A Multi-Site RI/FS Framework Approach for 30 MGP Sites in Region 5

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Acknowledgement

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What's a manufactured gas plant?

- Facilities that converted coal to methane
- Operated from the late 1800's to mid-1900's
- Facilities were located along a water body
- Main contaminants (PAHs) were associated with the copious quantities of coal tar produced as a byproduct

A Diverse Group of MGP Sites

- 30 Sites split between Wisconsin and Illinois
- Most are along urban rivers and streams
- Some have had extensive remediation in the upland areas and redevelopmemt
- The evaluation and remediation of the river portion of each site still needs to be completed

From the Chicago River to .....


The Wisconsin River
at Stevens Point

Focus of Program

- Considers all the pathways of concern to EPA and the states (human health and ecological)
- Builds upon insights from the EPA Remediation Guidance and National Research Council (NRC) studies
- Focuses on zones of exposure and risk
- Incorporating characterization of ambient conditions to define zones
- Incorporates measures of toxicity and bioavailability to help delineate zones
- Builds upon experience using an adaptive management approach

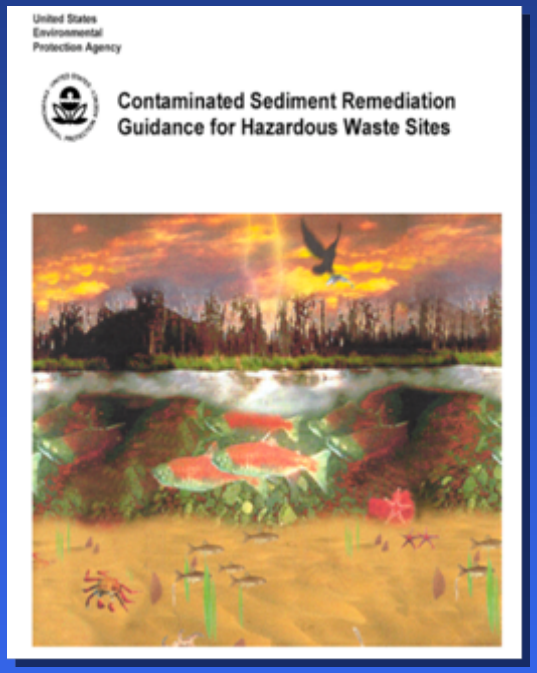
Multi-site Approach Advantage

- **Streamline RI work, minimize review time, and develop a consistent approach to assessing risk**

- **As site-specific data is generated and converges, less RI data is expected to be necessary for subsequent sites, saving time to remedial decisions**

The Zone Concept Extends From Recent USEPA Guidance:

- **Sediment management will:**
  - Be increasingly site-specific
  - Be guided by conceptual models
  - Be tied to overall management goals
  - Include a mix of technologies (no-action, MNR, capping, treatment and/or removal)
  - Rely on decision approaches that incorporate a comparative analysis of remedial options



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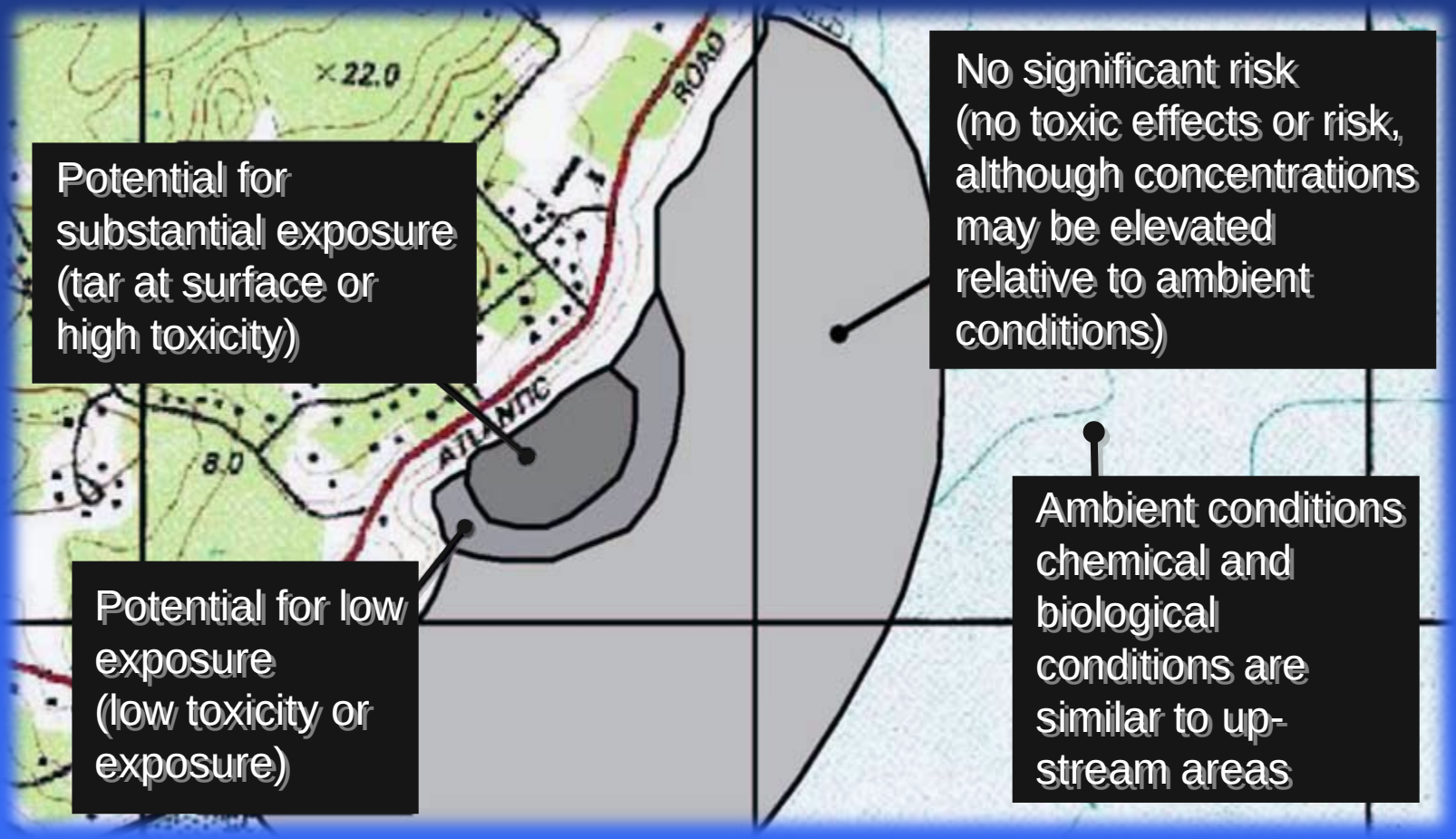
Overview of Zone Concept



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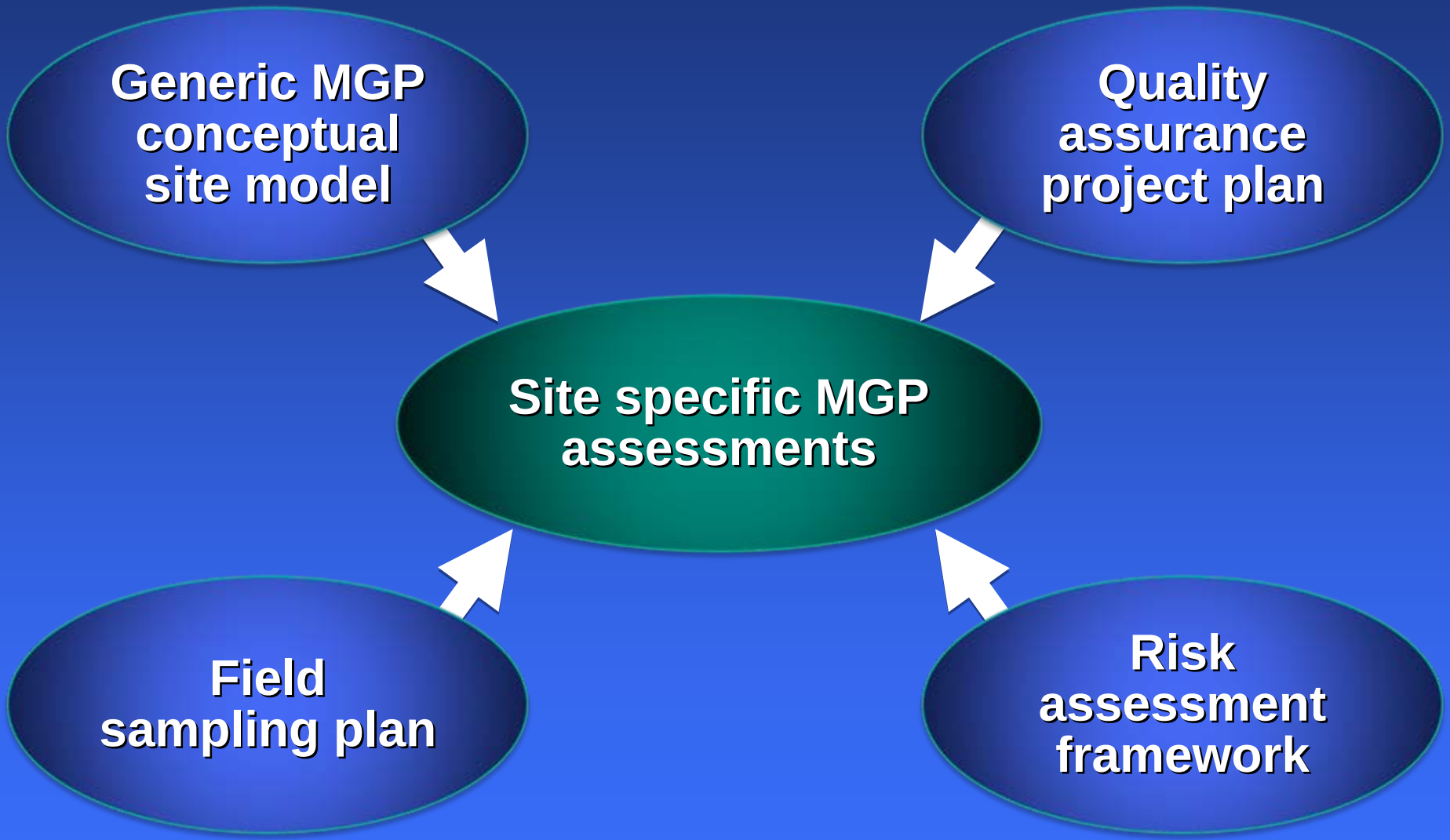
Tools for Differentiating Zones at MGP Sites

