Adaptive Management Basics

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Purpose

▶ Introduce the workshop and define adaptive management

▶ Describe the history, role and benefits of adaptive management

▶ Introduce the AM cycle

▶ Present a few key AM principles

▶ Point participants toward useful resources

▶ Establish a foundation for the remaining presentations in this workshop

What is Adaptive Management?

"Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process." (NRC 2004)

- OR -

Adaptive Management (AM) is a formal, science-based approach to risk management that permits implementation of actions despite uncertainties. Knowledge gained from monitoring and evaluating results is used to adjust and direct future actions.

- OR -

Adaptive management is doing while learning in the face of uncertain outcomes.

Origins of AM

Walters, C. 1986
Adaptive management of renewable resources. New York: MacMilla Publishing Comp

NRC. 2004
Adaptive Management for Water Resource Planners
The National Academies Press, Washington, D.C.

Holling, C.S., 1978.
Adaptive environmental assessment and management.
New York: John Wiley & Sons

Lee, K. 1993
Compass and gyroscope: Integrating science and politics for the environment.
Washington D.C. Island Press.

Williams, B.K., R.C. Szaro, and C.D. Shapiro. 2007.
Adaptive Management: US Department of the interior Technical Guide.
Adaptive Management Working Group, US Department of the Interior, Washington, DC

Nyberg, B. 1999.
An introductory guide to adaptive management for project leaders and participants.
Victoria, British Columbia: BC Forest Service.

