# Toxics Loading Studies

## Puget Sound Partnership

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# Toxics Loading Studies

- **Current situation: Wide variety of regulations related to toxic discharges, cleanup actions, source control. Disjointed, sparse data collection**
- **Goal: Develop a reduction strategy to prioritize enforcement and development of regulations, legislation, spending on cleanups, source control related to toxics**
- **Three phases of studies**

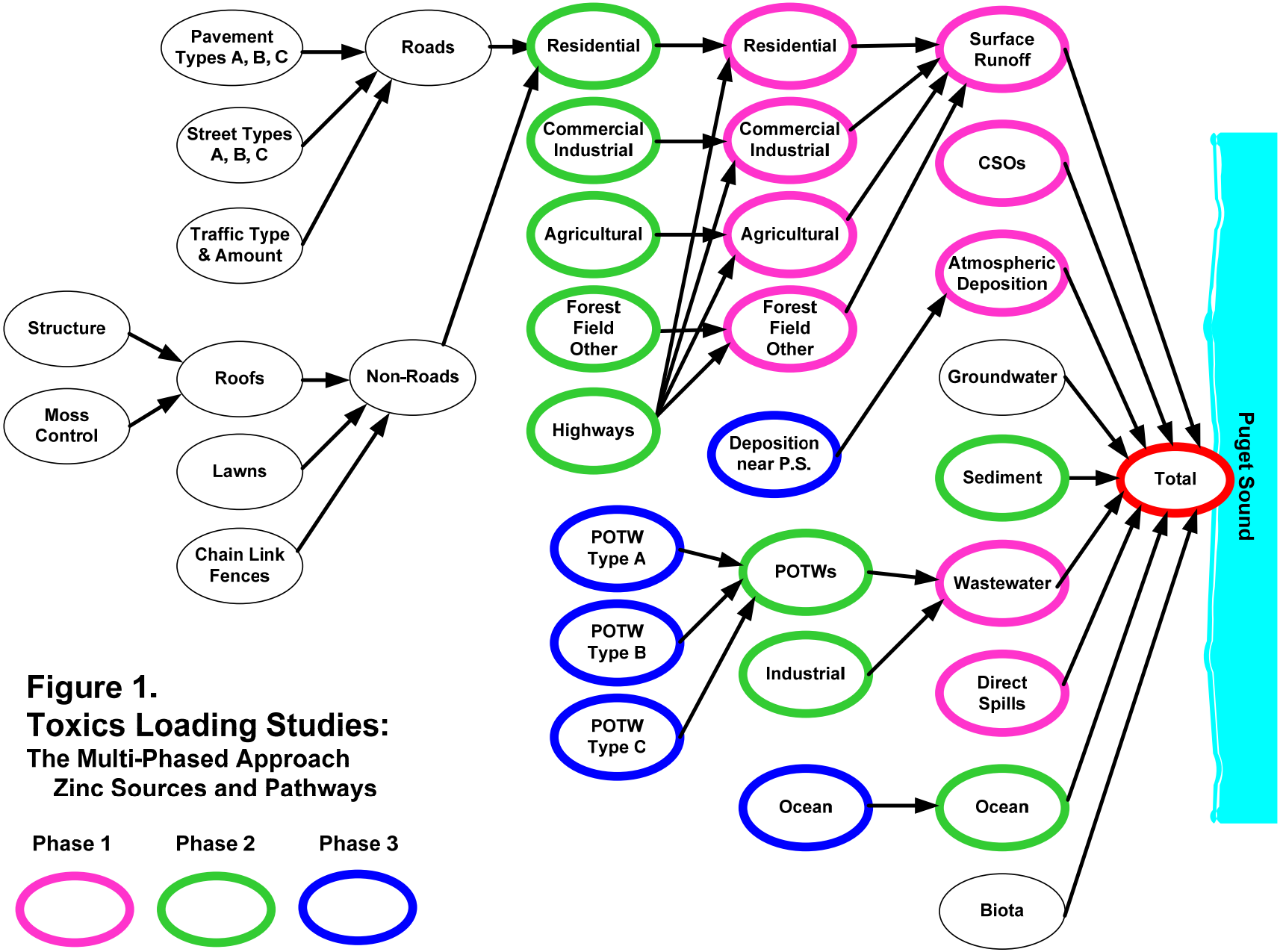



**Figure 1.**
**Toxics Loading Studies:**
**The Multi-Phased Approach**
**Zinc Sources and Pathways**

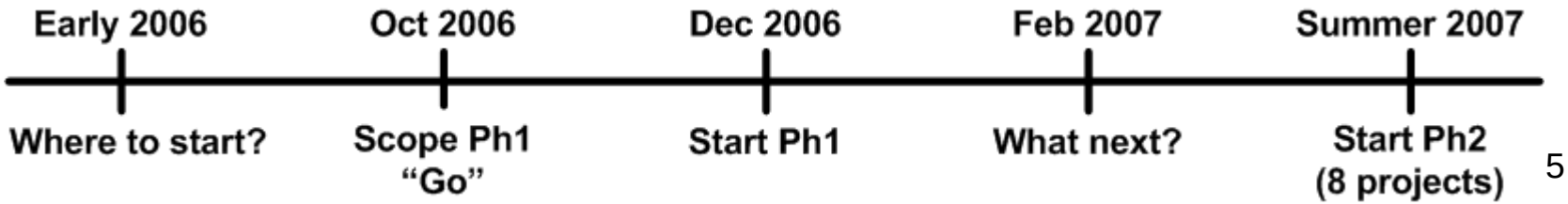
| Phase 1 Study Chemical | Category addressed | Harm or threat |
|---|---|---|
| Arsenic | Arsenic | Associated with sediment toxicity and benthic community impairment |
| Cadmium | Cadmium | Accumulation in shellfish |
| Copper | Copper | Associated with sediment toxicity and benthic community impairment; affects salmonids and stream health |
| Lead | Lead | Associated with sediment toxicity and benthic community impairment |
| Mercury | Mercury | Target of fish consumption advice; Associated with sediment toxicity and benthic community impairment |
| Total PCBs[1] | PCBs | Target of fish consumption advice; accumulation in fish, birds, mammals; associated with sediment toxicity and benthic community impairment |
| Low molecular weight PAHs[2] | PAHs | Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment |
| Carcinogenic PAHs[3] | PAHs | Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment |
| Other high molecular weight PAHs[4] | PAHs | Liver lesions and reproductive impairment in fish from urban bays; associated with sediment toxicity and benthic community impairment |
