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Adaptive Management: A Planning Tool Beyond Corrective Action

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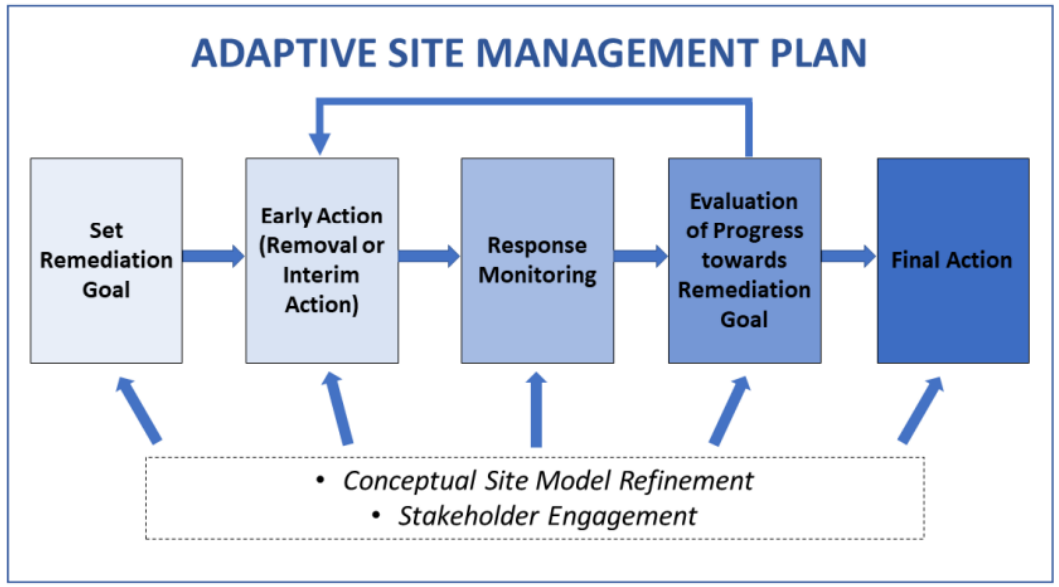
What is adaptive management?

- Origins – natural resource management
- Conscious and purposeful use of policy, science and technology to plan and implement experiments designed to enable people to learn about systems as they manage them to particular goals.
- learning (monitoring and evaluation, predicting (hypothesis), and doing (information and result drivers).
- AM is about testing hypotheses on a real-world scale.
- What separates it from pure scientific research (or Superfund risk assessment) is that it is designed to inform future management decisions.
- Uncertainty management
- Benefits – framework for actions that add value

USEPA Sediment Assessment & Monitoring Sheet (SAMS) 2022, OLEM Directive Number 9200.1-166

Adaptive Site Management – A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites



- At a practical level, the value of adaptive site management at sediment sites is the potential for expediting significant progress toward final remediation goals, while monitoring the system response and gauging what, if any, additional steps are needed to achieve those goals.
- Remediation under adaptive site management acts on what is known while acknowledging what is not fully understood.
- Reduce largest risks early.
- *Lessons learned – rebuild and stabilize the physical system with initial action – chemical bioavailability decreases, and ecosystem dynamics (diversity, energy flow and cycling of matter) restoration through engineering with nature.*

Adaptively Planning

Underutilized tool in managing complex contaminated sites

Land Use Planning is not haphazard or an intermittent process

Planning is a forward focused process that is adaptively updated on a continuing basis

Planning

The process of how people **anticipate needs, set goals**,
Take actions, to shape change
For individual or collective **benefit**.

CERCLA – A Planning Context

- **CERCLA Is a Public Works Statute**
  - "Public Work" - often includes the construction and maintenance of infrastructure such as roads, bridges, and schools
  - Infrastructure work needs to align with land use management
    - Typically directed by local and county authorities
- **Land Use Under CERCLA** (OSWER Directive No. 9355.7-04 1995) – Consultation local land use authorities and other locally affected parties to make remedial action assumptions about reasonably anticipated future land use are appropriate.
- **Adaptive Land Planning** is an iterative, flexible process for land management that prepares for uncertainties and changing conditions, such as climate change impacts or unexpected events.

"The U.S. Environmental Protection Agency (EPA) believes that early community involvement, with particular focus on the community's desired future uses of property associated with the CERCLA site, should result in a more democratic decision-making process; greater community support for remedies selected as a result of this process; and more expedited, cost-effective cleanups."

