

Phase 7 Watershed Model Plans

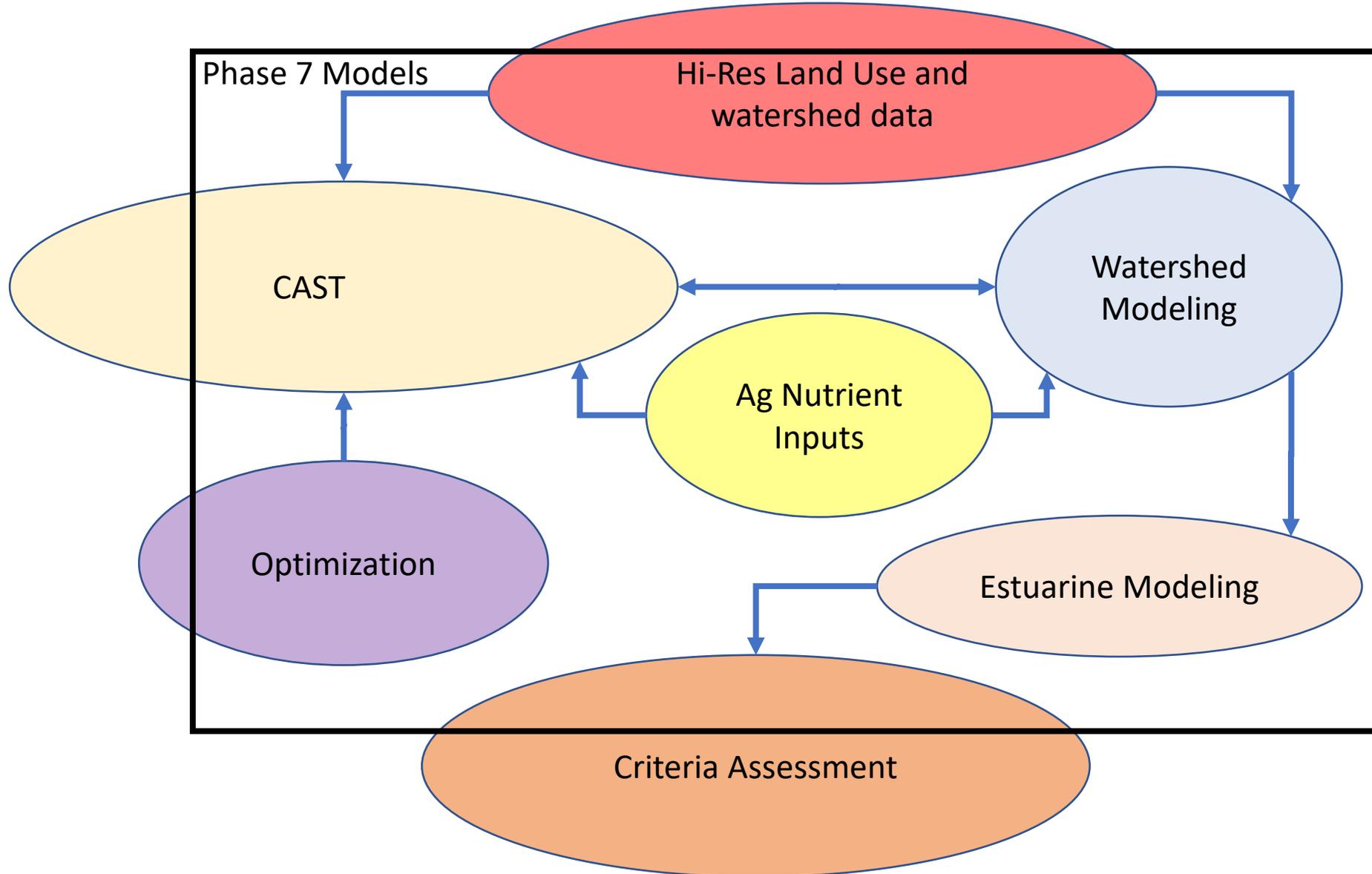
CBPO Staff

Gary Shenk, Gopal Bhatt, Isabella Bertani, Lewis Linker

MWG

07/12/2022

Phase 7 Development Tracks



Ag Nutrient
Inputs

Re-Establish Agricultural Modeling Team under Ag Workgroup of WQGIT

- Lead: Tom Butler
- Topics drawn from original Watershed Modeling Plan and other partnership documents
 - Decide to either simplify or incrementally improve application algorithm
 - Decide to keep or simplify land use classifications
 - Determine new sources of data
 - Determine new calculation methods
- Status: purpose, scope, and membership being discussed in AgWG and WTWG

