Camp Stanley Storage Activity

Jan. 25, 2011

Name	Organization	Phone
Julie Burdey	Parsons	512-719-6062
Bob Edwards	Noblis	210-408-5552
Wayne Elliott	Ft Worth Corps	817-886-1666
Mike Chapa	Weston	210.248.2423
Greg Stanton	USGS	512-927-3558
David v. Smith	USGS	303 236-1228
Chuck Blome	USGS	303-236-1278
Laura Marbury	Parsons	512/719-6855
Kim Rice	Parsons	512/719-6050
Russ Cason	Weston	210/~~830~~ 308-4338
Greg Lyssy	USEPA	214 543 4415
Kirk Coulter	TCEQ	512 239-2577
Chris Beal	Portage/CSSA	210-336-1171
Tim Cannizzo	US Army CSSA	210-295-7082
Brenda Shirley	Portage/CSSA	210-295-7320
Teresa Benavides	CSSA Safety	210-295-7356

Camp Stanley Storage Activity Status Update

January 25, 2011

INTRODUCTION

Agenda

9:30am Introduction

9:45am SWMU and AOC Updates

- SWMU B-4
- Overall approach to investigation/interim remedial action/closure
- B-34, AOC-45, other XRF/sampling sites
- SWMUs B-28, B-15/16, B-24
- Geophysical Survey

10:45am Break

11:00am Groundwater

- Well Survey Update
- Long-Term Monitoring Optimization (LTMO) and Data Quality Objectives (DQO) Update Review Status
- Planned Wells
- Downhole Logging
- 3D Mapping

12:00pm Lunch

Agenda (cont)

1:00pm Building 90 Decommissioning

1:30pm Treatability Study Updates

- AOC-65 Treatability Study
- Soil Vapor Analysis
- B-3 Treatability Study
- Isotope Analysis

2:45pm Miscellaneous

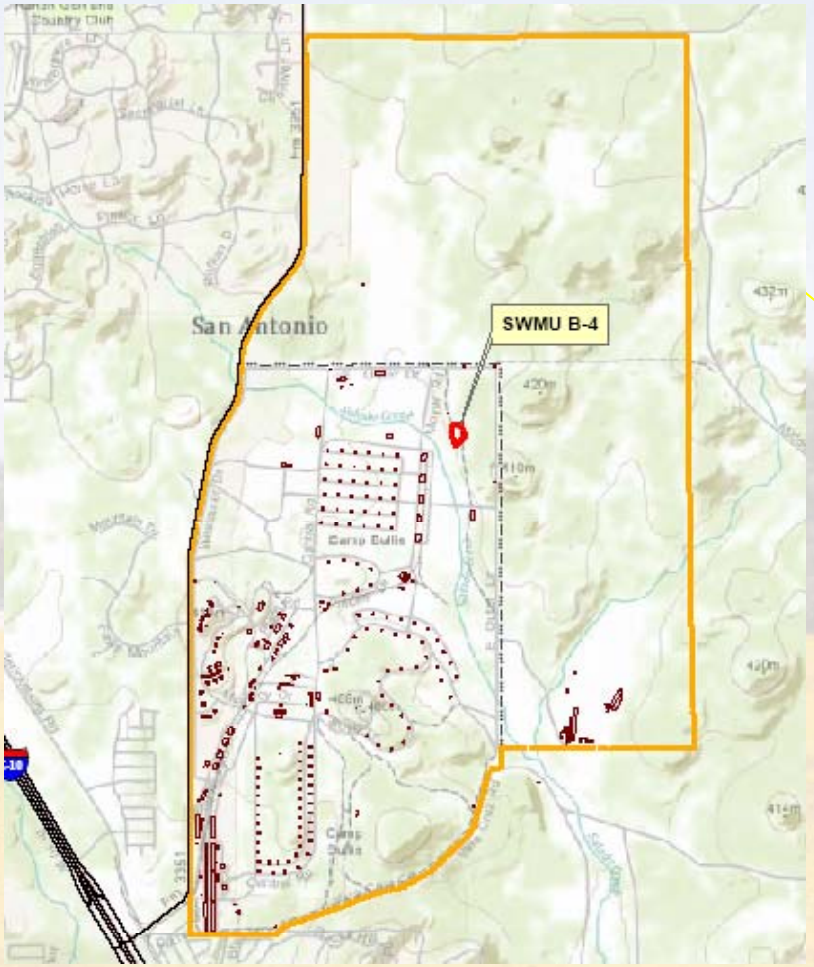
3:00pm Site visit to SWMU B-15/16

SWMU & AOC UPDATES

SWMU B-4

SWMU B-4 Background

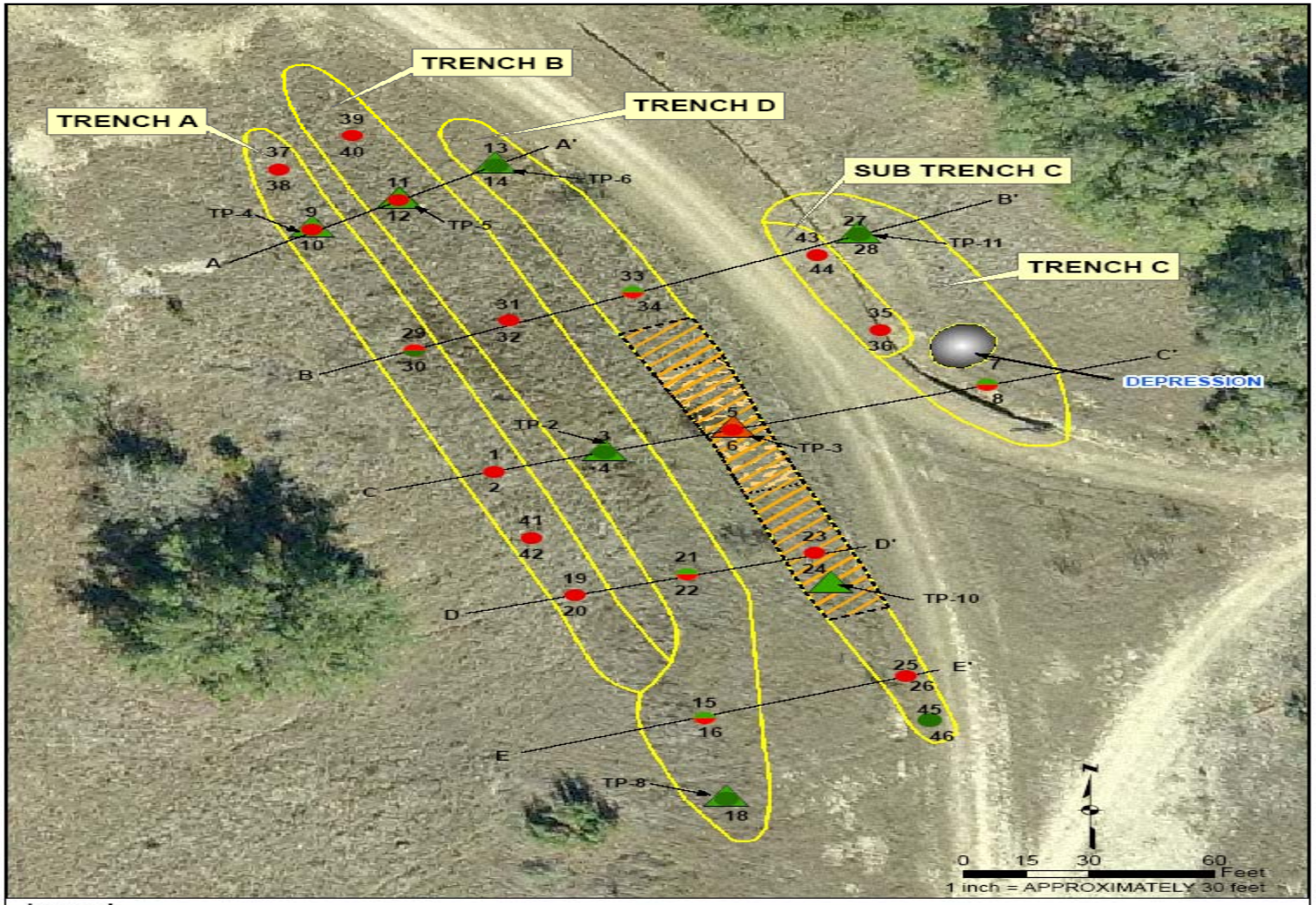
- Former disposal trenches used to bury classified documents, trash, munitions debris, small arms ammo, and miscellaneous waste.
- Period of use unknown (apparently into 80's based on 1982 historical aerial).



Site Area Approximately 2 Acres

SWMU B-4

- Four trenches found, 10 to 12 feet deep:
  - Munitions debris
  - Unexpended small arms ammo (Trench D)
  - Vehicle Parts
  - Misc metal debris, plastic sheeting, etc.
- Analytical results:
  - VOCs, SVOCs, and explosives < Tier 1 RALs
  - Metals - Ba, Cd, Cu, Pb, Hg, Ni, and Zn > Tier 1 RALs
  - Pb and Cd > TCLP limit in one sample in lower layer material from Trench D
  - Hg > background and Tier 1 RAL in native soil (LFM 6) in Trench D bottom



Legend

Sample Locations

23 / 24 — Upper Sample (LFM - 23) / Trench Material / Lower Sample (LFM - 24)

TP - 4 — Native Soil From Trench Bottom

Result Indicators

- < Target Goals (See Notes)
- > Target Goals
- Unexpended Small Arms Ammunition Found in Trench Material
- Extent of Trench Material Potentially Requiring Stabilization

A —— A' Exploratory Trench Transect

Notes:
1. Target goals equal the greater concentration of background, Texas Risk Reduction Program (TRRP) Residential Assessment Levels (30 Acre source), or Ecological Risk Benchmarks.
2. Barium, Cadmium, Lead, and Mercury were only constituents exceeding target goals.
3. Sample LFM-6, Trench D exceeded Federal Toxicity Characteristic Leaching Procedure (TCLP) Limits for Cadmium and Lead.

WESTON SOLUTIONS, Inc.
Suite 600
70 N.E. Loop 410
San Antonio, Texas 78216-5842
210-308-4300 • Fax 210-308-4329

FIGURE - 1
PHASE 1 EXPLORATORY EXCAVATION SUMMARY
ASSESSMENT AND INTERIM
REMOVAL ACTION - SWMU - B - 4
CAMP STANLEY STORAGE ACTIVITY
BOERNE, TEXAS

DATE	PROJECT NO.	SCALE
MAY, 2010	03886.535.018.0004.00	AS SHOWN

SWMU B-4 Interim Removal Action

- Remove trench soil and debris, segregate metal/debris
- Sift small arms ammo from Trench D. CSSA will dispose of ammo. Stabilize soil exceeding TCLP standards to non-hazardous waste criteria.
- Transport non-hazardous soil to East Pasture.
- Removal Goal: Background, TRRP PCLs or ecological benchmark screening values to attain Remedy A residential use closure.
- Confirmation Sampling
  - COC List: Ba, Cd, Cu, Pb, Hg, Ni, and Zn.
  - Minimum Sample frequency: 1 per 50 feet of sidewall and trench floor.

SWMU B-4 Trench C

Very High Metal Debris Content in Trench C

SWMU B-4 Trench C

Progressive Excavation of Trench C

Metal Debris from Trench C

SWMU B-4 Trench A

Northern Section Trench A with Debris Removed

AOC-64/SWMU B-71

- All COCs > Tier 2 PCLs Removed
- All COCs > Ecological Risk Benchmark Screening Values at 0-0.5 ft Removed
- Sidewall and Floor Samples Analyzed for VOCs, SVOCs, Metals and Explosives
- Vertical Delineation of Inorganic COCs to Background at Both Sites
- N-Nitrosodiphenylamine near RL in 2 of 4 Floor Samples at SWMU B-71.
  - Concentrations of 0.0132J and 0.0191J mg/kg (Tier 1 PCL 1.4 mg/kg).
- Benzene near RL in 1 of 5 Floor Samples at AOC 64
  - Concentration of 0.0015 mg/kg (Tier 1 PCL 0.013 mg/kg).
- APAR:
  - Follow up Eco Risk Confirmation Samples – January 2011
  - NFA Based on Post-Removal Conditions
  - To be Submitted for TCEQ Review March 2011

OVERALL APPROACH TO SITE CLOSURES

Overall Approach to Site Closures

- Remaining Open Sites: 24
- Goals:
  - Remedy-in-Place by 2020
  - Close approx. one site per quarter
  - Continue to close to Tier 1 PCLs with RIR, where possible
- Approach for Success:
  - Continue on-going efforts to address groundwater contamination
  - Complete closures nearly complete
  - Focus first on field efforts
    - XRF / soil sampling to identify extent
    - MEC / MD: On-site shredder
    - Geophysical surveys
  - Combine sites for reporting / closure when APAR required

SWMUs	**AOCs**
B-2	AOC-42
B-3	AOC-45
B-4	AOC-51
B-8	AOC-52
B-13	AOC-57
B-15/16	AOC-58
B-20/21	AOC-59
B-24	AOC-62
B-27	AOC-64
B-28	AOC-65
B-34	AOC-70
B-71	AOC-72

Est. 70,000 CY of material to be removed

For Remaining Open Sites

"*Determining Which Releases are Subject to TRRP*" (TCEQ, 2010)

RIR

- Concentrations do not exceed Tier 1 residential soil action levels.
- No evidence of other affected or threatened media (groundwater, surface water, or sediment).
- Site passes the Tier 1 Ecological Exclusion Criteria Checklist.
- CSSA's goal is to close as many sites as possible with RIR.

SWMUs	**AOCs**	
B-13	AOC-42	AOC-59
B-15/16	AOC-45	AOC-62
B-27	AOC-52	AOC-70
B-28	AOC-57	AOC-72
	AOC-58	

APAR

- Concentrations exceed Tier 1 residential soil action levels.
- Development of Tier 2 PCLs.
- If concentrations do not exceed Tier 2 PCLs, then no further action (NFA) may be recommended.

Non-Commercial Areas
B-2
B-3
B-8
B-20/21
B-24
AOC-51

Commercial Areas
B-34
AOC-65

Underway
(Non-Commercial)
AOC-64
B-71
B-4

EVALUATION OF REMAINING SITES AT CSSA

Site	Approximate Current Size of Site (acre)	Human Health Criteria/ Evaluation	EXCLUSION of Ecological Component Based on Size of Site (≤ 1 acre) or Other Characteristic	Ecological Habitat (Yes or No)	BCVI and/or GCWA Habitat † (Yes or No)	Expected Type of Closure Report Based on Current or Planned Removal/Excavation Activities
North Pasture (Non-commercial)						
B-2	3.6	Residential	--	Yes	Yes	APAR (Tier 2 HH and Eco)
B-8	5.2	Residential	--	Yes	Yes	APAR (Tier 2 HH and Eco)
B-20/21	36	Residential	--	Yes	Yes	APAR (Tier 2 HH and Eco)
B-24	4.1	Residential	--	Yes	Yes	APAR (Tier 2 HH and Eco)
East Pasture (Non-commercial)						
B-15/16	3.5	Residential	--	Yes	No	RIR (Tier 1 HH and Eco)
AOC-51	72	Residential	--	Yes	Yes	To be determined
AOC-59	0.2	Residential	≤ 1 acre	No	No	RIR (Tier 1 HH)
Inner Cantonment (NE Area; Non-commercial)						
B-28	1.4	Residential	--	Yes	No	RIR (Tier 1 HH and Eco)
AOC-42	2.5	Residential	--	Yes	No	RIR (Tier 1 HH and Eco)
AOC-52	0.5	Residential	≤ 1 acre	No	No	RIR (Tier 1 HH)
AOC-58	0.4	Residential	≤ 1 acre	No	No	RIR (Tier 1 HH)
AOC-62	0.4	Residential	≤ 1 acre	No	No	RIR (Tier 1 HH)
Inner Cantonment (Other Non-commercial)						
B-13	1.5	Residential	--	Yes	No	RIR (Tier 1 HH and Eco)
B-27	2.0	Residential	--	Yes	No	RIR (Tier 1 HH and Eco)
AOC-45	0.5	Residential	≤ 1 acre	No	No	RIR (Tier 1 HH)
AOC-70	0.006	Residential	≤ 1 acre	No	No	RIR (Tier 1 HH)
AOC-57	6.3	Residential	--	No	No	RIR (Tier 1 HH)
AOC-72	0.1	Residential	≤ 1 acre	No	No	RIR (Tier 1 HH)
Inner Cantonment (Commercial)						
B-34	0.2	Comm./Indus.	≤ 1 acre; comm./indus.	No	No	APAR (Tier 2 HH)

† Located within primary (core) and/or secondary (non-core) BCVI and/or GCWA habitat, or within foraging range of BCVI and/or GCWA.

STATUS OF REMAINING SITES

Status of Remaining Sites

Recently Completed/Underway:

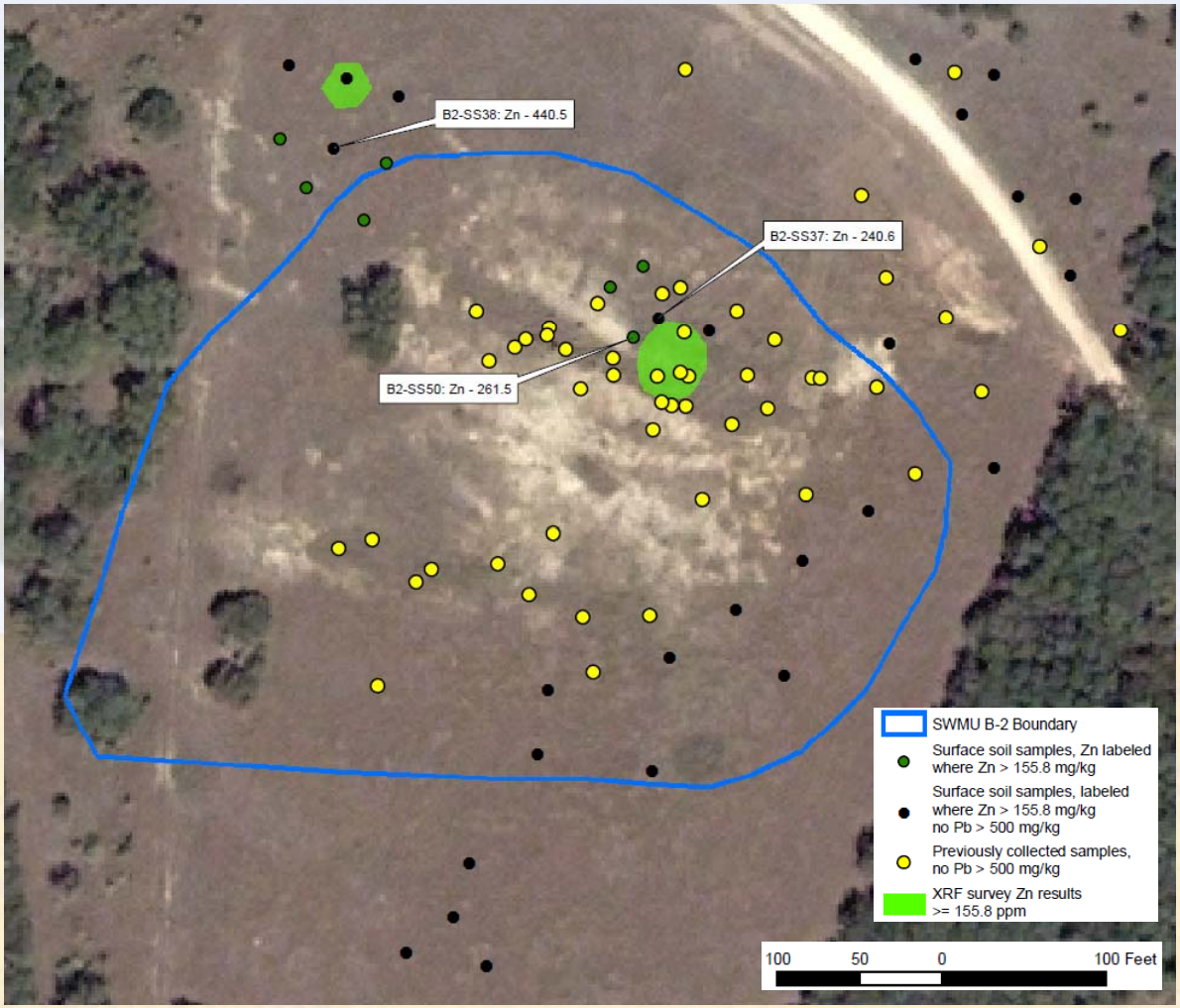
- Soil Removal: B-2, B-28
- Waste / MD Removal: B-4, B-15/16, B-24
- XRF / Soil Sampling: B-34, AOC-45, AOC-51, AOC-57, AOC-59, AOC-70, AOC-72

Future:

- Waste Removal / Soil Removal: B-13, B-8, B-20/21, AOC-42, AOC-52, AOC-58, AOC-62, B-27

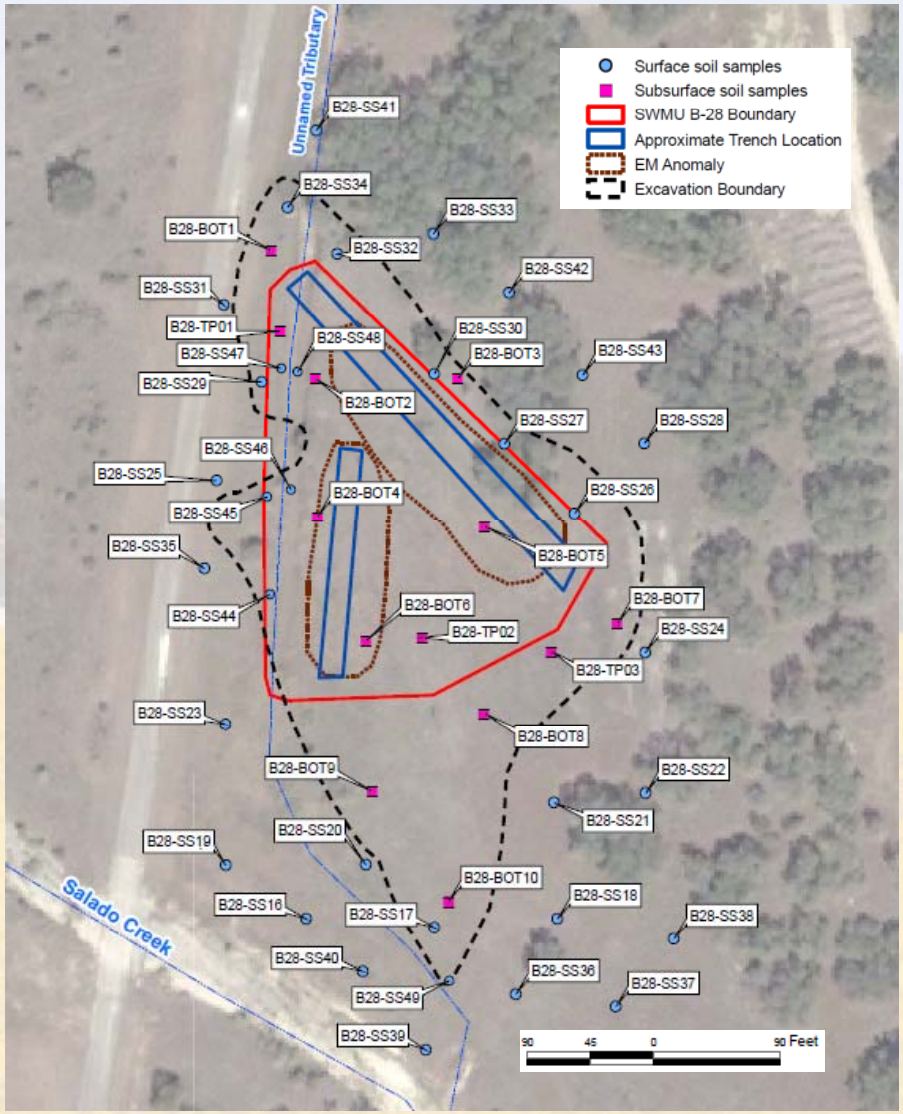
Soil Removal
SWMU B-2

- December 2010
  - Excavated previous DNT sample location
  - Additional soil samples collected across site to verify XRF results
    - Pb < Tier 2 PCL
    - 95% UCL Zn < Tier 2 PCL
- Next Steps
  - APAR and closure



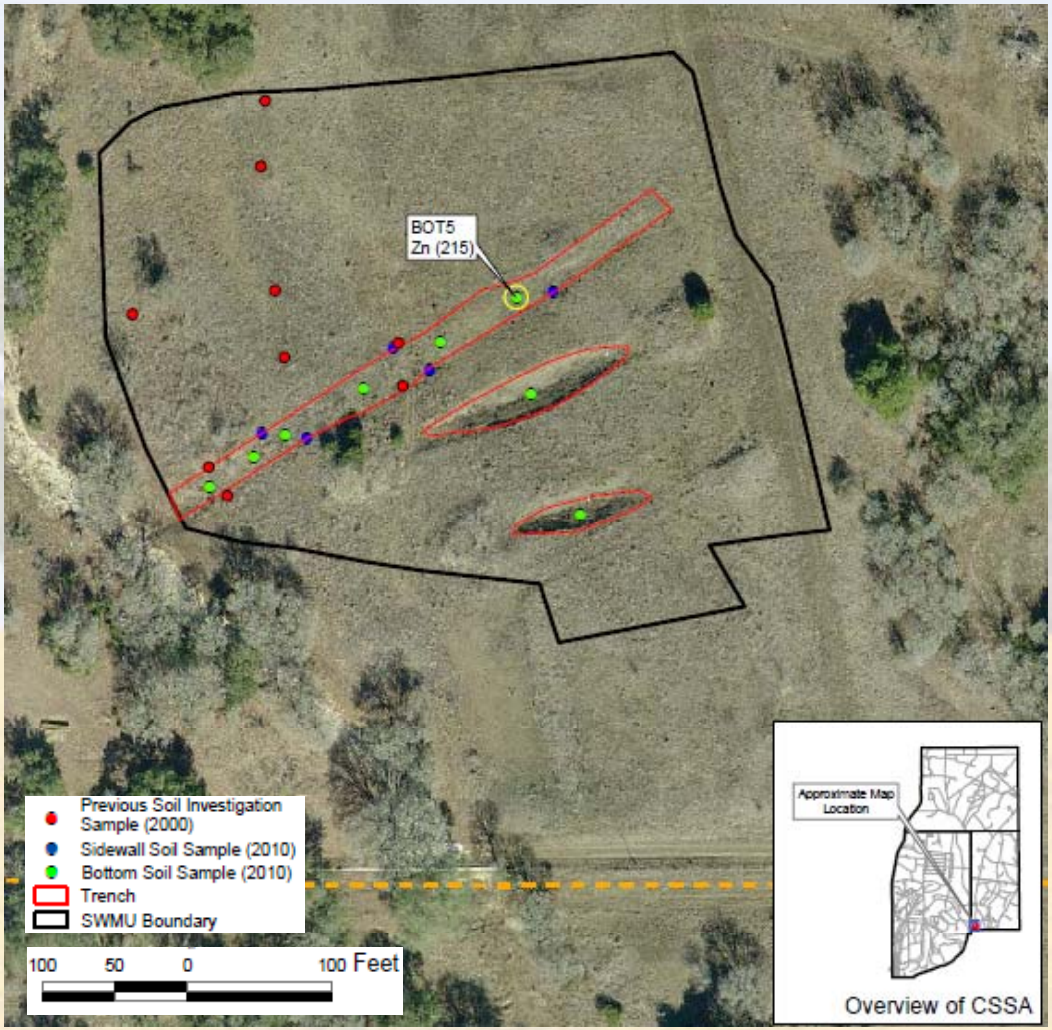
Soil Removal
SWMU B-28

- November 2010
  - Additional soil samples collected to verify excavation extent
- December 2010
  - Excavation to Tier 1 PCLs
  - Scraped surface soils across 2 acres to 1 foot deep
  - Removal of approx. 2,200 CY, hauled to east pasture berm
- Next steps
  - Awaiting BOT confirmation samples
  - RIR and closure



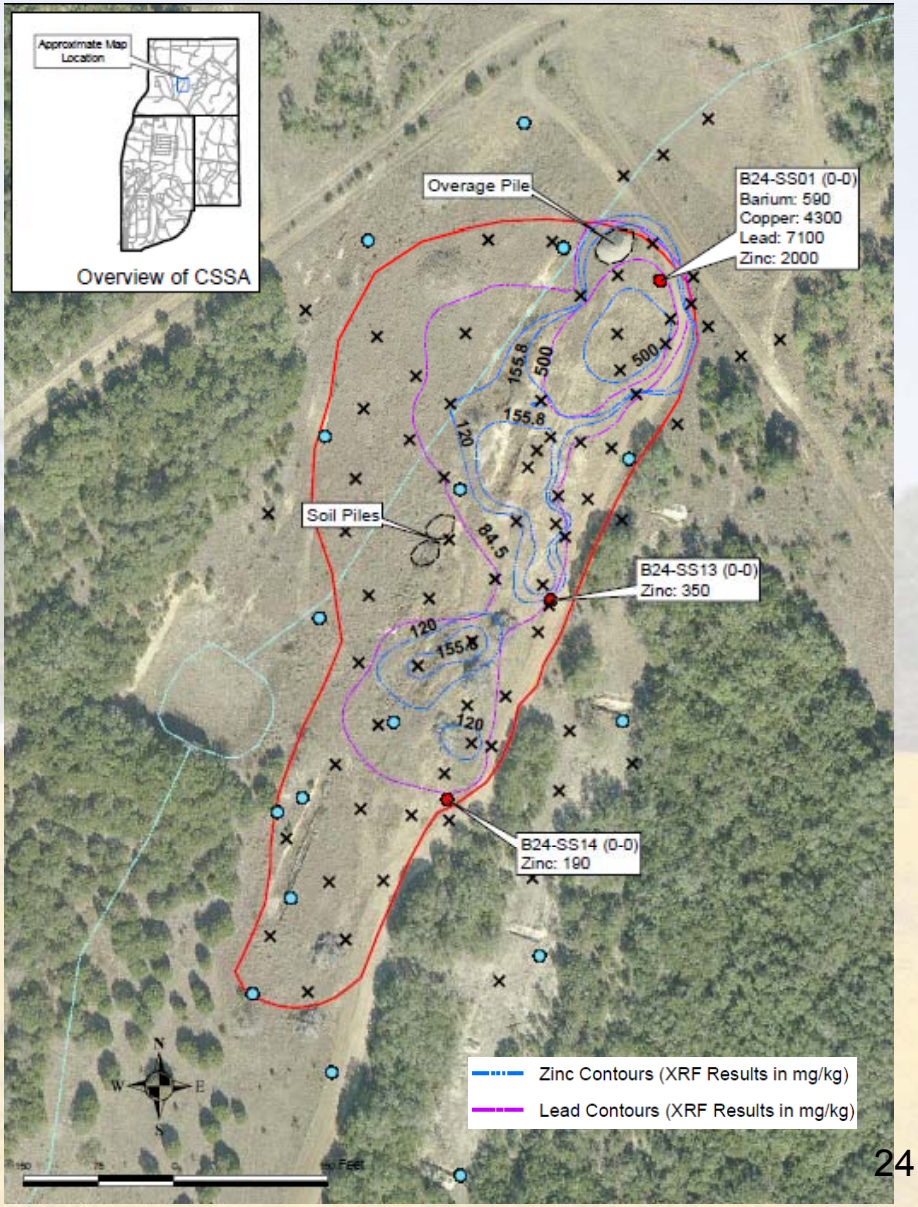
Waste / MD Removal
SWMU B-15/16

- Excavation to Tier 1 PCLs
- March 2010
  - Trench 1 excavated, 1,400 CY
    - Munitions debris, PCE labeled drum, target vehicles, weapons mounts, tires, misc. scrap metal
- January 2011
  - Trench 2 excavated (1,000 CY)
    - Gun barrels
  - Trench 3 excavated (500 CY)
    - Gun turrets, misc gun parts
  - Excavated elevated Zn area at BOT5
  - Ground sifting operations for MD removal and sorting
  - No MEC found
- Next Steps
  - Complete sifting operations
  - RIR and closure



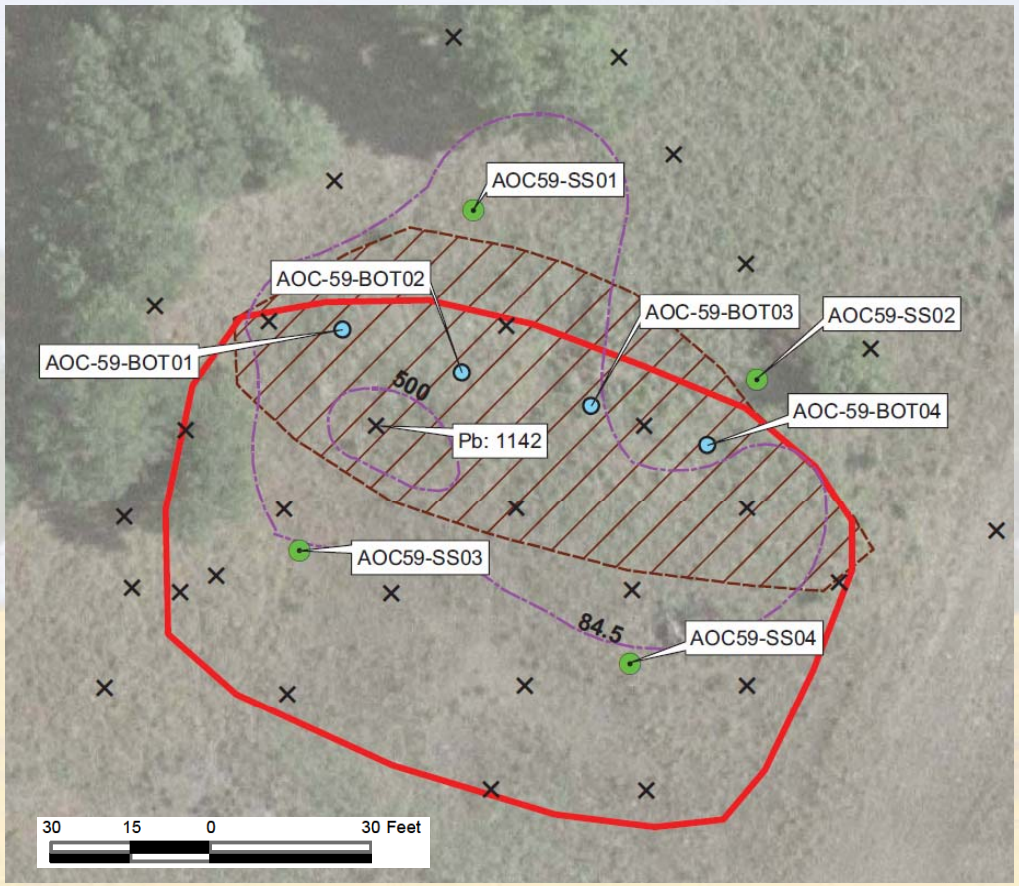
Soil / MEC & MD Removal
SWMU B-24

- MEC and MC contamination
- December 2010
  - XRF survey across site to help delineate soil contamination for removal: Pb and Zn > Tier 2 PCLs
- Next Steps
  - Sort overage pile
  - Collect surface soil samples to delineate contamination
  - Excavate contaminated soils (>Tier 2 PCLs)
  - APAR and closure



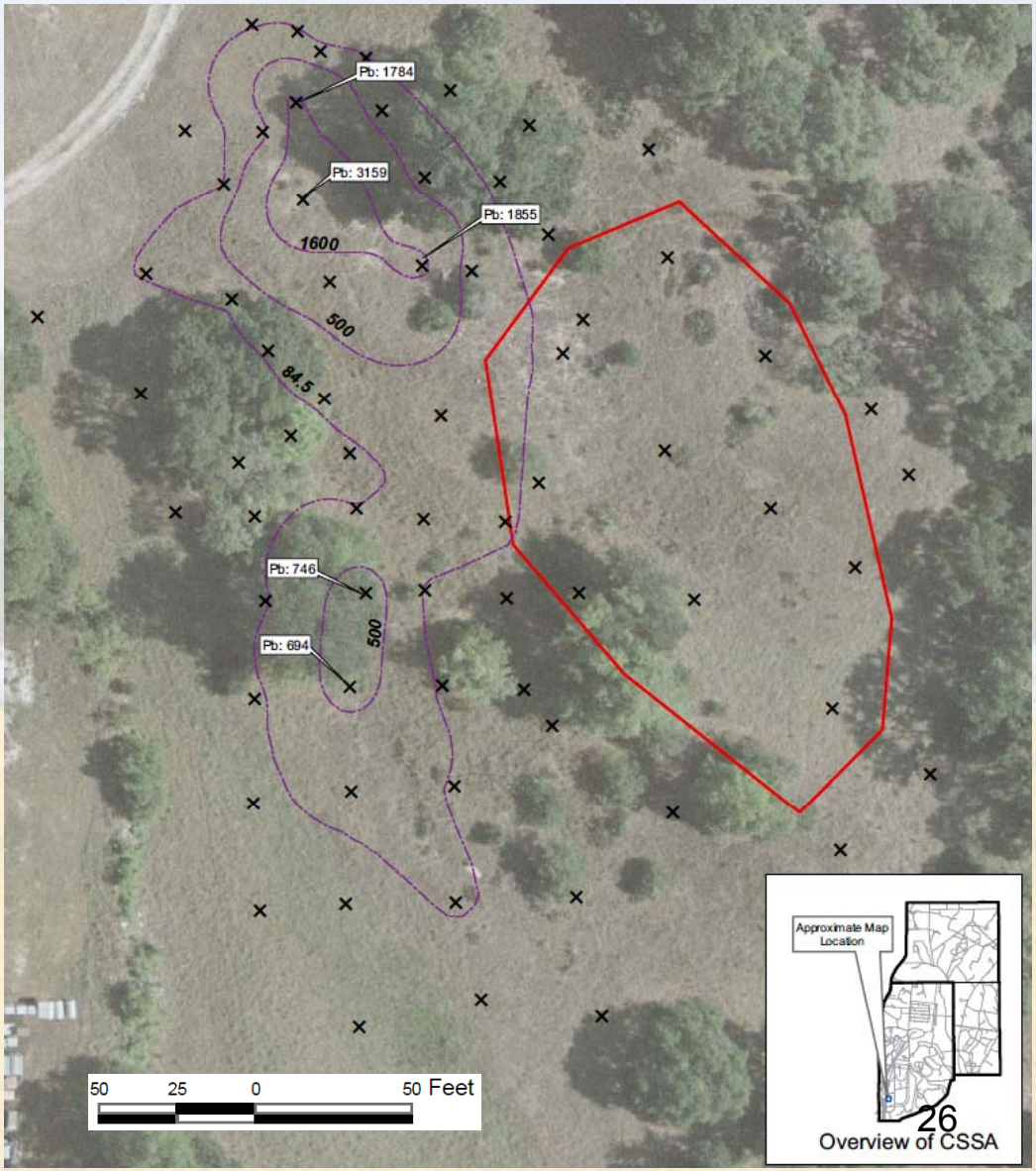
XRF / Soil Sampling
AOC-59

- Anomaly, 0.2 acres
- Previous work: BOT soil samples, geophysical survey
- December 2010
  - XRF survey: Pb > Tier 1 PCL
- January 2011
  - Surface soil samples collected – CSSA 9 metals, explosives
- Next Steps
  - Excavate contaminated soils (>Tier 1 PCLs)
  - RIR and closure



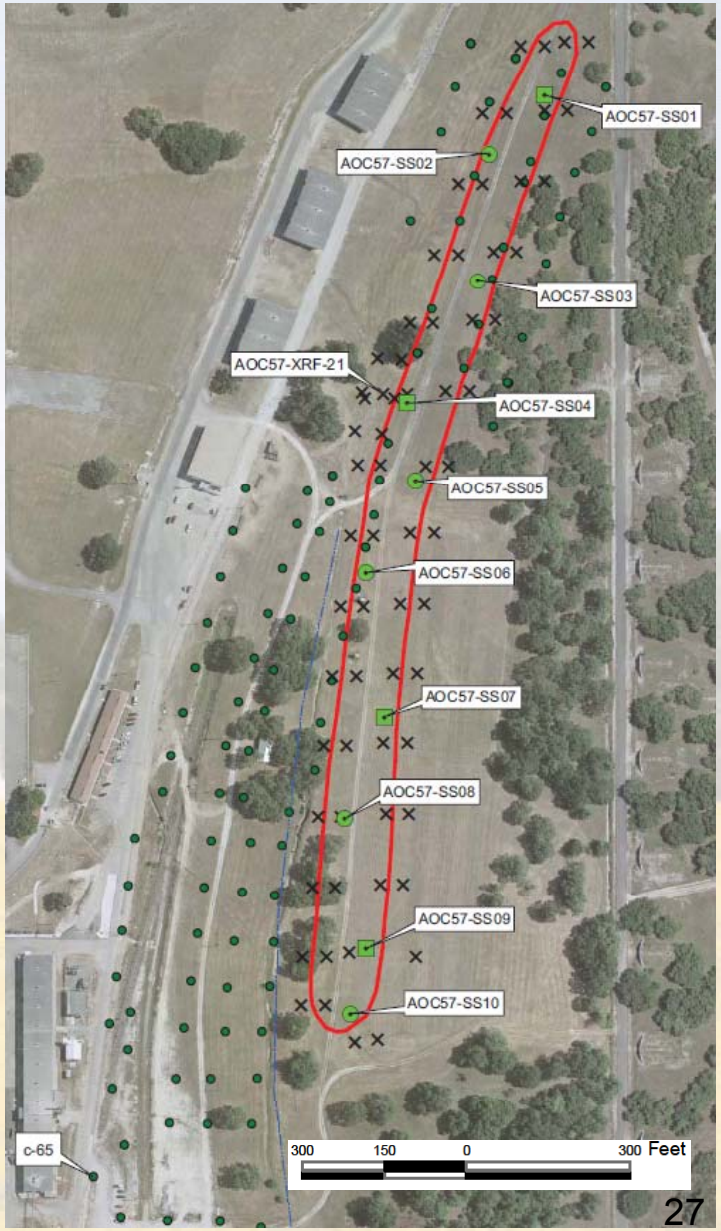
XRF Sampling
AOC-45

- Ammunition disposal area, 0.5 acre
- Previous work: none
- December 2010
  - XRF survey: Pb > Tier 1 PCLs, minimal Zn > background
- Next Steps
  - Work within CSSA's plans to construct retention pond in the area
  - RIR and Closure



