

Phase 7 Plans

Phase 7 Watershed Model Plans

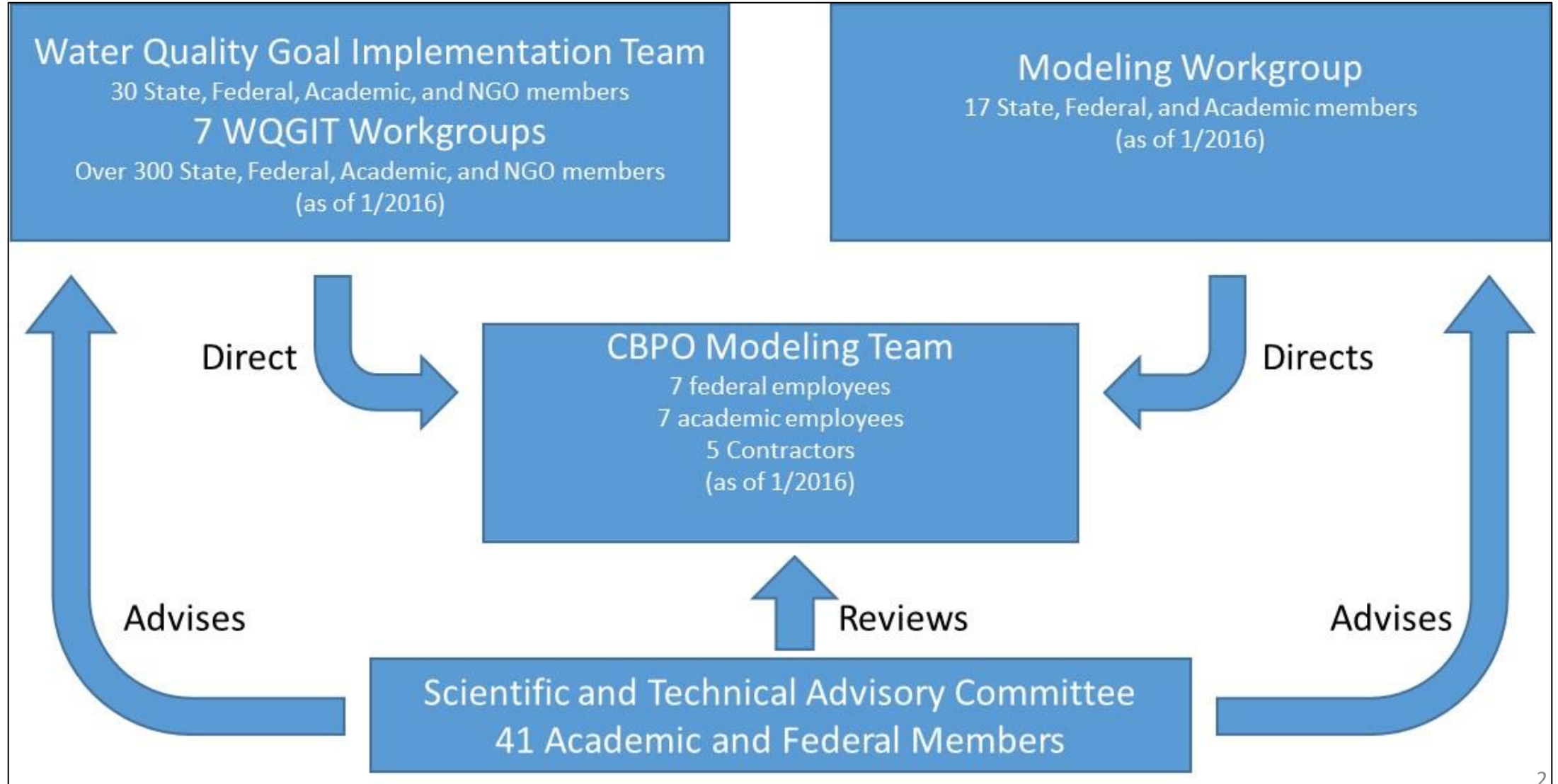
Gary Shenk – CBPO

MWG

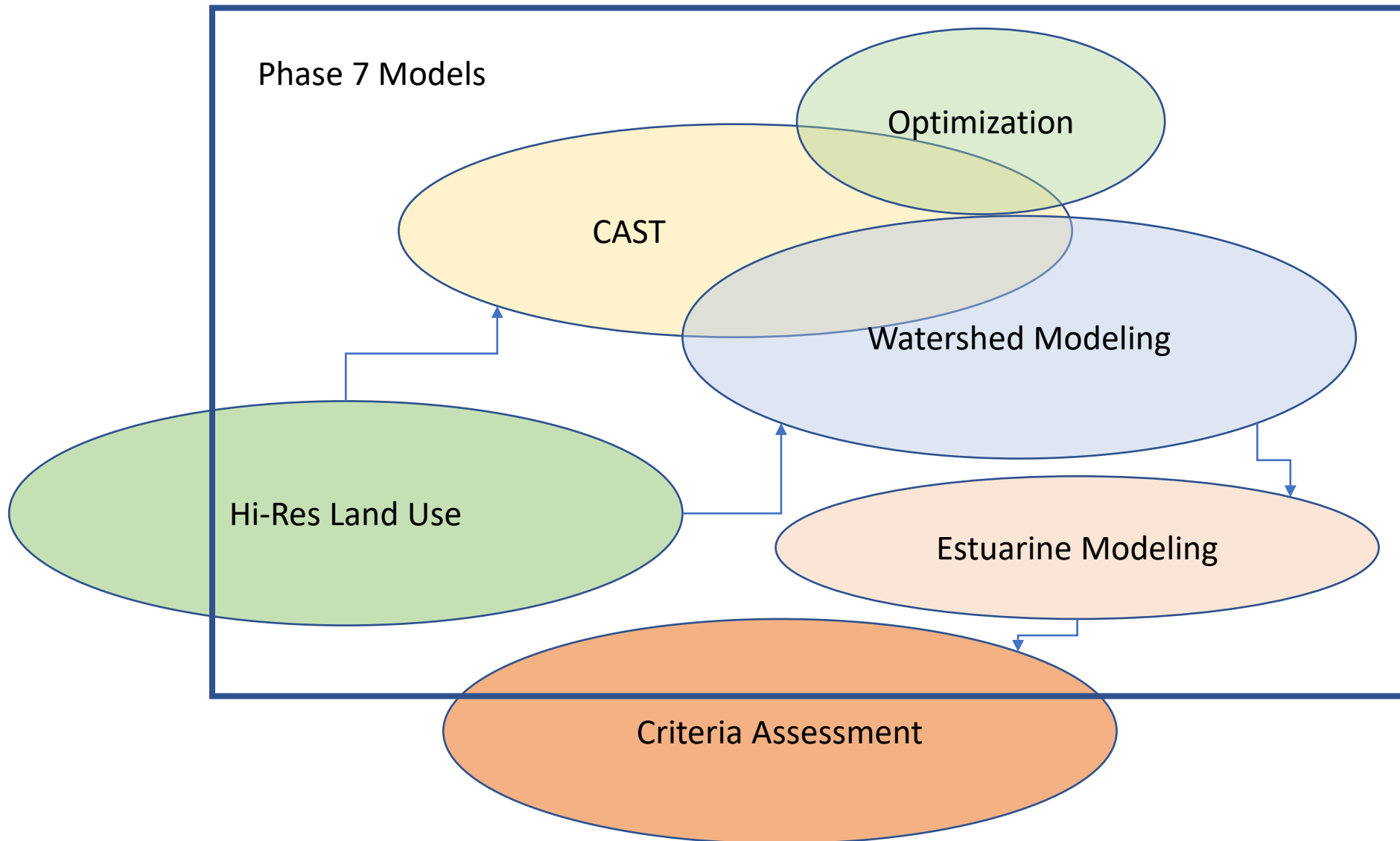
04/06/2022

Governance

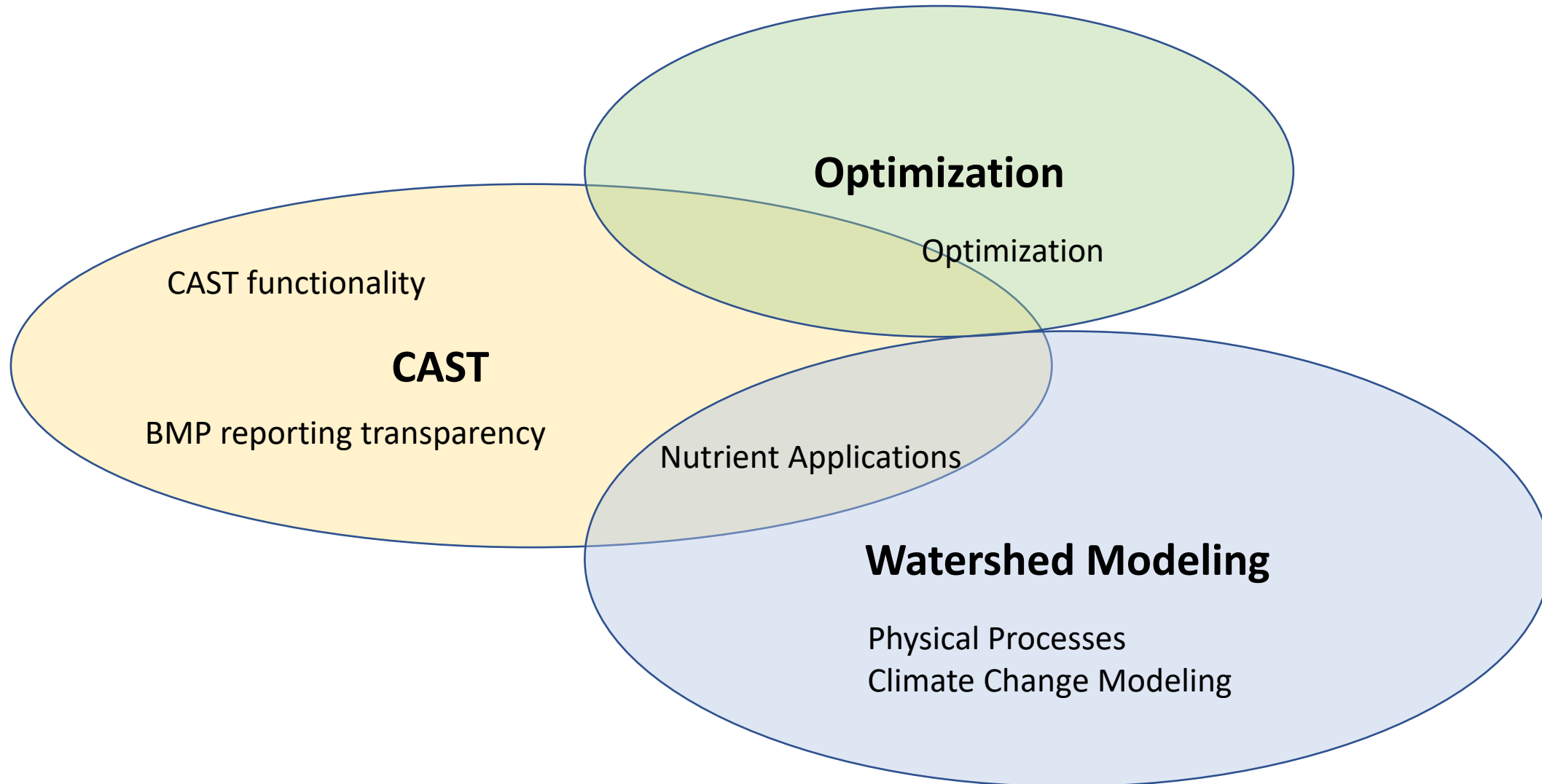
<https://cast-content.chesapeakebay.net/documents/P6ModelDocumentation%2F1%20Overview%202018%2005%2022.pdf>
https://www.chesapeakebay.net/who/group/modeling_team
<https://www.chesapeakebay.net/what/programs/modeling>



Phase 7 Development Tracks

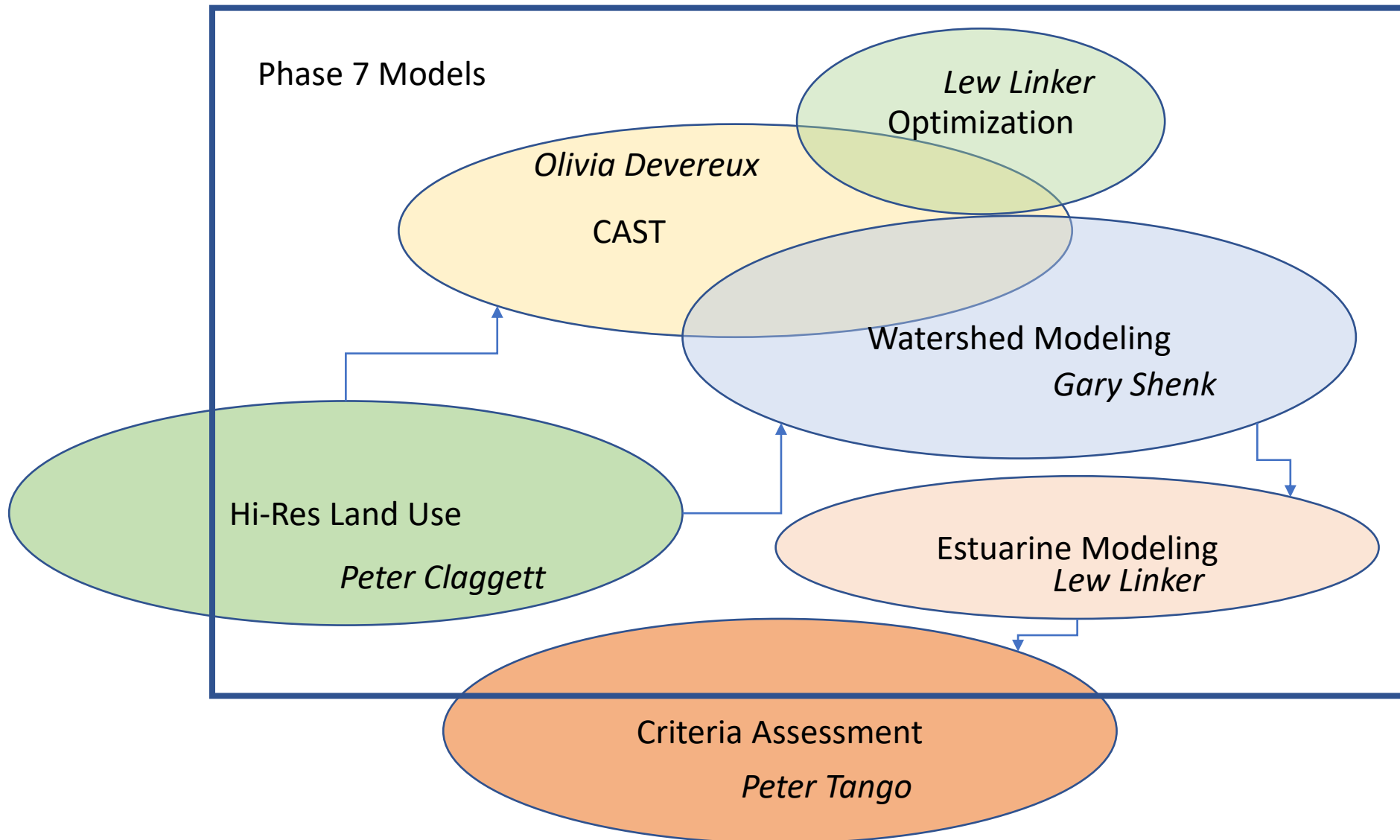


