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FIVE-YEAR REVIEW REPORT FOR THE RICHARDS GEBAUR AIR FORCE BASE SITE IN BELTON MCRCO KANSAS CITY MO (PUBLIC DOCUMENT)

3/1/2007

AIR FORCE REAL PROPERTY AGENCY

FIVE YEAR REVIEW REPORT

First Five Year Review Report

for

Former Richards-Gebaur AFB
Kansas City, Missouri

March 2007

Prepared By:

Air Force Real Property Agency

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Approved By:

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19 Mar 07
Date

FORMER RICHARDS-GEBAUR AFB

FIVE-YEAR REVIEW REPORT

FINAL

Prepared for:

Air Force Real Property Agency

Prepared by:

Booz Allen Hamilton Inc.

Overland Park, KS

March 2007

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LIST OF ACRONYMS

AFB	Air Force Base
AFRPA	Air Force Real Property Agency
AST	aboveground storage tank
BRAC	Base Realignment and Closure
BCT	BRAC Cleanup Team
BTC	Belton Training Complex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Constituent of Concern
DCA	dichloroethane
DCE	dichloroethene
DoD	Department of Defense
ECS	Evaluation and Consolidation Study
EE/CA	Engineering Evaluation/Cost Analysis
EO	Executive Order
FUDS	Formerly Used Defense Site
GSA	General Services Administration
IRA	interim remedial action
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
KCAD	Kansas City Aviation Department
LTM	Long-Term Monitoring
LUC	land use control

MCL	Maximum Contaminant Level
MDNR	Missouri Department of Natural Resources
MOA	Memorandum of Agreement
MRBCA	Missouri Risk-Based Corrective Action
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
NFRAP	no further response action planned
OU	operable unit
OWS	oil-water separator
PA	preliminary assessment
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
POL	petroleum, oil, and lubricants
PRG	preliminary remediation goal
RAO	Remedial Action Objective
RI	remedial investigation
ROD	record of decision
SI	site inspection
SVOC	semivolatile organic compound
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TPH-DRO	total petroleum hydrocarbons-diesel range organics
TPH-GRO	total petroleum hydrocarbons-gasoline range organics
EPA	United States Environmental Protection Agency

USACE	United States Army Corps of Engineers
USAF	United States Air Force
USAR	United States Army Reserves
USMC	United States Marine Corps
UST	underground storage tank
VOC	volatile organic compound

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name ***(from WasteLAN)***: Richards Gebaur Air Force Base		
EPA ID ***(from WasteLAN)***: MO9571824292		
Region: 7	**State:** MO	**City/County:** Belton / Cass
SITE STATUS		
NPL status: ☐ Final ☐ Deleted ☒ Other (specify): Not on the NPL		
Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☐ Complete		
Multiple OUs?* ☒ YES ☐ NO	**Construction completion date:** 09 / 23 /2004	
Has site been put into reuse? ☒ YES ☐ NO		
REVIEW STATUS		
Lead agency: ☐ EPA ☐ State ☐ Tribe ☒ Other Federal Agency Air Force Real Property Agency (AFRPA)		
Author name: Chris Morriss		
Author title: BRAC Environmental Coordinator (BEC)	**Author affiliation:** AFRPA	
Review period:** 08 /01 /2002 to 08/01 /2007		
Date(s) of site inspection: 08 / 2005		
Type of review: ☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☒ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☒ 1 (first) ☐ 2 (second) ☐ 3 (third) ☐ Other (specify) _____		
Triggering action: ☐ Actual RA Onsite Construction at OU #____ ☐ Actual RA Start at OU#____ ☐ Construction Completion ☐ Previous Five-Year Review Report ☒ Other (specify) Implementation of Land Use Controls at OUs 1 and 2		
Triggering action date ***(from WasteLAN)***: 08 / 01 / 2002		
Due date ***(five years after triggering action date)***: 08 / 01 / 2007		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

The Record of Decision (ROD) for OUs 1 and 2 was signed in September 2004 and selected land use controls (LUCs) as the final remedy at Sites FT002, SS003, SS006, SS009, SS012, ST005, and ST011. The following are findings based on the evaluation conducted as part of this Five-Year Review:

--The LUC remedy remains effective and protective of human health and the environment at all seven sites.

--LUCs are no longer required at OU-1 Sites FT002 and ST005.

--Groundwater contamination has remained within the established LUC boundaries at Sites SS003, SS006, SS009, SS012, ST005, and ST011 for the past 5 years.

--The concentration of TCE in upgradient monitoring well MW008 at Site SS003 has exceeded the MCL for the multiple sampling events.

--The concentration of TCE in perimeter monitoring well MW021 at Site SS006 exceeded the MCL during the April 2006 sampling event.

--Groundwater plumes at Sites SS009, SS012, ST005, and ST011 have remained generally stable over the last two years of semiannual monitoring. Although concentrations of contaminants have increased in individual monitoring wells at these sites, the monitoring well locations are located in the interior of the plumes. Downgradient perimeter monitoring wells do not exhibit increases in concentration that would imply that the plumes are unstable or expanding.

Recommendations and Follow-up Actions:

Based on these findings, the follow-up actions listed below should be implemented at the former Richards-Gebaur AFB:

--An Explanation of Significant Differences (ESD) should be completed for OU-1 to change the remedial action objectives (RAOs) and remedial action cleanup goals (RACGs) to reflect the new Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks (January 2004) and update memorandum dated March 2005. Based on these changes, the remedy for OU-1 can be changed from LUCs prohibiting residential use of the property and excavation of contaminated soil to No Further Action (NFA).

--A new monitoring well should be installed upgradient of Site SS003.

--In accordance with the Long-Term Monitoring (LTM) Plan decision logic, the frequency of groundwater monitoring at Sites SS003, SS009, SS012, ST005, and ST011 should be reduced to annual. However, monitoring frequency at the new upgradient SS003 monitoring well should be semiannual until it satisfies the decision logic in the LTM plan. In addition, monitoring frequency at Site SS006 should remain at semiannual because increases in contaminant concentrations at perimeter monitoring wells were observed during the April 2006 monitoring event. These increases indicated potential plume expansion that should be more closely monitored.

--A revised vapor intrusion risk evaluation should be conducted after a new TCE toxicity factor is approved by EPA. In order to ensure that this revised risk evaluation is representative of site conditions, the exposure point concentration should be based upon EPA's reasonable maximum concentration or the 95th percent upper confidence limit of wells within an area of the site representing a current or hypothetical future building footprint.

Protectiveness Statement(s):

The LUC remedy remains protective of human health and the environment at OU-1 (i.e., soil sites FT002 and ST005). However, based on the updated risk evaluation in the five year review, the residual soil contamination at these soil sites does not pose a risk to either current commercial/industrial workers or potential future residents. As

a result, the LUCs established in the ROD for OU-1 are no longer necessary and an Explanation of Significant Differences (ESD) is recommended.

The LUC remedy at OU-2 (i.e., groundwater sites SS003, SS006, SS009, SS012, ST005 and ST011) is protective of human health and the environment for current and potential future receptors.

Other Comments:

None.

EXECUTIVE SUMMARY

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that all remedies selected under CERCLA § 121 (remedies resulting in hazardous substances, pollutants, or contaminants remaining at the site), be subject to a five-year review. Executive Order 12580 delegated CERCLA remedial responsibilities, including five-year reviews, to the Secretary of Defense, with respect to releases from any facility or vessel under the jurisdiction, custody, or control of the Department of Defense (DoD). At the former Richards-Gebaur Air Force Base (AFB), MO, certain remedial actions are being performed in accordance with CERCLA that require five-year reviews to verify that previously implemented remedies remain protective of human health and the environment.

This Five-Year Review constitutes the first required review/reporting cycle for the former Richards-Gebaur AFB. Based on this review, the selected remedies for operable units (OUs) 1 and 2 remain protective of human health and the environment and are anticipated to remain protective in the future.

The report addresses seven sites:

- OU-1 Basewide Soil
  - FT002–Fire Training Area
  - ST005–Petroleum, Oil, and Lubricants (POL) Yard
- OU-2 Basewide Groundwater
  - SS003–Oil Saturated Area
  - SS006–Hazardous Materials Storage Area
  - SS009–Fire Valve Area
  - SS012–Communications Facility
  - ST005–POL Yard
  - ST011–UST 620A

The Record of Decision (ROD) for OUs 1 and 2 was completed in 2004 and selected land use controls (LUCs) as the final remedy at all the above seven sites. The following are findings based on the evaluation conducted as part of this Five-Year Review:

- The LUC remedy remains effective and protective of human health and the environment at all seven sites.

- LUCs are no longer required at OU-1 Sites FT002 and ST005.
- Groundwater contamination has remained within the established LUC boundaries for the past 5 years.
- Groundwater plumes at Sites SS009, SS012, ST005, and ST011 have remained generally stable over the last two years of semiannual monitoring. Although concentrations of contaminants have increased in individual monitoring wells at these sites, the monitoring well locations are located in the interior of the plumes. Downgradient perimeter monitoring wells do not exhibit increases in concentration that would imply that the plumes are unstable or expanding.

Based on these findings, the follow-up actions listed below should be implemented at the former Richards-Gebaur AFB:

- An Explanation of Significant Differences (ESD) should be completed for OU-1 to change the remedial action objectives (RAOs) and remedial action cleanup goals (RACGs) to reflect the new Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks (January 2004) and update memorandum dated March 2005. Based on these changes, the remedy for OU-1 can be changed from LUCs prohibiting residential use of the property and excavation of contaminated soil to No Further Action (NFA).
- In accordance with the Long-Term Monitoring (LTM) Plan decision logic, the frequency of groundwater monitoring at Sites SS003, SS009, SS012, ST005, and ST011 should be reduced to annual. However, monitoring frequency at the new upgradient SS003 monitoring well should be semiannual until it satisfies the decision logic in the LTM plan. In addition, monitoring frequency at Site SS006 should remain at semiannual because increases in contaminant concentrations at perimeter monitoring wells were observed during the April 2006 monitoring event. These increases indicated potential plume expansion that should be more closely monitored.
- A revised vapor intrusion risk evaluation should be conducted after a new TCE toxicity factor is approved by EPA. In order to ensure that this revised risk evaluation is representative of site conditions, the exposure point concentration should be based upon EPA's reasonable maximum concentration or the 95th percent upper confidence limit of wells within an area of the site representing a current or hypothetical future building footprint.

FORMER RICHARDS-GEBAUR AIR FORCE BASE (AFB)
KANSAS CITY, MISSOURI
FIRST FIVE-YEAR REVIEW REPORT

1.0 INTRODUCTION

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that all remedies selected under CERCLA § 121, which result in hazardous substances, pollutants, or contaminants remaining at the site, be subject to a five-year review. The purpose of the five-year review is to determine whether the remedies at a site remain protective of human health and the environment. The five-year review report documents the methods, findings, and conclusions of the protectiveness evaluation; identifies issues found during the review, if any; and provides recommendations to address the issues.

The United States Air Force Real Property Agency (AFRPA) prepared this five-year review pursuant to CERCLA §121, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and Executive Order (EO) 12580. CERCLA §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 the 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.*

EO 12580 establishes the Department of Defense (DoD) as the CERCLA lead agency for environmental restoration sites at their facilities. EO 12580 states:

> *The functions vested in the President by Sections 104(a), (b), and (c)(4), 113(k), 117(a) and (c), 119, and 121 of the Act (i.e., CERCLA) are delegated to the Secretaries of Defense and Energy, with respect to releases or threatened releases where either the release is on or the sole source of the release is from any facility or vessel under the jurisdiction, custody, or control of their departments.*

The NCP further establishes the lead agency's responsibility to conduct five-year reviews at CERCLA remedial action sites. The NCP [40 CFR §300.430(f)(4)(ii)] states:

> *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.*

As the lead agency, the United States Air Force (USAF) is responsible for conducting five-year reviews at their installations and this responsibility is delegated to the AFRPA at installations that have been closed in accordance with Base Realignment and Closure (BRAC) actions.

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 Force 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. Since 1994, the environmental cleanup and property disposal at the former base has been the responsibility of the AFRPA, its predecessor organization the Air Force Base Conversion Agency (AFBCA), and the Army Corps of Engineers. The installation's operational history is summarized in the table below.

Table 1-1 History of Installation Operations

Period	Type of Operations	Defense Systems Supported	Hazardous Substance Activities
Prior to 1941	Agriculture, Pasture, Undeveloped	None	None
1941 – 1952	Grandview Airport	None	General civilian aircraft maintenance
1952 – 1970	Aerospace Defense Command	F-86, F-102, and F-106 fighters; C-46, C-119, and C-124 cargo aircraft	Aircraft maintenance, munitions storage, bulk fuel storage, fuel hydrant system, fire protection training
1970 – 1977	Air Force Communications Service	C-130 cargo aircraft (1971)	Same as above except hazardous waste generation was reduced by half
1977 – 1980	Military Airlift Command	C-130 cargo aircraft	Same as above except fuel hydrant system decommissioned
1980 – 1982	Air Force Reserve 442nd Airlift Wing	C-130 cargo aircraft	Same as above except fewer personnel
1982 – 1994	Air Force Reserve 442nd Fighter Wing	A-10 Thunderbolt II fighter aircraft	Same as above except fire training ceased in 1989 and hazardous waste generation was again reduced by half
1985 - 1999	Municipal Airport	None	General civilian aircraft maintenance
1994 – Present	AFBCA/AFRPA	None	None

The former Richards-Gebaur AFB originally encompassed approximately 2,400 acres. In 1980, prior to BRAC, about 80 percent of the installation property was declared excess to USAF needs and transferred to the General Services Administration (GSA). Most of this property was transferred to the Cities of Kansas City and Belton in August 1985 via public benefit conveyance.

Richards-Gebaur AFB 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. 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 (BTC), located approximately four miles south of the cantonment area. The BTC is largely undeveloped land formerly used for Air Force training exercises.

The AFRPA assumed responsibility for environmental restoration of the 429 acres at the time of base closure (1994). This property is divided into the following two operable units (OUs) for the purposes of environmental investigation and remediation:

- OU-1 – Basewide Soil
- OU-2 – Basewide Groundwater

The environmental restoration of property that was transferred from USAF control in 1985, prior to BRAC and the 1986 Superfund Amendments and Reauthorization Act (SARA), is addressed under the Formerly Used Defense Sites (FUDS) Program. This property comprises OU-3 – FUDS Sites, which has been addressed separately by the U.S. Army Corps of Engineers (USACE) under the FUDS program throughout the remedial process.

In addition, the U.S. Army Reserves (USAR) and the U.S. Marine Corps (USMC) have assumed ownership and responsibility for environmental restoration activities on two other portions of the former base property.

- The 185-acre BTC (i.e., Parcel M) was transferred to the USAR in 1999. The USAF retained responsibility for environmental restoration activities on the BTC property, also known as IRP Site XO010, under the requirements of a Memorandum of Agreement (MOA) through completion and approval of No Further Response Action Planned (NFRAP) documentation in November 2003, at which time the USAR assumed responsibility for all environmental programs associated with the property .
- Approximately 48 acres of the 244 acre cantonment area (i.e., Parcels B, D, I, and O) were transferred to the USMC in 2005. The USAF retained

responsibility for environmental restoration activities on this property under the requirements of an MOA through September 30, 2006, after which the USMC assumed responsibility for ongoing environmental restoration activities.

As a result, the AFRPA is currently responsible for environmental restoration issues related to past USAF activities on approximately 196 acres of the original cantonment area property.

This five-year review was conducted by AFRPA in accordance with their responsibilities as CERCLA lead agency at the former Richards-Gebaur AFB. The review was conducted between August 2005 and June 2006 and is the first five-year review for the former Richards-Gebaur AFB. It addresses residual contamination sites in OUs 1 and 2. The five-year review for OU-3 will be conducted separately by the USACE.

The report is structured to address all applicable elements identified in Exhibit 3-3, Contents of a Five-Year Review Report, of the Comprehensive Five-Year Review Guidance (EPA, June 2001). The following table identifies the location of each recommended element within the report.

Table 1-2 Five-Year Review Report Organization

Report Element	Operable Unit 1	Operable Unit 2
Introduction	Section 1	
Five-Year Review Process	Section 2	
Scope and Applicability[1]	Section 3	
Background	Section 4.1	Section 5.1
Site Chronology	Section 4.2	Section 5.2
Remedial Actions	Section 4.3	Section 5.3
Technical Assessment	Section 4.4	Section 5.4
Issues	Section 4.5	Section 5.5
Recommendations and Follow-Up Actions	Section 4.6	Section 5.6
Protectiveness Statement(s)	Section 4.7	Section 5.7
Progress Since Last Review[2]	Not applicable	
Summary and Conclusions[3]	Section 6	
Next Review	Section 7	

[1] This section is not required by the guidance but was added to clarify the scope and applicability of the review
[2] This section is not applicable for the first five-year review. No prior reviews or protectiveness determinations have been made.
[3] This section is not required by the guidance but was added to summarize the conclusions/recommendations across both OUs.

2.0 FIVE-YEAR REVIEW PROCESS

2.1 Notification of Potentially Interested Parties

Parties to most likely have a significant interest in the five year review process and results were identified at the outset of the review, notified that the review was being initiated, and solicited for input on the review process. The primary stakeholders include:

- Regulatory Agencies – U.S Environmental Protection Agency (EPA) Region 7 and the Missouri Department of Natural Resources (MDNR).
- Affected Property Owners – The City of Kansas City, Missouri and USMC.

On March 2, 2006, representatives of the AFRPA met with these primary stakeholders, briefed them on the USAF's approach and process for the review, and presented a draft outline of the five-year review report.

2.2 Identification of Five-Year Review Team Members

The AFRPA conducted the five-year review, in accordance with their role as the CERCLA lead agency for the former Richards-Gebaur AFB, with technical support from Booz Allen Hamilton (Booz Allen).

- Mr. Chris Morriss, AFRPA, was the team leader. He provided oversight of all aspects of the review and approved the final five-year review report.
- Mr. Eric Holder, Booz Allen, was the technical lead for the review. He managed the day-to-day activities of the review and led the protectiveness evaluation and development of technical recommendations.
- Mr. Ed Baker and Mr. John Belin, Booz Allen, provided technical support for the review. Mr. Baker has supported the Installation Restoration Program (IRP) at the former Richards-Gebaur AFB for the past seven years. He provided historical context for the review as well as chemistry and hydrogeology expertise. Mr. Belin is a risk assessor and provided technical support for the remedy protectiveness evaluation.

EPA and MDNR provided regulatory oversight of the five-year review. In this capacity, they provided input and guidance during the five-year review process and reviewed and provided comments on the report.

2.3 Components and Schedule of the Five Year Review

CERCLA remedial action began at the former Richards-Gebaur AFB on October 9, 2001, with the initiation of the interim remedial action (IRA) at IRP Site FT002—Fire Training Area. On August 1, 2002, land use controls (LUCs) were implemented for OU 1 and 2 Sites SS003, SS006, SS009, SS012, FT002, ST005, and ST011 to prevent unacceptable exposure to contaminated soil and groundwater at the sites. These LUCs later became the principle component of the final remedy for OUs 1 and 2 and this action is the trigger for the five-year review and requires completion of the first five-year review report on or before August 1, 2007. Site inspections were conducted at the five-year review sites in August 2005, as part of the annual basewide groundwater and land use control (LUC) monitoring program. Document review, data evaluation, and protectiveness determinations were conducted between March and June 2006.

2.4 Document Review

The following documents provided the primary basis for the five year review:

- Final Evaluation and Consolidation Study (ECS), CH2M Hill, 1999
- Final Basewide Remedial Investigation (RI) Report, CH2M Hill, 2001
- Final Basewide RI Report Addendum, CH2M Hill, 2002
- Final Interim Action Report for Soils and Sediments (OU 1), CH2M Hill, 2003
- Final Record of Decision (ROD) (OUs 1 and 2), CH2M Hill, 2004
- LUC Management Plan, Booz Allen, 2004
- Final Long-Term Monitoring Plan for Groundwater (Operable Unit 2), CH2M Hill, 2005
- Final 2005 Annual Long-Term Monitoring (LTM) Report for Groundwater (OU 2), CH2M Hill, 2006

These documents define the nature and extent of contamination that was identified in OUs 1 and 2; describe the extent of soil excavation conducted as part of completed IRAs; define residual contamination that remains in place at concentrations exceeding unrestricted use and unlimited exposure criteria; and describe the final remedy selected to address the residual contamination. This information provides the basis for the five-year review.

2.5 Data Review and Evaluation

The data review focused on residual soil contamination that was not removed during previously competed IRAs and groundwater sampling results from the October 2000 through August 2005 long-term groundwater monitoring events. Additional groundwater monitoring data from the April 2006 monitoring event also became available after completion of the initial five-year review evaluation. This data was also evaluated to determine whether any changes in contaminant distribution had a significant affect on the original conclusions and recommendations of the five-year review. Significant changes were observed in the April 2006 groundwater data, as described in Section 5, and the report's conclusions and recommendations were modified accordingly. Residual soil contamination data included samples that were collected during the basewide RI from locations that were not later excavated during the subsequent IRAs as well as confirmation samples collected upon completion of the IRAs.

2.6 Community Notification

A public notice announcing initiation of the five-year review was published in the Southland Edition of the Kansas City Star on December 1, 2005 (Appendix A).

2.7 Other Community Involvement Activities

The final five-year review report will be placed in the information repository at the Grandview Mid-Continent Public Library. A second public notice will be published announcing the completion of the five-year review and its availability at the library. Additional community involvement activities are not planned as part of this five-year review due to lack of community interest. 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.

2.8 Site Inspections

Site inspections were conducted in August 2005 by CH2M Hill, as part of the annual LUC monitoring program and will continue to be conducted until the remedial action objectives (RAOs) established in the ROD for OUs 1 and 2 are met. Copies of the inspection checklists are included in Appendix B of the 2005 Annual LTM Report. Additional site inspections were not deemed necessary for the five-year review.

2.9 Site Interviews

Formal interviews were not conducted as part of this five-year review. Key members of the five-year review team have more than seven years experience overseeing environmental restoration activities at the former Richards-Gebaur AFB, including all phases of the RI, IRAs, RODs, and LTM/LUC programs on which this five-year review was based. As a result, no significant data gathering was necessary regarding the site usage or restoration history.

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 and regulatory requirements at project meetings on March 2 and May 18, 2006, both of which were attended by representatives of the key stakeholders (AFRPA, EPA, MDNR, USMC, and the City of Kansas City).

2.10 Protectiveness Determination for Each OU

Protectiveness determinations were conducted for OUs 1 (Basewide Soil) and 2 (Basewide Groundwater) in accordance with EPA's Comprehensive Five-Year Review Guidance (EPA 540-R-01-007), which recommends answering the following three questions when assessing the protectiveness of a remedy.

- Is the remedy functioning as intended by the decision document?
- Are the exposure assumptions, toxicity data, and remedial action objectives (RAOs) that were used at the time of remedy selection still valid?
- Has any other information come to light that could call into question the protectiveness of the remedy?

Sections 4 and 5 provide answers to these protectiveness questions, site-specific supporting information, recommendations and follow-on actions, and protectiveness statements for each OU.

3.0 SCOPE AND APPLICABILITY

This five-year review addresses OUs 1 and 2 at the former Richards-Gebaur AFB, Missouri. As described in Section 1, OU-3 has been addressed separately from OUs 1 and 2 under the FUDS program throughout the remedial process. The USACE will conduct a separate five-year review for OU-3.

3.1 Sites Addressed by the Five-Year Review

Seven IRP sites at the former Richards-Gebaur AFB have residual contamination remaining in place at concentrations that exceed the remedial action cleanup goals (RACGs) established in the ROD for OUs 1 and 2. These RACGs are conservative cleanup goals that are protective of residential reuse and representative of unlimited use/unrestricted exposure criteria. Constituents of concern (COCs) at the former Richards-Gebaur AFB include total petroleum hydrocarbons (TPH) in soil and tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE), and/or vinyl chloride in groundwater. Table 3-1 lists these residual contamination sites and identifies their associated operable units, COCs, and RACGs.

Table 3-1 Summary of Sites Addressed by the Five-Year Review

Site ID	Operable Unit	COCs in Soil	COCs in Groundwater				
		TPH	PCE	TCE	cis 1,2-DCE	1,1-DCE	Vinyl Chloride
FT002–Fire Training Area	1	✓					
ST005–Petroleum, Oils, and Lubricants (POL) Yard	1 & 2	✓		✓			✓
SS003–Oil Saturated Area	2			✓			
SS006–Hazardous Materials Storage Area	2			✓	✓	✓	✓
SS009–Fire Valve Area	2		✓	✓	✓	✓	✓
SS012–Communications Facility	2			✓			✓
ST011–Underground Storage Tank (UST) 620A	2			✓			✓
Remedial Action Cleanup Goal (RACG)		**200**	**5**	**5**	**70**	**7**	**2**
Units		**mg/kg**	**µg/L**				

In addition, during the August 2005 sampling event, 1,2-dichloroethane (DCA) was detected at Sites SS003 and SS009 and trichlorofluoromethane (Freon 11) was detected at Site ST005. In each instance, these new constituents were detected at locations within the existing plume (i.e., not at perimeter monitoring wells) at concentrations near or below the maximum contaminant level (MCL) or other applicable health-based criteria. As a result, their emergence as contaminants warrants further evaluation, but does not pose a significant concern with regard to the overall protectiveness of the remedy.

3.1.1 Operable Unit 1 Sites

As Table 3-1 indicates, two IRP sites (i.e., FT002 and ST005) at the former Richards-Gebaur AFB have residual soil contamination at concentrations greater than the RACGs established in the ROD. The majority of the contamination at both sites was removed during previous IRAs. The residual soil contamination at these sites is limited to TPH contamination that remained after completion of all IRA excavations. A detailed description and evaluation of these sites is presented in Section 4.

3.1.2 Operable Unit 2 Sites

As shown in Table 3-1, six sites (i.e., SS003, SS006, SS009, SS012, ST005, and ST011) remain at the former Richards-Gebaur AFB, with PCE, TCE, DCE, and/or vinyl chloride in groundwater at concentrations that exceed the RACGs. No remaining source contamination has been identified in soil at these sites, and the nature and extent of groundwater contamination varies significantly from site to site. However, in all cases, the extent of contamination is confined to a relatively small area and has remained within LUC boundaries during the last five years of monitoring. A detailed description and evaluation of these sites is presented in Section 5.

3.2 Sites Not Addressed by the Five-Year Review

Five-year reviews are only required for sites that are being addressed under CERCLA where contamination remains in place at concentrations that exceed unrestricted use and unlimited exposure criteria.

The majority of the environmental restoration sites at the former Richards-Gebaur AFB have been closed because either no significant contamination was identified at the site or because it was removed during subsequent IRAs. The BRAC Cleanup Team (BCT) has signed NFRAP decision documents for these sites to formally document their closure. The BCT is comprised of representatives from AFRPA, EPA, and MDNR. Tables 3-2 and 3-3 summarize the completed CERCLA phases and NFRAP signature dates for closed IRP and non-IRP sites respectively.

In addition, petroleum contamination sites are exempt from CERCLA and do not require five-year reviews. The majority of the petroleum program sites (e.g.,

underground storage tanks [USTs]) have been closed in accordance with MDNR requirements. Active petroleum sites are discussed in Section 3.2.2.

3.2.1 Previously Closed Sites

IRP Sites XO001, SS004, ST007, SS008, and OT010 were investigated as part of the basewide RI, and Sites XO001, SS004, and SS008 were determined to require no further action (NFA) because no significant contamination was identified at concentrations greater than residential screening criteria. NFRAP decision documents were signed by the BCT for IRP Sites XO001, SS004, and SS008 in August 2002. The NFRAP for Site XO001 was amended after additional investigation was conducted and resigned by the BCT in November 2003.

IRA options were evaluated for Sites ST007 and OT010 in an Engineering Evaluation/Cost Analysis (EE/CA) that was completed in 2001. Contaminated soil was subsequently excavated from the sites and disposed of at a permitted offsite landfill as part of an IRA that was completed in 2003. Both sites were determined to require NFA based on confirmation sample results collected after the IRA. NFRAP decision documents were signed by the BCT for IRP Site OT010 in August 2003 and Site ST 007 in November 2003.

Table 3-2 Summary of Closed IRP Sites

Site ID	RI	EE/CA	IRA	Closure	Date
XO001 – Belton Training Complex	✓			NFRAP	November 2003
SS004 – Hazardous Waste Drum Storage Area	✓			NFRAP	August 2002
ST007 – Former Underground Storage Tank Area	✓	✓	✓	NFRAP	November 2003
SS008 – Test Cell Area	✓			NFRAP	August 2002
OT010 – Small Arms Firing Range	✓	✓	✓	NFRAP	August 2003

Non-IRP sites, identified in Table 3-3 below, were evaluated, investigated, and remediated in parallel with the IRP sites. As a result of the site evaluations conducted as part of the ECS, NFRAP decision documents were signed by the BCT for Sites AOC004, AOC005, and AOC009 in October 1998. Sites AOC001, AOC002, AOC010, CS001, and CS002 were investigated as part of the Basewide RI. NFRAP decision documents were signed by the BCT for Sites AOC010, CS001, and CS002, in August 2002 based on the results of the basewide RI, which indicated no significant contamination was present.

Sites AOC001 and AOC002 were found to have contaminated sediment during the basewide RI. They were further evaluated as part of the EE/CA and the contaminated

sediment was removed during the IRA in 2002. NFRAP decision documents were signed by the BCT for Sites AOC001 and AOC002 in August 2003.

AOC012, AOC012A, and CS003 were addressed by separate investigations (i.e., not part of the Basewide RI) and removal actions. The BCT approved closure reports for each of these sites and signed NFRAP decision documents for Sites AOC012, AOC012A, and CS003 in November 2003.

Table 3-3 Summary of Closed Non-IRP Sites

Site ID	RI	EE/CA	IRA	Closure	NFRAP Date
AOC001 – Central Drainage Area	✓	✓	✓	NFRAP	August 2003
AOC002 – North Drainage Pond	✓	✓	✓	NFRAP	August 2003
AOC004 – Stressed Vegetation at Building 603				NFRAP	October 1998
AOC005 – Stressed Vegetation at Building 918				NFRAP	October 1998
AOC009 – Steamline Bleeder Release				NFRAP	October 1998
AOC010 – Building 918 Parking Lot	✓			NFRAP	August 2002
AOC012 – Fuel Hydrant Line				NFRAP	November 2003
AOC012A – Industrial Waste Line				NFRAP	November 2003
CS001 – Fuel Line - 942 Section	✓			NFRAP	August 2002
CS002 – OWS at Building 704	✓			NFRAP	August 2002
CS003 – OWS 9470 A&B				NFRAP	November 2003

3.2.2 Active Petroleum Program Sites

Residual petroleum hydrocarbon contamination remains in soil at the following two non-IRP sites.

Facility 1025 – Air Traffic Transceiver: This facility is located at the northernmost property boundary of the base, immediately south of the Highway 150 right-of-way. It consists of a small, single-story building that housed electronic communications equipment. The facility is situated on a level, grass-covered site that dips to the north towards Highway 150. Two USTs were located on the east side of the building. UST 1025A was a 550-gallon tank that supplied heating oil to the furnace in the building, and UST 1025B was a 275-gallon tank that supplied diesel fuel for a standby generator. Both were installed in 1953 when the facility was constructed. UST 1025A was replaced in 1968 by UST 1025C, which was a 1,000-gallon heating oil tank.

AOC006 – Tarmac Area : This site was part of the aircraft refueling system, which was installed in 1954. The site is located on the west side of Hangar Road, immediately west

of the fire station (Facility 900) and the control tower (Facility 901). The site consisted of underground piping that led from the Liquid Fuel Pump Station at Facility 902 (also known as IRP Site ST007) to six control boxes located adjacent to the aircraft apron. Piping led from the control boxes to six fuel hydrants located approximately 50 feet to the west, beneath the aircraft apron. The three northernmost fuel hydrants are located on BRAC property and are included in AOC006. The three southernmost fuel hydrants are located on previously transferred property and are being addressed under the FUDS program, so they are not included in AOC006.

Contamination at the above sites is limited to petroleum hydrocarbons that are being addressed under the MDNR petroleum program. Therefore, they are not subject to CERCLA five-year review requirements. However, both sites were evaluated in parallel with IRP soil contamination sites FT002 and ST005 to determine whether ongoing imposition of LUCs remains necessary. This evaluation and associated recommendations are included in Appendix E.

4.0 OPERABLE UNIT 1 – BASEWIDE SOIL

OU-1 was established to address all soil contamination issues on the 429 acres of land remaining under Air Force control at the time of base closure in 1994. Historically, there were several sites at the installation where soil was contaminated with petroleum hydrocarbons and one site, OT010–Small Arms Firing Range, where soil was contaminated with lead. As described in Section 3.2, the majority of these sites were remediated to residential reuse levels and NFA was required. When the ROD was finalized for OU-1 in 2004, only two IRP sites remained with soil contamination at concentrations exceeding unrestricted use and unlimited exposure criteria:

- FT002–Fire Training Area
- ST005–Petroleum, Oil, and Lubricants (POL) Yard

This section of the Five-Year Review evaluates the protectiveness of the remedy at these two OU-1 sites.

4.1 Background

FT002 – Fire Training Area: The site is located in the northern part of the former Richards-Gebaur AFB, north of the former crosswind runway, and several hundred feet inside the former northern boundary of the base along Highway 150. The site location is shown on Figure 2-2 in Appendix B-1. The site was constructed in 1965 for fire department training and the storage of combustible materials. From 1965 to 1969, waste oils, solvents, and fuels were routinely stored on site and burned in an unlined pit.

The site was upgraded in 1969 with a 100-foot diameter inwardly sloping concrete slab with a six-inch retaining curb around the perimeter to contain combustible fuel. JP-4 fuel was stored in a 5,000-gallon above-ground storage tank (AST) located southwest of the pad, and was pumped onto the pad via underground piping, where it was burned and extinguished for fire department training. A drain in the center of the pad collected liquid residues after the training exercise and conveyed them to an oil-water separator (OWS) located about 50 feet east of the pad, which discharged to ground surface further to the east. The site layout is shown on Figure 2-4 in Appendix B-1.

Fire training exercises at the site were discontinued in 1988. The AST was removed at that time, the OWS was closed in place by filling with concrete, and it's associated holding tank was removed. The buried fuel and drain lines were cleaned, flushed, and vented in 1996.

ST005 – POL Yard: The site is a former AST farm located east of the flight line and west of Andrews Road as shown on Figure 2-2 in Appendix B-1. The POL Yard began operation in 1954 as the main receiving, storage, and dispensing facility for various

fuels, oils, and lubricants used by the base and its support services. The POL Yard ceased operation in 1994.

Primary site features included:

- Three large ASTs, ranging in capacity from 187,000 to 260,000 gallons, that were used to store aviation gasoline (AVGAS), jet fuel (JP-4), and heating oil.
- Two pump houses that operated to fill the ASTs and distribute fuel from the ASTs to other locations on the base.
- Truck and rail car loading/unloading facilities.

A fourth large AST and associated pump house were also present in the POL Yard. However, they were transferred to the Kansas City Aviation Department (KCAD) in 1985. As such, they were not considered to be part of Site ST005 and were addressed separately by the USACE under the FUDS program.

The POL Yard ceased operation in 1994 and was decommissioned in 1996. The majority of the structures, including the three ASTs, two pump houses, and the truck/rail car loading/unloading facilities, were demolished and removed from the site at that time.

4.2 Site Chronology

FT002—Fire Training Area: The site was initially investigated in 1986 and again in 1989. During these investigations soil was analyzed for the presence of TPH, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals and no significant soil contamination was identified.

Site FT002 was further investigated during an RI in 1999 and an RI Addendum in 2000. A total of 71 soil samples were collected from 27 borings and the analyte list was expanded to investigate the presence of PCBs and dioxins/furans. These investigations identified a sizeable area of petroleum-contaminated soil in the vicinity of the concrete burn pad, underground piping, and OWS.

In 2001, approximately 6,569 cubic yards of contaminated soil was excavated from the site and disposed of at an approved off-site landfill. Remaining site structures, including the concrete burn pad, underground piping, and OWS, also were removed and the site was backfilled and re-graded. After completion of the IRA, approximately 170 cubic yards of residual petroleum-contaminated soil was estimated to remain at the site at depths of up to 18.5 feet below ground surface (bgs). Table 4-1 summarizes sample locations where soil contamination remains at Site FT002, and Figure 2-4 in Appendix B-1 shows the location of the residual contamination.

Table 4-1 Summary of Residual Soil Contamination at Site FT002

Sample Location	Depth Interval ft bgs	TPH-GRO (mg/kg)	TPH-DRO (mg/kg)	Total TPH (mg/kg)
FTA-B-W01D	3 - 6	4.14	430	434
FTA-G-W02D	3 - 6	0.58	290	291
SB-008	17.5 - 18.5	472	671	1,143
SB-025	17.5 - 18	20	425	445

ST005 – POL Yard: Extensive investigations were conducted at Site ST005 in 1986, 1989, 1991, and 1996. Over 350 soil samples were collected from across the site and analyzed for TPH, VOCs, SVOCs, and metals. The investigations identified extensive TPH contamination across the site, including approximately 10 percent of samples with concentrations greater than the commercial land use criterion of 500 mg/kg.

Site ST005 was further investigated during an RI in 1999 and an RI Addendum in 2000. A total of 240 additional soil samples were collected from 79 borings. Numerous areas of petroleum-contaminated soil were identified at locations across the site with the most significant contamination located along the southern portion of the site in the vicinity of the pump houses and truck and rail car loading/unloading area.

Between late 2001 and early 2002, all remaining structures were removed from the site, and approximately 20,164 cubic yards of petroleum-contaminated soil were excavated from twenty-five separate excavations and disposed of at an off-site landfill. After completion of the IRA, approximately 3,200 cubic yards of residual petroleum-contaminated soil were estimated to remain at the site. Table 4-2 summarizes sample locations where soil contamination remains at Site ST005, and Figure 2-5 in Appendix B-1 shows the location of the residual contamination.

Table 4-2 Summary of Residual Soil Contamination at Site ST005

Sample Location	Depth Interval (ft bgs)	TPH-GRO (mg/kg)	TPH-DRO (mg/kg)	Total TPH (mg/kg)
POL-F-W02D	3 - 12	32.32	350	382
POL-F-W04D	3 - 12	30	200	230
POL-H-W05D	3 - 12	544.5	160	705
POL-K-W02D	3 - 12	347.2	76	423
POL-L-F01	3 - 11	658.2	74	732
POL-L-W05D	3 - 11	788.1	88	876
POL-R-W04D	3 - 11	520	430	950

Sample Location	Depth Interval (ft bgs)	TPH-GRO (mg/kg)	TPH-DRO (mg/kg)	Total TPH (mg/kg)
POL-R-W05D	3 - 10	253	110	363
POL-S-W03D	3 - 10	446	280	726
POL-S-W06D	3 - 10	172	32	204
POL-U-W01D	3 - 10	33.9	230	264
POL-V-W06D	3 - 8	452	9.2	461
SB-001	15 - 17	649	27.24	676
SB-005	2 - 3	234	54	288
SB-027	7 - 8	24.1	300	324
SB-048	3 - 4	310	24.3	334
SB-048	7 - 8	199	4.49	203
SB-073	5 - 6	380	ND	380
954-1	4 - 6	-	-	369
954-6	2 - 4	-	-	202
955-1	0 - 2	-	-	256
955-2	6 - 7	-	-	887
955-3	0 - 2	-	-	337
955-4	0 - 2	-	-	487
955-9	8 - 10	-	-	366
957-9	0 - 2	-	-	226

4.3 Remedial Actions

As described above, the majority of the petroleum-contaminated soil at Sites FT002 and ST005 was excavated and disposed of at an approved off-site landfill during IRAs in 2001 and 2002. However, residual contamination was left in place at both sites that exceeded the residential RACG of 200 mg/kg and the commercial RACG of 500 mg/kg. Residual soil concentrations above the residential RACG occurred only in subsurface soils (i.e., ≥ 3 feet bgs) at FT002; however, at ST005, residual soil concentrations exceeded the residential RACG in both the surface (i.e., 0 - 3 feet bgs) and subsurface. Residual surface soil concentrations did not exceed the commercial RACG at either FT002 or ST005.

