

Climate-Resilient Stormwater Management

Practical Tools for Vulnerability Assessment
and Climate-Informed Decisionmaking

Michelle Miro and Krista Romita Grocholski

Advancing Climate-Resilient Stormwater Management

Practical tools to help stormwater agencies incorporate *climate resilience* into planning, design, and management across the Chesapeake Bay watershed.

Climate change is increasing rainfall intensity and stressing existing stormwater infrastructure.

This EPA-supported initiative is developing practical decision tools to help practitioners assess vulnerability and make *climate-informed design choices*.



ASSESS VULNERABILITY



USE CLIMATE DATA



ADAPT DESIGN



BUILD CAPACITY

Two Core Tools in the Toolkit

Today's briefing focuses on the *Vulnerability Assessment Guide* and the *Climate Data Decision Support Tool*.



Vulnerability Assessment Guide

- Helps users choose fit-for-purpose vulnerability assessment approaches
- Covers methods such as modeling and structured expert judgment
- Includes practical guidance, case studies, and templates



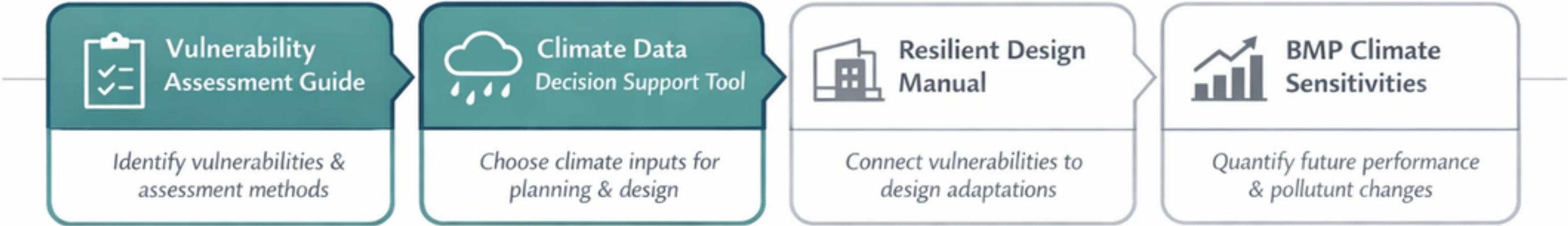
Climate Data Decision Support Tool

- Guides use of climate projection data in planning, design, and policy decisions
- Helps users choose scenarios, time horizons, and risk orientation
- Includes intuitive decision trees, examples, and case studies

Together, these tools help agencies move from understanding climate risk to *making actionable stormwater decisions*.

Where These Tools Fit in the Broader Initiative

The project is building an integrated suite of resources for climate-resilient stormwater management.



