Climate Change Adaptation

Wednesday, June 23, 2021, 2:00pm – 4:00pm Eastern

Speakers:
• Michael Craghan, U.S. Environmental Protection Agency
• Mike Molnar, Coastal States Organization
• Will Veatch, U.S. Army Corps of Engineers
• Amanda Babson, National Park Service
• Duane De Freese, Indian River Lagoon (Fla.) National Estuary Program

Watershed Academy Webcast

• The slides for today’s presentations are posted on the Watershed Academy webpage.
• A recording of the webcast will be posted within the next month. www.epa.gov/watershedacademy
• Note: The views expressed in the presentation are those of the authors and do not necessarily represent the views or policies of U.S. EPA. Mention of commercial enterprises, products, or publications does not mean that U.S. EPA endorses them.
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Audience Polling
Speakers

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SEA LEVEL ADAPTATION: SCENARIOS, TRIGGERS, AND PROJECT EXAMPLES

Will Veatch, PH
Hydrologist, New Orleans District
Regional Technical Specialist for Climate Adaptation, Mississippi Valley Division
Acting Lead, Climate Preparedness and Resilience CoP, US Army Corps of Engineers

EPA Watershed Academy Climate Ready Estuaries Webinar
June 23rd, 2021

*The views, opinions and findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation.*
USACE APPROACH TO SEA LEVEL ADAPTATION

Why is sea level changing?

Project impacts of sea level change

Sea level scenarios

Adaptation pathway examples

SEA LEVEL CHANGE IS HAPPENING NOW
WHY IS SEA LEVEL CHANGING?

1700 Years of Global Temperature Change from Proxy Data

Components of Sea Level Change

Sea level at a particular place can be higher or lower than the global mean due to regional effects.
SEA LEVEL CHANGE IMPACTS: STORM SURGE

1. Present situation
2. Sea level rise with subsidence
3. Sea level rise with changes to foreshore

Raising the downstream boundary increases river stage for the same discharge.

SEA LEVEL IMPACTS: RIVERINE FLOWLINE

Raising the downstream boundary increases river stage for the same discharge.
a. Research by climate science experts predict continued or accelerated climate change for the 21st century and possibly beyond, which would cause a continued or accelerated rise in global mean sea level. (See Appendix B)

b. The resulting local relative sea level change (SLC) will likely impact USACE coastal project and system performance. As a result, managing, planning, engineering, designing, operating, and maintaining for SLC must consider how sensitive and adaptable 1) natural and managed ecosystems and 2) human and engineered systems are to climate change and other related global changes.

c. Planning studies and engineering designs over the project life cycle, for both existing and proposed projects, will consider alternatives that are formulated and evaluated for the entire range of possible future rates of SLC, represented here by three scenarios of “low,” “intermediate,” and “high” SLC. These alternatives will include structural, nonstructural, nature-based, or natural solutions, or combinations of these solutions. Alternatives should be evaluated using “low,” “intermediate,” and “high” rates of future SLC for both “with” and “without” project conditions. The historic rate of SLC (as described in Appendix B) represents the “low” rate. The “intermediate” and “high” rates are based on the following:
SEA LEVEL UNCERTAINTY IS UNCERTAINTY IN THE RATE OF CHANGE

USACE SEA LEVEL SCENARIOS

Estimated Relative Sea Level Change Projections - Gauge: 9414290, San Francisco, CA

https://www.usace.army.mil/corpsclimate/
Critical point reached as soon as 2028 or as late as 2097 (!)

ADAPTATION AND RESILIENCE

Adaptation:
“Adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative effects.” Adaptation is an action.

Resilience:
“The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.” Resilience is a trait.

– EO 13653: “Preparing the United States for the Impacts of Climate Change”

Haasnoot et al. “Adaptation to uncertain sea-level rise; how uncertainty in Antarctic mass-loss impacts the coastal adaptation strategy of the Netherlands.” Environmental Research Letters (2020)
**THRESHOLDS, DECISION POINTS, LEAD TIMES**

Indicator value

(e.g. sea level rise)

Threshold value of indicator when intervention is needed

Initial Decision point based on range of conditions*

Monitor and Record values of indicator

Date of review

Time

Lead time for planning, design and construction

Predicted future range of indicator

**MEAN SEA LEVEL IS ONLY ONE COMPONENT OF COASTAL WATER LEVEL**

Profile-view schematic of coastal water level components

Crest of dune/structure

Engineering Technical Letter 1100-2-1:

*Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation*

**Key**

| $\eta_{NT}$ | non tidal residual |
| $\eta_t$ | astronomical tide |
| $\eta$ | wave setup |
| MSL | mean sea level |
| SWL | still water level |
| S | swash |
| DSWL | dynamic still water level |
| R | wave runup |
| TWL | total water level |

Based on previous work by UK Environment
100-year event reaches critical point as soon as 2060.