The ROD for OU-1 and OU-2 was signed in September 2004 and established the following remedial action objectives (RAOs) for OU-1:

- To remove the potential for residential exposure to soil containing petroleum hydrocarbons at concentrations exceeding MDNR's unrestricted land use criterion for TPH of 200 mg/kg.

- To remove the potential for worker exposure above the MDNR commercial-light industrial criterion of 500 mg/kg.

To accomplish these RAOs, LUCs were selected as the final remedy for OU-1. Restrictive covenants were placed in the Deed for the FT002 and ST005 property to perform the following actions:

- Preclude direct contact with (excavation of) the residually contaminated soil

- Prohibit residential use

- Require the property recipient to obtain approval from the Air Force, MDNR, and EPA for any proposals for a land use change that is inconsistent with the use restrictions and assumptions described in the ROD

The property was transferred to the City of Kansas City in 2005, and the Deed included the restrictive covenants described above. Figures 2-4 and 2-5 in Appendix B-1 show the LUC boundaries for Sites FT002 and ST005, respectively. Appendix C-1 includes a copy of the restrictive covenants from the Kansas City deed.

4.4 Technical Assessment

As part of the five-year review, OU-1 Sites FT002 and ST005 were reevaluated to ensure that remedies identified in the 2004 ROD remain protective of human health and the environment. The sites were reviewed to ensure that:

- 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

- No additional information has come to light that would call into question the protectiveness of the evaluation

Each of these issues is addressed separately below.

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

Yes. The LUCs required by the ROD (i.e., restrictive covenants prohibiting residential use of the property and excavation of contaminated soil) were included in the Deed at

the time of property transfer to the City of Kansas City. A LUC inspection was conducted in August 2005 in accordance with ROD requirements and no evidence was identified that would indicate that LUCs had been breeched. Neither Site FT002 nor Site ST005 is actively used for any purpose. Both sites remain undeveloped fields that have not been disturbed since completion of the IRAs in 2001. No residential use, excavation, or other activity inconsistent with the LUCs has occurred.

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

No. The exposure assumptions used in the ROD remain valid. Use of the Site FT002 and Site ST005 property remains very limited. Both sites consist of vacant grassy areas that are not actively used for any purpose, and surrounding land-use remains commercial-light industrial in nature. However, the conservative MDNR screening levels used to evaluate petroleum hydrocarbon contamination at the sites have been replaced by new risk-based corrective action guidance.

In March 2005, the MDNR promulgated a new approach to risk-based corrective action for managing petroleum releases, which is outlined in guidance from MDNR entitled *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* (January 2004) and in an update memorandum dated March 2005. This new approach incorporates tiered risk-based screening levels that are applicable to petroleum-contaminated sites at the former Richards-Gebaur AFB. Residual TPH contamination at Sites FT002 and ST005 was reevaluated based on this new guidance, as summarized below and described in greater detail in Appendix E.

FT002 – Fire Training Area: Table 4-3 provides a comparison of residual TPH concentrations at Site FT002 with the new MDNR Default Target Levels (DTLs). The maximum remaining concentration of TPH-diesel range organics (DRO) (i.e., 671 mg/kg) is less than the MDNR DTL of 4,140 mg/kg. The maximum remaining concentration of TPH-gasoline range organics (GRO) exceeded the MDNR DTL of 383 mg/kg at sample location SB-008 (472 mg/kg). Sample SB-008 was 17.5 to 18.5 feet below ground surface (bgs). As indicated in Table 4-3, the TPH-GRO concentration at this sample location was less than the MDNR Tier 1 Target Level for Residential Land Use for Type 2 Subsurface Soil (i.e., silty soil with moderate porosity and water content).

Table 4-3 Maximum Concentrations of COCs in Soil at Site FT002

COCs	Maximum Detected Concentration	MDNR Default Target Levels	MDNR Tier 1 Target Level Residential Land Use for Type 2 Soil	
			Surface	Subsurface
TPH-GRO	472	383	29,700	716
TPH-DRO	671	4,140	56,400	7,880

All units are mg/kg.
Shaded cells indicate concentrations that exceed MDNR Default Target Levels

Because maximum concentrations of COCs were less than relevant screening criteria, this reevaluation of the Site FT002 data indicates that residual soil contamination at the site does not pose a potential risk to either current commercial/industrial workers that may access the site or potential future residents. Based on this evaluation, no further action is required at Site FT002, and LUCs are not necessary.

ST005—POL Yard: Table 4-4 provides a comparison of residual TPH concentrations detected at Site ST005 with the new MDNR DTLs. The maximum concentration of TPH-DRO was detected at sample location POL-R-W04D (430 mg/kg), and does not exceed the MDNR DTL of 4,140 mg/kg. However, the concentration of TPH-GRO exceeded the MDNR DTL of 383 mg/kg at multiple sample locations, with the maximum concentration at sample location POL-L-W05D (788.1 mg/kg). This sample result also slightly exceeds the MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Subsurface Soil of 716 mg/kg. PAH data, specifically benzo(a)anthracene and benzo(a)pyrene, were also evaluated and no concentrations were identified that exceeded the MDNR DTLs.

Table 4-4 Maximum Concentrations of COCs in Soil at Site ST005

COCs	Maximum Detected Concentration		MDNR Default Target Levels	MDNR Tier 1 Target Level for Residential Land Use for Type 2 Soil	
	Surface	Subsurface		Surface	Subsurface
TPH-GRO	425	**788.1**	383	29,700	716
TPH-DRO	61.7	430	4,140	56,400	7,880

All units are mg/kg
Shaded cells indicate concentrations that exceed MDNR Default Target Levels
Bolded concentrations exceed the MDNR Tier 1 Target Level for Residential Land Use for Type 2 Soil

To more thoroughly evaluate residual TPH-GRO contamination at Site ST005, average and 95 percent upper confidence level (95% UCL) concentrations were calculated for TPH-GRO. These calculations used all 2002 confirmation sampling and 2001 remedial investigation data that exceeded the RACG of 200 mg/kg and were not excavated during interim remedial action activities. By including only those data points that

exceeded the RACG, the resulting average and 95% UCL TPH-GRO concentration substantially overestimates the mean concentration of TPH-GRO present at Site ST005. The average TPH-GRO concentration was 347.1 mg/kg, and the 95% UCL, calculated using a Student's T test, was 448.7 mg/kg. Both are significantly less than the MDNR Tier 1 Target Level for Residential Land Use for Type 2 Subsurface Soil of 716 mg/kg.

This reevaluation of the Site ST005 data indicates that residual soil contamination at the site does not pose a potential risk to either current commercial/industrial workers that may access the site or potential future residents. Based on this evaluation, no further action is required for soil at Site ST005, and LUCs addressing soil contamination are not necessary.

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

No. Based on discussions with the City of Kansas City , extensive redevelopment of the former Richards-Gebaur AFB is planned in the next few years, and the city has partnered with CenterPoint Properties and Hunt Midwest Enterprises to redevelop the property.

Redevelopment plans prepared by CenterPoint Properties include expansion of the existing intermodal center. Based on current redevelopment plans, the intermodal center will be expanded to ultimately consist of the following:

- A 497-acre International Freight Gateway leased by Kansas City Southern (KCS) for transfer of freight between rail and road transportation; and,
- A 900-acre Industrial Park, consisting of 5 to 6 million square feet of new facilities served by the railroad, including light manufacturing, warehouse, and distribution facilities.

These redevelopment plans include construction of new facilities, such as warehouses, in the vicinity of Sites FT002 and ST005. According to the ROD for OU-1, LUCs would prohibit excavation of contaminated soil at these sites during the redevelopment. However, as described above, the reevaluation of the RAOs for both sites indicates that the RAOs established in the ROD are overly conservative and the residual soil contamination at the sites does not pose a potential risk to either current commercial/industrial workers or potential future residents. As a result, none of the redevelopment plans would call into question the protectiveness of the remedy.

Hunt Midwest Enterprises plans to develop underground facilities beneath the former Richards-Gebaur AFB. These facilities would be constructed in limestone bedrock beneath the base and would not affect the residual contaminated soil at Sites FT002 and ST005. Therefore, they would have no effect on the protectiveness of the OU-1 remedy.

4.5 Issues

Based on the updated risk evaluation, the residual soil contamination at OU-1 Sites FT002 and ST005 does not pose a risk to either current commercial/industrial workers or potential future residents. As a result, the LUCs established in the ROD for OU-1 are no longer necessary.

4.6 Recommendations and Follow-Up Actions

An Explanation of Significant Differences (ESD) should be completed for OU-1 to change the RAOs and RACGs to reflect the new MRBCA Process for Petroleum Storage Tanks (January 2004) and update memorandum dated March 2005. Based on these changes, the remedy for OU-1 can be changed from LUCs prohibiting residential use of the property and excavation of contaminated soil to NFA. Following completion of the ESD, the restrictive covenants for contaminated soil at the OU-1 sites should be removed from the Kansas City deed and the LUC management plan should be revised to remove the LUC implementation and monitoring requirements for the OU-1 sites.

4.7 OU-1 Protectiveness Statement

The selected remedy for OU-1 remains protective of human health and the environment and is anticipated to remain protective in the future. Existing LUCs may be removed from OU-1 Sites FT002 and ST005 without compromising protectiveness. No further action is required at OU-1 sites to protect human health and the environment.

5.0 OPERABLE UNIT 2—BASEWIDE GROUNDWATER

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 at locations across the installation, and the following sites were found to have groundwater contaminated with chlorinated solvents, primarily PCE, TCE, DCE, dichloroethane (DCA), and vinyl chloride.

- SS003–Oil Saturated Area
- SS006–Hazardous Materials Storage Area
- SS009–Fire Valve Area
- SS012–Communications Facility
- ST005–POL Yard
- ST011–UST 620A

This section of the five-year review evaluates the protectiveness of the remedy at these six OU-2 sites.

5.1 Background

SS003—Oil Saturated Area: The site is located in the southern part of the former Richards-Gebaur AFB, south of 155th Street and southwest of Building 704. The site was used to store waste oil products generated by vehicle maintenance from the mid-1950s to the late 1980s. The site consists of a paved area in the southwest corner of the USMC motor pool parking area and extends to the southeast, into a grassy area beyond the southern edge of the pavement. The site location is shown on Figure 2-3, and the site layout is shown on Figure 2-6 in Appendix B-1.

SS006—Hazardous Materials Storage Area: The site is located in the central portion of the former installation, east of Hangar Road and north of 155th Street. The site lies off the northeast corner of Building 927 and extends down the grassy hillside behind the building. The site was the previous location of a hazardous materials storage rack for Building 927, which was used as an aircraft engine and propeller maintenance shop from 1957 to 1994. The site location is shown on Figure 2-3, and the site layout is shown on Figure 2-7 in Appendix B-1.

SS009—Fire Valve Area: The site is located in the central part of the former installation, on the southwest side of Building 605, near the intersection of Westover and Corkill Roads. Site SS009 was part of the Civil Engineering Complex and was in

use by the Air Force from 1955 until 1994. During this time, the building was used for various purposes, including a Carpenter Shop, Interior and Exterior Heat Shop, Roads and Grounds Shop, and Sanitation Shop. The USMC currently uses Building 605 for office space and adjacent areas for recreational equipment storage. The site location is shown on Figure 2-3, and the site layout is shown on Figure 2-8 in Appendix B-1.

SS012—Communications Facility: The site is located in the southeastern portion of the former installation on the northeast corner of the intersection of 155th Street and Maxwell Avenue. The site lies on the northeast side of Building 105, which operated as the base communications facility from 1954 to 1994. A 250-gallon UST was previously located on the north side of the building and was used to provide diesel fuel to a backup electric generator located inside Building 105. The site location is shown on Figure 2-3, and the site layout is shown on Figure 2-9 in Appendix B-1.

ST005—POL Storage Yard: As described in Section 4.1, the site is a former AST farm that operated from 1954 until 1994 as the main receiving, storage, and dispensing facility for various fuels, oils, and lubricants used by the base and its support services. The site location is shown on Figure 2-3, and the site layout is shown on Figure 2-10 in Appendix B-1.

ST011—UST-620A (Former CS004): The site is located in the east-central part of the Base at the northwest corner of Building 620. The former UST was used between 1966 and 1988 to receive waste liquids from the adjacent Air Force fuel-testing laboratory. The site location is shown on Figure 2-3, and the site layout is shown on Figure 2-11 in Appendix B-1.

5.2 Site Chronology

SS003—Oil Saturated Area: The site was initially identified in 1983 during the Phase I Records Search for the former Richards-Gebaur AFB, due to the presence of oil-stained soil. Investigations in 1986 and 1989 identified a small area of petroleum hydrocarbon contamination in soil. In 1991, approximately 42 cubic yards of contaminated soil was removed from the site, and an additional 15 cubic yards of soil were excavated in 1992. Three monitoring wells were installed at the site during a groundwater investigation in 1996 and five additional monitoring wells were installed during the RI in 1999–2000. Three soil samples were collected from monitoring wells installed during the RI. Soil and groundwater samples were analyzed for TPH, VOCs, SVOCs, and metals.

Sampling and analysis conducted during these investigations did not identify additional soil contamination. However, an approximately 0.27-acre area of groundwater contaminated with chlorinated solvents was delineated at the site. Groundwater monitoring was conducted on a quarterly basis at the site from October 2000–August 2004, and has been conducted semiannually since August 2004. In July

2003, two additional monitoring wells were installed at the site as part of the LTM program. Table 5-1 summarizes groundwater data from the August 2005 groundwater monitoring event presented in Appendix F.

Table 5-1 Summary of Groundwater Contamination at Site SS003

Sample Location	PCE	TCE	cis 1,2-DCE	trans 1,2-DCE	1,1-DCE	1,2-Dichloro-ethane (DCA)	Vinyl chloride
MW-004	ND	**53.6**	5.67	ND	ND	4.45	ND
MW-004 (FD)	ND	**48.8**	5.28	ND	ND	4.47	ND
MW-008	ND	**16.5**	1.46	ND	ND	ND	ND
MW-009	ND	**16.4**	5.98	ND	ND	ND	ND
MCL	**5**	**5**	**70**	**100**	**7**	**5**	**2**

Results are not shown for monitoring well locations where no constituents exceeded the MCL.
All units are µg/L.
Bolded concentrations exceed the MCL.
ND = Not detected
FD = Field duplicate
MCL = Maximum contaminant level

As shown in Table 5-1, TCE is the only constituent that exceeds the MCL at Site SS003. Monitoring well locations and the distribution of contamination are shown on Figure 10 in Appendix B-2. Monitoring conducted from October 2000–August 2005 indicates that the nature and extent of contamination remains generally stable, as shown on the temporal trend graph in Figure 17 of Appendix B-3. Maximum concentrations of TCE have fluctuated by approximately +/-20 µg/L at monitoring well MW-004, and no significant plume expansion has been observed. With the exception of monitoring well MW-008, TCE concentrations have been stable or declining at all monitoring well locations for the past five monitoring events, dating back to January 2004, and the concentration of TCE in downgradient perimeter wells remains below the MCL. Similar results were observed during the April 2006 sampling event. In April 2006, the concentration of TCE in monitoring well MW-008, an upgradient perimeter well, remained above the MCL for the third consecutive monitoring event. Overall, these data indicate that the plume is generally stable; however, a new upgradient monitoring well should be installed to reestablish the upgradient perimeter of the plume. The monitoring frequency at this new well should be semiannual until it satisfies the LTM decision logic for reduction to annual sampling.

SS006—Hazardous Materials Storage Area: The site was initially identified during a site inspection conducted as part of a Preliminary Assessment (PA) in 1990, that identified historical records of stressed vegetation behind the hazardous materials storage rack. Soil sampling conducted during the PA and during a Site Inspection (SI)

in 1991 identified a small area of soil contamination. In 1993, approximately 40 cubic yards of contaminated soil were excavated from the site. A total of 26 monitoring wells were installed and sampled during a groundwater investigation in 1996, the RI in 1999 - 2000, and the RI Addendum in 2001. Ten soil samples were collected for analysis during these investigations. Soil and groundwater samples were analyzed for TPH, VOCs, SVOCs, and metals.

Investigations conducted during the basewide RI and RI Addendum did not identify additional soil contamination. However, an approximately 5.5-acre area of groundwater contaminated with chlorinated solvents was delineated beneath the grassy area east of Facilities 927 and 930. Groundwater monitoring was conducted on a quarterly basis at the site from October 2000–August 2004, since which time monitoring has been conducted semiannually. Table 5-2 summarizes groundwater data from the August 2005 groundwater monitoring event.

Table 5-2 Summary of Groundwater Contamination at Site SS006

Sample Location	PCE	TCE	cis 1,2-DCE	trans 1,2-DCE	1,1-DCE	1,2-Dichloro-ethane (DCA)	Vinyl chloride
MW-005	ND	**121**	47.6	2.9	ND	ND	**2.71**
MW-011	ND	**128**	23.4	2.48	ND	ND	ND
MW-014	ND	**124**	8.48	0.4	ND	**11.4**	ND
MW-015	ND	**96.7**	2.42	ND	ND	ND	ND
MW-018	ND	**13.2**	23.7	ND	ND	ND	ND
MW-020	ND	**1,930**	**169**	33.4	2.65	ND	**11.8**
MW-020 (FD)	ND	**2,070**	**173**	29.4	2.82	ND	**10.4**
MW-025	ND	**12.2**	4.78	ND	ND	ND	ND
MCL	**5**	**5**	**70**	**100**	**7**	**5**	**2**

Results are not shown for monitoring well locations where no constituents exceeded the MCL.
All units are µg/L.
Bolded concentrations exceed the MCL.
FD = Field duplicate.
ND = Not detected.

As shown in Table 5-2, the highest contaminant concentrations at Site SS006 were detected at downgradient monitoring well MW-020. Monitoring well locations and the distribution of contamination are shown on Figure 13 in Appendix B-2. Monitoring conducted from October 2000–August 2005 indicates that the overall nature and extent of contamination remains generally stable, as shown on the temporal trend graphs in Figure 20 of Appendix B-3. Concentrations in the original source area at monitoring

well MW-005 and further down the central axis of the plume at monitoring well MW-015 exhibit decreasing trends. However, the concentration of TCE and cis 1,2-DCE in monitoring well MW-020 have exhibited an overall increasing trend since July 2002, with historical maximum concentrations of both constituents detected during the April 2006 monitoring event. In addition, during the April 2006 monitoring event, TCE was detected in downgradient perimeter monitoring well MW-021 at a concentration of 10 µg/L, which is greater than the MCL. This detection raises concerns that the plume may not be completely stable and the leading edge of the plume may be expanding slightly.

SS009 – Fire Valve Area: The site was initially identified in 1992 when an Air Force contractor reported the presence of a petroleum product in an excavation to repair an underground water valve. As a consequence, approximately 10 cubic yards of petroleum-contaminated soil were excavated from the site in 1993, and a PA/SI was conducted in 1994 during which 70 soil samples were collected from the site to assess the possible presence of additional soil contamination. A total of 14 monitoring wells were installed and sampled during the RI in 1999 - 2000, and as part of the groundwater monitoring program in 2003. Three additional soil samples were collected for analysis during these investigations. Soil and groundwater samples were analyzed for TPH, VOCs, SVOCs, and metals.

Investigations conducted during the basewide RI did not identify additional soil contamination. However, an approximately 0.68-acre area of groundwater contaminated with chlorinated solvents was delineated beneath Facility 605 and extending southeast, toward Andrews Road. Groundwater monitoring was conducted on a quarterly basis at the site from October 2000–August 2004. Since that time, monitoring has been conducted semiannually. Table 5-3 summarizes groundwater data from the August 2005 groundwater monitoring event.

Table 5-3 Summary of Groundwater Contamination at Site SS009

Sample Location	PCE	TCE	cis 1,2-DCE	trans 1,2-DCE	1,1-DCE	1,2-Dichloro-ethane (DCA)	Vinyl chloride
MW-003	**20.6**	**12.1**	**134**	ND	**33.2**	ND	**3.83**
MW-012	**13.0**	2.89	14.6	ND	6.12	4.45	**2.35**
MCL	**5**	**5**	**70**	**100**	**7**	**5**	**2**

Results are not shown for monitoring well locations where no constituents exceeded the MCL.
All units are µg/L.
Bolded concentrations exceed the MCL.
ND = Not detected.

As shown in Table 5-3, the highest contaminant concentrations at Site SS009 were detected at the original source area in monitoring well MW-003. Monitoring well locations and the distribution of contamination are shown on Figure 16 in Appendix B-2. Monitoring conducted from October 2000–August 2005 indicates that the overall nature and extent of contamination remains generally stable, as shown on the temporal trend graph in Figure 23 of Appendix B-3. Maximum concentrations of cis 1,2-DCE have fluctuated by approximately +/-50 µg/L at source area monitoring well MW-003, and the concentration of all constituents have exhibited a decreasing trend since January 2004. Similar results were observed during the April 2006 monitoring event.

SS012—Communications Facility: The UST was removed from the north side of the building in 1988 and replaced by a 275-gallon AST. A subsurface investigation was conducted in 1996, during which two soil samples and a groundwater sample were collected and analyzed for VOCs, PAHs, and TPH-DRO. In 2001, the AST was also removed and approximately 64 cubic yards of petroleum-contaminated soil was removed from the vicinity of the former UST. A total of 12 monitoring wells were installed and sampled during the RI Addendum in 2001, and five soil samples were collected from the wells closest to Facility 105. Soil and groundwater samples were analyzed for VOCs.

Investigations conducted during the RI Addendum did not identify additional soil contamination. However, an approximately 3.4-acre area of groundwater contaminated with chlorinated solvents was delineated beneath the grassy area northeast of Facility 105. Groundwater monitoring was conducted on a quarterly basis at the site from January 2002–August 2004. Since that time, monitoring has been conducted semiannually. Table 5-4 summarizes groundwater data from the August 2005 groundwater monitoring event.

Table 5-4 Summary of Groundwater Contamination at Site SS012

Sample Location	PCE	TCE	cis 1,2-DCE	trans 1,2-DCE	1,1-DCE	1,2-Dichloro-ethane (DCA)	Vinyl chloride
MW-001	0.975	**569**	17.4	0.628	0.424	ND	**7.07**
MW-002	ND	**192**	7.21	ND	ND	ND	ND
MW-003	ND	**5.88**	0.433	ND	ND	ND	ND
MW-012	ND	**81.2**	9.85	ND	ND	ND	ND
MCL	**5**	**5**	**70**	**100**	**7**	**5**	**2**

Results are not shown for monitoring well locations where no constituents exceeded the MCL.
All units are µg/L.
Bolded concentrations exceed the MCL.
ND = Not detected.

As shown in Table 5-4, the highest contaminant concentrations at Site SS012 were detected at monitoring well MW-001, near the former location of the UST. Monitoring well locations and the distribution of contamination are shown on Figure 19 in Appendix B-2. Monitoring conducted from January 2002–August 2005 indicates that the overall nature and extent of contamination remains generally stable, as shown on the temporal trend graph in Figure 26 of Appendix B-3. Although a significant spike in the TCE concentration was observed at monitoring well MW-001 in February 2005, the concentration decreased to near historical levels in August 2005 and remained near historical levels in April 2006.

ST005—POL Storage Yard: As described in Section 4.2, extensive investigations were conducted at Site ST005 in 1986, 1989, 1991, and 1996. Over 350 soil samples were collected from across the site and analyzed for TPH, VOCs, SVOCs, and metals, and extensive petroleum-contaminated soil was delineated and excavated from the site. These investigations also identified a separate area of the site where groundwater was contaminated with chlorinated solvents.

Groundwater contamination was further investigated during the RI in 1999–2000. Throughout these investigations a total of 34 monitoring wells were installed across the site, which delineated an area of groundwater contaminated with chlorinated solvents located east of the tank farm in the vicinity of the truck turnaround, as shown on Figure 2-10 in Appendix B-1. The estimated area of groundwater contamination is 0.85 acre. Groundwater monitoring was conducted on a quarterly basis at the site from October 2000–August 2004. Since that time, monitoring has been conducted semiannually. Table 5-5 summarizes groundwater data from the August 2005 groundwater monitoring event.

Table 5-5 Summary of Groundwater Contamination at Site ST005

Sample Location	PCE	TCE	cis 1,2-DCE	trans 1,2-DCE	1,1-DCE	1,2-Dichloro-ethane (DCA)	Trichloro-fluoro-methane	Vinyl chloride
MW-011	ND	**31.1**	0.79	ND	ND	ND	7.18	ND
MW-013	ND	**95.8**	1.79	ND	0.447	ND	20.6	ND
MW-018	ND	**2,480**	3.21	ND	3.99	ND	**1,900**	ND
MW-018 (FD)	ND	**3,600**	2.64	ND	3.12	ND	**1,860**	ND
MW-020	ND	ND	6.94	ND	ND	ND	ND	**7.33**
MW-024	ND	**65.8**	5.03	ND	ND	ND	7.93	ND
MCL	**5**	**5**	**70**	**100**	**7**	**5**	**1,300**	**2**

Results are not shown for monitoring well locations where no constituents exceeded the MCL.
All units are µg/L.
Bolded concentrations exceed the MCL.
FD = field duplicate

ND = Not detected.

As shown in Table 5-5, the highest contaminant concentrations at Site ST005 were detected in the presumed source area at monitoring well MW-018, located northeast of the former location of Facility 959, the easternmost pump house. Monitoring well locations and the distribution of contamination are shown on Figure 22 in Appendix B-2. Monitoring conducted from October 2000–August 2005 indicates that the overall nature and extent of contamination remains generally stable, as shown on the temporal trend graph in Figure 29 of Appendix B-3. Although short-term increases in TCE and vinyl chloride concentrations have occurred in monitoring wells MW-018, MW-019, and MW-020, the overall size of the plume and concentration of contaminants has remained consistent for the past five years. With the exception of monitoring well MW-018, similar concentrations were observed during the April 2006 monitoring event. In April 2006, the concentration of TCE detected in monitoring well MW-018 reached a historic high of 6,500 μg/L. Consistent with previous observations, this increase was limited to the source area of the plume. Significant increases in concentration were not observed in downgradient monitoring wells and the TCE concentration at the downgradient perimeter well remains non-detect. These observations indicate that, although a significant increase in concentration occurred in the source area, the overall distribution of contamination and size of the plume is stable and shows no signs of expansion beyond the LUC boundaries.

ST011—UST-620A (Former CS004): The UST was removed from the site in 1988. Low level TPH contamination was detected in a single sample collected during tank removal, and subsequent investigations in 1995 identified an area of petroleum contaminated soil. As a result, about 50 cubic yards of contaminated soil were excavated and disposed of at an approved landfill in 1995.

The site was further investigated during the 1999–2000 RI. Three monitoring wells were initially installed. Three groundwater and five soil samples were collected and analyzed for TPH, VOCs, SVOCs, and metals. These results identified an area of groundwater contaminated with chlorinated solvents, but they did not identify additional soil contamination. A total of seventeen monitoring wells were ultimately installed at the site, which delineated an approximately 0.11-acre area of groundwater contaminated with chlorinated solvents north of Facility 620. Groundwater monitoring was conducted on a quarterly basis at the site from October 2000–August 2004, since which time monitoring has been conducted semiannually. Table 5-6 summarizes groundwater data from the August 2005 groundwater monitoring event.

Table 5-6 Summary of Groundwater Contamination at Site ST011

Sample Location	PCE	TCE	cis 1,2-DCE	trans 1,2-DCE	1,1-DCE	1,2-Dichloro-ethane (DCA)	Vinyl chloride
MW-006	ND	7.35	3.5	ND	ND	ND	ND
MCL	**5**	**5**	**70**	**100**	**7**	**5**	**2**

Results are not shown for monitoring well locations where no constituents exceeded the MCL.
All units are μg/L.
Bolded concentrations exceed the MCL.
ND = Not detected.

As shown in Table 5-6, minimal groundwater contamination remains at Site ST011, with only monitoring well MW-006 containing concentrations of TCE exceeding the MCL. Monitoring well locations and the distribution of contamination are shown on Figure 25 in Appendix B-2. Monitoring conducted from October 2000–August 2005 exhibits a consistent decline in contaminant concentrations in all monitoring wells across the site, as shown on the temporal trend graphs in Figure 32 of Appendix B-3. In April 2006, the concentration of TCE in monitoring well MW-006 declined further to 5.7 μg/L; however, the concentration of TCE rebounded at interior monitoring well MW-003, where it was detected at a concentration of 36 μg/L. Concentrations at all remaining monitoring wells remained below MCLs indicating overall stability of the plume.

5.3 Remedial Actions

The ROD for OU-1 and OU-2 was signed in September 2004 and established the following RAO for OU-2.

- To prevent human exposure to contaminated groundwater with contaminant concentrations that pose risks greater than 1×10^{-4} to 1×10^{-6} or a hazard index of 1 for the reasonable maximum exposure scenario.

In order to accomplish these RAOs, LUCs were selected as the final remedy for OU-2 to:

- Prohibit extraction and use of groundwater.
- Prohibit land surface activities that may interfere with or damage the on-site monitoring wells.

The property was transferred to the City of Kansas City (Sites SS006, SS012, ST005, and ST011) and the USMC (Sites SS003 and SS009) in 2005. Restrictive covenants were placed in the Deed for the Sites SS006, SS012, ST005, and ST011 property and use restrictions were placed in the USMC's master plan to implement the restrictions described above. Figures 2-6 through 2-11 in Appendix B-1 show the LUC boundaries for each of the sites.

5.4 Technical Assessment

As part of the Five-Year review, OU-2 Sites SS003, SS006, SS009, SS012, ST005, and ST011 were reevaluated to ensure that remedies identified in the 2004 ROD remain protective of human health and the environment. The sites were reviewed to ensure that:

- 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.
- No additional information has come to light that would call into question the protectiveness of the remedy.

Each of these issues is addressed separately below.

5.4.1 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 (Appendix C-1) and have been included in the USMC's Master Plan (Appendix C-2). A LUC inspection was conducted in August 2005 in accordance with ROD requirements and there was no evidence indicating that the LUCs had been breached at that time. Groundwater wells have not been installed and groundwater is not extracted or used for any purpose, nor has any other significant development occurred on any of the OU-2 sites.

5.4.2 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. Each of these items was evaluated in detail as described in Appendix D and summarized below.

Exposure Assumptions: Site usage at all OU-2 sites remains commercial/light industrial in nature and groundwater at the sites is not used for any purpose. Drinking water in and around the former Richards-Gebaur AFB is obtained from the Missouri River via the City of Kansas City Water Department. As a result, no pathways exist for exposure to contaminated groundwater at any of the OU-2 sites, and there is no expectation that any 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 contaminated groundwater occurs.

Screening Criteria and Toxicity Data: The risk assessment conducted during the Basewide RI used EPA Region 9 Preliminary Remediation Goals (PRGs) 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 PRG and/or MCL, it was used as the default screening level. As summarized below and detailed in Appendix D, several PRGs and/or MCLs have changed significantly since the risk assessment was completed during the RI.

- The PRG for dibenzofuran decreased from 24 to 12.2 μg/L. However, dibenzofuran was not detected in groundwater at the site, so this change is not an issue of concern.

- The PRG for 1,1-DCE increased from 0.046 to 339 μg/L. However, the MCL for 1,1-DCE (i.e., 7 μg/L) was used as the screening criterion and cleanup level for this COC. The MCL has not changed since remedy selection and remains valid.

- The PRG decreased for PCE (1.1 to 0.104 μg/L), TCE (1.6 to 0.028 μg/L), and xylenes (1,400 to 206 μg/L). However, the MCLs for PCE (5 μg/L), TCE (5 μg/L), and xylenes (1,000 μg/L) were used as screening criteria and cleanup levels for these COCs. The MCLs have not changed since remedy selection and remain valid.

- The PRG for vanadium decreased from 260 μg/L to 36.5 μg/L. However, vanadium was dropped from the risk assessment because it was determined to be naturally occurring when compared to background concentrations.

- The MCL for nickel (100 μg/L) that was used in the risk evaluation during the Basewide RI has been rescinded. However, nickel was dropped from the risk assessment because it was determined to be naturally occurring when compared to background concentrations. Furthermore, the PRG for nickel, which remains in effect, is considerably higher at 730 μg/L.

- The MCL for arsenic decreased from 50 μg/L to 10 μg/L. Because this change had the potential to significantly affect the decision to exclude arsenic as a COC, it was further evaluated to determine its impact on the protectiveness of the remedy, as described in Appendix G. Although isolated individual sample results exceed the new MCL, the reasonable maximum exposure level for OU-2 [i.e., the 95 percent upper confidence level (UCL) on the mean], is less than the new MCL, indicating that arsenic is not a COC.

With the exception of the items described above, current PRGs and/or MCLs remain consistent with those used during the Basewide RI to define COCs.

Several other constituents, predominantly ethers, phthalates, and PAHs, also were screened out from further risk evaluation, based on the fact that they were not detected at their analytical reporting limit, which was higher than the PRG or MCL. These constituents are rarely found in significant concentrations in groundwater and there are no known sources of these constituents at the OU-2 sites. Therefore, the elevated reporting limits are not an issue of significant concern.

Based on this evaluation, the selection of COCs (i.e., PCE, TCE, cis 1,2-DCE, 1,1-DCE, and vinyl chloride) for the OU-2 sites remains valid. The changes in screening levels described above, would not significantly change the identification of COCs that were evaluated in the OU-2 risk assessment.

Underlying toxicity data (i.e., slope factors and reference doses) were further evaluated for the OU-2 COCs. Table 5-7 provides a comparison of the toxicity data that was used at the time of the risk assessment (i.e., old) in the Basewide RI to current (i.e., new) toxicity data.

Table 5-7 Toxicity Data Comparison for COCs at OU-2

Chemical	Oral Slope Factor		Change?	Oral Reference Dose		Change?
	Old	New		Old	New	
PCE	-	5.40×10^{-1}	Yes	-	1.00×10^{-2}	Yes
TCE	1.10×10^{-2}	4.00×10^{-1}	Yes	6.00×10^{-3}	3.00×10^{-4}	Yes
Cis 1,2-DCE	-	-	No	1.00×10^{-2}	1.00×10^{-2}	No
1,1-DCE	6.00×10^{-1}	-	Yes	9.00×10^{-3}	5.00×10^{-2}	Yes
Vinyl chloride	1.90	1.50	Yes	-	3.00×10^{-3}	Yes

With one exception, the changes resulted in less conservative toxicity data than were used in the original risk assessment or were not substantial enough to significantly change the risk evaluation.

The toxicity values for TCE (i.e., both the oral slope factor and reference dose) have become more conservative, indicating that the existing carcinogenic and noncarcinogenic risk estimates are likely to underestimate the risks associated with exposure to TCE, which was a COC for OU-2 (groundwater). However, the risk assessment conducted during the RI already concluded that TCE posed a potential risk to human health at the OU-2 sites and the existing remedies (i.e., LUCs) for OU-2

prohibit extraction and any use of TCE-contaminated groundwater, which ensures that all human exposure pathways to groundwater contaminants will remain incomplete.

Remedial Action Objectives: As described in Section 5.3, the RAO for OU-2 is to prevent exposure to groundwater with contaminant concentrations that pose risks greater than 1×10^{-6} to 1×10^{-4} 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 5-8 lists the remedial action cleanup goals (RACGs) that were established in the ROD for OU-2.

Table 5-8 Remedial Action Cleanup Goals for OU-2 Groundwater

COC	PCE	TCE	cis 1,2-DCE	1,1-DCE	Vinyl chloride
RACG	5	5	70	7	2

All units are µg/L.

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. A more detailed evaluation of the RACGs for each COC is provided in Appendix D.

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

No. The five year review identified and evaluated two issues that could potentially have an impact on the protectiveness of the OU-2 remedy: property redevelopment and vapor intrusion. Based on the evaluation presented below, neither issue calls into question the protectiveness of the remedy at this time.

Property Redevelopment: Based on discussions with the City of Kansas City, extensive redevelopment of the former Richards-Gebaur AFB is planned in the next few years, and the city has partnered with CenterPoint Properties and Hunt Midwest Enterprises to redevelop the property.

As described in Section 4.4.3, redevelopment plans prepared by CenterPoint Properties include expansion of the existing intermodal center to include a 497-acre International Freight Gateway and a 900-acre Industrial Park, consisting of 5 to 6 million square feet of new facilities served by the railroad, including light manufacturing, warehouse, and distribution facilities.

These redevelopment plans include construction of new facilities, such as warehouses, in the vicinity of Sites SS012 and ST005. According to the ROD for OU-2, LUCs would prohibit land surface activities that may interfere with or damage the on-site monitoring

wells during the redevelopment. No installation of groundwater wells is planned and development that would disturb the existing monitoring well network would be prohibited. As a result, none of the redevelopment plans would call the protectiveness of the remedy into question as long as the existing restrictive covenants are observed.

Hunt Midwest Enterprises plans to develop underground storage facilities beneath the former Richards-Gebaur AFB. These facilities would be constructed in bedrock beneath the base and would not be affected by the shallow contaminated groundwater at Sites SS003, SS006, SS009, ST005, and ST011. Therefore, this redevelopment should have no effect on the protectiveness of the OU-2 remedy.

Site SS009 is located on USMC property that was identified for closure by the Base Realignment and Closure (BRAC) Commission in 2005. Future use of this property is uncertain at this time. However, no future uses have been identified that would call the protectiveness of the remedy into question.

Vapor Intrusion: Hypothetical indoor air risks posed by vapor intrusion of OU-2 groundwater contaminants were evaluated during the RI in 2002 using Version 2.0 of the Johnson and Ettinger (J&E) Model. Since that time, maximum concentrations of contaminants, model structure, and underlying toxicity values have changed. As a result, hypothetical risks posed by vapor intrusion were reevaluated. TCE concentrations were the primary risk drivers in the previous evaluation and were used to screen for potential vapor intrusion risks during the reevaluation. This reevaluation was conducted using Version 3.1 of the J&E Model. Risk estimates were derived using both the peer-reviewed California EPA (CalEPA) toxicological value and as well as EPA's provisional toxicological value for TCE as described in detail in Appendix H and summarized below.

Facility 605 at Site SS009 is the only facility that is currently located above a contaminated groundwater plume. The maximum TCE concentration at Site SS009 was 12.1 μg/L during the August 2005 monitoring event. Using this concentration as the exposure point concentration, excess lifetime cancer risks calculated using both the CalEPA and provisional toxicological values for TCE ranged between 2.7×10^{-8} and 2.6×10^{-6}, indicating that there is no significant risk currently posed by the vapor intrusion of TCE.

