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REVISED DRAFT
Innovative Techniques and Integrated Approach in the USA

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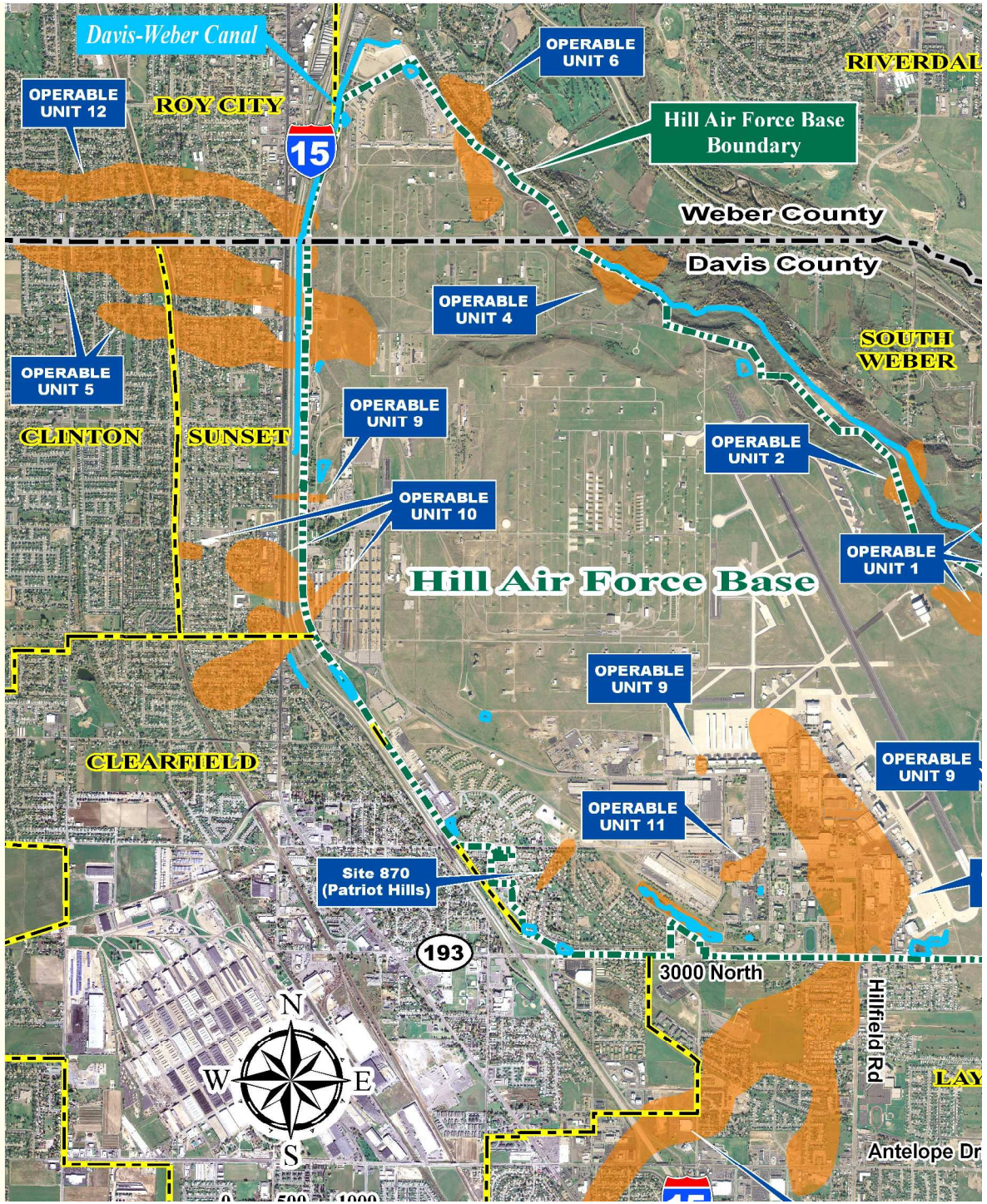
MWH®
BUILDING A BETTER WORLD

EXPLANATION

Groundwater contaminant concentration



Environmental Investigation History
Hill AFB, Utah, USA

- Began in 1987
- Originally 7 Operable Units (OUs)
- 13 OUs now identified
- TCE is primary contaminant of concern in groundwater at 8 OUs
- Most plumes extend off Base (some are >3 km)
- Residential Indoor Air Program
- Separate UST program for petroleum hydrocarbons

Site Management Team

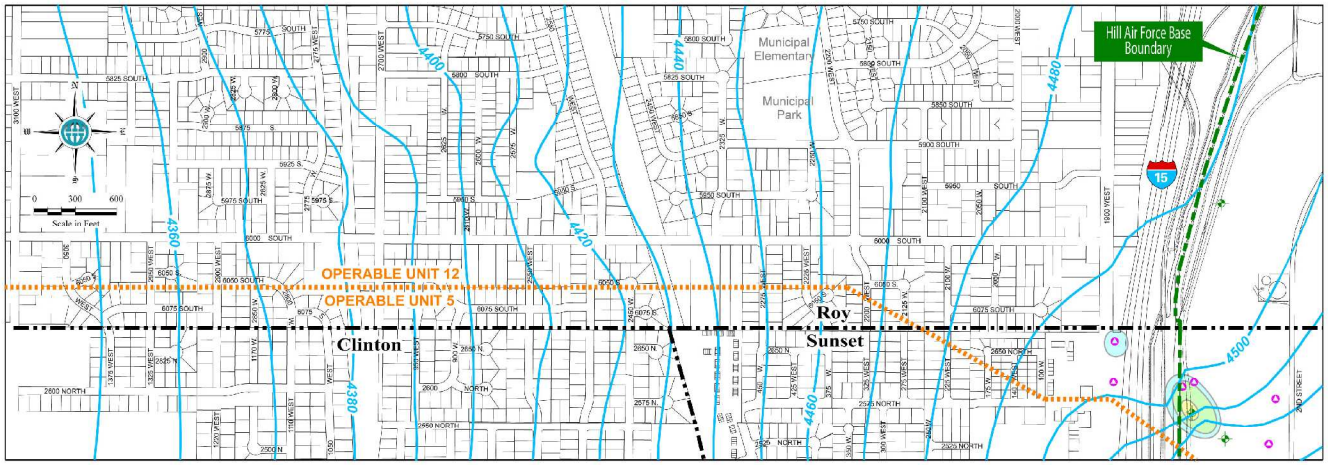
- United States Air Force -
  - Hill AFB Civil Engineering Environmental Restoration and the Air Force Center for Engineering and the Environment (AFCEE): (generally scientists and engineers – civilian employees of the U.S. Government)
- Environmental Consulting Firms
  - MWH, CH2M Hill, URS, Parsons, AEEC (primarily hydrogeologists, geologists, environmental engineers, chemists, database specialists, risk assessors, etc.)
- Subcontractors
  - Drilling and subsurface investigation companies, analytical laboratories, specialty remediation companies

