Practical Use of Risk Assessment Results

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MWH Global
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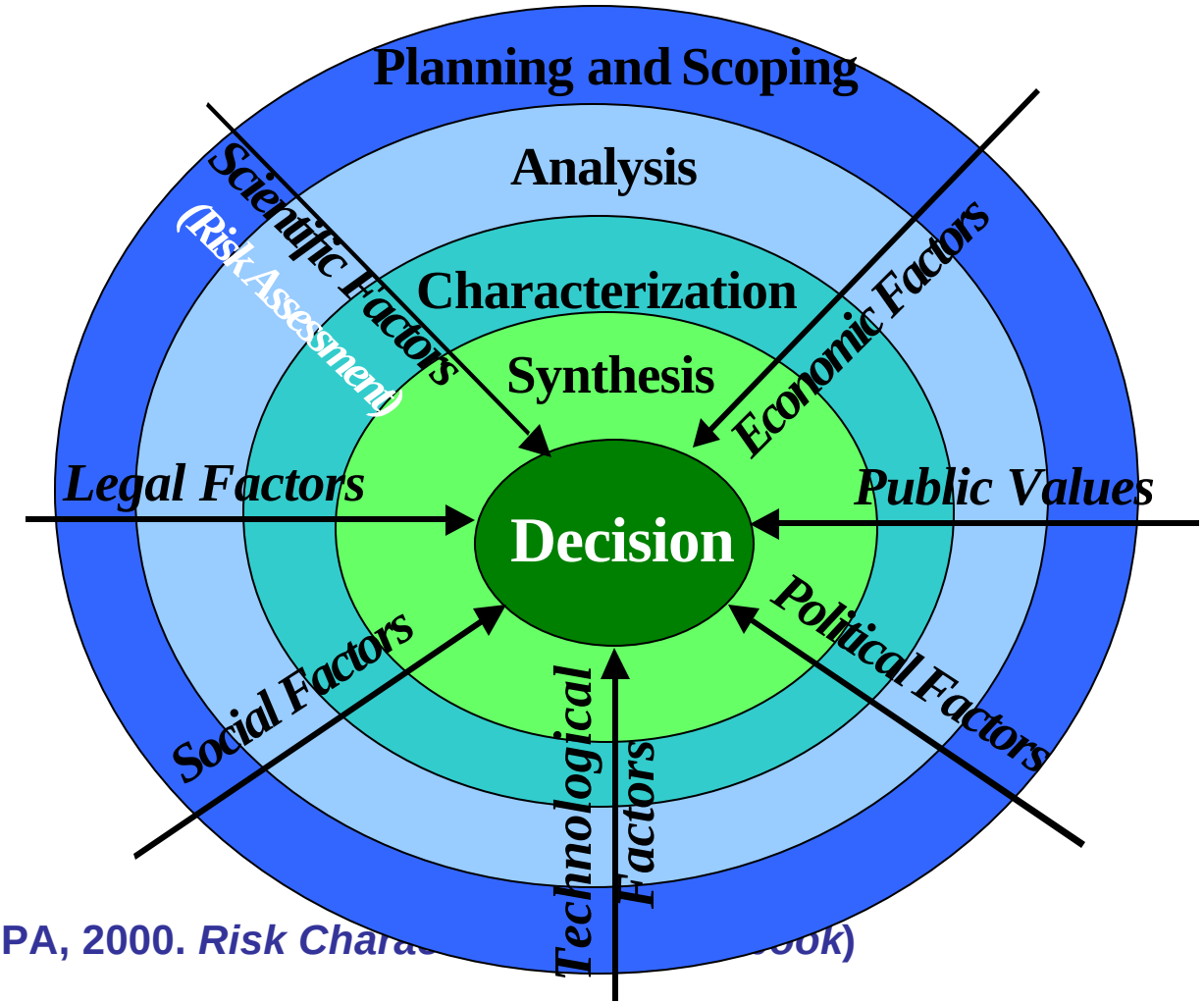
The Components of Risk-Based Decision Making (RBDM)



(From: USEPA, 2000. *Risk Charac* *ook*)

