

Baker

Baker Environmental, Inc.
Airport Office Park, Building 3
420 Rouser Road
Coraopolis, Pennsylvania 15108

May 8, 1998

(412) 269-6000
FAX (412) 269-2002

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Building N-26)
Norfolk, Virginia 23511-2699

Attn: Ms. Maritza Montegross
Navy Technical Representative
Code 18233

Re: Contract N62470-89-D-4814
Navy CLEAN, District III
Contract Task Order (CTO) 0312
Supplemental Groundwater Sampling Investigation
Operable Unit No. 9 (Site 73)
MCB, Camp Lejeune, North Carolina

Dear Ms. Montegross:

Baker Environmental, Inc. (Baker) has completed the Supplemental Groundwater Investigation (SGI) at Site 73, Amphibious Vehicle Maintenance Facility, MCB, Camp Lejeune, North Carolina. The investigation was conducted in response to requests by LANTDIV, the United States Environmental Protection Agency (USEPA) Region IV, and the North Carolina Department of Environment and Natural Resources (NC DENR) to collect additional groundwater data and supplement the findings of the Remedial Investigation (RI) in support of the remedial alternatives presented in the Draft Feasibility Study (as referenced in the scope modification request dated March 16, 1998). The investigation was completed April 21, 1998 and required the collection and analysis of groundwater samples from one shallow groundwater monitoring well (73-MW09) and five deep monitoring wells (73-DW02, -DW03, -DW04, -DW05 and -DW10). The groundwater samples were shipped to a fixed-base laboratory (Quanterra Environmental Services in Knoxville, Tennessee) and analyzed for volatile organic compounds via method SW846 8260A. A summary of the analytical results are discussed in the following paragraphs and summarized on Table 1.

Groundwater samples were collected during both RI phases and most recently, as part of a SGI. RI Phase I samples were collected at the site in April and May, 1995; Phase II samples were collected in February and March, 1996. Analytical results from the three rounds of sampling were compared to determine: (1) present contaminant levels; (2) if natural attenuation (i.e., TCE degradation) was evident; (3) if the extent of the contaminant plumes could be better defined; and (4) to clarify analytical discrepancies between Phase I and Phase II results. Details of these comparisons are provided in the following paragraphs.

Samples were collected from shallow groundwater monitoring well 73-MW09 to determine the levels of vinyl chloride and cis-1,2-dichloroethene (DCE) contamination and if trends in contaminant levels provide indirect evidence of natural attenuation. DCE was not detected in the sample collected during the SGI (Table 1). DCE was detected at relatively low levels (2 ug/l and 2J ug/l) in previous sampling events. Vinyl chloride was detected in Phase I (11 ug/l), Phase II (22 ug/l), and the SGI (37 ug/l) in previous sampling events. As depicted on Table 1, groundwater samples collected during all three sampling events provide evidence that DCE concentrations are decreasing while vinyl chloride concentrations continue to increase, thus providing indirect evidence that natural attenuation may be occurring in the shallow aquifer.



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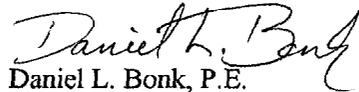
Groundwater samples were collected from the uppermost portion of the Castle Hayne aquifer (monitoring wells 73-DW02, -DW03, -DW04, -DW05 and -DW10) to confirm contamination levels reported in earlier sampling events, to determine the size and shape of contaminant plumes, and to provide evidence (if any) of natural attenuation in the Castle Hayne aquifer. Decreases in trichloroethene (TCE) concentrations were reported from Phase I and Phase II in monitoring wells 73-DW02, -DW04 and -DW05 (Table 1). The Phase II analytical results were further substantiated by data obtained during the SGI. TCE contamination was detected in monitoring well 73-DW05 in Phase I but not in Phase II or the SGI. During the three sampling events, TCE concentrations detected in groundwater samples from monitoring well 73-DW03 differed (110 ug/l, 320 ug/l, and 180 ug/l, respectively). Concentrations of trans-1,2-dichloroethene, cis-1,2-dichloroethene and vinyl chloride in monitoring wells 73-DW03 and -DW04 increased between Phase I and the SGI. The increase in TCE daughter product concentrations may be indirect evidence of degradation and therefore support the theory that natural attenuation is occurring in the Castle Hayne aquifer.

