COST AND PERFORMANCE CASE STUDY REPORT

Keesler Air Force Base Base Exchange Service Station, AOC-A (ST-06) **Site Name**

SITE INFORMATION

IDENTIFYING INFORMATION

Site Name: Base Exchange Service Station, Area of Concern – A (ST-06)

Location: Keesler Air Force Base, Mississippi

CERCLIS ID No.: NA

Regulatory Context: Lead agency is USEPA Region IV; however, UST-related guidelines and requirements of the Mississippi Dept. of Environmental Quality are being used. IRP site characterization report completed in 1991, and RCRA Facility Investigation Report completed in 1992.

TECHNOLOGY APPLICATION

Period of Performance: September 1997 – April 1999

Area of Contaminated Zone (source area plus dissolved plume): 4.0 acres

BACKGROUND

Waste Management Practice That Contributed to Contamination: leaking underground storage tank(s)

Site History: 10 MOGAS USTs removed in 1987; evidence of contamination showed that one or more of the tanks had leaked.

Remedy Selection: Bioventing system installed in 1993 and operated for 3 years. Density-driven convection (DDC) in-well aeration system installed in 1996 and operated at least through February 1998. Based on this RBCA analysis, recommended final remedial action is monitored natural attenuation because the site contamination does not currently (and will not in the future) pose a significant risk to potential receptors, the dissolved plume is stable and degrading, and institutional controls can be maintained with a high level of confidence.

SITE LOGISTICS/CONTACTS

(Provide name, address, telephone, e-mail)

Site Lead: Ms. Lisa Noble, 81st CES/CEVR, 508 L Street, Keesler AFB, MS 39534-2115, (601)377-5803, noblel@ces.kee.aetc.af.mil.

Oversight: Mr. Jim Gonzales, AFCEE/ERT, 3207 North Rd., Building 532, Brooks AFB, TX 78235-5363, (210) 536-4324, james.gonzales@hqafcee.brooks.af.mil.

Regulatory Contact: Mr. Robert Pope, USEPA Region IV, 61 Forsyth St., SW, Atlanta, GA 30303-3104, (404) 562-8506.

Mr. Bob Merrill, Mississippi DEQ, P.O. Box 10385, Jackson, MS 39289-0385, (601) 961-5171.

Prime Contractor: Mr. John Hicks, Parsons Engineering Science, Inc., 1700 Broadway, Suite 900, Denver, CO 80290, (303) 831-8100, john.hicks@parsons.com

Additional Contacts: NA

MATRIX DESCRIPTION

MATRIX IDENTIFICATION

Type of Matrix Processed Through Technology System: RBCA study addressed soil, groundwater, and soil gas

CONTAMINANT CHARACTERIZATION

Primary Contaminant Groups and Concentrations Measured During Site Investigation:
Gasoline constituents, see attached Table 1 for concentrations of target analytes in soil and attached Figure 1 for distribution of total lead and BTEX in groundwater.

Contaminant Properties:

Based on Tier 1 screening, only lead in groundwater was identified as a contaminant of potential concern at the BX Service Station. Lead is a non-soluble, non-volatile element that is extremely persistent in both soil and water. Environmental processes may transform one lead compound to another; however, lead itself is not degraded.

MATRIX CHARACTERISTICS AFFECTING TECHNOLOGY COST OR PERFORMANCE

(Provide information on relevant parameters for the application)

Parameter	Value	Measurement Procedure
Soil Classification	NA	NA
Clay Content and/or Particle Size Distribution	NA	NA
Additional Soil Characteristics (specify)	NA	NA

SITE GEOLOGY/STRATIGRAPHY/HYDROGEOLOGY

Describe heterogeneity, depth to groundwater, size and characteristics of applicable aquifers and units (especially important for in situ technologies)

Fine- to medium-grained sand to 20 feet below ground surface (bgs), underlain by a clay layer of unknown thickness. Groundwater present at 5 to 9 feet bgs. Average hydraulic conductivity of sand zone is 40 ft/day, calculated horizontal groundwater flow velocity is 0.8 ft/day.

