



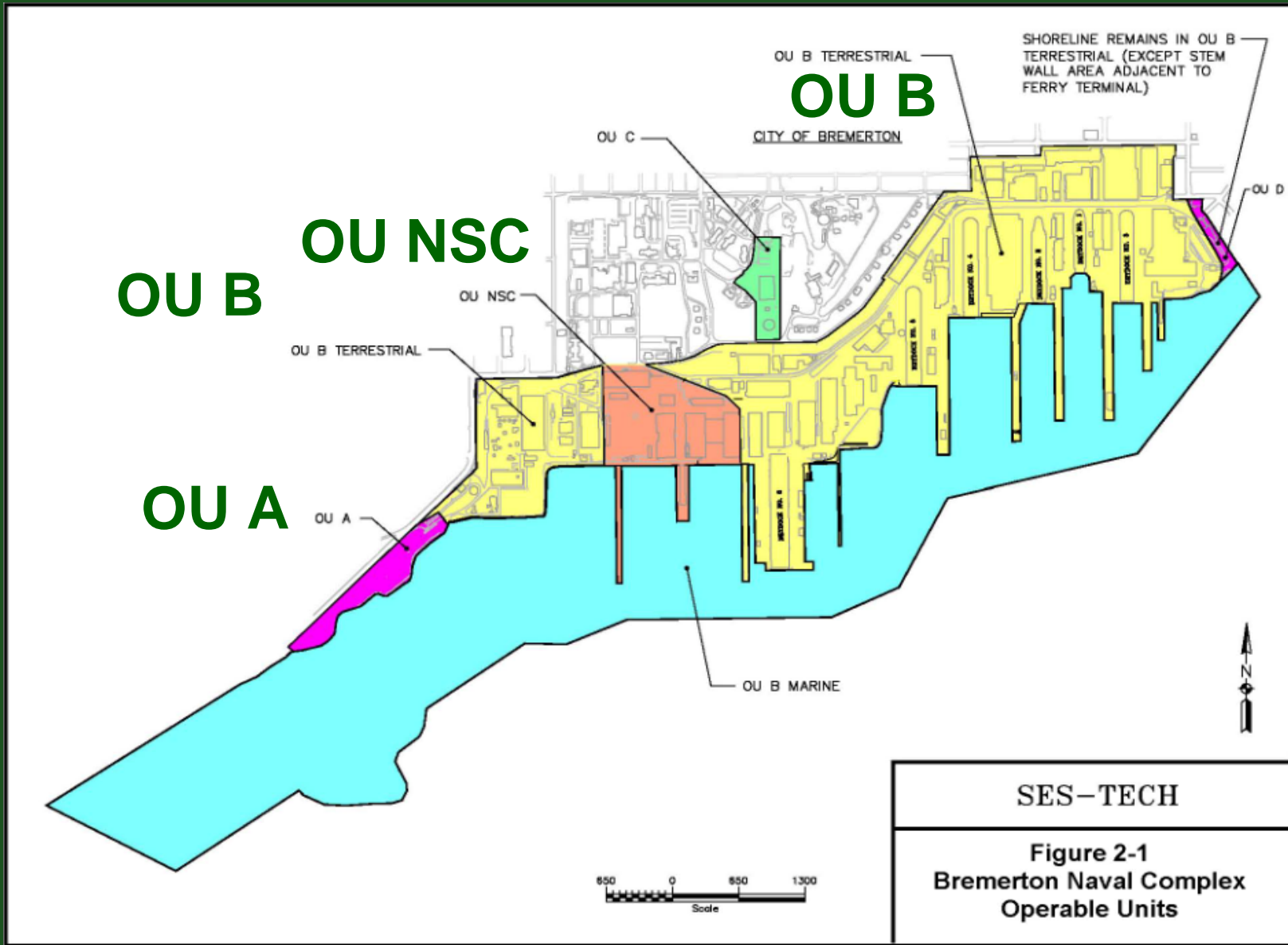
# Project Proposal: Mercury in Sinclair Inlet

**USGS Washington Water Science Center  
Tacoma, WA  
March 18, 2008**

# Agenda

## Morning (10am - noon)

- Introduction Bob Kimbrough
- History of Project Navy
- Project Proposal USGS
- Objective 1 USGS
- Objective 2 Tony Paulson
- Objective 3 Rick Dinicola
- Wrap-up Navy and USGS



SES-TECH

**Figure 2-1**  
**Bremerton Naval Complex**  
**Operable Units**

# Objective 1

- **Examining existing environmental data related to Hg:**
  - **Quality of environmental data**
  - **Marine Sediments**
  - **Marine Seawater**
  - **Marine Biota**
  - **Groundwater**

# Objective 1 (Cont.)

- **Examining loading of Hg to Sinclair Inlet from:**
  - **A) Ground-water from PSNS using new USGS data (20 samples) and a modified ground-water model,**
  - **B) Dry docks and steam plant (14 samples)**

# Objective 1

- **Examining existing environmental data related to Hg in:**
  - **Question 1: Are Hg concentration in the media of interest higher in PSNS than in Sinclair Inlet?**
  - **Question 2: Are Hg concentration in the media of interest higher in Sinclair Inlet than in other appropriate regions of Puget Sound?**

# Objective 1

- Examining existing environmental data related to Hg in:

- **Marine Sediments**

- Sources of Data
- Site Investigation
- Remedial Investigation
- Long Term Monitoring
- PSAMP

# Sediment Data from Navy Database





<b>Project</b>	<b>Depth</b>	<b>Bremerton Naval Complex</b>					
<b>Site Inv.</b>	<b>Internal</b>	<b>Hg</b>			<b>AI</b>	<b>TOC</b>	<b>Gr Size</b>
		<b>No.</b>	<b>No.</b>	<b>Method</b>	<b>No.</b>	<b>No.</b>	<b>No.</b>
		<b>Total</b>	<b>Accept.</b>				
		<b>OUA</b>					
<b>1990</b>	<b>0-4</b>	<b>7</b>	<b>0</b>	<b>TCLP</b>	<b>7</b>	<b>1</b>	<b>0</b>
<b>1993</b>	<b>0-5</b>	<b>10</b>	<b>6</b>	<b>TCLP</b>	<b>0</b>	<b>10</b>	<b>0</b>
		<b>OUB</b>					
<b>1990</b>	<b>0-4</b>	<b>48</b>	<b>48</b>	<b>Total</b>	<b>48</b>	<b>11</b>	<b>0</b>
<b>1994</b>	<b>0-10</b>	<b>24</b>	<b>4</b>	<b>Total?</b>	<b>23</b>	<b>24</b>	<b>18</b>
<b>1995</b>	<b>0-60</b>	<b>3</b>	<b>0</b>	<b>Total</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>1996</b>	<b>0-2</b>	<b>11</b>	<b>11</b>	<b>TCLP</b>	<b>10</b>	<b>11</b>	<b>0</b>
<b>1997</b>	<b>0-2</b>	<b>9</b>	<b>9</b>	<b>TCLP</b>	<b>8</b>	<b>9</b>	<b>0</b>
<b>2000</b>	<b>0-10</b>	<b>7</b>	<b>7</b>	<b>7471</b>	<b>0</b>	<b>15</b>	<b>7</b>
<b>2001</b>	<b>0-2</b>	<b>12</b>	<b>12</b>	<b>7471</b>	<b>0</b>	<b>12</b>	<b>12</b>
	<b>0-10</b>	<b>46</b>	<b>44</b>	<b>7471</b>	<b>0</b>	<b>46</b>	<b>44</b>
		<b>GRID</b>					
<b>2003</b>	<b>0-6,12,10,15</b>	<b>88</b>	<b>88</b>	<b>1631</b>	<b>0</b>	<b>76</b>	<b>88</b>
<b>2005</b>	<b>0-10</b>	<b>70</b>	<b>60</b>	<b>7471</b>	<b>0</b>	<b>70</b>	<b>70</b>
<b>2007</b>	<b>0-10</b>	<b>Only in spreadsheet</b>					