Co-produced with practitioners and Chesapeake Bay partners

Designed for practical use by municipal, regional, and state stormwater agencies

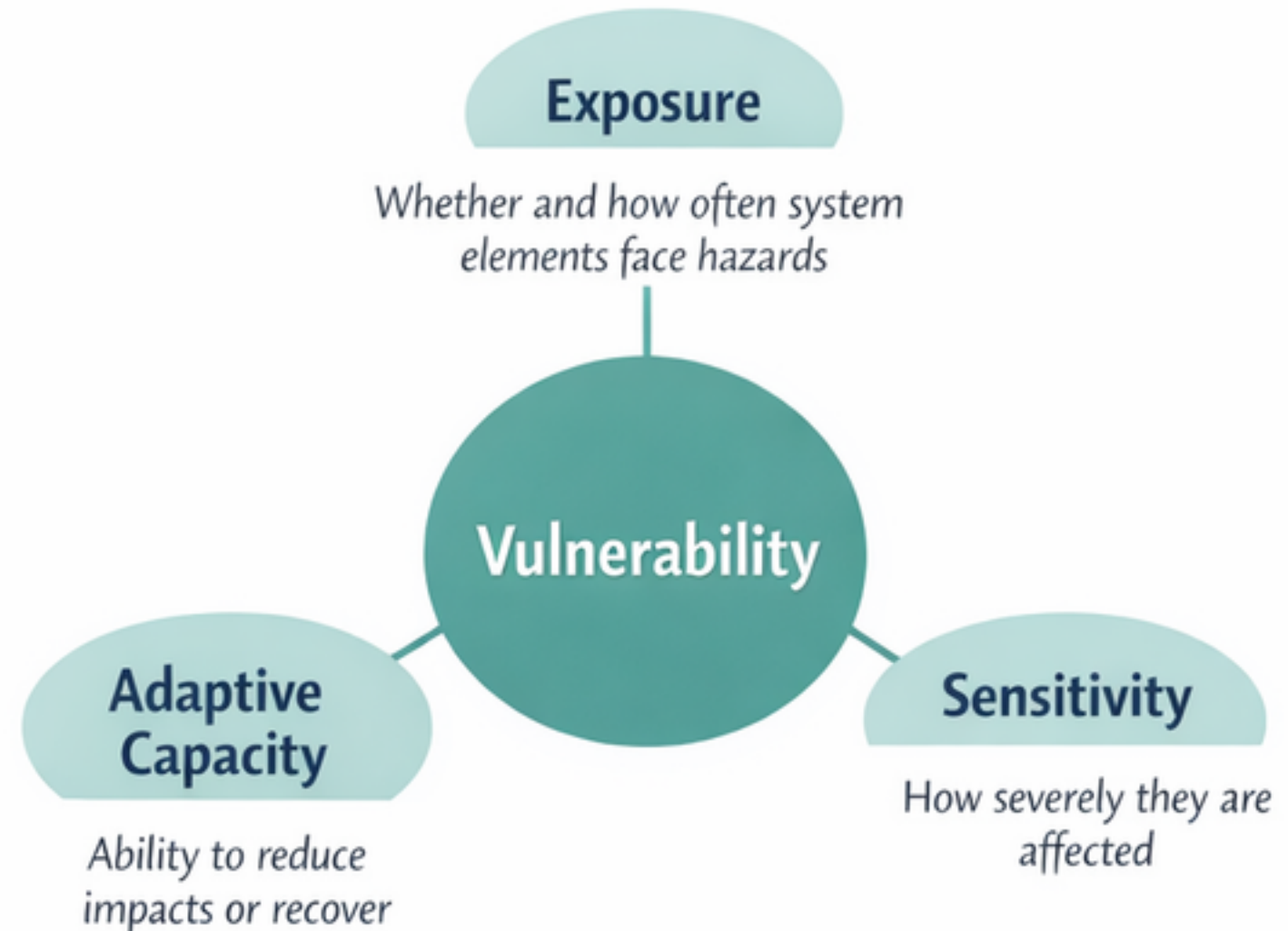
Additional resources expected through late 2026.

Vulnerability Assessment Guide: What It Is and Why It Matters

A practical framework to help stormwater agencies *design assessments that are fit for purpose, feasible, and decision-relevant.*

Core Purpose

- Helps agencies understand which assets, functions, or populations are most at risk
- Supports planning, compliance, investment prioritization, and resilience decisionmaking
- Emphasizes approaches that are right-sized to agency needs and resources

