EMAIL OF TRANSMITTAL AND U S EPA REGION IV COMMENTS ON SITE CHARACTERIZATION WORK PLAN FOR SITE 45 DRY CLEANING FACILITY SPILL AREA
MCRD PARRIS ISLAND SC
4/1/2008
U S EPA REGION IV

From:	Koroma-Llamas.Lila@epamail.epa.gov
To:	charles.cook2@navy.mil; art.sanford@navy.mil; koroma-llamas.lila@epa.gov; Sladic, Mark; timothy.j.harrington@usmc.mil; mmcrae@TechLawInc.com; AmickMS@dhec.sc.gov; darrel.pittman@usmc.mil; Kelly.Taylor2@ch2m.com; barkerjs@dhec.sc.gov
Cc:	huling.scott@epamail.epa.gov; Pivetz.Bruce@epamail.epa.gov; Keeley.Ann@epamail.epa.gov
Subject:	Fw: Parris Island MCRD
Date:	Tuesday, April 01, 2008 6:03:06 PM
Attachments:	Project Manager_Workplan responses.doc Parris Island Site Characterization Workplan_version 2.doc

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Hi Folks,

See attached. Let me know if these changes have satisfied your concerns and if the workplan is now approved for implementation.

Thanks,
Lila

----- Forwarded by Lila Koroma-Llamas/R4/USEPA/US on 04/01/2008 02:06 PM -----

Scott Huling/ADA/USEPA/US
03/28/2008 03:50 PM

To
Lila Koroma-Llamas/R4/USEPA/US@EPA
cc
Bruce Pivetz/ADA/USEPA/US, Ann Keeley/ADA/USEPA/US@EPA
Subject
Parris Island MCRD

Lila, the comments and recommendations provided by you and others in the Parris Island Partnering Team (PIPT) have been addressed and the site characterization workplan has been revised. Both electronic files are attached below. A hard copy of the memo to you addressing the comments and recommendations, and the revised workplan will be mailed on Monday. Currently, we plan to be on the site the week of April 21, 2008 for about 5 days. There are still a few details that we need to address I will be in close communication with you as my liaison with the PIPT. Thank you for your assistance on this project. Scott

(See attached file: Project Manager_Workplan responses.doc)(See attached file: Parris Island Site Characterization Workplan_version 2.doc)

Scott G. Huling, Ph.D., P.E.
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March 28, 2008

MEMORANDUM

SUBJECT: Parris Island Marine Corp Recruit Depot, Parris Island, SC

FROM: Scott G. Huling, Environmental Engineer
Applied Research and Technical Support Branch

TO: Lila Koroma-Llamas, Remedial Project Manager
USEPA Region 4, Atlanta, GA

Thank you for coordinating the distribution of the proposed in-situ chemical oxidation (ISCO) Phase I site characterization workplan at the Parris Island Marine Corp Recruit Depot (MCRD). Several technical issues and questions were raised by the following team Parris Island Partnering Team members; EPA Region 4; Meredith Amick (Project Manager) South Carolina Department of Health and Env. Control, Bureau of Land & Waste Management, Division of Waste Management; Don A. Vroblesky, Ph.D., Research Hydrologist, USGS, Stephenson Center, Columbia; (Darrel) Heber Pittman, US Marine Corps Recruit Depot, Natural Resources & Env. Affairs, PO Box 5028, Parris Island, SC. These technical issues and questions have been addressed below. The original comment and/or question is listed first, followed by a response. The Parris Island Site Characterization Workplan – Phase I, has been revised and is included. It is proposed to conduct the proposed site characterization activities the week of April 21, 2008. Site access for the proposed activities will take approximately 1 week. Please let me know if additional information can be provided to address any questions or comments. Scott Huling (580) 436-8610.

Lila Koroma-Llamas, Remedial Project Manager, EPA Region 4

1. The text in Section I, Introduction on Page 1 of the Parris Island Site Selection – Phase I Site Characterization Workplan Revision 2, dated April 4, 2008 (Workplan) indicates the selection criteria and site specific details of solid waste management unit (SWMU) 45 can be located in Appendix A. An Appendix A was not included with the electronic copy of the Workplan. For completeness, include Appendix A or revise the text as necessary. Also in this section, a plan-view isocontour map of the contaminant plume is mentioned. Please include it and reference it in the text.

