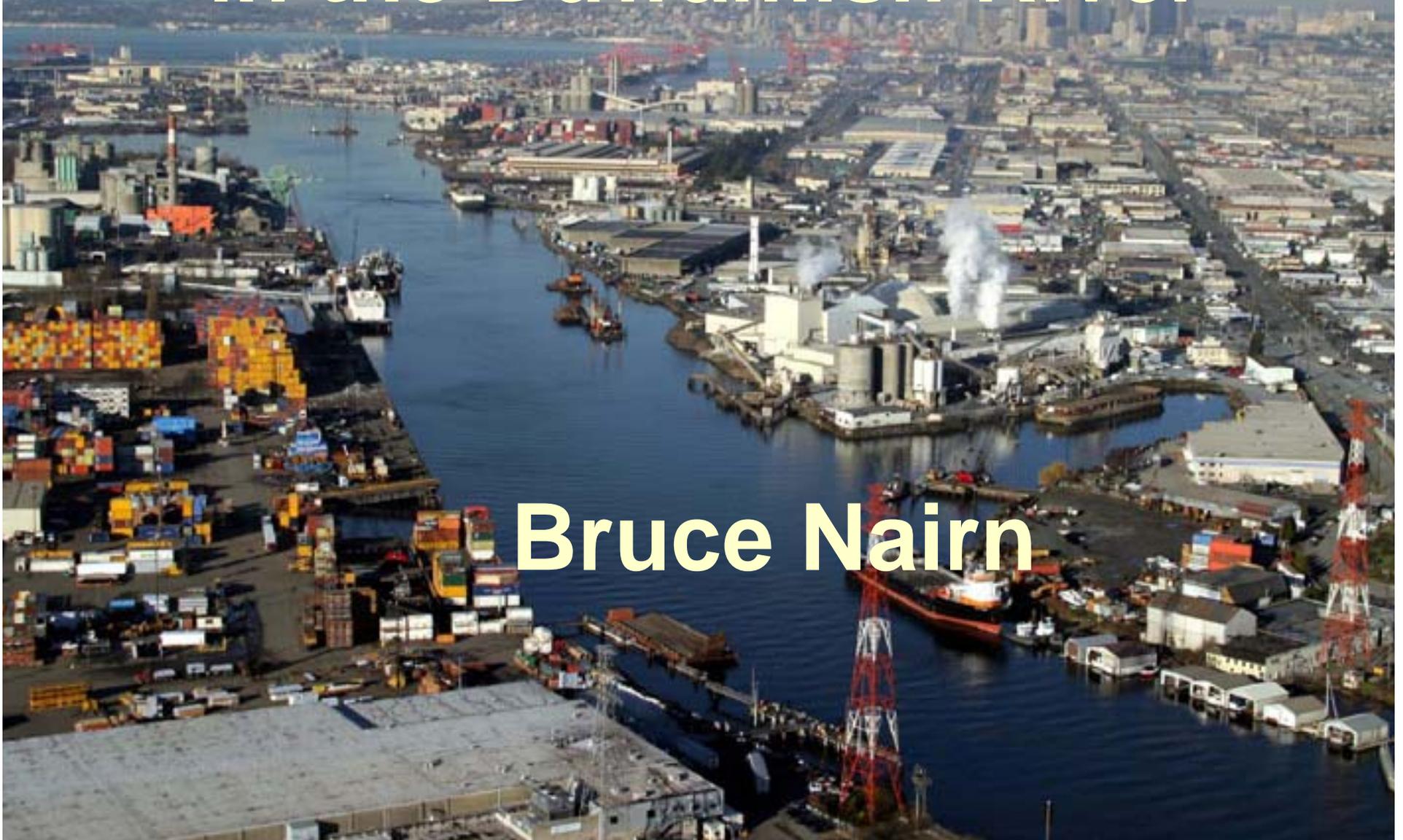


# 3-D Water Quality Modeling in the Duwamish River

**Bruce Nairn**



# Outline



- Objectives
- Overview of Dissolved Oxygen in the LDW
- Water Quality Criteria
- EFDC model
- Results
- Future Work

