Development of Climate Change Indicators and Metrics

Workshop Session with the Climate Resiliency Workgroup

October 16, 2017

Purpose of Today's Workshop

- Provide an update on project progress.
- Gather feedback from the CRWG on work to date.
- Engage the CRWG in assessing candidate indicators' "value added."
- Refine the vision for this suite of indicators.

Today's Agenda

1. Introduction and overview of progress to date
2. Review of indicator/topic matrix
3. Suggestions for constructing indicators
4. Review of data quality criteria scoring
5. Assessing "value added" and a vision for the final suite
6. Next steps and wrap-up

Project Goal

Track progress toward the climate resiliency goal in the 2014 Watershed Agreement:

- **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.

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.

Three "bins"

Look for three types of indicators:

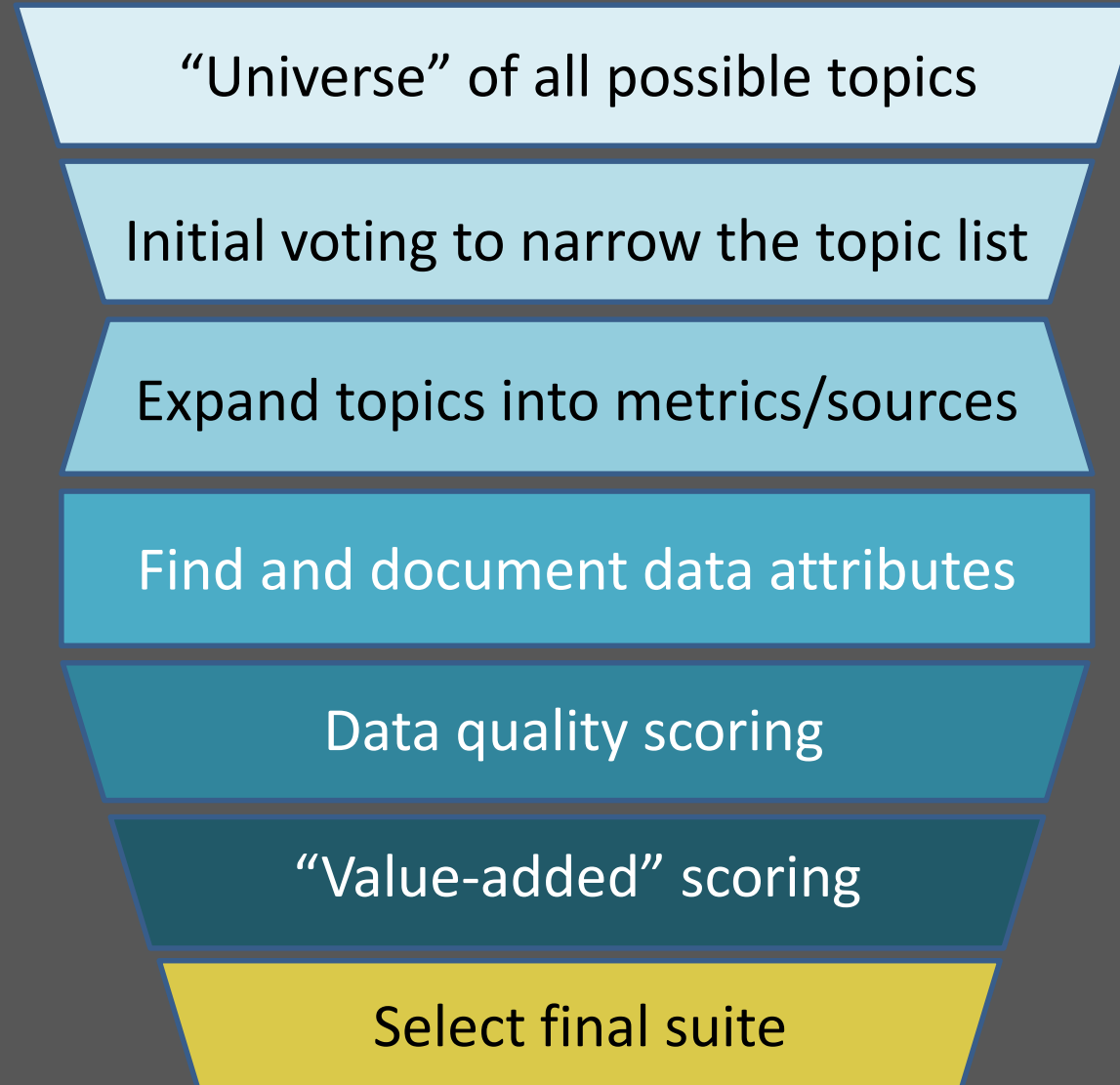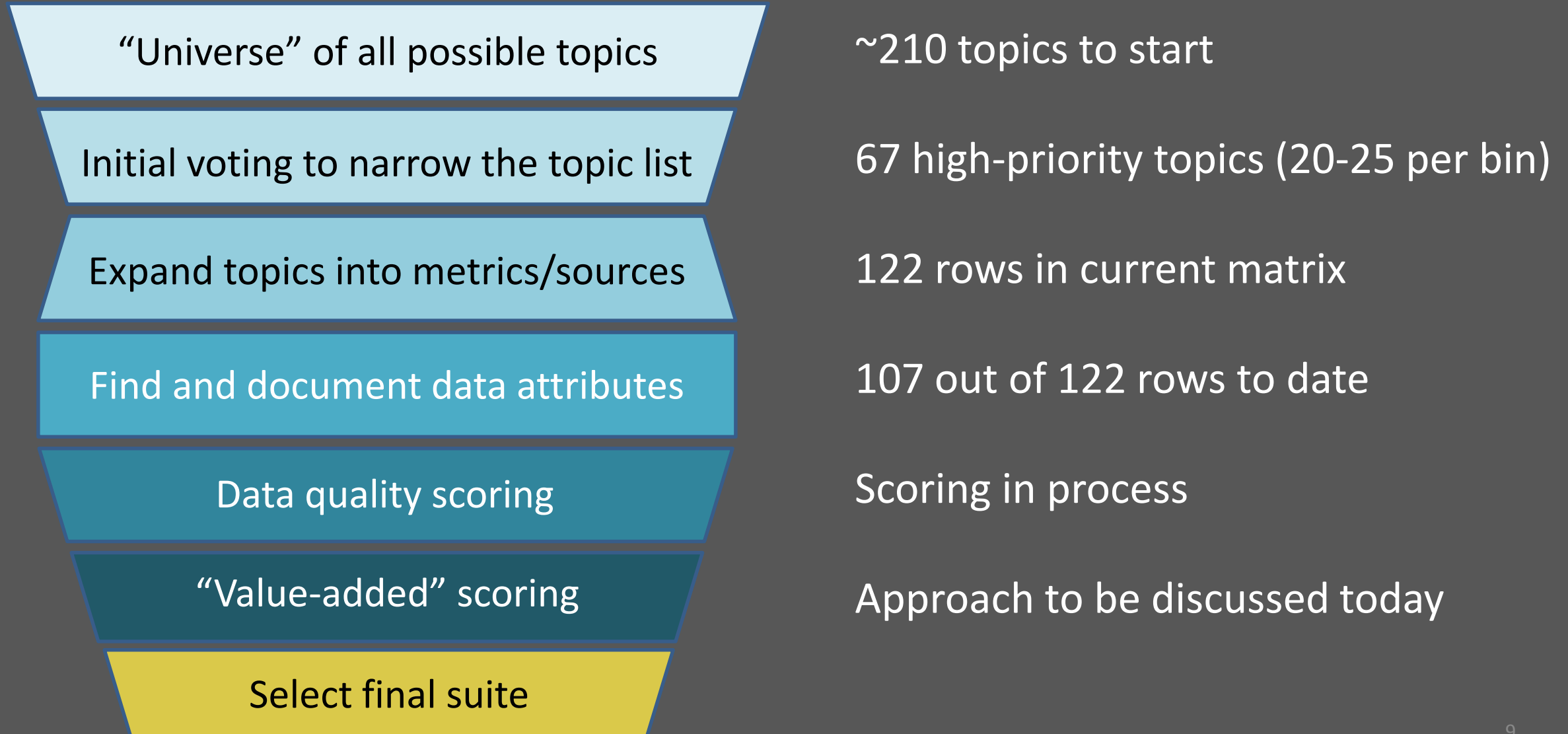| Physical climate trends | Ecological and societal impact | Programmatic progress towards resilience |

