Kirtland Air Force Base
Fuel Leak Cleanup

Presenters: Dennis McQuillan, NMED
Kathryn Lynnes, Air Force

Project Briefing

January 10, 2017

Project History and Cleanup Strategy

Dennis McQuillan
New Mexico Environment Department (NMED)
Chief Scientist

A Partnership for Success

A collaborative technical team is solving the complex hydrogeologic and engineering challenges posed by the fuel leak with support from Albuquerque's neighborhood groups

Westside Coalition Neighborhood Assoc.

US Army Corps of Engineers

Siesta Hills Neighborhood Assoc.

ABQ City Council District 6 Coalition of Neighborhood Assocs.

Elder Homestead Neighborhood Assoc.

Christ United Methodist Church

HAWLEY GEOMATTERS

Thomson and Associates

Site History

- **1951-53** – Kirtland Air Force Base (KAFB) Bulk Fuel Facility (BFF) constructed
- **1953-75** – Handling of aviation gasoline which contained the additive ethylene dibromide (EDB)
- **1999** – KAFB discovered and notified NMED of leak, ceased using underground pipelines, and initiated site investigations pursuant to Water Quality Control Commission (WQCC) regulations
- **2001** – KAFB notified NMED of detected fuel constituents in groundwater
- **2003-15** – Soil vapor extraction (SVE) remediation conducted
- **2007** – Light non-aqueous phase liquid (LNAPL) discovered on groundwater table
- **2008-11** – Bioslurping conducted to remove LNAPL
- **2009** – Water table began to rise
- **2010** – Project transferred from WQCC to Resource Conservation and Recovery Act (RCRA) authority
- **2014-present** – Interagency partnership, additional interim measures
- **2015** – Groundwater cleanup begins
- **2016 –** Cone of depression observed around toe of EDB plume

Current Regulatory Basis

NMED has been granted primacy by the U.S. Environmental Protection Agency to administer:

- The Safe Drinking Water Act (SDWA) program, including WQCC Underground Injection Control (UIC) and
- The RCRA program.

Public water systems, the Albuquerque Bernalillo County Water Utility Authority (Water Authority), KAFB, and the VA Hospital, must deliver water to consumers that meets SDWA standards.

Cleanup of the BFF site must comply with and continues to meet the corrective action provisions in KAFB's RCRA permit.

RCRA Corrective Action Process

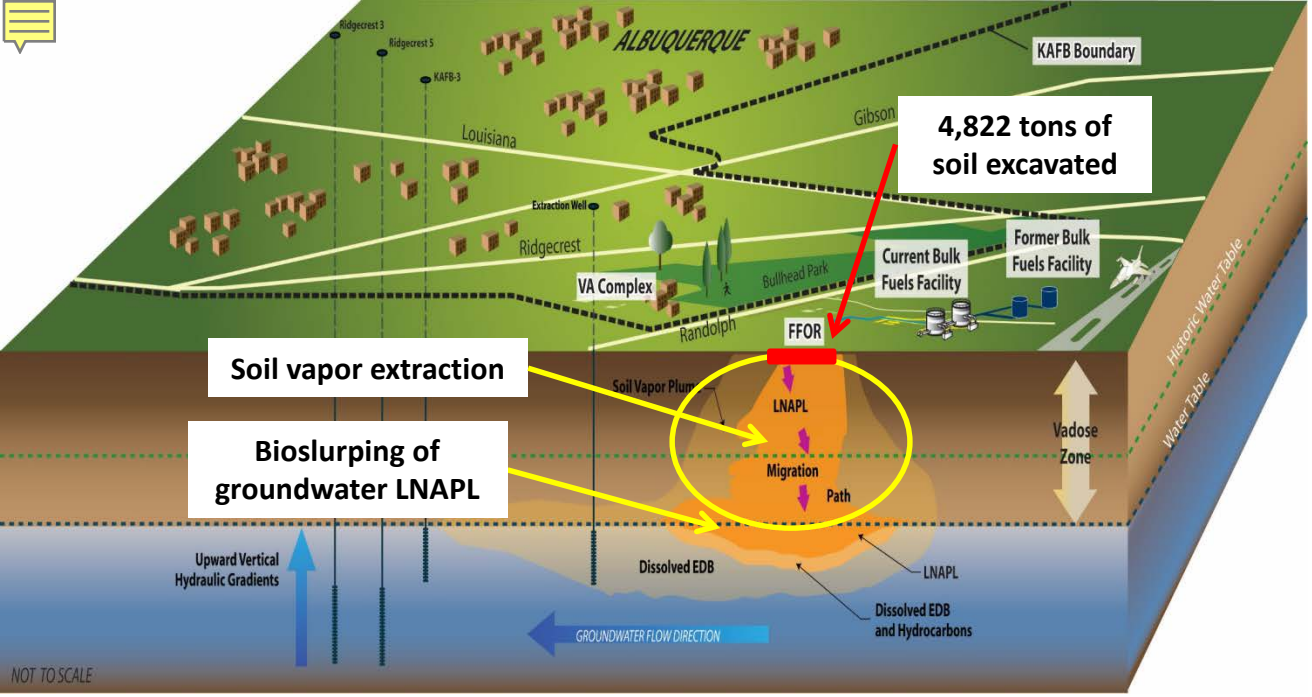
RCRA Facility Investigation (RFI) collects data to support corrective action decisions

- Site investigations are done to define the nature and extent of contamination
- Site investigations are performed in data-driven phases
- Interim measures can be implemented during RFI process
- The RFI report is approved by NMED

Conceptual Site Model Animation

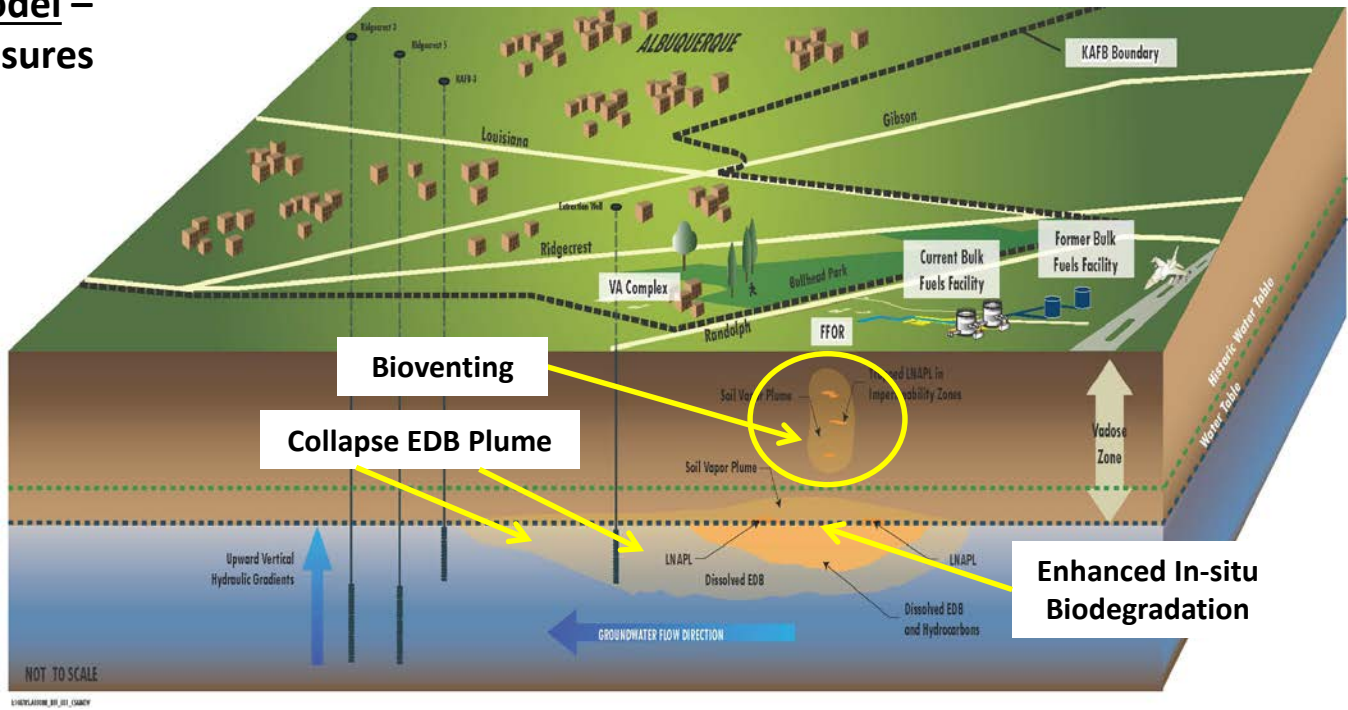
https://www.env.nm.gov/NMED/Issues/KirtlandFuelPlume/KAFBProjectImages.html

