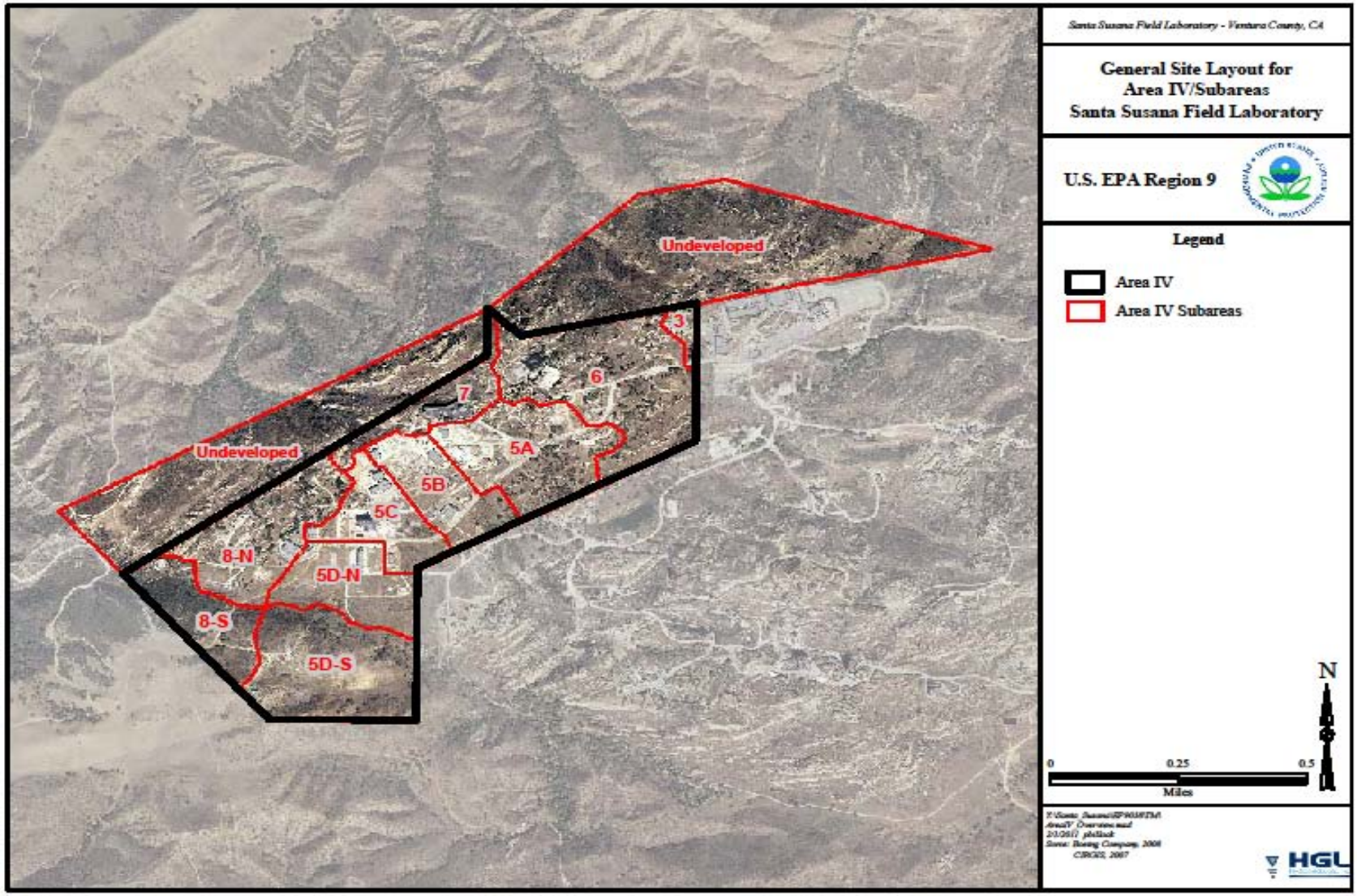
Overview of the Historical Site Assessment For Subarea 6

June 15, 2011

EPA Project Subareas



Subarea 6 Overview

- Covers approximately 57 acres
- Discussion of surface water drainage
- Four radiological use areas:
  - SRE Complex
  - Central Area
  - Old Conservation Yard
  - New Conservation Yard

Solid Radioactive Waste Storage
Liquid and Gas Radioactive Waste Storage Tanks
Vault
SRE Sodium Service Building
Electronics Shop, Maintenance Service Building
Equipment Repair Facility
Fire Pump Building
Central Area
Old Conservation Yard
Fuel Oil Storage Tank
Fuel Oil Storage Tank
Old Conservation Ya
Tetralin Heat Exchanger
SRE Complex
New Conservation Yard
Engr. Test Building
SRE Reactor Building
Contaminated Laundry Buildings
SRE Component Storage
Sodium Storage Building
Interim Storage for Contaminated Items
Contaminated Medical/ Storage Facility
Fire Department Service Buildin
Fuel Storage Facility
New Conservation Yard

Poss WDA (DB)
LTM
PA (LTM)
LTM
4-inch discharge from sump pump
IM
GS
DG
GS
GS
GS

Key Radiological Use Areas

SRE Complex

- Reactor Building
- Component Storage Building
- Equipment Repair Building
- Liquid and Gas Radioactive Waste Vault
- Solid Radioactive Waste Storage
- Intermediate Storage of Contaminated Items
- Three Sodium Cleaning Pads
- Septic System and SRE Pond
- Engineering Test Building

Central Area and Conservation Yards

- Contaminated Laundry Buildings
- Fuel Storage Building
- Old Conservation Yard
- New Conservation Yard

SRE Complex - 1958

SRE Complex - 1962

Sodium Reactor Experiment Building

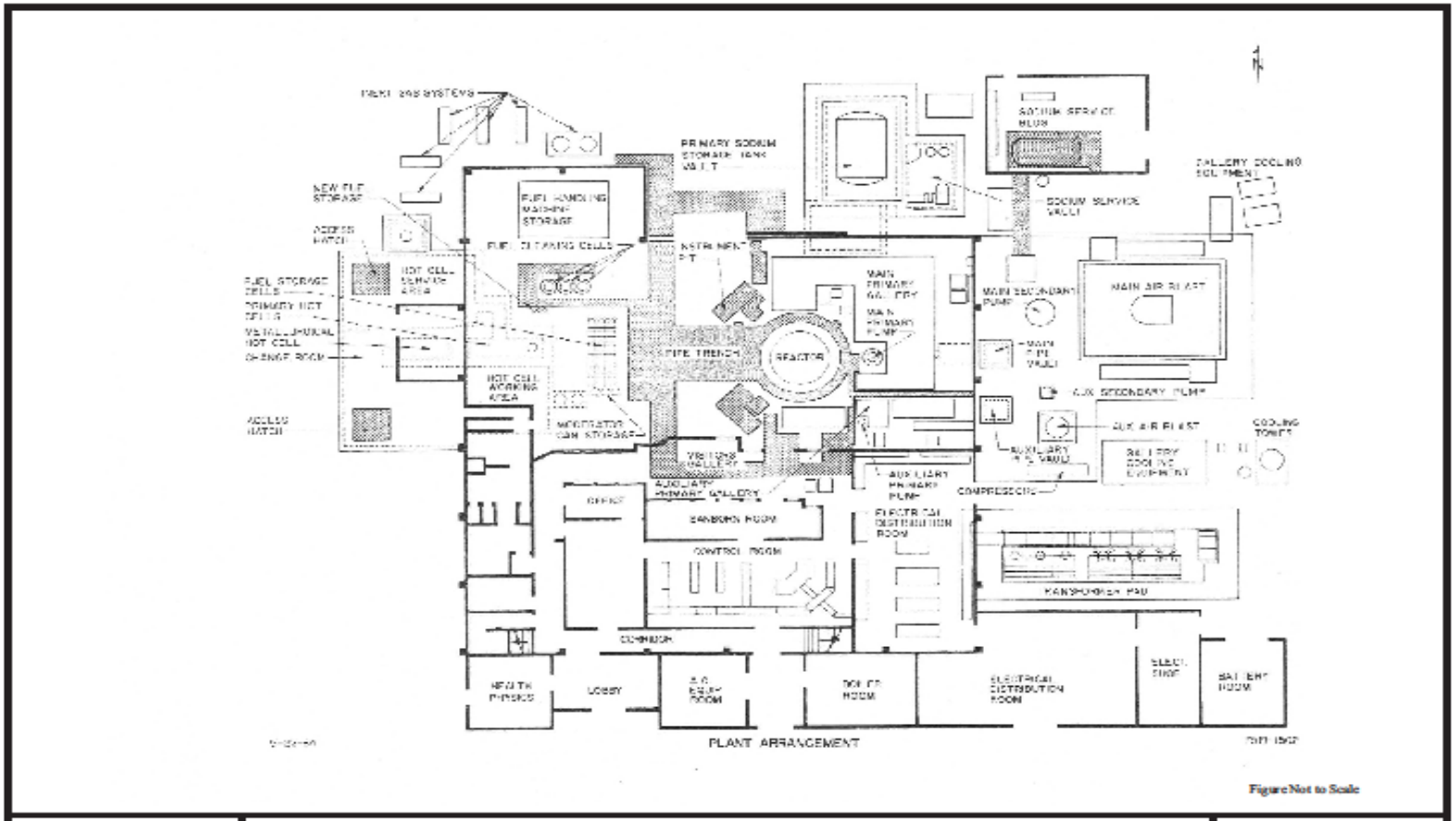
Figure 2.1.3c
Building 4143
Historical Photograph
1962

U.S. EPA Region 9

SRE Reactor Building Floor Plan

Santa Susana Field Laboratory
Historical Site Assessment

Draft Technical Memorandum: HSA-6



Y:/Santa_Susana/EP9058/TM/HSA_6
(2-1-3b)bldg4143FP.cdr
Project: EP9058
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3b
Building 4143
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-1-3)Bldg4143DB.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3l
Building 4143
Drainage to Bottom
Midsection of Fuel
Element in Channel 55

Reactor Building

- Built in 1957 and operated as a nuclear reactor until Feb 1964
- Nov 1958 to July 1959, 13 of 43 fuel elements were damaged causing SRE shutdown for 15 months
- Uranium-thorium metal alloy fuel (Core II) installed in 1964
- Power Expansion Program occurred May 1965 to Sep 1967
- Three liquid waste tanks: 150-ga, 350-ga, and 3,200-ga (grade)
- Connected to septic tank and leach field, then sewer system in 1964
- 42 documented incidents with 22 involving releases
- 1974 to 1979, subsurface structures demolished – depth of excavation 30 feet below ground surface (13000 pCi/g in soil)
- Demolished in 1999

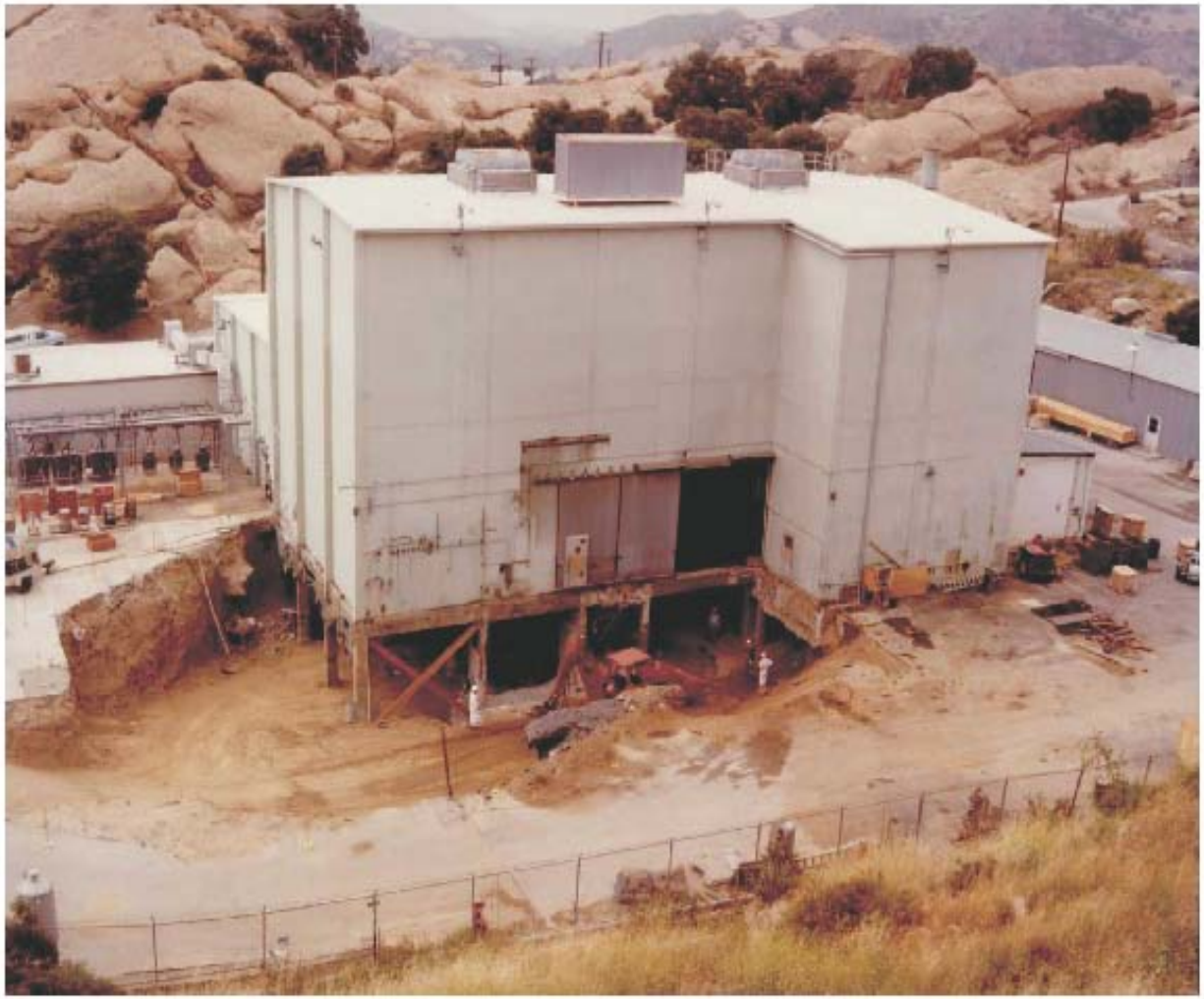
Reactor Building – Incident Summary

Incident Type	Fire	Release to Air	Explosion	Spills	Building Demo	Total # of Incidents
Release to Environment	2	11	2	3	4	22
Personnel Exposure – no evidence of release to environment						20
					Total Incidents	42

Y:/Santa_Susana/KP9058/TM/HSA_6
(2-1-3g)/Bldg4143RC.cdr
Project: KP9058
Revised: 05/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3g
Building 4143
Reactor Core Removal
1977



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Project: KP9058
Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4e
Building 4153
Site After
Demolition

SRE Complex – 1958 (South Side)

SRE Complex Support Bldgs (South)

Component Storage Bldg

- Interim storage of radioactive waste prior to shipment for disposal
- May 1962, most of building filled with spare parts and radiologically contaminated SRE components that required cleaning before reuse
- Demolished in 1998

Equipment Repair Bldg

- Used for the repair of radiologically contaminated equipment (i.e. primary sodium pump) and construct wooden shipping boxes for disposal
- Sodium on repair parts cleaned at sodium cleaning pads
- Demolished in 1999

SRE Complex – 1958 (West Side)

SRE Complex Support Bldgs (West)

Liquid and Gas Radioactive Waste Vault

- Used to hold gas and liquid for radioactivity decay
- Two 5000-ga liquid holdup tanks (leaks reported inside vault)
- Four 5000-ga gas holdup tanks
- Demolished in 1977

Solid Radioactive Waste Storage Area

- Temporary storage of radioactive waste such as plastic wrapped failed fuel elements
- Demolished prior to 1978

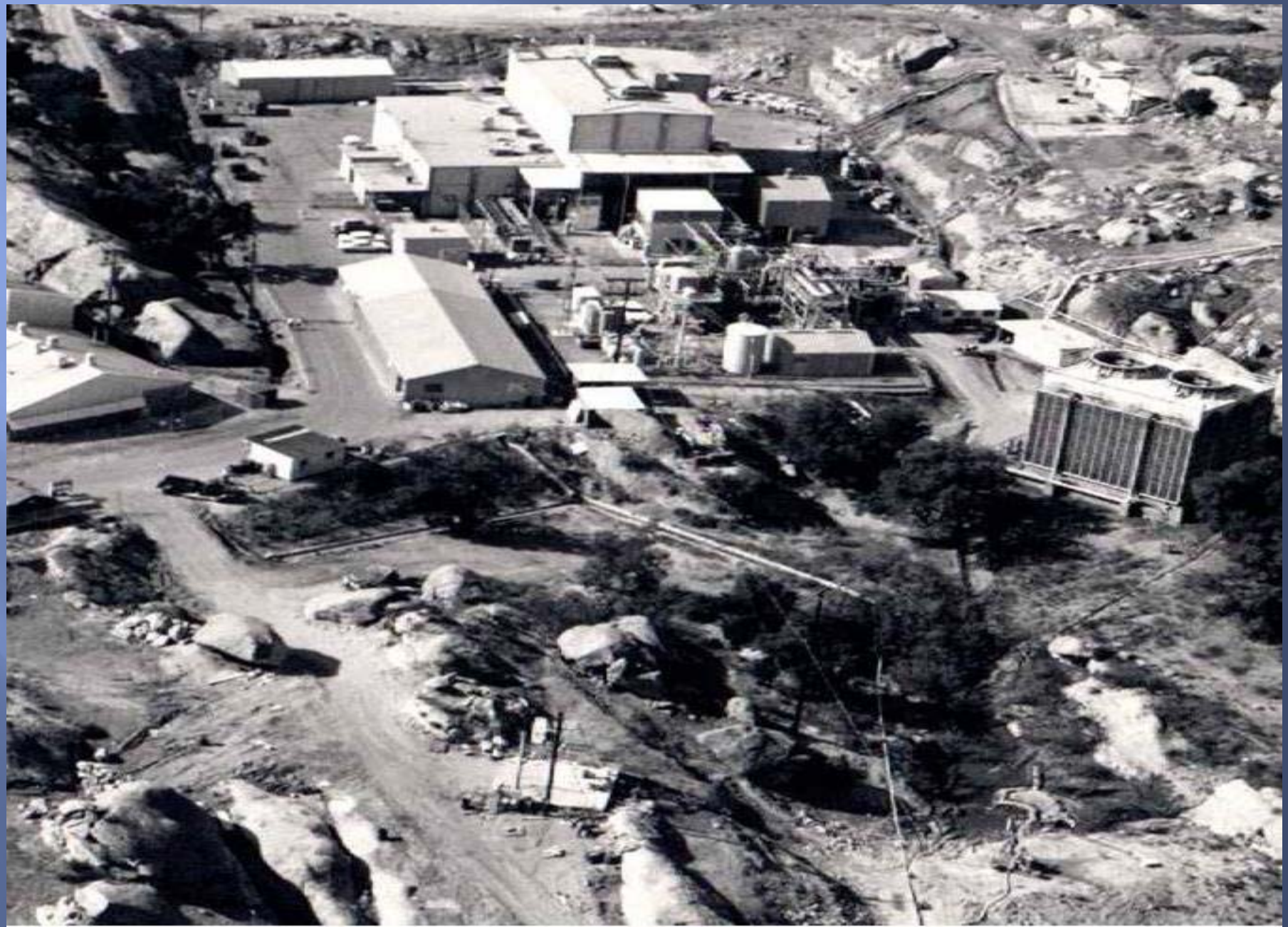
Storage Area for Contaminated Items

- Temporary open storage area for SRE

SRE Complex Sodium Cleaning Pads

- **Sodium Cleaning Pad** – steam cleaning pad used for cleaning sodium and low-level radioactivity from SRE equipment. Used from 1957 to 1960. Demolished in 1998.
- **Sodium Cleaning Building** – hot oil sodium cleaning facility used from 1966 for cleaning piping from SRE secondary loop. Demolished in 1978.
- **Sodium Cleaning Pad** – concrete pad used from 1957 for cleaning sodium from SRE equipment. Demolished in the 1970s.