Phase 7 Development Tracks



Phase 7 Development Tracks

Lead organizer



Additional Topics from the Partnership

- WQGIT processes – Jeremy Hanson
 - Ongoing discussion of WQGIT processes
- Planning Target calculations – Gary Shenk
 - Next decisions in 2027
 - Focus in 2025-2026
 - Can discuss any time
- Co-benefits
 - CBP partnership still figuring this out
 - Require participation from CBP GITs and WGs

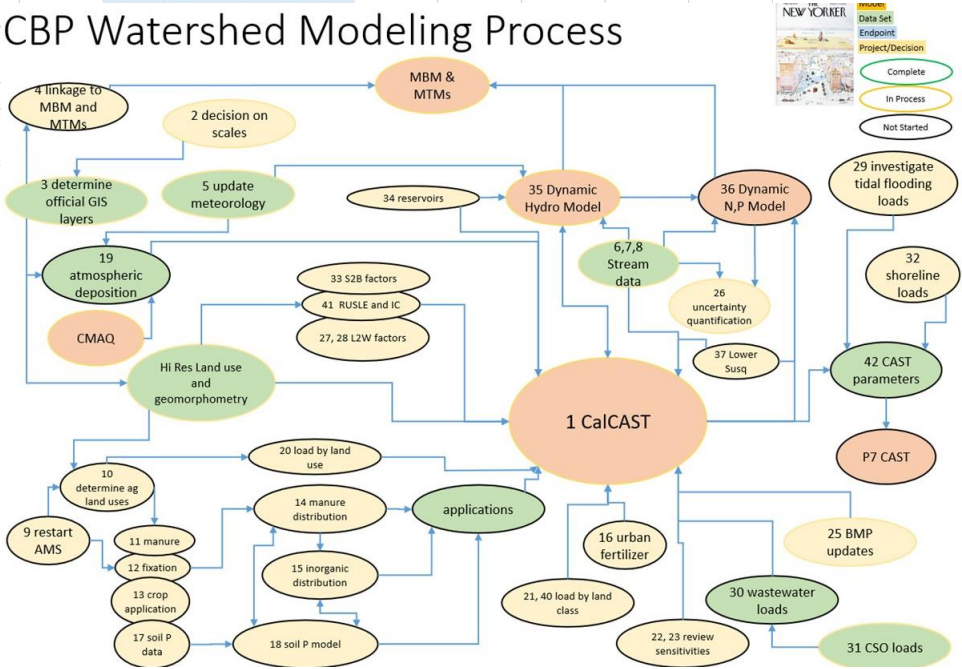
Each Track Has Provided Schedule Documents