Because redevelopment of the property has the potential to result in construction of additional buildings above the contaminated groundwater, additional evaluation was conducted to determine whether the maximum concentration of TCE detected at Site ST005 poses a significant risk to indoor air. The maximum concentration of TCE in groundwater at the former Richards Gebaur AFB during the August 2005 (3,600 μg/L) monitoring event was detected at Site ST005 monitoring well MW-018. Using the most current version of the J&E model, the same set of input parameters for soil and buildings, the maximum TCE concentration, as well as the CalEPA toxicological

parameters for TCE, the maximum estimated cancer risk is within the range of 10^{-6} to 10^{-4} for both residential (i.e., 1.4×10^{-5}) and worker (i.e., 8.1×10^{-6}) exposures. If EPA's upper bound, provisional toxicity value for TCE is used, the estimated risk slightly exceeds the acceptable risk range for both hypothetical residential (i.e., 7.7×10^{-4}) and worker (i.e., 4.6×10^{-4}) exposure scenarios.

5.5 Issues

Based on groundwater monitoring conducted from October 2000–August 2005, all of the chlorinated solvent contamination plumes in OU-2, with the possible exception of Site SS006, are stable or shrinking. Although concentrations have spiked periodically at individual monitoring wells, the overall nature and extent of contamination has remained consistent over time and within the established LUC boundaries. As a result, semiannual monitoring is not required to monitor the performance of the LUC remedy. At Site SS006, TCE was detected above the MCL in downgradient perimeter well MW-021. This detection indicates possible downgradient expansion of the plume.

During the August 2005 monitoring event 1,2-DCA was detected in groundwater at Sites SS003 and SS006 at concentrations near the MCL of 5 μg/L. In addition, Freon 11 was detected in samples from Site ST005. These constituents have not been historically detected at the former Richards-Gebaur AFB and have not been considered constituents of concern. However, because they are present in the interior portion of areas of known groundwater contamination, with significantly higher concentrations of other constituents, such as TCE, their emergence as contaminants of potential concern does not have any significant bearing on the overall risk to human health or the environment and does not adversely affect the protectiveness of the LUC remedy.

Also, an updated indoor air risk evaluation was conducted for the only building presently overlying a TCE plume (i.e., Building 605 at SS-009). The estimated residential and worker risks for occupants of Building 605 were within EPA's acceptable risk range using both the peer-reviewed CalEPA and provisional EPA TCE toxicity values. Therefore, the current remedy is protective and no further action is required to address this pathway at this time. However, if EPA's upper-bound, provisional TCE toxicity values are finalized and formally accepted into Integrated Risk Information System (IRIS), isolated areas of high TCE concentration such as at Site SS006 monitoring well MW-020 and Site ST005 monitoring well MW-018 may warrant further evaluation to determine whether they pose a significant indoor air risk via vapor intrusion.

5.6 Recommendations and Follow-Up Actions

In accordance with the LTM Plan decision logic, the groundwater monitoring program should be modified as described below:

- Monitoring frequency at Sites SS003, SS009, SS012, ST005, and ST011 should be reduced to annual.

- Monitoring frequency at Site SS006 should remain at semi annual to ensure that high concentrations of TCE at MW-020 remain within LUC boundaries. This recommendation is based on the fact that MW-020 is located near the downgradient edge of Site SS006, approximately 220 feet upgradient of Facility 605. Semiannual sampling of these wells is recommended to ensure timely notification in the event that groundwater contaminants migrate toward the Site SS006 boundary and Facility 605. In particular, if the concentration of TCE in monitoring well MW-021 persists at a concentration above the MCL for a second consecutive monitoring event, a new downgradient monitoring point will need to be established, in accordance with the LTM Plan decision logic. Although current contaminant concentrations are higher at Site ST005 monitoring well MW-018, the downgradient LUC boundary is approximately 450 feet away from this monitoring well and there are no buildings downgradient of the site for several thousand feet. As a result of this buffer zone, semiannual monitoring at Site ST005 is not necessary. Finally, monitoring frequency at the new upgradient monitoring well to be installed at SS003 should be semiannual until this well satisfies the LTM decision logic.

In addition, a revised vapor intrusion evaluation should be conducted after a new TCE toxicity factor is approved and promulgated. In order to ensure that this vapor evaluation is representative of site conditions, it is recommended that any future indoor air risk evaluations be based upon EPA's reasonable maximum concentration or the 95th percent upper confidence limit of wells within an area of the site representing a current or hypothetical future building footprint (e.g., ~1,200 ft^2). Use of the maximum TCE concentration in this five-year review serves only to provide a screening evaluation of the worst-case scenario and should not be used as a basis for final risk management decisions. A discussion of the necessity for a vapor intrusion risk re-evaluation once new TCE toxicity factors are promulgated should be included in the annual LUC letters to property owners.

5.7 OU-2 Protectiveness Statement

The selected remedy for OU-2 remains protective of human health and the environment and is 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 the OU-2 sites are adequate to ensure that significant exposures do not occur in the future.

6.0 SUMMARY AND CONCLUSIONS

6.1 Site-Wide Protectiveness Statement

As described in Sections 4.7 and 5.7, the selected remedy for OUs 1 and 2 remain protective of human health and the environment and are anticipated to remain protective in the future. As described in Sections 1.0 and 2.3, the USACE is responsible for OU-3, and as of this date investigation and remediation has not been completed. As a result, a remedy has not been selected and a protectiveness evaluation has not been conducted. The USACE will conduct a separate five-year review for OU-3, and resulting protectiveness statements will be referenced in future five-year reviews for OU 2.

6.2 Summary of OU-1 and OU-2 Conclusions and Recommendations

Based on the evaluation conducted as part of this Five-Year Review:

- The LUC remedy remains effective and protective of human health and the environment at all seven sites.
- LUCs are no longer required at OU-1 Sites FT002 and ST005.
- Groundwater contamination at OU-2 Sites SS003, SS006, SS009, SS012, ST005, and ST011 has remained within the established LUC boundaries for the past 5 years.
- Groundwater plumes at Sites SS003, SS009, SS012, ST005, and ST011 have remained generally stable over the last two years of semiannual monitoring. Although concentrations of contaminants have increased in individual monitoring wells at these sites, the monitoring well locations are located in the interior of the plumes. Downgradient perimeter monitoring wells do not exhibit increases in concentration that would imply that the plumes are unstable or expanding.

Based on these findings, an ESD should be completed for OU-1 to change the RAOs and RACGs to reflect the new MRBCA Process for Petroleum Storage Tanks (January 2004) and update memorandum dated March 2005. Based on these changes, the remedy for OU-1 can be changed from LUCs prohibiting residential use of the property and excavation of contaminated soil to NFA. Following completion of the ESD, the restrictive covenants for contaminated soil at the OU-1 sites should be removed from the Kansas City deed and the LUC management plan should be revised to remove the LUC implementation and monitoring requirements for the OU-1 sites.

In accordance with the Long-Term Monitoring (LTM) Plan decision logic the groundwater monitoring program should be modified as follows:

- Monitoring frequency at Sites SS003, SS009, SS012, ST005, and ST011 should be reduced from semiannual to annual.
- Monitoring frequency at Site SS006 should remain at semiannual to ensure that high concentrations of TCE at MW-020 remain within LUC boundaries. The monitoring frequency at the new SS003 upgradient well should be semiannual until it satisfies the LTM decision logic.

In addition, a revised vapor intrusion evaluation should be conducted after a new TCE toxicity factor is approved and promulgated. In order to ensure that this evaluation is representative of site conditions, any future indoor air risk evaluations should be based upon EPA's reasonable maximum concentration or the 95th percent upper confidence limit of wells within an area of the site representing a current or hypothetical future building footprint (e.g., ~1,200 ft^2).

7.0 NEXT REVIEW

No further Five-Year Reviews will be required for OU-1. As described in Section 4, reevaluation of TPH contamination in soil at Sites FT002 and ST005 does not pose a significant risk under a residential scenario, which is representative of unrestricted use and unlimited exposure criteria.

The next Five-Year Review for OU-2 is due within five years of the signature date on the cover of this five-year review report. The Air Force will be responsible for completing the review for Sites SS006, SS012, ST005, and ST011. Sites SS003 and SS009 were transferred to the USMC in 2005, and the USMC assumed responsibility for implementing the environmental restoration program at these sites in October 2006; consequently, the USMC will be responsible for conducting the next five-year review for Sites SS003 and SS009.

APPENDIX A

PUBLIC NOTICE

PUBLIC NOTICE
THE AIR FORCE REAL PROPERTY AGENCY IS CONDUCTING A CERCLA FIVE-YEAR REVIEW AT THE FORMER RICHARDS-GEBAUR AIR FORCE BASE, MO

The United States Air Force Real Property Agency (AFRPA) is conducting the first five-year review of the selected remedy that is being implemented to address environmental contamination at the former Richards-Gebaur Air Force Base (AFB). The remedy consists of land use controls designed to limit contact with isolated areas of soil contaminated with petroleum hydrocarbons and groundwater contaminated with chlorinated solvents.

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), reviews of long-term remedial actions are required every five years to ensure continued protection of human health and the environment until cleanup requirements are met. This review will be completed between November 2005 and October 2006, during which time input from the public will be considered. A subsequent public notice will announce the completion of the five-year review, at which time the final report will be provided for public review at the Grandview Mid-Continent Public Library.

If you have questions or comments, or would like more information on the sites under review, please contact:

Mr. Anthony Morriss
BRAC Environmental Coordinator/Former Richards-Gebaur AFB
AFRPA/DC-K
143 Billy Mitchell Boulevard, Suite 1
San Antonio, TX 78226-1816
Toll-free phone: 866-725-7617

APPENDIX B

SITE FIGURES

APPENDIX B-1

ROD FIGURES

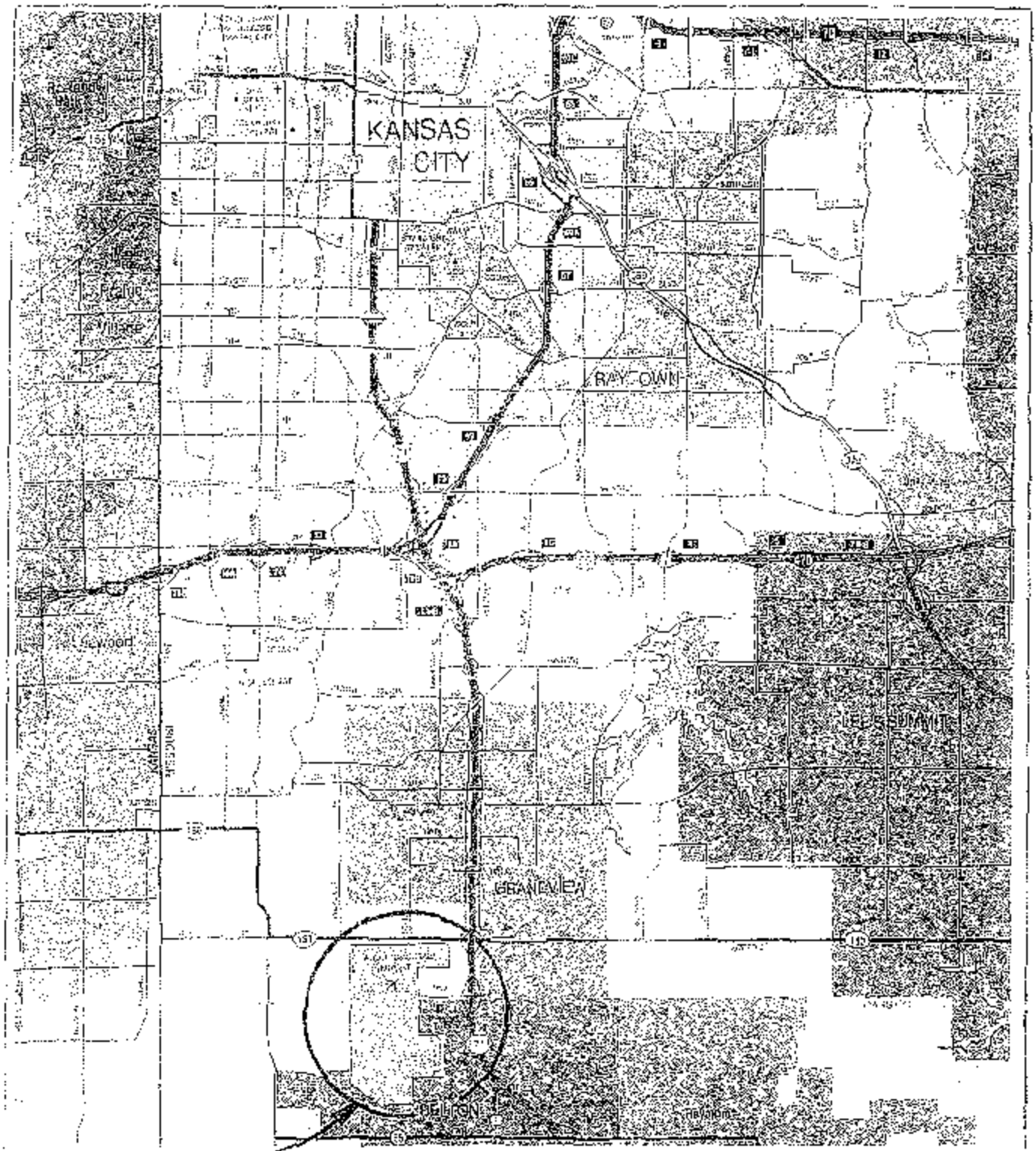


Figure 2-1

BASE LOCATION MAP

Richards–Gebaur AFB
Kansas City, Missouri

N

NOT TO SCALE

CH2MHILL

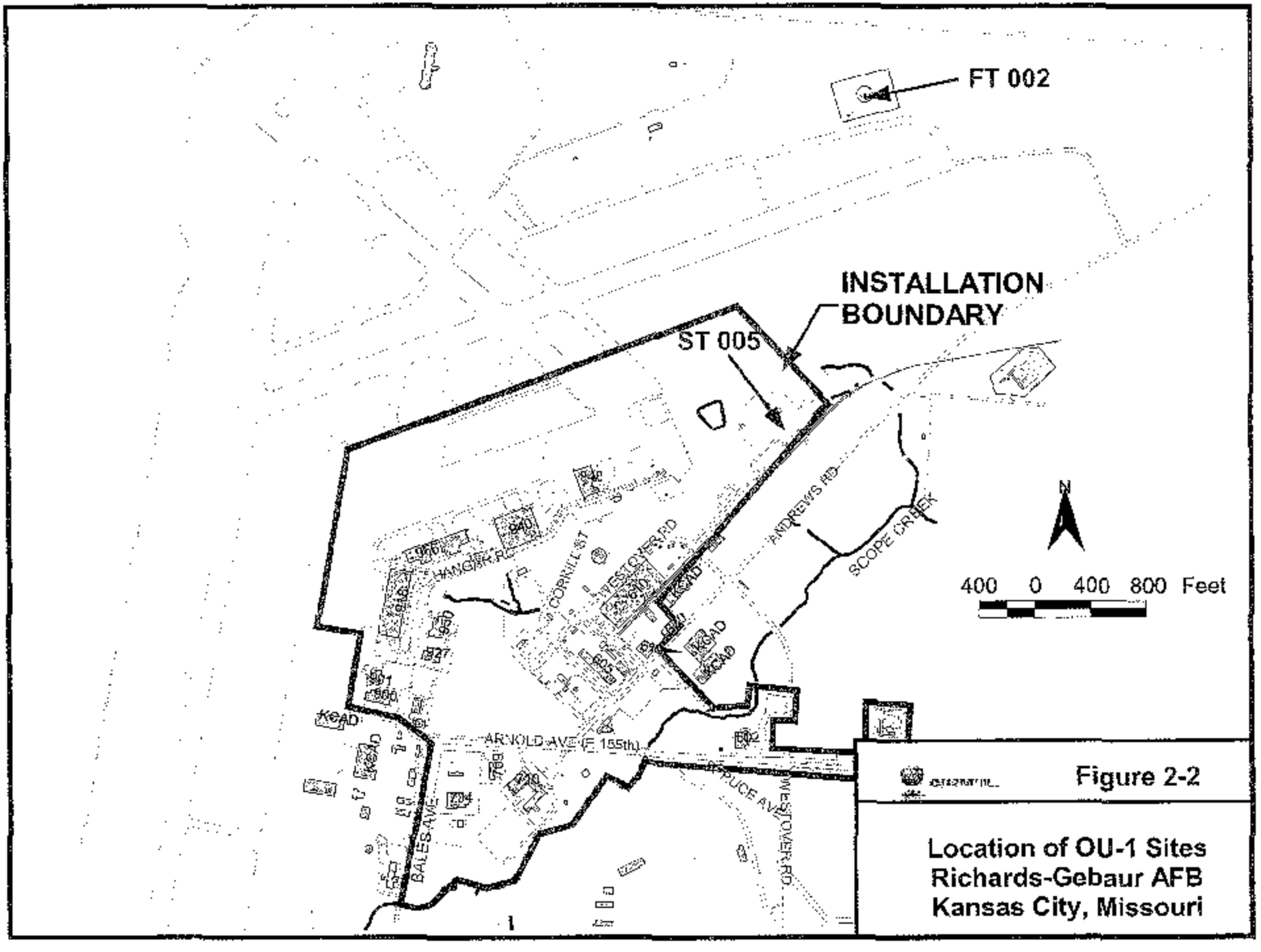
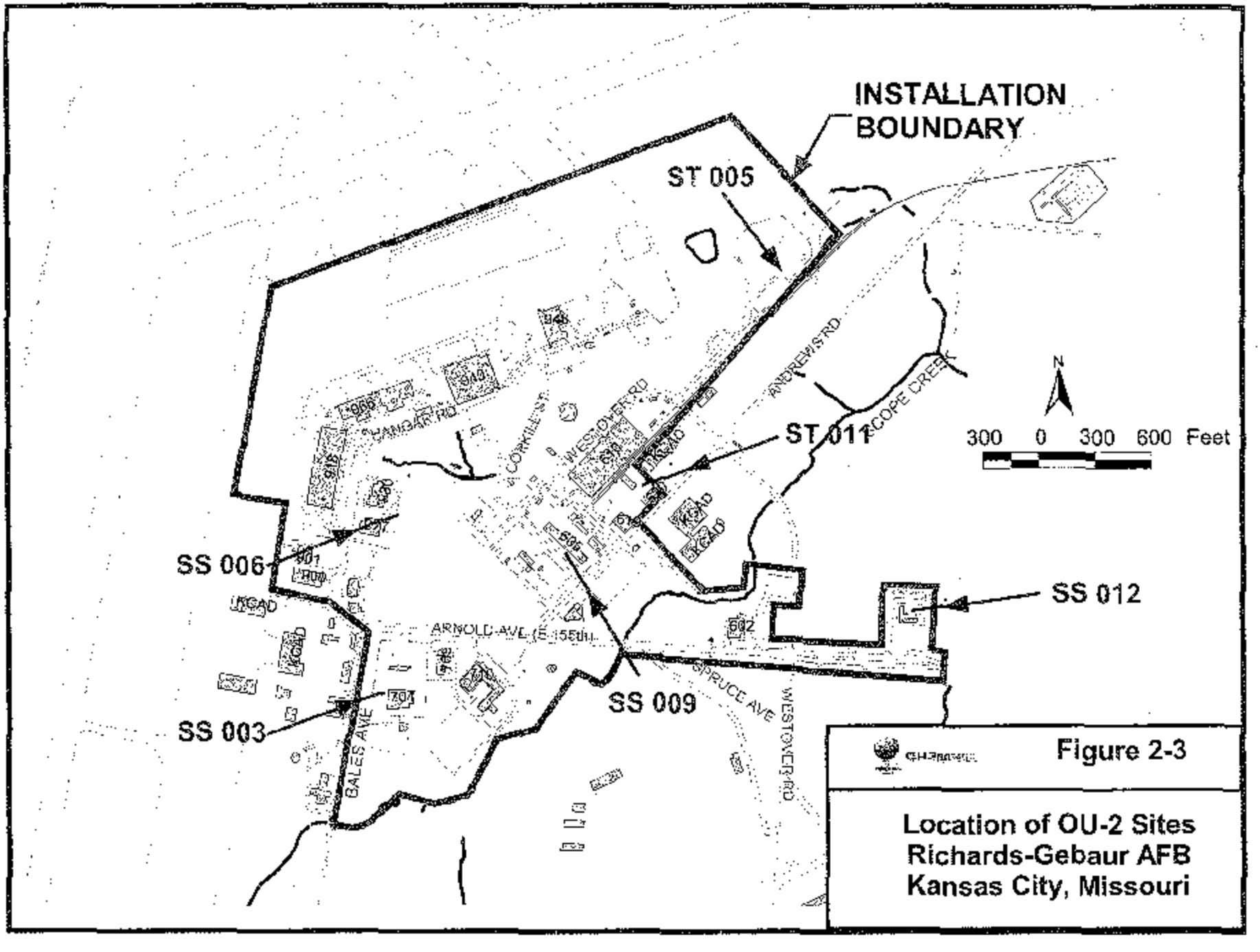


Figure 2-2

Location of OU-1 Sites
Richards-Gebaur AFB
Kansas City, Missouri


INSTALLATION BOUNDARY
ST 005
ST 011
SS 006
SS 012
SS 009
SS 003
N
300 0 300 600 Feet
HANGAR RD
CORKILL ST
WESTOVER RD
ANDREWS RD
COPE CREEK
ROAD
ARNOLD AVE (E 155th)
SPRUCE AVE
GALES AVE
WESTOVER RD
Figure 2-3
Location of OU-2 Sites
Richards-Gebaur AFB
Kansas City, Missouri

Note: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 60 days of signature of the ROD.

Legend

- Sample ID / Depth / Chemical Concentration (in ppm)
- IRA Excavation Floor Sample
- IRA Excavation Wall Sample
- TPH Concentration > 200 ppm
- IRA Limit
- Estimated Residual Contamination
- Provisional LUC Boundary

bgs Below Ground Surface

Former Waste Oil Tank (Removed)

Former Drain Line (Removed)

Former Discharge Line (Removed)

Former OWS (Removed)

Former Concrete Burn Pad (Removed)

Former Feed Line (Removed)

Former AST (Removed)

N

20 0 20 40 Feet

Estimated Volume of Residual Contamination = 170 cy

Figure 2-4

FT 002 - North Burn Pit
Residual Contamination Exceeding RACG in Soil
Richards-Gebaur AFB
Kansas City, Missouri

Note: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 60 days of signature of the ROD.

Legend

- Sample ID / Depth / Chemical Concentration (in ppm)
- IRA Excavation Floor Sample
- IRA Excavation Wall Sample
- TPH Concentration > 200 ppm
- IRA Limit
- Estimated Residual Contamination
- Provisional LUC Boundary

bgs Below Ground Surface

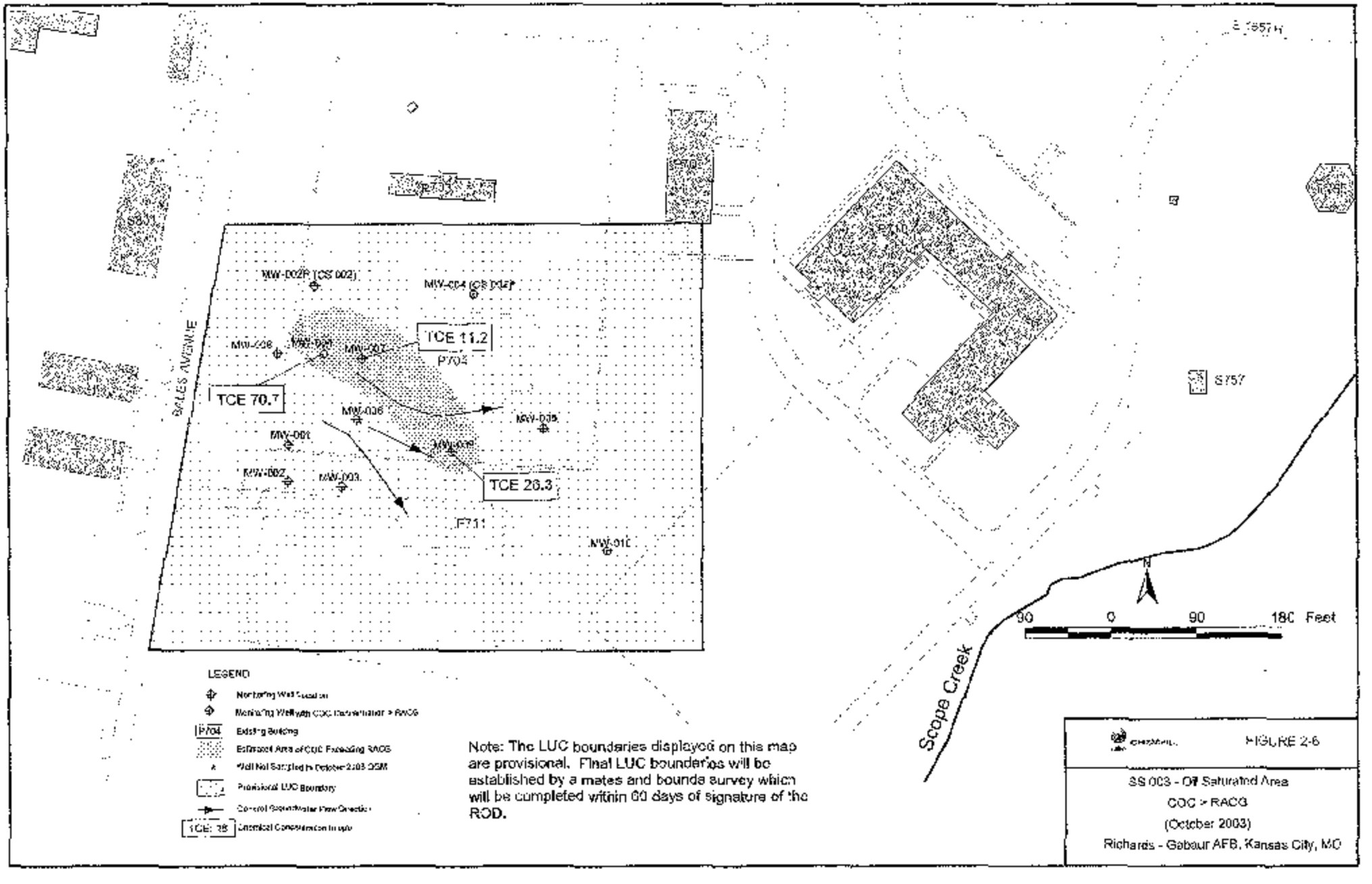
N

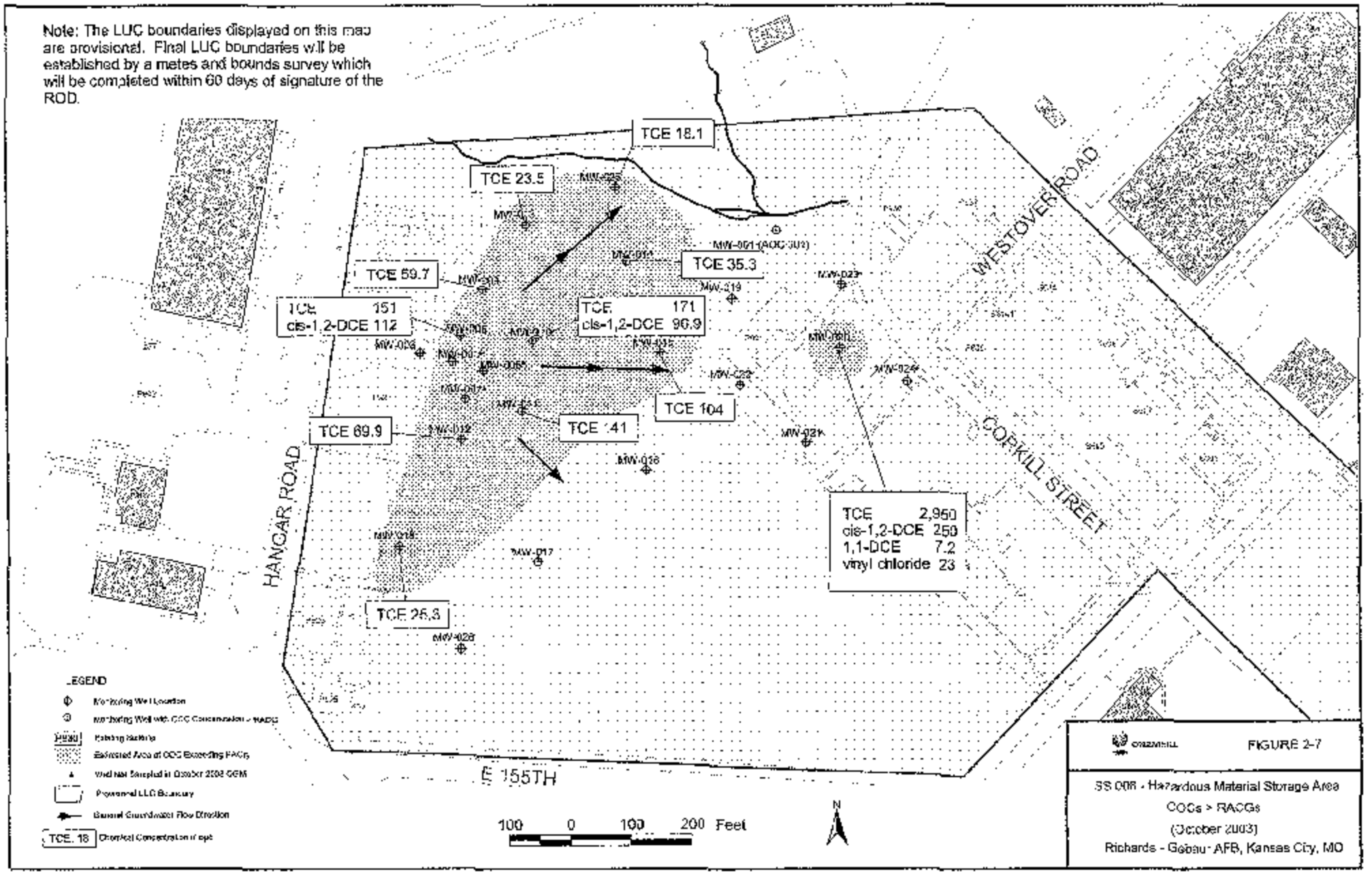
40 0 40 80 Feet

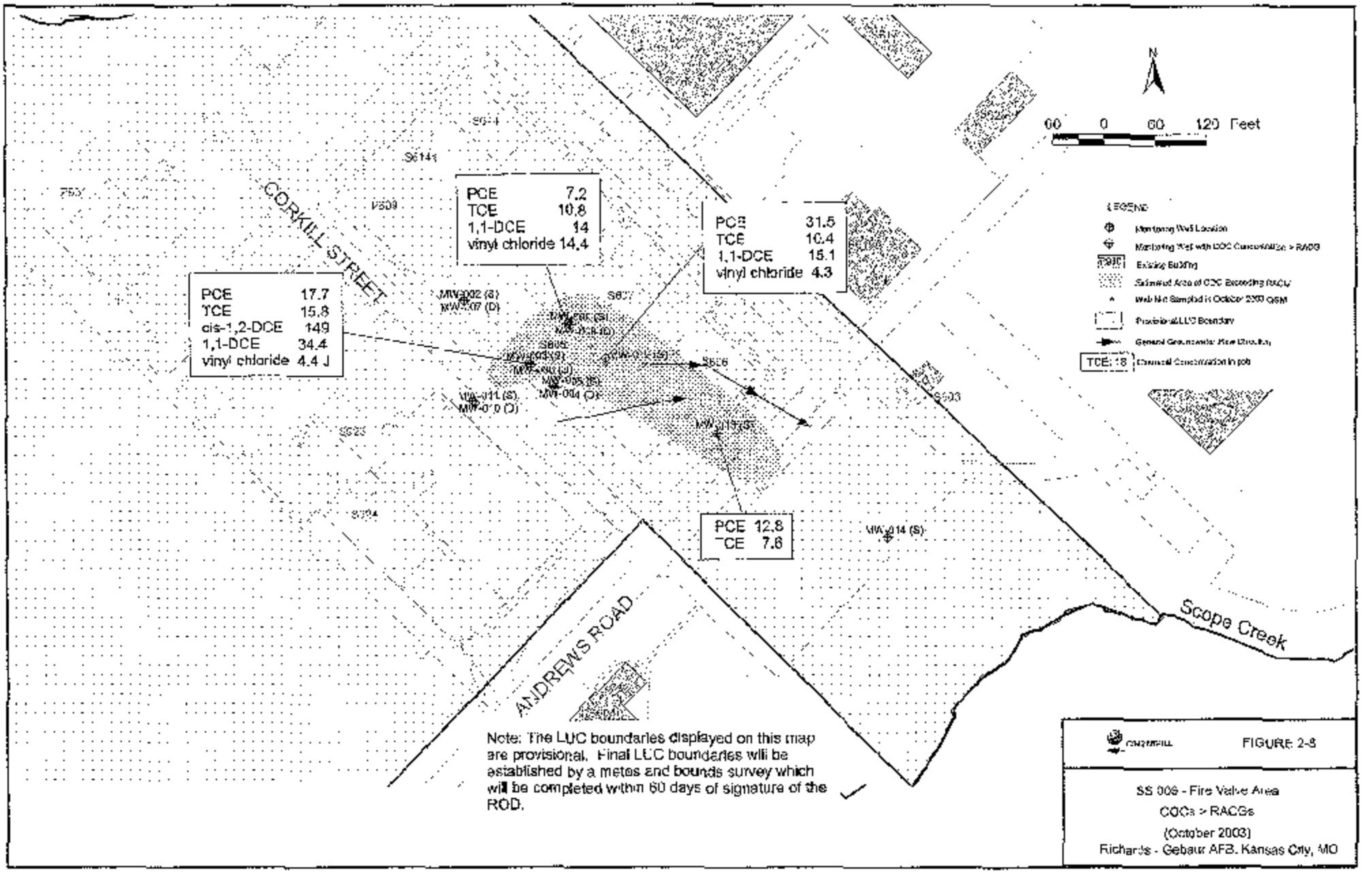
Estimated Volume of Residual Contamination = 3,200 cy

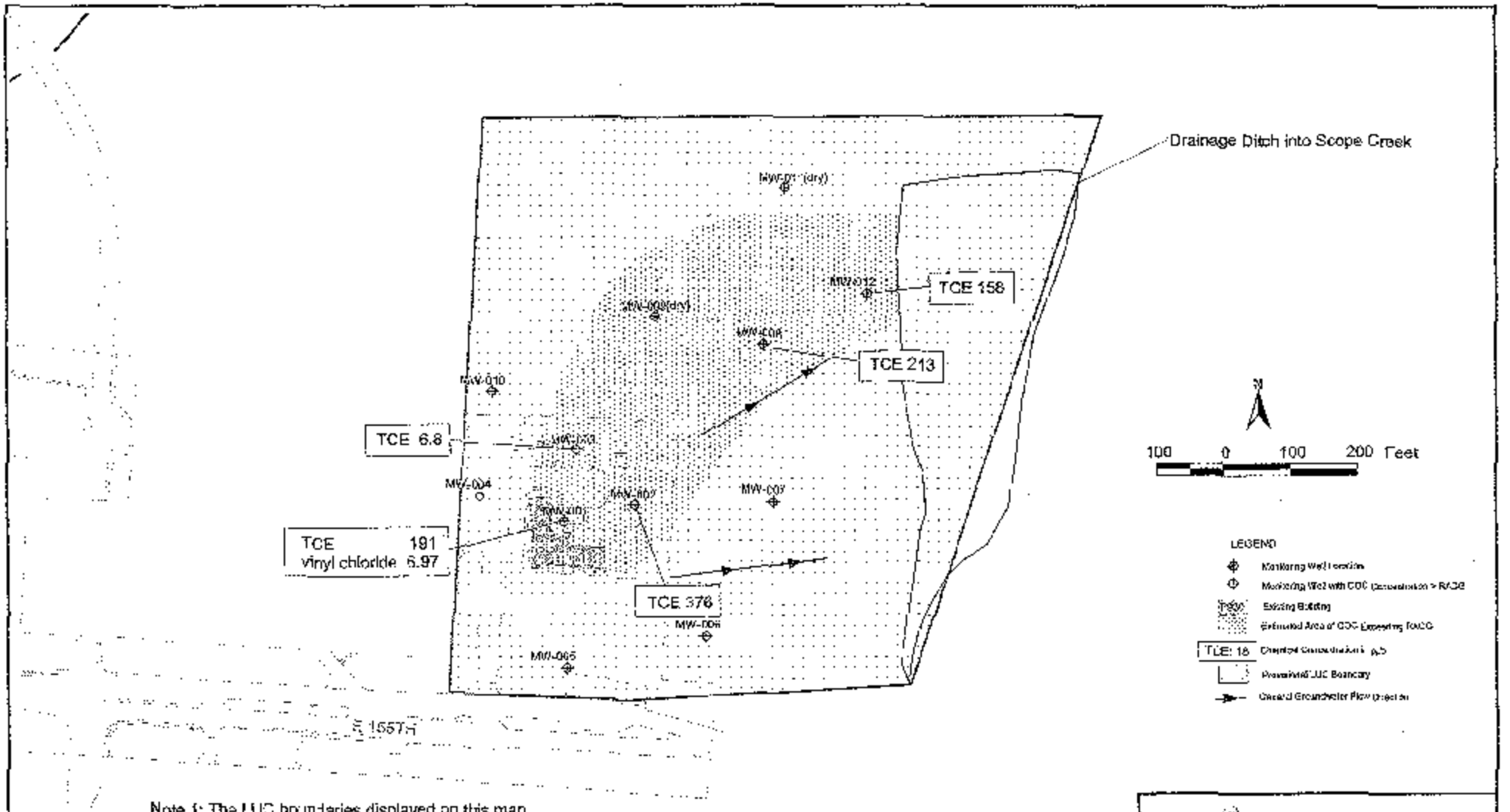
Figure 2-5

ST 005 - POL Storage Yard
Residual Contamination Exceeding RACG in Soil
Richards-Gebaur AFB
Kansas City, Missouri


MW-002R (CS 002)
MW-004 (CS 004)
TCE 11.2
P704
TCE 70.7
MW-006
MW-005
MW-001
MW-002
MW-003
TCE 28.3
P711
MW-010
S757
Scope Creek
N
90 0 90 180 Feet
LEGEND
Monitoring Well Location
Monitoring Well with COC Concentration > RACG
P704 Existing Building
Estimated Area of COC Exceeding RACG
Well Not Sampled in October 2003 GSM
Provisional LUC Boundary
General Groundwater Flow Direction
TCE: 28 Chemical Concentration in ug/l
Note: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 60 days of signature of the ROD.
FIGURE 2-6
SS 003 - Off Saturated Area
COC > RACG
(October 2003)
Richards - Gebaur AFB, Kansas City, MO


Note: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 60 days of signature of the ROD.
TCE 18.1
TCE 23.5
TCE 59.7
TCE 35.3
TCE 151
cis-1,2-DCE 112
TCE 171
cis-1,2-DCE 96.9
TCE 104
TCE 69.9
TCE 41
TCE 25.3
TCE 2,950
cis-1,2-DCE 250
1,1-DCE 7.2
vinyl chloride 23
MW-001 (AOC 302)
WESTOVER ROAD
CORKILL STREET
HANGAR ROAD
E 155TH
LEGEND
Monitoring Well Location
Monitoring Well with COC Concentration > RACG
Existing Facility
Estimated Area of COC Exceeding RACG
Well Not Sampled in October 2003 GEM
Proposed LUC Boundary
General Groundwater Flow Direction
TCE 18 Chemical Concentration (ug/L)
100 0 100 200 Feet
N
FIGURE 2-7
SS 008 - Hazardous Material Storage Area
COCs > RACGs
(October 2003)
Richards - Gebaur AFB, Kansas City, MO


N
60 0 60 120 Feet
CORKILL STREET
ANDREWS ROAD
Scope Creek
PCE 7.2
TCE 10.8
1,1-DCE 14
vinyl chloride 14.4
PCE 31.5
TCE 10.4
1,1-DCE 15.1
vinyl chloride 4.3
PCE 17.7
TCE 15.8
cis-1,2-DCE 149
1,1-DCE 34.4
vinyl chloride 4.4 J
PCE 12.8
TCE 7.6
MW-014 (S)
LEGEND
Existing Building
TCE: 18
Note: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 60 days of signature of the ROD.
FIGURE 2-8
SS 009 - Fire Valve Area
COCs > RACGs
(October 2003)
Richards - Gebaur AFB, Kansas City, MO

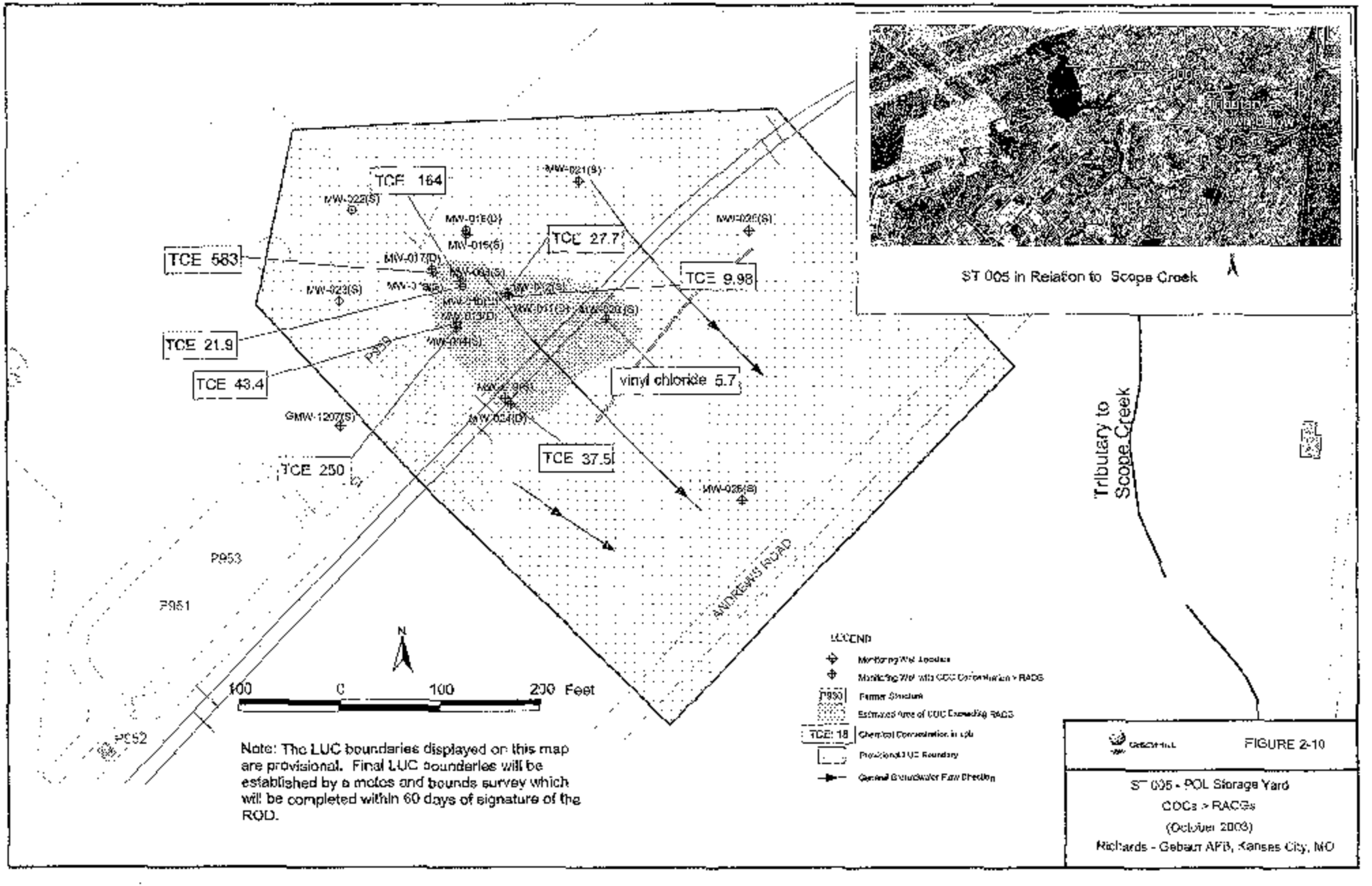


Note 1: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 60 days of signature of the ROD.