- Site specific conceptual models that consider all potential pathways
- Methods to detect and map spatial and vertical extent of NAPL
- Physical characterization
- Biological characterization
- Chemical characterization
- Toxicity measures
- Forensic and emerging methods

The Multi-site Documents



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Flexibility within the RAF

- Site-specific risk determination (complex sites)
- Lookup screening levels (less complex sites)
- Adaptive management
- Build on experience and data from previous work
- Focus on gray exposure zone
- Consider ambient conditions
- Only collect data that informs the remedial decisions

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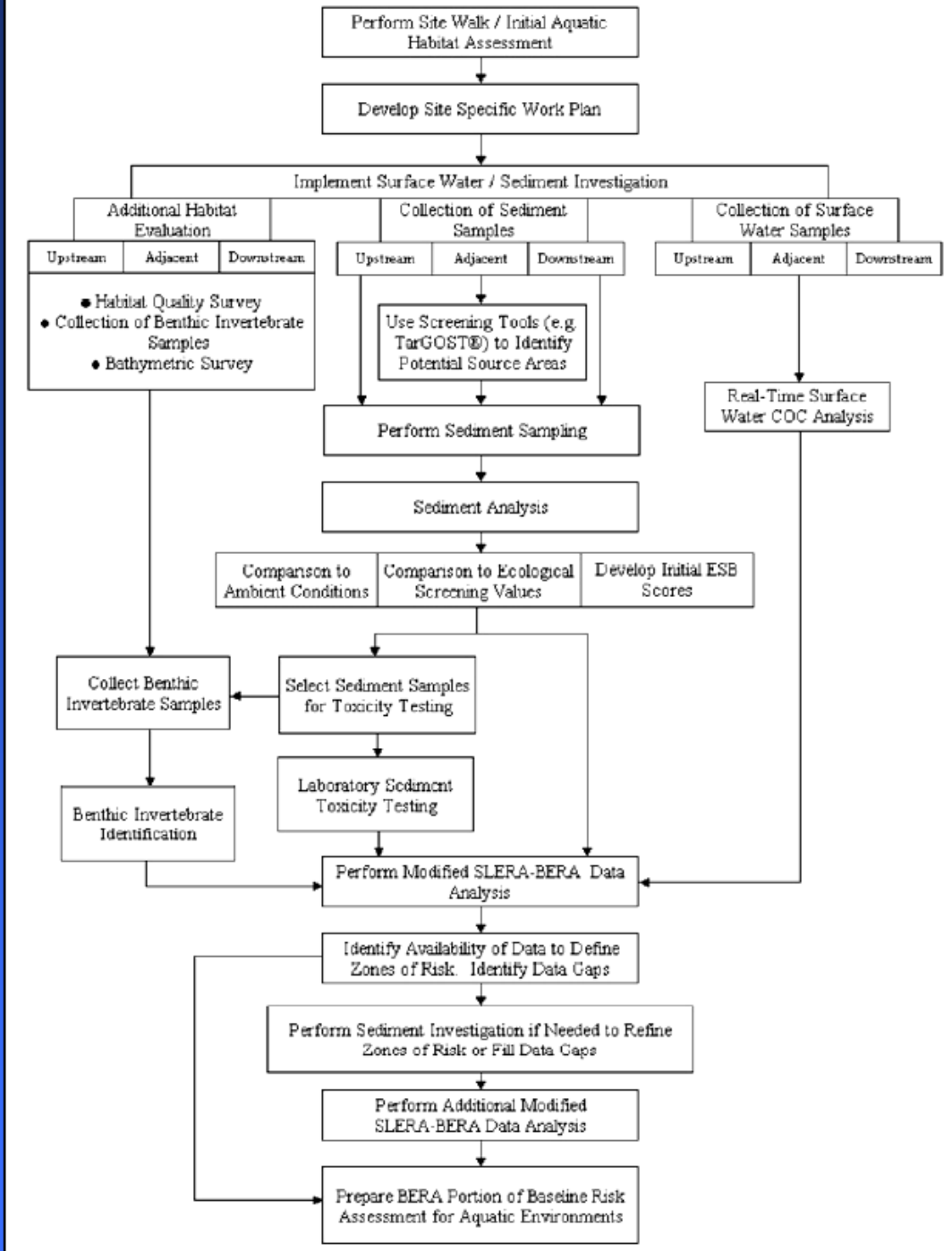
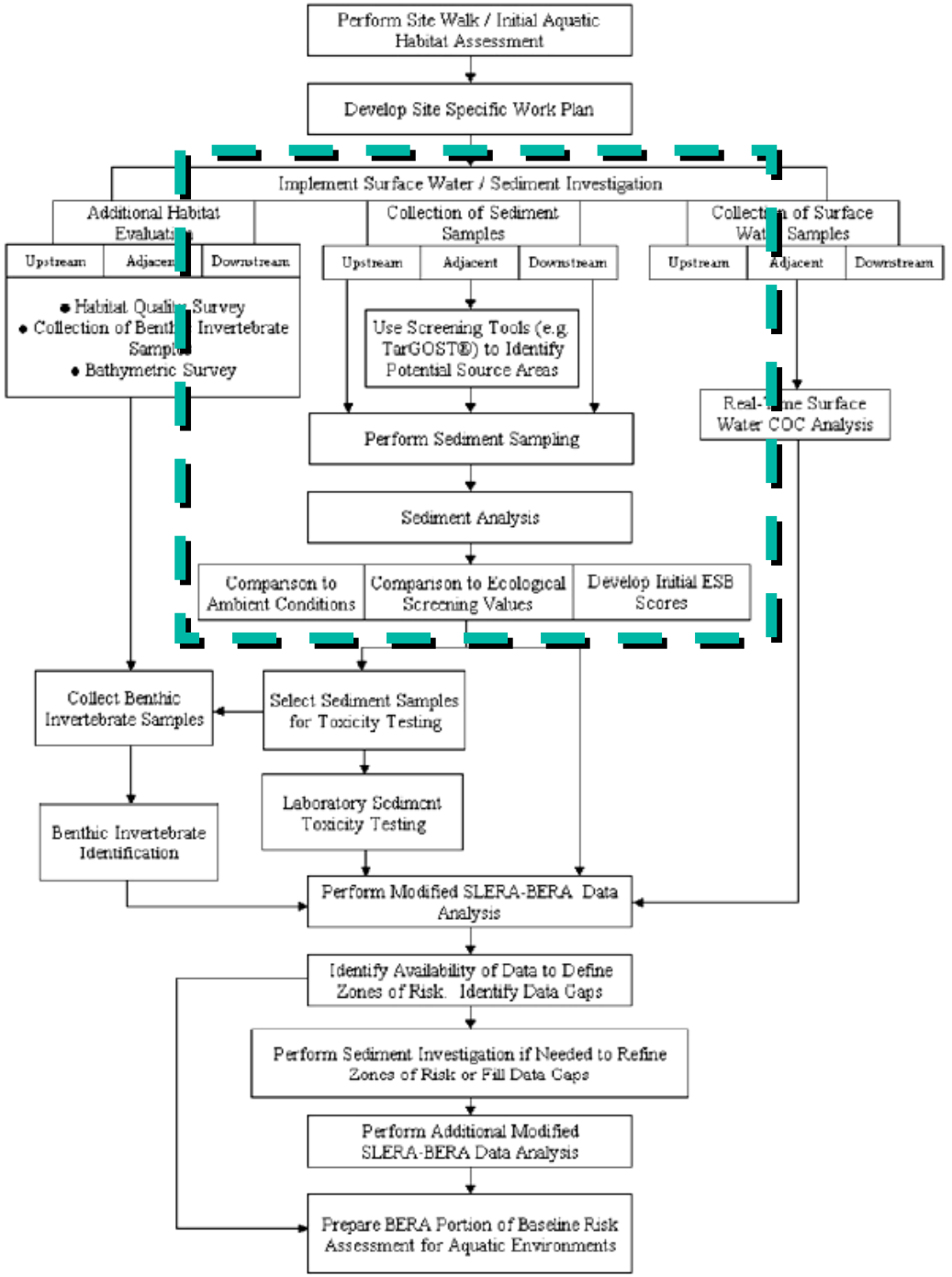
The Process for Evaluating Ecological Risks and Delineating Zones



