Potential for Offsite Exposures Associated with Contaminants from Santa Susana Field Laboratory

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SSFL Workgroup Meeting
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Limitations

- Conservative assumptions used to estimate some contaminant concentrations and exposures
  - Report characterizes *potential* exposures
  - No conclusions made with regards to *real risks*
  - Results most useful for *prioritizing* future monitoring and remediation efforts

- Report based on data collected *up to 2003*
  - Report characterizes potential exposures *up to 2003*
  - No knowledge of current status of site

OBJECTIVES

TIER I: WHAT WERE THE CONTAMINANTS OF POTENTIAL CONCERN (COCs)?

TIER II: WHAT WERE THE POTENTIAL EXPOSURE PATHWAYS OF CONCERN?

TIER III: WHAT WERE THE HOTSPOTS OF POTENTIAL CONCERN?

METHODOLOGY

Tier I.
Contaminants of Concern (COCs)

SCRAM to rank Contaminants of Potential Concern (COPCs) via Chemical-Specific Properties (Toxicity, Bioaccumulation, Persistence)

Weight SCRAM scores with Air Emissions

Weight SCRAM scores with Number of Positive Detections

Weight SCRAM scores with Health-Based Standards

Tier II.
Exposure Pathways

Estimate Contaminant Concentrations (Monitored and Modeled), Establish Dose Ratios using EPA's RAIS for different pathways & Screen for Pathways with Dose Ratios > 1

Tier III.
Hotspots

Refine Dose Ratios for Areas of Exposure Concern Based on Accessibility and Identify Hotspots

