

**Benchmarks for Incorporating
Adaptive Management into
Water Project Designs,
Operational Procedures, and
Planning Strategies**

*Report I
Federal Agency Inventory of Adaptive
Management Practices and Policies*

2013-R-11





Institute for Water Resources

The Institute for Water Resources (IWR) is a U.S. Army Corps of Engineers (USACE) Field Operating Activity located within the Washington DC National Capital Region (NCR), in Alexandria, Virginia and with satellite centers in New Orleans, LA; Davis, CA; Denver, CO; and Pittsburg, PA. IWR was created in 1969 to analyze and anticipate changing water resources management conditions, and to develop planning methods and analytical tools to address economic, social, institutional, and environmental needs in water resources planning and policy. Since its inception, IWR has been a leader in the development of strategies and tools for planning and executing the USACE water resources planning and water management programs.

IWR strives to improve the performance of the USACE water resources program by examining water resources problems and offering practical solutions through a wide variety of technology transfer mechanisms. In addition to hosting and leading USACE participation in national forums, these include the production of white papers, reports, workshops, training courses, guidance and manuals of practice; the development of new planning, socio-economic, and risk-based decision-support methodologies, improved hydrologic engineering methods and software tools; and the management of national waterborne commerce statistics and other Civil Works information systems. IWR serves as the USACE expertise center for integrated water resources planning and management; hydrologic engineering; collaborative planning and environmental conflict resolution; waterborne commerce data and marine transportation systems; and global climate change science.

The Institute's Hydrologic Engineering Center (HEC), located in Davis, CA specializes in the development, documentation, training, and application of hydrologic engineering and hydrologic models. IWR's Navigation and Civil Works Decision Support Center (NDC) and its Waterborne Commerce Statistical Center (WCSC) in New Orleans, LA, is the Corps data collection organization for waterborne commerce, vessel characteristics, port facilities, dredging information, and information on navigation locks. IWR's Risk Management center is a center of expertise whose mission is to manage and assess risks for dams and levee systems across USACE, to support dam and levee safety activities throughout USACE, and to develop policies, methods, tools, and systems to enhance those activities.

Other enterprise centers at the Institute's NCR office include the International Center for Integrated Water Resources Management (ICIWaRM), under the auspices of UNESCO, which is a distributed, intergovernmental center established in partnership with various Universities and non-Government organizations; and the Conflict Resolution and Public Participation Center of Expertise, which includes a focus on both the processes associated with conflict resolution and the integration of public participation techniques with decision support and technical modeling. The Institute plays a prominent role within a number of the USACE technical Communities of Practice (CoP), including the Economics CoP. The Corps Chief Economist is resident at the Institute, along with a critical mass of economists, sociologists and geographers specializing in water and natural resources investment decision support analysis and multi-criteria tradeoff techniques.

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and Planning Strategies**

Report I

**Federal Agency Inventory of Adaptive Management
Practices and Policies:**

Prepared for:

**Water Resources and Climate Change Adaptation Work group
of the**

Interagency Climate Change Adaptation Task Force

In October 2011, the Interagency Climate Change Adaptation Task Force published the *National Action Plan (NAP) Priorities for Managing Freshwater Resources in a Changing Climate*. The plan provides an overview of the challenges that a changing climate presents for the management of the Nation’s freshwater resources and recommends actions for Federal agencies to support water resource managers in understanding and reducing the risks of climate change.

The U.S. Army Corps of Engineers (USACE) is the lead agency for implementation of three actions in the NAP associated with the recommendation to support Integrated Water Resources Management (IWRM):

17. Work with States and interstate bodies (e.g., river basin commissions) to provide assistance needed to incorporate IWRM into their planning and programs, paying particular attention to climate change adaptation issues.
19. Working with States, review flood risk management and drought management planning to identify “best practices” to prepare for hydrologic extremes in a changing climate.
20. Develop benchmarks for incorporating adaptive management into water project designs, operational procedures, and planning strategies.

This report supports Action 20. It was prepared by a Federal interagency technical team.

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Introduction ¹

In 2009, the Obama Administration convened the Interagency Climate Change Adaptation Task Force, co-chaired by the Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA), and including representatives from more than 20 Federal agencies. On October 5, 2009, President Obama signed an Executive Order directing the Task Force to develop a report with recommendations for how the Federal Government can strengthen policies and programs to better prepare the Nation to adapt to the impacts of climate change. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as:

Adjustment in natural or *human systems* in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation – Adaptation that takes place before impacts of *climate change* are observed. Also referred to as proactive adaptation.

Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or *welfare* changes in *human systems*. Also referred to as spontaneous adaptation.

Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

On October 28, 2011 the Task Force released the 2011 Interagency Climate Change Adaptation Task Force Progress Report outlining the Federal Government's progress in expanding and strengthening the Nation's capacity to better understand, prepare for, and respond to extreme events and other climate change impacts. The report provides an update on actions in key areas of Federal adaptation, including: building resilience in local communities, safeguarding critical natural resources such as freshwater, and providing accessible climate information and tools to help decision-makers manage climate risks.

The 2011 Interagency Climate Change Adaptation Task Force Progress Report is available at: http://www.whitehouse.gov/sites/default/files/microsites/ceq/2011_adaptation_progress_report.pdf

The Interagency Climate Change Adaptation Task Force called for collaborative approaches within the government to address key cross-cutting issues related to climate change adaptation. The Task Force is working to ensure Federal Agencies align their climate change adaptation planning efforts to build a coordinated and comprehensive response to the impacts of climate change on public health, communities, oceans, wildlife, and water resources.

¹ excerpts from CEQ Climate Change Adaptation Task Force Website : <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation>

A federal Water Resources and Climate Change Adaptation Work Group was formed to work with stakeholders to develop the “*National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate*” in order to assure adequate water supplies and protect water quality, human health, property, and aquatic ecosystems.

The October 2011 National Action Plan is available at:

http://www.whitehouse.gov/sites/default/files/microsites/ceq/2011_national_action_plan.pdf

The Plan makes six priority recommendations. Including Recommendation 5: Support Integrated Water Resource Management (IWRM). Four supporting actions are identified for Recommendation 5 including:

Supporting Action 20: Develop benchmarks for incorporating adaptive management into water project designs, operational procedures, and planning strategies.

