New Mexico Environment Department

Public Field Trip Handbook

Kirtland Air Force Base Fuel Spill

April 23, 2016

Project Collaborators:

U.S. Air Force, Kirtland Air Force Base

U.S. Air Force Civil Engineering Center

U.S. Army Corps of Engineers

U.S. Environmental Protection Agency

City of Albuquerque, Environmental Health Department

Albuquerque-Bernalillo County Water Utility Authority

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New Mexico Bureau of Geology

New Mexico Environment Department

Introduction and Logistics

The Kirtland Air Force Base (AFB) Bulk Fuels Facility (BFF) operated in 1953 and was serviced by a railway and/or tanker delivery system that transported fuel. Fuel was offloaded through an offloading rack and transferred via a pump house that moved the fuel to two storage tanks. In 1999, fuel was discovered at the surface, pooling above the underground transfer pipe near the offloading rack. Remediation efforts began in 2000, including excavation and disposal of impacted soil at the source area.

Leaked aviation gasoline and jet fuel, or light non-aqueous phase liquid (LNAPL), from the Kirtland AFB BFF migrated through approximately 150 feet of alluvial fan sediments, and into the underlying Sierra Ladrones Formation, a thick sequence of sediments deposited by the ancestral Rio Grande. This stratigraphy sequence is approximately 500 feet thick and defines the vadose zone for the site. The water table is roughly 500 feet below ground surface, marking the top of the dissolved phase contamination at the site.

Initially, the LNAPL floated on the groundwater surface. As water supply wells were installed and pumping began, the regional groundwater level began to decline until 2009 when water levels started to rise. As the water level has risen, LNAPL has become submerged and trapped within the groundwater. This "trapped" LNAPL continues to release dissolved contaminants into the groundwater.

The Kirtland AFB bulk fuel spill site has four phases of jet fuel in the soil and groundwater:

- LNAPL residual fuel;
- Soil vapor (lighter fuel constituents that have volatilized to the vapor phase in soil);
- Adsorbed contaminants (attached to soil particles and aquifer matrix); and
- Dissolved contaminants (fuel constituents dissolved into groundwater).

In June 2015, the first extraction well began operation as part of an interim measure to begin cleaning up groundwater, with two additional wells coming online in December 2015. On December 31, 2015, the full-scale groundwater treatment system (GWTS) began operation and extraction rates have averaged close to 400 gallons per minute (gpm). A fourth extraction well is scheduled to come online in December 2016. These four extraction wells and treatment are being done as part of the EDB plume collapse interim measure. This field trip provides an opportunity to observe an active drilling site where the United States (U.S. Geological Survey (USGS) is working to install a set of nested sentinel wells for the Veterans Affairs (VA) Hospital water supply well. Additional stops include a tour of the GWTS and a stop at the Kirtland AFB Golf Course where treated water is used for irrigation of the greens. Geologists and water professionals from the New Mexico Environment Department (NMED), the United USGS, the NM Bureau of Geology, the Albuquerque Bernalillo County Water Utility Authority, the U.S. Air Force, the Air Force Civil Engineering Center, US Army Corps of Engineers, and Air Force Contractors are available for questions and discussion.

The GWTS began operation on December 31, 2015 with all three extraction wells. As of April 19, 2016, over 52 million gallons of EDB contaminated water has been extracted and a total of 20 grams of EDB removed.

This field trip consists of one "windshield" stop and two stops where you can get out and walk around. Transportation to the first stop at the USGS drilling location will depart from the Cesar Chavez Community Center, followed by stops at the EDB Plume Collapse full-scale GWTS and discharge locations, as outlined on the itinerary below.

Field trip stops are outdoors and on uneven terrain. Please bring sunscreen, a hat, drinking water, sturdy shoes (note: flip flops and sandals are not recommended), layers of clothing appropriate for Spring weather, and a clip board for field trip handouts.

