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Baker

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Airport Office Park, Building 3
420 Rouser Road
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(412) 269-6000
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May 12, 1992

Commander
Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia 23511-6287

Attn: Mr. Byron Brant
Code 1822

Re: Contract N62470-89-D-4814
CTO-0024, Final Revisions to RI/FS Project Plans
Marine Corps Base Camp Lejeune, North Carolina

Dear Mr. Brant:

Enclosed please find "replacement pages" to the RI/FS Project Plans for the referenced Contract Task Order. These replacement pages represent the finalization of the RI/FS Project Plans for Sites 6, 9, 48, and 69, MCB Camp Lejeune.

These changes have been made in accordance with your directions of May 8 and 11. Per the requirements of the scope of work, only replacement pages/figures are being forwarded to LANTDIV, EPA Region IV, the North Carolina DEHNR, and members of the Technical Review Committee. A summary of these changes is provided below.

Site 48 - MCAS Mercury Dump

The number of surface water/sediment sampling stations in the New River (and marsh area) has been reduced from 12 to 7. Surface water and sediment samples collected from three of the stations (upgradient, adjacent to the site, and downgradient from the site) will be analyzed for full TCL organics and TAL inorganics. All other surface water and sediment samples will be analyzed only for TAL inorganics. However, if on-site soil or groundwater samples exhibit organic contamination, all surface water and sediment samples will be analyzed for the class(es) of organic compounds detected onsite (e.g., volatiles, PCBs, pesticides, semi-volatiles, etc.).

All fish and shellfish samples will be analyzed for TAL inorganics. Approximately ten percent of the fish and shellfish samples will be analyzed for full TCL organics in addition to TAL inorganics. If on-site soil or groundwater samples exhibit organic contamination, all fish and shellfish samples will be analyzed for the class(es) of organic compounds detected onsite.

Soil samples and groundwater samples collected from two of the five monitoring wells (48 GWI and 48 GW4) will be analyzed for full TCL organics and TAL inorganics. The remaining samples will only be analyzed for TAL inorganics.

Site 69 - Rifle Range Chemical Dump

Benthic macroinvertebrate studies will be conducted in order to perform the ecological risk assessment, but fish and shellfish sampling and analysis will not be performed unless either surface waters or sediments are found to be contaminated with site-related constituents. If surface water and sediment samples are determined to be impacted by the site, fish and shellfish samples will be collected and analyzed for those classes of contaminants detected (e.g., volatiles, pesticides, metals, etc.). Ten percent of the fish and shellfish samples will be analyzed for full TCL organics and TAL inorganics.

Baker is planning to formally distribute these revised pages to the previously mentioned parties on May 18, 1992 unless otherwise directed. If you have any questions or additional changes, please do not hesitate to contact me at (412) 269-2016.

Sincerely,

BAKER ENVIRONMENTAL, INC.

Raymond P. Wattras
Project Manager

RPW/rw
Enclosure

cc: Mr. Marc Lambert (w/o enclosure)
Ms. Laurie Boucher (w/o enclosure)
Mr. Keith Simmons (w/o enclosure)
Mr. George Radford (w/enclosure)

FINAL

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK PLAN FOR SITES 6, 9, 48 AND 69 MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0024

Prepared For:

NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION
Norfolk, Virginia

Under:

Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

MAY 18, 1992

TABLE 5-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples[1]	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 9 (continued)	Soil - Storage Tank Area	7 borings/14 to 21 samples	TPH	III	EPA 418.1	7 days
		3 borings/6 to 9 soil samples	TCL Organics TAL Inorganics	IV	CLP	Routine
		1 boring/2 to 3 samples[2]	Grain Size Moisture Density Total TCLP Chlorine, Organic Total Fluoride Nitrogen (organic) Alkalinity (total) Corrosivity Ignitability Reactivity TOC	III III III III III III III III III III III	ASTM D422 ASTM D698 40 CFR 261 ASTM D808 SM 413A EPA 350.2 SM403 40 CFR 261 40 CFR 261 40 CFR 261 Walkey Black	Routine Routine Routine Routine Routine Routine Routine Routine Routine Routine Routine
	Soil - Monitoring Well Boreholes	5 borings/10 samples	TCL Organics TAL Inorganics	IV	CLP	Routine
	Groundwater	9 samples per round (3 existing and 6 new wells)	TCL Organics TAL Inorganics	IV	CLP[6]	Routine
Site 48	Soil - Edge of property	7 borings/14 samples	TAL Inorganics	IV	CLP	Routine
		2 borings/4 samples	TCL Organics TAL Inorganics	IV	CLP	14 days
	Soil - Monitoring Well Boreholes	2 borings/6 to 8 samples	TCL Organics TAL Inorganics	IV	CLP	Routine
		3 borings/9 to 12 samples	TAL Inorganics	IV	CLP	Routine