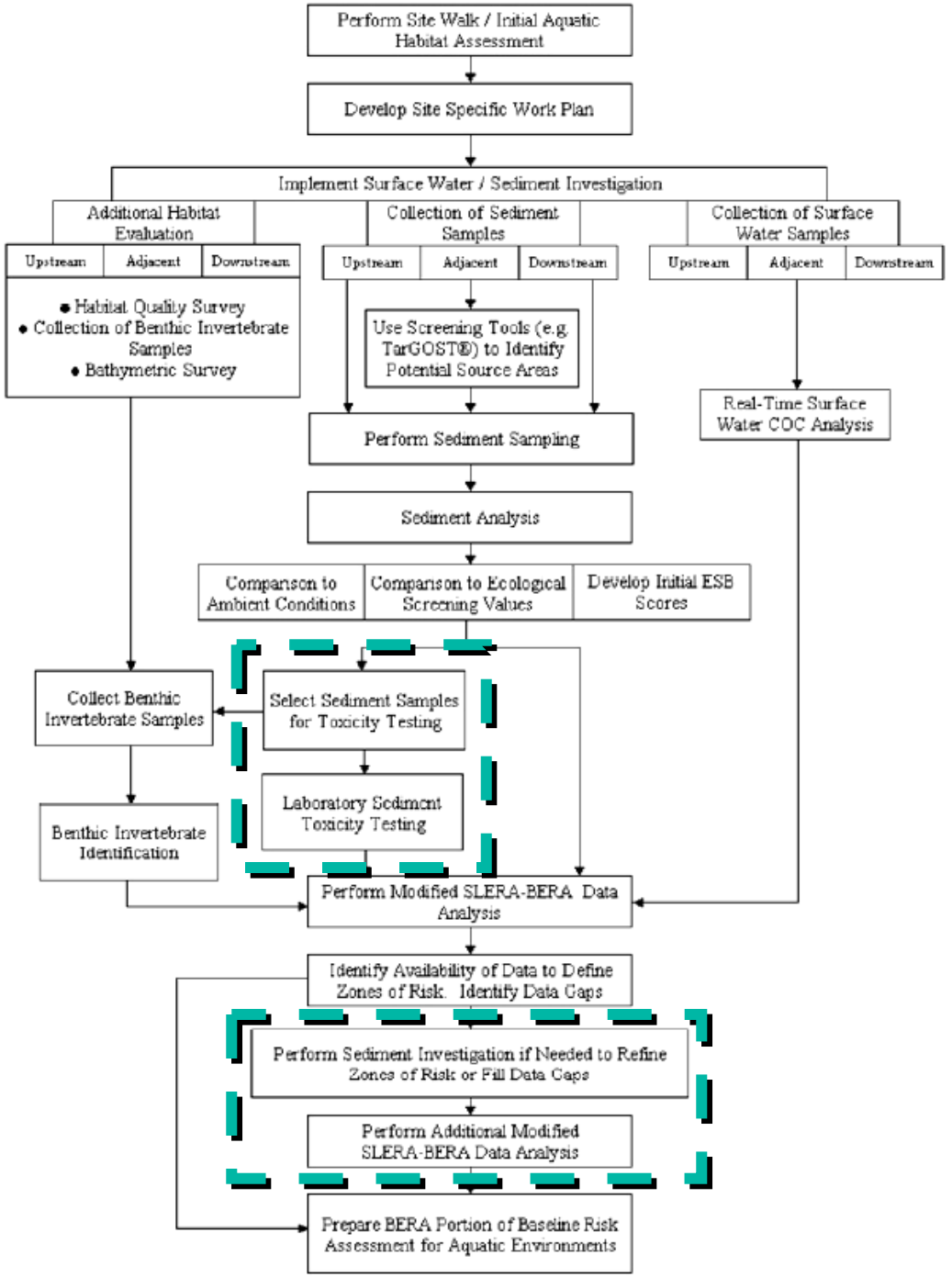
The Process For Evaluating Ecological Risks and Delineating Zones

- Begins with screening-level analyses that:
  - Relies on available data
  - Relies on screening values
  - Is augmented with new data
  - Defines major boundaries

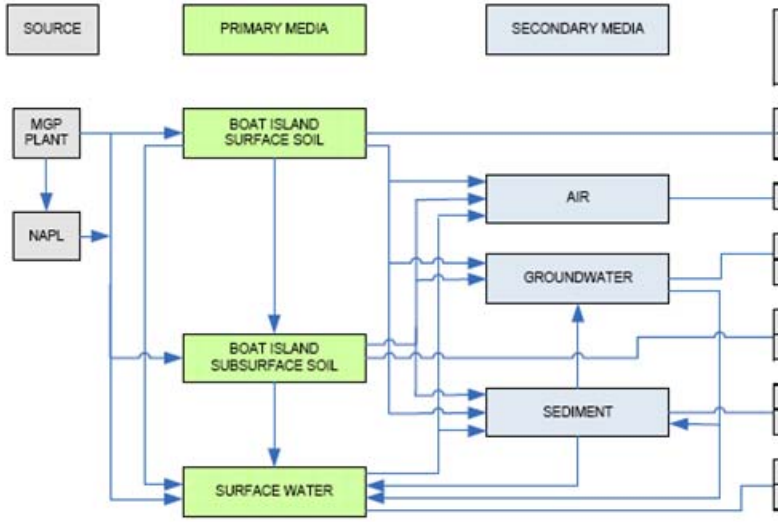


The Process For Evaluating Ecological Risks and Delineating Zones *(continued)*

- Relies on toxicity and bioavailability measures to refine exposure estimates to:
  - Distinguish low exposure from high and insignificant exposure zones
  - Guide remedy selection



Conceptual Site Model Refinement



EXPOSURE ROUTE	HUMAN RECEPTORS				ECOLOGICAL RECEPTORS			
	INDUSTRIAL/ COMMERCIAL WORKER	CONSTRUCTION WORKER	RECREATIONAL	RESIDENTIAL	BIRDS	MAMMALS	FISH	BENTHIC INVERTEBRATES
INGESTION	○	○	○	○	○	○	NA	NA
DERMAL	○	○	○	○	○	NA	NA	NA
INHALATION	○	○	○	○	NA	NA	NA	NA
INGESTION	NA	NA	NA	NA	NA	NA	NA	NA
DERMAL	NA	NA	NA	NA	NA	NA	NA	NA
INGESTION	○	○	○	○	NA	○	NA	NA
DERMAL	○	○	○	○	NA	NA	NA	NA
INGESTION	○	○	●	○	○	○	○	●
DERMAL	○	○	●	○	○	NA	○	●
INGESTION	○	○	○	○	○	○	○	○
DERMAL	○	○	○	○	○	NA	○	○

LEGEND:
- ● Pathway potentially complete and warrants further evaluation within the Baseline Risk Assessment.
- ○ Pathway not complete or considered insignificant; No further evaluation is recommended.
- ◊ Pathway potentially complete and will be evaluated based on the results of the ecological habitat assessment.

NA: Not Applicable

NOTES:
1. Discussion of exposure assumptions will be included in the CSM text.
2. Birds and mammals may include aquatic and terrestrial ecological receptors.

Figure 1		RIVER OU SHEBOYGAN CAMPMARINA FORMER MGP SHEBOYGAN, WI	Drawn By: JTB	Date 01/13/2009
			Checked	JMK
Revision 0		WISCONSIN PUBLIC SERVICE	Approved	MWK

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Is anybody home down there?

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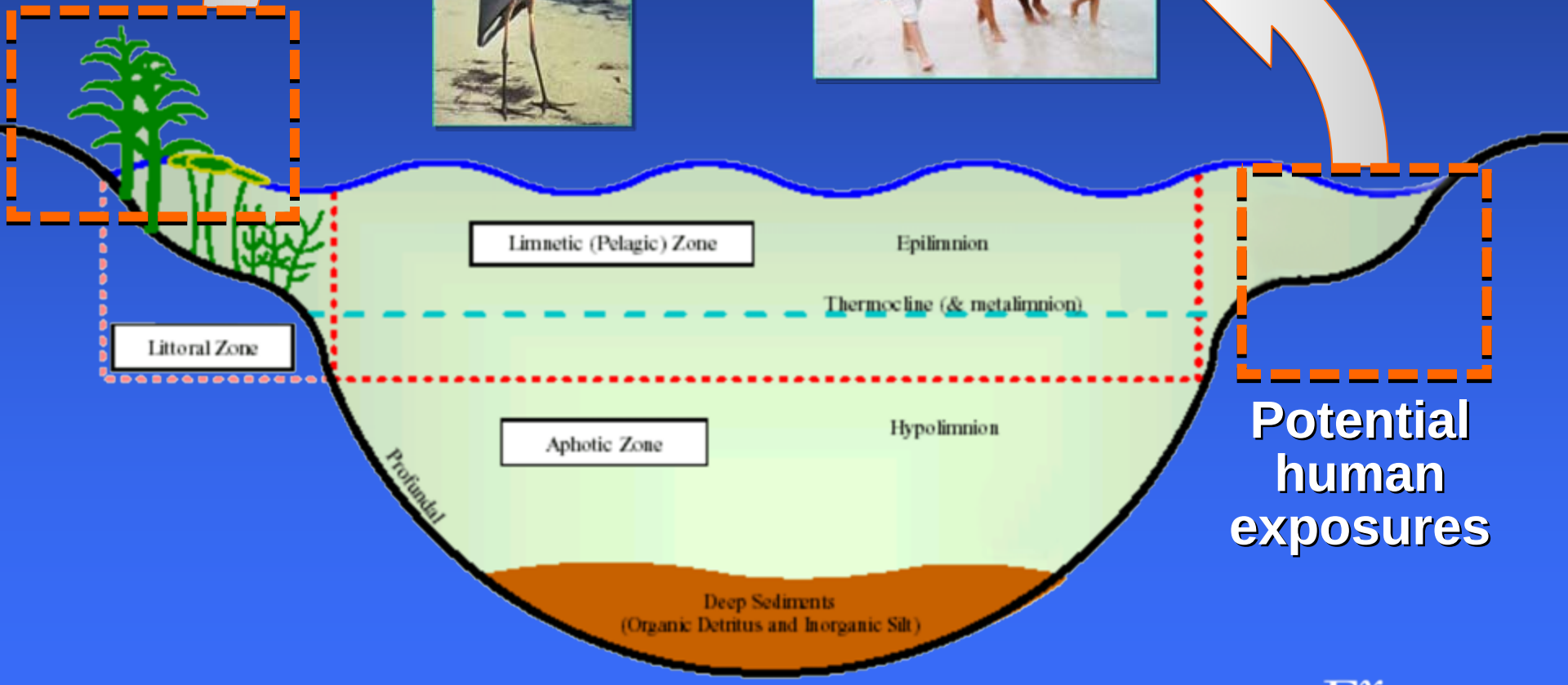
Bioaccessibility: The Importance of Water Depth at MGP Sites