Web page

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

The screenshot shows a web browser window displaying the Chesapeake Bay Program website. The page title is "Phase 7 Model Development". The header includes the Chesapeake Bay Program logo and navigation links: "Discover the Chesapeake", "Learn the Issues", "State of the Chesapeake", "Take Action", "In the News", "Who We Are", and "What We Do". A search bar is located in the top right corner. Below the navigation bar, the page content includes a sub-header "WHAT WE DO > PROGRAMS & PROJECTS > PHASE 7 MODEL DEVELOPMENT" and a main heading "Phase 7 Model Development". A paragraph states: "The Chesapeake Bay Program is updating its modeling and analysis tools used in the Chesapeake Bay TMDL." Below this text are social media icons for Facebook, Twitter, and Email. A list of seven interrelated projects is provided: 1. High Resolution Land Use, 2. Chesapeake Assessment Scenario Tool (CAST), 3. Optimization, 4. Agricultural Inputs, 5. Watershed Modeling, 6. Estuarine Modeling, and 7. Criteria Assessment. A diagram at the bottom illustrates the relationships between these models, showing "Hi-Res Land Use" (red oval) at the top, "CAST" (yellow oval) on the left, "Watershed Modeling" (blue oval) on the right, and "Ag Nutrient Inputs" (yellow circle) at the bottom. Arrows indicate bidirectional relationships between CAST and Watershed Modeling, and between Ag Nutrient Inputs and Watershed Modeling. A box labeled "Phase 7 Models" encompasses the CAST, Ag Nutrient Inputs, and Watershed Modeling components. On the right side of the page, a sidebar contains a "Modeling" section with a link to "Phase 7 Model Development", and a "Programs & Projects" section with links to "Modeling", "Monitoring", "Quality Assurance", "Resource Lands Assessment", "Chesapeake Bay TMDL", "Watershed Implementation Plans", and "BMP Verification".

Chesapeake Bay Program
Science. Restoration. Partnership.

Discover the Chesapeake | Learn the Issues | State of the Chesapeake | Take Action | In the News | Who We Are | What We Do

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.

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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