Note 2: MW-009, when not dry, has been consistently detected with TCE at levels exceeding RACG.

FIGURE 2-9

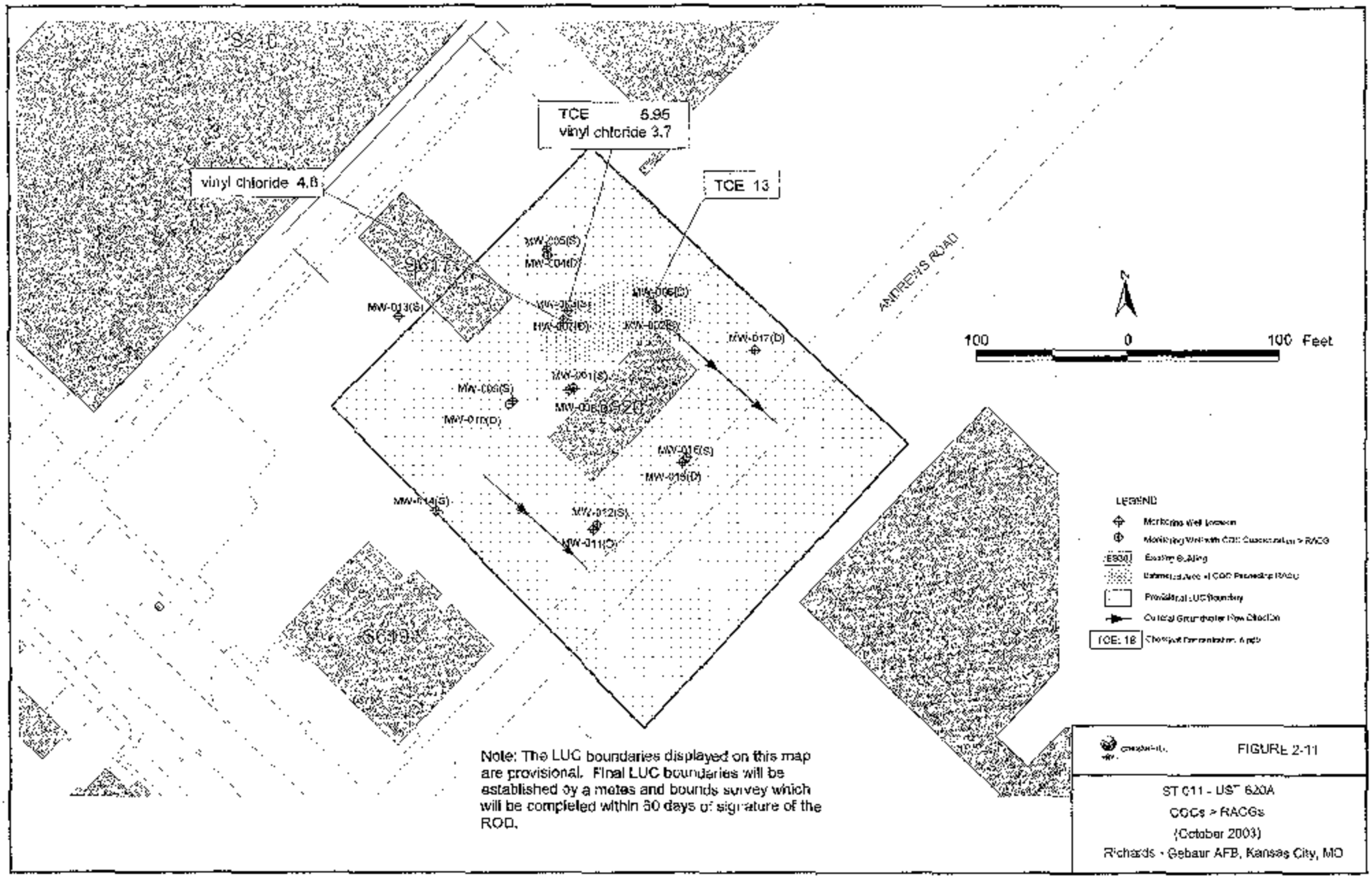
SS 012 - Communications Facility at Building 105
COCs > RACGs
(October 2003)
Richards - Gebaur AFB, Kansas City, MO



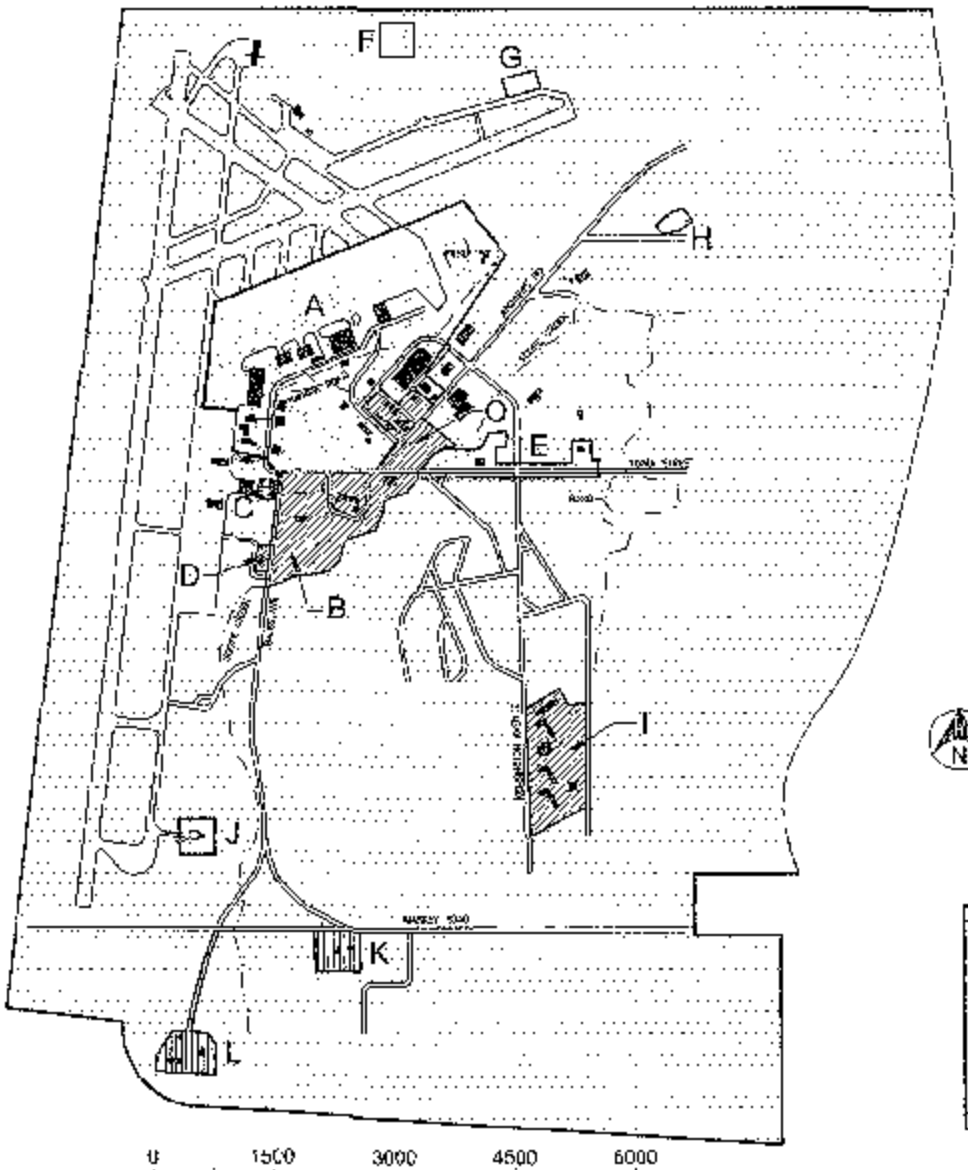
Note: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 60 days of signature of the ROD.

FIGURE 2-10

ST 005 - POL Storage Yard
COCs > RACGs
(October 2003)
Richards - Gebaur AFB, Kansas City, MO

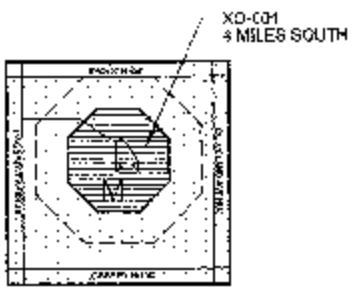


Note: The LUC boundaries displayed on this map are provisional. Final LUC boundaries will be established by a metes and bounds survey which will be completed within 30 days of signature of the ROD.



LEGEND

- ECONOMIC DEVELOPMENT CONVEYANCE (CITY OF KANSAS CITY, MO) (PARCELS A, C, E, F, G, H, AND J)
- FEDERAL TRANSFER (U.S. MARINE CORPS) (PARCELS B, D, I, AND O)
- NEGOTIATED SALE (CITY OF BELTON, MO) (PARCELS K AND L)
- FEDERAL TRANSFER (DEPARTMENT OF THE ARMY) (PARCEL M)
- PREVIOUSLY CONVEYED RICHARDS-GEBAUR AFB PROPERTY
- BELTON TRAINING COMPLEX PROPERTY EASEMENT BOUNDARY (TO BE CONVEYED WITH PARCEL)
- H PARCEL LABEL
- FACILITY



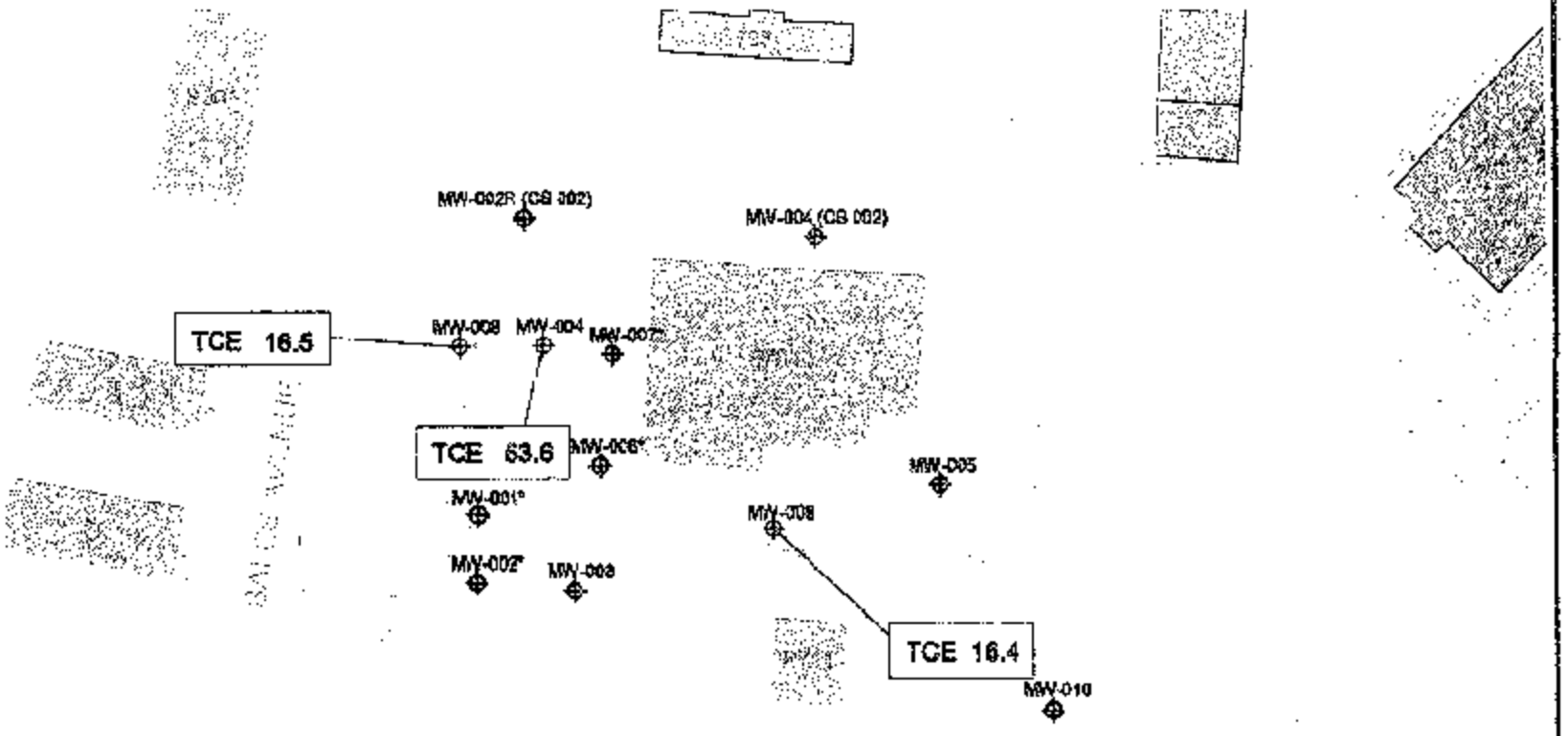
NOT TO SCALE

Figure 2-12
Transfer Parcelization Map
Richards-Gebaur AFB, Missouri

CH2MHILL

APPENDIX B-2

LTM REPORT FIGURES



LEGEND

- Monitoring Well Location
- Well with COC concentration exceeding RACGs
- TCE: 18 — Chemical Concentration in ppb
- P704 — Building Number
- Existing Building and Structure
- LUC Boundary for Property Transferred to the U.S. Marine Corps in 2005
- * Well not included in LTM Network

N

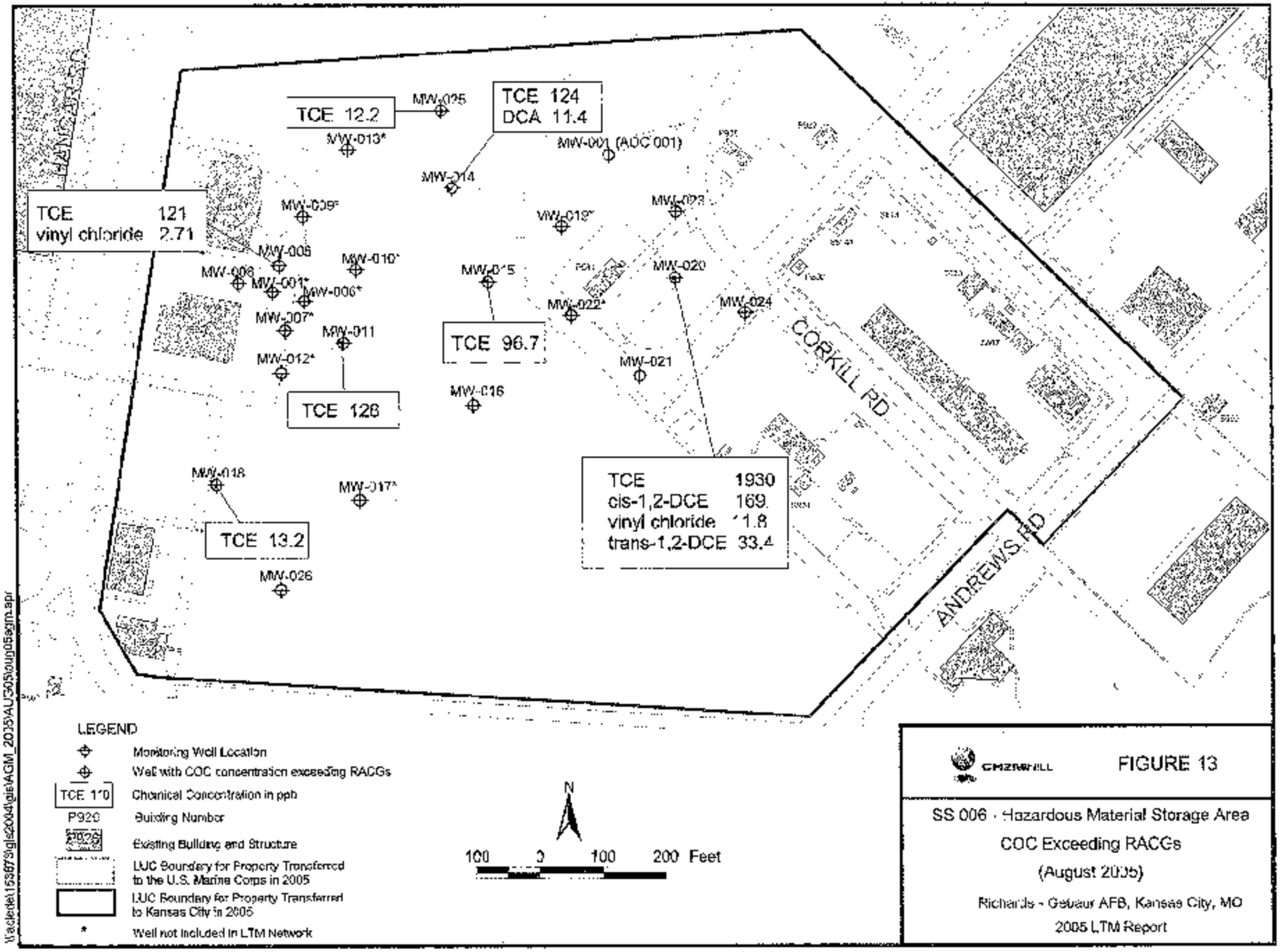
50 0 50 100 Feet

CH2MHILL

FIGURE10

SS 003 - Oil Saturated Area
COC Exceeding RACGs
(August 2005)
Richards - Gebaur AFB, Kansas City, MO
2005 Annual LTM Report

\\kcdata\t:\538773\gis\2005\gis\MGM_2005\AUG05\arcg\5sigmapr


TCE 12.2
MW-035
TCE 124
DCA 11.4
MW-013*
MW-001 (AOC 001)
MW-014
TCE 121
vinyl chloride 2.71
MW-009*
MW-019*
MW-023
MW-005
MW-010*
MW-008
MW-001*
MW-006*
MW-015
MW-020
MW-022*
MW-024
MW-007*
MW-011
TCE 96.7
MW-012*
MW-021
MW-016
TCE 128
CORKILL RD
MW-018
MW-017*
TCE 13.2
MW-026
TCE 1930
cis-1,2-DCE 169.
vinyl chloride 11.8
trans-1,2-DCE 33.4
ANDREWS RD
LEGEND
Monitoring Well Location
Well with COC concentration exceeding RACGs
TCE 110
Chemical Concentration in ppb
P920
Building Number
Existing Building and Structure
LUC Boundary for Property Transferred to the U.S. Marine Corps in 2005
LUC Boundary for Property Transferred to Kansas City in 2005
*
Well not included in LTM Network
N
100 0 100 200 Feet
CH2MHILL
FIGURE 13
SS 006 - Hazardous Material Storage Area
COC Exceeding RACGs
(August 2005)
Richards - Gebaur AFB, Kansas City, MO
2005 LTM Report

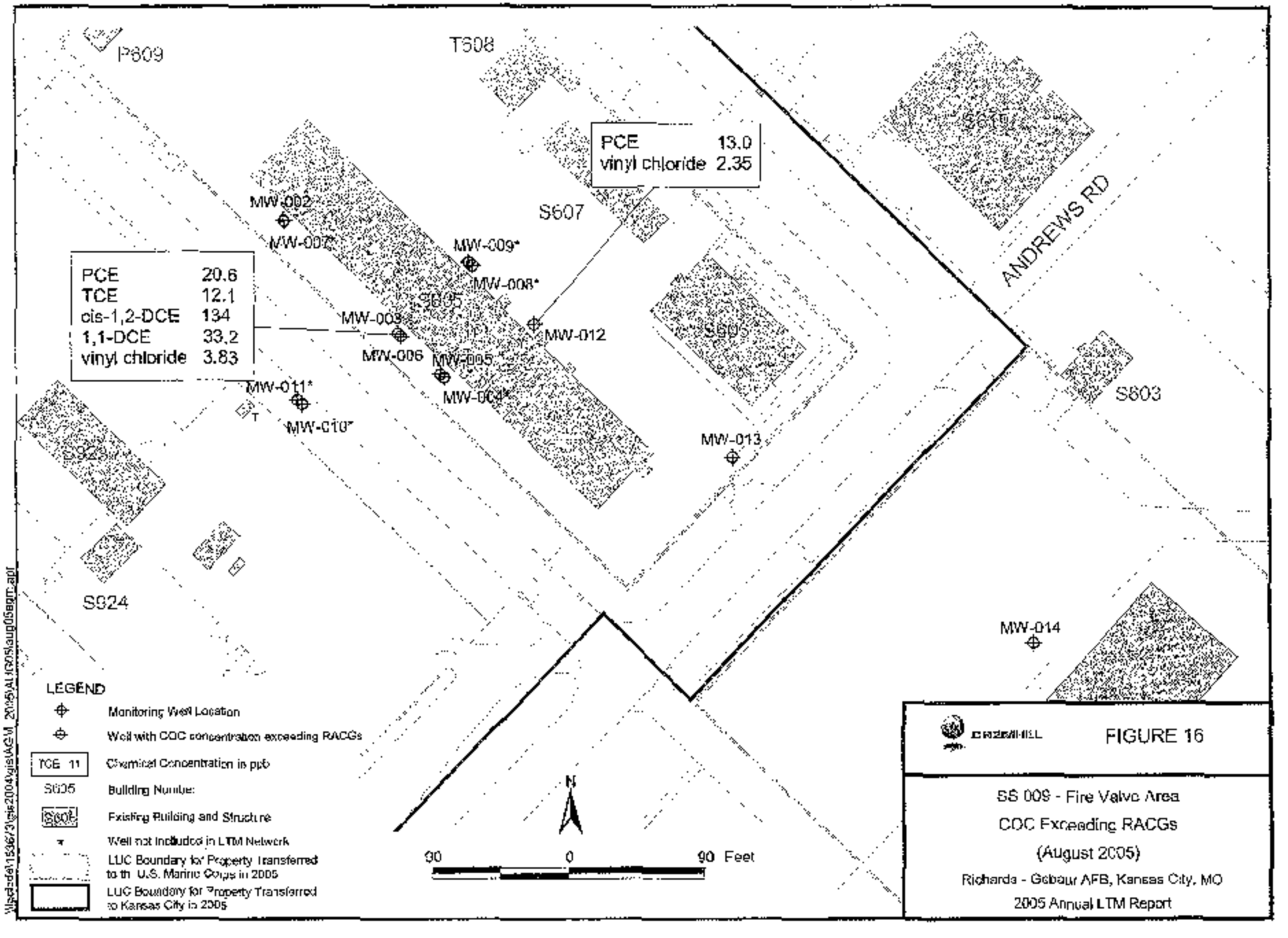
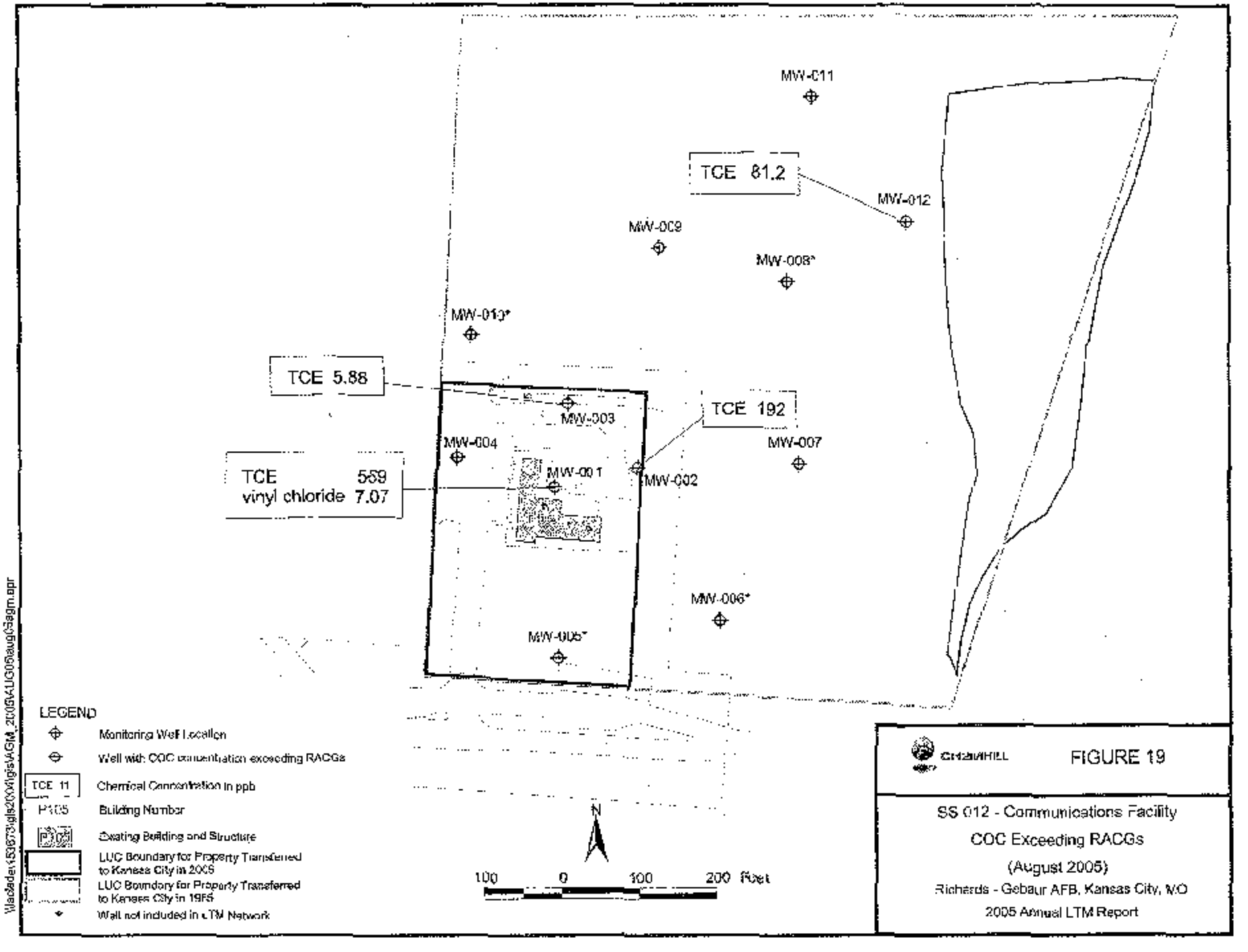
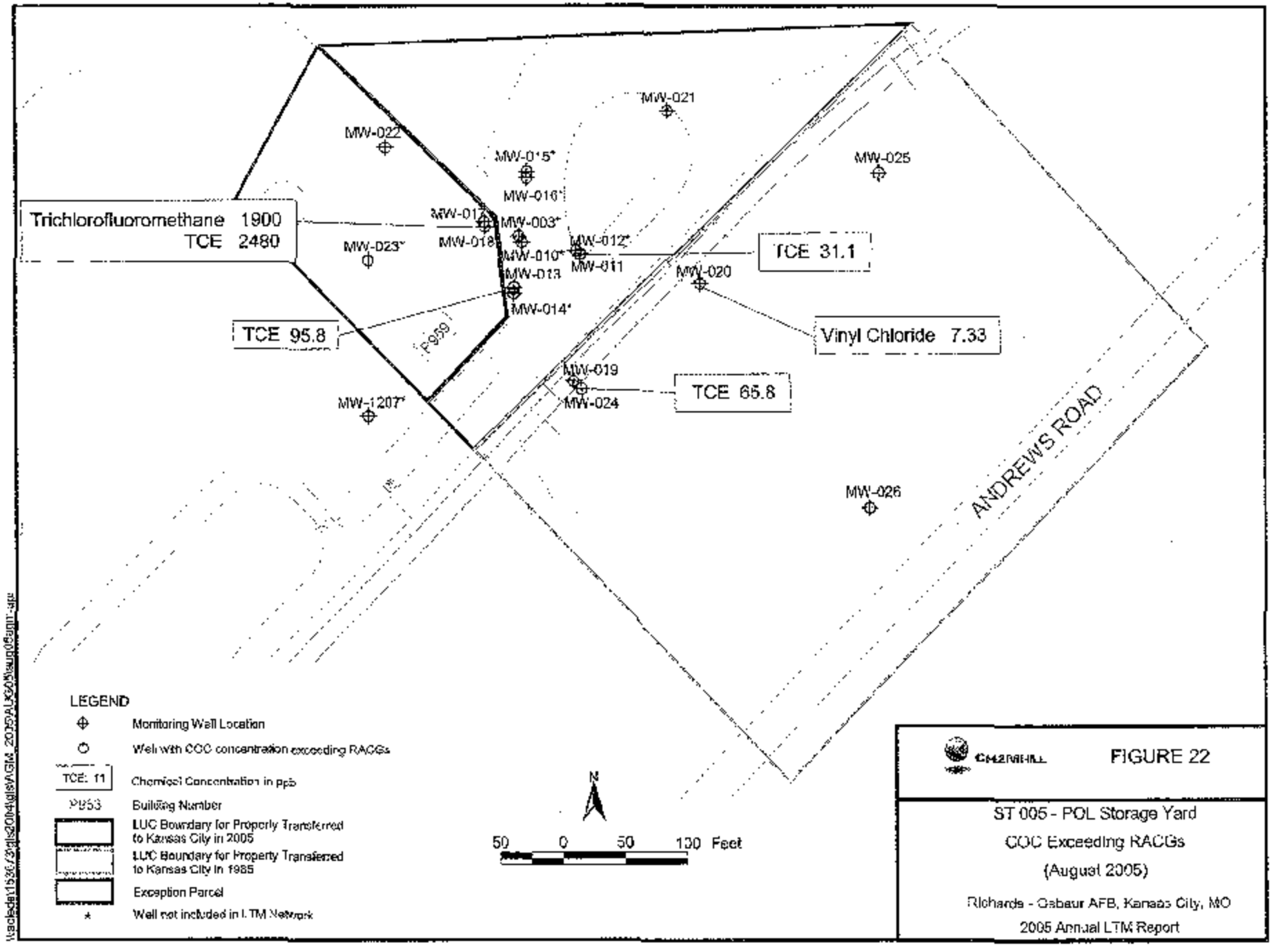


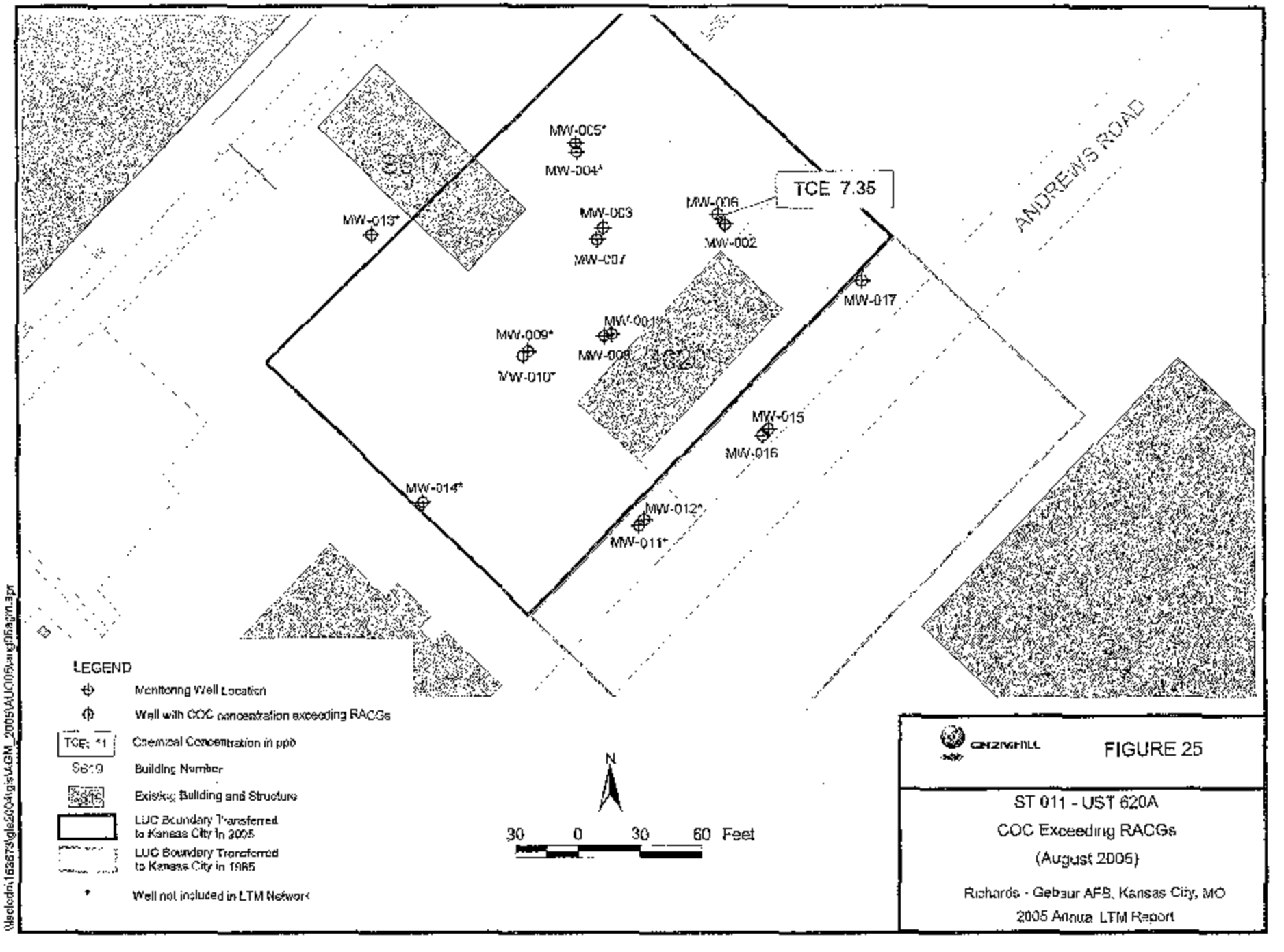
FIGURE 16

SS 009 - Fire Valve Area
COC Exceeding RACGs
(August 2005)
Richards - Gebaur AFB, Kansas City, MO
2005 Annual LTM Report

Wpadmin/11536/3/gis2004/gis/AGM_2005/AUG05/aug05sgrc.apr


MW-011
TCE 81.2
MW-012
MW-009
MW-008*
MW-010*
TCE 5.88
MW-003
TCE 192
MW-004
MW-007
TCE 569
vinyl chloride 7.07
MW-001
MW-002
MW-006*
MW-005*
LEGEND
Monitoring Well Location
Well with COC concentration exceeding RACGs
TCE 11
Chemical Concentration in ppb
P105
Building Number
Existing Building and Structure
LUC Boundary for Property Transferred to Kansas City in 2005
LUC Boundary for Property Transferred to Kansas City in 1995
Well not included in LTM Network
N
100 0 100 200 Feet
CH2MHILL
FIGURE 19
SS 012 - Communications Facility
COC Exceeding RACGs
(August 2005)
Richards - Gebaur AFB, Kansas City, MO
2005 Annual LTM Report


