potential COCs (e.g. results of previous investigations), exposure pathways and receptor groups should be provided. Site-specific approaches to completing the generic steps identified in the Volume III Master Work Plan should also be provided. If Work Plan/SAP addendums will be generated to complete the plans for conducting the Ecological Risk Assessment (ERA), these addendums should also be clearly identified and described (e.g. purpose, contents, submittal criteria) in the present SAP.

Response:
Section 5.2 will be rewritten to describe the Navy's approach for conducting the ERA portion of the baseline risk assessment. In summary, the Navy believes that the ERA should be performed at the screening level only (Steps 1 and 2 of the ERA process) with data obtained from the upcoming RI/RFI rather than evidence of exceedences.

Also, the text of Section 5.2 will be revised to include the resolutions made during the September 8, 1997 conference call of the Tier I Partnering Team. During this conference call, the Team resolved to collect surface water and sediment samples at Site 3 at the onset of the field effort and to obtain analytical results from these samples within seven days. The need for biota sampling will be evaluated based on the results of this analysis. If necessary, biota sampling will be conducted before demobilization of the field effort.

Also for Site 3, a figure will be included in the SAP that overlays analytical data from the Verification Step onto the proposed surface water and sediment sampling points. This figure will be used as a check to ensure that Verification Step sample locations that exceeded U.S. EPA screening criteria are resampled and that areas not sampled during the Verification Step are sampled. Additionally, sampling points have been added within the Pond northeast of the Causeway and Ribbon Creek (southeast of the causeway) to evaluate the possible migration of contaminants from the site.

5. **Comment** - Page 7-1, Section 7.2:
Regarding the rationale for the proposed sampling, the SAP currently includes some good general criteria for selecting sampling locations (e.g. "..a primary sampling concern will be to characterize the worst-case site condition of each media investigated.." (p. 4-6, Section 4.1); "If during field activities, the FOL deems that a location not contained in the Work Plan should be sampled because of surface features (e.g. depressions) that would cause preferential accumulation of contaminants, the sampling plan will be altered to include these locations (p. 7-1, Section 7.2).

However, as discussed and agreed to during the July 1997 Partnering Meeting, in order to assure that these goals are accomplished on a sample-specific basis, the RI Report will briefly describe (e.g. 1-2 sentences) the justification for each sample collected.

Response:
If during field activities, a sampling location is altered, rationale will be provided in the RI/RFI report that justifies such deviation.

7. **Comment** - Page 10-1, Section 10.2:
Section 5.13.10 (Estimating Variability) of the U.S. EPA Region 4 SOPQAM cites the need for collecting material and preservative blanks. The Navy's decision not to collect QA/QC blanks for grout, sand bentonite and a preservative blank is acceptable, so long as the Navy assumes the risk for false positive detections.

Response:
As indicated in the response to comments to the Draft RI Work Plan for Site 1/41, false positive detections have not been a historical problem. However, QA/QC blanks for grout, sand, and bentonite will be collected and held for analysis pending the analytical results of the field investigation. If it is suspected that inorganic contaminants have been introduced by well installation materials, the samples will be sent to the laboratory for analysis. For inorganics, holding times will not be exceeded because the holding time for inorganic analysis is considerably longer than the 3-week turn-around time anticipated for analytical results. For organics, material blank analysis is not anticipated because monitoring well purging and development activities should dissipate minor organic contamination if present.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT REMEDIAL INVESTIGATION WORK PLANS
SITE 2 (BORROW PIT LANDFILL) AND (SITE 15 - DIRT ROADS) - COMMENTS RECEIVED 2/20/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(D. HARGROVE, REVIEWER)

2) **Comment:** Section 4.2.2.1, Target Compound List (TCL) and Target Analyte List (TAL) Parameters, page 4-6:

This work plan proposes using the TCL and TAL parameters specified under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The State has expressed its need to recognize and follow the Resource Conservation and Recovery Act (RCRA).

Given the ongoing CERCLA/RCRA discussions in the negotiation of a Federal Facilities Agreement (FFA) among Navy, Marine Corps, U.S. EPA, and SCDHEC representatives, the combination of the analytes identified under CERCLA and RCRA should be used as a starting point for investigation. This could eliminate the possibility of resampling depending on the outcome of the FFA negotiations. In order to accomplish this, R.61-79.261 Appendix VIII constituents should be studied for soils and R.61-79.264 Appendix IX constituents should be studied for groundwater. Please revise the text accordingly.

Response:
As agreed upon during the February 28, 1997 and March 6, 1997 conference calls of the MCRD Parris Island Tier I Partnering Team, the following decisions were made to satisfy RCRA requirements.

- *Four groundwater samples will be collected and analyzed for Appendix IX constituents. Of the four samples, one will be collected at each of the following three sites: Site 1 - Incinerator Landfill, Site 2 - Borrow Pit Landfill, and Site 3 - Causeway Landfill. The remaining sample will be a background sample collected from PAI-02-GW02. PAI-02-GW02 is an existing monitoring well located upgradient of Site 2. The four samples will be collected at locations previously proposed in the Draft Work Plans. The remaining proposed groundwater samples will be analyzed using SW-846 methodologies on the parameters specified by the TCL/TAL.*

- *Soil samples will not be analyzed for Appendix VIII constituents because there is a lack of established methodologies for analyzing these compounds.*

The additional groundwater analytical requirements will be incorporated into the text of Section 4.2.2.

3) **Comment:** Section 6.0, Field Operations, page 6-1:
Note: It is good you have specified that a state certified geologist will be present for the field operations. However, all monitoring wells must still be installed by a state-certified well driller. This includes direct push groundwater sampling activities.

Response:
Section 6.0, Field Operations, will be revised to indicate that all well installation activities will be performed under the direction of a state-certified Professional Geologist and will be installed by a state-certified well driller.

4) **Comment:** Section 6.4, Monitoring Well Installation and Construction, page 6-3:
a) Note decision criteria for using different slot sizes at different depths. Is this assumed due to local geology or will this be determined upon drilling activities? Please revise to include the methodology used for making this determination.

Response:
There is sufficient history from existing wells to conclude that the upper wells would be screened in fine-grained material (silts and fine sand) and the deeper wells would be screened in more coarse-grained sands. Therefore, the anticipated well slot size is determined to be 0.010 and 0.020 inches accordingly.

6) **Comment:** Figure 6-1, Typical Monitoring Well Detail, page 6-5:
Include ID plate in monitoring well detail. Note that as per R.61-71.6(H), the information listed on the identification plate must include:

a) Well identification number
b) Date of construction
c) Driller name and certification number.
d) Screened interval
e) Static water level

Response:
The identification plate information listed above will be included in Figure 6-1.

RESPONSE TO SCDHEC COMMENTS TO
DRAFT FINAL REMEDIAL INVESTIGATION WORK PLAN
SITE 2 (BORROW PIT LANDFILL) AND SITE 15 (DIRT ROADS) - COMMENTS RECEIVED 7/18/97
MCRD PARRIS ISLAND, SOUTH CAROLINA

(D. HARGROVE, REVIEWER)

3. **Comment**: Response to comment #1

   This response clarifies that the groundwater risk assessment will be performed according to CERCLA requirements. However, compliance with the State Primary Drinking Water Standards has not been specified. According to the National Oil and Hazardous Substances Contingency Plan (NCP), remedial alternatives should be evaluated against NCP threshold criteria for overall protection of human health, and compliance with applicable or relevant and appropriate requirements (ARARs). The State Primary Drinking Water Standards are ARARs and must be followed. This comment does not require a specific revision. This is for future reference to be acknowledged in the resulting report.

   Response:
   This comment is acknowledged.

4. **Comment**: Response to comment #8

   The Division of Hydrogeology understands and accepts the reasoning behind removing Monitoring Well PAI-02-GW06 from the current investigative work. However, it should be noted that this well might be required at a future date to address the Floridan Aquifer.

   Response:
   As discussed in Section 4.0, further investigation to evaluate potential impacts to the Floridan aquifer may be warranted if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill and the competency of the Hawthorn Formation as a confining layer has not been established.

1.0 INTRODUCTION

This Work Plan for Site/Solid Waste Management Unit (SWMU) 3 - Causeway Landfill, Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina, has been prepared by Brown & Root Environmental, Inc., (B&R Environmental) for the Southern Division (SOUTHDIV) Naval Facilities Engineering Command (NAVFAC) under the Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0020. This Work Plan outlines the requirements and describes the procedures for performing the field investigation at Site/SWMU 3 - Causeway Landfill. It is intended for use in conjunction with the Master Work Plan, Volumes I, II, and III for MCRD Parris Island (B&R Environmental, 1998c).

MCRD Parris Island is located along the southern coast of South Carolina approximately 1 mile south of the city of Port Royal and 3 miles south of the city of Beaufort within Beaufort County. MCRD Parris Island covers approximately 8,047 acres, consisting of dry land, salt marshes, saltwater creeks, and ponds, as shown in Figure 1-1. MCRD Parris Island is the reception and recruit training facility for the Marine Corps for enlisted men from states east of the Mississippi River, and for enlisted women nationwide.

For the remainder of this document, Site/SWMU 3 will be referred to as Site 3; however, Site 3 is still recognized and designated as a RCRA SWMU by the State of South Carolina

1.1 SCOPE AND OBJECTIVE

The preamble of the National Contingency Plan (NCP) identifies a municipal landfill as a site where the treatment of wastes may be impracticable because of the size and heterogeneity of the landfill's contents (i.e., municipal waste co-disposed with industrial/hazardous waste). Because treatment usually is impractical, the United States Environmental Protection Agency (U.S. EPA) generally considers containment to be the appropriate response action, or the "presumptive remedy" for the source areas of municipal landfill sites (U.S. EPA, 1993). Therefore, an investigation approach is proposed that will correspond with the approach outlined in U.S. EPA's *Presumptive Remedy for CERCLA Municipal Landfill Sites* (U.S. EPA, 1993) and *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance)* (U.S. EPA, 1996a).

In following the presumptive remedy guidance, the objectives of this investigation are to characterize the nature and extent of potential contaminant migration from past landfilling operations at Site 3. Media of

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P:\GIS\APR\PARRIS.APR 8-SEP-97 DNP DEPOT LOCATION MAP

Rev. 0
03/27/98

SOURCE: USGS 7.5 MINUTE PARRIS ISLAND QUADRANGLE, 1956. PHOTOREVISED 1979.

DEPOT LOCATION MAP

MCRD, PARRIS ISLAND, SOUTH CAROLINA

3000 0 3000 6000 Feet

FIGURE 1-1

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concern that will be investigated consist of surface water and sediment located topographically downgradient of Site 3 and groundwater located below Site 3. Additionally, surface soils located within the boundaries of Site 3 will be investigated.

Data collected from this investigation will be used to assess the human health and ecological risks associated with potential migration of contaminants. Human health risks to construction workers, site employees (maintenance and other), adolescent trespassers, adult and adolescent recreational users, and future residents, as well as ecological risks to the site's native flora and fauna, will be assessed. Also, sampling is proposed to determine whether media contain contaminants at concentrations above applicable or relevant and appropriate requirements (ARARs). Based on this information, decisions for remedial action will be evaluated and determined. If the results of field activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered if it is determined that the presumptive remedy is not appropriate.

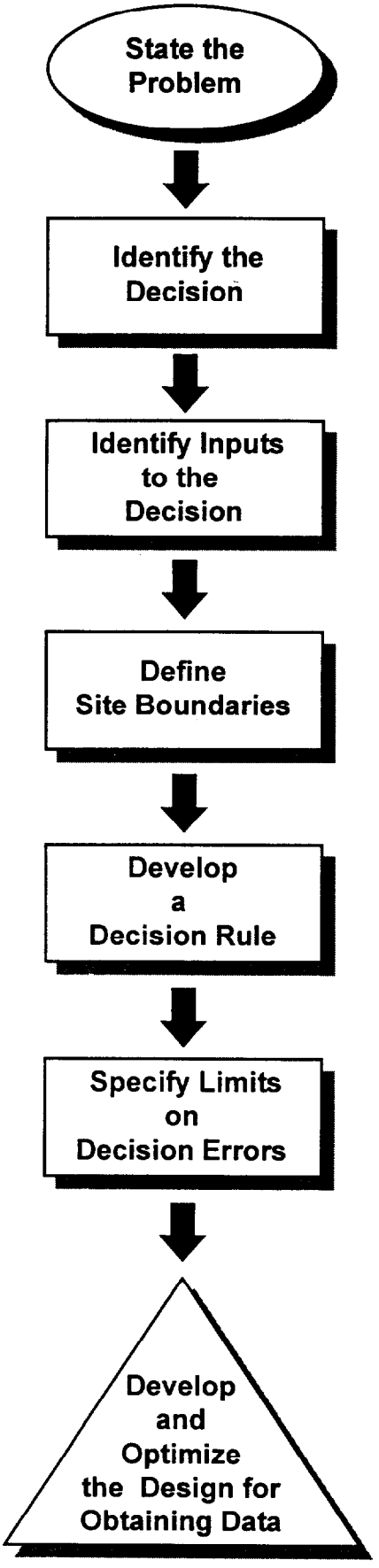
1.2 DATA QUALITY OBJECTIVES

This Work Plan has been developed using the Data Quality Objective (DQO) Process. The DQO Process is a focused, iterative process for developing the data collection strategy to support decision-making. The goal of the process is to conduct investigations in an efficient and effective manner without unnecessary precision or redundancy of data. The process consists of seven steps, ordered in a downward decision flow. A flow diagram with descriptions of each step is provided in Figure 1-2. The DQO Process is further explained in Volume I, Section 1.2.2, of the Master Work Plan (B&R Environmental, 1998c).

1.3 DOCUMENT ORGANIZATION

This Work Plan is intended to be used in conjunction with the Master Work Plan for MCRD Parris Island (Volumes I through III) and references the Master Work Plan where appropriate. This Work Plan includes the site-specific information to be used for sampling at Site 3, whereas the Master Field Sampling Plan (FSP) and the Master Quality Assurance Plan (QAP) provide general information that is applicable to all sites at MCRD Parris Island. Sections 1.0 through 4.0 of this site-specific Work Plan identify the project scope and objectives, summarize background information and existing data, and present the proposed sampling plan. Section 5.0 discusses the human health and ecological risk assessment. Sections 6.0 and 7.0 are the site-specific FSP. Sections 8.0 through 10.0 of this document describe the Quality Assurance and Quality Control (QA/QC) measures for ensuring that usable data is obtained.

FIGURE 1-2
DATA QUALITY OBJECTIVES PROCESS



- Definition of problem for data collection (Section 2.4)
- Review of historical & background information (Section 2.0)
- Preliminary assessment of existing data (Section 3.0)

- Statement of the action-based decision to resolve problem (Section 4.0)

- Identification of measurable variables and action levels to support decisions (Section 5.0)

- Definition of sampling population, and spatial and temporal boundaries and limitations (Section 4.0)

- Single statement synthesizing previous steps and summarizing how data will be used to make a decision (Master Work Plan, Volume III)
- An "if...then" statement defining values for deciding between alternative actions (Master Work Plan, Volume III)

- Definition of acceptable limits of decision error and potential consequences of incorrect decisions (Decision Document; Master Work Plan, Volume III)

- Development of alternative sampling designs and selection of most effective design for sampling and analysis (Section 4.2)

2.0 SITE BACKGROUND

This section presents a brief history of Site 3 - Causeway Landfill and describes the existing site conditions. It also summarizes previous investigation results. Figure 2-1 illustrates the location of Site 3 along with other sites (Sites 1, 2, 15, and 41) at the MCRD Parris Island facility where remedial activities are scheduled to take place.

2.1 SITE DESCRIPTION AND HISTORY

Site 3 is an integral part of a causeway connecting Horse Island and Parris Island, in the north section of MCRD Parris Island, as shown in Figure 2-1. The causeway is a gravel, two-lane road, consisting of alternate layers of solid waste and fill dirt constructed along a tidal marsh of the Broad River (across Ribbon Creek). At two locations along the causeway, three concrete pipes are buried beneath the causeway to allow tidal movement between the surface water bodies separated by the unit. Photos of the causeway are provided in Figure 2-2.

The Causeway Landfill (Site 3) functioned as the major disposal area for trash and other materials discarded in dumpsters around the MCRD during most of the period between 1960 and 1972. Between 1960 and 1965, this landfill received approximately 75 percent of the solid waste generated by the Depot. The remainder was disposed at Site 1, Incinerator Landfill, which was also in operation during that period. The site was inactive between 1966 and 1968. Between 1969 and 1972, the site received all of the Depot's solid waste. The solid waste disposed at the site included empty pesticide containers, oily rags, spend absorbent, petroleum and chlorinated solvent sludge, perchloroethylene still bottoms, mercury amalgam and beryllium waste, polychlorinated-biphenyl (PCB)-contaminated oil, and metal shavings. In 1972, landfilling operations ceased at Site 3.

The causeway was constructed in two separate sections across a tidal marsh of the Broad River. One section began from the northeast edge of Horse Island, and was built primarily with fill dirt taken from the borrow pits on Horse Island. Some solid wastes were also reportedly placed in this section of the causeway. The other section started near the southern end of Talasesa Street on Parris Island, and was built with both the solid waste mentioned in the previous paragraph and fill dirt. Examination of aerial photos taken in 1951, 1965, and 1972 illustrate that the two sections of causeway gradually extended into the marsh until they met in 1972. Reproductions of these photographs are provided in Appendix A. At its completion in 1972, the causeway was approximately 10 acres in size, 4,000-feet long, 100-feet wide,

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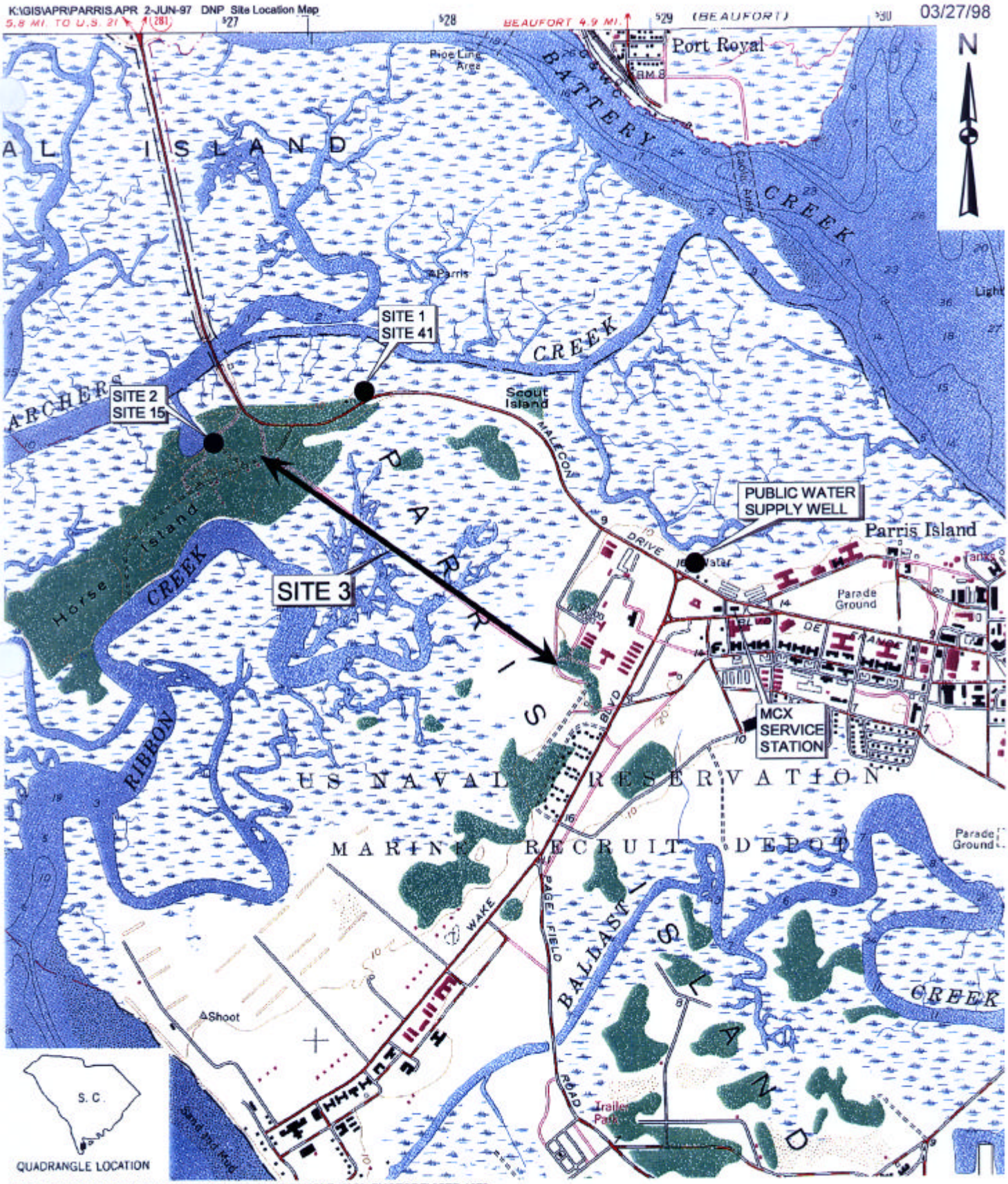

SOURCE: USGS 7.5 MINUTE PARRIS ISLAND QUADRANGLE, 1956. PHOTOREVISED 1979.

SITE LOCATION MAP

MCRD, PARRIS ISLAND, SOUTH CAROLINA

2000 0 2000 4000 Feet

FIGURE 2-1

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CAUSEWAY LANDFILL LOOKING SOUTHEAST FROM THE NORTHWEST END

NORTHERN SIDE OF CAUSEWAY LANDFILL SHOWING RIP RAP BANK OVERGROWN WITH VEGETATION

FIGURE 2-2
SHEET 1-2

SITE PHOTOS
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Brown & Root Environmental

POND AREA ON THE NORTHERN SIDE OF THE CAUSEWAY LANDFILL

SOUTHERN SIDE OF THE CAUSEWAY LANDFILL SHOWING CULVERT HEADWALL AND RIBBON CREEK

FIGURE 2-2
SHEET 2-2

SITE PHOTOS
SITE 3 – CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Brown & Root Environmental

and 10-feet high (above the water surface), with a gravel road surface and rip-rap sides overgrown with vegetation. Limited information is available concerning the presence and areal extent of fill material used to cover the landfill after disposal activities were discontinued in 1972. No significant landfill activity has taken place at Site 3 since 1972.

2.2 SITE HYDROGEOLOGY

A summary of the site hydrogeology for Site 3 is provided in this section.

2.2.1 Surficial Aquifer

The surficial, or water table, aquifer at Site 3 is unconsolidated and is restricted to the shallow, Pleistocene- to Holocene-age, fine-grained, sedimentary deposits of the Pamplico and Waccamaw Formations (Hughes et al., 1989). Based upon information obtained in this area, the upper 20 feet of sediment consists of very fine, yellow-brown sand with traces of clay and silt with thin (approximately 6 inches thick), discontinuous layers of greenish-gray silty clay. The surficial aquifer is estimated to be 30 feet thick in the area and usually ranges from a depth of 0 to 10 feet at MCRD Parris Island and is most commonly found at a depth of 3 feet. Seasonal changes can be as great as 6.5 feet (NEESA, 1986). An estimated transmissivity of 1,300 ft^2/day with a storage coefficient of 0.20 has been reported for sands within the shallow deposits (Hassen, 1985). Specific Site 3 aquifer characteristics will be determined during the field investigation.

2.2.2 Confining Layer

The surficial aquifer is underlain by the unconsolidated, Miocene-age, Hawthorn Formation (Hughes et al., 1989). The Hawthorn Formation is a geological formation that hydraulically separates the unconfined surficial aquifer from the underlying, artesian Floridan Aquifer. The elevation at the top of the Hawthorn Formation is reported to be within the range of 30 to 60 feet below mean sea level (msl) at Parris Island. The thickness of the Hawthorn Formation at Site 3 is anticipated to be between 20 and 40 feet (NEESA, 1986). The actual depth of this formation at Site 3 will be determined during the field investigation. Hughes et al., (1989), calculated the leakage through the Hawthorn Formation to be 0.0002 ft^3/day for every foot of head difference (using an average formation thickness of 30 feet and vertical hydraulic conductivity of 0.006 ft/day). The Hawthorn Formation consists of miocene deposits that appear to be locally discontinuous and varying in lithologic features across most of coastal South Carolina. This formation consists of sandy, clayey materials that are frequently eroded in coastal Beaufort County.

2.2.3 Floridan Aquifer

The principal source of groundwater used for consumption in the Beaufort County, South Carolina area is the Floridan Aquifer (Smith, 1987). This artesian aquifer system is contained within the Santee Limestone Formation, has a total depth of approximately 1,000 feet, and is divided into the Upper Unit and the Lower Unit (NEESA, 1986).

The only public supply well identified within a 1/4-mile radius of MCRD is located approximately 600 feet southwest of the MCX Service Station and is illustrated on Figure 2-1. The MCX Service Station is located in the north-central portion of the MCRD (Figure 2-1). The well was once used as a hot water source (Sirrine Environmental Consultants, Inc., 1991). It is currently not in use but has not been abandoned.

2.3 PREVIOUS INVESTIGATIONS

2.3.1 Initial Assessment Study

In 1986 the Naval Energy and Environmental Support Activity (NEESA) conducted an Initial Assessment Study (IAS) (NEESA, 1986) to identify potentially contaminated sites at the MCRD Parris Island that may pose a threat to human health or the environment. The IAS consisted of an investigation of activity records, a records search at various government agencies, an onsite survey to identify potentially contaminated areas, an evaluation of each site for its potential hazard to human health or to the environment, and a determination of the need for a confirmation study or an immediate mitigation action at each site. The IAS identified Site 3 - Causeway Landfill as a site requiring further investigation to assess potential long-term impacts. The study recommended the sampling of groundwater and surface water at seepage points along the causeway and also the sampling of the soil and sediment at these locations.

2.3.2 Interim RCRA Facility Assessment

An Interim RCRA Facility Assessment (RFA) was performed during January 1990 - March 1990. The RFA (Kearney, 1990) was based on the results of a Preliminary Review (PR) of the U.S. EPA Region 4 and South Carolina Department of Health and Environmental Control (SCDHEC) files and a Visual Site Inspection (VSI). The RFA identified Site 3 as one of the 44 Solid Waste Management Units (SWMUs) and areas of concern (AOCs) which it investigated. The report indicated that because there was documented disposal of waste containing hazardous constituents in an unlined unit in the immediate vicinity of surface waters, a RCRA Facility Investigation (RFI) was necessary for Site 3.

2.3.3 Verification Study

As a result of the recommendation made in the IAS, a verification study (VS) was conducted (McClelland, May 1990). The work at Site 3 consisted of collecting eight shallow soil/sediment samples and eight surface water samples along the flanks of the causeway (Figure 2-3). The samples were analyzed for volatile organic compounds, acid and base/neutral extractable organics, PCBs and pesticides, total metals (arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, and silver) and EP toxicity metals (arsenic, cadmium, chromium, lead, and mercury). No organic compounds were identified in any sediment or surface water samples collected at the Causeway Landfill.

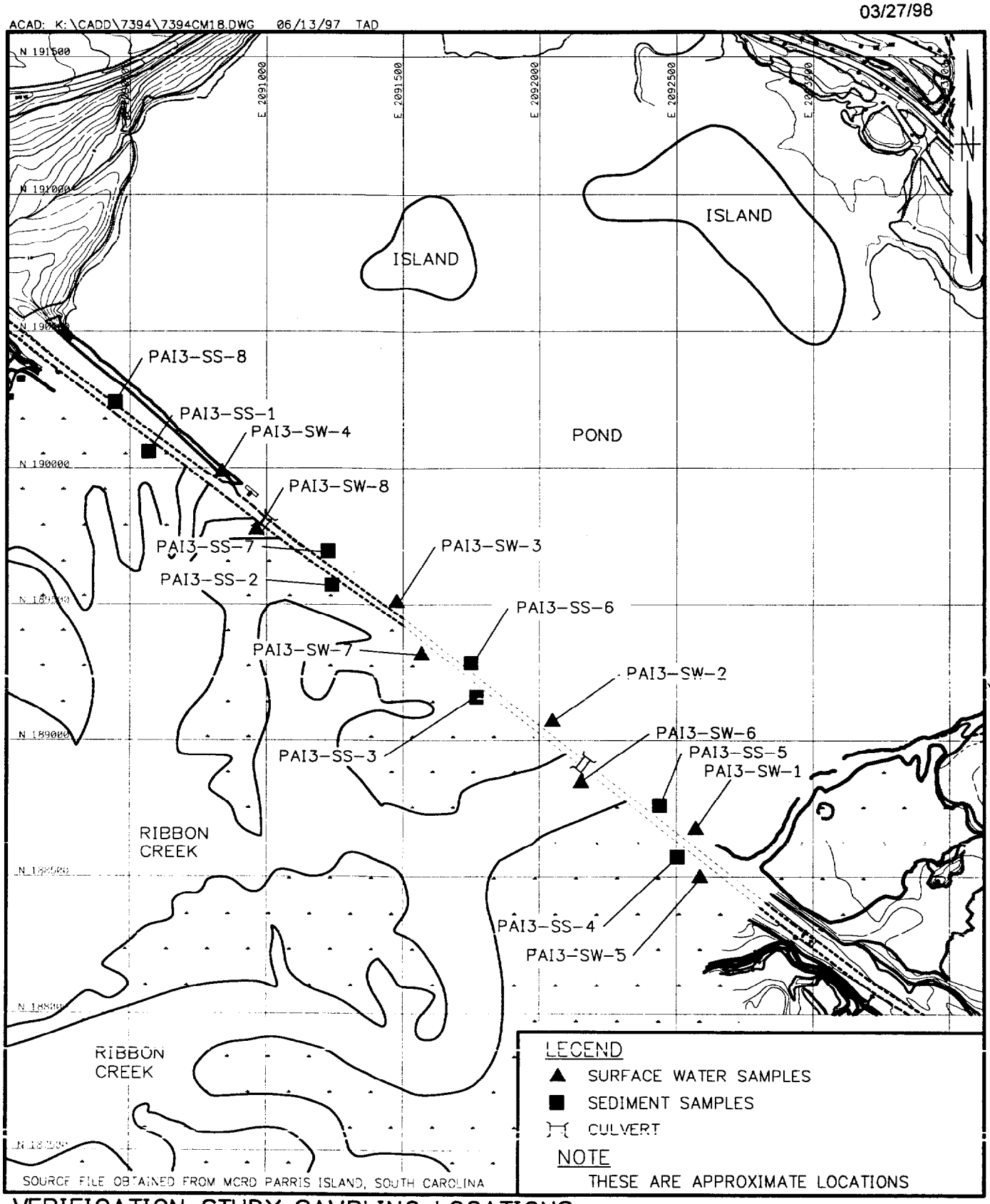
Inorganics were identified that exceed current U.S. EPA Region 4 Waste Management Division Saltwater and Sediment Screening Values. These exceedances are illustrated as follows.

Metal	SW Screening Value (ug/L)	Number of Exceedances	Sediment Screening Value (ppm)	Number of Exceedances
Cadmium	9.3	2	1	-
Chromium	103	-	52.3	-
Lead	8.5	5	30.2	-
Mercury	0.025	2	0.13	8
Selenium	71	-	-	-

Figure 2-4 shows the concentrations and locations of the sample analytical results. Site 3 was recommended for advanced sampling and assessment activities to address potential concerns regarding the harvesting of shellfish and fish species in the vicinity of the causeway landfill.

