Puget Sound Dissolved Oxygen Modeling

Project Advisory Committee

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Key Follow-up Actions from the Meeting

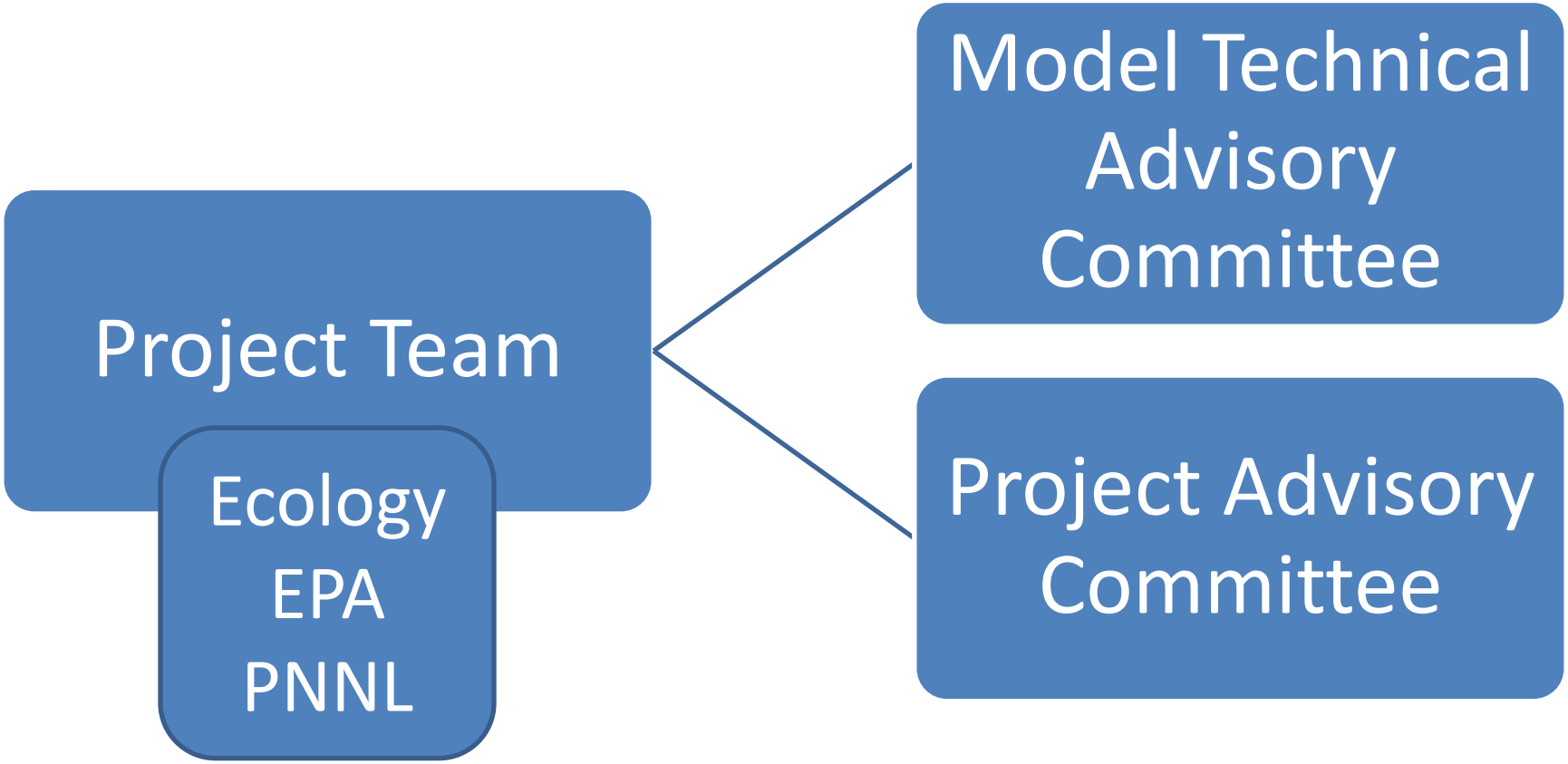
In addition to comments/suggestions about specific modeling issues:

- *Please submit comments on the draft project plan to Ecology by Wednesday, January 14, 2009. The project plan is available on-line http://www.ecy.wa.gov/programs/wq/PugetSound/DOModel.html.*
- *Comments sent to Ecology will be shared with the entire project advisory committee (please let me know if you don't want your comments shared). Comments will not be posted to the web.*
- *Andrew will contact John Thomas of the Washington On-Site Sewage Association to see if he would serve on the project advisory committee.*
- *Future meetings will address (1) key modeling assumptions, (2) model scenarios, (3) the hydrodynamic report, and (4) the water quality model.*
- *We will probably meet next in Spring '09. Stay tuned for details. Let Andrew know if you want more frequent meetings.*

Agenda

- Introductions
- Roles of advisory committee and Ecology
- Purpose
- Project background
- Project Plan available for review
- Next meeting

Organization



Project Advisory Committee:

- Knowledgeable people
- Representing full range of interests

Role of the Committee:

- Make recommendations
- Promote education
- Encourage discussions of issues

Ecology's role is to make final decisions

Role of Advisory Committee

- Review draft project plan
- Review hydrodynamic report
- Review water quality model report
- Modeling scenarios

Committee Members*

- Tribal
- Puget Sound Partnership
- Wastewater Treatment Plants
- Conservation District
- Dept. of Health
- University
- Business Interests
- Environmental Groups
- Municipalities
- Counties
- EPA
- USGS
- NOAA Fisheries