Project	Depth	Greater Sinclair Inlet					
Site Inv.	Interval	Hg			AI	TOC	Gr Size
		No.	No.	Method	No.	No.	No.
		Total	Accept.				
		<b>OUA</b>					
1995	0-10	7	7	Total	1	7	0
1994	0-10	17	12	Total?	17	17	17
2000	0-10	3	3	7471	0	3	3
2001	0-2	21	21	7471	0	21	21
		<b>GRID</b>					
2003	0-10,12,14,16	59	44	7471	29	58	0
2005	0-10	3	2	7431	3	3	3
2007	0-10	32	32	?	0	32	32

# Hg sediment data in Database:

- For DIFFERENT depth intervals,
- Using DIFFERENT analytical methods,
- And measured with DIFFERENT  
with ancillary data

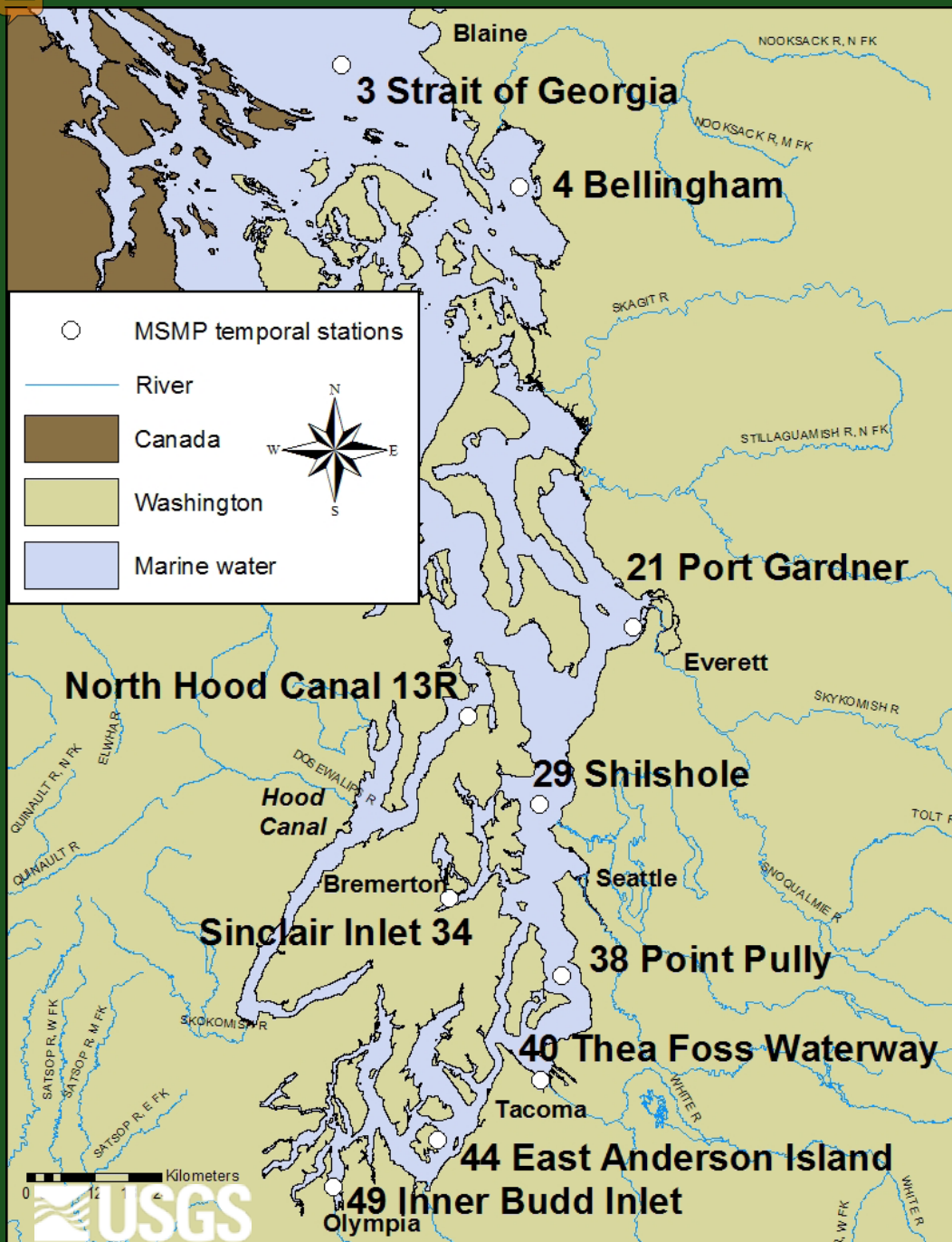
# Other sediment Data:

- Hg in RI/FS cores
- Sedimentation Rates from RI/FS
- ENVVEST Cores
- ENVVEST Sediment Traps
- Cap data
- Pit Data
- RI/FS data outside Sinclair Inlet  
(Holmes Harbor, Case Inlet and Port Orchard)