A planning strategy for climate change is to promote mid-course corrections in response to new information. As noted above, adaptive management is a key element of IWRM. According to the National Research Council, “Adaptive management promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood” (National Research Council, 2004). Federal agencies should develop benchmarks for incorporating adaptive management into their planning and operations and should allocate a portion of project funds for monitoring for adaptive management. (page 29).

The National Research Council (2004) defined adaptive management as follows :

“Adaptive management 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. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a ‘trial and error’ process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.”

Purpose

An interagency technical team has been formed to assist the Water Resources and Climate Change Adaptation Work Group in developing benchmarks for incorporating adaptive management into freshwater water projects (Supporting Action 20 for IWRM) The technical team is composed of staff from the U.S. Army Corps of Engineers (USACE), U.S. Geological Survey (USGS), U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and Forest Service (USFS), U.S. Environmental Protection Agency (EPA), and National Oceanic and Atmospheric Administration (NOAA) . Two tasks were identified for the team in consultation with the Workgroup.

provide inventory of existing “adaptive management” practices and policies to Workgroup (March 2012)

provide recommendations for wider application of adaptive management strategies to Workgroup (July 2012)

This report addresses Task 1 and is a summary of existing agency adaptive management practices and policies. An attempt was made to include not only policies and practices that explicitly called out adaptive management, but, also those practices and policies that were consistent with the principles of adaptive management. The report is not intended to be an all encompassing inventory of individual projects and programs. Rather the intent is to illustrate current uses of adaptive management in agencies.

The summary of existing practices and policies will provide a foundation for completing Task two. The technical team will consider the existing state of the art relevant to Adaptive Management evolving agency strategies and adaptive management tools for managing freshwater resources in a changing environment. The technical team will identify good approaches that could be shared among agencies to improve their adaptive management policies and practice. The technical team will evaluate how adaptive management can be applied in addressing climate change in planning and management. The IWRM team will review the results from the technical team and provide the recommendations to the Climate Change and Water Resources Workgroup.

Adaptive Management in Natural Resources Planning

Calls for the use of adaptive management are found in a growing number of large-scale resource planning and strategy documents (Strategic Habitat Conservation; Landscape Conservation Cooperatives; National Fish, Wildlife and Plants Climate Adaptation Strategy; Ecosystem Restoration; Regulatory Permitting; etc). Adaptive decision making is seen in these documents as a way to account for and ultimately reduce uncertainty, and recommendations for its use invariably include an emphasis on monitoring to produce the data needed for improved understanding and better management. The framework for adaptive management typically includes the following elements:

- Recognition of uncertainty about the impacts of drivers (e.g., climate, land use change) and the effectiveness of managing their consequences

- Monitoring and reporting of resource responses to management, with a focus on evaluating management effectiveness, gaining new knowledge, and improving future management actions

- Data management and sharing

- Decision support (e.g., vulnerability analysis, risk assessment, scenario planning) for decision making under uncertainty

Adaptive management is characterized in this documentation in terms of iterative decision making that is informed at each time by a best management practice reflecting current understanding of resources and their responses to management policies, plans, and actions. Several key adaptive management implementation roles can be identified:

- The role of monitoring is to track changes in drivers and resource responses, so as to evaluate and improve management as information is accumulated

- The role of assessment is to use monitoring and other data and information to improve understanding about the resource system and its responses to management.

The role of decision support is to promote sound decision making in the face of ongoing uncertainty, by means of a comparative analysis of management options' effects on program or project goals and objectives.

The role of adaptive governance (Folke, et al., 2005; Olssen, 2006)) is to establish and promote frameworks by which decision-makers can discuss, identify, and approve decisions to adjust management policies, plans, and actions

Two dominant sources of uncertainty are implicit in this framework. One is the uncertainty associated with drivers such as climate change and land use, which sometimes is referred to as *environmental variation*. This uncertainty is addressed by means of, e.g., scenario planning or time series analysis of environmental data, so as to represent the distribution or range of driver variability. The other source of uncertainty is a lack of understanding (or agreement) about resource structures, functions, and responses to management. This source is called *structural or process uncertainty*, and it is captured by, e.g., different hypotheses about how the resource system works or distributions of key parameters that are thought to control resource behavior. Environmental variation typically is treated as if it is exogenous and uncontrolled; structural uncertainty is treated as if it is endogenous and controllable through management. An analysis of uncertainty can emphasize either or both forms of uncertainty however, a defining feature of adaptive management is its focus on the reduction of structural uncertainty, i.e., on learning.

Common features of the most frequently documented approach to adaptive management include a resource model to forecast responses to management actions, along with multiple scenarios of driver trajectories. The variation among these scenarios produces variation among potential resource responses, which is accounted for in the decision analysis. It is assumed, either implicitly or explicitly, that the resource functions and processes used to forecast responses are only partially understood, but understanding can be improved over time with monitoring data. Decision analysis and support at each point in time involves a comparative analysis of predicted resource responses to management options, which informs the identification of an appropriate action.

A point of emphasis in this framework is that decision making at each time is based on both the current status of the resource and the environmental scenarios; however, it typically does not incorporate the prospect of learning. That is, anticipated learning is not included as a factor in guiding decisions. One result of this omission is that learning becomes an untargeted, but useful, outcome of decision making. It is for this reason that the approach is described as an example of passive adaptive management. Most of the strategic documents invoking adaptive resource management explicitly or implicitly use a passive approach.

It is worth noting that there are alternative forms of adaptive decision making in which anticipated learning does guide decision making at each time. Because these forms treat learning in a more proactive fashion, they are described in the adaptive management literature as active adaptive management. With active adaptive management, the factoring of potential learning directly into decision making means that decisions are informed by both current understanding and the prospect of improved understanding in the future. The explicit focus on learning in active adaptive management can accelerate the reduction of uncertainty about the resource system, and thereby accelerate improvements of management. On the other hand, a faster rate of learning carries with it a potential cost of reduced productivity in the short term.

Both passive and active forms are legitimate approaches to adaptive management, and both are used in resource management. As mentioned above, a standard (but not the only) form of passive adaptive management uses a best management practice for decision making, followed by post-decision monitoring, the updating of resource understanding through analysis of the monitoring data, and the incorporation of the updated understanding into future best management practices. A popular (but not the only) form of active adaptive management is iterative experimental management, in which future decision making is influenced by experimental results.