PROJECT ADAPTATION EXAMPLES

Simple Example: Levee Lift Schedule
PROJECT ADAPTATION EXAMPLES

More Complex Example: East Rockaway and Jamaica Bay (NAN)
More Complex Example: East Rockaway and Jamaica Bay (NAN)

Additional armor stone to be added when sea level trigger is met.

Figure 7-17: Seawall Adaptability Measures

More Complex Example: East Rockaway and Jamaica Bay (NAN)

Sea Level Change and Adaptability Relative for the Horizontally Composite Seawall with Beach and Dune

2nd Adaptation Consists of:
- Raising Beach Bemm with 1 ft.

1st Adaptation Consists of:
- Raising Seawall
- Raising Dune Crest
- Rebuilding access ramps and stairs
- Raising Beach Bemm with 1 ft.

Figure 7-18: Graphic Representation of Adaptability of Atlantic Ocean Shorefront Measures (red markers indicate the years at which adaptation measures are expected to occur).
More Complex Example: West Shore Lake Pontchartrain (MVN)

Project is constructed using intermediate SLR (year 2020)

Does monitoring confirm intermediate SLR?

- NO

- YES

First Levee Lift to maintain 100 year LORR intermediate (confirm with monitoring at 2030)

- YES

- OR

Second Levee Lift to maintain 100 year LORR intermediate (confirm with monitoring at 2040)

- YES

If low SLR, continue to monitor and potentially reduce need for future levee lifts. If high,

- OR

If high SLR, potential need to conduct a Post Authorization Change Report to increase the authorized construction limit of the system

Continue to monitor for changes in the future over remaining levee lifts, continue process

Slide courtesy of Fay Lachney, OWPR Plan Formulation

Critical Infrastructure at Risk

Critical Infrastructure at Risk

Relative Sea Level Rise (feet) (RSLR)

Year

50-year planning horizon

Lead time

Alternative Pathways

NS: Non-Structural
S: Structural

Most Complex Example: Adaptation Pathways

50-year planning horizon

Lead time

Alternative Pathways

NS: Non-Structural
S: Structural
USACE APPROACH TO SEA LEVEL ADAPTATION

Sea level is changing – the only uncertainty is the rate

Numerous impacts of sea level change to USACE projects

Sea level scenarios address uncertainty in future conditions

Triggers, thresholds, lead times, inform adaptation

Coastal Climate Adaptation
Frameworks and Examples from National Parks

Amanda Babson, PhD
Coastal Landscape Adaptation Coordinator
National Park Service
Interior Region 1 North Atlantic - Appalachian
Overview

**NPS Climate Change Frameworks**

Planning for a Changing Climate  
Resist-Accept-Direct  
Scenario Planning  
Cultural Resources Climate Change Strategy  
Facilities Management *Operational Resilience*  
Removing barriers to shoreline migration & Retreat

**Application examples**

- Historic Districts  
- Archeology Prioritization Framework  
- Next steps from facility vulnerability assessment to adaptation planning  
- Removing barriers to shoreline migration

118 Parks Vulnerable to Sea Level Rise

Over 11,000 Miles of Shoreline & 2.5 Million Water Acres
NPS Coastal Adaptation Guidance

- Coastal Adaptation Strategies Handbook (2016)
- Coastal Adaptation Strategies: Case Studies (2016)

NPS Climate Adaptation Frameworks

- Scenario Planning (2013)
- Cultural Resources Climate Change Strategy (2016)
- Resist-Accept-Direct (2020)
- Planning for a Changing Climate (2021)
- Facility Management Operational Resilience
Scenario Planning

- Scenarios are stories that offer a range of plausible future environments – not predictions, projections, or models
- Provide a framework to support decisions under conditions that are uncertain, and uncontrollable
Scenario Planning

Acadia National Park
- Scenarios can inform decisions on infrastructure, staffing and ecosystem management
- Emergency response plans for extreme events
- Engagement with community members
2b. We will prioritize cultural resource funding and management actions on projects that integrate vulnerability and resource significance. ... As such, all identified cultural resources should be evaluated in terms of their vulnerability and significance so that management decisions are directed to resources that are both significant and most at risk.
Climate Adaptation Planning for Archaeological Stewardship

Goals

• Develop a framework to prioritize archeological resource adaptation based on vulnerability and significance.

• Evaluate threatened cultural resources through a Tribal frame of seeing. Include Tribal perspectives of site significance or importance in decision making.

Facility Management Operational Resilience

Hazard Assessment and Resilience Planning Process

• Builds on asset vulnerability assessment protocol and applies Facility Management Toolkit.

