Toxics Loading Studies

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

\(^1\) 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)

– 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

• 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
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 $C/I_{\text{Hwy}}$ was High, but Total Loading $C/I_{\text{Resid}}$ was Low
    • Loading $\text{Resid}$ 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

Timeline:
- Mar 2008: 1st Ph2 proj finished
- Aug 2008: Start Ph3 (11 projects)
- Aug 2008: 2nd Ph2 proj finished
- Sept 2008: 3rd Ph2 proj finished
- Oct 2008: Ph3 Grant start date
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)
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

<table>
<thead>
<tr>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecology</td>
</tr>
<tr>
<td>PSP Science Panel</td>
</tr>
<tr>
<td>NOAA</td>
</tr>
<tr>
<td>USGS</td>
</tr>
<tr>
<td>WA Dept of Health</td>
</tr>
<tr>
<td>US Fish and Wildlife</td>
</tr>
<tr>
<td>USEPA</td>
</tr>
<tr>
<td>NMFS</td>
</tr>
<tr>
<td>WA Dept of Transportation</td>
</tr>
<tr>
<td>Wa Dept of Ag</td>
</tr>
<tr>
<td>Puget Sound Partnership</td>
</tr>
</tbody>
</table>

Toxics Loading Timeline


Where to start?  Scope Ph1 “Go”  Start Ph1  What next?  Start Ph2 (8 projects)  L.C. formed  PSP created  Finish Ph1


1st ECB meeting  What next?  1st S.P. meeting  1st Ph2 proj finished  Start Ph3 (11 projects)  2nd Ph2 proj finished  3rd Ph2 proj finished  Ph3 Grant start date


1st T.L. SC meeting  What next?  Final PSP Act. Agenda  NOW  Ph3 Yr2 proposal due  4th Ph2 proj finished  Draft T.L. Inventory due to PSP  Second Act. Agenda due
More info?