A Practitioner's Definition
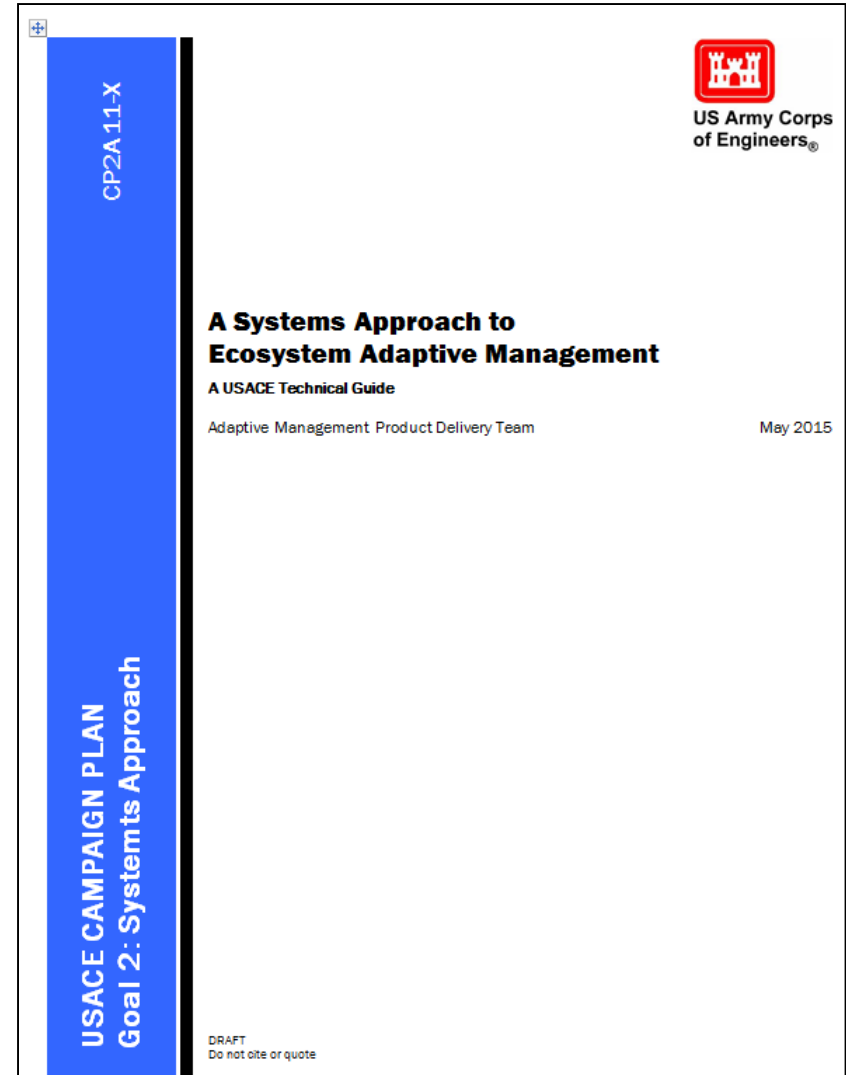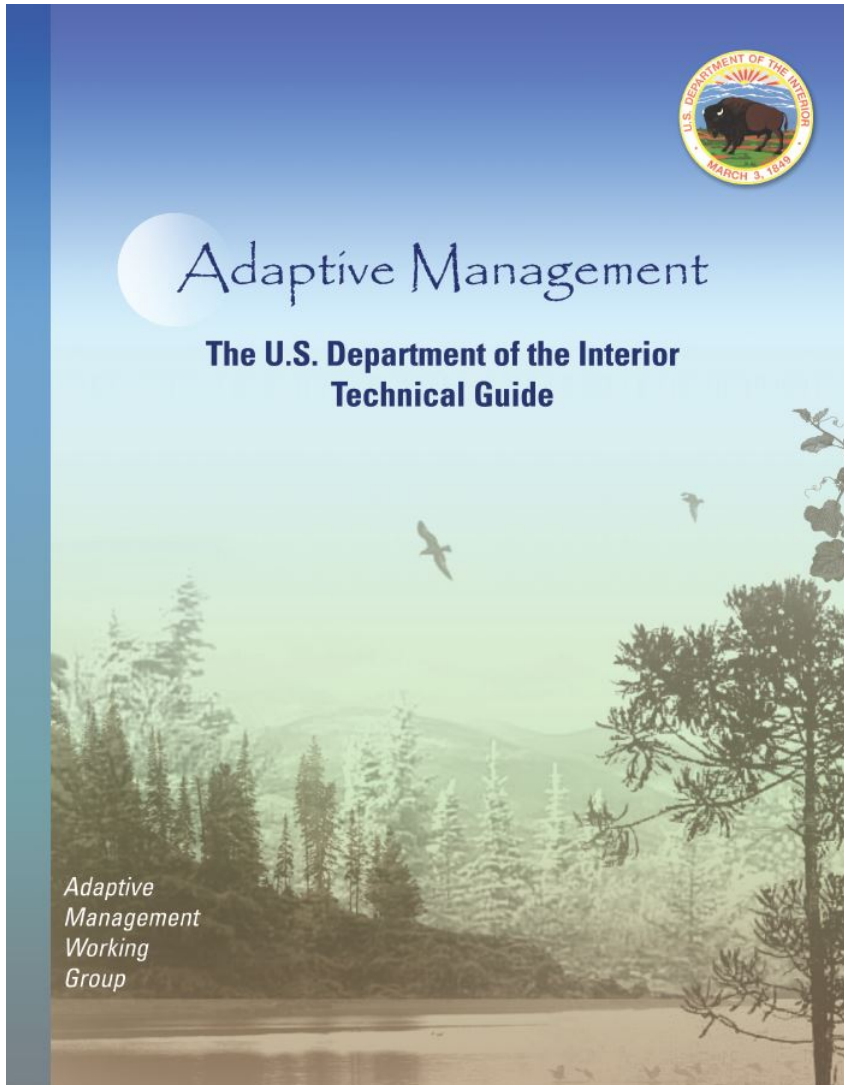
A **systematic, rigorous** approach for

designing and implementing **management actions**

in order to

maximize **learning** about **critical uncertainties**

that affect management **decisions or policies**

while simultaneously

striving to meet **management objectives**.

▶ Extensive practical experience with the general concept.

▶ Relatively little discussion of AM prior to ecosystem restoration authorities.

▶ Numerous institutional barriers and challenging factors.

