Rayonier Off-Property Soil Dioxin Study
Overview of Soil Sampling Plan

Technical Workshop – Port Angeles

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July 9, 2008

ecology and environment, inc.
International Specialists in the Environment

Overview

- Rayonier Mill timeline
- Setting
- Study objectives
- Background research
- Study design
- Next steps

Rayonier Operations History

1930	Rayonier Pulp Mill constructed
1974	Scrubbers/demisters installed on recovery & hog fuel boiler stacks
1988-89, 1990's	Hog fuel boiler ash and stack emissions tests confirm presence of dioxins/furans
1997	Mill ceased operations
1997-99	Mill demolished

Rayonier Environmental Investigation History

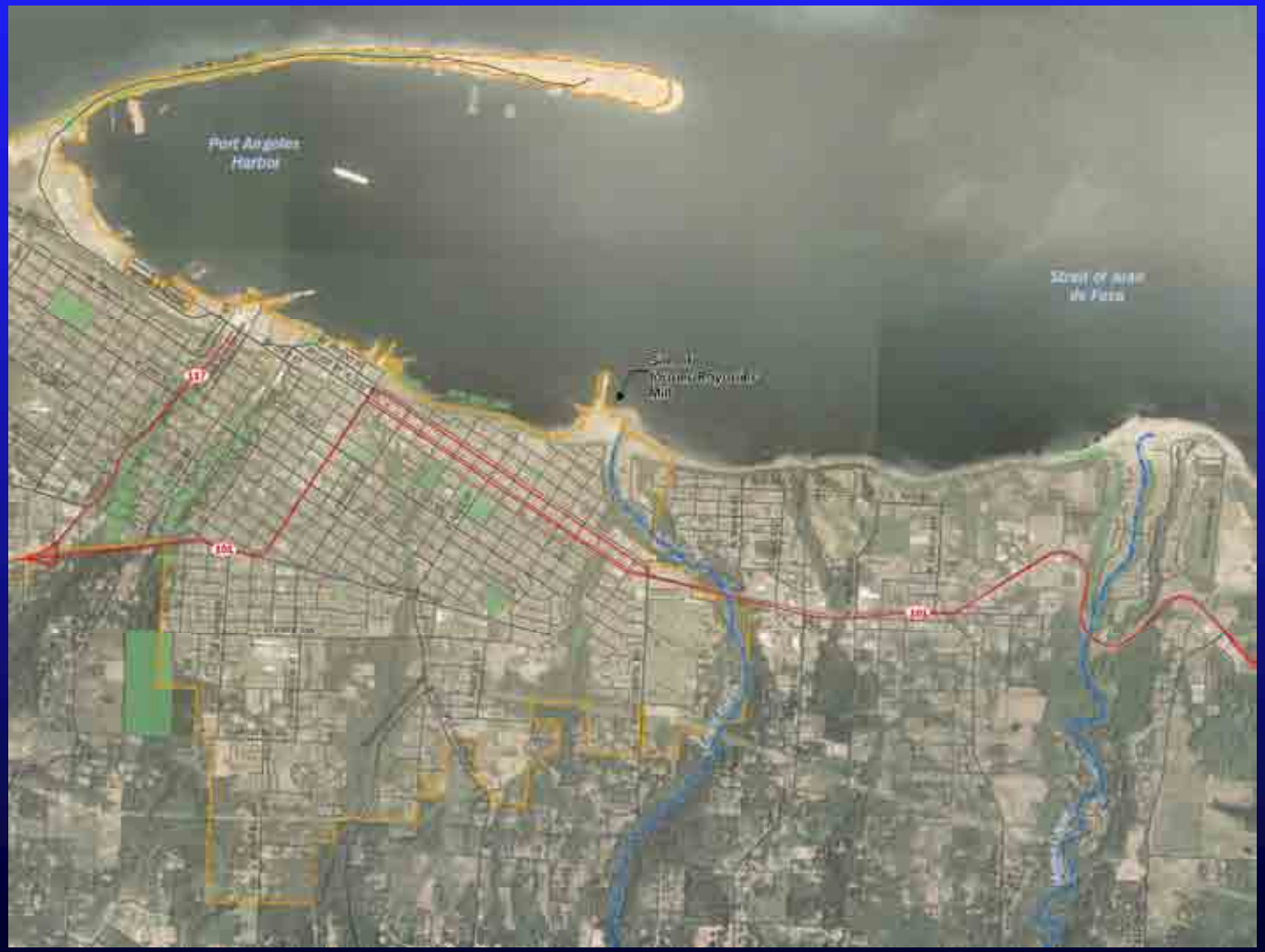
1991-99	Several interim cleanup & removal actions on-site
1993	Pre-closure multi-media compliance investigation
1997-98	EPA ESI Investigation EPA PA/SI of Mt. Pleasant and "13th & M" Street Landfills
2003	Rayonier-led remedial investigation for on-site upland and marine environments
2008-09	Ecology-led off-property dioxin soil study

Rayonier Pulp Mill Setting (1977)

Rayonier Pulp Mill (1990's)

Photo taken by Barbara Osborne, Clean Air Hotline

Land Use / Land Cover

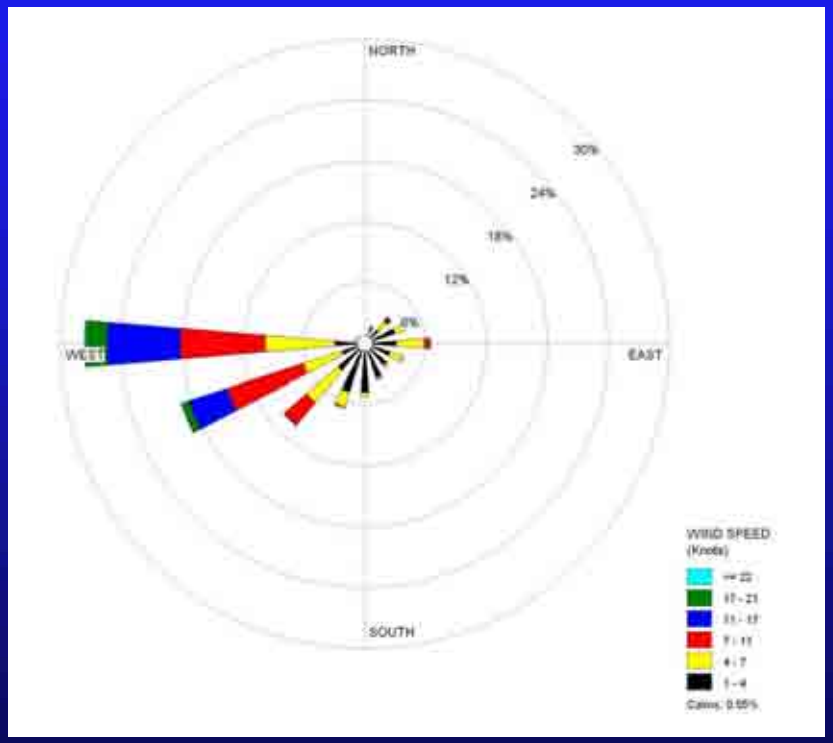


Area Setting

- Majority of Rayonier property flat, rising upwards of 100 ft to south
- Former hog fuel boiler stack rose to 150 ft, slightly above bluffs to south
- Prevailing winds from west, southwest
- Residential areas located in downwind direction, other areas surrounding Mill

Local Wind Patterns

- 2006 Ediz Hook met station data (shown)
- Predominant winds westerly
- Avg. 6.5 knots



Study Objectives

- Determine magnitude of D/F concentrations in off-property soils potentially impacted by former Mill emissions.
- Determine relative contribution to D/F concentrations in soil of former Mill emissions compared to other sources.

