Phase 7 Watershed Model Plans

CBPO Staff

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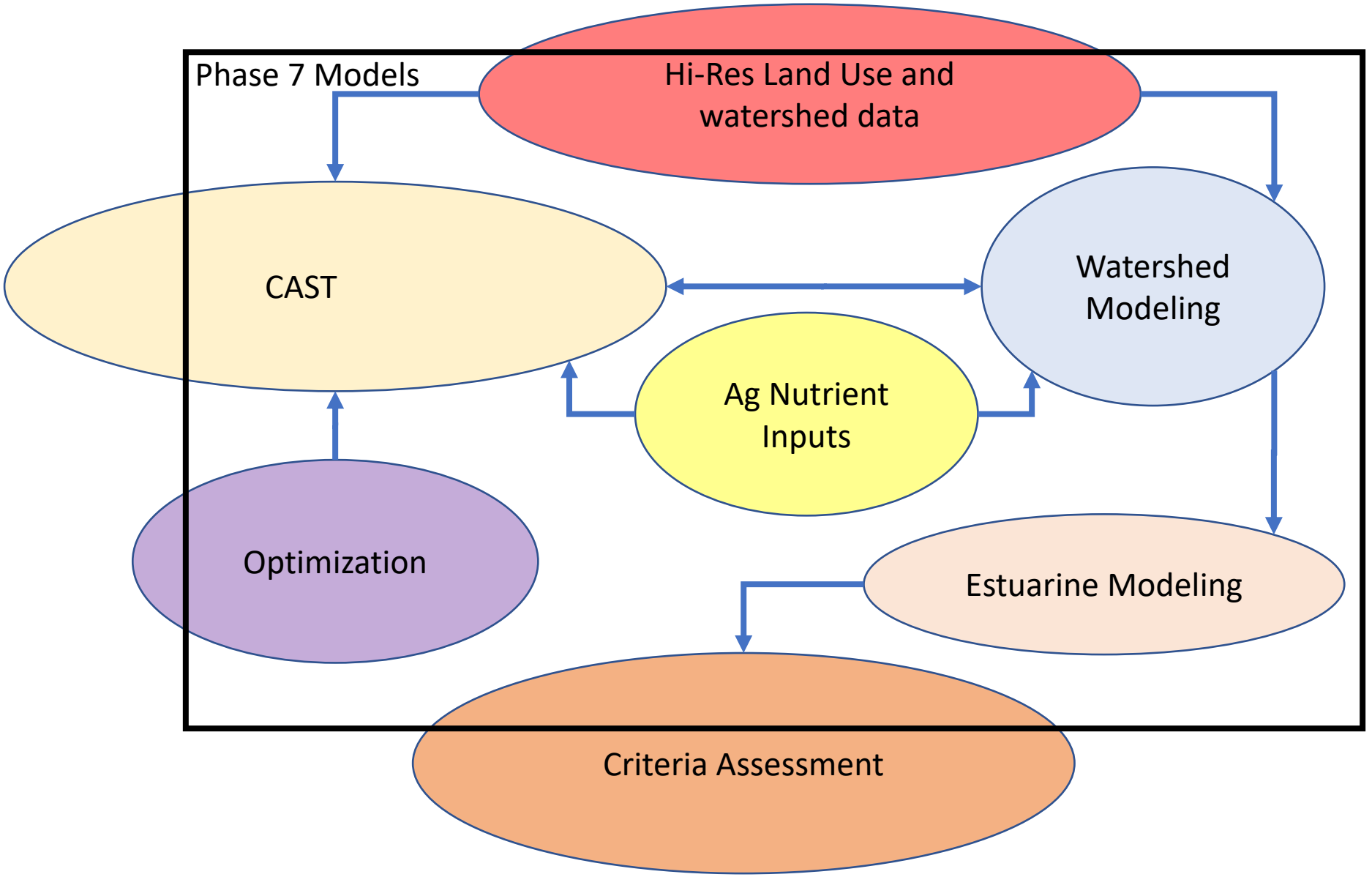
MWG