In summary, as depicted on Figures 1, 2, 3, 4, and 5 based on the available data and well placement, the plumes have essentially remained unchanged in shape and orientation. Decreases in TCE concentrations in conjunction with increases in daughter products may be the result of TCE natural attenuation. The changes in contaminant concentrations are evidence of natural attenuation, however this data itself is not conclusive. Additional information such as nutrient concentrations, pH, redox potential (Eh), terminal electron acceptors (e.g., oxygen, nitrate, sulfate, ferrous iron, etc.), and byproducts of respiration (e.g., carbon dioxide, methane, etc.) are needed to determine if natural attenuation is indeed occurring at the site. The SGI data confirmed the presence of contamination, but did not define the extent of the contaminant plumes. Baker recommends that the additional investigation, the Natural Attenuation Evaluation Study (NAES), presented in the Implementation Plan/Fee Proposal (IP/FP) dated February 20, 1998 be implemented. Additional monitoring wells are needed to better define the boundaries of the contaminant plumes. The NAES will include collection of the additional information (i.e., nutrient concentrations, pH, Eh, terminal electron acceptors and byproducts of respiration) in addition to contaminant concentrations to conclusively determine if TCE degradation is occurring as suspected.

Baker appreciates the opportunity to serve LANTDIV on this project. Should you have any questions regarding this letter, please contact me at (412) 269-2063 or Mr. Matthew Bartman (Activity Coordinator) at (412) 269-2053.

Sincerely,

BAKER ENVIRONMENTAL, INC.



Daniel L. Bonk, P.E.

Project Manager

DLB/JSC/lq
Enclosures

cc: Mr. Neal Paul, MCB, Camp Lejeune (w/attachments)
Ms. Lee Anne Rapp, P.E., LANTDIV, Code 18312 (w/o attachments)
Ms. Beth Collier, LANTDIV, Code 02115 (w/o attachments)