XRF / Soil Sampling AOC-57

- Area used for cleaning and maintenance activities, 6.3 acres
- Previous work: soil gas survey, no detections on site
- December 2010
  - XRF survey:
    Pb and Zn < background
- January 2011
  - Surface soil samples: 10 total, all for CSSA 9 metals plus 4 also for VOCs, SVOCs
- Next Steps
  - Based on sample results, RIR and site closure

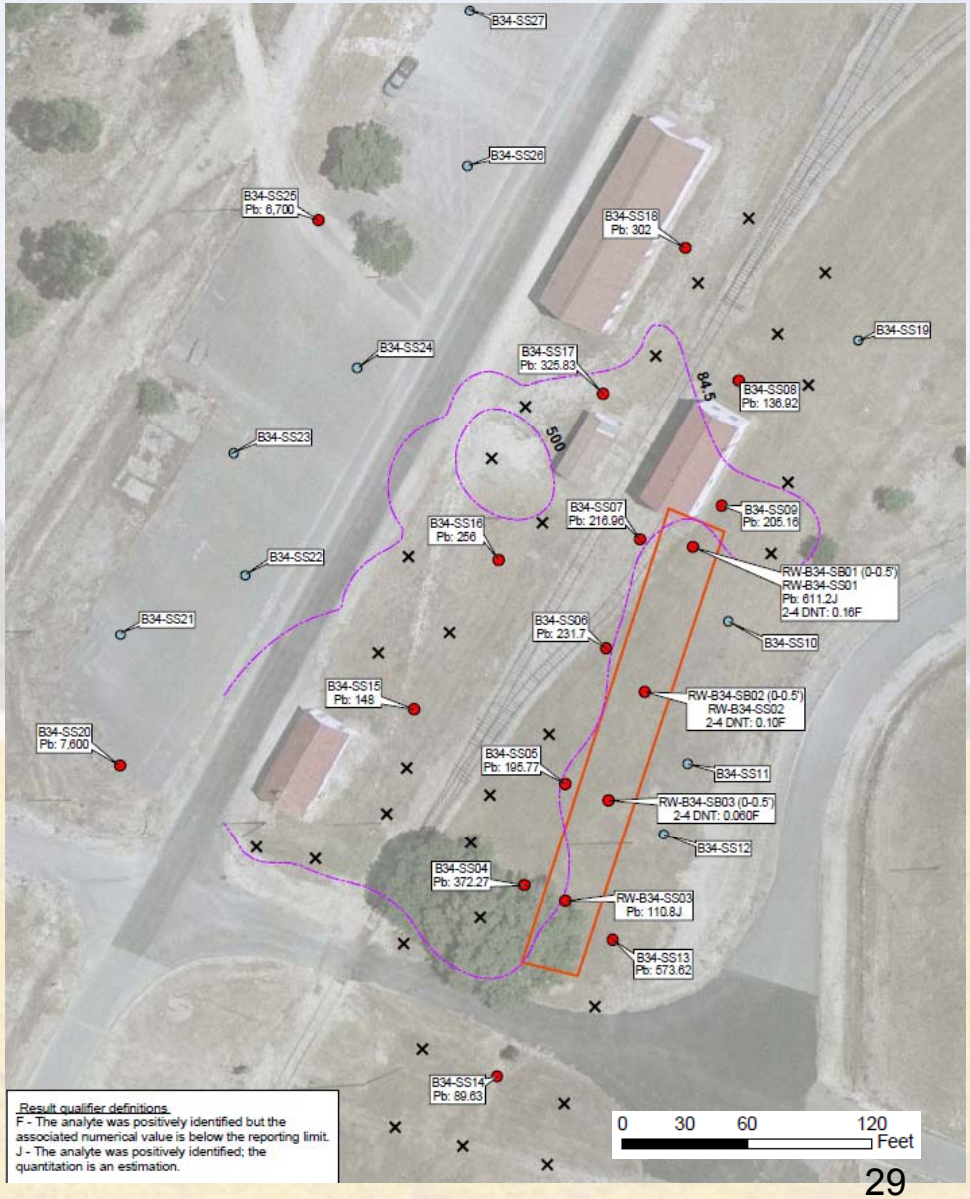


XRF Sampling
RMU-5

- Suspected former rocket range, 19.3 acres
- Previous investigations: none
- December 2010
  - XRF survey:
    Pb and Zn < background .
  - Large amount of MD observed, however nothing indicative of a rocket range, only activities that occurred on the B-20/21 site.
- Next Steps
  - Include in MEC investigations of SWMUs B-20/21 and B-24

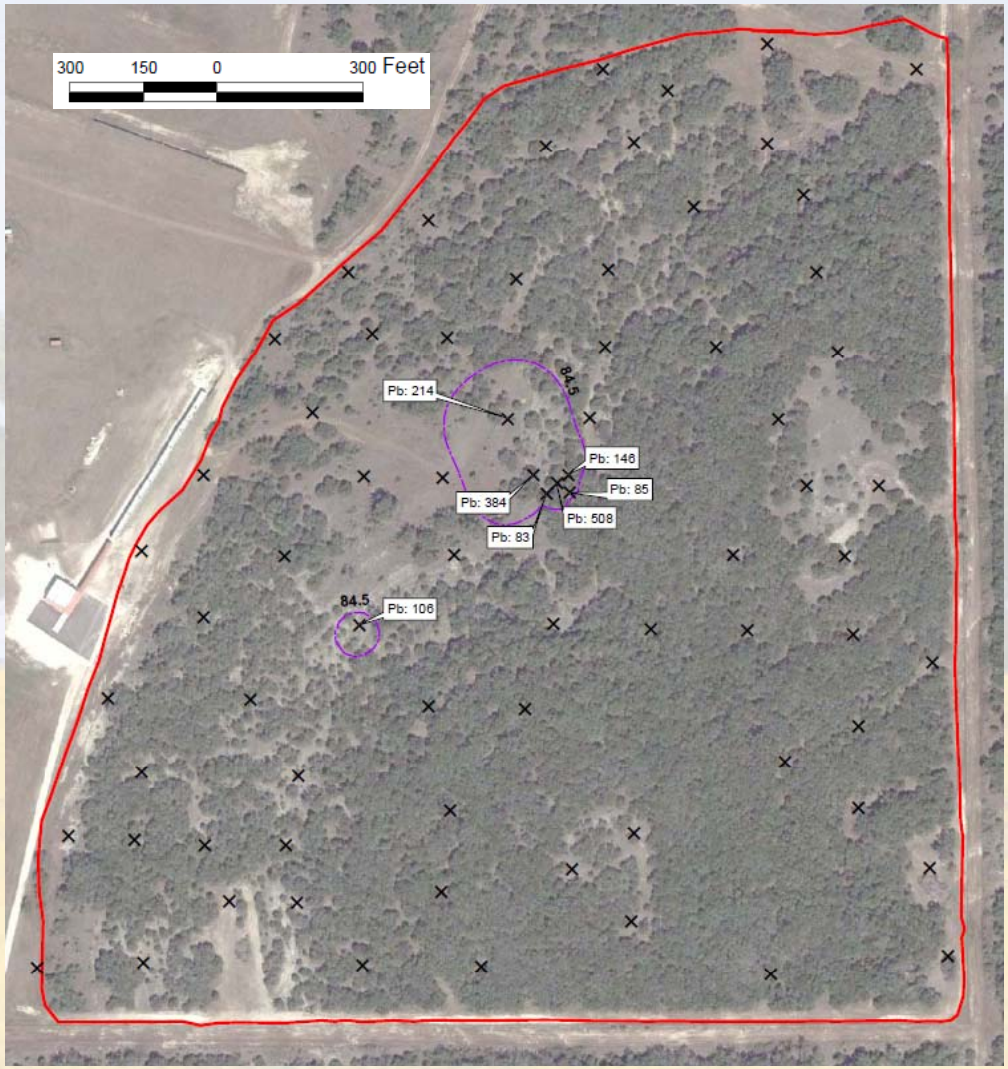
XRF / Soil Sampling SWMU B-34

- Soil contamination site, originally 0.5 acres
- Previous investigations: geophysical survey, surface and subsurface soil samples.
- December 2010
  - XRF survey: Pb > Tier 1 Commercial PCLs but not Tier 2
- January 2011
  - Developed site specific Tier 2 Commercial PCL for Pb (3,015 mg/kg).
  - Two surface soil samples above: SS20 (7,600 mg/kg) and SS25 (6,700 mg/kg)
- Next Steps
  - Surface soil sampling to confirm area > Tier 2 PCL for Pb
  - Potentially excavate contaminated soils (> Tier 2 PCL)
  - APAR and closure



XRF Sampling AOC-51

- Scattered ordnance site, 72 acres
- Previous investigations: surface soil sampling
- December 2010
  - XRF Survey: Pb > Tier 1 PCL, Zn > background, but not Tier 1 PCL
  - Significant MD throughout site, including expended projectiles, mortars
- Next Steps
  - Field map
  - geophysical survey



Soil Sampling
AOC-70

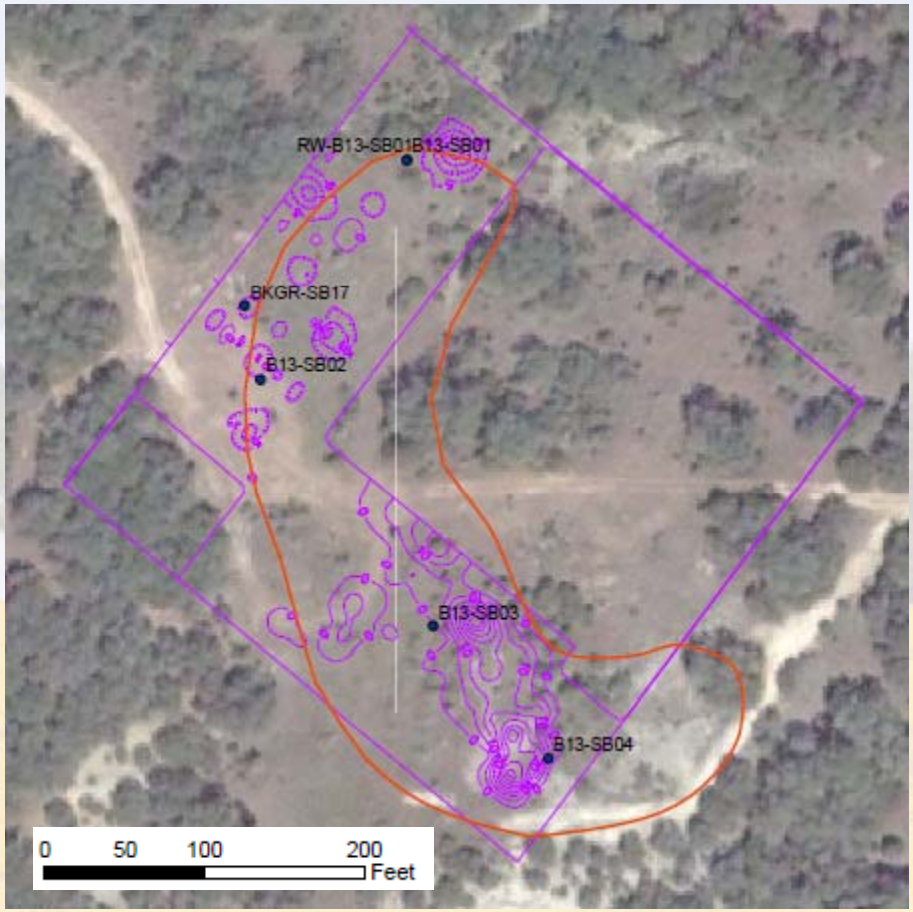
- Former pesticide storage and mixing building, 225 ft^2
- Previous investigations: None, however the building was pressure washed and remodeled in August 2006
- Confirmation samples of wash water showed no pesticides
- January 2011
  - Surface soil samples: pesticides and herbicides
- Next Steps
  - Pending sample results, remove contaminated soils to Tier 1 PCLs, if necessary
  - RIR and closure

XRF Sampling
AOC-72

- Construction debris landfill, 0.1 acre
- Previous investigations: none
- December 2010
  - XRF Survey: one location with Zn > background, but < Tier 1 PCL
- Next Steps
  - Soil sampling
  - Assess site for possible debris removal
  - RIR and closure

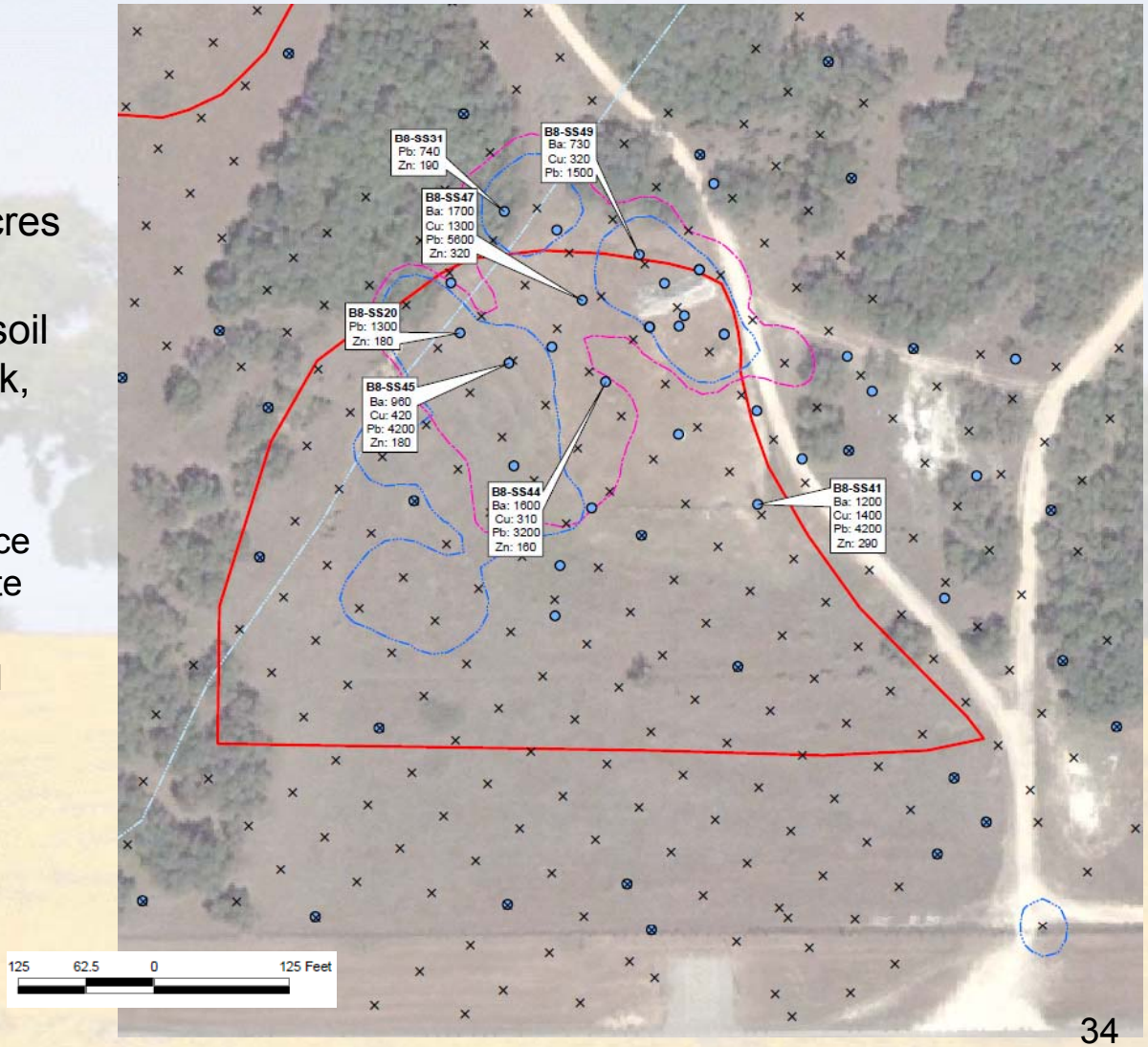
Upcoming Work
SWMU B-13

- Construction waste disposal site mixed with small arms munitions, 1.5 acres
- Previous investigations: geophysical survey, soil borings
- Next Steps
  - Excavate anomaly areas (> Tier 1 PCLs)
  - RIR and Closure



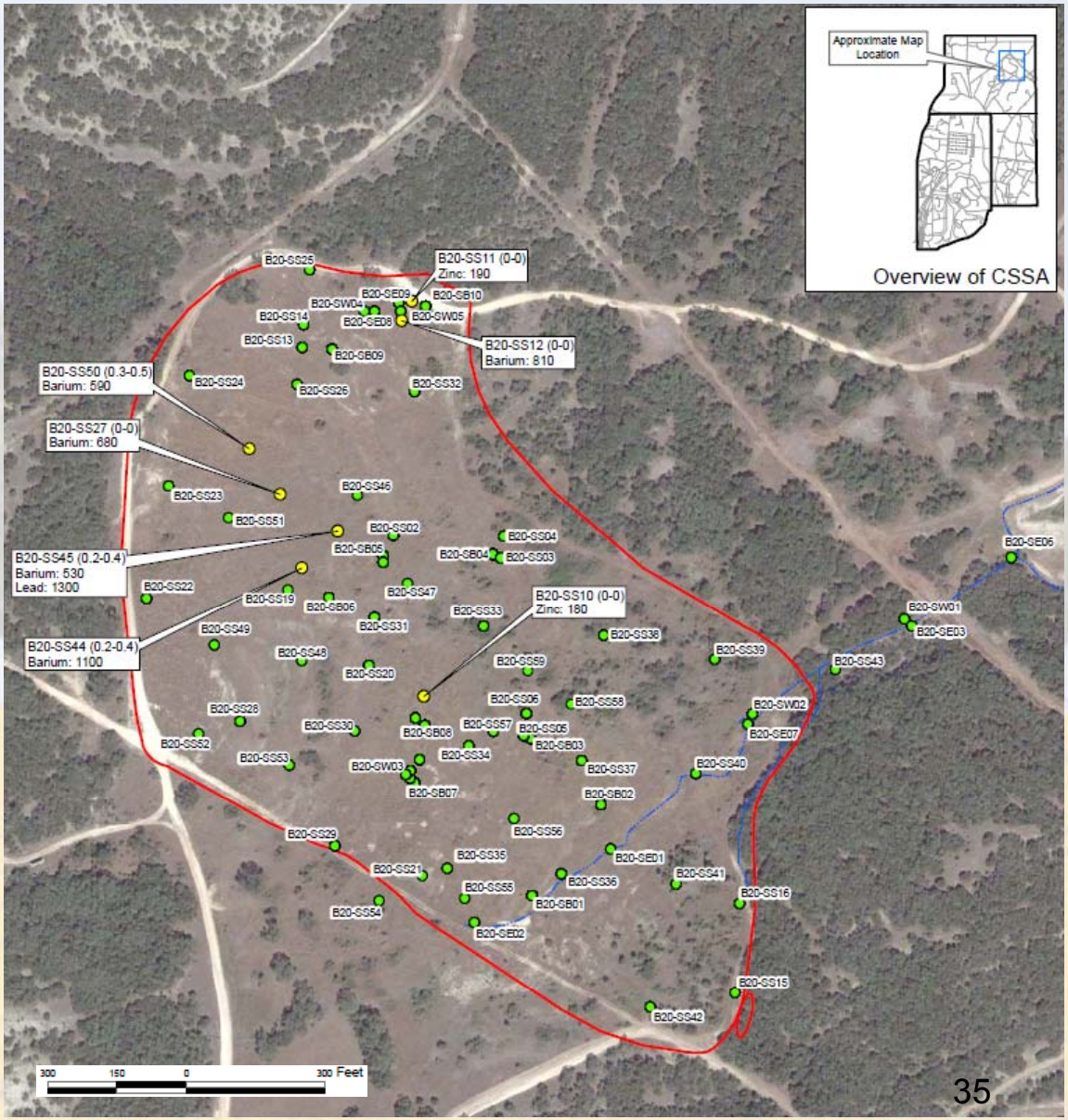
Upcoming Work
SWMU B-8

- Former burn area, 5.2 acres
- Previous investigations: surface and subsurface soil samples, excavation work, XRF survey
- Next Steps
  - Collect additional surface soil samples to delineate contamination
  - Excavate contaminated soils (>Tier 2 PCLs)
  - APAR and Closure



Upcoming Work
SWMU B-20/21

- OB/OD area, 36 acres
- MEC and MC contamination concerns
- Previous investigations: geophysical surveys, surface and subsurface soil sampling, MEC investigations
- Next Steps
  - Test new geophysical method for MEC
  - Excavate contaminated soils (> Tier 2 PCLs)
  - APAR and Closure for MC

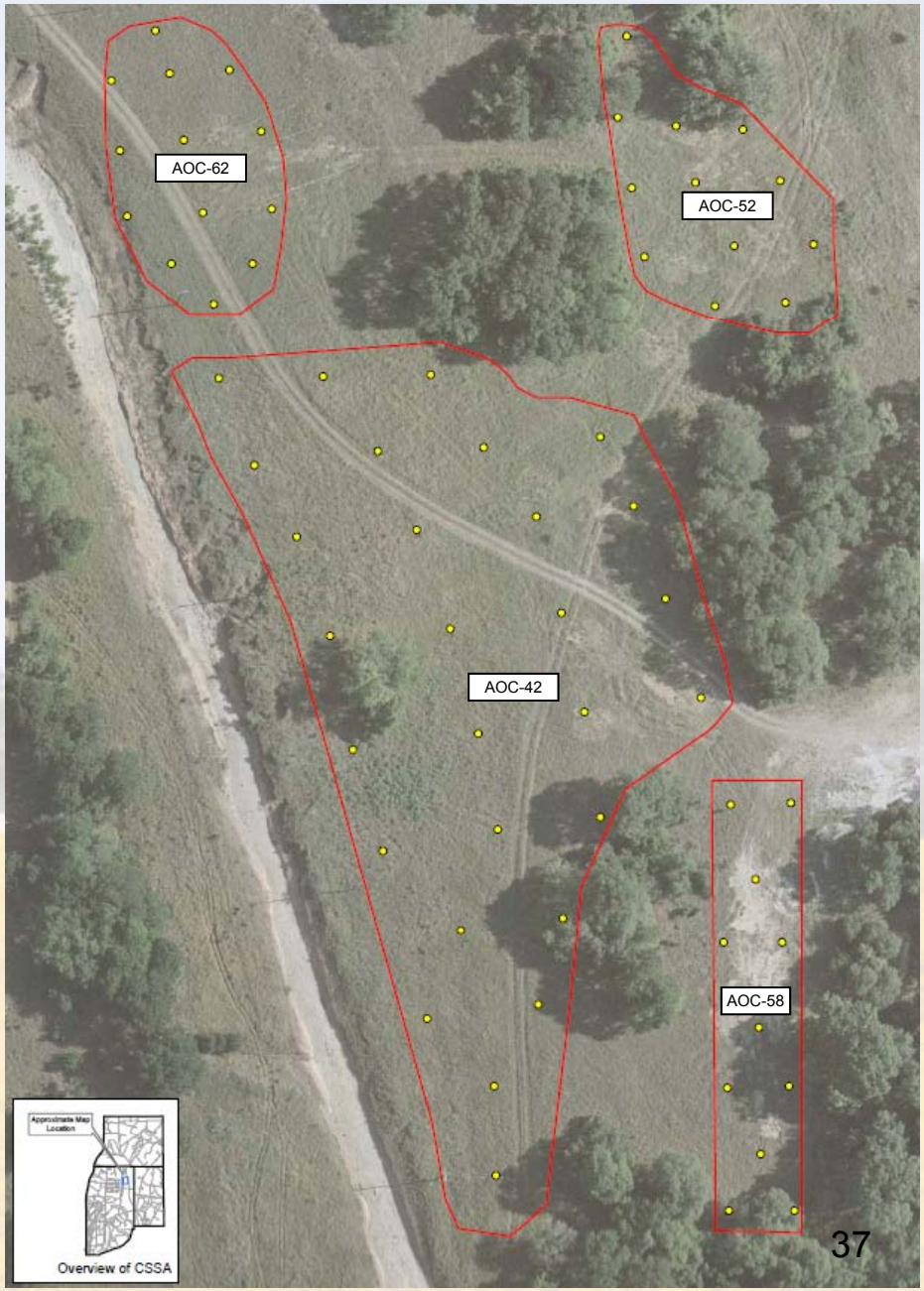


Upcoming Work
SWMU B-27

- Reportedly former sanitary landfill, 2 acres
- Previous investigations: geophysical survey, exploratory trenches (37mm projectiles)
- Next Steps
  - Possible geophysical survey
  - Excavate anomaly areas (> Tier 1 PCLs)
  - Work within CSSA's plans to construct retention pond in the area
  - RIR and Closure

Upcoming Work AOC-42, AOC-52, AOC-58, AOC-62

- Total area < 5 acres
- Trench areas containing MD, possibly MEC
- Next Steps
  - Possible USGS geophysical survey
  - Excavate anomaly areas to Tier 1 PCLs
  - Combined RIR and Closure



Planned Surface Geophysical Surveys on CSSA

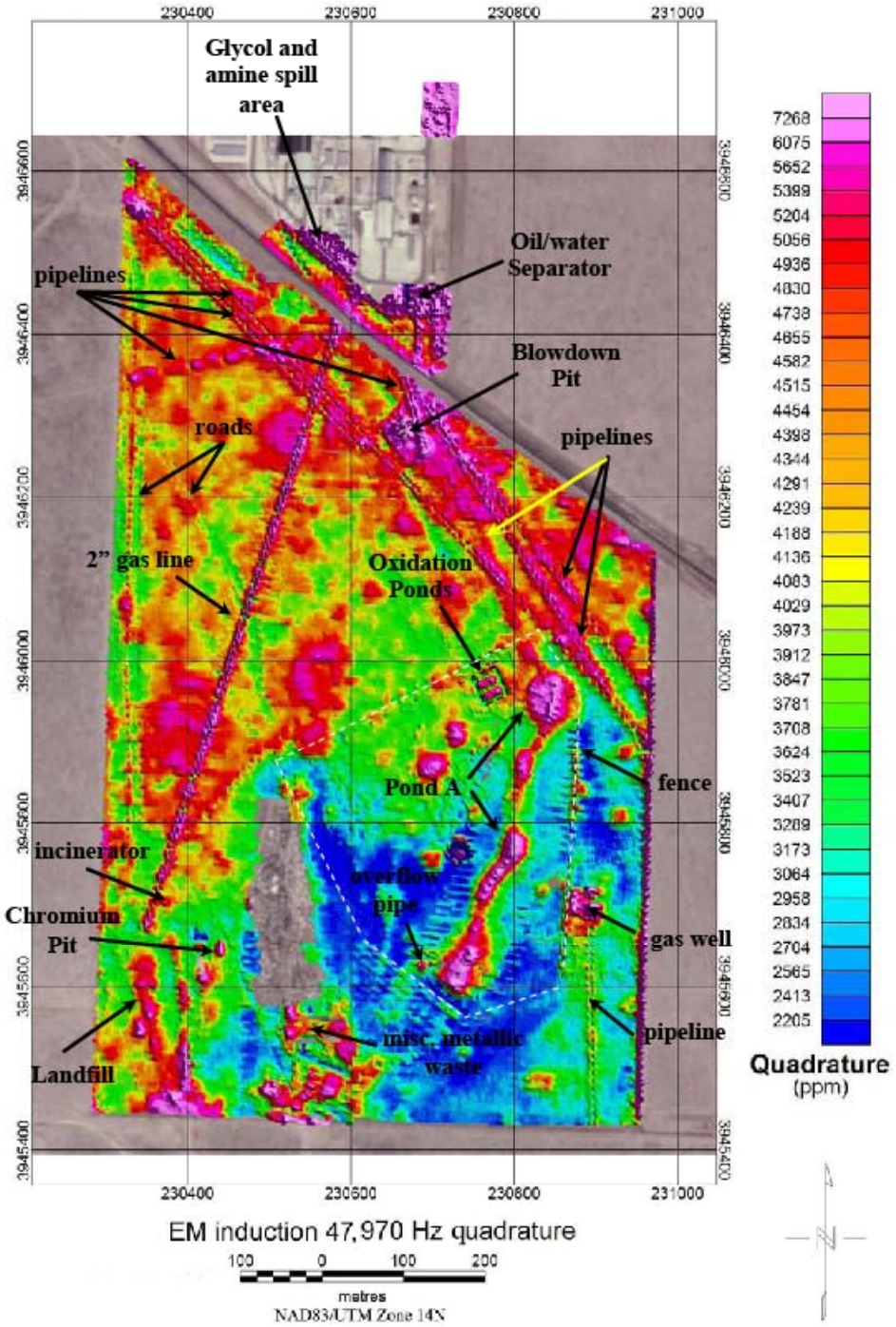
- Demonstration test using ALLTEM at B-20/21 OB/OD area
- Estimate trench volumes using ALLTEM and dc resistivity.

Trench Volume: ERI

- Proven technique: Exell Helium Plant, Masterson, Texas
- In conjunction with ALLTEM

Case Study: Exell Helium Plant Masterson, Texas

- November 2004 – January 2005
- Methods: EM induction; total field magnetics, dc resistivity
- Research-oriented integrated surface geophysical survey
- Derive estimates of potential contamination volumes and lateral extents of evaporation ponds to aid remediation.
- Characterization and volume calculation of a landfill.
- Investigators: Bethany Burton, Jared Abraham

