Phase 7 Watershed Model Plans

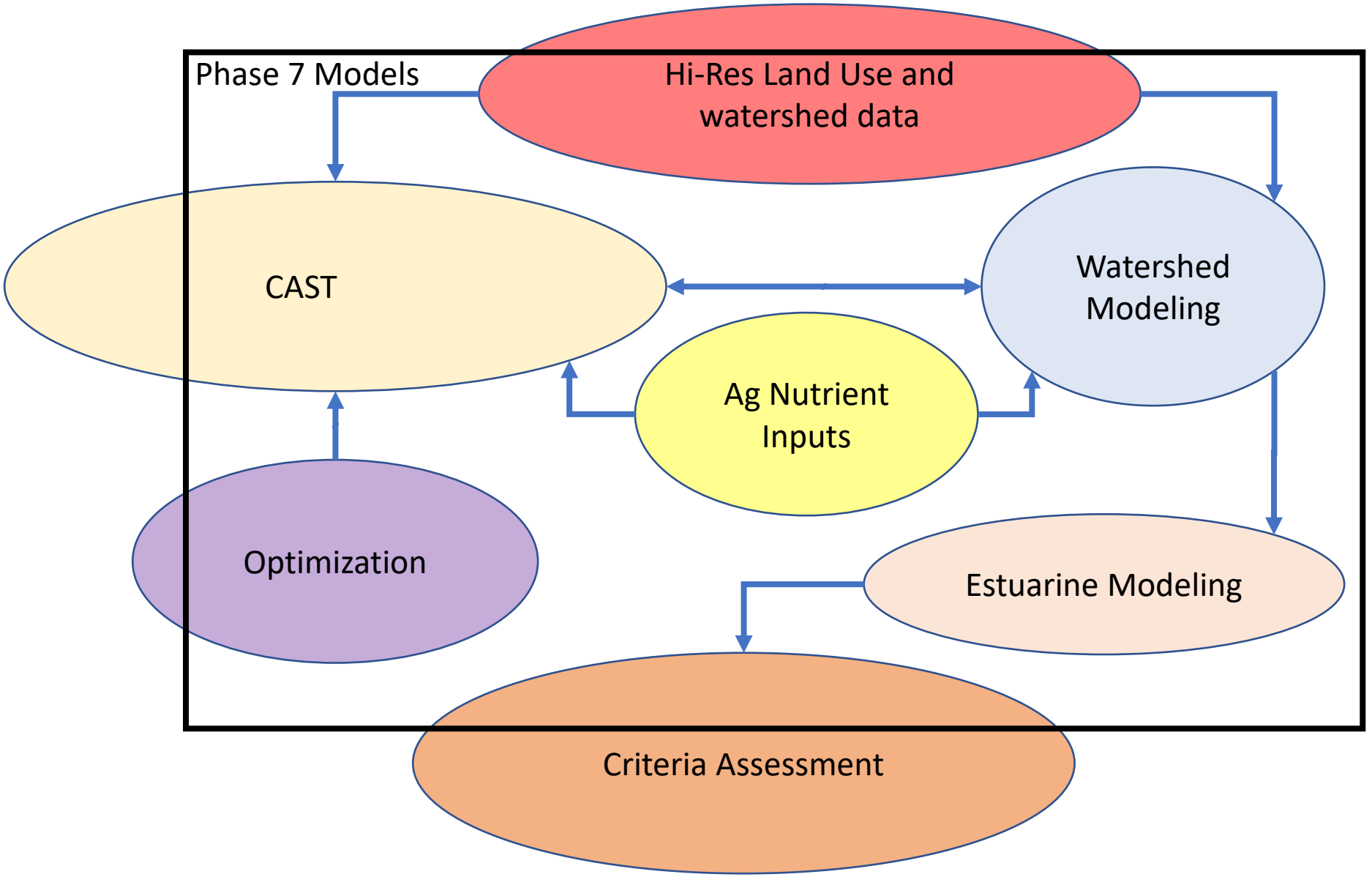
CBPO Staff

Gopal Bhatt, Isabella Bertani, Joseph Delesantro, Lewis Linker and others

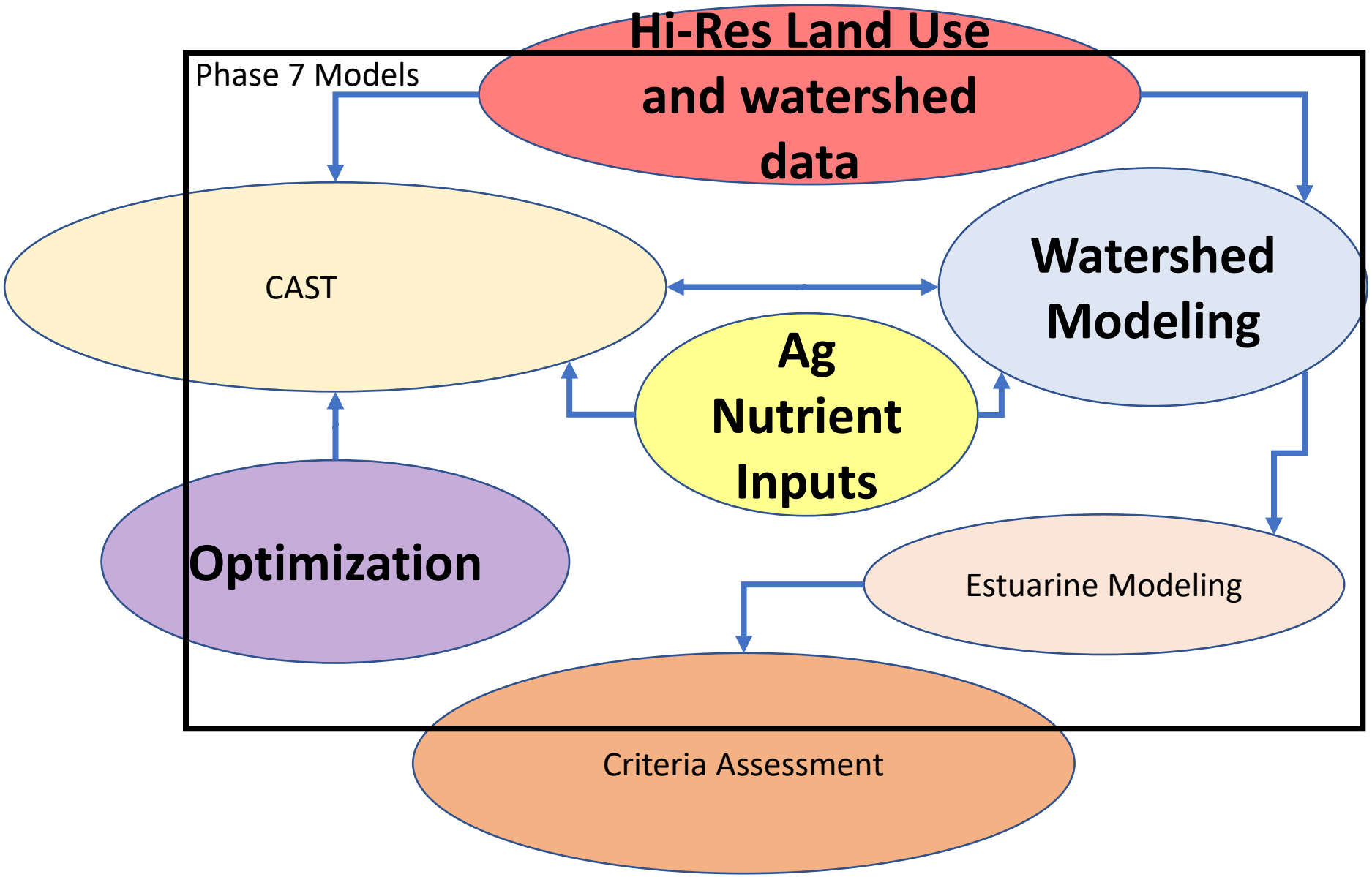
MWG

4/2/2024

Phase 7 Development Tracks



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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Science. Restoration. Partnership.

