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Interstate Technology & Regulatory Council (ITRC) Remediation Management of Complex Sites: Case Studies and Guidance

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Pacific Northwest National Laboratory

December 17, 2014

Outline

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Risk Informed Endpoints

- Background
  - DOE
  - Federal Agencies
- Define the problem
- Tradeoffs
- Development of Framework (2013-)
  - Why do we need one?
  - How do we apply it?
- Path forward

Office of Soil and Groundwater Remediation

- AFRI (2009-)
- ASCEM (2009-)
- Strategic Plan (2014)
- SciOps (2014)

Remediation Management of Complex Sites: ITRC

Definitions

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An **endpoint** is:

- risk-informed remediation goal or scenario permitted by regulations
- protective of human health and the environment
- scientifically and technically defensible
- based on systematic, objective understanding of the contamination issue and a holistic remediation approach.

An endpoint framework enables establishing a path for cleanup that may include intermediate remedial milestones and transition points and/or regulatory alternatives to standards-based remediation.

All approaches for reaching an endpoint ***REMAIN*** *protective of human health and the environment and meet regulatory requirements*

Resources: History

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USACE: Technical Impracticability Assessments: Guidelines for Site Applicability and Implementation", Phase II Report, March 2004

ESTCP: Alternative Endpoints and Approaches Selected for the Remediation of Contaminated Groundwater (ER-200832)

ITRC: Assessing Alternative Endpoints Technical and Regulatory Overview and Remedial Approaches to Address Draft Groundwater Cleanup Challenges: Remediation Risk Management (RRM); Risk Management for Site Remediation (RRM-1)

DoD guidance documents (NAVFAC Risk Management, Optimizing Remedies, Optimization Policies)

DOE guidance (site specific documents)

NRC (2000) Research Needs in Subsurface Science

NRC report (2012) Alternatives for Managing the Nations Complex Contaminated Groundwater sites

EPA: Guidance for Evaluating Technical Impracticability of Ground-Water Restoration; Use of Alternate Concentration Limits (ACL's) in Superfund Cleanups; Summary of Technical Impracticability Waivers at National Priorities List Sites (2012)

DOE Cleanup Goals

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- Reduce the life-cycle costs and accelerate the cleanup of the Cold War environmental legacy
- Reduced the EM legacy footprint by 40 percent by the end of 2011, leading to approximately 90 percent reduction by 2015

Why Do We Need Alternate Endpoints?

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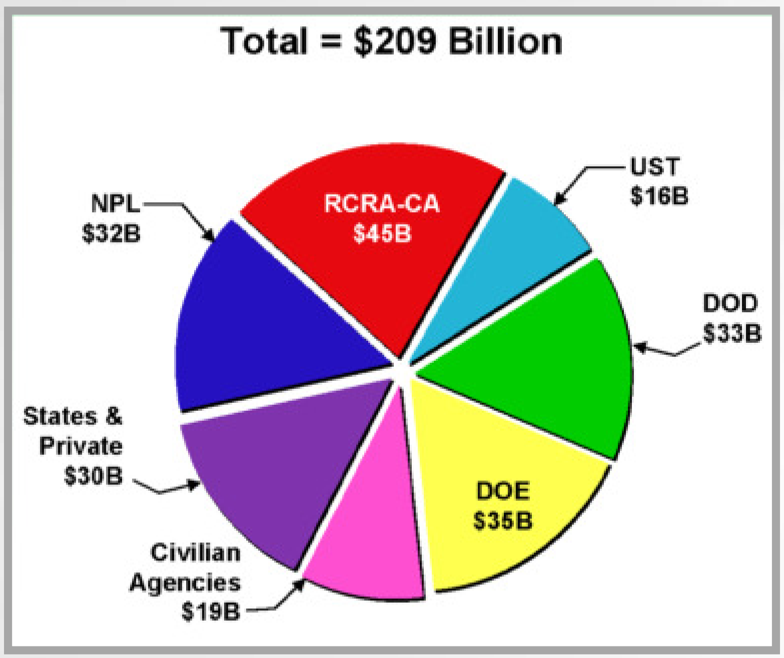
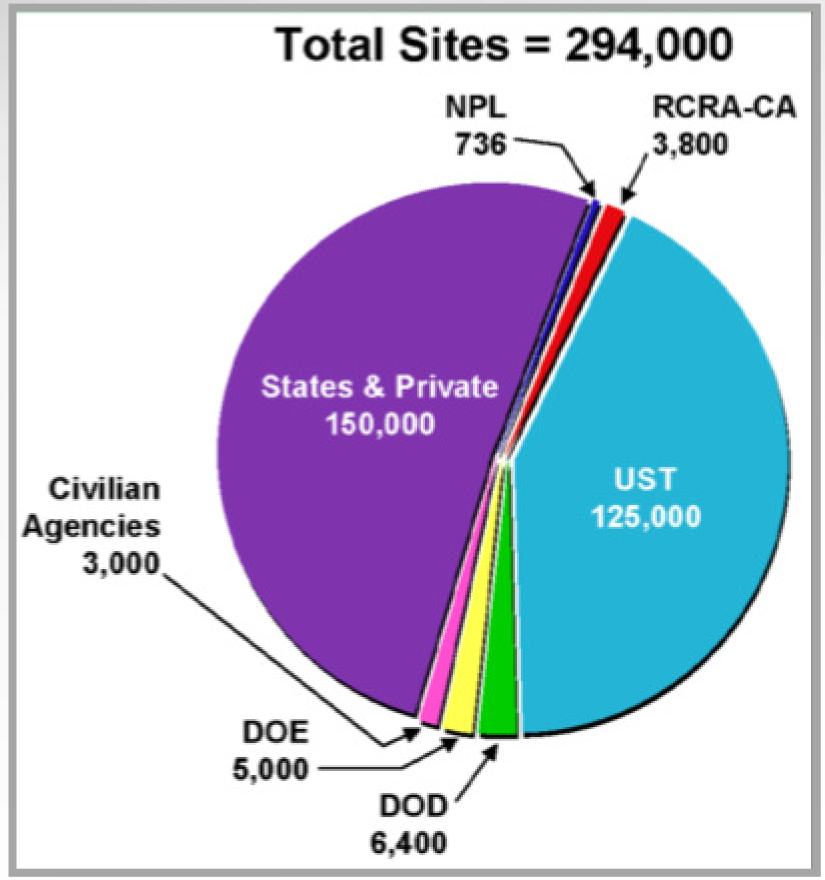
Remaining cleanup challenges are ***complex*** in contaminant type (radionuclides and metals) and location (deep, fractured rock)





