

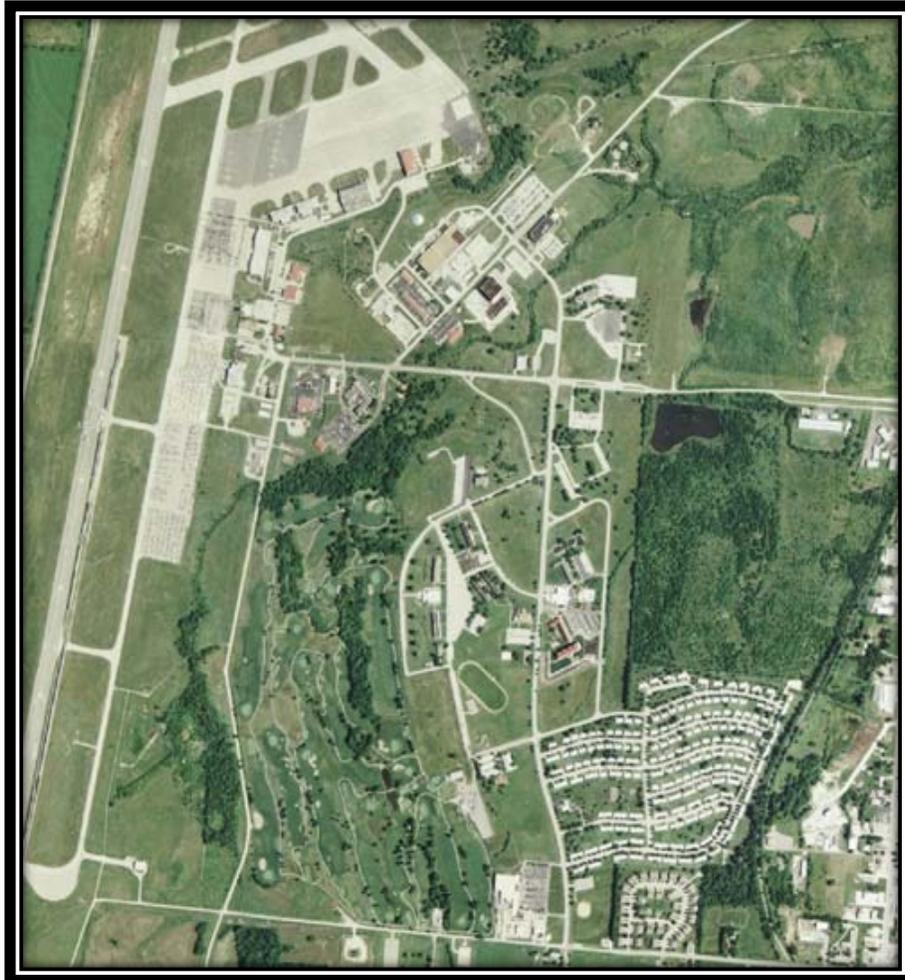
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SECOND FIVE-YEAR REVIEW REPORT SITE SS-003 AND SS-009 MCRO KANSAS CITY  
MO (PUBLIC DOCUMENT)  
9/1/2012  
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Final  
Five-Year Review Report  
Sites SS-003 and SS-009  
Former Richards-Gebaur Air Force Base, Kansas City, MO  
September 2012



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Installation SSIC#: 5090

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**Five-Year Review Report**  
**Second Five-Year Review Report**  
for Sites SS-003 and SS-009

Former Richards-Gebaur Air Force Base

Kansas City, MO

September 2012

PREPARED BY:

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## EXECUTIVE SUMMARY

The Department of Navy (Navy), the lead agency, conducted this Five-Year Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) review at the former Richards-Gebaur Air Force Base (AFB) with regulatory oversight from the United States Environmental Protection Agency (USEPA) Region 7 and Missouri Department of Natural Resources (MDNR). The Five-Year Review was prepared in accordance with the USEPA *Comprehensive Five-Year Review Guidance* (USEPA, 2001). This document addresses remedy components and Remedial Actions (RAs) that have been implemented within operable unit (OU) 2 Groundwater, Sites SS-003 (Oil Saturated Area) and SS-009 (Fire Valve Area) for which there is a Record of Decision (ROD) in place.

The objective of this Five-Year Review is to evaluate current remedies at former Richards-Gebaur AFB and to determine whether the remedies remain protective of human health and the environment in accordance with the requirements outlined in the ROD. The protectiveness of the remedies was evaluated through review of reports, site visits and inspections, and community involvement in the form of advertisements, information repositories and interviews with stakeholders. In addition, the objective of the Five-Year Review Report is to identify any issues that may be preventing a particular remedy from functioning as designed or as appropriate, and that could endanger the protection of human health and the environment.

This Five-Year Review constitutes the second required review/reporting cycle for the former Richards-Gebaur AFB, OU 2, Sites SS-003 and SS-009. A summary table of the OU 2 sites reviewed, documents reviewed, RODs, remedial action objectives (RAOs), and Remedy Components is provided as **Table ES-1**. This table also summarizes the protectiveness statements, and recommendations for each site.

Overall the remedy for OU 2 Groundwater at Sites SS-003 and SS-009 is protective of human health and the environment.

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**Table ES-1. Five-Year Review Summary Table**

Operable Unit 2 – Groundwater				
Data and Documents Reviewed	RAOs	Remedy Components	Protectiveness	Recommendations
<b>SS-003 Oil Saturated Area</b>				
<p><i>First Five Year Review for Former Richards-Gebaur AFB, March 2007</i></p> <p><i>ROD, July 2004</i></p> <p><i>Long Term Monitoring Plan for Groundwater (Operable Unit-2), March 2005</i></p> <p><i>Land Use Control/Institutional Control Management Plan, August 2005</i></p> <p><i>Environmental Condition of Property Report, April 2006</i></p> <p><i>Finding of Suitability to Transfer Marine Corps Activity, October 2011</i></p> <p>LTM Reports 2006-2011</p>	<p>Prevent human exposure to contaminated groundwater with contaminant concentrations that pose risks greater than 1X10<sup>-4</sup> to 1X10<sup>-6</sup> (carcinogens) or a hazard index of 1 (non-carcinogens) for the reasonable maximum exposure scenario.</p>	<p>Land Use Controls (LUCs)</p> <ul style="list-style-type: none"> <li>-Prohibit extraction and use of groundwater</li> <li>-Prohibit land surface activities that may interfere with or damage the on-site monitoring wells</li> </ul>	<p>The remedial actions are protective of human health and the environment and are anticipated to remain protective in the future. LUCs prohibiting extraction and use of groundwater are adequate to ensure that exposure to unacceptable risk does not occur in the future.</p>	<p>Continue LUCs until RACGs are met.</p>
		<p>LTM to support the LUCs and allow systematic, periodic evaluation of site groundwater quality to help ensure that the established LUC boundaries fully encompass the contaminated plumes and provide data to support terminating LUCs when RACGs are achieved</p>	<p>COC concentrations indicate that the groundwater plumes remain inside the LUC boundaries, and there is no indication that off-site migration is occurring.</p>	<p>Reduce monitoring to every other year beginning in April/May 2013. This will support the Five-Year Review.</p> <p>If results of samples are below RACGs, a follow on sampling event should be scheduled at least three (3) months later but no longer than one (1) year after the initial sampling event to determine if RACGs have been achieved.</p>

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**Table ES-1. Five-Year Review Summary Table (continued)**

Operable Unit 2 – Groundwater				
Data and Documents Reviewed	RAOs	Remedy Components	Protectiveness	Recommendations
<b>SS-009 Fire Valve Area</b>				
<p><i>First Five Year Review for Former Richards-Gebaur AFB, March 2007</i></p> <p>ROD, July 2004</p> <p><i>Long Term Monitoring Plan for Groundwater (Operable Unit-2), March 2005</i></p> <p>Memorandum of Agreement for the Transition of the Environmental Program of Richards-Gebaur Air Force Base between Unites States Marine Corps and Air Force Base Conversion, August 1998</p> <p><i>Amendment to Memorandum of Agreement for the Transition of the Environmental Program at Richards-Gebaur Air Force Base between Unites States Marine Corps and Air Force Real Property Agency, December 2004</i></p> <p><i>Land Use Control/Institutional Control Management Plan, August 2005</i></p> <p><i>Environmental Condition of Property Report, April 2006</i></p> <p><i>Finding of Suitability to Transfer Marine Corps Activity, October 2011</i></p> <p><i>LTM Reports 2006-2011</i></p>	<p>Prevent human exposure to contaminated groundwater with contaminant concentrations that pose risks greater than 1X10-4 to 1X10-6 (carcinogens) or a hazard index of 1 (non-carcinogens) for the reasonable maximum exposure scenario.</p>	<p>LUCs</p> <ul style="list-style-type: none"> <li>-Prohibit extraction and use of groundwater</li> <li>-Prohibit land surface activities that may interfere with or damage the on-site monitoring wells</li> </ul>	<p>The remedial actions are protective of human health and the environment and are anticipated to remain protective in the future. LUCs prohibiting extraction and use of groundwater are adequate to ensure that exposure to unacceptable risk does not occur in the future.</p>	<p>Maintain LUCs on the site until RACGs have been met</p>
		<p>LTM to support the LUCs and allow systematic, periodic evaluation of site groundwater quality to help ensure that the established LUC boundaries fully encompass the contaminated plumes and provide data to support terminating LUCs when RACGs are achieved</p>	<p>COC concentrations indicate that the groundwater plumes remain inside the LUC boundaries, and there is no indication that off-site migration is occurring.</p>	<p>Reduce monitoring to every other year beginning in April/May 2013. This will support the Five-Year Review.</p> <p>If results of samples are below RACGs, a follow on sampling event should be scheduled at least three (3) months later but no longer than one (1) year after the initial sampling event to determine if RACGs have been achieved. .</p>

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**Five-Year Review Summary Form**

SITE IDENTIFICATION		
<b>Site Name:</b> Former Richards-Gebaur Air Force Base, OU2: Sites SS-003 and SS-009		
<b>EPA ID:</b> M09571824292		
<b>Region:</b> 7	<b>State:</b> MO	<b>City/County:</b> Belton/Cass
SITE STATUS		
<b>NPL Status:</b> Non-NPL		
<b>Multiple OUs?</b> No	<b>Has the site achieved construction completion?</b> Yes	
REVIEW STATUS		
<b>Lead agency:</b> Other Federal Agency If "Other Federal Agency" was selected above, enter Agency name: US Navy		
<b>Author name (Federal or State Project Manager):</b> Commander, NAVFAC Midwest and BRAC Program Manager Office Southeast		
<b>Author affiliation:</b> US Navy		
<b>Review period:</b> November 2011 - September 2012		
<b>Date of site inspection:</b> December 22, 2011		
<b>Type of review:</b> Statutory		
<b>Review number:</b> 2		
<b>Triggering action date:</b> September 30, 2007		
<b>Due date (five years after triggering action date):</b> September 17, 2012		

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### Five-Year Review Summary Form (continued)

The table below is for the purpose of the summary form and associated data entry and does not replace the two tables required in Section VIII and IX by the FYR guidance. Instead, data entry in this section should match information in Section VII and IX of the FYR report.

#### Issues/Recommendations

<b>OU(s) without Issues/Recommendations Identified in the Five-Year Review:</b>
OU2

#### Issues and Recommendations Identified in the Five-Year Review:

<b>OU(s): 2 Groundwater</b>	<b>Issue Category: No Issue</b>			
	<b>Issue: N/A</b>			
	<b>Recommendation: N/A</b>			
<b>Affect Current Protectiveness</b>	<b>Affect Future Protectiveness</b>	<b>Implementing Party</b>	<b>Oversight Party</b>	<b>Milestone Date</b>
Choose an item.	Choose an item.	Choose an item.	Choose an item.	

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**Five-Year Review Summary Form (continued)**

To add additional issues/recommendations here, copy and paste the above table as many times as necessary to document all issues/recommendations identified in the FYR report.

**Protectiveness Statement(s)**

*Include each individual OU protectiveness determination and statement. If you need to add more protectiveness determinations and statements for additional OUs, copy and paste the table below as many times as necessary to complete for each OU evaluated in the FYR report.*

<i>Operable Unit:</i> 2 - Groundwater	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> N/A
<p><i>Protectiveness Statement:</i> The remedial actions at OU 2, Site SS-003 and SS-009 are protective of human health and the environment and are anticipated to remain protective in the future. Groundwater at the former Richards-Gebaur AFB is not currently used for any purpose, and LUCs prohibiting extraction and use of groundwater at OU 2 Site SS-003 and Site SS-009 are adequate to ensure that exposures do not occur in the future. The LTM program supports the LUCs and allows periodic evaluation of groundwater quality to help ensure that the LUC boundaries fully encompass the contaminant plume and remain protective of human health and the environment. Overall, COC concentrations indicate that the groundwater plumes remain inside the LUC boundaries at both sites, and there is no indication that off-site migration is occurring.</p>		

<b>Sitewide Protectiveness Statement (if applicable)</b>			
<i>For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.</i>			
<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> N/A		
<p><i>Protectiveness Statement:</i> The remedy at OU2 Groundwater at Sites SS-003 and SS-009 is protective of human health and the environment. (The first Five-Year Review addressed both OUs 1 and 2. OU 1 Sites included FT002 and ST005. OU 2 Sites included SS003, SS006, SS009, SS012, ST005 and ST011. This second Five-Year review will address OU 2 Sites SS-003 and SS-009 which are under the responsibility of the United States Marine Corps (USMC). The other sites will be addressed in a separate Five-Year Review document prepared by United States Air Force (USAF).)</p>			

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## ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
AFB	Air Force Base
AFRPA	Air Force Real Property Agency
AR	Administrative Record
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action—Navy
COC	chemical of concern
CSM	Conceptual Site Model
DCE	dichloroethene
FOST	Finding of Suitability for Transfer
HVAC	Heating, Ventilation and Air Conditioning
IC	Institutional controls
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
J&E	Johnson and Ettinger
LTM	long-term monitoring
LUC	land use control
µg/L	micrograms per liter
µg/	micrograms per meter cubed
MCL	Maximum Contaminant Level
MDNR	Missouri Department of Natural Resources
MNA	monitored natural attenuation
MW	monitoring well
MOA	Memorandum of Agreement
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCP	National Contingency Plan
NPL	National Priorities List
OU	operable unit
PCE	tetrachloroethene
ppb	parts per billion
RRG	Preliminary Remediation Goal
PRB	permeable reactive barrier
RA	remedial action
RAB	Restoration Advisory Board
RACG	Remedial Action Cleanup Goals

RAO	remedial action objective
RBC	risk-based concentration
RD	Remedial Design
Rfc	reference concentration
RfD	Reference Dose
RI	Remedial Investigation
ROD	Record of Decision
RSL	risk-based screening level
SARA	Superfund Amendments and Reauthorization Act
SI	Site Investigation
SVOC	semivolatile organic compound
TCE	trichloroethene
TPH	total petroleum hydrocarbons
URF	unit risk factor
USMC	United States Marine Corps
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UU/UE	unrestricted use and unlimited exposure
VI	vapor intrusion
VOC	volatile organic compound

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## 1.0 INTRODUCTION

The Department of Navy (Navy), the lead agency, conducted this Five-Year Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) review at the former Richards-Gebaur Air Force Base (AFB) with regulatory oversight from the United States Environmental Protection Agency (USEPA) Region 7 and the Missouri Department of Natural Resources (MDNR). The Five-Year Review was prepared in accordance with the USEPA *Comprehensive Five-Year Review Guidance* [Reference 1]. This document addresses remedies and Remedial Actions (RAs) that have been implemented within operable unit (OU) 2 Groundwater, Sites SS-003 Oil Saturated Area and SS-009 Fire Valve Area for which there is a Record of Decision (ROD) in place.

The objective of this Five-Year Review is to evaluate current remedies at former Richards-Gebaur AFB and to determine whether the remedies remain protective of human health and the environment in accordance with the requirements outlined in the ROD. The protectiveness of the remedies was evaluated through review of reports, site visits and inspections, and community involvement. In addition, the objective of the Five-Year Review Report is to identify any issues found during the review, if any, and recommendations to address them.

The Navy prepared this Five-Year Review Report pursuant to CERCLA 121 and the National Contingency Plan (NCP). CERCLA Section 121 states:

*If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

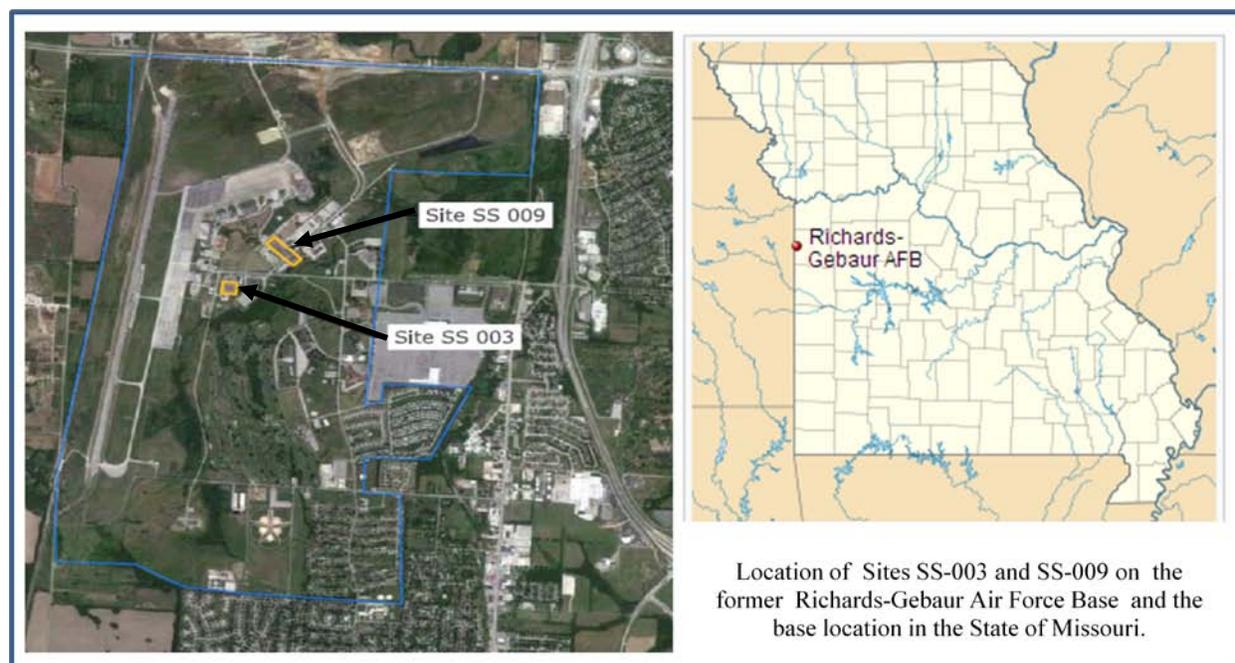
The USEPA interpreted this requirement further in the NCP as stated in 40 Code of Federal Regulations (CFR) 300.430 (f)(4)(ii):

*If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The statutory review process was initiated based on implementation of Land Use Controls (LUCs) at OU 2 in August 2002. The first Five-Year Review was completed September 2007, [Reference 2]. The first Five-Year Review addressed both OUs 1 and 2. OU 1 Sites included FT002 and ST005. OU 2 Sites included SS003, SS006, SS009, SS012, ST005 and ST011. This

second Five-Year review will address OU 2 Sites SS-003 and SS-009 which are under the responsibility of the United States Marine Corps (USMC). The other sites will be addressed in a separate Five-Year Review document prepared by United States Air Force (USAF). The current Five-Year Review for OU 2 Sites SS-003 and SS-009 is required because hazardous contaminants remain at concentrations exceeding criteria that allow for unlimited use and unrestricted exposure (UU/UE).

The Navy conducted this five-year review of the remedial actions implemented at the former Richards-Gebaur AFB, OU 2 Sites SS-003 and SS-009 in Kansas City, Missouri (Figure 1-1) from December, 2011 through September 2012. This report documents the results of that review. Resolutions Consultants conducted the 2011 site visits and data analysis from the long term monitoring results as a task order under the Navy's Naval Facilities Engineering Command (NAVFAC) Atlantic Comprehensive Long-term Environmental Action Navy (CLEAN) Contract Number N62470-11-D-8013. HydroGeoLogic, Inc. conducted the 2007, 2008, 2009, and 2010 site visits and data analysis from the long term monitoring results as a task order under the contract the USAF Contract Number FA8903-10-D-8596-0028. Technical support for the technical assessment was provided by the Navy and Marine Corps Public Health Center.



**Figure 1-1. Location of Base and Sites**

## 1.1 Facility Background

Richards-Gebaur AFB was originally established in 1953 as Grandview AFB. The installation was operated by the Air/Aerospace Defense Command until 1970, when the Air Forces Communication Service relocated its headquarters from Scott AFB, Illinois to Richards-Gebaur AFB, and assumed command. In 1977, the Air Force Communication Service moved back to Scott AFB and Richards-Gebaur AFB became a Military Airlift Command base. The Air Force Reserves assumed operational control of the installation in 1980 and remained the host organization until the installation closed in 1994 [Reference 2].

A Memorandum of Agreement (MOA) was signed in 1998 providing for the transfer of the management and execution management responsibilities of the Installation Restoration Program (IRP) from the Air Force Conversion Agency to the United States Marine Corps (USMC) [Reference 3]. As part of this MOA, the Air Force Base Conversion Agency agreed to complete actions at IRP sites SS-003 and SS-009, and obtain the necessary no further action, closure and decision documents from the appropriate regulatory agencies.

The MOA was amended in 2004 [Reference 4] to indicate that the USAF would remain responsible for groundwater monitoring and implementation of land use control measures at the site until Fiscal Year 2007, including the five year review program review in Fiscal Year 2007, after which point the USMC assumed responsibility. The property was formally transferred to the USMC in January of 2005.

In December 2011, City of Kansas City, Missouri accepted the Quitclaim Deed for approximately 0.378 acres of land for Homeless Provider Assistance under the provisions of 42 USC § 11411. This property is a portion of parcel O formerly owned by the MCSC and described in the Finding of Suitability for Transfer (FOST) dated April 2006 [Reference 5]. This area is also within the boundaries of Site SS-009 and therefore constrained by the environmental requirements applicable to that site. The City of Kansas City, Missouri entered a legally binding agreement dated January 20, 2011 with Heart N Hand Ministries, a Missouri non-profit corporation. Heart N Hands uses the property for warehousing purposes only. There is no residential use of the property by Heart N Hand in support of homeless persons. The use of the property for transitional housing or other residential purpose is restricted and any use of the property for that purpose would require additional actions and approvals.

The FOST addresses the entire 8.40 acres making up Parcel O which included the 0.378 acres previously transferred to the Heart N Hands Ministries as well as the remaining 8.022 acres which was transferred to the Kansas City Port Authority on May 22, 2012 for the intended use as an intermodal freight hub support facility.

The Navy currently manages the USMC environmental restoration program at SS-003 and SS-009. The chronology of the property environmental responsibility and ownership are included in Table 1-1.

**Table 1-1. Chronology of Ownership and Environmental Responsibility**

Timeframe	Site Description	Property Ownership	DoD Environmental Responsibility	Documentation
Prior 1941	Agriculture, Pasture, Undeveloped	Non-DoD	N/A	N/A
1941 – 1953	Grandview Airport	Non-DoD	N/A	N/A
1953 – 1994	Richards-Gebaur AFB	USAF	USAF	N/A
1994 – 1998	Air Force Real Property Agency (AFRPA) and Army Corps	AFRPA and Army Corps	AFRPA and Army Corps	Base Closure and Realignment Act of 1990
1998	Sites SS-003 and SS-009	USMC	AFB Conversion Agency	MOA dated August, 1998
2007	Sites SS-003 and SS-009	USMC	USMC	Amendment to MOA dated December 2004
2006	Site SS-009, Parcel O	USMC	USMC	FOST dated April 2006 – suitable for transfer
2011	Site SS-009, Parcel O (partial), 0.387 Acres	City of Kansas City, Missouri	Navy	Quitclaim Deed dated December 2011, transfer to Heart N Hands Ministries
2011	Site SS-009, Parcel O (full parcel), 8.40 Acres	City of Kansas City, Missouri	Navy	FOST dated October 2011 – suitable for transfer
2012	Site SS-009, Parcel O, 8.013 Acres	Kansas City Port Authority	Navy	Quitclaim Deed dated May 2011 – Transfer to Kansas City Port Authority

## 1.2 Report Organization

The Five-Year Review for the former Richards-Gebaur AFB, OU 2, Sites SS-003 and SS-009 is organized as follows:

- **Executive Summary** - Five-Year Review process. A summary table of OU 2 Sites SS-003 and SS-009, documents reviewed, Remedial Action Objectives (RAOs), and Remedy Components is provided as **Table ES-1**. This table also summarizes the protectiveness statements and recommendations.
- **Section 1**- Introduction and purpose of Five-Year Review. Includes the background of Richards-Gebaur AFB, Sites SS-003 and SS-009 and the chronology of ownership and environmental responsibilities.
- **Section 2** - Description of the Five-Year Review process, including administrative components, site inspections, community involvement, interviews and the team members.
- **Section 3** – Background information on Sites SS-003 and SS-009, including the physical characteristics, land and resource use, history of contamination, initial response and the basis for taking action.

- **Section 4** – RAs including the RAOs, the selected remedy, Remedial Action Cleanup Goals (RACGs), cost, and progress since last Five-Year Review.
- **Section 5** – Technical assessment including responses to questions.
- **Section 6** – Issues
- **Section 7** – Recommendations and Follow-up Actions
- **Section 8** - Protectiveness Statements
- **Section 9** – Next Review

References and Appendices are provided at the end of the document.

## **2.0 FIVE YEAR REVIEW PROCESS**

The Five-Year Review for the former Richards-Gebaur AFB, OU 2, Sites SS-003 and SS-009 was conducted in accordance with the *Comprehensive Five-Year Review Guidance* [Reference 1]. Remedy protectiveness for OU 2, Sites SS-003 and SS-009 was evaluated through document reviews, site inspections, and community involvement activities as described in the subsections below.

### **2.1 Document Review**

This Five-Year Review consisted of a review of site-specific documentation for each site. First, the ROD for OU 2 [Reference 6] was reviewed to identify the potential risks to human health and the environment, RAOs, selected remedy, and applicable or relevant and appropriate requirements (ARARs). The Long Term Monitoring Plan for Groundwater (Operable Unit-2) [Reference 6] was then reviewed to evaluate the design components for the remedy, monitoring requirements, and LUC boundaries. To confirm that the remedies were operational and functional in accordance with the RAOs, monitoring reports; including Land Use Controls/Institutional Control Management Plan [Reference 8] and Long-term Monitoring (LTM) Reports; were also reviewed to assess remedy performance and continued protection of human health and the environment.

**Table ES-1** summarizes the documents reviewed for each site.

### **2.2 Site Inspections**

Annual site inspections were conducted from 2007 through 2011 as part of the annual LUC monitoring program and will continue to be conducted until the RAOs established in the ROD for OU 2 are met for sites SS-003 and SS-009. The dates and specific information for each

LUC/Institutional Controls (ICs) inspection is provided in table 2-1. Additional site inspections were not deemed necessary for the five year review.

**Table 2-1. Documentation of LUC Inspections**

<b>Site SS-003 Oil Saturated Area</b>				
<b>Date of Inspection</b>	<b>Reason for Inspection</b>	<b>Inspector</b>	<b>Activities and Documentation of Completed Checklists</b>	<b>Results</b>
October 1, 2007	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, Annual Monitoring Report for Site SS-003, August 200	No violations or concerns noted.
November 6, 2008	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, 2008 Annual Monitoring Report for Site SS- 003, September 2009	No violations or concerns noted.
November 24, 2009	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, 2009 Basewide Groundwater and Land Use Controls/Institutional Controls Monitoring Report, July 2011	A land disturbance was noted, but there was no concern because the disturbance was associated with the well installation approved by the MDNR as part of LTM.
October 27, 2010	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, 2010 Basewide Groundwater and Land Use Controls/Institutional Controls Monitoring Report, August 2011	No violations or concerns noted.
December 22, 2011	LUC/IC Monitoring	Resolutions Consultants	Site Visit, Draft 2011 Groundwater Monitoring and Land Use Controls Report, May 2012	No violations or concerns noted.
<b>Site SS-009 Fire Valve Area</b>				
<b>Date of Inspection</b>	<b>Reason for Inspection</b>	<b>Inspector</b>	<b>Activities and Documentation of Completed Checklists</b>	<b>Results</b>
October 1, 2007	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, Annual Monitoring Report for Site SS 009, August 2009	No violations or concerns noted.
November 6, 2008	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, 2008 Annual Monitoring Report for Site SS009, September 2009	No violations or concerns noted.
November 24, 2009	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, 2009 Basewide Groundwater and Land Use Controls/Institutional Controls Monitoring Report, July 2011	No violations or concerns noted.
October 27, 2010	LUC/IC Monitoring	HydroGeoLogic, Inc.	Site Visit, 2010 Basewide Groundwater and Land Use Controls/Institutional Controls Monitoring Report, August 2011	No violations or concerns noted.
December 22, 2011	LUC/IC Monitoring	Resolutions Consultants	Site Visit, Draft 2011 Groundwater Monitoring and Land Use Controls Report, May 2012	No violations or concerns noted.

## 2.3 Community Involvement

A public notice announcing the initiation of the five-year review was published in the Kansas City Star, a newspaper in the City of Kansas City, County of Jackson, State of Missouri on January 25, 2012 as shown in the affidavit included in Appendix A.

The final five-year review report will be placed in the information repository at Grandview Mid-Continent Public Library and the Administrative Record (AR). A second public notice will be published announcing the completion of the five-year review and its availability at the library. The restoration advisory board (RAB) for the former Richards-Gebaur AFB was adjourned in November 2003, based on unanimous agreement of the RAB members, and no response was received from public notices published in November 2005, to determine whether there was public interest in restarting the RAB as discussed in [Reference 2].

## 2.4 Interviews

Formal interviews by telephone were conducted with the USMC Reserves on May 14, 2012, Kansas City Port Authority on May 11, 2012 and the Heart N Hands Ministries on May 7, 2012. The results of the interviews were positive. The requests for points of contact and additional information were forwarded to the appropriate Navy and Kansas City Port Authority personnel. The details of the interviews are included in Appendix B.

Additional information was gathered from the Air Force, regulatory agencies, and current property owners on an “as needed” basis, through informal conversations, and project meetings. In particular, extensive information was captured regarding future land use, building use and characteristics, and regulatory requirements at project meetings on May 2, 2012.

## 2.5 Team Members

The USMC conducted the five-year review, in accordance with their role as the CERCLA lead agency for the former Richards-Gebaur AFB, OU 2 Sites SS-003 and SS-009, with technical support from the Navy.

- Janice Nielsen, NAVFAC Atlantic (LANT) was the team leader. She provided oversight of all aspects of the review and approved the final five-year review report.
- Timothy Riordan, P.E., NAVFAC LANT provided technical support, coordinated with stakeholders, attended site visits and provided oversight for the review.
- Donna Caldwell, P.G., NAVFAC LANT provided technical support and expertise for the vapor intrusion aspects of the review.

## 3.0 SITE HISTORY AND BACKGROUND

The former Richards-Gebaur AFB originally encompassed approximately 2,400 acres. It closed on September 30, 1994, pursuant to the Defense Base Closure and Realignment Act of 1990 and recommendations of the Defense Base Closure and Realignment Commission (BRAC). At base

closure, Richards-Gebaur AFB was comprised of 429 acres of land that included 244 acres in the main cantonment area and 185 acres at the Belton Training Complex.

OU 2 was established to address groundwater contamination issues on the 429 acres of land that remained under Air Force control at the time of base closure in 1994. Extensive groundwater investigation was conducted for OU 2 at locations across the installation and groundwater was found to have tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE), 1,1-DCE and vinyl chloride above the RACGs. Site SS-003 was found to have groundwater contaminated with TCE in excess of the RACGs and SS-009 was found to have groundwater contaminated with PCE, TCE, cis-1,2-DCE, 1,1-DCE and vinyl chloride in excess of the RACGs. [Reference 6]

The LTM and LUC remedy for all of the sites at Richards-Gebaur was selected and implemented by the Air Force, USEPA and MDNR in 2004 as documented in the Final Record of Decision (Operable Units 1 and 2) [Reference 2]. The Navy will continue to follow the guidelines and procedures described in the ROD for sites SS-003 and SS-009.

### 3.1 Site SS-003

Site SS-003, Oil Saturated Area (Figure 3-1) is located in the southern part of the former base, situated near the southeast corner of the intersection of East 155th Street and Bales Avenue and south of Building 703. The site was used to store waste oil products generated by vehicle maintenance from the mid-1950s to the late 1980s [Reference 9]. The site is currently used as a vehicle maintenance and storage facility known as the Humvee Area. The adjacent fenced area located south of the Humvee Area is used for base facility maintenance operations.

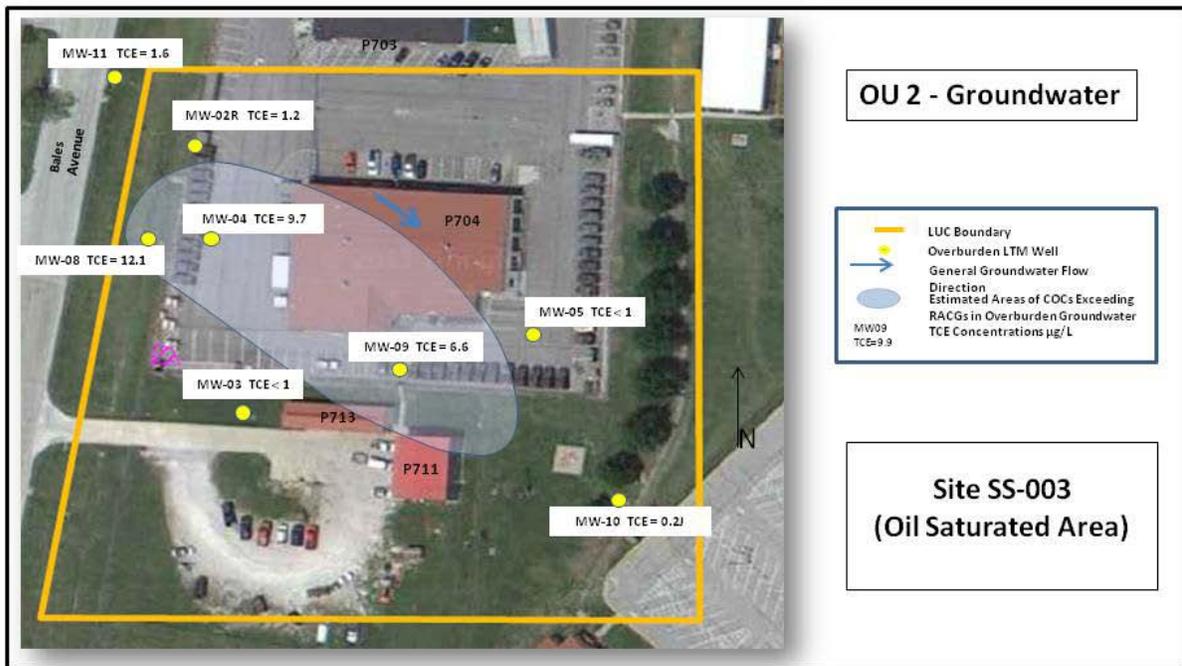


Figure 3-1. Site SS-003 Oil Saturated Area

Investigations in 1986 and 1989 identified a small area of total petroleum hydrocarbon (TPH) contamination in soil at the site. Approximately 42 cubic yards of contaminated soils were removed from the site in 1991 and 1992. Additional sampling conducted during the Remedial Investigation (RI) in 1999 to 2000 did not identify any additional soil contamination. This RI identified an area of chlorinated solvent groundwater contamination encompassing approximately 2.7 acres [Reference 2].

The source of the groundwater contamination is unknown, but is suspected to have originated from historical activities at the former waste oil storage area. The chemical of concern (COC) in groundwater at SS-003 is TCE, which has historically been detected at concentrations above the RACG. The highest groundwater concentrations have generally been located west and south of Building 703 [Reference 10].

The chronology of site events is shown on Table 3-1.

**Table 3-1. SS-003 – Chronology of Site Events**

Document	Date	Activities	AR #
<i>Installation Restoration Program Records Search for Richards-Gebaur Air Force Base, Missouri</i>	1983	Identified oil stained soil	2
<i>Soil Investigations</i>	1986 and 1989	Identified small area of petroleum hydrocarbon contamination in soil	N/A
<i>Installation Restoration Program Phase II Confirmation/Quantification, Stage 2</i>	July 1988	Collected soil, sediment, and surface water samples. Identified TPH compounds and lead at elevated concentrations in soil. Recommended excavation of affected soils. Concluded that impacted soil originated from a spill of waste oil previously stored at the site.	14, 15, 16
<i>Remedial Investigation (RI) at Richards-Gebaur Air Force Base, Belton, Missouri, for, FT002 – North Burn Pit, SS003 – Oil Saturated Area, SS004 – Hazardous Waste Drum Storage, ST005 – POL Storage Yard</i>	October 1991	Collected additional soil samples and evaluated concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals. Identified no additional areas of contamination and determined that existing impacts had not migrated off-site. A risk assessment was performed and concluded that potential risk was limited to direct contact of soil by site workers.	37
<i>Interim Remedial Action for SS003, Oil Saturated Area &amp; SS004, Hazardous Waste Drum Storage, Final Closure Report</i>	September 1992	Performed excavation of approximately 42 cubic yards of soil contaminated with TPH and lead. The area was backfilled with clean fill and resurfaced to match original conditions.	47
<i>Final Preliminary Groundwater Assessment, Oil Saturated Area SS003, Hazardous Waste Storage Area (SS004), Hazardous Materials Storage (SS006), and Fire Valve Area (SS009)</i>	November 1996	Installed three monitoring wells to evaluate site groundwater. Results indicated that all concentrations (TPH, VOCs, and metals) were below maximum contaminant levels (MCLs). Site was recommended for closure because source was previously excavated and no groundwater impacts were identified.	140
<i>Remedial Strategies for VOCs in Groundwater</i>	September 29, 2000	Development of strategy to address VOCs in groundwater. Evaluated remedial alternatives. Recommended pursuing a Negligible Impact on Water Quality determination with Monitored Natural Attenuation (MNA) as a contingency.	215
<i>Richards-Gebaur AFB Basewide Remedial Investigation (SS 003 Oil Saturated Area), RI Report</i>	December 2000	Installation and sampling of groundwater MWs; TCE was detected in concentrations above RACGs in four wells. Goals were to delineate the nature and extent of contamination in soil and groundwater, and to characterize risks posed by the site to human health and the environment.	285

Document	Date	Activities	AR #
<i>Results of October 2000 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	February 26, 2001	First monitoring event for the quarterly groundwater monitoring program established based on the 1999 Basewide RI. Objectives were to determine whether groundwater contamination was delineated, to evaluate trends of COC concentrations, and to investigate the potential for MNA. TCE was detected above the regulatory limit in five wells. It was recommended that MW- 006 be added to the quarterly groundwater monitoring program.	216
<i>Results of January 2001 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	May 8, 2001	TCE was detected above screening levels in four wells. Results were consistent with previous events and site was adequately delineated.	217
<i>Results of April 2001 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	July 9, 2001	TCE was detected above screening levels in four wells. Results were consistent with previous events and site was adequately delineated.	218
<i>Results of October 2001 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	March 13, 2002	TCE was detected above screening levels in three wells. Results were consistent with previous events and site was adequately delineated.	209
<i>Final Feasibility Study for Groundwater (Operable Unit– 2)</i>	November 2002	Developed and evaluated remedial action alternatives for site groundwater. Identified RAOs for groundwater. Developed and evaluated remedial alternatives for groundwater.	396
<i>Final Record of Decision(Operable Units 1 and 2)</i>	June 2004	Set forth the selected remedial action alternative of LTM and implementation of LUCs.	395
<i>Land Use Control/Institutional Control Management Plan</i>	August 2005	Implementation, monitoring, and enforcement of LUCs and institutional controls (ICs) to prevent exposure of VOCs in groundwater.	393
<i>Final Technical Memorandum for Long-Term Monitoring, April 2006 Semiannual Sampling Event</i>	October 2006	Performed semiannual sampling of groundwater in accordance with the LTM and LUC/IC remedy. TCE exceeded the RACG in three wells.	303
<i>Former Richards-Gebaur AFB Five-Year Review Report, Final</i>	March 2007	Review of groundwater monitoring data since 2002. Recommended installation of a new well upgradient of site and performance of a vapor intrusion risk evaluation after USEPA revises the toxicity factors for TCE. Also included recommendations to reduce monitoring frequency to annual, with the exception of the new upgradient well, which should be sampled on a semiannual basis.	389
<i>Final 2006 Annual Monitoring Report</i>	October 2007	Provided a summary of the April and October 2006 semiannual monitoring events and the LUC/IC activities performed in October 2006. TCE was detected at concentrations exceeding the RACG in three wells.	391
<i>Final Annual Monitoring Report for Site SS 003</i>	August 2009	Provided a summary of the April 2007 sampling events and the LUC/IC activities. Monitoring frequency reduced from semiannually to annually in 2007. TCE was detected at concentrations exceeding the RAGG in three wells.	N/A
<i>Final 2008 Annual Monitoring Report for Site SS 003</i>	September 2009	Provided a summary of the October 2008 sampling event and the LUC/IC activities. TCE was detected at concentrations exceeding the RACG in three wells.	N/A
<i>Final 2009 LTM Sampling and Groundwater Modeling Report</i>	July 2011	Provided a summary of the October 2009 sampling event and the LUC/IC activities. Upgradient well installed. TCE was detected at concentrations exceeding the RACG in three wells.	N/A
<i>Final 2010 Basewide Groundwater and Land Use Controls Monitoring Report</i>	August 2011	Provided a summary of the October 2010 sampling event and the LUC/IC activities. TCE was detected at concentrations exceeding the RAGG but the plume is stable or shrinking.	N/A
<i>Draft 2011 Groundwater Monitoring and Land Use Controls Report</i>	May 2012	Provided a summary of the December 2011 sampling event and the LUC/IC activities. TCE was detected at concentrations exceeding RAGGs. An analysis of the data indicates the groundwater contamination plumes are stable or decreasing in concentration.	N/A

### 3.2 Site SS-009

Site SS-009, Fire Valve Area (Figure 3-2) is located on relatively level ground in the southeastern portion of the installation and consists of two parcels. One parcel of the SS-009 site is located between Westover Road and Andrews Road and consists of several buildings including Building 605. The other parcel of Site SS-009 is located southeast of Building 605 and is situated between Andrews Road and Scope Creek. This parcel contains the former Navy dental clinic (Building 601) and is vacant. Site SS-009 was part of the Civil Engineering Complex and was in use by the Air Force from 1955 until 1994 [Reference 2]. During this time, Building 605 was used for various purposes, including a carpenter shop, roads and grounds shop, and sanitation shop. Building 609 was used as a hazardous waste storage area but has since been properly closed. The larger Building 605 is vacant and Building 607 has been demolished.

