Management of Contaminated Sediments - Willamette River Portland, Oregon USA

Philip Spadaro

November 2024

Disclaimers

- Comments represent my opinions only
- No company positions are stated
- No specific technologies, vendors, or contractors are endorsed
- No clients are represented
- No animals were harmed

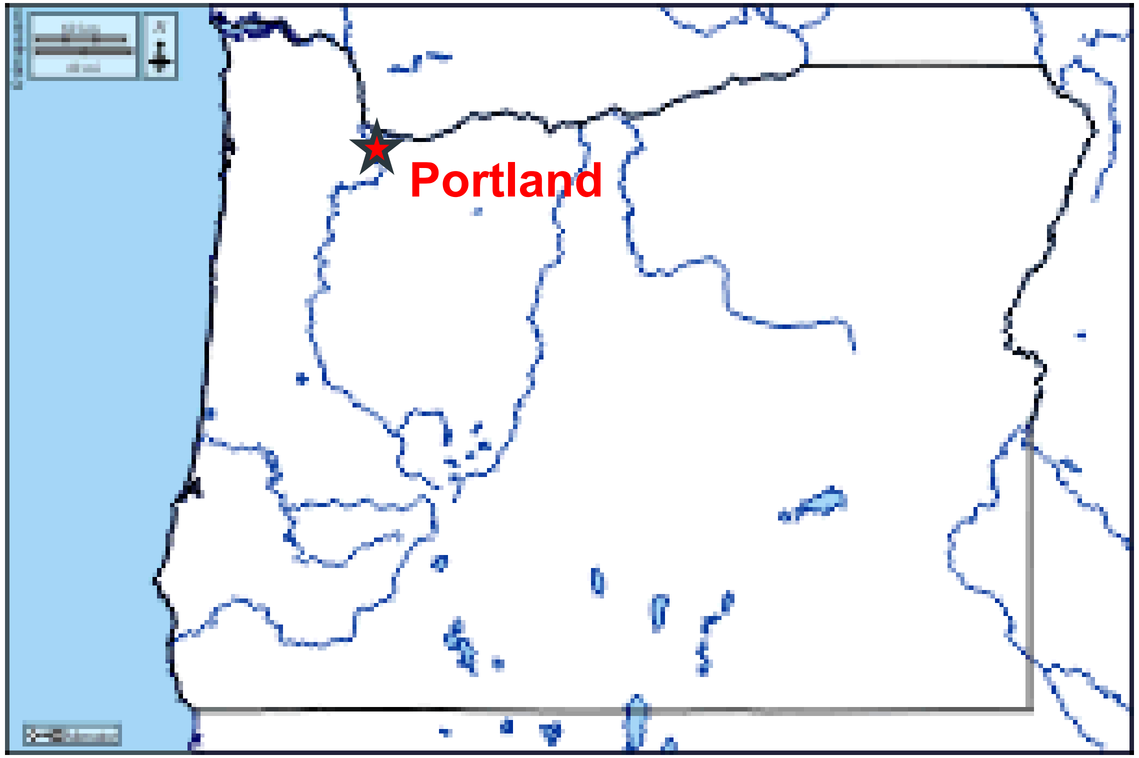
Urban
WATERWAY ASSOCIATES

Agenda

- Regulation of contaminated sediments in the USA
- CERCLA as a regulatory tool
- Portland Harbor site history
- Sediment characteristics
- Remedial design/technology
- Project cost and allocation
- Future timeline

Urban WATERWAY ASSOCIATES

Portland (Oregon) Harbor



Urban
WATERWAY ASSOCIATES

Some Facts About Portland

- Portland is home to one of the largest urban forests in the country
- The largest independently owned bookstore (Powell's) in the world is here
- Most Simpsons characters are named after streets in Portland

Urban WATERWAY ASSOCIATES

Available Legal/Administrative Management Frameworks

- Clean Water Act (CWA, 1972, Nixon Administration)
- Resource Conservation and Recovery Act (RCRA, 1976, Ford Administration)
- Toxic Substances Control Act (TSCA, 1976, Ford Administration)
- **Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, 1980, Carter Administration)**
- Great Lakes Legacy Act (GLLA, 2002, G.W. Bush Administration)
- Various State laws, programs, and policies
  - Most derive authority from the Clean Water Act
- Washington State is exceptional and has its own law to regulate the clean up of contaminated sediments

Urban WATERWAY ASSOCIATES

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or SuperFund)

- Established prohibitions and requirements concerning closed and abandoned hazardous waste sites
- Provided for strict (joint and several) liability of responsible parties for releases of hazardous waste at these sites
- Established a trust fund to provide for cleanup when no responsible party could be identified (no longer in use)
- CERCLA is not well suited for certain sites
  - Large and complex sites
  - Multiple sources of pollution
  - Diverse responsibility for pollution

