Phase 7 CBP Watershed Model Development

GIT Chairs Meeting

6/30/2021

Gary Shenk

What is the CBP Watershed Model

- CAST = CBP Watershed model
  - Web-accessible model of expected management effects
- Users design and run their own scenarios
- CAST answers the question
  - Given a set of management practices in a county, state, watershed, or CBW
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      - Land use type
      - Wastewater facility
    - What is the cost of implementing the plan
    - Are there co-benefits?

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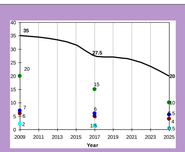
    - **Are there co-benefits?**

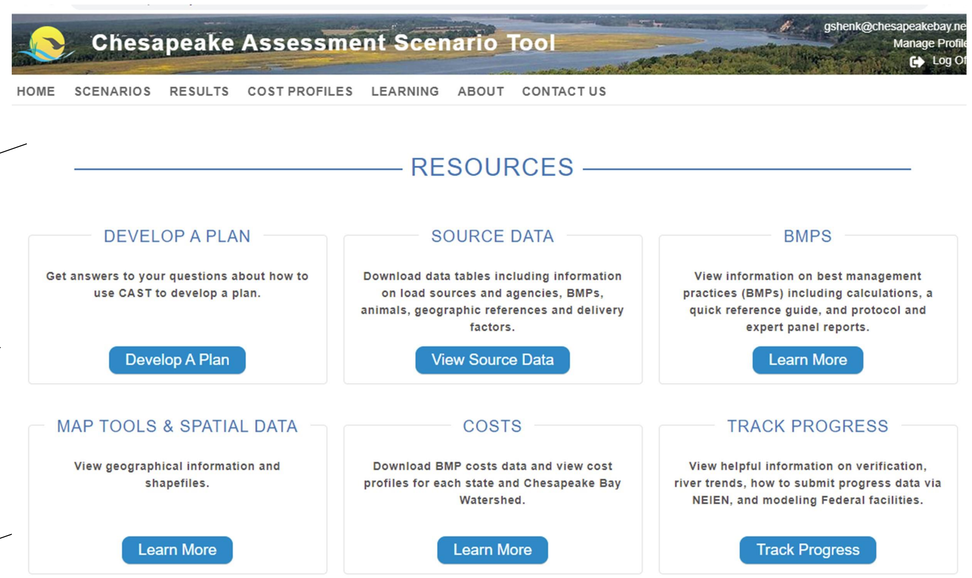
CAST use in the TMDL

1. Planning Targets Identify nutrient and sediment targets that meet CBP fairness principles

2. Watershed Implementation Plans identify Management practices that meet targets.

3. 2-Year Milestones with programmatic and pollutant reduction commitments





- Partnership uses CAST to create planning targets that reflect fairness principles.
- Jurisdictions use CAST to create WIPs aimed toward TMDL targets
- EPA uses CAST as one of the WIP evaluation criteria
- Hundreds of non-TMDL users as well