TABLE 5-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples[1]	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 48 (continued)	Soil - Locations to be determined based on geophysical investigation	5 borings per area of concern/ 10 samples	TCL Organics[7] TAL Inorganics	IV	CLP	Routine
		1 boring per area of concern/ 2 samples	Grain Size Moisture Density Total TCLP Chlorine, Organic Total Fluoride Nitrogen (organic) Alkalinity (total) Corrosivity Ignitability Reactivity TOC	III III III III III III III III III III III	ASTM D422 ASTM D698 40 CFR 261 ASTM D808 SM 413A EPA 350.2 SM403 40 CFR 261 40 CFR 261 40 CFR 261 Walkey Black	Routine Routine Routine Routine Routine Routine Routine Routine Routine Routine Routine
	Groundwater	3 samples per round	TAL Inorganics	IV	CLP[6]	Routine
		2 samples per round	TCL Organics TAL Inorganics	IV	CLP	19 days
		1 sample per round	BOD COD TSS TDS TVS	III III III III III	SM507 EPA 410.1 EPA 160.2 EPA 160.1 EPA 160.4	Routine Routine Routine Routine Routine
	Surface water - Intermittent stream	3 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
	Surface water - New River	5 samples	TCL Organics[10] TAL Inorganics	IV	CLP[6]	Routine
	Surface water - Marsh Area	2 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
	Sediment - Intermittent Stream	3 stations/6 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
			TOC	III	Walkey Black	Routine

TABLE 5-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples[1]	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 48 (continued)	Sediment - New River	5 stations/10 samples	TCL Organics[10] TAL Inorganics	IV	CLP[6]	Routine
			TOC	III	Walkey Black	Routine
		7 stations/14 samples	TAL Inorganics	IV	CLP	Routine
	Sediment - Marsh Area	2 stations/4 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
			TOC	III	Walkey Black	Routine
	Aquatic (fish) - New River and Marsh	5 stations/15 samples	TCL Organics[11] TAL Inorganics	III	SAS[5]	Routine
	Aquatic (shellfish) - New River and March	5 stations/15 samples	TCL Organics[11] TAL Inorganics	III	SAS[5]	Routine
Site 69	Soil - Hydropunching	16 borings/32 samples	TCL Organics TAL Inorganics	IV	CLP	Routine
			CSM	III	SAS[8]	Routine
	Groundwater - Hydropunching	16 samples	TCL Volatiles	III	EPA 601/602	24 hours
	Groundwater - Monitoring Wells	12 samples per round	TCL Organics TAL Inorganics	IV	CLP	Routine
			CSM	III	SAS[8]	Routine
	Sediment - Unnamed Tributary to New River	3 stations/6 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
			TOC	III	Walkey Black	Routine
	Sediment - Everett Creek	3 stations/6 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
			TOC	III	Walkey Black	Routine

TABLE 5-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69 MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples[1]	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 69 (continued)	Sediment - New River	3 stations/6 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
			TOC	III	Walkey Black	Routine
	Surface water - Unnamed Tributary to New River	3 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
	Surface water - Everett Creek	3 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
	Surface water - New River	3 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
	New River-Fish[12]	3 stations/9 samples total	TCL Organics[13] TAL Inorganics[13]	III	SAS[5]	Routine
	New River - Shellfish[12]	3 stations/9 samples total	TCL Organics[13] TAL Inorganics[13]	III	SAS[5]	Routine
	Everett Creek - Fish[12]	3 stations/9 samples total	TCL Organics[13] TAL Inorganics[13]	III	SAS[5]	Routine
	Everett Creek - Shellfish[12]	1 station/3 samples	TCL Organics[13] TAL Inorganics[13]	III	SAS[5]	Routine
	Unnamed Tributary to the New River - Fish[12]	3 stations/9 samples	TCL Organics[13] TAL Inorganics[13]	III	SAS[5]	Routine

BOD - Biological oxygen demand
COD - Chemical oxygen demand
TSS - Total suspended solids
TDS - Total dissolved solids
TVS - Total volatile solids
TOC - Total organic carbon
TPH - Total petroleum hydrocarbons
SAS - Special analytical services
CSM - Chemical surety compounds (see Tables 5-3 and 5-4)

