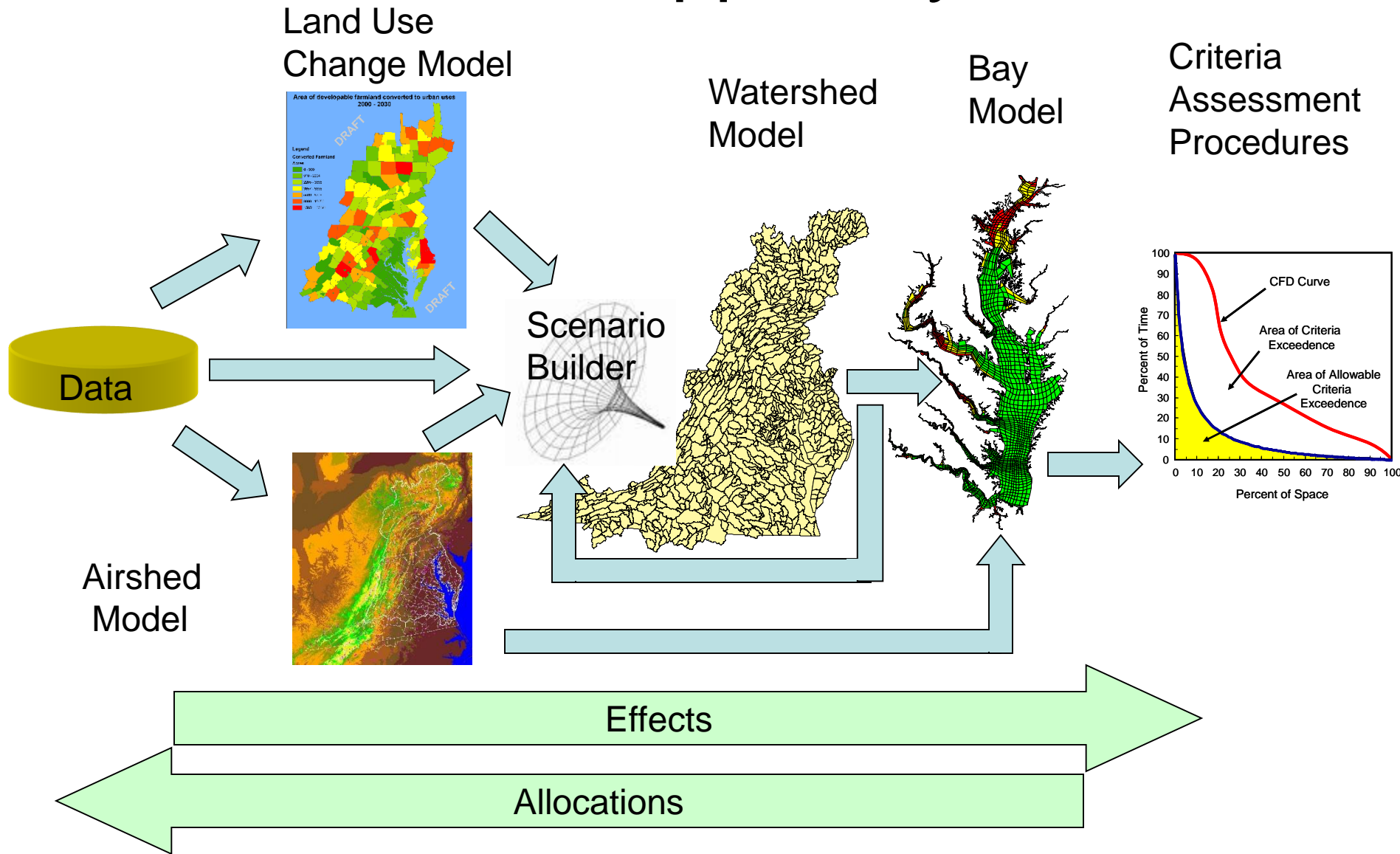
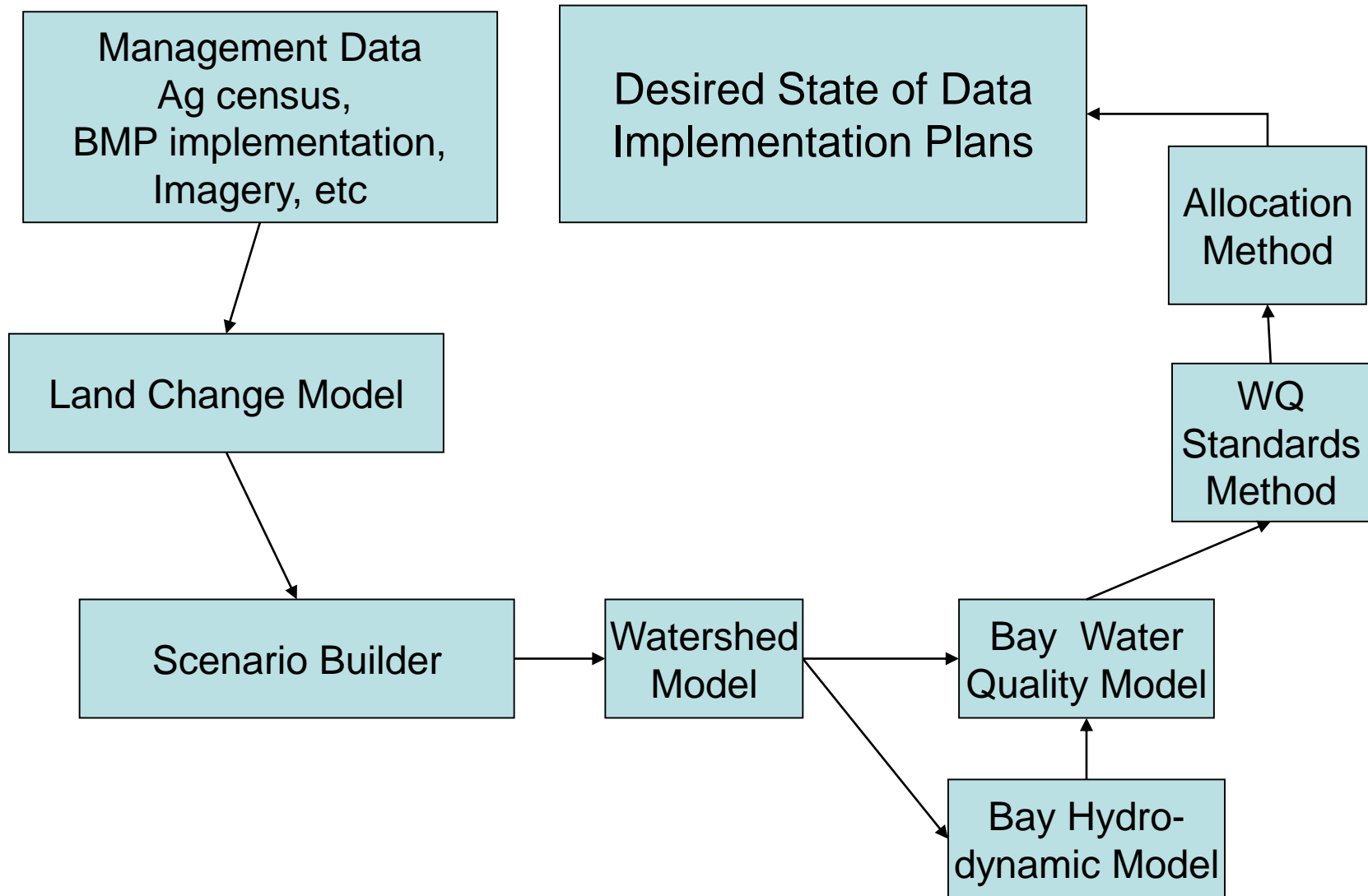


