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Final

Vapor Intrusion Evaluation Report
Volume 5 of 6—Courthouse Bay

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

NAVFAC
Naval Facilities Engineering Command
NAVFAC MID-ATLANTIC

Prepared for
Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Contract No. N62470-03-D-0260
Task Order-0021

November 2009

Prepared by

AGVIQ
AGVIQ ENVIRONMENTAL SERVICES
CH2M HILL
JOINT VENTURE

Final

Vapor Intrusion Evaluation Report
Volume 5 of 6

Marine Corps Base Camp Lejeune
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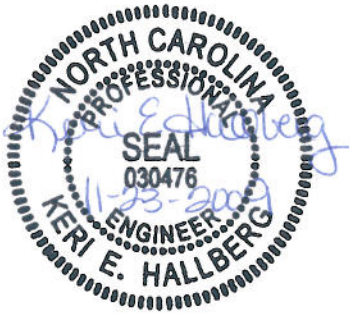

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CH2M HILL

Virginia Beach, Virginia

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Acronyms and Abbreviations

AF	attenuation factor
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
COC	chain of custody record
CSM	conceptual site model
ft	feet/foot
GWSL	Groundwater Screening Level
IR	Installation Restoration
MCB	Marine Corps Base
ppbv	parts per billion by volume
RSL	Regional Screening Level
SGSL	Soil Gas Screening Level
SWMU	solid waste management unit
TCE	trichloroethene
UST	underground storage tank
VOC	volatile organic compound

SECTION 1

Introduction

Courthouse Bay is located in the southern portion of Marine Corps Base (MCB) Camp Lejeune. It was built as a semi-independent village because it is not located near the main area at Hadnot Point. Courthouse Bay has its own water supply, recreation facilities, mess hall, barracks, and officers' quarters. Currently, Courthouse Bay is the home of the Marine Corps Engineer School and the 2nd Assault Amphibian Battalion. The complex originally was used during World War II as a Barrage Balloon School. The Engineer School moved to Courthouse Bay in 1945 from the 4th Regimental Area at Hadnot Point. Here, officers and enlisted personnel are given instruction and hands-on experience in a variety of engineer fields to prepare them for service with the Fleet Marine Force.

Courthouse Bay was one of the six investigation areas evaluated as part of the basewide vapor intrusion evaluation at MCB Camp Lejeune that took place from September 2007 to March 2009. The evaluation was performed in accordance with the Vapor Intrusion Evaluation Work Plan (CH2M HILL, 2008a). Buildings of interest at Courthouse Bay were selected for Phase I sampling according to the process detailed in the work plan. One Installation Restoration (IR) site (Site 73), one Resource Conservation and Recovery Act site (Solid Waste Management Unit [SWMU] 474), and two underground storage tank (UST) sites (Buildings 190 and 293) within Courthouse Bay were retained for further evaluation of vapor intrusion pathways.

The following sections provide information on the investigation methods, data obtained, and conclusions and recommendations from the vapor intrusion evaluation at Courthouse Bay.

SECTION 2

Investigation Methods

2.1 Phase I Sampling Event

One building of interest was identified in Courthouse Bay for data collection during the Phase I sampling event performed in June 2008. This building, Building A47, is located in Site 73 within 100 feet (ft) of a shallow groundwater well with exceedances of the site-specific groundwater-to-indoor air screening levels. Sample collection procedures are provided in Volume 1.

2.1.1 Phase I Sample Locations

Sample locations from the Phase I sampling event are shown on Figure V5-1. The field data sheets associated with the samples collected are provided in Appendix V5-A. The chain of custody records (COCs), which log the samples collected, are provided in Appendix V5-C.

Four subslab (sample type – SG) samples were collected from existing subslab probes in Building A47 during the Phase I field event. Quality control samples were collected in accordance with Section 2.7 of the Field Sampling Plan (CH2M HILL, 2008b). Table V5-1 lists the samples that were proposed in the work plan. There were no deviations from the work plan during the Phase I field event.

TABLE V5-1
Phase I Sampling Summary
Courthouse Bay, MCB Camp Lejeune, North Carolina

Site Name	Building	Sample Type	Sample ID	Sample Collected (Y/N)	Deviations
Site 73	A47	SG	IR73-SG01-08B	Y	—
		SG	IR73-SG02-08B	Y	—
		SG	IR73-SG03-08B	Y	—
		SG	IR73-SG04-08B	Y	—

2.2 Phase II Sampling Event

In accordance with the procedures described in Volume 1, Section 2 and the details provided in the refined conceptual site model (CSM) for Building A47 in Section 4, Phase II sampling was not proposed at Building A47.

SECTION 3

Quality Assurance

The data quality evaluation assesses the effect of the overall analytical process on the "availability" of the analytical data. "Availability" in this context refers to whether results can be used by the project team based on their analytical soundness. If a result is analytically sound, it is deemed available for use by the project team.