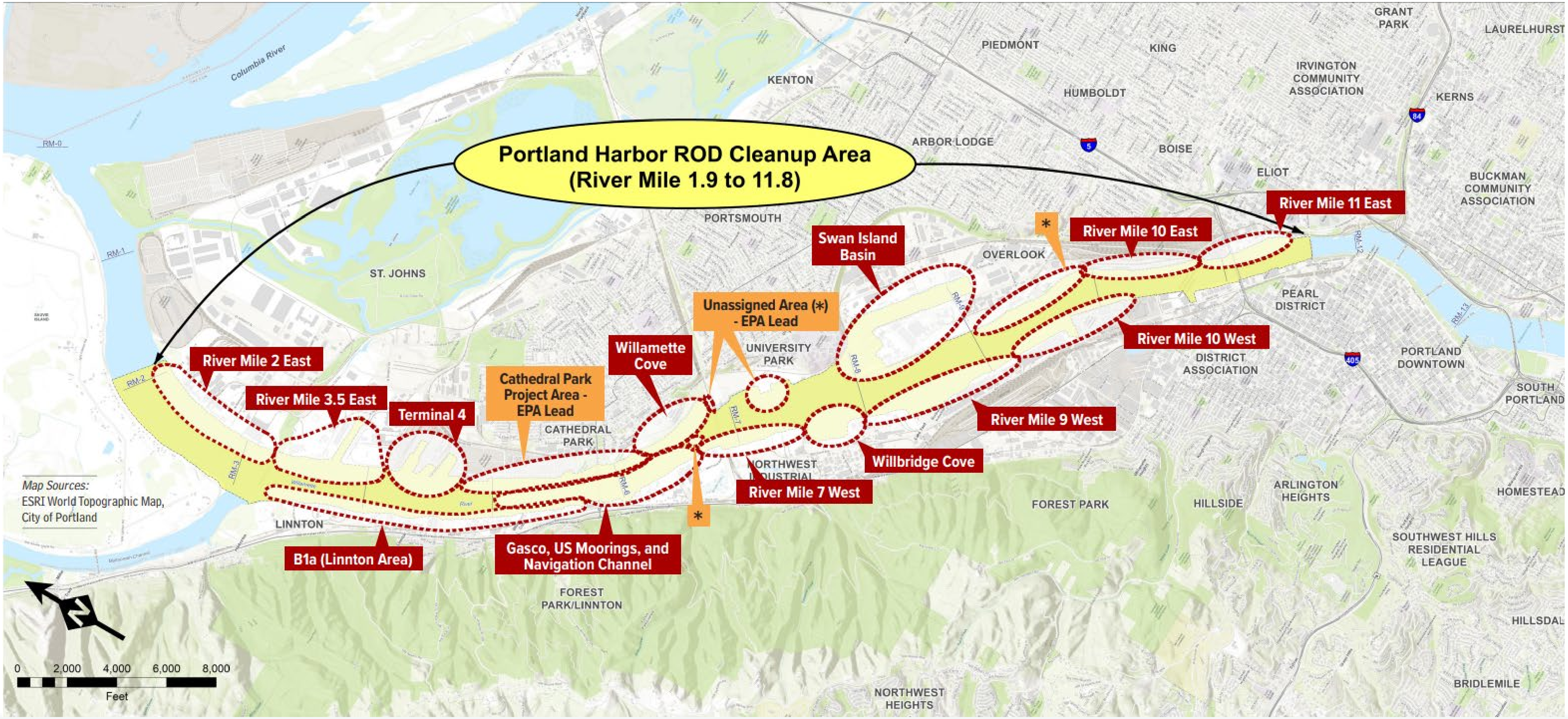
Urban WATERWAY ASSOCIATES

EPA Principles of Contaminated Sediment Management

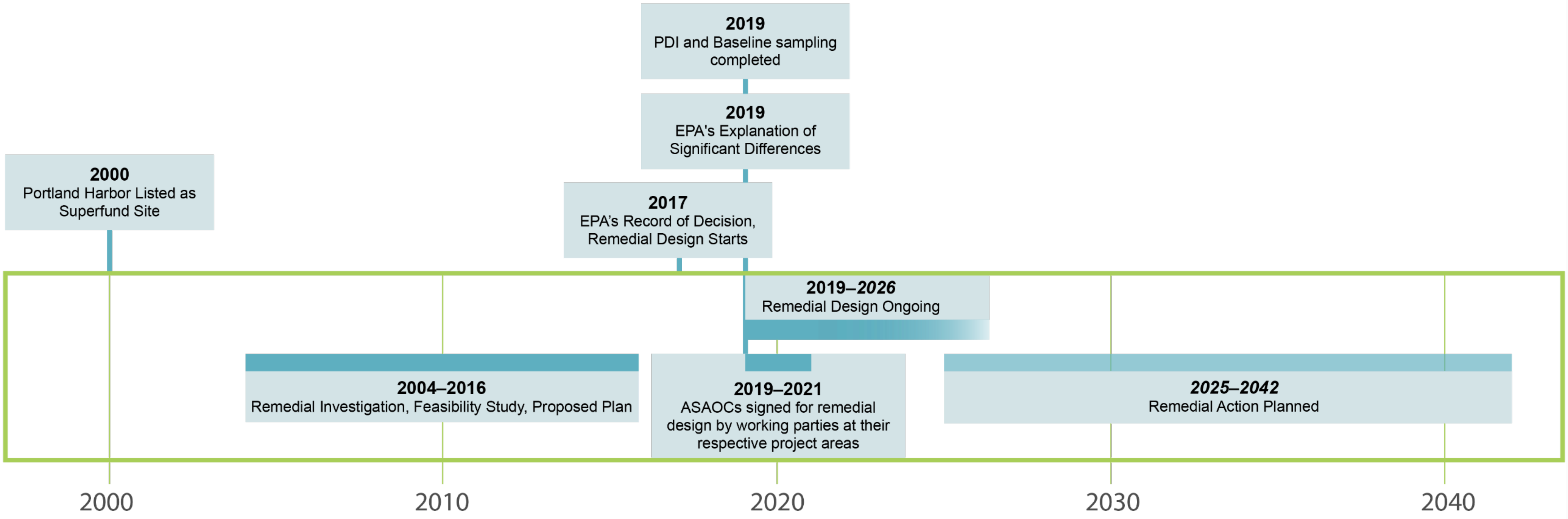
1. Control sources early
2. Involve the community early and often
3. Coordinate with states, local governments, tribes, and natural resource trustees
4. Develop and refine a conceptual site model that considers sediment stability
5. Use an iterative approach in a risk-based framework
6. Carefully evaluate the assumptions and uncertainties associated with site characterization data and site models
7. Select site specific, project specific, and sediment specific risk-management approaches that will achieve risk-based goals
8. Ensure that sediment cleanup levels are clearly ties to risk-management goals
9. Maximize the effectiveness of institutional controls and recognize their limitations
10. Design remedies to minimize short-term risks while achieving long-term protection
11. Monitor during and after sediment remediation to assess and document remedy effectiveness