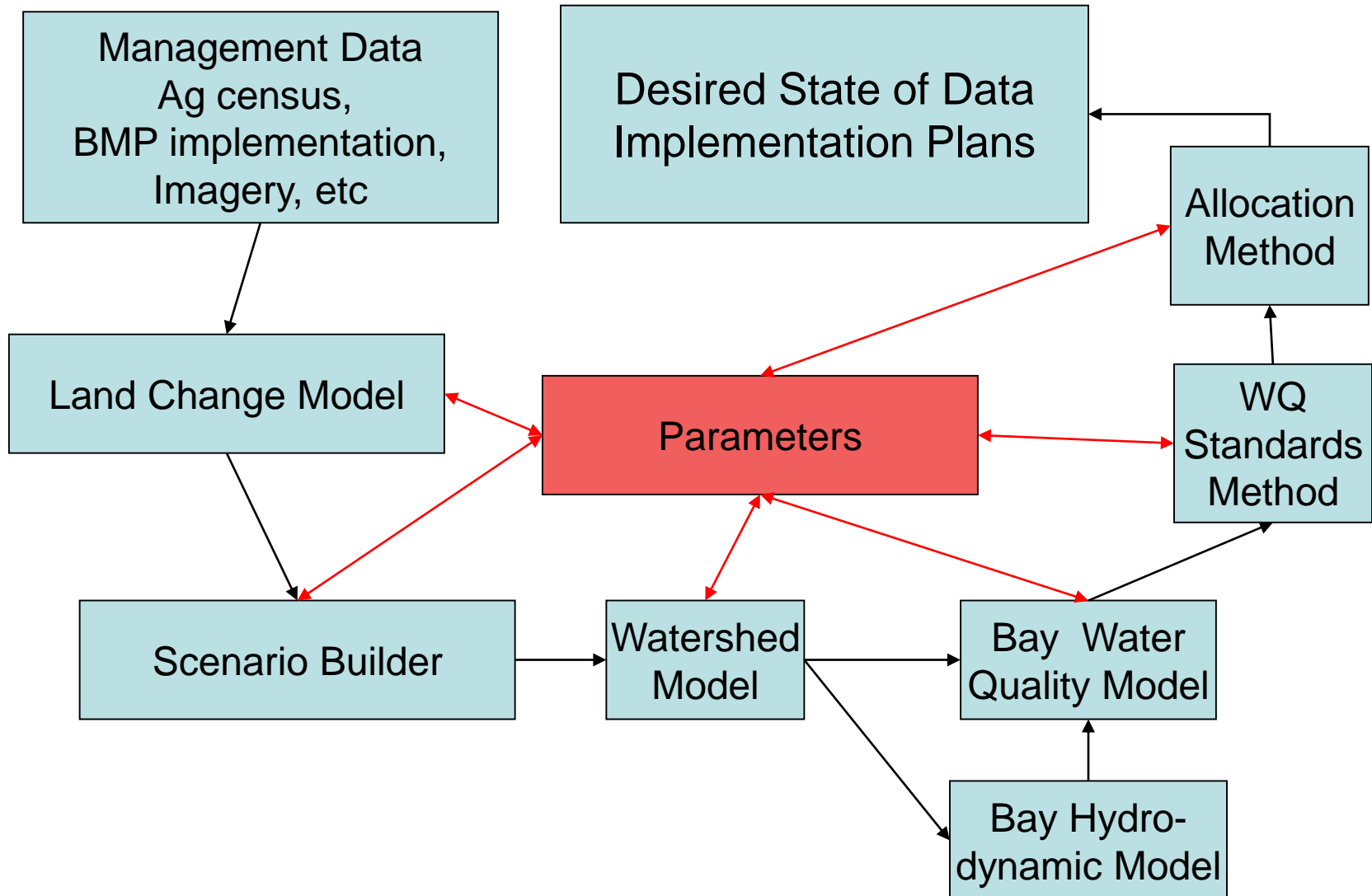
Chesapeake Bay Program Decision Support System



