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CNC CHARLESTON  
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SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL  
RESPONSE TO U S NAVY COMMENTS ON FINAL RCRA FACILITY INVESTIGATION  
REPORT CNC CHARLESTON SC

1/29/1999

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL



2600 Bull Street  
Columbia, SC 29201-1708

CERTIFIED MAIL

COMMISSIONER:  
Douglas E. Bryant

January 29, 1999

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Caretaker Site Office  
NAVFACENGCOM, Southern Division  
1690 Turnbull Avenue  
Building NH-51  
Charleston, SC 29405

William M. Hull, Jr., MD  
Vice Chairman

Roger Leaks, Jr.  
Secretary

Mark B. Kent

Re: Zone A Response to Comments and  
Final RCRA Facility Investigation (RFI) Report  
Dated August 7, 1998  
Charleston Naval Complex  
SC0 170 022 560

Cyndi C. Mosteller

Brian K. Smith

Rodney L. Grandy

Dear Mr. Shepard:

The South Carolina Department of Health and Environmental Control (Department) has received and reviewed the above referenced Response to Comments and Final RFI Report. The review was performed according to applicable State and Federal Regulations and the Charleston Naval Complex Hazardous Waste Permit effective September 17, 1998. The report presented recommendations on the next step in the corrective action process at units in Zone A. The Department after this review and according to permit condition II.E.8. believes that the units at Zone A should be classified as follows:

SWMU 1	CMS (to be addressed as part of SWMU 2)
SWMU 2	CMS (with conditions)
SWMU 38	CMS (with conditions)
SWMU 39	CMS (with conditions)
SWMU 42/AOC 505	CMS (with conditions)
SWMU 43	Pending (with conditions)
AOC 506	CMS (limited removal)
Ecological subzone A1	No further evaluation required.

Based on this review and contingent that the attached conditions are met the Department approves the Zone A final RFI report.

It should be noted that the permit shall be modified pursuant to R.61-79.270.41. The US EPA has not provided written comments or an approval letter to date

The Department's concurrence is based on the information provided by the Navy to date. Any new information contradicting the basis for this concurrence may require further investigation or action.

H. Shepard  
January 29, 1999  
Page two

Should you have any questions regarding this issue, please contact Johnny Tapia at (803) 896-4179 or Paul Bergstrand at (803) 896-4016.

Sincerely,

Joan Hartley, Manager  
Corrective Action Engineering Section  
Bureau of Land & Waste Management

cc: Paul Bergstrand, Hydrogeology  
Rick Richter, Trident EQC  
David Dodds, SOUTHNAVFACENGNCOM  
Dann Spariosu, EPA Region IV  
Todd Haverkost, ENSAFE



2600 Bull Street  
Columbia, SC 29201-1708

CERTIFIED MAIL

COMMISSIONER:  
Douglas E. Bryant

February 19, 1999

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Rodney L. Grandy

Henry Shepard II, P.E.  
Caretaker Site Office  
NAVFACENGCOM, Southern Division  
1690 Turnbull Avenue  
Building NH-51  
Charleston, SC 29405

Re: SWMU 43  
Publications and Printing Plant (Building 1628)  
Charleston Naval Complex  
SC0 170 022 560

Dear Mr. Shepard:

In correspondence dated January 29, 1999 the South Carolina Department of Health and Environmental Control (Department) provided conditional approval of the Zone A RCRA Facility Investigation (RFI) report, and determined the corrective action status of the units located within Zone A.

SWMU 43 status was determined as "Pending" based on the potential impact to ecological receptors in Noisette Creek. This issue was discussed with the Navy and its contractor Ensafe. The outcome of this discussion was to visit the unit to visually verify site conditions and potential past or present impacts to Noisette creek. After the visit to SWMU 43 by Mr. Paul Bergstrand, the Department has decided that a potential impact from this unit to Noisette creek (past and present) is unlikely.

Based on the above the Department believes that the corrective action status of SWMU 43 is "No Further Action" (NFA).

It should be noted that the permit shall be modified pursuant to R.61-79.270.41 to change the status on this unit.

The Department's concurrence is based on the information provided by the Navy to date. Any new information contradicting the basis for this concurrence may require further investigation or action.

Hartley to Shepard  
February 19, 1999  
page 2

Should you have any questions regarding this issue, please contact Johnny Tapia at (803) 896-4179 or Paul Bergstrand at (803) 896-4016.

Sincerely,



Joan Hartley, Manager  
Corrective Action Engineering Section  
Bureau of Land & Waste Management

cc: Paul Bergstrand, Hydrogeology  
Rick Richter, Trident EQC  
David Dodds, SOUTHNAVFACENGNCOM  
Dann Spariosu, EPA Region IV  
Todd Haverkost, ENSAFE



**DEPARTMENT OF THE NAVY**

SOUTHERN DIVISION  
NAVAL FACILITIES ENGINEERING COMMAND  
P.O. BOX 190010  
2155 EAGLE DRIVE  
NORTH CHARLESTON, S.C. 29419-9010

5090/11  
Code 18710  
16 Feb 1999

Mr. John Litton, P.E.  
Director, Division of Hazardous and Infectious Waste Management  
Bureau of Land and Waste Management  
South Carolina Department of Health and Environmental Control  
2600 Bull Street  
Columbia, SC 29201

Subj: SUBMITTAL OF ZONE C CORRECTIVE MEASURE STUDY WORKPLAN PAGE  
CHANGES

Dear Mr. Litton,

The purpose of this letter is to submit the enclosed Zone C Draft Corrective Measure Study (CMS) Work Plan page changes for Naval Base Charleston. The work plan is submitted to fulfill the requirements of condition IV.E.2 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and the U.S. Environmental Protection Agency (USEPA).

The revised workplan pages are sent in response to comments received from the Department and the USEPA. These responses have been previously discussed with Department personnel. The Navy requests that the Department and the USEPA review and provide comment or approval whichever is appropriate. If you should have any questions please contact Billy Drawdy (843) 743-9985 or myself at (843) 820-5563 respectively.

Sincerely,

A handwritten signature in black ink that reads "David P. Dodds".

DAVID P. DODDS  
Remedial Project Manager  
Installation Restoration III

Encl:

(1) Zone C Corrective Measure Study Workplan page changes, dated 4 February 1999

Copy to:

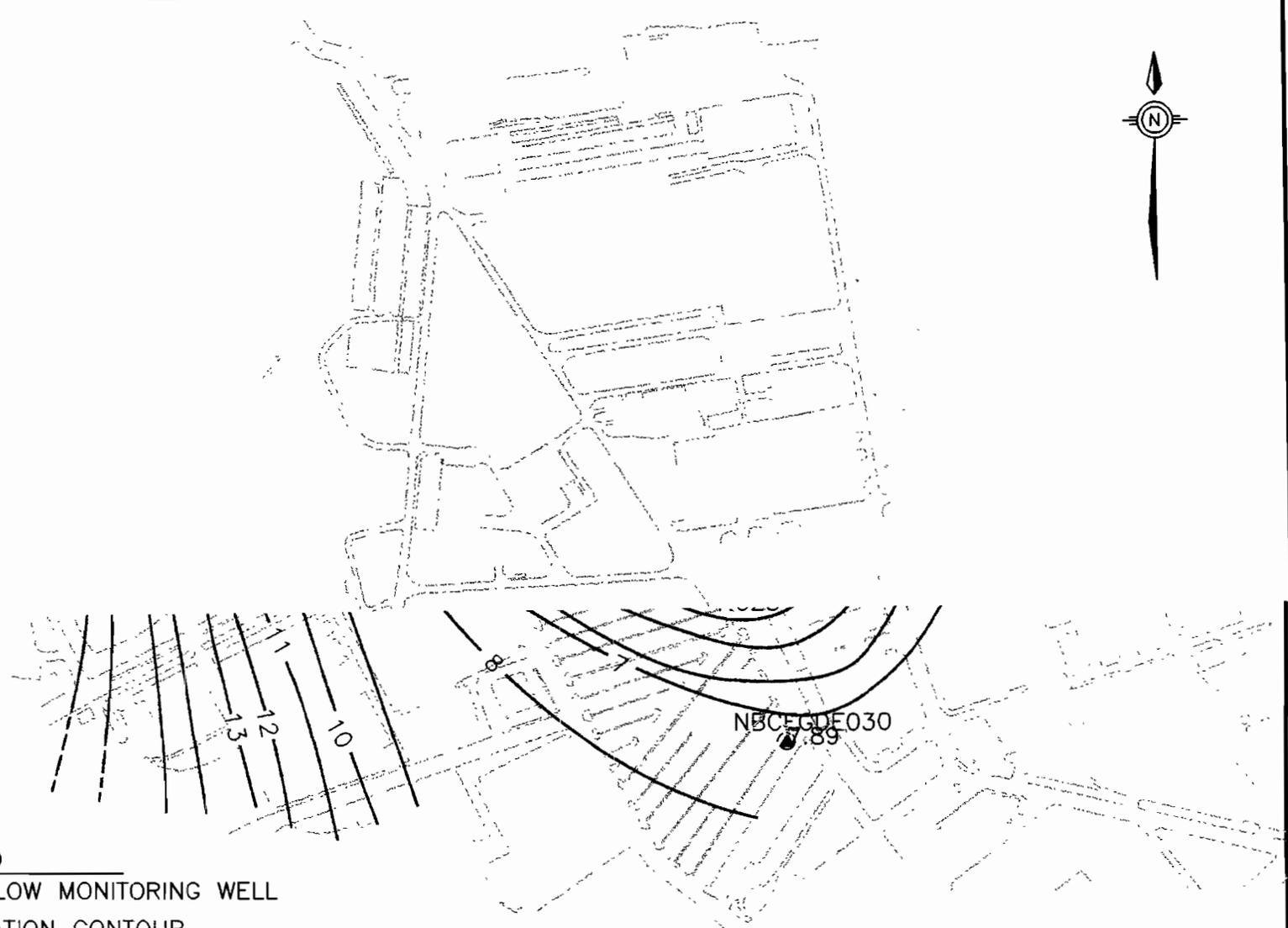
SCDHEC (Paul Bergstrand, Johnny Tapia), USEPA (Dann Spariosu)  
CSO Naval Base Charleston (Billy Drawdy), SOUTHNAVFACENGCOM (Tony Hunt)  
SPORTENVDETCASN (Bobby Dearhart)

### **FILING INSTRUCTIONS**

The following is a list of pages in the *Draft Zone C Corrective Measures Study Work Plan* dated *June 23, 1998*, that have been revised. The obsolete pages presently in your binders are listed in the column headed "Remove." New and replacement pages are listed in the column headed "Replace." Please file this instruction cover sheet preceding the Table of Content of *Draft Corrective Measures Study Work Plan for Zone C*.

If you have any questions, please call 843-884-0029.

<b>List of Changes/Revisions</b>	<b>Remove <u>Pages</u></b>	<b>Replace <u>Pages</u></b>
Section 4.6	Figure 4.4	Figure 4.4
Section 9.0	Figures 9.1 through 9.4	Figures 9.1 through 9.4
Appendix A		New Appendix A



**LEGEND**

- - SHALLOW MONITORING WELL
- 9 — - ELEVATION CONTOUR

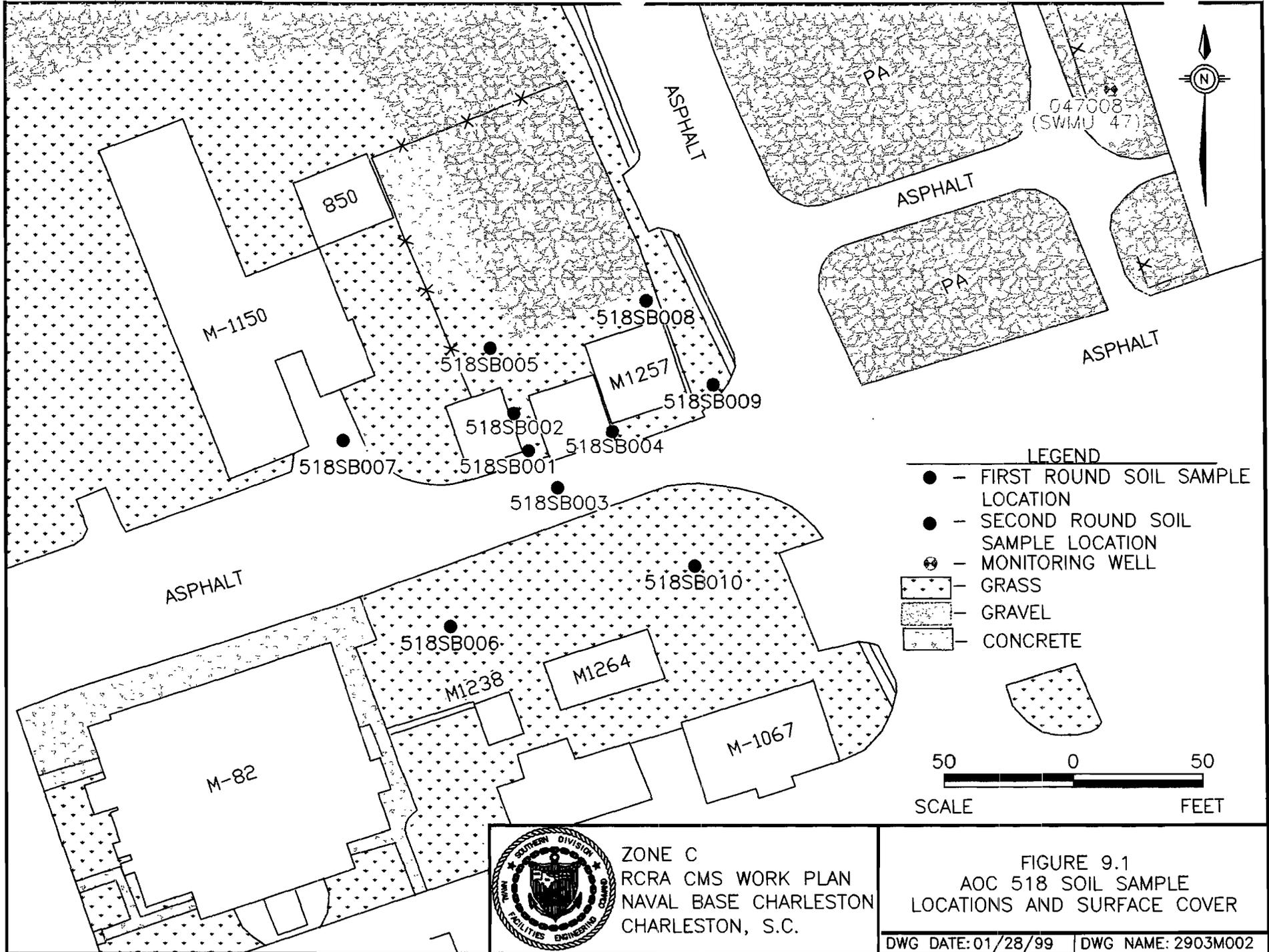
NOTES: ELEVATION IN FEET MSL  
 ND - NO DATA  
 CONTOUR INTERVAL = 1 FEET