2.3.4 Extended Site Inspection Report, Causeway Landfill

The Extended Site Inspection (ESI) was conducted to evaluate whether the consumption of fish and shellfish caught by recreational fishermen in the vicinity of the Causeway Landfill poses a risk to human health (ABB Environmental Services, Inc., August 1993). Fish and shellfish commonly harvested in the area were sampled and analyzed to determine whether tissue levels exceeded action levels established by the United States Food and Drug Administration (USFDA). The results of this screening are presented in Table 2-1. Biological tissues were analyzed for inorganic compounds (mercury), organic polynuclear aromatic hydrocarbons (PAHs), PCBs, and pesticides. Pesticides and PCBs, were detected in tissues on the pond side of the causeway at concentrations that may need to be considered for their effects on ecological receptors. The source of the pesticides and PCBs is not obvious because the geographical area covered by the investigation was small; however, the results of the ESI indicate that maximum chemical tissue concentrations for the five species sampled (mullet, flounder, crab, clam, and oyster) are



VERIFICATION STUDY SAMPLING LOCATIONS
SITE 3 – CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 2-3

0 500 1000
SCALE IN FEET

Brown & Root Environmental

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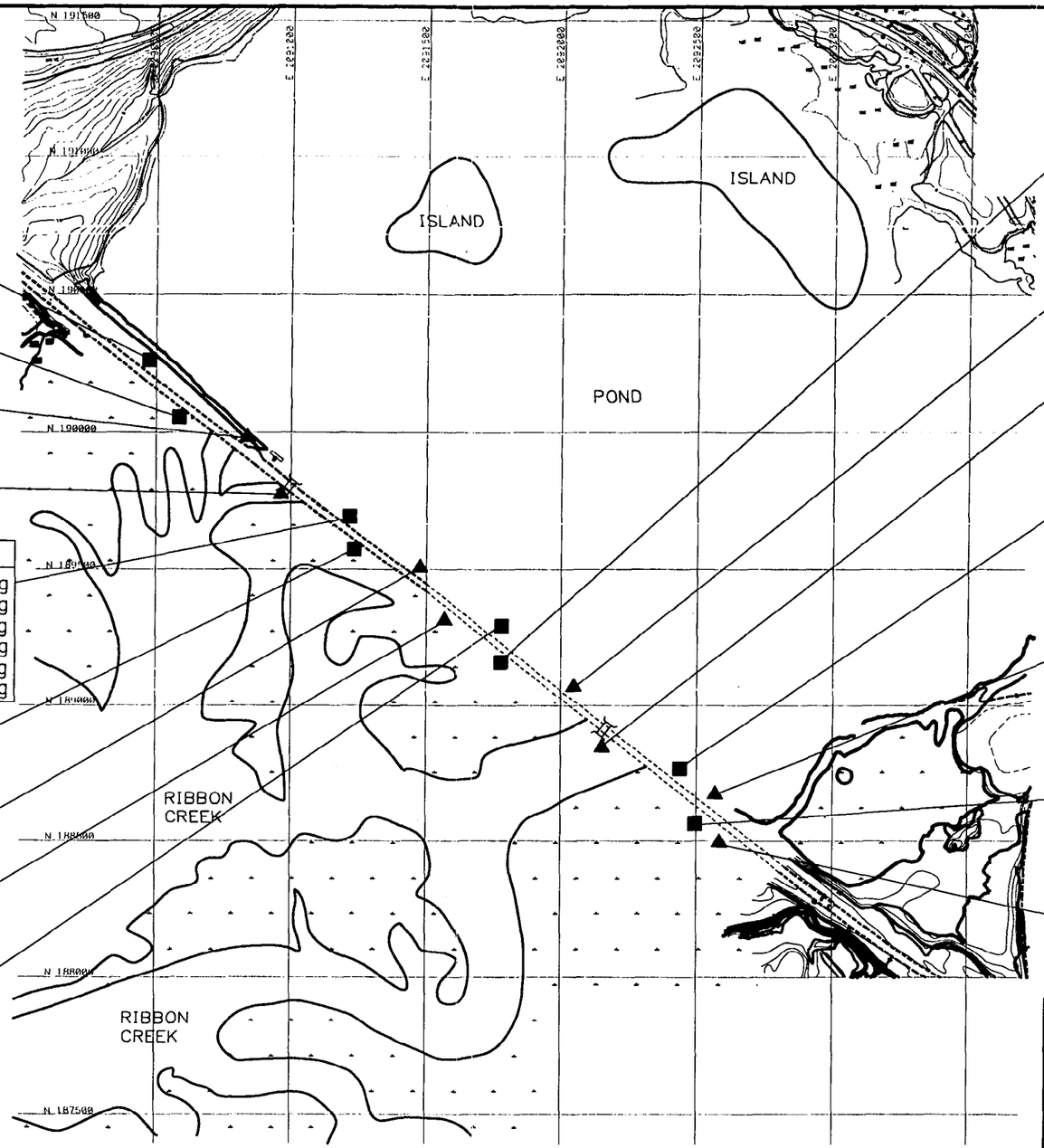
Rev. 0
03/27/98



PAI3-SS-8	
BARIUM	3.45 mg/kg
CHROMIUM	1.80 mg/kg
LEAD	23.9 mg/kg
MERCURY	0.45 mg/kg

PAI3-SS-1	
BARIUM	1.45 mg/kg
LEAD	0.48 mg/kg
MERCURY	0.45 mg/kg

PAI3-SW-4	
LEAD	0.013 mg/L

PAI3-SW-8	
LEAD	0.007 mg/L

PAI3-SS-7		DUP.
BARIUM	1.86 mg/kg	1.84 mg/kg
CHROMIUM	1.76 mg/kg	1.45 mg/kg
LEAD	4.32 mg/kg	4.65 mg/kg
MERCURY	0.35 mg/kg	0.40 mg/kg
SELENIUM	0.15 mg/kg	0.11 mg/kg
HEXAVALENT CHROMIUM	0.01 mg/kg	0.01 mg/kg

PAI3-SS-2	
BARIUM	2.53 mg/kg
LEAD	0.98 mg/kg
MERCURY	0.60 mg/kg

PAI3-SW-3	
LEAD	0.009 mg/L

PAI3-SW-7	
LEAD	0.006 mg/L

PAI3-SS-6	
BARIUM	2.38 mg/kg
LEAD	0.52 mg/kg
MERCURY	0.35 mg/kg

PAI3-SS-3	
BARIUM	5.88 mg/kg
CHROMIUM	2.58 mg/kg
LEAD	8.08 mg/kg
MERCURY	0.40 mg/kg

PAI3-SW-2	
LEAD	0.012 mg/L
MERCURY	0.0005 mg/L

PAI3-SW-6	
CADMIUM	0.013 mg/L
LEAD	0.011 mg/L

PAI3-SS-5	
BARIUM	3.74 mg/kg
CHROMIUM	2.43 mg/kg
LEAD	18.8 mg/kg
MERCURY	0.55 mg/kg
SELENIUM	0.16 mg/kg

PAI3-SW-1		DUP.
CADMIUM	0.01 mg/L	0.01 mg/L
LEAD	0.022 mg/L	0.011 mg/L
MERCURY	0.0016 mg/L	

PAI3-SS-4	
BARIUM	2.71 mg/kg
CHROMIUM	2.21 mg/kg
LEAD	6.80 mg/kg
MERCURY	0.30 mg/kg
HEXAVALENT CHROMIUM	0.01 mg/kg

PAI3-SW-5	
LEAD	0.006 mg/L

LEGEND
- ▲ SURFACE WATER SAMPLES
- ■ SEDIMENT SAMPLES
- CULVERT

NOTE: LOCATIONS ARE APPROXIMATE

SOURCE FILE OBTAINED FROM MCRD PARRIS ISLAND,SC

SURFACE WATER AND SEDIMENT ANALYTICAL RESULTS
VERIFICATION STUDY (1990)
SITE 3 – CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

0 500 1000
SCALE IN FEET

FIGURE 2-4

Brown & Root Environmental

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TABLE 2- 1

DATA COMPARISON WITH USFDA ACTION LEVELS
EXTENDED SITE INSPECTION (CONDUCTED BY ABB-ES, 1993)
CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Chemical	USFDA Action Level		Concentrations in Species[1] (ppb)										Values Above USFDA Levels
	(ppm)	(ppb)	Flounder		Mullet		Crab		Clam		Oyster		
			Pond	Tidal	Pond	Tidal	Pond	Tidal	Pond	Tidal	Pond	Tidal	
Aldrin	0.3	300	-	-	0.17	0.17	-	-	-	-	-	-	-
Dieldrin	0.3	300	-	-	0.43	0.57	0.43	0.98	-	0.094	-	-	-
Chlordane	0.3	300	0.53	-	1.2	1.3	0.57	0.52	-	0.18	0.99	0.4	-
DDT (2,4)	5	5,000	-	-	0.21	0.21	-	-	-	0.0696	0.29	-	-
DDT (4,4)	5	5,000	-	-	0.98	1.1	-	-	-	0.32	-	-	-
DDE (2,4)	5	5,000	0.53	-	0.095	0.31	0.2	-	-	0.11	0.565	0.29	-
DDE (4,4)	5	5,000	24	1.3	45	25	18	14	-	0.41	15.7	3.1	-
DDD (2,4)	5	5,000	-	-	0.26	0.27	-	-	-	0.088	-	-	-
DDD (4,4)	5	5,000	7.4	0.25	7.1	6.6	8.5	2.5	-	0.0936	7.5	0.97	-
Endrin	0.3	300	-	-	0.88	0.89	-	-	-	-	-	-	-
Heptachlor	0.3	300	-	-	0.38	0.38	-	-	-	-	-	-	-
Heptachlor epoxide	0.3	300	-	-	0.14	0.14	0.38	0.95	-	-	-	-	-
Mercury	1	1,000	66	58	5.6	7.8	28	59	-	8.2	13	9.6	-
Mirex	0.1	100	1.5	0.4	2.3	1.1	1.4	1.1	-	-	0.469	0.14	-
PCB (Aroclor 1254)	2	2,000	54	2.1	59	47	-	-	-	-	58	-	-

Notes:

1 Concentrations are reported as mean wet weight plus one standard error.

USFDA = U.S. Food and Drug Administration.
ppm = parts per million.
ppb = parts per billion.
DDT = dichlorophenyl trichloroethane.
DDE = dichlorophenyl dichloroethylene.
DDD = dichlorophenyl dichloroethane.
PCB = polychlorinated biphenyls.

below USFDA action levels for samples collected on both the pond and tidal creek side of the causeway. This report also identified the disposal of mercury amalgam in the landfill which could have an ecological impact if detected in site media.

2.4 STATEMENT OF PROBLEM

Based on known disposal practices conducted at Site 3 and the results of the Verification Study conducted by McClelland (1990) and the Extended Site Inspection conducted by ABB (1993), it has been determined that environmental media have been affected by the site and that further evaluation is needed to determine potential risks to human health and ecological receptors.

3.0 PRELIMINARY ASSESSMENT

This section presents a conceptual model and discussion of potential migration and human and ecological exposure pathways of contaminants from Site 3. Figure 3-1 presents a conceptual model of Site 3. A detailed discussion of potential receptors, media of concern, and exposure routes is found in Section 5.0.

3.1 SURFACE WATER

Surface water flow from Site 3 is generally to the east into an adjacent pond and west into an adjacent marsh and Ribbon Creek. Impacts to the surface water may be from direct runoff from the causeway and may also originate from surface water flowing through the causeway from tidal effects and discharging to Ribbon Creek or the surrounding marsh.

Surface water samples were collected during the Verification Step (McClelland, 1990) and no organic compounds were identified. However, several metals (dissolved lead, mercury, and cadmium) were identified in the surface water below screening levels. Therefore, additional investigation is proposed to verify that the surface water surrounding the site is not adversely impacted and is not a pathway for further contaminant migration. If surface water is found to be adversely impacted, incidental ingestion of and dermal contact with contaminants in surface water by human receptors would be possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors (aquatic organisms) would also be anticipated exposure pathways.

3.2 SEDIMENT

Several metals were detected in sediments sampled during the Verification Step (McClelland, 1990). Sediment contamination may have resulted from contaminants that are directly adsorbed to eroded soils or from contaminants adsorbing to sediment during transportation and deposition. Therefore, sediments located in the marsh and pond adjacent to the site may be impacted and may be transported into Ribbon Creek. If sediment is found to be adversely impacted, incidental ingestion of and dermal contact with contaminants in sediment by human receptors would be possible exposure pathways of concern. Ingestion, direct contact, and bioaccumulation by ecological receptors (organisms living and/or feeding on the water bottom) would also be anticipated exposure pathways.

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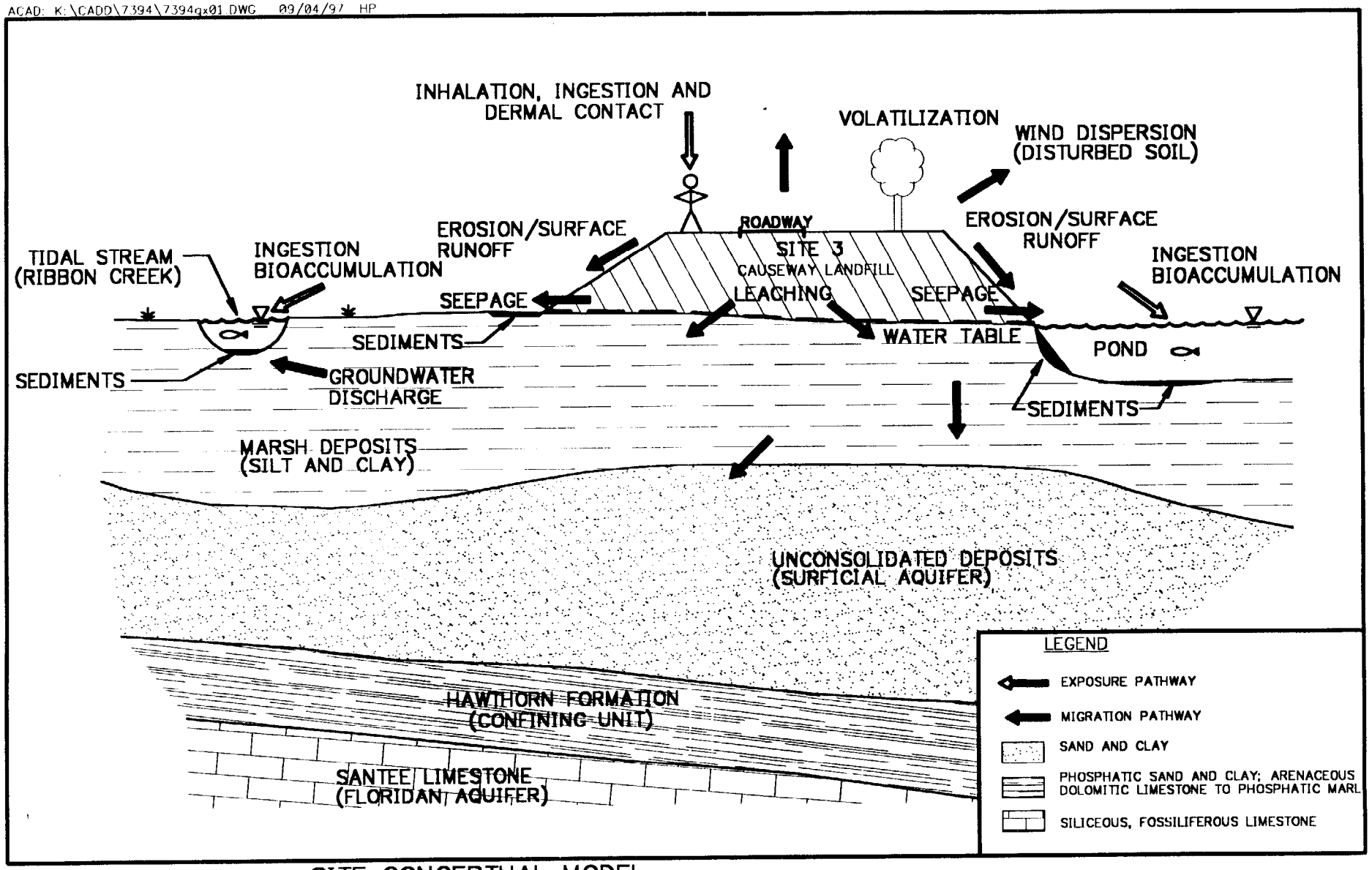

SITE CONCEPTUAL MODEL
SITE 3–CAUSEWAY LANDFILL
MCRD, PARRIS ISLAND, SOUTH CAROLINA
NOT TO SCALE

FIGURE 3–1

Brown & Root Environmental

3.3 GROUNDWATER

No groundwater samples were collected during the Verification Step (McClelland, 1990). The causeway was constructed across a tidal marsh and the surficial groundwater is anticipated to be shallow and tidally influenced. However, the marsh deposits underlying the landfill including the clay comprising the Hawthorn Formation may act as a partial barrier to the Floridan Aquifer and will be investigated. If groundwater is found to be adversely impacted, ingestion, dermal contact, and inhalation (via showering) of contaminants in groundwater by human receptors would be potential pathways of concern. Exposure to ecological receptors is not anticipated.

3.4 SOIL

The surface soil at Site 3 may be a contaminant source to surface water and sediment, via leaching and surface runoff, and to groundwater via leaching. Surface soils were not sampled during the VS (McClelland, 1990). If surface soil is found to be adversely impacted, incidental ingestion of and dermal contact with contaminants in the soil by human receptors would be possible exposure pathways of concern. In addition, the surface soil, if disturbed, may serve as a source for airborne transport of contaminants. Contaminants in the soil may also be accumulated by natural or cultivated vegetation which could be ingested by wildlife and/or human receptors. Additional exposure pathways involving direct ingestion or contact with contaminated soil by benthic invertebrates may also be of concern.

3.5 AIR

Site 3 has been revegetated and a two-lane gravel roadway was constructed on top following cessation of landfill operations. Since vegetative cover and roadway material reduces the potential for suspension of particulates and subsequent airborne transport, the air pathway is not considered to be significant to human or ecological risk provided that the surface cover is undisturbed. The potential for suspension of particles and subsequent airborne transport to human receptors will be evaluated during the risk assessment using the results from surface soil sampling.

4.0 INVESTIGATION SCOPING

The scope of this investigation is consistent with the U.S. EPA guidance entitled *Presumptive Remedy for CERCLA Municipal Landfill Sites* (U.S. EPA, 1993) and *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance)* (U.S. EPA, 1996a). In summary, field activities will characterize the nature and extent of contamination within Site 3 where potential for offsite migration of contamination exists. Surface water and sediment samples will be collected downgradient of the path of surface water runoff from Site 3 and groundwater samples will be collected below Site 3. Additionally, surface soil will be sampled throughout the site.

If the results of these activities indicate that areas of offsite contaminant migration exceed regulatory standards or pose unacceptable human and ecological risks, characterization of the extent of contamination within the landfill may be considered. Additionally, if analytical results indicate the lower surficial aquifer has been adversely impacted by the landfill, further investigation to determine the competency of the Hawthorn Formation as an adequate confining layer may be warranted. If analytical results indicate that both the lower surficial aquifer has been adversely impacted by the landfill and the Hawthorn Formation does not adequately act as a confining layer, investigation activities to evaluate potential impacts to the underlying Floridan aquifer may also be warranted.

In accordance with U.S. EPA guidance, the Administrative Record will include the necessary generic and site-specific information documenting the selection or non-selection of the containment presumptive remedy (U.S. EPA, 1996a).

4.1 INVESTIGATION RATIONALE

Previous investigations indicated the presence of metals in the surface water and sediments adjacent to Site 3 - Causeway Landfill. Based on the information presented in Section 3.0 for the site media, the proposed investigation of Site 3 will include the following media:

- Surface Water - Previous investigations detected low levels of dissolved metals (lead, mercury and cadmium) in the surface water. Additional surface water sampling is proposed to determine whether contaminants are migrating to the surface water at levels above ARARs and risk-based criteria (ecological and human health).

- Sediment - Previous investigations detected low levels of dissolved metals (barium, chromium, lead, mercury, selenium, hexavalent chromium) in the sediments adjacent to the site. However, the extent

of migration of contaminants from the site to adjacent sediments has not been evaluated. Sediment sampling is proposed to determine whether site-related constituents are present in sediments at levels above ARARs and risk-based criteria (ecological and human health).

- Groundwater - Previous investigations did not include groundwater sampling. A deep surficial aquifer monitoring well and shallow surficial monitoring wells are proposed to determine whether site-related compounds are leaching from the landfill at concentrations above ARARs and risk-based criteria (ecological and human health). For use in the human health risk assessment, sampling and analysis will be conducted for evaluating the use of groundwater as a practical drinking water source according to CERCLA (U.S. EPA, 1991). The analytical results of surface water and sediment sampling will be used to refine the placement of monitoring wells.

- Surface/Subsurface Soil - Previous investigations did not include soil sampling. Surface soil sampling is proposed to determine whether the surface soil is a source of contamination for the other migration pathways and to determine whether contamination exists at levels above ARARs and risk-based criteria (ecological and human health). Subsurface soil samples are proposed for groundwater modeling purposes to determine the extent of contaminant fate and transport.

- Air - Airborne contamination is not anticipated to pose a risk at this site. However, if field data and observations indicate that surface soil is contaminated, a decision to collect air samples will be determined.

During past investigations, relatively low concentrations of contaminants were detected for only a few compounds. To provide sufficient data for conducting subsequent steps of the CERCLA/RCRA process, a primary sample concern will be to characterize the worst-case site condition under investigation. Table 4-1 summarizes the rational for investigation of specific media at Site 3.

4.2 INVESTIGATION SUMMARY

The following section presents the proposed investigation at Site 3. All data will be collected in accordance with the Master FSP, Master QAP, and U.S. EPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM) (U.S. EPA, 1996b).

4.2.1 Sampling Activities

Table 4-2 summarizes the field investigation activities at Site 3 - Causeway Landfill, MCRD Parris Island, South Carolina.

TABLE 4-1

INVESTIGATION RATIONALE
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND
PAGE 1 OF 2

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution of Data Gaps/Needs
Surface Water	No organic compounds detected. Dissolved metals detected at low concentrations in all samples. Known depository of chemical constituents in this causeway in immediate vicinity of surface water. Fish and shellfish had chemical tissue concentrations (pesticides and PCBs) which were below USFDA action levels.	Surface water may be an exposure pathway of contaminants to human and ecological receptors. Contaminant migration to surface water may originate from soil, sediment, and/or groundwater.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Site hydrology • Modeling	• TCL, TAL (total and dissolved metals and cyanide) parameters • Water quality parameters • Hexavalent chromium • Water-level measurement • Tidal influence study
Sediment	Low level of dissolved metals were detected in all samples.	Sediments may be an exposure pathway of contaminants for human and ecological receptors. Contaminant migration to sediment may originate from soil, surface water, and/or groundwater.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Modeling • Volume calculations	• TCL, TAL (metals and cyanide) parameters • Hexavalent chromium • TOC • Grain-size analysis • Bulk density • pH • Sediment sampling results

TABLE 4-1

INVESTIGATION RATIONALE
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND
PAGE 2 OF 2

Media	Identified/Suspected Contaminants	Preliminary Assessment	Data Gaps/Needs	Resolution of Data Gaps/Needs
Groundwater	No previous sampling conducted.	Groundwater may be a pathway of contaminants from soils to surface water and sediment. Groundwater is a potential pathway of contaminants to human and ecological receptors.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Modeling • Site hydrology	• TCL, TAL (total and dissolved metals and cyanide) parameters • Water quality parameters • Appendix IX parameters • Hexavalent chromium • Horizontal hydraulic conductivity • Vertical hydraulic conductivity • Groundwater modeling parameters • Water-level measurements • Tidal influence study
Soil	No previous sampling performed. Know depository of solid waste, solid paint waste, and other chemical constituents.	Soils may be a pathway of contaminants to surface water and sediment and as a potential pathway to human and ecological receptors.	RI/RFI • Nature and extent characterization • Risk assessment FS/CMS • Geotechnical characterization • Determine presence and extent of cover (fill) material • Stratigraphy • Modeling	• TCL, TAL (metals and cyanide) parameters • Hexavalent chromium • Soil classification • Lithology • Groundwater modeling parameters

4.2.2 Analytical Parameter Rationale

This section provides the rationale for the proposed analytical program to be conducted on the samples collected from Site 3.

4.2.2.1 TCL and TAL Parameters

Based on the previous disposal practices conducted at Site 3, there is a potential for both organic and inorganic contamination at this site. To determine if contamination exists in the various media (surface water, sediment, groundwater, and surface soils), fixed-base laboratory analysis will be conducted. Samples from each medium will be analyzed for Target Compound List (TCL) organics and Target Analyte List (TAL) inorganics. These analyses will provide data at Site 3 to determine the nature and extent of contamination and to conduct a human health and ecological risk assessment. The TCL organics analysis includes both volatile and semivolatile organics. Samples from each media will also be analyzed for both TCL PCBs and TCL pesticides. Media will be analyzed for these parameters because pesticides and/or PCBs may have been disposed of at Site 3. TAL metals (total and dissolved) and cyanide will be analyzed because these constituents are potential components of the wastes disposed of at Site 3.

The results of these analyses will be compared against the screening criteria established in the decision document (Volume III of the Master Work Plan, Brown & Root Environmental, 1998c) to determine whether there is a potential risk to human or ecological receptors.

4.2.2.2 RCRA Appendix IX Parameters

One groundwater sample will be collected and analyzed for the inorganic (total and dissolved metals) and volatile, semivolatile, pesticide/PCB, organophosphorus, and herbicide organic constituents listed in Appendix IX of 40 CFR Part 264. The sample will be collected to satisfy RCRA requirements for the field investigation. The location of this sample will be discussed in Section 7.0.

4.2.2.3 Hexavalent Chromium

Sampling locations are chosen based on the likelihood of contaminant migration/accumulation and the results of previous investigations. At Site 3, three samples each will be collected in surface soil, groundwater, surface water and sediment and analyzed for hexavalent chromium.

TABLE 4-2

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND
PAGE 1 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location(1)	Analysis
Surface Water	• TCL, TAL parameters	• Collect surface water samples.	18	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals (Total and Dissolved) and Cyanide
	• Water quality parameters	• Collect surface water samples.	8	1	TOC pH Hardness ($CaCO_3$) Dissolved Oxygen and Salinity
	• Ecological parameters	• Collect surface water samples.	8	1	Temperature Secchi Disk readings
	• Tidal influence study	• Collect water elevations during 24 hour period.	2	48	Field Analysis
	• Risk assessment assumptions	• Collect surface water sample	3	1	Hexavalent chromium

TABLE 4-2

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND
PAGE 2 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location(1)	Analysis
Sediment	• TCL, TAL parameters	• Collect shallow sediment samples.	18	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals and Cyanide
	• TCL, TAL parameters	• Collect deep sediment sample.	1	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals and Cyanide
	• Ecological parameters	• Collect sediment samples.	8	1	TOC Grain-size analysis Bulk density pH
	• Risk assessment assumptions	• Collect sediment samples.	3	1	Hexavalent chromium

TABLE 4-2

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND
PAGE 3 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location(1)	Analysis
Groundwater	• TCL, TAL parameters	• Collect shallow groundwater samples.	3	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals (Total and Dissolved) and Cyanide
	• Risk assessment assumptions	• Collect groundwater sample.	3	1	Hexavalent chromium
	• Water quality parameters	• Collect shallow and deep groundwater samples.	4	1	TOC pH Hardness ($CaCO_3$) Turbidity, Total Dissolved Solids, Total Suspended Solids, Chloride, Fluoride, Nitrate/Nitrite, Sulfate, Dissolved Oxygen, Salinity
	• Horizontal hydraulic conductivity	• Perform slug tests.	4	1	Evaluation of horizontal hydraulic conductivity
	• Groundwater flow direction and gradient	• Measure monitoring well groundwater levels.	4	2	Collect water levels at high and low tide. (Can be incorporated in tidal influence readings)
		• Tidal influence study.	4	48	Collect water levels every 30 minutes over a 24-hour period during a full or new moon.

TABLE 4-2

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND
PAGE 4 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location(1)	Analysis
Groundwater (Continued)	• RCRA	• Collect deep groundwater sample.	1	1	Appendix IX VOCs Appendix IX SVOCs Appendix IX Pesticides/PCBs Appendix IX Organophosphorus Compounds Appendix IX Herbicides Appendix IX Metals (Total and Dissolved)
	• Vertical hydraulic conductivity	• Collect Shelby Tube at confining layer.	1	1	Permeability Test
Soil	• TCL, TAL parameters	• Collect surface soil samples.	16(2)	1	TCL VOCs TCL SVOCs TCL Pesticides/PCBs TAL Metals and Cyanide
	• Risk assessment assumptions	• Collect surface soil samples.	3	1	Hexavalent chromium
	• Soil classification	• Collect subsurface soil samples.	2	2 samples per soil boring	Grain-size analysis Atterberg Limits Natural moisture content

TABLE 4-2

SITE-SPECIFIC INVESTIGATION SUMMARY
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND
PAGE 5 OF 5

Media	Data Gap/Need	Investigation Activity	Number of Locations	Samples per Location(1)	Analysis
Soil (Continued)	• Soil Classification	• Collect surface soil sample.	1	1	Grain-size analysis Atterberg Limits Natural moisture content
	• Groundwater modeling parameters	• Collect subsurface soil samples in aquifer.	2	1	TOC pH Grain-size analysis Bulk density Specific gravity Porosity
	• Groundwater modeling parameters	• Collect surface soil sample.	2	1	TOC pH Grain-size analysis Bulk density Specific gravity Porosity
	• Soil loggings	• Document soil characteristics during monitoring well installation.	4	1	Continuous soil logs
	• Soil loggings	• After surface soil sample is collected, bore into the soil until the top limit of waste is reached. Document soil characteristics	12	1	Continuous soil logs until the top limit of waste is reached.

1 Does not include QA/QC samples.
2 Includes 4 surface soil samples taken during soil boring installation.

4.2.2.4 Water Quality Parameters

In addition to determining contaminant concentrations in surface water, water quality parameters such as Total Organic Carbon (TOC), pH, and hardness will be obtained. These parameters are necessary for modeling and risk assessment. Surface water measurements shall also include dissolved oxygen, temperature, Secchi Disk readings and salinity to assist in the ecological risk assessment. If surface water is not deep enough to provide valid Secchi Disk readings, turbidity meter readings will be used instead.

4.2.3 Groundwater and Ecological Modeling Parameter Rationale

Modeling will be conducted to evaluate the potential contaminant fate and transport. General parameters which are required to perform modeling include:

Aquifer

- Horizontal Hydraulic Conductivity (K_h) of surficial aquifer
- Vertical Hydraulic Conductivity (K_v) of confining layer
- Total Organic Carbon (TOC)
- Porosity
- Bulk Density
- Grain-Size Analysis
- Specific Gravity
- pH
- Secchi Disk Readings

Ecological

- TOC
- Bulk Density
- Grain-Size Analysis
- pH
- Hardness
- Secchi Disk Readings

4.2.3.1 Soil Classification

Soil classification is used to determine the geotechnical and geochemical properties of the soil and includes grain-size analysis, Atterberg Limits, and natural moisture content. Grain-size analysis is useful for determining the heterogeneity of the soil and can be used to estimate hydraulic conductivities. The natural moisture content of the soil is important in evaluating potential remedial actions and for contaminant transport through the vadose zone. The Atterberg Limits are used to determine engineering properties (water content boundaries) of the soil.

4.2.3.2 Horizontal Hydraulic Conductivity (K_h)

A slug test will be conducted at each monitoring well to determine the horizontal hydraulic conductivity of the aquifer in the immediate vicinity of the well. This information will be used to characterize the aquifer and in the groundwater modeling and during evaluation of aquifer remediation alternatives, if necessary.

4.2.3.3 Vertical Hydraulic Conductivity (K_v)

The Hawthorn Formation (confining unit), which underlies the surficial aquifer, will be evaluated to determine its vertical hydraulic conductivity by performing a permeability test on a core sample. ASTM Method D5084-90 and analysis Method SW-846-9100 will be utilized for the permeability testing. The sample will be collected using a Shelby Tube. A knowledge of the vertical hydraulic conductivity of the confining unit is useful to evaluate the potential of the unit to impede the migration of contaminated groundwater into the underlying water supply system.

4.2.3.4 Groundwater-Level Measurements

Groundwater-level data will be used to determine the depth, flow direction, and gradient of the groundwater. The water-level data is also useful for setting calibration targets for modeling. Groundwater-level measurements will be collected in accordance with SOP GH-1.2, "Evaluation of Existing Monitoring Wells and Water-Level Measurements," and the information obtained will be used to provide information concerning the site hydrogeology. The groundwater-level measurements will be collected synoptically at high and low groundwater elevations as determined by the tidal study.

4.2.3.5 Tidal Influence Study

Site 3 is located in an area that is affected by tidal influences. To evaluate the effect of the tidal fluctuations on contaminant flushing, a tidal study will be conducted over a minimum period of 24 hours.

The goal of the study will be to determine how the surface water tidal fluctuations and the groundwater elevations are related.

The tidal influence study will consist of collecting groundwater elevations and surface water elevations every 30 minutes over a minimum of a 24-hour period. Measurements will be collected until the high and low tide data are collected for the surface water verses the high and low groundwater elevations (i.e., the lag time between the surface water and groundwater will be determined). The length of the study will depend on the lag time between the high/low surface water elevation and the high/low groundwater elevations.

Groundwater-level measurements will be collected in accordance with SOP GH-1.2 "Evaluation of Existing Monitoring Wells and Water-Level Measurement." Surface water measurements will be obtained by installing a staff gauge in the surface water body and collecting measurements from a known reference point to the surface water elevation. Measurements will be collected during a full or new moon so that the extremes in water-level elevation can be determined.

Local tide tables and precipitation data will also be obtained during the course of the field investigation from the nearest local resource. The information will be used to determine tidal cycle peaks and precipitation impacts on surface water and ground water.

5.0 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

The following two sections briefly describe the human health and ecological risk assessment that will be conducted for Site 3.

5.1 HUMAN HEALTH RISK ASSESSMENT

A human health risk assessment for the site will be performed and documented. Analytical data generated during the investigation, as well as historical data for the site, will be used to determine whether measured chemical concentrations pose a significant threat to human receptors. The general methodologies which will be used to assess human health risks are contained in Appendix A of the Master Work Plan Volume III for MCRD Parris Island (B&R Environmental, 1997c).

Potential chemicals of concern (COCs) for the site, based on the Verification Step, are barium, cadmium, chromium, lead, mercury, and selenium. Based on data collected during the RI, the Region 3 RBC screening levels (U.S. EPA, 1997) will be used to identify additional site-specific COCs for soil, sediment, surface water, and groundwater. Included in the groundwater analysis will be pH, turbidity, dissolved solids, TOC, chloride, fluoride, nitrate/nitrite, dissolved oxygen, salinity, and sulfate to aid in determining whether the groundwater at Site 3 is suitable for use as a drinking water source. If it is determined that the groundwater is not potable, groundwater will be removed as a pathway of concern from the human health risk assessment.

The following potential receptor groups will be evaluated in the human health risk assessment:

- Adolescent Trespassers
  - Soil: ingestion, dermal contact
  - Surface Water: ingestion, dermal contact
  - Sediment: ingestion, dermal contact

- Construction Workers
  - Soil: ingestion, dermal contact
  - Groundwater: dermal contact, ingestion
  - Surface Water: ingestion, dermal contact

- Adult and Adolescent Recreational Users
  - Surface Water: ingestion, dermal contact
  - Finfish/shellfish: ingestion

- Workers (Maintenance, Other Employees)
  - Soil: ingestion, dermal contact
  - Groundwater: ingestion, dermal contact

- Future Residents
  - Soil: ingestion, dermal contact, vegetable consumption
  - Groundwater: ingestion, dermal contact, inhalation (showering)

Additional details on receptors and complete exposure pathways to be considered in the development of the human health risk assessment are provided in Section 3.3 of the Human Health Risk Assessment Methodology provided in Appendix A of the Master Work Plan, Volume III.

5.2 ECOLOGICAL RISK ASSESSMENT

An ecological risk assessment for this site will be performed and documented in the RI/RFI Report. Analytical data generated during the investigation, as well as historical data for the site, will be used to determine if measured chemical concentrations pose a significant threat to potential ecological receptors. The general methodologies which will be used to assess risks to ecological receptors are contained in Appendix B of the Master Work Plan Volume III for MCRD Parris Island (B& R Environmental, 1997c).

Selection of contaminants of potential concern will be accomplished by the comparison of maximum detected site concentrations to U.S. EPA Region 4 screening values. Cadmium, lead, mercury, pesticides, and PCBs have been identified as potential contaminants in the Verification Step (McCelland, 1990) and the Extended Site Inspection (ABB-ES, 1993).

The preliminary ecological risk assessment will begin with a "preliminary problem formulation" step, including review of historical documents, potential COCs, site characteristics, photographs, maps, and notes from a site visit. Contaminants may be present in three exposure media associated with the site: Media of concern include surface soil, sediment, and surface water. Additionally, groundwater discharge to surface water will be included as an exposure medium. Receptors may be exposed to such contaminants through direct contact, inhalation, ingestion of media, and ingestion of contaminated food. Preliminary receptors of concern at Site 3 may be:

- Terrestrial invertebrates,
- Terrestrial vertebrates,
- Aquatic life,
- Benthic invertebrates
- Avian piscivores
- Mammalian piscivores

Others may be added, depending on the results of sampling and the review of historical data.

The latter part of the preliminary assessment will include an evaluation of ecological effects, which will establish preliminary threshold levels for contaminant concentrations in exposure media, and if needed, for contaminant ingestion rates. A preliminary exposure assessment will entail the compilation of maximum contaminant concentrations in exposure media. If necessary, maximum ingestion rates for indicator species will be calculated. The preliminary risk calculations will be in the form of ratios; the exposure levels to be divided by the threshold values.

The preliminary risk assessment will be initially documented in the form of a technical memorandum. The purpose of the memorandum is to provide results as quickly as possible in case more investigation may be required. The preliminary risk assessment will conclude with recommendations for further investigation. If additional work is required, a work plan addendum will be submitted.

At the onset of field activities, surface water and sediment samples at Site 3 will be collected and analyzed for the parameters presented in Section 4.0. The need for biota sampling will be based on the results of this analysis. The Parris Island Tier I Partnering Team will be involved in this decision. If necessary, biota sampling will be conducted before demobilization of the field effort.

The concentrations of pesticides and PCBs identified in the ESI report (ABB, 1993) in the tissue of fish collected from the northern pond side of the causeway landfill will be considered within the context of an ecological risk assessment. Previous reports also identified the disposal of mercury amalgam in the landfill which could have an ecological impact if detected in site media. Data to be collected from the causeway landfill will include mercury analysis to determine if mercury is present in the landfill.

6.0 FIELD OPERATIONS

This section is the Site-Specific Field Sampling Plan (FSP) for the investigation at Site 3 - Causeway Landfill. It outlines the project-specific field investigation activities to be performed at Site 3 for this investigation. It is to be used in conjunction with the Master FSP, Volume II of the Master Work Plan for MCRD Parris Island (B&R Environmental, 1998c) and references the Master FSP where appropriate.

Field operation activities to be performed at MCRD Parris Island for this investigation include mobilization of equipment, soil boring installation, soil sampling, monitoring well installation, hydraulic conductivity testing (slug tests), surface water and sediment sampling, groundwater sampling, water-level measurements, site surveying, equipment decontamination, waste handling and site restoration. Monitoring well installation will be a priority of the field effort followed by water-level measurements. The results of these measurements will be used to characterize the depth, flow direction, and gradient of the groundwater.