Evaluation of laboratory performance is a check for compliance with the method requirements. Additionally, an independent, third-party validator reviewed the laboratory data to assess whether the analytical methods were within required control limits at the time of analysis. Evaluation of potential matrix interferences involves reviewing several areas of results, including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

The data evaluation and validation is a multi-tiered process. The process begins with an internal laboratory review, continues with an independent review by a third-party validator, and ends with an overall review by the Navy contractor project chemistry team. While only the data validator is allowed to apply qualifiers to the data, the process provides a medium for essential communication between the laboratory, validator, and project team, and allows for data quality to be thoroughly evaluated. Details of the data quality evaluation are presented in Appendix V5-B.

All data collected in support of Phase I sampling event are found to be of exceptional quality. No data was rejected because of quality assurance/quality control deficiencies, and all data is available for use by the project team.

SECTION 4

Vapor Intrusion Evaluation Results and Conclusions

4.1 Analytical Data

Table V5-2 presents a summary of the results from Phase I subslab soil gas samples. Figure V5-1 presents the Phase I sample locations at Courthouse Bay.

The text table (V5-4) presents the constituents that exceeded the screening levels. The other table (V5-2) includes only constituents that were detected in at least one sample of each sample type in the investigation area during that phase of investigation. The raw laboratory data tables are provided in Appendix V5-D.

4.2 Aerobic Degradation Potential

Petroleum hydrocarbons biodegrade under aerobic conditions in soil gas and groundwater near the top of the water table. Vadose zone oxygen concentrations above 4 percent are adequate for substantial degradation of benzene, toluene, ethylbenzene, and xylene (BTEX) constituents (DeVaull et al., 1997). The rate of degradation in the vapor phase of each petroleum hydrocarbon is different and can vary based on site conditions and the presence of other constituents. The aerobic biodegradation of petroleum hydrocarbons consumes oxygen and generates carbon dioxide.

Field measurements of oxygen were collected during Phase I with a MultiRae 5 gas meter to determine if sufficient oxygen is present in the subsurface to allow for aerobic biodegradation.

TABLE V5-3
Phase I Oxygen Measurements
Courthouse Bay, MCB Camp Lejeune

Sample ID	Oxygen (%)
IR73-SG01-08B	20.9
IR73-SG02-08B	20.9
IR73-SG03-08B	20.9
IR73-SG04-08B	20.9

At the four Phase I subslab soil gas sample locations, at least 4 percent oxygen was detected, which indicates there is the potential for aerobic biodegradation of hydrocarbons in the subslab soil gas at Building A47. If petroleum hydrocarbons are determined to be

constituents of interest at Building A47, the potential for aerobic biodegradation will be considered as an additional line of evidence for the vapor intrusion evaluation.

4.3 Building Specific Data Evaluations and Conceptual Site Model Discussions

A vapor intrusion CSM addresses the following three components: (1) the volatile organic compound (VOC) source (soil or groundwater contamination); (2) migration from the subsurface and through the slab; and (3) building characteristics and potential receptors (building occupants). Consistent with U.S. Department of Defense vapor intrusion guidance (2009), multiple lines of evidence were incorporated into the vapor intrusion CSM. The initial or primary source in most cases is assumed to be related to a fuel or solvent spill or leak, with groundwater, soil, and, soil gas being the secondary source potentially impacted.

Transport mechanisms for VOCs in the vadose zone primarily include diffusion and advection. VOCs migrate following concentration gradients from source areas of high concentration to surrounding areas of lower concentration by diffusion. If the proposed building is negatively pressurized in relation to the subsurface soil, soil gas will be pulled into the building through openings in the slab. Openings in the slab may include expansion joints, cracks, or utility conduits.

The building characteristics that affect vapor transport and VOC concentration include the pressurization of the building, indoor air volume, the rate of indoor-to-outdoor air exchange, and the integrity of the slab. Pressurization of the building is dependent on things such as the air handling system and the construction and use of the building. The indoor air volume and indoor-to-outdoor air exchange rate affects how quickly VOCs in the building dissipate or are diluted. The location (above, on, or below grade) of the slab determines how close the building is to the source area. The integrity (thickness and presence of openings) of the slab determines how readily VOCs may enter the building.

There is no building survey form for this building, as the subslab sample probes were installed during an earlier event by another contractor.

The information typically provided on the building survey forms was gathered during initial visits to the building and in some instances, obtained based only on rough estimates (e.g., dimensions were estimated, not measured). More complete and accurate information was gathered by the sampling team during other trips made to the buildings during the Phase II sampling event. Building information was also obtained from building schematics provided by the Navy and/or photographs; however, these documents and photos are not included in the report due to their sensitive nature.

4.3.1 Site 73

The Amphibious Vehicle Maintenance Facility (Site 73) began operations in 1946 and remains active today. Site 73 consists of numerous buildings, aboveground storage tanks, USTs, vehicle wash racks, and oil/water separators. Building A47 is the only building within Site 73 retained for further evaluation.