SRE Pond - 1958



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Project:SP9058
Revised: 05/11/11 TJ
Source: Boeing Company, 2008

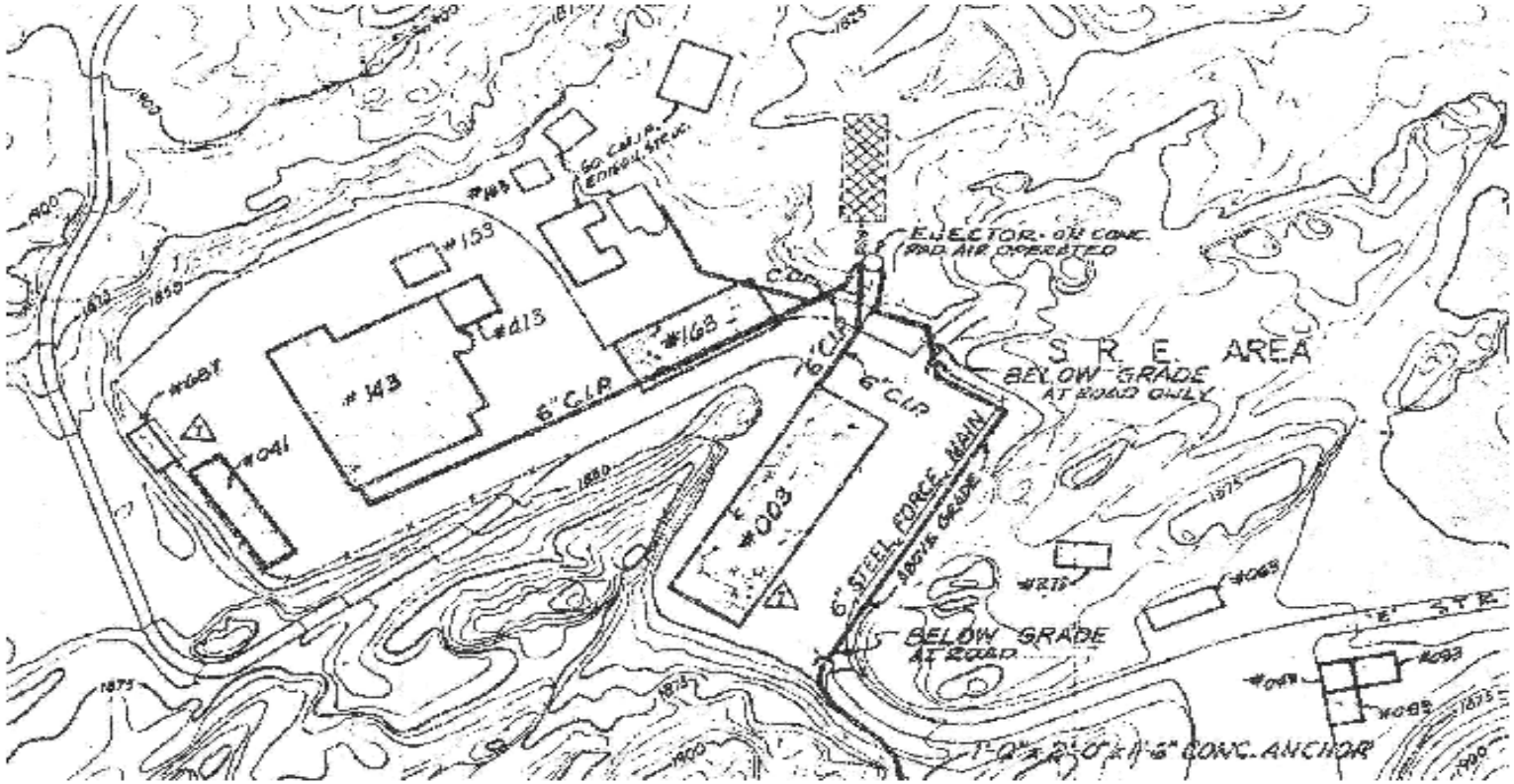
U.S. EPA Region 9

Figure 2.1.22c
Site 4773
1979 Photograph

SRE Pond

- 800,000-gallon capacity with a compacted native earth dam
- Collected all stormwater and industrial waste water from SRE complex
- Septic system leach field located upgradient of pond
- In 1958, 1.5-foot diameter valved outlet pipe added
- In 1959, 4-foot-diameter overflow pipe and pump back system added
- Industrial waste system terminated in a dry well adjacent to leach field, overflow into sump and pond
- Pond bottom dredged in 1979 (sediment > 50 pCi/g removed)
- Demolished in approximately 1988

SRE Complex Septic System



U.S. EPA Region 9

Figure 2.1.1g
Building 4003
Sewage System

Engineering Test Bldg

- 1957 through 1964, used to assemble fuel elements for SRE
- Hot Cave used to investigate chemistry of molten uranium and to study the separation of fission products and plutonium from uranium systems
- Contained two radioactive liquid holdup tanks below Hot Cave, two 5-gallon bottles below radioactive sinks
- Connected to septic system then in 1964 to sewer system
- Spill in upstairs lab in 1969
- Drainage channels discharge to SRE pond
- Demolished in 1999

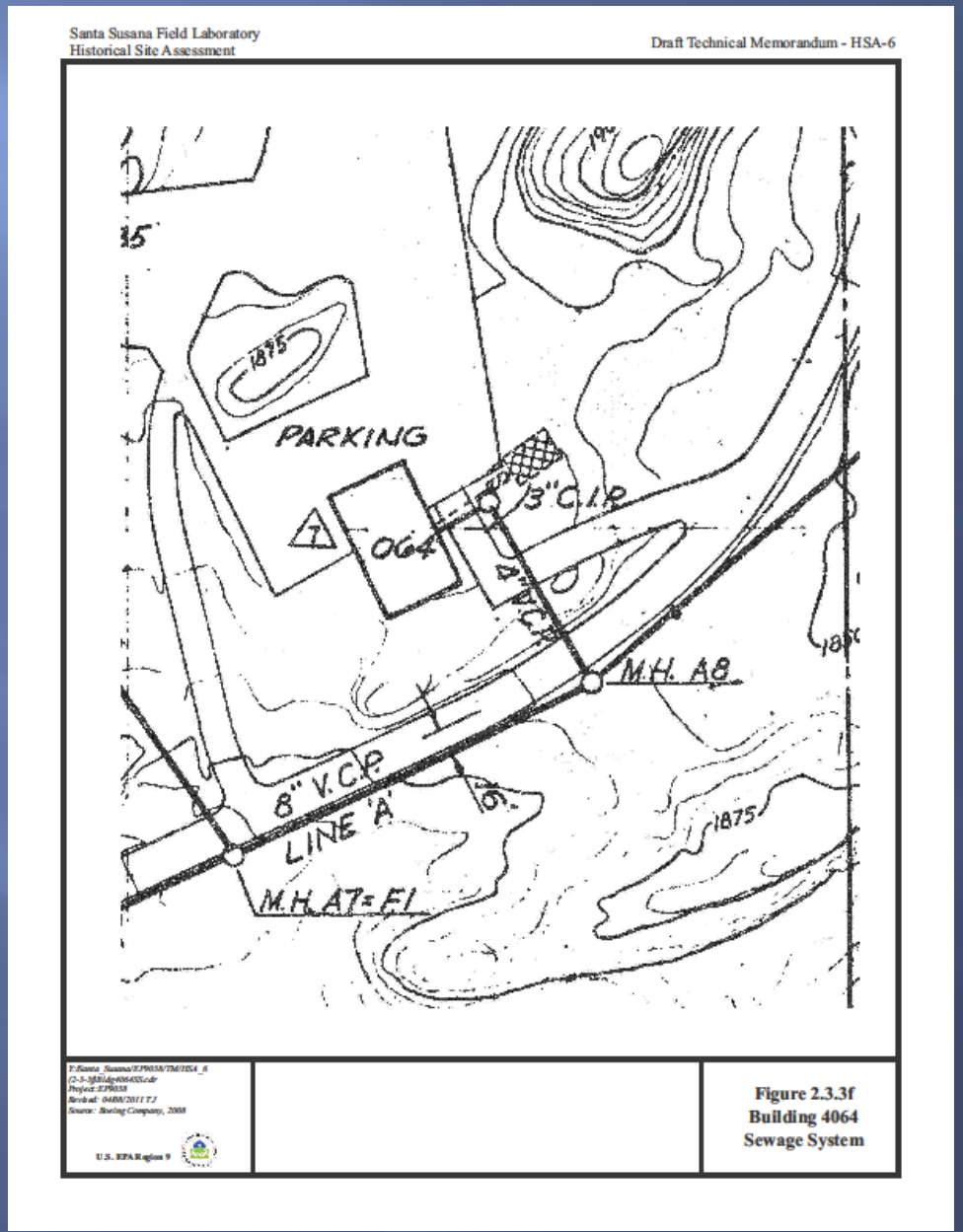
Contaminated Laundry Facility

Contaminated Laundry Facility

- Two buildings
- In operation 1957 to 1971
- Use presumed by EPA to wash rad worker clothing
- No apparent liquid waste holdup system
- Drainage appears to be northeast, wastewater may have flowed to SRE pond
- Sewer system not connected to Laundry Facility
- EPA presumes septic system received laundry effluents
- Building removed in 1976
- Slabs removed after 1995

Fuel Storage Facility

Fuel Storage Bldg Septic System



Fuel Storage Bldg Overview

- Stored packaged items of source materials (natural uranium, depleted uranium, thorium) and special nuclear materials (enriched uranium, plutonium, and U-233)
- Glove box in Room 104 - enriched uranium powders and source material powder packages were repackaged
- In early 1960s, “bird cages” and drums of special nuclear material recoverable scrap stored in Building 4064
- In 1960s and early 1970s, side yard housed 55-gallon drums of low-level enriched recoverable scrap
- 750-gallon septic tank and 120-linear-foot leach field
- Drainage northeast to Delta ponds in Area II
- Demolished in 1997

Summary of Incident Reports

Incident Type	Fire	Release to Air	Radio-activity Alarm	Spills	Explosion	Total # of Incidents
Release to Environment	0	0	2	4	2	8
Personnel Exposure – no evidence of release to environment						2
					Total Incidents	10

Old Conservation Yard

Old Conservation Yard

- Old Conservation Yard/Salvage Yard, including Barrel Storage Yard
- Covered approximately 3 acres
- Storage of excess salvageable item - no access or radiological controls
- Radiologically contaminated items found on site
- In early 1980s, site used as fuel tank farm
- Drainage to south and southwest into nearby drainage channels connected to Delta ponds in Area II
- 1 incident in 1976 – contaminated drums and soil
- Closed in 1977

New Conservation Yard

- New Conservation Yard began operation in 1977
- Fenced area that covered approximately 0.5 acre
- Storage of excess salvageable items
- Drainage to south and southeast into nearby drainage channels connected to Delta ponds in Area II

Summary of Findings

- HSA Aerial Photo Features
- Process Knowledge and Past Operation Practices
- Soil Removals/Excavations

Press WCH (Dh)
Ch
CH-LTM
Ch
Ch
Ch

Legend

Subarea 6 Groups

Centerline Roads
- Primary Roads
- Secondary Roads
- Tertiary Roads

Buildings
- Demolished
- Existing
- Parking Lots

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel

Process Knowledge Data
- Process Knowledge Features

Utilities
- Gas
- Storm Drain
- Sanitary Sewer
- Sanitary Waste
- Water
- Water (Removed)

Surface Features
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well

0 25 50 100
Scale In Feet

Historical Site Assessment
Draft Technical Memorandum - HSA-6

Processed Knowledge and Past Operational Practices Subarea 6 Santa Susana Field Laboratory

U.S. EPA Region 9

HGL

Gamma Radiation Scanning Update

June 15, 2011

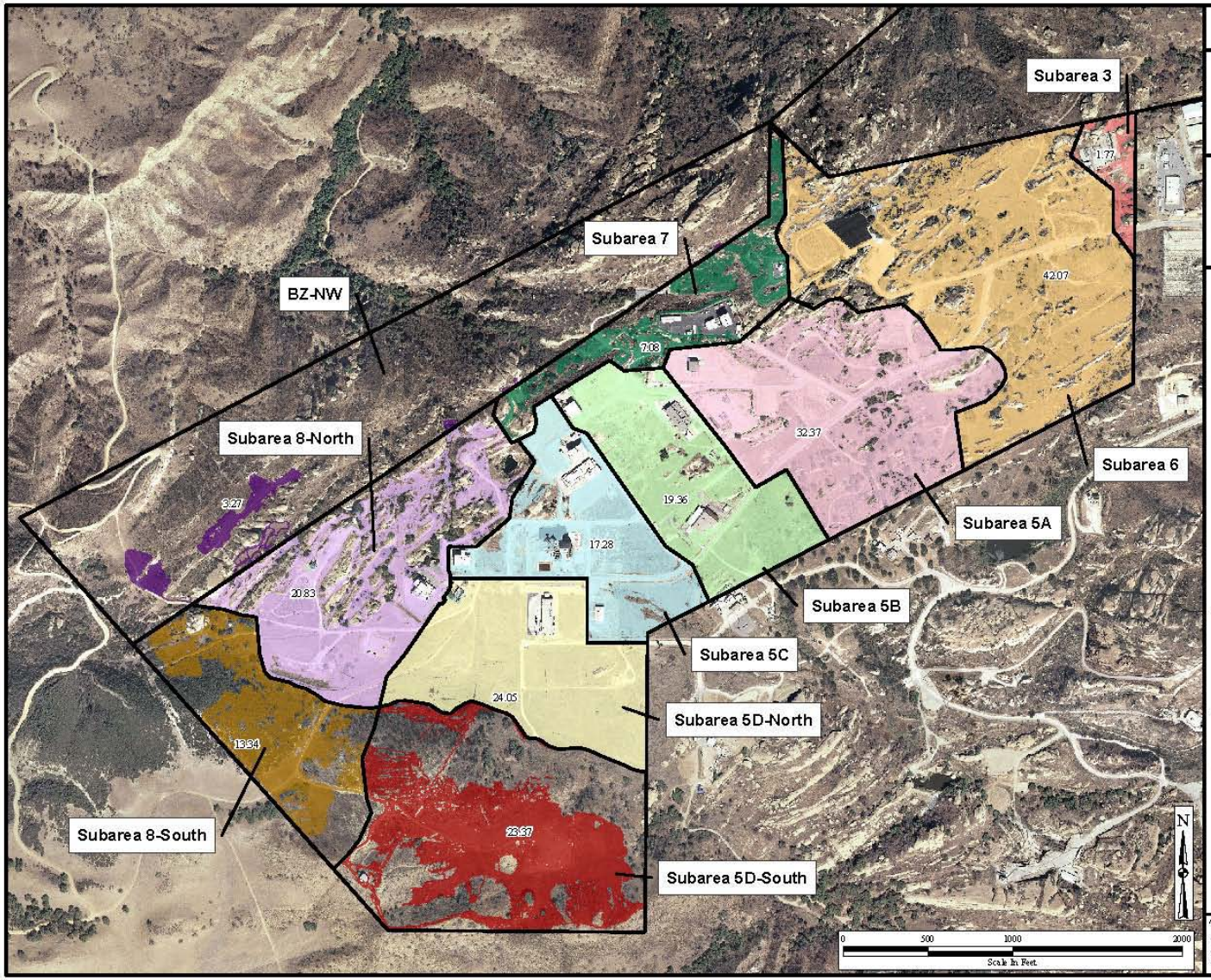
Agenda

- Gamma Scanning Accomplishments
- Scanning Coverage
- Subarea 6 Potential Gamma Radiation Anomalies
  - Gamma Scanning Data Analysis
  - Findings

Accomplishments in Subarea 6

- Scanned 90% of the accessible areas
- Completed gamma scanning data evaluation
- Identified, verified, and evaluated 59 Potential Gamma Radiation Anomalies (PGRAYs) including 27 indications of ^{137}Cs

Gamma Scanning Progress



HGL—Gamma Scanning, Santa Susana Field Laboratory Site Ventura County, California

Gamma Scanning Progress
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Gamma Scanning Coverage

Subarea

- BZ-NW
- Subarea 3
- Subarea 5A
- Subarea 5B
- Subarea 5C
- Subarea 5D-North
- Subarea 5D-South
- Subarea 6
- Subarea 7
- Subarea 8-North
- Subarea 8-South

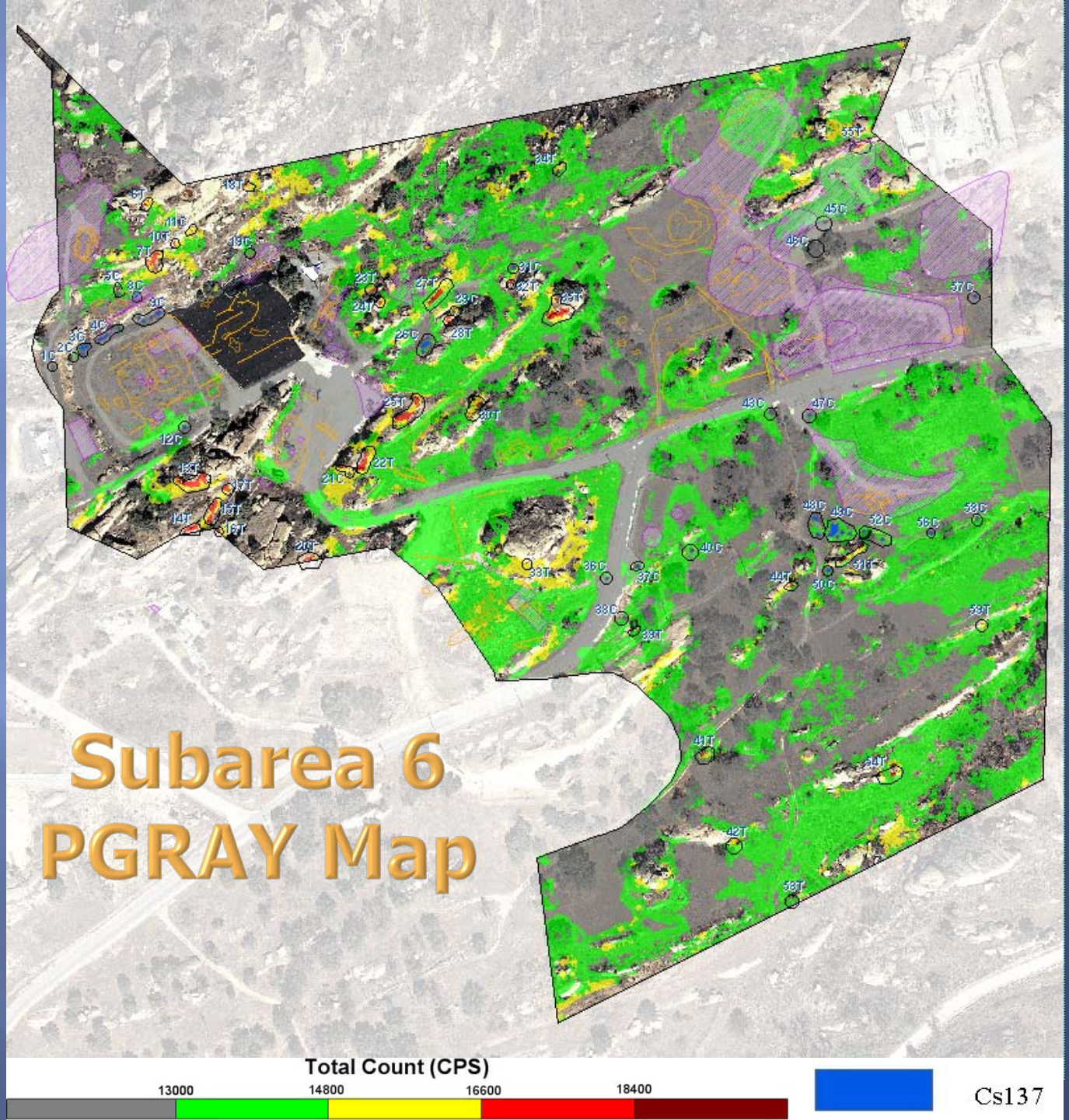
Type of Scanning Equipment	Week (03 June 11 thru 09 June 11)	Total To Date
ERGS	4.84	147.3
WMGS	0	24.87
MMGS	4.71	55.06
TMGS	2.28	14.33

Acreage Totals
Including Overlaps: 241.56
Excluding Overlaps: 204.9

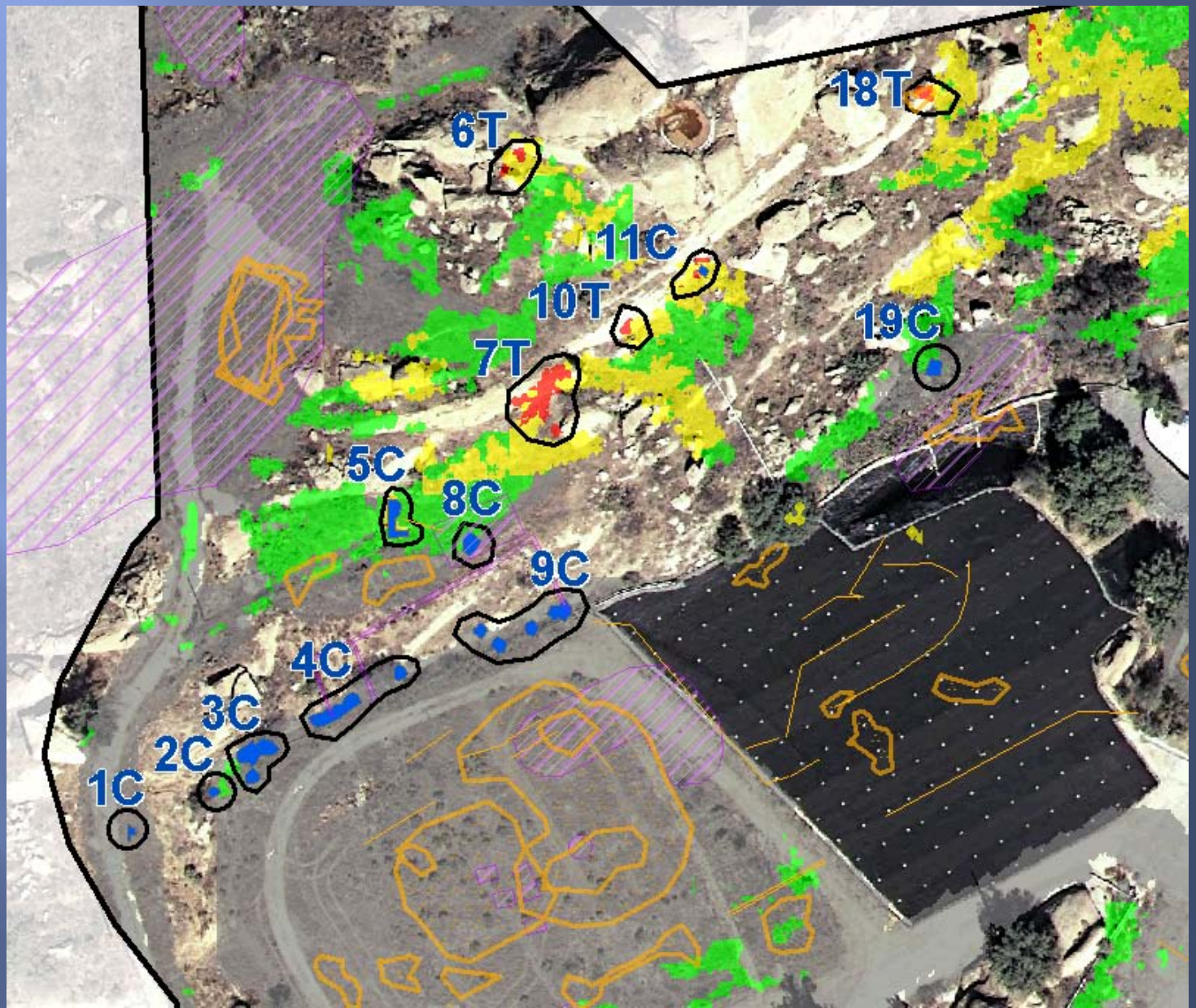
Notes:
- The totals listed in the table include overlap.
- The totals listed on the map exclude overlap.