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											

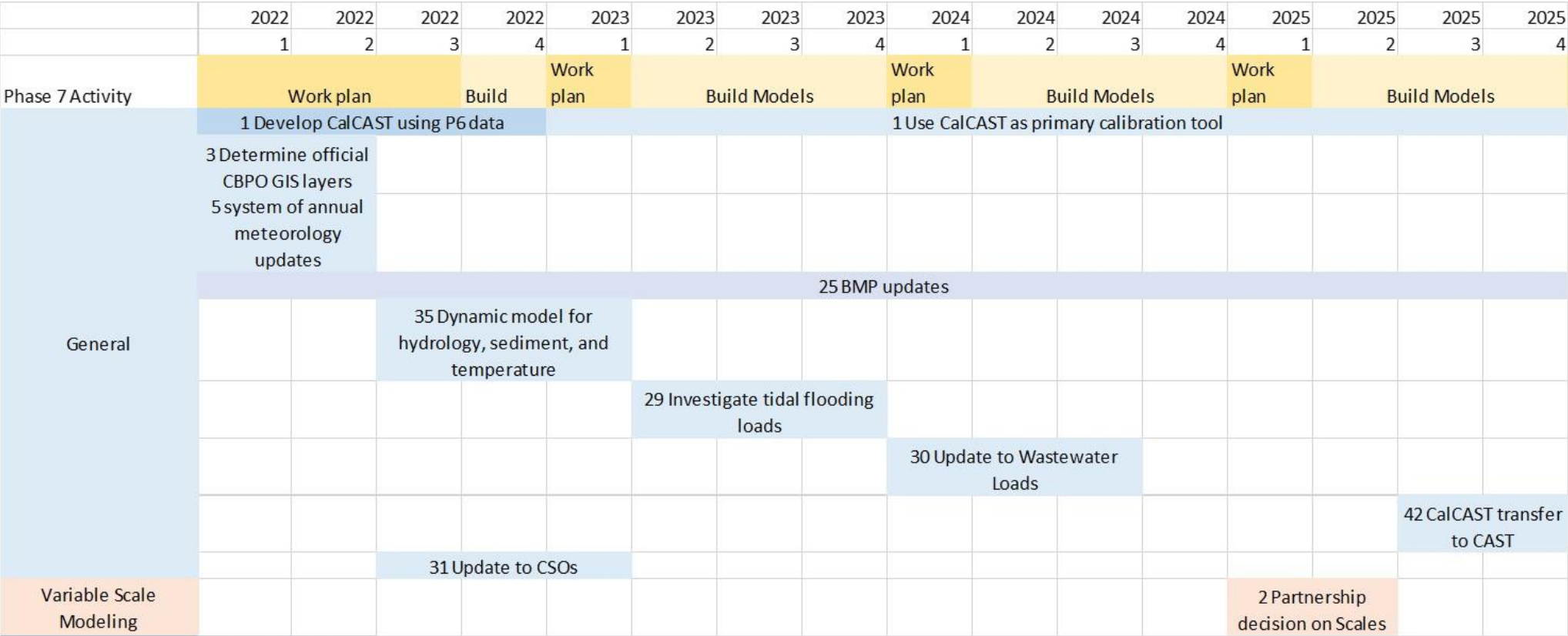
		What: short description	Why: who asked for it or why is it necessary	Who is C eke when the work	Variable Scale Modeling			31 Update to
Item	Category					development time		
1	General	Develop CalCAST. CalCAST will be a tool for comparing estimated load to monitored loads given a set of inputs and parameters. 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 with new ICM variables. Do new WSM variables match up?	

CBP Watershed Modeling Process



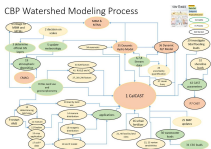
Each Track Has Provided Schedule Documents

Gantt Chart



Task ID	Task Name	Start Date	End Date	Duration	Owner	Dependencies	Notes
1	Develop CalCAST using P6 data	2022-01-01	2022-04-01	90 days	John Doe		
2	Determine official CBPO GIS layers	2022-04-01	2022-07-01	90 days	Jane Smith	1	
3	System of annual meteorology updates	2022-07-01	2022-10-01	90 days	John Doe	2	
4	Dynamic model for hydrology, sediment, and temperature	2022-10-01	2023-01-01	90 days	Jane Smith	3	
5	Investigate tidal flooding loads	2023-01-01	2023-04-01	90 days	John Doe	4	
6	Update to Wastewater Loads	2023-04-01	2023-07-01	90 days	Jane Smith	5	
7	Update to CSOs	2023-07-01	2023-10-01	90 days	John Doe	6	
8	Partnership decision on Scales	2023-10-01	2024-01-01	90 days	Jane Smith	7	
9	CalCAST transfer to CAST	2024-01-01	2024-04-01	90 days	John Doe	8	

Format will vary by Track



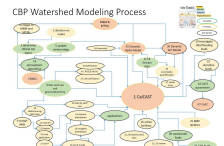
Each Track Has Provided Schedule Documents

Task List

		What: short description	Why: who asked for it or why is it necessary	Who in CBPO or elsewhere will do the work	Where in the CBP organizational chart do the decisions lie	When does this need to be done, including general dependencies and development time	How: A very short description with a link to the longer documentation
Item	Category						
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
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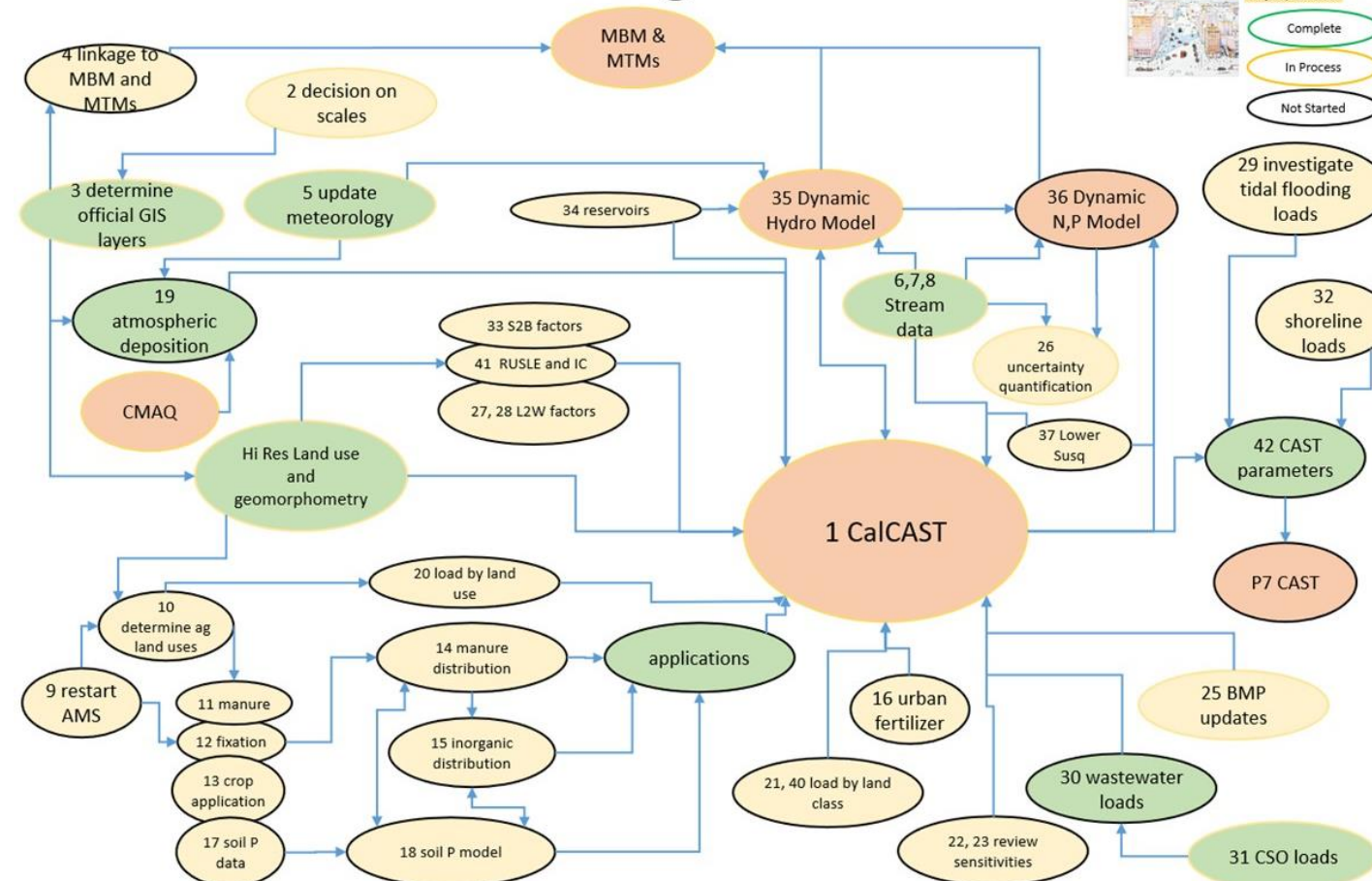
Format will vary by Track