10/04/2022

Phase 7 Development Tracks



Web page

- Overview
- Seven Projects
  - Descriptions
  - Documents
- Linked from
  - Modeling Workgroup
  - WQGIT
  - Many WQGIT WGs

Phase 7 Model Development | Ch

chesapeakebay.net/what/programs/modeling/phase_7_model_development

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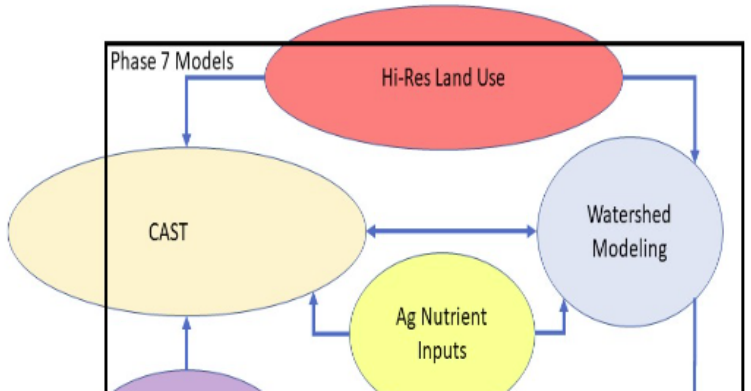
WHAT WE DO > PROGRAMS & PROJECTS > PHASE 7 MODEL DEVELOPMENT

Phase 7 Model Development

The Chesapeake Bay Program is updating its modeling and analysis tools used in the Chesapeake Bay TMDL.

Currently in development, the Phase 7 Modeling Tools will be used by the partnership to inform decisions related to nutrient and sediment reduction goals outlined in the Chesapeake Bay Watershed Agreement. Integral to this updated suite of tools is the ability to project climate change effect through 2035. The model, which will be ready for use by 2027, consists of six interrelated projects:

1. High Resolution Land Use
2. Chesapeake Assessment Scenario Tool (CAST)
3. Optimization
4. Agricultural Inputs
5. Watershed Modeling
6. Estuarine Modeling
7. Criteria Assessment