Influent tank and bag filters at GWTS

Two 20,000 pound carbon treatment vessels

Itinerary

10:00 a.m.	Registration Group A meets at the Cesar Chavez Community Center parking lot (south of the building).
10:10—10:20 a.m.	STOP 1 at the USGS VA Hospital Sentinel Well Site
10:25—11:15 a.m.	STOP 2 at the Full-Scale GWTS Building
11:25—11:50	STOP 3 at the Kirtland AFB Golf Course
12:00 p.m.	Registration Group A returns to Cesar Chavez Community Center
1:00 p.m.	Registration Group B meets at the Cesar Chavez Community Center parking lot (south of the building).
1:10—1:20 p.m.	STOP 1 at the USGS VA Hospital Sentinel Well Site
1:25—2:15 p.m.	STOP 2 at the Full-Scale GWTS Building
2:25—3:50 p.m.	STOP 3 at the Kirtland AFB Golf Course
4:00 p.m.	Registration Group B returns to Cesar Chavez Community Center

STOP 1 USGS VA Hospital Sentinel Well

Sentinel wells are an important part of the Kirtland AFB BFF monitoring program. Twenty-seven groundwater monitoring wells have been identified as sentinel wells to be used to identify migration of the dissolved-phase plume well in advance of the contamination reaching water supply wells. The sentinel well network provides an early warning system that is protective of the ABCWUA, Kirtland AFB, and VA Hospital water supply wells. Technical working groups are in the process of identifying early indicator parameters that can be used to trigger actions, such as increased monitoring.

The Hydrogeology Working Group identified the benefits of an additional set of nested sentinel wells in close proximity to, and up gradient of, the VA Hospital water supply well. The USGS is using a mud rotary drilling technique to drill the borehole where the nested wells will be installed. The total depth of the boring will be approximately 1200 feet below ground surface (bgs). There will be up to 3 wells nested in a borehole; the number of wells depends on the geology observed during drilling. The wells will be constructed similar to the Cesar Chavez and Southern sentinel wells with 3-inch diameter PVC casing and 20 feet of 3-inch diameter stainless steel screen.

Discussion topics for this stop will include:

- What is a sentinel well? (Adria Bodour, AFCEC)
- Drilling and well installation methods (Diane Agnew, NMED)

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STOP 2 EDB Plume Collapse Full-Scale Groundwater Treatment System

This stop provides an opportunity to tour and view the full-scale GWTS that began operation in December 2015, completely replacing the temporary treatment system viewed during the October 2015 field trip. The GTWS is currently treating water extracted from three extraction wells: KAFB-106228 that began operation in June 2015 and KAFB-106233 and KAFB-106234 that began operation in December 2015. A fourth extraction well is planned to come online for extraction in December 2016.

The full-scale GWTS consists of an influent holding tank, bag filters, two, 20,000 pound vessels containing granular activated carbon (GAC), and a treated water storage tank. The current GWTS is capable of treating up to 800 gpm and the building has sufficient room for expansion to accommodate additional treatment capacity, if needed. Treated effluent is routed through a discharge pipe that conveys the drinking water quality water to two discharge points:

- Kirtland AFB Tijeras Arroyo Golf Course Main Pond
- Kirtland well KAFB-7

The water discharged to the golf course main pond is used to irrigate the golf course. KAFB-7 is the location for an injection well pilot test. The Air Force is currently working on an application for an Underground Injection Classification discharge permit for injection at KAFB-7 and future injection well locations.

Discussion topics for this stop will include:

- Site geology and stratigraphy (Diane Agnew, NMED)
- EDB plume definition and data gaps (Wayne Bitner, AFCEC Kirtland IST)
- Drinking water supply well protection (Dennis McQuillan, NMED and Rick Shean, ABCWUA)
- Collapsing the EDB plume in groundwater (Adria Bodour, AFCEC)