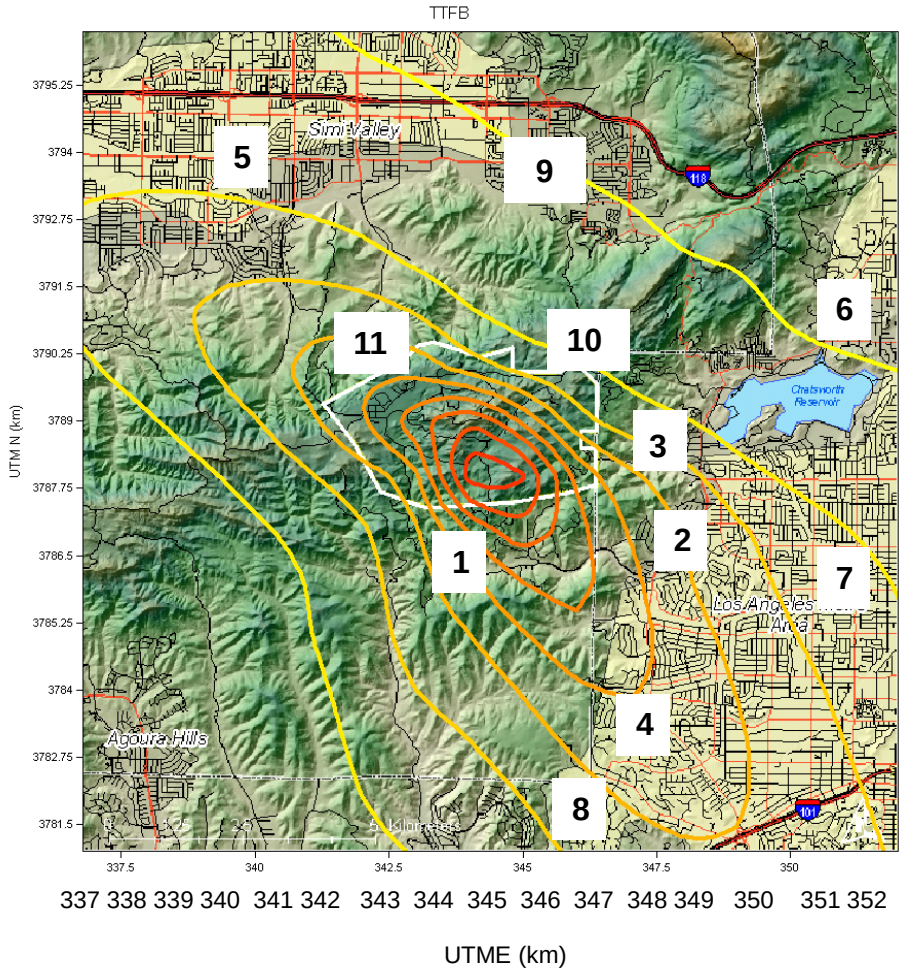
Data Sources

- US Agency for Toxic Substances & Disease Registry (ATSDR)
- US Environmental Protection Agency (EPA)
- US Dept of Energy (DOE)
- US Nuclear Regulatory Commission (NRC)
- US Geological Survey (USGS)
- CA Dept of Toxic Substances Control (DTSC)
- CA Dept of Health Services (DHS)
- CA Office of Environmental Health and Human Affairs (OEHHA)
- Ventura County Air Pollution District (VCAPD)
- LA Regional Water Quality Control Board (RWQCB)
- Southern CA Water Quality Dept
- Washington Mutual Bank
- Atomics International (AI)
- Committee to Bridge the Gap
- Rocketdyne / Boeing Company
- UCLA
- National Research Council
- Oak Ridge Institute
- Rockwell
- Techlaw
- Ogden
- McLaren-Hart
- Montgomery-Watson
- Klinefelder
- ITC
- ICF Kaiser
- Hargis and Associates
- Haley and Aldrich
- GRC
- ERG
- ERD
- ERC
- EG&G
- CH2MHill
- Sonoma Technology
- ABB Environmental

Data Gaps

- Inadequate assessment of vertical & horizontal hydraulic gradients
- Insufficient delineation of extent of groundwater contamination in areas east of facility
- Lack of current well use surveys in areas east, northeast & south of facility
- Inadequate monitoring data for offsite areas east and northeast of facility
- Insufficient long-term (>4 years) historical onsite meteorological data
- Insufficient air monitoring data (historical) for chemicals & radionuclides
- Potential for non-detection of significant concentrations in past monitoring programs due to the detection limits of monitoring devices (1948-1980s)
- Questionable data quality

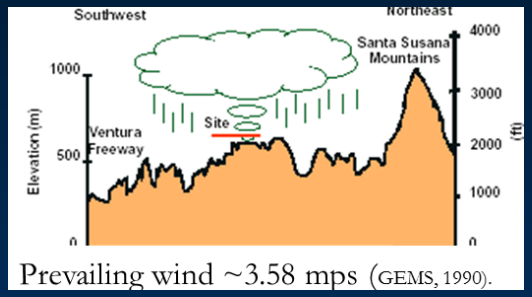
Location of Receptor Communities used in Exposure Analysis



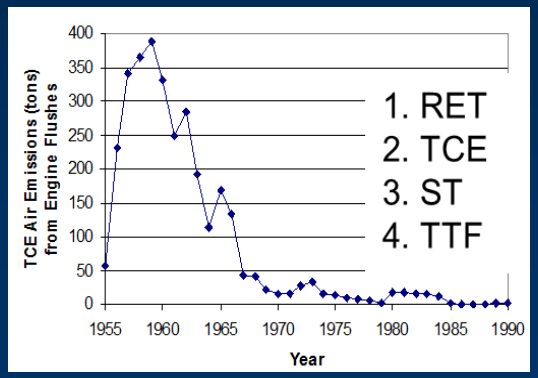
COMMUNITIES

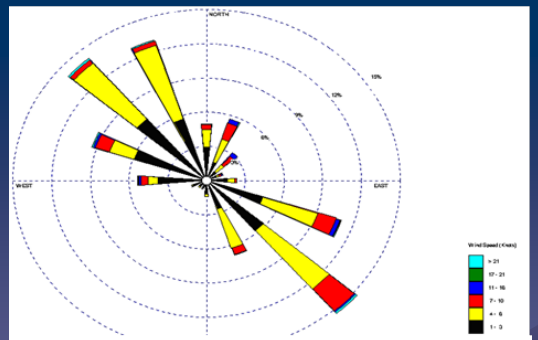
1. Bell Canyon
2. West Hills
3. Dayton Canyon
4. Woodland Hills
5. Simi Valley
6. Chatsworth
7. Canoga Park
8. Hidden Hills
9. Santa Susana Knolls
10. Sage Ranch / Woolsey Canyon
11. Brandeis-Bardin Inst.