Practical Uses: Forward Risk Assessments

- **Concentration ® Exposure x Toxicity = Risk**
- **Human Health**
- **Ecological**
- **Types of Quantitative Risk Assessments:**
  - Prospective or Retrospective
  - Deterministic
  - Probabilistic (one- and two-dimensional)
  - Screening -- Default, Prescriptive
  - Refined -- Site-specific, Customized, Focused

Practical Uses: Reverse Risk Assessments

- **Target Risk ¸ Toxicity = Exposure ® Concentration**
- **Example Regulatory Standards:**
  - **Water:** MCLs, HAs, AWQCs
  - **Air:** NAAQS, EIs
  - **Soil:** PRGs
  - **Workplace:** OSHA Standards, NIOSH Standards, ACGIH Standards
- **Example Site/Facility/Product-Specific Concentrations:**
  - **Media-specific:** RBCLs, SSLs
  - **Facility-specific:** Permissible Emission Levels
  - **Product-specific:** RBCs (Ex. Fertilizers), Pesticide Tolerance Levels, NSRLs (Prop 65)

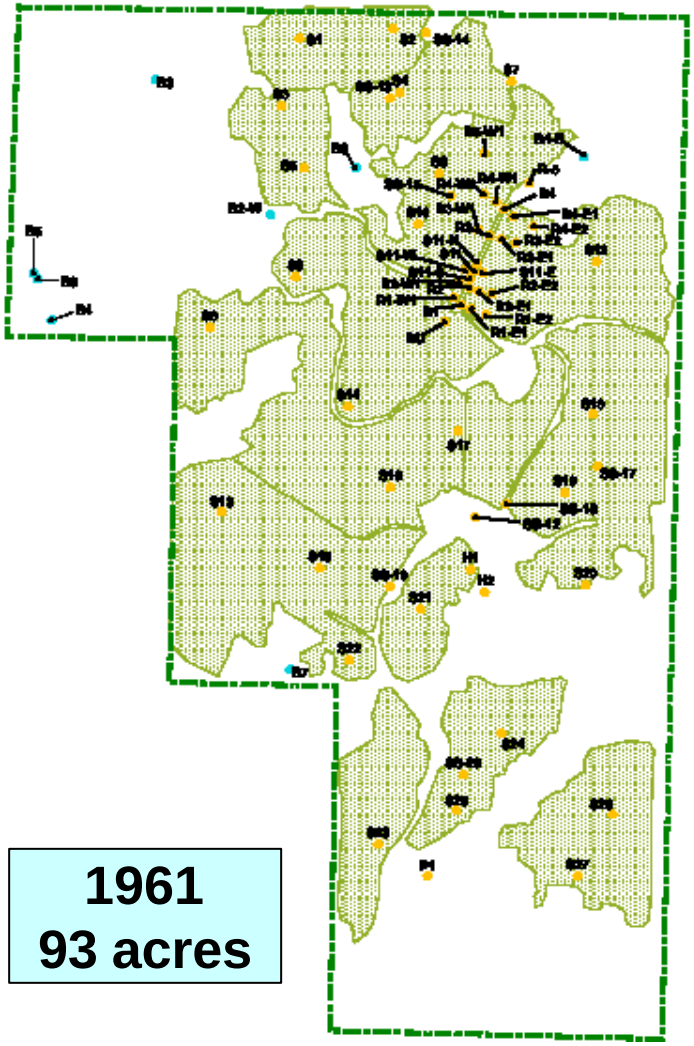
Keys to Maximizing the Benefits of Risk Assessment Results

- Follow the RBDM paradigm
- Begin with the end in mind:
  - Initial planning, establish objectives, involve stakeholders
- Apply the iterative risk assessment process:
  - Screening, deterministic, probabilistic
- Effectively use “best” science and available tools:
  - Be proactive, don’t be afraid to venture outside the box
- When negotiating with agencies, be prepared