| Sum of DDT and metabolites | Pesticides | Accumulation in fish, birds, and mammals; associated with sediment toxicity and benthic community impairment |
| Triclopyr[5] | Pesticides | Category thought to affect salmonids and stream health |
| Total dioxin TEQs from dioxins & furans | Dioxins and furans | Accumulation in birds and mammals; furans associated with sediment toxicity and benthic community impairment |
| Bis(2-ethylhexyl)phthalate | Phthalate esters | Category shown to accumulate in fish, invertebrates, and sediment of urban waterways at levels triggering sediment clean up activities |
| Total PBDEs[6] | PBDEs | Accumulation in sediments, fish, and harbor seals |
| Nonyl phenol | Hormone disrupting chemicals | Category thought to cause reproductive impairment observed in fish from urban bays |
| Oil or petroleum product[7] | | Kills and reduces fitness of marine organisms |
| Zinc | | Increasing concentrations may threaten aquatic resources |

[1] Sum of congeners, sum of Aroclors, etc. to be normalized as part of the project.
[2] Per WAC 173-204-320 this includes: acenaphthene, acenaphthylene, anthracene, fluorine, naphthalene, and phenanthrene.
[3] Per EPA this includes: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene.
[4] WAC 173-204-320 high molecular weight PAHs not on EPA list of carcinogenic PAHs includes: benzo(g,h,i)perylene, fluoranthene, and pyrene.
[5] Input from the project team did not reflect consensus about a current use pesticide to include. Other candidates suggested by project team members included: diazinon, dichlorbenil.
[6] Sum of congeners to be normalized as part of the project.
[7] Specified as crude oil, specific refined product (e.g., diesel, gasoline, heavy fuel oil) or analytical result as TPH-D or TRPH to be normalized as part of the project.