Cleanup Strategy



Implement multiple technologies, both simultaneously and sequentially, based on plume anatomy

<u>Conceptual Site Model</u> – before interim measures



<u>Current Conditions</u> –

- **12 years of SVE significantly reduced contamination in the vadose zone**
- **~4 years of bioslurping significantly reduced residual LNAPL**

2016 Strategic Plan

NMED Final 2016 Strategic Plan is available online:
http://www.nmenv.state.nm.us

Goal: Protect Albuquerque's aquifer and drinking water supply wells in the area of the fuel leak

Strategies to Achieve the Goal:

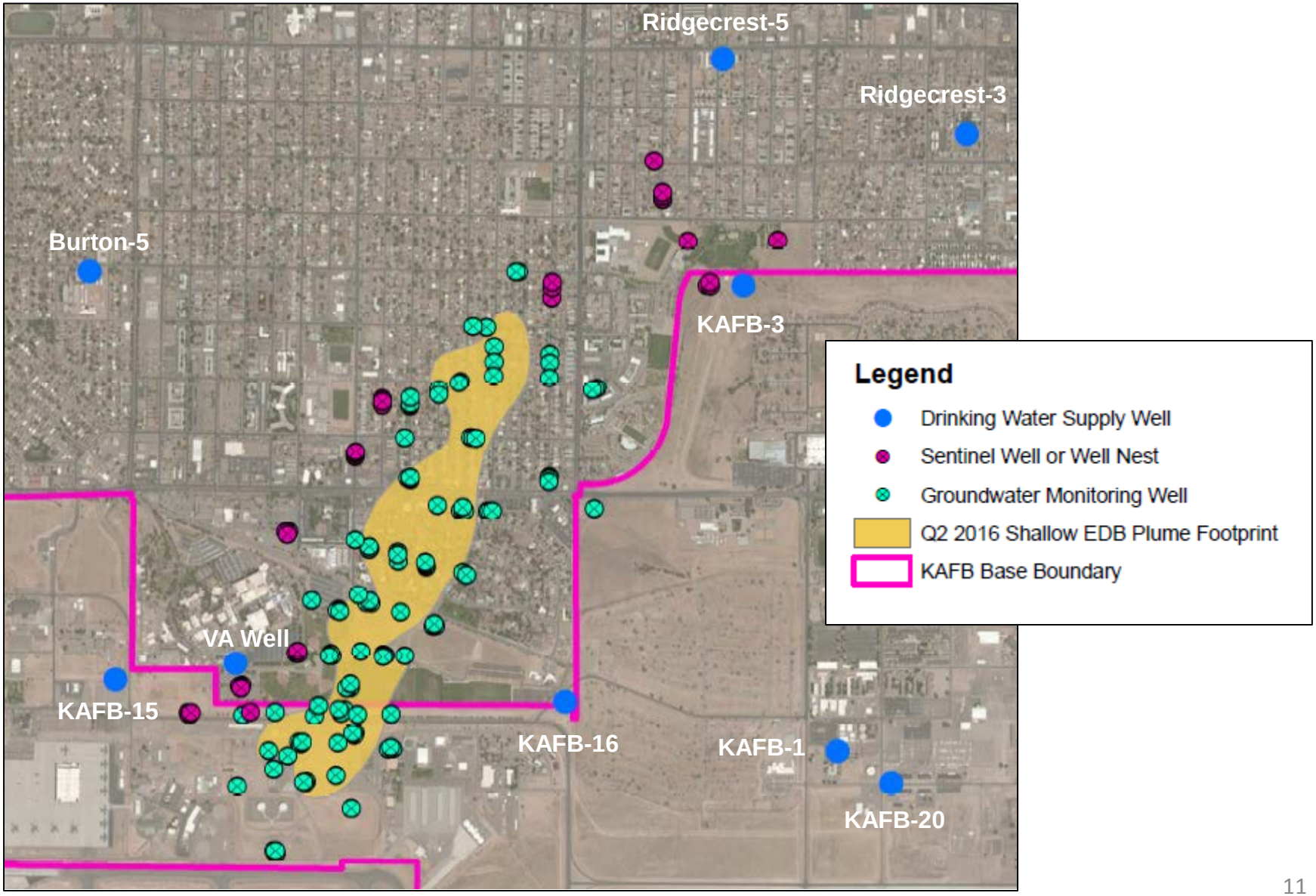
1. Implement a robust site monitoring & wellhead protection program
2. Characterize and remediate LNAPL, impacted soil, and associated dissolved phases in the source area
3. Collapse the dissolved EDB plume
4. Meet or exceed all requirements for providing public comment, information and involvement

2016 Strategic Plan

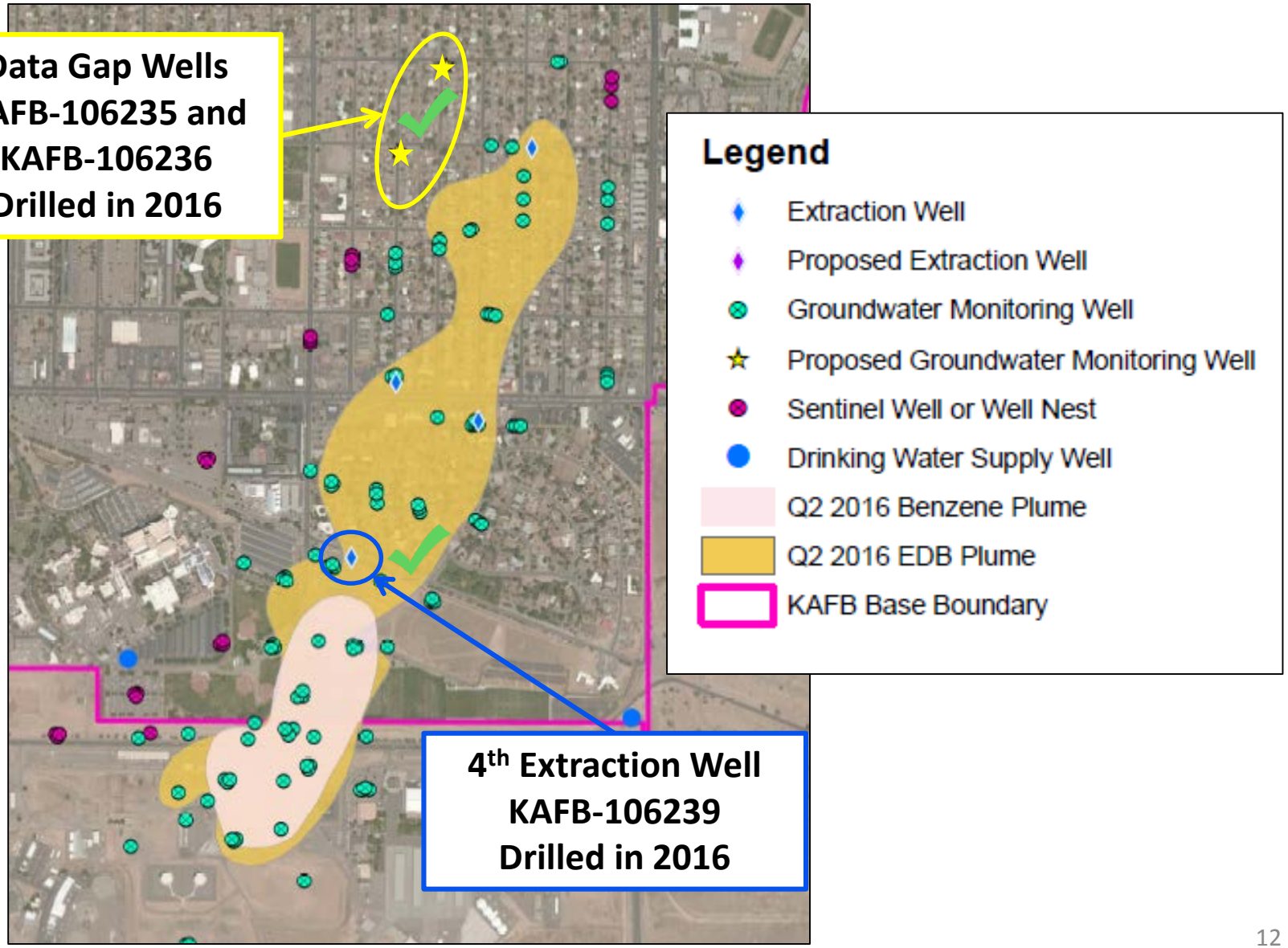
<u>Strategy #1</u> Implement a robust site monitoring & wellhead protection program