~ 300,000 sites

~ $200 billion

Source: Cleaning Up the Nation's Waste Sites: Markets and Technology Trends, 2004 Edition, EPA 542-R-04-015

Framework For Considerations in Defining and Achieving Remediation Endpoints

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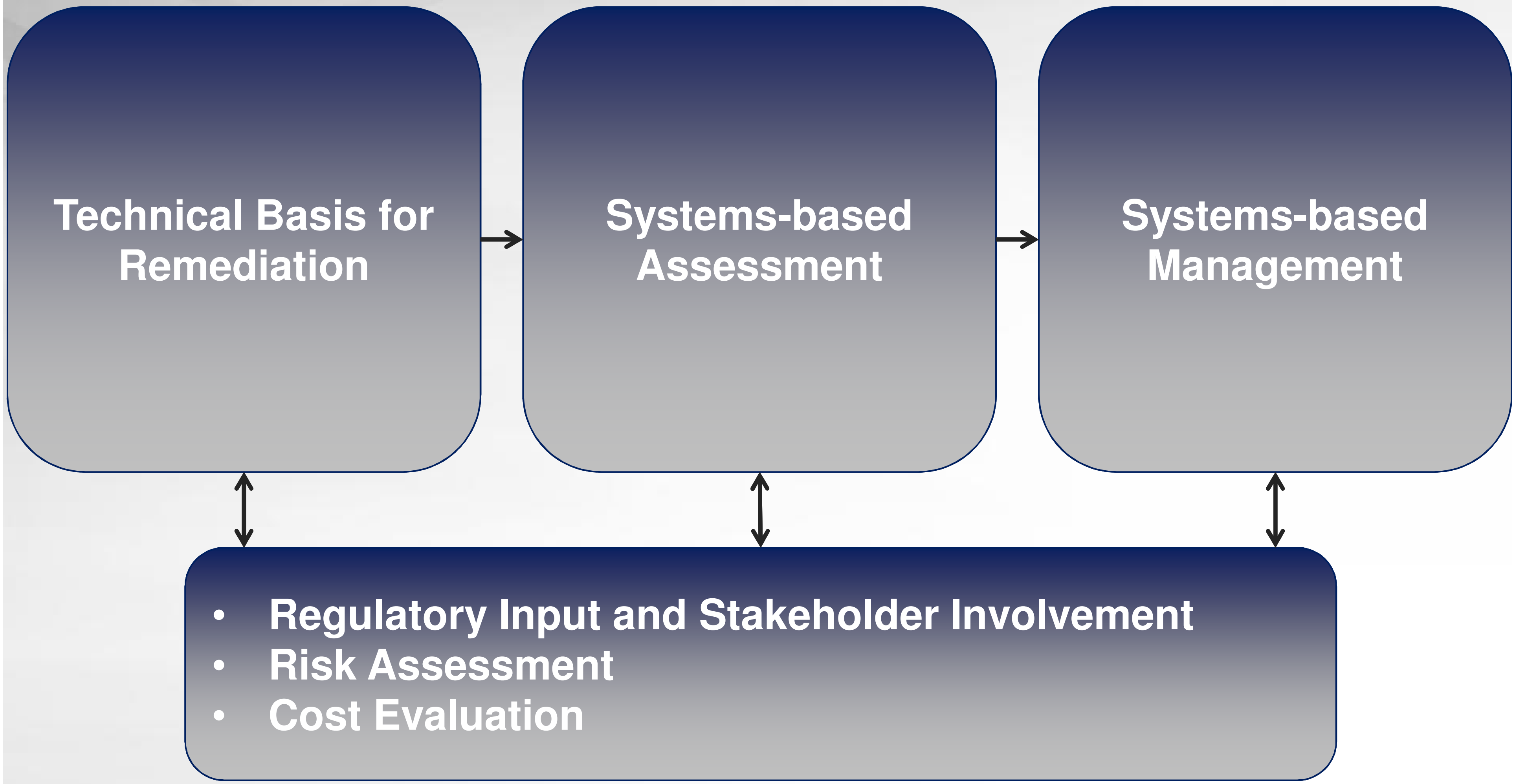

Where is the endpoint framework applicable?