TECHNOLOGY SYSTEM DESCRIPTION

PRIMARY TECHNOLOGY

Monitored natural attenuation

SUPPLEMENTAL TECHNOLOGY TYPES

Bioventing and density-driven convection in-well aeration

TABLE 1
SUMMARY OF SOIL ANALYTICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Analyte	Units	Sample Locations, Intervals, and Dates											
		SBA-14 (7 - 8)[a/] 17-Feb-98	SBA-14 (9 - 11) 18-Feb-98	SBA-15 (9 - 10) 18-Feb-98	SBA-16 (11 - 12) 18-Feb-98	SBA-16 (9 - 10) 18-Feb-98	WEI-B3 SBA-17 (9.5 - 10.5) 18-Feb-98	SBA-18 (8.5 - 9.5) 18-Feb-98	WEI-B1 SBA-19 (6.5 - 8) 18-Feb-98	SBA-19 (8.5 - 10) 18-Feb-98	SBA-100 (8.5 - 10) 18-Feb-98	SBA-20 (6 - 7) 18-Feb-98	SBA-20 (9.5 - 10.5) 18-Feb-98
Benzene	mg/Kg[b/]	0.0054U	0.017	NM	NM	NM	0.22	5.4U	0.0055U	0.28U	0.37U[c/]	4.6U	2.4U
Ethylbenzene	mg/Kg	0.0022U	0.0089	NM	NM	NM	0.09	4.2	0.0022U	0.28U	0.15U	1.9	0.95U
Toluene	mg/Kg	0.0054U	0.072	NM	NM	NM	0.75	12	0.0055U	0.11U	0.37U	4.6U	2.4U
Xylenes (total)	mg/Kg	0.0054U	0.034	NM	NM	NM	0.58	150	0.0055U	0.28U	0.37U	3.1J1[d/]	10
Total BTEX	mg/Kg	0.0184U	0.1319	NM	NM	NM	1.64	166.2	0.0187U	0.95U	1.26U	5	10
Naphthalene	mg/Kg	NM	0.26U	NM	NM	NM	0.27	2.1	0.22U	0.12J1	0.22U	NM	10
Lead	mg/Kg	NM	0.46J[e/]	0.40J	NM	0.18J	0.34J	8.7	4.2	NM	2.2	1.1	7.4
Total Organic Carbon	mg/Kg	NM	NM	2000U	2970	2000U	NM	NM	NM	NM	NM	NM	NM

Notes:

a/ depth in feet below ground surface.

b/ mg/kg = Milligrams per kilogram.

c/ U = The analyte was analyzed for and is not present above the reporting limit.

d/ J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

e/ J = The analyte was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environment.
The data should be considered as a basis of decision-making and are usable.