Other Stakeholders

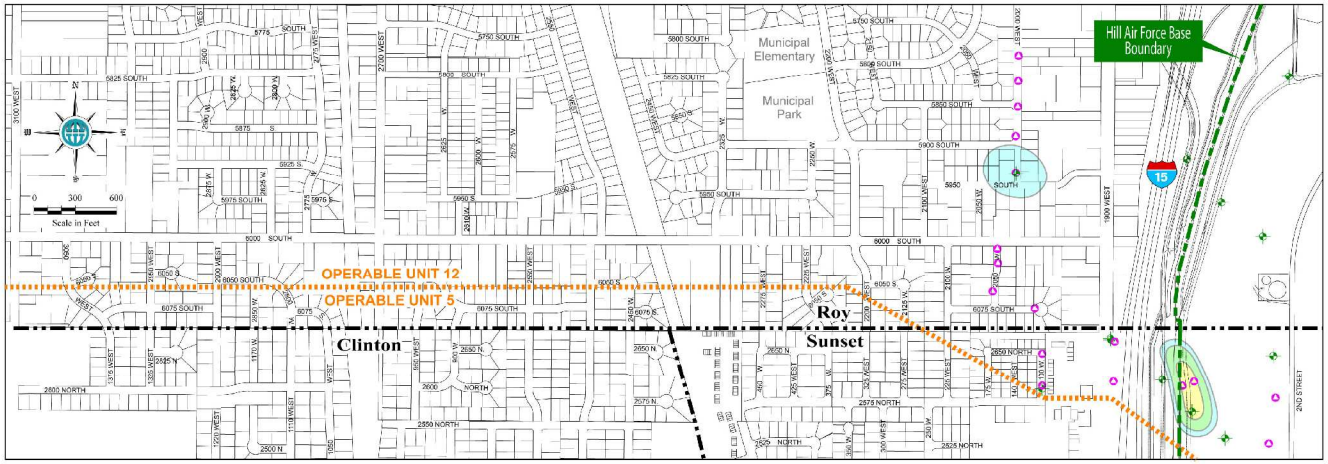
- Regulatory Agencies
  - U.S. Environmental Protection Agency
  - Utah Department of Environmental Quality
- Public and Restoration Advisory Board (RAB)
  - Landowners, Residents, Concerned Citizens and Citizen Groups
  - RAB, comprised of appointed citizens and representatives of surrounding municipalities. Provides structured citizen review of the restoration program.
- Municipalities and Public Utilities
  - Publicly-owned treatment facilities, water conservancy districts, etc.

Innovative Techniques for Rapid Delineation of Large Groundwater Contaminant Plumes

1998



1999



CPT Investigation Approach

- Lines of closely spaced (50-100 m apart) sampling locations along transects perpendicular to expected flow direction
- Transects 100-300 m apart (controlled by roadways)
- CPT and direct-push (Hydropunch) groundwater sampling performed at each location to identify geology, areal extent of contamination, and vertical extent of contamination (typically groundwater samples collected at 3 depths intervals)
- Transects typically extended until groundwater had contaminant concentrations of either ND or below regulatory limits (MCLs) (5 ug/l for TCE)

OU 12 TCE Plume Delineation

- Cone penetration testing (CPT) was performed at 220 locations and over 600 direct-push groundwater samples were collected

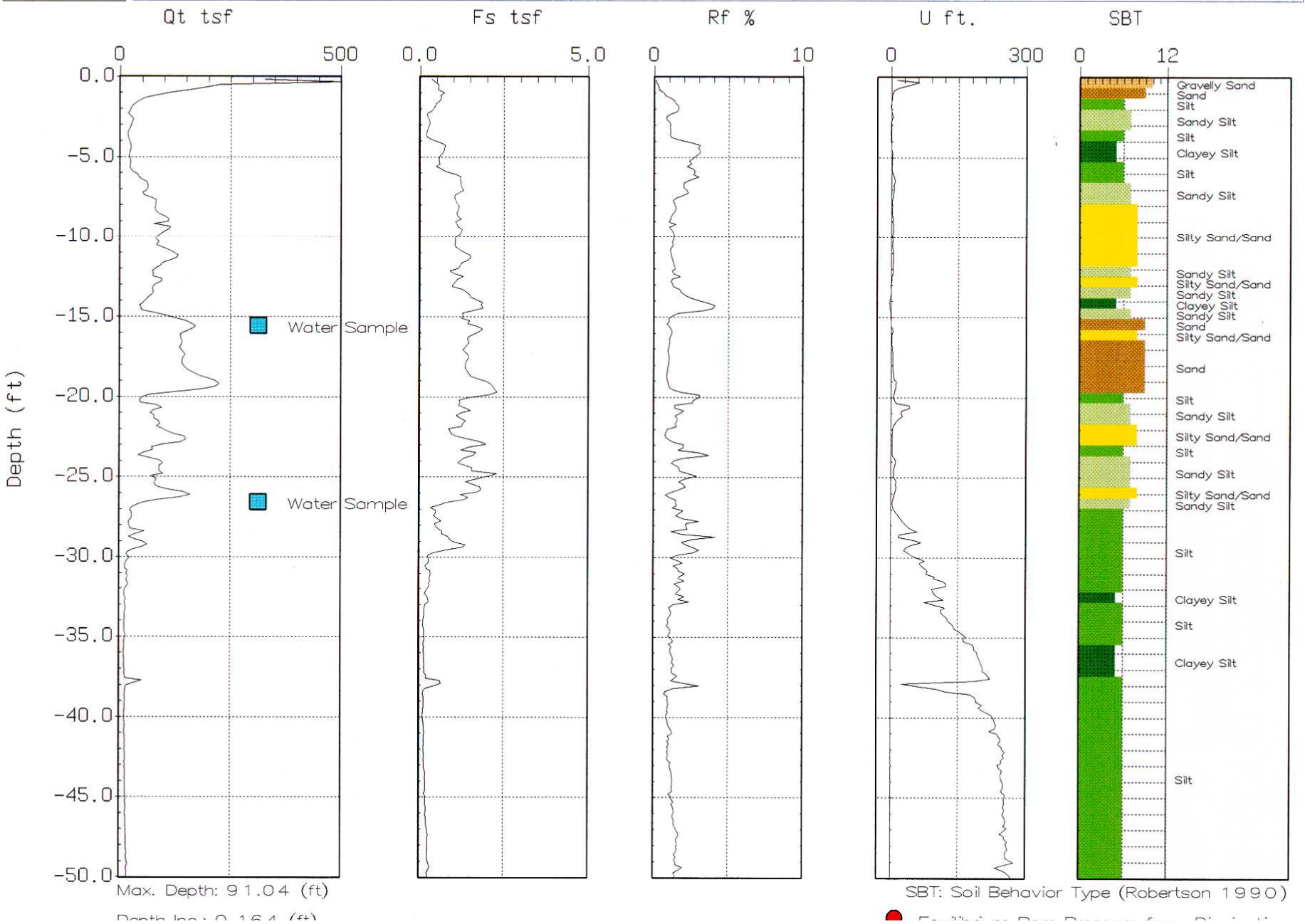
- Over 115 monitoring wells installed to delineate and monitor the OU 12 plume

CONETEC

MWH Americas, Inc.