Each Track Has Provided Schedule Documents

Flow Chart

CBP Watershed Modeling Process



Format will vary by Track

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Project Timeline											
	Initiation	Plan	Do	Check	Act	Plan	Do	Check	Act	Plan	Do
	1. Develop the Strategic Plan				2. the 14-Step Implementation						
	3. Develop the Business Plan				4. Develop the Financial Plan						
	5. Develop the Marketing Plan				6. Develop the Operations Plan						
	7. Develop the HR Plan				8. Develop the IT Plan						
	9. Develop the Legal Plan				10. Develop the Environmental Plan						
	11. Develop the Risk Management Plan				12. Develop the Quality Management Plan						
	13. Develop the Sustainability Plan				14. Develop the Innovation Plan						
	15. Develop the Governance Plan				16. Develop the Compliance Plan						
	17. Develop the Security Plan				18. Develop the Privacy Plan						
	19. Develop the Access Plan				20. Develop the Incident Response Plan						
	21. Develop the Disaster Recovery Plan				22. Develop the Business Continuity Plan						
	23. Develop the Information Security Plan				24. Develop the Information Security Standard						
	25. Develop the Information Security Procedure				26. Develop the Information Security Guideline						
	27. Develop the Information Security Control				28. Develop the Information Security Measure						
	29. Develop the Information Security Assessment				30. Develop the Information Security Audit						
	31. Develop the Information Security Monitoring				32. Develop the Information Security Reporting						
	33. Develop the Information Security Improvement				34. Develop the Information Security Review						
	35. Develop the Information Security Training				36. Develop the Information Security Awareness						
	37. Develop the Information Security Culture				38. Develop the Information Security Climate						
	39. Develop the Information Security Leadership				40. Develop the Information Security Commitment						
	41. Develop the Information Security Accountability				42. Develop the Information Security Responsibility						
	43. Develop the Information Security Transparency				44. Develop the Information Security Openness						
	45. Develop the Information Security Honesty				46. Develop the Information Security Integrity						
	47. Develop the Information Security Fairness				48. Develop the Information Security Justice						
	49. Develop the Information Security Equity				50. Develop the Information Security Balance						
	51. Develop the Information Security Harmony				52. Develop the Information Security Unity						
	53. Develop the Information Security Cooperation				54. Develop the Information Security Assistance						
	55. Develop the Information Security Support				56. Develop the Information Security Help						
	57. Develop the Information Security Guidance				58. Develop the Information Security Advice						
	59. Develop the Information Security Recommendation				60. Develop the Information Security Suggestion						
	61. Develop the Information Security Proposal				62. Develop the Information Security Offer						
	63. Develop the Information Security Request				64. Develop the Information Security Demand						
	65. Develop the Information Security Claim				66. Develop the Information Security Demand						
	67. Develop the Information Security Requirement				68. Develop the Information Security Need						
	69. Develop the Information Security Interest				70. Develop the Information Security Concern						
	71. Develop the Information Security Issue				72. Develop the Information Security Problem						
	73. Develop the Information Security Challenge				74. Develop the Information Security Task						
	75. Develop the Information Security Responsibility				76. Develop the Information Security Obligation						
	77. Develop the Information Security Duty				78. Develop the Information Security Liability						
	79. Develop the Information Security Accountability				80. Develop the Information Security Responsibility						
	81. Develop the Information Security Transparency				82. Develop the Information Security Openness						

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Web page

- Overview

Phase 7 Model Development | C x +

chesapeakebay.net/what/programs/modeling/phase_7_model_development

CBPO Scheduler Sign in to Concur... Citi Commercial Car... Chesapeake Bay Ge... https://gis.chesape... Priority Agricultural... Priority Agricultural... Mid-Atlantic IDF Cu...

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

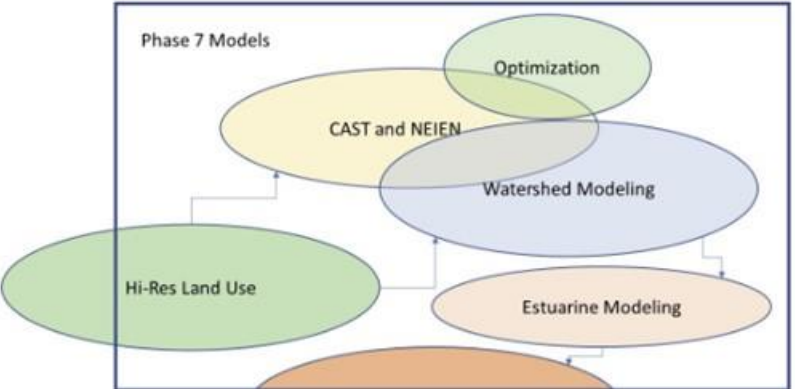
Phase 7 Model Development

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. Watershed Modeling
5. Estuarine Modeling
6. Criteria Assessment