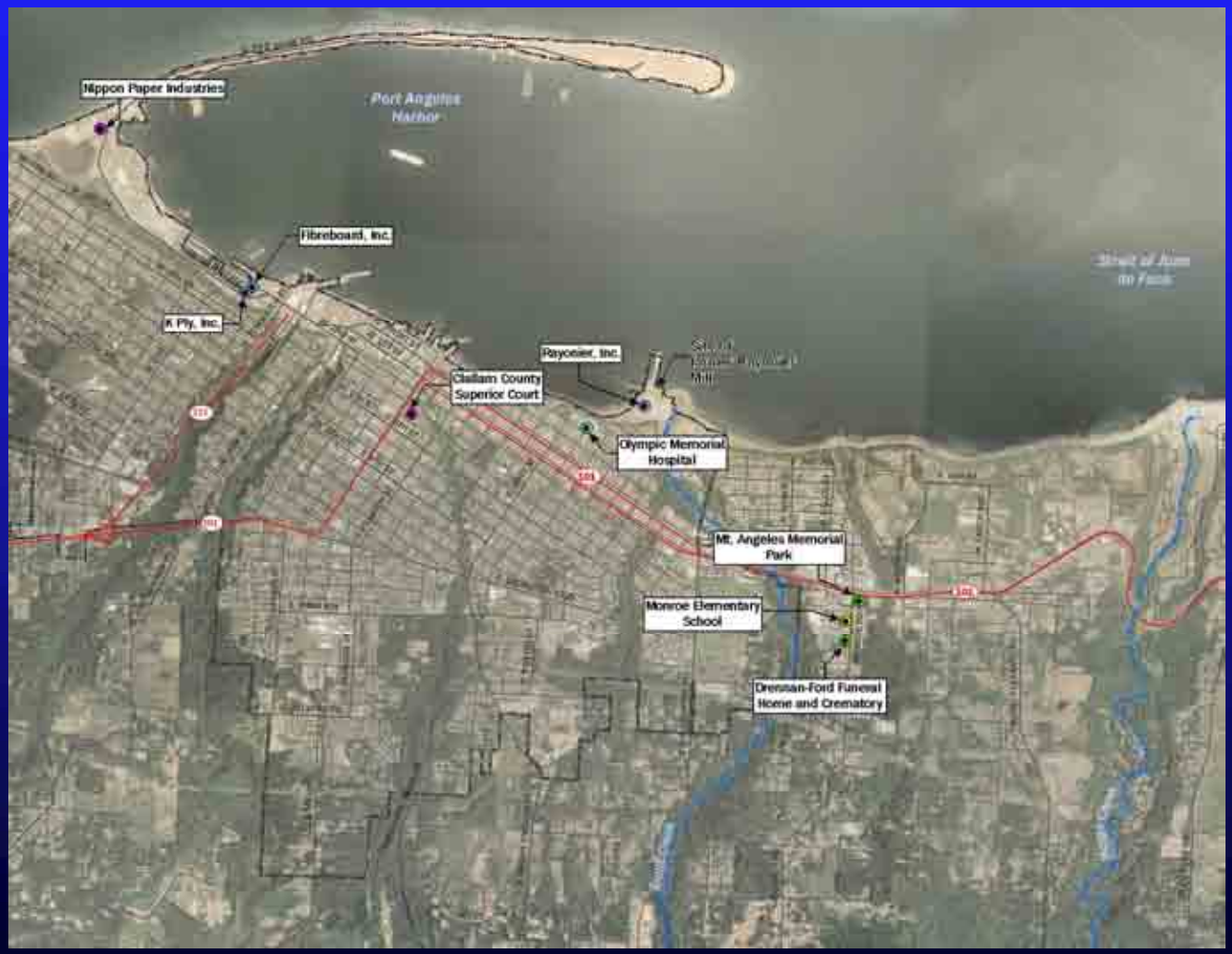
Out of Scope

- Complete delineation of extent of contamination
- Characterization of soils to support risk assessment and clean-up
- Definition of background D/F levels
- Interpolation of D/F concentrations from sampled to non-sampled properties

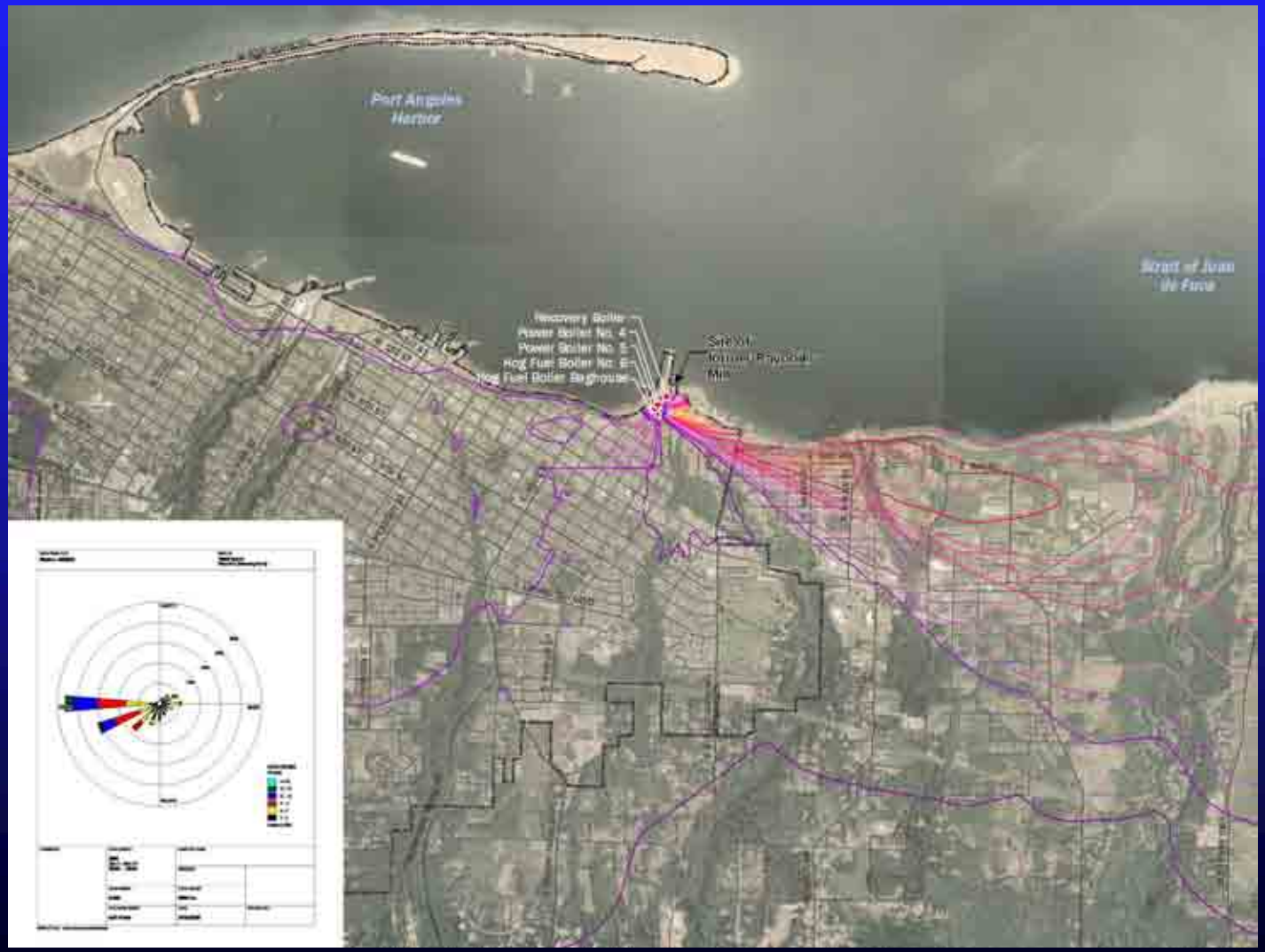
Background Research

- Sources of D/F emissions in Port Angeles
- Available D/F soil data in Port Angeles, Washington state
- Literature review – D/F air transport and soil impacts
- Methods for source identification / source allocation
- Other wide-area D/F study designs & sample collection methods

