

Santa Susana Field Laboratory: Exposure Pathways and Community Exposures



Study Progress and Future Plans
August 19, 2003

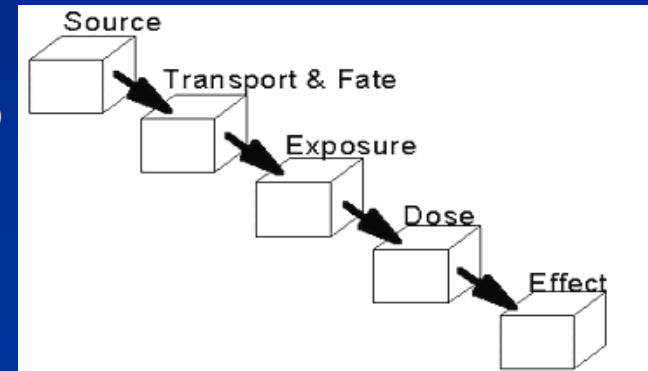
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Presented at the UCLA/SSFL Public Meeting
August 19, 2003
Grand Vista Hotel
Simi Valley, CA

SPECIFIC OBJECTIVES

1. Identify and rank SSFL contaminants of potential concern (COPCs).

- Review monitoring studies, inventory and waste reports, treatment logs, EPA / DHS site-inspection reports, land use permits, and well use surveys
- Assess toxicity and persistence of COPCs
- Compare and rank COPCs based on persistence, bioaccumulation, mobility, and toxicity
 - Compare Monitoring Data with Health-Based Concentration Limits:
 - Water: EPA Maximum Contaminant Limits (MCLs), Tap Water Screening Levels (TWSLs)
 - Soil: EPA Soil Screening Levels (SSLs)
 - Air: National Ambient Air Quality Standards (NAAQS)
 - Radionuclides: Nuclear Regulatory Commission (NRC) regulations



2. Determine potential exposure pathways.

- Identify potential exposure “hot-spots” locations from monitoring data, models, well use surveys and land permits.
- Estimate concentrations at receptor sites based on models (e.g., air dispersion, groundwater, multimedia) along with monitoring data (concentrations & emissions)

Partial List of the Contaminants Reviewed

Acetaldehyde	Chromium-total	Fluorine	NMA	PCE
Acetone	Chromium VI	Gamma radiation	4-Nitrophenol	1,1,1-TCA
Acenaphthalene	Chrysene	Heptachlor	2-Nitrophenol	TCE
Acrolein	Cobalt-60	HMX	PAHs	Tetraethyl lead
Acrylonitrile	Copper	Hydrazine	PCBs	Thallium
Alpha particles	Cyanide	Iodine-131	PCDD	Thorium
Aluminum	1,1-DCA	Iron-55	PCDF	Toluene
Anthrocene	1,2-DCA	Kerosene	Perchloric acid	Toxaphene
Arsenic	1,1-DCE	Lead	Perchloroethylene	1,2,4-TCB
Asbestos	Cis-1,2-DCE	Manganese	Plutonium	1,2,3-TCB
Benz(a)anthracene	Trans-1,2-DCE	Mercury	PM2.5	Tritium (H-3)
Benzo(a)pyrene	Dibenzofuran	Methoxychlor	PM10	Total TCDD-TEQ
Benzene	Dibenz(a,h)anthracene	Methylene chloride	Potassium-40	2,3,7,8-TCDD
DEHP	Di(2-ethylhexyl)phthalate	MMH	Pyrene	1,1-UDMH
Beryllium	2-Dimethyl hydrazine	Methylnaphthalene	Radium 226, 228	Uranium
Beta particles	1,4-Dioxane	4-Methylphenol	RDX	Vanadium
1,3-Butadiene	1,2,5,6-Dibenzoanthracene	Methyl bromide	Selenium	Vinyl chloride
Cadmium	Di-n-butylphthalate	Methyl chloride	Silver	VOCs
Carbon Tetrachloride	Di-n-octylphthalate	Napthalene	Silvex (2,4,5-TP)	Xylene
Cesium-137	Dimethylphthalate	Nickel	Strontium-90	Xenon-131
Chlorine pentafluoride	Diethylphthalate	Nitrogen tetroxide	Styrene	Zinc
Chlorine trifluoride	1,2-Diphenylhydrazine	NDMA	Sulfates	Zirconium-95, -97
Chloroform	Ethion	NDPA	1,1,1,1-Tetrachloroethane	
Chloromethane	Ethylbenzene	Zirconium-95, -97	1, 1, 2, 2-Tetrachloroethane	

