

# *Budd Inlet and Capitol Lake Water Quality Studies*

**For the  
Capitol Lake/Deschutes Estuary  
Executive Workgroup**

June 24, 2016



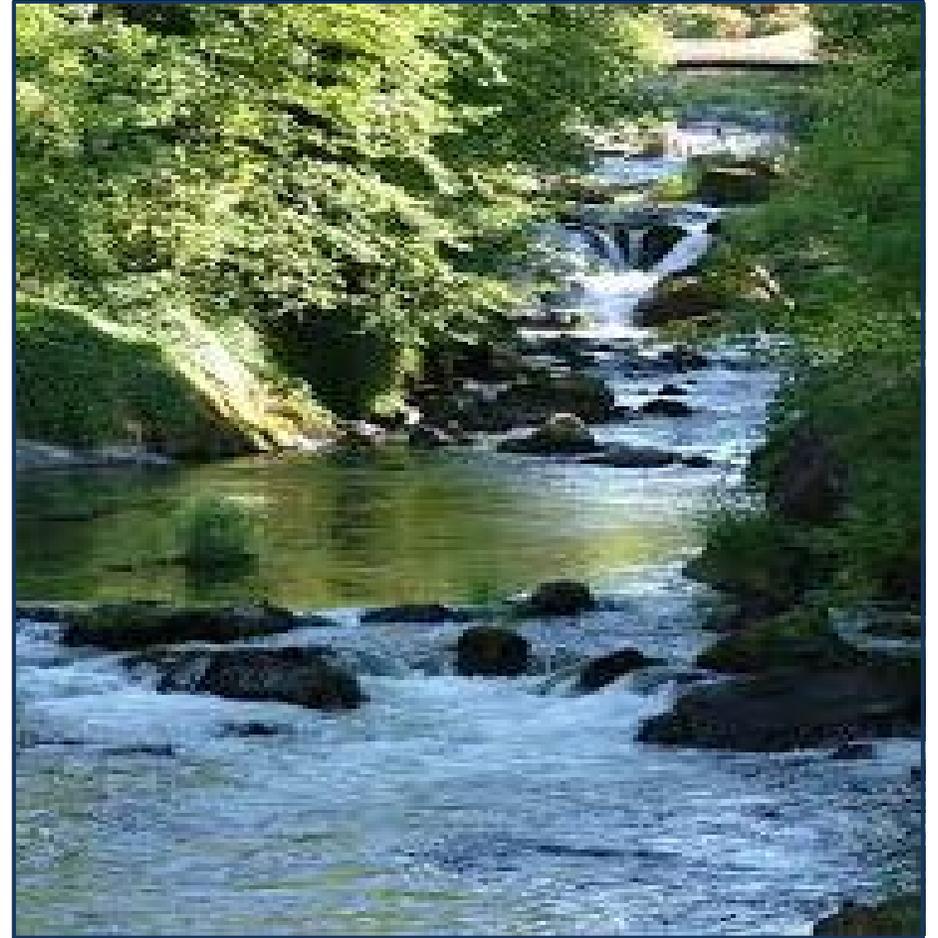
Rich Doenges

Anise Ahmed, Ph.D., P.E



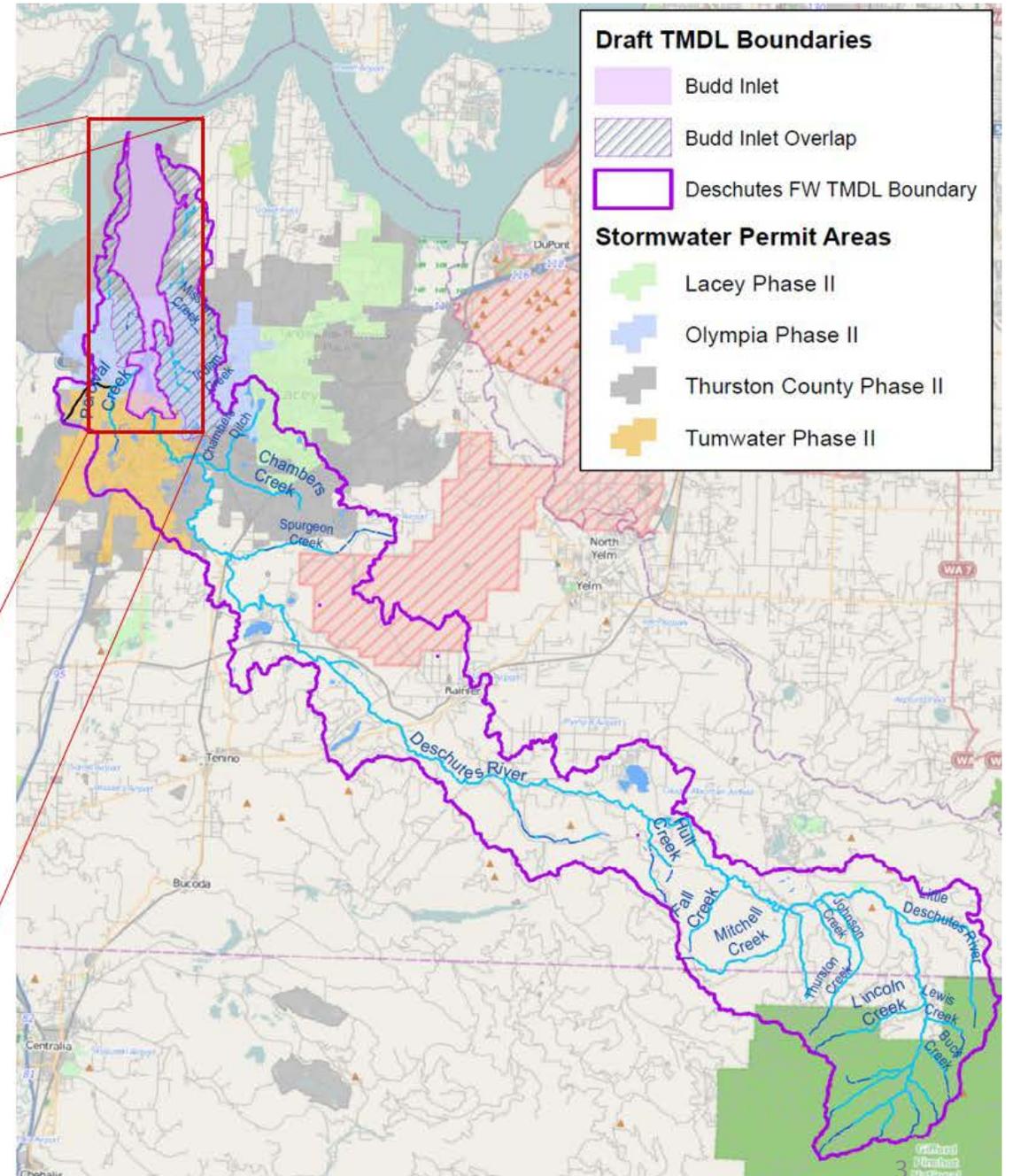
# *Clean Water Act*

- Federal Clean Water Act – 1972
- Sets water quality standards
- Monitor and assess polluted waters
- 303(d) list of polluted water bodies
- EPA requires water cleanup plans for 303(d) listed waterbodies
- Water cleanup plan