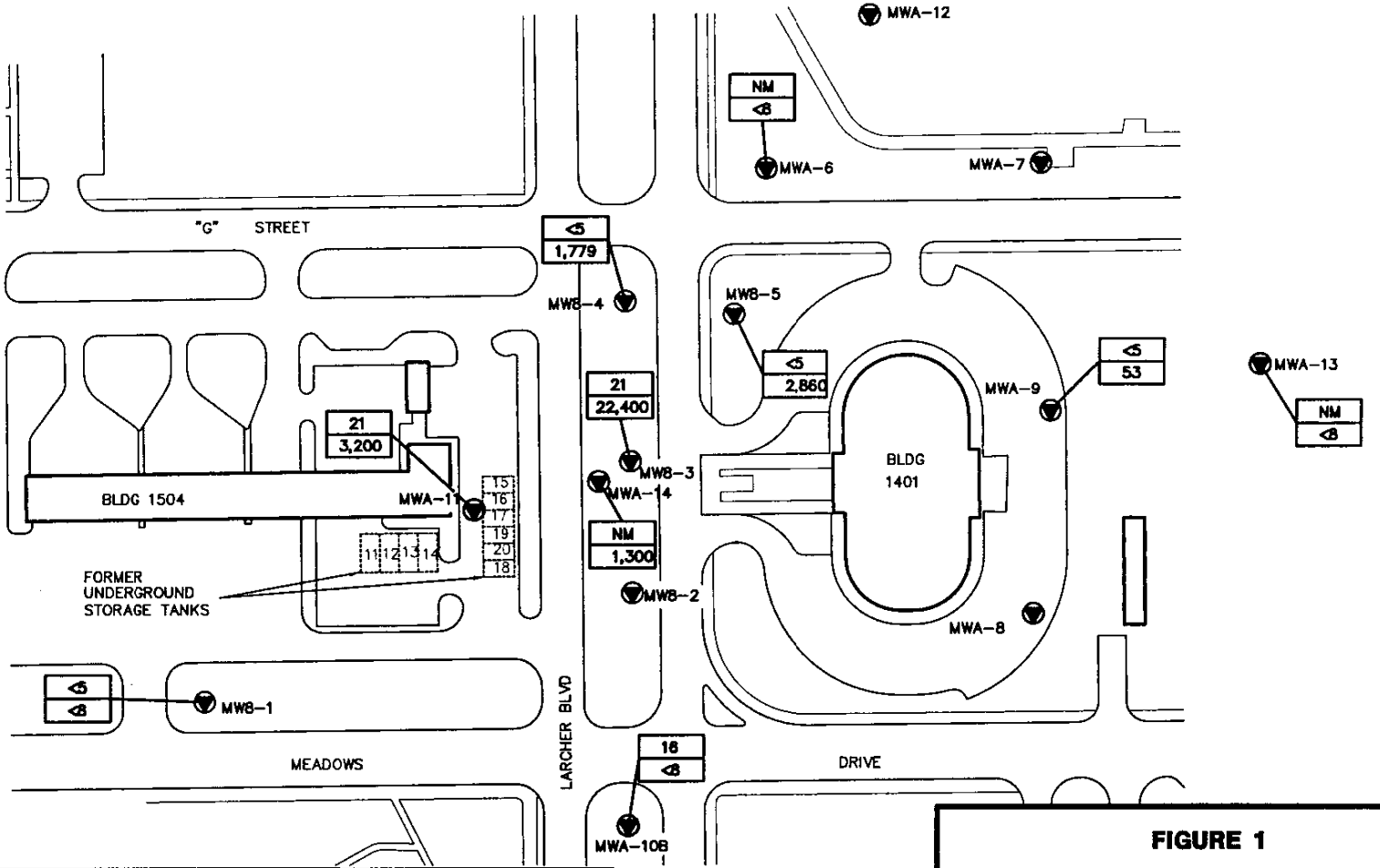
Analysis methods are SW7421 for lead, SW8020 for aromatic VOCs, and SW9060 for total organic carbon.

SBA-100 (8.5-10) is a duplicate of SBA-19 (8.5-10)

All analyses performed by Quanterra Laboratories of Arvada, Colorado

NM = Not Measured

BTEX = Benzene, Toluene, Ethylbenzene, and Total Xylenes



KEY MAP

LEGEND

- Monitoring Well
- Total Lead (µg/L) / BTEX (µg/L)
- NM Not Measured
- MWA-14 Is Screened Deeper In the Water Bearing Zone

N

0 120

SCALE

FIGURE 1

DISTRIBUTION OF TOTAL LEAD AND BTEX IN GROUNDWATER FEBRUARY 1998

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

PARSONS ENGINEERING SCIENCE, INC.

Atlanta, Georgia

REMEDIAL SYSTEM DESCRIPTION AND OPERATION

A total of 9 monitoring wells will be sampled quarterly for 1 year, and then annually for 4 years to document the effects of natural attenuation and ensure that downgradient receptors are protected. Samples will be analyzed for aromatic volatile organics and geochemical natural attenuation indicator parameters. If the 5-year monitoring period confirms that contamination has remained below target cleanup levels, performance monitoring will cease and the site will be placed in an inactive (but managed) status.

OPERATING PARAMETERS AFFECTING TECHNOLOGY COST OR PERFORMANCE

(Provide information on relevant operating parameters for the application.)

Parameter	Value
Example: Temperature	NA
Others (as appropriate)	NA

TIMELINE

(Provide dates for key activities for the application, focusing on events related to technology.)

