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FINAL

SAMPLE STRATEGY PLAN

**CORRECTIVE ACTION PLAN/
NATURAL ATTENUATION EVALUATION
OPERABLE UNIT NO. 10, SITE 35
CAMP GEIGER AREA FUEL FARM**

**MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA**

CONTRACT TASK ORDER 0323

DECEMBER 4, 1998

Prepared for:

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

Under the:

**LANTDIV CLEAN Program
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1.0 INTRODUCTION

This Final Sample Strategy Plan (SSP) has been prepared by Baker Environmental, Inc. (Baker) in support of the Corrective Action Plan (CAP) and Natural Attenuation Evaluation (NAE) for Operable Unit (OU) No. 10, Site 35, Marine Corp Base (MCB), Camp Lejeune, North Carolina.

The final Feasibility Study (FS) and Proposed Remedial Action Plan (PRAP) prepared for Site 35 identified monitored natural attenuation coupled with periodic monitoring as an appropriate remedial alternative for groundwater contamination in areas where active remediation was not proposed. A limited in-situ air sparging (IAS) system was installed and is in operation in an area where active remediation was appropriate. However, to date, remedial alternatives that address the balance of groundwater contamination have not been approved by federal or state regulators. To gain approval from federal and state regulators, the following must be demonstrated:

- Natural attenuative processes are reducing groundwater contamination at rates that are protective of human health and the environment and will lead to the achievement of remedial goals within a reasonable time frame.
- The operation of the current IAS system does not negatively impact natural attenuative processes.

The primary objective of the Natural Attenuation Evaluation (NAE) field investigation is to gather data to evaluate the potential of natural attenuation to remediate groundwater contamination and the impact of IAS operations on natural attenuative process.

The objective of the Sample Strategy Plan (SSP) is to identify sample media, locations and analytical parameters needed to support an evaluation of natural attenuative processes and impact of IAS operations at Site 35. Background information and the rationale behind the SSP have also been included.

2.0 SITE BACKGROUND

This section and includes a brief history of investigation and remedial activities that have occurred at Site 35 since 1994, and a brief description of the nature and extent of groundwater contamination at Site 35. Figures 1 and 2 depict the extent of groundwater contamination in the upper and lower portions of the surficial aquifer, as well as, the existing Camp Geiger street system and facilities.

2.1 Site History

Although several investigations have been conducted at Site 35, the first site-wide Remedial Investigation (RI) was conducted by Baker Environmental, Inc. (Baker) in 1994 to assess the nature and extent of groundwater contamination associated with the former Camp Geiger Fuel Farm. The footprints of the facilities associated with the former Camp Geiger Fuel Farm are located north of the intersection of Fourth and G Streets and are depicted on Figures 1 and 2. Extensive organic groundwater contamination was observed in both the upper and lower portion of the surficial aquifer. However, the extent of this organic contamination south of Fifth Street and north of Brinson Creek was not established during this investigation. During this investigation natural attenuation was not considered as a viable remedial alternative at this site and data supporting natural attenuation as a remedial alternative was not gathered.

The Interim Remedial Action (IRA) Feasibility Study for Shallow Groundwater in the Vicinity of the Former Fuel Farm was developed from the RI data gathered in 1994. This IRA/FS culminated in the signing of the Interim Record of Decision (ROD) for Surficial Groundwater for a Portion Operable Unit No. 10, Site 35 in September of 1995 and identified in-situ air sparging (IAS) as the selected remedy to treat contaminated groundwater in the vicinity of the former Camp Geiger Fuel Farm.

Between then fall of 1995 and spring of 1996 petroleum contaminated soils in two source areas were remediated. These source areas were generally located northeast of Building G-480 and within the footprint of the former Camp Geiger Fuel Farm above-ground storage tank area.

During the spring of 1996 the Supplemental Groundwater Investigation (SGI) was conducted. The objectives of the SGI were to determine if groundwater contamination had migrated across side of

Brinson Creek onto private property and assess the extent of groundwater contamination south of Fifth Street. The draft Feasibility Study (FS) and PRAP for Site 35 were developed from the data collected during the SGI, and identified monitored natural attenuation as an appropriate technology for the remediation of contaminated groundwater located up gradient of any IAS system. However, SGI data was insufficient to fully determine if natural attenuative processes were sufficient to protect human health and the environment.

An in-situ air sparging pilot evaluation was conducted in August and July of 1996 in Area B, depicted in Figures 1 and 2, to assess the viability of IAS as an alternative for remediating shallow groundwater contamination. The report recommended that an IAS trench be constructed on south side of the US Highway 17 Bypass Right-of-Way (ROW).

In February of 1997 a limited groundwater investigation was performed in an area immediately south of the US 17 Bypass ROW north of building TC 470 and east of F Street. The objective of this investigation was to verify levels of groundwater contamination and determine the optimal location of the Phase I IAS trench.

In August of 1997 the Final RAC design for an IAS system was submitted by Baker. The design provided for an IAS system that was to be constructed in two phases. Construction of Phase I was completed and began operations in early 1998. This system is currently undergoing a six month field test which began in mid-February. The preliminary results of Phase I operations indicate the IAS trench is effectively remediating groundwater that moves through the IAS trench. Baker is preliminarily recommending that the operation and monitoring of the IAS system be continued for an additional 3 months to fully assess system operations and the impact of the system operations on natural attenuative processes.

To assess natural attenuative processes in the vicinity of E and Fourth Streets and preliminarily assess the impact of the IAS system on natural attenuative processes, a Natural Attenuation Assessment (NAA) was performed during the first half of 1998. Groundwater samples were collected from eight shallow and nine intermediate monitoring wells and analyzed for natural attenuation parameters during three rounds of sampling that occurred in January, April and June of 1998. Data gathered during these rounds will be used to support the development of the CAP/NAE.

