Principles of Environmental Restoration

Applying the Principles to Response Design and Implementation

Objectives

- Apply the four principles of environmental restoration to response design and implementation
- Provide framework and tools for conducting response design and implementation in light of inherent uncertainties

The principles facilitate recognition of and capitalization on opportunities for improvement and innovation throughout remedial design and implementation (RDI)

The approach translates into cost and schedule savings in design, implementation, and completion by identifying and planning for potential "show-stoppers" while minimizing additional data gathering

The overall goal of the design process is to translate the requirements contained in the decision document into plans and specifications that, when implemented, meet the objectives

Similarly, the overall goal of implementation is to construct and complete a response according to the plans and specifications such that the result explicitly achieves the requirements and objectives of the decision document

Throughout the design and implementation process, there are opportunities (and needs) to identify and implement ways to improve and optimize a project. The goal of this session is to provide sites with several methods to accomplish this

The principles, as discussed in this module, are taken from a new course entitled Principles of Environmental Restoration II: Design and Implementation still under development

Principles Translated through the Remediation Process

Principle	Pre-Decision Document	Post-Decision Document		
		Design	Implementation	Post-Completion or Construction
Define objective and maintain focus on It (What needs to be done?)	Clear, concise statement of problem	Clear, concise statement of restoration objective	Clear, concise definition of closure - performance measurement based on that definition	Clear, concise definition of completion - performance measurement based on that definition
Early identification of probable means of achieving objective (How will it be done?)	Early identification of likely response actions	Early identification of likely design basis	Early development of draft work plans	Early identification of post-construction procedures for long term care
Uncertainties are inherent and must be managed (What are expected conditions and potential deviations?)	Evaluate effects uncertainty could have on response selection	Evaluate effects uncertainty could have on response design	Monitor indicators to provide early warning on which contingency will likely be needed, if any	Monitor indicators to provide early warning that response will fail to meet objective
Early open communication and consensual decision making by project team	Prepare problem statement, select response action and accept level of residual uncertainties	Develop consensus interpretation of decision document, approve designs, approve residual uncertainty management plan, and define/agree on objectives	Interpret performance measurement and contingency monitoring results, and approve implementation of contingencies	Review monitoring data, implementation of contingencies and be involved in 5 year reviews

Instructor Note: While reviewing this matrix for the first time, explain that we are moving horizontally across the table for all discussions in this session. This allows a full discussion of each principle from early design through implementation.

Define Objective and Maintain Focus on It

- Translate the requirements of the decision document into description of:
  - Overall objectives
  - Performance criteria
  - Determination of when project reaches completion

First need to remember where the principle came from: In the pre-decision phase, principle is to identify the problem. At this point, we have reached consensus that there is a problem and we are going to do something about it. What we are going to do about it is specified in the decision document. This principle translates into focusing on what is required -- from the point of the signed decision document, through implementation

We are assuming that the decision document has been signed and we have to ensure consensus on several key prescriptive elements in the decision document including:

•What are the performance objectives?

•What is the response and its components?

•What criteria/standards must be met?

•What are the additional requirements (e.g., ARARs, permit conditions, etc.)?

Need to have a clear understanding of these elements in the decision document before entering into the design phase of the project. This will help address:

•What we are required to do

•Why we are doing it

•When we can stop

Defining Objective during RDI

- Primary objective is achieved by working with the decision document to identify/clarify:
  - Performance objectives
  - Response action and its components
  - Criteria and standards
  - Other requirements and conditions
- Once "what" is required is identified, need to select performance metrics and criteria to define:
  - What we're measuring and how
  - Point for establishing objectives

Before entering into the design phase of a project, we need to clearly understand both what we need to accomplish and how we know when we have reached these goals

During the early design phase, need to focus on understanding what needs to be done. This means a clear understanding of the problem we are trying to solve, and the response prescribed in the legally-binding decision document

The response is the technical activity specified as the solution used to achieve performance objectives

•The response will be described as components

•The components will vary in detail

Understanding the response is important because it tells us:

•What to do

•What we cannot do (i.e., constraints in completing the work)

Standards and criteria should be clearly listed in the decision document. If they are not, the core team will need to specify what they will interpret as standards the response must attain