# Deschutes / Budd Inlet Watershed

Capitol Lake is an integral part of the Deschutes watershed



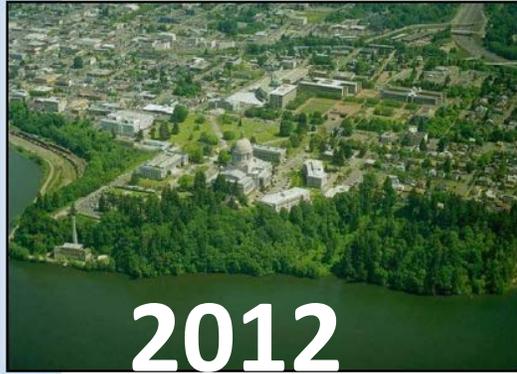
# *Water Quality Problems and Solutions: Deschutes River Above Tumwater Falls*

- Low Dissolved Oxygen
- High Stream Temperatures
- High pH
- Too Much Fecal Coliform Bacteria
- Too Much Fine Sediments



# *Budd Inlet and Capitol Lake: Two Major Studies*

## Water Quality Study Findings



**Deschutes River, Capitol Lake, and Budd Inlet  
Temperature, Fecal Coliform Bacteria,  
Dissolved Oxygen, pH, and Fine Sediment  
Total Maximum Daily Load Technical Report**