Sixteen Kilometers of River, 18 Project Areas

Sediment Management Areas



Project Timeline



Remedial Action Objectives

RAO	Media	Requirement
1	Sediment	Reduce cancer and non-cancer risks to people from incidental ingestion of and dermal contact with COCs in sediment and beaches to exposure levels that are acceptable for fishing, occupational, recreational, and ceremonial uses
2	Biota	Reduce cancer and non-cancer risks to acceptable exposure levels (direct and indirect) for human consumption of COCs in fish and shellfish
3	Surface Water	Reduce cancer and non-cancer risks to people from direct contact with COCs in surface water to exposure levels acceptable for fishing, occupational, recreational, and potential drinking water supply
4	Groundwater	Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for human exposure
5	Sediment	Reduce risk to benthic organisms from ingestion of and direct contact with COCs in sediment to acceptable exposure levels
6	Biota (Predators)	Reduce risks to ecological receptors that consume COCs in prey to acceptable exposure levels
7	Surface Water	Reduce risks to ecological receptors from ingestion of and direct contact with COCs in surface water to acceptable exposure levels
8	Groundwater	Reduce migration of COCs in groundwater to sediment and surface water such that levels are acceptable in sediment and surface water for ecological exposure
9	River Banks	Reduce migration of COCs in river banks to sediment and surface water such that levels are acceptable in sediment in surface water for human health and ecological exposures

Record of Decision - Table 17

Table 17. Summary of Cleanup Levels or Targets by Media

	Surface Water (1)			Groundwater (2)			River Bank Soil/Sediment (3)			Fish Tissue (4)		
Contaminant	**Unit**	**Conc.**	**Basis**	**Unit**	**Conc.**	**Basis**	**Unit**	**Conc.**	**Basis**	**Unit**	**Conc.**	**Basis**
Aldrin	µg/L	0.00000077	A				µg/kg	2	R	µg/kg	0.06	R
Arsenic	µg/L	0.018	A	µg/L	0.018	A	mg/kg	3	B	mg/kg	0.001	R
Benzene				µg/L	0.44	A						
BEHP	µg/L	0.2	A				µg/kg	135	R	µg/kg	72	R
Cadmium				µg/L	0.091	A/R(5)	mg/kg	0.51	R			
Chlordanes	µg/L	0.000081	A				µg/kg	1.4	R	µg/kg	3	R
Chlorobenzene				µg/L	64	R						
Chromium	µg/L	100	A	µg/L	11	A						
Copper	µg/L	2.74	A	µg/L	2.74	A/R	mg/kg	359	R			
Cyanide				µg/L	4	A						
DDx	µg/L	0.01	R	µg/L	0.001	A	µg/kg	6.1	R	µg/kg	3	R
DDD	µg/L	0.000031	A	µg/L	0.000031	A	µg/kg	114	R			
DDE	µg/L	0.000018	A	µg/L	0.000018	A	µg/kg	226	R			
DDT	µg/L	0.000022	A	µg/L	0.000022	A	µg/kg	246	R			

This is an excerpt only. Actual table lists over 50 chemicals

Record of Decision - Table 21

Table 21. Sediment RALs and PTW Thresholds for Selected Remedy

Contaminants	Site Wide RALs[1]	PTW Thresholds [2]	Navigation Channel RALs
Focused COCs			
PCBs	75	200	1,000
Total PAHs [4]	13,000	NA	170,000
2,3,7,8-TCDD	0.0006	0.01	0.002
1,2,3,7,8-PeCDD	0.0008	0.01	0.003
2,3,4,7,8-PeCDF	0.2	0.2	1
DDx	160	7,050	650
Additional Contaminants			
2,3,7,8-TCDF	NA	0.6	NA
1,2,3,4,6,7,8-HxCDF	NA	0.04	NA
cPAHs (BaP Eq)	NA	106,000	NA
Chlorobenzene	NA	>320	NA
Naphthalene	NA	>140,000	NA

- These are the chemicals around which the cleanup must be designed
- But the long-term goal is to achieve reduction of all the chemicals on Table 17 as well.