# Hg Data Outside Sinclair Inlet

**Brightwater (METRO)**

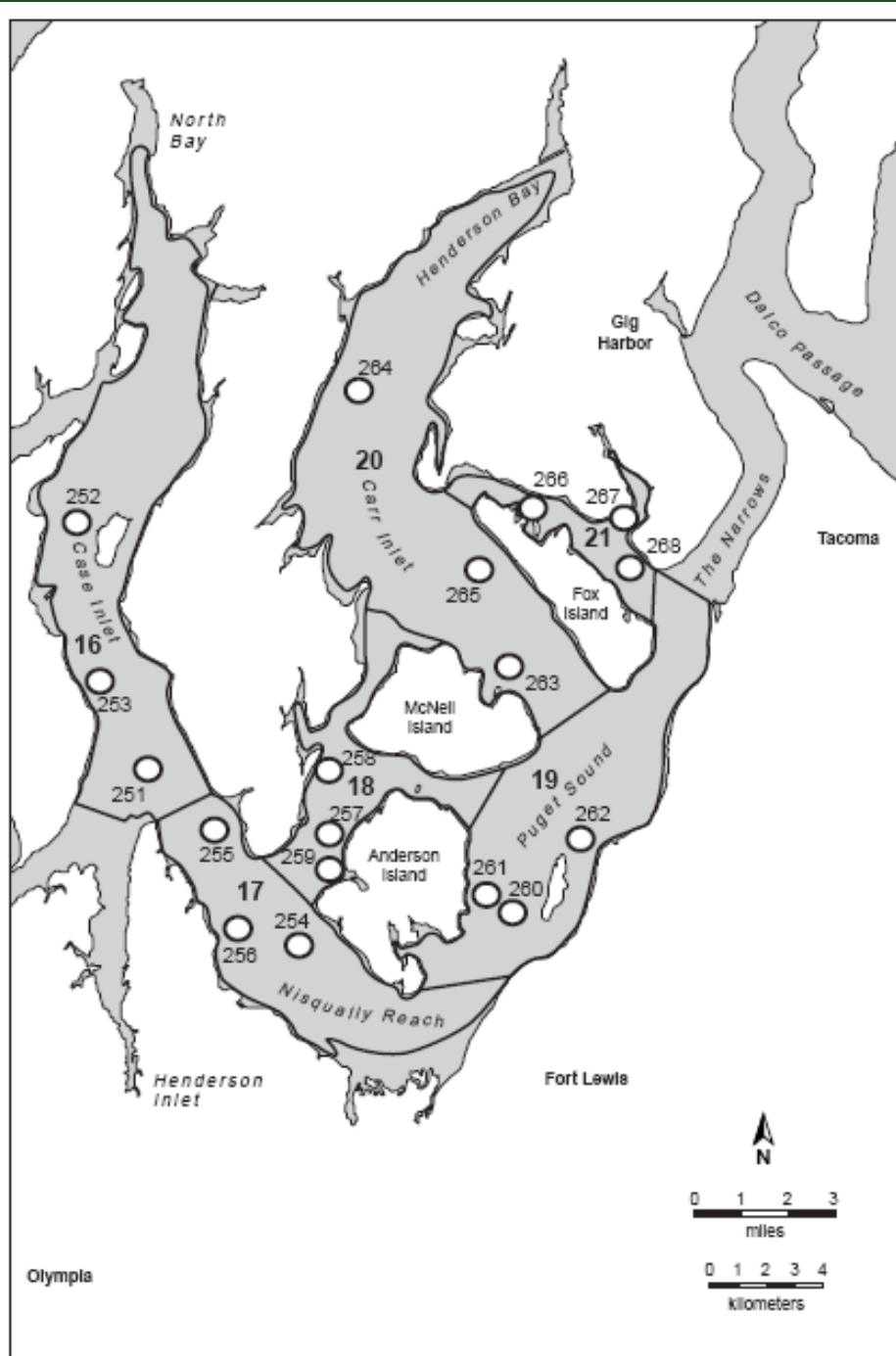
**PSAMP (WA Ecology)**



# Temporal Trends: PSAMP long-term sediment monitoring station locations



# PSAMP South Puget Sound Focus Study 1999



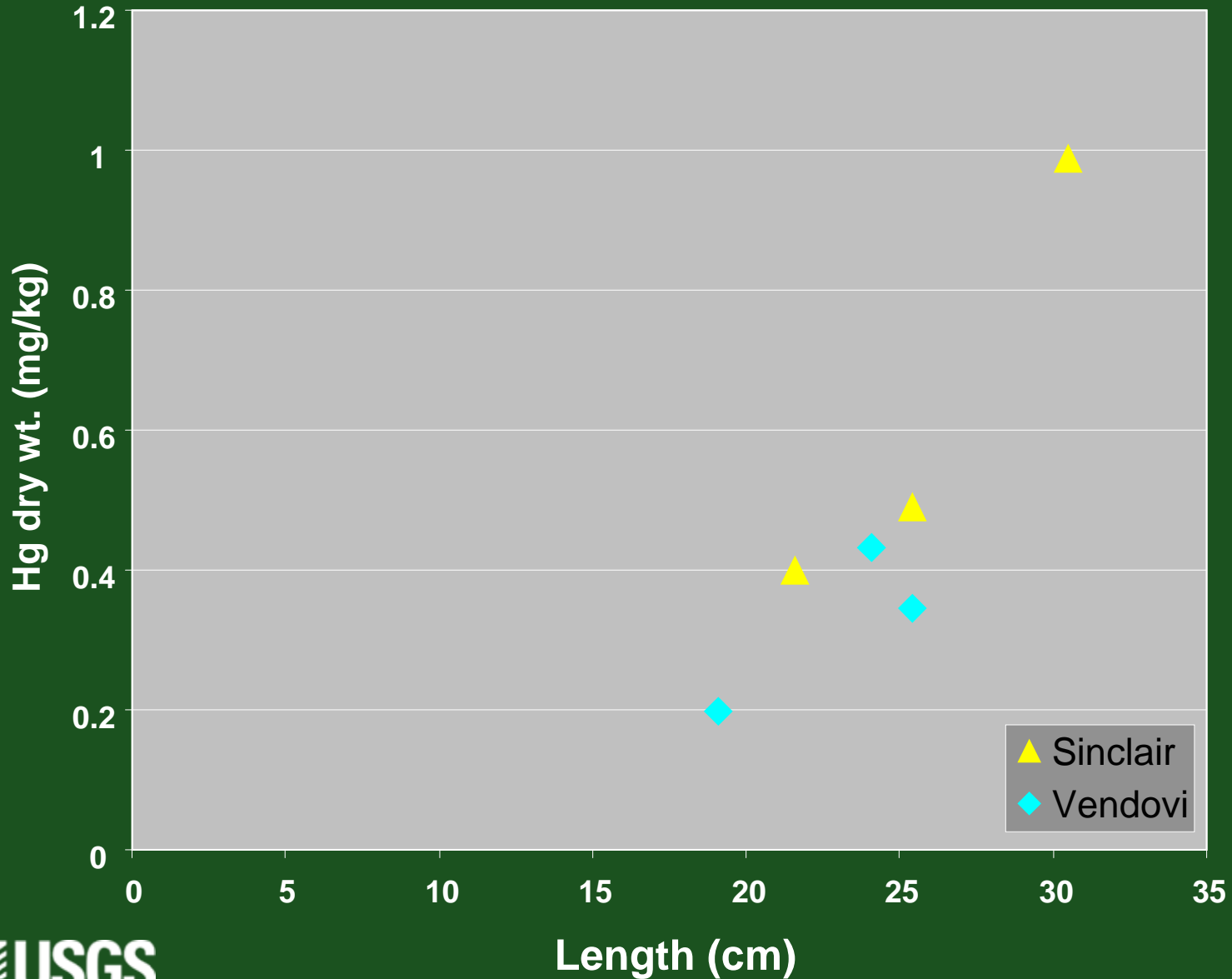


# Biota



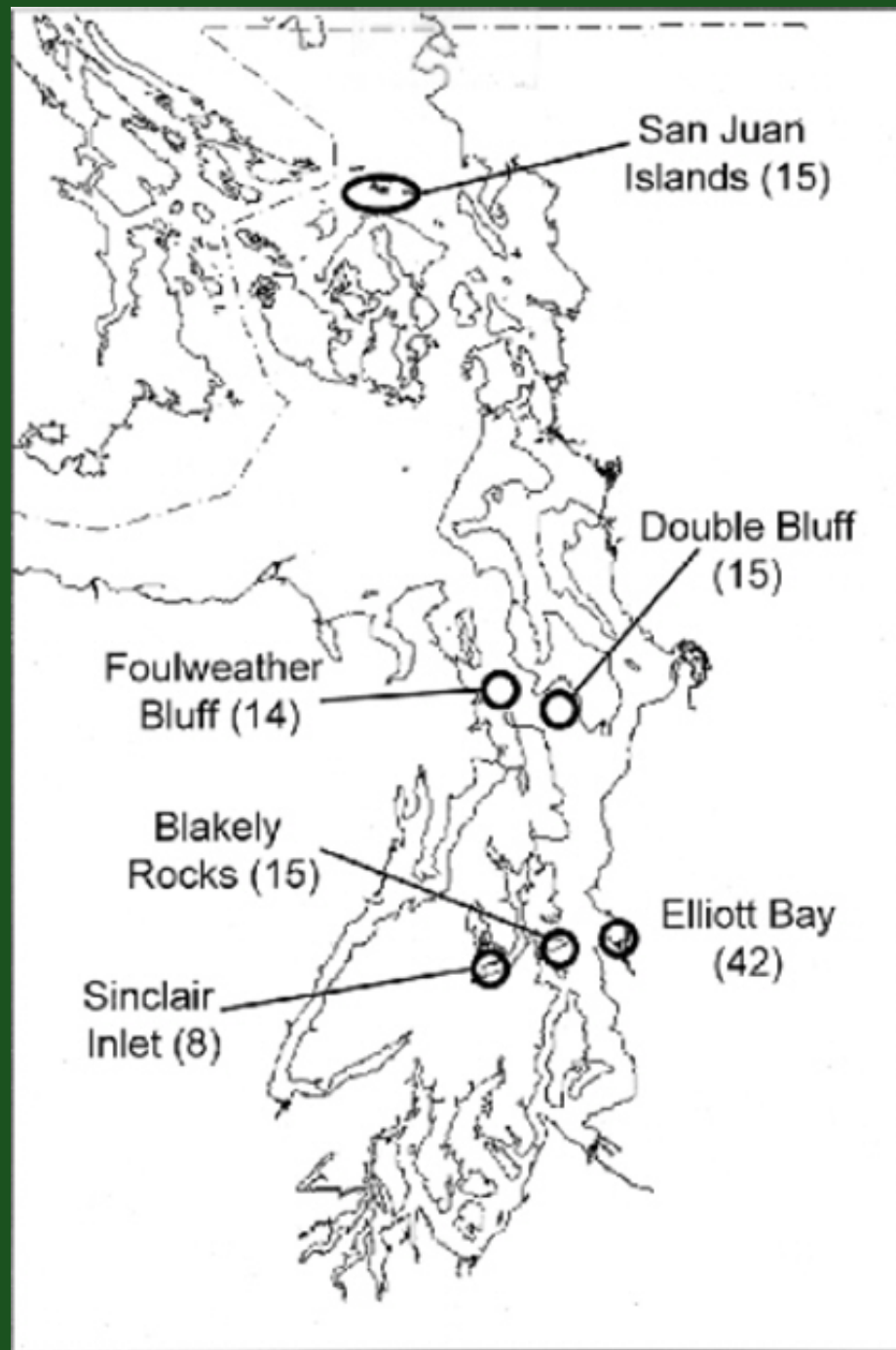


# Mercury Concentration Staghorn Sculpin



# ***West and O'Neill: Persistent Pollutants in Rockfish***

Figure 1. Location of sampling locations for quillback and brown rockfish in Puget Sound. Samples were taken from San Juan Islands, Double Bluff, and Blakely Rocks using hook-and-line in the fall of 1995; Foulweather Bluff and Sinclair Inlet were sampled using bottom trawls in the fall of 1997 and spring of 1996, respectively. Elliott Bay was sampled using hook-and-line and bottom trawls in the fall of 1995 and the spring of 1996 and 1997. Numbers in parentheses indicate sample sizes.