4

Phase 6 Model Structure

Average Load + △ Inputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

Stream Delivery

*

River Delivery

Direct Loads

Phase 6

Keep It Simple

Average Load + △ Inputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

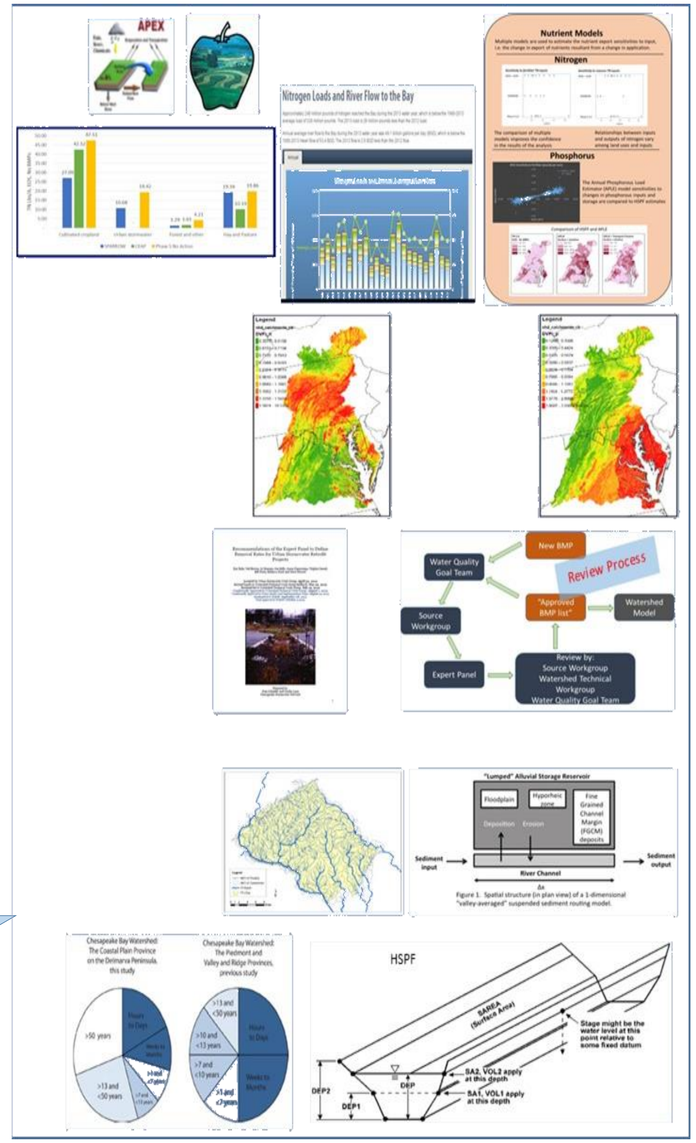
Stream Delivery

*

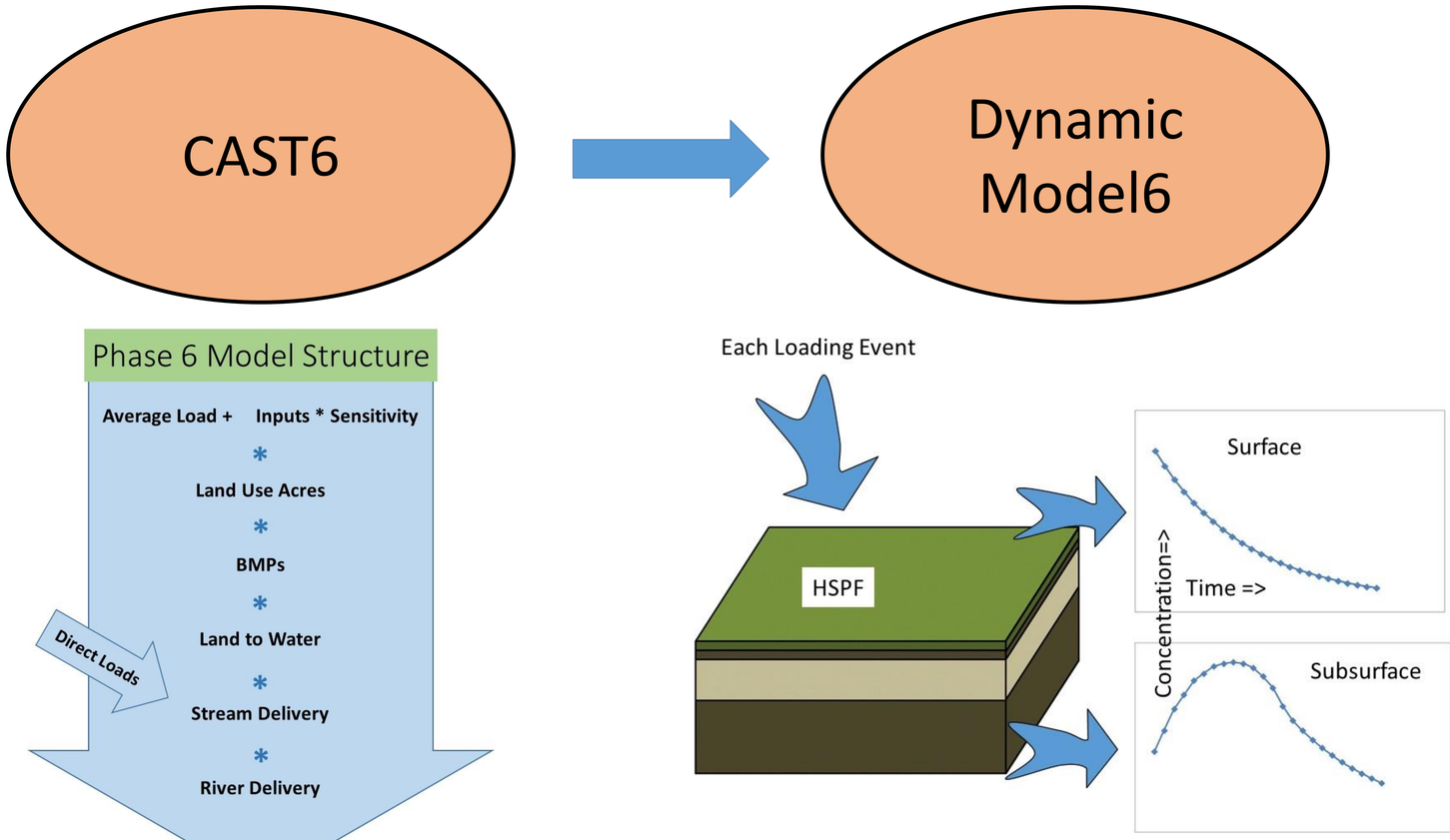
River Delivery

Direct Loads

Include Everything

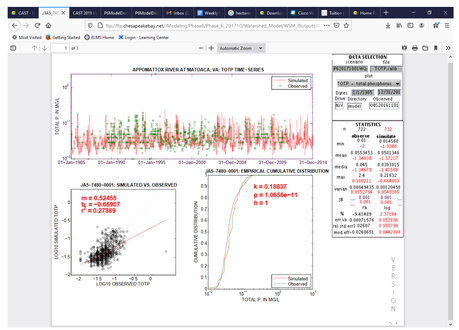


CBP **Phase 6** Model – Scenario Mode



CAST determines CBP official scenario loads

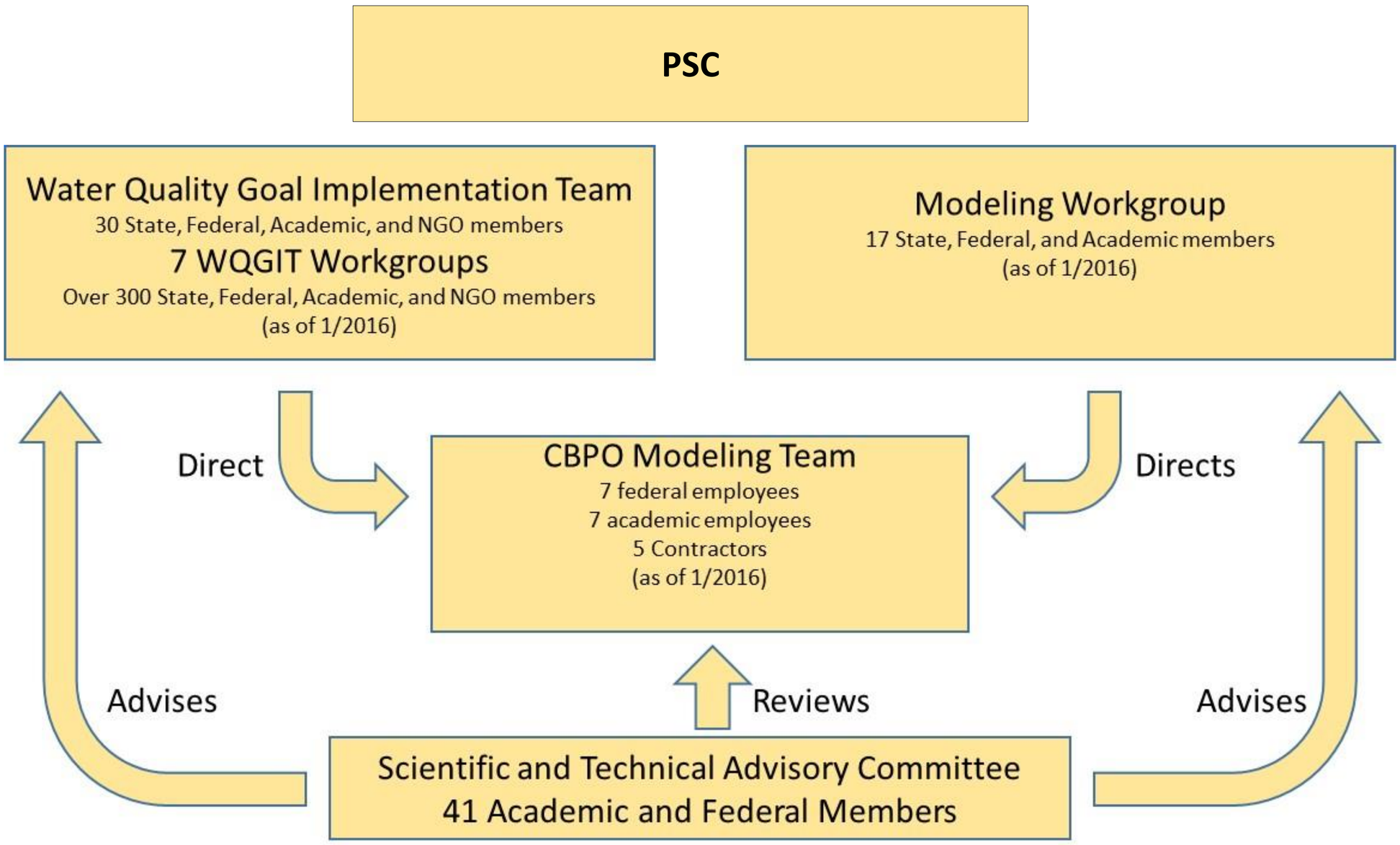
CAST loads are temporally disaggregated for estuarine model and comparison with observations