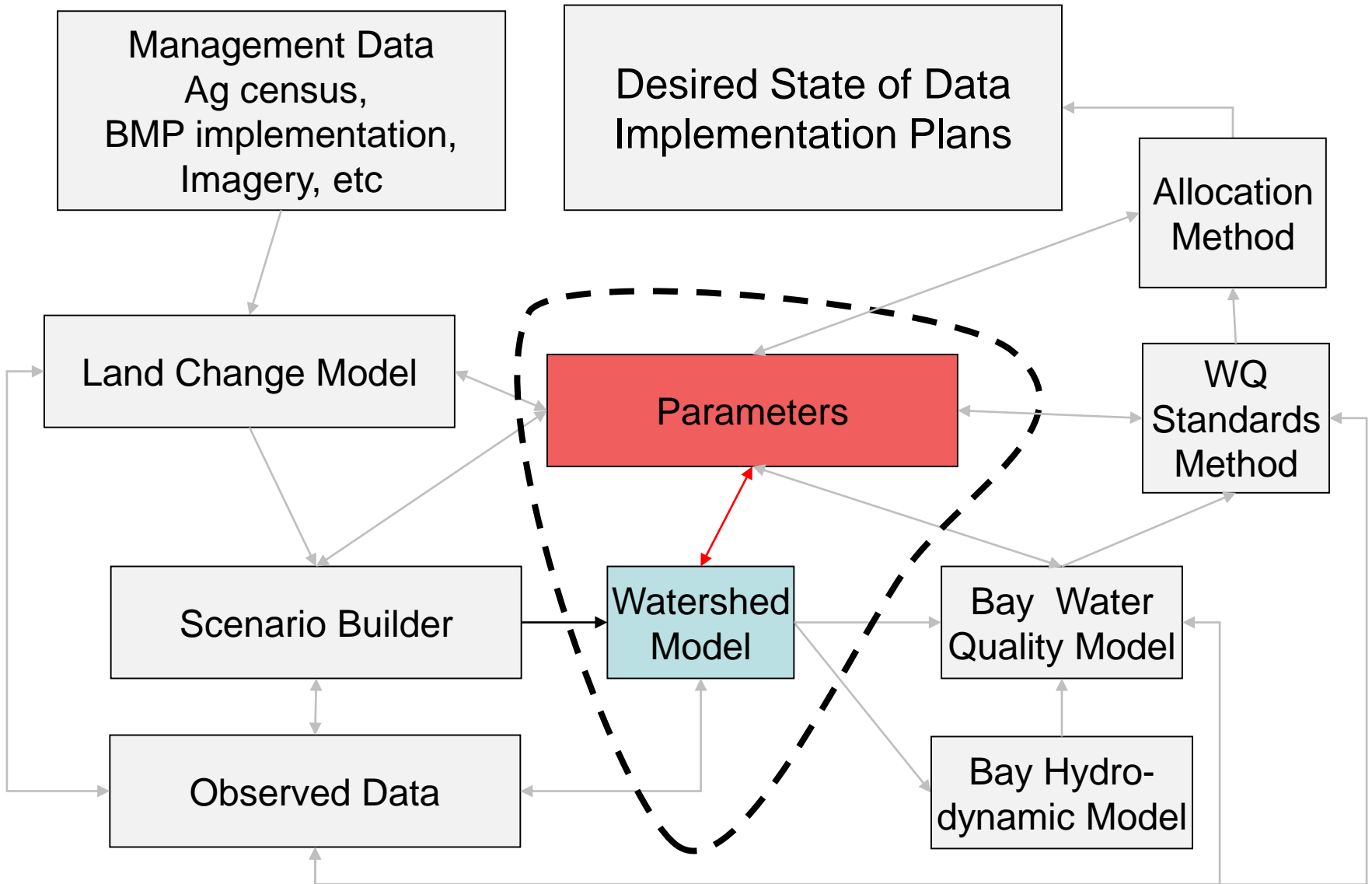
Decision Algorithm



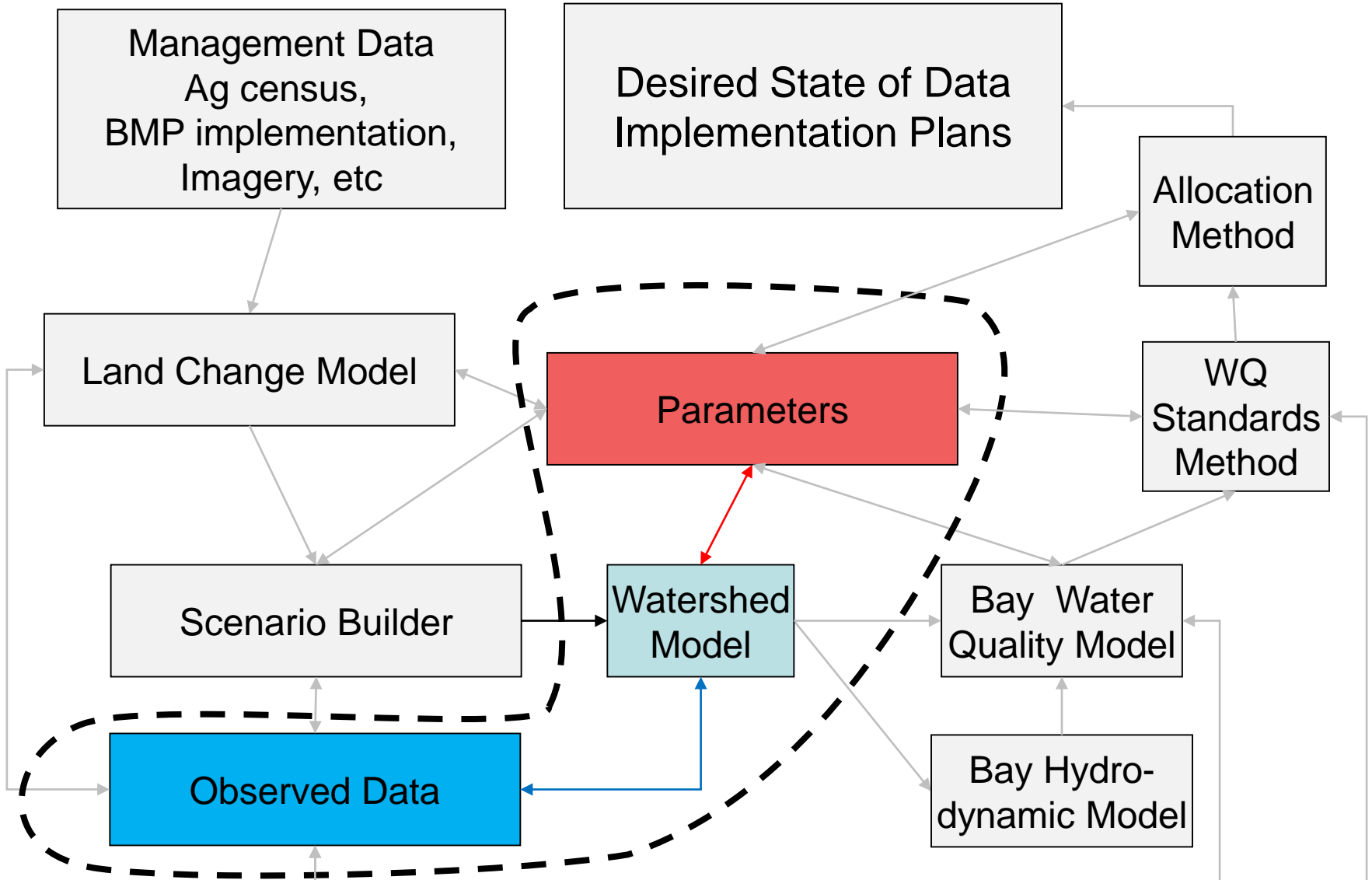
Decision Algorithm



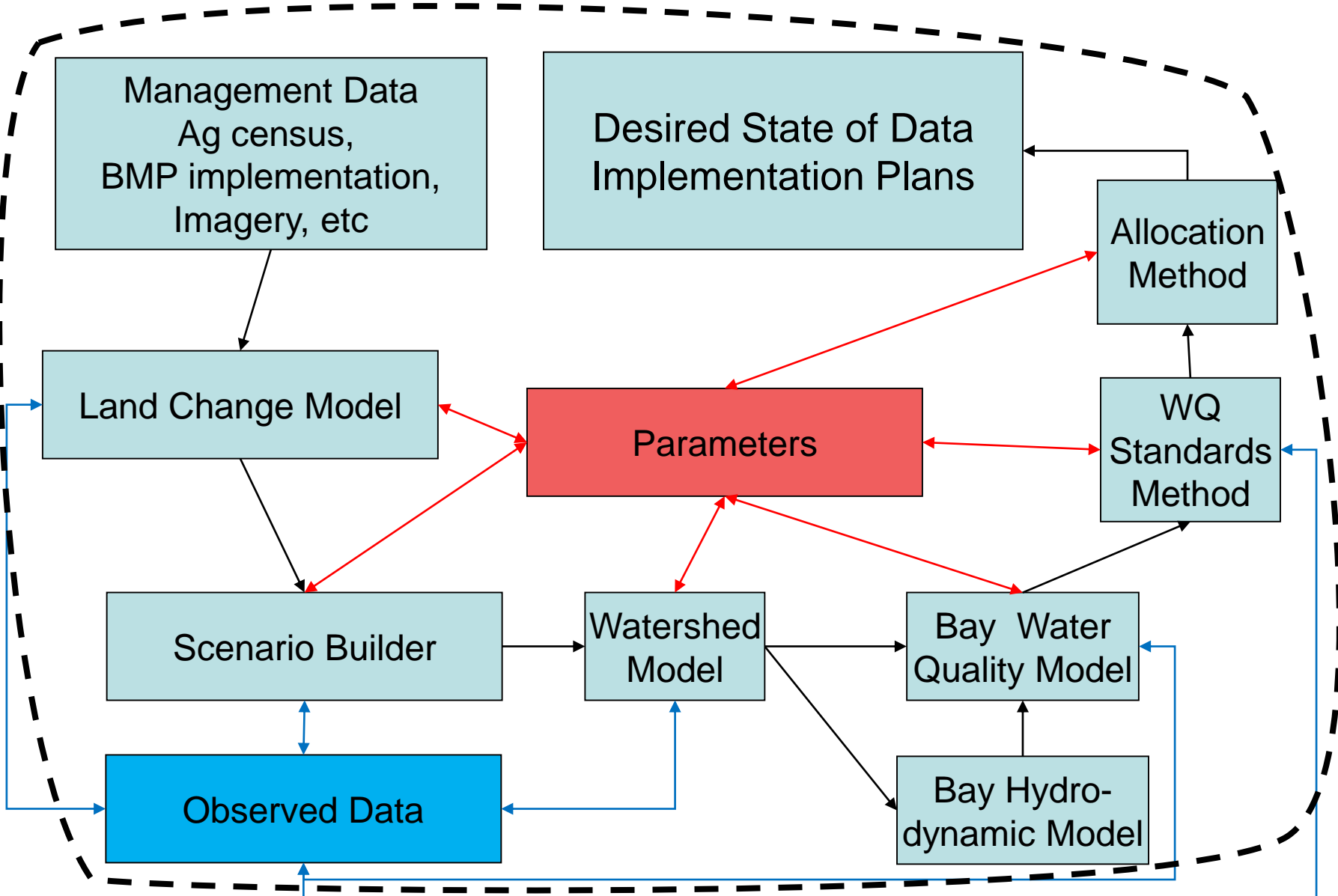
Uncertainty Quantification



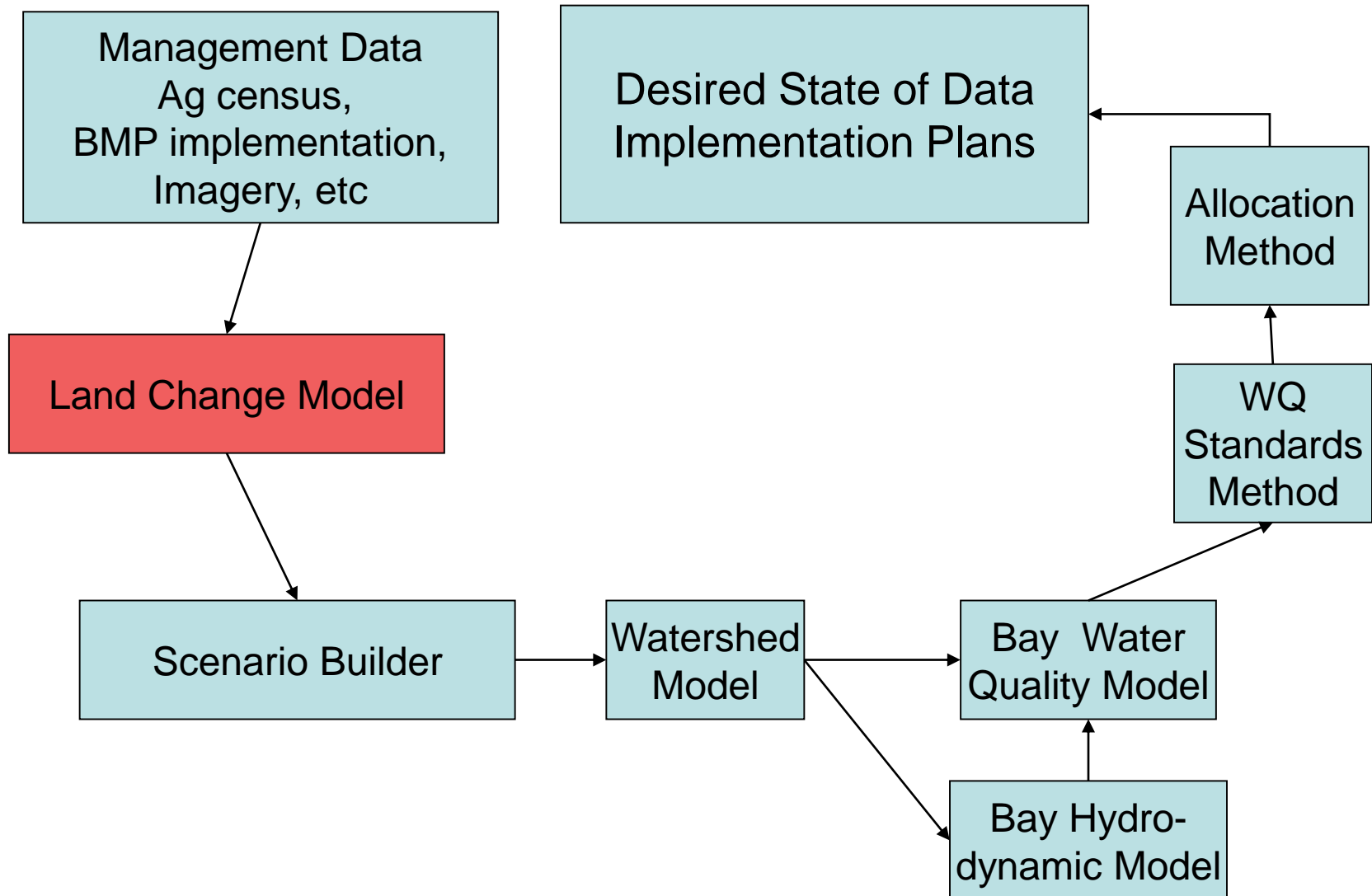
Uncertainty Quantification



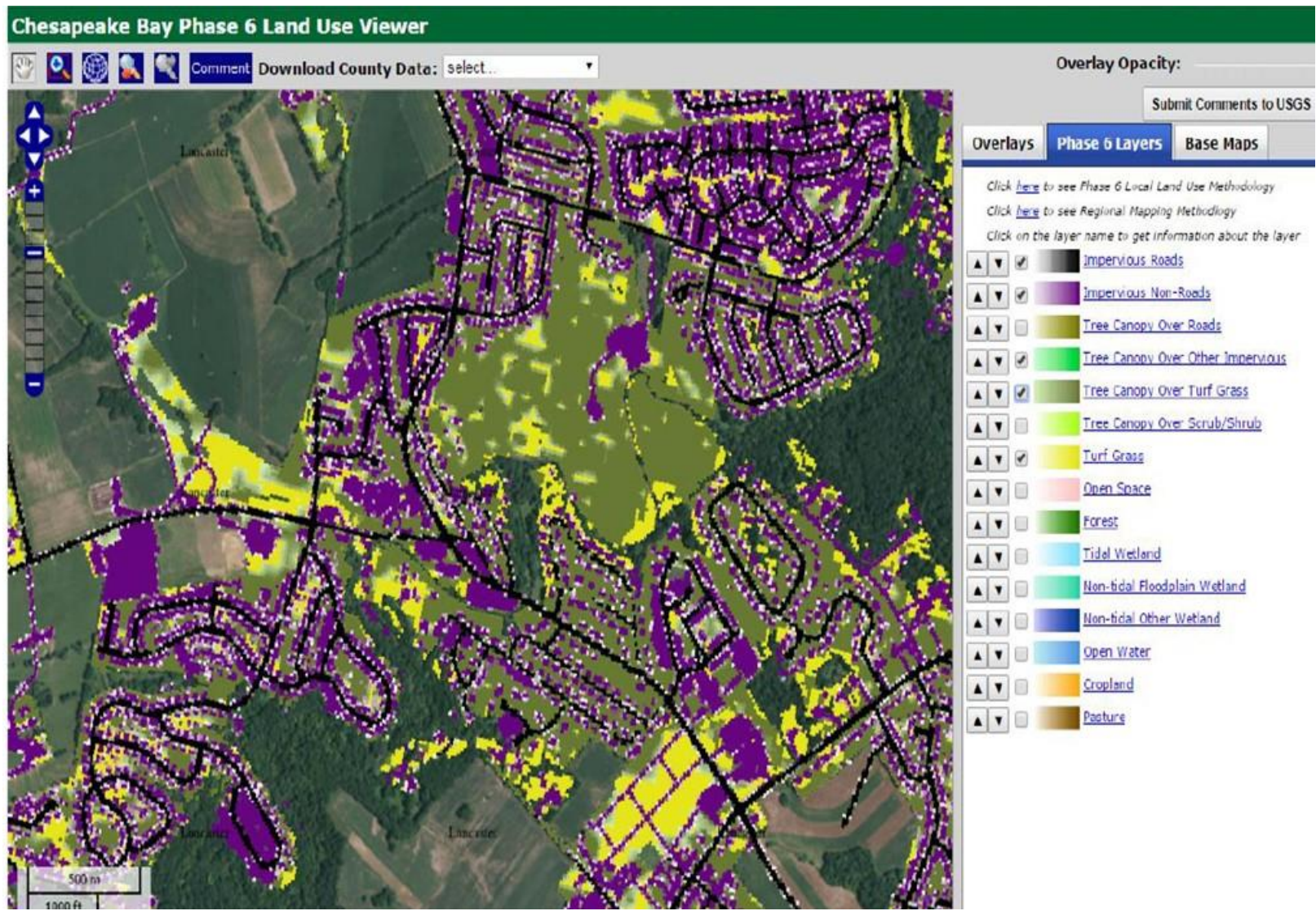
UQ for WIPs



Decision Algorithm

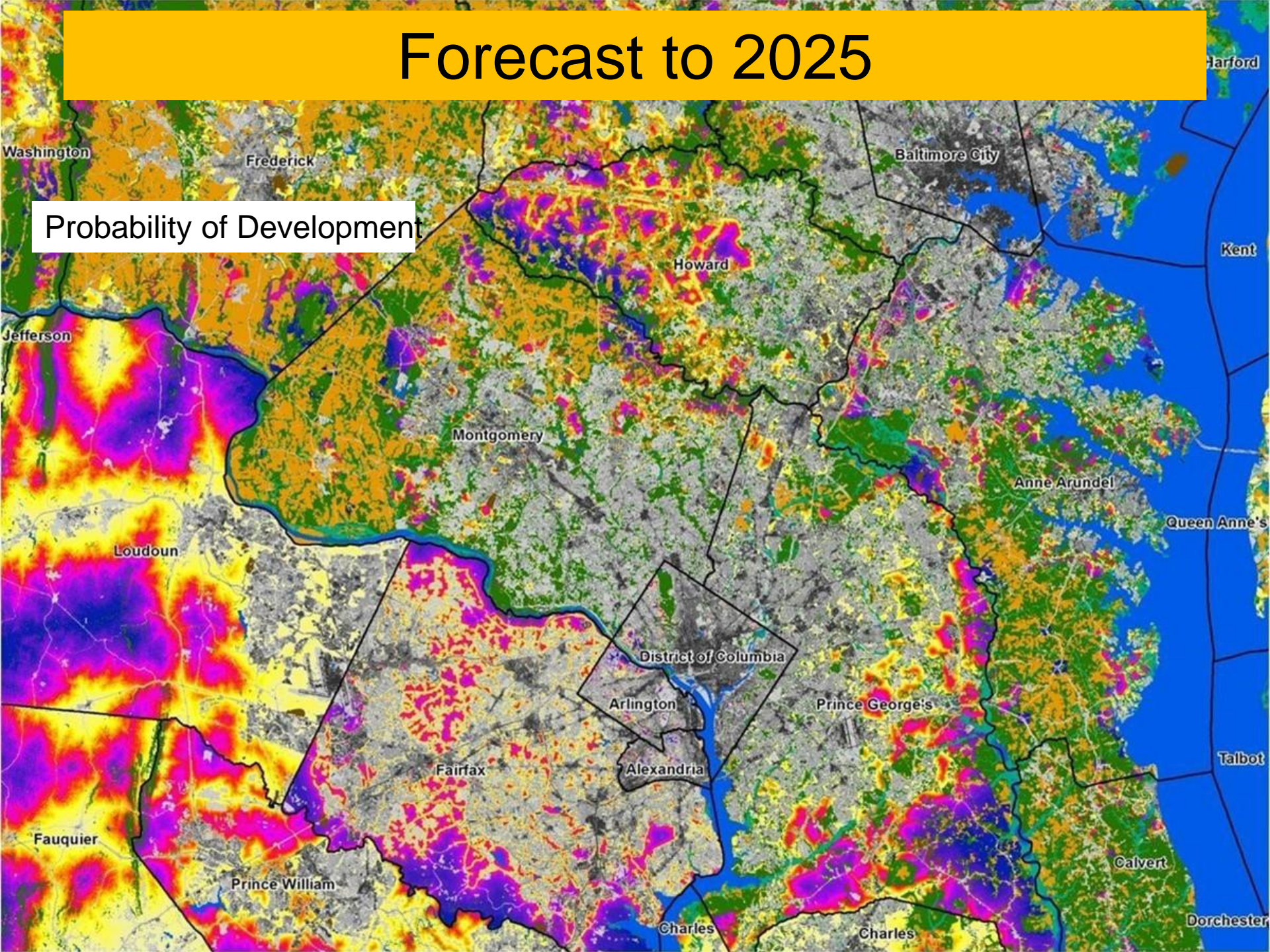


Start with 1-10 meter raster data



Forecast to 2025