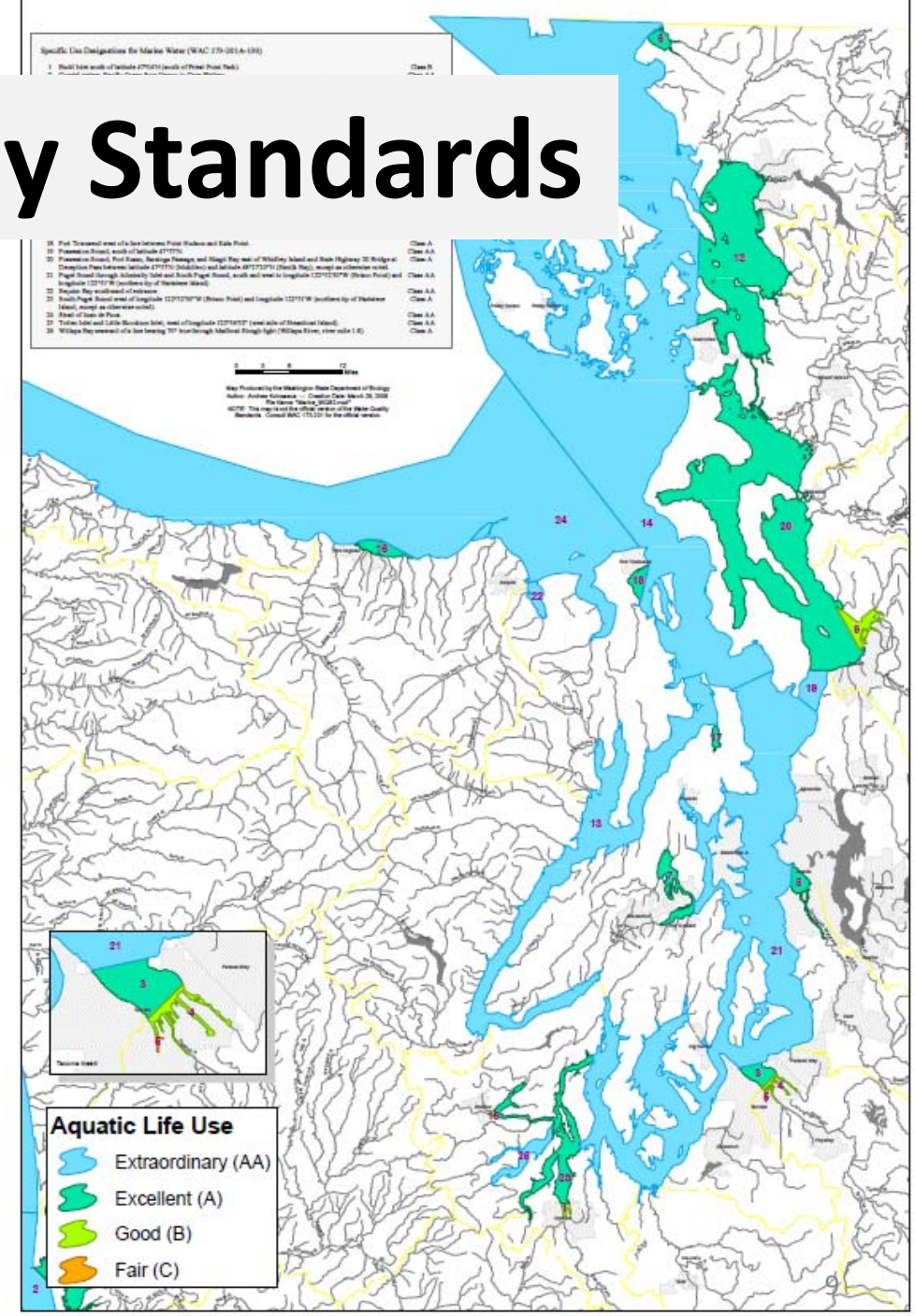
* Invited

Project Impetus

- A number of 303(d) listings for dissolved oxygen
- Some areas not covered by other efforts
- The impact of human activities on dissolved oxygen is uncertain

Water Quality Standards

- Extraordinary quality, 7.0 mg/L
- Excellent quality, 6.0 mg/L
- Good quality, 5.0 mg/L
- Fair quality, 4.0 mg/L



Water Quality Standards

- “When a waterbody's D.O. is lower… due to natural conditions, then human actions considered cumulatively may not cause the D.O… to decrease more than 0.2 mg/L.”

Project Objectives

- Are current nitrogen loads from point and nonpoint sources impacting water quality significantly?

- If so, what reductions are necessary to reduce human impacts in sensitive areas to acceptable levels?

What else is going on?

- South Puget Sound Dissolved Oxygen Study
  - Information available on Ecology website
  - More detailed, focused on South Sound
- Hood Canal
  - Evaluate low DO contributors; HCDOP
- Technological and Economic Evaluation of Nutrient Removal Technologies
  - Evaluate alternative nutrient control technologies at wastewater treatment plants