**Water Quality Study Findings**



June 2012

Publication No. 12-03-008

## Supplemental Modeling Scenarios



**Deschutes River, Capitol Lake,  
and Budd Inlet  
Total Maximum Daily Load Study**

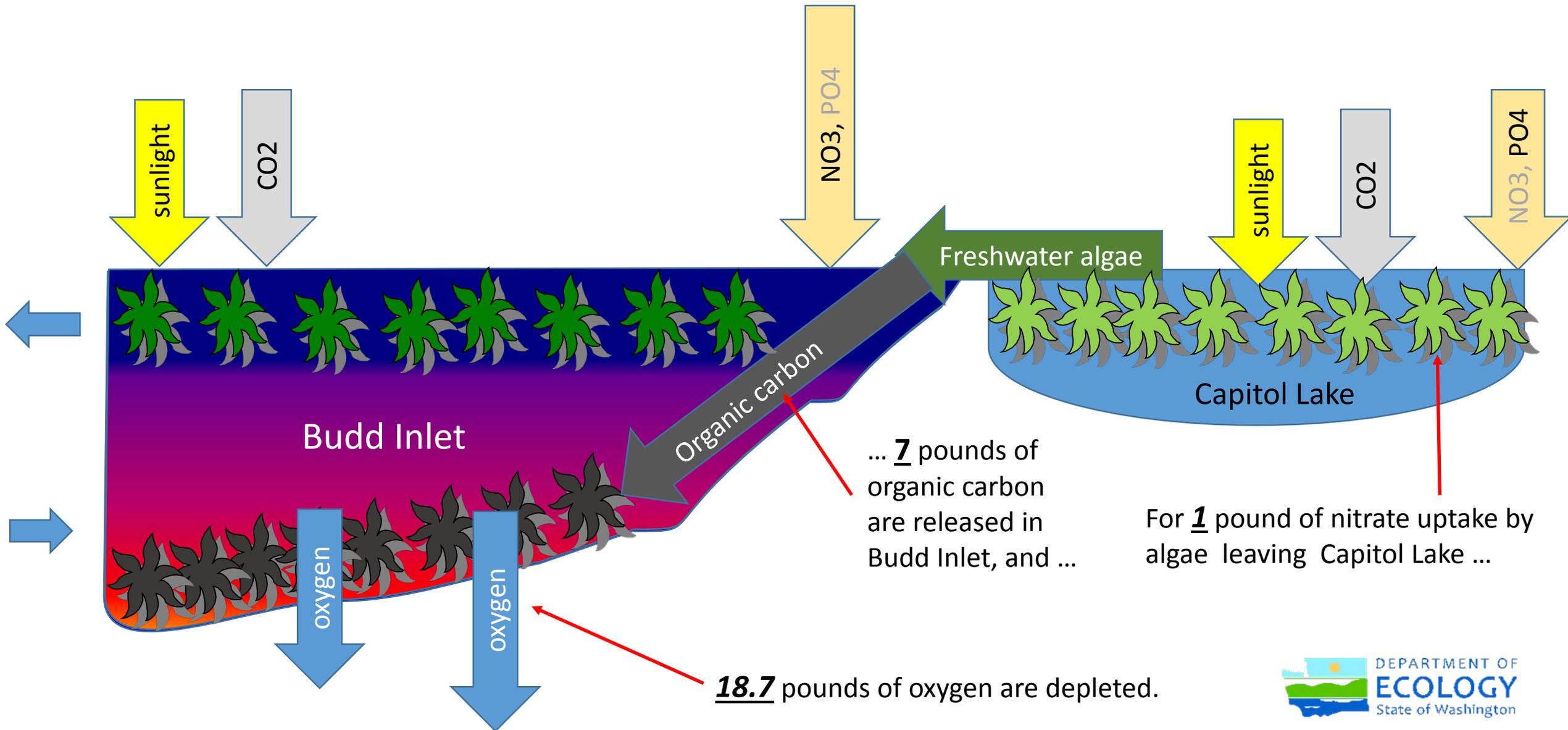
**Supplemental Modeling Scenarios**



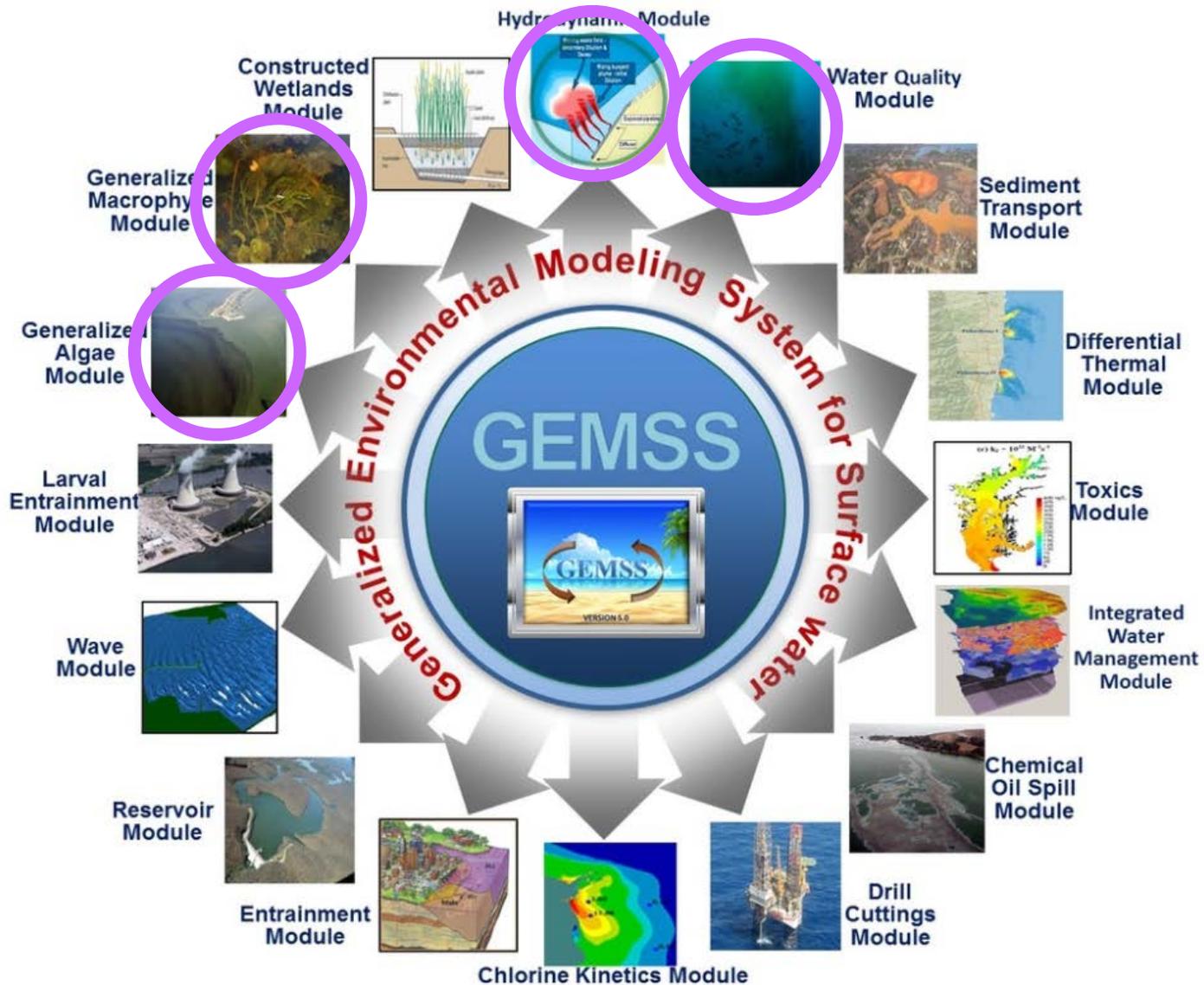
September 2015

Publication No. 15-03-002

# What are the major processes driving low dissolved oxygen in Budd Inlet?



# Budd Inlet and Capitol Lake Model



## GEMSS Model

Used nationwide for rivers, lakes, estuaries and coastal marine waters

4 Modules Used for Budd Inlet and Capitol Lake:

- Hydrodynamic and transport modules
- Water Quality module
- Macrophyte module
- Algae module





## *The Best Available Science Comprehensive Model Verification*

- Extensive field measurement campaign (2004)
- Model evaluated, improved and verified (2006-2012)

# *The Best Available Science Peer Review*



## *External review by Robert Ambrose, PE*

- GEMSS Code review (2010-2011)
- GEMSS Verification tests (2010-2011)