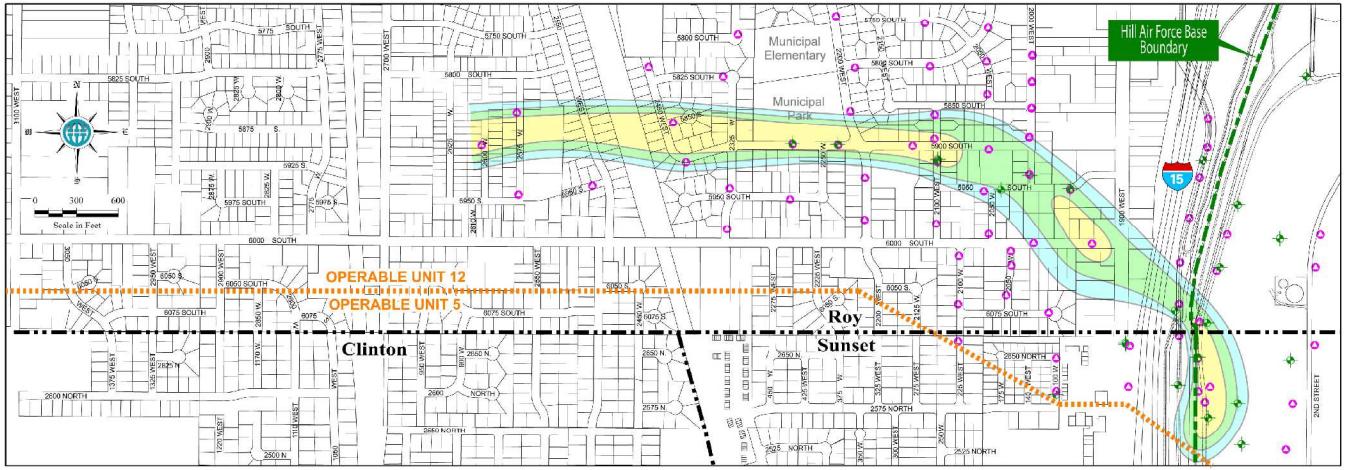
Hole No.: U5-2165
Location: OU-5

Cone: 20 TON A 112
Date: 12:05:01 12:53

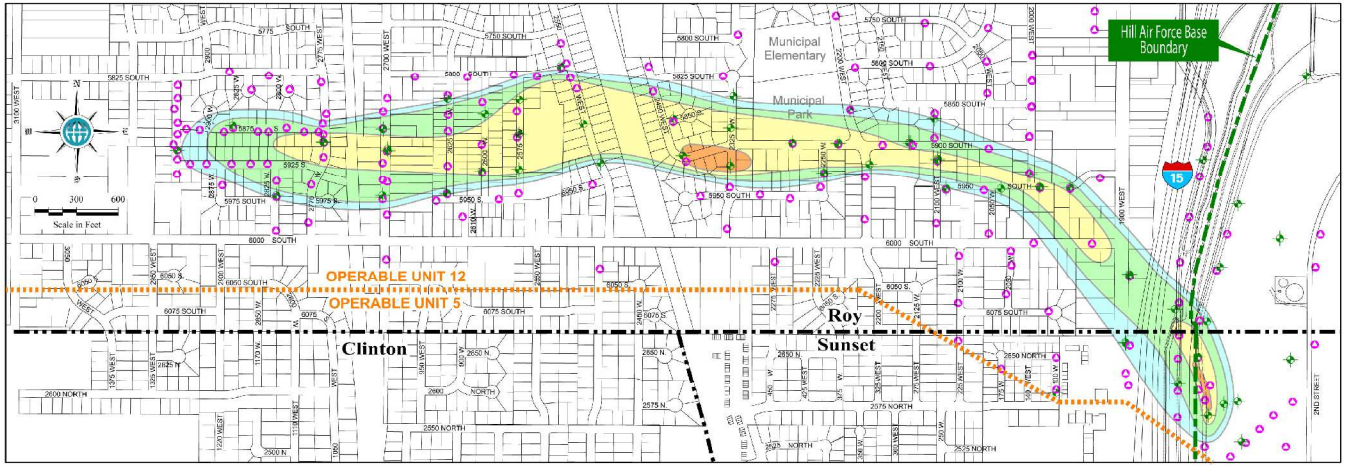


Investigation Results

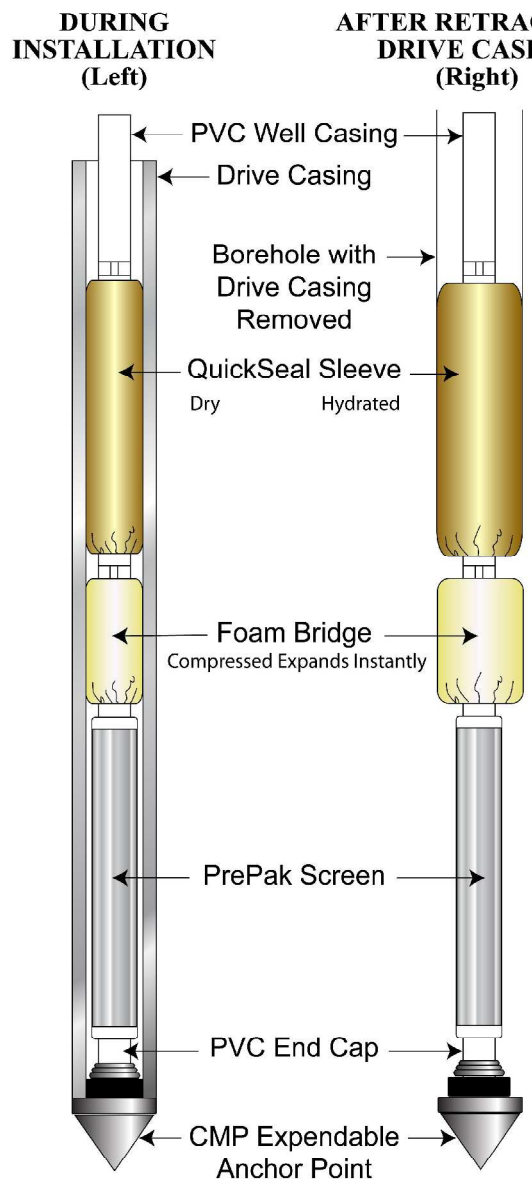
- 2000



2001



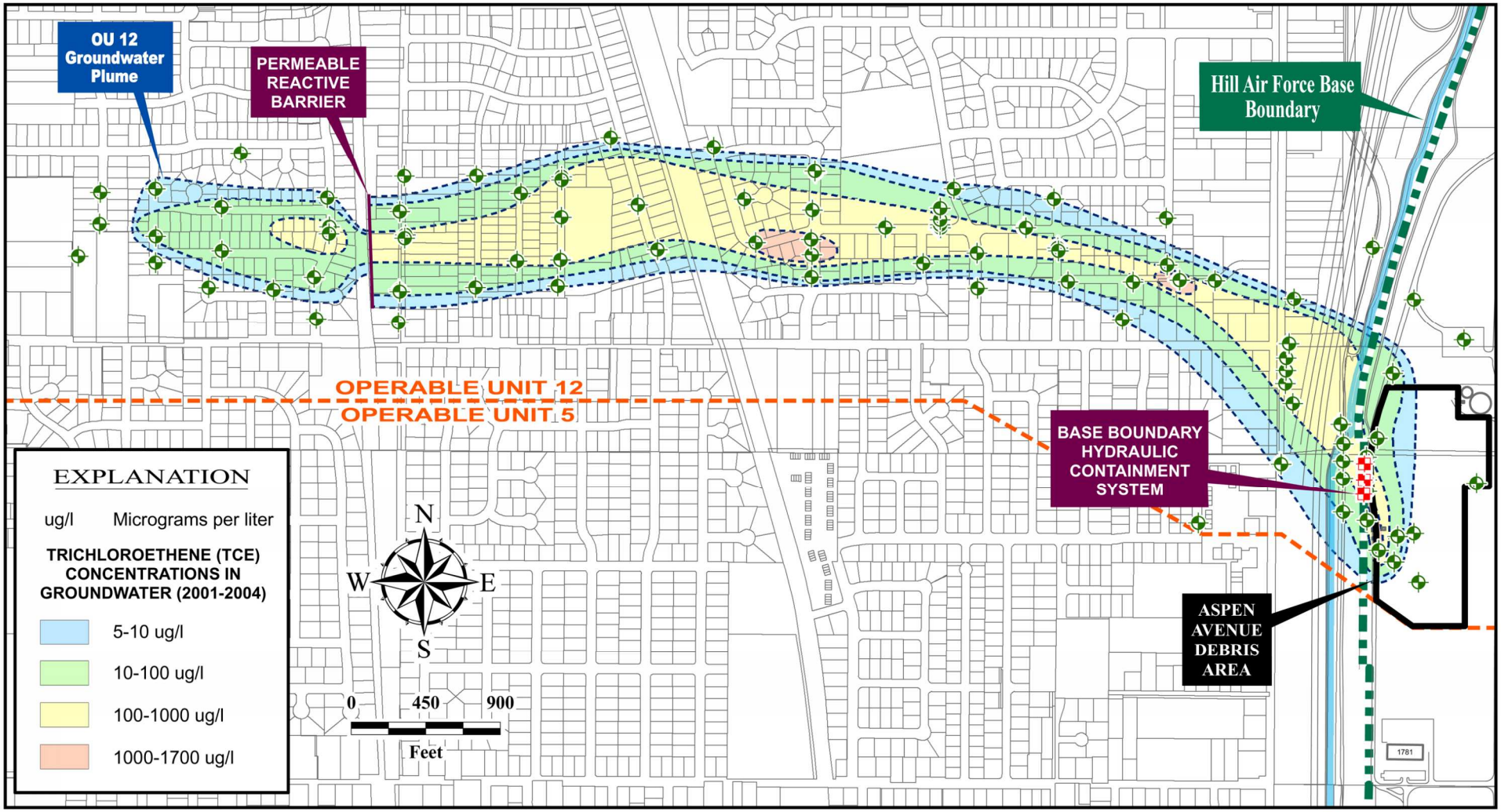
Direct-Push Microwell



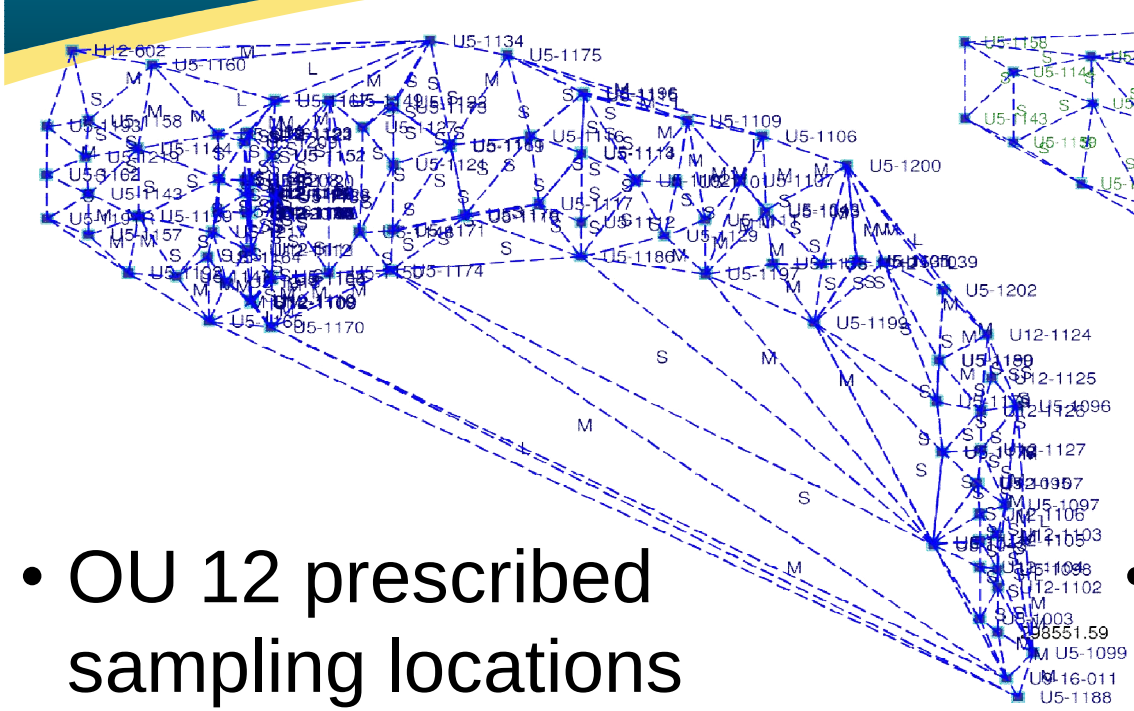
DRIVE CASING

SURFACE COMPLETION

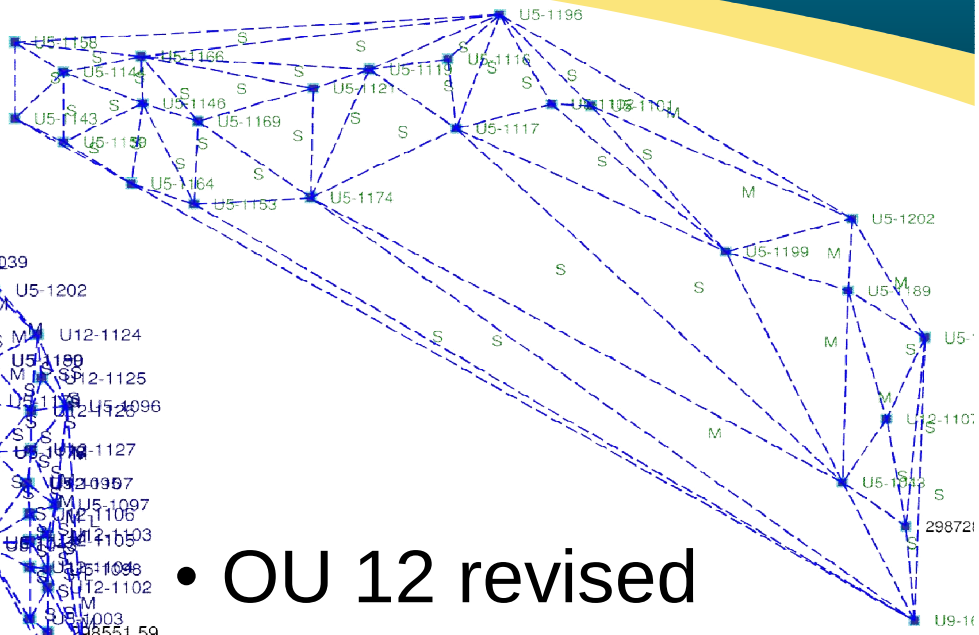
OU 12 Monitoring Well Network



Optimization of Monitoring Network with MAROS or GTS for Long-Term Monitoring



- OU 12 prescribed sampling locations