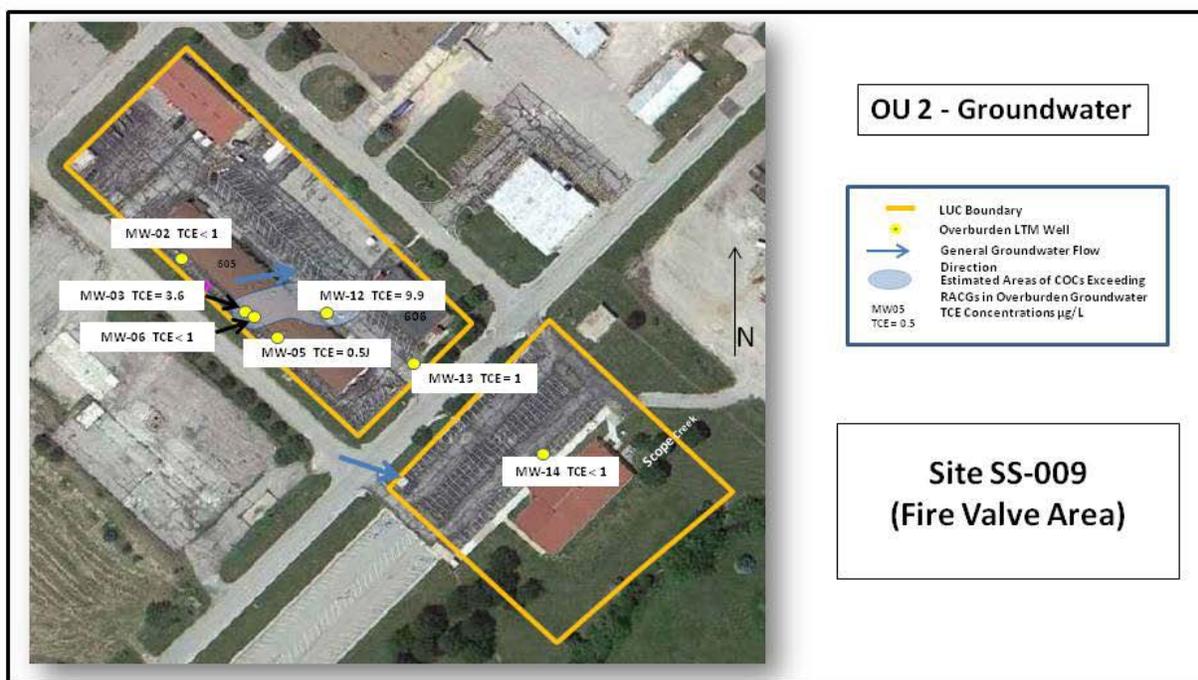


Figure 3-2. Site SS-009 Fire Valve Area

In 1992, petroleum-contaminated soils were discovered during repair of an underground water valve on site. Approximately 10 cubic yards of petroleum-contaminated soils were excavated from the site in 1993 [Reference 12]. Supplemental investigations did not identify additional soil contamination; however, an approximately 0.7-acre area of groundwater impacted by chlorinated solvents was identified during a subsequent investigation [Reference 6]. The source of the groundwater contamination was not determined, but is believed to be related to spills in the drainage swale adjacent to the fire valve located at the site. COCs in groundwater that have been detected above RACGs are 1,1-DCE; cis-1,2-DCE; PCE; TCE; and vinyl chloride. The source of this chlorinated solvent groundwater contamination was theorized to be related to spills that entered the drainage swale near a fire valve [Reference 12]. Groundwater contamination migrated under Building 605 and extended southeast to an area near Andrews Road.

The site chronology is shown in Tables 3-2.

**Table 3-2. SS-009 – Chronology of Site Events**

Document	Date	Activities	AR #
<i>Installation Restoration Program (IRP) Final Technical Report for Preliminary Assessment / Site Investigation of IRP Site SS009</i>	September 29, 1995	Delineated area of impacted soil discovered and removed during a March 1992 repair of a water line at the site. Collected soil samples; results indicated that a potential for TPH contamination in groundwater existed. A qualitative risk evaluation found no significant impacts or risks to human health or the environment in site soils. The report recommended pursuing a No Further Response Action for soil. Further investigation was recommended for groundwater.	352
<i>Final Preliminary Groundwater Assessment, Oil Saturated Area (SS003), Hazardous Waste Storage Area (SS004), Hazardous Materials Storage (SS006), and Fire Valve Area (SS009)</i>	November 1996	Installed two temporary wells for the evaluation of VOCs, TPH, semi-volatile organic compounds, metals, and polychlorinated biphenyls in groundwater. VOCs and metals were detected above MCLs. Site was recommended for closure because source was previously removed, exceedances in groundwater were detected slightly above one order of magnitude over MCLs, and the groundwater exposure pathway was incomplete.	140
<i>Remedial Strategies for VOCs in Groundwater</i>	September 29, 2000	Development of strategy to address VOCs in groundwater. Evaluated remedial alternatives. Recommended pursuing a Negligible Impact on Water Quality determination with Monitored Natural Attenuation (MNA) as a contingency.	215
<i>Richards-Gebaur AFB Basewide Remedial Investigation (SS 009 Fire Valve Area), RI Report</i>	December 2000	Installation and sampling of groundwater monitoring wells; PCE; TCE; cis-1,2-DCE; 1,1-DCE and VC were detected above RACGs in two wells. Goals were to delineate the nature and extent of contamination in soil and groundwater, and to characterize risks posed by the site to human health and the environment.	274
<i>Results of October 2000 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	February 26, 2001	First monitoring event for the quarterly groundwater monitoring program established based on the 1999 Basewide RI. Objectives were to determine whether groundwater contamination was delineated, to evaluate trends of COC concentrations, and to investigate the potential for MNA. VOCs were detected above the regulatory limit in well Monitoring Well (MW)-003. It was recommended that MW-009 be added to the quarterly groundwater monitoring program.	216
<i>Results of January 2001 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	May 8, 2001	VOCs were detected above screening levels in well MW-003. Results were consistent with previous events and site was adequately delineated.	217
<i>Results of April 2001 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	July 9, 2001	VOCs were detected above screening levels in wells MW-003 and MW-009. Results were consistent with previous events and site was adequately delineated.	218
<i>Results of October 2001 Quarterly Groundwater Monitoring at Richards-Gebaur Air Force Base</i>	March 13, 2002	VOCs were detected above screening levels in wells MW-003 and MW-009. Results were consistent with previous events and site was adequately delineated.	209
<i>Final Feasibility Study for Groundwater (Operable Unit– 2)</i>	November 2002	Developed and evaluated remedial action alternatives for site groundwater. Identified RAOs for groundwater.	396
<i>Final Record of Decision (Operable Units 1 and 2)</i>	June 2004	Developed and evaluated remedial alternatives for groundwater. Set forth the selected remedial action alternative of LTM and implementation of LUCs.	395
<i>Land Use Control/Institutional Control Management Plan</i>	August 2005	Implementation, monitoring, and enforcement of LUCs and ICs to prevent exposure of VOCs in groundwater.	393

Document	Date	Activities	AR #
<i>Final Technical Memorandum for Long-Term Monitoring, April 2006 Semiannual Sampling Event</i>	October 2006	Performed semiannual sampling of groundwater in accordance with the LTM and LUC/IC remedy. TCE exceeded the RACG in three wells.	303
<i>Former Richards-Gebaur AFB Five-Year Review Report, Final</i>	March 2007	Review of groundwater monitoring data since 2002. The report recommended installation of a new well upgradient of site and performance of a vapor intrusion risk evaluation after USEPA revises the toxicity factors for TCE. Also included recommendations to reduce monitoring frequency to annual, with the exception of the new upgradient well, which should be sampled on a semiannual basis.	389
<i>Final 2006 Annual Monitoring Report</i>	October 2007	Provided a summary of the April and October 2006 semiannual monitoring events and the LUC/IC activities performed in October 2006. VOCs were detected at concentrations exceeding RACGs in two wells.	391
<i>Final Annual Monitoring Report for Site SS 009</i>	August 2009	Provided a summary of the April 2007 sampling events and the LUC/IC activities. Monitoring frequency reduced from semiannually to annually in 2007. PCE, TCE, Cis-1,2-DCE, and vinyl chloride was detected at concentrations exceeding the RAGGs.	N/A
<i>Final 2008 Annual Monitoring Report for Site SS 009</i>	September 2009	Provided a summary of the October 2008 sampling event and the LUC/IC activities. PCE, TCE, Cis-1,2-DCE, and vinyl chloride was detected at concentrations exceeding the RAGGs.	N/A
<i>Final 2009 LTM Sampling and Groundwater Modeling Report</i>	July 2011	Provided a summary of the October 2009 sampling event and the LUC/IC activities. PCE, TCE, Cis-1,2-DCE, and vinyl chloride was detected at concentrations exceeding the RAGGs.	N/A
<i>Final 2010 Basewide Groundwater and Land Use Controls Monitoring Report</i>	August 2011	Provided a summary of the October 2010 sampling event and the LUC/IC activities. VOCs were detected at concentrations exceeding the RAGG but the plume is stable or shrinking.	N/A
<i>Draft 2011 Groundwater Monitoring and Land Use Controls Report</i>	May 2012	Provided a summary of the December 2011 sampling event and the LUC/IC activities. VOC's were detected at concentrations exceeding RAGGs. An analysis of the data indicates the groundwater contamination plumes are stable or decreasing in concentration.	N/A

### 3.3 Conceptual Site Model

The former Richards-Gebaur AFB is located in the Osage Plains groundwater province of the Central Lowland Non-glaciated Plains region. Groundwater is present in both the unconsolidated overburden soils and in the weathered limestone and shale bedrock. The presence of shallow groundwater in unconsolidated overburden soils and weathered near-surface bedrock is largely dependent on seasonal rainfall. Groundwater collects and resides in the transition zone between the soil overburden and weathered bedrock and is typically present as a perched groundwater zone. This perched zone is not laterally continuous across the base and frequently pinches out within the boundaries of the OU-2 sites, which inhibits horizontal movement of groundwater and associated contaminants, if present, within this zone. This perched groundwater zone is hydraulically connected to the underlying weathered limestone and, depending on the area, the underlying weathered shale. However, the relatively impermeable, deeper underlying consolidated shale layer limits vertical groundwater movement. Low-flow velocities predominate within the shallow groundwater zone and near stagnant groundwater conditions are common during extended periods of little or no precipitation. When present in sufficient quantity, shallow groundwater flow occurs in the soil overburden-weathered bedrock interfacial zone and the flow

direction typically follows surface topography. The topography ranges from 960 feet above mean sea level (amsl) on the northeast side of the AFB to 1,125 feet amsl on the south property margin. Dependent on seasonal rainfall and laterally discontinuous across the AFB, perched groundwater is present in the transition zone between the soil overburden and weathered bedrock. Shallow groundwater flow mimics topography with low flow velocities, and near stagnant groundwater conditions are common during extended periods of little or no precipitation. The conceptual site models for SS-003 and SS-009 are illustrated on Figures 3-3 and 3-4, respectively.

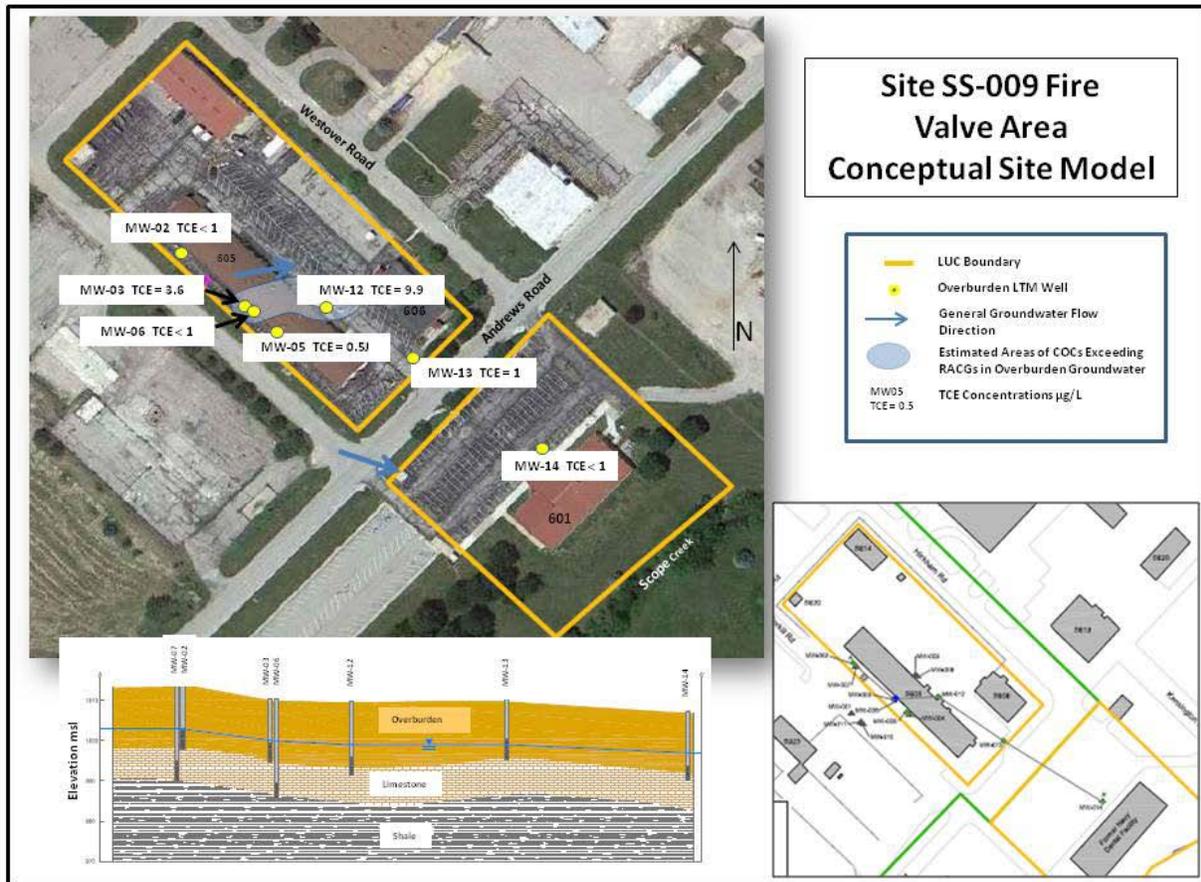
Groundwater is present in overburden soils at SS-003 generally between four to seven feet below ground surface (bgs). Borings advanced at SS-003 documented 15 to 20 feet of low to medium plasticity silty clay overburden underlain by up to 10 feet of weathered shale bedrock [Reference 10]. Groundwater flow is estimated to be less than 10 feet per year and flows to the east. Figure 3-3 shows the SS-003 monitoring well network, geologic setting, and distribution of TCE in shallow groundwater.



Figure 3-3. Site SS-003 Oil Saturated Area Conceptual Site Model

Groundwater is also present in overburden soils at SS-009 generally between six to ten feet bgs. The overburden is underlain by limestone and the limestone is underlain by shale. Groundwater flow is to the east at a low velocity on the order of less than 1 foot per year [Reference 10]. Figure 3-4 shows the SS-009 monitoring well network, geologic setting, and distribution of COCs in shallow groundwater.

As a result of the past storage and handling of solvents; VOC's are present in groundwater at both sites at concentrations slightly above remedial action goals. Impacted soils were removed from both sites prior to implementation of the groundwater LTM.



**Figure 3-4. Site SS-009 Fire Valve Area Conceptual Site Model**

The Conceptual Site Model (CSM) for each site includes consideration of potential risks to human and ecological receptors for current and reasonably anticipated future land use. A Tier 1 qualitative ecological exposure assessment concluded that there are no unacceptable ecological risks at Sites SS-003 and SS-009 [Reference 10].

Potential human health risks from exposure to site media were evaluated for: current/future site workers, current/future construction workers, current/future trespassers, and future residents

[Reference 10]. Current LUCs prohibit residential use. Because all contaminated soils have been removed from Sites SS-003 and SS-009, potential exposure to soil via incidental ingestion, dermal absorption, and inhalation of airborne particulates and soil source vapors by human receptors does not exist. Additionally, potential exposure pathways to surface water and sediment are incomplete because receptors would have negligible potential for contact with sediment and surface water in the drainage ditch at Site SS-003. Exposure pathways to groundwater through ingestion and dermal contact for current/future construction workers any incidental contact via construction worker to groundwater is not expected to pose unacceptable risk. Construction workers may expose ground water. Per OSHA requirements, work plans would notify workers that ground water might be contaminated, and appropriate precautions instituted, thus essentially eliminating the possibility of exposure through ingestion or dermal contact. While inhalation exposure is possible from vaporization of chemicals from exposed ground water, it is expected that both the magnitude and duration would be sufficiently small as to pose an insignificant risk. The vapor intrusion model demonstrates a risk below regulatory concern for vaporization from the totality of the ground water and dilution into a room. Vaporization from a smaller surface area of part of the ground water plus the greater dilution of outdoors (as contrasted with a room) would be expected to pose a lower risk, as the same physical and chemical properties govern both processes. Exposure pathways to groundwater through ingestion and dermal contact are incomplete under current and future conditions for current/future site workers, current/future trespassers, and future residents because there are no potable water supply wells and potable water at the Base is obtained from the Kansas City Water and Pollution Control Department. Because of poor quality and low yield of area groundwater, potable water is supplied by the City; exposure to groundwater for potable residential use is therefore considered an incomplete exposure pathway. The ROD included prohibiting groundwater extraction or use so as to eliminate this potential exposure pathway [Reference 6]. Current/future trespassers exposure to groundwater is considered to be an incomplete pathway as trespassers are unlikely to come into contact with groundwater.

The vapor intrusion pathway (volatilization of VOCs from groundwater beneath the building to soil gas and then to indoor air) was evaluated as part of this and previous Five-Year Reviews to assess potential risks to current/future site workers and potential future residence within 100 feet of impacted groundwater at Sites SS-003 and SS-009. Current/future construction workers may have the potential for dermal absorption and/or inhalation exposure to shallow groundwater at Sites SS-003 and SS-009 during excavation activities that extend below the water table but this activity will require approval from regulatory agencies prior to any excavation.

### **3.4 Basis for Action**

The response actions selected in the ROD for OU 2 Groundwater for Sites SS-003 and SS-009 are necessary to protect public health and the environment from actual or threatened releases of pollutants or contaminants that may present a substantial endangerment to public health or the environment.

For OU 2 Groundwater, the implementation of LUCs, supported by LTM, represents the final remedy for Site SS-003 and SS-009, which have VOCs in groundwater. The LUCs will prevent

potential risks posed by exposure to groundwater by prohibiting extraction and any use of the contaminated groundwater at both of the sites. Risks to future residents or workers from exposure to indoor air that is potentially contaminated as a result of VOC volatilization from groundwater is discussed in this Five-Year Review Report (Section 5.3).

Although not addressed in the ROD, potential risk to future residents or current/future workers via the vapor intrusion pathway have been evaluated (Section 5.3 of this Five-Year Review Report) with no unacceptable risks for current or future receptors based on current groundwater concentrations as a vapor source. There is no basis for additional action for the vapor intrusion pathway.

## **4.0 REMEDIAL ACTIONS**

The ROD was signed in September 2004 and there have been no changes to OU 2 Groundwater remedy.

### **4.1 Remedial Action Objectives**

The ROD for OU 1 and OU 2 was signed in September 2004. Only OU 2 sites SS-003 and SS-009 are addressed in this Five-Year Review. The OU 1 sites and the OU 2 sites not included in this Five-Year Review are addressed in the Air Force Five-Year Review issued in September 2012.

- To prevent human exposure to contaminated groundwater with contaminant concentrations that pose risks greater than 1 x  $10^{-6}$  to 1 x  $10^{-5}$  (carcinogens) or a hazard index of 1 (noncarcinogens) for the reasonable maximum exposure scenario.

The property was transferred to the City of Kansas City (Site SS-009) in 2012 and the USMC (Site SS-003) in 2005. Restrictive covenants were placed in the Deed for Site SS-009 property use and restrictions were placed in the USMC's master plan to implement the LUCs. Appendix C provides the LUC boundaries for each site.

### **4.2 Remedial Action Clean Up Goals for OU 2**

The ROD established the following RACGs for OU 2:

Consistent with the RAO, chemical specific RAGCs were derived from published MCLs promulgated under the Federal Clean Water Act. Table 4-1 lists the RACGs that were established in the ROD for OU 2.

**Table 4-1. RACGs from ROD 2004 for OU 2**

Chemical	Groundwater Clean Up Goals*
PCE	5 ppb
TCE	5 ppb
Cis-1,2-DCE	70 ppb
1,1-DCE	7 ppb
Vinyl Chloride	2 ppb

\* The groundwater cleanup goals were based on MCLs in effect at the time of the remedy selection, none of which have changed; therefore all of the clean up levels remain valid.

### 4.3 Cost

Sites SS-003 and SS-009 were previously administered by the United States Air Force (USAF) as part of the former Richards- Gebaur Air Force base. 2011 was the first year the Navy was responsible for the LTM and LUC inspection program started by the USAF and their contractors. The USAF continues to perform LTM and LUC inspections at the remaining Richards-Gebaur sites. The costs associated with work performed at Sites SS-003 and SS-009 during Fiscal Year 2012 was estimated to be \$14,000 for SS-003 and \$30,000 for SS-009. The total amount of \$44,000 includes project planning, one annual groundwater monitoring event and LUC inspections, laboratory analysis, reporting, and IDW disposal as shown in [Reference 13].

### 4.4 Progress Since Last Five-Year Review

Based on groundwater monitoring conducted from November 1999 – November 2011 for Site SS-003 and July 1998 – December 2011 for Site SS-009, all of the chlorinated solvent containing plumes in OU 2 Site SS-003 and SS-009 are not moving and shrinking. Although concentrations have increased sporadically at individual monitoring wells, the overall nature and extent of contamination has remained consistent over time and within established LUC boundaries. The periodic increases were minimal and within expected concentrations based on previous levels detected. Therefore they periodic increases were not deemed to be substantial. The current and historic groundwater concentrations were plotted for trend analysis of the data from sites SS-003 and SS-009.

COC concentration trends in groundwater for site SS-003 are provided in Appendix D and the COC concentration trends in groundwater for site SS-009 are provided in Appendix E. TCE concentrations in groundwater at site SS-003 show a generally stable to slightly decreasing trend over time. A nominal increase in TCE was observed at Site SS-003 well MW-008; however, the concentration detected during the December 2011 monitoring event was well below the historical maximum.

In February 2005, it was determined that the TCE concentration in upgradient well MW-008 at site SS-003 exceeded the action trigger in the Decision Rules listed in the Final LTM Plan for

groundwater, requiring the installation of a new upgradient well. To satisfy the requirements of the Decision Rules, well MW-011 was installed in November 2009 to replace well MW-008 as the upgradient LTM well for SS-003. Well MW-011 contained a TCE concentration of 1.6 micrograms per liter during the Round 28 monitoring event. This result is below the RACG of 5 micrograms per liter but is higher than the previous sampling result.

At Site SS-009, COC concentrations in groundwater show generally decreasing to stable trends over time. COC concentrations were non-detect or decreasing in all wells with the exception of MW-012, which showed nominal increases in concentrations for all COCs. However, COC concentrations have fluctuated historically, and the concentrations detected during the Round 28 event were consistent with historical trends. Furthermore, the presence of 1,1-DCE; cis-1,2-DCE, TCE, and vinyl chloride is an indication that dechlorination of PCE is occurring. The overall trend of PCE at well MW-012 is decreasing, which provides another line of evidence that dechlorination is occurring at the site.

The concentrations of TCE in the upgradient well MW-011 are below the RACG of 5 µg/l as reported in the 2010, 2011 and 2012 long term monitoring reports. The results from sampling well MW-011 were reported as 0.3 U µg/l, 0.50 U µg/l and 1.6 µg/l in October of 2009, October of 2010 and December 2011, respectfully. Two results were flagged with a U, meaning the chemical was undetected and the numerical value is at or below the method detection limit. Overall, COC concentrations indicate that the groundwater plumes remain inside the LUC boundaries at both sites, and there is no indication that off-site migration is occurring.

An updated indoor air risk evaluation was conducted for Site SS-003 and SS-009.

## 5.0 TECHNICAL ASSESSMENT

As part of this second Five-Year review, OU 2 Sites SS-003 and SS-009 were reevaluated to determine if the remedies identified in the 2004 ROD remain protective of human health and the environment. The sites were reviewed to determine if:

- The remedy continues to function as intended by the ROD;
- Exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection remain valid; and
- If any additional information has come to light that would call into question the protectiveness of the remedy.

Each issue is addressed separately below.

### 5.1 Remedy Function

#### **Question A: Is the remedy functioning as intended by the decision documents?**

Yes. The LUCs required by the ROD (i.e., restrictions prohibiting extraction and use of groundwater and land surface activities that may interfere with or damage the on-site monitoring

wells) were included in the Deed at the time of property transfer for Site SS-009 to the City of Kansas City in Appendix F, Kansas City Port Authority in Appendix G and Site SS-003 in the USMC's Master Plan Appendix H. A LUC inspection was conducted annually in accordance with ROD requirements, and there was no evidence indicating that the LUCs had been breached at that time. Additional groundwater wells have not been installed with the exception of the one monitoring well installed at Site SS-003 as part of the on-going LTM, and groundwater is not extracted or used for any purpose, nor has any other significant development occurred on either of the OU 2 sites SS-003 and SS-009.

The costs associated with work performed at Sites SS-003 and SS-009 during Fiscal Year 2012 was estimated to be \$14,000 for SS-003 and \$30,000 for SS-009. The total amount of \$44,000 includes project planning, one annual groundwater monitoring event and LUC inspections, laboratory analysis, reporting, and IDW disposal as shown in [Reference 12].

## **5.2 Exposure Assumptions, Toxicity Data, Cleanup Levels, Remedial Action Objectives Validity**

### **Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?**

Yes. Exposure assumptions, cleanup levels, and RAOs used at the time of remedy selection remain valid. Although some toxicity data were updated, the remedy for potential risk remains valid. Each of these items was evaluated and summarized below.

**Exposure Assumptions:** Site usage at OU 2 Sites SS-003 and SS-009 remains commercial/light industrial in nature and groundwater at the sites is not used for any purpose. The vapor intrusion pathway was evaluated as part of this Five-Year Review and there are no unacceptable risks to current or future receptors; the current remedy therefore remains protective. Exposure to chemical vapors potentially volatilizing from any exposed ground water during any future construction would not pose an unacceptable risk, as the exposure is below that which was estimated from vapor intrusion, as the potential source is smaller, the dilution factor greater, and the same chemical and physical properties apply to modeling both pathways. Drinking water in and around the former Richards-Gebaur AFB is obtained from the Missouri River via the City of Kansas City Water Department. Under current and future anticipated land use controls no direct exposure pathway for groundwater exists at the OU 2 Sites SS-003 and SS-009, and there is no expectation that any direct exposure will occur in the future. Although highly unlikely given the current and anticipated site usage, the remedy for OU 2 was based on ingestion and direct contact with contaminated groundwater by future residents, which is conservative and protective of human health. LUCs imposed as part of the remedy will effectively ensure that no exposure to groundwater occurs.

The vapor intrusion pathway was evaluated as part of this Five-Year Review and there are no unacceptable risks to current or future receptors; the current remedy therefore remains protective.

**Screening Criteria and Toxicity Data:** The risk assessment conducted during the Basewide RI used EPA Region 9 Preliminary Remediation Goals (PRGs) that are now termed Regional Screening Levels (RSLs) and Federal MCLs as the primary source of risk-based screening criteria to identify COCs for further risk evaluation. In cases where the analytical reporting limit was greater than the RSL and/or MCL, the reporting limit was used as the default screening level as summarized in Table 5-1.

**Table 5-1. RACGs for Groundwater in µg/L (ppb)**

Chemical of Concern	PCE	TCE	cis-1,2-DCE	1,1-DCE	Vinyl Chloride
MCL-based RACG from ROD; same as 2012 MCL	5	5	70	7	2
2004 PRG*	0.1	0.028	61	340	0.02
2012 RSL*	9.7	0.44	28	260	0.015

\* <http://www.epa.gov/reg3hwmdlrisk/humanlrbcconcentration table/index.htm>

Several RSLs have changed since the risk assessment was completed during the first 5-year review in 2007. These changes are listed in table 5-2, and discussed below.

- **None of the MCLs that were used for the remedy selection in the ROD have changed. Therefore, remedy selection remains valid.**
- The RSL for PCE increased from 0.1 to 9.7 µg/L.
- The RSL for TCE increased from 0.028 to 0.44 µg/L.
- The RSL for 1,1-DCE decreased from 340 to 260 µg/L; however, the new value remains higher than the 0.046 µg/L that was operative when the criteria for ROD were established.

The RSL for cis-1,2-DCE has decreased from 61 to 28; for 1,1-DCE, from 340 to 260; for vinyl chloride from 0.2 to 0.15µg/L. However, the risk assessment conducted during the RI already concluded that some of the COCs posed a potential risk to human health at these sites, and the existing remedies (i.e., LUCs) prohibit extraction and any use of contaminated groundwater, which ensures that all human exposure pathways to groundwater will remain incomplete.

**Table 5-2. Comparison of Toxicity Data (Cancer Potency and Reference Doses, i.e., RfDs) for COCs**

Chemical	Cancer Oral Slope Factor			Change? Yes/No	Oral Reference Dose RfD			Change? Yes/No
	ROD 2004	Cancer 2007	Cancer 2012		ROD 2004	RfD 2007	RfD 2012	
PCE	-	5.4x10 <sup>-1</sup>	2.1x10 <sup>-3</sup>	yes***	-	1.0x10 <sup>-2</sup>	6.0x10 <sup>-3</sup>	yes
TCE	1.1x10 <sup>-2</sup>	4.0x10 <sup>-1</sup>	4.6x10 <sup>-2*</sup>	yes***	6.0x10 <sup>-3</sup>	3.0x10 <sup>-4</sup>	5.0x10 <sup>-4</sup>	yes***
cis-1,2-DCE	-	-	-	no	1.0x10 <sup>-2</sup>	1.0x10 <sup>-2</sup>	2.0x10 <sup>-3</sup>	yes
1,1-DCE	6.0x10 <sup>-1</sup>	-	-	no	9.0x10 <sup>-3</sup>	5.0x10 <sup>-2</sup>	5.0x10 <sup>-2</sup>	no
vinyl chloride	1.9	1.5**	1.5**	no	-	3.0x10 <sup>-3</sup>	3.0x10 <sup>-3</sup>	no
* Adult value. Mutagenic mode of action (MOA) for carcinogenicity increases cancer potency for children. ** Lifetime value. Adult exposure only value: 7.2x10 <sup>-1</sup> . *** Change makes chemical less toxic, therefore presents less risk.								

With two exceptions, the changes resulted in less conservative toxicity data than were used in the original risk assessment. The RfD for PCE has changed, but less than two-fold; moreover, as RfDs are considered accurate to within an order of magnitude, these values are considered fundamentally equivalent or were not substantial enough to significantly change the risk evaluation. The RfD for cis-1,2-DCE has decreased more substantially; however, the remedy in the ROD prevents consumption of the water until the concentrations meet the goals. Thus, the current remedy remains protective of human health.

**Remedial Action Objectives:** As described in Section 5.3, the RAO is to prevent exposure to groundwater with contaminant concentrations that pose risks greater than 1 x 10<sup>-6</sup> to 1 x 10<sup>-4</sup> or a hazard index of 1 for the reasonable maximum exposure scenario. This risk range remains consistent with EPA remedy selection requirements; therefore, the RAO remains valid.

**Cleanup Levels:** Table 5-1 lists the remedial action cleanup goals (RACGs) that were established in the ROD. These RACGs were based on MCLs in effect at the time of remedy selection, none of which have changed; therefore, all of the cleanup levels remain valid.

### 5.3 Protectiveness of Remedy

**Question C: Has any other information come to light that could call into question the protectiveness of the remedy?**

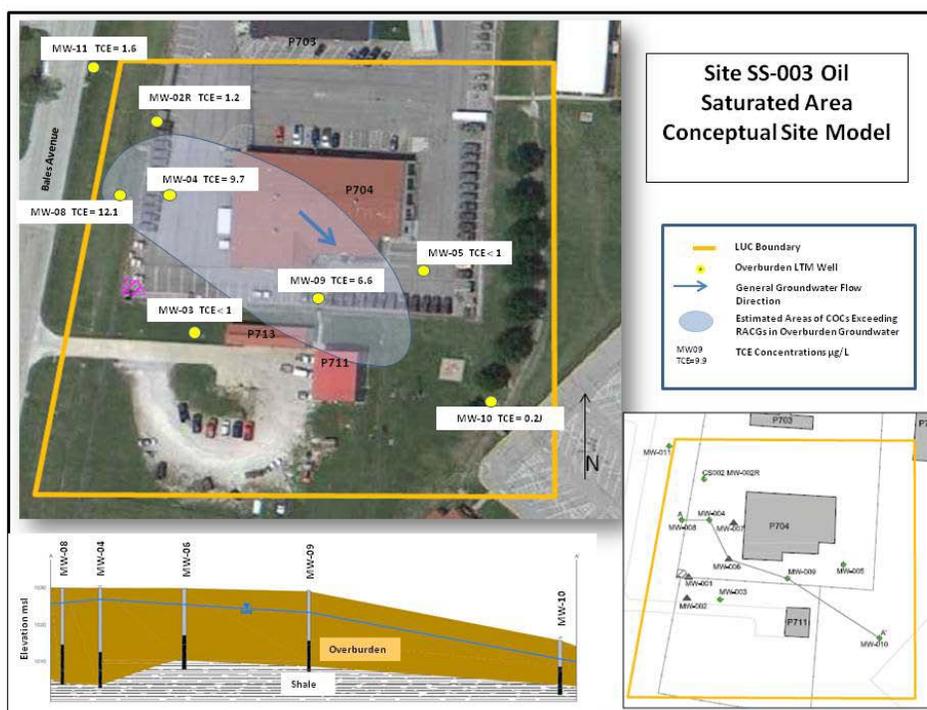
No. The five year review evaluated potential vapor intrusion (VI). As described below, no unacceptable risk was identified for the vapor intrusion pathway and therefore the remedy remains protective.

### 5.3.1 Vapor Intrusion Evaluation

Because VOCs are present in groundwater near occupied buildings, the VI pathway was evaluated to ensure potential risks to current and future building occupants are considered. The conceptual model for the vapor intrusion pathway consists of a groundwater vapor source with potential VI risk based on 2011 maximum TCE concentrations measured in shallow groundwater at Sites SS003 and SS009. Although low concentrations of other VOCs (PCE and DCE) were detected, TCE drives potential VI risk at these sites. Information on building characteristics, occupancy and use are based on interviews with building superintendents and property managers.

### 5.3.2 Vapor Intrusion Conceptual Site Model Site SS-003

The potential vapor source at Site SS003 is a TCE groundwater plume 2.7 acres in size with maximum TCE concentration measured in 2011 of 12 µg/L (Figure 5-1). Three buildings: P704, P711, and P713, are located with 100 ft of the plume. Depth to groundwater measured in 2011 generally ranged from four to seven feet below ground surface and occurs in silty clay overburden soils overlying weathered shale bedrock. Building characteristics most relevant to the VI pathway are summarized below.



**Figure 5-1. SS-003 Conceptual Site Model**

Building P704 currently supports the Marine Regiments vehicle maintenance and communications administrative activities. Future use is anticipated to remain a vehicle maintenance facility however Building P704 is not expected to continue to support

communication administrative functions. Occupants consist of 12 active duty Marines working a standard 40-hour week. Constructed in 1954, Building P704 is concrete slab-on-grade brick and cinder block construction with two-story-high ceiling and metal roof. The majority of the building floor space is open with high ceiling with the exception of few work spaces at ground level and steps to a mezzanine area of two administrative offices.

Office spaces are carpeted and the exposed maintenance area slab shows the concrete to be in good condition with no observed cracks visible. A floor drain in the vehicle maintenance area runs to a below grade oil-water separator outside the building. On the northwest portion of the building and outside the extent of the groundwater plume, a utility piping chase pit associated with steam heat system has been noted to fill with water. Groundwater is assumed to be the source of water in the chase pit. Chemicals and equipment typical for vehicle maintenance can be found in the building; a hazardous materials storage cabinet for the shop is outside the building.



The building is expected to have high air exchange rates with several windows that open and four garage bay doors that remain open during fair weather conditions. Heating, Ventilation and Air Conditioning (HVAC) system includes four 1200 cubic feet per minute (cfm) air handling units as well as window air conditioning units in office spaces.

Building P711, constructed in 1968, is a corrugated metal out-building with concrete slab floor with two garage bay roll up doors and four walk-out doors. Concrete slab is in excellent condition with no visible cracks. The building is used as a public works facility by seven contractor maintenance personnel and is not typically occupied full time (40-hour week) as personnel muster in Building 711 in the morning, at lunch, and at the end of the work day, while leaving the building for daily work sites across the base. P711 is also used for storage. There is a potential that Building P711 will be demolished in 2018 or if not slated for demolition may be used as a training facility for the Marine Corps.

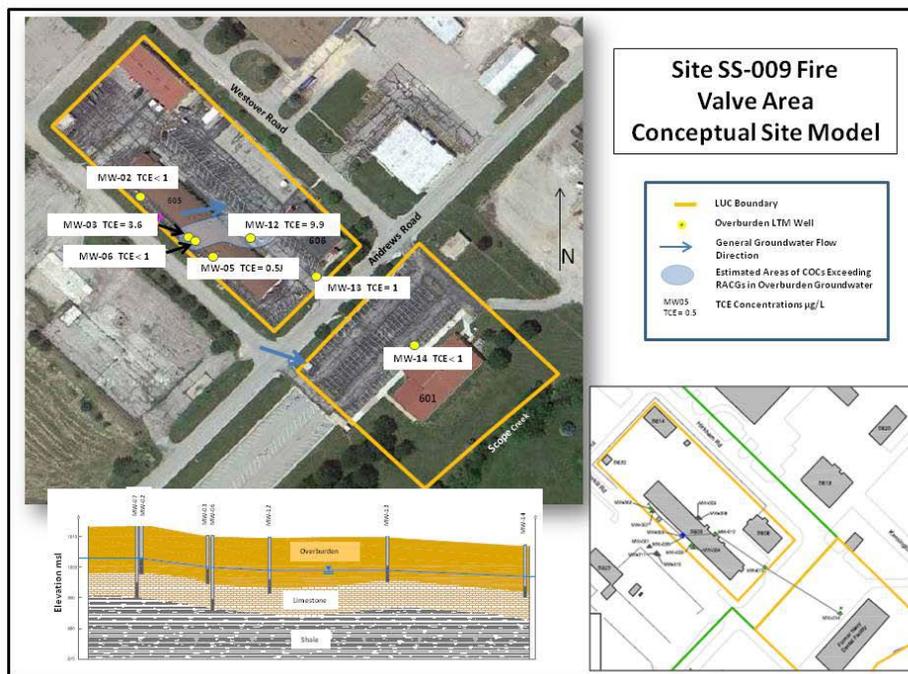
P711 is expected to have high air exchange rates with garage bay doors that remain open during fair weather conditions. HVAC system includes one 1200 cfm air handling unit.

Constructed since 2004, Building P713 is a brick and metal slab-on-grade structure that is used only for storage with no office space or heating and air systems.

### 5.3.3 Vapor Intrusion Conceptual Site Model Site SS-009

The potential vapor source at Site SS-009 is TCE groundwater plume about 0.6 acres in size with maximum TCE concentration of 9.9 µg/L (Figure 5-3). Two buildings: SS605 and SS606 are located with 100 ft of the plume. Depth to groundwater measured in 2011 generally ranged from

six to ten feet below ground surface and occurs in silty clay overburden soils overlying weathered shale bedrock. Building characteristics most relevant to the VI pathway are summarized below.



**Figure 5-3. SS-009 Conceptual Site Model**

Building SS605, constructed in 1953, is concrete slab-on-grade with stucco exterior walls. SS605 is about 15,800 ft<sup>2</sup> with approximately 3,000 ft<sup>2</sup> of open area and the majority comprised of individual office/classroom spaces. Most spaces have windows that open and are commonly open during fair weather. There is currently no full-time (40hr-week) occupancy of SS605. Current Port Authority tenant is the Metropolitan Community College using about 4,000 ft<sup>2</sup> for classroom space for about 4 hours/week-day for adult education (welding training). It is the expectation of the Port Authority to market the remaining space to future tenants as office space.

About 80% of the concrete floor is carpeted. Based on recently pulled carpet and inspection of non-carpeted areas, the concrete slab is in good condition with no visible cracks. High air exchange rates are expected with the six HVAC system air handling units and roof vents that range in capacity from 2,200 to 4,000 cfm.



**Figure 5-4. Building 605**

Similar to SS605, Building SS606 is concrete slab-on-grade with stucco exterior walls. SS606 is about 4,500 ft<sup>2</sup> with approximately 400 ft<sup>2</sup> of basement (8-10 ft below grade) mechanical room for boiler and water heater. The mechanical room does not overly the plume and no moisture problems have been identified in the mechanical room. Concrete floors are in good condition. Building 606 is comprised of individual office spaces; most spaces have windows that open and are expected to be open during fair weather.

Building 606 is currently vacant. It is the expectation of the Port Authority to market the building to future tenants as office space. High air exchange rates are expected with one 3,800 cfm and one 1,200 cfm HVAC system units and roof vents.

#### 5.3.4 VI Evaluation

A multiple line of evidence approach was used for the VI evaluation in this 2012 Five-Year Review, including consideration of the magnitude of potential vapor sources, distance from vapor sources to buildings, building characteristics, and potential use and occupancy of the buildings. In addition, consistent with previous vapor intrusion evaluations at the Sites, the Johnson and Ettinger (J&E) Model was used to estimate potential risks should vapor intrusion occur for current industrial land use as well as the most conservative potential future residential land use.

##### Johnson and Ettinger Model

As noted in the previous Five-Year Review, the VI pathway was initially evaluated at Richards-Gebaur AFB as part of the 2002 Feasibility Study [Reference 13]. The 2002 VI evaluation using the J&E Model concluded no unacceptable industrial or residential exposure risks (cancer risk within 10<sup>-6</sup> and 10<sup>-4</sup> and hazard index less than one) for the VI pathway. Appendix I of the 2007 Five-Year Review documented an updated VI evaluation using version 3.1 of the 2004 J&E Model and taking into account current toxicity values for TCE (CalEPA toxicity value and EPA provisional value). For this 2012 Five-Year Review, the VI pathway was evaluated using the same version 3.1 of the 2004 J&E Model. The only model inputs that were updated/changed were:

- Initial groundwater concentrations based on maximum detected TCE groundwater concentrations measured in 2011
- Depth to groundwater based on water levels measured in 2011
- Updated 2011 Integrated Risk Information System (IRIS) toxicity profile for TCE (<http://www.epa.gov/iris/subst/0199.htm>) inhalation unit risk factor (URF) of 4.1x10<sup>-6</sup> (µg/m<sup>3</sup>)<sup>-1</sup> for cancer and an inhalation non-cancer reference concentration (RfC) of 2x10<sup>-3</sup> µg/m<sup>3</sup>.

All other inputs to the 2012 model runs remained the same as the initial 2002 VI evaluation. Model input parameters are provided in Appendix I and demonstrate there are no unacceptable vapor intrusion risks for future residential or current industrial land use. Table 5-3 below summarizes vapor intrusion risk estimates from the J&E Model.