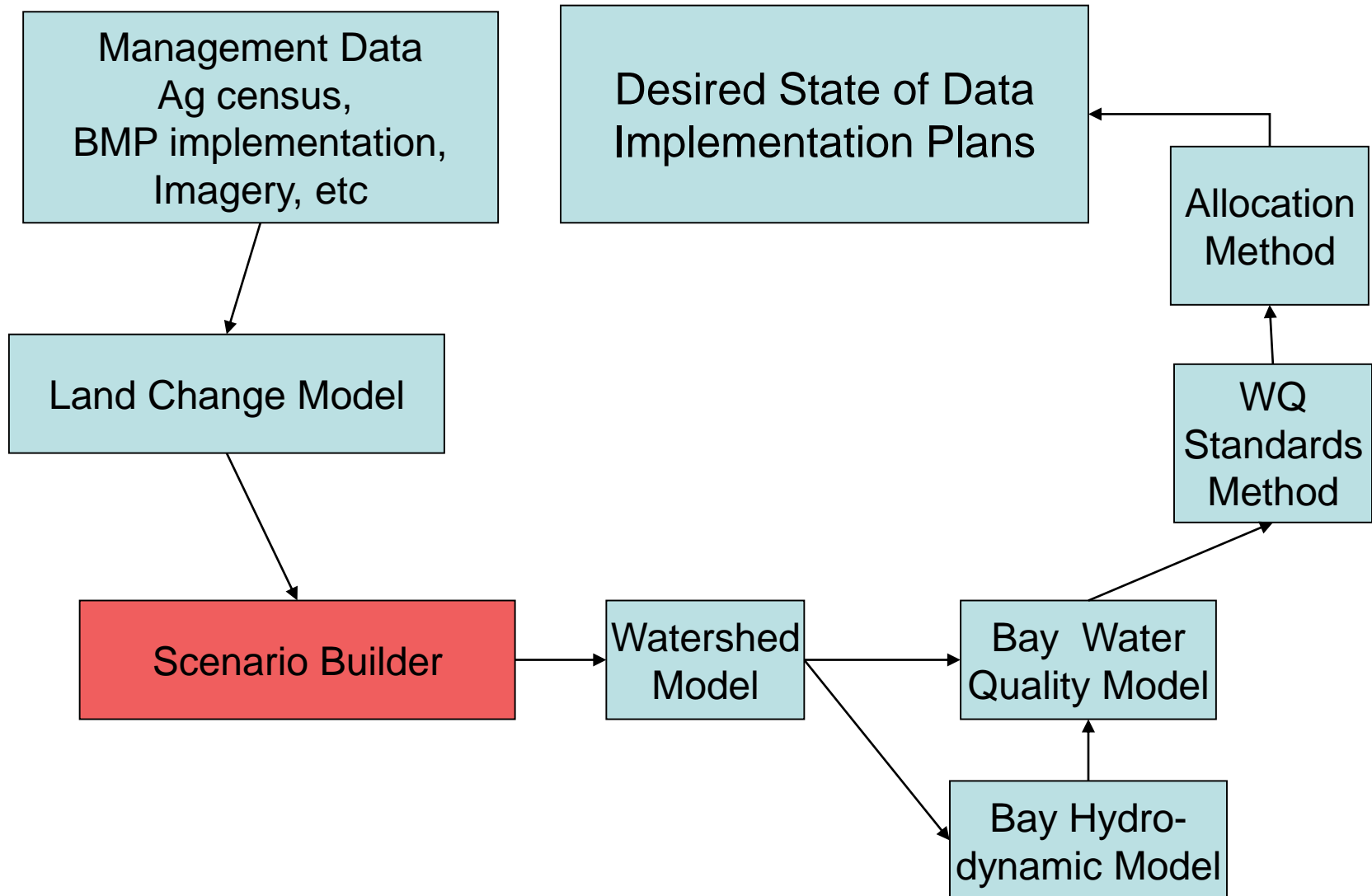
Probability of Development



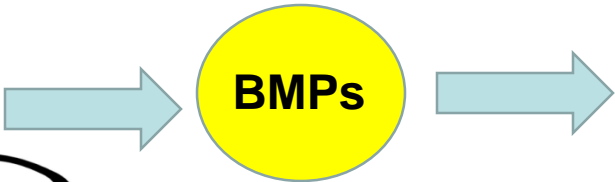
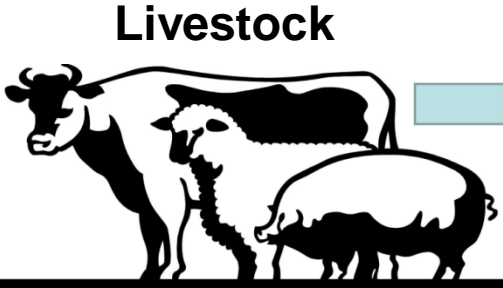
Land Change Model

- Run time
 - 50 processor hours
- Sensitive parameters
 - 8
- Calibration Data
 - Watershed wide every 5 years
 - Dense temporal and spatial data for a few counties

Decision Algorithm



Scenario Builder



Manure storage practice



Pasture



Crops



Fertilizer



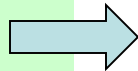
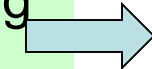
Image Credits
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<http://pubs.ext.vt.edu/442/442-308/442-308.html>

Sample Input and Output

Inputs

- BMP implementation
- Remote Sensing
- Crop acreage

- Crop yield
- Animal numbers



Parameters

- BMP effects on land use
- Tillage Type
- Plant and harvest dates
- Nutrient application by crop type
- Animal manure nutrient content