Air Dispersion Modeling



Prevailing wind ~3.58 mps (GEMS, 1990).




Wind Rose Plot of Surface Wind Data
SSFL Area IV: All Hours (Day); 94-97

- Emissions from rocket engine testing & flushing, storage tanks, groundwater stripping towers & open-pit burning of waste were analyzed
- Radionuclide emissions were not evaluated via air dispersion due to the lack of data
- Limitations included incomplete reporting of chemical usage, site activities and accidental discharges and emissions.

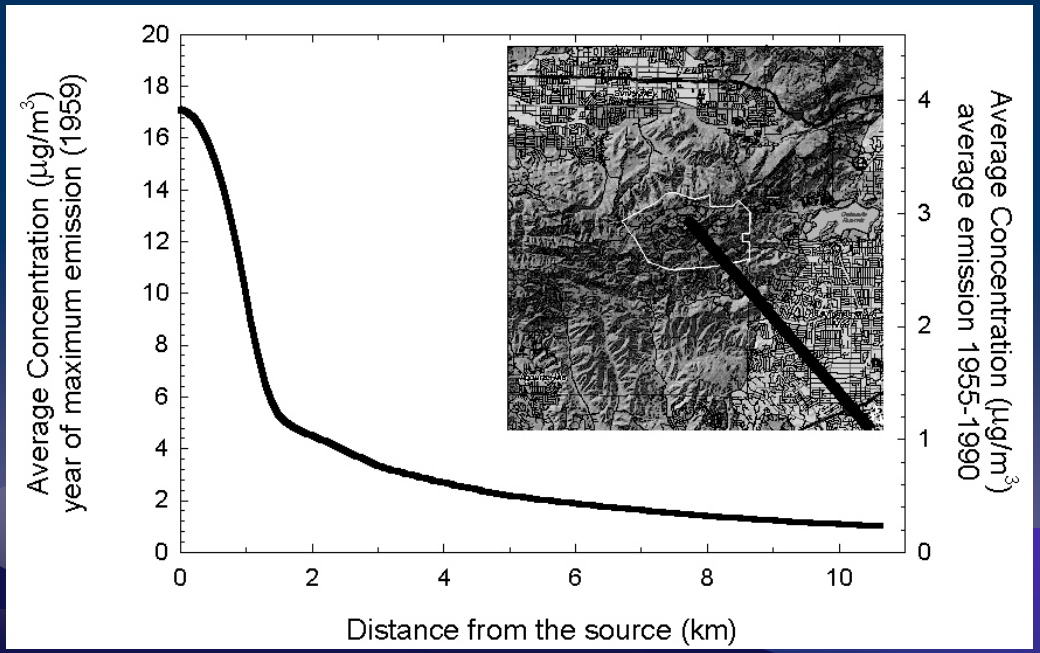
CONTAMINANTS ANALYZED FOR EMISSIONS (1940s-2002)

Organics
Benzene
1,3-butadiene
Hydrazine
TCA—methyl chloroform
TCE—trichloroethylene
Toluene
Xylene

