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DEPARTMENT OF THE AIR FORCE
377TH AIR BASE WING (AFGSC)

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Colonel Eric H. Froehlich
377 ABW/CC
2000 Wyoming Blvd SE
Kirtland AFB New Mexico 87117-5600

Mr. John Kieling, Manager
RCRA Permits Management Program
Hazardous Waste Bureau (HWB)
New Mexico Environment Department (NMED)
2905 Rodeo Park Road
Santa Fe, New Mexico 87505

RE: Requested Optimization of Monitoring and Reporting, Second Phase, Bulk Fuels Facility Spill Site.

Dear Mr. Kieling

We are pleased to submit the attached Technical Memorandum (hereafter referred to as Memo), which outlines the second phase of optimization recommendations for the monitoring and reporting programs for the Kirtland Air Force Base Bulk Fuels Facility Spill site. The attached Memo is a follow-on to the letter outlining the initial phase of optimization delivered on May 13, 2015. The recommendations in this letter represent the continued programmatic evaluation by the hydrogeologic working group and optimization subgroup as the second phase of optimization, and include: reducing sampling frequency for select analytes, revising the analytical suite, and realigning the corresponding reporting requirements accordingly. The intention of the attached request is to optimize data collection to target data that drive project decisions, reduce data redundancy, minimize safety risks, reduce cost to the public, and improve program sustainability. It is requested that changes outlined in this Memo be implemented in First Quarter of Calendar Year 2016.

As with the initial recommendations presented in the letter dated May 13, 2015, the attached recommendations are a direct result of the collaborative efforts of the hydrogeology working group and optimization subgroup. The group identified the need to evaluate and optimize current monitoring and reporting practices to better align with requirements under the New Mexico Environment Department guidance and industry standards to achieve a more effective monitoring and reporting program.

We appreciate your attention to this matter to initiate the second phase of monitoring and reporting optimization. We look forward to continued collaboration to improve project activities and documents. Please contact Mr. Wayne Bitner at 505.853.3484 or at ludie.bitner@us.af.mil.

KAFB4344

or Ms. Victoria Branson at 505.846.6362 or at victoria.branson@us.af.mil if you have any questions or concerns.

Sincerely,

ERIC H. FROEHLICH, Colonel, USAF
Commander

cc:
NMED-EHD (Roberts, McQuillan, Agnew)
NMED (Longmire)
NMED-HWB (Cobrain, McDonald)
NMED-GWQB (Cook, Bustamante, Huddleson)
NMED-PSTB (Reuter)
NMED-OGC (Kendall)
EPA Region 6 (King, Ellinger)
AFCEC-CZRX (Bodour)
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Public Info Repository (Central New Mexico Community College), Administrative Record/Information Repository (AR/IR), and File

# 40 CFR 270.11
# DOCUMENT CERTIFICATION
# DECEMBER 2015

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

ERIC H. FROEHLICH, Colonel, U.S. Air Force
Commander, 377th Air Base Wing

This document has been approved for public release.

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs

# Technical Memorandum:
# Requested Optimization of Monitoring and Reporting

This Technical Memorandum (hereafter referred to as Memo) presents the second phase of optimization for monitoring and reporting activities for the Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF) Spill site. The initial phase of optimization was presented in a letter dated May 13, 2015 and included reduction of the analyte list in accordance with NMED guidance and policy as well as optimization to the report content and format. On July 17, 2015, NMED issued a letter approving the request with additional considerations.

This Memo outlines the second phase of recommendations to optimize the monitoring program and corresponding reporting changes. The objective of the optimization initiative and recommendations described below is to reduce unnecessary sampling, while maintaining the data necessary to ensure protectiveness and drive remediation decisions at the BFF site. The following changes have been identified by collaborative efforts of the hydrogeology working group's optimization subgroup and are supported by utilization of the Air Force Civil Engineer Center Geostatistical Temporal-Spatial (GTS) Optimization software program for monitoring optimization. GTS employs statistical and geostatistical methods to optimize groundwater monitoring networks. The GTS software, specific BFF monitoring program analyses, and results were presented to the hydrogeology working group in February/March 2015 and again in August 2015.