Potential human exposures

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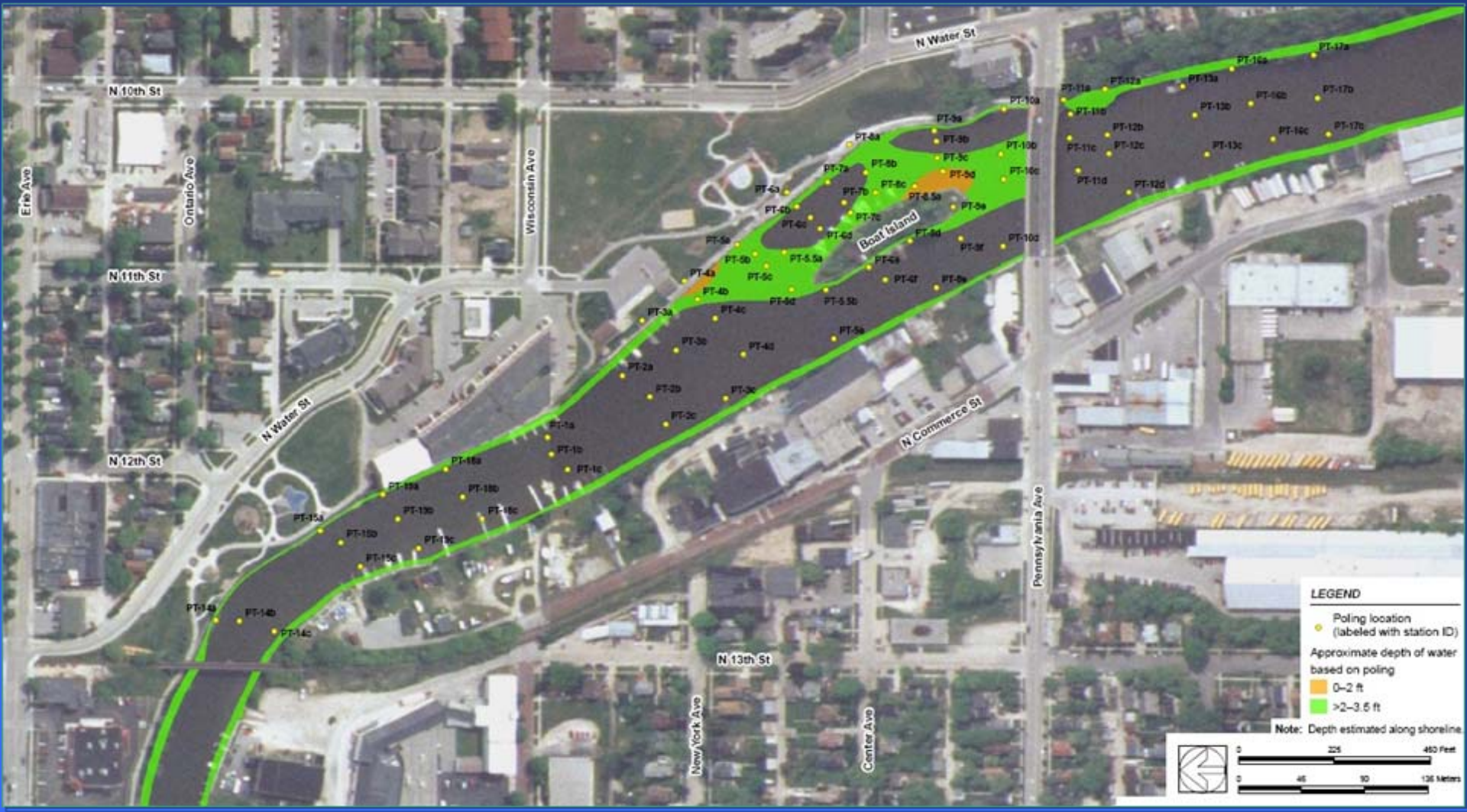
Wadeable Areas with the River



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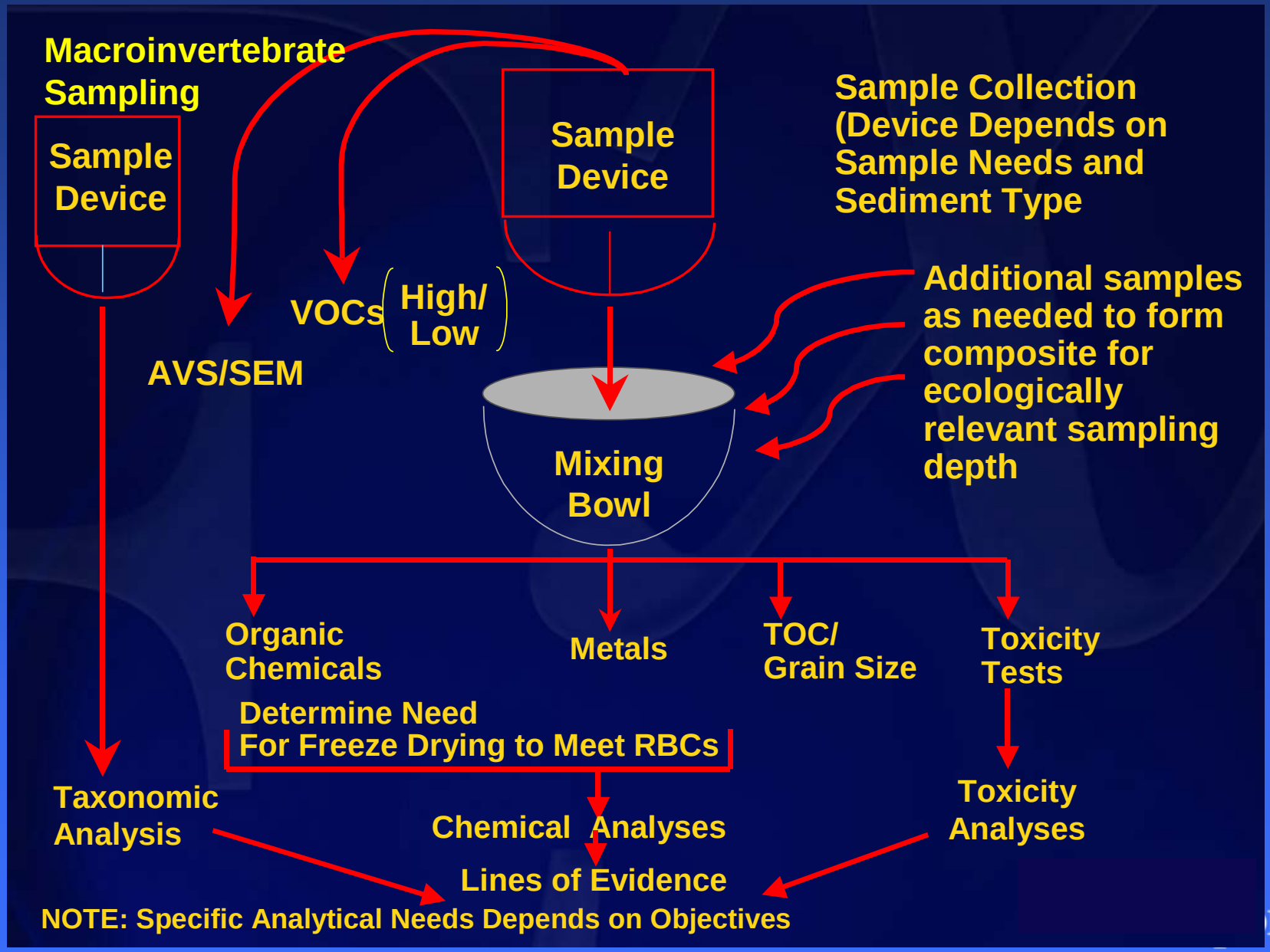
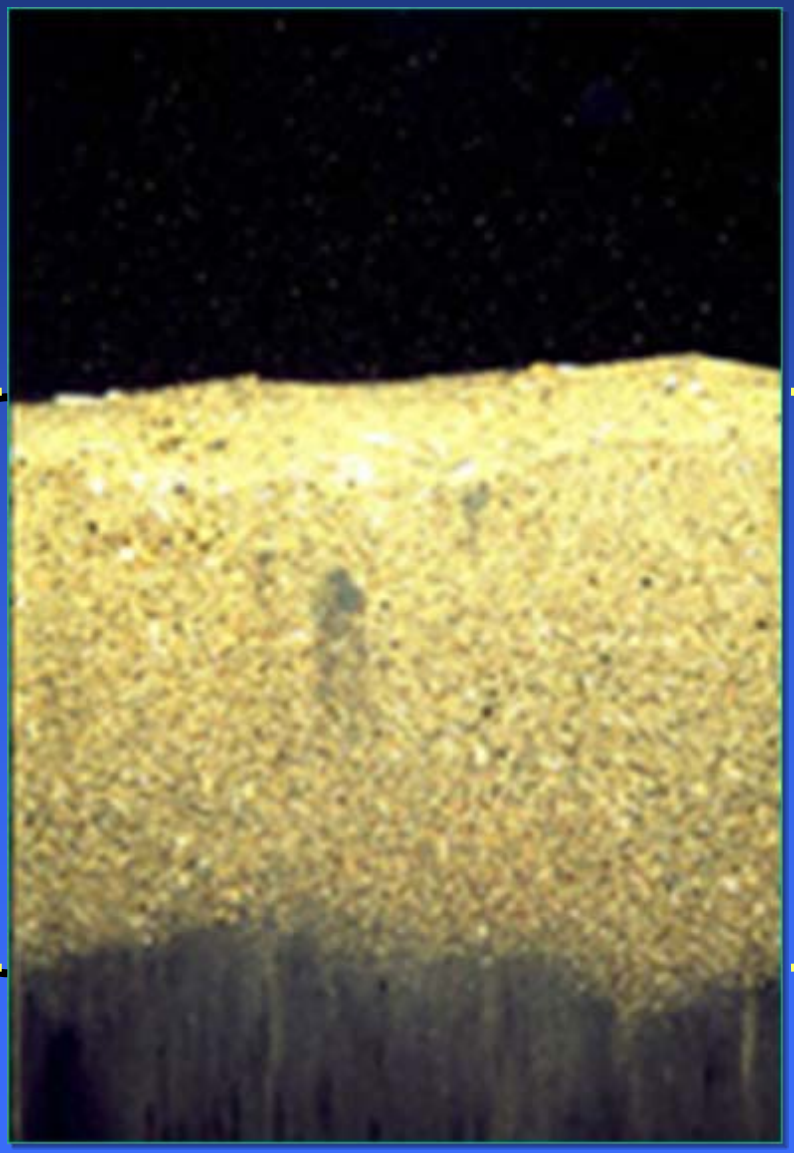
The Synoptic Sampling Approach