# Objectives



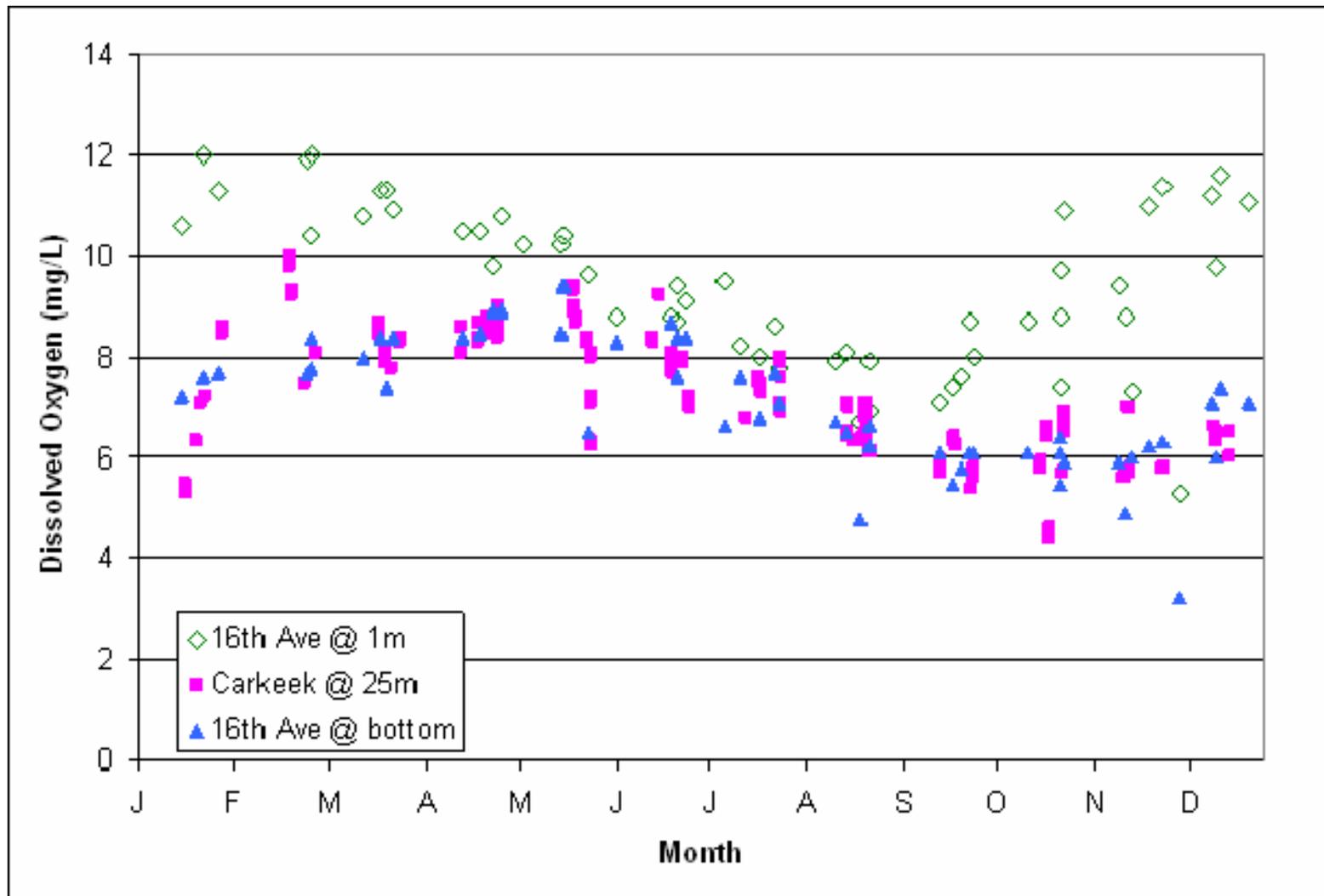
- Once per year CSO discharges are required to meet water quality criteria
- Do CSO discharges meet water quality criteria?

# Water Quality Criteria



- Excellent Water Quality (Class A):
  - Dissolved Oxygen > 6.0 mg/L
  - When natural conditions lower D.O. below this level, human actions considered cumulatively may not cause the D.O. to decrease more than 0.2 mg/L.