Project: BP0088
Edited By: PL 6/11/2011
Source: CIRGIS 2007, HGL 2010

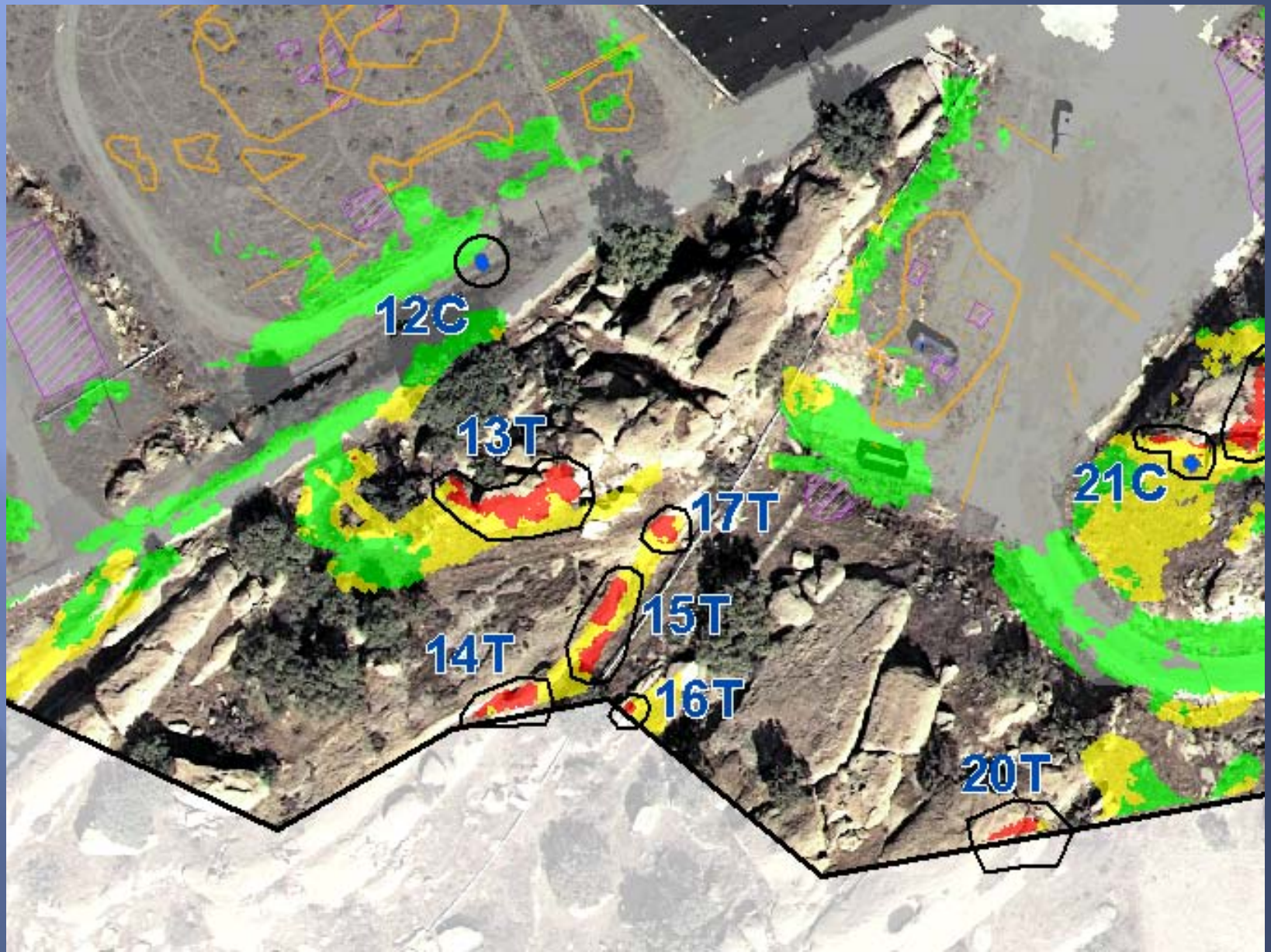
HGL TECHNOLOGIES, INC.