Response. Appendix A - Parris Island Site Selection Evaluation was accidentally not included in the e-mail transmittal to EPA Region 4. This appendix will be included in the revised workplan. The term, "isocontour map of the contaminant plume" was replaced with the term, "a plan-view map". The purpose of the plan-view map in Figure 1 is to identify the location of the ground water contaminant plume and to develop a conceptual model used in site characterization. This conceptual model is included as Figure 1.

2. The text Section II, A. Media Characterization, Page 3, last paragraph indicates the data analysis from the Phase I site characterization will be used to help assess well locations to be installed during Phase II. However, the Workplan does not discuss if the data will be submitted as a deliverables to the Parris Island (PI) Partnering Team. Review of the Phase I data by the PI Partnering Team will be required and a draft work plan submitted for review and approval. In the text, please commit to submitting a data summary and the Draft Workplan for Phase II to the PI Partnering Team for review and approval prior to well installation in Phase II.

Also, on Page 4, "Uncontaminated cores" in the "background" area are mentioned. It is important to recognize this is an industrialized area, and uncontaminated areas, especially background type areas, may be difficult to locate. Perhaps your intent was "upgradient"? Please clarify.

Response. The following statement was included in section II of the workplan. "The data and information derived from Phase I site characterization will be presented in the workplan submitted to EPA Region 4 for Phase II site characterization."

Our intention is to locate uncontaminated cores. Proposed core locations have been included in Figure 1. Assuming the cores are contaminated, additional cores will be collected during Phase II. The workplan was revised (Pg. 4) to include the following statement. "The background cores will first be analyzed for CVOCs to assure they are uncontaminated."

3. On Page 5, Please change the title of our team. Although I am not sure we have an official team name, for purposes of this document "Parris Island Partnering Team" may be more appropriate. Our work is not limited to Site 45.

Response. The term,"Parris Island Partnering Team" has been incorporated into the Workplan.

4. On page 7 a Health and Safety Plan and a QAPP are mentioned. Please provide these electronically for review only after your internal review is complete.

Response. The following sentence was added to the workplan. "Both the HASP and QAPP will be provided to the Parris Island Partnering Team when they have been approved."

5. The Workplan does not include a discussion on decontamination procedures of major equipment and/or sampling equipment. In order to assure cross contamination does not occur during sampling activities and that quality data is obtained, the Workplan should include a discussion of the decontamination procedures and the management of decontamination water.

Response. The following text was included in section II.A.1 Aquifer Cores. "The GeoProbe rods will be decontaminated between core locations. This will be performed using two side-by-side containers. Rods will be scrubbed with soapy water in the first container, and rinsed clean with high pressure jet washing in the second container. Rods will have a final rinse with clean water in the second container and laid on wracks to dry. CVOC concentrations are expected to be very low in the residual decontamination water. It is estimated that approximately 200 gallons of decon water will be produced and transported and disposed in the on-site waste water treatment system at the Parris Island MCRD Disposal."

6. The Workplan does not discuss how investigation derived waste or IDW (e.g., soil cutting, decontamination water, etc.) will be managed or disposed. To assure proper management and disposition of the IDW during the site characterization activities additional text addressing this issue is needed in the Workplan.

Response. Refer to the response for the previous comment.

7. A schedule of activities for the Phase I site characterization was not proposed in the Workplan. Multiple field investigation are currently occurring at SWMU 45 and for coordination purposes, a proposed work schedule for the Phase I site characterization field activities should be submitted to the PI Partnering Team prior to initiation of Phase I field activities.

Response. Currently, it is planned to execute the proposed site characterization activities the week of April 21-25, 2008.

Meredith Amick (Project Manager) South Carolina Department of Health and Env. Control, Bureau of Land & Waste Management, Division of Waste Management

Engineers Comments.
1. The revised Draft of the Phase I WP should be submitted for review.

Response. The revised workplan will be submitted to Lila Koroma-Llamas (EPA-Region 4) and will be re-distributed to the Parris Island Partnering Team.

2. Page 4 discusses uncontaminated cores. Will the cores be analyzed to verify that they are uncontaminated?

Response. The workplan was revised (Pg. 4) to include the following statement.

"The background cores will first be analyzed for CVOCs to assure they are uncontaminated."

Hydrogeologist Comments.
1. Page 4 states "Uncontaminated cores (2-3) collected over the 8-18' bgs interval in the southwest (background) portion of the plume will be collected and analyzed for textural analysis and total organic carbon (TOC)." - A map depicting the locations of these 2 - 3 cores should be submitted to the Department for approval prior to the installation.