- Quarterly testing of monitoring wells shows a relatively stable contamination plume
- Quarterly testing of sentinel wells shows no detections of any fuel constituents
- Monthly testing of drinking water supply wells shows no detections of any fuel constituents

Site Monitoring and Wellhead Protection



Drilling Activities



2016 Strategic Plan

<u>Strategy #2</u> Characterize and remediate LNAPL, impacted soil, and associated dissolved phases in the source area

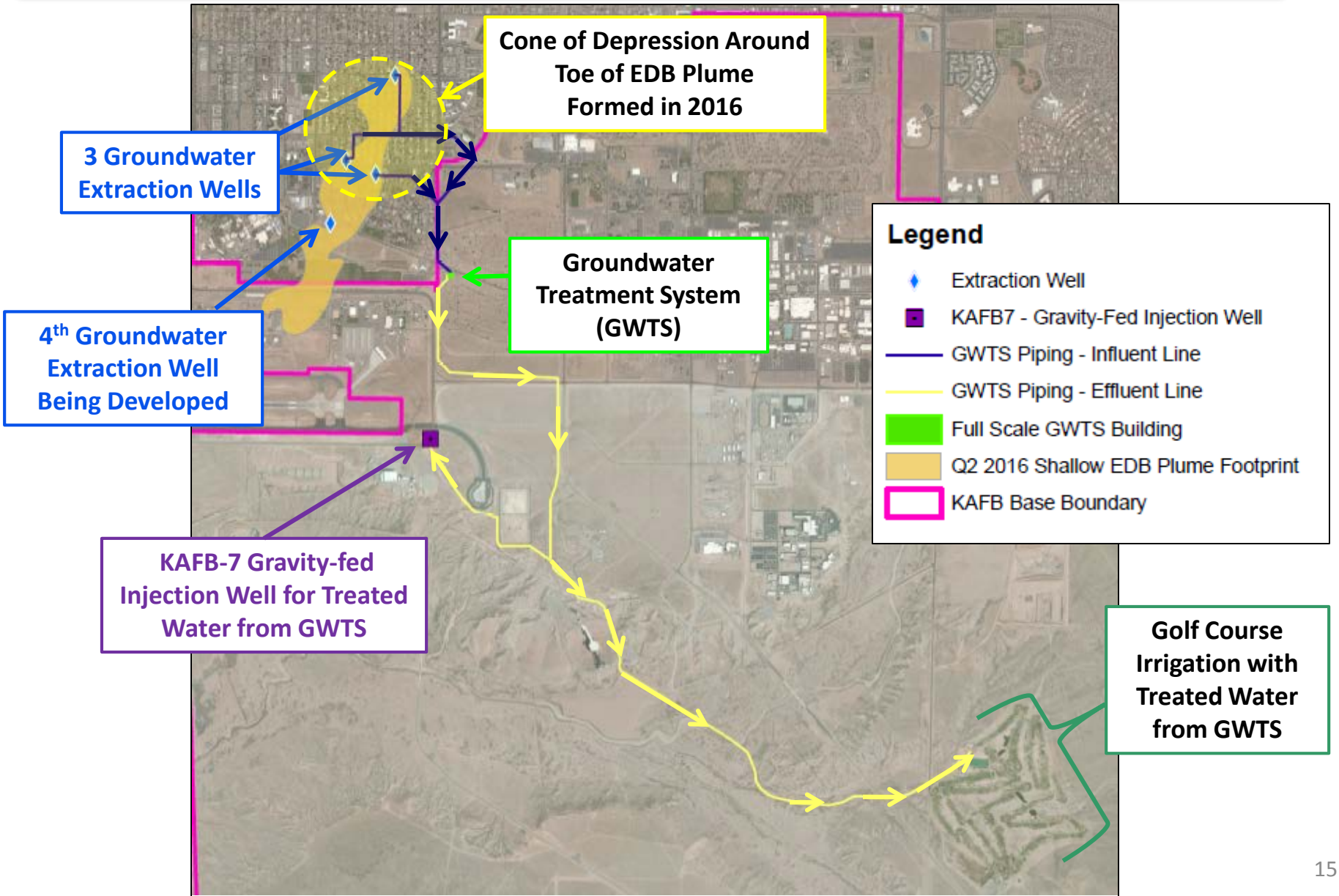
- Rebound and respiration monitoring provides valuable data on how soil bacteria are biodegrading fuel contamination
- SVE transitioning to bioventing
- Additional core drilling into LNAPL zone planned
- In situ bioremediation pilot tests planned