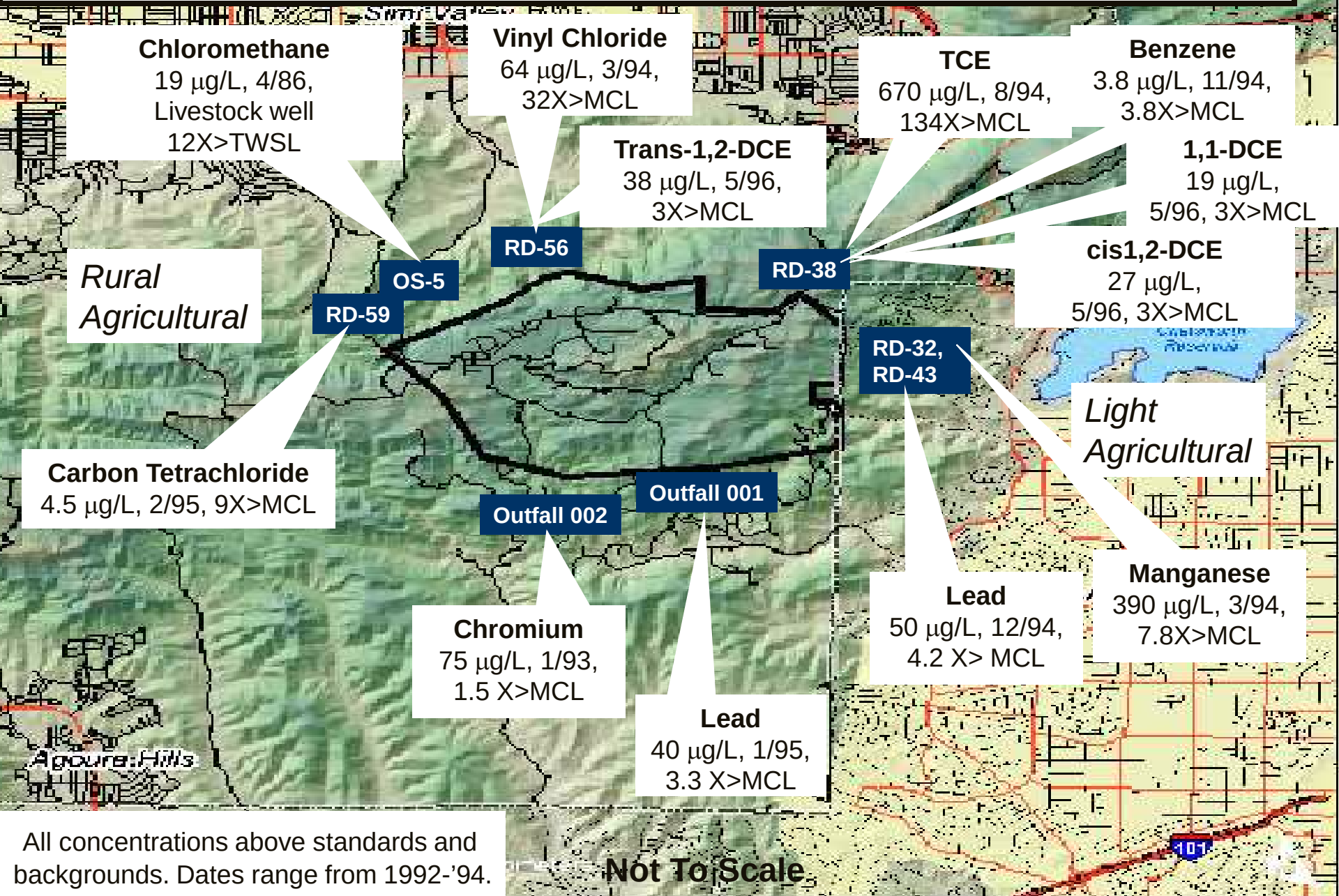
Metals
Arsenic
Beryllium
Cadmium
Chromium
Lead
Manganese

Air Pathway Results

- Largest source of toxic organic emissions
  - Use of TCE for cleaning of rocket engines
- Largest source of toxic metal emissions
  - Rocket engine exhaust
- Wind mostly from Northeast (11am-8pm; '94-'97)
  - Greatest impact may have been to southeast
- Estimated air concentrations did not consider atmospheric degradation or dry or wet deposition