**Table 5-3. Vapor Intrusion Risk Summary Results for TCE**

Richards-Gebaur AFB Sites SS-003 and SS-009 Vapor Intrusion Risk Summary Results for TCE Johnson & Ettinger Model V3.1 2004					
Site / Building	2011 TCE Source Concentration (µg/L)	Industrial Exposure Lifetime Cancer Risk	Industrial Exposure Non-cancer Hazard	Residential Exposure Lifetime Cancer Risk	Residential Exposure Non-cancer Hazard
SS-003 Oil Saturated Area / Building P704	12.1	9.1x10 <sup>-9</sup>	3.1x10 <sup>-3</sup>	5.2x10 <sup>-8</sup>	1.5x10 <sup>-2</sup>
SS-009 Fire Valve Area / Building S605	9.9	6.6x10 <sup>-9</sup>	2.3x10 <sup>-3</sup>	3.8x10 <sup>-8</sup>	1.1x10 <sup>-2</sup>
Notes: TCE updated IRIS values used in Model: RFC 0.002 mg/m <sup>3</sup> ; URF 4.1 x10 <sup>-6</sup> µg/m <sup>3</sup>					

Potential vapor intrusion is not a concern at Sites SS-003 or SS-009 based on the following:

- Vapor source strength in groundwater is very low (12 µg/L for SS-003) with maximum concentrations only slightly above the drinking water standard of 5 µg/L
- Building characteristics inhibiting vapor migration across the foundation based on good condition and high integrity of slab foundations
- Building characteristics suggestive of well ventilated structures with typical or higher than typical air exchange rates based on open bay garage doors, open windows, and high efficiency HVAC systems.
- Building characteristics with a potential to enhance vapor intrusion (SS-003 chase pit at Bldg. P704 and SS-009 basement mechanical room at Bldg. 605) do not overly the groundwater plume.
- No estimated unacceptable risks based on J&E Model using 2011 maximum concentrations of TCE for current receptors or the most conservative future residential receptors.

Vapor intrusion is not a concern at the current time based on the multiple lines of evidence presented herein. The Navy will include vapor intrusion consideration in the 5 year reviews as long as volatile organic compounds are present in groundwater above levels of concern.

## 5.4 Technical Assessment Summary

### **Question A: Is the remedy functioning as intended by the decision documents?**

Yes. The LUCs required by the ROD (i.e., restrictions prohibiting extraction and use of groundwater and land surface activities that may interfere with or damage the on-site monitoring wells) were included in the Deed at the time of property transfer to the City of Kansas City and have been included in the USMC's Master Plan. A LUC inspection was conducted annually in accordance with ROD requirements, and there was no evidence indicating that the LUCs had been violated. One monitoring well was installed at Site SS-003 as part of the on-going long-LTM and groundwater is not extracted or used for any purpose, nor has any other significant development occurred on either of the OU 2 sites SS-003 and SS-009.

### **Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?**

Yes. Exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection remain valid.

### **Question C: Has any other information come to light that could call into question the protectiveness of the remedy?**

No. The five year review evaluated one issue that could potentially have an impact on the protectiveness for the OU 2 remedy which is potential vapor intrusion and the remedy has been determined to be protective.

## 6.0 ISSUES

Based on groundwater monitoring conducted from November 2009 – December 2011 for Site SS-003 and July 1998 – April 2012 for Site SS-009, all of the chlorinated solvent plumes in OU 2 Site SS-003 and SS-009 are not moving and shrinking. The Trend Analysis for the sampling current and historic groundwater concentrations were plotted for trend analysis of the data from sites SS-003 and SS-009 and are included in Appendix E and Appendix F, respectively. The groundwater plumes have been shown to be stable and the frequency of monitoring is not necessary to characterize the plume and to continue to monitor for degradation to RACGs.

Overall, COC concentrations indicate that the groundwater plumes remain well inside the LUC boundaries at both sites, and there is no indication that off-site migration is occurring.

An updated indoor air risk evaluation was conducted for Site SS-003 and SS-009. Because vapor intrusion is not a concern based on the multiple lines of evidence presented herein, future vapor intrusion evaluations are not recommended unless groundwater concentrations are observed to significantly (one or more orders of magnitude) increase during future monitoring events or there are significant structural failures to the buildings overlying the plume.

## 7.0 RECOMMENDATIONS AND FOLLOW UP ACTIONS

There are no recommendations required to resolve issues affecting protectiveness. Data results from the LTM program indicate groundwater contamination remains at both sites in concentrations above applicable RACGs. An analysis of the data from both sites indicates the groundwater contamination plumes are stable or decreasing in concentration.

As stated in the ROD, LUCs at both sites must remain in place until groundwater concentrations fall below applicable RACGs. The current strategy at both sites is to continue the LTM program and maintain the LUCs until natural attenuation of the groundwater plumes results in COC concentrations below applicable RACGs.

The following discussions include recommendations that optimize the LTM program and not implementing these recommendations will not affect the protectiveness of the remedies at the site.

No changes in exit strategy are recommended based on the current and historical data. The analytical suite for both sites has been minimized and no reductions are feasible or recommended at this time.

Concentrations of COCs in site groundwater at Site SS-003 are currently above RACGs, and will likely remain so for several years. It is therefore recommended that the sampling frequency be reduced to every other year beginning in April/May 2013 as allowed in the ROD. The plume is not moving and shrinking which supports reducing the frequency of sampling in accordance with the Decision Rule pertaining to LTM sampling frequency at the former Richards-Gebaur Air Force Base which states, "If three successive years of annual monitoring indicate that the groundwater contaminant plume is stable or shrinking, then monitoring frequency will be reduced to every five years to coincide with the mandatory five-year remedial performance review."

Concentrations of COCs at site SS-009 continue to trend downward and there is no evidence that plume migration beyond the LUC boundaries is occurring. However, concentrations of COCs in site groundwater are currently above RACGs, and will likely remain so for several years. It is therefore recommended that the sampling frequency at site SS-009 be reduced to every other year beginning in April/May 2013 as allowed in the ROD. The plume is not moving and shrinking which supports reducing the frequency of sampling in accordance with the Decision Rule pertaining to LTM sampling frequency at the former Richards-Gebaur Air Force Base which states, "If three successive years of annual monitoring indicate that the groundwater contaminant plume is stable or shrinking, then monitoring frequency will be reduced to every five years to coincide with the mandatory five-year remedial performance review."

For both sites SS-003 and SS-009, when COC concentrations approach RACGs, reverting back to annual monitoring may be warranted to meet the requirements for site closure in accordance with the Long Term Monitoring Plan, which states: "The LUCs will be removed when the

concentrations of contaminants in groundwater are below the RACGs listed in Table 2 for two (2) consecutive sampling events occurring at least three (3) months apart but no longer than one (1) year apart.” [Reference 6].

Based on the Decision Rules, the current groundwater concentrations and the historical concentration trends, no additional monitoring wells are proposed. Wells at both sites are in good condition and do not require repair, replacement or abandonment.

An updated indoor air risk evaluation was conducted for Site SS-003 and SS-009. Because vapor intrusion is not a concern based on the multiple lines of evidence presented herein, future vapor intrusion evaluations are not recommended unless groundwater concentrations are observed to significantly (one or more orders of magnitude) increase during future monitoring events or there are significant structural failures to the buildings overlying the plume.

## **8.0 PROTECTIVENESS STATEMENTS**

The remedial actions at OU 2, Site SS-003 and SS-009 are protective of human health and the environment and are anticipated to remain protective in the future. Groundwater at the former Richards-Gebaur AFB is not currently used for any purpose, and LUCs prohibiting extraction and use of groundwater at OU 2 Site SS-003 and Site SS-009 are adequate to ensure that exposures do not occur in the future. The LTM program supports the LUCs and allows periodic evaluation of groundwater quality to help ensure that the LUC boundaries fully encompass the contaminant plume and remain protective of human health and the environment. Overall, COC concentrations indicate that the groundwater plumes remain inside the LUC boundaries at both sites, and there is no indication that off-site migration is occurring.

The remedy at OU2 Groundwater at Sites SS-003 and SS-009 is protective of human health and the environment. (The first Five-Year Review addressed both OUs 1 and 2. OU 1 Sites included FT002 and ST005. OU 2 Sites included SS003, SS006, SS009, SS012, ST005 and ST011. This second Five-Year review will address OU 2 Sites SS-003 and SS-009 which are under the responsibility of the United States Marine Corps (USMC). The other sites in OU2 as well as the entire OU1 will be addressed in a separate Five-Year Review document prepared by United States Air Force (USAF) since this is under the responsibility of the USAF.)

## **9.0 NEXT REVIEW**

The next Five-Year Review for OU 2, Site SS-003 and Site SS-009 is due within five years of the signature date on the cover of this five-year review report. The USMC will be responsible for the implementation of the environmental restoration program and completing the next five-year review. Planning and development of the next five year review should begin 12 months prior to the due date to ensure statutory deadline is met.

## ACKNOWLEDGEMENTS

The map used on Figure 1-1 used *Wikipedia, The Free Encyclopedia*. Wales, Jimmy. last modified on 10 May 2012 at 03:04. Wikipedia Foundation, May 16, 2012, [http://en.wikipedia.org/wiki/Richards-Gebaur\\_Air\\_Force\\_Base](http://en.wikipedia.org/wiki/Richards-Gebaur_Air_Force_Base)

The satellite views on the following Figures: (3-1, 3-2, 3-3, 3-4, 5-1 and 5-3) were obtained from Google Earth, last modified March 1, 2012, [www.google.com/earth/](http://www.google.com/earth/)

The information used to address question B utilized information provided to NAVFAC LANT by Dr. Resha M. Putzrath, Ph.D., DABT, Navy and Marine Corps Public Health Center; Portsmouth, VA, [Resha.Putzrath@med.navy.mil](mailto:Resha.Putzrath@med.navy.mil)

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- [6] United States Air Force, Air Force Real Property Agency, *Record of Decision (Operable Units 1 and 2)*, Kansas City, Missouri: 2004
- [7] United States Air Force, Air Force Real Property Agency, *Long Term Monitoring Plan for Groundwater (Operable Unit-2)*, Former Richards-Gebaur Air Force Base, Kansas City, Missouri: 2005
- [8] United States Air Force, Air Force Real Property Agency, *Land Use Control/Institutional Control Management Plan*, Kansas City, Missouri: 2005
- [9] United States Air Force, Richards-Gebaur Air Force Base, *Final Environmental Impact Statement*, Richards-Gebaur Air Force Base, Kansas City, Missouri: 1994
- [10] United States Air Force, Richards-Gebaur Air Force Base. *Basewide Remedial Investigation*, Richards-Gebaur Air Force Base, Missouri: 2000
- [11] United States Air Force, Richards-Gebaur Air Force Base, *Ecology and Environment*, Richards-Gebaur Air Force Base, Missouri: 1998
- [12] United States Air Force, Richards-Gebaur Air Force Base, *Installation Restoration Program (IRP) Preliminary Assessment/Site Inspection of IRP Site SS009 Final Technical Report*. Richards-Gebaur Air Force Base, Missouri: 1995

- [13] Department of the Navy, BRAC Program Management Office Southeast, *Draft 2011 Groundwater Monitoring and Land Use Controls Report*, Kansas City, Missouri: 2011
- [14] United States Air Force, Richards-Gebaur Air Force Base, *Final Feasibility Study for Groundwater (Operable Unit-2)*, Richards-Gebaur Air Force Base, Missouri: 2002

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**APPENDIX A**

**AFFIDAVIT OF PUBLICATION**

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# APPENDIX A – AFFIDAVIT OF PUBLICATION

## AFFIDAVIT OF PUBLICATION

THE McCLATCHY COMPANY, publishers of  
THE KANSAS CITY STAR, a newspaper published in  
the City of Kansas City, County of Jackson, State of  
Missouri, confirms that the notice and/or advertisement of

URS CORPORATION  
8300 COLLEGE BLVD.  
OVERLAND PARK, S 66210  
25146850

3441000

a true copy of which is hereto attached,  
was duly published in the above said newspaper

FOR THE PERIOD OF: 1 Day (s)

COMMENCING: January 25, 2012

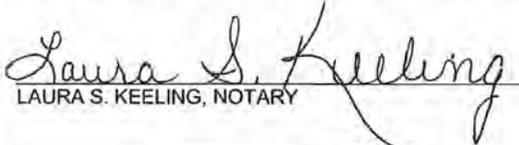
ENDING: January 25, 2012

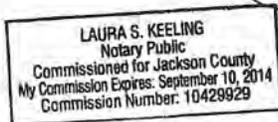
STAR EDITION (S): 1/25 (Zone only)

STAR PAPER (S): #130

VOLUME: #132

Subscribed and sworn to before  
me, this 25th day of January, 2012.  
I certify that I was duly qualified as  
a Notary Public for the State of Missouri,  
commissioned in Jackson County, Missouri.  
My commission expires September 10, 2014.

  
LAURA S. KEELING, NOTARY



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**APPENDIX B**

**INTERVIEW DOCUMENTATION**

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## APPENDIX B – INTERVIEW DOCUMENTATION

### Property Owners/Tenants Interviews for Kansas City Five Year Review

<b>Participants:</b>	Ron Phelps	Jim Webb
<b>Organization:</b>	Asset Management and Assessment Branch Facilities, Marine Forces Reserves	Asset Management and Assessment Branch Facilities, Marine Forces Reserves
<b>Phone Number:</b>	(816) 843-3745	(816) 843-3746
<b>e-mail:</b>	Ronald.o.phelps.ctr@usmc.mil	James.p.webb.ctr@usmc.mil
<b>Interviewers:</b>	Jan Nielsen, NAVFAC LANT	Donna Caldwell, LANT
<b>Date:</b>	Monday, May 14, 2012, 7:00 AM	
<b>Location:</b>	Telephone Interview	

	Question	Response
1.	What is your overall impression of the project?	Comfortable, relaxed, several sets of visitors have visited the site to view the site and well heads
2.	What effects have site operations had on the surrounding community?	Nil. Sampling wells heads are all mostly inside of the compound. Public is not impacted by the site. The plume and well heads are inside the LUC boundaries and all on DoD owned property. Have not slowed down any of the operations at the site.
3.	Are you aware of any community concerns regarding the site or its operation and administration?	None.
4.	Are you aware on any events, incidents, or activities at the site such as vandalism, trespassing, or emergency responses? Details.	No and have been involved and located here for 10 years.
5.	Do you feel well informed about the site's activities and progress?	OK. Would like to be included on the distribution for the annual reports and five year reviews.
6.	Have there been routine communications or activities (site visits, inspections, reporting activities, etc) conducted by your office regarding the site? Details.	Annual site visits and communications are good during the sampling efforts. The teams accessing the site always give notice of need to enter. We are the point of contact for these visits for access.
7.	Do you have any comments, suggestions, or recommendations regarding the site's management or operation?	Would like to have the data from the LTM annual reports and sampling efforts. Would also like to have a copy of the Five Year Review Report.

**Additional Information:**

- There is an area in building 704 that is below grade and fills with water on a regular basis. Would like the data on the plume so the potential concentrations of chemicals could be shared with the disposal facility for the water. Pumping of the pipe chase pit has not been continued because they did not want to impact the plume and the water may be groundwater. The pit is not within the plume boundaries but is located in the general area of the plume.
- Would like to know the anticipated and projected length of time that actions will be going on at the site for the Plume. Anticipates seeing this in the reports.
- There was significant discussion on the current and future use of the buildings on the site, the construction and condition of the buildings. This information is presented separately as part of the vapor intrusion discussion in the Five Year Review Report.

## APPENDIX B – INTERVIEW DOCUMENTATION

### Property Owners/Tenants Interviews for Kansas City Five Year Review

Participants:	Zoraya Lara	William Rulon	David Criswell, P.E.
Organization:	Kansas City Port Authority	Kansas City Port Authority	Navy BRAC Program Management Office Southeast
Title:	Associate Director, Real Estate and Trade	Superintendent	Deputy Base Closure Manager
Phone Number:	816-559-3722		(843) 743-2130
e-mail:	zlor@kcportauthority.com		<a href="mailto:david.criswell@navy.mil">david.criswell@navy.mil</a>
Interviewers:	Jan Nielsen, NAVFAC LANT	Donna Caldwell, LANT	
Date:	Friday, May 11, 2012, 10:00 AM		
Location:	Telephone Interview		

Questions:

	Question	Response
1.	What is your overall impression of the project?	Fine, Port Authority is happy with the project
2.	Have there been any complaints, violations or other incidents related to the site that you are aware of?	No, no incidents
3.	Do you feel well informed about the site's activities and progress?	Yes
4.	Do you have any comments, suggestions, or recommendations regarding the site's management or operation?	No, everything is fine
5.	What are the construction plans for this site?	Leasing the buildings for office and classroom use. Not all areas are currently leased but they are marketing the property for office use. There is currently a tenant in Building 605 that uses the area for classroom training.
6.	Do you know who to contact with any questions or concerns?	Yes, the BRAC Point of Contact, David Criswell

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Additional Information: There was significant discussion on the current and future use of the buildings on the site, the construction and condition of the buildings. This information is presented separately as part of the vapor intrusion discussion in the Five Year Review Report.

I shared with Ms. Lara the interest from Mr. Dawson of Heart N Hands in being invited to future public meetings on use of the Port Authority Site since it is adjacent to his area. I provided Ms. Lara, Mr. Dawson's e-mail and contact information.

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## APPENDIX B – INTERVIEW DOCUMENTATION

### Property Owners/Tenants Interviews for Kansas City Five Year Review

Interviewee:	Rick Dawson
Organization:	Heart N Hand
Title:	Executive Director
Phone Number:	(816)322-1133
e-mail:	hhhcenter@gmail.com
Interviewer:	Jan Nielsen, NAVFAC LANT
Date:	Monday, May 7, 2012 – 12:00 Noon
Location:	Telephone Interview

	Question	Response
1.	What is your overall impression of the project?	OK, likes the location and neighbors
2.	Have there been any complaints, violations or other incidents related to the site that you are aware of?	HNH site is a fenced in lot and they had a good relationship with the neighbors that are currently in place.
3.	Do you feel well informed about the site’s activities and progress?	Yes but would like to be included on the invites to public meetings that the Port Authority hosts on planned actions on their site.
4.	Do you have any comments, suggestions, or recommendations regarding the site’s management or operation?	A concern (not CERCLA related) that the fire alarm in their building has a panel box for their building and another building. Mr. Dawson can send the building number. The concern is the alarm keeps going off for the other building and he has to keep turning the power off to reset. Who can Mr. Dawson contact to resolve?
5.	What are the construction plans for this site?	Currently used as a warehouse and there are no anticipated changes in the use for the future
6.	Do you know who to contact with any questions or concerns?	Mr. Dawson’s initial point of contact would be EPA. I indicated I would send the Navy BRAC point of contact to Mr. Dawson in case he had any questions or concerns related to the CERCLA issues on the property.

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Additional Information:

I forwarded Mr. Dawson’s questions to Mr. David Criswell, Deputy Base Closure Manager, Navy BRAC Program Management Office Southeast. Mr. Criswell provided the following points of contact:

Kansas City Port Authority (Fire Alarm):  
 Joe Perry  
 Director of Real Estate and Development  
 300 Wyandotte, Suite 100,  
 Kansas City, Missouri 64105  
 816-559-3750 (office) 816-559-3759 (fax)

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## APPENDIX B – INTERVIEW DOCUMENTATION

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[jperry@kcportauthority.com](mailto:jperry@kcportauthority.com)

Regarding CERCLA related environmental concerns; your point of contact for the Navy is Ms. Thuane Fielding.

Thuane Fielding  
Base Closure Manager  
Navy BRAC Program Management Office Southeast  
4130 Faber Place Drive, Suite 202  
North Charleston, SC 29405  
phone number 843-743-2133,  
[thuane.fielding@navy.mil](mailto:thuane.fielding@navy.mil)

I also provided a point of contact for the Port Authority for invitations to future public meetings:

Zoraya Lara  
Associate Director, Real Estate and Trade  
300 Wyandotte, Suite 100  
Kansas City, MO 64105  
Phone: 816-559-3722  
Fax: 816-559-3759

[zlara@kcportauthority.com](mailto:zlara@kcportauthority.com)  
[www.kcportauthority.com](http://www.kcportauthority.com)

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**APPENDIX C**

**LAND USE CONTROL BOUNDARIES**

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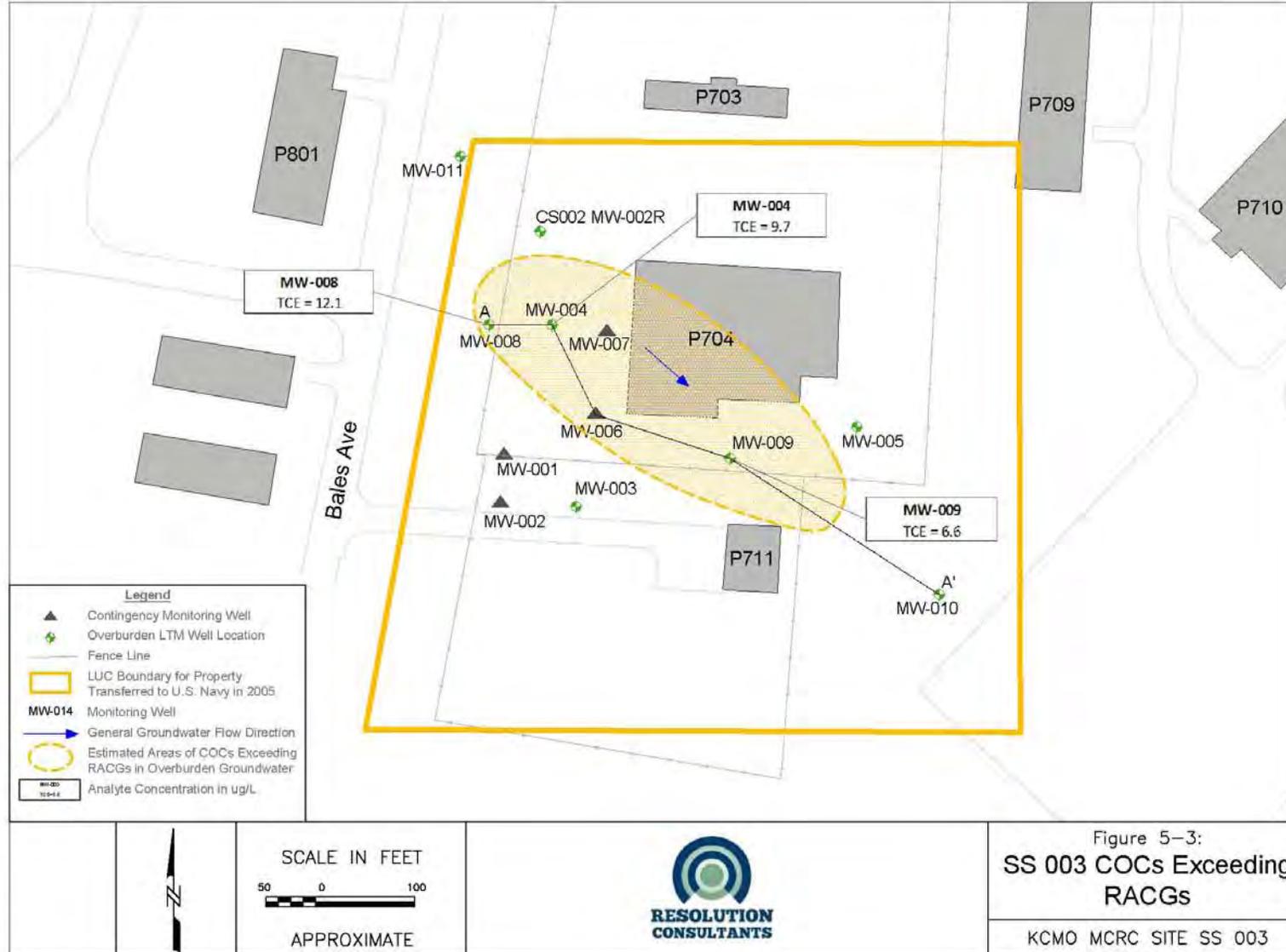
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**APPENDIX D**

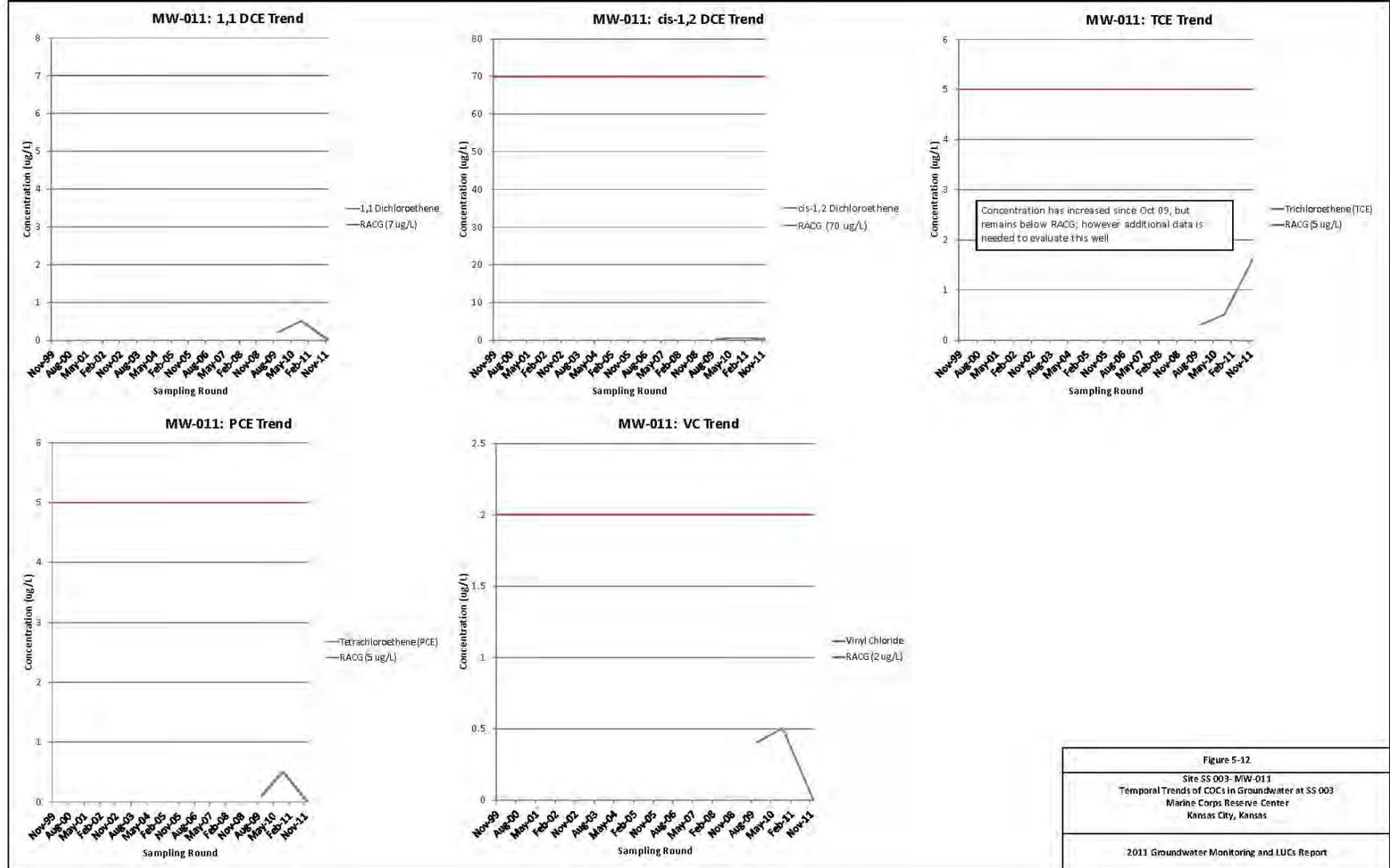
**SITE SS-003 PLUME MAP AND TREND GRAPHS**

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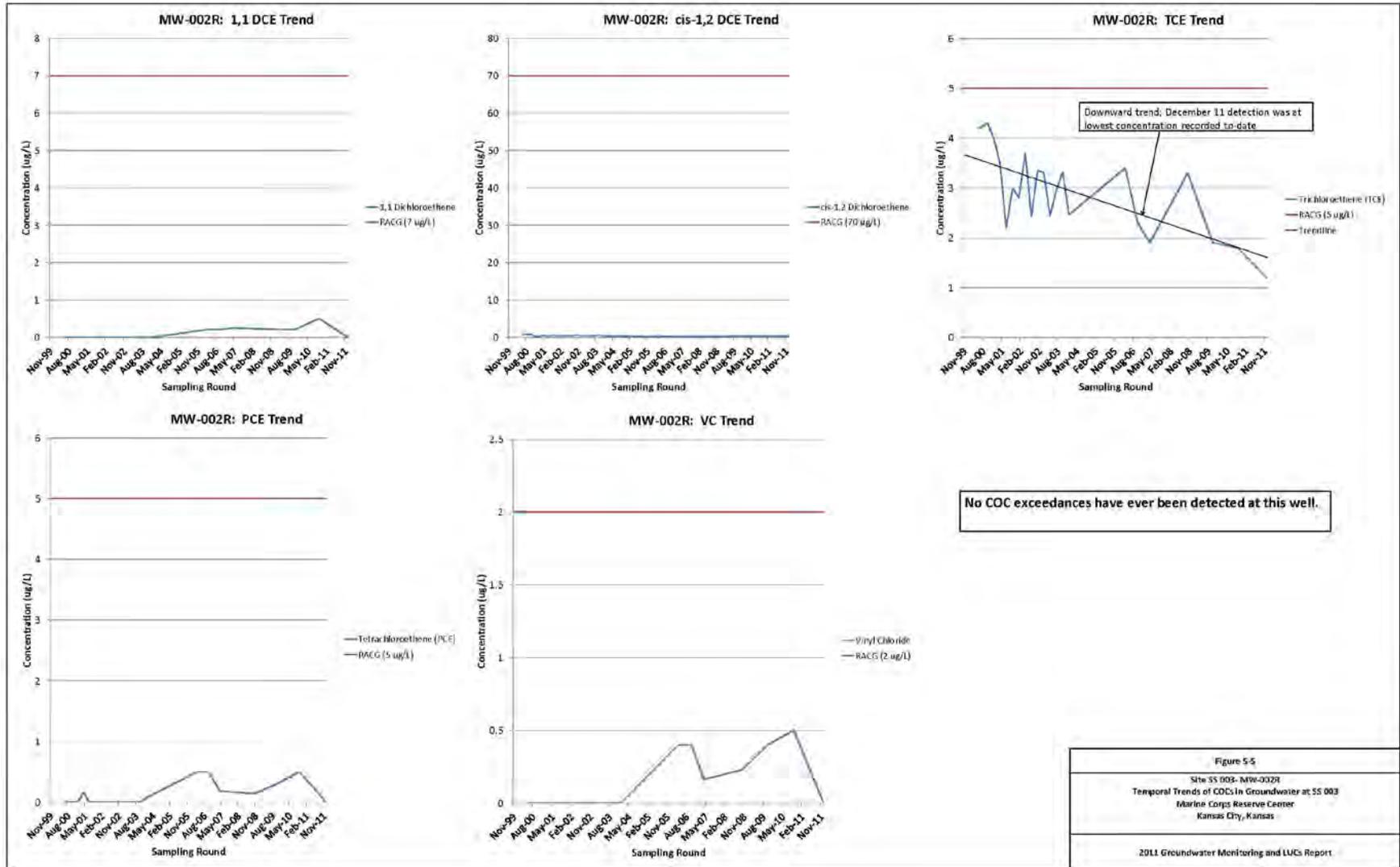
# APPENDIX D – SS-003 PLUME MAPS AND TREND GRAPHS



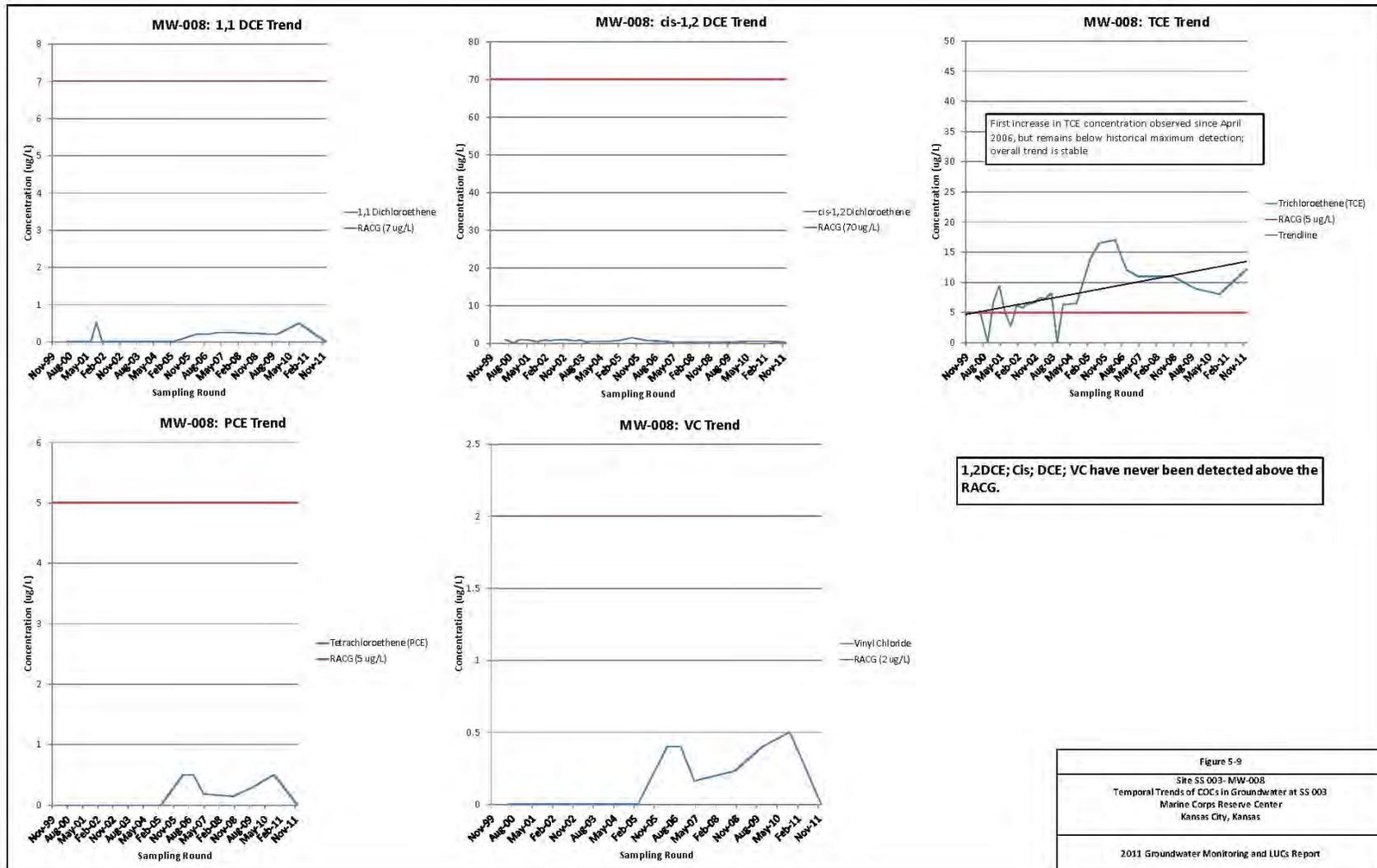
# APPENDIX D – SS-003 PLUME MAPS AND TREND GRAPHS



# APPENDIX D – SS-003 PLUME MAPS AND TREND GRAPHS



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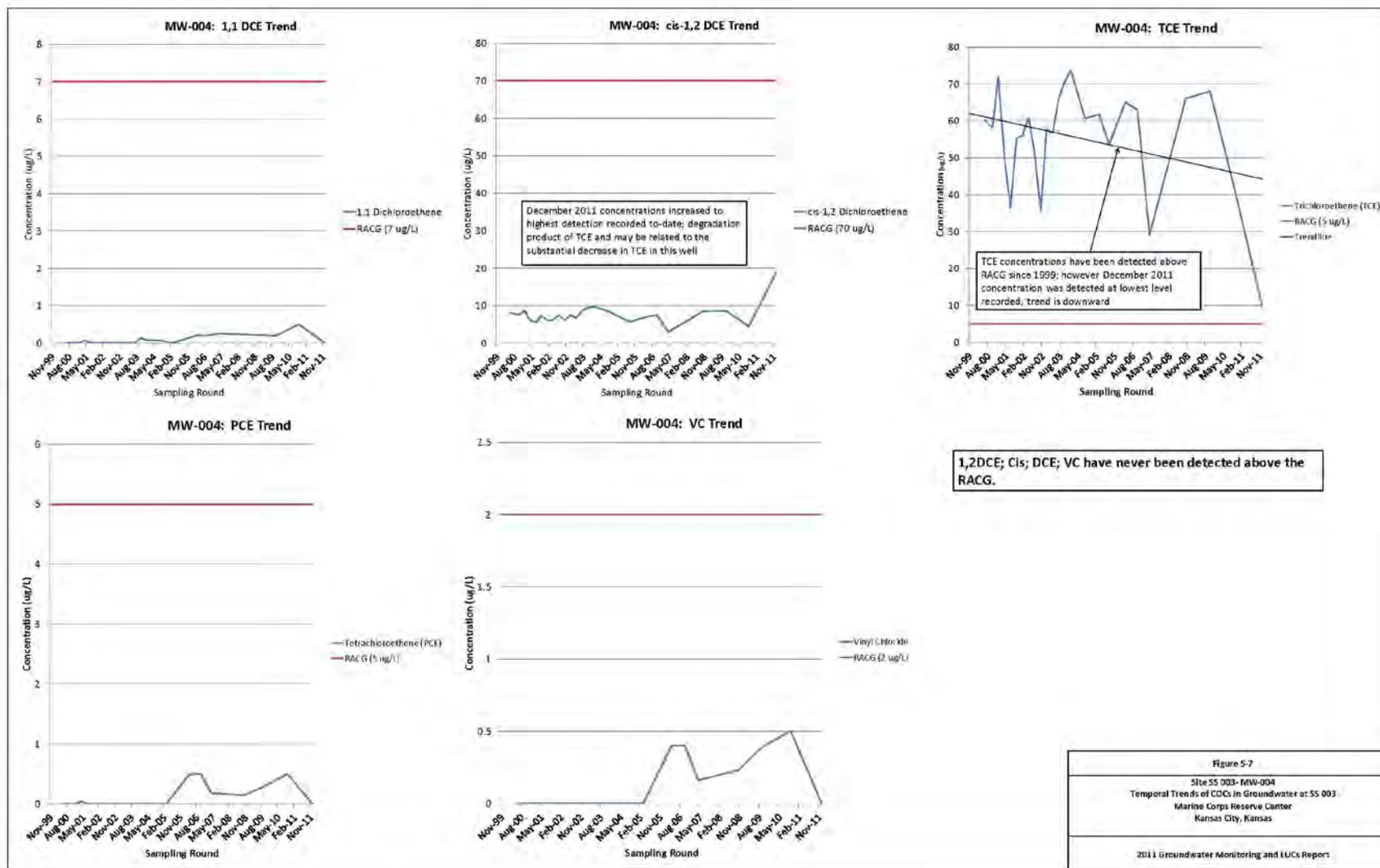
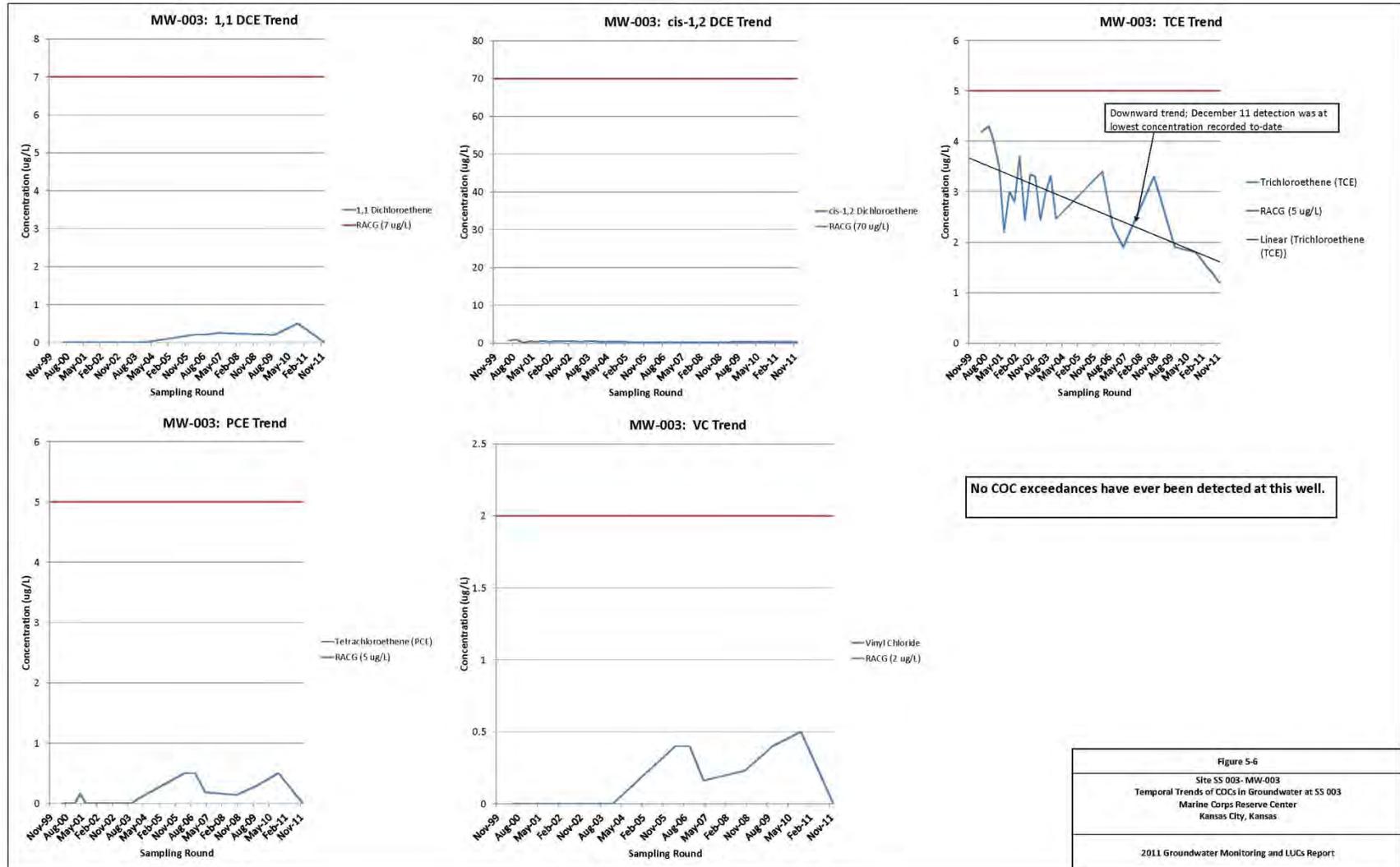
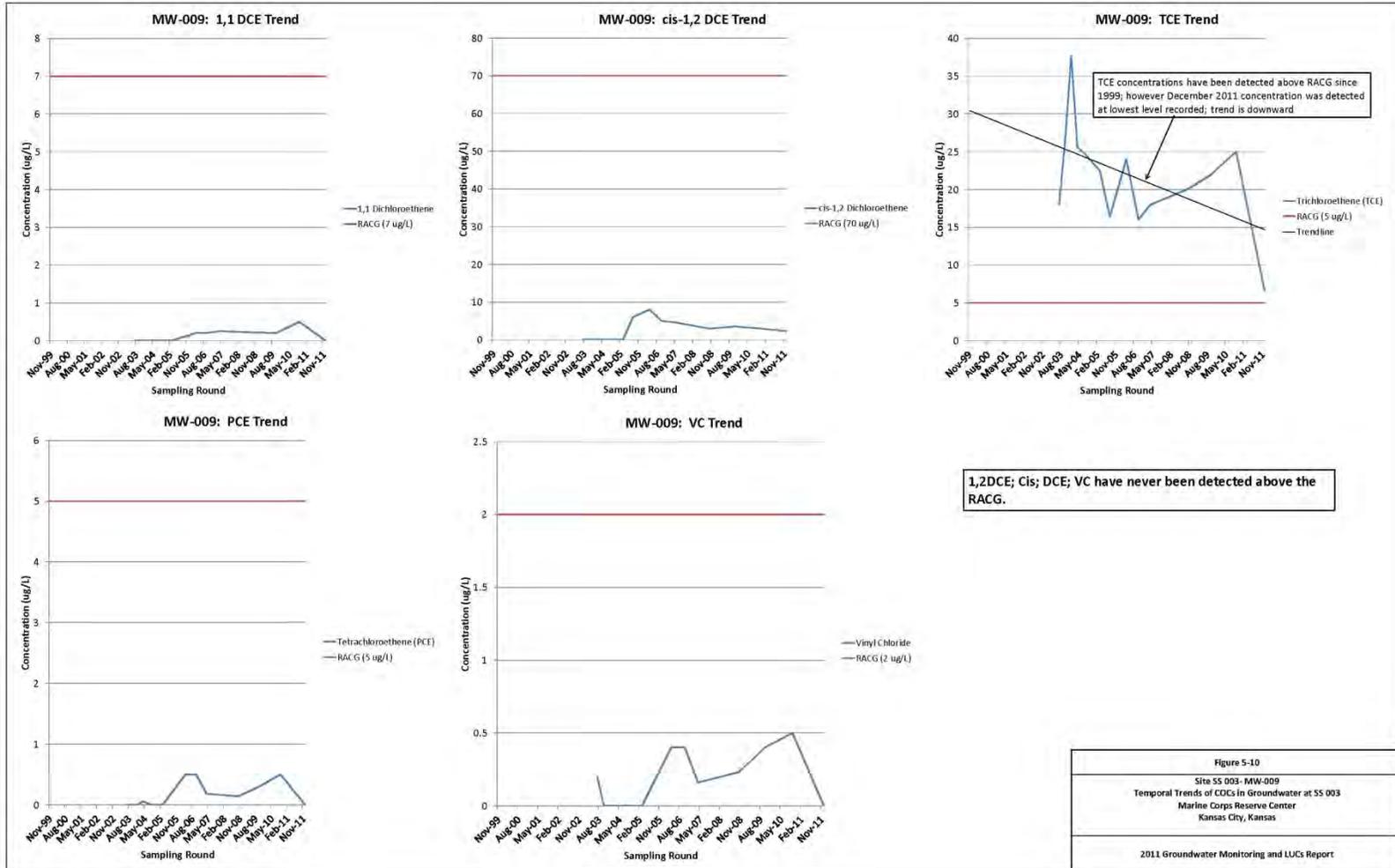