Outputs

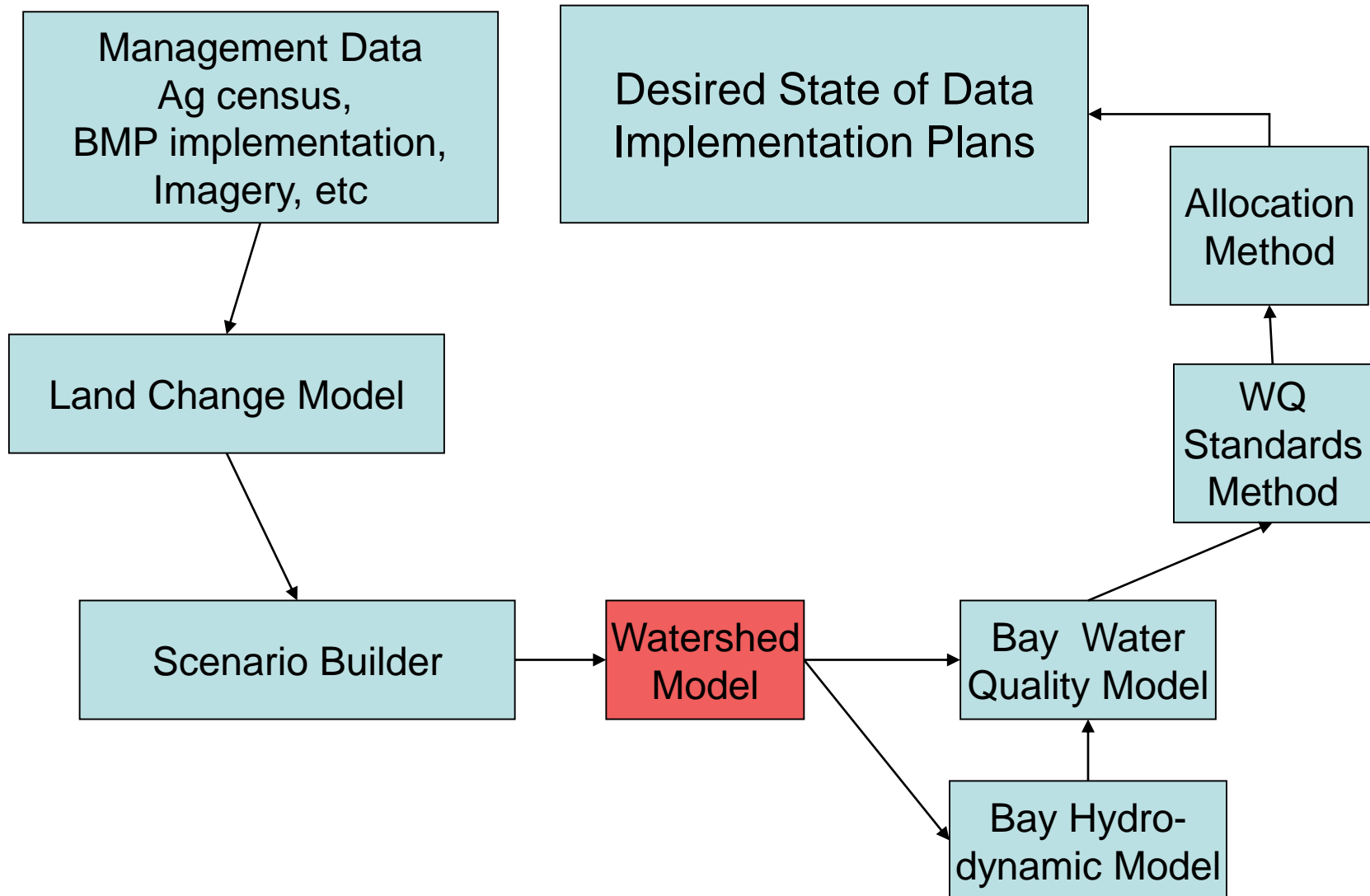
- BMP implementation on phase 5 scale
- Land use

- Crop Uptake
- Fertilizer
- Manure

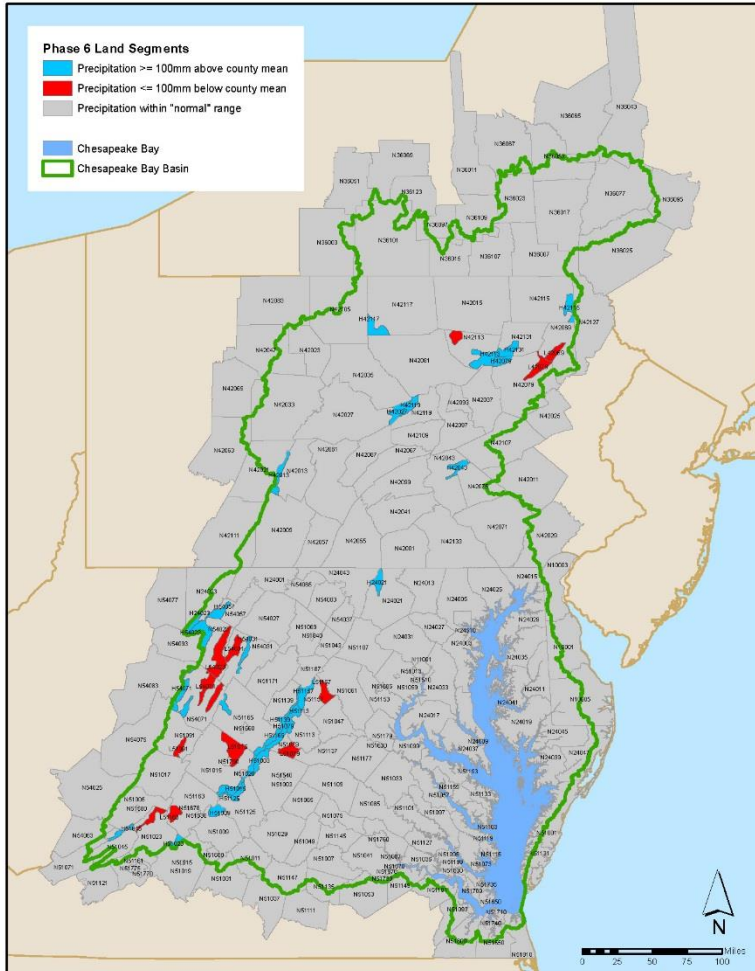
Scenario Builder

- Run time – database application
 - Up to 1 processor-hour
- Parameters
 - About 35
 - X Spatial, temporal, and categorical variability
- Calibration Data
 - Few and far between, mostly proprietary

Decision Algorithm



Watershed Model



Load for a land use in a segment =

Average Load + Δ Inputs * Sensitivity

*

Land Use Acres

*

BMPs

*

Land to Water

*

Stream Delivery

*

River Delivery

Direct
Loads



Multiple models

Average Load + Δ Inputs * Sensitivity

Multiple Lines of Evidence And multiple models

Land Use Acres

Scenario Builder

BMPs

Estimated with Sparrow
Estimated by Land Data team

Land to Water

Estimated with Sparrow
Estimated by USGS / WVU /
land data team

Stream Delivery

River Delivery

Simulated in HSPF
Calibrated with data, WRTDS, and Sparrow

*

*

*

*

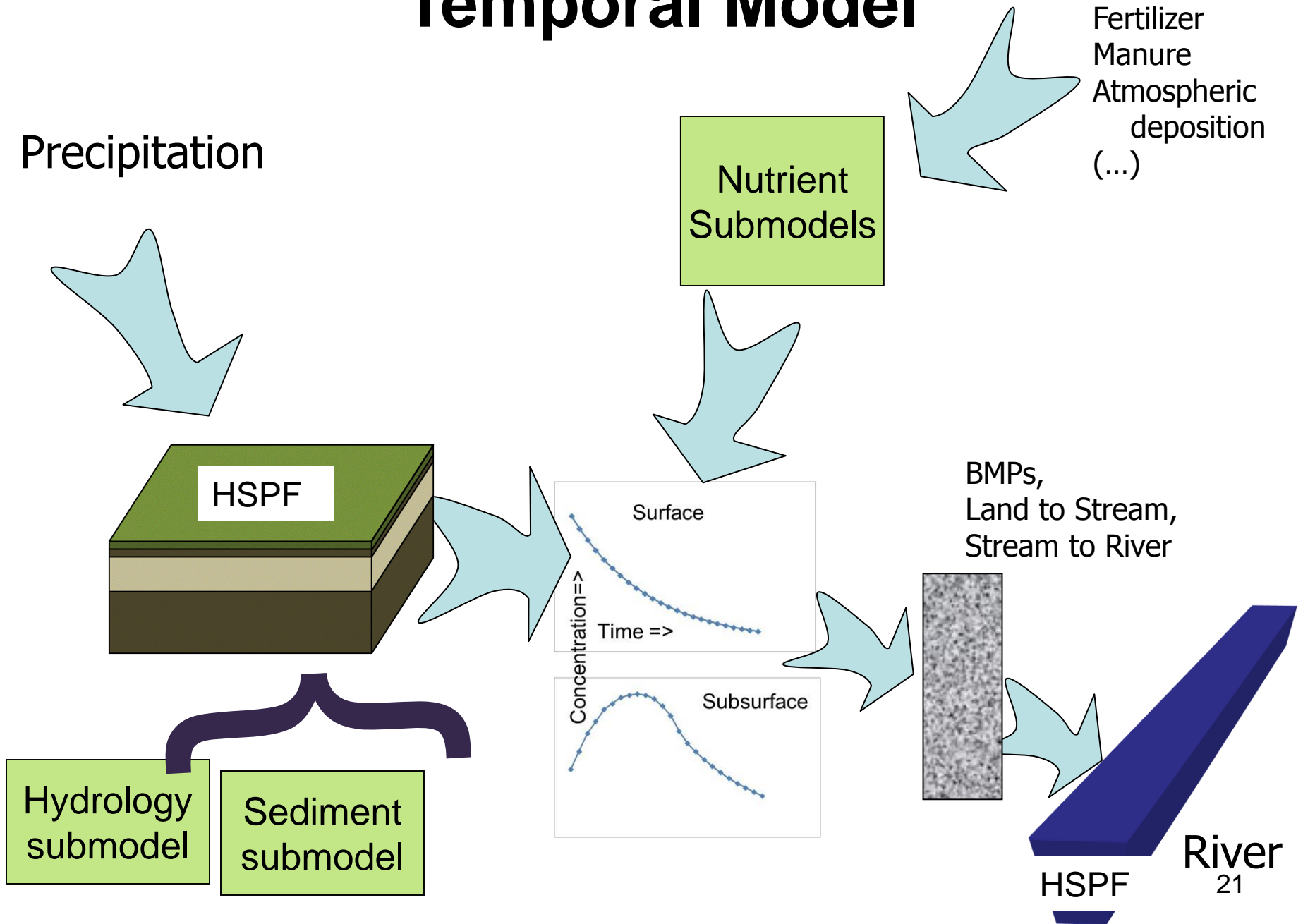
*



Steady-State WM

- Run time
 - Seconds
- Parameters
 - 8 X 2000 segments
- Calibration Data
 - Long-term Loads
 - Flow-normalized change in load