As part of the construction of the US Highway 17 Bypass a total of 50 permanent monitoring wells were abandoned at Site 35 in mid-June of 1998 by the North Carolina Department of Transportation (NC DOT). This restricted the ability to monitor source areas and downgradient monitoring wells located within and adjacent to the US Highway 17 Bypass ROW.

2.2 Summary of Nature and Extent of Contamination

The groundwater contamination associated with Site 35 is limited to the surficial aquifer. A confining unit that separates the surficial aquifer from the underlying Castle Hayne aquifer appears to prevent contamination from migrating vertically down into the Castle Hayne aquifer. The extent of groundwater contamination in the surficial aquifer at Site 35 extends over approximately 100 acres of Camp Geiger. The primary constituents of this contamination are fuel- and solvent-related compounds. Based on the results of the RI and the SGI, fuel-related contamination is prevalent in the upper portion of surficial aquifer and solvent-related contamination is prevalent in the lower portion of surficial aquifer.

The contaminants of concern that were identified in the RI include the following:

- Benzene
- Ethyl Benzene
- Xylenes (total)
- Methl Tertiary Butyl Ether
- Trichloroethane
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Vinyl Chloride
- Tetrachloroethene
- 1,1,2,2-Tetrachlorethane

2.2.1 Upper Surficial Aquifer

Although fuel-related groundwater contamination is prevalent in the upper surficial aquifer, solvent and fuel-related contaminant plumes overlap in this portion of the aquifer. Based on RI data, these mixed solvent and fuel-related contaminant plumes are generally located in an area north of Fifth

Street and east of E Street. The RI data indicates that there are two source areas (maximum levels over 1,000 ug/l) of fuel-related groundwater contamination that overlap four smaller plumes with lower levels of solvent-related contamination. Maximum contamination in these solvent-related plumes is approximately 50 to 100 ug/l. The fuel-related source areas are located along F Street, just northeast of Building G-480 and in the immediate vicinity of the former Camp Geiger Fuel Farm. The limits of fuel- and solvent-related contamination in the upper surficial aquifer, based on RI data, are depicted in Figure 1. Petroleum contaminated soil in the vicinity of these source areas was removed in 1996.

2.2.2 Lower Surficial Aquifer

Based on the results of the RI and the SGI, solvent-related contamination is prevalent in the lower portion of surficial aquifer. However, solvent and fuel-related groundwater contaminant plumes also overlap in this portion of the surficial aquifer north of Fifth Street. The RI data indicates that north of Fifth Street there are two source areas (maximum levels over 1,000 ug/l) of solvent-related groundwater contamination that overlap three plumes of fuel-related groundwater contamination. Maximum fuel-related contamination in these areas is approximately 50 to 100 ug/l. The two solvent-related source areas are centered near the intersection of E and Fourth Streets, and in the vicinity of Buildings TC-470, TC-473 and TC-474, respectively.

South of Fifth Street, groundwater contamination in the lower surficial aquifer is exclusively solvent-related. No source areas were identified south of Fifth Street during the RI and SGI. However, based on groundwater flow patterns it appears the solvent-related groundwater contamination south of Fifth Street originates from a source in the vicinity of buildings G-552, G-553 and G-554. The limits of solvent and fuel-related contamination in the lower portion of the surficial aquifer are depicted in Figure 2.

3.0 FIELD INVESTIGATION

The objectives of the NAE are as follows:

- To evaluate the potential for natural attenuation to remediate fuel- and solvent-related groundwater contamination in the surficial aquifer to levels that are protective of human health and the environment
- To evaluate the impact of IAS operations on natural attenuative process

To support the evaluation of natural attenuation and assess the impact of IAS operations the field effort will consist of a hydrological evaluation, groundwater investigation, and limited soil investigation. The data gathered during these investigations will be used to perform the following (Weidemeir, 1996):

- A site-wide assessment of contaminant concentrations along the flow path down gradient from suspected source areas
- An assessment of contaminant concentrations along the flow path up gradient, down gradient, and within the trench area
- A site-wide assessment of trends in the levels of parent compounds, daughter compounds, electron acceptors and donors, and metabolic byproducts
- A focused assessment of trends in the levels of parent compounds, daughter compounds, electron acceptors and donors, and metabolic byproducts in the vicinity of the air sparging trench
- Calculation of biodegradation rate constants
- Calculation of total assimilative capacity (BTEX only)

3.1 General Approach

The focus of the NAE field investigation is to gather site-wide data that will support the assessment of natural attenuative process and the impact of IAS operations. To adequately assess the potential of natural attenuation, a site-wide distribution of geochemical indicators and microbial by-products must be developed and contaminant flux must be calculated. A logical unit for gathering and reviewing groundwater data is the planar transect, a plane that bisects the contaminant plume and is perpendicular groundwater flow (EPA, 1998). Site 35 was overlaid with five planar transects (A through E) that are shown in Figures 1 and 2. These transects were located based on known contaminant concentrations and the direction of groundwater flow.

To assess the impact of IAS operations on natural attenuation, existing monitoring wells located within and immediately adjacent to IAS trench will be sampled. In addition, two temporary monitoring wells will be installed at distances of 25 and 65 feet downgradient of the trench.

The EPA recommends that a preliminary site characterization be conducted, as a first step, in support of proving natural attenuation as an adequate remedy. During such an investigation, a dense vertical and horizontal array of groundwater samples should be collected via Geoprobe™ or Hydropunch™ along temporary planar transects. Such characterizations are warranted at sites with limited contaminant quality and hydrological data. The optimal location of permanent wells is difficult without such data. However, the characterization of Site 35 is well beyond the preliminary stage. Under the RI and SGI, extensive horizontal and vertical characterizations of groundwater and soil contamination were performed. During these investigations, the areal extent of groundwater contamination and potential source areas were identified. Fuel-related contamination was detected primarily in the upper 10 feet of the surficial aquifer and solvent-related contamination was detected in the lower 5 feet of the surficial aquifer. In addition, the direction of groundwater flow and aquifer characteristics were well documented during these investigations. Considering the extensive body of information that exists, a full recharacterization of the site, using Geoprobe™ or Hydropunch™ probes, is not warranted.