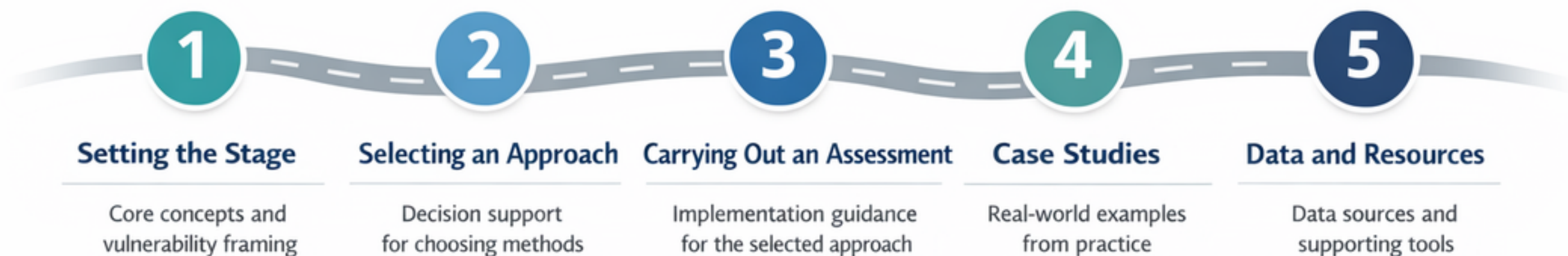


Assessments should be aligned with intended decisions from the outset

The guide is flexible rather than prescriptive

What's in the Guidebook

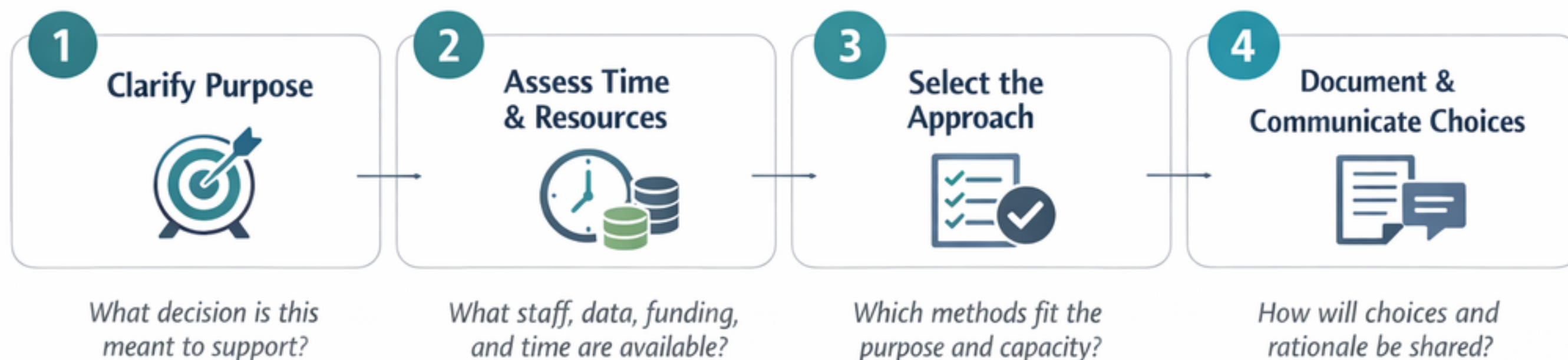
The guide is organized as a practical roadmap from foundational concepts to implementation support.



The guidebook functions as both a reference and a practical toolkit.

Start with the Decision You Need to Inform

A central message of the guide is that the purpose of the assessment should drive the approach.



Method selection follows purpose, capacity, and intended use.

Six Common Vulnerability Assessment Approaches

The guide reviews a spectrum of methods, from foundational qualitative approaches to more advanced quantitative analysis.

Expert Judgment

Structured input from staff, experts, or community members to identify vulnerabilities.

Best for: rapid scoping, local knowledge



Scorecards

Semi-quantitative ratings of exposure, sensitivity, and adaptive capacity.

Best for: prioritization with limited data



Indicators

Use measurable variables such as impervious area, asset age, or social vulnerability.

Best for: comparable screening across places or asset types



Spatial Analysis

Overlay hazards, assets, and populations to identify exposure hotspots.

Best for: mapping and communication



Statistical Analysis

Use historical data to estimate probability and consequences of hazards.

Best for: trend analysis, loss estimation



Modeling

Simulate stormwater system response under hazard scenarios.

Best for: detailed planning and design support



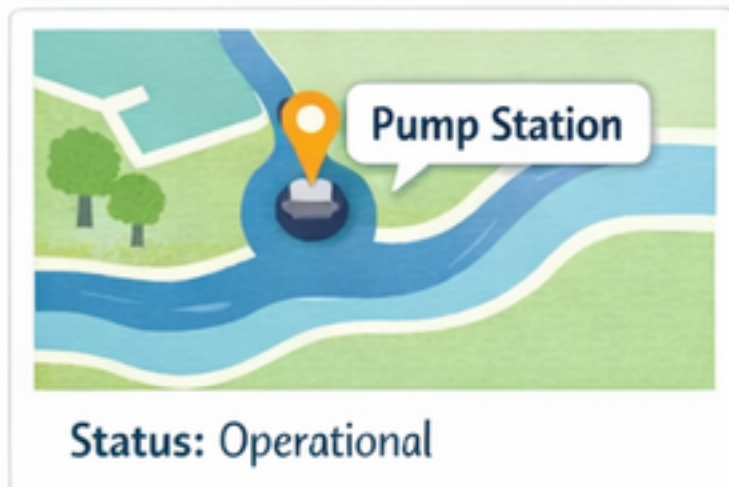
Agencies often layer multiple approaches to combine local knowledge, available data, and technical analysis.