Bioaccessibility: The Importance of Sediment Depth at Utility Sites

The biologically active zone can range from under an inch to a few feet



This zone is relevant for exposures to most biota

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Sediment Chemistry Data Used to Delineate the Ambient Zone

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Chicago River MGP Sites

Characterizing Ambient Conditions

Surface Sediment Ambient PAH Zone

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Sediment Toxicity Data used with Ambient Data to Delineate Four Zone of Exposure and Risk

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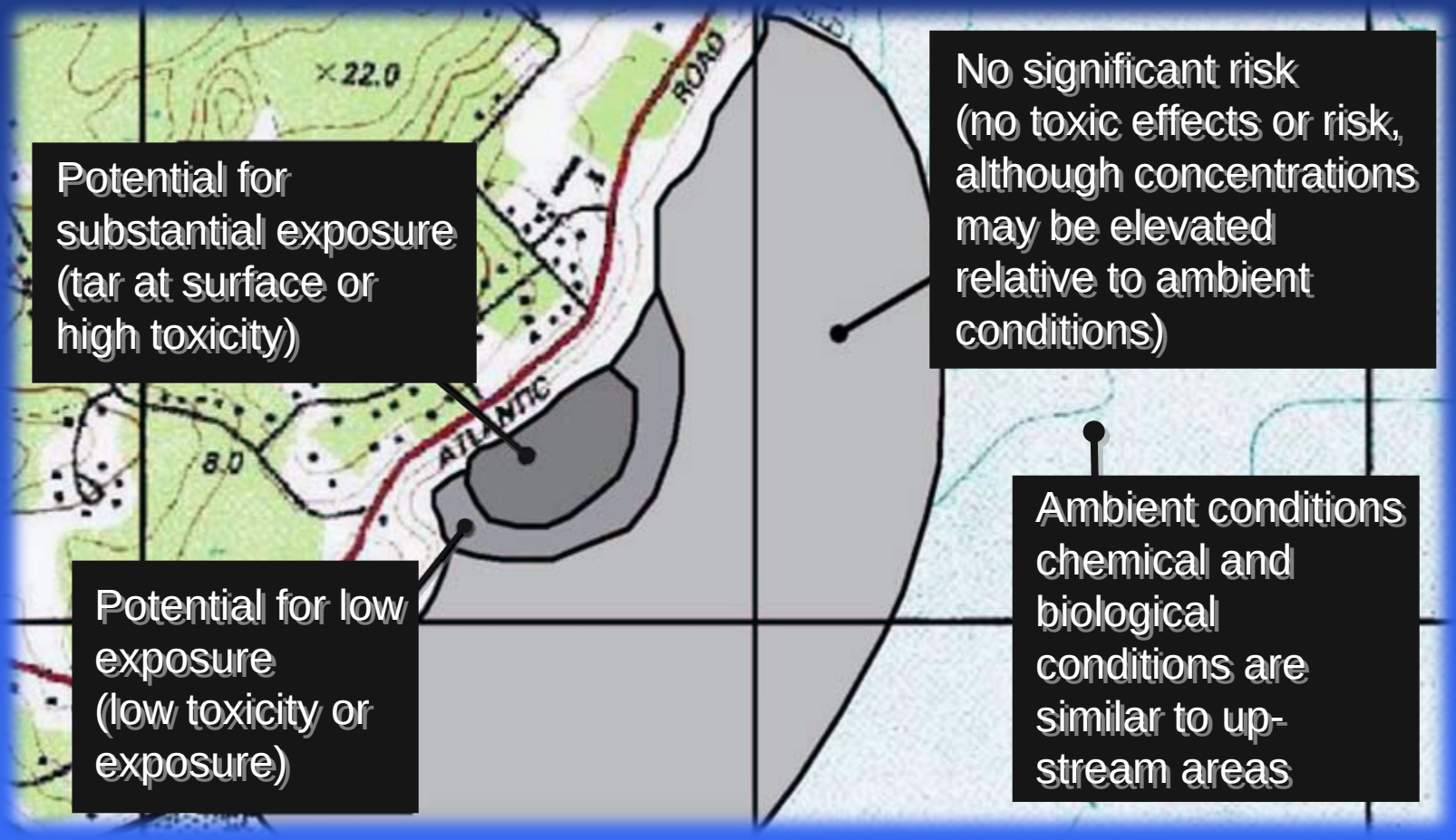
Review of Four Zones



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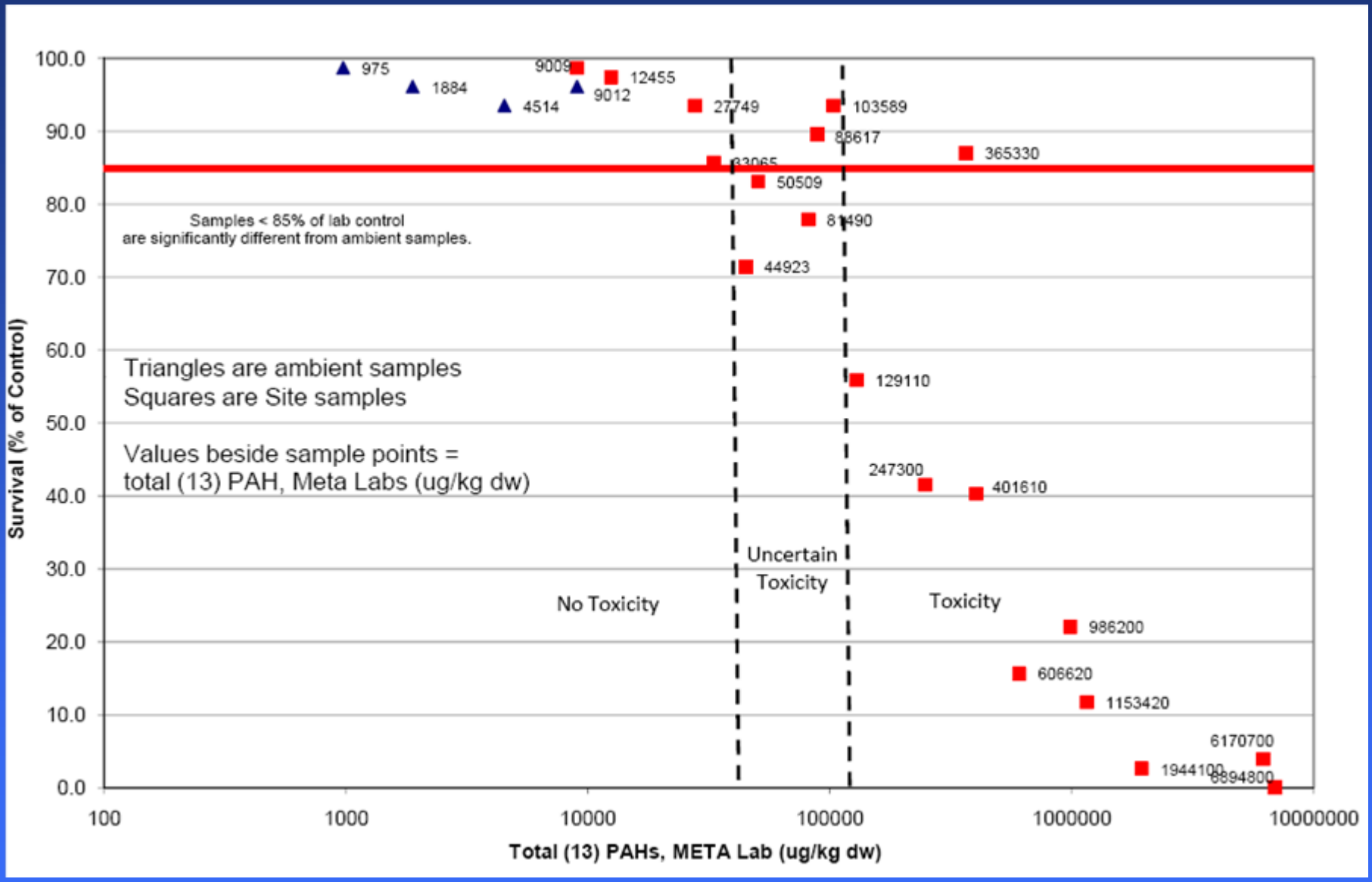
Survival Data versus Total PAHs