In concept if not implementation, the distinction between active and passive approaches to adaptive resource management is easily bridged. For example, the National Fish, Wildlife and Plants Climate Adaptation Strategy describes an adaptive strategy of “proactive climate change-related decisions today, recognizing that new information will become available over time that can be factored into future decisions.” A simple wording change can transform this strategy statement from passive adaptive management to a more active form, by restating it as “proactive climate change-related decisions today, recognizing that both updated measures of uncertainty and new information about system status will become available over time that can be factored into decision making.” However, it should be understood that this relatively minor wording change has important implications as to the approach taken in decision assessment, as well as the rate at which uncertainty is reduced and management is improved.

Finally, there are challenges posed by non-stationary resource changes. This important issue is a natural outgrowth of climate and large-scale land use change, and it has only recently begun to be addressed by the natural resource community. The idea is that directional changes in the means or ranges of resource drivers can induce structural changes in resource systems, so that patterns of change in the past are no longer indicative of current and future changes. The need to incorporate non-stationarity into management assessment opens up new challenges for decision analysis and support, especially in a context of adaptive decision making where a resource system is changing at the same time one seeks improved understanding of it. Adaptive decision making in the face of climate change likely will require new approaches to decision analysis and support that account for non-stationary environmental variation and potentially non-stationary resource responses.

Summary of existing Adaptive Management Policies and Practices by Agency

The balance of this report provides AM summaries from each of the participating agencies. Due to the diverse missions and programs of the individual agencies, no attempt was made to standardize the information at this time. Individual discussion pieces are also included as a context for the agency summaries. This chapter can be modified as needed after review by the IWRM team.

Inventory of Strategic Initiatives in Adaptive Management within Department of the Interior (DOI)

DOI

<http://www.doi.gov/initiatives/AdaptiveManagement/index.html>

“...Interior Department bureaus must make complex land management decisions, often with uncertain or incomplete information. Adaptive management offers a tool to help bureaus make better decisions in this context of uncertainty as the bureaus are accumulating more information. The Department’s policy is to encourage the use of adaptive management as appropriate as a tool in managing lands and resources.”

a) DOI Manual - chapter on adaptive management

<http://www.doi.gov/initiatives/AdaptiveManagement/documents/DOImanual3786.pdf>

Purpose. The purpose of this chapter is to provide implementation policy guidance for Department of the Interior bureaus and offices to incorporate adaptive management strategies into their land and resource management decisions.

Scope. This chapter applies to all DOI bureau and office activities involving the management of Federal lands and resources under the jurisdiction of DOI.

Definition. Building on the definition developed by the National Research Council, adaptive management is operationally defined in The Technical Guide.

Policy. The Department’s policy is to encourage the use of adaptive management as appropriate as a tool in managing lands and resources.

Implementation. *Adaptive Management: The U.S. Department of the Interior Technical Guide* is the technical basis for adaptive decision making for the Department and bureaus.

b) DOI Adaptive Management Working Group

The Adaptive Management Working Group is responsible for:

- (1) Developing a charter to direct the operations of the AMWG.
- (2) Providing communication, coordination and oversight of training, research, and technical assistance to bureaus on adaptive management.
- (3) Updating the Adaptive Management Technical Guide when necessary, and providing supplemental guidance as needed.
- (4) The AMWG will be led by a Departmental executive designated by the Assistant Secretary - Policy, Management and Budget.

c) DOI NEPA implementation and adaptive management

43 CFR Part 46 Implementation of the National Environmental Policy Act (NEPA) of 1969; Final Rule

<http://www.doi.gov/pmb/oepe/nepa-procedures.cfm>

Summary: The Department of the Interior (Department) is amending its regulations by adding a new part to codify its procedures for implementing the National Environmental Policy Act (NEPA), which are currently located in chapters 1–6 of Part 516 of the Departmental Manual

(DM). This rule contains Departmental policies and procedures for compliance with NEPA, Executive Order (E.O.) 11514, E.O. 13352 and the Council on Environmental Quality's (CEQ) regulations (40 CFR Parts 1500–1508). As a part of the conversion of the Department's NEPA procedures from 516 DM to regulations, a number of key changes have been made. This rule:

Highlights that adaptive management strategies may be incorporated into alternatives, including the proposed action.

Part 46—Implementation of the National Environmental Policy Act of 1969

§ 46.145 Using adaptive management.

Bureaus should use adaptive management, as appropriate, particularly in circumstances where long-term impacts may be uncertain and future monitoring will be needed to make adjustments in subsequent implementation decisions. The NEPA analysis conducted in the context of an adaptive management approach should identify the range of management options that may be taken in response to the results of monitoring and should analyze the effects of such options. The environmental effects of any adaptive management strategy must be evaluated in this or subsequent NEPA analysis.

d) **DOI coordinating adaptive management and NEPA**

PEP – Environmental Statement Memorandum No. ESM 10-20

<http://www.doi.gov/pmb/oepe/upload/ESM-10-20-Adaptive-Management-and-NEPA.pdf>

Summary: The Department of Interior provides guidance on the relationship between adaptive management (AM) and NEPA requirement. Compliance with NEPA is a statutory and regulatory requirement, whereas, AM is not. Thus, while the two may be very complimentary, AM does not replace NEPA. AM can be used within the NEPA process when:

The management actions under consideration in the AM approach are identified in the NEPA analysis,

The criteria for management adjustments are clearly articulated in the NEPA analysis, and

The AM Produces outcomes within the range analyzed in NEPA analysis.

Monitoring outcomes, as required in AM, is important to document NEPA compliance also. The memo contains a table comparing AM steps and corresponding NEPA components.

Fish and Wildlife Service

- a) **Strategic Habitat Conservation** <http://www.fws.gov/science/shc/index.html>
http://www.fws.gov/science/shc/pdf/SHC_fact_sheet.pdf

Strategic Habitat Conservation (SHC) is an adaptive resource management framework for making management decisions about where and how to deliver conservation efficiently to achieve specific biological outcomes. It is an adaptive management approach to landscape conservation that requires us to set biological goals for priority species populations, allows us to make strategic decisions about our work, and encourages us to constantly reassess and improve our actions. These are critical steps in dealing with a range of landscape-scale resource threats such as development, invasive species, and water scarcity--all magnified by accelerating climate change.