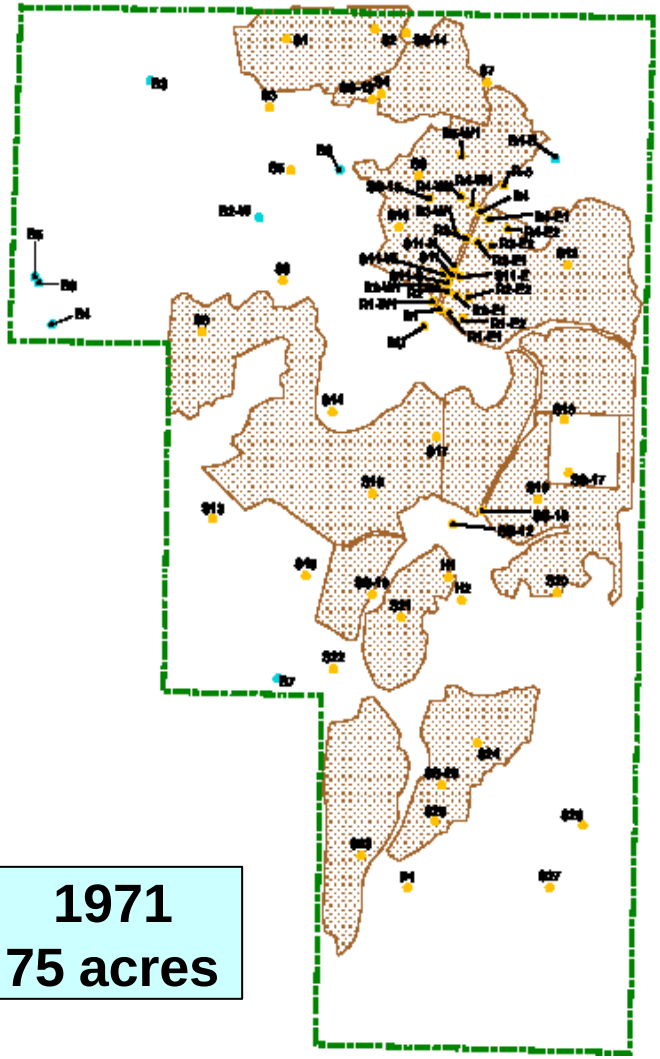
Case Example: Residential Development on Contaminated Land

- **Property Features:**
  - 180 acres
  - former orchard (1930s-1980s)
  - Pesticides - organochlorines, arsenicals
  - Property has high value
- **Development Plan:**
  - 65 lots
  - Rural residential
- **Regulatory Status:**
  - County unwilling to be RM
  - Entered State Voluntary Cleanup Program