2016 Strategic Plan

<u>Strategy #3</u> Collapse the dissolved EDB plume

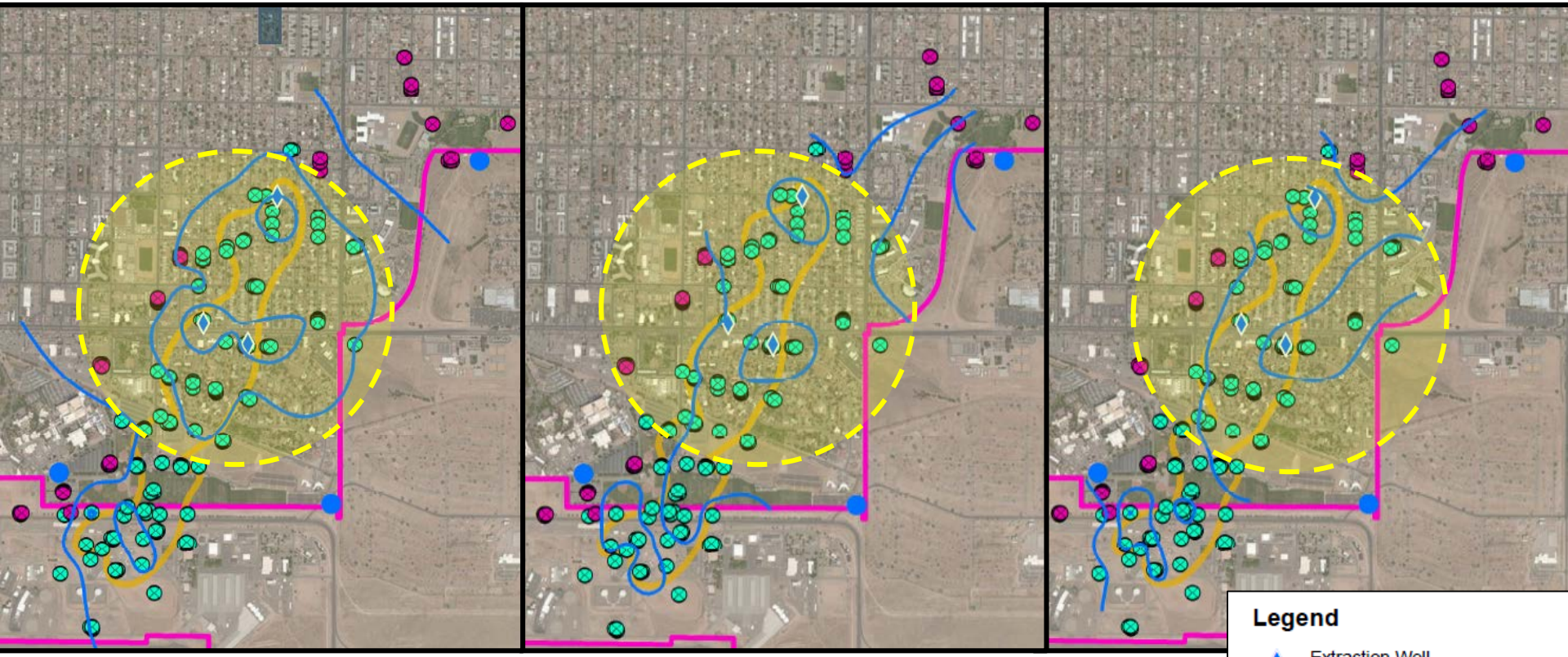
- Groundwater pump-and-treat began in 2015
- 141 million gallons of groundwater has been treated, with ~45 grams of EDB removed from the aquifer
- Treated groundwater contains no detectable fuel contaminants
- The cone of depression that has formed around the toe of the EDB plume is a major milestone towards containing and collapsing the EDB plume
- No evidence yet of EDB plume shrinkage

Groundwater Cleanup



A Persistent Cone of Depression

Q2 2016 GW Contours | Q3 2016 GW Contours | Q4 2016 GW Contours

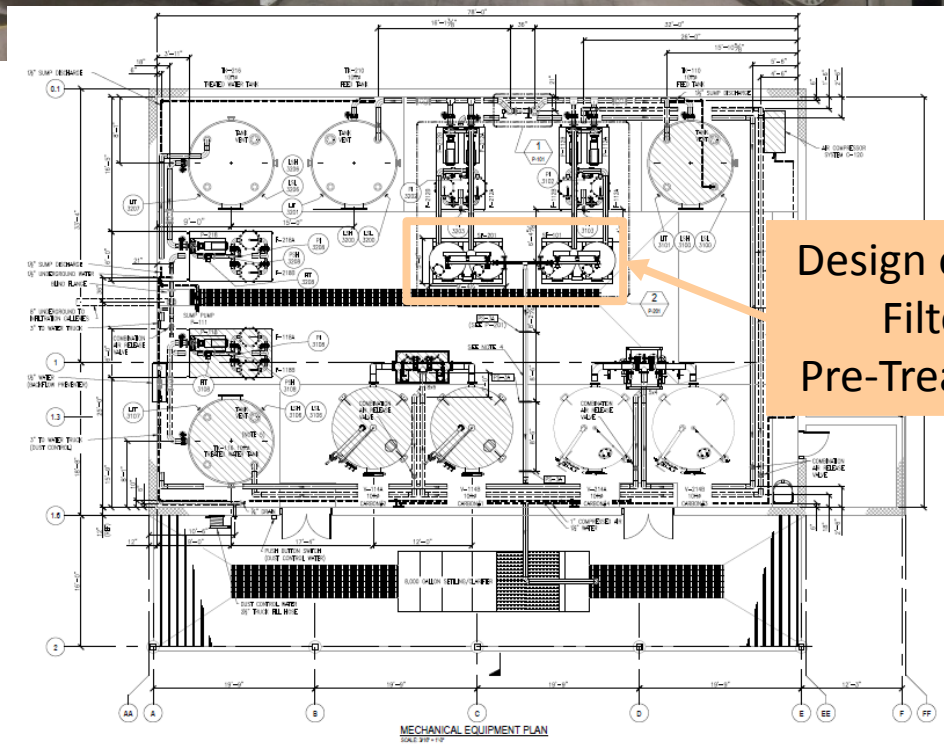


- Plume collapse will be confirmed with EDB concentrations over time
- Persistence of cone of depression → robust system design

GWTS Expansion

2 New 20,000 pound GAC Tanks added

Sacrificial anode added to extraction wells to prevent corrosion



Design of Sand Filters Pre-Treatment

2016 Strategic Plan

<u>Strategy #4</u> Meet or exceed all requirements for providing public comment, information and involvement

- Routine public meetings, upon request presentations, field trips, “deep dive” technical seminars, public workshops