MW-021
MW-022
MW-015*
MW-016*
MW-025
Trichlorofluoromethane 1900
TCE 2480
MW-017
MW-003*
MW-023*
MW-018
MW-010*
MW-012*
MW-011
TCE 31.1
MW-013
MW-020
MW-014*
TCE 95.8
P959
Vinyl Chloride 7.33
MW-019
MW-024
TCE 65.8
MW-1207*
ANDREWS ROAD
MW-026
LEGEND
Monitoring Well Location
Well with COC concentration exceeding RACGs
TCE: 11
Chemical Concentration in ppb
P953
Building Number
LUC Boundary for Property Transferred to Kansas City in 2005
LUC Boundary for Property Transferred to Kansas City in 1985
Exception Parcel
Well not included in LTM Network
N
50 0 50 100 Feet
CH2MHILL
FIGURE 22
ST 005 - POL Storage Yard
COC Exceeding RACGs
(August 2005)
Richards - Gebaur AFB, Kansas City, MO
2005 Annual LTM Report



CH2MHILL

FIGURE 25

ST 011 - UST 620A

COC Exceeding RACGs

(August 2005)

Richards - Gebaur AFB, Kansas City, MO

2005 Annual LTM Report

APPENDIX B-3

LTM REPORT TREND GRAPHS

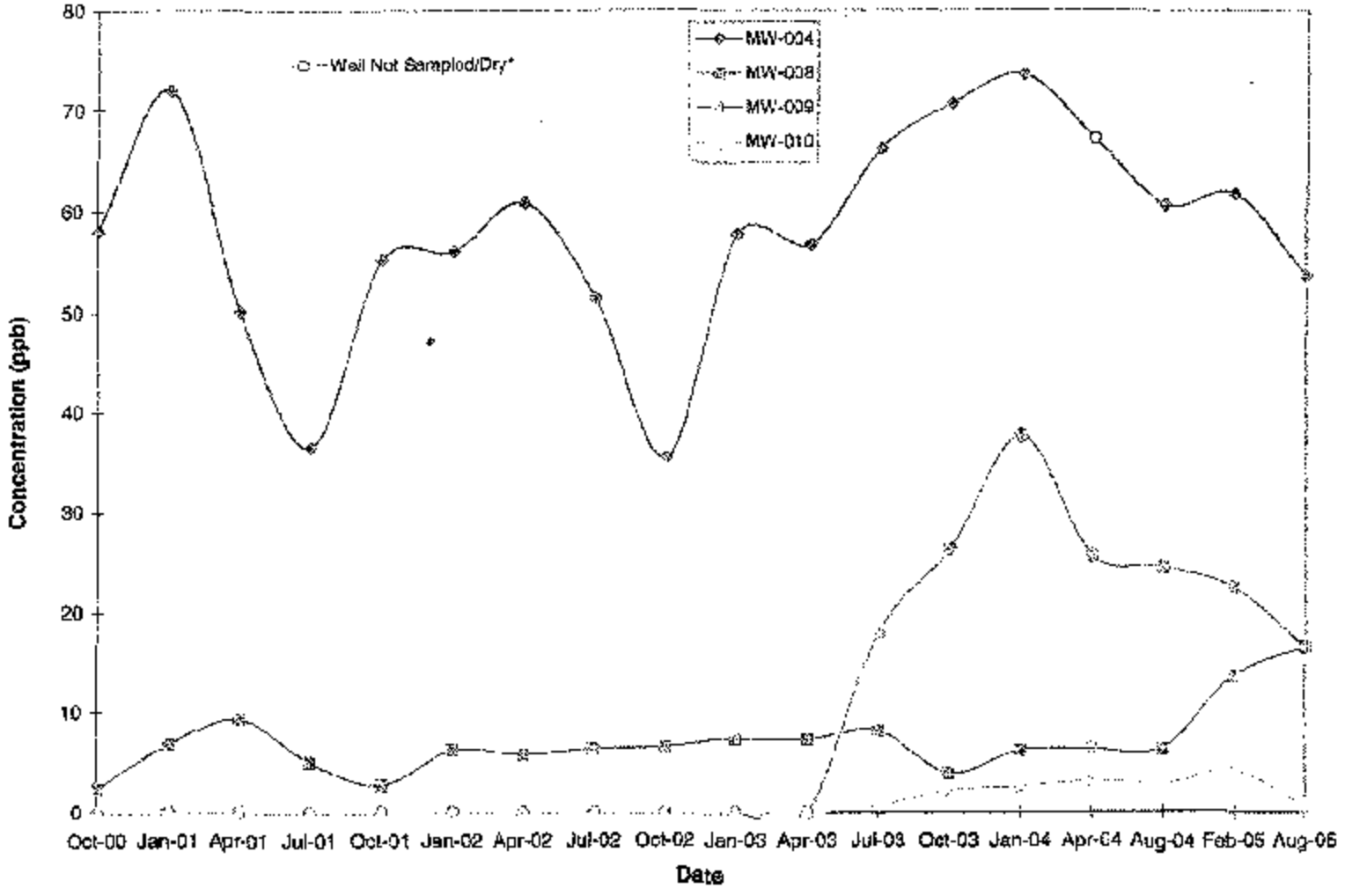
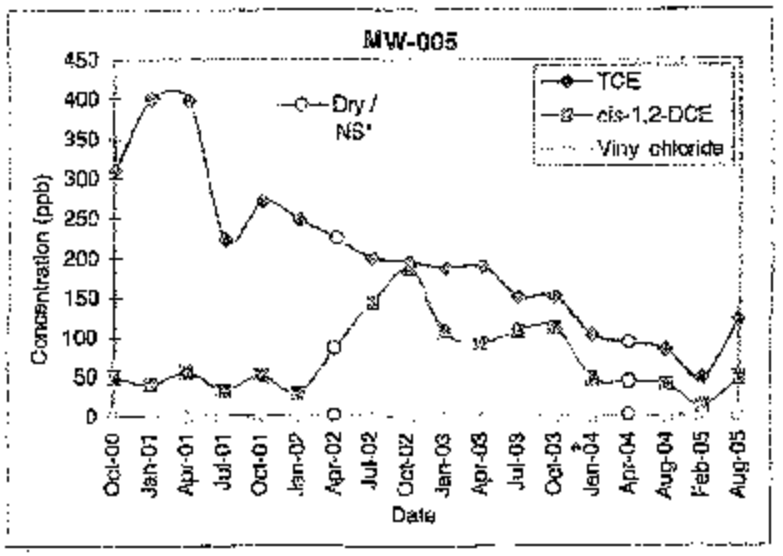
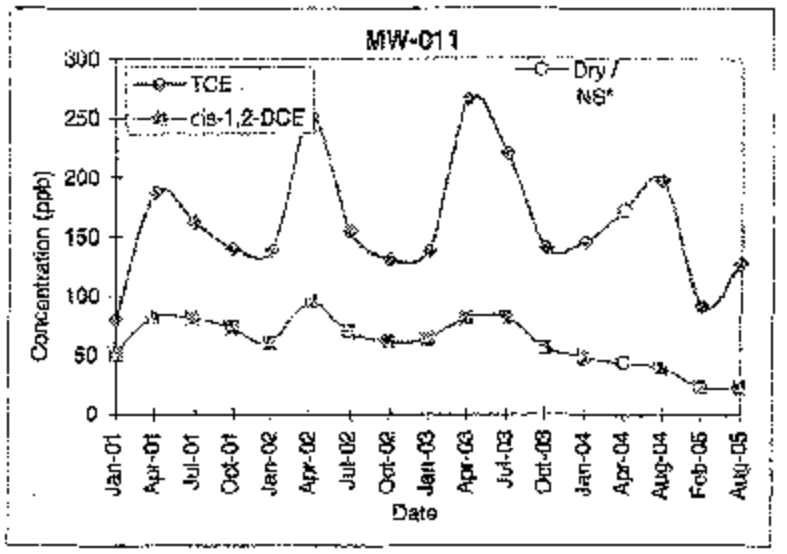
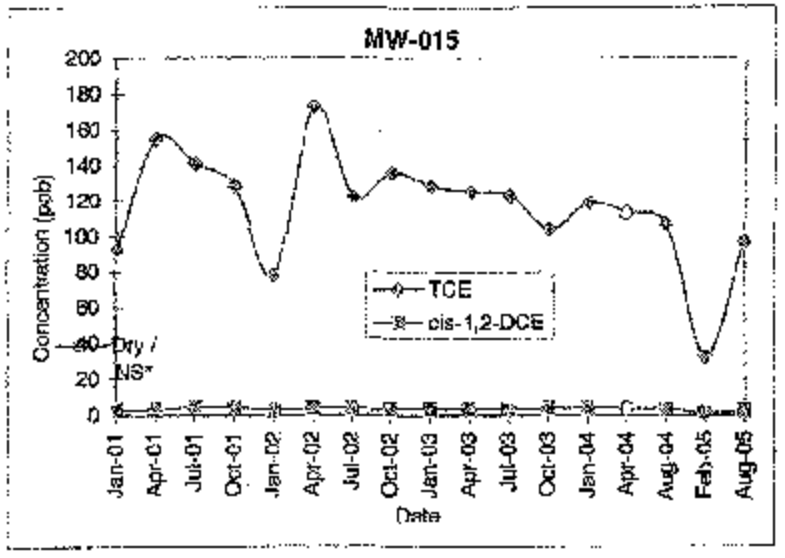


Figure 17: Temporal Trends of TCE in Groundwater at SS 003

*Well not sampled. Plotted as median between previous and subsequent data.







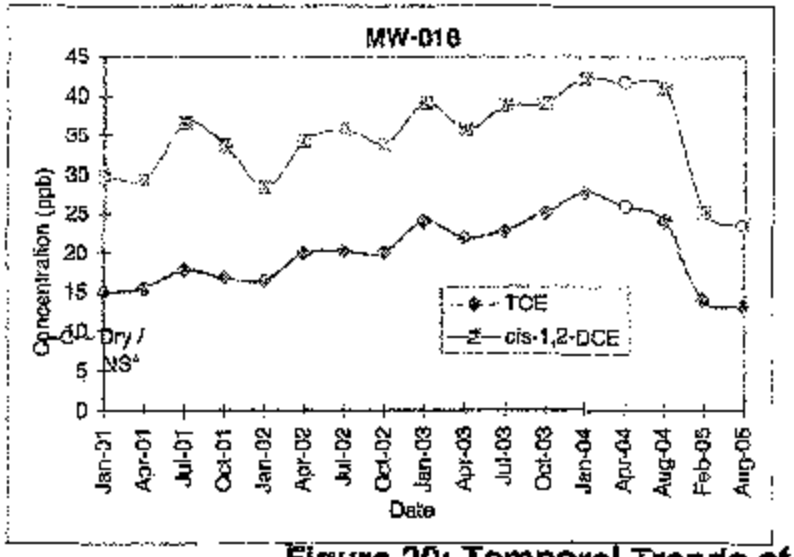
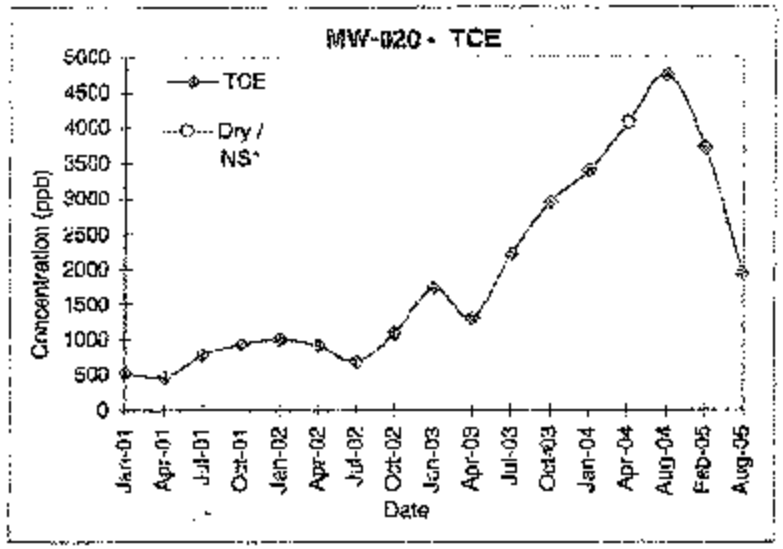
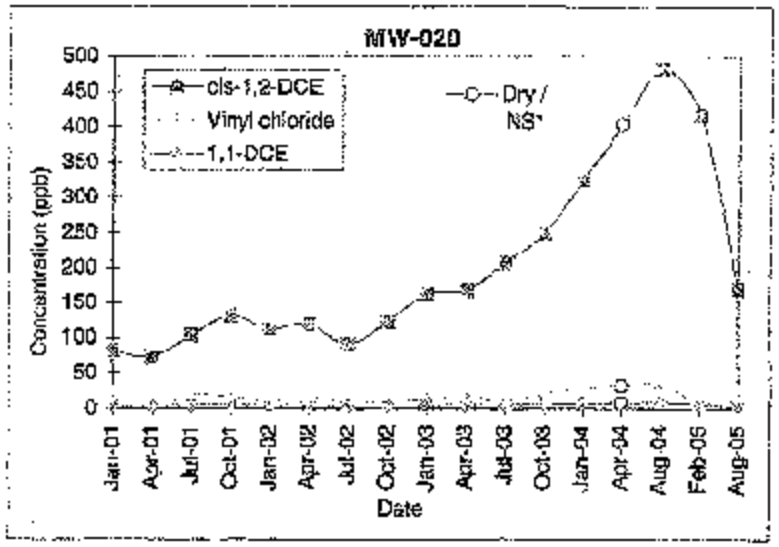


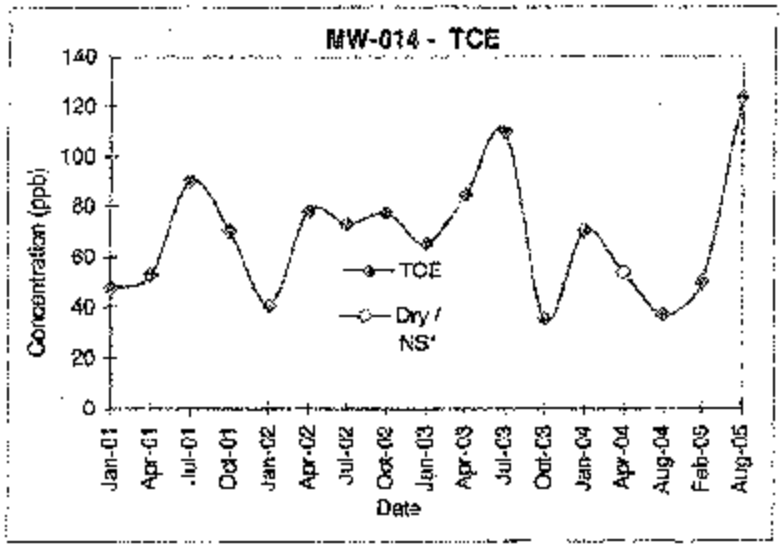
Figure 20: Temporal Trends of COCs in Groundwater at SS 006

*Well Not Sampled (NS).

Plotted as median between previous and subsequent date.







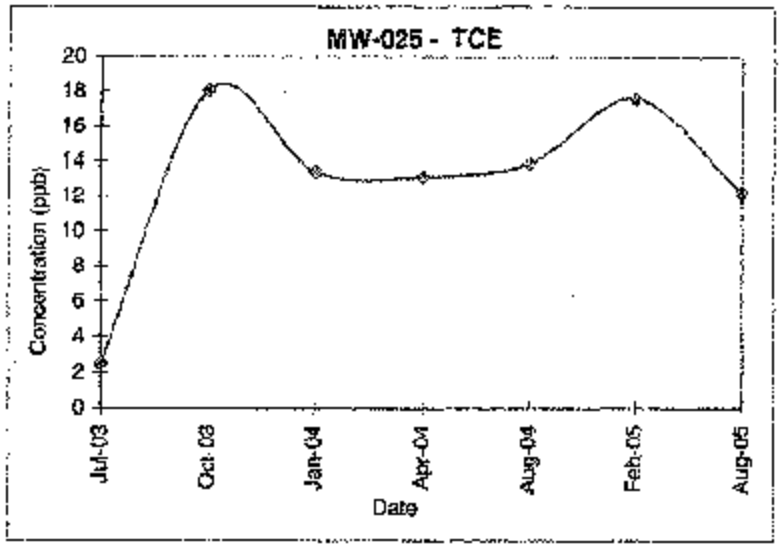
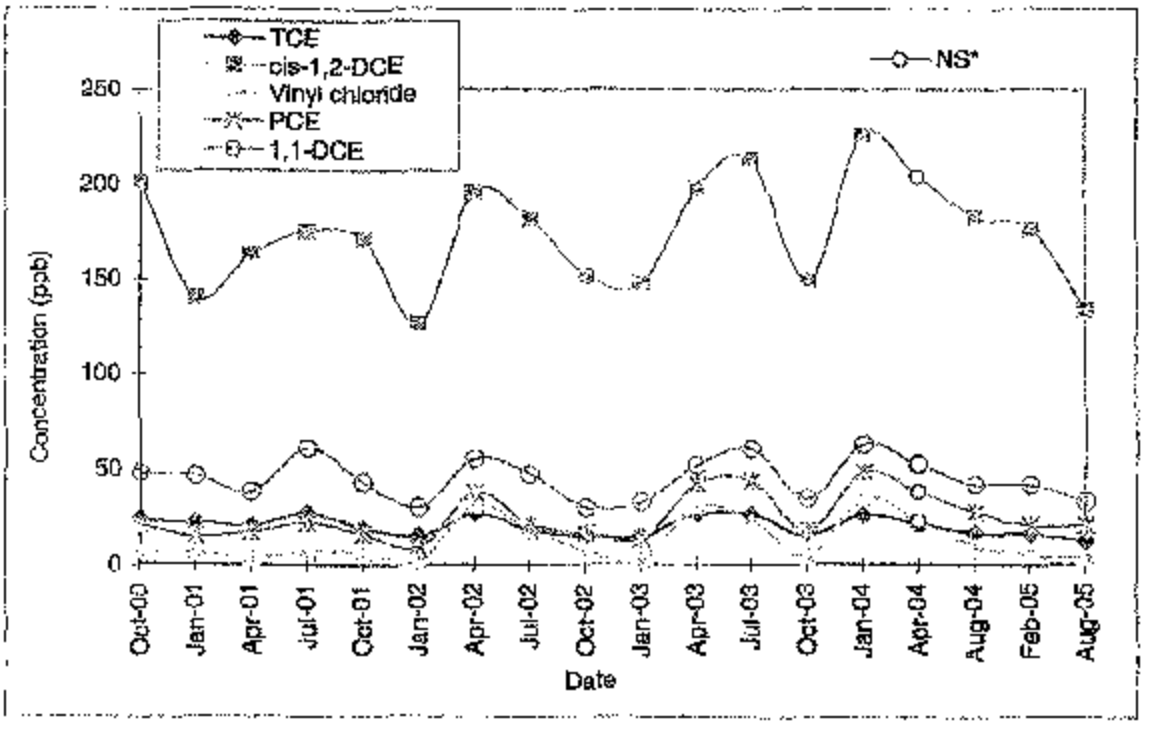


Figure 20: Temporal Trends of COCs in Groundwater at SS 006

*Well Not Sampled (NS).
Plotted as median between previous and subsequent data.



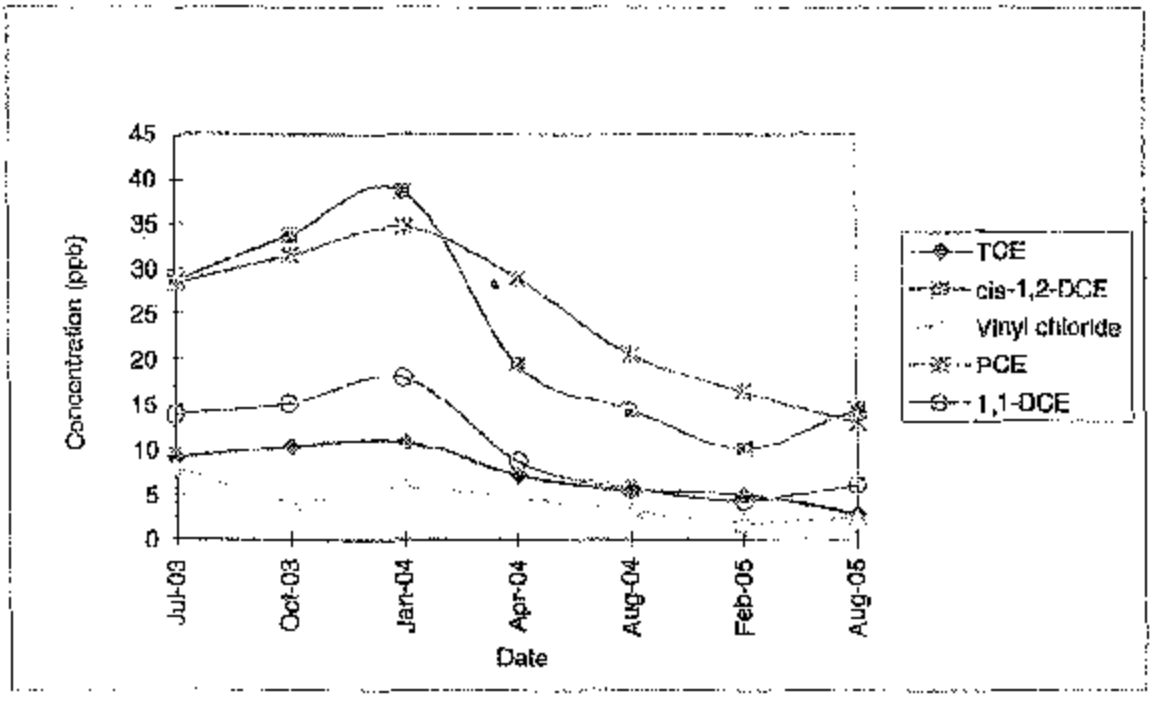
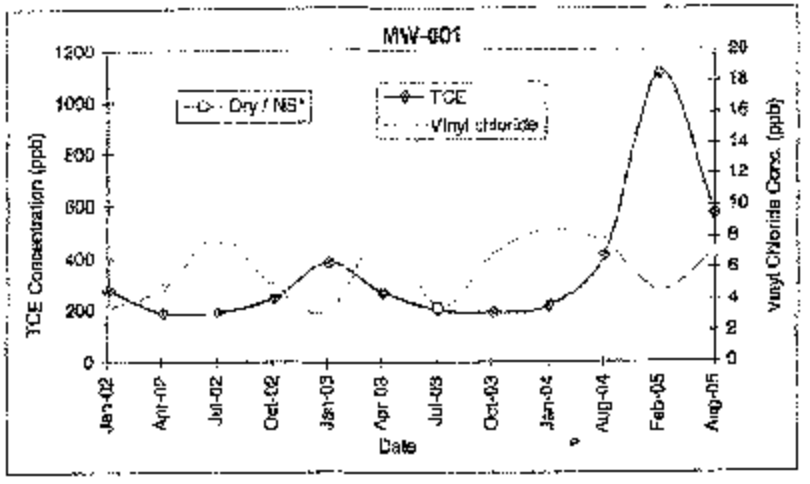
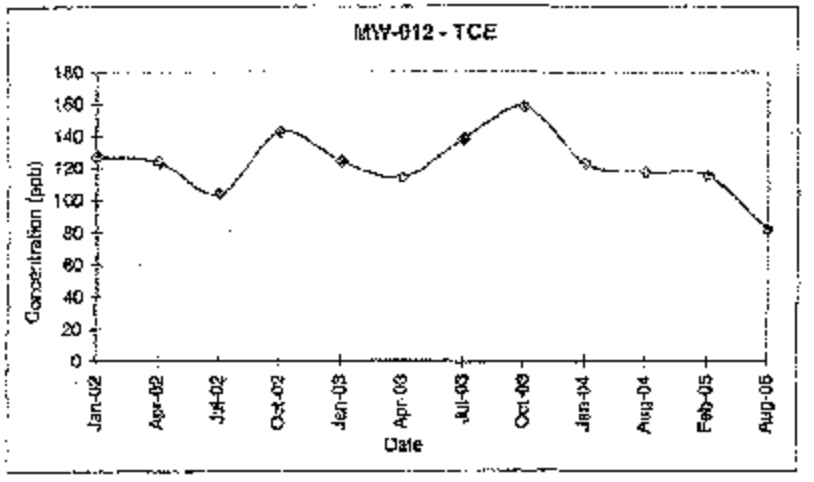
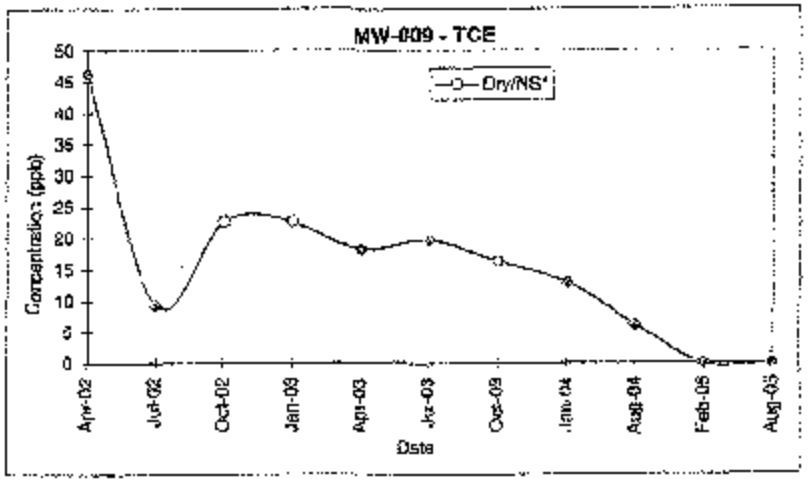


Figure 23: Temporal Trends of COCs in Groundwater at SS 009

*Well Not Sampled (NS). Plotted as median between previous and subsequent data.







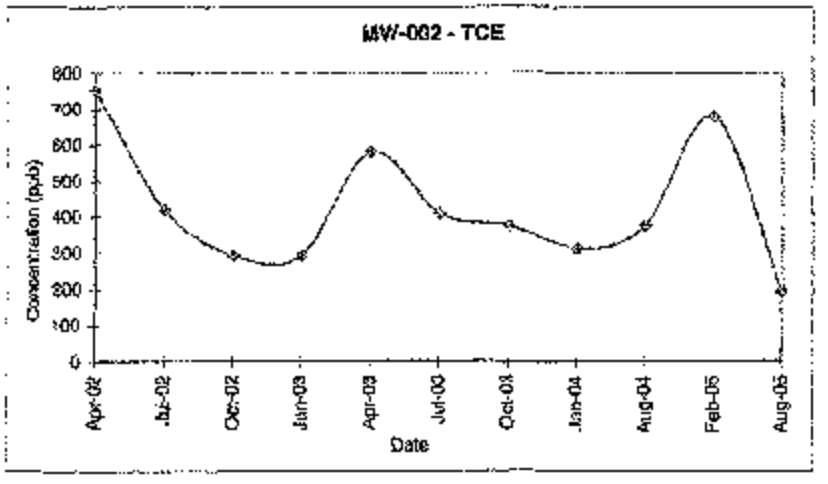


Figure 26: Temporal Trends of COCs in Groundwater at SS 012

*Well Not Sampled (NS). Plotted as median between previous and subsequent data.

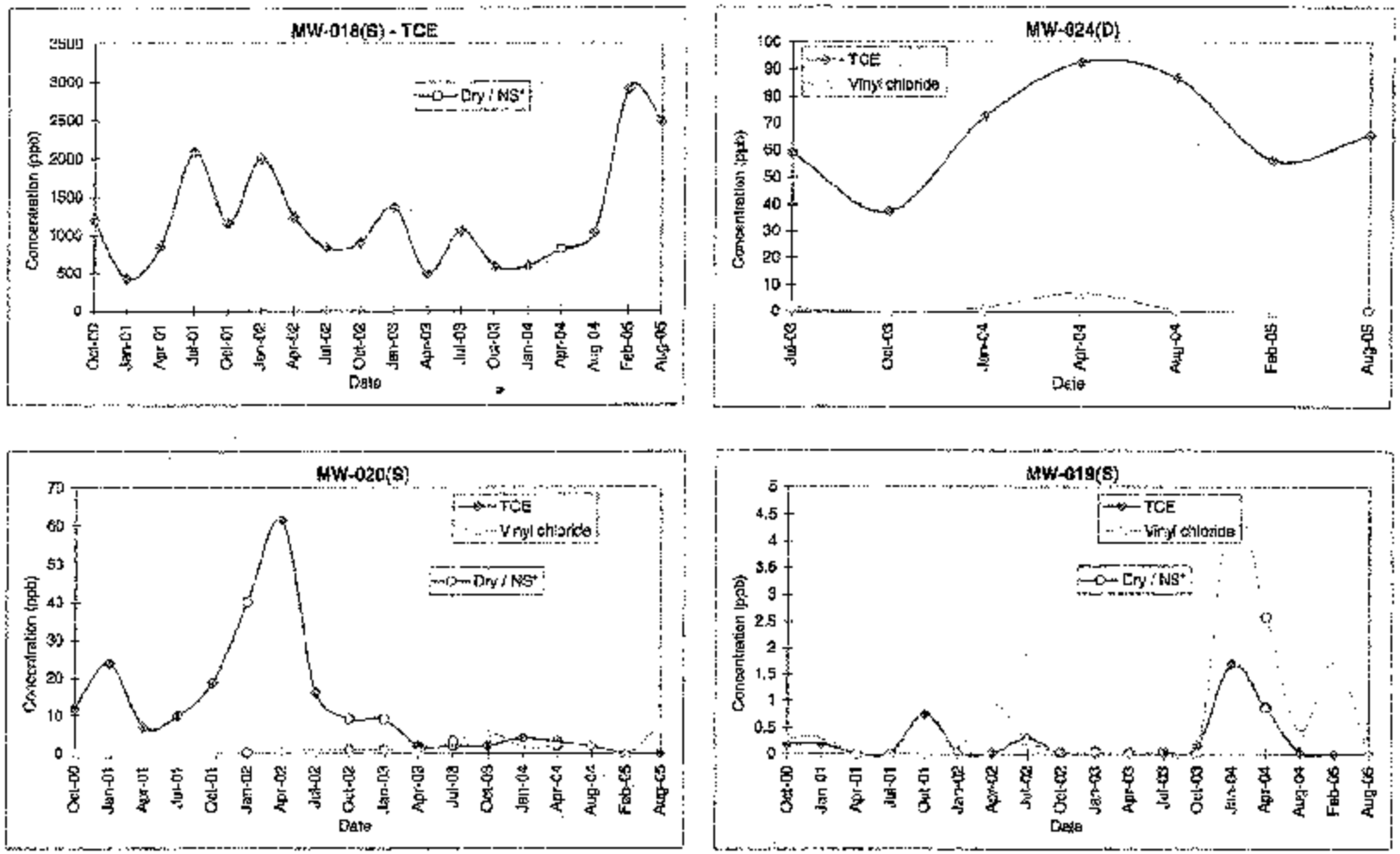


Figure 29: Temporal Trends of COCs in Groundwater at ST 005

*Well Not Sampled (NS). Plotted as median between previous and subsequent data.

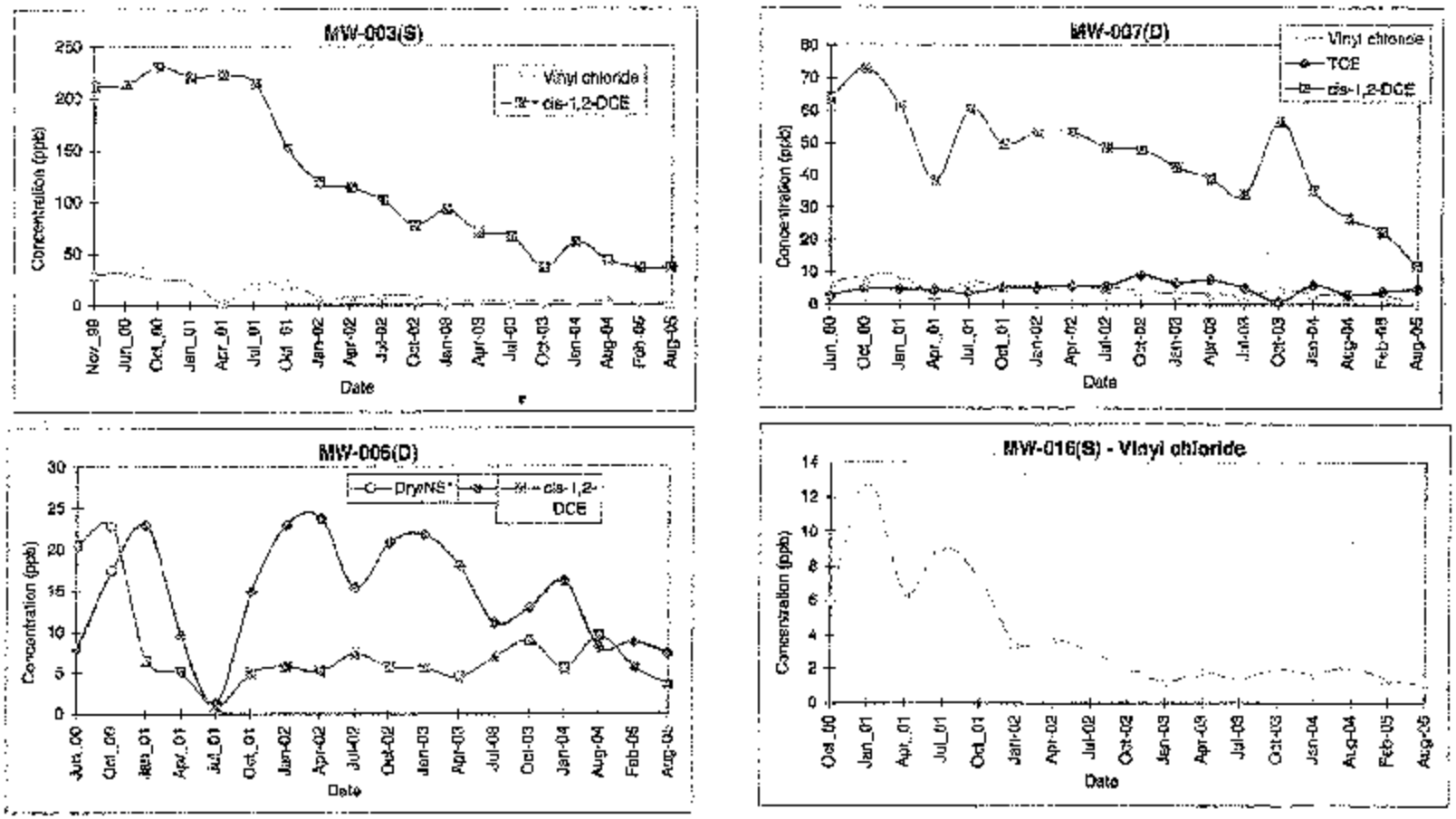


Figure 32: Temporal Trends of COCs in Groundwater at ST 011 (Former CS 004)

*Well Not Sampled (NS). Plotted as median between previous and subsequent data.

APPENDIX C

LAND USE CONTROL DOCUMENTATION

APPENDIX C-1

KANSAS CITY DEED

NOTICE

BREACH OF ANY ENVIRONMENTAL USE RESTRICTIVE COVENANT IN SECTION VII.B. BELOW, MAY AFFECT THE FOREGOING WARRANTY

B. Environmental Use Restrictive Covenants

1. For purposes of the environmental use restrictive covenants in this section, the term "Affected Property" include Property specifically described in Exhibit D to this Deed to which one or more of these environmental restrictive covenants may apply.

2. The following environmental use restrictive covenant(s) in this section is (are) being created to protect human health and the environment against (a) residual contaminant(s) as a component of the remedial action taken in Section A.2. above:

(a) For Operable Unit (OU) No. 1 Sites which include portions of FT002 (Fire Training Area), ST005 (Petroleum, Oil, Lubricant, or "POL" Yard), Area of Concern (AOC) 006, and Facility 1025 as depicted on **Exhibit D**, the Grantee is prohibited from using these areas for residential use. The Grantee is prohibited from subsurface drilling and excavation of residually contaminated soils on the portions of Affected Property described in this section B.2(a) unless it can be demonstrated to the satisfaction of the Federal and State regulatory agencies and the Grantor that there will be no adverse environmental impact on the Property or to the public.

(b) For OU-2 Sites which include portions of SS006, SS009, SS012, ST005, and ST011 as depicted on **Exhibit D**, the Grantee is prohibited from subsurface drilling, extraction and use of groundwater on the portions of Affected Property described in this section B.2(b) unless it can be demonstrated to the satisfaction of Federal and State regulatory agencies and the Grantor that there will be no adverse environmental impact on the Property or to the public.

(c) The Grantee covenants not to 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.

(d) The Grantee covenants not to disturb, interfere with, obstruct or impede any environmental investigation or remedial activity associated with environmental cleanup activities being conducted by the Government or to jeopardize the protectiveness of the environmental remedies put in place or to conduct or permit any activity that could negatively impact or restrict access for cleanup work on the Property.

3. It is the intent of the Grantor and the Grantee that the Environmental Use Restrictive Covenant(s) in this section bind the Grantee and shall run with the land. It is also the intent of the Grantor and the Grantee that the Grantor will retain the right to enforce any

restrictive covenant in this section through the chain of title, in addition to any State law that requires the State to enforce any restrictive covenant in this section. The Grantee covenants to insert all of this section in any deed to the Property that it delivers.

C. Modification or Release of Environmental Use Restrictive Covenant(s).

The Grantee may request from the United States a modification or release of one or more of the environmental use restrictive covenant(s) in whole or in part in this section, subject to the notification and concurrence or approval of the Missouri Department of Natural Resources ("MDNR"). In the event the request of the Grantee for modification or release is approved by the United States and MDNR, the United States agrees to modify or release the covenant(s), (the "Covenant Release") giving rise to such environmental use restriction in whole or in part. The Grantee understands and agrees that all costs associated with the Covenant Release shall be the sole responsibility of the Grantee, without any cost whatsoever to the United States. The United States shall deliver to the Grantee in recordable form the Covenant Release. The execution of the Covenant Release by the United States shall modify or release the environmental use restrictive covenant with respect to the Property in the Covenant Release.

APPENDIX C-2

U. S. MARINE CORPS MASTER PLAN

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

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

APPENDIX D

TOXICITY DATA EVALUATION

Appendix D

Toxicity Data Evaluation

Introduction

The Richards-Gebaur Air Force Base (AFB) five-year review process includes a review of the screening criteria, toxicity data, exposure assumptions, and remedial action objectives that were used at the time of remedy selection. The primary objective of this review is to determine whether these data, criteria, assumptions, and objectives are still protective of human health and the environment based on current land use scenarios. For example, a change in land use or new, more stringent toxicological data could effect the remedy selected in the ROD to such a degree that it would no longer be considered protective. This evaluation was performed for OU-1 (Soil), which included sites ST-005, FT-002, and for OU-2 (groundwater), which includes sites SS-003, SS-006, SS-009, ST-011 and SS-012.

Screening Criteria

As part of the Basewide Remedial Investigation (RI) Report completed in 2001, data from the investigation of soil and groundwater at the above referenced sites were compared with conservative screening criteria. For soil, the EPA Region 9 Preliminary Remediation Goals (PRGs) for residential soil and groundwater protection values based on a dilution attenuation factor (DAF) of 20 were the primary sources of screening criteria. The lowest value was selected as the screening criteria used in the Tier 1 risk evaluation to identify contaminants of concern (COCs). For groundwater, the PRGs for tap water and the Federal Maximum Contaminant Levels (MCLs) were the primary sources of screening criteria with the MCLs being selected in cases where values from both sources were available. Tables 1 and 2, respectively, provide a comparison of screening criteria for soil and groundwater used at the time of remedy selection with current comparable screening criteria selected from the same sources (e.g., PRGs and MCLs).