At the onset of field activities, surface water and sediment samples at Site 3 will be collected and analyzed for the parameters stated in Section 4.0. The need for biota sampling will be based on the results of this analysis. The Parris Island Tier I Partnering Team will be involved in this decision. If necessary, biota sampling will be conducted before demobilization of the field effort.

All field operation activities will be performed as described in the Master FSP and Standard Operating Procedures (SOPs) provided in Volume II of the Master Work Plan, except where noted. All well installation activities will be performed under the direction of a state-certified Professional Geologist familiar with all state, federal, and local laws, regulations, and requirements pertaining to the geologist's duties and responsibilities. Additionally, a state-certified driller will be used.

6.1 MOBILIZATION/DEMOBILIZATION

Mobilization activities will be performed in accordance with the procedures outlined in the Master FSP. If additional field investigations are occurring at other sites at MCRD Parris Island, field activities at Site 3 will be coordinated accordingly with the other field activities.

6.2 SITE RESTORATION

If investigation activities (e.g., monitoring well installation) disturb or alter the landscape, vegetation, causeway, or other features of Site 3, the site may require restoration to conditions prior to the

investigation. If vegetation is stressed or damaged as a result of investigation activities, the affected area will be reseeded. Portions of the causeway would be repaired if investigation activities damage the road. Additionally, all equipment used during the investigation and investigation-derived waste (IDW) will be removed from the site.

6.3 SOIL BORINGS

Four soil borings will be drilled at Site 3 for the purpose of monitoring well installation. From these borings, three will be converted to shallow surficial aquifer wells and one will be converted to a deep surficial aquifer well. Two samples will be collected at PAI-03-SB02 and PAI-03-SB03 in the vadose zone and within the aquifer. Surface soil samples will be taken at all soil boring locations. The mud-rotary drilling method will be used for advancing the soil borings. The mud-rotary drilling technique involves the downward advancement of 5 to 10 foot long sections of hollow, heavy-gauge steel rods. Hollow rods of sufficient diameter will be used to produce a 2-inch annular space between the casing and the borehole wall. The mud must be adequately thinned in order to allow the proper installation of the monitoring well materials.

Split-spoon samples will be collected continuously from the ground surface to the termination depth of the borings in accordance with ASTM Standard Method D 1586-84. The split-spoon samplers will have a minimum inside diameter (I.D.) of 2 inches and a length of 2 feet to fulfill sample volume requirements for chemical analysis. Each split-spoon sample will be field screened with a Flame Ionization Detector (FID) or Photoionization Detector (PID) upon collection and head-space field analysis shall be performed to prejudice the selection of the sample to be submitted for fixed-base laboratory analysis. Split-spoon samples will be divided and placed in chemical sample jars and 8-oz. lithologic sample jars. Selected chemical sample jars will be labeled, packed, and shipped to the laboratory. Lithologic sample jars will be labeled as described in the Master FSP and retained on site until completion of the investigation, at which time all lithologic samples will be properly disposed. Lithologic sampling will provide information relevant to contaminant fate and transport modeling.

At one soil boring, a Shelby Tube sample will be collected within the Hawthorn Formation (confining layer) in accordance with the methodologies described in B&R Environmental SOP Number SA-1.3, Section 5.2.3, "Procedure for Collecting Undisturbed Samples." Because the thickness and consistency of the Hawthorn Formation has not been verified during previous investigations, the following events will take place to prevent the possibility of compromising the integrity of the confining layer. Initially, a soil boring will be installed as described previously. Once the top of the Hawthorn Formation is encountered, any material removed from the confining unit will be replaced with a bentonite/cement mixture. Then, an

additional soil boring will be installed a few feet upgradient of the initial boring. The boring will be installed to the depth of the top of the Hawthorn Formation and from this depth, a Shelby Tube sample will be collected and removed material will be replaced with a bentonite/cement mixture. This procedure will ensure that no more than 2 feet of material will be removed from the confining layer, thus minimizing the potential to contaminate the underlying Floridan Aquifer.

A boring log will be maintained as described in the Master FSP for each soil boring by the state-certified field geologist. Field screening and head-space analysis results and a lithologic description of each split-spoon sample will be recorded on the boring log. At a minimum, the information outlined in the Master FSP will be recorded on the boring log for each boring.

6.4 MONITORING WELL INSTALLATION AND CONSTRUCTION

Monitoring wells will be installed and constructed in accordance with all applicable State of South Carolina regulations (e.g., Code of Laws of South Carolina 1976, Regulation 61-71 Well Standards), and follow guidelines established in Chapter 6 of the U.S. EPA Region 4 Environmental Investigations and Standard Operating Procedures and Quality Assurance Manual (EISOPQAM) (U.S. EPA, 1996b) and Volume II of the Master Work Plan (B&R Environmental, 1997). Prior to the construction of any monitoring well, a formal request will be submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) for approval. The request will contain the following information:

- Proposed location(s) on a scaled map or plate
- Proposed construction detail
- Intended purpose of the monitoring well(s)

The state also requires a formal submission detailing the activity performed during the installation of the monitoring well(s). A monitoring well record form or other form provided and/or approved by the state shall be completed and submitted within 30 days after completion of each monitoring well. The form shall contain the following information:

(a) Name and address of facility/owner
(b) Location of monitoring well(s) on a scaled map or plate
(c) Driller and certification number
(d) Date drilled
(e) Driller's or geologist's log
(f) Total depth

(g) Screened interval

(h) Diameter and construction details

(i) Depth to water table with date and time measured

(j) Surveyed elevation of measuring point with respect to an established benchmark

(k) State-certified professional geologist's seal and certification number

Three shallow surficial aquifer monitoring wells (PAI-03-GW01, PAI-03-GW03, and PAI-03-GW04) and one deep surficial aquifer monitoring well (PAI-03-GW02) will be installed at Site 3. The proposed locations of these wells are illustrated in Section 7.0; however, the analytical results of surface water and sediment sampling will be used to refine the placement of the monitoring wells.

The shallow wells will monitor the top of the surficial aquifer while the deep well will monitor the bottom of the surficial aquifer. The top of the screened interval for the shallow monitoring wells will be placed approximately 2 feet above the high tide water table, assuming sufficient water remains in the well during low tide to obtain a groundwater sample. Shallow monitoring wells will be constructed of 2-inch I.D., flush-threaded rigid PVC well screen and compatibly-threaded PVC well casing riser. The PVC shall meet National Sanitation Foundation (NSF) standard 14 (NSFWC) as specified in U.S. EPA Region 4 EISOPQAM (U.S. EPA, 1996b). PVC is appropriate for the application because sorption and leaching are not of sufficient impact and is expected to function properly for the expected duration of this project. All wells will be constructed with certified-clean well construction material provided by the drilling subcontractor and will follow procedures outlined in the Master FSP.

The borehole for the deep monitoring well will be advanced to the top of the confining unit (Hawthorn Formation) underlying the surficial aquifer. The bottom of the screened interval for the deep monitoring wells will be placed even with, or slightly below, the top of the confining unit. The deep monitoring well will be constructed of 2-inch I.D., flush-threaded rigid PVC well screen and PVC well casing riser. The PVC shall meet National Science Foundation (NSF) Standard 14 as specified in U.S. EPA Region 4 EISOPQAM. PVC is appropriate for the application because sorption and leaching are not of sufficient impact to affect the pipe and is expected to function properly for the expected duration of this project.

Well screens for shallow monitoring wells will be 10 feet long with 0.010-inch openings. Deep well screens will be 5 feet long with 0.020-inch openings. There is sufficient history from existing wells to conclude that the upper wells will be screened in fine-grained material (silt and fine sand) and the deeper wells will be screened in more coarse-grained sands. Therefore, the anticipated slot size for the shallow and deep well screens is determined to be 0.010 and 0.020 inches accordingly.

For both shallow and deep monitoring wells, a primary filter pack of clean, silica sand will be installed a minimum of 6 inches below the bottom of the well to a minimum of 2 feet above the top of the well screen. A sand passing U.S. Standard Sieve No. 20-30 will be used for finer formations (0.010 slot size), and sand passing U.S. Standard Sieve No. 10-20 will be used for coarser formations (0.020 slot size), as determined by the site geologist. A minimum 2-foot-thick seal of 100 percent sodium bentonite pellets will be installed above the primary filter pack and allowed to hydrate in accordance with the manufacturer's recommendations. The annular space above the bentonite seal will be grouted with neat cement or a bentonite/cement mixture from the top of the bentonite seal to a point at least two feet below the surface or below the frost line. The concrete used to form the pad will fill the remaining annular space. Figure 6-1 illustrates a typical monitoring well construction.

All monitoring wells will be completed with a 4-inch diameter, protective aluminum casing with a locking cap, as described in the Master FSP. A 4-foot by 4-foot-wide by 6-inch-thick concrete surface seal shall be placed flush with the ground surface. A minimum of three bumper guards consisting of steel pipes filled with cement slurry will be installed equidistant around the monitoring well. Additionally, a 4-inch by 4-inch aluminum tag identification plate will be affixed to each well and will contain the following information.

a) Well identification number
b) Date of construction
c) Drilling contractor and certification number
d) Depth of well
e) Screen interval
f) Static water level
g) Casing depth and inside diameter
h) Longitude and latitude of site

Prior to sampling, monitoring wells will be developed to remove formation cuttings, (as well as any residual drilling fluids) as described in the Master FSP, Volume II (B&R Environmental, 1997c).

6.5 HYDRAULIC CONDUCTIVITY

Slug tests will be performed at each proposed monitoring well to determine the hydraulic conductivity of the aquifer. The slug tests will be conducted according to the procedures described in Section 2.7.1 of the Master FSP, Volume II (B&R Environmental, 1997c).

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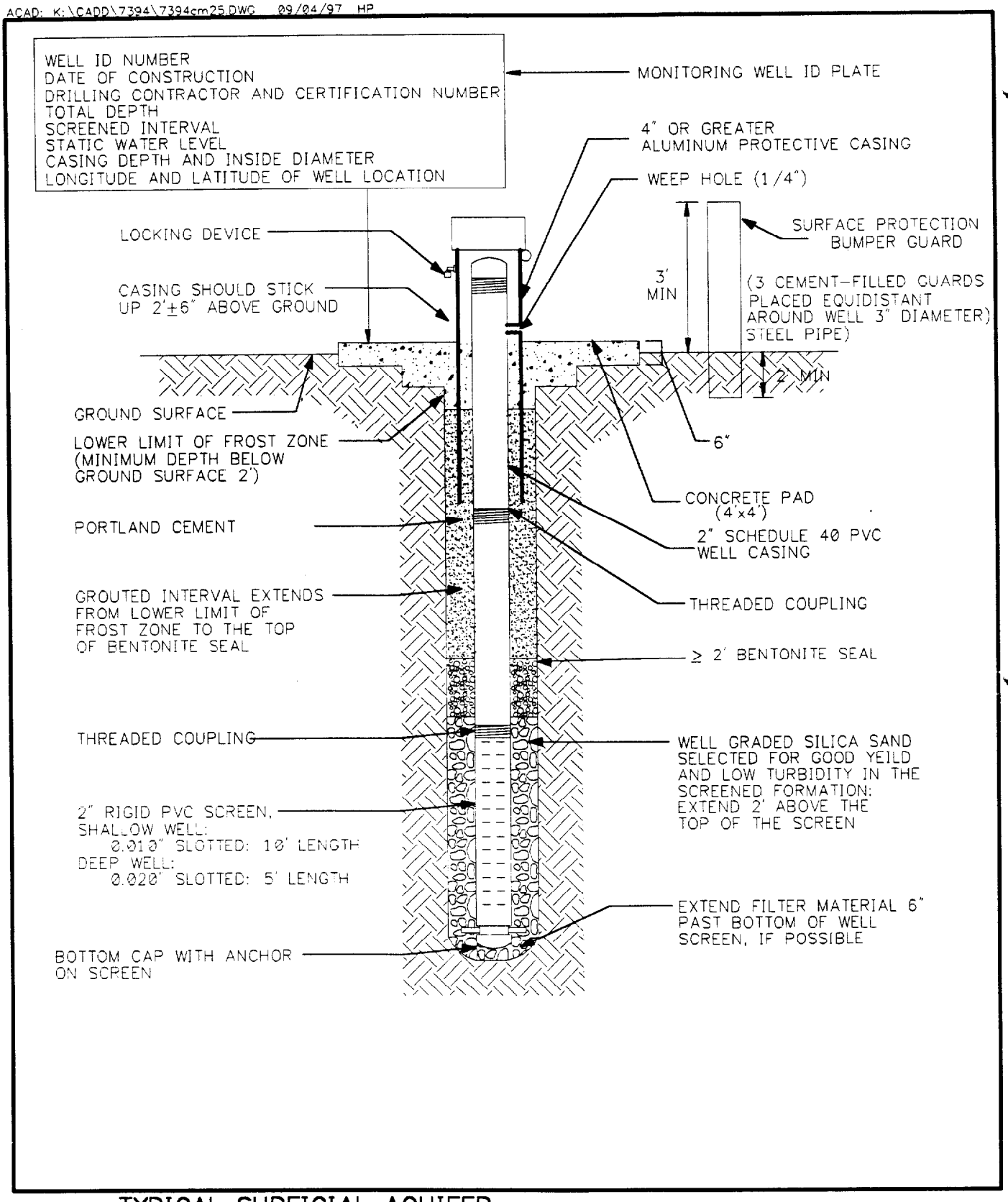

TYPICAL SURFICIAL AQUIFER
MONITORING WELL DETAIL
MCRD
PARRIS ISLAND, SOUTH CAROLINA
NOT TO SCALE

FIGURE 6-1

Brown & Root Environmental

6.6 SURVEYING

All soil samples, monitoring well locations, sediment and surface water sample locations will be surveyed. The staff gauges will also be surveyed. A third-order survey will be conducted by a professional surveyor licensed in the State of South Carolina according to the requirements described in the Master FSP (Section 2.7.1) of the Master Work Plan, Volume II (B&R Environmental, 1997c).

6.7 WATER-LEVEL MEASUREMENTS

Two synoptic rounds of water-level measurements of proposed monitoring wells at Site 3 will be conducted for this investigation. One round will be during high tide, and the second round will be collected during low tide, based on Naval tidal charts for MCRD Parris Island. This will be incorporated with the tidal influence study in which water levels are recorded every 30 minutes over a 24-hour period at each monitoring well (see Section 4.2.3.5).

Surface water levels will also be collected every hour over a 24-hour period to provide a time series record of water levels in the Causeway pond and Ribbon Creek caused by tidal influences. Two standard USGS staff gauges (National Oceanic Survey) or permanent features will be used as a reference point for measurements. A log book will be kept of all equipment used and calibration procedures conducted. All water-level readings will be noted with beginning and ending date and time, site location, stage scale, and time scale, and will be initialed by the field investigator. Water stage will be recorded to the nearest 0.01 foot.

All instrumentation should be checked for damage, warpage, legibility, etc., before use. The instrumentation will also be cleaned before and after use. All staff gauges and wells will be permanently marked by the Field Operations Leader (FOL) indicating the referenced points of measurement. The reference points will be subsequently surveyed for location and elevation.

Procedures for conducting surface water stage/tape downs shall be conducted in accordance with the procedures identified in Section 15.5 of the U.S. EPA Region 4 EISOPQAM (U.S. EPA, 1996b).

6.8 DECONTAMINATION

Decontamination of major equipment and sampling equipment will be in accordance with the Master FSP and B&R Environmental SOP Number SA-7.1, "Decontamination of Field Equipment and Waste

Handling." An area for the decontamination pad for major equipment and a source of potable water for steam washing will be arranged by the FOL through MCRD personnel.

6.9 WASTE HANDLING

All solid and liquid wastes generated as a result of this investigation will be handled in accordance with the procedures described in Section 2.11 of the Master FSP and B&R Environmental SOP Number SA-7.1, "Decontamination of Field Equipment and Waste Handling" (B&R Environmental, 1997c).

7.0 ENVIRONMENTAL SAMPLING

This section outlines the environmental sampling program and describes the sampling procedures for the field investigation at Site 3 - Causeway Landfill.

7.1 SUMMARY OF ENVIRONMENTAL SAMPLING

Table 7-1 summarizes the sampling program for the investigation. Figure 7-1 illustrates the proposed surface water and sediment sampling at Site 3. Figure 7-2 depicts the proposed soil sampling locations and Figure 7-3 shows the proposed groundwater sampling locations at Site 3. Proposed sampling locations are contingent upon utility location and clearance with MCRD personnel.

7.2 SAMPLING PROCEDURES

Section 7.2 presents the procedures that are proposed for surface water and sediment, surface and subsurface soil, and groundwater sampling. The entire length of the causeway will be sampled without any bias towards one section. Although historical records indicate that more solid waste debris may have been disposed in the southeastern portion of the causeway, waste materials (e.g., garbage) were observed along the entire length of the causeway during a recent site visit. Therefore, it is believed to be necessary to sample along the causeway's entire length.

If during field activities, the FOL deems that an area not contained in the Work Plan should be sampled because of surface features (e.g., depressions) that would cause preferential accumulation of contaminants, the location of samples presented in the sampling plan will be altered to include such areas. Rationale for such deviations will be provided in the RI/RFI report.

7.2.1 Surface Water and Sediment Sampling

Eighteen surface water samples and 19 sediment samples will be collected for this investigation at locations indicated on Figure 7-1. These sampling locations reflect areas where Verification Step sampling results exceeded U.S. EPA screening criteria and also areas where samples have not been collected to date. Additionally, sampling points are located within the Pond northeast of the Causeway and Ribbon Creek (southwest of the causeway) to evaluate the possible migration of contaminants from the site.

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	App. IX	Hexavalent Chromium	Additional Analysis
SURFACE WATER											
PAI-03-SW09	PAI-03-SW-009-00	Surface	•	•	•	•	•	•			Ecological parameters(1)
PAI-03-SW10	PAI-03-SW-010-00	Surface	•	•	•	•	•			•	
PAI-03-SW11	PAI-03-SW-011-00	Surface	•	•	•	•	•	•			Ecological parameters(1)
PAI-03-SW12	PAI-03-SW-012-00	Surface	•	•	•	•	•	•			Ecological parameters(1)
PAI-03-SW13	PAI-03-SW-013-00	Surface	•	•	•	•	•	•			Ecological parameters(1)
PAI-03-SW14	PAI-03-SW-014-00	Surface	•	•	•	•	•				
PAI-03-SW15	PAI-03-SW-015-00	Surface	•	•	•	•	•	•		•	Ecological parameters(1)
PAI-03-SW16	PAI-03-SW-016-00	Surface	•	•	•	•	•				
PAI-03-SW17	PAI-03-SW-017-00	Surface	•	•	•	•	•				
PAI-03-SW18	PAI-03-SW-018-00	Surface	•	•	•	•	•	•		•	Ecological parameters(1)
PAI-03-SW19	PAI-03-SW-019-00	Surface	•	•	•	•	•				
PAI-03-SW20	PAI-03-SW-020-00	Surface	•	•	•	•	•	•			Ecological parameters(1)

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	App. IX	Hexavalent Chromium	Additional Analysis
SURFACE WATER (Continued)											
PAI-03-SW21	PAI-03-SW-021-00	Surface	•	•	•	•	•				
PAI-03-SW22	PAI-03-SW-022-00	Surface	•	•	•	•	•	•			Ecological parameters(1)
PAI-03-SW23	PAI-03-SW-023-00	Surface	•	•	•	•	•				
PAI-03-SW24	PAI-03-SW-024-00	Surface	•	•	•	•	•				
PAI-03-SW25	PAI-03-SW-025-00	Surface	•	•	•	•	•				
PAI-03-SW26	PAI-03-SW-026-00	Surface	•	•	•	•	•				
SEDIMENT											
PAI-03-SD09	PAI-03-SD-009-01	0 - 0.5	•	•	•		•	TOC and pH only			Ecological parameters (2)
PAI-03-SD10	PAI-03-SD-010-01	0 - 0.5	•	•	•		•			•	
PAI-03-SD11	PAI-03-SD-011-01	0 - 0.5	•	•	•		•	TOC and pH only			Ecological parameters (2)
PAI-03-SD12	PAI-03-SD-012-01	0 - 0.5	•	•	•		•	TOC and pH only			Ecological parameters (2)
PAI-03-SD12	PAI-03-SD-012-02	0.5 - 1	•	•	•		•				

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 3 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	App. IX	Hexavalent Chromium	Additional Analysis
SEDIMENT (Continued)											
PAI-03-SD13	PAI-03-SD-013-01	0 - 0.5	•	•	•		•	TOC and pH only			Ecological parameters (2)
PAI-03-SD14	PAI-03-SD-014-01	0 - 0.5	•	•	•		•				
PAI-03-SD15	PAI-03-SD-015-01	0 - 0.5	•	•	•		•	TOC and pH only		•	Ecological parameters (2)
PAI-03-SD16	PAI-03-SD-016-01	0 - 0.5	•	•	•		•				
PAI-03-SD17	PAI-03-SD-017-01	0 - 0.5	•	•	•		•				
PAI-03-SD18	PAI-03-SD-018-01	0 - 0.5	•	•	•		•	TOC and pH only		•	Ecological parameters (2)
PAI-03-SD19	PAI-03-SD-019-01	0 - 0.5	•	•	•		•				
PAI-03-SD20	PAI-03-SD-020-01	0 - 0.5	•	•	•		•	TOC and pH only			Ecological parameters (2)
PAI-03-SD21	PAI-03-SD-021-01	0 - 0.5	•	•	•		•				
PAI-03-SD22	PAI-03-SD-022-01	0 - 0.5	•	•	•		•	TOC and pH only			Ecological parameters (2)
PAI-03-SD23	PAI-03-SD-023-01	0 - 0.5	•	•	•		•				
PAI-03-SD24	PAI-03-SD-024-01	0 - 0.5	•	•	•		•				

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 4 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	App. IX	Hexavalent Chromium	Additional Analysis
SEDIMENT (Continued)											
PAI-03-SD25	PAI-03-SD-025-01	0 - 0.5	•	•	•		•				
PAI-03-SD26	PAI-03-SD-026-01	0 - 0.5	•	•	•		•				
SOIL											
PAI-03-SB01	PAI-03-SB-001-01	0-1	•	•	•		•				
PAI-03-SB02	PAI-03-SB-002-01	0-1	•	•	•		•	TOC and pH only			•(6)(7)
PAI-03-SB02	PAI-03-SB-002-XX(3)	TBD(4)									•(6)
PAI-03-SB02	PAI-03-SB-002-XX(3)	TBD(5)						TOC and pH only			•(6)(7)
PAI-03-SB02	PA-03-SB-002-XX(3)	TBD(11)									•(10)
PAI-03-SB03	PAI-03-SB-003-01	0-1	•	•	•		•	TOC and pH only			•(7)
PAI-03-SB03	PAI-03-SB-003-XX(3)	TBD(4)									•(6)
PAI-03-SB03	PAI-03-SB-003-XX(3)	TBD(5)						TOC and pH only			•(6)(7)
PAI-03-SB04	PAI-03-SB-004-01	0-1	•	•	•		•				

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 5 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	App. IX	Hexavalent Chromium	Additional Analysis
SOIL (Continued)											
PAI-03-SS01	PAI-03-SS-001-01	0-1	•	•	•		•				
PAI-03-SS02	PAI-03-SS-002-01	0-1	•	•	•		•				
PAI-03-SS03	PAI-03-SS-003-01	0-1	•	•	•		•				
PAI-03-SS04	PAI-03-SS-004-01	0-1	•	•	•		•				
PAI-03-SS05	PAI-03-SS-005-01	0-1	•	•	•		•			•	
PAI-03-SS06	PAI-03-SS-006-01	0-1	•	•	•		•				
PAI-03-SS07	PAI-03-SS-007-01	0-1	•	•	•		•			•	
PAI-03-SS08	PAI-03-SS-008-01	0-1	•	•	•		•				
PAI-03-SS09	PAI-03-SS-009-01	0-1	•	•	•		•				
PAI-03-SS10	PAI-03-SS-010-01	0-1	•	•	•		•			•	
PAI-03-SS11	PAI-03-SS-011-01	0-1	•	•	•		•				
PAI-03-SS12	PAI-03-SS-012-01	0-1	•	•	•		•				

TABLE 7-1

SUMMARY OF ENVIRONMENTAL SAMPLING
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 6 OF 6

Sample Location	Sample Designation	Sample Depth (Feet below ground surface)	Sample Analysis								
			TCL VOCs	TCL SVOCs	TAL Metals (Total) and Cyanide	TAL Metals (Dissolved)	TCL Pest/ PCBs	TOC, pH, Hardness ($CaCO_3$)	App. IX	Hexavalent Chromium	Additional Analysis
GROUNDWATER											
PAI-03-GW01 (converted from PAI-03-SB01)	PAI-03-GW-001-01	Shallow Surficial	•	•	•	•	•	•		•	•(8)(9)
PAI-03-GW02 (converted from PAI-03-SB02)	PAI-03-GW-002-01	Deep Surficial						•	•		•(8)(9)
PAI-03-GW03 (converted from PAI-02-SB03)	PAI-03-GW-003-01	Shallow Surficial	•	•	•	•	•	•		•	•(8)(9)
PAI-03-GW04 (converted from PAI-03-SB04)	PAI-03-GW-004-01	Shallow Surficial	•	•	•	•	•	•		•	•(8)(9)

1 Dissolved oxygen, salinity, temperature, and Secchi Disk readings.
2 Grain-size analysis and bulk density.
3 XX = Sample depth determined in field.
4 Sample to be collected from the vadose zone.
5 Sample to be collected from the saturated zone.
6 Natural moisture content, grain-size analysis and Atterberg Limits.
7 Porosity, grain-size analysis, bulk density and specific gravity.
8 Perform slug test, water level measurements and tidal influence study.
9 Turbidity, TDS, TSS, chloride, fluoride, nitrate/nitrite, sulfate, salinity, and dissolved oxygen.
10 A Shelby Tube will be collected from the Hawthorn Formation to determine vertical conductivity.
11 Sample to be collected from the Hawthorn Formation.

TBD = To Be Determined

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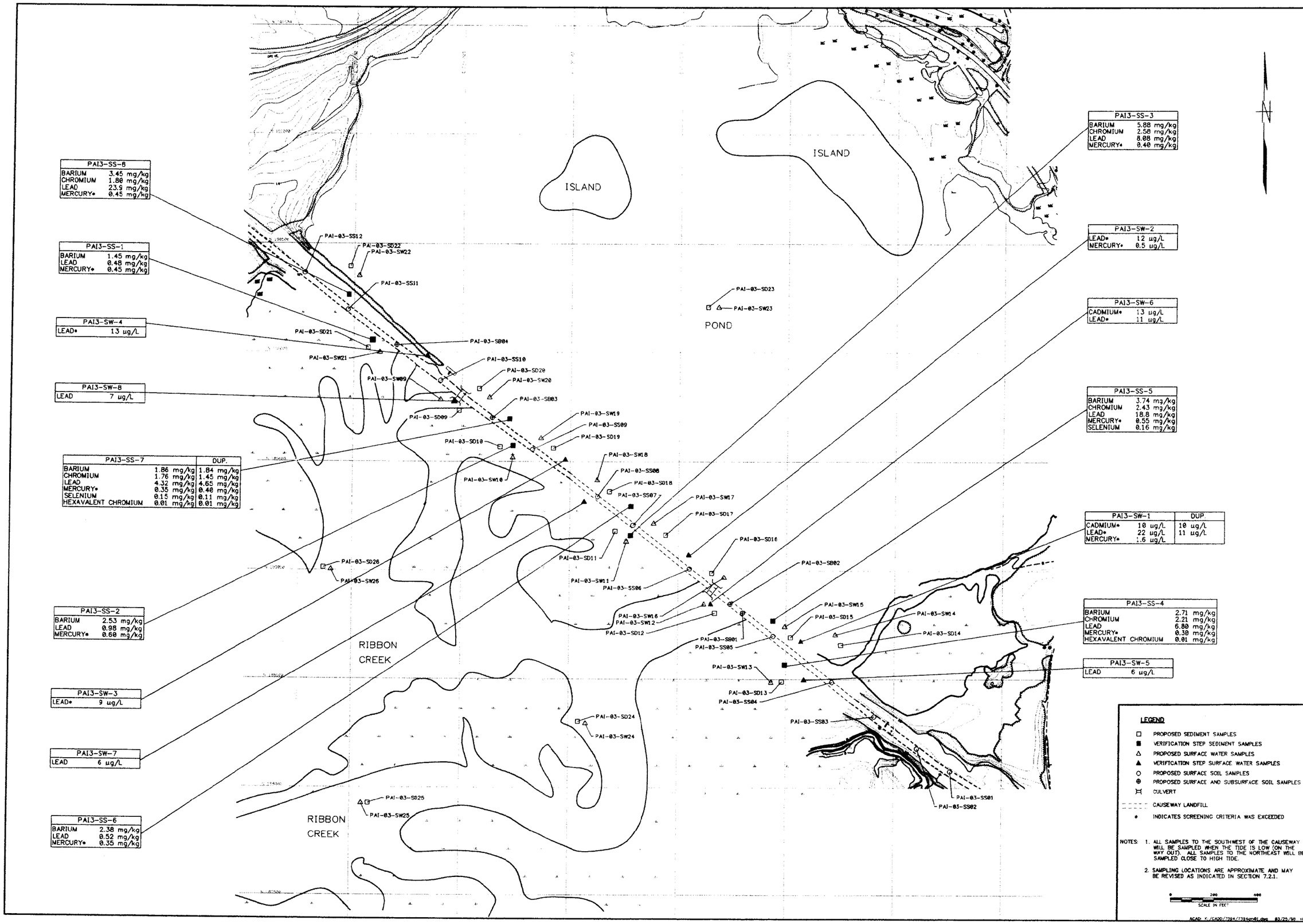
ISLAND
ISLAND
POND
RIBBON CREEK
RIBBON CREEK
PAI-03-SS12
PAI-03-SD22
PAI-03-SW22
PAI-03-SS11
PAI-03-SD23
PAI-03-SW23
PAI-03-SD21
PAI-03-SW21
PAI-03-SB04
PAI-03-SS10
PAI-03-SD20
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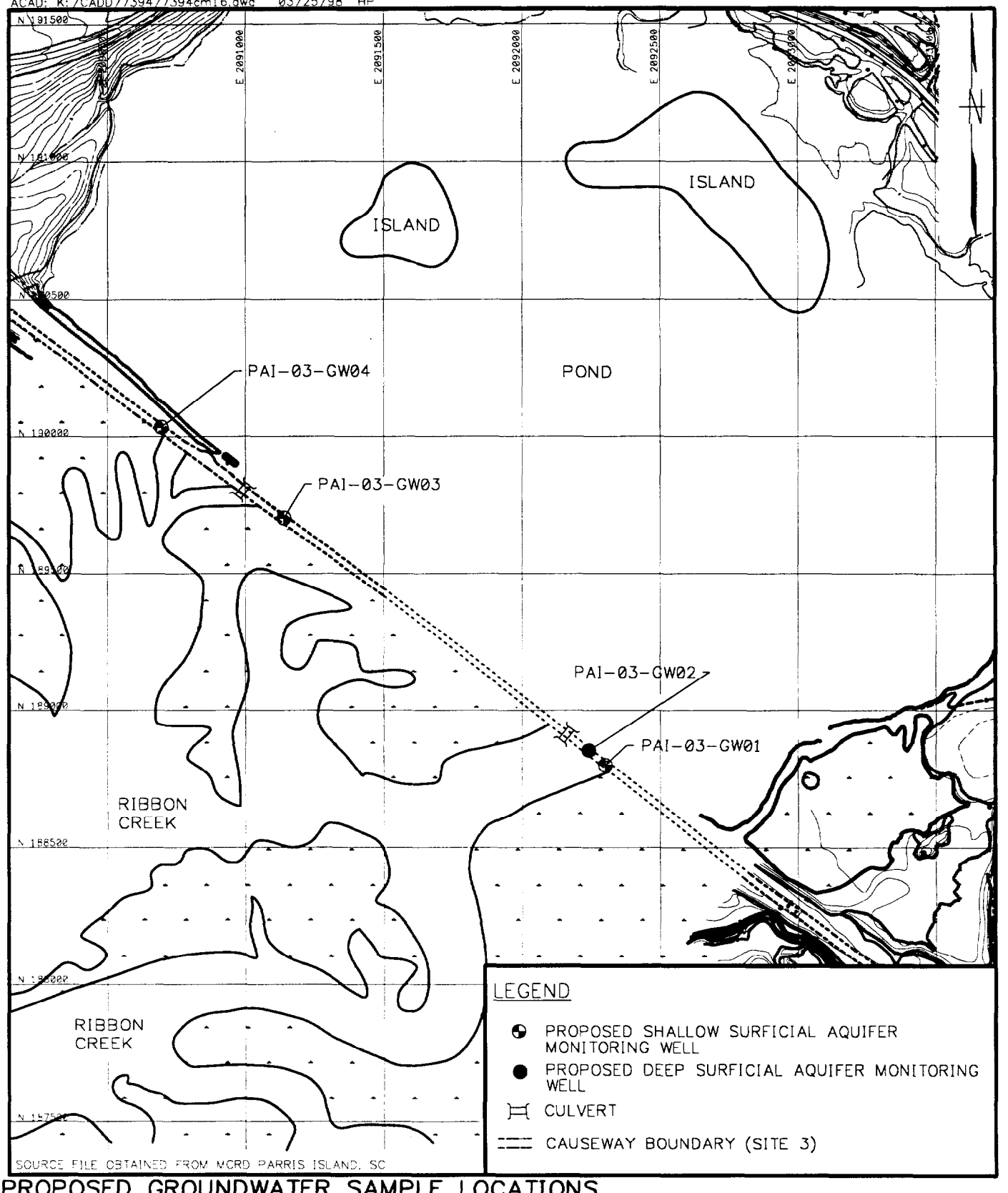
PAI-03-SD11
PAI-03-SD16
PAI-03-SW11
PAI-03-SS06
PAI-03-SB02
PAI-03-SD26
PAI-03-SW26
PAI-03-SW16
PAI-03-SW12
PAI-03-SD12
PAI-03-SW15
PAI-03-SD15
PAI-03-SW14
PAI-03-SD14
PAI-03-SB01
PAI-03-SS05
PAI-03-SW13
PAI-03-SD13
PAI-03-SS04
PAI-03-SS03
PAI-03-SD24
PAI-03-SW24
PAI-03-SD25
PAI-03-SW25
PAI-03-SS01
PAI-03-SS02
PAI3-SS-8
BARIUM 3.45 mg/kg
CHROMIUM 1.80 mg/kg
LEAD 23.9 mg/kg
MERCURY* 0.45 mg/kg
PAI3-SS-1
BARIUM 1.45 mg/kg
LEAD 0.48 mg/kg
MERCURY* 0.45 mg/kg
PAI3-SW-4
LEAD* 13 ug/L
PAI3-SW-8
LEAD 7 ug/L
PAI3-SS-7 DUP.
BARIUM 1.86 mg/kg 1.84 mg/kg
CHROMIUM 1.76 mg/kg 1.45 mg/kg
LEAD 4.32 mg/kg 4.65 mg/kg
MERCURY* 0.35 mg/kg 0.48 mg/kg
SELENIUM 0.15 mg/kg 0.11 mg/kg
HEXAVALENT CHROMIUM 0.01 mg/kg 0.01 mg/kg
PAI3-SS-2
BARIUM 2.53 mg/kg
LEAD 0.98 mg/kg
MERCURY* 0.60 mg/kg
PAI3-SW-3
LEAD* 9 ug/L
PAI3-SW-7
LEAD 6 ug/L
PAI3-SS-6
BARIUM 2.38 mg/kg
LEAD 0.52 mg/kg
MERCURY* 0.35 mg/kg
PAI3-SS-3
BARIUM 5.88 mg/kg
CHROMIUM 2.58 mg/kg
LEAD 8.08 mg/kg
MERCURY* 0.40 mg/kg
PAI3-SW-2
LEAD* 12 ug/L
MERCURY* 0.5 ug/L
PAI3-SW-6
CADMIUM* 13 ug/L
LEAD* 11 ug/L
PAI3-SS-5
BARIUM 3.74 mg/kg
CHROMIUM 2.43 mg/kg
LEAD 18.8 mg/kg
MERCURY* 0.55 mg/kg
SELENIUM 0.16 mg/kg
PAI3-SW-1 DUP.
CADMIUM* 10 ug/L 10 ug/L
LEAD* 22 ug/L 11 ug/L
MERCURY* .6 ug/L
PAI3-SS-4
BARIUM 2.71 mg/kg
CHROMIUM 2.21 mg/kg
LEAD 6.80 mg/kg
MERCURY* 0.30 mg/kg
HEXAVALENT CHROMIUM 0.01 mg/kg
PAI3-SW-5
LEAD 6 ug/L
LEGEND
PROPOSED SEDIMENT SAMPLES
VERIFICATION STEP SEDIMENT SAMPLES
PROPOSED SURFACE WATER SAMPLES
VERIFICATION STEP SURFACE WATER SAMPLES
PROPOSED SURFACE SOIL SAMPLES
PROPOSED SURFACE AND SUBSURFACE SOIL SAMPLES
CULVERT
CAUSEWAY LANDFILL
* INDICATES SCREENING CRITERIA WAS EXCEEDED
NOTES: 1. ALL SAMPLES TO THE SOUTHWEST OF THE CAUSEWAY WILL BE SAMPLED WHEN THE TIDE IS LOW (ON THE WAY OUT). ALL SAMPLES TO THE NORTHEAST WILL BE SAMPLED CLOSE TO HIGH TIDE.
2. SAMPLING LOCATIONS ARE APPROXIMATE AND MAY BE REVISED AS INDICATED IN SECTION 7.2.1.
0 200 400
SCALE IN FEET
DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
SOUTHERN DIVISION
NAVAL BASE
MCRD PARRIS ISLAND
CHARLESTON, SOUTH CAROLINA
PARRIS ISLAND, SOUTH CAROLINA
SITE 3 – CAUSEWAY LANDFILL
SURFACE WATER AND SEDIMENT ANALYTICAL RESULTS–
VERIFICATION STEP (1996) & PROPOSED SAMPLING
LOCATIONS
SOUTHDIV FOR COMMANDER, NAVFAC
PREP BY DATE APPR'D
REV DESCRIPTION
CODE I.D. NO. 80091
SPEC. NO. 84 –
CONSTRN. CONTR. NO.
N62472– –C–
NAVFAC DRAWING NO.
SIZE D
FIGURE 7-1

ACAD: K:/CADD/7394/7394cm16.dwg 03/25/98 HP



PROPOSED GROUNDWATER SAMPLE LOCATIONS

SITE 3 – CAUSEWAY LANDFILL

MCRD PARRIS ISLAND, SOUTH CAROLINA

FIGURE 7-2

0 500 1000

SCALE IN FEET

Brown & Root Environmental

Surface water and sediment sampling will be a priority of the field effort. The analytical results of the sampling will be used to identify areas where landfill contaminants may have migrated. From these results, groundwater monitoring well locations will be moved, if necessary, to characterize likely source areas of contamination. Additionally, the need for biota sampling will be based on the results of surface water and sediment analytical results. The Parris Island Tier I Partnering Team will be involved with the decisions concerning biota sampling and monitoring well locations.