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At all sites but especially complex ones with technical limitations to groundwater restoration

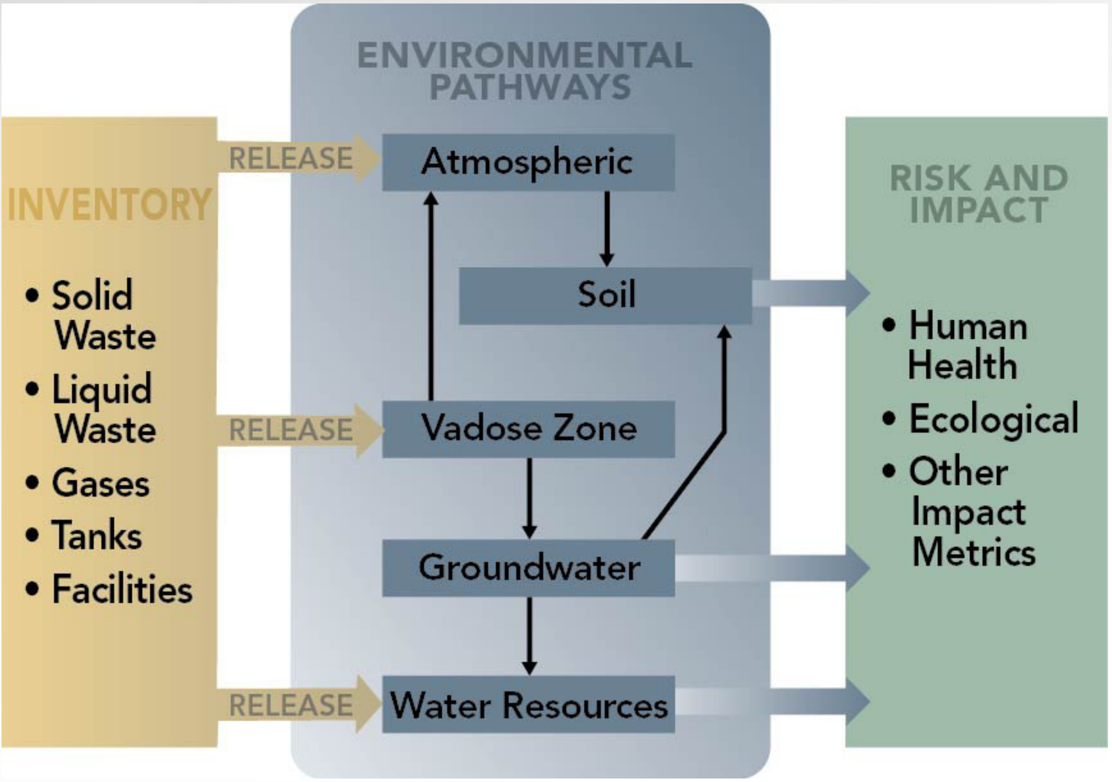
- Extensive, recalcitrant, or long-lived contamination
  Presence of non-aqueous phase liquid (NAPL), relatively immobile contaminants, metals and radionuclides

- Complex hydrogeological setting
  Highly heterogeneous, low permeability geology, any environment difficult to characterize

- Other site specific circumstances

How do we get there … risk considerations

- Risk needs to be evaluated at multiple levels and integrated for a holistic view of choosing alternate end state
  - Human Health
  - Ecological
- Balance current needs and drivers with future land use
- Cognizant of dollars saved versus risk reduction
- Are there high-consequence hazards where risk is always too great



Tradeoffs for Alternate Endpoints

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Competing influences of risk, cost, and technical defensibility in meeting remediation decision objectives

Increased Scientific and Technical Defensibility

Decreased Regulatory Acceptability

Increased Cost

High risk, complexity, and cost with little to no regulatory acceptance *e.g. Enhanced attenuation*	Scientific and technically defensible with minimal risk but costly and limited regulatory acceptance *e.g. Pump-and-Treat*
High risk and complexity but less costly and regulatory acceptable *e.g. Permeable reactive barriers*	**Scientifically and technically defensible with minimal risk or cost and regulatory acceptable** *e.g. Surface barrier; in situ bioremediation*

Decreased Uncertainty/Risk

How do we achieve these goals?