Subarea 6
PGRAY Map
Total Count (CPS)
13000
14800
16600
18400
Cs137

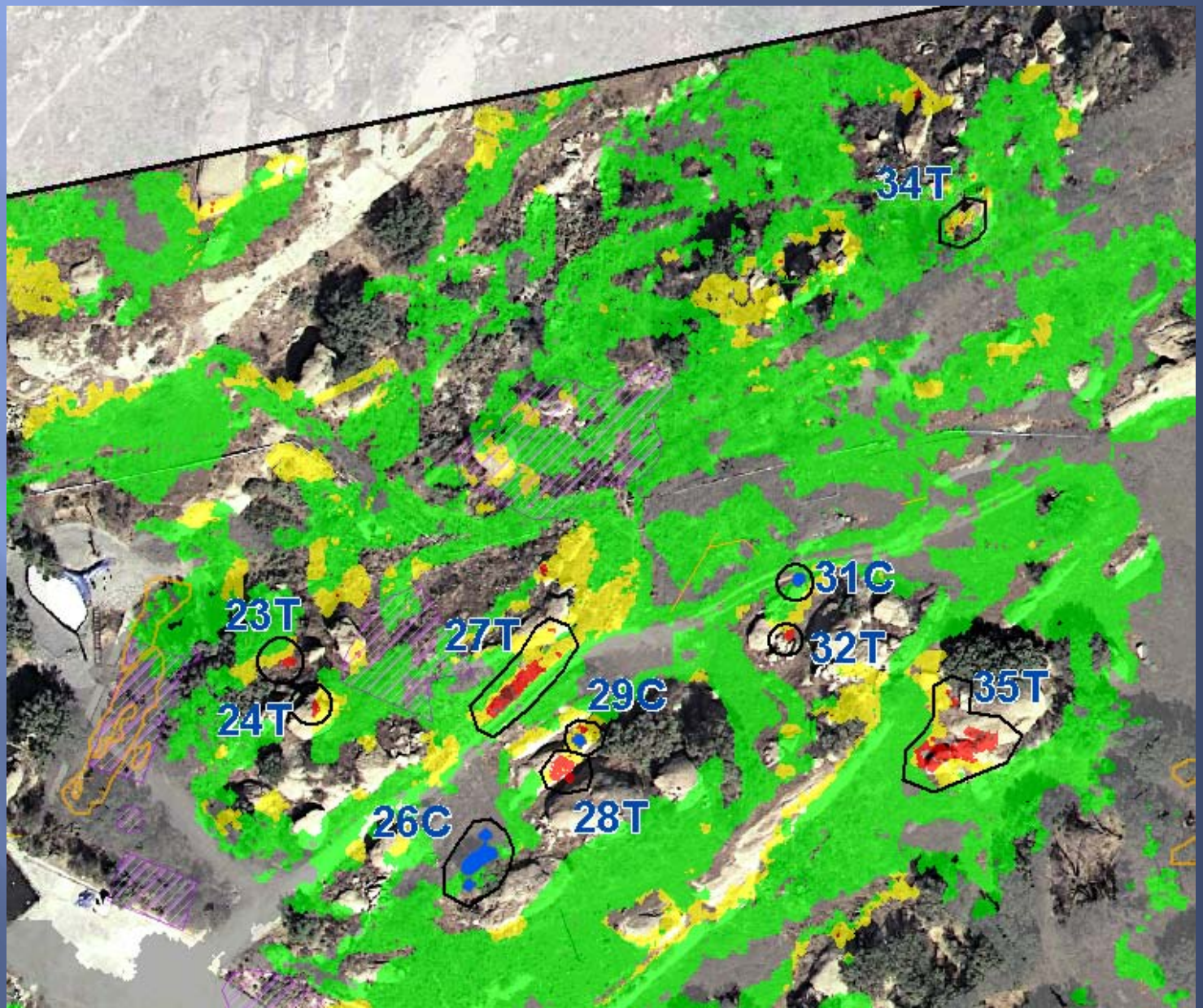
6 PGRAYs SRE-North Area



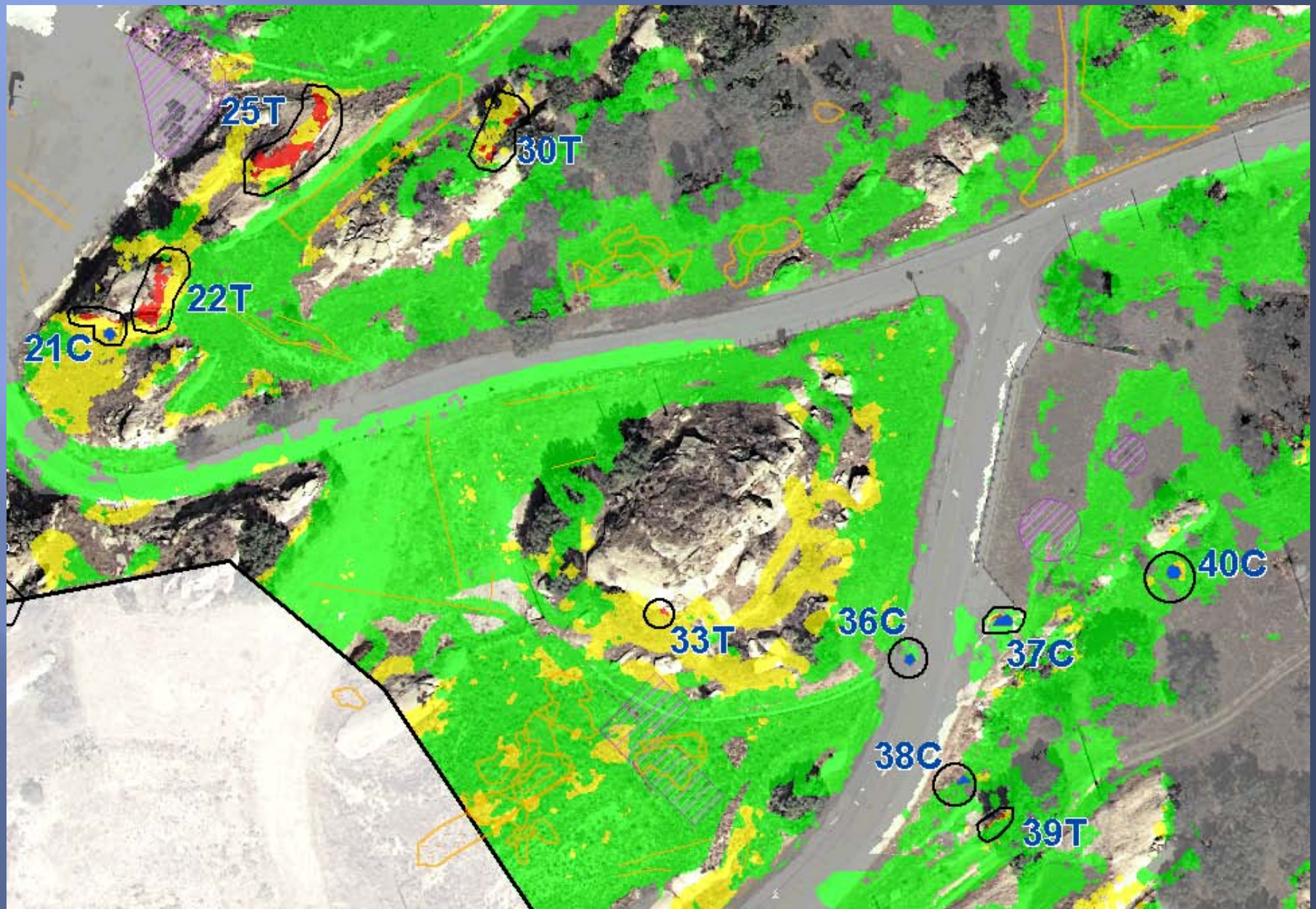
6 PGRAYs SRE-South Area



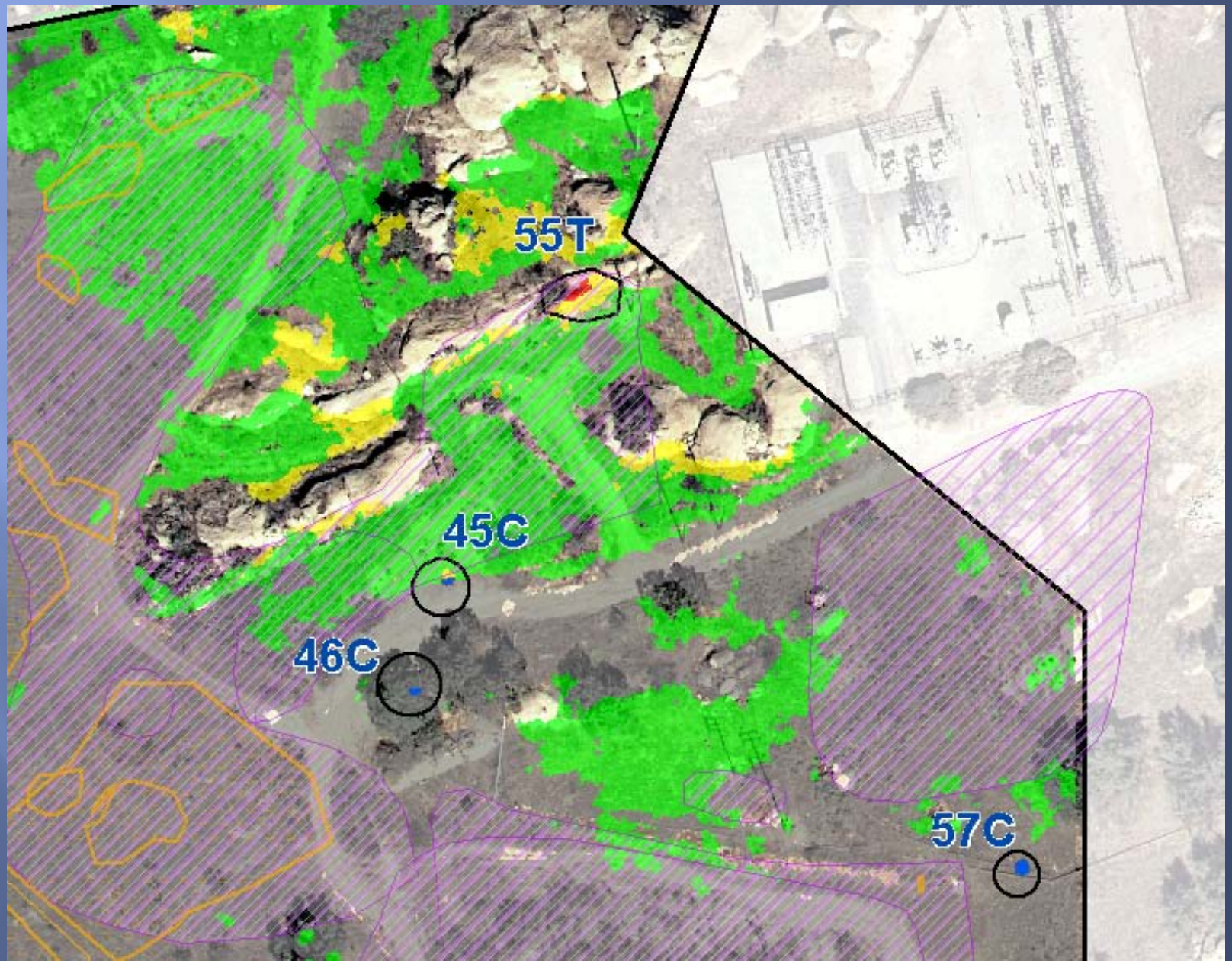
6 PGRAYs North Central Area



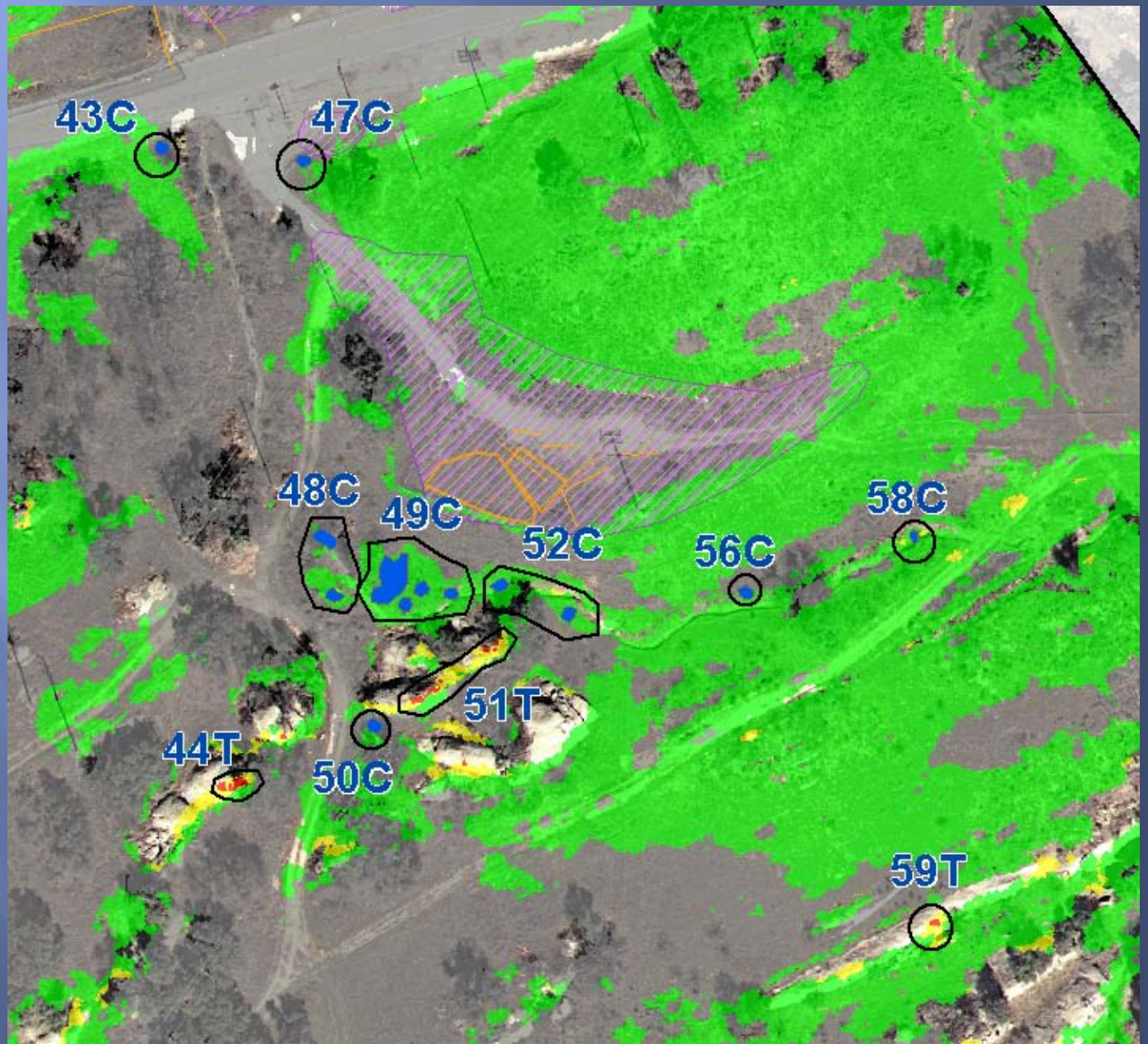
6 PGRAYs Central Area



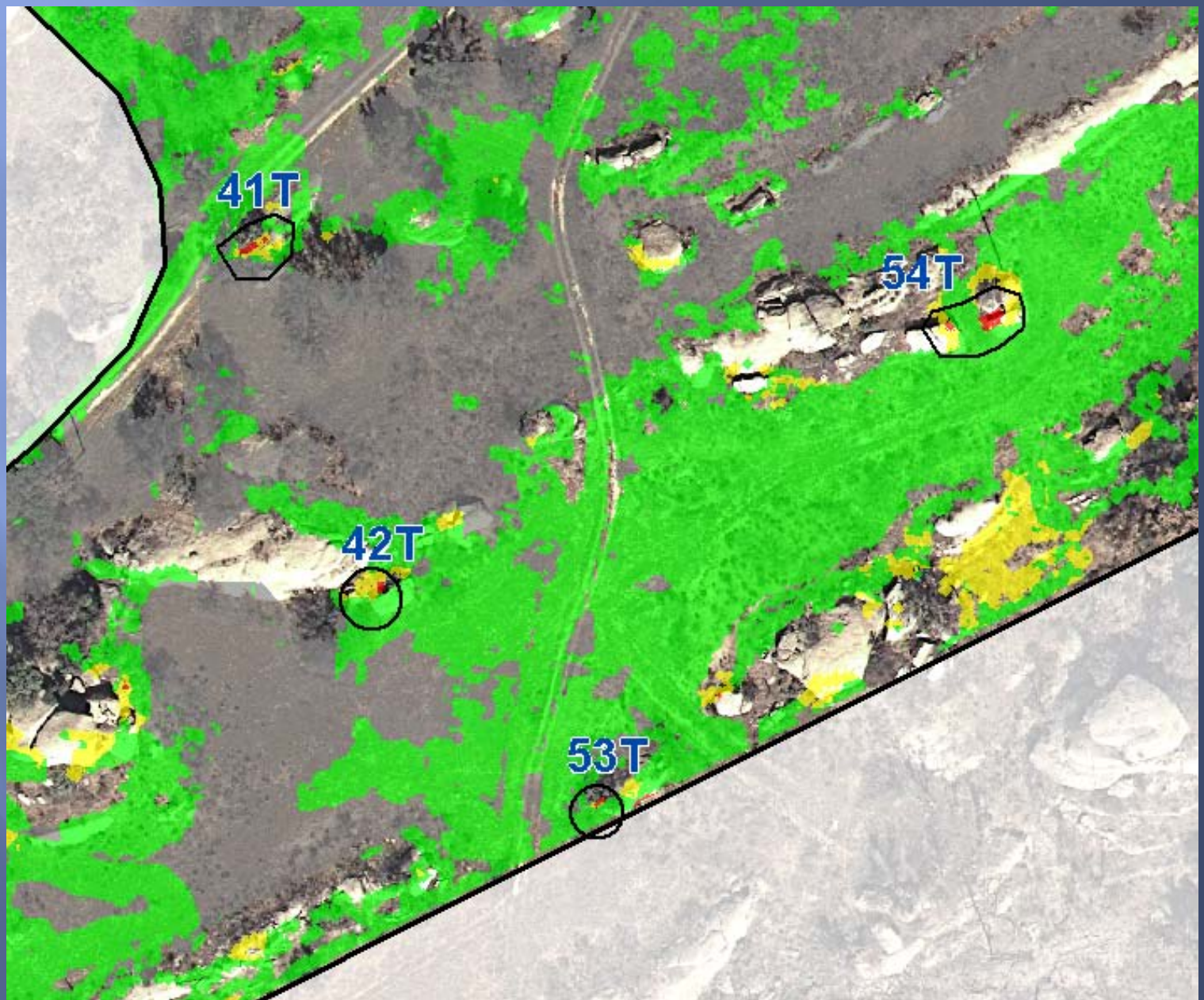
6 PGRAYs Old Conservation Yard



6 PGRAYs New Conservation Yard



6 PGRAYs Southeast Area

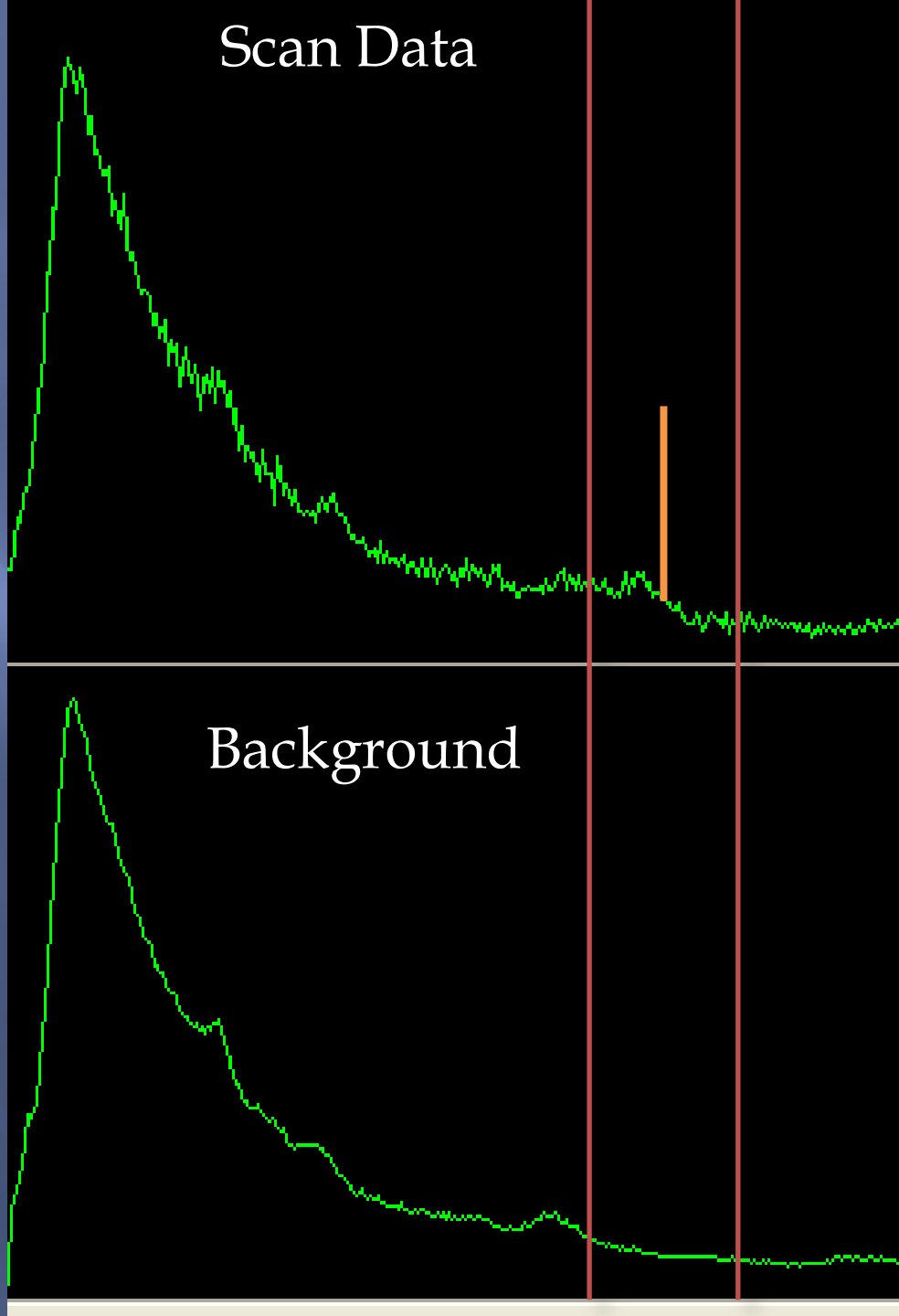


Assessment of Gamma Data

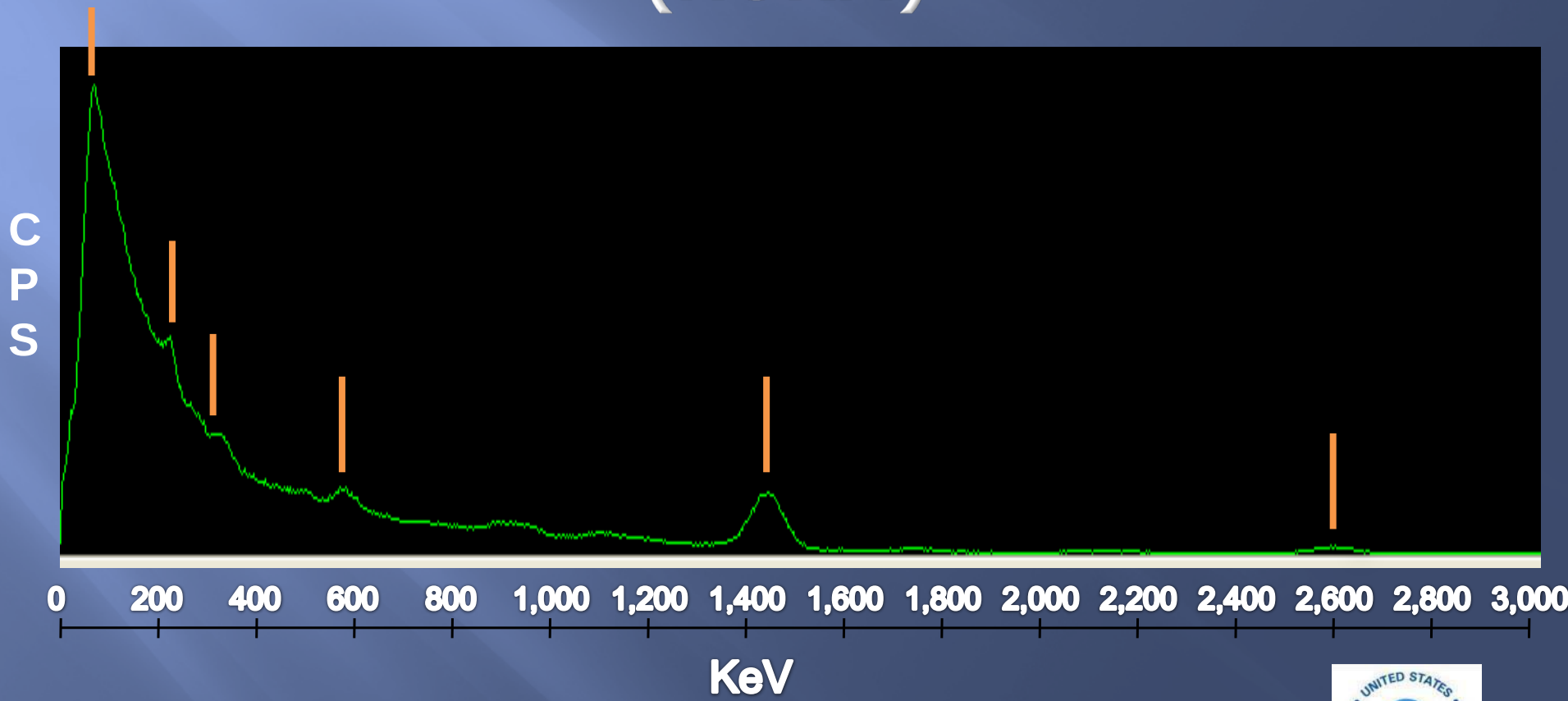
Radionuclides emit gammas at characteristic energies (two examples are, ^{40}K – 1461 KeV, ^{137}Cs – 662 KeV)

Each second of scanning data contains a full spectrum

These are inspected both mathematically and visually to determine the presence of radionuclide contaminants

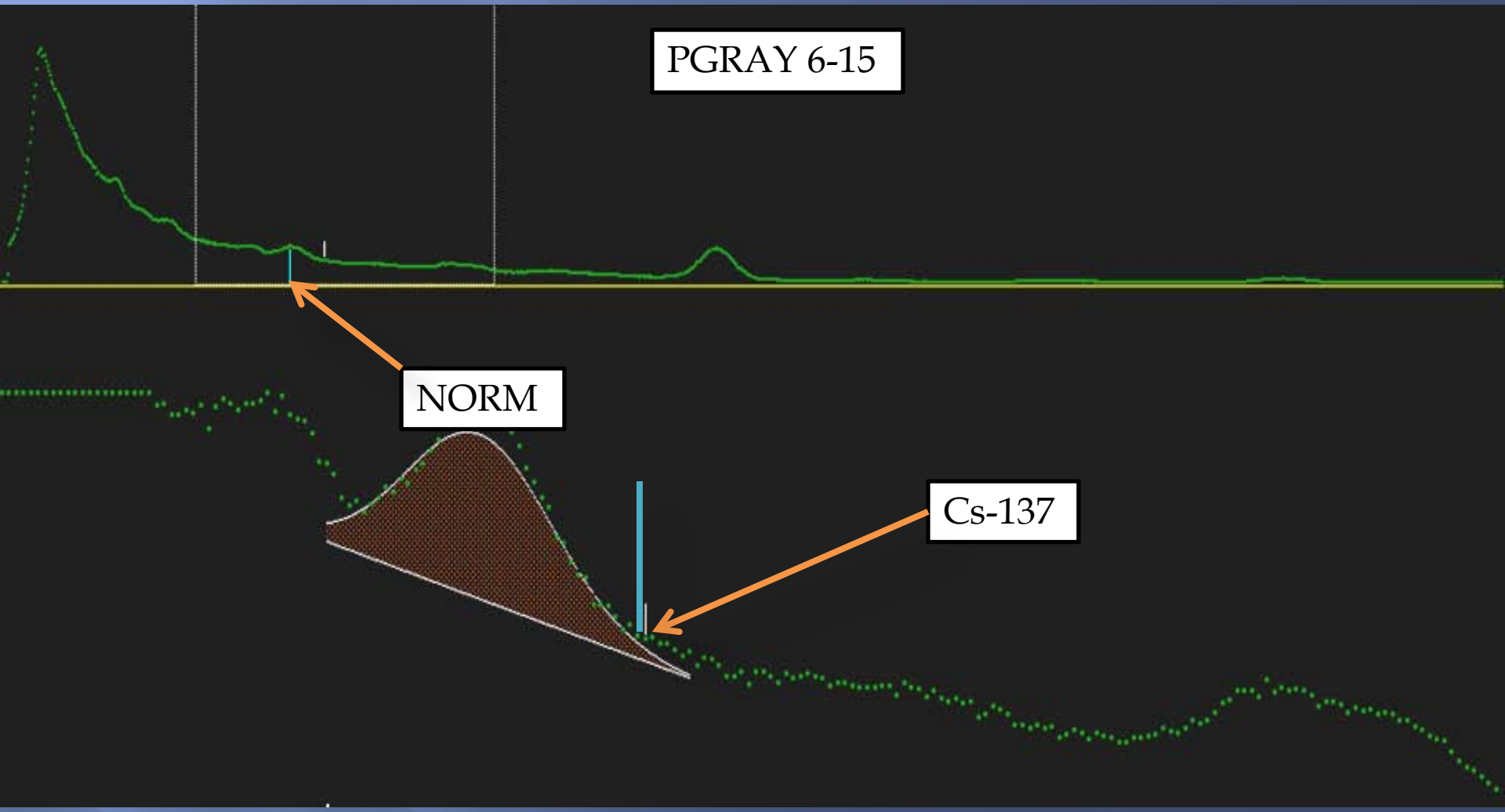


Gamma Spectrum of Soil Showing ^{238}U, ^{232}Th, and ^{40}K Peaks – Naturally Occurring Radioactive Materials (NORM)

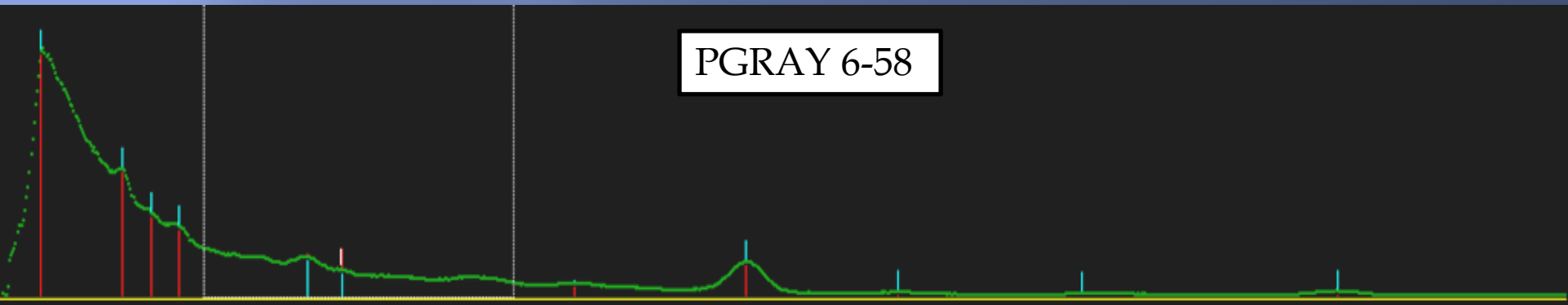


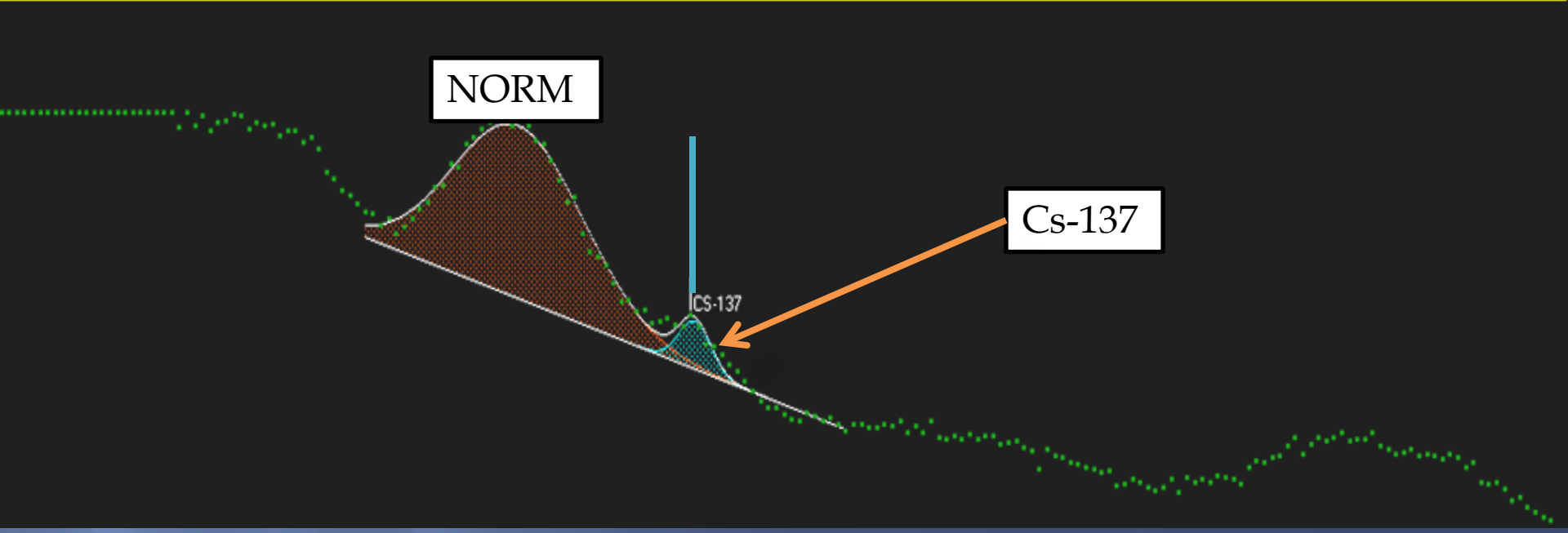
Scanning Detector Resolution For Determining Cs-137

Nuclide Identified	Peak Energy Range (KeV)	Source Nuclide	Source (KeV)	Separation (KeV)
NORM	595 - 605	Tl-208 Bi-214	584 609	**25**
Cs-137	657 - 667	Cs-137	662	**53**

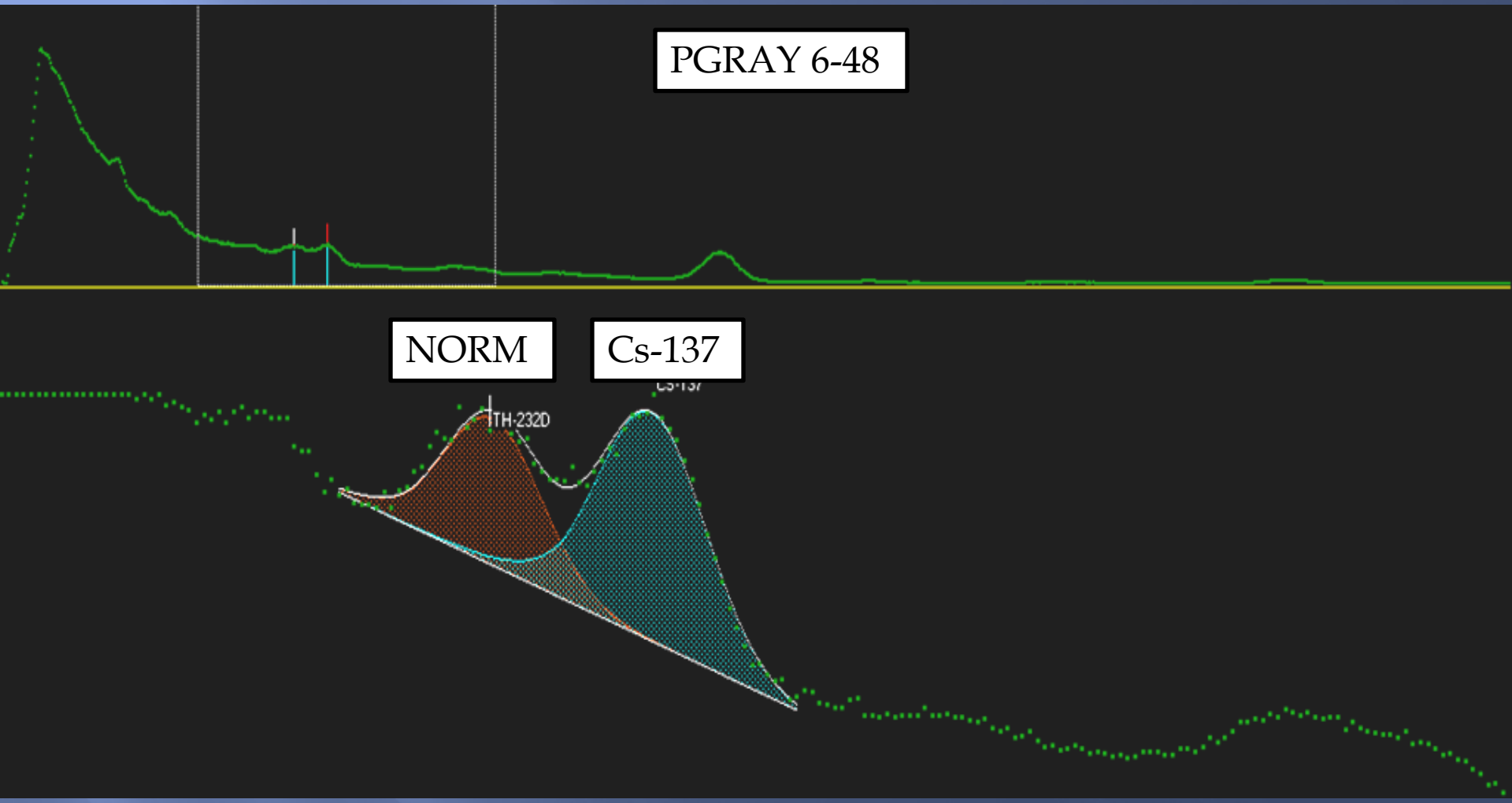


PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-15	NORM	595	47230

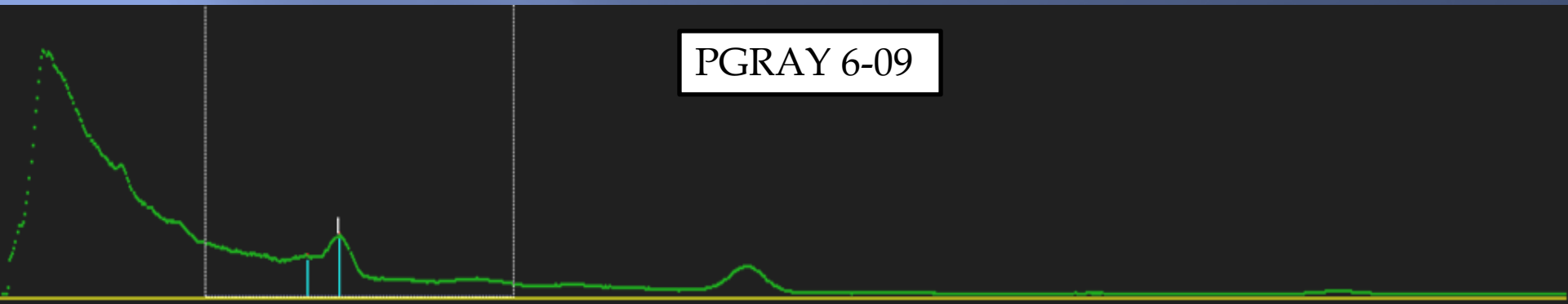


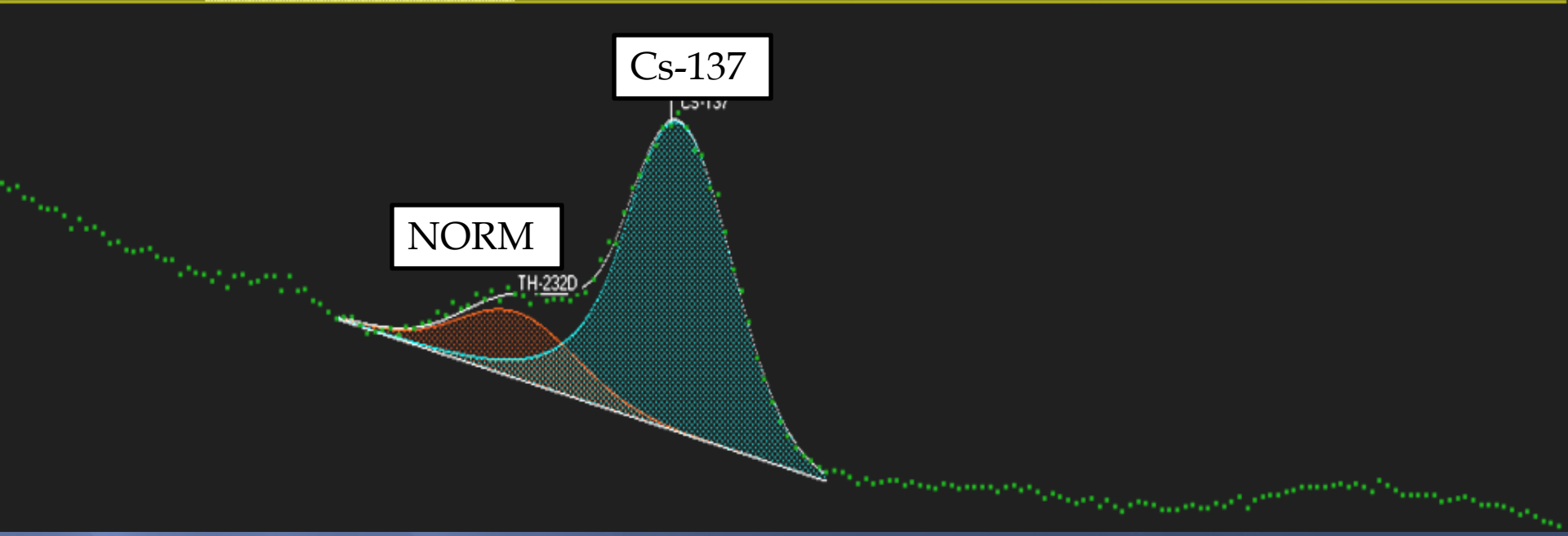


PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-58	NORM	599	31588
	Cs-137	666	8105

