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QUARTERLY MONITORING REPORT
OPERABLE UNIT NO. 1 – SITES 24 AND 78

FIRST QUARTER 1997 (JAN – MAR 97)

MARINE CORPS BASE
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DQOs	Data Quality Objectives
gpm	gallons per minute
IR	Installation Restoration
MCB	Marine Corps Base
MCLs	maximum contaminant levels
NCWQSs	North Carolina Water Quality Standards
NFESC	Naval Facilities Engineering Service Center
NTU	Neophelmetic Turbidity Units
OU	Operable Unit
ppm	parts per million
QA/QC	Quality Assurance/Quality Control
RI	Remedial Investigation
ROD	Record of Decision
SWMU	solid waste management unit
TAL	target analyte list
TCL	target compound list
TDS	total dissolved solids
TOC	top-of-casing
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOCs	volatile organic compounds
mg/L	milligrams per liter
µg/L	micrograms per liter

1.0 INTRODUCTION

The following quarterly monitoring report presents the sampling procedures and analytical findings of the monitoring program at Operable Unit (OU) No. 1 (Sites 24 and 78), Marine Corps Base (MCB) Camp Lejeune, North Carolina. Operational data and an evaluation of the groundwater treatment system at Site 78 are also provided within this quarterly monitoring report. The report describes the activities completed at Sites 24 and 78 during the first quarter of 1997 and presents recommendations concerning the monitoring program and groundwater treatment systems.

1.1 Report Organization

This quarterly monitoring report is comprised of five sections. Section 1.0 describes the sampling program procedures and methodology. Section 1.0 also provides groundwater elevation data, groundwater flow direction, and various field observations. Analytical results and findings are presented in Section 2.0. A comparison of previous analytical findings versus the most recent results is also included within Section 2.0. An evaluation of the northern and southern groundwater treatment systems at Site 78 is presented in Section 3.0. Section 4.0 provides recommendations to improve the groundwater treatment system at Site 78 and the quarterly sampling program at both Sites 24 and 78. Finally, references used in the preparation of this report are included in Section 5.0. All tables, figures, and attachments are provided after the text portion of the report.

1.2 Quarterly Sampling Program

The first quarter sampling event commenced on February 2, 1997 and continued through February 7, 1997. Sampling at Site 24 involved the collection of groundwater samples from the three shallow monitoring wells depicted in Figure 1-1. Groundwater samples from Site 78 were collected from 15 shallow monitoring wells, 2 intermediate wells, and 2 deep wells. Figure 1-2 depicts the groundwater sampling locations at Site 78.

During the quarterly sampling event a low flow purge and sampling technique was employed. The sampling methodology was developed in response to standard operating procedures (SOPs) issued by the United States Environmental Protection Agency (USEPA - Region IV, 1996). Prior to groundwater purging, water level and total depth measurements from each monitoring well were obtained. Water level and well depth measurements were used to calculate the volume of water necessary to purge each well. Table 1-1 provides a summary of monitoring well construction details.

A peristaltic pump, with the intake set two to four feet above the bottom of the well was used to purge each of the monitoring wells. While purging groundwater, a flow rate of less than 0.25 gallons per minute (gpm) was maintained. Groundwater samples were obtained directly from the pump discharge. Dedicated sections of polyethylene and silicon pump-head tubing were used during purge and sampling activities at each monitoring well. A minimum of three well volumes were purged from each monitoring well prior to sampling. Measurements of pH, specific conductance, dissolved oxygen, temperature, and turbidity were recorded to ensure that groundwater characteristics had stabilized before sampling. These measurements were recorded in a field logbook and are provided in Table 1-2.

Groundwater samples were collected to assess whether contamination, detected during previous investigative activities, was present in the shallow aquifer. Based upon previous sampling results and decision documents, the contaminants of concern at Site 24 were volatile organic compounds (VOCs), pesticides, and select metals. Contaminants of concern at Site 78 were limited to VOCs only.

Groundwater samples obtained from Site 24 were analyzed for target compound list (TCL) volatile organics, TCL pesticides, select target analyte list (TAL) metals, total dissolved solids (TDS), and total suspended solids (TSS). Groundwater samples obtained from Site 78 were analyzed for TCL volatile organics only. Samples were preserved at the time of collection with hydrochloric acid for volatile analyses, nitric acid for metal analyses, and sodium hydroxide for suspended and dissolved solids analyses. Table 1-3 provides a summary of requested analyses and groundwater samples submitted during the quarterly monitoring event. Groundwater samples were analyzed using various analytical methods, as provided in Table 1-3, and Level III Data Quality Objectives (DQOs). DQO Level III is equivalent to the Naval Facilities Engineering Service Center (NFESC) Level C, as specified in the "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Programs" document. Table 1-4 provides the various analytical method detection limits and comparative state and federal groundwater quality standards.

Trip blanks were prepared by the laboratory prior to the sampling event, placed in sample storage containers, and kept with the investigative samples throughout the sampling event. The trip blanks were then packaged for shipment with the environmental samples and sent for analysis. Trip blanks were used to determine if samples were cross-contaminated during storage and transportation to the laboratory.

Sample information, such as well number, sample identification, time and date of sample collection, samplers, analytical parameters, and required laboratory turnaround time was recorded in a field logbook and on sample labels. Chain-of-custody documentation, provided in Attachment A, accompanied the groundwater samples to the laboratory. Chain-of-custody forms were then compared to the monitoring plan; this comparison was used to verify that appropriate laboratory analyses had been requested. Upon receipt of the laboratory analytical results, a further comparison was performed to verify that each sample was analyzed for the requested analyses. Sample tracking documentation is provided as Attachment B. The sample designation format used during the monitoring program at Sites 24 and 78 is provided in Attachment C.

1.3 Groundwater Elevation and Flow Direction

The following sections provide information concerning groundwater flow patterns at Sites 24 and 78. Static water level measurements were collected after all well sampling activities had been completed. Measurements were recorded from top-of-casing (TOC) reference points marked on each monitoring well. Groundwater measurements were recorded to the nearest 0.01-foot using an electric measuring tape. The elevation data were obtained by subtracting the measured depth to groundwater from the surveyed reference elevation. For ease of discussion, groundwater elevation and flow direction for the two sites are presented separately.

1.3.1 Site 24

Water level measurements were collected at Site 24 on February 5, 1997. Table 1-5 provides a summary of the water level measurements and Figure 1-3 depicts the static elevations and approximate flow direction of groundwater. The general groundwater flow direction at Site 24 is south, in the direction of a series of tributaries which lead to Cogdels Creek. As shown on Figure 1-3, the flow direction near monitoring wells 24-GW07 and 24-GW08 is toward the south and southeast. Groundwater flow near wells 24-GW03 and 24-GW10 is generally toward the south and southwest. The slight difference in groundwater flow directions across Site 24 is most likely a result of the local topography and the influence of the surface water features.

1.3.2 Site 78

Water level measurements at Site 78 were collected on February 25, 1997. Table 1- 6 provides a summary of the water level measurements and Figure 1-4 depicts the static elevations and approximate flow direction of groundwater. The groundwater flow regime at Site 78 is relatively consistent. Groundwater flow is generally toward the southwest, in the direction of an unnamed tributary to Cogdels Creek.

1.4 Field Observations

Field observations have been recorded during each groundwater sampling event at Sites 24 and 78. Recommendations regarding the field observations which follow are presented in Section 3.0.

Groundwater samples from several of the monitoring wells throughout Site 78 exhibited sediment after having been purged for a reasonable amount of time. This suggests that the monitoring wells have either begun to deteriorate or were poorly constructed. Turbidity readings collected during groundwater sampling activities have been consistently high in few cases. Turbidity readings have ranged, in those few cases, between 100 nephlometric turbidity units (NTUs) and 200 NTUs. In general, it is preferred that groundwater samples be collected after turbidity readings stabilize at less than ten NTUs. In many cases, the older monitoring wells do not reach this turbidity level, resulting in less than ideal sampling conditions.

2.0 ANALYTICAL RESULTS AND FINDINGS

The section which follows presents analytical results and findings from groundwater monitoring performed at Sites 24 and 78 during the first quarter of 1997. Groundwater samples from Site 24 were obtained from three shallow monitoring wells. Quarterly sampling activities at Site 78 entailed the collection of groundwater samples from 15 shallow monitoring wells, 2 intermediate monitoring wells, and 2 deep monitoring wells. A summary of groundwater analytical results for Sites 24 and 78 are provided in Table 2-1 and Table 2-2, respectively. Positive detection summaries for Sites 24 and 78 are provided in Table 2-3 and Table 2-4.

Trip blanks accompanied the groundwater samples during field collection, shipment, and laboratory analysis. No organic compounds were detected among the three trip blanks submitted during the quarterly sampling event. Analytical results from the three trip blanks are presented in Table 2-5.

2.1 Site 24

The following sections present analytical results and findings from monitoring activities conducted at Site 24 during the first quarter of 1997.

2.1.1 Organic Compounds

As provided in Table 2-1, no volatile organic compounds were detected among the three groundwater samples extracted from the shallow aquifer at Site 24. In addition, there were no pesticide compounds detected among groundwater samples obtained from these monitoring wells. Groundwater samples collected at Site 24 were also analyzed for oil and grease according to USEPA Solid Waste Method 9071. The groundwater sample obtained from monitoring well 24-GW09 had the only positive detection of petroleum-related products at a concentration of 21 milligrams per liter (mg/L). Previous sampling results indicate that oil and grease compounds have not been detected among samples obtained from Site 24.

2.1.2 Selected Total Metals

As presented in Table 2-3, iron, lead, and manganese were the only total metals detected among the three groundwater samples submitted for analyses from Site 24. Iron was detected in each of the three samples, manganese was detected twice, and lead was detected in only one of the three samples. The sample obtained from monitoring well 24-GW09 exhibited the only positive total metal detection that exceeded an applicable water quality standard. Iron was detected in the sample obtained from well 24-GW09 at a concentration of 368 micrograms per liter (µg/L), which exceeds the North Carolina Water Quality Standard (NCWQSs) of 300 µg/L.

The observed concentrations of iron are typical of previous sampling events and analytical results obtained during numerous other groundwater investigations conducted throughout MCB Camp Lejeune. Although the concentration of metals among groundwater samples often exceed established water quality standards, the levels are generally characteristic of natural site conditions. Soils found within the coastal plain of North Carolina are naturally rich in metals. The observed total metal concentrations in groundwater are due more to geologic conditions (i.e., naturally occurring metals bound to unconsolidated soil particles) and sample acquisition methods than to mobile metal concentrations in the surficial aquifer. The presence of certain metals such as iron and manganese in groundwater is often a reflection of solids or colloids in samples. In order to limit the amount of solids and obtain a more

representative groundwater samples, a low-flow purge method was employed during sampling. However, the low-flow purge method can only reduce, not eliminate the amount of solids that are frequently present in groundwater samples. Well deterioration and improper well construction procedures or materials may also contribute to the presence of solids, and therefore, metals in groundwater samples.

2.1.3 Suspended and Dissolved Solids

Suspended solids were detected at a concentration of 6 mg/L in the sample obtained from 24-GW08. No other suspended solids were detected among the other two groundwater samples obtained at Site 24. All three of the shallow groundwater samples had detectable concentrations of dissolved solids, however. As provided in Table 2-3, monitoring wells 24-GW08, 24-GW09, and 24-GW10 had dissolved solid concentrations of 88, 56, and 24 milligrams per liter (mg/L), respectively. The detected concentrations of dissolved solids were below the NCWQS of 500 mg/L.

2.2 Site 78

The following sections present analytical results and findings from the monitoring event conducted at Site 78 during the first quarter of 1997. Positive VOC detections were primarily limited to samples obtained from the uppermost portion of the surficial aquifer (i.e., less than 25 below ground surface). One VOC was detected, however, at a low concentration in the sample obtained from intermediate monitoring well 78-GW09-2. The limited number of positive VOC detections among samples obtained from the deeper portion of the surficial aquifer and the Castle Hayne Aquifer suggests that migration of VOCs may be limited to the upper portion of the surficial aquifer only; however, only two deep and two intermediate groundwater samples were collected throughout Site 78. The sections which follow discuss the findings of groundwater monitoring at Site 78 in further detail.

2.2.1 Shallow and Intermediate Groundwater

Groundwater conditions within the upper portion of the surficial aquifer were evaluated at Site 78 through collection and analysis of samples from 15 shallow monitoring wells (refer to Table 1-2 for well construction details and Figure 1-2 for well locations). Two additional groundwater samples were obtained from intermediate wells set in the lower portion of the surficial aquifer (i.e., less than 75 feet below ground surface). The paragraphs which follow provide not only an evaluation of the most recent analytical data, but a comparison of those findings versus previous results.

A summary of groundwater analytical results is provided in Table 2-2; a graphic depiction of VOC results and their locations throughout the study area is presented in Figure 2-1. In general, the analytical data suggest two primary areas of chlorinated solvent contamination within Site 78. The two chlorinated solvent contaminant plumes are primarily limited to the uppermost portion of the surficial aquifer at Site 78. One area of contamination is located within the northern portion of the site and the other is located within the southern portion of the site. The northern plume area is located southwest of Buildings 902 and 903 toward monitoring well 78-GW23. The southern plume area is situated near the intersection of Fir and East Streets adjacent to monitoring well 78-GW09, extending south and west.

A total of six VOCs were detected among samples associated with the southern contaminant plume. As depicted in Figure 2-1, positive VOC detections in the southern portion of Site 78 were limited to shallow monitoring wells 78-GW01, 78-GW04-1, and 78-GW09-1, and intermediate well 78-GW09-2. Among these wells, the sample obtained from well 78-GW09-1 exhibited the highest concentrations of

each chlorinated solvent identified. As presented in Table 2-2, the solvents 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene (total), and trichloroethene were detected in the sample obtained from well 78-GW09-1 at concentrations of 500, 50, 78, 220, and 640 µg/L, respectively. Figure 2-2 depicts total chlorinated solvent concentrations in samples obtained from well 78-GW09-1 during the past seven quarterly monitoring events. The median concentration of total chlorinated solvents detected in well 78-GW09-1 is 1,488 µg/L. Figures 2-3, 2-4, and 2-5 depict the concentrations of 1,1-dichloroethene, 1,1,1-trichloroethane, and trichloroethene detected among samples obtained from well 78-GW09-1 during previous sampling events. Each of these compounds have been consistently detected at concentrations exceeding the NCWQS. Indicators of central tendency, including mean and median, have been calculated for each of the various compounds and are provided in Figures 2-2 through 2-5. As depicted in the figures, chlorinated solvent concentrations have increased since the previous sampling event, and remain above the applicable water quality standards.

As presented in Figure 2-1, 1,2-dichloroethene (total) was detected at 4 µg/L in the sample obtained from intermediate well 78-GW09-2; the NCWQS for 1,2-dichloroethene (total) is 70 µg/L. Intermediate well 78-GW09-2 is located approximately 150 feet southeast of shallow well 78-GW09-1. Similar concentrations of 1,2-dichloroethene (total) have been exhibited among samples obtained from intermediate well 78-GW09-2 during previous sampling events. The detections of 1,2-dichloroethene (total) during the most recent sampling events suggests that VOCs may have migrated to the deeper portion of the surficial aquifer. As shown in Figure 2-1, the detected concentrations are significantly lower than the NCWQS; however, the presence of this compound in the deeper portion of the shallow aquifer is notable. Additional periodic sampling will be required to monitor the presence of VOCs in the intermediate zone. Further data will confirm the vertical migration of contaminants within the plume area. As mentioned, the detected concentrations of the last three sampling quarters do not exceed applicable water quality standards. In addition, there have been no detections of VOCs in samples obtained from deep monitoring well 78-GW09-3, located nearly 200 feet east of 78-GW09-1. These analytical results suggest that the identified chlorinated solvents are primarily located in the uppermost portion of the surficial aquifer in the southern plume area of Site 78, with limited vertical migration.

A total of four chlorinated solvents and four petroleum-related compounds were detected among samples associated with the northern contaminant plume. As depicted in Figure 2-1, positive VOC detections in the northern portion of Site 78 were limited to samples obtained from shallow monitoring wells 78-GW23 and 78-GW24-1. As presented in Table 2-4, the chlorinated solvents 1,2-dichloroethene (total) and trichloroethene were detected in samples obtained from wells 78-GW23 and 78-GW24-1. The sample obtained from 78-GW23 had the highest concentrations of each identified contaminant. The maximum concentrations of 1,1-dichloroethene, 1,2-dichloroethene (total), trichloroethene, and vinyl chloride were 4, 7900, 57, and 360 µg/L, respectively. Figure 2-6 depicts total chlorinated solvent concentrations in samples obtained from well 78-GW23 during the past seven quarterly monitoring events. The increased concentration of total chlorinated solvents detected in well 78-GW23 during the last three quarters is the result of differing laboratory analyses; not until the third quarter of 1996 were groundwater samples submitted for 1,2-dichloroethene (total) analyses. Figures 2-7 and 2-8 depict the concentrations of specific compounds detected in prior samples obtained from well 78-GW23.

Within the northern contaminant plume, benzene, toluene, ethylbenzene, and xylene (total) have also been detected among shallow groundwater samples obtained from 78-GW23. Of these petroleum-related contaminants, only benzene was detected at a concentration which exceeded the NCWQS of 1.0 µg/L and the MCL of 5.0 µg/L. The concentrations of benzene, toluene, ethylbenzene, and total xylenes associated with the northern contaminant plume were 16, 3, 7, and 46 µg/L, respectively. Results from samples collected during previous quarterly events confirm the presence of

petroleum-related compounds in the northern portion of Site 78. Previous sampling results from intermediate monitoring well 78-GW24-2, located adjacent to shallow well 78GW24-1, have exhibited benzene, ethylbenzene, and toluene at concentrations of 4.8, 3.5, and 15 µg/L, respectively. These data suggest that petroleum-related compounds may have begun to migrate vertically from the surficial aquifer. Additional sampling data will be required before the migration of VOCs from the surficial aquifer to deeper zones can be confirmed.

Shallow monitoring wells 78-GW15 and 78-GW39 are situated in areas removed from the main contaminant plumes at Site 78; however, VOCs have been detected among samples obtained from these wells during previous sampling events. For example, trichloroethene was detected at a concentration of 1 µg/L in the sample obtained from well 78-GW15. In addition, the sample obtained from monitoring well 78-GW39 exhibited a low concentration of tetrachloroethene during the most recent sampling event. The detections of contaminants in samples obtained from monitoring wells 78-GW15 and 78-GW39 demonstrate that VOCs are present at low concentrations in areas of the site removed from the main contaminant plumes.

2.2.2 Deep Groundwater

The following section presents analytical results and findings from two deep groundwater samples obtained at Site 78 during the first quarter of 1997 (i.e., collected from depths greater than 100 feet below ground surface). As provided in Table 2-4, no VOCs were detected among the two groundwater samples obtained from the deep aquifer. Toluene has been detected at a concentration of 0.8 µg/L in a sample collected from deep well 78-GW24-3 during a previous quarterly monitoring event. The detection was considerably less than both the NCWQS and MCL of 1,000 µg/L. No other analytical results have indicated the presence of VOCs in the deep aquifer, implying that volatile contaminants have not begun to migrate vertically from the shallow aquifer to the deep aquifer. Additional analytical data will be required to evaluate the presence of VOCs in the Castle Hayne Aquifer at Site 78.

3.0 TREATMENT SYSTEM EVALUATION

Two independent groundwater extraction and treatment systems have been operating within the Hadnot Point Industrial Area since December 1994. The systems were designed to collect and treat VOC-contaminated shallow groundwater from both the northern and southern portions of Site 78. The systems were also designed to mitigate the potential for off-site contaminant migration.

As depicted in Figure 3-1, the northern treatment system currently includes one active recovery well (RW-10) and five inactive recovery wells (RW-1, RW-2, RW-3, RW-4, and RW-11). The southern treatment system includes four active recovery wells (RW-5, RW-6, RW-7, and RW-8) and one inactive recovery well (RW-9). Shallow groundwater extracted via the five active recovery wells is treated at either the northern or southern treatment systems, then discharged to the Hadnot Point Sewage Treatment Plant. Five of the six currently inactive recovery wells were taken off-line during 1996 due to low concentrations of contaminants being extracted. The sixth inactive recovery well was taken off-line during 1996 due to high concentrations of solids within the extracted groundwater. The concentration of solids within groundwater extracted via RW-11 suggests that it was poorly constructed during installation.

The following treatment system evaluation is divided into two sections. The first section focuses upon system components located within each treatment plant. These in-plant components include oil and water separators, metals removal systems, low-profile air strippers, and liquid-phase carbon adsorption units. The second section focuses upon the groundwater recovery components that are located outside of each treatment plant. These recovery components include recovery wells, piping, and pumps.

3.1 In-Plant Components

Both the northern and southern treatment plants contain oil and water separators; metals removal systems including flocculation tanks, settling tanks, and sand filters; low profile air strippers; and liquid-phase carbon adsorption units. Monitoring activities at both treatment plants include sampling of plant influent, plant effluent, oil and water separator effluent, sand filter effluent, and air stripper effluent. Tables 3-1 and 3-2 present monthly sampling results obtained during January, February, and March 1997 for the northern and southern treatment plants, respectively. No sampling was performed at the southern treatment plant during January 1997; the systems were off-line while being cleaned and maintained. Attachment E contains the Monthly Progress Reports for January, February, and March 1997 prepared by OHM Remediation Services Corporation. The following assessment of treatment components is based on monthly sampling results from January through March 1997 and the Monthly Progress Reports presented in Attachment E.

Analytical results indicate that in-plant treatment components of both the northern and southern systems are functioning effectively. The treatment components are either treating contamination to the remediation levels or eliminating contamination altogether. Influent to both the northern and southern treatment plants has historically contained the VOCs trans-1,2-dichloroethene, trichloroethylene, vinyl chloride, benzene, and cis-1,2-dichloroethylene at concentrations exceeding remediation levels. Based on VOC concentrations in the air stripper effluent samples, the air stripper has successfully treated these contaminants to concentrations that are below the remediation levels, and in most cases, below the detection levels. Similarly, VOC concentrations in the plant effluent have been below the remediation levels and, frequently, below the detection levels. This indicates that VOC treatment is functioning effectively.

In addition to VOCs, plant influent has consistently contained metals, dissolved solids, and suspended solids. Based on sampling results from the sand filter effluent, the majority of metals have been reduced to below the remediation levels and suspended solids have been reduced to below the discharge limits. Calcium and dissolved solid concentrations, however, are not adequately being reduced during treatment and have resulted in the need for continued cleaning and maintenance. In addition, the Monthly Progress Reports (refer to Attachment E) suggest that suspended solids are clogging many of the treatment subsystems and have resulted in a loss of pressure. In fact, many of the maintenance items cited in the Monthly Progress Reports relate to the presence of either calcium build-up or sludge. Recommendations supplied within the Draft Remedial System Repair Report, provided as Attachment F, suggest that a larger filter press may be required to more effectively process solids.

Finally, oil and grease influent concentrations have typically been below the discharge limit of 1.00 parts per million (ppm). As a result, the effectiveness of the oil and water separators cannot be adequately determined at this time.

3.2 Groundwater Recovery Components

Recovery wells RW-10 and RW-11 are situated within a portion of the northern contaminant plume which has exhibited relatively high concentrations of VOCs. As a result, the two recovery wells have historically extracted groundwater with concentrations of VOCs at nearly the same rate and efficiency. However, recovery well RW-11 has been taken off-line due to high concentrations of solids within groundwater extracted during its operation. In addition, RW-10 is located approximately 140 feet upgradient of monitoring well 78-GW23, where VOCs have been detected at levels well above water quality standards.

The southern recovery wells are situated in a line as a downgradient contaminant barrier. The recovery wells are positioned to limit contaminant migration and intercept the contaminated plume as it travels in the direction of groundwater flow. Because the southern recovery wells are located at the downgradient edge of the contaminant plume, these recovery wells have been extracting groundwater with lower VOC concentrations when compared to the northern recovery wells. Recovery wells RW-5 and RW-6 have typically removed VOCs at relatively higher concentrations than recovery wells RW-7 and RW-8 because they are positioned closer to the most highly contaminated portion of the suspected contaminant plume.

Compared to the southern recovery system, the northern recovery system has been extracting higher concentrations of VOCs. The northern recovery system is positioned in the portion of the suspected contaminant plume that contains relatively higher VOC concentrations. The southern recovery system is positioned at the downgradient edge of the suspected contaminant plume rather than within the most highly contaminated area.