Figure S-7  
 Site SS 003- MW-004  
 Temporal Trends of COCs in Groundwater at SS 003  
 Marine Corps Reserve Center  
 Kansas City, Kansas  
 2011 Groundwater Monitoring and LUCs Report

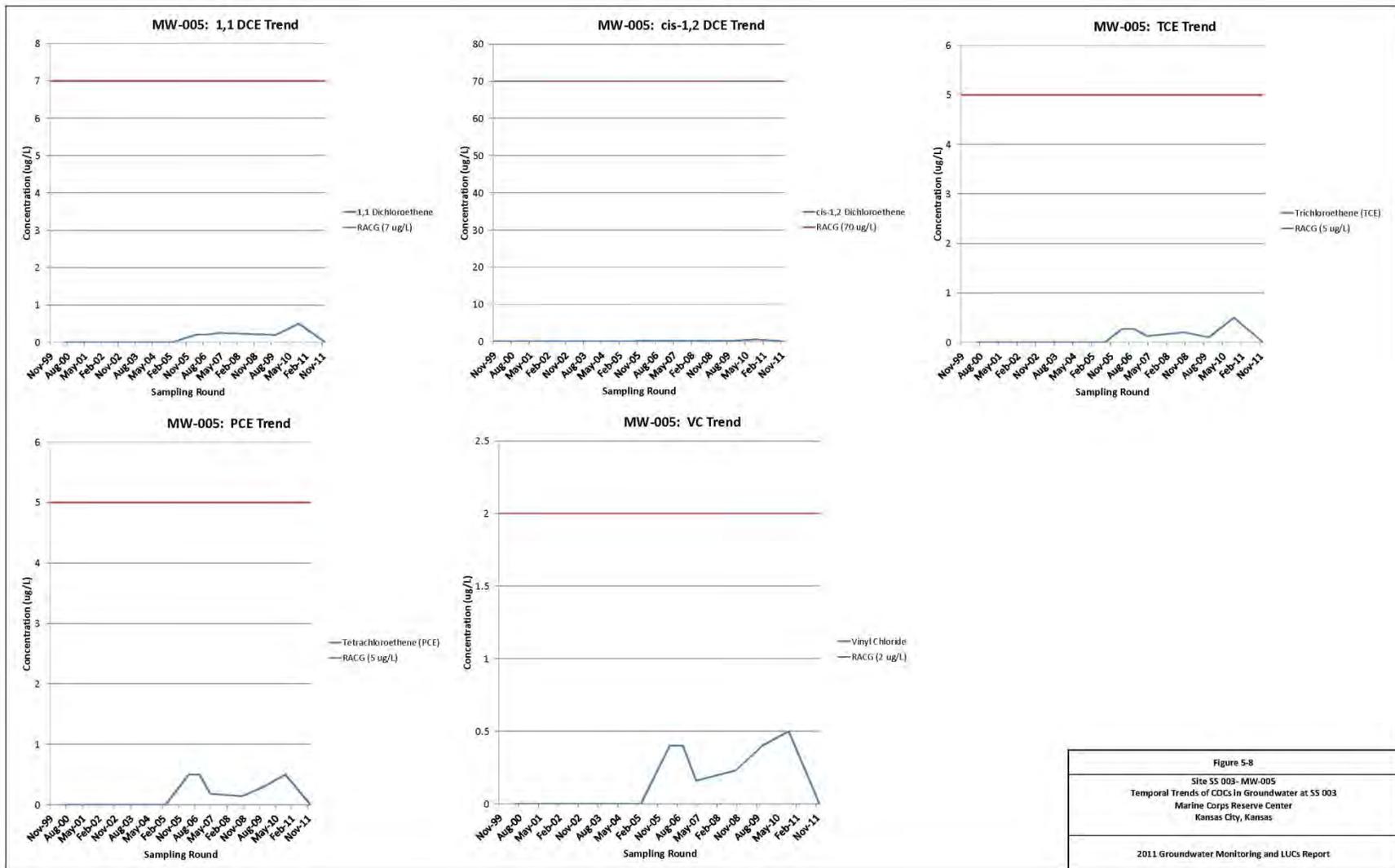
# APPENDIX D – SS-003 PLUME MAPS AND TREND GRAPHS



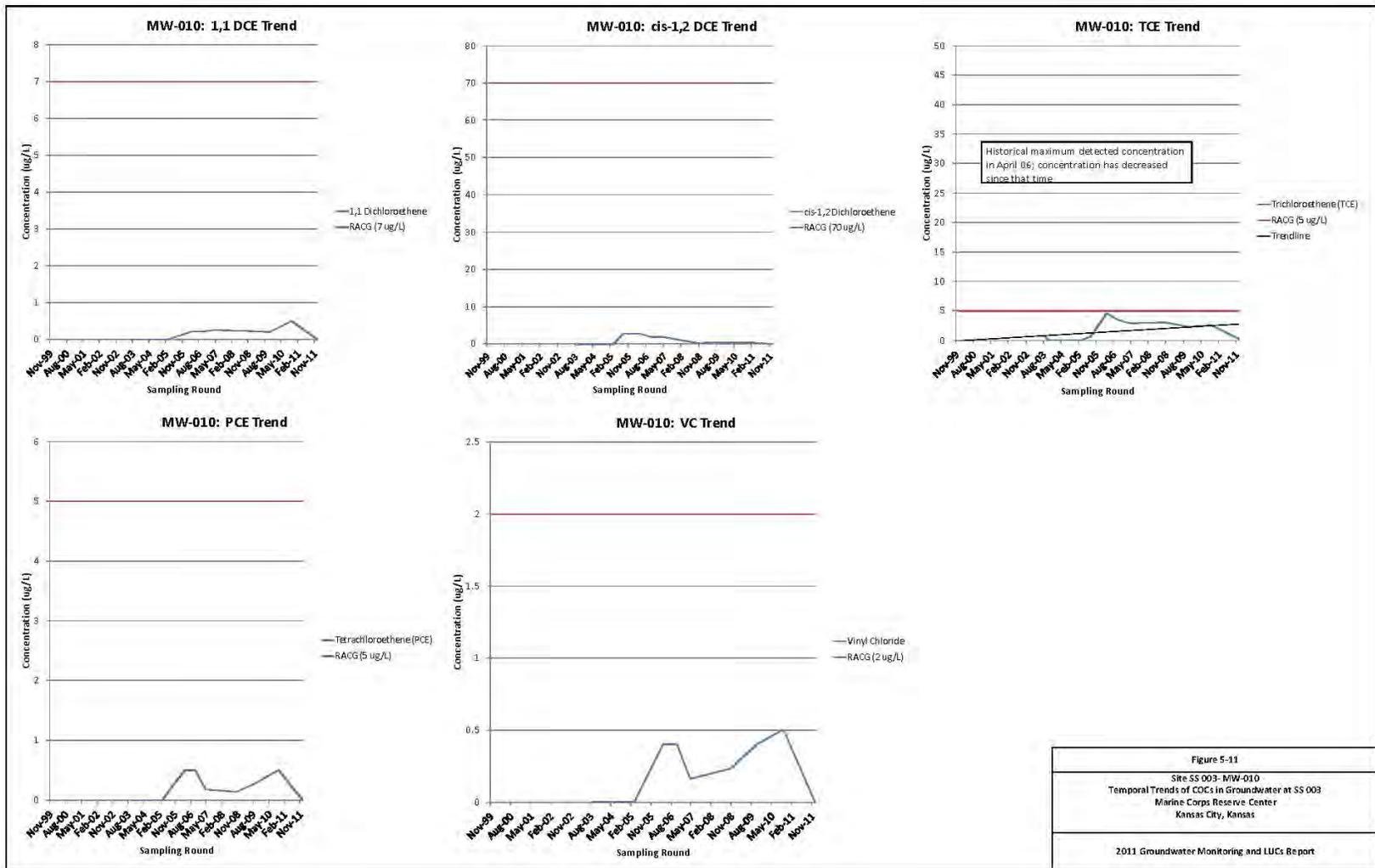
# APPENDIX D – SS-003 PLUME MAPS AND TREND GRAPHS



# APPENDIX D – SS-003 PLUME MAPS AND TREND GRAPHS



# APPENDIX D – SS-003 PLUME MAPS AND TREND GRAPHS



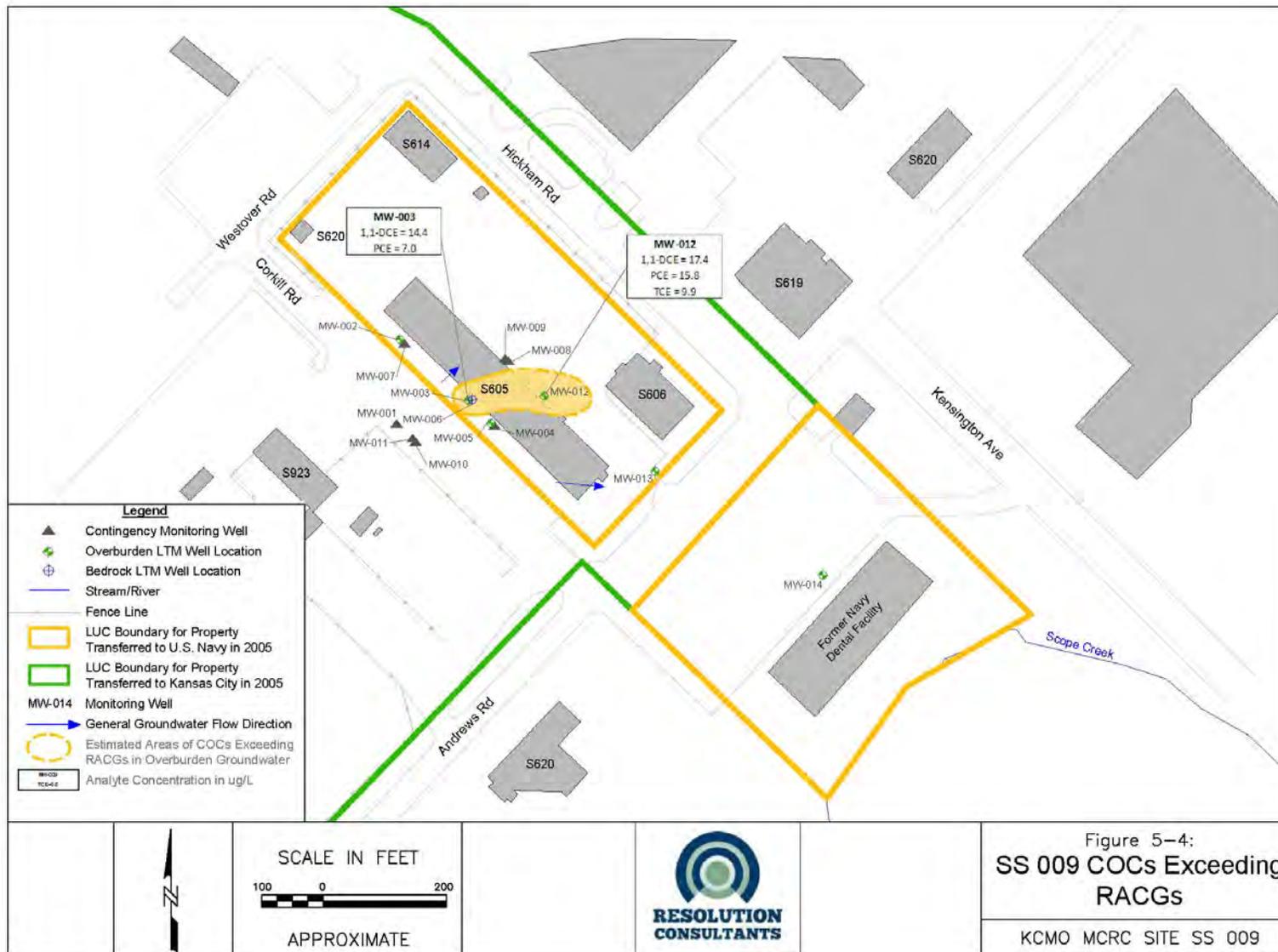
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**APPENDIX E**

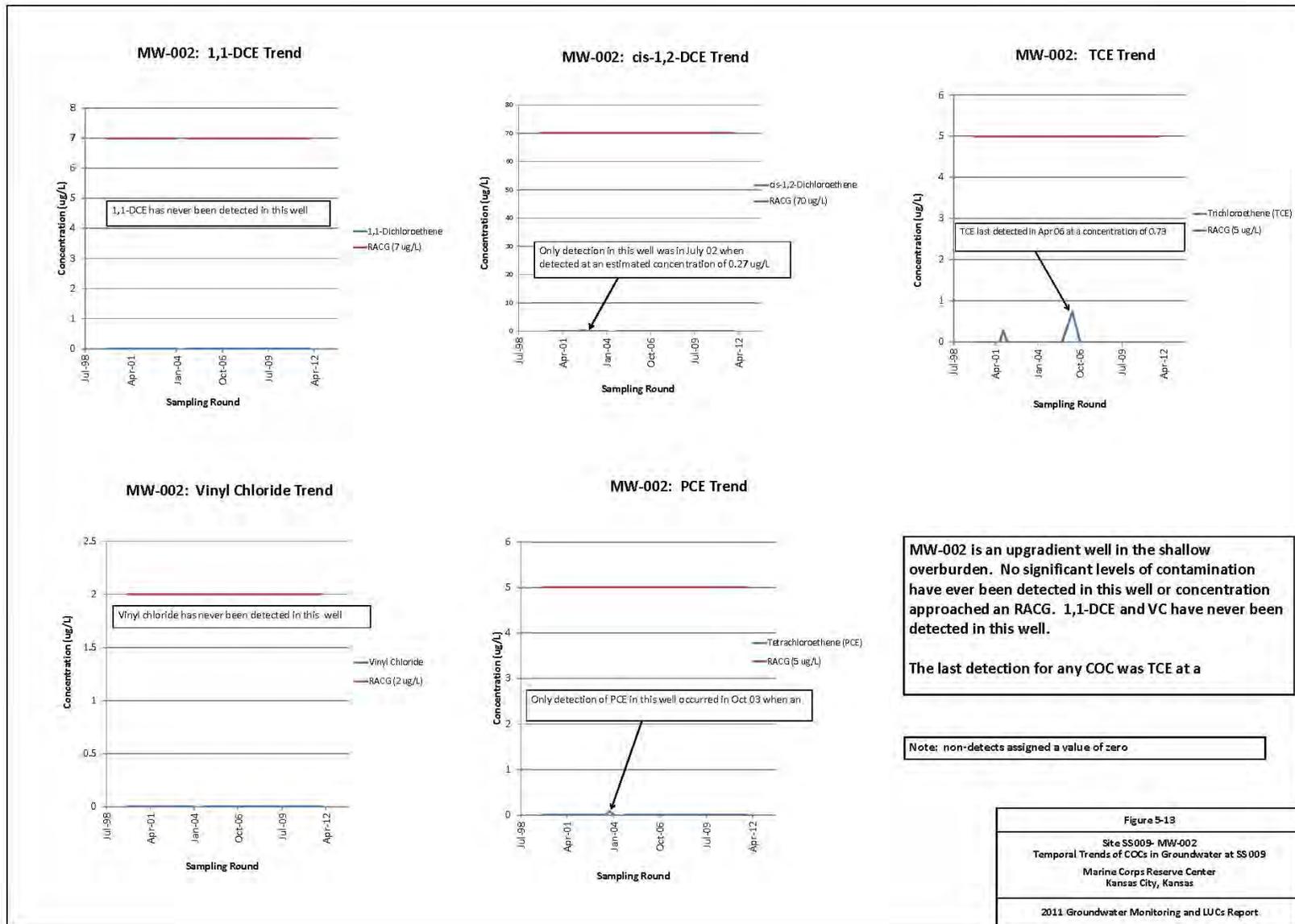
**SITE SS-009 PLUME MAP AND TREND GRAPHS**

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# APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS



# APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS



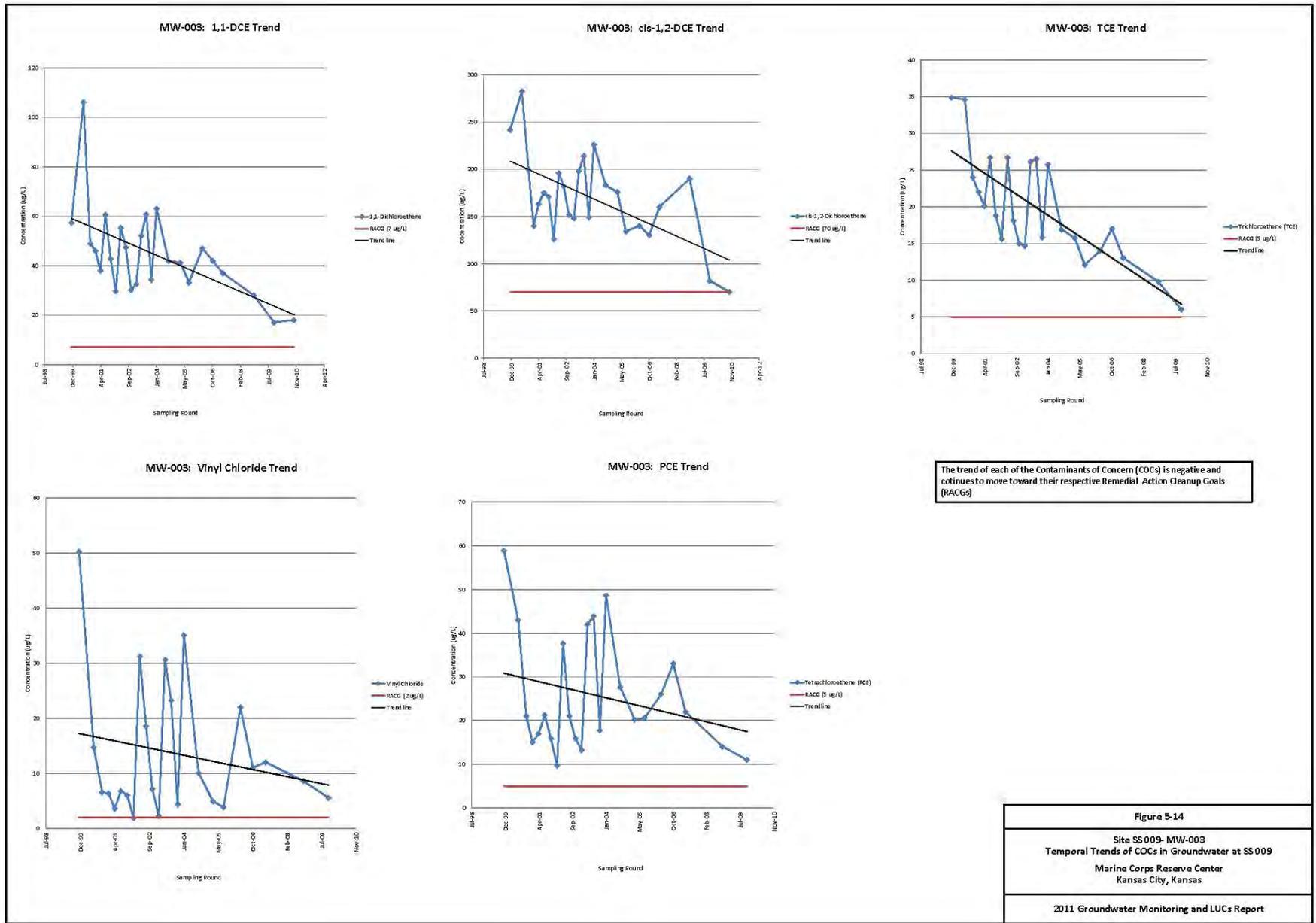
MW-002 is an upgradient well in the shallow overburden. No significant levels of contamination have ever been detected in this well or concentration approached an RACG. 1,1-DCE and VC have never been detected in this well.

The last detection for any COC was TCE at a

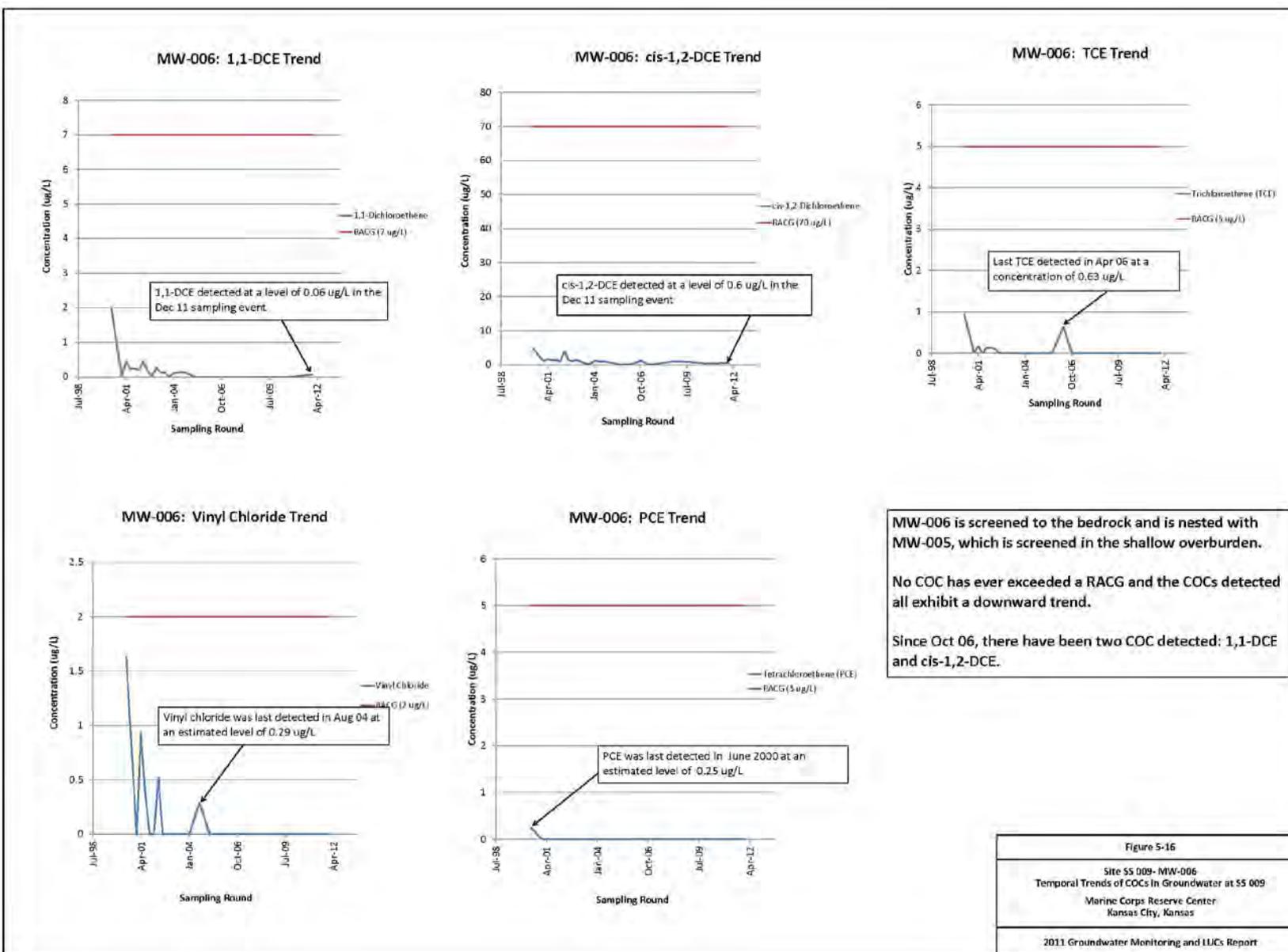
Note: non-detects assigned a value of zero

Figure 5-13  
 Site SS009- MW-002  
 Temporal Trends of COCs in Groundwater at SS 009  
 Marine Corps Reserve Center  
 Kansas City, Kansas  
 2011 Groundwater Monitoring and LUCs Report

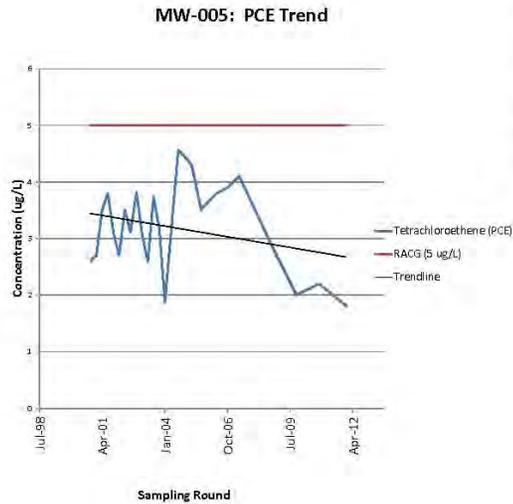
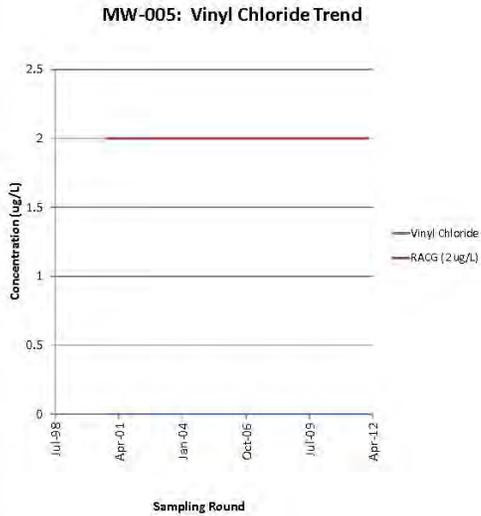
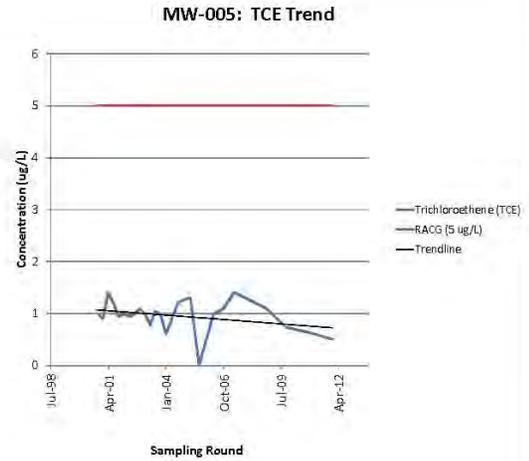
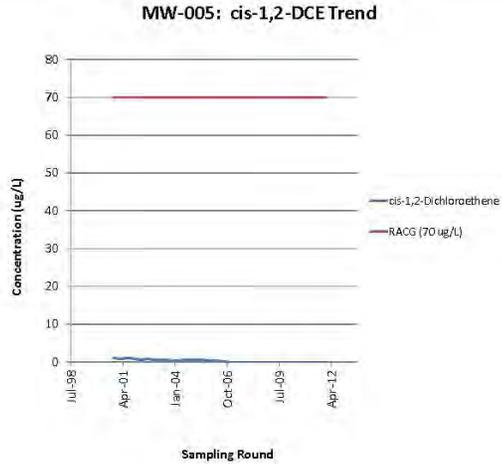
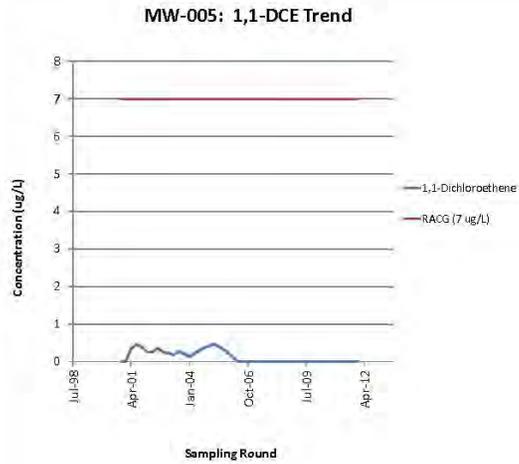
# APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS



## APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS



# APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS

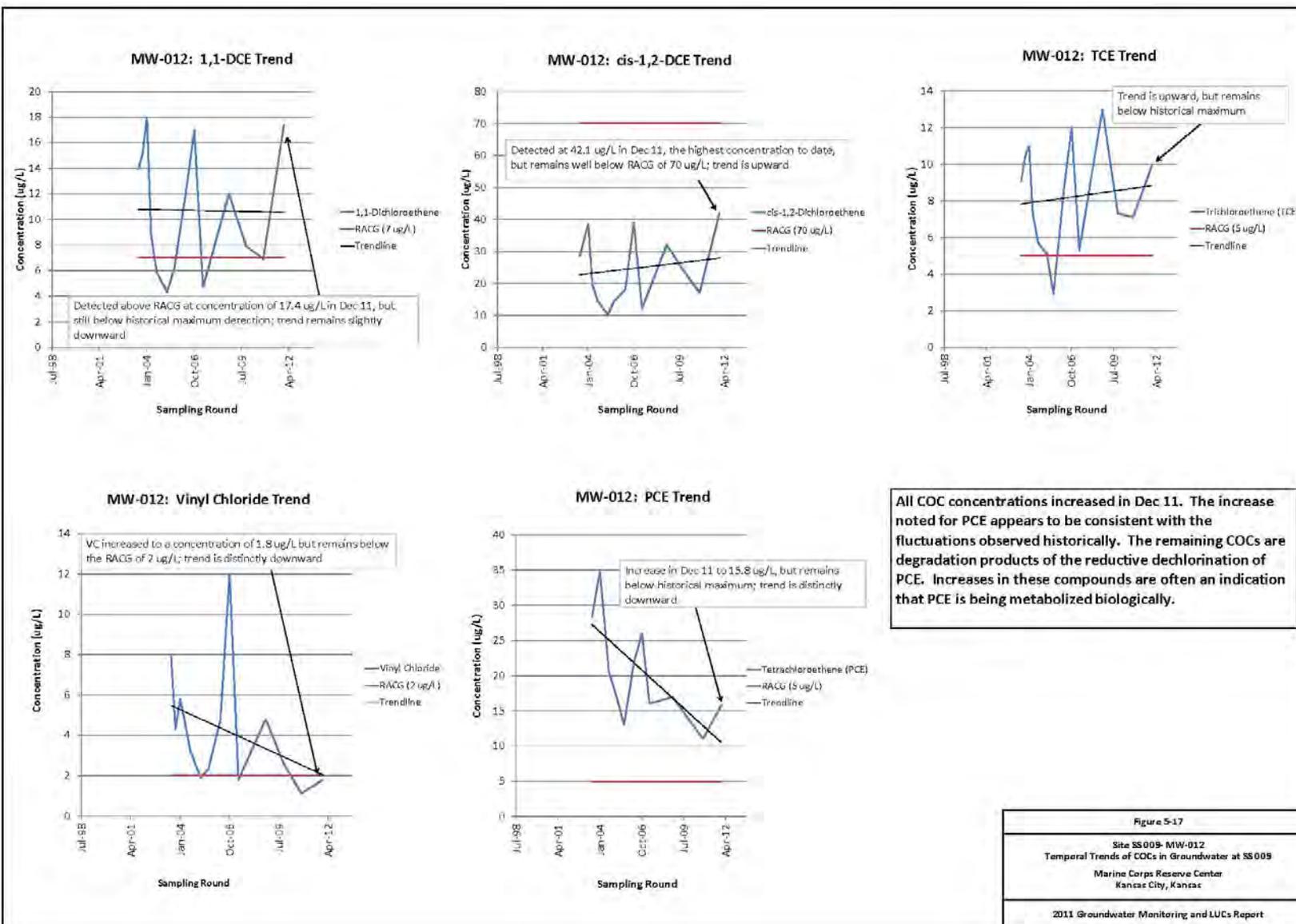


No RACG has ever been exceeded in this well and only TCE and PCE have been detected since Aug 05. Both exhibit downward concentration trends.

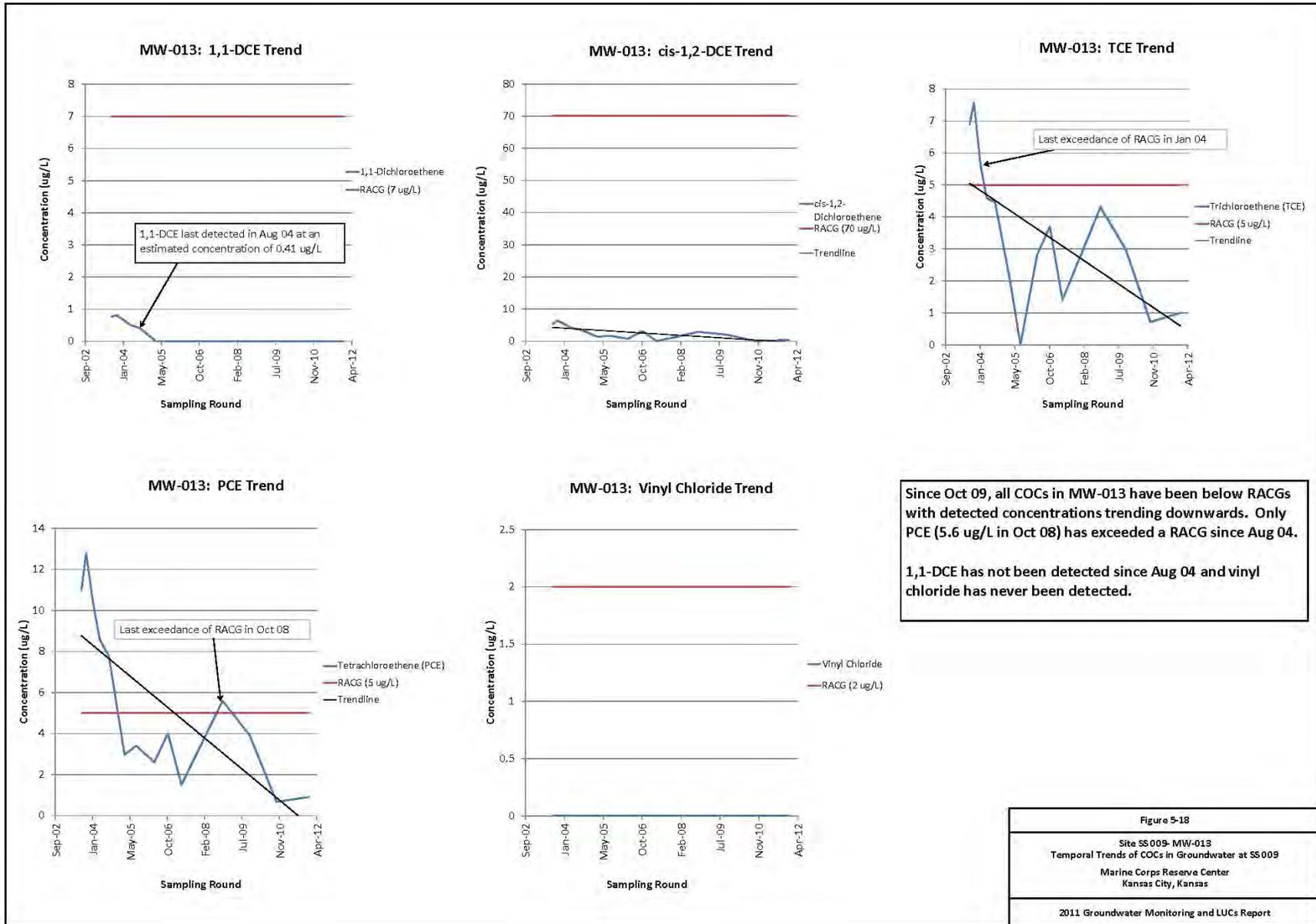
Vinyl chloride has never been detected in this well and 1,1-DCE and cis-1,2-DCE have not been detected since Apr 06.

Figure 5-15  
 Site SS009- MW-005  
 Temporal Trends of COCs in Groundwater at SS009  
 Marine Corps Reserve Center  
 Kansas City, Kansas  
 2011 Groundwater Monitoring and LUCs Report

## APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS



# APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS



# APPENDIX E – SS-009 PLUME MAPS AND TREND CHARTS

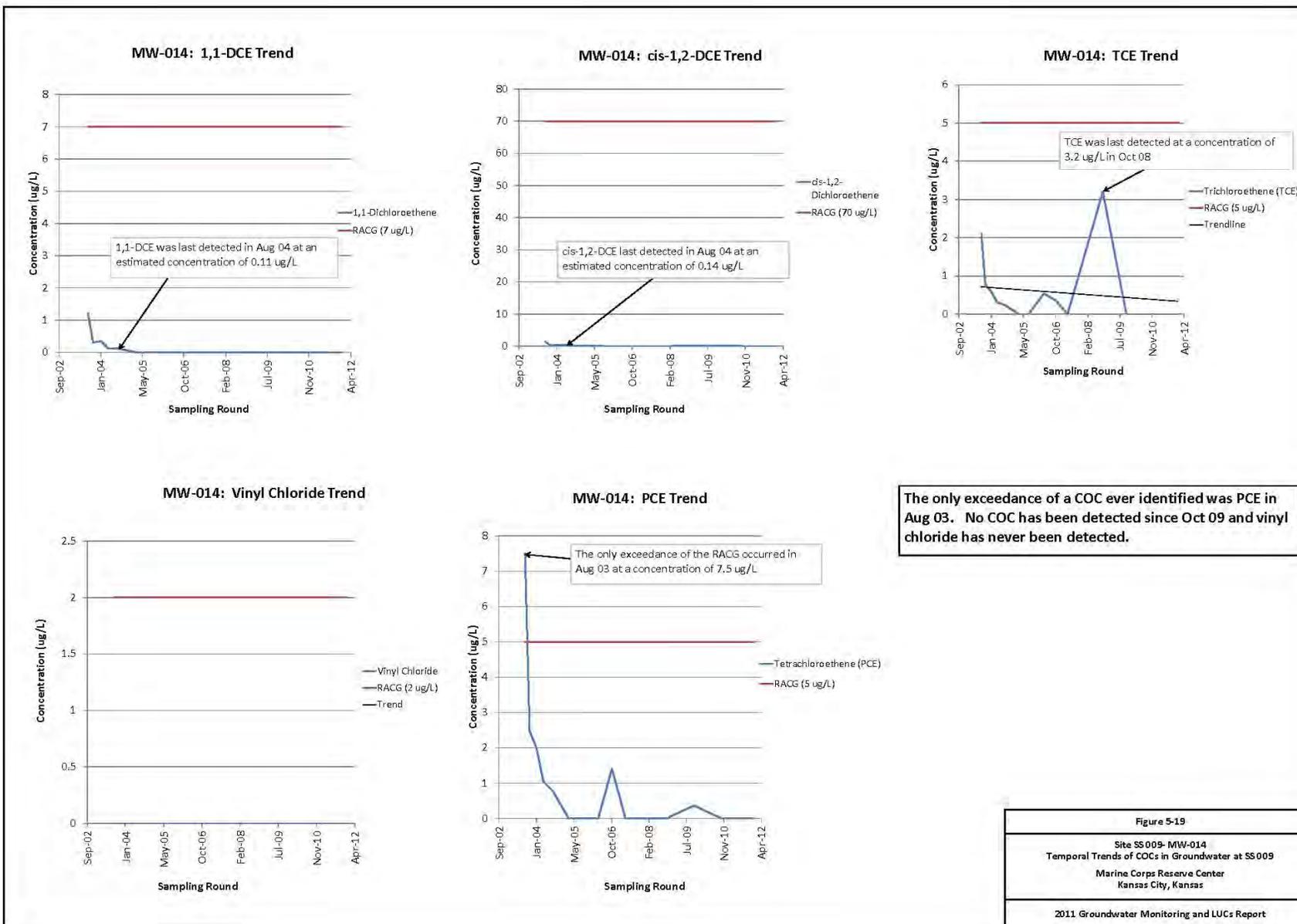


Figure 5-19  
 Site SS 009- MW-014  
 Temporal Trends of COCs in Groundwater at SS009  
 Marine Corps Reserve Center  
 Kansas City, Kansas  
 2011 Groundwater Monitoring and LUCs Report

**APPENDIX F**

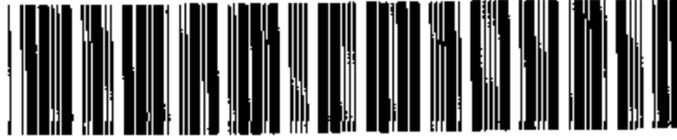
**DEED TRANSFER TO CITY OF KANSAS CITY  
(WITHOUT ENCLOSURES)**

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RECORDER'S CERTIFICATION  
JACKSON COUNTY, MISSOURI

04/04/2012 01:56:02 PM

INSTRUMENT TYPE: QCD FEE: \$642.00 206 Pages



INSTRUMENT NUMBER/BOOK & PAGE:

2012E0035995

ROBERT T. KELLY, DIRECTOR, RECORDER OF DEEDS

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Title of Document: QuitClaim Deed

Date of Document: December 22, 2011

Grantor: United States of America

Grantee: City of Kansas City, Missouri

Grantee's Mailing Address: 414 E. 12<sup>th</sup> St. 28<sup>th</sup> Floor  
Kansas City, MO 64106

Legal Description: see Exhibits A and B on pages 14 and 17  
attached hereto

Reference Document No:

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499900

Please return to:

Robert L. Patterson

First American Title Insurance Company

911 Main St., Suite 2500

Kansas City, MO 64105

# QUITCLAIM DEED

THIS INDENTURE ("Quitclaim Deed") is made the 22 nd day of December 2011 between the **United States of America**, acting by and through the Secretary of the Navy, Navy Base Realignment and Closure Program Management Office Southeast, Charleston, South Carolina, hereinafter referred to as "**GOVERNMENT**," and the **City of Kansas City, Missouri**, hereinafter referred to as "**GRANTEE**," acting as the Local Redevelopment Authority for surplus Government real and personal property at the former Marine Corps Support Activity, Kansas City, Missouri. This Quitclaim Deed is based upon the following facts:

## Recitals

A. GRANTOR is acting hereunder pursuant to the authority contained in the Federal Property and Administrative Services Act of 1949, approved June 30, 1949, (63 Stat. 377), as amended, and 49 U.S.C. Sections 47151-47153 (formally known as the Surplus Property Act of 1944 [58 Stat. 765], as amended), and a delegation of that authority from the Administrator of General Services to the Secretary of Defense and subsequent delegation to the Secretary of the Navy whereby, the Secretary of the Navy may convey surplus property at a closing installation to representatives of the homeless or to the installation's Local Redevelopment Authority for homeless assistance use pursuant to Section 2905(b)(7) of the Defense Base Closure and Realignment Act of 1990 (P.L. 101-510; 10 U.S.C. 2687 note), as amended, and the implementing regulations of the Department of Defense (32 CFR Parts 174 and 176).