Project Background

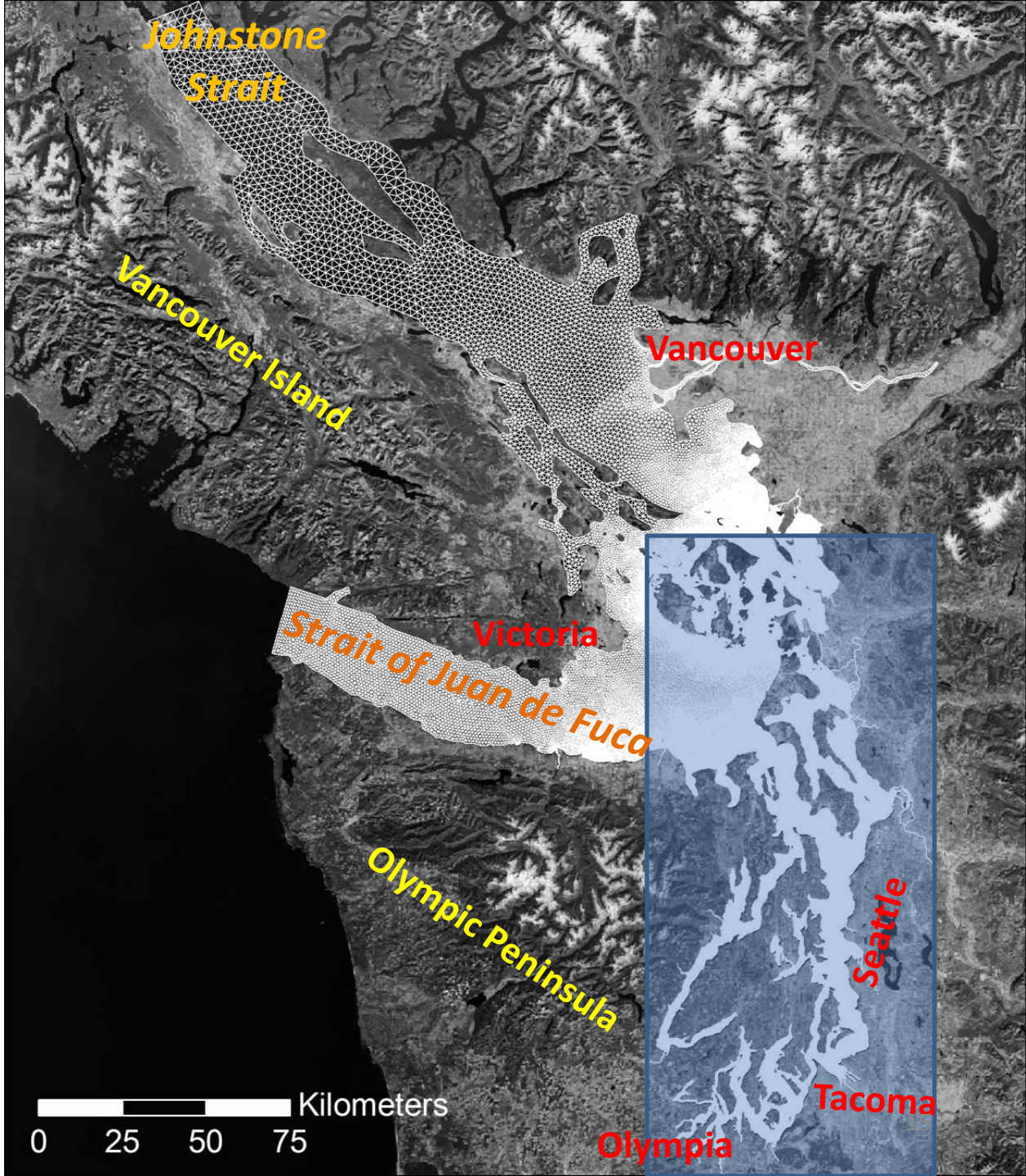
Mindy Roberts

Project Objectives

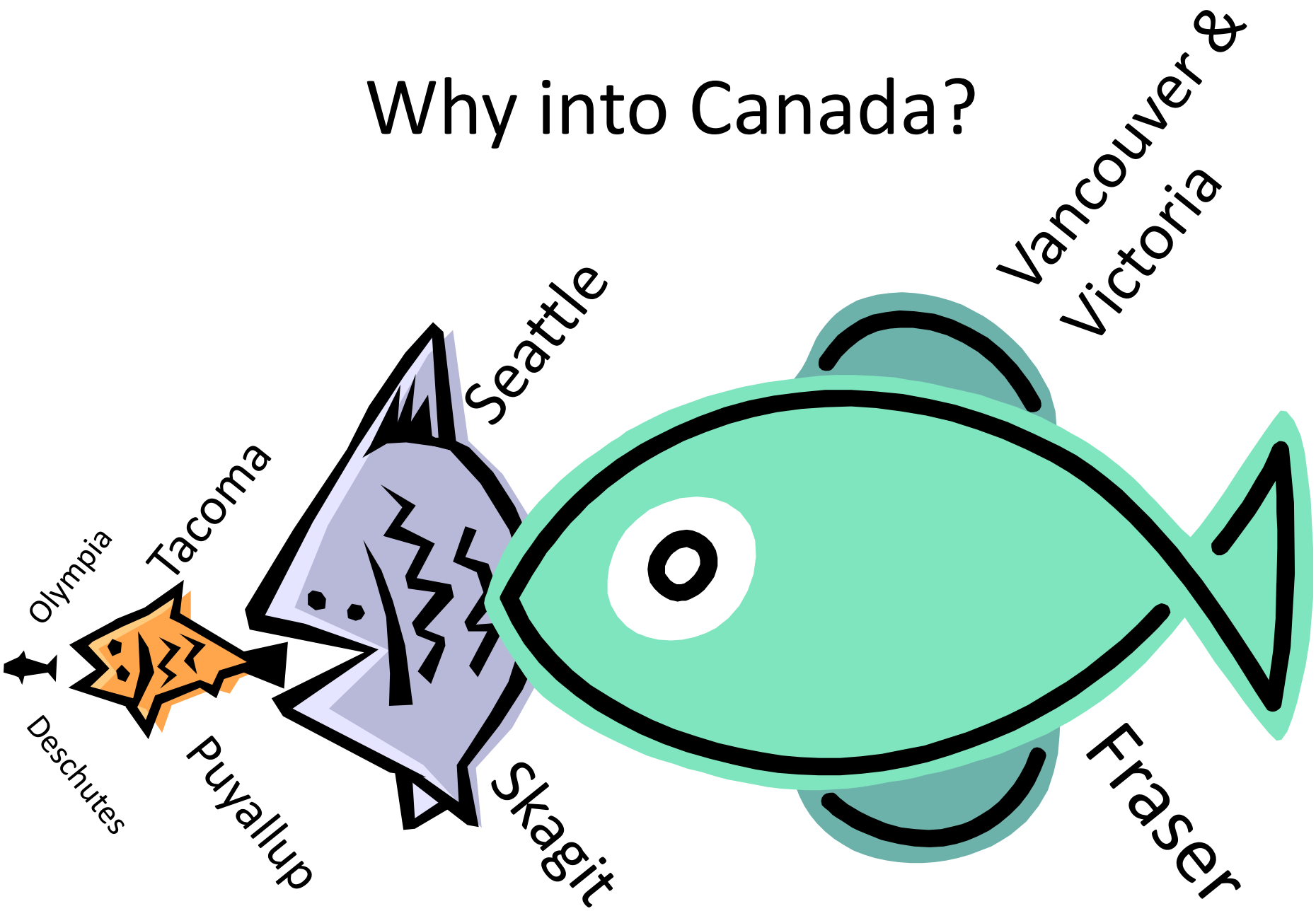
- Are current nitrogen loads from point and nonpoint sources impacting water quality significantly?