# Phase 1 Toxic Chemical Loadings to Puget Sound

- **PSAT, Ecology, DoH, U.S.EPA**
- **U.S. EPA National Estuary Program (NEP) Grant: $135,000**

- **Goal: Begin quantifying toxics loads with existing data**



# Phase 1 Outcomes

- First PSP results
- Broad participation in data sources and steering group
- Initial look at loadings and data gaps

# Phase 1 Findings (1 of 2)

- **Data gaps abound**
  - **Some data don't interface well**
  - **Little to no data for some chemicals**
  - **Hydrology and regulatory data needs differ**
- **Surface runoff was the greatest loading source for most chemicals**
  - **Developed lands usually generated more runoff per unit area**
  - **Runoff from developed areas contained greater concentrations of toxic chemicals**
- **Air deposition**
  - **Loadings for most chemicals were a fraction of surface runoff**
  - **Loading rates for HPAHs, cPAHs, & PBDEs were comparable to surface runoff**

# Phase 1 Findings (2 of 2)

- **Wastewater: municipal and industrial wastewater data were incomplete**
  - **Of over 1 million data points, only 5,770 matched pairs of flow and concentration were available**
- **CSOs: represented <1% of total loading**
  - **Concentrations of toxics similar to runoff from developed lands but had much lower flow rates**
  - **Did not evaluate localized impacts (e.g., Lower Duwamish)**
- **Direct oil spills**
  - **Loading represented 4% of that from runoff (Includes only oil & petroleum products)**

# Phase 1 Recommendations (1 of 2)

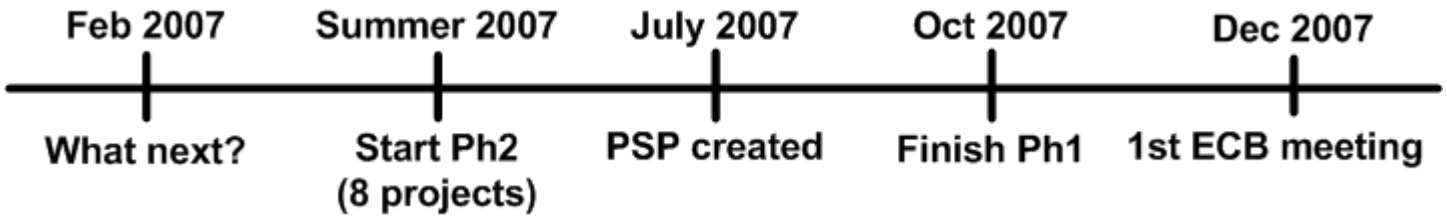
- **In filling the data gaps:**
  - **Search agencies' existing sources**
  - **Conduct more extensive literature searches**
  - **Extrapolate from existing data**
  - **Collect and analyze new environmental data**
- **Conduct further study to:**
  - **Estimate contributions from:**
    - **Sediment**
    - **Ocean Input**
    - **Biota**
  - **Evaluate specific chemicals and pathways:**
    - **Phthalates**
    - **PAHs**
    - **PCBs**
    - **Hormone disrupters**
    - **PBDEs**

# Phase 1 Recommendations (2 of 2)

- Use a mass balance (model) approach to:
  - Assess whether load estimates are consistent and realistic
  - Evaluate contaminant fate:
    - Degradation
    - Transformation
  - Predict effects of reductions to loadings
- Quantify contributions from industrial and municipal wastewater
- Improve surface runoff loadings based on land use
  - Paved surfaces and other land uses
- Develop and test regional air pollutant transport models

# Phase 2 Toxic Chemical Loadings to Puget Sound

- **Refine Phase 1, still existing information, more time**
- **Series of projects**
- **No formal process for prioritization**



# Phase 2 Studies

A. Roadways & Surface Runoff
B. Wastewater Dischargers
C. Assess Sediment to Biota Transfer
D. Ocean Boundary
E. Box Model
F. Develop Toxics Biological Observing System

# Phase 2 Conclusions & Recommendations

- **Ocean Flux**
  - **Conclusions**
    - Most usable data (15,000 records) were for metals (mostly KC)
    - Limited or no data existed for organics
  - **Recommendation**
    - Collect samples for analyses of organics (and some metals) from the Straits of Juan de Fuca and Georgia
- **Sediment**
  - **Conclusions**
    - Insufficient data for sediment-to-water calculation
    - Sediment-to-food web bioaccumulation model verified
  - **Recommendation**
    - Assess sediment-to-water exchange of toxics with new data