Response. Figure 1 has been revised to include the proposed locations of background cores. Figure 1 is included in the revised work plan.

2. Figure 1/Page 9 - The legend should be updated to include the meaning of all the symbols shown; e.g. T1 and the straight lines that aren't storm sewers.

Response. Figure 1 has been revised to include the proposed locations of the transects used to locate aquifer core locations. Figure 1 is included in the revised work plan.

3. Figure 1/Page 9 - The proposed boring locations (or at least the general locations of each boring) should be included on the appropriate map.

Response. Figure 1 has been revised to include the proposed locations of the aquifer cores. Figure 1 is included in the revised work plan.

4. Figure 2/Page 10 - In the revised document there should be a north arrow and a legend for this map.

Response. Figure 2 has been deleted from the work plan. It was not critical to illustrate the data and information in Figure 2 to convey the details of the proposed site characterization activities. Rather, the information was referenced in Vroblesky (2007).

Charles Cook, Naval Air Station, JAX, Navy Facilities Engineering SE Installation Restoration, SC IPT, Jacksonville, FL 32212-0030

No comments on this plan. As discussed, I am interested in seeing your report for use in the feasibility study. I understand your bench test on the cores will also determine: if peat layer is a positive or negative factor and oxidation's detrimental and or positive impacts on microbial dechlorinating population.

Response. The role of the peat materials will be assessed in the treatability study being conducted by Dr. Rick Watts (Washington State University). The results of the treatability study will be provided to Charles Cook.

Don A. Vroblesky, Ph.D., Research Hydrologist, USGS, Stephenson Center, Columbia, SC.

No major comments. On page 4, the present USGS plan is to install 3 new wells into the lower aquifer rather than the 4 wells cited in the workplan.

Response. The workplan was revised to indicate that 3 wells will be installed in the lower aquifer.

(Darrel) Heber Pittman, US Marine Corps Recruit Depot, Natural Resources & Env. Affairs, PO Box 5028, Parris Island, SC.

I don't have any comments on the work plan other than to correct my own contact information. My FedEx address should be changed to Building #864, NREAO.

Response. The workplan was revised to indicate the change in FedEx address.

Parris Island Site Characterization Workplan – Phase I
(C:\Projects\Oxidation\SERDP ISFO\second proposal\Parris Island\Site Characterization\Parris Island Site Characterization Workplan – Phase I_version 2.doc, 3/28/08)

I. Introduction

The site characterization workplan is a detailed presentation of proposed site characterization activities at the Parris Island Marine Corp Recruit Depot, Solid waste management unit (SWMU) 45 (Former MWR Dry Cleaning Facility). This site was selected by the Peroxygen Team based on an analysis of site selection criteria in conjunction with site specific details of SWMU 45 (Appendix A). The overall objective involves the collaboration between the Department of Defense, Environmental Security Technology Certification Program (DOD-ESTCP), Washington State University (WSU), Environmental Research Management (ERM), FMC Corp., and the Environmental Protection Agency-Robert S. Kerr Environmental Research Center (EPA-RSKERC).

Truck-mounted and/or Hydrotrax-mounted Geoprobe rigs owned by the EPA-RSKERC will be used for the subsurface investigation activities. Personnel from the EPA RSKERC, and possibly other collaborators will be performing these activities.

Proposed pre-oxidation site characterization activities occur in two phases, Phase I and II. The objective of Phase I is to (1) obtain aquifer materials for the laboratory studies to be conducted by Dr. RickWatts (Washington State University (WSU)), (2) obtain aquifer materials for microbial characterization to be conducted by Dr. Ann Keeley (US EPA) (3) perform preliminary characterization of chlorinated volatile organic compounds (CVOCs) distribution at the site by sampling and analyzing aquifer material, (4) establish the lithology (sand, silt, clay), and stratigraphy (layering, lenses, orientation), (5) assess the presence of NAPL, and/or heavily contaminated sludge and soil near the suspected source area (cracked/leaking sanitary sewer drain pipe), and (6) make a general assessment of site accessibility issues.