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- **What has been done at other sites**
- **Interagency collaboration**
- **Lessons Learned**
- **Technology/expertise transfer**

  Resources available include:

  Assessing Alternative Endpoints for Groundwater Remediation at Contaminated Sites
  EPA policy and guidance
  ITRC overview document and training
  Navy Alternative Restoration Technology Team workgroup
  AFCEE and Army initiatives
  ESTCPs' Alternative Endpoints and Approaches for Groundwater Remediation

- **Regulatory and stakeholder engagement**
- **Risk-informed understanding and defensibility**
- **Robust long-term management of residual contamination**

Policy & Technical Needs for Remediation and Alternate Endpoints

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Challenges	Key Issues	Opportunities
Scientific and Technical	Understand the nature and magnitude of problems to determine which risks are most critical and establish priorities for remediation needs and closure requirements	• Systems-based Approaches for Remediation and Decision Support • Characterization vs. Predictive Understanding (e.g. mass flux based conceptual models) • Technologies vs. Remedial Strategies • Point source vs. Systems-based Monitoring • Active/Passive Remediation Efforts–Transition and Exit Strategies.
Regulatory	Based on scientific and technical understanding, determine what must be accomplished through cleanup efforts	• Risk-informed definition of regulatory requirements • Priorities based on protection of human health and the environment
Institutional and Closure Management	Define what end state or condition would constitute progress or completion of cleanup	• Process to effectively define end states from scientifically and technically defensible understanding • Clearly defined and credible cleanup scope of work to achieve risk-based end states • Transition complex sites to LTM or MNA
Budget and Resource Allocation	Allocate limited resources (i.e., federal budget dollars) to provide benefit to society (e.g., reduced risk, recovered resources, etc.)	• Risk-informed choices to prioritize resources, drive 'cleanup demand' and complete site cleanup

Risk-Based Alternative End Point Strategies for Site Closure and/or Long-Term Management

Technically-based approaches to achieve alternative end point strategies, which are risk-based, cost-effective, sustainable, and protective of public health and environment

Applied Field Research Initiatives & ASCEM

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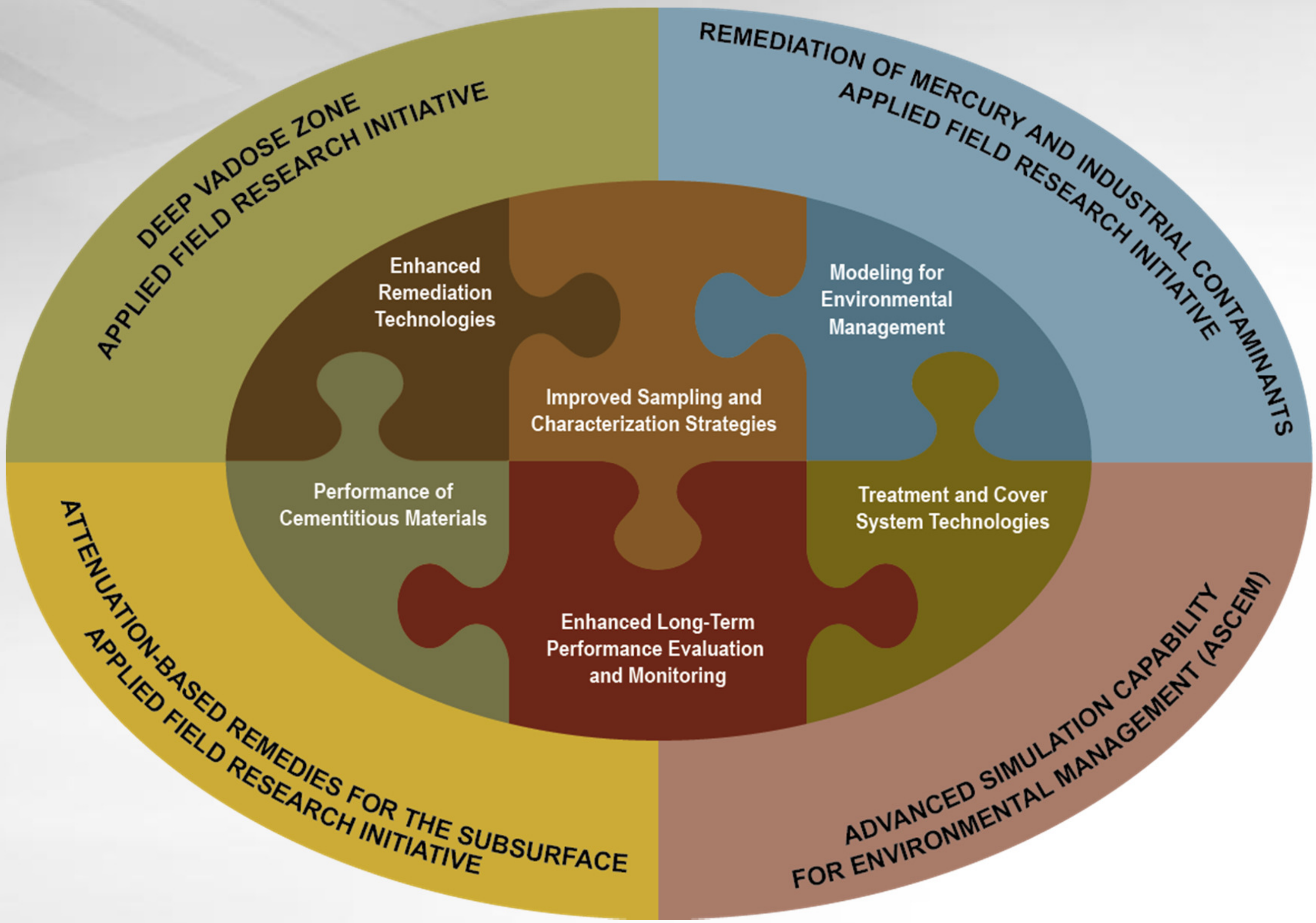