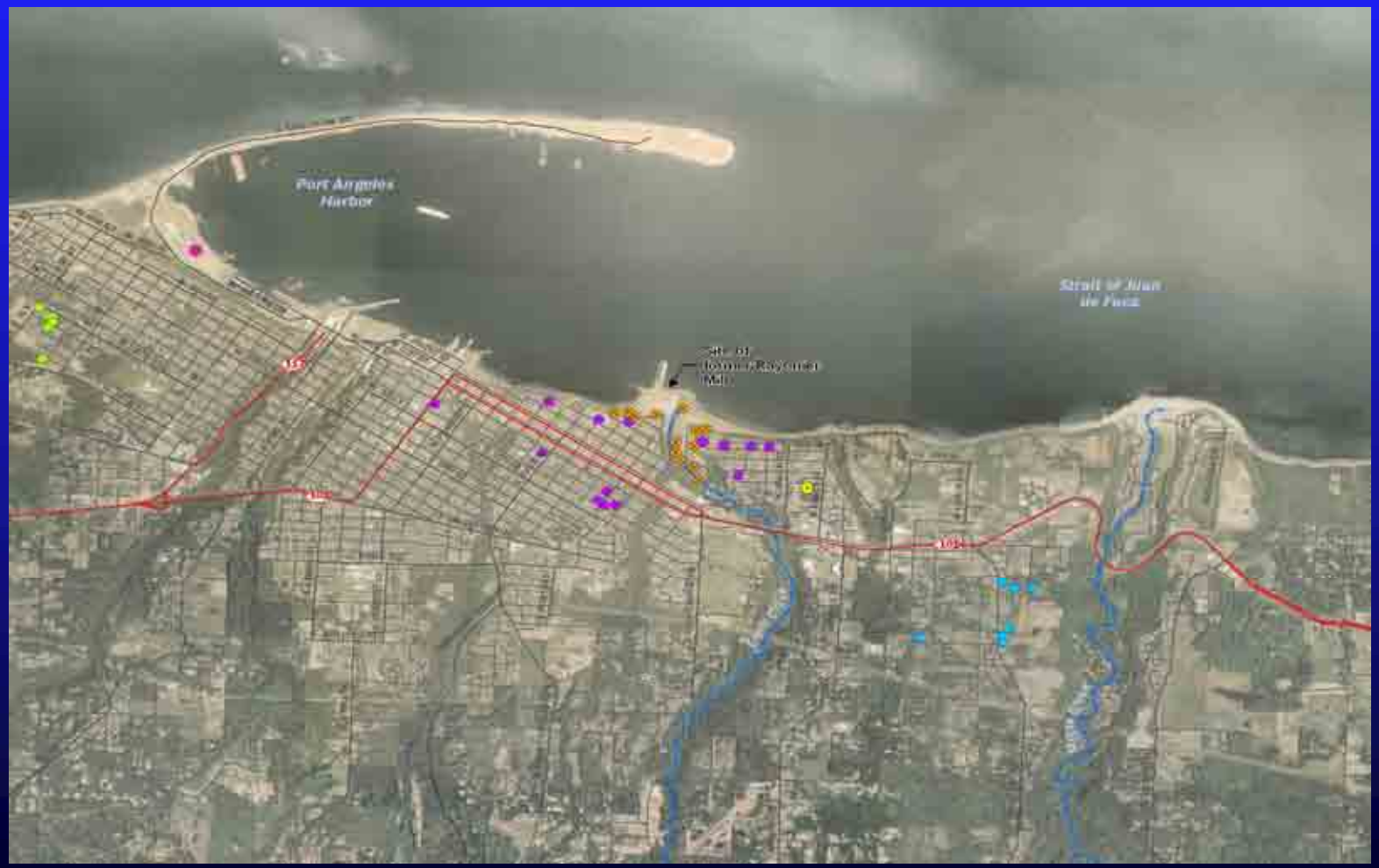
“Sources” of Dioxins/Furans



Air Dispersion & Deposition Model



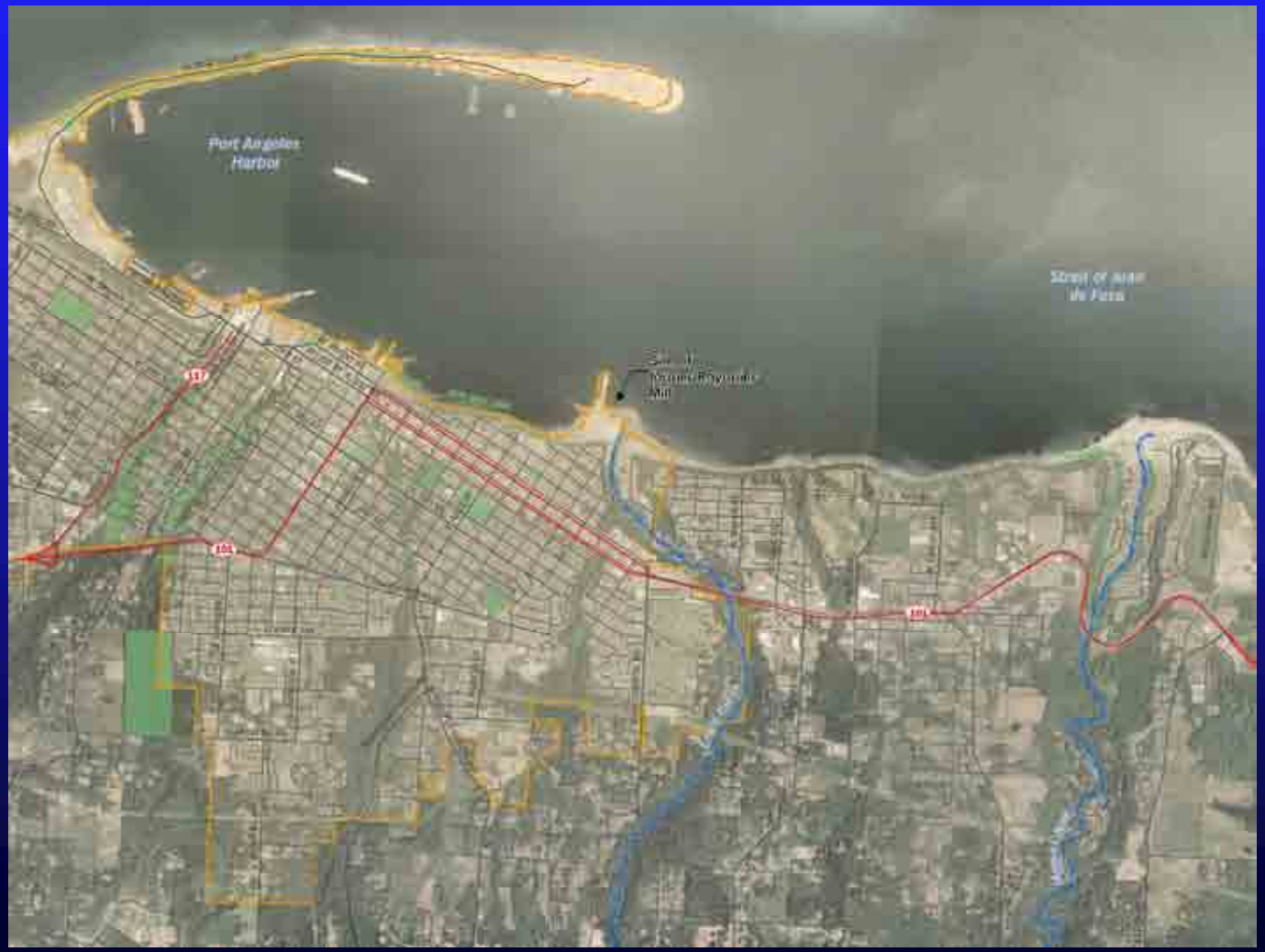
Previous Soil Sampling Locations



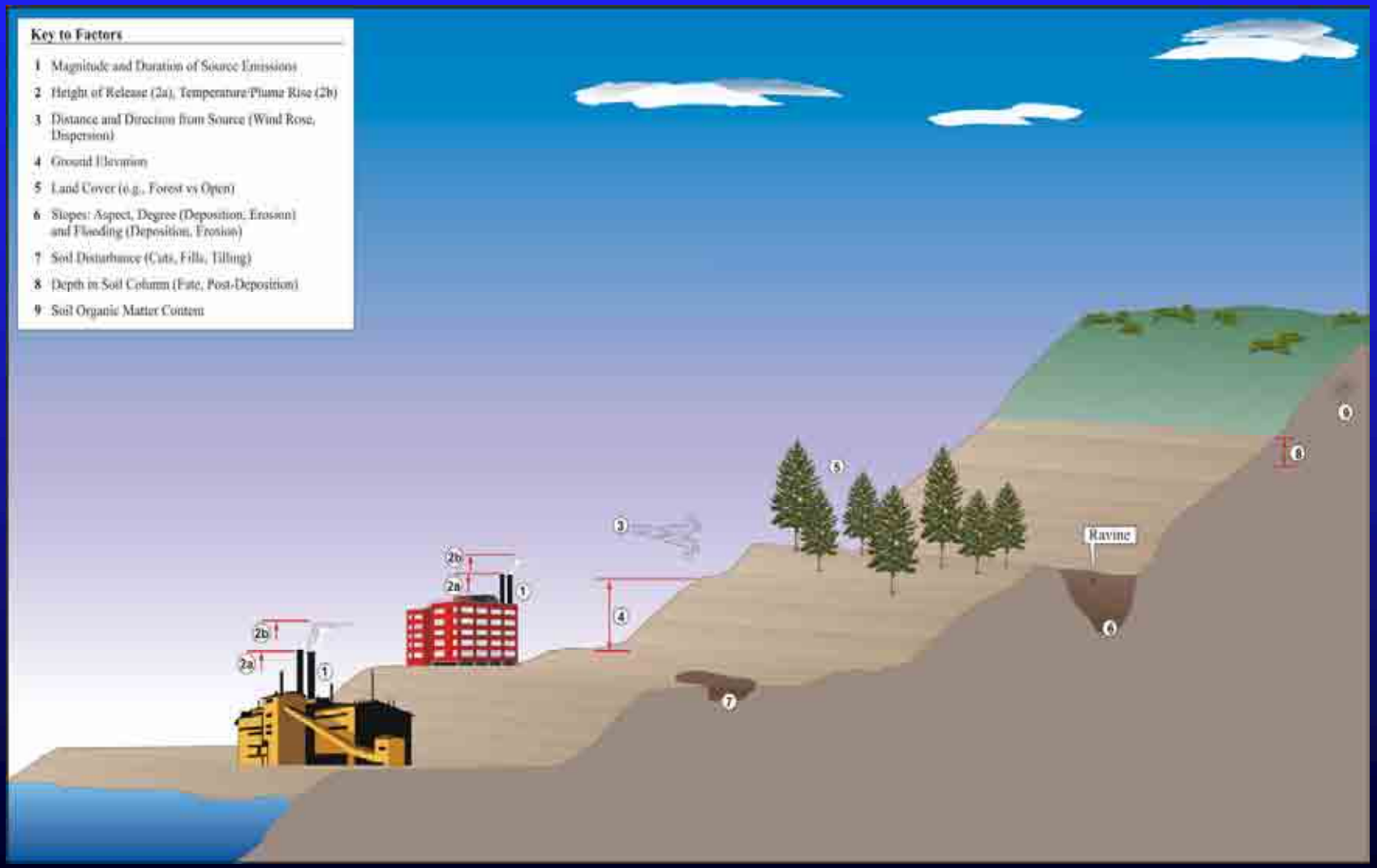
Area Topography

Verified Odor Complaint Locations

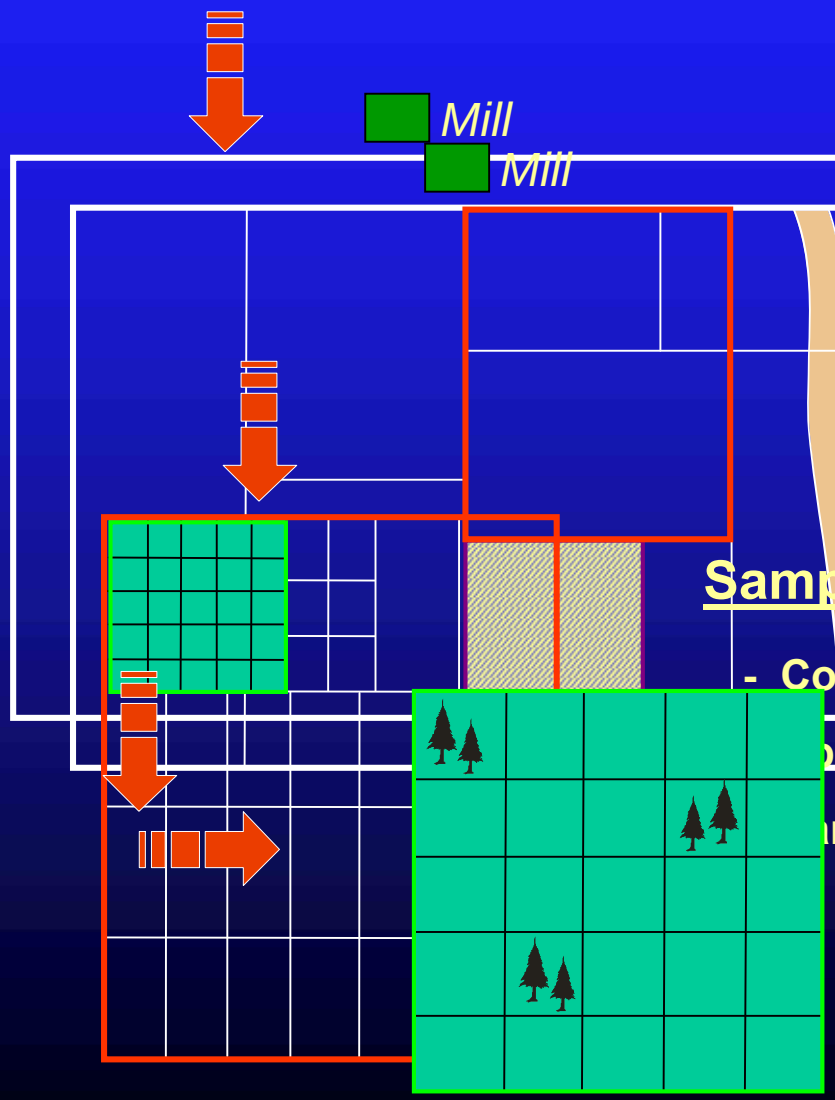
Land Use / Land Cover



Factors Affecting Particle Deposition



Sampling Design: Overview



Study Area Boundaries
Sampling Zones

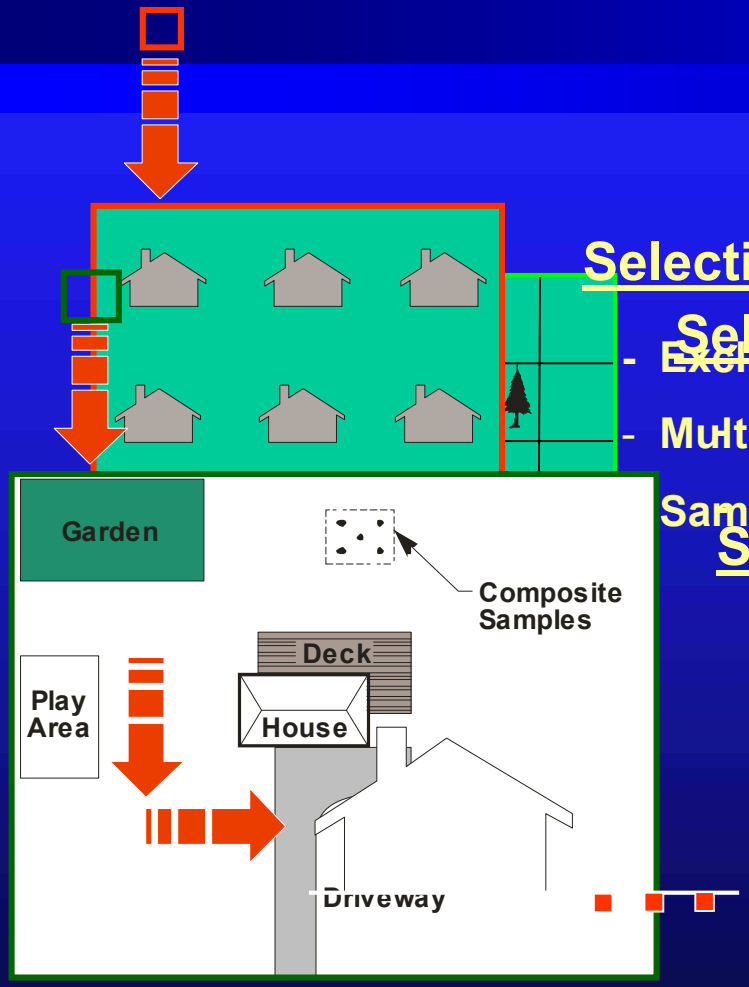
- Exclusion Criteria
- Land Use/Land Cover
- Sample Allocation

Sample Allocation

- Constraint (n=100)

Selection of Properties (I)

- Preference for Undisturbed (Forest)
- Developed (Mostly Residential) Locations, Spatial Coverage



Selection of Properties (II)

- Exclusion, Preference Criteria
- Multiple Access Requests
- Sample One Property per Set
- Spatial Coverage

Selection of Properties (I)

- Preference for Undisturbed (Forest)
- Developed (Mostly Residential) Locations,

Sampling Locations Within Property

- Exclusion, Preference Criteria
- Composite Samples (5 to 1)

Sample Depth

- Nominal 10' Template
  - 0 to 4 Inches
  - Bulk Sample (Unsieved)
  - Archived After Analysis