Soil

Table 1 indicates that multiple changes in screening criteria for contaminants identified in soil have occurred since the RI was completed in 2001. However, as indicated in the notes column of Table 1 and described below, none of the changes in screening criteria were likely to have a significant influence on the protectiveness of the selected remedies. The following bullets provide a brief summary of the screening criteria evaluation provided in Table 1. Contaminants for which screening criteria did not change are not addressed.

Table 1
Operable Unit 1 (Soil) Screening Level Evaluation

	Soil and Sediment Screening Criteria										
Chemicals	2000 Residential PRG	Current Residential PRG	2000 Industrial PRG	Current Industrial PRG	2000 Groundwater Protection Value (DAF=20)	Current Groundwater Protection Value (DAF=20)	Screening Criteria at the Time of Remedy Selection	Comparable Current Criteria	Screening Criteria Percent Change	Screening Criteria Change Significantly Impacts Remedy	Note
Aluminum	7.6E+04	3.5E+02	1.0E+05	1.0E+05	-	-	7.60E+04	3.48E+02	-99.54%	No	Naturally occurring; Excluded as a COC based on background
Antimony	3.1E+01	3.1E+01	8.2E+02	4.1E+02	5.0E+00	5.0E+00	5.00E+00	5.00E+00	0.00%	No	No significant change in screening level
Arsenic[1]	3.9E-01	3.9E-01	2.7E+00	1.6E+00	2.9E+01	2.9E+01	1.80E+01	3.90E-01	0.00%	No	Naturally occurring; Excluded as a COC based on background
Barium	5.4E+03	5.4E+03	1.0E+05	6.7E+04	1.6E+03	1.6E+03	1.60E+03	1.60E+03	0.00%	No	No significant change in screening level
Benzene	6.7E-01	6.4E-01	1.5E+00	1.4E+00	3.0E-02	3.0E-02	3.00E-02	3.00E-02	0.00%	No	No significant change in screening level; Retained as COC
Beryllium	1.5E+02	1.5E+02	2.2E+03	1.9E+03	6.3E+01	6.3E+01	6.30E+01	6.30E+01	0.00%	No	No significant change in screening level
Bis(2-chloroethyl)ether	2.1E-01	2.2E-01	6.2E-01	5.8E-01	4.0E-04	4.0E-04	4.00E-04	4.00E-04	0.00%	No	No significant change in screening level
Bis(2-chloroisopropyl)ether	2.9E+00	2.9E+00	8.1E+00	7.4E+00	-	-	2.90E+00	2.88E+00	-0.54%	No	No significant change in screening level
Bis(2-ethylhexyl)phthalate	3.5E+01	3.5E+01	1.8E+02	1.2E+02	-	-	3.50E+01	3.47E+01	-0.74%	No	No significant change in screening level
Cadmium	3.7E+01	3.7E+01	8.1E+02	4.5E+02	8.0E+00	8.0E+00	8.00E+00	8.00E+00	0.00%	No	No significant change in screening level
Chromium[1]	2.1E+02	2.1E+02	4.5E+02	4.5E+02	3.8E+01	3.8E+01	4.50E+01	3.80E+01	0.00%	No	Naturally occurring; Excluded as a COC based on frequency of detection
Dibenzofuran	2.9E+02	1.5E+02	5.1E+03	1.6E+03	-	-	2.90E+02	1.45E+02	-49.91%	No	Contaminant not detected in soil and not selected as a COC
Dibromochloromethane	1.1E+00	1.1E+00	2.7E+00	2.6E+00	4.0E-01	4.0E-01	4.00E-01	4.00E-01	0.00%	No	No significant change in screening level
3,3-Dichlorobenzidine	1.1E+00	1.1E+00	5.5E+00	3.8E+00	7.0E-03	7.0E-03	7.00E-03	7.00E-03	0.00%	No	No significant change in screening level
1,1-Dichloroethane	5.9E+02	5.1E+02	3.1E+03	1.7E+03	2.3E+01	2.3E+01	2.30E+01	2.30E+01	0.00%	No	No significant change in screening level
1,1-Dichloroethylene	5.4E-02	1.2E+02	1.2E-01	4.1E+02	6.0E-02	6.0E-02	5.40E-02	1.24E+02	228660.51%	No	Maximum detected concentrations less than new, higher screening level
1,2-Dichloroethylene (cis)	4.3E+01	4.3E+01	1.5E+02	1.5E+02	4.0E-01	4.0E-01	4.00E-01	4.00E-01	0.00%	No	No significant change in screening level
1,2-Dichloroethylene (trans)	6.3E+01	6.9E+01	2.1E+02	2.3E+02	7.0E-01	7.0E-01	7.00E-01	6.95E+01	9827.09%	No	Maximum detected concentrations less than new, higher screening level
1,2-Dichloropropane	3.5E-01	3.4E-01	7.7E-01	7.4E-01	3.0E-02	3.0E-02	3.00E-02	3.00E-02	0.00%	No	No significant change in screening level
Ethylbenzene	2.3E+02	4.0E+02	2.3E+02	4.0E+02	1.3E+01	1.3E+01	1.30E+01	3.95E+02	2938.46%	No	Maximum detected concentrations less than new, higher screening level
Iron[1]	2.3E+04	2.3E+04	1.0E+05	1.0E+05	-	-	4.95E+04	2.30E+04	0.00%	No	Naturally occurring; Excluded as a COC based on background
Lead	4.0E+02	4.0E+02	1.0E+03	8.0E+02	-	-	4.00E+02	4.00E+02	0.00%	No	No significant change in screening level
Manganese[1]	1.8E+03	1.8E+03	3.2E+04	1.9E+04	-	-	2.37E+03	1.80E+03	0.00%	No	Naturally occurring; Excluded as a COC based on background
Nickel	1.6E+03	1.6E+03	4.1E+04	2.0E+04	1.3E+02	1.3E+02	1.30E+02	1.30E+02	0.00%	No	No significant change in screening level
PCBs											
Arochlor 1260	2.2E-01	2.2E-01	1.0E+00	7.4E-01	-	-	2.20E-01	2.22E-01	0.84%	No	No significant change in screening level

Table 1 (continued)

	Soil and Sediment Screening Criteria										
Chemicals	2000 Residential PRG	Current Residential PRG	2000 Industrial PRG	Current Industrial PRG	2000 Groundwater Protection Value (DAF=20)	Current Groundwater Protection Value (DAF=20)	Screening Criteria at the Time of Remedy Selection	Comparable Current Criteria	Screening Criteria Percent Change	Screening Criteria Change Significantly Impacts Remedy	Note
PAHs											
Benzo(a)anthracene	6.2E-01	6.2E-01	2.9E+00	2.1E+00	2.0E+00	2.0E+00	6.20E-01	6.21E-01	0.23%	No	No significant change in screening level; Retained as COC
Benzo(b)fluoranthene	6.2E-01	6.2E-01	2.9E+00	2.1E+00	5.0E+00	5.0E+00	6.20E-01	6.21E-01	0.23%	No	No significant change in screening level
Benzo(k)fluoranthene	6.2E+00	6.2E+00	2.9E+01	2.1E+01	4.9E+01	4.9E+01	6.20E+00	6.21E+00	0.23%	No	No significant change in screening level
Benzo(a)pyrene	6.2E-02	6.2E-02	2.9E-01	2.1E-01	8.0E+00	8.0E+00	6.20E-02	6.21E-02	0.23%	No	No significant change in screening level; Retained as COC
Chrysene	6.2E+01	6.2E+01	2.9E+02	2.1E+02	1.6E+02	1.6E+02	6.20E+01	6.21E+01	0.23%	No	No significant change in screening level
Dibenz(a,h)anthracene	6.2E-02	6.2E-02	2.9E-01	2.1E-01	2.0E+00	2.0E+00	6.20E-02	6.21E-02	0.23%	No	No significant change in screening level; Retained as COC
Indeno(1,2,3-cd)pyrene	6.2E-01	6.2E-01	2.9E+00	2.1E+00	1.4E+01	1.4E+01	6.20E-01	6.21E-01	0.23%	No	No significant change in screening level
Naphthalene	5.6E+01	5.6E+01	1.9E+02	1.9E+02	8.4E+01	8.4E+01	5.60E+01	5.59E+01	-0.15%	No	No significant change in screening level
1,1,2,2-Tetrachloroethane	3.8E-01	4.1E-01	9.0E-01	9.3E-01	3.0E-03	3.0E-03	3.00E-03	4.08E-01	13487.29%	No	Maximum detected concentrations less than new, higher screening level
Toluene	5.2E+02	5.2E+02	5.2E+02	5.2E+02	1.2E+01	1.2E+01	1.20E+01	1.20E+01	0.00%	No	No significant change in screening level
Trichloroethylene	2.8E+00	5.3E-02	6.1E+00	1.1E-01	6.0E-02	6.0E-02	6.00E-02	5.30E-02	-11.69%	No	Selected as a COC and evaluated in risk assessment
Vanadium	5.5E+02	7.8E+01	1.4E+04	1.0E+03	6.0E+03	6.0E+03	5.50E+02	7.82E+01	-85.78%	No	Contaminant not detected in soil and not selected as a COC
Vinyl chloride	2.2E-02	7.9E-02	4.9E-02	7.5E-01	1.0E-02	1.0E-02	1.00E-02	7.91E-02	690.68%	No	Maximum detected concentrations less than new, higher screening level
Xylenes	2.1E+02	2.7E+02	2.1E+02	4.2E+02	2.1E+02	2.1E+02	2.10E+02	2.71E+02	28.87%	No	Contaminant not detected in soil and not selected as a COC
TPH combined	NA	NA	NA	NA	NA	NA	2.0E+02	NA	-	No	**Significant increase in screening levels for TPH fractions warrants additional evaluation to determine whether sites can be closed based on residual concentrations**
TPH GRO	NA	2.9E+04	NA	5.2E+04	NA	3.8E+04	NA	2.90E+04	-	No	
TPH DRO	NA	5.6E+04	NA	4.0E+05	NA	4.8E+10	NA	5.60E+04	-	No	

1 - Criteria at the time of remedy selection was based on the reporting limit.

- PRGs for 1,1-dichloroethylene, trans 1,2-dichloroethylene, ethyl benzene, 1,1,2,2-tetrachloroethane, vinyl chloride, and xylenes increased or became less conservative and, therefore, will not influence the protectiveness of the remedy.
- PRGs for aluminum, dibenzofuran, and vanadium decreased significantly; however, these contaminants were not detected at concentrations greater than the currently comparable screening criteria. In addition, aluminum and vanadium were excluded from the risk assessment because they are naturally occurring in soil and based on a background evaluation of soil at Richards-Gebaur AFB
- PRGs for trichloroethylene (TCE) decreased because a new provisional toxicity factor was used; however, the new toxicity factor is still highly controversial and is not widely accepted in scientific or regulatory spheres. As a result, EPA Region 7 does rely solely on the new PRG for TCE, but considers this value within the context of available toxicity values (i.e., CalEPA value, old IRIS value, etc.). The remedy that was selected considered exposure to TCE, and therefore, remains protective.

For some contaminants, a reporting limit was selected as the soil screening level where the reporting limit for a particular analytical method was significantly greater than other screening criteria available at the time of the RI. These contaminants include arsenic, chromium, iron, and manganese. In each case, the reporting limit that was used as the screening criteria for the RI exceeds the currently available screening criteria. However, each of these contaminants are naturally occurring and were excluded from further consideration in the risk assessment based on a background evaluation of soil at Richards-Gebaur AFB.

Groundwater

Table 2 indicates that multiple changes in screening criteria for contaminants identified in groundwater have occurred since the RI was completed in 2001. However, as indicated in the notes column, only one of the changes in screening criteria was likely to have a potentially significant influence on the protectiveness of the selected remedies. The following bullets provide a brief summary of the screening criteria evaluation provided in Table 2. Contaminants for which screening criteria did not change are not addressed.

- PRGs for aluminum, 1,1-dichloroethane, bis(2-chloroethyl)ether, bis(2-chloroisopropyl)ether, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, dibromochloromethane, indeno(1,2,3-cd)pyrene, naphthalene, and 1,1,2,2-tetrachloroethane increased or became less conservative and, therefore, will not influence the protectiveness of the remedy.

- The PRG for vanadium decreased or became more conservative; however, these contaminants were excluded from the risk assessment because they are naturally

Table 2
Operable Unit 2 (groundwater) Screening Level Evaluation

	Groundwater Screening Criteria								
Chemicals	2000 Tap Water PRG	Current Residential Tap Water PRG	2000 Maximum Contaminant Level	Current Maximum Contaminant Level	Screening Criteria at the Time of Remedy Selection	Comparable Current Criteria	Screening Criteria Percent Change	Screening Criteria Change Significantly Impacts Remedy	Note
Aluminum	3.60E+04	3.65E+04	-	-	3.60E+04	3.65E+04	1.39%	No	No significant change in screening level
Antimony[1]	1.50E+01	1.46E+01	6.00E+00	6.00E+00	6.00E+00	6.00E+00	0.00%	No	No significant change in screening level
Arsenic[1]	4.50E-02	4.48E-02	5.00E+01	1.00E+01	5.00E+01	1.00E+01	-80.00%	YES	Significant change in screening levels that required additional evaluation
Barium[1]	2.60E+03	2.55E+03	2.00E+03	2.00E+03	2.00E+03	2.00E+03	0.00%	No	No significant change in screening level
Benzene[1]	4.10E-01	3.54E-01	5.00E+00	5.00E+00	5.00E+00	5.00E+00	0.00%	No	No significant change in screening level
Beryllium[1]	7.30E+01	7.30E+01	4.00E+00	4.00E+00	4.00E+00	4.00E+00	0.00%	No	No significant change in screening level
Bis(2-chloroethyl)ether[2]	9.80E-03	1.02E-02	-	-	1.00E+01	1.02E-02	3.95%	No	Contaminant not detected in groundwater and not selected as a COC
Bis(2-chloroisopropyl)ether[2]	2.70E-01	2.74E-01	-	-	1.00E+01	2.74E-01	1.64%	No	Contaminant not detected in groundwater and not selected as a COC
Bis(2-ethylhexyl)phthalate[1,2]	4.80E+00	4.80E+00	6.00E+00	6.00E+00	1.00E+01	6.00E+00	0.00%	No	Contaminant not detected in groundwater and not selected as a COC
Cadmium[1,2]	1.80E+01	1.82E+01	5.00E+00	5.00E+00	7.00E+00	5.00E+00	0.00%	No	Naturally occurring; Excluded as a COC based on background
Chromium[1]	NA	-	1.00E+02	1.00E+02	1.00E+02	1.00E+02	0.00%	No	No significant change in screening level
Dibenzofuran	2.40E+01	1.22E+01	-	-	2.40E+01	1.22E+01	-49.31%	No	Contaminant not detected in groundwater and not selected as a COC
Dibromochloromethane[2]	1.30E-01	1.33E-01	-	-	5.00E-01	1.33E-01	2.62%	No	Contaminant not detected in groundwater and not selected as a COC
3,3-Dichlorobenzidine[2]	1.50E-01	1.49E-01	-	-	2.00E+01	1.49E-01	-0.40%	No	Contaminant not detected in groundwater and not selected as a COC
1,1-Dichloroethane	8.10E+02	8.11E+02	-	-	8.10E+02	8.11E+02	0.14%	No	No significant change in screening level
1,1-Dichloroethylene[1]	4.60E-02	3.39E+02	7.00E+00	7.00E+00	7.00E+00	7.00E+00	0.00%	No	No significant change in screening level; Retained as COC
1,2-Dichloroethylene (cis)[1]	6.10E+01	6.08E+01	7.00E+01	7.00E+01	7.00E+01	7.00E+01	0.00%	No	No significant change in screening level; Retained as COC
1,2-Dichloroethylene (trans)[1]	1.20E+02	1.22E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	0.00%	No	No significant change in screening level
1,2-Dichloropropane[1]	1.60E-01	1.65E-01	5.00E+00	5.00E+00	5.00E+00	5.00E+00	0.00%	No	No significant change in screening level
Ethylbenzene[1]	1.30E+03	1.34E+03	7.00E+02	7.00E+02	7.00E+02	7.00E+02	0.00%	No	No significant change in screening level
Iron[1]	1.10E+04	1.09E+04	3.00E+02	3.00E+02	3.00E+02	3.00E+02	0.00%	No	No significant change in screening level; Naturally occurring contaminant
Lead[1]	-	-	1.50E+01	1.50E+01	1.50E+01	1.50E+01	0.00%	No	No significant change in screening level; Naturally occurring contaminant
Manganese[1]	8.80E+02	8.76E+02	5.00E+01	5.00E+01	5.00E+01	5.00E+01	0.00%	No	No significant change in screening level; Naturally occurring contaminant
Nickel	7.30E+02	7.30E+02	1.00E+02	-	1.00E+02	7.30E+02	630.00%	No	Naturally occurring; Excluded as a COC based on background
PCBs			-	-					
Arochlor 1260[1,2]	3.40E-02	3.36E-02	5.00E-01	5.00E-01	1.00E+00	5.00E-01	0.00%	No	Contaminant not detected in groundwater and not selected as a COC

Table 2 (continued)

	Groundwater Screening Criteria								
Chemicals	2000 Tap Water PRG	Current Residential Tap Water PRG	2000 Maximum Contaminant Level	Current Maximum Contaminant Level	Screening Criteria at the Time of Remedy Selection	Comparable Current Criteria	Screening Criteria Percent Change	Screening Criteria Change Significantly Impacts Remedy	Note
PAHs			-	-					
Benzo(a)anthracene[2]	9.20E-02	9.21E-02	-	-	1.00E+01	9.21E-02	0.11%	No	Contaminant not detected in groundwater and not selected as a COC
Benzo(b)fluoranthene[2]	9.20E-02	9.21E-02	-	-	1.00E+01	9.21E-02	0.11%	No	Contaminant not detected in groundwater and not selected as a COC
Benzo(k)fluoranthene[2]	9.20E-01	9.21E-01	-	-	1.00E+01	9.21E-01	0.11%	No	Contaminant not detected in groundwater and not selected as a COC
Benzo(a)pyrene[1, 2]	9.20E-03	9.21E-03	2.00E-01	2.00E-01	1.00E+01	2.00E-01	0.00%	No	Contaminant not detected in groundwater and not selected as a COC
Chrysene[2]	9.20E+00	9.21E+00	-	-	1.00E+01	9.21E+00	0.11%	No	Contaminant not detected in groundwater and not selected as a COC
Dibenz(a,h)anthracene[2]	9.20E-03	9.21E-03	-	-	1.00E+01	9.21E-03	0.11%	No	Contaminant not detected in groundwater and not selected as a COC
Indeno(1,2,3-cd)pyrene[2]	9.20E-02	9.21E-02	-	-	1.00E+01	9.21E-02	0.11%	No	Contaminant not detected in groundwater and not selected as a COC
Naphthalene[2]	6.20E+00	6.20E+00	-	-	1.00E+01	6.20E+00	0.05%	No	Excluded as COC due to detection in unrepresentative groundwater sample
Tetrachloroethylene[1]	1.10E+00	1.04E-01	5.00E-03	5.00E-03	5.00E-03	5.00E-03	0.00%	No	No significant change in screening level; Retained as COC
1,1,2,2-Tetrachloroethane[2]	5.50E-02	5.53E-02	-	-	4.00E-01	5.53E-02	0.61%	No	Contaminant not detected in groundwater and not selected as a COC
Toluene[1]	7.20E+02	7.23E+02	1.00E+03	1.00E+03	1.00E+03	1.00E+03	0.00%	No	No significant change in screening level; Retained as COC
Trichloroethylene[1]	1.60E+00	2.80E-02	5.00E+00	5.00E+00	5.00E+00	5.00E+00	0.00%	No	No significant change in screening level; Retained as COC
Vanadium	2.60E+02	3.65E+01	-	-	2.60E+02	3.65E+01	-85.96%	No	Naturally occurring; Excluded as a COC based on background
Vinyl chloride[1, 2]	2.00E-02	1.98E-02	2.00E+00	2.00E+00	2.00E+00	2.00E+00	0.00%	No	No significant change in screening level; Retained as COC
Xylenes	1.40E+03	2.06E+02	1.00E+04	1.00E+04	1.00E+04	1.00E+04	0.00%	No	No significant change in screening level

1 - Federal Maximum Contaminant Level selected as the screening criteria.

2 - Criteria at the time of remedy selection was based on the reporting limit.

occurring in soil and based on a background evaluation of soil at Richards-Gebaur AFB.

- PRGs for 3,3-dichlorobenzidine and dibenzofuran decreased; however, neither were detected at a concentration greater than the currently comparable screening criteria.
- The MCL for nickel, which was used as the screening level in the risk evaluation during the Basewide RI, has been rescinded. A comparison of the current PRG with the MCL used as the original screening criteria indicates that the screening criteria for nickel has decreased. However, nickel was excluded from the risk assessment because it is naturally occurring in soil and based on a background evaluation of soil at Richards-Gebaur AFB.
- In January 2006, the MCL for arsenic decreased significantly from 50 micrograms per liter (µg/l) to 10 µg/l. Consequently, arsenic was reevaluated to determine if this change will affect the protectiveness of the selected groundwater remedies (Appendix F).

For some contaminants, a reporting limit was selected as the groundwater screening level where the reporting limit for a particular analytical method was significantly greater than other screening criteria available at the time of the RI. These contaminants include bis(2-chloroethyl)ether, bis(2-chloroispropyl)ether, bis(2-ethylhexyl)phthalate, cadmium, bromodichloromethane, 3,3-dichlorobenzidine, polychlorinated biphenyls (Arochlor 1260), benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, 1,1,2,2-tetrachloroethane, and vinyl chloride. In each case, the reporting limit that was used as the screening criteria for the RI exceeds the currently available screening criteria. However, with the exception of naphthalene, none of these contaminants were detected in groundwater at significant concentrations and they were not evaluated in the risk assessment. Naphthalene was only detected in one groundwater sample that was determined to be unrepresentative of groundwater conditions. As a result, naphthalene was not retained as a contaminant of concern in the risk assessment. Therefore, the fact that the reporting limit used as the original screening level are less than the currently relevant screening criteria will not impact the protectiveness of the remedy.

Toxicity Data

Tables 3 and 4, respectively, provide a review of toxicity data for soil and groundwater presented in the 2001 RI for Richards-Gebaur AFB. These tables provide a comparison of the data used in the baseline risk assessment and in the ROD with updated values. Updated toxicity data were primarily obtained from EPA's Integrated Risk Information System (IRIS) database (Updated March 8, 2006), Provisional Peer Reviewed Toxicity Values (PPRTVs) developed by EPA's National Center for Environmental Assessment,

and other toxicity information sources (e.g., EPA's Health Effects Assessment Summary Tables, other EPA sources, and non-EPA sources). Several changes in toxicity data have occurred since toxicity screens and risk estimates were developed in baseline risk assessment and ROD for the various operable units. Additional assessment and review of the available and newly available scientific studies associated with a contaminant are the primary reason changes in toxicity data have occurred.

Soil

Slight changes in the oral slope factor (2.90E-02 to 5.50E-02) and oral reference dose for benzene (3.00E-03 to 4.00E-03) and in the oral reference dose for dibenzofuran (4.00E-03 to 2.00E-03) occurred; however, these changes were minimal and are unlikely to influence the risk estimates significantly. The oral slope factor for TCE increased from 1.10E-02 to 4.00E-01, indicating the existing carcinogenic risk estimates used to select the remedies for Richards-Gebaur AFB may have underestimated the risks associated with exposure to TCE. The oral reference dose for TCE decreased from 6.00E-3 to 3.00E-4, also indicating that the existing noncarcinogenic hazard estimates used to select the remedies for Richards-Gebaur AFB may have underestimate the hazard associated with exposure to TCE. However, TCE was not selected as a COC for OU-1 (soil) because of the limited frequency of detection and the low concentrations that were detected. It should also be noted that these new toxicity values are still provisional and no final values have been published in IRIS, EPA's preeminent database of toxicological data.

Table 3
Toxicity Data Comparison for Contaminants of Concern in Soil

Chemical	Oral Slope Factor		Change	Oral Reference Dose		Change
	Old	New		Old	New	
Benzene	2.90E-02	5.50E-02	Yes	3.00E-03	4.00E-03	Yes
Benzo(a)anthracene	7.30E-01	7.30E-01	No	-	-	No
Benzo(a)pyrene	7.30E+00	7.30E+00	No	-	-	No
Dibenz(a,h)anthracene	7.30E+00	7.30E+00	No	-	-	No
Dibenzofuran	-	-	No	4.00E-03	2.00E-03	Yes
Trichloroethylene*	1.10E-02	4.00E-01	Yes	6.00E-03	3.00E-04	Yes
Toluene	-	-	-	2.00E-01	2.00E-1	No

*The toxicity values listed for TCE are provisional and still under review.

Groundwater

The oral reference dose for 1,1-dichloroethylene increased from 9.00E-03 to 5.00E-02. These new criteria are less restrictive than the old criteria and, thus, do not change the protectiveness of the remedy. Slight changes in oral slope factor for vinyl chloride (1.90E+00 to 1.50E+00) and in the oral reference doses for benzene (3.00E-03 to 4.00E-03) and dibenzofuran (4.00E-03 to 2.00E-03) occurred; however, these changes were minimal and are unlikely to influence the risk estimates significantly. The oral slope factor for TCE increased from 1.10E-02 to 4.00E-01 and the oral reference dose decreased from 6.00E-3 to 3.00E-4, indicating that the existing carcinogenic and noncarcinogenic risk estimates may have underestimated the risks associated with exposure to TCE, which was a groundwater COC. However, the existing remedies (i.e., land use

controls) for OU-2 prohibit extraction and any use of TCE-contaminated groundwater. This result renders all human exposure pathways to contaminants incomplete. It should also be noted that these new toxicity values are still provisional and no final values have been published in IRIS.

Table 4
Toxicity Data Comparison for Contaminants of Concern in Groundwater

Chemical	Oral Slope Factor		Change	Oral Reference Dose		Change
	Old	New		Old	New	
1,1-Dichloroethylene	6.00E-01	-	Yes	9.00E-03	5.00E-02	Yes
1,2-Dichloroethylene (cis)	-	-	No	1.00E-02	1.00E-02	No
Tetrachloroethylene	-	5.40E-01	Yes	-	1.00E-02	Yes
Trichloroethylene*	1.10E-02	4.00E-01	Yes	6.00E-03	3.00E-04	Yes
Vinyl chloride	1.90E+00	1.50E+00	Yes	-	3.00E-03	Yes

* The toxicity values listed for TCE are provisional and still under review.

Exposure Pathways and Assumptions

Chapter 3.0 of the *Draft 2005 Annual Long-Term Monitoring Report for Groundwater (Operable Unit 2)* (LTM Report) dated January 2006, details the result of the first annual LUCs/Institutional Controls (ICs) site inspection that were conducted at each of the sites where residual contamination is present at concentrations that do not permit unrestricted land use or use of groundwater. Copies of the actual checklists that were completed as part of this inspection are included in Appendix C of the LTM Report These checklists document that:

- No change in current land use on or near the site has occurred
- Human health or ecological routes of exposure or receptors have not changed or been newly identified that could affect the protectiveness of the selected remedy
- No new contaminants or contaminant courses have been identified
- Only anticipated toxic byproducts of the remedy that were previously addressed by the Record of Decision (e.g., breakdown products of TCE in groundwater such as vinyl chloride) were identified
- No changes in the physical conditions of the site have occurred that would affect the protectiveness of the remedy

The recent site inspections documented in the LTM Report support the conclusion that the exposure pathways and assumptions used to evaluate risks in the baseline risk assessments included in the RI dated November 2001 remain appropriate and the protectiveness of the selected remedy has not been impacted.

Remedial Action Objectives (RAOs)

As shown in Table 5, the original remedial action cleanup goals (RACGs) for total petroleum hydrocarbons (TPH) in soil, which were based on the Missouri Department

of Natural Resources (MDNR) Cleanup Levels for Missouri (CALM), were compared with current standards. Since the original RACG for TPH was selected, the Missouri Department of Natural Resources (MDNR) has promulgated new procedures for selecting cleanup goals that are outlined in a guidance document entitled *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* dated January 2004. These procedures are considered state ARARs that must be met for contaminated soil at OU-1 because leaks of TPH occurred from petroleum storage tanks. The MRBCA cleanup levels for TPH are evaluated separately as gasoline range organics (GRO) and diesel range organics (DRO). Under the MRBCA, four risk-based target levels (RBTLs) - default target levels, Tier 1 RBTLs, Tier 2 site-specific target levels (SSTLs), and Tier 3 SSTLs - can be used as cleanup levels. Based on a conservative evaluation of the site specific characteristics of OU-1 (soil), the Tier 1 RBTLs were selected representing residential land use for Type 1 surficial soil. Soil concentrations protective of groundwater were not used because domestic use of contaminated groundwater is not a complete exposure pathway. Table 5 provides a comparison of the RACGs at the time of remedy selected, which were based on MDNR's Cleanup Levels for Missouri (CALM), and the current RACGs, which are based on the MRBCA Tier 1 RBTLs.

Table 5
Remedial Action Cleanup Goals for OU-1 (Soil)

Chemical	MDNR's Cleanup Levels for Missouri	Missouri Risk-Based Corrective Action Tier 1 Levels	Change
OU-1 (Soil) (mg/kg)			
TPH-Combined	200	-	-
TPH-GRO	-	29,000	-
TPH-DRO	-	56,000	-

Units - mg/kg

The Tier 1 RBTLs for TPH-GRO (29,000 mg/kg) and TPH-DRO (52,000 mg/kg) from the recently promulgated MRBCA are substantially greater than the old RACG of 200 mg/kg. As a result, the selected remedies for OU-1 (soil) appear to have been significantly more conservative and more extensive than what would currently be necessary under the MRBCA requirements. Therefore, the remedial action goals remain protective and are most likely substantially overprotective. Consequently, a more thorough evaluation of the TPH contamination remaining at OU-1 was completed to determine if clean closure requirements can be satisfied (Appendix D).

As shown in Table 6, RACGs were also selected for tetrachloroethylene (PCE), TCE, cis 1,2-dichloroethylene (DCE), 1,1-DCE, and vinyl chloride in groundwater.

Table 6 Remedial Action Cleanup Goals for OU-2 (Groundwater)			
Chemical	**2000 Maximum Contaminant Level**	**2006 Maximum Contaminant Level**	**Change**
PCE	5	5	No
TCE	5	5	No
cis-1,2-DCE	70	70	No
1,1-DCE	7	7	No
Vinyl chloride	2	2	No

Units - µg/l

No changes have occurred to the MCLs for COCs in groundwater. Therefore, the RACGs for COCs in groundwater and the selected remedy remain protective.

APPENDIX E

TPH AND PAH DATA EVALUATION

Appendix E

Total Petroleum Hydrocarbon Sites Closure Evaluation

Introduction

In March 2005, the Missouri Department of Natural Resources (MDNR) disseminated a new approach to risk-based corrective action for managing petroleum releases. The approach is outlined in guidance from MDNR entitled *Missouri Risk-Based Corrective Action (MRBCA) Process for Petroleum Storage Tanks* (January 2004) and in an update memorandum dated March 2005. This new approach incorporates tiered risk-based screening levels that are applicable to petroleum-contaminated sites at Richards-Gebaur Air Force Base (AFB).

Using MDNR's new risk-based corrective action approach, four sites — ST005, FT002, Building 1025, and AOC006 — that are contaminated with total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAHs) were reevaluated to determine whether land use controls (LUCs) remain necessary, or if a recommendation for No Further Action (NFA) could be supported. An NFA determination means that the concentrations of constituents of concern (COCs) present at the site do not pose an unacceptable risk to human health or the environment, regardless of how the site may be used or developed in the future.

Methods

Residual TPH and PAH concentrations from soil confirmation sampling data (which was collected after removal actions and from historical data [e.g., basewide remedial investigation] that were not excavated during removal actions) served as the basis for this evaluation. Following the MRBCA process, a stepwise evaluation of the data from each of the four sites was conducted. The following steps were performed:

- Maximum contaminant concentrations at each site were compared with the MDNR Default Target Levels (DTLs). If the maximum concentration did not exceed the DTLs, the evaluation was concluded.
- If the maximum concentrations exceeded the DTLs, maximum contaminant concentrations were compared with the MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Surface and Subsurface Soil, as appropriate. If the maximum concentration did not exceed the Tier 1 value, the evaluation was concluded.
- If the maximum concentration exceeded the Tier 1 value, average and 95th percent upper confidence level (95% UCL) concentrations were calculated using EPA's ProUCL software (i.e., ProUCL Version 3.0). These calculations were then compared with the MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Surface and Subsurface Soil, as appropriate. If the representative concentration did not exceed the Tier 1 value, the evaluation was concluded.

MDNR's DTLs are considered no further action levels that are protective of both the unrestricted use and unlimited exposure scenario and the current and reasonably anticipated future use, which is commercial/industrial. MDNR's MRBCA guidance states that:

> "if maximum media-specific concentrations at a site are less than the DTLs, and provided the site poses no obvious risks to ecological receptors, MDNR will issue an NFA letter pertaining to the site."

As described above, in cases where maximum concentrations exceeded the DTLs, a comparison was made with the MDNR Tier 1 Target levels for Residential Land Use for Type 2 Surface or Subsurface Soil, as appropriate. Residential screening levels were chosen because they are conservative and are representative of an unrestricted use and unlimited exposure scenario. Because the selected criteria are protective of residential land use, they should also be protective of the current and anticipated future land use (e.g., commercial/industrial) at the former base. Based on the information provided in MDNR's guidance document, Type 2 soil (i.e., silty soil with moderate porosity and water content) was selected because it most closely represents the characteristics of soil found at each of the four sites. If maximum site contaminant concentrations do not exceed their respective MDNR Tier 1 Target Levels, the site is not considered to pose an unacceptable risk and can be considered for NFA and closure.

Results

Building 1025

Table E-1 at the end of this appendix provides a comparison of residual TPH contamination detected in Building 1025 soil with the MDNR DTLs for TPH-gasoline range organics (GRO) and TPH-diesel range organics (DRO). As indicated in Table E-1, the maximum detected concentrations of TPH-GRO (193.6 milligrams per kilogram [mg/kg]) and TPH-DRO (1,495 mg/kg) were less than their respective MDNR DTLs.

AOC006

Table E-2 provides a comparison of residual TPH and PAH contamination detected at AOC006 with the MDNR DTLs. The maximum detected concentrations of all contaminants except benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, and dibenz(a,h)anthracene were less than their respective MDNR DTLs.

Sample locations CB6WSW-1, and CB6NSW-1 contained concentrations of benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, and/or dibenz(a,h)anthracene that exceeded the MDNR DTLs. These sample locations were collected from 3 feet below ground surface (bgs). As shown in Table E-2, maximum soil contaminant concentrations were compared with MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Subsurface Soil. In all cases, contaminant concentrations were less than their respective Tier 1 values for subsurface soil.

FT002

Table E-3 provides a comparison of residual TPH contamination at Site FT002 with the MDNR DTLs. The maximum concentration of TPH-DRO was detected at sample location SB-008 (671 mg/kg); however, the concentration did not exceed the MDNR DTL of 4,140 mg/kg. Concentrations of TPH-GRO exceeded the MDNR DTL of 383 mg/kg at sample location SB-008 (472 mg/kg). All other concentrations were less than the MDNR DTLs.

Sample SB-008 was 17.5 to 18.5 feet bgs. As indicated in Table E-3, TPH-GRO concentrations at this sample location was less than the MDNR Tier 1 Target Level for Residential Land Use for Type 2 Subsurface Soil (712 mg/kg).

ST005

Table E-4 provides a comparison of residual TPH contamination detected at Site ST005 with the MDNR DTLs. The maximum concentration of TPH-DRO was detected at sample location POL-R-W04D (430 mg/kg), which does not exceed the MDNR DTL of 4,140 mg/kg. Concentrations of TPH-GRO exceeded the MDNR DTLs of 383 mg/kg at multiple sample locations, with the maximum concentration located at sample location POL-L-W05D (788.1 mg/kg). PAH data, specifically benzo(a)anthracene and benzo(a)pyrene, were also evaluated and no concentrations were identified that exceeded the MDNR DTLs.

A more detailed evaluation indicates that all residual TPH-GRO concentrations are less than the MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Subsurface Soil of 716 mg/kg, except one subsurface soil concentration. The TPH-GRO concentration at sample location POL-L-W05D was 788.1 mg/kg.

In an effort to more thoroughly evaluate residual TPH-GRO contamination at Site ST-005, average and 95th percent upper confidence level (95% UCL) TPH-GRO concentrations were calculated using all 2002 confirmation sampling and 2001 remedial investigation data that exceeded the remedial action cleanup goal (RACG) of 200 mg/kg and were not excavated during interim remedial action activities. By including only those data points that exceeded the RACG, the resulting average and 95% UCL TPH-GRO concentrations will substantially overestimate the mean concentration of TPH-GRO present at Site ST005. If the entire data set for Site ST005 had been included (i.e., non-detected data and detected concentrations below the RACGs), the average and 95% UCL TPH-GRO concentrations would decrease significantly. These biased high estimates of the mean concentration of TPH-GRO at Site ST005 were calculated in an effort to conservatively evaluate potential risks posed by the site and to determine if closure of the site was appropriate. The 95% UCL concentration for TPH-GRO at site ST-005 was calculated using the most current version of EPA's ProUCL software (i.e., ProUCL Version 3.0). This software was developed by EPA to support risk assessment and cleanup decisions at contaminated sites and has been incorporated into the current EPA risk assessment guidance (*Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*, OSWER 9285.6-10, December 2002). Table E-5 provides the output from the ProUCL 95% UCL calculation for TPH-GRO in subsurface soil at Site ST005.

The average TPH-GRO concentration was 347.1 mg/kg. The 95% UCL, calculated using a Student's T test, was 448.7 mg/kg. Both are significantly less than the MDNR Tier 1 Target Levels for Residential Land Use for Subsurface Soil Type 2 of 716 mg/kg.

Conclusions

Following the MRBCA process recently promulgated by MDNR, residual TPH and PAH contamination at Building 1025, AOC006, Site FT002, and Site ST005 do not pose a significant risk to human health or the environment based on a comparison with unrestricted use and unlimited exposure criteria. These criteria are designed to be protective of both the current and reasonably anticipated future. The result indicate that:

- Building 1025 – All residual TPH concentrations are less that the MDNR DTLs.
- AOC006 – All TPH and PAH concentrations were less than the MDNR DTLs except benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, and dibenz(a,h)anthracene, which were all significantly less than the MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Subsurface Soil.
- FT002 – All TPH-DRO concentrations were less than the MDNR DTL. Concentrations of TPH-GRO exceeded the MDNR DTLs at two sample locations but were less than the MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Subsurface Soil.
- ST005 – Only TPH-GRO exceeded the MDNR DTLs. Average and 95% UCL concentrations were significantly less than the MDNR Tier 1 Target Levels for Residential Land Use for Type 2 Subsurface Soil.

Therefore, it is concluded that all four sites can support a NFA determination and should initiate closure activities according to MDNR procedures.