ZONE C  
 RCRA CMS WORK PLAN  
 NAVAL BASE CHARLESTON  
 CHARLESTON, S.C.

FIGURE 4.4  
 ZONE C  
 SHALLOW GROUNDWATER ELEVATION  
 MAP - JANUARY, 1998

DWG DATE: 01/29/99 | DWG NAME: 2903B008



**LEGEND**

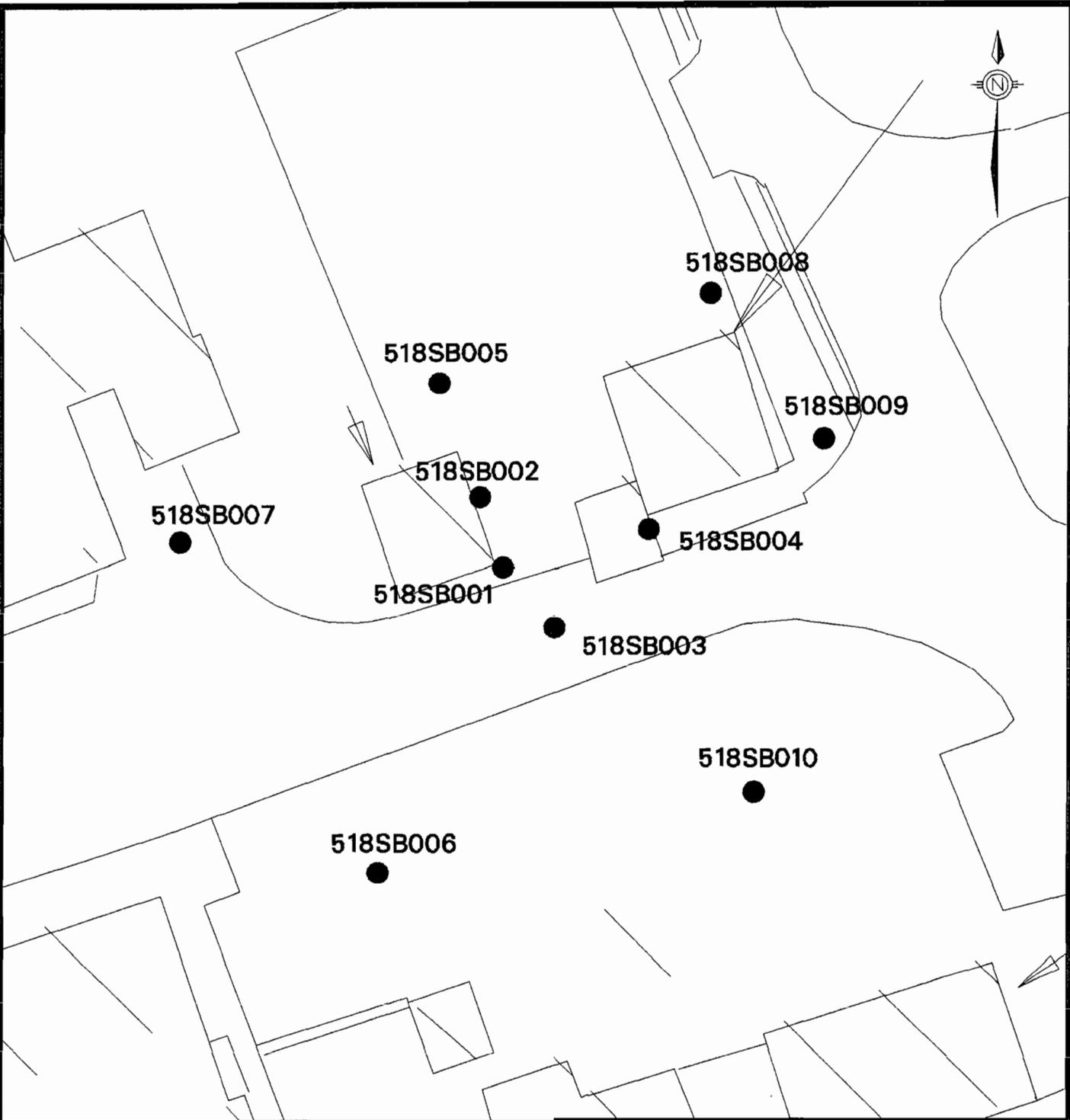
- - FIRST ROUND SOIL SAMPLE LOCATION
- - SECOND ROUND SOIL SAMPLE LOCATION
- ⊗ - MONITORING WELL
- [Grass pattern] - GRASS
- [Gravel pattern] - GRAVEL
- [Concrete pattern] - CONCRETE

50 0 50  
SCALE FEET



ZONE C  
RCRA CMS WORK PLAN  
NAVAL BASE CHARLESTON  
CHARLESTON, S.C.

FIGURE 9.1  
AOC 518 SOIL SAMPLE  
LOCATIONS AND SURFACE COVER

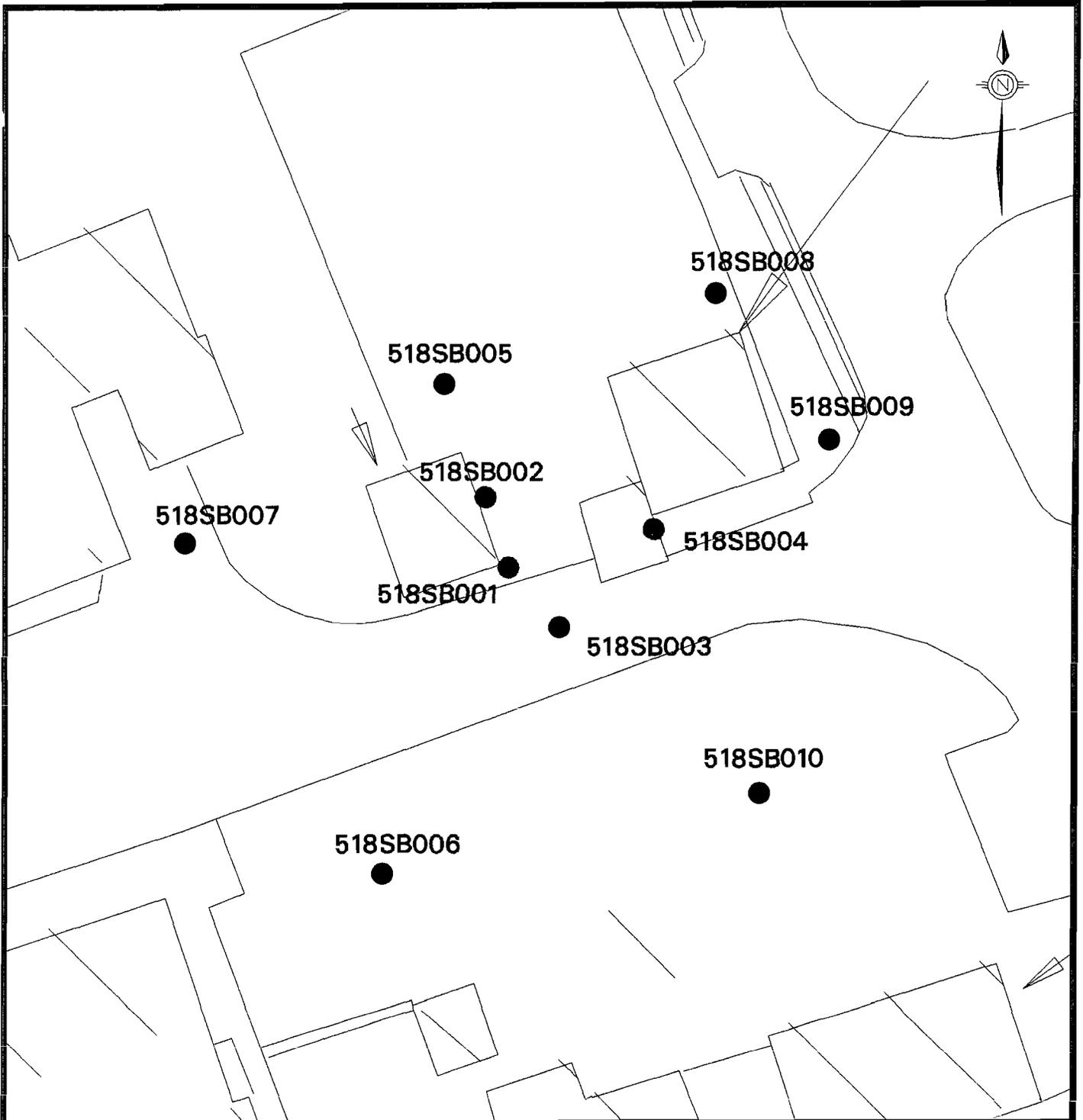


- LEGEND**
- NO COPCs DETECTED
  - < 1E-6
  - 1E-6 to 5E-6
  - 5E-6 to 1E-5
  - 1E-5 to 1E-4
  - > 1E-4



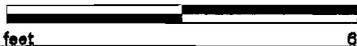
**ZONE C  
RCRA CMS WORK PLAN  
NAVAL BASE, CHARLESTON  
CHARLESTON, S.C.**