- Not optimized – redundant locations and too frequent given historic site knowledge



- OU 12 revised sampling locations based on MAROS Sufficiency and Redundancy analysis and optimization

HydraSleeve for Long-Term Monitoring to Reduce Sampling Costs and Carbon Footprint

- Reduces sampling costs significantly
- Reduces IDW (99% decrease in purge water)
- Increases number of wells sampled per day
- Data are comparable, but VOC concentrations were biased low by ~ 3 ug/l on average

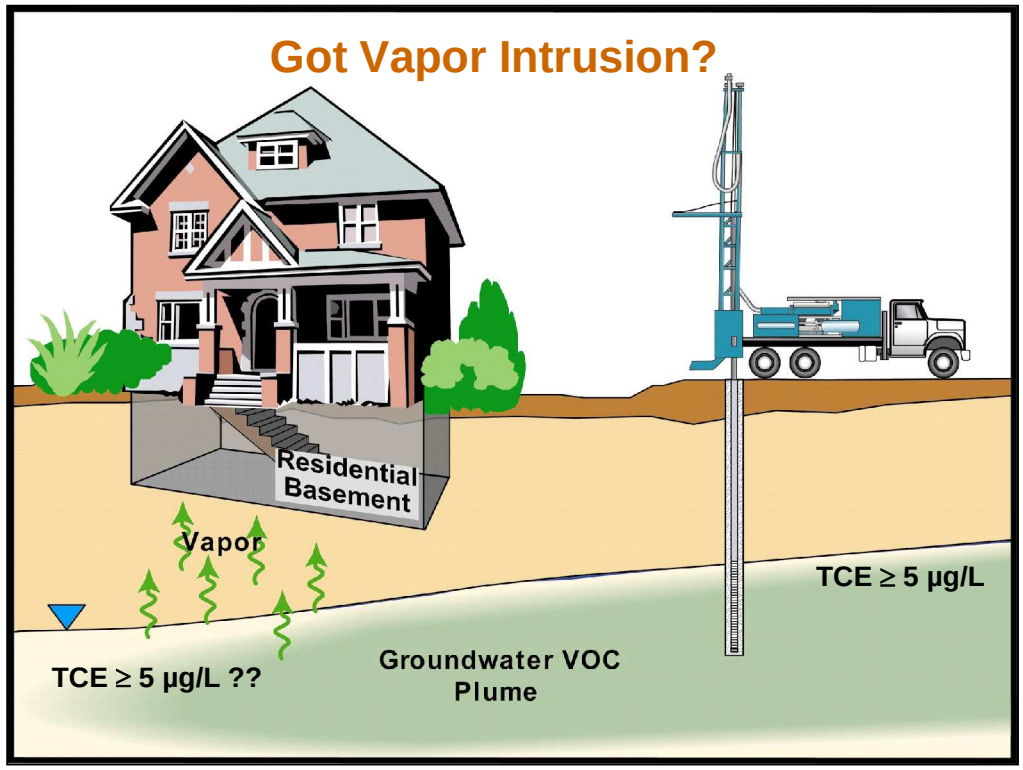
Indoor Air Sampling Program

Since January 2001:

- ~1819 homes sampled
- ~7200 air samples collected
- 364 homes with detections

Vapor Removal Systems (VRS):

- 106 systems installed



HAFB Indoor Air Program
2010 Status

- 2710 letters sent
- 633 agreed to sampling
- 630 homes sampled
- 710 samples collected
- 77 homes had detections
- 12 above action level
  - 9 - Tetrachloroethene (PCE)
  - 1 - Trichloroethene (TCE)
  - 1 - Carbon Tetrachloride (CTCL)
  - 1 - trans-Dichloroethene (tDCE)

Stakeholders

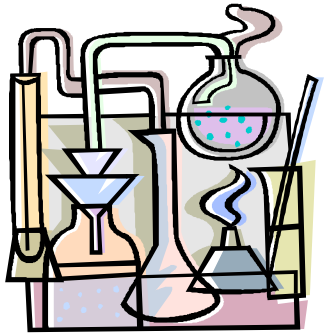
Hill AFB Environmental Restoration Project Manager

Hill AFB Community Involvement Team (CIT)