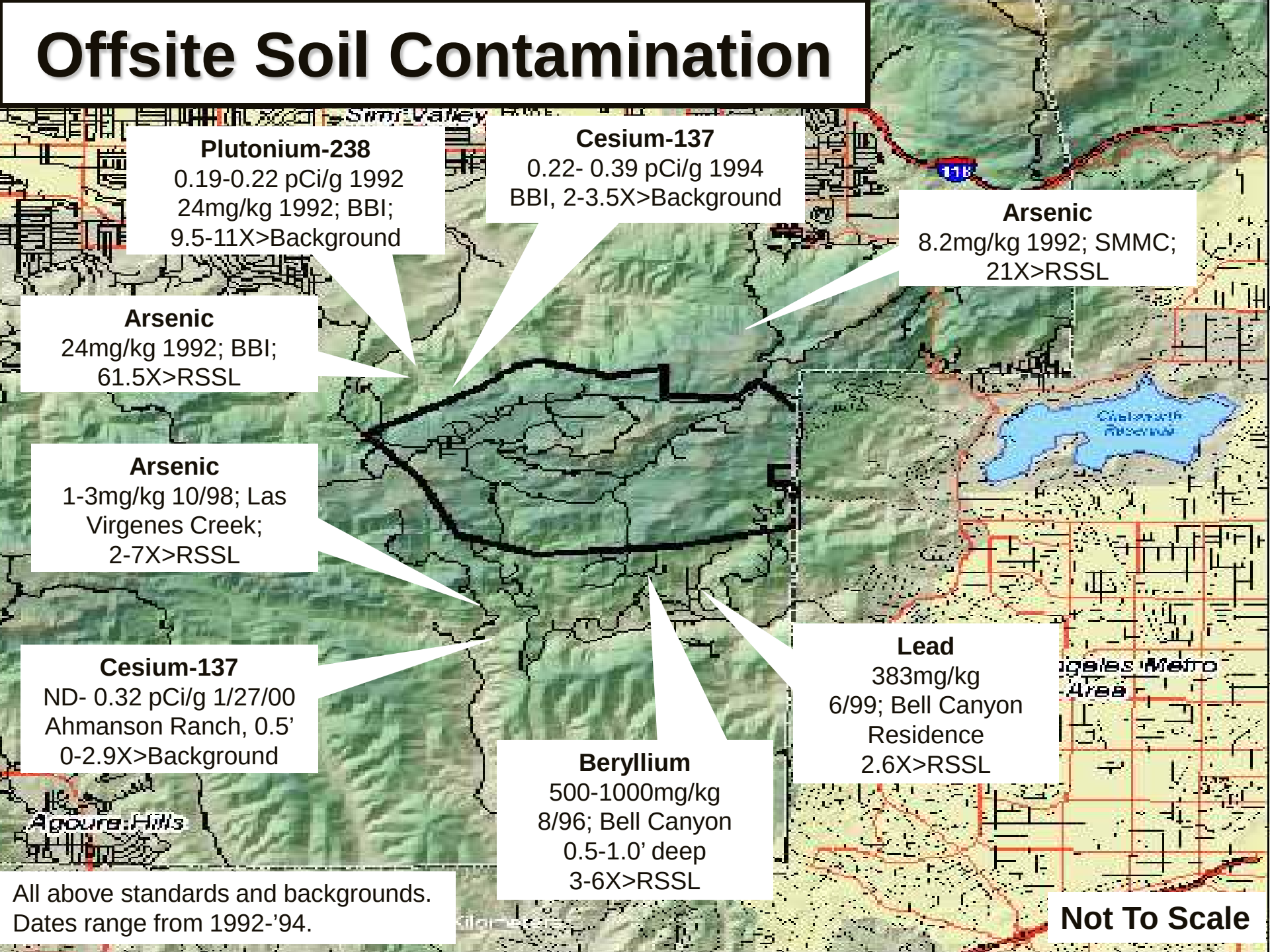


Offsite Wells or Spring Contamination



All concentrations above standards and backgrounds. Dates range from 1992-'94.

Offsite Soil Contamination



Plutonium-238
0.19-0.22 pCi/g 1992
24mg/kg 1992; BBI;
9.5-11X>Background

Cesium-137
0.22- 0.39 pCi/g 1994
BBI, 2-3.5X>Background

Arsenic
8.2mg/kg 1992; SMMC;
21X>RSSL

Arsenic
24mg/kg 1992; BBI;
61.5X>RSSL

Arsenic
1-3mg/kg 10/98; Las
Virgenes Creek;
2-7X>RSSL

Cesium-137
ND- 0.32 pCi/g 1/27/00
Ahmanson Ranch, 0.5'
0-2.9X>Background

Lead
383mg/kg
6/99; Bell Canyon
Residence
2.6X>RSSL

Beryllium
500-1000mg/kg
8/96; Bell Canyon
0.5-1.0' deep
3-6X>RSSL

All above standards and backgrounds.
Dates range from 1992-'94.