# West and O'Neill: Persistent Pollutants in Rockfish

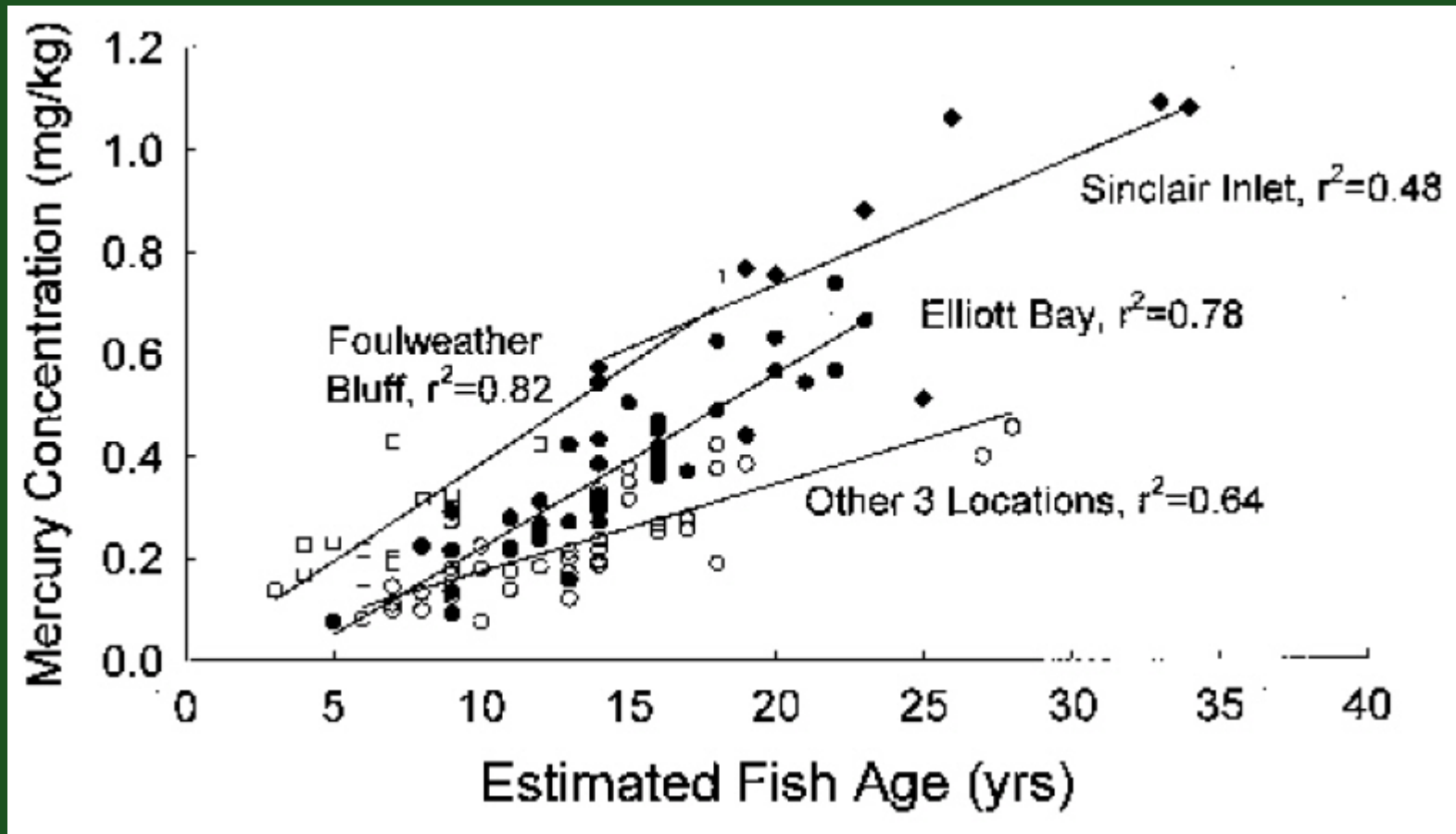
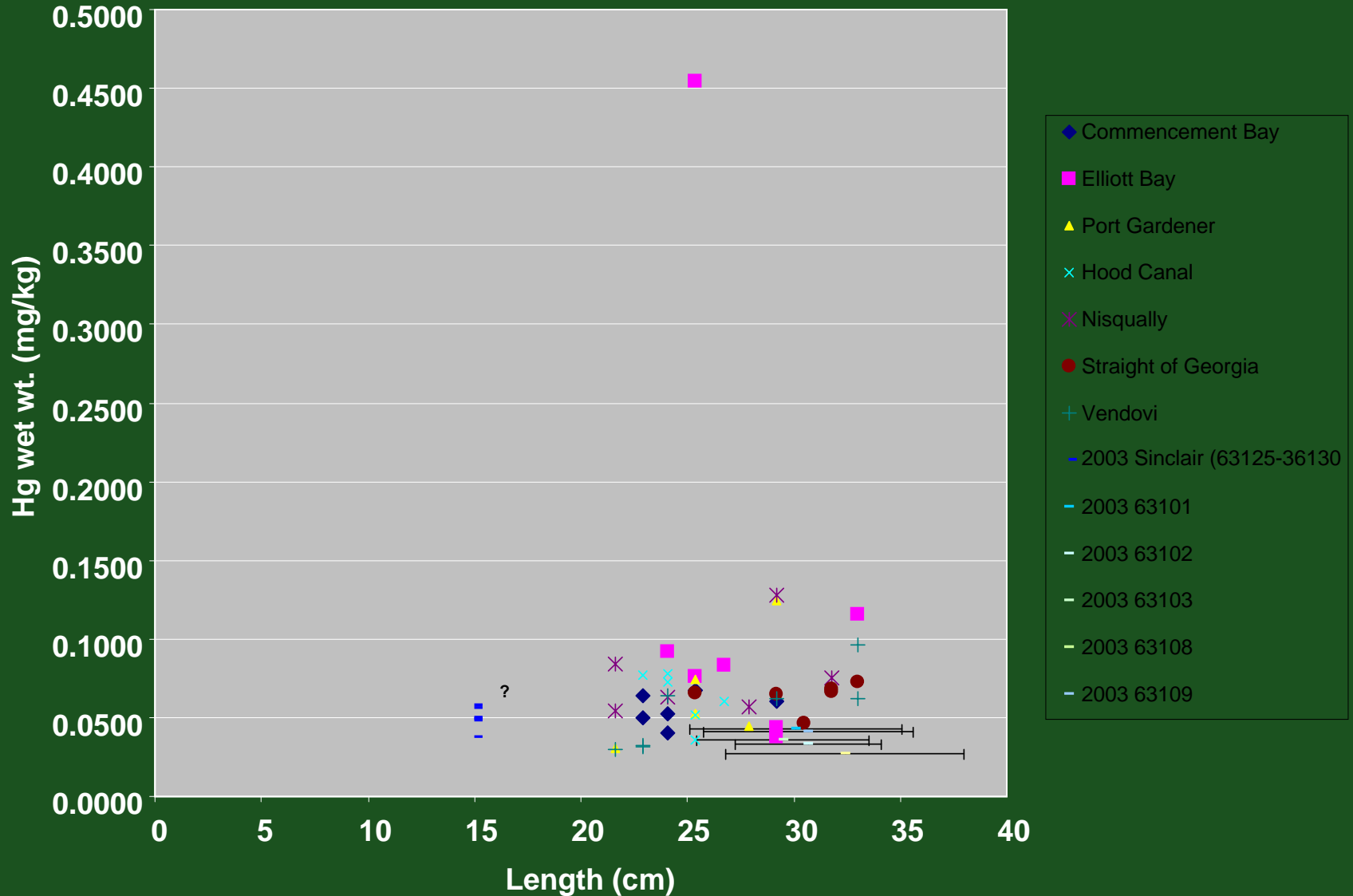


Figure 2. Accumulation of mercury in muscle tissue from quillback and brown rockfish sampled from Sinclair Inlet (diamonds), Foulweather Bluff (open squares), Elliott Bay (filled circles), and three locations (San Juan Islands, Double Bluff, and Blakely Rocks) grouped together (open circles). Lines were fitted using least squares model I linear regression analysis;  $p < 0.05$  for all regressions.

