



*Being Prepared for Climate Change
A Workbook for Developing
Risk-Based Adaptation Plans*

ASWM • Natural Floodplain Function Alliance

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Climate Ready Estuaries

Climate Ready Estuaries works with the National Estuary Programs and the coastal management community to:

- assess climate change vulnerabilities;
- develop and implement adaptation strategies;
- engage and educate stakeholders.

CRE shares NEP examples to help other coastal managers, and provides technical guidance and assistance about climate change adaptation.

Climate Change and Wetlands

Air and water temperature

Invasive species and habitat change

Ice

Sea level rise

Tides

Salinity

Habitat transgressions

Loss of coastal marshes

Living shorelines

Deeper estuaries

1990s



2012



Climate Change and Wetlands

Hydrology

- Salinity

- Sediment sources

- Turbidity

Storms

- Natural and nature-based features

- Overwash and inlets

Carbon dioxide

- Photosynthesis

- Ocean acidification

- Blue carbon

Vulnerability Assessment + Implementing an Action Plan Climate Change Adaptation

A vulnerability assessment is an understanding of how climate change will affect an organization.

A VA is a ranked description of how climate changes would keep an organization from reaching its goals.

The VA tells you what your biggest risks are. An action plan tells what you will do about the risks.

Being Prepared for Climate Change

A Workbook for Developing Risk-Based Adaptation Plans



www.epa.gov/cre

Why risk-based plans?

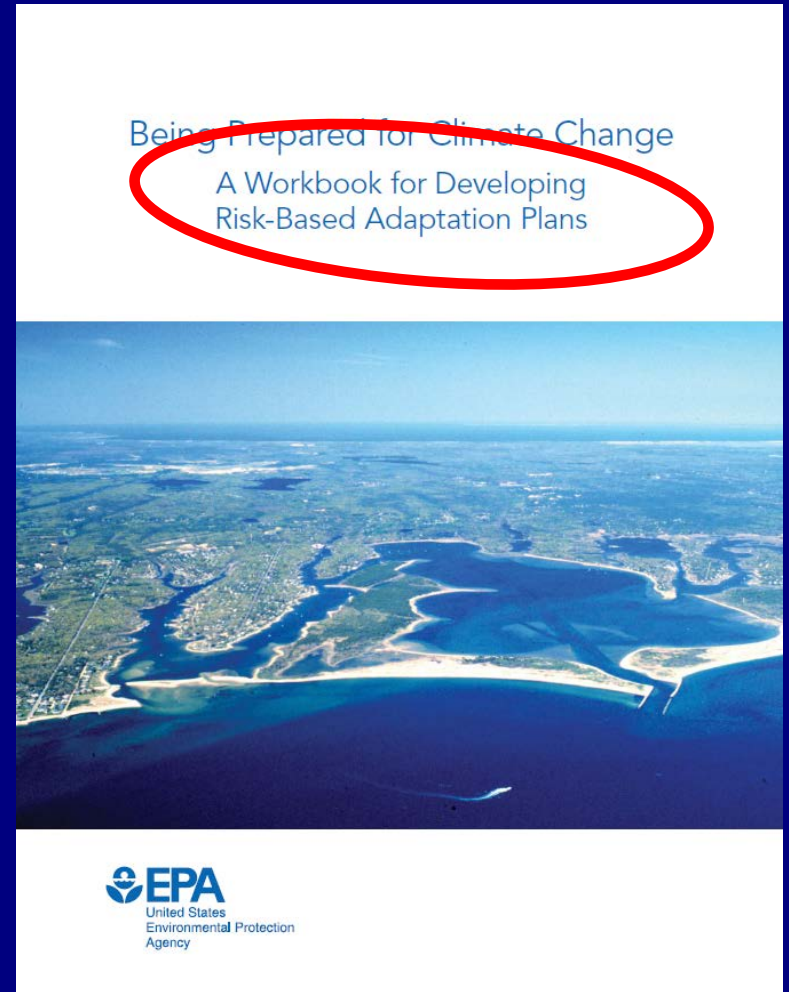
Risk management is about an organization.

Your organization's:

- Goals.
- Context.
- Decisions.

It clarifies your situation.

You get a better plan.



How do you decide what to do?



100+ discrete risks
from climate change.

(unfortunately, $5 \times 6 \times 4 > 100$)

How do you decide what to do if you don't have the resources to do everything you need to do?!

Vulnerability Assessment

1—Communication and Consultation



2—Establishing the Context for the Vulnerability Assessment



3—Risk Identification

4—Risk Analysis

5—Risk Evaluation:
Comparing Risks



Risk evaluation

An example consequence/probability matrix.