• Pilot workshops at Colonial National Historical Park (VA) and Fort Pulaski National Monument (GA). Example from Timucuan Ecological and Historical Preserve (FL).

• Review Vulnerabilities and Risks
• Assess Mission Criticality and Integrated Systems Assessment
• Identify Potential Resilience strategies
• Map Regional Relationships and Coordination for Resilience Strategies
• Prepare a Resilience Roadmap and Monitoring Actions
Timucuan Adaptation Planning: Fort Caroline

Adaptation Strategies: Option D | Redesign & Reconstruct

- Relocate ~300’ southeast to higher elevation outside of the Category 3 hurricane storm surge area
- Remove trees and regrade
- Reconstruct Fort
- Allows the fort to be re-sited and wetlands to be reestablished in previous fort location

Removing barriers to shoreline migration & Retreat

Gateway National Recreation Area: Floyd Bennett Field Fishing Access & Fort Tilden Beach Road
Removing barriers to shoreline migration & Retreat

Cape Cod National Seashore: Herring Cove Beach Parking Lot

Questions?
IRL COUNCIL/IRLNEP
Evolving and Expanding Focus on Climate Change

FY 2010: Grant to City of Satellite Beach for climate change/sea level rise planning to be incorporated into the City’s Comprehensive Growth Management Plan.


FY 2013: Grant to Balmoral Group to prioritize TMDLs using seagrass habitat vulnerability to sea level rise.

FY 2014: Grant to the Balmoral Group to model seagrass restoration success and long-term sustainability under changing conditions of water quality and sea level rise.

FY 2018: Climate-Ready Estuary Risk-Based Vulnerability Assessment – Final draft technical report completed and submitted to IRLNEP October 1, 2018. Work supported by a $25,000 EPA supplemental award included in the FY 2018 EPA grant award (900D36215-2).

FY 2019: Climate-Ready Estuary Action Plan – Final draft technical report submitted to IRLNEP March 20, 2020. Work supported by a $52,050 EPA supplemental award that was combined with the previous FY 2018 EPA grant award (900D36215-2).

Adoption of IRL Comprehensive Conservation and Management Plan - Looking Ahead to 2030. Coastal resiliency, climate change and sea level rise issues are incorporated throughout the plan.
Lesson Learned: Pick the Right Team

Acknowledgements

• RW Parkinson Consulting Inc., Clay Henderson and The Balmoral Group for contractor support.

• Extensive conversations and comments from the IRLNEP Management Conference and the IRL community of scientific knowledge and practice.

• Jennifer DiMaio, EPA Region 4, for comments, federal insights, and edits.

• Michael Craghan, Ph.D. EPA Headquarters. Climate Ready Estuaries.
SETTING THE STAGE
Vulnerable Estuary at Risk

- Narrow - Shallow - Microtidal
- Spans 2 climate zones (tropical zone moving north)
- Significant human-built infrastructure at risk
- Continued statewide population growth (1,000 – 1,500 people per day)

Tropical Storm Faye (August 2008)

SLR CONCERNS GO BACK OVER A DECADE...

Analysis by Peter W. Harlem, FIU in 2009 for the Space Coast Climate Change Initiative founded by RW Parkinson
ALIGN CLIMATE READY PLANNING WITH CCMP LOOKING AHEAD TO 2030 (ADOPTED 2019)

CLIMATE READY ESTUARY
Phase 1: Risk-based vulnerability assessment

Vulnerability Considerations (conditions today, historic trends and projected future conditions)

Initial Focus on 5 primary stressors
1. Warmer temperatures
2. Changes in precipitation
3. Increasing storminess
4. Coastal acidification
5. Sea level rise
**SUMMARY OF RISKS**

**LESSON LEARNED**

**DEFINE PROCESS AND QUANTIFY**

<table>
<thead>
<tr>
<th>GOAL</th>
<th>WATER TEMPERATURE</th>
<th>CHANGES IN PRECIPITATION</th>
<th>INCREASING STORMINESS</th>
<th>COASTAL ACIDIFICATION</th>
<th>SEA LEVEL RISE</th>
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| Natural Resources (Habitats and Living Resources) | | | | | | |
| Biodiversity | 2 | 3 | 1 | 3 | 13 |
| Seagrasses | 4 | 3 | 1 | 2 | 10 |
| Wetlands and Impounded Marshes | 2 | 3 | 0 | 3 | 8 |
| Rare Threatened and Endangered Species | 4 | 3 | 1 | 3 | 14 |
| Fisheries | 3 | 3 | 3 | 2 | 12 |
| Biotoxins and Infectious Agents | 2 | 2 | 2 | 2 | 8 |
| Invasive exotic species | 2 | 3 | 2 | 2 | 9 |
| Living shorelines | 1 | 1 | 1 | 1 | 5 |
| Archeological Resources | 1 | 1 | 1 | 1 | 5 |
| SUM | 22 | 19 | 7 | 19 | 87 |

| Stakeholder Engagement (One Voice) | | | | | | |
| Public access | 3 | 2 | 0 | 2 | 8 |
| Public Education and Involvement | 2 | 2 | 2 | 1 | 7 |
| SUM | 5 | 4 | 3 | 3 | 16 |