Indicator Development Process

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-October 2017
Gather feedback and prioritize candidate indicators	October-Nov. 2017
Develop implementation plan	Dec. 2017-January 2018
Develop the top three to six indicators	March-April 2018
Compile final results	May-July 2018

Indicator Development "Funnel"

"Universe" of all possible topics

Initial voting to narrow the topic list

Expand topics into metrics/sources

Find and document data attributes

Data quality scoring

"Value-added" scoring

Select final suite

Indicator Development by the Numbers

"Universe" of all possible topics	~210 topics to start
Initial voting to narrow the topic list	67 high-priority topics (20-25 per bin)
Expand topics into metrics/sources	122 rows in current matrix
Find and document data attributes	107 out of 122 rows to date
Data quality scoring	Scoring in process
"Value-added" scoring	Approach to be discussed today
Select final suite	

Overarching Themes

- Select the *best* indicators, not the *easiest*

- No perfect way to do it!
  - Establish an approach but be open to adjustment

- Aim to be objective
  - Defined scoring criteria, applied according to a rubric

- Be open to future possibilities
  - Not just what's under the lamppost

- A team effort

Review of Indicator/Topic Matrix

- A quick tour…
  - Condensed version on paper
  - Detailed version electronically
  - Sources/metrics split out into separate rows (e.g., ID #1.1)

- Before we get into scoring, focus on data sources
  - Though we're not looking to go back up the funnel…