Table E-1 - Maximum Concentrations of Contaminants of Concern in Soil at Building 1025

COCs	Maximum Detected Concentration	MDNR Default Target Levels
TPH-GRO	193.6	383
TPH-DRO	1,495	4,140

All units are mg/kg

Table E-2 - Maximum Concentrations of Contaminants of Concern in Soil at AOC006

COCs	Maximum Detected Concentration	MDNR Default Target Levels	MDNR Tier 1 Target Level for Residential Land Use for Type 2 Soil	
			Surface	Subsurface
TPH-GRO	237.9	383	n/a	n/a
TPH-DRO	470	4,140	n/a	n/a
Acenaphthene	0.1 F	209	n/a	n/a
Anthracene	0.42	3,140	n/a	n/a
Chrysene	3.68	183	n/a	n/a
Benzo(a)anthracene	2.76	1.84	1.84	496,000
Benzo(b)fluoranthene	4.9	1.84	1.84	131,000
Benzo(a)pyrene	3.15	0.19	0.19	147,000
Benzo(g,h,i)perylene	1.45	-	n/a	n/a
Diben(a,h)anthracene	0.4 F	0.184	0.184	3,770,000
Indeno(1,2,3-cd)pyrene	1.46	-	n/a	n/a
Phenanthrene	3.19	-	n/a	n/a
Fluoranthene	6.27	1,190	n/a	n/a
Fluorene	0.14 F	271	n/a	n/a
Pyrene	5.82	751	n/a	n/a

All units are mg/kg
n/a - not applicable because the maximum concentration did not exceed the MDNR Default Target Level
Shaded cells indicate concentrations that exceed the MDNR Default Target Level

Table E-3 – Maximum Concentrations of Contaminants of Concern in Soil at FT002

COCs	Maximum Detected Concentration	MDNR Default Target Levels	MDNR Tier 1 Target Level for Residential Land Use for Type 2 Soil	
			Surface	Subsurface
TPH-GRO	472	383	29,700	716
TPH-DRO	671	4,140	56,400	7,880

All units are mg/kg.
Shaded cells indicate concentrations that exceed MDNR Default Target Levels

Table E-4 - Maximum Concentrations of Contaminants of Concern in Soil at ST005

COCs	Maximum Detected Concentration		MDNR Default Target Levels	MDNR Tier 1 Target Level for Residential Land Use for Type 2 Soil	
	Surface	Subsurface		Surface	Subsurface
TPH-GRO	425	**788.1**	383	29,700	716
TPH-DRO	61.7	430	4,140	56,400	7,880

All units are mg/kg
Shaded cells indicate concentrations that exceed MDNR Default Target Levels
Bolded concentrations exceed the MDNR Tier 1 Target Level for Residential Land Use for Type 2 Soil

Table E-5: ProUCL Output for Site ST005 TPH-GRO Data

General Statistics

Data File		Variable:	32.32
Raw Statistics		Normal Distribution Test	
Number of Valid Samples	17	Shapiro-Wilk Test Statisitic	0.945873
Number of Unique Samples	17	Shapiro-Wilk 5% Critical Value	0.892
Minimum	24	Data are normal at 5% significance level	
Maximum	788.1		
Mean	347.1188	95% UCL (Assuming Normal Distribution)	
Median	347.2	Student's-t UCL	448.6612
Standard Deviation	239.804		
Variance	57505.96	Gamma Distribution Test	
Coefficient of Variation	0.690841	A-D Test Statistic	0.954264
Skewness	0.129399	A-D 5% Critical Value	0.76081
		K-S Test Statistic	0.175822
Gamma Statistics		K-S 5% Critical Value	0.214007
k hat	1.250708	Data follow approximate gamma distibution	
k star (bias corrected)	1.069211	at 5% significance level	
Theta hat	277.5378		
Theta star	324.6496	95% UCLs (Assuming Gamma Distribution)	
nu hat	42.52408	Approximate Gamma UCL	535.8128
nu star	36.35317	Adjusted Gamma UCL	561.5011
Approx.Chi Square Value (.05)	23.55089		
Adjusted Level of Significance	0.03461	Lognormal Distribution Test	
Adjusted Chi Square Value	22.47346	Shapiro-Wilk Test Statisitic	0.803913
		Shapiro-Wilk 5% Critical Value	0.892
Log-transformed Statistics		Data not lognormal at 5% significance level	
Minimum of log data	3.178054		
Maximum of log data	6.669625	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	5.399351	95% H-UCL	1135.891
Standard Deviation of log data	1.206492	95% Chebyshev (MVUE) UCL	1048.047
Variance of log data	1.455623	97.5% Chebyshev (MVUE) UCL	1316.103
		99% Chebyshev (MVUE) UCL	1842.647
		95% Non-parametric UCLs	
		CLT UCL	442.7852
		Adj-CLT UCL (Adjusted for skewness)	444.7356
		Mod-t UCL (Adjusted for skewness)	448.9654
		Jackknife UCL	448.6612
		Standard Bootstrap UCL	438.5889
		Bootstrap-t UCL	453.7273
RECOMMENDATION		Hall's Bootstrap UCL	446.2332
Data are normal (0.05)		Percentile Bootstrap UCL	442.1235
		BCA Bootstrap UCL	441.6071
Use Student's-t UCL		95% Chebyshev (Mean, Sd) UCL	600.6368
		97.5% Chebyshev (Mean, Sd) UCL	710.3342
		99% Chebyshev (Mean, Sd) UCL	925.8136

APPENDIX F

AUGUST 2005 GROUNDWATER MONITORING DATA

Table 4: Compounds Detected in Groundwater, February 2005 and August 2005 Long-Term Monitoring Event
Richards-Gebaur Air Force Base

Site	Media	Location	QAQC Type	Sample Date	Detected Concentration	Analyte	Units
SS-003							
	WATER	SS03-MW003	N	3/2/2005	0.086 J	Chloroform	UG/L
	WATER	SS03-MW003	N	3/2/2005	0.518 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW003	N	3/2/2005	0.665	Ethylbenzene	UG/L
	WATER	SS03-MW003	N	3/2/2005	0.788 J	Trichloroethene	UG/L
	WATER	SS03-MW004	N	8/25/2005	4.45	1,2-Dichloroethane	UG/L
	WATER	SS03-MW004	FD	8/25/2005	4.47	1,2-Dichloroethane	UG/L
	WATER	SS03-MW004	N	3/1/2005	0.225 J	Chloroform	UG/L
	WATER	SS03-MW004	FD	3/1/2005	0.235 J	Chloroform	UG/L
	WATER	SS03-MW004	N	8/25/2005	5.67	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW004	N	3/1/2005	6.89	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW004	FD	8/25/2005	5.28	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW004	FD	3/1/2005	7.2	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW004	N	3/1/2005	0.356 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS03-MW004	FD	3/1/2005	0.355 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS03-MW004	N	3/1/2005	61.7	Trichloroethene	UG/L
	WATER	SS03-MW004	FD	3/1/2005	60.2	Trichloroethene	UG/L
	WATER	SS03-MW004	N	8/25/2005	53.6	Trichloroethene	UG/L
	WATER	SS03-MW004	FD	8/25/2005	48.8	Trichloroethene	UG/L
	WATER	SS03-MW005	N	8/25/2005	0.544 J	Chloromethane	UG/L
	WATER	SS03-MW008	N	3/1/2005	0.121 J	Chloroform	UG/L
	WATER	SS03-MW008	N	8/26/2005	1.46	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW008	N	3/1/2005	0.83 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW008	N	8/26/2005	16.5	Trichloroethene	UG/L
	WATER	SS03-MW008	N	3/1/2005	13.7	Trichloroethene	UG/L
	WATER	SS03-MW009	N	3/2/2005	0.129 J	Benzene	UG/L
	WATER	SS03-MW009	N	3/2/2005	0.432 J	Carbon tetrachloride	UG/L
	WATER	SS03-MW009	N	3/2/2005	1.63	Chloroform	UG/L
	WATER	SS03-MW009	N	8/25/2005	1.03	Chloroform	UG/L
	WATER	SS03-MW009	N	8/25/2005	5.98	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW009	N	3/2/2005	10.4	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW009	N	8/25/2005	16.4	Trichloroethene	UG/L
	WATER	SS03-MW009	N	3/2/2005	22.5	Trichloroethene	UG/L
	WATER	SS03-MW010	N	8/26/2005	2.59	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW010	N	3/2/2005	5.1	cis-1,2-Dichloroethene	UG/L
	WATER	SS03-MW010	N	3/2/2005	4.26	Trichloroethene	UG/L
	WATER	SS03-MW010	N	8/26/2005	0.677 J	Trichloroethene	UG/L
SS-006							
	WATER	SS06-MW005	N	8/28/2005	1.32	Chlorobenzene	UG/L
	WATER	SS06-MW005	N	8/28/2005	0.259	Chloroform	UG/L
	WATER	SS06-MW005	N	3/6/2005	12.3	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW005	N	8/28/2005	47.6	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW005	N	8/28/2005	2.9	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW005	N	3/6/2005	0.665 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW005	N	3/6/2005	47	Trichloroethene	UG/L
	WATER	SS06-MW005	N	8/28/2005	121	Trichloroethene	UG/L
	WATER	SS06-MW005	N	8/28/2005	2.71	Vinyl chloride	UG/L
	WATER	SS06-MW008	N	8/28/2005	0.312	Chloroform	UG/L

U-flagged and R-flagged data are not included in this table.

Qualifier Description
J = The analyte was positively identified, the quantitation is an estimate.
F = The analyte was positively identified but the associated numerical value is below the reporting limit (RL).
B = The analyte was found in an associated blank, as well as in the sample.
M = A matrix effect was present.

Site	Media	Location	QAQC Type	Sample Date	Detected Concentration	Analyte	Units
SS-006							
	WATER	SS06-MW011	N	8/27/2005	23.4	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW011	N	3/6/2005	24.2	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW011	N	3/6/2005	0.626	Ethylbenzene	UG/L
	WATER	SS06-MW011	N	8/27/2005	2.48	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW011	N	3/6/2005	2.42	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW011	N	3/6/2005	91.7	Trichloroethene	UG/L
	WATER	SS06-MW011	N	8/27/2005	128	Trichloroethene	UG/L
	WATER	SS06-MW014	N	8/28/2005	11.4	1,2-Dichloroethane	UG/L
	WATER	SS06-MW014	N	3/6/2005	3.91	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW014	N	8/28/2005	8.48	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW014	N	8/28/2005	0.4 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW014	N	3/6/2005	50	Trichloroethene	UG/L
	WATER	SS06-MW014	N	8/28/2005	124	Trichloroethene	UG/L
	WATER	SS06-MW015	N	8/28/2005	2.42	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW015	N	3/6/2005	1.27	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW015	N	8/28/2005	96.7	Trichloroethene	UG/L
	WATER	SS06-MW015	N	3/6/2005	32.3	Trichloroethene	UG/L
	WATER	SS06-MW018	N	8/27/2005	23.7	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW018	N	3/6/2005	25.2	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW018	N	3/6/2005	14	Trichloroethene	UG/L
	WATER	SS06-MW018	N	8/27/2005	13.2	Trichloroethene	UG/L
	WATER	SS06-MW020	FD	8/28/2005	2.65	1,1-Dichloroethene	UG/L
	WATER	SS06-MW020	FD	3/7/2005	6.68	1,1-Dichloroethene	UG/L
	WATER	SS06-MW020	N	3/7/2005	6.94 J	1,1-Dichloroethene	UG/L
	WATER	SS06-MW020	N	8/28/2005	2.82	1,1-Dichloroethene	UG/L
	WATER	SS06-MW020	N	3/7/2005	286	1,2,3-Trichlorobenzene	UG/L
	WATER	SS06-MW020	FD	3/7/2005	0.418	Benzene	UG/L
	WATER	SS06-MW020	N	8/28/2005	0.242 J	Chloroform	UG/L
	WATER	SS06-MW020	FD	8/28/2005	0.268	Chloroform	UG/L
	WATER	SS06-MW020	FD	8/28/2005	173	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	N	8/28/2005	169	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	FD	3/7/2005	424	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	N	3/7/2005	417	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	N	8/28/2005	33.4	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	FD	8/28/2005	29.4	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	FD	3/7/2005	54.1 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	N	3/7/2005	52.4 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS06-MW020	N	8/28/2005	1930 J	Trichloroethene	UG/L
	WATER	SS06-MW020	N	3/7/2005	3730	Trichloroethene	UG/L
	WATER	SS06-MW020	FD	3/7/2005	4070	Trichloroethene	UG/L
	WATER	SS06-MW020	FD	8/28/2005	2070 J	Trichloroethene	UG/L
	WATER	SS06-MW020	FD	8/28/2005	10.4	Vinyl chloride	UG/L
	WATER	SS06-MW020	FD	3/7/2005	5.87	Vinyl chloride	UG/L
	WATER	SS06-MW020	N	8/28/2005	11.8	Vinyl chloride	UG/L
	WATER	SS06-MW020	N	3/7/2005	10.5	Vinyl chloride	UG/L
	WATER	SS06-MW021	N	8/28/2005	0.25	Chloroform	UG/L
	WATER	SS06-MW023	N	8/28/2005	0.235 J	Chloroform	UG/L
	WATER	SS06-MW023	N	3/7/2005	3.99 J	Methylene chloride	UG/L
	WATER	SS06-MW024	N	8/28/2005	0.283	Chloroform	UG/L
	WATER	SS06-MW025	N	8/28/2005	0.27	Chloroform	UG/L

U-flagged and R-flagged data are not included in this table.

Qualifier Description

J = The analyte was positively identified, the quantitation is an estimate.

F = The analyte was positively identified but the associated numerical value is below the reporting limit (RL).

B = The analyte was found in an associated blank, as well as in the sample.

M = A matrix effect was present.

Site	Media	Location	QAQC Type	Sample Date	Detected Concentration	Analyte	Units
SS-006							
	WATER	SS06-MW025	N	3/6/2005	7.74	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW025	N	8/28/2005	4.78	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW025	N	3/6/2005	17.6	Trichloroethene	UG/L
	WATER	SS06-MW025	N	8/28/2005	12.2	Trichloroethene	UG/L
	WATER	SS06-MW026	N	8/27/2005	0.301 B	1,2,3-Trichlorobenzene	UG/L
	WATER	SS06-MW026	N	8/27/2005	0.657 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW026	N	3/6/2005	0.743 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS06-MW026	N	3/6/2005	0.883 J	Trichloroethene	UG/L
SS-009							
	WATER	SS09-MW003	N	3/2/2005	85.3	1,1-Dichloroethane	UG/L
	WATER	SS09-MW003	N	8/26/2005	57.6	1,1-Dichloroethane	UG/L
	WATER	SS09-MW003	N	3/2/2005	41.3	1,1-Dichloroethene	UG/L
	WATER	SS09-MW003	N	8/26/2005	33.2	1,1-Dichloroethene	UG/L
	WATER	SS09-MW003	N	3/2/2005	1.56	Benzene	UG/L
	WATER	SS09-MW003	N	8/26/2005	1.16	Benzene	UG/L
	WATER	SS09-MW003	N	3/2/2005	0.093 J	Chloroform	UG/L
	WATER	SS09-MW003	N	3/2/2005	176	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW003	N	8/26/2005	134	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW003	N	3/2/2005	20.2	Tetrachloroethene	UG/L
	WATER	SS09-MW003	N	8/26/2005	20.6	Tetrachloroethene	UG/L
	WATER	SS09-MW003	N	8/26/2005	0.744 J	Toluene	UG/L
	WATER	SS09-MW003	N	3/2/2005	1.23	Toluene	UG/L
	WATER	SS09-MW003	N	8/26/2005	12.1	Trichloroethene	UG/L
	WATER	SS09-MW003	N	3/2/2005	15.7	Trichloroethene	UG/L
	WATER	SS09-MW003	N	8/26/2005	3.83	Vinyl chloride	UG/L
	WATER	SS09-MW003	N	3/2/2005	4.9	Vinyl chloride	UG/L
	WATER	SS09-MW005	N	3/2/2005	1.2	1,1-Dichloroethane	UG/L
	WATER	SS09-MW005	N	3/2/2005	0.468 J	1,1-Dichloroethene	UG/L
	WATER	SS09-MW005	N	8/26/2005	0.332 J	1,1-Dichloroethene	UG/L
	WATER	SS09-MW005	N	3/2/2005	0.673 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW005	N	8/26/2005	0.446 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW005	N	8/26/2005	3.51	Tetrachloroethene	UG/L
	WATER	SS09-MW005	N	3/2/2005	4.29	Tetrachloroethene	UG/L
	WATER	SS09-MW005	N	3/2/2005	1.31	Trichloroethene	UG/L
	WATER	SS09-MW006	N	3/2/2005	0.664	1,1-Dichloroethane	UG/L
	WATER	SS09-MW006	N	8/26/2005	0.25	1,2,3-Trichlorobenzene	UG/L
	WATER	SS09-MW006	N	3/2/2005	0.439 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW006	N	3/2/2005	0.345 J	Toluene	UG/L
	WATER	SS09-MW012	N	3/3/2005	3.03	1,1-Dichloroethane	UG/L
	WATER	SS09-MW012	N	8/26/2005	3.7	1,1-Dichloroethane	UG/L
	WATER	SS09-MW012	N	8/26/2005	6.12	1,1-Dichloroethene	UG/L
	WATER	SS09-MW012	N	3/3/2005	4.33	1,1-Dichloroethene	UG/L
	WATER	SS09-MW012	N	8/26/2005	4.45	1,2-Dichloroethane	UG/L
	WATER	SS09-MW012	N	3/3/2005	10.2	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW012	N	8/26/2005	14.6	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW012	N	8/26/2005	13	Tetrachloroethene	UG/L
	WATER	SS09-MW012	N	3/3/2005	16.5	Tetrachloroethene	UG/L
	WATER	SS09-MW012	N	8/26/2005	2.89	Trichloroethene	UG/L
	WATER	SS09-MW012	N	3/3/2005	5.04	Trichloroethene	UG/L
	WATER	SS09-MW012	N	3/3/2005	1.9	Vinyl chloride	UG/L

U-flagged and R-flagged data are not included in this table.

Qualifier Description

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F = The analyte was positively identified but the associated numerical value is below the reporting limit (RL).

B = The analyte was found in an associated blank, as well as in the sample.

M = A matrix effect was present.

Site	Media	Location	QAQC Type	Sample Date	Detected Concentration	Analyte	Units
SS-009							
	WATER	SS09-MW012	N	8/26/2005	2.35	Vinyl chloride	UG/L
	WATER	SS09-MW013	N	3/2/2005	0.65	1,1-Dichloroethane	UG/L
	WATER	SS09-MW013	N	3/2/2005	1.37	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW013	N	8/26/2005	1.75	cis-1,2-Dichloroethene	UG/L
	WATER	SS09-MW013	N	3/2/2005	2.96	Tetrachloroethene	UG/L
	WATER	SS09-MW013	N	8/26/2005	3.41	Tetrachloroethene	UG/L
	WATER	SS09-MW013	N	3/2/2005	2.06	Trichloroethene	UG/L
	WATER	SS09-MW014	N	3/3/2005	0.634	Ethylbenzene	UG/L
SS-012							
	WATER	SS012-MW001	N	3/4/2005	0.782	1,1-Dichloroethane	UG/L
	WATER	SS012-MW001	N	3/4/2005	0.527 J	1,1-Dichloroethene	UG/L
	WATER	SS012-MW001	N	8/29/2005	0.424 J	1,1-Dichloroethene	UG/L
	WATER	SS012-MW001	N	8/29/2005	0.214 J	1,2,3-Trichlorobenzene	UG/L
	WATER	SS012-MW001	N	3/4/2005	3.5	1,2-Dichlorobenzene	UG/L
	WATER	SS012-MW001	N	8/29/2005	3.52	1,2-Dichlorobenzene	UG/L
	WATER	SS012-MW001	N	8/29/2005	1	1,3-Dichlorobenzene	UG/L
	WATER	SS012-MW001	N	3/4/2005	0.882	1,4-Dichlorobenzene	UG/L
	WATER	SS012-MW001	N	8/29/2005	0.97	1,4-Dichlorobenzene	UG/L
	WATER	SS012-MW001	N	8/29/2005	0.348	Benzene	UG/L
	WATER	SS012-MW001	N	3/4/2005	0.247 J	Benzene	UG/L
	WATER	SS012-MW001	N	8/29/2005	7.25	Chlorobenzene	UG/L
	WATER	SS012-MW001	N	3/4/2005	4.3	Chlorobenzene	UG/L
	WATER	SS012-MW001	N	3/4/2005	25.9	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW001	N	8/29/2005	17.4	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW001	N	3/4/2005	1.09	Tetrachloroethene	UG/L
	WATER	SS012-MW001	N	8/29/2005	0.975 J	Tetrachloroethene	UG/L
	WATER	SS012-MW001	N	3/4/2005	0.975 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS012-MW001	N	8/29/2005	0.628 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS012-MW001	N	3/4/2005	1110	Trichloroethene	UG/L
	WATER	SS012-MW001	N	8/29/2005	569	Trichloroethene	UG/L
	WATER	SS012-MW001	N	8/29/2005	7.07	Vinyl chloride	UG/L
	WATER	SS012-MW001	N	3/4/2005	4.58	Vinyl chloride	UG/L
	WATER	SS012-MW002	N	8/29/2005	0.35	Chloroform	UG/L
	WATER	SS012-MW002	N	3/4/2005	0.191 J	Chloroform	UG/L
	WATER	SS012-MW002	N	8/29/2005	7.21	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW002	N	3/4/2005	26.3	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW002	N	3/4/2005	0.426 J	trans-1,2-Dichloroethene	UG/L
	WATER	SS012-MW002	N	3/4/2005	680	Trichloroethene	UG/L
	WATER	SS012-MW002	N	8/29/2005	192	Trichloroethene	UG/L
	WATER	SS012-MW003	N	8/29/2005	0.265	Chloroform	UG/L
	WATER	SS012-MW003	N	3/4/2005	0.757 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW003	N	8/29/2005	0.433 J	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW003	N	8/29/2005	5.88	Trichloroethene	UG/L
	WATER	SS012-MW003	N	3/4/2005	7.98	Trichloroethene	UG/L
	WATER	SS012-MW004	N	8/28/2005	0.258	Chloroform	UG/L
	WATER	SS012-MW012	N	3/4/2005	10.3	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW012	N	8/29/2005	9.85	cis-1,2-Dichloroethene	UG/L
	WATER	SS012-MW012	N	3/4/2005	115	Trichloroethene	UG/L
	WATER	SS012-MW012	N	8/29/2005	81.2	Trichloroethene	UG/L

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B = The analyte was found in an associated blank, as well as in the sample.

M = A matrix effect was present.

Site	Media	Location	QAQC Type	Sample Date	Detected Concentration	Analyte	Units
ST-005							
	WATER	ST05-MW011	N	3/3/2005	0.132 J	Chloroform	UG/L
	WATER	ST05-MW011	N	8/25/2005	0.79 J	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW011	N	3/3/2005	1.12	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW011	N	8/25/2005	31.1	Trichloroethene	UG/L
	WATER	ST05-MW011	N	3/3/2005	35.7	Trichloroethene	UG/L
	WATER	ST05-MW011	N	8/25/2005	7.18	Trichlorofluoromethane	UG/L
	WATER	ST05-MW011	N	3/3/2005	10.1	Trichlorofluoromethane	UG/L
	WATER	ST05-MW013	N	3/4/2005	0.568	1,1-Dichloroethane	UG/L
	WATER	ST05-MW013	N	3/4/2005	0.662 J	1,1-Dichloroethene	UG/L
	WATER	ST05-MW013	N	8/24/2005	0.447 J	1,1-Dichloroethene	UG/L
	WATER	ST05-MW013	N	3/4/2005	5.01 J	Acetone	UG/L
	WATER	ST05-MW013	N	3/4/2005	0.25 J	Benzene	UG/L
	WATER	ST05-MW013	N	8/24/2005	0.187 J	Chloroform	UG/L
	WATER	ST05-MW013	N	3/4/2005	0.302	Chloroform	UG/L
	WATER	ST05-MW013	N	8/24/2005	1.79	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW013	N	3/4/2005	3.02	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW013	N	3/4/2005	123	Trichloroethene	UG/L
	WATER	ST05-MW013	N	8/24/2005	95.8	Trichloroethene	UG/L
	WATER	ST05-MW013	N	3/4/2005	27.4	Trichlorofluoromethane	UG/L
	WATER	ST05-MW013	N	8/24/2005	20.6	Trichlorofluoromethane	UG/L
	WATER	ST05-MW017	N	3/3/2005	1.06	Trichloroethene	UG/L
	WATER	ST05-MW017	N	3/3/2005	0.86 J	Trichlorofluoromethane	UG/L
	WATER	ST05-MW017	N	8/25/2005	0.565 J	Trichlorofluoromethane	UG/L
	WATER	ST05-MW018	N	3/3/2005	0.583	1,1-Dichloroethane	UG/L
	WATER	ST05-MW018	FD	3/3/2005	0.582	1,1-Dichloroethane	UG/L
	WATER	ST05-MW018	N	8/25/2005	3.99	1,1-Dichloroethene	UG/L
	WATER	ST05-MW018	FD	8/25/2005	3.12	1,1-Dichloroethene	UG/L
	WATER	ST05-MW018	N	3/3/2005	2.84	1,1-Dichloroethene	UG/L
	WATER	ST05-MW018	FD	3/3/2005	2.84	1,1-Dichloroethene	UG/L
	WATER	ST05-MW018	FD	3/3/2005	1.15	1,2-Dichloroethane	UG/L
	WATER	ST05-MW018	N	3/3/2005	0.604	Benzene	UG/L
	WATER	ST05-MW018	N	8/25/2005	0.573	Benzene	UG/L
	WATER	ST05-MW018	FD	3/3/2005	0.585	Benzene	UG/L
	WATER	ST05-MW018	FD	8/25/2005	0.456	Benzene	UG/L
	WATER	ST05-MW018	FD	8/25/2005	3.95	Chloroform	UG/L
	WATER	ST05-MW018	N	8/25/2005	4.65	Chloroform	UG/L
	WATER	ST05-MW018	FD	3/3/2005	4.46	Chloroform	UG/L
	WATER	ST05-MW018	N	3/3/2005	4.62	Chloroform	UG/L
	WATER	ST05-MW018	FD	8/25/2005	2.64	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW018	N	3/3/2005	2.95	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW018	N	8/25/2005	3.21	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW018	FD	3/3/2005	3.03	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW018	FD	8/25/2005	3600 J	Trichloroethene	UG/L
	WATER	ST05-MW018	N	8/25/2005	2480 J	Trichloroethene	UG/L
	WATER	ST05-MW018	N	3/3/2005	2910	Trichloroethene	UG/L
	WATER	ST05-MW018	FD	3/3/2005	2560	Trichloroethene	UG/L
	WATER	ST05-MW018	N	8/25/2005	1900	Trichlorofluoromethane	UG/L
	WATER	ST05-MW018	FD	8/25/2005	1860	Trichlorofluoromethane	UG/L
	WATER	ST05-MW018	FD	3/3/2005	1360	Trichlorofluoromethane	UG/L
	WATER	ST05-MW018	N	3/3/2005	1620	Trichlorofluoromethane	UG/L

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Site	Media	Location	QAQC Type	Sample Date	Detected Concentration	Analyte	Units
ST-005							
	WATER	ST05-MW019	N	3/4/2005	0.772	Ethylbenzene	UG/L
	WATER	ST05-MW019	N	3/4/2005	0.655 J	Isopropylbenzene	UG/L
	WATER	ST05-MW019	N	3/4/2005	1.8	Vinyl chloride	UG/L
	WATER	ST05-MW020	N	8/24/2005	0.777	Benzene	UG/L
	WATER	ST05-MW020	N	3/4/2005	0.674 J	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW020	N	8/24/2005	6.94	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW020	N	8/24/2005	0.511 J	Isopropylbenzene	UG/L
	WATER	ST05-MW020	N	8/24/2005	0.546 J	sec-Butylbenzene	UG/L
	WATER	ST05-MW020	N	8/24/2005	7.33	Vinyl chloride	UG/L
	WATER	ST05-MW021	N	3/3/2005	5.8	Trichloroethene	UG/L
	WATER	ST05-MW021	N	8/25/2005	1.79	Trichlorofluoromethane	UG/L
	WATER	ST05-MW021	N	3/3/2005	2.5	Trichlorofluoromethane	UG/L
	WATER	ST05-MW022	N	3/3/2005	4.78	Trichloroethene	UG/L
	WATER	ST05-MW022	N	8/25/2005	2.27	Trichloroethene	UG/L
	WATER	ST05-MW024	N	3/3/2005	0.769	1,1-Dichloroethane	UG/L
	WATER	ST05-MW024	N	3/3/2005	0.123 J	Chloroform	UG/L
	WATER	ST05-MW024	N	3/3/2005	5.73	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW024	N	3/3/2005	56.4	Trichloroethene	UG/L
	WATER	ST05-MW024	N	3/3/2005	4.86	Trichlorofluoromethane	UG/L
	WATER	ST05-MW024	N	8/24/2005	5.03	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW024	N	8/24/2005	5	Methylene chloride	UG/L
	WATER	ST05-MW024	N	8/24/2005	65.8	Trichloroethene	UG/L
	WATER	ST05-MW024	N	8/24/2005	7.93	Trichlorofluoromethane	UG/L
	WATER	ST05-MW025	N	3/3/2005	0.95 J	Trichloroethene	UG/L
	WATER	ST05-MW025	N	8/24/2005	0.426 J	Trichlorofluoromethane	UG/L
	WATER	ST05-MW026	N	3/3/2005	0.615 J	1,1-Dichloroethane	UG/L
	WATER	ST05-MW026	N	3/3/2005	22.8	cis-1,2-Dichloroethene	UG/L
	WATER	ST05-MW026	N	8/24/2005	16.9	cis-1,2-Dichloroethene	UG/L
ST-011							
	WATER	ST011-MW001	N	3/5/2005	0.504 J	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW001	N	8/27/2005	0.389 J	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW002	N	8/27/2005	0.867 J	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW002	N	3/5/2005	0.574 J	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW003	N	8/27/2005	35.3	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW003	N	3/5/2005	35.2	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW003	N	8/27/2005	1.68	trans-1,2-Dichloroethene	UG/L
	WATER	ST011-MW003	N	3/5/2005	2.31	trans-1,2-Dichloroethene	UG/L
	WATER	ST011-MW003	N	3/5/2005	1.65	Vinyl chloride	UG/L
	WATER	ST011-MW003	N	8/27/2005	0.793 J	Vinyl chloride	UG/L
	WATER	ST011-MW006	N	3/5/2005	5.7	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW006	N	8/27/2005	3.5	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW006	N	8/27/2005	7.35	Trichloroethene	UG/L
	WATER	ST011-MW006	N	3/5/2005	8.82	Trichloroethene	UG/L
	WATER	ST011-MW006	N	3/5/2005	0.568 J	Vinyl chloride	UG/L
	WATER	ST011-MW007	N	3/5/2005	0.087 J	Benzene	UG/L
	WATER	ST011-MW007	N	3/5/2005	22.3	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW007	N	8/27/2005	11.9	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW007	N	3/5/2005	2.1	trans-1,2-Dichloroethene	UG/L
	WATER	ST011-MW007	N	8/27/2005	0.972 J	trans-1,2-Dichloroethene	UG/L
	WATER	ST011-MW007	N	3/5/2005	3.77	Trichloroethene	UG/L

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M = A matrix effect was present.

Site	Media	Location	QAQC Type	Sample Date	Detected Concentration	Analyte	Units
ST-011							
	WATER	ST011-MW007	N	8/27/2005	4.66	Trichloroethene	UG/L
	WATER	ST011-MW007	N	3/5/2005	2.96	Vinyl chloride	UG/L
	WATER	ST011-MW007	N	8/27/2005	0.51 J	Vinyl chloride	UG/L
	WATER	ST011-MW008	N	8/27/2005	2.53	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW008	N	3/5/2005	2.36	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW008	N	3/5/2005	0.566 J	Vinyl chloride	UG/L
	WATER	ST011-MW016	N	8/27/2005	4.45	1,2-Dichloroethane	UG/L
	WATER	ST011-MW016	N	3/5/2005	0.152 J	Benzene	UG/L
	WATER	ST011-MW016	N	3/5/2005	2.25	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW016	N	8/27/2005	2.54	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW016	N	3/5/2005	0.485 J	trans-1,2-Dichloroethene	UG/L
	WATER	ST011-MW016	N	8/27/2005	0.538 J	trans-1,2-Dichloroethene	UG/L
	WATER	ST011-MW016	N	3/5/2005	1.42	Vinyl chloride	UG/L
	WATER	ST011-MW016	N	8/27/2005	0.994 J	Vinyl chloride	UG/L
	WATER	ST011-MW017	N	8/27/2005	1.48	cis-1,2-Dichloroethene	UG/L
	WATER	ST011-MW017	N	3/5/2005	1.09	cis-1,2-Dichloroethene	UG/L

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Table 5: Compounds Exceeding Tier 1 Screening Levels in Groundwater, February 2005 and August 2005 Long-Term Monitoring Event
Richards-Gebaur Air Force Base

Site	Media	Location	QAQC Type	Sample Date	Units	Analyte	Detected Concentration	Screening Level
SS-003								
	Water	SS03-MW004	N	3/1/2005	UG/L	Trichloroethene	61.7	5
	Water	SS03-MW004	FD	3/1/2005	UG/L	Trichloroethene	60.2	5
	Water	SS03-MW004	N	8/25/2005	UG/L	Trichloroethene	53.6	5
	Water	SS03-MW004	FD	8/25/2005	UG/L	Trichloroethene	48.8	5
	Water	SS03-MW009	N	3/2/2005	UG/L	Trichloroethene	22.5	5
	Water	SS03-MW008	N	8/26/2005	UG/L	Trichloroethene	16.5	5
	Water	SS03-MW009	N	8/25/2005	UG/L	Trichloroethene	16.4	5
	Water	SS03-MW008	N	3/1/2005	UG/L	Trichloroethene	13.7	5
SS-006								
	Water	SS06-MW020	FD	3/7/2005	UG/L	cis-1,2-Dichloroethene	424	70
	Water	SS06-MW020	N	3/7/2005	UG/L	cis-1,2-Dichloroethene	417	70
	Water	SS06-MW020	FD	8/28/2005	UG/L	cis-1,2-Dichloroethene	173	70
	Water	SS06-MW020	N	8/28/2005	UG/L	cis-1,2-Dichloroethene	169	70
	Water	SS06-MW020	FD	3/7/2005	UG/L	Trichloroethene	4070	5
	Water	SS06-MW020	N	3/7/2005	UG/L	Trichloroethene	3730	5
	Water	SS06-MW020	FD	8/28/2005	UG/L	Trichloroethene	2070 J	5
	Water	SS06-MW020	N	8/28/2005	UG/L	Trichloroethene	1930 J	5
	Water	SS06-MW011	N	8/27/2005	UG/L	Trichloroethene	128	5
	Water	SS06-MW014	N	8/28/2005	UG/L	Trichloroethene	124	5
	Water	SS06-MW005	N	8/28/2005	UG/L	Trichloroethene	121	5
	Water	SS06-MW015	N	8/28/2005	UG/L	Trichloroethene	96.7	5
	Water	SS06-MW011	N	3/6/2005	UG/L	Trichloroethene	91.7	5
	Water	SS06-MW014	N	3/6/2005	UG/L	Trichloroethene	50	5
	Water	SS06-MW005	N	3/6/2005	UG/L	Trichloroethene	47	5
	Water	SS06-MW015	N	3/6/2005	UG/L	Trichloroethene	32.3	5
	Water	SS06-MW025	N	3/6/2005	UG/L	Trichloroethene	17.6	5
	Water	SS06-MW018	N	3/6/2005	UG/L	Trichloroethene	14	5
	Water	SS06-MW018	N	8/27/2005	UG/L	Trichloroethene	13.2	5
	Water	SS06-MW025	N	8/28/2005	UG/L	Trichloroethene	12.2	5
	Water	SS06-MW020	N	8/28/2005	UG/L	Vinyl chloride	11.8	2
	Water	SS06-MW020	N	3/7/2005	UG/L	Vinyl chloride	10.5	2
	Water	SS06-MW020	FD	8/28/2005	UG/L	Vinyl chloride	10.4	2
	Water	SS06-MW020	FD	3/7/2005	UG/L	Vinyl chloride	5.87	2
	Water	SS06-MW005	N	8/28/2005	UG/L	Vinyl chloride	2.71	2

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M = A matrix effect was present.

Site	Media	Location	QAQC Type	Sample Date	Units	Analyte	Detected Concentration	Screening Level
SS-009								
	Water	SS09-MW003	N	3/2/2005	UG/L	1,1-Dichloroethene	41.3	7
	Water	SS09-MW003	N	8/26/2005	UG/L	1,1-Dichloroethene	33.2	7
	Water	SS09-MW003	N	3/2/2005	UG/L	cis-1,2-Dichloroethene	176	70
	Water	SS09-MW003	N	8/26/2005	UG/L	cis-1,2-Dichloroethene	134	70
	Water	SS09-MW003	N	8/26/2005	UG/L	Tetrachloroethene	20.6	5
	Water	SS09-MW003	N	3/2/2005	UG/L	Tetrachloroethene	20.2	5
	Water	SS09-MW012	N	3/3/2005	UG/L	Tetrachloroethene	16.5	5
	Water	SS09-MW012	N	8/26/2005	UG/L	Tetrachloroethene	13	5
	Water	SS09-MW003	N	3/2/2005	UG/L	Trichloroethene	15.7	5
	Water	SS09-MW003	N	8/26/2005	UG/L	Trichloroethene	12.1	5
	Water	SS09-MW012	N	3/3/2005	UG/L	Trichloroethene	5.04	5
	Water	SS09-MW003	N	3/2/2005	UG/L	Vinyl chloride	4.9	2
	Water	SS09-MW003	N	8/26/2005	UG/L	Vinyl chloride	3.83	2
	Water	SS09-MW012	N	8/26/2005	UG/L	Vinyl chloride	2.35	2
SS-012								
	Water	SS012-MW001	N	3/4/2005	UG/L	Trichloroethene	1110	5
	Water	SS012-MW002	N	3/4/2005	UG/L	Trichloroethene	680	5
	Water	SS012-MW001	N	8/29/2005	UG/L	Trichloroethene	569	5
	Water	SS012-MW002	N	8/29/2005	UG/L	Trichloroethene	192	5
	Water	SS012-MW012	N	3/4/2005	UG/L	Trichloroethene	115	5
	Water	SS012-MW012	N	8/29/2005	UG/L	Trichloroethene	81.2	5
	Water	SS012-MW003	N	3/4/2005	UG/L	Trichloroethene	7.98	5
	Water	SS012-MW003	N	8/29/2005	UG/L	Trichloroethene	5.88	5
	Water	SS012-MW001	N	8/29/2005	UG/L	Vinyl chloride	7.07	2
	Water	SS012-MW001	N	3/4/2005	UG/L	Vinyl chloride	4.58	2
ST-005								
	Water	ST05-MW024	N	8/24/2005	UG/L	Methylene chloride	5	4.3
	Water	ST05-MW018	FD	8/25/2005	UG/L	Trichloroethene	3600 J	5
	Water	ST05-MW018	N	3/3/2005	UG/L	Trichloroethene	2910	5
	Water	ST05-MW018	FD	3/3/2005	UG/L	Trichloroethene	2560	5
	Water	ST05-MW018	N	8/25/2005	UG/L	Trichloroethene	2480 J	5
	Water	ST05-MW013	N	3/4/2005	UG/L	Trichloroethene	123	5
	Water	ST05-MW013	N	8/24/2005	UG/L	Trichloroethene	95.8	5
	Water	ST05-MW024	N	8/24/2005	UG/L	Trichloroethene	65.8	5
	Water	ST05-MW024	N	3/3/2005	UG/L	Trichloroethene	56.4	5
	Water	ST05-MW011	N	3/3/2005	UG/L	Trichloroethene	35.7	5
	Water	ST05-MW011	N	8/25/2005	UG/L	Trichloroethene	31.1	5

Qualifier Description
J = The analyte was positively identified, the quantitation is an estimate.
F = The analyte was positively identified but the associated numerical value is below the reporting limit (RL).
B = The analyte was found in an associated blank, as well as in the sample.
M = A matrix effect was present.