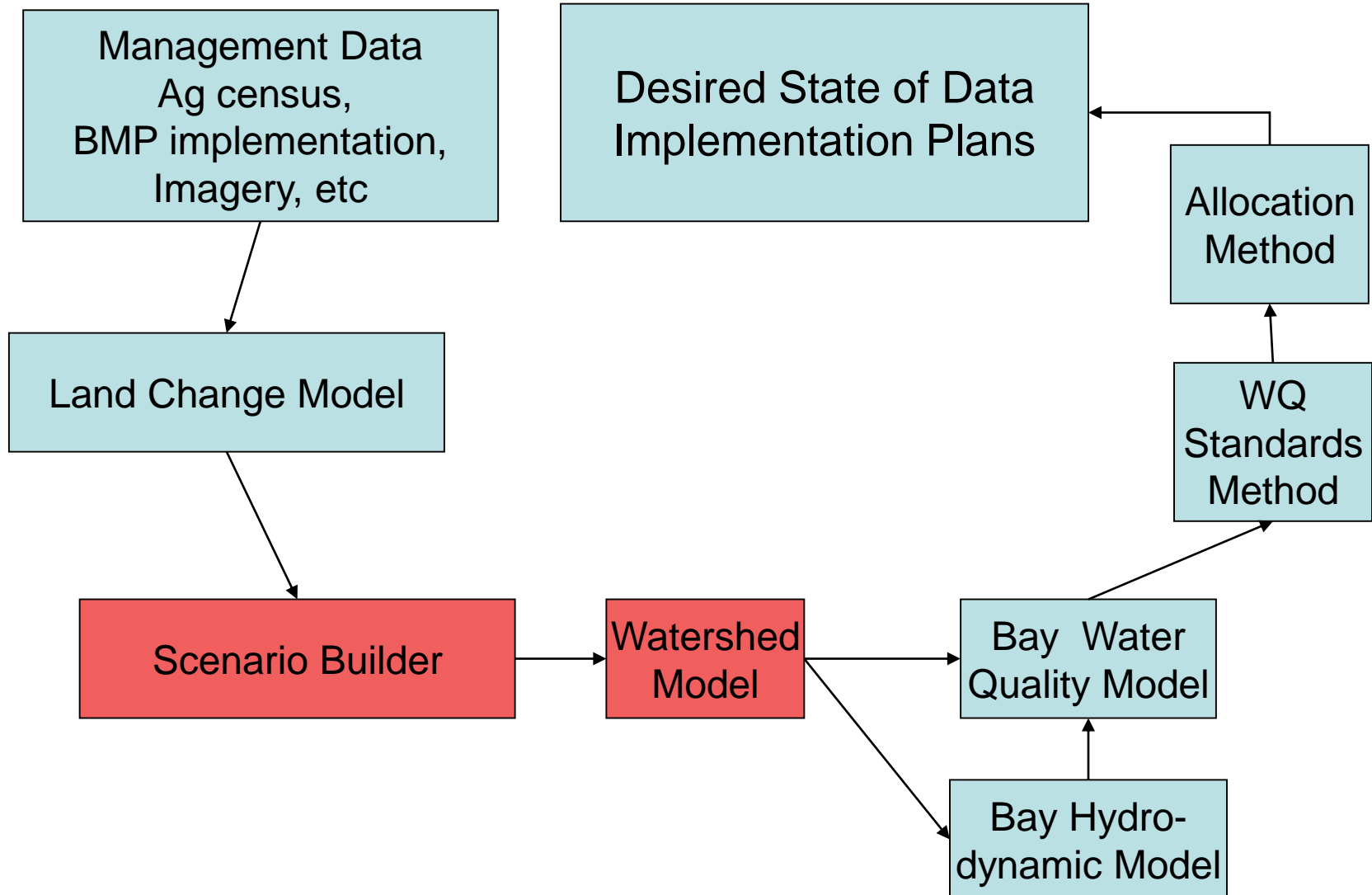
Temporal Model



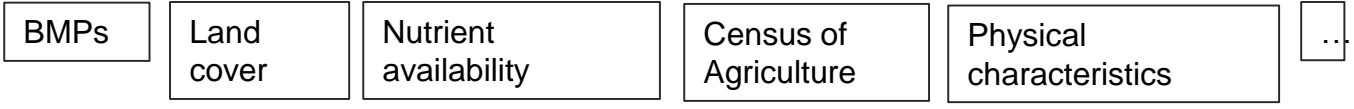
Dynamic WM

- Run time
 - 300 processor-hours
- Parameters
 - Hydrology
 - 7 x 244 segments + 50 land use ratios
 - River Water Quality
 - 31 x 600 segments
- Calibration Data
 - Flow and concentration at approximately 150 sites over 30 years.
 - WQ load estimates at about 50 sites

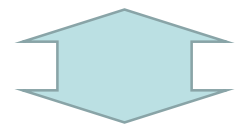
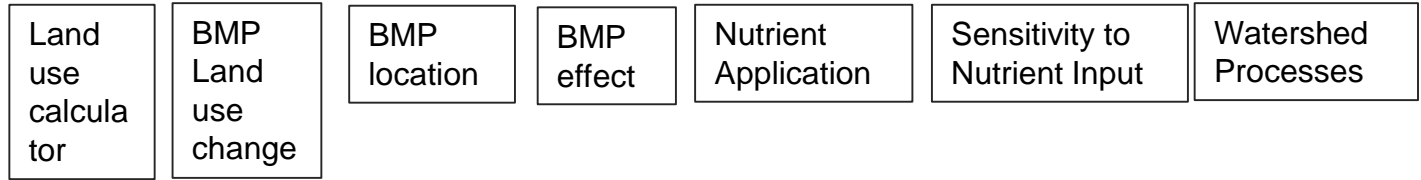
Decision Algorithm