Decision documents typically include a section containing additional requirements that must be met. These requirements are not necessarily linked directly to solving the original problem; rather, they describe other legal frameworks under which the work must be conducted

As we move into implementation, need to determine what is required to monitor performance during implementation. Ultimately, striving to know what measurements can be used to demonstrate that the performance objectives have been met (i.e., mission accomplished)10

Early Identification of Probable Means of Achieving Objective

- Identify areas of flexibility in decision documents that can be leveraged to optimize design and implementation
- Identify opportunities for continual improvement
- Identify opportunities to optimize projects and incentivize contractors

The previous principle helps us determine what is required by the decision document. However, identifying what is required and developing how to get there are two fundamentally different exercises

This principle focuses on how to achieve the requirements, thus enabling implementation and completion

Basically, this is the process of selecting a design basis and translating it into plans and specifications to implement the requirements

Pre-decision principle is focused on identifying a likely response action. However, in post-decision phase the focus becomes identifying the design basis and translating it into plans and specifications to ensure successful implementation of the selected response action

By intention, decision documents are written at a general level and are insufficient as the sole basis to start implementation. A significant amount of work is necessary to develop the level of detail required for implementation. That effort constitutes design and begins with a selection of the basis of design. Developing the design basis and detailing the design (i.e., plans and specifications) is a critical step

Means of Achieving Objective during RDI

- Select design basis for developing plans and specifications
- Capture optimization/innovation opportunities
- Manage uncertainty with project delivery strategies
- Look for ways to incentivize projects

Design basis is integral to developing plans and specifications

•Design basis is not provided in the decision document

•Design basis is best developed by focusing on desired end state because design standards do not routinely apply

•Proper selection of design basis provides room for innovation/optimization throughout design

Design must consider how to manage inherent uncertainty should deviations from the estimate be encountered during implementation

Once a design basis is developed, there is an opportunity to evaluate alternative methods to do a better job

Optimization/Innovation opportunities depend on response requirements and flexibility allowed in selecting the design basis. These opportunities are captured during implementation with value engineering, systems integration, and approaches to find optimum cause of action

Project delivery strategies are devised as one means of better managing uncertainty. These strategies include tradeoffs between in-house and contractor labor. They also Involve selection of appropriate contract types and contractor selection methods

Always look for ways to incentivize achievement of end points. Be cognizant of the difference between minimizing cost and incentivizing performance. Incentives can range from including award fees for targeted actions, to profit sharing of savings or avoided costs

Uncertainties are inherent and must be managed

- Once a response is selected, must evaluate implementation uncertainties including:
  - The range of values surrounding the selected design basis
  - The potential effects should project encounter conditions different than the estimate upon which the design is based

To this point, we have discussed uncertainty in terms of uncertainty in the pre-decisional phase (i.e., what is the best response given our known site conditions) and how potential deviations from our assumptions affect the desirability of any given response

During design, the goal is to evaluate the impacts of deviations from the design basis/criteria and design contingencies that can be implemented when conditions warrant, thus mitigating the impact

Essentially this "implementation" uncertainty is manifested by the possibility that values, other than those used in the design basis, may occur

In post-decision phase, still need to rely on identifying uncertainties, evaluating and planning for these uncertainties, preparing mitigating contingencies, and verification that performance objectives are met

During implementation, monitor selected indicators to determine if thresholds are exceeded and contingencies need to be implemented

Managing Uncertainties during RDI

- Mitigate uncertainties arising from incomplete knowledge or changes in site conditions, technology performance, and regulatory requirements
- Evaluate impacts if estimates in design basis are different than what is encountered
- Ensure response is meeting all objectives
- Decide appropriate level of contingency development

For each subcomponent and design basis there may be multiple types of uncertainties. For each design basis, need to identify these potential uncertainties

For each design basis the following questions should be addressed in the evaluation process:

•What is the range of possible values?

•Is there a threshold value within that range that would require a change in design?

•What are the potential impacts of the value(s) that exceed the threshold?

•How will you determine if the threshold is exceeded?

•If threshold is exceeded, what can you do to mitigate the impact?

•How long will it take to implement the contingency versus how long until impact is felt?