Preliminary data and information (TetraTech NUS, 2004; Vroblesky, 2007; 2008) involving site characterization at SWMU 45 has been used to scope Phase I and II site characterization activities. A plan-view map of the contaminant plume has been prepared based on ground water samples collected and analyzed for CVOCs (Vroblesky, 2007; 2008). This plan-view map has served as the basis for the preliminary site conceptual model of CVOCs at the site. Data and information from Phase I will be used to further develop the site conceptual model that will guide the design and deployment of in-situ chemical oxidation (ISCO) at the site. Phase I site characterization data and information will be used to refine the existing site conceptual model by further delineating the longitudinal and transverse axes of the plume, the vertical profile of contaminant distribution, and to establish the background (pre-oxidation) microbial content of the aquifer. Data gaps identified after the Phase I investigation will be used to help guide site characterization activities in Phase II. The collective data and information from Phase I

and II will serve as the CVOC baseline conditions upon which to further refine the site conceptual model and to establish pre-oxidation conditions.

II. Phase I Site Characterization Activities

Samples used by the USGS in the development of the plan-view maps of the CVOCs plume were derived from conventional ground water monitoring wells, ground water monitoring wells installed with direct push technology, and real-time samples collected and analyzed via membrane interface probe (MIP) technology.

Currently, an investigation by the USGS (Vroblesky, 2008) is planned at site 45 involving site characterization and a critical analysis of the fate and transport of CVOCs. The proposed activities in the ISCO Team's workplan have been and will continue to be coordinated with the Parris Island Partnering Team and Dr. Vroblesky. This will avoid potential situations where multiple field activities occur simultaneously. Through the coordination of these two independent studies, high quality data and information can be obtained to guide future decisions at the site regarding environmental protection and remediation in general, and specifically ISCO activities.

A. Media Characterization

1. *Aquifer cores.* Aquifer cores will be collected along the longitudinal and transverse axes of the southern plume (Figure 1). MIP data presented by Vroblesky (2007) indicate that the contamination is predominantly distributed between 8-16' below ground surface (bgs) (Vroblesky, 2007). There is one location where the contamination appears to exist at depths > 16' bgs and is located approximately at mid-point in the plume. The region of interest will be 8-18' bgs.

All exploratory borings performed in this investigation will be filled with a bentonite slurry using forced injection through Geoprobe rod to the bottom of the boring, gradually injecting at shallower depths until the borehole is filled. Ideally, this will help assure the direct emplacement of bentonite in the abandoned exploratory boring. The objective of sealing these borehole locations is to (1) prevent vertical conduits which may allow the escape of injected oxidant and reagent solutions during ISCO, and (2) to prevent the potential preferential pathway for vertical contaminant transport (cross contamination of contaminated ground water and/or DNAPL).

It is proposed that aquifer cores be collected at 6 transects (T1-T6) along the longitudinal axis, and 3 cores be collected per transect (Figure 1). Locations along each transect will be labeled A-C. These cores will be collected using the closed-piston (protected sampling) method where discrete intervals are sampled.

Core locations will be on 20' centers and aquifer core location "B" will be on the longitudinal axis of the PCE ground water plume at each transect. Therefore, the core locations on each transect will span approximately 40' with the middle core (i.e., core B, Table 1) to be located on the longitudinal transect. A duplicate aquifer core will be

collected at location "B" and provided to WSU. Cores collected for WSU will be off-set by 0.5-1' from the other core location "B". To establish baseline conditions, it is proposed that continuous cores be collected from 10-18' bgs. This will involve 2-4' cores (10-14', and 14'-18' bgs). At each core location, 4 samples will be collected at the midpoint of the four 2' intervals. For example, in the intervals of 10-12', 12-14', 14-16', and 16-18', samples will be collected at 11, 13, 15, and 17' bgs (Figure 1, Table 1). Assuming the CVOC data suggests contaminant concentrations extend to an elevation above the highest or lowest sampling point in each interval, additional samples (in storage) can be analyzed to refine contaminants at this interval. The field investigation being conducted by the USGS (Vroblesky, 2008) may provide information on the depth of the clay layer that exists at approximately 20' bgs. Assuming this clay layer is found to exist at a more shallow depth, (i.e., 18' bgs), the aquifer core sampling interval will be modified to include shallower intervals (8-10', 10-12', 12-14', 14-16') to prevent penetration into the clay layer. Aquifer cores will be sealed, placed in an ice chest with blue ice blocks and transported to WSU (Pullman, WA) and the EPA RSKERC (Ada, OK).