CHEMICAL SCORING AND RANKING ASSESSMENT MODEL

Bioconcentration: Vegetation, Animal

Environmental Persistence: Biota, Sediment, Soil, Water, Air

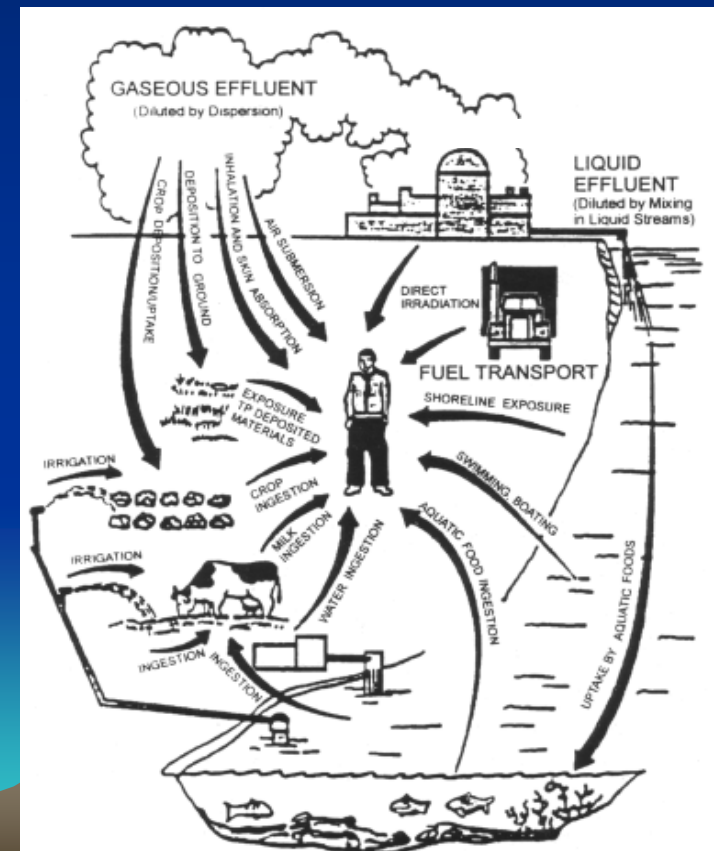
Acute Toxicity: Terrestrial - plants, mammals, herps, birds, invertebrates

Aquatic- plants, amphibians, warm and cold water fish, invertebrates

Chronic Toxicity: Terrestrial/ Aquatic

Organ / System Effects:

General, Reproductive, Developmental, Mutagenicity, Carcinogenicity, Behavioral, Immune, & Endocrine Effects



Source: DOE, 2003.

Preliminary Ranking of Non-Radionuclides Associated with SSFL

Chemical	Chemical Score	Uncertainty Score	Composite Score	Rank
PCBs	53	8	61	1
Hydrazine	27	19	46	2
TCE	22	16	38	3
Benzene	19	17	36	4
Beryllium	23	12	35	5
Bis(2ethylhexyl)phthalate (DEHP)	26	8	34	6
Nitrosodimethylamine (NDMA)	13	20	33	7
Perchlorate	8	24	32	8
Carbon Tetrachloride	18	12	30	9
Arsenic	8	24	39	10

* Based just on chemical properties- to be weighted by emissions.

Some Chemicals of Concern (COCs)

- Hydrazine** - Used in rocket engine fuel, 1955-present
- Dominant fate is NDMA, a probable carcinogen
 - NDMA found onsite in soil
 - Can migrate via air

- Perchlorate** - Used in solid rocket engine fuel, 1960s
- Very persistent
 - Found in groundwater in 2000-'01
 - Can migrate via water

- Beryllium** - Used in rocket engine fuel, 1962-1967
- Can Bioaccumulate
 - Found in air in 1964-1969
 - Can migrate via air



Source: Boeing, 2003.

Source: EPA, 2003.