(1) Baseline no. of samples do not include field QA/QC samples.
(2) Assumes 2 to 3 samples per borehole.
(3) Routine analytical turnaround is between 28 to 40 days following receipt of sample.
(4) Assumes 2 to 4 samples per borehole.
(5) Standard operating procedures for the conduct of marine environmental sampling and analysis (OSWER, 1991).
(6) Volatiles will be analyzed by EPA Method 601/602.
(7) Center borehole only with 14 day turnaround.
(8) Modified 8270 (see QAPP).
(9) Optional based on presence of organics in onsite soil or groundwater.
(10) Three of the five stations will undergo organic analysis.
(11) Approximately 10 percent of samples. However, if organics are detected in onsite soil or groundwater samples, all fish/shellfish samples will be analyzed for TCL organics in addition to TAL inorganics.
(12) To be conducted pending presence of site-related contaminants in surface water or sediment samples.
(13) Actual analysis will be dependent on those site-related constituents detected in surface water or sediment samples. In any event, at least 10 percent of the fish and shellfish samples will be analyzed for full TCL organics and TAL inorganics.

accordance with ASTM Method D1586-84. Samples will be collected from the surface and just above the water table, which should be less than five feet bgs. Samples collected from two of the nine boreholes (the selected boreholes will be directly behind the building) will be analyzed for full TCL organics and TAL inorganics via CLP protocols (Level IV data quality). The remaining samples will be analyzed only for TAL inorganics since the only known problem at this site is related to mercury.

Areas of concern detected during the Geophysical Investigation will be further evaluated under the Soil Investigation. For each area of concern, five boreholes will be augered to the top of the water table. Four boreholes will be augered at the "corners" of each area of concern. The fifth borehole will be augered to the water table in the center of the area of concern. Soil samples will be collected from the surface and just above the water table in accordance with ASTM Method D1586-84. Samples collected from the four "corner" boreholes will be analyzed for full TAL inorganics via CLP protocols (Level IV data quality). Samples collected from the center borehole will be analyzed for full TCL organics and TAL inorganics (CLP Method, Level IV data quality). Routine analytical turnaround will be requested on all samples, except for those samples collected from the center borehole (14 day analytical turnaround).

Soil samples also will be collected during the construction of shallow monitoring wells. Samples will be collected just above the water table and below the water table in the saturated zone so that groundwater results can be correlated with soil conditions. All samples will be analyzed for TAL inorganics via CLP protocol (Level IV, Routine Analytical Turnaround). Samples collected from monitoring well boreholes 48GW1 and 48GW4 will be analyzed for full TCL organics (Level IV, 14-day turnaround) in addition to TAL inorganics.

5.3.3.3 Groundwater Investigation

A Groundwater Investigation will be conducted at Site 48 to assess groundwater quality that may be impacted by the disposal of mercury wastes behind Building 804. The groundwater investigation will include the construction of monitoring wells, the collection of two rounds of groundwater samples and water level measurements, and aquifer pumping tests. In addition, groundwater will be monitored to assess the influence of tides on groundwater flow direction.

Monitoring Well Construction

No monitoring wells have been constructed at this site. In order to fully characterize the site area, five shallow wells will be installed during this RI. The proposed well locations are shown on Figure 5-7. Table 5-2 provides the rationale and purpose for each proposed well location.

All shallow wells will be constructed of 4-inch PVC Casing to a depth of at least 15 feet below the top of the water table. Well screens will be a standard 10 foot length. This well depth and screen length will allow for seasonal or tidal fluctuations in the water table and will represent the surficial aquifer at the site. Detailed well construction procedures are provided in the Field Sampling and Analysis Plan (FSAP).

Groundwater Sampling and Analysis

Two rounds of groundwater samples will be collected from each well. The first round will be collected during this field investigation, which is anticipated to occur in the Summer of 1992. The second round of groundwater samples will be collected in the November or December 1992.

Groundwater samples collected from Wells 48GW1 and 48GW4 will be analyzed for full TCL organics and TAL inorganics. Samples collected from the remaining wells will only be analyzed for TAL inorganics.

TCL volatiles will be analyzed via Method 601/602. All other organic analyses will be analyzed via CLP protocols. Inorganic samples will be analyzed for both total and dissolved constituents. Only total (unfiltered) inorganic analyses will be used in the risk assessment. The second round of sampling may only focus on inorganics if no organic contaminants are detected during the initial sampling round. In the event that organics are detected onsite, the other three wells will be resampled and analyzed for those constituents detected (e.g., volatiles, pesticides, PCBs, etc.).

Well 48GW4 will also be sampled for analysis of engineering parameters to evaluate process options for treatment of the groundwater. These analytical parameters will include: biological oxygen demand, chemical oxygen demand, total suspended solids (TSS), total dissolved solids (TDS), and total volatile solids (TVS).

Sampling procedures are outlined in the FSAP.

Water Level Measurements

Static water level measurements will be collected from each well during both sampling rounds. Water level measurements shall be collected within a one hour period, if possible. Groundwater level data will be used to evaluate groundwater flow direction and aquifer conditions. Groundwater levels in at least three of the five wells will be measured over a 24-hour period to assess the influence of tides on the direction of groundwater flow. Water level measurement techniques are described in the FSAP.