Strategic Habitat Conservation is a science-based adaptive resource management framework for conserving species on a landscape scale and is the Service's strategic response to climate change. Working with others, we will bring to bear the best available planning, research, monitoring, and management tools to deliver conservation in the right places at the right time to address the challenges posed by climate change.

- b) **Landscape Conservation Cooperatives** <http://www.fws.gov/science/shc/lcc.html>

To ensure we're putting science in the right places, the Service and USGS have developed a national geographic framework for implementing strategic habitat conservation at landscape scales. This national geographic framework for strategic habitat conservation serves as a base geography for Landscape Conservation Cooperatives (LCCs), which are public-- private, management-- science partnerships that inform integrated resource management actions addressing climate change and other stressors within and across landscapes. LCCs are fundamental units of planning and science capacity to help us carry out the functional elements of SHC, so that the Service can work with partners to connect project- and site-specific efforts to larger biological goals and outcomes across the continent.

- c) **Adaptive Harvest Management**
<http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/AHM/AHM-intro.htm>

In 1995, the USFWS adopted the concept of adaptive resource management for regulating duck harvests in the United States. The adaptive approach explicitly recognizes that the consequences of hunting regulations cannot be predicted with certainty, and provides a framework for making objective decisions in the face of that uncertainty. Inherent in the adaptive approach is an awareness that management performance can be maximized only if regulatory effects can be predicted reliably. Thus, adaptive management relies on an iterative cycle of monitoring, assessment, and decision making to clarify the relationships among hunting regulations, harvests, and waterfowl abundance.

U.S. Geological Survey

- a) **Science and Decisions Center**

The USGS Science and Decisions Center (SDC) is an interdisciplinary center for applications and research in decision science, ecosystem services, and resilience. SDC is building capacity

and mechanisms for delivering resource science that is relevant and adds value to decision-making by partner agencies such as the Fish and Wildlife Service, National Park Service, and Bureau of Land Management in the Department of the Interior (DOI). Its mission is to promote the integration of science with natural resource management. The Center constitutes the USGS institutional presence for three “sustainability science” focus areas – decision science (adaptive management, decision analysis), ecosystem services, and resilience – which together form a scientific basis for natural resource decision-making.

b) Climate Science Centers <http://nccwsc.usgs.gov>

<http://pubs.usgs.gov/fs/2011/3057/FS11-3057.pdf>

“In 2008 Congress created the National Climate Change and Wildlife Science Center (NCCWSC) within the USGS; this center was formed to address challenges resulting from climate change and to empower natural resource managers with rigorous scientific information and effective tools for decision-making. Located at the USGS National Headquarters in Reston, Virginia, the NCCWSC... is now leading the effort to establish eight regional DOI Climate Science Centers. The mission of the NCCWSC is to provide natural resource managers with the tools and information they need to develop and execute management strategies that address the impacts of climate and other ongoing global changes on fish and wildlife and their habitats. The DOI Climate Science Centers and the Landscape Conservation Cooperatives provide complementary decision support for adaptive management of climate change impacts on natural and cultural resources. Together, NCCWSC, CSCs, and LCCs form the cornerstones of DOI’s integrated approach to climate change science and adaptation.”

c) Glen Canyon Dam adaptive management program

http://www.gcmrc.gov/research_areas/adaptive_management/adaptive_management_default.aspx

“In 1996, the Secretary of the Interior signed a formal decision altering the historical flows from Glen Canyon Dam and establishing the Glen Canyon Dam Adaptive Management Program. Also known as “learning by doing,” adaptive management is a way to evaluate and revise management actions as new information becomes available. In the context of the management of Glen Canyon Dam, adaptive management was selected to create a process whereby “the effects of dam operations on downstream resources would be assessed and the results of those assessments would form the basis of future modifications of dam operations.” The Grand Canyon Monitoring and Research Center is responsible for the scientific monitoring and research efforts of the program. Science in the adaptive management process is the “compass” used to evaluate the effects of Glen Canyon Dam operations on resources of concern and to inform changes in course when necessary.”

d) Grand Canyon Monitoring and Research Center <http://www.gcmrc.gov/>

“The USGS Grand Canyon Monitoring and Research Center (GCMRC) is the science provider for the Glen Canyon Dam Adaptive Management Program. In this role, the research center provides the public and decision makers with relevant scientific information about the status and trends of natural, cultural, and recreational resources found in those portions of Grand Canyon National Park and Glen Canyon National Recreation Area affected by Glen Canyon Dam operations.”

Bureau of Reclamation

Glen Canyon Dam adaptive management program

<http://www.usbr.gov/uc/rm/amp/index.html>

“The adaptive management program was developed to provide an organization and process for cooperative integration of dam operations, downstream resource protection, and management and monitoring and research information, as well as to improve the values for which the Glen Canyon National Recreation Area and Grand Canyon National Park were established.”

US Environmental Protection Agency Summary

Water Quality, Safety & Adaptive Management

The federal approach to protecting public health and the environment includes adaptive management processes under the Clean Water Act (CWA) and Safe Drinking Water Act (SDWA). Under the CWA, States update their water quality standards every three years and assess the quality of their streams and lakes every two years. States also update their point source discharge permit effluent limits every five years. Point source discharge permits may be reopened in less than five years to address new or updated water quality standards. Under the SDWA, EPA formally reviews and seeks public comment on federal drinking water standards every six years and emerging contaminants for potential regulation every five years.

EPA and its State partners periodically update technical assistance and guidance documents across all our water programs to reflect changing circumstances and support voluntary partnership initiatives that can be tailored to local and changing conditions. EPA and its State partners frequently consult about the effects of shifting circumstances on program implementation e.g., during annual program planning meetings.

For more information, please see:

State Water Quality Standards:

http://water.epa.gov/scitech/swguidance/standards/about_index.cfm

State Water Quality Assessments: <http://water.epa.gov/lawsregs/guidance/cwa/305b/index.cfm>

Point Source Discharge Permits: http://cfpub.epa.gov/npdes/home.cfm?program_id=45 and http://www.epa.gov/npdes/pubs/pwm_2010.pdf

Drinking Water 6 Year Review:

<http://water.epa.gov/lawsregs/rulesregs/regulatingcontaminants/sixyearreview/sixyearoccurencedata/index.cfm>

Drinking Water Contaminant Candidate List (CCL):

<http://water.epa.gov/scitech/drinkingwater/dws/ccl/index.cfm>

State Program Planning: http://water.epa.gov/resource_performance/planning/ and http://water.epa.gov/resource_performance/grants.cfm

USEPA: Water Utilities Asset Management & Adaptive Management

Water utilities must deliver safe drinking water and provide for the collection, treatment and disposal of wastewater and storm water. The selection of technology, particularly for treatment, will be based in part on local conditions. The key steps include: assessment of asset condition, and prioritized decision making with regard to the risk and consequence of asset failure.