▶ WRDA 2007
  - Sec. 2036
  - Sec. 2039

▶ AM Implementation Guidance

▶ Major ER Programs
  - CERP
  - UMRR
  - MRRP
  - LCA
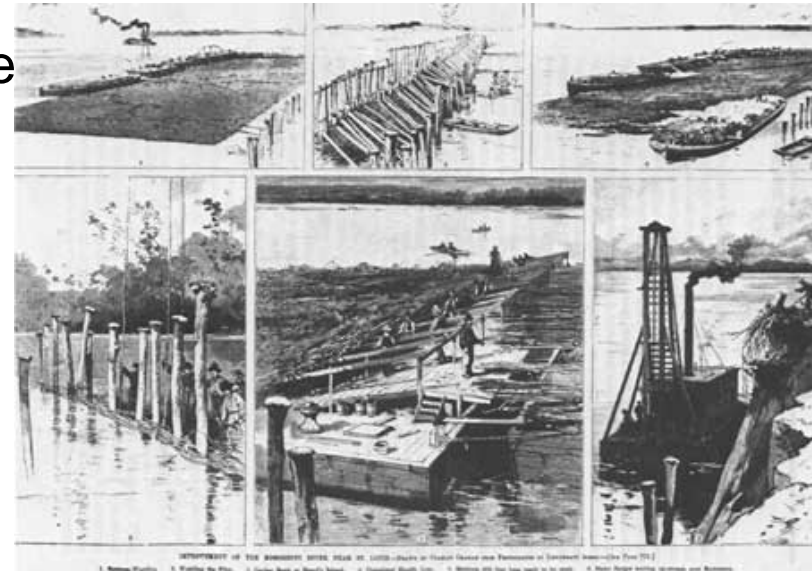
Role and Limitations of AM

▶ AM should be considered for all ER Projects

▶ Not all projects lend themselves to AM. Three elements must be present for AM to proceed:
  1. One or more critical uncertainty
  2. Ability to learn through monitoring
  3. Ability to make adjustments based on new knowledge

▶ Additionally, AM should afford a more cost-effective strategy than other alternatives (difficult to know *a priori*)

▶ Finally, institutional commitment is needed (see #3 above); this can be elusive for various reasons

Is Adaptive Management Needed?

QUESTIONS

Is there sufficient flexibility within the project design and operations that permits adjustment of management alternatives?

If No, adaptive management is not possible
If Yes, continue with questions

Is the managed system well understood and are management outcomes readily predictable?

Do participants agree on the most effective design and operations to achieve goals and objectives?

Are the project/program goals and objectives understood and agreed upon?

ANSWERS

Yes to all

Adaptive Management is not needed

No to any

Adaptive Management can probably improve success

What are the benefits of AM?

► Provides a precautionary approach to act in the face of uncertainty

► Improved probability of project/program success

► Incorporates flexibility and robustness into project/ program design, implementation, and operations

► Process of developing an AM plan inevitably improves the plan formulation process & products

► Promotes collaboration and conflict resolution among agencies and stakeholders, scientists and managers while empowering all the above groups

► Moves the state of science and understanding of ecosystem restoration forward in a deliberate way

► Can improve cost effectiveness

AM Strategies

Passive Adaptive Management :

-Most widely used approach but often criticized

-Useful when action adjustments related to system state anticipated or when applying project learning to programs

-Focus on mgt objectives; learning is opportunistic but not an imperative

Active (Hypothesis-Driven) Adaptive Management :

-Deliberate experimentation (perturb system for response)

-Requires trade-off between objectives and learning

-Requires ability to control actions, partition factors

-Adequate design is critical (controls and replication)

Contingency Planning :

-Not AM, but can be an important part of an AM plan/program

-Requires careful consideration of alternative outcomes

-Identification of criteria and triggers for objectionable outcomes

-Employs pre-defined "Contingencies" in the event they are needed

Adapted from Walters, C.J. (1986) *Adaptive Management of Renewable Resources*

Characteristics of Active AM

▶ Treats management as an 'experiment'
- ◾ seeks to learn from contrasting management actions
- ◾ takes a 'systems approach' – requires planning rigor

▶ Addresses critical uncertainty
- ◾ explicitly recognizes decision-relevant uncertainties
- ◾ learning is (at least initially) a prime objective

▶ 'Closes the loop'
- ◾ requires predictions of outcomes
- ◾ confronts decision-makers with information
- ◾ makes adjustments based on actual outcomes