# English Sole Mercury Concentration, PSAMP 2005 & 2003





**Marine Water:**

**RI/FS: High Detection Limits**

**ENVVEST**

**Brightwater (METRO)**

# Objective 1 (Cont.)

- **Examining Loading of Hg to Sinclair Inlet from:**
  - **A) Ground-water from PSNS using new USGS data (20 samples) and a modified ground-water model,**
  - **B) Dry docks and steam plant (14 samples)**

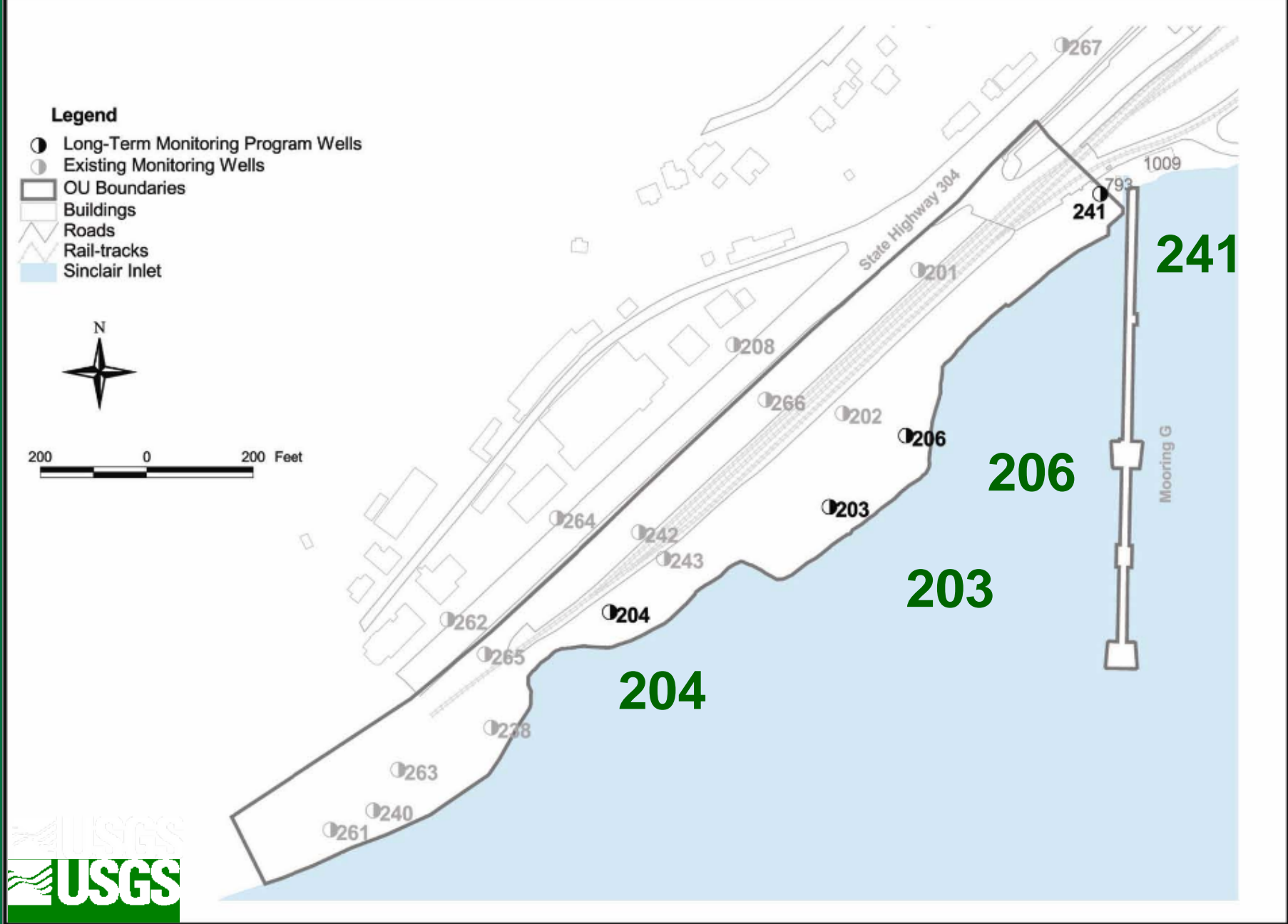
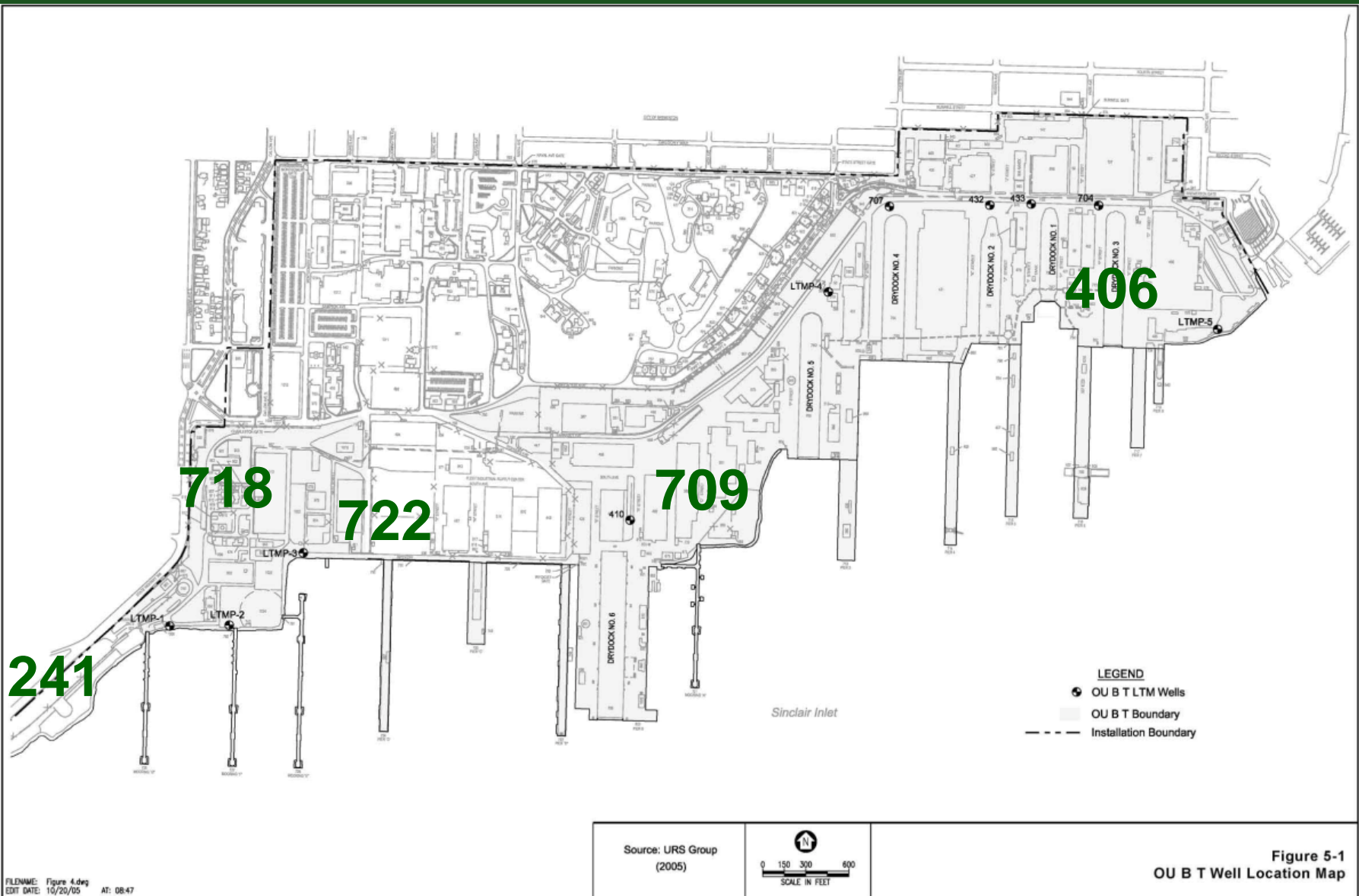
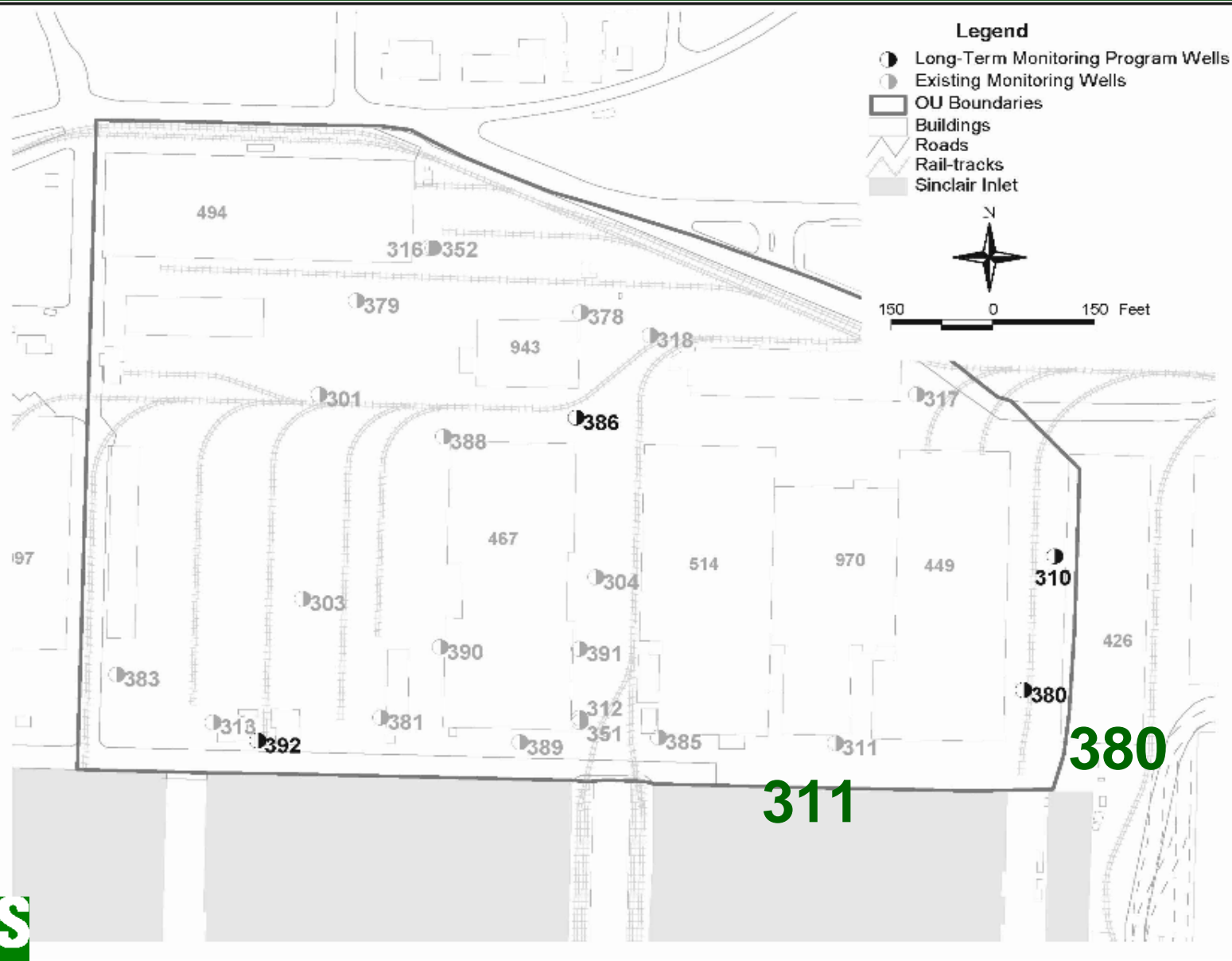


