SUBJECT

CSSA Update Meeting

DATE

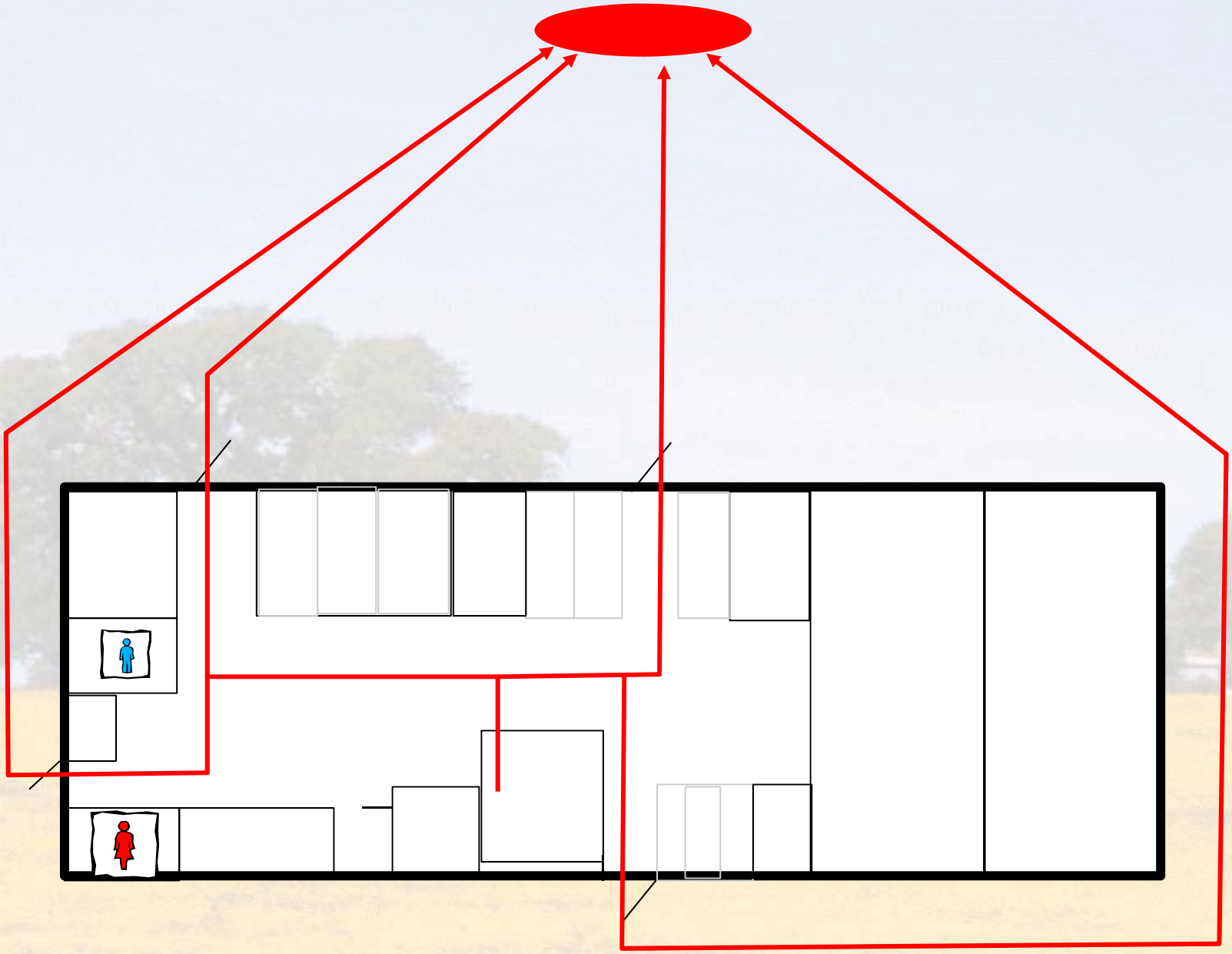
1/24/2013

Name	Organization
Laura Marbury	Parsons
GREG LYSSY	USEPA
Julie Burdey	Parsons
Gina	Govt Contracts
Jennifer	"
Scott Pearson	PARSONS
Steve Rembish	Parsons
Loni Carcamer	Govt Contracts Counsel
Adrien Lindley	Parsons
Ken Rice	Parsons
Larry	Govt Contracts
Jorge Salazar	TCEQ
KIRK COULTER	TCEQ
Gabriel Moreno-Fergusson	CSSA

Camp Stanley Storage Activity Status Update

January 24, 2013

INTRODUCTIONS AND WELCOME



Emergency Evacuation & Restrooms

Agenda

Introduction

SWMU and AOC Updates

Groundwater

- Groundwater Monitoring Update
- CS-1/CS-13
- EAA Tracer Study

Treatability Study Updates

- SWMU B-3
- AOC-65 SVE
- AOC-65 ISCO
- Plan for Vapor Intrusion Sampling

Human/Ecological Risk Assessment

Closure Path for EPA Order

Adjourn

STATUS OF REMAINING SITES

Site Closure Status

Recent TCEQ Closure Approvals: 2

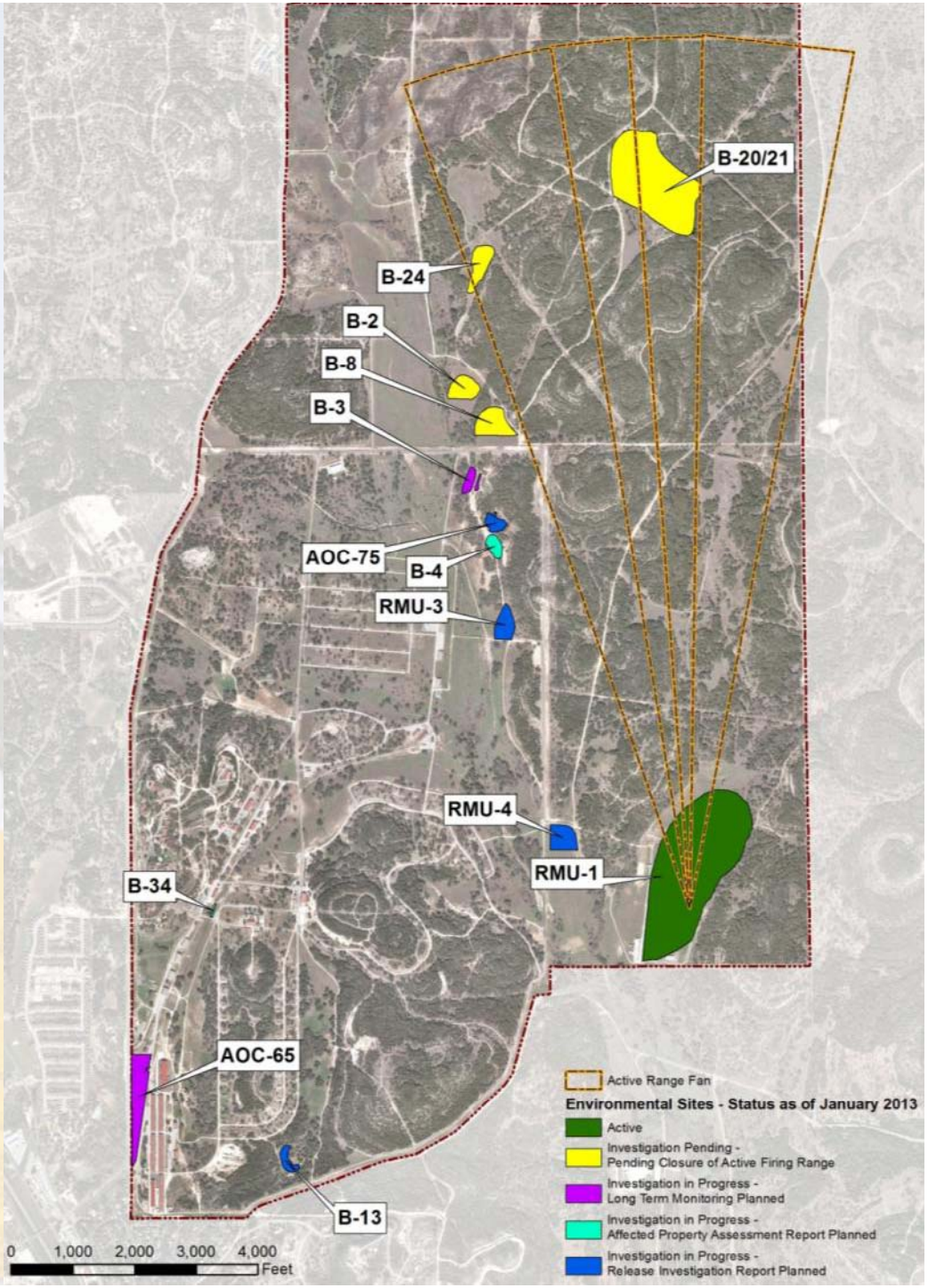
AOC-51
RMU-5

Field Efforts In Progress
SWMU B-13 (90% complete)
AOC-75 (70%)
RMU-3 (70%)
RMU-4 (20%)

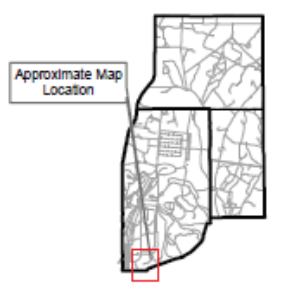
Closure Report in Progress/Review
SWMU B-4 (APAR Submitted 11/1/2012)
SWMU B-34

Consolidated Sites within RMU-1 (active range)
SWMU B-2
SWMU B-8
SWMU B-20/21
SWMU B-24

Groundwater Sites
AOC-65
SWMU B-3

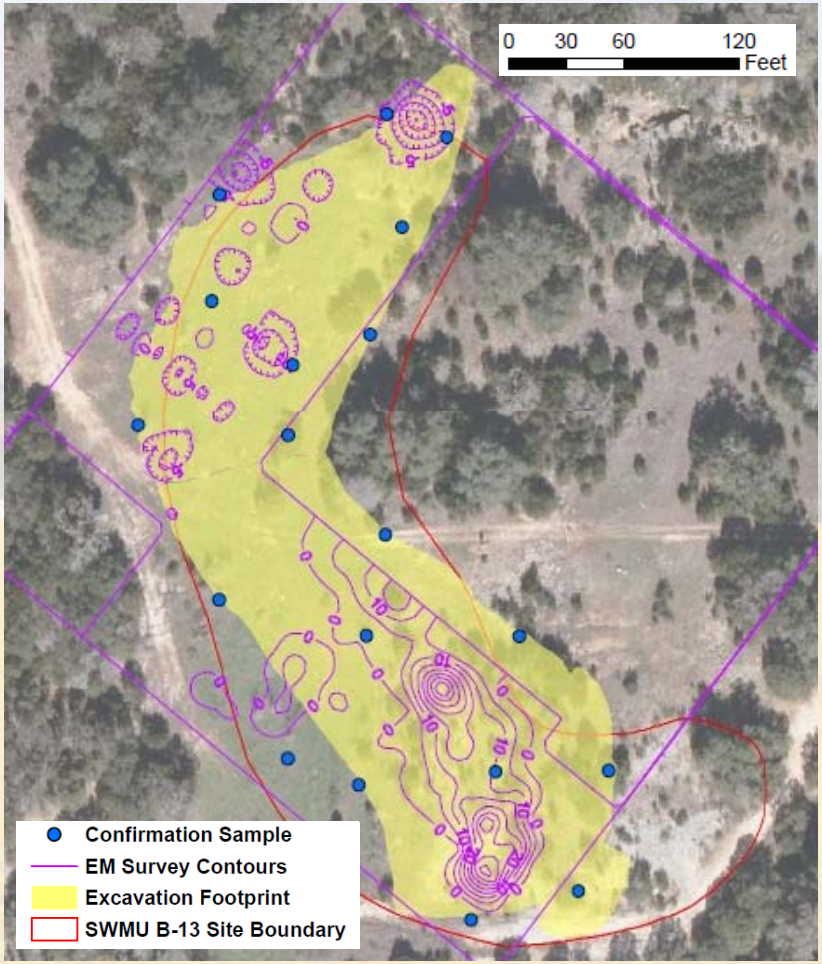


FIELD EFFORTS IN PROGRESS



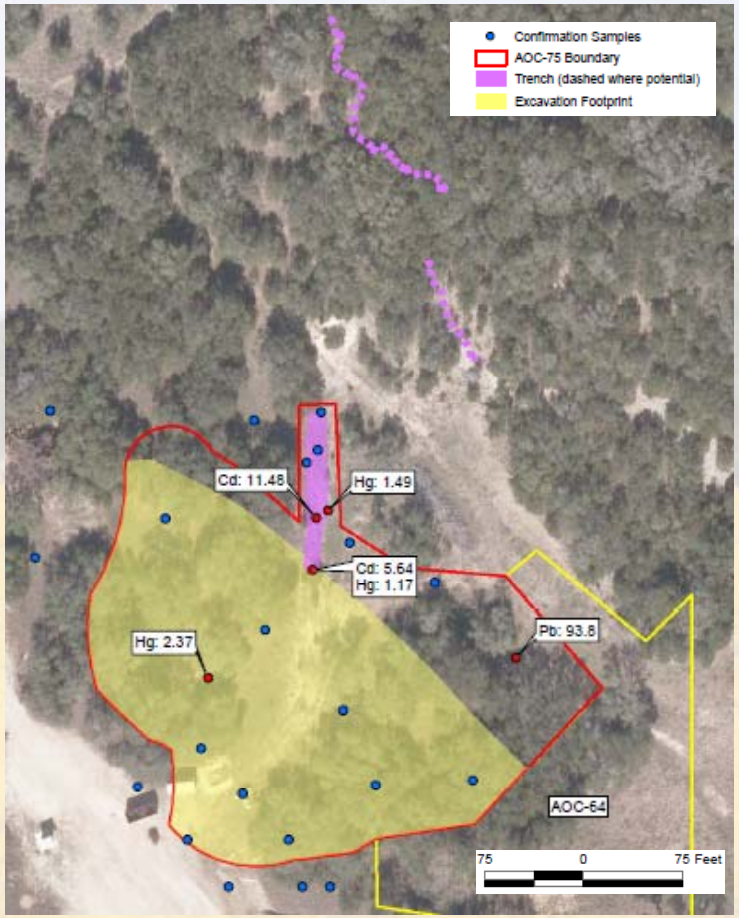
SWMU B-13

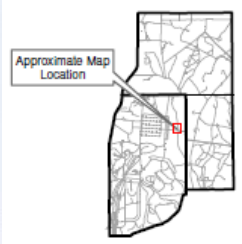
- Disposal area, 3 acres
- COCs: chromium, copper, lead, nickel, and zinc
- Progress to Date
  - Excavation completed – 11/2012
  - Average depth of excavation ~ 5 - 9 ft
  - Total of 7,500 CY removed
    - 5,000 CY transported to a NH Class 2 landfill (1,620 CY contained small amounts of non-friable transite asbestos)
    - 2,500 CY to be managed at east pasture berm
- Next Steps
  - Complete hauling of soils
  - Submit RIR to TCEQ requesting NFA
  - Convert site into wildlife water tank



AOC-75

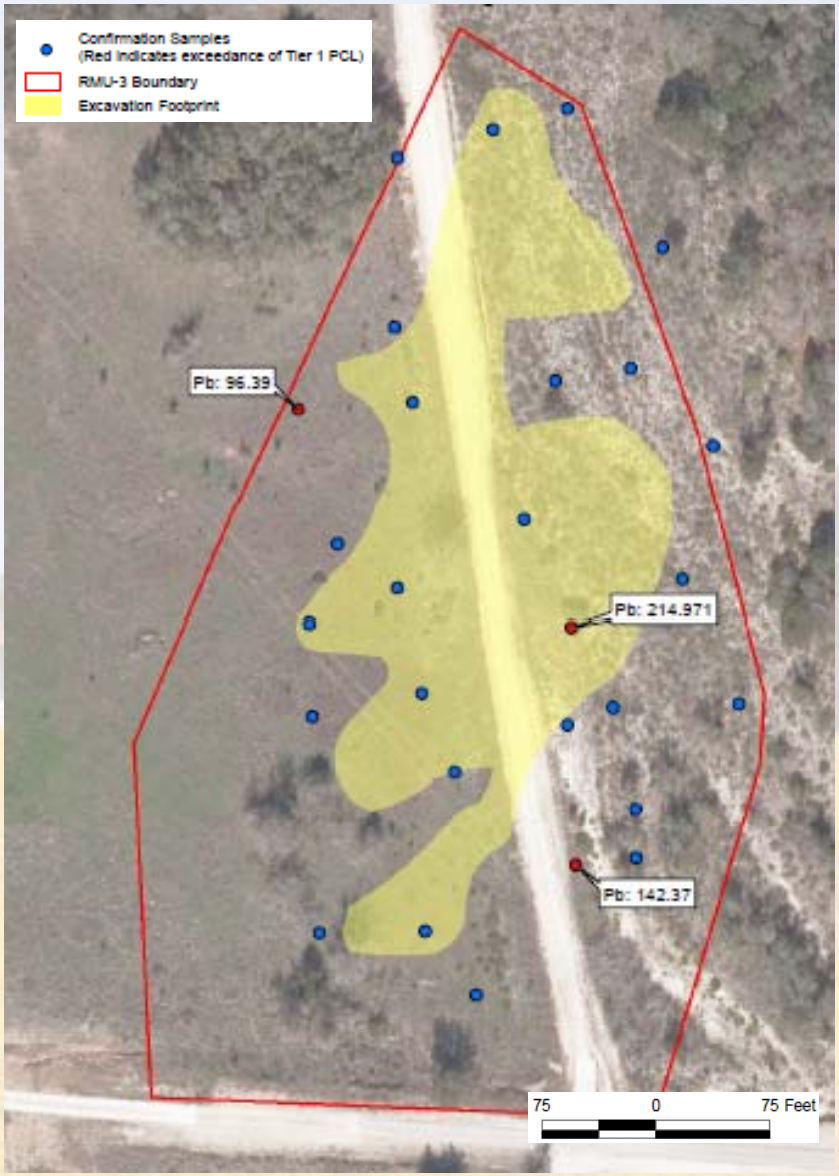
- Area with elevated mercury north of SWMU B-4, 1.2 acres
- COCs: mercury, lead, cadmium, barium (removed)
- Progress to Date
  - First phase of excavation completed – December 2012
  - Depth of excavation ~ 1 to 3 ft
  - 3,000 CY excavated to date – awaiting management at east pasture berm
- Next Steps
  - Investigate potential trench to the north. If present, close as part of AOC-75
  - Complete excavation
  - Complete hauling soils
  - Submit RIR to TCEQ requesting NFA

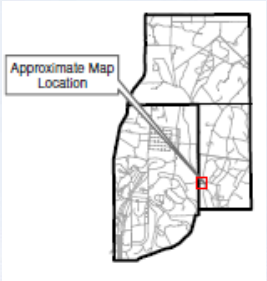




RMU-3

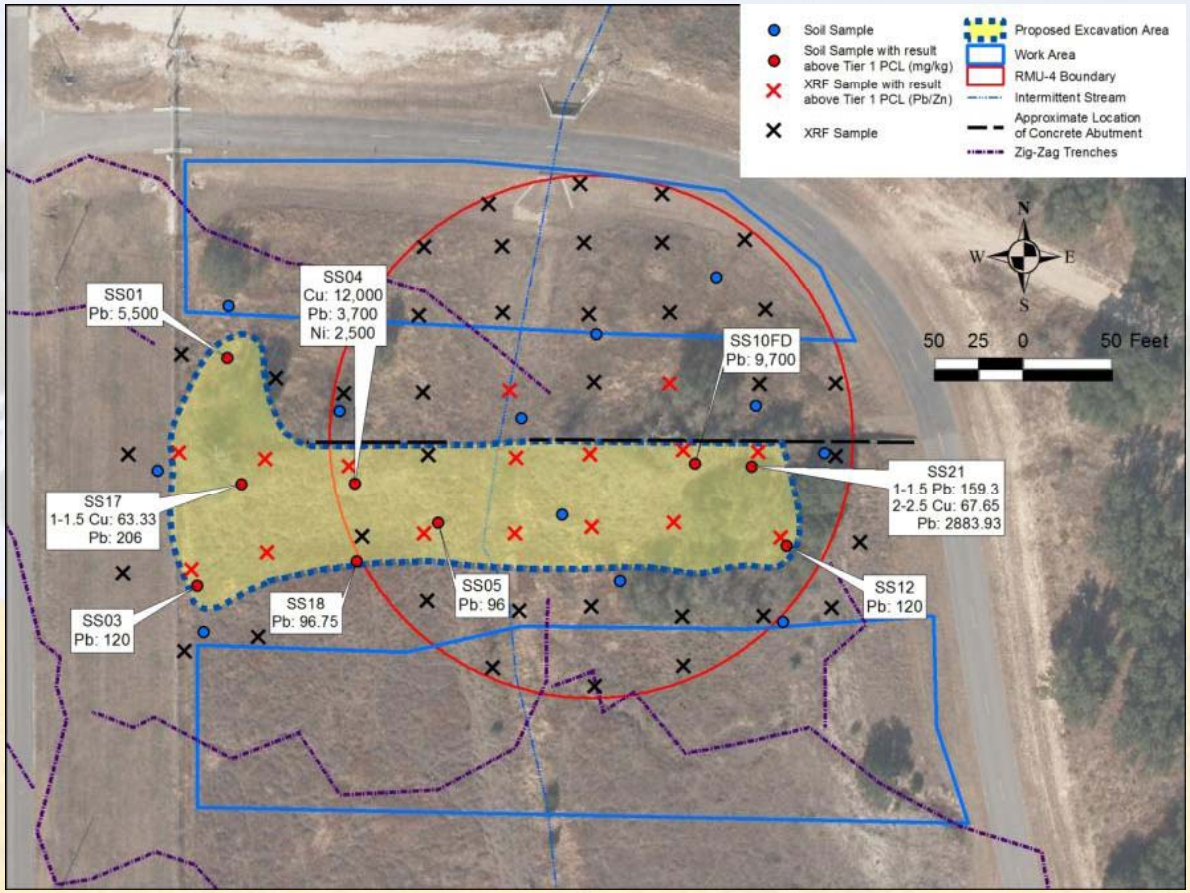
- Rifle range, 0.5 acres
- COC: lead
- Progress to Date
  - First phase of excavation completed – December 2012
  - Depth of excavation ~ 1 to 3 ft
  - 3,000 CY excavated to date
- Next Steps
  - Complete excavation
  - Complete hauling of soils
  - Submit RIR to TCEQ requesting NFA





RMU-4

- Small arms range abutment, 1.6 acres
- COCs: copper, lead, and nickel
- Progress to Date
  - Surface UXO Clearance
  - Vegetation removed
- Next steps
  - Excavation of contaminated soil
  - Submit RIR to TCEQ requesting NFA decision.

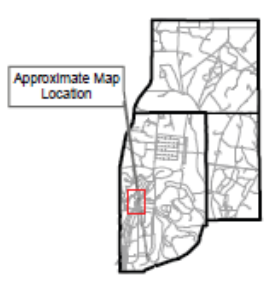


CLOSURE REPORT IN PROGRESS/REVIEW

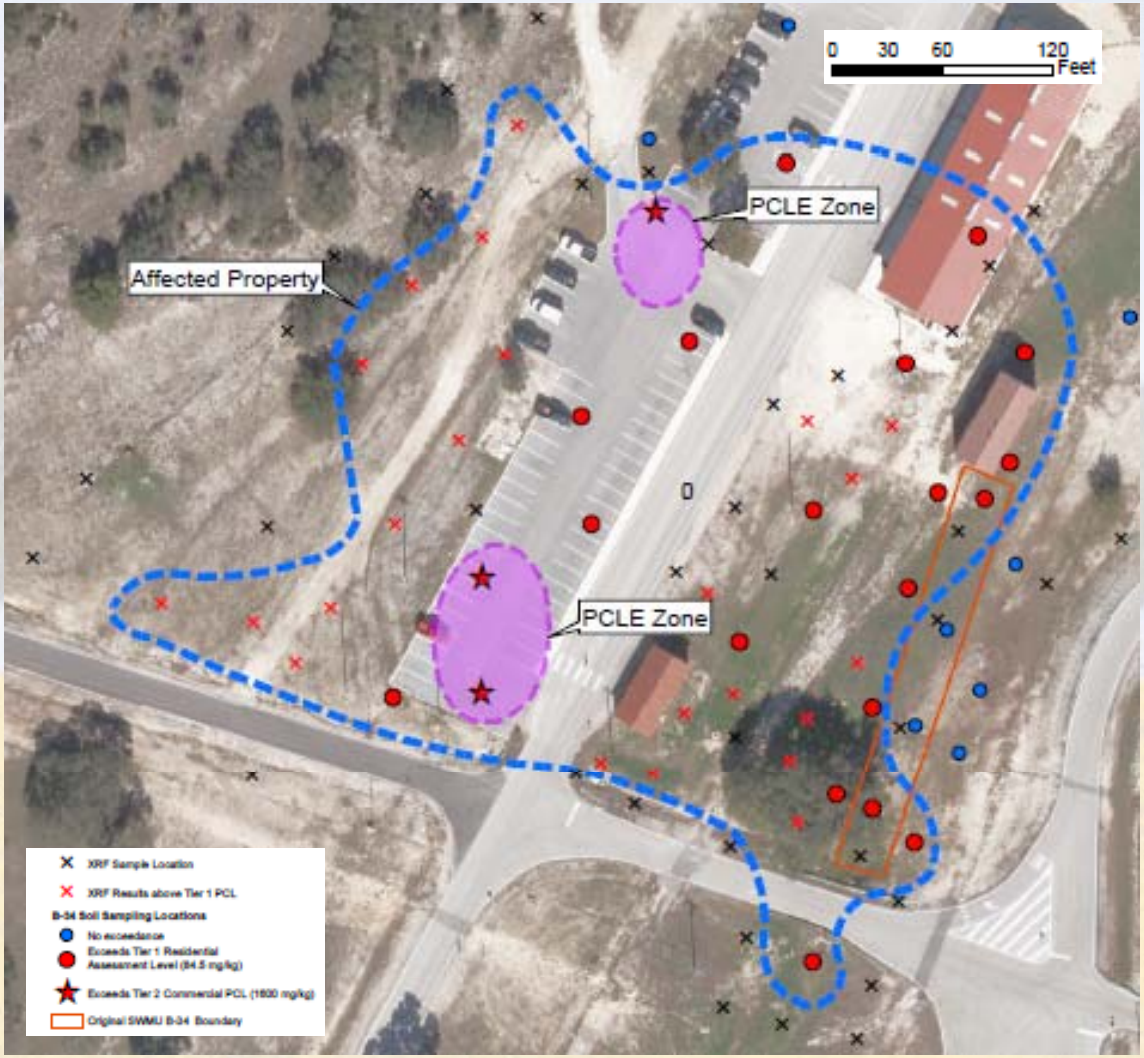
SWMU B-4

- APAR submitted by Weston to TCEQ, November 1, 2013
- Awaiting TCEQ Approval.