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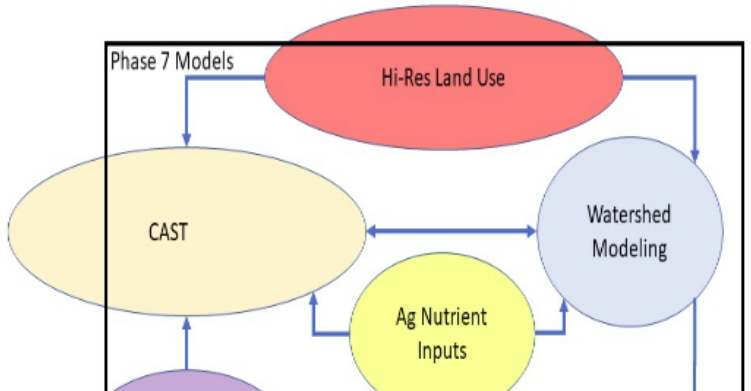
WHAT WE DO > PROGRAMS & PROJECTS > PHASE 7 MODEL DEVELOPMENT

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

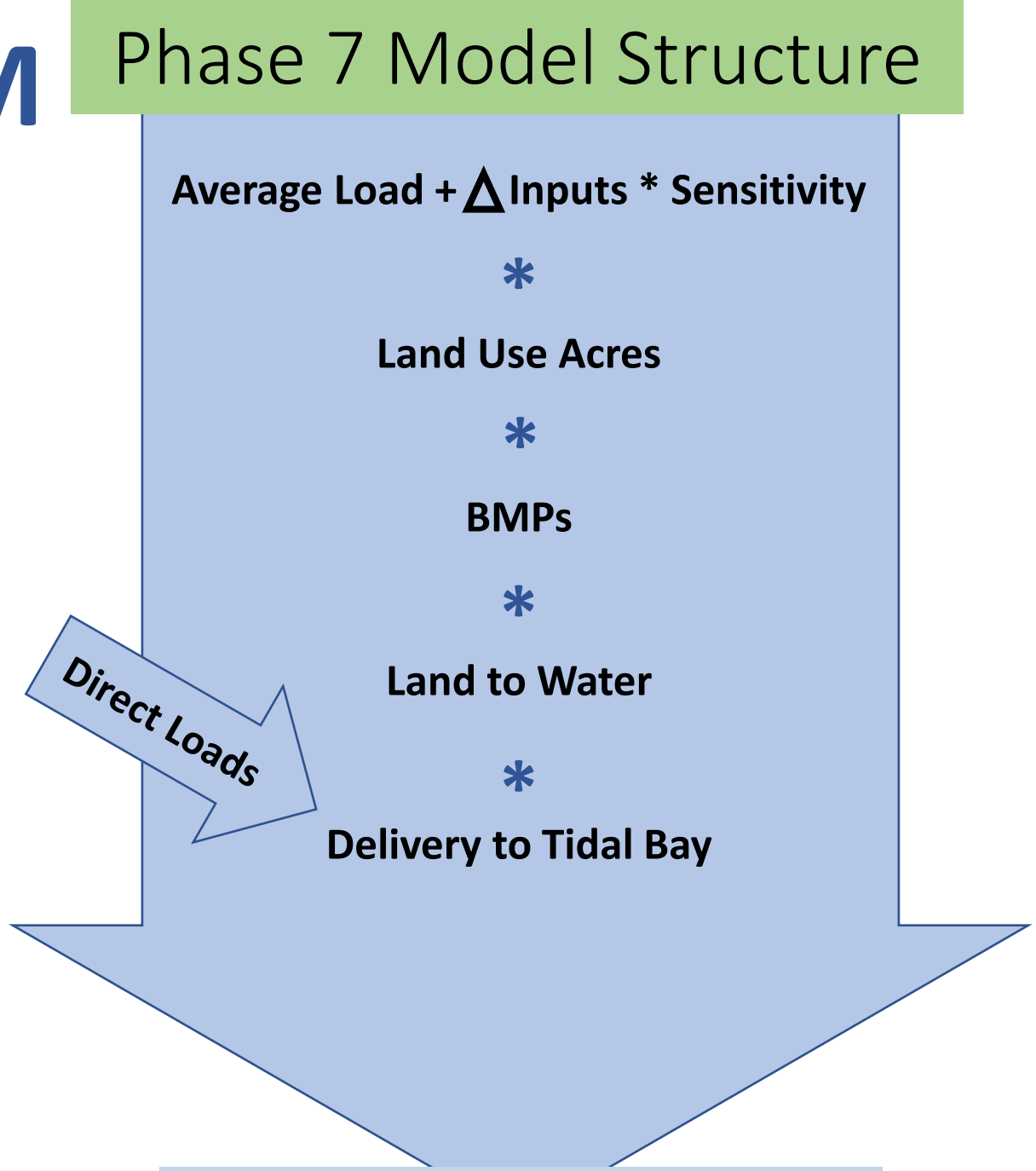
Programs & Projects

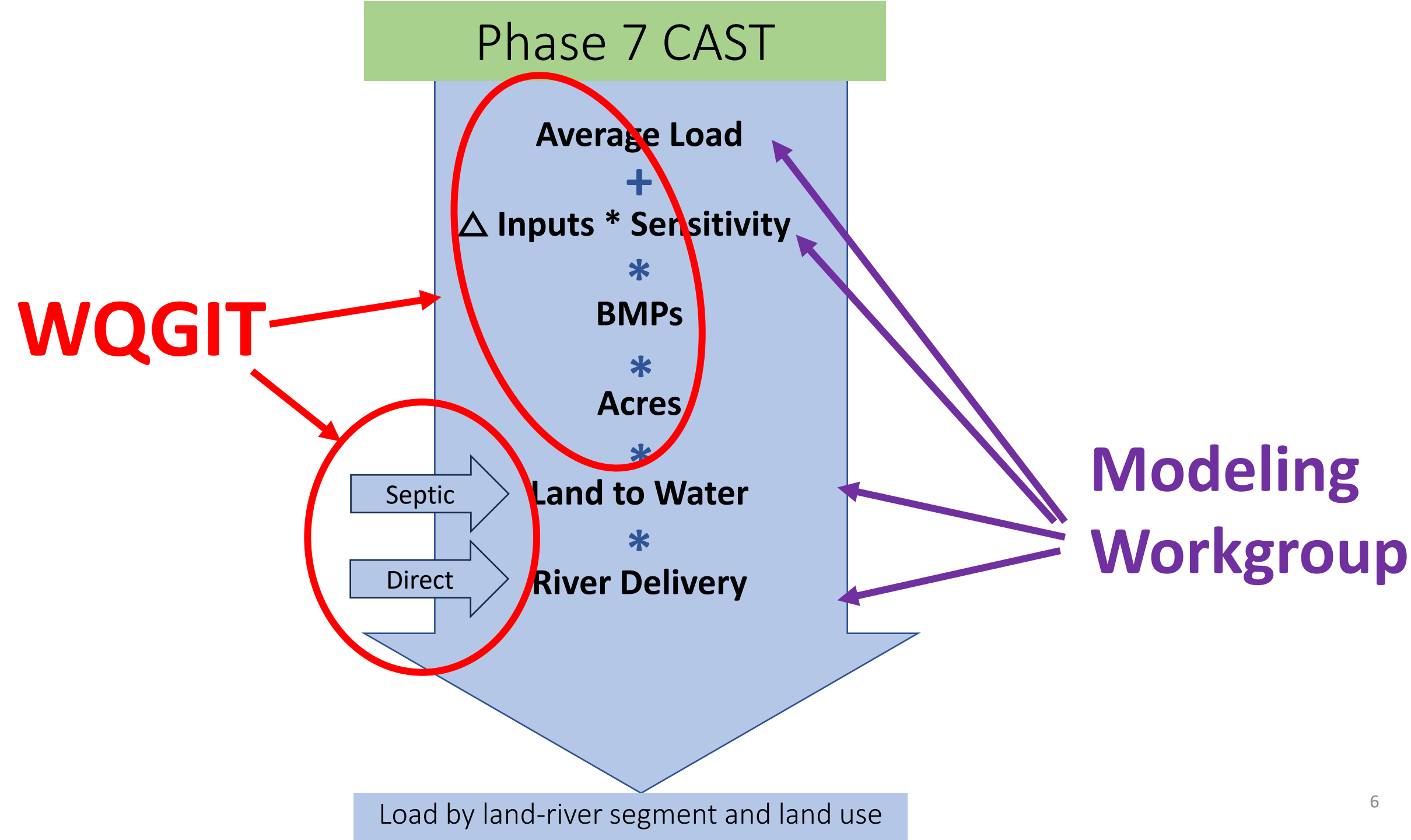
Modeling
Monitoring
Quality Assurance
Resource Lands Assessment
Chesapeake Bay TMDL
Watershed Implementation Plans
BMP Verification