Discussion Questions

1. What is your overall impression of the breadth of topics and sources covered here?

Discussion Questions

2. Are you aware of any notable strengths or limitations to specific data sources that we should note?

3. Are you aware of additional data sources for these topics that we may have missed?

- Let's make a list…

Suggestions for Constructing Indicators

Changes in Stream Water Temperatures in the Chesapeake Bay Region, 1960–2014

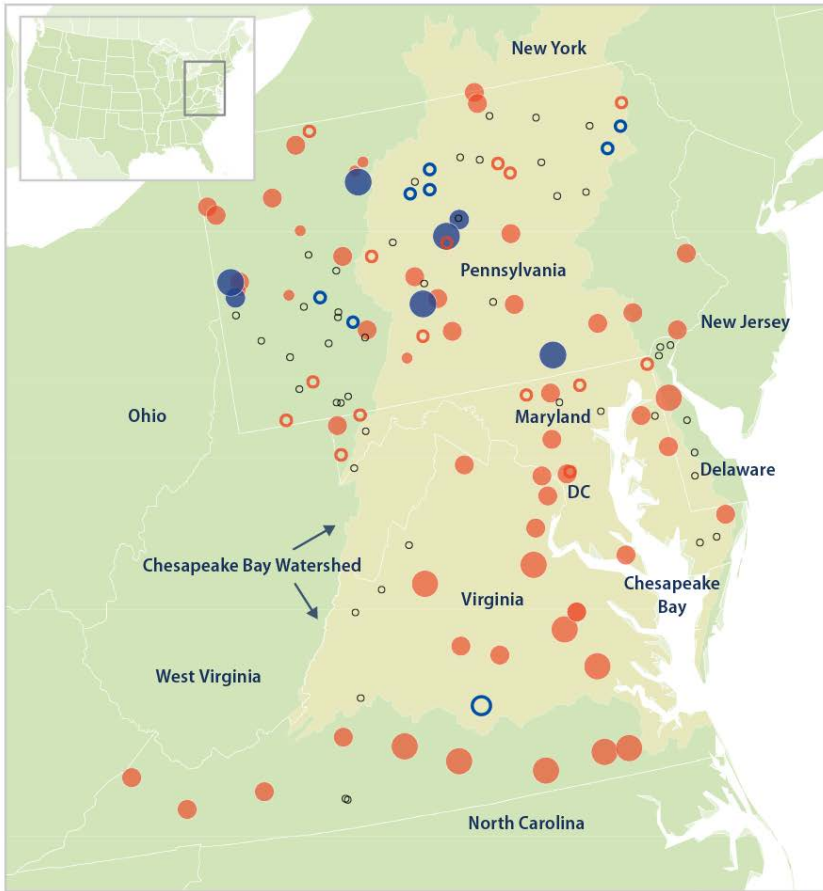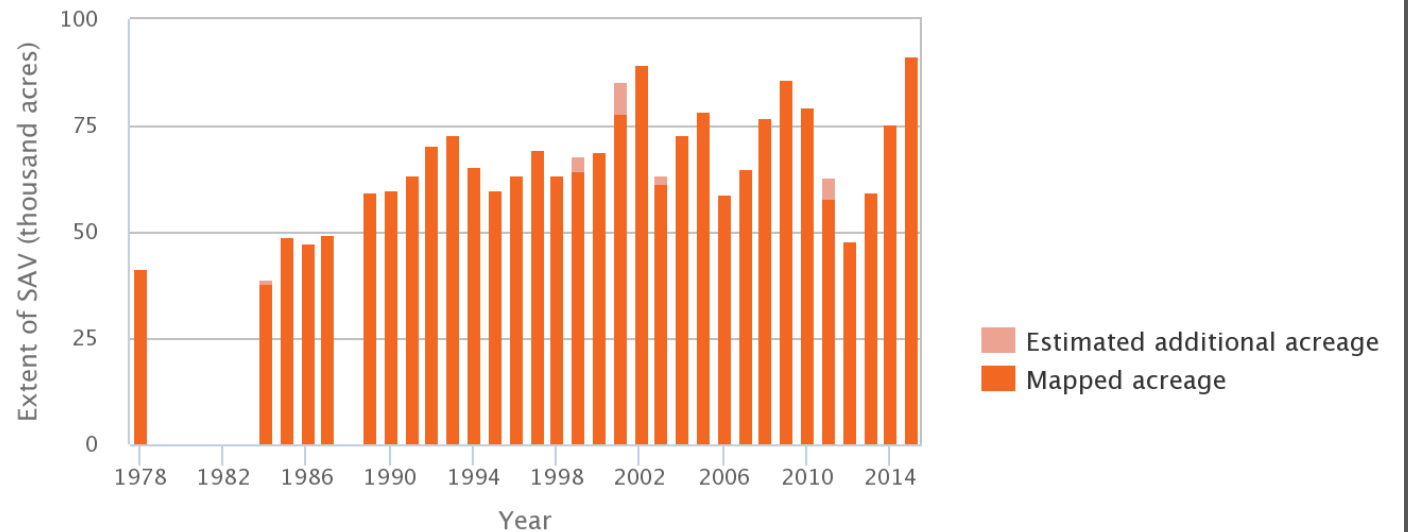Sometimes it's obvious how we'd transform data into an indicator...

Exhibit 1. Extent of submerged aquatic vegetation (SAV) in the Chesapeake Bay, 1978–2015

Suggestions for Constructing Indicators

…but sometimes it's not.

Example:

> 153: # states, communities, land conservation agencies, or NGOs with climate adaptation plans (or mgmt plans that at least mention climate change)
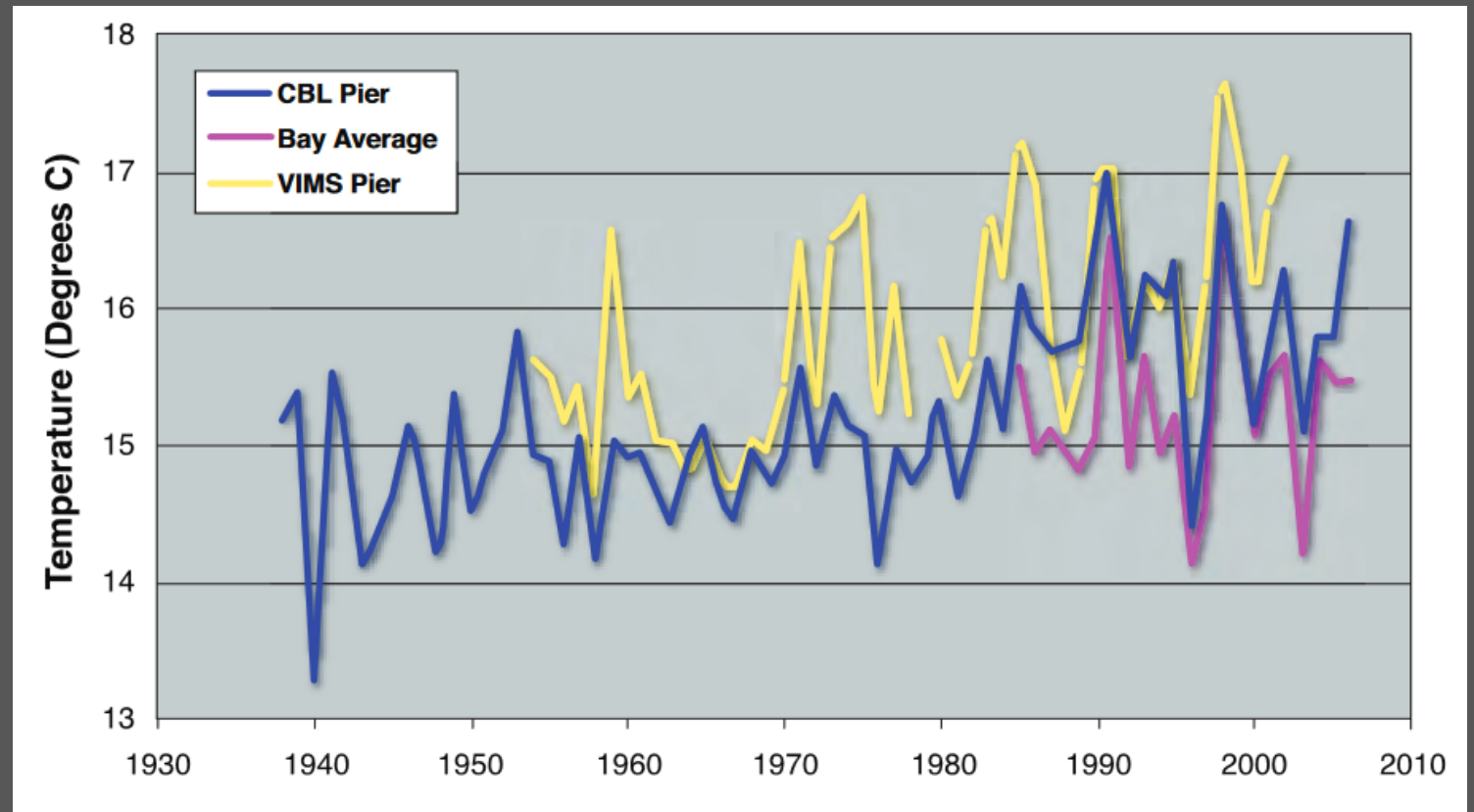
Discussion Questions

1. What approaches would you suggest to construct indicators from specific data sources, beyond the suggestions already captured in the matrix?

   − Some ideas in detailed matrix, but the floor is open

Suggestions for Constructing Indicators

We're also open to combining data from multiple sources into one indicator, if it leads to a stronger indicator...

...but we ought to do it carefully!

Discussion Questions

2. What principles should be applied when combining multiple data sources into a single indicator?

- Let's make a list…

Discussion Questions

3. What are some examples of topics from the matrix that might work well as hybrid indicators? How do you envision that the resulting indicators would look?