SWMU B-34



- Original site - buried pipeline, 0.5 acres, C/I land classification, ecological pathway incomplete
- Progress to Date
  - geophysical survey, surface and subsurface sampling, and XRF survey
- Current Status
  - Affected Property = lead levels exceed Residential Assessment Level (84.5 mg/kg) ~ 3 acres
  - PCL Exceedance (PCLE) Zone = lead levels exceed Tier 2 based critical PCL (1,600 mg/kg) ~ 0.2 acres
- Next Steps
  - Approval of Lead Tier 2 PCL for $^{GW}Soil_{Ing}$ Pathway
  - Implement Remedy Standard A - excavation of PCLE Zone
  - Submit APAR requesting NFA decision to TCEQ



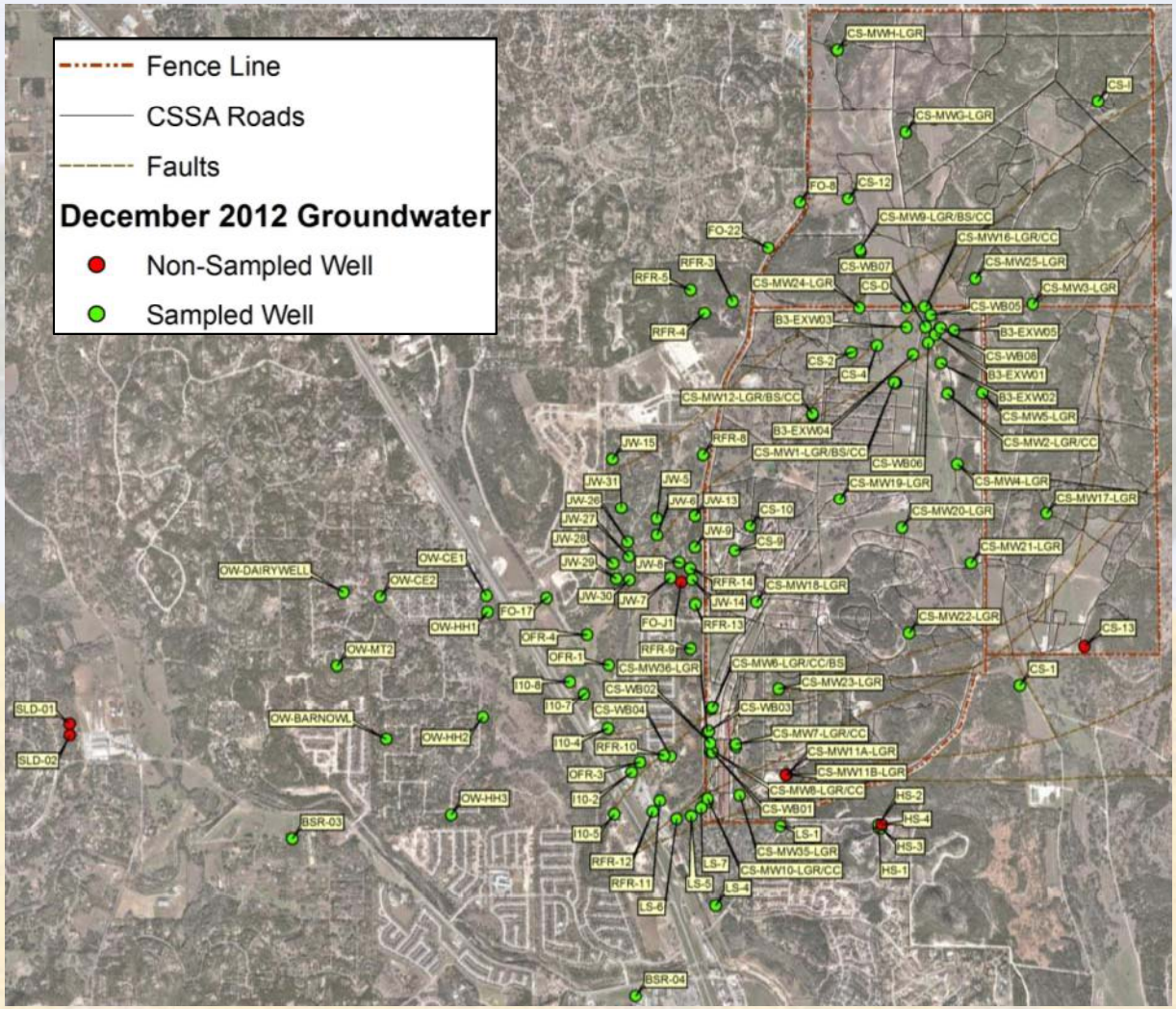
GROUNDWATER UPDATE

Groundwater Monitoring Program
Overview

- Quarterly Monitoring Program:
  - On-post since December 1999: 53 events
  - Off-post since September 2001: 46 events
- Wells include:
  - 45 On-post monitoring wells
  - 4 On-post drinking water supply wells
  - 2 On-post former drinking water wells
  - 4 Westbay®-equipped wells
  - 5 Bioreactor Extraction Wells
  - 63 Off-post private and public supply wells (1 new well)
- 6 off-post wells have GAC units due to past exceedances

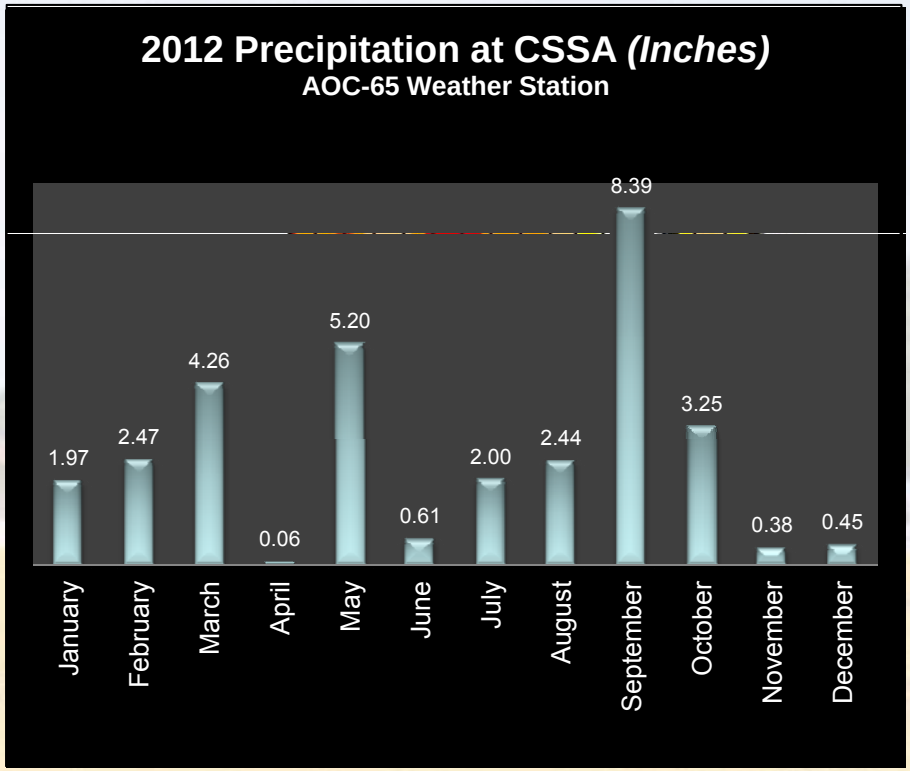
Groundwater Monitoring Program
Sampling Locations

- 11+ yrs of quarterly off-post monitoring.
- 13+ yrs of quarterly on-post monitoring.
- Sampling locations vary quarterly per DQOs and LTMO.



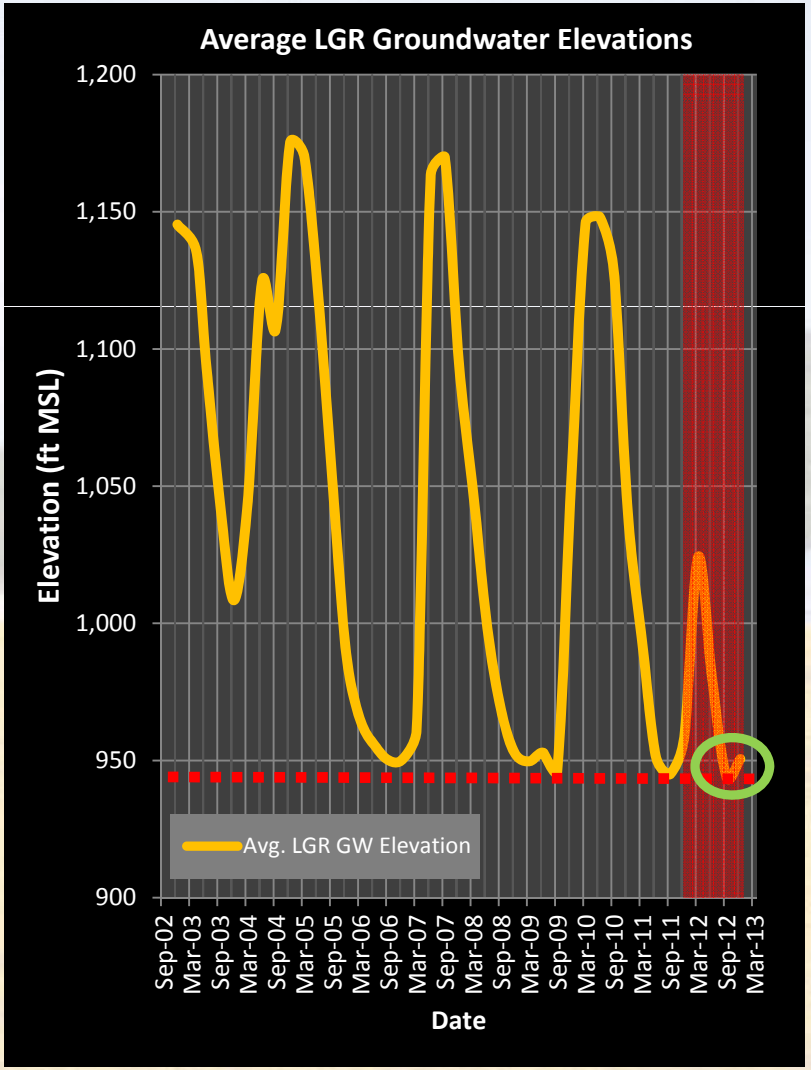
Groundwater Monitoring Program
Climatic Conditions

- In June 2012, CSSA was experiencing a *"moderate"* drought. A total of 14.6" of rain fell in the first 6 months of 2012.
- An additional 16.1" of rainfall fell between July and October 2012, reducing drought stage to *"abnormally dry"*.
- Only 0.8" of rain fell between November and December 2012, teetering the drought stage between *"moderate"* and *"severe"*.
- January rains have returned the area to *"abnormally dry"*.
- Even though we ended under drought conditions, CSSA received a nearly "average" rainfall amount of 31.5" in 2012.



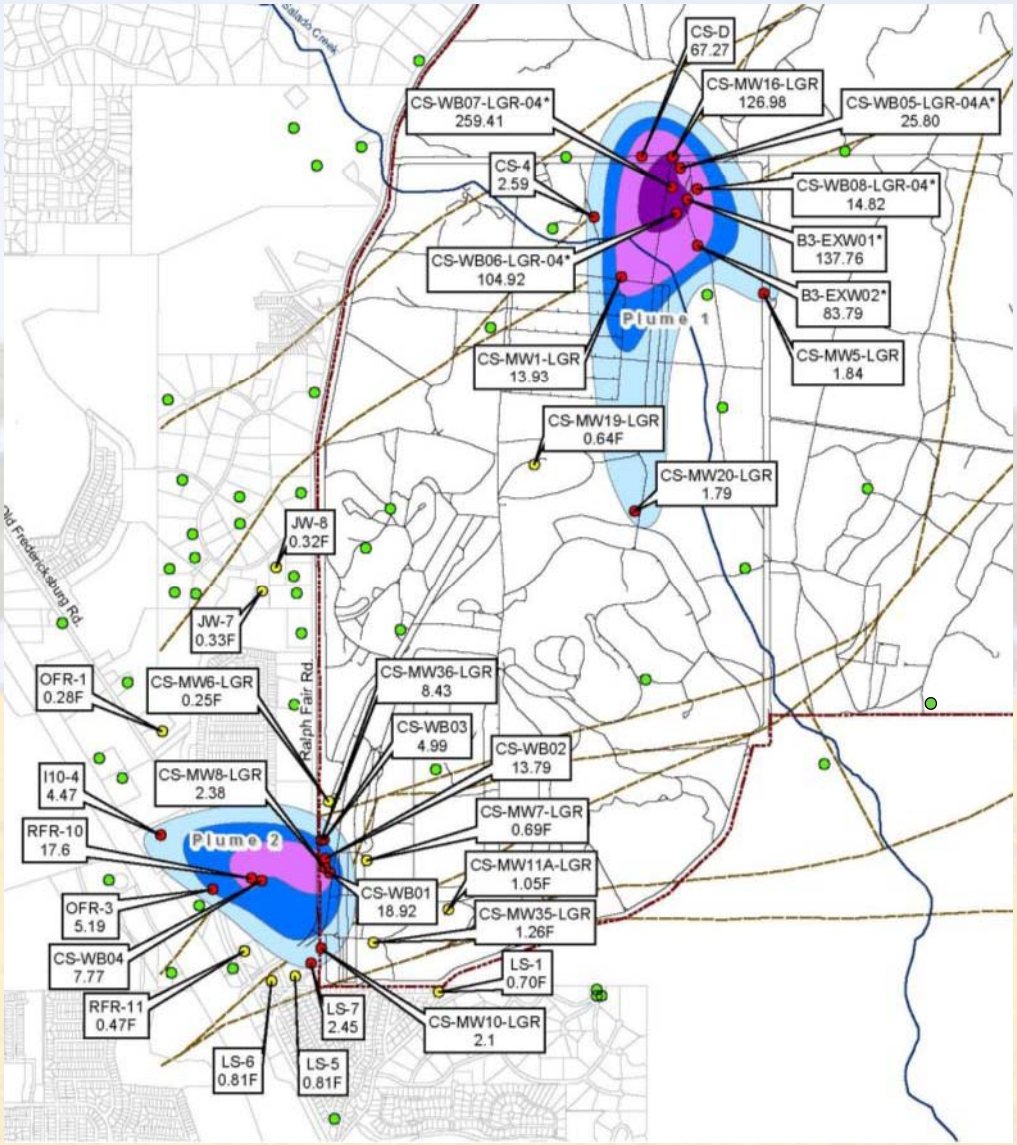
Groundwater Monitoring Program
Aquifer Conditions

- In the first quarter of 2012, the aquifer levels rebounded more than 66 feet, but have since declined ~73 feet by the end of 2012.
- The rains of mid-September and October only resulted in a 6.4-foot rebound as measured in December 2012.
- Note that the average aquifer elevation "bottoms out" near the top of the LGR production zone during droughts.



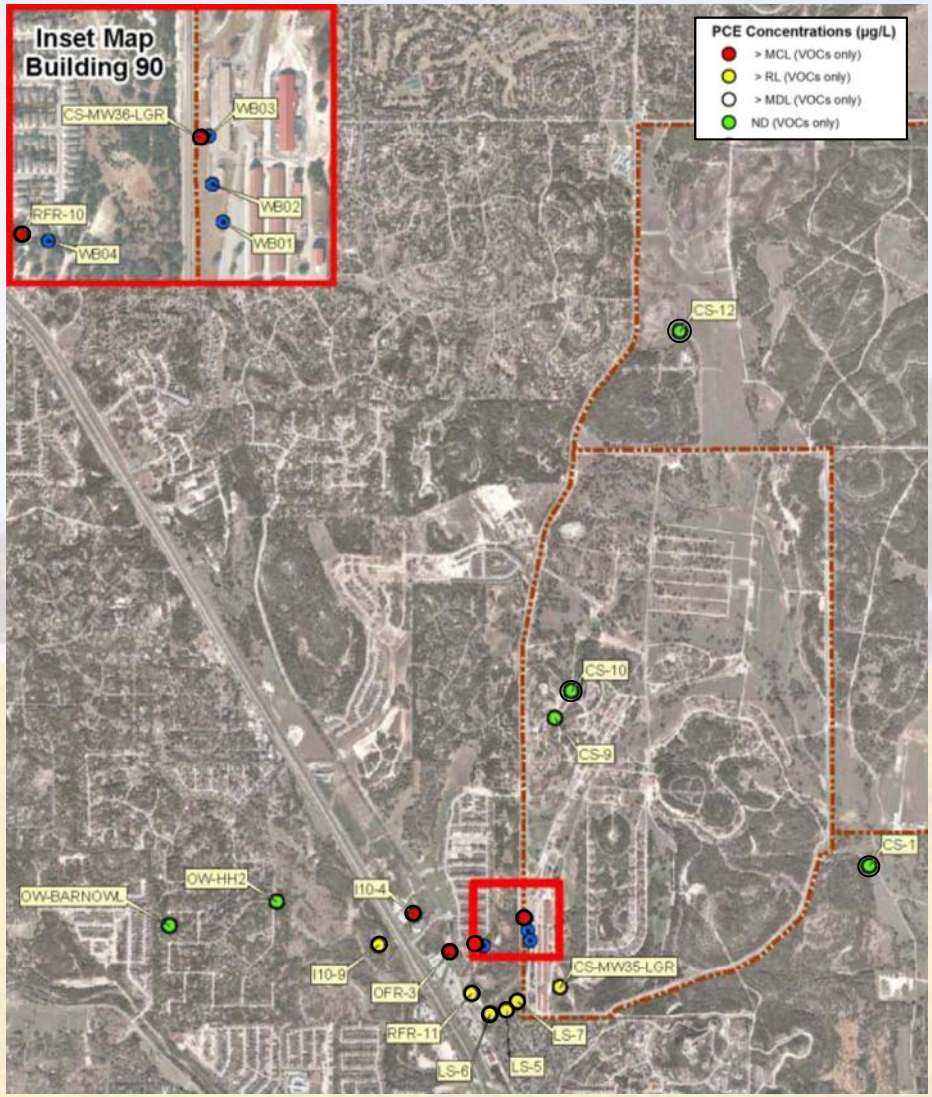
Groundwater Monitoring Program
General Facts

- **Plume 1** originates from SWMUs B-3 and O-1 in the Inner Cantonment.
- **Plume 2** originates from AOC-65 in the SW corner of CSSA.
- Concern about increasing trend at I10-4 west of CSSA (Plume 2) prompted additional sampling locations west of IH-10 (13 new wells since March 2011).
- The new DQOs and LTMO program (approved in 2010) went into effect in June 2011.
- A **"snapshot"** event (all LGR and off-post wells sampled) occurs every 9 months.
- December 2012 is the most recent **snapshot** event.



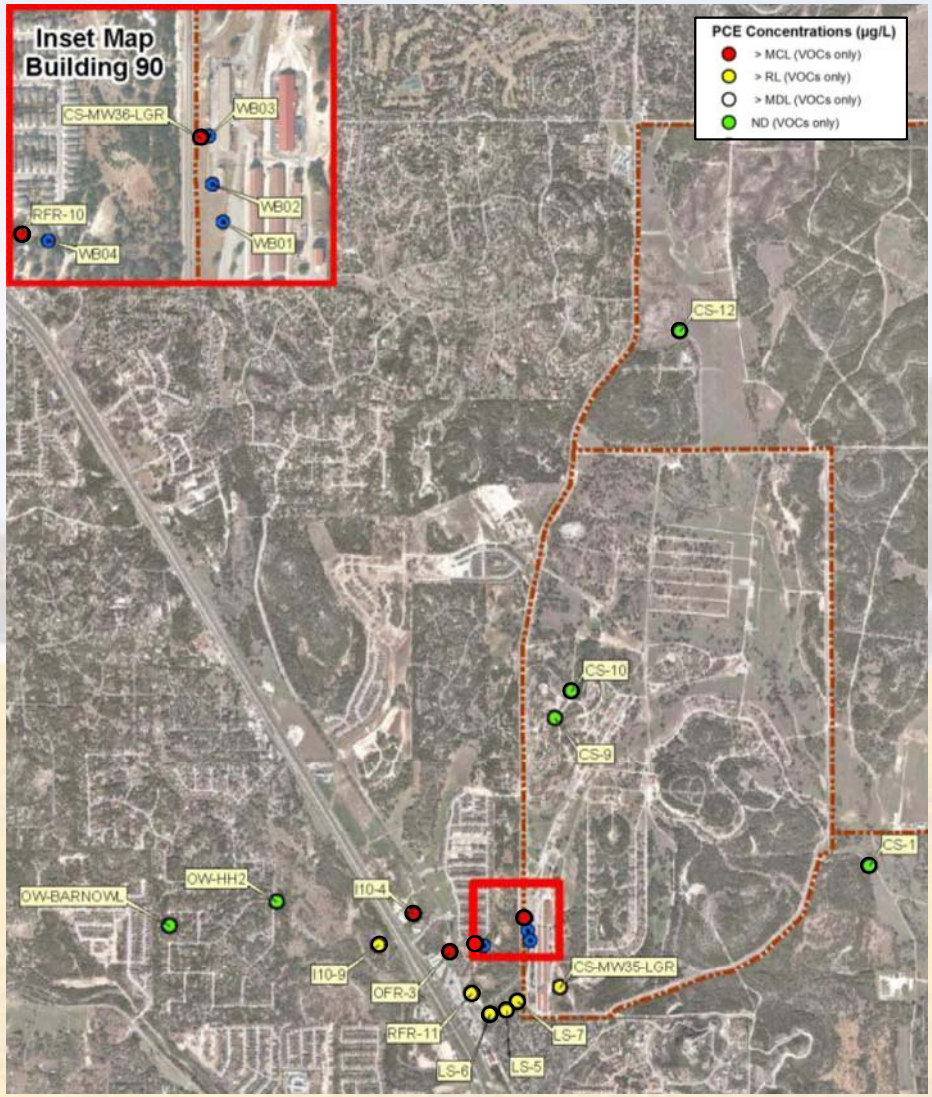
Groundwater Monitoring Program
June 2012 Results Overview

- This LTMO event included 6 On-post and 10 Off-post wells.
  - Supply wells CS-1, CS-10, and CS-12 continue to be free of VOCs. All metals were below ALs, MCLs, SCLs.
  - One on-post well (CS-MW36-LGR) continues to exceed the MCL for PCE (7.71 µg/L).
  - Three off-post wells (I10-4, OFR-3, and RFR-10) continue to exceed MCLs for PCE and/or TCE.