The northern and the southern treatment systems were designed to handle a maximum influent of 80 gallons per minute. Because the actual pumping rates are lower than 80 gpm, the treatment systems are currently operating well below their maximum capacity. Based on past experience at MCB Camp Lejeune, a 100-foot radius of influence can be expected for a recovery well that is pumping at 5 gpm (Baker, April 1996). For the recovery wells at Site 78, the most recently observed pumping rates were between 2.9 and 3.5 gpm. Thus, a radius of influence closer to 75 feet may be expected for each recovery well at Site 78.

4.0 RECOMMENDATIONS

The ROD for OU1 stipulates that groundwater samples from Site 24 and Site 78 be collected periodically and possible off-site migration of known contaminants be monitored through laboratory analyses (Baker, 1994a). Groundwater sampling was implemented to ensure that potential human and ecological receptors would not be exposed to known site contaminants. The sections which follow describe recommendations which have recently been implemented and recommendations which are proposed for future consideration.

4.1 Implemented Recommendations

Detailed information pertaining to the implemented recommendations which follow has been presented within previous groundwater monitoring reports. The final disposition of each recommendation is presented here to update information regarding the monitoring program. It is also the intent of this report to provide a thorough listing of recommendations and implemented actions.

4.1.1 Sample Analyses

The subsections which follow detail modifications to the analytical requirements of monitoring program activities at OU1.

4.1.1.1 Site 24 Sample Analyses

Groundwater samples from both monitoring and supply wells at OU1 have been collected quarterly and analyzed for VOCs, total metals, dissolved solids, and suspended solids. The contaminant of concern in groundwater at Site 24, however, was identified during the Remedial Investigation (RI) as heptachlor epoxide (Baker, 1994b). The pesticide heptachlor epoxide was detected in groundwater samples collected from shallow monitoring wells 24-GW08, 24-GW09, and 24-GW10. These same wells are identified in the ROD for inclusion in the monitoring program at OU1. Heptachlor epoxide was detected in each of the three wells at concentrations exceeding the NCWQS of 0.004 µg/L, but less than the Federal Maximum Contaminant Level (MCL) of 0.2 µg/L. Until it can be determined that pesticides are no longer a concern at this site, samples will be obtained from shallow monitoring wells 24-GW08, 24-GW09, and 24-GW10 and submitted for pesticide analyses.

4.1.1.2 Site 78 Sample Analyses

Groundwater samples collected throughout Site 78 have been submitted for oil and grease analyses. The ROD stipulates only that samples be collected and analyzed for VOCs, total metals, dissolved solids, and suspended solids. Oil and grease analyses were added to the monitoring program in response to engineering requirements of the groundwater treatment system. However, only treatment plant influent and effluent need be submitted for oil and grease analyses as an indicator of oil and water separator efficiency. In addition, concentrations of oil and grease compounds have not been detected among any samples collected during the most recent sampling events. Analytical results from previous monitoring events at Site 78 suggest that oil and grease compounds have been detected infrequently and at concentrations less than 15 mg/L. Based upon this information, groundwater samples will no longer be submitted for oil and grease analyses.

Total metal, dissolved solid, and suspended solid analyses have also been eliminated from the sampling program. Although positive detections of metals and dissolved solids have been greater than applicable

North Carolina standards, these analyses are not required to determine or monitor VOC contaminant migration. In addition, there is no history or evidence to suggest that metal disposal activities may have occurred at Site 78. The sediments of North Carolina's coastal plain are naturally rich in metals, particularly iron and manganese. It is not uncommon to detect total metal concentrations in groundwater at MCB Camp Lejeune that are greater than the applicable water quality standards.

4.1.2 Groundwater Sampling Scheme

The sections which follow describe a number of adjustments to the monitoring program at Site 78. These adjustments pertain to the number and locations of groundwater sampling points utilized during the monitoring program. Two primary areas of groundwater contamination have been identified and are actively undergoing treatment at Site 78. The adjustments are intended to improve the effectiveness of treatment systems already in place and provide necessary analytical data in support of the selected remedy.

4.1.2.1 Sampling Inactive Recovery Wells

Recovery wells RW-1 through RW-4 and RW-9 were being sampled as part of the monitoring program at Site 78. The five identified recovery wells were not actively extracting groundwater for treatment, however. Recovery wells RW-1 through RW-4 and RW-9 were deactivated as a result of low influent contaminant concentrations. In fact, sampling results obtained since the inception of monitoring program activities at Site 78 have suggested that little to no contamination has been present within samples obtained from the identified recovery wells. Additionally, samples collected from the recovery wells via the low-flow sampling method may not accurately reflect true contaminant concentrations in groundwater. The low-flow sampling method, employed throughout MCB Camp Lejeune, does not remove a sufficient volume of groundwater at the minimum required flow rate from larger diameter recovery wells. Based upon this information, none of the 11 installed recovery wells will be sampled as part of the current monitoring program at Site 78.

4.1.2.2 Sampling Select Monitoring Wells

Monitoring well 78-GW22-1 was located within the former fuel farm area. Petroleum-related contaminants were consistently detected at concentrations exceeding applicable water quality standards within groundwater samples obtained from well 78-GW22-1 during the monitoring program. The former fuel farm is being addressed as part of the UST Program at MCB Camp Lejeune and an active product recovery system is in operation within 250 feet of monitoring well 78-GW22-1. As a result, groundwater samples will not be retained for analysis in the future from 78-GW22-1.

At least two additional monitoring wells, included in the quarterly monitoring program, are situated adjacent to other unrelated areas of concern. Monitoring well 78-GW05 is located within 200 feet of IR Site 94 and well 78-GW19 is situated near a UST site associated with Building 1115. Samples collected from both monitoring wells 78-GW05 and 78-GW19 have exhibited concentrations of organic compounds below 2 µg/L. Site 94 and the former UST at Building 1115, however, are being or are planned to be addressed as part of other investigations. Based upon this information, groundwater samples will no longer be collected from wells 78-GW05 and 78-GW19 as part of the monitoring program at Site 78.

Samples that have been obtained from deep monitoring well 78-GW31-3 have exhibited little to no contamination during the previous six monitoring events. Toluene was the only organic compound

detected among the samples obtained from 78-GW31-3. During the second quarter of 1996 toluene was detected at a concentration of 1.1 µg/L. The NCWQS for toluene is 1,000 µg/L. Based upon this information, no additional samples will be obtained from deep monitoring well 78-GW31-3 during the monitoring program.

4.1.3 Shallow Monitoring Well Abandonment

Recorded field observations suggested that shallow monitoring well 78-GW22-1 had begun to deteriorate or was poorly constructed during the 1986 Confirmation Study. Soil particles from the surrounding undifferentiated formation were entering the well, most likely bypassing the screen and sandpack. Sediments, as a result, were introduced into groundwater samples obtained from 78-GW22-1. The presence of soil particles in groundwater samples obtained from well 78-GW22-1 may have biased total metal analytical results. A number of total metals were detected at concentrations exceeding both state and federal screening standards in samples obtained during the monitoring program from 78-GW22-1. Monitoring well 78-GW22-1 was located within the former fuel farm area and had also exhibited concentrations of petroleum contaminants far in excess of applicable water quality standards. In addition, the former fuel farm is actively being addressed as part of the UST Program at MCB Camp Lejeune and several monitoring wells are located within close proximity of 78-GW22-1. Based upon this information, well 78-GW22-1 was abandoned according to accepted procedures. Figures 4-1 and 4-2 depict conditions of the well site before abandonment and immediately following abandonment.

4.1.4 Well Security and Aesthetics

A majority of the monitoring wells at Site 78 that were installed during the 1986 Confirmation Study had begun to show signs of deterioration. The bollards and protective casings of several wells had developed peeling paint and rust. In addition, a number of the padlocks used to secure the protective covers were either missing or no longer functioned properly. Both the usability and security of each monitoring well would need to be maintained if the wells were going to remain reliable groundwater sample collection points in the future. As recommended, bollards and well casings were painted with a weather resistant paint. New protective locking covers were installed on the wells that had been without covers. New padlocks that operate with a universal key were installed on several of the monitoring wells at Sites 24 and 78. Figures 4-3 through 4-12 depict the typical monitoring well repairs performed.

Monitoring wells 78-GW09-2 and 78-GW14 were converted from stick-up to flush mounted. New protective locking caps and locks were installed on monitoring wells 78-GW11, 78-GW24-2, 78-GW24-3, and 78-GW29. Damaged flush mount covers were replaced on monitoring wells 78-GW15 and 78-GW31-3. Peeling paint and rust were removed from twenty-nine IR Program monitoring wells throughout Site 78. Two coats of weather-resistant paint were applied to the bollards and protective casings of the wells after the rust had been removed.

4.2 Proposed Recommendations

Based upon the observations and findings presented in Sections 1.0, 2.0, and 3.0 of this quarterly monitoring report, the following recommendations for the OU1 monitoring program are provided. If non-significant changes are made to a component of the selected remedy described in the ROD, the changes must be recorded in a post-decision document file. If significant changes are made to a component of the selected remedy, the changes will need to be presented in an Explanation of Significant Differences document.

4.2.1 Install Additional Recovery Wells

As indicated in Section 3.0, a majority of treatment system capacity for both the northern and southern treatment plants is currently underutilized. In addition, the recovery well systems are not extracting groundwater from the most contaminated portions of the two suspected chlorinated solvent plumes. Three additional recovery wells, supplementing the nine existing recovery wells (RW-1 through RW-9), were proposed as part of the selected remedy for OU1. Two of the three additional wells (RW-10 and RW-11) were installed within the northern contaminant plume at Site 78. The third recovery well, proposed for the most contaminated portion of the southern plume, was never installed. It is therefore recommended that at least one recovery well be added to the southern treatment system. The additional recovery well should be installed 100 feet south of monitoring well 78-GW09. Groundwater samples obtained from 78-GW09 have consistently exhibited the highest concentrations of chlorinated solvents within the southern portion of Site 78. Continued groundwater monitoring activities and treatment system analyses may, in the future, require that additional recovery wells be installed within the southern contaminant plume.

The northern treatment system is actively treating groundwater contaminants extracted from only one recovery well (RW-10) within the northern contaminant plume. Although the active recovery well is extracting contamination from the surficial aquifer, it is situated upgradient of monitoring well 78-GW23. Groundwater samples obtained from 78-GW23 have consistently exhibited concentrations of chlorinated solvents in excess of applicable water quality standards. Vinyl chloride has been detected at concentrations ranging from 6 to 360 µg/L in each of the previous seven samples obtained from well 78-GW23 during the monitoring program. The expected radius of influence for RW-10, however, does not intercept 78-GW23. Based upon this information, it is recommended that at least one additional recovery well be installed 75 to 100 feet southwest of monitoring well 78-GW23 to extract contaminated groundwater from the northern contaminant plume.

During January 1997, recovery well RW-11 was taken off-line due to high concentrations of solids within groundwater extracted during its operation. Although situated within the northern contaminant plume, operation of RW-11 will no longer be feasible due to high sediment load. The well may have been installed within very loose surficial soils or may have been installed improperly. Based upon this information, it is recommended that RW-11 be removed and reinstalled or retrofitted if possible. If repairs are not possible a replacement well is recommended to be installed approximately 50 feet northeast of its current location. Continued groundwater monitoring activities and treatment system analyses may, in the future, require that additional recovery wells be installed within the northern contaminant plume.

In order to provide a more detailed assessment of treatment system efficiency in the future, it is recommended that additional recovery wells be placed near existing shallow monitoring wells (i.e., within 75 to 100 feet). The monitoring wells will serve to confirm the presence of contamination prior to recovery well installation. In addition, nearby monitoring wells can be employed to roughly determine the capture zone (i.e., radius of influence) of each recovery well and monitor contaminant concentrations as treatment activities continue in the future. If an existing monitoring well is not situated within the proposed capture zone or underground utilities would make installation of a new recovery well near an existing monitoring well prohibitive, it is recommended that a new monitoring well be installed prior to recovery well installation.

The depth, design, and general construction of any additional recovery wells should be similar to existing recovery wells currently operating as part of the northern and southern treatment systems. In addition

to current systems, a sampling port installed at each active recovery well is recommended. Discrete samples could be obtained from each recovery well via the sampling port. Contaminant concentrations in groundwater extracted from each recovery well could then be determined; providing a measure of recovery well efficiency. If additional recovery wells are to be added to the treatment systems, details concerning their placement and design can be provided prior to installation.

4.2.2 Modify Site 24 Sample Analyses

It is recommended that TCL volatile organic, TAL metal, TSS, and TDS analyses be eliminated from the monitoring program for Site 24. Although positive total metal detections have exceeded applicable North Carolina standards, these analyses are not necessary to determine the presence of heptachlor epoxide; the contaminant of concern identified in the ROD. In addition, VOCs have not been detected during any of the three monitoring events.

Analytical results from soil samples collected throughout Site 24 during the RI confirm the presence of pesticides. In general, pesticides have a tendency to adhere to soil material. Suspended soil particles, or colloids, in the groundwater samples from Site 24 were likely to have been the cause of the detected pesticide contaminant. A low-flow purge method is now used during sample collection to reduce the amount of suspended material in samples and more accurately reflect true aquifer conditions. Because of the low-flow purge method, it is unlikely that any pesticides will be detected in future groundwater samples. If the lack of groundwater pesticide contamination is confirmed, possibly after three sampling events, pesticide samples from Site 24 should also no longer be necessary.

4.2.3 Modify Sampling Frequency

The majority of groundwater samples obtained from Site 78 during the past seven sampling quarters have exhibited similar concentrations of the same VOCs. In fact, several laboratory results have remained nearly constant throughout the monitoring program. Although groundwater is actively being extracted and treated, none of the groundwater recovery wells have monitoring wells within their expected capture zones. Without means to monitor the progress of active treatment systems, groundwater samples currently being obtained serve only to confirm the presence of site contaminants. Based upon this information, a reduction in the number of yearly sampling events from four to two is recommended. Semiannual sampling will sufficiently monitor site contaminants in groundwater at Site 78, given current treatment system components. If treatment system components are modified in the future, an alternate sampling frequency may be developed.

4.2.4 Locate and Commence Sampling Additional Monitoring Wells

Additional monitoring wells within the northern and southern contaminant plume areas will be identified for future sampling. Monitoring wells installed as part of any number of unrelated investigations will be employed to better define the extent of the two suspected groundwater contaminant plumes. Any additional sampling data acquired from supplemental investigations will also aid in the placement of future recovery wells. A Groundwater Monitoring Well Coverage Plan is currently being prepared for MCB Camp Lejeune. Information presented in the Groundwater Monitoring Well Coverage Plan document will be used to identify other existing monitoring wells within Site 78. Additional monitoring wells, however, may need to be installed in the future if an adequate amount of supplemental data can not be acquired.

A number of monitoring wells have recently been installed in the northern portion of Site 78. The newly installed monitoring wells are associated with ongoing Underground Storage Tank (UST) investigations adjacent to Building 900. The monitoring wells are situated within or immediately adjacent to the northern contaminant plume. Other monitoring wells adjacent to Buildings 1601 and 1607, located within the suspected southern plume area, may also be employed as sampling points in the future. Well construction details and previous analytical data will be used to determine which monitoring wells are appropriate to sample in the future; possibly two monitoring wells near Building 900 and one monitoring well near Building 1600.

Monitoring wells 78-GW02 and 78-GW03 are located approximately 110 and 270 feet respectively from recovery well RW-05. The monitoring wells may be used to monitor the presence of contamination in uppermost portion of the shallow aquifer surrounding the southern treatment plant. Samples obtained from the two existing monitoring wells could also possibly provide more information regarding the effectiveness of the treatment system. Based upon this information, it is recommended that groundwater samples be obtained from 78-GW02 and 78-GW03 as part of the monitoring program.

5.0 REFERENCES

Baker Environmental, Inc. (Baker). October 1996. Corrective Action Plan for Operable Unit No. 1 (Sites 21, 24, and 78). Revised Final. Prepared for the Navy Atlantic Division Naval Facilities Engineering Command, Norfolk, Virginia.

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Baker Environmental, Inc. (Baker). June 1994b. Remedial Investigation Report. Operable Unit No. 1 (Sites 21, 24, and 78). Final. Prepared for the Navy Atlantic Division Naval Facilities Engineering Command, Norfolk, Virginia.

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OHM Remediation Services Corporation. November 1996. Work Plan for Systems Cleaning for North and South Groundwater Treatment Plants, Operable Unit 1, Site 78. Prepared for the Navy Atlantic Division Naval Facilities Engineering Command, Norfolk, Virginia.

U.S. Environmental Protection Agency, Region IV. May 1996. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.

TABLES

TABLE 1-1

SUMMARY OF WELL CONSTRUCTION DETAILS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO - 0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Monitoring Well Number	Date Installed	Top of Casing Elevation (feet, msl)	Ground Surface Elevation (feet, msl)	Boring Depth (feet, bgs)	Well Depth (feet, bgs)	Screen Interval Depth (feet, bgs)	Depth to Sand Pack (feet, bgs)	Depth to Bentonite (feet, bgs)	Stick-Up (feet, ags)
24-GW08	1993	26.20	23.60	19.0	19.0	9.1-18.2	7.0	5.0	NA
24-GW09	1993	16.55	13.80	12.5	12.5	2.6-11.7	1.5	0.5	NA
24-GW10	1993	19.33	17.30	18.0	18.0	8.0-17.2	6.0	4.0	NA
78-GW01	1986	NA	NA	27.0	25.0	5.0-25.0	3.0	2.0	1.8
78-GW04-1	1986	31.63	28.90	27.0	24.5	4.5-24.5	3.0	2.0	2.6
78-GW08	1986	28.72	26.30	27.0	25.0	5.0-25.0	3.0	2.0	3.12
78-GW09-1	1987	NA	NA	27.0	25.0	5.0-25.0	3.0	2.0	2.35
78-GW09-2	1987	27.60	25.40	76.0	75.0	55.0-75.0	52.0	49.0	1.92
78-GW09-3	1986	26.97	24.70	152.0	150.0	130.0-150.0	105.0	10.0	2.25
78-GW10	1986	28.13	25.70	27.0	25.0	5.0-25.0	3.0	2.0	2.22
78-GW11	1986	28.22	25.50	25.5	25.0	5.0-25.0	3.0	2.0	2.49
78-GW14	1986	27.32	25.00	25.5	25.0	5.0-25.0	3.0	2.0	1.92
78-GW15	1986	27.03	26.80	25.5	25.0	5.0-25.0	3.0	2.0	0.08
78-GW17-1	1986	30.00	27.50	25.5	25.0	5.0-25.0	3.0	2.0	2.16
78-GW21	1986	33.51	31.20	25.0	25.0	5.0-25.0	3.0	2.0	NA
78-GW22	1986	32.36	30.40	25.0	25.0	5.0-25.0	3.0	2.0	NA
78-GW23	1986	32.08	30.00	25.5	25.0	5.0-25.0	3.0	2.0	1.82
78-GW24-1	1986	32.84	30.50	25.5	25.0	5.0-25.0	3.0	2.0	1.55
78-GW24-2	1987	33.73	30.40	80.0	76.6	56.6-76.6	51.6	48.6	2.88
78-GW24-3	1987	32.32	30.50	155.0	148.2	128.2-148.2	90.0	84.0	2.24
78-GW25	1986	32.58	30.10	25.5	25.0	5.0-25.0	5.0	3.0	2.17
78-GW39	1993	19.44	16.80	20.0	20.0	10.0-20.0	8.0	6.0	19.44

Notes:

ags = Above ground surface
bgs = Below ground surface
msl = Mean Sea Level
NA = Information not available

TABLE 1-2

SUMMARY OF GROUNDWATER FIELD PARAMETERS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Well Number/ Date of Measurement	Measuring Time	Well Volumes	Field Parameters				
			Dissolved Oxygen (mg/L)	Specific Conductance (µmhos/cm)	Temperature (°C)	pH (S.U.)	Turbidity (N.T.U.)
24-GW08 2-3-97	0840	0.5	2.2	125	14.0	5.90	6.1
	0848	1.0	2.7	133	16.0	5.93	13.9
	0856	1.5	2.0	125	16.5	5.94	7.8
	0904	2.0	2.0	125	16.5	5.95	10.0
	0912	2.5	2.0	129	17.0	5.99	6.9
	0920	3.0	2.2	132	17.0	6.05	5.9
24-GW09 2-3-97	1635	0.5	3.5	65	15.5	4.12	60.3
	1646	1.0	3.3	65	15.0	4.13	39.4
	1655	1.5	3.2	65	15.0	4.15	32.2
	1702	2.0	3.1	68	15.0	4.17	24.3
	1712	2.5	3.1	69	15.0	4.20	19.1
	1721	3.0	3.0	68	15.0	4.22	15.0
24-GW10 2-4-97	0800	0.5	3.8	40	14.5	4.47	1.4
	0810	1.0	3.1	38	15.0	4.50	1.5
	0820	1.5	3.2	38	15.0	4.61	0.9
	0830	2.0	3.3	38	15.0	4.62	1.7
	0840	2.5	3.3	35	15.0	4.64	1.6
	0850	3.0	3.3	35	15.0	4.64	0.8
78-GW01 2-4-97	1056	0.5	2.9	430	14.0	6.01	200+
	1104	1.0	2.5	403	16.5	5.92	68.7
	1114	1.5	4.5	395	16.5	6.15	10.4
	1124	2.0	4.3	392	16.5	6.12	9.6
	1134	2.5	4.6	405	15.5	6.28	8.8
	1144	3.0	4.5	410	15.5	6.29	6.0
78-GW04-1 2-2-97	0951	1.0	1.7	189	22.5	6.11	200+
	0955	2.0	1.5	261	22.0	6.32	200+
	1001	3.0	1.3	315	23.0	6.46	167.1
	1005	4.0	1.7	370	22.5	6.66	152.5
	1012	5.0	1.7	402	22.5	6.69	116.8
	1021	6.0	1.6	418	22.0	6.79	92.4
	1032	7.0	1.4	432	23.0	6.85	71.3
	1038	8.0	1.5	439	21.0	6.86	58.9
78-GW08	0939	0.5	3.0	179	14.5	5.84	200+
	0945	1.0	2.6	172	18.5	5.80	189.5
	0952	1.5	2.7	172	18.5	5.84	126.8
	0958	2.0	2.7	165	19.5	5.82	105.5
	1007	2.5	2.5	168	19.0	5.79	62.8
	1014	3.0	2.4	168	20.0	5.81	39.5

TABLE 1-2 (Continued)

SUMMARY OF GROUNDWATER FIELD PARAMETERS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Well Number/ Date of Measurement	Measuring Time	Well Volumes	Field Parameters				
			Dissolved Oxygen (mg/L)	Specific Conductance (µmhos/cm)	Temperature (°C)	pH (S.U.)	Turbidity (N.T.U.)
78-GW09-1 2-2-97	1530	0.5	3.6	420	18.5	6.73	8.4
	1538	1.0	3.5	428	18.5	6.67	6.3
	1543	1.5	3.4	425	19.0	6.64	4.5
	1548	2.0	3.5	430	19.0	6.64	2.8
	1553	2.5	3.4	430	18.0	6.59	2.1
	1600	3.0	3.4	430	19.0	6.60	NR
78-GW09-2 2-2-97	1309	0.5	1.5	500	22.0	7.87	7.0
	1332	1.0	2.8	500	22.0	8.03	2.4
	1400	1.5	2.0	500	22.0	8.16	3.0
	1422	2.0	1.8	500	23.0	8.13	0.9
	1441	2.5	1.6	500	23.0	8.15	0.6
	1505	3.0	1.6	500	23.0	8.15	0.5
78-GW09-2	1249	0.5	2.2	285	21.0	11.19	0.4
	1338	1.0	2.1	390	20.0	11.31	0.0
	1418	1.5	1.9	395	21.0	11.30	0.0
	1506	2.0	2.2	360	21.0	11.29	0.8
	1555	2.5	2.2	362	22.0	11.33	0.0
	1641	3.0	1.9	330	21.0	11.34	0.05
78-GW10 2-3-97	1020	0.5	2.7	205	19.0	6.43	78.9
	1027	1.0	2.9	208	18.0	6.46	69.3
	1034	1.5	2.8	210	20.5	6.53	36.6
	1041	2.0	2.6	210	19.5	6.47	30.2
	1048	2.5	2.6	210	19.5	6.49	20.0
	1055	3.0	2.9	210	20.0	6.51	17.3
78-GW11 2-5-97	1450	0.5	3.8	100	19.0	4.75	149.0
	1455	1.0	4.0	99	18.5	4.78	50.5
	1500	1.5	3.7	99	18.5	4.81	26.3
	1505	2.0	3.8	99	18.5	4.82	15.3
	1510	2.5	3.8	99	18.5	4.84	16.3
	1515	3.0	3.8	95	18.5	4.80	7.3
78-GW14 2-2-97	0832	0.5	2.0	230	18.5	4.22	117.5
	0840	1.0	2.0	230	20.0	4.12	52.4
	0848	1.5	2.0	220	20.0	4.17	21.1
	0856	2.0	2.0	218	20.0	4.11	21.5
	0904	2.5	2.0	212	20.0	4.17	8.9
	0912	3.0	2.0	215	18.0	4.21	8.8