Air Force Perspective

Kate Lynnes

Air Force Senior Advisor

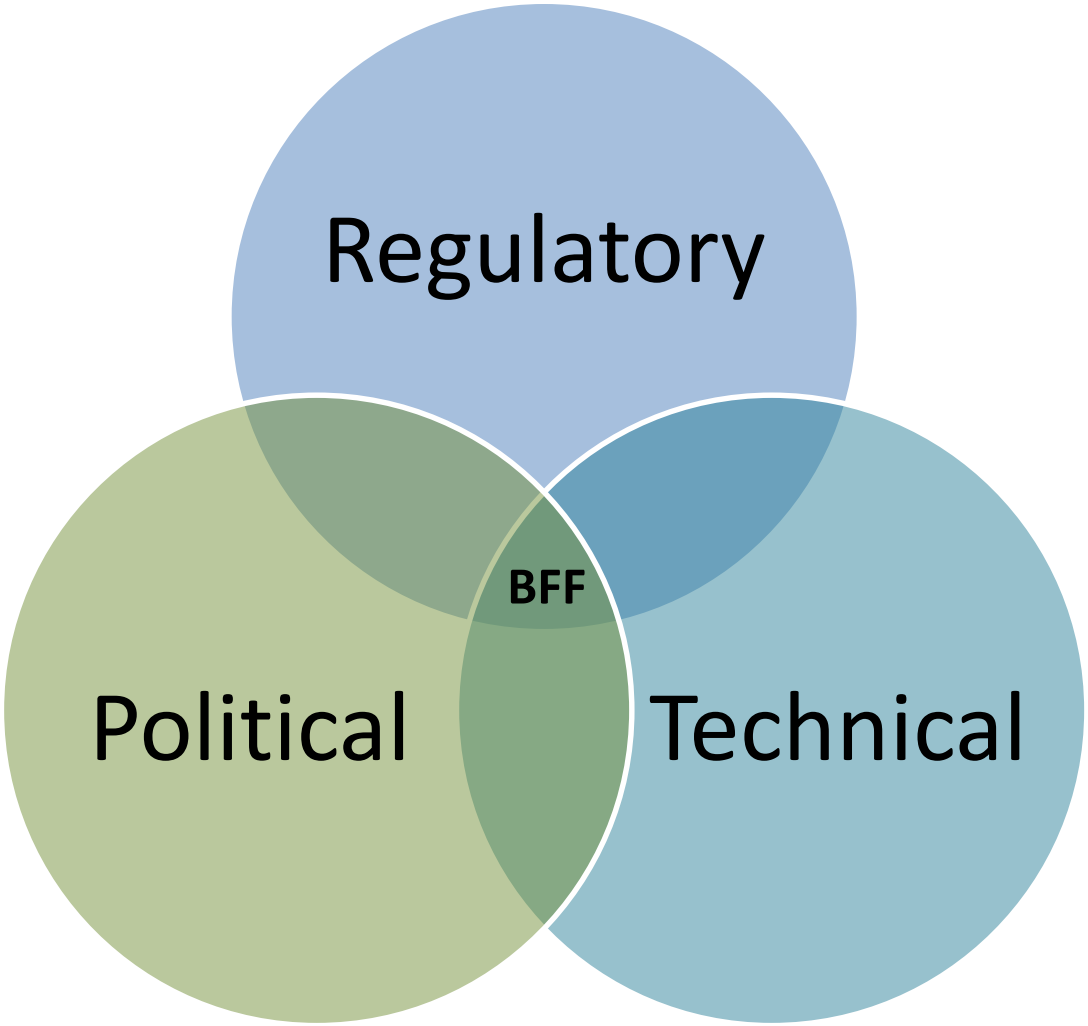
Air Force & NMED Commitment

- Cleaning up the BFF site is one of the top priorities of the Air Force and NMED
- Initiating groundwater cleanup in June 2015 was a huge milestone in this project
- Working collaboratively with the Air Force, NMED, Water Authority, City of Albuquerque, and EPA Region 6 has been critical to our success
- Air Force and NMED will not allow fuel contamination to impact any drinking water wells

New Air Force Project Team

- Air Force Civil Engineer Center (AFCEC) assumed technical and programmatic lead, and brought wide-breadth of subject matter experts
- KAFB 377th Air Base Wing continued involvement and support of RCRA Permit requirements
- U.S. Army Corps of Engineers assigned a dedicated Project Manager for contract oversight
- Secretary of the Air Force brought in a Senior Advisor

Three Key Components to Success



Regulatory Component

The BFF cleanup is a regulatory torte with many layers:

- Corrective Action requirements in RCRA permit → Hazardous Waste Bureau
- Air quality, noise permits, and right-of-entry license agreements → City of Albuquerque
- Class V UIC for the injection of treated groundwater → Ground Water Quality Bureau
- Point of Diversion permits and prohibition on groundwater use over plume → Office of the State Engineer

RCRA Corrective Measures Evaluation

- NMED will direct the Air Force to perform a Corrective Measures Evaluation (CME) once the RFI Report and risk assessment have been approved
- CME will evaluate potential remedial alternatives against threshold and evaluation criteria defined in the KAFB RCRA permit
- As part of the CME Report, the Air Force will recommend a remedy or remedies to NMED
- NMED's selection of a final remedy(ies) will include a robust public participation process as required by RCRA
- After the public hearing, NMED will select a final remedy or remedies and will issue a written response to public comments

Risk Assessment

- Data collected during the RFI must be evaluated to determine if the contaminants released poses a threat to human health or the environment
- This evaluation process uses both screening levels and cleanup criteria established by the NMED in their *Risk Assessment Guidance for Site Investigations and Remediation* (July 2015)

Exposure Pathways

Potential risk occurs when a human or ecological receptor is exposed to contamination.

No exposure pathways or risks from BFF fuel contamination are present

Potential Exposure Pathway	Risk Level	Explanation
Drinking Water		**Drinking water provided by the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) continues to be free of any detectable fuel contamination and is safe for all uses.** Public drinking water wells near the groundwater contamination plume are tested monthly, and show no detections of any fuel compounds. Sentinel wells, which are monitoring wells located between the drinking water wells and the contamination plume, are tested quarterly and show no detections.
Surface Soil		**Surface soil contamination never migrated off of Kirtland.** Surface soil contamination has only occurred at the Kirtland Air Force Base Bulk Fuels Facility (BFF) industrial area which is not accessible to the general public. Contaminated soil has been excavated and removed for off-site disposal.
Surface Water		**There is no pathway for contaminants to enter surface water.**
Vapor Intrusion		**Homes and businesses are not at risk for vapor contamination.** There is no off-Base surface or near-surface soil contamination, and groundwater contaminants are too deep, to allow vapors to enter homes and buildings.
Garden Vegetables		**There is no risk of contamination to garden vegetables.** ABCWUA water is safe for irrigation. There is no off-Base surface soil contamination, and vapors from groundwater are too deep, for fuel to contaminate garden vegetables.
Recreational Activities		**There is no risk of contamination to people enjoying recreational activities in Bullhead Park or in the Dog Park.** Reclaimed ABCWUA water is used to irrigate the parks. There is no off-Base surface soil contamination, and vapors from groundwater are too deep, to pose a risk to people in the park areas.

(June 2016)

Safe	Use Caution	Unsafe

WQCC Class V UIC Discharge Permit

- KAFB golf course reduces irrigation in winter months; therefore another discharge option is needed
- Gravity-fed injection of clean water is green and sustainable technology
- Permit proposes gravity-fed injection wells into the regional aquifer including KAFB-7
- Permit posted for Public Comment Nov 9, 2016; comments due Feb 11, 2017
- Currently, operating under a temporary permission to gravity-fed KAFB-7 treated effluent from GWTS