## *Independent EPA sponsored review by Scott Wells, Ph.D.*

- GEMSS Input file review (2008-2011)
- GEMSS code review for Macrophyte

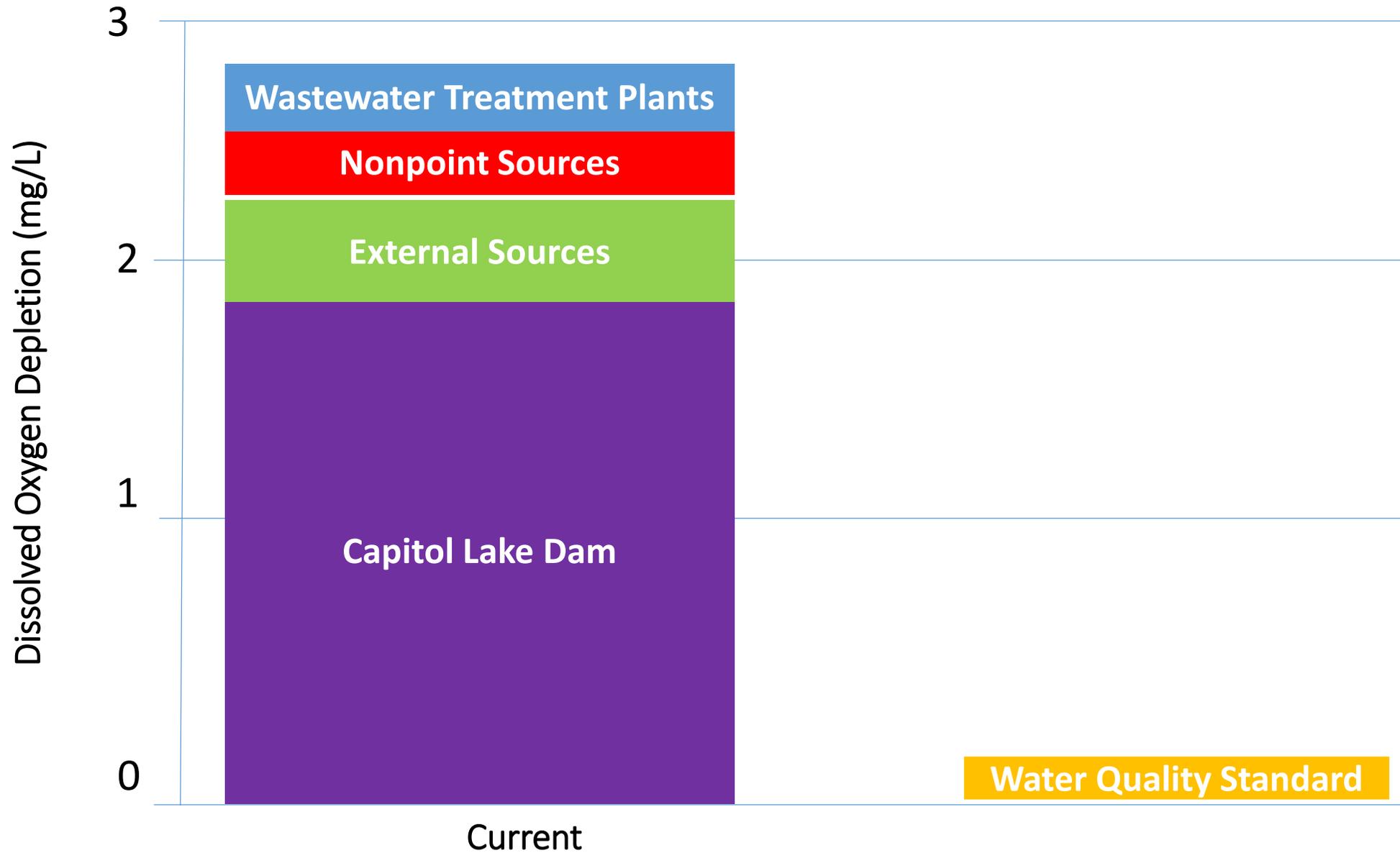


## *Independent EPA sponsored review by Jim Fitzpatrick*

- Model theory review for phytoplankton (2012)
- Reviewed prior code review ( of Robert Ambrose ) (2012)