- If so, what reductions are necessary to reduce human impacts in sensitive areas to acceptable levels?

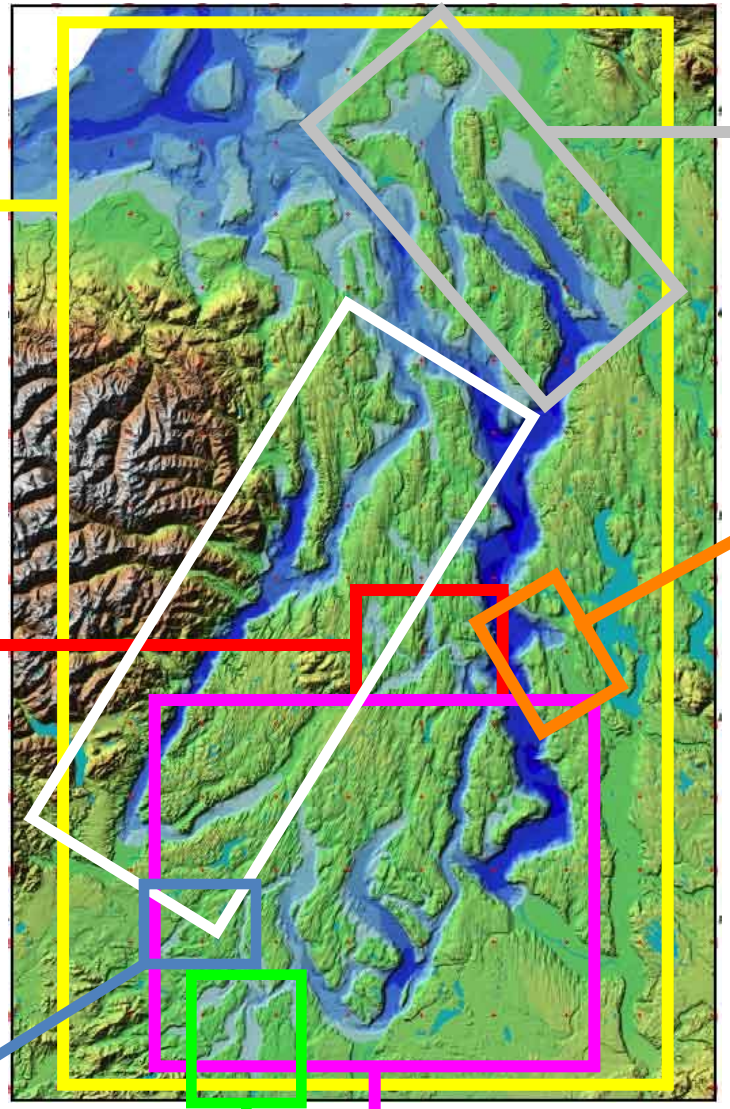
Domain?


Johnstone Strait
Vancouver Island
Vancouver
Victoria
Strait of Juan de Fuca
Olympic Peninsula
Seattle
Tacoma
Olympia
Kilometers
0 25 50 75

Why into Canada?



Marine Modeling Efforts in Puget Sound



PS DO Modeling (Ecology, PNNL); PRISM (UW, KC-DNR, Ecology); Brightwater (KC-DNR)

(PS DO Modeling includes hydrodynamics and biogeochemical processes. PRISM currently includes hydrodynamics, temp, & salinity. Brightwater analysis included hydrodynamics, temp, salinity, & tracer.)

Whidbey Basin (PNNL)
(hydrodynamics, temp, salinity)

Duwamish Estuary/ Elliott Bay (KC-DNR)
(hydrodynamics, temp, salinity, metals, organics, fecal coliform)

Dyes/Sinclair Inlet (PSNS & Ecology)
(hydrodynamics, temp, salinity, fecal coliform)

Hood Canal (HCDOP: UW, USGS)
(hydrodynamics, temp, salinity, nutrients, phytoplankton, DO)

Oakland Bay (Ecology)
(hydrodynamics, temp, salinity, fecal coliform)

Budd Inlet (Ecology/LOTT)
(hydrodynamics, temp, salinity, nutrients, phytoplankton, DO)

South Sound (Ecology SPS-MEM)
(hydrodynamics, temp, salinity, nutrients, phytoplankton, DO)

Funding

- $740,000 over two years
  - Part of Puget Sound initiative
  - From EPA $20m to support Puget Sound Partnership
    - $3-5m set aside for immediate science needs
  - Includes $340,000 contract with Battelle
  - Includes purchase of computer cluster
    - Remote access to be developed