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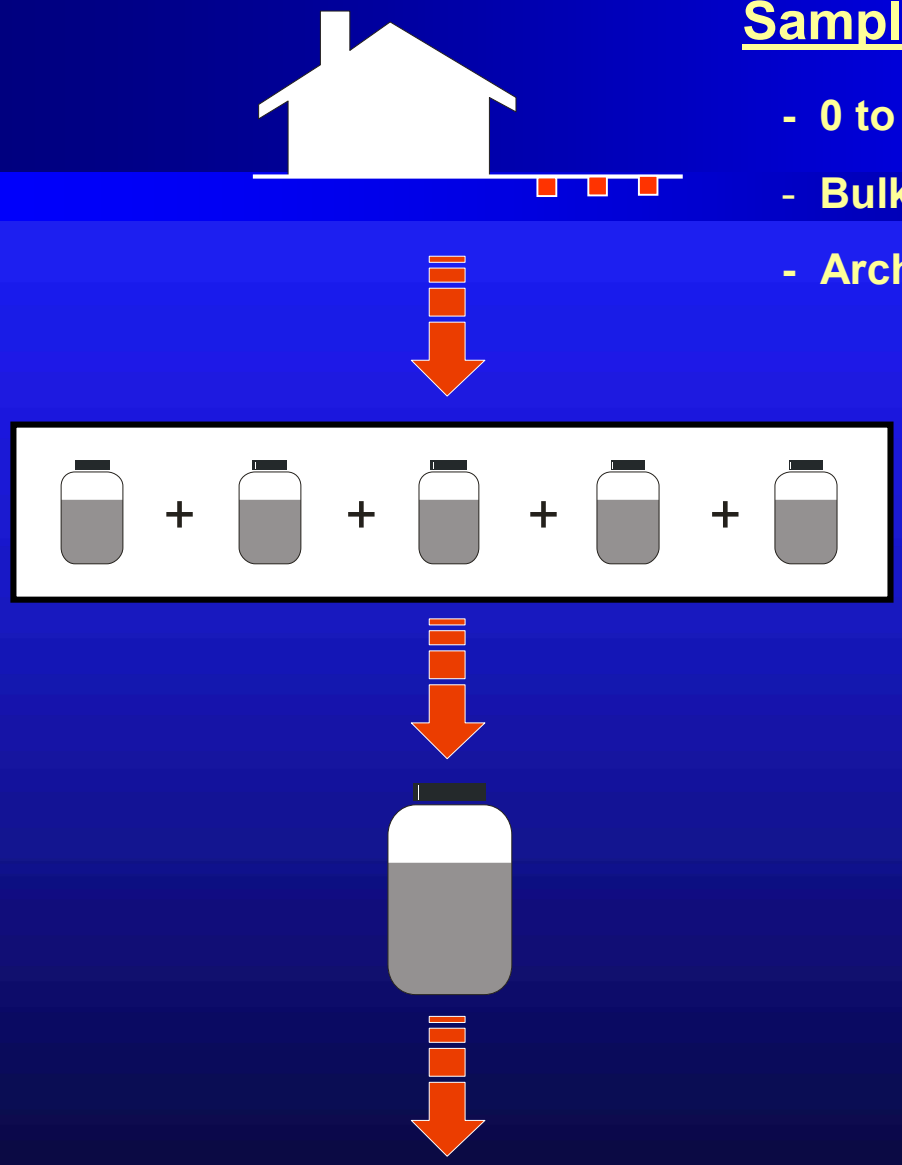
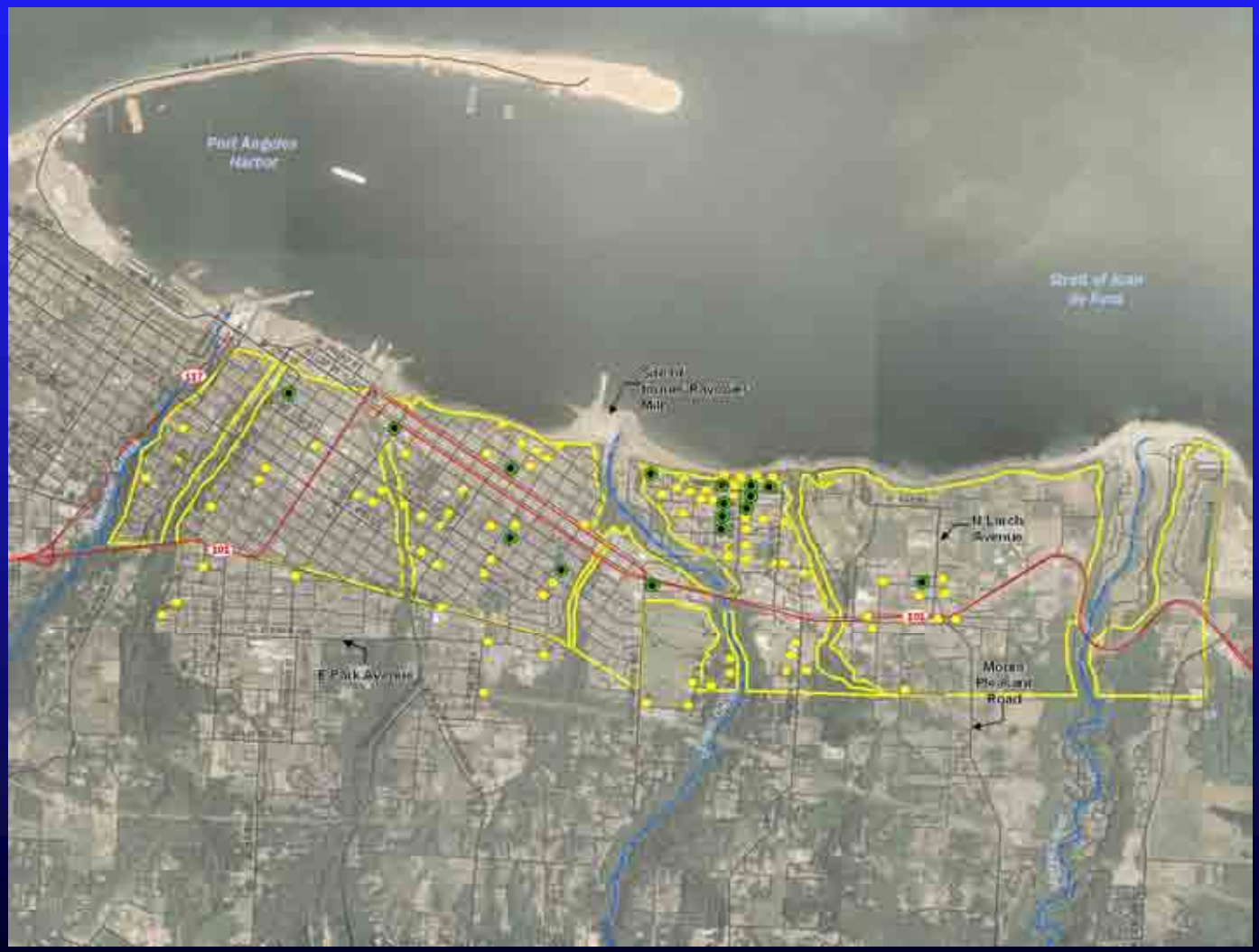
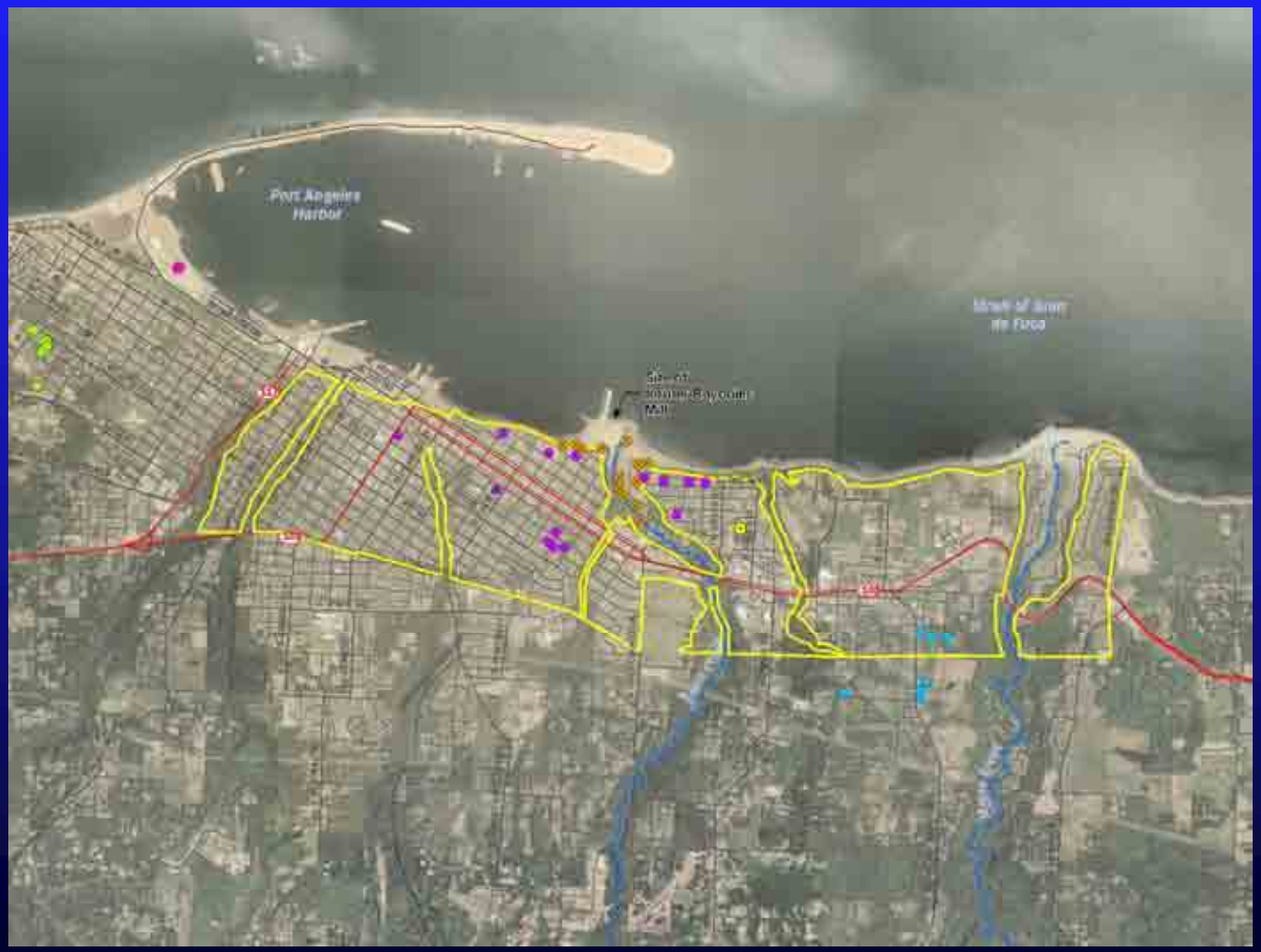