**FIGURE 9-2  
AOC 518  
POINT RISK ESTIMATES ABOVE BACKGROUND  
FOR SURFACE SOIL RESIDENTIAL SCENARIO**



**LEGEND**

- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

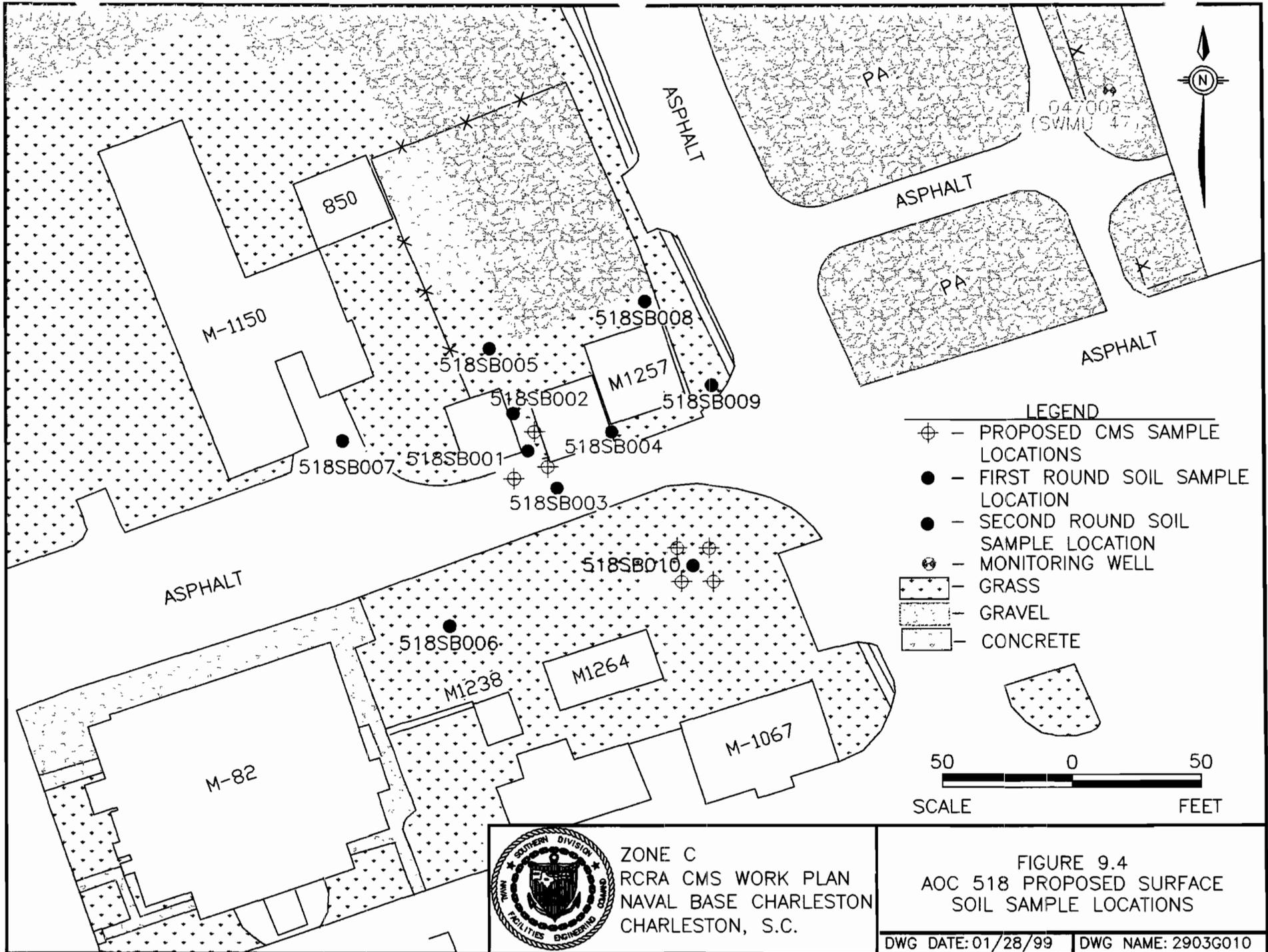


**ZONE C  
RCRA CMS WORK PLAN  
NAVAL BASE, CHARLESTON  
CHARLESTON, S.C.**

**FIGURE 9-3  
AOC 518  
POINT RISK ESTIMATES ABOVE BACKGROUND  
FOR SURFACE SOIL INDUSTRIAL SCENARIO**

ANL:

/home3/projects/charleston\_dir/zone\_c\_dir/fak\_dir/walncms.a.m



## **USE OF TPH AND TIC ANALYTICAL RESULTS FOR RFI EVALUATION AT CNC**

### **INTRODUCTION**

Following the announcement of base closure, the number of environmental sites investigated at the Charleston Naval Complex (CNC) increased dramatically from 36 to over 400. Petroleum releases were identified as a concern at a large number of these sites throughout the base and considerable discussion occurred between members of the project team whether these petroleum impacted sites should be investigated in the RFI or managed under guidelines established for addressing petroleum in the SCDHEC underground storage tank program. Generally, a decision was made on a site-by-site basis and depended on whether the project team had sufficient knowledge to know whether the product managed at the site was virgin petroleum or if other RCRA-regulated compounds were potentially present. At questionable sites, the team agreed to keep the sites in the RFI, analyze for a broad spectrum of constituents, and also analyze for total petroleum hydrocarbons (TPH).

TPH presents the total amount of petroleum hydrocarbons present as a single number, but it doesn't give any information on the individual hydrocarbon constituents present. TPH analysis is a useful tool for cost effectively identifying hotspots or delineating boundaries of contamination which is why it is commonly used. The TPH analysis at the CNC was originally performed using Method 418.1 by IR, and then later the switch was made to Method 8015 (modified for Gasoline Range Organics/Diesel Range Organics) by GC methods.

If the analytical data confirmed only TPH or those constituents which make up petroleum hydrocarbons were found, the site would be transferred over to the petroleum program. The feeling of the team was that it would save time and money to address these sites in the petroleum corrective action program than the more cumbersome RCRA corrective action program. For the most part this approach has worked. Yet, there does exist a number of sites where the analytical scheme of analyzing for a full suite of compounds plus TPH has led to some confusion. A typical question which often arises is; "What needs to be done at sites where the risk drivers are not TPH

related, yet TPH detections were reported?" While TPH itself is not explicitly regulated, some of the components that make up TPH are subject to regulatory thresholds and/or cleanup criteria. However, TPH is covered under the broad wording of the SC Pollution Control Act.

This memo is intended to provide the project team a summary of available literature references regarding the composition of TPH, how TPH values are used in risk assessments, and site-specific examples of how TPH data were used in the RFI. The CNC information contained in this memo and the references cited should be useful in helping the project team make appropriate risk management decisions concerning TPH.

### **COMPONENTS OF PETROLEUM HYDROCARBONS**

To understand how the approach used for the RFI at the CNC can work, it is helpful to first have a basic knowledge of the composition of petroleum fuels. Petroleum fuels are complex mixtures of hundreds to thousands of chemicals. Petroleum fuels are derived from crude oil that is primarily hydrocarbons (organic compounds composed of hydrogen and carbon) but some non-hydrocarbons (compounds containing other elements such as oxygen, sulfur, and nitrogen) are also present.

Petroleum hydrocarbons are made up of paraffinic, cycloparaffinic, and aromatic hydrocarbons. The most important petroleum fractions are various hydrocarbon gases (butane, ethane, and propane), naphtha of several grades, gasoline, kerosene, diesel oil, fuel oil, gas oil, lubricating oils, paraffins, and asphalt. Paraffins (interchangeable with the word *alkanes*) are a class of aliphatic hydrocarbons which are straight- or branched-chain hydrocarbons. The branched-chain paraffins are much more suitable for gasoline than the straight-chain. Cycloparaffins such as cyclopropane, cyclobutane, and cyclohexane are ring-structured hydrocarbons and are derived from petroleum or coal tar. Aromatic compounds are single or multi-benzene ring hydrocarbons which comprise about 10 to 40% of gasoline and about 25 to 35% of No. 2 fuel oil. Heavy fuel oils typically contain 15 to 40% aromatic hydrocarbons, dominated by the heavier polynuclear aromatic hydrocarbons (PAHs), which are the multi-benzene ring hydrocarbons.

As stated above, TPH can be divided into the Gasoline Range Organics (GRO) and the Diesel Range Organics (DRO). The GRO values consist of fractions of hexanes, cycloparaffins, and aromatic hydrocarbons. Because methyl-tert-butyl ether (MTBE) has been added to gasoline since about 1980, analysis of samples for MTBE by Method 8260 can determine if the gasoline present is pre-1980. MTBE was added as an oxygenate to reduce carbon monoxide exhaust emissions and also as an antiknock agent. Some aromatic hydrocarbons that may be present in gasoline are benzenes, toluenes, cycloalkanes, and xylenes.

The DRO compounds consist mainly of fuel and diesel oils, naphtha, lubricating oil, paraffins, and PAH. There are mainly four types of fuel oils which may be found totaled in the DRO analysis. The No.1 fuel is used for domestic heating. No.4 fuel is used for commercial or industrial burner installation not equipped with preheating facilities. The No.5 and No.6 fuel oils are bunker fuels, which must usually be preheated before being burned. These fuels are used in furnaces and boilers of utility plants, ships, locomotives, metallurgical operations, and industrial power plants. Diesel oil is fuel for diesel engines in trucks, ships, and other automotive equipment, and is obtained from distillation of petroleum. Diesel oil is composed chiefly of unbranched paraffins.

#### **ANALYSIS FOR TPH AND TPH COMPONENTS**

Analysis for TPH used for site characterization purposes is typically performed by EPA Method 8015. The results can be separated into the diesel range fraction and the gasoline range fraction as noted above; however, these results are not compound specific and only represent the total amount of petroleum hydrocarbons.

The SW846 8260 Appendix IX and USEPA Contract Laboratory Program (CLP) methods of analysis for volatile organic compounds (VOCs) are capable of generating compound-specific results. Of the indicator compounds listed above, compounds such as benzene, toluene, ethylbenzene, and xylene are normally reported in the volatile organic analysis. MTBE and naphthalene can also be reported in the SW846 8260 method upon request. Because those compounds only represent a portion of the gasoline components which may be present, the laboratory can be asked to report them as "tentatively identified compounds" (TICs). These are

compounds that are present in the sample, show up on the chromatogram, and are identified by a comparison to the analytical laboratory's mass spectra library in the gas chromatograph/mass spectrometer (GC/MS). A typical library contains 50,000 to 70,000 compounds and their mass spectra.

For every GC/MS, a calibration curve is created with five standards made up from the method analyte or regulatory list and the compound's instrument response factor is determined. Quantitation of the results can then be made on the compounds present in the sample. Typically a list consists of 25 to 50 compounds, therefore, quantitation of the TICs is not exact since standards were not analyzed for these compounds and TICs can only be reported as an estimated value since there is no response factor associated with the TICs. Reviewing the TICs can provide useful information when there appears to be a large discrepancy between TPH values and VOC and semi-volatile organic compound (SVOC) results, but the procedure still does not account for petroleum hydrocarbons that do not separate in the GC column and elute as an extremely elevated baseline on the chromatogram.

Similarly, the SW846 method for SVOCs can identify compounds specific to the diesel range petroleum hydrocarbons. The TICs for the samples discussed later did show detections of unknown PAHs, methyl-naphthalenes, alkanes, and cycloalkanes, which are all constituents of petroleum hydrocarbons.

## **TOTAL PETROLEUM HYDROCARBONS IN RISK ASSESSMENTS**

As mentioned above, TPH analyses usually determine the total amount of hydrocarbons present as a single number and give little or no indication of the types of hydrocarbons present. These analyses are useful for site characterization, but are not suitable for risk assessments because the general measure of TPH does not provide sufficient information about the amounts of individual compounds present. On the other hand, it is not practicable to attempt to evaluate every compound present in petroleum hydrocarbons. This effort would be time consuming, cost prohibitive, and counter to the goal of expedited cleanup. For this reason, the risk assessment community has focused on assessing the impacts of a select group of indicator compounds that are

inherently assumed to represent a significant fraction of the overall potential risk associated with petroleum hydrocarbons.

## **INDICATOR COMPOUNDS**

Indicator compounds are selected based on their concentrations, exposure routes, toxicological properties, mobility, and aesthetic characteristics. Aromatic hydrocarbons (BTEX, PAHs, etc.) are typically selected because they are the constituents that human and ecological receptors tend to be the most sensitive to with respect to adverse affects. Aliphatic hydrocarbons are usually of less concern because of their relatively low toxicities. Additives such as MTBE, ethylene dibromide (EDB), and ethylene dichloride (EDC) may need to be considered if they are identified as being present in significant quantities. Toxicity information for the indicator compounds is readily available from the Integrated Risk Information System (IRIS) and EPA Health Effects Assessment Summary Tables (HEAST) databases. Significant information may exist in the literature regarding a number of the other components of petroleum hydrocarbons, but if confirmatory information is not available on either IRIS or HEAST, there is generally a reluctance to use the information for risk assessment purposes.

Of the 162 recognized compounds in GRO and 82 compounds in DRO, only 18 compounds are listed in the IRIS or HEAST databases. Some of the most common indicator compounds selected based on the criteria outlined above are:

Benzen
Toluene
Ethylbenzene
Xylenes
Lead
Benzo(a)pyrene
Anthracene
Fluoranthene
Benzo(a)anthracene

Fluorene
Naphthalene
Pyrene
Phenanthrene
Chysene
Benzo(k)flouranthene
Benzo(g,h,i)perylene
Benzo(b)flouranthene
Dibenz(a,h)anthracene

Other compounds that are sometimes present as additives that are occasionally used as indicator compounds are:

Methyl- <i>t</i> -butyl Ether	Isopropylbenzene
<i>n</i> -Butyl Alcohol	<i>n</i> -Hexane
Methyl Alcohol	Ethylene Dibromide
Dibromoethane	Ethylene Dichloride

The significance placed on these compounds is evidenced by the fact that the majority of them are listed as the chemicals of concern (COCs) in the SCDHEC *Risk Based Corrective Action for Petroleum Releases* guidance. The only other prominent COCs that are of interest to the petroleum program that are not listed above are the metals (in addition to lead) that are commonly associated with waste oil.

### **APPLICATION AT CHARLESTON NAVAL COMPLEX**

Generally, sites with TPH detections can be characterized under one of three scenarios. For illustrative purposes of this memo, samples in Zones A, C, and H that were identified as having high TPH concentrations were selected to demonstrate how the information is being evaluated to support the RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) process.

#### **Scenario 1**

- High TPH detections
- Indicator compounds detected
- Indicator compounds are risk drivers. (Other COCs may also be present.)
- Site was retained in the RFI/CMS process.

#### **Scenario 2**

- High TPH detections
- Indicator compounds detected
- No or very low risk at site
- Site is candidate for completion under the UST program.

#### **Scenario 3**

- TPH detected
- No or very few indicator compounds detected
- Either no risk or risk drivers are COCs other than indicators
- Site may be retained in the RFI/CMS process, may be transferred to the UST program, or the site may be recommended for NFA.