GTS uses both non-linear trend estimation and locally weighted spatial mapping to optimize sampling frequencies and support identification of essential or redundant sampling locations. GTS analyses were run using 131 wells within the BFF well network (drinking water wells were omitted), and using analytical data from 1991-2015 as well as a more recent dataset from 2011-2015. The results of the GTS analyses for the BFF wells were reviewed with subject matter experts within the optimization subgroup and have been incorporated to design a revised monitoring program for the site. Based on the results of the GTS analysis, it is recommended that sampling frequency be reduced to semi-annual or annual for site constituents. The analyses consistently showed that reducing the sampling frequency has no impact on the ability to ensure protectiveness, assess overall contaminant trends, and provide sufficient data to meet the objectives of the monitoring program—to track plume size and stability, and monitor contaminants of concern.

In addition, as the monitoring program is optimized, there are corresponding changes to the report content and structure that support the continued effort of optimized reporting. This Memo also presents the requested reporting changes. This is in line with the recommendations for streamlined reporting outlined in the May 13, 2015 letter, and is described in more detail below.

## 1. Optimize Analytical Program and Sampling Frequency

### *Review of Analytical Program*

Analytical data from 2011 through 2015 were evaluated using empirical data and the GTS software to examine trends in concentrations of contaminants of concern, assess the dataset, identify data redundancies, and establish optimal monitoring frequency. Each analyte was also evaluated for its role in informing plume dynamics, risk, or any other relevant site decision. Based on these evaluations, the optimization subgroup made recommendations for to retained, reduced in frequency, or removed from the monitoring program. Results of this evaluation indicated that most wells showed either no trend or a decreasing concentration trend for individual analytes, presenting immediate opportunities to reduce analyses that were not informing risk or utilized for site decisions.

The primary constituents driving risk associated with the site, as well as informing corrective actions and site decisions include ethylene dibromide (EDB), benzene, and other select volatile organic compounds

(VOCs), metals, anions, and alkalinity. Thus, the optimization subgroup recommends continuing the analyses at frequencies described in the following section, for the following analytes:

- EDB (Environmental Protection Agency [EPA] Method 8011)
- VOCs – Table 2 list (EPA Method 8260C)
- Total/Dissolved Metals (EPA Method 6010C)
- Total Metals (EPA Method 6020A)
- Anions (EPA Method 300.0/353.2)
- Alkalinity (EPA Method Standard Methods [SM] 2320B)
- Wet chemistry parameters (SM 4500NH3B/C, SM 4500S3CF)
- Field parameters (temperature, pH, dissolved oxygen, specific conductance, turbidity, oxidation reduction potential).

The optimization subgroup further identified analyses that were not used to inform risk, monitor site conditions, or used to support site decisions. In general, these include constituents that characteristically exhibit lower mobility and solubility. While these analyses are typical for initial characterization of fuel releases, they are no longer used to inform site characterization or remediation and are not primary indicators for tracking the plume and associated risks. Naphthalene is the most mobile constituent captured by these analyses, which the group recommended retaining via the VOC method (EPA Method 8260C). Based on these factors, the optimization subgroup recommended that the following analyses be removed from the BFF site analytical program:

- Total petroleum hydrocarbons-diesel range organics (EPA Method 8015C)
- Total petroleum hydrocarbons-gasoline range organics (EPA Method 8015C)
- Semivolatile organic compounds (EPA Method 8270D)
- Polynuclear aromatic hydrocarbons (EPA Method 8270D Mod)
- Field analysis for alkalinity (laboratory analysis will continue).

Groundwater samples will be collected in accordance with the New Mexico Environment Department (NMED)-approved Groundwater Investigation Work Plan (U.S. Army Corps of Engineers [USACE], 2011a) and the NMED-accepted Quality Assurance Project Plan (USACE, 2011b) or any NMED-approved work plans and/or addenda prepared subsequently for this project. Collection of field parameter readings will continue during each sampling event.