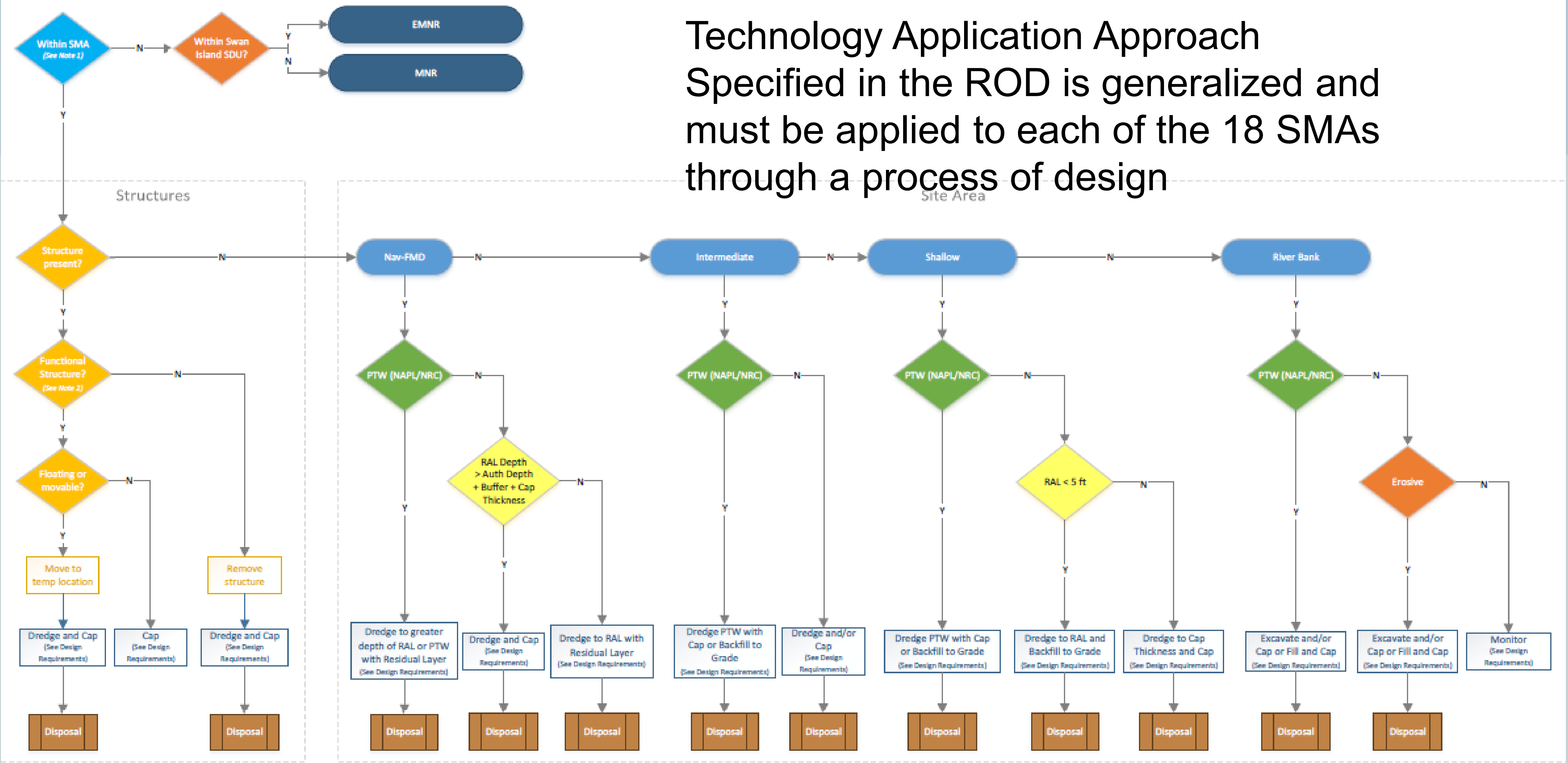
Urban
WATERWAY ASSOCIATES

Available Remedial Technologies

- Source control
- Institutional controls
- Natural recovery/natural attenuation
- Enhanced natural recovery
- *In-situ* treatment
- Capping in place
- Sediment removal
  - *Ex-situ* Treatment
  - Support operations
    - Dewatering
    - Water treatment
  - Disposal

Urban
WATERWAY ASSOCIATES

Technology Application Approach Specified in the ROD is generalized and must be applied to each of the 18 SMAs through a process of design