Of the 19 sediment samples, 18 will be collected at a 0- to 6-inch depth to reflect recent offsite migration. At one sediment sample location (at PAI-03-SD12), an additional sample will be collected at a 6- to 12-inch depth to reflect historical accumulation. Collection of surface sediments will be biased towards depositional areas. The surface water and sediment samples will be collected in accordance with sampling methodologies described in the Master FSP and B&R Environmental SOP Number SA-1.2, "Surface Water and Sediment Sampling."

The surface water and sediment samples will be collected at the same locations. Sampling points located to the southwest of the causeway will be sampled at low tide (on the way out). At low tide, preferential accumulation of contaminants from the causeway landfill is likely to occur to the southwest of the causeway. Likewise, sampling locations located to the northwest of the causeway will be sampled at high tide. Surface water samples will be filtered in the field for dissolved metals analysis in addition to the unfiltered samples collected for total metals analysis. Because of the close proximity of Sites 1 and 41 to Site 3, background samples collected for Sites 1 and 41 will be used to determine background conditions at Site 3 (B&R Environmental, 1998a).

7.2.2 Surface Soil Sampling

Surface soil samples will be collected at sixteen locations for this investigation as shown on Figure 7-1. Surface soil samples will be collected from the 0-1 foot sampling interval for the sixteen proposed soil borings. Once the sample is collected, field personnel will continue to bore into the soil until the top limit of waste is reached. The lithology of these borings will be recorded. Background soil samples collected for Site 1 will be used to determine background conditions at Site 3 (B&R Environmental 1998a). The surface soil samples will be collected in accordance with the methodologies described in the Master FSP and B&R Environmental SOP Number SA-1.3, "Soil Sampling." Samples will be collected to bias the worst-case scenario based on visual and field instrumentation evaluation.

7.2.3 Subsurface Soil Sampling

Four subsurface soil samples will be collected for this investigation in accordance with the methodologies described in the Master FSP and B&R Environmental SOP Numbers GH-1.5, "Borehole and Sample Logging" and GH-1.3, "Soil and Rock Drilling Methods." Two subsurface soil samples will be collected from two boring locations that will be converted to surficial aquifer monitoring wells (PAI-03-GW02 and PAI-03-GW03). Subsurface soil sample locations are shown in Figure 7-1. The subsurface soil samples will include one from the vadose zone and one within the aquifer. Soil classification parameters will be conducted on both samples. Groundwater modeling parameters will be determined for the sample taken within the aquifer. Also, a Shelby Tube sample will be collected during the installation of monitoring well PAI-01-GW02 in accordance with the methodologies described in B&R Environmental SOP Number SA-1.3, Section 5.2.3, "Procedure for Collecting Undisturbed Samples" and Section 6.3 of this Work Plan.

7.2.4 Groundwater Sampling

Four groundwater samples will be collected for this investigation at the proposed locations shown in Figure 7-2. Analytical results of surface water and sediment sampling will be used to refine placement of monitoring wells so as to characterize likely source areas of contaminants. The monitoring wells will be sampled during this investigation in accordance with the Master FSP and B&R Environmental SOP Number SA-1.1 "Groundwater Sample Acquisition and Onsite Water Quality Testing." Groundwater samples will be collected using low-flow sampling techniques in accordance with the U.S. EPA Region 4 EISOPQAM (U.S. EPA, 1996b) and B&R Environmental SOP Number SA-1.1, Section 5.7, "Low Flow Purging and Sampling," (B&R Environmental, 1998c) at low tide when the dilution anticipated to be minimized. A portion of each sample will be filtered in the field for dissolved metals analysis.

Background groundwater samples will not be taken at Site 3. However, an upgradient groundwater sample will be collected during field activities associated with Site 2 (B&R Environmental, 1998b). The analytical results of this sample will be used to estimate representative upgradient conditions at Site 3.

7.2.5 Biological Sampling

Biological sampling may be required when a screening-level ecological risk assessment indicates that there is enough potential for environmental harm to justify further sampling. The goal of the sampling would be to better characterize risk to ecological receptors, so that there would be adequate information for making risk management decisions regarding remediation. The type of work needed to better characterize environmental risk may include toxicity testing, tissue analysis, and population/community investigation. Biological sampling would be necessary for tissue analysis and population/community

investigation, while toxicity testing is usually done on water, sediment, or soil samples. SOP SA-4.1 and SOP SA-4.4, contained in Appendix B, will be used for biological sampling. If tissue sampling is required at a site, specific instructions will be made part of the appropriate site work plan.

7.3 SAMPLE HANDLING

7.3.1 Sample Containers, Preservation, Holding Times, and Analyses

Sample handling includes the proper selection of sample containers and the preservation and allowable holding times for the required analyses. The site-specific QAPP summarizes the sample handling requirements for this investigation.

7.3.2 Sample Nomenclature

Each sample will be assigned a unique codified sample identification number. The sample nomenclature format described in the Master FSP and B&R Environmental SOP Number CT-04, "Sample Nomenclature," will be used for this investigation. The unique nomenclature established for this sampling event is as follows.

1		2		3		4
AAA-NN	-	AA	-	NNN	-	NN
Site Location and Site Number		Media		Sample Number		Sample Depth

1	PAI - Parris Island 03 - Site 3	3	An ascending sequential number of samples collected
2	SW - Surface Water SD - Sediment SS - Surface Soil SB - Soil Boring/Subsurface Soil GW - Groundwater	4	Bottom of sample interval or sample round.

7.3.3 Sample Documentation, Packaging, and Shipping

Matrix-specific sample logsheets will be maintained for each sample collected. In addition, sample collection information will be recorded in field notebooks and the Site Logbook. Further description of sample documentation is provided in the Master FSP and B&R Environmental SOP Number SA-6.3, "Field Documentation" (B&R Environmental, 1998c).

Samples will be packaged and shipped according to the Master FSP and B&R Environmental SOP Number SA-6.1, "Non-Radiological Sample Handling" (B&R Environmental, 1998c).

7.3.4 Sample Custody and Shipment

Sample custody procedures are designed to provide proper documentation of sample acquisition and integrity. Sample custody will be maintained and documented at all times. Custody begins at the time of collection and ends at the time of disposal by the laboratory. The procedures for custody and shipment are described in Section 4.0 of the Master QAP and B&R Environmental SOP Number SA-6.1 (B&R Environmental, 1998c).

8.0 QUALITY ASSURANCE PLAN

A general discussion of the Data Quality Process is provided in the Master Work Plan (B&R Environmental, 1998c). Site-specific data quality objectives are provided in Section 4.0, and the laboratory DQOs are discussed in Section 10.0 of this document.

9.0 PROJECT MANAGEMENT ORGANIZATION

B&R Environmental will be responsible for management, implementation, and inspection of the field investigation for MCRD Parris Island Site 3. B&R Environmental will coordinate activities with program personnel and MCRD Navy personnel when appropriate.

9.1 PROJECT ORGANIZATION

An organizational chart of the site-specific project personnel for this investigation is provided in Figure 9-1.

9.2 PROJECT PERSONNEL RESPONSIBILITIES

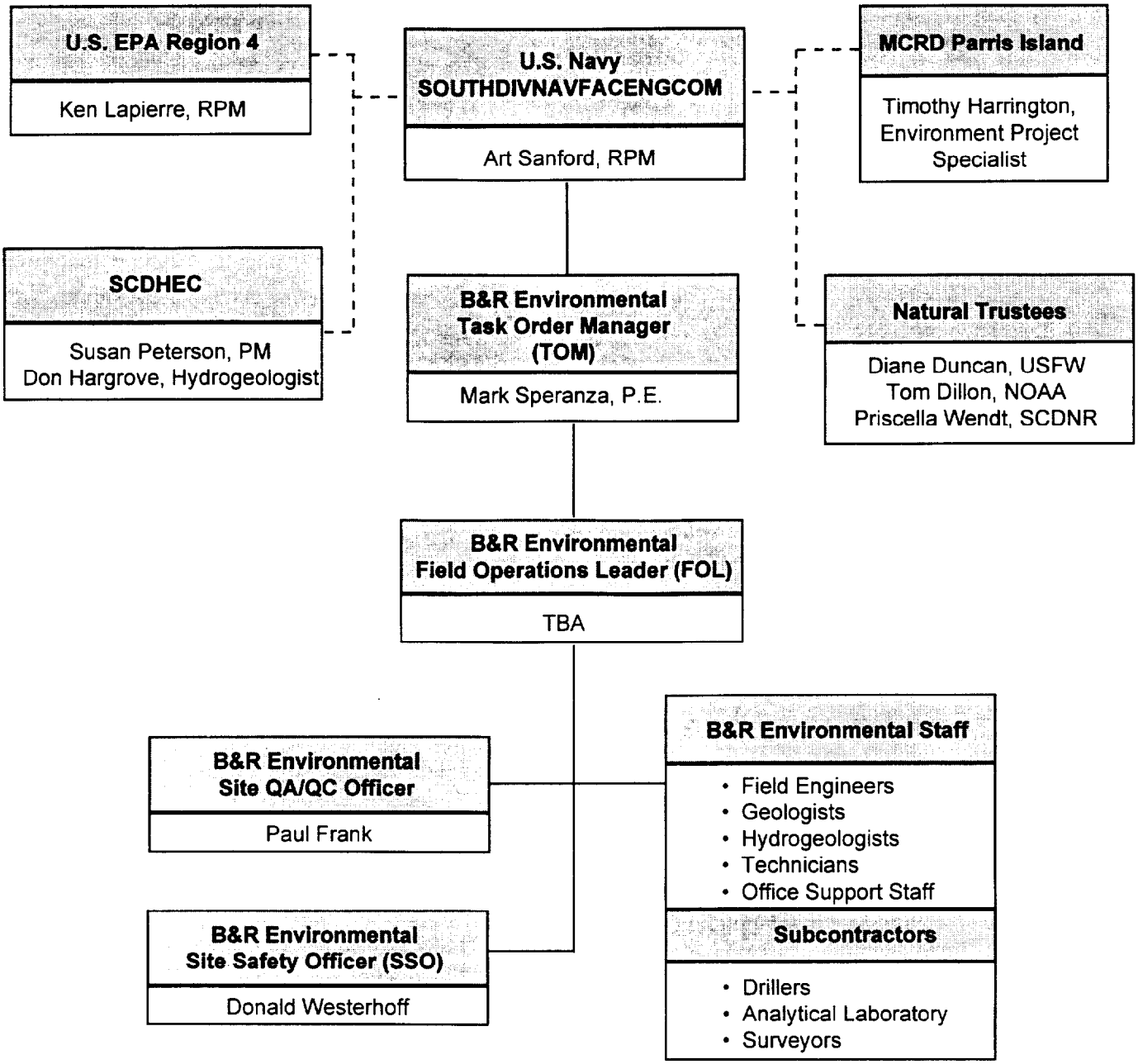
A description of responsibilities of individual project team members is provided below.

The responsibilities of the Task Order Manager (TOM) are provided in the Master Work Plan. The Field Operations Leader (FOL) will be responsible for coordinating all site personnel and field activities. The FOL will:

- Act as liaison between the TOM, field team members, Site Safety Officer (SSO), and Site Quality Assurance/Quality Control (QA/QC) officer.
- Supervise all subcontractors.
- Oversee the mobilization and demobilization of all equipment, personnel, and subcontractors, and ensure the availability and maintenance of all field sampling and monitoring equipment and materials.
- Oversee the completion of all site documentation.
- Assume custody of all samples and ensure the proper handling and shipment of all samples.
- Resolve all logistical, weather, personnel, and equipment problems that may arise and initiate field change requests after consultation with the TOM, when necessary.

FIGURE 9-1

**PROJECT PERSONNEL ORGANIZATION
SITE 1 - INCINERATOR LANDFILL
SITE 41 - FORMER INCINERATOR
MCRD PARRIS ISLAND, SOUTH CAROLINA**



NOAA: National Oceanic and Atmospheric Administration
PM: Project Manager
RPM: Remedial Project Manager
SCNDR: South Carolina Department of Natural Resources
TBA: To Be Assigned
USFW: U.S. Fish and Wildlife Service

A Professional Geologist certified in the State of South Carolina will provide direction for the well installation activities and review of boring logs. Mr. Stan Conti (License Number 242) or Ms. Adel Baker (License Number 103) of B&R Environmental have been tentatively identified as candidates.

The Site QA/QC Officer will be responsible for ensuring all site activities are performed according to the QA/QC guidelines outlined in the Master QAP. The Site QA/QC officer will:

- Act as liaison between the B&R Environmental Quality Assurance Manager (QAM), laboratory, and site personnel.
- Ensure that field duplicates and quality control blanks are collected at the proper frequency and volume.
- Ensure that all measuring and testing equipment is calibrated, used, and maintained in accordance with applicable procedures.
- Manage bottleware procurement and oversee field preservation and filtration activities.

The SSO will advise the FOL on issues of site health and safety. The duties of the SSO are described in the Master Health and Safety Plan (HASP) of the Master Work Plan, Volume II (B&R Environmental, 1998c).

10.0 DATA QUALITY REQUIREMENTS

The purpose of this section is to relate the site-specific laboratory analyses and field QA/QC samples to the DQO statements established for this investigation. The Master QAP of the Master Work Plan (Volume II) is referenced where appropriate.

10.1 LABORATORY ANALYSES

Section 5.0 of the Master QAP describes the laboratory and methodology requirements for the sample analyses for this investigation. Section 5.5 of the Master QAP describe the data reporting requirements for this investigation. Section 5.6 of the Master QAP describes the criteria for laboratory selection. The laboratory selected to perform work at this site must be South Carolina state certified.

10.2 EXTERNAL (FIELD) QC SAMPLES

Section 3.3 of the Master QAP contains a general description of external quality control measures.

10.2.1 Field QC Sample Types and Frequencies

Table 10-1 summarizes the frequency and type of QA/QC samples to be collected for this investigation.

TABLE 10-1

FREQUENCY OF FIELD QC SAMPLES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Type Of Sample	Organics	Inorganics
Field Duplicate/Split Samples	1/10 samples/media	1/10 samples/media
Source Water Blank	1/source/sampling event	1/source/sampling event
Trip Blank (VOCs only)	1/cooler containing VOC samples	NA
Equipment Rinsate Blank	1/day/matrix	1/day/matrix
Field Blank	As needed; Depends on site conditions	As needed; Depends on site conditions

QA/QC blanks for grout, sand, and bentonite will be collected and held for analysis pending the analytical results of the field investigation. If it is suspected that inorganic contaminants have been introduced by well installation materials, the samples will be sent to the laboratory for analysis.

Detailed descriptions of QC sample types are provided in Sections 3.3.1 through 3.3.5 of the Master QAP of the Master Work Plan (Volume II) (B&R Environmental, 1998c).

10.2.2 Matrix Spike/Duplicate Sample Aliquots

Laboratory duplicate and matrix spike samples will be analyzed as described in Section 3.4 of the Master QAP of the Master Work Plan (Volume II). The field sampling team will provide the appropriate additional sample volume as prescribed by the laboratory requirements. The additional sample aliquots required for analysis of matrix spike/duplicates will be collected with a frequency of 1 per 20 samples per matrix.

10.3 BOTTLEWARE REQUIREMENTS

The bottleware and preservation requirements for the analyses proposed for this investigation are provided in Table 10-2. Pre-preserved, certified clean bottleware will be supplied by the laboratory subcontractor.

10.4 SAMPLE CUSTODY AND SHIPMENT

Sample custody procedures are designed to provide proper documentation of sample acquisition and integrity. Sample custody and shipment procedures for this investigation are described in Section 4.0 of the Master QAP of the Master Work Plan (Volume II).

10.5 INTERNAL (LABORATORY) QC CHECKS

Descriptions of the internal (laboratory) QC check types are provided in Section 6.0 of the Master QAP of the Master Work Plan (Volume II) (B&R Environmental, 1998c).

10.5.1 Laboratory Duplicate, Spike, and Method Blank Analyses

Table 10-3 summarizes the frequency and type of laboratory QC checks to be performed for this investigation.

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
AQUEOUS (SURFACE WATER & GROUNDWATER)					
TCL and Appendix IX Volatile Organic Compounds	SW-846 8260B	2 x 40 mL	Glass; Teflon-lined septum cap	HCl to pH<2; Cool to 4°C; zero headspace	14 days to analysis
TCL and Appendix IX Semivolatile Organic Compounds	SW-846 8270C	2 x1 L	Amber glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Total TAL and Appendix IX Metals	SW-846 6010B/ 7000A Series	1 L	High-Density Polyethylene (HDPE)	HNO_3 to pH<2	6 months, except Hg (28 days)
Dissolved TAL Metals and Appendix IX Metals	SW-846 6010B/ 7000A Series	1 L	HDPE	HNO_3 to pH<2	6 months, except Hg (28 days)
Cyanide	SW-864 9010B/9012A	500 mL	Glass or HDPE	NaOH to pH>12; Cool to 4°C	14 days to analysis
Hexavalent Chromium	SW-846 7196A	250 mL	Glass of HDPE	Cool to 4°C	24 hours to analysis
TCL and Appendix IX Pesticides	SW-846 8081A	2 x 1 L[4]	Amber glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
TCL and Appendix IX PCBs	SW-846 8082	2 x 1 L[4]	Amber glass	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Total Organic Carbon (TOC)	EPA 415.1	60 mL	Glass or HDPE	HCl or $H_2SO_4$to pH <2; Cool to 4°C	28 days to analysis
pH	EPA 150.1	60 mL	Glass or HDPE	None Required	Analyze immediately
Turbidity	EPA 180.1	250 mL	Glass or HDPE	Cool to 4°C	48 hours to analysis
Total Dissolved Solids (TDS)	EPA 160.1	250 mL	Glass or HDPE	Cool to 4°C	7 days to analysis
Total Suspended Solids (TSS)	EPA 160.2	250 mL	Glass or HDPE	Cool to 4°C	7 days to analysis
Chloride	EPA 325.2	250 mL	Glass or HDPE	None required	28 days to analysis
Fluoride	EPA 340.2	500 mL	HDPE	None required	28 days to analysis

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 2 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
AQUEOUS (SURFACE WATER & GROUNDWATER) (Continued)					
Appendix IX Organophosphorous Pesticides	SW-846 8141A	2 x 1L	Amber Glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Appendix IX Herbicides	SW-846 8151A	2 x 1L	Amber Glass; Teflon-lined cap	Cool to 4°C; dark	7 days to extraction; 40 days from extraction to analysis
Nonhalogenated Organic Compounds (Isobutyl alcohol, propionitrile, Acetonitrile, 1,4-Dioxane, and Methacrylonitrile)	SW-846 8015B Modified	2 x 40 mL	Glass; Teflon-lined septum cap	HCl to pH <2; Cool to 4°C	14 days to analysis
Nitrate/Nitrite	EPA 353.3	250 mL	Glass or HDPE	H_2SO_4 to pH <2; Cool to 4°C	28 days to analysis
Sulfate	EPA 375.4	250 mL	Glass or HDPE	Cool to 4°C	28 days to analysis
Salinity	SM2520B	250 mL	Glass or HDPE	Cool to 4°C	Analyze immediately
Hardness	EPA 130.2	250 mL	Glass or HDPE	HNO_3 to pH<2; Cool to 4°C	6 months to analyze
SOLID (SURFACE & SUBSURFACE SOIL & SEDIMENT)					
TCL Volatile Organic Compounds	SW-846 8260B	5 X 5 g	Glass EnCore™ Samplers	Cool to 4°C; At lab add sample to be preserved with either sodium biosulfate solution or by adding to 5 ml reagent water and then freezing at -10°C	Extract within 48 hours; 14 days to analysis
TCL Semivolatile Organic Compounds	SW-846 8270C	8 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 3 OF 4

Analysis	Analytical Method	Sample Volume[1]	Bottleware	Preservation[2]	Holding Time[3]
SOLID (SURFACE & SUBSURFACE SOIL & SEDIMENT) (Continued)					
Total TAL Metals and Cyanide	SW-846 6010B/7000 Series and 9010B/9012A	8 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	6 months, except Hg (28 days); cyanide 14 days
TCL PCBs	SW-846 8082	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
TCL Pesticides	SW-846 8081A	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	14 days to extraction; 40 days from extraction to analysis
Hexavalent Chromium	SW-846 3060A/7196A	4 oz.	Glass; Wide-mouth; Teflon-lined cap	Cool to 4°C	7 days to extraction; 24 hours from extraction to analysis
Total Organic Content (TOC)	SW-846 9060	4 oz.	Glass; Wide-mouth	Cool to 4°C	28 days to analysis
Natural Moisture Content and Grain-Size Analysis	ASTM D 421/ 422	1 qt.	Glass; Wide-mouth	None	None
Atterberg Limits	ASTM D 4318	NA[5]	Shelby Tube	None	None
Bulk Density	MSA	NA	Shelby Tube	None	None
Specific Gravity	ASTM D854	NA	Shelby Tube	None	None
Porosity	Calculation	NA	NA	None	None
pH	SW-846-9045C	4 oz.	Glass; Wide-mouth	Cool to 4°C	Analyze immediately
Permeability	ASTM Method D5084-90/ SW-846 9100	NA	Shelby Tube	None	None

TABLE 10-2

SUMMARY OF BOTTLEWARE, PRESERVATION, AND HOLDING TIMES
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 4 OF 4

1 Sample volume may vary based on the laboratory.
2 HCl - Hydrochloric acid; HNO_3 - Nitric acid; NaOH - Sodium hydroxide; H_2SO_4 - Sulfuric acid.
3 Holding times are measured from the date of sample collection.
4 Two 1L bottles of samples are sufficient for pesticides and PCB analyses if both are performed for the same sample.
5 NA - Not applicable.

TABLE 10-3

**FREQUENCY OF LABORATORY QC CHECKS
SITE 3 - CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA**

Type Of Sample	Organics	Inorganics
Laboratory Duplicate	NA	1/20 samples/media
Matrix Spike	1/20 samples/media	1/20 samples/media
Matrix Spike Duplicate	1/20 samples/media	NA
Surrogate Spike	Each sample for chromatographic analyses	NA
Method Blank	Based on method requirements with a minimum of 1/Batch of 20 samples	Based on method requirements with a minimum of 1/Batch of 20 samples

NA - Not Applicable

10.5.2 Other Laboratory QC Checks

Calibration and preventive maintenance of laboratory instruments are described in Section 6.6 of the Master QAP of the Master Work Plan (Volume II). Handling and storage of samples, use of qualified technicians, and independent confirmation of data computations and deliverables are described in the Laboratory Quality Assurance Plan (LQAP).

10.6 PROJECT RECORDS

Recordkeeping and evidentiary file concerns are described in Section 7.0 of the Master QAP of the Master Work Plan (Volume II). All protocols described therein will be strictly observed.

10.7 DATA REDUCTION, VALIDATION, AND REPORTING

The data generated from this investigation will be validated in accordance with the U.S. EPA National Functional Guidelines for Organic and Inorganic Data Review. The corresponding requirements as discussed in Section 8.0 of the Master QAP, Volume II, for data validation, data assessment, electronic deliverables, and data interpretation and reporting will be followed.

10.8 PERFORMANCE AND SYSTEM AUDITS

The protocol for conducting audits as outlined in Section 10.0 of the Master QAP, Volume II shall be followed.

10.9 CORRECTIVE ACTIONS

In the event there are discrepancies in field activities from the established procedures and/or requirements or modifications to the proposed Work Plan, the procedures established in Section 10 of the Master QAP, Volume II, for documenting nonconformances shall be implemented and, if appropriate, a "Field Task Modification Request Form" completed.

10.10 TRAINING AND QUALITY PLANNING

Training requirements and pro-active management practices are provided in the Master Work Plan, Volume II (B&R Environmental, 1998c).

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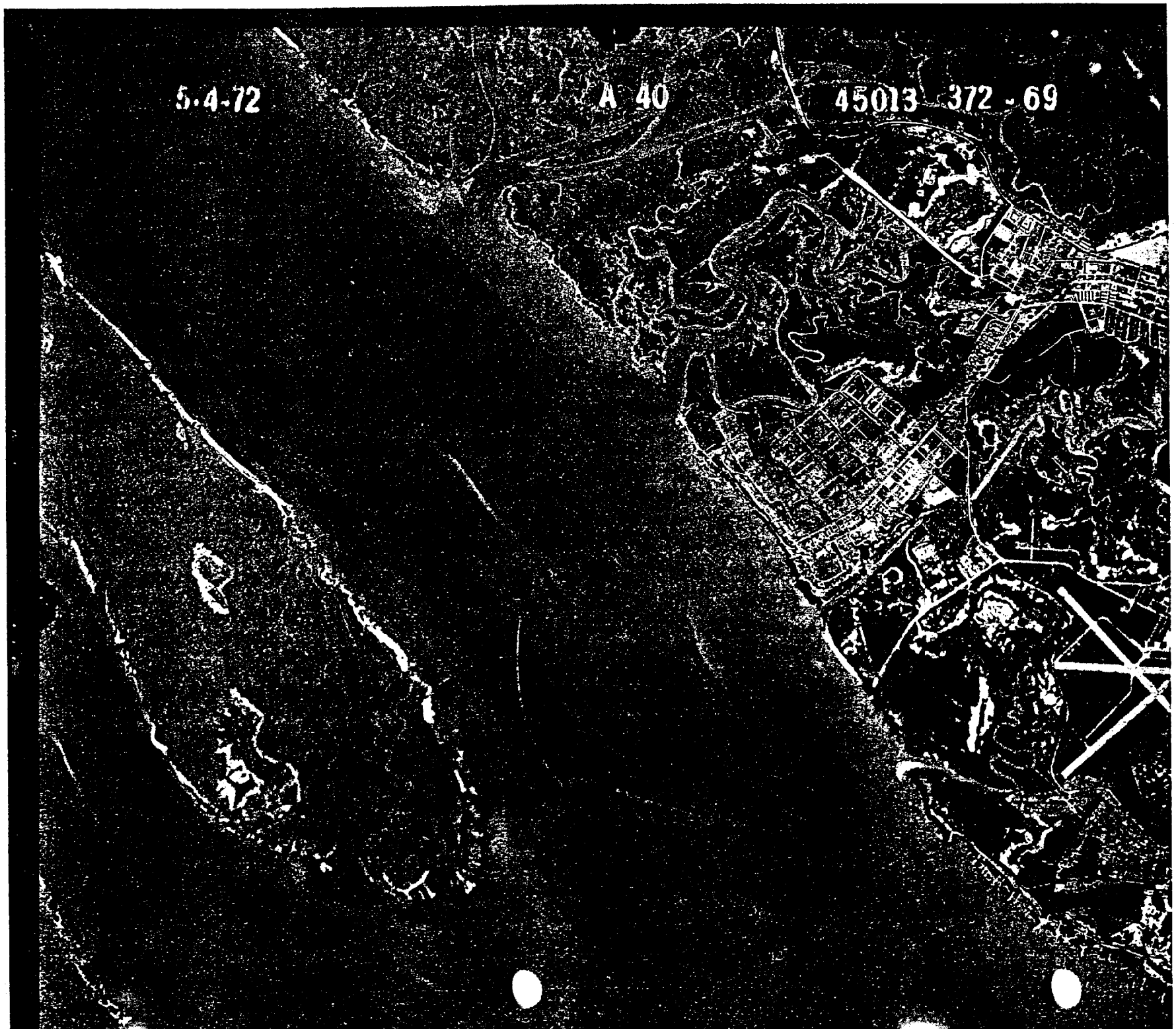
APPENDIX A

AERIAL PHOTOGRAPHS

11-1-65
CDU-1GG-2C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APPENDIX B

WORK PLAN ADDENDUM 4 – SEDIMENT DELINEATION SAMPLING

WORK PLAN ADDENDUM 4
SEDIMENT DELINEATION SAMPLING AT SITE/SWMU 3 – CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

Objective

The purpose of this Work Plan Addendum is to propose sampling activities to better delineate detections of PAHs, PCBs, and pesticides in sediment at Site/SWMU 3 (Causeway Landfill) at MCRD Parris Island, South Carolina.

Background

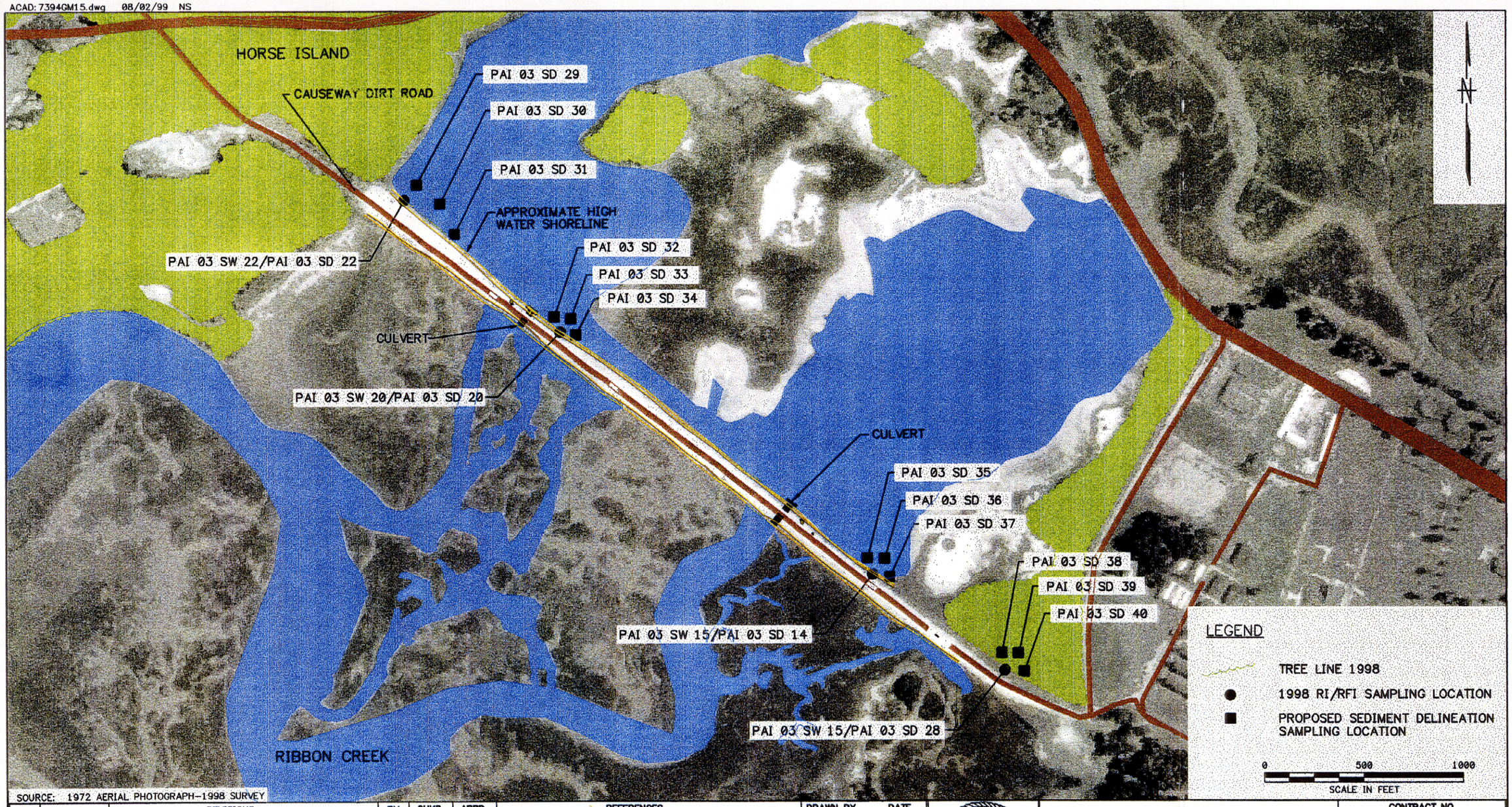
An RI/RFI was conducted at Site/SWMU 3 from May to September 1998. As part of the investigation, sediment samples were collected along the sides of the causeway. Sediment results identified four areas that exceed human health and ecological criteria for PAHs, PCBs, and/or pesticides. Most of the previous samples were collected near the causeway. Consequently, little analytical information is available on sediment further out into the pond to define the extent of these chemicals.

Proposed Field Activities

Twelve sediment samples will be collected at the approximate locations shown on Figure 1. The samples will be collected in accordance with SOP Number SA-1.2, "Surface Water and Sediment Sampling," and will be analyzed for the following compounds. The sediment samples will be biased towards depositional areas, if present.