Complete Study Area Boundary

Study Area & Odor Complaint Locations



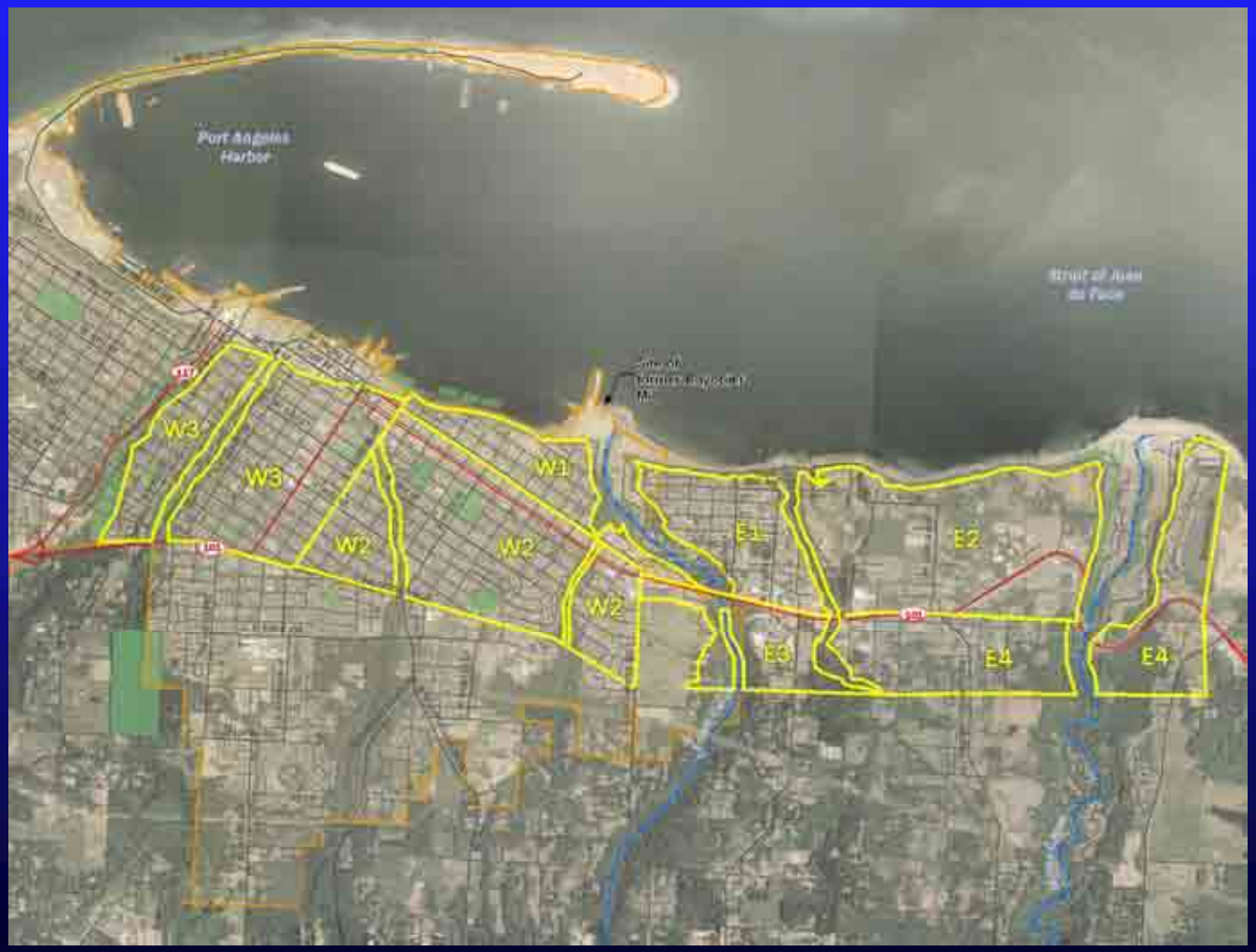
Study Area & Previous Soil Sampling Locations



Study Area & Air Model Results

Study Area & Sources

Study Area Zones



Within-zone Grid Spacing

Sample Allocation

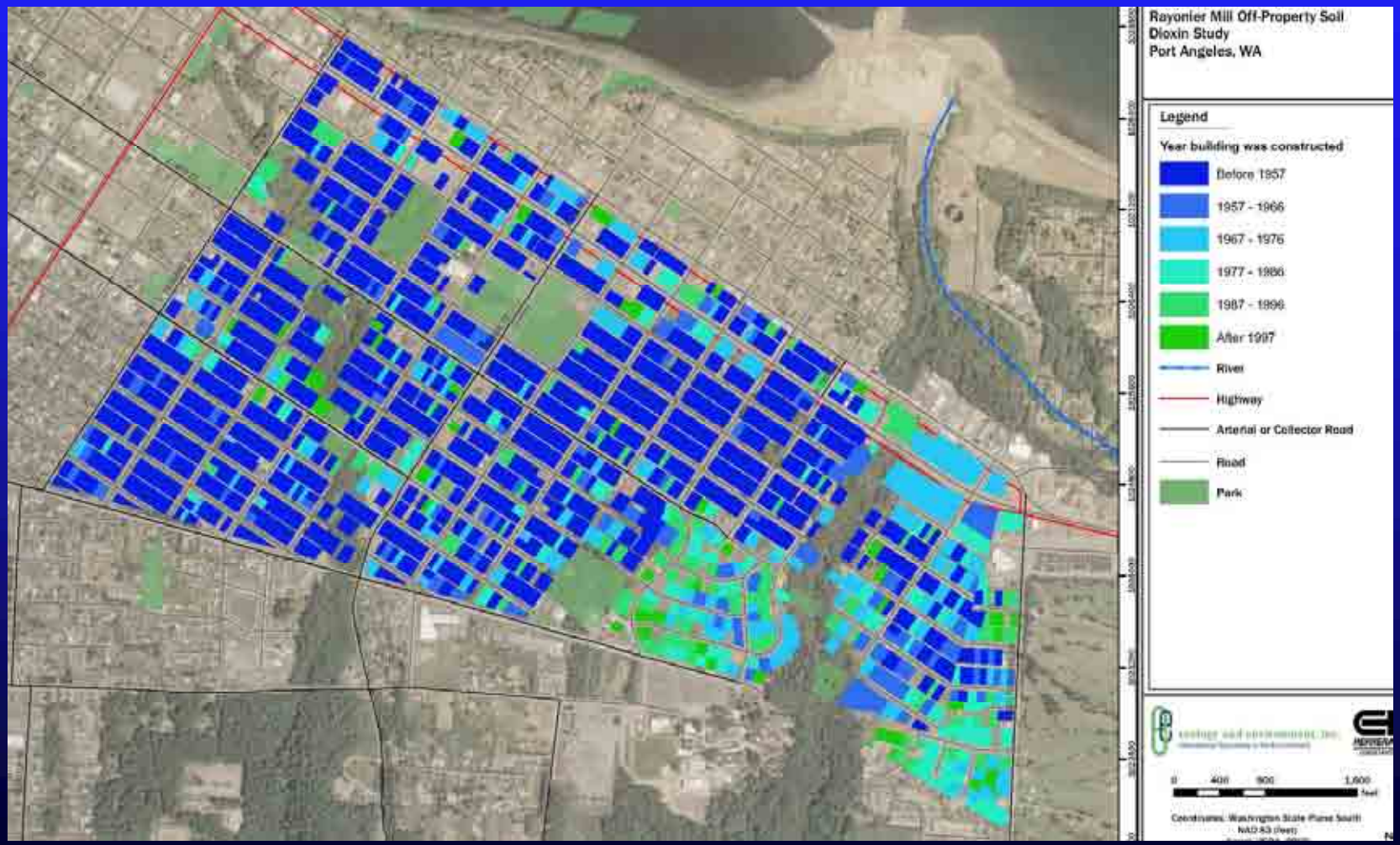
- 100 total samples
  - 1 sample per grid cell (79 samples)
  - 3 samples per transect (9 samples)
  - forest “targeted” samples (10 samples)
  - roadway samples (2 samples)
- 0-10 cm (0-4 inch) depth
- 5 subsamples per sample