TABLE 1-2 (Continued)

SUMMARY OF GROUNDWATER FIELD PARAMETERS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Well Number/ Date of Measurement	Measuring Time	Well Volumes	Field Parameters				
			Dissolved Oxygen (mg/L)	Specific Conductance (µmhos/cm)	Temperature (°C)	pH (S.U.)	Turbidity (N.T.U.)
78-GW15 2-5-97	1235	0.5	5.0	300	22.0	6.17	5.38
	1242	1.0	5.0	310	21.5	6.21	2.3
	1246	1.5	5.0	300	21.0	6.20	2.6
	1251	2.0	5.0	298	21.5	6.18	2.4
	1256	2.5	5.1	298	22.0	6.23	1.7
	1301	3.0	5.2	295	22.0	6.24	1.4
78-GW17-1 2-2-97	1715	0.5	4.9	485	17.0	7.41	77.1
	1720	1.0	5.0	465	17.0	7.56	53.5
	1725	1.5	5.2	441	17.0	7.51	21.5
	1731	2.0	4.4	420	17.0	7.52	16.6
	1738	2.5	4.8	455	17.0	7.52	14.2
	1746	3.0	5.0	450	17.0	7.50	7.6
78-GW21 2-3-97	1445	0.5	3.0	205	20	5.41	57.9
	1453	1.0	2.6	180	19.5	5.18	65.8
	1501	1.5	2.6	180	19.5	5.14	32.2
	1509	2.0	2.5	181	19.5	5.14	35.9
	1517	2.5	2.4	180	18.0	5.17	5.1
	1524	3.0	2.5	178	19.0	5.15	2.9
78-GW22 2-5-97	1110	0.5	1.7	270	17.0	6.45	9.9
	1117	1.0	2.0	299	16.5	6.43	5.0
	1124	1.5	1.8	303	17.0	6.47	5.0
	1131	2.0	1.8	295	16.0	6.48	5.8
	1138	2.5	2.0	308	17.0	6.47	3.8
	1145	3.0	1.7	310	17.0	6.48	2.6
78-GW23 2-5-97	0950	0.5	2.2	185	18.5	4.44	17.2
	0958	1.0	2.2	200	18.0	4.52	13.5
	1007	1.5	2.1	193	18.5	4.59	26.0
	1015	2.0	2.0	190	18.5	4.65	36.1
	1022	2.5	1.8	188	19.0	4.67	28.2
	1030	3.0	1.9	184	19.5	4.68	19.4
78-GW24-1 2-4-97	1538	0.5	2.1	211	14.5	5.56	35.3
	1548	1.0	2.1	205	14.5	5.50	15.7
	1558	1.5	2.2	200	14.5	5.46	7.6
	1608	2.0	2.2	195	14.0	5.38	6.30
	1618	2.5	2.2	187	14.0	5.34	4.5
	1628	3.0	2.3	178	14.0	5.27	2.8

TABLE 1-2 (Continued)

SUMMARY OF GROUNDWATER FIELD PARAMETERS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Well Number/ Date of Measurement	Measuring Time	Well Volumes	Field Parameters				
			Dissolved Oxygen (mg/L)	Specific Conductance (µmhos/cm)	Temperature (°C)	pH (S.U.)	Turbidity (N.T.U.)
78-GW24-2 2-4-97	1320	0.5	1.8	458	19.5	7.06	4.9
	1345	1.0	1.9	460	19.0	7.03	5.5
	1405	1.5	1.7	458	17.5	7.03	9.2
	1430	2.0	1.9	461	19.0	7.05	5.8
	1455	2.5	1.7	465	18.5	7.31	4.0
	1520	3.0	1.8	462	18.5	7.21	3.1
78-GW24-3 2-4-97	1300	0.5	2.5	395	19.0	7.07	4.3
	1340	1.0	2.3	340	18.5	7.08	2.7
	1430	1.5	1.9	320	19.0	7.13	55.3
	1510	2.0	2.5	320	19.5	7.49	45.2
	1550	2.5	2.3	310	19.0	7.31	36.2
	1630	3.0	2.2	310	19.0	7.24	40.3
78-GW25 2-5-97	0837	0.5	3.2	248	15.5	5.40	10.3
	0845	1.0	3.2	259	15.5	5.49	5.9
	0852	1.5	3.2	260	16.0	5.50	2.3
	0900	2.0	3.3	242	16.5	5.53	1.5
	0908	2.5	3.2	258	16.0	5.56	1.3
	0918	3.0	3.2	255	15.5	5.56	1.0
78-GW39	1343	0.5	3.8	272	21.0	4.56	2.3
	1351	1.0	3.9	260	19.5	4.64	2.2
	1358	1.5	3.9	260	20.0	4.61	1.1
	1405	2.0	3.9	258	19.5	4.59	1.1
	1412	2.5	3.6	250	19.5	4.62	1.1
	1419	3.0	4.0	255	19.5	4.60	1.0

Notes:

N.T.U. = Nephelometric Turbidity Units
S.U. = Standard Units
µmhos/cm = micro ohms per centimeter
°C = Degrees Centigrade
mg/L = milligrams per liter

TABLE 1-3

GROUNDWATER SAMPLING SUMMARY
OPERABLE UNIT NO.1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Sample Location	Media	TCL Volatiles[1]	TCL Pesticides[2]	TAL Metals[3]	Oil & Grease[4]	Total Dissolved Solids[5]	Total Suspended Solids[5]	Sample Identification
24-GW08	GW	X	X	X	X	X	X	24-GW08-97A
24-GW09	GW	X	X	X	X	X	X	24-GW09-97A
24-GW10	GW	X	X	X	X	X	X	24-GW10-97A
78-GW01	GW	X						78-GW01-97A
78-GW04-1	GW	X						78-GW04-97A
78-GW08	GW	X						78-GW08-97A
78-GW09-1	GW	X						78-GW09-97A
78-GW09-2	GW	X						78-GW09IW-97A
78-GW09-3	GW	X						78-GW09DW-97A
78-GW10	GW	X						78-GW10-97A
78-GW11	GW	X						78-GW11-97A
78-GW14	GW	X						78-GW14-97A
78-GW15	GW	X						78-GW15-97A
78-GW17-1	GW	X						78-GW17-97A
78-GW21	GW	X						78-GW21-97A
78-GW22	GW	X						78-GW22A-97A
78-GW23	GW	X						78-GW23-97A
78-GW24-1	GW	X						78-GW24-97A
78-GW24-2	GW	X						78-GW24IW-97A
78-GW24-3	GW	X						78-GW24DW-97A
78-GW25	GW	X						78-GW25-97A
78-GW39	GW	X						78-GW39-97A

Notes:

[1] Target Compound List (TCL) Organics by U.S. Environmental Protection Agency (EPA) Method 8260.
[2] TCL Pesticides by USEPA, Contract Laboratory Program, Scope of Work, Document Number OLM01.8.
[3] Selected Target Analyte List Metals (Antimony, Arsenic, Beryllium, Chromium, Iron, Lead, Manganese, Mercury, Nickel) by Solid Waste Method 6010.
[4] Oil and Grease by Solid Waste Method 9070.
[5] Total Suspended and Dissolved Solids by Solid Waste Method 160.1 and 160.2.

GW = Groundwater
X = Requested Analyses

TABLE 1-4

ANALYTICAL METHOD DETECTION LIMITS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Parameter	Analytical Method	MDL or CRQL	NCWQS	MCL
Volatile Organics µg/L:				
Chloromethane	8260	0.5	NA	NA
Vinyl Chloride	8260	0.5[1]	0.015	2
Bromomethane	8260	0.5	NA	NA
Chloroethane	8260	0.5	NA	NA
1,1-dichloroethene	8260	0.5	7	7
Acetone	8260	2	700	NA
Carbon Disulfide	8260	2	700	NA
Methylene Chloride	8260	0.5	5	5
1,2-dichloroethene (Total)	8260	0.5	70	70
1,1-dichloroethane	8260	0.5	700	NA
2-butanone	8260	2	NA	NA
Chloroform	8260	0.5[1]	0.19	100
1,1,1-trichloroethane	8260	0.5	200	200
Carbon Tetrachloride	8260	0.5[1]	0.3	5
Benzene	8260	0.5	1	5
1,2-dichloroethane	8260	0.5[1]	0.38	5
Trichloroethene	8260	0.5	NA	5
1,2-dichloropropane	8260	0.5	0.56	5
Bromodichloromethane	8260	0.5	0.6	100
Cis-1,3-dichloropropene	8260	0.5	NA	NA
4-methyl-2-pentanone	8260	2	NA	NA
Toluene	8260	0.5	1000	1000
Trans-1,3-dichloropropene	8260	0.5[1]	0.2	NA
1,1,2-trichloroethane	8260	0.5	NA	5
Tetrachloroethene	8260	0.5	0.7	5
2-hexanone	8260	2	NA	NA
Dibromochloromethane	8260	0.5	NA	NA
Chlorobenzene	8260	0.5	50	100
Ethylbenzene	8260	0.5	29	700
Xylene, Total	8260	0.5	530	10000
Styrene	8260	0.5	100	100
Bromoform	8260	0.5[1]	0.19	100
1,1,2,2-tetrachloroethane	8260	0.5	NA	NA

TABLE 1-4 (Continued)

ANALYTICAL METHOD DETECTION LIMITS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB, CAMP LEJEUNE, NORTH CAROLINA

Parameter	Analytical Method	MDL or CRQL	NCWQS	MCL
Pesticides (µg/L):				
alpha-BHC	OLM01.8	0.05	NA	NA
beta-BHC	OLM01.8	0.05	NA	NA
delta-BHC	OLM01.8	0.05	NA	NA
gamma-BHC (Lindane)	OLM01.8	0.05	0.2	0.2
Heptachlor	OLM01.8	0.05 (2)	0.008	0.4
Aldrin	OLM01.8	0.05	NA	NA
Heptachlor epoxide	OLM01.8	0.05 (2)	0.004	0.2
Endosulfan I	OLM01.8	0.05	NA	NA
Dieldrin	OLM01.8	0.1	NA	NA
4,4'-DDE	OLM01.8	0.1	NA	NA
Endrin	OLM01.8	0.1	2	2
Endosulfan II	OLM01.8	0.1	NA	NA
4,4'-DDD	OLM01.8	0.1	NA	NA
Endosulfan sulfate	OLM01.8	0.1	NA	NA
4,4'-DDT	OLM01.8	0.1	NA	NA
Methoxychlor	OLM01.8	0.1	35	40
Endrin ketone	OLM01.8	0.1	NA	NA
Endrin aldehyde	OLM01.8	0.1	NA	NA
alpha-Chlordane	OLM01.8	0.1 (2)	0.027	NA
gamma-Chlordane	OLM01.8	0.1 (2)	0.027	NA
Toxaphene	OLM01.8	0.1 (2)	0.031	3
Metals (µg/L):				
Barium, Total	6010A	1.4	2000	2000
Beryllium, Total	6010A	0.7	NA	4
Cadmium, Total	6010A	2.6	5	5
Chromium, Total	6010A	3.3	50	100
Lead, Total	7421	1.2	15	15
Manganese, Total	6010A	1.6	NA	50

TABLE 1-4 (Continued)

ANALYTICAL METHOD DETECTION LIMITS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB, CAMP LEJEUNE, NORTH CAROLINA

Parameter	Analytical Method	MDL or CRQL	NCWQS	MCL
Wet Chemistry (mg/L):				
Total Dissolved Solids	160.1	10	500	500
Total Suspended Solids	160.2	5	NA	NA

Notes:

(1) Method Detection Limit greater than North Carolina Water Quality Standard
(2) Contract Required Quantitation Limit greater than North Carolina Water Quality Standard.

CRQL = Contract Required Quantitation Limit
MCL = Federal Maximum Contaminant Level. Maximum permissible level of a contaminant in water which is delivered to any user of a public water system. (U.S. Environmental Protection Agency - Drinking Water Regulations and Health Advisories.)
MDL = Method Detection Limit
NA = Standard not available
NCWQS = North Carolina Water Quality Standards. Values Applicable to Groundwater (North Carolina Administrative Code, Title 15A, Subchapter 2L).
mg/L = Milligrams per liter or parts per million
µg/L = Micrograms per liter or parts per billion

TABLE 1-5

SUMMARY OF WATER LEVEL MEASUREMENTS
OPERABLE UNIT NO. 1 - SITE 24
INDUSTRIAL AREA FLY ASH DUMP
MCB CAMP LEJEUNE, NORTH CAROLINA

Well ID	Reference Elevation [1]	Third Quarter SWL (Date 7-30-96)	Third Quarter SWE (Date 7-30-96)	Fourth Quarter SWL (Date 11-7-96)	Fourth Quarter SWE (Date 11-7-96)	First Quarter SWL (Date 2-5-97)	First Quarter SWE (Date 2-5-97)
24-GW03	15.88	5.14	10.74	4.64	11.24	5.00	10.88
24-GW04	19.17	8.89	10.28	8.38	10.79	8.70	10.47
24-GW06	12.70	4.95	7.75	NA [2]	NA [2]	4.91	7.79
24-GW07	29.82	15.43	14.39	13.94	15.88	15.71	14.11
24-GW08	26.20	15.76	10.44	14.48	11.72	15.18	11.02
24-GW09	16.55	5.66	10.89	5.93	10.62	6.15	10.40
24-GW10	19.93	11.06	8.87	11.07	8.86	11.21	8.72

Notes:

[1] Top of PVC well casing (in feet above mean sea level [MSL])

SWL = Static water level taken from top of PVC well casing
SWE = Static water elevation (in feet above MSL)
NA = Data not available

TABLE 1-6

SUMMARY OF WATER LEVEL MEASUREMENTS
OPERABLE UNIT NO. 1 - SITE 78
HADNOT POINT INDUSTRIAL AREA
MCB CAMP LEJEUNE, NORTH CAROLINA

Well ID	Reference Elevation [1]		Third Quarter SWL (Date 8-9-96)	Third Quarter SWE (Date 8-9-96)	Fourth Quarter SWL (Date 11-7-96)	Fourth Quarter SWE (Date 11-7-96)	First Quarter SWL (Date 2-25-97)	First Quarter SWE (Date 2-25-97)
	Original	Modified[2]						
78-GW04-1	31.63		19.31	12.32	18.51	13.12	18.79	12.84
78-GW05	28.63		8.91	19.72	9.01	19.62	9.76	19.87
78-GW06	27.94		NA	NA	NA	NA	13.41	14.53
78-GW08	28.72		12.30	16.42	11.61	17.11	12.08	16.64
78-GW09-2	27.60	24.76	13.55	14.05	12.96	14.64	10.76	14.00
78-GW09-3	26.97		12.76	14.21	12.17	14.80	12.80	14.17
78-GW10	28.13		10.79	17.34	10.69	17.44	11.04	17.09
78-GW11	28.22	27.93	11.65	16.57	11.70	16.52	11.99	15.94
78-GW12	30.08		NA	NA	NA	NA	10.26	19.82
78-GW14	27.32	24.67	9.71	17.61	9.41	17.91	7.06	17.61
78-GW15	27.03	26.55	8.70	18.33	7.50	19.53	7.51	19.04
78-GW16	32.40		NA	NA	NA	NA	10.75	21.65
78-GW17-1	30.00		10.94	19.06	9.65	20.35	9.94	20.06
78-GW19	29.07		6.64	22.43	7.70	21.37	7.13	21.94
78-GW21	33.51		9.85	23.66	9.40	24.11	9.64	23.87
78-GW22	32.36		5.71	26.65	6.62	25.74	5.70	26.66
78-GW23	32.08		8.63	23.45	8.46	23.62	8.27	23.81
78-GW24-1	32.84		5.85	26.99	6.82	26.02	6.02	26.82
78-GW24-2	33.73	32.5	11.33	22.40	11.46	22.27	10.29	22.21
78-GW24-3	32.32		10.34	21.98	10.13	22.19	10.54	21.78
78-GW25	32.58		6.31	26.27	7.07	25.51	6.62	25.96

TABLE 1-6 (continued)

SUMMARY OF WATER LEVEL MEASUREMENTS
OPERABLE UNIT NO. 1 - SITE 78
HADNOT POINT INDUSTRIAL AREA
MCB CAMP LEJEUNE, NORTH CAROLINA

Well ID	Reference Elevation [1]		Third Quarter SWL (Date 8-9-96)	Third Quarter SWE (Date 8-9-96)	Fourth Quarter SWL (Date 11-7-96)	Fourth Quarter SWE (Date 11-7-96)	First Quarter SWL (Date 2-25-97)	First Quarter SWE (Date 2-25-97)
	Original	Modified[2]						
78-GW31-3	25.99		9.21	16.78	8.77	17.22	9.16	16.83
78-GW36	29.68		NA	NA	NA	NA	11.46	18.22
78-GW39	19.44		14.81	4.63	NA	NA	14.83	4.61

Notes:

[1] Top of PVC well casing (in Feet above mean sea level [MSL])
[2] Top of PVC well casing after monitoring well maintenance or conversion (in feet above MSL)

SWL = Static water level taken from top of PVC well caasing
SWE = Static water elevation (in feet above MSL)
NA = Data not available

TABLE 2-1

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
OPERABLE UNIT No. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367
MCB, CAMP LEJEUNE, NORTH CAROLINA

Fraction (units)	Detected Contaminants or Analytes	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Qualitative Assessment of Positive Detections
		NCWQS	MCL					NCWQS	MCL	
Organics (µg/L)	Volatile Organics			ND	ND		0/3			
	Pesticides			ND	ND		0/3			
	Oil and Grease	NE	NE	21.0	21.0	24-GW09	1/3	NA	NA	No Standards Established, Central
Total Metals (µg/L)	Iron, Total	300	NE	14.7	368	24-GW09	3/3	1/3	NA	1 Exceeds NCWQS, Central
	Lead, Total	15	15	2.6	2.6	24-GW09	1/3	0/3	0/3	Does Not Exceed Standards, Central
	Manganese, Total	50	NE	3.5	19.3	24-GW09	2/3	0/3	NA	Niether Exceed Standards
Wet Chemistry (mg/L)	Total Dissolved Solids	500	NE	24	88	24-GW08	3/3	0/3	NA	None Exceed Standard
	Total Suspended Solids	NE	NE	6	6	24-GW09	1/3	NA	NA	No Standard Established, Central

Notes:

- Concentrations presented in micrograms per liter (µg/L) or parts per billion for organic and metal results, wet chemistry results presented in milligrams per liter (mg/L) or parts per million.

NA - Not applicable

NCWQS - North Carolina Water Quality Standards (North Carolina Administrative Code, Title 15A, Subchapter 2L).

ND - Not Detected

NE - Not Established

MCL - Federal Maximum Contaminant Level. Maximum permissible level of a contaminant in water which is delivered to any user of a public water system (U.S. Environmental Protection Agency - Drinking Water Regulations and Health Advisories).

TABLE 2-2

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
OPERABLE UNIT No. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Fraction (units)	Detected Contaminants or Analytes	Comparison Criteria		Min.	Max.	Location of Maximum Detection	Detection Frequency	Detections Above		Qualitative Assessment of Positive Detections
		NCWQS	MCL					NCWQS	MCL	
Volatile Organics (µg/L)	Vinyl Chloride	0.015	2.0	360	360	78-GW23	1/19	1/1	1/1	1 Exceeds Both Standards, North
	Acetone	700	NE	4	4	78-GW01	1/19	0/1	NA	Does Not Exceed NCWQS, South
	1,1-Dichloroethene	7.0	7.0	4	78	78-GW09	2/19	1/2	1/2	1 Exceeds Both Standards, South
	1,1-Dichloroethane	700	NE	50	50	78-GW09	1/19	0/19	NA	Does Not Exceed NCWQS, South
	1,2-Dichloroethene (Total)	70	70	2.0	7,900	78-GW23	6/19	3/6	3/6	3 Exceed Both Standards
	1,1,1-Trichloroethane	200	200	500	500	78-GW09	1/19	1/1	1/1	1 Exceeds Both Standards, South
	Trichloroethene	2.8	5	0.9	640	78-GW09	6/19	5/6	5/6	5 Exceed Both Standards, North and South
	Benzene	1.0	5	16	16	78-GW23	1/19	1/1	1/1	1 Exceeds Both Standards, North
	Tetrachloroethene	0.7	5	0.7	0.7	78-GW39	1/19	0/1	0/1	Does Not Exceed Standards, South
	Toluene	1,000	1,000	3	3	78-GW23	1/19	0/1	0/1	Does Not Exceed Standards, North
	Ethylbenzene	29	700	7	7	78-GW23	1/19	0/1	0/1	Does Not Exceed Standards, North
	Xylene (Total)	530	10,000	46	46	78-GW23	1/19	0/1	0/1	Does Not Exceed Standards, North

Notes:

- Concentrations presented in micrograms per liter (µg/L) or parts per billion for organic and metal results, wet chemistry results presented in milligrams per liter (mg/L) or parts per million.

NA - Not applicable

NCWQS - North Carolina Water Quality Standards (North Carolina Administrative Code, Title 15A, Subchapter 2L).

ND - Not Detected

NE - Not Established

MCL - Federal Maximum Contaminant Level. Maximum permissible level of a contaminant in water which is delivered to any user of a public water system (U.S. Environmental Protection Agency - Drinking Water Regulations and Health Advisories).