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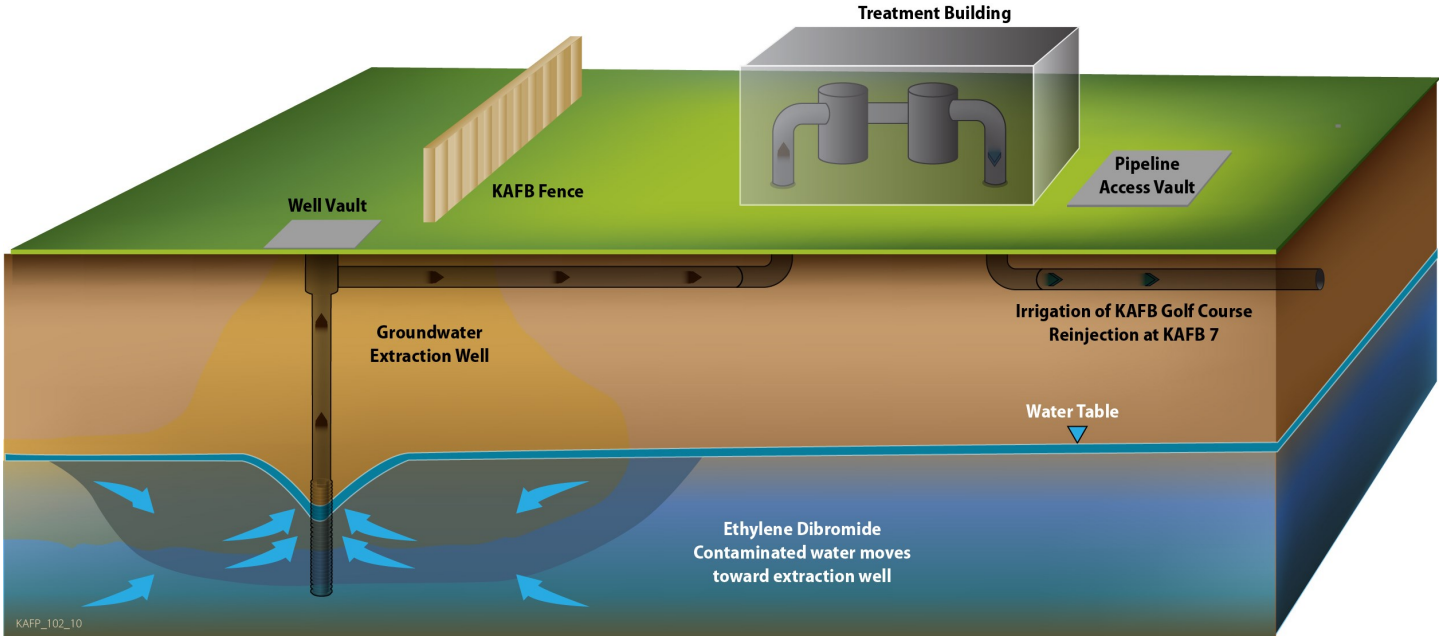
Conceptual diagram of pump and treat remediation



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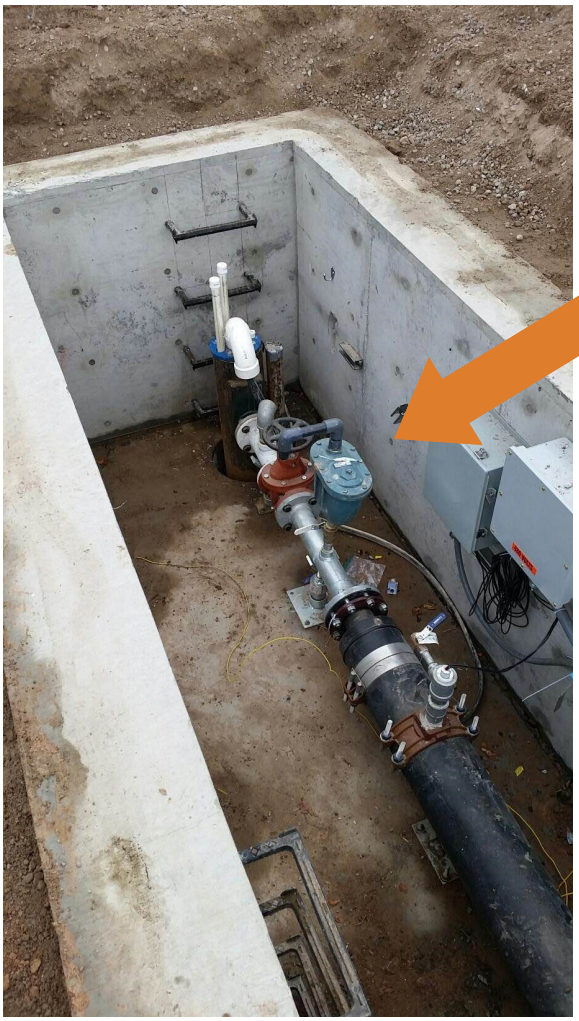

Wellhead construction at extraction well KAFB-106233. This is where manual and electrical controls are housed for the operation of the extraction well. Once construction is completed, the well is covered with vault lid and is not accessible by the public.