Start Date	End Date	Activity
August 1997	August 1997	Kickoff Meeting
Sept. 1997	Nov. 1997	Project Work Plan (draft and final)
Feb. 1998	Feb. 1998	Field Site Characterization
March 1998	April 1999	Data Analysis and Corrective Action Plan (draft and final)
1999	2004	Long-term Monitoring

TECHNOLOGY SYSTEM PERFORMANCE

CLEANUP GOALS/STANDARDS

Typical cleanup levels for soil and water at gasoline UST sites in Mississippi are 100 ppm BTEX and 18 ppm BTEX, respectively. In addition, the Mississippi Department of Environmental Quality (MDEQ) has developed generic, risk-based screening levels (RBSLs) that are available on "look-up" tables. The RBSLs vary according to the distance of the nearest receptor from the source area. The closest receptor to the site is the Back Bay of Bixoxi, located approximately 2,100 feet northeast of the site. The MDEQ look-up tables have RBSLs for receptors located 1,400 feet and 2,600 feet from the source. To be conservative, the 1,400-foot RBSLs were selected as the appropriate set of Tier 1 screening values. However, these values do not include a RBSL for lead. The USEPA (1994a) Office of Solid Waste directive on risk assessment and cleanup of residential soil lead recommends that soil lead levels less than 400 ppm be considered safe for residential use; this level was used as the RBSL for lead in soil. Table 2 compares the maximum site concentrations for each compound measured in soil to the appropriate RBSL.

As with soil, the 1,400-foot receptor RBSLs were selected as the appropriate set of Tier 1 screening values for groundwater. In addition, the USEPA MCL for lead of 15 μg/L was used as the RBSL for this constituent. Table 3 compares the maximum site concentrations for each compound measured in groundwater to the appropriate RBSL.

Maximum-detected concentrations of BTEX in soil gas were compared to the chemical-specific OSHA 8-hour time-weighted average PELs (Table 4).

Based on the above-described comparisons, only lead in groundwater was identified as a chemical of potential concern for the BX Service Station. The USEPA (1994b) Integraded Exposure Uptake Biokinetic (IEUBEK) model, which provides an estimate of potential blood lead levels in residential children associated with exposure to all site media (soil and

TABLE 2
COMPARISON OF MAXIMUM SITE SOIL CONCENTRATIONS
TO TARGET CLEANUP LEVELS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Chemical Name	Units	Maximum Concentration Detected	Location of Maximum Detection	Date of Maximum Detection	Target Levels[a/]	Number of Times Exceeded
Total BTEX	mg/kg[b/]	166.2	SBA-18	18-Feb-98	100	1
Lead	mg/kg	8.7	SBA-18	18-Feb-98	400	0
Acenaphthene	mg/kg	NA[c/]	NA	NA	>res[d/]	0
Acenaphthylene	mg/kg	NA	NA	NA	>res	0
Anthracene	mg/kg	NA	NA	NA	>res	0
Benzene	mg/kg	0.22	SBA-17	18-Feb-98	>res	0
Benzo(b)fluoranthene	mg/kg	NA	NA	NA	>res	0
Benzo (g,h,i)perylene	mg/kg	NA	NA	NA	>res	0
Benzo(k)fluoranthene	mg/kg	NA	NA	NA	>res	0
Benzo(a)pyrene	mg/kg	NA	NA	NA	>res	0
Chrysene	mg/kg	NA	NA	NA	>res	0
Dibenzo(a,h)anthracene	mg/kg	NA	NA	NA	>res	0
Ethylbenzene	mg/kg	4.2	SBA-18	18-Feb-98	>res	0
Fluoranthene	mg/kg	NA	NA	NA	>res	0
Fluorene	mg/kg	NA	NA	NA	>res	0
Indeno(1,2,3-cd)pyrene	mg/kg	NA	NA	NA	>res	0
Naphthalene	mg/kg	10	SBA-20	18-Feb-98	>res	0
Phenanthrene	mg/kg	NA	NA	NA	>res	0
Pyrene	mg/kg	NA	NA	NA	>res	0
Toluene	mg/kg	12	SBA-18	18-Feb-98	>res	0
Xylenes, Total	mg/kg	150	SBA-18	18-Feb-98	>res	0

Notes: Shading indicates maximum site concentration is above target level.

[a/] Total BTEX based on MDEQ Typical Cleanup Level (Table 1.1), lead based on USEPA (1994c), all other Target Levels based on MDEQ RBSL "look-up" tables and a distance to receptor of 1,400 feet.

[b/] mg/kg = Milligrams per kilogram.

[c/] NA = Not available.

[d/] >res = the RBSL exceeds the expected soil residual contamination under free product (worst case) conditions.