Agricultural Areas



1961
93 acres



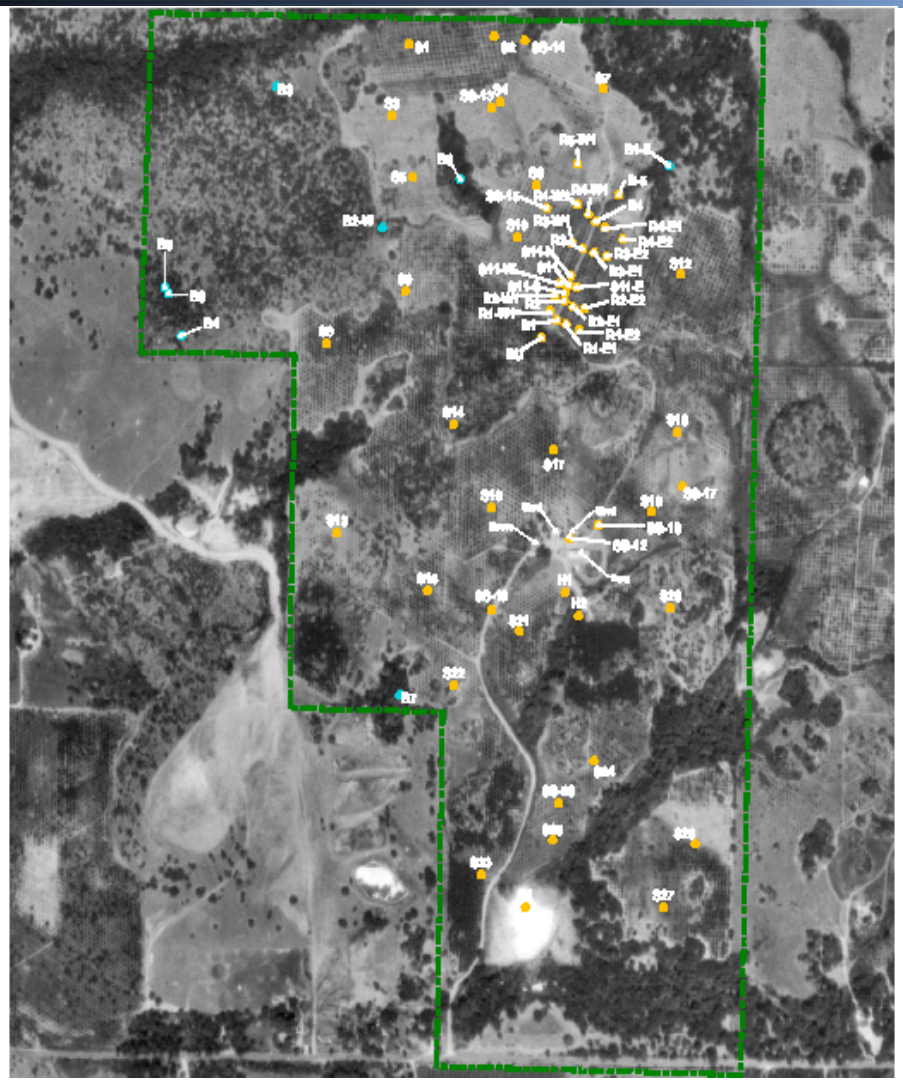
1971
75 acres

Keys to Success

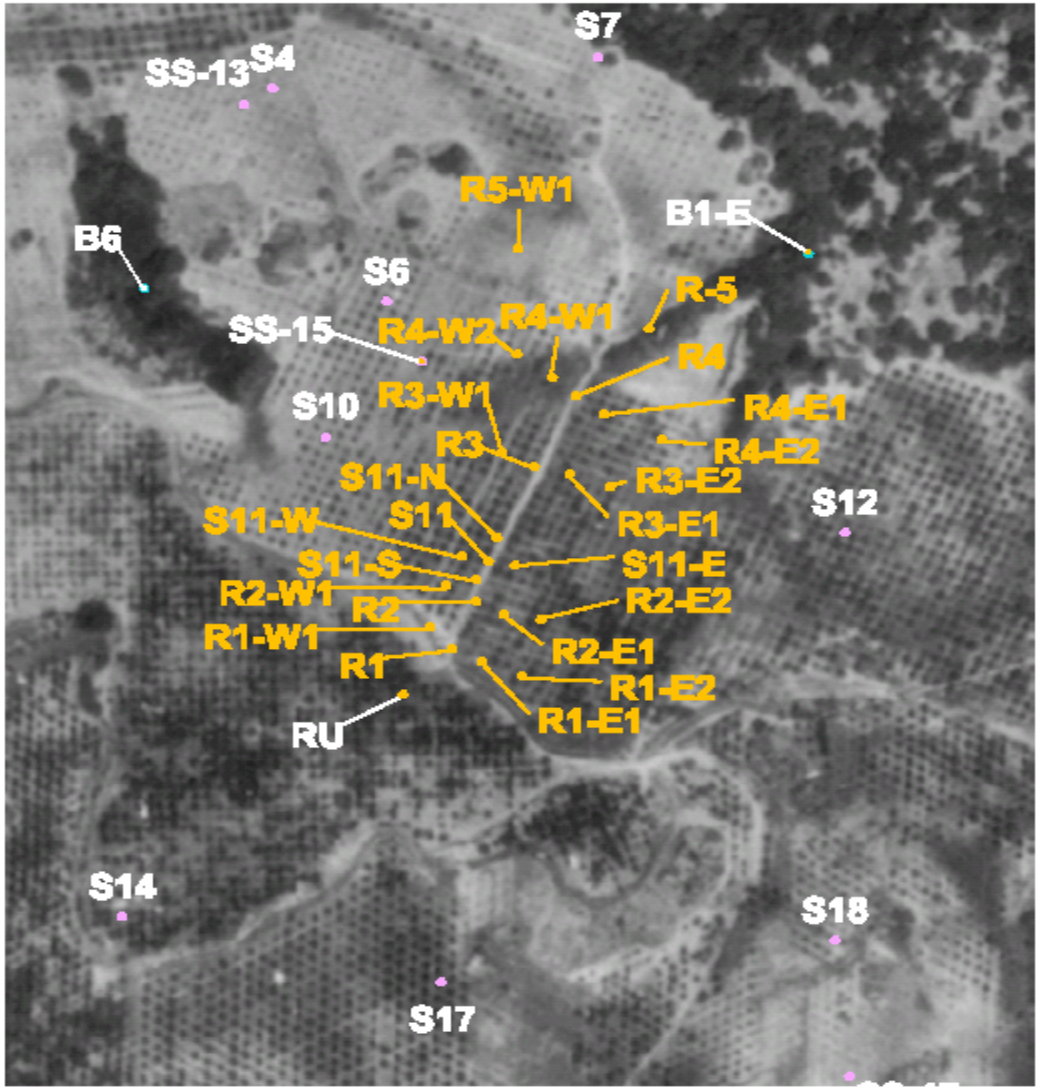
- **Result:** integration of essential tools and strategies identified cost-effective cleanup approach
- **Strategies:**
  - Redevelopment plan developed first
  - Risk-based approach determined from the get-go
  - Sampling plan developed to support risk assessment
  - Early stakeholder interaction
- **Essential tools:**
  - Toxicology (arsenic)
  - Geostatistics (GIS platform)
  - Tiered risk assessment
  - Strategic study (bioavailability)