Phase 7 Models

Optimization

CAST and NEIEN

Watershed Modeling

Hi-Res Land Use

Estuarine Modeling

Modeling

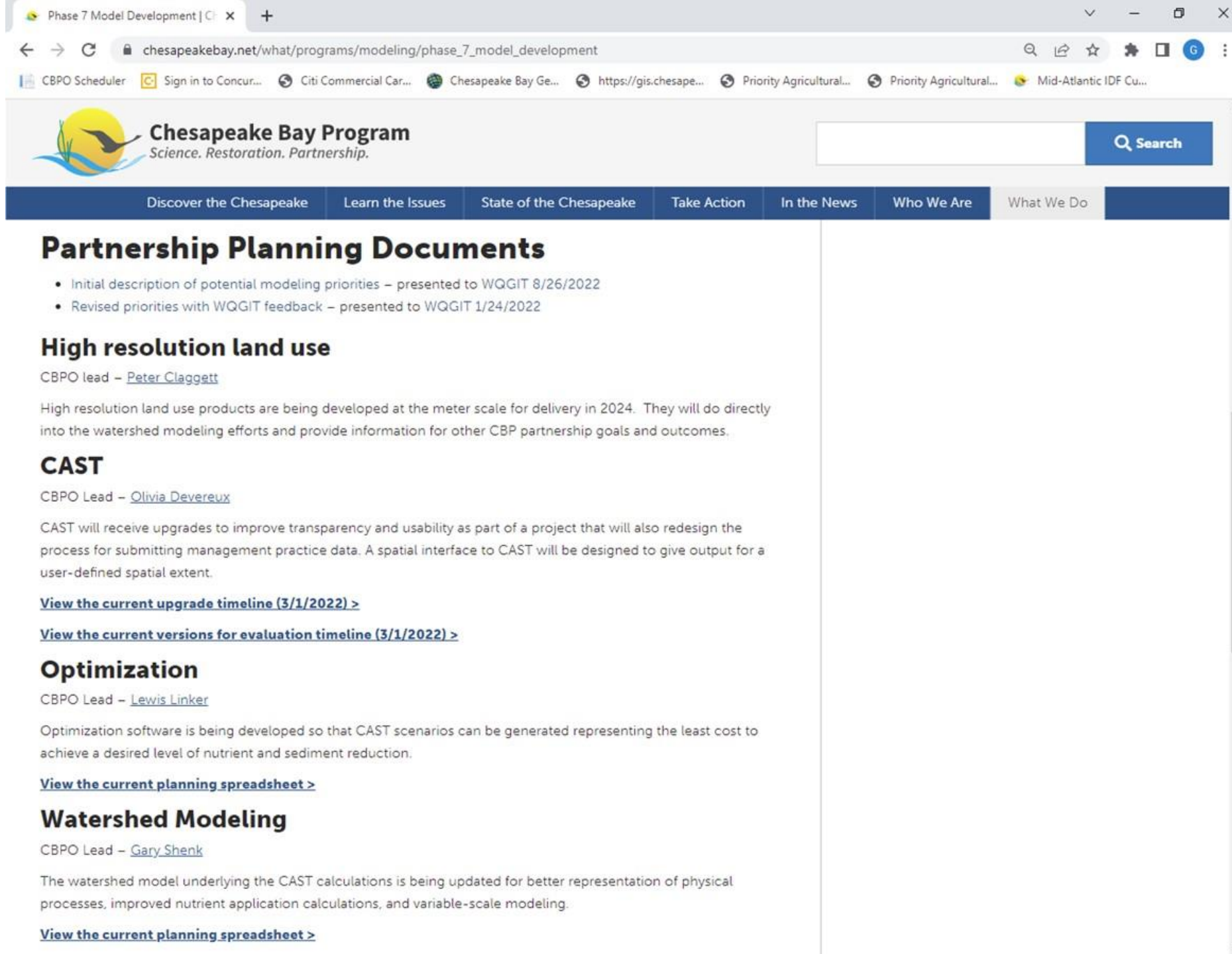
Phase 7 Model Development

Programs & Projects

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

Web page

- All six projects




The screenshot shows a web browser window with the URL chESAPEAKEbay.net/what/programs/modeling/phase_7_model_development. The page header features the Chesapeake Bay Program logo and a search bar. A navigation menu includes links for 'Discover the Chesapeake', 'Learn the Issues', 'State of the Chesapeake', 'Take Action', 'In the News', 'Who We Are', and 'What We Do'. The main content area is titled 'Partnership Planning Documents' and lists two bullet points: 'Initial description of potential modeling priorities – presented to WQGIT 8/26/2022' and 'Revised priorities with WQGIT feedback – presented to WQGIT 1/24/2022'. Below this is a section for 'High resolution land use' with a lead by Peter Claggett, followed by a paragraph about the development of high-resolution land use products for 2024 delivery. The 'CAST' section, led by Olivia Devereux, describes upgrades to the CAST system for transparency and usability, including a redesigned process for submitting management practice data and a new spatial interface. It includes links to 'View the current upgrade timeline (3/1/2022) >' and 'View the current versions for evaluation timeline (3/1/2022) >'. The 'Optimization' section, led by Lewis Linker, describes the development of optimization software for CAST scenarios, aiming for the least cost to achieve nutrient and sediment reduction, with a link to 'View the current planning spreadsheet >'. Finally, the 'Watershed Modeling' section, led by Gary Shenk, describes updates to the watershed model for better representation of physical processes and improved calculations, also with a link to 'View the current planning spreadsheet >'.

Phase 7 Model Development | C...

chESAPEAKEbay.net/what/programs/modeling/phase_7_model_development

CBPO Scheduler Sign in to Concur... Citi Commercial Car... Chesapeake Bay Ge... https://gis.chesape... Priority Agricultural... Priority Agricultural... Mid-Atlantic IDF Cu...

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

Partnership Planning Documents

- Initial description of potential modeling priorities – presented to WQGIT 8/26/2022
- Revised priorities with WQGIT feedback – presented to WQGIT 1/24/2022

High resolution land use

CBPO lead – [Peter Claggett](#)

High resolution land use products are being developed at the meter scale for delivery in 2024. They will do directly into the watershed modeling efforts and provide information for other CBP partnership goals and outcomes.

CAST

CBPO Lead – [Olivia Devereux](#)

CAST will receive upgrades to improve transparency and usability as part of a project that will also redesign the process for submitting management practice data. A spatial interface to CAST will be designed to give output for a user-defined spatial extent.

[View the current upgrade timeline \(3/1/2022\) >](#)

[View the current versions for evaluation timeline \(3/1/2022\) >](#)

Optimization

CBPO Lead – [Lewis Linker](#)

Optimization software is being developed so that CAST scenarios can be generated representing the least cost to achieve a desired level of nutrient and sediment reduction.

[View the current planning spreadsheet >](#)

Watershed Modeling

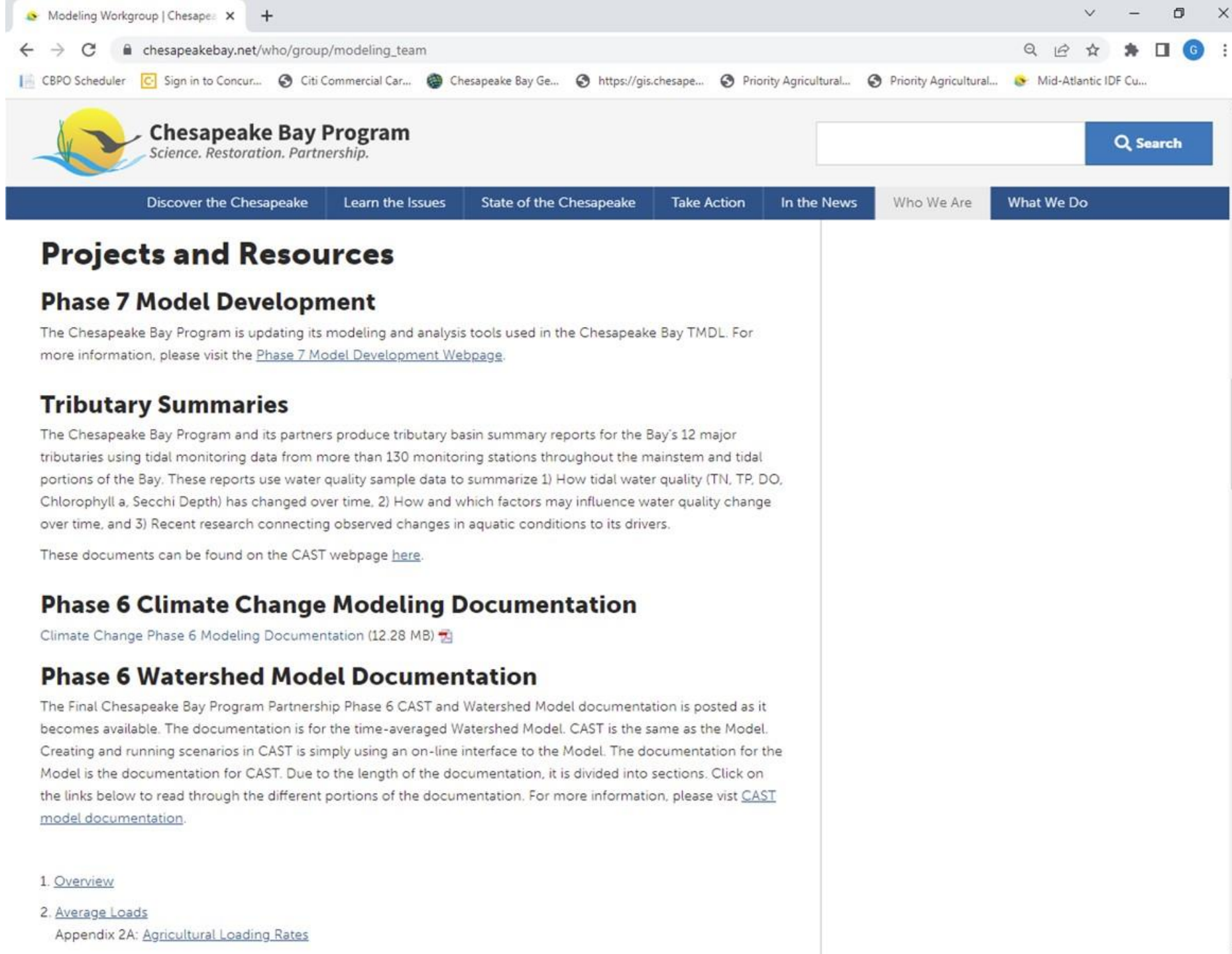
CBPO Lead – [Gary Shenk](#)

The watershed model underlying the CAST calculations is being updated for better representation of physical processes, improved nutrient application calculations, and variable-scale modeling.

[View the current planning spreadsheet >](#)

Web page

- Linked from
 - Modeling Workgroup
 - WQGIT
 - Many WQGIT WGs



The screenshot shows a web browser window with the URL chesapeakebay.net/who/group/modeling_team. The page header features the Chesapeake Bay Program logo and tagline "Science. Restoration. Partnership." along with a search bar. A navigation menu includes links for "Discover the Chesapeake", "Learn the Issues", "State of the Chesapeake", "Take Action", "In the News", "Who We Are", and "What We Do".