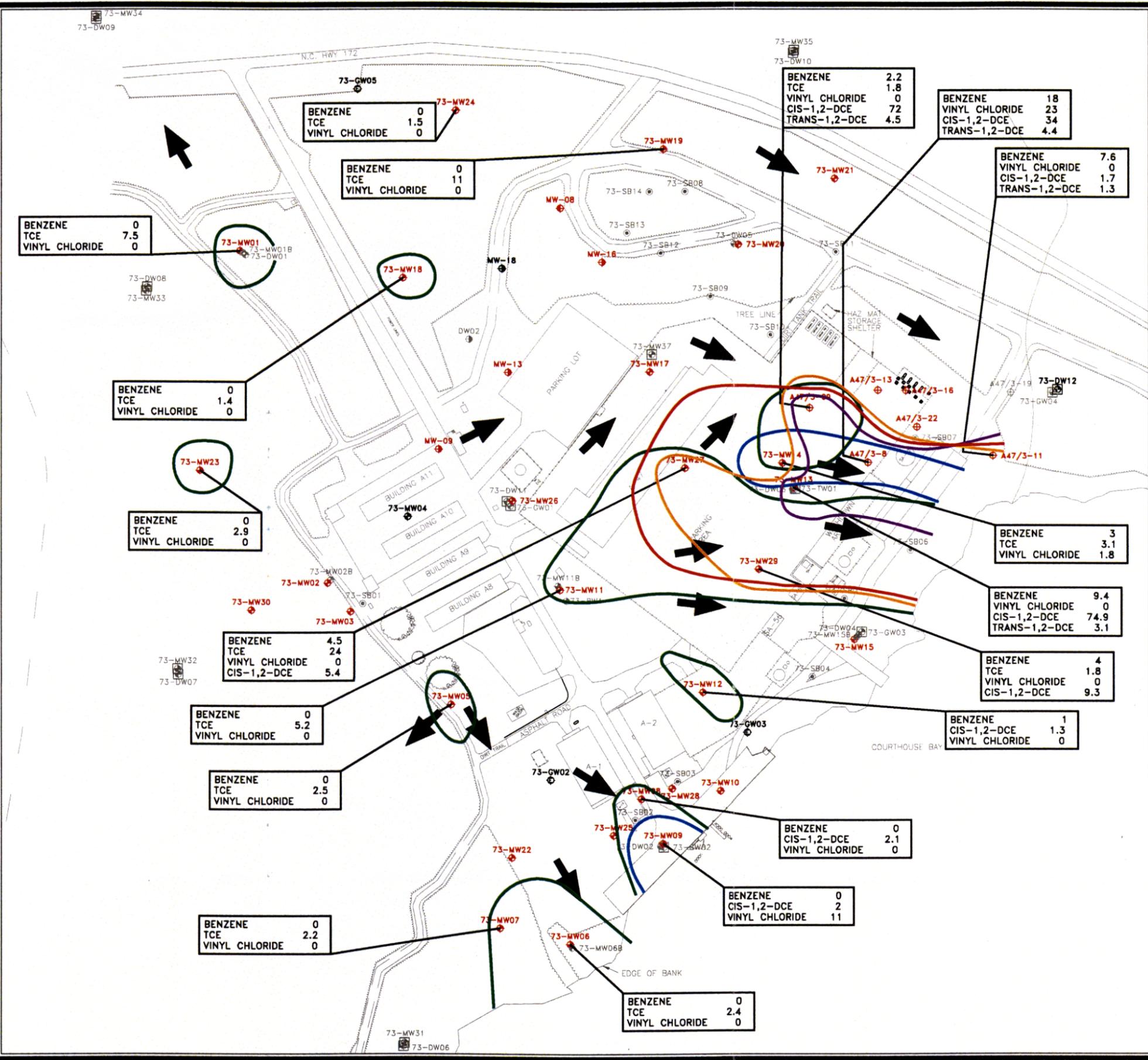
TABLE 1

**CONCENTRATION COMPARISON
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY
SUPPLEMENTAL GROUNDWATER INVESTIGATION, CTO-0312**

Monitoring Well	Phase I Results (µg/L)	Phase II Results (µg/L)	Supplemental Groundwater Investigation Sampling Results (µg/L)	Trends/Comments
73-MW09				
- cis-1,2-Dichloroethene	2	NS	ND	Concentration decreasing
- 1,2-Dichloroethene (total)	NS	2J	NS	No trend established; Methods 601/602 and SW846 8260A do not report total 1,2-dichloroethene
- Vinyl Chloride	11	22	37	Concentration increasing
- Benzene	ND	3J	ND	Only one detection; suspect result in Phase II
73-DW02				
- Chloroform	1J	ND	ND	Non-site related contaminant
- Trichloroethene	25J	ND	ND	Contaminant concentration decreased over time
73-DW03				
- 1,2-Dichloroethane	0.7	ND	ND	Concentration decreasing
- Trichloroethene	110	320	180	Fluctuating concentrations, changes in concentrations may be due to differences in analytical methods
- Benzene	2.4	ND	2.2	Fluctuating concentrations, changes in concentration may be due to differences in analytical methods
- trans-1,2-Dichloroethene	1.8	NS	2.5	Concentration increasing
- cis-1,2-Dichloroethene	67	NS	94	Concentration increasing
- Vinyl chloride	ND	4J	4.7	Concentration increasing
- Chloroethane	ND	3J	ND	Fluctuating concentration
- Dichloroethene (total)	NS	120	NS	No trend established; Methods 601/602 and SW846 8260A do not report total 1,2-dichloroethene
73-DW04				
- Chloroform	5.5J	ND	ND	Non-site related contaminant
- 1,2-Dichloroethane	0.6	ND	ND	Concentration decreasing
- Trichloroethene	4.3J	ND	ND	Concentration decreasing
- cis-1,2-Dichloroethene	ND	NS	1.9	Concentration increasing
73-DW05				
- Trichloroethene	19	ND	ND	Concentration decreasing; suspect result in Phase I
73-DW10				
	NS	ND	ND	No contaminants detected

Notes:

- (1) Phase I samples were analyzed per Method 601/602.
- (2) Phase II samples were analyzed per CLP Methods.
- (3) Supplemental Groundwater Investigation samples were analyzed per Method SW846 8260A.
- (4) ND = Not detected above method detection limits.
- (5) NS = Not sampled.



LEGEND

- 73-SB01 SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- 73-MW17 SHALLOW WELLS SAMPLED DURING PHASE I
- ➔ APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTES:

THE ISOCONCENTRATION LINES THAT ARE DEPICTED DEFINE THE APPROXIMATE EXTENT OF CONTAMINATION OF THE FOLLOWING:

- TRICHLOROETHENE (TOTAL TCE) (PARTS PER BILLION = ppb)
- VINYL CHLORIDE (ppb)
- BENZENE (ppb)
- CIS-1,2-DCE (ppb)
- TRANS-1,2-DCE (ppb)

IF ONLY TCE OR DCE WAS DETECTED THEN ONLY THE DETECTED CONTAMINANT WAS NOTED.