2014 Strategic Framework

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How do we achieve alternative endpoints?

- What has been done at other sites
  - Lessons Learned
  - Technology/expertise transfer
- Interagency collaboration
- Regulatory and stakeholder engagement

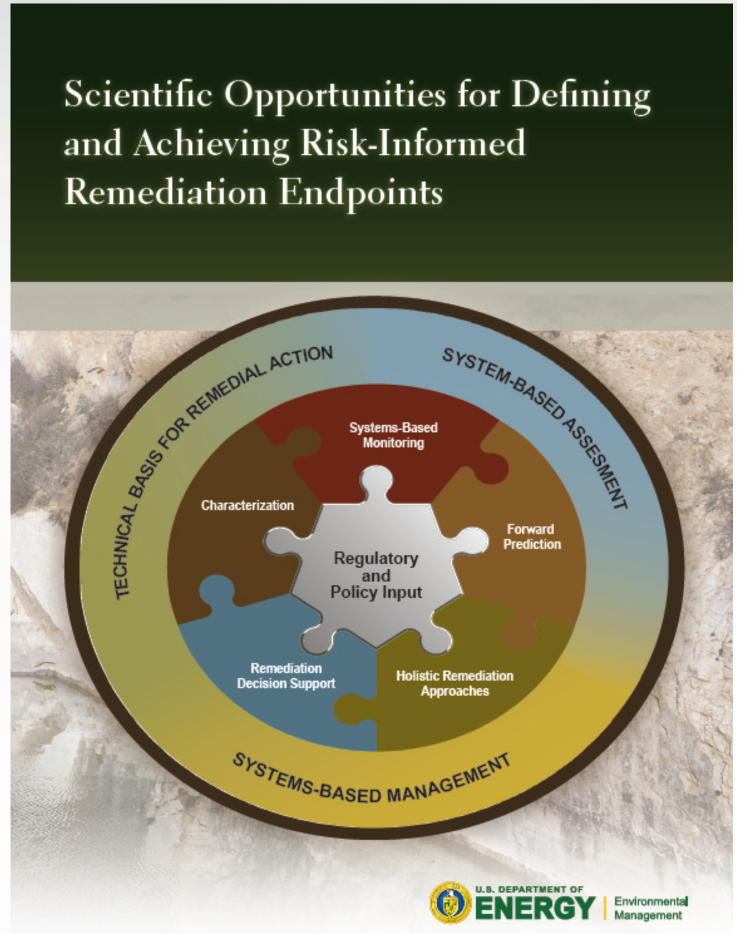
What are the benefits?

- Risk-informed understanding and defensibility
- Common expectations and acceptable terms (between agencies and contractors) for remedial performance
- Meet regulatory requirements despite technical challenges & limitations
- Robust long-term management of residual contamination, cognizant of human health and environment
- Leverage resources

Collaborative effort: DOE, DoD, site personnel

2014 SciOps: R&D to Remediate Complex Sites

Provides structured, "systems-based" approach, consistent with the CERCLA and RCRA, *to* facilitate remediation decisions and reach remediation endpoints at complex sites where restoration may be uncertain, require long time frames, or involve progressive and adaptive management approaches.