Building A47

Building A47 is located within Site 73. It is used as an amphibious vehicle maintenance area and contains a welding room and office space. For this evaluation, it is classified as a large industrial building. Building A47 was included in Phase I because it is located within 100 ft of one monitoring well that had an exceedance of the site-specific Groundwater Screening Levels (GWSLs). Shallow groundwater flows to the southeast; Building A47 is located up-gradient of IR73-MW27.

Building Characteristics

Building A47 is a one-story concrete block building approximately 400 ft long by 200 ft wide by 25 ft high. The building likely has perimeter wall footings with additional footings underneath the pillars observed within the building. The concrete slab is level with the exterior ground surface; it is approximately 6 inches thick. The entire floor surface is bare concrete with expansion joints that appear to be in good condition.

The northwest side of the building contains two levels of offices with ceilings approximately 8 ft high. There are approximately 10 windows and several doors along the northwest side of the building. The southeast side of the building contains the amphibious vehicle maintenance area; the ceiling is approximately 25 ft high. There are eight large bay doors along southeast wall, which typically remain open during business hours. There is a welding shop at the northeast corner of the building; it is a large room with several large mobile ventilation fans. Building A47 has a multi-zone heating and cooling system.

Potential indoor sources of VOCs observed during the Phase I sampling event include degreasers, cleaning supplies, and spray paint. There are between 50 and 100 people occupying the building during normal working hours with are 7 a.m. to 3 p.m. on weekdays.

Analytical Results

Historical (2002 to 2007) shallow groundwater VOC concentrations within 100 ft of Building A47, which were above the site-specific GWSLs, are summarized in this section and were taken from the work plan (CH2M HILL, 2008a). The historical groundwater exceedances are shown on Figure V5-2. Phase I subslab soil gas sample locations are shown on Figure V5-1. The four subslab soil gas samples were collected from the pre-existing permanent probes located in Building A47. Table V5-4 lists the results for VOCs with GWSL and/or Soil Gas Screening Level (SGSL) exceedances.

TABLE V5-4
Summary of Building A47 Investigation Results
Courthouse Bay, MCB Camp Lejeune, North Carolina

Building A47 Historical (2002 – 2007) Site-Specific Groundwater Screening Level Exceedances

Well ID	Screen Depth (ft bgs)	TCE (µg/L)
GWSL		*49.1*
IR73-MW27	3 to 18	190

Building A47 Phase I Subslab Soil Gas Screening Level Exceedances

Sample ID	TCE (ppbv)
SGSL (based on industrial air RSL;AF=1E-01)	*11.4*
Base-Specific SGSLs (AF=1E-03)	*1,140*
IR73-SG01-08B	-
IR73-SG02-08B	-
IR73-SG03-08B	-
IR73-SG04-08B	-

- indicates the compound does not exceed the screening level
AF – attenuation factor; bgs – below ground surface; ppbv – parts per billion by volume; RSL = Regional Screening Level; TCE = trichloroethene

Refined Conceptual Site Model

Historical (2002 to 2007) trichloroethene (TCE) concentrations in a nearby monitoring well, IR73-MW27 (3 to 18 ft bgs surface screen depth), were up to 3.9 times the site-specific GWSL. This monitoring well is located approximately 50 ft southeast and down-gradient of Building A47 (Figure V5-2). These TCE historical groundwater impacts triggered the Phase I sampling.

Four subslab soil gas samples were collected during Phase I from existing subslab soil gas probes in Building A47. There were no exceedances of the generic SGSLs in the four subslab soil gas samples; therefore, significant vapor intrusion impacts are not expected, and additional sampling was not proposed for Phase II.

Conclusions

Although TCE was detected in exterior historical groundwater above site-specific screening levels at Building A47, it was not detected is subslab soil gas samples above the generic SGSL. Therefore, vapor intrusion impacts are not expected.

Recommended Further Actions

1. An additional round of subslab sample data should be collected at Building A47 to address temporal variability associated with soil gas sampling.

2. If remedial actions are being performed to address groundwater or soil contamination, the vapor intrusion pathway should be re-evaluated during and after remedial actions.

Section 5, Overall Conclusions and Recommendations, is not included in this volume because there was only one building of interest at Courthouse Bay. Additionally, since there were no areas of significant soil gas contamination at Courthouse Bay, no buildings were recommended for vapor intrusion evaluation due to potential preferential pathways.

SECTION 5

References

CH2M HILL. 2008a. Vapor Intrusion Evaluation Work Plan.

CH2M HILL. 2008b. Field Sampling Plan.

DOD. 2009. Tri-Services

DeVaull et al. 1997

ITRC. 2007.