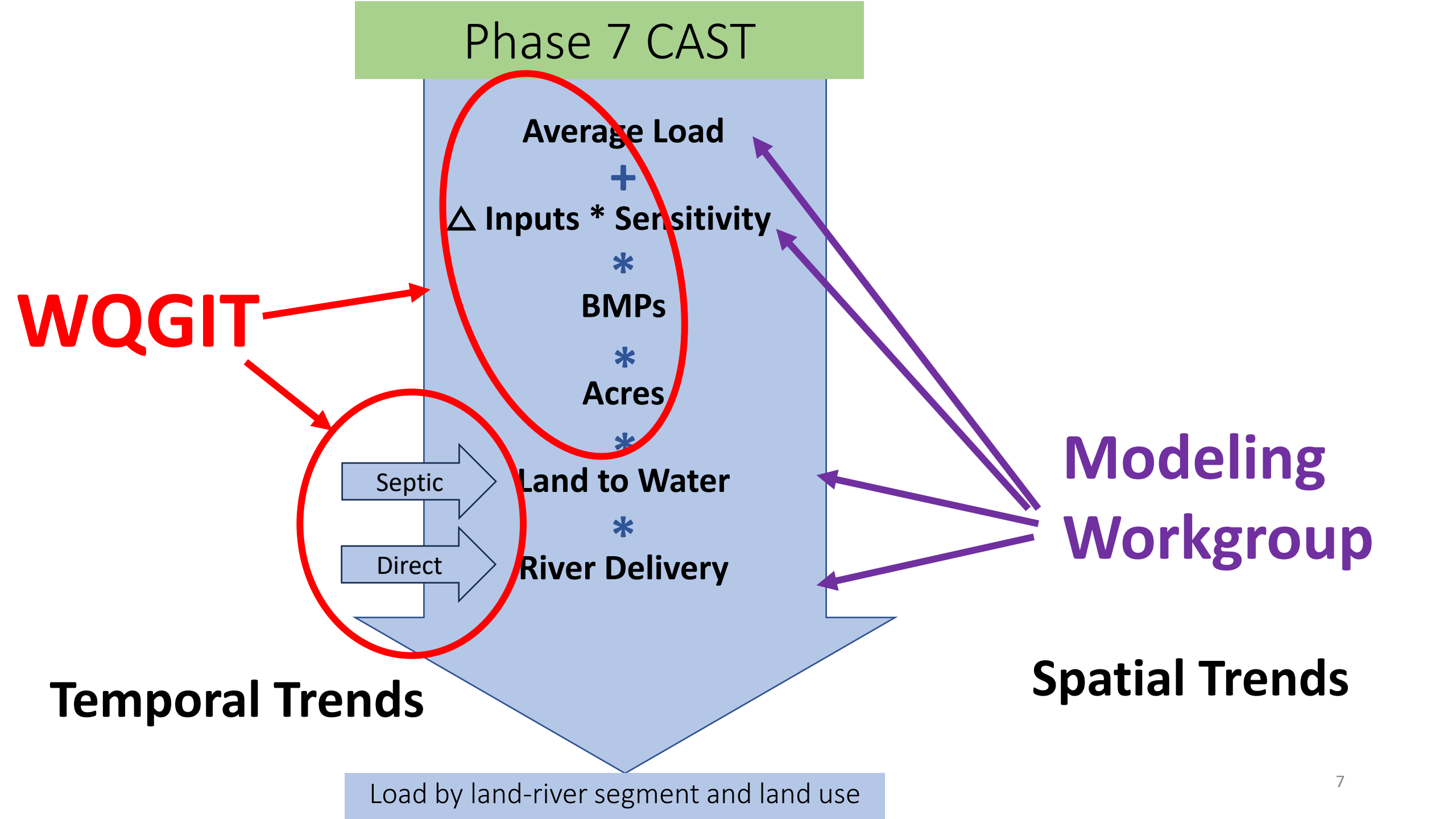
Cast/CalCast/DM

Phase 7
CAST

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




Phase 7 CAST
Average Load
+
Δ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery
Septic
Direct
WQGIT
Modeling Workgroup
Load by land-river segment and land use


Phase 7 CAST
Average Load
+
△ Inputs * Sensitivity
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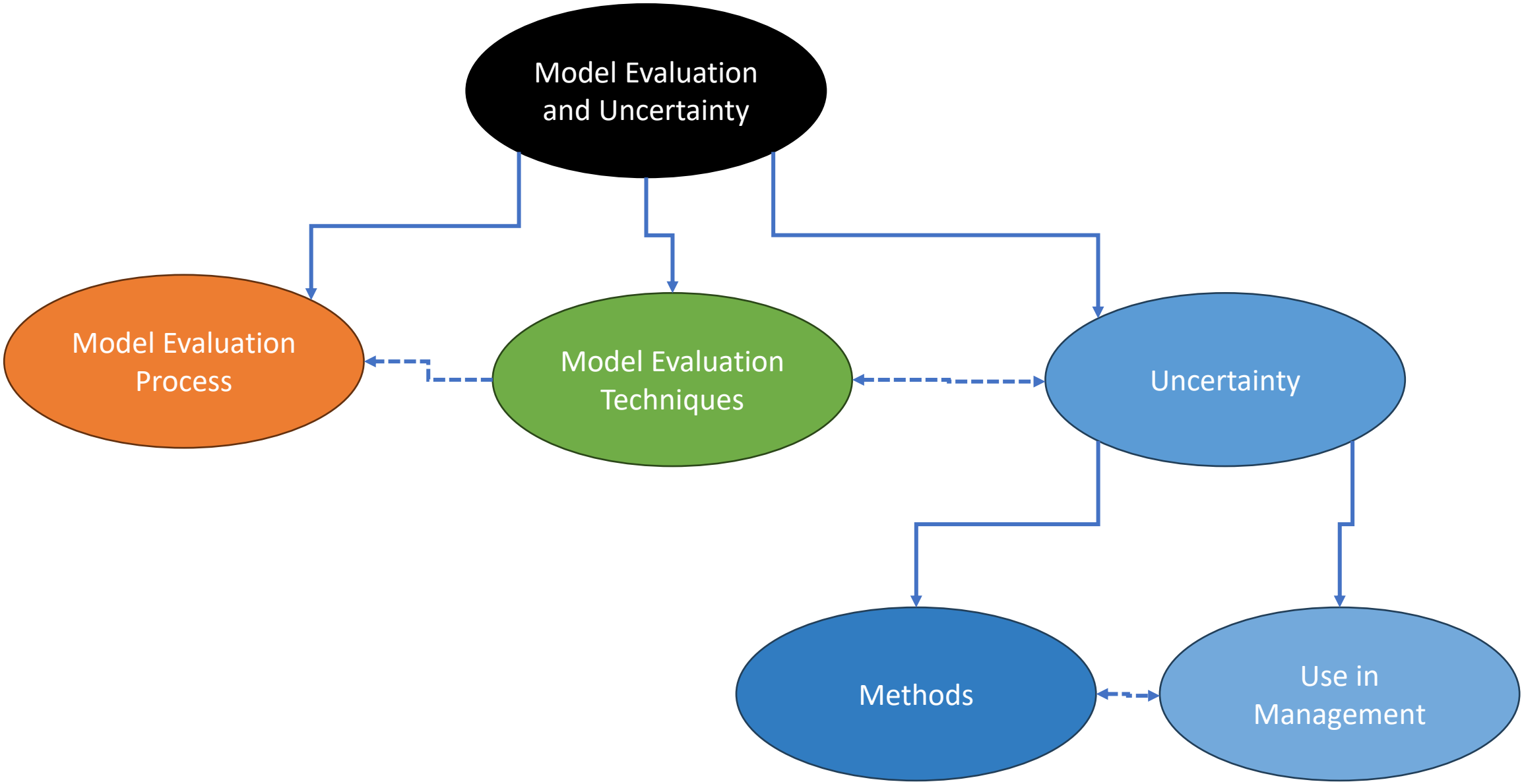
WQGIT
Septic
Direct
Modeling Workgroup
Temporal Trends
Spatial Trends
Load by land-river segment and land use