Review of Data Quality Criteria Scoring

Two parts:

1. Required criteria
2. Desirable criteria

Required Data Quality Criteria

- 11 criteria
  - Two can only be considered after indicator is constructed
- **Purpose:** Ensure all indicators meet a minimum standard
- Scored YES/NO
- Consider ability to meet these criteria in the future
- In practice, most topics pass
- More details in handout

Required Criteria

Topical relevance	The indicator provides information about physical climate trends, ecological or societal response, or programmatic progress toward resilience. The connection to climate change is documented or can be explained easily.
Spatial coverage	The indicator provides information that is specific to the Chesapeake Bay, the Chesapeake Bay watershed, or geographic sub-units within the watershed.
Temporal coverage	Multiple years of data are available to describe changes or trends, and the latest available data are timely.
Actual observations	The indicator is based on observed data. Modeling and statistical inference (if any) is limited to spatial interpolation between data points, such as the process used to generate a gridded map.
Credible methods	The indicator is based on sound data collection and analytical methods that reflect the state of the science.
Data quality and integrity	The data provider uses quality assurance procedures to ensure data quality and management systems to protect the integrity of the data.

Required Criteria

Objectivity	The indicator is developed and presented in a clear, complete, and unbiased manner that accurately represents the underlying trends in physical conditions.
Uncertainty	Sources of uncertainty are known and understood.
Transparency and reproducibility	The specific data used and the specific assumptions, analytical methods, and statistical procedures employed are clearly stated. Documentation is sufficient to allow the indicator to be reproduced independently.
Feasibility	The indicator is feasible to construct, and a program is in place to continue to collect data, thereby allowing the indicator to be updated in the future.
Peer-review validation	If an indicator is based on physical measurements of environmental conditions, it must use data from a peer-reviewed publication, a program that uses peer-reviewed methods to collect and analyze data, and/or a program whose data have been used and validated in peer-reviewed publications.

Desirable Data Quality Criteria

- 10 criteria
- **Purpose:** Assist with prioritization, especially when choosing between sources or metrics for a single topic
- Scored HIGH/MODERATE/LOW
- Translated into point total
- Definitions and rubric in electronic version of matrix workbook

Desirable Data Quality Criteria

1. Relationship to other indicators (assessed later as part of assembling the optimal suite)
2. Spatial coverage
3. Spatial resolution
4. Temporal coverage
5. Temporal resolution
6. Consistency of methods
7. Peer-review validation
8. Uncertainty
9. Other limitations (e.g., confounding factors)
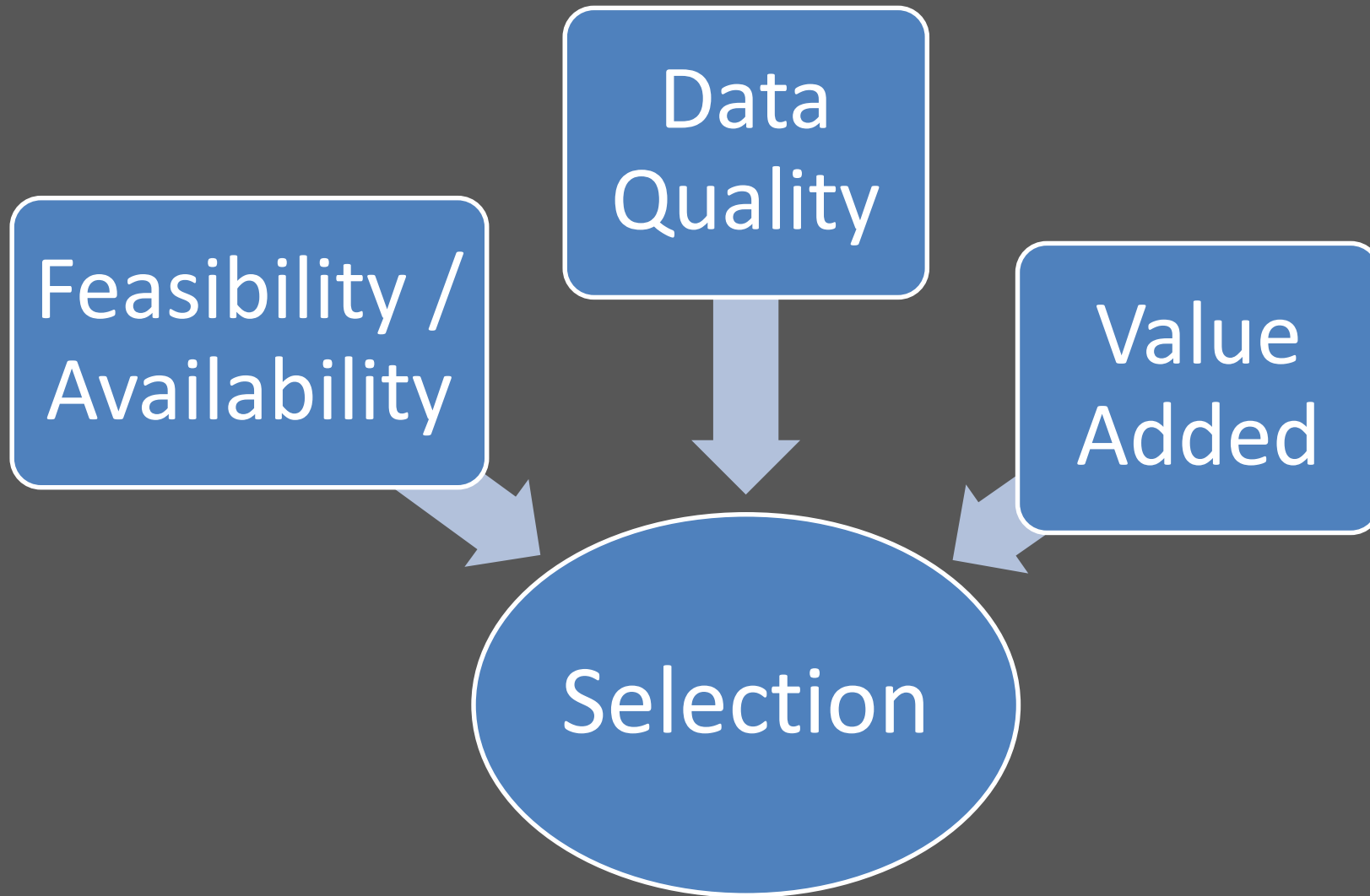10. Understandability