Table

TABLE V5-2
Summary of Courthouse Bay Phase I Subslab Soil Gas Analytical Results
Vapor Intrusion Report
Courthouse Bay, MCB Camp Lejeune, North Carolina

Station ID **Sample ID** **Sample Date** **Chemical Name**	**Industrial Shallow Generic SGSL (AF=0.1) (ppbv)**	**Unrestricted Shallow Generic SGSL (AF=0.1) (ppbv)**	IR73-SG01 IR73-SG01-08B 06/24/08	IR73-SG02 IR73-SG02-08B 06/24/08	IR73-SG03 IR73-SG03-08B 06/24/08	IR73-SG04 IR73-SG04-08B 06/24/08
Volatile Organic Compounds (ppbv)						
1,4-Dichlorobenzene	1.83	0.366	2 U	**0.82 J**	**1.1 J**	2 U
2-Butanone	74,600	17,600	8 J	6.2 J	2.3 J	2.3 J
2-Hexanone	31,700	7,570	0.93 J	5 U	5 U	5 U
4-Methyl-2-pentanone	31,700	7,560	1.5 J	2.9 J	5 U	2.7 J
Acetone	589,000	135,000	69	80	58	630
Benzene	5.01	0.97	2 U	**1.2 J**	0.8 J	0.73 J
Carbon disulfide	9,950	2,340	1.9 J	5 U	0.69 J	5 U
Cyclohexane	75,500	18,300	1.8 J	2.8 J	0.6 J	0.63 J
Dichlorodifluoromethane (Freon-12)	1,780	425	65	1.5 J	2 U	0.7 J
Ethylbenzene	11.3	2.23	**2.9**	2.2	1.1 J	**5.4**
Isopropylbenzene	3,660	854	4 U	0.69 J	4 U	1.8 J
Methylene chloride	74.8	15	5 U	5 U	10	5 U
Tetrachloroethene	3.1	0.605	**2.1**	**0.64 J**	**1.1 J**	**1.7 J**
Toluene	58,400	13,800	590	330	67	250
Trichloroethene	11.4	2.23	0.5 J	2 U	2 U	0.76 J
Trichlorofluoromethane(Freon-11)	5,520	1,300	5.6	1.4 J	0.93 J	0.75 J
cis-1,2-Dichloroethene	--	--	2 U	2 U	2 U	0.72 J
m- and p-Xylene	1,010	230	4.6	4.8	2.1	13
o-Xylene	7,140	1,680	1.4 J	2.3	0.89 J	3.8

Notes:
J - Analyte present, value may or may not be accurate or precise
NA - Not analyzed
U - The material was analyzed for, but not detected
ppbv - parts per billion volume
SGSL - Soil Gas Screening Level
Bold text indicates exceedance of Unrestricted Generic criteria

Figures

\\APHRODITE\PROJ\USNAVFACENGCOM\315007CAMPLEJEUNE\PROJECTS\Vapor_Intrusion\VI_Final_3_9_09\Phase_I\Figure_V5_1_Rd2_CourthouseBay_Site73_Phase_1.mxd

Legend

- Monitoring Well with exceedances
- Existing Subslab Sample Locations
- Shallow Groundwater Flow
- Buildings Investigated
- MCAS, New River
- Camp Geiger
- Courthouse Bay
- Hadnot Point
- Mainside
- Tarawa Terrace

N

0 200 400 800 Feet

Figure V5-1
Courthouse Bay Phase I Sample Locations
Vapor Intrusion Report
MCB Camp Lejeune
North Carolina

AGVIQ CH2M HILL

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Legend

- Monitoring Well with exceedances
- Existing Subslab Sample Locations
- Shallow Groundwater Flow
- Steam Line
- Storm Sewer Drainage Line
- Storm Sewer Utility Line
- Electrical Utility Line
- Water Utility Line
- Wastewater Utility Line
- Buildings Investigated
- MCAS, New River
- Camp Geiger
- Courthouse Bay
- Hadnot Point
- Mainside
- Tarawa Terrace

IR86-IS10-GW-10-12-08B - Sample with one or more exceeding constituents AF = 0.1

N

0 200 400 Feet

Figure V5-2
Site 73 Historical Groundwater Exceedances and Utility Locations
Courthouse Bay
MCB Camp Lejeune
North Carolina

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Appendix V5-A
Field Data Sheets

Figure 2-4
CH2MHILL

Indoor Vapor Intrusion Assessment
Sub-slab Vapor Field Sampling Log - Summa Canister Method

Project Info

Project Name: TO 21 - Soil Vapor Intrusion Project #: TO 21
By: K. Riggs, P. Brown, J. Chalk Date: 6/24/08

Structure

Identification: A-47 - Amphib maint. Bldg.
Address: Courthouse Bay, MCB Lejeune
Slab Information:
☒ Concrete slab on grade (directly on top of soil) ☐ Other (describe)
☐ Concrete slab on gravel underlayment
Condition of slab: Installed 2/2007
Type of Sub Slab Soil:
Is water present in the soil: NO