# Dissolved Oxygen



# 50 years ago...

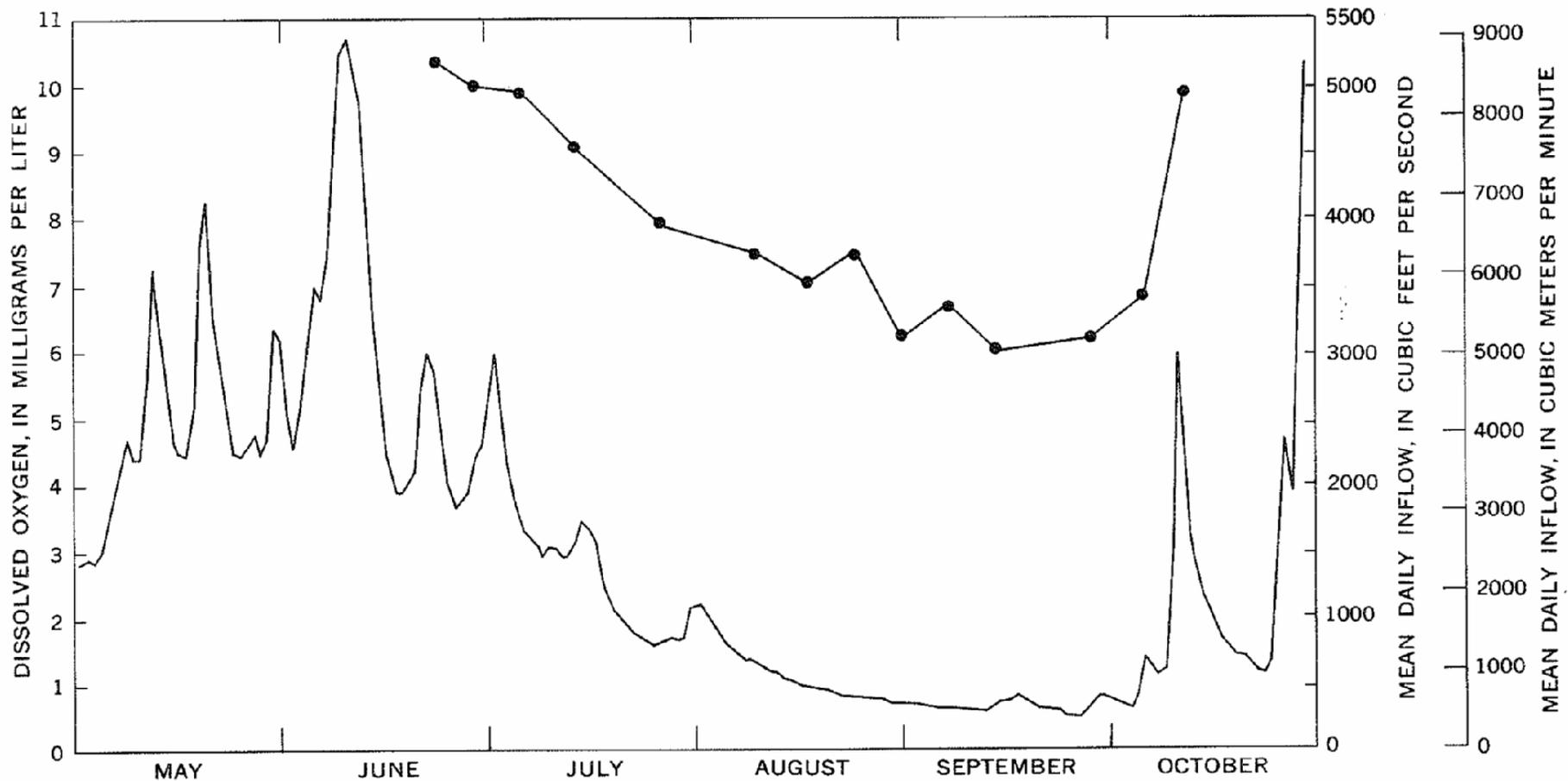
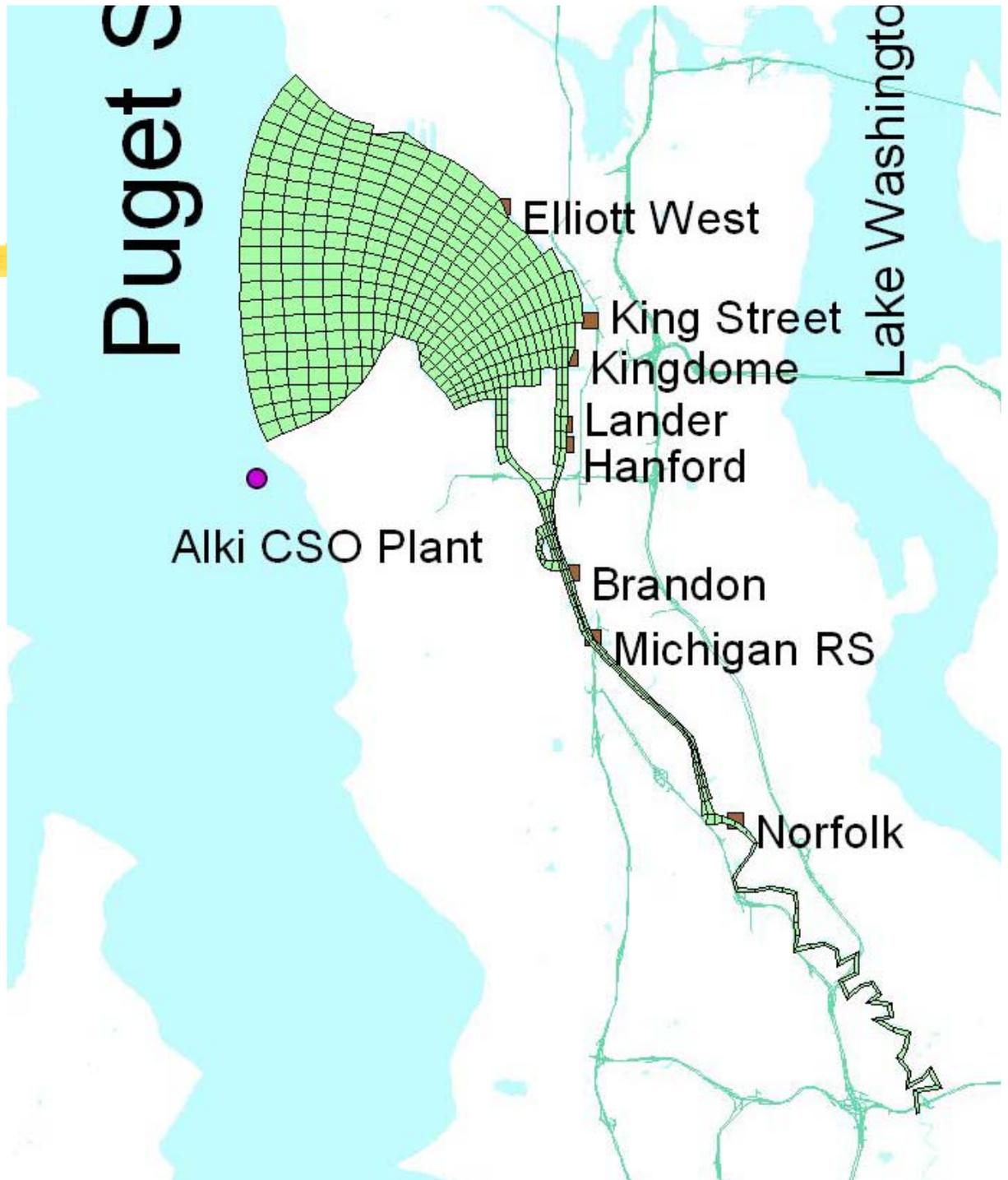