***Optimize Sample Frequency***

To date, sampling has been conducted on a quarterly basis for all BFF site wells. After review of the empirical data and GTS analyses, the optimization subgroup recommended classification of subsets of wells within the BFF site as listed below and shown on Figure 1. Establishing the following classifications was a critical function of the optimization as it allowed segregation of sampling frequency to more specific wells and analytes, therefore providing optimal data required to drive decisions while remaining protective of downgradient drinking water wells. The classifications include the following:

- **Source Area Wells** (26 wells): The optimization subgroup identified wells within the benzene plume footprint as source area wells. The team recognized that these wells are key areas to track and monitor benzene, toluene, ethylbenzene, and xylene (BTEX) constituents, which is where more frequent BTEX monitoring will be focused. Wells outside of this area in the more distal areas of the plume have not had benzene detections between 2011 and 2015, thus prompting the team to focus data collection and analyses on EDB and other parameters while sampling for BTEX and other select VOCs at a lower frequency in the distal areas.

- **Proximal and Signal Wells** (30 wells): To ensure protectiveness, the team further identified a subset of wells within the network that would serve as proximal wells and signal wells to act as a decision trigger if constituents were detected there at elevated concentrations. This classification includes the following groups:

    - **Downgradient Proximal Wells** (18 wells): These wells are located between the leading edge of the EDB plume and drinking water supply wells KAFB-3, Ridgecrest-5, and Burton-5.

    - **Veterans Affairs (VA) Proximal Wells (9 wells): These wells are located between the plume and the VA Medical Center drinking water supply well, adjacent to the benzene plume footprint.**

    - **Signal Wells (3 wells): The signal wells include three wells outside the downgradient boundary of the benzene plume that would indicate migration of the BTEX constituents, and prompt a re-evaluation of the sampling frequency for BTEX or naphthalene.**

- **Newly Installed Monitoring Wells** (20 wells): This group includes the new monitoring wells installed in late 2014 and early 2015.

- **Extended Well Network** (139 wells): This classification includes all monitoring wells installed at the BFF site to date, including the source area, proximal, signal, and newly installed wells listed above.

In general, the GTS evaluation resulted in a recommended frequency of semiannual or annual for all analytes. The team further reviewed the empirical data, data trends, results of the GTS evaluation, and risk and decision drivers to recommend an optimal sampling frequency for each subset of wells. Table 1 presents the recommended analyses and sampling frequency for each of the subsets of the monitoring network.

Though the GTS results indicated semiannual monitoring was optimal for EDB, the team recommended retaining quarterly sampling for EDB at all of the proximal wells (including downgradient and VA proximal wells), as well as the newly installed monitoring wells that require additional data to evaluate concentrations and trends. Similarly, though the GTS results indicated semiannual sampling was optimal for benzene, the team recommended quarterly sampling for BTEX at the 9 VA proximal wells adjacent to the benzene plume footprint. This quarterly monitoring ensures protectiveness by monitoring the most critical constituents at the highest frequency.

The team recommended semiannual monitoring for EDB, metals, anions, and alkalinity for the full BFF well network (139 wells) to continue to track plume concentrations and dynamics. Similarly, the team recommended semiannual sampling for BTEX within the 26 source area wells, as well as BTEX and naphthalene at the 3 signal wells.

Lastly, the team recommended that the additional VOCs continue to be analyzed on an annual basis using the targeted VOC list (EPA Method 8260C), which also includes BTEX and naphthalene. The GTS analyses confirm this frequency retains the integrity of the dataset and continues to provide a robust quantity of data to assess plume trends and support site decisions.

Table 2 provides the analyte list associated with each of the analytical methods. Attachment 1 lists each well and the analytes that would be sampled during each event. The anticipated schedule is to conduct semiannual analyses during the Second and Fourth Quarters of the calendar year and annual analyses during

the Fourth Quarter. The timing of the quarterly events would be similar to the current schedule (First, Second, Third, and Fourth Quarters).