The first transect closest to the new dry cleaner building will have to be located based on a visual observation. This is mainly attributed to the presence of septic sewer and storm sewer lines in that proximity. The location of this transect will also be coordinated with the USGS to assess whether any new information on contaminant distribution and subsurface utilities in this area has been obtained. Arrangements will be made to limit access to the drive-through driveway for the new dry cleaner operation. Each transect will be located approximately 33' downgradient from the previous transect.

Core sample collection will begin at the southeastern-most transect (i.e., transect no. 6), and move towards the source area for the southern plume. One of the field objectives during aquifer core sample collection is to avoid penetration into the confining unit that separates the surficial and lower aquifers. Aquifer cores will be extruded into transparent acetate sleeves which permit the visual inspection of the core. This approach will be used to help assess whether the core has penetrated into the confining unit. Assuming the confining unit is encountered, subsequent cores will be advanced over a shorter interval to avoid the confining unit. Proposed USGS field activities (Vroblesky, 2008) include 3 new wells into the lower aquifer. These activities will precede our field activities and therefore, may provide information on the depth to the top of the confining unit. This information will be used to refine this workplan before field activities commence.

The 18 core locations (4 samples/core) results in 72 core samples (Table 1). Each core sample will be sampled and analyzed for CVOCs (PCE, TCE, DCE, VC). Nested wells installed during a subsequent trip to the site will approximately correspond with the same depth interval of the aquifer cores. Wells will also be installed for oxidant injection purposes during Phase II. Data analysis from Phase I site characterization will be used to help assess well locations to be installed during Phase II. The data and information derived from Phase I site characterization will be presented in the workplan for Phase II site characterization and submitted to the Parris Island Partnering Team.

Table 1. Summary of aquifer core sample collection and proposed analysis. [1]			
Transect	Core Location on Transect		
	A	B	C
1	4	4	4
2	4	4	4
3	4	4	4
4	4	4	4
5	4	4	4
6	4	4	4
[1] Summary: 18 core locations, 4 samples per core (locations A, B, C), 72 core samples.			

Aquifer cores will be used to help establish the lithology (sand, silt, clay) and stratigraphy (layering, lenses, orientation) to improve the hydrologic conceptual model. Geologic cross-sections of the southern plume area will be prepared in conjunction with other data available from earlier investigations. Cross-sections diagrams will provide a detailed conceptual model used to assist in the design the ISCO treatment system and in post-oxidation treatment performance evaluation. Uncontaminated cores (2-3) collected over the 8-18' bgs interval in the southwest (background) portion of the plume will be collected and analyzed for textural analysis and total organic carbon (TOC). The background cores will first be analyzed for CVOCs to assure they are uncontaminated. Uncontaminated cores are proposed for this purpose to avoid potential contact with CVOCs during sample handling and analysis. Specific intervals for textural analysis will be selected after the CVOC data has been analyzed. The objective of this effort is to refine the contaminant transport and hydrologic conceptual model.

VOC data will be used to identify the most contaminated aquifer cores that will be screened for DNAPL using the FLUTe® ribbon or hydrophobic dye tests. Visual inspection for pyrite and quantification of manganese oxides will be performed during the laboratory investigations at WSU.

The GeoProbe rods will be decontaminated between core locations. This will be performed using two side-by-side containers. Rods will be scrubbed with soapy water in the first container, and rinsed clean with high pressure jet washing in the second container. Rods will have a final rinse with clean water in the second container and laid on wracks to dry. CVOC concentrations are expected to be very low in the residual decontamination water. It is estimated that approximately 200 gallons of decon water will be produced and transported and disposed in the on-site waste water treatment system at the Parris Island MCRD Disposal.

2***. Analytical.*** A subsample of the aquifer core will be collected and placed in a sample vessel and amended with methanol. The methanol/water (mixture) extraction solution will be removed and analyzed for CVOCs using EPA RSKOP 259.1 (CVOCs by GC/MS headspace). The residual aquifer material and methanol/water mixture will be

dried and weighed and the analytical results will be reported on a dry weight basis. Ground water samples will be collected and analyzed for CVOCs using EPA RSKOP 299.0. Total organic carbon (TOC) analysis of aquifer samples collected in background cores will be analyzed using EPA RSKOP 120.3.

B. Facilities Management.

1. Electrical/water. Available at the site.
2. Security. The US Marine Corp Recruit Depot is a secure area. It is planned to leave one of the GeoProbe rigs at the Parris Island MCRD for temporary storage and has been tentatively approved.