Sediment Sample	Sample Analysis
PAI-03-SD-29, PAI-03-SD-30, PAI-03-SD-31	TCL SVOCs, SW-846 8310
PAI-03-SD-32, PAI-03-SD-33, PAI-03-SD-34	TCL PCBs, SW-846 8062
PAI-03-SD-35, PAI-03-SD-36, PAI-03-SD-37	TCL Pesticides, SW-846 8081A
PAI-03-SD-38, PAI-03-SD-39, PAI-03-SD-40	TCL Pesticides, SW-846 8081A

ACAD: 7394GM15.dwg 08/02/99 NS



SOURCE: 1972 AERIAL PHOTOGRAPH-1998 SURVEY

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY NJS DATE 6/29/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SEDIMENT DELINEATION SAMPLING
SITE 3-CAUSEWAY LANDFILL
MCRD PARRIS ISLAND, SOUTH CAROLINA

CONTRACT NO. 7394
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 1
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

2

78 A 034

Rev. 1
09/27/99

Health and Safety Plan Addendum for

Site/SWMU 2- Borrow Pit Landfill

Marine Corps Recruit Depot
Parris Island, South Carolina
U.S. EPA Identification Number
SC6 170 022 762

Southern Division
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888
Contract Task Order 0020

September 1999

Rev. 1
09/27/99

HEALTH AND SAFETY PLAN ADDENDUM
FOR
SITE/SWMU 2-BORROW PIT LANDFILL

MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA
U.S. EPA Identification Number
SC6 170 022 762

September 1999
COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Anderson Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0020

PREPARED UNDER THE SUPERVISION OF:

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PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

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CLEAN HEALTH AND SAFETY MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

1.0 INTRODUCTION

The following information represents modifications to the Health and Safety Plan (HASP) for the Remedial Investigation (RI) site activities that are to be conducted at the Marine Corps Recruit Depot, Parris Island, South Carolina, as part of Contract Task Order (CTO) 0020. This document is incorporated as an Addendum to the aforementioned HASP dated March 1998. This Addendum addresses the task of test pitting operations and sampling at Site/SWMU 2-Borrow Pit Landfill. The following sections and tables of the HASP are addended by this document:

Attachment I Site-Specific Training Documentation

In addition various document and guidance have been developed since this HASP was prepared and are incorporated in this addendum as the following attachments:

- Attachment II Emergency Response Protocol
- Attachment III Safe Work Permit
- Attachment IV Heat Stress
- Attachment V Equipment Checklist
- Table 5-1 Tasks/Hazards/Control Measures Compendium (Attachment VI)
- Attachment VII SOP Utility Location and Excavation Clearance
- Attachment VIII Injury Illness Report

It is the responsibility of the Task Order Manager (TOM) to forward copies of this Addendum to the field crew to be inserted into the field copies of the HASP. It is the FOL's responsibility to ensure that all members of the field crew review this Addendum. The FOL will ensure all field crew members sign the site-specific training documentation sheet (Attachment I of this Addendum), indicating they have reviewed the elements of this Addendum and the HASP, understand its requirements, and any questions they may have had have been answered to their satisfaction.

The modifications to the individual sections are as follows.

4.0 SCOPE OF WORK

The purpose of this work is to investigate whether waste material is present at Site/SWMU 2 (Borrow Pit Landfill). Test pitting will be conducted at 14 locations illustrated in the Work Plan Addendum for Test Pitting Operations at Site/SWMU 2-Borrow Pit Landfill, Figure 1. The excavated soils will not be considered as waste and will be placed back in the excavation. Subsurface soil samples will be collected at 3 of the test pit locations. Personnel will not enter the excavation but will remove the sample from the bucket of the backhoe being used to excavate the pit. The soils will be sampled for TCL VOCs, SVOCs, PCB/pesticides and TAL inorganics.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION

The tasks to be conducted at the site are discussed in the Table 5-1 (Attachment II). Additionally, Safe Work Permits for these tasks are also included as Attachment III.

6.0 HAZARD ASSESSMENT

Table 6-1 of the HASP describes the chemicals of concern for Site 2. In addition, since the development of the HASP, TtNUS has prepared and issued a Standard Operating Procedure on "Utility Locating and Excavation Clearance". This SOP must be followed for all ground penetrations or excavations. One Utility Clearance Form will be required for Site 2 since clearance for the site will be obtained for all site test pit points at one time. In an area of unknown underground hazards separate clearances will be completed. A copy of the SOP is included as Attachment VII of this Addendum.

Also given the location and the planned schedule of the work to be conducted, ambient temperature extremes (i.e., heat stress) are a potential hazard. Attachment IV discusses heat stress disorders and recommended actions to prevent heat stress.

ATTACHMENT I

SITE-SPECIFIC TRAINING DOCUMENTATION

SITE-SPECIFIC TRAINING DOCUMENTATION FOR
RCRA FACILITY INVESTIGATION AT MCRD PARRIS ISLAND SITE/SWMU 2 BORROW PIT LANDFILL AND HASP ADDENDUM

My signature below indicates that I am aware of the potential hazardous nature of performing investigation activities at MCRD Parris Island, South Carolina, and that I have received site-specific training, which included the elements, presented below:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- The contents of the health and safety plan and addendum
- Emergency response procedures (evacuation and assembly points)
- Review contents of relevant Material Safety Data Sheets
- Review of the use of Safe Work Permits

My signature below indicates that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction, and that the dates of my training and medical surveillance indicated below are accurate.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

ATTACHMENT II

EMERGENCY RESPONSE PROTOCOLS

EMERGENCY RESPONSE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of exposure situations. In the event of a personnel exposure to a hazardous substance or agent:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the exposed person is a Tetra Tech NUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the Continuum Healthcare physician. Continuum Healthcare will contact the medical facility and request specific testing which may be appropriate. The care of the involved worker will be monitored by Continuum Healthcare physicians. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call Continuum Healthcare at 1-800-229-3674, being prepared to provide:
  - Any known information about the nature of the exposure.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the exposed Tetra Tech NUS, Inc. employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
  - Fax appropriate MSDS to Continuum Healthcare at (770) 457-1429.
- Contact Corporate Health and Safety Manager (Matt Soltis) at 1-800-245-2730.

As environmental data is gathered and the exposure scenario becomes more clearly defined, this information should be forwarded to the Continuum Healthcare Medical Director or Assistant Medical Director.

Continuum Healthcare will compile the results of all data and provide a summary report of the incident. A copy of this report will be placed in each involved worker's medical file in addition to being distributed to appropriately designated company officials. Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. This generalized summary will be accompanied by a personalized letter describing the findings/results. A copy of the personal letter will be filed in the continuing medical file maintained by Continuum Healthcare.

POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. Exposing Agent

Name of Product or Chemicals (if known): _____

_____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? _____

How long did individual work in area before signs/symptoms developed? _____

Was protective gear being used? If yes, what was the PPE? _____

Was there skin contact? _____

Was the exposing agent inhaled? _____

Were other persons exposed? If yes, did they experience symptoms? _____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Nausea / Vomiting
Dizziness
Weakness

Delayed Symptoms:

Weakness
Nausea / Vomiting
Shortness of Breath
Cough
Loss of Appetite
Abdominal Pain
Headache
Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat
Tearing
Headache
Cough
Shortness of Breath
Chest Tightness / Pressure
Cyanosis
Nausea / Vomiting
Dizziness
Weakness
Loss of Appetite
Abdominal Pain
Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)

Improved: _____ Worsened: _____ Remained Unchanged: _____

V. Treatment of Symptoms (check off appropriate response)

None: _____ Self-Medicated: _____ Physician Treated: _____

ATTACHMENT III

SAFE WORK PERMIT

SAFE WORK PERMIT FOR TEST PIT OPERATIONS AT SITE 2-BORROW PIT LANDFILL

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): **Test Pit excavations Site 2 Borrow Pit** Landfill. Test pits will be excavated in an effort to determine the extent of contamination. Depths of the test pits are to range between 4 and 10 feet.

II. Required Monitoring Instruments: PID (with at least a 9.5 eV lamp source) or FID

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR ☐ Escape Pack ☐
Half face APR ☐ SCBA ☐
SKA-PAC SAR ☐ Bottle Trailer ☐
Skid Rig ☐ None ☒

Level D Minimum Requirements: Sleeved shirt and long pants, safety footwear, and nitrile gloves. Safety glasses, hard hats, and hearing protection will be worn when working in the vicinity of the back-hoe. Modifications/Exceptions: See Section VI below.

V. Chemicals of Concern	Action Level(s)	Response Measures
Potential site contaminants include VOCs, SVOCs, TAL Inorganics and PCBs/Pesticides	Any sustained readings above background in worker	Suspend site activities and report to an unaffected area. breathing zones.

VI. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☒ No (See Note)	Gloves (Type - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☒ Yes	☐ No

Modifications/Exceptions: Reflective vests for high traffic areas. Tyvek coverall if there is a potential for soiling work cloths. PVC or PE coated Tyvek if saturation of work cloths may occur.

VII. Procedure review with permit acceptors	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☒	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☒	☐

VIII. Site Preparation

Utility Clearances obtained for areas of subsurface investigation ☒ Yes ☐ No

IX. Equipment Preparation	Yes	NA
Equipment drained/depressurized	☐	☒
Equipment purged/cleaned	☐	☒
Isolation checklist completed	☐	☒
Electrical lockout required/field switch tested	☐	☒
Blinds/misalignments/blocks & bleeds in place	☐	☒
Hazardous materials on walls/behind liners considered	☐	☒

X. Additional Permits required (Hot work, confined space entry, excavation etc.) ☐ Yes ☒ no

If yes, complete permit required or contact Health Sciences, Pittsburgh Office

XI. Special instructions, precautions: Test pits will be excavated in accordance with 29 CFR 1926.650-.652. Site personnel will not be permitted to enter any excavation. Samples will be collected from the bucket of the backhoe or by using a remote sampling device. Equipment, personnel, and machinery will be kept away from the edges of open excavations (> 3 feet). Open excavations will be barricaded. If any intact containers or drums are uncovered as a result of excavation activities, site operations will be suspended and the site contact will be notified. Follow guidance provided in the SOP for "Utility Location and Excavation Clearance"..

Permit Issued by: _____ Permit Accepted by: _____

ATTACHMENT IV

HEAT STRESS

HEAT STRESS

Because some physically demanding fieldwork is expected to take place during warmer months or periods, heat related disorders are a potential problem. Discussed below are the common heat-related disorders and the recommended actions to prevent heat stress.

Heat Related Disorders

Heat Rash

Also known as prickly heat, this condition affects the skin. It occurs in situations where the skin remains wet most of the time. The sweat ducts become plugged and a skin rash soon appears.

Signs and Symptoms

- Skin rash will appear on affected areas of the body.
- Tingling or prickling sensation will be felt on the affected areas.

Heat Cramps

Heat cramps are muscle pains, usually in the lower extremities, the abdomen, or both, that occur after profuse sweating with accompanying salt depletion. Heat cramps most often afflict people in good physical condition, who overwork in conditions of high temperature and humidity. Untreated, heat cramps may progress to heat exhaustion.

Signs and Symptoms

- Cramps in the extremities and abdomen that begin suddenly during vigorous activity. Heat cramps can be mild with only slight abdominal cramping and tingling in the extremities, but more commonly present intense and incapacitating pain in the abdomen and extremities.
- Respiration rate will increase, decreasing after the pain subsides.
- Pulse rate will increase
- Skin will be pale and moist.
- Body temperature will be normal
- Generalized weakness will be noted as the pain subsides.
- Loss of consciousness and airway maintenance are seldom problems with this condition.

Treatment for heat cramps is aimed at eliminating the exposure and restoring the loss of salt and water.

Heat Exhaustion

Heat exhaustion is a more severe response to salt and water loss, as well as an initial disturbance in the body's heat-regulations system. Like heat cramps, heat exhaustion tends to occur in people working in hot environments. Heat exhaustion may progress to heat stroke. Treatment for heat exhaustion is similar in principle to that for heat cramps.

Signs and Symptoms

- Heat exhaustion may be accompanied present by a headache, fatigue, dizziness, or nausea with occasional abdominal cramping. More severe cases of heat exhaustion may resulting partial or complete temporary loss of respiration nd circulation due to cerebral ischemia.

- Sweating will be profuse.

- Pulse rate will be rapid and weak.

- Respiration rate will be rapid and shallow.

- The skin will be pale and clammy

- The body temperature will be normal or decreased.

- The person could be irritable and restless.

Heat Stroke

Heat stroke is caused by a severe disturbance in the body's heat-regulating system and is a profound emergency: The mortality rate ranges from 25 to 50 percent. It is most common in men over 40, especially alcoholics. It can also occur to people of any age having too much exposure to the sun or prolonged confinement in a hot atmosphere. Heat stroke comes on suddenly. As the sweating mechanism fails, the body temperature begins to rise precipitously, reaching 106°F (41°C) or higher within 10 to 15 minutes. If the situation is not corrected rapidly, the body cells -- especially have very vulnerable cells to the brain--are literally cooked, and the central nervous system is irreversibly damaged. The treatment for heat stroke is aimed at maintaining vital functions and causing as rapid a decrease of body temperature as possible.

Signs and Symptoms

- The person's pulse will be strong and bounding.
- The skin will be hot, dry, and flushed.
- The worker may experience headache, dizziness, and dryness of mouth
- Seizures and coma can occur.
- Loss of consciousness and airway maintenance problems can occur.

These are only guidelines for heat related emergencies. Actual training in emergency medical care or basic first aid is recommended.

Controlling Heat Stress

The SSO shall visually monitor personnel to note for signs of heat stress. Field personnel will also be instructed to observe for symptoms of heat stress and methods on how to control it. One or more of the following control measures can be used to help control heat stress:

- Provide adequate liquids to replace lost body fluids. Personnel must replace water and salt lost from sweating. Personnel must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.

- Replacement fluids can be commercial mixes such as Gatorade®.

- Establish a work regime that will provide adequate rest periods for cooling down. This may require additional shifts of workers.

- Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments.
- Breaks are to be taken in a cool rest area (77°F is best).
- Personnel shall remove impermeable protective garments during rest periods.
- Personnel shall not be assigned other tasks during rest periods.
- Personnel shall be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

The heat stress of personnel onsite may be monitored utilizing biological monitoring.

One of the following biological monitoring procedures may be utilized by the SSO to monitor heat stress concerns.

- Heart rate (HR) shall be measured by the pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats/minute. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of rest period stays the same. If the pulse rate is 100 beats/minute at the beginning of the next rest period, the following work cycle should be shortened by 33 percent. The length of the initial work period will be determined by using the table below.

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUES

	Work Load		
Work-Rest Regimen	Light	Moderate	Heavy
Continuous	80.0°F	80.0°F	77.0°F
75% Work - 25% Rest, Each Hour	87.0°F	82.4°F	78.6°F
50% Work - 50% Rest, Each Hour	88.5°F	85.0°F	82.2°F
25% Work - 75% Rest, Each Hour	90.0°F	88.0°F	86.0°F

- Body temperature shall be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the oral temperature exceeds 99.7°F at the beginning of the next rest period, the following work cycle shall be further shortened by 33 percent. OT should be measured at the end of the rest period to make sure that it has dropped below 99°F. At no time shall work begin with the oral temperature above 99°F.

NOTE: External temperatures in excess of those stated above shall be regarded as inclement weather. Work continuation, termination, or alteration of the work schedule will be at the discretion of the FOL or SSO.

ATTACHMENT V

EQUIPMENT INSPECTION CHECKLIST

Attachment V
EQUIPMENT INSPECTION

COMPANY:_____ **UNIT NO.**_____
FREQUENCY: Inspect daily, document prior to use and as repairs are needed.

Inspection Date: ____/____/____ Time: _____ Equipment Type:_____
(e.g., bulldozer)

	Good	Need Repair	N/A
Tires or tracks	❒	❒	❒
Hoses and belts	❒	❒	❒
Cab, mirrors, safety glass	❒	❒	❒
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	❒	❒	❒
- Is the equipment equipped with audible back-up alarms and back-up lights?	❒	❒	❒
Horn and gauges	❒	❒	❒
Brake condition (dynamic, park, etc.)	❒	❒	❒
Fire extinguisher (Type/Rating -_____)	❒	❒	❒
Fluid Levels:			
- Engine oil	❒	❒	❒
- Transmission fluid	❒	❒	❒
- Brake fluid	❒	❒	❒
- Cooling system fluid	❒	❒	❒
- Windshield wipers	❒	❒	❒
- Hydraulic oil	❒	❒	❒
Oil leak/lube	❒	❒	❒
Coupling devices and connectors	❒	❒	❒
Exhaust system	❒	❒	❒
Blade/boom/ripper condition	❒	❒	❒
Accessways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	❒	❒	❒
Power cable and/or hoist cable	❒	❒	❒
Steering (standard and emergency)	❒	❒	❒

Safety Guards:

	Yes	No
– Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?_____	❒	❒
– Hot pipes and surfaces exposed to accidental contact?_____	❒	❒
– All emergency shut offs have been identified and communicated to the field crew?_____	❒	❒
– Have emergency shutoffs been field tested? _____	❒	❒
– Results?_____	❒	❒
– Are any structural members bent, rusted, or otherwise show signs of damage?_____	❒	❒

EQUIPMENT INSPECTION (Continued)

- Are fueling cans used with this equipment approved type safety cans?_____ ❒ ❒
- Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use?_____ ❒ ❒

Portable Power Tools:

- Tools and Equipment in Safe Condition?_____ ❒ ❒
- Saw blades, grinding wheels free from recognizable defects (grinding wheels have been sounded)?_____ ❒ ❒
- Portable electric tools properly grounded?_____ ❒ ❒
- Damage to electrical power cords?_____ ❒ ❒
- Blade guards in place?_____ ❒ ❒
- Components adjusted as per manufacturers recommendation?_____ ❒ ❒

Cleanliness:

- Overall condition (is the decontamination performed prior to arrival on-site considered acceptable)?_____
- Where was this equipment used prior to its arrival on site?_____
- Site Contaminants of concern at the previous site?_____
- Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls?_____

Operator Qualifications (as applicable for all heavy equipment):

- Does the operator have proper licensing where applicable, (e.g., CDL)?_____
- Does the operator, understand the equipments operating instructions?_____
- Is the operator experienced with this equipment? _____
- Does the operator have emotional and/or physical limitations which would prevent him/her from performing this task in a safe manner?_____
- Is the operator 21 years of age or more?_____

Identification:

- Is a tagging system available, for positive identification, for tools removed from service?_____

Additional Inspection Required Prior to Use On-Site

	Yes	No
Does equipment emit noise levels above 90 decibels?	❒	❒
If so, has an 8-hour noise dosimetry test been performed?	❒	❒

- Results of noise dosimetry:_____
- Defects and repairs needed:_____
- General Safety Condition: _____
- Operator or mechanic signature:_____

Approved for Use: ❒ Yes ❒ No

_____
Site Safety Officer Signature

ATTACHMENT VI

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM FOR MARINE CORPS RECRUIT DEPOT PARRIS ISLAND, SOUTH CAROLINA

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Excavation of test pits (to be conducted at Site 2-Borow Pit Landfill) The purpose of this activity is to determine the horizontal extent of landfill contamination	*Chemical hazards:* 1. Based on historical usage and past analyses of the site, the following are contaminants of concern: <u>Site 2 (Borrow Pit Landfill)</u> 1) Air/particulate/water borne contaminants including but not limited to, - various metals (lead, chromium, mercury amalgam, and beryllium) paint and solvent wastes including aliphatic petroleum and chlorinated solvent compounds (methylene chloride, perchloroethylene), PCB contaminated oils, diesel fuel and kerosene and miscellaneous domestic trash, and construction debris. See Table 6-1 for more information on the chemicals of concern. 2) Transfer of contamination into clean areas or onto persons. *Physical hazards:* 3) Moving machinery/Vehicular and foot traffic (contact entanglement with equipment or machinery) 4) Excavation collapse 5) Energized systems (contact with underground or overhead utilities) 6) Noise in excess of 85 dBA 7) Lifting (strain/muscle pulls) 8) Slips, trips, and falls 9) Ambient temperature extremes (heat stress) 10) Contact with sharp objects (glass, metal, etc.) 11) Insect/animal bites and stings, poisonous plants, etc. 12) Inclement weather	***Chemical hazards:*** 1) Use real-time monitoring instrumentation, action levels, and identified PPE to control exposures to potentially contaminated media (air, water, soils, etc.). Generation of dusts should be minimized. If airborne dusts are observed, area wetting methods may be used. If area wetting methods are not feasible, termination of activities may be used to minimize exposure to excessive airborne dusts. 2) Restrict the cross use of equipment and supplies between locations and activities without first going through a suitable decontamination. ***Physical hazards:*** 3) All equipment to be employed will be: - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturer's design, and documented as such using Equipment Inspection Checklist provided as Attachment V. Complete the Equipment Inspection Checklist for each piece of equipment used at the site. Equipment operation will be: - Conducted by knowledgeable operators and coordinated by experienced ground crew, as applicable. - Coordinated by ground crew who will verify safety of bucket position relative to ground conditions, personnel, and drums/objects. Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e., Bucket boom + 3 feet). - All equipment shall be equipped with movement warning systems. - Employ safety belts and follow the site traffic rules. 4) All excavations shall be in conformance with requirements established under 29 CFR 1926.650 - .652 concerning sloping, shoring, storage, and movement on and over and around trenches and excavations. **- No personnel associated with this field effort will enter any excavations (including test pits).** - All supplies, clean fill, and vehicular traffic will be maintained at a minimum distance of 3 feet from the excavation, or 2 feet if a sidewall restraining device is employed. - When drums or other containers are uncovered, the excavation activities shall be halted until the SSO characterizes any site contaminants and evaluates the implications of excavating and removing the drum. - Excavations will not proceed any closer than 6 feet to any foundation, footer, and/or support base. - Whenever possible, the teeth of the bucket will have a flat bar or cutting bar attached to the teeth to prevent the teeth of the backhoe from snagging an undetected utility. - No test pit will be permitted to be left open, or unattended. - Site control during excavation will be accomplished through the use of barricade tape and weighted poles and signs indicating excavation in progress 5) All test pit operations shall be performed in accordance with the Tetra Tech NUS SOP for "Utility Locating and Excavation Clearance" (Attachment VII) All utility clearances shall be obtained prior to any excavation activities. Where the utility clearance cannot be obtained in a reasonable period, or not located, excavations shall proceed with extreme caution and proceed using cable and piping locators and other geophysical detection methods to avoid utility damage and unintentional contact with buried drums or objects. 6) Hearing protection will be worn by all personnel in the immediate area of the excavator during test pit operations. 7) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 8) Preview work locations for unstable/uneven terrain. Avoid working/walking too close to excavation and other areas of unsure footing. 9) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat stress concerns is provided in Attachment VI. 10) Avoid contacting sharp or jagged edges of containers or debris. Wear leather or cut-resistant gloves when handling sharp objects. 11) Avoid potential nesting areas of biting/stinging insects and animals. Use commercially available insect repellents. Avoid contact with poisonous vegetation. Wear appropriate clothing. Tape ankle and wrist areas to prevent ticks, chiggers, etc., from attaching themselves to your skin. Follow directions as specified in Section 4 of the Tetra Tech NUS.Health and Safety Guidance Manual. 12) Suspend or terminate operations until directed otherwise by SSO	*Continuous monitoring will be performed during operations to ensure safe work conditions do not change as a result of work being performed or other external factors. Monitoring of each excavation activity, in particular, will be performed in an attempt to anticipate and characterize site contaminants.* A direct reading Photoionization Detector (PID) with a lamp strength of 11.7eV or higher, or Flameionization Detector (FID), will be used to screen samples and to detect the presence of VOCs, SVOCs, and any other detectable contaminants. Source monitoring of the test pits will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location which may impact the field crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained readings (greater than 1 minute in duration) above background in the breathing zone of the at-risk employees requires site activities to be suspended and site personnel to report to an unaffected area. - Work may only resume if airborne readings in worker breathing zone return to background levels. If elevated readings in the worker's breathing zone persist, the PHSO and HSM will be contacted to determine necessary actions and levels of protection. Site contaminants may adhere to or be part of airborne dusts or particulates generated during site activities. Generation of dusts should be controlled to minimize the potential for inhalation of contaminated dusts and particulates. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, by avoiding dust plumes, or evacuating the operation area until dust subsides.	All test pit operations will be performed in Level D protection. Level D protection constitutes the following minimum protection - Standard field dress (long pants, sleeved shirts) - Steel toe safety shoes or boots - Hard-hat, safety glasses, and earplugs or muffs. *- Tyvek coveralls will be worn if there is a possibility of soiling work attire* *- Impermeable boot covers* *- PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire.* *- Gloves – Nitrile for handling soils and/or debris* *(These items are optional as conditions dictate)* **Note:** The Safe Work Permit(s) for this task (see Attachment III) will be issued at the beginning of each day to address the tasks planned for that day. Additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for outer protective equipment (boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the test pitting operations bordering the support zone. This decontamination procedure for Level D protection will consist of - Equipment drop - Soap/water wash and rinse of reusable PPE (e.g., splash suits), as applicable - Removal and disposal of disposable PPE items (gloves, disposable boot covers, etc) - Wash hands and face, leave contamination reduction zone.

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ATTACHMENT VII

SOP FOR UTILITY LOCATING

AND

EXCAVATION CLEARANCE

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1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations.
Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility service locating and excavation clearance. It is the policy of TtNUS to provide a safe and healthful work environment for the protection of our employees. The purpose of this SOP is to aid in achieving the objectives of the TtNUS Utility Locating and Clearance Policy. The TtNUS Utility Locating and Clearance Policy should be reviewed by anyone involved with underground or overhead utility services.

2.0 SCOPE

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of methods used to determine the presence or absence of utility services.
This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to development of detailed operating procedures. This guidance is not intended to provide a detailed description of methodology and operation. Specialized expertise during both planning and execution of several of the geophysical methods may also be required.

3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer -- A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey -- A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal detection -- A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer -- A magnetometer equipped with two sensors that are vertically separated a fixed distance apart. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar -- Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.

4.0 RESPONSIBILITIES

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with this procedure and the TtNUS Utility Locating and Clearance Policy.

Site Manager (SM) or Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standards Operating Procedures or as otherwise dictated by the approved project plan(s).

Site Health & Safety Officer (HSO) – Responsible to provide technical assistance and verify full compliance with this SOP and the TtNUS Utility Locating and Clearance Policy. The HSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager and to the Project Manager.

5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed from a buried and overhead standpoint.

5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown on client properties. The following procedure must be followed prior to beginning any excavation that might potentially be in the vicinity of underground utility services.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM is responsible for arranging for the procurement of a qualified, experienced, utility locating contractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.

2. A site inspection must be performed to compare the site plan information to actual conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation must be marked at the site in white paint or pin flags to notify personnel of the proposed excavation activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional Information regarding utility locations shall be added to project maps upon completion of this exercise.

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire on (and

comply with) property owner requirements. It is important to note that private property owners may require from several days to several weeks advance notice prior to locating utilities.

4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State "one-call" services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who are to mark their respective lines within the specified time frame.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using such methods as passive and intrusive surveys, physical probing, or hand auguring. Each method has advantages and disadvantages including complexity, applicability, and price.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment and utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed with a hand augur or pole made of non-conductive material. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.

8. All uncovered utilities must be supported. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate Health and Safety Manager. All repairs require that the line be locked-out/tagged-out prior to work.

5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be adequate to prevent employees from contacting such lines directly with any part of their body or indirectly though conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

6.0 UNDERGROUND LOCATING TECHNIQUES

6.1 Geophysical Methods

Geophysical methods include electromagnetics, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References in Section 6.0.

Electromagnetics

Electromagnetic (EM) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A good example of this type of geophysical equipment is an EM-61.

EM locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced EM surveys, simple magnetic locating and traced nonmetallic surveys.

When access can be gained to a conduit, a flexible insulated trace wire can also be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Magnetics

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's) and steel utility lines. A good example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Ground Penetrating Radar

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs.

gas, electrical vs. telephone), hence, verification is necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

6.2 Passive Detection Surveys

Acoustic Surveys

Acoustic location methods are generally most applicable to waterlines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

Thermal Imaging

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree. High-quality hand-held thermal imagers are available from $15,000 to $30,000, with prices decreasing as new systems are introduced.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to determine the exact horizontal and vertical location of utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

Hand-auger Surveys

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other physical methods, borings must be hand-augured for all locations where there is a potential to impact buried utilities. Hand auguring must be performed to depths of no less than 4 feet. The minimum hand auger depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 3 presents frost line depths for the regions of the continental United States. At a minimum, hand auger depths must be at least to the frost line depth plus two (2) feet, but never less than 4 feet below ground surface (bgs). For auguring, the hole must be reamed by hand to at least the diameter of the drill rig auger or bit prior to drilling. For soil

gas surveys, the survey probe shall be placed as close as possible to the cleared hand auger. It is important that a post-hole digger is not used in place of a hand augur.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, tile probes may be used instead of or in addition to hand augurs. Tile probes must be performed to the same depth requirements as hand augurs. Depending upon the site conditions and intended probe usage, tile probes should be made of non-conductive material such as fiberglass.

7.0 REFERENCES

TtNUS Utility Locating and Clearance Policy

TtNUS SOP GH-3.1; Resistivity and Electromagnetic Induction

TtNUS SOP GH-3.2; Magnetic and Metal Detection Surveys

TtNUS SOP GH-3.4; Ground-penetrating Radar Surveys

ATTACHMENT 1
LISTING OF UNDERGROUND UTILITY CLEARANCE RESOURCES

Alabama
Alabama Line Location (800) 292-8525
Tucson Blue Stake Center (800) 782-5348

Alaska
Locate Call Center of Alaska Inc. (800) 478-3121

Arizona
Arizona Blue Stake Inc. (800) 782-5348

Arkansas
Arkansas One Call System Inc. (800) 482-8998

California
Underground Service Alert North (800) 227-2600
Underground Service Alert South (800) 227-2600

Colorado
Utility Notification Center of Colorado (800) 922-1987

Connecticut
Call Before You Dig (800) 922-4455

Delaware
Miss Utility of Delmarva (800) 282-8555

District of Columbia
Miss Utility (800) 257-7777

Florida
Call Sunshine (800) 432-4770

Georgia
Utilities Protection Center Inc. (800) 282-7411

Idaho
Palouse Empire Underground Coordinating Council (800) 882-1974
Utilities Underground Location Center (800) 424-5555
Kootenai Country Utility Coordinating Council (800) 428-4950
Shoshone County One Call (800) 398-3285
Dig Line (800) 342-1585
One Call Concepts (800) 626-4950

Illinois
Julie Inc. (800) 892-0123
Digger (Chicago Utility Alert Network) (312) 744-7000

Indiana
Indiana Underground Plant Protection Services (800) 382-5544

Iowa
Underground Plant Location Service Inc. (800) 292-8989

Kansas
Kansas One-Call Center (800) 344-7233

Kentucky
Kentucky Underground Protection Inc. (800) 752-6007

Louisiana
Louisiana One Call (800) 272-3020

Maine
Dig Safe – Maine (800) 225-4977

Maryland
Miss Utility (800) 257-777
Miss Utility of Delmarva (800) 282-8555

Massachusetts
Dig Safe – Massachusetts (800) 322-4844

Michigan
Miss Dig System (800) 482-7171

Minnesota
Gopher State One Call (800) 252-1166

Mississippi
Mississippi One-Call System Inc. (800) 227-6477

Missouri
Missouri One Call System Inc. (800) 344-7483

Montana
Utilities Underground Location Center (800) 424-5555
Montana One Call Center (800) 551-8344

Nebraska
Diggers Hotline of Nebraska (800) 331-5666

Nevada
Underground Service Alert North (800) 227-2600

New Hampshire
Dig Safe – New Hampshire (800) 225-4977

New Jersey
New Jersey One Call (800) 272-1000

New Mexico
New Mexico One Call System Inc. (800) 321-ALERT
Las Cruces-Dona Utility Council (505) 526-0400

New York
Underground Facilities Protection Organization (800) 962-7962
New York City: Long Island One Call Center (800) 272-4480

North Carolina
The North Carolina One-Call Center Inc. (800) 632-4949

North Dakota
Utilities Underground Location Center (800) 795-0555

Ohio
Ohio Utilities Protection Service (800) 362-2764

Oil & Gas Producers Underground Protection Service (800) 925-0988

Oklahoma
Call Okie (800) 522-6543

Oregon
Utilities Underground Location Center
(800) 424-5555

Douglas Utilities Coordinating Council
(503) 673-6676

Josephine Utilities Coordinating Council
(503) 476-6676

Rogue Basin Utility Coordinating Council
(503) 779-6676

Utilities Notification Center
(800) 332-2344

Pennsylvania
Pennsylvania One Call System Inc.
(800) 242-1776

Rhode Island
Dig Safe – Rhode Island (800) 225-4977

South Carolina
Palmetto Utility Protection Service Inc.
(800) 922-0983

South Dakota
South Dakota One Call (800) 781-7474

Tennessee
Tennessee One-Call System (800) 351-1111

Texas
Texas One Call System (800) 245-4545

Texas Excavation Safety System (800) 344-8377

Lone Star Notification Center (800) 669-8344

Utah
Blue Stakes Location Center (800) 662-4111

Vermont
Dig Safe – Vermont (800) 225-4977

Virginia
Miss Utility of Virginia (800) 552-7001

Miss Utility (800) 257-7777

Miss Utility of Delmarva (800) 441-8355

Washington
Utilities Underground Location Center
(800) 424-5555

Grays Harbor & Pacific County
Utility Coordinating Council
(206) 535-3550

Utilities County of Cowlitz County
(360) 425-2506

Chelan-Douglas Utilities Coordinating Council
(509) 663-6111

Upper Yakima County
Underground Utilities Council
(800) 553-4344

Inland Empire Utility Coordinating Council
(509) 456-8000

Palouse Empire Utilities Coordinating Council
(800) 822-1974

Utilities Notification Center (800) 332-2344

West Virginia
Miss Utility of West Virginia Inc. (800) 245-4848

Wisconsin
Diggers Hotline Inc. (800) 242-8511

Wyoming
West Park Utility Coordinating Council
(307) 587-4800

Call-In Dig-In Safety Council (800) 300-9811

Fremont County Utility Coordinating Council
(800) 489-8023

Central Wyoming Utilities Coordinating Council
(800) 759-8035

Southwest Wyoming One Call (307) 362-8888

Carbon County Utility
Utility Coordinating Council (307) 324-6666

Albany County Utility Coordinating Council
(307) 742-3615

Southeast Wyoming Utilities Coordinating Council
(307) 638-6666

Wyoming One-Call
(800) 348-1030

Utilities Underground Location Center
(800) 454-5555

Converse County Utility Coordination Council
(800) 562-5561

ATTACHMENT 2
UTILITY CLEARANCE FORM

Project No.: _____ Completed by: _____

Site Location: _____ Work Date: _____

Excavation Method/Overhead Equipment: _____

			Circle One
1.	Underground Utilities		
	a)	Review of existing maps?	yes no N/A
	b)	Interview local personnel?	yes no N/A
	c)	Site visit and inspection?	yes no N/A
	b)	Excavation areas marked in the field?	yes no N/A
	e)	Utilities located in the field?	yes no N/A
	f)	Located utilities added to site maps?	yes no N/A
	g)	State One-Call agency called?	yes no N/A
		Caller: _____	
		Ticket Number: _____ Date: _____	
	h)	Geophysical survey performed?	yes no N/A
		Survey performed by: _____	
		Method: _____ Date: _____	
	i)	Hand auguring performed?	yes no N/A
		Auguring completed by: _____	
		Total depth: _____ feet Date: _____	
	j)	Trench/excavation probed?	yes no N/A
		Probing completed by: _____	
		Depth/frequency: _____ Date: _____	
2.	Overhead Utilities		Present Absent
	a)	Determination of nominal voltage	yes no N/A
	b)	Marked on site maps	yes no N/A
	c)	Necessary to lockout/insulate/re-route	yes no N/A
	d)	Document procedures used to lockout/insulate/re-route	yes no N/A
	e)	Minimum acceptable clearance (SOP Section 5.2): _____	

6. Approval:

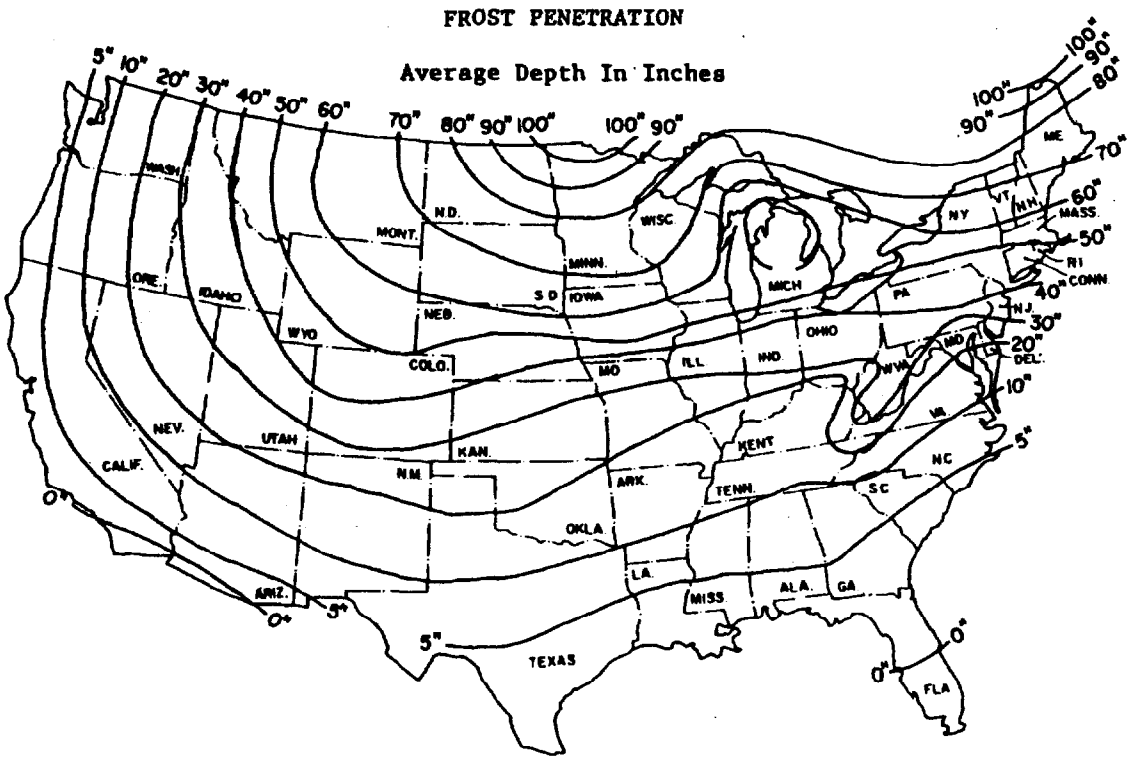
_____ _____

Site Manager/Field Operations Leader Date

cc: PM/Project File
Program File

ATTACHMENT 3

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

ATTACHMENT VIII

INJURY/ILLNESS PROCEDURE

AND REPORT FORM

CASE NO. _____

TETRA TECH NUS, INC.

INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:

- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room.
- If incident involves a chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Diethorn at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours. You will be required to complete an Injury/Illness Report (attached). You may also be required to participate in a more detailed investigation from the Health Sciences Department.
- If further medical treatment is needed, The Hartford Network Referral Unit will furnish a list of network providers customized to the location of the injured employee. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work. Please call Marilyn Diethorn at (412) 921-8475 for the number of the Referral Unit.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local human resources representative, corporate health and safety coordinator, or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries (Tetra Tech or Company) pay premiums on behalf of their employees. The type of injuries or illnesses covered and the amount of benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

CASE NO. _____

WHO IS COVERED:

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits. All employees must follow the above injury/illness reporting procedures. Consultants, independent contractors, and employees of subcontractors are not covered by Tetra Tech's Worker's Compensation plan.

WHAT IS COVERED:

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported. Please note that if you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

CASE NO. _____

TETRA TECH NUS, INC.
INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

To: Corporate Health and Safety Manager
Human Resource Administrator

Prepared by: _____

Position: _____

Project Name: _____

Office: _____

Project No. _____

Telephone: _____

Information Regarding Injured or Ill Employee:

Name: _____

Office: _____

Home address: _____

Gender: M ☐ F ☐ No. of dependents: _____

_____

Marital status: _____

Home telephone: _____

Date of birth: _____

Occupation (regular job title): _____

Social Security No.: _____

Department: _____

Date of Accident: _____

Time of Accident: _____

Location of Accident Was place of accident or exposure on employer's premises Yes ☐ No ☐

Street address:

City, state, and zip code: _____

County: _____

Narrative Description of How Accident Occurred: (Be specific. Explain what the employee was doing and how the accident occurred.)

TETRA TECH, INC.
INJURY/ILLNESS REPORT

Did employee die? Yes ☐ No ☐
Was employee performing regular job duties? Yes ☐ No ☐
Was safety equipment provided? Yes ☐ No ☐
Was safety equipment used? Yes ☐ No ☐
Note: Attach any police reports or related diagrams to this accident report.

Witness(es):

Name:

Address:

Telephone:

Describe the Illness or Injury and Part of Body Affected:

Name the Object or Substance which Directly Injured the Employee:

Medical Treatment Required:

☐ No ☐ Yes ☐ First Aid Only

Physician's Name: _____

Address: _____

Hospital or Office Name: _____

Address: _____

_____

Telephone No.: _____

Lost Work Days:

☐ No. of Lost Work Days _____

Last Date Worked _____

Time Employee Left Work _____

Date Employee Returned to Work _____

☐ No. of Restricted Work Days _____

☐ None

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: _____

Date of Report: _____ Time of Report: _____

	Printed Name	Signature	Telephone No.	Date
Project or Office Manager				
Site Safety Coordinator				
Injured Employee				

To be completed by Human Resources:

Date of hire: Hire date in current job:

Wage information: $ _____ per _____ (hour, day, week, or month)

Position at time of hire:

Shift hours:

State in which employee was hired:

Status: ☐ Full-time ☐ Part-time Hours per week: _____ Days per week: _____

Temporary job end date:

To be completed during report to workers' compensation insurance carrier:

Date reported: Reported by:

TeleClaim phone number:

TeleClaim account number:

Location code:

Confirmation number:

Name of contact:

Field office of claims adjuster:

Rev. 0
03/27/98

Health and Safety Plan
for
Site/SWMU 1 - Incinerator Landfill
Site/SWMU 2 - Borrow Pit Landfill
Site/SWMU 3 - Causeway Landfill
Site/SWMU 15 - Dirt Roads and
SWMU 41 - Former Incinerator

Marine Corps Recruit Depot
Parris Island, South Carolina
U.S. EPA Identification Number
SC6 170 022 762

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0020

March 1998

Rev. 0
03/27/98

HEALTH AND SAFETY PLAN
FOR
SITE/SWMU 1 - INCINERATOR LANDFILL
SITE/SWMU 2 - BORROW PIT LANDFILL
SITE/SWMU 3 - CAUSEWAY LANDFILL
SITE/SWMU 15 - DIRT ROADS AND
SWMU 41 - FORMER INCINERATOR

MARINE CORPS RECRUIT DEPOT
PARRIS ISLAND, SOUTH CAROLINA
U.S. EPA IDENTIFICATION NUMBER
SC6 170 022 762

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Brown & Root Environmental
661 Andersen Drive
Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0020

MARCH 1998

APPROVED BY:

MARK SPERANZA, P.E.
TASK ORDER MANAGER
BROWN & ROOT ENVIRONMENTAL
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

FOR:

MATTHEW M. SOLTIS, CIH, CSP
CLEAN HEALTH AND SAFETY MANAGER
BROWN & ROOT ENVIRONMENTAL
PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

The objective of this Health and Safety Plan (HASP) is to provide the minimum safety practices and procedures for Brown & Root Environmental (B&R Environmental) and subcontractor personnel engaged in proposed Remedial Investigation (RI) activities that are to be conducted at the Marine Corps Recruit Depot (MCRD) Parris Island, South Carolina.

This HASP has been prepared using the latest available information regarding known or suspected chemical contaminants and potential and foreseeable physical hazards associated with the proposed work at the various sites identified at the MCRD facility. This HASP has been designed to be used in accordance with the Brown & Root Environmental Health and Safety Guidance Manual. The Guidance Manual provides detailed information pertaining to procedures to be performed on site as directed by the HASP, as well as B&R Environmental standard operating procedures. The Health and Safety Guidance Manual and this HASP must both be present at the site to comply with the requirements stipulated in the Occupational Safety and Health Administration (OSHA) standard 29 CFR 1910.120.

This HASP has been written to support proposed tasks and techniques associated with the scope of work as presented in Section 3.0. Should the proposed work site conditions and/or suspected hazards or if new information becomes available this document will be modified. All changes to the HASP will be made with the approval of the B&R Environmental CLEAN Health and Safety Manager (HSM) and the Project Manager (PM). The PM will notify all affected personnel of all changes. Revision indicators within the plan and Section 15.0 Document Status will record all changes to this plan.

The elements of this HASP are in compliance with the requirements established by OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER) and sections of 29 CFR 1926, "Safety and Health Regulations for Construction." The information contained in this plan, as well as policies on conducting on site operations, have been obtained from the B&R Environmental Health and Safety Program and MCRD policies and procedures.

1.1 AUTHORITY

This Contract Task Order (CTO) 0020 and the requirements setforth represent an integral part of an overall effort conducted under the Comprehensive Long - Term Environmental Action Navy (CLEAN) contract, administered through the U.S. Navy Southern Division Naval Facilities Engineering Command, as defined under Contract No. N62467-94-D-0888.

1.2 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for B&R Environmental and subcontractor employees engaged in on site activities. Personnel assigned to these positions shall exercise the primary responsibility for all on site health and safety. These persons will be the primary point of contact for any questions regarding the safety and health procedures and the selected control measures.

- The B&R Environmental Task Order Manager (TOM) is responsible for the overall direction and implementation of health and safety for this project.

- The B&R Environmental Field Operations Leader (FOL) is responsible for implementation of this HASP with the assistance of an appointed Site Safety Officer (SSO). The FOL manages field activities, executes the work plan, and enforces safety procedures, as applicable to the work plan.

- The SSO supports site activities by advising the FOL on all aspects of health and safety on site. These duties may include the following:

  - Coordinates all health and safety activities with the FOL.
  - Selects, inspects, implements, and maintains personal protective equipment.
  - Establishes work zones and control points.
  - Directs and assists in the development of decontamination areas and procedures.
  - Implements air monitoring program in support of on site activities.
  - Verifies training and medical status of on site personnel status in relation to site activities.
  - Implements hazard communication, respiratory protection, and other associated safety and health programs, as necessary.
  - Coordinates emergency services.
  - Provides site-specific training for all on site personnel.

- Compliance with these requirements is monitored by the Project Health and Safety Officer (PHSO) and is coordinated through the Health and Safety Manager.

1.3 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Marine Corps Recruit Depot **Address:** Parris Island, South Carolina

Site Point of Contact: _____ **Phone Number:** _____

Purpose of Site Visit: This activity will be divided into a multi-task operation performed sequentially through the execution of the elements as defined in the scope of work (See Section 4.0).

Proposed Dates of Work: TBD

Project Team:

B&R Environmental Personnel:	Discipline/Tasks Assigned:
Mark Speranza, PE	Task Order Manager (TOM)
TBD	Field Geologist
Matthew M. Soltis, CIH, CSP	Health and Safety Manager (HSM)
TBD	Site Safety Officer (SSO)
Donald J. Westerhoff, CSP	Project Health and Safety Officer (PHSO)

Non-B&R Environmental Personnel	Affiliation/Discipline/Tasks Assigned
TBD	
TBD	

Prepared by: Donald J. Westerhoff, CSP

Reviewed and Approved by:

Mark P. Speranza

Mark Speranza, PE
Project Manager

Fax:

Matthew M. Soltis, CIH, CSP
CLEAN Health & Safety Manager

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a preplanning effort to direct and guide field personnel in the event of an emergency. Since a majority of potential emergency situations will require assistance from outside emergency responders, B&R Environmental and subcontractor personnel will not provide emergency response support for emergency events beyond the capabilities of on site personnel. In the event of emergencies that cannot be handled by on site personnel, an evacuation will be initiated. In an evacuation, site personnel will move to a safe place of refuge and the appropriate emergency response agencies will be notified. The emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the area of operations, which ensures adequate emergency response time. This emergency action plan conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as allowed in OSHA 29 CFR 1910.120(l)(1)(ii).

B&R Environmental personnel will through the necessary actions provide incidental response measures for incidents such as:

- Incipient spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provision of initial medical support for injury/illnesses requiring only first-aid level support
- Provision of site control and security measures, as necessary

2.2 PRE-EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, injury or illnesses resulting from exposure to chemical or physical hazards or fire are the most probable emergencies that could be encountered during site activities. To minimize and eliminate these potential emergency situations, pre-emergency planning activities associated with this project shall be implemented. The SSO and/or the FOL are responsible for:

- Coordinating response actions with MCRD, Parris Island Emergency Services personnel to ensure that B&R Environmental emergency action activities are compatible with existing facility emergency response procedures.

- Initial site inspection and preparation of investigation areas prior to sending equipment and personnel in to initiate proposed activities. In this manner potential physical hazards can be identified, blocked or barricaded, or removed prior to exposing field personnel.

- Periodic site safety surveys of work activities performed by B&R Environmental FOL and/or the SSO, and subcontractor supervisory representative to identify potential hazards and emergency situations.

- Establishing and maintaining information at the project staging area (support zone) for easy access in the event of an emergency. This information will include the following:

  - Chemical Inventory List (for substances used on site), with Material Safety Data Sheets.
  - On site personnel medical records (medical data sheets).
  - A logbook identifying personnel on site each day.
  - A copy of this HASP.
  - A copy of the B&R Environmental Health and Safety Guidance Manual.

- Identifying a chain of command for emergency action.

- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.

- Drilling and practicing incidental response measures periodically.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

Foreseeable emergency situations that may be encountered during site activities will generally be recognizable by visual observation. Visual observation will be the principal method of identifying physical hazards that may be associated with the proposed scope of work. Visual observation may also play a role in detecting some chemical exposures. A clear knowledge of signs and symptoms of chemical overexposures will provide the information to on site personnel of what to expect and what symptoms may be evident in the event an overexposure takes place. These potential hazards, the activities with which they have been associated, and the recommended control methods are discussed in detail in Sections 5.0 and 6.0 of this document. Additionally, as stated above, early recognition will be supported by periodic

site surveys to eliminate any situation predisposed to an emergency. The FOL, SSO, and subcontractor supervisory personnel will constitute the site evaluation team responsible for these periodic surveys. Site surveys will be conducted at least once a week during the initiation of this effort.

The above actions will provide for the early recognition of potential emergency situations. B&R Environmental will only provide incipient stage (i.e., early stage spill response) support. Should an incident take place, B&R Environmental may take defensive measures to control these situations depending on the nature and extent of the incident. However, if the FOL and the SSO determine that an incident has progressed to a serious emergency situation, B&R Environmental will withdraw, and notify the appropriate response agencies using Table 2-1.

2.3.2 Prevention

B&R Environmental and subcontractor personnel will minimize the potential for emergencies by ensuring compliance with the HASP, the Health and Safety Guidance Manual, applicable OSHA regulations, and by following directions given by those persons responsible for the health, safety, and welfare of the field crews.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

In the event that the site must be evacuated, all personnel will immediately stop activities and report to a safe place of refuge at the support zone area. The safe place of refuge may also serve as the telephone communication point, as communication with emergency response agencies may be necessary. Telephone communication points and safe places of refuge will be determined prior to the commencement of site activities and will be conveyed to personnel as part of issuing the Safe Work Permits to be issued for all exclusion zones activities on a daily basis. Places of refuge and evacuation routes are identified in Section VII, of the Safe Work Permit (See Section 9.4). Upon reporting to the refuge location, personnel will remain there until directed otherwise by the B&R Environmental FOL, SSO, or the On-Scene Incident Commander. The FOL or the SSO will take a head count at this location to confirm the presence of all site personnel. The site logbook will be used to take the head count. Emergency response agencies will be notified of any unaccounted for personnel.

TABLE 2-1
EMERGENCY REFERENCE
MCRD PARRIS ISLAND, SOUTH CAROLINA

AGENCY	TELEPHONE
EMERGENCY (Fire, Police, and Ambulance)	911
Hospital: Beaufort Memorial Hospital	(803) 522-5200
Provost Marshall's Office	(803) 525-2478
Facility Point of Contact Harold (Dean) Bradley, NREAO	(803) 525-2630
Chemtrec National Response Center	(800) 424-9300 (800) 424-8802
B&R Environmental, Pittsburgh Office	(412) 921-7090
Health and Safety Manager Matthew M. Soltis, CIH, CSP	(412) 921-8912
Project Health and Safety Officer Donald J. Westerhoff, CSP	(412) 921-7281
Task Order Manager, Mark Speranza, PE	(412) 921-8916
Maintenance (Emergency) Maintenance Division, Utilities Branch	(803) 525-3145 (803) 525-3405
Navy Remedial Project Manager, Art Sanford	(803) 820-7482

2.5 EVACUATION ROUTES AND PROCEDURES

Once an evacuation is initiated, personnel will terminate site activities and proceed immediately to the designated place of refuge as identified on the Safe Work Permit for activities conducted within that area, unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to a designated alternate location and remain there until further notification from the FOL. The use of these locations as assembly points provides communication and a direction point for emergency services, should they be needed.

Evacuation procedures will be discussed prior to the initiation of any work at the site. Primary and secondary evacuation routes will be conveyed to site personnel each day as part of issuing the Safe Work Permits for a particular task and area. Evacuation routes from the site are dependent upon the location at which work is being performed and the circumstances under which an evacuation is required. Additionally, site location and meteorological conditions (i.e., wind speed and direction) will influence the designation of evacuation routes. As a result, assembly points will be selected, and will be proceeded to by field personnel in the event of an emergency by the most direct route possible without further endangering themselves.

2.6 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT

During any site evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. Decontamination will not be performed if the incident warrants immediate evacuation. However, it is unlikely that an evacuation would occur which would require workers to evacuate the site without first performing the necessary decontamination procedures.

2.7 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

Since B&R Environmental personnel will not always be working in close proximity to each other, hand signals, voice commands, air horns, and two-way radios will comprise the mechanisms to alert site personnel of an emergency.

If an incident occurs, site personnel will initiate the following procedures:

- Initiate incident alerting procedures (if needed) verbally, by air horn, or using two-way radios.

- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and as many details as possible. Once all personnel are evacuated, incipient response procedures will be enacted to control the situation.

- If the FOL and/or the SSO determine that the situation is beyond the capabilities of the site personnel emergency services will be contact using the emergency reference information listed in Table 2-1. Explain the situation and the appropriate emergency services will be dispatched. **Stay on the phone follow the instructions of the emergency dispatcher.**

2.8 PERSONAL PROTECTIVE EQUIPMENT (PPE) AND EMERGENCY EQUIPMENT

A first-aid kit, stretcher, fire extinguishers (strategically placed), and fire blanket will be maintained on site and shall be immediately available for use in the event of an incident. The PPE used in support of everyday activities will serve as the first line of defense in an emergency. This PPE will be required in all work areas of the site and will be accessible to authorized personnel.

2.9 EMERGENCY CONTACTS

Prior to performing work at the site, all personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. A mobile phone shall be available on site, if a telephone communications point near the area of operation is not available or if telephone service to the site trailer is not provided. As indicated earlier, Table 2-1 provides a list of emergency contacts and their corresponding telephone numbers. This table must be posted on site where it is readily available to all site personnel.

2.10 EMERGENCY ROUTE TO HOSPITAL

The closest hospital to MCRD is Beaufort Memorial Hospital in Beaufort, South Carolina. Area maps showing the proximity of the MCRD to the hospital shall be incorporated into this HASP as in Figure 2-1. Directions to the hospital is provided below:

Beaufort Memorial Hospital:

- Leave the island by way of Malecon Drive, over Archers Creek and across the Causeway.
- Exit the Main Gate and proceed east over Battery Creek (Bell Memorial Bridge) onto Ribaut Road.
- Proceed approximately three (3) miles north on Ribaut Road to the hospital.
- Follow signs to entrance of Beaufort Memorial Hospital.

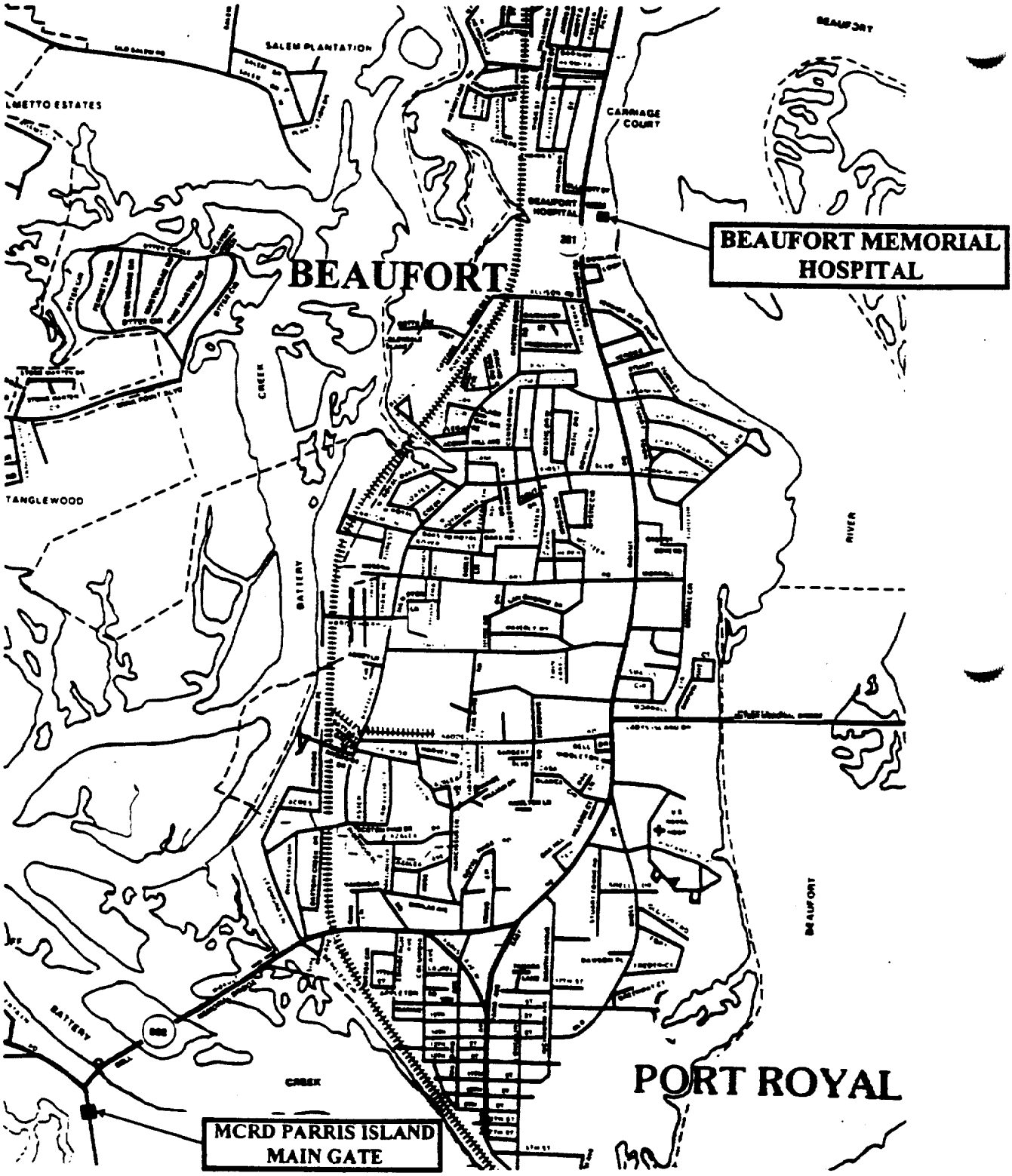

FIGURE 2-1

EMERGENCY ROUTE

MCRD PARRIS ISLAND

3.0 SITE BACKGROUND

3.1 FACILITY HISTORY

The MCRD Parris Island is located approximately 3 miles south of the city of Beaufort, South Carolina. MCRD Parris Island was placed on the United Sates Environmental Protection Agency's (U.S. EPA's) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) in January of 1995, primarily dye to the presence of unlined landfills placed in direct contact with surrounding wetlands. Additional information regarding site background is contained in the Volume I Master Work Plan (Master Project Plan).

3.2 SITE DESCRIPTIONS/SITE ACTIVITIES

3.2.1 Site 1 - Incinerator Landfill and Site 41 - Former Incinerator

Site 1 - Incinerator Landfill is located on the northeastern tip of Horse Island at MCRD Parris Island. The landfill extends approximately 670 feet into the marsh toward Archers Creek and is approximately 400 feet in width. The landfill occupies approximately 4 acres and is currently covered with mature pine trees.

Site 41 - Former Incinerator is located to the south of Site 1. The former incinerator unit consisted of a coal-fired brick chamber approximately 43 feet long, 34 feet tall, and 20 feet wide. Emissions were vented through a hole in the top of the chamber. A ramp was situated along one of the unit's sides to provide access to the top of the incinerator. Trucks carried wastes up the ramp and discharged them into the hole.

When the incinerator began operations in 1921, a small piece of land behind the incinerator jutted out into the marsh to the north of Malecon Drive. From 1921 to 1965, Site 1 served as the disposal site for combustion residues from the incinerator, formerly located adjacent to the landfill. The majority of wastes disposed of in the landfill during this time were nonhazardous, combustible domestic wastes (ash residues) and other noncombustible wastes (e.g., cans, bottles, and construction debris). Additionally, hazardous wastes generated from the MCRD from 1921 to 1959 were treated in the incinerator and disposed of in the landfill. Paint thinners (mineral spirits), diesel fuels, kerosene, and strippers (methylene chloride) were also poured onto the landfill and burned (NEESA, 1986). No auxiliary fuels were used for open burning.

Wastes were initially piled on the land or placed in trenches into the marsh, extending the edge of the landfill further into the marsh. Fill dirt was also used to build up the land at the edge of the marsh. The landfill progressively extended farther into the marsh as wastes were dumped on the edge of the fill. Site 41 remained in operation until 1959. Site 1 continued to be used for disposal of combustible trash and noncombustible waste until 1965. Since 1965, no significant disposal or intrusive activity has taken place within the boundaries of Sites 1 and 41.

Field operation activities at these sites will include soil boring installation and soil sampling, monitoring well installation, surface water and sediment sampling, groundwater sampling, and other miscellaneous activities including slug tests, water-level measurements, site surveying, equipment decontamination, waste handling, and site restoration.

3.2.2 Site 2 - Borrow Pit Landfill

Site 2 - Borrow Pit Landfill is a landfill that was in operation from 1965 to 1968. It is located in the central portion of Horse Island, in the north section of MCRD Parris Island. The southwest border of the landfill is located approximately 100 feet from a marsh area. The landfill occupies approximately 1.9 acres and is currently covered with mature pine trees. The water table is approximately 15 to 17 feet below ground surface.

In the 1960s, Site 2 consisted of a pit that had been dug to provide fill dirt for the base. When waste disposal at the Borrow Pit Landfill was initiated, the unlined pit consisted of a hole approximately 10 feet deep. The landfill served as the disposal site for domestic trash, construction debris, solid paint wastes, cleaning rags (contaminated with oil, mineral spirits, and kerosene), spent absorbent, solvent sludge (aliphatic petroleum and chlorinated solvent compounds), perchloroethylene still bottoms, metal shavings, PCB-contaminated oil, mercury amalgam, and beryllium wastes from the MCRD from 1966 to 1968. An estimated 33,000 tons of solid waste refuse and 16 tons of solid paint wastes were disposed in this landfill during the period of operation. Most of the wastes were located in the central and eastern portions of Site 2 (NEESA, September 1986). Liquid paint wastes including thinners (mineral spirits, kerosene, and diesel fuel) and stripper (methylene chloride) were also brought to this landfill by paint shop personnel and burned. During the three year period, approximately 2,800 gallons of liquid paint wastes were burned annually in this landfill (NEESA, September 1986). The landfill was the facility's primary landfill after the termination of operations at the Site 1 - Incinerator Landfill and the temporary suspension of operations at the Site 3 - Causeway Landfill. When the landfill operations were terminated, the pit was approximately half filled with wastes, and was approximately 6 feet deep. Since 1968, no significant disposal or intrusive activity has taken place at Site 2.

Field operation activities at these sites will include soil boring installation and soil sampling, monitoring well installation, surface water and sediment sampling, groundwater sampling, and other miscellaneous activities including slug tests, water-level measurements, site surveying, equipment decontamination, waste handling, and site restoration.

3.2.3 Site 15 - Dirt Roads

Site 15 is approximately 1.5 miles of dirt road accessing Elliott's Beach and 0.5 miles of road accessing the Borrow Pit Landfill. In the past, the MCRD routinely sprayed the Depot's dirt and gravel roads with oils to reduce dust. From about 1918 until 1966, waste lube oil, cutting oil, petroleum-based solvents (kerosene, gasoline, mineral spirits), hydraulic fluids, and water-based coolants were transported by roads and grounds personnel from various depot shops and sprayed on Depot roads for dust suppression. From 1918 to 1940, an estimated 11,000 gallons were sprayed on all Depot roads, the majority of which was applied during the 1930s. Most of the Depot roads were paved in the 1940s. However, from the early 1940s to 1966, approximately 16,200 gallons of waste oils and hydraulic fluids continued to be applied to the dirt roads accessing Elliott's Beach and the Borrow Pit Landfill. Most of the dirt road accessing Elliott's Beach was recently paved and only 0.25 miles of dirt road remains.

Field operation activities at these sites will include soil boring installation and soil sampling, monitoring well installation, surface water and sediment sampling, groundwater sampling, and other miscellaneous activities including slug tests, water-level measurements, site surveying, equipment decontamination, waste handling, and site restoration.

3.2.4 Site 3 - Causeway Landfill

Site 3 is an integral part of a causeway connecting Horse Island and Parris Island, in the north section of MCRD Parris Island. The causeway is a gravel, two-lane road, consisting of alternate layers of solid waste and fill dirt constructed along a tidal marsh of the Broad River (across Ribbon Creek). At two locations along the causeway, three concrete pipes are buried beneath the causeway to allow tidal movement between the surface water bodies separated by the unit.

The Causeway Landfill (Site 3) functioned as the major disposal area for trash and other materials discarded in dumpsters around the MCRD during most of the period between 1960 and 1972. Between 1960 and 1965, this landfill received approximately 75 percent of the solid waste generated by the Depot. The remainder was disposed at Site 1, Incinerator Landfill, which was also in operation during that period.

The site was inactive between 1966 and 1968. Between 1969 and 1972, the site received all of the Depot's solid waste. The solid waste disposed at the site included empty pesticide containers, oily rags, spend absorbent, petroleum and chlorinated solvent sludge, perchloroethylene still bottoms, mercury amalgam and beryllium waste, polychlorinated-biphenyl (PCB)-contaminated oil, and metal shavings. In 1972, landfilling operations ceased at Site 3.

The causeway was constructed in two separate sections across a tidal marsh of the Broad River. One section began from the northeast edge of Horse Island, and was built primarily with fill dirt taken from the borrow pits on Horse Island. Some solid wastes were also reportedly placed in this section of the causeway. The other section started near the southern end of Talasesa Street on Parris Island, and was built with both the solid waste mentioned in the previous paragraph and fill dirt. Examination of aerial photos taken in 1951, 1965, and 1972 illustrate that the two sections of causeway gradually extended into the marsh until they met in 1972. Reproductions of these photographs are provided in Appendix A. At its completion in 1972, the causeway was approximately 10 acres in size, 4,000-feet long, 100-feet wide.

4.0 SCOPE OF WORK

This section of the HASP addresses all proposed site activities that are to be conducted at the MCRD, Parris Island facility. This site-specific HASP, particularly Table 5-1, provides information related to each of those tasks to be performed as part of the scope of work. If other tasks, other than those identified, are to be performed at this site this HASP will have to be modified.

The activities to be conducted as part of the scope of work include mobilization and demobilization; soil borings; monitoring well installations; subsurface soil samples collected with split-spoon samplers; surface water and sediment sampling; groundwater sampling; and other miscellaneous activities including slug tests, water-level measurements, site surveying, equipment decontamination, waste handling, and site restoration.