Project Tasks

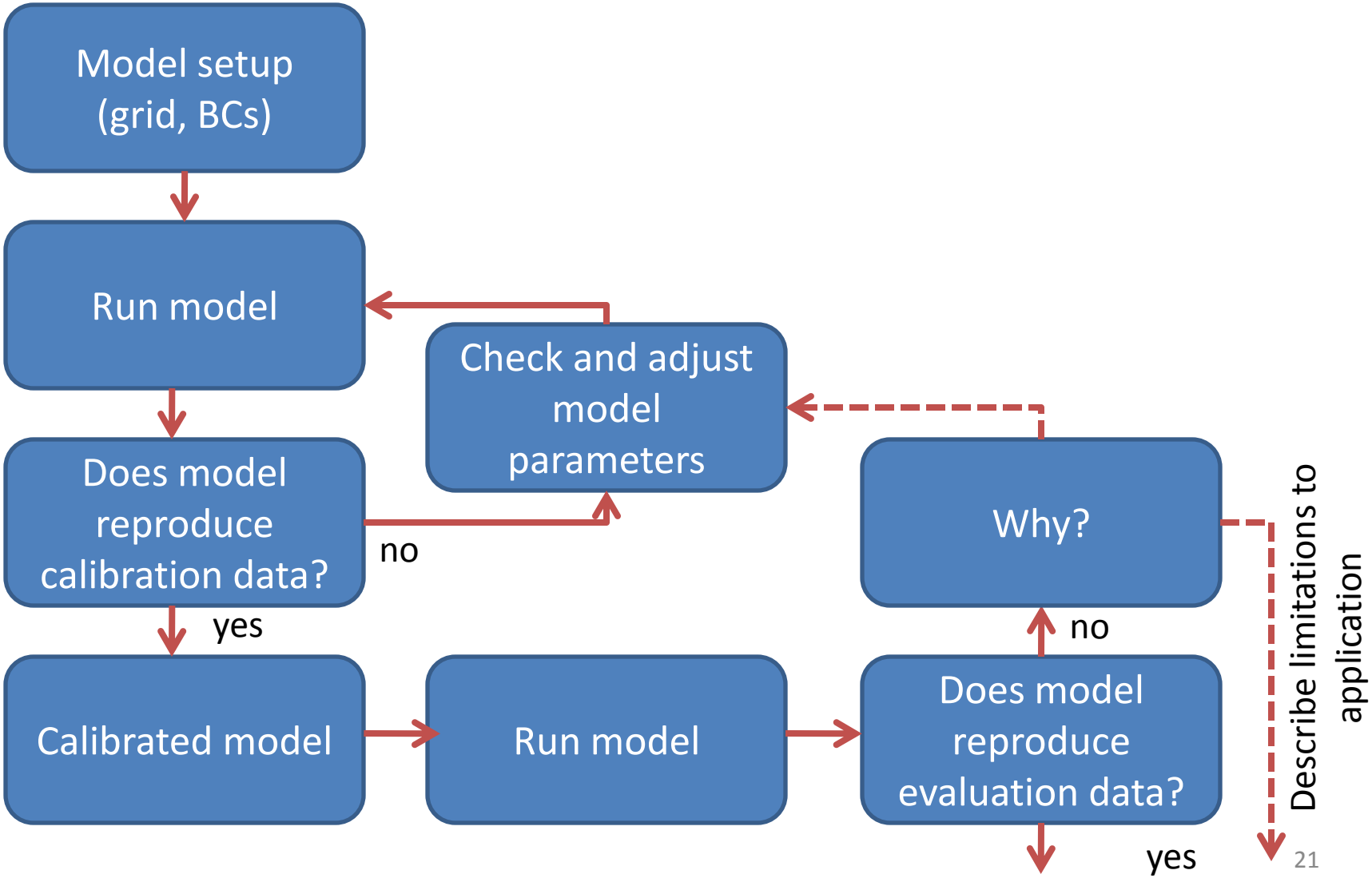
1. Establish Model TAC and Project AC
2. Ecology develops Box Model
3. **PNNL, Ecology, and EPA develop intermediate-scale hydrodynamic and water quality model**
4. Ecology develops subsequent project plan for next detailed study

Existing Project Constraints

- No* new data collection
- No new hydrodynamic or water quality model software development
- Computer run time goals (govern spatial and temporal scale)
- Budget/schedule constraints

* Adding TOC and DOC to ambient monitoring in major rivers to fill known gap.