# Phase 2 Conclusions & Recommendations

- **Roadways**
  - **Conclusions**
    - **Unit Loading $_{C / I, Hwy}$ was High, but Total Loading $_{C / I, Hwy}$ was Low**
    - **Loading $_{Resid}$ was largest source of toxics**
  - **Recommendations**
    - **Collect empirical Puget Sound-specific data**
    - **Collect empirical data for specific toxic chemicals**
- **Priority Pollutants**
  - **Conclusions**
    - **Discharge flow more important than concentration**
    - **"ND" results created most of the loading uncertainty**
  - **Recommendations**
    - **Require lower analytical reporting limits**
    - **Collect samples paired with measured flow rates**

# Phase 3 Toxic Chemical Loadings to Puget Sound

- **Fill data gaps with field studies**
- **Goal: reduction strategy**

# Phase 3 Projects

- **17 Proposed Projects**
- **11 Received Funding (2 only for half)**

  **1 Project Split; 1 Project Merged**

  **Plus 1 Project Funded by WA Legislature**

| | |
|---|---|
| U.S. EPA 2008 NEP Grant | $1,983,800 |
| U.S. EPA | $ 30,000 |
| U.S. EPA (NOAA / USFWS) | $ 475,000 |
| Washington Legislature (PSP) | $ 310,000 |

- **Project Leads:** Ecology, U.S. EPA, WDFW, NOAA, U.S. FWS

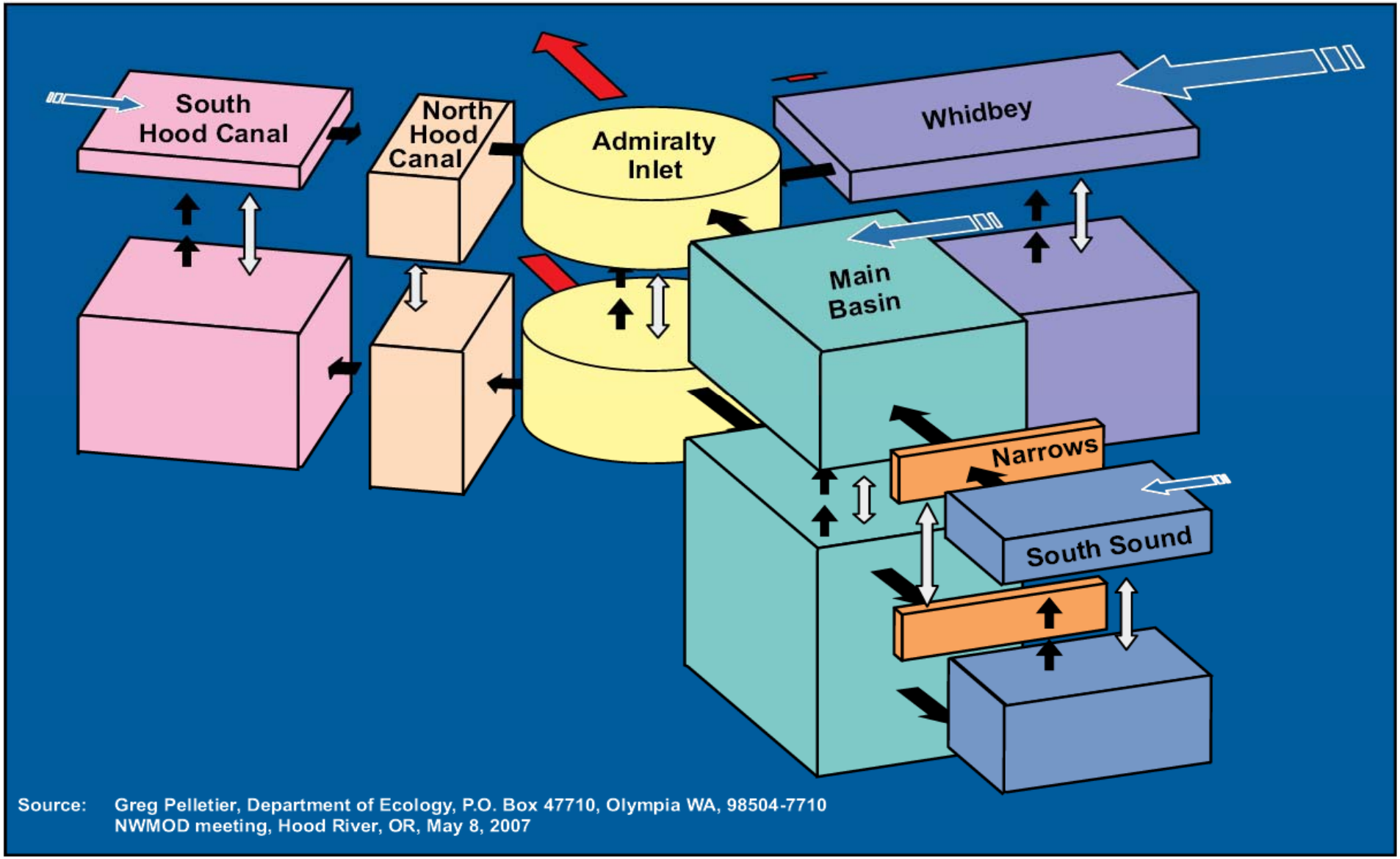
# Potential Phase 3 Projects (1 of 2)