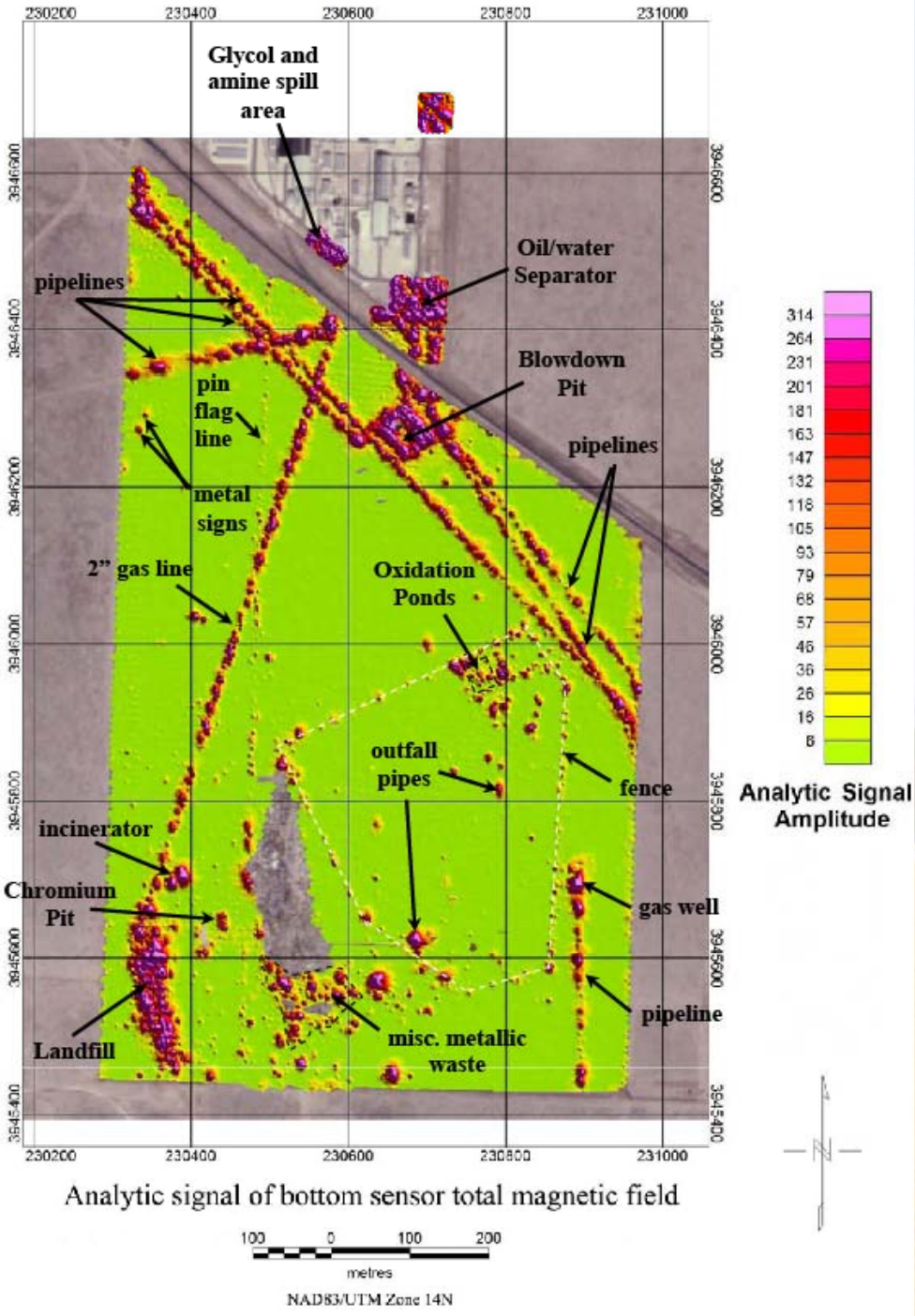


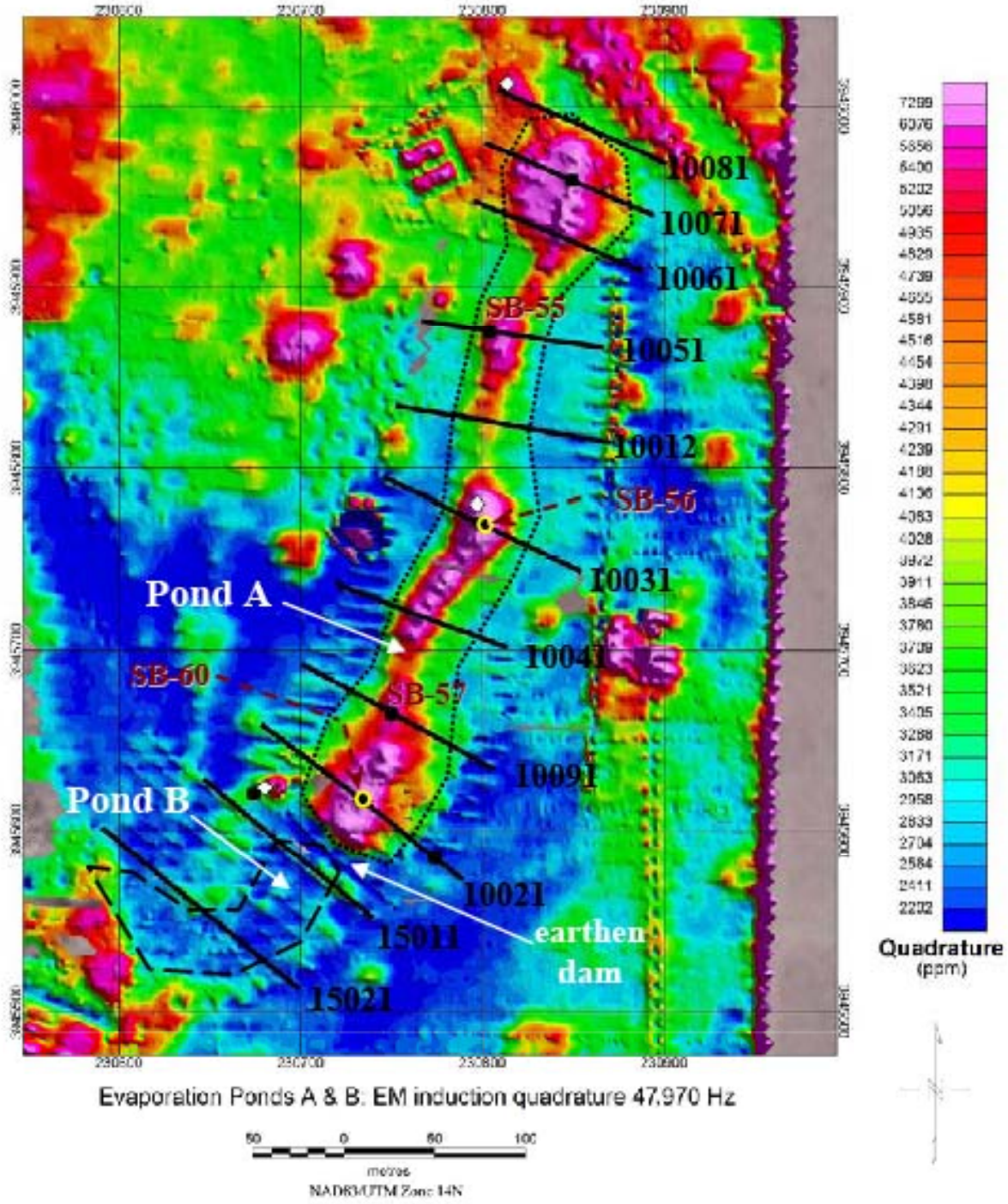
EM Conductivity

Map of EM induction 47,970 Hz quadrature data from GEM-2

Total Field Magnetics

- G-858 dual head magnetometer
- Integrated GPS
- Analytic signal grid

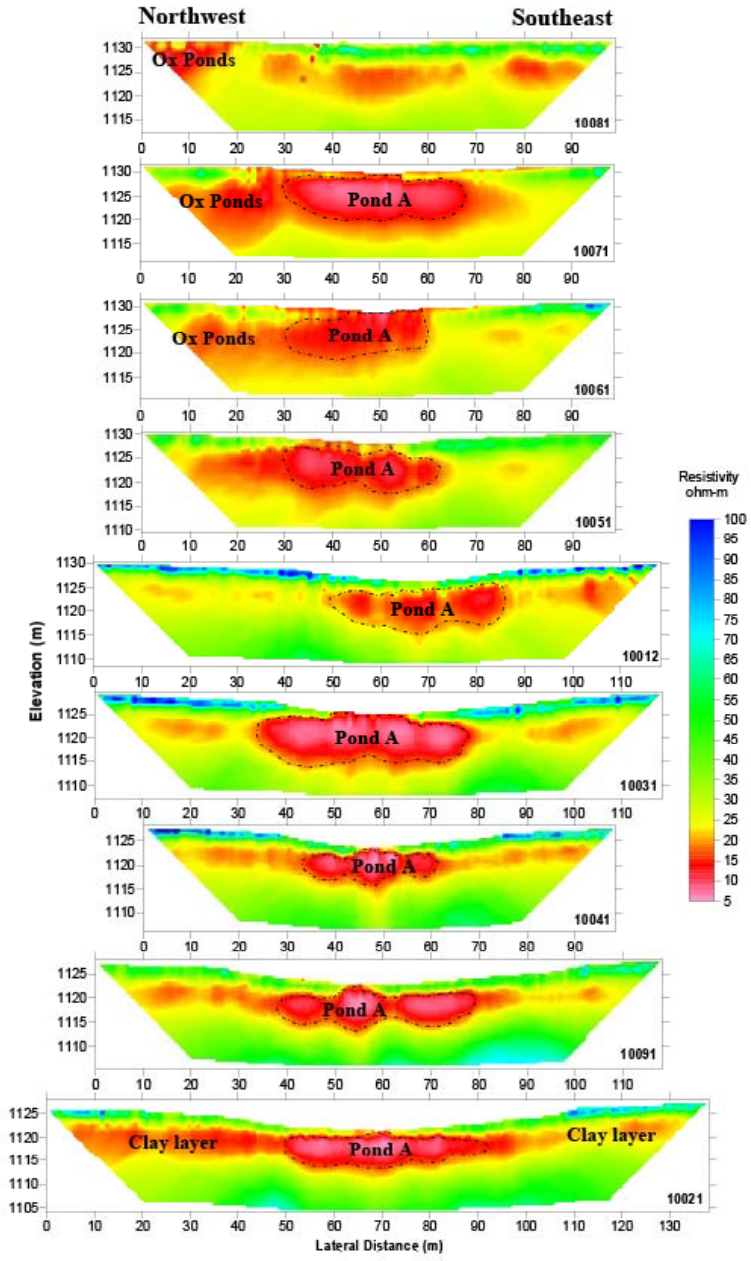




dc Resistivity

AGI SuperSting R8:
43 2-D transects
4 3-D grids

Eleven resistivity transects shown over evaporation ponds

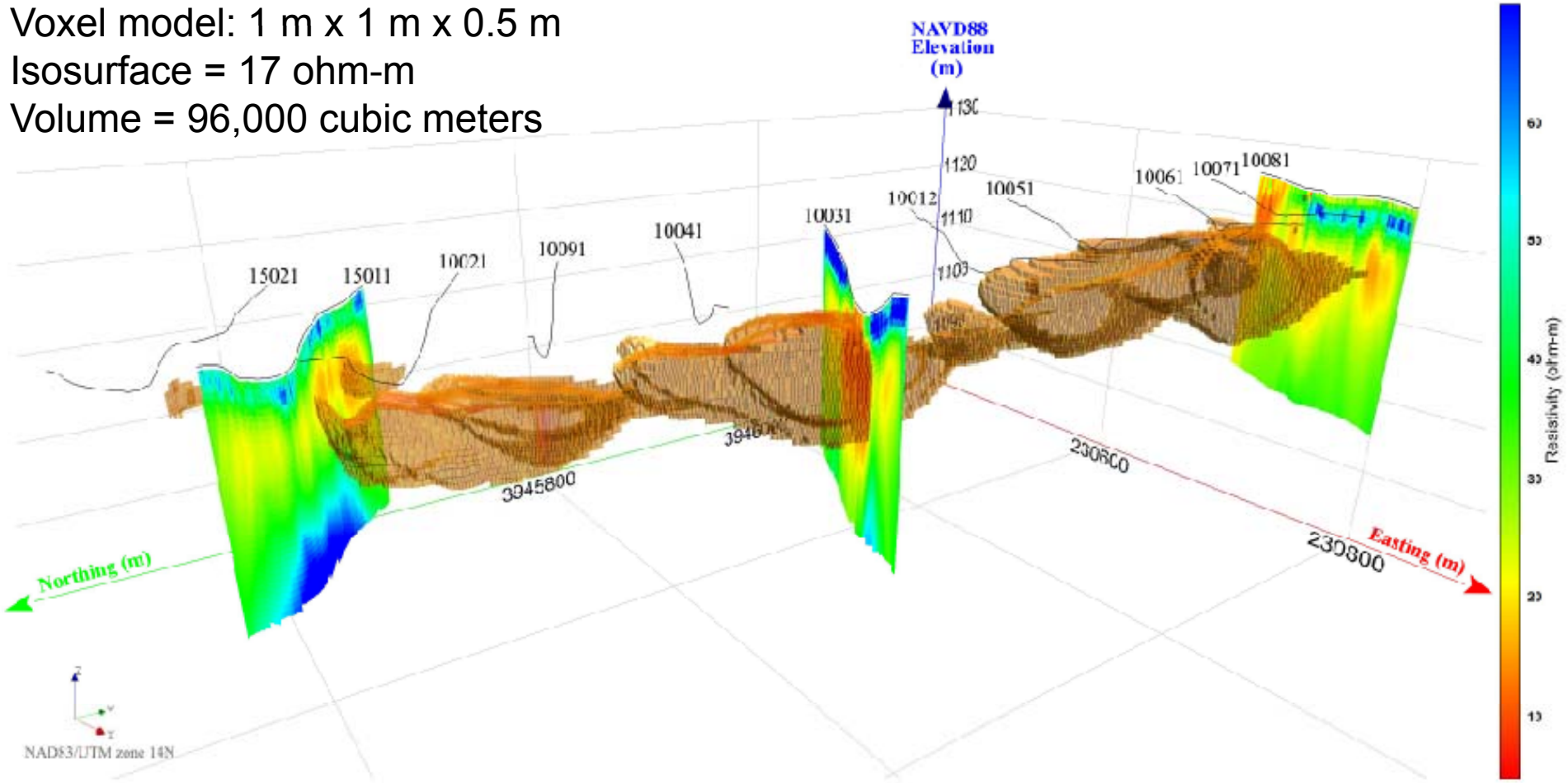


2-D Resistivity Sections

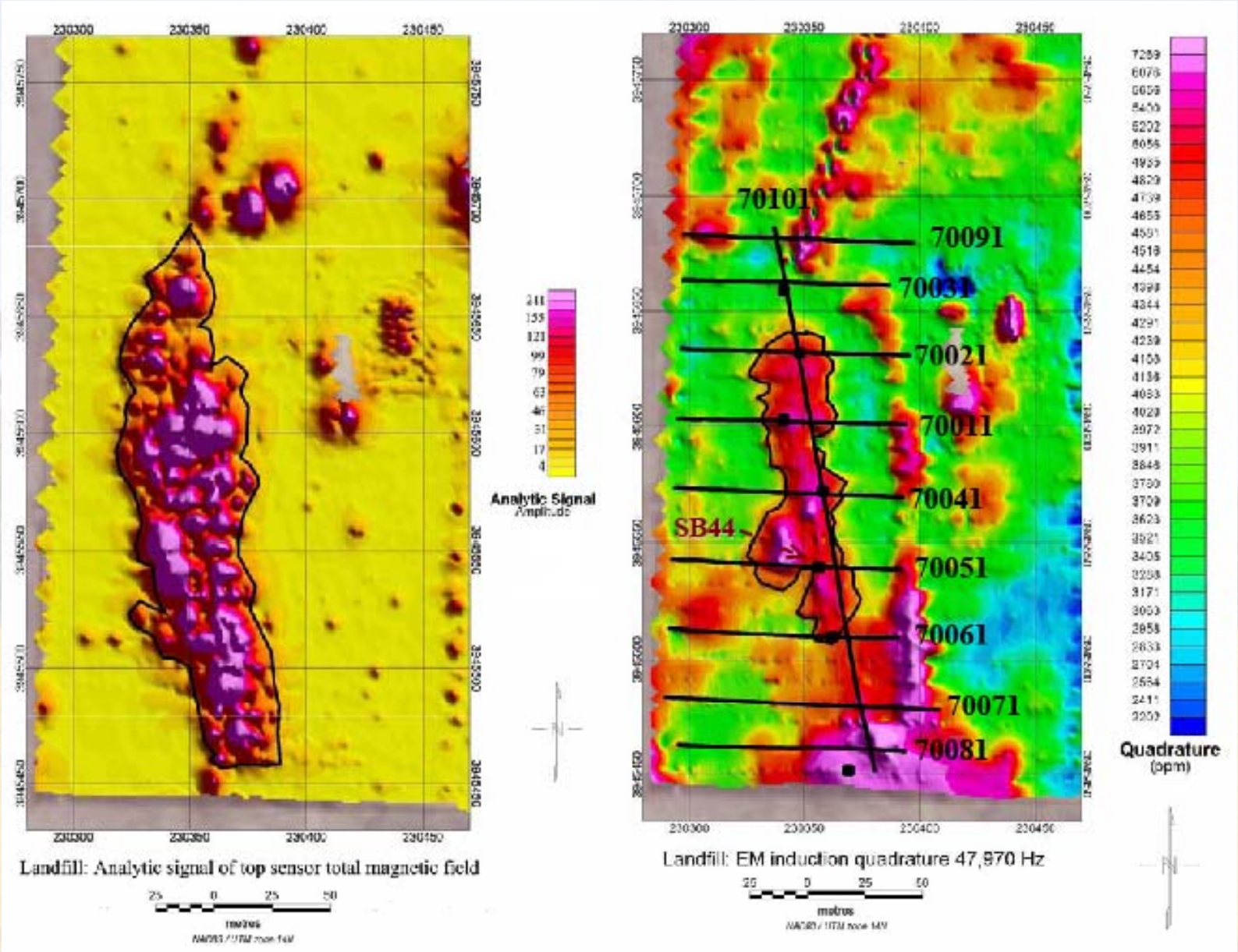
Low resistivity values from clays

3-D Voxel Model of Ponds

Voxel model: 1 m x 1 m x 0.5 m
Isosurface = 17 ohm-m
Volume = 96,000 cubic meters



Landfill Survey



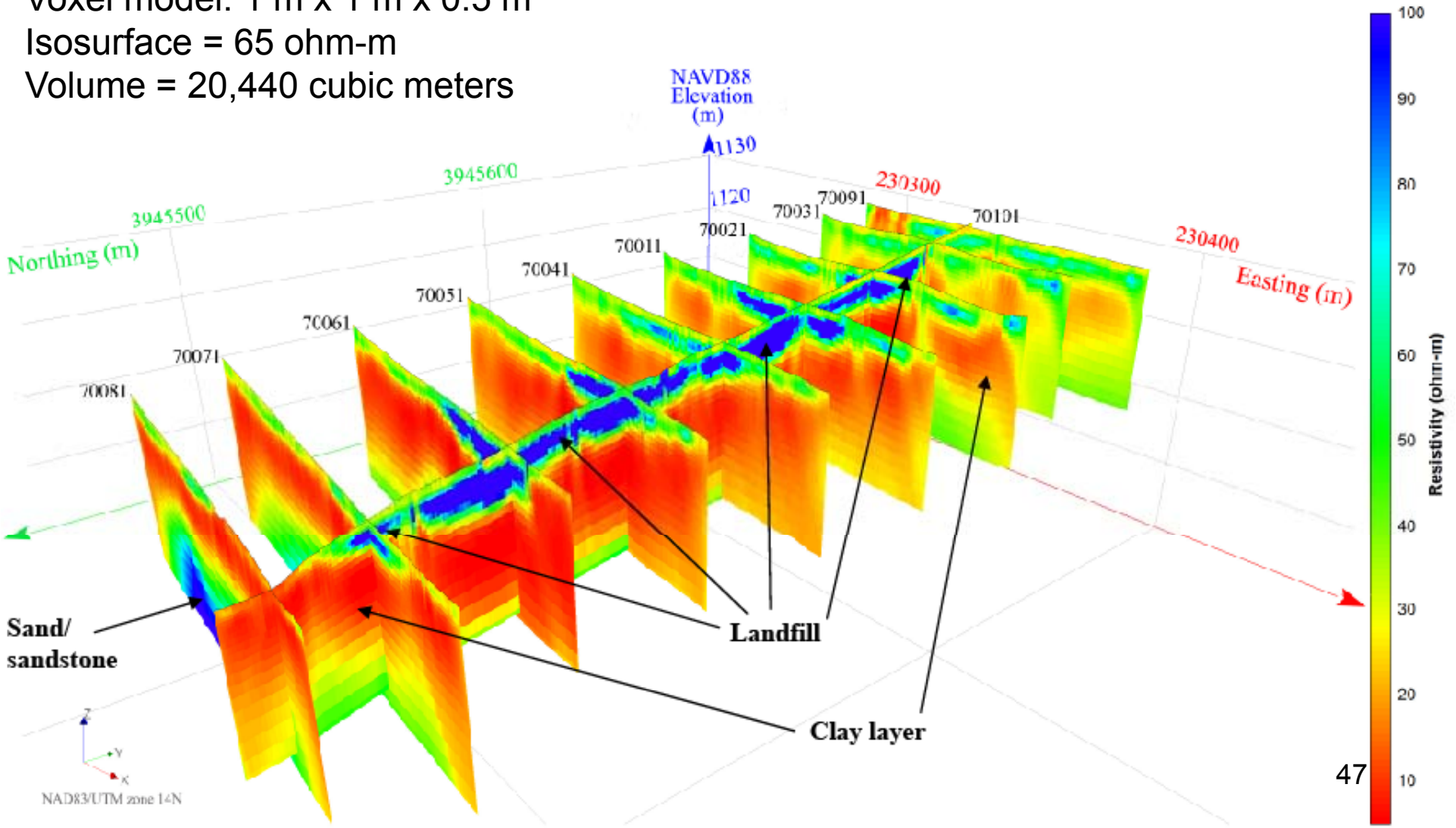
Magnetics

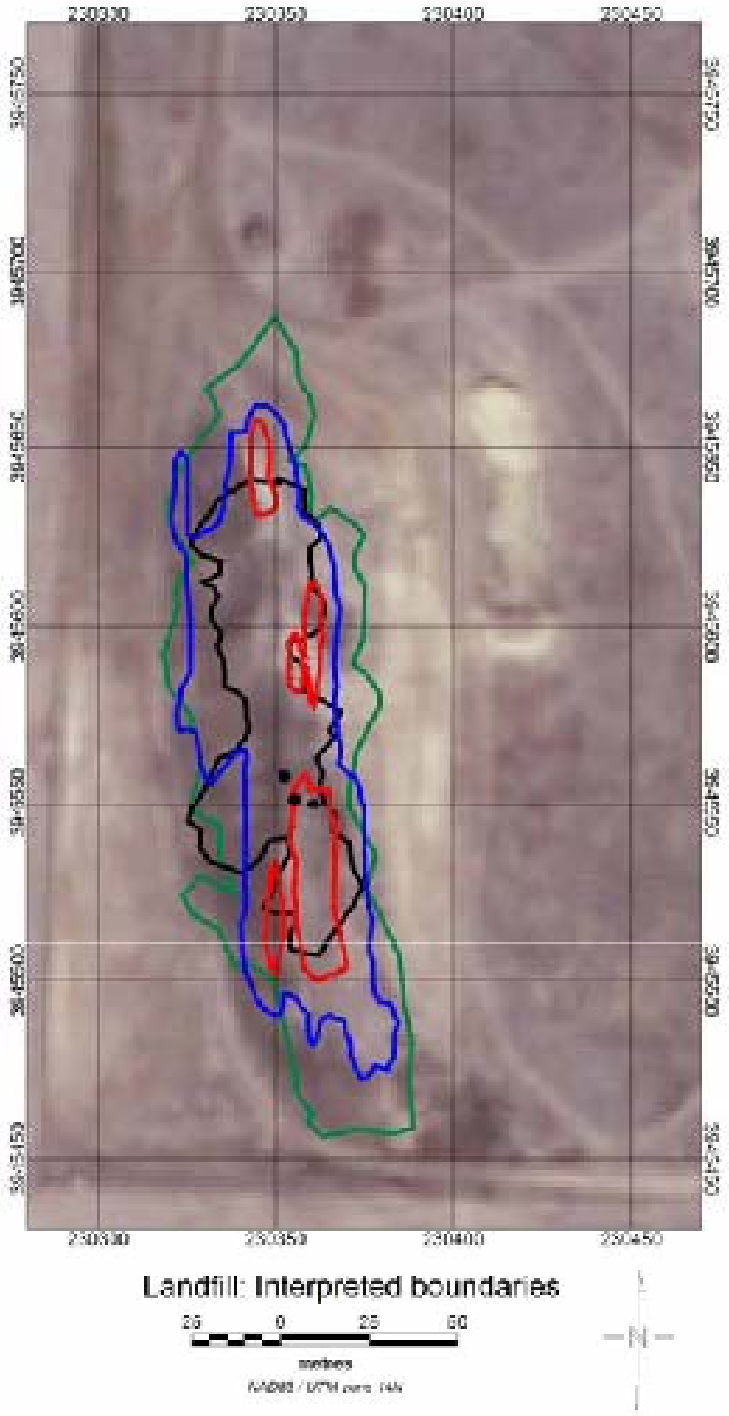
Electromagnetics

Landfill Boundaries and Volume

Fence diagram of 2-D resistivity transects

Voxel model: 1 m x 1 m x 0.5 m
Isosurface = 65 ohm-m
Volume = 20,440 cubic meters





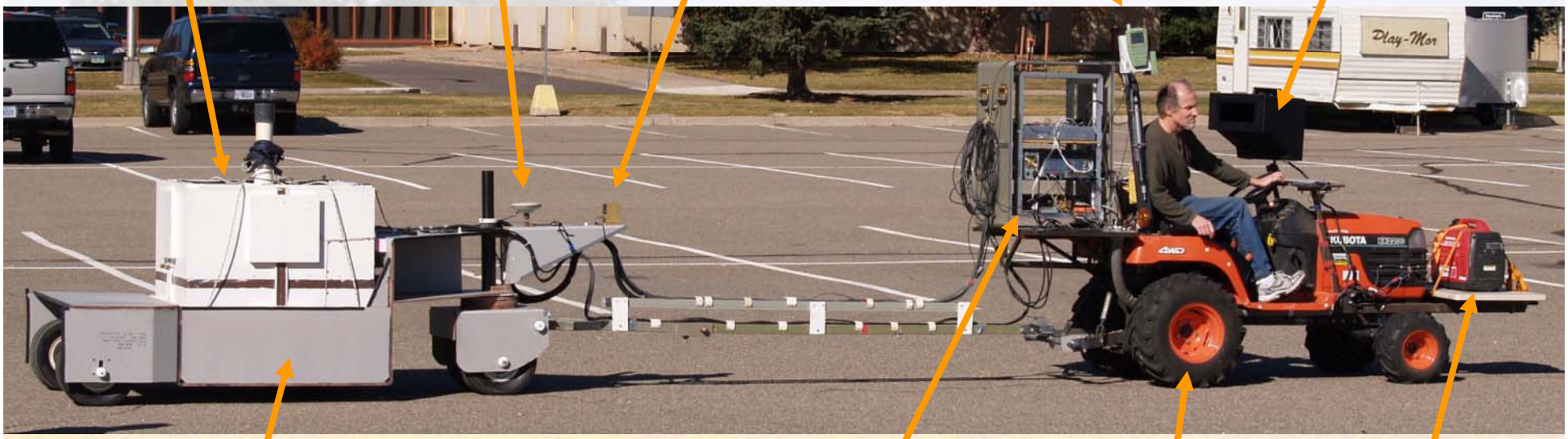
Landfill Boundaries

Black = EM quadrature
Blue = dc resistivity >65 ohm-m
Red = dc resistivity >175 ohm-m
Black Dots = subsidence areas

UXO: ALLTEM

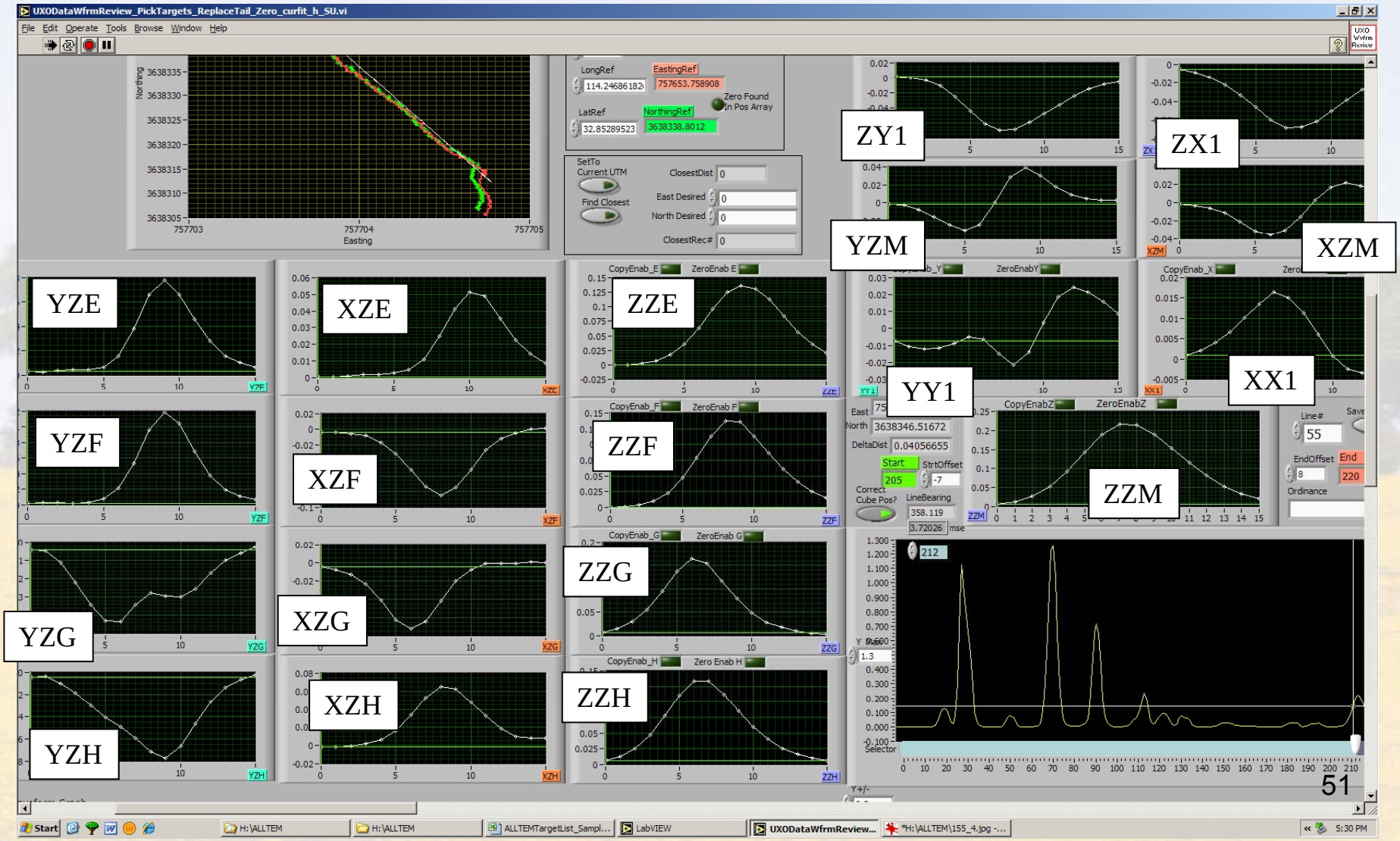
- Prototype system developed under the Strategic Environmental Research and Development Program (**SERDP**) for 4 years.
- Testing and evaluation under Environmental Security Technology Certification Program (**ESTCP**) for 3 years.
- Demonstrate that ALLTEM data, with appropriate data processing and inversion, provide better discrimination between unexploded ordnance (UXO) and non-UXO targets than existing benchmark electromagnetic induction (EMI) systems.
- Demonstrate that the ALLTEM prototype system and software are sufficiently mature that they could be operated by DoD or contractor personnel, after appropriate training, and gain acceptance in the UXO community as a viable system for UXO detection, location, and discrimination.
- Principal Investigator: Theodore H. Asch
- Team of engineers, technicians and programmers

ALLTEM System Components

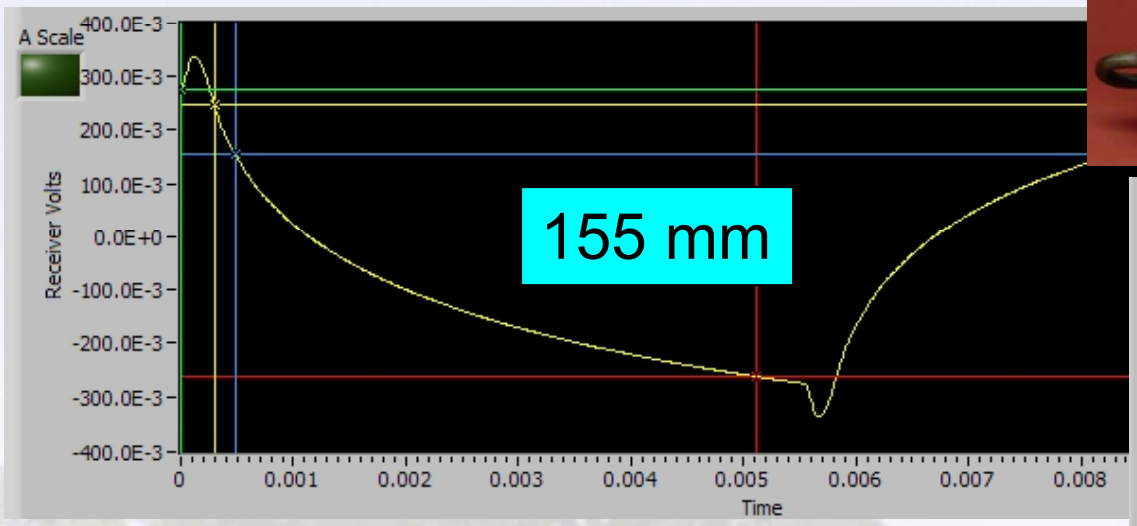


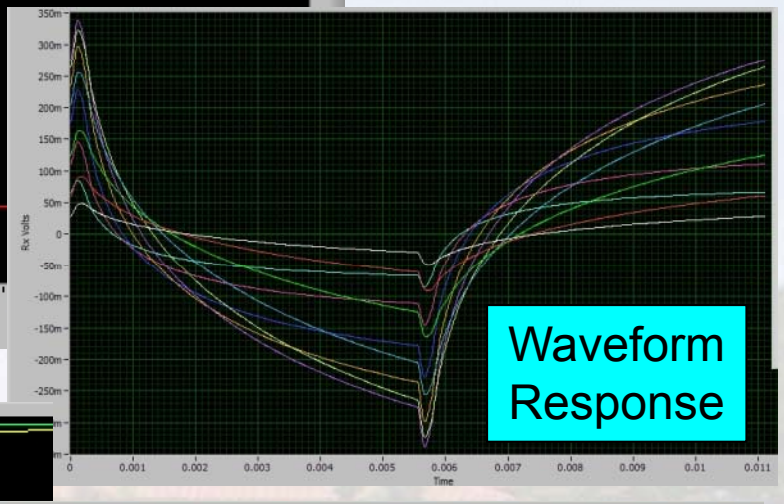
ALLTEM Data Processing

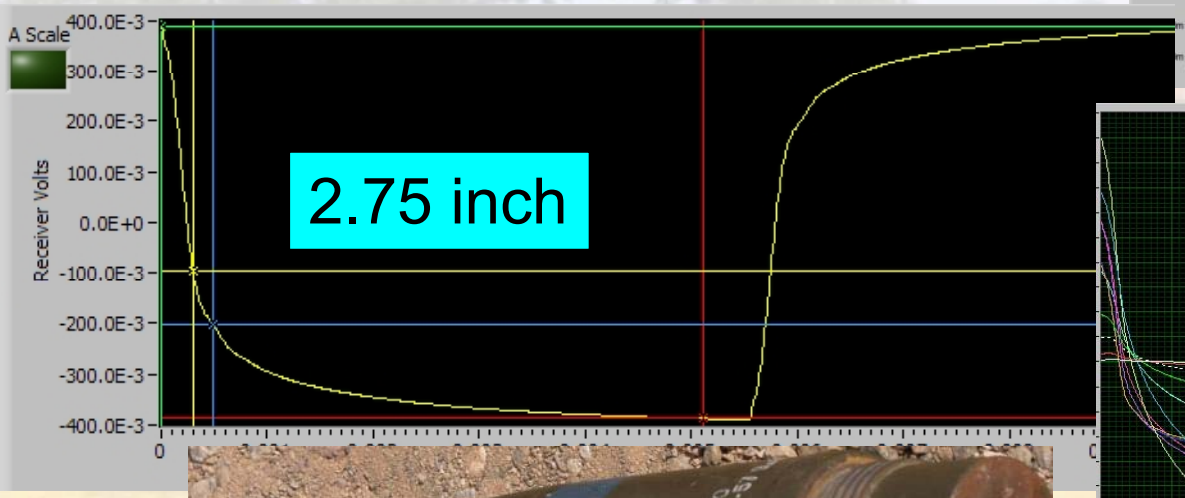
Responses of the 19 coil-pairs (polarizations) displayed in LabView software

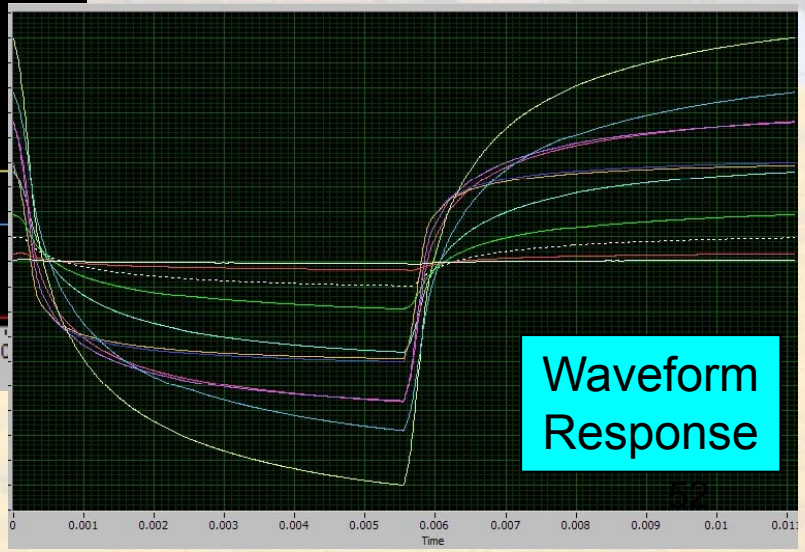


Target Responses

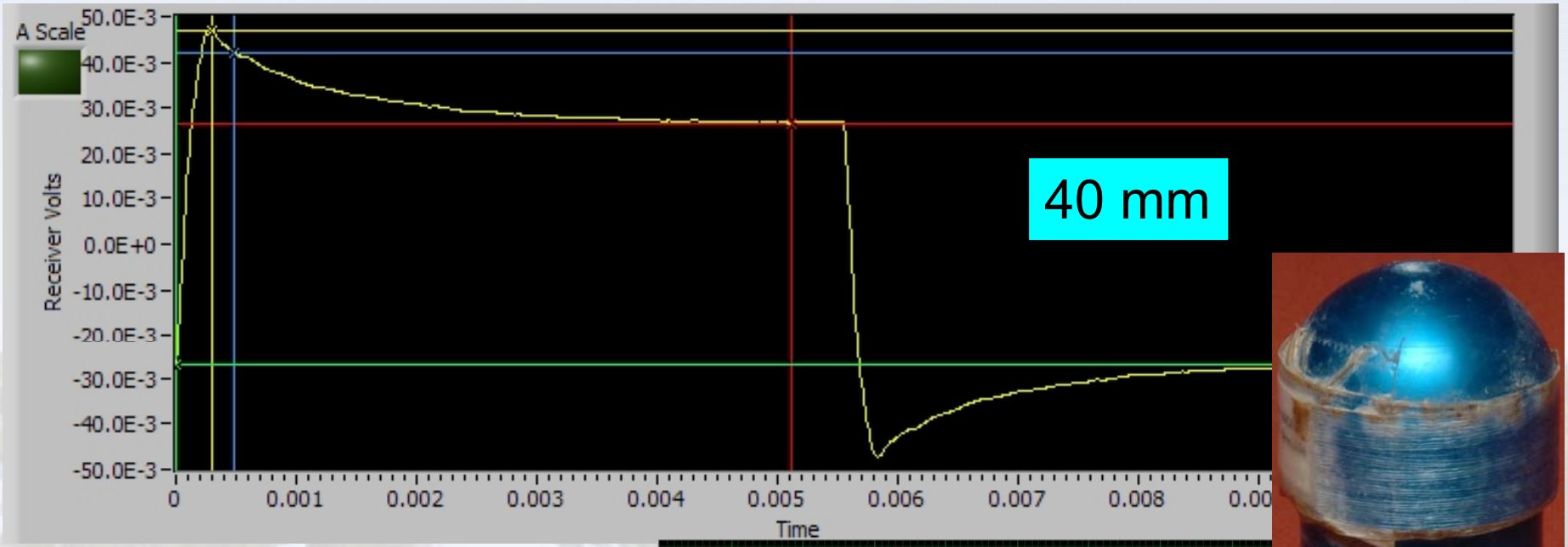


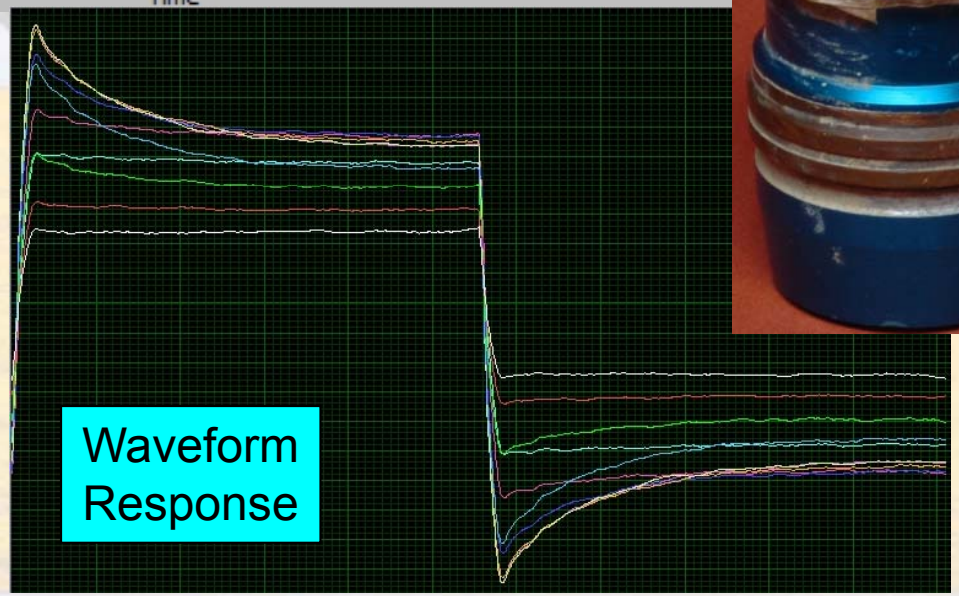


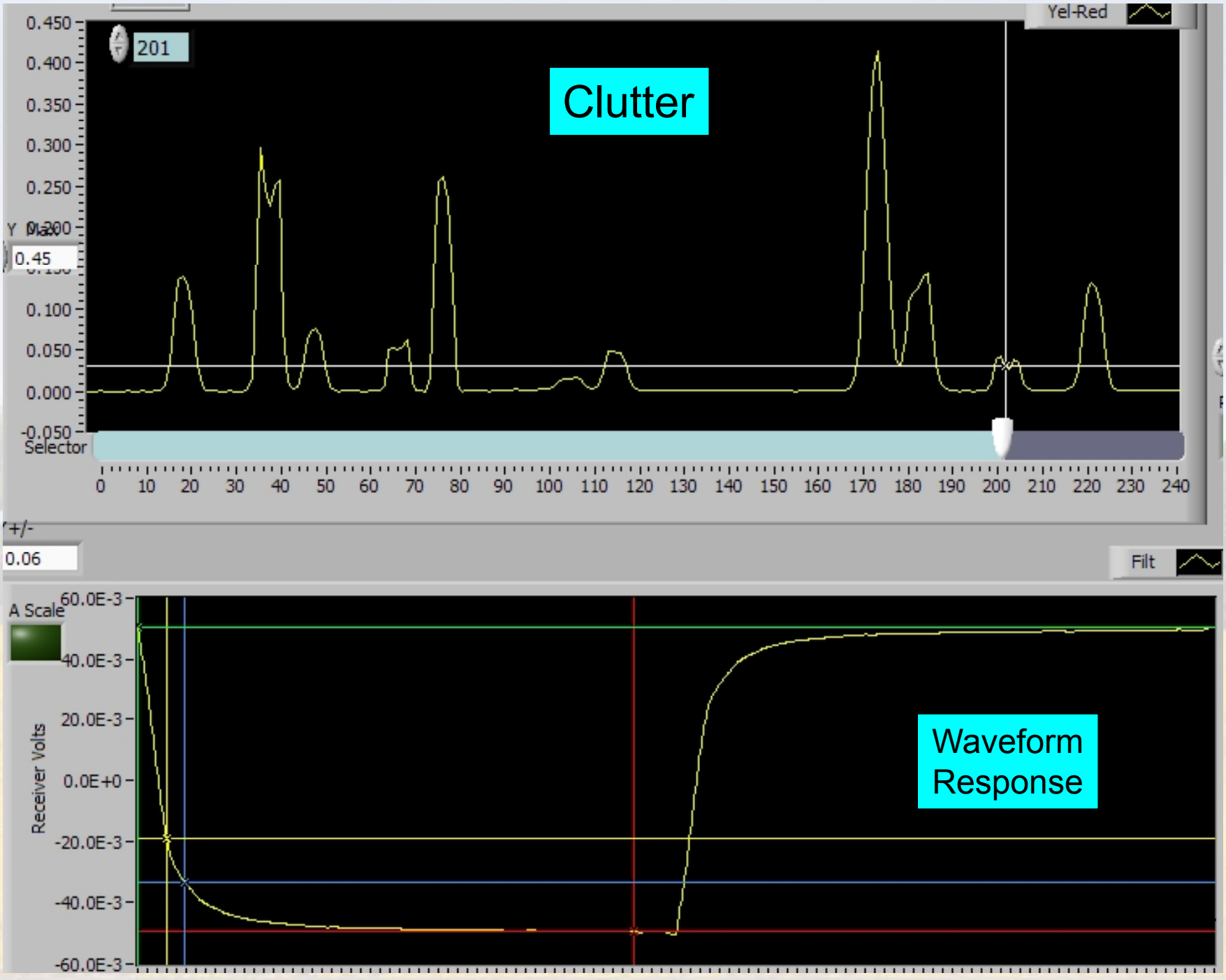


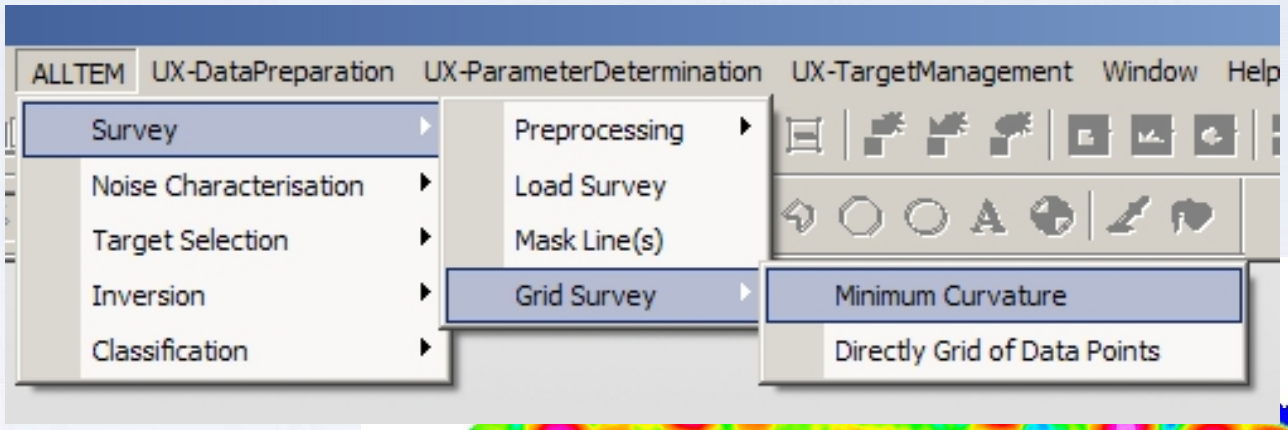


Target Responses

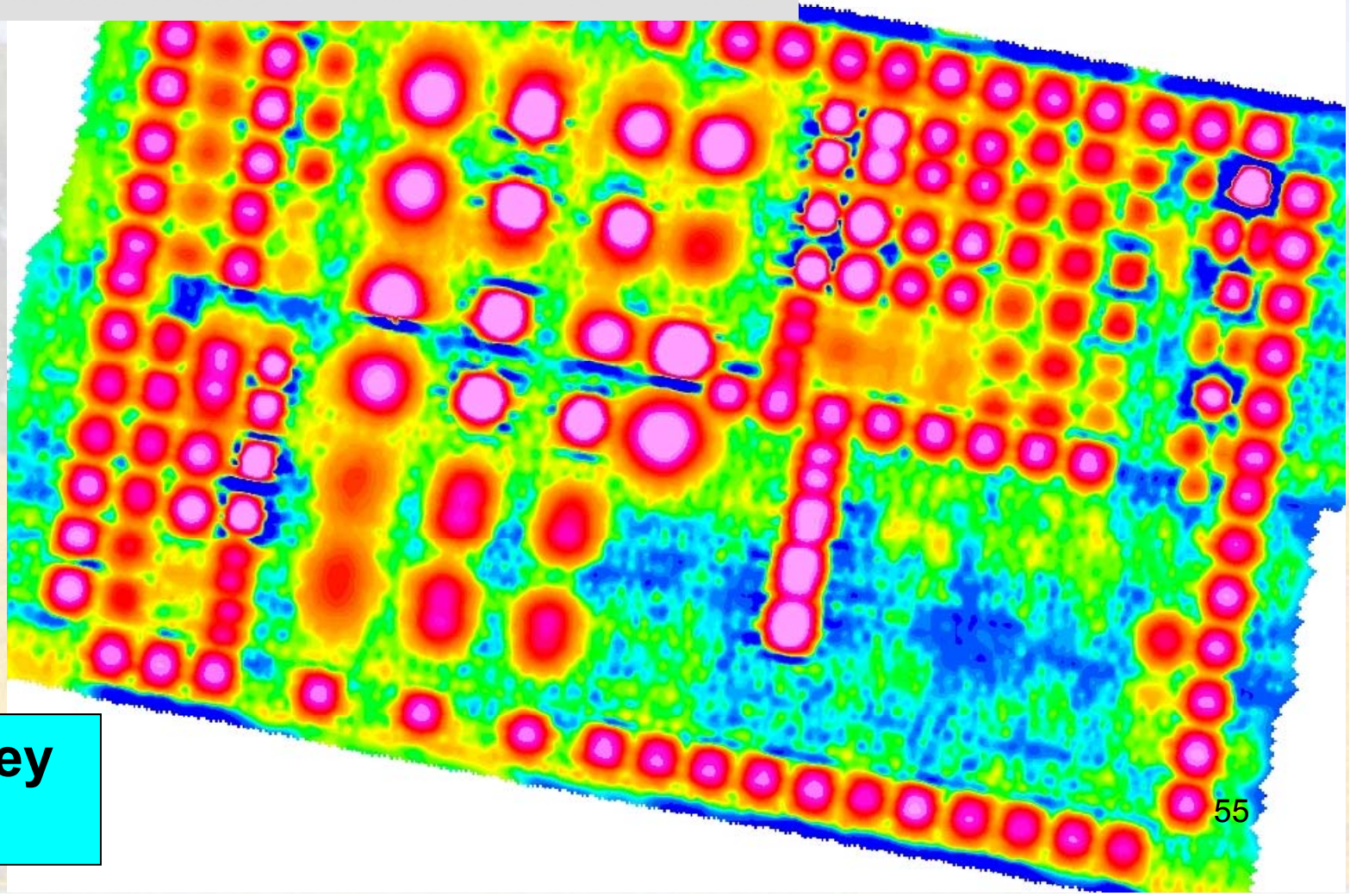




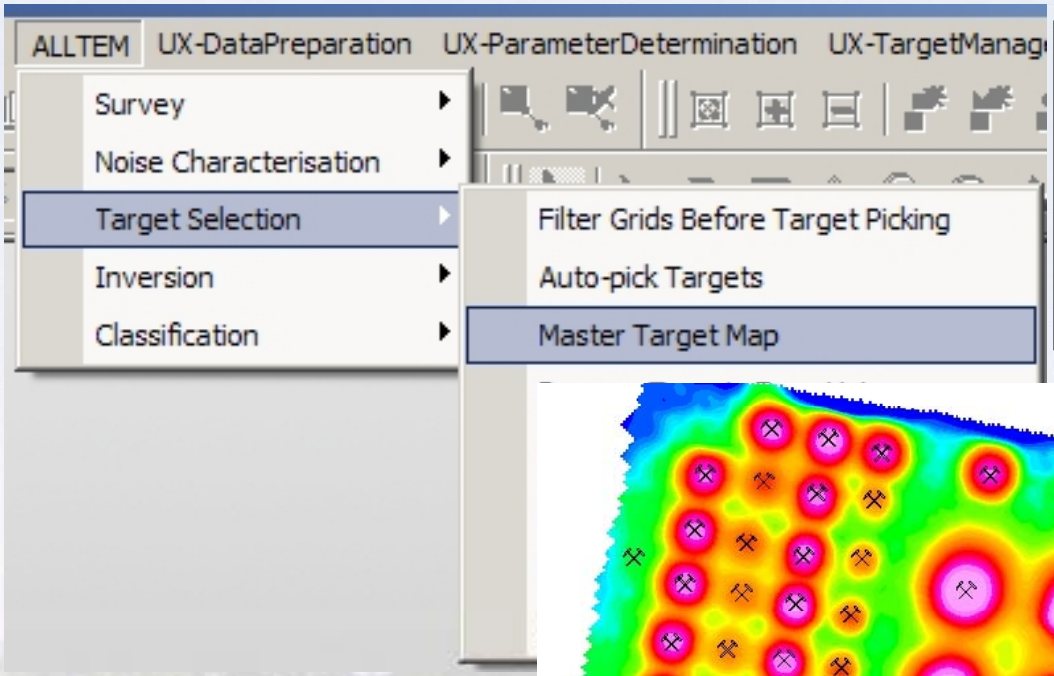

Yel-Red
201
Clutter
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
-0.050
Y Max
0.45
Selector
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240
+/-
0.06
Filt
A Scale
60.0E-3
40.0E-3
20.0E-3
0.0E+0
-20.0E-3
-40.0E-3
-60.0E-3
Receiver Volts
Waveform
Response