3.2 Groundwater Investigation

A total of 17 temporary and permanent monitoring wells will be installed and sampled under the NAE. Twelve of these wells are permanent and five are temporary. Of the 12 permanent wells, four will be screened in the upper portion of the surficial aquifer (shallow) and eight will be screened in the lower portion of the surficial aquifer (intermediate). Of the five temporary wells to be installed, three will be screened in the upper portion of the surficial aquifer and two will be screened in the lower portion of the surficial aquifer. Shallow wells are constructed with a 10-foot screen and intermediate wells are constructed with a five-foot screen. In addition to sampling the new wells, 22 existing wells will be sampled. Nine of these are shallow monitoring wells and 13 are intermediate wells. Existing and proposed monitoring wells are shown in Figures 1 and 2.

To assess the impact of IAS operations on natural attenuation, two intermediate temporary wells will be installed and eight existing monitoring wells will be sampled. Four of the existing wells are intermediate and four are shallow.

Survey coordinates will be provided for all new monitoring wells.

3.3 Groundwater Analyses

A summary of all analytical methods is presented in Table 1. Samples collected from temporary monitoring wells will be analyzed immediately and the results will be made available via facsimile within 24 hours. Raw data from permanent wells will be provided by the laboratory within 28 days. All samples to be analyzed will be shipped via overnight courier to EA Laboratories of Sparks, Maryland.

In addition to fixed-base laboratory analysis that will be performed, all groundwater samples will be analyzed at the wellhead for the following parameters:

- Ferrous iron by method 8146.
- Sulfate by method 8051.
- Total alkalinity by method 8203.
- Chloride by method 8113.

A Hach DR2010 spectrophotometer will be used to analyze for ferrous iron, sulfate, and chloride in the field. Method 8203 (total alkalinity) is a manual titration method. In addition to chemical analysis, conductivity, pH, redox potential and dissolved oxygen will be monitored at each well.

3.4 Hydrological Investigation

The hydrological investigation will include the performance of slug tests on the 12 new permanent wells and three existing wells. These tests will provide hydraulic conductivity data that is needed to determine groundwater flow data. In addition to the slug tests, a round of static water levels will be collected.

3.5 Soil Investigation

A total of four subsurface soil samples will be collected and analyzed for total organic carbon by the Walkley-Black method. Levels of natural organic carbon are used to determine the contaminant transport velocity. These samples will be collected from two background well borings (MW-69B and MW-70B). From each well boring a soil sample will be collected at the water table and from the two foot interval immediately above the semiconfining unit. Table 2 provides sample designations for these samples.

3.6 Surface Water Investigation

A total of six surface water samples will be collected from Brinson Creek and analyzed for volatile organic compounds by method 8260B. Five of these samples will be collected from locations adjacent to proposed monitoring wells MW-61A, MW-62A, MW-63B, MW-64B and MW-65B. One sample will be collected as a background sample upstream of proposed monitoring well MW-61A. Table 3 provides sample designations for these samples.

3.7 Field Investigation Methods

Temporary and permanent monitoring well installation methods, well development methods, and soil and groundwater sampling methods that will be used during the NAE field investigation are described in the following documents:

- RI/FS Work Plan (Baker, 1993).
- RI/FS Sample and Analysis Plan (Baker, 1993).
- Letter amendment to the above documents submitted to LANTDIV on March 13, 1996.

4.0 INVESTIGATION DERIVED WASTE (IDW)

During this investigation drill cuttings will be generated from borehole advancement. These cuttings will be containerized in 55 gallon drums or a roll-off box. Development and purge water will be stored in a 5,000-gallon tanker or a 1,000-gallon polyethylene tank.

A composite of the drill cuttings will be collected from the roll-off box and analyzed for Target Compound Leaching Procedure (TCLP) Volatiles and RCRA Hazardous Waste Characteristics in order to assess disposal options. A single sample will be collected from the tanker or polyethylene tank used to store IDW during the investigation. This sample will be analyzed for Contract Laboratory Protocol (CLP) Volatile Organic Compounds (VOCs). Based on the analytical results and the prior approval of LANTDIV and MCB Camp Lejeune, liquid IDW will be transported to an on base facility for treatment and disposal.

5.0 SCHEDULE

A schedule of deliverables and mile stone dates associated with the NAE/CAP are presented below.

Deliverables	Milestone Dates
Draft CAP/NAE	2/22/99
Draft Long-Term Monitoring Plan	3/15/99
Final CAD/NAE	3/15/99
Final Long-Term Monitoring Plan	6/1/99

6.0 REFERENCES

NC DENR, 1995. North Carolina Department of Environment and Natural Resources. 15A NCAC 2L Implementation Guidance. Division of Environmental Management. Raleigh, North Carolina, December 1995.

USEPA. 1998. United States Environmental Protection Agency. Seminar On Monitored Natural Attenuation For Groundwater. Philadelphia, Pennsylvania, September 1998.

USEPA. 1997. United States Environmental Protection Agency. The Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. Office of Solid Waste Management and Emergency Response. Washington, D.C. OSWER Directive 9200.4-17. December 1997.

USEPA. 1996. United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4. Athens, Georgia. May 1996.

Wiedemeier, Todd, et al. 1996. Technical Protocols for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. Air Force Center for Environmental Excellence. San Antonio, Texas. November 1996.

Wiedemeier, Todd, et al. 1995. Technical Protocols for Implementing Intrinsic Remediation With Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater. Air Force Center for Environmental Excellence. San Antonio, Texas. December 1995.