Partnership Discussions - WQGIT

- Scale
- Model Evaluation and Uncertainty
  - Discussion group formed
  - History of uncertainty discussion
  - Methods
  - Use in management

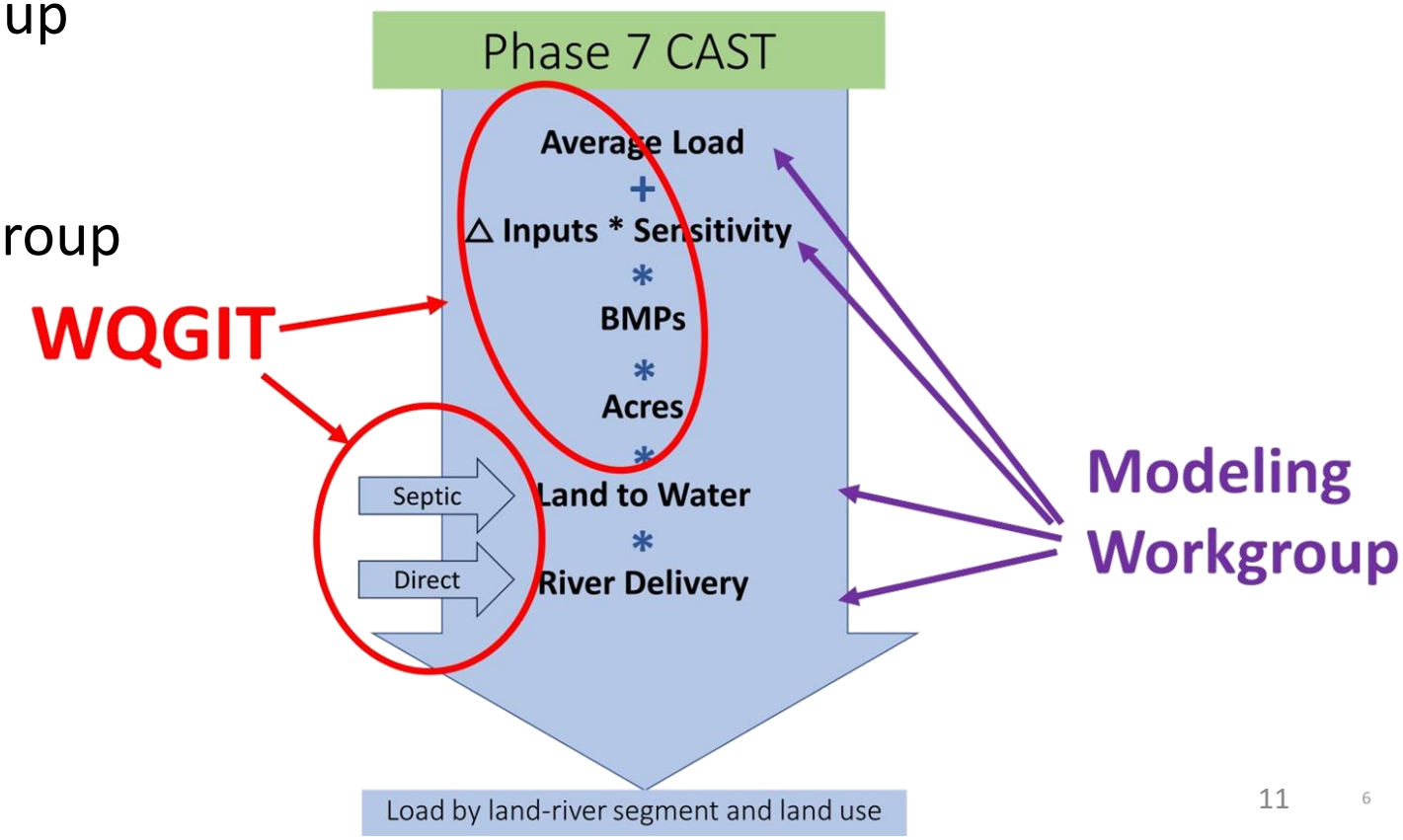
Watershed Models Scales

- **CalCAST** is being developed at the **NHD100k** scale to incorporate more monitoring data and to support finer scale modeling
- The **Dynamic Model** will run at the **NHD100k** scale because it is required by the estuarine model
- **Phase 7 CAST will be built at the scale that the WQGIT decides**


Model Evaluation and Uncertainty
Model Evaluation Process
Model Evaluation Techniques
Uncertainty
Methods
Use in Management

Partnership Discussions – WQGIT Workgroups

- Workgroups
  - Wastewater Treatment Workgroup
  - Urban Stormwater Workgroup
  - Forestry Workgroup
  - Timber Harvest Task Force
  - Watershed Technical Workgroup
- Discuss
  - Land uses
  - Inputs
  - BMPs
  - Sources
  - Loading ratios