Important to note that monitoring for performance measurements and monitoring for the need to implement contingencies are different. Performance measurements are making sure that the response is on track to meet all performance objectives. Monitoring for contingencies focuses on "catching" a show-stopper and implementing a contingency to make sure that the response remains on track

It may not be necessary to fully develop or contract all contingencies

Compare the expected value costs of having the contingency on standby versus less fully developed state. Contract flexibility also needs to be determined (e.g., contracts with options and pre-placed contracts)1111

Example Uncertainty Evaluation

Component	Design Basis	Range	Threshold	Impact	Probability	Monitoring	Contingency	Time to Implement
Excavation	No utilities	Water Storm sewer Electrical	Any one utility	Halt excavation Damage or disrupt service	Low	Visual	Cocoon Hand dig	1-2 day 1-2 day
	Only Cr (III) present	Cr (VI) present	> RCRA limits	Remedy illegal w/o treatment Delay while new plan approved Revised H&S plan Staging areas Delays in analytical services	Moderate	Field wet chemistry Visual	Contract to ship/treat off-site TSD Reduce to Cr (III)	30-60 days if contingency not developed, including all permits and contracts, prior to implementing response

A site has soil contaminated from discharge of chrome plating materials. Company records indicate the effluent was treated to reduce all hexavalent Chromium, Cr(VI), to trivalent chromium, Cr (III), then discharged into a drying pond. Field sampling provided a three-dimensional array of data indicating a large, irregular shaped volume of soil containing Cr(III) only. Geophysical surveys and a cursory look at plant layouts indicate no underground utilities in the area. Armed with that "knowledge", a procurement was prepared in which the bidder would offer a fixed unit price bid for excavation, stabilization of the chromium in cement, and subsequent reburial. A minimum volume of soil was guaranteed. The contractor was required to use x-ray fluorescence to monitor total chromium levels during excavation. A cut off value for total chromium was used to segregate clean soils from those requiring stabilization

Early Open Communication and Consensual Decision Making by Core Team

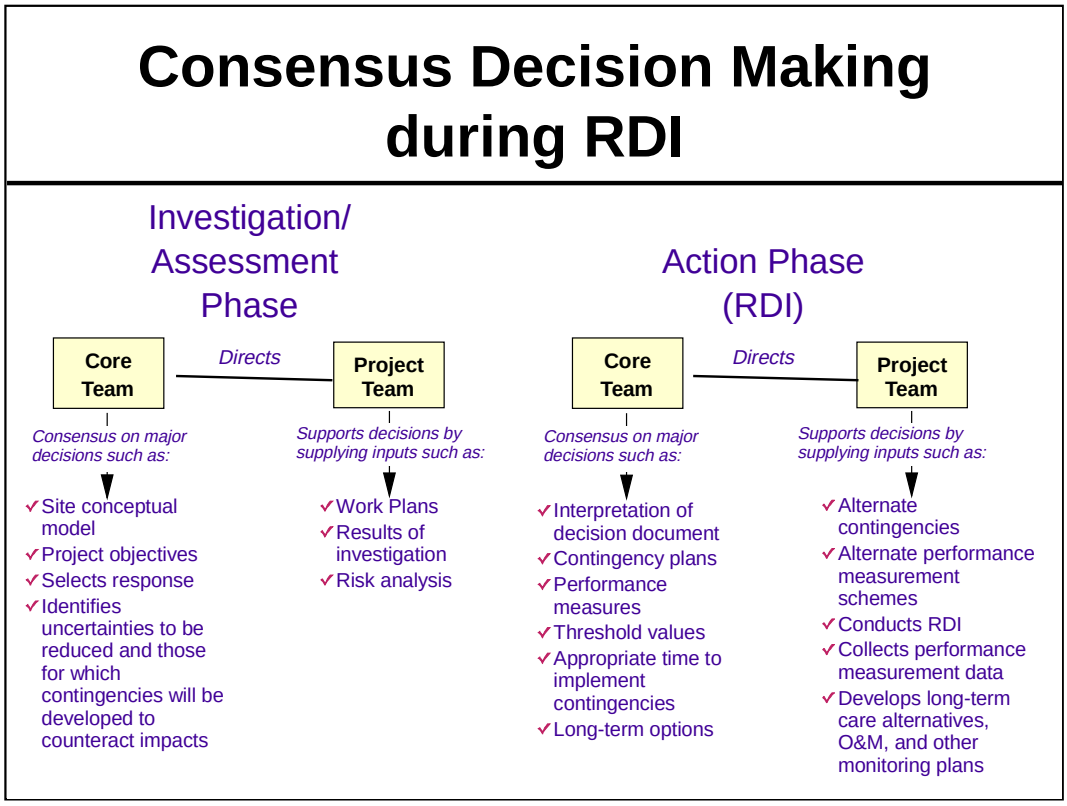
- Role of the core team evolves from the pre-decision stages through design and implementation