Projects and Resources

Phase 7 Model Development


The Chesapeake Bay Program is updating its modeling and analysis tools used in the Chesapeake Bay TMDL. For more information, please visit the [Phase 7 Model Development Webpage](#).

Tributary Summaries

The Chesapeake Bay Program and its partners produce tributary basin summary reports for the Bay's 12 major tributaries using tidal monitoring data from more than 130 monitoring stations throughout the mainstem and tidal portions of the Bay. These reports use water quality sample data to summarize 1) How tidal water quality (TN, TP, DO, Chlorophyll a, Secchi Depth) has changed over time, 2) How and which factors may influence water quality change over time, and 3) Recent research connecting observed changes in aquatic conditions to its drivers.

These documents can be found on the CAST webpage [here](#).

Phase 6 Climate Change Modeling Documentation

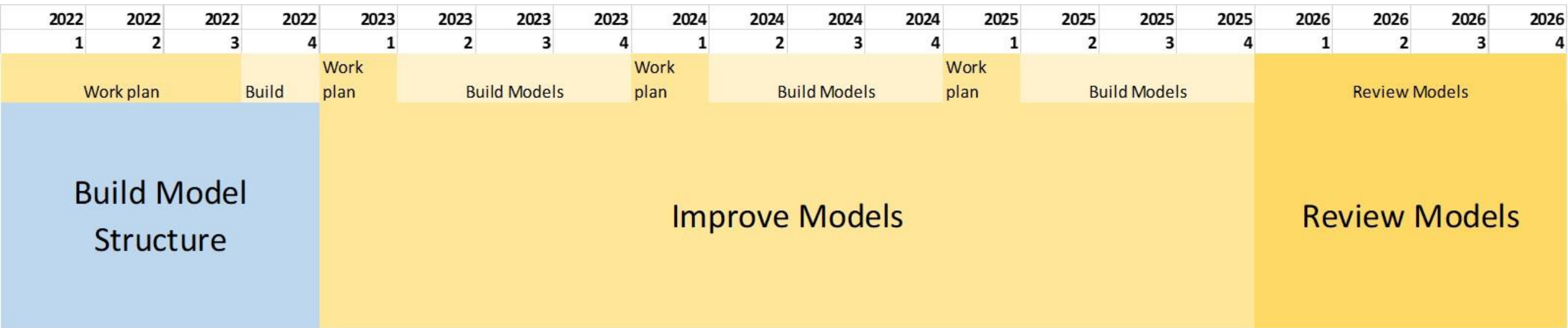
Climate Change Phase 6 Modeling Documentation (12.28 MB) 

Phase 6 Watershed Model Documentation

The Final Chesapeake Bay Program Partnership Phase 6 CAST and Watershed Model documentation is posted as it becomes available. The documentation is for the time-averaged Watershed Model. CAST is the same as the Model. Creating and running scenarios in CAST is simply using an on-line interface to the Model. The documentation for the Model is the documentation for CAST. Due to the length of the documentation, it is divided into sections. Click on the links below to read through the different portions of the documentation. For more information, please visit [CAST model documentation](#).

1. [Overview](#)
2. [Average Loads](#)
 - Appendix 2A: [Agricultural Loading Rates](#)

Watershed Model Plan – Big Picture



Watershed
Model Plan –
slightly more
detail

	2022	2022	2022	2022
	1	2	3	4
Phase 7 Activity	Work plan			Build
General	1 Develop CalCAST using P6 data			
	3 Determine official CBPO GIS layers meteorology updates			
		35 Dynamic model for hydrology, sediment, and temperature		
		36 Dynamic model for nutrients		
Physical Process Simulation	6 Streamflow data			
	7 stream conc data			
		8 Stream load data		
Uncertainty Quantification	26 Methods			

Watershed Model Plan – A little more detail

Item	Category	What: short description	Why: who asked for it or why is it necessary	Who in CBPO or elsewhere will do the work	Where in the CBP organizational chart do the decisions lie	When does this need to be done, including general dependencies and development time	How: A very short description with a link to the longer documentation
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.	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	Counties have updated boundaries. NHD necessary to use many important data sets, shoreline determines	McDonald, Fitch, Ahmed, Bhatt	MWG	early 2022	CBPO discussions, with results to be written into section 2

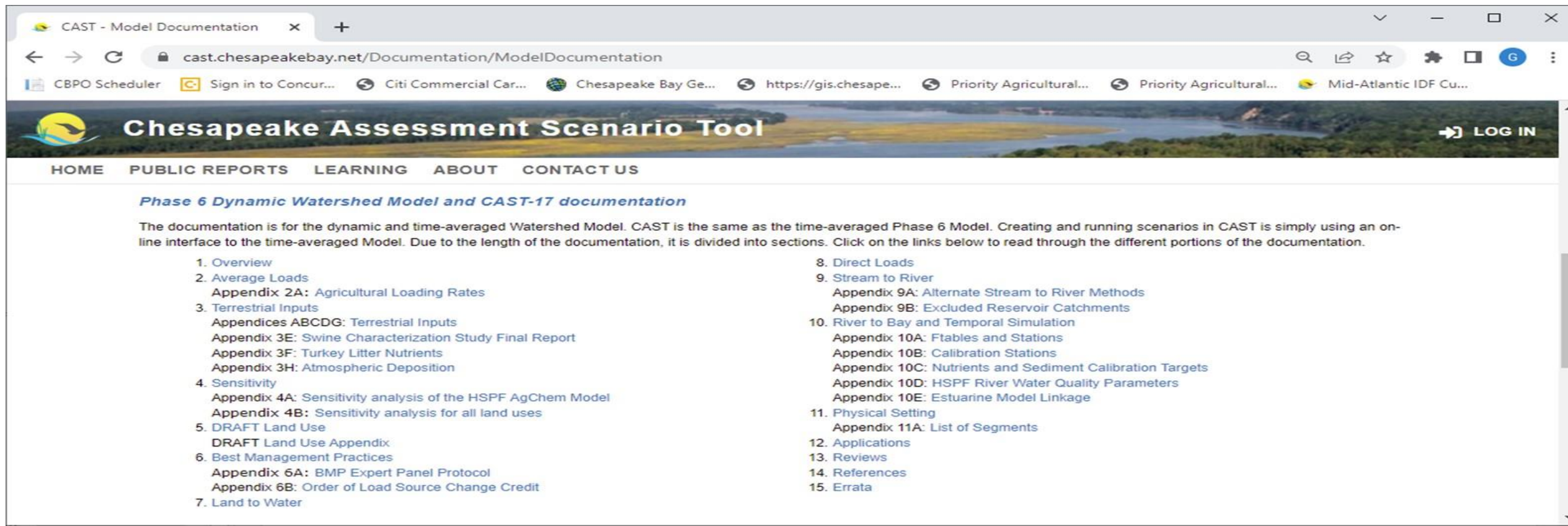
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Watershed Model Plan – sample task

Item	4
Category	Main bay and tributary models
What: short description	physical and chemical linkage with estuarine model
Why: who asked for it or why is it necessary	Needed to run estuarine models
Who in CBPO or elsewhere will do the work	Bhatt
Where in the CBP organizational chart do the decisions lie	MWG
When does this need to be done, including general dependencies and development time	late 2022. Need to determine form of dynamic model first for the variable description.
How: A very short description with a link to the longer documentation	Section 2 of P7 documentation. Identify set of terminal segments. Identify estuarine cell for each terminal segment. Compare old ICM variables with new ICM variables. Do new WSM variables match up?

Full Details in Draft Documentation

- P6 documentation being updated to P7
- Expect rolling releases as we complete sections



The screenshot shows a web browser window with the address bar displaying `cast.chesapeakebay.net/Documentation/ModelDocumentation`. The page header features the "Chesapeake Assessment Scenario Tool" logo and a "LOG IN" button. Below the header is a navigation menu with links: HOME, PUBLIC REPORTS, LEARNING, ABOUT, and CONTACT US. The main content area is titled "Phase 6 Dynamic Watershed Model and CAST-17 documentation" and includes a paragraph explaining the documentation's purpose. Below this, there are two columns of numbered links for navigation.

Chesapeake Assessment Scenario Tool LOG IN

HOME PUBLIC REPORTS LEARNING ABOUT CONTACT US

Phase 6 Dynamic Watershed Model and CAST-17 documentation

The documentation is for the dynamic and time-averaged Watershed Model. CAST is the same as the time-averaged Phase 6 Model. Creating and running scenarios in CAST is simply using an on-line interface to the time-averaged Model. Due to the length of the documentation, it is divided into sections. Click on the links below to read through the different portions of the documentation.