Site Characterization

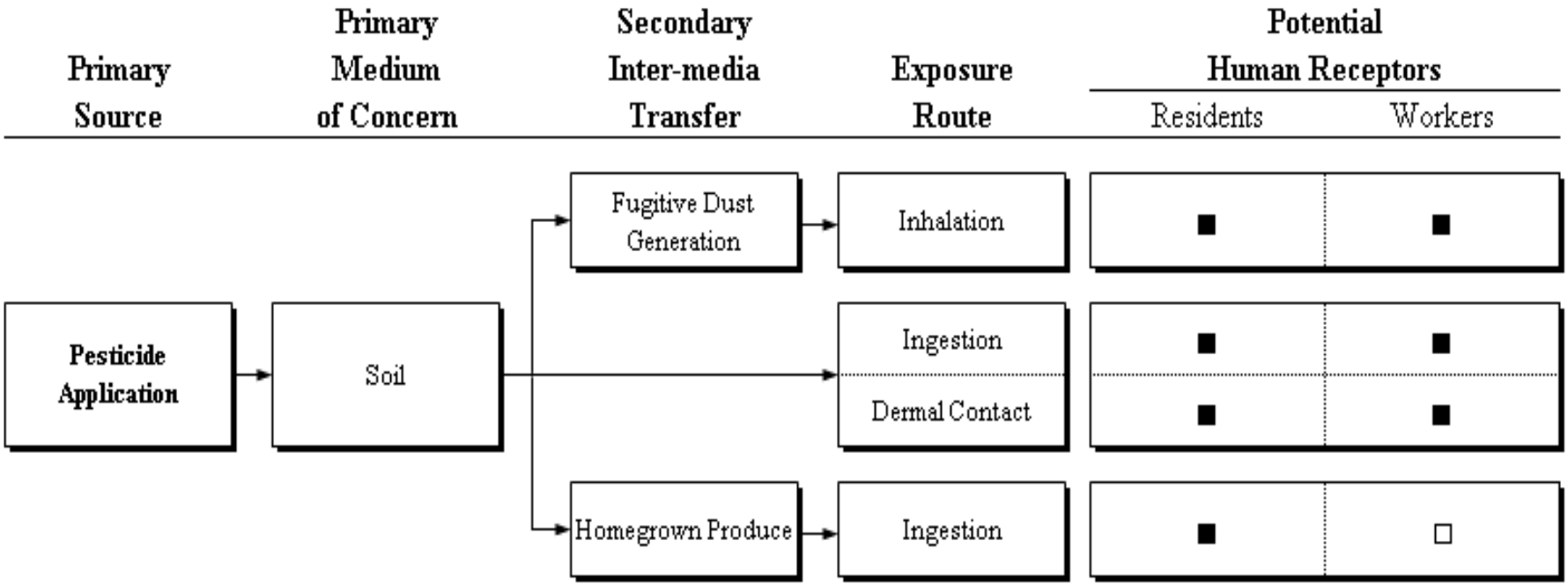
- **Soil:**
  - Phased sampling approach
  - orchard area: 88 soil samples taken - mostly surface -
  - non-orchard: 7 background samples
- **Findings:**
  - **Three areas:** Orchard, non-orchard, filling area
  - **COPCs:** OC pesticides, lead, arsenic
  - **Arsenic:** ND - 124 ppm
  - **Background:** ~20 ppm As
- **Bioavailability:** As, Pb in soil