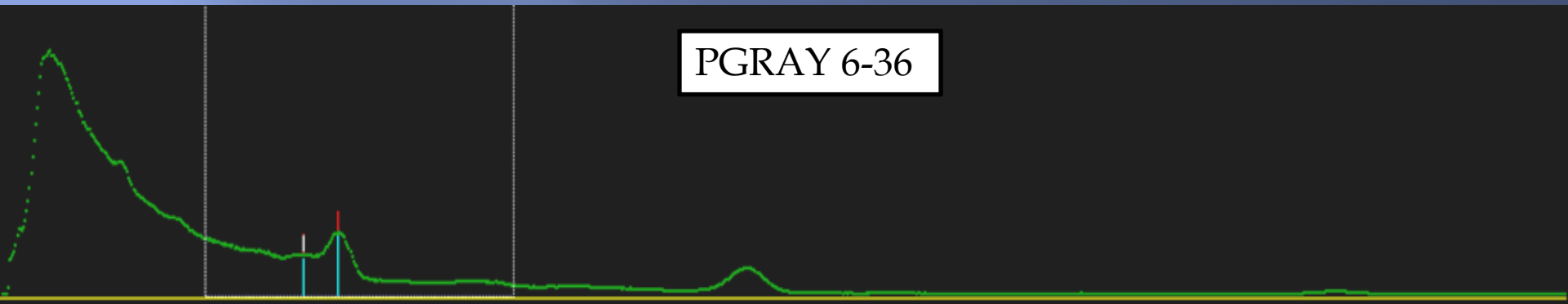


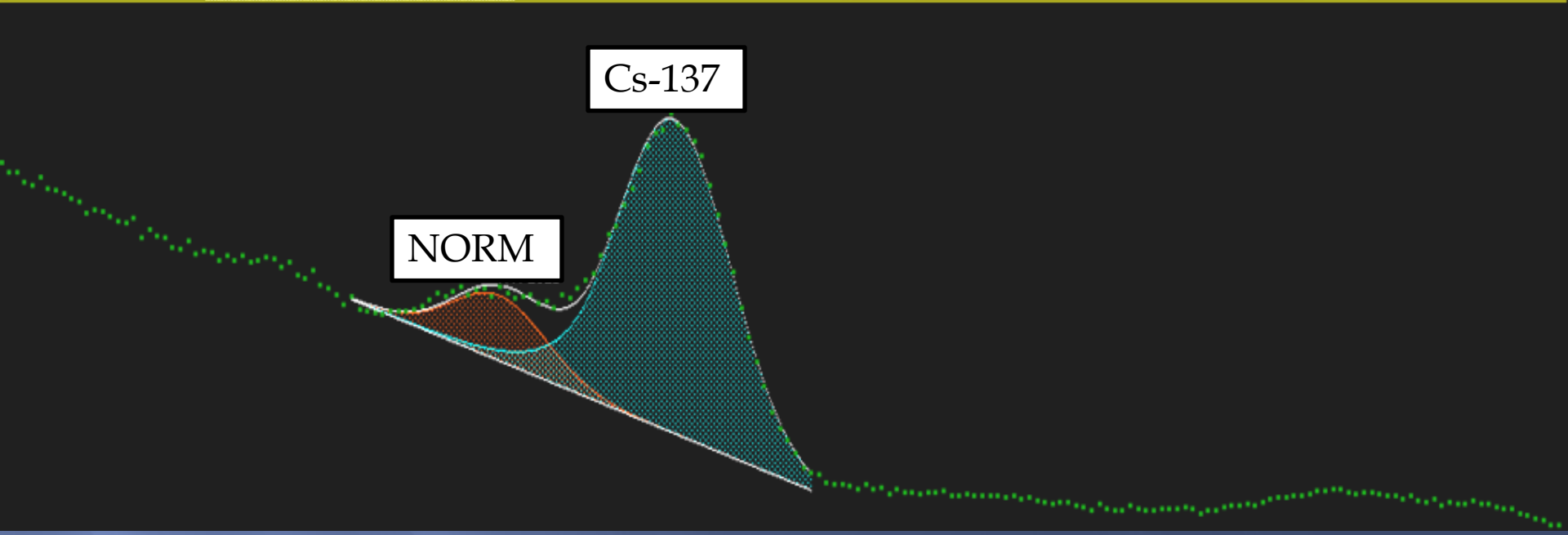
PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-48	NORM	598	32017
	Cs-137	661	51872



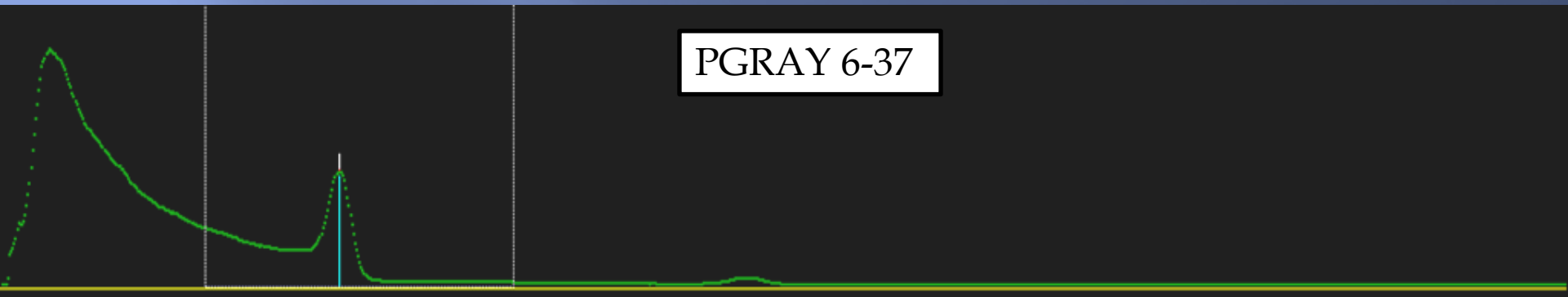


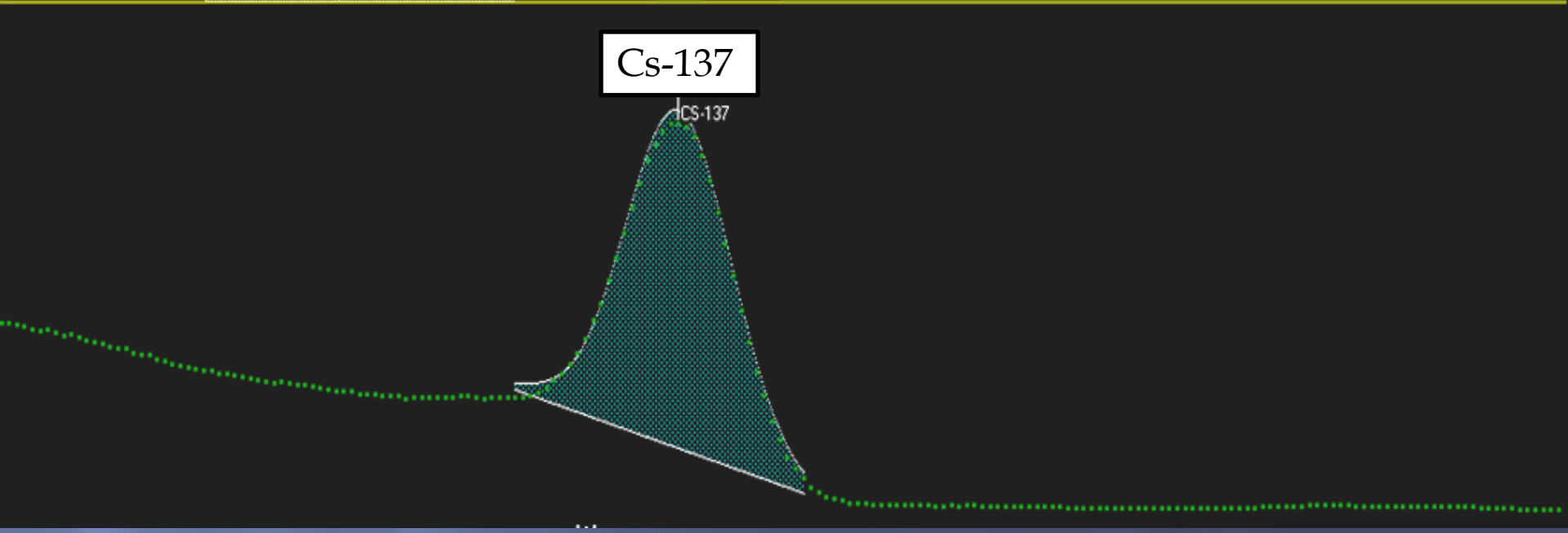
PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-09	NORM	600	30617
	Cs-137	662	123564



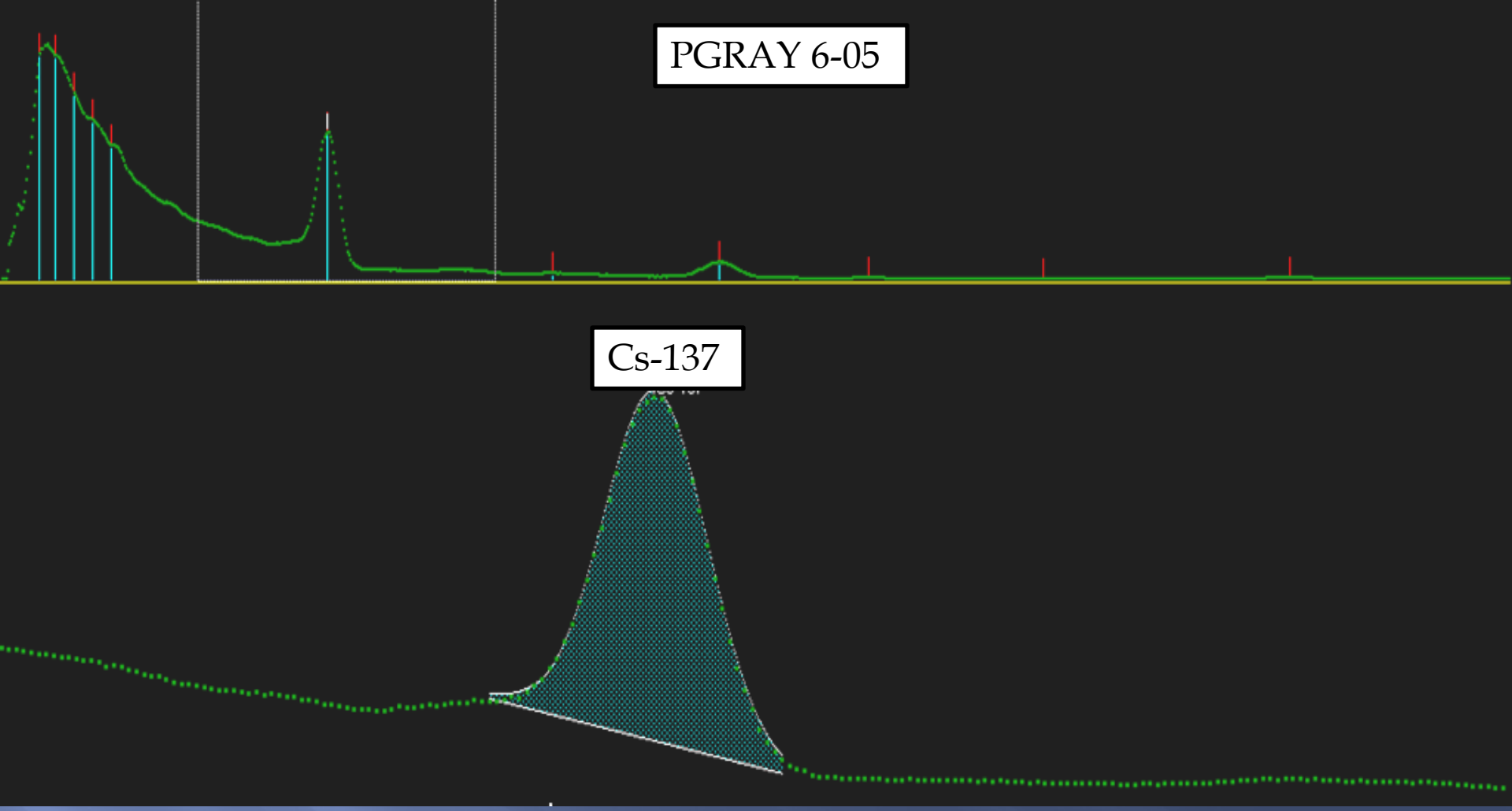


PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-36	NORM	592	35398
	Cs-137	660	156977



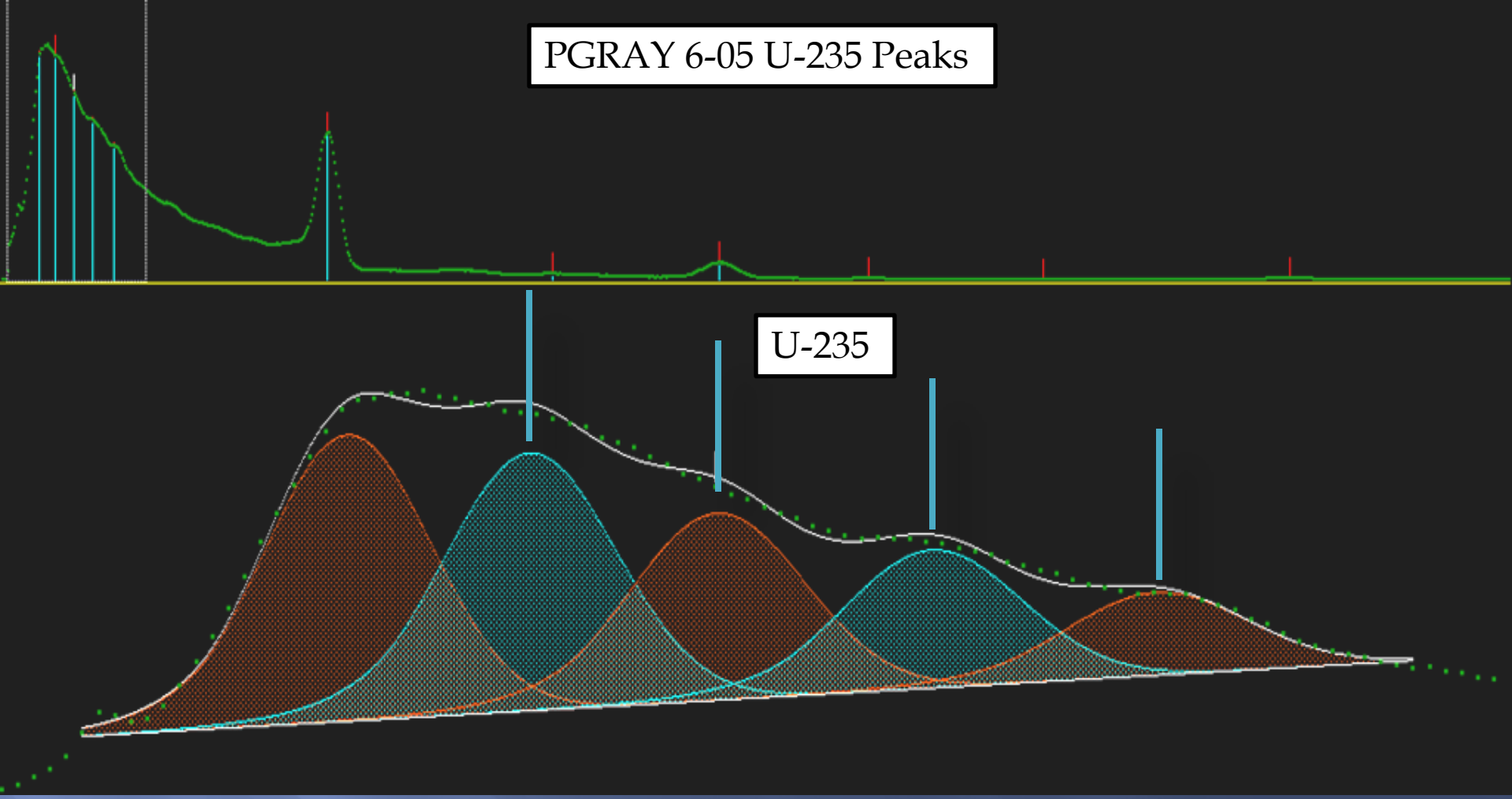


PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-37	Cs-137	661	1127543



PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-05	Cs-137	662	635831
	U-235	110	589799
	U-235	145	406459
	U-235	185	306216
	U-235	236	187322

PGRAY 6-05 U-235 Peaks



PGRAY Number	Nuclide Identified	Energy (KeV)	Peak Area (counts)
6-05	Cs-137	662	635831
	U-235	110	589799
	U-235	145	406459
	U-235	185	306216
	U-235	236	187322

Preliminary Evaluation 6 Potential GRAYs

Potential GRAY	Evaluation
1-5, 8, 9, 12, 19, 21, 26, 28, 29, 36-40, 43, 45-49, 52, 56, 58	Positive Anomalies (GRAYs)
55	Suspect due to another line of evidence at the location
6, 7, 10, 11, 13-18, 20, 22-25, 27, 30-35, 41, 42, 44, 50, 51, 53, 54, 59	NORM
NORM is Naturally Occurring Radioactive Materials (Uranium, Thorium, and Potassium-40)	

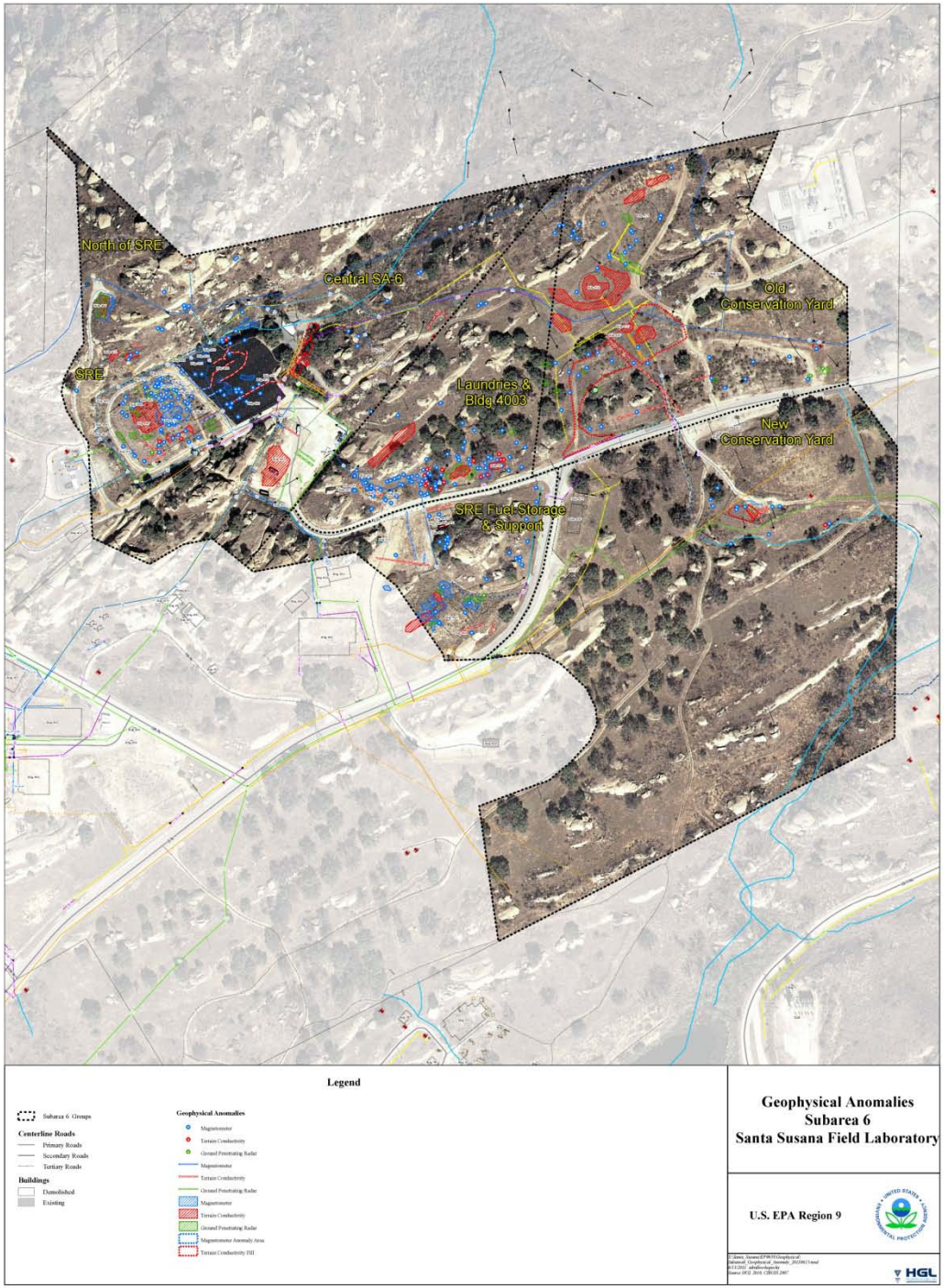
Confidence in Detection of Gamma Emitting Radionuclides

PGRAYs From Scanning Data	Verification Count Result
29 Cs-137 PGRAYs	26 have Cs-137, one also has U-235
30 TCPS PGRAYs	1 TPCS anomaly has Cs-137

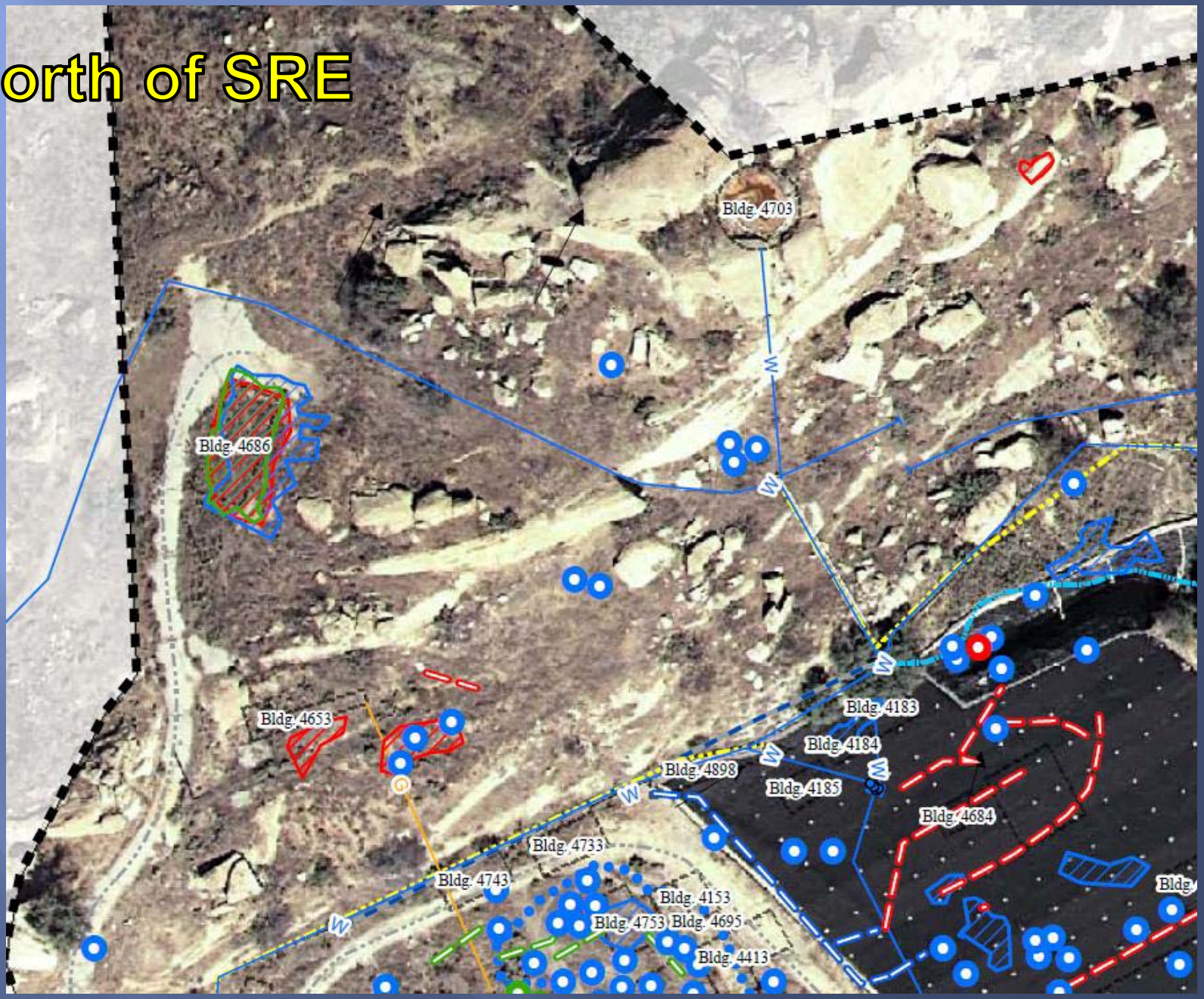
Questions?