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

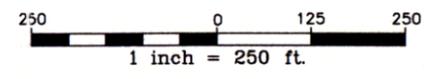
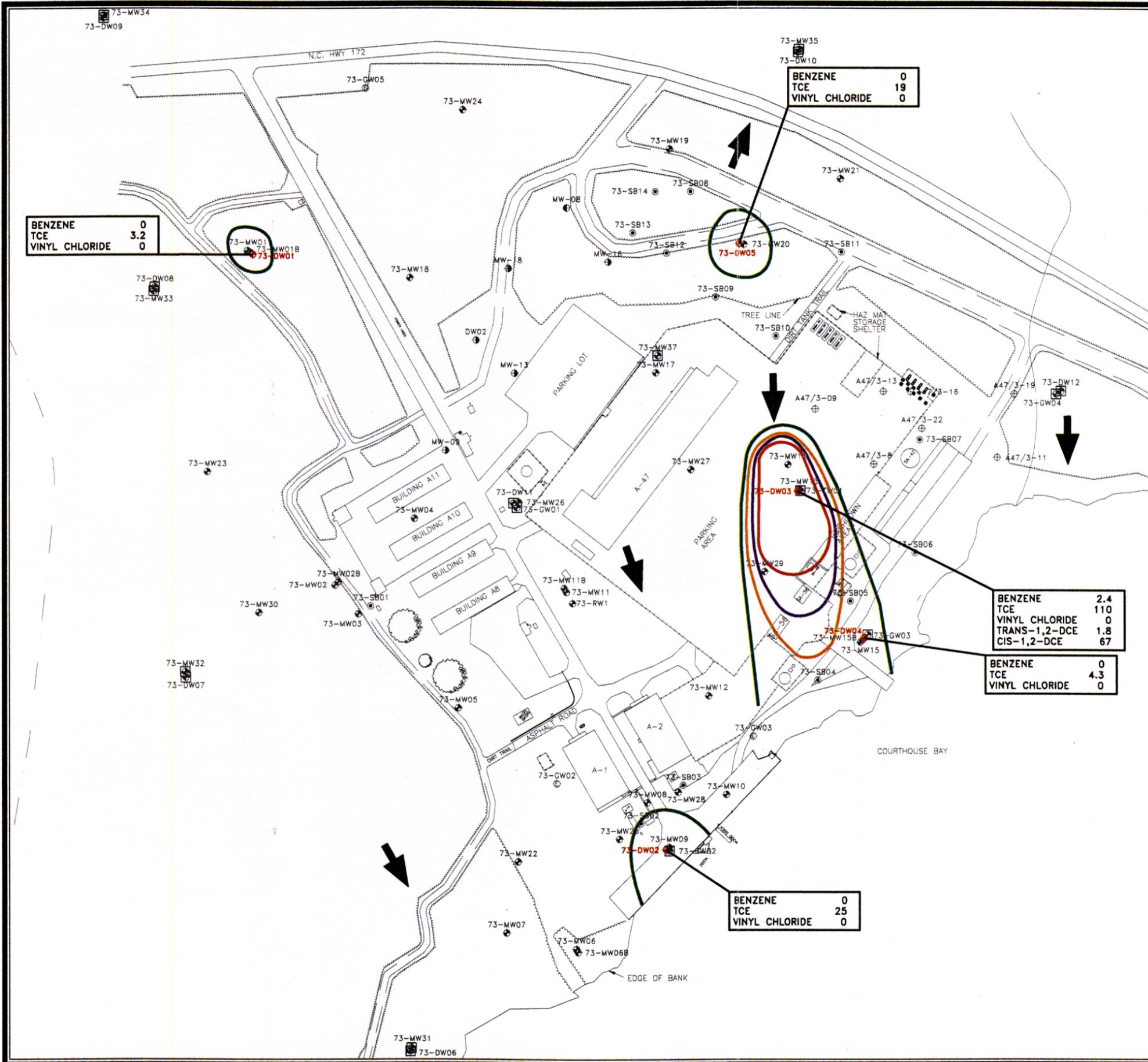


FIGURE 1
ISOCONCENTRATION MAP DEFINING
VOC DETECTIONS IN THE
UPPER PORTION OF THE SURFICIAL AQUIFER (PHASE I)
SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY

MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA



LEGEND

- 73-SB01 SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- 73-DW05 DEEP WELLS SAMPLED DURING PHASE I
- ➔ APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTES:

THE ISOCONCENTRATION LINES THAT ARE DEPICTED DEFINE THE APPROXIMATE EXTENT OF CONTAMINATION OF THE FOLLOWING:

- TRICHLOROETHENE (TOTAL TCE) (PARTS PER BILLION = ppb)
- BENZENE (ppb)
- TRANS-1,2-DCE (ppb)
- CIS-1,2-DCE (ppb)

IF ONLY TCE OR DCE WAS DETECTED THEN ONLY THE DETECTED CONTAMINANT WAS NOTED.