**2. Reporting Optimization**

The optimization subgroup further recognized that with optimization of the monitoring program, the reporting requirements would shift to best communicate each event's data collection, data analysis and interpretation, and results and recommendations. Initial recommendations to improve the report usability and format were discussed previously in the letter dated May 13, 2015, and while not discussed in this section, are anticipated for optimization of reporting.

The optimization team recommends compilation of a robust annual report to coincide with the annual sampling event (Fourth Quarter). This annual report would assimilate and present all data collected that year, and include data evaluation and interpretation in comparison with historical site data. In addition, the annual report would include discussion of contaminant data and trends, an updated conceptual site model, and all the analytical data and QC reports associated with that calendar year. The optimization subgroup recommends a non-cumulative data report be submitted for each of the quarterly events (First Quarter and Third Quarter) and the semiannual event (Second Quarter). The data reports will contain the elements outlined in the May 13, 2015 request letter and the NMED approval letter dated July 17, 2015.

**References:**

USACE. 2011a. *Groundwater Investigation Work Plan, Bulk Fuels Facility (BFF) Spill, Solid Waste Management Units ST-106 and SS-111, Kirtland Air Force Base, Albuquerque, New Mexico.* Prepared by Shaw Environmental & Infrastructure, Inc. for the USACE Albuquerque District under USACE Contract No. W912DY-10-D-0014, Delivery Order 0002. March.

USACE. 2011b. *Light Non-Aqueous Phase Liquid (LNAPL) Containment Interim Measure Work Plan, Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111.* Prepared by Shaw Environmental & Infrastructure, Inc. for the USACE Albuquerque District under USACE Contract No. W912DY-10-D-0014, Delivery Order 0002. November.

**Table 1**
**Proposed Monitoring Program**

| Analyte | Analysis[a] | Well Locations | Number of Wells |
|---|---|---|---|
| **QUARTERLY** | | | |
| EDB | EPA Method 8011 | Newly Installed Wells | 20 |
| EDB | EPA Method 8011 | Proximal Wells (9 VA wells; 18 downgradient wells) | 27 |
| BTEX | EPA Method 8260C - BTEX (4 analytes) | VA Proximal Wells | 9 |
| **SEMIANNUAL** | | | |
| BTEX | EPA Method 8260C - BTEX (4 analytes) | Source Area Wells | 26 |
| BTEX+Naphthalene | EPA Method 8260C - BTEX, Naphthalene (5 analytes) | Signal Wells[b] | 3 |
| EDB | EPA Method 8011 | Extended Network | 139 |
| Total Metals | EPA Method 6010C (Calcium, Potassium, Magnesium, Sodium) | Extended Network | 139 |
| Dissolved Metals | EPA Method 6010C (Iron, Manganese) | Extended Network | 139 |
| Total Metals | EPA Method 6020A (Arsenic, Lead)[c] | Extended Network | 139 |
| Anions | EPA Method 300.0 (Chloride, Bromide, Sulfate) | Extended Network | 139 |
| Anions | EPA Method 353.2 (Nitrate-Nitrite) | Extended Network | 139 |
| Ammonia Nitrogen | Standard Method 4500NH3B/C | Extended Network | 139 |
| Sulfide | Standard Method 4500S2CF | Extended Network | 139 |
| Alkalinity - Bicarbonate/Carbonate | Standard Method 2320B | Extended Network | 139 |
| **ANNUAL** | | | |
| VOC | EPA Method 8260C (Table 2 list) | Extended Network | 139 |
| **DISCONTINUE** | | | |
| DRO/GRO | EPA Method 8015C | NA | NA |
| SVOC | EPA Method 8270D | NA | NA |
| PAH/SVOC | EPA Method 8270D (Low Detection Limit) | NA | NA |

**NOTE**: Field parameters will continue to be collected during all sampling events and include: temperature, pH, specific conductivity, dissolved oxygen, oxidation reduction potential, and turbidity (alkalinity discontinued).