TABLE 2-3
POSITIVE DETECTIONS IN GROUNDWATER
OPERABLE UNIT NO. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	24-GW08-97A	24-GW09-97A	24-GW10-97A
DATE SAMPLED	02/03/97	02/03/97	02/04/97
OIL & GREASE (mg/L)			
OIL & GREASE, GRAV.	5.1 U	21	5.5 U
WET CHEMISTRY (mg/L)			
TOTAL DISSOLVED SOLIDS	88	56	24
TOTAL SUSPENDED SOLIDS	4 U	6	4 U
TOTAL METALS (ug/L)			
IRON, TOTAL	61.7	368	14.7
LEAD, TOTAL	2.6	1.1 U	1.1 U
MANGANESE, TOTAL	3.5	19.3	1 U

NOTES
ug/L = micrograms per liter
mg/L = milligrams per liter
U = not detected

TABLE 2-4
POSITIVE DETECTIONS IN GROUNDWATER
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID DATE SAMPLED	78-GW01-97A 02/04/97	78-GW04-97A 02/02/97	78-GW08-97A 02/04/97	78-GW09-97A 02/02/97	78-GW09IW-97A 02/02/97	78-GW09DW-97A 02/02/97	78-GW10-97A 02/03/97
VOLATILES (ug/L)							
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U	.5 U	0.5 U	0.5 U	0.5 U
ACETONE	4	2 U	2 U	20 U	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	78	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	50	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	3	2	0.5 U	220	4	0.5 U	0.5 U
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	500	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	12	8	0.5 U	640	0.5 U	0.5 U	0.5 U
BENZENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U

NOTES
ug/L = micrograms per liter
U = not detected

TABLE 2-4
POSITIVE DETECTIONS IN GROUNDWATER
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	78-GW11-97A	78-GW14-97A	78-GW15-97A	78-GW17-97A	78-GW21-97A	78-GW22A-97A	78-GW23-97A
DATE SAMPLED	02/05/97	02/02/97	02/05/97	02/02/97	02/03/97	02/05/97	02/05/97
VOLATILES (ug/L)							
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	360
ACETONE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7900
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 U	0.5 U	1	0.5 U	0.5 U	0.5 U	57
BENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	16
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	46

NOTES
ug/L = micrograms per liter
U = not detected

TABLE 2-4
POSITIVE DETECTIONS IN GROUNDWATER
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	78-GW24-97A	78-GW24DW-97A	78-GW24IW-97A	78-GW25-97A	78-GW39-97A
DATE SAMPLED	02/04/97	02/04/97	02/04/97	02/05/97	02/05/97
VOLATILES (ug/L)					
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	2 U	2 U	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	120	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	19	0.5 U	0.5 U	0.5 U	0.5 U
BENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.7
TOLUENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

NOTES
ug/L = micrograms per liter
U = not detected

TABLE 2-5
TRIP BLANK ANALYTICAL RESULTS
OPERABLE UNIT NO. 1 - SITES 24 AND 78
ONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

SAMPLE ID	78-TB-01-97A	78-TB02-97A	78-TB03-97A
DATE SAMPLED	02/03/97	02/04/97	02/05/97
VOLATILES (ug/L)			
CHLOROMETHANE	0.5 U	0.5 U	0.5 U
BROMOMETHANE	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U
CHLOROETHANE	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	0.5 U	0.5 U	0.5 U
ACETONE	2 U	2 U	2 U
CARBON DISULFIDE	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	0.5 U	0.5 U	0.5 U
CHLOROFORM	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U
2-BUTANONE	2 U	2 U	2 U
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 U	0.5 U	0.5 U
DIBROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U
BENZENE	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U
4-METHYL-2-PENTANONE	2 U	2 U	2 U
2-HEXANONE	2 U	2 U	2 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U
STYRENE	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U

NOTES
ug/L = micrograms per liter
U = not detected

TABLE 3-1

SAMPLING RESULTS - NORTHERN TREATMENT PLANT
FIRST QUARTER, 1997
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	January 1997					February 1997				
	Plant Influent	Oil/Water Separator Effluent	Air Stripper Effluent	Sand Filter Effluent	Final Effluent	Plant Influent	Oil/Water Separator Effluent	Air Stripper Effluent	Sand Filter Effluent	Final Effluent
Volatiles										
trans-1,2-Dichloroethene	<0.01	NA	<0.001	NA	<0.001	<0.01	NA	<0.0005	NA	<0.0005
Trichloroethylene	0.016	NA	<0.0005	NA	<0.0005	0.016	NA	<0.0005	NA	<0.0005
Vinyl Chloride	0.218	NA	<0.0005	NA	<0.0005	0.001	NA	<0.0005	NA	<0.0005
Benzene	0.034	NA	<0.0005	NA	<0.0005	0.038	NA	<0.0005	NA	<0.0005
1,2-cis-Dichloroethylene	1.09	NA	0.001	NA	<0.0005	0.030	NA	<0.0005	NA	<0.0005
Total Metals										
Antimony	<0.001	NA	NA	<0.001	<0.001	<0.001	NA	NA	<0.001	<0.001
Arsenic	<0.002	NA	NA	<0.002	<0.002	<0.002	NA	NA	<0.002	<0.002
Beryllium	<0.001	NA	NA	<0.001	<0.001	<0.005	NA	NA	<0.005	<0.005
Calcium	63.6	NA	NA	59.9	66.8	82.3	NA	NA	68.9	60.9
Chromium	<0.004	NA	NA	<0.004	<0.004	<0.01	NA	NA	<0.01	<0.01
Iron	21.2	NA	NA	0.088	0.104	9.96	NA	NA	0.125	0.753
Lead	0.002	NA	NA	0.003	0.004	<0.001	NA	NA	<0.001	0.001
Manganese	0.055	NA	NA	0.058	0.008	0.061	NA	NA	<0.015	<0.015
Mercury	<0.0001	NA	NA	<0.0001	<0.0001	<0.0001	NA	NA	<0.0001	<0.0001
Nickel	<0.007	NA	NA	<0.007	<0.007	<0.004	NA	NA	<0.04	<0.04
Wet Chemistry										
Oil & Grease	<1.00	<1.00	NA	NA	<1.00	<1.00	<1.00	NA	NA	<1.00
Total Dissolved Solids (TDS)	224	NA	NA	221	229	220	NA	NA	226	217
Total Suspended Solids (TSS)	60	NA	NA	4.00	10.0	9.0	NA	NA	<1.00	<1.00
pH	7.5	NA	NA	7.7	8.17	7.66	NA	NA	NA	8.35

Notes:

All concentrations are reported in milligrams per liter (mg/L) or parts per million.
NA = Not analyzed.

TABLE 3-1 (Continued)

SAMPLING RESULTS - NORTHERN TREATMENT PLANT
FIRST QUARTER, 1997
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	March 1997				
	Plant Influent	Oil/Water Separator Effluent	Air Stripper Effluent	Sand Filter Effluent	Final Effluent
Volatiles					
trans-1,2-Dichloroethene	<0.0006	NA	NA	NA	<0.0005
Trichloroethylene	0.020	NA	NA	NA	<0.0005
Vinyl Chloride	0.001	NA	NA	NA	<0.0005
Benzene	0.047	NA	NA	NA	<0.0005
1,2-cis-Dichloroethylene	0.034	NA	NA	NA	<0.0005
Total Metals					
Antimony	<0.001	NA	NA	<0.001	<0.001
Arsenic	<0.002	NA	NA	<0.002	<0.002
Beryllium	<0.001	NA	NA	<0.001	<0.001
Calcium	79.0	NA	NA	69.7	82.3
Chromium	<0.004	NA	NA	<0.004	<0.004
Iron	9.88	NA	NA	0.166	0.151
Lead	<0.001	NA	NA	<0.001	0.002
Manganese	0.063	NA	NA	0.002	0.003
Mercury	<0.0001	NA	NA	<0.0001	<0.0001
Nickel	<0.007	NA	NA	<0.007	<0.007
Wet Chemistry					
Oil & Grease	<1.00	NA	NA	NA	<1.00
Total Dissolved Solids (TDS)	217	NA	NA	224	225
Total Suspended Solids (TSS)	15.0	NA	NA	<1.00	<1.00
pH	6.82	NA	NA	NA	8.13

Notes:

All concentrations are reported in milligrams per liter (mg/L) or parts per million.
NA = Not analyzed.

TABLE 3-2

SAMPLING RESULTS - SOUTHERN TREATMENT PLANT
FIRST QUARTER 1997
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA

Contaminant	February 1997					March 1997				
	Plant Influent	Oil/Water Separator Effluent	Air Stripper Effluent	Sand Filter Effluent	Final Effluent	Plant Influent	Oil/Water Separator Effluent	Air Stripper Effluent	Sand Filter Effluent	Final Effluent
Volatiles										
trans-1,2-Dichloroethene	<0.0025	NA	<0.0005	NA	<0.0005	<0.0025	NA	NA	NA	<0.0005
Trichloroethylene	0.035	NA	<0.0005	NA	<0.0005	0.0268	NA	NA	NA	<0.0005
Vinyl Chloride	<0.0025	NA	<0.0005	NA	<0.0005	<0.0025	NA	NA	NA	<0.0005
Benzene	<0.0025	NA	<0.0005	NA	<0.0005	<0.0025	NA	NA	NA	<0.0005
1,2-cis-Dichloroethylene	0.094	NA	0.0009	NA	<0.0005	0.102	NA	NA	NA	<0.0005
Total Metals										
Antimony	<0.001	NA	NA	<0.001	<0.001	<0.001	NA	NA	<0.001	<0.001
Arsenic	<0.002	NA	NA	<0.002	<0.002	<0.002	NA	NA	<0.002	<0.002
Beryllium	<0.005	NA	NA	<0.005	<0.005	<0.001	NA	NA	<0.001	<0.001
Calcium	126	NA	NA	133	135	165	NA	NA	150	178
Chromium	<0.010	NA	NA	<0.010	<0.010	<0.004	NA	NA	<0.004	<0.004
Iron	<0.100	NA	NA	<0.100	<0.100	0.471	NA	NA	0.032	0.116
Lead	0.001	NA	NA	<0.001	0.005	<0.001	NA	NA	0.001	<0.001
Manganese	<0.015	NA	NA	0.037	0.020	0.034	NA	NA	0.029	0.005
Mercury	<0.0001	NA	NA	<0.0001	<0.0001	<0.0001	NA	NA	<0.0001	<0.0001
Nickel	<0.040	NA	NA	<0.040	<0.040	<0.007	NA	NA	<0.007	<0.007
Wet Chemistry										
Oil & Grease	<1.02	<1.00	NA	NA	<1.00	<1.18	<1.11	NA	NA	<1.18
Total Dissolved Solids (TDS)	381	NA	NA	458	456	491	NA	NA	467	468
Total Suspended Solids (TSS)	<1.00	NA	NA	<1.00	<1.00	<1.00	NA	NA	<1.00	<1.00
pH	8.17	NA	NA	NA	NA	7.32	NA	NA	NA	8.23

Notes:

Southern Treatment Plant off-line during January 1997.
All concentrations are reported in milligrams per liter (mg/L) or parts per million.
NA = Not analyzed.

FIGURES

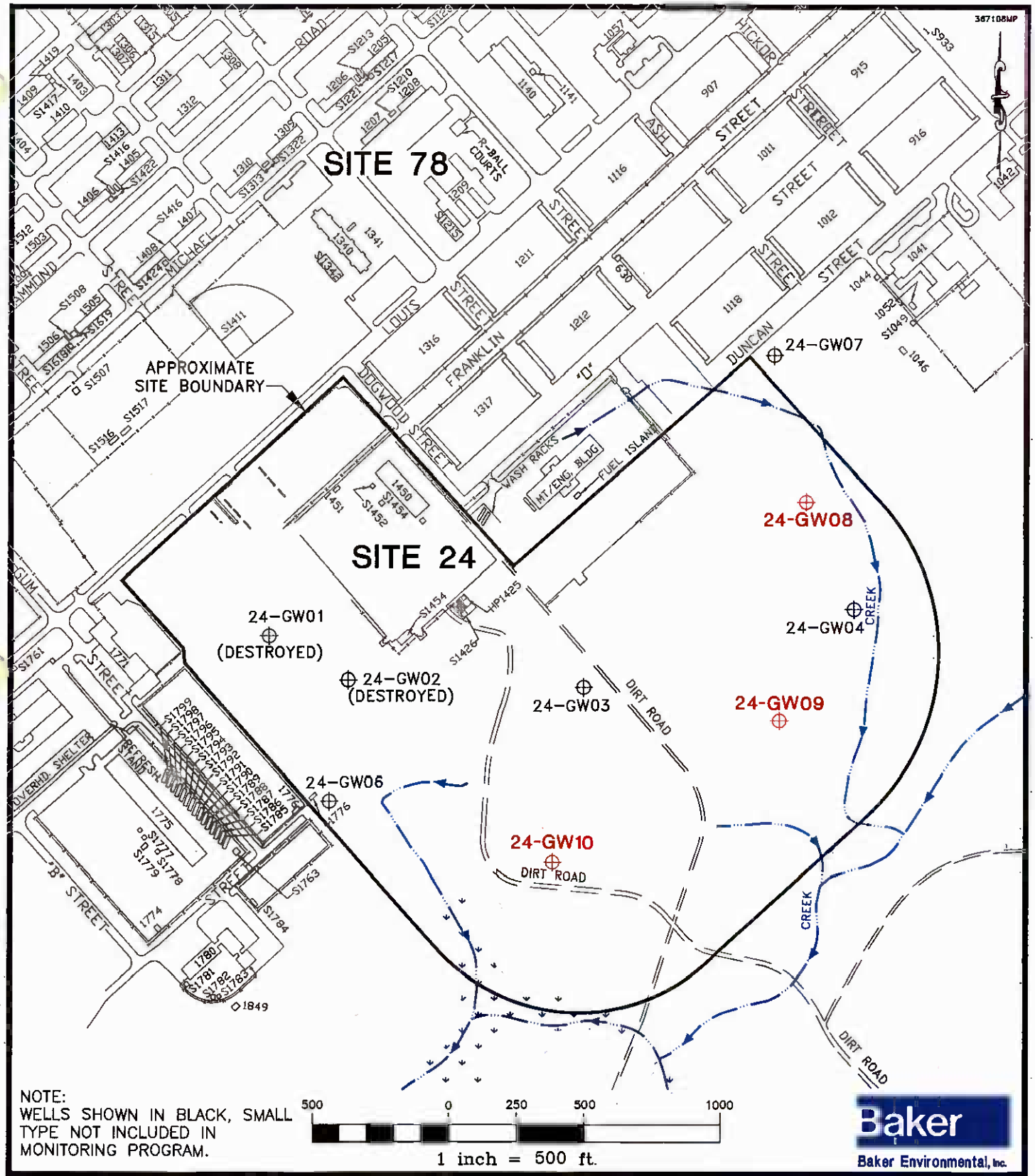


FIGURE 1-1
WELL LOCATION MAP
OPERABLE UNIT No. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01780JJBIV

LEGEND

RW-1 RECOVERY WELL

78-GW09-1 SHALLOW MONITORING WELL

78-GW09-2 INTERMEDIATE MONITORING WELL

78-GW09-3 DEEP MONITORING WELL

APPROXIMATE DIRECTION OF SURFACE WATER FLOW

APPROXIMATE SITE BOUNDARY

367101MP

78-GW13 78-GW20 78-GW06 78-GW14 78-GW19 78-GW22-2 RW-9 78-GW07 78-GW05 GW18 RW-8 78-GW08 78-GW31-2 78-GW31-3 78-GW15 78-GW17-1 78-GW22-1 (ABANDONED) RW-4 78-GW30-2 78-GW24-2 RW-7 78-GW09-1 78-GW10 78-GW32-2 RW-3 78-GW30-3 78-GW24-3 78-GW24-1 78-GW09-2 78-GW09-3 78-GW32-3 78-GW23 RW-10 RW-6 78-GW04-2 78-GW04-3 78-GW17-2 RW-2 RW-11 78-GW04-1 78-GW12 78-GW16 RW-5 78-GW11 78-GW22 78-GW25 78-GW01 78-GW02 78-GW36 RW-1 78-GW03 78-GW21 78-GW33 APPROXIMATE SITE BOUNDARY 78-GW29 78-GW37 78-GW35 78-GW34 78-GW38 78-GW39

SITE 78

SITE 24

NOTE:
-WELLS SHOWN IN BLACK, SMALL TYPE NOT INCLUDED IN MONITORING PROGRAM.

500 0 250 500
1 inch = 500 ft.

Baker
Baker Environmental, Inc.

FIGURE 1-2
WELL LOCATION MAP
OPERABLE UNIT No. 1 – SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

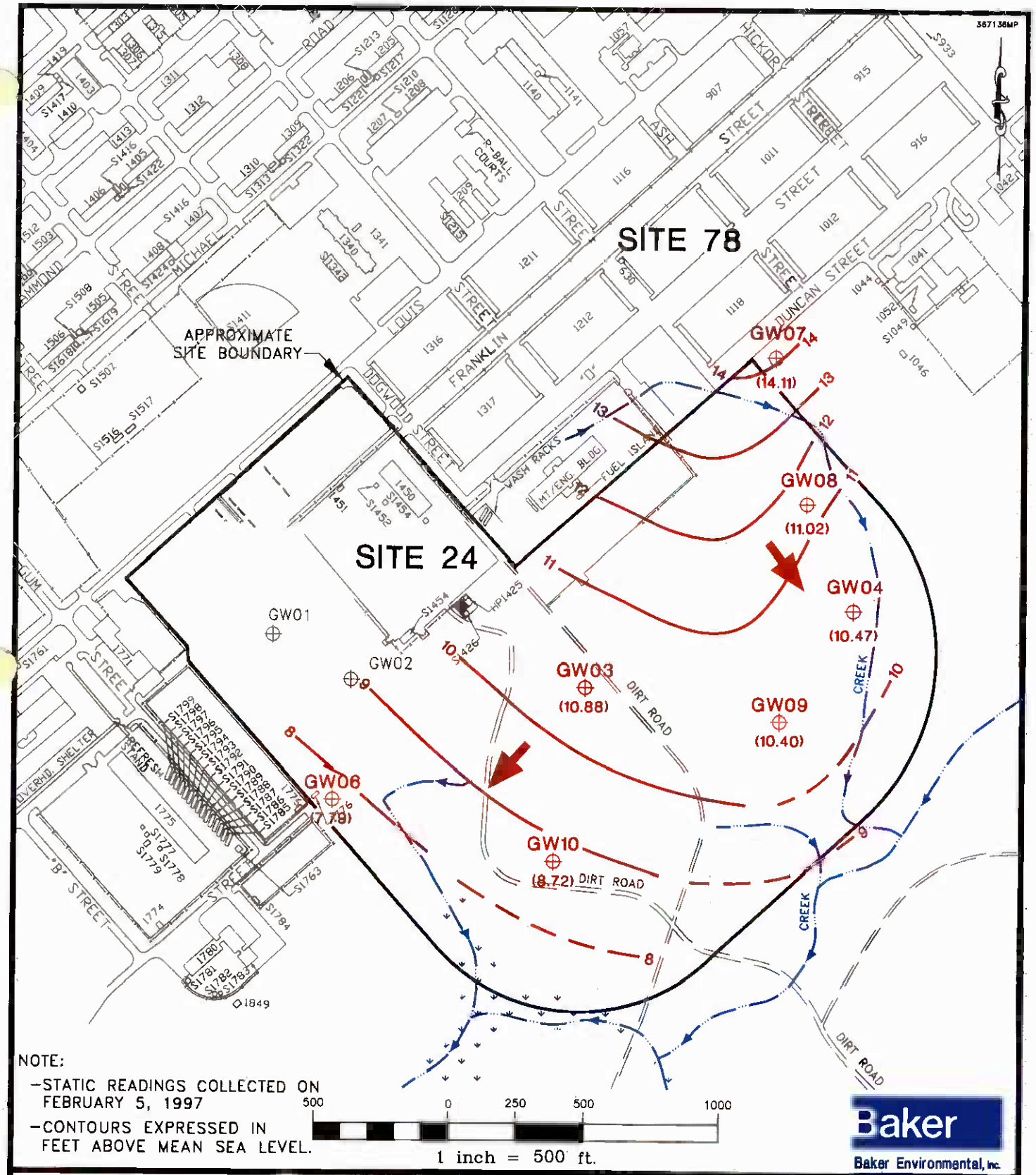


FIGURE 1-3
SHALLOW GROUNDWATER CONTOUR MAP
FEBRUARY 5, 1997
OPERABLE UNIT No. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

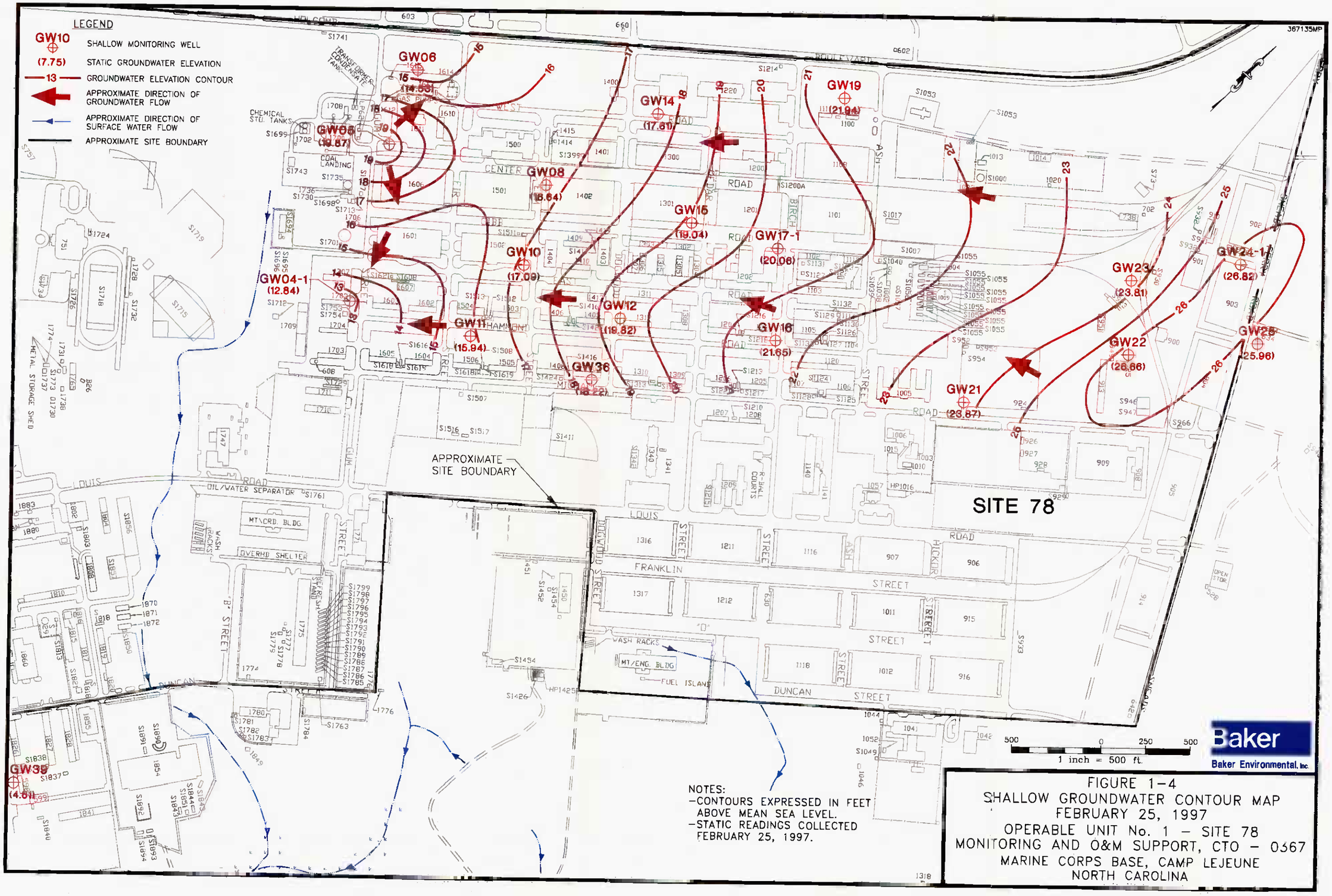


FIGURE 1-4
SHALLOW GROUNDWATER CONTOUR MAP
FEBRUARY 25, 1997
OPERABLE UNIT No. 1 – SITE 78
MONITORING AND O&M SUPPORT, CTO – 0567
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

LEGEND

- RW-1 — RECOVERY WELL
- GW09-1 — SHALLOW MONITORING WELL
- GW09-2 — INTERMEDIATE MONITORING WELL
- GW09-3 — DEEP MONITORING WELL
- APPROXIMATE DIRECTION OF SURFACE WATER FLOW

SAMPLE ID	78-GW01-97A
SAMPLE DATE	02/04/97
ACETONE	4
1,2-DICHLOROETHENE (TOTAL)	3
TRICHLOROETHENE	12

SAMPLE ID	78-GW04-97A
SAMPLE DATE	02/02/97
TRICHLOROETHENE	8
1,2-DICHLOROETHENE (TOTAL)	2

SAMPLE ID	78-GW15-97A
SAMPLE DATE	02/05/97
TRICHLOROETHENE	1

SAMPLE ID	78-GW09-97A
SAMPLE DATE	02/02/97
1,1,1-TRICHLOROETHANE	500
1,1-DICHLOROETHANE	50
1,1-DICHLOROETHENE	78
1,2-DICHLOROETHENE (TOTAL)	220
TRICHLOROETHENE	640

SAMPLE ID	78-GW09W-97A
SAMPLE DATE	02/02/97
1,2-DICHLOROETHENE (TOTAL)	4

SAMPLE ID	78-GW23-97A
SAMPLE DATE	02/05/97
BENZENE	16
TOLUENE	3
ETHYLBENZENE	7
XYLENE (TOTAL)	46
1,1-DICHLOROETHENE	4
1,2-DICHLOROETHENE (TOTAL)	7900
TRICHLOROETHENE	57
VINYL CHLORIDE	360

SAMPLE ID	78-GW24-97A
SAMPLE DATE	02/04/97
1,2-DICHLOROETHENE (TOTAL)	120
TRICHLOROETHENE	19

SAMPLE ID	78-GW39-97A
SAMPLE DATE	02/05/97
TETRACHLOROETHENE	0.7

NOTES:
- CONCENTRATIONS PRESENTED IN MICROGRAMS PER LITER OR PARTS PER BILLION.
- SAMPLE LOCATIONS SHOWN WITHOUT CONCENTRATIONS INDICATE NONDETECTABLE LEVELS.
- CONTAMINANTS THAT EXCEED THE NCWQS ARE SHOWN IN GREEN.
- CONTAMINANTS THAT EXCEED BOTH NCWQS AND MCL ARE SHOWN IN RED.