### Scenario 1

Under the first scenario, the risk management decision making process with respect to TPH is the easiest for the project team. SWMU 39 in Zone A was selected as an example of this situation. TPH detections are reported in multiple soil samples along with various indicator compounds. The analytical results for samples 039SB00801 and 039SB00802 presented in Table 1 are representative of much of the soil data for the site. These samples are from the same location, but different depth intervals. The laboratory data sheets reporting the VOC and SVOC TICs are in Attachment 1.

**Table 1**  
**SWMU 39**  
**Data Comparison of TPH and Associated Indicator Compounds ( $\mu\text{g}/\text{kg}$ )**

Parameter	039SB00801	039SB00802
TPH-Gasoline	1300000	19000000
TPH-Diesel	380000	9500000
Benzene	6 U	990 D
Ethylbenzene	6 U	22000 D
Xylenes	6 U	48000 D
Anthracene	810 U	1100
Fluorene	810 U	10000
Phenanthrene	300 J	12000
Pyrene	810 U	890

**Notes:**

- U — non-detect
- J — estimated
- D — diluted

In both samples, high TPH concentrations are evident. The surface interval sample (039SB00801) does not contain the indicator compounds that are present in the 3- to 5-foot interval sample (039SB00802). Similarly, the laboratory only reported two TICs in the surface interval, whereas 30 were reported in the lower interval. A number of possible explanations related to the fate and transport characteristics of these compounds in the environment could be given to explain the

differences in the respective concentrations of the samples, but that is beyond the scope of this memo. What is important is that indicator compounds are identified at this site as contaminants of concern (COCs) for both soil and groundwater in the baseline risk assessment (BRA).

Site characterization, the baseline risk assessment, and ultimately CMS decisions will be based on these indicator compounds, along with other COCs which happen to be present at this site. The TPH data served its intended purpose as screening data to alert the team to the presence of petroleum contamination but its significance was down played once individual COCs were identified. In the end, the project team can be confident that TPH will be addressed when the individual COCs are addressed. The collection of additional TPH data during the CMS would not be recommended since it would not offer any additional value to the study.

## **Scenario 2**

Under the second scenario, high TPH detections are reported at SWMU 178 in Zone H along with multiple indicator compounds. Soil samples were collected from six locations at this site. TPH was detected at all six locations. Nine indicator compounds were detected with an individual sample detection frequency ranging from none detected to all nine being detected in one sample. To demonstrate how the data evaluation was performed with respect to SWMU 178, the surface and subsurface interval samples results (TPH and indicator compounds only) from the same location are presented in Table 2.

The surface interval sample 178SB00501 is the location where all nine indicator compounds were detected. With the exception of toluene, the indicator compounds are the heavier fraction petroleum hydrocarbons identified by a semi-volatile scan. Since the TPH result is approximately two orders of magnitude greater in the deeper interval sample, it might be reasonable to expect similar detections of indicator compounds, but that is not the case.

**Table 2**  
**SWMU 178**  
**Data Comparison of TPH and Associated Indicator Compounds (ug/kg)**

<b>Parameter</b>	<b>178SB00501</b>	<b>178SB00502</b>
<b>TPH</b>	<b>140000</b>	<b>10000000</b>
Benzene	6 U	6 U
Ethylbenzene	6 U	6 U
Toluene	4.7 J	6 U
Xylenes	6 U	6 U
Chrysene	150 J	21000 U
Benzo(a)pyrene	140 J	21000 U
Fluoranthene	270 J	21000 U
Benzo(a)anthracene	140 J	21000 U
Benzo(b)fluoranthene	200 J	21000 U
Benzo(k)fluoranthene	130 J	21000 U
Phenanthrene	110 J	21000 U
Pyrene	290 J	21000 U

**Notes:**

- U — non-detect
- J — estimated

The results of the volatile and semi-volatile organic scans for 17800502 are all non-detect, which seems to contradict the TPH data. In reality, the TPH data for this sample provide valuable insight as to why the quantitation limits for the semi-volatile scan are significantly elevated. The substantially elevated petroleum hydrocarbon concentrations have created a matrix interference which, as previously mentioned, results in an extremely elevated baseline on the chromatogram.

At this point in the data evaluation process, the TIC results become very important. A review of the TICs for sample 178SB00502 (Attachment 2) shows that the laboratory has reported the presence of 20 hydrocarbon compounds with a combined estimated concentration of

862,000  $\mu\text{g}/\text{kg}$ . More may be present, but in this case the laboratory was asked to report the 20 highest concentrations.

The carcinogenic PAHs (expressed as benzo[a]pyrene equivalents) were the only COCs identified in the baseline risk assessment for SWMU 178. A residential risk of 2E-06 was calculated for the site (Attachment 2). The risk may be slightly understated due to the fact that the indicator compounds could not be positively identified and quantified in some samples due to concentrations of petroleum hydrocarbons being elevated to the point they caused analytical interferences. This is a concern that should not be completely dismissed, but it does not affect the foregone conclusion that the primary concern at this site is petroleum hydrocarbons. As a result, the project team was able to transfer this site for completion under the UST program.

Future decisions will likely be based on the presence/absence of indicator compounds, but TPH analyses may have some added benefit to assessment work under the petroleum program. The analytical laboratory should be informed of the past results and potential interference problems so they can offer possible remedies or alternative means of quantifying the indicator compounds. Another consideration is the fact that TPH could be used to delineate or screen the areas of highest concentrations and the more sensitive, compound-specific analyses used to define the outer perimeter where the concentrations will eventually reach non-detect levels.

### **Scenario 3**

The third scenario has proven to be one of the more difficult for the team when it comes to making risk management decisions. The difficulties appear to stem largely from data presentation deficiencies and lack of a clear explanation of how the available data are used to make decisions. Under Scenarios 1 and 2, this memo has focused on the comparison of compound-specific VOC/SVOC results to TPH results and how TIC results were used to help interpret that data. Under those scenarios, it is apparent that a sufficient number of indicator compounds were detected to make decisions and that the TPH and TIC results are simply ancillary data. What has not been addressed is that TIC data, while available for use by the authors of the RFI reports, has not been included, or at least minimally discussed in the RFI reports for the benefit of the

reviewers. Since one of the criteria for Scenario 3 is none or very few detections of indicator compounds, the TIC data become a necessary tool in helping to evaluate the TPH results.

Consider AOC 698 in Zone K as an example. No indicator compounds were detected in any of the eight samples analyzed for VOCs and SVOCs. The sampling protocol for the CNC RFI calls for duplicate samples to be collected at a frequency of one per every 10 site samples. The duplicate is analyzed for a broader spectrum of constituents which in this case included TPH. This duplicate sample was collected at soil boring 698SB002 from the surface interval. A TPH detection of 149,000  $\mu\text{g}/\text{kg}$  was reported. Benzene and TPH were detected in groundwater. Considering the fact a petroleum aboveground storage tank (AST) is located at the site, the team could reasonably assume it to be the source of the release.

The primary surface soil risk driver at the site is not benzene, but rather arsenic with a maximum detection of only 10.5 mg/kg. With the exception of benzene, the other groundwater COCs are either metals or pesticides (Attachment 3).

To evaluate Scenario 3, TIC data (Attachment 3) were reviewed for the same sample for which TPH analysis was performed, plus two additional sample locations near the AST to see if it provided an explanation of TPH detections in soil. Not surprisingly, petroleum constituents were found in every sample. It should not be a concern that TPH analysis was only performed on one sample because the TIC data can provide the same basic information about the presence of petroleum at the site.

Ironically, the TPH data were minimally discussed in the RFI report and the TIC data were not discussed at all. The reason is that, to date, these parameters are generally considered insignificant in the RFI in terms of decision making because neither TPH nor the TICs contribute to risk values nor are they "regulated" constituents.

To the contrary, the TPH and TIC data provide valuable information to the project team in the absence of indicator compounds. Even if TPH and TICs are not regulated under either the RCRA

or UST programs and neither contributes to risk, their presence could present some interesting problems to the team if regarded too lightly. If a decision were made by the team to proceed into the CMS with this site on the basis of the primary risk driver arsenic, the presence of petroleum in soil could potentially be overlooked and have unknown consequences on remedies designed to address non-petroleum-related contaminants. Sites that pose low risk such as AOC 698 could possibly be considered for no further action solely on the basis of calculated risk numbers. What if a site similar to AOC 698 were located near a sensitive environment such as the Cooper River and future reuse plans call for considerable construction activities? The site could be deemed suitable for redevelopment on the basis of non-detect results for regulated constituents. In reality, petroleum is present and could be released into the river during construction activities causing a visible product sheen on the water. This actually happened on a site currently listed in the Georgia Hazardous Sites Index.

On the other hand, the team may decide that the TPH poses no risk, the site is not located near a sensitive receptor, there is little chance it will migrate to other media, or it won't adversely affect remedies selected to address other COCs. In such a case, a prudent risk management decision could simply be to acknowledge its presence but leave it be. The data have to at least be presented so the project team can make a risk management decision considering all the facts.

## **CONCLUSIONS**

Petroleum indicator compounds identified as COCs and/or non-petroleum-related COCs identified through the baseline risk assessment process clearly serve as the basis for making risk management decisions under the first two scenarios described above. Though not discussed in the memo, Scenarios 1 and 2 are far more common at CNC than the third scenario. Even so, the third scenario illustrates that there are unique situations where the identification of petroleum constituents through the reporting of TICs and TPH with respect to soil can have a substantial impact on risk management decisions despite the fact there are no regulatory thresholds for either.

The CNC data support what the literature references point out; TPH analysis is a cost effective tool for site characterization, but most often the data are of little use in risk assessments and

subsequently in risk management decisions. TPH data were most helpful when used as ancillary information to help interpret the results of the compound-specific analyses. The same can be said for the TIC data since the two contain redundant information. The only significant difference in how the two were used in the RFI is that the TPH results were presented in the report, whereas the TIC data were not.

A review of the data and how it was presented in the RFI showed that the confusion caused by the presence of TPH with the conspicuous absence of COCs can be eliminated through a logical, sequential explanation of the data. In all three scenarios, there were sufficient data gathered to adequately characterize the site, but often some of the data were either not presented or presented separately rather than discussed in the context of what it meant in terms of the "big picture." Every site is unique, and how TPH and TIC data are best used will likely be determined on a case-by-case basis, but through effective data presentation, the best use should become evident.

## REFERENCES

American Society for Testing and Materials, 1994, Emergency Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. *Annual Book of ASTM Standards*.

Heath, J., et al., 1993, Review of Chemical, Physical, and Toxicologic Properties of Components of Total Petroleum Hydrocarbons. *Journal of Soil Contamination*. 2:1-25.

Sax, Irving, and Lewis, Richard, 1987, *Hawley's Condensed Chemical Dictionary*, Eleventh Edition.

**Attachment 1**

**SWMU 39**

**VOC and SVOC TIC Laboratory Data Sheets  
and Summary of Risk and Hazard-Based COCs**

**VOLATILE ORGANIC ANALYSIS RESULTS**  
**FOR ANALYSES USING METHOD 8260**  
**TENTATIVELY IDENTIFIED COMPOUNDS**

<b>Client Sample ID: NBCA1039SB00801</b>	<b>LAL Sample ID: L5506-11</b>
<b>Date Received: 03-OCT-95</b>	<b>Date Analyzed: 12-OCT-95</b>
<b>Matrix: SOIL</b>	<b>Analytical Dilution Factor: 1</b>
<b>Analytical Batch: 101195-8260-J2</b>	<b>Preparation Dilution Factor: 0.982</b>

<b>Tentatively Identified Compound</b>	<b>Estimated Concentration (µg/Kg)</b>	<b>Retention Time (minutes)</b>	<b>Data Qualifier(s)</b>
UNKNOWN	30	8.52	J
UNKNOWN HYDROCARBON	20	11.68	J

**VOLATILE ORGANIC ANALYSIS RESULTS**  
**FOR ANALYSES USING METHOD 8260**  
**TENTATIVELY IDENTIFIED COMPOUNDS**

<b>Client Sample ID: NBCA\039SB00802</b>	<b>LAL Sample ID: L5506-12</b>
<b>Date Received: 03-OCT-95</b>	<b>Date Analyzed: 13-OCT-95</b>
<b>Matrix: SOIL</b>	<b>Analytical Dilution Factor: 1</b>
<b>Analytical Batch: 101295-8260-J2</b>	<b>Preparation Dilution Factor: 0.982</b>

<b>Tentatively Identified Compound</b>	<b>Estimated Concentration (µg/Kg)</b>	<b>Retention Time (minutes)</b>	<b>Data Qualifier(s)</b>
UNKNOWN	300	9.05	J
UNKNOWN	200	9.45	J
UNKNOWN	200	10.76	J
UNKNOWN	400	13.01	J
UNKNOWN	400	13.50	J
UNKNOWN	30	14.75	J
UNKNOWN	40	14.91	J
UNKNOWN	50	15.98	J
UNKNOWN HYDROCARBON	30	18.33	J
UNKNOWN	50	19.01	J