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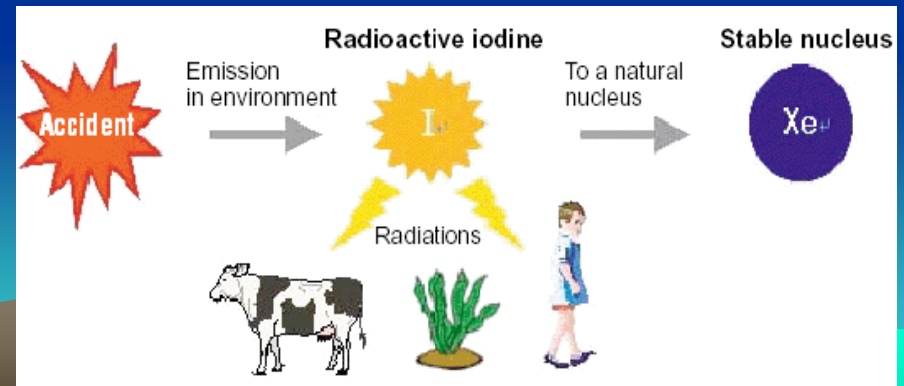
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 - Can migrate via air

- Iodine-131** - Forms from uranium and plutonium (nuclear reactor fuel)
- Not monitored for (8 day half-life)
 - Can cause thyroid nodules, cancer, and Grave's disease



Source: Boeing, 2003.



Source: EPA, 2003.

Potential Exposure Pathways

PATHWAY	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	MEDIA	CHEMICALS OF POTENTIAL CONCERN	ROUTES OF EXPOSURE	EXPOSED POPULATIONS	
1	Air Stripping	Air	Radioactivity, Metals, Beryllium	Inhalation, Skin Contact, Particle Ingestion	Brandeis-Bardin Institute, Santa Monica Mountains Conservancy, Sage Ranch, Simi Valley, Santa Susana Knolls, West Hills, Bell Canyon, Canoga Park	1987-present
2	Thermal Treatment (Burning)	Air	Hydrazines, TCE, Perchlorate, Dioxins, Dibenzofurans, Beryllium, Mixtures of Fuels/ Solvents/Explosives	Inhalation, Skin Contact, Particle Ingestion	Brandeis-Bardin Institute, Santa Monica Mountains Conservancy, Sage Ranch, Simi Valley, Santa Susana Knolls, West Hills, Bell Canyon, Canoga Park	1958-1990
3	Rocket Engine Testing	Air	Hydrazines, TCE, Perchlorate, Beryllium, Metallic Oxide Particulates, PAHs, VOCs, Dioxins, Dibenzofurans	Inhalation, Skin Contact, Particle Ingestion	Brandeis-Bardin Institute, Santa Monica Mountains Conservancy, Sage Ranch, Simi Valley, Santa Susana Knolls, West Hills, Bell Canyon, Canoga Park	1948- present
4	Spills/ Accidents	Air	Radioactivity, TCE, Metals, Hydrazines, Perchlorate, Beryllium, Solvents, Asbestos	Inhalation, Skin Contact, Particle Ingestion	Brandeis-Bardin Institute, Santa Monica Mountains Conservancy, Sage Ranch, Simi Valley, Santa Susana Knolls, West Hills, Bell Canyon, Canoga Park	1948-present