FIGURE 24.—Fresh-water inflow and DO content at station 7.7, May–October 1955. Circles, DO at the surface; solid line, fresh-water inflow.

EFDC

Environmental  
Fluid  
Dynamics  
Computer  
Code



# EFDC Simulation



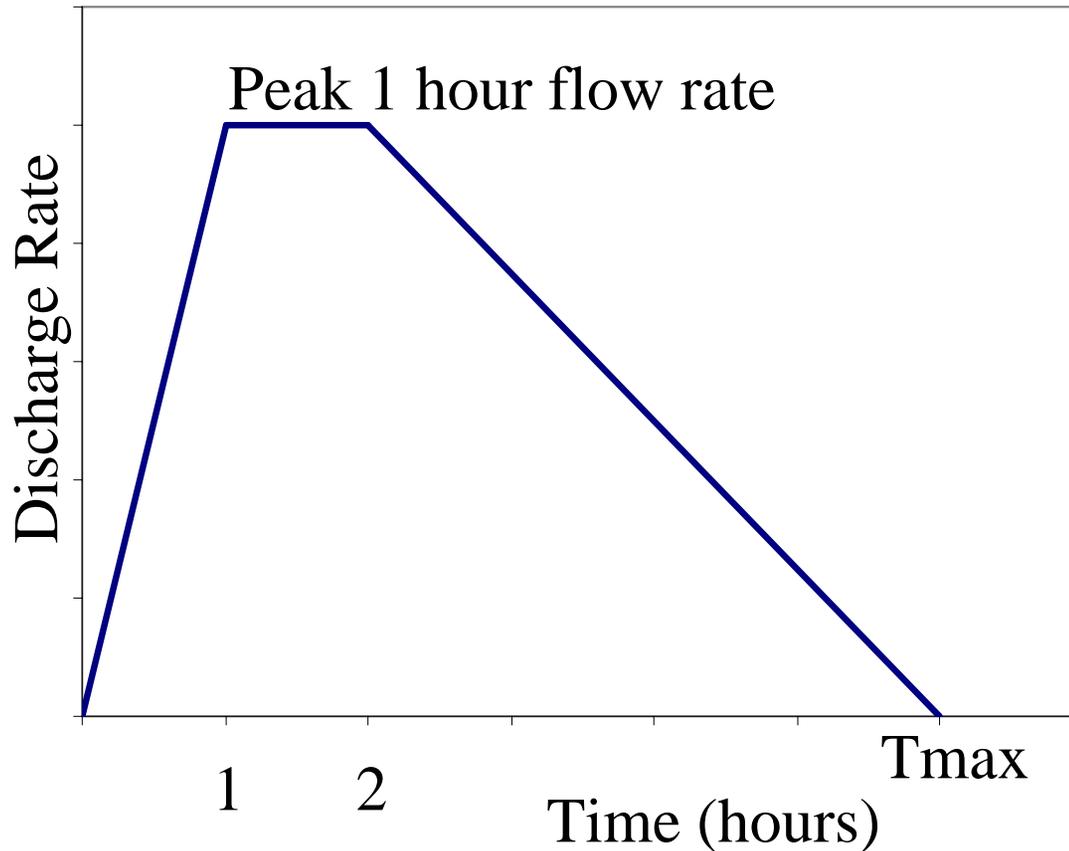
- EFDC grid from Elliott Bay/Duwamish WQA
- Once per year CSO event (volume, flow)
- Critical conditions: Autumn
- All CSOs discharge simultaneously