Collaborative effort: DOE, site personnel

Remediation Endpoints for Complex Site Closure

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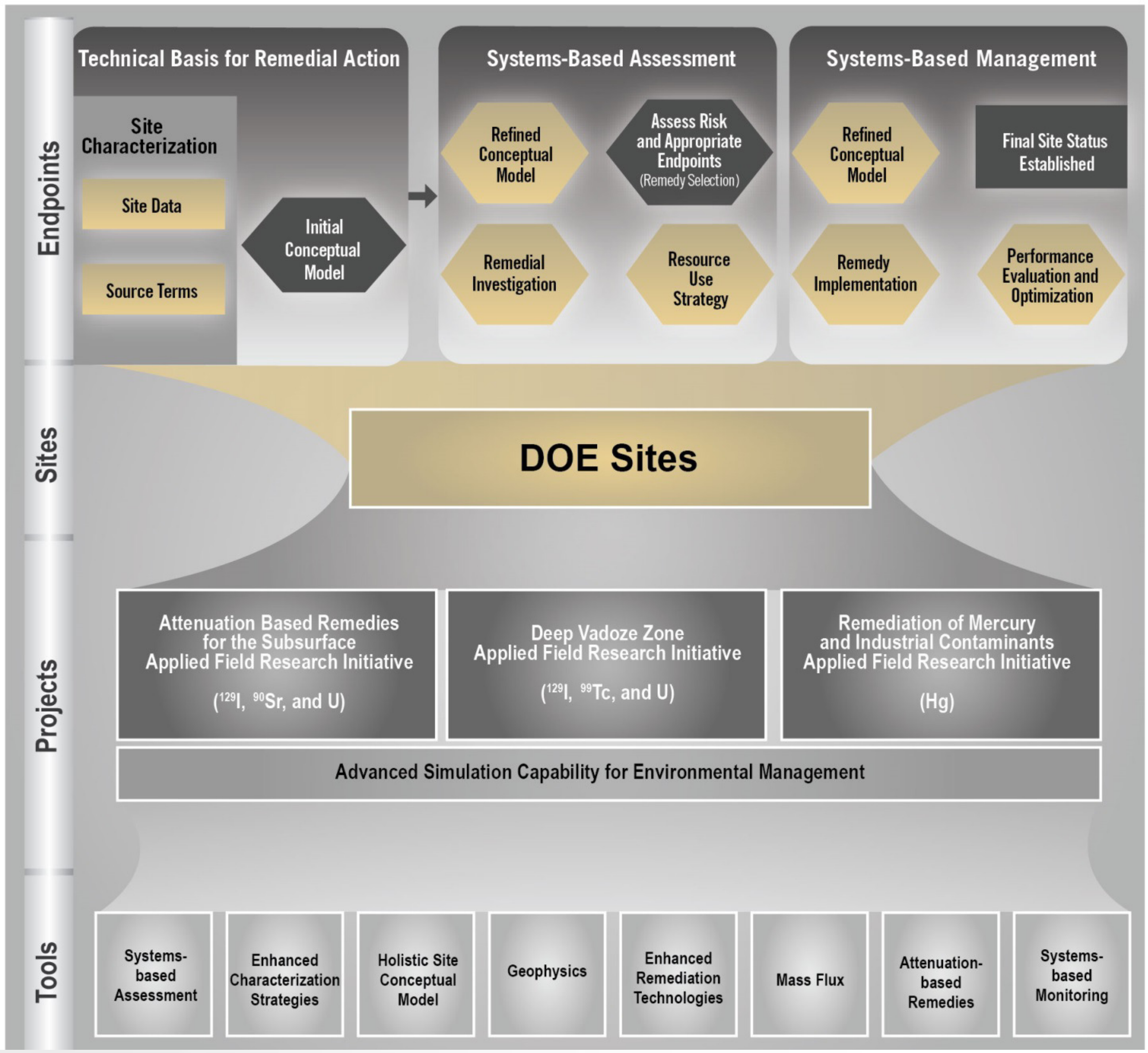

ITRC Remediation Management of Complex Sites

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TEAM LEADERS

- **Carl Spreng**

Colorado Department of Public Health and Environment

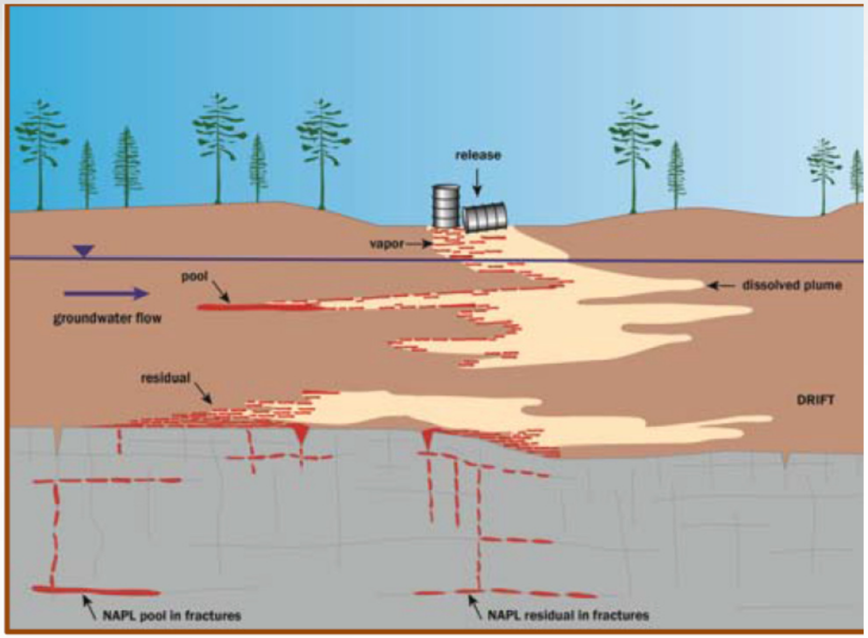
- **John Price**

Washington Department of Ecology

PROGRAM ADVISOR

- **Rula Deeb**

Geosyntec Consultants



Outline

- Scope of the project/team
- Survey results (selected ?s)
- Current work scope
  - Charge
  - Tech Reg
  - Case Studies
  - Document status
  - Flow Chart
- Path forward

What is the project?