Adaptive measures are integral to a mature Asset Management process. The analytic process must establish (1) which asset failures are critical; (2) the likelihood of an event that would cause such failure, (3) a mitigating action to avoid or reduce the consequences, and (4) the time horizon for action within the life-cycle of the particular facility.

For more information about sustainable infrastructure management, please see:

<http://water.epa.gov/infrastructure/sustain/index.cfm> ,

http://water.epa.gov/infrastructure/sustain/asset_management.cfm ,

http://water.epa.gov/infrastructure/sustain/am_resources.cfm , and

http://water.epa.gov/type/watersheds/wastewater/upload/guide_smallsystems_assetmanagement_bestpractices.pdf

DRAFT examples of EPA fresh water adaptive approaches

Technical Assistance & Partnership Initiatives: The protection of water quality and public health is an essential facet of IWRM. The following examples are all implemented through voluntary State and local partnerships which provide the flexibility to adjust to local and changing conditions. These examples are arranged by those focused on fresh water resources and those involving the management of drinking water and waste water infrastructure.

Management of Fresh Water Resources

Healthy Watersheds Initiative (HWI):

HWI seeks to protect an interconnected network of healthy watersheds including habitat and key functional processes that will provide ecological resilience to demographic and land use trends. HWI's assessment and protection of the hydrologic requirements of aquatic ecosystems will provide some of the foundation for IWRM.

<http://water.epa.gov/polwaste/nps/watershed/index.cfm>

Climate Ready Estuaries (CRE):

The Climate Ready Estuaries program works with the National Estuary Programs and the coastal management community to: (1) assess climate change vulnerabilities, (2) develop and implement adaptation strategies, and (3) engage and educate stakeholders. CRE shares NEP examples to help other coastal managers, and provides technical guidance and assistance about climate change adaptation.

<http://www.epa.gov/cre/index.html>

Green Infrastructure (GI) Strategic Agenda

EPA fosters GI for controlling storm water runoff by using natural systems and systems engineered to mimic natural processes to manage rain water as a resource. These voluntary

practices will help to protect, restore and improve the resilience of watersheds' ecological functions.

http://cfpub.epa.gov/npdes/home.cfm?program_id=298

Water Quality Planning:

Protecting water quality at the watershed scale entails complex technical, economic and legal issues. States may voluntarily use federal water quality and watershed planning resources (e.g., CWA sections 106, 604(b) and 319(h) planning funds) to conduct assessments or develop plans to increase their adaptive capacity and prioritize adaptive responses.

http://www.water.ca.gov/climatechange/docs/Climate_Change_Handbook_Regional_Water_Planning.pdf

<http://www.epa.gov/CRE/downloads/2010-CRE-Progress-Report.pdf>

Water Infrastructure Management & Operations

Climate Ready Water Utilities Community Resilient (CRWU):

The U.S. Environmental Protection Agency has developed its Climate Ready Water Utilities initiative to assist drinking water, wastewater and storm water utilities in becoming “climate ready.” Through the development of tools and other resources, CRWU supports the implementation of plans and adaptation strategies at water and wastewater utilities that account for potential climate change impacts and build water sector resilience. This is accomplished through providing a clear understanding of climate science and adaptation options and by promoting the consideration of integrated water resources management planning in the water sector.

<http://water.epa.gov/infrastructure/watersecurity/climate/>

Community-Based Water Resiliency (CBWR):

This voluntary initiative assists water and wastewater utilities in establishing a shared understanding of water needs and the potential impacts of water service interruptions to critical facilities, such as hospitals. Developing strong partnerships within watersheds is important to improving resource management and preparing for changes in water quantity.

<http://water.epa.gov/infrastructure/watersecurity/communities/index.cfm>

Infrastructure Sustainability:

EPA collaborates with stakeholders to help bring about more sustainable asset management practices for the collection and distribution systems, treatment plants and other infrastructure that collects, treats and delivers water-related services. For example EPA is providing technical assistance by developing a water utilities' handbook to incorporate sustainability into water utility planning e.g., analyzing infrastructure alternatives based on life cycle costs (green and natural systems), and designing rates to fund, operate, maintain, and replace the alternatives chosen. <http://water.epa.gov/infrastructure/sustain/>

Waste Water Reclamation and Reuse (R&R):

An increasing number of communities are viewing wastewater as a resource in adapting to prospective drought or increased demand e.g., by distributing treated waste water for park irrigation; non-potable water uses typically account for more than half of all water use. EPA has

developed guidelines that describe the types of reuse applications, technical and legal issues in the United States, public involvement, and water reuse in other countries to inform communities' voluntary exploration of this issue.

http://water.epa.gov/infrastructure/sustain/availability_wp.cfm

Water Use Efficiency & WaterSense:

WaterSense helps consumers make water-efficient choices and encourages innovation in manufacturing by standardizing certification criteria to ensure product efficiency, performance and quality. This voluntary partnership initiative extends water supplies and reduces operating costs.

http://water.epa.gov/infrastructure/sustain/wec_wp.cfm | <http://www.epa.gov/watersense/>

US Department of Agriculture

Natural Resources Conservation Service (NRCS): Adaptive Management Policies and Practices

NRCS has established a Climate Change (CC) Coordination Team. The first and primary responsibility of this team is to develop a vulnerability assessment and adaptation strategy document. This document will examine various components of NRCS conservation activities and our work with partners. It most likely will not encompass aspects of our agency infrastructure (buildings, energy use, vehicles, etc.) as that is being handled through separate efforts within USDA. This is part of a larger effort that is being conducted by every Department and agency. NRCS developed a preliminary assessment document in August parts of which were integrated into a USDA vulnerability/adaptation document that the Climate Change Program Office (CCPO) and the agencies assembled in September.