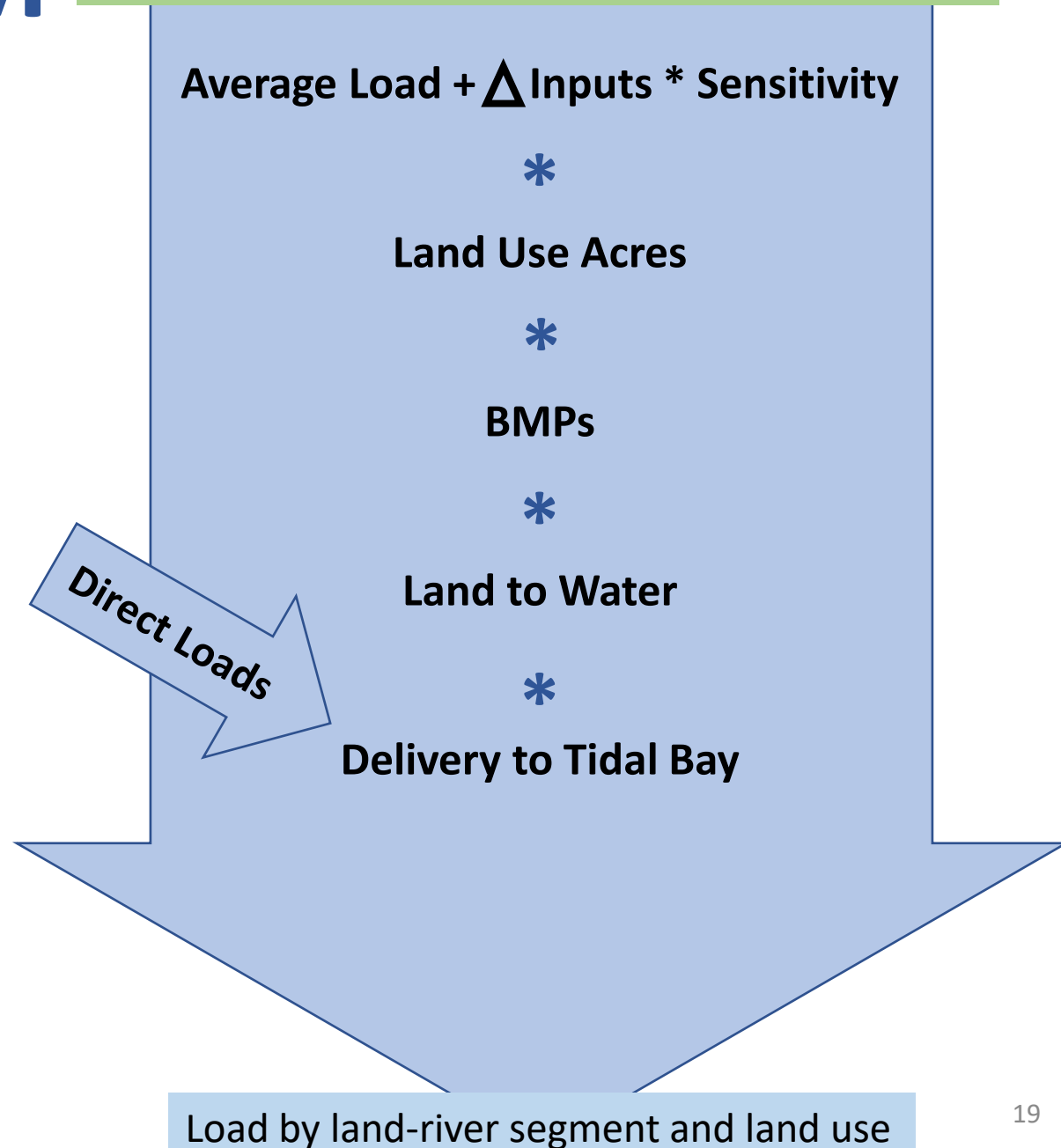
- 1. Overview
- 2. Average Loads
 - Appendix 2A: Agricultural Loading Rates
- 3. Terrestrial Inputs
 - Appendices ABCDG: Terrestrial Inputs
 - Appendix 3E: Swine Characterization Study Final Report
 - Appendix 3F: Turkey Litter Nutrients
 - Appendix 3H: Atmospheric Deposition
- 4. Sensitivity
 - Appendix 4A: Sensitivity analysis of the HSPF AgChem Model
 - Appendix 4B: Sensitivity analysis for all land uses
- 5. DRAFT Land Use
 - DRAFT Land Use Appendix
- 6. Best Management Practices
 - Appendix 6A: BMP Expert Panel Protocol
 - Appendix 6B: Order of Load Source Change Credit
- 7. Land to Water
- 8. Direct Loads
- 9. Stream to River
 - Appendix 9A: Alternate Stream to River Methods
 - Appendix 9B: Excluded Reservoir Catchments
- 10. River to Bay and Temporal Simulation
 - Appendix 10A: Ftables and Stations
 - Appendix 10B: Calibration Stations
 - Appendix 10C: Nutrients and Sediment Calibration Targets
 - Appendix 10D: HSPF River Water Quality Parameters
 - Appendix 10E: Estuarine Model Linkage
- 11. Physical Setting
 - Appendix 11A: List of Segments
- 12. Applications
- 13. Reviews
- 14. References
- 15. Errata