Choosing the Right Output: Asset-Specific vs. Category-Based

The guide distinguishes between assessments designed to act on individual assets and those designed to inform broader planning across categories or places.

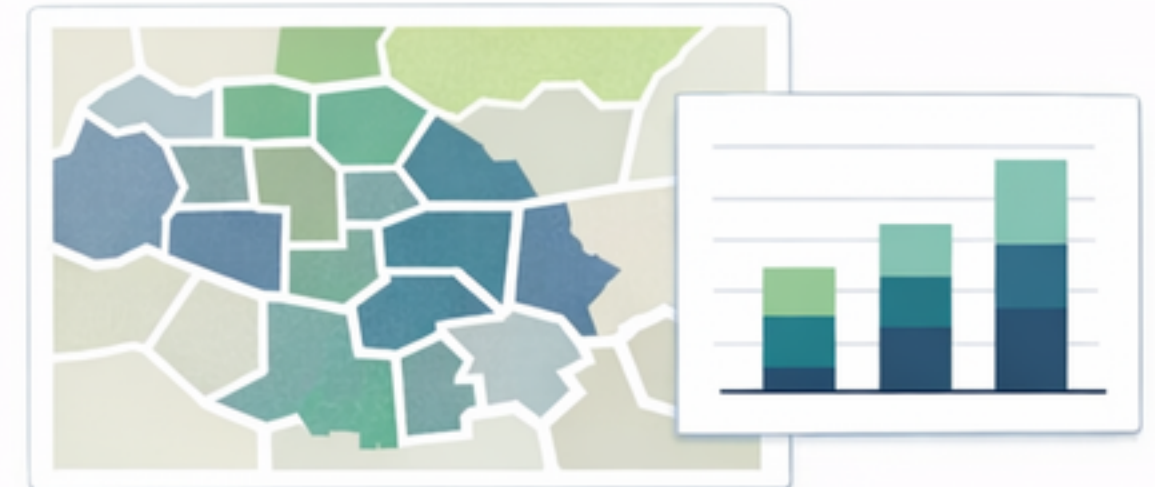
Asset-Specific

- Focuses on individual, named assets
- Supports targeted maintenance, upgrades, and design decisions
- Requires more detailed site- or asset-level information



Category-Based

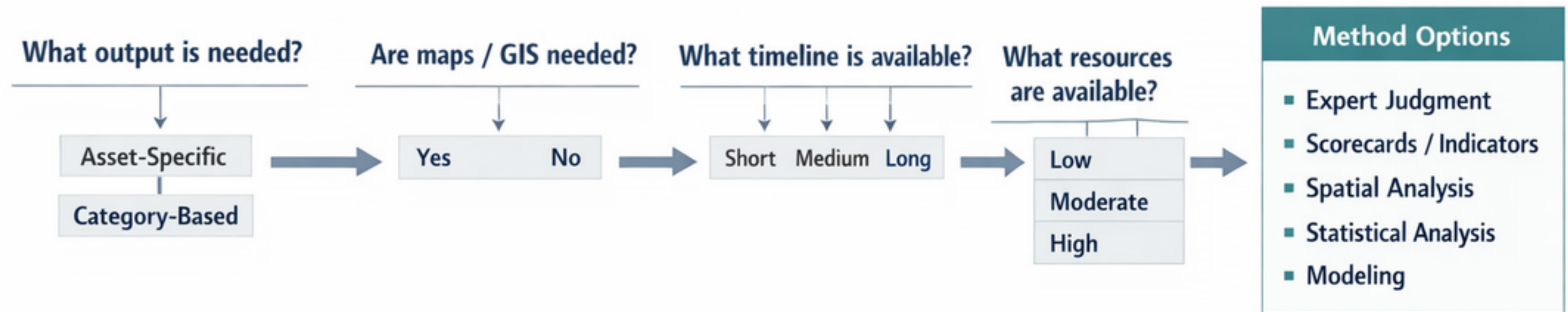
- Focuses on groups of assets or geographic areas
- Supports strategic planning, prioritization, and communication
- Can be used even when full asset inventories are incomplete



Some agencies need both: *broad screening to identify priorities, then deeper analysis for the highest-risk assets.*

Decision Support for Selecting an Approach

The guide helps users choose an assessment approach based on output needs, available information, timeline, and resources.