TABLE 3
COMPARISON OF MAXIMUM SITE GROUNDWATER CONCENTRATIONS
TO TARGET CLEANUP LEVELS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Chemical Name	Units	Maximum Concentration Detected	Location of Maximum Detection	Date of Maximum Detection	Target Levels [a/]	Number of Times Exceeded
Total BTEX	µg/L [b/]	22,400	MW8-3	20-Feb-98	18,000	1
Total Lead	µg/L	21	MW8-3	20-Feb-98	15	3
Acenaphthene	µg/L	1	MWA-11	20-Nov-92	>sol [e/]	0
Acenaphthylene	µg/L	10 U [c/]	NA [d/]	20-Nov-92	>sol	0
Anthracene	µg/L	10 U	NA	20-Nov-92	>sol	0
Benzene	µg/L	2,500	MW8-3	20-Feb-98	56,000	0
Benzo(b)fluoranthene	µg/L	10 U	NA	20-Nov-92	>sol	0
Benzo (g,h,i)perylene	µg/L	10 U	NA	20-Nov-92	>sol	0
Benzo(k)fluoranthene	µg/L	10 U	NA	20-Nov-92	>sol	0
Benzo(a)pyrene	µg/L	10 U	NA	20-Nov-92	>sol	0
Chrysene	µg/L	10 U	NA	20-Nov-92	>sol	0
Dibenzo(a,h)anthracene	µg/L	10 U	NA	20-Nov-92	>sol	0
Ethylbenzene	µg/L	1,700	MW8-3	20-Feb-98	>sol	0
Fluoranthene	µg/L	10 U	NA	20-Nov-92	>sol	0
Fluorene	µg/L	10 U	NA	20-Nov-92	>sol	0
Indeno(1,2,3-cd)pyrene	µg/L	10 U	NA	20-Nov-92	150.00	0
Naphthalene	µg/L	320	MW8-3	19-Nov-92	>sol	0
Phenanthrene	µg/L	10 U	NA	20-Nov-92	>sol	0
Pyrene	µg/L	10 U	NA	20-Nov-92	>sol	0
Toluene	µg/L	10,000	MW8-3	20-Feb-98	>sol	0
Xylenes, Total	µg/L	8,200	MW8-3	20-Feb-98	>sol	0

Notes: Shading indicates maximum site concentration is above target level.

[a/] Total BTEX based on MDEQ Typical Cleanup Level (Table 1.1), lead based on USEPA (1996), all other Target Levels based on MDEQ RBSL "look-up" tables and a distance to receptor of 1,400 feet.

[b/] µg/L = Micrograms per Liter.

[c/] U = Analyte not detected above corresponding number.

[d/] NA = Not available.

[e/] >sol = greater than the maximum solubility possible.

TABLE 4
COMPARISON OF MAXIMUM SITE SOIL GAS CONCENTRATIONS
TO OSHA PERMISSIBLE EXPOSURE LIMITS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Chemical	Maximum Detected Concentration (ppmv [a/])	OSHA PEL (ppmv) [b/]	Maximum Concentration Above PEL?
Benzene	ND	1	No
Toluene	.006 M[d/]	200	No
Ethylbenzene	0.020	100	No
Xylenes	0.041	100	No
TPH [e/]	1.943	-- [f/]	--

Notes:

[a/] ppmv = Parts per million, volume per volume.

[b/] Occupational Safety and Health Administration (NIOSH, 1997) 8-hour time-weighted average permissible exposure limit.

[c/] ND = Not detected above reporting limits.

[d/] M data qualifier indicates potential bias due to matrix interferences.

[e/] TPH = Total petroleum hydrocarbons.

[f/] "--" = No PEL available.

groundwater contaminated with lead), was used to evaluate the significance of the maximum detected groundwater lead concentration. The modeling results indicated that the impacts of lead in site media on potential future residents are not significant.