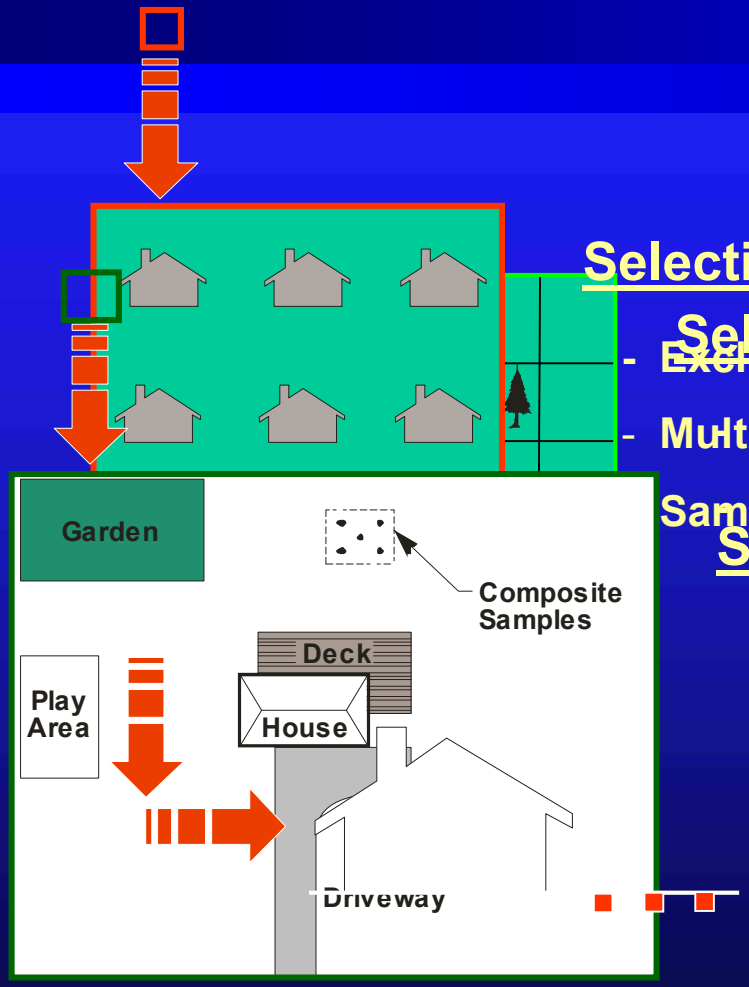
Within-zone Sample Allocation

Zone	Spacing (ft^2)	No. Samples
W1	750	12
W2	1,250	16
W3	1,900	6
E1	600	24
E2	1,600	9
E3	1,100	6
E4	1,900	6

Zones E1 and E2

Building Age





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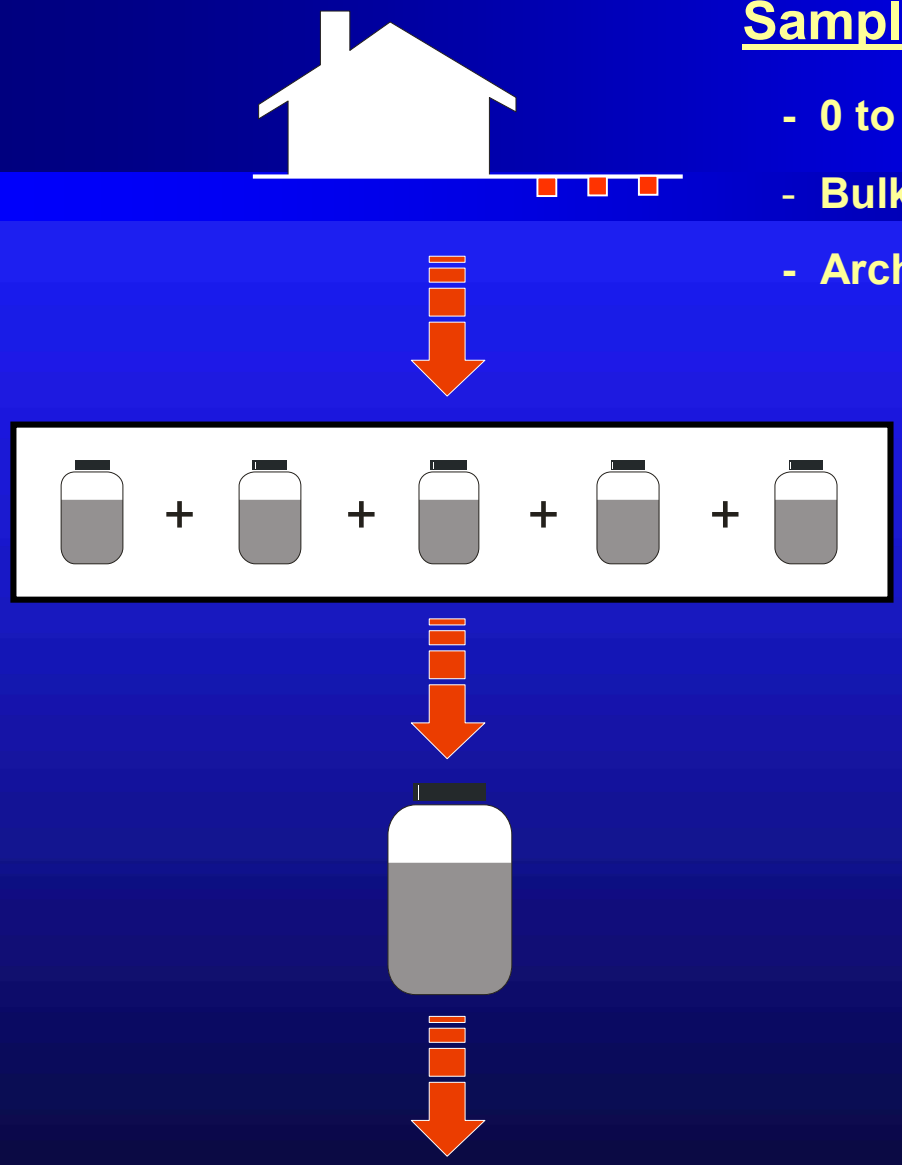


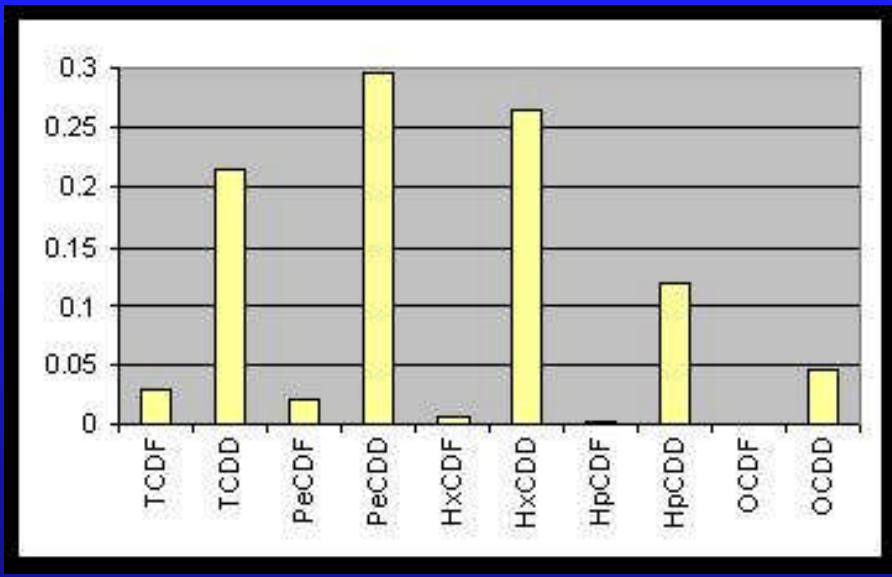
Chemical Analysis

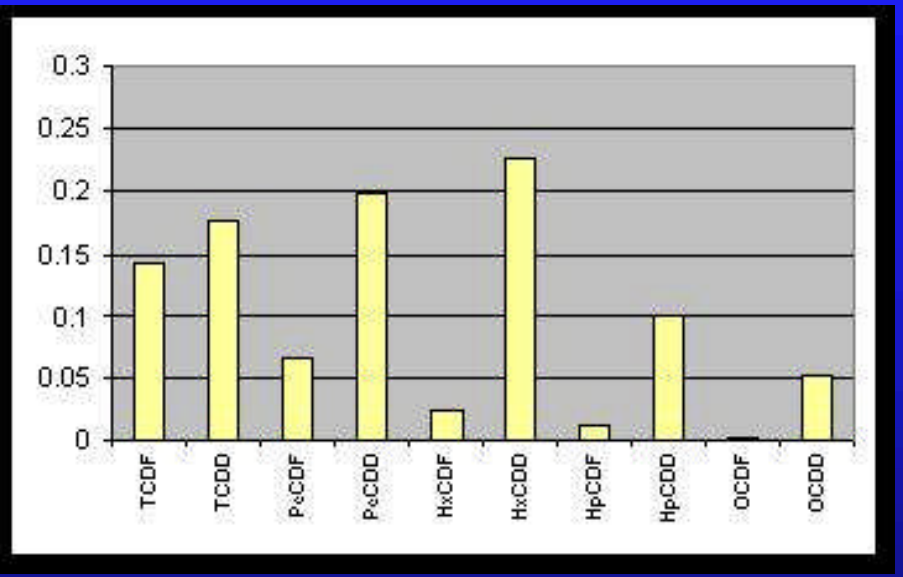
- Axys Analytical Services Ltd.
  - Dioxins/furans
    - 17 of 2,3,7,8-substituted congeners
    - 10 homologue groups
  - Total organic carbon
- EcoChem Inc. third-party data validators