- **Atmospheric deposition of toxics**
  **(Ecology Air Quality Program, Batelle NW)**
- **Sampling & analyses of surface runoff**
  **(Ecology Water Quality Program)**
- **Exchange between Puget Sound & Ocean**
  **(Ecology Environmental Assessment Program)**
- **Refine model and run simulations**
  **(Ecology Environmental Assessment Program)**
- **Analyze Priority Pollutants for small POTWs**
  **(Ecology Water Quality Program)**

WASHINGTON STATE DEPARTMENT OF ECOLOGY

# Ecology Box Model

Puget Sound Box Model for Analysis of Toxics and the Food Web




Source: Greg Pelletier, Department of Ecology, P.O. Box 47710, Olympia WA, 98504-7710
NWMOD meeting, Hood River, OR, May 8, 2007

# Potential Phase 3 Projects (2 of 2)

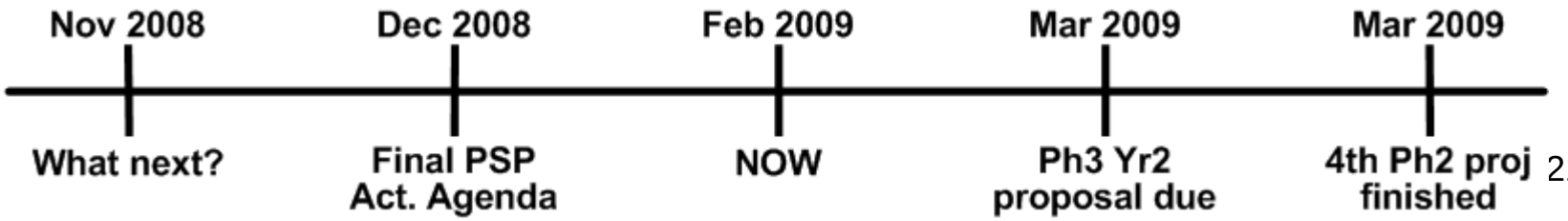
- **Sampling & analyses of biota**
  **(NOAA & USFWS)**
  - Harbor seals
  - Marine mammal prey
  - Stormwater toxicity to salmonids
  - Plankton
- **Estimate PPCP input and removal by POTWs**
  **(U.S. EPA & Ecology Env'l Assessment Program)**

# Phase 3 Year 2 Toxic Chemical Loadings to Puget Sound

- Action Agenda for guidance
- Remainder of U.S. EPA 2008 NEP Grant
- PSP needs inventory of toxic chemical sources by Spring 2010

# Potential
# Phase 3 Year 2 Projects

- Proposals submitted to U.S. EPA
- Proposed projects:
  - Air Deposition
  - Surface Runoff Complete Ocean Exchange
  - Link Sources to Puget Sound
  - Effects of Urban Stormwater on Salmon
  - Synthesis Report