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

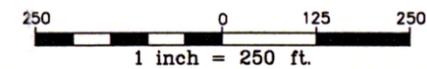
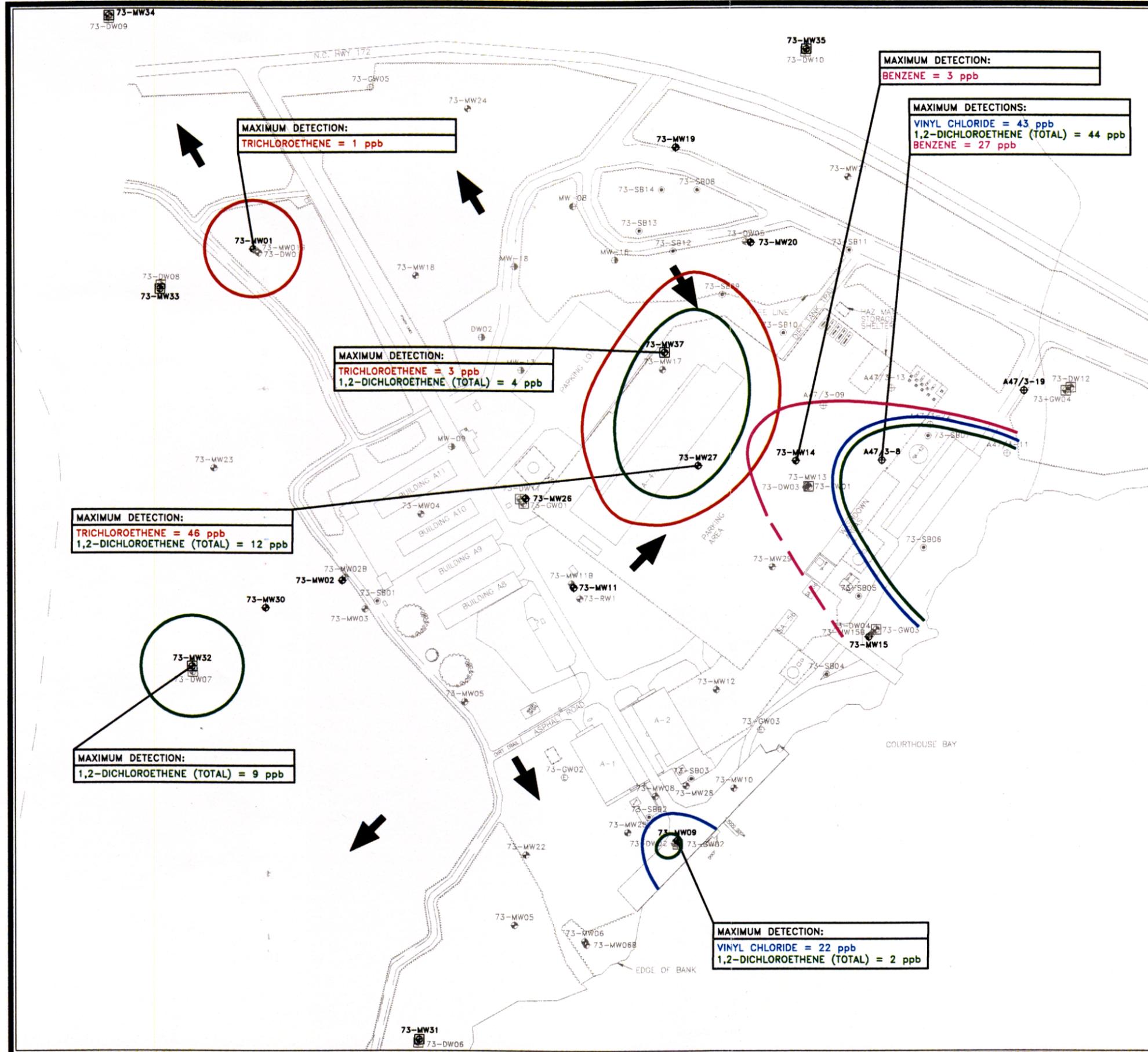


FIGURE 2
 ISOCONCENTRATION MAP DEFINING
 VOC DETECTIONS IN THE
 UPPER PORTION OF THE CASTLE HAYNE AQUIFER (PHASE I)
 SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY

MARINE CORPS BASE, CAMP LEJEUNE
 NORTH CAROLINA



LEGEND

- 73-SB01 SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-B MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- ➔ APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTES:

- THE FOLLOWING ISOCONCENTRATION LINES DEFINE THE AREAS OF CONCERN:
- TRICHLOROETHENE = 1.0 PARTS PER BILLION (ppb)
- CIS-1,2-DICHLOROETHENE (TOTAL) = 1.0 ppb
- VINYL CHLORIDE = 1.0 ppb
- BENZENE = 1.0 ppb
- PHASE II DATA FROM THE UPPER PORTION OF THE SURFICIAL AQUIFER WAS USED TO DEVELOP ISOCONCENTRATION LINES.
- ONLY HIGHLIGHTED WELLS WERE SAMPLED DURING PHASE II.

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

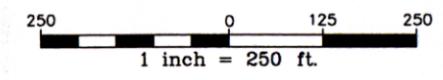
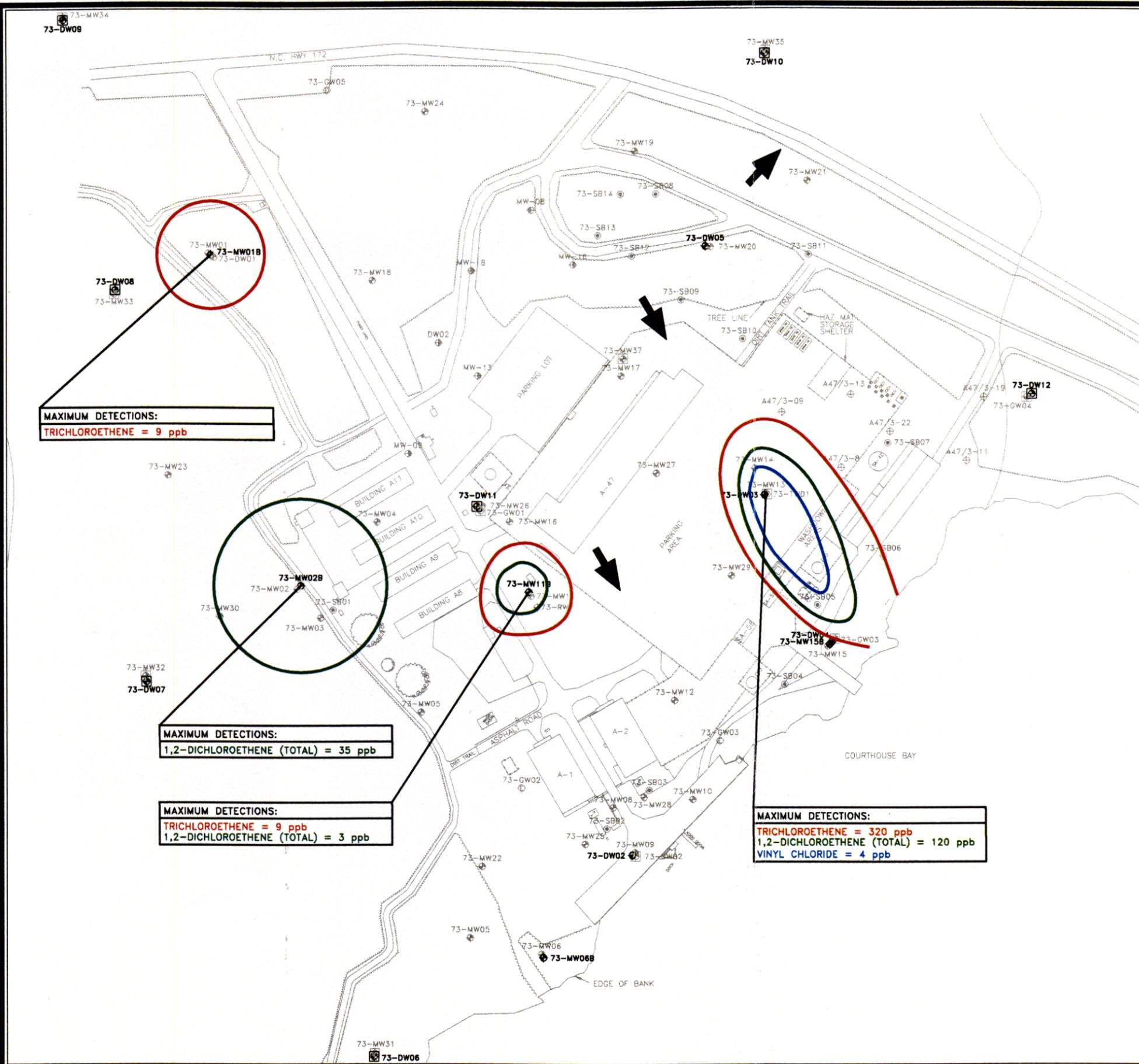