Polarization: ZZM

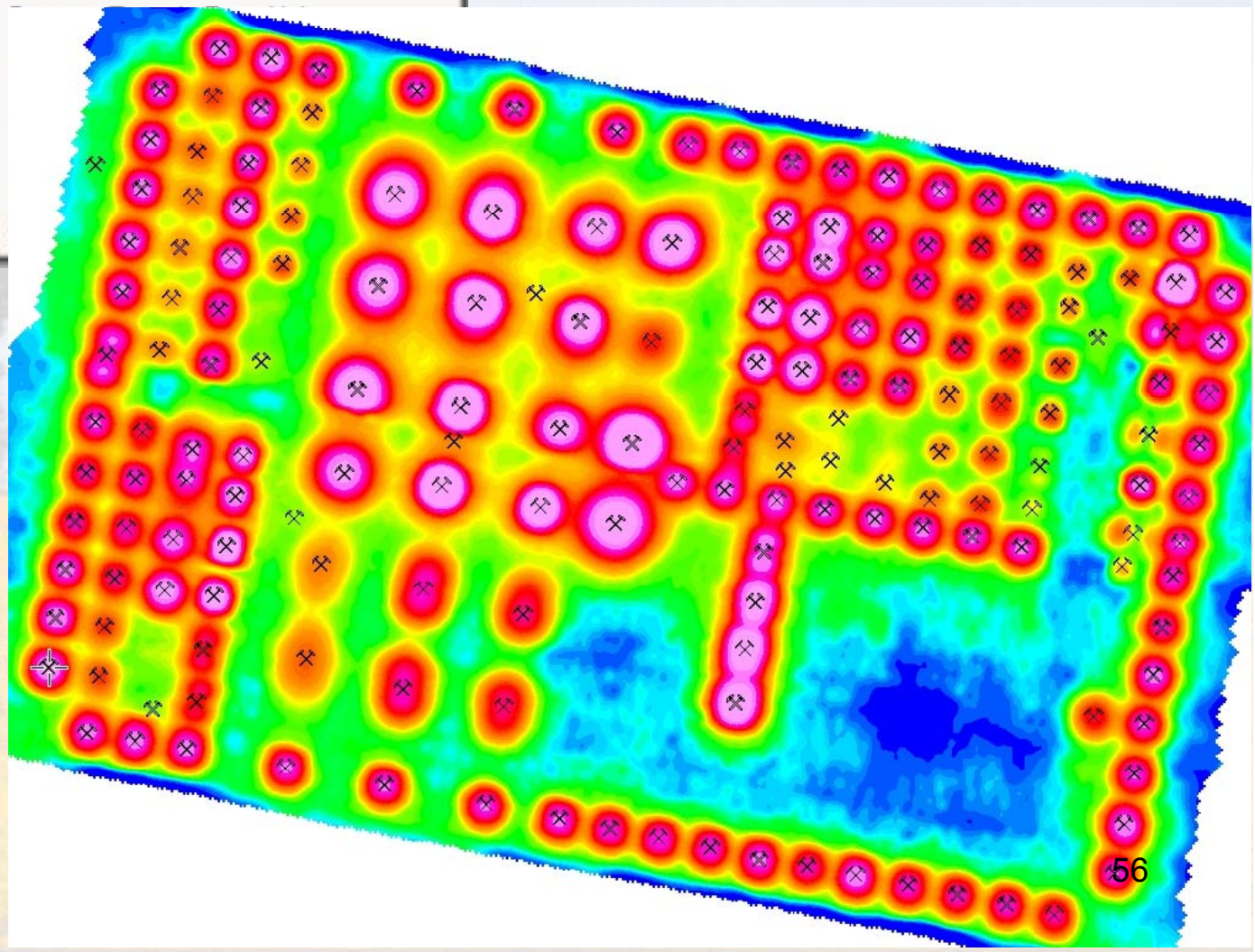


Grid Survey Data

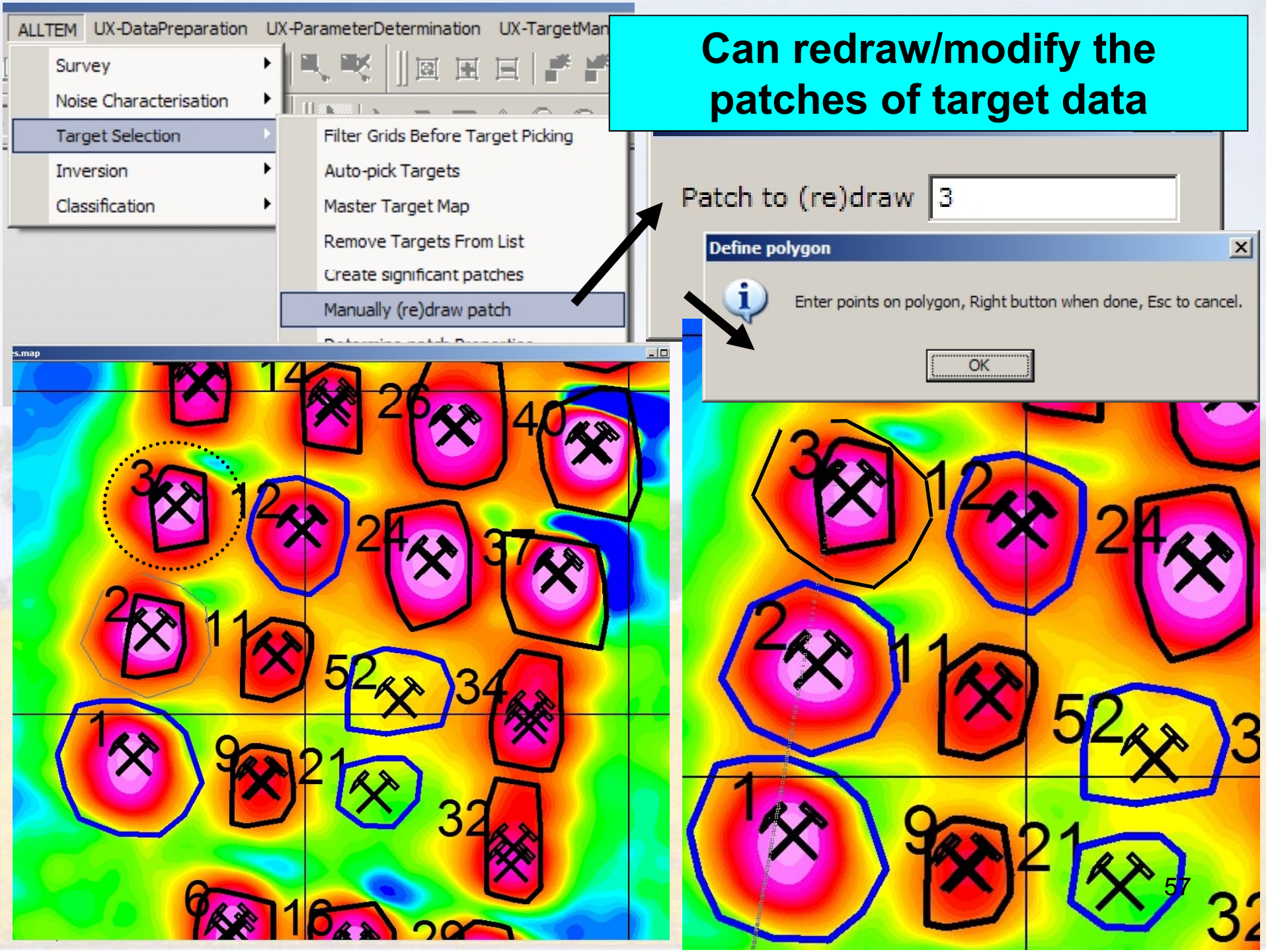


Create One 'Master' Target Map That Combines Targets From All Polarizations

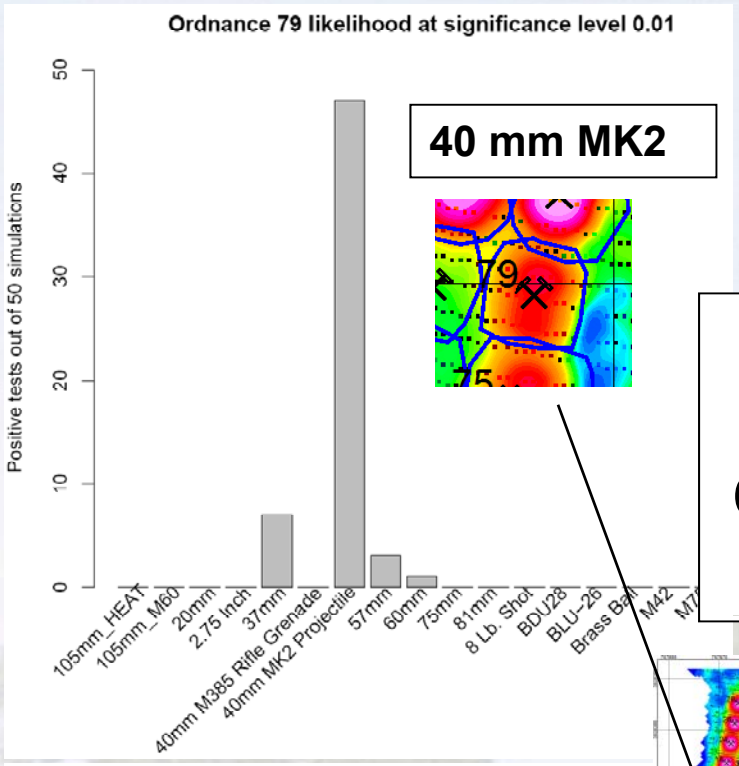
Targets shown against ZZM background

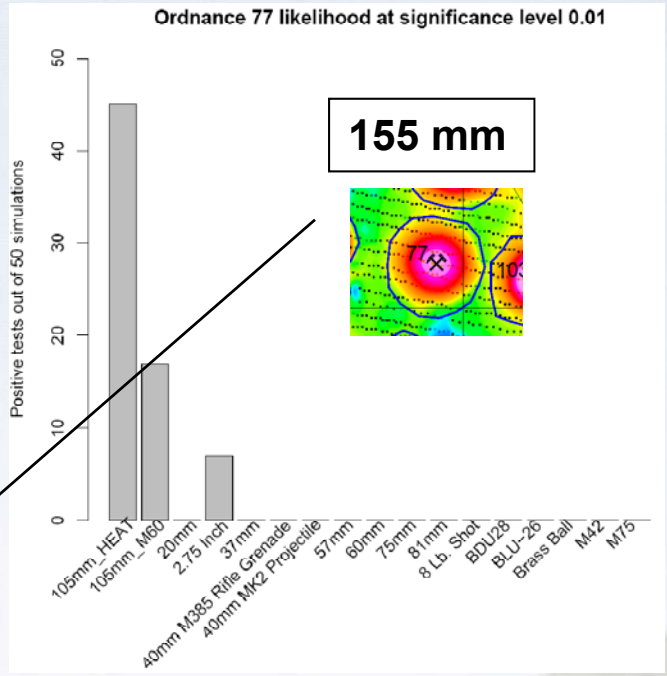


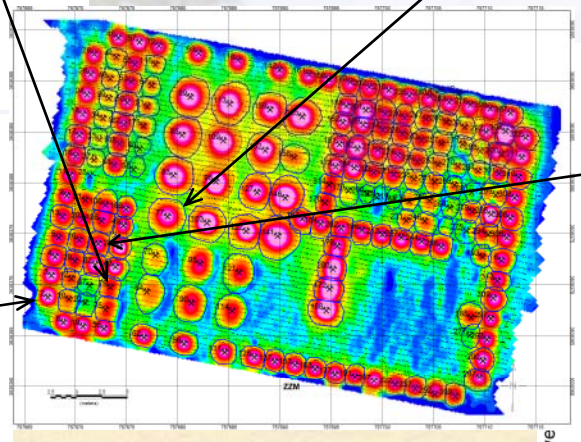
Can redraw/modify the patches of target data

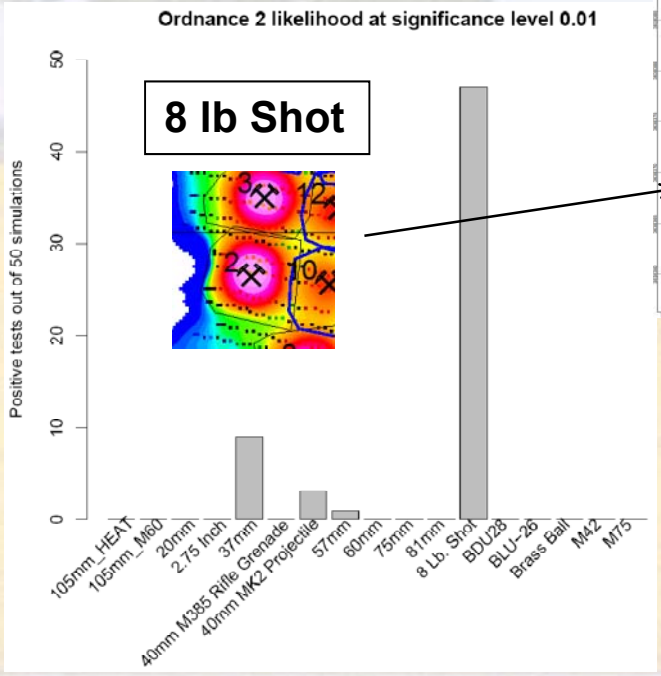


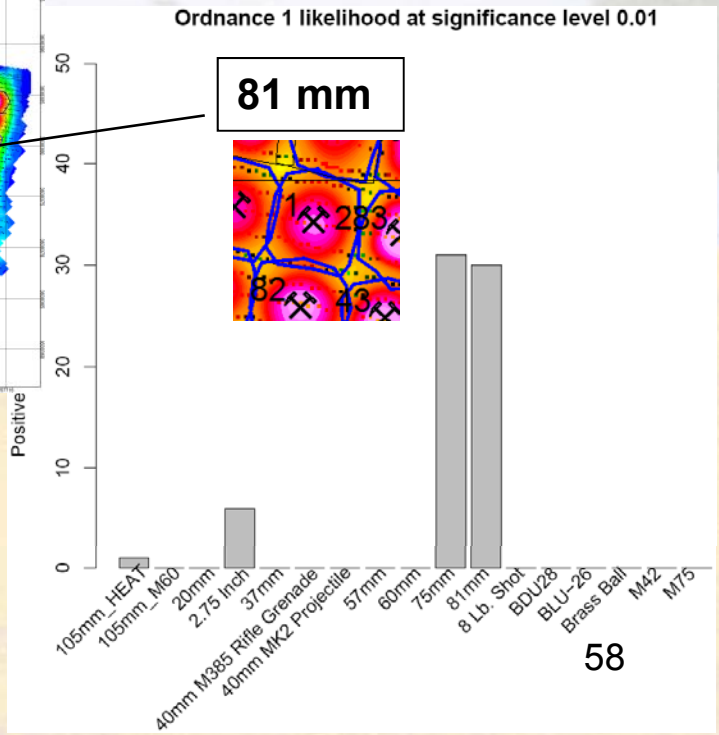
Cal Grid Inversion & Classification Results



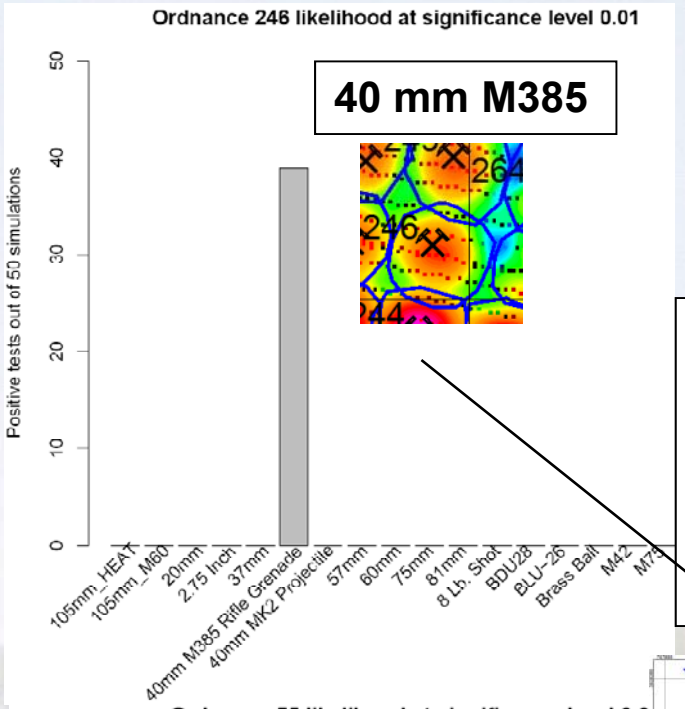




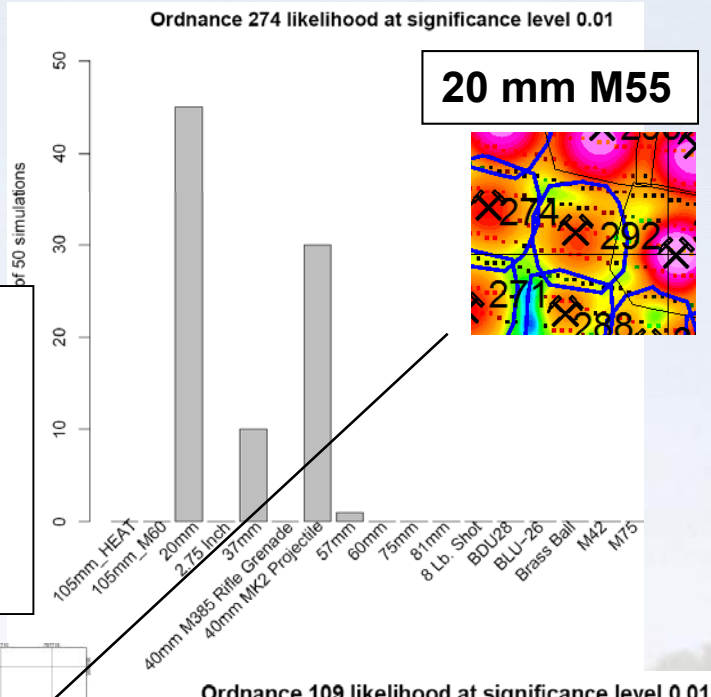




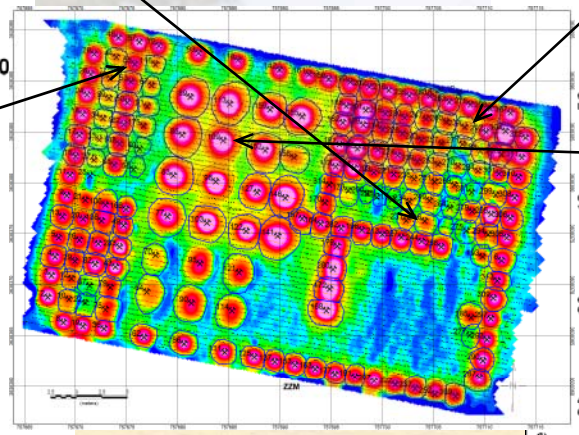
Cal Grid Inversion & Classification Results

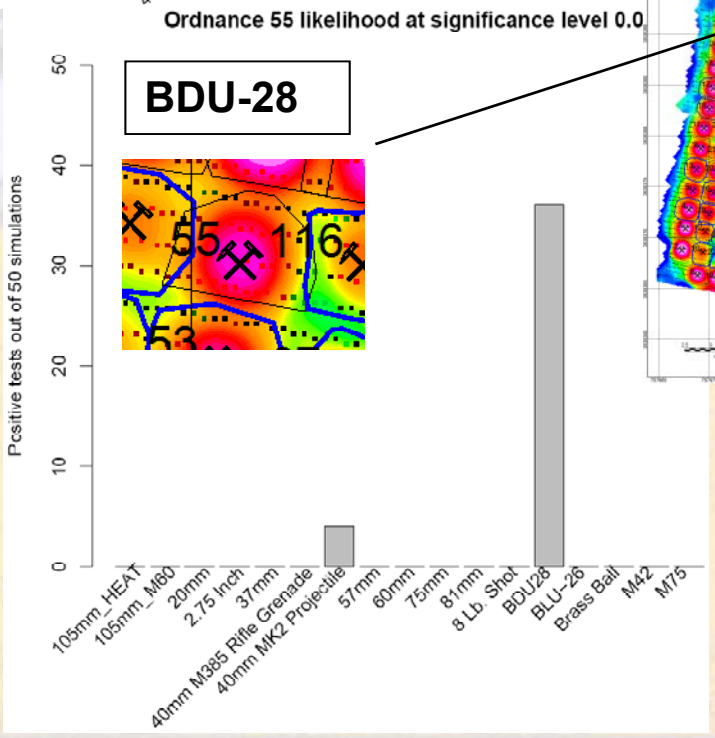


40 mm M385

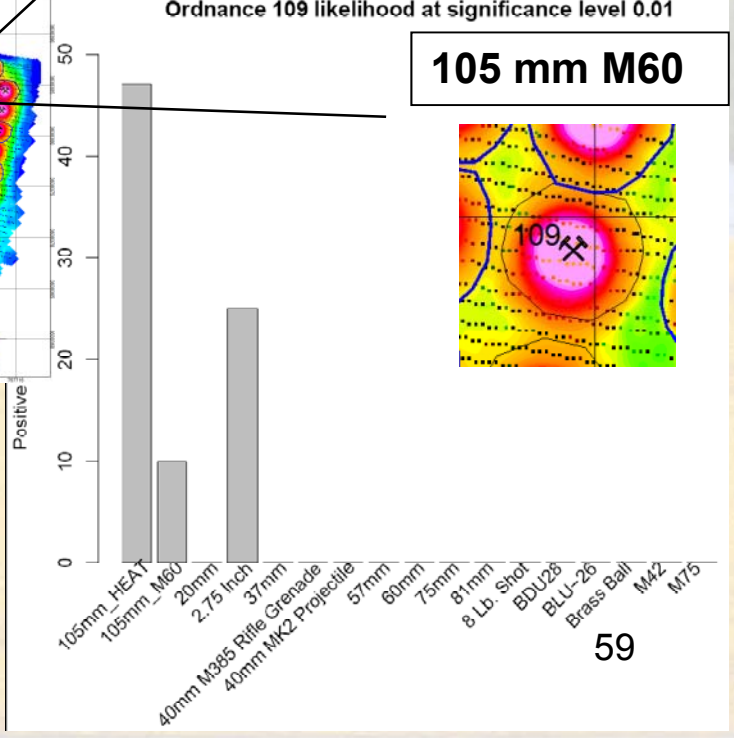


20 mm M55





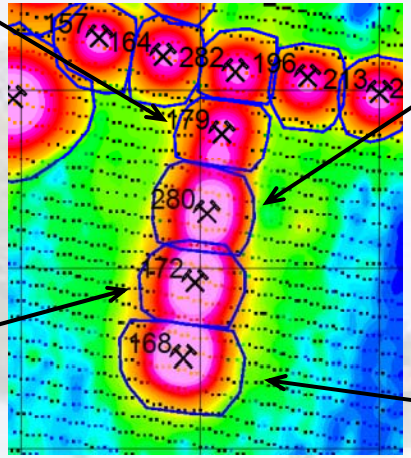
BDU-28



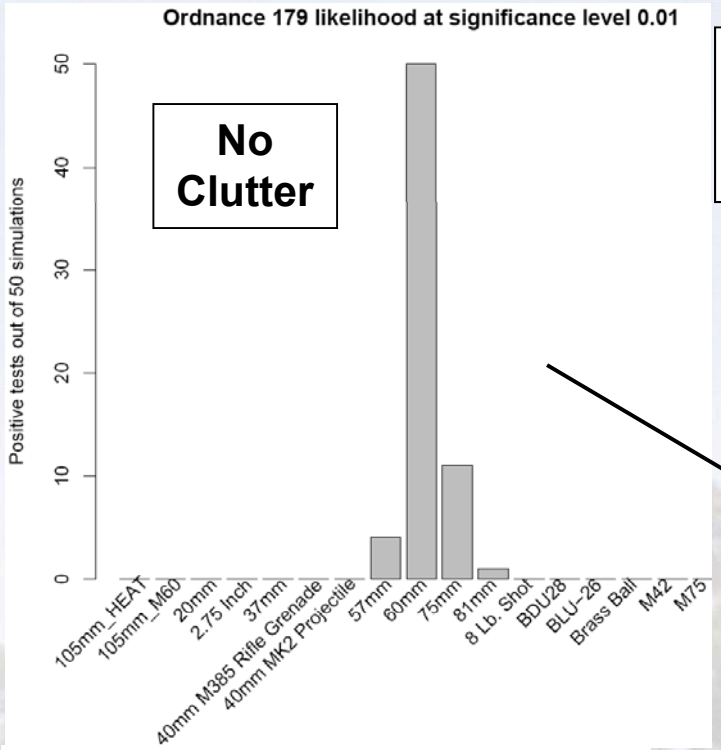
105 mm M60

Classification Results

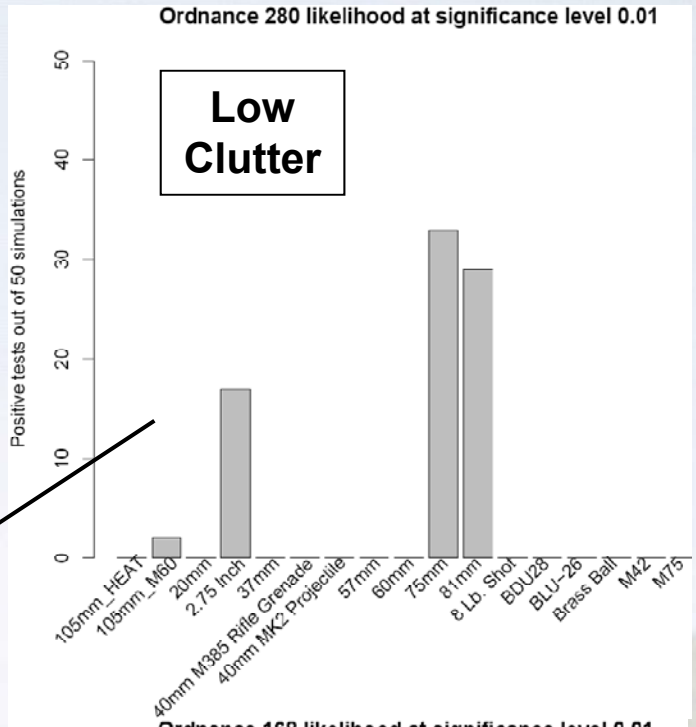
60 mm with Clutter



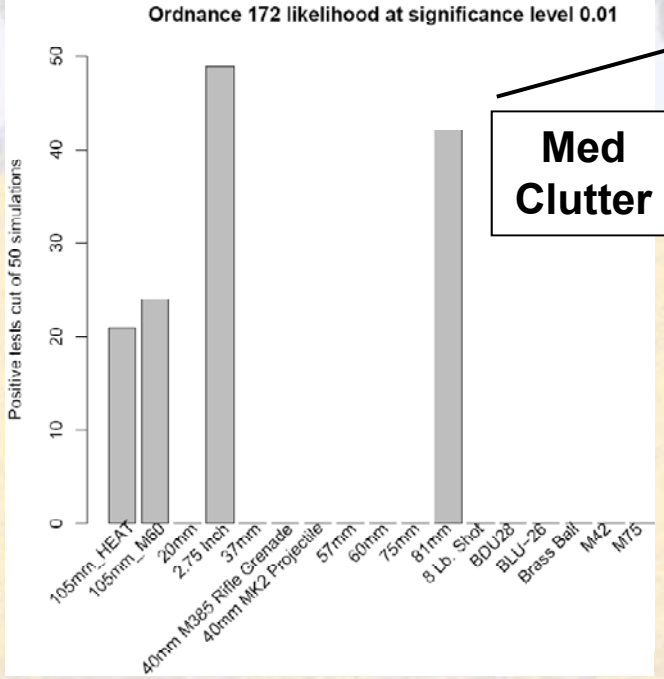
No Clutter



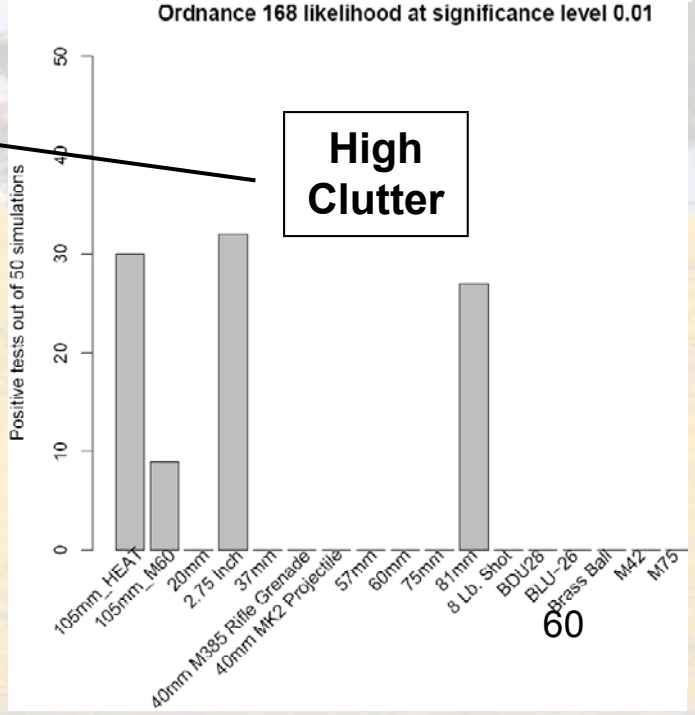
Low Clutter



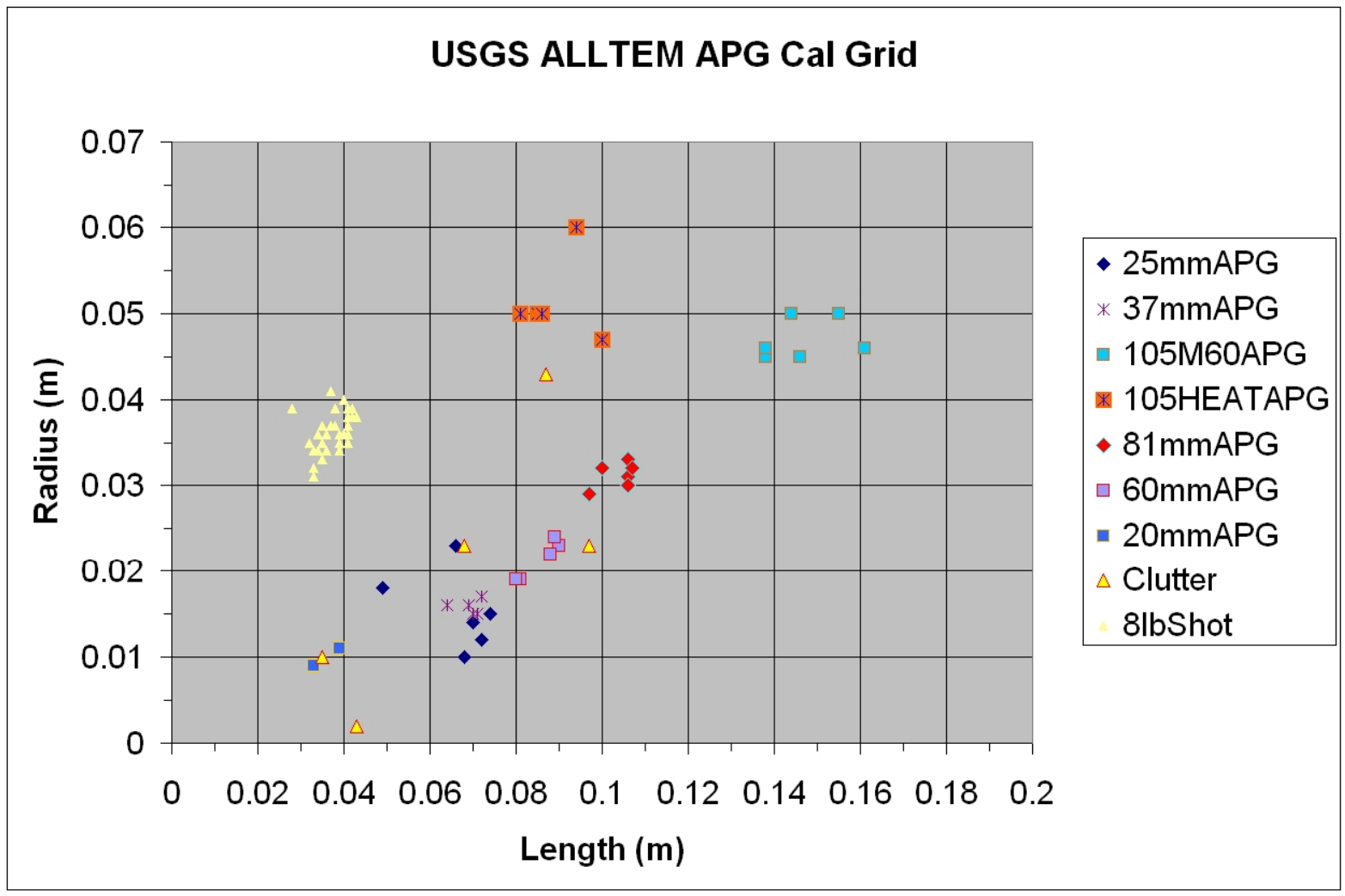
Med Clutter



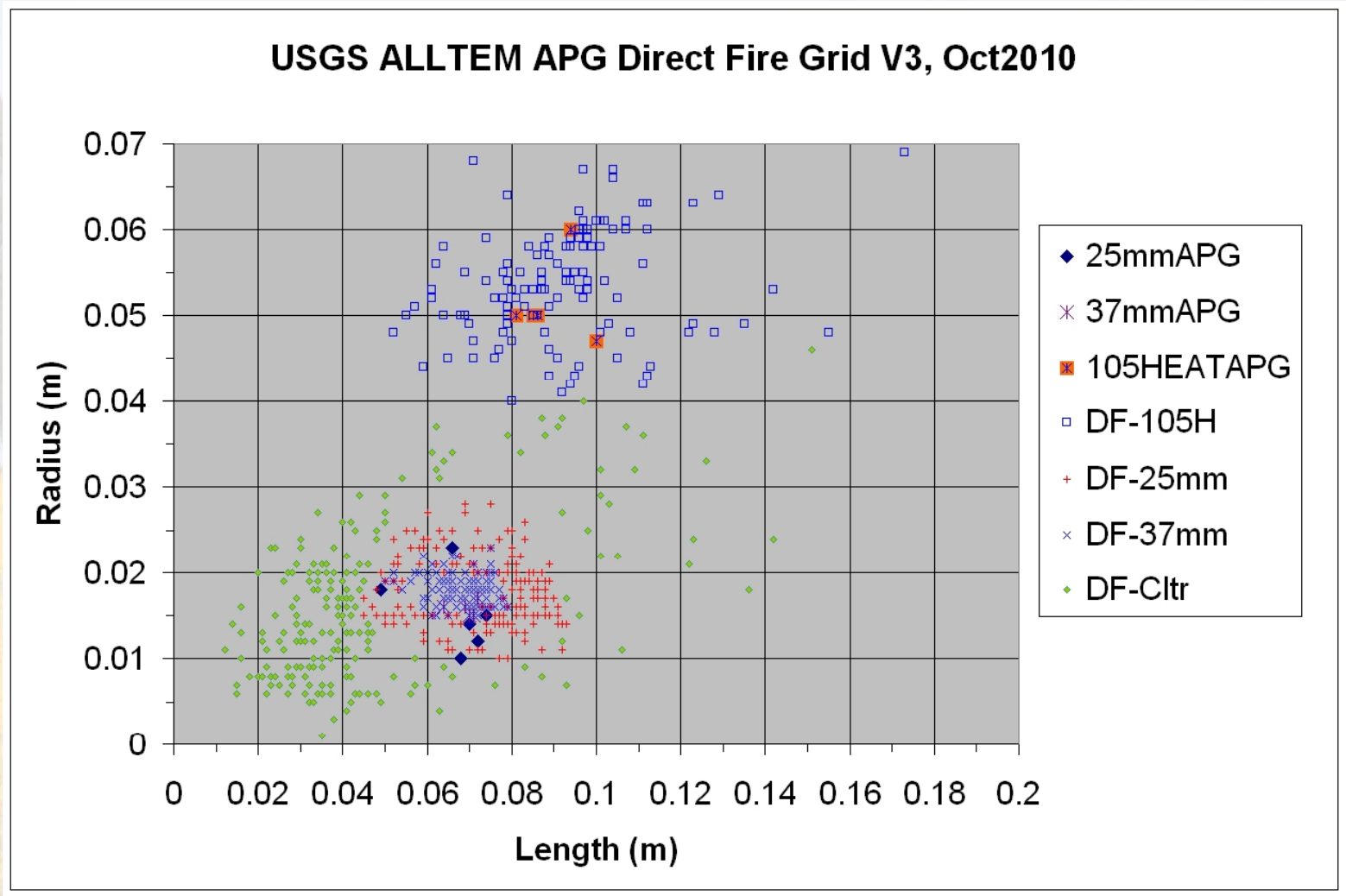
High Clutter



Aberdeen Proving Ground Data Analysis – Calibration Grid Results For Known Targets



Aberdeen Proving Ground Data Analysis Results – Direct Fire Area V3, Oct 2010



Technical Progress

Aberdeen Proving Ground Data Analysis Results – Direct Fire Area V3, Oct 2010

Scoring Summary (rounded to 5%) –

Only individual UXO scored (groups were excluded from analysis)

For the Response (detection) stage:

- Pd(O detected) = 95%
- % false positives (detected C called O)= 45%
- Pd(Depth: 0-4xdiam.)= 95%
- Pd(4-8xdiam.)= 95%
- Pd(>8xdiam.)= 90%

For the Classification stage (only includes items detected in the response stage):

- Pcc(detected O called O) = >95%
- Pcc(0-4xdiam.)= >95%
- Pcc(4-8xdiam.)= >95%
- Pcc(>8xdiam.)= 95%
- No significant dependence on UXO type is observed

Technology Transfer – ALLTEM System

- **Future Technology Transfer activities:** The most effective means of ensuring transfer (and use) of the ALLTEM (or other equivalent tools) by DOD contractors is to get the system into the field and demonstrate it at actual field sites.