A Hot Spot


S7
SS-13
S4
R5-W1
B1-E
B6
S6
R-5
SS-15
R4-W2
R4-W1
R4
S10
R3-W1
R4-E1
R3
R4-E2
S11-N
R3-E2
S12
S11-W
S11
R3-E1
S11-S
S11-E
R2-W1
R2
R2-E2
R1-W1
R2-E1
R1
R1-E2
R1-E1
RU
S14
S18
S17

Conceptual Site Model



■ Complete exposure pathway.

□ Incomplete or insignificant exposure pathway.

Summary of Tier 1 (Screening) Risk Assessment

Receptor	Surface Soils		
	Non-Cancer Hazard Index	Theoretical Cancer Risks	Blood Lead Level (ug/dL)
Child Resident	7.9	3 E-4	15.4
Age-Adjusted Resident	2.9	5 E-4	6.3
Construction Worker	2.9	2 E-5	3.9

Summary of Tier 2 (Deterministic) Results

Receptor	Theoretical Cancer Risks	Non-Cancer Hazard Index	Blood Lead (µg/dL)
	Orchard Area (Area 1)		
Construction Worker	1 E-6	0.20	3.9
Child Resident	9 E-5	0.90	5.1
Age-Adjusted Resident	1 E-4	0.51	6.3
	Remote Filling Area (Area 2)		
Construction Worker	7 E-6	1.0	3.9
Child Resident	3 E-4	3.1	9.8
Age-Adjusted Resident	3 E-4	1.7	6.3

Summary of Tier 3 (Probabilistic) Results

	Remote Filling Area Soils					
	ILCR			Non-Cancer Hazard Index		
Receptor	50th	90th	95th	50th	90th	95th
Child Resident	3 E-6	1 E-5	2 E-5	0.30	1.1	1.9
Age-Adjusted Resident	5 E-6	2 E-5	5 E-5	0.18	0.80	1.5

	Orchard Area Soils					
	ILCR			Non-Cancer Hazard Index		
Receptor	50th	90th	95th	50th	90th	95th
Child Resident	5 E-7	2 E-6	4 E-6	0.084	0.35	0.58
Age-Adjusted Resident	1 E-6	7 E-6	1 E-5	0.052	0.24	0.48

