Development of Climate Change Indicators and Metrics for the Chesapeake Bay

October 2018 Update

Project Goals

Eastern Research Group (ERG) worked with the Chesapeake Bay Program to develop a suite of indicators that can be used to track and analyze trends, impacts, and progress towards advancing "climate resiliency." While this work undoubtedly relates to existing indicators for other goals in the 2014 Watershed Agreement, the chief aim of this project was to track progress toward the climate resiliency goal and outcomes:

> **Goal:** Increase the resiliency of the Chesapeake Bay watershed, including its living resources, habitats, public infrastructure, and communities, to withstand adverse impacts from changing environmental and climate conditions.
>
> **Monitoring and Assessment outcome:** Continually monitor and assess the trends and likely impacts of changing climatic and sea level conditions on the Chesapeake Bay ecosystem, including the effectiveness of restoration and protection policies, programs and projects.
>
> **Adaptation outcome:** Continually pursue, design, and construct restoration and protection projects to enhance the resiliency of Bay and aquatic ecosystems from the impacts of coastal erosion, coastal flooding, more intense and more frequent storms and sea-level rise.

Key Definitions for This Project

Resilience is the ability to anticipate, prepare for, and adapt to changing conditions and to withstand, respond to, and recover rapidly from disruptions.

Our working definition of resilience is intentionally broad. We will seek further input and define the term operationally over the course of the project.

An ***indicator*** is a numerical value derived from actual measurements of a state or ambient condition, ecological or societal response, or programmatic action, whose trends over time represent or draw attention to underlying trends in the condition of the environment or measure progress towards a desirable state or condition.

Project Framework and Criteria

ERG and the Bay Program sought a balance of indicators across three categories:

- Indicators of ***physical climate trends*** based on measurements of physical or chemical attributes of the environment.
- Indicators of ***ecological and societal impact*** that measure a) attributes of ecological systems, particularly attributes that may be influenced by physical climate trends, or b) impacts on society, such as health or economic outcomes.
- Indicators of ***programmatic progress toward resilience*** that quantify resilience or show evidence of learning or adaptation over time. Responses include management actions such as designating land for protection, as well as physical actions such as constructing systems to reduce combined sewer overflows into the Bay.

ERG worked with the Bay Program and its workgroups to screen and prioritize candidate indicators according to several sets of criteria:

- Fundamental data quality standards that every proposed indicator must be able to meet.
- Additional data quality considerations to help us select the best data source or metric for a given topic.
- "Value-added" criteria to prioritize indicators that will provide the most relevant and useful information.
- Considerations for the overall suite, including balance across the three bins, balance of tidal and nontidal topics, balance of societal and ecological issues, and an interest in indicators with causal connections to each other.

We worked with our partners to design these criteria to focus on indicators that will be useful and relevant to technical users, such as scientists and policy analysts involved in management and oversight. Public relevance was also important.

Workflow

Step	Timeframe
Establish framework (categories, definitions, criteria)	May 2017
Compile lists of potential indicators and data sources	May–June 2017
Evaluate candidate indicators against the criteria	June–Aug 2017
Gather feedback and prioritize candidate indicators	Sep–Dec 2017
Develop implementation plan	Dec 2017–May 2018
Develop six indicators	Mar–July 2018
Compile final results	July 2018

ERG followed an iterative process that engaged the diverse membership of the Climate Resiliency Workgroup at several key junctures for input and review. These interactions included gathering suggested topics, cooperatively developing screening and scoring criteria, and collecting prioritization rankings from workgroup members. ERG also interacted with other workgroups and individual subject matter experts to gather input, capture other groups' priorities, and learn about the best available data sources for the topics of interest to this project.

Results

Our screening, scoring, and prioritization steps resulted in the selection of 21 indicators for the proposed suite:

Protected Lands
Restored Habitat
Air Temperature (average and hot extremes)
Coastal Flooding
Precipitation (total and heavy events)
Sea Level Change
Stream Water Temperature
Upstream Flooding
Acidification
Bay Water Temperature
Harmful Algal Blooms

Property at Risk or Damaged
Urban Tree Canopy
Wetland Extent and Physical Buffering Capacity
Bird Species Ranges
BMPs and Green Infrastructure
Land Use/Land Cover
Shoreline Condition
Wetland Migration Corridors
Fish Population Distribution
Submerged Aquatic Vegetation Composition

These indicators are approximately evenly divided across the three conceptual categories, with a few that straddle multiple categories. Feasibility was one consideration, but candidate indicators were not restricted to existing datasets. Thus, some of these indicators may require substantial data collection and analysis. The goal of this project was essentially to identify the indicators that the Bay Program *wants*. Resources and organizational priorities will determine which indicators are actually *developed*, and on what timeframe.

ERG developed and submitted a detailed implementation plan that describes how the entire suite of indicators can be developed. For those indicators that will require substantial development, the plan suggests possible next steps. The implementation plan is intended as a "living document" that will help to inform future efforts.

With the remaining project resources, ERG worked with the Bay Program to develop maps, summary text, and technical documentation for eight of these indicators. They can be viewed by selecting "Climate Change" at www.chesapeakeprogress.com.

For More Information

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