Discussion Questions

1. What is your impression of the way in which we have assessed data quality and related considerations?

2. What suggestions would you make, if any, to improve this step of the indicator assessment process?

Assessing "Value Added"

Data Quality

Feasibility / Availability

Value Added

Selection

- How to define?
- How to measure?
- Relative weight?

It all comes back to the purpose
that these indicators
are intended to serve.

Discussion Questions

1. In your opinion, what should be the stated purpose(s) of this suite of indicators?

- Let's make a list…

2. What characteristics should we use to assess each candidate indicator with regard to "value added"?

An example:

2. What characteristics should we use to assess each candidate indicator with regard to "value added"?

- Initial ideas:
  - "Importance" score
  - Extent to which it's affected by climate (sensitivity?)
    - Is climate the major driver? One of several significant drivers? Or just a minor driver?
  - Extent to which our actions can influence the results
  - Connection to Watershed Agreement Climate Resiliency Goal and Outcomes (i.e., monitoring/assessing trends and impacts; adaptation)
  - Connection to larger set of Watershed Agreement goals and outcomes

Discussion Questions

2. What characteristics should we use to assess each candidate indicator with regard to "value added"?

Characteristic	How to score it

Discussion Questions

3. What additional considerations do you feel are important when selecting the final suite of indicators—for example, number of indicators and qualities that make for a cohesive "whole"?

- Let's make a list…

Discussion Questions

4. What is the relative importance of each of the considerations identified in response to the previous questions? For example, how important is "desired data quality" versus "value added"?

"Value-Added" Scoring Exercise

- Posters on the walls
  - Three broad bins
  - Condensed columns
  - Condensed rows for scoring by general topic (67), not specific source or metric
  - ID #s to cross-reference with detailed matrix
- Add new criteria
- Onsite logistics
- Logistics for remote participants

Next Steps

- **Workgroup input:** Chance for supplementary comments
  - Target date?
- Finish populating matrix and assessing data quality, with adjustments as needed
- Incorporate "value-added" scores per today's input
- Propose a suite of indicators for consideration
- Final questions or comments?

Thank you!

ERG