Geophysical Investigation

June 15, 2011


North of SRE
Central SA-6
Old Conservation Yard
SRE
Laundries & Bldg 4003
New Conservation Yard
SRE Fuel Storage & Support
Legend
Subarea 6 Groups
Centerline Roads
Primary Roads
Secondary Roads
Tertiary Roads
Buildings
Demolished
Existing
Geophysical Anomalies
Magnetometer
Terrain Conductivity
Ground Penetrating Radar
Magnetometer
Terrain Conductivity
Ground Penetrating Radar
Magnetometer
Terrain Conductivity
Ground Penetrating Radar
Magnetometer Anomaly Area
Terrain Conductivity Fill
Geophysical Anomalies
Subarea 6
Santa Susana Field Laboratory
U.S. EPA Region 9
HGL

North of SRE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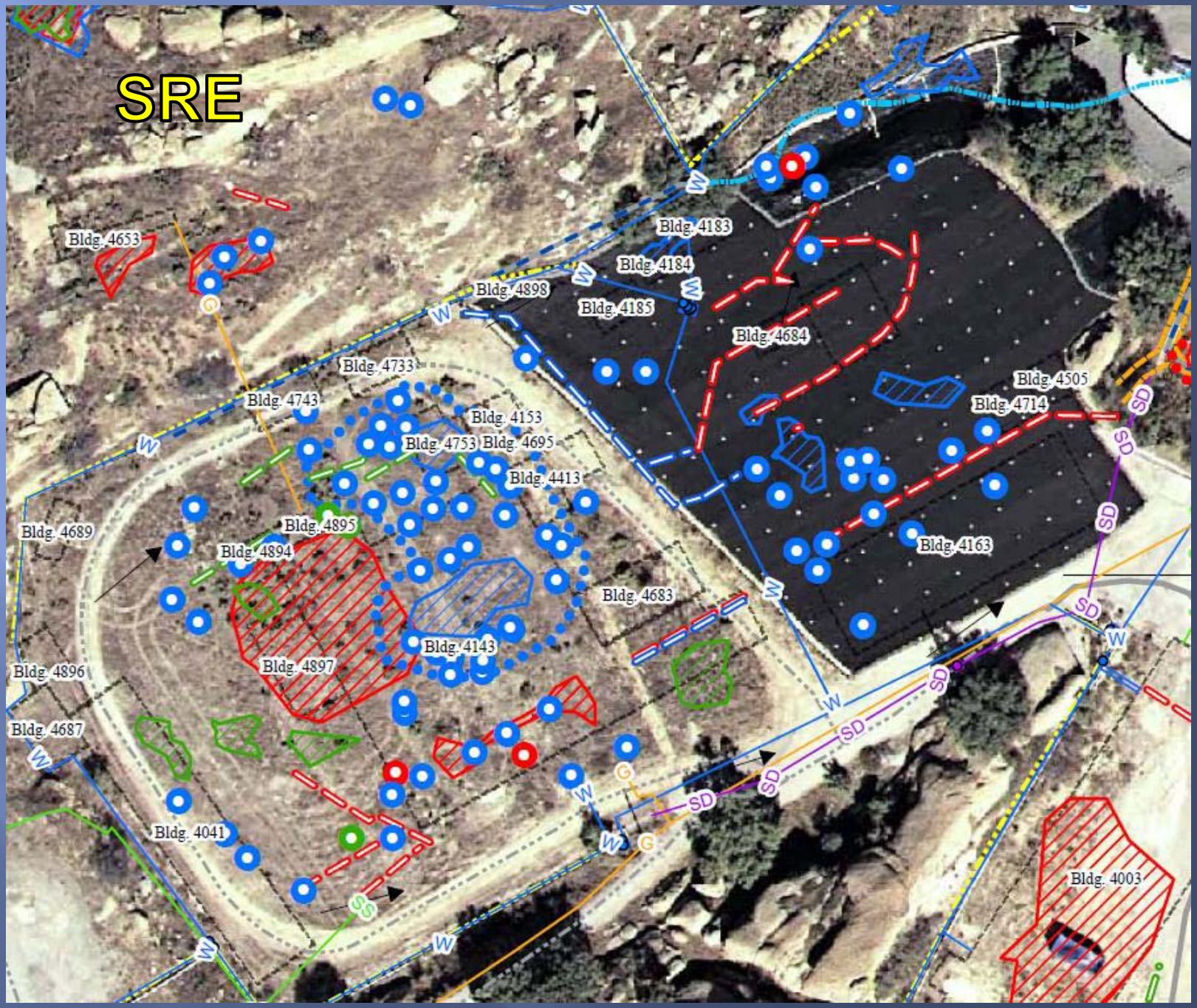
Bldg. 4753
Bldg. 4695
Bldg. 4413


SRE
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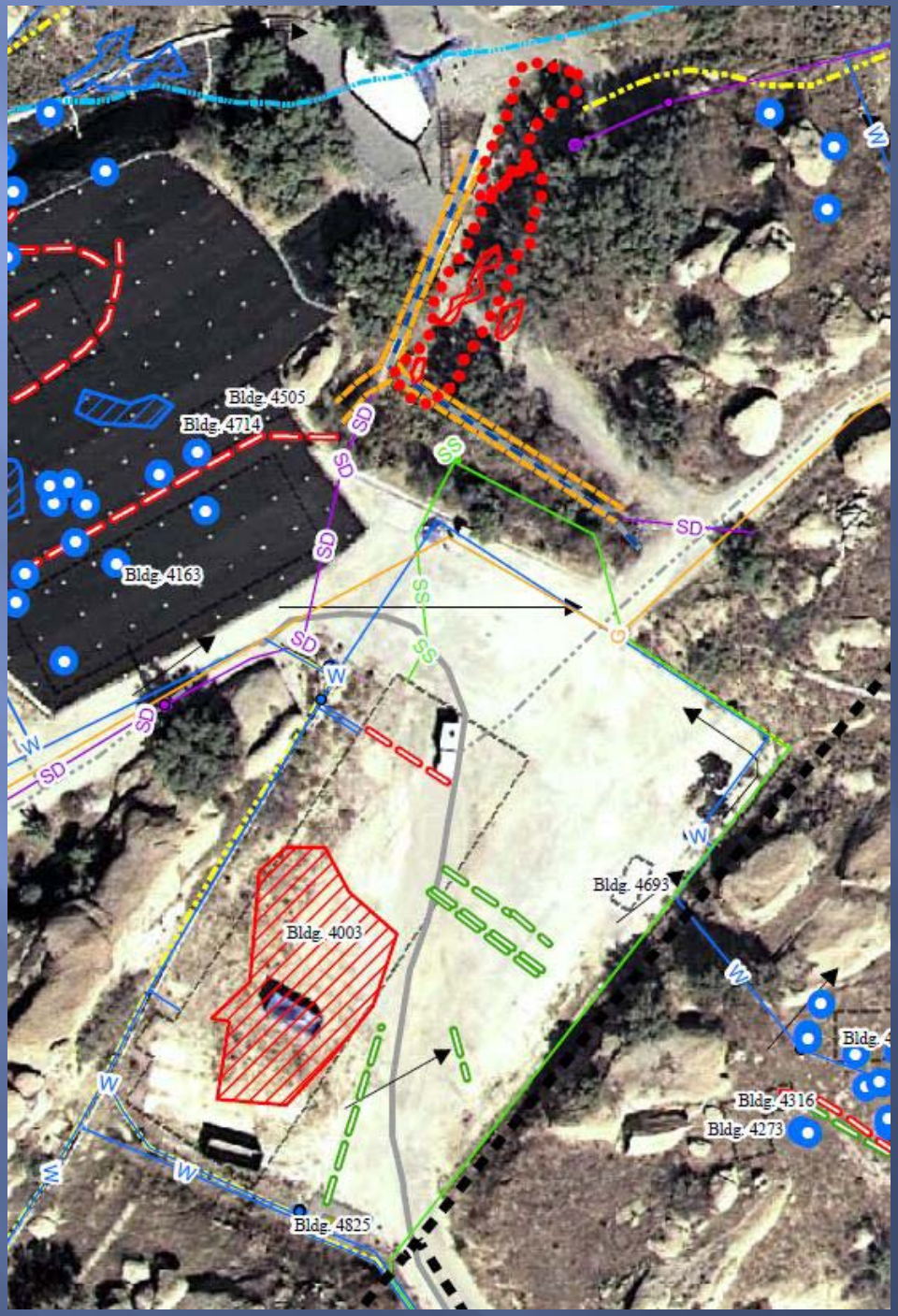
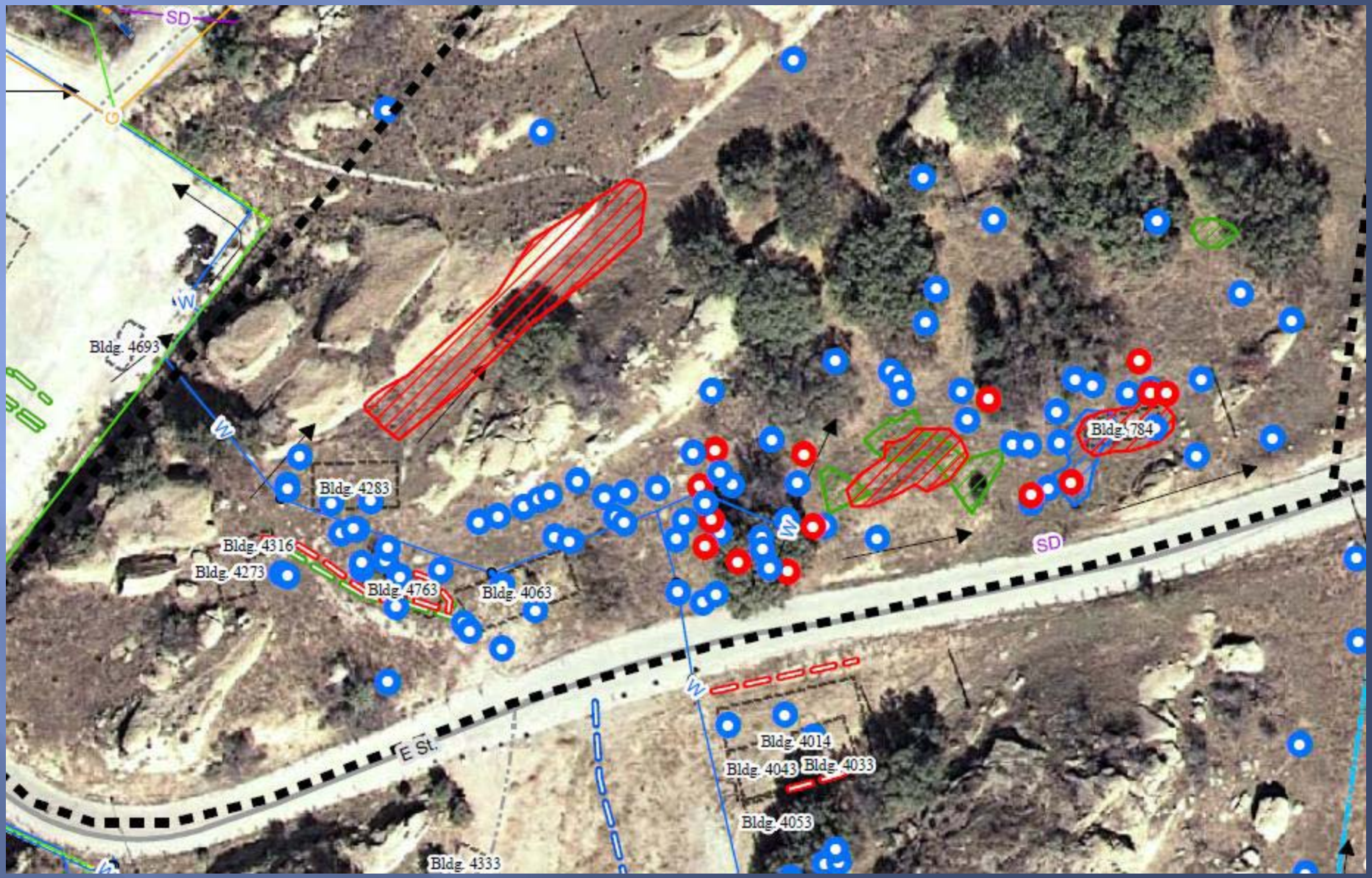
Bldg. 4041
Bldg. 4003
W
G
SD
SS



Building 4003


SD
W
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Bldg. 4273
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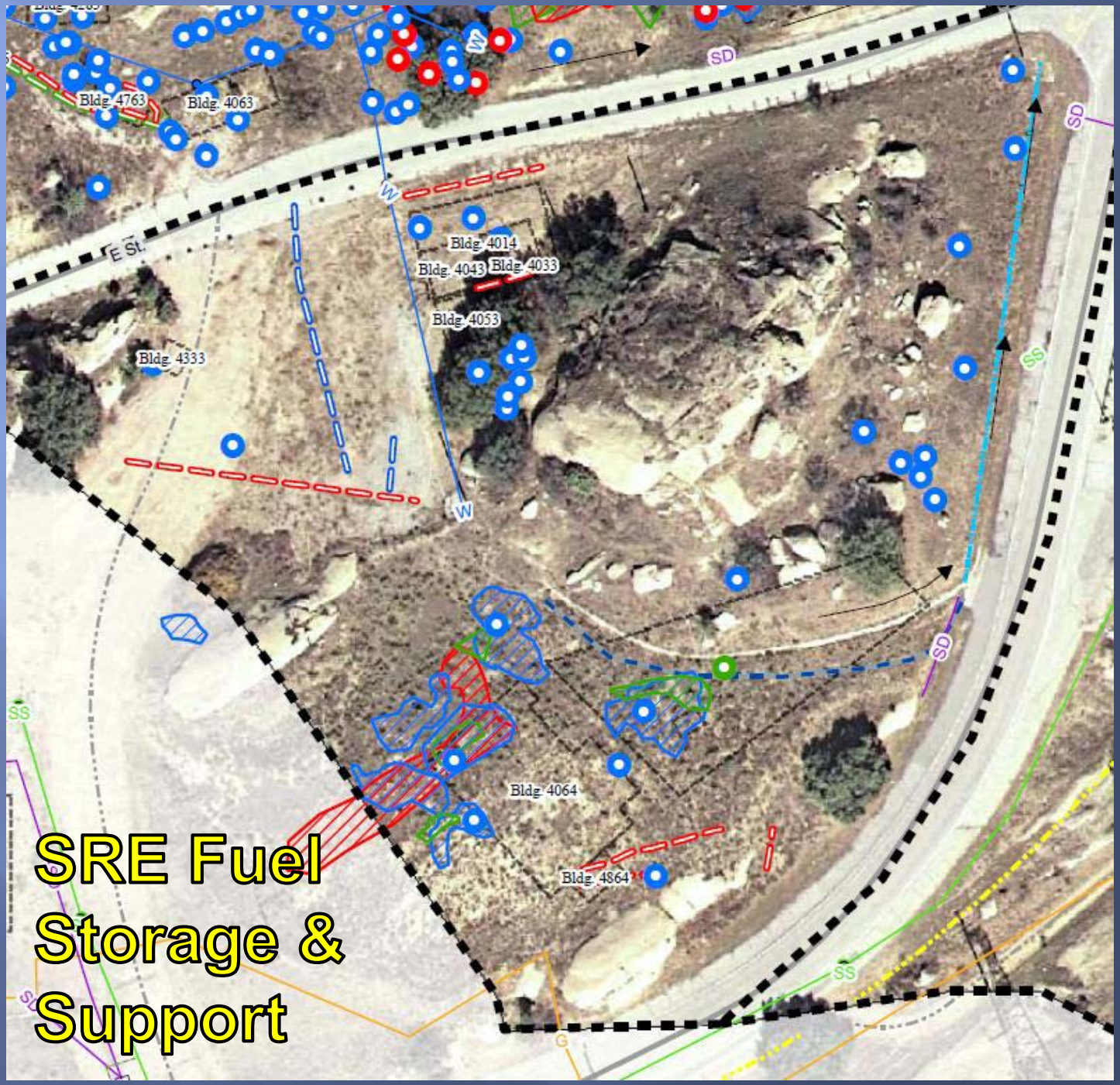
Bldg. 4063
Bldg. 784
SD
E St.
Bldg. 4014
Bldg. 4043
Bldg. 4033
Bldg. 4053
Bldg. 4333

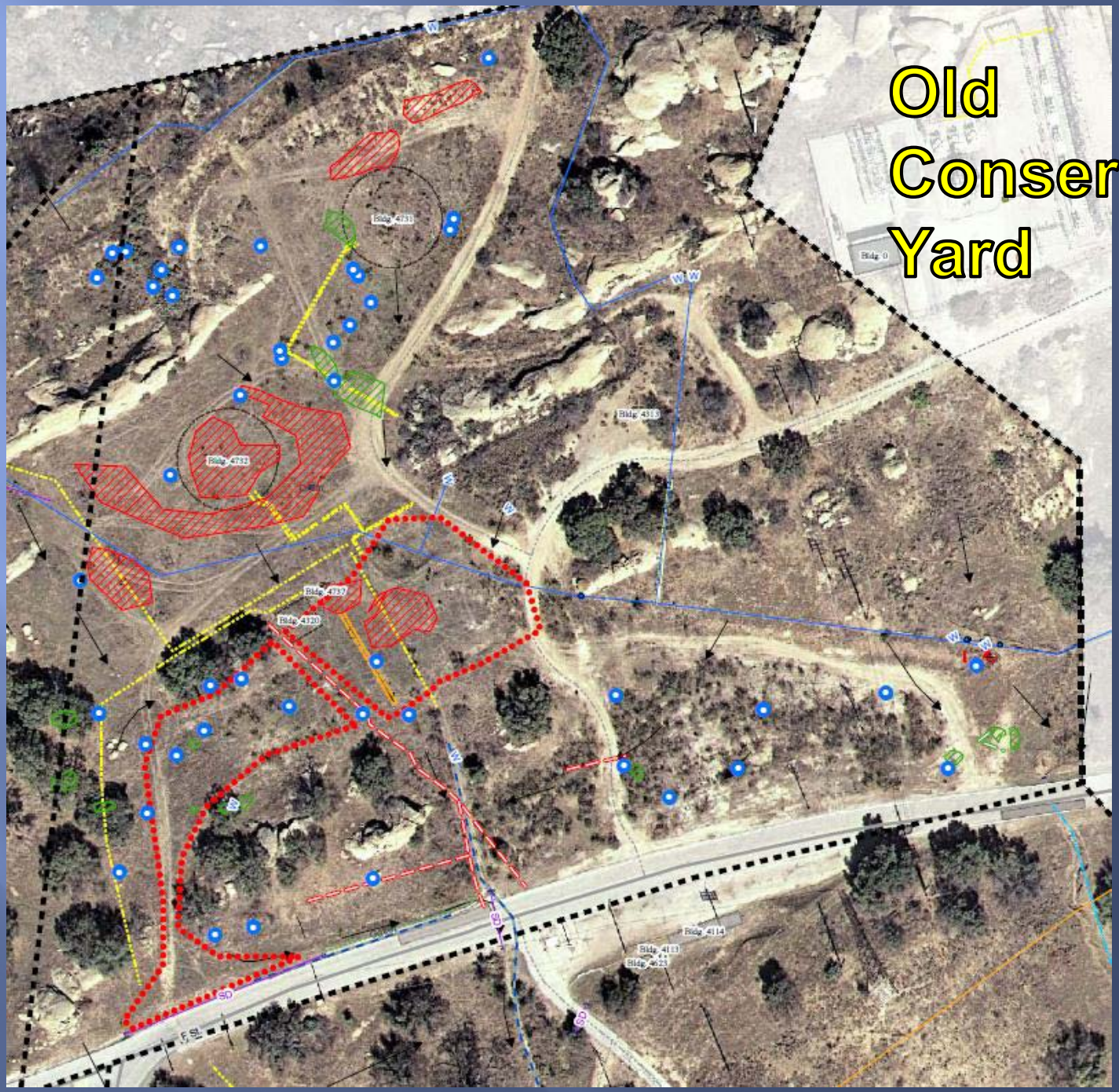
Laundries



SRE Fuel Storage & Support

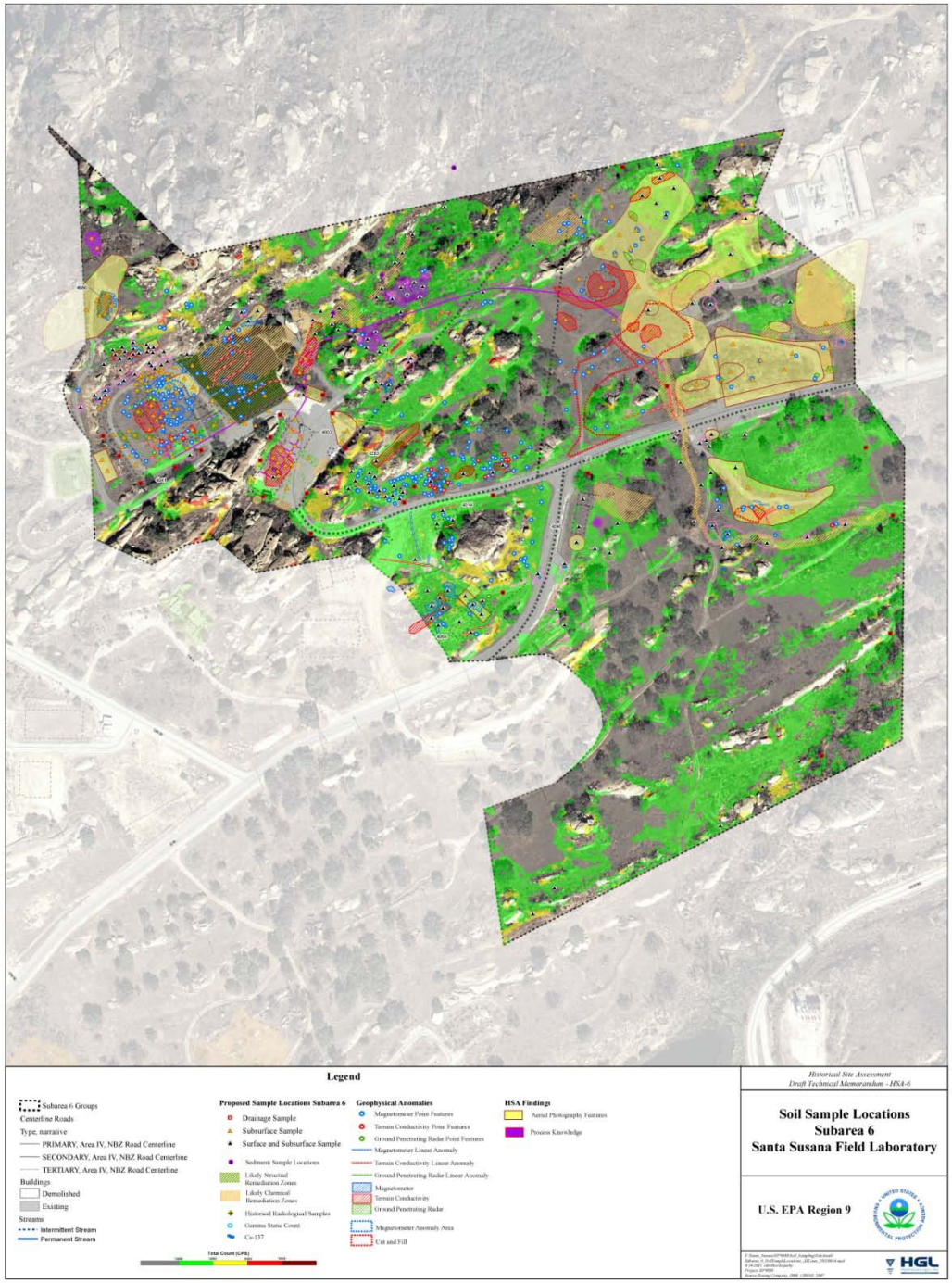
Central
Subarea 6
Bldg 4723
Bldg 4688
Bldg 4724
SD

Old Conservation Yard



New
Conservation
Yard
Bldg. 4114
Bldg. 4113
Bldg. 4623

Questions?