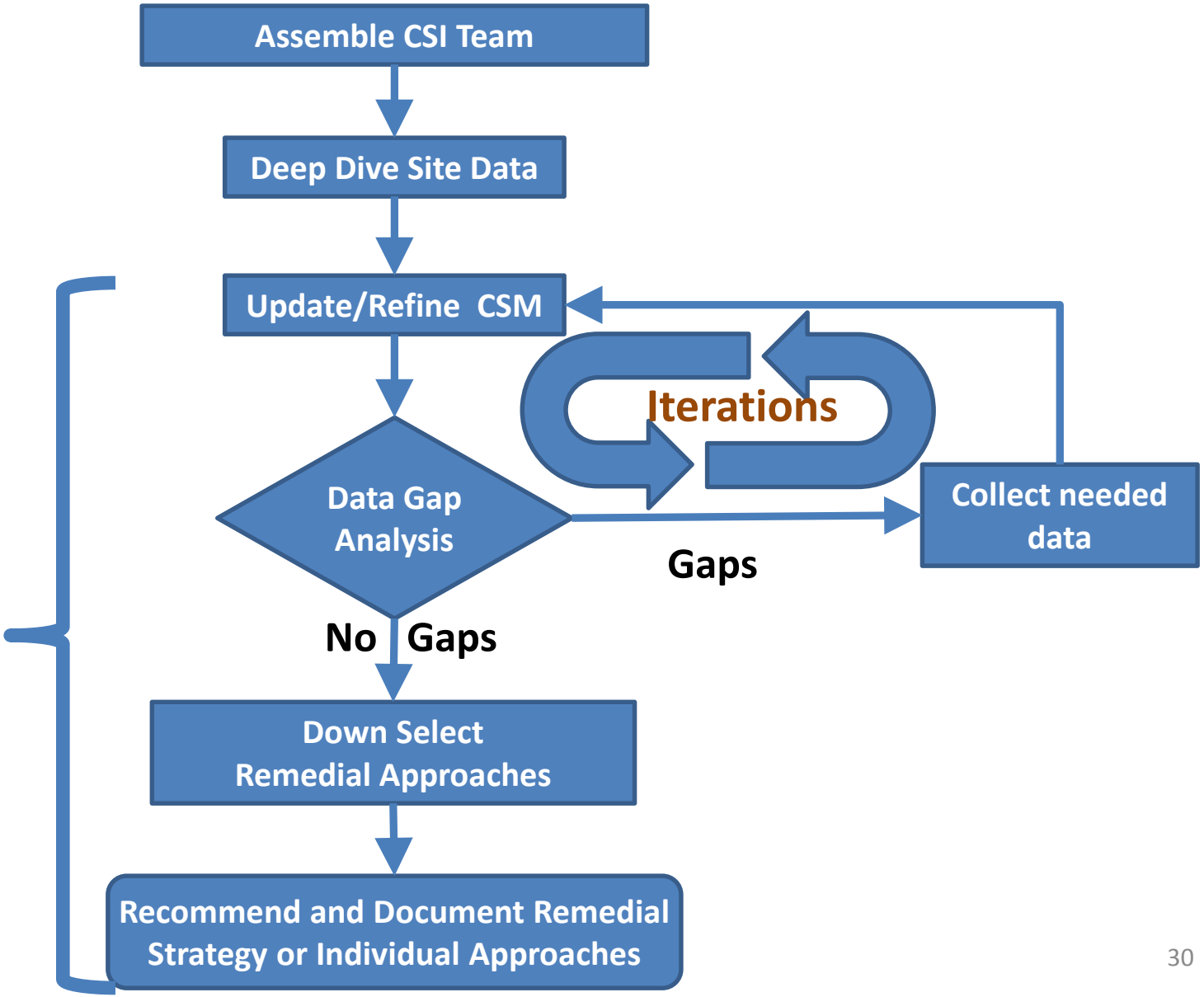
Technical Component

BFF uses a data-driven, collaborative technical approach that includes:

- Complex Site Initiative (CSI)
- Technical working groups
- Innovative pilot tests
- Cost consciousness

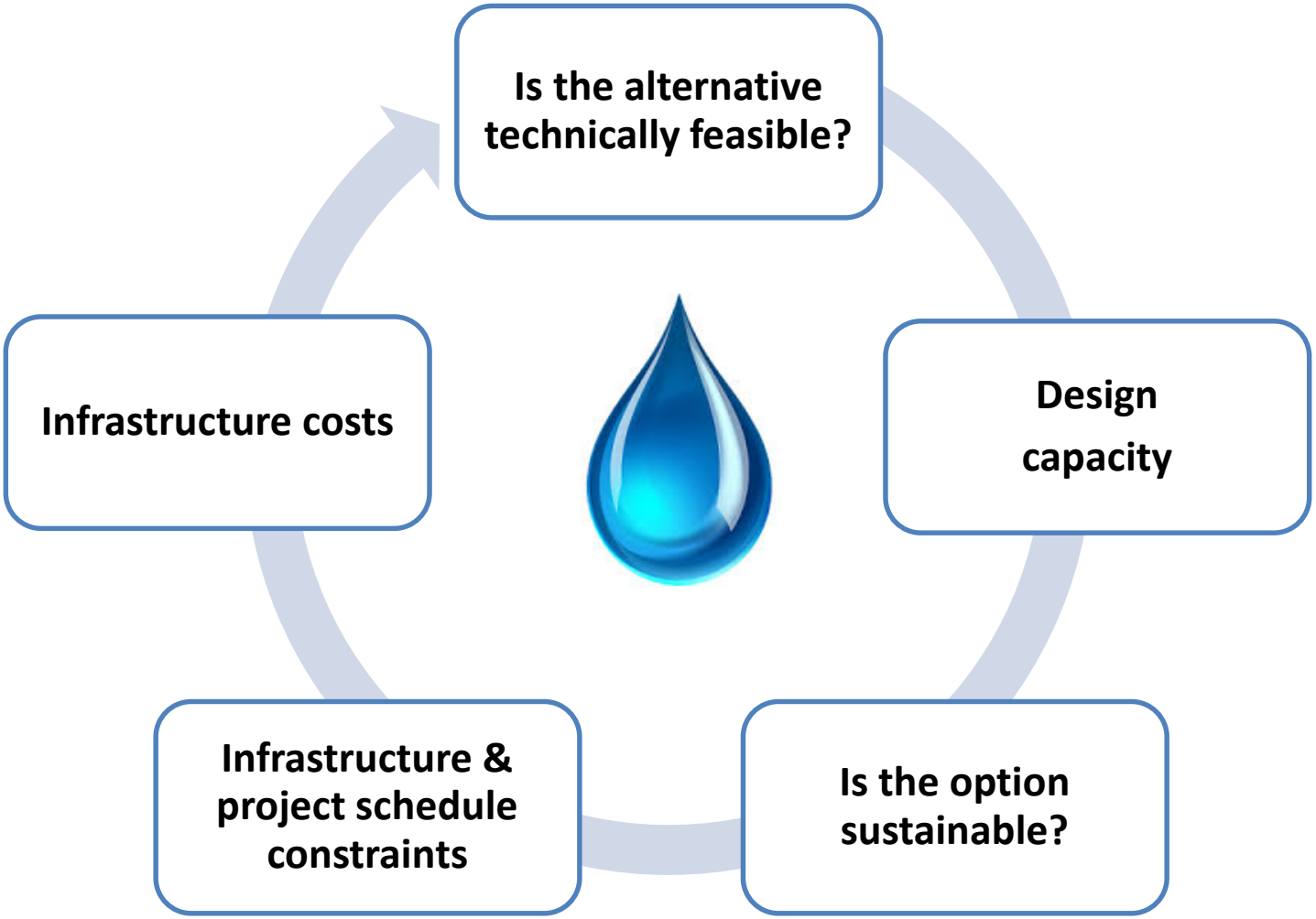
Air Force Complex Site Initiative

Present CSI processes and findings to public and stakeholders



Technical Considerations of Treated Water

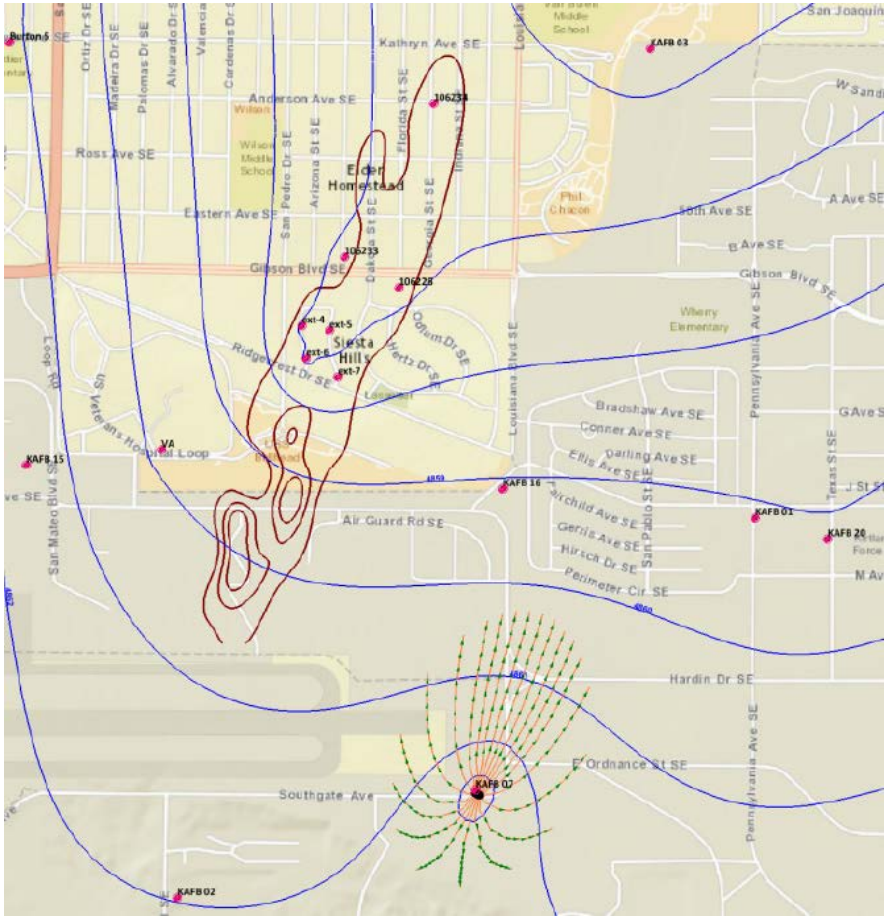
Important factors partners considered when evaluating beneficial use alternatives:



KAFB-7 UIC Pilot Test

- Pilot test gravity-fed injection from Feb 20 - Jun 21, 2016
- No contaminants in treated effluent
- Initial vs. steady-state operations during injection
  - KAFB-7 groundwater rose
    - 2-14 feet vs 3-6 feet
- Minimal aquifer response to observation wells surrounding KAFB-7
- Injection is a viable, beneficial use of treated water

Particle tracking with an injection rate of 800 gallons per minute



Arrows = 1 year intervals

Reducing Project Cost to Taxpayers Without Compromising Public Health & Safety

- **Multiple monitoring wells in a single borehole**
  - Maximizing well installation produces better data, is significantly less expensive, less disruptive to the neighborhood, and safer for workers
- **Optimization of groundwater and vadose zone monitoring**
  - With 4 years of robust monitoring data, it is no longer necessary to test every well for every chemical analyte on a quarterly basis
- **Passive diffusion bag (PDB) sampler validation study**
  - If validated, PDB sampling will be significantly less expensive, safer for workers, and produce less waste
- **Elimination of duplicative permitting**
  - NMED determined that requiring both a RCRA Hazardous Waste Permit and a WQCC Groundwater Discharge Permit for the same land application of treated groundwater was inefficient

Political Component

- Commitment to improving inter-governmental communication and coordination
- Regular updates to the Federal Congressional Delegation, City and County elected officials and staff, the Radioactive and Hazardous Materials Committee, and the Water Authority Board
- Regular stakeholder meetings
- Technical working groups that include Water Authority, City of Albuquerque, and EPA Region 6

Historical Community Involvement

- Public had tremendous mistrust and no confidence the problem was being adequately addressed, not enough information
- Project began to share more information with the community in 2014
- Door-to-door outreach in neighborhoods affected by drilling
- Community Relations Plan prepared
- Implementation was not seen as enough

Expanded Community Involvement

- Change in project team resulted in better communication with the public
- Better communication and access to information about project activities
- Project documents prepared that outline community engagement activities and opportunities

Improved Public Relations

- Dramatic improvement as reflected by
  - Questions have dramatically changed to clarifications versus confrontational
  - Applause versus cursing
- Revising the community stakeholder involvement plan
- This should be iterative and dynamic progress

Officials outline Kirtland fuel spill cleanup efforts

By Ollie Reed Jr. / Journal Staff Writer
Friday, March 13th, 2015 at 12:05am

Albuquerque Journal March 2015

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From left, hydrogeologist Tom Champion talks to Albuquerque residents Tanner and David Gay and Bridget Llanes about a display illustrating the Kirtland fuel spill. (Marla Brose/Albuquerque Journal)

Industrial Strength Clean-up

Albuquerque Free Press May 2016

Current Project Timeline

we are here

2016 | 2017 | 2018

Site Assessment and Characterization

RFI

RFI Addendum

Corrective Measures Evaluation

Drilling

Core Sampling

Site Soil and Groundwater Monitoring Program

INTERIM CLEANUP MEASURES

Bioventing Pilot Test

EDB Plume Collapse (Groundwater Treatment System)

LNAPL Enhanced Bioremediation Pilot Test

Site Permitting

Public Meetings, Field Trips, and Outreach

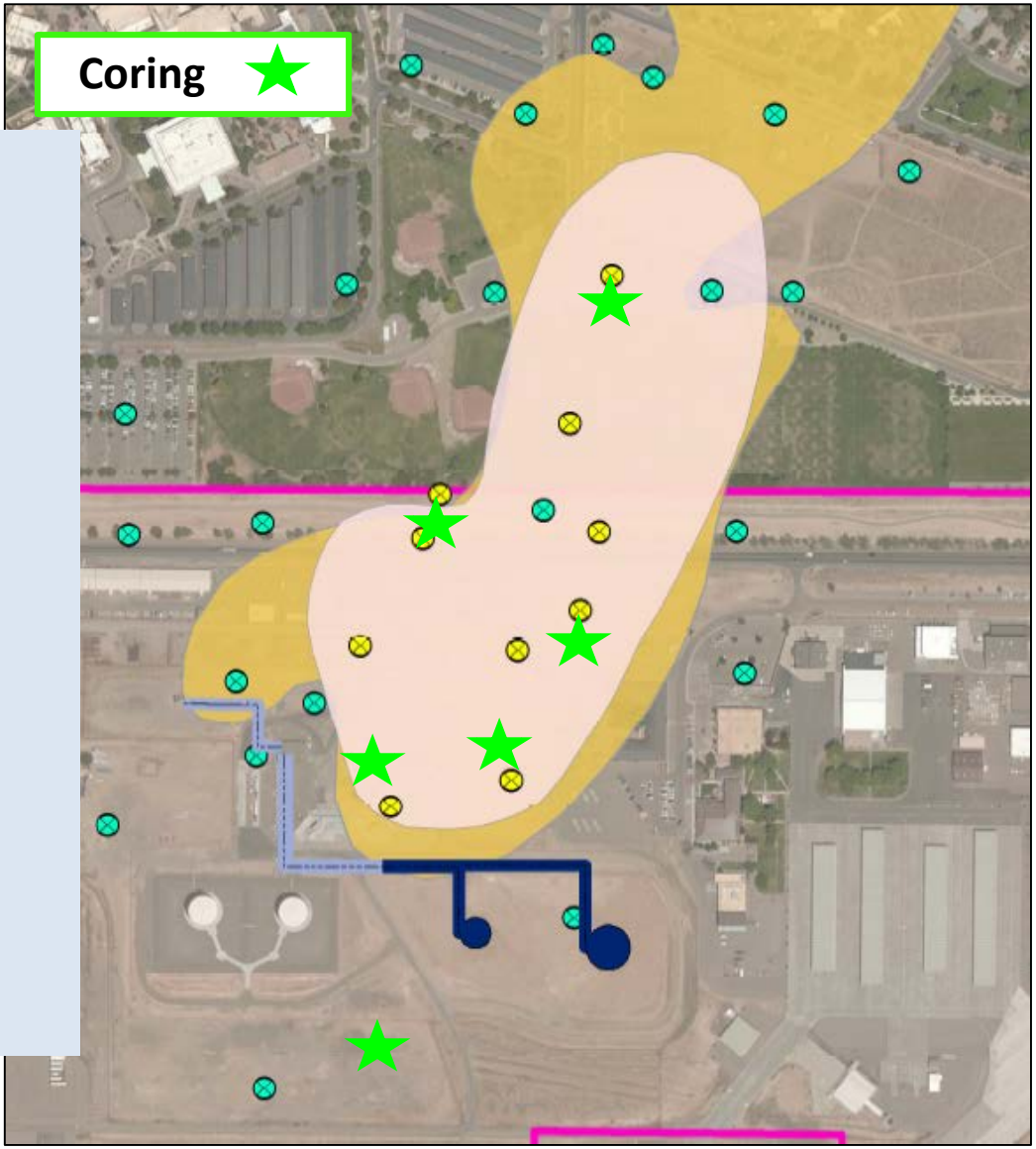
CSI - Complex Site Initiative • EDB - Ethylene Dibromide • LNAPL - Light Non-Aqueous Phase Liquid • RFI - RCRA Facility Investigation Report • SVE - Soil Vapor Extraction

Questions?