PERFORMANCE DATA AND DATA ASSESSMENT

Analytical data are compared to Tier 1 RBSLs in Tables 2 through 4. Temporal variations in soil contaminant concentrations from 1996 to 1998 (during which time the in-well DDC system was operational) are shown on Figure 2. Total BTEX concentrations measured at all site monitoring wells from 1988 to 1998 indicate substantial oscillation in dissolved BTEX concentrations at the plume core (MW8-3, MW8-4, MW8-5, and MWA-11) during this period have been measured. These oscillations can be attributed to groundwater table fluctuations and the operation of the interim remediation systems since May 1993. The total BTEX plume appears to have been relatively stable, as evidenced by consistent BTEX concentrations in downgradient well MWA-9. In addition, no BTEX concentrations have been detected in cross-gradient and downgradient wells MWA-6, MWA-7, MWA-8, MWA-10, MWA-10B, and MWA-13. Stable plume length indicates that the mass of BTEX input in the groundwater system in the source area is apprroximately equal to the mass of BTEX being removed vial natural attenuation processes.

PERFORMANCE DATA QUALITY

An electronic Level III validation was performed on the February 1998 analytical results obtained from the fixed-base laboratories. Analytical results associated with non-compliant QC criteria were qualified appropriately.

COST OF THE TECHNOLOGY SYSTEM

PROCUREMENT PROCESS

Procurement involved selection of an analytical subcontractor. Bids were obtained from three qualified analytical laboratories, and the selected firm was Quanterra in Wheat Ridge, Colorado.

COST DATA

(Identify organization that provided cost data and whether cost data are actual or estimated costs)

Item	Cost ($ Year Basis)	Actual or Estimated (A or E)
Capital (specify cost/activity) Bioventing	$40,000	E
Operation and maintenance (specify cost/activity) LTM	$15,000 (cost per event)	E
Other (specify)		

REGULATORY/INSTITUTIONAL ISSUES

Identify the approvals, licenses, and permits required to operate the technology at the site.