  Camp Stanley, near San Antonio, Texas, has requested a proposal for a proof of concept over an OB/OD area and trenches. Scheduled for late February, 2011.

GROUNDWATER UPDATE

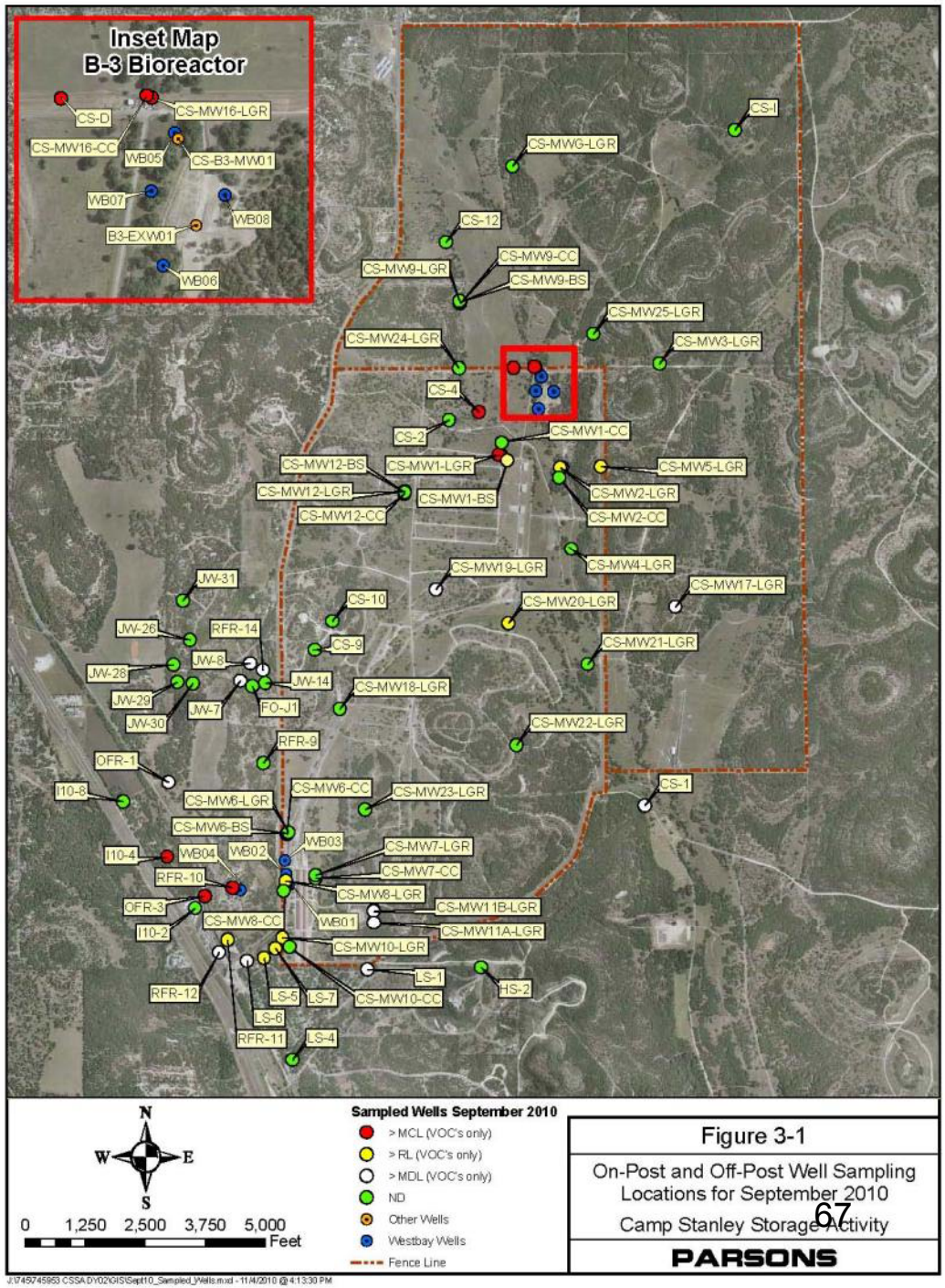
Groundwater Monitoring Program
Overview

- Quarterly Monitoring Program:
  - On-post since December 1999: 46 events
  - Off-post since September 2001: 39 events
- Wells included:
  - 44 On-post monitoring wells
  - 2 On-post drinking water supply wells
  - 2 On-post former drinking water wells
  - 1 Future drinking water well
  - 4 Westbay®-equipped wells
  - 51 Off-post private and public supply wells
- 5 off-post wells have GAC units due to past exceedances

Groundwater Monitoring Program

Sampling Locations

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



Groundwater Monitoring Program
Recent Changes

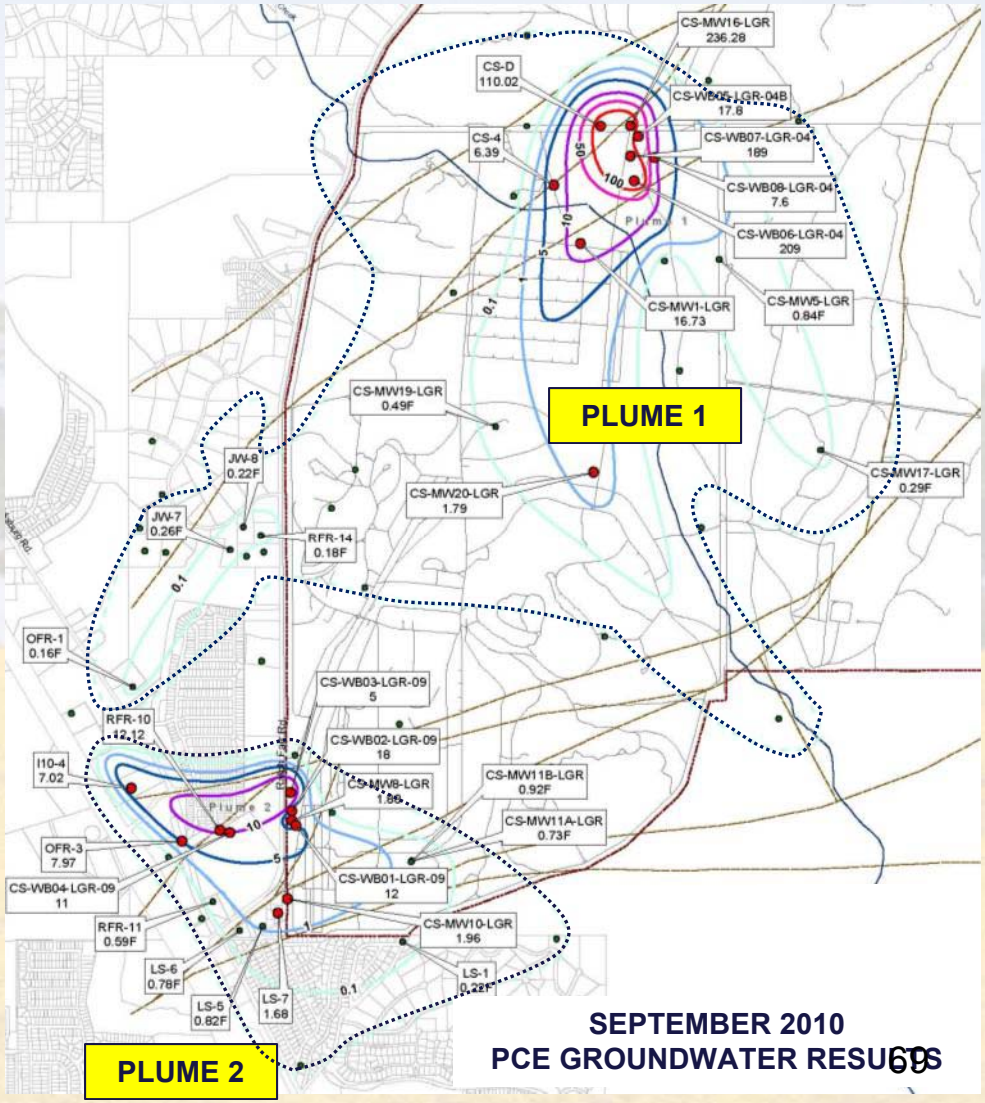
- Continuing the trend started in September 2009, the San Antonio area received above average rainfall (37+ inches) in 2010. CSSA received ample rainfall through September 2010, at which time the area entered a “dry” cycle.

- Aquifer levels continued to stay above average for most of the year.

- Future supply well, CS-12, has been added to the groundwater monitoring schedule. No VOCs have been reported. CSSA is currently completing construction activities to start-up the well for production.

Groundwater Monitoring Program
2010 Results Overview

- September 2010 was the last "snapshot" sampling event (e.g., all wells sampled).
- 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.
- Both plumes have migrated off-post to the west.
- Dashed line represents historical extent of VOC detections above MDL.
- Concern about increasing trend at I10-4 west of CSSA (Plume 2).



Groundwater Monitoring Program
September 2010 Results Overview

- Two quarterly groundwater events (September and December 2010) have occurred since last regulatory meeting in July 2010. The September event was the 9-month "snapshot" during which all wells were sampled in the same timeframe.
- In September 2010, 45 On-Post and 31 Off-Post wells were sampled.
  - Trace hit of TCE at CS-10 was not reported this time.
  - Lead above AL CS-MW9-BS. Mercury above the MCL at former supply well CS-9. No more lead in new wells MW20 - MW25.
  - The same five On-Post and three Off-Post wells continue to exceed the MCL for either PCE, TCE, or cis-1,2-DCE.
  - Off-Post well I10-4 continues to hover above the PCE MCL at 7.02 µg/L. The well continues to remain inactive.
- Generally, no significant changes to the Plumes since last meeting.

Groundwater Monitoring Program
December 2010 Results Overview

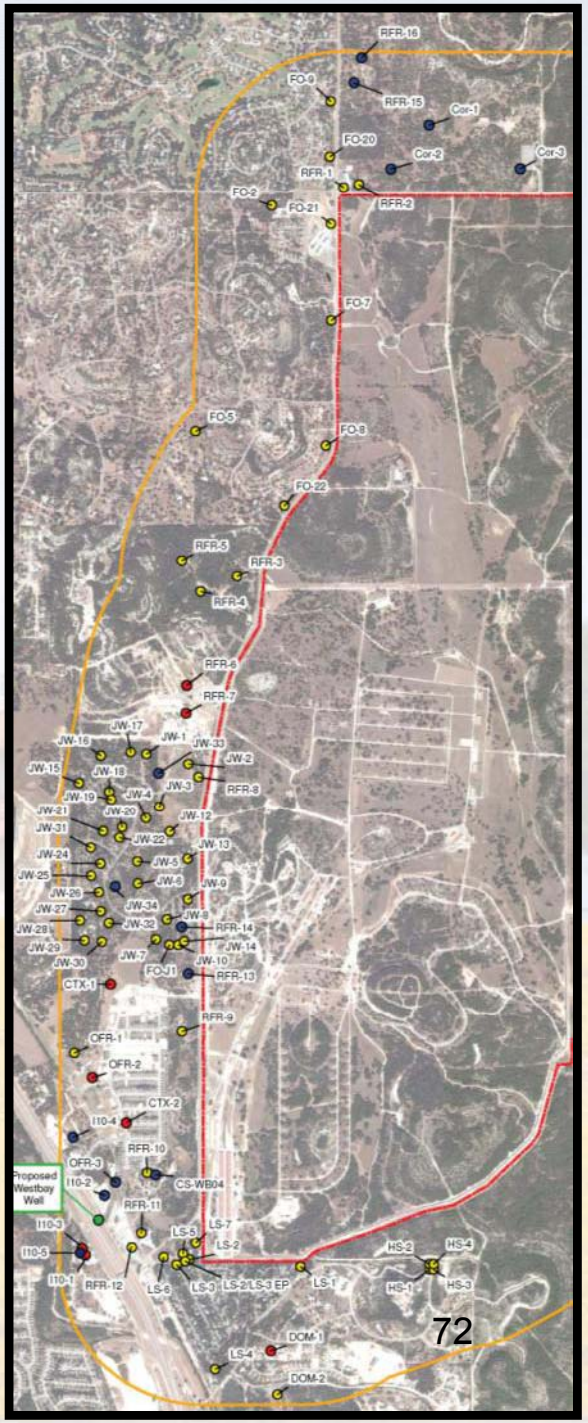
- In December 2010, 10 On-Post and 23 Off-Post wells were sampled.

  - Highest measured PCE levels at RFR-10 (35 µg/L) and I10-4 (7.86 µg/L) since 2001.

  - Lead above the AL in three wells:
    - 0.0474 µg/L at CS-9 (inactive supply well)
    - 0.0186 µg/L at CS-12 (future supply well)
    - 0.0183 µg/L at CS-MW25-LGR

Groundwater
Well Survey Update

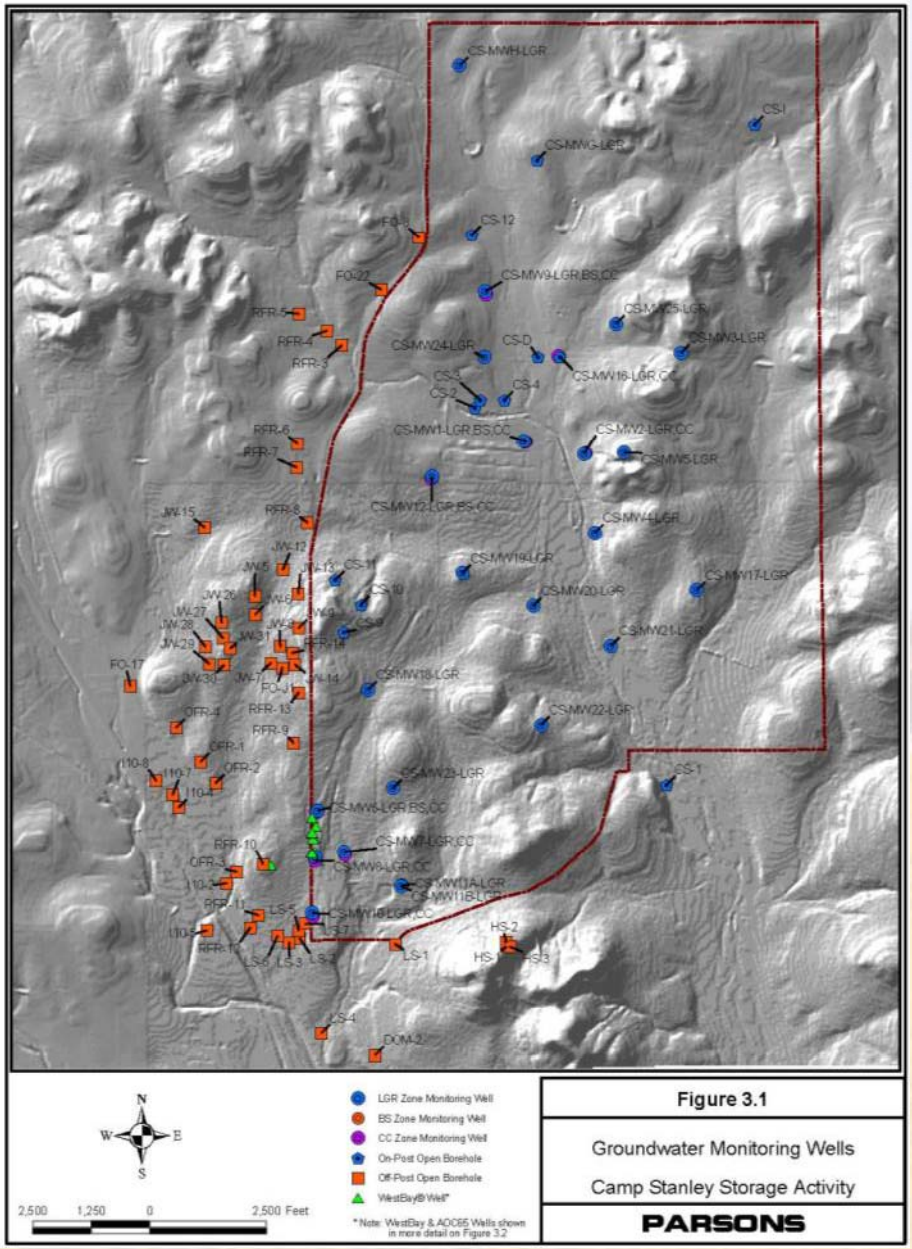
- Parsons has expanded the original 2001 ¼-mile survey (per Consent Order) to include wells within ½ mile of CSSA by state agency records review.
- 2010 Survey identified 77 wells within ½ mile of CSSA.
- Only 11 new wells since 2001 survey. These had already been previously identified and incorporated into the network as appropriate.
- Since 2001, two wells were confirmed to be plugged/abandoned. Another five wells were presumed plugged/abandoned due to property redevelopment.
- In summary, CSSA has remained vigilant in keeping up with groundwater activities surrounding the post and no “new” wells were discovered that CSSA was not already aware of.



Long-Term Monitoring Optimization (LTMO) Process Background

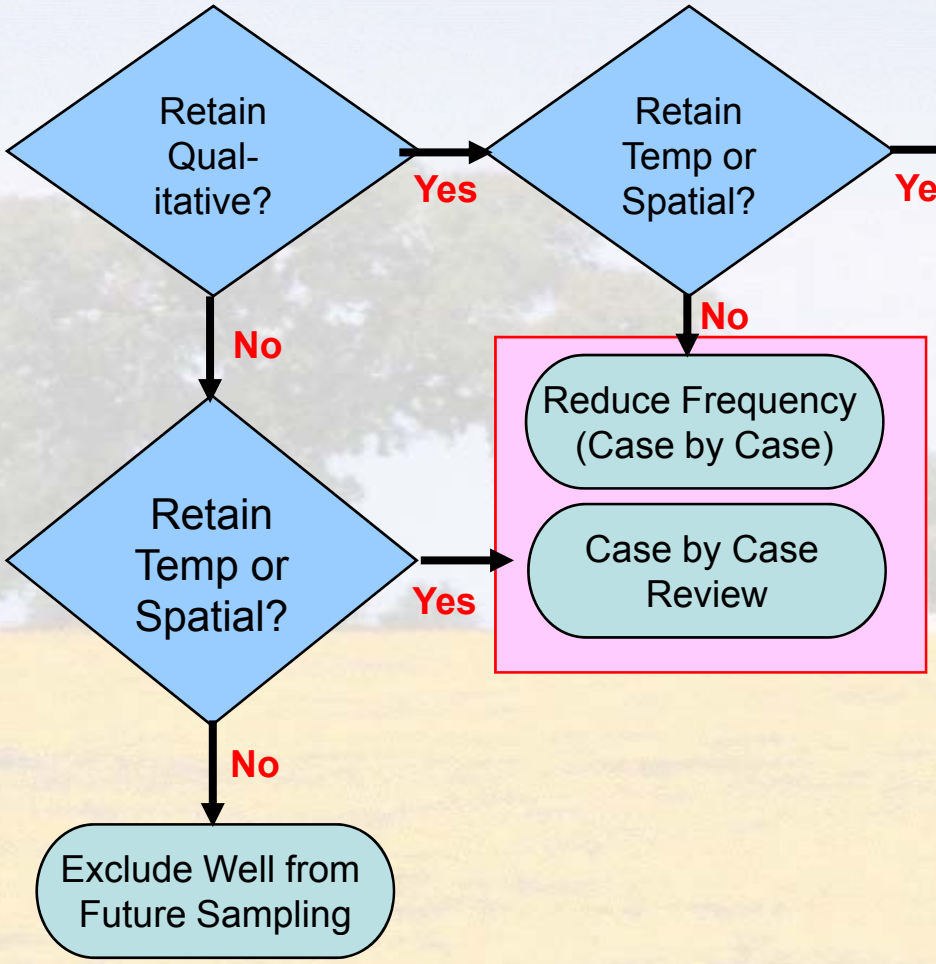
- A summary of the LTMO process was presented to EPA and TCEQ during a meeting on January 20, 2005.
- The 3-Tiered LTMO Approach includes:
  - Qualitative Evaluation, Temporal Evaluation, Spatial Evaluation and combining all three.
- Initially submitted and approved in 2005, and the LTMO approach was adopted in December 2005 (on-post only).
- The report was updated with new data through December 2009 and submitted to the regulators in November 2010 with recommendations (currently awaiting approval).

Groundwater Monitoring Program



- 111 Sampling Locations Evaluated
- 56 On-Post Wells
- 51 Off-Post Wells
- 4 Westbay® Wells Evaluated in "Vertical" Analysis
- 14 New Locations since 2004
- 8 Off-Post wells dropped out

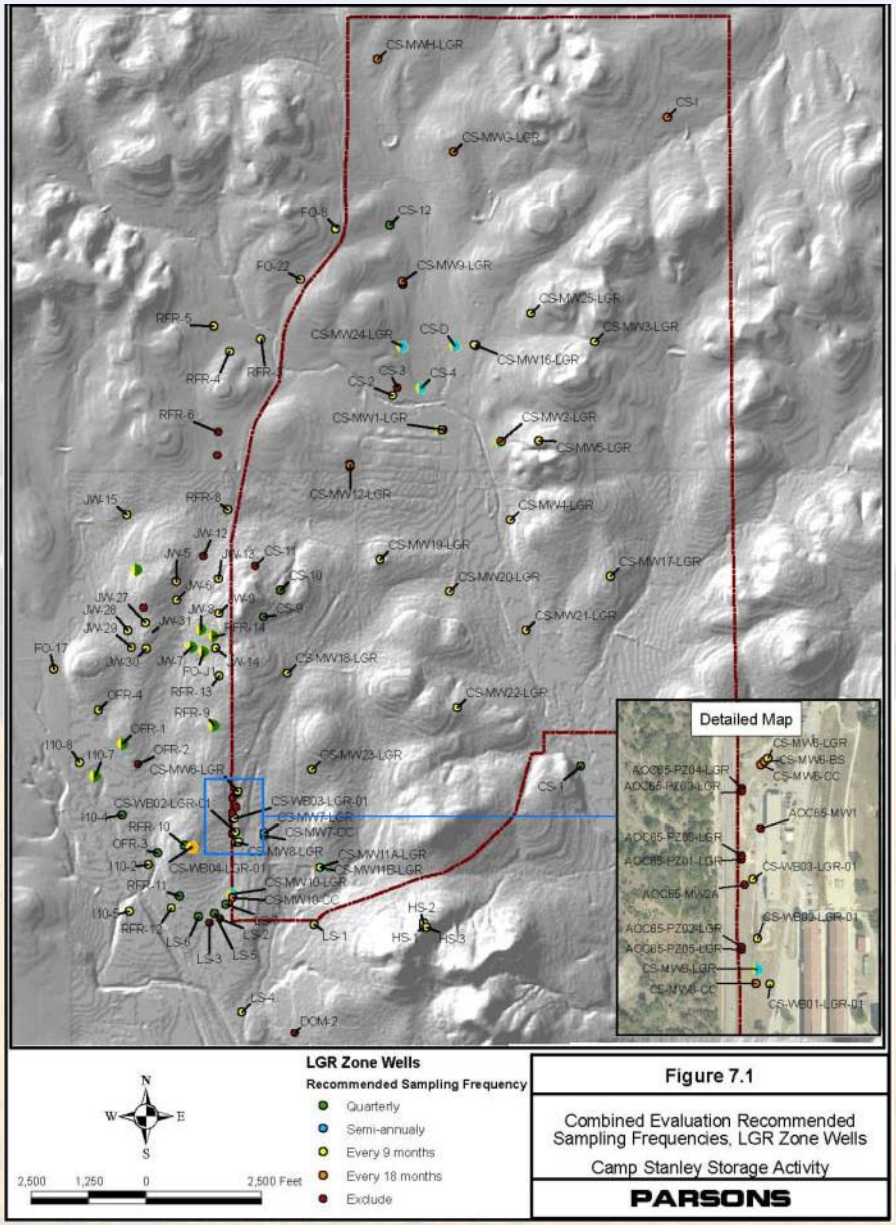
Combined Evaluation



Frequency Adjustment Evaluation

- Combine 3 Analyses to Determine Final Distribution and Frequency Recommendation
- Qualitative Verified & Refined by Quantitative

Combined Evaluation Summary



- 89 On & Off-Post Wells
  - 14 (18-months)
  - 49 (9-months)
  - 8 (Semi-Annual + 9-month Snapshot)
  - 10 (Quarterly)
  - 8 (Quarterly due to Off-Post DQOs)
- 4 Westbay Wells
  - 37 LGR Zones (9-months)
  - 9 BS/CC Zones (18-months)
- AOC-65
  - Exclude PZs and MWs

LTMO Recommendations

	18-month	9-month	Semi-Annual + 9-month	Quarterly	DQO Quarterly	Westbay 18-month Schedule[1]	Westbay 9-month Schedule[1]	Totals
On-Post	14	20	8	4	-	-	-	46
Off-Post	-	29	-	6	8	-	-	43
Westbay		8*	-	0	-	9	37	46
	14	49	8	10	8	9	37	135

Notes: [1] The Westbay schedule will follow 1 quarter behind the On-Off-Post Schedule

** 8 LGR Westbay Zones will also be sampled on the On/Off-Post Schedule for Mapping Purposes*

- On & Off-Post Wells
  - Reduce from 209 to 152 (27%) sampling events per year
    - On-Post: 100 to 76 events (24% reduction)
    - Off-Post: 109 to 76 events (30% reduction)
- Westbay® Wells
  - Reduce from 85 to 69 sampling events per year (19% reduction)

LTMO Recommendations

Schedule Type	Well Count	YEAR 1				YEAR 2				YEAR 3				YEAR 4				YEAR 5			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
9-Month (On/Off Post)	49	9			9			9			9			9			9			9	
18-Month (On-Post Only)	14	18						18						18						18	
Quarterly (On/Off-Post)	10	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
Semi + 9-Month Snapshot (On-Post Only)	8	SA		SA	9	SA		SA		SA	9	SA		SA		SA	9	SA		SA	
DQO Quarterly/9-Month (Off-Post Only)	8	Q	Q	Q	Q	Q	Q	9			9			9			9			9	
Westbay (LGR Zones)	29		9			9			9				9		9			9			9
Westbay (LGR Zones)	8	9	9		9	9		9	9		9	9		9	9		9	9		9	9
Westbay (BS/CC Zones)	9		18						18						18						18

- Proposed LTMO Sampling Schedule
  - Base Sampling Schedule is 9 months
    - Overall Sample Reduction which still produces an area-wide "Snapshot" event.
    - Westbay sampling is staggered by 1 quarter for scheduling/manpower effectiveness.

2010 Groundwater DQO Update

- Along with the 2010 LTMO report, revised 2010 Groundwater DQOs were also submitted to EPA and TCEQ.
- Major changes to the DQOs include:
  - Revised metals analyte list for on-post wells (added Cr and Hg; dropped Ni)
  - Addition of the 9-month “Snapshot” monitoring event
  - Implementation of the 2010 LTMO recommendations (pending approval)
  - Addition of one drinking water well (CS-12)
- For off-post wells, the increased sampling frequencies stipulated in the DQOs supersede the LTMO recommendations if thresholds are exceeded.

SUMMARY

- The updated DQO and LTMO recommendations for on- and off-post were submitted to EPA and TCEQ November 2010.
- CSSA would like to implement LTMO recommendations in the March 2011 sampling event.
- Comments/Discussion?

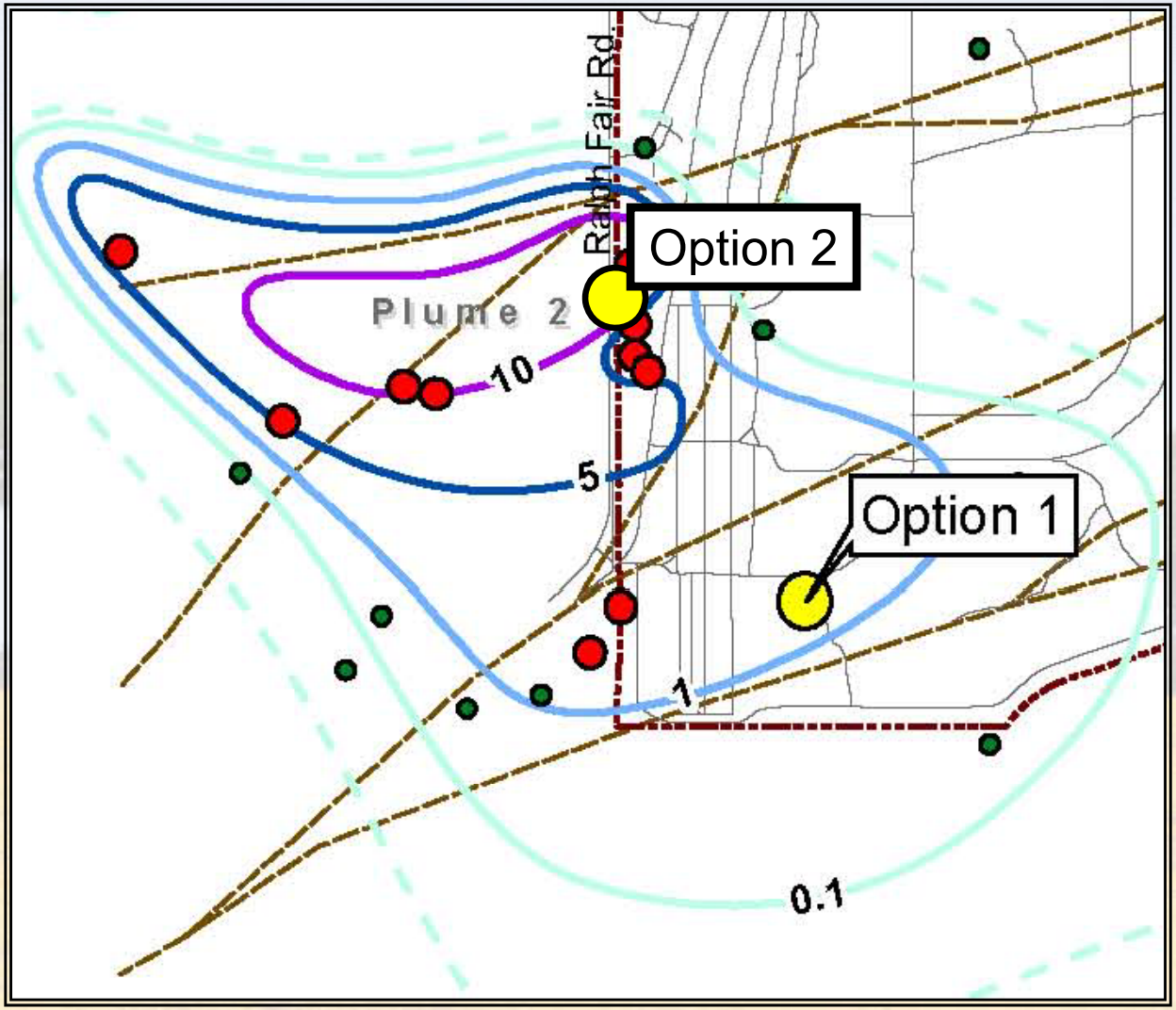
Groundwater
Planned Wells

- Current Delivery Order has new wells scoped for installation:
  - New LGR well to support/enhance basewide groundwater monitoring program SE of warehouse section (Plume 2),
  - New LGR well west of AOC-65 at fenceline.

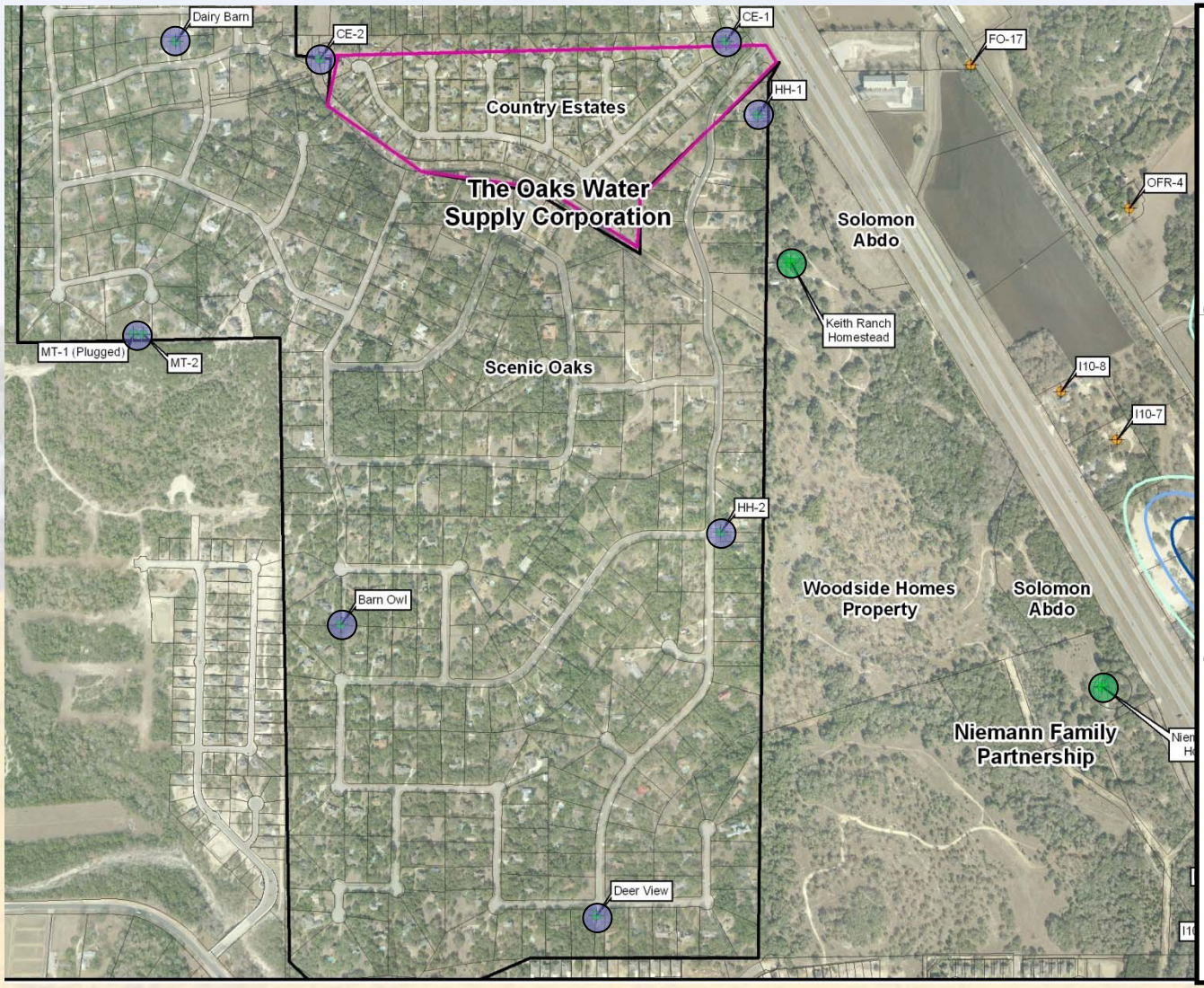
Groundwater
Planned Wells

On-Post

1. Southeast of AOC-65 (Plume 2).
2. Downgradient of SWMU B-15/16. Help determine if Plume 1 actually extends past CS-MW22-LGR towards CS-1.
3. Find ND point in SE corner of Post
4. Validate/delineate occurrence of PCE at CS-MW17-LGR



Groundwater
Off-Post Strategy



Off-Post

1. Two existing private wells are expected to exist at the Niemann Partnership and Woodside Home Development.
2. Eight wells are present in the Oaks WSC corporation.

Groundwater
Planned Wells: Off-Post Strategy

- Expanded Monitoring Program:
  - Contact Niemann Family Partnership to arrange for well sampling at their presumed well across from I10-4.
  - Contact Woodside Development to gain access to the presumed well at the former Keith Ranch Homestead.
  - Contact The Oaks WSC to arrange for sampling of their easternmost supply wells. Determination of well completion (Middle of Lower Trinity Aquifer will be considered). Their 2009 Consumer Confidence Report indicated no VOCs in the PWS.

Groundwater Downhole Logging

- CSSA is contracting with the USGS to perform borehole logging in and around CSSA.
- A total of 13 Off-Post wells and 5 On-Post wells have been selected for consideration. Actual number will depend on funding constraints.
- Final selections will be based upon spatial importance within the plume, (missing geologic information & structural significance), depth and casing, and accessibility.
- All well will be logged by a standard suite of geophysical tools.
- Selected wells (unlimited access and long open intervals to the formation) will be logged for an extended suite of geophysical tools that aid in porosity/permeability, clay content, and advanced imaging.