Phase 7 Models

Hi-Res Land Use

CAST

Watershed Modeling

Ag Nutrient Inputs

Modeling

Phase 7 Model Development

Programs & Projects

Modeling

Monitoring

Quality Assurance

Resource Lands Assessment

Chesapeake Bay TMDL

Watershed Implementation Plans

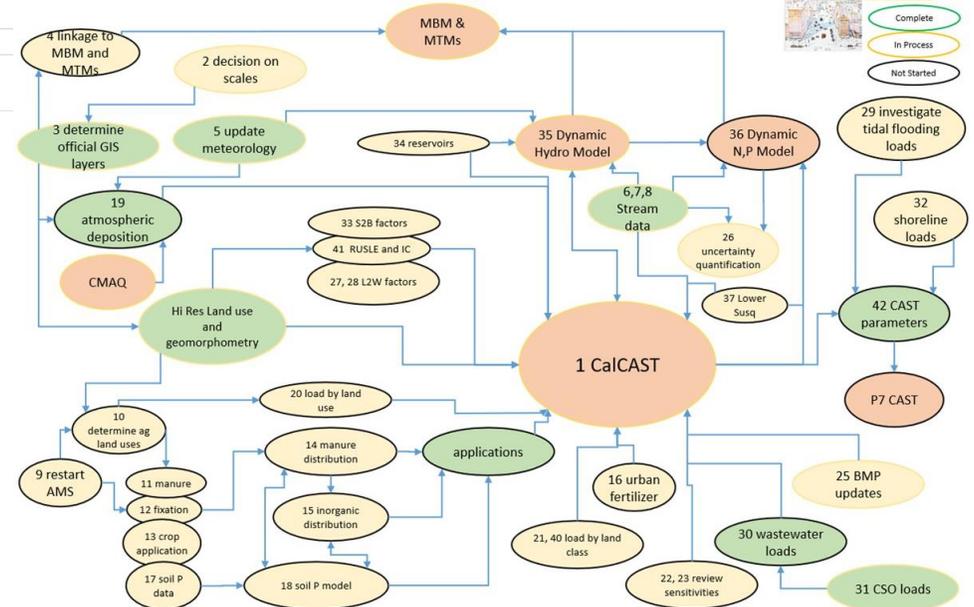
BMP Verification

Each Track Has Provided Schedule Documents

Format will vary by Track

	2022	2022	2022	2022	2023	2023	2023	2023	2024	2024	2024	2024	2025	2025	2025	2025
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Phase 7 Activity	Work plan				Build	Work plan	Build Models				Work plan	Build Models				
General	1 Develop CalCAST using P6 data				1 Use CalCAST as primary calibration tool											
	3 Determine official CBPO GIS layers															
	5 system of annual meteorology updates															
	25 BMP updates															
	35 Dynamic model for hydrology, sediment, and temperature															
Variable Scale Modeling					29 Investigate tidal flooding loads											
									30 Update to Wastewater							
													31 Update to CSOs			