[a] Proposed constituents to be analyzed for as part of sampling optimization are included in Table 2.

[b] Elevated detections above regulatory standards in signal wells indicate review by the team to evaluate additional sampling requirements.

[c] Arsenic will be added to the analyte list for EPA Method 6020A to provide information on redox chemistry.

BTEX = benzene, toluene, ethylbenzene, and xylenes

DRO = diesel range organic

EDB = ethylene dibromide

EPA = U.S. Environmental Protection Agency

GRO = gasoline range organics

NA = not applicable

PAH = polynuclear aromatic hydrocarbon

SVOC = semivolatile organic compound

VOC = volatile organic compound

**Table 2**
**Analyte List for Proposed Monitoring Program**

| Chemical Class & Analytical Method | Parameter |
|---|---|
| VOCs/ BTEX/ Naphthalene (EPA Method 8260C) | 1,1,2-TRICHLOROETHANE |
| | 1,2-DIBROMOETHANE |
| | 1,2-DICHLOROETHANE |
| | 1,3,5-TRIMETHYLBENZENE |
| | 2-BUTANONE |
| | 2-CHLOROTOLUENE |
| | 2-HEXANONE |
| | 4-METHYL-2-PENTANONE |
| | ACETONE |
| | BENZENE |
| | CARBON DISULFIDE |
| | CHLOROMETHANE |
| | DICHLORODIFLUOROMETHANE |
| | ETHYLBENZENE |
| | ISOPROPYLBENZENE |
| | METHYL TERT-BUTYL ETHER |
| | METHYLENE CHLORIDE |
| | NAPHTHALENE |
| | N-BUTYLBENZENE |
| | N-PROPYLBENZENE |
| | P-ISOPROPYLTOLUENE |
| | SEC-BUTYLBENZENE |
| | TERT-BUTYLBENZENE |
| | TOLUENE |
| | TRICHLOROETHENE |
| | TRICHLOROFLUOROMETHANE |
| | XYLENES |
| EDB (EPA Method 8011) | 1,2-DIBROMOETHANE |
| Metals (EPA Method 6010C) | DISSOLVED IRON (FIELD FILTERED) |
| | DISSOLVED MANGANESE (FIELD FILTERED) |
| | CALCIUM |
| | POTASSIUM |
| | MAGNESIUM |
| | SODIUM |
| Metals (EPA Method 6020A) | ARSENIC |
| | LEAD |
| Anions (EPA Method 300.0) | CHLORIDE |
| | SULFATE |
| | BROMIDE |
| Anions (EPA Method 353.2) | NITRATE-NITRITE NITROGEN |
| Wet Chemistry (SM 2320B/ SM 4500NH3B/C) | AMMONIA NITROGEN/ SULFIDE |
| Alkalinity (Standard Method 2320B) | BICARBONATE |
| | CARBONATE |
| Field Parameters | TEMPERATURE |
| | PH |
| | SPECIFIC CONDUCTIVITY |
| | DO |
| | ORP |
| | TURBIDITY |