# DO in CSO Effluent



<b>Location</b>	<b>Date</b>	<b>Time</b>	<b>Temp (deg C)</b>	<b>DO (mg/L)</b>
<b>King</b>	<b>11/3/2005</b>	<b>12:19</b>	<b>14.3</b>	<b>8.3</b>
<b>Lander<sup>b</sup></b>	<b>11/3/2005</b>	<b>13:58</b>	<b>13.5</b>	<b>7</b>
<b>Lander<sup>c</sup></b>	<b>11/3/2005</b>	<b>14:03</b>	<b>13.8</b>	<b>8.2</b>
<b>Brandon</b>	<b>11/3/2005</b>	<b>14:18</b>	<b>10.2</b>	<b>10.9</b>
<b>S. Michigan</b>	<b>11/3/2005</b>	<b>14:26</b>	<b>11.5</b>	<b>10.1</b>

# Conceptual CSO Hydrograph



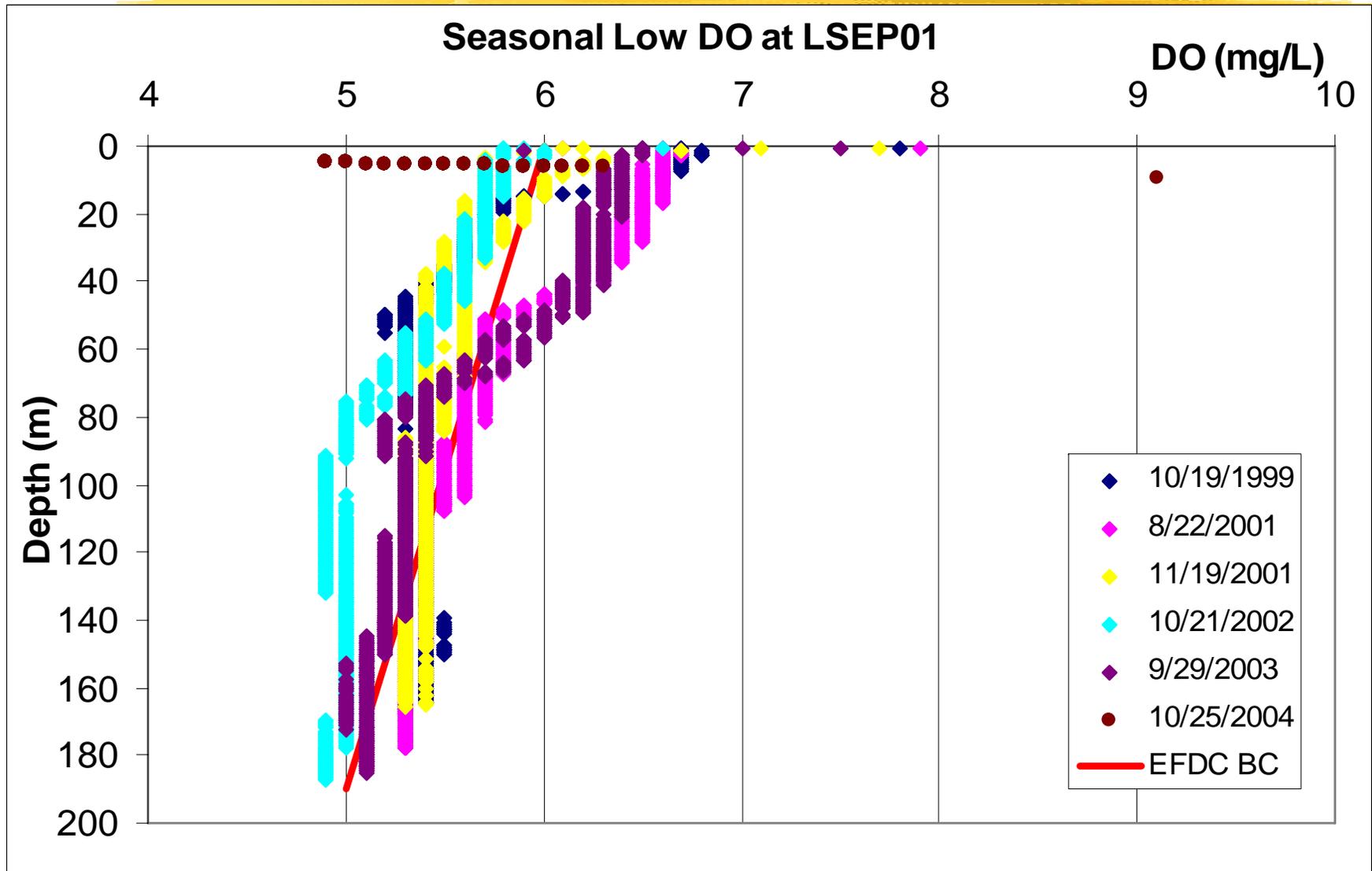
DO = 7 mg/L

BOD = 64 mg/L

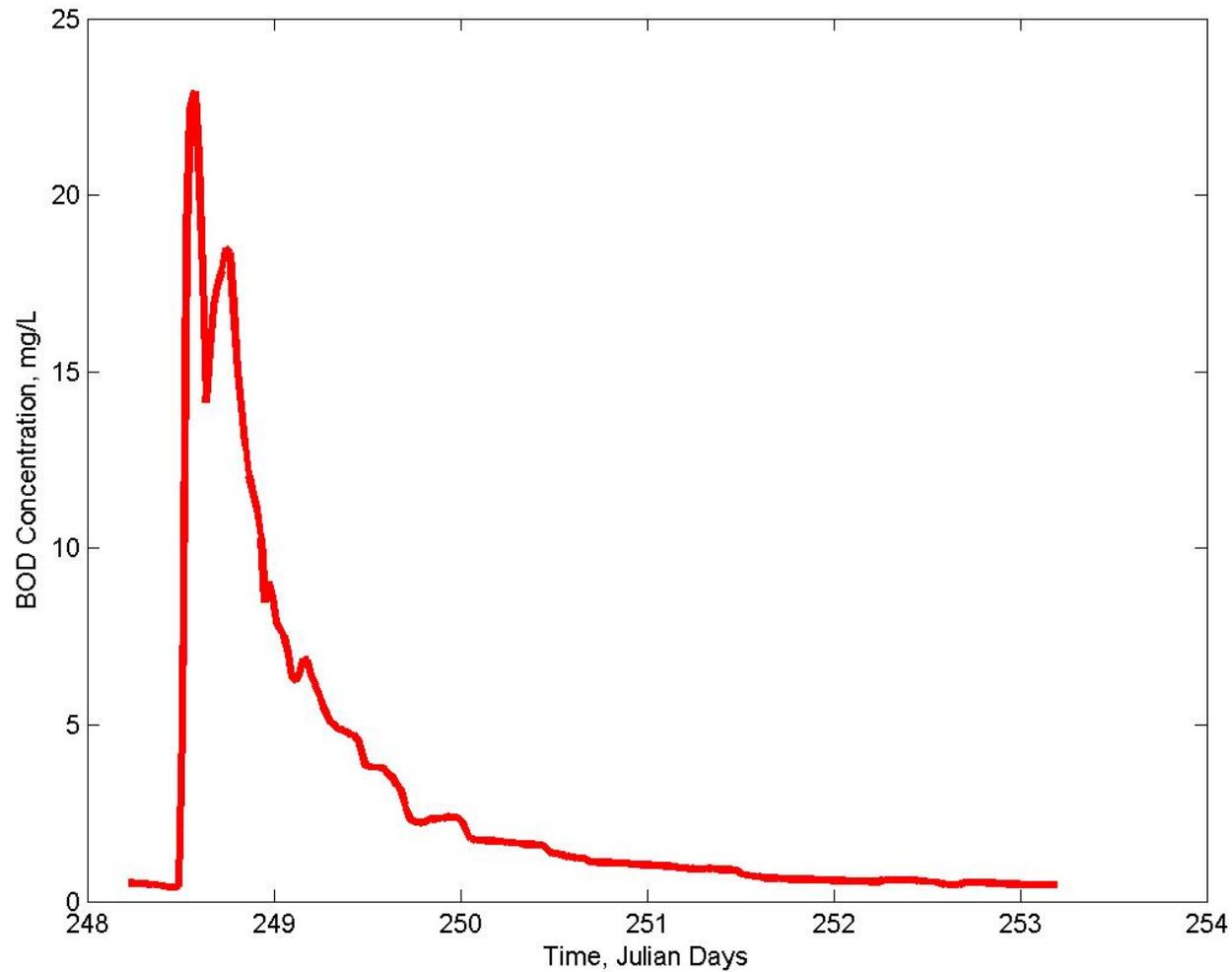
Decay Rate = 0.39/day

CSO	Peak Q	Duration
Elliott West	200	15
Kingdome	75	13
King	22	8
Hanford	118	5
Lander	54	19
Brandon	25	14
Michigan	75	3
Norfolk	101	11