Modeling

Phase 7 Model Development

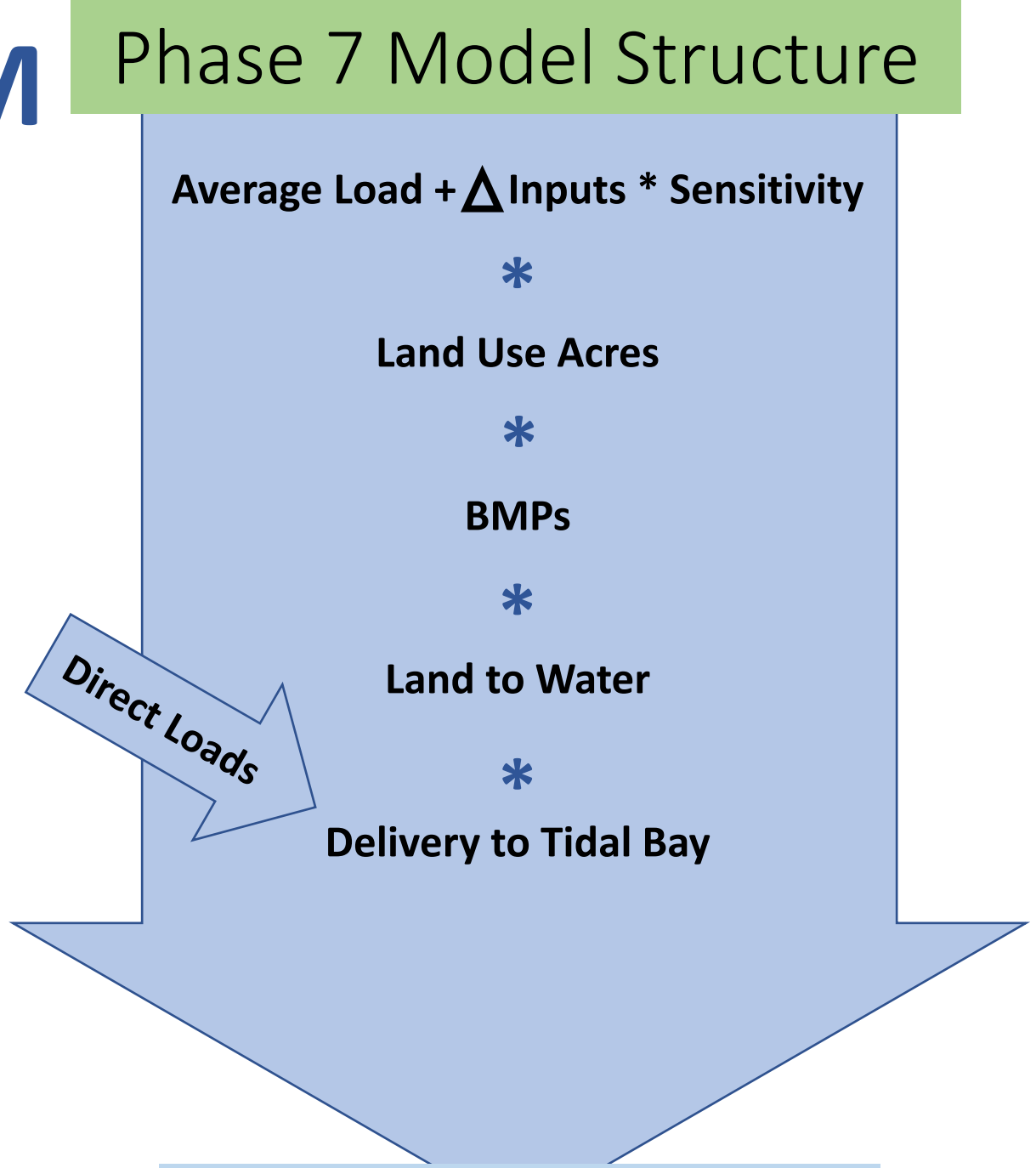
Programs & Projects

Modeling
Monitoring
Quality Assurance
Resource Lands Assessment
Chesapeake Bay TMDL
Watershed Implementation Plans
BMP Verification