General modeling approach



Model Technical Advisory Committee

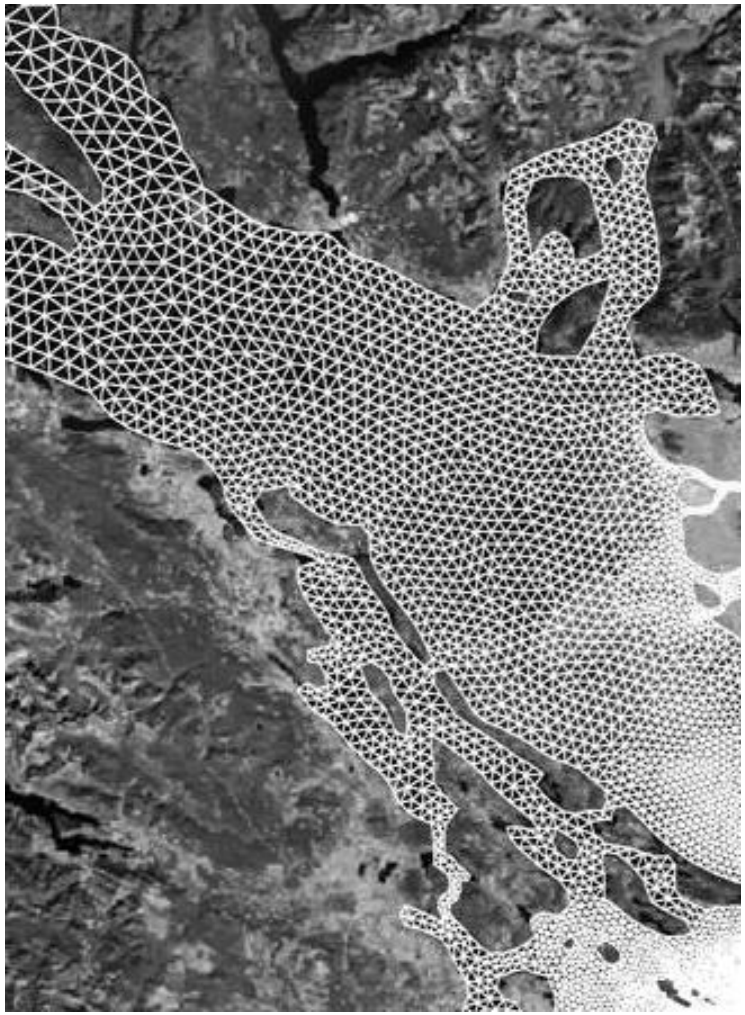
Ben Cope	EPA Region 10
Bruce Nairn	King County WTD
Bob Johnston	U.S. Navy
Parker MacCready	UW School of Oceanography
Tyle Zuchowski	LOTT Alliance
Paul McElhany	NOAA Northwest Fisheries Science Center
Heather Trim	People for Puget Sound
Scott Redman	Puget Sound Partnership
Ed Josberger	U.S. Geological Survey
Bob Ambrose	EPA HQ

November 4, 2008 MTAC workshop

- Lessons learned from other model efforts
- Brainstorming session
  - Software to be considered
  - Dominant processes affecting DO
  - Greatest uncertainty for model input/output
  - Time scales
    - Hours/days/weeks, weeks/months/seasons
    - Years/decades
- Summary as QAPP appendix

Hydrodynamic model recommendation

- FVCOM
  - Unstructured grid (large and small grid cells)
  - Public domain, peer reviewed, supported
  - Decoupled WQ model
- Draft QAPP has evaluation criteria and performance (many models)

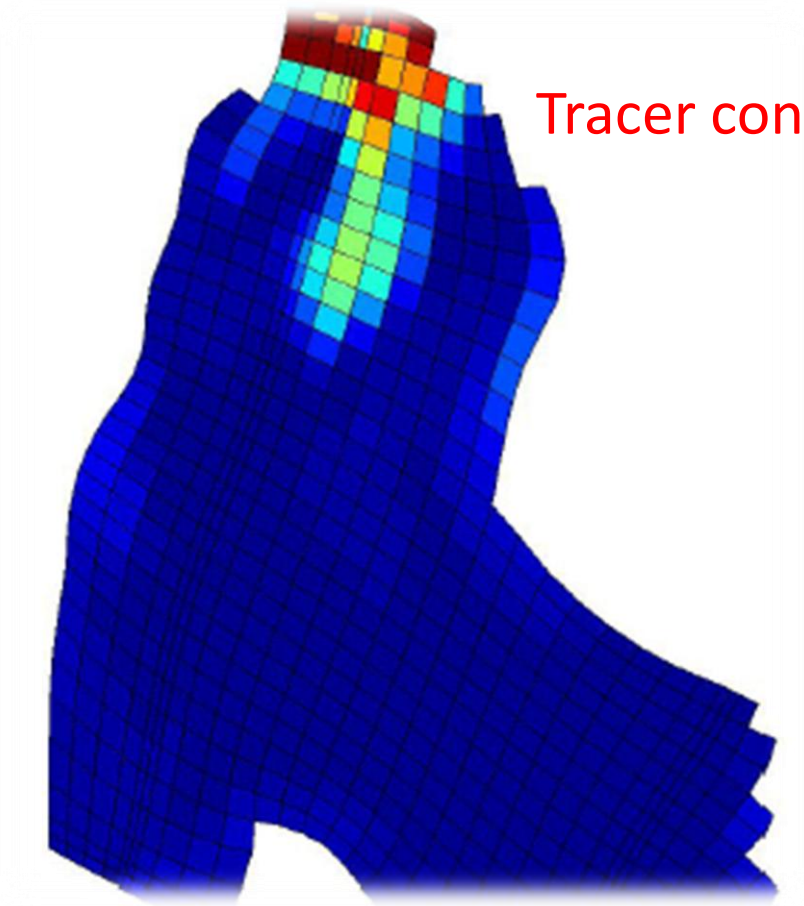


From draft QAPP, now out for external review

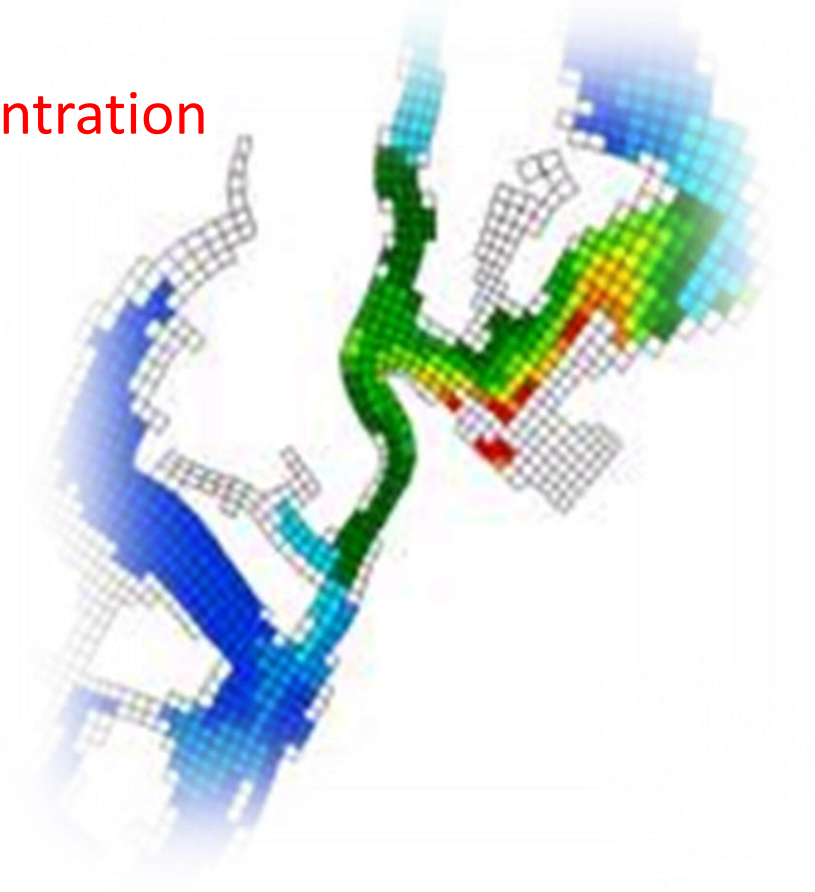
Hydrodynamic model development and testing