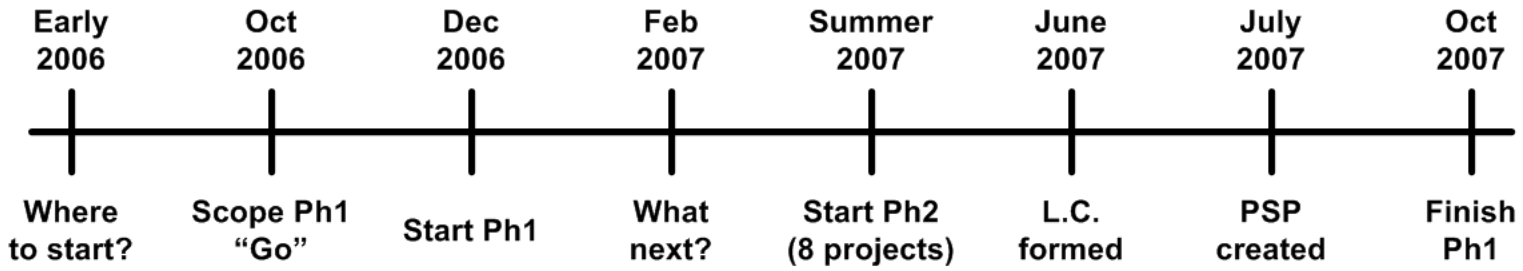
# Interagency Steering Committee

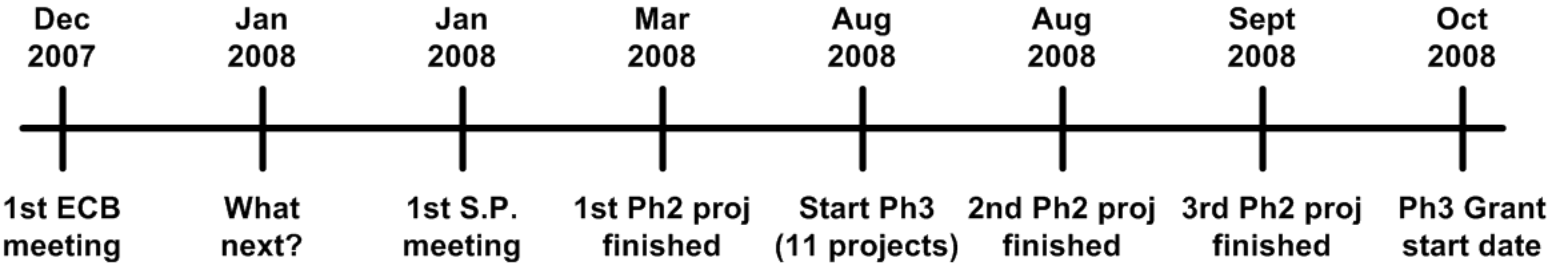
- **Limited to coordinating delivery of loading projects**
- **Toxics reduction strategy will require broader participation**

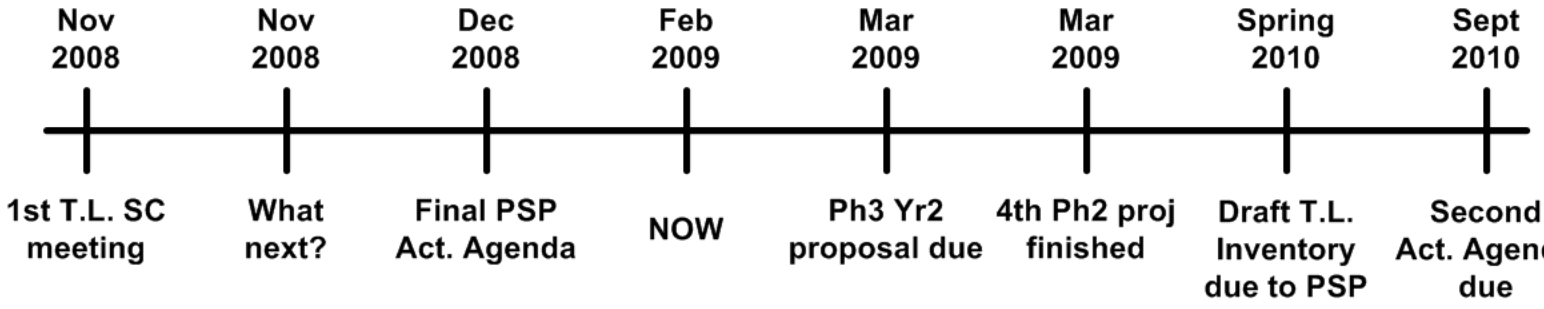
# Steering Committee Members

| | |
|---|---|
| **Ecology** | **USEPA** |
| **PSP Science Panel** | |
| **NOAA** | **NMFS** |
| **USGS** | **WA Dept of Transportation** |
| **WA Dept of Health** | **Wa Dept of Ag** |
| **US Fish and Wildlife** | **Puget Sound Partnership** |

# Toxics Loading Timeline



# More info ?

- http://www.ecy.wa.gov/programs/wq/pstoxics/index.html