Cast/CalCast/DM

Phase 7 CAST

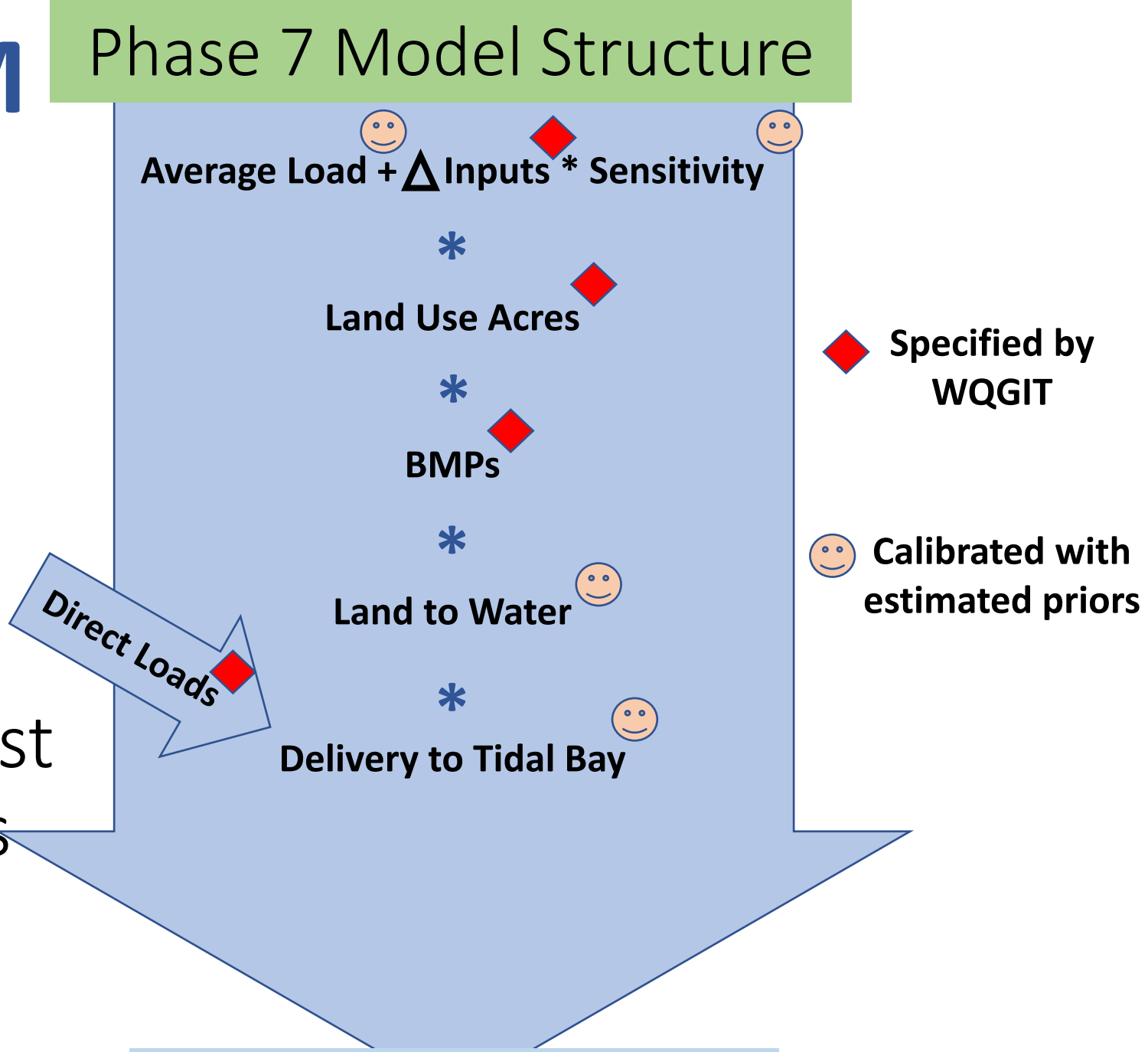
Deterministic Scenario Tool:
1 set of loads for 1 set of inputs