FEDERAL MAXIMUM CONTAMINANT LEVELS (MCLs) AND NORTH CAROLINA WATER QUALITY STANDARDS (NCWQS)

Organic Contaminants	NCWQS	MCL
Acetone	700	NA
Vinyl Chloride	0.015	2.0
1,1-Dichloroethene	7.0	7.0
1,1-Dichloroethane	700	
1,2-Dichloroethene (Total)	70	
1,1,1-Trichloroethane	200	200
Trichloroethene	2.8	5.0
Benzene	1.0	5.0
Tetrachloroethene	0.7	5.0
Toluene	1000	1000
Ethylbenzene	29	700
Xylene (Total)	530	10000

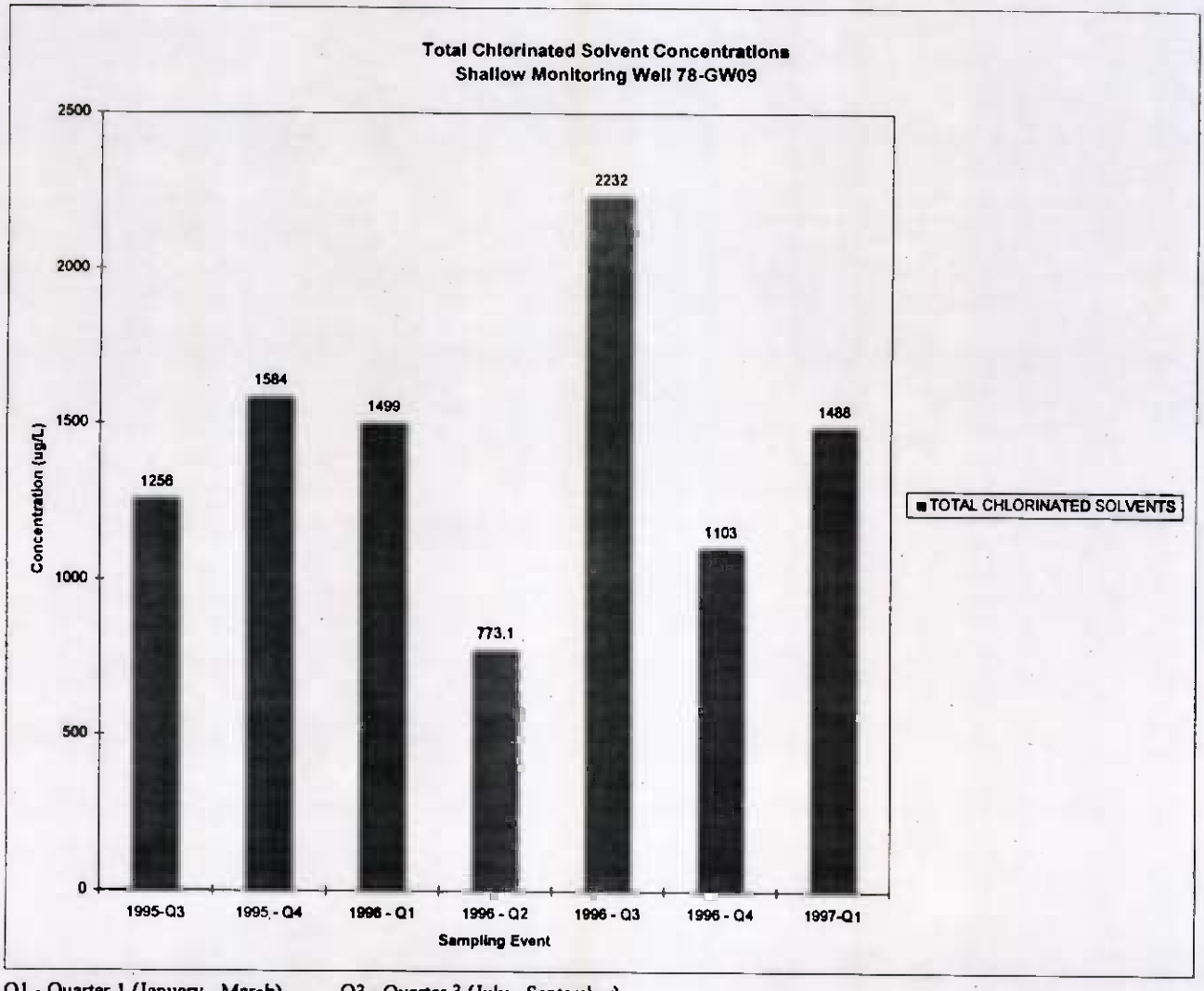
500 0 250 500
1 inch = 500 ft.

Baker Environmental, Inc.

FIGURE 2-1
VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER
OPERABLE UNIT No. 1 – SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

FIGURE 2-2

TOTAL CHLORINATED SOLVENT RESULTS FROM 78-GW09
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-367
MCB, CAMP LEJEUNE, NORTH CAROLINA

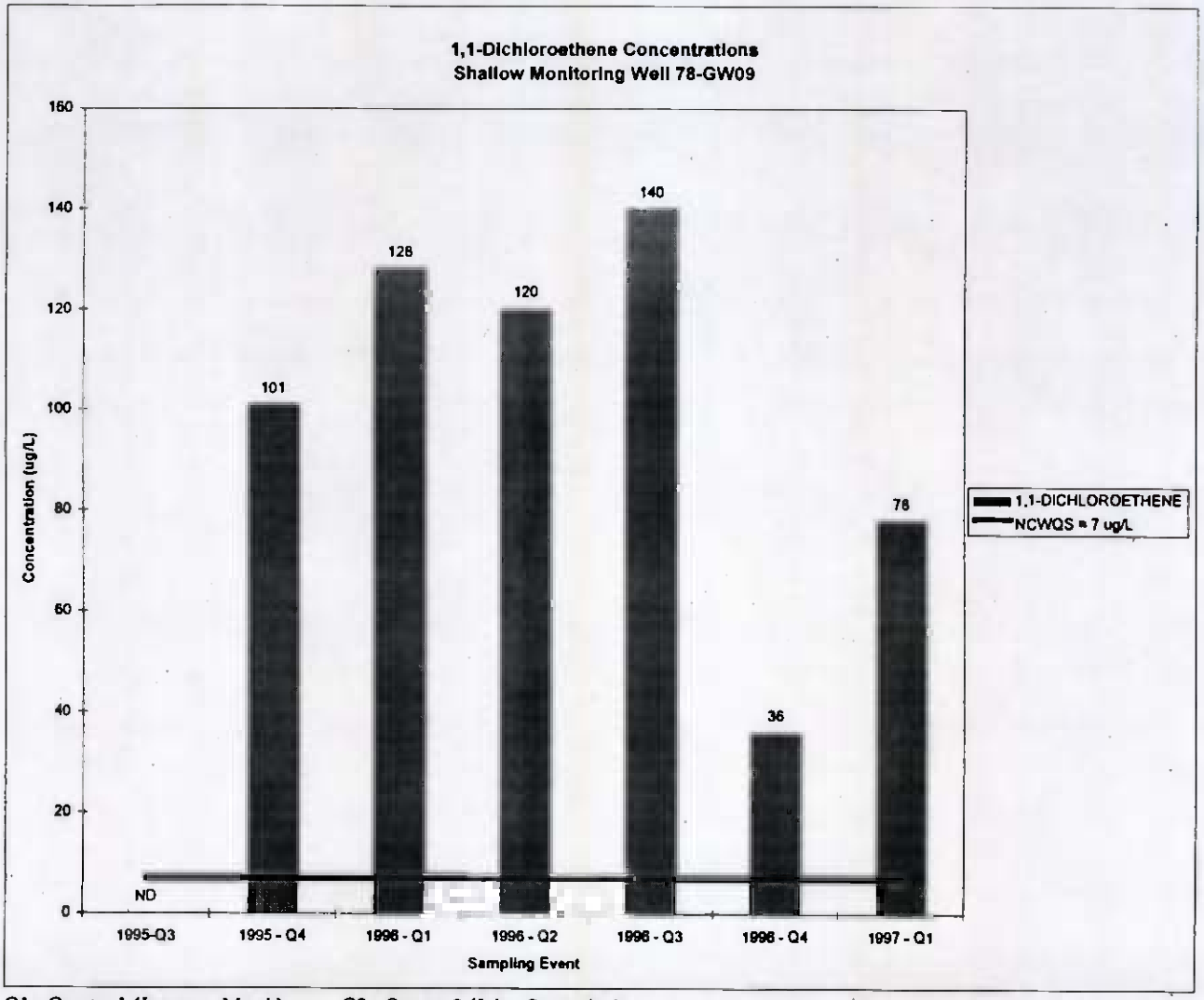


Q1 - Quarter 1 (January - March)
Q2 - Quarter 2 (April - June)
Q3 - Quarter 3 (July - September)
Q4 - Quarter 4 (October - December)

Contaminants	Mean Total (ug/L)	Median Total (ug/L)	Detection Frequency	Detections Above Standards
TOTAL CHLORINATED SOLVENTS	1419	1488	7/7	N/A

FIGURE 2-3

1,1-DICHLOROETHENE RESULTS FROM 78-GW09
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-367
MCB, CAMP LEJEUNE, NORTH CAROLINA



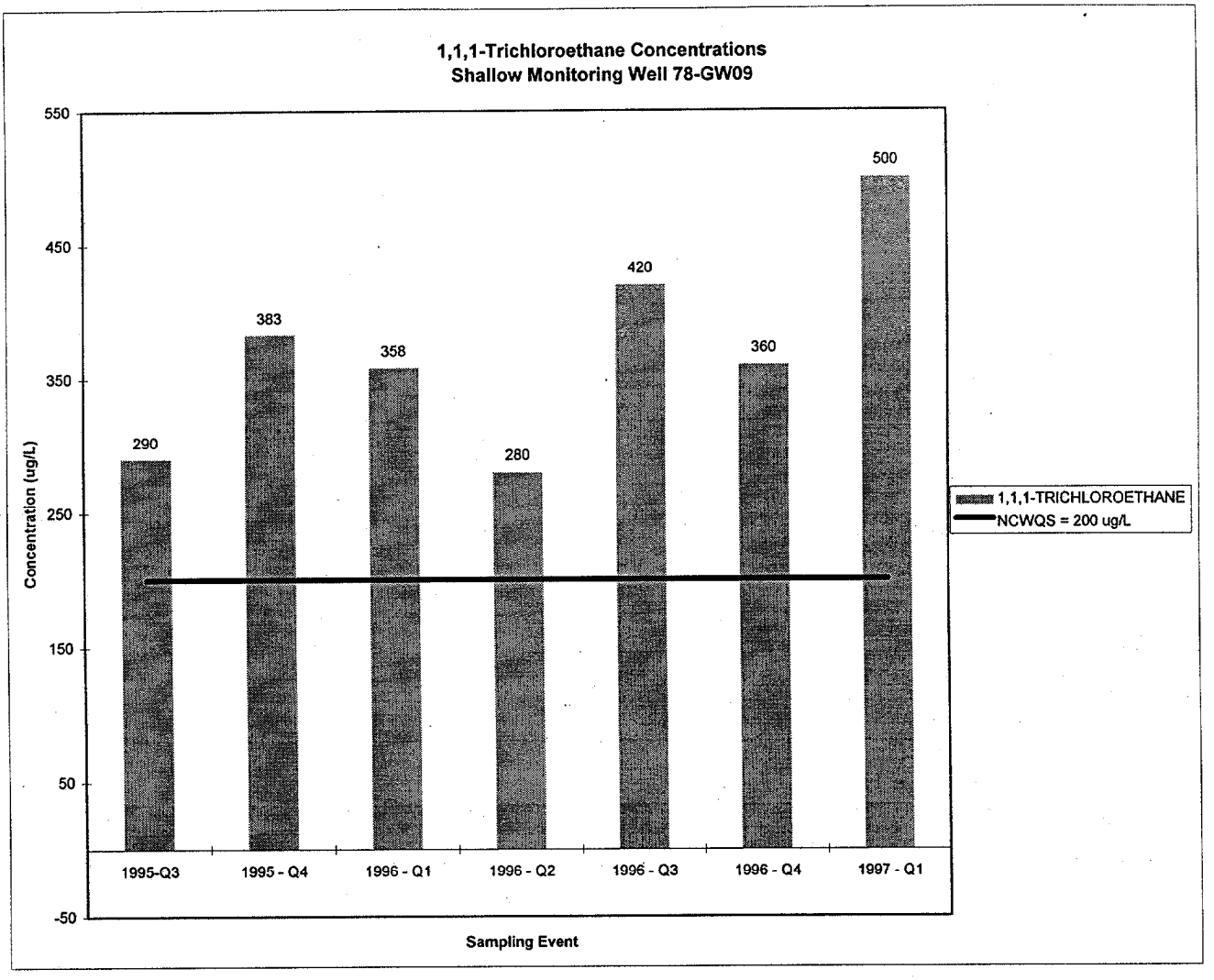
Q1 - Quarter 1 (January - March)
Q2 - Quarter 2 (April - June)
Q3 - Quarter 3 (July - September)
Q4 - Quarter 4 (October - December)

Notes:
Federal Maximum Contaminant Level (MCL) = 7 micrograms per liter (ug/L)
North Carolina Water Quality Standard (NCWQS) = 7 micrograms per liter (ug/L)
ND = Not Detected

Contaminant	Mean Detection (ug/L)	Median Detection (ug/L)	Detection Frequency	Detections Above Standards
1,1-DICHLOROETHENE	86	110	6/7	6/7

FIGURE 2-4

1,1,1-TRICHLOROETHANE RESULTS FROM 78-GW09
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-367
MCB, CAMP LEJEUNE, NORTH CAROLINA



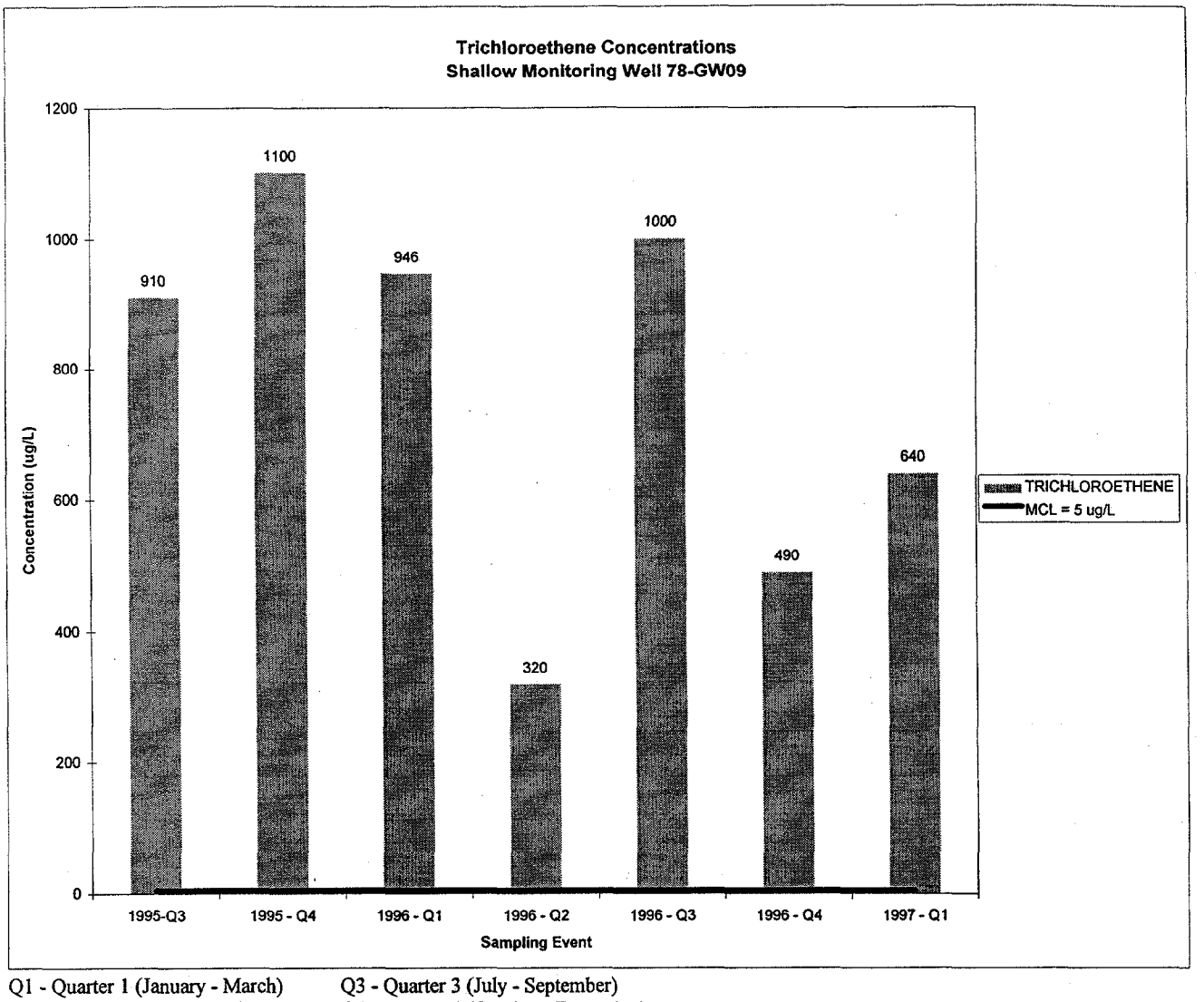
Q1 - Quarter 1 (January - March)
Q2 - Quarter 2 (April - June)
Q3 - Quarter 3 (July - September)
Q4 - Quarter 4 (October - December)

Notes:
Federal Maximum Contaminant Level (MCL) = 200 micrograms per liter (ug/L)
North Carolina Water Quality Standard (NCWQS) = 200 micrograms per liter (ug/L)

Contaminant	Mean Detection (ug/L)	Median Detection (ug/L)	Detection Frequency	Detections Above Standards
1,1,1-TRICHLOROETHANE	370	360	7/7	7/7

FIGURE 2-5

TRICHLOROETHENE RESULTS FROM 78-GW09
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-367
MCB, CAMP LEJEUNE, NORTH CAROLINA



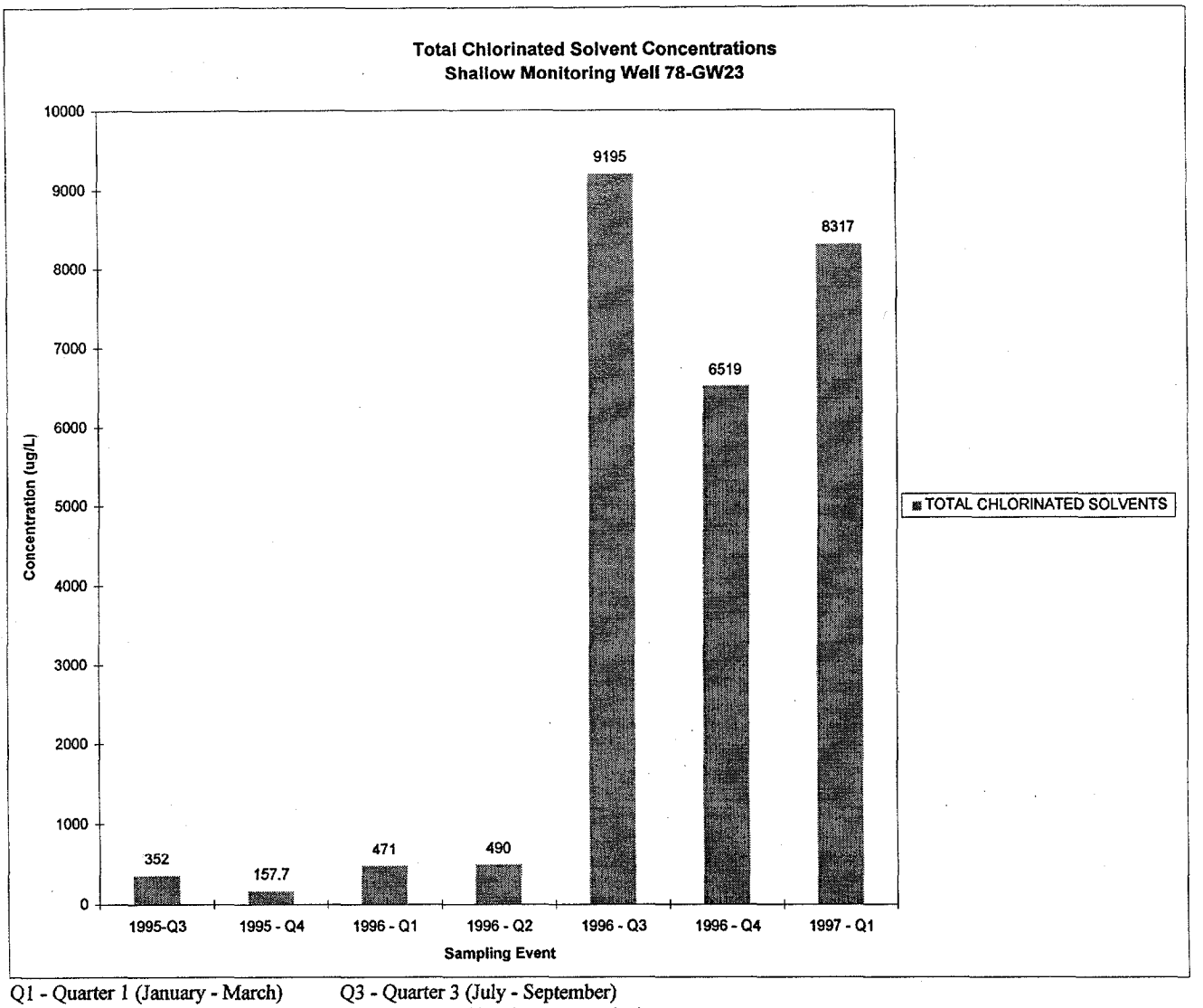
Q1 - Quarter 1 (January - March)
Q2 - Quarter 2 (April - June)
Q3 - Quarter 3 (July - September)
Q4 - Quarter 4 (October - December)

Notes:
Federal Maximum Contaminant Level (MCL) = 5 micrograms per liter (ug/L)
There is no North Carolina Water Quality Standard (NCWQS)

Contaminant	Mean Detection (ug/L)	Median Detection (ug/L)	Detection Frequency	Detections Above Standards
TRICHLOROETHENE	772	910	7/7	7/7

FIGURE 2-6

TOTAL CHLORINATED SOLVENT RESULTS FROM 78-GW23
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-367
MCB, CAMP LEJEUNE, NORTH CAROLINA

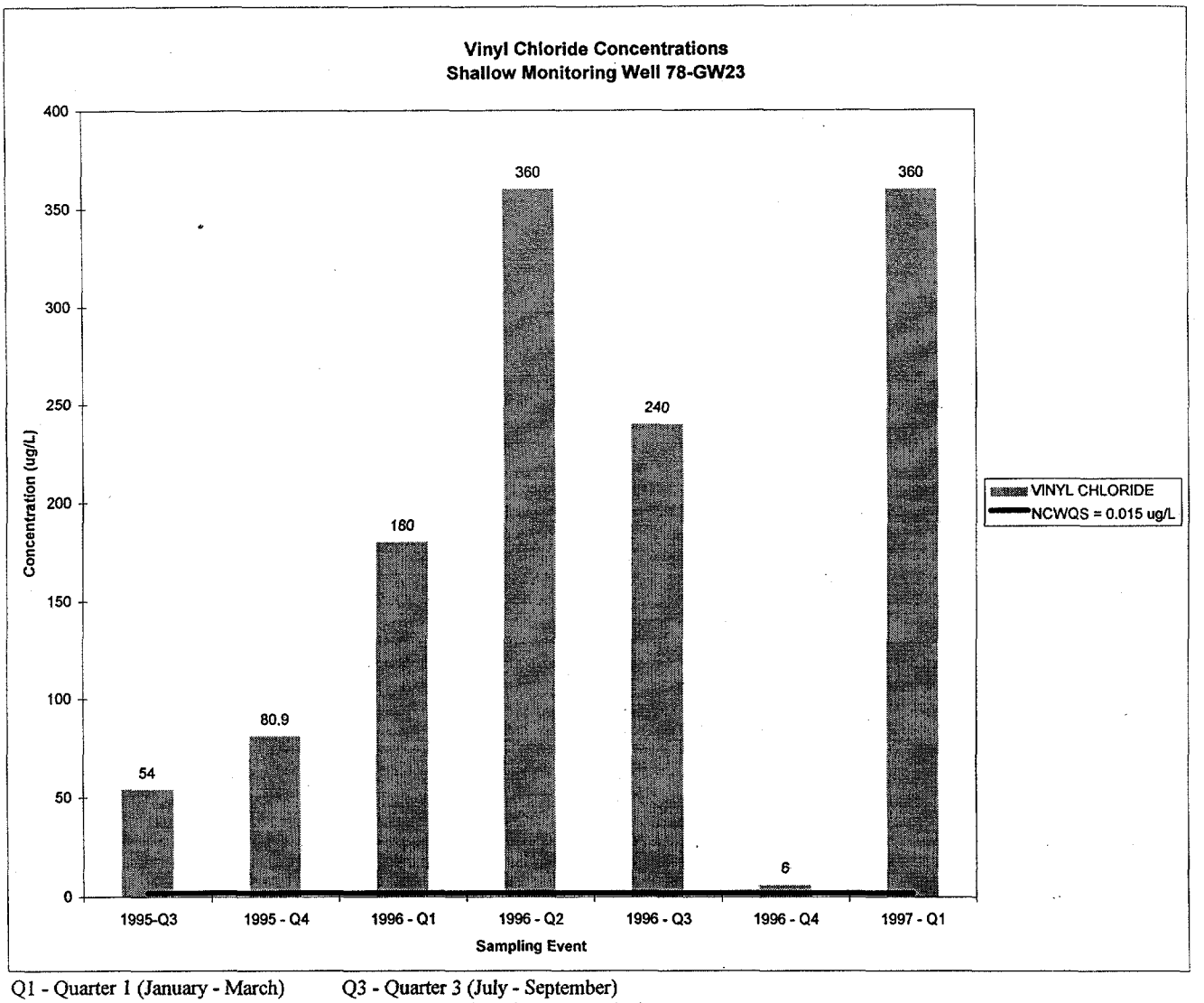


Q1 - Quarter 1 (January - March)
Q2 - Quarter 2 (April - June)
Q3 - Quarter 3 (July - September)
Q4 - Quarter 4 (October - December)