- Grid set up
- Boundary conditions
  - Oceanic inputs, met data, watershed flows
- Compare (*qualitative and quantitative*)
  - Water surface elevation
  - Current velocity data (*where available*)
  - Density profiles (*temperature, salinity*)
- Check and adjust grid volume, bottom friction
- Documentation and review

Example hydrodynamic model application



Tracer concentration

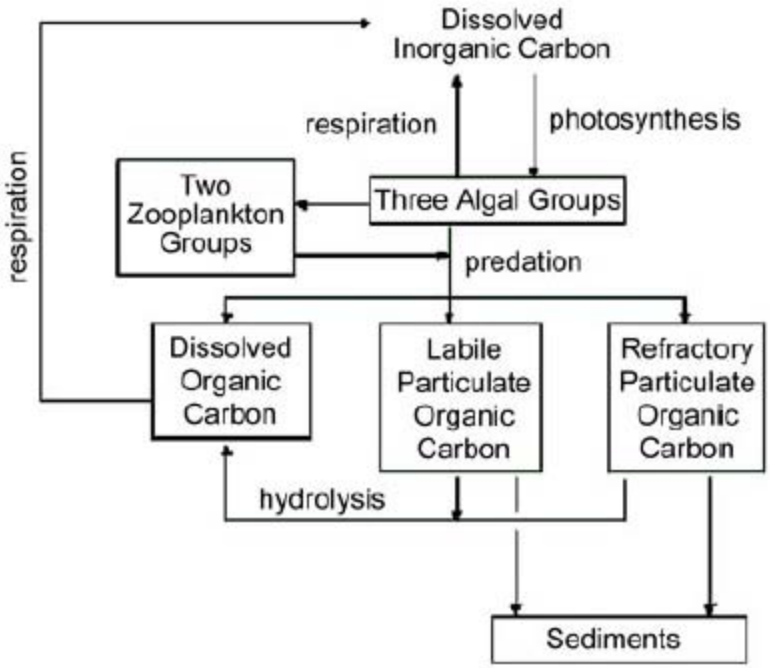


Source: B. Johnston, ENVVEST

Source: S. Albertson, SPS DO Study

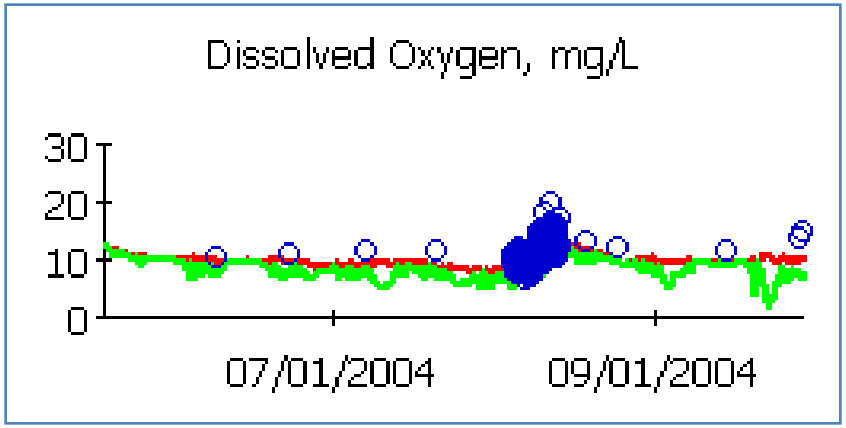
Water quality model recommendation

- CE-QUAL-ICM
  - Chesapeake Bay and other applications
  - Full eutrophication kinetics
  - Sediment diagenesis
  - Decoupled from hydrodynamics



Water quality model development and testing

- Boundary conditions
  - Meteorology (rain, solar radiation, wind, etc.)
  - Oceanic nutrient exchanges
  - Watershed nutrient inputs
    - Rivers
    - Direct discharges of wastewater
  - Sediment fluxes
- Compare, adjust, iterate
  - Many processes affect DO
- Document and review



Model scenarios

- Whole-Sound testing– DO levels under…
  - Natural conditions
  - Current river nonpoint sources
  - Current point and nonpoint sources
  - Maximum permitted point and current nonpoint sources
  - Alternatives to current levels