Legend
Subarea 6 Groups
Centerline Roads
Type, narrative
PRIMARY, Area IV, NBZ Road Centerline
SECONDARY, Area IV, NBZ Road Centerline
TERTIARY, Area IV, NBZ Road Centerline
Buildings
Demolished
Existing
Streams
Intermittent Stream
Permanent Stream
Proposed Sample Locations Subarea 6
Drainage Sample
Subsurface Sample
Surface and Subsurface Sample
Sediment Sample Locations
Likely Structural Remediation Zones
Likely Chemical Remediation Zones
Historical Radiological Samples
Gamma Static Count
Cs-137
Total Count (CPS)
Geophysical Anomalies
Magnetometer Point Features
Termain Conductivity Point Features
Ground Penetrating Radar Point Features
Magnetometer Linear Anomaly
Termain Conductivity Linear Anomaly
Ground Penetrating Radar Linear Anomaly
Magnetometer
Termain Conductivity
Ground Penetrating Radar
Magnetometer Anomaly Area
Cut and Fill
HSA Findings
Aerial Photography Features
Process Knowledge
Historical Site Assessment
Draft Technical Memorandum - HSA-6
Soil Sample Locations
Subarea 6
Santa Susana Field Laboratory
U.S. EPA Region 9
HGL

Co-Located Chemical Sampling Update for HSA 6

Laura Rainey
California Department of Toxic Substances Control

Stephie Jennings
US Department of Energy

June 15, 2011

Co-Located Sampling Objectives

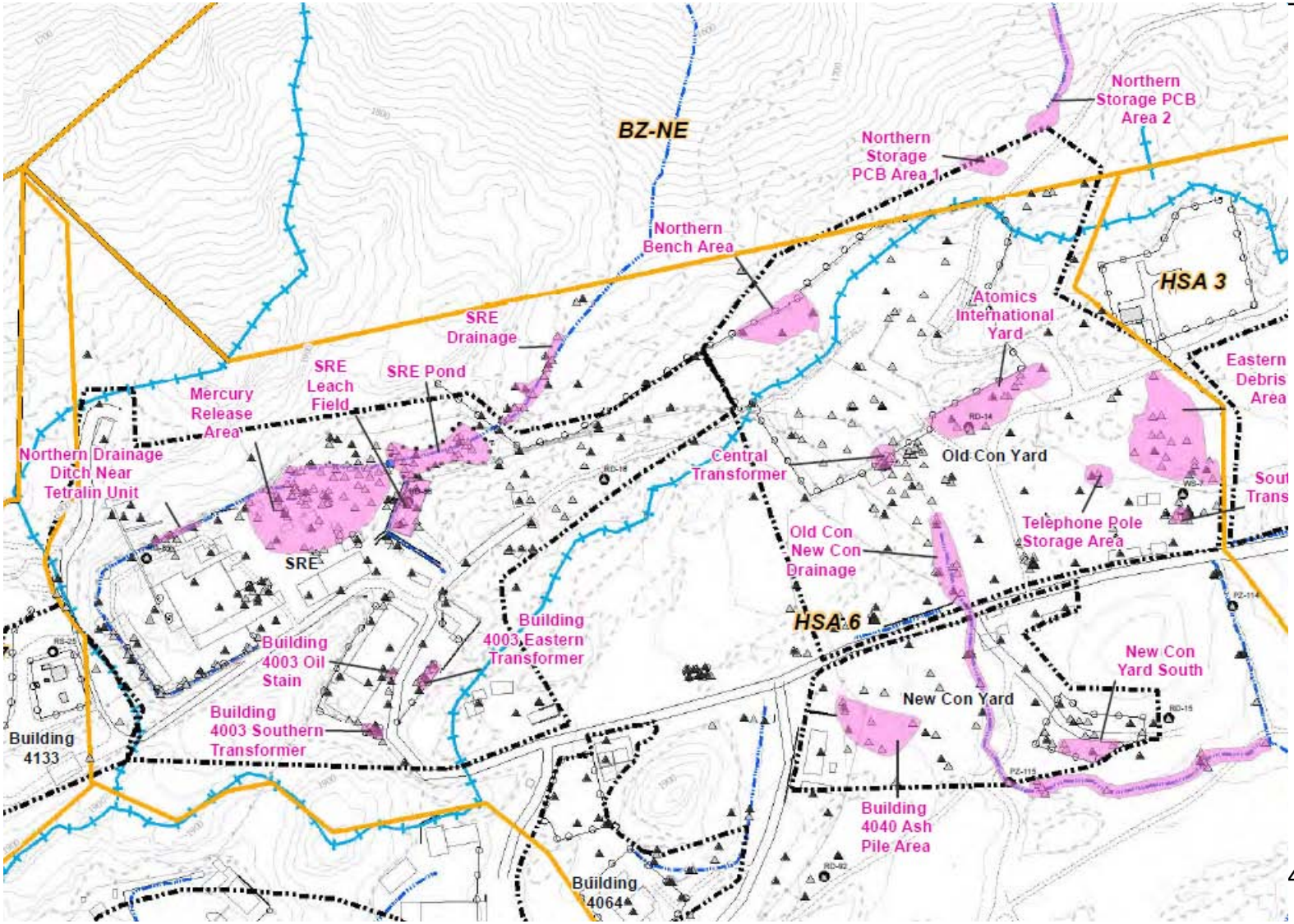
- Utilize opportunity to obtain additional chemical data for ultimate use in making cleanup decisions, per Administrative Order on Consent between DOE and DTSC, signed December 6, 2010

- Take advantage of the additional information that EPA has obtained to target sampling (EPA Historical Site Assessments, Gamma Scanning Data, Geophysical logging, former worker interviews, aerial photography analysis)

Co-located Chemical Sampling Decision Process

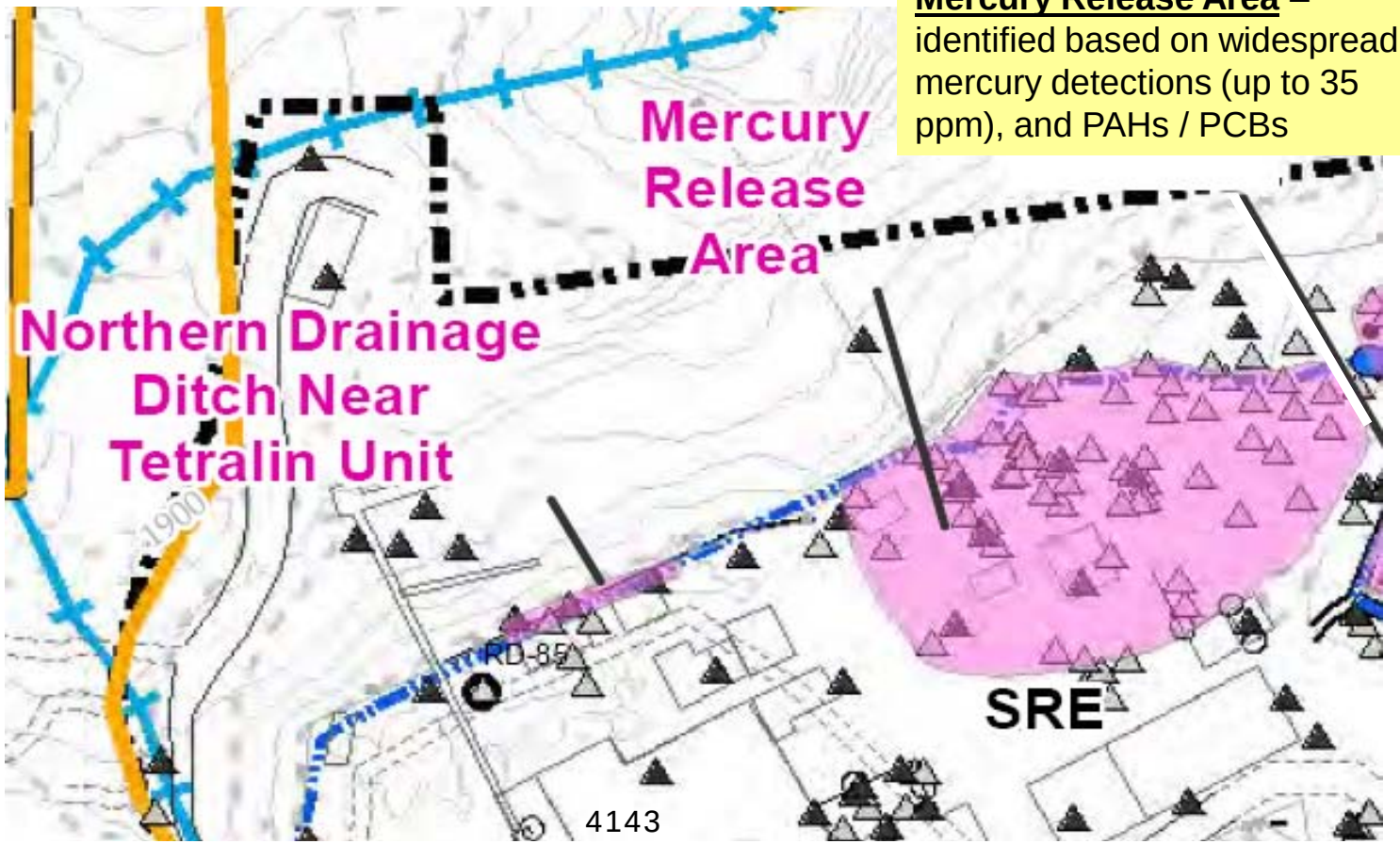
- DTSC and DOE: Review RFI data and historical information on operations to identify “clearly contaminated” areas likely to need remediation producing “blobs” on map
- DOE: Transmit map with these areas to EPA and share with stakeholders at Technical Work Group meetings
- DOE, DTSC, and EPA: Attend Technical Work Group Meetings to understand EPA’s rationale and community concerns for sampling
- DTSC and DOE: Review EPA’s information (gamma scanning results, geophysical results, HSA findings, aerial photo analysis) and Technical Work Group Meeting input to determine co-located chemical sampling needs

19 Clearly Contaminated Areas in HSA 6



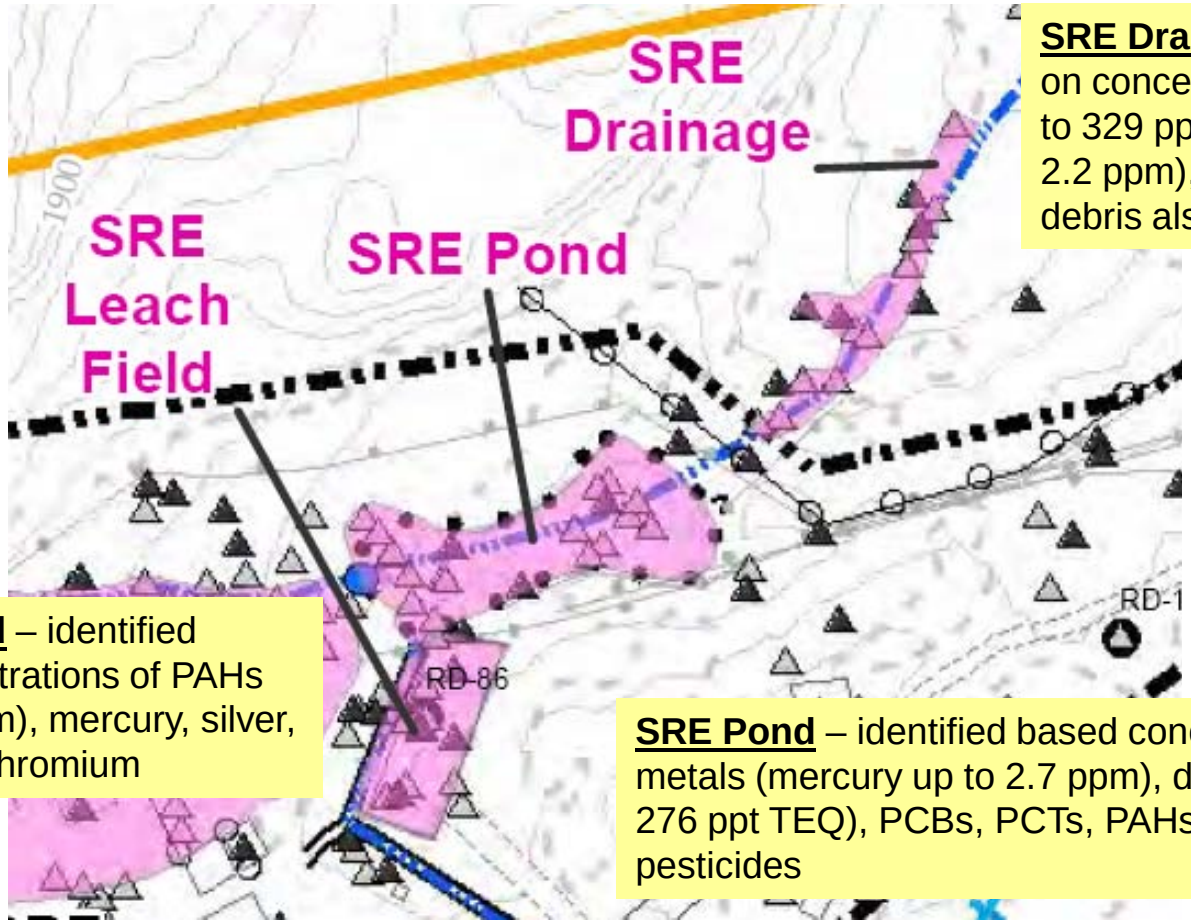
SRE Area

Mercury Release Area – identified based on widespread mercury detections (up to 35 ppm), and PAHs / PCBs



Northern Drainage Ditch Near Tetralin Unit – identified based concentrations of polychlorinated biphenyls (PCBs, up to 167 ppb), polychlorinated terphenyls (PCTs), polyaromatic hydrocarbons (PAHs, up to 424 BaP), and metals (most notably, cobalt and mercury)

SRE Pond Area



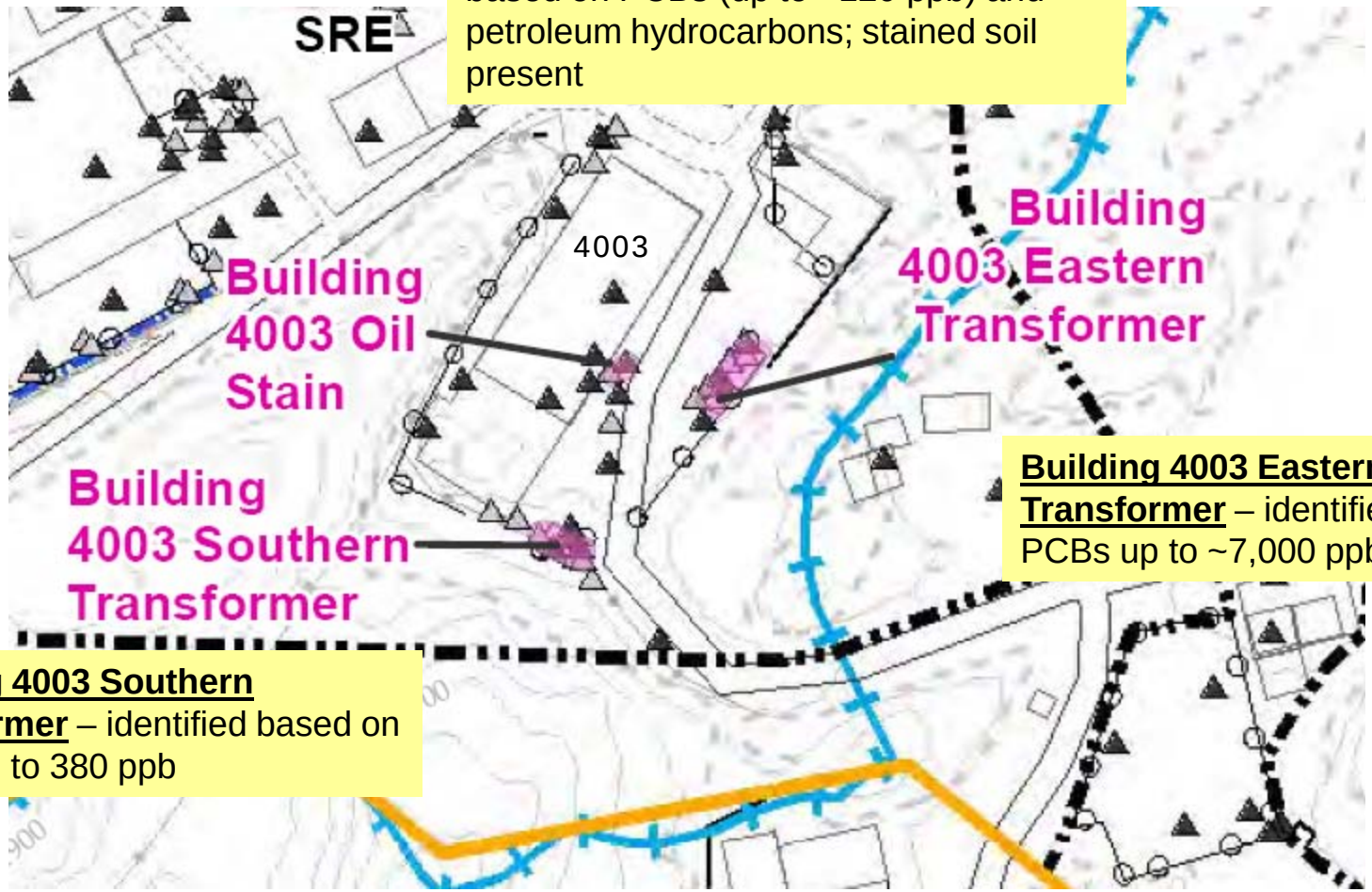
SRE Drainage –identified based on concentrations of dioxins (up to 329 ppt TEQ), mercury up to 2.2 ppm), and PCBs/PAHs; debris also present below dam

SRE Leach Field – identified based on concentrations of PAHs (up to 15,000 ppm), mercury, silver, and hexavalent chromium

SRE Pond – identified based concentrations of metals (mercury up to 2.7 ppm), dioxins (up to 276 ppt TEQ), PCBs, PCTs, PAHs, and pesticides

SRE Building 4003 Area

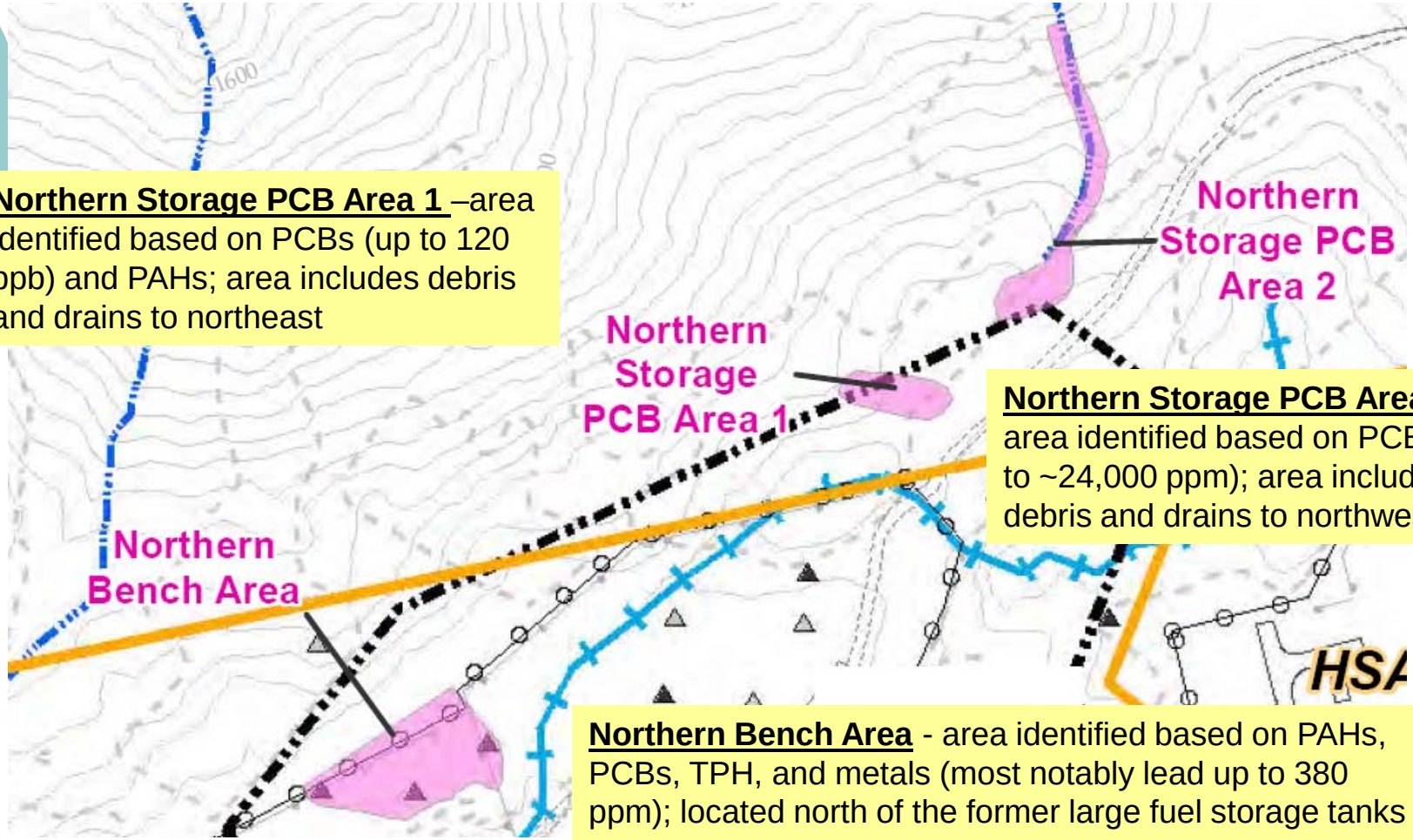
Building 4003 Oil Stain – identified based on PCBs (up to ~120 ppb) and petroleum hydrocarbons; stained soil present