CBP Watershed Modeling Products

	Existing	Long term
TMDL tracking	CAST6-2017 CAST6-2019… CAST6-2025	CAST7-2025
Calibration, Estuarine loading Water supply	P6 Dynamic Model	P7 Dynamic Model

CBP TMDL Model Oversight



2023 Prototype

Opportunity

…
Geomorphometry

Land Use

Computing Power

New Science

Fine-scale tools (field doc)

P7
CAST
DM

Partnership Need

PSC directives

WQGIT needs

STAC recs

Other GIT needs

Water supply partners

Model
Data Set
Endpoint
Project/Decision

Complete

In Process

Not Started

Top …

Up

P7 CAST DM

Partnership Need

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PSC directives

1. Reassess 2035 climate in 2025
2. Don't change planning targets until 2025

Water supply partners

NHD100k hourly flow & temperature
Low flow extremes ; Reservoirs

Other GIT needs

CAST inputs and outputs at NHD100k or NHD24k
Time-averaged N, P, S, flow, temp characteristics

STAC recs

Finer scale
Better characterize sources and sinks
Uncertainty Quantification (including BMPs)
Formalized optimization of CAST calibration

Revolutionize sediment
Match with monitoring data
More models in ensemble

WQGIT needs

Science needs database – 1 science need: Finer Scale

1) refine urban phosphorus sensitivities
2) investigate the impact of urban BMPs using SWAT and/or SWMM models.

P7 CAST DM

Partnership Need

Model
Data Set
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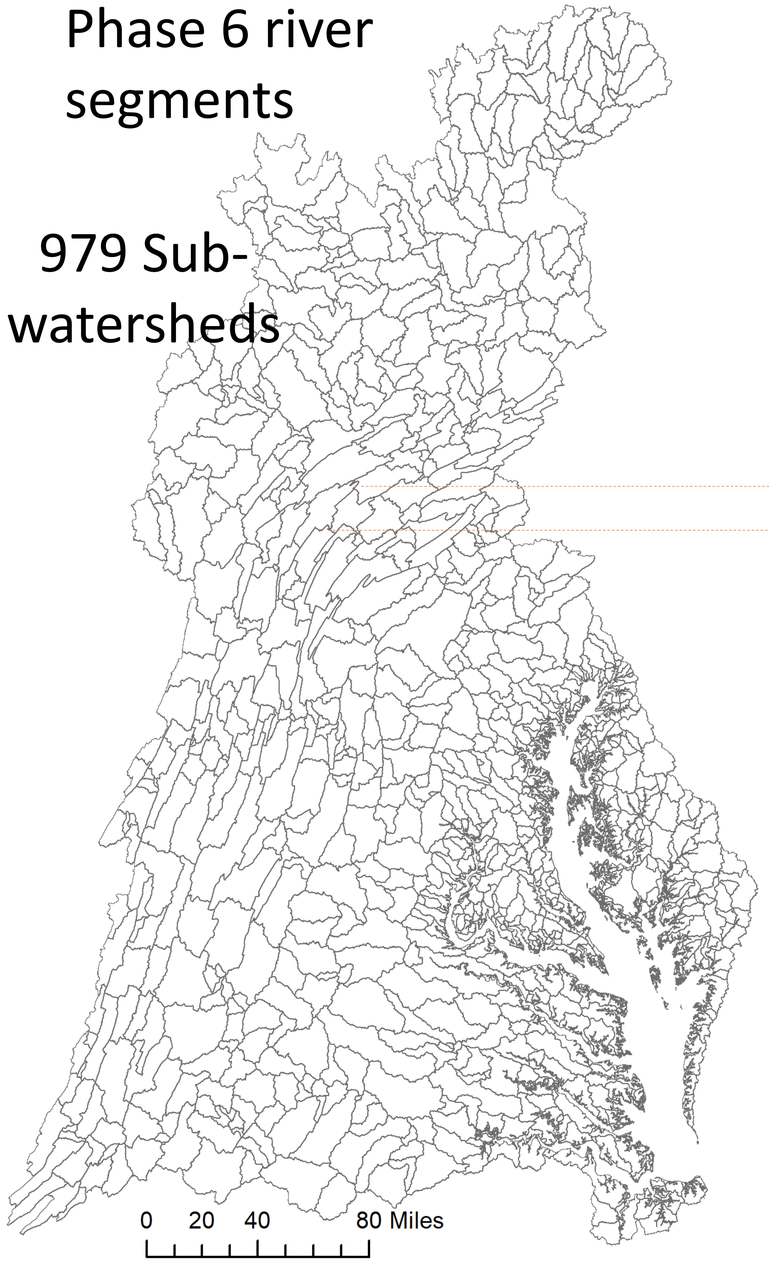
Scale – Phase 6 vs. Phase 7