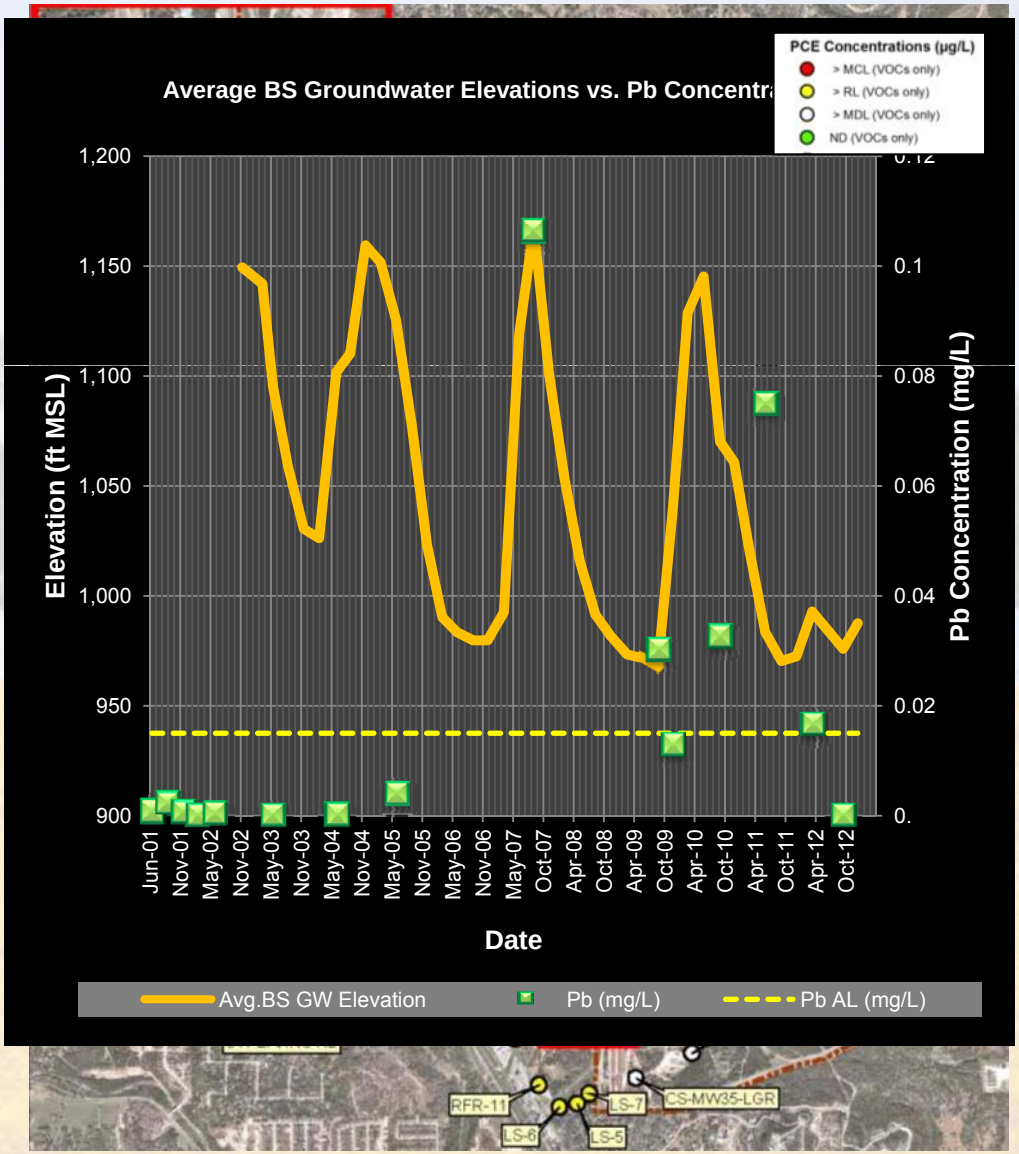
Groundwater Monitoring Program
June 2012 Results Overview

- I10-9, LS-6, and RFR-10 reported the highest TCE concentrations since their sampling inception.
  - **RFR-10**: 14.24 µg/L (sampled since 2001)
  - **LS-6**: 3.37 µg/L (sampled since 2001)
  - **I10-9**: 1.42 µg/L (sampled since 2011)
- Semi-annual GAC maintenance, including a carbon exchange, took place in July 2012. The next GAC maintenance, with carbon exchange, scheduled for January 2013.



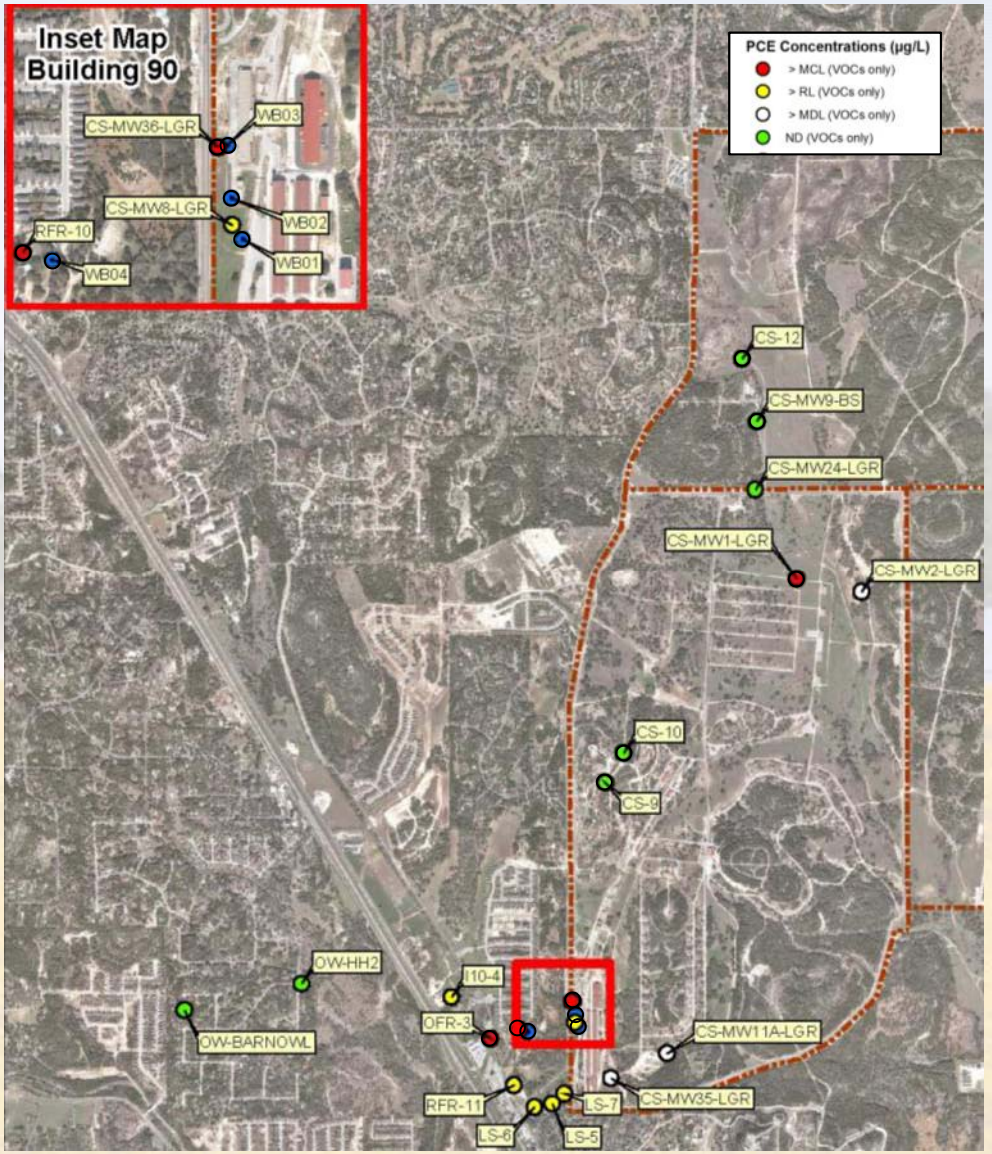
Groundwater Monitoring Program
September 2012 Results Overview

- This LTMO event included 10 On-post,16 Off-post, and 4 Westbay wells. 4 On-post wells could not be sampled due to depressed water levels or renovation (CS-1). IH-9 is no longer available for sampling.
  - Supply wells CS-10 and CS-12 continue to be free of VOCs. All metals were below ALs, MCLs, SCLs.
  - Two on-post wells continue to exceed the MCL for either PCE, TCE, or *cis*-1,2-DCE.
  - On-post well CS-MW9-BS, Pb concentrations have not been ND since June 2003, and has exceeded AL since 2009. It was re-developed in June 2012 and sampled in September 2012 (ND).



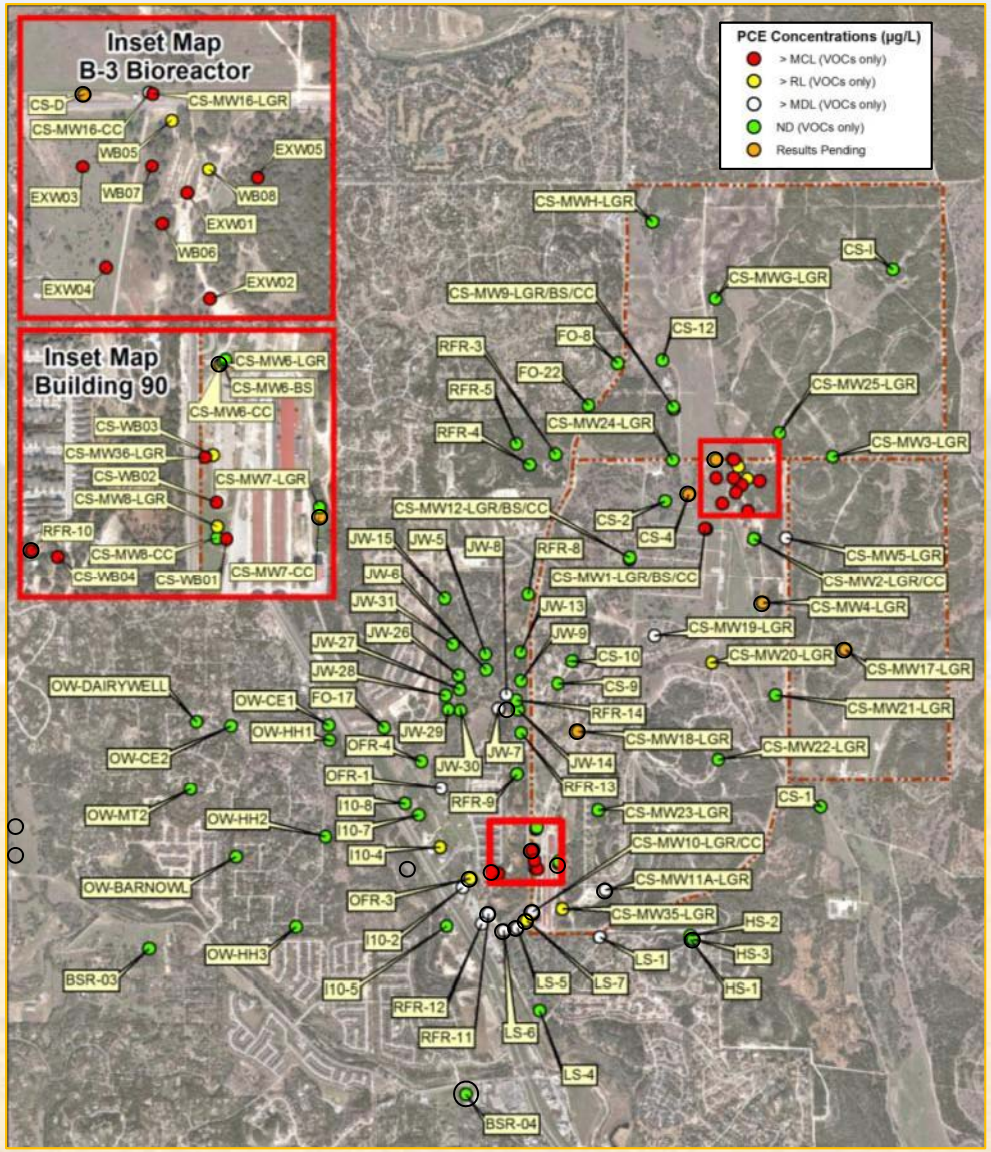
Groundwater Monitoring Program
September 2012 Results Overview

- Pb/Hg were reported above the AL in CS-9.
- 39 zones were sampled from 4 Westbay wells. 14 zones exceeded the MCL for PCE or TCE.
- Off-post, OFR-3 (7.92 µg/L) and RFR-10 (11.91 µg/L) exceeded the MCL for PCE.



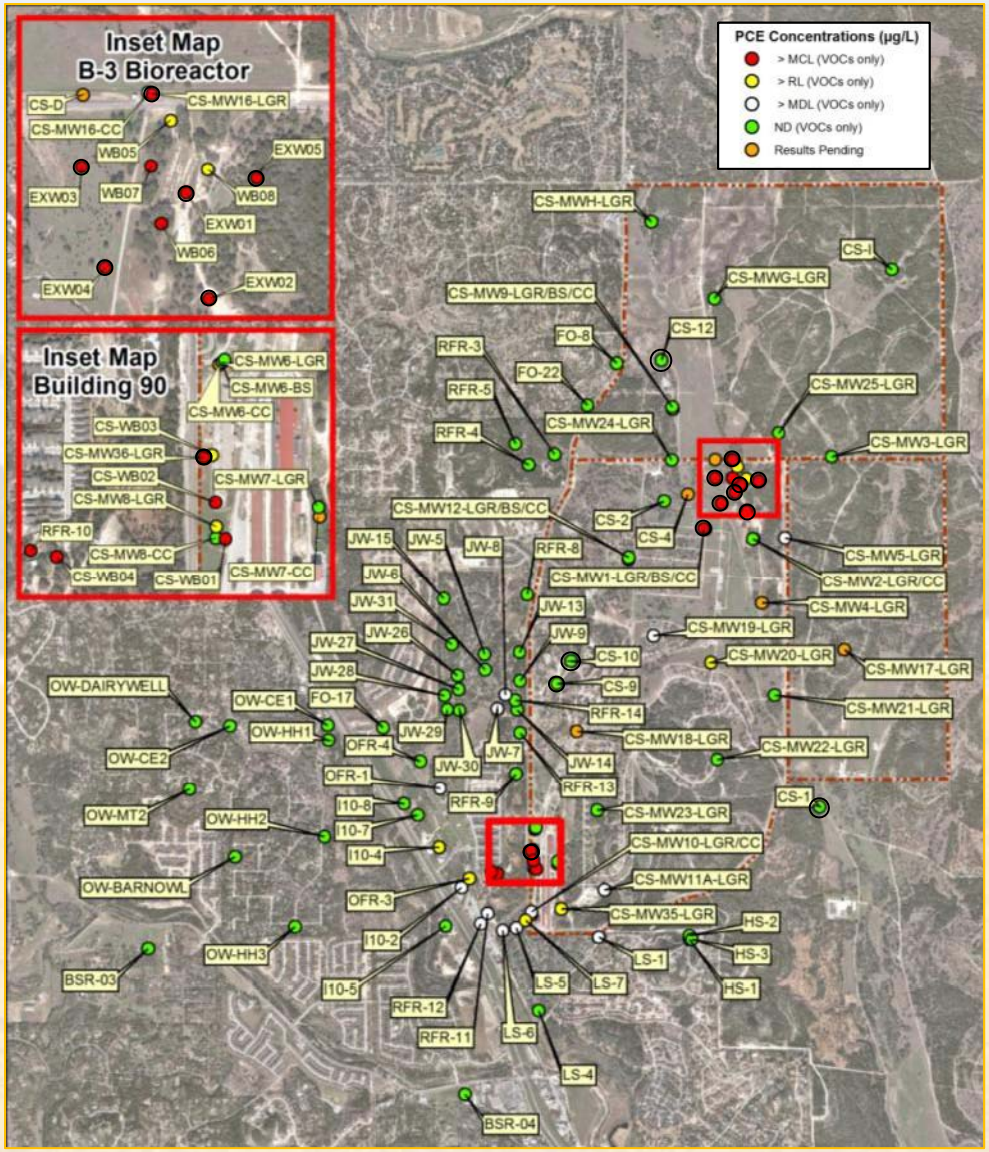
Groundwater Monitoring Program
December 2012 Results Overview

- "Snapshot" event included 51 On-post and 53 Off-post wells.
  - 1 On-Post well (MW11B-LGR) could not be sampled due to depressed water level.
  - 8 On-Post wells still have results pending from the laboratory.
  - 4 Off-Post wells (FO-J1, HS-4, SLD-1, and SLD-2) had no access or maintenance issues. I10-9 has been plugged for property development.
  - A new well, BSR-04, was added to the program. No VOCs were detected in that well.
  - Semi-annual GAC maintenance, including a carbon exchange, took place in January 2013. The next GAC maintenance, with carbon exchange, scheduled for July 2013.



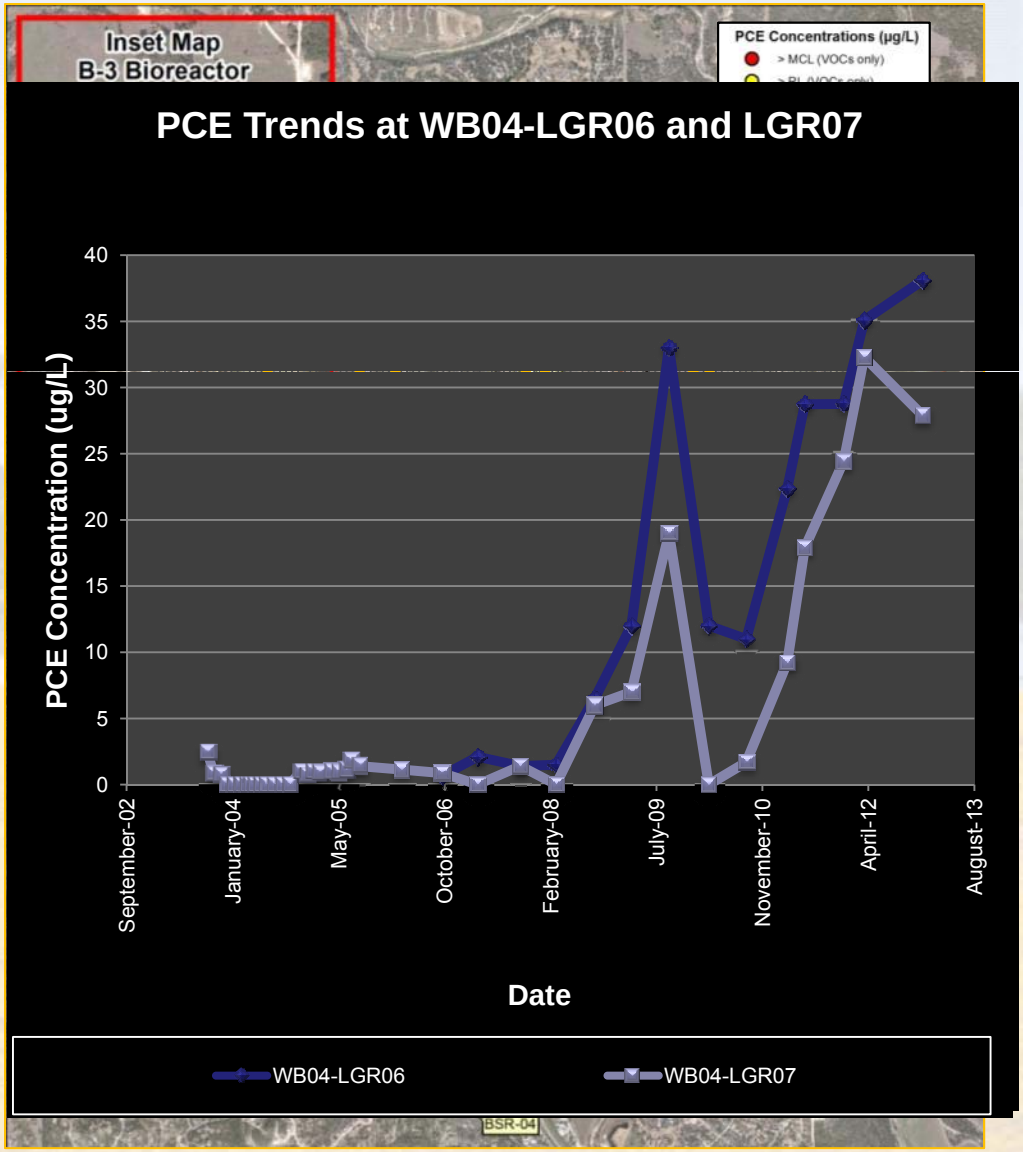
Groundwater Monitoring Program
December 2012 Results Overview

- Supply wells CS-10, and CS-12 continue to be free of VOCs. CS-1 had TCE at 0.49F µg/L. All metals were below ALs, MCLs, SCLs.
- CS-9 (inactive supply well) exceeded Hg MCL (0.0036 mg/L). This well has exceeded the Hg MCL 9 times in the past 20 samples since June 2006.
- Four on-post monitoring wells and 5 extraction wells continue to exceed the MCL for either PCE, TCE, or *cis*-1,2-DCE.
- DCE/PCE/TCE concentrations at MW36-LGR have decreased by more than 50% since September but are still above the pre-ISCO levels.



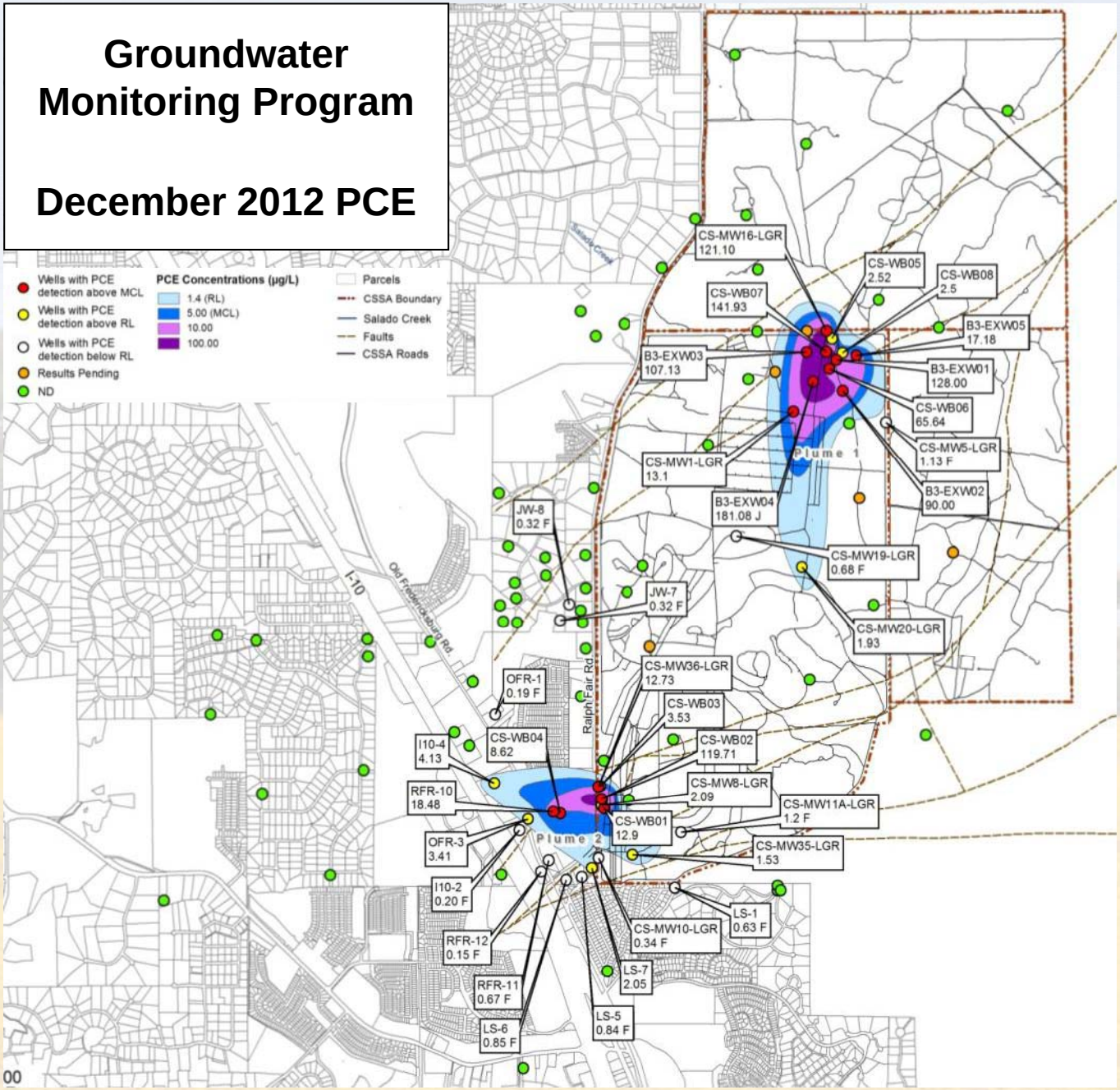
Groundwater Monitoring Program
December 2012 Results Overview

- MW9-BS was ND for lead for the second straight quarter since re-development in June 2012.
- Off-Post multi-port well WB04 continues to show PCE/TCE increases in the LGR06 and LGR07 zones since March 2008.
- At WB02-LGR09, there was a significant increase in PCE between September 2012 (13.55 µg/L) and December 2012 (119.71 µg/L). This is postulated to be a result of the ISCO treatability study. TCE concentration behaved in a similar fashion.
- Additional results/conclusions regarding PCE/TCE concentrations at the AOC-65 multi-port wells will be discussed during the ISCO pilot study segment of the presentation.