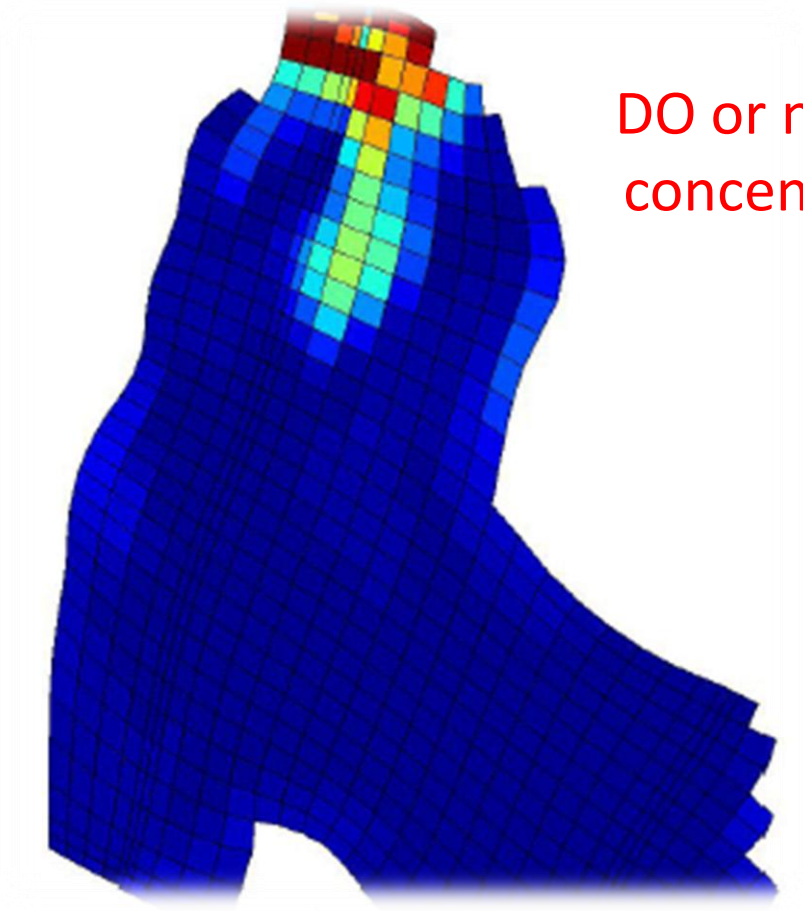
Potential management questions

Effect of DO from…

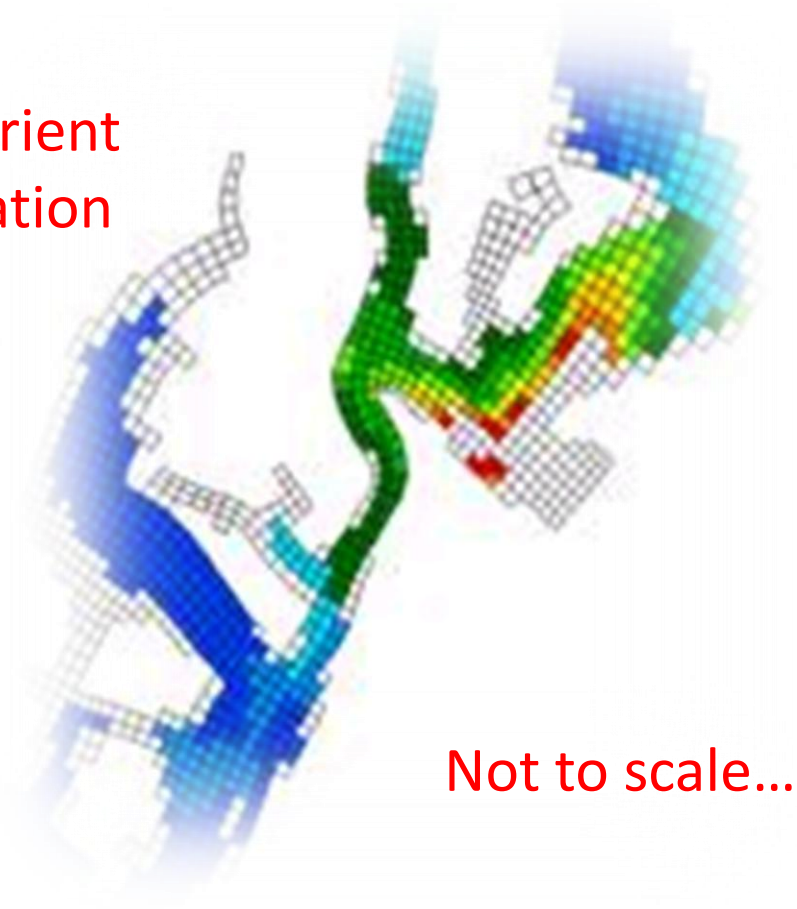
- Increase nonpoint sources (double?)
- Decrease WWTP nitrogen concentrations
  - Denitrification: 8 mg/L? 3 mg/L?
- Increase wastewater volume (population)

- Do areas of influence overlap in space or time?

Example water quality model application



DO or nutrient concentration



Not to scale…

Source: B. Johnston, ENVVEST

Source: S. Albertson, SPS DO Study

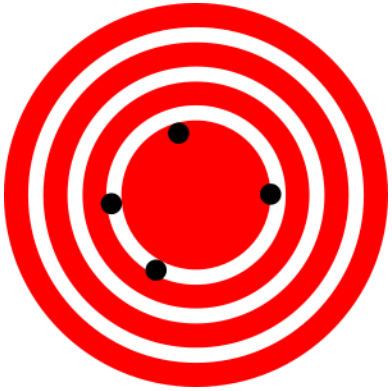
General project schedule

Dates	Item
(tbd today)	Model Technical Advisory Committee workshop
Fall 2008	Review QA Project Plan for intermediate-scale model
(ongoing)	Track quarterly progress reports
Summer 2009	Review hydrodynamic model report via Project Advisory Committee representative
Winter 2009	Review water quality findings via Project Advisory Committee representative

Jargon: Precision vs. Accuracy

High precision

Low accuracy



Low precision

High accuracy