AM Cycle
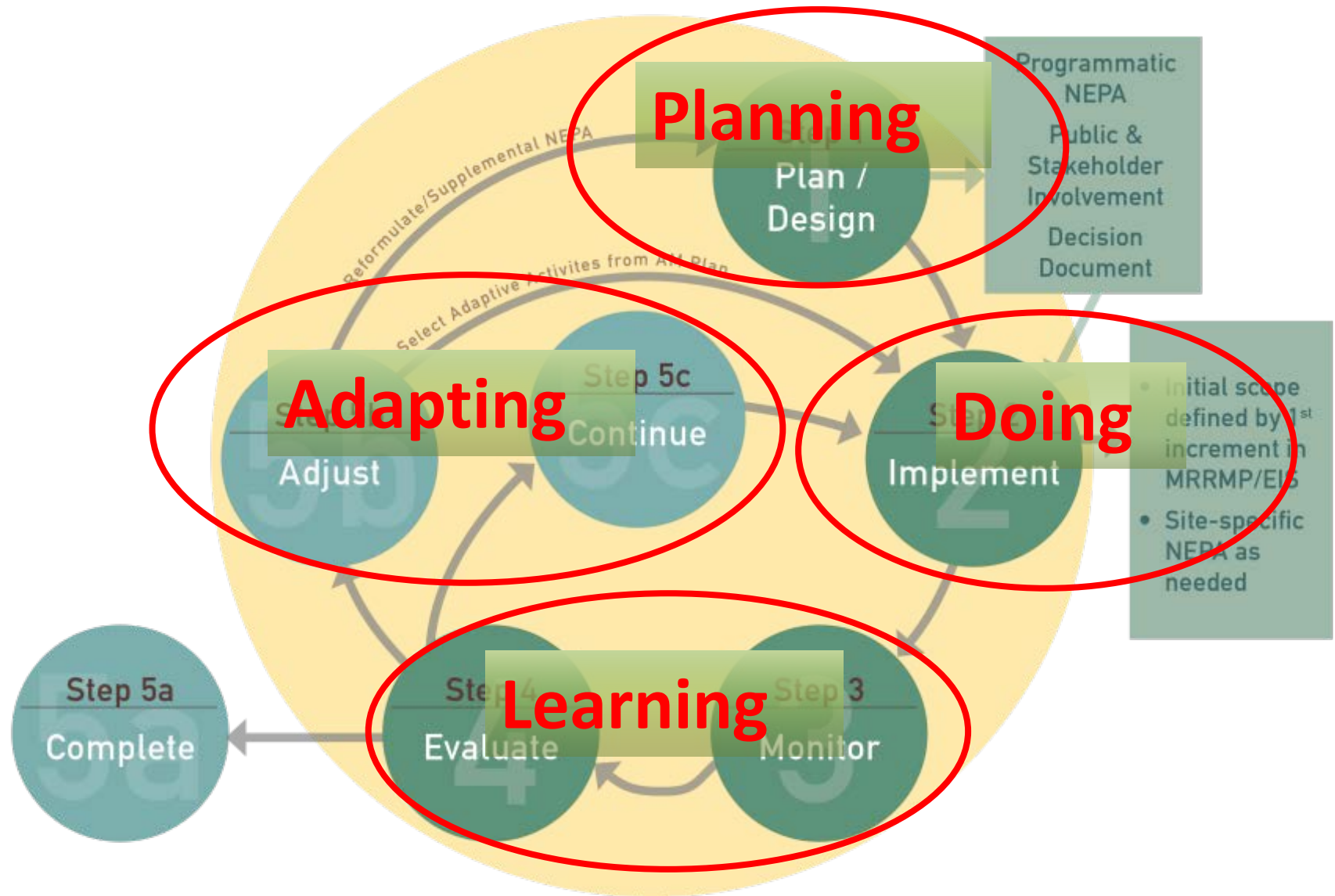
- ► **PLAN**: Frame problem and analyze actions from the view of management uncertainties
- ► **DO**: Implement and monitor actions using principles of experimental design
- ► **LEARN**: Evaluate data to learn about effectiveness of actions and reduce uncertainties



*This and the next set of figures taken from ESSA (2012).