Influent, untreated water holding tank and bag filters.

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Vessels containing 20,000 pounds of GAC
Treated water holding tank

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In February 2013, the Air Force started an injection pilot test at KAFB-7, a former water supply well. This pilot test will provide necessary data to evaluate injection as a long-term, sustainable option for discharge of treated groundwater from the GWTS.

In order to prepare KAFB-7 for use as an injection well the well was re-developed, which included the use of a soft brush to clean the well screen. Additionally, the Air Force conducted a short-term pumping test of the well to estimate aquifer properties and well efficiency.

Following the well redevelopment and testing, infrastructure for injection was installed at the well. A pipe with valves and meters was installed in the well; the well valves communicate with the GWTS treatment system so that injection rates can be adjusted, if needed, depending on well performance. Water levels in KAFB-7 and nearby monitoring wells are being measured to evaluate aquifer response and the USGS is completing a gravity survey that will provide a high accuracy evaluation of water table changes throughout the pilot test.

STOP 3 Discharge of Treated Groundater at Kirtland AFB Tijeras Arroyo Golf Course

The discharge point at the Kirtland AFB Tijeras Arroyo Golf Course is the main site to see at this stop. Treated groundwater from the GWTS is conveyed from the treatment system through underground pipelines to the outlet point in the main pond. The water is then used to fills the ponds that serve as the reservoirs for golf course irrigation and golf hazards for the golfers that visit the course. The golf course has the capacity to utilize up to 700 gpm of treated water between March and October. During the winter months, the irrigation needs drop dramatically and an alternate discharge option is needed for the treated groundwater.

Along the route to the golf course we passed the location of KAFB-7, the location of the injection pilot test. Treated water at KAFB-7 is gravity-fed down a pipe installed in the center of the well.

Discussion topics for this stop will include:

- What is an injection well? (Diane Agnew, NMED)
- Beneficial use of treated water (Kate Lynnes, Air Force)
- Site geology and soil types (Adria Bodour, AFCEC and Dennis McQuillan, NMED)

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Upcoming Public Outreach Opportunities

Below are multiple opportunities to keep up to date on the Kirtland AFB Bulk Fuels Facility spill site:

Quarterly Public Meeting	July 14, 2016 5:30 p.m. Poster Session and 6:00 p.m. Presentation African American Performing Arts Center 310 San Pedro Dr NE, Albuquerque, NM 87108
Public Field Trip	October 15, 2016 TBD

Please check the NMED website for the Kirtland AFB BFF Project for upcoming public outreach events and for news updates on what is happening on the project:

https://www.env.nm.gov/NMED/Issues/KirtlandFuelPlume/index.html

Contact the Air Force

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References for Additional Information

New Mexico Environment Department:

⇒ KAFB Jet Fuel Plume Remediation web section: www.nmenv.state.nm.us/NMED/Issues/KirtlandFuelPlume

- **Project Documents Page: Groundwater Extraction Pilot and Additional Characterization**
  - KAFB workplan, August 1, 2014 Link to PDF on NMED website
  - NMED approval letter, August 20, 2014 Link to PDF on NMED website

- **Public Outreach Archive Page: Public Meeting Presentations and Field Trip Handouts**

- **Site also includes:** additional documents, modeling videos, biographies of technical working group members

- **Historical Reports and Correspondence** (dating back to 1999)
  - NMED Hazardous Waste Bureau Webpage link http://www.nmenv.state.nm.us/HWB/kafbperm.htm

Kirtland Air Force Base:

⇒ Project website: http://www.kirtlandjetfuelremediation.com

- **Project Documents Page: Quarterly Monitoring and Site Investigation Reports** (full text, figures and tables)

- **Site also includes:** past meeting materials, maps & photos, frequently asked questions, contacts

U.S. Environmental Protection Agency :

- **EPA's RCRA Orientation Manual** http://www.epa.gov/osw/inforesources/pubs/orientat/

Glossary of Terms

The terms in this glossary are general definitions for common regulatory and scientific terms.

A

Adsorb—To take up and hold (a gas, liquid, or dissolved substance) in a thin layer of molecules on the surface of a solid substance.