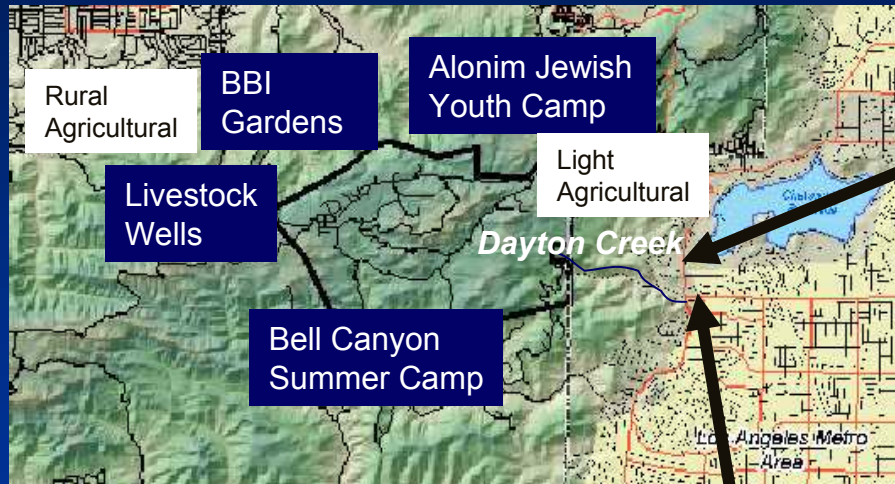
Potential Exposure Pathways

PATH-WAY	EXPOSURE PATHWAY ELEMENTS					TIME
	SOURCE	MEDIA	CHEMICALS OF POTENTIAL CONCERN	ROUTES OF EXPOSURE	EXPOSED POPULATIONS	
5	Chemical Storage (Unlined Ponds/Canals and Spills/Leaks), and NPDES Outfalls	Ground-water (Private Wells/ Supply Wells)	Radioactivity, TCE, Metals, Hydrazines, Perchlorate, Beryllium, VOCS, Solvents, PCBs, Dioxins, PAHS, Dibenzofurans, Asbestos, Arsenic	Ingestion, Inhalation, Skin Contact, Bioconcentration	Brandeis-Bardin Institute, Santa Monica Mountains Conservancy, Sage Ranch, Simi Valley, Santa Susana Knolls, Chatsworth, Ahmanson Ranch, Bell Canyon, West Hills, Canoga Park, Woolsey Canyon, Dayton Canyon, Russel Valley, Woodland Hills, Northridge	1948-present
6	Chemical Storage (Spills/Leaks) and NPDES Outfalls	Ground-water to Surface Water (Springs)	Radioactivity, TCE, Metals, Hydrazines, Perchlorate, Beryllium, VOCS, Solvents, PCBs, Dioxins, PAHS, Dibenzofurans, Asbestos, Arsenic	Ingestion, Inhalation, Skin Contact, Bioconcentration	Brandeis-Bardin Institute, Santa Monica Mountains Conservancy, Sage Ranch, Simi Valley, Santa Susana Knolls, Chatsworth, Ahmanson Ranch, Bell Canyon, West Hills, Canoga Park, Woolsey Canyon, Dayton Canyon, Russel Valley, Woodland Hills, Northridge	1948-present
7	Chemical Storage (Spills/Leaks) NPDES Outfalls, and Air/Water Deposition	Surface Soil/ Sediment	Radioactivity, Beryllium, PAHs, Dioxins, PCBs, Dibenzofurans, Asbestos, Arsenic	Inhalation, Skin Contact, Particle Ingestion, Bioconcentration	Brandeis-Bardin Institute, Santa Monica Mountains Conservancy, Simi Valley, Sage Ranch, Santa Susana Knolls, Chatsworth, Ahmanson Ranch, Bell Canyon, West Hills, Canoga Park, Woolsey Canyon, Dayton Canyon, Russel Valley, Woodland Hills, Northridge	1948-present

Is Contaminated Groundwater an Issue of Concern?

“42 privately-owned water wells within 1 mile of SSFL. Most of these wells used for livestock; 7 known to have been used, or are being used for drinking water; 1 was used for lawn irrigation.”

GRC '95, '98.

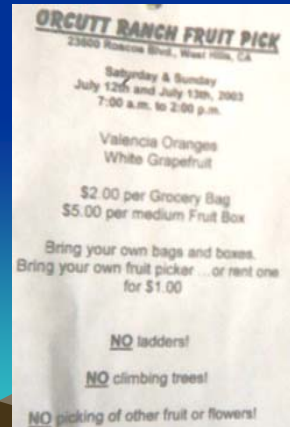


Kids play in waterways in West Hills.

“It was discovered that livestock from the neighboring property had been entering the RD facility through a break in the fence located by the sampling basin for outfall 006. This situation existed for approximately three weeks.”