Phase 7 CAST

Average Load

Δ Inputs * Sensitivity

*

BMPs

*

Acres

*

Land to Water

*

River Delivery

Phase 6 method

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed

Average Loads

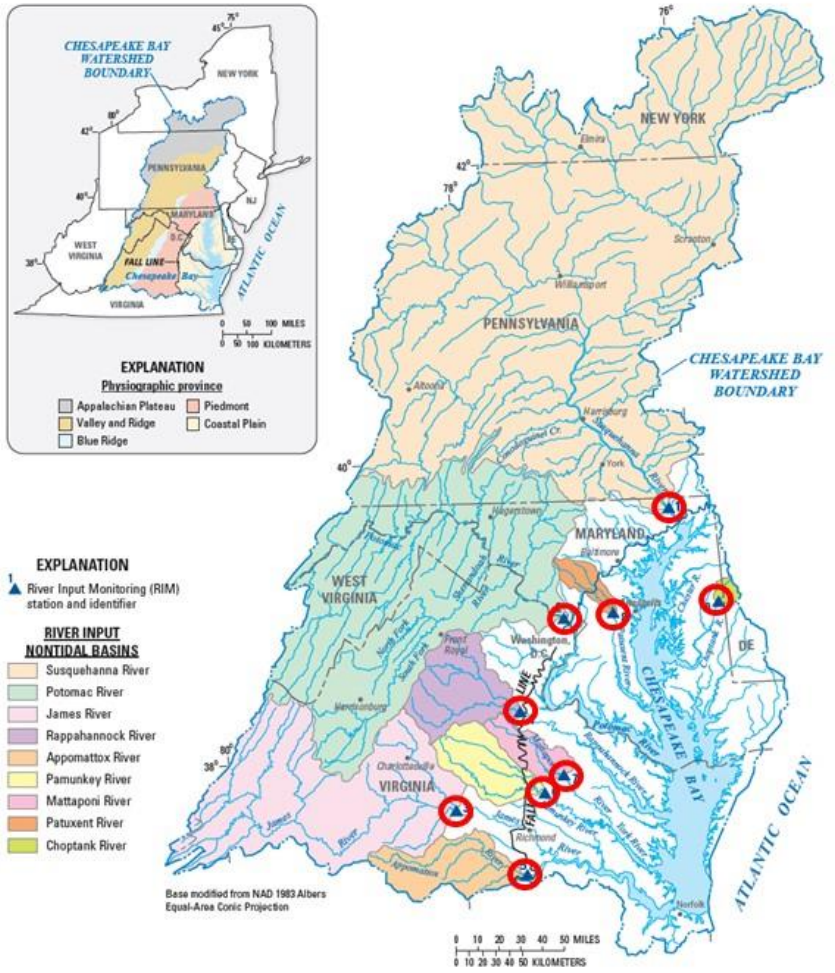
Estimate Total Non-point Source

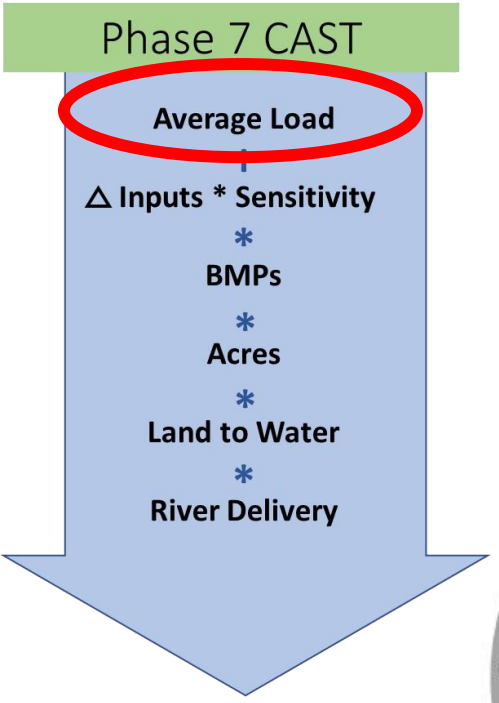
Modeling Workgroup

Monitoring Data

subtract point source

divide by transport

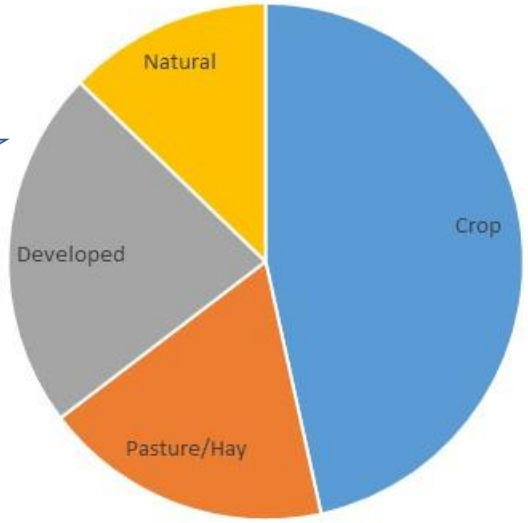




Phase 6 method

Average Loads

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed



Divide into Broad Classes

Modeling Workgroup

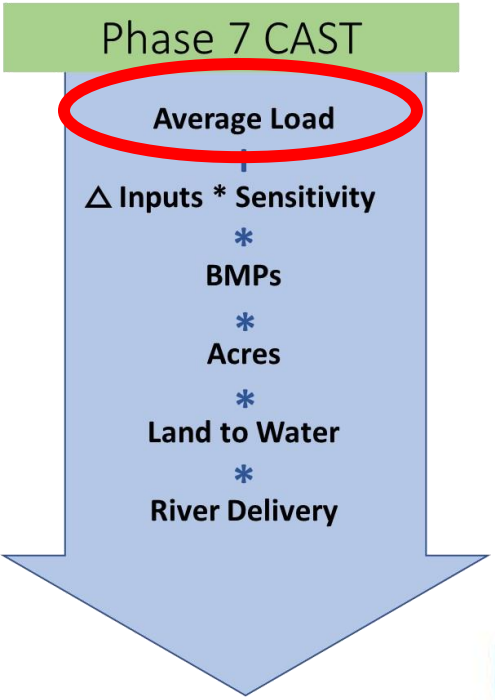
P5: Multiple models

Phase 5.3.2

Sparrow

CEAP

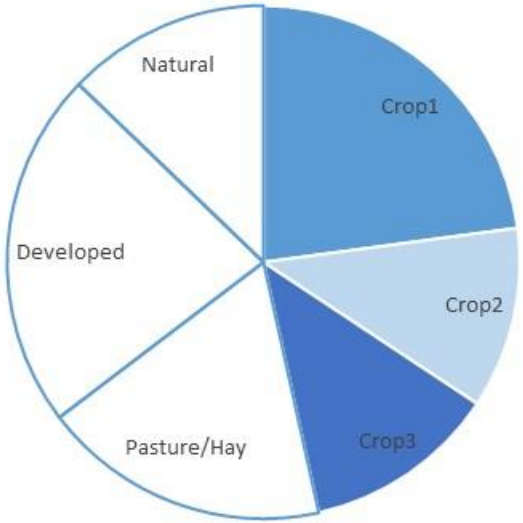
P6: Multiple Models and CalCAST



Phase 6 method

Average Loads

Average Loads – Average edge-of-small-stream loading rate for a given land use for the entire CB watershed



Split Classes into individual land uses

MWG and WQGIT Workgroups

Multiple lines of evidence to develop ratios

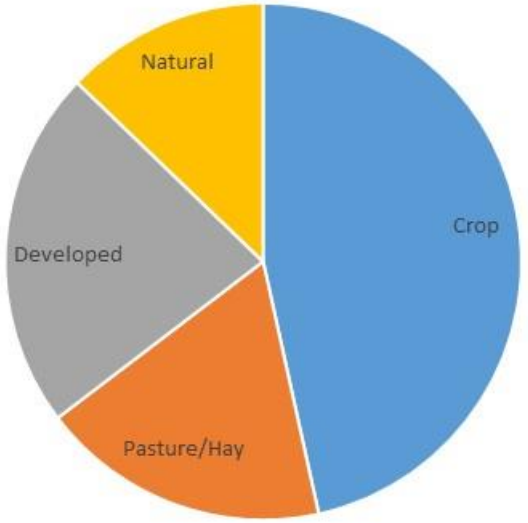
- for example silage is 16% higher than grain