Contaminant	Mean Detection (ug/L)	Median Detection (ug/L)	Detection Frequency	Detections Above Standards
TOTAL CHLORINATED SOLVENTS	3643	490	7/7	N/A

FIGURE 2-7

VINYL CHLORIDE RESULTS FROM 78-GW23
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-367
MCB, CAMP LEJEUNE, NORTH CAROLINA



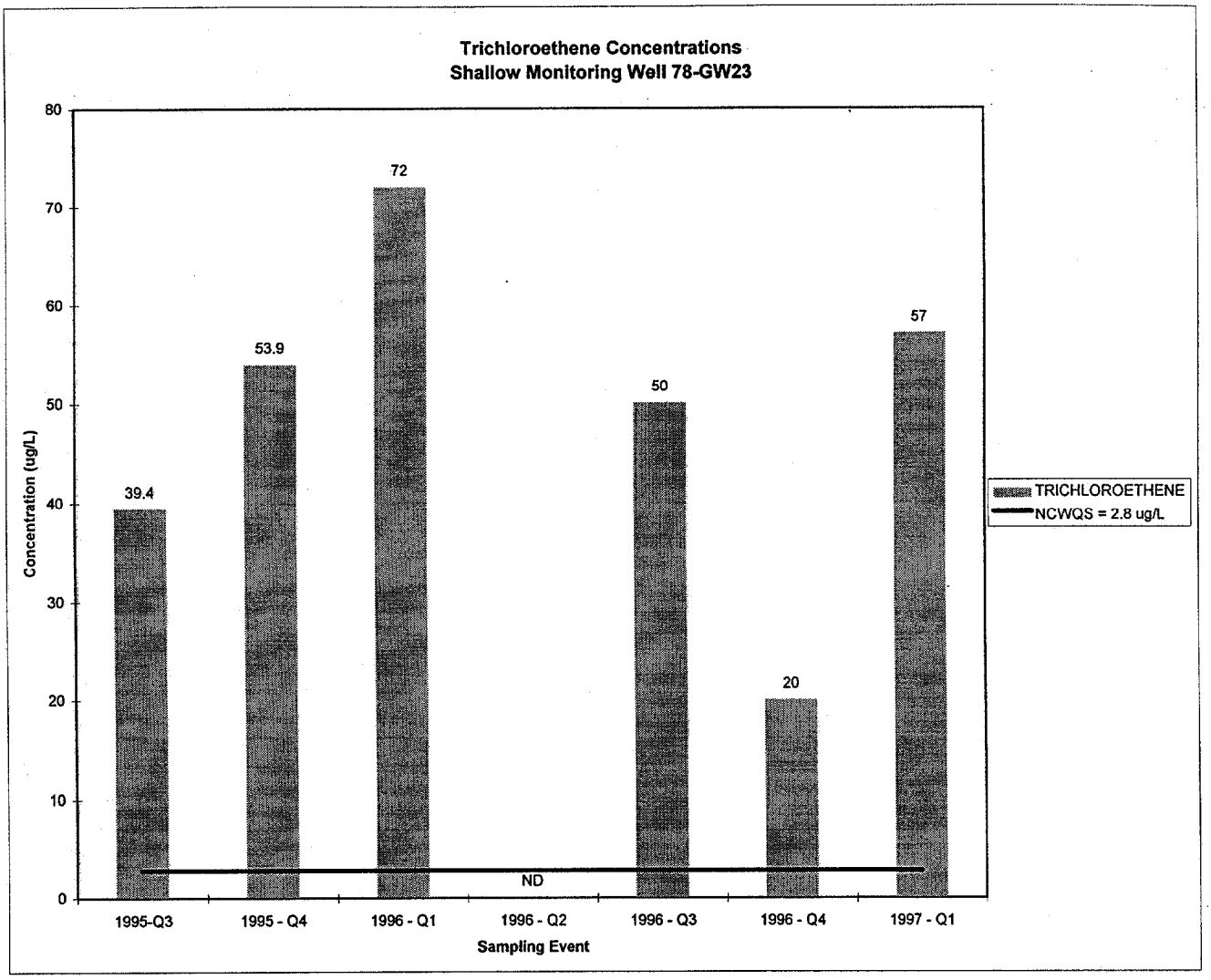
Q1 - Quarter 1 (January - March)
Q2 - Quarter 2 (April - June)
Q3 - Quarter 3 (July - September)
Q4 - Quarter 4 (October - December)

Notes:
Federal Maximum Contaminant Level (MCL) = 2 micrograms per liter (ug/L)
North Carolina Water Quality Standard (NCWQS) = 0.015 micrograms per liter (ug/L)

Contaminant	Mean Detection (ug/L)	Median Detection (ug/L)	Detection Frequency	Detections Above Standards
VINYL CHLORIDE	183	180	7/7	7/7

FIGURE 2-8

TRICHLOROETHENE RESULTS FROM 78-GW23
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-367
MCB, CAMP LEJEUNE, NORTH CAROLINA



Q1 - Quarter 1 (January - March)
Q2 - Quarter 2 (April - June)
Q3 - Quarter 3 (July - September)
Q4 - Quarter 4 (October - December)

Notes:
Federal Maximum Contaminant Level (MCL) = 5 micrograms per liter (ug/L)
North Carolina Water Quality Standard (NCWQS) = 2.8 micrograms per liter (ug/L)
ND = Not Detected

Contaminant	Mean Detection (ug/L)	Median Detection (ug/L)	Detection Frequency	Detections Above Standards
TRICHLOROETHENE	42	47	6/7	6/7

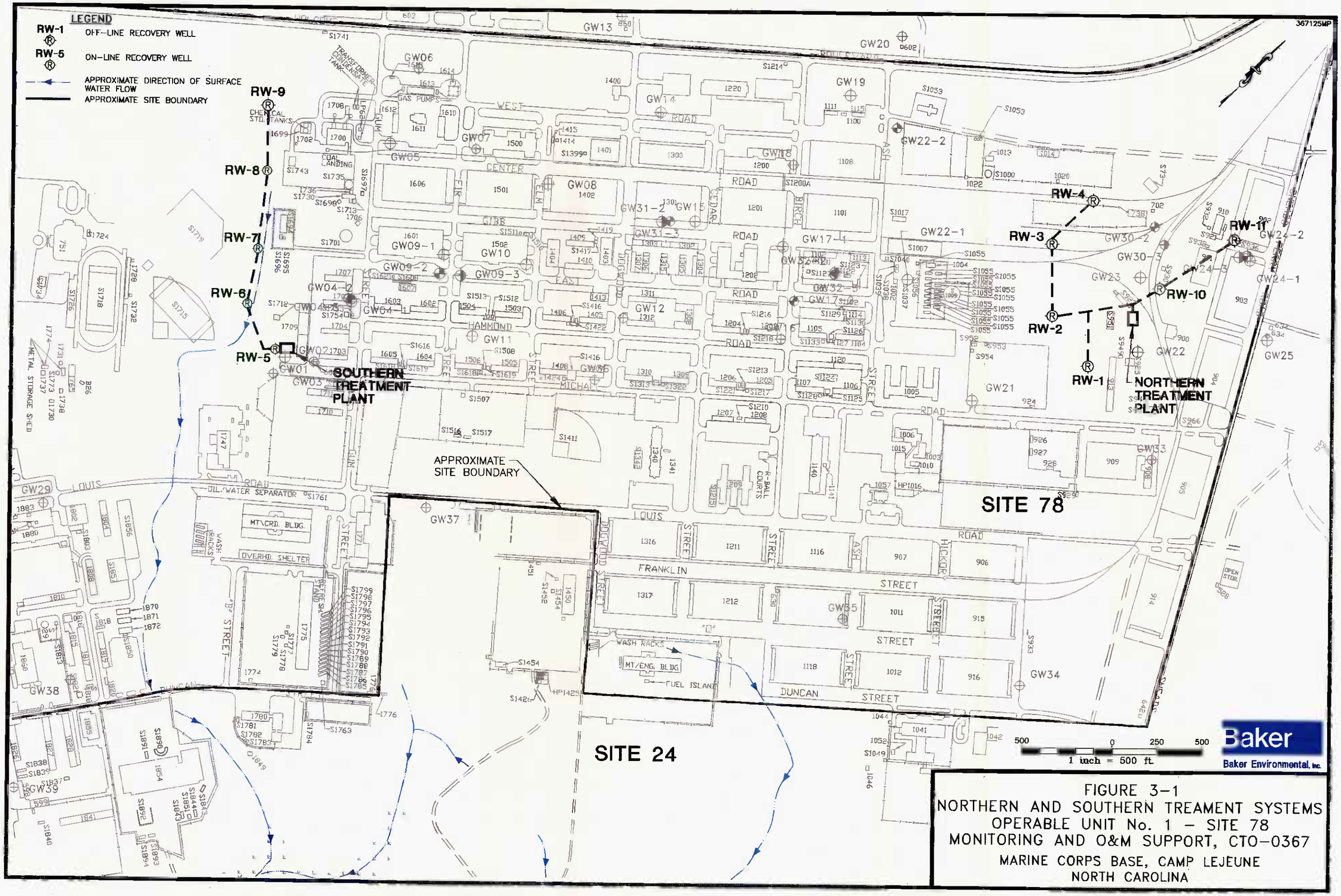


FIGURE 3-1
NORTHERN AND SOUTHERN TREAMENT SYSTEMS
OPERABLE UNIT No. 1 – SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA

01780JJB2Y

Figure 4-1 Shallow monitoring well 78-GW22-1 was abandoned according to procedures stipulated by North Carolina. The well had begun to exhibit signs of subsurface deterioration.

Figure 4-2 The pad, bollards, and protective casing of monitoring well 78-GW22-1 were also removed. Topsoil and grass seed were used to restore the site.

Figure 4-3 Intermediate monitoring well 78-GW24-2 was constructed during the 1986 Confirmation Study without a locking cap.

Figure 4-4 A locking cap and lock were installed on monitoring well 78-GW24-2. In addition, peeling paint and rust were removed and two coats of paint were then applied.

Figure 4-5 The protective lid of deep monitoring well 78-GW31-3 was damaged. Without a proper seal runoff from the surrounding parking area may have entered the well.

Figure 4-6 A new protective cover and concrete pad were installed at deep well 78-GW31-3. The new concrete pad was constructed with a slightly higher elevation so that runoff would be less likely to enter the well.

Figure 4-7 Soil from beneath the pad of intermediate monitoring well 78-GW09-2 had begun to erode and the well had become unsightly.

Figure 4-8 Monitoring well 78-GW09-2 was converted from a stick-up to a flush mount. Topsoil and grass seed were used to restore the site.

Figure 4-9 Shallow monitoring well 78-GW14 is located in a high-traffic area. One of the four protective bollards had been recently struck by a vehicle and bent.

Figure 4-10 Monitoring well 78-GW14 was converted from a stick-up to a flush mount to reduce the possibility of damage from further collisions. Top soil and grass seed were used to restore the site.

Figure 4-11 Shallow monitoring well 78-GW19 was struck by a vehicle during hurricane debris removal activities.

Figure 4-12 The damaged bollard was replaced and the concrete pad of well 78-GW19 was repaired. The excess concrete and bollard, pictured here, were removed after all well maintenance activities had been completed.

ATTACHMENTS

ATTACHMENT A
CHAIN-OF-CUSTODY DOCUMENTATION

Baker Environmental, Inc.
Airport Office Park, Bldg. 3
420 Rouser Road
Coraopolis, PA 15108
412-269-6000
412-269-6097 (fax)

CHAIN-OF-CUSTODY RECORD

Lab and BOA #: Weston B. Ramirez
Delivery Order #:
Project Number: 367
Project Name: Monitoring and O&M
Field Team: JPT/TFT
SEND RESULTS TO: Tom Trebilcock

Notes ~~Sample Number~~	1997 Date	Time	Sample Location	Matrix Type (1) GB (2)	Matrix Type (1) COM (2)	Analytical Methods: TCL VOAs by 8260	Pesticides	Oil & Grease	Metals	TSS/TDS								General Comments / ~~Remarks~~
						Type of Container(s) (3)												
						Number of Container(s)												Sample No.
GW	2/2	0815	Site 78	X		X												78-GW14-97A
GW	2/2	1100	Site 78	X		X												78-GW04-97A
GW	2/2	1645	Site 78	X		X												78-GW09DW-97A
GW	2/2	1515	Site 78	X		X												78-GW09IW-97A
GW	2/2	1605	Site 78	X		X												78-GW09-97A
GW	2/2	1750	Site 78	X		X												78-GW17-97A
GW	2/3	0930	Site (1) ~~78~~	X		X	X	X	X	X								24-GW08-97A
GW	2/3	1100	Site 78															78-GW10-97A

Coc # OU197A-001

Relinquished By: _____ Date: _____ Time: _____
Received By: _____ Date: _____ Time: _____
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐ _____

Relinquished By: _____ Date: _____ Time: _____
Received By: _____ Date: _____ Time: _____
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐ _____

Relinquished By: _____ Date: _____ Time: _____
Received By: _____ Date: _____ Time: _____
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐ _____

Sample Stored at 4 Degrees C: Yes ☒ No ☐
Chain-of-custody seal on cooler: Yes ☒ Number: _____ No ☐
Analysis turnaround: Priority ☐ _____ hrs. Regular ☒
See Work Order ☐
See Analysis Request Form ☐

Sample Disposal: Return to Baker ☐ Lab Disposal ☒
Archive until: _____ (date)

NOTES:
(1) A - Air; GW - Groundwater; L - Leachate; S - Spring; SS - Surface Soil; SB - SubSurface Soil; SW - Surface Water; W - Waste; WP - Wipe; WW - Wastewater
(2) GB - Grab; COM - Composite
(3) P - Plastic; G - Glass

White - Return with analytical results; Yellow - Laboratory Copy; Pink - Field Copy

Courier Name: FedEx
Courier Pickup Number: 355827 4285
File Name: _____

(1) 24-GW08-97A location = Site 24

Baker Environmental, Inc.
Airport Office Park, Bldg. 3
420 Rouser Road
Coraopolis, PA 15108
412-269-6000
412-269-6097 (fax)

CHAIN-OF-CUSTODY RECORD

Lab and BOA #: Weston B. Ramirez
Delivery Order #:
Project Number: 367
Project Name: Monitoring
Field Team: JPT/TFT
SEND RESULTS TO: Tom Trebilcock

Notes ~~Sample Number~~	1997 Date	Time	Sample Location	Matrix Type (1) GB (2)	Matrix Type (1) COM (2)	Analytical Methods: VOAs by 8260	Type of Container(s) (3): G/P	Number of Container(s)	General Comments: Sample No. ~~Remarks~~
GW	2/4	1635	Site 78	X		X			78-GW24DW-97A
GW	2/4	1525	"	X		X			78-GW24IW-97A
GW	2/4	1630	"	X		X			78-GW24-97A
GW	2/5	0925	"	X		X			78-GW25-97A
GW	2/5	1035	"	X		X			78-GW23-97A
GW	2/5	1150	"	X		X			78-GW22A-97A
GW	2/5	1305	"	X		X			78-GW15-97A
GW	2/5	1420	"	X		X			78-GW39-97A
GW	2/5	1520	"	X		X			78-GW11-97A
Blank	2/5	1600	—			X			78-TB03-97A

COC # OU197A-002

Relinquished By: [signature] Date: 2/5/97 Time: 1630
Received By: Date: Time:
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐

Relinquished By: Date: Time:
Received By: Date: Time:
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐

Relinquished By: Date: Time:
Received By: Date: Time:
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐

Sample Stored at 4 Degrees C: Yes ☒ No ☐
Chain-of-custody seal on cooler: Yes ☒ Number: ____ No ☐
Analysis turnaround: Priority ☐ ____ hrs. Regular ☒
See Work Order ☐
See Analysis Request Form ☐
Sample Disposal: Return to Baker ☐ Lab Disposal ☒
Archive until: ____ (date)

NOTES:
(1) A - Air; GW - Groundwater; L - Leachate; S - Spring; SS - Surface Soil; SB - SubSurface Soil; SW - Surface Water; W - Waste; WP - Wipe; WW - Wastewater
(2) GB - Grab; COM - Composite
(3) P - Plastic; G - Glass

White - Return with analytical results; Yellow - Laboratory Copy; Pink - Field Copy

Courier Name: FedEx
Courier Pickup Number: 355827426 3
File Name:

Baker Environmental, Inc.
Airport Office Park, Bldg. 3
420 Rouser Road
Coraopolis, PA 15108
412-269-6000
412-269-6097 (fax)

CHAIN-OF-CUSTODY RECORD

Lab and BOA #: Weston B. Ramirez
Delivery Order #:
Project Number: 367
Project Name: Monitoring
Field Team: JPT/TFT
SEND RESULTS TO: Tom Trebilcock

Notes ~~Sample Number~~	1997 Date	Time	Sample Location	Matrix Type (1) GB (2)	Matrix Type (1) COM (2)	Analytical Methods: VOAs	Pesticides	Oil & Grease	Metals	TSS & TDS								General Comments
						Type of Container(s) (3) G/2	G/1	G/1	P/1	P/1								
						Number of Container(s)												Sample No. ~~Remarks~~
GW	2/3	1530	Site 78	X		X												78-GW21-97A
GW	2/3	1730	Site 24	X		X	X	X	X	X								24-GW09-97A
GW	2/4	0855	Site 24	X		X	X	X	X	X								24-GW10-97A
GW	2/4	1025	Site 78	X		X												78-GW08-97A
GW	2/4	1155	Site 78	X		X												78-GW01-97A
Blank	2/4	1200	—	X		X												78-TB02-97A

COC # 01197A-002

Relinquished By: [signature] Date: 2/4/97 Time: 1700
Received By: _____ Date: _____ Time: _____
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐ _____

Relinquished By: _____ Date: _____ Time: _____
Received By: _____ Date: _____ Time: _____
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐ _____

Relinquished By: _____ Date: _____ Time: _____
Received By: _____ Date: _____ Time: _____
Shipped by (check one): Hand ☐ Overnight ☐ Other ☐ _____

Sample Stored at 4 Degrees C: Yes ☒ No ☐
Chain-of-custody seal on cooler: Yes ☒ Number: _____ No ☐
Analysis turnaround: Priority ☐ _____ hrs. Regular ☒
See Work Order ☐
See Analysis Request Form ☐
Sample Disposal Return to Baker ☐ Lab Disposal ☒
Archive until: _____ (date)

NOTES:
(1) A - Air; GW - Groundwater; L - Leachate; S - Spring; SS - Surface Soil; SB - SubSurface Soil; SW - Surface Water; W - Waste; WP - Wipe; WW - Wastewater
(2) GB - Grab; COM - Composite
(3) P - Plastic; G - Glass

White - Return with analytical results; Yellow - Laboratory Copy; Pink - Field Copy

Courier Name: FedEx
Courier Pickup Number: _____
File Name: _____

ATTACHMENT B
SAMPLE TRACKING FORM

Sample Tracking and Chain-of-Custody Documentation - Sites 24 and78
Monitoring and O&M Program Support, CTO-367
MCB Camp Lejuene, North Carolina

MATRIX	SAMPLE ID	DATE SHIPPED	Analysis Requested						Analysis Received						DATE RECEIVED	TURNAROUND TIME	RFW #	COMMENTS
			TCL Volatiles (EPA 8260)	TAL Metals (SW 6010/7470)	Oil & Grease (SW 9070)	Total Dissolved Solids	Total Suspended Solids	Pesticides (SOW OLM01.8)	TCL Volatiles (EPA 8260)	TAL Metals (SW 6010/7470)	Oil & Grease (SW 9070)	Total Dissolved Solids	Total Suspended Solids	Pesticides (SOW OLM01.8)				
Groundwater	**COC# OU197A-001**																	
	78-GW14-97A	2/3/97	X						X						2/24/97	21	9702G858	
	78-GW04-97A	2/3/97	X						X						2/24/97	21	9702G858	
	24-GW08-97A	2/3/97	X	X	X	X	X	X	X	X	X	X	X	X	2/24/97	21	9702G858	
	78-GW09-97A	2/3/97	X						X						2/24/97	21	9702G858	
	78-GW09IW-97A	2/3/97	X						X						2/24/97	21	9702G858	
	78-GW09DW-97A	2/3/97	X						X						2/24/97	21	9702G858	
	78-GW10-97A	2/3/97	X						X						2/24/97	21	9702G858	
	78-GW17-97A	2/3/97	X						X						2/24/97	21	9702G858	
	78-TB-01-97A	2/3/97	X						X						2/24/97	21	9702G858	
	COC# OU197A-002																	
	78-GW21-97A	2/4/97	X						X						2/24/97	20	9702G858	
	24-GW09-97A	2/4/97	X	X	X	X	X	X	X	X	X	X	X	X	2/24/97	20	9702G858	
	24-GW10-97A	2/4/97	X	X	X	X	X	X	X	X	X	X	X	X	2/24/97	20	9702G858	
	78-GW08-97A	2/4/97	X						X						2/24/97	20	9702G858	
	78-GW01-97A	2/4/97	X						X						2/24/97	20	9702G858	
	78-TB02-97A	2/4/97	X						X						2/24/97	20	9702G858	
	78-GW11-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW15-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW22A-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW23-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW24-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW24IW-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW24DW-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW25-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-GW39-97A	2/5/97	X						X						2/24/97	19	9702G858	
	78-TB03-97A	2/5/97	X						X						2/24/97	19	9702G858	
TOTALS			25	3	3	3	3	3	25	3	3	3	3	3				

TAL Metals (SW 6010/7470) - Antimony, Arsenic, Beryllium, Chromium, Iron, Lead, Nickel, Mercury, Manganese

ATTACHMENT C
SAMPLE DESIGNATIONS

SAMPLE DESIGNATIONS

In order to accurately identify and differentiate samples collected during the monitoring program, all samples were designated with a unique identification number. The unique sample number identifies the site, the sample media, the sampling station's number, and the quarter in which the sample was collected. The sample designation format is as follows:

Site Number - Sample Station Identifier - Year and Quarter

An explanation of each identifier is provided below:

Site Number	The investigation was conducted at Sites 24 and 78.
Sample Station Identifier	Each monitoring well has been assigned a unique identification number. The identification number may include the qualifiers "DW" which denotes a deep monitoring well, "IW" which denotes an intermediate monitoring well, or "GW" which denotes groundwater.
Year	The investigation was conducted during 1997.
Quarter	The investigation was conducted during the fourth quarter. The four quarters of year are identified by the first four letters of the alphabet (i.e., A, B, C and D).