Groundwater Monitoring Program

December 2012 PCE



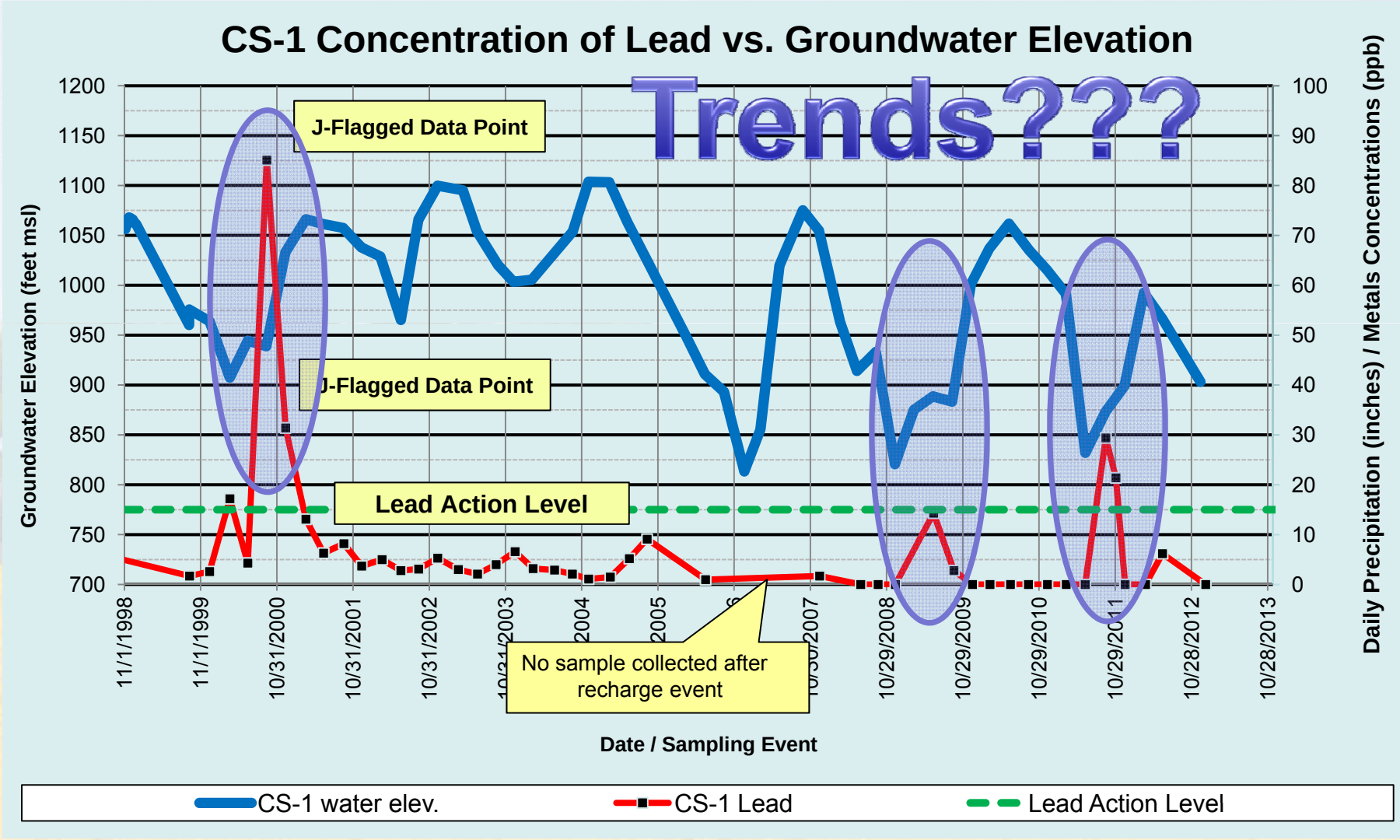
Groundwater Monitoring Program
March 2013 Overview

- In accordance with the LTMO schedule, 22 samples will be collected in March 2013.
  - 17 Off-post wells
  - 5 On-post wells
- Validated results will be available in mid-April.

Supply Well CS-1

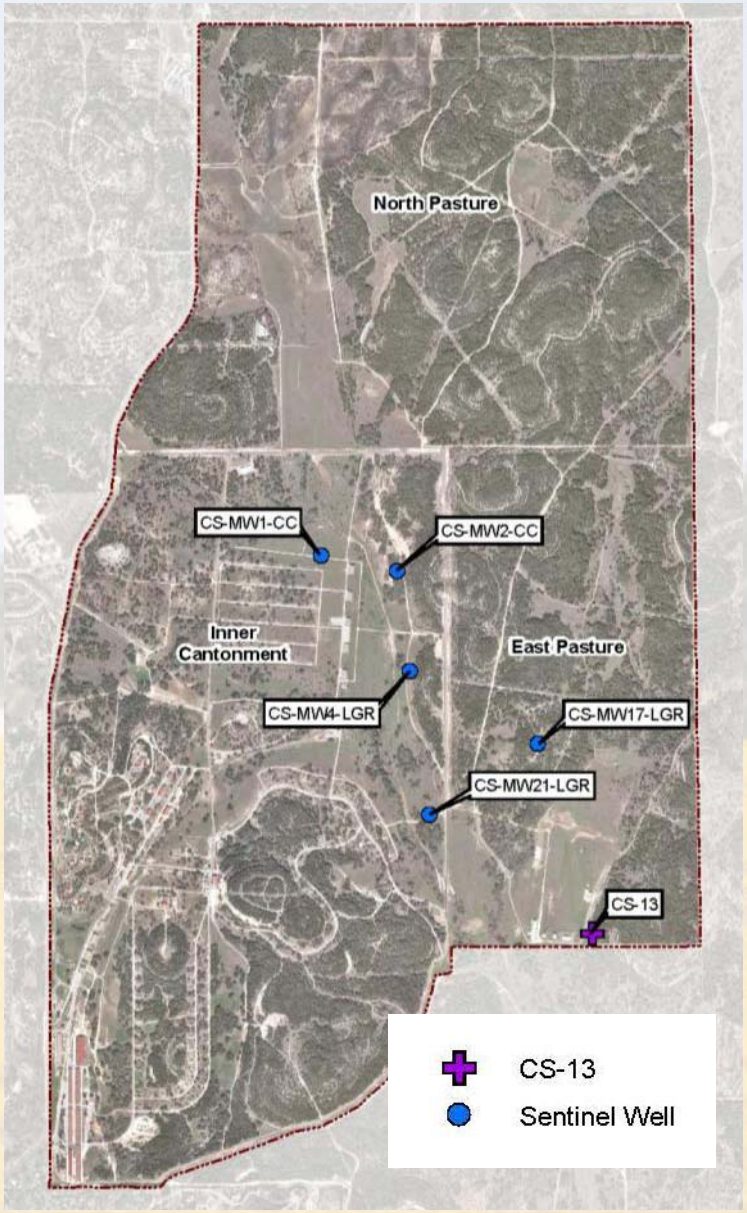
- Re-construction efforts at CS-1 are complete. The housing, disinfection system, and controls have been constructed.
- Before start-up of the well, 3 consecutive daily samples were collected to confirm that no BACT presence had developed in the well while it was down for 6 months.
- Well has been connected to distribution and is being integrated into the water system.
- Sodium Hypochlorite (bleach) disinfection has replaced the previous gas chlorination system.
- Controls have been tested/calibrated. Operation is automated by the SCADA system.

Supply Well CS-1



Supply Well CS-13

- Well was installed in Spring 2012 as a fire suppression well with the option to convert to public water supply if it met CSSAs DQOs.
- After a series of meetings, negotiations, and concessions, in October 2012 the TCEQ Water Supply Division has *"conditionally approved the well for use."*
- The approval includes a sampling schedule for sentinel wells to detect any migration of contaminants due to pumping influences.
- To establish a baseline, the 5 sentinel wells were sampled for BACT in December 2012.
- All BACT results were "NOT FOUND".



Supply Well CS-13

- Parsons has drafted *Engineering Plans and Specifications* for submittal to the TCEQ for construction approval and permitting.
- Power will be supplied to the well by spring so that the well can be incorporated into the quarterly groundwater sampling program.

Edwards Aquifer Authority (EAA)
Proposed Cibolo Creek Tracer Test

- The EAA is planning a surface water/groundwater tracer study to evaluate groundwater flow and recharge in portions of the Cibolo Creek channel and the Trinity Aquifer.
- The study boundary is the Bexar/Comal county line (Cibolo Creek) and the Edwards outcrop area to the south.
- The EAA initially contacted CSSA in September 2012 to gauge interest in participation. A EEA transmittal received in November 2012 requested permission to use CSSA wells as southwest monitoring points.

www.edwardsaquifer.org
http://www.flickr.com/photos/edwards-aquifer/8142611535/in/photostream/

Edwards Aquifer Authority (EAA)
Proposed Cibolo Creek Tracer Test

- EAA will use existing wells to monitor the progress of the dye. Monitoring sites are already established at Camp Bullis.
- Meeting is pending with EAA to determine if CSSA wells are suitable and available.
- CSSA has several concerns:
  - *Substantial cost to provide escort, support, and equipment. Cost to support sampling over one year period (~$30K) must be provided by EAA.*
  - *Scope will increase dramatically as the EAA realizes how many wells CSSA owns.*
  - *EAA may push to use CSSA's good reputation with off-post well owners for off-post access.*

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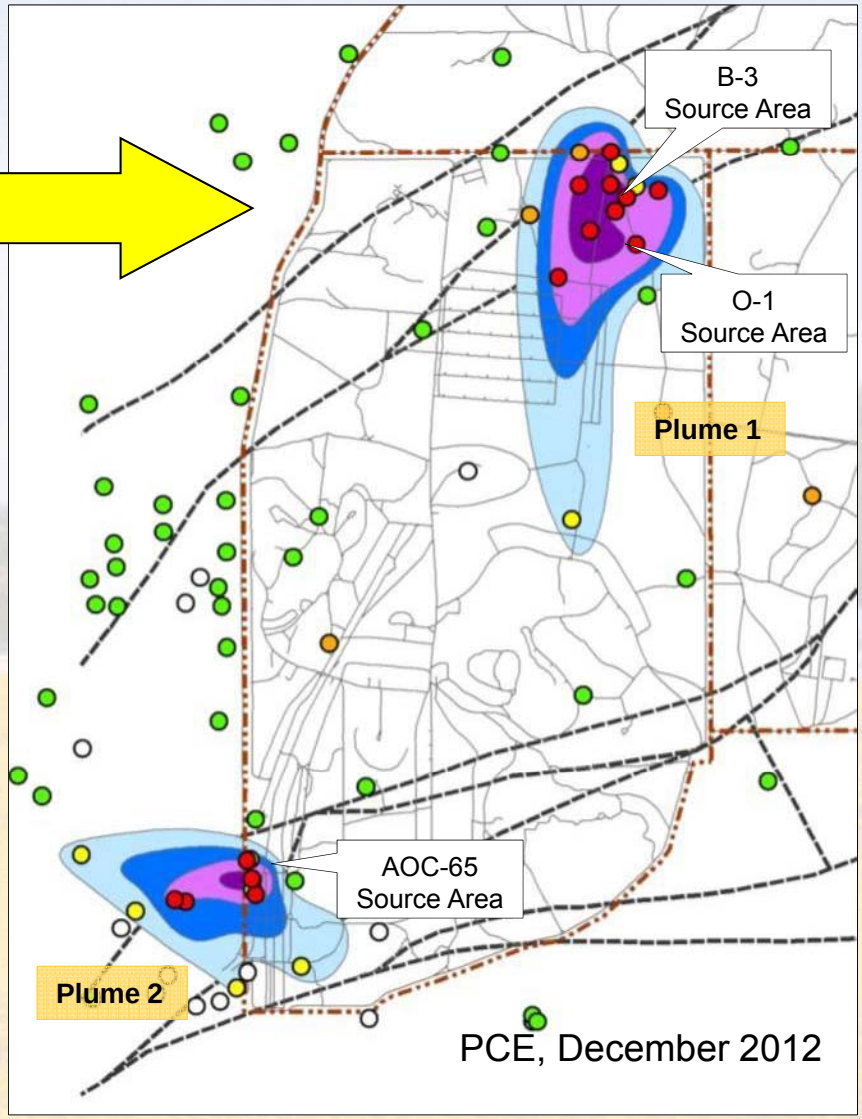
http://www.flickr.com/photos/edwards-aquifer/8142611535/in/photostream/

TREATABILITY STUDY UPDATES

SWMU B-3 and AOC-65
Description

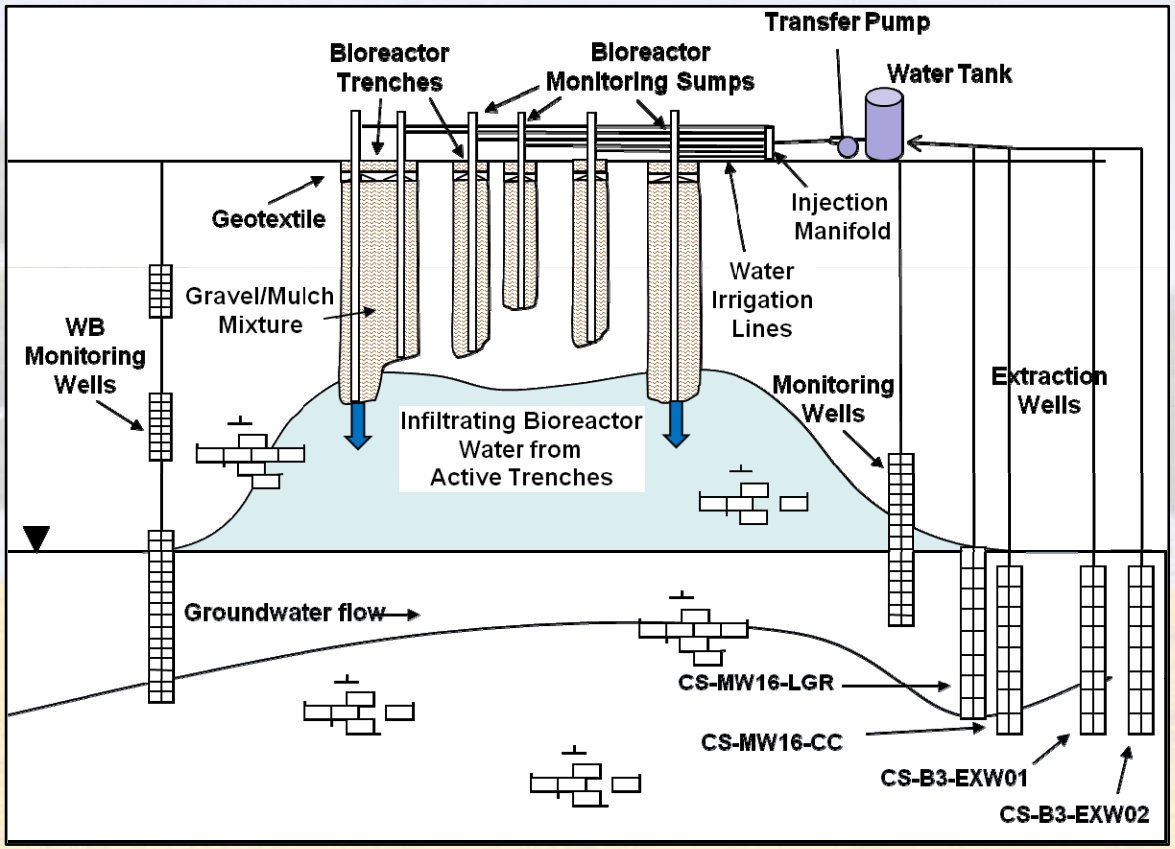
1. **SWMU B-3 Bioreactor:** Enhanced anaerobic bioremediation of chlorinated hydrocarbons in underlying fractured limestone at Plume 1.

2. **AOC-65 Soil Vapor Extraction and ISCO Treatment:** Destruction of chlorinated hydrocarbons in underlying fractured limestone at Plume 2.



B-3 Bioreactor
General Observations

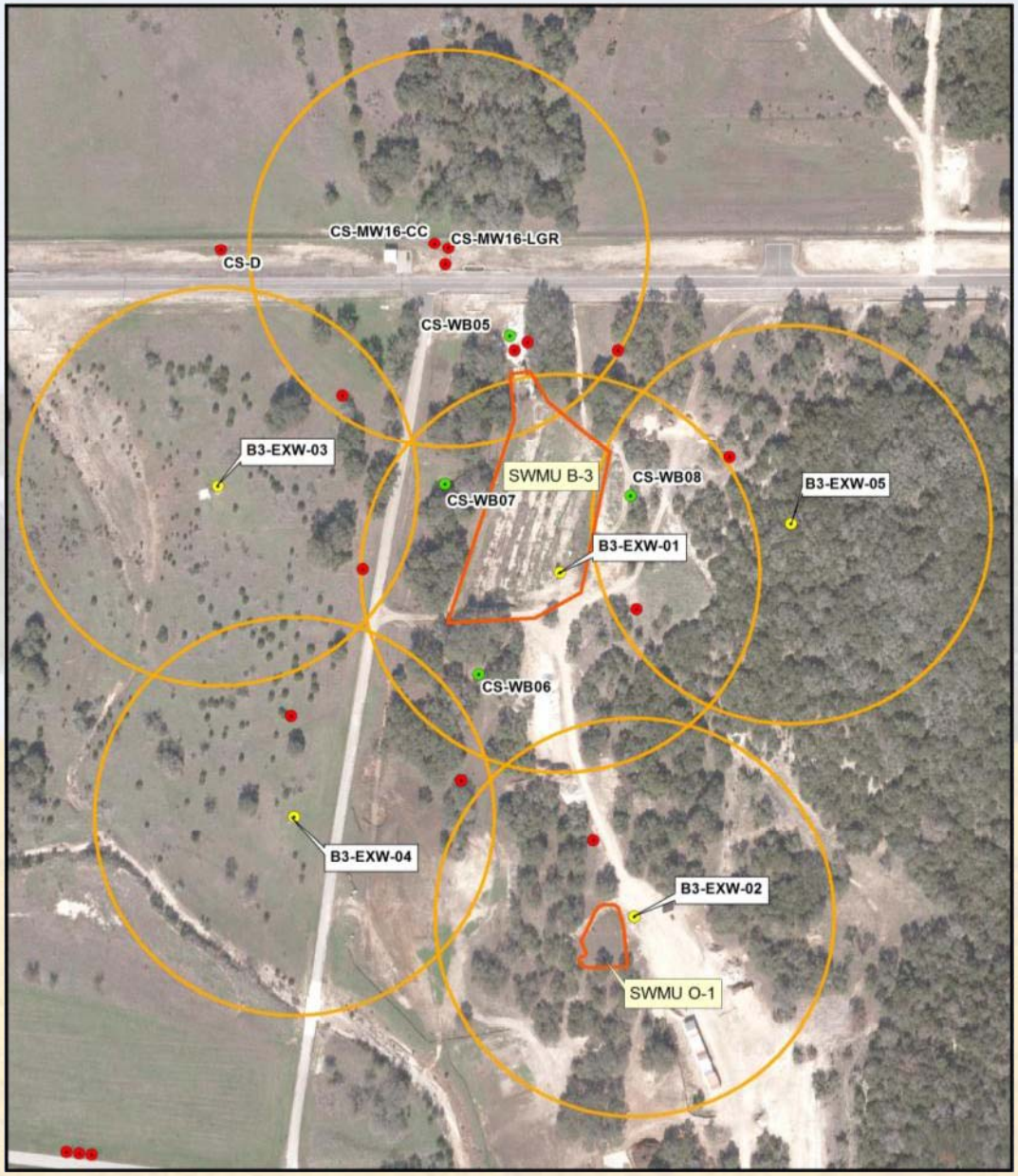
- Bioreactor is effectively treating approximately 50,000 gallons of injected contaminated groundwater per day in Trenches 1 and 6.
- Biotic degradation is occurring with biological degradation end products ethene, ethane, and CO_2 identified in surrounding UGR wells and LGR wells.
- Significant contamination likely remains in the fractured bedrock formation. Underlying VOC's are being mobilized.



Bioreactor Conceptual Diagram

Recent Bioreactor Activities

- EXWs -01, -02, -03, -04, and -05 are operational and are contributing extracted water (10, 10, 20, 10, 10 gpm, respectively) to the bioreactor.
- MWs 16-CC and 16-LGR contribute ~15 and 10 gpm, respectively.



Recent Bioreactor Activities (cont.)

- The bioreactor control building has been completed and SCADA automation and control is currently being installed.
- Groundwater is being extracted via 7 wells and injected into Trenches 1 and 6.

B-3 Bioreactor
Current Sampling Efforts

Regulatory Sampling
- VOCs
- TDS
- pH at injection site (field)

Regulatory Sampling Locations
- Injection Manifold (UIC) - Quarterly
- Trench Sumps - Semi-Annual
- WB-03B Zones - Semi-Annual

Performance Sampling
- MEE + CO_2
- Ferrous Iron
- Manganese
- Arsenic
- Total Organic Carbon
- Dissolved Organic Carbon
- Sulfide
- Sulfate and Chloride
- *Dehalococcoides*
- Dissolved Hydrogen

Performance Sampling Locations

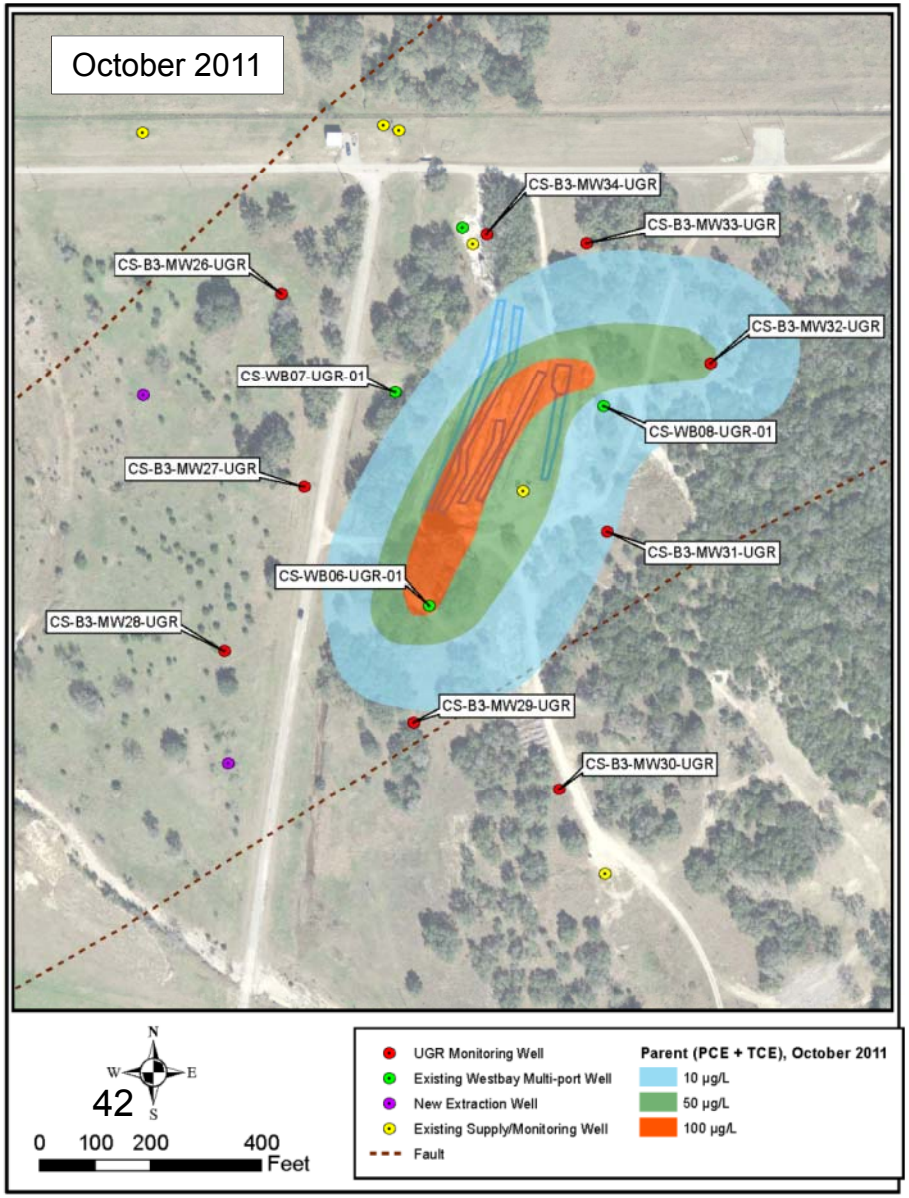
Frequency: Semi-Annual
- Trench Sumps (5)
- WB zones (27)
- Extraction Wells (7)
- LGR Monitoring Wells (4)
- UGR Monitoring Wells (9)