The goal is not to prescribe one method, but to match the the approach to the decision context.

The Guide Encourages Layered Approaches

*Agencies can start **simple**, **validate** what they learn, and build toward more detailed analysis as capacity grows.*



Layering does not mean every assessment must end in modeling.

From Selecting an Approach to Carrying It Out

The guide pairs method selection with a practical six-step process for implementation.

1 Determine Purpose and Define Scope

Clarify objectives, hazards, audiences, and boundaries.



2 Select and Implement Approach

Match methods to decision needs, capacity, and outputs.



3 Engage Stakeholders

Bring in agencies, experts, and community voices early and often.



4 Collect and Organize Data

Assemble infrastructure, hazard, population, and planning data.



5 Assess Exposure, Sensitivity, and Adaptive Capacity

Integrate evidence to identify what is most vulnerable and why.



6 Implement and Communicate Findings

Translate results into recommendations, maps, dashboards, and decisions.



The guide is not just about choosing a method—it is about using assessments to support action.

What Makes the Guide Practical

The document is designed to be usable—not just informative.



Examples Throughout

Illustrates decisions, method choices, and key concepts with concrete examples.



Case Studies

Shows how agencies have carried out vulnerability assessments in real-world contexts.



Fillable Worksheet

Provides a structured tool to document choices and walk users through the guidebook steps.



Communication and Transparency

Helps users record rationale, share decisions, and support stakeholder understanding.

Together, these features help agencies move from concept to implementation.

Access the Vulnerability Assessment Resources

Two companion resources support stormwater agencies in selecting and carrying out vulnerability assessments.

Full Practical Guide

Comprehensive guidance on methods, decision trees, implementation steps, worksheets, case studies, and data resources.

rand.org/pubs/tools/TLA4308-1.html



Vulnerability Assessment Snapshot

A concise overview designed to help users quickly identify an appropriate approach and navigate the full guide.

chesapeakestormwater.org/.../vulnerability-snapshot-3.30.26.pdf



Use the snapshot for quick orientation; use the full guide for method selection, implementation, and supporting resources.

Climate Data Decision Support Tool: What It Helps You Do

A structured guide for selecting projected IDF curve change factors for planning, design, and policy decisions.

Why this tool matters

- Future rainfall is **changing**, but there is **no single “most likely”** projection
- Practitioners need a **transparent** way to connect climate data choices to decision context
- The tool supports selection of projected rainfall change factors from the Mid-Atlantic IDF Curve Tool



1. Determine purpose and context



2. Select a risk orientation



3. Select a change factor

Then communicate and document the rationale.

The goal is not to find one “correct” projection, but to make defensible choices that fit the decision.

How the Guide Works: Three Main Steps

The guide follows the same sequence practitioners typically use when incorporating projected rainfall into stormwater decisions.



The guidance is designed to structure choices—not eliminate judgment.

Step 1: Determine Purpose and Context

Before selecting climate inputs, first clarify what decision the IDF Curve Tool is meant to inform.

Two Primary Decision Contexts



Infrastructure-Level Decisions

Designing or evaluating individual assets or systems; focus on performance, function, and reliability.



Policy-Level Decisions

Updating manuals, regulations, or permit requirements; focus on consistency, predictability, and fairness across projects.