Aquifer Testing

Aquifer tests may be conducted to determine shallow aquifer characteristics such as groundwater flow velocity, hydraulic conductivity, and transmissivity. The tests may involve groundwater pumping from monitoring wells with a submersible pump and recording changes in water levels in nearby wells or wells monitoring deeper flow systems.

The design of the site-specific aquifer tests will depend on the preliminary results of the RI. The spacial distribution of the monitoring wells installed during the RI and groundwater analytical data will influence the design of the pumping tests. The selection of pumping durations, location of observation wells (additional observation wells will be necessary), and treatment/disposal options for the extracted groundwater will be determined as field data are evaluated.

Typical aquifer testing activities have been discussed previously and will not be repeated here (see Section 5.3.2.3).

5.3.3.4 Surface Water/Sediment Investigation

Surface Water and Sediment Investigations will be conducted on the New River and intermittent stream which discharges into the New River to assess human health and ecological impacts associated with these waters. This section outlines the sampling and analytical requirements. Specific sampling procedures can be found in the FSAP.

Intermittent Stream

As shown in Figure 5-7, three surface water and sediment sampling stations have been identified to characterize upgradient site conditions and potential impacts from Site 48 (i.e., Stations SW/SD 1 through 3 on Figure 5-7). One surface water sample will be collected from the bank of the intermittent stream at each sampling station. A surface (top six inches) and a subsurface (6 to 12 inches bgs) sediment sample will be collected at each station (i.e., 6 sediment samples total). Surface water samples will be collected by dipping the sample bottles directly into the water or by using a clean glass container to obtain the sample, then pouring the sample directly into the appropriate sample bottles. All surface water and sediment samples will be analyzed for TAL inorganics (Level IV, Routine turnaround time). If organics are detected in onsite soil and/or groundwater samples, surface water and sediment samples also will be analyzed for organics.

Surface water samples will be collected at each station prior to obtaining the sediment sample. In addition, downstream sample stations will be sampled first, with subsequent samples taken moving upstream. Sediment samples will be obtained using a hand coring device. The FSAP discusses both surface water and sediment sampling activities.

New River Estuary

Surface water and sediment samples will be obtained from the "marsh" area, and along the New River upgradient, adjacent, and downgradient areas from Site 48 as shown on Figure 5-7. Samples will be taken along the banks of the New River near the site as well as offshore locations to assess the potential migration of contaminants due to tidal affects. Samples collected from the marsh area also would be used to assess tidal affects on the migration and transport of sediments.

As shown on Figure 5-7, 12 surface water and sediment stations have been identified in the New River (Stations SW/SD 4 through SW/SD10). In addition, seven sediment stations along the New River (Stations SD1 through SD7) have been proposed to better characterize the sediments nearest to the site.

Sediment samples will be collect from the surface (top six inches) and subsurface (6 to 12 inches bgs). Surface water samples will be collected from the edge of the river or intermittent stream at each surface water/sediment sampling station. At those locations within the marsh area or offshore areas (Stations SW8, SW9, SW10, SW14, and SW15), two surface water samples will be obtained: one from the surface and one from the bottom of the river or marsh.

All surface water and sediment samples will be analyzed for TAL inorganics. Surface water and sediment samples collected from sample locations SW/SD4, SW/SD5, and SW/SD9 will be analyzed for full TCL organics in addition to TAL inorganics. In the event that onsite soil and/or groundwater samples exhibit organic contamination, all surface water and sediment samples will be analyzed for those classes of contaminants (e.g., volatiles, pesticides, etc.) detected onsite. CLP methods will be employed on all surface water and sediment samples. All samples will be analyzed in accordance with Level IV QA/QC.

Sampling details are provided in the FSAP.

5.3.3.5 Aquatic/Ecological Survey

Aquatic/Ecological Surveys will be conducted in the New River, including the marsh area, to evaluate potential ecological impacts from past activities at Site 48. The Aquatic/Ecological Survey will include the collection of benthic macroinvertebrate and fish samples to assess environmental stresses posed by Sites 48. Benthic, fish, and shellfish collection stations have been identified on Figure 5-8. The collection stations represent upgradient, adjacent, and downgradient sampling locations. Although not shown on Figure 5-8, a reference station from a similar waterway will be included in this investigation for comparison purposes. The reference station will be identified in conjunction with the DEHNR and the U.S. Fish and Wildlife.

Ecological stresses to the aquatic community posed by water or sediment quality will be assess by calculating faunal densities, species richness, and species diversity for benthic macroinvertebrates at each sampling station. Population statistics will be determined for fish at each sampling station. In addition, three fish and three shellfish samples per station will be collected for subsequent laboratory analysis of whole body parts (fish only) and fillets. Each fish sample will represent a different species as discussed previously in Section 5.3.1.7. All fish and shellfish samples will be analyzed for TAL inorganics. Approximately 10 percent of the fish and shellfish will also be analyzed for TCL organics. However, if organics are detected onsite, all fish and shellfish samples will be analyzed for those classes of compounds detected onsite in addition to TAL inorganics.