**SEMIVOLATILE ORGANIC ANALYSIS RESULTS  
FOR ANALYSES USING METHOD 8270  
TENTATIVELY IDENTIFIED COMPOUNDS**

Client Sample ID: NBCA1039SB00802	LAL Sample ID: L5506-32
Date Received: 03-OCT-95	Date Analyzed: 16-OCT-95
Matrix: SOIL	Analytical Dilution Factor: 1
Analytical Batch: 101695-8270-K	Preparation Dilution Factor: 0.980

Tentatively Identified Compound	Estimated Concentration (µg/Kg)	Retention Time (minutes)	Data Qualifier(s)
ETHYLBENZENE	1,000	3.95	J
XYLENE ISOMER	1,000	4.06	J
XYLENE ISOMER	1,000	4.73	J
UNKNOWN	2,000	4.95	J
SUBSTITUTED BENZENE	20,000	6.01	J
SUBSTITUTED NAPHTHALENE	2,000	10.46	J
UNKNOWN	2,000	10.65	J
UNKNOWN	2,000	10.95	J
UNKNOWN	30,000	11.37	J
UNKNOWN	7,000	11.42	J
UNKNOWN	50,000	11.51	J
UNKNOWN HYDROCARBON	70,000	11.86	J
UNKNOWN	8,000	12.05	J
UNKNOWN	30,000	12.51	J
UNKNOWN PAH	20,000	12.84	J
UNKNOWN PAH	10,000	13.05	J
UNKNOWN PAH	7,000	13.09	J
UNKNOWN PAH	6,000	13.69	J
UNKNOWN PAH	7,000	13.77	J
UNKNOWN PAH	10,000	13.92	J

Table 10.4.46  
 Summary of Risk and Hazard-based COCs  
 SWMU 39  
 NAVBASE - Charleston, Zone A  
 Charleston, South Carolina

Medium	Exposure Pathway		Future	Future	Future	Site Worker		Identification					
			Resident Adult Hazard Quotient	Resident Child Hazard Quotient	Resident Iwa ILCR	Hazard Quotient	ILCR	of COCs					
Surface Soil	Incidental Ingestion	Aluminum	0.014	0.13	ND	0.0018	ND	1					
		Aroclor 1260	ND	ND	5.3E-07	ND	5.9E-08						
		Arsenic	0.032	0.29	1.6E-05	0.0040	1.8E-06	1	2		4		
		Benzo(a)pyrene equivalents	ND	ND	1.4E-05	ND	1.6E-06			2		4	
		Beryllium	0.000048	0.00044	1.2E-06	0.000061	1.3E-07			2			
	Dermal Contact	Manganese	0.0031	0.029	ND	0.00039	ND						
		Mercury	0.006	0.06	ND	0.0008	ND						
		Aluminum	0.0029	0.0094	ND	0.0020	ND						
		Aroclor 1260	ND	ND	2.4E-07	ND	9.6E-08						
		Arsenic	0.0065	0.021	1.8E-06	0.0046	7.4E-07			2			
		Benzo(a)pyrene equivalents	ND	ND	6.5E-06	ND	2.7E-06			2		4	
		Beryllium	0.00010	0.00032	1.3E-07	0.000070	5.3E-08						
		Manganese	0.00063	0.0021	ND	0.00045	ND						
		Mercury	0.0013	0.0043	ND	0.00094	ND						
Surface Soil Pathway Sum			0.07	0.6	4E-05	0.02	7E-06						
Groundwater Pathways	Ingestion	Aluminum (Al)	0.031	0.072	ND	0.011	ND						
		Arsenic (As)	4.0	9.2	9.8E-04	1.4	2.3E-04	1	2	3	4		
		Barium (Ba)	0.027	0.063	ND	0.0096	ND						
		Benzene	0.94	2.2	4.5E-05	0.34	1.0E-05	1	2	3	4		
		Beryllium (Be)	0.0014	0.0033	1.7E-05	0.00050	3.9E-06			2		4	
		Chlorobenzene	0.0043	0.0101	ND	0.0015	ND						
		Chloroform	0.0099	0.023	3.3E-07	0.0035	7.7E-08						
		Chloromethane	ND	ND	2.6E-07	ND	6.1E-08						
		Chromium (Cr)	0.015	0.035	ND	0.0053	ND						
		1,2-Dichloroethane	ND	ND	4.1E-06	ND	9.5E-07						
		1,1-Dichloroethene	0.010	0.024	3.1E-05	0.0037	7.1E-06			2		4	
		cis-1,2-Dichloroethene	0.38	0.89	ND	0.14	ND	1			3		
		1,2-Dichloroethene (total)	0.38	0.89	ND	0.14	ND	1			3		
		Dioxin Equiv.	ND	ND	1.2E-06	ND	2.7E-07			2			
		Ethylbenzene	0.013	0.031	ND	0.0048	ND						
		bis(2-Ethylhexyl)phthalate	0.0076	0.018	1.2E-06	0.0027	2.7E-07			2			
		Lead (Pb)	ND	ND	ND	ND	ND						
		Manganese (Mn)	2.8	6.6	ND	1.0	ND	1			3		
		2-Methylnaphthalene	0.13	0.30	ND	0.046	ND	1					
		4-Methylphenol	0.085	0.20	ND	0.030	ND	1					
		Naphthalene	0.20	0.46	ND	0.071	ND	1					
		1,1,2,2-Tetrachloroethane	ND	ND	6.7E-06	ND	1.6E-06			2		4	
		Tetrachloroethene	0.043	0.10	1.2E-05	0.015	2.9E-06	1	2		4		
		Thallium (Tl)	0.85	2.0	ND	0.30	ND	1			3		
		Trichloroethene	0.027	0.062	9.6E-07	0.0095	2.2E-07						
		Vanadium (V)	0.0089	0.021	ND	0.0032	ND						
		Vinyl chloride	ND	ND	1.7E-04	ND	3.9E-05			2		4	
		m+p Xylene	0.00059	0.0014	ND	0.00021	ND						
		Inhalation	Benzene	1.65	3.9	4.5E-05	0.59	1.0E-05	1	2	3	4	
			Chlorobenzene	0.015	0.035	ND	0.0054	ND					
			Chloroform	0.0099	0.023	0.0	0.0035	1.0E-06			2		4
			Chloromethane	ND	ND	0.0	ND	2.9E-08					
			1,2-Dichloroethane	0.029	0.067	4.1E-06	0.010	9.5E-07			2		
1,1-Dichloroethene	0.0103		0.024	8.9E-06	0.0037	2.1E-06			2		4		
cis-1,2-Dichloroethene	0.38		0.89	ND	0.14	ND	1			3			
1,2-Dichloroethene (total)	0.38		0.89	ND	0.14	ND	1			3			
Ethylbenzene	0.0047		0.011	ND	0.0017	ND							
1,1,2,2-Tetrachloroethane	ND		ND	6.8E-06	ND	1.6E-06			2		4		
Tetrachloroethene	0.043		0.10	4.8E-07	0.015	1.1E-07	1						
Trichloroethene	0.027		0.062	5.3E-07	0.0095	1.2E-07							
Vinyl chloride	ND		ND	2.6E-05	ND	6.1E-06			2		4		
m+p Xylene	0.14		0.32	ND	0.049	ND	1						
Groundwater Pathway Sum			13	30	1E-03	5	3E-04						
Sum of All Pathways			13	30	1E-03	5	3E-04						

Notes:

ND Indicates not determined due to the lack of available risk information.

NA Not applicable

ILCR Indicates incremental excess lifetime cancer risk

HI Indicates hazard index

1- Chemical is a COC by virtue of projected child residence non-carcinogenic hazard.

2- Chemical is a COC by virtue of projected future resident lifetime ILCR.

3- Chemical is a COC by virtue of projected site worker non-carcinogenic hazard.

4- Chemical is a COC by virtue of projected site worker ILCR.

**Attachment 2**  
**SWMU 178**  
**VOC and SVOC TIC Laboratory Data Sheets**  
**and Summary of Risk and Hazard**  
**and Hazard Quotients and Incremental Lifetime Cancer Risks**

1F  
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET  
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT SAMPLE NO.

082427  
1785B00502

Lab Name: PACE INCORPORATED                      Contract: \_\_\_\_\_

Lab Code: \_\_\_\_\_      Case No.: CHARL      SAS No.: \_\_\_\_\_      SDG No.: CHS06

Matrix: (soil/water) SOLID                      Lab Sample ID: 41292-029

Sample wt/vol:      31              (g/mL) G                      Lab File ID: >F8409

Level:      (low/med) LOW                      Date Received: 08/24/94

% Moisture: not dec. 19              dec. \_\_\_\_                      Date Extracted: 08/29/94

Extraction:      (SepF/Cont/Sonc)                      Date Analyzed: 09/15/94

GPC Cleanup:      (Y/N) N                      pH:                      Dilution Factor: 50

CONCENTRATION UNITS:  
(ug/L or ug/Kg) UG/KG

Number TICs found: 20

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	26730143 TRIDECANE, 7-METHYL-	10.09	47000	J
2.	UNKNOWN	10.32	17000	J
3.	54105667 CYCLOHEXANE, UNDECYL-	10.90	15000	J
4.	31295564 DODECANE, 2,6,11-TRIMETHYL-	11.14	72000	J
5.	UNKNOWN	11.28	13000	J
6.	UNKNOWN	11.36	13000	J
7.	UNKNOWN	11.89	40000	J
8.	52896909 HEPTANE, 3-ETHYL-5-METHYL-	11.94	74000	J
9.	UNKNOWN	12.24	45000	J
10.	14905567 TETRADECANE, 2,6,10-TRIMETHYL	12.76	25000	J
11.	UNKNOWN	12.86	19000	J
12.	2131422 NAPHTHALENE, 1,4,6-TRIMETHYL	12.99	23000	J
13.	UNKNOWN	13.07	17000	J
14.	UNKNOWN	13.14	28000	J
15.	UNKNOWN	13.37	21000	J
16.	1921706 PENTADECANE, 2,6,10,14-TETRA	13.56	68000	J
17.	1921706 PENTADECANE, 2,6,10,14-TETRA	14.03	190000	J
18.	UNKNOWN	14.40	23000	J
19.	74764117 IRON, TRICARBONYL [N-(PHENYL-	14.84	91000	J
20.	629970 DOCOSANE	15.45	21000	J

Table 6.2.6.12  
 Summary of Risk and Hazard for SWMU 178  
 NAVBASE - Charleston Zone H  
 Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil	Incidental Ingestion	ND	ND	2E-06	ND	2E-07
	Dermal Contact	ND	ND	8E-07	ND	3E-07
Sum of All Pathways		ND	ND	2E-06	ND	5E-07

Notes:  
 ND indicates not determined due to the lack of available risk information.  
 ILCR indicates incremental excess lifetime cancer risk  
 HI indicates hazard index

Table 6.2.6.10  
Hazard Quotients and Incremental Lifetime Cancer Risks  
Incidental Surface Soil Ingestion  
SWMU 178  
Naval Base Charleston  
Charleston, SC

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day) <sup>-1</sup>	Potential Future Resident adult Hazard Quotient	Potential Future Resident child Hazard Quotient	Potential Future Resident Iwa ILCR	Future Site Worker adult Hazard Quotient	Future Site Worker adult ILCR
Benzo(a)pyrene equivalents	NA	7.3	ND	ND	2.0E-06	ND	2.2E-07

NOTES:

- NA Not available
- ND Not Determined due to lack of available information
- Iwa lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
- ILCR Incremental Lifetime excess Cancer Risk

Table 6.2.6.11

Hazard Quotients and Incremental Lifetime Cancer Risks

Dermal Contact With Surface Soil

SWMU 178

Naval Base Charleston

Charleston, SC

Chemical	Dermal Adjustment	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day) <sup>-1</sup>	Potential Future Resident adult Hazard Quotient	Potential Future Resident child Hazard Quotient	Potential Future Resident lwa ILCR	Potential Current Worker adult Hazard Quotient	Potential Current Worker adult ILCR
Benzo(a)pyrene equivalents	0.5	NA	14.6	ND	ND	9.0E-07	ND	3.7E-07

NOTES:

- NA Not available
- ND Not Determined due to lack of available information
- lwa lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
- ILCR Incremental Lifetime excess Cancer Risk
- Dermal to absorbed dose adjustment factor is applied to adjust for Oral SF and RfD (i.e., the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI)

**Attachment 3**

**AOC 698**

**VOC and SVOC TIC Laboratory Data Sheets  
and Summary of Risk and Hazard-Based COCs**

**G:\DCOOKE\WP\CLEAN\charl\TPH Memo\TPH Risk Memo 5.wpd**

1E  
 VOLATILE ORGANICS ANALYSIS DATA SHEET  
 TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00101

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-05  
 Sample wt/vol: 5.00 (g/mg) Lab File ID: S9705  
 Level: (low/med) LOW Date Received: 12/04/96  
 %Moisture: not dec. 13.19 Date Analyzed: 12/05/96  
 GC Column: CAP ID: 0.53 (mm) Dilution Factor: 1.00  
 Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number of TICs found: 12 CONCENTRATION UNITS:  
 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	14.51	330	J
2.	Unknown	15.60	480	J
3.	Unknown	15.85	440	J
4.	Unknown Hydrocarbon	16.01	360	J
5.	Unknown	16.52	510	J
6.	Unknown	16.68	390	J
7.	Unknown Hydrocarbon	16.84	1200	J
8.	Unknown	17.46	680	J
9.	Unknown Hydrocarbon	17.74	1000	J
10.	Unknown	18.20	310	J
11.	Unknown	18.39	330	J
12.	Unknown	18.67	310	J