Not To Scale

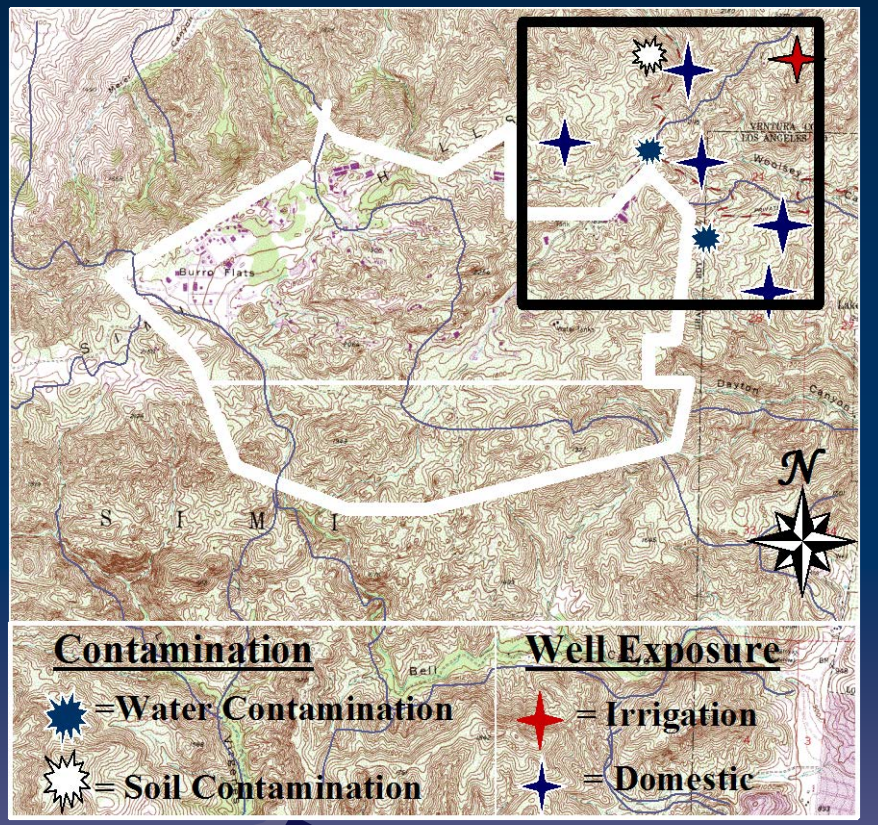
Exposure Assessment

- Due to significant data gaps absolute exposures and health risks could not be determined
  - Conservative exposure assumptions and maximum site-specific contaminant concentrations were used to develop an upper exposure range
  - Results were used to rank and prioritize areas of potential concern for the purpose of future monitoring and review
- Field visits were conducted to identify potential exposure pathways
  - For example, contaminants may have migrated from Dayton Creek through Orcutt Ranch which is used to grow community vegetables
  - Contaminants may have migrated from Bell Creek through Bell Canyon which is accessible to children and hikers
- Exposure scenarios considered: residential, occupational & recreational use
  - Transport routes considered: surface water flow/runoff; groundwater transport; air dispersion
  - Exposures routes considered: direct and secondary ingestion, inhalation, dermal contact

TCE DOSE RATIOS for Worst Case Scenarios

Exposure to Contaminated Groundwater

Chemical	Exposure Pathway	Dose Ratio[a]
TCE **Detected in groundwater** ***(.01 - .9 mg/L)*** ***TCE $_{MCL}$=.005 mg/L***	Inhalation	~200 - 20,000
	Ingestion	~50 – 4000
	Vegetable Ingestion	~40 – 4000
	Dermal Contact	~10 - 1000



[a] – order of magnitude ranges

MCL "Maximum contaminant level" drinking water standard

NOTE: Groundwater is a potable water source; Avg. lifetime dose range: 1.2×10^{-4} - 1.1×10^{-2} mg/kg-d.