Benthic macroinvertebrates will be collected by one of two methods depending on the depth of the water: Ekman grab (shallower water) or Standard Ponar (deeper waters). Fish will be collected at the stations by electroshocking procedures near the shoreline or in the marsh area, or by gill nets in the more open (and deeper) waters.

Specific sampling and analysis procedures are described in the FSAP.

5.3.3.6 Surveying

All newly-installed monitoring wells at Site 48 will be surveyed. The vertical accuracy shall be surveyed to 0.01 feet and the horizontal accuracy within 0.1 foot. In addition, other soil sampling stations (i.e., boreholes) that may be added to the field investigation will be surveyed for horizontal control within 1 foot accuracy at this time. Control will be established by use of horizontal and vertical control points near the site that are tied into the North Carolina State Plane Coordinate System. If control points cannot be located, two benchmarks/monuments

be collected at each station (i.e., 12 sediment samples total). Surface water samples will be collected by dipping the sample bottles directly into the water or by using a clean glass container to obtain the sample, then pouring the sample directly into the appropriate sample bottles.

Surface water samples will be collected at each station prior to obtaining the sediment sample. In addition, downstream sample stations will be sampled first, with subsequent samples taken moving upstream. Sediment samples will be obtained using a hand coring device.

All surface water and sediment samples will be analyzed for full TCL organics and TAL inorganics in accordance with CLP protocols (Level IV data quality).

The FSAP discusses both surface water and sediment sampling activities.

5.3.4.6 Aquatic/Ecological Survey

Aquatic/Ecological Surveys will be conducted in the New River, Everett Creek, and the unnamed stream to the north of Site 69 to evaluate potential ecological impacts from past activities at Site 69. The Aquatic/Ecological Survey will include the collection of benthic macroinvertebrate samples to assess environmental stresses posed by Sites 69. Fish and shellfish samples will also be collected if site-related contaminants are detected in surface water or sediment samples. Benthic, fish, and shellfish collection stations have been identified on Figure 5-10. The collection stations represent upgradient, adjacent, and downgradient sampling locations.

Benthic macroinvertebrates will be collected by one of two methods depending on the depth of the water: Ekman grab (shallower water) or Standard Ponar (deeper waters). Fish will be collected at the stations by electroshocking procedures in shallower waters or by gill nets in the more open (and deeper) waters.

Specific sampling and analysis procedures are described in the FSAP.

If surface waters or sediments are contaminated with site-related constituents, three fish and three shellfish samples from each sample station will be analyzed for those site-related constituents detected onsite in accordance with EPA Standard Procedures for the Conduct of Marine Environmental Sampling and Analysis (ERL, 1991).

Table 5-1 summarizes the sampling and analytical requirements of this program.

FINAL

REMEDIAL INVESTIGATION/ FEASIBILITY STUDY SAMPLING AND ANALYSIS PLAN FOR SITES 6, 9, 48 AND 69 MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0024

Prepared For:

NAVAL FACILITIES ENGINEERING COMMAND ATLANTIC DIVISION
Norfolk, Virginia

Under:

Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

MAY 18, 1992

TABLE 3-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples[1]	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 9 (continued)	Soil - Storage Tank Area	7 borings/14 to 21 samples	TPH	III	EPA 418.1	7 days
		3 borings/6 to 9 soil samples	TCL Organics TAL Inorganics	IV	CLP	Routine
		1 boring/2 to 3 samples[2]	Grain Size	III	ASTM D422	Routine
			Moisture Density	III	ASTM D698	Routine
			Total TCLP	III	40 CFR 261	Routine
			Chlorine, Organic	III	ASTM D808	Routine
			Total Fluoride	III	SM 413A	Routine
			Nitrogen (organic)	III	EPA 350.2	Routine
			Alkalinity (total)	III	SM403	Routine
			Corrosivity	III	40 CFR 261	Routine
			Ignitability	III	40 CFR 261	Routine
			Reactivity	III	40 CFR 261	Routine
			TOC	III	Walkey Black	Routine
	Soil - Monitoring Well Boreholes	5 borings/10 samples	TCL Organics TAL Inorganics	IV	CLP	Routine
	Groundwater	9 samples per round (3 existing and 6 new wells)	TCL Organics TAL Inorganics	IV	CLP[6]	Routine
Site 48	Soil - Edge of property	7 borings/14 samples	TAL Inorganics	IV	CLP	Routine
		2 borings/4 samples	TCL Organics TAL Inorganics	IV	CLP	14 days
	Soil - Monitoring Well Boreholes	2 borings/6 to 8 samples	TCL Organics TAL Inorganics	IV	CLP	Routine
		3 borings/9 to 12 samples	TAL Inorganics	IV	CLP	Routine