The above listings represent a summary of the identified tasks as they apply to the scope and application of this HASP. For a more detailed description of associated tasks see the Work Plan (WP) or the Implementation Plan.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
FOR MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SOUTH CAROLINA
PAGE 1 OF 5

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Air Monitoring Type/Action Levels	Personal Protective Equipment	Decontamination Procedures
Mobilization/ Demobilization	***Chemical hazards:*** Exposure to potential site contaminants is not anticipated during this activity. However, chemicals brought on site in support of field activities are to be identified, logged, accompanied by an appropriate MSDS, properly stored, and evaluated for purposes of hazard communication. ***Physical hazards:*** Potential physical hazards associated with this task may include: 1) Lifting (muscle strains and pulls) 2) Pinches and compressions 3) Slip, trips, and falls 4) Moving machinery 5) Biological hazards (Insect/animal bites and stings)* 6) Vehicular and foot traffic *The biological hazard concern may exist for all site tasks.	***Chemical Hazards:*** To eliminate potential chemical hazards associated with this task ensure the following: - A chemical inventory list is generated for all chemical brought on site (Complete Section 5.0 of the B&R Health and Safety Guidance Manual). - Material Safety Data Sheets must be available for all chemicals brought on site (Complete Section 5.0 of the B&R Health and Safety Guidance Manual). - Materials are stored in accordance with recommended practices and according to compatibility (See MSDS for storage and compatibility recommendations). ***Physical hazards:*** 1) Employ machinery or multiple personnel for heavy lifts. - Use proper lifting techniques. 2) Use pinch bars or other equipment to keep hands from pinch points. 3) Preview and prepare work locations where unstable/uneven terrain exists. Barricade all excavations deeper than 2 feet from access closer than two feet from the edge from foot and vehicular traffic. 4) All equipment to be employed will be - Inspected in accordance with OSHA, and manufacturers design. The inspection will include the completion of the Equipment Record Sheet documenting the review and acceptance/failure of safety devices, guards, emergency stops. The Equipment Record Sheet may be found in Section 10.0 of the B&R Environmental Health and Safety Guidance Manual. - Operated by knowledgeable operators, and knowledgeable ground crew, as applicable. - Establish safe zones of approach (i.e. Boom + 3 feet). - Secure all loose articles to avoid possible entanglement. 5) Avoid insect nesting areas, employ repellents. Report potential hazards to the SSO. Frequently inspect clothing and persons during and after activities in wooded areas for ticks and other vectors. 6) Identify all access/egress routes and locations to within established areas of operation. - All equipment capable of self propelled movement will be equipped with movement alarms as applicable. - Traffic regulations for MCRD are to be followed as posted. - Traffic regulations for B&R Environmental, operational areas will be posted by the SSO as required.	Not required during mobilization/demobilization.	Mobilization/demobilization activities is intended to initiate and proceed in Level D protection Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants; or coveralls) - Safety shoes (Boots with steel toe) - Safety glasses - Hardhat (when overhead hazards exists, or identified as an operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, or as directed on an operation by operation scenario. As a general rule of thumb, if you need to raise your voice to be heard while engaged in conversation with someone who is within 2 feet of your position you may be exposed to excessive noise levels and should employ hearing protection until the SSO can quantify the potential hazard through sound level measurements or noise dosimetry. (Note: If the use of hearing protection becomes necessary, the SSO must implement a site Hearing Conservation Program, using section 6 of the Brown & Root Environmental Health and Safety Guidance Manual.) **Note:** The Safe Work Permit(s) (See Section 9.4) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	As potential site contaminants are not anticipated as part of this task, personal decontamination is not required. All equipment arriving/leaving the site will be inspected prior to permitting this equipment to enter or exit the site. The SSO will inspect the equipment and give the clearance to allow the equipment to pass. Failure to pass inspection will prohibit entering or exiting the site as applicable. All equipment which fails the inspection will have to be decontaminated again to a level acceptable to the SSO prior to passage on or off site. All equipment permitted to pass on/off site will be documented. this may be accomplished using an Equipment Record Sheet provided in section 10.0 of the B&R Environmental Health and Safety Guidance Manual.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
FOR MARINE CORPS RECRUIT DEPOT, PARRIS ISLAND, SOUTH CAROLINA

Tasks/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Soil Borings/ Monitoring Well Installations	***Chemical hazards*** 1) Air/particulate/water borne contaminants including but not limited to, - various metals (lead, chromium, mercury amalgam, and beryllium) paint and solvent wastes including aliphatic petroleum and chlorinated solvent compounds (methylene chloride, perchloroethylene), PCB contaminated oils, diesel fuel and kerosene and miscellaneous domestic trash, and construction debris. 2) Transfer of contamination into clean areas or onto persons ***Physical hazards*** 3) Rotating machinery (entanglement) 4) Noise 5) Energized systems 6) Lifting 7) Slips, trips, and falls 8) Traffic hazards 9) Biological hazards (see sampling entry on page 3 of 5 for controls)	***Chemical hazards*** 1) Use real-time monitoring instrumentation, action levels, personal sampling, and identified PPE to control exposures to potentially contaminated media (e.g., air, water, soils, etc.). - Identify and physically barricade operational zones where potential contamination may exist to prevent incidental contact and transfer outside of the operational area. 2) Decontaminate all equipment and supplies between drilling events and prior to leaving the site. ***Physical hazards*** 3) All equipment to be used will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design and documented as such using Equipment Record Sheet (See Section 10.0 of the B&R Environmental Health and Safety Guidance Manual. - Operated by Certified operators, and knowledgeable ground crew. - Only manufacturer approved equipment may be used in conjunction with equipment repair procedures (i.e., pins for auger flights etc.). In addition to the equipment considerations, the following standard operating procedures will be employed: - All personnel not directly supporting the drilling operation will remain at least 25 feet from the point of operation. - All loose clothing/protective equipment will be secured to avoid possible entanglement. - Hand signals will be established prior to the commencement of drilling. - The Driller and helper can simultaneously handle moving augers or flights only when there is a standby person to activate the emergency stop device. - The Driller must never leave the controls while tools are rotating unless all personnel are clear of the rotating equipment. - A long handled shovel or equivalent shall be used to clear away drill cuttings from the hole and rotating equipment. Hands or feet shall **not** be used for this purpose. - A remote sampling device must be used to sample drill cuttings near rotating tools. The Driller shall shutdown operations if the sampler is near the tools. - Never climb a drill mast while equipment is rotating. - Use ANSI approved fall protection (i.e., belts, lanyards and a fall protection slide rail) or portable ladders which meet OSHA requirements when climbing drill masts. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to insure its operational status. - Areas will be inspected prior to the movement of drill rigs and support vehicle to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - Drill rigs and support vehicles will be moved no closer to banks, ditches, and other excavations than 3 feet unless the wall is supported. 4) Excessive noise levels will be mitigated through the use of hearing protection. Any piece of equipment or operation that has the potential to generate excessive noise levels (You must raise your voice to speak to someone within two feet of where you are standing) will require hearing protection until sound level measurements and/or noise dosimetry may be conducted to quantify the associated noise levels. 5) All utility clearances shall be obtained in writing prior to subsurface activities. The locations of all underground utilities will be identified and marked prior to all subsurface investigations. Where the clearance cannot be obtained in a reasonable period, or not located, drilling shall proceed with extreme caution using a magnetometer for periodic downhole surveys to at least 6 feet. - Drilling, drill masts or other projecting devices shall be at least 20 feet from overhead power lines and a minimum of 3 feet from identified underground locations. 6) Employ machinery or multiple personnel for heavy lifts. - Use proper lifting techniques. 7) Work areas will be kept clear of clutter. 8) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom + 3 feet). - All equipment shall be equipped with movement warning systems. - All personnel working in high equipment traffic areas are required to wear reflective vests for high visibility. - Employ safety belts and follow the site traffic rules. Traffic patterns will be dictated supporting on site activities. However, regulated patterns in and about the work zones and support thereof will be established to safely control the flow patterns of mechanized vehicles and pedestrians.	Direct reading instrument such as photoionization detectors with an 11.7 eV lamp source or flame ionization detectors will be used to detect potential volatile compounds including chlorinated hydrocarbons and constituents of fuels, solvents and paint products. **Elevated airborne concentrations impacting the field crews or downwind receptors are not anticipated. The following information is provided as a contingency action only.** These instruments will only be employed as a screening devices to be employed in the following manner: 1) Source monitoring of the borehole and split-spoon samples will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source or downwind location(s) which may impact operations crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained reading above background in the breathing zone of the at-risk employees will require site activities to be terminated until breathing zone readings return to background levels or the contaminant of concern is identified through additional monitoring activities (i.e., Dräger tubes). Many of the potential contaminants of concern are solid at ambient temperatures. Therefore, control of potential exposures to airborne particulates will be facilitated through engineering controls (e.g., using water to suppress airborne contaminant laden dust and particulates) and/or PPE. 2) The SSO may perform noise dosimetry to ensure the drilling, and any contributing levels associated with the operation do not surpass the noise attenuation factors associated with the hearing protection selected. If excessive noise levels are measured, or if hearing protection use becomes necessary, the SSO must institute a site-specific Hearing Conservation Program (see section 6 of the B&R Environmental Health and Safety Guidance Manual. 3) When utilities cannot be identified a procedure permitting downhole magnetometer surveys every 2 feet to a total of 6 feet.	All drilling and monitoring well installation operations are to be initiated in Level D protection. Level D protection constitutes the following minimum protection: - Standard field dress (Long pants and sleeved shirts - Steel toe safety shoes These following items will be incorporated during drilling operations: - Nitrile gloves with a cotton liner, - Hardhat, safety glasses, *and earplugs or muffs.* *- Tyvek coveralls will be worn if there is a possibility of soiling work attire* *- Impermeable boot covers* *- PVC or PE coated Tyvek will be incorporated if there is a potential for saturation of work attire. (These items are optional as conditions dictate)* Level C protection upgrade will be required whenever airborne dusts are observed and cannot be controlled. Level C protection may also be required based on elevated monitoring instrument readings and results of additional air monitoring activities (i.e., Dräger tube). - For airborne dusts, Air-Purifying Respirators (APRs) with organic vapor/HEPA cartridges will be used. - The type of respirator and cartridge to be used for elevated instrument readings will be based on the specific contaminant of concern and associated concentrations determined through additional monitoring activities. If this type of protection appears to be warranted, selection will be performed by the Project Health and Safety Officer. Chemical protective clothing for Level C protection will consist of impermeable boot covers, nitrile gloves with a cotton liner, Tyvek coveralls (unless free phase product is encountered). Free phase product or splash potential PVC or PE splash suit. Site activities are not anticipated to require Level B protection. As a result, specific elements of Level B protection and the associated action levels for upgrading to Level B are not addressed in this HASP. If additional monitoring efforts indicate the need for Level C or B protection, this HASP will be modified accordingly. As site conditions may change the following equipment will be maintained during all on site activities - Fire Extinguishers (Strategically placed) - First-aid kit	**Personnel Decontamination** - Will consist of a soap/water wash and rinse for outer protective equipment (e.g., boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the drilling operations bordering the support zone. This decontamination procedure for **Level D** protection will consist of: - Equipment drop - Soap/water wash and rinse of outer gloves and outer boots, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Wash hands and face, leave contamination reduction zone For **Levels C & B** in addition to that described above: SCBA air tank or APR cartridge change out would take place at this point. - Outer suit, boot covers, outer glove removal - Respiratory (face mask) protection removal - Wash hands and face, leave contamination reduction zone **Equipment Decontamination** - All equipment decontamination will take place at a centralized decontamination pad utilizing steam or pressure washers. Heavy equipment such as drill rigs, will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will be restricted access to exclusion zones, or also have their wheels/tires sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the on site activity. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on site and that which is to leave the site. No equipment will be authorized access or exit without this authorization. Evaluation will consist of - Visual inspection - Scanning equipment with monitoring instruments

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
FOR MCRD, PARRIS ISLAND, SOUTH CAROLINA
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Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Air Monitoring Type/Action Levels	Personal Protective Equipment	Decontamination Procedures
Multi-media sampling including soils (subsurface); sediments; water (surface and subsurface); air (personal and area) and Investigative Derived Waste (IDW). Miscellaneous activities including slug tests and water level measurements are included as part of this task given the similar hazards and potentials for exposure to site contaminants.	***Chemical hazards:*** 1) Air/particulate/water borne contaminants including but not limited to, - various metals (lead, chromium, mercury amalgam, and beryllium) paint and solvent wastes including aliphatic petroleum and chlorinated solvent compounds (methylene chloride, perchloroethylene), PCB contaminated oils, diesel fuel and kerosene and miscellaneous domestic trash, and construction debris. 2) Transfer of contaminants into clean areas or onto persons ***Physical hazards:*** 3) Noise 4) Lifting (muscle strains and pulls) 5) Pinches and compressions 6) Slip, trips, and falls 7) Biological hazards (Insect/animal bites and stings)	***Chemical hazards:*** 1) Employ real-time monitoring instrumentation, action levels, personal sampling, and identified PPE to identify, quantify, and control exposures to potentially contaminated media (e.g., air, water, soils). 2) Restrict the cross use of equipment and supplies between sampling locations without first going through a suitable decontamination. ***Physical hazards:*** 3) Due to operational and contributory activities in and about work areas, generated noise levels may be excessive. If necessary, the SSO may direct the use of hearing protection. In that event, the SSO must implement a site Hearing Conservation Program (using section 6 of the B&R Environmental Health and Safety Guidance Manual). As a general rule of thumb, anytime you must raise your voice to speak to someone to be heard within 2 feet of where you are standing the potential exists that sound pressure levels may be excessive. Therefore, personnel will be required to employ hearing protection in these situations until sound level measurements and/or noise dosimetry may be conducted to quantify the associated noise levels. 4) Employ machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 5) Use pinch bars or other equipment to remove hands from machine points of operation or other potential pinch points when acquiring samples. 6) Preview work locations for unstable/uneven terrain. Barricade all excavations deeper than 2 feet from access closer than 2 feet from the edge. 7) Avoid insect nesting areas. For areas where ticks exists, wear light colored clothing with taped ankle and wrist seams. Carefully inspect body areas for ticks. If necessary, use insect repellents. Report potential hazards to the SSO.	Monitoring instrumentation will be used to bias environmental samples. It is not anticipated that surface waters will require monitoring as part of sample acquisition. Wells to be sampled must be opened and allowed to vent and reach equilibration prior to sampling. Subsurface soils monitoring direction and action levels will proceed using photoionization detectors w/10.6 eV and/or flame ionization detectors **Elevated airborne concentrations impacting the field crews or downwind receptors are not anticipated. The following information is provided as a contingency action only.** 1) Source monitoring will be conducted at regular intervals to be determined by the SSO. Positive sustained results at a source location which may impact operations crew will require the following actions: - Monitor the breathing zone of at-risk and downwind employees. Any sustained reading above background in the breathing zone of the at-risk employees will require site activities to be terminated until breathing zone readings return to background levels or the contaminant of concern is identified through additional monitoring activities (i.e., Dräger tubes). Many of the potential contaminants of concern are solid at ambient temperatures. Therefore, control of potential exposures to airborne particulates will be facilitated through engineering controls (e.g., using water to suppress airborne contaminant laden dust and particulates) and/or PPE.	All sampling activities are anticipated to proceed in a modified Level D protection, or as specified on the Safe Work Permit. Level D - (Minimum Requirements) For sampling activities: - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe) - Safety glasses - Hard hat (when overhead hazards exists, or identified as a operation requirement) - Reflective vest for high traffic areas - Hearing protection for high noise areas, or as directed by the SSO. - Inner nitrile gloves (Clean pair for each sample location) Level C protection upgrade will be required whenever airborne dusts are observed and cannot be controlled. Level C protection may also be required based on elevated monitoring instrument readings and results of additional air monitoring activities (i.e., Dräger tube). - For airborne dusts, Air-Purifying Respirators (APRs) with organic vapor/HEPA cartridges will be used. - The type of respirator and cartridge to be used for elevated instrument readings will be based on the specific contaminant of concern and associated concentrations determined through additional monitoring activities. If this type of protection appears to be warranted, selection will be performed by the Project Health and Safety Officer. Chemical protective clothing for Level C protection will consist of impermeable boot covers, nitrile gloves with a cotton liner, Tyvek coveralls (unless free phase product is encountered). Free phase product or splash potential PVC or PE splash suit. Site activities are not anticipated to require Level B protection. As a result, specific elements of Level B protection and the associated action levels for upgrading to Level B are not addressed in this HASP. If additional monitoring efforts indicate the need for Level C or B protection, this HASP will be modified accordingly. Fire Extinguishers and first aid kits will be maintained on site during all activities	Decontaminate sample containers in accordance with the Work Plan, Sample and Analysis Plan and/or the QA/QC Plan. If any solvent use is necessary for sample decontamination activities, obtain the appropriate MSDS from the solvent supplier. All solvent users must review the contents of that MSDS. Follow the PPE and other control requirements specified on the manufacturer's MSDS. **Personnel Decontamination** - Will consist of a soap/water wash and rinse for outer protective equipment (e.g., boots, gloves, PVC splash suits, etc.). This function will take place at an area adjacent to the sampling site bordering the work zone. This decontamination procedure for **Level D** protection will consist of - Equipment drop - Soap/water wash and rinse of outer gloves and outer boots, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Wash hands and face, leave contamination reduction zone For **Levels C & B** in addition to that described above, SCBA air tank or APR cartridge change out would take place at this point. - Outer suit, boot covers, outer glove removal - Respiratory (face mask) protection removal - Wash hands and face, leave contamination reduction zone **Equipment decontamination:** All sampling equipment will undergo a soap/water wash and rinse utilizing a suitable potable water source until visibly clean. Sampling equipment may also be high pressure soap/water wash and rinse or steam cleaned. All chemical decontamination will proceed in accordance with the other site documents such as the Work Plan, QA/QC Plan , and the Sampling Analysis Plan. Obtain manufacturer's MSDS and observe the requirements specified on that document.

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
FOR MCRD, PARRIS ISLAND, SOUTH CAROLINA
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Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Air Monitoring	Personal Protective Equipment	Decontamination Procedures
Decontamination of sampling, and heavy equipment	***Chemical hazards:*** 1) Air/particulate/water borne contaminants including but not limited to, - various metals (lead, chromium, mercury amalgam, and beryllium) paint and solvent wastes including aliphatic petroleum and chlorinated solvent compounds (methylene chloride, perchloroethylene), PCB contaminated oils, diesel fuel and kerosene and miscellaneous domestic trash, and construction debris. - Decontamination fluids - Liquinox (detergent). If solvent use is required for sample decontamination, obtain MSDS from the manufacturer. Users of any chemicals (including solvents) must be familiar with the contents of the MSDS, and the controls and requirements specified on the MSDS must be observed. ***Physical hazards:*** 2) Lifting (muscle strains and pulls) 3) Pinches and compressions 4) Flying projectiles when steam or pressure washing equipment	1) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. - Have a means by which the eyes and/or skin may be flushed (i.e., portable shower or emergency eyewash, etc.) readily accessible. Refer to manufacturer MSDS for decontamination fluids to determine appropriate PPE measures, handling procedures, and other information such as exposure data, signs and symptoms of exposure and first-aid measures. 2) Use multiple persons where necessary for lifting and handling heavy pieces of equipment for decontamination purposes. 3) If necessary, provide racks for air drying of decontaminated equipment to prevent unstable equipment from collapsing. 4) Utilize appropriate PPE including face shields and safety glasses. Coated Tyvek coveralls will be used if the potential for saturation of work cloths exists.	1) Use visual observation, and occasional real-time monitoring instrumentation to ensure that all equipment and/or areas which has been cleaned and dried is properly cleaned of potentially contaminated media (e.g., air, water, soils). **Elevated airborne concentrations impacting field crews or downwind receptors are not anticipated for this task.**	***For Drill rigs:*** This applies to high pressure soap/water, steam cleaning wash and rinse procedures. Level D Minimum requirements - - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe) - Chemical resistant boot covers - Nitrile outer gloves, cotton liners - If overspray cannot be controlled, PVC Rain suits or PE or PVC coated Tyvek - Safety glasses underneath a splash shield ***For sampling equipment including trowels, split spoons, ballers, etc.:*** Level D Minimum requirements - - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe) - Nitrile outer gloves, cotton liners - Safety glasses underneath a splash shield In the event of overspray of chemical decontamination fluids, employ splash apron or PVC Rain suits or PE or PVC coated Tyvek as necessary. Respiratory protection is not anticipated for these activities.	This decontamination procedure for **Level D** protection will consist of - Soap/water wash and rinse of outer gloves - Soap/water wash and rinse of the outer splash suit, as applicable - Wash hands and face, leave contamination reduction zone

TABLE 5-1
TASKS/HAZARDS/CONTROL MEASURES COMPENDIUM
FOR MCRD PARRIS ISLAND, SOUTH CAROLINA
PAGE 5 OF 5

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment	Decontamination Procedures
Surveying activities	***Chemical hazards*** 1) Limited potential for contact with air/particulate/water borne contaminants including but not limited to, - various metals (lead, chromium, mercury amalgam, and beryllium) paint and solvent wastes including aliphatic petroleum and chlorinated solvent compounds (methylene chloride, perchloroethylene), PCB contaminated oils, diesel fuel and kerosene and miscellaneous domestic trash, and construction debris. Exposure to site contaminants during this activity is anticipated to be unlikely given the limited contact with potentially contaminated media. ***Physical hazards*** 2) Slip, trips, and falls 3) Biological hazards (Insect/animal bites and stings, poisonous plants) 4) Hazards associated with lifting and carrying equipment	1) Generally, monitoring instrumentation is not needed during surveying activities recognizing that contact with potentially contaminated media is limited. 2) Minimize contact with potentially contaminated soils, water, debris, etc. 3) Avoid potential nesting areas of biting/stinging insects and animals. Use commercially available insect repellents and have snake bite kits available. Avoid contact with poisonous vegetation. Wear appropriate clothing. Tape ankle and wrists areas to prevent ticks, chiggers, etc. from attaching themselves to you skin. Wear light colored clothing so that ticks and other biting insects can be easily visible. 4) Obtain help when handling heavy or cumbersome loads. Avoid areas of rocky or uneven terrain. Use appropriate equipment (rope ladders, harnesses, ladders, etc.) when needed.	No air monitoring is needed given the limited potential that volatile contaminants are present. The potential for exposure to site contaminants during this activity is considered minimal. Minimize the generation of airborne dusts since many site contaminants are in the form of a particulate or may be bound to particulates.	Surveying activities shall be performed in Level D protection Level D Protection consists of the following: Steel-toe boots, safety glasses, hard hats (if working near machinery), and standard field dress including sleeved shirts and long pants. Tyvek coveralls may be worn to provide additional protection against poisonous plants and insects, particularly ticks. Boot covers and gloves may be required at the discretion of the SSO. Disposable boot covers may be required in any areas suspected of having surface contamination. Work gloves may be worn if desired. Surgical style nitrile gloves may be required if the potential for contact with contaminated media exists.	Personnel Decontamination - Will consist of the removal and disposal of outer protective clothing (disposable boots covers, gloves, etc.), if worn. This function will take place at an area adjacent to the surveying operations. The decontamination procedure will consist of: - An equipment drop - Removal and disposal of disposable PPE - Wash hands and face, leave contamination reduction zone

6.0 HAZARD ASSESSMENT

This section provides information regarding the chemical and physical hazards associated with the MCRD Parris Island site and the activities that are to be conducted as part of the scope of work. Table 6-1 provides various information related to the chemical hazards that may be present at the site. Specifically, toxicological information, exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data are also discussed in that table.

6.1 CHEMICAL HAZARDS

Potential chemical hazards associated with each site is based on information regarding previous site disposal practices and landfill operations. Contaminants of concern include solid and liquid paint and solvent wastes (including mineral spirits, perchloroethylene and methylene chloride), aliphatic petroleum compounds (primarily identified as diesel fuels, gasoline, and kerosene and associated constituents including BTEX compounds), PCBs, various metals including chromium, lead, mercury, and beryllium, and miscellaneous domestic trash and construction debris. Information on the toxicological, chemical, and physical properties of several potential contaminants of concern are addressed in Table 6-1 of this HASP. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (i.e., drilling, monitoring well installations, sampling, etc.).

6.2 PHYSICAL HAZARDS

In addition to the chemical hazards discussed above, the following physical hazards may be present during the performance of site activities.

- Contact / entanglement with rotating equipment or machinery.
- Slips, trips, and falls.
- Contact with underground or overhead utilities (electric lines, gas lines, water lines, etc.).
- Strain from heavy lifting.
- Pinch / compression points.
- Noise in excess of 85 decibels (dBA).
- Heat stress and inclement weather (depending on season)
- Contact with poisonous plants and disease carrying animals and insects.
- Water hazards and unstable terrain.

These physical hazards and their applicability to each site task are discussed in detail in Table 5-1. Additionally, each of these physical hazards is discussed in greater detail in the B&R Environmental Health and Safety Guidance Manual.

6.3 OTHER POTENTIAL SITE CONCERNS

Unexploded Ordnance (UXO)

Based on available information no Explosive Ordnance Disposal (EOD) activities were performed at any of the sites associated with this project. As a result, UXO is not anticipated to be encountered during proposed site activities. If items suspected of being UXO are encountered, site activities will be suspended and the appropriate site contacts will be immediately notified. If UXO is identified, this HASP will be modified and appropriate control measures will be implemented.

Radiological Hazards

Recently, site investigations at several military installations have uncovered various radiological sources that were not previously believed to exists onsite. Radiological sources previously identified at these sites have included Gaseous Tritium Light Sources (GTLS) which include runway lights, taxiway indicators and facility exits signs; radium sources used as a luminescent coatings on aircraft indicators; smoke detectors; and munitions containing depleted uranium (DU). Although radiological sources are not anticipated to be present at any of the proposes sites, previous site activities and disposal practices may have included the inadvertent disposal of potential radiological sources. As a result, personnel will report any unidentified material to the site contact. Hand-held radiological monitoring instruments (Ludlum Model 19 or equivalent) may be used to screen proposed areas of work to ensure that no radiological sources exist.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
MCRD, PARRIS ISLAND, SOUTH CAROLINA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Benzene	71-43-2	PID: I.P 9.24 eV, 100% response with PID and 10.2 eV lamp. FID: 150% relative response ratio with FID.	Air sample using 2 mil Tedlar sample bags or charcoal tube with carbon disulfide desorption. Sampling and analytical protocol in accordance with NIOSH Method # 3700 or #1500 and OSHA 07.	OSHA: 1 ppm 5 ppm (STEL) *See 29 CFR 1910.1028* ACGIH: 10 ppm NIOSH: 0.1 ppm IDLH: 500 ppm	Inadequate - Odor threshold 1.4-120 ppm. The use of half-face air-purifying respirators with organic vapor cartridge up to 10 ppm is acceptable despite the inadequate warning properties, providing cartridges are changed at the beginning of each shift. **Recommended gloves:** Butyl/neoprene blend - >8.00 hrs; Silver shield as a liner - >8.00 hrs; Viton - >8.00 hrs	**Boiling Pt:** 176°F; 80°C **Melting Pt:** 42°F; 5.5°C **Solubility:** 0.07% **Flash Pt:** 12°F; -11°C **LEL/LFL:** 1.2% **UEL/UFL:** 7.8% **Vapor Density:** 2.77 **Vapor Pressure:** 75 mmHg **Specific Gravity:** 0.88 **Incompatibilities:** Strong oxidizers, fluorides, perchlorates, and acids **Appearance and Odor:** Colorless to a light yellow liquid with an aromatic odor	Overexposure may result in irritation to the eyes, nose, throat, and respiratory system. CNS effects include giddiness, lightheadedness, headaches, staggered gait, fatigue, and lassitude and depression. Additional effects may include nausea, difficulty breathing, and intoxication. Long duration exposures may result in respiratory collapse. May cause damage to the blood forming organs and may cause a form of cancer called leukemia. The ACGIH, IARC, and OSHA list benzene as a carcinogen.
General PAHs / Coal Tar Pitch Volatiles / Creosote / cresol (Fluoranthene, pyrene, benzo(a) anthracene, benzo(a) pyrene, benzo(f)fluoranthene, benzo(k)fluoranthene), etc.)	(CAS Numbers vary depending on specific compound)	PID: I.P. of 8.97 eV, relative response ratio unknown. FID: Response factor unknown but given the substances flammability, detection by FID can be anticipated.	Refer to NIOSH methods for each specific compound for appropriate air sampling protocols. Many PAHs can be sampled using NIOSH Method 5506 or 5515 - Teflon filter with support ring - High pressure liquid chromatography with UV detector. For cresol (a major constituent of creosote) by silica gel or xad-7 sorbent tube; Acetone desorption and analysis by gas chromatography - flame ionization detector or high-pressure liquid chromatography. (NIOSH Method #2001, or OSHA Method #32)	**General PAHs**: Most PAHs have no established exposure limits. Other Coal Tar Pitch Volatiles / PAHs such as chrysene and benzo(a)pyrene have an exposure limit of 0.2 mg/m^3 (OSHA and ACGIH). 0.1 mg/m^3 - (NIOSH) **Creosote / Cresol:** OSHA; ACGIH: 5 ppm NIOSH: 2.3 ppm IDLH: 80 mg/m^3	Adequate - use a full-face air-purifying respirator with organic vapor / dust/mist cartridge up to 250 ppm. Cresol has an Odor Threshold of 0.00005-0.0079 ppm. **Recommended gloves:** Viton >96.00 hrs; butyl rubber >90.00 hrs; neoprene >4.50 hrs	Properties of various PAHs/Coal Tar Pitch Volatiles vary depending upon the specific compound. *For Creosote/Cresol:* **Boiling Pt:** 376-397°F; 191-203°C **Melting Pt:** 52-96°F; 10.9-35.5°C **Solubility:** Insoluble **Flash Pt:** 178°F; 81°C **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** 3.72 **Vapor Pressure:** 1 mmHg @ 100-127° F; 38-53°C **Specific Gravity:** 1.030-1.038 **Incompatibilities:** Nitric acid, oleum, chlorosulfonic acid, oxidizers **Appearance and Odor:** Yellowish or colorless, flammable, oily liquid (often brownish because of impurities or oxidation)	Regulated based on effects on respiratory tract and skin irritation Other effects may include eye irritation and central nervous system, disturbances. Acute exposures may result in difficulty breathing, respiratory failure and skin and eye irritation and burns. Chronic exposure may damage the liver, kidneys, lungs and skin and cause photosensitivity. IARC, NTP, NIOSH, ACGIH, and the EPA list some PAHs such as benzo(a)pyrene as a potential carcinogen (ARC 2A, NTP-2, ACGIH TLV-A2, NIOSH-X, EPA-B2).