In pre-decision stage, core team identifies the problem, evaluates alternatives, and selects the response

During design, core team interprets the decision document and approves uncertainty management plan

During implementation, core team interprets monitoring data and approves implementation of contingencies

Important to recognize the continued importance of having the core team involved through design and implementation; however, the level of involvement required/desired will vary significantly, depending on the core team, complexity of the response, project delivery strategy, level of public interest, and site conditions



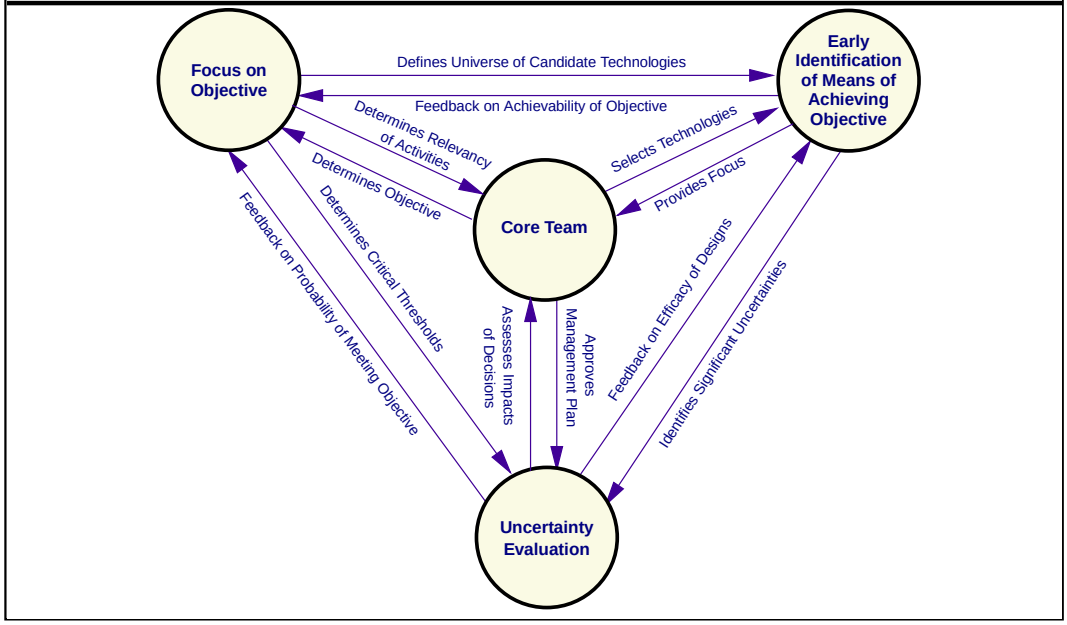
The core team needs to establish a framework for decision making under which decisions may be made by the contractors or subcontractors, but above which the core team must be notified. In essence, the core team creates a delegation of authority framework that indicates who can make which decisions under which circumstances

Through consensus, the core team establishes clear basis for response and design while meeting defined project objectives

Issues requiring core team approval:

- Objectives/requirements of the response
- Latitude available for optimization during design and implementation
- Approach to detecting if a threshold will be exceeded
- Countermeasure to be implemented to mitigate impacts of uncertainty
- What constitutes an exceedence of a threshold
- What verifies performance
- When construction is complete
- Determining that monitoring data have not indicated a need for any changes going forward

Interrelationship among principles during RDI



How core teams apply these principles will vary from site to site and from project to project