Residents

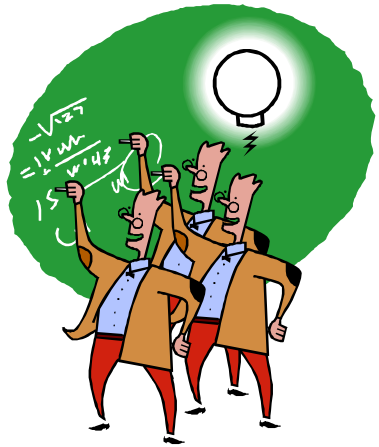
MWH Sampling Coordinator

MWH Air Sampling Team



Laboratory

MWH Database Manager



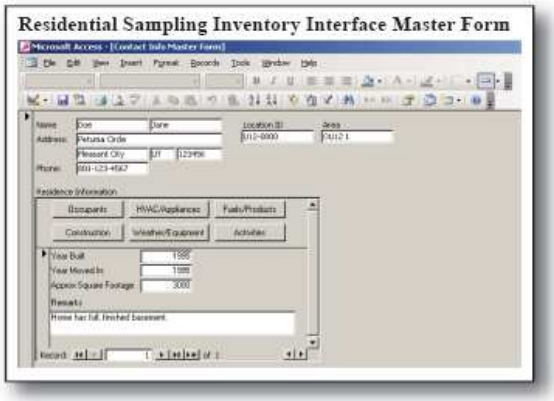
MWH Scientists

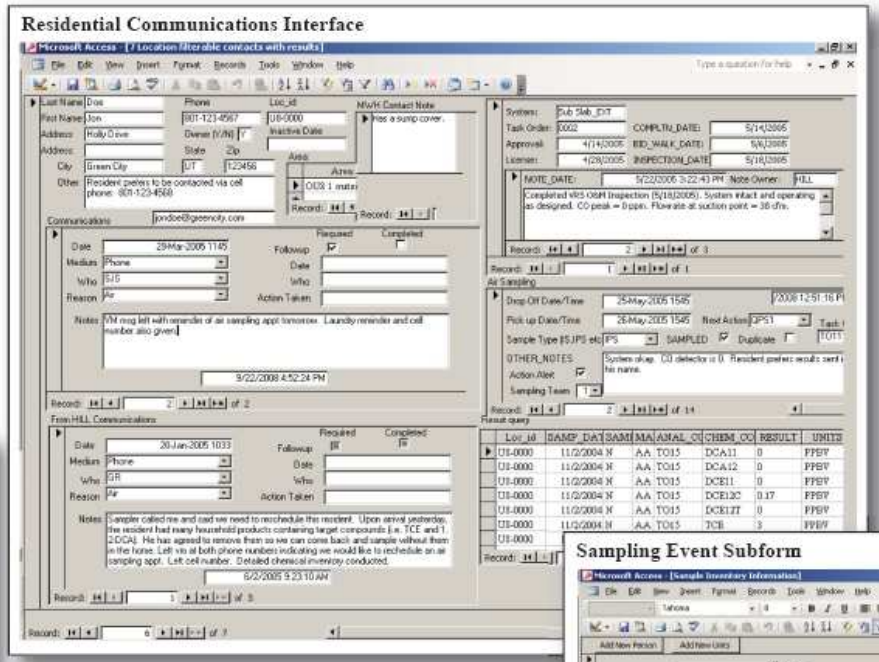
Community Relations

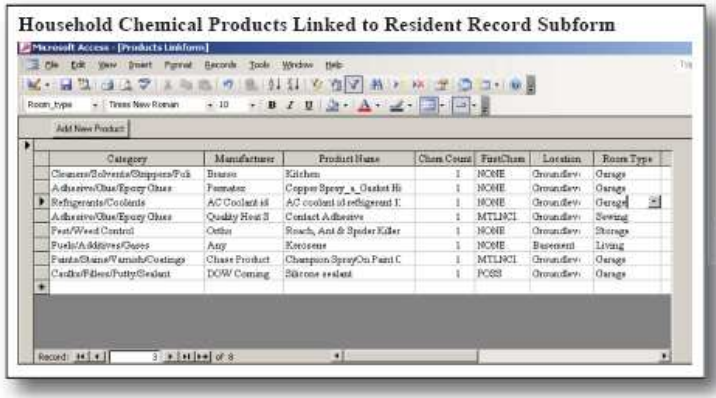
- Public Meetings
  - present information and results
  - provides forum to obtain public feedback

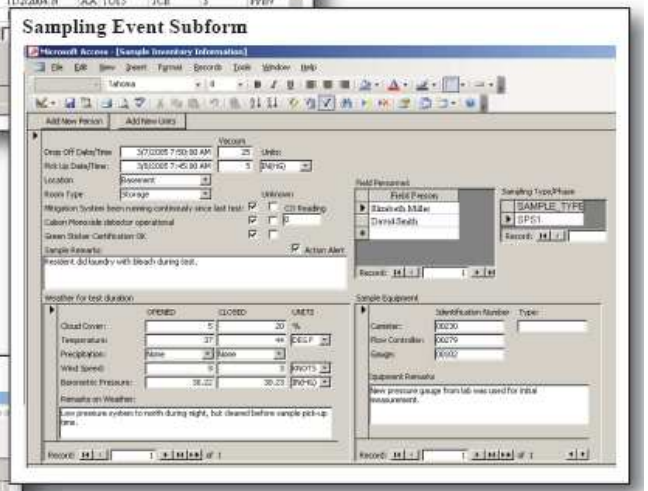
- Contact potentially impacted residents to request sampling
  - use database to identify residents
  - certified mailings to request sampling
  - door to door solicitation of non-respondents
  - schedule sampling event with residents

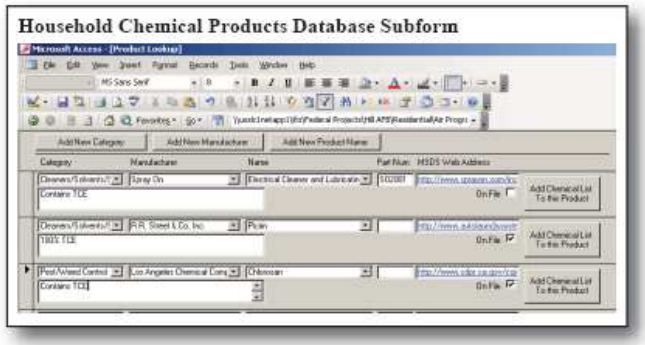
Indoor Air Sampling Program Database Interface

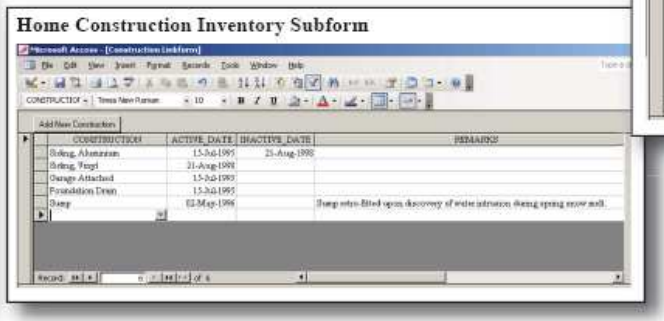








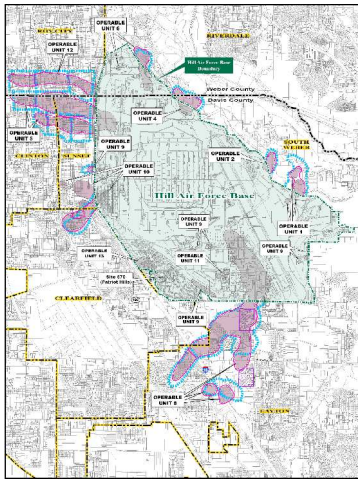




HILL AIR FORCE BASE
BASEWIDE
INDOOR AIR SAMPLING
DATABASE INTERFACE
FIGURE 5-1

Multiple Lines of Evidence:

Approach for Determining the Presence or Absence of Vapor Intrusion in a Residence



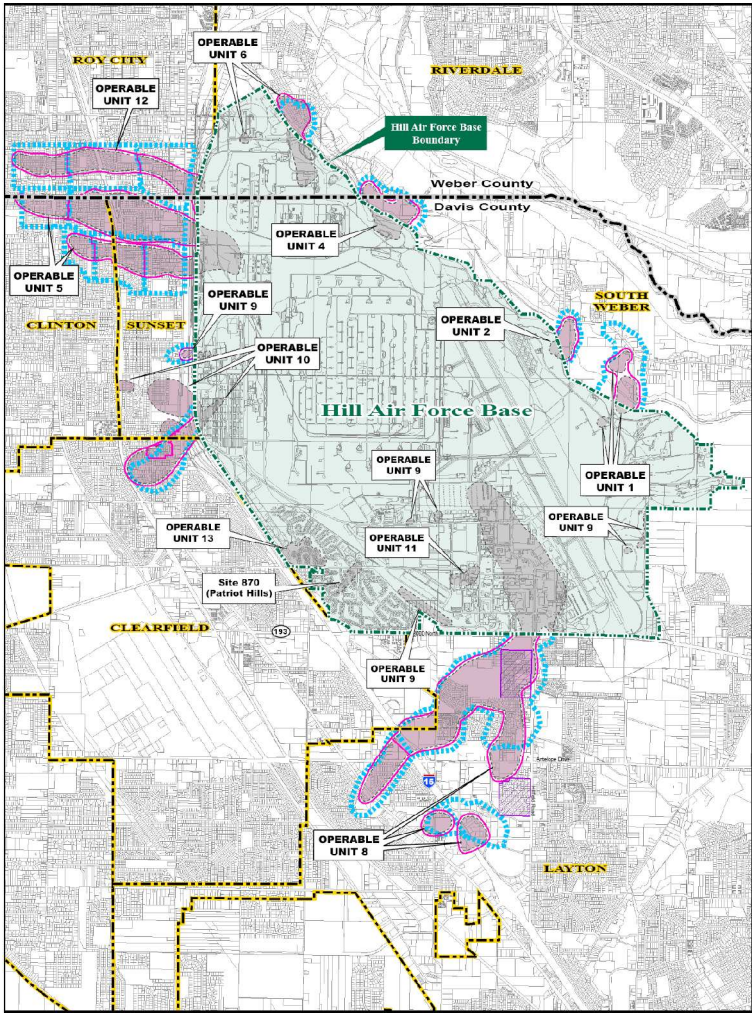
The indoor air sampling program includes homes located above the known or suspected extent of groundwater contamination.

Indoor air samples are collected in dedicated SUMMA® canisters

Identification of household products or activities that could potentially interfere with air sample results.

The INFICON HAPSITE® portable GC/MS is utilized in the identification of interior contaminant sources.

Groundwater Contamination and Potential Vapor Intrusion Risk

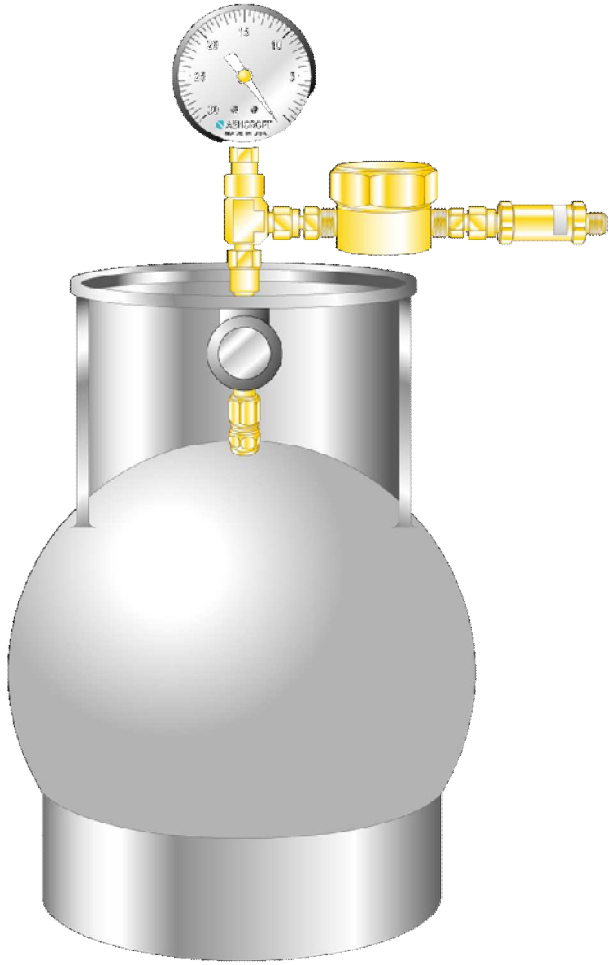


- Contaminants from groundwater have the potential to volatilize, migrate through the overlying vadose zone, and create a potential vapor intrusion risk.
- Groundwater investigations define contaminants of concern and the areal extent of the groundwater plume.
- Residences contacted for inclusion in the indoor air sampling program are based on their location with respect to groundwater contamination.
- Groundwater data can be used in conjunction with indoor air sampling data to calculate attenuation factors.

Interior Sources of Indoor Air Contaminants

- A detailed chemical inventory of all residences is performed prior to initiating indoor air sampling.
- 292 common household products have been identified as containing contaminants of concern (COC) that could potentially interfere with indoor air sample results.
- Homeowner activities including the use of COC containing products or dry cleaning storage, can potentially impact air sample results.

SUMMA® Canister Sampling



- Indoor air samples are collected in stainless steel 6-liter SUMMA® canisters equipped with a 24-hour flow-rate controller.
- SUMMA® canisters are placed in the lowest livable room of the residence.
- Indoor air samples are analyzed by U.S. EPA Method TO15 for target contaminants.
- Dedicated SUMMA® canisters are batch certified clean by the laboratory.

INFICON HAPSITE® Portable GC/MS

- The use of the HAPSITE® allows for the real-time identification and removal of interior sources, which may not have ingredients listed, have an incomplete ingredients list, or are activities, such as dry cleaning or taxidermy.