B. GRANTEE, by submission of its Reuse Plan for surplus government property located at the former Marine Corps Support Activity, Kansas City, Missouri ("MCSA Kansas City"), dated February 11, 2011, requested a portion of said surplus property containing approximately 0.378 acres of land and improvements for Homeless Provider Assistance under the provisions of 42 U.S.C. § 11411.

C. GRANTEE's Reuse Plan was approved by the United States Department of Housing and Urban Development ("HUD") on March 10, 2011 and the GOVERNMENT approved a transfer of approximately 0.378 acres of land and improvements (referred to hereinafter as the "**PROPERTY**") to the GRANTEE for subsequent conveyance to its selected Homeless Provider.

D. The GOVERNMENT has found and determined that the **PROPERTY** at MCSA Kansas City to be conveyed to GRANTEE is suitable for transfer pursuant to the Finding of Suitability for Transfer ("**FOST**") dated October 3, 2011. The FOST sets forth the basis of the GRANTOR'S determination that all the property at MCSA Kansas City, including the portion being conveyed by this Quitclaim Deed, is suitable for transfer pursuant to 42 U.S.C. Section 9620(h)(3).

NOW THEREFORE, by the acceptance of this Quitclaim Deed or any rights hereunder, the GRANTEE, for itself, its successors and assigns, agrees that the transfer of **PROPERTY** by this Quitclaim Deed is accepted subject to the following terms, restrictions, reservations, covenants, and conditions set forth below, which shall run with the land, provided that the **PROPERTY**, both real and personal, transferred hereby may be successively transferred only with the proviso that any such subsequent transferee assumes all of the obligations upon the GRANTEE by the provisions of this Quitclaim Deed.

IN CONSIDERATION OF THE FOREGOING, of the terms and conditions set forth below and of other good and valuable consideration (the receipt and adequacy of which, as consideration, the parties hereto both acknowledge), the parties hereto, intending to be legally bound hereby, have agreed to, and do hereby, effectuate the conveyance set forth below.

### **Conveyance Language**

GOVERNMENT does hereby, subject to any easements and encumbrances of record and subject to the reservations, exceptions, notices, covenants, conditions, and restrictions expressly contained herein, grant, sell, convey, remise, release, and quitclaim unto GRANTEE, its successors, and its assigns, without any warranty express or implied as to the quantity or quality of GOVERNMENT's title (except such warranties as are specifically set forth herein, required by 42 U.S.C. § 9620(h)(3), or otherwise required by law), all GOVERNMENT's right, title, and interest in the PROPERTY, including, but not limited to the underlying estate, buildings, structures, and improvements, and personal property situated or installed thereon, commonly known as and referred to herein as "Parcel HUD", together with a dedicated right of ingress and egress identified as "Easement", more fully described on the documents attached to this Quitclaim Deed and incorporated herein as Exhibits "A" and "B" respectively.

TOGETHER WITH all and singular the ways, waters, water-courses, driveways, rights, hereditaments and appurtenances, whatsoever thereunto belonging, or in any wise appertaining, and the reversions and remainders, rents, issues and profits thereof; and all the estate, right, title, interest, property, claim and demand whatsoever of GOVERNMENT, in law, equity, or otherwise howsoever, of, in, and to the same and every part thereof; and

TO HAVE AND TO HOLD the said lots or pieces of ground above described, the hereditaments and premises hereby granted, or mentioned and intended so to be, with the appurtenances, unto the said GRANTEE, its successors, and its assigns, and subject to the reservations, restrictions, and conditions set forth in this instrument, to and for the only proper use and behoof of the said GRANTEE, its successors, and its assigns forever.

### **Special Sections**

**I. Use of PROPERTY Solely to Assist Homeless:** GRANTEE covenants that it will use the PROPERTY solely to assist the homeless as authorized under Section 2905(b)(7) of Public Law 101-510 for purposes in support of homeless persons as defined in 24 CFR Part 586 and 42 U.S.C. § 11301. However, use of the PROPERTY for transitional housing or other residential purposes is restricted hereunder pursuant to Special Section IX below, and would require approvals in accordance with Special Sections XIV and XV below. Any use of the PROPERTY for residential purposes would also require the proper abatement of Asbestos Containing Materials and Lead Based Paint in accordance with Special Sections XVI and XVII below.

**II. Compliance with Legally Binding Agreement:** GRANTEE covenants that it shall comply with the terms and provisions of the Legally Binding Agreement dated January 20, 2011, between GRANTEE and Heart N Hand Ministries, a Missouri non-profit corporation.

**III. Notice of Environmental Condition:** Information concerning the environmental condition of the PROPERTY is contained in the document known as the FOST, dated October 3, 2011, which is attached hereto and made a part hereof as Exhibit "C" and incorporated herein by reference. An **Environmental Condition of Property ("ECP")** report is referenced in the FOST; the FOST and ECP reference environmental conditions on the PROPERTY and on other property not subject to this Quitclaim Deed. Those restrictions and environmental conditions described in the FOST and ECP which are applicable to the PROPERTY are contained in this Quitclaim Deed. The FOST sets forth the basis for the GOVERNMENT's determination that the PROPERTY is suitable for transfer. Together, the ECP and FOST contain all pertinent information currently known by the GOVERNMENT as to the environmental condition of the PROPERTY. GRANTEE hereby acknowledges that it has been provided copies of the ECP and FOST.

**IV. Notice of Potential for Vapor Intrusion:** Groundwater contamination in excess of Remedial Action Cleanup Goals ("RACGs") remains on the PROPERTY. Before construction of any improvements on this site, the potential for vapor intrusion from groundwater and possible resulting impacts to indoor air quality should be considered and, as needed, addressed during building and design.

**V. Description of Remedial Action Taken:** Pursuant to section 120(h)(3)(A)(i)(III) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA") (42 U.S.C. § 9620(h)(3)(A)(i)(III)), a remedial action consisting of Land Use Controls/Institutional Controls ("LUCs/ICs") supported by a Long-Term Monitoring ("LTM") program for groundwater has been taken on the PROPERTY. The selected remedial actions being implemented at the PROPERTY, although not yet completed, have been determined by the United States Environmental Protection Agency ("USEPA") to be "operating properly and successfully" ("OPS") pursuant to CERCLA Section 120(h)(3)(B).

**VI. Notices Pursuant to Section 120(h)(3)(A)(i)(I) and (II) of CERCLA:** Pursuant to section 120(h)(3)(A)(i)(I) and (II) of CERCLA, available information regarding the type, quantity, and location of hazardous substances and the time at which such substances were stored, released, or disposed of, as defined in section 120(h), is provided in Exhibit "D", attached hereto and made a part hereof.

**VII. CERCLA Covenants:** Pursuant to section 120(h)(3)(A)(ii) and (B) of CERCLA, the GOVERNMENT warrants that:

- a. all remedial action necessary to protect human health and the environment with respect to any hazardous substance identified pursuant to section 120(h)(3)(A)(i)(I) of CERCLA remaining on the PROPERTY has been taken before the date of this Quitclaim Deed; and
- b. that any additional remedial action found to be necessary after the date hereof shall be conducted by the United States of America.

**VIII. Access Rights Pursuant to Section 120(h)(3)(A)(iii) of CERCLA:** GOVERNMENT retains and reserves a perpetual and assignable easement and right of access on, over, and through the PROPERTY, to enter upon the PROPERTY in any case in which a remedial action or corrective action is found to be necessary on the part of GOVERNMENT, without regard to whether such remedial action or corrective action is on the PROPERTY or on adjoining or nearby lands. Such easement and right of access includes, without limitation, the right to perform any environmental investigation, survey, monitoring, sampling, testing, drilling, boring, coring, testpitting, installing, monitoring or pumping wells or other treatment facilities, response action, corrective action, or any other action necessary for the GOVERNMENT to meet its responsibilities under applicable laws as provided for in this Quitclaim Deed. Such easement and right of access shall be binding on the GRANTEE and its successors and assigns and shall run with the land.

In exercising such easement and right of access, the GOVERNMENT shall provide the GRANTEE or its successors or assigns, as the case may be, with reasonable notice of its intent to enter upon the PROPERTY and exercise its rights under this clause, which notice may be severely curtailed or eliminated in emergency situations. The GOVERNMENT shall use reasonable means to avoid and to minimize interference with the GRANTEE's and the GRANTEE's successors' and assigns' quiet enjoyment of the PROPERTY. At the completion of work, the work site shall be reasonably restored. Such easement and right of access includes the right to obtain and use utility services, including water, gas, electricity, sewer and communications services available on the PROPERTY at a reasonable charge to the GOVERNMENT. Excluding the reasonable charges for such utility services, no fee, charge, or compensation will be due the GRANTEE, nor its successors and assigns, for the exercise of the easement and right of access hereby retained and reserved by the GOVERNMENT.

In exercising such easement and right of access, neither the GRANTEE nor its successors and assigns, as the case may be, shall have any claim at law or equity against the GOVERNMENT, or any officer or employee of the GOVERNMENT, based on actions taken by the GOVERNMENT or its officers, employees, agents, contractors of any tier, or servants pursuant to and in accordance with this clause: Provided, however, that nothing in this paragraph shall be considered as a waiver by the GRANTEE and its successors and assigns from any remedy available to them under the Federal Tort Claims Act.

**IX. Covenant and Restriction regarding Non-residential Use:** GRANTEE hereby covenants, on behalf of itself, its successors, and its assigns, that residential reuse of the PROPERTY, without prior written approval of the GOVERNMENT, USEPA, and Missouri Department of Natural Resources ("MDNR") will be prohibited. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, any kind of school, including pre-schools, elementary schools, and secondary schools, playgrounds, and adult convalescent and nursing care facilities.

**X. Covenant and Restriction regarding Groundwater:** GRANTEE hereby covenants, on behalf of itself, its successors, and its assigns, that use and/or extraction of the groundwater within the PROPERTY, for any purpose (including, but not limited to, human consumption, dewatering, irrigation, heating/cooling purposes, and/or industrial or agricultural uses) is prohibited without prior written approval from the GOVERNMENT, USEPA, and MDNR.

Subsurface drilling and/or excavation of the groundwater within the PROPERTY are prohibited without prior written approval from the GOVERNMENT, USEPA, and MDNR.

**XI. Covenant and Restriction regarding GRANTEE compliance with Health and Safety**

**Plan:** GRANTEE covenants that it shall comply or require its lessees and licensees to comply with the provisions of any health and safety plan put into effect by the GOVERNMENT in connection with any ongoing or future environmental investigative and/or remedial activities to be undertaken by the GOVERNMENT on the PROPERTY.

**XII. Covenant and Restriction regarding Non-interference with Remedial Systems'**

**Operations and Controls:** The GRANTEE, its successors and assigns, shall not hinder or prevent the GOVERNMENT from constructing, upgrading, operating, maintaining, and monitoring any groundwater and/or soil treatment facilities and groundwater and/or soil monitoring networks or engage in any activity that will disrupt or hinder further remedial investigation, response actions, or oversight activities on any known or hereafter discovered sites within the PROPERTY. The GRANTEE, its successors and assigns, shall not disturb, move, damage, mar, tamper with, interfere with, obstruct, or impede any monitoring wells, treatment facilities, piping, and other facilities associated with environmental cleanup activities being conducted by the GOVERNMENT on the PROPERTY. The GRANTEE, its successors and assigns, shall not disturb, move, damage, mar, tamper with, interfere with, obstruct, or impede any environmental investigation or remedial activity associated with environmental cleanup activities being conducted by the GOVERNMENT or jeopardize the protectiveness of the environmental remedies put in place or conduct or permit any activity that could negatively impact or restrict access for cleanup on the PROPERTY.

**XIII. Covenant and Restriction regarding Annual Inspections:** GRANTEE covenants that it or its designee shall perform annual inspections of the PROPERTY to ensure that all Land Use Controls (LUCs), are being complied with and provide a written certification to MDNR, with a copy to the GOVERNMENT certifying such compliance, for as long as LUCs are required on the PROPERTY. Such annual certifications shall be provided using the form attached hereto as **Exhibit "E"** or similar form as may later be approved by MDNR. If a LUC violation is discovered after transfer of the PROPERTY, the Grantee, its successors and assigns, shall notify the GOVERNMENT, USEPA and MDNR, as soon as practicable, but in no case longer than 10 days after the specific deficiency(ies) is found. Within 10 days of reporting the deficiency(ies), the GRANTEE, its successors and assigns, shall provide a written explanation indicating the specific deficiencies and what efforts or measures have been or will be taken to correct those deficiencies.

**XIV. Release of Environmental Conditions and/or GRANTEE Covenants:** The GOVERNMENT shall release the aforementioned groundwater notification and groundwater LUCs from the PROPERTY only with USEPA and MDNR written concurrence. It is anticipated that USEPA and MDNR shall both give their concurrence if sampling demonstrates that the RACGs applicable to the PROPERTY and remedial objectives have been met. The GOVERNMENT shall consider a request to release the environmental conditions and GRANTEE covenants related to the PROPERTY only with EPA and MDNR written concurrence. The GOVERNMENT shall respond promptly and in good faith to any written request by the GRANTEE, its successors or assigns that the GOVERNMENT extinguish, release

or otherwise modify any of the environmental conditions or GRANTEE covenants because of full satisfaction of the essential purposes thereof, or achievement of remedial goals. Any such request must include a letter from EPA and MDNR, or other suitable documentation, stating that site rehabilitation with respect to environmental conditions on the PROPERTY has been achieved and no further remedial action is required. Once the required regulatory concurrences noted above have been obtained by the GRANTEE, or its successors or assigns, the GOVERNMENT shall deliver to the GRANTEE, or its successors or assigns, in recordable form a Deed Amendment or Covenant Release relating specifically to the aforementioned LUCs. The execution of the Deed Amendment or Covenant Release by the GOVERNMENT shall remove these LUCs with respect to the portion(s) of the PROPERTY specified in the Deed Amendment or Covenant Release.

**XV. Development, Improvement or Maintenance of Land Restricted by Environmental Conditions, Covenants or LUCs:** In the event the GRANTEE, its successors and assigns desires to develop, improve, use, or maintain the PROPERTY in a manner that is restricted or prohibited by the environmental conditions, covenants or LUCs contained within this Quitclaim Deed, the GRANTEE, its successors and assigns shall provide the GOVERNMENT with a written request seeking approval for the requested activity. The GOVERNMENT shall respond to these written requests promptly and in good faith PROVIDED the request includes both a full description of the proposed work, including but not limited to the actual work plan maps, drawings and specifications AND, documentation from EPA and MDNR indicating that EPA and MDNR have reviewed the proposed development, improvement, or maintenance activity and do not object thereto.

**XVI. Asbestos-Containing Materials Hazard Disclosure and Acknowledgement:** GRANTEE hereby acknowledges that asbestos containing materials ("ACM") remain in buildings on the PROPERTY and agrees to manage any and all remaining ACM in accordance with applicable laws and regulations. An Asbestos Containing Materials Hazard Disclosure and Acknowledgement Statement is provided as EXHIBIT "F" to this Quitclaim Deed.

The GRANTEE covenants, on behalf of itself, its successors and assigns, as a covenant running with the land, that it will prohibit occupancy and use of buildings and structures, or portions thereof, containing known asbestos hazards or known ACM hazards prior to abatement of such hazards. In connection with its use and occupancy of the PROPERTY, including, but not limited to, demolition of buildings and structures containing ACM, GRANTEE will comply with all applicable Federal, State and local laws relating to asbestos or ACM.

The GRANTEE acknowledges that the GOVERNMENT assumes no liability for damages for personal injury, illness, disability, or death to the GRANTEE, its successors, assigns, employees, invitees, or to any other person, including members of the general public, arising from or incident to the purchase, transportation, removal, handling, use, disposition, or other activity causing or leading to contact of any kind whatsoever with ACM in structures on the PROPERTY, whether the GRANTEE, its successors or assigns, has properly warned, or failed to properly warn the persons injured.

**XVII. Lead Based Paint Hazard Disclosure and Acknowledgment:** The PROPERTY contains improvements that, due to their age, are likely to have been painted with lead based

paint ("LBP"). This, in turn, creates the possibility, through the action of normal weathering and maintenance, that there may be lead from LBP in the soil surrounding these structures. Lead from paint, paint chips, and dust can pose health hazards if not managed properly. A Lead Based Paint Hazard Disclosure and Acknowledgment Statement is provided as **Exhibit "G"** to this Quitclaim Deed.

The GOVERNMENT shall have no obligation for the demolition of nonresidential buildings, structures, or facilities built prior to 1978, which creates the potential for lead to be released to soil as a result of such activities. With respect to nonresidential buildings, structures, or facilities, which the GRANTEE intends to demolish or redevelop for residential use after conveyance, the GRANTEE may, under applicable law or regulation, be required by regulatory agencies to evaluate the soil adjacent to such nonresidential buildings, structures, or facilities for soil-lead hazards, and to abate any such hazards that may be present, after demolition and prior to occupancy of any newly constructed residential structures.

The GRANTEE covenants and agrees that it shall prohibit residential occupancy and use of buildings and structures, or portions thereof, prior to identification and/or evaluation of any LBP hazards, and abatement of any hazards identified as required.

The GRANTEE covenants and agrees, on behalf of itself, its successors and assigns, that it shall comply with all Federal, State, and local laws relating to LBP in its use and occupancy of the PROPERTY (including demolition and disposal of existing improvements). The GRANTEE shall hold harmless and indemnify the GOVERNMENT from and against any and all loss, judgment, claims, demands, expenses, or damages of whatever nature or kind which might arise or be made against the GOVERNMENT as a result of LBP having been present on the PROPERTY. Improvements on the PROPERTY were constructed prior to 1978 and, as with all such improvements, a LBP hazard may be present.

**XVIII. Pesticides:** The PROPERTY may contain pesticide residue from pesticides that have been applied in the management of the PROPERTY. The GOVERNMENT knows of no use of any registered pesticide in a manner inconsistent with its labeling and believes that all applications were made in accordance with the Federal Insecticide, Fungicide and Rodenticide Act ("FIFRA") (7 U.S.C. Sec. 136, et seq.), its implementing regulations, and according to the labeling provided with such substances. It is the GOVERNMENT's position that it shall have no obligation under the covenants provided pursuant to section 120(h)(3)(A)(ii) of CERCLA for the remediation of legally applied pesticides.

**XIX. GRANTEE Notice Requirement regarding future sale or assignment:** GRANTEE, on behalf of its successors and assigns, lessees and licensees, contractors and agents, covenants that it shall provide written notice to the GOVERNMENT, USEPA and MDNR, and other applicable local regulatory agencies, if any, of any subsequent sale, assignment, or lease of the PROPERTY or any portion thereof, and provide contact information concerning the new owner or occupant.

The following are points of contact for the GOVERNMENT, USEPA, and MDNR:

**GOVERNMENT**

Director  
BRAC Program Management Office SE  
4130 Faber Place Drive  
Suite 202  
North Charleston, SC 29405

**USEPA**

US Environmental Protection Agency  
Region 7  
901 North 5<sup>th</sup> Street  
Kansas City, Kansas 66101

**State of Missouri**

Missouri Department of Natural Resources  
Attn: Mr. Ruben Zamarripa  
P.O. Box 176, Jefferson City, MO 65102-0176

The GRANTEE, its successors and assigns, agree that if any portion of the PROPERTY is conveyed by deed, the GRANTEE, its successors and assigns, shall provide notice to the party to whom the PROPERTY or any portion thereof is transferred ("the subsequent owner") of all CERCLA Hazardous Substances as contained in the Quitclaim Deed, LUCS, and GRANTEE covenants, and the subsequent owner, its successors and assigns, shall then be bound by the same LUCS and GRANTEE covenants.

**General Provisions**

**XX. Conveyance is "As Is – Where Is":** Except as expressly provided in this Quitclaim Deed or as otherwise required by law, the PROPERTY is being conveyed "AS IS" and "WHERE IS," without representation, warranty, or guaranty as to quality, quantity, character, condition, size, kind, or fitness for a particular purpose.

**XXI. Covenant regarding Non-Discrimination:** GRANTEE covenants for itself, its successors, and assigns and every successor in interest to the PROPERTY, or any part thereof, that GRANTEE and its successors, and assigns shall not discriminate upon the basis of race, color, religion, disability, or national origin in the use, occupancy, sale, or lease of the PROPERTY, or in their employment practices conducted thereon. This covenant shall not apply however, to the lease or rental of a room or rooms within a family dwelling unit, nor shall it apply with respect to PROPERTY used primarily for religious purposes. The GOVERNMENT shall be deemed a beneficiary of this covenant without regard to whether it remains the owner of any land or interest therein in the locality of the PROPERTY hereby conveyed and shall have the sole right to enforce this covenant in any court of competent jurisdiction.

**XXII. General Notice Provision:** To facilitate such future cooperation, the following points of contact have been designated by the GOVERNMENT, GRANTEE, and the State of Missouri:

**GOVERNMENT – US Government Point of Contact:**

Director  
Navy BRAC Program Management Office Southeast  
4130 Faber Place Drive, Suite 202  
North Charleston, SC 29405

**GRANTEE:**

Mr. Claude Page  
City Of Kansas City, Planning Department  
29<sup>th</sup> Floor City Hall  
414 East 12<sup>th</sup> Street  
Kansas City, Missouri 64106

**State of Missouri:**

Missouri Department of Natural Resources  
Attn: Mr. Ruben Zamarripa  
P.O. Box 176, Jefferson City, MO 65102-0176

**USEPA**

US Environmental Protection Agency  
Region 7  
901 North 5<sup>th</sup> Street  
Kansas City, Kansas 66101

[SIGNATURE PAGE FOLLOWS]

**EXECUTION**

EFFECTIVE this 22nd day of December, 2011.

**UNITED STATES OF AMERICA**  
Acting by and through  
Department of the Navy

By: [Signature]  
WILLIAM R. CARSILO  
Real Estate Contracting Officer

WITNESSES:

\_\_\_\_\_

\_\_\_\_\_  
(Print Name)

\_\_\_\_\_

\_\_\_\_\_  
(Print Name)

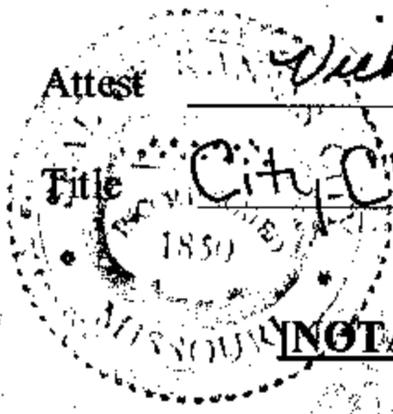
**ACCEPTANCE**

The **CITY OF KANSAS CITY, MISSOURI** does hereby accept this Quitclaim Deed and by acceptance agrees to all of the terms and condition thereof.

Executed this 28<sup>th</sup> day of MARCH, 2011/2

By [Signature]  
Title Director of Finance

(OFFICIAL SEAL)

Attest Debbie Thompson-Carr  
Title City Clerk  


**NOTARY PAGES ATTACHED TO THIS SIGNATURE PAGE**

# CALIFORNIA ALL-PURPOSE CERTIFICATE OF ACKNOWLEDGMENT

State of California

County of San Francisco

On 12/22/2011 before me, Thom O'Brien, notary public  
(Here insert name and title of the officer)

personally appeared William R. Carsillo

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

*[Handwritten Signature]*  
 \_\_\_\_\_  
 Signature of Notary Public



(Notary Seal)

## ADDITIONAL OPTIONAL INFORMATION

### INSTRUCTIONS FOR COMPLETING THIS FORM

*Any acknowledgment completed in California must contain verbiage exactly as appears above in the notary section or a separate acknowledgment form must be properly completed and attached to that document. The only exception is if a document is to be recorded outside of California. In such instances, any alternative acknowledgment verbiage as may be printed on such a document so long as the verbiage does not require the notary to do something that is illegal for a notary in California (i.e. certifying the authorized capacity of the signer). Please check the document carefully for proper notarial wording and attach this form if required.*

- State and County information must be the State and County where the document signer(s) personally appeared before the notary public for acknowledgment.
- Date of notarization must be the date that the signer(s) personally appeared which must also be the same date the acknowledgment is completed.
- The notary public must print his or her name as it appears within his or her commission followed by a comma and then your title (notary public).
- Print the name(s) of document signer(s) who personally appear at the time of notarization.
- Indicate the correct singular or plural forms by crossing off incorrect forms (i.e. ~~he~~/she/~~they~~, is /~~are~~) or circling the correct forms. Failure to correctly indicate this information may lead to rejection of document recording.
- The notary seal impression must be clear and photographically reproducible. Impression must not cover text or lines. If seal impression smudges, re-seal if a sufficient area permits, otherwise complete a different acknowledgment form.
- Signature of the notary public must match the signature on file with the office of the county clerk.
  - ❖ Additional information is not required but could help to ensure this acknowledgment is not misused or attached to a different document.
  - ❖ Indicate title or type of attached document, number of pages and date.
  - ❖ Indicate the capacity claimed by the signer. If the claimed capacity is a corporate officer, indicate the title (i.e. CEO, CFO, Secretary).
- Securely attach this document to the signed document

#### DESCRIPTION OF THE ATTACHED DOCUMENT

\_\_\_\_\_  
 (Title or description of attached document)

\_\_\_\_\_  
 (Title or description of attached document continued)

Number of Pages \_\_\_\_\_ Document Date \_\_\_\_\_

\_\_\_\_\_  
 (Additional information)

#### CAPACITY CLAIMED BY THE SIGNER

- Individual (s)
- Corporate Officer  
 \_\_\_\_\_  
 (Title)
- Partner(s)
- Attorney-in-Fact
- Trustee(s)
- Other \_\_\_\_\_

**NOTARY CERTIFICATION**

**State of Missouri        )**

**County of Jackson     )**

On this 28<sup>th</sup> day of March, 2012, before me appeared Randall J. Landes, to me personally known, who, being by me duly sworn did say that he is the Director of Finance of Kansas City, Missouri and that the seal affixed to the foregoing instrument is the seal of Kansas City, Missouri and that said instrument was signed and sealed in behalf of said City by authority of its City Council and said Randall J. Landes acknowledged said instrument to be the free act and deed of said City.



Notary Public

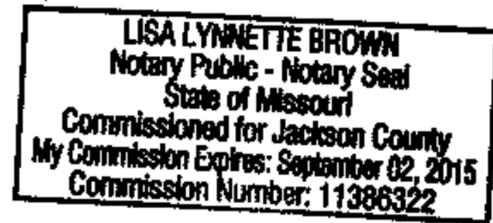


Exhibit "A"

**LEGAL DESCRIPTION AND PLAT OF CONVEYED PROPERTY**

**Homeless Provider conveyance to KC LRA**

13  
41

**EXHIBIT A**

**PARCEL HUD**

PARCEL DESCRIPTION: ALL THAT PART OF THE SOUTHEAST QUARTER OF SECTION 34, TOWNSHIP 47 NORTH, RANGE 33 WEST, IN KANSAS CITY, JACKSON COUNTY, MISSOURI, BEARINGS ARE REFERENCED TO GRID NORTH OF THE MISSOURI STATE PLANE COORDINATE SYSTEM, 1983, WEST ZONE, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHEAST CORNER OF THE SOUTHEAST QUARTER OF SECTION 34, T47N, R33W, BEING A FOUND ALUMINUM CAP IN MONUMENT BOX, PER CERTIFIED LAND CORNER RECORD, DOCUMENT NUMBER 600-65354; THENCE N86°11'50"W ALONG THE SOUTH LINE OF SAID SOUTHEAST QUARTER, A DISTANCE OF 928.30 FEET TO A POINT ON THE SOUTHWESTERLY PROLONGATION OF THE NORTHWESTERLY RIGHT-OF-WAY LINE OF ANDREWS ROAD, AS DESCRIBED IN QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275 AND RECORDED AT THE JACKSON COUNTY, MISSOURI RECORDER OF DEEDS OFFICE IN KANSAS CITY, MISSOURI; THENCE N43°56'08"E ALONG THE SOUTHWESTERLY PROLONGATION OF AND ALONG SAID NORTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 758.50 FEET TO A POINT ON THE SOUTHWESTERLY RIGHT-OF-WAY LINE OF HICKAM ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED AND BEING A FOUND PIN AND CAP, STAMPED "A.S.C. / MLS 76-D / KLS 3"; THENCE N46°05'07"W ALONG SAID SOUTHWESTERLY RIGHT-OF-WAY LINE OF HICKAM ROAD, A DISTANCE OF 327.24 FEET TO THE POINT OF BEGINNING; THENCE S43°54'53"W, A DISTANCE OF 78.17 FEET; THENCE N46°05'07"W, A DISTANCE OF 168.67 FEET; THENCE S43°54'53"W, A DISTANCE OF 54.65 FEET; THENCE N46°05'07"W, A DISTANCE OF 24.81 FEET TO A POINT ON THE SOUTHEASTERLY RIGHT-OF-WAY LINE OF WESTOVER ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275; THENCE N43°52'08"E ALONG SAID SOUTHEASTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 132.82 FEET TO A POINT ON THE SOUTHWESTERLY RIGHT-OF-WAY LINE OF SAID HICKAM ROAD AND BEING A FOUND PIN AND CAP, STAMPED "A.S.C. / MLS 76-D / KLS 3"; THENCE S46°05'07"E ALONG SAID SOUTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 193.58 FEET TO THE POINT OF BEGINNING. THE PARCEL DESCRIBED ABOVE CONTAINS 16,487 SQUARE FEET OR 0.378 ACRES, MORE OR LESS.



**Exhibit "B"**

**LEGAL DESCRIPTION AND PLAT OF ACCESS EASEMENT**

**Homeless Provider conveyance to KC LRA**

1/26

**EXHIBIT B**

**EASEMENT**

EASEMENT DESCRIPTION: ALL THAT PART OF THE SOUTHEAST QUARTER OF SECTION 34, TOWNSHIP 47 NORTH, RANGE 33 WEST, IN KANSAS CITY, JACKSON COUNTY, MISSOURI, BEARINGS ARE REFERENCED TO GRID NORTH OF THE MISSOURI STATE PLANE COORDINATE SYSTEM, 1983, WEST ZONE, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHEAST CORNER OF THE SOUTHEAST QUARTER OF SECTION 34, T47N, R33W, BEING A FOUND ALUMINUM CAP IN MONUMENT BOX, PER CERTIFIED LAND CORNER RECORD, DOCUMENT NUMBER 600-65354; THENCE N86°11'50"W ALONG THE SOUTH LINE OF SAID SOUTHEAST QUARTER, A DISTANCE OF 928.30 FEET TO A POINT ON THE SOUTHWESTERLY PROLONGATION OF THE NORTHWESTERLY RIGHT-OF-WAY LINE OF ANDREWS ROAD, AS DESCRIBED IN QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275 AND RECORDED AT THE JACKSON COUNTY, MISSOURI RECORDER OF DEEDS OFFICE IN KANSAS CITY, MISSOURI; THENCE N43°56'08"E ALONG THE SOUTHWESTERLY PROLONGATION OF AND ALONG SAID NORTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 538.95 FEET TO A POINT ON THE NORTHEASTERLY RIGHT-OF-WAY LINE OF CORKILL ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED; THENCE N46°10'13"W ALONG SAID NORTHEASTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 403.18 FEET TO THE POINT OF BEGINNING; THENCE CONTINUING N46°10'13"W ALONG SAID NORTHEASTERLY RIGHT-OF-WAY LINE OF CORKILL ROAD, A DISTANCE OF 27.00 FEET; THENCE N43°54'53"E, A DISTANCE OF 87.37 FEET; THENCE N46°05'07"W, A DISTANCE OF 65.65 FEET; THENCE N43°54'53"E, A DISTANCE OF 54.65 FEET; THENCE S46°05'07"E, A DISTANCE OF 168.67 FEET; THENCE N43°54'53"E, A DISTANCE OF 78.17 FEET TO A POINT ON THE SOUTHWESTERLY RIGHT-OF-WAY LINE OF HICKAM ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275; THENCE S46°05'07"E ALONG SAID SOUTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 9.98 FEET; THENCE S43°54'53"W, A DISTANCE OF 132.82 FEET; THENCE N46°05'07"W, A DISTANCE OF 86.00 FEET; THENCE S43°54'53"W, A DISTANCE OF 87.33 FEET TO THE POINT OF BEGINNING. THE EASEMENT DESCRIBED ABOVE CONTAINS 12,902 SQUARE FEET OR 0.296 ACRES, MORE OR LESS.



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**APPENDIX G**

**DEED FOR PORT AUTHORITY TRANSFER**

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ELECTRONICALLY RECORDED  
JACKSON COUNTY, MISSOURI  
05/29/2012 12:27:07 PM  
QCD FEE: \$ 96.00 26 Pages

INSTRUMENT NUMBER:  
2012E0057011

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*Above Line for Recorder Use Only*

Document Title: **Quitclaim Deed**

Grantor: **United States of America**  
Grantor's Statutory Address: 1455 Frazee Road, Suite 900  
San Diego, CA 92108

Grantee: **The Port Authority of Kansas City, Missouri**  
Grantee's Statutory Address: 300 Wyandotte, Suite 100  
Kansas City, Missouri 64105

*Effective*  
Date of Document: *May 22*, 2012

Legal Description: See Exhibit "A," pp. 15-16  
Exhibit "B," pp. 17-20

Reference Book and Page: N/A

CONTINENTAL TITLE

*0135 565 / 1 of 3*

Execution

1

*Above Line for Recorder Use Only*

Document Title: **Quitclaim Deed**

Grantor: **United States of America**  
Grantor's Statutory Address: 1455 Frazee Road, Suite 900  
San Diego, CA 92108

Grantee: **The Port Authority of Kansas City, Missouri**  
Grantee's Statutory Address: 300 Wyandotte, Suite 100  
Kansas City, Missouri 64105

*Effective*  
Date of Document: *May 22*, 2012

Legal Description: See Exhibit "A," pp. 15-16  
Exhibit "B," pp. ~~17~~-20

Reference Book and Page: N/A

CONTINENTAL TITLE

*0135 565 / 1 OF 3*

## QUITCLAIM DEED

THIS INDENTURE (hereinafter referred to as the "Quitclaim Deed") is made <sup>effective</sup> this 22<sup>nd</sup> day of May, 2012 between the United States of America, acting by and through the Secretary of the Navy, Base Realignment and Closure Program Management Office Southeast, Charleston, South Carolina, hereinafter referred to as the "GOVERNMENT" or the "GRANTOR", and The Port Authority of Kansas City, Missouri, a political subdivision of the State of Missouri created pursuant to Section 68.010, et seq., RSMo., hereinafter referred to as the "GRANTEE", for surplus government real and personal property at the former Marine Corps Support Activity, Kansas City, Missouri ("MCSA"). This Quitclaim Deed is based upon the following facts:

### RECITALS

#### WHEREAS:

The GOVERNMENT is acting hereunder pursuant to the authority contained in the Federal Property and Administrative Services Act of 1949, approved June 30, 1949, (63 Stat. 377), as amended, and 49 U.S.C. Sections 47151-47153 (formally known as the Surplus Property Act of 1944 [58 Stat. 765], as amended), and a delegation of that authority from the Administrator of General Services to the Secretary of Defense and subsequent re-delegation to the Secretary of the Navy whereby, the Secretary of the Navy may convey surplus property at a closing installation to a public body for public purposes at fair market value pursuant to the negotiated sale provisions of 40 U.S.C. 545(b) as implemented by 41 CFR 102-75.885 and under the power and authority provided by the Defense Base Closure and Realignment Act of 1990, as amended (Pub. L. No. 101-510; "Base Closure Act"); and

GRANTEE, under the provisions of 40 U.S.C. 545(b)(8), by submission of its offer to purchase, dated January 5, 2012 offered fair market value for approximately 8.02 acres of land and improvements at MCSA, such land being more fully described on the document attached to this Quitclaim Deed and incorporated herein as Exhibit "A" (hereinafter referred to as the "Negotiated Sale Property") for public use, including, but not limited to, the development of an intermodal transportation facility; and

The GOVERNMENT has found and determined that the Negotiated Sale Property is suitable for transfer pursuant to the Finding of Suitability for Transfer ("FOST") dated October 3, 2011. The FOST sets forth the basis of the GRANTOR's determination that all the property at MCSA, including the portion being conveyed by this Quitclaim Deed, is suitable for transfer pursuant to 42 U.S.C. Section 9620(h)(3); and

NOW THEREFORE, by the acceptance of this Quitclaim Deed or any rights hereunder, the GRANTEE, for itself, its successors and assigns, agrees that the transfer of the Negotiated Sale Property by this Quitclaim Deed is accepted subject to the following terms, restrictions, reservations, covenants, and conditions set forth below, which shall run with the land, provided that the Negotiated Sale Property, both real and personal, transferred hereby may be successively transferred only with the proviso that any such subsequent transferee assumes all of the obligations upon the GRANTEE by the provisions of this Quitclaim Deed.

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IN CONSIDERATION OF THE FOREGOING, of the terms and conditions set forth below and of other good and valuable consideration of six hundred and fifteen thousand dollars and no cents (\$615,000.00), the receipt and adequacy of which, as consideration, the parties hereto, intending to be legally bound hereby, have agreed to, and do hereby, effectuate the conveyance set forth below.

### Conveyance Language

The GOVERNMENT does hereby, subject to any easements and encumbrances of record and subject to the reservations, exceptions, notices, covenants, conditions, and restrictions expressly contained herein, grant, sell, convey, remise, release, and quitclaim unto GRANTEE, its successors and its assigns, without any warranty express or implied as to the quantity or quality of GOVERNMENT's title (except such warranties as are specifically set forth herein, required by 42 U.S.C. Section 9620(h)(3), or otherwise required by law), all of GOVERNMENT's right, title, and interest in that certain real property, including, but not limited to the underlying estate, buildings, structures, and improvements, and personal property situated or installed thereon, being referred to herein as the Negotiated Sale Property; and

TOGETHER WITH all and singular the ways, waters, water courses, driveways, rights, hereditaments and appurtenances, whatsoever thereunto belonging, or in any wise appertaining, and the reversions and remainders, rents, issues and profits thereof; and all the estate, right, title, interest, property, claim and demand whatsoever of the GOVERNMENT, in law, equity, or otherwise howsoever, of, in, and to the same and every part thereof; and

TO HAVE AND TO HOLD the Negotiated Sale Property, the hereditaments and premises hereby granted, or mentioned and intended so to be, with the appurtenances, unto the said GRANTEE, its successors, and its assigns, and subject to the reservations, restrictions, and conditions set forth in this instrument, to and for the use and behoof of the said GRANTEE, its successors and assigns forever.

### Special Sections

I. Notice of Environmental Condition: Information concerning the environmental condition of the Negotiated Sale Property is contained in the FOST and an Environmental Condition of the Property ("ECP") report also prepared by the GOVERNMENT in preparation for transfer of the Negotiated Sale Property. The FOST further identifies the environmental notifications, covenants, and restrictions applicable to that portion of the Negotiated Sale Property referred to as "Site SS009" in the FOST. These notifications, covenants and restrictions, which are applicable only to that portion of the Negotiated Sale Property designated as Site SS 009, are contained in this Quitclaim Deed. Site SS 009 is more fully described in the Plat of Survey attached to this Quitclaim Deed and incorporated herein as Exhibit "B". The FOST sets forth the basis for the GOVERNMENT's determination that the Negotiated Sale Property is suitable for transfer. Together, the ECP and FOST contain all pertinent information currently known by the

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GOVERNMENT as to the environmental condition of the Negotiated Sale Property. GRANTEE hereby acknowledges that it has been provided copies of the ECP and FOST.

II. Covenant regarding Mineral Interests in the Negotiated Sale Property. By that certain Quitclaim Deed recorded on March 26, 2009, in the public records of Jackson County, Missouri under document number 2009E0028142, the United States of America, by and through the Bureau of Land Management, as grantor, quitclaimed to The Port Authority of Kansas City, Missouri, as grantee, federally owned mineral interests associated with certain property as more particularly described therein, which property included the Negotiated Sale Property. Such federally owned mineral interests consisted of all of the Bureau of Land Management's right, title, interest and estate in and to all minerals, excepting oil and gas, lying upon the surface or at any depth of the property and including, but not limited to, those minerals which may be produced by wells, mines and open pit or strip mining, together with the right of ingress and egress at all times for the purpose of mining, drilling, exploring, operating and developing the property for all minerals, excepting oil and gas, and removing the same therefrom. GRANTEE covenants and agrees for itself and its successors and assigns as a covenant running with the land that it shall not take any action in furtherance of its interests under the March 26, 2009 Quitclaim Deed described above, that either interferes with the GRANTOR's Comprehensive Environmental Response, Compensation, and Liability Act of 1980 ("CERCLA") remedial actions or the environmental covenants, conditions and reservations described in this Quitclaim Deed.