US Forest Service: Adaptive Management Policies and Practices

Adaptive Management in the Climate Change Program

The Forest Service has initiated a program to transform management to respond to climate change. This program has great potential to facilitate adaptive management policies, principally because it highlights the nature of the uncertainties that managers face. The approach taken so far emphasizes risk management and applies business models to speed implementation. Elements to date that support an adaptive management approach include: a program principle of continual monitoring and incorporation of new science; improved scientist-manager-stakeholder partnerships; vulnerability assessments that include uncertainties; and “improved, coordinated, and enhanced” monitoring systems that combined with science lead to advances in understanding.

The Forest Service officially defines adaptive management in the Code of Federal Regulations at 36 CFR 220.3, as: A system of management practices based on clearly identified intended outcomes and monitoring to determine if management actions are meeting those outcomes; and, if not, to facilitate management changes that will best ensure that those outcomes are met or re-evaluated. Adaptive management stems from the recognition that knowledge about natural resource systems is sometimes uncertain.

In practice, over the past several decades, many activities in the Forest Service were or could have been described as adaptive management that may or may not have met this definition. Most early activities were very passive forms of adaptive management, where monitoring

followed action that was then supposed to lead to change. There are not many examples, however, where an entire cycle was completed to the point that new decisions were closely linked to a formal learning process. Some more formal versions of adaptive management have been tried at different scales that have proven important in helping shape future directions in the Forest Service—a very few selected examples are given below. The single most important feature of adaptive management has unfolded in the, still draft, Forest Service planning rule, also described below. If adopted, a more formal approach to adaptive management will be institutionalized through the planning process. Given the widespread interest among individual practitioners, Ranger Districts, Forests, and Regions, the new planning rule may facilitate wide use of adaptive management by the Forest Service.

Brief description of individual adaptive management efforts as examples:

Probably the pre-eminent and largest-scale example of adaptive management is the Northwest Forest Plan. The US District Court injunction blocking management activities in 1992 mandated an new approach to managing the forest in the 24 million acres of federal lands in the range of the Northern Spotted Owl. The unprecedented Presidential summit set in motion a regional assessment (FEMAT) which outlined ways to implement adaptive management. The resulting Northwest Forest Plan established an adaptive management land-use designation creating 10 adaptive management areas, and developed a number of adaptive management processes, including a mandated 10-year interpretive report. In this report, monitoring results, science, and adaptive management process were reviewed. Much was learned about successes and failures and that led to recommendations, subsequently adopted by the regional executives, completing the learning cycle. More recent regional assessments like the Sierra Nevada Forest Plan adopted adaptive elements that are now playing out in forms of monitoring reports. Recent Individual Forest Plans, for example, the Huron Manistee National Forest, have also developed detailed monitoring plans intended to complete adaptive management cycles.

At smaller landscape scales, individual Forests tried various forms of adaptive management in the course of managing the land. For example, a rigorous form of adaptive management was adopted on the Siuslaw National Forest, where 16,000 acres were included in a landscape study comparing different operational approaches to managing older plantations inside a landscape designated as late-successional reserve. This management action was established with a full experimental design that speeds comparison of the different approaches. The three approaches reflected the range of societal differences in managing the Forest from very passive to active. Management in the late-successional reserves changed notably, in large part, as a result of this action.

Synopsis of adaptive management in the New Planning Rule related to water and climate change

The Forest Service has proposed a new planning rule (Rule) that deviates substantially from the standing version adopted in 1982 (synopsis Appendix 1). The Rule proposes major increases in stakeholder and researcher participation in developing assessments to inform official decision making, and in monitoring and reporting activities through time. Planning has become “learning and planning” and this change in emphasis is intended to increase learning activity in support of better management outcomes. The importance of uncertainty in planning—especially relating to climate change and watersheds—and the need for adaptive management is described in modest

detail in the programmatic EIS (PEIS) supporting the Rule decision (see Chap 3, p. 92-95, 169-170, and 197-199).

The six most significant institutional changes in the proposed Rule that relate to adaptive management are:

Assessments are required to inform decisions that dramatically increase participation of stakeholders and researchers—these are likely to help uncover a broad range of uncertainties, bring forth important questions, and lead to decision-changing feedback; Officials responsible for making decisions about National Forest, Grassland, or Prairie (Unit) plans are required to list monitoring questions and associated indicators designed to guide monitoring to inform management by testing assumptions, tracking changes, and evaluating effectiveness;

A formal monitoring program is required as part of the plan that specifies how questions will be addressed through time;

Regional Foresters are also required to develop a planning-centric monitoring strategy for questions that can best be answered at a geographic scale broader than one Unit.

The questions, monitoring program, and regional strategy require coordination with associated Station Directors, and therefore, the learning processes set forth are likely to have more scientific validity than before; and

A formal feedback process is established where biennial reports on results from Unit Plans and regional learning efforts are made available to the public.

US Army Corps of Engineers: Adaptive Management Policies And Practices

The following is a selection of laws, policies, and technical guidance that support USACE implementation of adaptive management and may relate to uncertainties associated with Climate Change. A USACE Climate Change Adaptation Plan and Report 2011 provides additional context

http://www.corpsclimate.us/docs/usace_climate_change_adaptation_report_03_june_2011.pdf

Legislation

a) Water Resources Development Acts (WRDA)

Water Resources Development Acts (WRDA) provide authority for the Corps of Engineers to accomplish individual studies and projects.. Projects and programs covering all Corps mission areas are typically authorized within a WRDA. The Corps primary mission areas are navigation, flood risk management and ecosystem restoration, .. WRDA legislation passed in 2000 and 2007 authorized individual programs and projects that included specifically identified adaptive management projects and practices. Some of those specific project authorizations are identified below.

WRDA 2000

Sec. 259 – Authorization of Las Vegas (Nevada) Wash Comprehensive Adaptive Management Plan. \$10,000,000 to carry out restoration and Lake Mead improvement.

Sec. 601 – Authorization of Comprehensive Everglades Restoration Plan to restore everglades ecosystem using the principles of AM to incorporate new information to improve the plan and its

implementation. Authorization of Adaptive Assessment and Monitoring at \$100 million dollars; pilot projects to test technologies; 50-50 cost share.

WRDA 2007

Section 5018 – Missouri River authorization to include AM as part of implementation strategy.