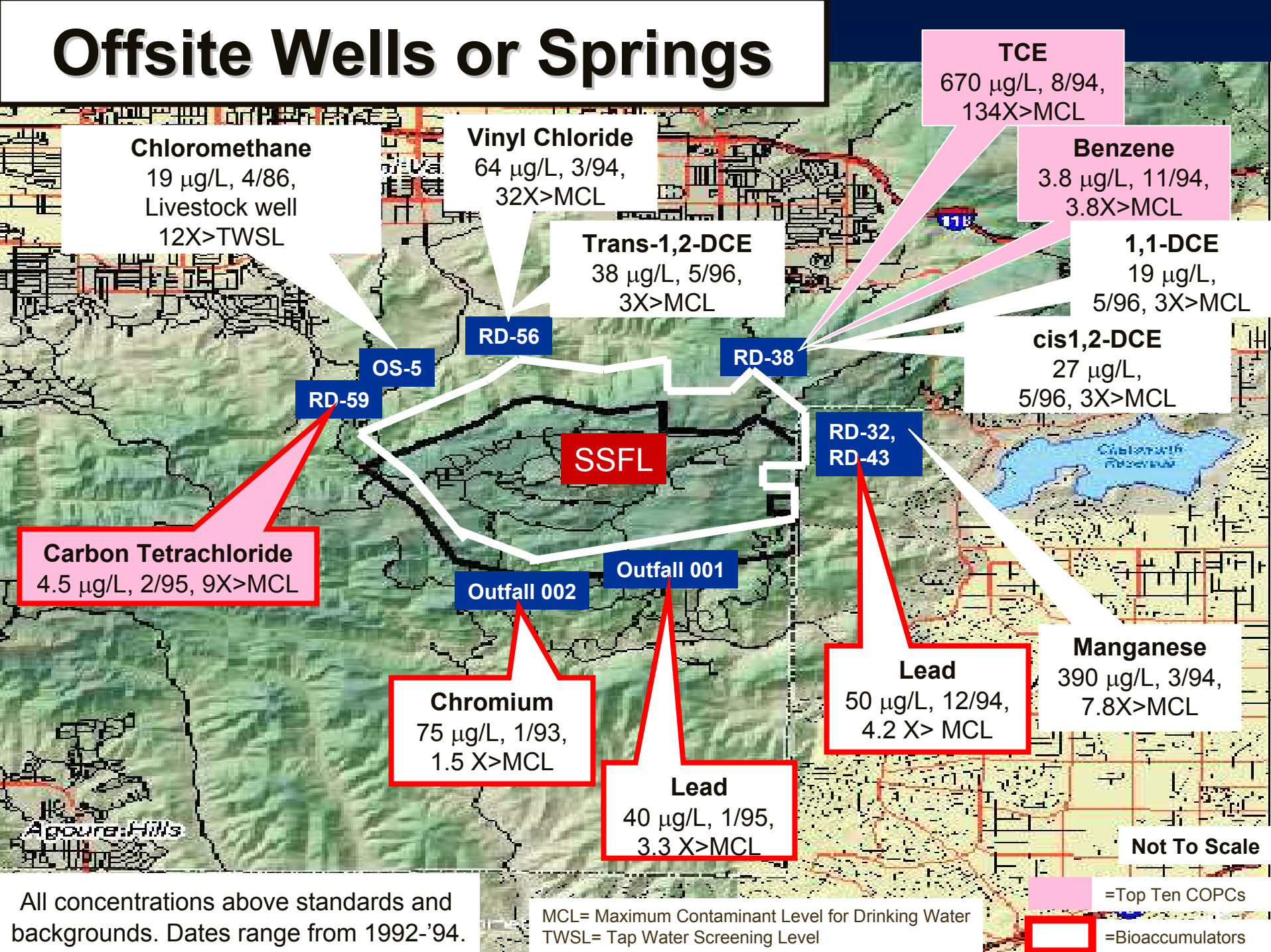
Rocketdyne NPDES Annual Rep, Feb 28, 1997

ORCUTT RANCH



Dayton Canyon Creek runs from SSFL through Orcutt Ranch.

Offsite Wells or Springs



Chloromethane

19 $\mu\text{g/L}$, 4/86,
Livestock well
12X>TWSL

Vinyl Chloride

64 $\mu\text{g/L}$, 3/94,
32X>MCL

Trans-1,2-DCE

38 $\mu\text{g/L}$, 5/96,
3X>MCL

TCE

670 $\mu\text{g/L}$, 8/94,
134X>MCL

Benzene

3.8 $\mu\text{g/L}$, 11/94,
3.8X>MCL

1,1-DCE

19 $\mu\text{g/L}$,
5/96, 3X>MCL

cis-1,2-DCE

27 $\mu\text{g/L}$,
5/96, 3X>MCL

SSFL

Carbon Tetrachloride

4.5 $\mu\text{g/L}$, 2/95, 9X>MCL

Outfall 002

Outfall 001

Chromium

75 $\mu\text{g/L}$, 1/93,
1.5 X>MCL

Lead

40 $\mu\text{g/L}$, 1/95,
3.3 X>MCL

Lead

50 $\mu\text{g/L}$, 12/94,
4.2 X>MCL

Manganese

390 $\mu\text{g/L}$, 3/94,
7.8X>MCL

Not To Scale

 =Top Ten COPCs

 =Bioaccumulators

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

MCL= Maximum Contaminant Level for Drinking Water
TWSL= Tap Water Screening Level