C. Coordination.

The successful execution of this project involves the coordination of the following organizations.

Parris Island Partnering Team (PIPT)

Department of Defense - On-site Environmental Staff

Charles Cook, Naval Air Station, JAX, Navy Facilities Engineering SE Installation Restoration, SC IPT, PO Box 30, North Ajax Street, Bldg 135, Jacksonville, FL 32212-0030, Phone (904) 542-6409, Fax (904) 542-6104, e-mail charles.cook2@navy.mil

(Darrel) Heber Pittman, US Marine Corps Recruit Depot, Natural Resources & Env. Affairs, PO Box 5028, Parris Island, SC 29905-9001, phone: (843) 228-3615, fax: (843) 228-2616, e-mail: darrel.pittman@usmc.mil, Fed Exp: Building 864 NREAO

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EPA

Lila Llamas, USEPA, Region 4, Sam Nunn AFC, 61 Forsyth Street, Atlanta, GA 30303-3104, phone: (404) 562-9969, fax: (404) 562-8518, e-mail: Koroma-Llamas.Lila@epa.gov

South Carolina Department of Health and Env. Control

Meredith Amick, Project Manager, SC Department of Health & Env. Control
Bureau of Land & Waste Management, Division of Waste Management, 2600 Bull St

Columbia, SC 29201, phone: (803) 896-4218, fax: (803) 896-4002, e-mail AmickMS@dhec.sc.gov

USGS

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In-Situ Chemical Oxidation (Peroxygen) Team

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Bruce Pivetz, Shaw Environmental (EPA Contractor) P.O. Box 1198, Ada, OK, 74820, Phone: (580) 436-8998, e-mail pivetz.bruce@epa.gov

ERM

Dick Brown, 250 Phillips Blvd., Suite 280, Ewing NJ 08618, Direct Dial: 609-403-7530, Office Phone: 609-895-0050, Cell 609-647-4119, Fax: 609-895-0111 e-mail dick.brown@erm.com

Rick Lewis, 399 Boylston Street, 6th Floor, Boston, MA, 02116, USA, (617) 646-7863, rick.lewis@erm.com

Tim Pac, 171 Forbes Blvd., Suite 5000, Mansfield, MA 02048, (617) 646 7862 Fax: (508) 261 7777, Mobile: (617) 285 4466, tim.pac@erm.com

FMC Corp.

Phillip Block, 215-299-6645, philip_block@fmc.com

D. Health and Safety Plan (HASP), and quality Assurance Project Plan (QAPP)

The Health and Safety Plan (US EPA, 2008a) prepared for this project will be implemented during field activities at this site. Currently, the draft HASP is under review at EPA RSKERC by the Health and Safety Manager.

The Quality Assurance Project Plan (US EPA, 2008b) prepared for this project will be adhered to during this study. Scheduled audits may be performed by the EPA RSKERC Quality Assurance Manager, Mr. Steve Vandegrift. Currently, the draft QAPP is under review at EPA RSKERC by the Quality Assurance Manager.

Both the HASP and QAPP will be provided to the Parris Island Partnering Team when they have been approved.

E. References

TetraTech NUS, 2004. Remedial Investigation RCRA Facilities Investigation for Site /WMU 45 Former MWR Dry Cleaning Facility (Contract No. N62467-94-D-0888).

US EPA, 2008a. Health and Safety Plan for the Field Demonstration and Validation of Peroxygen-Based ISCO for the Remediation of Contaminated Groundwater Using Rational and Mechanism-Based Design at Solid Waste Management Unit 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

US EPA, 2008b. GWERD Quality Assurance Project Plan for Field Demonstration and Validation of Peroxygen-Based ISCO for the Remediation of Contaminated Groundwater Using Rational and Mechanism-Based Design at Solid Waste Management Unit 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

Health and Safety Plan for the Field Demonstration and Validation of Peroxygen-Based ISCO for the Remediation of Contaminated Groundwater Using Rational and Mechanism-Based Design at Solid Waste Management Unit 45, Marine Corps Recruit Depot, Parris Island, South Carolina.

US EPA RSKOP Method 259.1. Determination of Volatile Organic Compounds (Fuel Oxygenates, Aromatic and Chlorinated Hydrocarbons) in Water Using Automated Headspace Gas Chromatography/Mass Spectrometry (TEKMAR 7000 HS-Varian 2100T GC/MS System-ION Trap Detector).