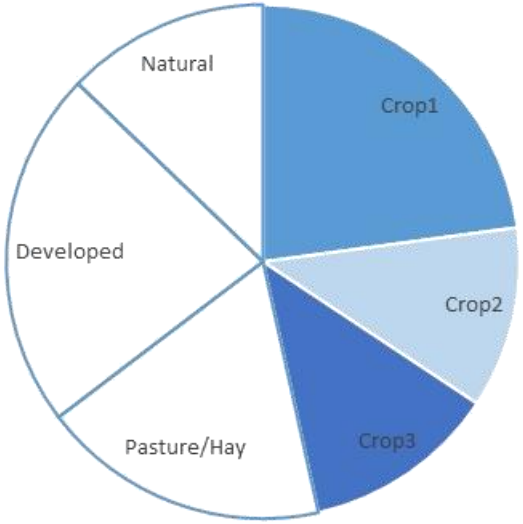
Phase 7 CAST

Average Load
+
Δ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery

Phase 7 method

Simultaneous Estimation with CalCAST





$$\mathrm{NPS}_{l,c,t} = \left(\mathrm{CLR} \times \mathrm{RC}_{cl_l} \times \mathrm{RL}_l + \sum_i \left(\left(\mathrm{Input}_{i,l,c,t} - \widehat{\mathrm{Input}_{i,l}} \right) \times \mathrm{Sens}_{i,cl_l} \times \mathrm{RL}_l \right) \right) \times \mathrm{Acres}_{l,c,t} \times BMP_{i,c,t}$$

Phase 7 CAST

Average Load
+
Δ Inputs * Sensitivity
*
BMPs
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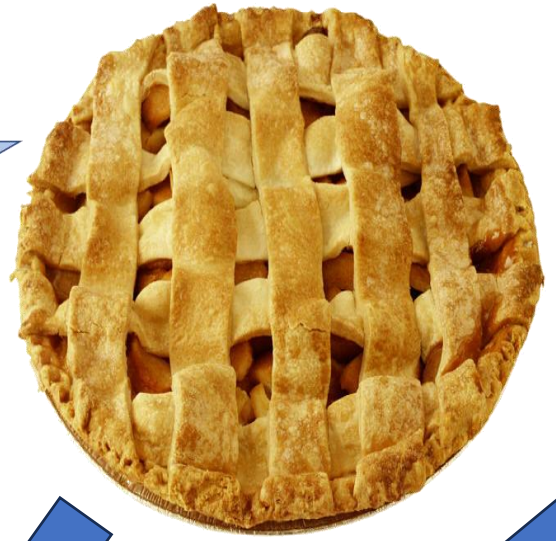
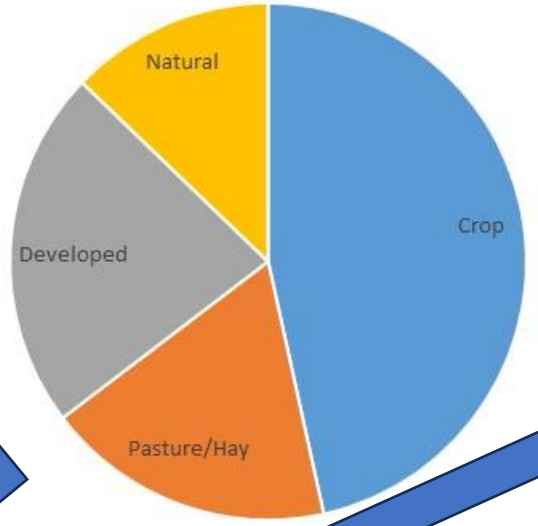
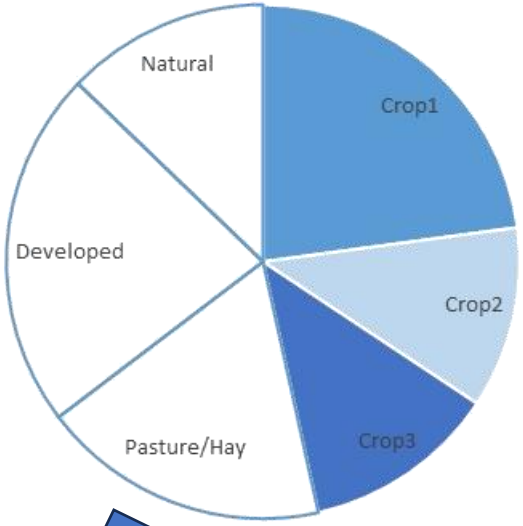
*
Land to Water
*
River Delivery

Phase 7 method

Simultaneous Estimation with CalCAST







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Phase 7 CAST

Average Load
+
Δ Inputs * Sensitivity
*
BMPs
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Acres
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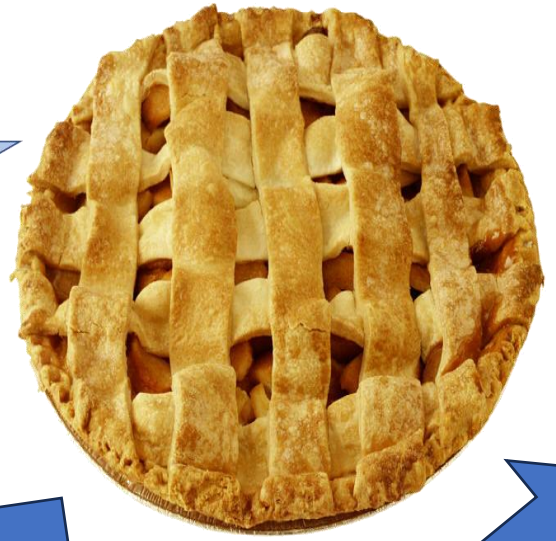
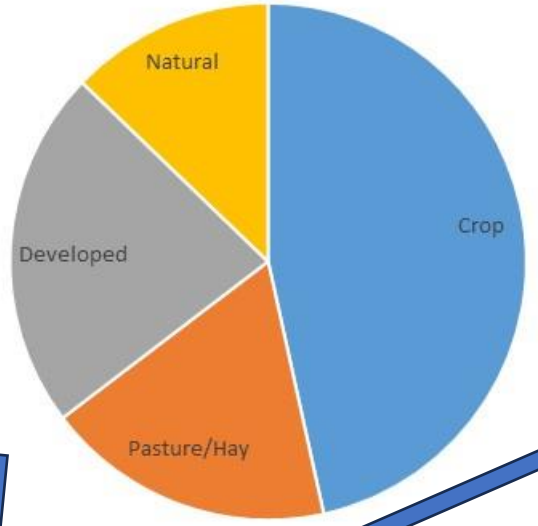
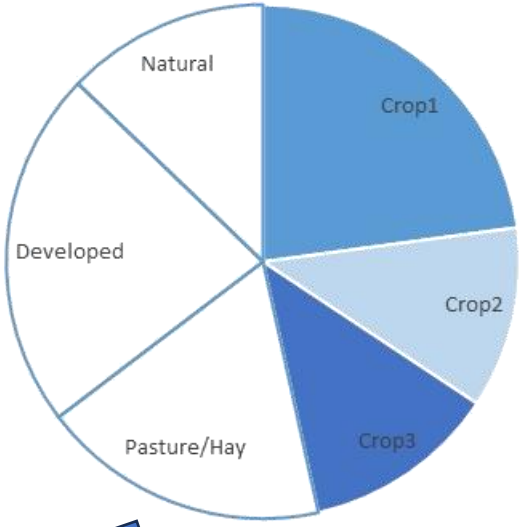
Land to Water
*
River Delivery