Dose Ratios for Worst Case Scenarios of Exposure to Contaminated Groundwater

Chemical Concentration	Locale	Media /Year of Detection	Pathway	Exposure Scenario		
				Recreational	Occupational	Residential
				Dose Ratio	Dose Ratio	Dose Ratio
TCE (10- 900 µg/L)	North-east	Groundwater 1994	Ingestion	0 - 14	10 – 1100	48 – 4200
			Inhalation	-	-	230 - 21,000
			Dermal	-	-	12 – 1000
			Veg. Ing.	-	-	44 - 4000
Vinyl Chloride (64 µg/L)	North-east	Groundwater 1994	Ingestion	3	270	1100
			Inhalation	-	-	120
			Dermal	-	-	29
1,1-DCE (19 µg/L)	North-east	Groundwater 1996	Ingestion	-	23	89
			Inhalation	-	-	200
			Dermal	-	-	5
			Veg. Ing.	-	-	20

Inhalation Dose Ratios (DR) for Worst Case Scenarios

Location	DR[a] - TCE	Location	DR - Hydrazine & Derivative[b]
West Hills	19-67	Bell Canyon	3-38
Bell Canyon	14-55	West Hills	2-15
Dayton Canyon	16-53	Dayton Canyon	3-13
Simi Valley	14-44	Woodland Hills	<9
Santa Susana Knolls	5-15	Canoga Park	<7
Canoga Park	4-14	Simi Valley	<4
Chatsworth	4-12	Hidden Hills	<3
Woodland Hills	3-10		
Hidden Hills	2-8		

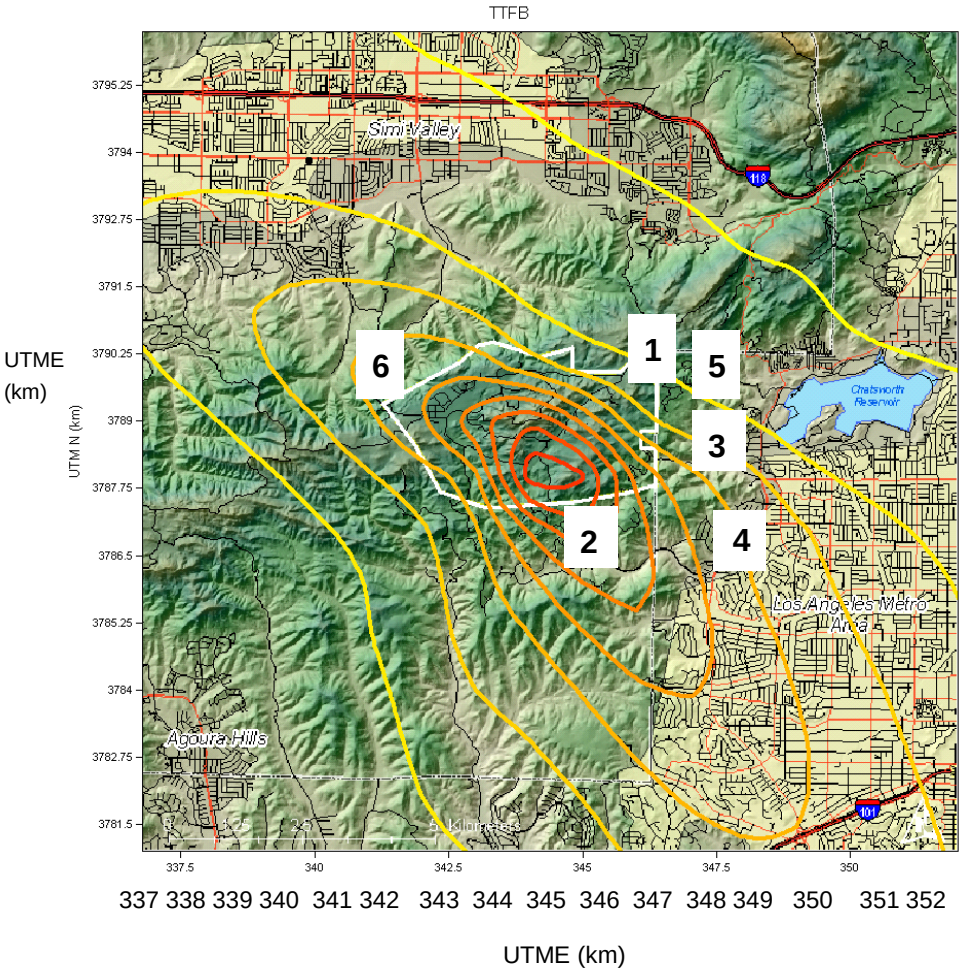
Dose ratio (DR) = (Lifetime average daily dose) / (Acceptable lifetime daily dose; ALADD).