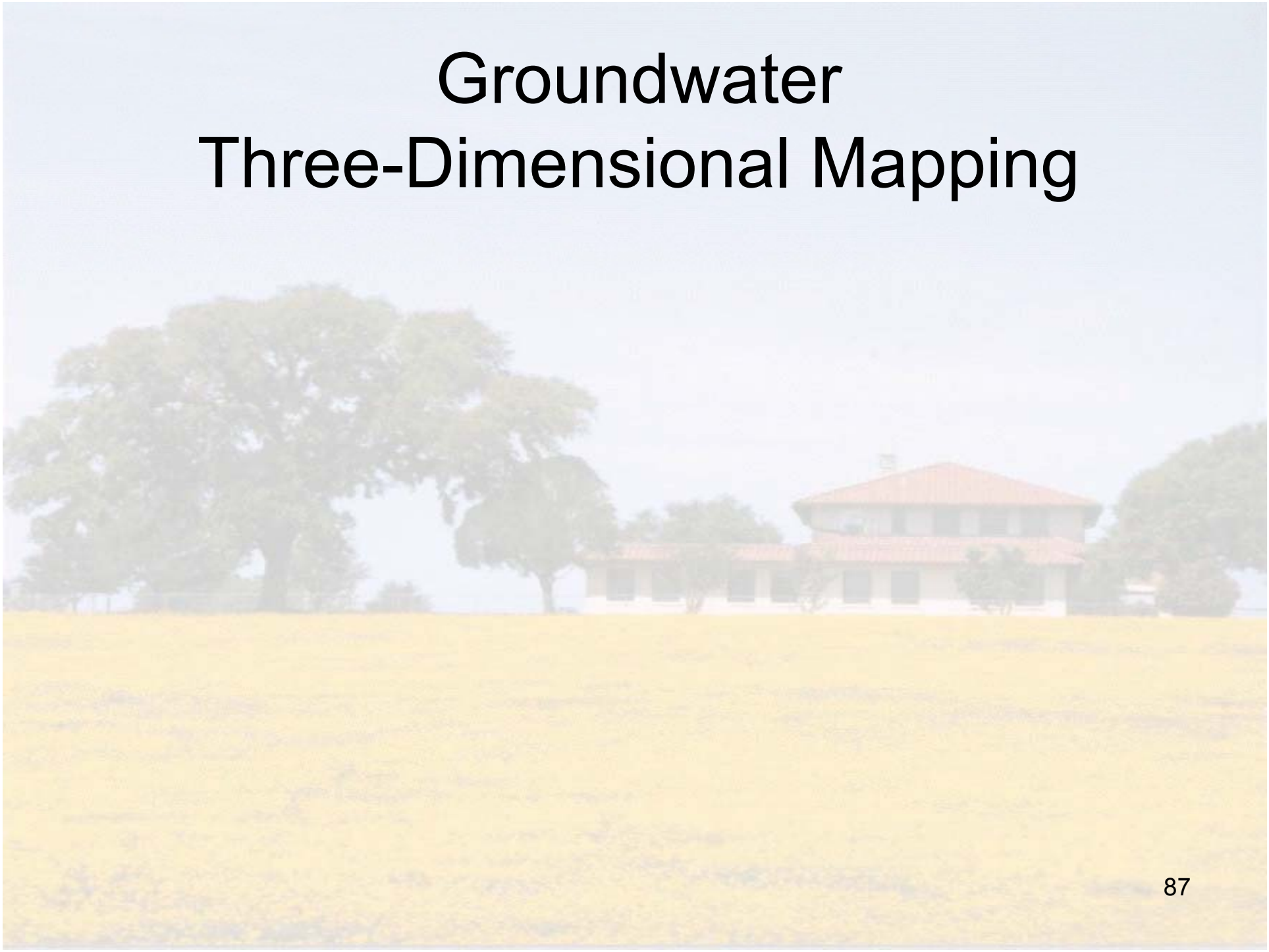
Borehole Geophysics

USGS Equipment

- Well depths down to 3,000 feet
- Standard borehole logging methods
  - Caliper
  - Gamma
  - Spontaneous potential
  - Normal resistivity
  - Fluid resistivity
  - Temperature
  - Magnetic susceptibility
- Borehole electromagnetic (EM) induction logging
  - Single induction
  - Dual induction
- Borehole imaging
  - Acoustic Televiewer
  - Optical Televiewer
  - Borehole video camera (for assessing borehole conditions)
- Borehole flowmeter methods
  - Electromagnetic
  - Heat Pulse
- Full waveform sonic
  - Porosity Calculation
  - Fracture detection
- Neutron porosity
  - Single detector
  - Dual detector
- Gamma-Gamma Density
- Spectral gamma

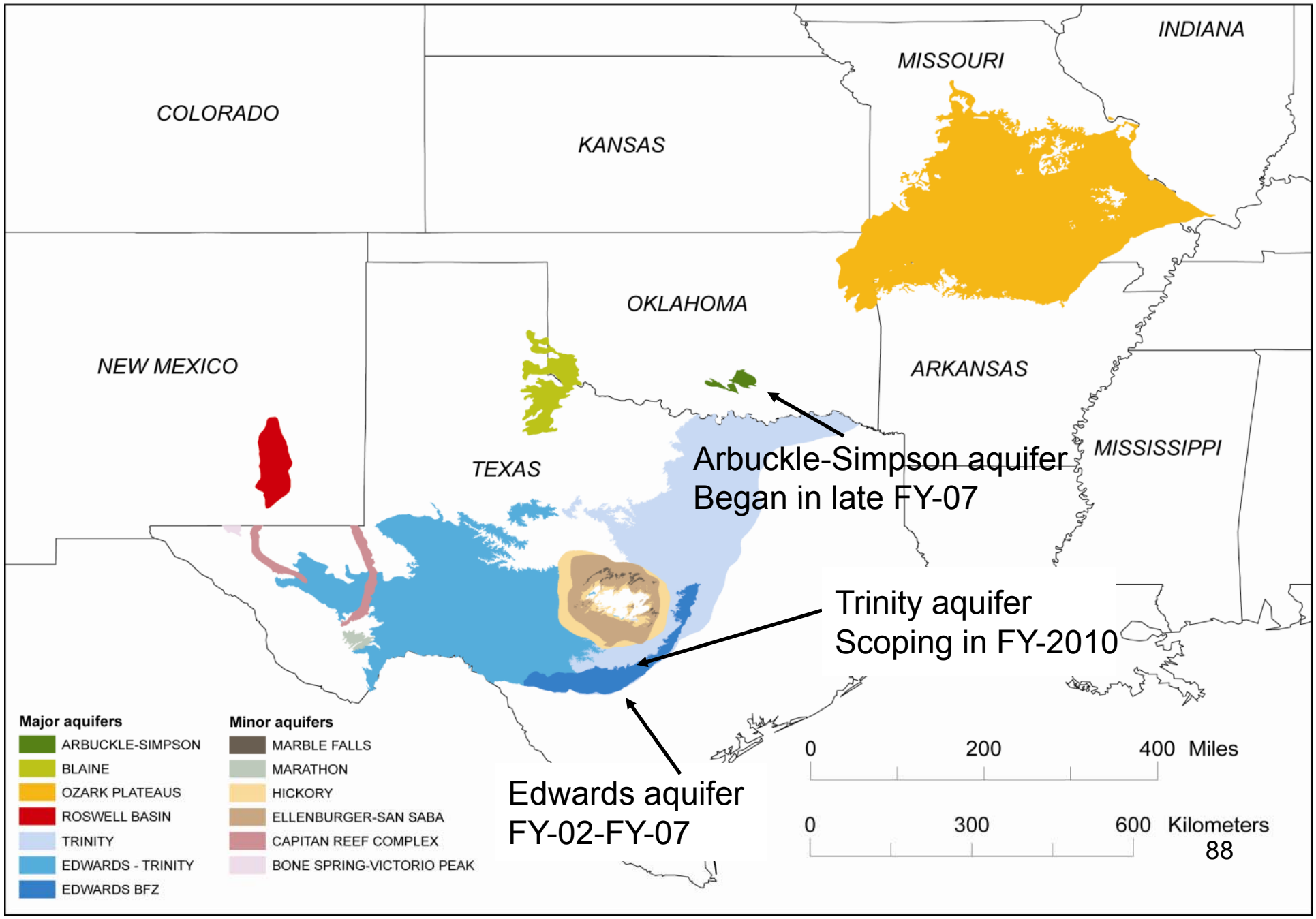
USGS science for a changing world

Groundwater
Three-Dimensional Mapping

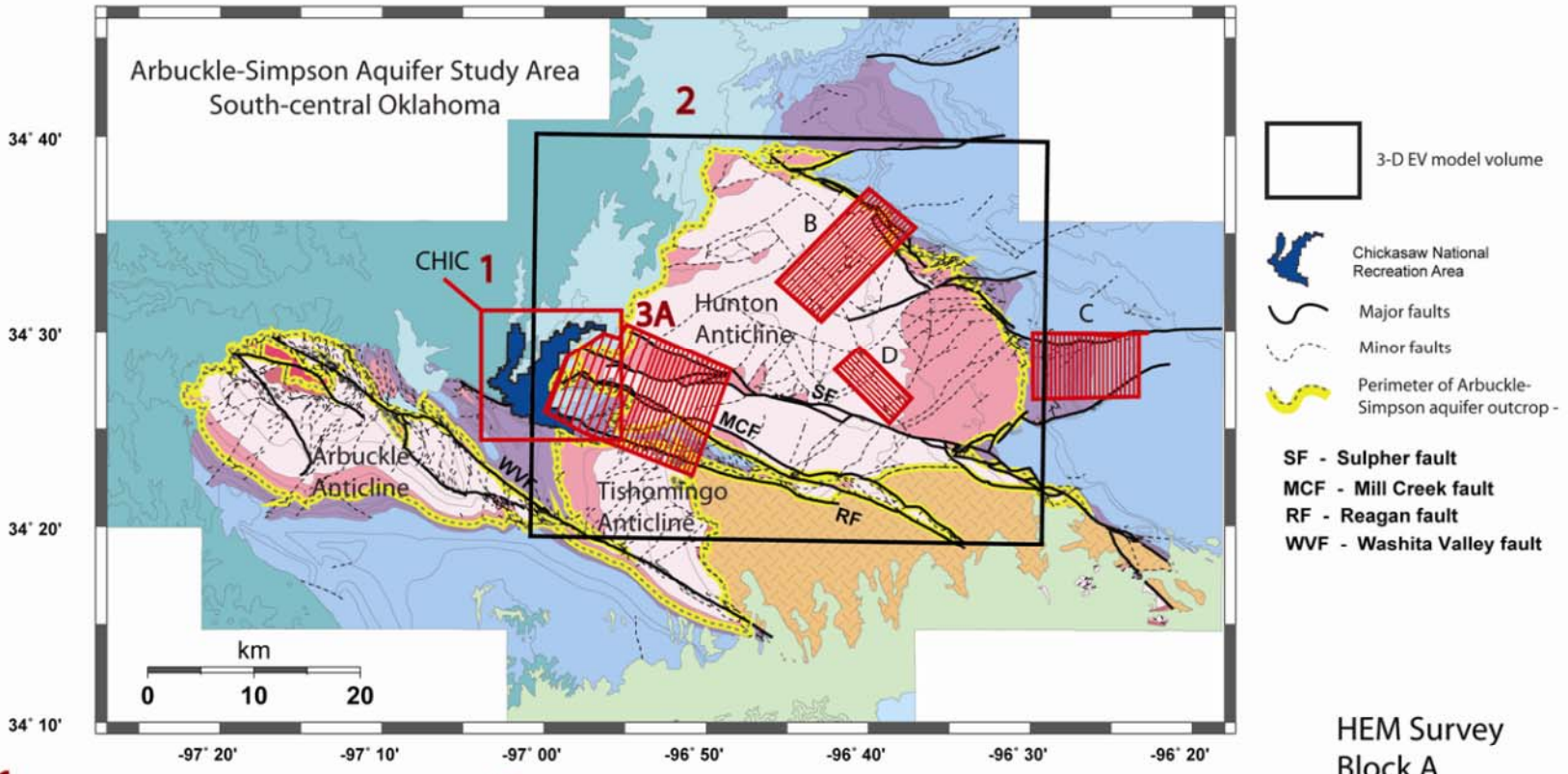


Framework Geology of Mid-Continent Carbonate Aquifers

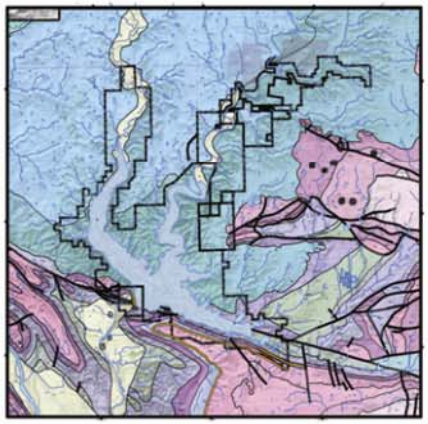
National Cooperative Geologic Mapping Program



Arbuckle-Simpson Study Areas - Mapping/3-D EV Modeling/Geophysics

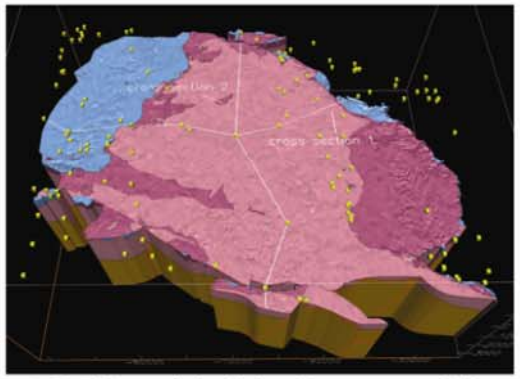


1



New 1:24K Geologic Map of CHIC

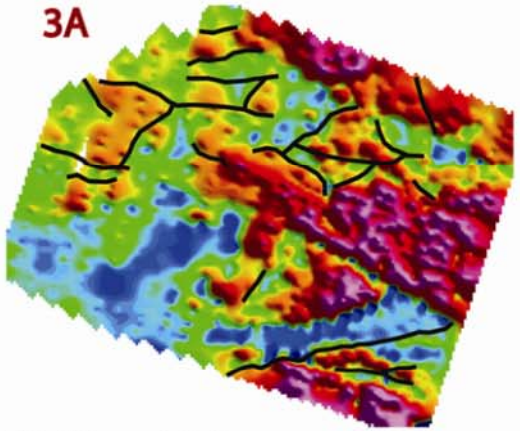
2



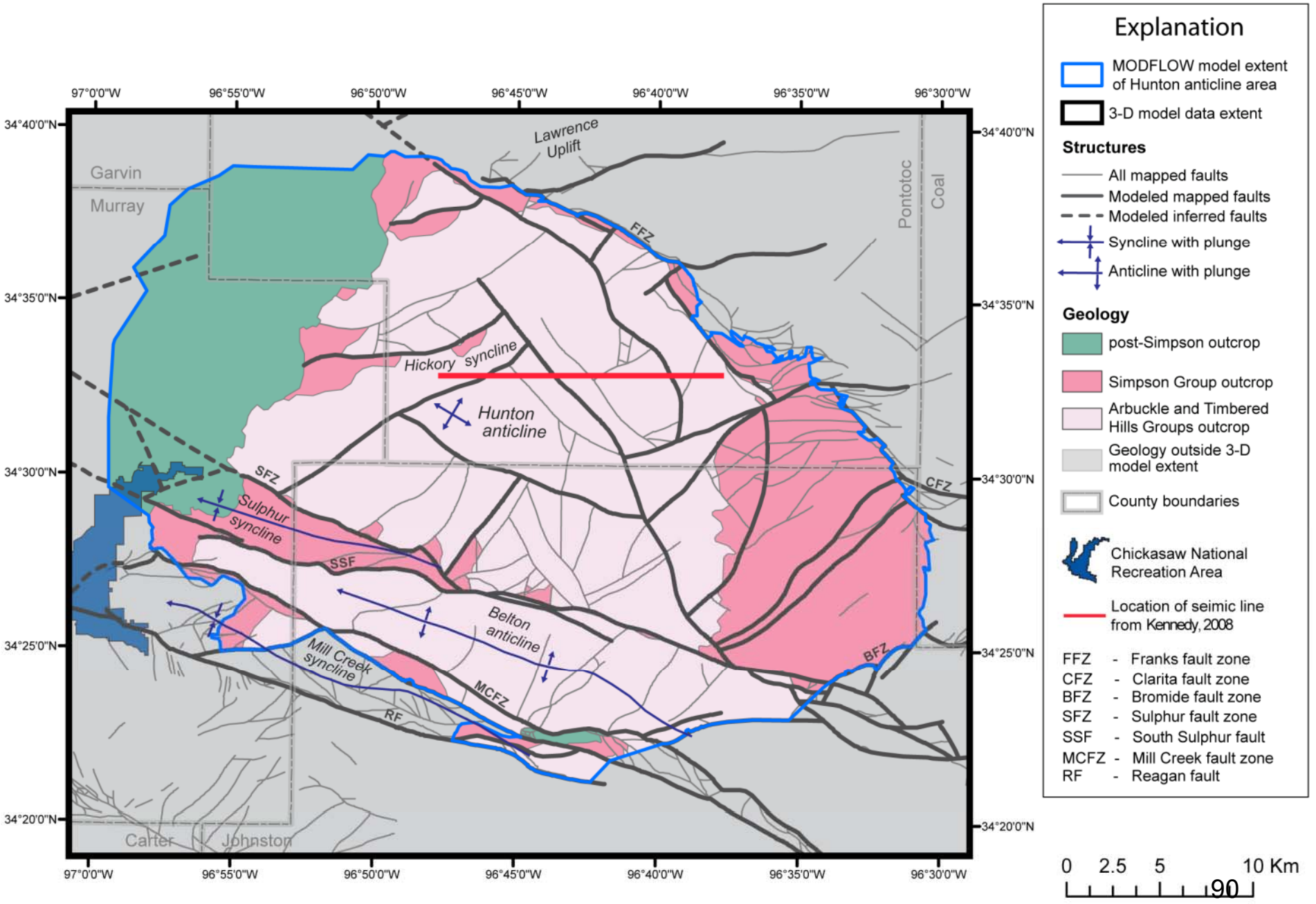
3-D EV model of the Hunton anticline
(USGS OF 2010-1126)

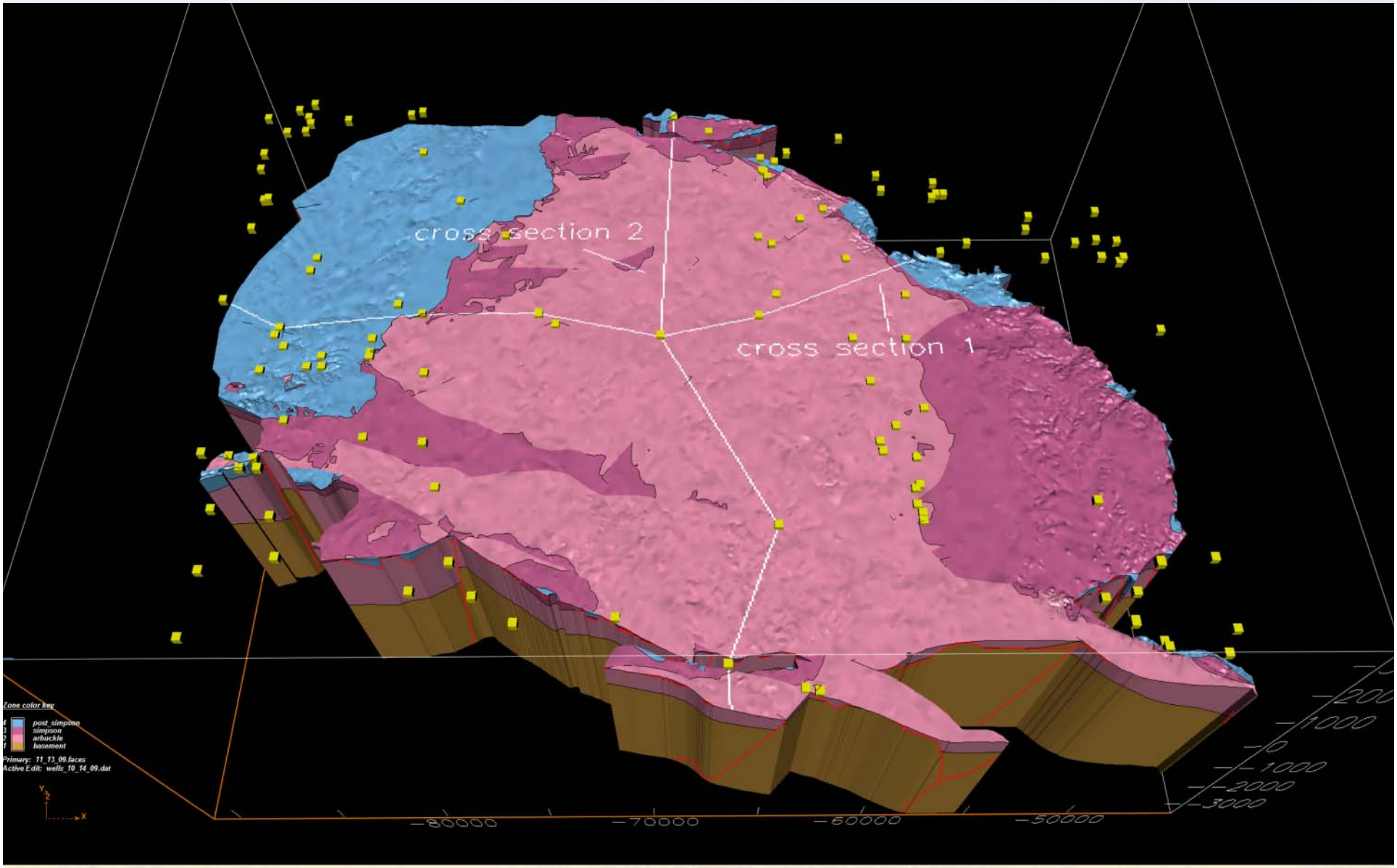
HEM Survey
Block A

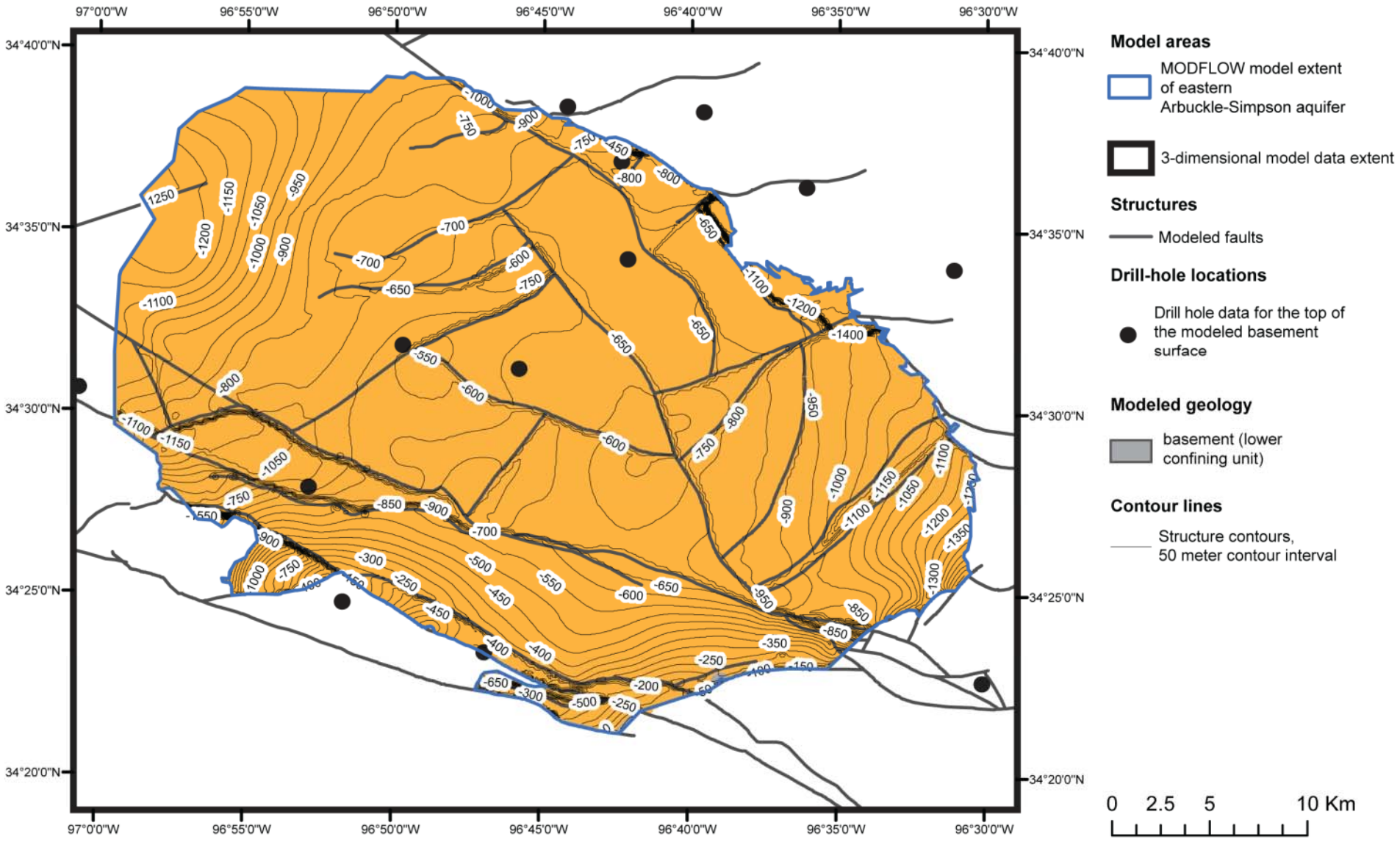
3A



100 kHz resistivity


Explanation
MODFLOW model extent of Hunton anticline area
3-D model data extent
Structures
All mapped faults
Modeled mapped faults
Modeled inferred faults
Syncline with plunge
Anticline with plunge
Geology
post-Simpson outcrop
Simpson Group outcrop
Arbuckle and Timbered Hills Groups outcrop
Geology outside 3-D model extent
County boundaries
Chickasaw National Recreation Area
Location of seimic line from Kennedy, 2008
FFZ - Franks fault zone
CFZ - Clarita fault zone
BFZ - Bromide fault zone
SFZ - Sulphur fault zone
SSF - South Sulphur fault
MCFZ - Mill Creek fault zone
RF - Reagan fault
Garvin
Murray
Lawrence Uplift
Pontotoc
Coal
Hickory syncline
Hunton anticline
Sulphur syncline
Belton anticline
Mill Creek syncline
Carter
Johnston
97°0'0"W
96°55'0"W
96°50'0"W
96°45'0"W
96°40'0"W
96°35'0"W
96°30'0"W
34°40'0"N
34°35'0"N
34°30'0"N
34°25'0"N
34°20'0"N
0 2.5 5 10 Km


cross section 2
cross section 1
Zone color key
post_simpson
simpson
arbuckle
basement
Primary: 11_13_09.faces
Active Edit: wells_10_14_09.dat
-80000
-70000
-60000
-50000
-200
-1000
0
1000
2000
3000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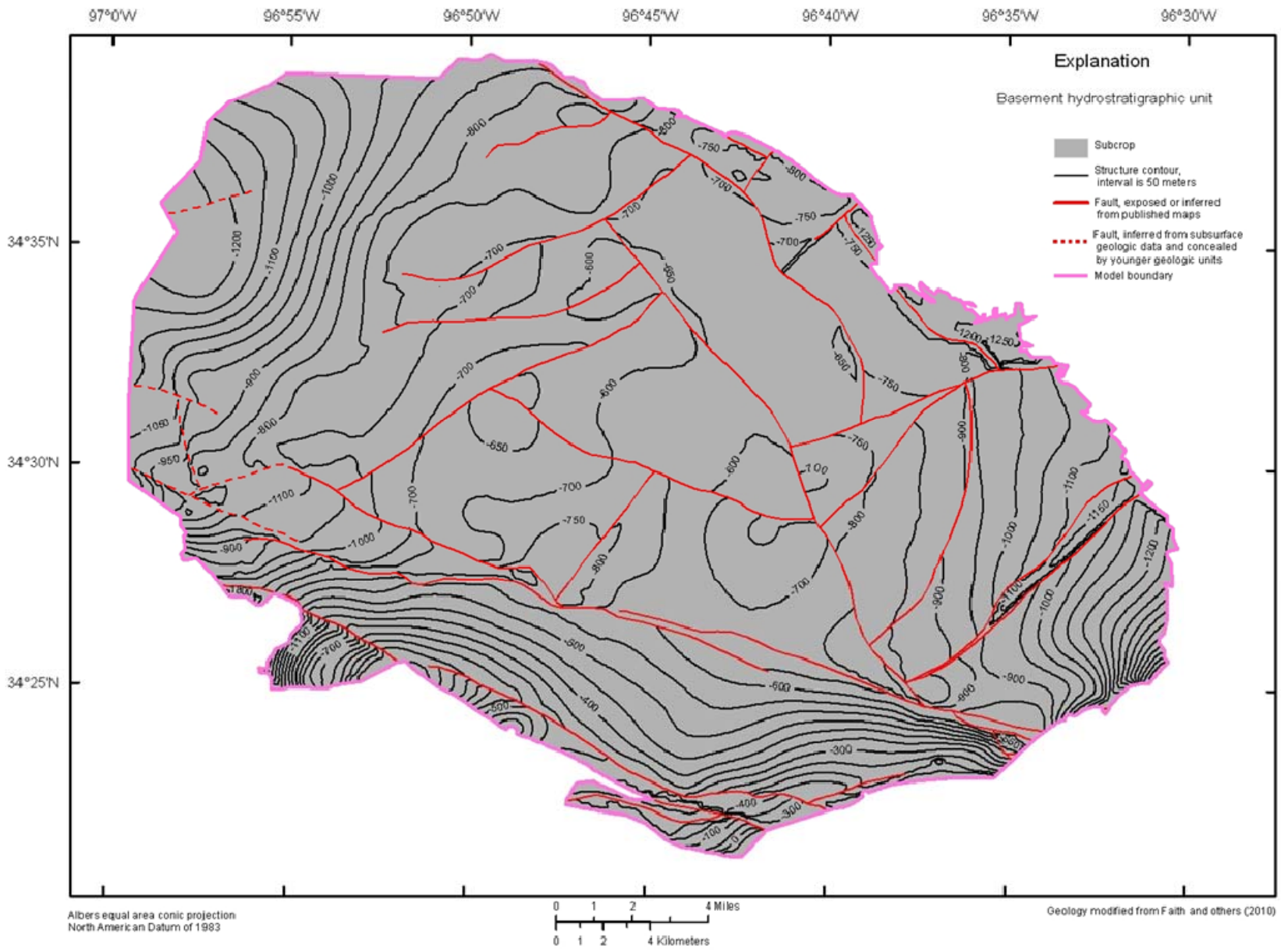
96°35'0"W
96°30'0"W
34°40'0"N
34°35'0"N
34°30'0"N
34°25'0"N
34°20'0"N
Model areas
MODFLOW model extent of eastern Arbuckle-Simpson aquifer
3-dimensional model data extent
Structures
Modeled faults
Drill-hole locations
Drill hole data for the top of the modeled basement surface
Modeled geology
basement (lower confining unit)
Contour lines
Structure contours, 50 meter contour interval
0 2.5 5 10 Km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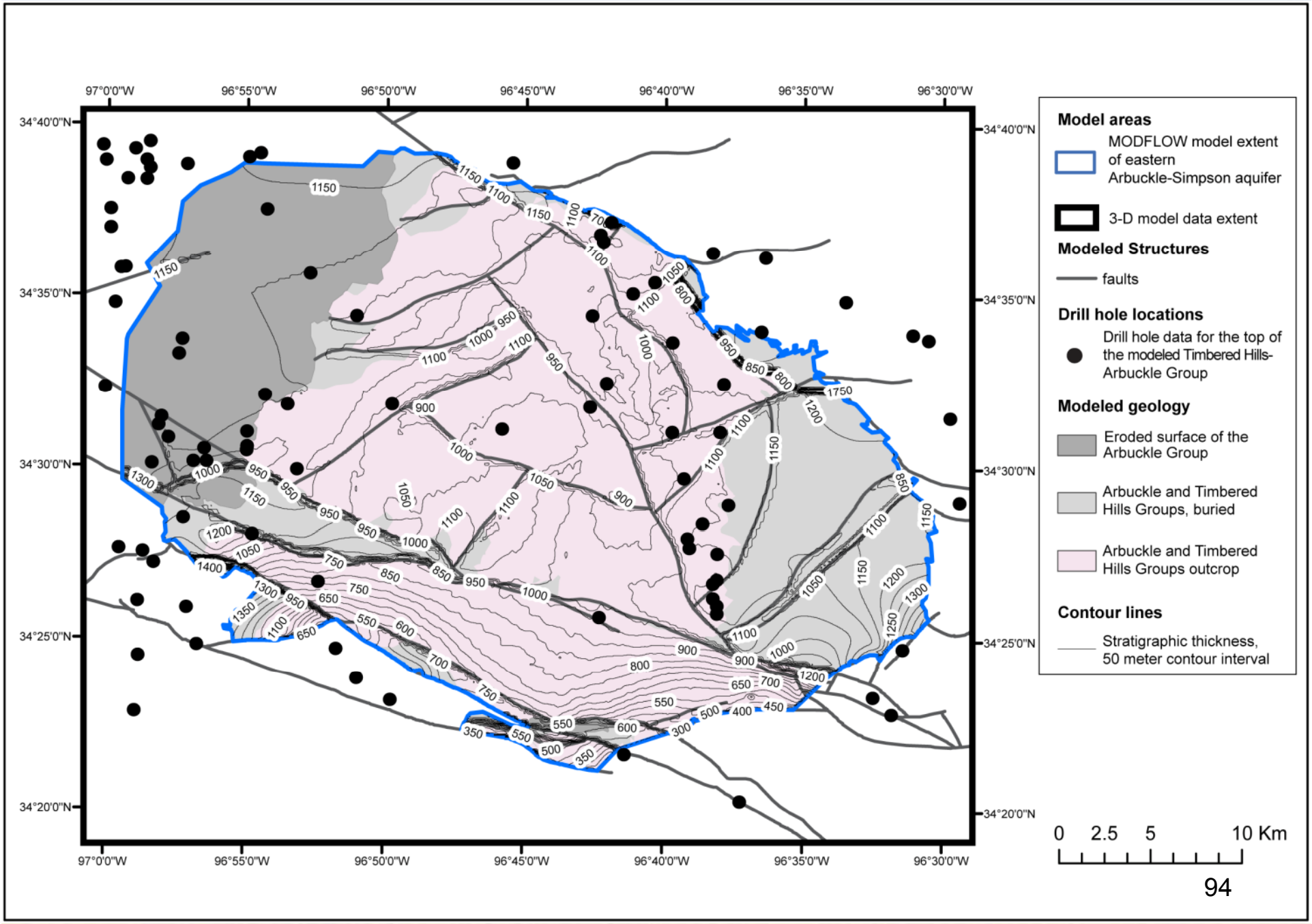
96°55'W
96°50'W
96°45'W
96°40'W
96°35'W
96°30'W
34°35'N
34°30'N
34°25'N
Explanation
Basement hydrostratigraphic unit
Subcrop
Structure contour, interval is 50 meters
Fault, exposed or inferred from published maps
Fault, inferred from subsurface geologic data and concealed by younger geologic units
Model boundary
Albers equal area conic projection
North American Datum of 1983
0 1 2 4 Miles
0 1 2 4 Kilometers
Geology modified from Faith and others (2010)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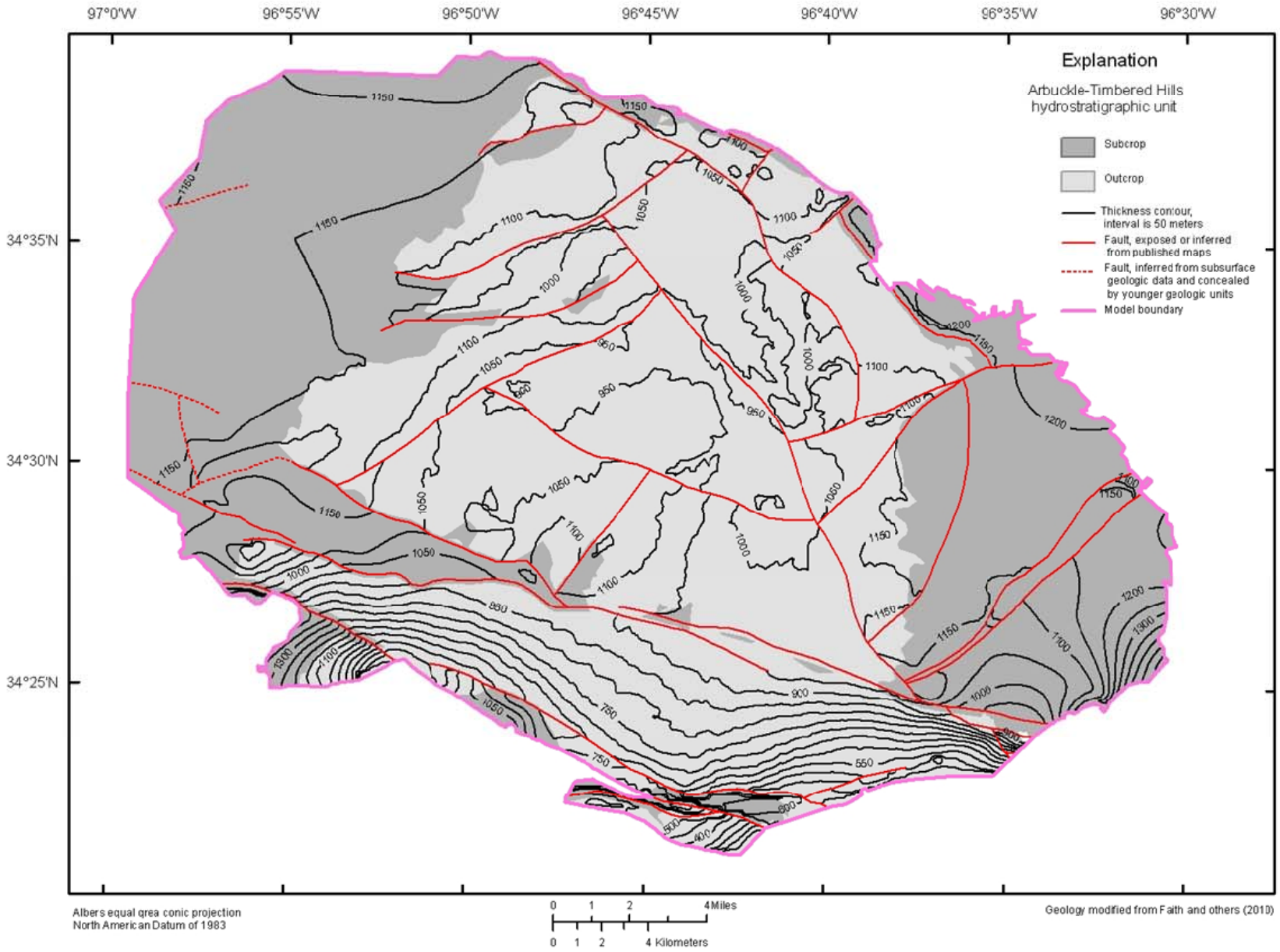
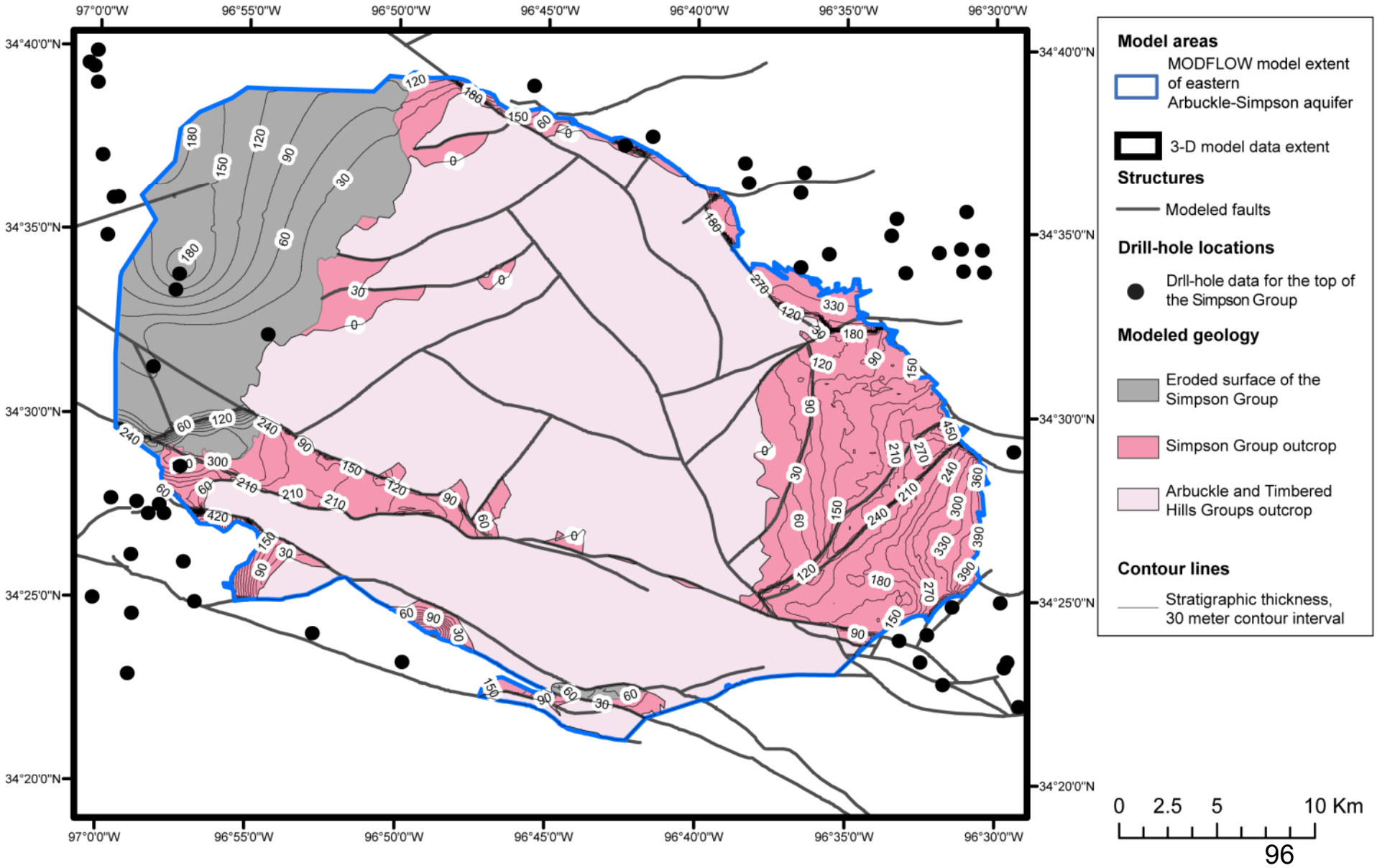
96°35'0"W
96°30'0"W
34°40'0"N
34°35'0"N
34°30'0"N
34°25'0"N
34°20'0"N
Model areas
MODFLOW model extent of eastern Arbuckle-Simpson aquifer
3-D model data extent
Modeled Structures
faults
Drill hole locations
Drill hole data for the top of the modeled Timbered Hills-Arbuckle Group
Modeled geology
Eroded surface of the Arbuckle Group
Arbuckle and Timbered Hills Groups, buried
Arbuckle and Timbered Hills Groups outcrop
Contour lines
Stratigraphic thickness, 50 meter contour interval
0 2.5 5 10 Km