Cast/CalCast/DM

Phase 7 Model Structure

Phase 7
CAST

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

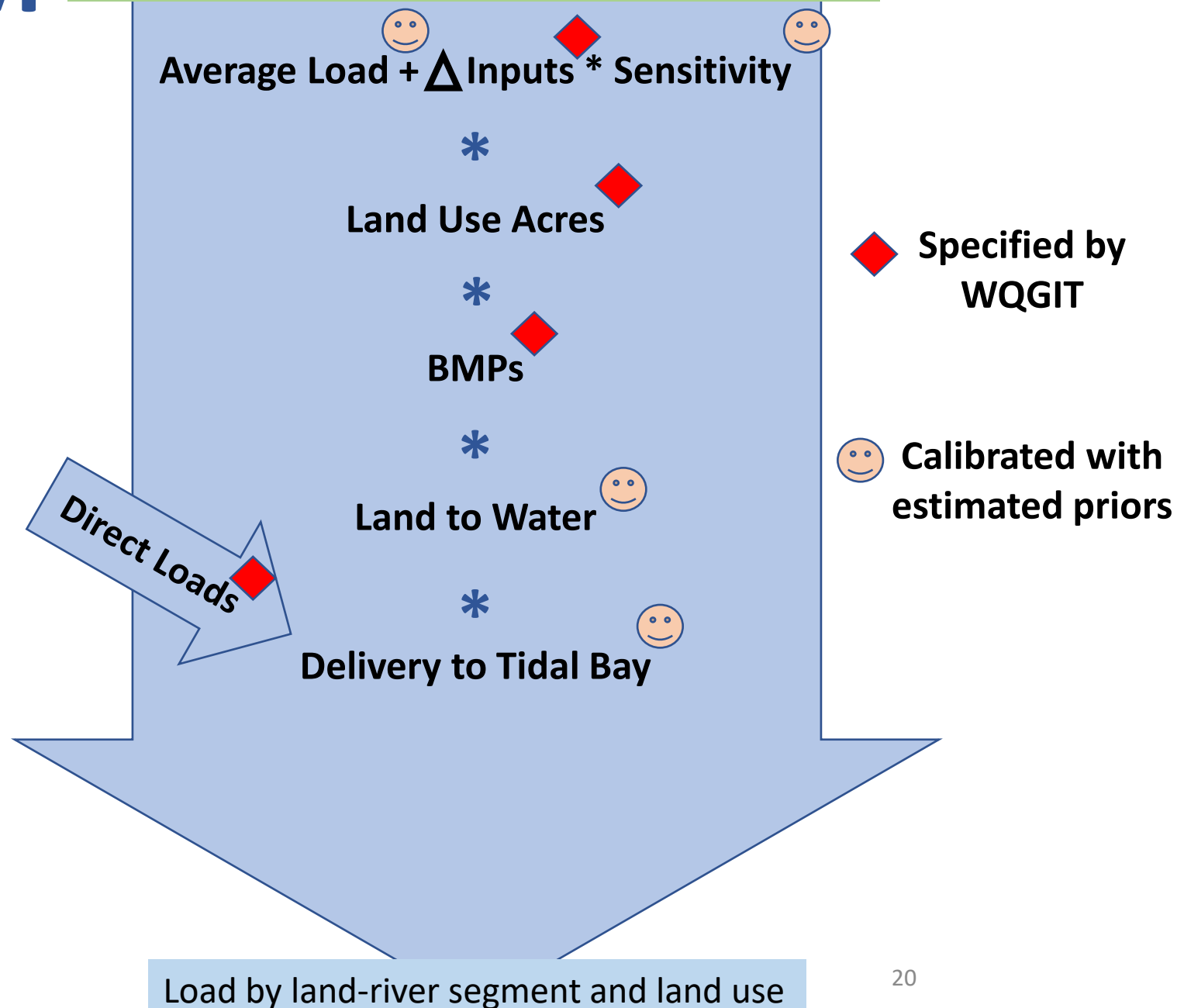


Cast/CalCast/DM

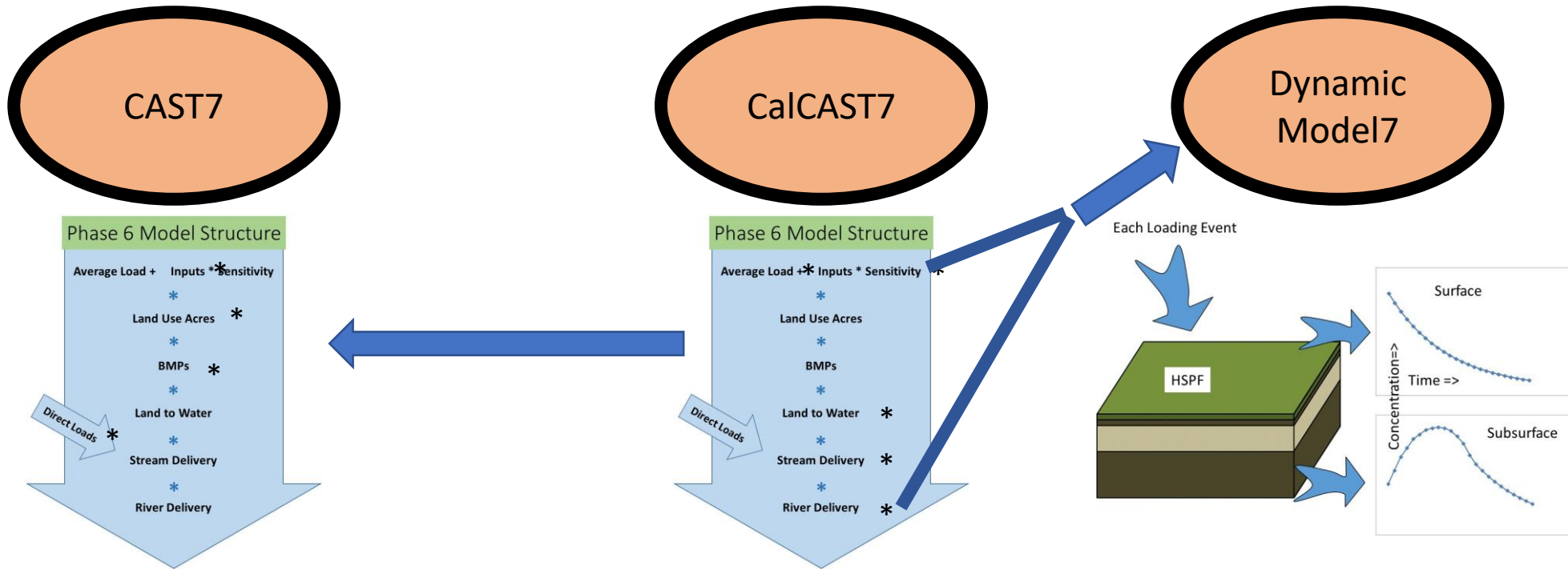
Phase 7 Model Structure

Phase 7
CalCAST

Tool for finding
parameters that
best match
observations



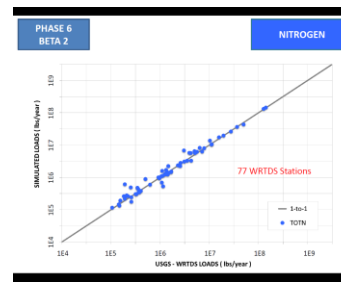
CBP Phase 7 Model – Calibration Mode



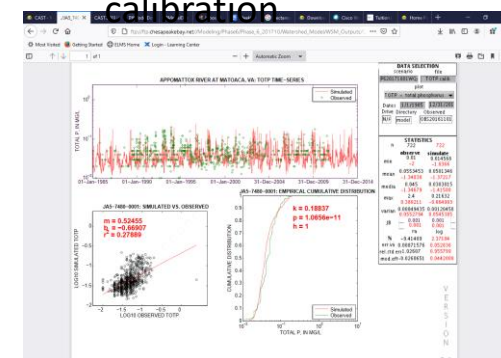
CAST determines
CBP official
scenario loads

Calibration of
meta-parameters
to spatial loads

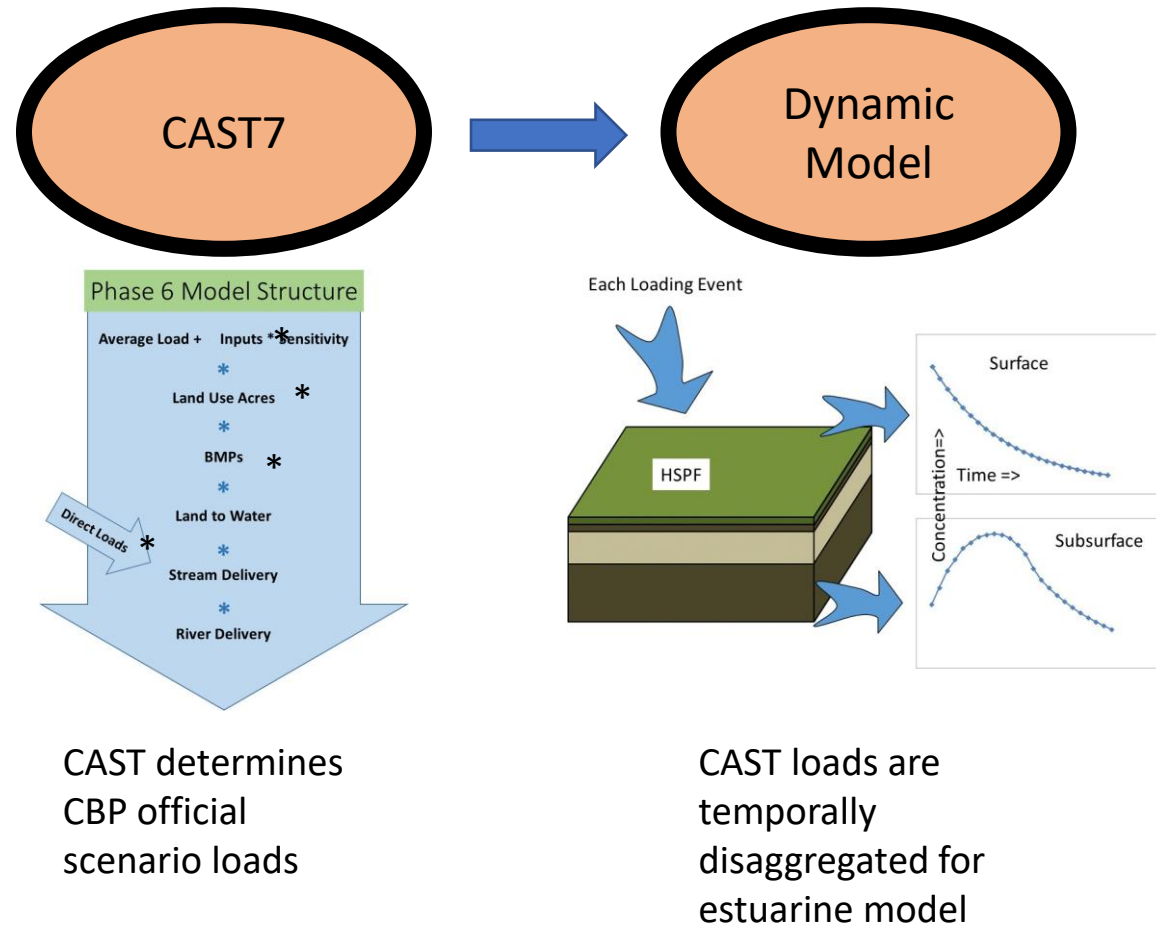
Temporal
calibration



Potential
feedback



CBP Phase 7 Model – Scenario Mode



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

10:40 Progress in Phase 7 WSM Development – Gopal Bhatt, Penn State

Gopal will describe progress in development of the Phase 7 Dynamic Model and Phase 7 CAST models.

11:00 Discussion of Phase 7 WSM Development Progress

11:10 Structure and Development of CalCAST – Isabella Bertani, UMCES

Isabella will describe the role and overall structure of the CalCAST simulation and the progress being made in its development. CalCAST is a relatively parsimonious 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. Isabella will provide an overview of initial steps taken to implement CalCAST in a Bayesian calibration framework and get feedback on potential next steps, including initial thoughts on future GIS and land-use data needs.

11:30 Discussion of CalCAST development