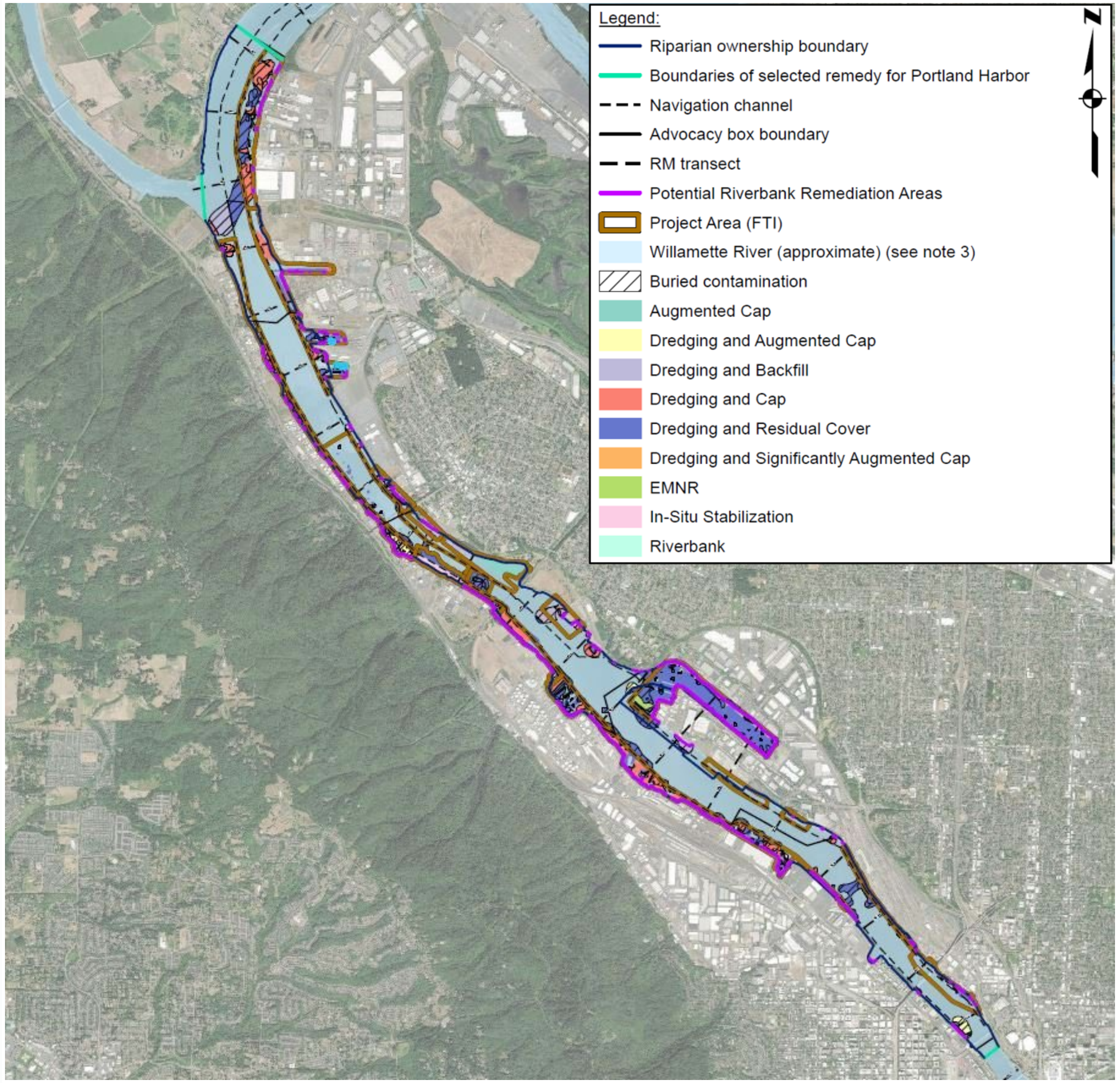


Notes:
(1) Contamination is defined in three dimensions.
(2) Currently operating or used to stabilize bank. Service life > 50 yrs.

From Intention to Implementation

- Design is the process of converting the intentions of the ROD into something that can be built
- Design is both a process and a product
- Involves many stakeholders
- Conducted by the responsible parties and their design consultants
- Results in a suitable design addressing the intentions of the ROD as well as the needs of the stakeholders