III. Notice of Potential Vapor Intrusion for Site SS 009: Groundwater contamination in excess of Remedial Action Cleanup Goals ("RACGs") remains on Site SS 009. Before construction of any improvements on any portion of the Negotiated Sale Property including Site SS 009, the potential for vapor intrusion from groundwater and possible resulting impacts to indoor air quality should be considered and, as needed, addressed during building and design.

IV. Description of Remedial Action Taken at Site SS 009: Pursuant to section 120(h)(3)(A)(i)(III) of CERCLA (42 U.S.C. § 9620(h)(3)(A)(i)(III)), a remedial action consisting of Land Use Controls/Institutional Controls ("LUCs/ICs") supported by a Long-Term Maintenance ("LTM") program for groundwater has been taken on Site SS 009. The selected remedial actions being implemented at Site SS 009, although not yet completed, have been determined by the United States Environmental Protection Agency ("USEPA") to be "operating properly and successfully" ("OPS") pursuant to CERCLA Section 120(h)(3)(B). The specific environmental covenants and restrictions set out in this Quitclaim Deed are part of the LUCs/ICs and LTM program (collectively, the LUCs/ICs and LTM program are hereinafter referred to as the "LUCs") for Site SS 009.

V. Notices Pursuant to Section 120(h)(3)(A)(i)(I) and (II) of CERCLA: Pursuant to section 120(h)(3)(A)(i)(I) and (II) of CERCLA, available information regarding the type, quantity, and location of hazardous substances and the time at which such substances were stored, released, or disposed of, as defined in Section 120(h), is provided in Exhibit "C", attached hereto and made a part hereof.

VI. CERCLA Covenants: Pursuant to section 120(h)(3)(A)(ii) and (B) of CERCLA, the GOVERNMENT warrants that:

a. All remedial action necessary to protect human health and the environment with respect to any hazardous substance identified pursuant to section 120(h)(3)(A)(i)(I) of CERCLA remaining on the Negotiated Sale Property has been taken before the date of this Quitclaim Deed; and

b. That any additional remedial action found to be necessary after the date hereof shall be conducted by the United States of America.

VII. Access Rights Pursuant to Section 120(h)(3)(A)(iii) of CERCLA: GOVERNMENT retains and reserves a perpetual and assignable easement and right of access on, over, and through the Negotiated Sale Property, to enter upon the Negotiated Sale Property in any case in which a remedial action or corrective action is found to be necessary on the part of the GOVERNMENT, without regard to whether such remedial action or corrective action is on the Negotiated Sale Property or on adjoining or nearby lands. Such easements and right of access includes, without limitation, the right to perform any environmental investigation, survey, monitoring, sampling, testing, drilling, boring, coring, testpitting, installing, monitoring or pumping wells or other treatment facilities, response action, correction action, or any other action necessary for the GOVERNMENT to meet its responsibilities under applicable laws as provided for in this Quitclaim Deed. Such easement and right of access shall be binding on the GRANTEE and its successors and assigns and shall run with the land.

In exercising such easement and right of access, the GOVERNMENT shall provide the GRANTEE or its successors or assigns, as the case may be, with reasonable notice of its intent to enter upon the Negotiated Sale Property and exercise its rights under this clause, which notice may be severely curtailed or eliminated in emergency situations. The GOVERNMENT shall use reasonable means to avoid and to minimize interference with the GRANTEE's and the GRANTEE's successors' and assigns' quiet enjoyment of the Negotiated Sale Property. At the completion of work, the work site shall be reasonably restored. Such easement and right of access includes the right to obtain and use utility services, including water, gas, electricity, sewer and communications services available on the Negotiated Sale Property at a reasonable charge to the GOVERNMENT. Excluding the reasonable charges for such utility services, no fee, charge, or compensation will be due the GRANTEE, nor its successors and assigns, for the exercise of the easement and right of access hereby retained and reserved by the GOVERNMENT.

In exercising such easement and right of access, neither the GRANTEE nor its successors and assigns, as the case may be, shall have any claim at law or equity against the GOVERNMENT, or any officer or employee of the GOVERNMENT, based on actions taken by the GOVERNMENT or its officers, employees, agents, contractors of any tier, or servants pursuant to and in accordance with this clause; provided, however, that nothing in this paragraph shall be considered as a waiver by the GRANTEE and its successors and assigns from any remedy available to them under the Federal Tort Claims Act.



VIII. Covenant and Restriction regarding Non-residential Use of Site SS 009: GRANTEE hereby covenants, on behalf of itself, its successors and assigns, that residential reuse of Site SS 009, without prior written approval of the GOVERNMENT, USEPA, and the Missouri Department of Natural Resources (“MDNR”) will be prohibited. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, any kind of school, including pre-schools, elementary schools, and secondary schools, playgrounds, and adult convalescent and nursing care facilities.

IX. Covenant and Restrictions regarding Groundwater at Site SS 009: GRANTEE hereby covenants, on behalf of itself, its successors and assigns, that use and/or extraction of the groundwater within Site SS 009, for any purpose (including, but not limited to, human consumption, dewatering, irrigation, heating/cooling purposes, and/or industrial or agricultural uses) is prohibited without prior written approval from the GOVERNMENT, USEPA, and MDNR. Subsurface drilling and/or excavation of the groundwater within Site SS 009 are prohibited without prior written approval from the GOVERNMENT, USEPA, and MDNR.

X. Covenant and Restriction regarding GRANTEE compliance with Health and Safety Plan for Site SS 009: GRANTEE covenants that it shall comply or require its lessees and licensees to comply with any reasonable provisions of any health and safety plan put into effect by the GOVERNMENT in connection with any ongoing or future environmental investigation and/or remedial activities to be undertaken by the GOVERNMENT on Site SS 009. As of the date of this Quitclaim Deed, no such health and safety plan has been put into effect or is contemplated by the GOVERNMENT.

XI. Covenant and Restriction regarding Non-interference with Remedial Systems’ Operations and Controls at Site SS 009: The GRANTEE, its successors and assigns, shall not hinder or prevent the GOVERNMENT from constructing, upgrading, operating, maintaining, and monitoring any groundwater and/or soil treatment facilities and groundwater and/or soil monitoring networks or engage in any activity that will disrupt or hinder further remedial investigation, response actions, or oversight activities on any known or hereafter discovered sites within Site SS 009. The GRANTEE, its successors and assigns, shall not disturb, move, damage, mar, tamper with, interfere with, obstruct, or impede any monitoring wells, treatment facilities, piping, and other facilities associated with environmental cleanup activities being conducted by the GOVERNMENT on Site SS 009. The GRANTEE, its successors and assigns, shall not disturb, move, damage, mar, tamper with, interfere with, obstruct, or impede any environmental investigation or remedial activity associated with environmental cleanup activities being conducted by the GOVERNMENT or jeopardize the protectiveness of the environmental remedies put in place or conduct or permit any activity that could negatively impact or restrict access for cleanup on Site SS 009.

XII. Covenant regarding Annual Certification of Compliance with LUCs on Site SS 009: GRANTEE covenants that it or its designee shall annually provide a written certification to MDNR, with a copy to the GOVERNMENT, certifying that the LUCs set out in Special Sections VIII, IX, X and XI are being complied with, for as long as LUCs are required on Site SS 009. Such annual certifications shall be provided using the form attached hereto as Exhibit “D,” or similar form as may later be approved by MDNR. If a LUC violation is discovered after transfer



of the Negotiated Sale Property, the GRANTEE, its successors and assigns, shall notify the GOVERNMENT, USEPA, and MDNR, as soon as practicable, but in no case longer than ten (10) days after the specific deficiency(ies) is found. Within ten (10) days of reporting the deficiency(ies), the GRANTEE, its successors and assigns, shall provide a written explanation indicating the specific deficiencies and what efforts or measures have been or will be taken to correct those deficiencies.

XIII. Release of Environmental Condition and/or GRANTEE Covenant LUCs: The GOVERNMENT shall release the groundwater notification and groundwater LUCs from Site SS 009 only with USEPA and MDNR written concurrence. It is anticipated that USEPA and MDNR shall both give their concurrence if sampling demonstrates that the RACGs applicable to Site SS 009 and remedial objectives have been met. The GOVERNMENT shall consider a request to release the LUCs related to Site SS 009 only with USEPA and MDNR written concurrence. The GOVERNMENT shall respond promptly and in good faith to any written request by the GRANTEE, its successors or assigns that the GOVERNMENT extinguish, release or otherwise modify any of the LUCs because of full satisfaction of the essential purposes thereof, or achievement of remedial goals. Any such request must include a letter from USEPA and MDNR, or otherwise suitable documentation, stating that site rehabilitation with respect to environmental conditions on Site SS 009 has been achieved and no further remedial action is required. Once the required regulatory concurrences noted above have been obtained by the GRANTEE, or its successors or assigns, the GOVERNMENT shall deliver to the GRANTEE, or its successors or assigns, in recordable form, a Deed Amendment or Covenant Release relating specifically to the applicable LUCs. The execution of the Deed Amendment or Covenant Release by the GOVERNMENT shall remove these LUCs with respect to the portion(s) of Site SS 009 specified in the Deed Amendment or Covenant Release.

XIV. Development, Improvement or Maintenance of Land Restricted by LUCs: In the event the GRANTEE, its successors and assigns desires to develop, improve, use, or maintain any portion of the Negotiated Sale Property that includes any portion of Site SS 009 in a manner that is restricted or prohibited by the LUCs contained within this Quitclaim Deed, the GRANTEE, its successors and assigns shall provide the GOVERNMENT with a written request seeking approval for the requested activity. The GOVERNMENT shall respond to these written requests promptly and in good faith PROVIDED the request includes both a full description of the proposed work, including but not limited to the actual work plan maps, drawings, and specifications AND, documentation from both the USEPA and MDNR indicating that USEPA and MDNR have reviewed the proposed development, improvement, or maintenance activity and do not object thereto.

XV. Asbestos-Containing Materials Hazard Disclosure and Acknowledgement: GRANTEE hereby acknowledges that asbestos-containing materials ("ACM") remain in buildings on the Negotiated Sale Property and agrees to manage any and all remaining ACM in accordance with applicable laws and regulations. An Asbestos-Containing Materials Hazard Disclosure and Acknowledgement Statement is provided as Exhibit "E" to this Quitclaim Deed.

In addition to the aforementioned covenants and restrictions contained in this Quitclaim Deed, the GRANTEE covenants, on behalf of itself, its successors and assigns, as a covenant running



with the land, that it will prohibit occupancy and use of buildings and structures, or portions thereof, containing known asbestos hazards or known ACM hazards prior to abatement of such hazards. In connection with its use and occupancy of the Negotiated Sale Property, including, but not limited to, demolition of buildings and structures containing ACM, GRANTEE will comply with all applicable Federal, State, and local laws relating to asbestos or ACM.

The GRANTEE acknowledges that the GOVERNMENT assumes no liability for damages for personal injury, illness, disability, or death to the GRANTEE, its successors and assigns, employees, invitees, or to any other person, including members of the general public, arising from or incident to the purchase, transportation, removal, handling, use, disposition, or other activity causing or leading to contact of any kind whatsoever with ACM in structures on the Negotiated Sale Property, whether the GRANTEE, its successors or assigns, has properly warned, or failed to properly warn the persons injured.

XVI. Lead Based Paint Hazard Disclosure and Acknowledgement: The Negotiated Sale Property contains improvements that, due to their age, are likely to have been painted with lead based paint ("LBP"). This in turn, creates the possibility, through the action of normal weathering and maintenance, that there may be lead from LBP in the soil surrounding these structures. Lead from paint, paint chips, and dust can pose health hazards if not managed properly. A Lead Based Paint Hazard Disclosure and Acknowledgement Statement is provided as Exhibit "F" to this Quitclaim Deed.

The GOVERNMENT shall have no objections for the demolition of nonresidential buildings, structures, or facilities built prior to 1978, which creates the potential for lead to be released to soil as a result of such activities. With respect to nonresidential buildings, structures, or facilities, which the GRANTEE intends to demolish or redevelop for residential use after conveyance, the GRANTEE may, under applicable law or regulation, be required by regulatory agencies to evaluate the soil adjacent to such nonresidential buildings, structures, or facilities for soil-lead hazards, and to abate any such hazards that may be present, after demolition and prior to occupancy of any newly constructed residential structures.

In addition to the aforementioned covenants and restrictions contained in this Quitclaim Deed, the GRANTEE covenants and agrees that it shall prohibit residential occupancy and use of buildings and structures, or portions thereof, prior to identification and/or evaluation of any LBP hazards, and abatement of any hazards identified as required.

The GRANTEE covenants and agrees, on behalf of itself, its successors and assigns, that it shall comply with all federal, state, and local laws relating to LBP in its use and occupancy of the Negotiated Sale Property (including demolition and disposal of existing improvements). The GRANTEE shall hold harmless and indemnify the GOVERNMENT from and against any and all loss, judgment, claims, demands, expenses, or damages of whatever nature or kind which might arise or be made against the GOVERNMENT as a result of LBP having been present on the Negotiated Sale Property. Improvements on the Negotiated Sale Property were constructed prior to 1978 and, as with all such improvements, a LBP hazard may be present.



XVII. Pesticides: The Negotiated Sale Property may contain pesticide residue from pesticides that have been applied in the management of the Negotiated Sale Property. The GOVERNMENT knows of no use of any registered pesticide in a manner inconsistent with its labeling and believes that all applications were made in accordance with the Federal Insecticide, Fungicide and Rodenticide Act ("FIRFA") (7 U.S.C. Sec 136, et seq.), its implementing regulations, and according to the labeling provided with such substances. It is the GOVERNMENT's position that it shall have no obligation under the covenants provided pursuant to section 120(h)(3)(A)(ii) of CERCLA for the remediation of legally applied pesticides.

XVIII. GRANTEE Notice Requirement regarding Future Sale or Assignment: GRANTEE, on behalf of itself and its successors and assigns, lessees and licensees, contractors and agents, covenants that it shall provide written notice to the GOVERNMENT, USEPA, and MDNR, and other applicable local regulatory agencies, if any, of any subsequent sale, assignment, lease, and transfer of the Negotiated Sale Property or any portion thereof, and provide contact information concerning the new owner or occupant.

The following are points of contact for the GOVERNMENT, USEPA, and MDNR:

GOVERNMENT  
Director  
BRAC Program Management Office SE  
4130 Faber Place Drive  
Suite 202  
North Charleston, SC 29405

USEPA  
US Environmental Protection Agency  
Region 7  
901 North 5<sup>th</sup> Street  
Kansas City, Kansas 66101

State of Missouri  
Missouri Department of Natural Resources  
Attn: Mr. Ruben Zamarripa  
P.O. Box 176  
Jefferson City, MO 65102-0176

The GRANTEE, its successors and assigns, agrees that if any portion of the Negotiated Sale Property is conveyed by deed, the GRANTEE, its successors and assigns, shall provide notice to the party to whom the Negotiated Sale Property or any portion thereof is transferred ("the subsequent owner") of all CERCLA Hazardous Substances, LUCs, and GRANTEE covenants, as contained in this Quitclaim Deed, and the subsequent owner, its successors and assigns, shall then be bound by the same LUCs and GRANTEE covenants.

XIX. Excess Profits Covenant for Negotiated Sales to Public Bodies:

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a. This covenant shall run with the land for a period of three (3) years from the date of conveyance. With respect to the Negotiated Sale Property described in this Quitclaim Deed, if at any time within a three (3) year period from the date of transfer of title by the GOVERNMENT, the GRANTEE, or its successors or assigns, shall sell or enter into agreements to sell the Negotiated Sale Property, either in a single transaction or in a series of transactions, it is covenanted and agreed that all proceeds received or to be received in excess of the GRANTEE's or a subsequent seller's actual allowable costs will be remitted to the GOVERNMENT. In the event of a sale of less than the entire Negotiated Sale Property, actual allowable costs will be apportioned to the Negotiated Sale Property based on a fair and reasonable determination by the GOVERNMENT.

b. For purposes of this covenant, the GRANTEE's or a subsequent seller's allowable costs shall include the following:

1. The purchase price of the Negotiated Sale Property.
2. The direct costs actually incurred and paid for improvements that serve only the Negotiated Sale Property, including road construction, storm and sanitary sewer construction, other public facilities or utility construction, building rehabilitation and demolition, landscaping, grading, and other site or public improvements.
3. The direct costs actually incurred and paid for design and engineering services with respect to the improvements described in b.2 of this section.
4. The finance charges actually incurred and paid in conjunction with loans obtained to meet any of the allowable costs enumerated above.

c. None of the allowable costs described in paragraph b. of this section will be deductible if defrayed by federal grants or if used as matching funds to secure federal grants.

d. To verify compliance with the terms and conditions of this covenant, the GRANTEE, or its successors or assigns, shall submit an annual report for each of the subsequent three (3) years to the GOVERNMENT at the address set out in Special Section XVIII on the anniversary date of this Quitclaim Deed. Each report will identify the Negotiated Sale Property involved in this transaction and will contain such of the following items of information as are applicable at the time of submission:

1. A statement indicating whether or not a resale has been made.
2. A description of each portion of the Negotiated Sale Property that has been resold.
3. The sale price of each of such resold portion.
4. The identity of each purchaser.
5. The proposed land use.
6. An enumeration of any allowable costs incurred and paid that would offset any realized profit.

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e. The GOVERNMENT may monitor the Negotiated Sale Property and inspect records related thereto to ensure compliance with the terms and conditions of this covenant and may take any actions that it deems reasonable and prudent to recover any excess profits realized through the resale of the Negotiated Sale Property.

### General Provisions

XX. Conveyance is "As Is-Where Is": Except as expressly provided in this Quitclaim Deed or as otherwise required by law, the Negotiated Sale Property is being conveyed "AS IS" and "WHERE IS," without representation, warranty, or guaranty as to quality, quantity, character, condition, size, kind, or fitness for a particular purpose.

XXI. Covenant regarding Non-Discrimination: GRANTEE covenants for itself, its successors and assigns, and every successor in interest to the Negotiated Sale Property, or any part thereof, that GRANTEE and its successors and assigns shall not discriminate upon the basis of race, color, religion, disability, or national origin in the use, occupancy, sale, or lease of the Negotiated Sale Property, or in their employment practices conducted thereon. This covenant shall not apply however, to the lease or rental of a room or rooms within a family dwelling unit, nor shall it apply with respect to Negotiated Sale Property used primarily for religious purposes. The GOVERNMENT shall be deemed a beneficiary of this covenant without regard to whether it remains the owner of any land or interest therein in the locality of the Negotiated Sale Property hereby conveyed and shall have the sole right to enforce this covenant in any court of competent jurisdiction.

XXII. General Notice Provision: To facilitate future cooperation, the following points of contact have been designated by the GOVERNMENT, GRANTEE, and the State of Missouri:

GOVERNMENT – US Government Point of Contact:  
Director  
BRAC Program Management Office SE  
4130 Faber Place Drive  
Suite 202  
North Charleston, SC 29405

GRANTEE:  
Mr. Michael Collins, President  
The Port Authority of Kansas City, Missouri  
300 Wyandotte  
Suite 100  
Kansas City, MO 64105

USEPA  
US Environmental Protection Agency  
Region 7  
901 North 5<sup>th</sup> Street



Kansas City, Kansas 66101

State of Missouri  
Missouri Department of Natural Resources  
Attn: Mr. Ruben Zamarripa  
P.O. Box 176  
Jefferson City, MO 65102-0176

XXIII. Non-Applicability to Other Property. None of the provisions of this Quitclaim Deed, including, but not limited to, the environmental notifications, covenants and restrictions contained herein, are intended to be applicable to the property identified and described on Exhibit "B" as Site SS 006.

XXIV. Exhibits: The following exhibits are attached hereto and made a part of this Quitclaim Deed:

Exhibit "A"	Property Description
Exhibit "B"	Site SS009 Plat Survey
Exhibit "C"	CERCLA Sec 120(h) Notification of Hazardous Substances
Exhibit "D"	Annual Certification Form
Exhibit "E"	ACM Hazardous Disclosure and Acknowledgement Statement
Exhibit "F"	LBP Hazardous Disclosure and Acknowledgement Statement

A handwritten signature, possibly "JMC", is written in cursive. To its left, the letters "MC" are written inside a circle.

**EXECUTION**

Effective this 22<sup>nd</sup> day of May 2012.

UNITED STATES OF AMERICA  
Acting by and through  
Department of the Navy

WITNESSES:

By: Esther P. Ewell  
ESTHER P. EWELL  
Real Estate Contracting Officer

Sarah Ann Moore

Sarah Ann Moore  
(Printed Name)

Katie A. Slayton

Katie A. Slayton  
(Printed Name)

[NOTARY PAGES ATTACHED TO THIS SIGNATURE PAGE]



**CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT**

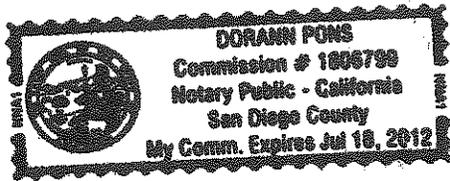
State of California

County of San Diego }

On May 22, 2012 before me, Dorann Pons, Notary Public  
Date Here Insert Name and Title of the Officer

personally appeared Esther P. Ewell, and in witness  
Name(s) of Signer(s)  
of Katie Slayton and Sarah Ann Moore

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that ~~he/she~~ they executed the same in ~~his/her~~ their authorized capacity(ies), and that by ~~his/her~~ their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.



I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature Dorann Pons  
Signature of Notary Public

Place Notary Seal Above

**OPTIONAL**

*Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.*

**Description of Attached Document**

Title or Type of Document: Quitclaim Deed to Port Authority of Kansas City

Document Date: 22 May 12 Number of Pages: 26

Signer(s) Other Than Named Above: \_\_\_\_\_

**Capacity(ies) Claimed by Signer(s)**

Signer's Name: Esther P. Ewell

- Individual
- Corporate Officer — Title(s): \_\_\_\_\_
- Partner —  Limited  General
- Attorney in Fact
- Trustee
- Guardian or Conservator

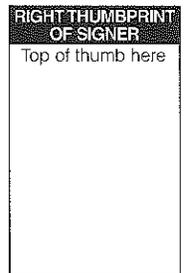
Other: Real Estate Contracting Officer  
 Signer Is Representing: Dept of Navy



Signer's Name: \_\_\_\_\_

- Individual
- Corporate Officer — Title(s): \_\_\_\_\_
- Partner —  Limited  General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: \_\_\_\_\_

Signer Is Representing: \_\_\_\_\_



ACKNOWLEDGEMENT OF GRANTEE'S COVENANTS

TO INDICATE ACCEPTANCE of the covenants and agreements contained in this Quitclaim Deed and receipt of the documents described herein, GRANTEE has executed this document on the date written below.

(GRANTEE)

Executed this 21<sup>st</sup> day of May, 2012.

THE PORT AUTHORITY OF KANSAS CITY, MISSOURI

By: Joanne M. Collins  
Joanne M. Collins  
Title: Chairwoman

(OFFICIAL SEAL)

Attest: Michael M. Collins  
Michael M. Collins  
Title: President

Approved as to form:  
Mark R. Coulter  
Mark R. Coulter, General Counsel,  
Director of Intergovernmental Affairs

STATE OF MISSOURI     )  
  ) ss.  
COUNTY OF JACKSON    )

On this 21<sup>st</sup> day of May, 2012, before me, a Notary Public in and for the county and state aforesaid, personally appeared Joanne M. Collins and Michael M. Collins, to me personally known to be the persons described in and who executed the foregoing instrument, who, being by me duly sworn, did say that they are the Chairwoman and President, respectively, of the Board of Commissioners of The Port Authority of Kansas City, Missouri, a political subdivision of the State of Missouri created pursuant to Section 68.010, et seq., RSMo., that said instrument was signed on behalf of said political subdivision by authority of its Board of Commissioners, and said persons acknowledged said instrument to be the free act and deed of said political subdivision.

{Notarial Seal} SUSAN Y. SCHEERER  
Notary Public - State of Missouri  
My Commission Expires April 22, 2015  
Clay County  
Commission #11446873

Susan Y. Scheerer  
Signature of Notary Public  
SUSAN Y. SCHEERER  
Printed or Typed Name of Notary Public

My Commission expires: April 22, 2015

*Handwritten initials/signature in the bottom right corner.*

EXHIBIT "A"

LEGAL DESCRIPTIONS OF NEGOTIATED SALE PROPERTY

Tract I:

ALL THAT PART OF THE SOUTHEAST QUARTER OF SECTION 34 AND THE SOUTHWEST QUARTER OF SECTION 35, ALL IN TOWNSHIP 47 NORTH, RANGE 33 WEST, IN KANSAS CITY, JACKSON COUNTY, MISSOURI, BEARINGS ARE REFERENCED TO GRID NORTH OF THE MISSOURI STATE PLANE COORDINATE SYSTEM, 1983, WEST ZONE, MORE PARTICULARLY DESCRIBED AS FOLLOWS: COMMENCING AT THE SOUTHEAST CORNER OF THE SOUTHEAST QUARTER OF SECTION 34, T47N, R33W, BEING A FOUND ALUMINUM CAP IN MONUMENT BOX, PER CERTIFIED LAND CORNER RECORD, DOCUMENT NUMBER 600-65354; THENCE N03°35'06"E ALONG THE EAST LINE OF SAID SOUTHEAST QUARTER, A DISTANCE OF 49.97 FEET TO A POINT ON THE NORTH RIGHT-OF-WAY LINE OF ARNOLD AVENUE, AS NOW ESTABLISHED; THENCE N86°23'26"W ALONG SAID NORTH RIGHT-OF-WAY LINE, A DISTANCE OF 305.54 FEET TO THE POINT OF BEGINNING; THENCE CONTINUING N86°23'26"W ALONG SAID NORTH RIGHT-OF-WAY LINE, A DISTANCE OF 478.04 FEET, TO A POINT ON THE SOUTHEASTERLY RIGHT-OF-WAY LINE OF ANDREWS ROAD, AS DESCRIBED IN QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275 AND RECORDED AT THE JACKSON COUNTY, MISSOURI RECORDER OF DEEDS OFFICE IN KANSAS CITY, MISSOURI, AND BEING A FOUND "CORPS OF ENGINEERS" CAP IN CONCRETE; THENCE N43°56'08"E ALONG SAID SOUTHEASTERLY RIGHT-OF-WAY LINE OF ANDREWS ROAD, A DISTANCE OF 774.51 FEET TO A POINT BEING A FOUND "CORPS OF ENGINEERS" CAP IN CONCRETE; THENCE S46°04'26"E, A DISTANCE OF 403.51 FEET TO A POINT BEING A FOUND "CORPS OF ENGINEERS" CAP IN CONCRETE; THENCE S43°38'39"W, A DISTANCE OF 65.14 FEET TO A POINT AT THE APPROXIMATE CENTERLINE OF A CREEK; THENCE THE FOLLOWING FIVE COURSES ALONG THE APPROXIMATE CENTERLINE OF SAID CREEK, ALSO SAID FIVE COURSES BEING DESCRIBED IN SAID QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275: N88°33'00"W, A DISTANCE OF 28.96 FEET (DEED AND MEASURED); THENCE S74°58'12"W, A DISTANCE OF 80.48 FEET (DEED AND MEASURED); THENCE S54°07'46"W, A DISTANCE OF 73.49 FEET (DEED AND MEASURED); THENCE S38°16'09"W, A DISTANCE OF 85.59 FEET (DEED AND MEASURED); THENCE S33°38'04"W, A DISTANCE OF 156.59 FEET (DEED AND MEASURED) TO THE POINT OF BEGINNING. THE PARCEL DESCRIBED ABOVE CONTAINS 221,768 SQUARE FEET OR 5.091 ACRES, MORE OR LESS.

Tract II:

ALL THAT PART OF THE SOUTHEAST QUARTER OF SECTION 34, TOWNSHIP 47 NORTH, RANGE 33 WEST, IN KANSAS CITY, JACKSON COUNTY, MISSOURI, BEARINGS ARE REFERENCED TO GRID NORTH OF THE MISSOURI STATE PLANE COORDINATE SYSTEM, 1983, WEST ZONE, MORE PARTICULARLY DESCRIBED AS FOLLOWS: COMMENCING AT THE SOUTHEAST CORNER OF THE SOUTHEAST QUARTER OF SECTION 34, T47N, R33W, BEING A FOUND ALUMINUM CAP IN MONUMENT BOX, PER CERTIFIED LAND CORNER RECORD, DOCUMENT NUMBER 600-65354; THENCE N86°11'50"W ALONG THE SOUTH LINE OF SAID SOUTHEAST QUARTER, A DISTANCE OF 928.30 FEET TO A POINT ON THE SOUTHWESTERLY PROLONGATION OF THE NORTHWESTERLY RIGHT-OF-WAY LINE OF ANDREWS ROAD, AS DESCRIBED IN QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275 AND RECORDED AT THE JACKSON COUNTY, MISSOURI RECORDER OF DEEDS OFFICE IN KANSAS CITY, MISSOURI; THENCE N43°56'08"E ALONG THE SOUTHWESTERLY PROLONGATION OF AND ALONG SAID NORTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 538.95 FEET TO A POINT ON THE NORTHEASTERLY RIGHT-OF-WAY LINE OF CORKILL ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED AND BEING THE **POINT OF BEGINNING**; THENCE N46°10'13"W ALONG SAID NORTHEASTERLY RIGHT-OF-WAY LINE OF CORKILL ROAD, A DISTANCE OF 520.57 FEET MEASURED, (520.60 FEET DEED), TO A POINT ON THE SOUTHEASTERLY RIGHT-OF-WAY LINE OF WESTOVER ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275,

Execution

15



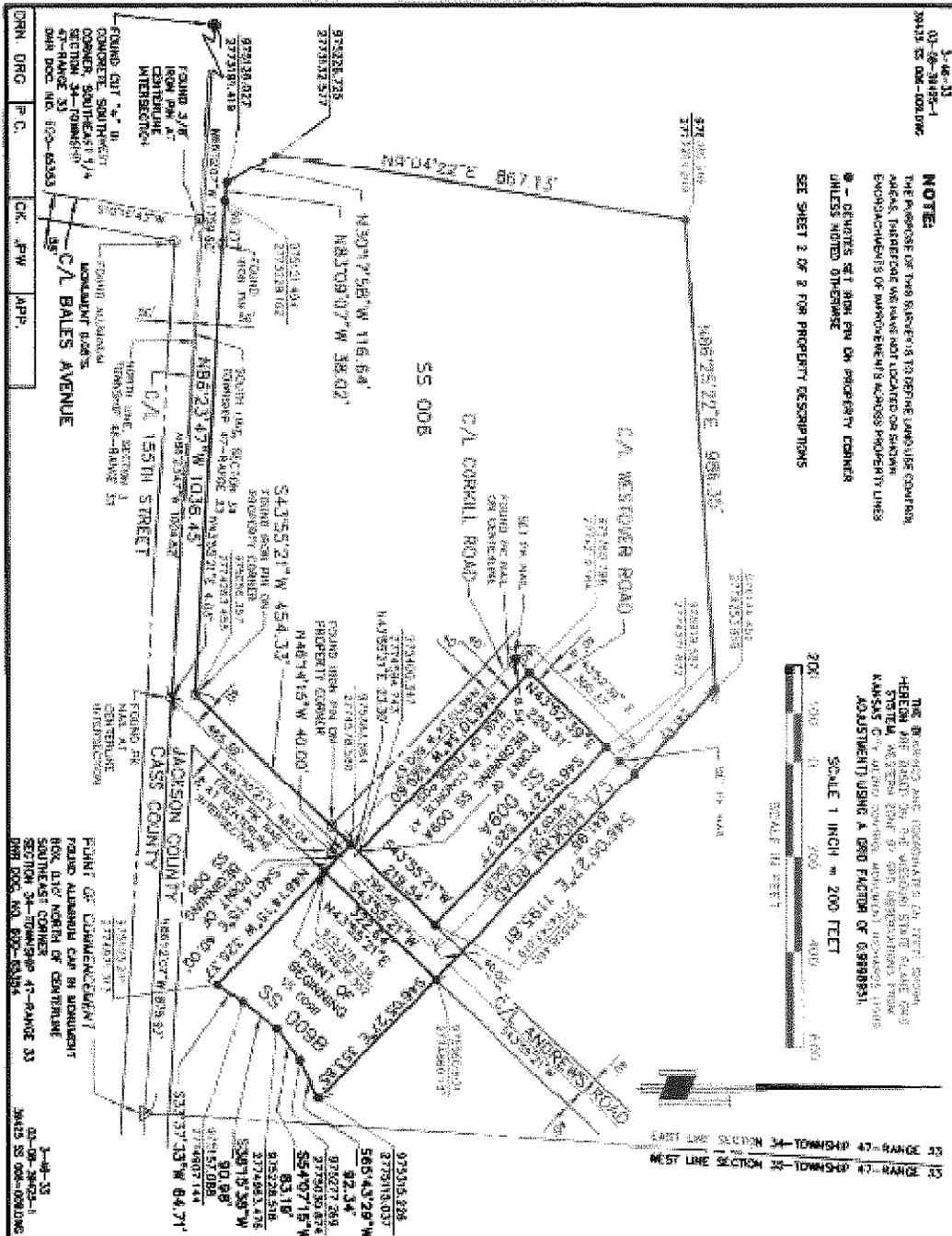
AND BEING A FOUND PIN AND CAP, STAMPED "A.S.C. / MLS 76-D / KLS 3"; THENCE N43°52'08"E ALONG SAID SOUTHEASTERLY RIGHT-OF-WAY LINE OF WESTOVER ROAD, A DISTANCE OF 87.50 FEET; THENCE S46°05'07"E, A DISTANCE OF 24.81 FEET; THENCE N43°54'53"E, A DISTANCE OF 54.65 FEET; THENCE S46°05'07"E, A DISTANCE OF 168.67 FEET; THENCE N43°54'53"E, A DISTANCE OF 78.17 FEET TO A POINT ON THE SOUTHWESTERLY RIGHT-OF-WAY LINE OF HICKAM ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275; THENCE S46°05'07"E ALONG SAID SOUTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 327.24 FEET TO A POINT ON THE NORTHWESTERLY RIGHT-OF-WAY LINE OF SAID ANDREWS ROAD AND BEING A FOUND PIN AND CAP, STAMPED "A.S.C. / MLS 76-D / KLS 3"; THENCE S43°56'08"W ALONG SAID NORTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 219.55 FEET TO THE **POINT OF BEGINNING**. THE PARCEL DESCRIBED ABOVE CONTAINS 98,031 SQUARE FEET OR 2.250 ACRES, MORE OR LESS.

Tract III:

ALL THAT PART OF THE SOUTHEAST QUARTER OF SECTION 34, TOWNSHIP 47 NORTH, RANGE 33 WEST, IN KANSAS CITY, JACKSON COUNTY, MISSOURI, BEARINGS ARE REFERENCED TO GRID NORTH OF THE MISSOURI STATE PLANE COORDINATE SYSTEM, 1983, WEST ZONE, MORE PARTICULARLY DESCRIBED AS FOLLOWS:

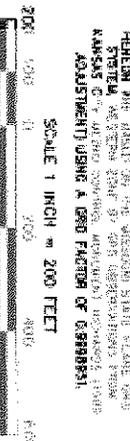
**COMMENCING** AT THE SOUTHEAST CORNER OF THE SOUTHEAST QUARTER OF SECTION 34, T47N, R33W, BEING A FOUND ALUMINUM CAP IN MONUMENT BOX, PER CERTIFIED LAND CORNER RECORD, DOCUMENT NUMBER 600-65354; THENCE N86°11'50"W ALONG THE SOUTH LINE OF SAID SOUTHEAST QUARTER, A DISTANCE OF 928.30 FEET TO A POINT ON THE SOUTHWESTERLY PROLONGATION OF THE NORTHWESTERLY RIGHT-OF-WAY LINE OF ANDREWS ROAD, AS DESCRIBED IN QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275 AND RECORDED AT THE JACKSON COUNTY, MISSOURI RECORDER OF DEEDS OFFICE IN KANSAS CITY, MISSOURI; THENCE N43°56'08"E ALONG THE SOUTHWESTERLY PROLONGATION OF AND ALONG SAID NORTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 838.50 FEET TO A POINT ON THE NORTHEASTERLY RIGHT-OF-WAY LINE OF HICKAM ROAD, AS DESCRIBED IN SAID QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275, AND BEING THE **POINT OF BEGINNING**; THENCE N46°05'07"W ALONG SAID NORTHEASTERLY RIGHT-OF-WAY LINE OF HICKAM ROAD, A DISTANCE OF 175.84 FEET (DEED AND MEASURED); THENCE N43°49'15"E ALONG A LINE DESCRIBED IN SAID QUIT CLAIM DEED, DOCUMENT NUMBER 2005K0019275, A DISTANCE OF 167.03 FEET (DEED AND MEASURED); THENCE S46°03'47"E ALONG A LINE DESCRIBED IN SAID QUIT CLAIM DEED, A DISTANCE OF 176.17 FEET (MEASURED), (176.11 FEET, DEED) TO A POINT ON THE NORTHWESTERLY RIGHT-OF-WAY LINE OF SAID ANDREWS ROAD; THENCE S43°56'08"W ALONG SAID NORTHWESTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 166.96 FEET TO THE **POINT OF BEGINNING**. THE PARCEL DESCRIBED ABOVE CONTAINS 29,392 SQUARE FEET OR 0.675 ACRES, MORE OR LESS.

# EXHIBIT "B"



1-46-33  
03-26-3485-1  
20113 SS 006-008-009

**NOTES**  
THE PURPOSE OF THIS SURVEY IS TO DEFINE LAND USE CONTROL AREAS. THEREFORE WE HAVE NOT LOCATED OR SHOWN ENCUMBRANCES OF INTERESTS ACROSS PROPERTY LINES UNLESS NOTED OTHERWISE.  
@ - DENOTES SET BACK FROM PROPERTY CORNER.  
SEE SHEET 2 OF 2 FOR PROPERTY DESCRIPTIONS.



THIS SURVEY AND RECONSTRUCTION OF THE PROPERTY LINES ARE MADE BY THE ORIGINAL SURVEYOR AND HIS SUCCESSORS AND ARE NOT TO BE CONSIDERED AS A GUARANTEE OF THE ACCURACY OF THE SURVEY. ADJUSTMENTS USING A GROUND FACTOR OF 0.999991.

DATE	REVISION	BY
8/10/2004	REV. PER CLIENT REVIEW	DRG
8/13/2004	REV. TRACT NUMBERS PER CLIENT REVIEW & REDUCE TO 11"x17"	DRG

SHEET 1 OF 2

PLAT OF SURVEY

THIS IS TO CERTIFY THAT THIS SURVEY WAS EXECUTED IN ACCORDANCE WITH THE CURRENT MINIMUM STANDARDS FOR PROPERTY BOUNDARY SURVEYS AS ESTABLISHED BY THE MISSOURI BOARD FOR ARCHITECTS, PROFESSIONAL ENGINEERS AND LAND SURVEYORS.

DATE: JULY 8, 2004  
FOR: CH2M  
LAND USE CONTROL BOUNDARY - SITE SS 006 AND SS 009  
FORMER RICHARDS-GEBAUR AFB  
KANSAS CITY, MISSOURI

**ANDERSON**  
SURVEY COMPANY  
2024 W. EXPEDITION WAY  
LETS SUMMIT, MISSOURI 64060  
(816) 246-5000



EXHIBIT "B" Continued

PROPERTY DESCRIPTION:

SS 009A TO USMC

A TRACT OF LAND BEING PART OF SECTION 34-TOWNSHIP 47-RANGE 33, KANSAS CITY, JACKSON COUNTY, MISSOURI BEING DESCRIBED AS FOLLOWS: COMMENCING AT THE SOUTHEAST CORNER OF SAID SECTION 34; THENCE NORTH  $86^{\circ}-12'-07''$  WEST, ALONG THE SOUTH LINE OF SAID SECTION 34, A DISTANCE OF 875.92 FEET TO THE CENTERLINE OF ANDREWS ROAD; THENCE NORTH  $43^{\circ}-55'-21''$  EAST, ALONG SAID CENTERLINE, A DISTANCE OF 482.04 FEET; THENCE NORTH  $46^{\circ}-14'-15''$  WEST, A DISTANCE OF 40.00 FEET TO THE NORTHWESTERLY RIGHT OF WAY LINE OF SAID ANDREWS ROAD; THENCE NORTH  $43^{\circ}-55'-21''$  EAST, ALONG SAID RIGHT OF WAY LINE 40.00 FEET NORTHWESTERLY OF AND PARALLEL WITH SAID CENTERLINE, A DISTANCE OF 23.30 FEET TO THE POINT OF INTERSECTION OF SAID NORTHWESTERLY RIGHT OF WAY LINE AND THE NORTHEASTERLY RIGHT OF WAY LINE OF CORKILL ROAD, SAID POINT ALSO BEING THE POINT OF BEGINNING OF THE TRACT TO BE DESCRIBED HEREIN; THENCE NORTH  $46^{\circ}-10'-34''$  WEST, ALONG SAID NORTHEASTERLY RIGHT OF WAY LINE 40.00 FEET NORTHEASTERLY OF AND PARALLEL WITH THE CENTERLINE THEREOF, A DISTANCE OF 520.60 FEET; THENCE NORTH  $43^{\circ}-52'-39''$  EAST, ALONG THE SOUTHEASTERLY RIGHT OF WAY LINE OF WESTOVER ROAD 40.00 FEET SOUTHEASTERLY OF AND PARALLEL WITH THE CENTERLINE THEREOF, A DISTANCE OF 220.31 FEET; THENCE SOUTH  $46^{\circ}-05'-27''$  EAST, ALONG THE SOUTHWESTERLY RIGHT OF WAY LINE OF HICKAM ROAD 40.00 FEET SOUTHWESTERLY OF AND PARALLEL WITH THE CENTERLINE THEREOF, A DISTANCE OF 520.77 FEET; THENCE SOUTH  $43^{\circ}-55'-21''$  WEST, ALONG THE NORTHWESTERLY RIGHT OF WAY OF SAID ANDREWS ROAD 40.00 FEET NORTHWESTERLY OF AND PARALLEL WITH THE CENTERLINE THEREOF, A DISTANCE OF 219.54 FEET TO THE POINT OF BEGINNING.

THE ABOVE DESCRIPTION CONTAINS 114,513 SQUARE FEET OR 2.296 ACRES MORE OR LESS.

THE ABOVE DESCRIPTION WAS PREPARED BY ANDERSON SURVEY COMPANY.