.1F  
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET  
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00101DL1

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-05DL1  
 Sample wt/vol: 30 (g/ml)G Lab File ID: L679705.D  
 Level: (low/med) LOW Date Received:  
 %Moisture: 13.19 decanted: (Y/N) N Date Extracted: 12/03/96  
 Concentrated Extract Volume: 1000.00 (uL) Date Analyzed: 01/02/97  
 Injection Volume: 2.00 (u/L) Dilution Factor: 40.00  
 GPC Cleanup: (Y/N) N pH: 0.00

Number of TICs found: 22 CONCENTRATION UNITS:  
 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	8.77	16000	J
2.	Unknown	12.57	22000	J
3.	Unknown	12.74	28000	J
4.	Unknown	12.94	48000	J
5.	Unknown	13.58	53000	J
6.	Unknown aliphatic hydrocarbo	13.89	50000	J
7.	Unknown	14.02	69000	J
8.	Unknown	14.44	19000	J
9.	Unknown	15.07	17000	J
10.	Unknown	16.24	43000	J
11.	Unknown aliphatic hydrocarbo	16.49	310000	J
12.	Unknown	17.13	29000	J
13.	Unknown aliphatic hydrocarbo	17.41	31000	J
14.	Unknown aliphatic hydrocarbo	17.47	240000	J
15.	Unknown aliphatic hydrocarbo	18.21	95000	J
16.	Unknown aliphatic hydrocarbo	18.31	62000	J
17.	Unknown aliphatic hydrocarbo	19.18	60000	J
18.	Unknown aliphatic hydrocarbo	19.78	43000	J
19.	Unknown aliphatic hydrocarbo	20.00	38000	J
20.	Unknown aliphatic hydrocarbo	20.33	21000	J
21.	Unknown aliphatic hydrocarbo	21.57	25000	J
22.	Unknown aliphatic hydrocarbo	22.29	21000	J

1E  
VOLATILE ORGANICS ANALYSIS DATA SHEET  
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00102DL

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-06DL  
 Sample wt/vol: 5.00 (g/mG) Lab File ID: SR976  
 Level: (low/med) LOW Date Received: 12/04/96  
 %Moisture: not dec. 4.67 Date Analyzed: 12/06/96  
 GC Column: CAP ID: 0.53 (mm) Dilution Factor: 5.00  
 Soil Extract Volume: (uL) Soil Aliquot Volume: (uL)

Number of TICs found: 12 CONCENTRATION UNITS:  
 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.04926-90-3	Cyclohexane, 1-ethyl-1-methy	12.57	1200	J
2.	Unknown	12.98	1700	J
3.	Unknown	13.79	170	J
4.	Unknown	14.32	190	J
5.	Unknown	15.62	240	J
6.	Unknown Hydrocarbon	15.75	1200	J
7.	Unknown ethyldimethylbenzene	16.05	380	J
8.	Unknown	16.26	250	J
9.	Unknown	16.54	190	J
10.	Unknown	16.65	240	J
11.	Unknown	16.86	170	J
12.00767-58-8	1H-Indene, 2,3-dihydro-4-met	17.42	240	J

.1F  
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET  
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00102DL

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-06DL  
 Sample wt/vol: 30 (g/ml)G Lab File ID: 679706.D  
 Level: (low/med) LOW Date Received: 12/04/96 (2096)  
 %Moisture: 4.67 decanted: (Y/N) N Date Extracted: 12/03/96 (210196)  
 Concentrated Extract Volume: 1000.00 (uL) Date Analyzed: 01/02/97  
 Injection Volume: 2.00 (uL) Dilution Factor: 5.00  
 GPC Cleanup: (Y/N) N pH: 0.00

CONCENTRATION UNITS:

Number of TICs found: 21 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.00123-42-2	2-Pentanone, 4-hydroxy-4-met	3.85	200000	J
2.	Unknown aliphatic hydrocarbo	7.48	13000	J
3.	Unknown benzene substituted benzene isomer	7.82	5700	J
4.	Unknown benzene	7.88	9900	J
5.	Unknown benzene substituted benzene isomer	8.37	3200	J
6.	Unknown benzene substituted benzene isomer	8.48	16000	J
7.	Unknown (12097)	8.61	11000	J
8.	Unknown (12097)	8.72	5000	J
9.	Unknown benzene substituted benzene isomer	8.82	7200	J
10.	Unknown aliphatic hydrocarbo	9.22	3900	J
11.	Unknown	9.43	41000	J
12.	Unknown	10.01	8100	J
13.	Unknown	10.09	4700	J
14.	Unknown	10.50	5100	J
15.	Unknown aliphatic hydrocarbon	10.69	51000	J
16.	Unknown aliphatic hydrocarbo	12.09	61000	J
17.	Unknown aliphatic hydrocarbo	19.30	3500	J
18.	Unknown aliphatic hydrocarbo	20.13	4000	J
19.	Unknown aliphatic hydrocarbo	21.63	12000	J
20.	Unknown aliphatic hydrocarbo	22.34	6900	J
21.	Unknown aliphatic hydrocarbo	24.97	3800	J

FORM I SV-TIC

(2097)

3/90

.1F  
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET  
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00201

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-07  
 Sample wt/vol: 30 (g/ml)G Lab File ID: AB265.D  
 Level: (low/med) LOW Date Received: 12/04/96  
 %Moisture: 3.88 decanted: (Y/N) N Date Extracted: 12/09/96  
 Concentrated Extract Volume: 1000.00 (uL) Date Analyzed: 12/17/96  
 Injection Volume: 2.00 (u/L) Dilution Factor: 1.00  
 GPC Cleanup: (Y/N) N pH: 0.00

Number of TICs found: 20 CONCENTRATION UNITS:  
(ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	6.72	130	J
2.	Unknown	7.34	99	JB
3.	Unknown	7.51	110	J
4.	Unknown	7.65	450	JB
5.	Unknown	8.12	420	JB
6.	Unknown	8.16	310	J
7.	Unknown	8.25	360	JB
8.	Unknown	8.30	270	JB
9.	Unknown	9.88	490	J
10.	Unknown	10.66	530	J
11.	Unknown	11.08	120	J
12.	Unknown	11.82	1000	J
13.	Unknown aliphatic hydrocarbo	20.00	480	J
14.	Unknown caboxylic acid	22.48	430	J
15.	Unknown aliphatic hydrocarbo	26.85	330	J
16.	Unknown aliphatic hydrocarbo	27.72	150	JB
17.	Unknown aliphatic hydrocarbo	28.73	400	JB
18.	Unknown aliphatic hydrocarbo	31.24	100	J
19.	Unknown	31.37	190	J
20.	Unknown	39.79	1000	J

1F  
 SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET  
 TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00202

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-08  
 Sample wt/vol: 30 (g/ml)G Lab File ID: AB266.D  
 Level: (low/med) LOW Date Received: 12/04/96  
 %Moisture: 5.78 decanted: (Y/N) N Date Extracted: 12/09/96  
 Concentrated Extract Volume: 1000.00 (uL) Date Analyzed: 12/17/96  
 Injection Volume: 2.00 (u/L) Dilution Factor: 1.00  
 GPC Cleanup: (Y/N) N pH: 0.00

Number of TICs found: 3 CONCENTRATION UNITS:  
 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	8.10	44000	J
2.	Unknown	13.23	390	J
3.	Unknown	13.93	600	J

1F  
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET  
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00301

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-10  
 Sample wt/vol: 30 (g/ml)G Lab File ID: AB268.D  
 Level: (low/med) LOW Date Received: 12/04/96  
 %Moisture: 25.93 decanted: (Y/N) N Date Extracted: 12/09/96  
 Concentrated Extract Volume: 1000.00 (uL) Date Analyzed: 12/17/96  
 Injection Volume: 2.00 (u/L) Dilution Factor: 1.00  
 GPC Cleanup: (Y/N) N pH: 0.00

Number of TICs found: 20 CONCENTRATION UNITS:  
 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	6.77	460	J
2.	Unknown	7.43	320	J
3.	Unknown	7.54	140	J
4.	Unknown	7.67	550	JB
5.	Unknown	8.14	510	JB
6.	Unknown	8.19	340	JB
7.	Unknown	8.28	420	JB
8.	Unknown	8.32	280	JB
9.	Unknown	9.64	1000	J
10.	Unknown	9.89	240	J
11.	Unknown	10.24	140	J
12.	Unknown	10.67	660	J
13.	Unknown	11.86	3000	J
14.	Unknown aliphatic hydrocarbo	19.99	280	J
15.	Unknown aliphatic hydrocarbo	21.02	160	J
16.	Unknown aliphatic hydrocarbo	22.42	160	J
17.	Unknown aliphatic hydrocarb	25.27	140	JB
18.	Unknown aliphatic hydrocarb	26.84	270	J
19.	Unknown aliphatic hydrocarb	28.74	200	JB
20.	Unknown aliphatic hydrocarb	31.23	140	J

.1F  
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET  
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

698SB00302

Lab Name: S-CUBED Contract:  
 Lab Code: CEIMIC Case No.: ZONE K SAS No.: SDG No.: 6797  
 Matrix: (soil/water) SOIL Lab Sample ID: 6797-11  
 Sample wt/vol: 30 (g/ml)G Lab File ID: AB269.D  
 Level: (low/med) LOW Date Received: 12/04/96  
 %Moisture: 8.30 decanted: (Y/N) N Date Extracted: 12/09/96  
 Concentrated Extract Volume: 1000.00 (uL) Date Analyzed: 12/17/96  
 Injection Volume: 2.00 (u/L) Dilution Factor: 1.00  
 GPC Cleanup: (Y/N) N pH: 0.00

CONCENTRATION UNITS:

Number of TICs found: 19 (ug/L or ug/Kg) UG/KG

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	5.43	76	J
2.	Unknown	5.73	78	J
3.	Unknown	6.85	110	J
4.	Unknown	7.16	78	J
5.	Unknown	7.32	180	JB
6.	Unknown	7.49	140	J
7.	Unknown	7.62	490	JB
8.	Unknown	8.10	430	JB
9.	Unknown	8.16	340	JB
10.	Unknown	8.25	420	JB
11.	Unknown	8.28	240	JB
12.	Unknown	8.39	91	J
13.	Unknown	9.63	200	J
14.	Unknown	9.86	400	J
15.	Unknown	10.66	320	J
16.	Unknown	11.08	82	J
17.	Unknown	11.80	320	J
18.	Unknown	19.90	82	J
19.	Unknown <del>aliphatic hydrocarbo</del> 120197 <sub>g</sub>	24.55	110	J

Table 10.9.19  
 Summary of Risk and Hazard-based COCs  
 AOC 698  
 Naval Base Charleston, Zone K  
 Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident Iwa ILCR	Current Site Worker Hazard Quotient	ILCR	Identification of COCs		
Surface Soil	Incidental Ingestion	<b>Inorganics</b>								
		Arsenic (As)	0.048	0.45	2.5E-05	0.017	2.8E-06	2	4	
		Beryllium (Be)	0.00018	0.0017	4.4E-06	0.00006	4.9E-07	2		
			Cadmium (Cd)	0.005	0.05	ND	0.0020	ND		
			<b>Pesticides</b>							
			Heptachlor epoxide	0.014	0.13	1.8E-06	0.0049	2.1E-07	2	
	Dermal	<b>Inorganics</b>								
		Arsenic (As)	0.010	0.032	2.8E-06	0.0070	1.1E-06	2	4	
		Beryllium (Be)	0.000037	0.00012	4.9E-07	0.000026	2.0E-07			
		Cadmium (Cd)	0.0011	0.0037	ND	0.0008	ND			
		<b>Pesticides</b>								
		Heptachlor Epoxide	0.0011	0.0037	8.3E-08	0.0008	3.4E-08			
Surface Soil Pathway Sum			0.08	0.7	3E-05	0.03	5E-06			
Groundwater Pathways	Ingestion	<b>Pesticides</b>								
		delta-BHC	ND	ND	5.7E-06	ND	1.8E-06	2	4	
		<b>Volatile Organics</b>								
	Benzene	ND	ND	2.2E-06	ND	7.0E-07	2			
	Inhalation	<b>Volatile Organics</b>								
Benzene		0.08	0.2	2.2E-06	0.03	7.0E-07	2			
Groundwater Pathway Sum			0.08	0.2	1E-05	0.03	3E-06			
Sum of All Pathways			0.2	0.9	4E-05	0.06	8E-06			

Notes:

ND indicates not determined due to the lack of available risk information.

ILCR indicates incremental excess lifetime cancer risk

HI indicates hazard index

1- Chemical is a COC by virtue of projected child residence noncarcinogenic hazard.

2- Chemical is a COC by virtue of projected future resident lifetime ILCR.

3- Chemical is a COC by virtue of projected site worker noncarcinogenic hazard.

4- Chemical is a COC by virtue of projected site worker ILCR.