Under this sample designation format the sample number 78-GW09DW-97A refers to:

78-GW09DW-97A	Site 78
78-GW09DW-97A	Groundwater sample
78-GW09DW-97A	Monitoring well No.9
78-GW09DW-97A	Deep monitoring well
78-GW09DW-97A	Year 1997.
78-GW09DW-96A	The first quarter (i.e., January through March)

ATTACHMENT D
ANALYTICAL RESULTS - First Quarter 1997

GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 1997
OPERABLE UNIT NO. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

SAMPLE ID	24-GW08-97A	24-GW09-97A	24-GW10-97A
DATE SAMPLED	02/03/97	02/03/97	02/04/97
VOLATILES (ug/L)			
CHLOROMETHANE	0.5 U	0.5 U	0.5 U
BROMOMETHANE	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U
CHLOROETHANE	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	0.5 U	0.5 U	0.5 U
ACETONE	2 U	2 U	2 U
CARBON DISULFIDE	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	0.5 U	0.5 U	0.5 U
CHLOROFORM	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U
2-BUTANONE	2 U	2 U	2 U
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 U	0.5 U	0.5 U
DIBROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U
BENZENE	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U
4-METHYL-2-PENTANONE	2 U	2 U	2 U
2-HEXANONE	2 U	2 U	2 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U
STYRENE	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U

GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 1997
OPERABLE UNIT NO. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

SAMPLE ID	24-GW08-97A	24-GW09-97A	24-GW10-97A
DATE SAMPLED	02/03/97	02/03/97	02/04/97
PESTICIDES/PBS (ug/L)			
ALPHA-BHC	0.05 U	0.05 U	0.05 U
BETA-BHC	0.05 U	0.05 U	0.05 U
DELTA-BHC	0.05 U	0.05 U	0.05 U
GAMMA-BHC (LINDANE)	0.05 U	0.05 U	0.05 U
HEPTACHLOR	0.05 U	0.05 U	0.05 U
ALDRIN	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE	0.05 U	0.05 U	0.05 U
ENDOSULFAN I	0.05 U	0.05 U	0.05 U
DIELDRIN	0.1 U	0.1 U	0.1 U
4,4'-DDE	0.1 U	0.1 U	0.1 U
ENDRIN	0.1 U	0.1 U	0.1 U
ENDOSULFAN II	0.1 U	0.1 U	0.1 U
4,4'-DDD	0.1 U	0.1 U	0.1 U
ENDOSULFAN SULFATE	0.1 U	0.1 U	0.1 U
4,4'-DDT	0.1 U	0.1 U	0.1 U
METHOXYCHLOR	0.5 U	0.5 U	0.5 U
ENDRIN KETONE	0.1 U	0.1 U	0.1 U
ENDRIN ALDEHYDE	0.1 U	0.1 U	0.1 U
ALPHA-CHLORDANE	0.05 U	0.05 U	0.05 U
GAMMA-CHLORDANE	0.05 U	0.05 U	0.05 U
TOXAPHENE	5 U	5 U	5 U
AROCLOR-1016	1 U	1 U	1 U
AROCLOR-1221	2 U	2 U	2 U
AROCLOR-1232	1 U	1 U	1 U
AROCLOR-1242	1 U	1 U	1 U
AROCLOR-1248	1 U	1 U	1 U
AROCLOR-1254	1 U	1 U	1 U
AROCLOR-1260	1 U	1 U	1 U

GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 1997
OPERABLE UNIT NO. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA
OIL & GREASE AND WET CHEMISTRY

SAMPLE ID	24-GW08-97A	24-GW09-97A	24-GW10-97A
DATE SAMPLED	02/03/97	02/03/97	02/04/97
OIL AND GREASE (mg/L)			
OIL & GREASE, GRAV.	5.1 U	21	5.5 U
WET CHEMISTRY (mg/L)			
TOTAL DISSOLVED SOLIDS	88	56	24
TOTAL SUSPENDED SOLIDS	4 U	6	4 U

GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 1997
OPERABLE UNIT NO. 1 - SITE 24
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA
INORGANICS

SAMPLE ID	24-GW08-97A	24-GW09-97A	24-GW10-97A
DATE SAMPLED	02/03/97	02/03/97	02/04/97
TOTAL METALS (ug/L)			
ANTIMONY, TOTAL	2.6 U	2.6 U	2.6 U
ARSENIC, TOTAL	1.7 U	1.7 U	1.7 U
BERYLLIUM, TOTAL	0.5 U	0.5 U	0.5 U
CHROMIUM, TOTAL	1.8 U	1.8 U	1.8 U
IRON, TOTAL	61.7	368	14.7
LEAD, TOTAL	2.6	1.1 U	1.1 U
MANGANESE, TOTAL	3.5	19.3	1 U
MERCURY, TOTAL	0.1 U	0.1 U	0.1 U
NICKEL, TOTAL	8.7 U	8.7 U	8.7 U

GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 1997
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

SAMPLE ID	78-GW01-97A	78-GW04-97A	78-GW08-97A	78-GW09-97A	78-GW09IW-97A	78-GW09DW-97A	78-GW10-97A
DATE SAMPLED	02/04/97	02/02/97	02/04/97	02/02/97	02/02/97	02/02/97	02/03/97
VOLATILES (ug/L)							
CHLOROMETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
CHLOROETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
ACETONE	4	2 U	2 U	20 U	2 U	2 U	2 U
CARBON DISULFIDE	2 U	2 U	2 U	20 U	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	78	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	50	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	3	2	0.5 U	220	4	0.5 U	0.5 U
CHLOROFORM	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	2 U	2 U	2 U	20 U	2 U	2 U	2 U
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	500	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	12	8	0.5 U	640	0.5 U	0.5 U	0.5 U
DIBROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
BENZENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
4-METHYL-2-PENTANONE	2 U	2 U	2 U	20 U	2 U	2 U	2 U
2-HEXANONE	2 U	2 U	2 U	20 U	2 U	2 U	2 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
STYRENE	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U

GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 1997
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

SAMPLE ID	78-GW11-97A	78-GW14-97A	78-GW15-97A	78-GW17-97A	78-GW21-97A	78-GW22A-97A	78-GW23-97A
DATE SAMPLED	02/05/97	02/02/97	02/05/97	02/02/97	02/03/97	02/05/97	02/05/97
VOLATILES (ug/L)							
CHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	360
CHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
CARBON DISULFIDE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	4
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7900
CHLOROFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 U	0.5 U	1	0.5 U	0.5 U	0.5 U	57
DIBROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	16
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
4-METHYL-2-PENTANONE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-HEXANONE	2 U	2 U	2 U	2 U	2 U	2 U	2 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3
CHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	7
STYRENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	46

GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 1997
OPERABLE UNIT NO. 1 - SITE 78
MONITORING AND O&M SUPPORT, CTO-0367
MCB CAMP LEJEUNE, NORTH CAROLINA
ORGANICS

SAMPLE ID	78-GW24-97A	78-GW24DW-97A	78-GW24IW-97A	78-GW25-97A	78-GW39-97A
DATE SAMPLED	02/04/97	02/04/97	02/04/97	02/05/97	02/05/97
VOLATILES (ug/L)					
CHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
VINYL CHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ACETONE	2 U	2 U	2 U	2 U	2 U
CARBON DISULFIDE	2 U	2 U	2 U	2 U	2 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHENE (TOTAL)	120	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	2 U	2 U	2 U	2 U	2 U
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	19	0.5 U	0.5 U	0.5 U	0.5 U
DIBROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
4-METHYL-2-PENTANONE	2 U	2 U	2 U	2 U	2 U
2-HEXANONE	2 U	2 U	2 U	2 U	2 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.7
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
STYRENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
XYLENE (TOTAL)	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

ATTACHMENT E
MONTHLY REMEDIAL SYSTEM PROGRESS REPORTS

OHM Corporation

MONTHLY PROGRESS REPORT
CONTRACT N62470-93-D-3032
DELIVERY ORDER 0118

REMEDIAL SYSTEM OPERATION, REVIEW AND REPAIR
NORTH AND SOUTH TREATMENT PLANTS
OPERABLE UNIT (OU) NO. 1, SITE 78
HADNOT POINT INDUSTRIAL AREA
MCB CAMP LEJEUNE, NORTH CAROLINA

Prepared by:

OHM Remediation Services Corp.
Eastern Region
200 Horizon Center Boulevard
Trenton, New Jersey 08691-1904

James A. Dunn, Jr., P.E.
Project Manager

Approved by:

John P. Franz
Program Manager

January 31, 1997
Delivery Order 0118
OHM Project 18859

TABLE OF CONTENTS

1.0 INTRODUCTION

This Monthly Progress Report has been prepared to summarize the activities performed from January 1, 1997 to January 31, 1997, as well as a summary of the work planned for the month of February 1997 by OHM Remediation Services Corp., (OHM), on Delivery Order 0118 of the Navy-LANTDIV RAC Contract N62470-93-D-3032. This delivery order was signed on May 23, 1996 for a Design Review and Site Visit as the Scope of Work for the North and South Treatment Plants located in the Hadnot Point Industrial Area, Site 78, at Marine Corps Base Camp Lejeune, North Carolina. Subsequent modifications to this delivery order have been issued for the operation, review, maintenance and repair of the plants.

The remediation effort consists of:

1. Operation of the two treatment plants for a period of one year commencing 7/1/96
2. Preparation of plans for the major maintenance event and the engineering review of the treatment trains
3. Performance of a detailed systems evaluation in conjunction with the cleaning and repair of the components of the treatment systems
4. Presentation of findings at a meeting at the base

Such work is specified in the Statement of Work Design Package Section 01010 dated June 20, 1996 and NAVFAC General Paragraphs Section 01010 dated 02/95 and OHM's proposals dated July 1, 1996, July 17, 1996 and July 26, 1996. The total delivery order value to date, including approved modifications is $252,050.26 cost plus $21,554.71 fee. Modification No. 2 was issued during August 1996.

New problem areas and corrective actions taken are identified, and an analysis of project costs and schedule are provided.

2.0 WORK ACCOMPLISHED

During the month of January 1997, OHM has performed the following:

1. Restarted (January 8, 1997) and continued the daily operation and maintenance of the North plant. Plant downtime after restart totaled 36 hours attributable primarily to removal of solids from RW-11.
2. Commenced cleaning, repair and review of the systems design of the South plant on January 9, 1997. Restarted plant on January 30, 1997. The South Plant had an excessice amount of oily mud in all of the treatment units most probably from the IDW waters from the basewide heating oil tank removal program.
3. Installed a new paddle type flowmeter with a range of 24-416 gallons per minute in a horizontal portion of the effluent discharge line. The existing flowmeter was removed and will be salvaged/resold, if possible.
4. The oil/water separator was thoroughly cleaned. A fixed ladder and platform assembly

will be installed to provide safe access to the coalescing media for periodic cleaning.

5. The building drainage sump was thoroughly cleaned.
6. The sludge build-up in the flocculation tank was removed and the tank pressure washed.
7. The sludge holding tank was pressure washed.
8. A core blowdown line and a filtrate blowdown line were added to enhance filter cake quality. All sludges from the cleaning operations were filter pressed. The existing filter cloths were inspected and found to be in good condition.
9. The sludge settling tank was pressure washed.
10. The primary feed pumps were inspected, removed and replaced, based upon our experience in the North Plant.
11. The multi-layer sand filters were completely plugged with mud which resulted in a 35-40 psig pressure loss within the units. The media was vacuum removed and the units pressure washed. New media was installed in the units. The automatic backwash control valving was disassembled and cleaned in accordance with the manufacturers recommendations. No local representative/distributor is available for these units.
12. The low profile air stripper was completely disassembled and the components pressure washed (10,000 psi) to remove calcium build-up. New gaskets were installed and the unit re-assembled.
13. The auto-drain system for the air compressor was replaced. The dryer was serviced by the manufacturers representative. A coalescent filter and a particulate filter were added to the air system immediately downstream of the air dryer.
14. The secondary feed pumps were replaced with Goulds pumps.
15. The air blower was raised to prevent intrusion of water from the air stripper sump.
16. The bag filter housings were pressure washed to remove all calcium build-up. The three inch PVC ball valves were replaced with two inch bronze valves for better service life.
17. The upper diffusers in the liquid phase carbon units were totally clogged with calcium and required replacement. The replacement diffusers were manufactured with larger openings. The carbon required replacement in both units.
18. The backwash tank had accumulated solids and therefore was cleaned.
19. The sand filter backwash pump and the carbon backwash pumps were re-plumbed to permit use of either or both pumps for back washing either unit.
20. The remote notification system will be reprogrammed and reactivated to contact our onsite representative in the event of a plant malfunction.
21. All other PVC ball valves subject to handling raw water prior to the filter press were changed to bronze or steel valves for better service life.

3.0 WORK PLANNED

During the month of February 1997, OHM is scheduled to perform the following:

1. Complete cleaning, repairs and review of system designs of the South plant.
2. Commence preparation of review report for the plants.

4.0 PROBLEMS AND SOLUTIONS

To date, there have been no problem areas on this delivery order.

OHM Corporation

MONTHLY PROGRESS REPORT
CONTRACT N62470-93-D-3032
DELIVERY ORDER 0118

REMEDIAL SYSTEM OPERATION, REVIEW AND REPAIR
NORTH AND SOUTH TREATMENT PLANTS
OPERABLE UNIT (OU) NO. 1, SITE 78
HADNOT POINT INDUSTRIAL AREA
MCB CAMP LEJEUNE, NORTH CAROLINA

Prepared by:

OHM Remediation Services Corp.
Eastern Region
200 Horizon Center Boulevard
Trenton, New Jersey 08691-1904

James A. Dunn, Jr., P.E.
Project Manager

Approved by:

John P. Franz
Program Manager

February 28, 1997
Delivery Order 0118
OHM Project 18859

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1.0 INTRODUCTION

This Monthly Progress Report has been prepared to summarize the activities performed from February 1, 1997 to February 28, 1997, as well as a summary of the work planned for the month of March 1997 by OHM Remediation Services Corp., (OHM), on Delivery Order 0118 of the Navy-LANTDIV RAC Contract N62470-93-D-3032. This delivery order was signed on May 23, 1996 for a Design Review and Site Visit as the Scope of Work for the North and South Treatment Plants located in the Hadnot Point Industrial Area, Site 78, at Marine Corps Base Camp Lejeune, North Carolina. Subsequent modifications to this delivery order have been issued for the operation, review, maintenance and repair of the plants.

The remediation effort consists of:

1. Operation of the two treatment plants for a period of one year commencing 7/1/96
2. Preparation of plans for the major maintenance event and the engineering review of the treatment trains
3. Performance of a detailed systems evaluation in conjunction with the cleaning and repair of the components of the treatment systems
4. Presentation of findings at a meeting at the base

Such work is specified in the Statement of Work Design Package Section 01010 dated June 20, 1996 and NAVFAC General Paragraphs Section 01010 dated 02/95 and OHM's proposals dated July 1, 1996, July 17, 1996 and July 26, 1996. The total delivery order value to date, including approved modifications is $252,050.26 cost plus $21,554.71 fee. Modification No. 2 was issued during August 1996.

New problem areas and corrective actions taken are identified, and an analysis of project costs and schedule are provided.

2.0 WORK ACCOMPLISHED

During the month of February 1997, OHM has performed the following:

1. Continued the daily operation and maintenance of the North plant. Plant downtime totaled 0 hours for the month.
2. Continued the daily operation and maintenance of the South plant. Plant downtime totaled 30 hours for the month primarily attributable to the repair of the air line serving RW 11.

3.0 WORK PLANNED

During the month of March 1997, OHM is scheduled to perform the following:

1. Continue the normal operation and maintenance of the North and South plants.
2. Complete and forward a draft review report for both plants.

OHM Corporation

MONTHLY PROGRESS REPORT
CONTRACT N62470-93-D-3032
DELIVERY ORDER 0118

REMEDIAL SYSTEM OPERATION, REVIEW AND REPAIR
NORTH AND SOUTH TREATMENT PLANTS
OPERABLE UNIT (OU) NO. 1, SITE 78
HADNOT POINT INDUSTRIAL AREA
MCB CAMP LEJEUNE, NORTH CAROLINA

Prepared by:

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James A. Dunn, Jr., P.E.
Project Manager

Approved by:

John P. Franz
Program Manager

March 31, 1997
Delivery Order 0118
OHM Project 18859

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ATTACHMENTS

1.0 INTRODUCTION

This Monthly Progress Report has been prepared to summarize the activities performed from March 1, 1997 to March 31, 1997, as well as a summary of the work planned for the month of April 1997 by OHM Remediation Services Corp., (OHM), on Delivery Order 0118 of the Navy-LANTDIV RAC Contract N62470-93-D-3032. This delivery order was signed on May 23, 1996 for a Design Review and Site Visit as the Scope of Work for the North and South Treatment Plants located in the Hadnot Point Industrial Area, Site 78, at Marine Corps Base Camp Lejeune, North Carolina. Subsequent modifications to this delivery order have been issued for the operation, review, maintenance and repair of the plants.

The remediation effort consists of:

1. Operation of the two treatment plants for a period of one year commencing 7/1/96
2. Preparation of plans for the major maintenance event and the engineering review of the treatment trains
3. Performance of a detailed systems evaluation in conjunction with the cleaning and repair of the components of the treatment systems
4. Presentation of findings at a meeting at the base

Such work is specified in the Statement of Work Design Package Section 01010 dated June 20, 1996 and NAVFAC General Paragraphs Section 01010 dated 02/95 and OHM's proposals dated July 1, 1996, July 17, 1996 and July 26, 1996. The total delivery order value to date, including approved modifications is $252,050.26 cost plus $21,554.71 fee. Modification No. 2 was issued during August 1996.

New problem areas and corrective actions taken are identified, and an analysis of project costs and schedule are provided.

2.0 WORK ACCOMPLISHED

During the month of March 1997, OHM has performed the following:

1. Continued the daily operation and maintenance of the North plant. Plant downtime totaled 00 hours for the month.
2. Continued the daily operation and maintenance of the South plant. Plant downtime totaled 00 hours for the month.
3. Submitted a draft review report for both plants and received comments on same from LANTDIV.

3.0 WORK PLANNED

During the month of April 1997, OHM is scheduled to perform the following:

1. Continue the normal operation and maintenance of the North and South plants.
2. Respond to comments on the draft review report for both plants.

ATTACHMENT F
DRAFT REMEDIAL SYSTEM REPAIR REPORT

Draft Repair Report
Remedial System Operation, Review and Repair
North and South Water Treatment Plants
Operable Unit (OU) No. 1, Site 78
Hadnot Point Industrial Area
MCB Camp Lejeune, North Carolina

Prepared for:

DEPARTMENT OF THE NAVY
Contract No. N62470-93-D-3032
Delivery Order 0078

Prepared by

OHM Remediation Services Corp.
Norcross, Georgia

John P. Franz, P.E.
Program Manager

James A. Dunn, P.E.
Senior Project Manager

Fred Haas
Senior Project Manager

March 1997

OHM Project No. 18859

TABLE OF CONTENTS

1.0 *INTRODUCTION*

This project summary outlines OHM Remediation Services Corp.'s (OHM) implementation of the scope of work under Delivery Order No. 0118 of the Navy Atlantic Division (LANDIV) Contract N62470-93-D-3032. This summary presents the results of the remedial system cleaning and repair for both the North and South groundwater treatment systems located at Site 78 in the Hadnot Point Industrial area at MCB Camp Lejeune as outlined in the Work Plan. An interim report was issued on December 11, 1996 discussing activities and recommendations for the North Plant and Appendix B contains an interim report issued on January 20, 1997 discussing activities and recommendations for the South Plant. The following topics are discussed in the report:

- Water Treatment Operation Prior to Cleaning and Repair
- Inspection of Equipment following Shutdown
- Action Items During Cleaning and Repairing
- Safety
- Start-up of Equipment After Repair
- Disposal of Waste Material
- Recommendations

1.1 SITE BACKGROUND

Site 78, constructed in the late 1930s, was the first developed area at MCB Camp Lejeune. It was comprised of approximately 75 buildings and facilities including maintenance shops, gas stations, administration offices, commissaries, snack bars, warehouses, and storage yards. Due to the industrial nature of the site, spills and leaks have consisted of petroleum-related products and solvents.

1.2 NORTH AND SOUTH GROUNDWATER TREATMENT SYSTEMS

The North and South groundwater treatment systems were designed by Baker Environmental and built by O'Brien & Gere in 1995. Remedial Systems was contracted to provide the water treatment equipment and controls system. O'Brien & Gere operated the plants from January 1995 to July 1995. PDG Environmental Services, Inc. was contracted for operation and maintenance (O&M) of the plants for the time period from July 1995 to June 1996. Remedial Systems closed in the spring of 1996 and technical data on their equipment is no longer available. OHM assumed O&M of the plants in June 1996.

Figure 1.1 shows the water treatment process flow diagram. The system was designed for a flow rate of approximately 80 gallons per minute. The process steps are oil/water

separator, flocculation tank, surge settling tank, sand filters, air stripper, bag filters, and activated carbon. The sludge from the oil/water separator, metals flocculation tank, and surge settling tank are processed in a plate-and-frame filter press. Backwash waters from the sand filters and carbon cells are also processed through the filter press.

The oil storage tank had not received any oil from the oil/water separator during the two years of operation. Metal contamination was low enough that the flocculation system did not need to be operated. One of the recovery wells was producing a fine clay sludge. The filter press could not produce an acceptable filter cake from the clay sludge coming from the wells.

Both the North and the South Plants have a history of prior operational problems. Most of the problems were related to heavy calcification downstream of the air stripper. Plants were shutdown every six months to remove calcium deposits from the air stripper and pumps. A calcium sequestering system was installed to help minimize future problems.

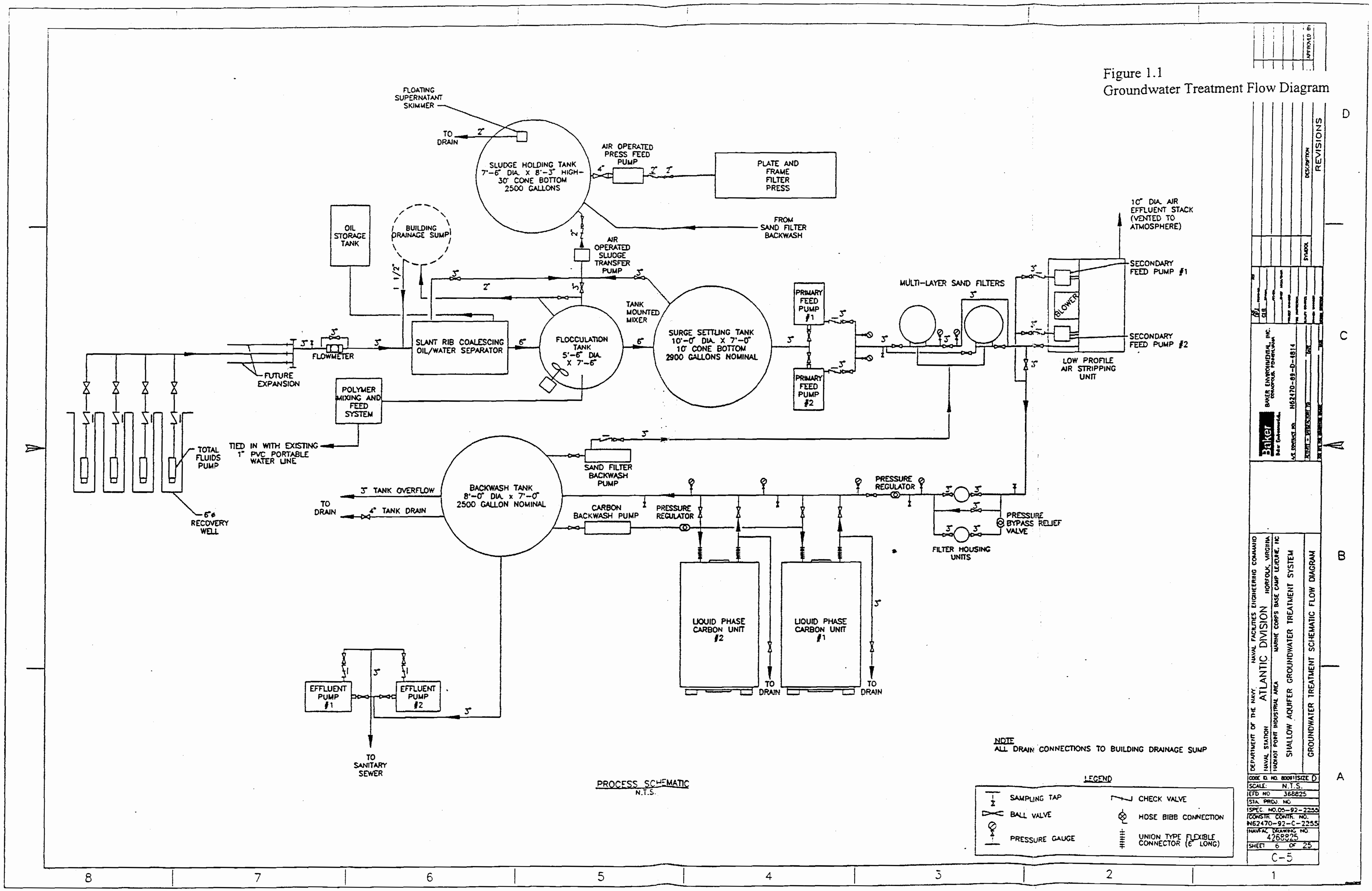

Figure 1.1
Groundwater Treatment Flow Diagram

01780JJ01Z

2.0 SCOPE OF WORK/OBJECTIVES

OHM was tasked with performing the following scope of work:

- Operate the water treatment plants
- Review operating procedures and identify potential difficulties
- Inspect equipment during shutdown
- Repair equipment as needed
- Continue operation
- Recommend solutions for long-term operation

Objectives of the project are as follows:

- Restore the two water treatment plants to proper working condition
- Modify plants to minimize long-term maintenance

3.0 *PROJECT PERSONNEL AND EQUIPMENT*

OHM effectively combined existing personnel at the Base, with crews from the Georgia offices, and local subcontractors to complete this project.