Data Analysis

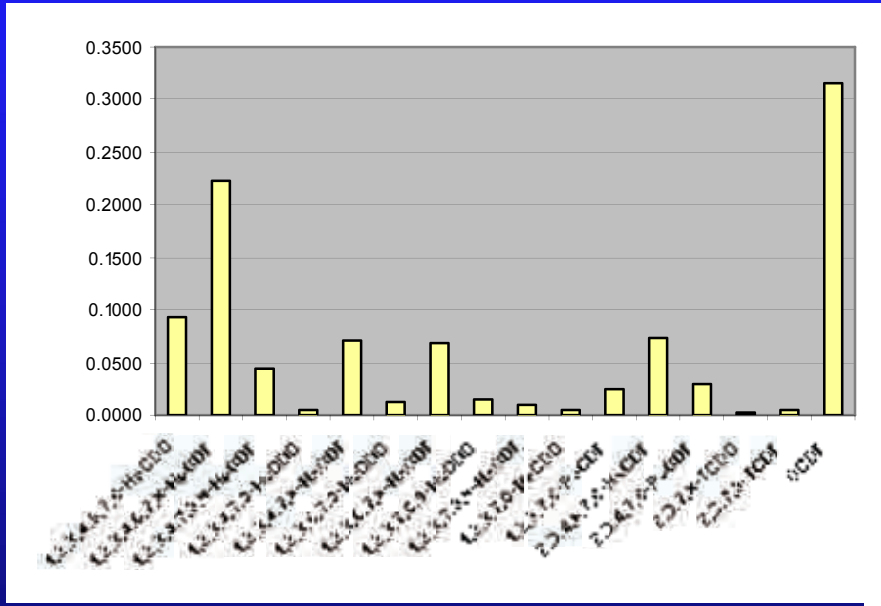
- Infometrix Inc. / Dr. Scott Ramos to perform source identification/allocation
- Begin with general summary statistics, graphical data presentation
- Chemometric evaluation is multi-tool process
  - "Backward" evaluation of data
  - Principal components analysis for data visualization
  - Variety of mixture analysis methods (PVA, PMF, ALS)

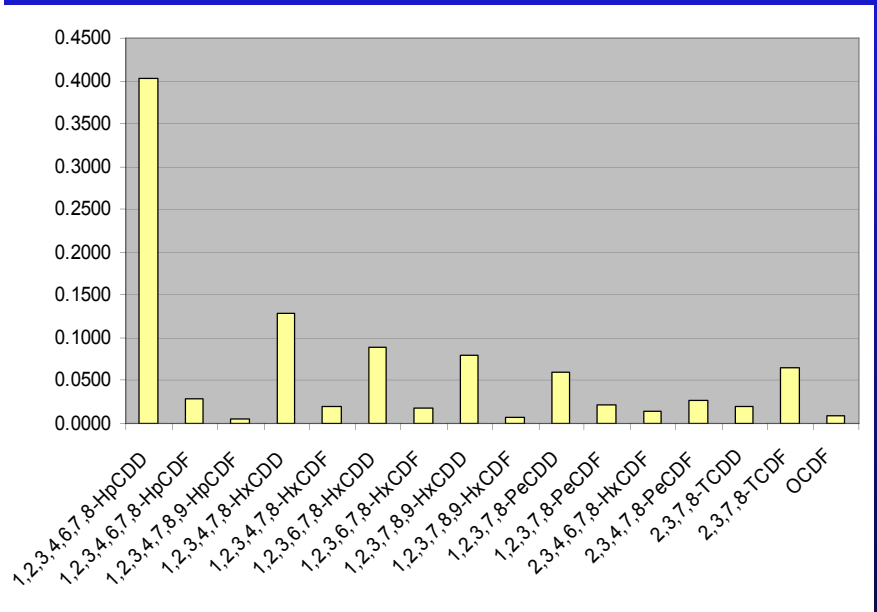
Data Characterization - Example Homologue Profiles





Data Characterization - Example Congener Profiles





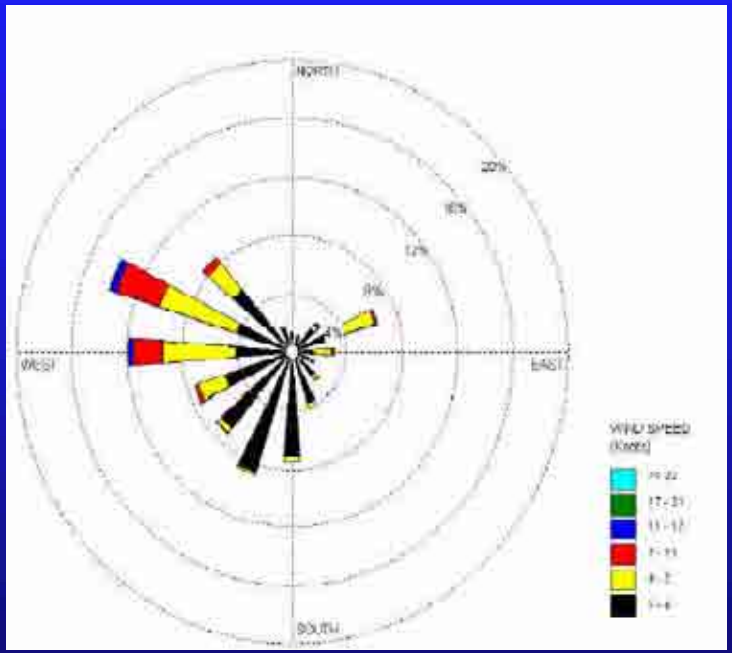
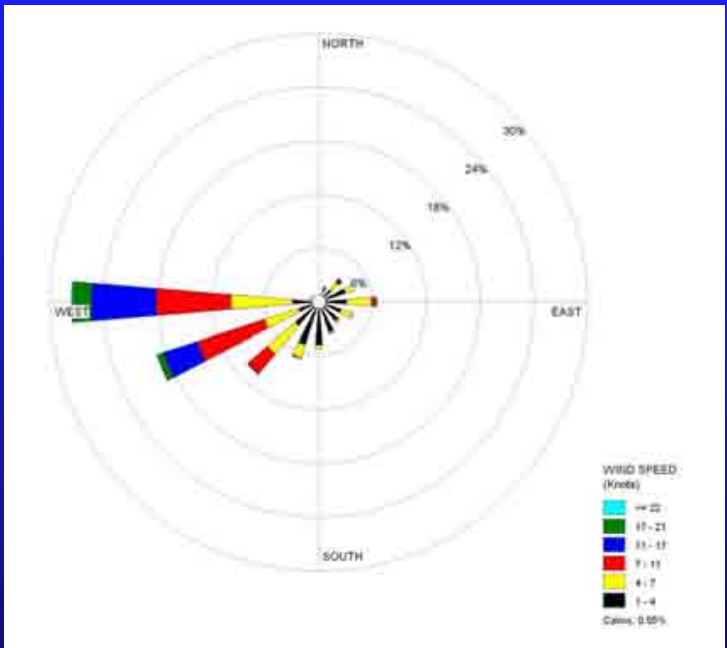
Next Steps – Soil Sampling Plan

Public comment period	June 30 – July 29
Public meeting	July 9
Finalize SSP	August 11

Next Steps – Field Sampling

Develop SQAP, HASP	June – July
Develop cultural resource monitoring plan / coordinate with DAHP, LEKT, City	June – July
Acquire property access	August
Field logistics	August
Field event	September

Next Steps – Data Analysis & Reporting

Analyze data (Axys)	Sept. – Oct.
Validate data (EcoChem)	Oct. – Nov.
Preliminary data evaluation & report results to property owners	Nov. – Dec.
Chemometric analysis (Infometrix)	Dec. – Feb.
Final report development	Mar. – June

Onsite (1998) vs Ediz Hook (2006) met data