OSWER Directive No. 9355.7-04 1995

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Complex Contaminated Sediment Site Characteristics

- Large Geographical Areas – evolving land uses
- Long Term Management (over 30 years)
- Impacts to Natural Resources
- Disruptions to Land Use
- Requires Watershed-Based Planning Context
- Risk Assessment Based Cleanup Objectives Are Technically Impracticable
- Uncertainties of response of site-specific systems to remedial actions

Complex Sediment Contaminated Site Characteristics

Wicked Problems (Rittel and Webber 1973) – issues or projects that are difficult or impossible to solve due to:

Constantly evolving requirements	Conflicting stakeholder values	No clear stopping point or definitive solution	Incomplete or contradictory information	They are in-part symptoms of other problems	Each wicked problem is unique

An integrated ASM and Adaptive Land Planning Process provides a more informed approach to site-specific sediment site management

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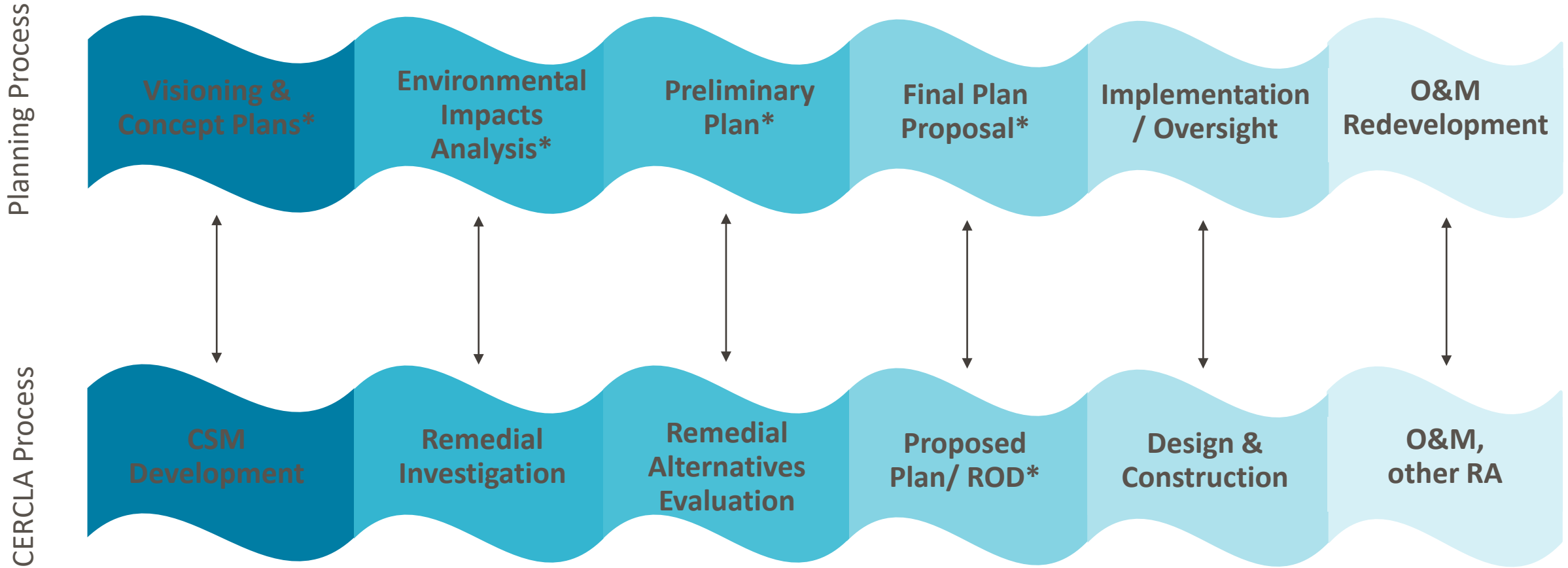
Parallels in Contaminated Site Management with Community Planning



* Public Engagement

Aligning Contaminated Site Management (CSM) with Adaptive Community Planning

- Structure CSM Team to include **planning expertise**
- True **Early Community Engagement**
  - **Comprehensive Planning Review** (local, regional, state, federal) to identify relevant planning considerations for the likely duration of the CSM project (e.g., growth projections, types of land development, resource needs)
  - **Evaluate Regional Resiliency** (includes climate change & sea level rise) and potential influence on contaminated site
  - Meetings with community representatives and planners
  - **Public meeting**
- Identify points of **overlapping and mutual interests** and needs (e.g., flood management, water supply, biodiversity)
  - Can focus on **Engineering with Nature (EWN)** type projects
  - Sustainability Goals (e.g., sediment beneficial use)