FIGURE 3
ISOCONCENTRATION MAP DEFINING VOC DETECTIONS IN THE UPPER PORTION OF THE SURFICIAL AQUIFER (PHASE II) SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY SUPPLEMENTAL GROUNDWATER INVESTIGATION, CTO-0312

MARINE CORPS BASE, CAMP LEJEUNE
NORTH CAROLINA



LEGEND

- 73-SB01 SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)
- ➔ APPROXIMATE DIRECTION OF GROUNDWATER FLOW

NOTES:

- THE FOLLOWING ISOCONCENTRATION LINES DEFINE THE AREAS OF CONCERN:
- TRICHLOROETHENE = 1.0 PARTS PER BILLION (ppb)
- 1,2-DICHLOROETHENE (TOTAL) = 1.0 ppb
- VINYL CHLORIDE = 1.0 ppb
- PHASE II DATA FROM THE UPPER PORTION OF THE CASTLE HAYNE AQUIFER AND LOWER PORTION OF THE SURFICIAL AQUIFER WAS USED TO DEVELOP THE ISOCONCENTRATION LINES.
- ONLY HIGHLIGHTED WELLS WERE SAMPLED DURING PHASE II.

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

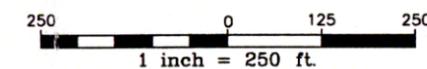
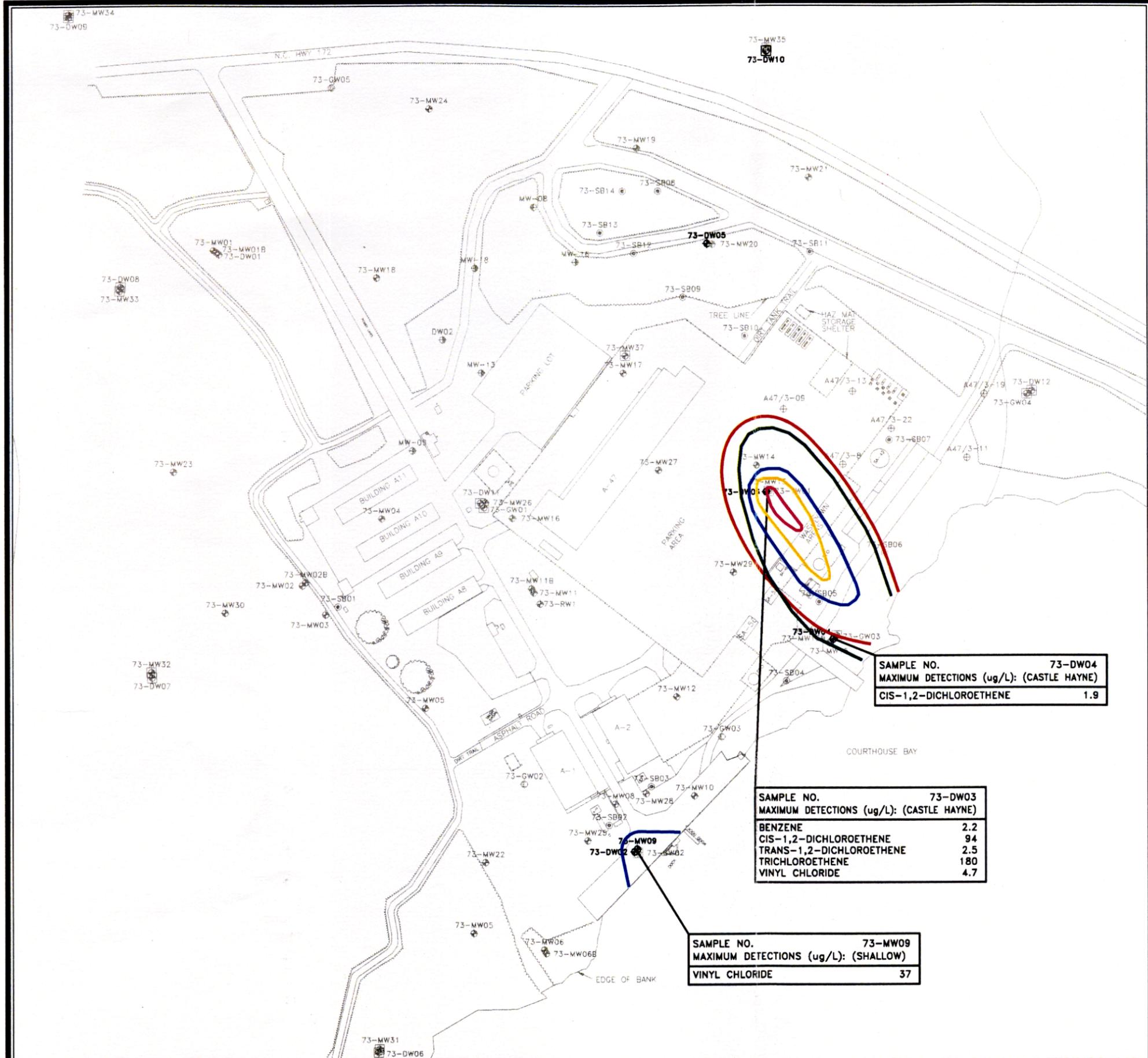