Building 4003 Eastern Transformer – identified based on PCBs up to ~7,000 ppb

Building 4003 Southern Transformer – identified based on PCBs up to 380 ppb

Old Con – Northern Area



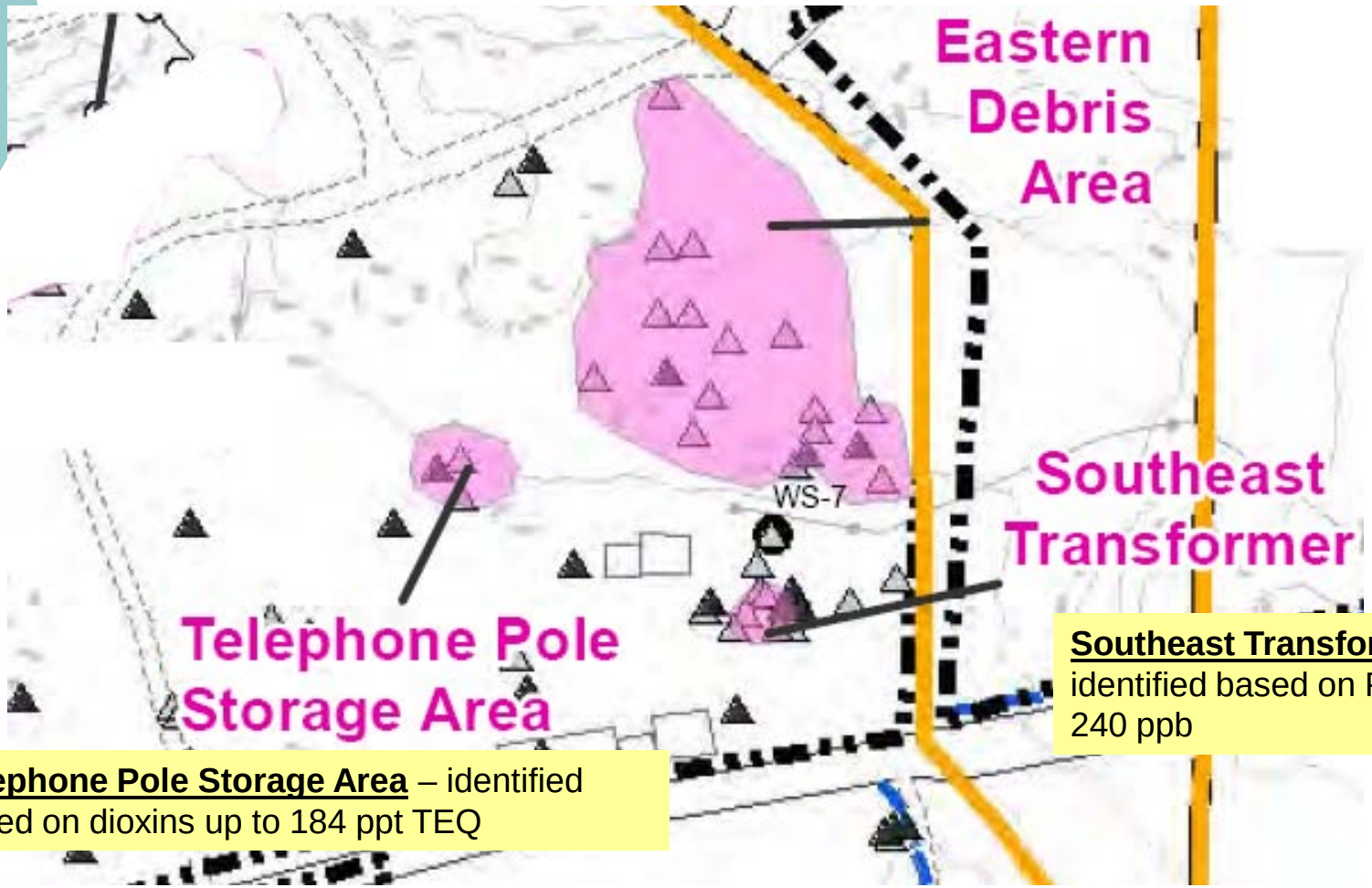
Northern Storage PCB Area 1 –area identified based on PCBs (up to 120 ppb) and PAHs; area includes debris and drains to northeast

Northern Storage PCB Area 2 – area identified based on PCBs up to ~24,000 ppm); area includes debris and drains to northwest

Northern Bench Area - area identified based on PAHs, PCBs, TPH, and metals (most notably lead up to 380 ppm); located north of the former large fuel storage tanks

Old Con – Southeast Area

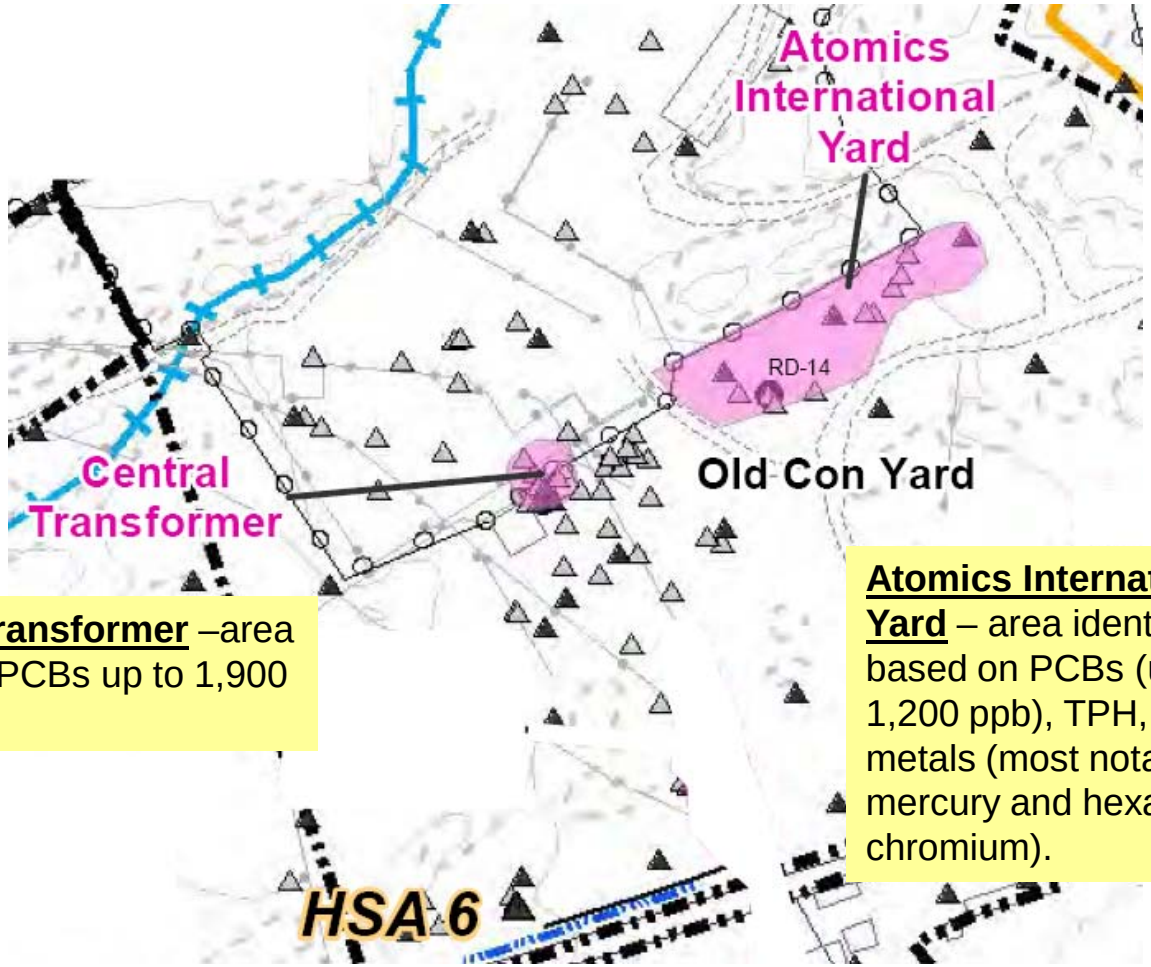
Eastern Debris Area – identified based on dioxins (up to 52 ppt TEQ), metals (most notably, silver, cadmium, and lead), PCBs, and PAHs; area includes debris and burnt materials



Southeast Transformer – identified based on PCBs up to 240 ppb

Telephone Pole Storage Area – identified based on dioxins up to 184 ppt TEQ

Old Con - Central Area

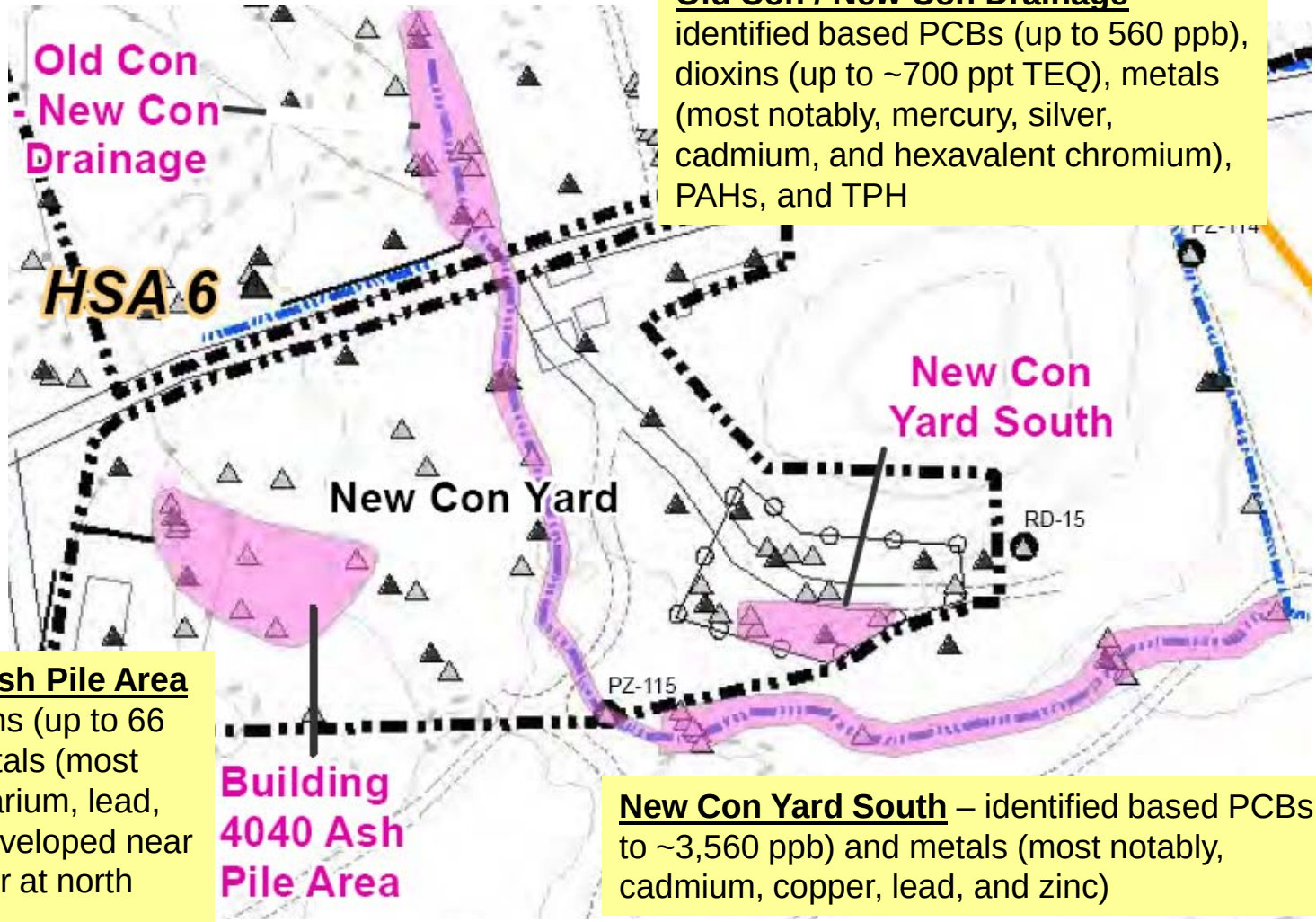


Central Transformer –area based on PCBs up to 1,900 ppb

Atomics International (AI) Yard – area identified based on PCBs (up to 1,200 ppb), TPH, and metals (most notably, mercury and hexavalent chromium).

Old Con / New Con Area

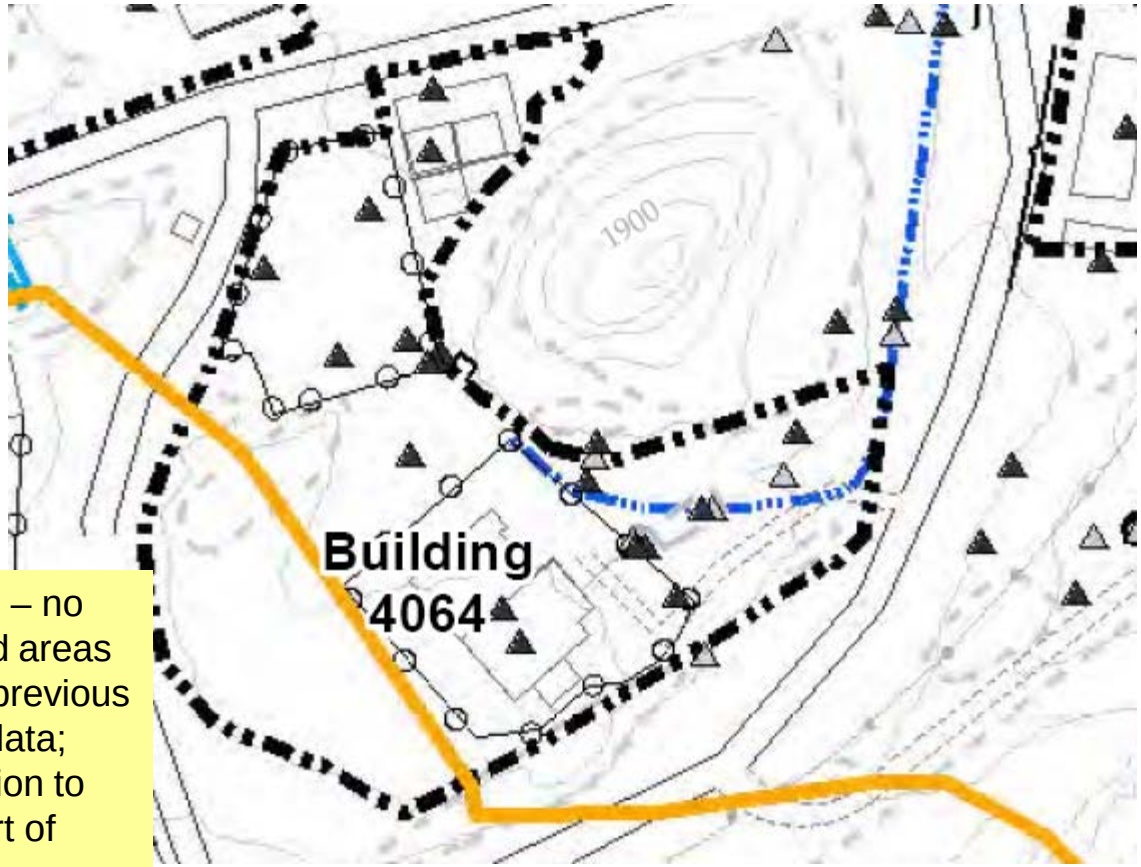
Old Con / New Con Drainage – identified based PCBs (up to 560 ppb), dioxins (up to ~700 ppt TEQ), metals (most notably, mercury, silver, cadmium, and hexavalent chromium), PAHs, and TPH



Building 4040 Ash Pile Area – identified dioxins (up to 66 ppt TEQ and metals (most notably, silver, barium, lead, zinc); ash pile developed near former incinerator at north end of building.

New Con Yard South – identified based PCBs (up to ~3,560 ppb) and metals (most notably, cadmium, copper, lead, and zinc)

Building 4064 Area



<u>Building 4064 Area</u> – no clearly contaminated areas identified based on previous chemical sampling data; additional investigation to be conducted as part of chemical co-located sampling program

HSA 6 Identified Chemical Contamination Areas

Base Map Legend

- Administrative Area Boundary
- Site Boundary
- Existing Building
- Removed Building
- Ponds
- Excavation
- Dirt Road
- A/C Curbing
- Fence
- Pipe
- Leachfield
- NPDES Outfall
- Well
- Drainage
- Surface Water Divide
- Bedrock Outcrop
- Elevation Contour

Figure Legend

- 2010/2011 Chemical Soil Samples
- Previous Chemical Soil Samples
- HSA Boundary
- HSA 6 Identified Chemical Contamination Areas

Acronym List for DTSC/DOE Slides 6-15-11:

AI - Atomics International
BaP - Benzo(a)pyrene
BZ-NE - Buffer Zone Northeast
HSA - Historical Site Assessment
New Con - New Conservation Yard
Old Con - Old Conservation Yard
PAH - polynuclear aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCT - polychlorinated terphenyls
ppb - parts per billion
ppm - parts per million
ppt - parts per trillion
SRE - Sodium Reactor Experiment
TEQ - toxicity equivalency quotient (dioxins)

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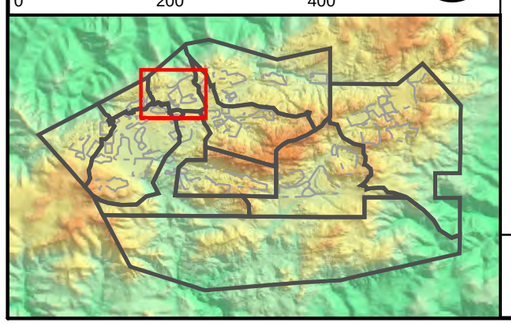
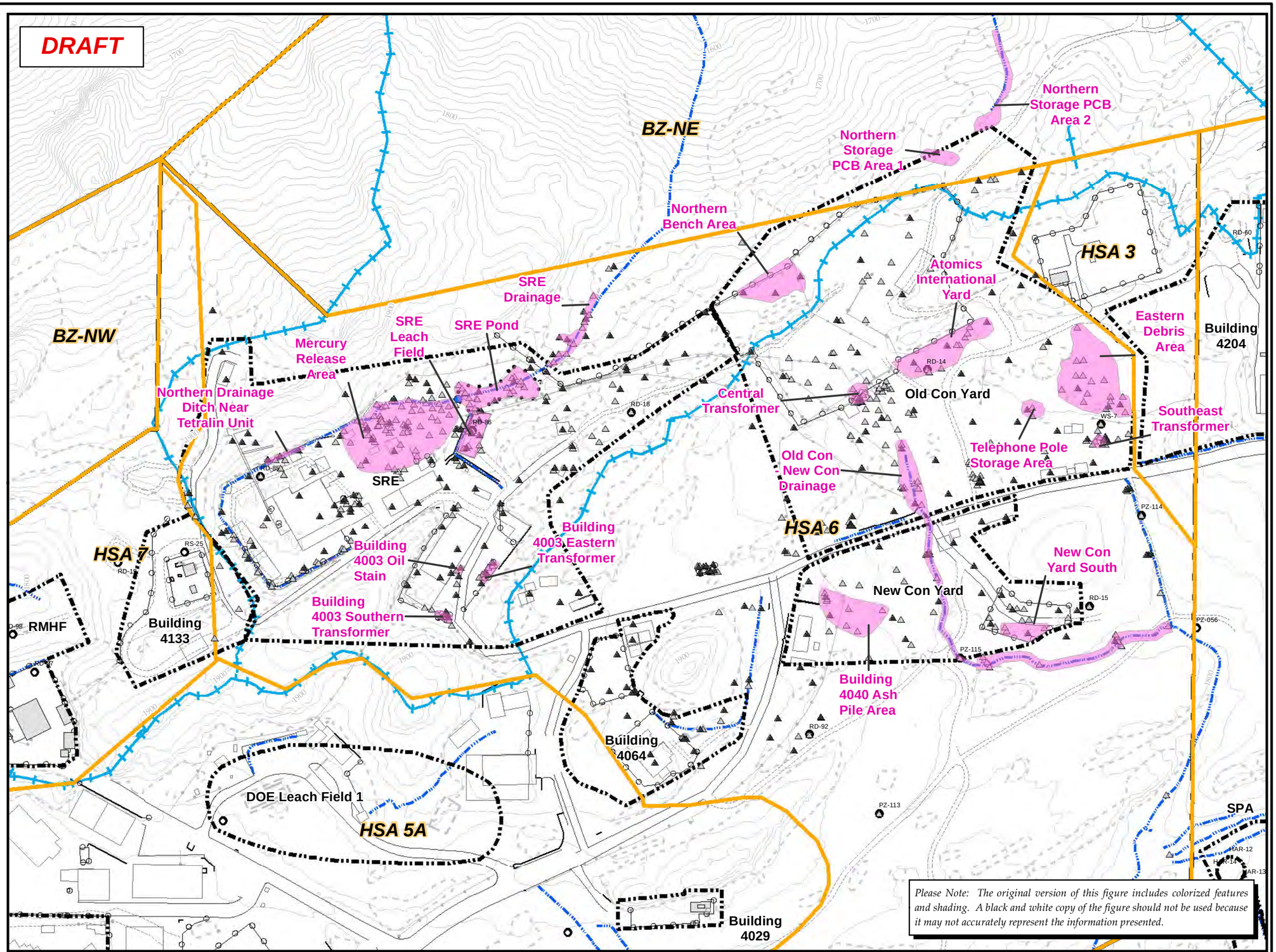
Date: 6/13/2011

1 inch = 200 feet

0 200 400 Feet





Please Note: The original version of this figure includes colorized features and shading. A black and white copy of the figure should not be used because it may not accurately represent the information presented.

MWH

S A N T A S U S A N A F I E L D L A B O R A T O R Y

FIGURE 1