97°0'W
96°55'W
96°50'W
96°45'W
96°40'W
96°35'W
96°30'W
34°35'N
34°30'N
34°25'N
Explanation
Arbuckle-Timbered Hills hydrostratigraphic unit
Subcrop
Outcrop
Thickness contour, interval is 50 meters
Fault, exposed or inferred from published maps
Fault, inferred from subsurface geologic data and concealed by younger geologic units
Model boundary
Albers equal area conic projection
North American Datum of 1983
0 1 2 4 Miles
0 1 2 4 Kilometers
Geology modified from Faith and others (2010)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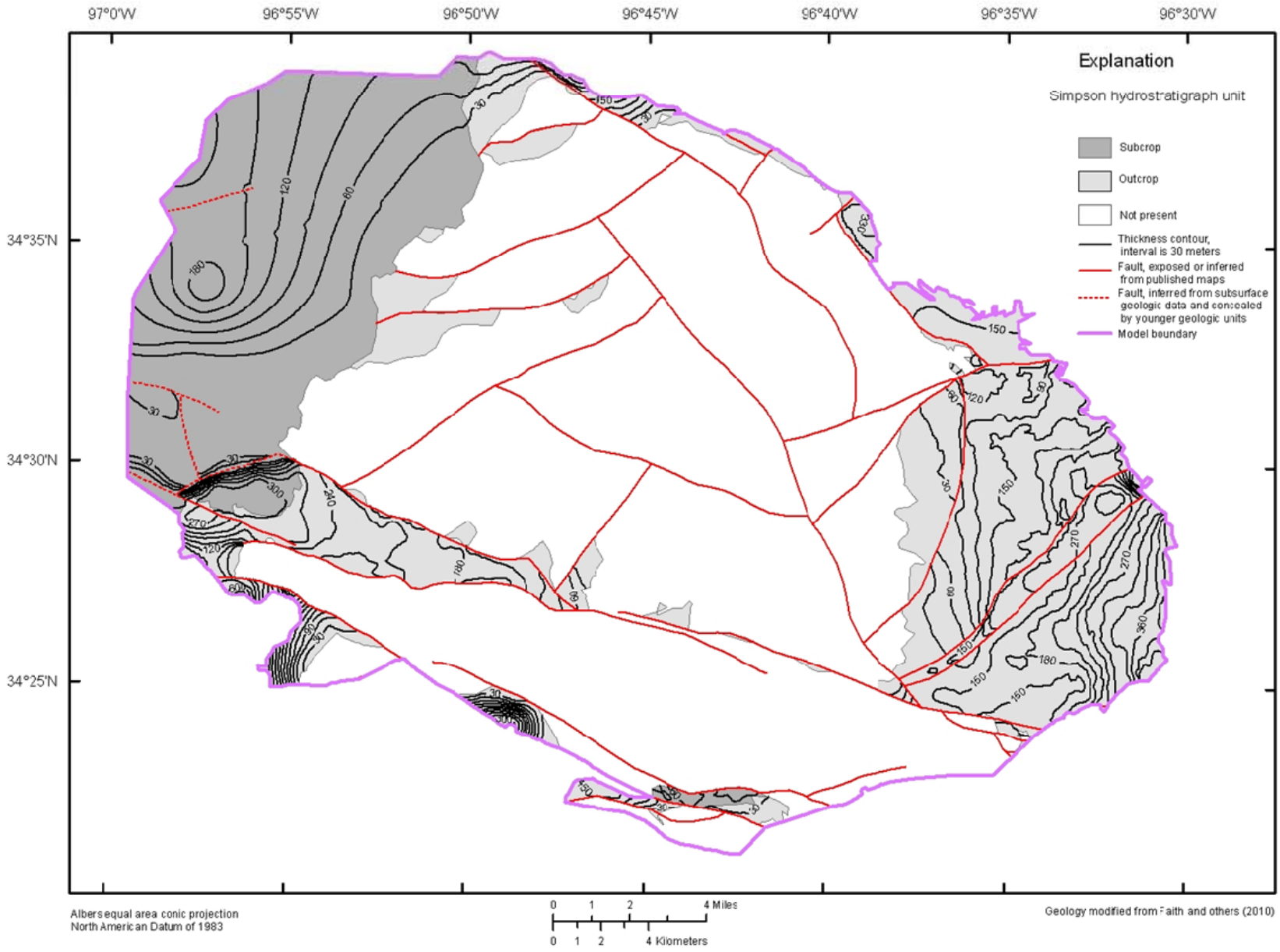
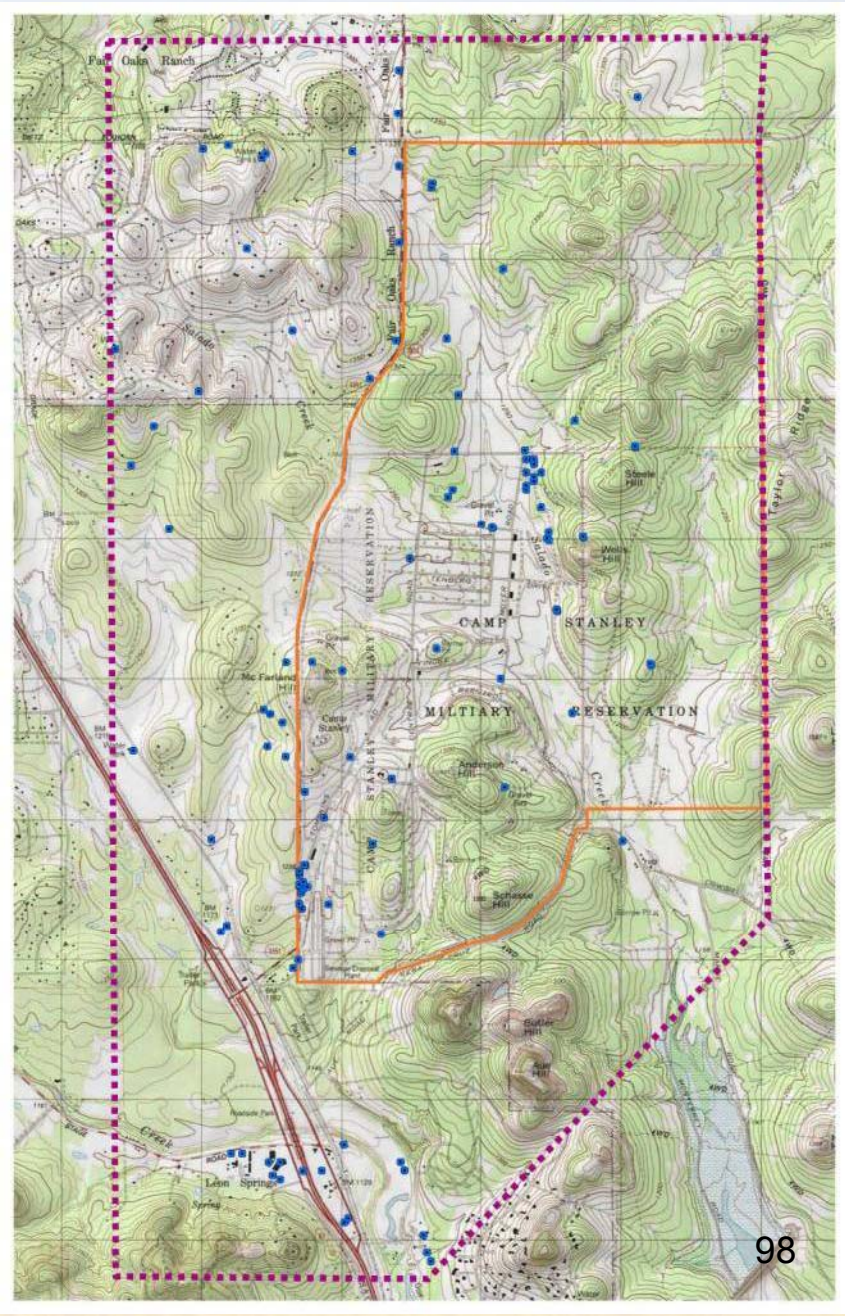
96°55'0"W
96°50'0"W
96°45'0"W
96°40'0"W
96°35'0"W
96°30'0"W
34°40'0"N
34°35'0"N
34°30'0"N
34°25'0"N
34°20'0"N
Model areas
MODFLOW model extent of eastern Arbuckle-Simpson aquifer
3-D model data extent
Structures
Modeled faults
Drill-hole locations
Drll-hole data for the top of the Simpson Group
Modeled geology
Eroded surface of the Simpson Group
Simpson Group outcrop
Arbuckle and Timbered Hills Groups outcrop
Contour lines
Stratigraphic thickness, 30 meter contour interval
0 2.5 5 10 Km


97°0'W
96°55'W
96°50'W
96°45'W
96°40'W
96°35'W
96°30'W
34°35'N
34°30'N
34°25'N
Explanation
Simpson hydrostratigraph unit
Subcrop
Outcrop
Not present
Thickness contour, interval is 30 meters
Fault, exposed or inferred from published maps
Fault, inferred from subsurface geologic data and concealed by younger geologic units
Model boundary
Albers equal area conic projection
North American Datum of 1983
0 1 2 4 Miles
0 1 2 4 Kilometers
Geology modified from Faith and others (2010)

CSSA 3-D EV Model

- Extend model further west?
- Extend north to Cibolo Creek?



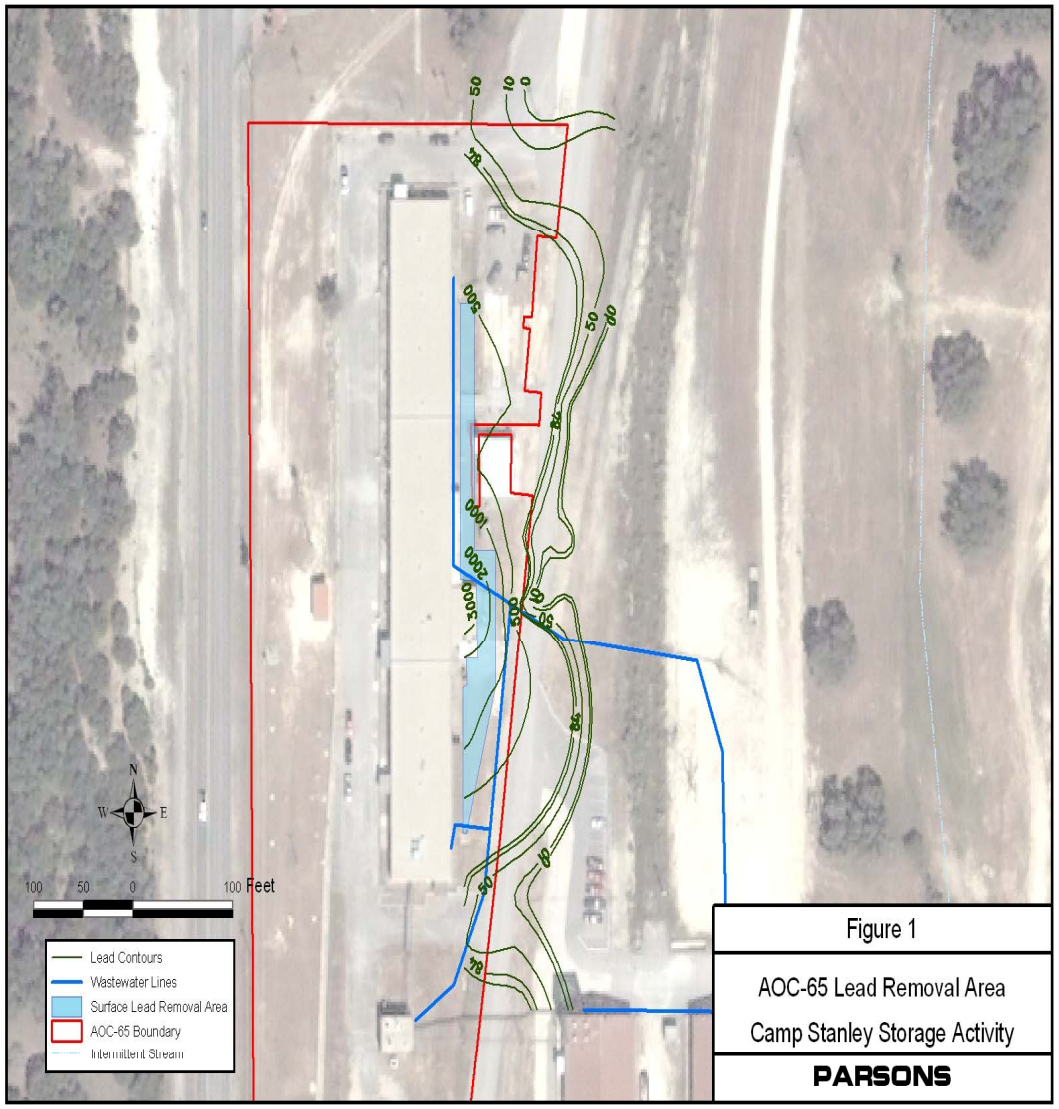
BUILDING 90 DECOMMISSIONING

Building 90 Decommissioning

- Move into Building 210 started Jan 10
- Old equipment and materials are scheduled for decommissioning.
  - May exceed one time CESQG weight limit requirements
  - PCB contaminated equipment will be cleaned, oil collected for disposal, and metal portion managed as scrap
- Building will be re-designated as storage once renovated.
  - Room being built inside to facilitate remediation activities in the area of the former vat.
  - Anticipate re-designating existing Vapor Extraction Well 9(VEW-9) into steam injection well near former vat area.

Building 90 Decommissioning

- Lead contaminated sewer line sand bedding and surface soils near Building 90 Test Fire Room were removed to east pasture range berm for maintenance material.



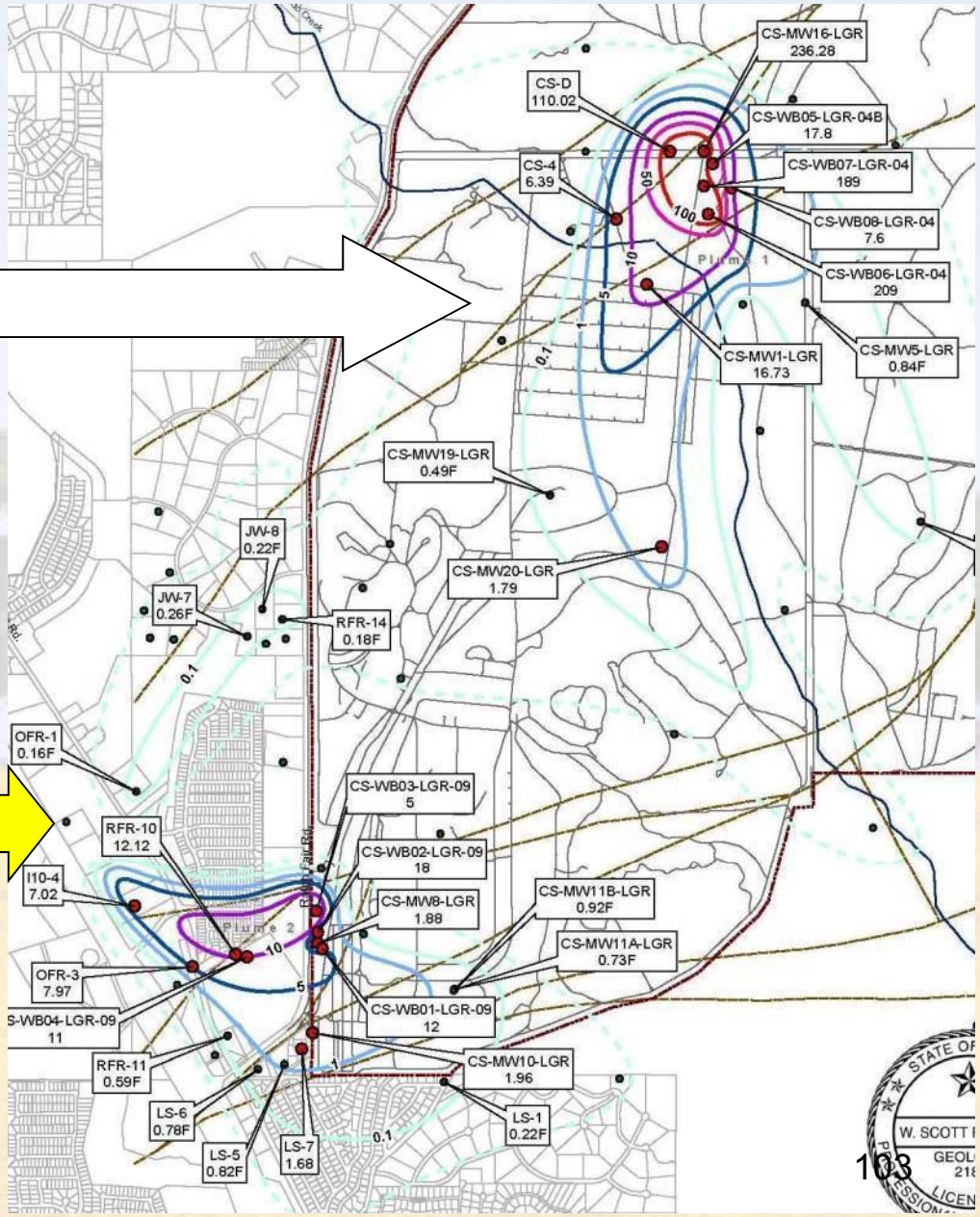
TREATABILITY STUDY UPDATES

CSSA Pilot Studies
Description

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

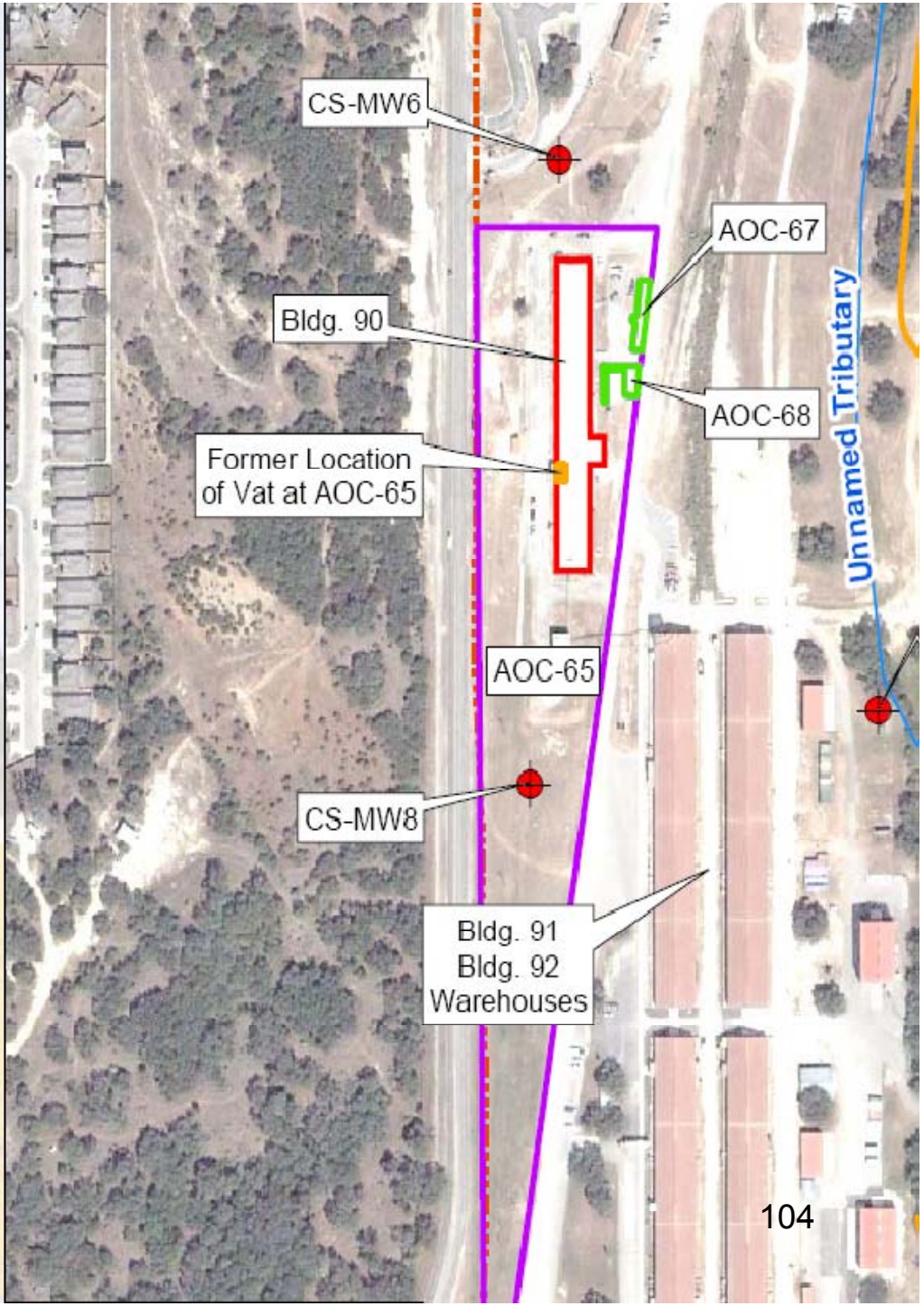
2. **AOC-65 Soil Vapor Extraction Pilot Study:** Removal of chlorinated hydrocarbons in underlying fractured limestone at Plume 2.

PCE, 2010



AOC-65 Background

- AOC-65 consists of an area surrounding Building 90.
- Operations included chlorinated solvent degreasing units (vats) which were removed in 1995.
- Initial investigations identified groundwater plume (2) in 1999.
- Interim Removal Actions in 2001 excavated and disposed ~ 1,300 CY of impacted soil media off-post.
- SVE Pilot Study initiated in 2002, which continues to operate within Permit By Rule Limits.



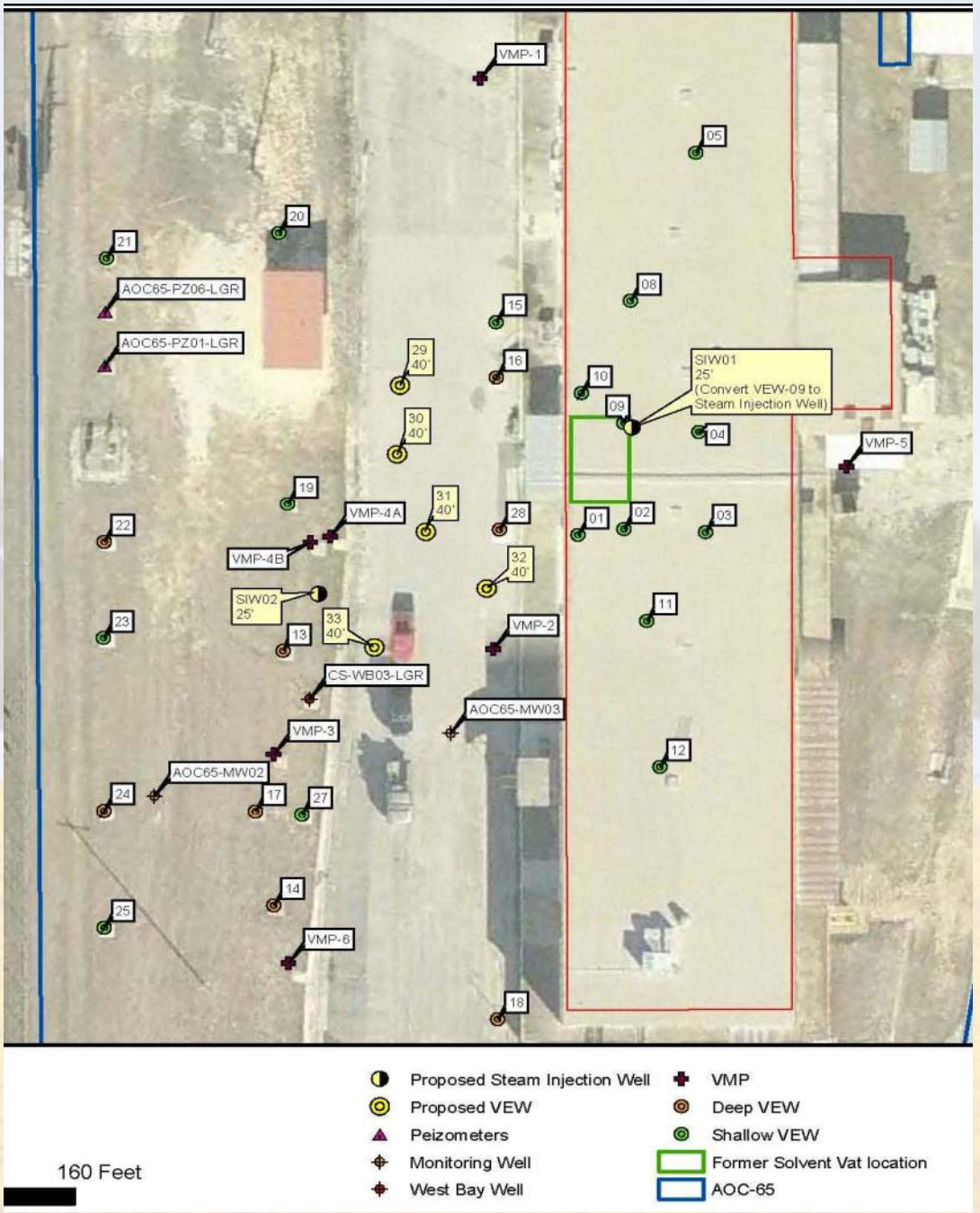
AOC-65 Treatability Study Objectives
Review and Summary

- Determine if thermally enhanced SVE (using steam) is effective for removal of additional CVOC from the underlying limestone formation.
  - Installing steam injection well(s) to potentially increase contaminant mass removal from underlying limestone.
- Perform a Treatability Assessment for AOC-65 to identify any additional and/or potential remedial options for remediating groundwater plume 2.
  - Completing Technology Assessment for treatment of AOC-65 groundwater operable unit.
    - **Identify path forward for additional pilot studies and remediation.**
- Determine if a vapor intrusion potential exists from Plume 2 contamination.
  - Data collected and a Vapor Intrusion Survey Report is being drafted.
    - **Identify and establish key criteria to determine risk associated with Plume 2.**

Treatability Study Updates
SVE Enhancement

- Install steam injection well (SIW) in current VEW-9 location nearest to former vat location and near WB03.
- Install additional surrounding VEWs to help capture vapors from newly installed steam injection well(s)
- Collect data to provide assessment of enhanced SVE technology

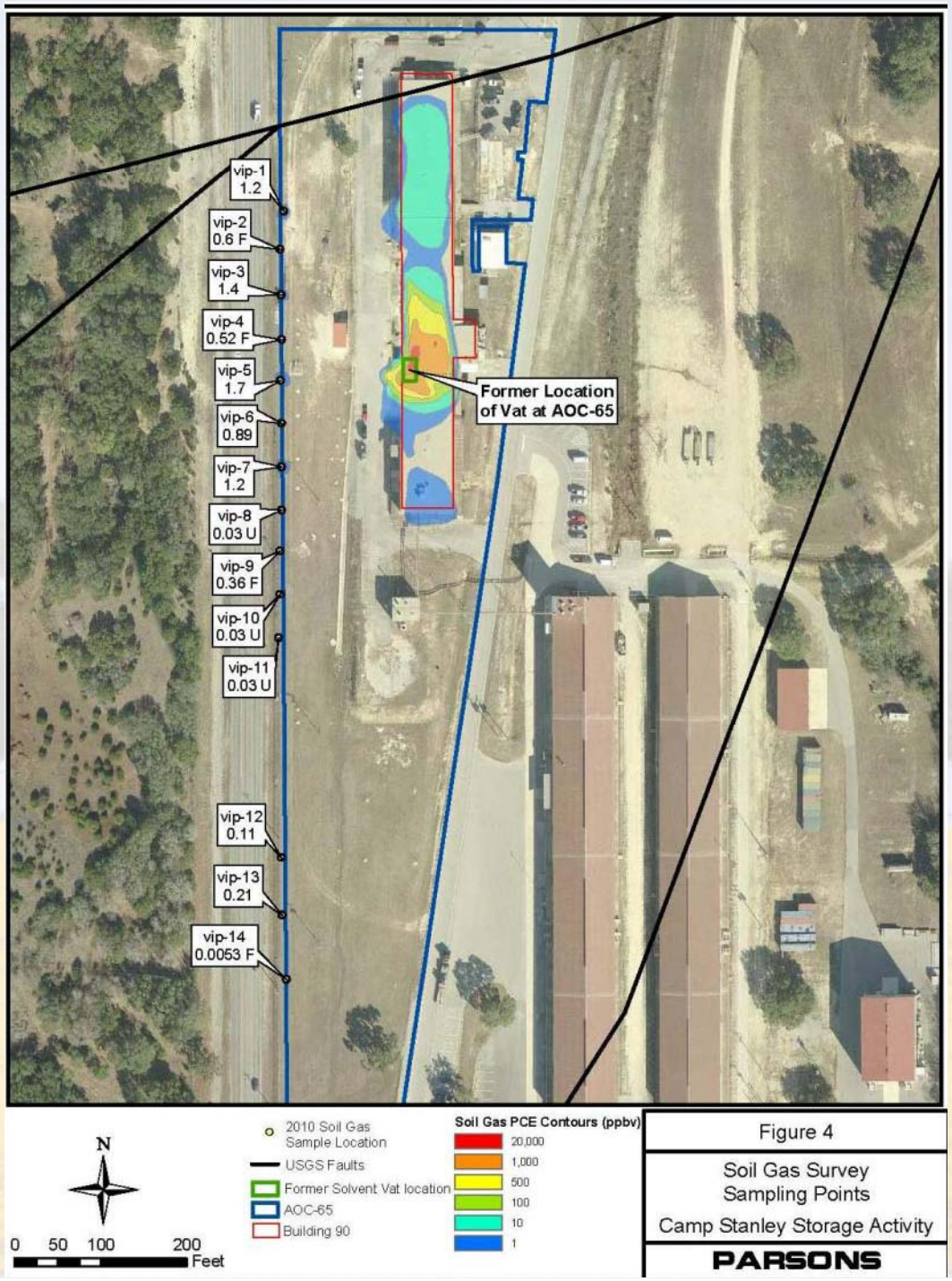
- **Right: Draft location of SIW and additional VEWs for enhanced SVE study.**



Treatability Study Updates

Vapor Intrusion Survey

- 2010 results indicates the PCE/TCE in soil gas has extended to the south and west of the source area.
- A Draft Vapor Intrusion Survey Report will provide all analytical data results and identify potential key criteria and risk to surrounding neighborhood.
- Right: **Aerial photograph soil gas vapor concentrations from 2010.**



AOC-65 Vapor Intrusion Study
2010 Indoor Vapor Monitoring Results

- RBSL for residential indoor air calculated using TCEQ toxicity data for PCE is 1.6 ppbv or 6.1 µg/m3.

- Currently, indoor air from within Building 90 indicate PCE concentrations of approximately 0.24 ppbv or 1.6 µg/m3 which is below TCEQ RSL criteria but above the USEPA RBSL for PCE.

Sample ID	US EPA Risk Based Screening Levels	PCE Results (µg/m^3)	PCE Results (ppbv)
Bldg 90 Air 01 w/ SVE off	0.07 ppbv or 0.41 µg/m3	1.60	0.24
Background 01		ND	ND
Bldg 90 Air 02 w/ SVE on		1.5	0.22
Background 02		0.635	0.072

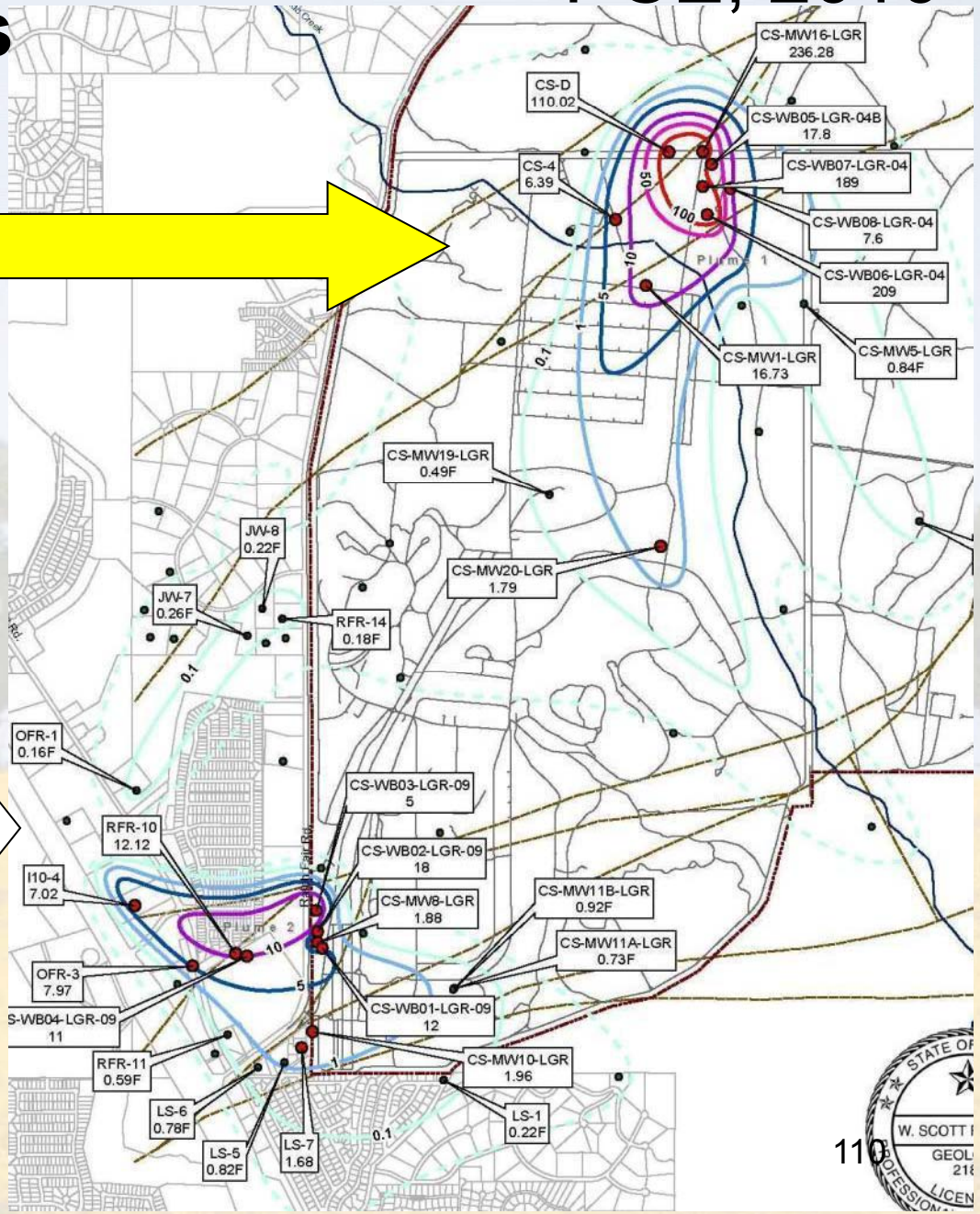
AOC-65 Treatability Study
Next Steps

- Continue monitoring SVE system to determine effectiveness of treating source area.
- Install thermal wells and conduct pilot-scale study.
- Complete Vapor Intrusion Survey Report.
- Continue investigation/evaluation of other potential treatment options for AOC-65 and Plume 2.

CSSA Pilot Studies
Description

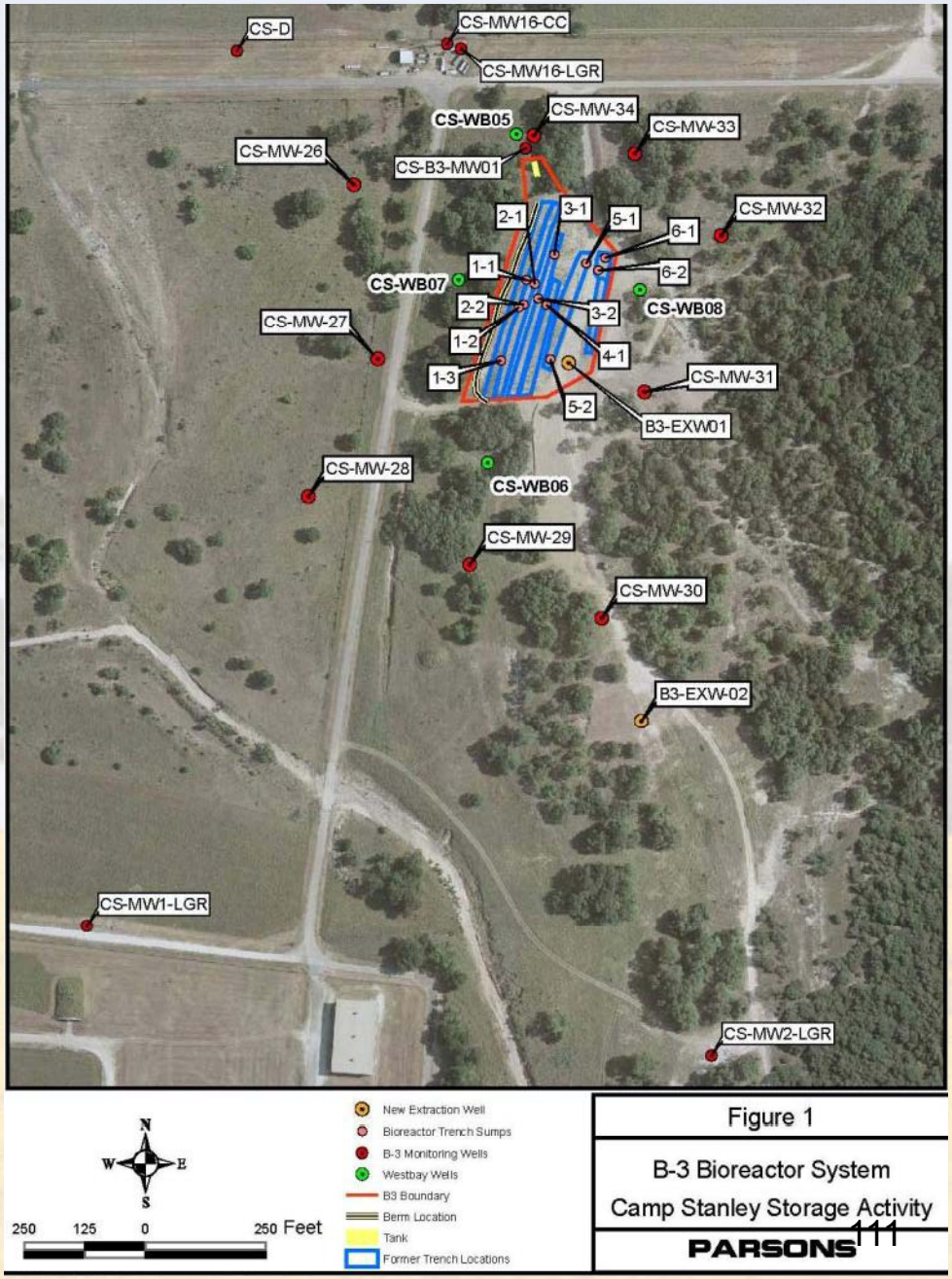
1. **SWMU B-3 Bioreactor Pilot Study:** Enhanced anaerobic bioremediation of chlorinated hydrocarbons in underlying fractured limestone at Plume 1.

2. **AOC-65 Soil Vapor Extraction Pilot Study:** Removal of chlorinated hydrocarbons in underlying fractured limestone at Plume 2.



SWMU B-3
Background

- SWMU B-3 consists of 6 trenches operating from 1970's thru1980's.
- Identified in 1995 as potential source of groundwater contamination at nearby supply well (well 16).
- ~15,200 CY waste excavated from SWMU B-3 and disposed off-post in 2006.
- Bioreactor initiated operations in 2007 under TCEQ UIC Authorization No. 5X26004321.



B-3 Bioreactor Pilot Study
General Observations

- Bioreactor is effectively treating an average of 20,000 gallons of injected contaminated groundwater per day.
- Biotic degradation is occurring with biological degradation end products ethylene and CO_2 indentified in surrounding UGR wells and LGR wells.
- Significant contamination likely remains in the fractured bedrock formation. Underlying CAH's are being flushed.