**GRAND TOTAL** 39 35 36 10 34 154

**RISK ANALYSIS SCORING MATRIX**

Make initial determination of the consequence, likelihood, spatial scale, and urgency of the risks posed to the goals of the IRLNEP by the five climate stressors. Each risk was scored from 1 (low) to 3 (high).
# PRIORITIZE RISKS TO IRLNEP MANAGEMENT GOALS AND OBJECTIVES

## PHASE 2: ADAPTATION PLANNING

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<th>Category and Vital Sign</th>
<th>Temperature</th>
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Lesson Learned: Focus on Local and State Adaptation Actions

Nine Adaptation Actions that would Reduce Risk to IRL from Climate Change Stressors

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<th>Adaptation Action</th>
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<td>Reduce pollutant loadings from WWTP during high rainfall events</td>
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<tr>
<td>Precipitation</td>
<td>Reduce pollutant loadings from OSTDS during high rainfall events</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Reduce pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events</td>
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<td>Storms</td>
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<tr>
<td>Storms</td>
<td>Reduce pollutant loadings from surface water storage and conveyance infrastructure due to more frequent and intense storms</td>
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<tr>
<td>Sea Level Rise</td>
<td>Reduce pollutant loadings from WWTP caused by rising water table and sea level (inundation, erosion)</td>
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<tr>
<td>Sea Level Rise</td>
<td>Reduce pollutant loadings from OSTDS caused by rising water table and sea level (inundation, erosion)</td>
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<tr>
<td>Sea Level Rise</td>
<td>Reduce pollutant loadings from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)</td>
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Lesson Learned: Connected Leadership Is Essential
LESSONS LEARNED: CRITICAL PATH
DECISIONS ENHANCED SUCCESS OF PROJECT

• **Develop a methodology** that could be analyzed, discussed, updated and reproduced.

• **Engage multiple stakeholders and partners** through multiple meetings and events. Over 50 stakeholder organizations were consulted. Multiple presentations given to community of habitat restoration practitioners with polling: IRLNEP Management board (1/1); IRLNEP STEMAC (2/2); Florida Northeast Estuarine Habitat Restoration Team (2/1); Florida East Central Estuarine Habitat Restoration Team (2/2).

• **Translate the technical results**: Community Guide to Climate Change.

• **Publication in peer-reviewed scientific journals**
  
  

IRLNEP: MOVING FORWARD

• Actively engage in climate change planning at local, state and federal levels.

• Recognize and reward efforts to include coastal resilience, climate change and sea level rise considerations in all proposals funded by IRL Council and IRLNEP.

• Address climate change in each of the 32 vital signs of IRL health with a focus on issues beyond water quality and biological resources.

• Address significant gaps in knowledge (costal acidification, habitat restoration and planning).

• Use power of the IRLNEP to change perspectives and decision-making (Example: FDOT expansion of SR 528)
MOVING FORWARD - EXPAND PARTNERSHIPS/ADDRESS GAPS

• Expand engagement in climate change planning at local, state and federal levels.
  - Southeast and Caribbean Disaster Resilience Partnership/SECOORA
  - U.S. Geological Survey/Southeast Ocean and Coastal Acidification Network
  - East Central Florida Regional Resilience Collaborative

• Address climate change in each of the 32 vital signs of IRL health with a focus on issues beyond water quality.

• Projects funded with IRLNEP annual competitive grants program should consider climate change and sea level rise.

• Address significant gaps in knowledge (i.e., coastal acidification, habitat restoration and planning restoration activities for future outcomes)

COMMUNITY LEADERS AND POLICY MAKERS WILL DECIDE....

MITIGATE: Take measures to reduce the pace and magnitude of the changes in global climate being caused by human activities.

ADAPT: Take measures to reduce the adverse impacts on well-being resulting from the changes in climate that do occur.

Suffer the adverse impacts that are not avoided by either mitigation or adaptation.

February 2007 Presidential Address
Dr. John Holdren to the American Association for the Advancement of Science
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Participation Certificate

- If you would like to obtain a participation certificate you can access the PDF in the **Handouts** section of your control panel.
Watershed Academy Webcasts

More webcasts coming soon!

The slides from today’s presentations are posted on the Watershed Academy webpage. A recording of the webcast will be posted within the next month.  
www.epa.gov/watershedacademy

Thank You!