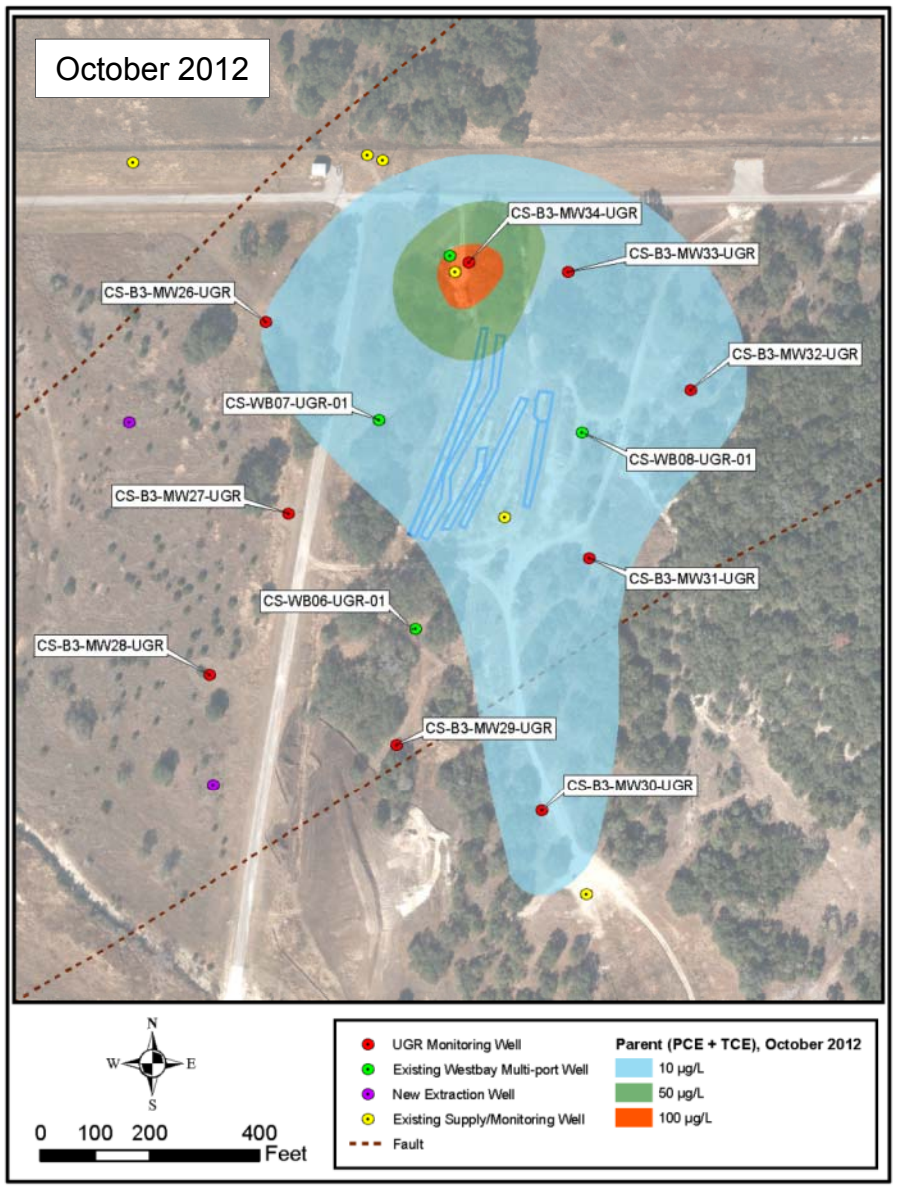
Trench Sump Field Parameters

Frequency: Monthly
- **pH**
- **DO**
- **Conductivity**
- **ORP**
- **Temp**
- **Water Level**

B-3 Bioreactor

UGR Observations – PCE and TCE

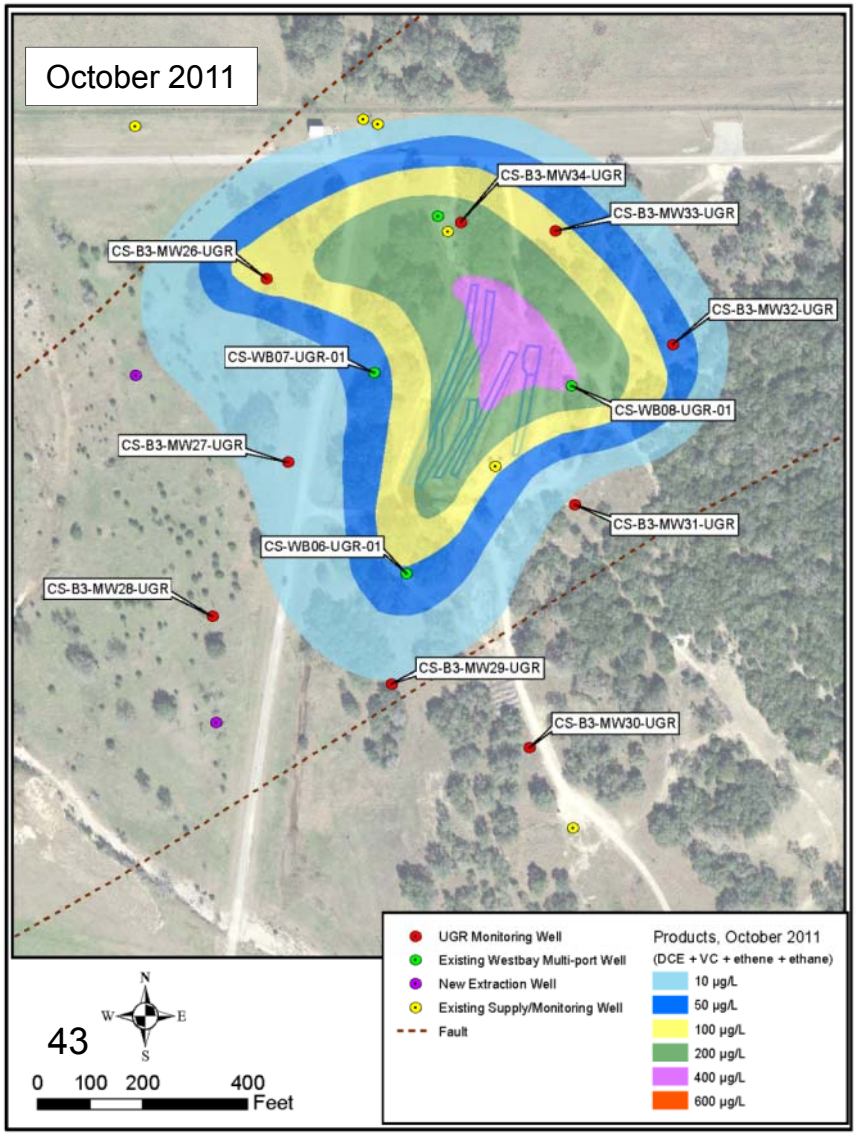


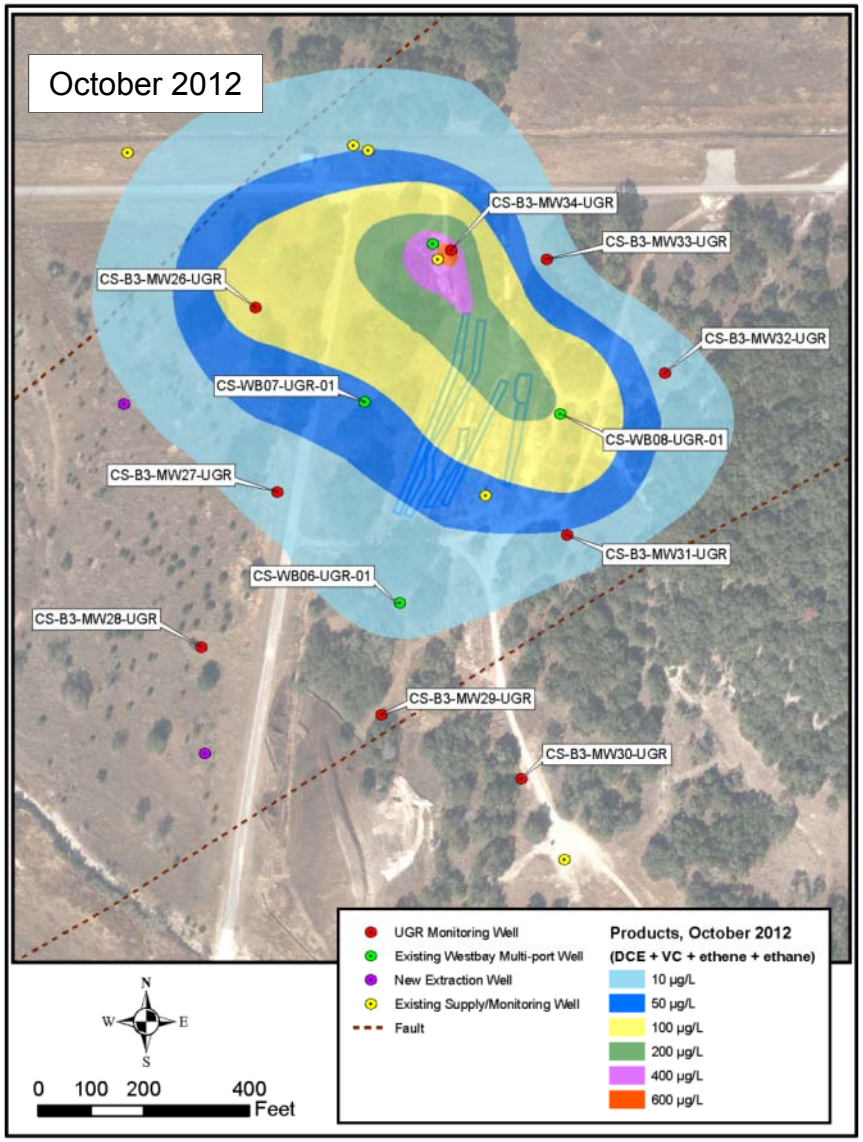


B-3 Bioreactor

UGR Observations – Dechlorination Products

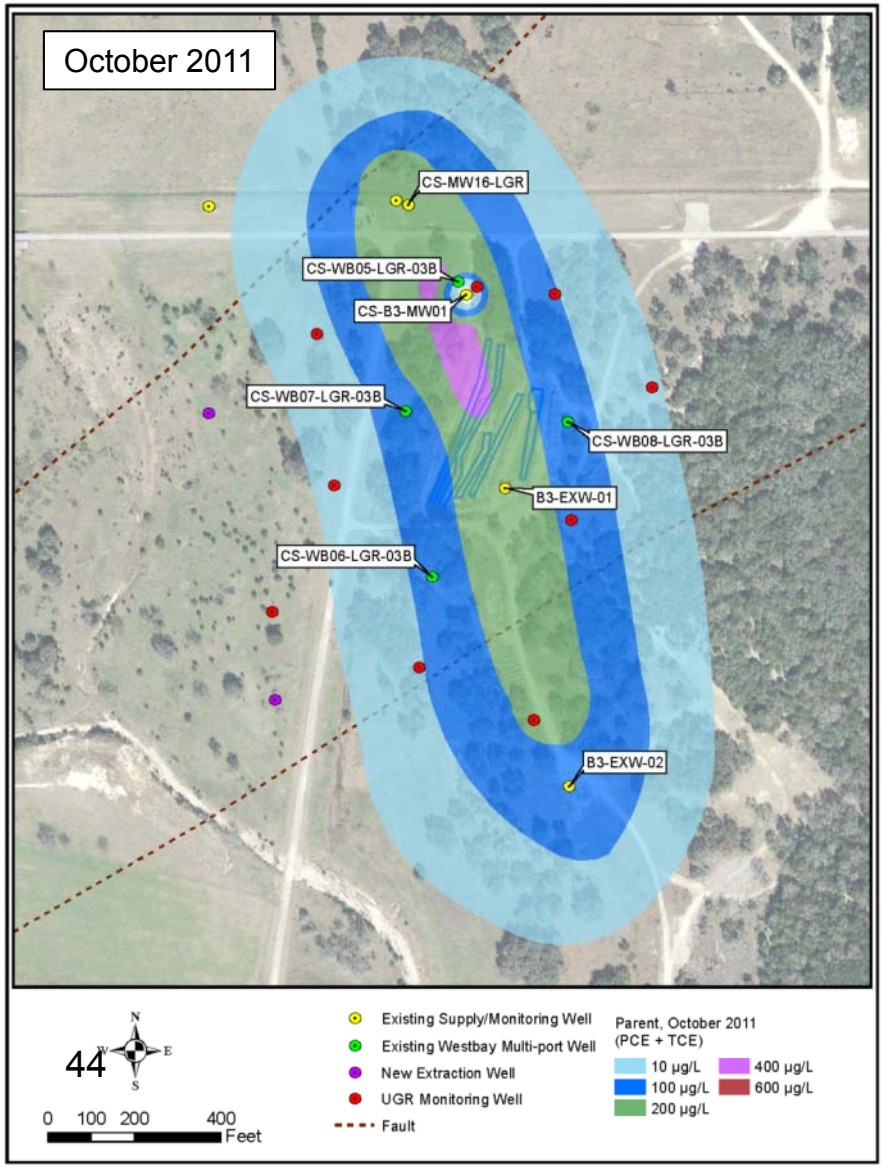
- Widespread presence of degradation products shows bioreactor influence.

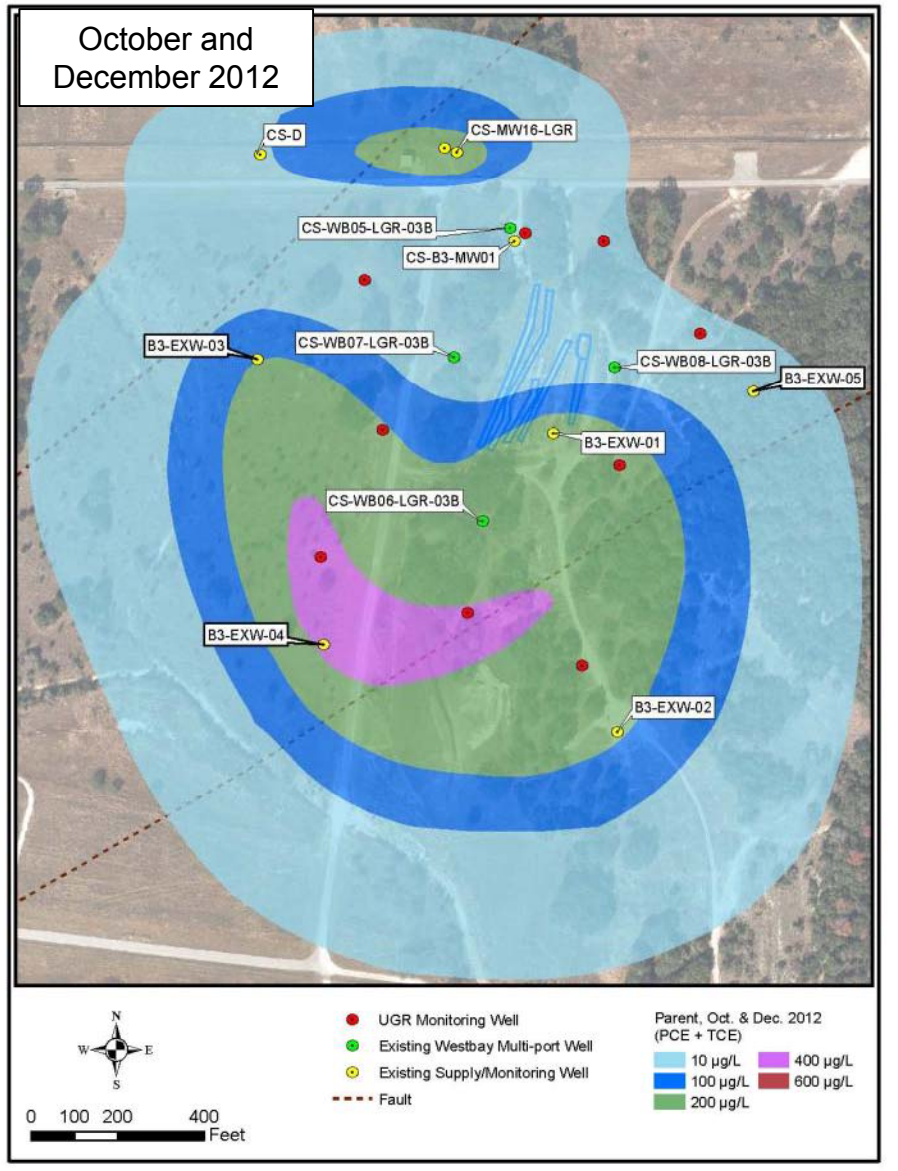




B-3 Bioreactor
LGR Observations – PCE and TCE

- Lack of PCE and TCE in the vicinity of CS-B3-MW01 reflect degradation associated with lactate injection in 2006.

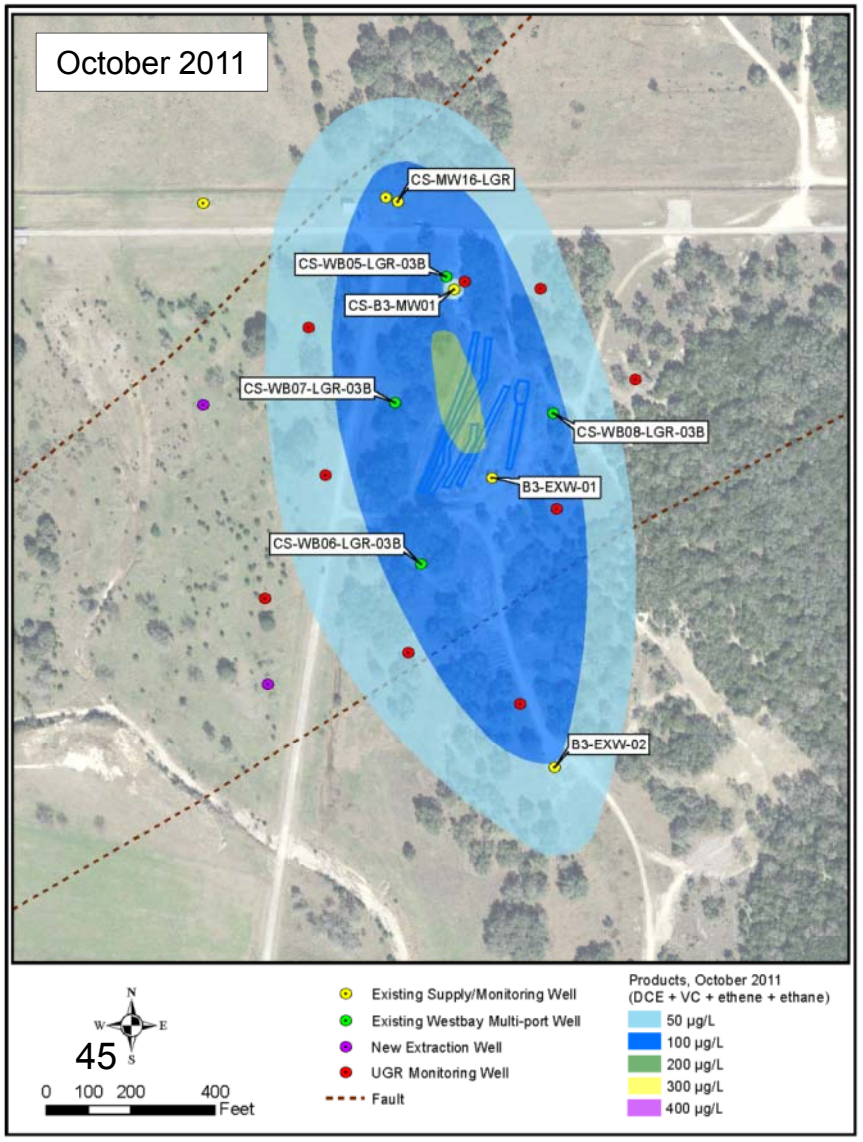


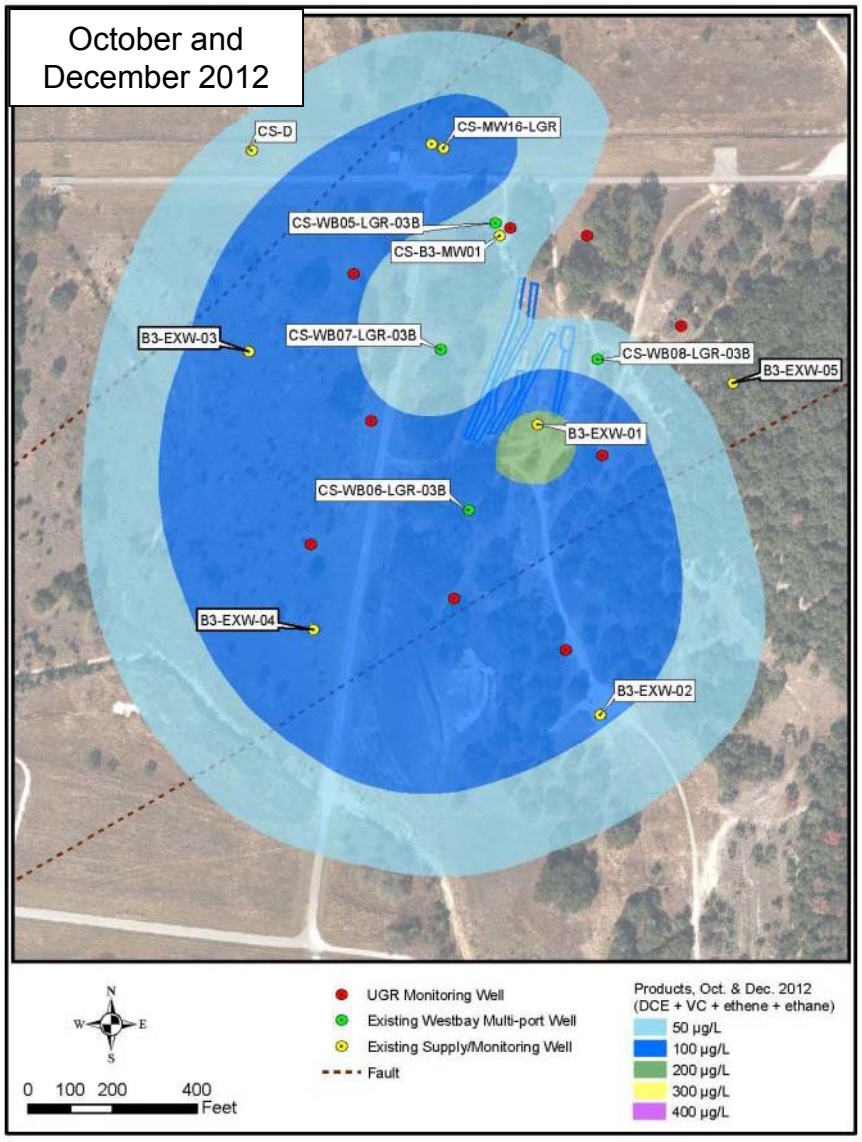


B-3 Bioreactor

LGR Observations – Dechlorination Products

- Moderate to low concentrations of *cis*-DCE are pervasive across the site.
- VC is detected at WB05 in LGR-03B, LGR-04A and LGR-04B zones, and LGR-CS-B3-MW01 (6.3, 40, 223, and 69 µg/L, respectively), possibly due to lactate injection activities.
- Low concentrations of ethene are present in WB07 in LGR-01 and LGR-02, WB05 in LGR-04A and LGR-04B, and in CS-B3-MW01.