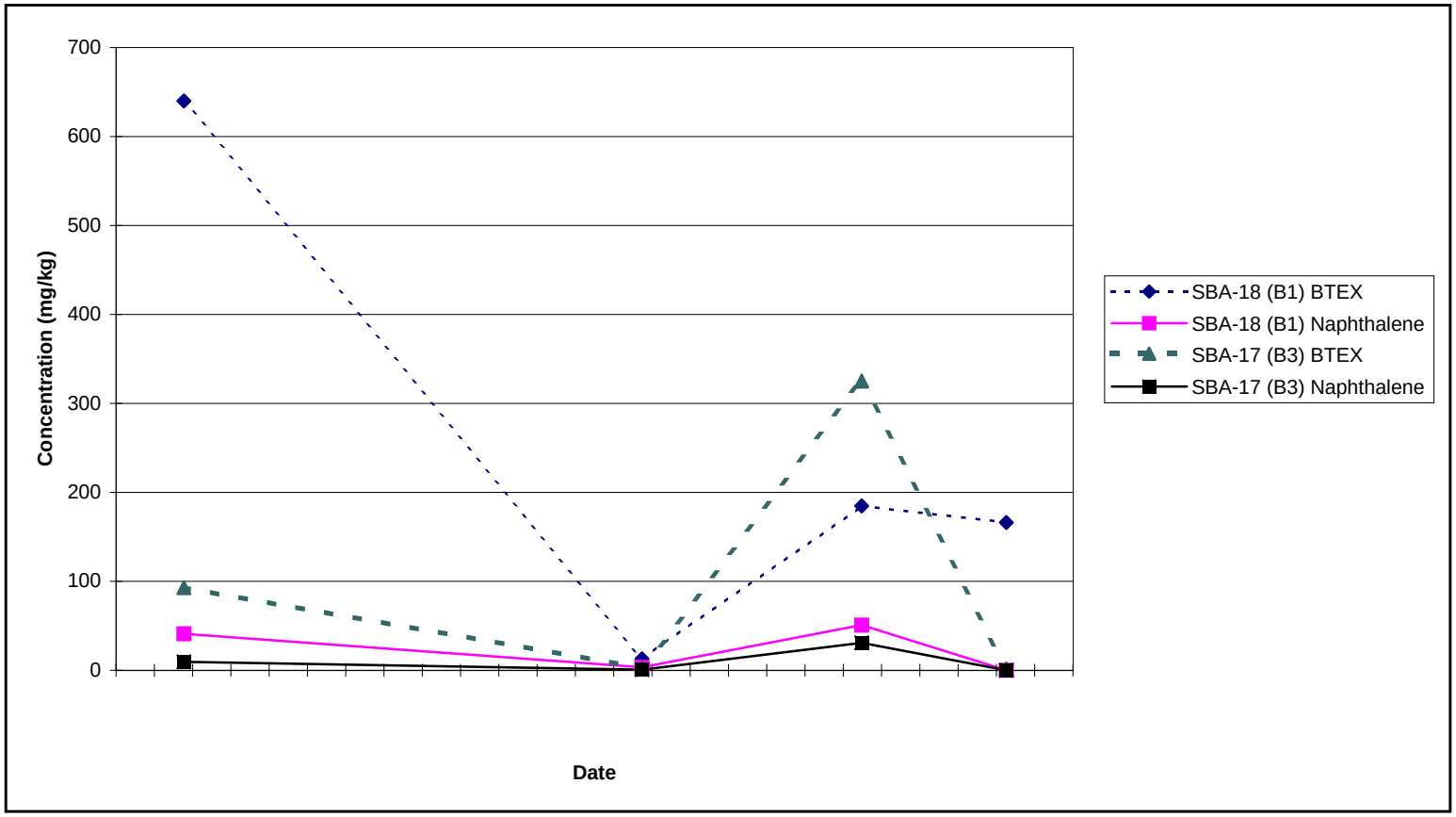
NA

TECHNOLOGY APPLICABILITY AND ALTERNATIVES

(Provide only for demonstration-scale reports)

Identify technology applicability, competing technologies, and technology maturity; may also discuss commercialization and intellectual property issues.

FIGURE 2
HISTORICAL COMPARISON OF SOIL ANALYTICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi



Remediation by natural attenuation (RNA) is applicable for all petroleum-hydrocarbon contaminated sites. RNA is advantageous for the following reasons:

- Contaminants can be transformed to innocuous byproducts (e.g., carbon dioxide or water), not just transferred to another phase or location within the environment;
- Current pump-and-treat technologies are energy-intensive and generally no more effective in reducing residual contamination;
- The process is nonintrusive and allows continuing use of infrastructure during remediation;
- Engineered remedial technologies may pose a greater risk to potential receptors than RNA (e.g., contaminants may be transferred into another medium during remediation activities); and
- RNA can be less costly than conventional, engineered remedial technologies.

A potential disadvantage of RNA is that, in some cases, natural attenuation rates are too slow to make RNA a practical remedial alternative.

OBSERVATIONS AND LESSONS LEARNED

COST OBSERVATIONS AND LESSONS LEARNED

Provide observations and lessons learned related to cost of the application.

PERFORMANCE OBSERVATIONS AND LESSONS LEARNED

The following conclusions were drawn from the risk-based assessment of the site:

- Concentrations of target analytes in all sampled media do not exceed applicable MDEQ RBSLs or OSHA PELs, and detected concentrations of total lead in groundwater do not pose a risk to potential receptors;
- Geochemical data strongly indicate that biodegradation of fuel hydrocarbons is occurring at the site, primarily via the anaerobic processes of sulfate reduction, nitrogen fixation, and methanogenesis;
- Previous and current source removal efforts have reduced hydrocarbon concentrations in vadose zone and saturated zone soils, and the current system does not have an adverse effect on the natural attenuation processes at the site;
- Available data indicate that the dissolved plume is stable, is entirely contained within the existing monitoring well network, and should not impact potential downgradient receptors;
- Keesler AFB is an active base where institutional controls can be maintained with a high level of confidence; and
- None of the potential exposure pathways identified for the site are considered complete.

Per the above conclusions, monitored natural attenuation is appropriate for the BX Service Station.

OTHER OBSERVATIONS AND LESSONS LEARNED

A long-term monitoring plan was negotiated with the MDEQ and the USEPA Region IV that included monitoring of nine wells for five years. Monitoring will occur quarterly for the first year and annually for the second through fifth years. The purpose of the monitoring is to verify the effectiveness of naturally-occurring remediation processes at limiting plume migration and reducing dissolved contaminant concentrations.

The risk-based corrective action process performed for this site can be used to achieve cost-effective site closure at other relatively low-risk fuel-contaminted sites.

REFERENCES

List of references used in preparation of the cost and performance report.

USEPA, 1994a. Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.

USEPA, 1994b. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children. Office of Emergency and Remedial Response. PEA 540-R-93-081.

ACKNOWLEDGMENTS

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