TABLES

TABLE 1
GROUNDWATER SAMPLE SUMMARY
SITE 35, CAMP GEIGER FUEL FARM
CORRECTIVE ACTION PLAN AND NATURAL ATTENUATION EVALUATION
MARINE CORP BASE CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well Designation	Sample Designation	Proposed, Existing or Temporary Well	Sampled under CTO 323, NAE	Sampled Under CTO 367, LTM	VOAs, Method 8260 (incl. MTBE)	Dissolved Gas, Method RSK 175	Nitrate by IC, EPA Method 300.0	Sulfate by IC, EPA Method 300.0	Nitrite by IC, EPA Method 300.0	Orthophosphate by IC, EPA Method 300.0	Total Organic Carbon, SW 9060	Total Organic Nitrogen, EPA Method 351.	Ammonia, EPA Method 350.1
Background/Site Boundary Wells													
IR35-MW69B	IR35-GW69IW-98C2	P	x		x	x	x	x	x	x	x	x	x
IR89-MW42B	IR89-GW42IW-98C2	P	x		x	x	x	x					
Transect A													
IR35-MW37B	IR35-GW37IW-98C2	E	x		x	x	x	x					
IR35-MW38A	IR35-GW38-98C2	E		x	x	x	x	x	x	x	x	x	x
IR35-MW38B	IR35-GW38IW-98C2	E		x	x	x	x	x					
IR35-MW39B	IR35-GW39IW-98C2	E	x		x	x	x	x					
IR35-TW48B	IR35-TW48IW-98C2	T	x		x								
IR35-MW70B	IR35-GW70IW-98C2	P	x		x	x	x	x	x	x	x	x	x
Transect B													
IR35-MW09B	IR35-GW09IW-98C2	E	x		x	x	x	x					
IR35-MW10A	IR35-GW10-98C2	E		x	x	x	x	x					
IR35-MW10B	IR35-GW10IW-98C2	E		x	x	x	x	x					
IR35-MW30B	IR35-GW30IW-98C2	E	x		x	x	x	x					
IR35-MW40B	IR35-GW40IW-98C2	E	x		x	x	x	x					
IR35-MW43B	IR35-GW43IW-98C2	E	x		x	x	x	x					
IR35-TW47B	IR35-TW47IW-98C2	T	x		x								
IR35-MW71B	IR35-GW71IW-98C2	P	x		x	x	x	x	x	x	x	x	x
Transect C													
IR35-MW14A	IR35-GW14-98C2	E	x		x	x	x	x					
IR35-MW14B	IR35-GW14IW-98C2	E		x	x	x	x	x					
IR35-MW31A	IR35-GW31-98C2	E	x		x	x	x	x					
IR35-MW31B	IR35-GW31IW-98C2	E	x		x	x	x	x					
IR35-MW32A	IR35-GW32-98C2	E	x		x	x	x	x					
IR35-MW32B	IR35-GW32IW-98C2	E	x		x	x	x	x					
IR35-MW34B	IR35-GW34IW-98C2	E	x		x	x	x	x					
IR35-TW42A	IR35-TW42IW-98C2	T	x										
IR35-TW43A	IR35-TW43IW-98C2	T	x										
IR35-TW44A	IR35-TW44IW-98C2	T	x										
IR35-MW66A	IR35-GW66-98C2	P	x		x	x	x	x					
IR35-MW67A	IR35-GW67-98C2	P	x		x	x	x	x					
IR35-MW68B	IR35-GW68IW-98C2	P	x		x	x	x	x					

TABLE 1
GROUNDWATER SAMPLE SUMMARY
SITE 35, CAMP GEIGER FUEL FARM
CORRECTIVE ACTION PLAN AND NATURAL ATTENUATION EVALUATION
MARINE CORP BASE CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well Designation	Sample Designation	Proposed, Existing or Temporary Well	Sampled under CTO 323, NAE	Sampled Under CTO 367, LTM	VOAs, Method 8260 (incl. MTBE)	Dissolved Gas, Method RSK 175	Nitrate by IC, EPA Method 300.0	Sulfate by IC, EPA Method 300.0	Nitrite by IC, EPA Method 300.0	Orthophosphate by IC, EPA Method 300.0	Total Organic Carbon, SW 9060	Total Organic Nitrogen, EPA Method 351.	Ammonia, EPA Method 350.1
Transect D													
IR35-MW23A	IR35-GW23-98C2	E	x		x	x	x	x					
IR35-MW47A	IR35-GW47-98C2	E	x		x	x	x	x					
IR35-MW47B	IR35-GW47IW-98C2	E	x		x	x	x	x					
IR35-MW55A	IR35-GW55-98C2	E	x		x	x	x	x					
IR35-MW55B	IR35-GW55IW-98C2	E	x		x	x	x	x					
Transect E													
IR35-MW61A	IR35-GW61-98C2	P	x		x	x	x	x					
IR35-MW62A	IR35-GW62-98C2	P	x		x	x	x	x					
IR35-MW63B	IR35-GW63IW-98C2	P	x		x	x	x	x					
IR35-MW64B	IR35-GW64IW-98C2	P	x		x	x	x	x					
IR35-MW65B	IR35-GW65IW-98C2	P	x		x	x	x	x					
IAS Trench Monitoring													
IR35-MP3S	IR35-GW03-98C	E		x	x	x	x	x					
IR35-MP3D	IR35-GW03IW-98C2	E		x	x	x	x	x					
IR35-TW45B	IR35-TW45IW-98C2	E		x	x	x	x	x					
IR35-TW46B	IR35-TW46IW-98C2	E		x	x	x	x	x					
IR35-MP6S	IR35-GW06-98C2	E		x	x	x	x	x					
IR35-MP6D	IR35-GW06IW-98C2	E		x	x	x	x	x					
IR35-OP1S	IR35-GW01-98C2	E		x	x	x	x	x					
IR35-OP1D	IR35-GW01IW-98C2	E		x	x	x	x	x					
IR35-OP2S	IR35-GW02-98C2	E		x	x	x	x	x					
IR35-OP2D	IR35-GW02IW-98C2	E		x	x	x	x	x					