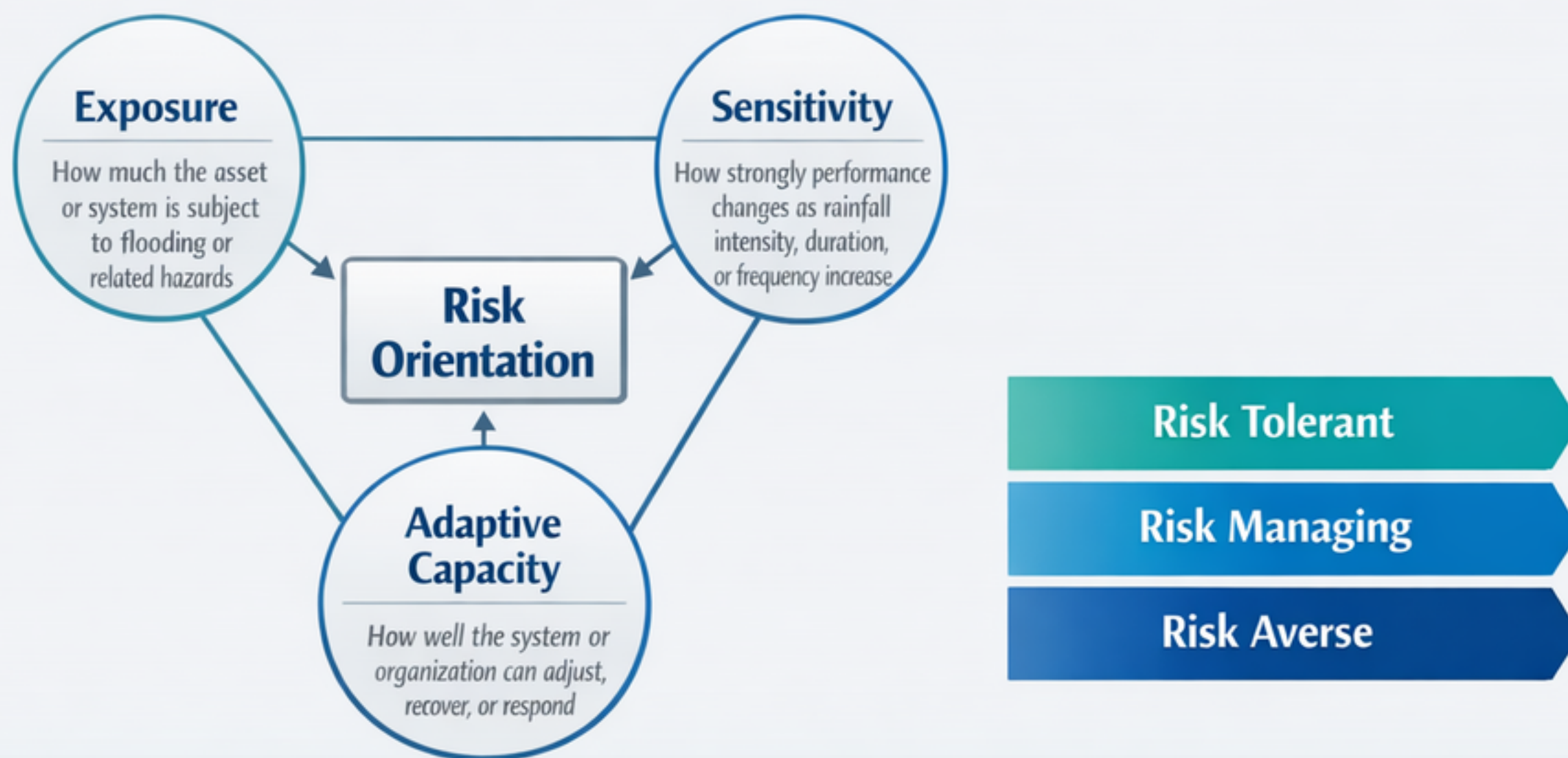
Key Questions to Ask

- What specific outcome matters most?
- How critical is the asset or system to operations or public safety?
- What counts as acceptable performance as conditions change?
- How long will the asset, plan, or policy remain in effect?

For most users, the guide is primarily scoped to infrastructure-related design and planning decisions.

Step 2: Select a Risk Orientation

The guide uses exposure, sensitivity, and adaptive capacity to determine how conservative or flexible the decision approach should be.



High sensitivity often points toward a more risk-averse orientation, regardless of the other dimensions.