Offsite Soil Contamination

Plutonium-238
0.19-0.22 pCi/g, 1992
BBI, 9.5-11X>Background

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

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

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

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

SSFL

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

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

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

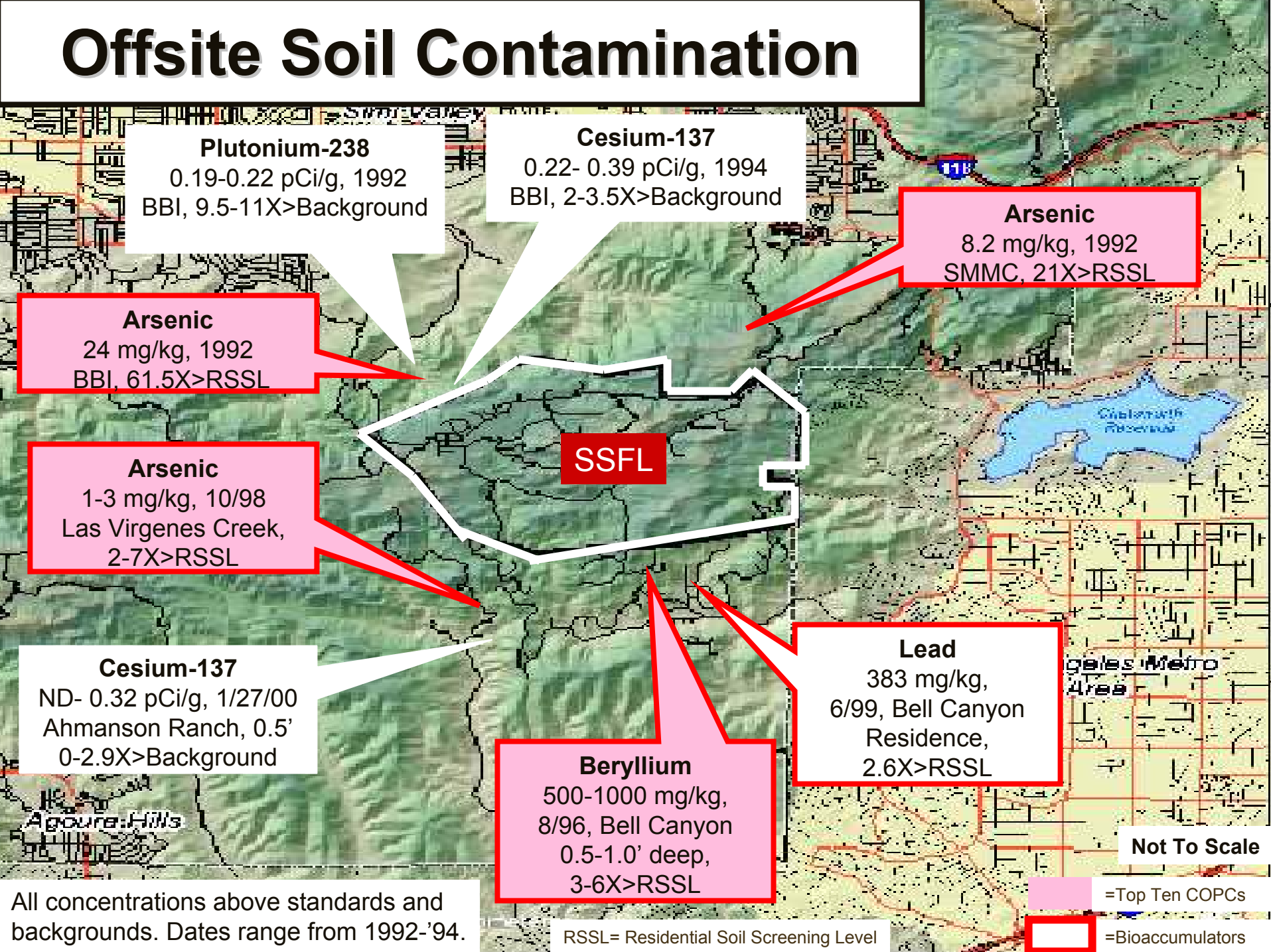
Not To Scale

=Top Ten COPCs

=Bioaccumulators

RSSL= Residential Soil Screening Level

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



WORK REMAINING

- Update chemical ranking
- Complete assessment of exposure pathways
- Estimate potential exposures
 - Ranges of conservative exposures upper limits based on cumulative dose assumption