US EPA RSKOP Method 299.0. Determination of Volatile Organic Compounds (Fuel Oxygenates, Aromatic and Chlorinated Hydrocarbons) in Water Using Automated Headspace Gas Chromatography/Mass Spectrometry (Agilent 6890/5973 Quadrupole GS/MS System)

US EPA RSKOP Method 120.3 Determination of Total Carbon and Total Organic Carbon in Solids using the LECO CR-412 Carbon Analyzer.

Vroblesky, D. 2007. "Preliminary Results: USGS Investigation of Site 45 MCRD, Parris Island, April-July, 2007. Power Point presentation given to the Parris Island Environmental Team on July 30, 2007.

Vroblesky, D. 2008. Progress Report for US Geological Survey FY 2007 Activities and Workplan for FY 2008 Field Activities at Site 45, Marine Corps Recruit Depot, Parris Island, South Carolina. U.S. Geological Survey, 720 Gracern Road, Suite 29, Columbia, SC, 29210-7651.

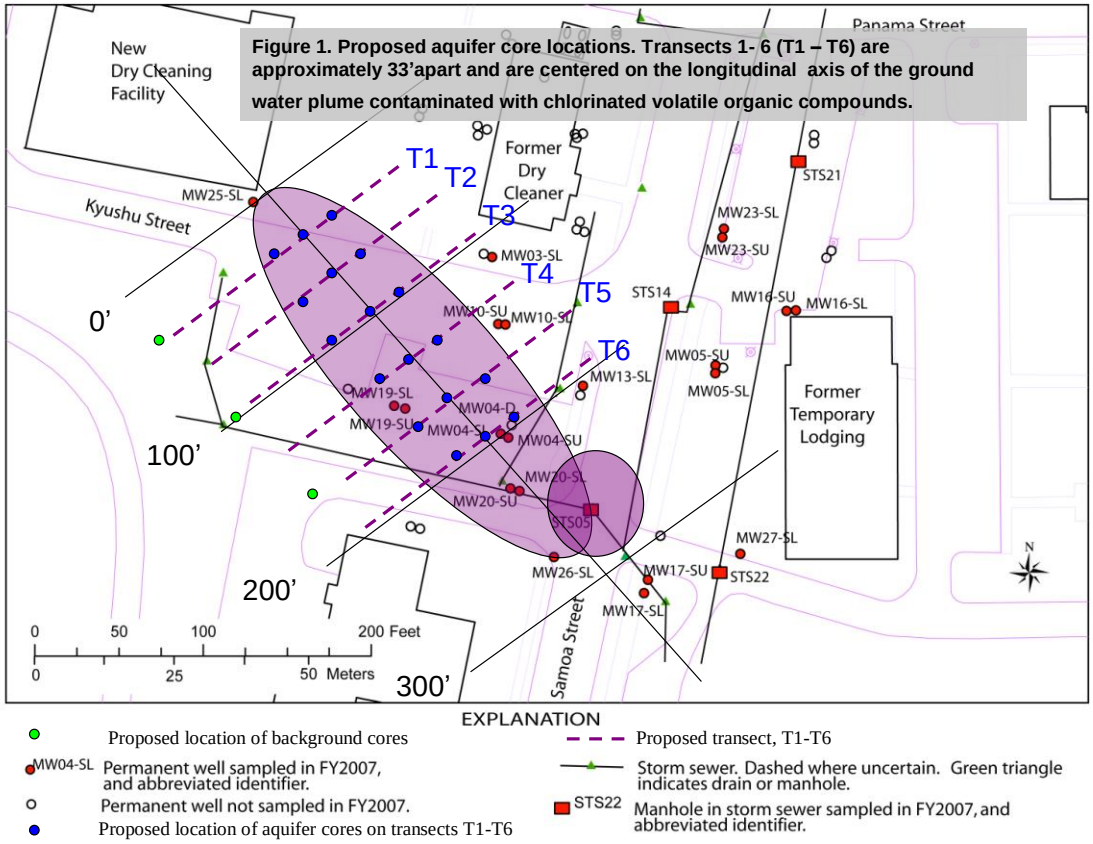

Figure 1. Proposed aquifer core locations. Transects 1- 6 (T1 – T6) are approximately 33'apart and are centered on the longitudinal axis of the ground water plume contaminated with chlorinated volatile organic compounds.