Phase 7 method

CalCAST can help identify parameters







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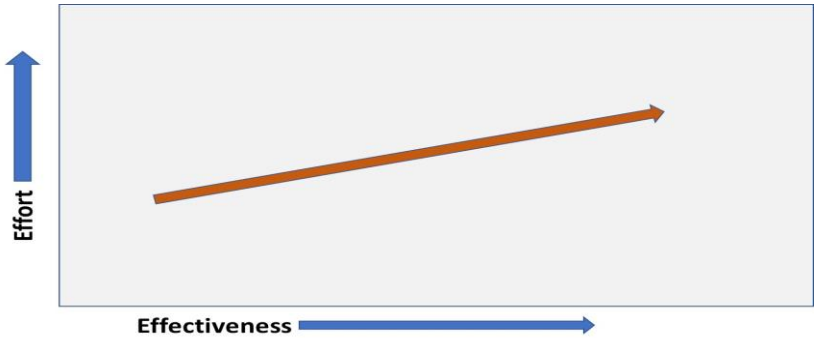
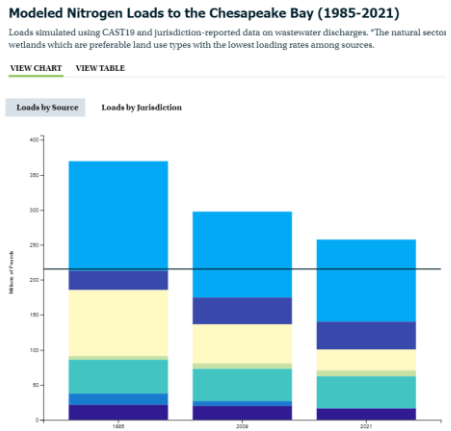
Consistency > Accuracy

Spatial and temporal trends are more important that the absolute value



Spatial - Model used to allocate responsibility between jurisdictions



Temporal - Model used to track TMDL, based on changes since 1995

Data Ideals

Wastewater Treatment WG topics

- Boat Discharges
- WWTP
  - Drinking Water plants
- CSOs
- SSOs and Bypass
- Exfiltration

Phase 7 CAST Structure

Informs

Constrains

Average Load
+
Δ Inputs * Sensitivity
*****
BMPs
*****
Acres
*****
Land to Water
*****
River Delivery

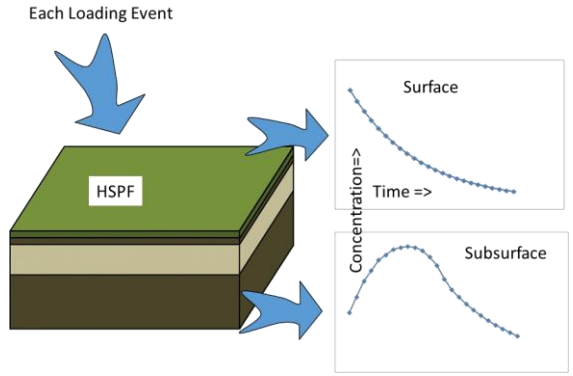
Load by land-river segment and land use

CalCAST

Average Load
+
Δ Inputs * Sensitivity
*****
BMPs
*****
Acres
*****
Land to Water
*****
River Delivery

Load by land-river segment and land use

Dynamic Watershed Model



CAST model documentation; section 1
https://cast.chesapeakebay.net/Documentation/ModelDocumentation