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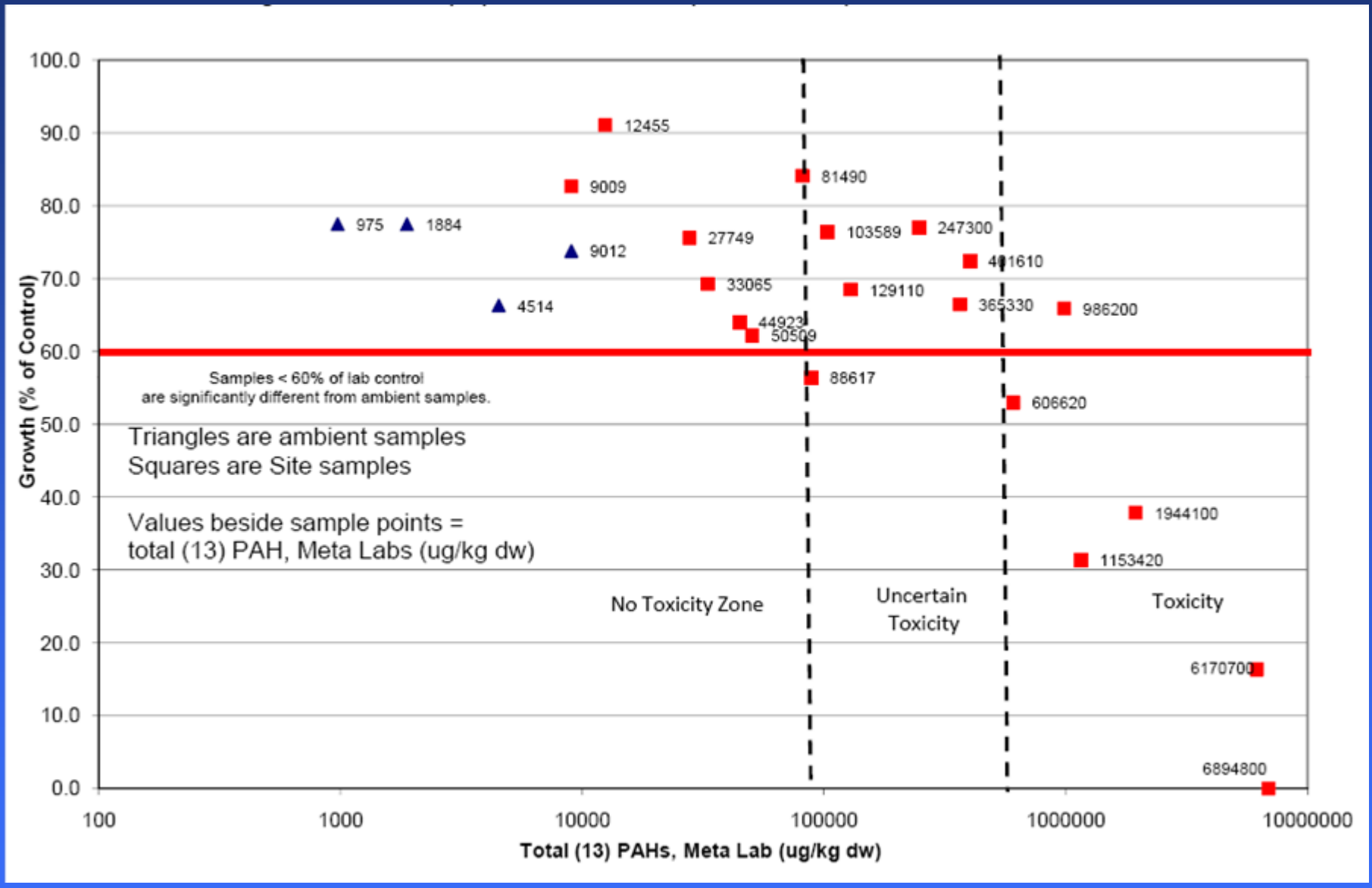
Growth Data versus Total PAHs



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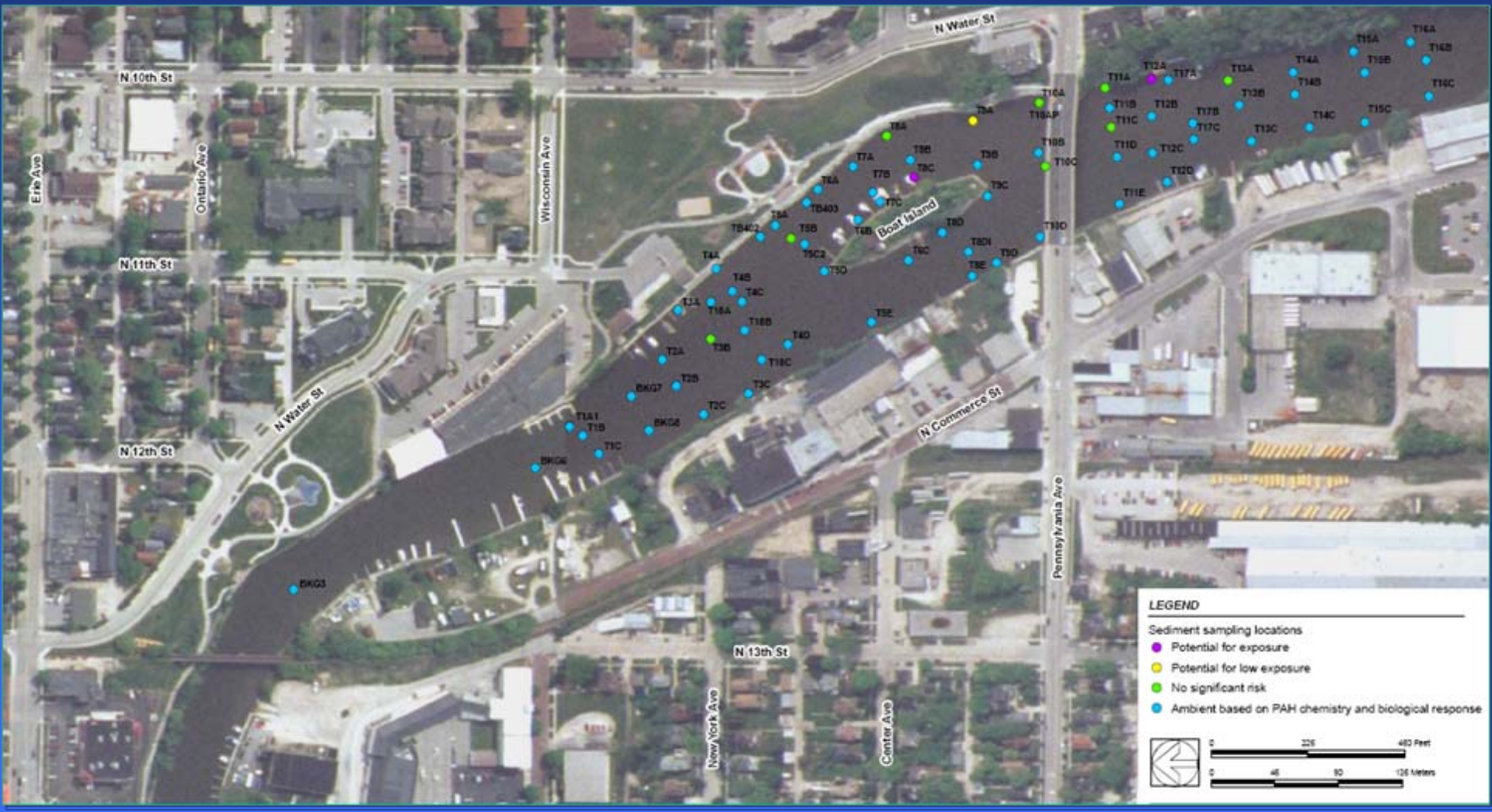
Surface Sediment Zones