Sub-slab Probe Installation, Leak Checking, Probe Purging, & Sampling Log

	Sample location (show in diagram)	1	2	3	4
	Sample Identification (field ID)	IR73-04-SG-08B	IR73-03-SG-08B	IR73-02-SG-08B	IR73-01-SG-08B
Probe Installation	Depth of slab (inches)	6"	6"	6"	6"
	Depth of hole drilled (inches below slab surface)	1"	1"	1"	1"
	Depth of installed probe (inches below slab surface)	7"	7"	7"	7"
Manifold Leak check	Leak check (sampling manifold) - Pass/No Pass	Leak check performed in 2007			
Probe Purge	Purge rate, cc/min.	200	200	200	200
	Purge Start (time of day)	0955	1023	1055	1124
	Purge vacuum, " Hg	0	0	0	0
	Purge completed (time of day)	1010	1038	1110	1139
Helium Leak Check (optional)	Leak check (Helium) - %	NA	NA	NA	NA
Canister Sampling	Canister & flow controller ID (if used)	B3598, 09	18690, 10	B4843, 41	50330, 75
	Initial Canister Pressure (" Hg)	-30	-30	-30	-27
	Sampling rate, cc/min	200	200	200	200
	Sampling period started (time of day)	1010	1038	1110	1139
	Sampling vacuum, " Hg	NA	NA	NA	NA
	Sampling period ended (time of day)	1015	1043	1115	1144
	Final Canister Pressure (" Hg)	-3	-3	0	-2

Observations and Comments:

VOC	5.1	0.0	0.0	0.0
CO	2	2	4	2
LEL	0	0	0	0
O_2	20.9	20.9	20.9	20.9
H_2S	0	0	0	0

Appendix V5-B
Data Validation/Quality Assurance Technical Memorandum

Data Quality Evaluation

1 Data Quality Assessment

This data quality evaluation assesses the effect of the overall analytical process on the "availability" of the analytical data. "Availability" in this context refers to whether results can be used by the project team based on their analytical soundness. If a result is analytically sound, it is available for use by the project team.

Evaluation of laboratory performance is a check for compliance with the method requirements; in other words, a check of whether the laboratory analyzed the samples within the limits of the analytical method. Additionally, an independent, third-party validator reviewed the laboratory data to assess whether the analytical methods were within required control limits at the time of analysis. Evaluation of potential matrix interferences involves reviewing several areas of results, including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

The data evaluation and validation is a multi-tiered approach. The process begins with an internal laboratory review, continues with an independent review by a third-party validator, and ends with an overall review by the Navy contractor project chemistry team. This process provides a medium for essential communication between the laboratory, validator, and project team, and allows for data quality to be thoroughly evaluated.

1.1 Laboratory Internal Quality Control Review

Before releasing the analytical data, the laboratory reviewed both the sample and quality control (QC) data to verify sample identity, instrument calibration, quantitation limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. In addition, the QC data were tabulated and the results reviewed to ascertain whether they were within the contract-required or laboratory-defined limits for accuracy and precision. Any nonconforming data were discussed in the data package cover letter and case narrative. The case narrative was then reviewed by the data validator and incorporated into the data validation report. If necessary, qualifiers were applied based on this information.

1.2 Data Validation

An independent data validator reviewed all data packages using the validation criteria defined by U.S. Environmental Protection Agency (USEPA) National Functional Guidelines, analytical methods, and applicable laboratory standard operating procedures (SOPs). These criteria help the validator create a thorough and systematic approach to the validation process. As stated above, the data validation process was independent and separate from the laboratory's internal review. The process was specifically focused on the effects of the laboratory's performance and sample matrix on the analytical results. Areas of review consisted of holding time compliance, surrogate recovery accuracy, matrix spiked sample precision and accuracy, blank contamination, initial and continuing calibration accuracy and

precision, laboratory control sample accuracy, internal standard response and retention time accuracy, instrument tune criteria accuracy, and duplicate sample precision (laboratory and field duplicates). Additionally, the analytical spectrum and raw data output were reviewed and laboratory results selected by the validator were recalculated from the raw data to verify final laboratory quantitation.

When multiple analyses were performed, the analytical run with the lowest quantitation limits was selected by the validator if the QC criteria were met for that analysis. If a sample was analyzed more than once as a result of concentrations exceeding the calibration range, the data validator selected results from the appropriate dilution. When multiple analyses were performed and QC criteria were outside control limits for all analyses, the data validator selected results from the analytical run with the least number of exceptions or best possible QC.

Qualification of data is not an unusual occurrence. To define a laboratory QC exceedance and when a laboratory QC exceedance occurs, the laboratory refers to its in-house SOPs. The SOPs are based on U.S. Department of Defense requirements, the requested analytical method, and accumulated laboratory experience. When a laboratory QC exceedance occurs, the situation may be acceptable or it may require further action by the laboratory, such as application of a laboratory qualifier or reanalysis of the sample. The data validator uses a separate set of QC criteria, based on guidance from the USEPA region that applies to the samples. Data validation criteria exceedances may result in the qualification of or rejection of data, as deemed appropriate by the third-party data validator.