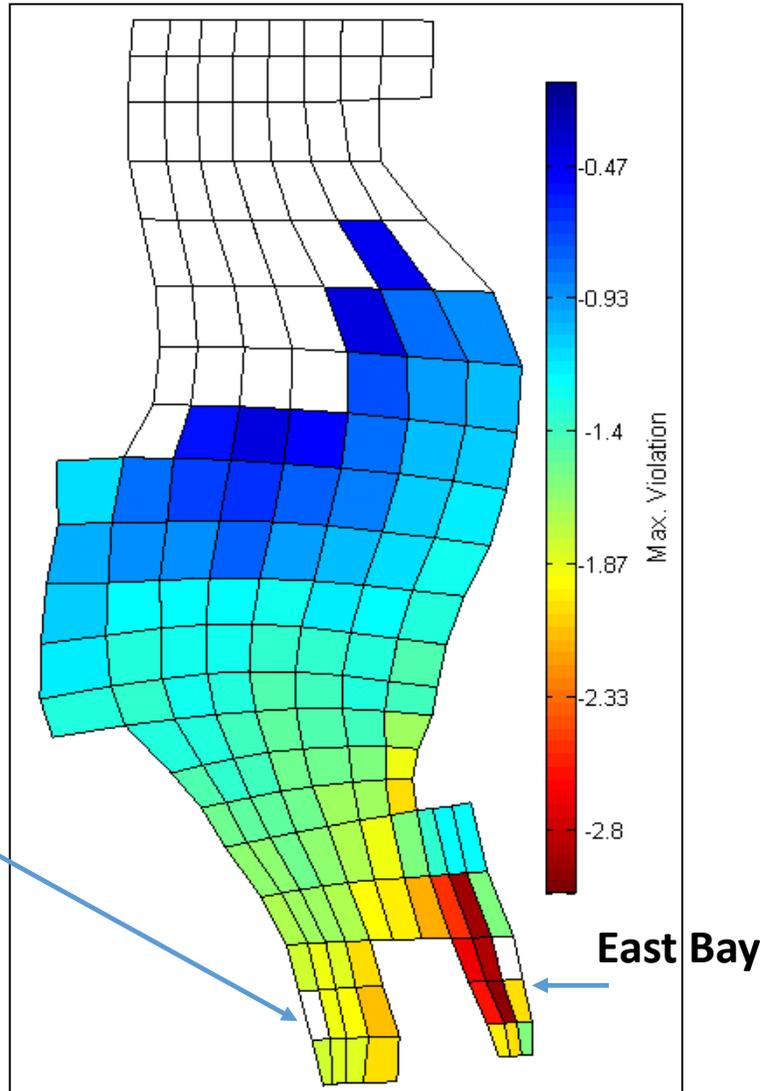


# What have we learned from Budd Inlet-Capitol Lake modeling exercise?

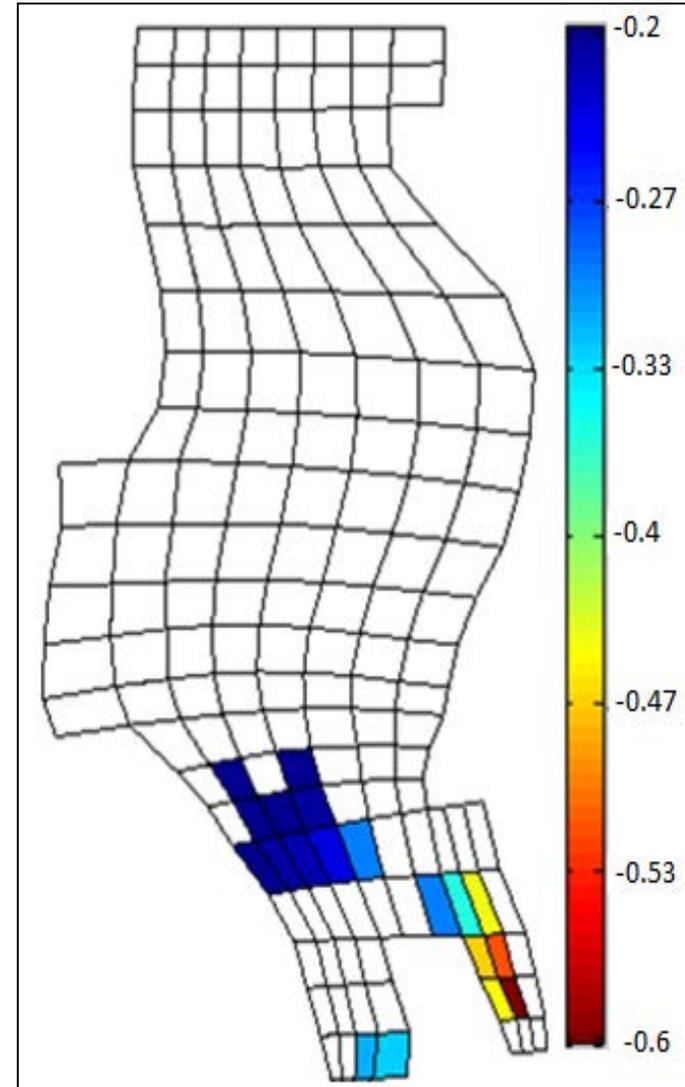


# Oxygen Depletion Modeled in Budd Inlet

All human sources-with dam

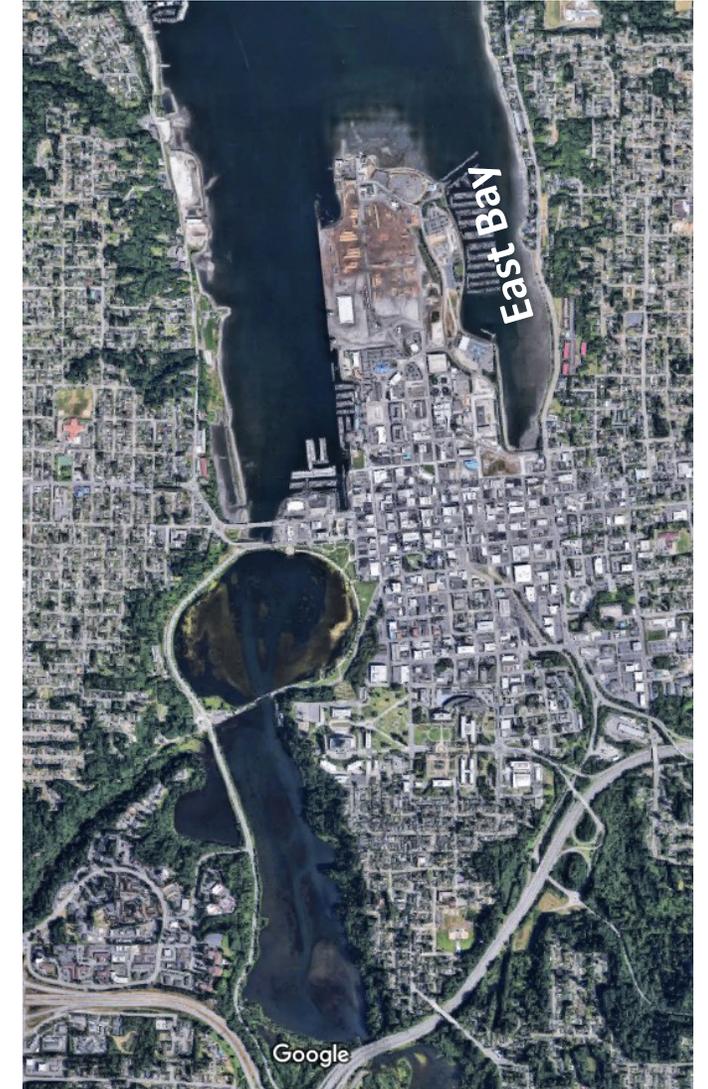


All human sources-without dam

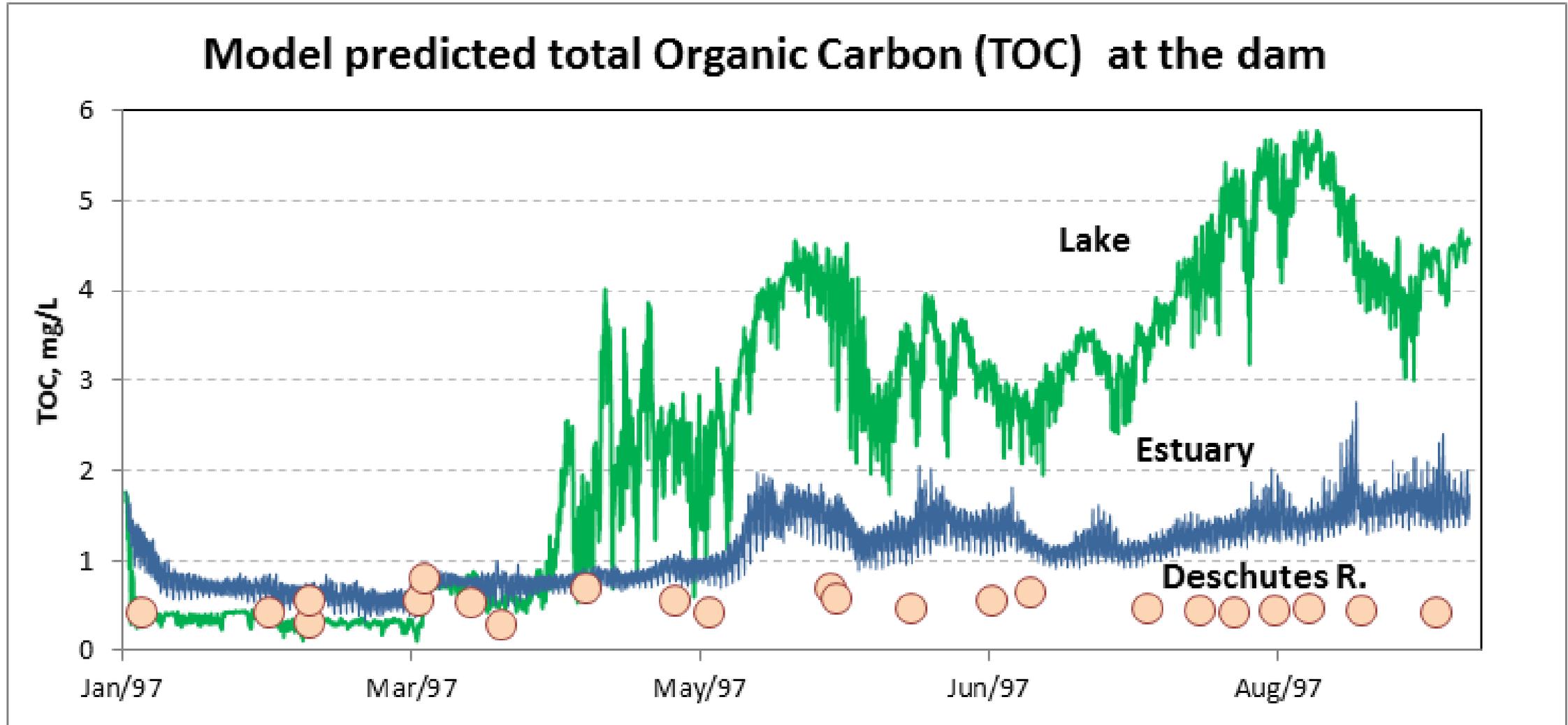


# *Why does Capitol Lake have such a large impact on dissolved oxygen levels in East Bay?*

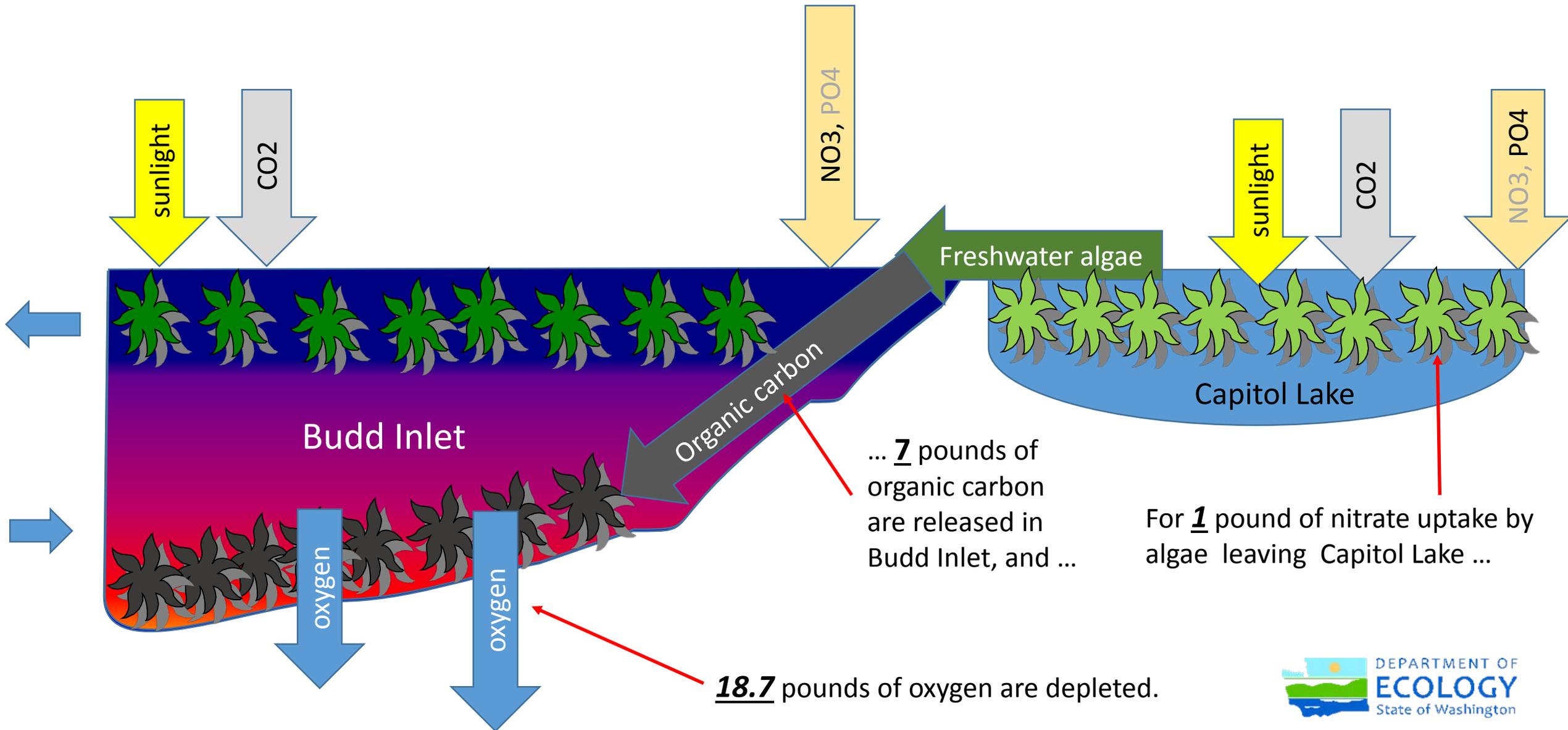
- Capitol Lake increases the total organic carbon load to Budd Inlet.
- Capitol Lake increases the residence time of water in East Bay.