Section 5056 – Rio Grande Environmental Management Program (Colorado, New Mexico, and Texas). Implementation of monitoring and AM program.

Section 7001 – 7008, 7010, and 7011 - Louisiana Coastal Area (LCA). The WRDA authorization supports adaptive management by directing the Secretary of Army to carry out the LCA program in accordance to the report to the Chief of Engineers dated January 31, 2005. Language from the Chief's Report calls for feasibility studies to identify specific sites, scales, and adaptive management measures and to optimize features and outputs necessary to achieve the restoration objectives. The authorization identifies monitoring and adaptive management as critical elements of LCA projects. The 2004 LCA Ecosystem Restoration Study began to formulate a framework for adaptive management by identifying basic elements of adaptive management and defining the role of the S&T program in the implementation of an adaptive management plan/program.

Section 8001 - Navigation and Ecosystem Sustainability Program (NESP) - NESP will be implemented under an incremental adaptive management approach that will focus on delivering meaningful navigation and restoration benefits as early as possible, scheduling projects to provide early benefits, and generating knowledge that can be applied to future projects. A reach planning notebook has been developed to standardize and guide adaptive management at multiple scales for NESP. Program language includes directives about sustainability and selecting projects that restore natural river processes.

b) USACE Comprehensive Everglades Restoration Plan (CERP)

Section 601 of the 2000 WRDA authorized the Comprehensive Everglades Restoration Plan to restore everglades ecosystem using the principles of AM to incorporate new information to improve the plan and its implementation (see 2000 WRDA above). Success for the natural system will be to recover and sustain those essential hydrological and biological characteristics that both defined the original pre-drainage greater Everglades and made it unique among the world's wetlands. CERP is being planned, implemented, assessed, and refined using the principles of adaptive management. Adaptive management will determine if ecosystem responses match expectations, including the achievement of the expected performance levels and the interim targets. It is anticipated that adaptive management will help determine if the project operations, or the sequence and schedule of projects, should be modified to achieve the goals and purposes of CERP. CERP is intended to increase net benefits, improve cost effectiveness, and seek continuous improvement of the South Florida ecosystem based on new information resulting from changed or unforeseen circumstances, new scientific and technical information, and new or updated modeling. Key CERP AM documents include:

2003 Programmatic Regulations – Requires development of adaptive management program to ensure new information is incorporated into the plan to improve implementation of the plan to better achieve goals and objectives. 2004 Monitoring and Assessment Plan (updated 2009) contains a list of system-wide - regional hypotheses based on conceptual ecological models

regarding expected responses to CERP and natural system adjustments in key drivers.

http://www.evergladesplan.org/pm/recover/recover_map_2009.aspx

2006 CERP Adaptive Management Strategy – Overall framework to implement CERP AM program.

2011 CERP AM Integration Guide – Technical guide on how to apply AM within context of CERP implementation.

http://www.evergladesplan.org/pm/pm_docs/adaptive_mgmt/062811_am_guide_final.pdf.

2011 CERP Guidance Memorandum 56: formal guidance to integrate AM into CERP program and project management.

http://www.cerpzone.org/documents/cgm/CGM_56_Adaptive_Management.pdf

The Everglades Adaptive Management Program website can be found at:

http://www.evergladesplan.org/pm/program_docs/adaptive_mgmt.aspx

c) USACE – Louisiana Coastal Area (LCA)

In 2007, Congress authorized the LCA program to address wetlands loss threats in this important region. The program includes authority for 15 ecosystem restoration projects, 3 programs (Beneficial Use of Dredged Materials, Science and Technology, and Demonstration Projects), investigations into modifications of existing structures, and additional large-scale and long-term studies.

The LCA program emphasizes the use of restoration strategies directed at achieving and sustaining a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana. WRDA 2007 language (Section 7007) specifically includes authorization for a Science and Technology (S&T) program and a Demonstration Project program. The WRDA authorization supports adaptive management by directing the Secretary of Defense to carry out the LCA program in accordance to the report to the Chief of Engineers dated January 31, 2005. Language from The Chief’s Report calls for feasibility studies to identify specific sites, scales, and adaptive management measures and to optimize features and outputs necessary to achieve the restoration objectives. The authorization identifies monitoring and adaptive management as critical elements of LCA projects.

The LCA web site is <http://www.lca.gov/>.

d) USACE – Missouri River Recovery Program (MRRP)

The primary problem on the Missouri River is the alteration and degradation of riverine processes and habitat that has jeopardized the existence of the three Federally listed species: the interior least tern (endangered), the piping plover (threatened), and the pallid sturgeon (endangered). The major program components include habitat creation, flow modifications, science, and public involvement. The Integrated Science Program (ISP) of the recovery efforts is also implementing efforts targeted at long-term monitoring of the listed species, special studies to answer specific research questions, and ongoing development of a program specific adaptive management program.

The MRRP has received direction on the incorporation and application of monitoring and adaptive management as part of the 2000 and 2003 Amended Biological Opinions under the Endangered Species Act. The use of adaptive management was also included in the Record of Decision (ROD) for the Missouri River Master Water Control Manual. The current situation on

the Missouri River Basin highlights a two-fold need for adaptive management. For ongoing habitat creation activities and existing monitoring, adaptive management is being integrated with existing processes to ensure that management actions are driven by specific goals and objectives aimed at recovering species while meeting other authorized purposes. The second need is for adaptive management to inform and guide the development of the ongoing Missouri River Ecosystem Restoration Plan and EIS. Specifically, within the planning process, adaptive management will provide a structure for broader evaluation of actions to address the uncertainty.

The MRRP web site is <http://www.moriverrecovery.org/mrrp/f?p=136:1:1265668070615376>.