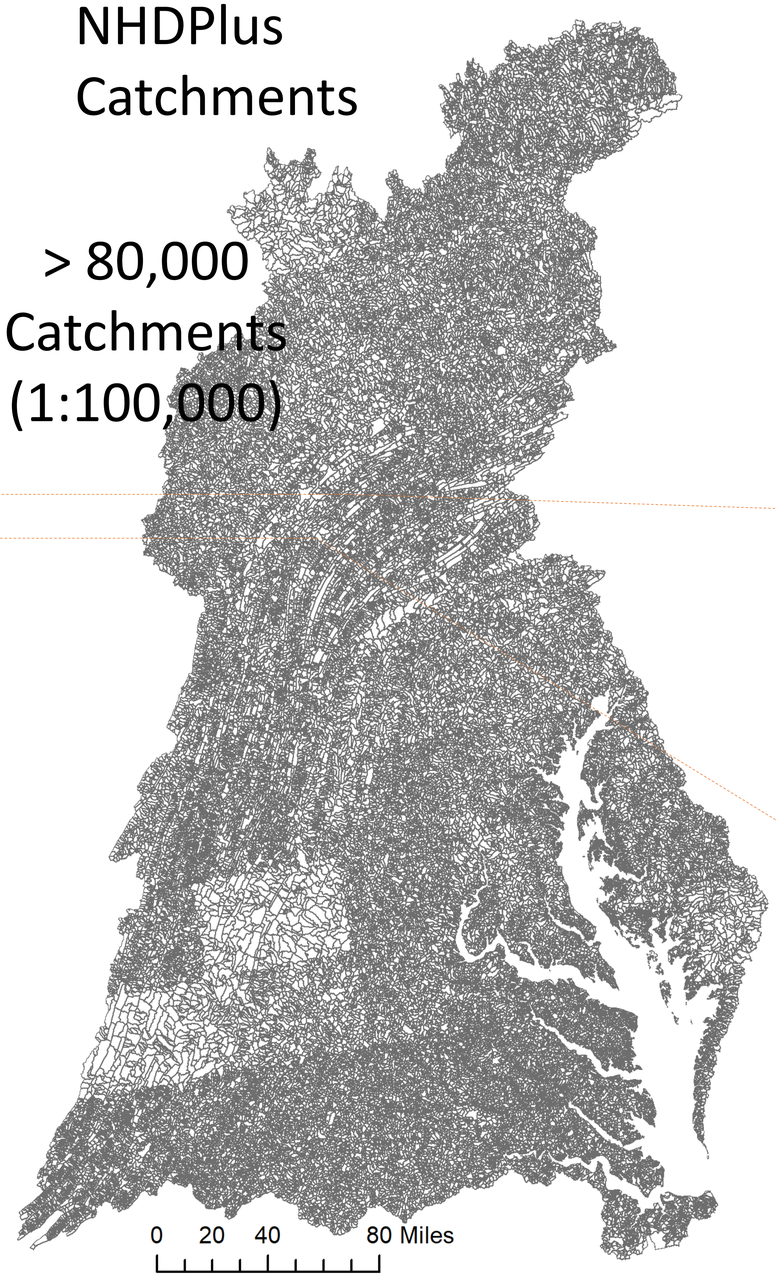
Phase 6 river segments

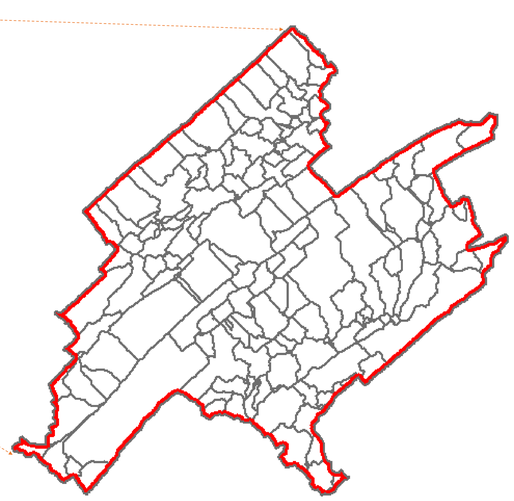
979 Sub-watersheds



NHDPlus Catchments

> 80,000 Catchments (1:100,000)



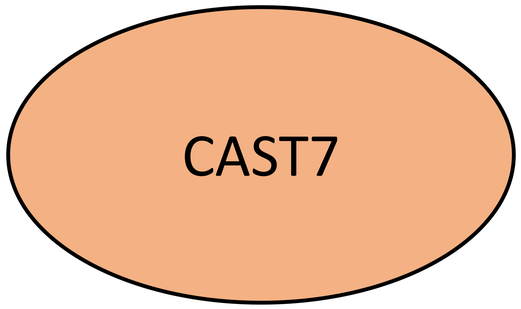


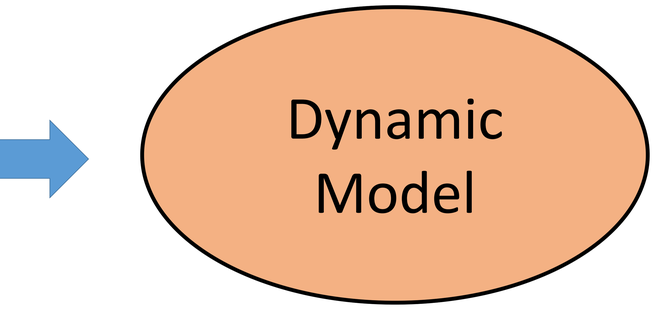
- Simulation at NHD catchments would be considerably finer scale than that of Phase 6 (approx. 80x)
- Ability to represent watershed characteristics at finer scale

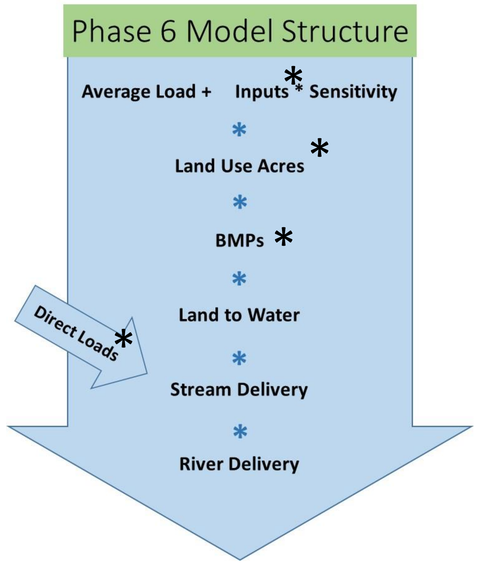
CBP **Phase 7** Model – Scenario Mode

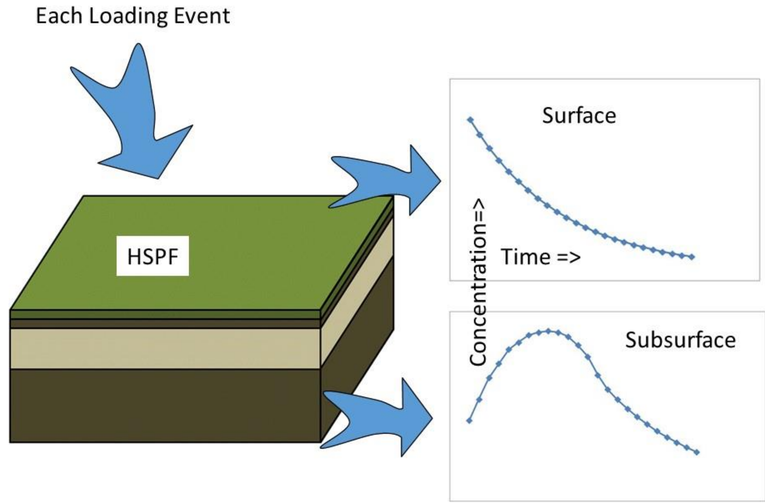
NHD 100k

NHD 100k









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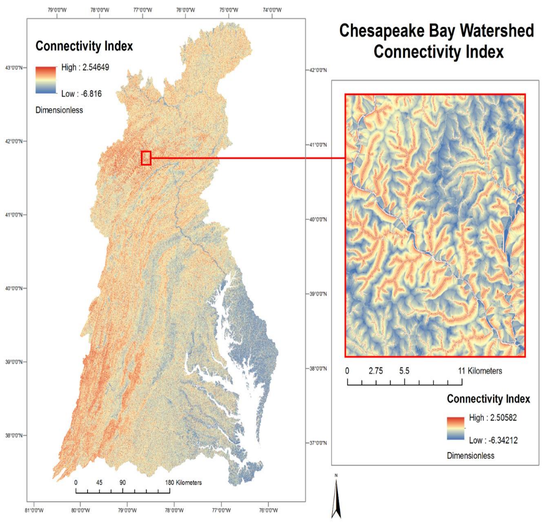
CBP **Phase 7** Model – Scenario Mode