Risk-Based Cleanup Levels: Options

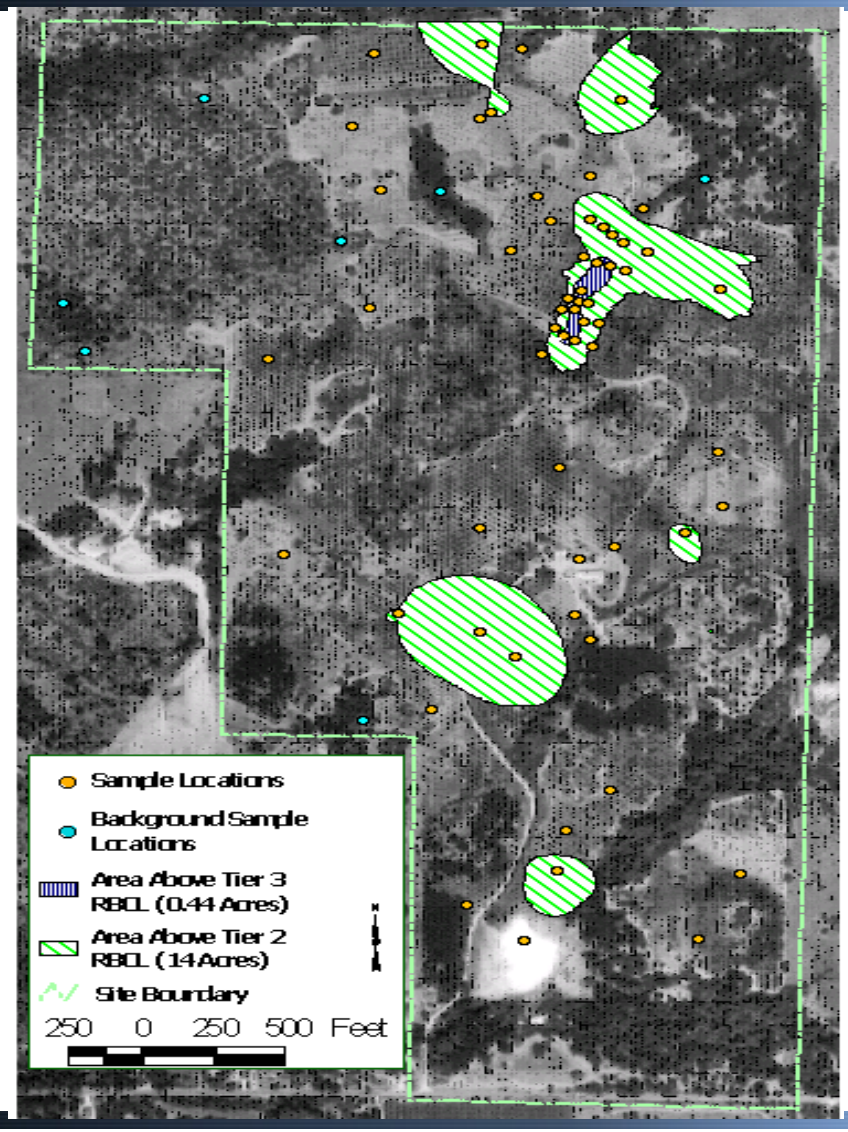
Method	Remote Filling Area 95% UCL (mg/kg)	Resident Adult ILCR	Resident Child HI	Cancer Soil Target Range[a]		Non-Cancer Soil Target[b]
Tier 1 Deterministic	124.0 (max)	3 E-4	6.9	0.41	41	18
Tier 2 Deterministic	65.4	3 E-4	3.0	0.22	22	22
Tier 3 50th Percentile	65.4	4 E-6	0.3	16	1,600	230
Tier 3 90th Percentile	65.4	2 E-5	1.1	2.8	280	61
Tier 3 95th Percentile	65.4	4 E-5	1.8	1.5	150	36
Tier 3 99th Percentile	65.4	2 E-4	4.9	0.4	40	13