Cast/CalCast/DM

Phase 7 CalCAST

Tool for finding parameters that best match observations

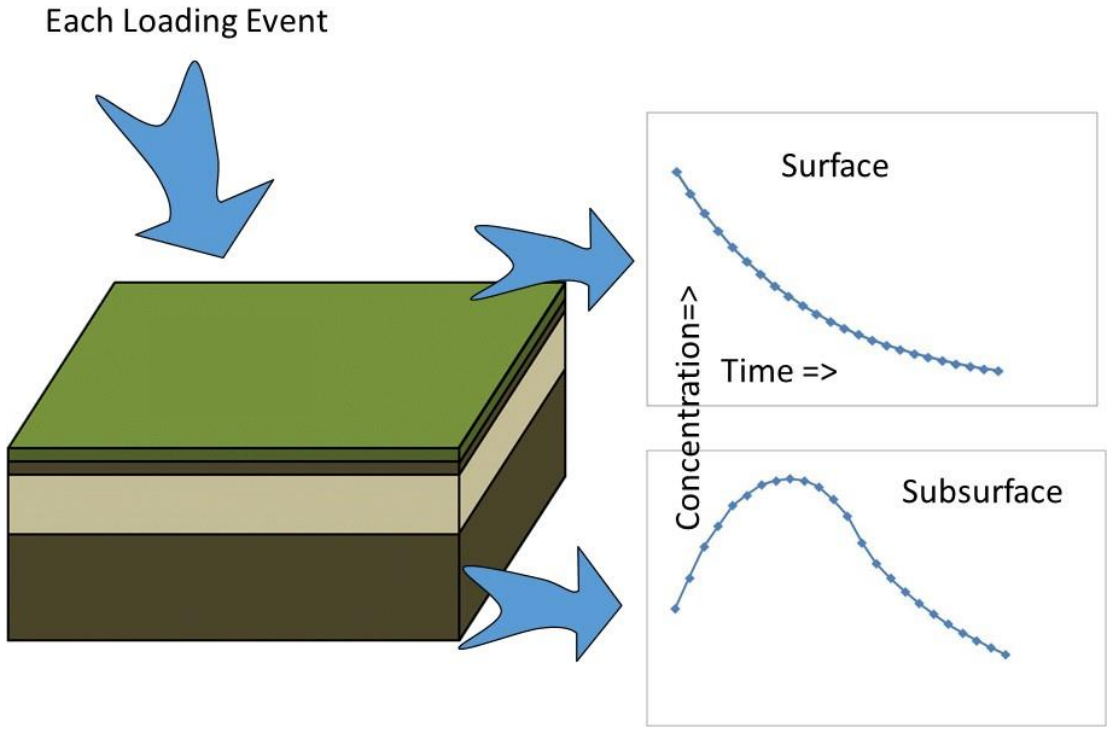


Cast/CalCast/DM

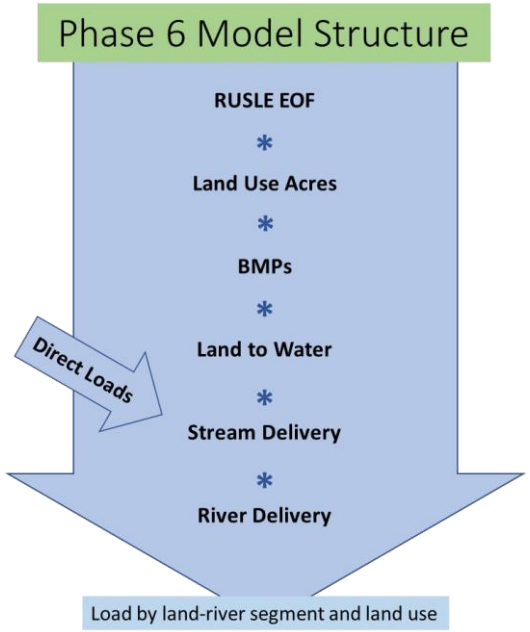
Phase 7
Dynamic Model

Tool for

- loading estuarine models
- Comparing against observations
- Other potential collaborative projects

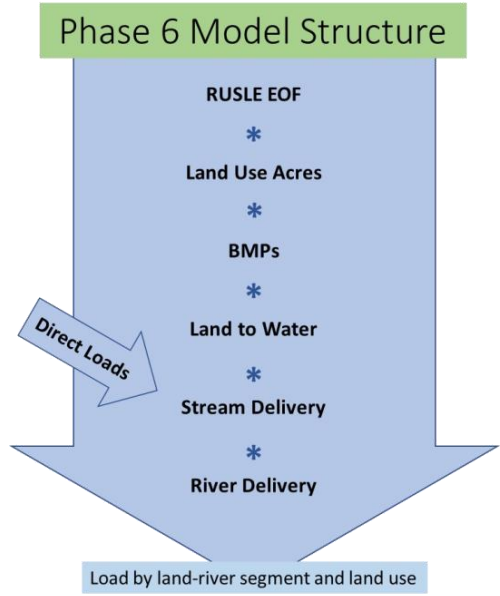


CBP Watershed Model for Sediment



- Nonpoint EOS = RUSLE * BMP * Land-to-Water * Acres
- Edge-of-stream load = Nonpoint EOS + Point EOS + Erosion – Deposition
- Delivered Load at a Gauge = Edge-of-stream load X Delivery Factors