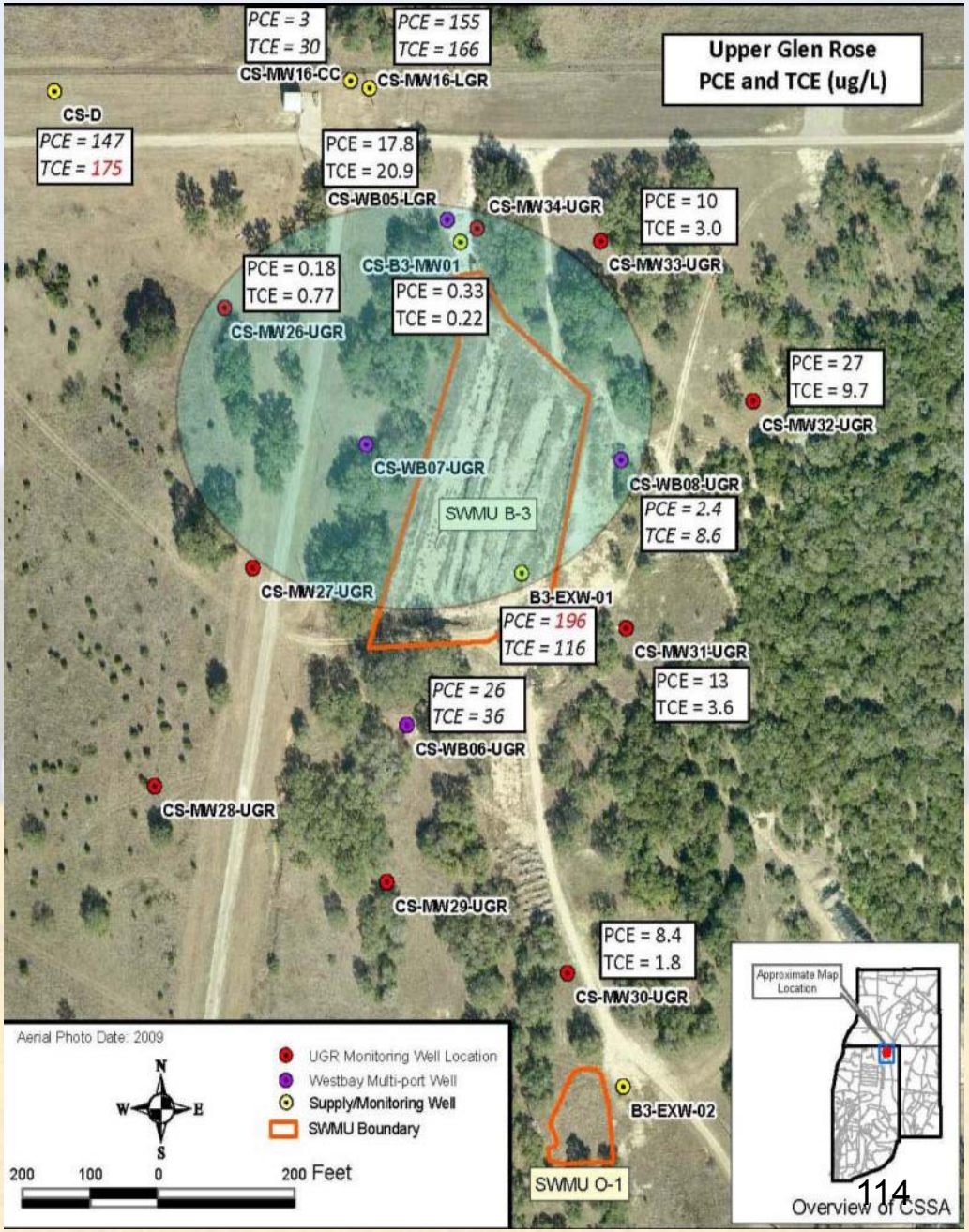
B-3 Bioreactor Pilot Study Objectives

Review and Summary

- Determine if the bioreactor is an effective approach for treatment of groundwater at SWMU B-3 (Plume 1).
  - Bioreactor continues to provide positive data as an effective approach for treatment of Plume 1.
    - **Biodegradation occurring with biological degradation end products ethylene and CO_2 identified in surrounding UGR wells and WB05-O4B LGR and B3-MW01 wells.**
- Evaluate the extent of bioreactor influence on the effectiveness of treatment in the surrounding fractured media.
  - Local extent of bioreactor continues being investigated.
    - **All 9 shallow monitoring and a few LGR wells indicate some level of bioreactor influence.**
    - **Continue monitoring of bioreactor system at least through Oct 2011.**
- Evaluate the migration of contaminants through the underlying formations and into the underlying aquifer.
  - Local migration pathway(s) investigation continues.
    - **Evidence of biological degradation confirms bioreactor influence pathways through subsurface.**

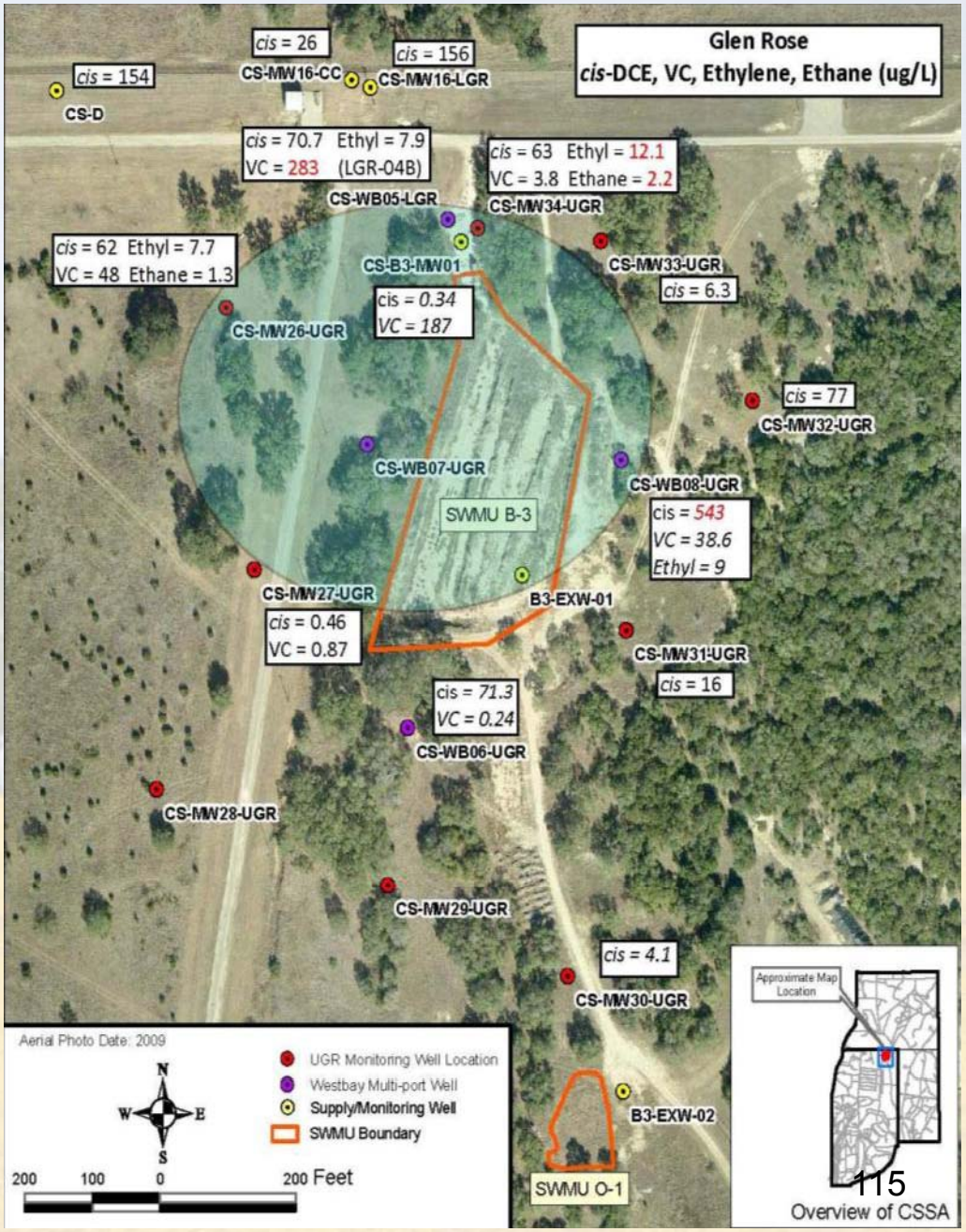
B-3 Bioreactor Pilot Study
Observations

- Shallow wells south and east of the bioreactor contain elevated concentrations of PCE and TCE.
- Shallow wells to the west of the bioreactor continue to contain minor concentrations of PCE or TCE approximately equal to concentration levels in bioreactor.



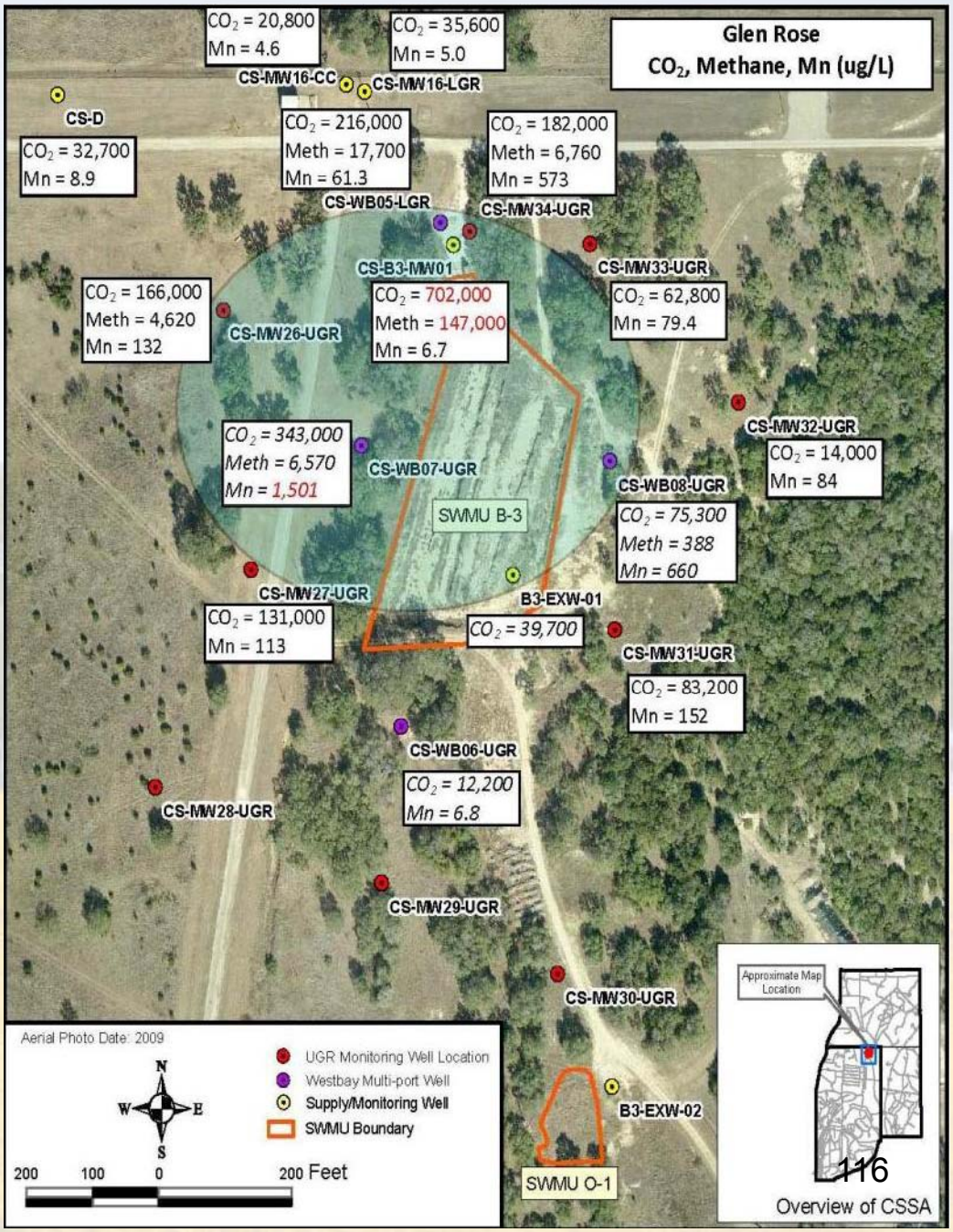
B-3 Bioreactor Pilot Study
Observations

- Monitoring wells north and west of the bioreactor contain elevated concentrations of microbial degradation products vinyl chloride (VC) and ethylene (Ethyl) indicating bioreactor influence.
- Shallow wells to the east of the bioreactor contain degradation compound concentrations of *cis*-DCE.



B-3 Bioreactor Pilot Study
Observations

- Shallow wells surrounding the bioreactor contain elevated concentrations of other biotic degradation products Carbon Dioxide (CO_2), Methane (Meth) and Manganese (Mn).
- CS-MW-28 continues to be a dry well indicating potential fault line somewhere southwest of SWMU B-3.



SWMU B-3 Bioreactor Treatability Study
Next Steps

- Continue monitoring bioreactor for UIC Permit and Performance parameters.
- Continue investigation of degradation pathways through microbial and isotope analysis.
- Continue investigation/evaluation of other potential enhancement options for the bioreactor.

ISOTOPE ANALYSIS

Treatability Study Updates
SWMU B-3 Isotope Analysis

Investigation Objectives

- Evaluate biogeochemical pathways of CAH degradation
- Validate critical performance monitoring parameters for the bioreactor and optimization
- Identify new tools to evaluate bioreactor performance that could be transferred to other sites

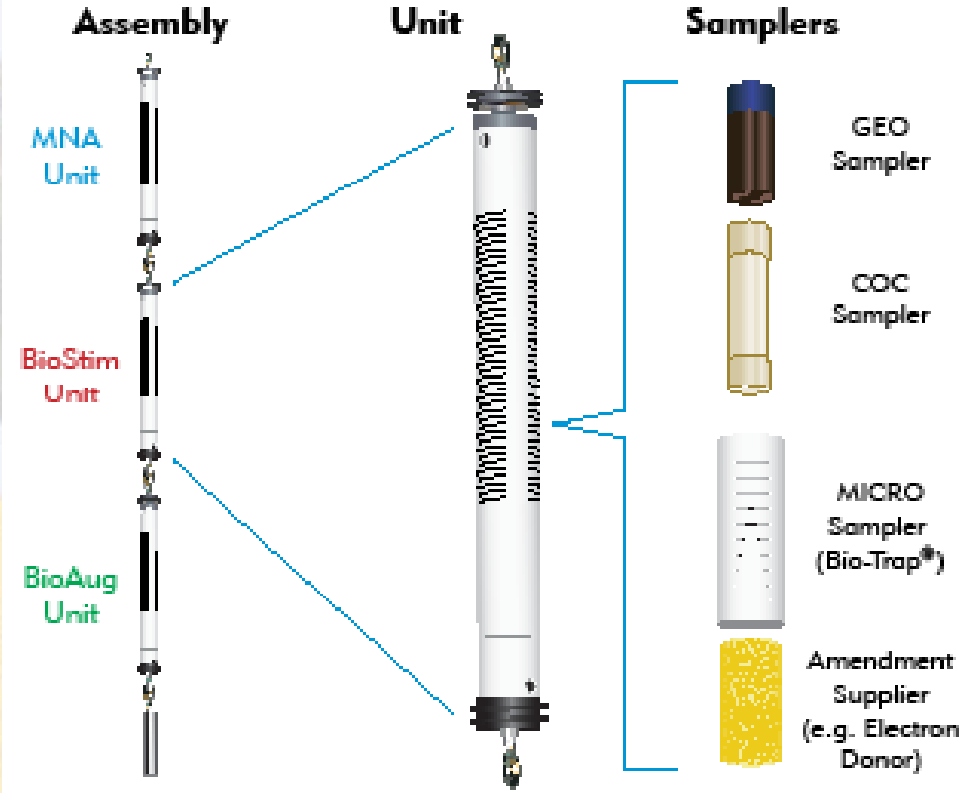
Field and Laboratory Investigations

- Stable Isotope Probes to evaluate:
  - Oxidation of ^{13}PCE to $^{13}CO_2$
  - Trends in PCE degradation
  - Trends in microbial biomass production
- Laboratory microcosms to evaluate:
  - Most efficient pathway for CAH degradation
  - Other in-situ bacteria capable of CAH degradation

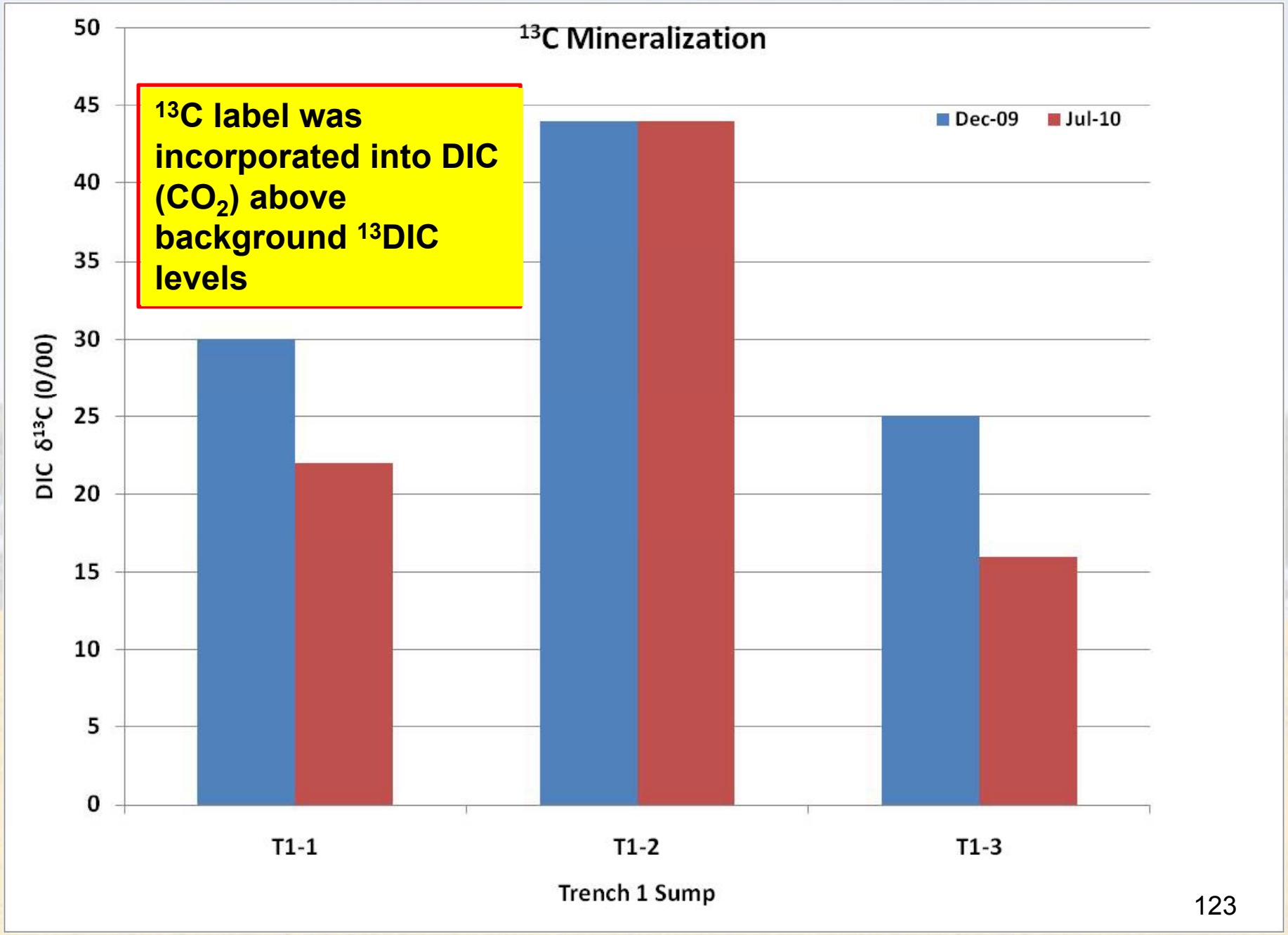
Biotrap contained ^{13}PCE and a sorbent

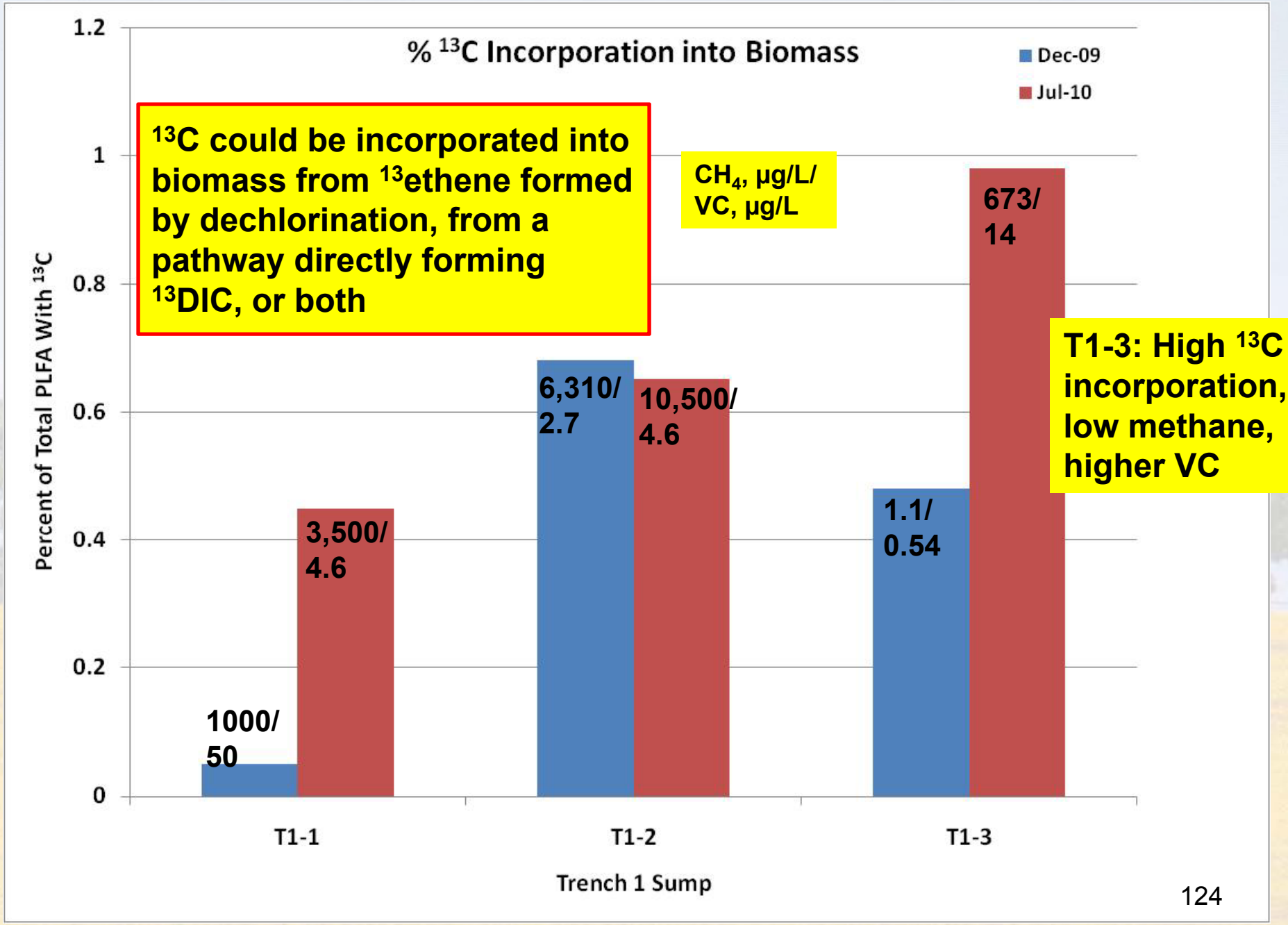
Microbes utilize ^{13}PCE in degradation reactions; daughter products are sorbed in Bio-Trap for subsequent analysis

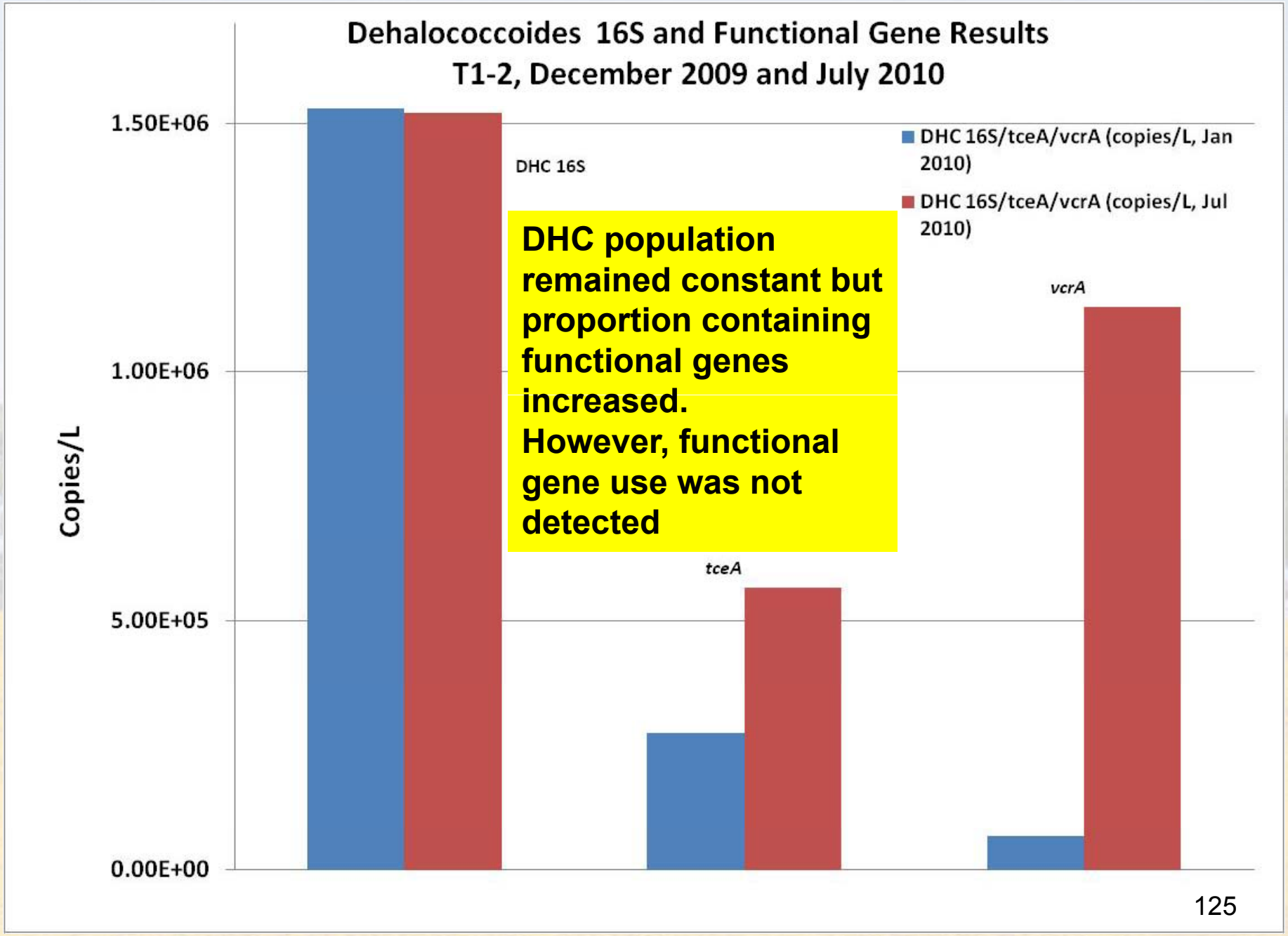
Bio-Trap®—In Situ Microcosms

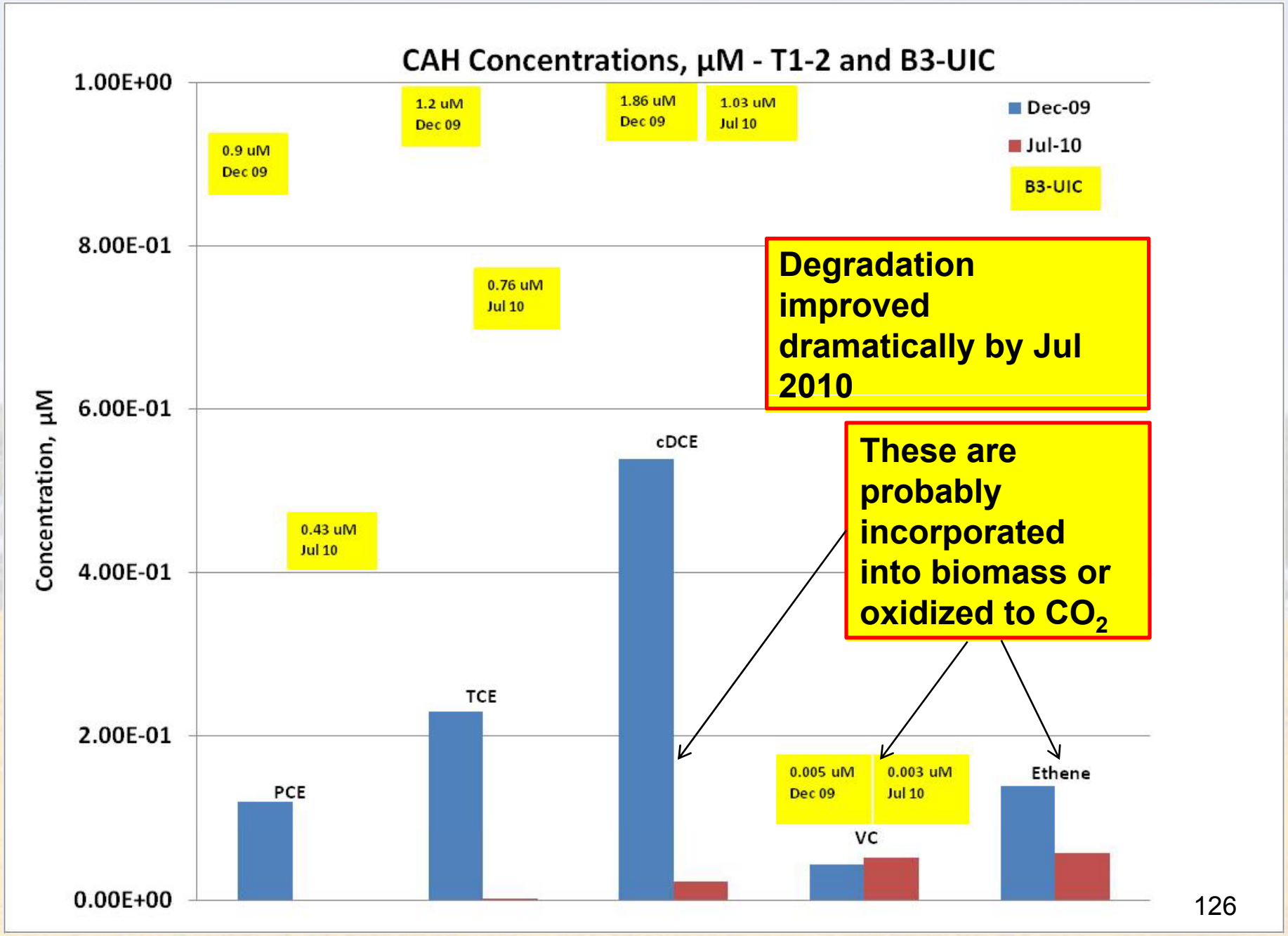



T1-3, Winter 2009-2010

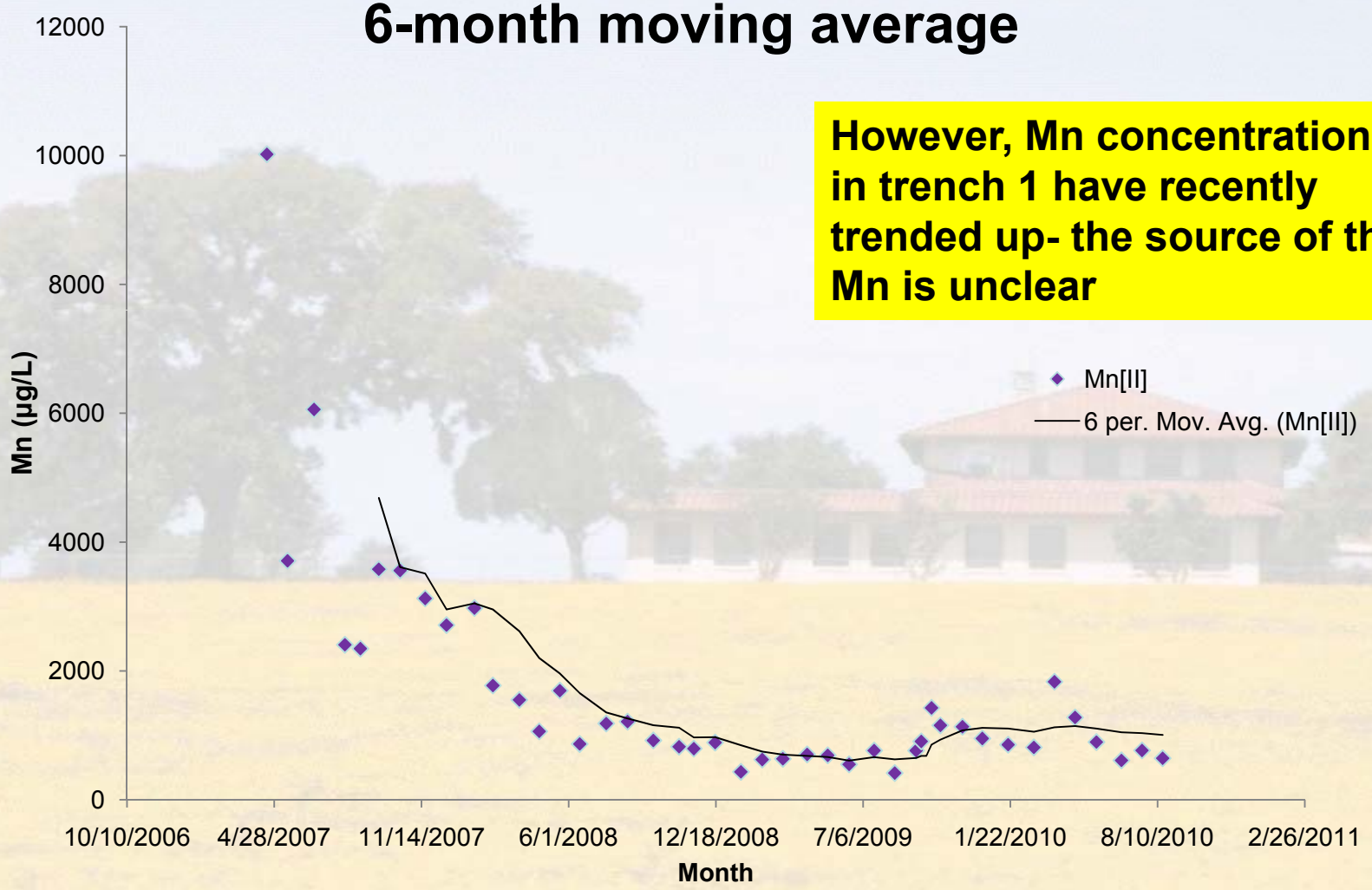

^{13}C Mineralization
^{13}C label was incorporated into DIC (CO_2) above background ^{13}DIC levels
Dec-09
Jul-10
DIC δ^{13}C (0/00)
50
45
40
35
30
25
20
15
10
5
0
T1-1
T1-2
T1-3
Trench 1 Sump


% 13C Incorporation into Biomass
Dec-09
Jul-10
Percent of Total PLFA With 13C
1.2
1
0.8
0.6
0.4
0.2
0
13C could be incorporated into biomass from 13ethene formed by dechlorination, from a pathway directly forming 13DIC, or both
CH4, µg/L/ VC, µg/L
1000/ 50
3,500/ 4.6
6,310/ 2.7
10,500/ 4.6
1.1/ 0.54
673/ 14
T1-3: High 13C incorporation, low methane, higher VC
T1-1
T1-2
T1-3
Trench 1 Sump


Dehalococcoides 16S and Functional Gene Results
T1-2, December 2009 and July 2010
1.50E+06
1.00E+06
5.00E+05
0.00E+00
Copies/L
DHC 16S
tceA
vcrA
DHC 16S/tceA/vcrA (copies/L, Jan 2010)
DHC 16S/tceA/vcrA (copies/L, Jul 2010)
DHC population remained constant but proportion containing functional genes increased.
However, functional gene use was not detected

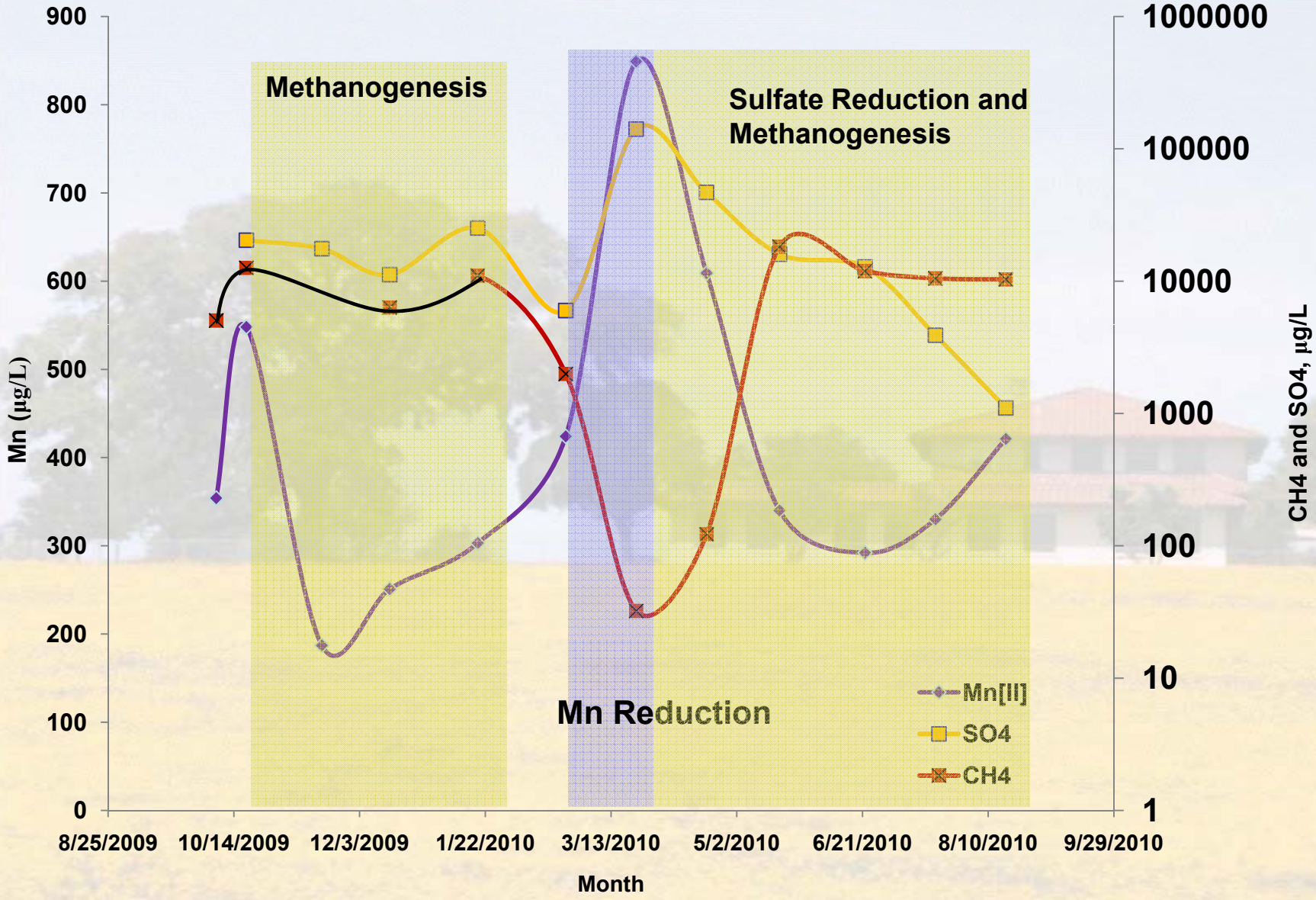

CAH Concentrations, µM - T1-2 and B3-UIC
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Concentration, µM
Dec-09
Jul-10
B3-UIC
0.9 uM
Dec 09
1.2 uM
Dec 09
1.86 uM
Dec 09
1.03 uM
Jul 10
0.76 uM
Jul 10
0.43 uM
Jul 10
0.005 uM
Dec 09
0.003 uM
Jul 10
PCE
TCE
cDCE
VC
Ethene
Degradation improved dramatically by Jul 2010
These are probably incorporated into biomass or oxidized to CO_2

Manganese [II] in T1-2
6-month moving average



However, Mn concentrations in trench 1 have recently trended up- the source of the Mn is unclear

Redox processes October 2009-August 2010
T1-2



Effects of redox conditions on degradation

- Studies have indicated that under methanogenic conditions VC is oxidized anaerobically to acetate, thus enhancing complete dechlorination.

- A shift in redox conditions due to introduction of Mn, Fe, and SO4 results in decreased levels of DHC's functional dechlorination genes but may still be degrading CAHs

- The most effective pathway for CAH degradation is going to be investigated by Texas A&M University. This will provide us better controls for the system to enhance the reactions that will completely degrade CAHs and increases the rate of vinyl chloride degradation.

Summary of Findings

- Overall he bioreactor is showing its capability for complete dechlorination of CAHs.
- The bioreactor is an exceedingly complex system of interacting microorganisms, nutrient inputs and varying geochemical conditions.
- Different parts of bioreactor trench 1 are very heterogeneous
- DIC containing ^{13}C label is formed from degradation of CAH in bioreactor, probably through both oxidation of VC and microbial utilization of ethene

Summary of Findings - concluded

- Contaminant degradation in the bioreactor appears to cycle between reductive dechlorination by *Dehalococcoides* (under methanogenic conditions) and dechlorination/anaerobic oxidation facilitated by manganese reduction

- Saturation of bioreactor with fresh water alters geochemical conditions, reduces/eliminates certain microbial activity, and appears to switch degradation pathways

- Determination of the most efficient pathway is crucial to enhance degradation rates and assure complete dechlorination.

Critical Monitoring Parameters

- **DCE and VC**
- ***Dehalococcoides* (16S only)**
- **Microorganism mediating anaerobic oxidation?**
- **VFAs**
- **Dissolved Mn and Fe**
- **SO_4 and H_2S**
- **CH_4**
- **Dissolved Hydrogen**
- **ORP**

Optimization Opportunities

- **The degradation pathway that needs to be enhanced is the one that completely degrades CAHs by eliminating vinyl chloride the fastest**
  - Determine an optimum balance between methanogenesis/reductive dechlorination and manganese reduction
  - Transfer findings to future implementations in other sites such as AOC-65

Miscellaneous…

- Updating CSSA QAPP
  - Last version (Ver. 1, January 2003) approved by TCEQ and EPA
  - Method updates
- Need for hard copy of Environmental Encyclopedia
- Next meeting
- Optional: Site visit to B-15/16