Figure 3-1  
OU A Well Location Map

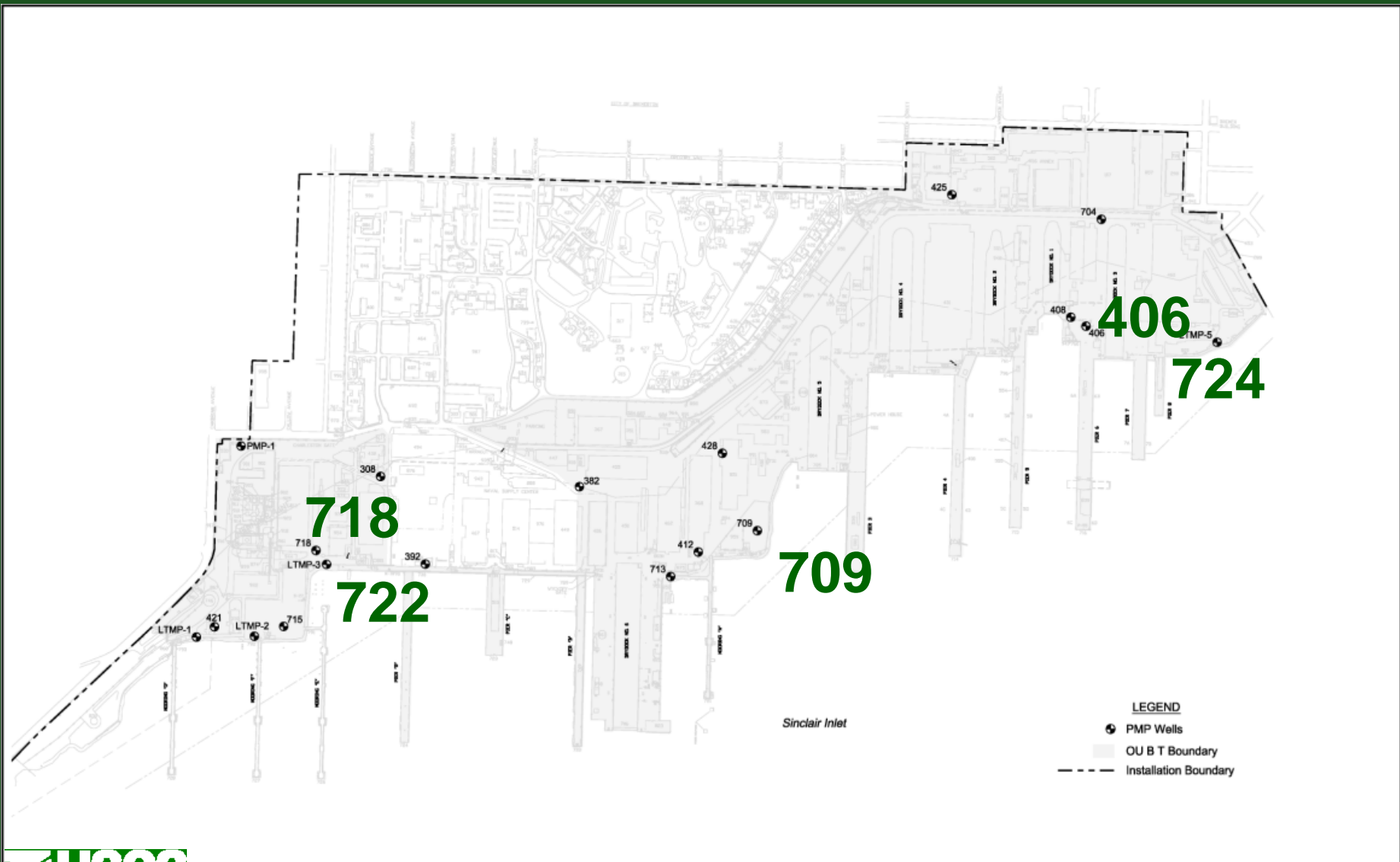






SES-TECH

Figure 4-1  
OU NSC Well Location Map



**LEGEND**

- PMP Wells
- OU B T Boundary
- - - Installation Boundary



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U.S. NAVY

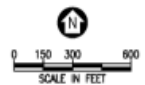


Figure 6-1  
 PMP Well Location Map

















Field Log  
Date: \_\_\_\_\_  
Location: \_\_\_\_\_  
Time: \_\_\_\_\_  
Weather: \_\_\_\_\_  
Water Level: \_\_\_\_\_  
Temperature: \_\_\_\_\_  
pH: \_\_\_\_\_  
Dissolved Oxygen: \_\_\_\_\_  
Conductivity: \_\_\_\_\_  
Turbidity: \_\_\_\_\_  
Other: \_\_\_\_\_





2

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# Drydock Sampling

**Dry Docks 4/5: Dec. 2007- April 2008  
(monthly)**

**Dry Dock 6 : February – June 2008**

**Steam Plant : March- April 2008**



# Revised GW model

- Purpose -- estimate Hg flux to Inlet from entire BNC
- Convert 1996 USGS model to SEAWAT
  - saltwater boundaries
  - transient simulations over tidal cycle
  - possible grid refinement & recalibration

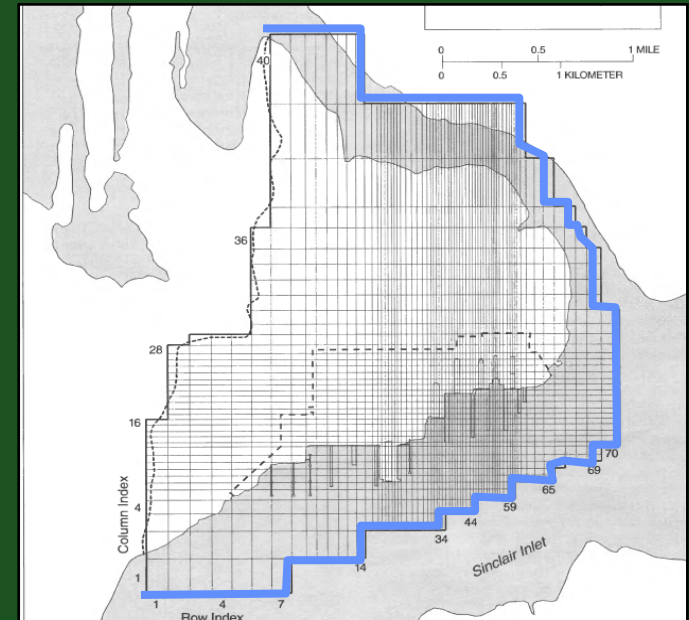
**USGS**  
science for a changing world

**User's Guide to SEAWAT:**

A Computer Program For Simulation of Three-Dimensional Variable-Density Ground-Water Flow

Techniques of Water-Resources Investigations of the U.S. Geological Survey

**BOOK 6**  
Chapter A7



# Objective 2

- **Total and methyl-Hg Survey**
  - 1) Nine marine sites (August- September 2008)
  - 2) Five wells (April 2008)
  - 3) Dry docks and steam plant (April 2008)
  - 4) Five stream samples (April and July 2008)
  - 6) Two wastewater treatment plants (April, July, August)
  - 7) Six storm events

# Objective 2

- **Total and methyl-Hg Survey**
  - **1) Nine marine sites (August- September 2008)**

Total and methyl-Hg in porewater, near-bottom water column and near-surface water column.

Hg concentrations in sediments (**depth of sediments to be decided, 0-2 cm or 0-10 cm**)

Ancillary data associated with organic matter will be c



# Objective 2

- **Total and methyl-Hg Survey**
- **1) Nine marine sites (August- September 2008)**
  - Three sites within OU B: grid (71, 52, 39)
  - Three within Sinclair Inlet: sub-tidal in Gorst mudflats, center channel of PSNS, and Port Orchard marine.
  - Three outside Sinclair Inlet (**to be decided**): longitudinal gradient away from Sinclair Inlet or biogeochemical gradient?



# Objective 2

- **Total and methyl-Hg Survey**
  - **2) Five wells (April 2008)**
    - LTMP-3, 718 behind LTMP-3,
    - LTMP-5 and 206 (freshwater in OU A)
    - 380 – deepest well (**reference ?**)
  - **4) Five stream samples (April and July 2008)**
  - **ENVEST SITES: Gorst, Anderson, Blackjack, Annapolis Creeks and Olney.**

# Objective 2

- **Total and methyl-Hg Survey**
  - **7) Six storm events**

**Probably not until fall of 2008**

**Locations to be decided: Stream samples for surface water or PSNS storm water sample**

## Objective 3

### Mercury in ground water near Mooring E

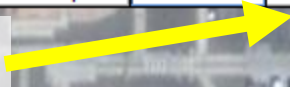
- High total Hg concentrations in LTMP-3
  - data confounded by high turbidity
- Possible conceptual models:
  - Terrestrial source of Hg; discharge directly to Inlet
  - Terrestrial source of Hg; captured in DD6
  - Marine source of Hg; drawn landward then captured in DD6
- Conceptual model refinement (ongoing)
- Preliminary well sampling (May)
- Nearshore investigation/sampling (June 2-6)



**GW to inlet**



**GW to Dry dock 6**



**Well 718**  
SC 2,600  
DO 0.5  
Hg n.d.

**Well LTMP-3**  
SC 34,400  
DO 5.7  
Hg .2-5 ppb

