

# Final Deliverables Memo for Scope 15: Development of Climate Change Indicators and Metrics

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## Overview

In 2017 and 2018, Eastern Research Group, Inc. (ERG) worked with the Chesapeake Bay Program Office (CBPO) and the Climate Resiliency Workgroup (CRWG) to conceptualize, select, and partially develop a suite of indicators that can be used to track progress toward the “Climate Resiliency” goal and outcomes in the 2014 *Chesapeake Bay Watershed Agreement*. This memo summarizes our approach, findings, and outputs. It also provides an index to a set of documents that describe our methods in more detail and memorialize inputs and outputs for all key stages of the project. We have posted all documents to the project area on Google Drive.

## Project Summary

ERG began by scoping the project with our CBPO counterparts, developing a detailed work plan, and preparing an EPA-standard quality assurance project plan (QAPP). We also reviewed several framework options for defining, organizing, and prioritizing indicators, and we recommended a framework approach to CBPO that we felt was best suited to the goals of this project.

Next, we facilitated a stepwise process to identify candidate indicators and select the most promising topics for development. Our process followed these high-level steps:

1. **Develop a master list of potential topics**—the “universe” of topics for consideration. Sources for this list included lists from prior ERG projects, ERG and CBPO staff input, input from various workgroup co-chairs and coordinators, and a review of key monitoring networks in the Chesapeake watershed and the variables they collect. This list included approximately 210 topics.
2. **Narrow the list to a smaller set of the most promising topics** based on initial impressions of “value added.” Voting was conducted by asking approximately 35 individuals (ERG and CBPO staff, CRWG members, and members of other key workgroups) to select their top 10 indicators in each of the three bins specified in the project scoping documents: physical climate trends, ecological and societal impacts, and programmatic progress towards resilience. ERG compiled the scores and applied a consistent cutoff to narrow the list to approximately 67 topics—20 to 25 per bin.
3. **Expand the list to capture options for characterizing each topic.** ERG performed this step because some topics can be characterized in multiple ways, using different variables or different data sources. This step resulted in a list of 122 options for the 67 most promising topics.
4. **Compile information about each potential variable and data source**, including temporal and spatial characteristics, data availability, and use in existing indicators or peer-reviewed analyses. This compilation gave ERG a basis for assessing data quality.

5. **Assess each topic with respect to a set of required data quality criteria.** ERG scored each topic and each metric/source option objectively to ensure that any topic we put forward for further consideration could be represented with high-quality, consistent, replicable data. Most topics passed this screening step, but we removed a few from consideration because they did not pass.
6. **Select high-priority indicator topics** based on “value added.” ERG worked with the CRWG to establish a set of criteria for assessing the value that any given topic would add as part of a suite of climate change indicators for the Chesapeake watershed. Then we asked project partners to score each indicator against these criteria. We received scores from ERG and CBPO project team members, scores from individual CRWG members, and collective ratings from several additional workgroups. ERG combined the results and used them to select 30 topics: the top 10 in each of the three bins.
7. **Select a narrower suite of topics** based on a set of “suite selection” criteria developed jointly by ERG, CBPO, and the CRWG. These criteria emphasize balance and connections between indicators. ERG proposed a suite of 21 indicators to CBPO and the CRWG, and we adjusted the final suite based on their input. This step does not lock the program into developing this exact set of indicators, as the indicators that are actually developed will depend on resource availability and evolving priorities.
8. **Identify the optimal metrics and data sources for each selected topic.** ERG revisited the metadata we compiled for each dataset (e.g., temporal and spatial characteristics) and scored each dataset with respect to a set of desired data quality criteria—criteria that can be used to prioritize sources that provide the longest record, the best spatial coverage, and other desirable characteristics. Results from this step fed into the recommendations in our implementation plan.

After completing all the scoring steps and selecting a suite of topics and recommended data sources to address them, ERG developed an implementation plan to guide the development of these indicators. For each indicator, our plan characterizes the status of indicator development (i.e., progress along a spectrum of five key steps); identifies recommended data sources, where available; describes actions that can be taken to advance the development of each indicator, along with suggestions on who may be best equipped to perform these actions; and presents the anticipated costs and timeframes for each step in developing the indicator and maintaining it in the future. This implementation plan is intended as a “living document” that will provide a starting point for future decisions and indicator development efforts.

With the resources remaining in our contract, CBPO tasked ERG with developing a subset of indicators. ERG helped to develop explanatory text for two indicators that already existed on Chesapeake Progress for other purposes, and just needed to be repurposed with an additional focus on climate change. ERG also developed portions of six indicators that we adapted and updated from EPA’s suite of national climate change indicators. We have delivered these indicator materials to CBPO under separate cover.

## [Index of Key Project Documents](#)

We have numbered a set of key documents and organized them into folders as follows:

### **Folder #1: Description and Methods**

1. Memo in which ERG reviewed several framework options for defining, organizing, and prioritizing indicators, and we recommended a framework approach to CBPO that we felt was best suited to the goals of this project. This memo lays out our initial set of required and desirable data quality criteria.

2. A description of some mid-course adjustments to the scoring process, which ERG implemented based on partner feedback and our own observations from the initial stages of scoring. These adjustments added emphasis to “value-added” scoring.
3. A presentation that ERG delivered to the CRWG in October 2017. It outlined some of our key methodological steps and prompted the workgroup for input on other steps. This version of the file includes notes that ERG took onscreen to capture workgroup members’ input.
4. Additional notes from the October 2017 workshop in which the CRWG provided methodological input and participated in a “value-added” scoring exercise.
5. A fact sheet that concisely summarized project methods and progress as of December 2017.

#### **Folder #2: Topic Lists and Scoring**

1. The initial list of approximately 210 potential topics, grouped into three bins.
2. The topic list with tallies from the initial round of “value-added” voting.
3. The topic list narrowed to the most promising ~67 topics, then expanded to provide information about metric and data source options within each topic area. The “detailed” worksheet provides additional metadata that had been gathered on each data source as of that point in time, including temporal and spatial characteristics.
4. The narrowed topic list, with columns added to capture detailed “value-added” scoring input from the CRWG and other partners. This file was distributed to elicit this input. The “detailed” worksheet provides metric/source metadata and the full results of ERG’s “required data quality criteria” assessment for each topic/metric/source.
5. Compiled results from all the individuals and groups that provided detailed “value-added” scoring. This file identifies the top 10 indicator topics in each of the three bins, based on this round of scoring.
6. A matrix that ERG used to assess the top 30 indicator topics with respect to the value they would add to a cohesive suite of indicators.
7. A presentation that ERG delivered to the CRWG in November 2017 to summarize results, propose a suite of 21 indicators, and elicit feedback on our recommendations.

#### **Folder #3: Implementation Plan**

This folder contains the most recent version of the indicator implementation plan that ERG delivered to CBPO for the proposed suite of 21 indicators. It includes Microsoft Word and PDF versions of the same file.

#### **Folder #4: Other Resources**

This folder includes a matrix of monitoring networks that ERG assembled with input from CBPO and CRWG members. While not intended to be a complete representation of all sources of environmental sampling and monitoring data in the Chesapeake watershed, this list did give us a starting point for identifying data sources that could be used to address some of the topics on the list of proposed indicators.

ERG also compiled dozens of published reports and journal articles as part of this project. As these publications were largely provided by CRWG members, and they are likely already available to CBPO and the CRWG, we have not attempted to compile them all as part of this summary package. That said, we are happy to provide additional project files upon request.