TABLE 3-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples[1]	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 48 (continued)	Soil - Locations to be determined based on geophysical investigation	5 borings per area of concern/ 10 samples	TCL Organics[7] TAL Inorganics	IV	CLP	Routine
		1 boring per area of concern/ 2 samples	Grain Size Moisture Density Total TCLP Chlorine, Organic Total Fluoride Nitrogen (organic) Alkalinity (total) Corrosivity Ignitability Reactivity TOC	III III III III III III III III III III III	ASTM D422 ASTM D698 40 CFR 261 ASTM D808 SM 413A EPA 350.2 SM403 40 CFR 261 40 CFR 261 40 CFR 261 Walkey Black	Routine Routine Routine Routine Routine Routine Routine Routine Routine Routine Routine
	Groundwater	3 samples per round	TAL Inorganics	IV	CLP[6]	Routine
		2 samples per round	TCL Organics TAL Inorganics	IV	CLP	19 days
		1 sample per round	BOD COD TSS TDS TVS	III III III III III	SM507 EPA 410.1 EPA 160.2 EPA 160.1 EPA 160.4	Routine Routine Routine Routine Routine
	Surface water - Intermittent stream	3 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
	Surface water - New River	5 samples	TCL Organics[10] TAL Inorganics	IV	CLP[6]	Routine
	Surface water - Marsh Area	2 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
	Sediment - Intermittent Stream	3 stations/6 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
			TOC	III	Walkey Black	Routine

TABLE 3-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69
MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples[1]	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 48 (continued)	Sediment - New River	5 stations/10 samples	TCL Organics[10] TAL Inorganics	IV	CLP[6]	Routine
			TOC	III	Walkey Black	Routine
		7 stations/14 samples	TAL Inorganics	IV	CLP	Routine
	Sediment - Marsh Area	2 stations/4 samples	TCL Organics[9] TAL Inorganics	IV	CLP[6]	Routine
			TOC	III	Walkey Black	Routine
	Aquatic (fish) - New River and Marsh	5 stations/15 samples	TCL Organics[11] TAL Inorganics	III	SAS[5]	Routine
	Aquatic (shellfish) - New River and March	5 stations/15 samples	TCL Organics[11] TAL Inorganics	III	SAS[5]	Routine
Site 69	Soil - Hydropunching	16 borings/32 samples	TCL Organics TAL Inorganics	IV	CLP	Routine
			CSM	III	SAS[8]	Routine
	Groundwater - Hydropunching	16 samples	TCL Volatiles	III	EPA 601/602	24 hours
	Groundwater - Monitoring Wells	12 samples per round	TCL Organics TAL Inorganics	IV	CLP	Routine
			CSM	III	SAS[8]	Routine
	Sediment - Unnamed Tributary to New River	3 stations/6 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
			TOC	III	Walkey Black	Routine
	Sediment - Everett Creek	3 stations/6 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
			TOC	III	Walkey Black	Routine

TABLE 3-1 (Continued)

SUMMARY OF SAMPLING AND ANALYTICAL PROGRAMS AT SITES 6, 9, 48, AND 69 MCB CAMP LEJEUNE, NORTH CAROLINA

Study Area	Investigation	Baseline No. of Samples(1)	Analysis	Data Quality Level	Analytical Method	Laboratory Turnaround Time
Site 69 (continued)	Sediment - New River	3 stations/6 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
			TOC	III	Walkey Black	Routine
	Surface water - Unnamed Tributary to New River	3 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
	Surface water - Everett Creek	3 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
	Surface water - New River	3 samples	TCL Organics TAL Inorganics	IV	CLP	14 day
	New River-Fish(12)	3 stations/9 samples total	TCL Organics(13) TAL Inorganics(13)	III	SAS(5)	Routine
	New River - Shellfish(12)	3 stations/9 samples total	TCL Organics(13) TAL Inorganics(13)	III	SAS(5)	Routine
	Everett Creek - Fish(12)	3 stations/9 samples total	TCL Organics(13) TAL Inorganics(13)	III	SAS(5)	Routine
	Everett Creek - Shellfish(12)	1 station/3 samples	TCL Organics(13) TAL Inorganics(13)	III	SAS(5)	Routine
	Unnamed Tributary to the New River - Fish(12)	3 stations/9 samples	TCL Organics(13) TAL Inorganics(13)	III	SAS(5)	Routine

BOD - Biological oxygen demand
COD - Chemical oxygen demand
TSS - Total suspended solids
TDS - Total dissolved solids
TVS - Total volatile solids
TOC - Total organic carbon
TPH - Total petroleum hydrocarbons
SAS - Special analytical services
CSM - Chemical surety compounds (see Tables 5-3 and 5-4)