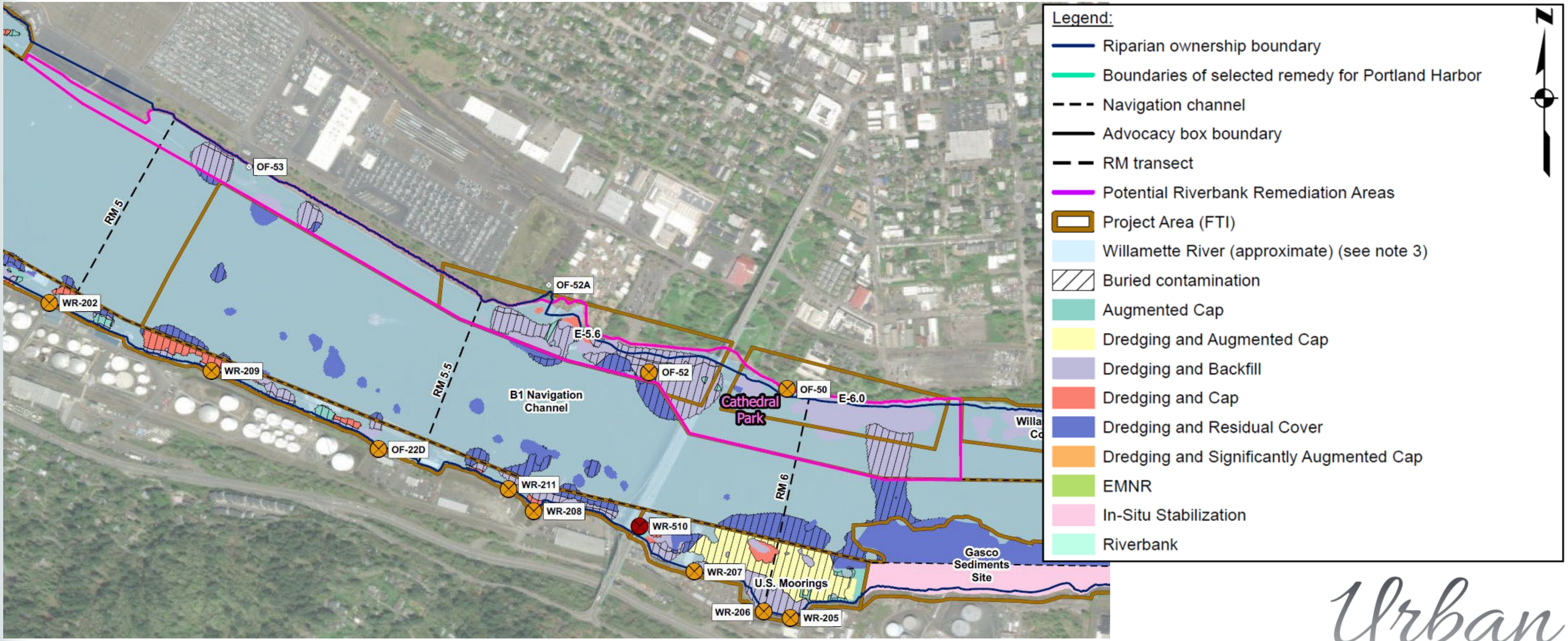
SMAs and Technology Application



- Application of the remedial technology application flow diagram results in complex juxtapositions
- Creating a constructible project will be challenging
- Key questions include the transitions between technologies
- Significant questions about order of construction as well as transloading, shipment, and disposal remain

Urban
WATERWAY ASSOCIATES

Example Area



Urban WATERWAY ASSOCIATES

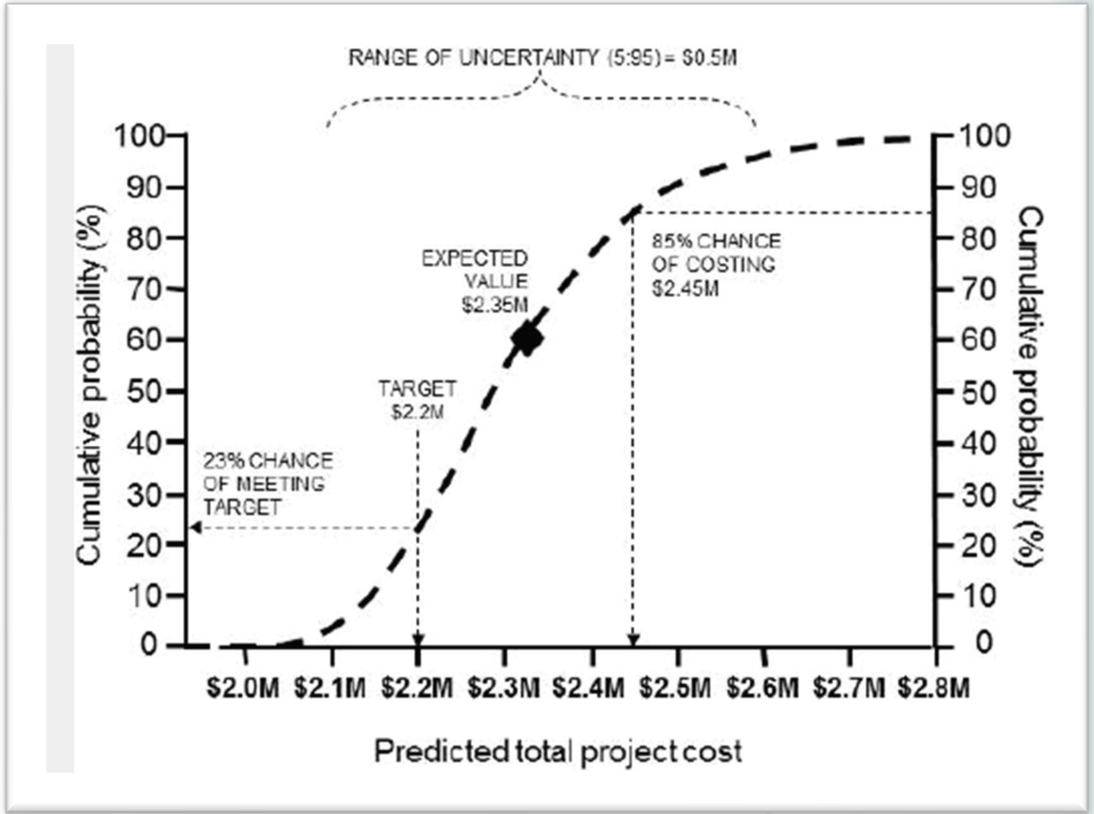
Portland Harbor, Oregon

- EPA Project costs (2017) of $1.05B USD
- Current estimates are as high as $4.0B USD
- EPA role
  - In-water lead
  - Staff have limited construction experience
- State role
  - Upland source control lead
  - Coordinate with EPA for in-water work
  - Provide support and secondary review of documents (e.g., proposed plan, ROD)
  - Model ASAOC allows for State to assume oversight role instead of EPA