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- Remediation of groundwater to a condition allowing for UU/UE remains a significant challenge
- A 2012 NRC committee examined cleanup efforts nationally and reported that at least 126,000 sites across the country have residual contamination at levels inhibiting site closure with an estimated "cost to complete" of $127 billion. Of these sites, roughly 10% are "complex"
- Conventional remedies and approaches are often difficult to apply successfully at complex sites

ITRC's ***Remediation Management of Complex Sites*** **Team**

Survey Results …

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9. The percentage of remediation sites that are complex is

	Response Percent	Response Count
<0-5%	1.8%	2
6-10%	23.2%	26
11-25%	**33.0%**	**37**
26-50%	17.0%	19
51-75%	9.8%	11
>75%	1.8%	2
No opinion/don't know	13.4%	15
	answered question	**112**
	skipped question	**5**

14. The following contaminant-related challenges usually make for a complex site [adapted from ITRC January 2012] (check all that apply)

	Response Percent	Response Count
Form of the contamination in the environment (e.g., dissolved, sorbed, present as a light or dense nonaqueous-phase liquid [NAPL])	**92.7%**	**102**
Depth and lateral extent of contamination (e.g., regional contamination from acid mine drainage or from various sources discharging into receiving surface water body)	91.8%	101
Transformation potential or degradability by biotic or abiotic processes	64.5%	71
Partitioning properties, including NAPL dissolution rate, aqueous solubility, volatility, and adsorption affinity for NAPL	80.0%	88
Mobility factors such as interfacial surface tension, viscosity, and specific gravity	74.5%	82
Presence of persistent and ubiquitous anthropogenic contaminants (such as DDT, polycyclic aromatic hydrocarbons)	65.5%	72
	answered question	**110**
	skipped question	**7**

16. The presence of any of the following hydrogeologic conditions usually make for a complex site (check all that apply) [adapted from ITRC Jan 2012]

	Response Percent	Response Count
Contamination in multiple geologic units	**88.2%**	**97**
Contamination in "deep" units	72.7%	80
Subtle variations in geology within limited vertical and horizontal distances	47.3%	52
Anisotropy	47.3%	52
Preferential geologic formations	48.2%	53
Fractures and fault zones	85.5%	94
Highly heterogenous aquifers	73.6%	81
Deep alluvial basins	30.0%	33
Karst aquifers	63.6%	70
Fractured bedrock aquifers	80.0%	88
No opinion/no experience	4.5%	5
	answered question	**110**
	skipped question	**7**

17. A remediation/restoration time frame greater than the following usually makes for a complex site

	Response Percent	Response Count
10 years or longer	11.2%	12
30 years or longer	28.0%	30
60 years or longer	5.6%	6
100 years or longer	14.0%	15
Restoration time frame does not determine whether a site is a complex site	**46.7%**	**50**
	Share your understanding of a "reasonable" time frame in years?	34
	answered question	**107**
	skipped question	**10**

19. A site becomes complex when

	Response Percent	Response Count
Remediation costs are greater than $10 million	3.7%	4
Remediation costs are greater than $20 million	2.8%	3
Remediation costs are greater than $50 million	1.8%	2
Remediation costs are greater than $100 million	2.8%	3
Remediation costs are disproportionate to benefits (i.e., risk reduction)	17.4%	19
Cost alone does not determine whether a site is a complex site (but may be an indicator of complexity)	**71.6%**	**78**
Share your understanding of a "reasonable" cost		26
answered question		**109**
skipped question		**8**

20. Use of or need for a specific regulatory mechanism usually makes for a complex site (select all that apply)

	Response Percent	Response Count
Technical Impracticability (TI) waiver	51.9%	55
Other ARAR waivers	33.0%	35
State designated groundwater management or containment zones	28.3%	30
Alternative point of compliance	32.1%	34
Alternate concentration limits	36.8%	39
Use of a specific regulatory mechanism may be an indicator of complexity but does not determine whether a site is a complex site	**70.8%**	**75**
List other regulatory mechanisms that have been or could be used at complex sites		13
answered question		**106**
skipped question		**11**

21. Who do you represent?

	Response Percent	Response Count
EPA	2.8%	3
State/Local Government	26.6%	29
Public/Tribal Stakeholder	3.7%	4
Private Sector	**52.3%**	**57**
DOD	8.3%	9
DOE	4.6%	5
Academia	2.8%	3
	answered question	**109**
	skipped question	**8**

What is the team working on?