BTEX = Benzene, toluene, ethylbenzene, xylenes

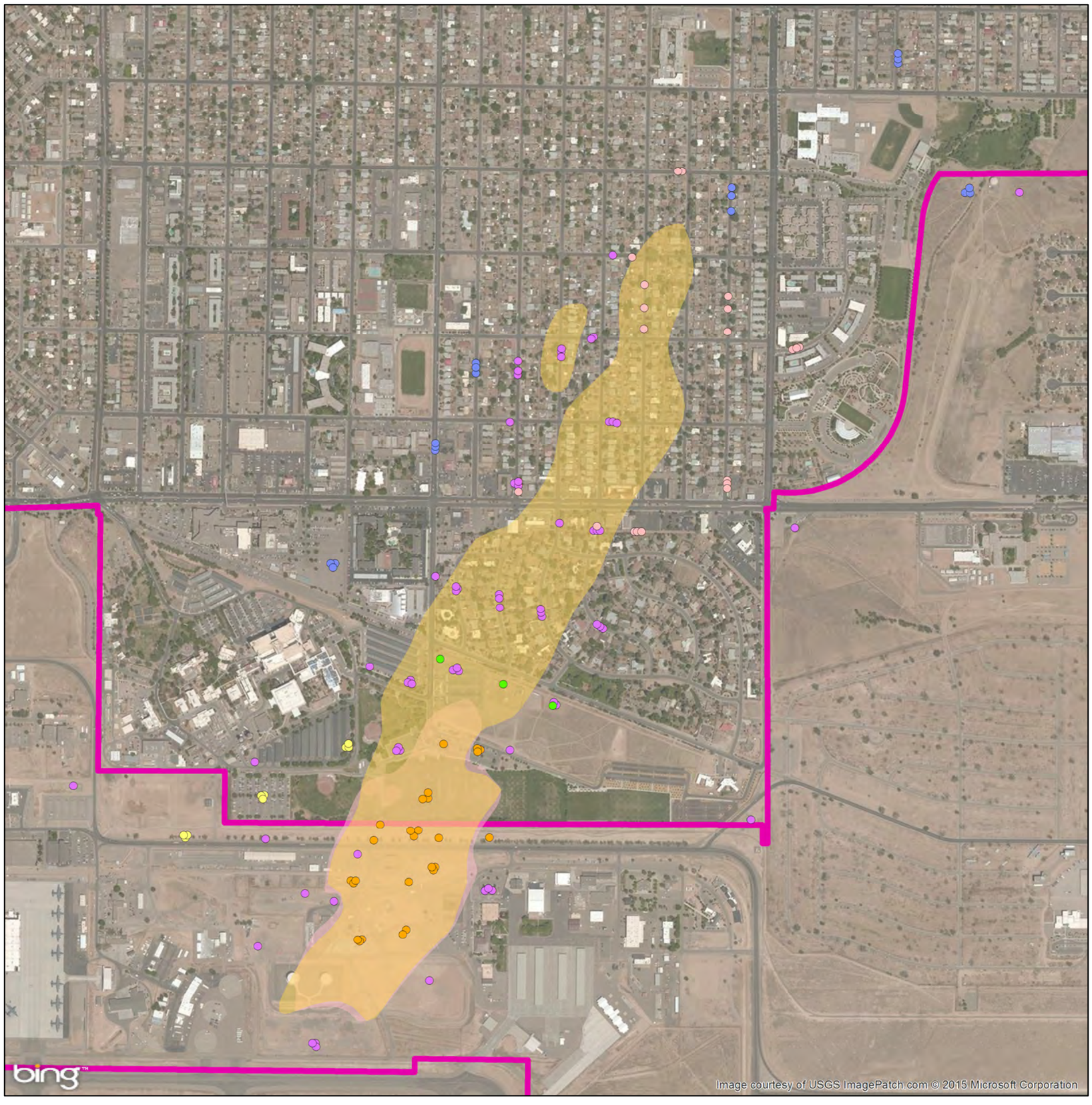
DO = dissolved oxygen

EDB = ethylene dibromide

EPA = U.S. Environmental Protection Agency

ORP = oxidation reduction potential

VOCs = volatile organic compounds




## Legend

**Recommended Groundwater Well Network Classifications**

- Extended Well Network (139 wells)
- Newly Installed Wells (20 wells)
- Signal Wells (3 wells)
- Source Area Wells (26 wells)
- VA Proximal Wells (9 wells)
- Downgradient Proximal Wells (18 wells)
- Q3 2015 EDB Plume
- Q3 2015 Benzene Plume
- KAFB Base Boundary