Urban
WATERWAY ASSOCIATES

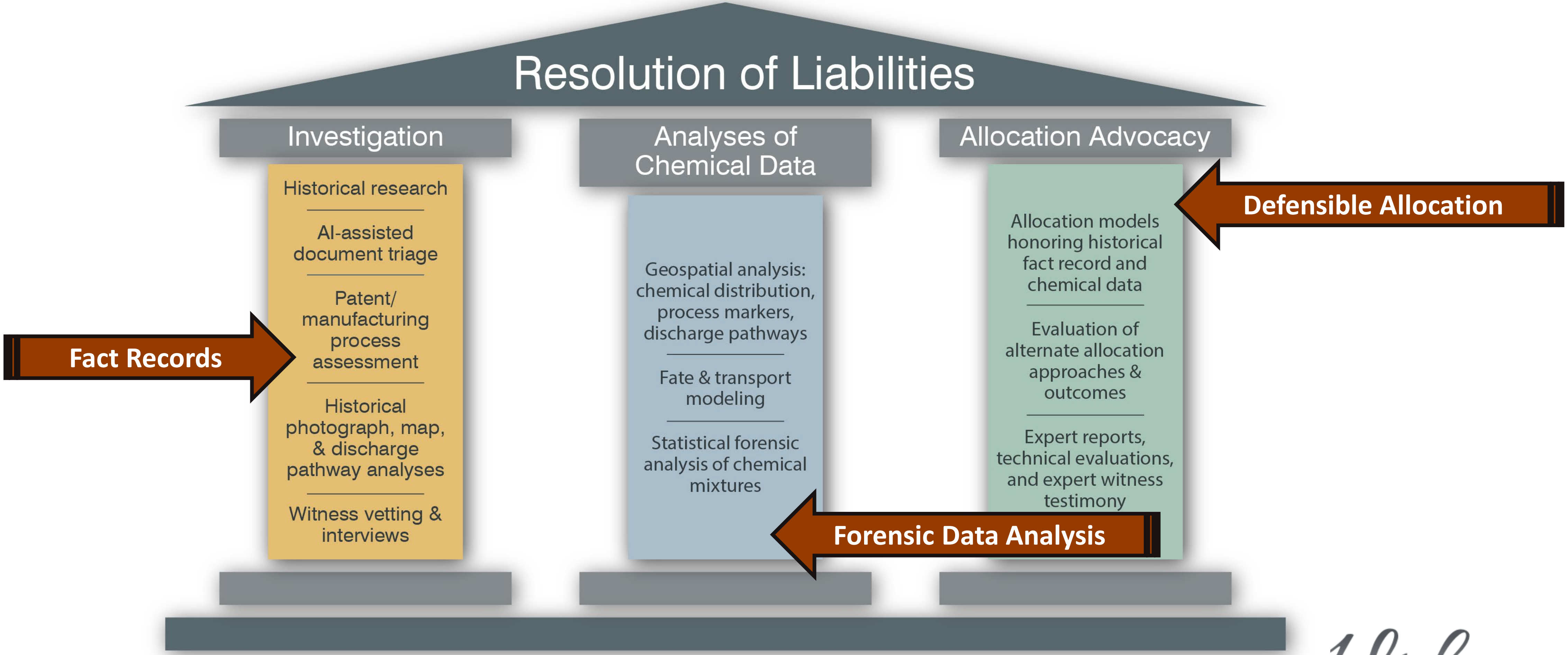
Use Probabilistic Estimating of the Cost

- Original estimates were for comparative purposes only
- With design still subject to significant uncertainties, probabilistic cost estimates provide more insight into risk factors
- Uncertainties abound
- Largest cost uncertainties are transport and disposal



Urban
WATERWAY ASSOCIATES

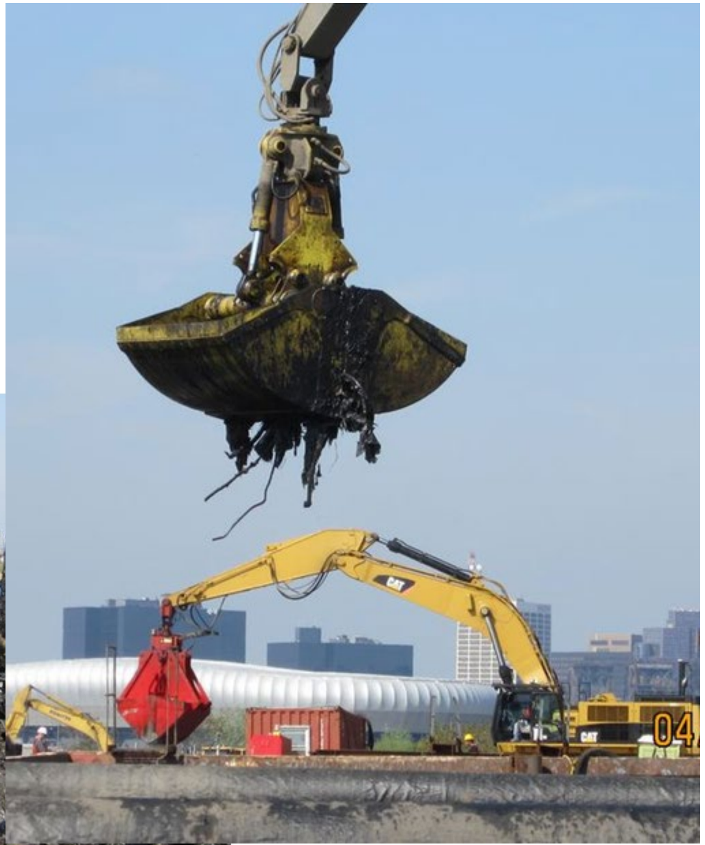
Foundations of PRP Allocation



Urban
WATERWAY ASSOCIATES

Areas of Special Interest During Design

- Slope instability
- Seismic vulnerability
- Erosion protection
- Waterfront structures
- Business interruption
- Receration loss
- Under-pier areas
- Dredging residuals
- Debris