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
MCRD PARRIS ISLAND, SOUTH CAROLINA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Ethylbenzene	100-41-4	PID: I.P 8.76, High response with PID and 10.2 eV lamp. FID: 100% response with FID.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol in accordance with OSHA Method #07 or NIOSH Method #1501 Aromatic Hydrocarbon.	ACGIH; NIOSH: 100 ppm; 125 ppm STEL OSHA: 100 ppm IDLH: 800 ppm	Adequate - Can use air-purifying respirator with organic vapor cartridge up to 800 ppm. **Recommended gloves:** Neoprene or nitrile w/ silver shield when potential for saturation; Teflon >3.00 hrs	**Boiling Pt:** 277°F; 136°C **Melting Pt:** -139°F; -95°C **Solubility:** 0.01% **Flash Pt:** 55°F; 13°C **LEL/LFL:** 1.0% **UEL/UFL:** 6.7% **Vapor Density:** 3.66 **Vapor Pressure:** 10 mmHg @ 79°F; 26 °C **Specific Gravity:** 0.87 **Incompatibilities:** Strong oxidizers **Appearance and odor:** Colorless liquid with an aromatic odor. Odor Threshold of 0.092-0.60.	Regulated primarily because of its potential to irritate the eyes and respiratory system. In addition, effects of overexposure may include headaches, narcotic effects, CNS changes (i.e., coordination impairment, impaired reflexes, tremoring) difficulty in breathing, possible chemical pneumonia, and potentially respiratory failure or coma.
Kerosene (Fuel Oil No. 1 range oil) Fuel Oil No. 1 is a refined petroleum solvent (predominantly C9-C16)	8008-20-6	Components of this substance will be detected readily however no documentation exists as to the relative response ratio of either PID or FID.	Air sample using charcoal tube as a collection media; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol in accordance with NIOSH Method #1550.	OSHA and ACGIH have not established exposure limits for kerosene. NIOSH has established a 100 mg/m3 REL (approximately 14 ppm)	Adequate warning properties - Kerosene / petroleum odor **Recommended Air Purifying cartridges:** Organic vapor **Recommended gloves:** Nitrile	**Boiling Pt:** 347-617°F; 175-325°C **Melting Pt:** Not available **Solubility:** Negligible **Flash Pt:** 100-162°F; 38-72°C **LEL/LFL:** 0.7% **UEL/UFL:** 5% **Vapor Density:** Not available **Vapor Pressure:** 5 mmHg @ 70°F; 21° C **Specific Gravity:** 0.81 **Incompatibilities:** strong oxidizers, **Appearance and odor:** Light amber liquid with a mild petroleum (kerosene) odor.	Excessive inhalation of aerosol or mist can cause respiratory tract irritation, headache, dizziness, nausea, stupor, convulsions, or unconsciousness, depending on concentration and duration of exposure. Kerosene is irritating to skin and mucous membranes. Repeated skin contact causes dermatitis. High concentrations in a confined space may adequately displace oxygen thereby resulting in suffocation.
Diesel Fuel No.2-D	Mixture	Components of this substance will be detected readily however no documentation exists as to the relative response ratio of either PID or FID.	Air sample using charcoal tube as a collection media; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol in accordance with NIOSH Method #1550.	OSHA; NIOSH; ACGIH: 5 mg/m^3 as mineral oil mist. In addition NIOSH and ACGIH establish 10 mg/m^3 as a STEL.	Adequate warning properties - Kerosene / petroleum odor **Recommended Air Purifying cartridges:** Organic vapor **Recommended gloves:** Nitrile	**Boiling Pt:** <170-400°F; 77-204°C **Melting Pt:** Not available **Solubility:** Negligible **Flash Pt:** 125°F; 52°C **LEL/LFL:** 0.6% **UEL/UFL:** 7.5% **Vapor Density:** >5 **Vapor Pressure:** <1 mmHg @ 70°F; 21 °C **Specific Gravity:** 0.86 **Incompatibilities:** strong oxidizers, halogens, and hypochlorites **Appearance and odor:** Colorless to amber with a kerosene odor	Prolonged or repeated exposures to this product may cause skin and eye irritation. Due to the defatting capabilities this exposure may lead to a dermatitis condition. High vapor concentrations are irritating to the eyes and respiratory tract. Exposure to high airborne concentrations may result in narcotic effects including dizziness, headaches, and anesthetic to unconsciousness. High concentrations in a confined space may adequately displace oxygen thereby resulting in suffocation.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
MCRD PARRIS ISLAND, SOUTH CAROLINA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Aviation / Jet Fuels such as JP-4	N/A	Components of this substance will be detected readily however no documentation exists as to the relative response ratio of either the PID or FID.	Air sample using charcoal tube and carbon disulfide desorption; Sampling and analytical protocol shall proceed in accordance with NIOSH Method #1501.	USAF 8 hr - 200 ppm	Kerosene odor threshold ~ 800 ppm Rating - Poor to Adequate **Recommended Air Purifying cartridges:** Organic vapor **Recommended gloves:** Nitrile	**Boiling Pt:** <290-470°F; 143-243°C **Melting Pt:** Not available **Solubility:** Negligible **Flash Pt:**-10 to -50°F; -23 to -45°C **LEL/LFL:** <1% **UEL/UFL:** 8% **Vapor Density:** >1 **Vapor Pressure:** 75 mmHg; 70°F; 21°C **Specific Gravity:** 0.78 **Incompatibilities:** strong oxidizers **Appearance and odor:** Colorless to amber with a kerosene odor	Based on the constituents of jet fuels, it can be surmised that JP-4 is irritating to the eyes, skin, and respiratory tract. **Direct contact** may result in mild irritation with a possible drying and defatting of the skin **Ingestion** may result in gastrointestinal irritation, nausea, and vomiting and may be harmful or even fatal. **Inhalation** of vapors or mists of JP-4 may result in headache, nausea, confusion, narcotic effect, and drowsiness. Chronic inhalation of jet fuel vapors may produce symptoms such as fatigue, anxiety, mood changes, liver and kidney damage, and memory difficulties in exposed workers.
Methylene chloride	75-09-2	PID: I.P. 11.32 eV, High response with PID and 11.7 eV lamp. FID: 100% response with FID.	Air sample using charcoal or Anasorb CMS sorbent tube; carbon disulfide desorption; gas chromatography-flame ionization detector; Sampling and analytical protocol shall proceed in accordance with OSHA Method #59, 80, or NIOSH Method #1005.	OSHA: 50 ppm, 100 ppm (Ceiling) ACGIH: 50 ppm NIOSH: Lowest feasible concentration IDLH: 2300 ppm	Inadequate - Odor threshold 160 ppm. Use a gas mask with a Type N canister for concentrations up to 25 ppm. In excess of 25 ppm, use a supplied air respirator (airline respirator with emergency escape cylinder or a Self-Contained Breathing Apparatus - (SCBA). **Recommended gloves:** Nitrile rubber latex glove 3.00 hrs (vendor specific); supported Polyvinyl alcohol glove, unsupported 1-8 hrs; Silver shield 1.90 hrs	**Boiling Pt:** 104°F; 39.8°C **Melting Pt:** -141°F; -96°C **Solubility:** 2% **Flash Pt:** Not available **LEL/LFL:** 13% **UEL/UFL:** 12% **Vapor Density:** 2.93 **Vapor Pressure:** 380 mmHg @ 72°F; 22°C **Specific Gravity:** 1.33 **Incompatibilities:** Strong oxidizers, caustics, metals (i.e. aluminum, magnesium, potassium, sodium, lithium), and concentrated acids **Appearance and Odor:** Colorless liquid with a chloroform-like odor. (Note: A gas above 104°F; 40°C).	Effects of overexposure may include CNS effects - cause sleepiness, fatigue, weakness, lightheadedness, numbness of the limbs, altered cardiac rate and incoordination. These signs and symptoms may be accompanied by nausea, gastric and pulmonary irritation leading possibly to pulmonary edema. In addition to the narcosis long term effects may include liver injury. Listed as possessing carcinogenic properties by NTP, IARC, and ACGIH.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
MCRD PARRIS ISLAND, SOUTH CAROLINA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Toluene	108-88-3	PID: I.P 8.82 eV, High response with PID and 10.2 eV lamp. FID: 110% response with FID.	Air sample using charcoal tube; carbon disulfide desorption. Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1500.	OSHA: 200 ppm 300 ppm (Ceiling) ACGIH: 50 ppm (skin) NIOSH: 100 ppm 150 ppm STEL IDLH: 500 ppm	Adequate - Odor threshold 1.6 ppm is considered good. Can use air-purifying respirator with organic vapor cartridge up to 1,000 ppm. **Recommended gloves:** Teflon >15.00 hrs; Viton >16.00 hrs; silver shield >6,00 hrs; supported nitrile (Useable time limit 0.5 hr, complete submersion for the nitrile selection); PV alcohol >25.00 hrs	**Boiling Pt:** 232°F; 111°C **Melting Pt:** -139°F; -95°C **Solubility:** 0.05% (61°F;16°C) **Flash Pt:** 40°F; 4°C **LEL/LFL:** 1.2% **UEL/UFL:** 7.1% **Vapor Density:** 3.14 **Vapor Pressure:** 20 mmHg @ 65°F; 18 °C **Specific Gravity:** 0.87 **Incompatibilities:** Strong oxidizers **Appearance and odor:** Colorless liquid with a sweet pungent aromatic odor.	Overexposure to this substance may result in mild to moderate irritation at all points of contact, and CNS changes including euphoria, confusion, nervousness, and possibly paresthesia characterized by an abnormal burning sensation, pricking, or numbness. At 200-500 ppm exposure has resulted in headaches, nausea, eye irritation, loss of appetite, bad taste, impair coordination, fatigue, and weariness. Chronically, toluene overexposure may result in dermatitis, liver, and kidney damage.
Xylene All isomers o-,m-, p-	1330-20-7	PID: I.P. 8.56 eV, High response with PID and 10.2 eV lamp. FID: 110% response with FID.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA 07, or NIOSH Method 1500.	ACGIH, & NIOSH: 100 ppm, 150 ppm STEL OSHA: 100 ppm IDLH: 900 ppm	Adequate - Odor thresholds for the following isomers: 0.6 m-; 5.4 p-; 20 o- ppm. Can use air-purifying respirator with organic vapor cartridge up to 9 00 ppm concentrations. **Recommended gloves:** PV Alcohol >12.67 hrs; Viton >8.00 hrs; CPE >1.00 hr; Butyl 0.87 hrs; Nitrile is acceptable for limited operations and contact (>0.20 hrs)	**Boiling Pt:** 269-281°F; 132-138°C **Melting Pt:** -13o/-54m/56p°F; -25o/-48m/13p °C **Solubility:** 0.02 % **Flash Pt:** 81-90°F;27-32°C **LEL/LFL:** 0.9% **UEL/UFL:** 7.0% **Vapor Density:** 3.66 **Vapor Pressure:** 7-9 mmHg @ 70°F; 21°C **Specific Gravity:** 0.86-0.88 **Incompatibilities:** Strong oxidizers and strong acids **Appearance and odor:** Colorless liquid with an aromatic odor.	Effects may of overexposure include irritation at all points of contact, CNS changes (i.e. dizziness, excitement, drowsiness, incoherent, staggering gait), difficulty in breathing, pulmonary edema, and possibly respiratory failure. Chronic effects may include dermatitis and cornea vacuolization.
Beryllium	7440-41-7 as Be	Particulate form - This substance is unable to be detected by PID/FID.	Air sample using a particulate filter; acid desorption; AAS/GF detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7102.	OSHA: 0.002 mg/m³, (Ceiling) 0.005 mg/m³ NIOSH: 0.0005 mg/m³ ACGIH: 0.002 mg/m³	No identifiable warning properties to indicate presence and thereby detection. **Recommended APR Cartridge:** Suitable for dust and fume. Organic vapor acid gases with HEPA filter. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 5378°F; 2970°C **Melting Pt:** 2332°F; 1278°C **Solubility:** Insoluble **Flash Pt:** Not available (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 1.85 **Incompatibilities:** Halocarbons, strong oxidizers, acids and caustics **Appearance and odor:** gray to white hard light metal, brittle	Overexposure to this substance may result in respiratory symptoms including difficulty in breathing, coughing, rales, chest pain, possibly pulmonary edema, weakness, fatigue, headache, weight loss. Direct contact may result in irritant action on the skin (dermatitis), eyes (conjunctivae), and mucous membranes. This substance has been identified as a potential human carcinogen.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
MCRD PARRIS ISLAND, SOUTH CAROLINA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Chromium Compounds	7440-47-3 (Element)	Not detectable by PID. Not detectable by FID.	Air sample using mixed cellulose -ester filter; acid desorption and analysis by atomic absorption. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7024.	OSHA & NIOSH: (Chromium II, III) 0.5 mg/m³ (Chromium VI) 0.1 mg/m³ (Ceiling) ACGIH: 0.5 mg/m³ (Chromium II, III compounds), 0.05 mg/m³ (Chromium VI compounds) IDLH: 30 mg/m³ (Chromium VI compounds)	The use of a air purifying, full face-piece respirator with a high efficiency particulate filter for concentrations up to 0.1 mg/m³. **Recommended Gloves:** This is in particulate form. Therefore any glove suitable to prevent skin contact.	**Boiling Pt:** 4788°F; 2642°C **Melting Pt:** 3452°F; 1900°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 7.14 **Incompatibilities:** Strong oxidizers, peroxides, and alkalis **Appearance and Odor:** Appearance and odor vary depending upon the specific compound.	Health hazards are characterized normally through chronic exposure manifesting as histologic fibrosis of the lungs and ulceration of the nasal septum and skin. IARC, NTP and ACGIH list various chromium compounds as possessing carcinogenic properties.
Lead	7439-92-1	Particulate form - Unable to be detected by either PID or FID.	Air sample using a mixed cellulose ester filter; or HNO_3 or H_2O_2 desorption; or Atomic absorption detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #7082 or #7300.	OSHA: 0.05 mg/m³ ACGIH: 0.15 mg/m³ NIOSH: 0.10 mg/m³ IDLH: 100 mg/m³ as lead	The use of a air purifying, full-face respirator with high efficiency particulate air filter for up to 2.5 mg/m³. **Recommended gloves:** This is in the particulate form. Therefore any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances).	**Boiling Pt:** 3164°F; 1740°C **Melting Pt:** 621°F; 327°C **Solubility:** Insoluble **Flash Pt:** Not applicable (Airborne dust may burn or explode when exposed to heat, flame, or incompatible chemicals) **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable **Vapor Density:** Not available **Vapor Pressure:** 0 mmHg **Specific Gravity:** 11.34 **Incompatibilities:** Strong oxidizers, peroxides, sodium acetylide, zirconium, and acids **Appearance and Odor:** Metal: A heavy ductile, soft gray solid.	Overexposure to this substance via ingestion or inhalation may result in metallic taste in the mouth, dry throat, thirst, Gastrointestinal disorders (burning stomach pain, nausea, vomiting, possible diarrhea sometimes bloody or black, accompanied by severe bouts of colic), CNS effects (muscular weakness, pain, cramps, headaches, insomnia, depression, partial paralysis possibly coma and death. Extended exposure may result in damage to the kidneys, gingival lead line, brain, and anemia.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
MCRD PARRIS ISLAND, SOUTH CAROLINA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Mercury	7439-97-6	Jerome Mercury Vapor Analyzer This substance is unable to be detected by PID/FID.	Air sample using Hydrar® sorbent tube; acid desorption; AA cold detection. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #6009.	OSHA; NIOSH; ACGIH: as alkyl compounds 0.01 mg/m³; STEL 0.03 mg/m³ IDLH: 10 mg/m³	No identifiable warning properties to indicate presence and thereby detection. **Recommended APR Cartridge:** Suitable for Metallic mercury with HEPA filter. Preferably, with an end-of-service life indicator. **Recommended gloves:** Rubber gloves	**Boiling Pt:** 674°F; 356.9°C **Melting Pt:** -38°F; -38.89°C **Solubility:** Insoluble **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** 0.0012 mmHg @ 77° F; 25°C **Specific Gravity:** 13.6 **Incompatibilities:** Acetylene, ammonia, chlorine dioxide, azides, calcium, sodium carbide, lithium, rubidium, and copper **Appearance and odor:** Silvery-white heavy mobile liquid, odorless	This substance is corrosive to all points of contact. Systemic symptoms include irritability, wakefulness, muscle weakness and tremors, increased reflexes, gingivitis, anorexia, headache, tinnitus, hypermobility, GI disturbances (nausea, vomiting), diarrhea (sometimes bloody), liver changes, dermatitis, and fever. Symptoms experienced via inhalation include to those above coughing, chest pain, dyspnea, bronchial pneumonitis, and excessive salivation.
Aroclor-1260 (Polychlorinated Biphenyl, PCB) It should be noted that this substance is representative of the more common isomers Aroclor - 1242, 1254, which may be encountered.	11096-82-5 53469-21-9 (42%) 11097-69-1 (54%)	Substance is not volatile (VP=0.00006 mmHg), I.P. is unknown however is anticipated to be elevated, therefore, PID is not anticipated to detect this substance. Substance is non combustible and as a result will not be detected by FID.	Air sample using a particulate filter, Florisil sorbent tube with glass fiber filter; hexane desorption; gas chromatography-electron capture detector. Sampling and analytical protocol shall proceed in accordance with NIOSH Method #5503 (PCBs).	OSHA; ACGIH: 0.5 mg/m³ (skin) NIOSH: 0.001 mg/m³ IDLH: 5 mg/m³	Inadequate - However due to the low volatility it is assumed unless agitated this substance does not present a volatile vapor or gas respiratory threat. For dusty conditions where this material may cling to particulates, use a HEPA filter. APRs are approved for escape only when concentrations exceed the exposure limits. Concentrations greater than the exposure limits require PAPR or supplied air respirators. **Recommended glove:** Butyl rubber >24 hrs; Neoprene rubber >24.00 hrs; Silver shield or Viton (for pure product).	**Boiling Pt:** distillation range 689- 734°F; 365-390°C **Melting Pt:** -2 to 50°F; -19 to 10°C **Solubility:** Insoluble **Flash Pt:** Not applicable **LEL/LFL:** Not applicable **UEL/UFL:** Not applicable Nonflammable liquid, however, exposure to fire results in black soot containing PCBs, dibenzofurans, & chlorinated dibenzo-p-dioxins **Vapor Density:** Not available **Vapor Pressure:** 0.00006 - 0.001 mmHg **Specific Gravity:** 1.566 @ 60°F; 15.5°C **Incompatibilities:** Strong oxidizers **Appearance and Odor:** Colorless to pale yellow, viscous liquid or solid (Aroclor 54 below 50°F) with a mild, hydrocarbon odor	This substance is irritating to the eyes and skin. Chronic effects of overexposure may include potential to cause liver damage, chloracne, and reproductive effects. Recognized as possessing carcinogenic properties by NIOSH, and NTP.
Waste Oils All information is based on mineral oil	N.E. 8012-95-1 for mineral oil	Varies between fractions however waste oils tend to be less volatile. The FID tends to handle the longer chained aliphatic hydrocarbons more efficiently than its PID counterpart and would be selected as the instrument of choice.	Sampling and analytical protocol shall be in accordance with NIOSH Method #5026 is the recommended method for mineral oil mist.	ACGIH; NIOSH: 5 mg/m³ (Oil mists); 10 mg/m³ STEL OSHA: 5 mg/m³ (Oil mists)	Non-volatile substance, therefore no respiratory protection is required. In an aerosol form dust and mist respirator would be considered acceptable for up to 500 mg/m³. **Recommended gloves:** Any glove suitable to prevent skin contact (Nitrile has been the one most widely used for the other substances, and will be acceptable).	**Boiling Pt:** 680°F; 360°C **Melting Pt:** Not available **Solubility:** Insoluble **Flash Pt:** 275-500°F; 135-260°C depends on the distillation fraction **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** Not available **Vapor Pressure:** <0.5 mmHg **Specific Gravity:** 0.90 **Incompatibilities:** None reported **Appearance and odor:** Colorless, oily, with an odor of burned lubricating oil.	Minor irritation to the eyes, skin, and respiratory system.

TABLE 6-1
CHEMICAL, PHYSICAL, AND TOXICOLOGICAL DATA
MCRD PARRIS ISLAND, SOUTH CAROLINA

Substance	CAS No.	Air Monitoring/Sampling Information		Exposure Limits	Warning Property Rating	Physical Properties	Health Hazard Information
Tetrachloroethylene See also Perchloroethylene PERK PCE	127-18-4	PID: I.P. 9.32 eV, relative response ratio 200% with 10.6 eV lamp. FID: 70% relative response ratio with a FID.	Air sample using charcoal tube; carbon disulfide desorption; GC/FID detection. Sampling and analytical protocol shall proceed in accordance with OSHA Method #07, or NIOSH Method #1003.	ACGIH: 25 ppm 100 ppm STEL OSHA: 100 ppm 200 ppm Ceiling; 300 ppm 5-minute max peak in any 3-hr period. IDLH: 150 ppm	Odor threshold for this substance has been determined to be at airborne concentrations of approximately 47 ppm, which is considered adequate. APR with organic vapor/acid gas cartridges should be used for escape purposes only. Exceedances over the recommended exposure limits requires the use of airline or airline/APR combination units. **Recommended glove:** Viton, PV alcohol 5-16 hrs; silver shield >6.00 hrs; teflon 10-24 hrs; and Nitrile in that order. The breakthrough time for the nitrile glove ranges between 1.5 - 5.5 hrs. during complete immersion.	**Boiling Pt:** 250°F; 121°C **Melting Pt:** -2°F; 19°C **Solubility:** 0.02% **Flash Pt:** Not available **LEL/LFL:** Not available **UEL/UFL:** Not available **Vapor Density:** 5.83 **Vapor Pressure:** 14 mmHg @ 77°F; 25°C **Specific Gravity:** 1.62 @ 77°F; 25°C **Incompatibilities:** Strong oxidizers, alkalis, fuming sulfuric acid, and chemically active metals. When heated to decomposition temperatures will emit toxic fumes of chlorine. **Appearance and Odor:** Colorless liquid with a mild chloroform like odor.	Overexposure may result in irritation to eyes, nose, throat, and skin. Potential CNS effects including sleepiness, incoordination, headaches, hallucinations, distorted perceptions, and stupor (narcosis). Systematically, symptoms may result in nausea, vomiting, weakness, tremors, and cramps. Chronic exposures may result in dermatitis, enlarged tender liver, kidney, and lung damage. This material is considered a animal carcinogen (liver tumors), however, inadequate evidence exists concerning carcinogenic potential in humans.
Gasoline	8006-61-9	Relative response ratios for the components of gasoline range from 100 - 200% for PID and FID detection.	See components for measurement considerations.	ACGIH & OSHA: 300 ppm 500 ppm STEL NIOSH: Reduce to lowest feasible concentration.	**Respiratory Protection:** Odor threshold 0.7 ppm, adequate air purifying respirator with organic vapor cartridges up to 100 ppm. **Recommended Gloves:** Nitrile >6.00 hrs; PV alcohol >6.00 hrs; Viton/neoprene >8.00 hrs	**Boiling Pt:** 102°F; 39°C **Melting Pt:** Not available **Solubility:** Negligible **Flash Pt:** -50°F; -45°C **LEL/LFL:** 1.4% **UEL/UFL:** 7.6% **Vapor Density:** ~5 **Vapor Pressure:** 38-300 mmHg (varies seasonally) **Specific Gravity:** 0.74 @ 20/20°C **Incompatibilities:** Strong oxidizers, peroxides, strong acids, and perchlorates **Appearance and Odor:** Colorless liquid with gasoline odor.	Overexposure to this substance may result in irritation to the eyes, skin, and mucous membranes. Systematically, headache, fatigue, blurred vision, dizziness, slurred speech, confusion, possible convulsion, and chemical pneumonia (aspiration). Prolonged or chronic exposures may result in possible liver or kidney damage. Components of this substance have been determined to be confirmed human carcinogens.

7.0 AIR MONITORING

Monitoring devices such as Direct Reading Instruments (DRIs), may be employed at the site to detect and evaluate the presence of site contaminants and other potentially harmful agents as indicated in Table 6-1. The specific type of monitoring and the associated instruments, frequency of use, and applicable action levels are dependent upon the specific scope of work and the contaminants of concern. As a result, specific air monitoring measures and requirements have been established in Table 5-1 of this site-specific HASP. Additionally, Section 1.0 of the B&R Environmental Health and Safety Guidance Manual contains detailed information regarding direct reading instrumentation and personal and area air sampling procedures, as well as general calibration procedures of various instruments.

In several cases, many of the contaminants of concern are unable to be detected or are difficult to detect with the use of direct reading instruments employed for site operations. In particular, metals, PCBs, and some PAHs exhibit poor detection characteristics (i.e., the non photoionizable or non combustible nature of the contaminant). The greatest potential for exposure to these contaminants generally would be as a result of inhalation or ingestion of contaminant laden particulates (dusts). As a result, any observations of airborne particulates will indicate a potential for exposure and require control measures such as area wetting. Given the proposed activities, it is not anticipated that contaminants identified in this HASP will be encountered in any appreciable concentrations. However, as a precaution, monitoring instruments will be used in an attempt to identify and quantify any potential contaminants of concern. Additionally, potential exposures and hazards associated with site contaminants will be minimized through adherence to the requirements of this HASP (site control measures, decontamination efforts, safe work practices, etc.).

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for both B&R Environmental and subcontractor personnel participating in on site activities.

8.1.1 Requirements for B&R Environmental Personnel

All B&R Environmental personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the MCRD, Parris Island facility. B&R Environmental personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of B&R Environmental introductory, supervisory, and refresher training as well as site-specific training will be maintained at the site. Copies of certificates or other official documentation will be used to fulfill this requirement.

B&R Environmental will conduct a brief meeting daily to discuss operations planned for that day and to issue Safe Work Permits (See Section 9.4) for those operations.

8.1.2 Requirements for Subcontractors

Identified B&R Environmental subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work at the MCRD facility. B&R Environmental subcontractors must certify that each employee has had such training by sending B&R Environmental a letter, on company letterhead, containing the information in the example letter provided in Figure 8-1. This letter will be accompanied by training certificates or some other form of official documentation for all subcontractor personnel participating in site activities.

FIGURE 8-1

OSHA COMPLIANCE/TRAINING LETTER

The following statements must be typed on company letterhead and signed by an officer of the company and accompanied by copies of personnel training certificates:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. Mark Speranza, P.E.
Task Order Manager
B&R Environmental
Foster Plaza 7, 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: HAZWOPER Training for Marine Corps Recruit Depot, Parris Island, South Carolina

Dear Mr. Speranza:

As an officer of XYZ Corporation, I hereby state that I am aware of the potential hazardous nature of the subject project. I also understand that it is our responsibility to comply with all applicable occupational safety and health regulations, including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1900 through 1910 and Part 1926.

I also understand that Title 29 CFR 1910.120, entitled "Hazardous Waste Operations and Emergency Response," requires an appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as requested by 29 CFR 1910.120(e) and have had 8 hours of refresher training as required by 29 CFR 1910.120(e)(8) and site supervisory personnel have had training in accordance with 29 CFR 1910.120(e)(4).

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

Enc. Copies of training certificates

8.2 SITE-SPECIFIC TRAINING

B&R Environmental will provide site-specific training to all B&R Environmental and subcontractor personnel who will perform work on this project. Site-specific training will also be provided to all personnel (DOD, OSHA, EPA, SouthDiv Navy personnel, and other authorized visitors) who may enter the site to perform functions that may or may not be directly related to site operations. Site-specific training will include:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure to site contaminants
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of the contents of relevant Material Safety Data Sheets
- Associated hazards and restricted areas within the MCRD.

Site-specific documentation will be established through the use of Figure 8-2. All site personnel and visitors must sign this document upon receiving site-specific training.

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for B&R Environmental Personnel

All B&R Environmental personnel participating in project field activities will have had a physical examination meeting the requirements of B&R Environmental's medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained in the B&R Environmental Pittsburgh office and made available, as necessary.

FIGURE 8-2
SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing remedial activities at Marine Corps Recruit Depot, Parris Island, South Carolina, and that I have received site-specific training which included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure to site contaminants
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of contents of relevant Material Safety Data Sheets
- Associated hazards and restricted areas within the MCRD.

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

I further state, by the presence of my signature below that, the date of my training (introductory, refresher, and supervisory, as applicable) and my medical surveillance requirements are accurate and correct to the best of my knowledge.

Name	40-Hour General Site Worker Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Date of Medical Surveillance	SIGNATURE

8.3.2 Medical Surveillance Requirements for Subcontractors

Identified subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided in Figure 8-3 shall be used to satisfy this requirement, providing it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute "Subcontractor Medical Approval Form" with a letter, on company letterhead, containing all of the information in the example letter presented in Figure 8-4 of this HASP.

8.3.3 Requirements for All Field Personnel

Each field team member, including subcontractors and visitors, entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet found in the B&R Environmental Health and Safety Guidance Manual. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTIONS

In situations in which the exclusion zone is not entered or when there is no potential for exposure to site contaminants, subcontractor personnel may be exempt from some of the training and medical surveillance requirements. All subcontractors and visiting personnel are required to receive site-specific training (as discussed in Section 8.2) regarding information provided in this HASP. Examples of subcontractors who may be exempt from training and medical surveillance requirements may include surveyors who perform surveying activities at the site perimeter, or in areas were there is no potential for exposure to site contaminants.

FIGURE 8-3

SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of _____
Company Name

Participant Name: _____ Date of Exam: _____

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f), and was found to be medically -

   ( ) qualified to perform work at the Marine Corps Recruit Depot, Parris Island work site
   ( ) not qualified to perform work at the Marine Corps Recruit Depot, Parris Island Center work site

and,

2. Undergone a physical examination in accordance with OSHA 29 CFR 1910.134(b)(10) and was found to be medically -

   ( ) qualified to wear respiratory protection
   ( ) not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

( ) A copy of OSHA Standard 29 CFR 1910.120 and appendices.
( ) A description of the employee's duties as they relate to the employee's exposures.
( ) A list of known/suspected contaminants and their concentrations (if known).
( ) A description of any personal protective equipment used or to be used.
( ) Information from previous medical examinations of the employee that is not readily available to the examining physician.

Part B

I, _____, have examined _____
Physician's Name (print) Participant's Name (print)

and have determined the following information:

FIGURE 8-3
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

   _____
   _____
   _____

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

   _____
   _____
   _____

3. Recommended limitations upon the employee's assigned work:

   _____
   _____
   _____

I have informed this participant of the results of this medical examination and any medical conditions which require further examination of treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the Marine Corps Recruit Depot, Parris Island work site, this participant

( ) may
( ) may not

perform his/her assigned task.

Physician's Signature _____

Address _____

Phone Number _____

NOTE: Copies of test results are maintained and available at:

_____
Address

FIGURE 8-4

MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO
XYZ CORPORATION
555 E. 5th Street
Nowheresville, Kansas 55555

Month, day, year

Mr. Mark Speranza, P.E.
Task Order Manager
B&R Environmental Corp.
Foster Plaza 7, 661 Andersen Drive
Pittsburgh, Pennsylvania 15220

Subject: Medical Surveillance for Marine Corps Recruit Depot, Parris Island, South Carolina

Dear Mr. Speranza:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response: Final Rule." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative- pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the Marine Corps Recruit Depot, Parris Island work site.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name and Title of Company Officer)

9.0 SITE CONTROL

This section outlines the means by which B&R Environmental will delineate work zones and use these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site. This three zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants, and protect individuals who are not cleared to enter work areas.

9.1 EXCLUSION ZONE

The exclusion zone will be considered those areas of the site of known or suspected contamination. It is not anticipated that significant amounts of surface contamination are present in the proposed work areas of this site. It is anticipated that this will remain so until/unless contaminants are brought to the surface by intrusive activities, such as drilling or sampling. Furthermore, once intrusive activities have been completed and surface contamination has been removed, the potential for exposure is again diminished and the area can then be reclassified as part of the contamination reduction zone. Therefore, the exclusion zones for this project will be limited to those areas of the site where active work is being performed plus a designated area surrounding the point of operation (see Table 5-1 for specific operation). The exclusion zone for most site activities will be fragmented to represent the areas where the soils are disturbed through drilling or sampling activities. All exclusion zones will be delineated using barrier tape, cones and/or drive poles, and postings to inform and direct facility personnel.

9.1.1 Exclusion Zone Clearance

A pre-startup site visit will be conducted by members of the identified field team in an effort to identify proposed subsurface investigation locations, obtain utility clearances, and provide upfront notices concerning scheduled activities within the facility.

In all cases, no subsurface activities will proceed without utility clearance. In the event that a utility is struck during a subsurface investigative activity, the emergency numbers provided in Section 2.9, Table 2-1 will be notified.

When base personnel are working within the proximity of this investigation, they will be moved or their operation temporarily discontinued to remove them from potential hazards associated with this operation.

9.2 CONTAMINATION REDUCTION ZONE

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. A limited personnel and equipment decontamination may take place in this area, to the extent required to move equipment or personnel as necessary to a central decontamination location. This area will also serve as a focal point in supporting exclusion zone activities. This area will be delineated using barrier tape, cones and/or drive poles, and postings to inform and direct facility personnel.

9.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

9.4 SAFE WORK PERMITS

All exclusion zone activities conducted in support of this project will be done so using this HASP as a reference guide and Safe Work Permits to incorporate site-specific information to guide and direct field crews on a task by task basis. An example of the Safe Work Permit to be used during site activities is illustrated in Figure 9-1.

All permits will be issued by the SSO or his/her on site representative in the morning prior to the commencement of on site activities. The Safe Work Permits are to be completed in accordance with the specifications contained in Table 5-1 and the other sections of this HASP as appropriate.

All personnel identified on the permit as participating in the task will be made aware of its contents by the supervisor accepting the permit. Any problems which occurred throughout the task will be documented by the supervisor on the permit.

All permits will be returned to the FOL or the SSO at the end of the day.

FIGURE 9-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): _____

II. Names: _____

III. Onsite Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ _____
B&RE

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☐ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☐

Modifications/Exceptions: _____

V. Chemicals of Concern | Action Level(s) | Response Measures

Chemicals of Concern	Action Level(s)	Response Measures

VI. Additional Safety Equipment/Procedures

Hardhat	☐ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes	☐ No
Safety Glasses	☐ Yes	☐ No	Safety belt/harness	☐ Yes	☐ No
Chemical/splash goggles	☐ Yes	☐ No	Radio	☐ Yes	☐ No
Splash Shield	☐ Yes	☐ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☐ No	Gloves (Type)	☐ Yes	☐ No
Steel toe/shank Workboots	☐ Yes	☐ No	Work/rest regimen	☐ Yes	☐ No

Modifications/Exceptions: _____

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☐	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment inspected	☐	☐	Assembly points	☐	☐

VIII. Equipment Preparation

	Yes	NA
Equipment drained/depressured	☐	☐
Equipment purged/cleaned	☐	☐
Isolation checklist completed	☐	☐
Electrical lockout required/field switch tested	☐	☐
Blinds/misalignments/blocks & bleeds in place	☐	☐
Hazardous materials on walls/behind liners considered	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No
If yes, fill out appropriate section(s) on safety work permit addendum

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____
Job Completed by: _____ Date: _____

9.5 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by B&R Environmental
- Regulatory personnel (i.e., DOD, EPA, OSHA)
- Southern Division Navy Personnel
- Other authorized visitors

All non-DOD personnel working on this project are required to gain initial access to the base by coordinating with the B&R Environmental FOL or designee and following established base access procedures.

Once access to the base is obtained, all personnel who require site access into areas of ongoing operations will be required to obtain permission from the FOL and the Base Contact. Upon gaining access to the site, all site visitors wishing to observe operations in progress will be escorted by a B&R Environmental representative and shall be required to meet the minimum requirements discussed below:

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.

- All site visitors will be required to produce the necessary information supporting clearance to the site. This shall include information attesting to applicable training and medical surveillance as stipulated in Section 8.0 of this document. In addition, to enter the site operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items, they will be permitted to enter the operational zone. All visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. Any and all visitors not meeting the requirements, as stipulated in this plan, for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause the termination of all on site activities until the unauthorized visitor is removed from the premises. Removal of unauthorized visitors will be accomplished

with support from the Base Contact. If necessary, the Base Contact will be notified of any unauthorized visitors.

9.6 SITE SECURITY

Site security will be accomplished using B&R Environmental field personnel. B&R Environmental will retain complete control over active operational areas. As this activity takes place at a Navy facility, the first line of security will take place at the base gate restricting the general public. The second line of security will take place at the work site referring interested parties to the Base Contact. The Base Contact will serve as a focal point for base personnel, interested parties, and serve and the final line of security and the primary enforcement contact.

9.7 SITE MAP

Once the areas of contamination, access routes, topography, and dispersion routes are determined, a site map will be generated and adjusted as site conditions change. These maps will be posted to illustrate up-to-date collection of contaminants and adjustment of zones and access points.

9.8 BUDDY SYSTEM

Personnel engaged in on site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

9.9 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

B&R Environmental and subcontractor personnel will provide MSDSs for all chemicals brought on site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of all chemicals used on site will be developed using the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request.

9.10 COMMUNICATION

As personnel may not always be working in proximity to one another during field activities, a supported means of communication between field crews will be used as necessary. Two-way radio communication

devices will be submitted for approval by MCRD for use while at the facility. Any communications devices used by site personnel must meet approval of EOD personnel.

External communication will be accomplished by using the telephones at predetermined and approved locations or through cellular phones. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of activities at the MCRD, the FOL will determine and arrange for telephone communications, if it is determined a cellular means will not be used.

10.0 SPILL CONTAINMENT PROGRAM

10.1 SCOPE AND APPLICATION

It is not anticipated that bulk hazardous materials (over 55-gallons) will be handled at any given time as part of this scope of work. It is also not anticipated that any spillage would constitute a danger to human health or the environment. However, as the job progresses, the potential for accumulating Investigative Derived Wastes (IDW), such as decontamination fluids, soil cuttings, purge waters from well development, etc. in a central staging area does exist. Once these materials are characterized, they can be removed from this area and be properly disposed of. Because these IDW remain uncharacterized while in the staging area, a spill containment program will be developed and instituted as part of this HASP.

10.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, limited areas are vulnerable to this hazard including:

- Resource deployment
- Waste transfer
- Central staging

It is anticipated all IDW generated as a result of this scope of work will be containerized, labeled, and staged to await further analyses. The results of this analysis will determine the method of disposal.

10.3 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic walk-around by the personnel staging or disposing of drums will be conducted during working hours to visually determine that storage vessels are not leaking. If a liquid leak is detected, the contents will be transferred into a new vessel using a hand pump. The leak will then be collected and contained using absorbents such as Oil-dry, vermiculite, or sand. The absorbents will be stored at the vulnerable areas in a conspicuously marked drum. This used absorbent material will also be containerized for disposal pending analysis. All inspections will be documented in the project logbook.

10.4 PERSONNEL TRAINING AND SPILL PREVENTION

All personnel will be instructed in the procedures for spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and the SSO will serve as the Spill Response Coordinators for this operation, should the need arise.

10.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment that will be maintained at the staging area at all times for the purpose of supporting this Spill Prevention/Containment Program.

- Sand, clean fill, vermiculite, or other non combustible absorbent (Oil-dry);
- Drums (55-gallon U.S. DOT 17-E or 17-H)
- Shovels, rakes, and brooms
- Container labels

10.6 SPILL CONTROL PLAN

This section describes the procedures the B&R Environmental field crew members will employ upon the detection of a spill or leak.

1. Notify the SSO or FOL immediately upon the detection of a leak or spill.

2. Employ the personal protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point in the vessel. Spread the absorbent material in the area of the spill, covering it completely.

3. Transfer the material to a new vessel; collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment or disposal options.

4. Re-containerize spills, including 2-inches of top cover affected by the spill. Await test results for treatment or disposal options.

It is not anticipated that a spill will occur that the field crews cannot handle. Should this occur, notification of the appropriate emergency response agencies will be carried out by the FOL or SSO in accordance with the procedures discussed in Section 2.0 of this HASP.

11.0 CONFINED-SPACE ENTRY

Personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces. A confined space is defined as an area that has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, manholes, sewers, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

Additionally, a Permit-Required Confined Space may also have one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly caving walls or by a floor that slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space operations, consult the Health and Safety Guidance Manual or call the HSM. Any activity that may be considered a confined-space entry shall require modifications of this HASP and shall result in the immediate notification of the Project Health and Safety Officer. This determination shall be made by the FOL and SSO.

12.0 MATERIALS AND DOCUMENTATION

The B&R Environmental Field Operations Leader (FOL) shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for all chemicals brought on site, including decontamination solutions, fuels, sample preservatives, calibration gases, etc.
- Follow-up Reports (to be completed by the FOL)
- A full-size OSHA Job Safety and Health Poster (posted in the site trailer)
- Training/Medical Surveillance Documentation Form (Blank)
- First-Aid Supply Usage Form
- Emergency Reference Form (Section 2.0, extra copy for posting)
- Drilling Log Forms

12.1 MATERIALS TO BE POSTED AT THE SITE

The following documentation is to be posted at the site for quick reference purposes. In situations where posting of these documents is not feasible (such as no office trailer), these documents should be separated and be immediately accessible to site personnel.

Chemical Inventory Listing - This list represents all chemicals brought on site, including decontamination solutions, sample preservatives, fuel, calibration gases, etc.. This list should be posted in a central area.

Material Safety Data Sheets (MSDSs) - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all substances employed on site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster - This poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance Posting - This listing is found within the training section of the HASP (See Figure 8-1). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. This lists indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) - This list of numbers and the directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards - Medical Data Sheets will be filled out by all on site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to all personnel to be carried on their person.

Hearing Conservation Standard (29 CFR 1910.95) - This standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring - All results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels - Where chemical inventories have been separated, because of quantities and incompatibilities, these areas will be conspicuously marked using Department of Transportation (DOT) placards and acceptable [Hazard Communication 29 CFR 1910.1200 (f)] labels.

13.0 ACRONYMS / ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air-Purifying Respirator
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CNS	Central Nervous System
CRZ	Contamination Reduction Zone
CSP	Certified Safety Professional
CQP	Construction Quality Plan
dBA	Decibels measured on the A-scale
DRI	Direct Reading Instrument
eV	electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
FTL	Field Team Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HSM	Health and Safety Manager
IDLH	Immediately Dangerous to Life and Health
IDW	Investigative Derived Wastes
MCRD	Marine Corps Recruit Depot
MSDS	Material Safety Data Sheet
N/A	Not Available
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollution Discharge Elimination System
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PCB	Polychlorinated Byphenyls
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photoionization Detector
PPE	Personal Protective Equipment
PPM	parts per million

PVC	poly vinyl chloride
SAP	Sampling and Analyses Plan
SCBA	Self-Contained Breathing Apparatus
SOPs	Standard Operating Procedures
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
TBD	To be determined
TOM	Task Order Manager
TSD	Treatment Storage and Disposal Facility
TWA	Time-Weighted Average
UV	Ultra violet
WP	Work Plan

14.0 DOCUMENT STATUS REPORT

Revision Requested:	By Whom:	Date:
Revisions Made:	Approval: PM: HSM	