The data validator examines each data point and determines any effects that QC exceedances have had. Most often, these effects dictate that the result or quantitation limit should be considered estimated, but is still available for use. The J-qualification, UJ-qualification, NJ-qualification, and U-qualification of results are common occurrences and have no adverse effect on the availability of that result to the project team for making decisions. J-qualified and NJ-qualified results are available, at the reported result, for use as detects as long as they are considered "estimated" by the project team. Human health risk assessment guidance suggests that these qualifiers "indicate uncertainty in the reported concentration of the chemical, but not in its assigned identity. Therefore, these data can be used just as positive data with no qualifiers or codes." In addition, one should use "J-qualified concentrations the same way as positive data that do not have this qualifier" (*Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual*. [Part A] EPA/540/1-89/002. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC. 1989). U-qualified and UJ-qualified results are available, at the reported quantitation limit, for use as non-detects as long as they are considered "nondetect," "attributable to blank contamination," or "nondetect, estimated quantitation limit," as appropriate.

In extreme cases, a result is rejected and deemed to be unusable. "Unusable" in this instance is defined as a result that is not analytically sound and is not generally considered available for use by the project team. In some cases, the project team may still decide to use a rejected result. An example of this occurrence would be if a result is rejected because it is biased extremely high, yet it is still below the project action limits. A conservative decision may be made to consider this result a non-exceedance, even if its concentration was rejected. For that reason, it is important to examine why a result was rejected. For the most part,

however, rejected results are not usable, and the R-qualifier is the only qualifier that has an adverse effect on the availability of data.

In large datasets, rejected results are often inconsequential because there is sufficient non-rejected data available to the project team. If there are enough non-rejected data or the project team is able to infer results from adjacent sampling locations or there is other site-specific information that can provide additional lines of evidence, it may not be necessary to know the concentrations of some rejected constituents. It may also not be necessary to prove a constituent's absence if there are sufficient additional lines of evidence.

1.2.1 Primary Data Validation Qualifiers

The following data validation qualifiers were applied to one or more analytical results:

- **U** - Not detected. Sample was analyzed for this parameter, but it was not detected at greater than reported quantitation limit. The data validator may also apply this qualifier to indicate that a concentration is attributed to blank contamination, but this qualifier does not necessarily indicate a quality control problem.
- **UJ –** Not detected, quantitation limit is estimated. The sample was analyzed for this parameter, but it was not detected above the reported quantitation limit. The quantitation limit for this parameter is estimated due to a quality control issue.
- **J** - Concentration estimated. The parameter was positively identified and the associated numerical value is the approximate concentration of the parameter in the sample.
- **R** - Rejected. The result was rejected due to a quality control issue. The presence or absence of the parameter cannot be verified and the result generally is not usable as detected or not detected. R is also used to indicate an analytical result that is redundant because of reanalysis or dilution, in which case, there is no effect on the quality or usability of data.
- **[No qualifier present] -** Detected. Qualification was not warranted.

2 Impact of Data Quality on Project Data Quality Objectives and Data Usability

The laboratories analyzed the samples in accordance with USEPA methods. The data packages were reviewed by an independent data validator using USEPA National Functional Guidelines, analytical methods, and applicable laboratory SOPs.

The laboratory used various qualifiers to represent "below reporting limit," "nondetect," and "detected." The data validator utilized J-qualifiers, NJ-qualifiers, UJ-qualifiers, U-qualifiers, and R-qualifiers to represent "estimated," "presumptively present at approximate quantity," "nondetect, estimated quantitation limit," "nondetect" or "attributable to blank contamination," and "rejected," respectively.

The J- and UJ-qualifiers indicate that some results are estimated. These qualifiers indicate that data are available for use as detects and nondetects, respectively. These qualifiers do not necessarily indicate a problem that adversely affects the availability of data. For

example, J-qualifiers are often applied simply because results are below the quantitation limit.

USEPA Region 4 data validation guidance mandates the use of J- and UJ-qualifiers when quality assurance (QA)/QC exceedances dictate their necessity. In general, J-, UJ-, and U-qualified results are available for use as qualified.

3 Phase I Sampling – Courthouse Bay

The purpose of this data quality evaluation is to summarize the findings of the data validation and any effects on the availability of the data for the Phase I sampling at Courthouse Bay as well as to provide an assessment of data usability.

3.1 Soil Gas Data

This evaluation assesses the analytical results of soil gas samples collected on June 24, 2008.

3.1.1 Volatile Organic Compounds

Volatiles were analyzed by USEPA Method TO-15. Excluding field QC samples, 184 distinct data points were generated. There were no rejected results. The volatiles dataset is 100 percent complete (all volatiles results are available for use). The validation process resulted in the following qualifiers for results in the volatiles fraction:

- 1.6 percent (3 of 184 results) were U-qualified as "attributable to blank contamination" (see Section 3.1.1.1).
- 19 percent (35 of 184 results) were J-qualified as "estimated" because the results were below the quantitation limit (see Section 3.1.1.2).