CBP Watershed Modeling Process



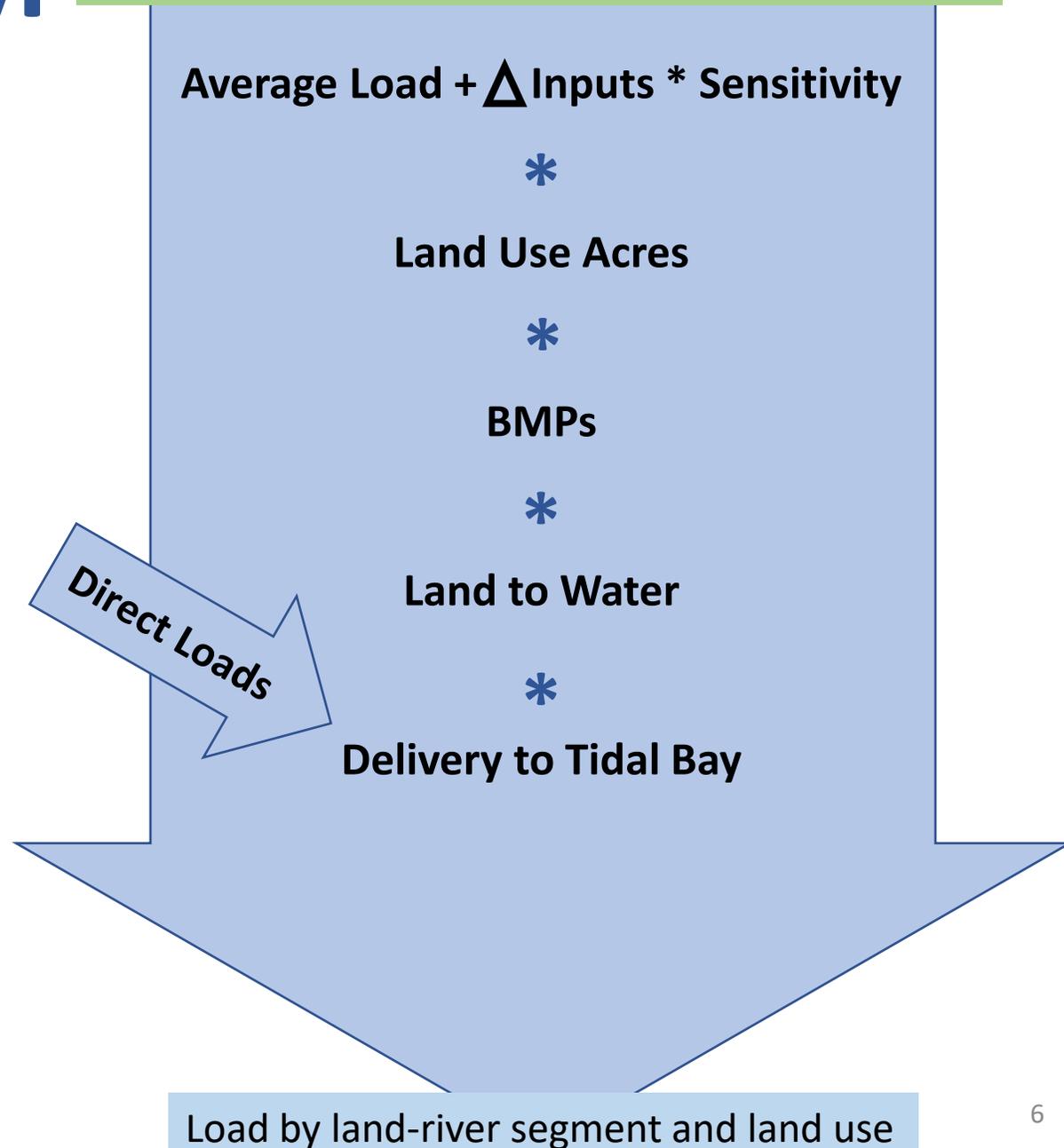
Item	Category	What: short description	Why: who asked for it or why is it necessary	Who is involved when the work	development time		
1	General	Develop CalCAST. CalCAST will be a tool for comparing estimated load to monitored loads given a set of inputs and parameters. It will be used in the calibration	CalCAST allows the CBP to test various data sets and strategies to see which match monitoring data best. Primary suggestion of STAC Phase 6 STAC review and Future of Modeling workshop. Allows efficient incorporation of all other development priorities	Bertani; Bhatt; Shenk	MWG	First priority. The rest of development depends on CalCAST. Need decisions on scale. 2022	A model of loads at a point is developed in Section 12 of the documentation. It will be implemented for speed of calculation with the potential to wrap parameter estimation techniques around it
2	variable scale modeling	Discuss scale and reach decision	Development of various Phase 7 tasks will benefit from knowledge of the output scale	Shenk	WQGIT, MWG	2022-2025	Presentation to WQGIT and MWG on various aspects, discussed in section 2
3	General	determine official versions of GIS layers: NHD, county, shoreline, Lrseg	Counties have updated boundaries. NHD necessary to use many important data sets, shoreline determines watershed/estuarine parameters. Lrseg may change for NHD boundaries	McDonald, Fitch, Ahmed, Bhatt	MWG	early 2022	CBPO discussions, with results to be written into section 2
4	Main bay and tributary models	physical and chemical linkage with estuarine model	Needed to run estuarine models	Bhatt	MWG	late 2022. Need to determine form of dynamic model first for the variable description.	Identify set of terminal segments. Identify estuarine cell for each terminal segment. Compare old ICM variables for the variable description. Do new WSM variables match up?