10m pixel

Distributed Static Model7

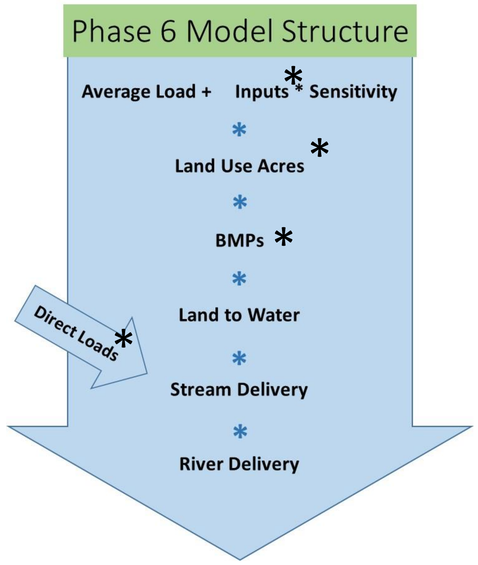


CAST loads can be downscaled to finer scale to apply differential BMP crediting

(if credible methods are found)

NHD 100k

CAST7



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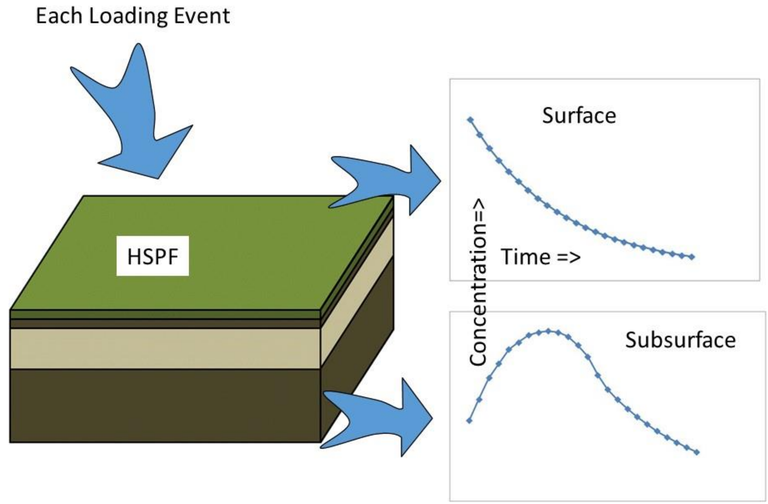
Dynamic Model



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2021 2022
Hydrology
Sediment

- Inputs
- Structure

- Improvements

2022 2023
Nitrogen
Phosphorus

- Improvements
- Scale consistency

2024
Review
Refine

- STAC review
- Partnership review

- Refinements

2025
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1. Reassess 2035 climate in 2025
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PSC
directives

2021 2022
Hydrology
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- WQGIT gives priorities in October 2021
  - Climate change!
  - Scale?
  - Uncertainty?
  - Something else?

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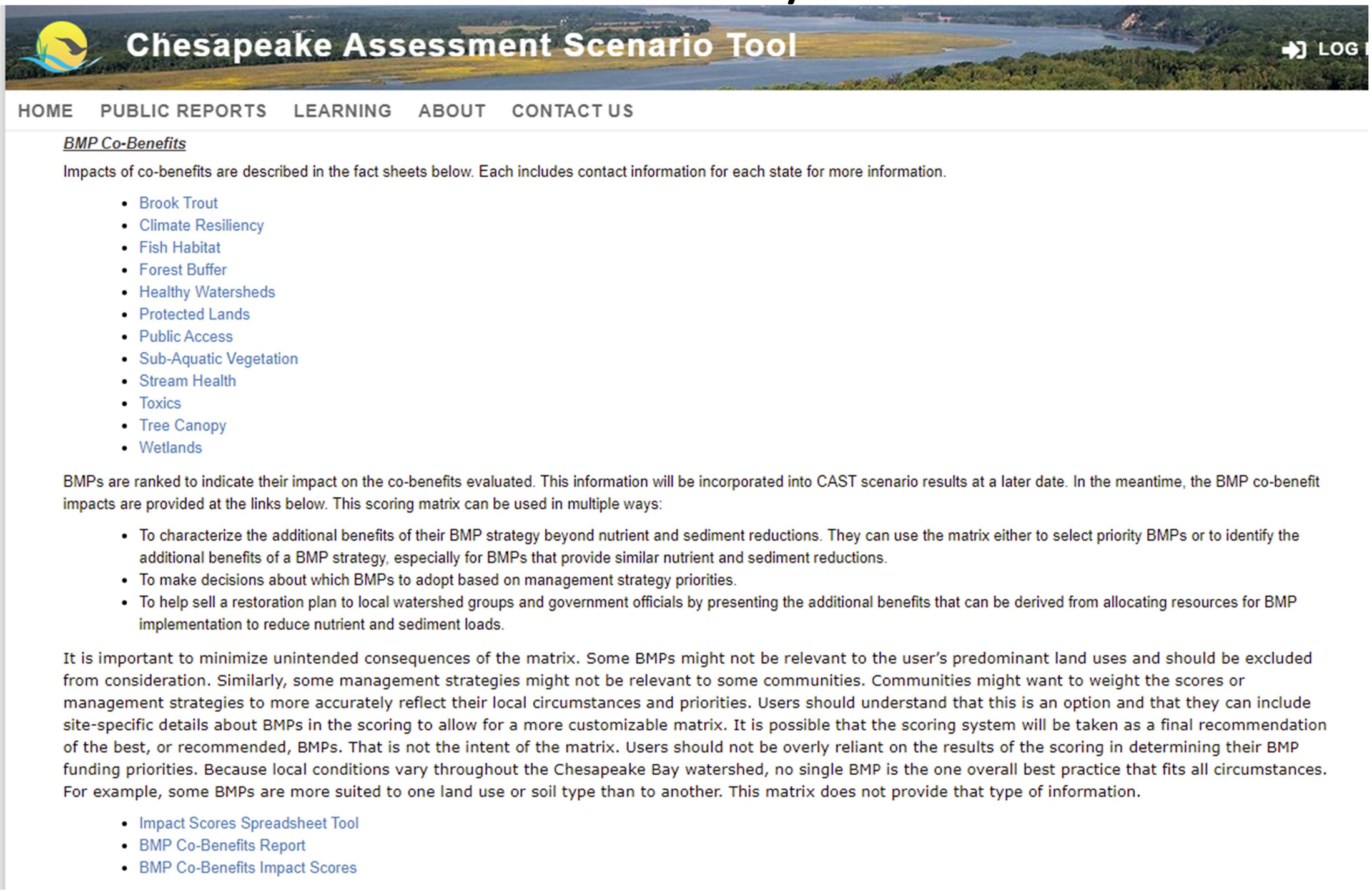
      https://cast.chesapeakebay.net/Documentation/DevelopPlans