Assess Step

► **Define the problem**

► **Identify measurable objectives** (*what are you trying to achieve and how will you know when you get there?*)

► **Identify mgm't (i.e. decision-relevant) uncertainties** (*what do you want to learn about achieving objectives?*)

► **Build conceptual and/or quantitative models; explore hypotheses, alternative actions**

► **Incorporate insights** (*what would you change based on what you learn?*)
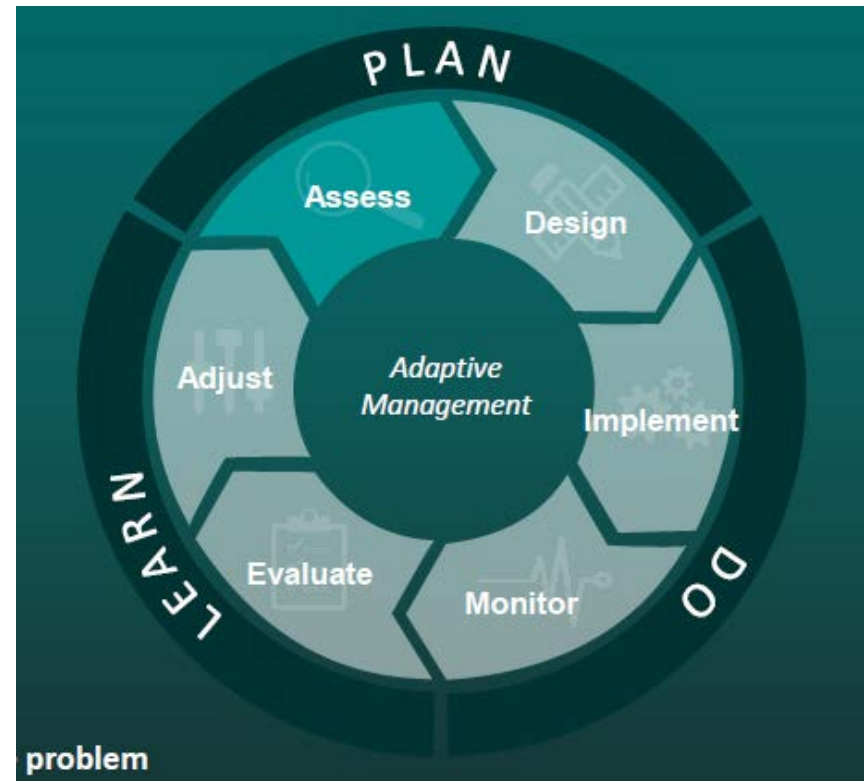
Plan/Design Step

- **Design management treatments; contrasts, replicates, controls…**
- **Identify metrics/indicators of treatment responses** (*will you be able to detect changes?*)
- **Design plans for next steps (power analysis, statistical monitoring design, field sampling protocols, data analysis plans)**
- **Predict expected outcomes and responses, ID decision criteria & contingencies**
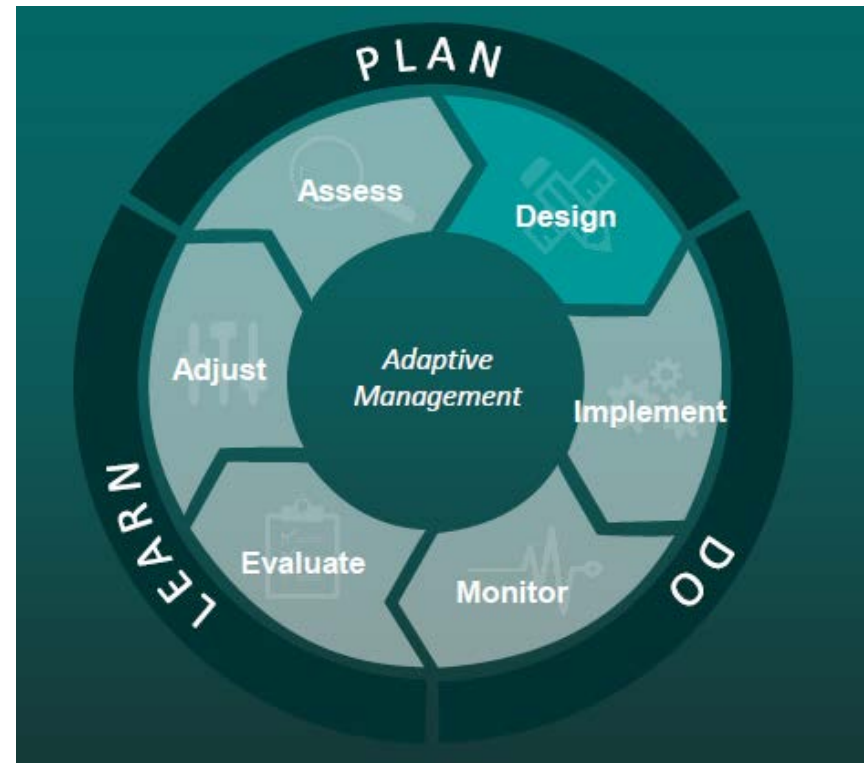
Implementation Step