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2600 Bull Street  
Columbia, SC 29201-1708

CERTIFIED MAIL

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Douglas E. Bryant

February 19, 1999

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Caretaker Site Office  
NAVFACENCOM, Southern Division  
1690 Turnbull Avenue  
Building NH-51  
Charleston, SC 29405

William M. Hull, Jr., MD  
Vice Chairman

Roger Leaks, Jr.  
Secretary

Mark B. Kent

Re: SWMU 43  
Publications and Printing Plant (Building 1628)  
Charleston Naval Complex  
SC0 170 022 560

Cyndi C. Mosteller

Brian K. Smith

Rodney L. Grandy

Dear Mr. Shepard:

In correspondence dated January 29, 1999 the South Carolina Department of Health and Environmental Control (Department) provided conditional approval of the Zone A RCRA Facility Investigation (RFI) report, and determined the corrective action status of the units located within Zone A.

SWMU 43 status was determined as "Pending" based on the potential impact to ecological receptors in Noisette Creek. This issue was discussed with the Navy and its contractor Ensaf. The outcome of this discussion was to visit the unit to visually verify site conditions and potential past or present impacts to Noisette creek. After the visit to SWMU 43 by Mr. Paul Bergstrand, the Department has decided that a potential impact from this unit to Noisette creek (past and present) is unlikely.

Based on the above the Department believes that the corrective action status of SWMU 43 is "No Further Action" (NFA).

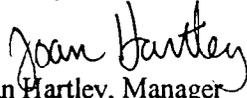
It should be noted that the permit shall be modified pursuant to R.61-79.270.41 to change the status on this unit.

The Department's concurrence is based on the information provided by the Navy to date. Any new information contradicting the basis for this concurrence may require further investigation or action.

Hartley to Shepard  
February 19, 1999  
page 2

Should you have any questions regarding this issue, please contact Johnny Tapia at (803) 896-4179 or Paul Bergstrand at (803) 896-4016.

Sincerely,



Joan Hartley, Manager  
Corrective Action Engineering Section  
Bureau of Land & Waste Management

cc: Paul Bergstrand, Hydrogeology  
Rick Richter, Trident EQC  
David Dodds, SOUTHNAVFACENGCOM  
Dann Spariosu, EPA Region IV  
Todd Haverkost, ENSAFE



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2600 Bull Street  
Columbia, SC 29201-1708

CERTIFIED MAIL

COMMISSIONER:  
Douglas E. Bryant

March 12, 1999

BOARD:  
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Chairman

Henry Shepard II, P.E.  
Caretaker Site Office  
NAVFACENGCOM, Southern Division  
1690 Turnbull Avenue  
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Charleston, SC 29405

William M. Hull, Jr., MD  
Vice Chairman

Roger Leaks, Jr.  
Secretary

Mark B. Kent

Cyndi C. Mosteller

Brian K. Smith

Rodney L. Grandy

Re: Review of the Draft Zone F RCRA Facility Investigation Report  
Dated December 31, 1997  
Charleston Naval Complex  
SC0 170 022 560

Dear Mr. Shepard:

The South Carolina Department of Health and Environmental Control (Department) has reviewed the above referenced Zone F Draft RFI Report. The review was done according to applicable State and Federal Regulations, and the Charleston Naval Base Hazardous Waste Permit, effective September 17, 1998. The US EPA did not provide written comments. Based on this review, the Department believes that the Charleston Naval Complex has not met the requirements under Permit condition II.E.7. Additional investigation at several units is needed to define the nature and extent of contamination. Please revise the Draft Zone F RFI Report according to the attached comments.

Upon receipt of this letter and within sixty (60) days, please make the specified changes/corrections and resubmit the Final Zone F RFI Report to the Department and U.S. EPA for a final review. The responses should be complete and the changes/corrections should be clearly identified for a more efficient review.

Should you have any questions regarding this issue, please contact me at (803) 896-4179, Paul Bergstrand at (803) 896-4016, or Eric Cathcart at (803) 896-4045.

Sincerely,

Johnny Tapia P., Environmental Engineer Associate  
Corrective Action Engineering Section  
Bureau of Land & Waste Management

Attachments

cc: Paul Bergstrand / Eric Cathcart, Hydrogeology  
Rick Richter, Trident EQC  
Tony Hunt, SOUTHNAVFACENGCOM  
Dann Spariosu, EPA Region IV  
Todd Haverkost, ENSAFE

**SOUTH CAROLINA DEPARTMENT OF HEALTH  
AND ENVIRONMENTAL CONTROL (SCDHEC)**

**COMMENTS ON THE DRAFT ZONE F  
RCRA FACILITY INVESTIGATION REPORT**

Dated December 31, 1997

Johnny Tapia

1. The RCRA Facility Assessment (RFA) lists AOC 621 as being located in Zone F, however this unit has not been included as part of figure 1-2, table 1.1 or this RFI report. If no investigation has been performed at this unit, work should be proposed in accordance with the current RCRA permit. Please clarify.
2. Section 4.3. "Data Validation Reports" is an enumeration of the results and detections of blank samples in soil and groundwater. These results should be interpreted in a relevant and meaningful manner by describing if the blank detection means the contaminant is present in the sample, is a product of cross-contamination, etc.. This would clarify the significance of the presence of certain contaminants in the samples collected at each unit. As written, contributes minimum value for the review of the document. Please revise this section.
3. Table 6.4 which calculates the Soil Screening Levels for the protection of groundwater needs to revise and recalculate the values for Thallium and Benzo(a)pyrene. The MCL values for the Target Leachate Concentration are not correct, therefore the calculated SSL values need to be verified. Please correct and consider implications throughout the report.
4. The second paragraph of page 6.16 needs to be revised for the statements made about the use of the highest of background values (upper or lower soil) used as the screening alternative to SSLs. The same approach is mentioned for groundwater where the greater of shallow or deep background concentrations is used as an screening alternative to the tap water RBCs. Using this approach defeats the purpose of collecting two set of samples (upper and lower) to determine background reference concentrations and is not a conservative screening process. In addition, the same paragraph states that this approach is proposed based only on assumptions. The Screening process should continue as previously approved. Please revise this paragraph and consider implications throughout the report.

5. Please clarify in the text that according to EPA's latest guidance on dioxins the 1,000 ng/Kg (as 2,3,7,8-TCDD TEQs) is based on a residential cleanup level with a risk level of 1E-4. Please clarify also that this cleanup level is being used as a screening number due to the complex and time-consuming calculations involved with risk presented by dioxins. For instance page 7.7 needs this clarification. Please correct accordingly.
6. Page 7.10, "Summary of COPCs" paragraph makes the statement that "If no groundwater impacts were identified, the current soil concentrations were considered sufficiently protective of the underlying aquifer". The Department does not necessarily agree with this statement. Other factors as age of the unit, age of the spills, type of contaminants present, barriers present (asphalt, concrete, etc. ) would influence the presence of contaminants in groundwater. Please modify this statement and consider this factors when making this statement in reference to a specific unit.
7. It may be appropriate to determine a background reference concentration, at Zone F soil and groundwater, for chemicals considered essential nutrients specially for iron. This natural nutrient has been detected at higher concentrations than usual throughout this zone and may be of concern. An evaluation can not be properly done at this time without having an appropriate background concentration and it has been dismissed many times without further consideration. This should be corrected in the final RFI report.
8. This comment is applicable to all units in zone F. The Risk uncertainty section generally summarizes all detections and explain contributing or mitigating factors to be considered when reaching a decision on the fate of the unit. Since groundwater contamination is assessed based mainly on the first quarter of groundwater sampling, mitigating or contributing factors, such as results of subsequent rounds of groundwater sampling that confirm or refute possible contamination, should be acknowledged. Also, new contaminants detected should be mentioned. Please revise the report .

**SWMU 4/ AOC 619:**

9. The SSL values used in table 10.1.3 for the comparison to lower soil samples detections, need to be revised for the implications that comment # 3 may have, and also other values that don't seem to agree with the SSLs calculated on table 6.4. Please revise.
10. There are two defined areas where subsurface samples were not collected. These areas are: One encompassing soil samples 619SB0011 and 619SB008.

The other area encompasses soil borings 5, 6, 2, and 7 for AOC 619. Nearby detections of contaminants suggest that the extent has not been defined for VOCs, metals and SVOCs. Detections of VOCs and BEQs seem to coincide. The extent of this contamination should be defined.

**SWMU 36 /AOC 620:**

11. There is one detection of 4-methylphenol in subsurface soil at 036SB001. There were no samples collected from the subsurface soil around this detection to determine if it is isolated. The extent of this contaminant should be delineated.
12. The presence of PCBs, lead, chromium is not defined at these units. Detections exceeding RBCs/SSLs were found on samples where only surface soil samples were collected. The concentration gradient with depth has not been verified. The extent of these constituents should be delineated. Comment # 6 is applicable when concluding that concentrations of contaminants present may be protective of groundwater due to the presence of “barriers”.
13. Table 2.7 should be rectified to show that manganese does exceed the listed Tap water RBC. Please correct. Additionally, the statement made on page 10.2.60, section 10.2.5.4 is not correct. Organic exceedances in soil are repeated in groundwater at well 620001 second quarter. Please correct.
14. Figure 10.2.15 was not included in the draft report. The final report should include this figure as appropriate.
15. Wells 3 and 4 were analyzed for metals only. There is lack of data to verify the presence of organics downgradient from building 68 which were detected in surface soil (when analyzed). Additional groundwater samples are needed to verify the presence/absence of these contaminants on the downgradient side of this unit. Please propose additional work to fill all data gaps.
16. The first paragraph on page 10.2.90 states “the assumption was made that this child would ingest 0.1 grams of soil from the most heavily contaminated area ...” This approach sounds appropriate, except that the concentration used was the mean concentration not the maximum detected. For groundwater, the highest concentration was used for the toxicity calculations related to lead. The approach should remain consistent by using the highest detection as described in the text. Please revise. In addition, lead should be identified as a COC. After the lead toxicity calculations are made, lead is not mentioned thereafter, not even in the COC summary section. This oversight should be corrected.

**SWMU 109:**

17. The soil at this unit has demonstrated to have elevated levels of BEQs and metals in two defined areas. Sediments were sampled at a nearby catch basin (109M003) that also detected high levels of constituents exceeding RBCs and background values. There is a probable connection between the surface soil and sediments produced by runoff. Additionally, there is only one well in relation with this unit that, which according to the gw flowmaps, appears not to be properly located to be able to intercept any type of groundwater contamination derived from the operations at this unit. Groundwater sampling should be re-evaluated at this unit. The catch basin should be considered for cleanup.

**AOC 607:**

18. The source area for the groundwater contamination should be defined at this unit. Soil boring 607SB004 detected PCE in upper and lower soils in excess of SSLs for the protection of groundwater. It should be considered as a possible source area that needs to be investigated and defined. Please explain the kind of work proposed to find the source area. Also, very high concentration of organics and inorganics were found in sediment samples collected from catch basins, which could potentially be coming from this unit. These sediments/catch basins need consideration for corrective action.

**AOC 609:**

19. Additional groundwater samples may be needed to determine if chemicals as Pentachlorophenol, Lead and Thallium are consistently present. These constituents were detected at levels exceeding MCLs or background after the first round of groundwater sampling, which is the only round considered to identify potential COPCs. In addition, the thallium background value used in table 10.5.8 should be replaced by the correct value of 5.58.
20. Arsenic was detected in soil and groundwater exceeding acceptable levels. There is a strong possibility that there is a transfer of contamination from soil to groundwater. This potential problem should be acknowledged and remediated.
21. NAVBASE should report if the Department's UST program is already addressing this unit for groundwater contamination present. If so, based on their investigation/remediation objectives, it will be determined if the unit could be transferred to this program or is kept under the Subtitle C of RCRA.

#### AOC 611:

22. Groundwater was not investigated at this unit even though is located next to an area with confirmed groundwater contamination and potential materials released at this unit would indicate that groundwater is/was at risk. There are no downgradient wells identified that could confirm/deny groundwater impacts. Based on this, groundwater needs to be sampled as part of the investigation of this unit. Please propose wells locations.
23. Detections of PCBs in surface soil are not defined. Detections in subsurface soil of several metals exceeding SSLs (As, Hg) merit more samples for the definition of extent. More soil and groundwater samples are needed within this area.

#### AOC 613/AOC 615/SWMU 175:

24. The presence and/or confirmation of removal of several USTs and associated piping within the area of AOC 613 and 615 should be clarified; as well as it needs to be confirmed if the UST program is assessing or remediating this area. Please include a clear summary of this information in the revised RFI report.
25. The report states that soil screening data was collected and analyzed in lieu of discrete soil samples as proposed in the approved work plan. The work plan however, also proposes that 10% of the samples will be analyzed for Appendix IX constituents. This approved proposal has not been met. Additional Appendix IX samples should be collected. The reported presence of dioxins in groundwater after the first round of sampling at one of the wells, calls for additional sampling .
26. At this group of units, the soil investigation was done by collecting screening samples at a depth that is between the surface and subsurface soil layers. Only one discrete sample was collected and analyzed at the subsurface soil interval. **Any conclusion about the lower soil contamination would be inappropriate and the least speculative in nature.** All lower soil conclusions and statements should be revised in this section of the report, specially the fate and transport section. There is a considerable investigatory gap on this group of units that need to be filled. Additional work is needed.
27. Tables 10.7.9 and 10.7.10 need to be corrected. These tables show the results of groundwater sampling, therefore the units should be ug/L instead of ug/Kg. Please revise.