P = Proposed permanent well
E = Existing well
T = Proposed Temporary well

TABLE 2
SOIL SAMPLE SUMMARY
SITE 35, CAMP GEIGER FUEL FARM
CORRECTIVE ACTION PLAN AND NATURAL ATTENUATION EVALUATION
MARINE CORP BASE, CAMP LEJEUNE, NORTH CAROLINA

Soil Boring Location	Sample Designation	TOC	Turn	Comment
IR35-TW69B ^{1,2}	IR356-TW69IW-XX	X	28D	Sample to be taken from the upper portion of the surficial aquifer
IR35-TW69B ^{1,3}	IR356-TW69IW-XX	X	28D	Sample to be taken from the lower portion of the surficial aquifer
IR35-TW47B ^{1,2}	IR356-TW47IW-XX	X	28D	Sample to be taken from the upper portion of the surficial aquifer
IR35-TW47B ^{1,3}	IR356-TW47IW-XX	X	28D	Sample to be taken from the lower portion of the surficial aquifer

TOC = Total Organic Carbon

Turn = Turnaround Time

Notes:

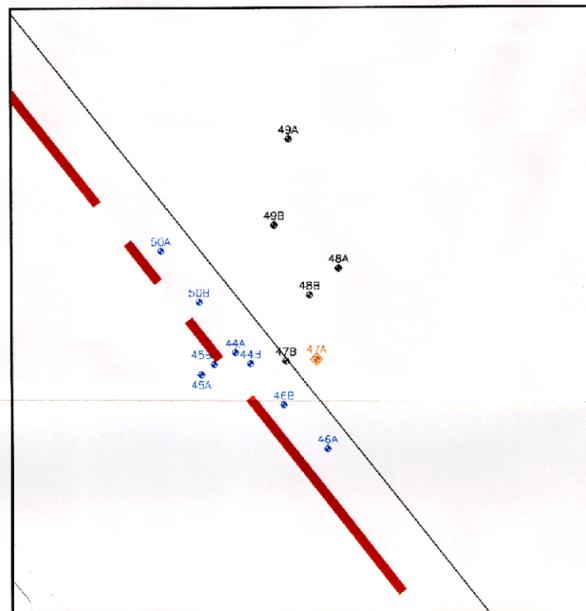
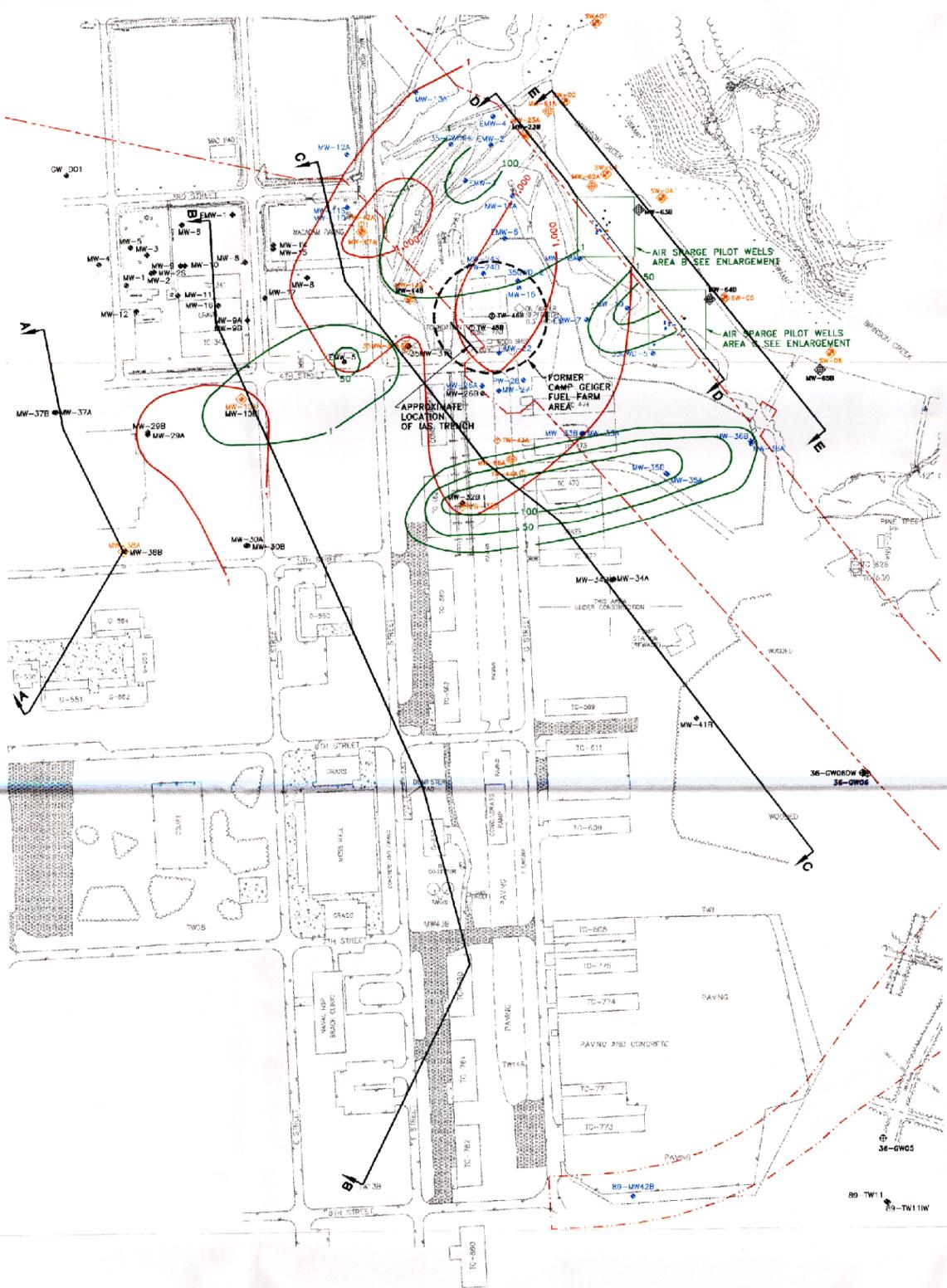
1. Two samples will be taken from each soil boring location.
2. Samples collected from the upper portion of the surficial aquifer should be taken just beneath the water table.
3. Samples collected from the lower portion of the surficial aquifer should be taken just above the confining unit.