► **Implement the actions/treatments as designed**

► **Document the implementation and any deviations**
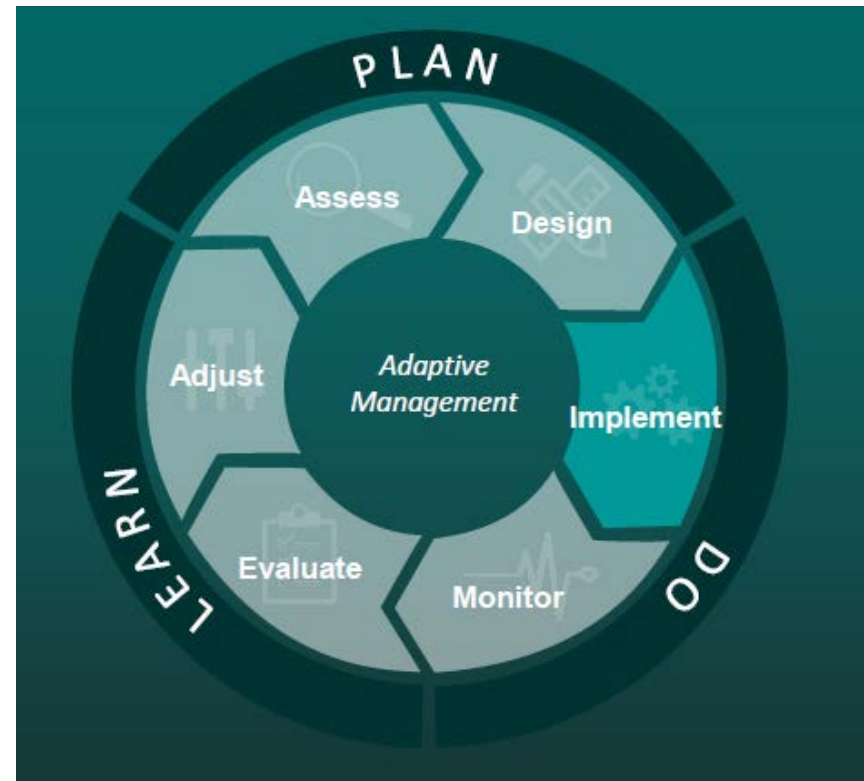
Monitoring Step

► **Gather data on performance of treatments/actions following pre-defined protocols**

► **Implementation monitoring** (*was the treatment/action implemented correctly?*)

► **Effectiveness monitoring** (*what were the results/responses?*)

► **Validation monitoring** (*did the system respond as expected to the treatment/action?*)

- **Analyze data as related to management uncertainties/questions/hypotheses**

- **Compare actual results with earlier predictions**

- **Consider best available science (whatever the source)**

- **Draw conclusions** (*what was learned?*)