The MRRP adaptive management web site is

<http://www.moriverrecovery.org/mrrp/f?p=136:17:1265668070615376>

e) USACE – Navigation and Ecosystem Sustainability Program (NESP)

A dual purpose authorization for Navigation and the Environment on the Upper Mississippi River System was passed by Congress in the Water Resources Development Act of 2007. NESP authorizes the first increment of an ambitious 50-year effort based on recommendations from the Upper Mississippi River–Illinois Waterway Navigation Study (USACE 2004). The Implementation Guidance for the program provides for approximately \$300 million to support adaptive management activities associated with \$1.7 billion of ecosystem restoration. The program is designed to be implemented under an incremental adaptive approach that will focus on delivering meaningful navigation and restoration benefits, scheduling projects to provide early benefits, and generating knowledge that can be applied to future projects. A reach planning notebook has been developed to standardize goals and objectives and guide adaptive management at multiple scales

(http://www.mvr.usace.army.mil/EMP/Documents/UMRS_EcoRestoreObject2009.pdf). A

NESP Science panel has produced an AM guide

(<http://www2.mvr.usace.army.mil/UMRS/NESP/Documents/Adaptive%20Mgmt%20-Final.pdf>)

The NESP web site is <http://www2.mvr.usace.army.mil/UMRS/NESP//>.

The NESP adaptive management web site is

http://www2.mvr.usace.army.mil/UMRS/NESP/Documents/Water%20Level%20Management%20Report_Final%2028Oct2010.pdf.

f) USACE - Columbia River Channel Improvement Project (CRCIP)

The CRCIP Adaptive Environmental Management Program was initiated as part of the terms and conditions defined by the 2002 NMFS Biological Opinion concerning the Corps proposal for channel improvements on the Lower Columbia River and estuary. In addition, issues concerning 401 coastal zone certification required by the states were incorporated into the CRCIP Adaptive Environmental Management Program.

The CRCIP adaptive management approach differs from programs aimed at ecosystem restoration. While there are ecosystem restoration actions associated with this program, the main emphasis lies in assessing potential negative impacts (risks) posed by channel improvements on listed native salmonids and otherwise valued ecological resources (e.g., Dungeness crab, smelt, sturgeon). As a result, a passive adaptive management approach has been undertaken. The program has been designed to monitor the possible impacts posed by channel dredging, where the main driving force for dredging is to increase the opportunity for commercial navigation.

The general adaptive management approach is described in the CRCIP Adaptive Environmental Management Plan,

(<http://www.nwp.usace.army.mil/Portals/24/docs/environment/aem/AppendixB.pdf>). The continuing CRCIP AEM program has been in operation since 2003.

The CRCIP AEM program is in the process of transition from the project construction phase to a correspondingly appropriate adaptive management program for post-construction and operations and maintenance activities by 2013.

The CRCIP web site is:

<http://www.nwp.usace.army.mil/Missions/Environment/AdaptiveEnvironmentalManagement.aspx>

g) USACE - Support to the Great Lakes

In support of United States obligations under the provisions of the International Boundary Waters Treaty of 1909 and the 1950 Niagara Treaty (US/Canadian Treaties) the Great Lakes Ohio River Division provide consulting engineering services and support to the International Joint Commission (IJC), the International Niagara Committee, and the international Great Lakes community in general. This effort is coordinated through the United States Department of State.

International Upper Great Lakes Study (IUGLS) – USACE staff participate in studies to assess the need for changes in the operating rules and criteria governing Lake Superior Outflow regulation to meet the contemporary and emerging needs, interests, and preferences for managing the upper Great Lakes system in a sustainable manner. As part of this effort, an Adaptive Management plan was being prepared which called for improved bi-national Great Lakes hydro climate monitoring and modeling, better tracking and understanding of physical changes in the system, enhancement of information management, and the development of improved tools and processes for decision-makers. The final report, completed in March 2012, was provided to the IJC. After public consultation and IJC review recommendations will be submitted to governments.

The final report of the IUGLS can be found at: <http://www.iugls.org/>

Lake Ontario St. Lawrence River Working Group (LOSLR WG) – USACE staff are participating in Working Group efforts toward development of a draft new approach to Lake Ontario water management that would consider all environmental, social, and economic interests (recreational boating, commercial navigation, coastal property, hydropower, public water supply, and interest concerned with the health and resilience of the environment). As part of the initiative, an adaptive management strategy is being formulated to provide regular monitoring and review of existing practices toward improvement in the capability of existing and future regulation plans. The AM strategy will address socio-economic changes in the basin and any significant changes in climate, such as more intense storm events or prolonged droughts.

Additional information regarding the LOSLR WG investigations can be found at:

<http://www.ijc.org/loslr/en/index.php>

Policy Guidance

a) USACE - National Policy Guidance

Policy Guidance Letters dated 31 August 2009 provide implementation guidance for Section 2036 of WRDA 2007 and Section 2039 of WRDA 2007. This guidance states:

USACE Policy Guidance on Implementation Section 2036 of WRDA 2007 – Requires development of AM plans connected to Civil Works projects that require mitigation. Intent is to ensure mitigation plans are monitored and contingency funds are identified for options to improve mitigation, if not determined to meet success criteria.

USACE Policy Guidance on Implementation of Section 2039 of WRDA 2007 – Monitoring Ecosystem Restoration. Requires a plan for monitoring the success of an ecosystem restoration project. Monitoring is continued until success is determined. An adaptive management plan appropriately scoped to the scale of the project will also be developed.

<http://www.whitehouse.gov/sites/default/files/microsites/091203-ceq-revised-principles-guidelines-water-resources.pdf>

Technical Guidance

a) USACE Technical Guidance

2004 National Research Council report on AM for Water Resources Project Planning. Reviews of USACE policies, guidance, projects using adaptive management. Includes recommendations on better use of the approach for USACE water resource projects.

<http://www.nap.edu/openbook.php?isbn=0309091918>

Engineering Circular 1165-2-212 (October 2011) on Sea-Level Change Considerations for Civil Works Programs: Guidance on Sea-level Change considerations in project planning and design. Recommend assessing risk and effects and evaluating designs that account for sea-level rise uncertainty.

<http://planning.usace.army.mil/toolbox/library/ECs/EC11652212Nov2011.pdf>

b) Program Specific Guidance

2011 CERP Adaptive Management Integration Guide – Technical guide on how to implement AM for restoration projects and CERP program. Integrates AM principles into CERP process (USACE six-step planning process, project design, construction, and operations). AM principles include: Stakeholder engagement and collaboration; employ formal, science base management approach to use new information to address uncertainties; incorporate flexibility and robustness into project plan, design and implementation; Iteratively incorporate scientific information into decision-making process to support changes to implementation; seek most cost effective approach to maximize ecosystem restoration.

http://www.evergladesplan.org/pm/pm_docs/adaptive_mgmt/062811_am_guide_final.pdf

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