Cast/CalCast/DM

Phase 7 Model Structure

Phase 7
CAST

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

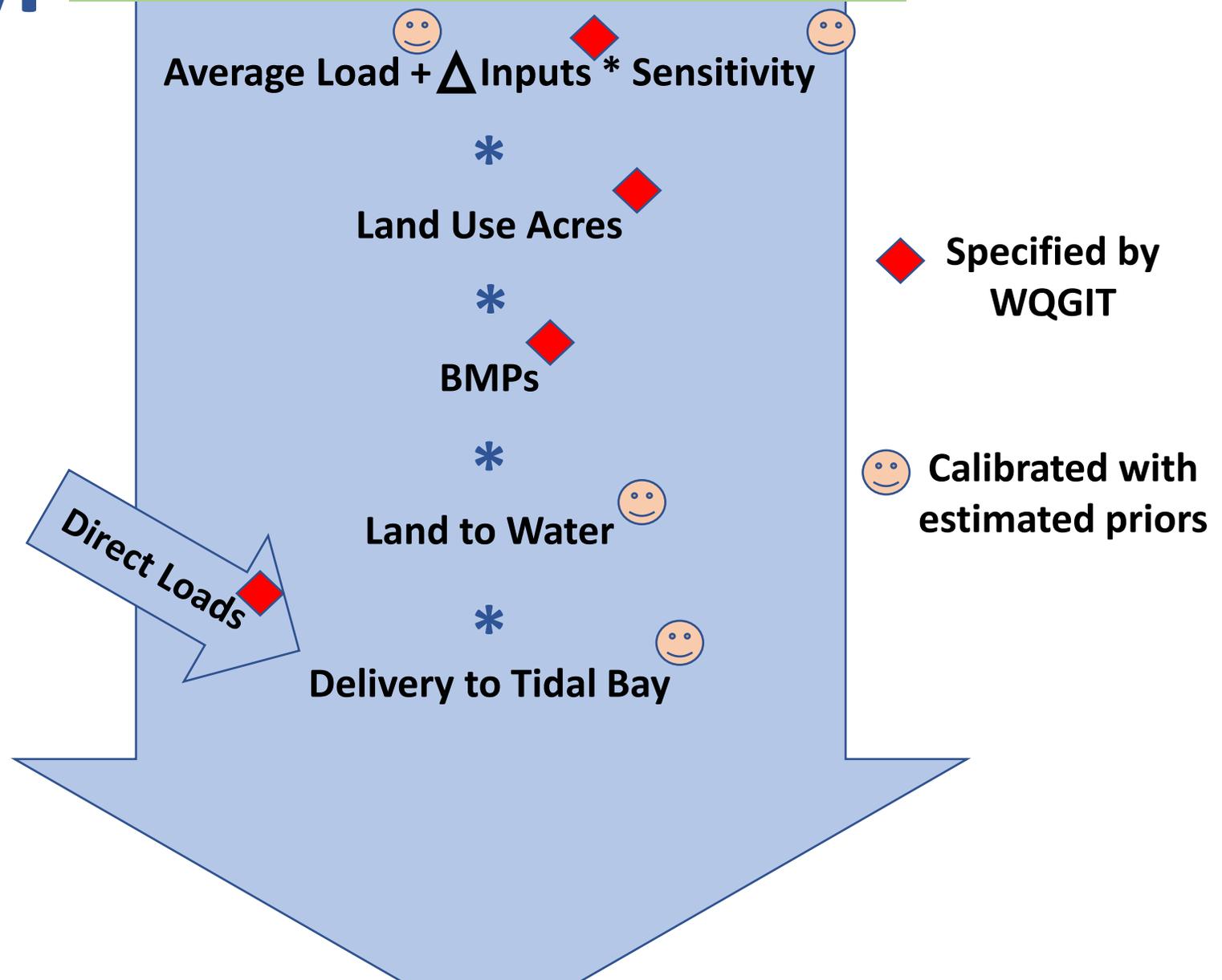


Cast/CalCast/DM

Phase 7 Model Structure

Phase 7
CalCAST

Tool for finding
parameters that
best match
observations

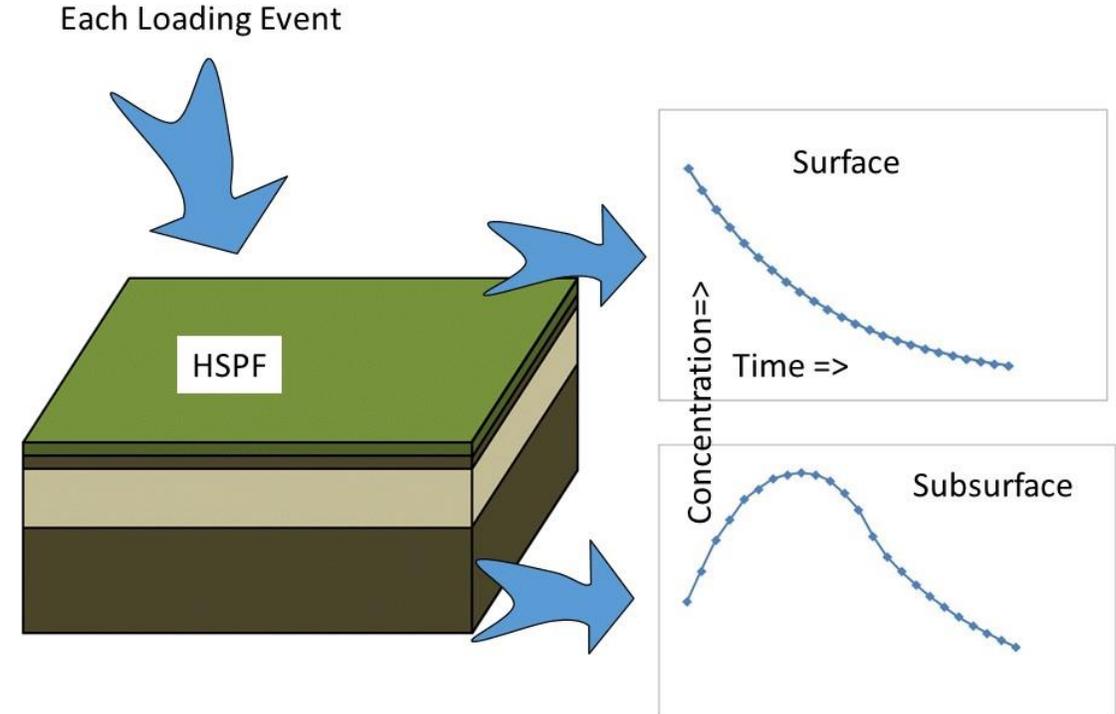


Cast/CalCast/DM

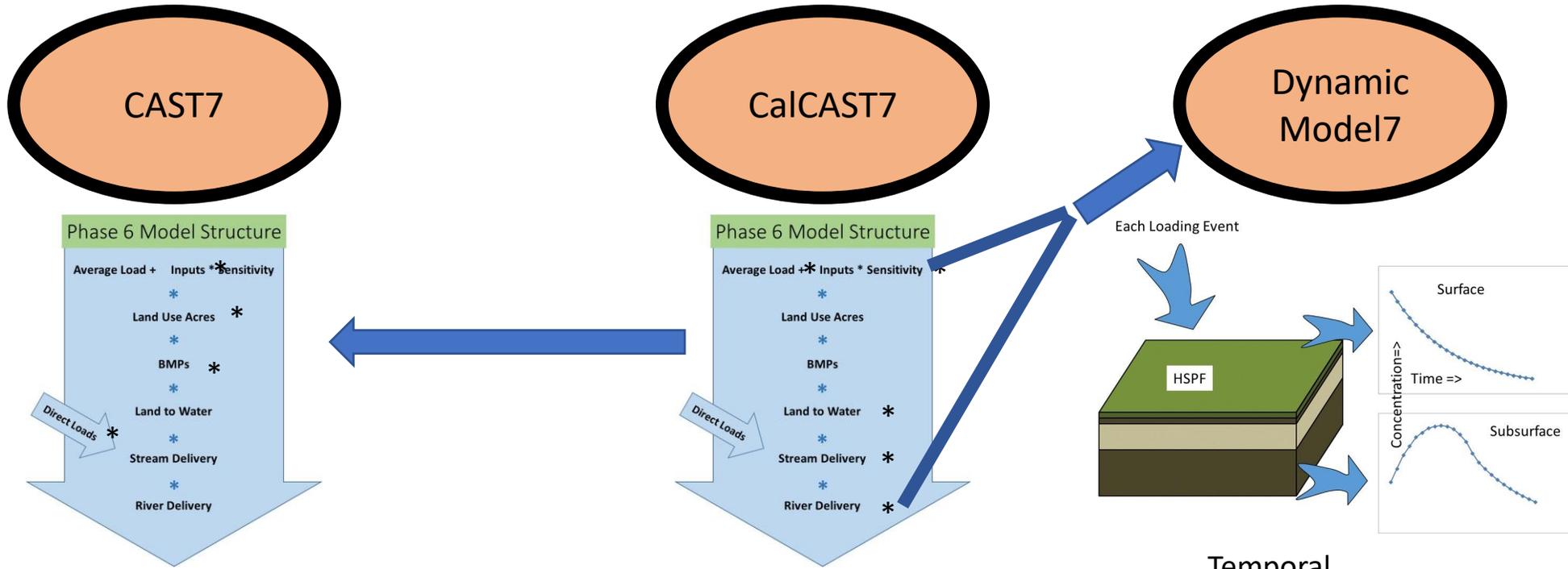
Phase 7 Dynamic Model

Tool for

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



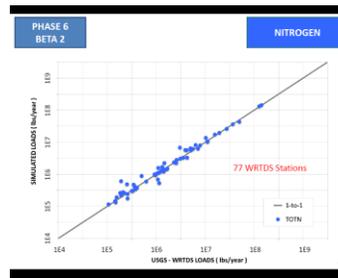
CBP Phase 7 Model – Calibration Mode



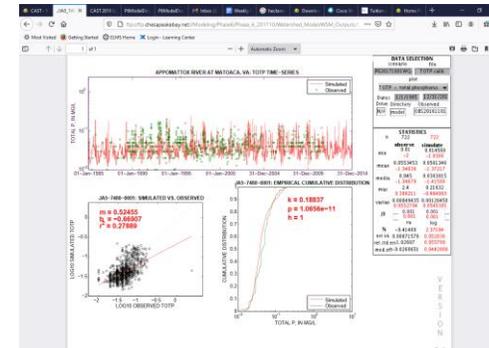
CAST determines
CBP official
scenario loads

Calibration of
meta-parameters