(1) Baseline no. of samples do not include field QA/QC samples.
(2) Assumes 2 to 3 samples per borehole.
(3) Routine analytical turnaround is between 28 to 40 days following receipt of sample.
(4) Assumes 2 to 4 samples per borehole.
(5) Standard operating procedures for the conduct of marine environmental sampling and analysis (OSWER, 1991).
(6) Volatiles will be analyzed by EPA Method 601/602.
(7) Center borehole only with 14 day turnaround.
(8) Modified 8270 (see QAPP).
(9) Optional based on presence of organics in onsite soil or groundwater.
(10) Three of the five stations will undergo organic analysis.
(11) Approximately 10 percent of samples. However, if organics are detected in onsite soil or groundwater samples, all fish/shellfish samples will be analyzed for TCL organics in addition to TAL inorganics.
(12) To be conducted pending presence of site-related contaminants in surface water or sediment samples.
(13) Actual analysis will be dependent on those site-related constituents detected in surface water or sediment samples. In any event, at least 10 percent of the fish and shellfish samples will be analyzed for full TCL organics and TAL inorganics.

3.3.2.3 Monitoring Well Boreholes

Soil samples will be collected from boreholes augered during the installation of shallow monitoring wells. Soil samples will be collected from just above the water table and just below the water table in the saturated zone. Soil samples collected from monitoring well boreholes 48GW1 and 48GW4 will be analyzed for TCL organics and TAL inorganics in accordance with CLP protocols. Soil samples collected from the three other well boreholes will only be analyzed for TAL inorganics. The well locations are shown on Figure 3-7. A summary of sample numbers and analysis associated with this activity is provided in Table 3-1.

3.3.3 Groundwater Investigation

Five (5) shallow (approximately 15 feet below the water table) groundwater monitoring wells will be installed at this site. Monitoring well locations are presented on Figure 3-7. Groundwater samples will be collected from each monitoring well during two rounds of sampling. Groundwater samples collected from wells 48GW1 and 48GW4 will be submitted to the laboratory for analyses of TCL organics and TAL inorganics depicted on Table 3-1. Samples collected from the other 3 wells will only be analyzed for TAL inorganics.

3.3.4 Surface Water/Sediment Investigation

Surface Water and Sediment Investigations will be conducted on the New River and intermittent stream which discharges into the New River to assess human health and ecological impacts associated with these waters. This section outlines the sampling and analytical requirements. Specific sampling procedures can be found in Section 5.4 and 5.5.

Sample analytical parameters are included in Table 3-1.

3.3.4.1 Intermittent Stream

As shown in Figure 3-7, three surface water and sediment sampling stations have been identified to characterize upgradient site conditions and potential impacts from Site 48 (i.e., Stations SW/SD 1 through 3 on Figure 3-7). One surface water sample will be collected from the bank of the intermittent stream at each sampling station. A surface (top six inches) and a subsurface (6 to 12 inches bgs) sediment sample will be collected at each station (i.e., 6 sediment samples total). All surface water and sediment samples will be analyzed for TAL inorganics, as depicted on Table 3-1. However, if organics are detected in onsite soil or groundwater samples, surface water and sediments shall also be analyzed for either full TCL organics or those organic classes that are site-related (i.e., volatiles, pesticides, etc.).

3.3.4.2 New River Estuary

Surface water and sediment samples will be obtained from the "marsh" area, and along the New River upgradient, adjacent, and downgradient areas from Site 48 as shown on Figure 3-7. Samples will be taken along the banks of the New River near the site as well as offshore locations to assess the potential migration of contaminants due to tidal affects. Samples collected from the marsh area also would be used to assess tidal affects on the migration and transport of sediments.

As shown on Figure 3-7, 12 surface water and sediment stations have been identified in the New River (Stations SW/SD4 through SW/SD10). In addition, seven sediment stations along the New River (Stations SD1 through SD7) have been proposed to better characterize the sediments nearest to the site.

Sediment samples will be collect from the surface (top six inches) and subsurface (6 to 12 inches bgs). Surface water samples will be collected from the edge of the river or intermittent stream at each surface water/sediment sampling station. At those locations within the marsh area or offshore areas (Stations SW8, SW9, SW10, SW14, and SW15), two surface water samples will be obtained: one from the surface and one from the bottom of the river or marsh.

All surface water and sediment samples will be analyzed for TAL inorganics. However, surface water and sediment samples collected from sample locations SW/SD4, SW/SD5, and SW/SD9 will be analyzed for full TCL organics in addition to TAL inorganics. In the event that onsite soil and/or groundwater samples exhibit organic contamination, all surface water and sediment samples will be analyzed for those classes of compounds (e.g., volatiles, PCBs, etc.) detected onsite. CLP methods will be employed on all surface water and sediment samples. All samples will be analyzed in accordance with Level IV QA/QC (Table 3-1).