Likelihood (probability) of occurrence	High	<p>1. Warmer water may stress immobile biota</p> <p>2. Warmer water may lead to changes in drinking water treatment processes</p> <p>n. _____</p>	<p>1. Warmer water may hold less dissolved oxygen</p> <p>2. Sea level rise may cause bulkheads, sea walls and revetments to become more widely adopted</p> <p>n. _____</p>	<p>1. Shoreline erosion from sea level rise may lead to loss of beaches, wetlands and salt marshes</p> <p>2. Combined sewer overflows may increase from more intense precipitation</p> <p>n. _____</p>
	Medium	<p>1. Increased wildfires from warmer summers may lead to soil erosion</p> <p>2. Warmer winters may lead species that once migrated through to stop and stay</p> <p>n. _____</p>	<p>1. Parasites and bacteria may have greater abundance, survival or transmission due to warmer water</p> <p>2. Warmer summers may drive greater water demand</p> <p>n. _____</p>	<p>1. More frequent drought may diminish freshwater flow in streams</p> <p>2. More intense precipitation may cause more flooding</p> <p>n. _____</p>
	Low	<p>1. Warmer water may lead open seasons and fish to be misaligned</p> <p>2. Warmer winters may lead to more freeze/thaw cycles that impact water infrastructure</p> <p>n. _____</p>	<p>1. Warmer water may lead jellyfish to be more common</p> <p>2. Ocean acidification may cause the recreational shellfish harvest to be lost</p> <p>n. _____</p>	<p>1. Contaminated sites may flood from sea level rise</p> <p>2. Warmer water may promote invasive species</p> <p>n. _____</p>
		Low	Medium	High
Consequence of impact				

Color key:



Action Plan



Step 6—Establishing the Context for the Action Plan

Step 7—Risk Evaluation: Deciding on a Course

Step 8a—Finding Adaptation Actions

Step 8b—Selecting Ad. Actions

Step 9—Preparing and Implementing an Action Plan

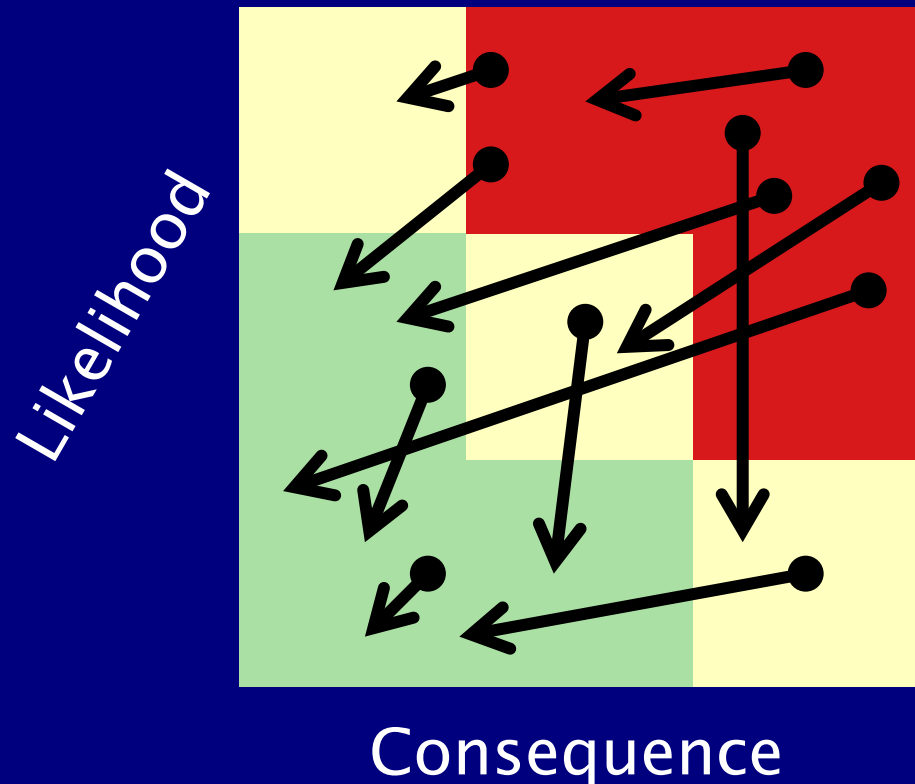
Step 10—Monitoring & Review

Mitigating actions

Risks are mitigated by actions that lower their likelihood or consequence.

When a risk is mitigated it would be re-plotted closer to the lower left.

Your aim is to have no red risks.



A risk-based climate change adaptation plan

Q: How do you decide what to do if you don't have the resources to do everything you need to do?

The vulnerability assessment points toward the biggest risks! The ones that are highly likely to occur and will have high consequences when they do.

The action plan points to the actions that reduce the most risk and don't have bad side effects.