Co-benefits currently in CAST



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Brook Trout Co-benefit

Brook Trout:
Principles for Phase III Watershed Implementation Plans

Protecting Brook Trout for the Benefit of Watershed Residents

Brook Trout are a valuable species to the Chesapeake Bay watershed, providing social, economic, and ecological benefits to residents. Designated as the state fish in New York, Pennsylvania, Virginia, and West Virginia, Brook Trout play an important part in the natural heritage of the watershed. Brook Trout are highly prized by recreational anglers who spend millions of dollars annually on related goods and services, including travel, that directly benefit local and state economies.

Photo: Chesapeake Bay Program

The presence of Brook Trout indicate healthy waters as they rely on clean, cold headwater stream habitat for survival. They are particularly sensitive to changes in water temperatures (preferring waters under 68°F) and to human actions impacting land use. Increases in impervious surface, tree clearing, and water impoundments can warm stream temperatures above 68°F, leading to stress on and possible death of Brook Trout populations. Brook Trout are also very sensitive to sediment deposits, which degrade habitat and smother eggs in spawning nests built in the gravel of streams.

Photo: Chesapeake Bay Program

As they are just one of the many species that inhabit headstream waters, the protection of Brook Trout also safeguards additional fish habitat. Adopting certain Brook Trout habitat protection practices, like streamside and agricultural buffer plantings, can also benefit other priorities like water quality and stream health.

If Brook Trout are present in your area, you have a unique location that is worthy of conservation and attention.

Best Management Practices with Brook Trout in Mind

Best management practices (BMPs) are designed to improve water quality and achieve the Chesapeake Bay TMDL, but many of these same measures may enhance Brook Trout habitat as well. Incorporating the protection of Brook Trout habitat into project design does not necessarily require large changes. With deliberate planning, you can maximize your water quality investment by implementing practices that result in the improvement of Brook Trout habitat and added ecosystem value. The chart below highlights current BMPs that experts have rated based on the value a BMP provides to several Chesapeake Bay Program (CBP) outcomes. **Comparing across multiple CBP outcomes demonstrates how a BMP can provide co-benefits to more than one outcome.** However, case-by-case evaluation of co-benefits is recommended.

Last Updated: Feb. 2018

Best Management Practice	Brook Trout	Additional Co-Benefits					
		Habitat and Biodiversity	Stream Health	Fish Habitat	Healthy Watersheds	Forest Buffer	Tree Canopy
Agricultural Forest Buffer	4.5	4	4	4.5	4	5	4.5
Streamside Forest Buffer	4.5	4	3	4.5	3	5	5
Forest Conservation	4	5	4	4	5	3.5	5
Agricultural Stream Restoration	3	3	5	3	1	1	0
Agricultural Stream Access Control with Fencing	3	2	1	1.5	1	1	1

*Values were taken from the Quantification of BMP Impact on the Chesapeake Bay Program Management Strategies survey by Tetra Tech and are based on the best professional judgment of subject matter experts. Appendix E. Final Impact Scores evaluates BMP effects on outcomes on a scale of +5 (very beneficial) to -5 (very harmful). **This table shows select BMPs that scored a 3 or higher for the Brook Trout Outcome, however, not all of these BMPs would merit the score of +3 for all projects. Closer evaluation of project site designs, including those from BMPs shown in the above table, is warranted when interpreting these scores.** More information on Brook Trout and the outcome's guiding documents can be found at the Chesapeake Bay Program's Habitat Goal Implementation Team webpage.

-5 -4.5 -4 -3.5 -3 -2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5

Guiding Principles for Phase III Watershed Implementation Plan

WIP Development

1. Know where your Brook Trout populations exist (use EBTJV Spatial Tool, State Identified Priority Brook Trout Sub-watershed, Contacts links below).
2. Recognize and consider existing stressors: extent of agriculture, mining, and impervious surface in the watershed, water impoundments, impassable dams/culverts, and brown trout competition (use USFWS Fish Habitat Tool, NAACC, and Chesapeake Dam Prioritization links below).
3. Reduce impacts to Brook Trout - design and implement BMPs to reduce impervious surface, avoid/minimize creating permanent pools, increase forest buffers, consider brown trout competition when planning in-stream work, protect groundwater sources (consider streamside wetland restoration), and reduce blockages to fish passage. Avoid BMPs that may increase stream temperature or high velocity flow events.

WIP Implementation

1. Capitalize on co-benefits: choose water quality BMPs that also protects other fish habitat, stream health, and healthy watersheds. Streambank stabilization, access control fencing, floodplain reconnection, and off-stream watering systems improve fish habitat and reduce sedimentation and phosphorus loading.
2. Engage partners: Collaborate with Federal and state agencies, elected officials, and NGOs to share resources, help identify watersheds and streams important to Brook Trout, and incorporate conservation efforts into your WIPs (use Contacts links below).

Last Updated: Feb. 2018

Tools and Resources

- Eastern Brook Trout Joint Venture Spatial Tool
  Includes information on the extent of Brook Trout habitat and habitat status.
- State Identified Priority Brook Trout Sub-watersheds
  Includes description, HUC12 codes, and map.
- USFWS Fish Habitat Decision Support Tool – Chesapeake Bay Brook Trout Assessment
  Includes information on Brook Trout habitat stressors and future habitat quality change.
- North Atlantic Aquatic Connectivity Collaborative (NAACC)
  Includes information, maps, and a regional database on road-stream crossings (bridges/culverts).
- Chesapeake Fish Passage Prioritization Tool
  Includes map and information on dams.