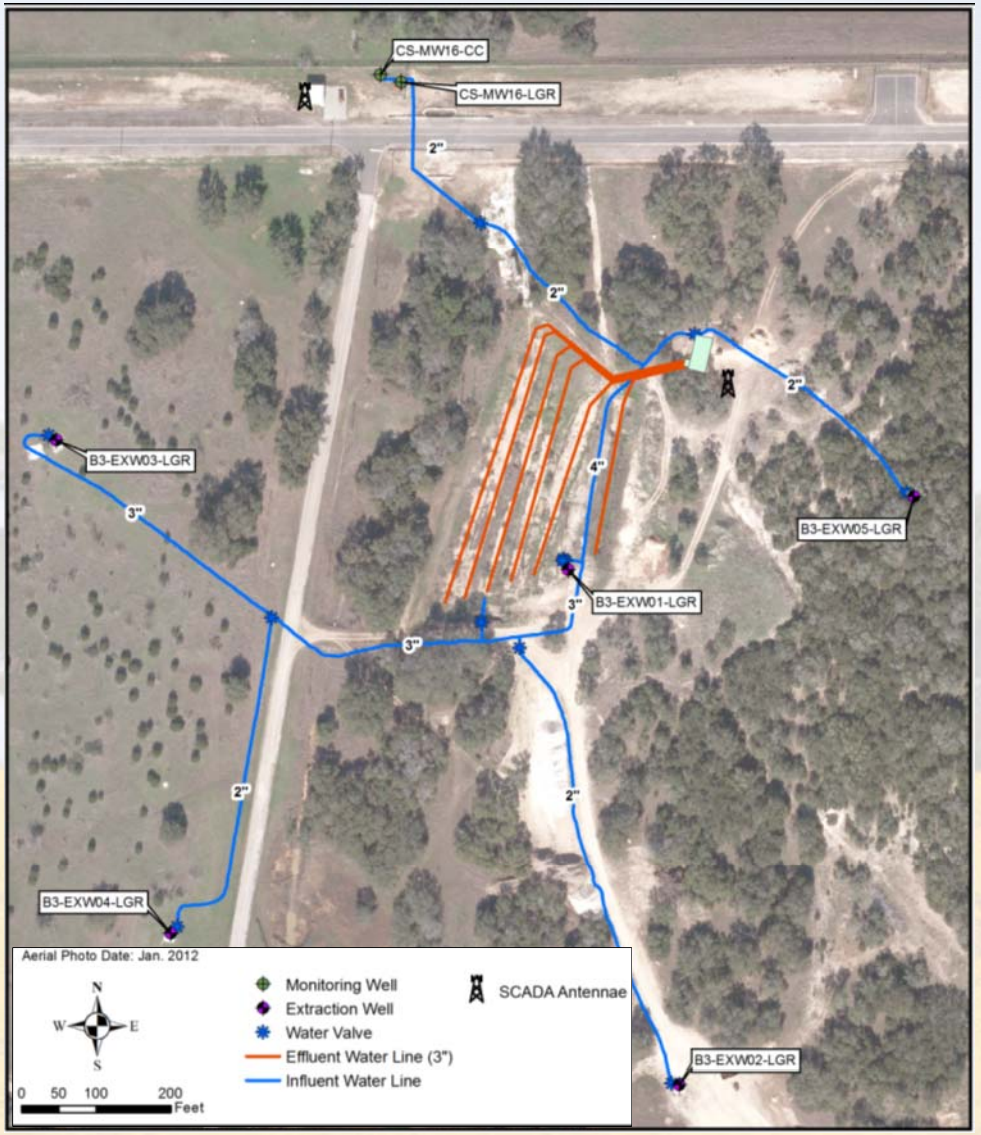




SWMU B-3 Bioreactor

Next Steps

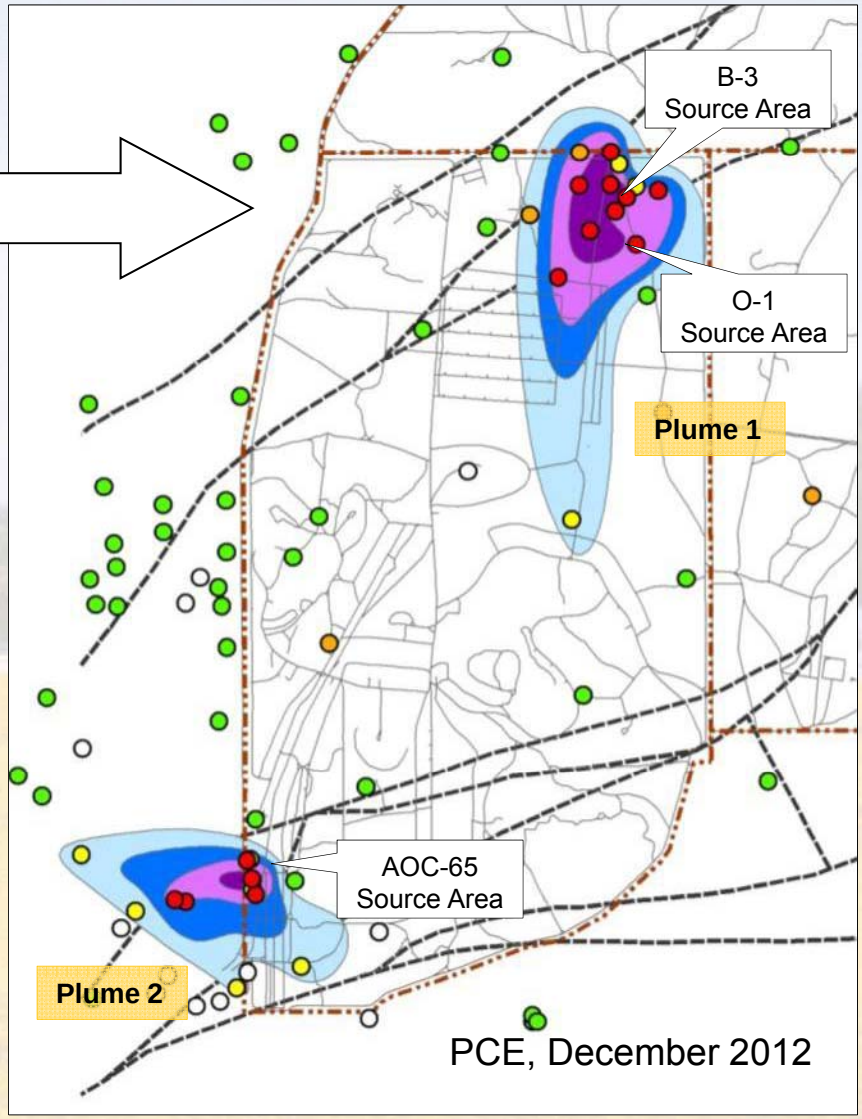
- Continue monitoring bioreactor.
- Automate bioreactor system via SCADA control installation.
- Recharge remaining trenches with additional mulch/gravel mixture and install new injection lines.



SWMU B-3 and AOC-65
Description

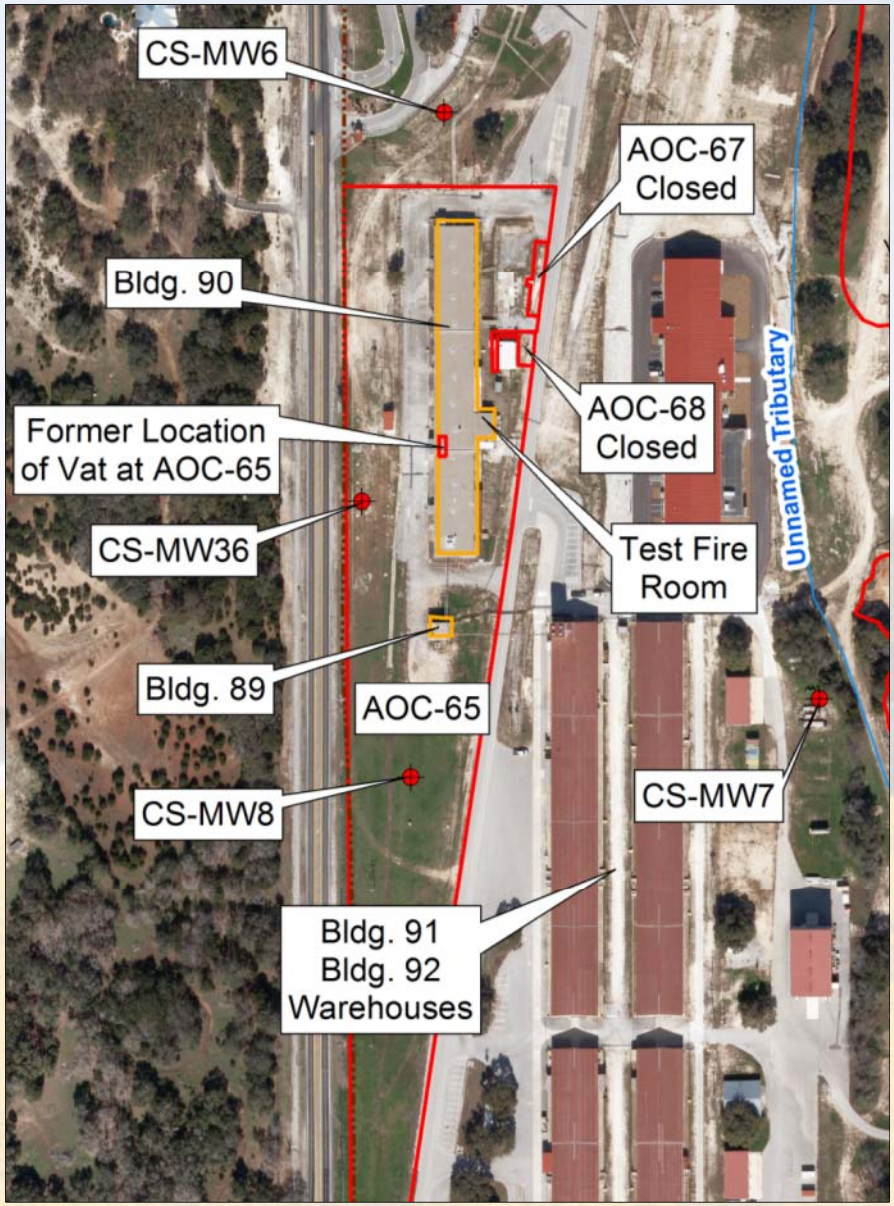
1. **SWMU B-3 Bioreactor:** Enhanced anaerobic bioremediation of chlorinated hydrocarbons in underlying fractured limestone at Plume 1.

2. **AOC-65 Soil Vapor Extraction and *In-Situ* Chemical Oxidation:** Removal/destruction of chlorinated hydrocarbons in underlying fractured limestone at Plume 2.



AOC-65
Background

- AOC-65 consists of an area surrounding Building 90.
- Chlorinated solvent use was discontinued in 1995.
- Initial investigations identified groundwater plume (2) in 1999.
- Interim Removal Actions in 2001 excavated and disposed of ~1,300 CY of impacted soil media off-post.
- SVE Pilot Study initiated in 2002.
- Interim Removal Action in 2012 excavated and managed ~1,000 CY of impacted soil media on-post as Class 3 waste.
- SVE Pilot Study operations ceased in conjunction with commencement of ISCO treatability study (July 2012).



AOC-65 Treatability Studies - SVE and *In situ* Chemical Oxidation (ISCO)

Activities since July 2012 :

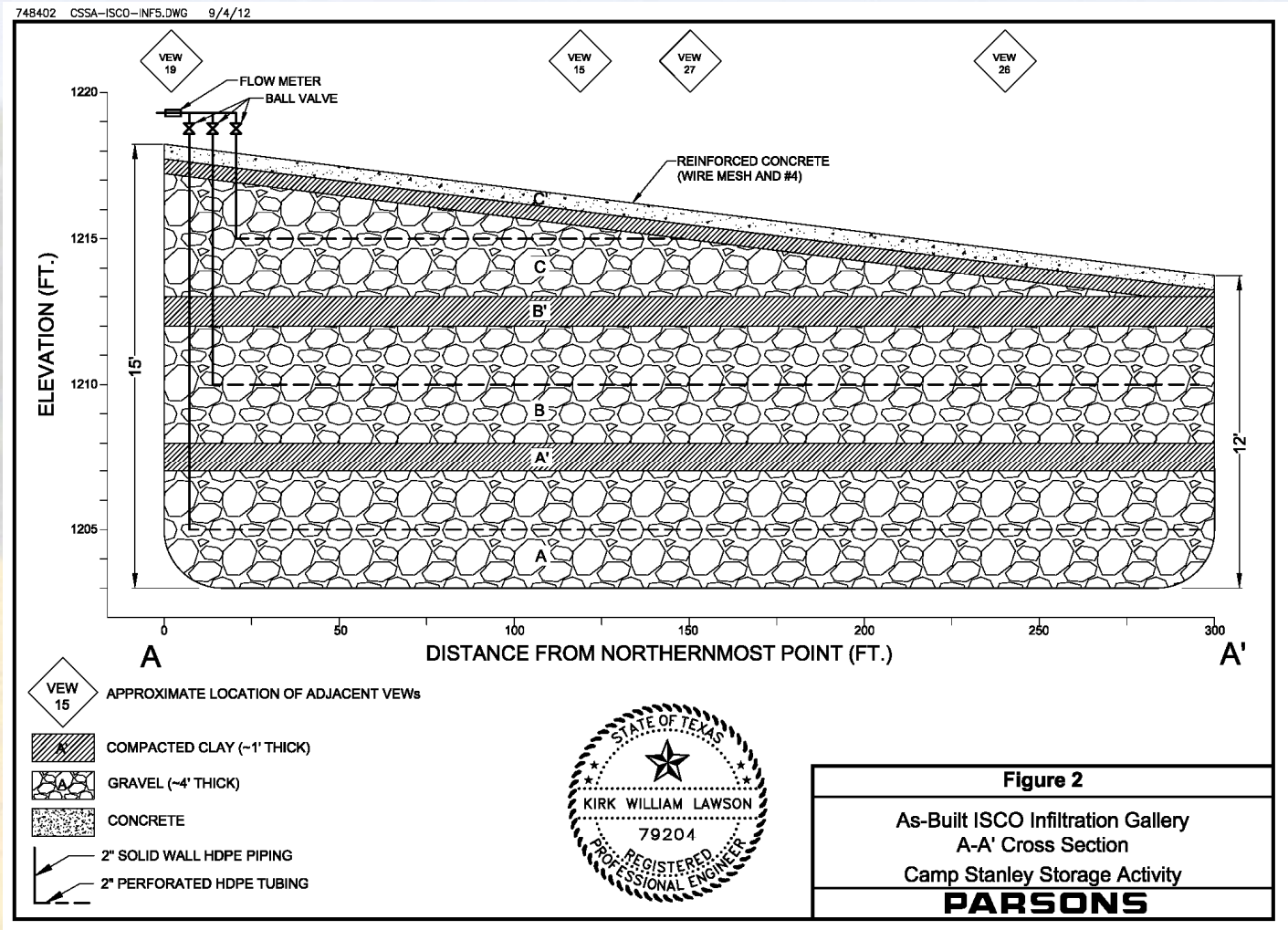
- Review of SVE treatability study performance data indicated cessation of operations warranted. SVE system currently being dismantled.
  - VEWs within Building 90 plugged and abandoned. Remaining VEWs will serve as monitoring wells for ISCO study.
  - Initiated dismantling of SVE system, expect to be complete in 1st quarter of 2013.
- Initiated ISCO treatability study with sampling of all nearby on-post and off-post wells to establish groundwater chemistry condition prior to injection of ISCO chemicals.
  - Injected ~15,000 gallons of sodium persulfate/sodium hydroxide ISCO solution into infiltration gallery and former steam injection well (SIW-01).
  - Completed ISCO performance monitoring on days 1, 5, 15, 30, 60, and 120 following injections.

AOC-65 ISCO Pilot Study

- The January 2012 IRA consisted of excavating a trench ~310 ft. long, ~3.5 ft. wide, and ~15 ft. deep.
- Approximately 1,000 CY of materials were removed.
- Sampling data indicated the presence of PCE in concentrations as high as 0.32 mg/kg in removed soils.
- Characterization data indicated soils met Class 3 waste criteria.

ISCO Infiltration Gallery Construction

- Each zone is comprised of ½" - sized quartz gravel and includes a 2" perforated HDPE line that runs the length of the trench and is separated from adjacent zones by a 1-foot thick layer of compacted clay.
- ISCO material was also injected at SIW-01, located in the former vat within Bldg. 90.



In-Situ Chemical Oxidation (ISCO)

Chemical oxidation involves increasing the oxidation state of a substance (chlorinated solvents) thereby transforming them into a new species.

Oxidation of target compounds may occur in 3 ways:

- Addition of an oxygen atom,
- Removal of a hydrogen atom,
- Removal of electrons without the removal of a proton from the target compound.

AOC-65 Oxidant Selection:

Klozur Sodium Persulfate

- *Formula* – $Na_2S_2O_8$
- *Stability* – typically more stable than other types of oxidants (e.g. hydrogen peroxide or ozone)
- *Oxidation potential* – relatively high (persulfate anion $S_2O_8^{2-}$ = 2.1 V) and (sulfate radical $SO4^{-\bullet}$ = 2.6 V) when catalyzed (activated with NaOH); also may generate hydroxyl radical $OH^{-\bullet}$ = 2.8V)
- *Solubility* – high; density of injection fluid is greater than water, therefore, allows greater vertical transport in fractures
- *Reaction Rate* – generally slow (up to a few weeks), allows for greater dispersal within the formation

In-Situ Chemical Oxidation (ISCO)

General Chemical Reaction

Generation of Sulfate Radicals:

$Na_2S_2O_8$ + Activator → **$2SO_4^{-\bullet}$** + Na

The chemical equation for the complete oxidation of TCE (C_2HCl_3) is:

$3NaS_2O_8 + C_2HCl_3 + 4H_2O \rightarrow 2CO_2 + 9H^+ + 3Cl^- + 3Na^+ + 6SO_4^{-2}$

HCl, NaCl, H_2SO_4,, Na_2SO_4

ISCO Treatability Study Injections

Water source (hydrant)

Water addition line

Persulfate Chute

16” diaphragm pump

Eductor for sodium hydroxide addition

Flowmeters

Mixing Tank

20% Sodium Persulfate - oxidant

ISCO Solution injection/recirculation line

To Infiltration Gallery Manifold

25% Sodium Hydroxide - activator (blue chemical hose)

ISCO Solution injection/recirculation line (recirculation configuration)

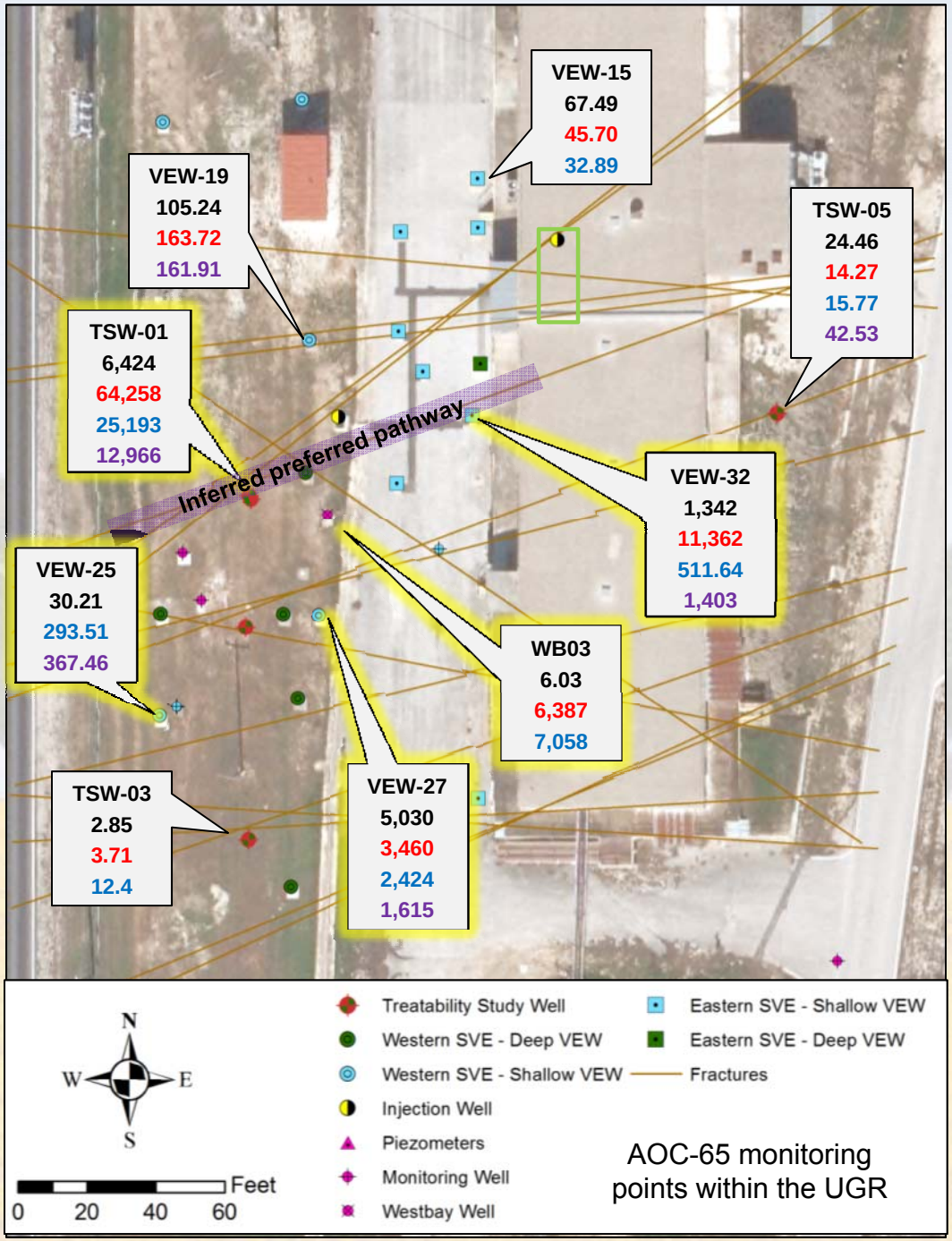
Mixing Persulfate (500 gal batches)

ISCO Treatability Study

UGR PCE + TCE (µg/L)

Baseline sampling
30-Day sampling
60-Day sampling
120-Day sampling

Monitoring results suggest an overall mobilization of contaminants along preferred pathways.



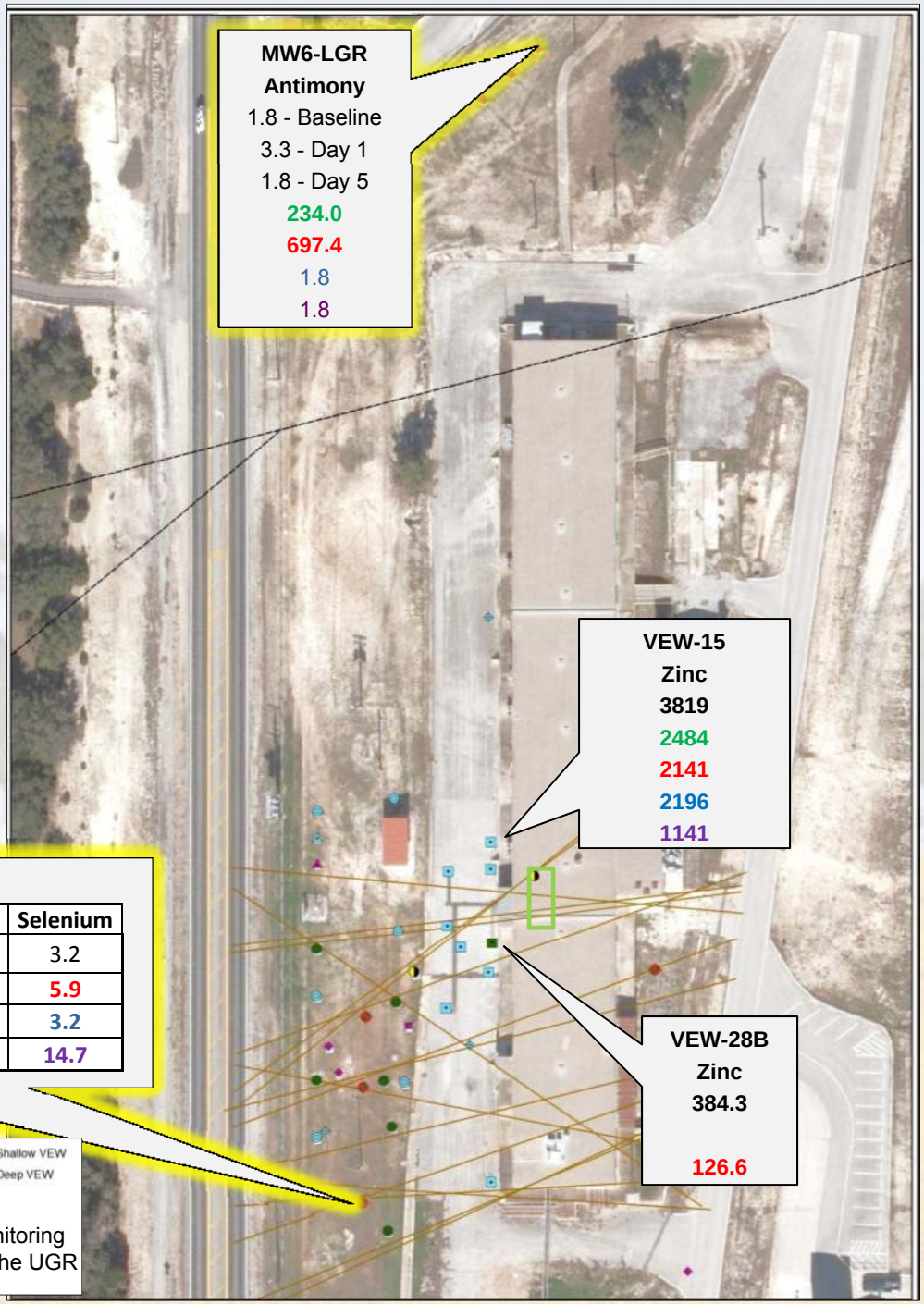
AOC-65 monitoring points within the UGR

ISCO Treatability Study

UGR Metals (various) (µg/L)

Baseline sampling
15-Day sampling
30-Day sampling
60-Day sampling
120-Day sampling

Metals may be leached (mobilized) in areas where acids generated from persulfate reaction is not buffered alkaline material (NaOH).