[a]Target Cancer Risk Range is 1×10^{-6} to 1×10^{-4}

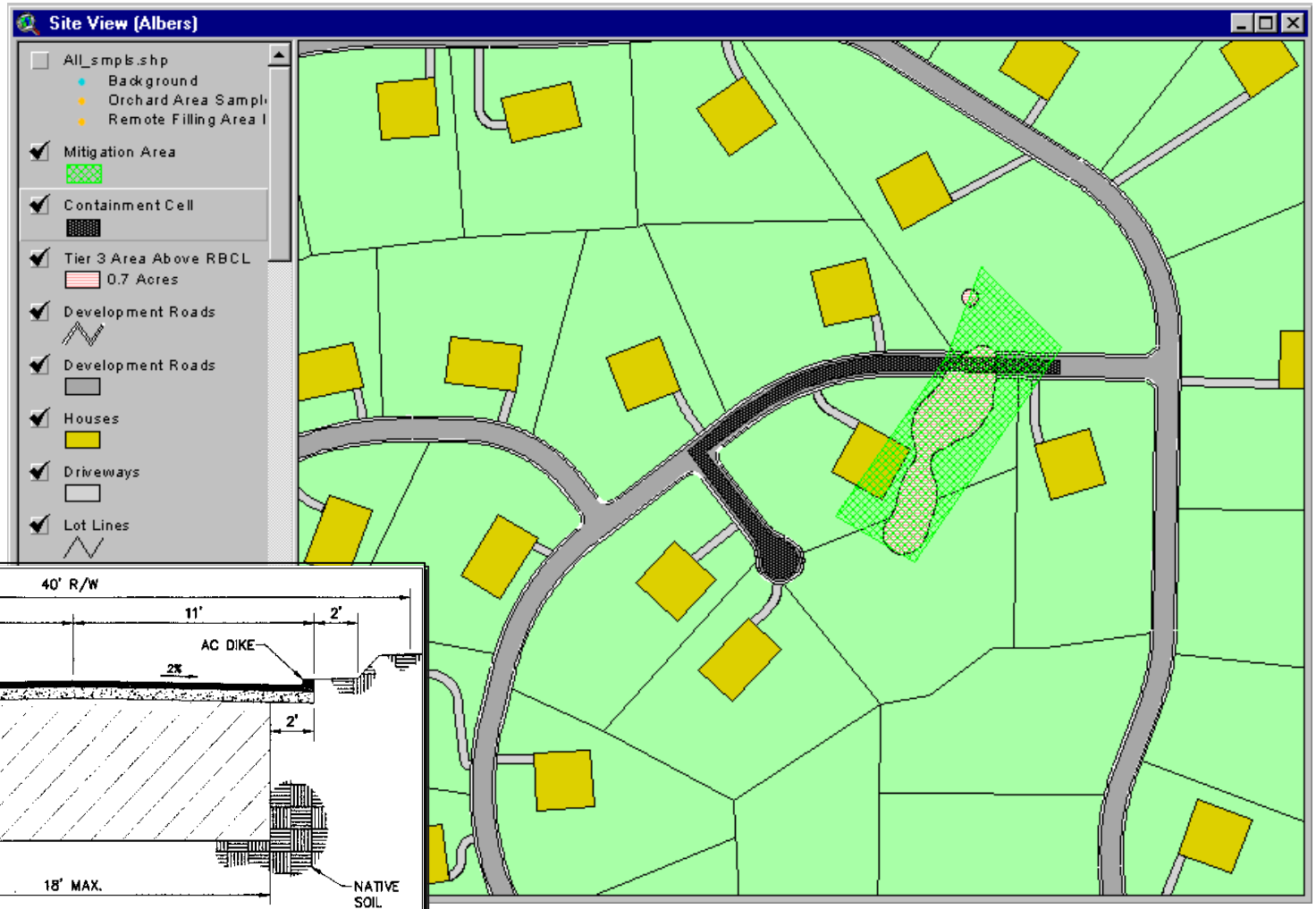
[b]Target HI is 1.0

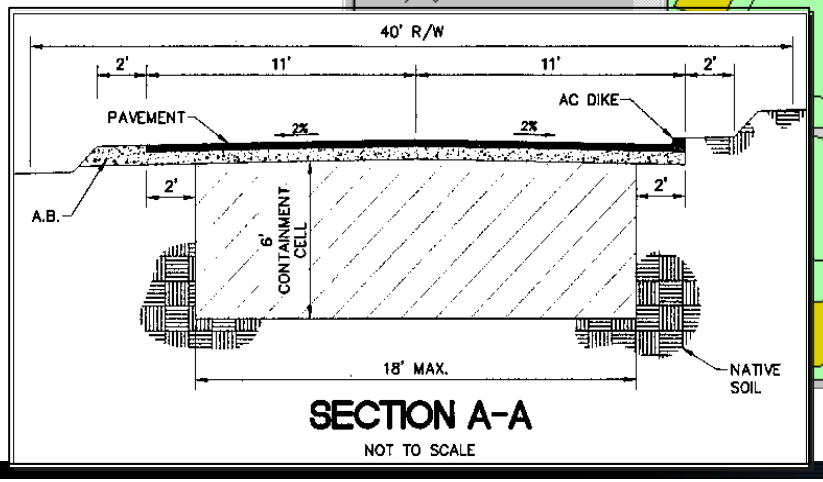
Tier 2 vs Tier 3

- **Results:**
  - Remediation area reduced ~97%
  - Significant cost savings
  - Stakeholder acceptance



The Selected Remedial Alternative





Summary

- Redevelopment plan developed first
- Risk-based approach established at outset
- Site characterization plan developed to support RBDM
- Early stakeholder interaction
- Proactive regulatory negotiation
- Integrated application of essential tools:
  - Toxicology (arsenic)
  - Geostatistics (GIS platform)
  - Tiered risk assessment
  - Site-specific bioavailability study