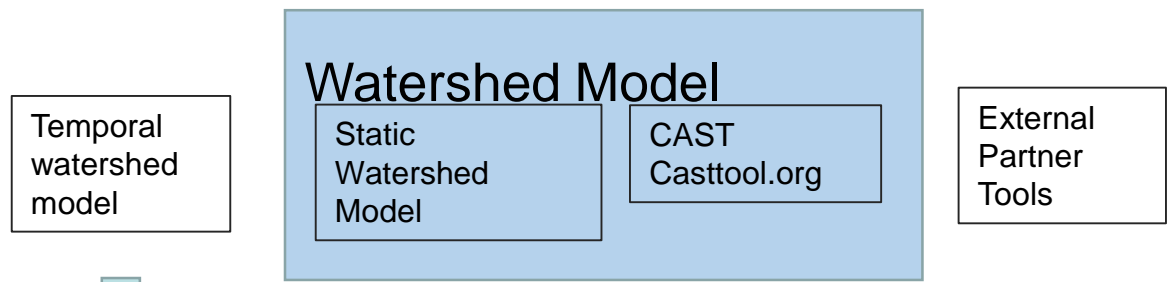
Data



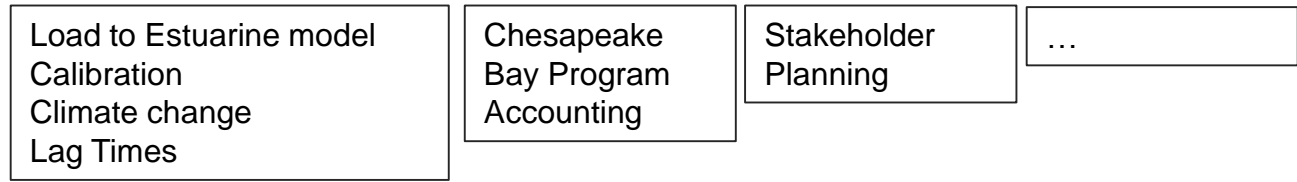
Logic Engines



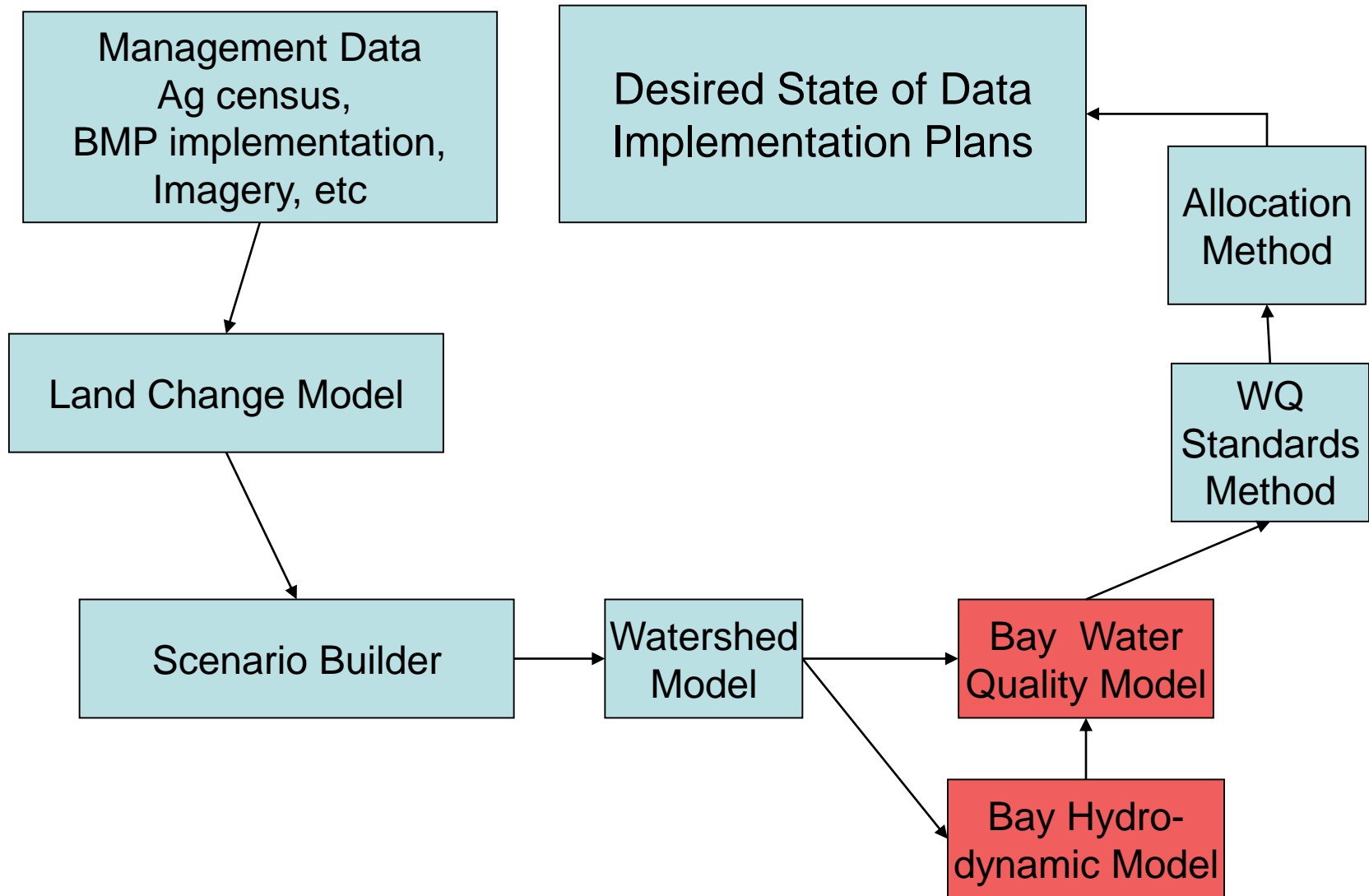
Tools



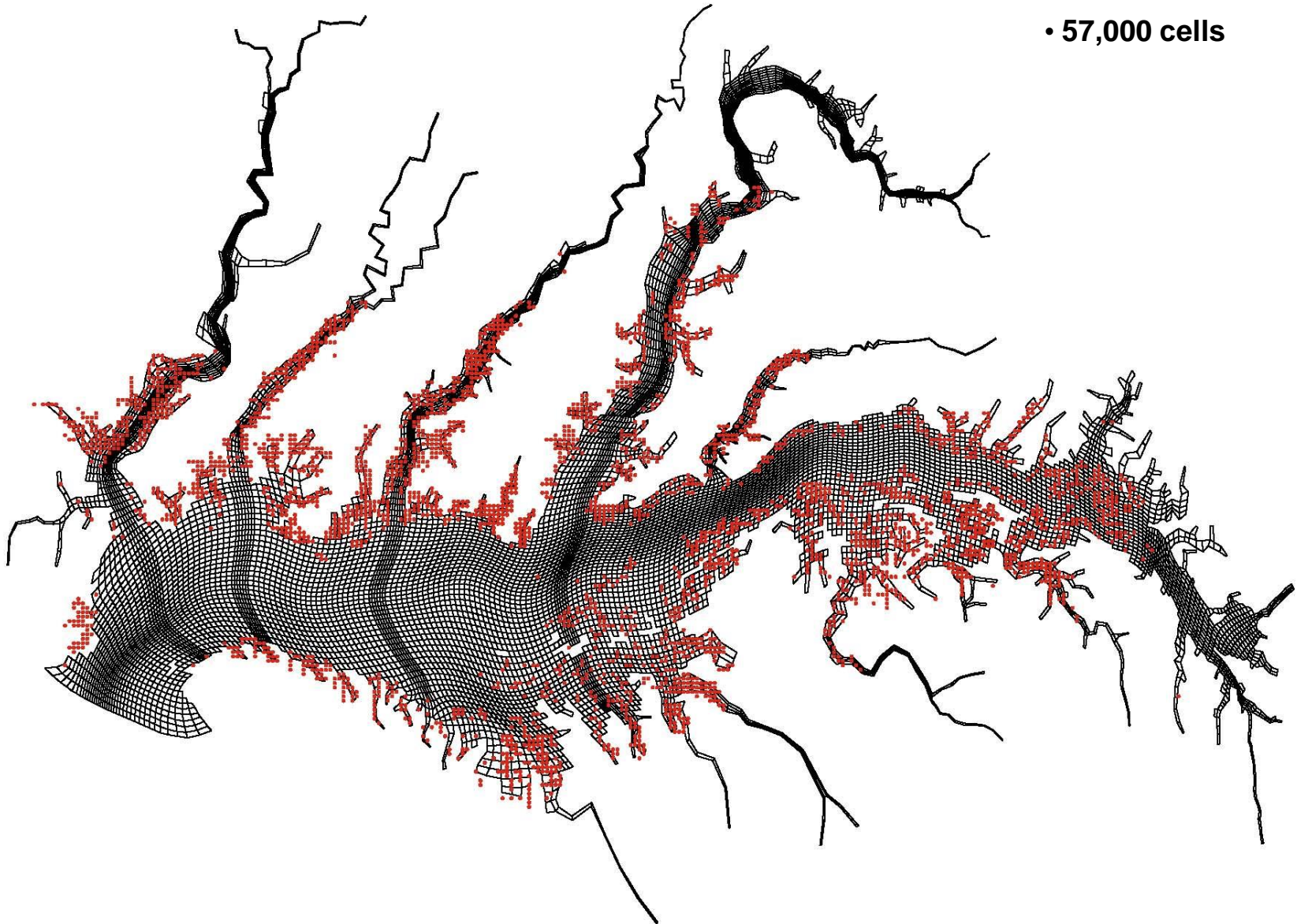
Products



Decision Algorithm



Estuarine Models



Hydrodynamic Model

- Run time
 - 160 processor-days (10-year simulation)
- Parameters
 - Choice of turbulence algorithm
- Calibration Data
 - Salinity at approximately 150 sites over 30 years.

Estuarine Water Quality Model

- Run time
 - 16 processor-days (10-year simulation)
- Parameters
 - About 100
 - 30 state variables can grow, die, and sink
- Calibration Data
 - Dissolved Oxygen, N, P, Carbon, others at approximately 150 sites over 30 years.

UQ for WIPs