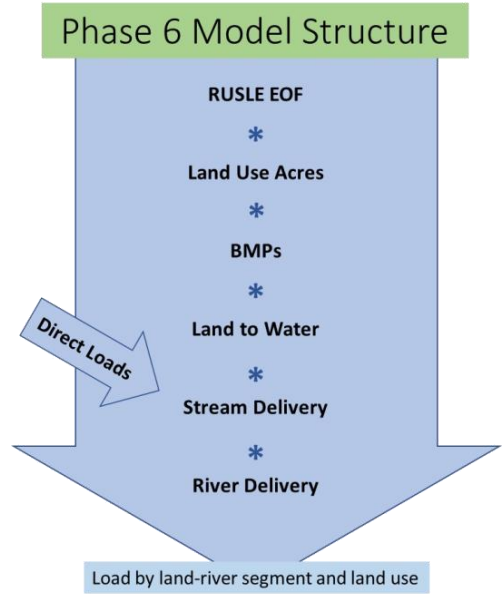
CBP **Phase 6** Model for Sediment

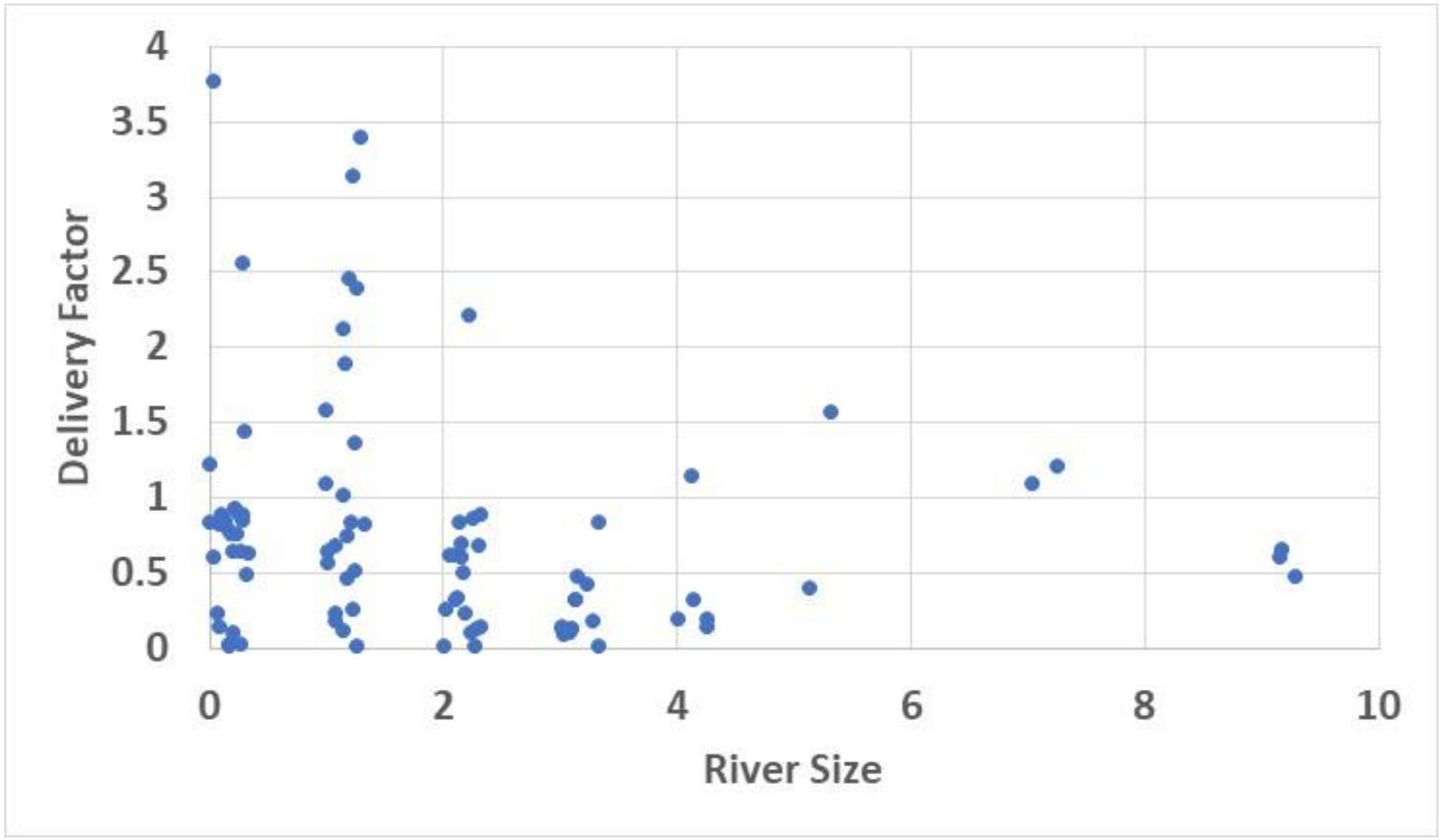


- Nonpoint EOS = RUSLE * BMP * Land-to-Water * Acres
- Edge-of-stream load = Nonpoint EOS + Point EOS + Erosion – Deposition
- Delivered Load at a Gauge = Edge-of-stream load * Stream * River

Phase 6 strategy:
Specify all factors in black text
Calibrate River Delivery in Dynamic Model
Modify factors if calibration is unreasonable

CBP **Phase 6** Model for Sediment