Backup Slides

LNAPL Data Gaps

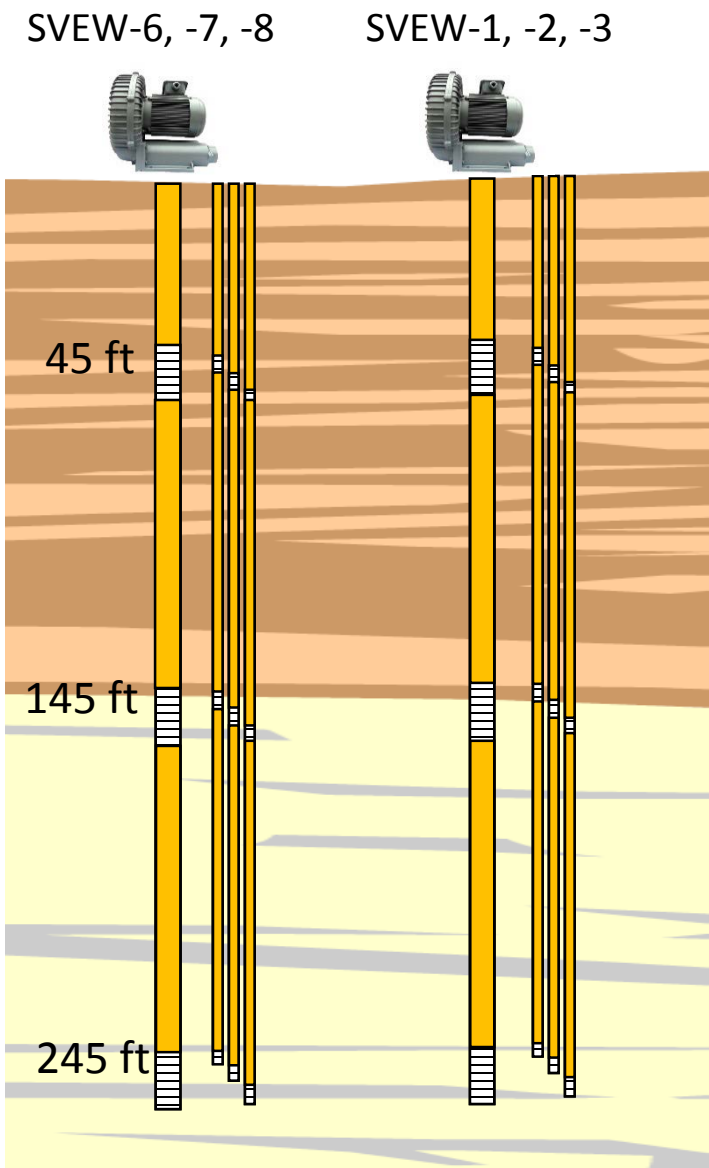
- Interim measure bioslurping removed
-
-



KAFB Base Boundary

Vadose Zone Interim Measure

- Bioventing area targeting rebound zone 50 – 300 feet below ground surface
- olism EDB



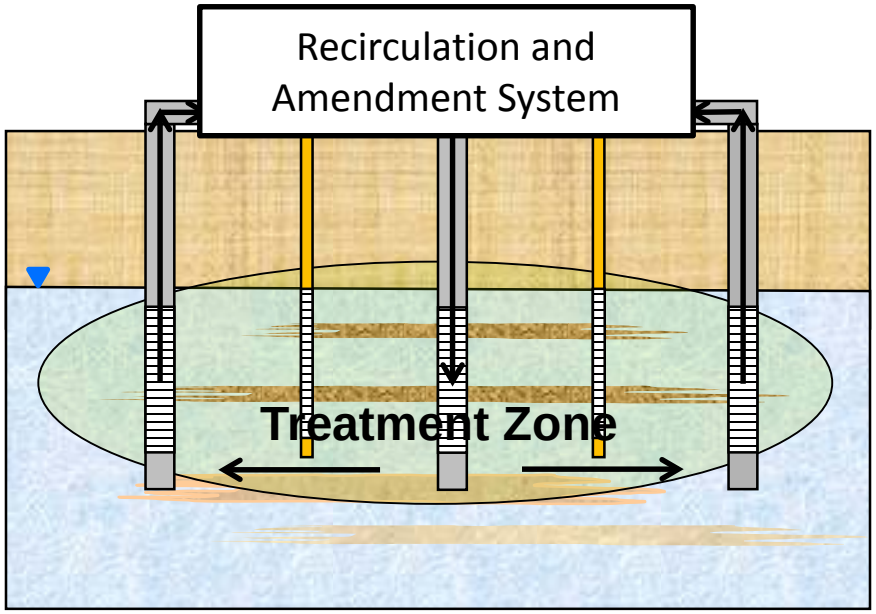
LNAPL Interim Measures

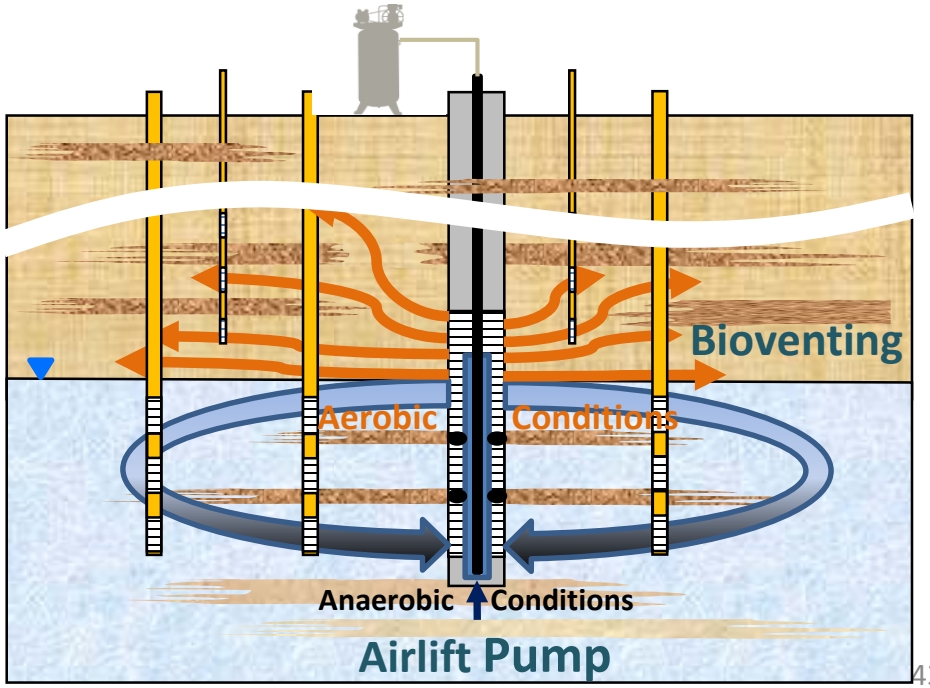
EDB In Situ Biodegradation

- Treating EDB trapped in smeared LNAPL through anaerobic biodegradation

Air-lift Enhanced Bioremediation

- Treating smeared LNAPL through aerobic biodegradation





CSI Tools

Geographical Information System

- Platform for maintaining, communicating, and analyzing site data

Geostatistical Temporal/Spatial optimization software

- Evaluates sampling frequency and monitoring network along with visualization of non-linear trends

Sequence Stratigraphy

- A best fit interpretation of imperfect data sets including geophysical and lithologic logs integrated in the context of depositional analogues

Groundwater Modeling

- Analytic element and finite difference