Methods

STEP ONE: Communication and Consultation

Stakeholder	Issue/Area of Focus	When should/did they become involved?
Angel Dieppa, Jobos Bay NERR		September workshop
Benito Pinto, La Regata	Recreational/Navigation/Fishing	September workshop
Craig Lilyestrom, DNER	Marine Resources/Fisheries	September workshop
David Cuevas, EPA	Water resources	September workshop
Ernesto Diaz, DNER-PRCZMP	Coastal hazards, development, nonpoint and point sources of pollution, public access	September workshop
Ernesto Olivares, SJBEP	Enforcement	September workshop
Evelyn Huertas, EPA		September workshop
Gustavo Garcia, SJBEP and DNER Assistant to Secretary	Public Policy	September workshop
Jorge Bauza, SJBEP	ALL	September workshop
Jose Rivera, NOAA		September workshop
Jose Seguinot Barbosa	Public health, water quality	September workshop
Julio Morell, CariCOOS	Monitoring, modeling and data management	September workshop
Katia Aviles, Proyecto ENLACE	Environmental justice communities, health, water quality, recreation, fisheries, marine resources	September workshop
Luis Jorge Herrera, IDS		September workshop
Luis Soler, USGS		September workshop
Pablo Mendez, UPR/SJBEP		September workshop
Pedro Diaz, USGS	Monitoring	September workshop
Pedro Gelabert, SJBEP	ALL	September workshop
Pedro Guevara, JCA	Water quality	September workshop
Ray David Rodriguez, Fideicomiso		September workshop
Raimundo Espinosa, TNC		September workshop
Vance Vicente		September workshop
Jorge Ortiz Zayas, UPR-ITES		September workshop
Ernesto Otero, RUM_CIMA		September workshop
Angel Melendez, JCA	Water quality	September workshop
Jose Juan Terrasa, Turismo	Recreation, coastal hazards, marine resources	September workshop

Methods

STEP THREE: Risk Identification

During risk identification process we also conducted community workshops.

Taller para la evaluación de riesgos en las comunidades del Estuario de la Bahía de San Juan



Deseamos conocer cómo su comunidad se ha visto afectada por el **cambio climático**. Este fenómeno incluye aumento en las mareas, inundaciones, erosión en las costas, presencia de nuevas especies invasoras y otros.

Acompáñenos en una reunión comunitaria para discutir estos asuntos de gran importancia para su comunidad.

FECHA Y HORA

10 de julio de 2013

5:00pm - 7:00pm

LUGAR

Choliseo

Coliseo de Puerto Rico José Miguel Agrelot

www.estuario.org

¡ESPACIOS LIMITADOS! Por favor reserve su lugar llamando al **787 725 8165** ó escriba al correo electrónico **isabela117@gmail.com**



Methods

STEP FIVE:
Evaluation/Comparing Risks
Using a consequence/probability matrix to reach consensus about each risk

RECREATIONAL ACTIVITIES IN AND ON THE WATER				
Likelihood (probability) of Occurrence	High	<ol style="list-style-type: none"> 1. Open seasons and fish may become misaligned (place or region; decades) 2. Increased occurrence of Ciguatera fish poisoning (extensive; already occurring or soon to occur) 3. Desired fish may not be around (extensive; decades) 4. More frequent or more intense bad weather may decrease recreational opportunities and reduce the activity of bathers (place or region; within the next 15-30 years) 5. Increased recreational fishing charter ships (place or region; decades) 6. Critical clearance under bridges may decrease (site; decades) 	<ol style="list-style-type: none"> 1. Increase in solid waste – more people using the beach and recreational activities (extensive; already occurring) 2. Greater NPS pollution may impair recreation as a result of bacterial contamination (extensive; already occurring) 3. Beaches or public access sites may be threatened by coastal erosion or inundation (place or region; already occurring) 4. Impacts to hotel infrastructure as a product of erosion (site; already occurring) 5. Increased aquatic security risks (place or region; within the next 15-30 years) 6. Harmful algal blooms may be more likely (extensive; within the next 15-30 years) 7. Increase in nautical activities (place or region; within the next 15-30 years) 	
	Medium	<ol style="list-style-type: none"> 1. Decrease of dry days in winter impacting tourism industry (place or region; within the next 15-30 years) 2. Freshwater flows in streams may not support recreational uses like boating, kayaking, fishing or stand-up paddleboarding (SUP) (place or region; decades) 3. Less tourism due to northern areas being warmer, less recreational use of water bodies (place or region; already occurring or soon to occur) 4. Too hot for enjoyment of outdoor recreational activities (place or region; already occurring or soon to occur) 	<ol style="list-style-type: none"> 1. Eco-tourism resources or attractions may be degraded (e.g., birding, diving, fishing) (extensive; decades) 	
	Low	<ol style="list-style-type: none"> 1. Recreational shellfish harvesting may be lost (place or region; decades) 	<ol style="list-style-type: none"> 2. Increased estuary salinity may drive away targeted recreational fish (place or region; decades) 	<ol style="list-style-type: none"> 1. Invasive plants may clog creeks, canals and waterways reducing public access (extensive; decades) 2. Jellyfish may be more common (place or region; within the next 15-30 years) 3. Increased use of vessels (place or region; decades)
		Low	Medium	High
		Consequence of Impact		

Final Report

Report: Assessing the San Juan Bay Estuary Program's Vulnerabilities to Climate Change



September 2013



Is this workbook for you?

- Do you have environmental goals?
- Do you think climate change might affect what you are trying to accomplish?
- Do you have lots of risks in a variety of sectors?
- Do you have partners and stakeholders who should be involved?
- Do you have resource constraints?
- Could you use some decision support?

Then,

Yes!

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