Contacts for More Information

For more assistance on how to build Brook Trout habitat benefits into your Watershed Implementation Plan, please reach out to your jurisdictional contact below or contact the Chesapeake Bay Program's Brook Trout Action Team Lead, Dr. Stephen Faulkner at faulkners@usgs.gov.

Jurisdiction	Website	Lead	Email
CBP Contact	Habitat Goal Implementation Team	Jennifer Greiner	Jennifer_greiner@fws.gov
Maryland	MD Dept. of Natural Resources	Alan Heft	Alan.heft@maryland.gov
New York	NY Dept. of Environmental Conservation	Fred Henson	Fred.henson@dec.ny.gov
Pennsylvania	PA Fish and Boat Commission	Jason Detar	jdetar@pa.gov
Virginia	VA Dept. of Game and Inland Fisheries	Steve Reeser	Steve.reeser@dgif.virginia.gov
West Virginia	WV Dept. of Natural Resources	David Thorne	David.w.thorne@wv.gov

Last Updated: Feb. 2018

Brook Trout Co-benefit

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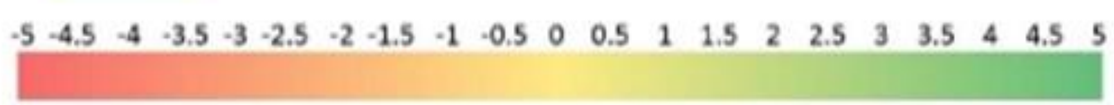
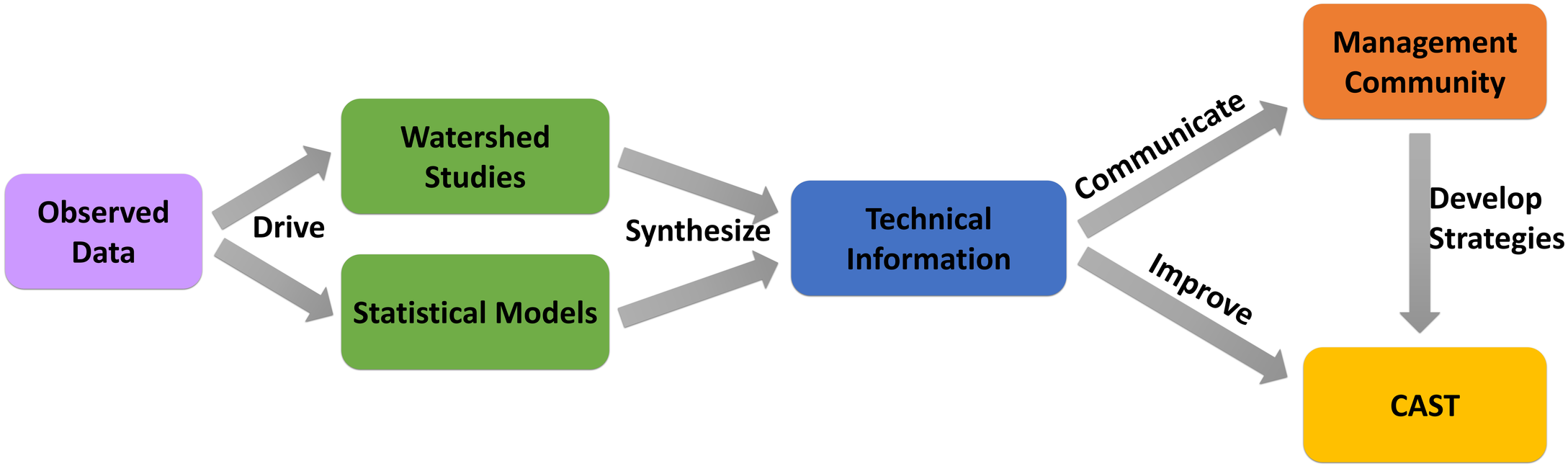


How Monitoring and Analysis Inform CAST



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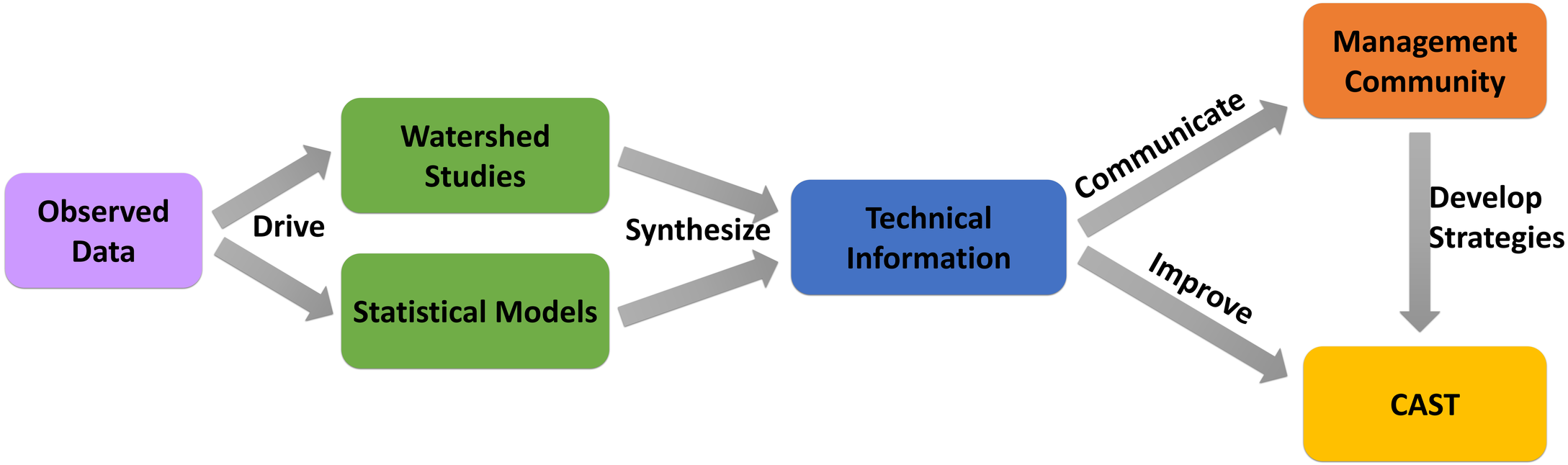
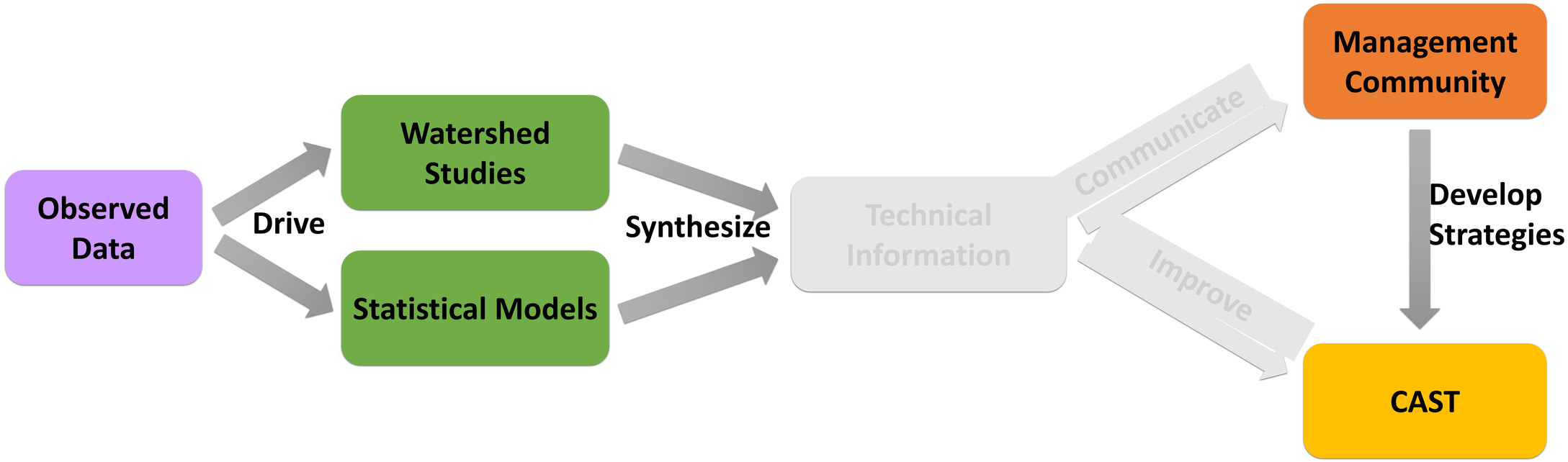