FIGURE 1

Recommended Groundwater Network Well Classifications

Bulk Fuels Facility
Kirtland Air Force Base, New Mexico

N

2,000 1,000 0 2,000 Feet

**Attachment 1**
**Recommended Groundwater Monitoring Program by Quarter**

| Well ID | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|
| **EXTENDED WELL NETWORK - NO ADDITIONAL MONITORING REQUIRED[a]** | | | | |
| KAFB-3411 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| ST-106-VA-2 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-003 | None | EDB, Metals, Anions, Alkalinity,Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-015 | None | EDB, Metals, Anions, Alkalinity,Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-016 | None | EDB, Metals, Anions, Alkalinity,Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106001 | None | EDB, Metals, Anions, Alkalinity,Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106002 | None | EDB, Metals, Anions, Alkalinity,Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106007 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106015 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106016 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106019 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106020 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106021 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106022 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106023 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106024 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106025 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106026 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106027 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106035 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106036 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106037 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106039 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106040 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106042 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106043 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106044 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106045 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106046 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106047 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106048 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106052 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106053 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106054 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106055 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106057 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106058 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106070 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106071 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106072 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106073 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106074 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106075 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106082 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106083 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106084 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106085 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106086 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |

**Attachment 1**
**Recommended Groundwater Monitoring Program by Quarter**

| | | | | |
|---|---|---|---|---|
| KAFB-106087 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106088 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106089 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106090 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106091 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106092 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106093 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106094 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106095 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106096 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106103 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106104 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106105 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106106 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106107 | None | EDB, Metals, Anions, Alkalinity, Field Parameters | None | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| **NEWLY INSTALLED WELLS** | | | | |
| KAFB-106212 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106213 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106214 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106215 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106216 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106217 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106218 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106219 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106221 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106220 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106222 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106223 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106224 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106225 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106226 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106227 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106229 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106230 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106231 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106232 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| **VA PROXIMAL WELLS** | | | | |
| KAFB-106003 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106004 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106013 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106097 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106098 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106099 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106100 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106101 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106102 | BTEX, EDB, Field Parameters | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | BTEX, EDB, Field Parameters | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| **DOWNGRADIENT PROXIMAL WELLS** | | | | |
| KAFB-106029 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106030 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106031 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106032 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |

**Attachment 1**
**Recommended Groundwater Monitoring Program by Quarter**

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|---|---|---|---|---|
| KAFB-106033 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106034 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106049 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106050 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106051 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106201 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106202 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106203 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106204 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106205 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106206 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106207 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106208 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106209 | EDB, Field Parameters | EDB, Metals, Anions, Alkalinity, Field Parameters | EDB, Field Parameters | EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| **SOURCE AREA WELLS** | | | | |
| KAFB-106005 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106006 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106008 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106009 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106010 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106011 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106012R | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106014 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106028-510 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106059 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106060 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106061 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106062 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106063 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106064 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106065 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106066 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106067 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106068 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106069 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106076 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106077 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106078 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106079 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106080 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106081 | None | BTEX, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| **SIGNAL WELLS** | | | | |
| KAFB-106017 | None | BTEX+Naph, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX+Naph, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106018 | None | BTEX+Naph, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX+Naph, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |
| KAFB-106038 | None | BTEX+Naph, EDB, Metals, Anions, Alkalinity, Field Parameters | None | BTEX+Naph, EDB, VOC's, Metals, Anions, Alkalinity, Field Parameters |

Notes:

[a] The extended well network includes all groundwater monitoring wells are that currently sampled under SWMU SS-111 (139 wells total). It is proposed that all groundwater monitoring wells be sampled for the following: VOC's (annually), EDB (semiannually), metals (semiannually), anions (semiannually), and alkalinity (semiannually). Select wells have been identified for additional or more frequent monitoring of risk-driving constituents.

**Attachment 1**
**Recommended Groundwater Monitoring Program by Quarter**

BTEX = benzene, toluene, ethylbenzene, and xylenes
BTEX+Naph = benzene, toluene, ethylbenzene, xylenes, and naphthalene
EDB = ethylene dibromide
VOCs = volatile organic compound
ID = identification
KAFB = Kirtland Air Force Base
SWMU = Solid Waste Management Unit