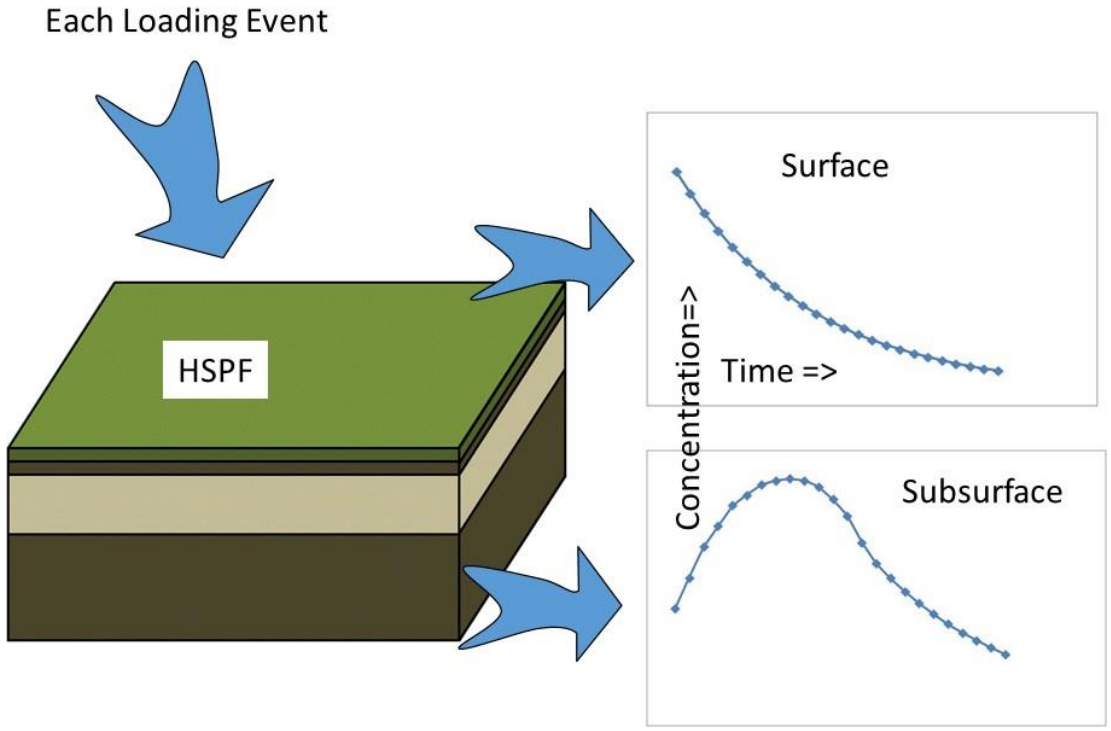
Cast/CalCast/DM

Phase 7

Dynamic Model

Tool for

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



Gopal Bhatt

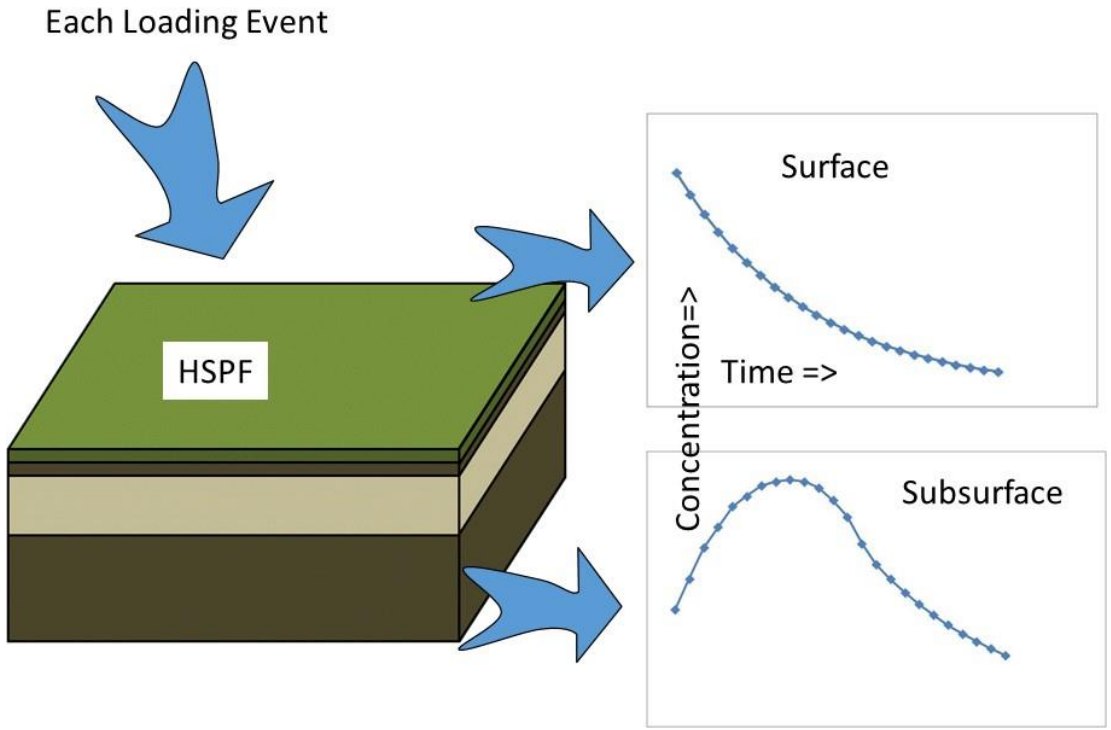
Cast/CalCast/DM

Phase 7

Dynamic Model

Nitrogen – making significant progress

Starting phosphorus and sediment



Gopal Bhatt

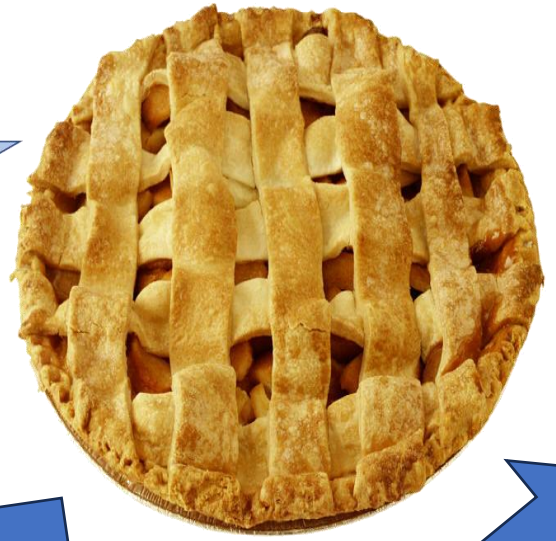
Phase 7 CAST

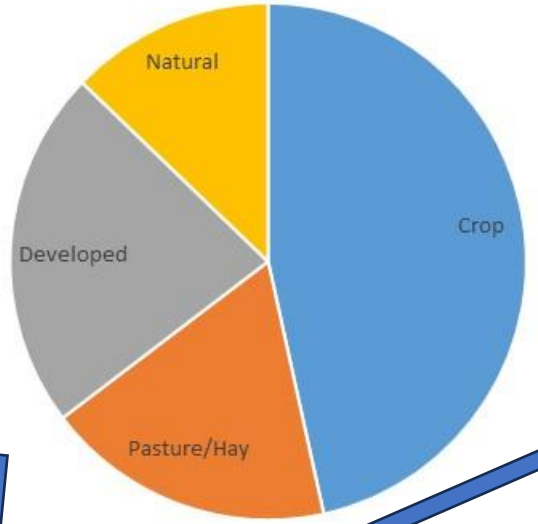
Average Load
+
Δ Inputs * Sensitivity
*
BMPs
*
Acres
*
Land to Water
*
River Delivery

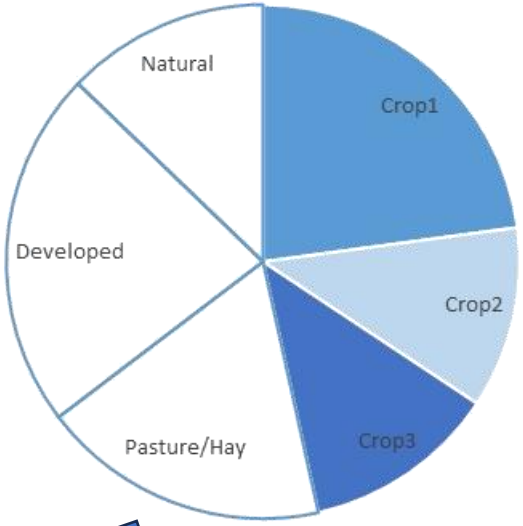
Phase 7 method

Isabella Bertani

CalCAST can help identify parameters







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Phase 7 CAST

Average Load
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△ Inputs * Sensitivity
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BMPs
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Acres
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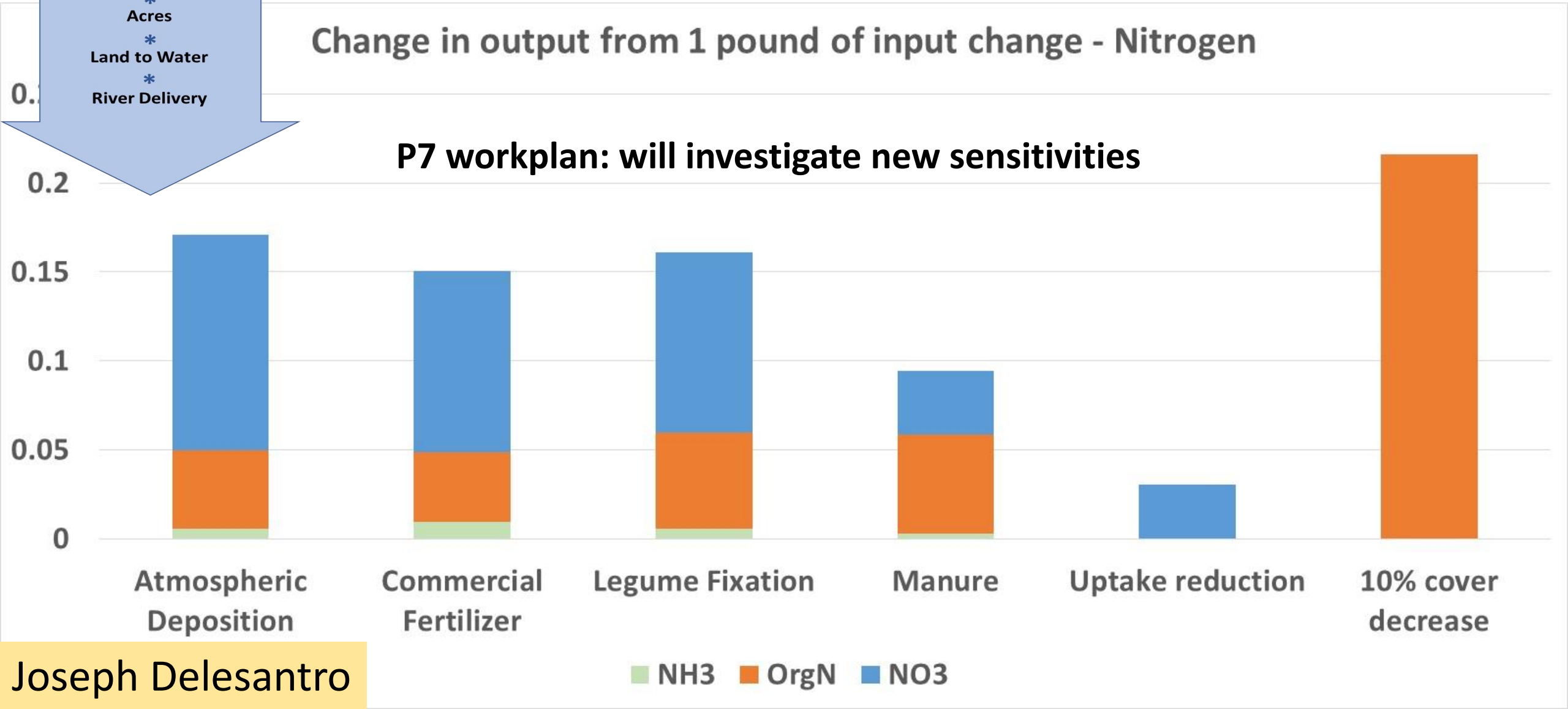
Land to Water
*
River Delivery

Double Cropped land

Sensitivities – all else being equal…



Joseph Delesantro

Watershed Model Plan – Big Picture

2022	2022	2022	2022	2023	2023	2023	2023	2024	2024	2024	2024	2025	2025	2025	2025	2026	2026	2026	2026
1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Work plan			Build	Work plan	Build Models			Work plan	Build Models			Work plan	Build Models			Review Models			

Build Model Structure

Improve Models

Review Models

Phase 7 Watershed Model Plans

CBPO Staff

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1/5/2024