to spatial loads

Temporal
calibration

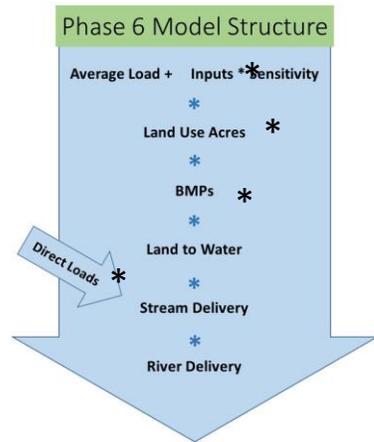


Potential
feedback



CBP Phase 7 Model – Scenario Mode

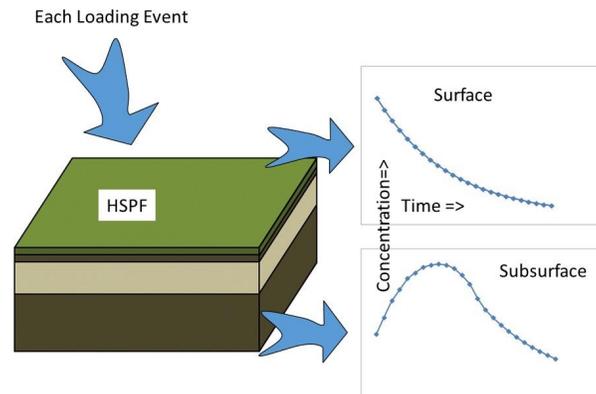
CAST7



CAST determines
CBP official
scenario loads



Dynamic
Model7



CAST loads are
temporally
disaggregated for
estuarine 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

10:00 Progress in Phase 7 WSM Development – Gopal Bhatt, Penn State

Prior presentations have showcased structural details and prototypes of an operational Phase 7 Dynamic Watershed Model for NHDplus scale hydrology. However, the model results of the prototype were based on Phase 6 calibration. Gopal will provide an overview of the progress made during this quarter on hydrology calibration and proposed method updates with respect to incorporating (a) potential options for simple routing, (b) CalCAST average annual hydrologic responses (i.e., total flow and stormflow) at NHDplus catchment and land use scale, and (c) daily streamflow monitoring information and corresponding hydrograph statistics, in the model calibration.

10:30 Discussion of Phase 7 WSM Development Progress

10:40 Update on CalCAST Development: Sediment 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 sediment 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 Discussion of CalCAST development