Site	Media	Location	QAQC Type	Sample Date	Units	Analyte	Detected Concentration	Screening Level
ST-005								
	Water	ST05-MW021	N	3/3/2005	UG/L	Trichloroethene	5.8	5
	Water	ST05-MW018	N	8/25/2005	UG/L	Trichlorofluoromethane	1900	1300
	Water	ST05-MW018	FD	8/25/2005	UG/L	Trichlorofluoromethane	1860	1300
	Water	ST05-MW018	N	3/3/2005	UG/L	Trichlorofluoromethane	1620	1300
	Water	ST05-MW018	FD	3/3/2005	UG/L	Trichlorofluoromethane	1360	1300
	Water	ST05-MW020	N	8/24/2005	UG/L	Vinyl chloride	7.33	2
ST-011								
	Water	ST011-MW006	N	3/5/2005	UG/L	Trichloroethene	8.82	5
	Water	ST011-MW006	N	8/27/2005	UG/L	Trichloroethene	7.35	5
	Water	ST011-MW007	N	3/5/2005	UG/L	Vinyl chloride	2.96	2

Qualifier Description
J = The analyte was positively identified, the quantitation is an estimate.
F = The analyte was positively identified but the associated numerical value is below the reporting limit (RL).
B = The analyte was found in an associated blank, as well as in the sample.
M = A matrix effect was present.

APPENDIX G

GROUNDWATER ARSENIC EVALUATION

Appendix G

Groundwater Arsenic Evaluation

Introduction

Arsenic was excluded as a contaminant of concern in groundwater following the base-wide remedial investigation (RI) in 1999 because only two disparate and unrelated locations on base had total arsenic concentrations above the historic maximum contaminant level (MCL) of 50 μg/L. In addition, arsenic presence in the groundwater was judged to be largely related to the presence of suspended solids since all dissolved arsenic concentrations on base were less than the historic MCL. In January 2001, the Environmental Protection Agency (EPA) promulgated a new MCL for arsenic of 10 μg/L that became effective in January 2006. Due to the new MCL, a reevaluation of arsenic and its exclusion as a contaminant of concern was conducted. The following evaluation compares representative on-base concentrations to background concentrations of total and dissolved arsenic using current EPA methodology.

Methods

The groundwater data collected during the 1999 basewide RI for on-base total and dissolved arsenic (Tables G-2 and G-3 at the end of this appendix) and background total and dissolved arsenic (Tables G-4 and G-5) were compiled and served as the basis for this evaluation. One half the detection limit was used as a proxy concentration to represent non-detections (i.e., results qualified with a "U") in each of these data sets. A series of 95th upper confidence limit concentrations (95 UCLs) were then calculated for each data set using the most current version of EPA's ProUCL software (i.e., ProUCL Version 3.0). This software was developed by EPA to support risk assessment and cleanup decisions at contaminated sites and has been incorporated into the current EPA risk guidance (*Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*, OSWER 9285.6-10, December 2002).

ProUCL computes five different parametric UCLs (e.g., Student t-UCL, Gamma UCL, H-UCL, etc.) and 10 different non-parametric UCLs (e.g., Jackknife UCL, Bootstrap-t UCL, Chebyshev UCL, etc.) and then recommends the 95 UCL that most closely represents the distribution of the data (i.e., normal, lognormal, gama or non-parametric). This follows current EPA guidance which states that the best fit 95 UCL is the most appropriate concentration to represent site-wide exposures.

Results

The raw ProUCL outputs for each of the four data sets (i.e., on-base dissolved arsenic, on-base total arsenic, background dissolved arsenic, and background total arsenic) are summarized in Table G-1; detailed output from the ProUCL software is presented in

Tables G-6 through G-9. The shaded box in each table is the recommended, best fit 95 UCL for each data set. The on-base recommended representative concentrations for total and dissolved arsenic were then compared to the new arsenic MCL (i.e., 10 µg/L). If the on-base representative concentration did not exceed the new MCL, then no further evaluation was necessary. If the on-base concentration exceeded the new MCL, it was further compared to the background representative concentration. The comparisons to the new MCL and background for each on-base data set are presented in the table below.

Table G-1
Arsenic Groundwater Evaluation

Analyte	95 UCL On-base (µg/L)	95 UCL Background (µg/L)	On-base Exceeds MCL (10 µg/L)	Background Exceeds MCL (10 µg/L)	On-base Exceeds Background
Arsenic, Total	12.95	19.48	Yes	Yes	No
Arsenic, Dissolved	5.69	2.54	No	---	---

Conclusions

Using current EPA methodology and software, total and dissolved arsenic concentrations in groundwater were evaluated to determine whether representative concentrations onsite were greater than the new MCL and if so, whether these onsite concentrations exceeded background. This evaluation demonstrated that the representative concentration of dissolved arsenic on-base was less than the new arsenic MCL. Although slightly greater than the new MCL, the on-base total arsenic concentration was less than the background total arsenic concentration. Consequently, arsenic need not be considered a COC and no further evaluation of this constituent is necessary. It should be noted that the biological activity of iron-reducing bacteria in Missouri aquifers has been linked to arsenic levels in groundwater due to the reductive dissolution of arsenic by these bacteria and subsequent release into groundwater (Geological Society of America).

Table G-2: On-base Groundwater – Dissolved Arsenic Data

Site	Location	NativeID	QAQC Type	Sample Date	Analyte	Matrix	Units	MDL	Final Result	Data Flag
AOC-001	AC01-MW02	AOC01-MW002-D	N	11/29/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0008	F
AOC-001	AOC01-MW001	AOC01-MW001-D	N	11/29/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
AOC-001	AC01-MW02	AOC01-MWFD02-D	FD	11/29/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
AOC-002	AC02-DPW1	AOC02-DPWFD01-D	FD	11/11/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.001	F
AOC-002	AC02-DPW1	AOC02-DPW001-D	N	11/11/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
AOC-002	AC02-MW01	AOC02-MW001-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
AOC-002	AC02-MW02	AOC02-MW002-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
CS-002	CS02-MW001	CS002-MW001-D	N	11/10/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0012	F
CS-002	CS02-MW004	CS002-MW004-D	N	11/9/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0006	F
CS-002	CS02-MW03	CS002-MW003-D	N	11/9/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
CS-002	CS02-MW004	CS002-MWFD04-D	FD	11/9/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
CS-004	CS04-MW003	CS004-MW003-D	N	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0063	
CS-004	CS04-MW001	CS004-MW001-D	N	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0017	F
CS-004	CS04-MW002	CS004-MW002-D	N	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
CS-004	CS04-MW003	CS004-MWFD03-D	FD	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
FT-002	FT02-GMW604	FT002-GMW604-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
FT-002	FT02-GMW605	FT002-GMW605-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
FT-002	FT02-GMW606	FT002-GMW606-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
FT-002	FT02-GMW607	FT002-GMW607-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	UM
FT-002	FT02-GMW605	FT002-GMWFD605-D	FD	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
HMW	968HMW-PZ01	968HMWPZ01F	N	7/30/2001	Arsenic,dissolved	Water	MG/L	0.005	0.0072	
SEP	1049SEP-CL01A	1049SEPCL01AF	N	7/30/2001	Arsenic,dissolved	Water	MG/L	0.005	0.0025	U
SEP	1025SEP-CL01	1025SEPCL01AF	N	7/30/2001	Arsenic,dissolved	Water	MG/L	0.005	0.0025	U
SEP	1049SEP-CL01B	1049SEPCL01BF	N	7/30/2001	Arsenic,dissolved	Water	MG/L	0.005	0.0025	U
SS-003	SS03-MW004	CS002-MW005-D	N	11/9/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0015	F
SS-003	SS03-MW002	SS003-MW002-D	N	11/22/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.001	F
SS-003	SS03-MW001	SS003-MW001-D	N	11/22/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0008	F
SS-003	SS03-MW003	SS003-MW003-D	N	11/22/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
SS-003	SS03-MW003	SS003-MWFD03-D	FD	11/22/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
SS-004	SS04-MW3	SS004-MW003-D	N	11/23/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0014	M
SS-004	SS04-MW2	SS004-MW002-D	N	11/23/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0007	F
SS-004	SS04-MW1	SS004-MW001-D	N	11/23/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
SS-006	SS06-MW001	SS006-MW001-D	N	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
SS-006	SS06-MW001	SS006-MWFD01-D	FD	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
SS-009	SS09-MW002	SS009-MW002-D	N	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0008	F
SS-009	SS09-MW003	SS009-MW003-D	N	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U

Table G-2: On-base Groundwater – Dissolved Arsenic Data (cont.)

Site	Location	NativeID	QAQC Type	Sample Date	Analyte	Matrix	Units	MDL	Final Result	Data Flag
ST-005	ST05-MW9	ST005-MW0009-D	N	11/17/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0344	
ST-005	ST05-MW3D	ST005-MWFD03D-D	FD	11/18/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0079	
ST-005	ST05-MW2D	ST005-MW002D-D	N	11/19/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0048	F
ST-005	ST05-MW3D	ST005-MW003D-D	N	11/18/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0047	F
ST-005	ST05-MW5D	ST005-MW005D-D	N	11/12/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0041	F
ST-005	ST05-MW3S	ST005-MW003S-D	N	11/18/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0035	F
ST-005	ST05-MW1205	ST005-MW1205-D	N	11/17/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0033	M
ST-005	ST05-MW1	ST005-MW001-D	N	11/11/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0016	F
ST-005	ST05-MW1208R	ST005-MW1208R-D	N	11/17/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0015	F
ST-005	ST05-MW4D	ST005-MW004D-D	N	11/18/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0015	F
ST-005	ST05-MW7S	ST005-MW007S-D	N	11/12/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0008	F
ST-005	ST05-MW2	ST005-MW0002-D	N	11/17/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0007	F
ST-005	ST05-MW003	ST005-MW003	N	11/11/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
ST-005	ST05-MW4	ST005-MW0004-D	N	11/17/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
ST-005	ST05-MW1206	ST005-MW1206-D	N	11/17/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
ST-005	ST05-MW1207	ST005-MW1207-D	N	11/17/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
ST-005	ST05-MW7S	ST005-MWFD07S-D	FD	11/12/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
ST-005	ST05-MW1S	ST005-MW001S-D	N	11/16/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	UM
ST-005	ST05-MW8S	ST005-MW008S-D	N	11/18/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
XO-001	X01-MW02	XO001-MW002-D	N	12/2/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0026	F
XO-001	X01-MW03	XO001-MW003-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
XO-001	X01-MW06	XO001-MW006-D	N	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
XO-001	X01-MW06	XO001-MWFD06-D	FD	12/1/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U

Table G-3: On-base Groundwater – Total Arsenic Data

Site	Location	Native ID	QAQC Type	Sample Date	Analyte	Matrix	Units	MDL	Final Result	Data Flag
AOC-001	AC01-MW02	AOC01-MW002	N	11/29/1999	Arsenic	Water	MG/L	0.0006	0.0451	J
AOC-001	AC01-MW02	AOC01-MWFD02	FD	11/29/1999	Arsenic	Water	MG/L	0.0006	0.0228	J
AOC-001	AOC01-MW001	AOC01-MW001	N	11/29/1999	Arsenic	Water	MG/L	0.0006	0.0084	
AOC-002	AC02-MW01	AOC02-MW001	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0135	
AOC-002	AC02-DPW1	AOC02-DPW001	N	11/11/1999	Arsenic	Water	MG/L	0.0006	0.0016	F
AOC-002	AC02-DPW1	AOC02-DPWFD01	FD	11/11/1999	Arsenic	Water	MG/L	0.0006	0.0015	F
AOC-002	AC02-MW02	AOC02-MW002	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0007	F
CS-002	CS02-MW03	CS002-MW003	N	11/9/1999	Arsenic	Water	MG/L	0.0006	0.0092	
CS-002	CS02-MW004	CS002-MW004	N	11/9/1999	Arsenic	Water	MG/L	0.0006	0.0055	
CS-002	CS02-MW004	CS002-MWFD04	FD	11/9/1999	Arsenic	Water	MG/L	0.0006	0.0042	F
CS-002	CS02-MW005	CS002-MW005	N	11/9/1999	Arsenic	Water	MG/L	0.0006	0.001	F
CS-002	CS02-MW001	CS002-MW001	N	11/10/1999	Arsenic	Water	MG/L	0.0006	0.0008	F
CS-004	CS04-MW003	CS004-MW003	N	11/30/1999	Arsenic	Water	MG/L	0.0006	0.0154	J
CS-004	CS04-MW003	CS004-MWFD03	FD	11/30/1999	Arsenic	Water	MG/L	0.0006	0.012	J
CS-004	CS04-MW001	CS004-MW001	N	11/30/1999	Arsenic	Water	MG/L	0.0006	0.0104	
CS-004	CS04-MW002	CS004-MW002	N	11/30/1999	Arsenic	Water	MG/L	0.0006	0.005	
FT-002	FT02-GMW605	FT002-GMWFD605	FD	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0264	J
FT-002	FT02-GMW607	FT002-GMW607	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0213	M
FT-002	FT02-GMW606	FT002-GMW606	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.015	
FT-002	FT02-GMW605	FT002-GMW605	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0121	J
FT-002	FT02-GMW604	FT002-GMW604	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0038	F
HMW	968HMW-PZ01	968HMWPZ01	N	7/26/2001	Arsenic	Water	MG/L	0.005	0.0602	
HMW	968HMW-PZ01	968HMWFDPZ01	FD	7/26/2001	Arsenic	Water	MG/L	0.005	0.0347	
SEP	1049SEP-CL01B	1049SEPCL01B	N	7/30/2001	Arsenic	Water	MG/L	0.005	0.0106	
SEP	1025SEP-CL01	1025SEPCL01A	N	7/30/2001	Arsenic	Water	MG/L	0.005	0.0025	U
SEP	1049SEP-CL01A	1049SEPCL01A	N	7/30/2001	Arsenic	Water	MG/L	0.005	0.0025	U
SS-003	SS03-MW001	SS003-MW001	N	11/22/1999	Arsenic	Water	MG/L	0.0006	0.0125	
SS-003	SS03-MW002	SS003-MW002	N	11/22/1999	Arsenic	Water	MG/L	0.0006	0.0026	F
SS-003	SS03-MW003	SS003-MWFD03	FD	11/22/1999	Arsenic	Water	MG/L	0.0006	0.001	F
SS-003	SS03-MW003	SS003-MW003	N	11/22/1999	Arsenic	Water	MG/L	0.0006	0.0003	U
SS-004	SS04-MW1	SS004-MW001	N	11/23/1999	Arsenic	Water	MG/L	0.0006	0.0194	
SS-004	SS04-MW3	SS004-MW003	N	11/23/1999	Arsenic	Water	MG/L	0.0006	0.0103	
SS-004	SS04-MW2	SS004-MW002	N	11/23/1999	Arsenic	Water	MG/L	0.0006	0.0011	F
SS-006	SS06-MW001	SS006-MWFD01	FD	11/30/1999	Arsenic	Water	MG/L	0.0006	0.0048	F
SS-006	SS06-MW001	SS006-MW001	N	11/30/1999	Arsenic	Water	MG/L	0.0006	0.0036	F
SS-009	SS09-MW002	SS009-MW002	N	11/30/1999	Arsenic	Water	MG/L	0.0006	0.0094	

Table G-3: Onsite Groundwater – Total Arsenic Data (cont.)

Site	Location	Native ID	QAQC Type	Sample Date	Analyte	Matrix	Units	MDL	Final Result	Data Flag
ST-005	ST05-MW9	ST005-MW0009	N	11/17/1999	Arsenic	Water	MG/L	0.0006	0.0565	
ST-005	ST05-MW3D	ST005-MWFD03D	FD	11/18/1999	Arsenic	Water	MG/L	0.0006	0.0141	
ST-005	ST05-MW3D	ST005-MW003D	N	11/18/1999	Arsenic	Water	MG/L	0.0006	0.0134	
ST-005	ST05-MW1205	ST005-MW1205	N	11/17/1999	Arsenic	Water	MG/L	0.0006	0.0134	
ST-005	ST05-MW5D	ST005-MW005D	N	11/12/1999	Arsenic	Water	MG/L	0.0006	0.0103	
ST-005	ST05-MW2	ST005-MW0002	N	11/17/1999	Arsenic	Water	MG/L	0.0006	0.0085	
ST-005	ST05-MW3S	ST005-MW003S	N	11/18/1999	Arsenic	Water	MG/L	0.0006	0.0078	
ST-005	ST05-MW2D	ST005-MW002D	N	11/19/1999	Arsenic	Water	MG/L	0.0006	0.0068	
ST-005	ST05-MW4	ST005-MW0004	N	11/17/1999	Arsenic	Water	MG/L	0.0006	0.0062	
ST-005	ST05-MW1207	ST005-MW1207	N	11/17/1999	Arsenic	Water	MG/L	0.0006	0.0056	
ST-005	ST05-MW8S	ST005-MW008S	N	11/18/1999	Arsenic	Water	MG/L	0.0006	0.0047	F
ST-005	ST05-MW7S	ST005-MWFD07S	FD	11/12/1999	Arsenic	Water	MG/L	0.0006	0.0042	F
ST-005	ST05-MW4D	ST005-MW004D	N	11/18/1999	Arsenic	Water	MG/L	0.0006	0.0032	F
ST-005	ST05-MW7S	ST005-MW007S	N	11/12/1999	Arsenic	Water	MG/L	0.0006	0.0029	F
ST-005	ST05-MW1	ST005-MW001	N	11/11/1999	Arsenic	Water	MG/L	0.0006	0.0019	F
ST-005	ST05-MW1208R	ST005-MW1208R	N	11/17/1999	Arsenic	Water	MG/L	0.0006	0.0016	F
ST-005	ST05-MW1206	ST005-MW1206	N	11/17/1999	Arsenic	Water	MG/L	0.0006	0.0008	F
ST-005	ST05-MW1S	ST005-MW001S	N	11/16/1999	Arsenic	Water	MG/L	0.0006	0.0003	UM
XO-001	X01-MW02	XO001-MW002	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0044	F
XO-001	X01-MW03	XO001-MW003	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.001	F
XO-001	X01-MW06	XO001-MW006	N	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0003	U
XO-001	X01-MW06	XO001-MWFD06	FD	12/1/1999	Arsenic	Water	MG/L	0.0006	0.0006	F

Table G-4: Background Groundwater – Dissolved Arsenic Data

Site	Location	Native ID	QAQC Type	Sample Date	Analyte	Matrix	Units	MDL	Final Result	Data Flag
BG-001	BG01-MW09	BG001-MW009-D	N	11/30/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0031	F
BG-001	BG01-MW02	BG001-MWFD02-D	FD	11/23/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0009	F
BG-001	BG01-MW03	BG001-MW003-D	N	11/29/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0009	F
BG-001	BG01-MW02	BG001-MW002-D	N	11/23/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
BG-001	BG01-MW01	BG001-MW001-D	N	11/22/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U
BG-001	BG01-MW05	BG001-MW005-D	N	12/2/1999	Arsenic, Dissolved	Water	MG/L	0.0006	0.0003	U

Table G-5: Background Groundwater – Total Arsenic Data

Site	Location	Native ID	QAQC Type	Sample Date	Analyte	Matrix	Units	MDL	Final Result	Data Flag
BG-001	BG01-MW03	BG001-MW003	N	11/29/1999	Arsenic	Water	MG/L	0.0006	0.0231	
BG-001	BG01-MW09	BG001-MW009	N	11/30/1999	Arsenic	Water	MG/L	0.0006	0.0089	
BG-001	BG01-MW02	BG001-MWFD02	FD	11/23/1999	Arsenic	Water	MG/L	0.0006	0.0054	
BG-001	BG01-MW01	BG001-MW001	N	11/22/1999	Arsenic	Water	MG/L	0.0006	0.0043	F
BG-001	BG01-MW02	BG001-MW002	N	11/23/1999	Arsenic	Water	MG/L	0.0006	0.0023	F
BG-001	BG01-MW05	BG001-MW005	N	12/2/1999	Arsenic	Water	MG/L	0.0006	0.0017	F

Table G-6: On-base Total Arsenic – ProUCL Output

Data File	Onsite Groundwater - Total Arsenic EPC		
C:\Documents and Settings\501455\My Documents\AFCEE\Richards Gebaur\5 Yr Review\GW Arsenic Data_0.5 MDL-_total.xls			
Raw Statistics		Normal Distribution Test	EPC (mg/L)
Number of Valid Samples	58	Lilliefors Test Statisitic	0.2217005
Number of Unique Samples	48	Lilliefors 5% Critical Value	0.1163375
Minimum	0.0003	Data not normal at 5% significance level	
Maximum	0.0602		
Mean	0.009995	95% UCL (Assuming Normal Distribution)	
Median	0.00555	Student's-t UCL	0.0127718
Standard Deviation	0.012649		
Variance	0.00016	Gamma Distribution Test	
Coefficient of Variation	1.265534	A-D Test Statistic	0.440722
Skewness	2.513649	A-D 5% Critical Value	0.7879337
		K-S Test Statistic	0.0789143
Gamma Statistics		K-S 5% Critical Value	0.1210441
k hat	0.834223	Data follow gamma distribution	
k star (bias corrected)	0.802568	at 5% significance level	
Theta hat	0.011981		
Theta star	0.012454	95% UCLs (Assuming Gamma Distribution)	
nu hat	96.76988	Approximate Gamma UCL	0.0129519
nu star	93.09787	Adjusted Gamma UCL	0.0130382
Approx.Chi Square Value (.05)	71.8423		
Adjusted Level of Significance	0.045862	Lognormal Distribution Test	
Adjusted Chi Square Value	71.36719	Lilliefors Test Statisitic	0.0887638
		Lilliefors 5% Critical Value	0.1163375
Log-Transformed Statistics		Data are lognormal at 5% significance level	
Minimum of log data	-8.111728		
Maximum of log data	-2.810083	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	-5.313242	95% H-UCL	0.0184255
Standard Deviation of log data	1.313692	95% Chebyshev (MVUE) UCL	0.0223291
Variance of log data	1.725786	97.5% Chebyshev (MVUE) UCL	0.0270721
		99% Chebyshev (MVUE) UCL	0.0363889
		95% Non-parametric UCLs	
		CLT UCL	0.0127267
		Adj-CLT UCL (Adjusted for skewness)	0.0133125
		Mod-t UCL (Adjusted for skewness)	0.0128632
		Jackknife UCL	0.0127718
		Standard Bootstrap UCL	0.0127736
		Bootstrap-t UCL	0.0137278
RECOMMENDATION		Hall's Bootstrap UCL	0.0136608
Data follow gamma distribution (0.05)		Percentile Bootstrap UCL	0.0128948
		BCA Bootstrap UCL	0.0135966
Use Approximate Gamma UCL		95% Chebyshev (Mean, Sd) UCL	0.0172344
		97.5% Chebyshev (Mean, Sd) UCL	0.0203669
		99% Chebyshev (Mean, Sd) UCL	0.0265203

Table G-7: Background Total Arsenic – ProUCL Output

Data File	Background Total Arsenic EPC		
C:\Documents and Settings\501455\My Documents\AFCEE\Richards Gebaur\5 Yr Review\GW Background Arsenic Data_0.5 MDL_total.xls			
Raw Statistics		Normal Distribution Test	EPC (mg/L)
Number of Valid Samples	6	Shapiro-Wilk Test Statisitic	0.7699494
Number of Unique Samples	6	Shapiro-Wilk 5% Critical Value	0.788
Minimum	0.0017	Data not normal at 5% significance level	
Maximum	0.0231		
Mean	0.007617	95% UCL (Assuming Normal Distribution)	
Median	0.00485	Student's-t UCL	0.0142036
Standard Deviation	0.008007		
Variance	6.41E-05	Gamma Distribution Test	
Coefficient of Variation	1.051261	A-D Test Statistic	0.3160609
Skewness	1.933832	A-D 5% Critical Value	0.7089371
		K-S Test Statistic	0.2059098
Gamma Statistics		K-S 5% Critical Value	0.3379835
k hat	1.421538	Data follow gamma distribution	
k star (bias corrected)	0.82188	at 5% significance level	
Theta hat	0.005358		
Theta star	0.009267	95% UCLs (Assuming Gamma Distribution)	
nu hat	17.05845	Approximate Gamma UCL	0.0194853
nu star	9.86256	Adjusted Gamma UCL	0.0286037
Approx.Chi Square Value (.05)	3.855211		
Adjusted Level of Significance	0.01222	Lognormal Distribution Test	
Adjusted Chi Square Value	2.626226	Shapiro-Wilk Test Statisitic	0.9667649
		Shapiro-Wilk 5% Critical Value	0.788
Log-Transformed Statistics		Data are lognormal at 5% significance level	
Minimum of log data	-6.377127		
Maximum of log data	-3.767923	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	-5.268683	95% H-UCL	0.0456394
Standard Deviation of log data	0.944968	95% Chebyshev (MVUE) UCL	0.0195122
Variance of log data	0.892964	97.5% Chebyshev (MVUE) UCL	0.0247793
		99% Chebyshev (MVUE) UCL	0.0351254
		95% Non-parametric UCLs	
		CLT UCL	0.0129935
		Adj-CLT UCL (Adjusted for skewness)	0.0157511
		Mod-t UCL (Adjusted for skewness)	0.0146338
		Jackknife UCL	0.0142036
		Standard Bootstrap UCL	0.0125027
		Bootstrap-t UCL	0.0283529
RECOMMENDATION		Hall's Bootstrap UCL	0.0384946
Data follow gamma distribution (0.05)		Percentile Bootstrap UCL	0.0136
		BCA Bootstrap UCL	0.01465
Use Approximate Gamma UCL		95% Chebyshev (Mean, Sd) UCL	0.0218654
		97.5% Chebyshev (Mean, Sd) UCL	0.0280308
		99% Chebyshev (Mean, Sd) UCL	0.0401417

Table G-8: On-base Dissolved Arsenic – ProUCL Output

Data File	Onsite Groundwater - Dissolved Arsenic EPC		
C:\Documents and Settings\501455\My Documents\AFCEE\Richards Gebaur\5 Yr Review\GW Arsenic Data_0.5 MDL_dissolved.xls			
Raw Statistics		Normal Distribution Test	EPC (mg/L)
Number of Valid Samples	59	Lilliefors Test Statisitic	0.3643959
Number of Unique Samples	21	Lilliefors 5% Critical Value	0.1153474
Minimum	0.0003	Data not normal at 5% significance level	
Maximum	0.0344		
Mean	0.001914	95% UCL (Assuming Normal Distribution)	
Median	0.0003	Student's-t UCL	0.0029263
Standard Deviation	0.004654		
Variance	2.17E-05	Gamma Distribution Test	
Coefficient of Variation	2.431909	A-D Test Statistic	5.7251004
Skewness	6.137032	A-D 5% Critical Value	0.7998958
		K-S Test Statistic	0.2732737
Gamma Statistics		K-S 5% Critical Value	0.1210485
k hat	0.668429	Data do not follow gamma distribution	
k star (bias corrected)	0.64574	at 5% significance level	
Theta hat	0.002863		
Theta star	0.002963	95% UCLs (Assuming Gamma Distribution)	
nu hat	78.8746	Approximate Gamma UCL	0.0025541
nu star	76.19736	Adjusted Gamma UCL	0.0025728
Approx.Chi Square Value (.05)	57.08717		
Adjusted Level of Significance	0.045932	Lognormal Distribution Test	
Adjusted Chi Square Value	56.67336	Lilliefors Test Statisitic	0.2993965
		Lilliefors 5% Critical Value	0.1153474
Log-Transformed Statistics		Data not lognormal at 5% significance level	
Minimum of log data	-8.111728		
Maximum of log data	-3.369699	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	-7.168812	95% H-UCL	0.0022082
Standard Deviation of log data	1.164635	95% Chebyshev (MVUE) UCL	0.0027054
Variance of log data	1.356375	97.5% Chebyshev (MVUE) UCL	0.0032315
		99% Chebyshev (MVUE) UCL	0.004265
		95% Non-parametric UCLs	
		CLT UCL	0.0029101
		Adj-CLT UCL (Adjusted for skewness)	0.0034273
		Mod-t UCL (Adjusted for skewness)	0.0030069
		Jackknife UCL	0.0029263
		Standard Bootstrap UCL	0.0028878
		Bootstrap-t UCL	0.0045544
RECOMMENDATION		Hall's Bootstrap UCL	0.0065357
Data are Non-parametric (0.05)		Percentile Bootstrap UCL	0.0030407
		BCA Bootstrap UCL	0.0037729
Use 97.5% Chebyshev (Mean, Sd) UCL		95% Chebyshev (Mean, Sd) UCL	0.0045544
		97.5% Chebyshev (Mean, Sd) UCL	0.0056971
		99% Chebyshev (Mean, Sd) UCL	0.0079417

Table G-9: Background Dissolved Arsenic – ProUCL Output

Data File	Background Dissolved Arsenic EPC		
C:\Documents and Settings\501455\My Documents\AFCEE\Richards Gebaur\5 Yr Review\GW Background Arsenic Data_0.5 MDL_dissolved.xls			
Raw Statistics		Normal Distribution Test	EPC (mg/L)
Number of Valid Samples	6	Shapiro-Wilk Test Statisitic	0.69343167
Number of Unique Samples	3	Shapiro-Wilk 5% Critical Value	0.788
Minimum	0.0003	Data not normal at 5% significance level	
Maximum	0.0031		
Mean	0.000967	95% UCL (Assuming Normal Distribution)	
Median	0.0006	Student's-t UCL	0.00185978
Standard Deviation	0.001086		
Variance	1.18E-06	Gamma Distribution Test	
Coefficient of Variation	1.123101	A-D Test Statistic	0.67122405
Skewness	2.067671	A-D 5% Critical Value	0.71000927
		K-S Test Statistic	0.29652373
Gamma Statistics		K-S 5% Critical Value	0.33848222
k hat	1.348203	Data follow gamma distribution	
k star (bias corrected)	0.785213	at 5% significance level	
Theta hat	0.000717		
Theta star	0.001231	95% UCLs (Assuming Gamma Distribution)	
nu hat	16.17844	Approximate Gamma UCL	0.00254187
nu star	9.422553	Adjusted Gamma UCL	0.00377761
Approx.Chi Square Value (.05)	3.583375		
Adjusted Level of Significance	0.01222	Lognormal Distribution Test	
Adjusted Chi Square Value	2.411172	Shapiro-Wilk Test Statisitic	0.81774626
		Shapiro-Wilk 5% Critical Value	0.788
Log-Transformed Statistics		Data are lognormal at 5% significance level	
Minimum of log data	-8.111728		
Maximum of log data	-5.776353	95% UCLs (Assuming Lognormal Distribution)	
Mean of log data	-7.356295	95% H-UCL	0.00560503
Standard Deviation of log data	0.94274	95% Chebyshev (MVUE) UCL	0.00241194
Variance of log data	0.88876	97.5% Chebyshev (MVUE) UCL	0.00306247
		99% Chebyshev (MVUE) UCL	0.00434029
		95% Non-parametric UCLs	
		CLT UCL	0.0016957
		Adj-CLT UCL (Adjusted for skewness)	0.00209547
		Mod-t UCL (Adjusted for skewness)	0.00192213
		Jackknife UCL	0.00185978
		Standard Bootstrap UCL	N/R
		Bootstrap-t UCL	N/R
RECOMMENDATION		Hall's Bootstrap UCL	N/R
Data follow gamma distribution (0.05)		Percentile Bootstrap UCL	N/R
		BCA Bootstrap UCL	N/R
Use Approximate Gamma UCL		95% Chebyshev (Mean, Sd) UCL	0.00289862
		97.5% Chebyshev (Mean, Sd) UCL	0.00373458
		99% Chebyshev (Mean, Sd) UCL	0.00537666

APPENDIX H

VAPOR INTRUSION EVALUATION

Appendix H

Evaluation of Vapor Intrusion from Groundwater to Indoor Air

Introduction

During the Remedial Investigation / Feasibility Study (RI/FS), the groundwater-to-indoor air exposure pathway was evaluated as part of the risk assessment to evaluate the potential risk to future workers and residents in structures overlying contaminated groundwater at the former Richards Gebaur Air Force Base (RG). This evaluation was documented in Appendix B of the 2002 Feasibility Study conducted by CH2MHill. The 2000 version of the Johnson and Ettinger (J&E) Model was used to estimate the potential risk at each monitoring location based on current groundwater concentrations at the time of the evaluation. The evaluation demonstrated that the maximum potential risk was well below the USEPA range of 10^{-6} to 10^{-4} and a non-cancer hazard quotient of one for both residential and worker exposures. As a result, the FS concluded that there was no need to select and implement any remedy to protect future receptors from exposure to this potential pathway.

Since the completion of the FS, institutional controls, restricting the extraction and subsequent use of groundwater, have been instituted as part of the selected remedy. Long-term monitoring (LTM) of groundwater has also been implemented as part of the remedy. Since the implementation of the LTM program, groundwater concentrations at certain monitoring wells have increased to levels higher than those used in the 2002 vapor intrusion evaluation. The United States Environmental Protection Agency (USEPA) has also updated the Johnson-Ettinger (J&E) model by modifying certain assumptions and default input parameters. As a result, a reevaluation of the vapor intrusion pathway was necessary to assess whether the remedy implemented in the Record of Decision (ROD) remains protective.

Methods

As part of the five-year review, the vapor intrusion pathway was reevaluated using version 3.1 of the Johnson-Ettinger model (2004 J&E Model). The major changes from Version 2.0 to Version 3.1 are discussed in detail in the vapor intrusion user's manuals for the model. The most significant change is that the 2000 version of the J&E model used a unit risk factor (URF) value that is derived from a withdrawn toxicity value for TCE, and Version 3.1 uses a provisional URF value that is based on the most conservative upper bound range of toxicological studies. This provisional upper bound URF has not been officially adopted by EPA and is not included in EPA's preeminent database of approved toxicological values (i.e., Integrated Risk Information System or

IRIS). Current Air Force policy dictates the use of California EPA's (CalEPA) inhalation slope factor until a new value is formally accepted in the IRIS (July 14, 2006 USAF Memorandum, "Toxicity Values for Use in Risk Assessments and Establishing Risk-Based Cleanup Levels"). Therefore, the results from version 3.1 of the J&E model were adjusted to use the peer-reviewed CalEPA toxicity value. For comparison purposes, this reevaluation also modeled indoor air exposures using EPA's provisional toxicity value.

The input parameters used in the original evaluation of indoor air exposure at the former Richards Gebaur AFB (RG) are listed in Table B-1 of the FS (2002). The 2002 evaluation was conducted for both residential and worker exposure scenarios. The same soil and building properties were used at all sites and monitoring locations. Therefore, under each exposure scenario, the concentration of contaminants was the only variable when assessing the risk at individual monitoring locations. According to the FS, the maximum estimated excess lifetime cancer risk for both the residential and worker exposure scenarios were well below the USEPA risk range of 10^{-6} to 10^{-4}.

In the FS, risk from all VOCs detected above their MCLs were evaluated; however, Trichloroethylene (TCE) by far resulted in the maximum calculated risk. Therefore, this reevaluation of indoor air exposures was limited to estimating the potential risk from TCE. The groundwater monitoring data collected since the initial evaluation show that the maximum TCE concentration from all sites is now detected at MW-18 in ST-005, 3,600 µg/L (August 2005).

Results

The results of the new evaluation, along with a comparison to the 2002 evaluation are summarized in the table below.

Table 1
Hypothetical Maximum Indoor Air Risk Evaluation for TCE in Groundwater

TCE Source Conc. (µg/L)	TCE URF (ug/m3)-1)	Residential Exposure Excess Lifetime Cancer Risk	Worker Exposure Excess Lifetime Cancer Risk	Comparison to USEPA Risk Threshold 10^{-6} to 10^{-4}
J&E Model Version 2.0 (2002)				
1,100	1.7×10^{-6}	8.3×10^{-7}	5.5×10^{-7}	Both below range
J&E model Version 3.1 (2006)				
3,600	2.0×10^{-6} (CalEPA tox value)	1.4×10^{-5}	8.1×10^{-6}	Both within range
	1.1×10^{-4} (EPA provisional value)	7.7×10^{-4}	4.6×10^{-4}	Both above range

Using the most current version of the J&E model, (with the same set of input parameters for soil and buildings used in the 2002 RI/FS evaluation) and CalEPA's

toxicity value, the maximum estimated cancer risk based on the maximum groundwater concentration of TCE measured in August 2005 (i.e., MW18 at ST005) is within EPA's acceptable range for both residential and worker exposures. If EPA's upper bound, provisional toxicity value for TCE is used, the estimated risk exceeds the target risk range for both hypothetical residential and worker exposure scenarios.

Currently, there is only one building located over an area of TCE contaminated groundwater at RG (i.e., Building 605 at SS-009). A current worker and hypothetical resident risk evaluation using the maximum current concentration of TCE beneath this building is presented in Table 2. The maximum concentration of TCE detected at this site is at well MW-003 (12.1 µg/L, August 2005).

Table 2
Current Indoor Air Risk Evaluation for TCE in Groundwater

TCE Source Conc. (µg/L)	TCE URF (ug/m3)-1)	Residential Exposure Excess Lifetime Cancer Risk	Worker Exposure Excess Lifetime Cancer Risk	Comparison to USEPA Risk Threshold 10^{-6} to 10^{-4}.
2006 Evaluation using J&E model Version 3.1				
12.1	1.1×10^{-4} (EPA provisional value)	2.6×10^{-6}	1.5×10^{-6}	Both within range
	2.0×10^{-6} (CalEPA peer-reviewed value)	4.6×10^{-8}	2.7×10^{-8}	Both below range

Conclusions

Indoor air risks posed to future residents and workers by vapor migration from contaminated groundwater was evaluated using the maximum concentration of TCE (MW-18 at ST-005). This evaluation conservatively estimates future risk because no buildings currently overlay the area around MW-18. Using the most current version of the J&E model and the peer-reviewed CalEPA toxicity value, the maximum estimated cancer risk based on the highest groundwater concentration of TCE is within the target risk range for both residential and worker exposures. If EPA's upper bound, provisional toxicity value for TCE is used, the estimated risk exceeds the target risk range for both hypothetical residential and worker-exposure scenarios. A current indoor air risk evaluation was also conducted for the only building presently overlaying a TCE plume (i.e., Building 605 at SS-009). The estimated residential and worker risks for occupants of this building were within or below EPA's target risk range using the provisional or the CalEPA TCE toxicity values, respectively. Therefore, the current remedy remains protective and no further action is required to address this pathway at this time. A revised risk evaluation is recommended after a final TCE toxicity factor is approved and included in the IRIS. It should be noted that the hypothetical risk evaluation presented here was based upon maximum site concentrations, an overly conservative assumption. It is recommended that any future indoor air risk evaluations

be based on the EPA reasonable maximum concentration or the 95th percent upper confidence limit of wells within an area of the site representing a current or hypothetical future building footprint (e.g., ~1,200 ft^2).