TSW-03

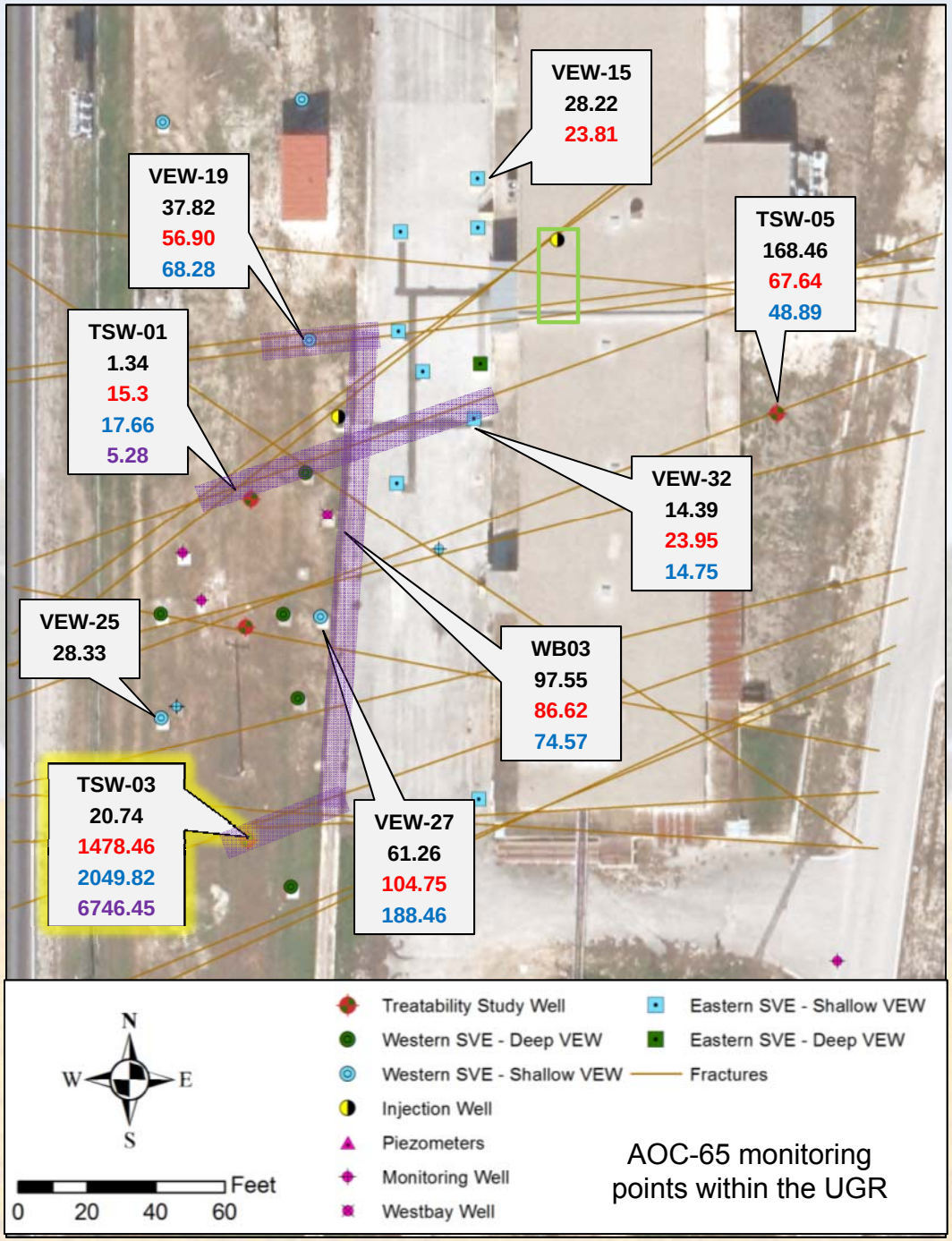
Arsenic	Chromium	Nickel	Silver	Mercury	Selenium
0.2	2.1	1	0.081	0.1	3.2
10.7	**95.2**	**19.7**	**3.803**	**0.5**	**5.9**
12.4	**150**	**7.6**	**2.984**	**1.1**	**3.2**
17.4	**391.9**	**6.7**	**4.176**	**4.0**	**14.7**

ISCO Treatability Study

UGR Oxidation Products Chloride and Sulfate (µg/L)

Baseline sampling
30-Day sampling
60-Day sampling
120-Day sampling

Salts precipitate as a byproduct of oxidation of chlorinated compounds in areas where metals are leached



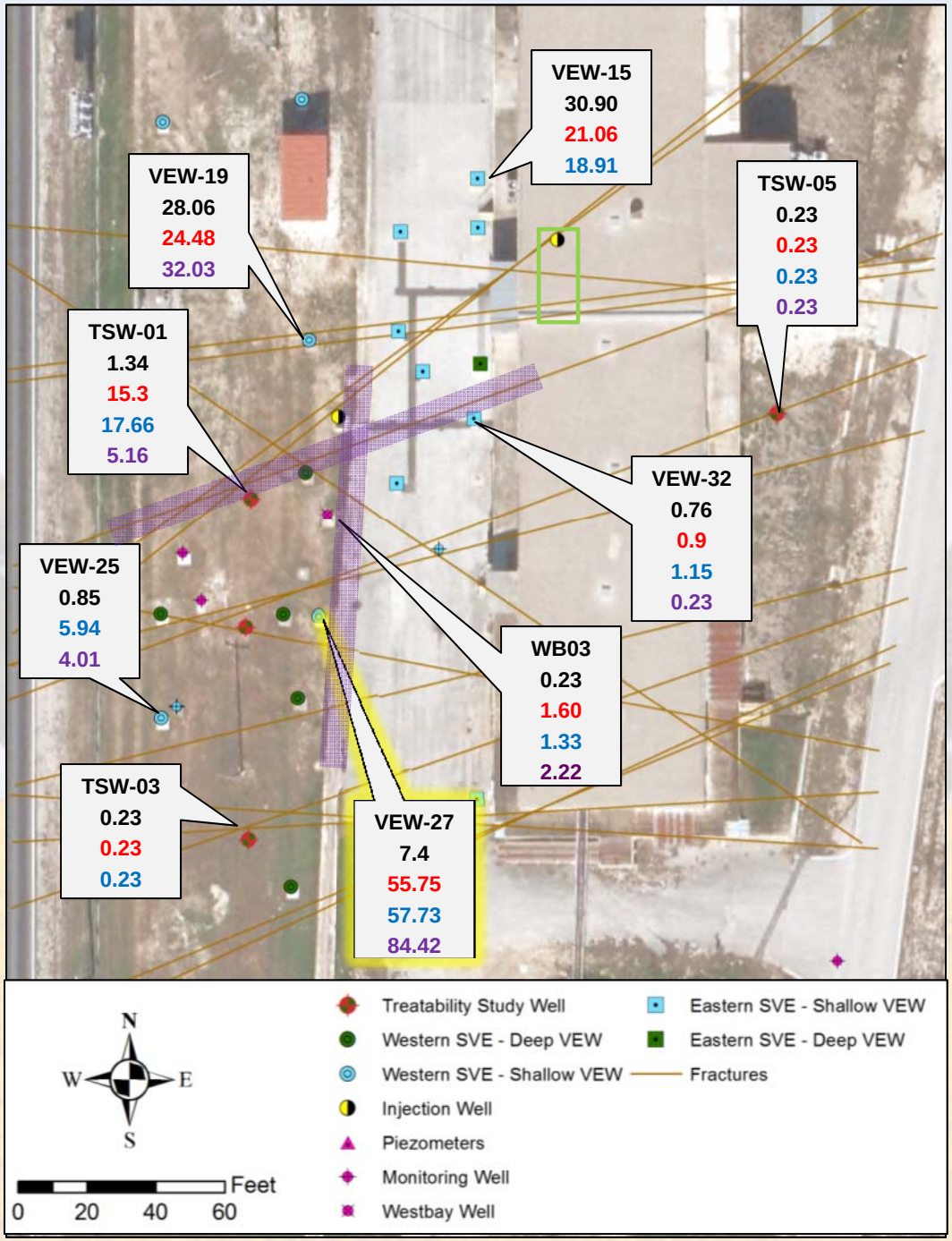
AOC-65 monitoring points within the UGR

ISCO Treatability Study

UGR Reductive Dechlorination Products (DCE + VC) (µg/L)

Baseline sampling
30-Day sampling
60-Day sampling
120-Day sampling

Secondary reductive dechlorination products are present.

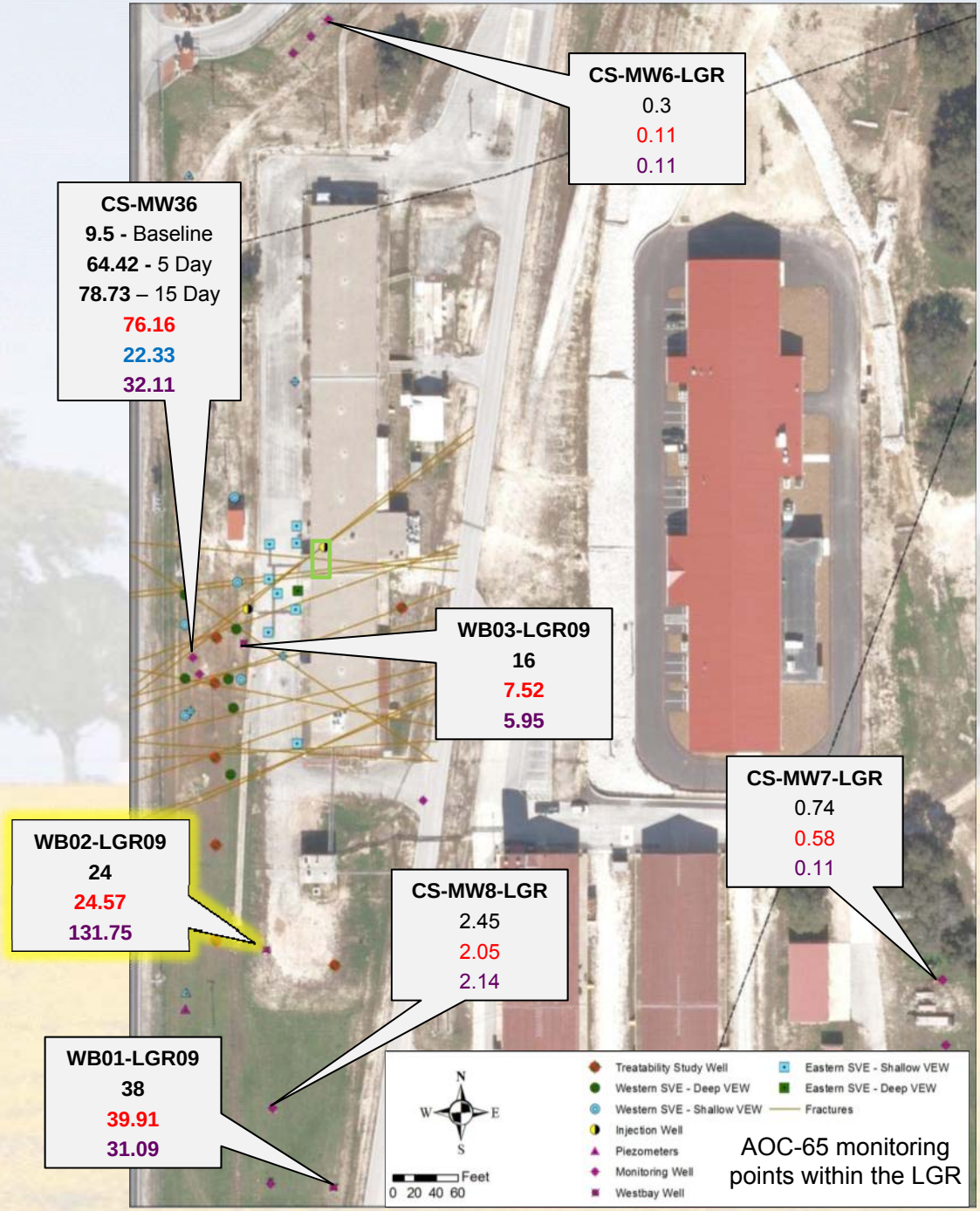


ISCO Treatability Study

LGR PCE + TCE (µg/L)

Baseline sampling
30-Day sampling
60-Day sampling
120-Day sampling

Monitoring results indicate vertical and lateral mobilization of contaminants.



AOC-65 monitoring points within the LGR

AOC-65 ISCO Treatability Study

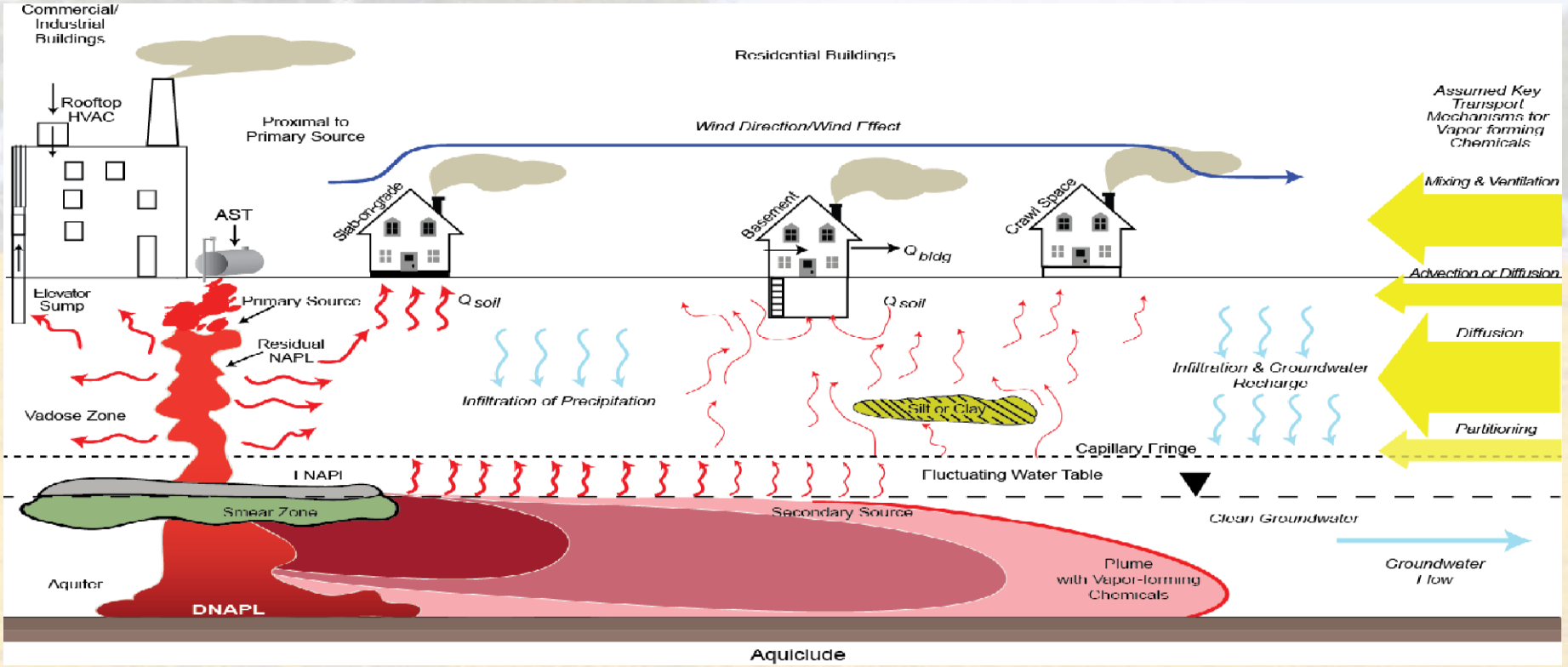
- Results from pre-GAC off-post wells indicate no significant changes in VOC, Metals, or Sulfate/chloride concentrations
- Continued monitoring of off-post wells recommended in conjunction with expanded ISCO injections.

AOC-65 ISCO Treatability Study
Next Steps

- Continue monitoring AOC-65 wells and monitoring points to determine effectiveness of treating source area.
- Continue ISCO treatability study using additional amounts of Klozur sodium persulfate activated with sodium hydroxide.
  - Application of oxidant and activator within all zones of infiltration gallery, SIW-01 and possibly nearby piezometers located near the fence line.
  - Sample collection at 15, 30 and 60 days after ISCO application at selected on-post and off-post GAC wells.
    - Lab Analyses: VOCs, Chlorides/Sulfates and EPA Priority Metals
    - Field analysis: Water levels, pH, ORP, DO, temperature, and conductivity
  - Sample collection for field and laboratory analysis is expected to continue on a quarterly basis at selected on-post and off-post well.
- Prepare ISCO Treatability Study Report

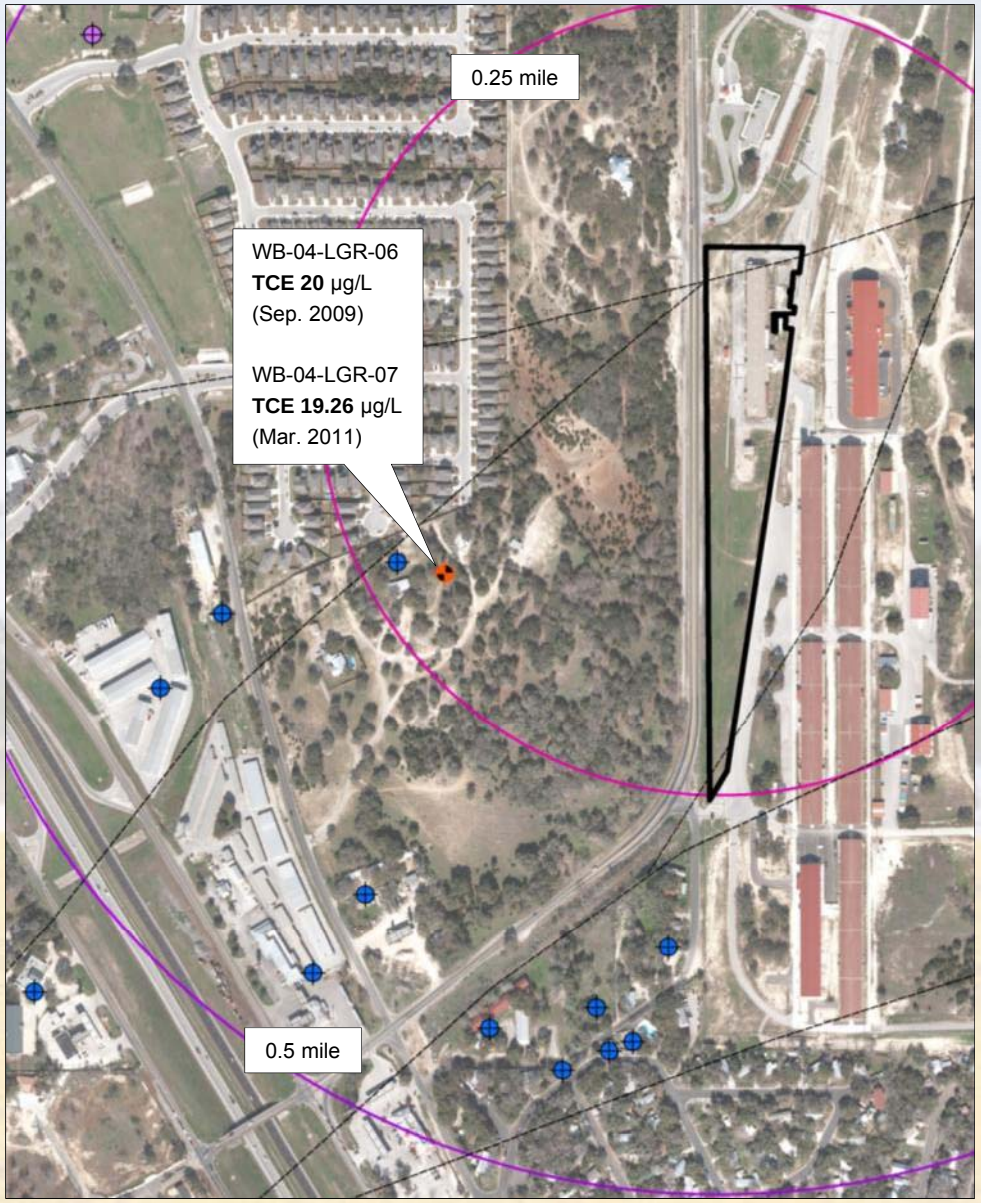
Vapor Intrusion - Introduction

- Vapor Intrusion is the general term given to migration of hazardous vapors from any subsurface contamination source, such as contaminated groundwater, through vadose zone and into indoor air.
  - USEPA uses Regional Screening Levels (RSLs) to identify chemical-specific concentrations for individual contaminants in air, drinking water and soil that may warrant further investigation or site cleanup. RSLs are based on target risk on 1 in a million (i.e., $1x10^{-6}$). **RSLs are not clean-up standards.**
  - TCEQ uses Risk-Based Exposure Limits (RBELs) and is the human health protective concentration that is applied at the point of exposure. RBELs are based on target risk of 1 in 100,000 (i.e., $1x10^{-5}$). RBELs are used in calculating the Protective Concentration Levels (PCLs).



Vapor Intrusion

- Previous work performed: soil vapor sampling, two industrial hygiene surveys, and soil gas/indoor air surveys, all contained within a Parsons white paper submitted to USEPA in 12/2011.
  - White paper concluded that only well CS-WB04-LGR-06 & 07 exceeded TCEQ RBEL for TCE at 12.2 µg/m3 with a calculated indoor air concentration of ~13 µg/m3.
  - If the groundwater data are compared with the more conservative USEPA residential air RSLs, exceedences occurred at least one time in 22 of the 40 off-post wells for PCE, and nine of the off-post wells for TCE.
- Since the June 2011 data review, USEPA updated and lowered the toxicity value for TCE and also concluded that TCE is mutagenic. The resulting TCE residential air RSL is currently 0.43 µg/m^3 with the RBEL at 2.1 µg/m^3 (non cancer exposure level).



Vapor Intrusion

- USEPA commented on the White Paper indicating that groundwater levels for TCE and PCE are above risk based values and recommended an investigation through indoor air sampling in the off-site residential areas.
- Additionally, USEPA indicated that there would be little correlation between indoor air values found in Building 90 to off-site residential structures due to difference in construction techniques.
  - Therefore, CSSA intends to collect indoor air data from off-site residential structures overlying Plume 2.

- CSSA is attempting to identify VI risks using USEPA RSL and TCEQ RBELs as guidance:

	Groundwater MCL (µg/L)	EPA RSL (µg/m³)	TCEQ $^{Air}RBEL_{Inh}$ (µg/m³)	
PCE	5	9.4	64	cancer
			39	non-cancer
TCE	5	0.43	5.9	cancer
			2.1	non-cancer
		November 2012	June 2012	

Calculated Groundwater Concentrations for RSL or RBEL

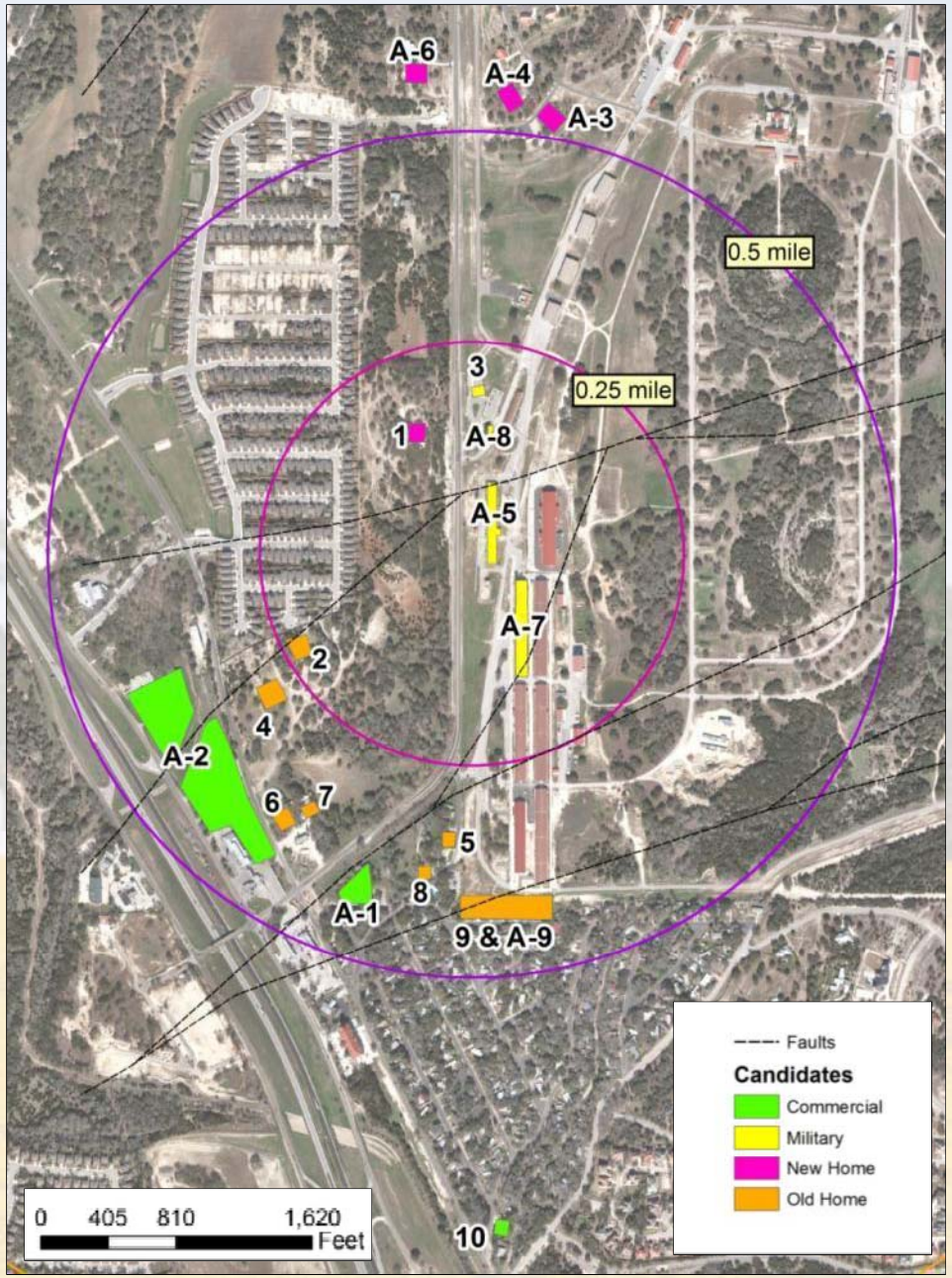
	Groundwater MCL (µg/L)	EPA RSL (µg/L)	TCEQ $^{Air}RBEL_{Inh}$ (µg/L)	
PCE	5	8.19	55.8	cancer
			607.5	non-cancer
TCE	5	0.67	5.1	cancer
			3.3	non-cancer

Calculated Groundwater Concentrations = (Indoor Air Concentration (µg/m³) / Attenuation factor (0.0015)) / (Henry's Law Constant (unitless) * Conversion factor (1000 L/m³))

Where; Indoor Air Concentration = RSL or RBEL, and Henry's Law Constant = 0.428 and 0.765 for TCE and PCE, respectively

Vapor Intrusion
Next Steps

- Work to be performed: collect indoor air samples from 10 locations on and off-post.
  - Samples will be collected from residences, enclosed crawl spaces, one full-time (24/7) occupied military building, and one water supply well enclosure.
  - 10 sample locations and 10 alternate sample locations have been identified.
- Samples will be collected over a 24-hr period and will be analyzed for PCE and TCE using level IV analysis via USEPA Method TO15 Selective Ion Monitoring (SIM).
- Analytical results will be compared with USEPA residential air RSLs for PCE and TCE (9.4 and 0.43 µg/m^3, respectively).