Decision (continue/adjust/complete) Step

- **Adapt actions/treatments based on what was learned**

  OR

- **Implement contingency plans following criteria**

  OR

- **Modify the experiment (design, monitoring), or modify policy and practices**

  OR

- **Determine success**
- **Share new knowledge with others**
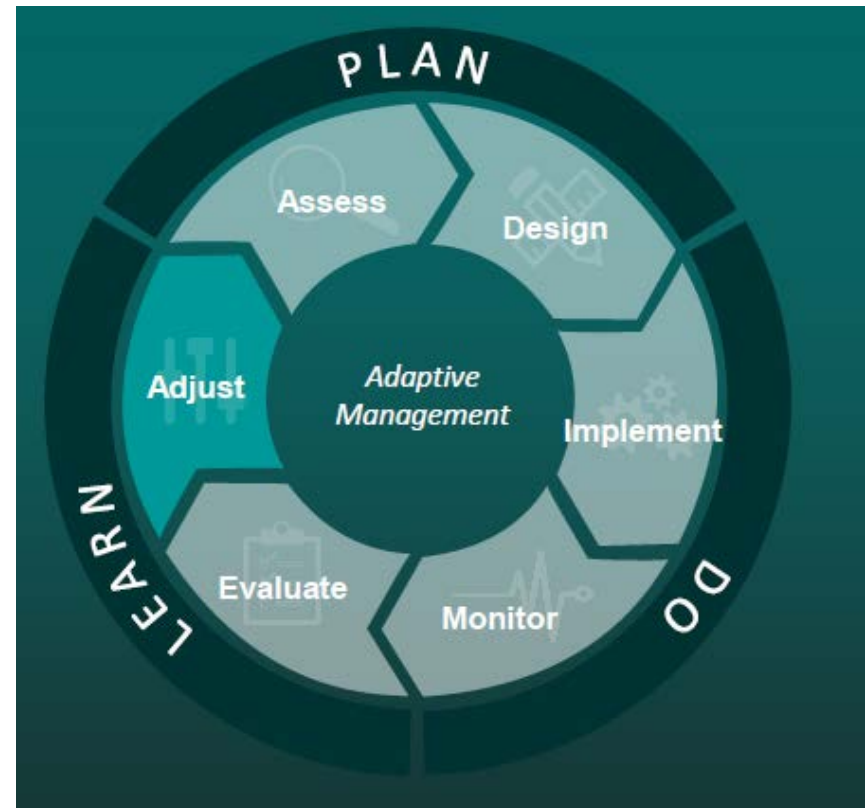
Common Elements

▶ Embracing risk and uncertainty as a way of moving forward

▶ Explicit characterization of system uncertainty through conceptual and numerical model inferences

▶ Iterative decision-making (evaluating results and adjusting actions on the basis of what has been learned)

▶ Feedback between monitoring and decisions (learning)

▶ A governance & decision process coupled with a willingness and ability to change

Required Mindset for AM

▶ Be honest about uncertainties and tackle them head-on

▶ View choices/management actions** as 'treatments' to be tested

▶ Make a commitment to learning

▶ Mistakes are not all bad – they enhance learning

▶ Expect surprises and learn from them

▶ Encourage creativity and innovation

▶ Start small; build on successes

*** ….where actions can include various **management actions** related to allocation, restoration, levels and patterns of disturbance, as well as **policy-oriented measures** related to permitting, incentives, and financing, among others.*

Lessons from a Practitioner

- AM has a critical planning component that requires careful consideration of uncertainties and outcomes; it is not strictly a post-construction consideration

- Development of an AM plan is as much about the *process* as it is the *product*

- Not all projects or programs lend themselves to AM

- Governance is crucial and may be difficult to assure for some projects and programs

- Cost estimates are complicated by uncertainties

- Refinement during PED is likely, and flexibility in implementation is probably needed

- Successful efforts typically have an AM "champion"

Lane Lefort

References (see Handout #10)

Fischenich, C., et al. 2012. *The application of Adaptive Management to ecosystem restoration projects. EBA Technical Notes Collection. ERDC TN-EMRRP-EBA-10. Vicksburg, MS: U.S. Army Engineer Research and Development Center. www.wes.army.mil/el/emrrp*

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Walters (1986) *Adaptive Management of Renewable Resources* (McGraw-Hill)

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC. http://www.doi.gov/ppa/upload/TechGuide.pdf