FIGURE 4
 ISOCONCENTRATION MAP DEFINING VOC DETECTIONS IN THE LOWER PORTION OF THE SURFICIAL AQUIFER AND UPPER PORTION OF THE CASTLE HAYNE AQUIFER (PHASE II) SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY SUPPLEMENTAL GROUNDWATER INVESTIGATION, CTO-0312
 MARINE CORPS BASE, CAMP LEJEUNE NORTH CAROLINA



LEGEND

- 73-SB01 SOIL BORINGS ADVANCED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW01 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE I (APRIL-MAY, 1995)
- 73-MW31 MONITORING WELLS INSTALLED BY BAKER DURING REMEDIAL INVESTIGATION, PHASE II (FEBRUARY-MARCH, 1996)
- A47/3-8 MONITORING WELLS INSTALLED DURING UST INVESTIGATION BY GSI AND LAW-CATLIN AND ASSOCIATES (1993)
- MW-18 MONITORING WELLS INSTALLED BY BAKER DURING UST INVESTIGATION (1992 AND 1993)
- MW-08 MONITORING WELLS INSTALLED DURING A UST INVESTIGATION BY ATEC AND ASSOCIATES (1991)
- 73GW-02 MONITORING WELLS INSTALLED BY ESE DURING CONFIRMATORY SAMPLING (1990)

NOTES:

ONLY HIGHLIGHTED WELLS WERE SAMPLED DURING SUPPLEMENTAL GROUNDWATER INVESTIGATION. THE FOLLOWING ISOCONCENTRATION LINES DEFINE THE AREAS OF CONCERN:

- TRICHLOROETHENE = 1.0 PARTS PER BILLION (ppb)
- 1,2-DICHLOROETHENE (TOTAL) = 1.0 ppb
- VINYL CHLORIDE = 1.0 ppb
- TRANS-1,2-DICHLOROETHENE = 1.0 ppb
- BENZENE = 1.0 ppb

SAMPLE NO.	73-DW04
MAXIMUM DETECTIONS (ug/L): (CASTLE HAYNE)	
CIS-1,2-DICHLOROETHENE	1.9

SAMPLE NO.	73-DW03
MAXIMUM DETECTIONS (ug/L): (CASTLE HAYNE)	
BENZENE	2.2
CIS-1,2-DICHLOROETHENE	9.4
TRANS-1,2-DICHLOROETHENE	2.5
TRICHLOROETHENE	180
VINYL CHLORIDE	4.7

SAMPLE NO.	73-MW09
MAXIMUM DETECTIONS (ug/L): (SHALLOW)	
VINYL CHLORIDE	37

SOURCE: LANIER SURVEYING CO., APRIL 4, 1996.

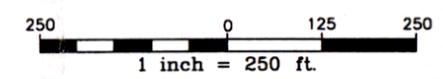


FIGURE 5
 DETECTED VOLATILE ORGANICS IN THE SHALLOW AQUIFER AND UPPER PORTION OF THE CASTLE HAYNE AQUIFER (SUPPLEMENTAL GROUNDWATER INVESTIGATION) SITE 73 - AMPHIBIOUS VEHICLE MAINTENANCE FACILITY SUPPLEMENTAL GROUNDWATER INVESTIGATION, CTO-0312

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