EXHIBIT "B" Continued

PROPERTY DESCRIPTION:

SS 009B TO USMC

A TRACT OF LAND BEING PART OF SECTION 34-TOWNSHIP 47-RANGE 33, KANSAS CITY, JACKSON COUNTY, MISSOURI BEING DESCRIBED AS FOLLOWS: COMMENCING AT THE SOUTHEAST CORNER OF SAID SECTION 34; THENCE NORTH  $86^{\circ}-12'-07''$  WEST, ALONG THE SOUTH LINE OF SAID SECTION 34, A DISTANCE OF 875.92 FEET TO THE CENTERLINE OF ANDREWS ROAD; THENCE NORTH  $43^{\circ}-55'-21''$  EAST, ALONG SAID CENTERLINE, A DISTANCE OF 482.04 FEET; THENCE SOUTH  $46^{\circ}-14'-15''$  EAST, A DISTANCE OF 40.00 FEET TO THE SOUTHEASTERLY RIGHT OF WAY LINE OF SAID ANDREWS ROAD AND THE POINT OF BEGINNING OF THE TRACT TO BE DESCRIBED HEREIN; THENCE NORTH  $43^{\circ}-55'-21''$  EAST, ALONG SAID RIGHT OF WAY LINE 40.00 FEET SOUTHEASTERLY OF AND PARALLEL WITH THE CENTERLINE THEREOF, A DISTANCE OF 322.64 FEET; THENCE SOUTH  $46^{\circ}-05'-27''$  EAST, ALONG THE SOUTHEASTERLY PROLONGATION OF THE NORTHEASTERLY RIGHT OF WAY LINE OF HICKAM ROAD, A DISTANCE OF 353.85 FEET; THENCE SOUTH  $65^{\circ}-43'-29''$  WEST, A DISTANCE OF 92.34 FEET; THENCE SOUTH  $54^{\circ}-07'-15''$  WEST, A DISTANCE OF 83.19 FEET; THENCE SOUTH  $38^{\circ}-15'-38''$  WEST, A DISTANCE OF 90.98 FEET; THENCE SOUTH  $33^{\circ}-37'-33''$  WEST, A DISTANCE OF 64.71 FEET; THENCE NORTH  $46^{\circ}-14'-15''$  WEST, A DISTANCE OF 325.37 FEET TO THE POINT OF BEGINNING.

THE ABOVE DESCRIPTION CONTAINS 102,912 SQUARE FEET OR 2.363 ACRES MORE OR LESS.

THE ABOVE DESCRIPTION WAS PREPARED BY ANDERSON SURVEY COMPANY.

Handwritten signature and initials in the bottom right corner, including a circled 'mc' and the name 'epe'.

EXHIBIT "C"

Marine Corps Support Center, Kansas City  
 CERCLA Hazardous Substance Notice/Response Action Summary

The table below identifies those hazardous substances that it is known, based upon a complete search of agency files, were stored for one year or more in quantities greater than or equal to 1,000 kg (or greater than or equal to 1 kg if designated an acutely hazardous waste under 42 CFR Part 267.301) and/or were released or disposed of on the property to be transferred in quantities greater than or equal to their respective reportable quantities under 40 CFR 302.4. The information in this notice is required under the authority of regulations promulgated under section 120(h) of the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA" or "Superfund"), 42 U.S.C. section 9620(h).

Bldg. or Facility ID	Description	Substance Name	CERCLA Registry Number	40 CFR 302.4 Regulatory Synonyms	RCRA HW No.	Quantity Stored	Date of Storage	Quantity Released	Date of Release	Response Actions Taken
8509	Fire Valve Area	Pentachloroethene	127164	Ethene, tetrachloro Tetrachloroethene Tetrachloroethylene PCE	4210	Unknown	Unknown	Unknown	Unknown	10 cubic yards of soil were removed in 1993. Selected remedy for groundwater is monitored natural attenuation and implementation of Land Use Controls (LUCs). The remedy was deemed to be Operating Property and Successfully (OPS) by USEPA in Aug 2011.
8509	Fire Valve Area	Trichloroethene	79-01-6	TCE	U223	Unknown	Unknown	Unknown	Unknown	
8509	Fire Valve Area	1,1-Dichloroethene	-	-	-	Unknown	Unknown	Unknown	Unknown	
8509	Fire Valve Area	cis-1,2-Dichloroethene	-	-	-	Unknown	Unknown	Unknown	Unknown	
8509	Fire Valve Area	Vinyl Chloride	-	-	-	Unknown	Unknown	Unknown	Unknown	

*me*  
*AMC*  
*epe*

**EXHIBIT "D"**

**Land Use Control (LUC) Inspection Form**

for Port Authority of Kansas City Transferred Sites

"NEGOTIATED SALE PARCEL"

Evaluation Period (month/year): From \_\_\_\_\_ / \_\_\_\_\_ through \_\_\_\_\_ / \_\_\_\_\_

SITE	Restricted Media			Inspection Frequency	A check mark indicates the LUC has been complied with. "N" means a LUC has not been complied with. Shading indicates LUC not required										Remarks
	Groundwater	Soil	Sediment		Groundwater Not Being Used	Monitoring Wells Not Disturbed	Land Not Being Used for Residential Use	Sediment Not Disturbed	Surface Soils Not Disturbed	Subsurface Soils Not Disturbed	Adjacent Wetlands Not Disturbed	Landfill Cover	Not Disturbed	Site Access Restrictions in Place	
SS009	●			Annual				/	/	/	/	/	/	/	See Note 1

Notes:

- 1- Site remedy includes long-term groundwater monitoring with LUC inspections and certification.

Inspections conducted by: \_\_\_\_\_ Date: \_\_\_\_\_

EXHIBIT "D" Continued

Annual Land Use Control (LUC) Compliance Certification  
Marine Corps Support Activity Kansas City

Property Owner: Port Authority of Kansas City Evaluation Period (month/year): From \_\_\_\_\_ through \_\_\_\_\_

I, the undersigned, hereby certify that I am an authorized representative of Port Authority of Kansas City and that the above described land use controls have been complied with for the period noted. Any known deficiencies and completed or planned actions to address such deficiencies shall be described in the comment section below.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Print Name: \_\_\_\_\_ ( ) Phone Number: \_\_\_\_\_

Comments: (attach additional sheets as needed)

Mail original form to EPA Region 7, and copies to MDNR and the Navy at the below addresses:

<b>EPA Point of Contact</b>	<b>MDNR Point of Contact</b>	<b>Navy Point of Contact</b>
US Environmental Protection Agency Region 7 Missouri/Kansas Remedial Branch Attn: Kenneth Rapplean 901 North 5th Ave. Kansas City, Kansas 66101	Missouri Department of Natural Resources Attn: Mr. Ruben Zamarripa P.O. Box 176 Jefferson City, MO 65102-0176	BRAC PMO SE Attn: David Criswell 4130 Faber Place Dr Suite 202 North Charleston, SC 29405

**EXHIBIT "E"**  
**ASBESTOS-CONTAINING MATERIALS**  
**HAZARD DISCLOSURE AND ACKNOWLEDGEMENT FORM**  
**(NON-RESIDENTIAL STRUCTURES)**

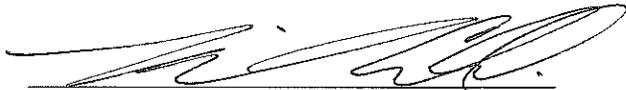
**ASBESTOS WARNING STATEMENT**

YOU ARE ADVISED THAT CERTAIN BUILDINGS WITHIN THE MARINE CORPS SUPPORT ACTIVITY (MCSA) KANSAS CITY MAY HAVE ASBESTOS-CONTAINING MATERIALS. INDIVIDUALS (WORKERS) MAY SUFFER ADVERSE HEALTH EFFECTS AS A RESULT OF INHALATION EXPOSURE TO ASBESTOS. THESE ADVERSE HEALTH EFFECTS INCLUDE ASBESTOSIS (PULMONARY FIBROSIS) AND MESOTHELIOMAS (BENIGN OR MALIGNANT TUMORS).

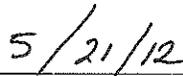
**ACKNOWLEDGEMENT**

I acknowledge the following:

- (1) I have read and I understand the above-stated Asbestos Warning Statement.
- (2) I have received from the Government the following document(s): *The Environmental Condition of Property Report for the Marine Corps Support Activity (MCSA) Kansas City dated April 28, 2006 and the Finding of Suitability to Transfer the MCSA Kansas City dated October 3, 2011*, representing the best information available to the Government as to the presence of and condition of asbestos-containing-materials hazards in the buildings covered by this transfer (deed).
- (3) I understand that my failure to inspect or to become fully informed of the condition of all or any portion of the property offered will not constitute grounds for any claim or demand for adjustment or withdrawal of any bid or offer made after its opening or tender.
- (4) I understand that, upon execution of this transfer (deed), I shall assume full responsibility for preventing future asbestos exposure by properly managing and maintaining or, as required by applicable federal, state, or local laws or regulations, for abating any asbestos hazard that may pose a risk to human health.



Transferee (or duly authorized agent)



Date

Negotiated Sale to Port Authority of Kansas City



**EXHIBIT "F"**

**LEAD BASED PAINT HAZARD DISCLOSURE AND ACKNOWLEDGEMENT FORM  
LEAD-BASED PAINT HAZARD DISCLOSURE  
AND ACKNOWLEDGEMENT FORM  
(NON-RESIDENTIAL STRUCTURES)**

**LEAD WARNING STATEMENT**

**YOU ARE ADVISED THAT STRUCTURES CONSTRUCTED PRIOR TO 1978 MAY PRESENT EXPOSURE TO LEAD FROM LEAD-BASED PAINT THAT MAY PLACE YOUNG CHILDREN AT RISK OF DEVELOPING LEAD POISONING. LEAD POISONING IN YOUNG CHILDREN MAY PRODUCE PERMANENT NEUROLOGICAL DAMAGE. YOU ARE FURTHER ADVISED THAT LEAD POISONING ALSO POSES A PARTICULAR RISK TO PREGNANT WOMEN. WORKERS MAY ALSO SUFFER ADVERSE HEALTH EFFECTS FROM LEAD DUST AND FUME EXPOSURE.**

**ACKNOWLEDGEMENT**

I acknowledge that:

(1) I have read and understand the above stated Lead Warning Statement;

(2) I have received from the Federal Government the following document(s): *The Environmental Condition of Property Report for the Marine Corps Support Activity (MCSA) Kansas City dated April 28, 2006 and the Finding of Suitability to Transfer the MCSA Kansas City dated October 3, 2011*, representing the best information available to the Government as to the presence of Lead-Based Paint and Lead-Based Paint hazards for the buildings covered by this Transfer;

(3) I understand that my failure to inspect, or to become fully informed as to the condition of all or any portion of the property offered will not constitute grounds for any claim or demand for adjustment or withdrawal of any bid or offer made after its opening or tender; and

(4) I understand that upon execution of this Transfer, I shall assume full responsibility for preventing future lead exposure by properly managing and maintaining or, as required by applicable Federal, state, or local laws or regulations, for abating any lead-based paint hazard that may pose a risk to human health.



Transferee (or duly authorized agent)

Date

5/21/12



**REAL PROPERTY CERTIFICATE OF VALUE - JACKSON COUNTY, MISSOURI**

(REQUIRED TO BE FILED WITH DEED AT TIME OF RECORDING)

Please type or print all information. This form must be prepared by the Buyer or his/her Representative.

**Grantor's (Seller) Name:** United States of America,  
acting by and through the Secretary of the Navy

**Grantee's (Buyer) Name:** The Port Authority of  
Kansas City, Missouri

**Address of Property:** 15400-15431 Andrews Road,  
Kansas City, Missouri

**Grantee's address, if different from above:** \_\_\_\_\_  
300 Wyandotte, Suite 100, Kansas City, MO 64105

**Parcel ID Number:** See Attachment A *page 2*

**FOR OFFICE USE ONLY  
DO NOT WRITE IN THIS SPACE**

1. Is this newly constructed residential property?  YES Date occupied: \_\_\_/\_\_\_/\_\_\_  NO
2. Is this vacant land?  YES  NO
3. Intended use of property: Present Use  Renovation  New Development / Construction   
Other
4.  Check if the transaction transfers property in any of the following ways:

<input type="checkbox"/> sale for delinquent taxes <input type="checkbox"/> sale of cemetery lot <input type="checkbox"/> lease or transfer of severed mineral interests <input type="checkbox"/> by order of any court <input type="checkbox"/> by executory contract for deed <input type="checkbox"/> by lease or easement <input checked="" type="checkbox"/> to or from the United States, the State of Missouri, or any agency, or political subdivision thereof. <input type="checkbox"/> for purpose of confirming, correcting, modifying, or supplementing a previously recorded deed, without additional consideration <input type="checkbox"/> solely for the purpose of releasing security for a debt or other obligation <input type="checkbox"/> by deed of partition <input type="checkbox"/> by deed where no money or other valuable consideration is given for the transfer.	<input type="checkbox"/> by deed pursuant to merger, consolidation, sale or transfer of substantially all of the assets of a corporation. <input type="checkbox"/> by deed as a part of the contribution to the capital of a corporation, partnership, limited liability company, or other similar entity. <input type="checkbox"/> by deed executed by personal representative to convey to devisees or heirs property passing by testate or intestate succession by deed which conveys property held in name of any partnership, not a family, to any partner or his or her spouse. <input type="checkbox"/> by deed which is a gift of property. <input type="checkbox"/> by deed between family members, or to or from a family corporation, partnership, or trust for the benefit of a family member, for no consideration.
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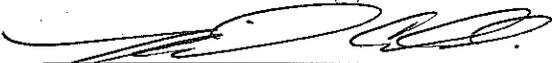
IF ANY OF THE ABOVE ITEMS IN THE SHADED BOX ARE CHECKED, PLEASE PROCEED TO #11 BELOW

5. Total Sales Price (including all assumed mortgages and liens): \$ \_\_\_\_\_  
 Points were paid by:  SELLER  BUYER  NONE
6. Was there new financing?  YES  NO Did financing concessions affect sales price?  YES  NO
7. Is this deed part of a trade?  YES  NO
8. Was any personal property included in the sale price? (For example: furniture, equipment, machinery, livestock, crops, business franchise or inventory... etc.)  YES  NO  
 Please describe: \_\_\_\_\_
9. Was this transaction at arm's length?  YES  NO  
 (An arm's length transaction is one between unrelated parties under no duress.)
10. If you believe this transaction does not represent market value, please attach any additional information that you want the county assessor to consider.
11. I certify, under penalties of law, that this statement has been examined by me and, to the best of my knowledge and belief, is a true, correct and complete statement.

ANY PERSON WHO FAILS TO FILE A COMPLETED CERTIFICATE OF VALUE WHEN REQUIRED BY LAW, OR WHO KNOWINGLY FILES A FALSE CERTIFICATE, MAY BE PUNISHED BY A FINE OF UP TO \$1,000.

For assistance in filing this form,  
 Call the Assessor's Office at (816) 881-3530  
 415 E. 12<sup>th</sup> St., Suite 100M  
 Kansas City, MO 64106-2752

5/21/12  
 Date

  
 Signature of Grantee/Representative

Michael M. Collins, President  
 Print Name and Position

**ATTACHMENT A**  
**to**  
**Jackson County Certificate of Value**

**Grantor/Seller:** United States of America, acting by and through the Secretary of the Navy

**Grantee/Buyer:** The Port Authority of Kansas City, Missouri

**Property:** 15400-15431 Andrews Road, Kansas City, Missouri

**Parcel ID Numbers:** To the best of the Grantee's/Buyer's knowledge, the real property generally affects the following tax parcels:

Parcel Number: 67-900-04-01-03-0-00-000

Parcel Number: 67-900-04-02-00-0-00-000

Parcel Number: 67-900-04-01-02-0-00-000

2

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**APPENDIX H**

**BASE MASTER PLAN**

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# Master Plan

For

## Marine Corps Support Activity Kansas City, Missouri



**Southern Division  
Naval Facilities Engineering Command**

**August 2001**

Produced by:



**WOOLPERT**

Charlotte, NC  
[www.woolpert.com](http://www.woolpert.com)

### 3.E.1.C Land Use Controls (Amendment 5/12/05)

On 22 December 2004, the Air Force transferred land parcels B, D, I, and O to the Marine Corps Mobilization Command (MOBCOM). A Memorandum of Agreement (MOA) between the Air Force and the Marine Corps executed this transfer.

As a result of the transfer MOBCOM received responsibility for the two remediation sites discussed earlier in the Base Master Plan. Sites SS003 and SS009 are now on Marine Corps owned properties. MOBCOM took responsibility for performing Land Use Controls (LUC), Institutional Controls (IC), and the associated Communication Plan. Additionally, MOBCOM will take over responsibility for the monitoring wells, which are part of the remediation process, in fiscal year 2007. The Metes and Bounds surveys and the LUC boundary diagrams are displayed in this Master Plan, Appendix D

The intent of the LUC/IC actions is to restrict subsurface drilling and the extraction and subsequent use of the contaminated ground water, within the prescribed LUC/IC boundaries. Also, the LUC/IC actions involve protecting the monitoring wells. The Land Use Control/Institutional Control Management Plan, 2005 (LUC/ICMP) should be consulted prior to any deep land disturbance within the LUC/IC boundaries. In addition to a detailed description of LUC/IC implementation, monitoring, enforcement and termination, the LUC/ICMP also provides aerial photos, metes and bounds surveys, site maps, and a Communication Plan. Finally, the plan has within the appendices a copy of the MOA between the Air Force and the Marine Corps.

### 3.E.1.D Land Use Controls From Adjacent City of Kansas City Leased Property (ST005) (Amendment 5/12/05)

The Marine Corps leases property from the City of Kansas City, Missouri (Government Lease N62467-93-RP-00026). The affected Marine Corps leased properties are Tracts 2 and 3. Tract 2 is roughly bounded on its northwestern boundary by land parcel A (see LUC/ICMP), and on its southeast boundary by Andrews road. Tract 3 in turn is roughly bounded on its northwestern boundary by Andrews Road, and on its southeast boundary by a southwest to northeast line, which runs roughly parallel to Scope Creek. The City of Kansas City has leased parcel A, from the Air Force Real Property Agency (AFRPA). Site ST005 is located on AFRPA property leased by the City of Kansas City (Parcel A). This site has an associated groundwater plume. This plume has crossed the Parcel A/Tract 2 boundary and spread onto the Marine Corps controlled property Tract 2. The plume is spreading southeasterly across Tract 2 and in the direction of Tract 3 of Marine Corps controlled property. Consequently, the Land Use Control boundary related to ST005 extends onto Marine Corps controlled property Tracts 2 and 3, as evidenced in Appendix A, Figure 15 "ST 005 POL Storage Yard Land Use Control Boundaries For Groundwater" of the LUC/ICMP. Additionally, the Metes and Bounds survey of the LUC boundary is displayed in Appendix A of the LUC/ICMP. The same figures are incorporated into Appendix D of this Master Plan.

The Land Use Control/Institutional Control Management Plan, March 2005 (table 4, page 11) prescribes the following use restriction for site ST005. "No subsurface drilling, extraction and subsequent use of groundwater within the LUC/IC boundaries without prior approval from Air Force, MDNR, and USEPA." And "No disturbance of, interference with, or damage to, the groundwater monitoring wells."

5/12/05

RP

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**APPENDIX I**

**VAPOR INTRUSION INPUTS**

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**Vapor Intrusion Calculations for Former Richards-Gebaur Air Force Base**

**OU 2 Site SS-003  
TCE Industrial Building P704**

**Calculations by Donna Caldwell, P.G.  
NAVFAC LANT**

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**Richards-Gebaur AFB SS009 Industrial 2012 5 YR Review**

GW-ADV  
Version 3.1; 02/04

Reset to  
Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES

**ENTER**  
Chemical  
CAS No.  
(numbers only,  
no dashes)

**ENTER**  
Initial  
groundwater  
conc.,  
C<sub>w</sub>  
(µg/L)

Chemical

79016      9.90E+00

Trichloroethylene

MORE  
↓

<b>ENTER</b> Average soil/ groundwater temperature, T <sub>s</sub> (°C)	<b>ENTER</b> Depth below grade to bottom of enclosed space floor, L <sub>F</sub> (cm)	<b>ENTER</b> Depth below grade to water table, L <sub>WT</sub> (cm)	<b>ENTER</b> Thickness of soil stratum A, h <sub>A</sub> (cm)	<b>ENTER</b> Thickness of soil stratum B, (Enter value or 0) h <sub>B</sub> (cm)	<b>ENTER</b> Thickness of soil stratum C, (Enter value or 0) h <sub>C</sub> (cm)	<b>ENTER</b> Soil stratum directly above water table, (Enter A, B, or C)	<b>ENTER</b> SCS soil type directly above water table	<b>ENTER</b> Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	<b>ENTER</b> User-defined stratum A soil vapor permeability, k <sub>v</sub> (cm <sup>2</sup> )
13.9	15	274	274			A	CL	CL		

MORE  
↓

<b>ENTER</b> Stratum A SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum A soil dry bulk density, ρ <sub>b</sub> <sup>A</sup> (g/cm <sup>3</sup> )	<b>ENTER</b> Stratum A soil total porosity, n <sup>A</sup> (unitless)	<b>ENTER</b> Stratum A soil water-filled porosity, θ <sub>w</sub> <sup>A</sup> (cm <sup>3</sup> /cm <sup>3</sup> )	<b>ENTER</b> Stratum B SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum B soil dry bulk density, ρ <sub>b</sub> <sup>B</sup> (g/cm <sup>3</sup> )	<b>ENTER</b> Stratum B soil total porosity, n <sup>B</sup> (unitless)	<b>ENTER</b> Stratum B soil water-filled porosity, θ <sub>w</sub> <sup>B</sup> (cm <sup>3</sup> /cm <sup>3</sup> )	<b>ENTER</b> Stratum C SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum C soil dry bulk density, ρ <sub>b</sub> <sup>C</sup> (g/cm <sup>3</sup> )	<b>ENTER</b> Stratum C soil total porosity, n <sup>C</sup> (unitless)	<b>ENTER</b> Stratum C soil water-filled porosity, θ <sub>w</sub> <sup>C</sup> (cm <sup>3</sup> /cm <sup>3</sup> )
CL	1.50	0.430	0.3								

MORE  
↓

<b>ENTER</b> Enclosed space floor thickness, L <sub>crack</sub> (cm)	<b>ENTER</b> Soil-bldg. pressure differential, ΔP (g/cm-s <sup>2</sup> )	<b>ENTER</b> Enclosed space floor length, L <sub>B</sub> (cm)	<b>ENTER</b> Enclosed space floor width, W <sub>B</sub> (cm)	<b>ENTER</b> Enclosed space height, H <sub>B</sub> (cm)	<b>ENTER</b> Floor-wall seam crack width, w (cm)	<b>ENTER</b> Indoor air exchange rate, ER (1/h)	<b>ENTER</b> Average vapor flow rate into bldg. OR Leave blank to calculate Q <sub>soil</sub> (L/m)
15	40	1928	1928	244	1	1	5

MORE  
↓

<b>ENTER</b> Averaging time for carcinogens, AT <sub>C</sub> (yrs)	<b>ENTER</b> Averaging time for noncarcinogens, AT <sub>Nc</sub> (yrs)	<b>ENTER</b> Exposure duration, ED (yrs)	<b>ENTER</b> Exposure frequency, EF (days/yr)	<b>ENTER</b> Target risk for carcinogens, TR (unitless)	<b>ENTER</b> Target hazard quotient for noncarcinogens, THQ (unitless)
70	25	8.333	250	1.0E-05	1

END

Used to calculate risk-based  
groundwater concentration.

Diffusivity in air, $D_a$ ( $\text{cm}^2/\text{s}$ )	Diffusivity in water, $D_w$ ( $\text{cm}^2/\text{s}$ )	Henry's law constant at reference temperature, H ( $\text{atm}\cdot\text{m}^3/\text{mol}$ )	Henry's law constant reference temperature, $T_R$ ( $^\circ\text{C}$ )	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ ( $\text{cal}/\text{mol}$ )	Normal boiling point, $T_B$ ( $^\circ\text{K}$ )	Critical temperature, $T_C$ ( $^\circ\text{K}$ )	Organic carbon partition coefficient, $K_{oc}$ ( $\text{cm}^3/\text{g}$ )	Pure component water solubility, S ( $\text{mg}/\text{L}$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RfC ( $\text{mg}/\text{m}^3$ )
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	4.1E-06	2.0E-03

**END**

Exposure duration, $\tau$ (sec)	Source-building separation, $L_T$ (cm)	Stratum A soil air-filled porosity, $\theta_a^A$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum B soil air-filled porosity, $\theta_a^B$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum C soil air-filled porosity, $\theta_a^C$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A effective total fluid saturation, $S_{ie}$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A soil intrinsic permeability, $k_i$ ( $\text{cm}^2$ )	Stratum A soil relative air permeability, $k_{ra}$ ( $\text{cm}^2$ )	Stratum A soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ )	Thickness of capillary zone, $L_{cz}$ (cm)	Total porosity in capillary zone, $n_{cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Air-filled porosity in capillary zone, $\theta_{a,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Water-filled porosity in capillary zone, $\theta_{w,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Floor-wall seam perimeter, $X_{crack}$ (cm)
2.63E+08	259	0.130	ERROR	ERROR	0.630	1.27E-09	0.531	6.74E-10	46.88	0.43	0.055	0.375	7,712

Bldg. ventilation rate, $Q_{building}$ ( $\text{cm}^3/\text{s}$ )	Area of enclosed space below grade, $A_B$ ( $\text{cm}^2$ )	Crack-to-total area ratio, $\eta$ (unitless)	Crack depth below grade, $Z_{crack}$ (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm- $\text{m}^3/\text{mol}$ )	Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless)	Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s)	Stratum A effective diffusion coefficient, $D_A^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum B effective diffusion coefficient, $D_B^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum C effective diffusion coefficient, $D_C^{eff}$ ( $\text{cm}^2/\text{s}$ )	Capillary zone effective diffusion coefficient, $D_{cz}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Total overall effective diffusion coefficient, $D_T^{eff}$ ( $\text{cm}^2/\text{s}$ )	Diffusion path length, $L_d$ (cm)
2.52E+05	3.72E+06	2.07E-03	15	8,509	5.90E-03	2.50E-01	1.77E-04	4.82E-04	0.00E+00	0.00E+00	3.46E-05	1.44E-04	259

Convection path length, $L_D$ (cm)	Source vapor conc., $C_{source}$ ( $\mu\text{g}/\text{m}^3$ )	Crack radius, $r_{crack}$ (cm)	Average vapor flow rate into bldg., $Q_{soil}$ ( $\text{cm}^3/\text{s}$ )	Crack effective diffusion coefficient, $D^{crack}$ ( $\text{cm}^2/\text{s}$ )	Area of crack, $A_{crack}$ ( $\text{cm}^2$ )	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, $\alpha$ (unitless)	Infinite source bldg. conc., $C_{building}$ ( $\mu\text{g}/\text{m}^3$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RFC ( $\text{mg}/\text{m}^3$ )
15	2.48E+03	1.00	8.33E+01	4.82E-04	7.71E+03	8.76E+145	8.02E-06	1.99E-02	4.1E-06	2.0E-03

END

**Richards-Gebaur AFB SS009 Industrial 2012 5 YR Review**

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

INCREMENTAL RISK CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA	NA	1.47E+06	NA	6.6E-09	2.3E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL  
DOWN  
TO "END"

END

VLOOKUP TABLES

SCS Soil Type	Soil Properties Lookup Table							Bulk Density		SCS Soil Name
	$K_s$ (cm/h)	$\alpha_1$ (1/cm)	N (unitless)	M (unitless)	$n$ (cm <sup>3</sup> /cm <sup>3</sup> )	$\theta_r$ (cm <sup>3</sup> /cm <sup>3</sup> )	Mean Grain Diameter (cm)	(g/cm <sup>3</sup> )	$\theta_w$ (cm <sup>3</sup> /cm <sup>3</sup> )	
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

CAS No.	Chemical	Chemical Properties Lookup Table											URF extrapolated (X)	RIC extrapolated (X)	
		Organic carbon partition coefficient, $K_{oc}$ (cm <sup>3</sup> /g)	Diffusivity in air, $D_a$ (cm <sup>2</sup> /s)	Diffusivity in water, $D_w$ (cm <sup>2</sup> /s)	Pure component water solubility, S (mg/L)	Henry's law constant, H' (unitless)	Henry's law constant at reference temperature, H (atm-m <sup>3</sup> /mol)	Henry's law constant reference temperature, $T_R$ (°C)	Normal boiling point, $T_B$ (°K)	Critical temperature, $T_C$ (°K)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3\text{-yr}$ )			Reference conc., RIC (mg/m <sup>3</sup> )
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	0.0E+00		
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04		
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03	X	X
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01	X	X
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04	X	X
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01	X	
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	0.0E+00		
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03		X
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02		
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00		
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02		X
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00	X	
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	2.52E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03		
74873	Hydrogen chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02		
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.5E-03		
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02		X
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01	X	
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01		
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02		
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03		
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	3.0E+00		
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01		
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00		
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02		X
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02	X	X
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01		
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01		
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01		
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01		
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01		
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01		
76131	1,1,2-Trichloro-1,2,2-trifluoroethane	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01		
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03		X
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04		
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00		X
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03	X	
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00		
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02		X
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03	X	
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00		X
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	2.1E-01		X
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02		
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01		
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01		X
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01		X
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04		X
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02		X
91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	0.0E+00	3.0E-03		
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02		X
92524	Biphenyl	4.38E+03	4.04E-02	7.45E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01		X
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01		
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01		

VLOOKUP TABLES

95578 2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02	X
95636 1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	6.0E-03	
96184 1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X
96333 Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01	X
97632 Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01	X
98066 tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01	X
98828 Cumene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01	
98862 Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01	X
98953 Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.37E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03	
100414 Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	0.0E+00	1.0E+00	
100425 Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00	
100447 Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X
100527 Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01	X
103651 n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01	X
104518 n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01	X
106423 p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	1.0E-01	
106467 1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01	
106934 1,2-Dibromoethane (ethylene dibromide)	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04	
106990 1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03	
107028 Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05	
107062 1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	0.0E+00	
107131 Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03	
108054 Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01	
108101 Methylisobutylketone (4-methyl-2-pentanone)	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00	
108383 m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01	
108678 1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03	
108872 Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00	
108883 Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	4.0E-01	
108907 Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	6.0E-02	
109693 1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00	X
110009 Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03	X
110543 Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01	
111444 Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00	
115297 Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02	X
118741 Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03	X
120821 1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03	
123739 Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X
124481 Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X
126987 Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04	
126998 2-Chloro-1,3-butadiene (chloroprene)	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03	
127184 Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	6.0E-01	
129000 Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14,370	0.0E+00	1.1E-01	X
132649 Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66,400	0.0E+00	1.4E-02	X
135988 sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88,730	0.0E+00	1.4E-01	X
141786 Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7,633.66	0.0E+00	3.2E+00	X
156592 cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7,192	0.0E+00	3.5E-02	X
156605 trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6,717	0.0E+00	7.0E-02	X
205992 Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17,000	2.1E-04	0.0E+00	X
218019 Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16,455	2.1E-06	0.0E+00	X
309002 Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15,000	4.9E-03	1.1E-04	X
319846 alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15,000	1.8E-03	0.0E+00	
541731 1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9,230.18	0.0E+00	1.1E-01	X
542756 1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7,900	4.0E-06	2.0E-02	
630206 1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	1.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01	X
1634044 MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6,677.66	0.0E+00	3.0E+00	
7439976 Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14,127	0.0E+00	3.0E-04	

**Vapor Intrusion Calculations for Former Richards-Gebaur Air Force Base**

**OU 2 Site SS-003  
TCE Residential Building P704**

**Calculations by Donna Caldwell, P.G.  
NAVFAC LANT**

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**Richards-Gebaur AFB SS003 Residential 2012 5 YR Review**

GW-ADV  
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES

**ENTER**  
Chemical CAS No. (numbers only, no dashes)

**ENTER**  
Initial groundwater conc.,  $C_w$  ( $\mu\text{g/L}$ )

Chemical

79016 1.21E+01

Trichloroethylene

MORE ↓

<b>ENTER</b> Average soil/groundwater temperature, $T_s$ ( $^{\circ}\text{C}$ )	<b>ENTER</b> Depth below grade to bottom of enclosed space floor, $L_f$ (cm)	<b>ENTER</b> Depth below grade to water table, $L_{WT}$ (cm)	<b>ENTER</b> Thickness of soil stratum A, $h_A$ (cm)	<b>ENTER</b> Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm)	<b>ENTER</b> Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm)	<b>ENTER</b> Soil stratum directly above water table, (Enter A, B, or C)	<b>ENTER</b> SCS soil type directly above water table	<b>ENTER</b> Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	<b>ENTER</b> User-defined stratum A soil vapor permeability, $k_v$ ( $\text{cm}^2$ )
13.9	15	183	183			A	CL	CL		

MORE ↓

<b>ENTER</b> Stratum A SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum A soil dry bulk density, $\rho_b^A$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum A soil total porosity, $n^A$ (unitless)	<b>ENTER</b> Stratum A soil water-filled porosity, $\theta_w^A$ ( $\text{cm}^3/\text{cm}^3$ )	<b>ENTER</b> Stratum B SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum B soil dry bulk density, $\rho_b^B$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum B soil total porosity, $n^B$ (unitless)	<b>ENTER</b> Stratum B soil water-filled porosity, $\theta_w^B$ ( $\text{cm}^3/\text{cm}^3$ )	<b>ENTER</b> Stratum C SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum C soil dry bulk density, $\rho_b^C$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum C soil total porosity, $n^C$ (unitless)	<b>ENTER</b> Stratum C soil water-filled porosity, $\theta_w^C$ ( $\text{cm}^3/\text{cm}^3$ )
CL	1.50	0.430	0.3								

MORE ↓

<b>ENTER</b> Enclosed space floor thickness, $L_{crack}$ (cm)	<b>ENTER</b> Soil-bldg. pressure differential, $\Delta P$ ( $\text{g/cm} \cdot \text{s}^2$ )	<b>ENTER</b> Enclosed space floor length, $L_B$ (cm)	<b>ENTER</b> Enclosed space floor width, $W_B$ (cm)	<b>ENTER</b> Enclosed space height, $H_B$ (cm)	<b>ENTER</b> Floor-wall seam crack width, $w$ (cm)	<b>ENTER</b> Indoor air exchange rate, ER (1/h)	<b>ENTER</b> Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m)
15	40	961	961	488	1	0.45	5

MORE ↓

<b>ENTER</b> Averaging time for carcinogens, $AT_c$ (yrs)	<b>ENTER</b> Averaging time for noncarcinogens, $AT_{nc}$ (yrs)	<b>ENTER</b> Exposure duration, ED (yrs)	<b>ENTER</b> Exposure frequency, EF (days/yr)	<b>ENTER</b> Target risk for carcinogens, TR (unitless)	<b>ENTER</b> Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

END

Used to calculate risk-based groundwater concentration.

Diffusivity in air, $D_a$ ( $\text{cm}^2/\text{s}$ )	Diffusivity in water, $D_w$ ( $\text{cm}^2/\text{s}$ )	Henry's law constant at reference temperature, H ( $\text{atm}\cdot\text{m}^3/\text{mol}$ )	Henry's law constant reference temperature, $T_R$ ( $^\circ\text{C}$ )	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ ( $\text{cal}/\text{mol}$ )	Normal boiling point, $T_B$ ( $^\circ\text{K}$ )	Critical temperature, $T_C$ ( $^\circ\text{K}$ )	Organic carbon partition coefficient, $K_{oc}$ ( $\text{cm}^3/\text{g}$ )	Pure component water solubility, S ( $\text{mg}/\text{L}$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RfC ( $\text{mg}/\text{m}^3$ )
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	4.1E-06	2.0E-03

**END**

Exposure duration, $\tau$ (sec)	Source-building separation, $L_T$ (cm)	Stratum A soil air-filled porosity, $\theta_a^A$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum B soil air-filled porosity, $\theta_a^B$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum C soil air-filled porosity, $\theta_a^C$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A effective total fluid saturation, $S_{ie}$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A soil intrinsic permeability, $k_i$ ( $\text{cm}^2$ )	Stratum A soil relative air permeability, $k_{ra}$ ( $\text{cm}^2$ )	Stratum A soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ )	Thickness of capillary zone, $L_{cz}$ (cm)	Total porosity in capillary zone, $n_{cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Air-filled porosity in capillary zone, $\theta_{a,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Water-filled porosity in capillary zone, $\theta_{w,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Floor-wall seam perimeter, $X_{crack}$ (cm)
9.46E+08	168	0.130	ERROR	ERROR	0.630	1.27E-09	0.531	6.74E-10	46.88	0.43	0.055	0.375	3,844

Bldg. ventilation rate, $Q_{building}$ ( $\text{cm}^3/\text{s}$ )	Area of enclosed space below grade, $A_B$ ( $\text{cm}^2$ )	Crack-to-total area ratio, $\eta$ (unitless)	Crack depth below grade, $Z_{crack}$ (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm-m <sup>3</sup> /mol)	Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless)	Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s)	Stratum A effective diffusion coefficient, $D_{A}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum B effective diffusion coefficient, $D_{B}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum C effective diffusion coefficient, $D_{C}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Capillary zone effective diffusion coefficient, $D_{cz}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Total overall effective diffusion coefficient, $D_{T}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Diffusion path length, $L_d$ (cm)
5.63E+04	9.24E+05	4.16E-03	15	8,509	5.90E-03	2.50E-01	1.77E-04	4.82E-04	0.00E+00	0.00E+00	3.46E-05	1.05E-04	168

Convection path length, $L_D$ (cm)	Source vapor conc., $C_{source}$ ( $\mu\text{g}/\text{m}^3$ )	Crack radius, $r_{crack}$ (cm)	Average vapor flow rate into bldg., $Q_{soil}$ ( $\text{cm}^3/\text{s}$ )	Crack effective diffusion coefficient, $D_{crack}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Area of crack, $A_{crack}$ ( $\text{cm}^2$ )	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, $\alpha$ (unitless)	Infinite source bldg. conc., $C_{building}$ ( $\mu\text{g}/\text{m}^3$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RFC ( $\text{mg}/\text{m}^3$ )
15	3.03E+03	1.00	8.33E+01	4.82E-04	3.84E+03	6.25E+292	1.01E-05	3.07E-02	4.1E-06	2.0E-03

END

**Richards-Gebaur AFB SS003 Residential 2012 5 YR Review**

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

INCREMENTAL RISK CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA	NA	1.47E+06	NA	5.2E-08	1.5E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL  
DOWN  
TO "END"

END

VLOOKUP TABLES

SCS Soil Type	Soil Properties Lookup Table							Bulk Density			SCS Soil Name
	$K_s$ (cm/h)	$\alpha_1$ (1/cm)	N (unitless)	M (unitless)	$n$ (cm <sup>3</sup> /cm <sup>3</sup> )	$\theta_r$ (cm <sup>3</sup> /cm <sup>3</sup> )	Mean Grain Diameter (cm)	(g/cm <sup>3</sup> )	$\theta_w$ (cm <sup>3</sup> /cm <sup>3</sup> )		
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay	
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam	
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam	
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand	
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand	
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay	
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam	
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt	
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay	
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam	
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam	
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam	

CAS No.	Chemical	Chemical Properties Lookup Table													URF extrapolated (X)	RIC extrapolated (X)
		Organic carbon partition coefficient, $K_{oc}$ (cm <sup>3</sup> /g)	Diffusivity in air, $D_a$ (cm <sup>2</sup> /s)	Diffusivity in water, $D_w$ (cm <sup>2</sup> /s)	Pure component water solubility, S (mg/L)	Henry's law constant, H' (unitless)	Henry's law constant at reference temperature, H (atm-m <sup>3</sup> /mol)	Henry's law constant reference temperature, $T_R$ (°C)	Normal boiling point, $T_B$ (°K)	Critical temperature, $T_C$ (°K)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3\text{-yr}$ )	Reference conc., RIC (mg/m <sup>3</sup> )			
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	0.0E+00			
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04			
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03			
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01			
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04			
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01			
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	0.0E+00			
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03			
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02			
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00			
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02			
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00			
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	2.52E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03			
74873	Hydrogen chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02			
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.5E-03			
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02			
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01			
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01			
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02			
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03			
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	3.0E+00			
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01			
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00			
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02			
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02			
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01			
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01			
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01			
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01			
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01			
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E-01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01			
76131	1,1,2-Trichloro-1,2,2-trifluoroethane	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01			
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03			
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04			
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00			
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03			
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00			
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02			
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03			
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00			
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	2.1E-01			
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02			
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01			
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01			
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01			
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04			
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02			
91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	0.0E+00	3.0E-03			
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02			
92524	Biphenyl	4.38E+03	4.04E-02	7.45E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01			
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01			
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01			

VLOOKUP TABLES

95578 2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02	X
95636 1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	6.0E-03	
96184 1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X
96333 Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01	X
97632 Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01	X
98066 tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01	X
98828 Cumene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01	
98862 Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01	X
98953 Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03	
100414 Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	0.0E+00	1.0E+00	
100425 Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00	
100447 Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X
100527 Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01	X
103651 n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01	X
104518 n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01	X
106423 p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	1.0E-01	
106467 1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01	
106934 1,2-Dibromoethane (ethylene dibromide)	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04	
106990 1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03	
107028 Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05	
107062 1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	0.0E+00	
107131 Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03	
108054 Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01	
108101 Methylisobutylketone (4-methyl-2-pentanone)	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00	
108383 m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01	
108678 1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03	
108872 Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00	
108883 Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	4.0E-01	
108907 Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	6.0E-02	
109693 1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00	X
110009 Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03	X
110543 Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01	
111444 Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00	
115297 Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02	X
118741 Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03	X
120821 1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03	
123739 Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X
124481 Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X
126987 Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04	
126998 2-Chloro-1,3-butadiene (chloroprene)	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03	
127184 Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	6.0E-01	
129000 Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14,370	0.0E+00	1.1E-01	X
132649 Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66,400	0.0E+00	1.4E-02	X
135988 sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88,730	0.0E+00	1.4E-01	X
141786 Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7,633.66	0.0E+00	3.2E+00	X
156592 cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7,192	0.0E+00	3.5E-02	X
156605 trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6,717	0.0E+00	7.0E-02	X
205992 Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17,000	2.1E-04	0.0E+00	X
218019 Chrysenes	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16,455	2.1E-06	0.0E+00	X
309002 Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15,000	4.9E-03	1.1E-04	X
319846 alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15,000	1.8E-03	0.0E+00	
541731 1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9,230.18	0.0E+00	1.1E-01	X
542756 1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7,900	4.0E-06	2.0E-02	
630206 1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	97,682,825.25	7.4E-06	1.1E-01	X
1634044 MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6,677.66	0.0E+00	3.0E+00	
7439976 Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14,127	0.0E+00	3.0E-04	

**Vapor Intrusion Calculations for Former Richards-Gebaur Air Force Base**

**OU 2 Site SS-009  
TCE Industrial Building 605**

**Calculations by Donna Caldwell, P.G.  
NAVFAC LANT**

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**Richards-Gebaur AFB SS003 Industrial 2012 5 YR Review**

GW-ADV  
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES

**ENTER** Chemical CAS No. (numbers only, no dashes)  
**ENTER** Initial groundwater conc.,  $C_w$  ( $\mu\text{g/L}$ )

Chemical

79016 1.21E+01

Trichloroethylene

MORE ↓

<b>ENTER</b> Average soil/ groundwater temperature, $T_s$ ( $^{\circ}\text{C}$ )	<b>ENTER</b> Depth below grade to bottom of enclosed space floor, $L_f$ (cm)	<b>ENTER</b> Depth below grade to water table, $L_{WT}$ (cm)	<b>ENTER</b> Totals must add up to value of $L_{WT}$ (cell G28)			<b>ENTER</b> Soil stratum directly above water table, (Enter A, B, or C)	<b>ENTER</b> SCS soil type directly above water table	<b>ENTER</b> Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	<b>ENTER</b> User-defined stratum A soil vapor permeability, $k_v$ ( $\text{cm}^2$ )
Thickness of soil stratum A, $h_A$ (cm)	Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm)	Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm)								
13.9	15	183	183			A	CL	CL		

MORE ↓

<b>ENTER</b> Stratum A SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum A soil dry bulk density, $\rho_b^A$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum A soil total porosity, $n^A$ (unitless)	<b>ENTER</b> Stratum A soil water-filled porosity, $\theta_w^A$ ( $\text{cm}^3/\text{cm}^3$ )	<b>ENTER</b> Stratum B SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum B soil dry bulk density, $\rho_b^B$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum B soil total porosity, $n^B$ (unitless)	<b>ENTER</b> Stratum B soil water-filled porosity, $\theta_w^B$ ( $\text{cm}^3/\text{cm}^3$ )	<b>ENTER</b> Stratum C SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum C soil dry bulk density, $\rho_b^C$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum C soil total porosity, $n^C$ (unitless)	<b>ENTER</b> Stratum C soil water-filled porosity, $\theta_w^C$ ( $\text{cm}^3/\text{cm}^3$ )
CL	1.50	0.430	0.3								

MORE ↓

<b>ENTER</b> Enclosed space floor thickness, $L_{crack}$ (cm)	<b>ENTER</b> Soil-bldg. pressure differential, $\Delta P$ ( $\text{g/cm} \cdot \text{s}^2$ )	<b>ENTER</b> Enclosed space floor length, $L_B$ (cm)	<b>ENTER</b> Enclosed space floor width, $W_B$ (cm)	<b>ENTER</b> Enclosed space height, $H_B$ (cm)	<b>ENTER</b> Floor-wall seam crack width, $w$ (cm)	<b>ENTER</b> Indoor air exchange rate, $ER$ (1/h)	<b>ENTER</b> Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m)
15	40	1928	1928	244	1	1	5

MORE ↓

<b>ENTER</b> Averaging time for carcinogens, $AT_c$ (yrs)	<b>ENTER</b> Averaging time for noncarcinogens, $AT_{nc}$ (yrs)	<b>ENTER</b> Exposure duration, $ED$ (yrs)	<b>ENTER</b> Exposure frequency, $EF$ (days/yr)	<b>ENTER</b> Target risk for carcinogens, $TR$ (unitless)	<b>ENTER</b> Target hazard quotient for noncarcinogens, $THQ$ (unitless)
70	25	8.33	250	1.0E-05	1

END

\*Exposure Duration 25 years divided by 3 to account for 8-hr day exposure time

Used to calculate risk-based groundwater concentration.