Natural and Human systems	Scientists	Translators Boundary-Spanners Bridge-Builders	Management

Perceived resource need for “co-benefits”



Natural and Human systems

Scientists

Translators
Boundary-Spanners
Bridge-Builders

Management

Perceived resource need for “co-benefits”

1.2 Scope of Work and Offeror’s Minimum Qualifications

This section provides a description of the Scope of Work, maximum bid amount, project outcomes, project steps and timeline, expected deliverables, and minimum qualifications. A general description of the Scope of Work sections is included in Appendix A.

Scope of Work:

Scope #	FFY20 Scope Title	Maximum Bid Amount	Award Details
Scope of Work 9*	Methods to Integrate Co-Benefits of Toxic Contaminant Reduction into Decision-Making Tools	$56,000	One contract will be awarded

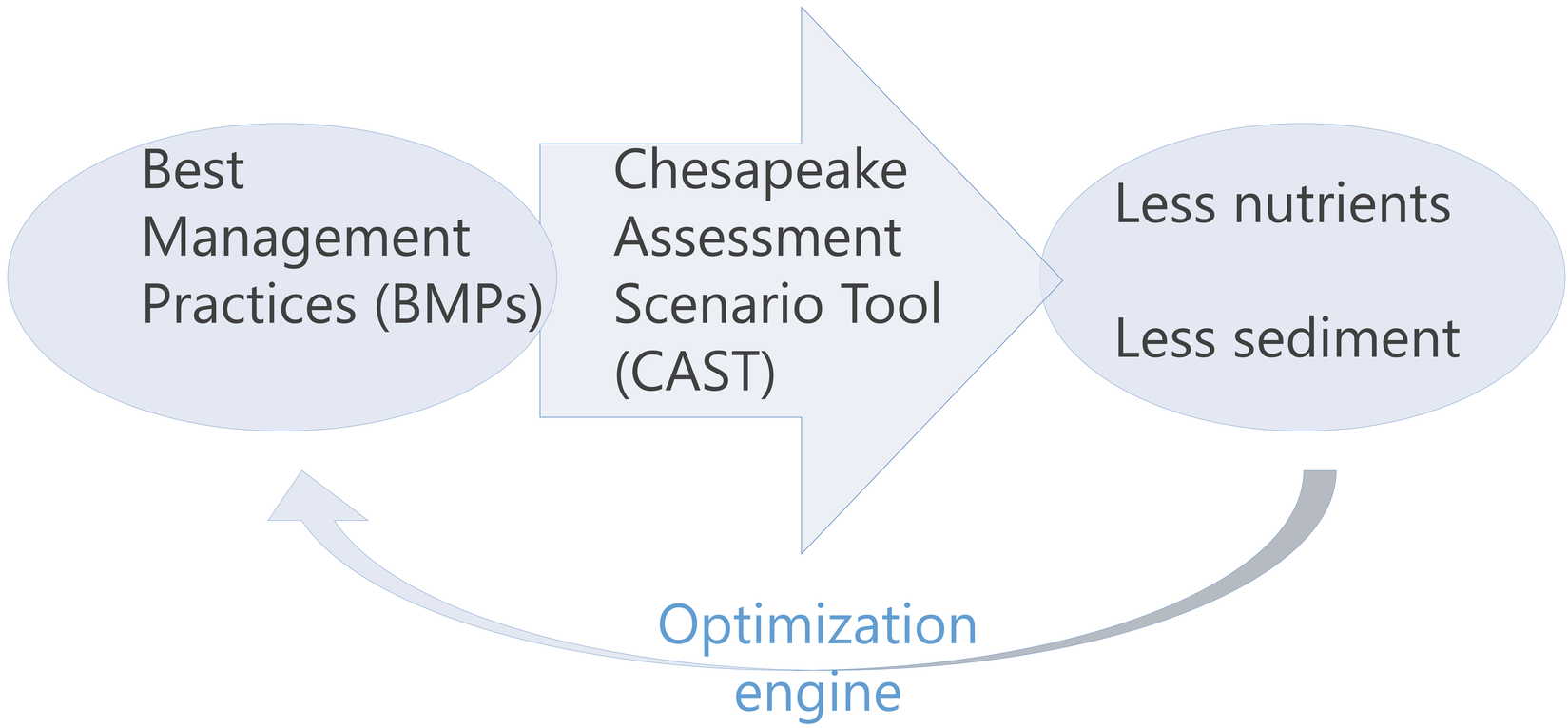
**This scope was originally advertised in December 2020 and is being readvertised in this RFP with an adjusted scope of work.*

Translators
Boundary-Spanners
Bridge-Builders

…stay tuned

- 10:50 am RESES Ecosystem Services Valuation Project – Ryann Rossi and Vanessa Van Note, EPA

Optimization engine



Co-benefits can be included as negative costs or as constraints

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Sediment

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- Structure

- Improvements

2022 2023
Nitrogen
Phosphorus

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- Scale consistency

QUESTIONS AND COMMENTS

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