3.3.5 Aquatic/Ecological Survey

Aquatic/Ecological Surveys will be conducted in the New River, including the marsh area, to evaluate potential ecological impacts from past activities at Site 48. The Aquatic/Ecological Survey will include the collection of benthic macroinvertebrate and fish samples to assess environmental stresses posed by Sites 48. Benthic, fish, and shellfish collection stations have been identified on Figure 3-8. The collection stations represent upgradient, adjacent, and downgradient sampling locations. Although not shown on Figure 3-8, a reference station from

a similar waterway will be included in this investigation. The reference station will be identified in conjunction witht he DEHNR and the U.S. Fish and Wildlife.

Ecological stresses to the aquatic community posed by water or sediment quality will be assess by calculating faunal densities, species richness, and species diversity for benthic macroinvertebrates at each sampling station. Population statistics will be determined for fish at each sampling station. In addition, three fish and three shellfish samples per station will be collected for subsequent laboratory analysis of whole body parts (fish only) and fillets. Each fish sample will represent a different species as discussed previously in Section 3.1.5. All fish and shellfish samples will be analyzed for TAL inorganics (Table 3-1). Approximately 10 percent of the fish and shellfish samples will also be analyzed for TCL organics. However, if onsite soil or groundwater samples indicate organic contamination, all fish and shellfish samples will be analyzed for the class of organics (e.g., volatiles, pesticides, etc.) detected in soil or groundwater.

Specific sampling and analysis procedures are described in Section 5.6.

3.4 Site 69

Sampling investigations at Site 69 include an off-site soil investigation, an off-site groundwater investigation, a surface water/sediment investigation, and an aquatic/ecological survey.

3.4.1 Geophysical Investigation

A geophysical investigation will be conducted to:

- Identify subsurface anomalies that may be associated with buried drums or bulk wastes.

- Identify waste disposal boundaries associated with past disposal practices.

The geophysical investigation will involve the use of electromagnetic terrain conductivity profiling and ground penetrating radar techniques to obtain the required information. The investigation will be conducted along transects across the site at 20-foot spacings to collect information to adequately define subsurface features. Data obtained during this investigation will be used to define suspected drum/waste disposal areas and any area not suspected of containing buried wastes. Once these areas are defined, the information will be evaluated to assess the potential contents and area of disposal. These areas will be identified in the field with wooden stakes and surveyed.

3.4.4.3 Everett Creek

As shown in Figure 3-10, three surface water and sediment sampling stations have been identified in Everett Creek to characterize surface water and sediment quality. One surface water sample will be collected from the center of this stream at each sampling station. A surface (top six inches) and a subsurface (6 to 12 inches bgs) sediment sample will be collected at each station (i.e., 12 sediment samples). All surface water/sediment samples will be analyzed for TCL organics and TAL inorganics via CLP protocols.

3.4.5 Aquatic/Ecological Survey

Aquatic/Ecological Surveys will be conducted in the New River, Everett Creek, and the unnamed stream to the north of Site 69 to evaluate potential ecological impacts from past activities at Site 69. The Aquatic/Ecological Survey will include the collection of benthic macroinvertebrate samples to assess environmental stresses posed by Sites 69. Fish and shellfish samples will be collected if site-related contaminants are detected in surface water or sediment samples. Benthic, fish, and shellfish collection stations have been identified on Figure 3-10. The collection stations along the New River represent upgradient, adjacent, and downgradient sampling locations. Sampling stations for the unnamed tributary and Everett Creek were chosen to represent the entire length of these streams.

Specific sampling and analysis procedures are described in Section 5.6.

If surface waters or sediments are contaminated with site-related organic or inorganic constituents, three fish and three shellfish samples will be collected at each station along the New River and at the mouth of Everett Creek prior to discharging into the New River. Fish samples (no shellfish) will only be collected from the other two stations in Everett Creek and at all three stations in the unnamed tributary north of Site 69.

Two of the three fish samples will represent whole fish. The third fish samples will represent fillets. The laboratory will process all fish samples. Each fish sample will represent a different species as discussed previously in Section 3.1.5.

The fish and shellfish samples from each sample station will be analyzed for those classes of organics (e.g., volatiles, pesticides, etc.) and/or TAL inorganics in accordance with EPA Standard Procedures for the Conduct of Marine Environmental Sampling and Analysis (ERL, 1991).

Table 3-1 summarizes the sampling and analytical requirements of this program.

SECTION II

FINAL

QUALITY ASSURANCE PROJECT PLAN FOR SITES 6, 9, 48 AND 69 MARINE CORPS BASE CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0024

Prepared For:

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