Diffusivity in air, $D_a$ ( $\text{cm}^2/\text{s}$ )	Diffusivity in water, $D_w$ ( $\text{cm}^2/\text{s}$ )	Henry's law constant at reference temperature, H ( $\text{atm}\cdot\text{m}^3/\text{mol}$ )	Henry's law constant reference temperature, $T_R$ ( $^\circ\text{C}$ )	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ ( $\text{cal}/\text{mol}$ )	Normal boiling point, $T_B$ ( $^\circ\text{K}$ )	Critical temperature, $T_C$ ( $^\circ\text{K}$ )	Organic carbon partition coefficient, $K_{oc}$ ( $\text{cm}^3/\text{g}$ )	Pure component water solubility, S ( $\text{mg}/\text{L}$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RfC ( $\text{mg}/\text{m}^3$ )
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	4.1E-06	2.0E-03

**END**

Exposure duration, $\tau$ (sec)	Source-building separation, $L_T$ (cm)	Stratum A soil air-filled porosity, $\theta_a^A$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum B soil air-filled porosity, $\theta_a^B$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum C soil air-filled porosity, $\theta_a^C$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A effective total fluid saturation, $S_{ie}$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A soil intrinsic permeability, $k_i$ ( $\text{cm}^2$ )	Stratum A soil relative air permeability, $k_{ra}$ ( $\text{cm}^2$ )	Stratum A soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ )	Thickness of capillary zone, $L_{cz}$ (cm)	Total porosity in capillary zone, $n_{cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Air-filled porosity in capillary zone, $\theta_{a,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Water-filled porosity in capillary zone, $\theta_{w,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Floor-wall seam perimeter, $X_{crack}$ (cm)
2.63E+08	168	0.130	ERROR	ERROR	0.630	1.27E-09	0.531	6.74E-10	46.88	0.43	0.055	0.375	7,712

Bldg. ventilation rate, $Q_{building}$ ( $\text{cm}^3/\text{s}$ )	Area of enclosed space below grade, $A_B$ ( $\text{cm}^2$ )	Crack-to-total area ratio, $\eta$ (unitless)	Crack depth below grade, $Z_{crack}$ (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm-m <sup>3</sup> /mol)	Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless)	Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s)	Stratum A effective diffusion coefficient, $D_{A}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum B effective diffusion coefficient, $D_{B}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum C effective diffusion coefficient, $D_{C}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Capillary zone effective diffusion coefficient, $D_{cz}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Total overall effective diffusion coefficient, $D_{T}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Diffusion path length, $L_d$ (cm)
2.52E+05	3.72E+06	2.07E-03	15	8,509	5.90E-03	2.50E-01	1.77E-04	4.82E-04	0.00E+00	0.00E+00	3.46E-05	1.05E-04	168

Convection path length, $L_D$ (cm)	Source vapor conc., $C_{source}$ ( $\mu\text{g}/\text{m}^3$ )	Crack radius, $r_{crack}$ (cm)	Average vapor flow rate into bldg., $Q_{soil}$ ( $\text{cm}^3/\text{s}$ )	Crack effective diffusion coefficient, $D_{crack}$ ( $\text{cm}^2/\text{s}$ )	Area of crack, $A_{crack}$ ( $\text{cm}^2$ )	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, $\alpha$ (unitless)	Infinite source bldg. conc., $C_{building}$ ( $\mu\text{g}/\text{m}^3$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RFC ( $\text{mg}/\text{m}^3$ )
15	3.03E+03	1.00	8.33E+01	4.82E-04	7.71E+03	8.76E+145	8.94E-06	2.71E-02	4.1E-06	2.0E-03

END

**Richards-Gebaur AFB SS003 Industrial 2012 5 YR Review**

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

INCREMENTAL RISK CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA	NA	1.47E+06	NA	9.1E-09	3.1E-03

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL  
DOWN  
TO "END"

END

VLOOKUP TABLES

SCS Soil Type	Soil Properties Lookup Table							Bulk Density		SCS Soil Name
	$K_s$ (cm/h)	$\alpha_1$ (1/cm)	N (unitless)	M (unitless)	$n$ (cm <sup>3</sup> /cm <sup>3</sup> )	$\theta_r$ (cm <sup>3</sup> /cm <sup>3</sup> )	Mean Grain Diameter (cm)	(g/cm <sup>3</sup> )	$\theta_w$ (cm <sup>3</sup> /cm <sup>3</sup> )	
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam

CAS No.	Chemical	Chemical Properties Lookup Table													URF extrapolated (X)	RIC extrapolated (X)
		Organic carbon partition coefficient, $K_{oc}$ (cm <sup>3</sup> /g)	Diffusivity in air, $D_a$ (cm <sup>2</sup> /s)	Diffusivity in water, $D_w$ (cm <sup>2</sup> /s)	Pure component water solubility, S (mg/L)	Henry's law constant, H' (unitless)	Henry's law constant at reference temperature, H (atm-m <sup>3</sup> /mol)	Henry's law constant reference temperature, $T_R$ (°C)	Normal boiling point, $T_B$ (°K)	Critical temperature, $T_C$ (°K)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3\text{-yr}$ )	Reference conc., RIC (mg/m <sup>3</sup> )			
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	0.0E+00			
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04			
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03			
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01			
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04			
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01			
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	0.0E+00			
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03			
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02			
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00			
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02			
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00			
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	2.52E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03			
74873	Hydrogen chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02			
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.5E-03			
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02			
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01			
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01			
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02			
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03			
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	3.0E+00			
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01			
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00			
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02			
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02			
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01			
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01			
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01			
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01			
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01			
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01			
76131	1,1,2-Trichloro-1,2,2-trifluoroethane	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01			
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03			
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04			
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00			
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03			
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00			
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02			
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03			
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00			
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	2.1E-01			
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02			
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01			
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01			
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01			
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04			
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02			
91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	0.0E+00	3.0E-03			
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02			
92524	Biphenyl	4.38E+03	4.04E-02	7.45E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01			
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01			
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01			

VLOOKUP TABLES

95578 2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02	X
95636 1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	6.0E-03	
96184 1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X
96333 Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01	X
97632 Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01	X
98066 tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01	X
98828 Cumene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01	
98862 Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01	X
98953 Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.39E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03	
100414 Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	0.0E+00	1.0E+00	
100425 Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00	
100447 Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X
100527 Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01	X
103651 n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01	X
104518 n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01	X
106423 p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	1.0E-01	
106467 1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01	
106934 1,2-Dibromoethane (ethylene dibromide)	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04	
106990 1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03	
107028 Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05	
107062 1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	0.0E+00	
107131 Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03	
108054 Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01	
108101 Methylisobutylketone (4-methyl-2-pentanone)	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00	
108383 m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01	
108678 1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03	
108872 Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00	
108883 Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	4.0E-01	
108907 Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	6.0E-02	
109693 1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00	X
110009 Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03	X
110543 Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01	
111444 Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00	
115297 Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02	X
118741 Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03	X
120821 1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03	
123739 Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X
124481 Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X
126987 Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04	
126998 2-Chloro-1,3-butadiene (chloroprene)	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03	
127184 Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	6.0E-01	
129000 Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14,370	0.0E+00	1.1E-01	X
132649 Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66,400	0.0E+00	1.4E-02	X
135988 sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88,730	0.0E+00	1.4E-01	X
141786 Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7,633.66	0.0E+00	3.2E+00	X
156592 cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7,192	0.0E+00	3.5E-02	X
156605 trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6,717	0.0E+00	7.0E-02	X
205992 Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17,000	2.1E-04	0.0E+00	X
218019 Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16,455	2.1E-06	0.0E+00	X
309002 Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15,000	4.9E-03	1.1E-04	X
319846 alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15,000	1.8E-03	0.0E+00	
541731 1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9,230.18	0.0E+00	1.1E-01	X
542756 1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7,900	4.0E-06	2.0E-02	
630206 1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	9768.282525	7.4E-06	1.1E-01	X
1634044 MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6,677.66	0.0E+00	3.0E+00	
7439976 Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14,127	0.0E+00	3.0E-04	

**Vapor Intrusion Calculations for Former Richards-Gebaur Air Force Base**

**OU 2 Site SS-009  
TCE Residential Building 605**

**Calculations by Donna Caldwell, P.G.  
NAVFAC LANT**

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**Richards-Gebaur AFB SS009 Residential 2012 5 YR Review**

GW-ADV  
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES

**ENTER**  
Chemical CAS No. (numbers only, no dashes)

**ENTER**  
Initial groundwater conc.,  $C_w$  ( $\mu\text{g/L}$ )

Chemical

79016 9.90E+00

Trichloroethylene

MORE ↓

<b>ENTER</b> Average soil/groundwater temperature, $T_s$ ( $^{\circ}\text{C}$ )	<b>ENTER</b> Depth below grade to bottom of enclosed space floor, $L_f$ (cm)	<b>ENTER</b> Depth below grade to water table, $L_{WT}$ (cm)	<b>ENTER</b> Totals must add up to value of $L_{WT}$ (cell G28)			<b>ENTER</b> Soil stratum directly above water table, (Enter A, B, or C)	<b>ENTER</b> SCS soil type directly above water table	<b>ENTER</b> Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	<b>ENTER</b> User-defined stratum A soil vapor permeability, $k_v$ ( $\text{cm}^2$ )
Thickness of soil stratum A, $h_A$ (cm)	Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm)	Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm)								
13.9	15	274	274			A	CL	CL		

MORE ↓

<b>ENTER</b> Stratum A SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum A soil dry bulk density, $\rho_b^A$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum A soil total porosity, $n^A$ (unitless)	<b>ENTER</b> Stratum A soil water-filled porosity, $\theta_w^A$ ( $\text{cm}^3/\text{cm}^3$ )	<b>ENTER</b> Stratum B SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum B soil dry bulk density, $\rho_b^B$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum B soil total porosity, $n^B$ (unitless)	<b>ENTER</b> Stratum B soil water-filled porosity, $\theta_w^B$ ( $\text{cm}^3/\text{cm}^3$ )	<b>ENTER</b> Stratum C SCS soil type Lookup Soil Parameters	<b>ENTER</b> Stratum C soil dry bulk density, $\rho_b^C$ ( $\text{g/cm}^3$ )	<b>ENTER</b> Stratum C soil total porosity, $n^C$ (unitless)	<b>ENTER</b> Stratum C soil water-filled porosity, $\theta_w^C$ ( $\text{cm}^3/\text{cm}^3$ )
CL	1.50	0.430	0.3								

MORE ↓

<b>ENTER</b> Enclosed space floor thickness, $L_{crack}$ (cm)	<b>ENTER</b> Soil-bldg. pressure differential, $\Delta P$ ( $\text{g/cm} \cdot \text{s}^2$ )	<b>ENTER</b> Enclosed space floor length, $L_B$ (cm)	<b>ENTER</b> Enclosed space floor width, $W_B$ (cm)	<b>ENTER</b> Enclosed space height, $H_B$ (cm)	<b>ENTER</b> Floor-wall seam crack width, $w$ (cm)	<b>ENTER</b> Indoor air exchange rate, ER (1/h)	<b>ENTER</b> Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m)
15	40	961	961	488	1	0.45	5

MORE ↓

<b>ENTER</b> Averaging time for carcinogens, $AT_C$ (yrs)	<b>ENTER</b> Averaging time for noncarcinogens, $AT_{NC}$ (yrs)	<b>ENTER</b> Exposure duration, ED (yrs)	<b>ENTER</b> Exposure frequency, EF (days/yr)	<b>ENTER</b> Target risk for carcinogens, TR (unitless)	<b>ENTER</b> Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-05	1

END

Used to calculate risk-based groundwater concentration.

Diffusivity in air, $D_a$ ( $\text{cm}^2/\text{s}$ )	Diffusivity in water, $D_w$ ( $\text{cm}^2/\text{s}$ )	Henry's law constant at reference temperature, H ( $\text{atm}\cdot\text{m}^3/\text{mol}$ )	Henry's law constant reference temperature, $T_R$ ( $^\circ\text{C}$ )	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ ( $\text{cal}/\text{mol}$ )	Normal boiling point, $T_B$ ( $^\circ\text{K}$ )	Critical temperature, $T_C$ ( $^\circ\text{K}$ )	Organic carbon partition coefficient, $K_{oc}$ ( $\text{cm}^3/\text{g}$ )	Pure component water solubility, S ( $\text{mg}/\text{L}$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RfC ( $\text{mg}/\text{m}^3$ )
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	4.1E-06	2.0E-03

**END**

Exposure duration, $\tau$ (sec)	Source-building separation, $L_T$ (cm)	Stratum A soil air-filled porosity, $\theta_a^A$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum B soil air-filled porosity, $\theta_a^B$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum C soil air-filled porosity, $\theta_a^C$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A effective total fluid saturation, $S_{ie}$ ( $\text{cm}^3/\text{cm}^3$ )	Stratum A soil intrinsic permeability, $k_i$ ( $\text{cm}^2$ )	Stratum A soil relative air permeability, $k_{ra}$ ( $\text{cm}^2$ )	Stratum A soil effective vapor permeability, $k_v$ ( $\text{cm}^2$ )	Thickness of capillary zone, $L_{cz}$ (cm)	Total porosity in capillary zone, $n_{cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Air-filled porosity in capillary zone, $\theta_{a,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Water-filled porosity in capillary zone, $\theta_{w,cz}$ ( $\text{cm}^3/\text{cm}^3$ )	Floor-wall seam perimeter, $X_{crack}$ (cm)
9.46E+08	259	0.130	ERROR	ERROR	0.630	1.27E-09	0.531	6.74E-10	46.88	0.43	0.055	0.375	3,844

Bldg. ventilation rate, $Q_{building}$ ( $\text{cm}^3/\text{s}$ )	Area of enclosed space below grade, $A_B$ ( $\text{cm}^2$ )	Crack-to-total area ratio, $\eta$ (unitless)	Crack depth below grade, $Z_{crack}$ (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm-m <sup>3</sup> /mol)	Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless)	Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s)	Stratum A effective diffusion coefficient, $D_A^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum B effective diffusion coefficient, $D_B^{eff}$ ( $\text{cm}^2/\text{s}$ )	Stratum C effective diffusion coefficient, $D_C^{eff}$ ( $\text{cm}^2/\text{s}$ )	Capillary zone effective diffusion coefficient, $D_{cz}^{eff}$ ( $\text{cm}^2/\text{s}$ )	Total overall effective diffusion coefficient, $D_T^{eff}$ ( $\text{cm}^2/\text{s}$ )	Diffusion path length, $L_d$ (cm)
5.63E+04	9.24E+05	4.16E-03	15	8,509	5.90E-03	2.50E-01	1.77E-04	4.82E-04	0.00E+00	0.00E+00	3.46E-05	1.44E-04	259

Convection path length, $L_D$ (cm)	Source vapor conc., $C_{source}$ ( $\mu\text{g}/\text{m}^3$ )	Crack radius, $r_{crack}$ (cm)	Average vapor flow rate into bldg., $Q_{soil}$ ( $\text{cm}^3/\text{s}$ )	Crack effective diffusion coefficient, $D^{crack}$ ( $\text{cm}^2/\text{s}$ )	Area of crack, $A_{crack}$ ( $\text{cm}^2$ )	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, $\alpha$ (unitless)	Infinite source bldg. conc., $C_{building}$ ( $\mu\text{g}/\text{m}^3$ )	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup>	Reference conc., RFC ( $\text{mg}/\text{m}^3$ )
15	2.48E+03	1.00	8.33E+01	4.82E-04	3.84E+03	6.25E+292	9.08E-06	2.25E-02	4.1E-06	2.0E-03

END

**Richards-Gebaur AFB SS009 Residential 2012 5 YR Review**

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

INCREMENTAL RISK CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)	Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	NA	NA	1.47E+06	NA	3.8E-08	1.1E-02

MESSAGE AND ERROR SUMMARY BELOW: (DO NOT USE RESULTS IF ERRORS ARE PRESENT)

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

SCROLL  
DOWN  
TO "END"

END

VLOOKUP TABLES

SCS Soil Type	Soil Properties Lookup Table							Bulk Density			SCS Soil Name
	$K_s$ (cm/h)	$\alpha_1$ (1/cm)	N (unitless)	M (unitless)	$n$ (cm <sup>3</sup> /cm <sup>3</sup> )	$\theta_r$ (cm <sup>3</sup> /cm <sup>3</sup> )	Mean Grain Diameter (cm)	(g/cm <sup>3</sup> )	$\theta_w$ (cm <sup>3</sup> /cm <sup>3</sup> )		
C	0.61	0.01496	1.253	0.2019	0.459	0.098	0.0092	1.43	0.215	Clay	
CL	0.34	0.01581	1.416	0.2938	0.442	0.079	0.016	1.48	0.168	Clay Loam	
L	0.50	0.01112	1.472	0.3207	0.399	0.061	0.020	1.59	0.148	Loam	
LS	4.38	0.03475	1.746	0.4273	0.390	0.049	0.040	1.62	0.076	Loamy Sand	
S	26.78	0.03524	3.177	0.6852	0.375	0.053	0.044	1.66	0.054	Sand	
SC	0.47	0.03342	1.208	0.1722	0.385	0.117	0.025	1.63	0.197	Sandy Clay	
SCL	0.55	0.02109	1.330	0.2481	0.384	0.063	0.029	1.63	0.146	Sandy Clay Loam	
SI	1.82	0.00658	1.679	0.4044	0.489	0.050	0.0046	1.35	0.167	Silt	
SIC	0.40	0.01622	1.321	0.2430	0.481	0.111	0.0039	1.38	0.216	Silty Clay	
SICL	0.46	0.00839	1.521	0.3425	0.482	0.090	0.0056	1.37	0.198	Silty Clay Loam	
SIL	0.76	0.00506	1.663	0.3987	0.439	0.065	0.011	1.49	0.180	Silt Loam	
SL	1.60	0.02667	1.449	0.3099	0.387	0.039	0.030	1.62	0.103	Sandy Loam	

CAS No.	Chemical	Chemical Properties Lookup Table													URF extrapolated (X)	RIC extrapolated (X)
		Organic carbon partition coefficient, $K_{oc}$ (cm <sup>3</sup> /g)	Diffusivity in air, $D_a$ (cm <sup>2</sup> /s)	Diffusivity in water, $D_w$ (cm <sup>2</sup> /s)	Pure component water solubility, S (mg/L)	Henry's law constant, H' (unitless)	Henry's law constant at reference temperature, H (atm-m <sup>3</sup> /mol)	Henry's law constant reference temperature, $T_R$ (°C)	Normal boiling point, $T_B$ (°K)	Critical temperature, $T_C$ (°K)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Unit risk factor, URF ( $\mu\text{g}/\text{m}^3\text{-yr}$ )	Reference conc., RIC (mg/m <sup>3</sup> )			
56235	Carbon tetrachloride	1.74E+02	7.80E-02	8.80E-06	7.93E+02	1.24E+00	3.03E-02	25	349.90	556.60	7,127	1.5E-05	0.0E+00			
57749	Chlordane	1.20E+05	1.18E-02	4.37E-06	5.60E-02	1.99E-03	4.85E-05	25	624.24	885.73	14,000	1.0E-04	7.0E-04			
58899	gamma-HCH (Lindane)	1.07E+03	1.42E-02	7.34E-06	7.30E+00	5.73E-04	1.40E-05	25	596.55	839.36	15,000	3.7E-04	1.1E-03			
60297	Ethyl ether	5.73E+00	7.82E-02	8.61E-06	5.68E+04	1.35E+00	3.29E-02	25	307.50	466.74	6,338	0.0E+00	7.0E-01			
60571	Dieldrin	2.14E+04	1.25E-02	4.74E-06	1.95E-01	6.18E-04	1.51E-05	25	613.32	842.25	17,000	4.6E-03	1.8E-04			
67641	Acetone	5.75E-01	1.24E-01	1.14E-05	1.00E+06	1.59E-03	3.87E-05	25	329.20	508.10	6,955	0.0E+00	3.5E-01			
67663	Chloroform	3.98E+01	1.04E-01	1.00E-05	7.92E+03	1.50E-01	3.66E-03	25	334.32	536.40	6,988	2.3E-05	0.0E+00			
67721	Hexachloroethane	1.78E+03	2.50E-03	6.80E-06	5.00E+01	1.59E-01	3.88E-03	25	458.00	695.00	9,510	4.0E-06	3.5E-03			
71432	Benzene	5.89E+01	8.80E-02	9.80E-06	1.79E+03	2.27E-01	5.54E-03	25	353.24	562.16	7,342	7.8E-06	3.0E-02			
71556	1,1,1-Trichloroethane	1.10E+02	7.80E-02	8.80E-06	1.33E+03	7.03E-01	1.72E-02	25	347.24	545.00	7,136	0.0E+00	2.2E+00			
72435	Methoxychlor	9.77E+04	1.56E-02	4.46E-06	1.00E-01	6.46E-04	1.58E-05	25	651.02	848.49	16,000	0.0E+00	1.8E-02			
72559	DDE	4.47E+06	1.44E-02	5.87E-06	1.20E-01	8.59E-04	2.09E-05	25	636.44	860.38	15,000	9.7E-05	0.0E+00			
74839	Methyl bromide	1.05E+01	7.28E-02	1.21E-05	1.52E+04	2.55E-01	2.52E-03	25	276.71	467.00	5,714	0.0E+00	5.0E-03			
74873	Hydrogen chloride (chloromethane)	2.12E+00	1.26E-01	6.50E-06	5.33E+03	3.61E-01	8.80E-03	25	249.00	416.25	5,115	1.0E-06	9.0E-02			
74908	Hydrogen cyanide	3.80E+00	1.93E-01	2.10E-05	1.00E+06	5.44E-03	1.33E-04	25	299.00	456.70	6,676	0.0E+00	3.5E-03			
74953	Methylene bromide	1.26E+01	4.30E-02	8.44E-06	1.19E+04	3.52E-02	8.59E-04	25	370.00	583.00	7,868	0.0E+00	3.5E-02			
75003	Chloroethane (ethyl chloride)	4.40E+00	2.71E-01	1.15E-05	5.68E+03	3.61E-01	8.80E-03	25	285.30	460.40	5,879	8.3E-07	1.0E+01			
75014	Vinyl chloride (chloroethene)	1.86E+01	1.06E-01	1.23E-05	8.80E+03	1.10E+00	2.69E-02	25	259.25	432.00	5,250	8.8E-06	1.0E-01			
75058	Acetonitrile	4.20E+00	1.28E-01	1.66E-05	1.00E+06	1.42E-03	3.45E-05	25	354.60	545.50	7,110	0.0E+00	6.0E-02			
75070	Acetaldehyde	1.06E+00	1.24E-01	1.41E-05	1.00E+06	3.23E-03	7.87E-05	25	293.10	466.00	6,157	2.2E-06	9.0E-03			
75092	Methylene chloride	1.17E+01	1.01E-01	1.17E-05	1.30E+04	8.96E-02	2.18E-03	25	313.00	510.00	6,706	4.7E-07	3.0E+00			
75150	Carbon disulfide	4.57E+01	1.04E-01	1.00E-05	1.19E+03	1.24E+00	3.02E-02	25	319.00	552.00	6,391	0.0E+00	7.0E-01			
75218	Ethylene oxide	1.33E+00	1.04E-01	1.45E-05	3.04E+05	2.27E-02	5.54E-04	25	283.60	469.00	6,104	1.0E-04	0.0E+00			
75252	Bromoform	8.71E+01	1.49E-02	1.03E-05	3.10E+03	2.41E-02	5.88E-04	25	422.35	696.00	9,479	1.1E-06	7.0E-02			
75274	Bromodichloromethane	5.50E+01	2.98E-02	1.06E-05	6.74E+03	6.54E-02	1.60E-03	25	363.15	585.85	7,800	1.8E-05	7.0E-02			
75296	2-Chloropropane	9.14E+00	8.88E-02	1.01E-05	3.73E+03	5.93E-01	1.45E-02	25	308.70	485.00	6,286	0.0E+00	1.0E-01			
75343	1,1-Dichloroethane	3.16E+01	7.42E-02	1.05E-05	5.06E+03	2.30E-01	5.61E-03	25	330.55	523.00	6,895	0.0E+00	5.0E-01			
75354	1,1-Dichloroethylene	5.89E+01	9.00E-02	1.04E-05	2.25E+03	1.07E+00	2.60E-02	25	304.75	576.05	6,247	0.0E+00	2.0E-01			
75456	Chlorodifluoromethane	4.79E+01	1.01E-01	1.28E-05	2.00E+00	1.10E+00	2.70E-02	25	232.40	369.30	4,836	0.0E+00	5.0E+01			
75694	Trichlorofluoromethane	4.97E+02	8.70E-02	9.70E-06	1.10E+03	3.97E+00	9.68E-02	25	296.70	471.00	5,999	0.0E+00	7.0E-01			
75718	Dichlorodifluoromethane	4.57E+02	6.65E-02	9.92E-06	2.80E+02	1.40E+01	3.42E-01	25	243.20	384.95	9,421	0.0E+00	2.0E-01			
76131	1,1,2-Trichloro-1,2,2-trifluoroethane	1.11E+04	7.80E-02	8.20E-06	1.70E+02	1.97E+01	4.80E-01	25	320.70	487.30	6,463	0.0E+00	3.0E+01			
76448	Heptachlor	1.41E+06	1.12E-02	5.69E-06	1.80E-01	6.05E+01	1.48E+00	25	603.69	846.31	13,000	1.3E-03	1.8E-03			
77474	Hexachlorocyclopentadiene	2.00E+05	1.61E-02	7.21E-06	1.80E+00	1.10E+00	2.69E-02	25	512.15	746.00	10,931	0.0E+00	2.0E-04			
78831	Isobutanol	2.59E+00	8.60E-02	9.30E-06	8.50E+04	4.83E-04	1.18E-05	25	381.04	547.78	10,936	0.0E+00	1.1E+00			
78875	1,2-Dichloropropane	4.37E+01	7.82E-02	8.73E-06	2.80E+03	1.15E-01	2.79E-03	25	369.52	572.00	7,590	1.9E-05	4.0E-03			
78933	Methylethylketone (2-butanone)	2.30E+00	8.08E-02	9.80E-06	2.23E+05	2.29E-03	5.58E-05	25	352.50	536.78	7,481	0.0E+00	5.0E+00			
79005	1,1,2-Trichloroethane	5.01E+01	7.80E-02	8.80E-06	4.42E+03	3.73E-02	9.11E-04	25	386.15	602.00	8,322	1.6E-05	1.4E-02			
79016	Trichloroethylene	1.66E+02	7.90E-02	9.10E-06	1.47E+03	4.21E-01	1.03E-02	25	360.36	544.20	7,505	4.1E-06	2.0E-03			
79209	Methyl acetate	3.26E+00	1.04E-01	1.00E-05	2.00E+03	4.84E-03	1.18E-04	25	329.80	506.70	7,260	0.0E+00	3.5E+00			
79345	1,1,2,2-Tetrachloroethane	9.33E+01	7.10E-02	7.90E-06	2.96E+03	1.41E-02	3.44E-04	25	419.60	661.15	8,996	5.8E-05	2.1E-01			
79469	2-Nitropropane	1.17E+01	9.23E-02	1.01E-05	1.70E+04	5.03E-03	1.23E-04	25	393.20	594.00	8,383	2.7E-03	2.0E-02			
80626	Methylmethacrylate	6.98E+00	7.70E-02	8.60E-06	1.50E+04	1.38E-02	3.36E-04	25	373.50	567.00	8,975	0.0E+00	7.0E-01			
83329	Acenaphthene	7.08E+03	4.21E-02	7.69E-06	3.57E+00	6.34E-03	1.55E-04	25	550.54	803.15	12,155	0.0E+00	2.1E-01			
86737	Fluorene	1.38E+04	3.63E-02	7.88E-06	1.98E+00	2.60E-03	6.34E-05	25	570.44	870.00	12,666	0.0E+00	1.4E-01			
87683	Hexachloro-1,3-butadiene	5.37E+04	5.61E-02	6.16E-06	3.20E+00	3.33E-01	8.13E-03	25	486.15	738.00	10,206	2.2E-05	7.0E-04			
88722	o-Nitrotoluene	3.24E+02	5.87E-02	8.67E-06	6.50E+02	5.11E-04	1.25E-05	25	495.00	720.00	12,239	0.0E+00	3.5E-02			
91203	Naphthalene	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	4.82E-04	25	491.14	748.40	10,373	0.0E+00	3.0E-03			
91576	2-Methylnaphthalene	2.81E+03	5.22E-02	7.75E-06	2.46E+01	2.12E-02	5.17E-04	25	514.26	761.00	12,600	0.0E+00	7.0E-02			
92524	Biphenyl	4.38E+03	4.04E-02	7.45E-06	7.45E+00	1.23E-02	2.99E-04	25	529.10	789.00	10,890	0.0E+00	1.8E-01			
95476	o-Xylene	3.63E+02	8.70E-02	1.00E-05	1.78E+02	2.12E-01	5.18E-03	25	417.60	630.30	8,661	0.0E+00	1.0E-01			
95501	1,2-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	1.56E+02	7.77E-02	1.90E-03	25	453.57	705.00	9,700	0.0E+00	2.0E-01			

VLOOKUP TABLES

95578 2-Chlorophenol	3.88E+02	5.01E-02	9.46E-06	2.20E+04	1.60E-02	3.90E-04	25	447.53	675.00	9,572	0.0E+00	1.8E-02	X
95636 1,2,4-Trimethylbenzene	1.35E+03	6.06E-02	7.92E-06	5.70E+01	2.52E-01	6.14E-03	25	442.30	649.17	9,369	0.0E+00	6.0E-03	
96184 1,2,3-Trichloropropane	2.20E+01	7.10E-02	7.90E-06	1.75E+03	1.67E-02	4.08E-04	25	430.00	652.00	9,171	5.7E-04	4.9E-03	X
96333 Methyl acrylate	4.53E+00	9.76E-02	1.02E-05	6.00E+04	7.68E-03	1.87E-04	25	353.70	536.00	7,749	0.0E+00	1.1E-01	X
97632 Ethylmethacrylate	2.95E+01	6.53E-02	8.37E-06	3.67E+03	3.44E-02	8.40E-04	25	390.00	571.00	10,957	0.0E+00	3.2E-01	X
98066 tert-Butylbenzene	7.71E+02	5.65E-02	8.02E-06	2.95E+01	4.87E-01	1.19E-02	25	442.10	1220.00	8,980	0.0E+00	1.4E-01	X
98828 Cumene	4.89E+02	6.50E-02	7.10E-06	6.13E+01	4.74E+01	1.46E-02	25	425.56	631.10	10,335	0.0E+00	4.0E-01	
98862 Acetophenone	5.77E+01	6.00E-02	8.73E-06	6.13E+03	4.38E-04	1.07E-05	25	475.00	709.50	11,732	0.0E+00	3.5E-01	X
98953 Nitrobenzene	6.46E+01	7.60E-02	8.60E-06	2.09E+03	9.82E-04	2.37E-05	25	483.95	719.00	10,566	0.0E+00	2.0E-03	
100414 Ethylbenzene	3.63E+02	7.50E-02	7.80E-06	1.69E+02	3.22E-01	7.86E-03	25	409.34	617.20	8,501	0.0E+00	1.0E+00	
100425 Styrene	7.76E+02	7.10E-02	8.00E-06	3.10E+02	1.12E-01	2.74E-03	25	418.31	636.00	8,737	0.0E+00	1.0E+00	
100447 Benzylchloride	6.14E+01	7.50E-02	7.80E-06	5.25E+02	1.70E-02	4.14E-04	25	452.00	685.00	8,773	4.9E-05	0.0E+00	X
100527 Benzaldehyde	4.59E+01	7.21E-02	9.07E-06	3.30E+03	9.73E-04	2.37E-05	25	452.00	695.00	11,658	0.0E+00	3.5E-01	X
103651 n-Propylbenzene	5.62E+02	6.01E-02	7.83E-06	6.00E+01	4.37E-01	1.07E-02	25	432.20	630.00	9,123	0.0E+00	1.4E-01	X
104518 n-Butylbenzene	1.11E+03	5.70E-02	8.12E-06	2.00E+00	5.38E-01	1.31E-02	25	456.46	660.50	9,290	0.0E+00	1.4E-01	X
106423 p-Xylene	3.89E+02	7.69E-02	8.44E-06	1.85E+02	3.13E-01	7.64E-03	25	411.52	616.20	8,525	0.0E+00	1.0E-01	
106467 1,4-Dichlorobenzene	6.17E+02	6.90E-02	7.90E-06	7.90E+01	9.82E-02	2.39E-03	25	447.21	684.75	9,271	0.0E+00	8.0E-01	
106934 1,2-Dibromoethane (ethylene dibromide)	2.50E+01	2.17E-02	1.19E-05	4.18E+03	3.04E-02	7.41E-04	25	404.60	583.00	8,310	2.2E-04	2.0E-04	
106990 1,3-Butadiene	1.91E+01	2.49E-01	1.08E-05	7.35E+02	3.01E+00	7.34E-02	25	268.60	425.00	5,370	3.0E-02	2.0E-03	
107028 Acrolein	2.76E+00	1.05E-01	1.22E-05	2.13E+05	4.99E-03	1.22E-04	25	325.60	506.00	6,731	0.0E+00	2.0E-05	
107062 1,2-Dichloroethane	1.74E+01	1.04E-01	9.90E-06	8.52E+03	4.00E-02	9.77E-04	25	356.65	561.00	7,643	2.6E-05	0.0E+00	
107131 Acrylonitrile	5.90E+00	1.22E-01	1.34E-05	7.40E+04	4.21E-03	1.03E-04	25	350.30	519.00	7,786	6.8E-05	2.0E-03	
108054 Vinyl acetate	5.25E+00	8.50E-02	9.20E-06	2.00E+04	2.09E-02	5.10E-04	25	345.65	519.13	7,800	0.0E+00	2.0E-01	
108101 Methylisobutylketone (4-methyl-2-pentanone)	9.06E+00	7.50E-02	7.80E-06	1.90E+04	5.64E-03	1.38E-04	25	389.50	571.00	8,243	0.0E+00	3.0E+00	
108383 m-Xylene	4.07E+02	7.00E-02	7.80E-06	1.61E+02	3.00E-01	7.32E-03	25	412.27	617.05	8,523	0.0E+00	1.0E-01	
108678 1,3,5-Trimethylbenzene	1.35E+03	6.02E-02	8.67E-06	2.00E+00	2.41E-01	5.87E-03	25	437.89	637.25	9,321	0.0E+00	6.0E-03	
108872 Methylcyclohexane	7.85E+01	7.35E-02	8.52E-06	1.40E+01	4.22E+00	1.03E-01	25	373.90	572.20	7,474	0.0E+00	3.0E+00	
108883 Toluene	1.82E+02	8.70E-02	8.60E-06	5.26E+02	2.72E-01	6.62E-03	25	383.78	591.79	7,930	0.0E+00	4.0E-01	
108907 Chlorobenzene	2.19E+02	7.30E-02	8.70E-06	4.72E+02	1.51E-01	3.69E-03	25	404.87	632.40	8,410	0.0E+00	6.0E-02	
109693 1-Chlorobutane	1.72E+01	8.26E-02	1.00E-05	1.10E+03	6.93E-01	1.69E-02	25	351.60	542.00	7,263	0.0E+00	1.4E+00	X
110009 Furan	1.86E+01	1.04E-01	1.22E-05	1.00E+04	2.21E-01	5.39E-03	25	304.60	490.20	6,477	0.0E+00	3.5E-03	X
110543 Hexane	4.34E+01	2.00E-01	7.77E-06	1.24E+01	6.82E+01	1.66E+00	25	341.70	508.00	6,895	0.0E+00	2.0E-01	
111444 Bis(2-chloroethyl)ether	1.55E+01	6.92E-02	7.53E-06	1.72E+04	7.36E-04	1.80E-05	25	451.15	659.79	10,803	3.3E-04	0.0E+00	
115297 Endosulfan	2.14E+03	1.15E-02	4.55E-06	5.10E-01	4.58E-04	1.12E-05	25	674.43	942.94	14,000	0.0E+00	2.1E-02	X
118741 Hexachlorobenzene	5.50E+04	5.42E-02	5.91E-06	5.00E-03	5.40E-02	1.32E-03	25	582.55	825.00	14,447	4.6E-04	2.8E-03	X
120821 1,2,4-Trichlorobenzene	1.78E+03	3.00E-02	8.23E-06	4.88E+01	5.81E-02	1.42E-03	25	486.15	725.00	10,471	0.0E+00	4.0E-03	
123739 Crotonaldehyde (2-butenal)	4.82E+00	9.56E-02	1.07E-05	3.69E+04	7.99E-04	1.95E-05	25	375.20	568.00	9	5.4E-04	0.0E+00	X
124481 Chlorodibromomethane	6.31E+01	1.96E-02	1.05E-05	2.60E+03	3.20E-02	7.81E-04	25	416.14	678.20	5,900	2.4E-05	7.0E-02	X
126987 Methacrylonitrile	3.58E+01	1.12E-01	1.32E-05	2.54E+04	1.01E-02	2.46E-04	25	363.30	554.00	7,600	0.0E+00	7.0E-04	
126998 2-Chloro-1,3-butadiene (chloroprene)	6.73E+01	8.58E-02	1.03E-05	2.12E+03	4.91E-01	1.20E-02	25	332.40	525.00	8,075	0.0E+00	7.0E-03	
127184 Tetrachloroethylene	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.53E-01	1.84E-02	25	394.40	620.20	8,288	5.9E-06	6.0E-01	
129000 Pyrene	1.05E+05	2.72E-02	7.24E-06	1.35E+00	4.50E-04	1.10E-05	25	667.95	936	14,370	0.0E+00	1.1E-01	X
132649 Dibenzofuran	5.15E+03	2.38E-02	6.00E-06	3.10E+00	5.15E-04	1.26E-05	25	560	824	66,400	0.0E+00	1.4E-02	X
135988 sec-Butylbenzene	9.66E+02	5.70E-02	8.12E-06	3.94E+00	5.68E-01	1.39E-02	25	446.5	679	88,730	0.0E+00	1.4E-01	X
141786 Ethylacetate	6.44E+00	7.32E-02	9.70E-06	8.03E+04	5.64E-03	1.38E-04	25	350.26	523.3	7,633.66	0.0E+00	3.2E+00	X
156592 cis-1,2-Dichloroethylene	3.55E+01	7.36E-02	1.13E-05	3.50E+03	1.67E-01	4.07E-03	25	333.65	544	7,192	0.0E+00	3.5E-02	X
156605 trans-1,2-Dichloroethylene	5.25E+01	7.07E-02	1.19E-05	6.30E+03	3.84E-01	9.36E-03	25	320.85	516.5	6,717	0.0E+00	7.0E-02	X
205992 Benzo(b)fluoranthene	1.23E+06	2.26E-02	5.56E-06	1.50E-03	4.54E-03	1.11E-04	25	715.9	969.27	17,000	2.1E-04	0.0E+00	X
218019 Chrysene	3.98E+05	2.48E-02	6.21E-06	6.30E-03	3.87E-03	9.44E-05	25	714.15	979	16,455	2.1E-06	0.0E+00	X
309002 Aldrin	2.45E+06	1.32E-02	4.86E-06	1.70E-02	6.95E-03	1.70E-04	25	603.01	839.37	15,000	4.9E-03	1.1E-04	X
319846 alpha-HCH (alpha-BHC)	1.23E+03	1.42E-02	7.34E-06	2.00E+00	4.34E-04	1.06E-05	25	596.55	839.36	15,000	1.8E-03	0.0E+00	
541731 1,3-Dichlorobenzene	1.98E+03	6.92E-02	7.86E-06	1.34E+02	1.27E-01	3.09E-03	25	446	684	9,230.18	0.0E+00	1.1E-01	X
542756 1,3-Dichloropropene	4.57E+01	6.26E-02	1.00E-05	2.80E+03	7.24E-01	1.77E-02	25	381.15	587.38	7,900	4.0E-06	2.0E-02	
630206 1,1,1,2-Tetrachloroethane	1.16E+02	7.10E-02	7.90E-06	1.10E+03	9.90E-02	2.41E-03	25	403.5	624	97,682,825.25	7.4E-06	1.1E-01	X
1634044 MTBE	7.26E+00	1.02E-01	1.05E-05	5.10E+04	2.56E-02	6.23E-04	25	328.3	497.1	6,677.66	0.0E+00	3.0E+00	
7439976 Mercury (elemental)	5.20E+01	3.07E-02	6.30E-06	2.00E+01	4.40E-01	1.07E-02	25	629.88	1750	14,127	0.0E+00	3.0E-04	