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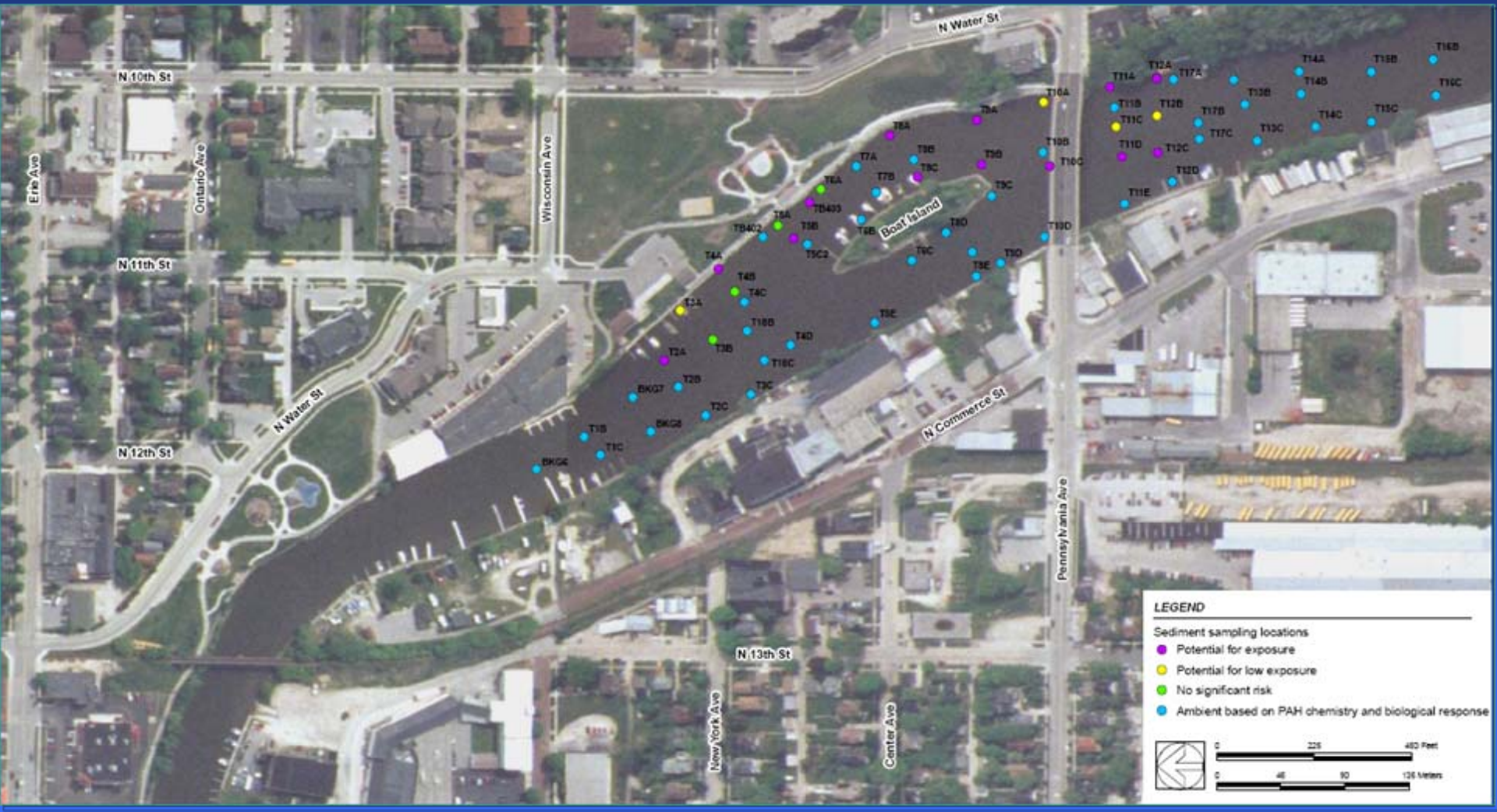
Near Surface Sediment Risk Zones



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Bioavailability of Chemicals in Sediments Remains a Muddy Issue

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Bioavailability Can Influence Exposures of PAHs to Humans and Ecological Receptors At MGP Sites

Bioaccumulation in invertebrates

Diet

Dermal contact bioaccumulation in shellfish incidental ingestion

Water exposure

The Biologically Available Fraction

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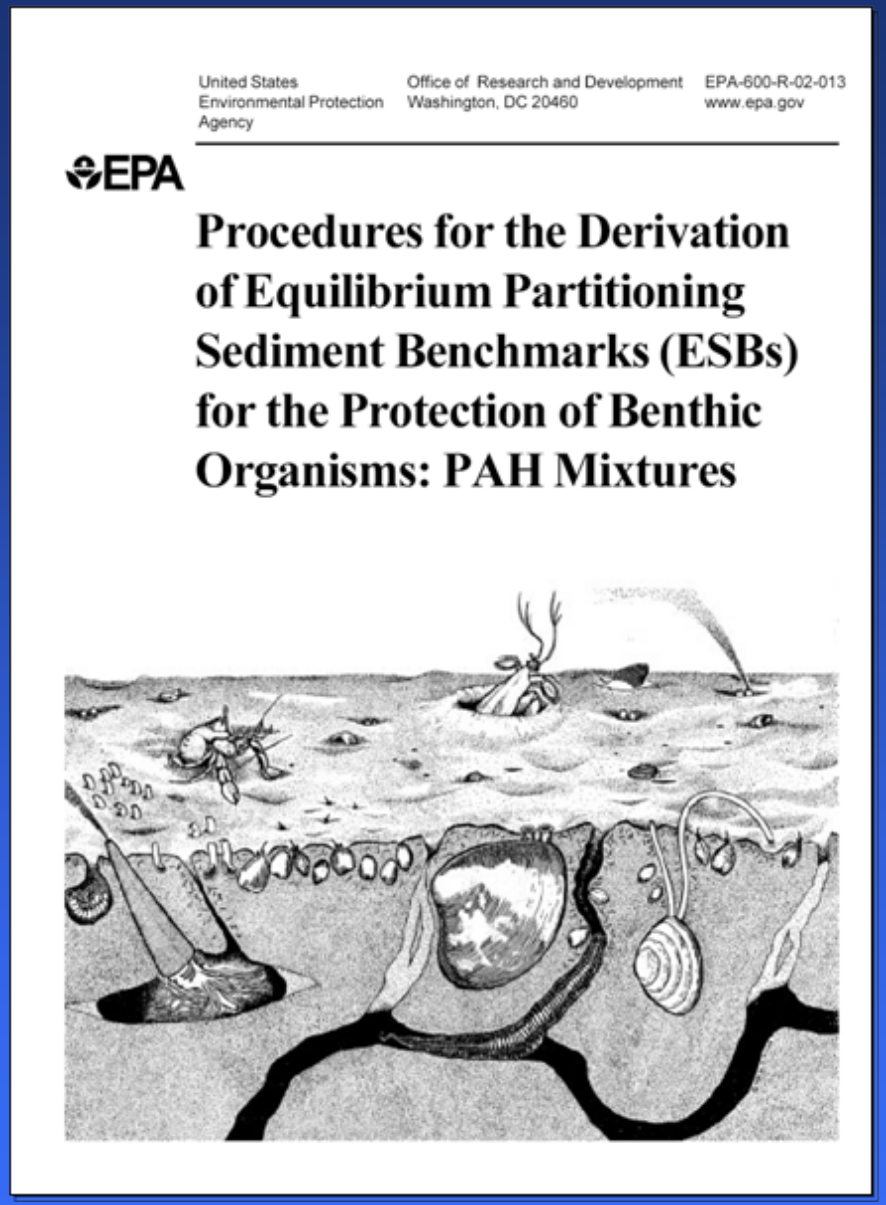
Available Methods for Evaluating Bioavailability of PAHs in Sediments

- Direct measurements in pore water adjusted for DOC
- Estimate from measures of black carbon and natural carbon
- Solid phase micro extraction (SPME)
- Supercritical fluid extraction (SFE)
- In-field passive samplers

The Consideration of Bioavailability in the RAF is Based on U.S. EPA's Guidance

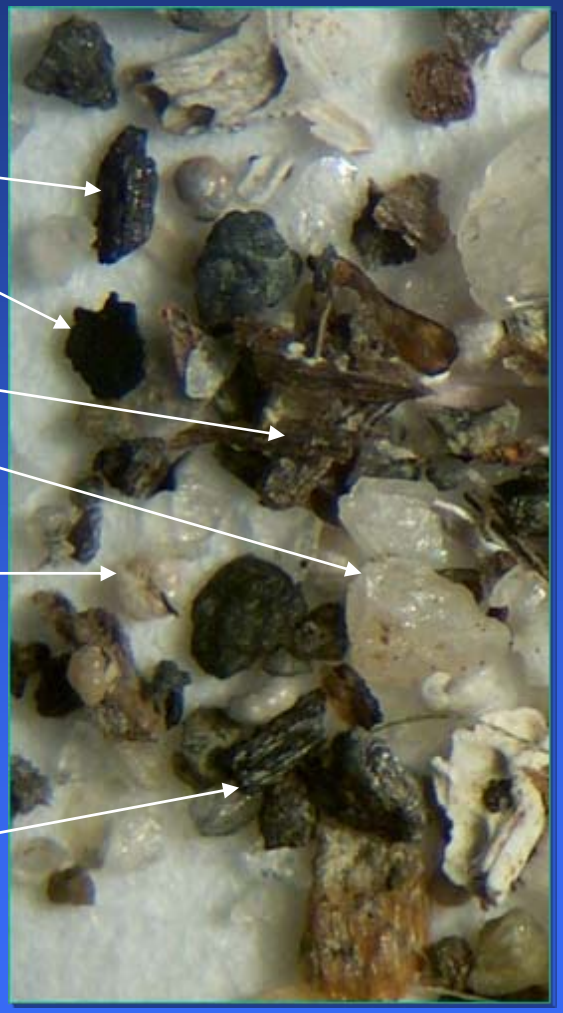
One can apply the general PAH ESB approach to the interstitial water or develop site-specific partition coefficients