TABLE 3
SURFACE WATER SAMPLE SUMMARY
SITE 35, CAMP GEIGER FUEL FARM
CORRECTIVE ACTION PLAN AND NATURAL ATTENUATION EVALUATION
MARINE CORP BASE, CAMP LEJEUNE, NORTH CAROLINA

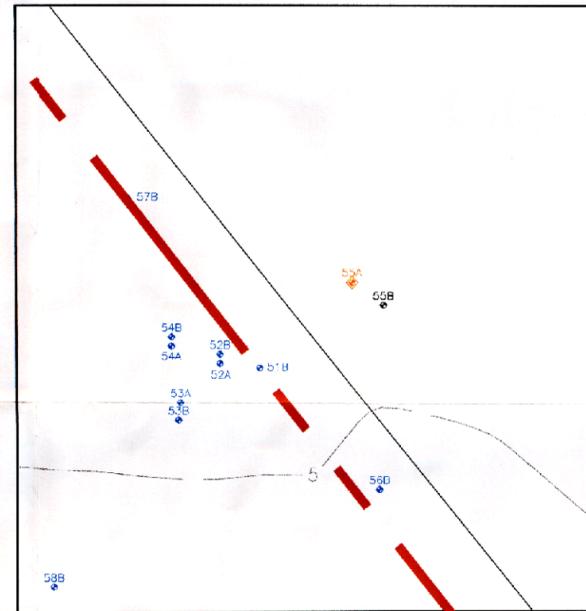
Soil Boring Location	Sample Designation	VOA s Method 8260	Comment
IR35-SW01	IR35-SW01-98C2	x	Up gradient sample.
IR35-SW02	IR35-SW02-98C2	x	Adjacent to MW-61A.
IR35-SW03	IR35-SW03-98C2	x	Adjacent to MW-62A.
IR35-SW04	IR35-SW04-98C2	x	Adjacent to MW-63B.
IR35-SW05	IR35-SW05-98C2	x	Adjacent to MW-64B.
IR35-SW06	IR35-SW06-98C2	x	Adjacent to MW-65B.

VOA = Volatile Organic Analysis

FIGURES



AIR SPARGE PILOT WELLS IN AREA B
20 0 10 20
1 INCH = 20 FEET



AIR SPARGE PILOT WELLS IN AREA C
20 0 10 20
1 INCH = 20 FEET

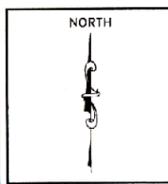
- NOTES:**
- 1.) MONITORING WELLS WITH AN "A" DESIGNATION AFTER THE WELL NUMBER (MW-32A) ARE SCREENED ACROSS THE WATER TABLE AND CONSIDERED SHALLOW WELLS.
 - 2.) MONITORING WELLS WITH A "B" DESIGNATION AFTER THE WELL NUMBER (MW32B) ARE SCREENED IN THE LOWER PORTION OF THE SURFICIAL AQUIFER AND CONSIDERED INTERMEDIATE WELLS.
 - 3.) MONITORING WELLS MW10A, EMW05, EMW06, MW31A, MW16A, MW18A, MW46A, AND MW38A WERE SAMPLED AND ANALYZED FOR NATURAL ATTENUATION PARAMETERS DURING THREE ROUNDS OF SAMPLING THAT OCCURRED JAN. 1998 THROUGH JUNE 1998.

- LEGEND**
- ISOPETHS OF FUEL-RELATED GROUNDWATER CONTAMINATION BASED ON DATA GATHERED DURING 1994 REMEDIAL INVESTIGATION
 - ISOPETHS OF SOLVENT-RELATED GROUNDWATER CONTAMINATION BASED ON DATA GATHERED DURING 1994 REMEDIAL INVESTIGATION AND THE 1996 SUPPLEMENTAL GROUNDWATER INVESTIGATION
 - US 17 JACKSONVILLE BYPASS RIGHT-OF-WAY LIMITS
 - US 17 JACKSONVILLE BYPASS EASEMENT LIMITS
 - EXISTING SHALLOW MONITORING WELLS TO BE SAMPLED DURING THE NATURAL ATTENUATION EVALUATION (NAE)
 - PROPOSED SHALLOW MONITORING WELL LOCATIONS. THESE WELLS TO BE INSTALLED DURING THE NAE.
 - PROPOSED TEMPORARY SHALLOW MONITORING WELL LOCATIONS. THESE WELLS ARE TO BE INSTALLED DURING THE NAE.
 - PROPOSED SURFACE WATER SAMPLE
 - PROPOSED PERMANENT INTERMEDIATE WELL. THESE WELLS ARE TO BE INSTALLED DURING THE NAE.
 - SHALLOW MONITORING WELL (SCREENED IN THE UPPER PORTION OF THE CASTLE HAYNE AQUIFER)
 - EXISTING SHALLOW MONITORING WELLS (SCREENED IN THE UPPER PORTION OF THE SURFICIAL AQUIFER)
 - EXISTING INTERMEDIATE MONITORING WELLS (SCREENED IN THE LOWER PORTION OF THE SURFICIAL AQUIFER)
 - EXISTING DEEP MONITORING WELLS (SCREENED IN THE UPPER PORTION OF THE CASTLE HAYNE AQUIFER)
 - DEEP MONITORING WELL (SCREENED IN THE CASTLE HAYNE AQUIFER)
 - EXISTING MONITORING WELLS ABANDONED DURING CONSTRUCTION OF US HIGHWAY 17 BYPASS
 - TRANSECT LINE