- Interior sources have been identified and removed from 24 of the 26 homes investigated using the HAPSITE ®

- The Hapsite is not intended to generate lab certifiable results, but rather to be used as a screening tool in the multiple lines of evidence approach for determining the presence or absence of VI in a residence..

Mitigation Action Levels (MALs) / Screening Levels

TABLE 7-1

COMPARISON OF 2004 AND 2009 MITIGATION ACTION LEVELS
BASEWIDE RESIDENTIAL INDOOR AIR SAMPLING PROGRAM
HILL AIR FORCE BASE, UTAH
(Page 1 of 1)

	2004 MAL ($\mu g/m^3$)	2009 MAL/ Screening Level ($\mu g/m^3$)	2004 MAL (ppbv)	2009 MAL/ Screening Level (ppbv)
Carbon Tetrachloride	1.6	1.6	0.26	0.26
Chloroform[a]	NA	8.3	NA	1.7
1,1-Dichloroethane	500	15	120	3.8
1,2-Dichloroethane[b]	0.94	NA	0.23	NA
1,1-Dichloroethene	200	209	50	53
cis-1,2-Dichloroethene	35	63	8.8	16
trans-1,2-Dichloroethene	70	63	18	16
Tetrachloroethene	8.1	4.1	1.2	0.61
1,1,1-Trichloroethane[b]	2200	NA	400	NA
Trichloroethene	2.3	12	0.43	2.3
Vinyl Chloride	2.8	2.8	1.1	1.1

NA Not applicable; no criteria initially developed for this compound
MAL Mitigation Action Level
$\mu g/m^3$ micrograms per cubic meter
ppbv parts per billion by volume

[a] Chloroform screening level is a proposed risk-based action level.

[b] This analyte has been removed from the sampling program.

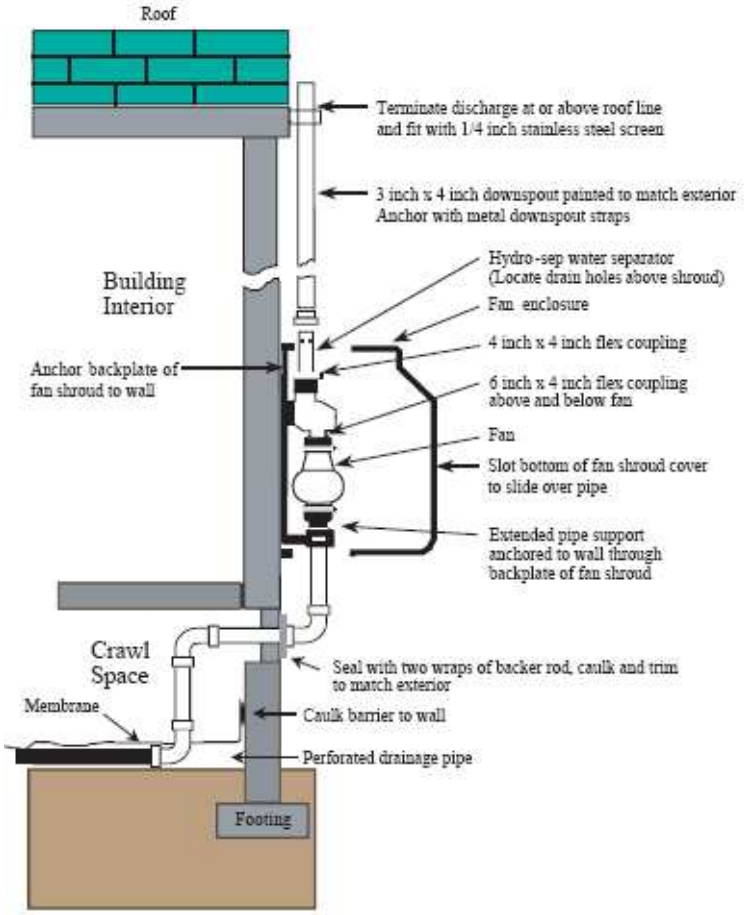
- The methodology for determining if vapor intrusion is a concern in a residence involves the application of MALs.

- The MALs for the indoor air program were established based on COCs identified in underlying impacted groundwater.

- The MALs are risk-based.

- If COCs are detected in indoor air samples at concentrations exceeding the MALs a VRS system is recommended to the resident.

Vapor Removal System (VRS)



SOURCE:
Specifications for Soil Gas Reduction Systems
July 19, 2002 by Doug Kladder

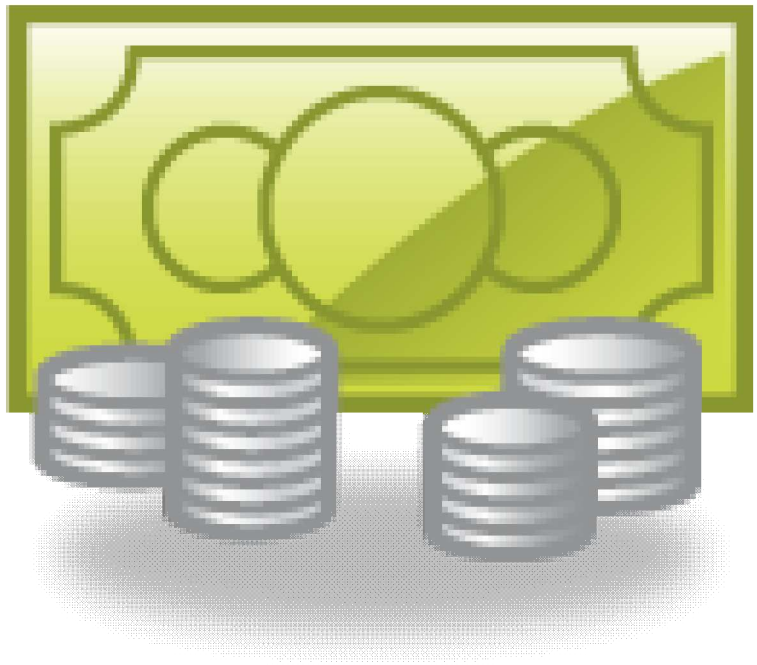
- VRSs are installed to mitigate COCs present in indoor air as a result of confirmed vapor intrusion.
- Primarily VRSs operate continuously, create negative pressure in the soil or fill material underlying the structures foundation, and do not negatively impact the use or aesthetics of the structure.
- 106 VRSs have been installed to date.
- Indoor air sampling continues on an annual basis to verify effective VRS operation.

Indoor Air Program Costs

- Current MWH air sampling contract ~1M Euros over 18 month period and assumes the collection of ~ 1000 air samples.

- Cost per indoor air sample is ~1000 Euros. This cost per sample includes:
  - Laboratory analysis
  - Data validation
  - Monthly and annual data reporting
  - Sample collection
  - Project management
  - Sample coordination / scheduling
  - Public meetings

- VRS installation costs:
  ~ 1500 Euros per system



Questions?

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