PAH Target Analytes

- Priority pollutants (PAH_{16})
  - Naphthalene
  - Acenaphthene
  - Acenaphthylene
  - Fluorene
  - Anthracene
  - Phenanthrene
  - Fluoranthene
  - Pyrene
  - Benz[a]anthracene
  - Chrysene
  - Benzo[b]fluoranthene
  - Benzo(k)fluoranthene
  - Benzo[a]pyrene
  - Indeno[1,2,3-cd]pyrene
  - Dibenz[a,h]anthracene
  - Benzo(g,h,i)perylene
- Forensics analyte list (PAH_{42})
  - C_1–C_4 Naphthalenes
  - C_1–C_3 Fluorenes
  - C_1–C_4 Phenanthrenes
  - C_0–C_4 Dibenzothiophenes
  - C_1–C_3 Fl/Py
  - C_1–C_4 Chrysenes
  - Benzo[e]pyrene
  - Perylene

The Carbon Story: It Makes a Difference for Organic Chemicals



Hunters Point Sed (63–250 mm)

Collaborator: Upal Ghosh

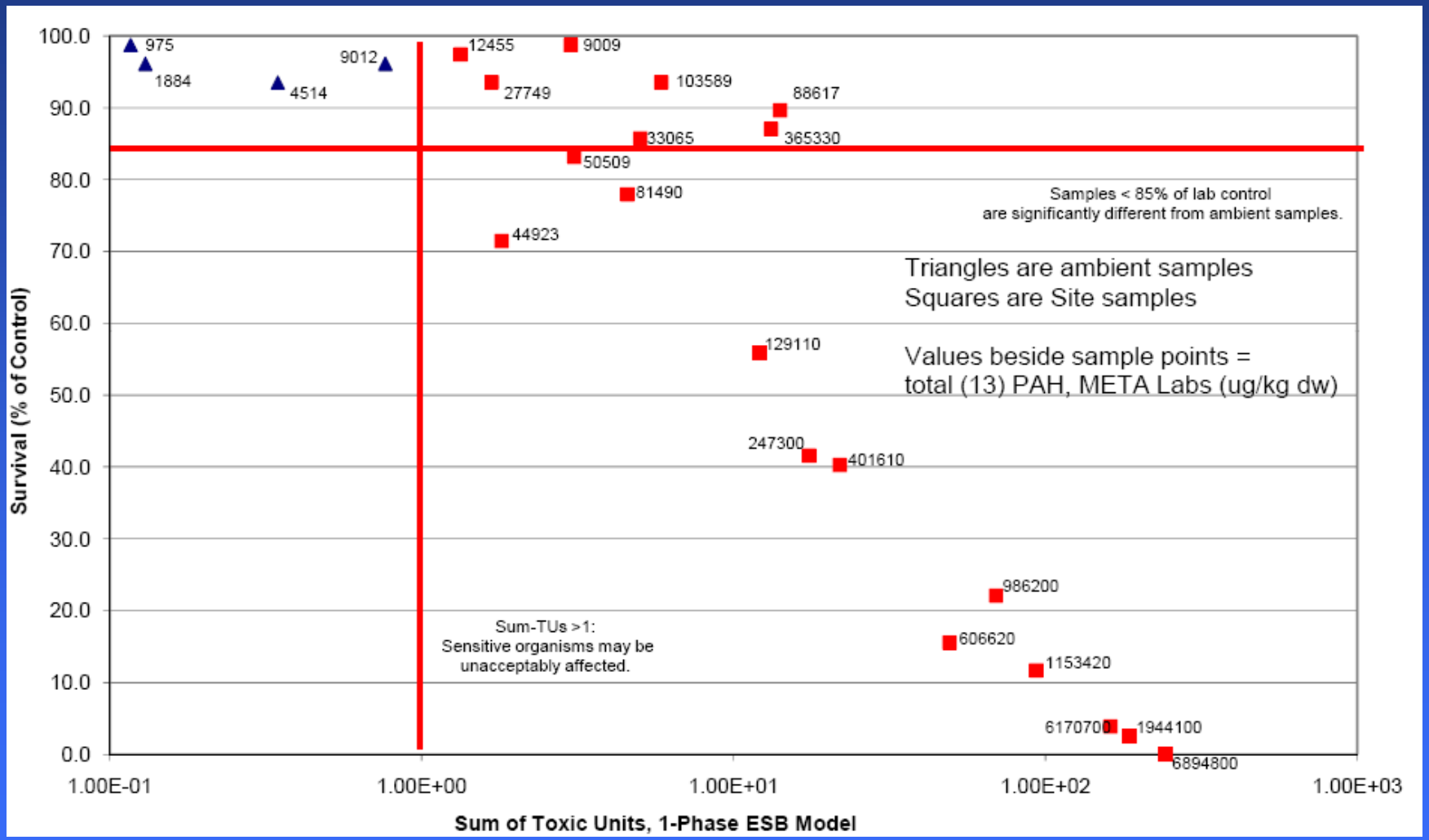
- **Sediment contains sand, silt, clays, charcoal, wood, char, coal, coal byproducts**
- **Over time PCBs, pesticides and PAHs accumulate in coal, charcoal, coke, and pitch and become less bioavailable**

Petrography images

coal charcoal coke

Sources: Ghosh et al. (2000), *ES&T*, 34, 1729–1736
Ghosh et al. (2001), *ES&T*, 35, 3468–3475
Talley et al. (2001), *ES&T*, 36, 477–483

ESB Phase 1 Model Results Compared to Actual Toxicity Data



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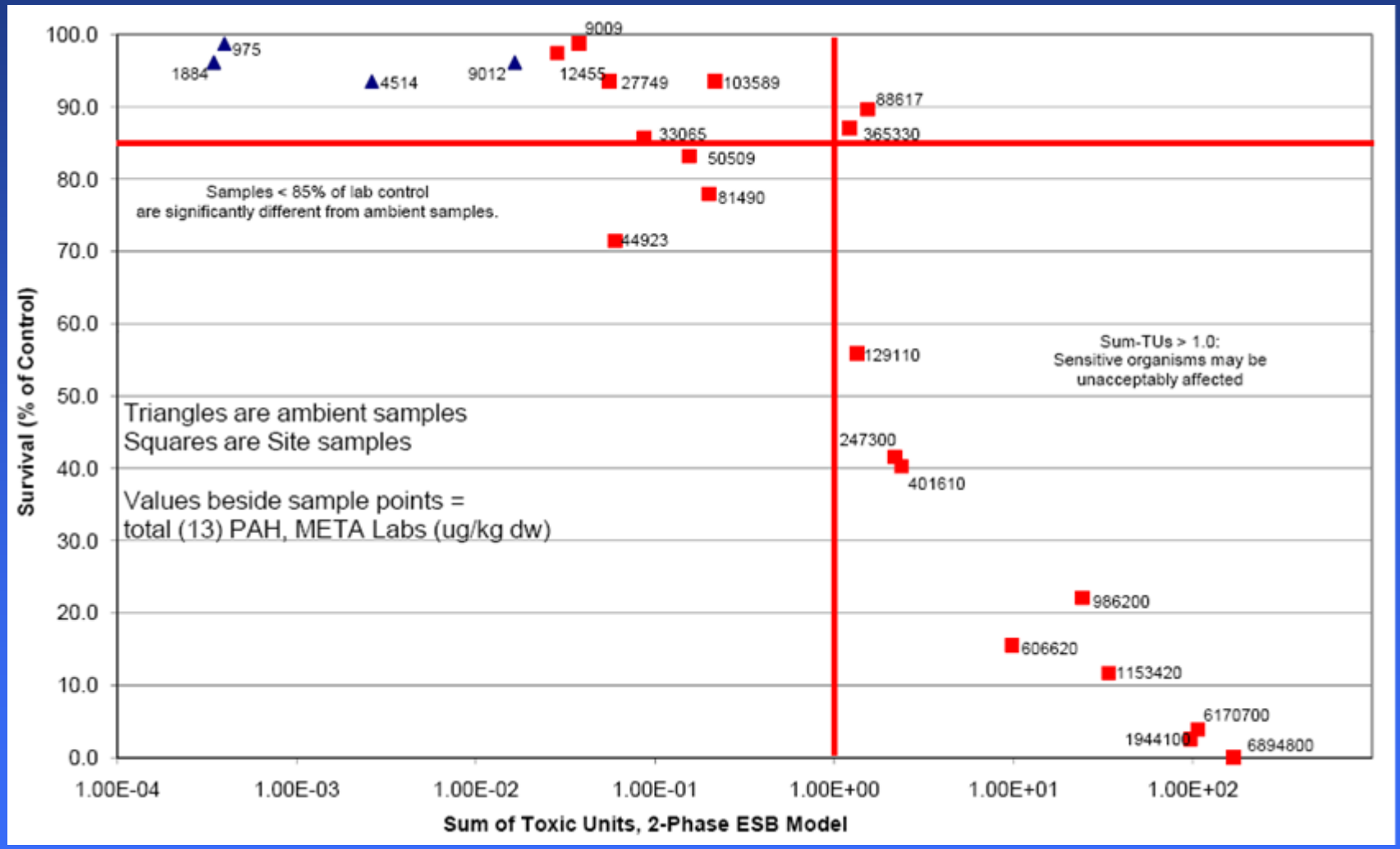
ESB Phase 2 Model Results Compared to Actual Toxicity Data



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Summary of Multi-site Approach

- A consistent but flexible approach developed to be applied to all 30 sites
- An approach to delineate exposure zones was developed
- The approach considers all exposure pathways relevant to a specific site
- Zones can be defined in terms of degrees of exposure as well as physical characteristics
- The approach is designed to guide subsequent remedial decisions consistent with guidance