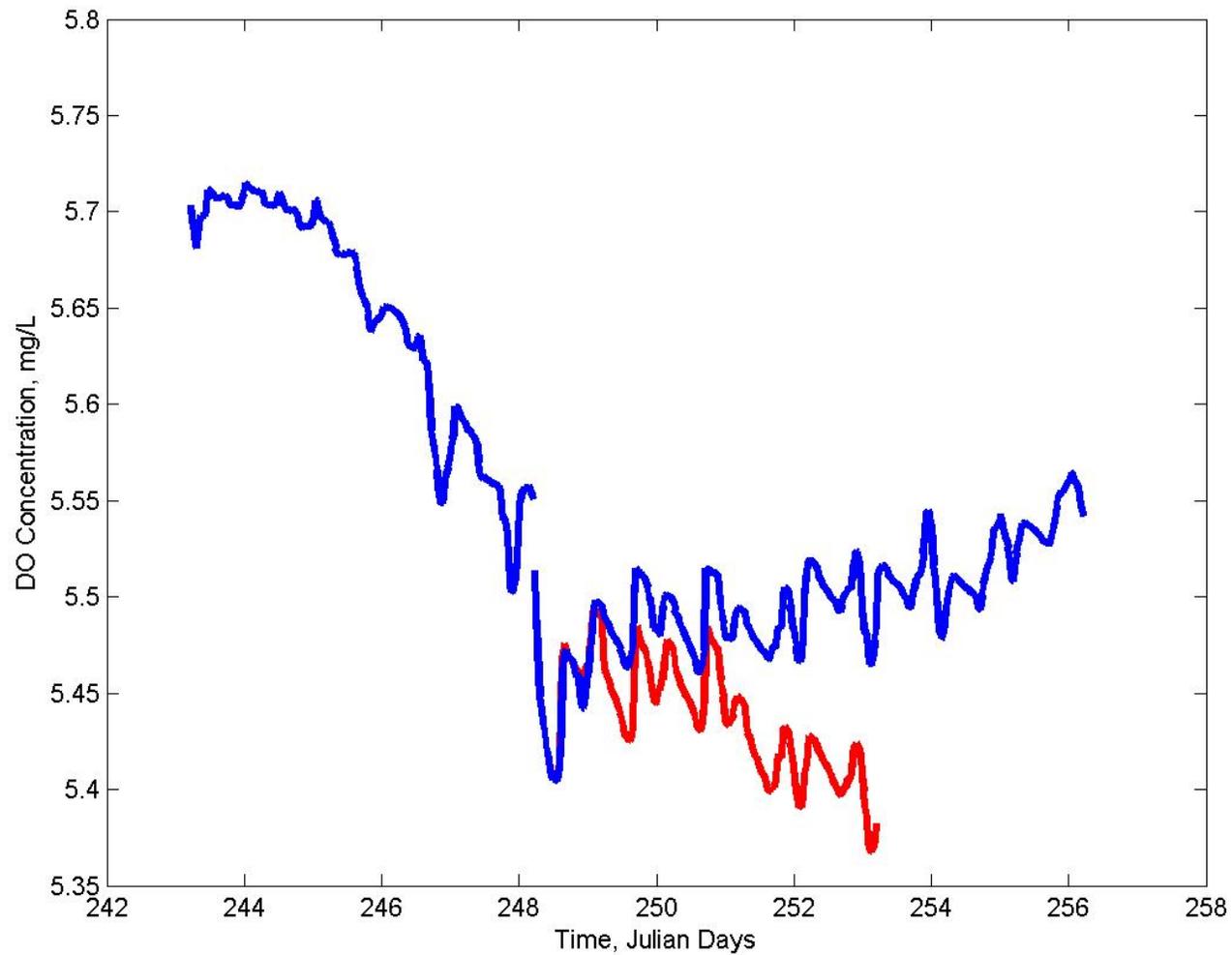
# Elliott Bay Boundary



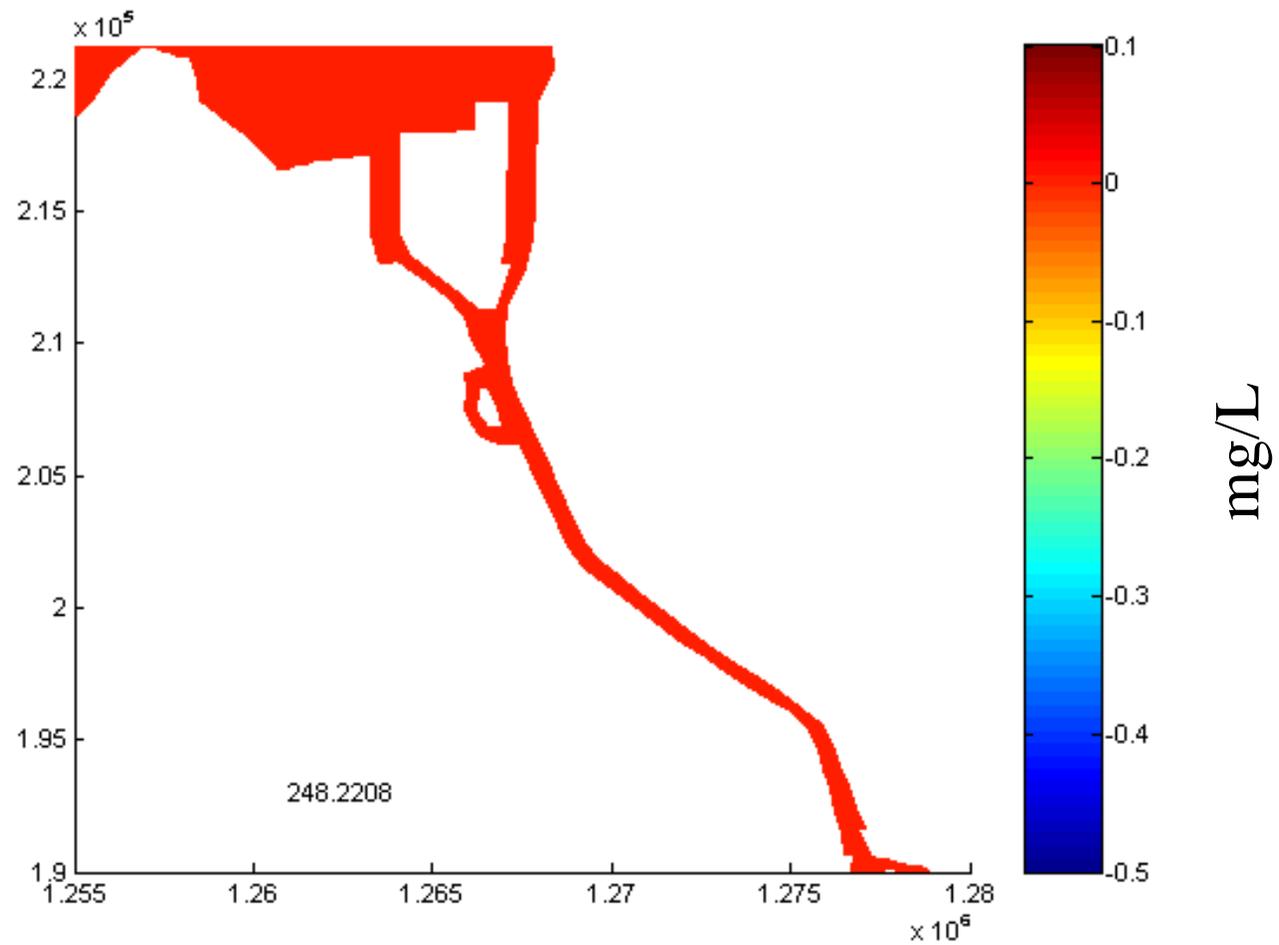
# Maximum BOD Concentrations



# Minimum DO Concentrations



# DO reduction in LDW



# Future Work



- Any issues with localized DO reduction?
- Sensitivity to Duwamish River flows, other tidal conditions
- Dissolved Oxygen in Duwamish River, Elliott Bay
- Influence of non-CSO discharges (stormwater)

CSOs