HUMAN/ECOLOGICAL RISK ASSESSMENT

Tissue Sampling for Lead

- USEPA Comment on February 29, 2012
  - "It is also recommended that an ecological risk assessment be conducted, where the waste is remaining in place, on wildlife species that are being harvested, to ensure that there are not any potential exposures above acceptable risk levels."
  - Subsequent conversations with USEPA clarified that the concern is human health risk due to ingestion of game animals

Tissue Sampling for Lead

- To address USEPA concerns, CSSA
  - Collected tissue samples for lead analysis
    - To determine potential human health risk from ingestion of harvested animals
    - To determine potential exposure of game animals to lead
  - Game species evaluated included
    - Deer
    - Turkey
    - Feral Hogs

Literature Review

- Most literature regarding lead and wildlife is concerned with exposure to the lead shot used to harvest the animal
  - Very little on lead exposure from contaminated soil

Concentrations of Lead in Mourning Doves

- Compared Pb concentrations in liver and bone in doves harvested in areas that either allowed or prohibited the use of lead shot
- Evaluated whether doves had ingested lead pellets

Concentrations of Lead in Mourning Doves

- Mourning Doves with pellets (lead or steel) present in crop
  - Liver
    - Median – 37 mg/kg
    - Q3 – 72 mg/kg
  - Wing Bone
    - Median – 89 mg/kg
    - Q3 – 237 mg/kg

Concentrations of Lead in Mourning Doves

- Mourning Doves without pellets present in crop
  - Liver (females)
    - Median – 0.34 mg/kg
    - Q3 – 0.73 mg/kg
  - Wing Bone (lead shot permitted)
    - Median – 2.74 mg/kg
    - Q3 – 9.65 mg/kg

» Franson, et al. 2009

Concentration of Lead in Bald Eagles

- K. Neumann (SOAR)
  - Looked at bone concentrations in bald eagles
  - Did not report concentrations
  - Defined bone concentrations greater than 10 mg/kg as “abnormal”

Neumann, 2009

Concentrations of Lead in Humans

- ATSDR reports the body burden of lead
  - Measured concentrations in the patella using XRF
  - Lowest quintile (20^{th} percentile) is 6 mg/kg
  - Median is 29 mg/kg
  - 94% of body burden in adults is in the bone
  - 73% of body burden in children is in the bone

Concentrations of Lead in Deer

- Few studies that looked at “background” concentrations of lead in deer tissue
- Most studies looked at concentrations of lead in meat for consumption
  - Source of lead was the bullet used to harvest the animal (not contaminated media)
- Hunt, et al. (2009) identified the presence of lead in deer bone, but did not quantify it
  - Determined bone lead was from a different source than muscle lead

Concentrations of Lead in Deer

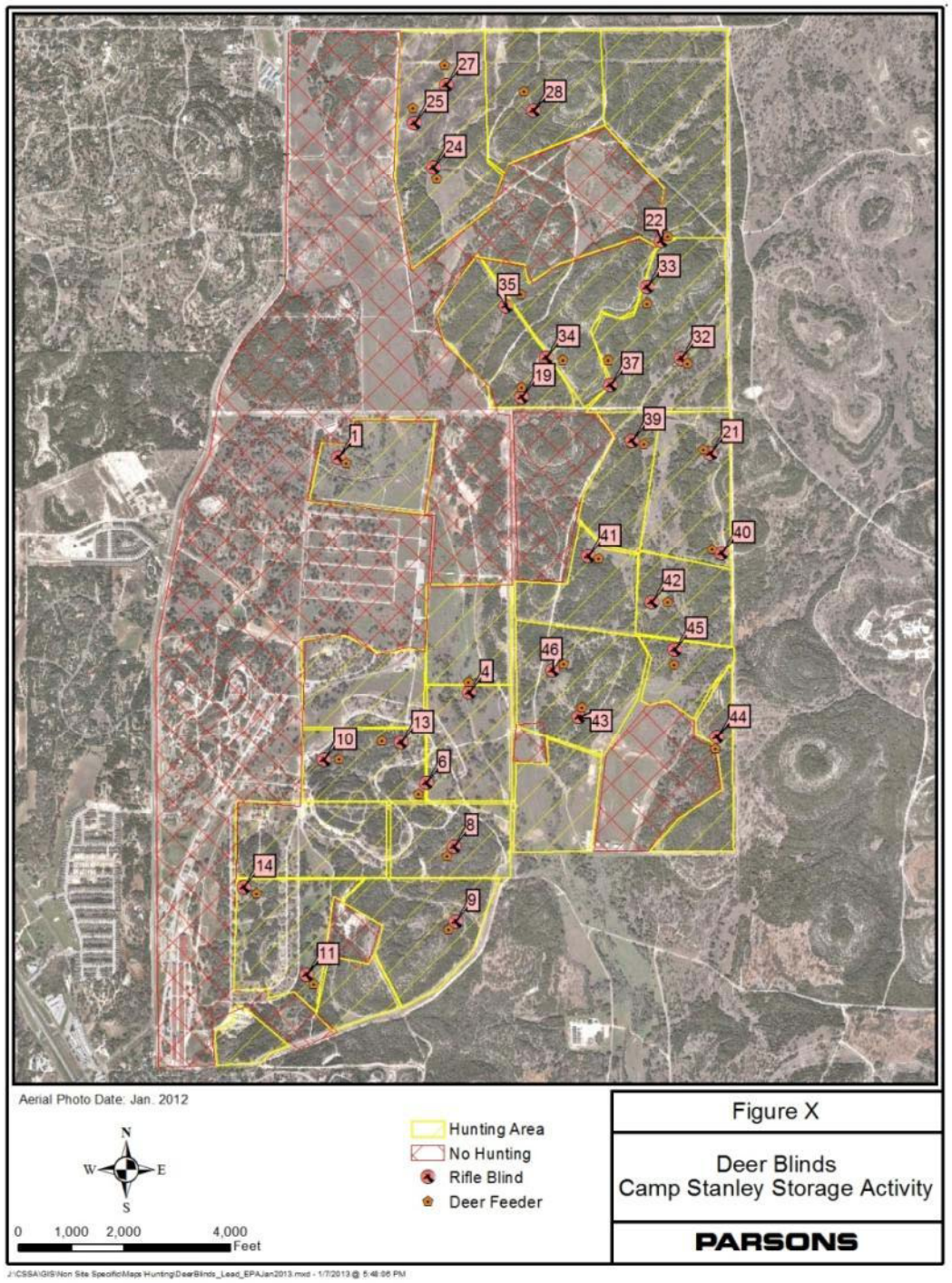
- Witkowski et al. (1982)
  - Lead concentration in deer mandibles from Pennsylvania was approximately 36 mg Pb/kg bone (ash weight)
- Woolff et al. (1982)
  - Mean lead concentration in deer livers from Illinois was 4.4 mg/kg (dry weight)

Concentrations of Lead in Deer

- Kierdorf et al. (2008)
  - Mean lead concentration in roe deer teeth from Germany were 2.36 mg/kg for first molars and 1.09 mg/kg for third molars (dry weight)

Spatial Evaluation

- Total of 29 blinds
  - 11 in North Pasture
  - 9 in East Pasture
  - 8 in SW portion of Inner Cantonment
  - 1 north of H&I



Spatial Evaluation

- Hunting success at 13 blinds
  - 2 in North Pasture
  - 6 in East Pasture
  - 5 in SW portion of Inner Cantonment

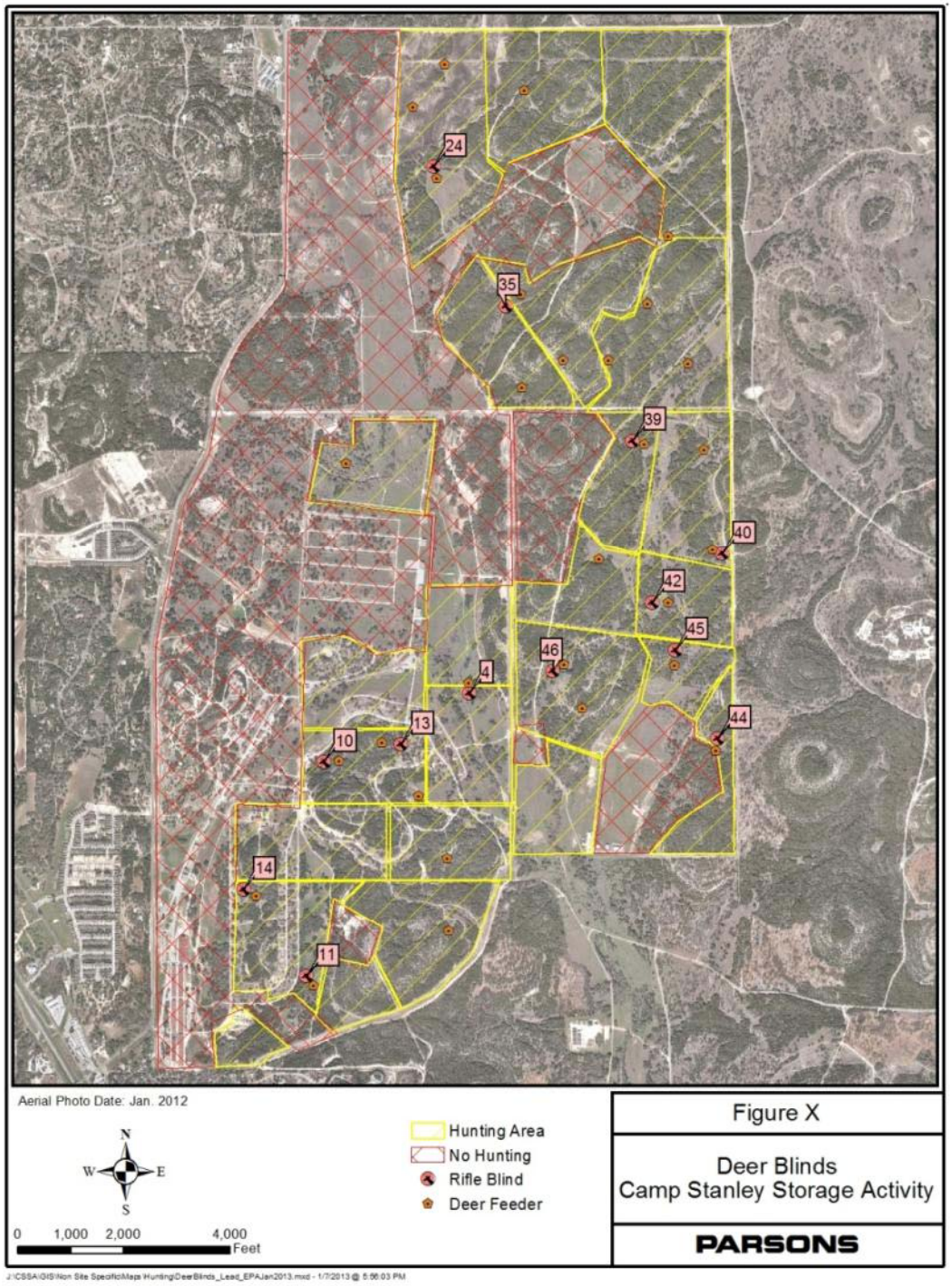
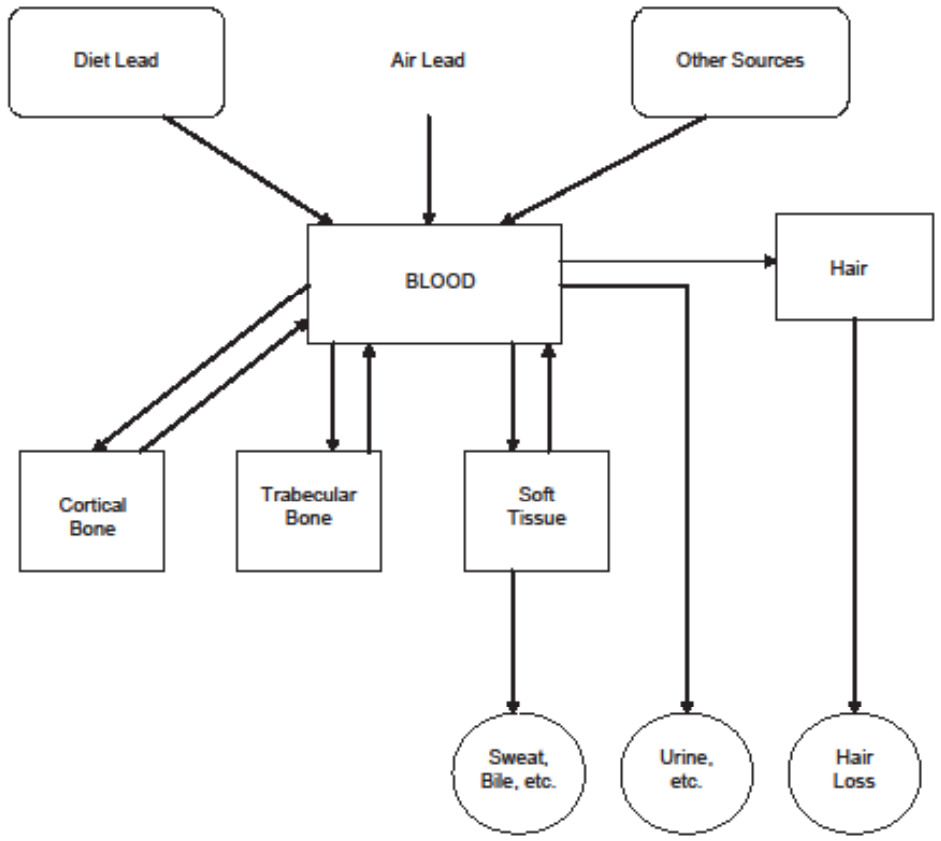


Figure 3-7. Compartments and Pathways of Lead Exchange in the Marcus (1985b) Model*



*Schematic model for lead kinetics, in which bone is represented as a cortical (slow=$t_{1/2}$ $1.2x10^4$–$3.5x10^4$ days) and trabecular (fast=$t_{1/2}$ 100–700 days) compartments.

Source: Marcus 1985b

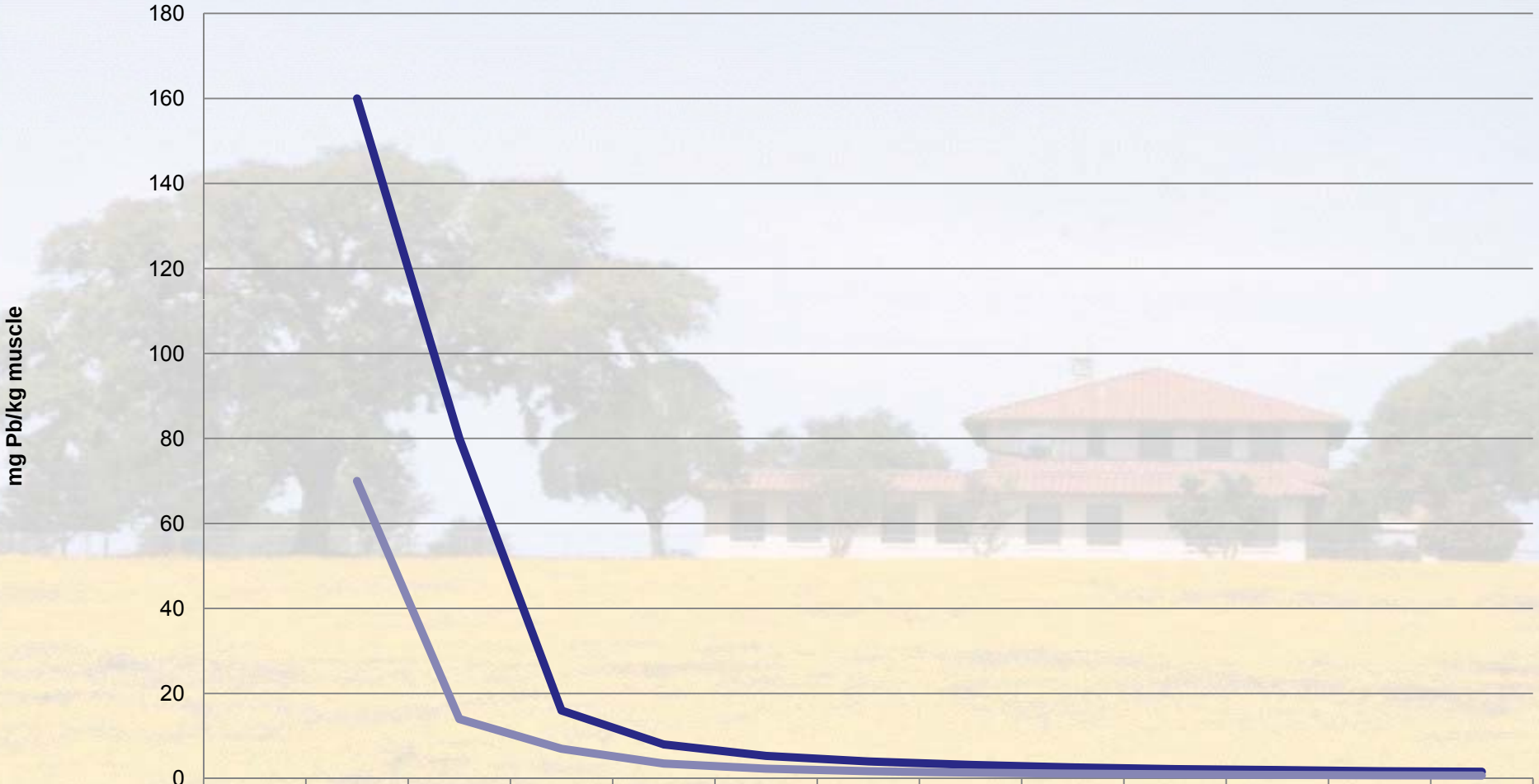
Tissue Sampling for Lead

- Tissues sampled
  - Muscle
    - Represents tissue consumed by human receptors and used to determine potential risk
  - Liver
    - Will reflect animal's recent exposure to lead
    - Lead is not stored in liver, but excreted
  - Bone
    - Will reflect animal's historic exposure to lead
    - Up to 94% of adult's body burden of lead is sequestered in bone

Screening Levels in Tissue

- USEPA's Integrated Exposure Uptake Biokinetic Model used to calculate acceptable tissue concentrations
  - Assumed 10 µg/dL PbB acceptable limit in children (however, anticipate drop to 5 µg/dL PbB)
  - Assuming 1% of child's meat diet obtained from CSSA -- tissue [Pb] < 160 mg/kg
  - Assuming 10% of child's meat diet obtained from CSSA -- tissue [Pb] <16 mg/kg

IEUBK Model Results



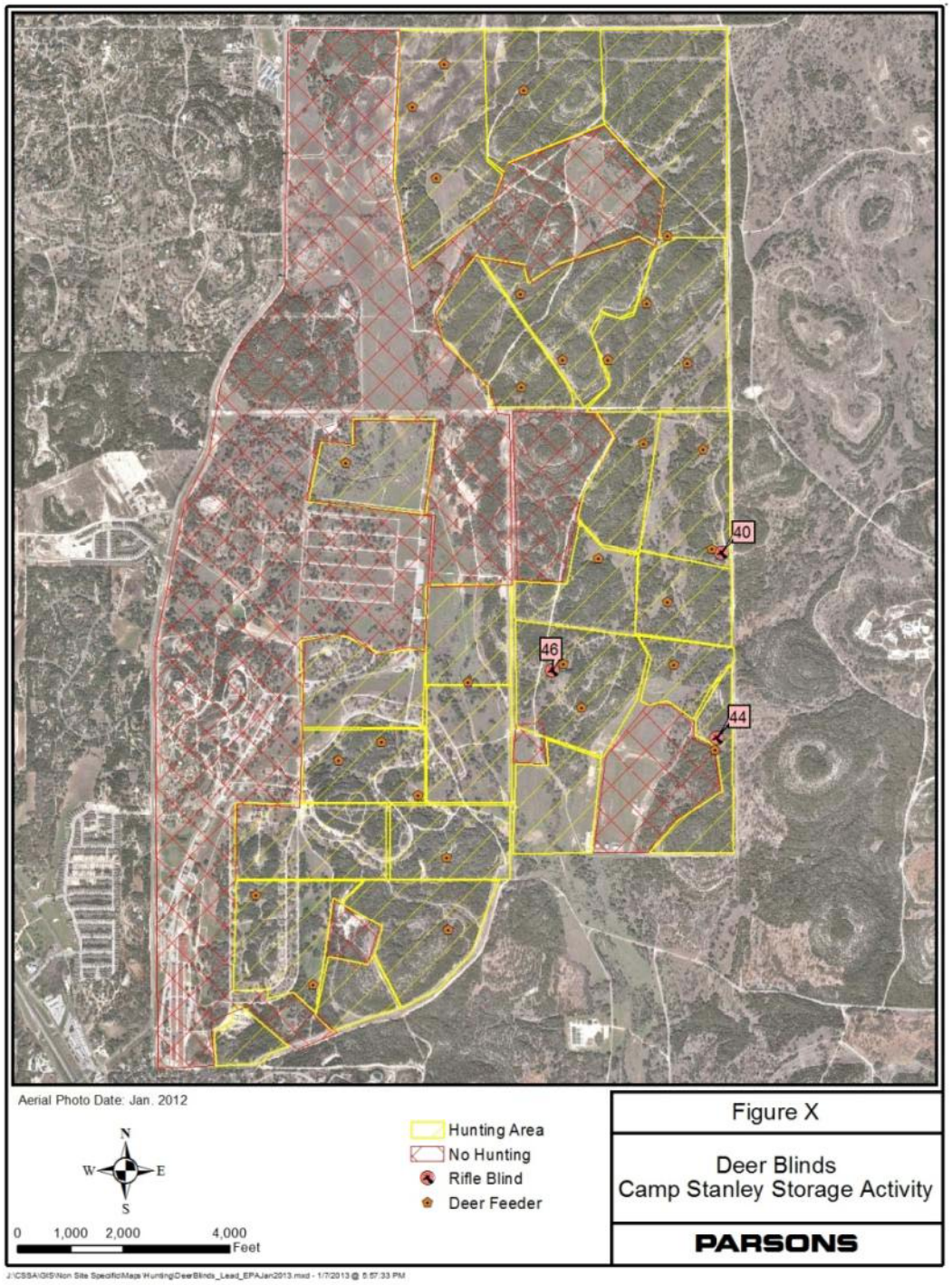
% of Diet	1	5	10	20	30	40	50	60	70	80	90	100
10 ug/dL PbB	160	80	16	8	5.3	4	3.2	2.6	2.2	2	1.7	1.6
5 ug/dL PbB	70	14	7	3.5	2.3	1.7	1.4	1.1	1	0.85	0.75	0.7

Results

- Samples collected from 21 animals
  - 19 deer,1 feral hog, 1 turkey
  - No Pb detected in muscle or liver samples
    - <0.5 mg/kg
  - Pb detected in 5 bone samples
    - Concentrations range from 0.71 – 2.7 mg Pb/kg bone

Spatial Evaluation

- Lead in bone at 3 blinds
  - 3 in East Pasture



Conclusions

- No evidence of risk to human health
  - Muscle tissue was all ND for lead
- Some animals may be exposed to lead
  - Five animals with detectable lead in bone
  - Concentrations are low and likely don't pose a risk to the animal
  - Exposed animals were all harvested from area of active range

Conclusions (cont)

- With regards to Risk Assessment required by Order:
  - No additional risk assessment required for sites closed under RRS1 or TRRP
  - SWMU B-3 and AOC-65 pose no ecological risk (groundwater contamination sites)
  - Other sites are in active range fan; risk evaluation not appropriate at this time

CLOSURE PATH FOR EPA ORDER

CSSA 3008(h) Order Timeline