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Team Charge

- Technical and regulatory guidance document
    - Compile and synthesize existing guidance
    - Compile case studies
    - Provide consensus on strategies to meet cleanup goals at complex sites
    - Compile relevant tools to support these strategies
    - Provide guidance on how these tools could be used to support specific aspects of remedy selection, implementation and long-term performance evaluation
- Existing tools and approaches may be adapted to focus on providing technical justification and implementation approaches for remedies at complex sites

Documents…

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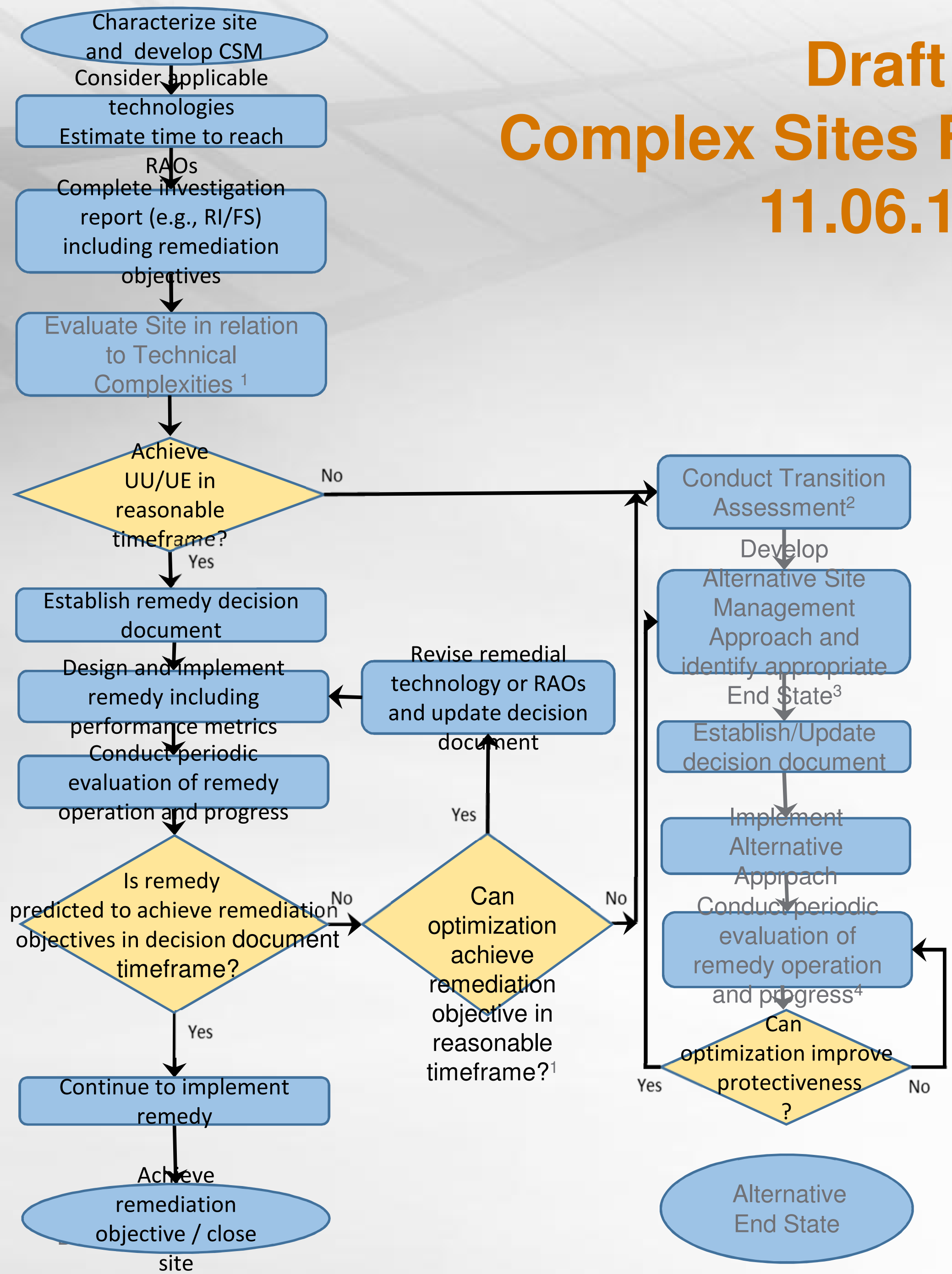
TechReg Draft Outline

- Introduction
- Challenges to closing complex sites
  - Technical
  - Regulatory
  - Other
- Closure concepts
- Remediation strategies for complex sites
- Long-term management of complex sites
- Lessons learned from case studies
- Stakeholder considerations
- Summary and conclusions
- References

Case Studies Document

Draft
Complex Sites Flow Chart
11.06.14



Footnotes

1. Go to Complex Site Attribute Evaluation, P. #
2. Go to Transition Assessment Flowchart/Process, P. #
3. Go to flow chart on Alternative Management Approach and Selection of End State
4. Go to Long Term OM&M, P. #

Path forward & Challenges

- Challenge: Diverse members ~190 currently from wide perspectives
- Short timeline for reaching consensus, producing documents
- Spring & Fall Meetings in 2015
- Working / writing calls- weekly or bi-weekly for ALL subgroups
    - Introduction was completed by one of three sub-groups formed following the Spring Meeting in Garden Grove (March 2014)
    - Remaining section drafts to be completed by several writing group formed during and after the Fall Meeting in Las Vegas (October 2014)
    - Due dates for written sections are on or before January 31, 2015
    - The goal is to have a draft document ready for discussion by the team during the Spring Meeting (April 2015)

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Questions…