180 0 90 180
1 INCH = 180 FEET

REVISIONS	
DRAWN	GLB/WJH
REVIEWED	MDS
S.O.#	62470-323-0000-07000
CADD#	323600WP

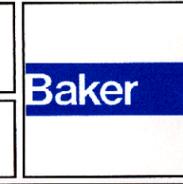
DRAWN	GLB/WJH
REVIEWED	MDS
S.O.#	62470-323-0000-07000
CADD#	323600WP



NORTH

SITE 35, CAMP GEIGER FUEL FARM, NAE
MARINE CORPS BASE CAMP LEJEUNE
CAMP LEJEUNE, NORTH CAROLINA

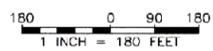
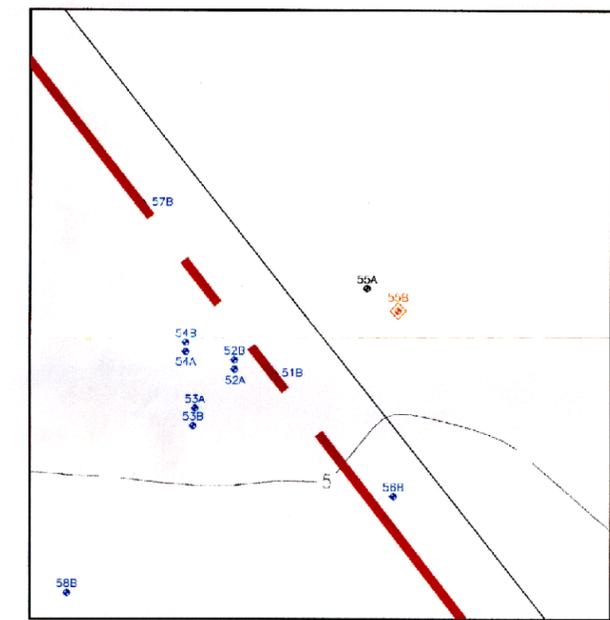
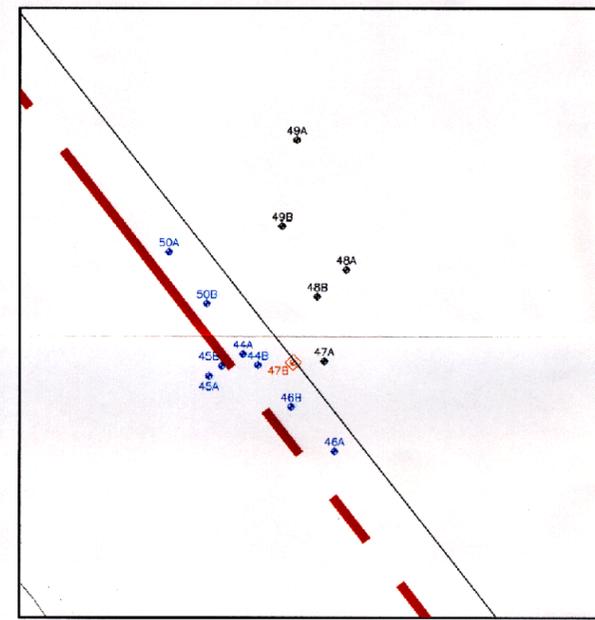
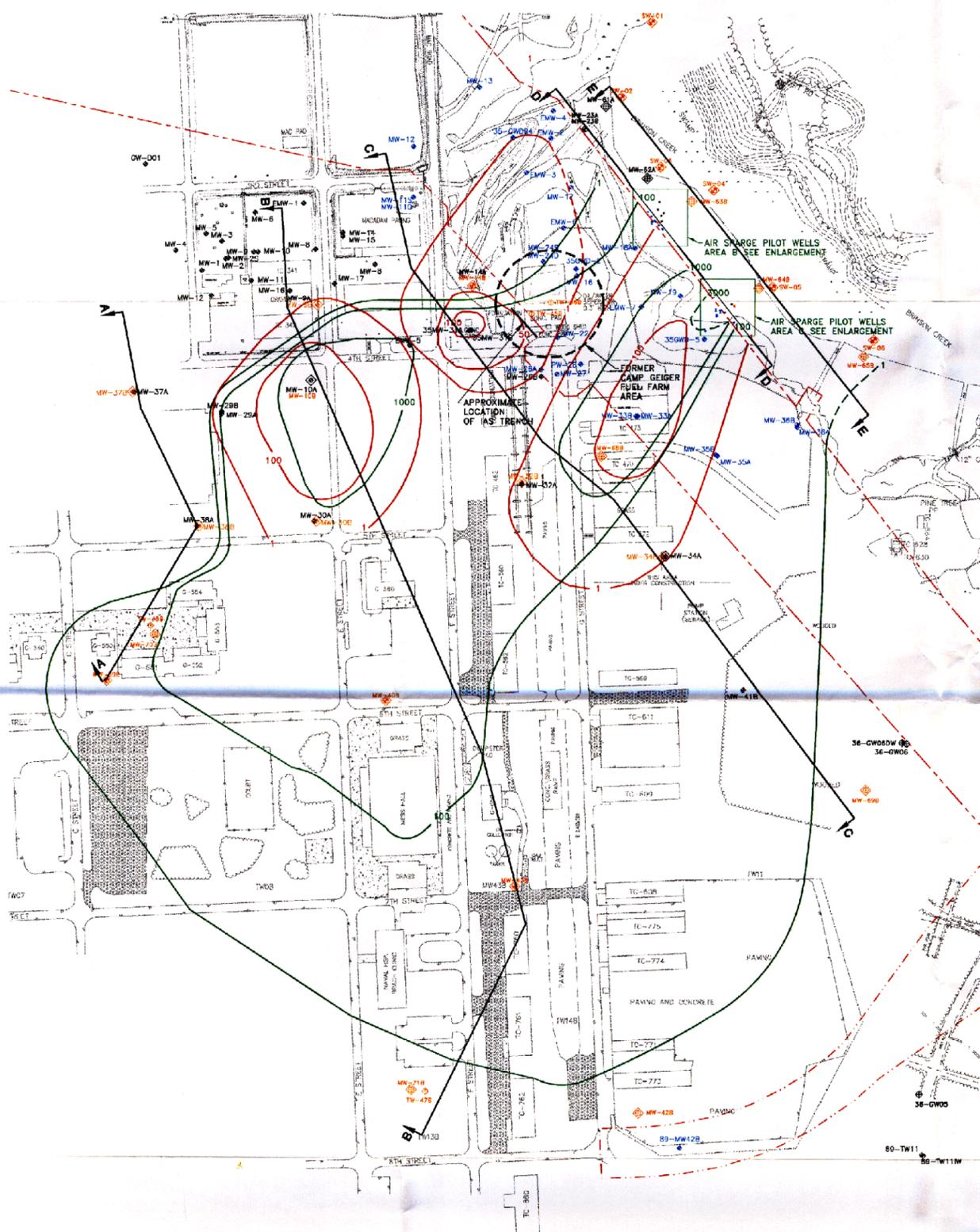
BAKER ENVIRONMENTAL, Inc.
Coraopolis, Pennsylvania