Aligning Contaminated Site Management (CSM) with Community Planning

- Planning Synergies Evaluation (PSE)
  - Integrating planned and funded infrastructure and natural resource projects into remedy planning to reduce uncertainties and CSM planning
    - More realistic understanding of risks and practical risk reduction options in context of projects and actual land use in the vicinity of contaminated site
    - Shared technical and engineering knowledge of site/area/watershed
    - Opportunities for Public-Private Partnerships and Complementary Funding
    - PSE process is iteratively and adaptively managed through duration of CSM work

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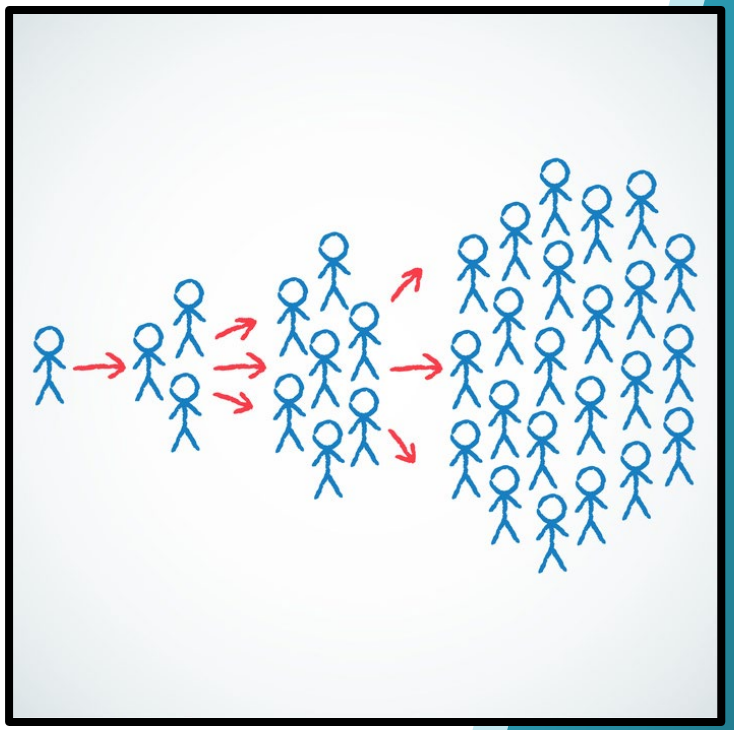
• Aligning Contaminated Site Management (CSM) with Community Planning

- Making PSE Actionable & Integrating Adaptive Site Management (ASM) with Adaptive Land Planning
  - Creating a **sense of urgency** for a changed approach to land use, management, development
  - **Building coalition of supporters** for aligned approach to ASM and community planning
  - Build consensus to **reduce "Green Tape"**
  - **Re-evaluate planning analysis** when ASM are considered and changes occur



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Overcoming Obstacles

EPA and State Agency Management of Community Involvement

- Often limits communications to EPA-led events/press releases at some major milestones
- An Adaptive Planning Approach can be acknowledged in and supplemental to EPA Community Involvement Plan

Local and Regional Municipalities Willingness to Engage

- Perceived lack of staff resources and funding
- Present plan for collaboration to key officials, managers, planners
  - Identify potential mutual benefits

PRPs Reluctance to Add More Planning and Community Involvement

- Scope creep/increased costs and uncertainty of realization of benefits
- Conflicts among stakeholders and between regulatory agencies
- Uncertainty of timetable collaborative efforts and funding
- Holistic risk analysis can provide a quantifiable context for understanding the potential benefits

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Examples Adaptive Planning

Forested Wetland

Coastal/Estuary

Benefits that drive consideration of this integrated adaptive approach to contaminated sediment sites:

- Reduced uncertainties early and iteratively
- Community support for pragmatic risk reduction
- Reducing highest risks early through reduced exposure potential
- Reduced Green Tape through collaboration
- Reducing the collateral injury to the natural environment through acceptance of more sustainable remedial action (multi-purpose, multi-use)
- Incorporation of natural processes into remedial actions (e.g., Engineering with Nature, Monitored Natural Restoration) in a manner consistent with community planning goals and needs
- Remedial action integrated into a planning vision yielding mutual benefits and enhancement through joint of funding of related land planning and remedial actions (private-public), and
- Early actions adaptively implemented through an integrated process can reduce the risks and uncertainties, leading to shorter project durations and reduced scope of remedial actions

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Questions?