# Capitol Lake increases total organic carbon load to Budd Inlet



# What are the major processes driving low dissolved oxygen in Budd Inlet?



Website: [www.ecy.wa.gov/programs/wq/tmdl/deschutes/](http://www.ecy.wa.gov/programs/wq/tmdl/deschutes/)

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# **Budd Inlet and Capitol Lake Water Quality Studies**

*A presentation for the Capitol Lake/Deschutes Estuary Executive Workgroup*

June 24, 2016

## **Presenter Bios**

### **Rich Doenges**

Manager for Ecology's Southwest Region Water Quality section.

BS degree in Natural Resources and a MFS in Forest Ecology.

Nearly 30 years post-graduate experience managing natural resource and environmental projects and programs, including water quality permitting, watershed management and resource lands conservation.

Engagement with Deschutes TMDL began in 2009 while working for Thurston County.

### **Dr. Anise Ahmed, PhD, PE**

Licensed Environmental Engineer at Department of Ecology for 25 years.

BS degree in Civil Engineering and a MS and PhD in Environmental Engineering.

Experience with water quality and hydrodynamic model includes working with different modeling tools that have evaluated Budd Inlet; South and Central Puget Sound; the waters of Puget Sound and Straits of Georgia; Willapa Bay and various rivers in Washington.

Author of several government science reports and journal articles. Currently, paper on "flushing times in South Sound" is under review by Journal of Estuarine, Coastal and Shelf Science.