Notes:

a. DRs are based on 1953–2004 air emission estimates; max receptor concentrations derived from dispersion models; and lifetime exposure scenarios for an adult male. The ALADDs to which exposure doses are compared are based on EPA's Chronic Inhalation Cancer Slope Factor (for 1×10^{-6} cancer risk).

b. Hydrazine derivatives include hydrazine, and UDMH (unsymmetrical-dimethylhydrazine).

Potential Offsite Hotspots



Potential "Hot Spot"

Area where:

i. contaminant levels exceed health-based standards;
ii. exposure is possible;
iii. exposure could result in an adverse health effect at the levels detected.

Potential Hotspots

1. Northeast Quadrant
2. Bell Canyon
3. Dayton Canyon
4. West Hills
5. Woolsey Canyon
6. Northwest Quadrant

Ranking of Exposure Pathways of Potential Concern

1. Exposure to groundwater contaminants from private wells or gardens north and east of facility
   a) COPCs: TCE; vinyl chloride; 1,1-DCE
   b) Health effects: cancers of the liver, lung, bladder, kidney, biliary tract and skin; non-Hodgkin's lymphoma; liver, kidney, and nervous system toxicity; peripheral neuropathy; anemia; skin diseases.

2. Exposure to soil south, north and east of facility
   a) COPCs: arsenic, lead
   b) Health effects: nausea, abdominal pain, diarrhea, cramps; constipation, headache, fatigue, neurodevelopmental effects

3. Exposure to air contaminants (early '50s to early '80s)
   a) COPCs: TCE, hydrazine (and oxidation products like NDMA)
   b) Health effects (hydrazine): Cancer of lung, liver, mammary gland, nose; kidney and liver damage

RECOMMENDATIONS

- Areas to monitor
  - Dayton & Woolsey Canyons, Meier & Runckle Canyons, Bell Canyon campgrounds & playgrounds, Bell Creek, Dayton Canyon & Creek, Orcutt Ranch, Santa Monica Mountains Conservancy/Sage Ranch, Black Canyon, West Hills, & Brandeis-Bardin Institute campground & garden
- Contaminants to monitor
  - Perchlorate, beryllium, chromium, NDMA, PCDD/PCDFs, mercury, PCBs, asbestos, arsenic, lead, TCE, DCE & radionuclides
- Conduct well-use survey for areas NE & E of SSFL (within 1 km) to assess private well use & contamination
- Municipal water supply companies using wells in Ventura & LA Counties (within 3 miles of site) should monitor perchlorate, NDMA, 1,4-dioxane & chromium
- Onsite unrestricted SSFL land use not recommended

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Disclaimer: *Any opinions expressed today are the sole opinions of the presenter and do not express the opinions of UCLA , LSU or ATSDR*


SSFL Site Boundary
Santa Susana Knolls
Simi Valley
Santa Susana Pass Road
Brandeis-Bardin Institute
Black Canyon
Box Canyon Road
Box Canyon
Mountain Recreation Conservancy Authority
Plummer Street
Woolsey Canyon Road
Chatsworth Reservo
NASA AREA II
BOEING AREA I
Valley Circle Blvd.
Rocketdyne Boulevard
Runkle Canyon
Dayton Canyon
Los Angeles
SSFL Site Boundary
Bell Canyon