Alluvial Fan —A triangle-shaped deposit of gravel, sand, and fine-grained sediment (clay or silt). This sediment is called alluvium.

Aquifer—A zone of soil or rock below the surface of the earth that is capable of producing water.

B

Biodegradation— The breaking down of organic substances by microorganisms through the breaking of intramolecular bonds.

Bioremediation— The use of living organisms to clean up contaminants from soil, water, or wastewater.

C

Contaminant— Any physical, chemical, biological, or radiological substance in air or soil or water that has an adverse effect. Any chemical substance whose concentration exceeds background concentrations or which is not naturally occurring in the environment.

Contamination—Introduction into air, water, and soil of chemicals, toxic substances, wastes, or wastewater in a concentration that makes the impacted medium unfit for its next intended use.

D

Dissolved Phase —The part of hydrocarbon contamination which has partitioned into a body of water.

E

Effluent— Treated (or un-treated) wastewater that flows out of a treatment plant.

Ethylene dibromide (EDB) - A colorless, heavy, synthetic liquid that was primarily used in anti-knock gasoline mixtures, particularly aviation fuel. The maximum contaminant level for EDB in groundwater is 0.05 micrograms per liter (or 0.05 parts per billion), as defined by the EPA.

Extraction well—A well specifically designed for the removal of groundwater or air.

G

Granular Activated Carbon (GAC) - A porous adsorbent material created through the heating of organic material such as coal, wood, or coconut shell, which is then crushed into granules. The granular activated carbon is positively charged and therefore able to remove dissolved organic solutes by adsorption onto the activated carbon.

Groundwater— Water under the surface of the earth that fills pores in soil or opening in rock. When groundwater accumulates in sufficient quantities and quality, it may be used as a source of drinking water.

H

HDPE—High density polyethylene material known for its strength

Hydrocarbons— Chemical compounds that consist primarily of carbon and hydrogen, such as petroleum.

I

Influent—Untreated wastewater flowing into a treatment plant.

Injection Well —A device that is used to place fluid (e.g., treated water) into soil or rock formations.

In situ— Where contaminated material(s) are treated without prior excavation or extraction from the ground.

Interim Measure— Early action(s) taken to eliminate, reduce, or control the hazards posed by a site or to expedite the completion of site cleanup.

L

Light Non-Aqueous Phase Liquid (NAPL) - Contaminants that remain undiluted as the original bulk liquid in the subsurface (e.g., free product).

M

Monitoring well— A well that provides access to groundwater or soil vapor that provides access for field measurements and collection of samples for laboratory analysis.

P

Plume—A visible or measurable discharge of a contaminant from a given point of origin.

R

RCRA (or ACT) - Resource Conservation and Recovery Act (RCRA) of 1980 (as amended), is the principal federal law in the United States governing the disposal of solid waste and hazardous waste.

Receptor—A person, organism, habitat, or water that is being, or could be, harmed by a potential contaminant.

Remediation—An action taken to improve a contaminated site in order to prevent, minimize, or mitigate damage to human health, or the environment. Remediation includes the development and application of a planned approach that removes, destroys, contains or otherwise reduces the availability of contaminants to receptors of concern.

Respiration—A process in living organisms involving the production of energy, typically with the intake of oxygen and the release of carbon dioxide, from the oxidation of complex organic substances.

S

Saturated Zone—The zone where voids of the soil or rock are filled with water. In an unconfined aquifer, the water table forms the upper boundary of the saturated zone.

Soil vapor—The vapor of gas phase of a substance that is found in the unsaturated zone.

Soil Vapor Extraction (SVE) - A physical treatment process for remediation of volatile contaminants in a vadose zone.

U

Unconfined Aquifer —An aquifer where the water level (water table) is free to rise and fall. The pressure is atmospheric at the water table.

V

Vadose Zone —The zone between the earth surface and the water table within which the moisture content is less than saturation. The soil pore space typically contains air or soil vapor.

Volatile Organic Compounds (VOCs) - Human-made hydrocarbon compounds that have low boiling points and therefore evaporate readily. Propane, benzene, and other components of gasoline are all volatile organic compounds.

W

Water Level—The upper limit of the saturated zone. It is measured by installing wells that extent a few feet into the saturated zone and then recording the water level in those wells.

Water Table—The level of groundwater.