PROPOSED SAMPLING LOCATIONS
IN THE UPPER PORTION OF
THE SURFICIAL AQUIFER
CONTRACT TASK ORDER - 0323

SCALE AS SHOWN DATE SEPTEMBER 1998

SHEET NO.
1
OF 2



- NOTES:**
- 1.) MONITORING WELLS WITH AN "A" DESIGNATION AFTER THE WELL NUMBER (MW-32A) ARE SCREENED ACROSS THE WATER TABLE AND CONSIDERED SHALLOW WELLS.
 - 2.) MONITORING WELLS WITH A "D" DESIGNATION AFTER THE WELL NUMBER (MW-32D) ARE SCREENED IN THE LOWER PORTION OF THE SURFICIAL AQUIFER AND CONSIDERED INTERMEDIATE WELLS.
 - 3.) MONITORING WELLS MW10B, MW14B, MW22B, MW16B, MW18B, MW17B, MW46B, AND MW38B WERE SAMPLED AND ANALYZED FOR NATURAL ATTENUATION PARAMETERS DURING THREE ROUNDS OF SAMPLING THAT OCCURRED JAN. 1998 THROUGH JUNE 1998.

- LEGEND**
- ISOPLETHS OF FUEL-RELATED GROUNDWATER CONTAMINATION BASED ON DATA GATHERED DURING 1994 REMEDIAL INVESTIGATION
 - ISOPLETHS OF SOLVENT-RELATED GROUNDWATER CONTAMINATION BASED ON DATA GATHERED DURING 1994 REMEDIAL INVESTIGATION AND THE 1995 SUPPLEMENTAL GROUNDWATER INVESTIGATION
 - US 17 JACKSONVILLE BYPASS RIGHT-OF-WAY LIMITS
 - US 17 JACKSONVILLE BYPASS EASEMENT LIMITS
 - EXISTING INTERMEDIATE MONITORING WELLS TO BE SAMPLED DURING THE NATURAL ATTENUATION EVALUATION (NAE)
 - PROPOSED INTERMEDIATE MONITORING WELL LOCATIONS. THESE WELLS ARE TO BE INSTALLED DURING THE NAE
 - PROPOSED TEMPORARY INTERMEDIATE MONITORING WELL LOCATIONS. THESE WELLS ARE TO BE INSTALLED DURING THE NAE
 - PROPOSED SURFACE WATER SAMPLE
 - PROPOSED SHALLOW MONITORING WELL LOCATION. THESE WELLS ARE TO BE INSTALLED DURING THE NAE
 - SHALLOW MONITORING WELL (SCREENED IN THE UPPER SURFICIAL AQUIFER)
 - EXISTING SHALLOW MONITORING WELLS (SCREENED IN THE UPPER PORTION OF THE SURFICIAL AQUIFER)
 - EXISTING INTERMEDIATE MONITORING WELLS (SCREENED IN THE LOWER PORTION OF THE SURFICIAL AQUIFER)
 - EXISTING DEEP MONITORING WELLS (SCREENED IN THE UPPER PORTION OF THE CASTLE HAYNE AQUIFER)
 - DEEP MONITORING WELL (SCREENED IN THE CASTLE HAYNE AQUIFER)
 - EXISTING MONITORING WELLS ABANDONED DURING CONSTRUCTION OF US HIGHWAY 17 BYPASS
 - TRANSECT LINE

REVISIONS

DRAWN GLB/WJH
 REVIEWED MDS
 S.O.# 82470-323-0000-07000
 CADD# 323601WP



SITE 35, CAMP GEIGER FUEL FARM, NAE
 MARINE CORPS BASE CAMP LEJEUNE
 CAMP LEJEUNE, NORTH CAROLINA

BAKER ENVIRONMENTAL, Inc.
 Coraopolis, Pennsylvania



PROPOSED SAMPLING LOCATIONS
 IN THE LOWER PORTION OF
 THE SURFICIAL AQUIFER
 CONTRACT TASK ORDER - 0323

SCALE AS SHOWN
 DATE SEPTEMBER 1998

SHEET NO.

2

OF 2