The OHM crew included the following personnel:

- Senior Project Manager
- Site Supervisor
- Project Accountant
- Certified Industrial Hygienists (Safety Plan)
- Chemical Engineer
- Equipment Operator
- (2) Recovery Technicians

The subcontract crew included the following personnel:

- Pump and Piping Installation Specialist
- Electrician
- Heating and Ventilation Contractor
- Air Compressor Specialist
- Vacuum Truck Operators

Key equipment used during the project were:

- High-Pressure Washer
- PID and LEL/OXYGEN Meters
- Tripod and Harnesses for Confined Space Entry
- Personal Protective Equipment - PPE
- Hand-tools
- Vehicles
- Scissors Lift (rental)
- Vacuum Truck (rental)
- Equipment Trailer (subcontractor's)

4.0 SAFETY

Site Health and Safety Plan (SHSP) was prepared prior to performing on-site activities. An initial briefing was held with site personnel to review the contents of the SHSP.

The four key safety issues during the repair activities were:

- Confined space entry,
- High-pressure washing,
- Hot work permits, and
- Proper lifting techniques.

Morning meetings reviewed previous days activities, problems encountered and resolutions. The agenda included an overview of the day's activities, task assignments, and responsibilities. The safety activities contributed to zero accidents for this project.

Several suggestions improved productivity, as well as the safety aspects of the project. Methods for loading sand and carbon in the vessels were discussed and procedures were implemented. Piping was modified to improve the method for treating the waste water from the filter press. A vacuum system was used for removing carbon from drums.

5.0 *WATER TREATMENT PLANT OBSERVATIONS PRIOR TO CLEANING AND REPAIR*

5.1 NORTH PLANT OPERATION

On December 4, 1996, the water treatment plant was operated to remove water from the oil/water separator, flocculation tank, and surge settling tank. The flow meter from the wells was not working properly. The flow meter's digital readout was 0 gpm, while the Honeywell Chart Recorder had a readout of 90 gpm. One of the two air compressor units was not operating. The air compressor air dryer did not appear to be removing any water. Both of the primary pumps had leaky pump seals and both of the secondary pumps had leaky seals. The sand filter had an operating pressure of 30 psig. The tray gaskets on the air stripper were leaking. The blower on the air stripper flooded with water when the sump reached a high level. The air stripper blower was operating at close to 19 inches of water column. Carbon cell no. 1 appeared to be plugged and was being by-passed. The PVC valves on the bag filter system were difficult to close. By-pass valves that were infrequently used could not be opened.

5.2 SOUTH PLANT OPERATION

On January 9, 1997, the water treatment plant was operated to process 5,000 gallons of water and sludge from the base-wide heating oil tank removal program. At the conclusion of processing the 5,000 gallons of water, the operating tanks were drained and the residual water was processed through the sand filter, air stripper, and carbon. As with the North Plant, the influent flow meter was not operational. The air compressor air dryer did not appear to be removing any water. Both of the primary pumps and both of the secondary pumps had leaky pump seals. The sand filter had an operating pressure of 20 to 25 psig. The tray gaskets on the air stripper were leaking. The blower on the air stripper flooded with water when the sump reached a high level. The blower was operating at 17 to 19 inches of water column. The pressure drop through the carbon cells was less than 7 psig. The PVC ball valves on the bag filter system were difficult to open and close.

The sludge from the base-wide heating oil tank removal program was difficult to process. The sludge contained a "waxy" material that partially blinded the filter media of the filter press. The cake formed was of poor quality.

6.0 *INSPECTION OF EQUIPMENT FOLLOWING SHUTDOWN*

6.1 NORTH PLANT INSPECTION

Sludge had completely plugged the coalescing media in the oil/water separator. Attempts to clean the coalescing media were unsuccessful. The flocculation tank and surge tank contained several inches of sludge.

The sand filter media contained a sand/clay mixture throughout the entire bed. Clay had reached the pea gravel layer at the bottom of the sand filter. The high pressure drop through the media and the large amount of clay indicated that the media needed to be replaced.

Calcium deposits were evident in the air stripper trays and on the closed-impellers of the secondary pumps. There was also a thin layer of calcium on the impellers of the primary pumps. Carbon cell no. 1 was inspected and the holes in the distribution piping at the top of the carbon cell were plugged with calcium. The carbon was removed from the cell and the bottom nozzles showed no signs of calcium buildup. It was apparent that the carbon in cell no. 1 had not been appreciably used. Carbon cell no. 2 distribution piping contained small pieces of calcium that appeared to have broken off the walls of the inlet piping.

Carbon cell no. 2 had approximately 6-inches of very fine "clay-like" sludge on top of the carbon. The inlet water was channeling around the sludge and traveling down the side walls of the tank. Backwashing of the carbon was not removing sludge buildup from the carbon bed.

6.2 SOUTH PLANT INSPECTION

The coalescing media in the oil/water separator was easily cleaned with a garden hose. The flocculation tank and surge tank contained several inches of sludge probably from processing the sludge from the tanker.

The top layers of the sand filter media contained a sand/clay mixture. The media needed to be replaced.

Calcium deposits were evident in the air stripper trays and on the closed-impellers of the secondary pumps. The impellers of the primary pumps appeared to be clean. Carbon cell no. 1 was inspected and the holes in the distribution piping at the top of the carbon cell were partially plugged with calcium. In both cells, the carbon had reacted with calcium. In Carbon Cell No. 1, a pry-bar was used to break the calcium/carbon blocks apart. The

carbon was drummed for disposal. The bottom nozzles in the carbon cells showed no signs of calcium deposits.

Both carbon cells also contained approximately 12-inches of very fine "clay-like" sludge on top of the carbon. The inlet water was channeling around the sludge and traveling down the side walls of the tanks. Backwashing of the carbon was not removing sludge buildup from the carbon beds.

7.0 ACTION ITEMS DURING CLEANING AND REPAIRING

The O&M Manual was updated with the new equipment. A list of equipment vendors contacted during this project is presented in Appendix A. Personnel at Hydroquip Corporation previously worked at Remedial Systems. They were very helpful in assisting with finding replacement parts for the Remedial Systems equipment.

7.1 ACTION ITEMS FOR THE NORTH PLANT

#1) *The coalescing media for the oil/water separator was replaced with larger 3/4" spacing media.*

A permanent platform to inspect and/or clean the oil/water separator and the coalescing media was constructed.

The coalescing media should be cleaned on a monthly basis until the clay levels in the wells are diminished.

#2) *The flocculation tank was cleaned and clay sludge was removed from the bottom of the tank.*

This tank should be drained and checked every two months for clay sludge.

With Well No. 2 operating after cleaning the treatment system, clay settled into the bottom of the tanks again. After Well No. 2 was removed from service, this tank was drained and cleaned again.

#3) *The surge tank was cleaned and clay sludge was removed from the bottom of the tank.*

This tank should be drained and checked every two months for clay build up.

#4) *The primary feed pump seals were leaking and had calcium deposits on the impellers.*

Costs for new impellers and seals were approximately $625. There was no local representative for the existing Carver Pumps in the Jacksonville area. After freight, repair, and installation fees, it was determined to be more cost effective to order new pumps. The primary feed pumps were replaced with new stainless steel pumps.

#5) *The sand filters were operating at 30 psig and the design pressure is 15 psig.*

The sand was removed using a vacuum truck. Bruner Corporation provided the replacement multimedia sand that was identical to the original material. The control valves for the sand filter automatic backwash system were taken apart and cleaned.

#6) *The air stripper blower was operating at 19 inches of water column. The trays were covered with calcium, the tray gaskets on the stripper leaked, and the blower filled with water when the water in air stripper sump reached mid-level.*

The design pressure could not be quantified for this air stripper blower. Standard design is approximately 7 inches of water column, but an over sized blower was installed on the system which increased the air flow rate and the pressure. Remedial Systems was no longer in business to provide design criteria. To remove the calcium, the stripper trays were pressure washed at greater than 7,000 psig. The air stripper tray gasket material was replaced The blower was raised by erecting an 8-inch stand to prevent flooding from the air stripper sump.

The air stripper should be inspected after two months of operation to determine if the calcium sequestering agent is working properly at the current dosage.

#7) *The secondary feed pumps were leaking and the impellers were coated with calcium.*

The pumps were replaced with new stainless steel pumps.

#8) *Piping and valves after the air stripper had approximately 1/8" thick calcium deposits.*

The PVC valves at the bag filters were replaced with brass valves. The piping was not internally cleaned since the bag filters remove any calcium particles which may flake off the piping.

#9) *The bag filter housings had a thin calcium coating and the gasket was leaking.*

The bag filter housing was thoroughly cleaned and the head gaskets replaced. The bag filter housing will be inspected every time the bag filters are changed. This inspection will be used to visually determine the effectiveness of the calcium sequestering agent.

#10) *Carbon Cell No. 1 inlet piping was plugged and not in operation. Carbon Cell No. 2 had a 6-inch layer of clay on top of the carbon. A 75 gallon per minute pump was being used for backwashing the carbon cells.*

The clay layer was removed from Carbon Cell No. 2. The carbon inlet distribution piping was replaced with slotted pipe for both carbon cells.

Water from the discharge tank is used to backwash the sand filters and carbon cells. The sand filter backwash pump is a 200 gallons per minute pump, while the carbon backwash pump is a 75 gallons per minute pump. Interconnecting piping and valving between the pumps was modified to allow use of either backwash pump for the sand filter or the carbon cells.

#11) Discharge tank

The discharge tank had accumulated solids and was cleaned. A new flow meter (paddle type) was installed in a horizontal run of the discharge piping.

A flow test was conducted to ensure the discharge tank could gravity drain at an acceptable flow rate should more wells be installed. The tank discharges at a rate of 80 to 90 gallons per minute.

#12) Air compressor

One of the air compressor motors was not working and was replaced. The air dryer was not cooling the air and removing water. The dryer was out of warranty. The Ingersoll-Rand representative replaced the dryer controller and thermocouple. The unit appears to operating properly. The dryer at the South Plant has been replaced twice in the last eighteen months of operation. There appears to be a problem with these dryers that needs to be monitored.

To improve the quality of air to the air-operated control valves, the air compressor delivery system was upgraded. An auto-drain valve was installed on the compressor tank. An air filter and oil filter were installed downstream of the dryer.

#13) Filter press

A core blowdown line and a filtrate blowdown line were installed to improve the quality of the filter cake. To further improve operations, piping to and from the filter press was modified The discharge from the filter press is routed either to the surge tank or the oil/water separator. Piping from the sump was modified to allow direct routing to the filter press holding tank

The filter cloths appear to working properly. A cloth was removed from the filter plate, and the filter plate was clean. The filter cloths were pressure washed and found to be in good condition.

The sludge from the bottoms of the tanks was processed following the modifications to the filter press. An acceptable filter cake was produced.

#14) *Pneumatic controller for well pump no. 2 was not operating and was replaced with a spare controller. Four of the spare pneumatic controllers were bench tested and only two were operational.*

A confined space entry was made into well sump no. 2. The well controller was replaced and the well was placed back on line. A sample was taken from the well after one week of operation. A fine clay material was in the sample. Approximately 24-hours was required for the clay to settle in the sample jar. Well no. 2 was taken off line.

#15) *Autodialer alarm for the air stripper blower was malfunctioning.*

Paper work was completed to have the Base provide telephone service for the autodialer. The operating manual for the autodialer was obtained from the manufacturer. The autodialer was connected to a mobile telephone to test performance. The autodialer alarm for the air stripper blower was malfunctioning. The PLC alarm system for the blower was still operating properly and would shutdown the water treatment system when the blower was not working. The autodialer blower alarm was disconnected from the system.

The following autodialer alarms are operational:

- Power failure
- High-high level in the surge tank
- High-high level in the air stripper sump

A new battery was installed in the autodialer backup power system.

#16) *Flow meter was not operational.*

The original flow meter at the beginning of the process was replaced. A new paddle style flow meter with a battery operated flow monitor was installed in the gravity discharge line from the treated water tank. The paddle style meter was used to minimize pressure drop in the gravity flow line. The battery flow monitor maintains a digital record of total flow despite power outages. Since the flow meter is now located in the treated water line, scheduled cleaning and inspection of the paddle should be every six months.

#17) Electric room heaters

Three space heaters are located in the North Plant, as well as one main heater. The main electric room heater was designed by Absolut Air Control to draw in outside air and heat the air 15 to 20 degrees F. During cold weather, it was more effective to turn off the main heater (discharge air from the heater was only 35 degrees F) and operate the space heaters.

Only five of the six heating coils in the main heater were operational. Fuses were replaced for one of the coils. In addition, the main heater vent system was modified to re-circulate air from the building along with outside air. The building can now be heated to 60 degrees F without a problem and the existing thermostat controls the room temperature.

#18) Standing water on floor of treatment building does not drain.

The concrete floor in the treatment building is not properly slopped to the floor drains. The cost to install additional trench drains would be significant and would not solve all of the problems. A shop vac should be used to regularly remove puddles of water on the floor.

7.2 ACTION ITEMS FOR THE SOUTH PLANT

Many of the action items for the North and the South Plant were identical. Differences for the South Plant are placed in italics.

#1) The coalescing media for the oil/water separator was inspected and was clean.

The coalescing media and inlet chamber were fairly clean. Clay in the inlet water is not a concern at the South Plant. The media was pressure washed and returned to service.

A ladder and platform to inspect the oil/water separator was constructed.

#2) The flocculation tank was cleaned and clay sludge was removed from the bottom of the tank.

Clay sludge in the bottom of the tanks was probably caused when treating the 5,000 gallons of water and sludge from the base-wide heating oil tank removal program. The wells appear to be in good shape, but the water from each well should be inspected for clay solids every six months.

#3) *The surge tank was cleaned and clay sludge was removed from the bottom of the tank. .*

Clay sludge in the bottom of the tanks was probably caused when treating the 5,000 gallons of water and sludge from the base-wide heating oil tank removal program.

#4) *The primary feed pumps seals were leaking and had calcium deposits on the impellers.*

The primary feed pumps were replaced with stainless steel pumps.

#5) *The sand filters were operating at 25 psig and the design pressure is 15 psig.*

The sand was removed using a vac truck. Bruner Corporation provided the multimedia replacement sand that was identical to the original material. One of the control valves for the sand filter automatic backwash system was taken apart and inspected. The control valve was clean so the other control valves were not taken apart.

#6) *The air stripper blower was operating at 19 inches of water column, the trays were covered with calcium, the gaskets on stripper leaked, and the blower filled with water when the water in air stripper sump reached mid-level.*

The design pressure could not be quantified for this air stripper blower. Standard design is approximately 7 inches of water column, but an over sized blower was put on the system which increased the air flow rate and the pressure. Remedial Systems was no longer in business to provide design criteria. To remove the calcium, the stripper trays were pressure washed at greater than 7,000 psig. The air stripper tray gasket material was replaced. The blower was raised by erecting an 8-inch stand to prevent flooding from the air stripper sump.

The air stripper should be opened after two months of operation to determine if the calcium sequestering system is working properly at the current doses.

#7) *The secondary feed pumps were leaking and the impellers were coated with calcium.*

The pumps were replaced with new stainless steel pumps.

#8) *Piping and valves after the air stripper had approximately 1/8" thick calcium deposit.*

The PVC valves at the bag filters were replaced with brass valves. The piping was not internally cleaned since the bag filters will remove any calcium as the calcium particles which may flake off the piping.

#9) *The bag filter housings had a thin calcium coating and the gasket was leaking.*

The bag filter housings were thoroughly cleaned and the gaskets were replaced.. The bag filter housings will be inspected every time the bag filters are changed. This inspection will be used to visually determine the effectiveness of the calcium sequestering agent.

#10) *The carbon inlet distribution piping was partially plugged. Carbon cells no. 1 and no. 2 had 12-inch layers of clay on top of the carbon. The carbon in cell no. 1 was solidified in blocks. A 75 gallon per minute pump was being used for backwashing the carbon cells.*

The carbon inlet distribution piping was replaced with slotted pipe for both carbon cells.

Calcium had deposited between the carbon particles to form blocks of carbon in Carbon cell no. 1. To remove the carbon, a pry bar was used to break the blocks into manageable pieces. The carbon was placed in drums. The carbon in cell no. 2 was partially white from the calcium, but had not yet formed blocks. This carbon was also removed. Two thousand pounds of virgin carbon was placed in each carbon cell.

Water from the discharge tank is used to backwash the sand filters and carbon cells. The sand filter backwash pump is a 200 gallons per minute pump, while the carbon backwash pump is a 75 gallons per minute pump. Interconnecting piping and valving between the pumps was modified to allow use of either backwash pump for the sand filters or the carbon cells.

#11) *Discharge tank*

The discharge tank had accumulated solids and was cleaned. A new flow meter (paddle type) was installed in a horizontal run of the discharge piping.

A flow test was conducted to ensure the discharge tank could gravity drain at an acceptable flow rate should more wells be installed. The tank discharges at a rate of 80 gallons per minute.

#12) *Air compressor*

The air dryer was not cooling the air and removing water. The dryer was still in warranty. The Ingersoll-Rand representative repaired the unit. The unit appears to operating correctly.

To improve the quality of air to the air-operated control valves, the air compressor delivery system was upgraded. An auto-drain valve was installed on the compressor tank. An air filter and oil filter was installed downstream of the dryer.

#13) *Filter cake from the press was watery.*

A core blowdown line and a filtrate blowdown line were installed to increase the dryness of the filter cake. Piping from the sump was modified to allow direct routing to the filter press holding tank

The filter cloths appear to working properly. A cloth was removed from the filter plate, and the filter plate was clean. The filter cloths were pressure washed and found to be in good condition.

The hydraulic pump on the filter press was not operating. The air filter was plugged and required replacement.

The sludge from the bottoms of the tanks was processed following the modifications to the filter press. An acceptable filter cake was produced.

#14) *Pneumatic controllers for all the wells were operational.*

#15) *Autodialer alarm for the air stripper blower was malfunctioning.*

Paper work was completed to have the Base provide telephone service for the autodialer. The operating manual for the autodialer was obtained from the manufacturer. The autodialer was connected to a mobile telephone to test performance. The autodialer alarm for the air stripper blower was malfunctioning. The PLC alarm system for the blower was still operating properly and would shutdown the water treatment system when the blower was not working. The autodialer blower alarm was disconnected from the system.

The following autodialer alarms are operational:

- Power failure
- High-high level in the surge tank
- High-high level in the air stripper sump

A new battery was installed in the autodialer backup power system.

#16) Flow meter was not operational.

The original flow meter at the beginning of the process was replaced. A new paddle style flow meter with a battery operated flow monitor was installed in the gravity discharge line from the treated water tank. The paddle style meter was used to minimize pressure drop in the gravity flow line. The battery flow monitor maintains a digital record of total flow despite power outages. Since the flow meter is located in the treated water line, scheduled cleaning and inspection of the paddle should be every six months.

#17) Electric room heaters

Three space heaters are located in the South Plant, as well as one main heater. The main electric room heater was designed by Absolut Air Control to draw in outside air and heat the air 15 to 20 degrees F. During cold weather, it was more effective to turn off the main heater (discharge air from the heater was only 35 degrees F) and operate the space heaters.

Only four of the six heating coils in the main heater were operational. Fuses were replaced for two of the coils. In addition, the main heater vent system was modified to re-circulate air from the building along with outside air. The building can now be heated to 60 degrees F without a problem and the existing thermostat controls the room temperature.

#18) Standing water on floor of treatment building did not reach drains.

The concrete floor in the treatment building is not properly slopped to the floor drains. The cost to install additional trench drains would be significant and would not solve all of the problems. A shop vac should be used to regularly remove puddles of water on the floor.

8.0 START-UP OF EQUIPMENT AFTER REPAIR

The startup of the North and South Plants went very smoothly. The pressure drop across the sand filters decreased from 25 psig down to 15 psig. The air stripper blower is operating at a pressure of 14 inches of water instead of 19 inches of water. The pressure drop across the carbon cells operating in series is less than 10 psig.

The new primary and secondary pumps are operating at their design capacity of 40 gallons per minute.

The flow meter on the discharge line was checked to ensure that it was properly recording the amount of water processed.

Clay was starting to appear in the North Plant. The wells were sampled and Well No .2 was shutdown due to the high clay content. The North Plant was shutdown and the oil/water separator, the flocculation tank, and the surge tank were cleaned. A significant amount of clay had accumulated in all three vessels.

The stainless steel bag filter housing was cleaned. The housing is inspected for calcium deposits every time the bag filters are changed in the system. This inspection procedure will be used to ensure that the calcium sequestering system is working properly.

9.0 DISPOSAL OF MATERIAL

Waste material was generated when replacing the coalescing media from the oil/water separator in the North Plant, filter media from the sand filters from both the North and the South Plants, carbon from both carbon cells at the South Plant, and filter cake from the filter presses for both the North and the South Plants.

The materials were sampled. The analytical results showed that the waste material was non-hazardous.. The material will be disposed at the Base landfill.

10.0 PHOTOGRAPH LOG

The photograph log is presented in Appendix B and Appendix C. Appendix B contains the "before repairs" photographs while Appendix C contains the "after repairs photographs."

The pictures show:

- The clay sludge in the oil/water separator and feed tanks,
- The calcium deposits on the pumps and piping,
- The calcium buildup on the air stripper trays,
- The blocks of carbon removed from the carbon cells,
- The new stainless steel pumps, and
- The new brass ball valves on the bag filter system.

11.0 RECOMMENDATIONS AND CONCLUSIONS

Clay and calcium are the two major factors affecting maintenance requirements for the North and South Plants. The treatment systems can handle the clay, but at low levels and there will be an increase in maintenance costs. It is recommended that Well No. 2 at the North Plant be replaced to eliminate the clay problems.

The calcium sequestering system needs to be monitored to assure that it working properly. The air stripper will still require cleaning, but the period between cleaning should increase to once every year.

The carbon cells should be inspected after six months of operation to assure that clay is not accumulating on the top of the carbon bed.

Processing of large quantities of sludge is not practical with the existing filter press. To be able to properly process water from other activities at the Base with existing equipment, the amount of sludge must be minimized. If sludge must be processed, a larger press can be installed to replace the existing press. Solids will be removed through the press prior to entering the water treatment tanks. Off-site disposal of waste water containing sludge is expensive. The cost to replace the filter press may be an economical means of handling the water from the base-wide heating oil tank removal program.

Voltage spikes have been observed at the North Plant. Electrical motors and equipment can be damaged. Voltage monitoring should be considered if periodic voltage spikes are causing equipment problems.

The water treatment systems are capable of processing 80 gallons per minute of water. Additional wells can be added to both systems. A well at this site generates between 2 gallons per minute and 10 gallons per minute of flow. Compressor requirements for the well pumps are 0.7 SCFM of air flow (assuming 50% cycle time for the compressor) per gallon of water pumped from the wells. The existing air compressor should be large enough to handle the additional air flow rate for the new wells.

If additional wells are not required, it may be cost effective to consolidate water treatment plants to minimize maintenance costs. It may also be possible to route new water treatment requirements to the North and South plants. Options for effectively using this excess water treatment capacity needs to be investigated further.

Appendix A

Vendors for Replacement Parts

Vendors for Replacement Parts

Item	Vendor	Contact	Telephone Number
Sand Filters	Bruner Corporation	Randy Hagen	(414) 747-3700
Air Compressor	Air Components	Jeff Riley	(704) 596-0123
Air Dryer	Pro Maintenance	Jim	(910) 686-1101
Oil/Water Separator	Hydro Quip Inc.	Lou Silvio	(508) 695-3640
Air Stripper	Hydro Quip Inc.	Lou Silvio	(508) 695-3640
Air Stripper	Remedial Systems		Out of business
Carbon Cells	Monarch Water Treatment	Rick	(513) 372-7200
Bag Filters	Carolina Plastics Supply	Mike Watkins	(800) 535-0541
Flow Meter	Carolina Plastics Supply	Mike Watkins	(800) 535-0541
Nibco PVC Valves	Carolina Plastics Supply	Mike Watkins	(800) 535-0541
Goulds Pumps	Tencarva Machinery	Scott Hudson	(910) 799-8800
Autodialer	Tano Automation	Keith	(504) 276-0571
Griswold Flow Cont.	Heat Transfer Sales		(919) 870-0571
Room Heater	Absolut Aire		(616) 382-1875
Room Heater	Climate Control	Mike Smith	(910) 353-9040