3.1.1.1 Blank Contamination

Three results were U-qualified as "attributable to blank contamination" because methylene chloride were detected in associated blank samples. Methylene chloride is a common laboratory contaminant. The U-qualification of detects to indicate that they are "attributable to blank contamination" does not affect the availability of results because they are available for use as nondetects at the adjusted quantitation limit.

3.1.1.2 Quantitation Limits

A total of 35 results were J-qualified as "estimated" simply because the results were lower than the quantitation limit. The J-qualification of detects does not affect the availability of results because they are available for use as detects at the reported concentration.

4 Overall Assessment

All data collected in support of Phase I sampling event are found to be of exceptional quality. No data was rejected because of QA/QC deficiencies, and all data is available for use by the project team.

Appendix V5-C
Chains of Custody Records

TAL Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
phone 865-291-3000 fax 865-584-4315

SVII TO21

Canister Samples Chain of Custody Record

TestAmerica assumes no liability with respect to the collection and shipment of these samples.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Contact Information
Company: AGVIQ
Address: 4610 Westgrove Ct
City/State/Zip: VA Beach VA 23455
Phone: 757-318-9420
FAX: 757-318-9421
Project Name: TO 21 - Vapor Intrusion
Site/location: Site 73, MCB Lejeune
PO #

Project Manager: Bob Brown
Phone: 757-544-3006
Site Contact: Kirsti Riggs
TAL Contact: 757-544-3392

Analysis Turnaround Time
Standard (Specify)
Rush (Specify)

Sampled By: K. Riggs, P. Brown

1 of 3 COCs

Sample Identification	Sample Date(s)	Time Start	Time Stop	Canister Vacuum in Field, "Hg (Start)	Canister Vacuum in Field, "Hg (Stop)	Flow Controller ID	Canister ID	TO-15	TO-14A	EPA 3C	EPA 25C	ASTM D-1946	Other (Please specify in notes section)	Sample Type	Indoor Air	Ambient Air	Soil Gas	Landfill Gas	Other (Please specify in notes section)
IR73-03-SG-08B	6/24/08	1038	1043	-30	-3	10	1869D	X									X		
IR73-02-SG-08B	6/24/08	1110	1115	-30	0	41	104743	X									X		
IR73-01-SG-08B	6/24/08	1139	1144	-27	-2	75	5033D	X									X		
IR89-IS12-SV-4-5-08B	6/24/08	1330	1335	-30	-3	86	B3845	X									X		
IR89-IS11-SV-4-5-08B	6/24/08	1400	1405	-30	0	89	B4667	X									X		
IR89-IS10-SV-4-5-08B	6/24/08	1427	1432	-30	-3	59	B4672	X									X		

Sampled by :
CHAMHILL / AGVIQ

Temperature (Fahrenheit)	Interior	Ambient	
Start			
Stop			

Pressure (inches of Hg)	Interior	Ambient	
Start			
Stop			

Special Instructions/QC Requirements & Comments:

Canisters Shipped by: Kim Stokes	Date/Time: 6/25/08 1200	Canisters Received by:
Samples Relinquished by: [signature]	Date/Time: 6/24/08 1700	Received by:
Relinquished by:	Date/Time:	Received by:

TAL Knoxville
5815 Middlebrook Pike
Knoxville, TN 37921
phone 865-291-3000 fax 865-584-4315

JVII TO-21

Canister Samples Chain of Custody Record

TestAmerica assumes no liability with respect to the collection and shipment of these samples.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Contact Information
Company: AGVIQ
Address: 4410 Westgrove Ct.
City/State/Zip: VA Beach VA 23455
Phone: 757-318-9420
FAX: 757-318-9421
Project Name: TO 21
Site/location: MCAS New River
PO #

Project Manager: Bob Brown
Phone: 757-544-3004
Site Contact: Kristi Riggs
TAL Contact: 757-544-2392

Sampled By: KR JC

2 of 3 COCs

Analysis Turnaround Time
Standard (Specify)
Rush (Specify)

Sample Identification	Sample Date(s)	Time Start	Time Stop	Canister Vacuum in Field, "Hg (Start)	Canister Vacuum in Field, "Hg (Stop)	Flow Controller ID	Canister ID	TO-15	TO-14A	EPA 3C	EPA 25C	ASTM D-1946	Other (Please specify in notes section)	Sample Type	Indoor Air	Ambient Air	Soil Gas	Landfill Gas	Other (Please specify in notes section)
USTA54151-TS04-SV-5-6-08B	6/23/08	1548	1554	-30	-2	08	L5177	X									X		
TR86-TS12-SV-5-6-08B	6/23/08	0837	0842	-30	-3	98	50310	X									X		
TR86-TS13-SV-5-6-08B	6/23/08	0959	1006	30	-3	31	L5108	X									X		
~~USTI613-TS11-SV-9-10-08B~~	~~6/23/08~~					~~64~~	~~L5182~~	~~X~~									~~X~~		~~X~~
US TI613-TS4-SV-9-10-08B	6/23/08	1620	1625	-30	-3	71	50890	X									X		
TR73-04-SG-08B	6/24/08	1010	1015	-30	-3	09	B3598	X									X		