Urban
WATERWAY ASSOCIATES

Understand What it Might Take to do it Right

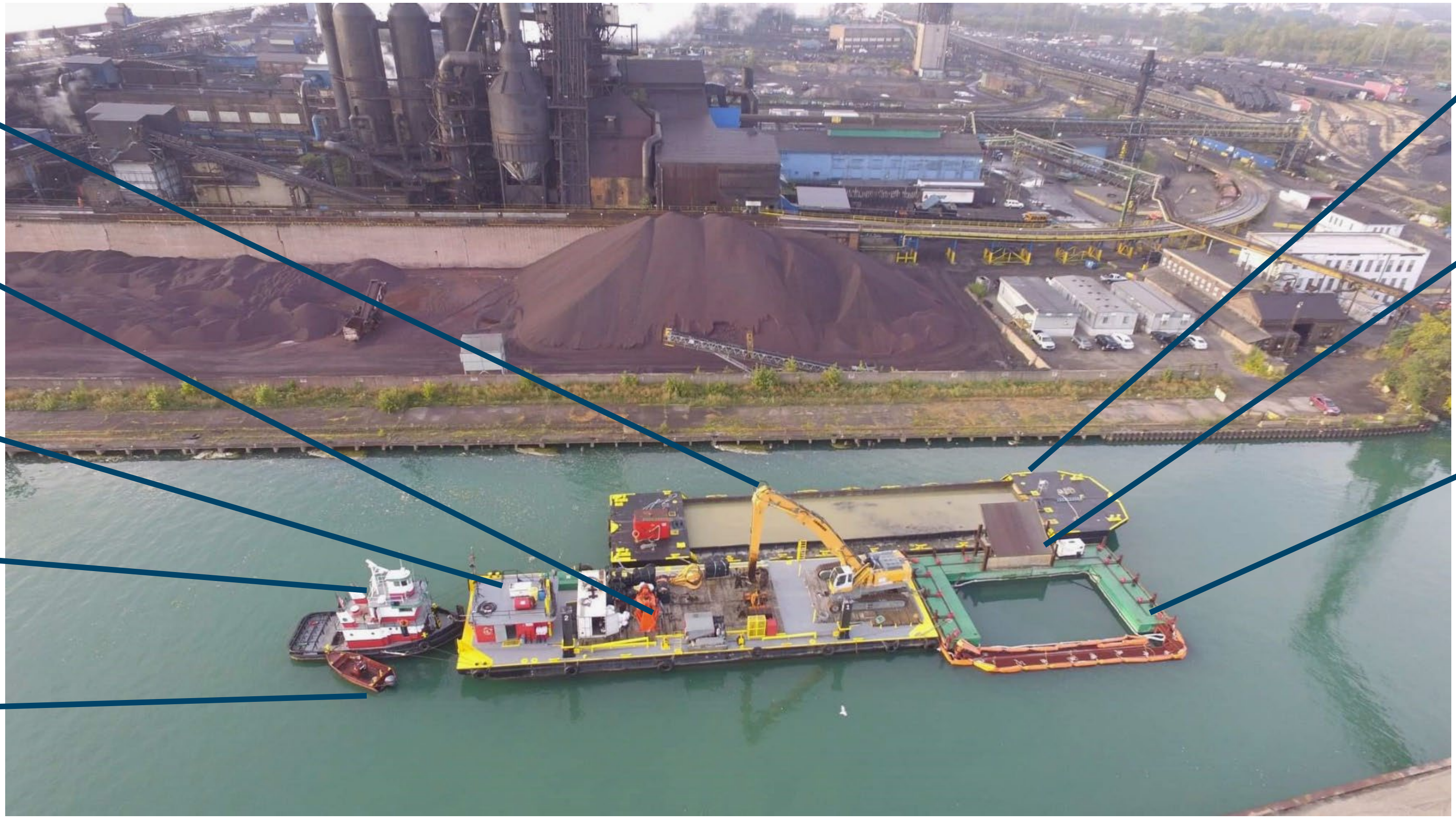
Backhoe Excavator

Environmental Bucket

Spud Barge

Tug Boat

Crew Boat



Transport Barge

Spill Plate

Turbidity Enclosure

Survey Boat (Not Shown)

Urban WATERWAY ASSOCIATES

Verify Source Control

- Recent studies suggest sources are not sufficiently controlled to prevent recontamination
- Potential pathways include
  - Stormwater discharge
  - In-stream particle transport
  - CSO discharges
  - Bank erosion
  - Groundwater
  - Ongoing industrial operations

Urban WATERWAY ASSOCIATES

Thank You

Philip Spadaro

Principal Scientist and Advisor

Urban Waterway Associates, LLC

pspadaro@urbanwaterwayassociates.com

+1 206-390-2842

Urban WATERWAY ASSOCIATES

About the Presenter: Philip Spadaro

- Expert in urban and contaminated sediment management, industrial waterfront redevelopment, source control, and environmental effects of dredging
- Technically based in environmental chemistry with strong proficiency in hydrogeology, geology, regulatory affairs, and remediation technology
- Technical support for investigation, cleanup, monitoring, litigation, allocation, construction claims, cost-recovery actions and other matters related to sediment remediation
- Evaluation of fate and transport of contaminants in estuarine, riverine, and marine aquatic environments.

Urban
WATERWAY ASSOCIATES