Step 3: Select a Change Factor

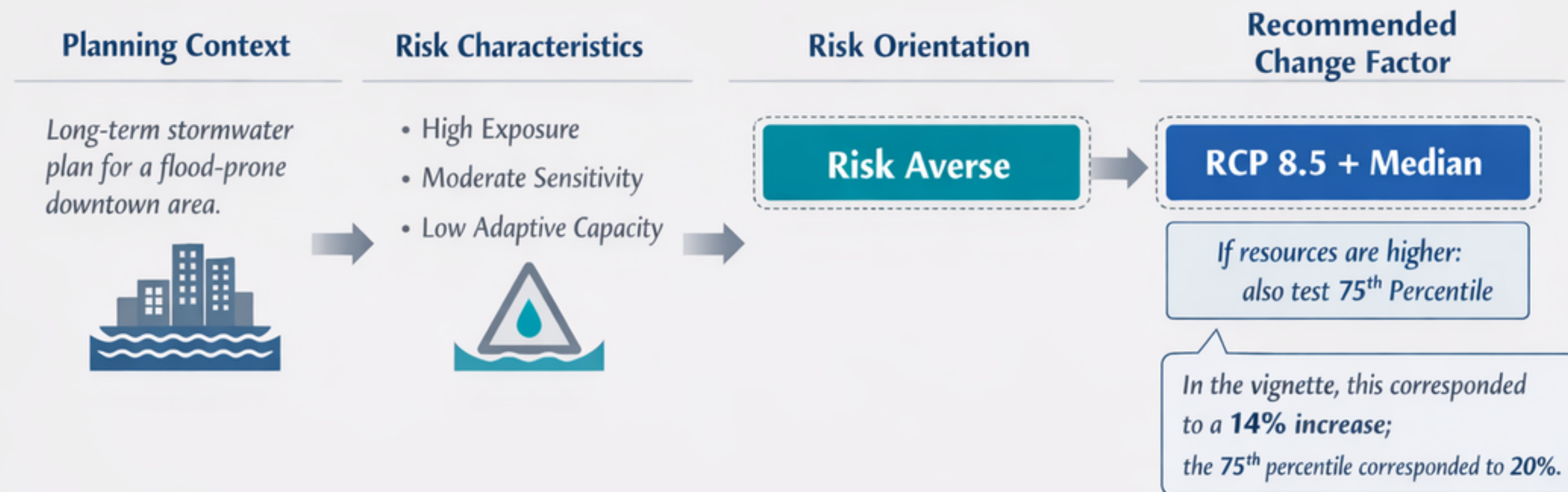
Use the selected risk orientation to guide the choice of time period, emissions scenario, and percentile within the IDF Curve Tool.



The goal is to make *defensible* choices that fit the decision context—not to identify one “**most likely**” future.

Illustrative Example: From Risk Orientation to Change Factor

The report's vignette shows how the guide can translate local conditions into a defensible climate-data choice.



The goal is not to produce one universal answer, but a choice that fits the stakes, planning horizon, and capacity of the user.

Communicating Climate-Informed Choices

A key contribution of the guidance is helping practitioners *explain why a particular climate-informed choice was made.*



Explain Why Future Rainfall Matters

Historical standards may underestimate future extremes.



Explain Why There Is a Range

Projections reflect multiple plausible futures, not one forecast.



Explain Why This Choice Fits the Decision

Change factors should match risk, lifespan, and consequences of failure.

“The goal is transparent, defensible communication with staff, decisionmakers, and the public.”

Access the Full Decision Support Resources

Use the full report and the IDF Curve Tool together.

Full Decision Support Guide



Complete step-by-step guidance for selecting projected IDF curve change factors, including decision trees, vignettes, communication language, and policy applications.

rand.org/pubs/tools/TLA4308-2.html

Projected IDF Curve Tool



Interactive tool for viewing and applying climate-adjusted IDF curve change factors for the Chesapeake Bay watershed and Virginia.

midatlantic-idf.rcc-acis.org

An interactive version of the guidance will be available soon on the tool website.

Recommended use: *apply the report's framework to choose inputs, then use the IDF tool to retrieve the relevant change factors.*

Questions

Discussion and feedback welcome.

Contact Us

Michelle Miro | mmiro@rand.org

Krista Romita Grocholski | kristarg@rand.org