Sampled by :
CHAM HILL /AGVIQ

Temperature (Fahrenheit)	Interior	Ambient	
Start			
Stop			

Pressure (inches of Hg)	Interior	Ambient	
Start			
Stop			

Special Instructions/QC Requirements & Comments: L-5182 and 64 malfunctioned - switched to new canister - 50890

Canisters Shipped by: Kim Stokes	Date/Time: 6/25/08 1200	Canisters Received by:
Samples Relinquished by: Kimberly Stokes	Date/Time: 6/24/08 1700	Received by:
Relinquished by:	Date/Time:	Received by:

Appendix V5-D
Laboratory Data

TO - 21
Camp Lejeune - Courthouse Bay
Soil Gas Raw Analytical Results
June 2008

Station ID **Sample ID** **Sample Date**	IR73-SG01 IR73-SG01-08B 06/24/08	IR73-SG02 IR73-SG02-08B 06/24/08	IR73-SG03 IR73-SG03-08B 06/24/08	IR73-SG04 IR73-SG04-08B 06/24/08
Chemical Name				
Volatile Organic Compounds (ppbv)				
1,1,1-Trichloroethane	2 U	2 U	2 U	2 U
1,1,2,2-Tetrachloroethane	2 U	2 U	2 U	2 U
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	2 U	2 U	2 U	2 U
1,1,2-Trichloroethane	2 U	2 U	2 U	2 U
1,1-Dichloroethane	2 U	2 U	2 U	2 U
1,1-Dichloroethene	2 U	2 U	2 U	2 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U
1,2-Dibromoethane	2 U	2 U	2 U	2 U
1,2-Dichlorobenzene	2 U	2 U	2 U	2 U
1,2-Dichloroethane	2 U	2 U	2 U	2 U
1,2-Dichloropropane	2 U	2 U	2 U	2 U
1,3-Dichlorobenzene	2 U	2 U	2 U	2 U
1,4-Dichlorobenzene	2 U	0.82 J	1.1 J	2 U
2-Butanone	8 J	6.2 J	2.3 J	2.3 J
2-Hexanone	0.93 J	5 U	5 U	5 U
4-Methyl-2-pentanone	1.5 J	2.9 J	5 U	2.7 J
Acetone	69	80	58	630
Benzene	2 U	1.2 J	0.8 J	0.73 J
Bromodichloromethane	2 U	2 U	2 U	2 U
Bromoform	2 U	2 U	2 U	2 U
Bromomethane	2 U	2 U	2 U	2 U
Carbon disulfide	1.9 J	5 U	0.69 J	5 U
Carbon tetrachloride	2 U	2 U	2 U	2 U
Chlorobenzene	2 U	2 U	2 U	2 U
Chloroethane	2 U	2 U	2 U	2 U
Chloroform	2 U	2 U	2 U	2 U
Chloromethane	5 U	5 U	5 U	5 U
Cyclohexane	1.8 J	2.8 J	0.6 J	0.63 J
Dibromochloromethane	2 U	2 U	2 U	2 U
Dichlorodifluoromethane (Freon-12)	65	1.5 J	2 U	0.7 J
Ethylbenzene	2.9	2.2	1.1 J	5.4
Isopropylbenzene	4 U	0.69 J	4 U	1.8 J
Methyl-tert-butyl ether (MTBE)	10 U	10 U	10 U	10 U
Methylene chloride	5 U	5 U	10	5 U
Styrene	2 U	2 U	2 U	2 U
Tetrachloroethene	2.1	0.64 J	1.1 J	1.7 J
Toluene	590	330	67	250
Trichloroethene	0.5 J	2 U	2 U	0.76 J
Trichlorofluoromethane(Freon-11)	5.6	1.4 J	0.93 J	0.75 J
Vinyl chloride	2 U	2 U	2 U	2 U
cis-1,2-Dichloroethene	2 U	2 U	2 U	0.72 J
cis-1,3-Dichloropropene	2 U	2 U	2 U	2 U
m- and p-Xylene	4.6	4.8	2.1	13
o-Xylene	1.4 J	2.3	0.89 J	3.8
trans-1,2-Dichloroethene	2 U	2 U	2 U	2 U
trans-1,3-Dichloropropene	2 U	2 U	2 U	2 U

Notes:

J - Analyte present, value may or may not be accurate or precise

NA - Not analyzed

U - The material was analyed for, but not detected

ppbv - parts per billion volume