28. Table 10.7.11 needs to be corrected for the MCL for dioxin, which is 0.03 ng/L instead of 1,900. Please revise.
29. A preliminary comparison of soil screening samples collected showed that PCE, Methylene chloride, Benzo(a)anthracene, Arsenic, Chromium, and Thallium exceeded their respective SSLs or lower soil background reference concentrations. In addition, a fair assessment of contaminant presence is further complicated because of the erratic changes on the group of parameters analyzed at each sampling location. The logic for this sampling scheme is not well understood nor it helps the Department on making a contamination presence determination. All Appendix IX constituents are suspect to be present within these group of units. Further sampling, as asked by previous comments, should include the full set of Appendix IX analytes.
30. Table 10.7.28 was incomplete. This table should summarize all COCs for all media. Please revise for the missing groundwater COCs.

**AOC 616:**

31. The only medium investigated at this unit was soil. The location of this unit is between AOC 613/AOC 615/SWMU 175 and AOC 617. Even though the past use of this unit was as a paint shop and that suspected chemicals were solvents, any possible groundwater contamination would be investigated and remediated under the corrective action at the surrounding units. Therefore, based on the above, the Department agrees with the conclusion that this unit requires No Further Action (NFA).

**AOC 617:**

32. The figures for this unit need to identify the location of the UST. Please correct all figures.
33. Iron was consistently detected in groundwater at levels much higher than Tap water RBCs. Considering past operations of this unit, iron should be included in the risk assessment as a potential threat to human health or the environment. Please revise.
34. Well 617002 was installed later in the investigation process, however it detected higher levels and more chemicals than the previously installed well. There is a question about if the investigation was conducted at the footprint of this former operation, and about the definition of the extent of groundwater contamination, i.e. higher and more frequent detections located on upgradient

well. The lack of definition of extent and location of groundwater contamination is acknowledged in the report, and should be clarified. Please propose additional groundwater work.

35. Please revise the statement on page 11.1 that includes SCDHEC on a default accepted residential risk range of  $1E-04$  to  $1E-06$ . The residential risk level above  $1E-06$  that could remain at a unit is strictly a unit-specific decision. This should be clarified in this section.

**Zone F**  
**Draft RFI Report Comments**  
Eric Cathcart, SCDHEC  
26 February 1999

*General Comments*

1. Soil sample blanks for the following areas contained detectable contaminants: SWMU 4, AOC 619, SWMU 36, AOC 620, SWMU 109, AOC 607, AOC 609, AOC 611, AOC 613, AOC 616, AOC 617, and Grid soil samples. Groundwater blanks contained detectable contaminants for the following areas: AOC 619, AOC 620, SWMU 109, AOC 607, AOC 609, AOC 613, GEL samples, Location 240, AOC 617, and Grid groundwater samples. These detections were noted in the volatile, semivolatile, and metals methods. In accordance with the Environmental Protection Agency, *Standard Operating Procedures* for sample collection, trace contaminants in field, trip, equipment, and distilled water blanks may indicate a problem with either decontamination procedures and/or cross contamination of samples during collection or transport. The RFI report should fully explain the existence of trace contaminants in blanks. Please revise the text to include this/these explanation(s).

*Specific Comments*

2. AOC 619/SWMU 4

Thallium concentrations in wells 619001 and 619003 are .0034 mg/l and .0066 mg/l, respectively. The Maximum contaminant limit is .002 mg/l. The Department is aware that the Navy is performing an overall base evaluation on the occurrence of Thallium in groundwater.

3. Page 10.2, SWMU 36/AOC 620, Groundwater-to-surface water cross-media transport

The report states that groundwater discharged to the Cooper River “would experience significant dilution, attenuating concentrations even further”. This statement assumes a single contaminant source that has been identified and contained. The report; however, does not account for the enrichment of surface and/or groundwater contamination from a downgradient or upgradient source. The area downgradient of SWMU 36/AOC 620 has been investigated for lead contamination in the subsurface and is known to have elevated levels. Also, the location upgradient of this area has been identified as exhibiting elevated levels of lead. This is important information and should be included in the RFI Report. If the Navy is interested in pursuing natural dilution as an option for remediation, then the Department suggests the production of a comprehensive fate and transport model.

4. Page 10.4.99, AOC 607

The RFI Report states that factors suggest a “depletion of residual mass contributions”; however, the Navy has not located the point source for contamination or produced records that quantify the amount of solvents released to the environment. Without the information, this statement cannot be supported.

The Navy has not provided an adequate amount of information to declare that tetrachloroethene (PCE) is naturally degrading as stated on page 10.4.100. The Navy should produce an isoconcentration map for the seven organic compounds that were detected in groundwater at concentrations above tap water RBC’s. The vertical extent of the DNAPL should also be defined.

Figure 10.4-18, 10.4-26 and 10.4-28

The tetrachloroethene plume must be delineated further. The area surrounding well 60701D should be delineated further.

5. Figures 10.5-9 through 10.5-17, AOC 609

The organics in groundwater surrounding well SME005 have not been fully delineated. Additional groundwater wells should be installed.

6. Pg. 11.6, AOC 609

Several VOCs that exist above MCL in groundwater at this site have not been fully defined horizontally. Well data from other wells that may exist around SME005 should be used to produce isoconcentration maps.

7. AOC 611

Please update the RFI Report to include Interim Measures.

8. AOC 613/615 and SWMU 175

The area downgradient of well GEL 014 has not been fully delineated. Information should be reported from existing wells at other areas of investigation or a request should be submitted to install additional wells. Please include all information pertaining the assessment of the petroleum contamination by the UST program of SCDHEC.

9. Page 10.7.109, Table 10.7.11, AOC 613/615 and SWMU 175

An analysis was performed for one quarter in well GEL014 for total petroleum hydrocarbons (TPH) with significant results. TPH is not a “recognized” component and therefore lacks either an MCL or RBC. Emphasis should be placed on results of VOC and SVOC analyses.

10. Figure 10.7.39, AOC 613/615 and SWMU 175

Point risk estimates for DPT 11 and DPT 15 are listed as “No COPC’s detected” ; however, no data exists for DPT 11 or DPT 15. The point risk estimate figure should be revised to indicate that samples were “Not Taken”.

11. Page 11.8, AOC 613/615 and SWMU 175

The RFI Report mentions an underground storage tank that “allegedly contained waste oil and other waste liquids”. Due to the uncertainty of the contents, the Department recommends sampling for all possible contaminants including, but not limited to, breakdown products (ie., vinyl chloride, etc).

12. Page 10.9.46 and 10.9.75, AOC 617

The RFI Report indicates the possibility of organic species exhibiting significant enrichment with depth. The source of the organics has not been positively identified; therefore, further investigations should be performed.

## Zone F RFI Report Summary

Eric F. Cathcart, SCDHEC

26 February, 1999

SWMU/AOC	Site Name & Detections	Proposed Action	DHEC Recommendation
619/4	<i>Soil:</i> Metals <i>GW:</i> Chloromethane Thallium	CMS-Basewide study for Thallium	CMS
620/36	<i>Soil:</i> Metals (Lead) <i>GW:</i> Thallium Barium	CMS	Define upgradient/ downgradient sources for lead. (Map & Model)  CMS-(RFI not complete)
109	<i>Soil:</i> Metals	CMS	CMS
607	<i>Soil:</i> VOC Metals <i>GW:</i> VOC (PCE) Metals	CMS	Define vertical extent of DNAPL.  CMS-(RFI not complete)
609	<i>Soil:</i> Metals <i>GW:</i> VOC Metals	CMS	Further investigation around SME005.  CMS-(RFI not complete)
611	<i>Soil:</i> Metals	CMS	Update RFI Report to include Interim Measures.  CMS
613/615/175	<i>Soil:</i> Metals <i>GW:</i> Metals VOC	CMS	Delineate area downgradient of GEL014.  CMS-(RFI not complete)
616	<i>Soil:</i> Metals	NFA	NFA
617	<i>Soil:</i> Metals <i>GW:</i> Metals VOC	CMS	Define source of organics.  CMS-(RFI not complete)



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March 16, 1999

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Charleston, SC 29405

Re: Draft Zone A Corrective Measures Study (CMS) Work Plan  
Responses to Comments and Revised Pages  
Charleston Naval Complex  
SC0 170 022 560

Dear Mr. Shepard:

The Department is in receipt of correspondence dated September 9, 1998 in which the Navy submitted revised pages and responses to the Department's comments dated July 14, 1998. Based on the review of your responses, additional comments were generated that shall be addressed and incorporated in the final revised Zone A Corrective Measures Study Work Plan.

Upon receipt of this letter and within thirty (30) days, please revise and resubmit the final Zone A CMS Work Plan. This final submittal shall include a detailed description of the additional changes made to address the attached comments and their location within the document. In addition, final revised pages should not be redlined, instead should be a document ready for approval.

Further, the Department is available to clarify any of the attached comments, by any means, before the final document is submitted.

Should you have any questions regarding this issue, please contact me at (803) 896-4179 or Paul Bergstrand at (803) 896-4016.

Sincerely,

Johnny Tapiá, Environment Engineer Associate  
Corrective Action Engineering Section  
Bureau of Land & Waste Management

attachments

cc: Paul Bergstrand, Hydrogeology  
Rick Richter, Trident EQC  
David Dodds, SOUTHNAVFACENGCOM  
Dann Spariosu, EPA Region IV  
Todd Haverkost, ENSAFE

**Zone A CMS Work Plan**  
**Reply to Response to Comments of 13 July 1998**  
Paul M. Bergstrand  
15 March 1999

The following are replies to some of the response to comments

**DHEC Comment 8:**

Page 5-23 Comparative Water Quality Data

The response to comments and the text revision is not satisfactory. Please delete the reference to wastewater and the sentence "This information is relevant ....."

**DHEC Comment 9:**

Page 5-24

Please delete the word "However" in the additional text.

**NEW TEXT**

Page 5-30

This is a good addition. The evaluation of grid sample detections with nearby SWMUs and AOCs should be considered in all future documents.

**DHEC Comment 12:**

Page 5-43

While detections above RBC may be mentioned, the general effect is still to minimize or de-emphasize constituents which may pose a threat to groundwater. A better presentation of detections which may pose a threat to groundwater should be made in all future documents.

**DHEC Comment 13:**

Page 5-47, Section 5.1.8 Remedial Objectives.

The modifications to the second paragraph on this page are contradictory. Please put a period after “requires further assessment” and delete “at this site because:” and the three bullets.

**DHEC Comment 15:**

Page 5-53

My note in the comment indicates DDE was also detected in groundwater. This portion of the text was not revised to include this information. Please correct this section of the text.

**DHEC Comment 16:**

Page 5-65, Figures 5-3-8 through 5-3-14

The response indicates more complete groundwater flow maps will be available in the CMS Report. This is confounding since important decisions are intended to be made from the Work Plan. The CMS Work Plan as well as the CMS Report must represent the horizontal and vertical extent of contamination and how that contamination has changed over time.

**DHEC Comment 18:**

Pages 5-86 and 5-87 are missing. The response to comments discussed technical impracticability and not being able to meet remedial goals for some remedial technologies. Contingency remedial plans must be considered in the event a selected remedial technology fails to meet the remedial goal. Please send the missing pages.

## **NEW TEXT**

Page 5-84

This section regarding mercury in the soils states that mercury was above the SSL in 4 soil boring locations and references the August 1998 RFI Report. A major problem in the RFI became apparent while reviewing the RFI Report for CMS data. The problem is the RFI was using the groundwater RBC exceedence for mercury of 11 ppb instead of the MCL which is 2.0 ppb. Another problem is that even though the SWMUs overlap the metals contamination, in particular mercury, was evaluated in a SWMU by SMWU manner and not comprehensively,. Metals analysis was not conducted during subsequent SWMU 39 soil borings or during the fifth groundwater sampling event. Numerous detections of mercury in soil were reported from the SWMU 2 soil investigation, some significantly above the SSL. Numerous detections of mercury were reported at low levels in 18 groundwater samples during the October 1997 SWMU 39 groundwater sampling event. Because of these concerns, metals analysis must be included with future Zone A groundwater analytical rounds. The Final CMS Workplan should make a comprehensive review and evaluation of mercury detections in Zone A and include the results of that review in the revisions.

## **NEW TEXT**

Page 5-89, Remedial Objectives for Groundwater

Please change “Control and/or monitor potential offsite migration” to “Control and prevent potential offsite migration”.

## **DHEC Comment 19:**

Page 5-90

Better communication with HESS OIL COMPANY is critical at this phase of corrective action. Regular scheduled meetings with the Naval Base Project Team and Hess Oil Company are now necessary.

## **NEW INFORMATION**

Arc-View maps of SWMU 39 must be updated to accurately represent the tidal creeks west of the North Gate. These tidal creeks may have significant influence on the contamination present at this site.