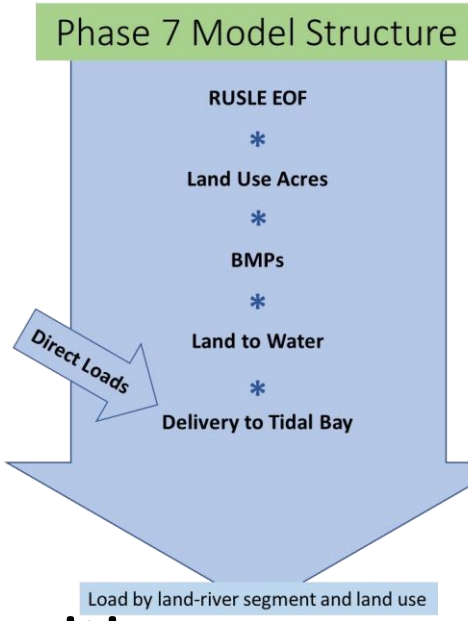


Strategy creates a lot of leverage in rivers

Delivery factors were grouped upstream of 94 calibration stations

Still high variability

CBP **Phase 7** Model for Sediment



- Nonpoint EOS = RUSLE * BMP * Land-to-Water * Acres
- Edge-of-stream load = Nonpoint EOS + Point EOS + Erosion – Deposition
- Delivered Load at a Gauge = Edge-of-stream load * Stream * River

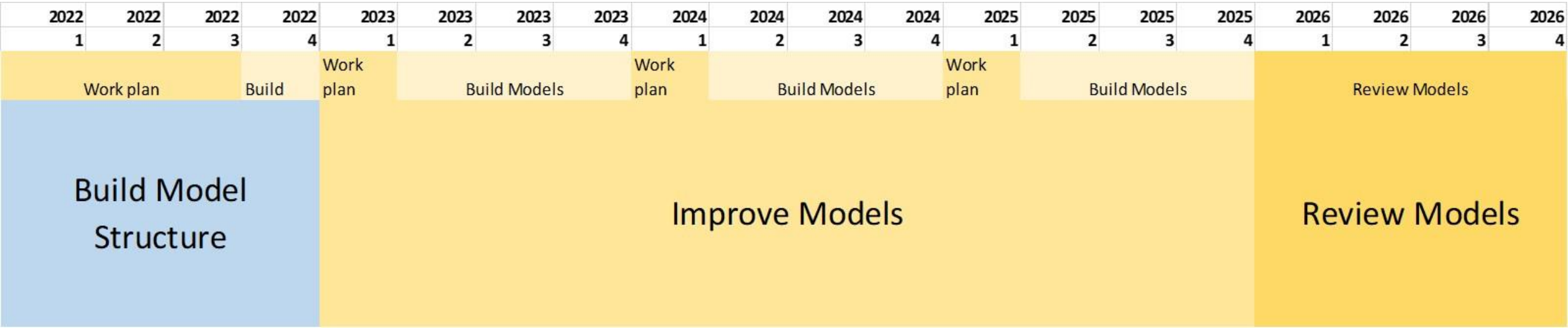
Phase 7 strategy:

Specify all factors in black text

Simultaneously calibrate all factors in purple text in CalCAST

Specify end result of Dynamic Model

Watershed Model Plan – Big Picture



Goals for the end of 2022

- Model Structure
  - CalCAST and the Dynamic Model run at the NHD scale for flow, sediment, and nutrients
- Output quality
  - Reasonable outputs for 1985-2020
- Documentation
  - Section 1 overview: draft
  - Section 2 physical setting and segmentation: nearly finished
  - Section 3 meteorological and stream data: nearly finished
  - Section 12 CalCAST: early draft
  - Section 13 Dynamic Model: early draft

Watershed Model Plan – Year 1 - 2022

Year	2022	2022	2022	2022
Quarter	1	2	3	4
CalCAST - Isabella	Develop CalCAST			
	Develop initial equations	refine equations		
	Gather Watershed Data			
	Develop statistical models to investigate potential important predictors			
	Investigate software types	Optimize for cloud		
	Initial Hydrology Model			
		Initial Sediment Model		
			Initial Nutrient Models	
Dynamic Model - Gopal	Create Data systems		Dynamic model Development	
	system of annual meteorology updates			
	Determine official CBPO GIS layers			
	Stream Flow, concentration, and load data			
		Initial hydrology model		
			Initial Sediment Model	
				Initial Nutrient Models

Goals for the end of 2025

- Model Structure
  - CalCAST and the Dynamic Model run at the NHD scale for flow, sediment, and nutrients
  - CAST running on scale of WQGIT's choosing
- Output quality - Improvement on phase 6
  - Spatial apportionment of loads by land use and region
  - Change in loads over time due to
    - Management actions
    - Climate change
  - Accuracy of spatial and temporal loads to the estuary in calibration period
- Documentation – all 20 sections complete

Summary and next steps

- Expect updates on development of the structure this year
- Expect improvements in inputs and calibration through 2025
- Expect documentation as tasks are complete

10:30 Update on CalCAST Development: Nitrogen Component – Isabella Bertani, UMCES
Isabella will provide an update on the progress made in the development of CalCAST, specifically focusing on adding the capability to predict nitrogen load. CalCAST is a relatively parsimonious Bayesian modeling tool that is being developed to test predictors and spatially calibrate parameters that will ultimately inform prediction of flow and loads at monitoring stations throughout the watershed.

11:00 Progress in Phase 7 WSM Development – Gopal Bhatt, Penn State
This quarter the NHDplus scale Phase 7 Dynamic Watershed Model (DWM) was expanded to include sediment simulation. DWM is using the nested model segmentation and hybrid process simulation structure as presented previously. Gopal will provide an overview of the progress made during this quarter on the aspects of (a) incorporation of CalCAST Stormflow in an operational DWM hydrology calibration framework, (b) incorporation of CalCAST Sediment in the DWM, and (c) minor refinements to the Total Flow model calibration.

11:40 Development of Efficient Multi-Objective Optimization Procedures – Gregorio Toscano, Kalyan Deb, Pouyan Nejadhashemi, Sebastian Hernandez-Suarez, and Julian Blank, MSU
Progress in the development of efficient multi-objective (MO) optimization procedures including developing generative MO optimization using the current hybrid optimization procedure developed and to develop simultaneous MO customized optimization using population-based evolutionary algorithms.

12:20 Formation of the Agricultural Modeling Team– Tom Butler, EPA-CBPO
Tom will describe the status of the Ag Modeling Team and its role in determining the agricultural data inputs for the Phase 7 Watershed Model. He will provide background for how this group will function in collaboration with the Modeling Workgroup.