

**Example Using
Polybrominated Diphenyl Ethers
(PBDEs)**

Feeders for Substance Identification

National Chemical Management Program Status

Canada

- PBDEs were declared "toxic" under CEPA (1999) and are on Schedule 1
- tetra, penta, and hexaBDE slated for VE under CEPA

United States

- PDBE Project Plan (c-penta, c-octa and c-deca)
- penta and octaBDE - voluntary cesation of production
- decaBDE is included in EPA's High Production Volume (HPV) program.

Great Lakes Screening and Surveillance

- PBDEs are included in the Great Lakes Screening Project.
- All PBDEs are included in the monitoring plan for CMP.

Feeders for Substance Identification (*Continued*)

Other Sources of Information

UN Stockholm Convention

- Both pentaBDE and octaBDE have been recommended to the COP for listing in Annex A - Elimination.

UNECE Convention on Long Range Transboundary Air Pollution (LRTAP)

- The pentaBDE and octaBDE commercial mixtures are considered a Persistent Organic Pollutant (POP) under the UNECE POPs Protocol. Both are in the Risk Management Stage.

II

Considerations for Substance Selection

- The Framework provides categories of considerations to facilitate the evaluation of potential threat to the Great Lakes Basin (GLB):

^{1a} Monitoring and surveillance	^{1b} Environmental levels and trends	^{1c} Source/Use/Release/Exposure
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^{2a} Environmental benchmarks	^{2b} Environmental and health data
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³ Other reasons for concern
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Monitoring and Surveillance

Great Lakes Monitoring and Surveillance

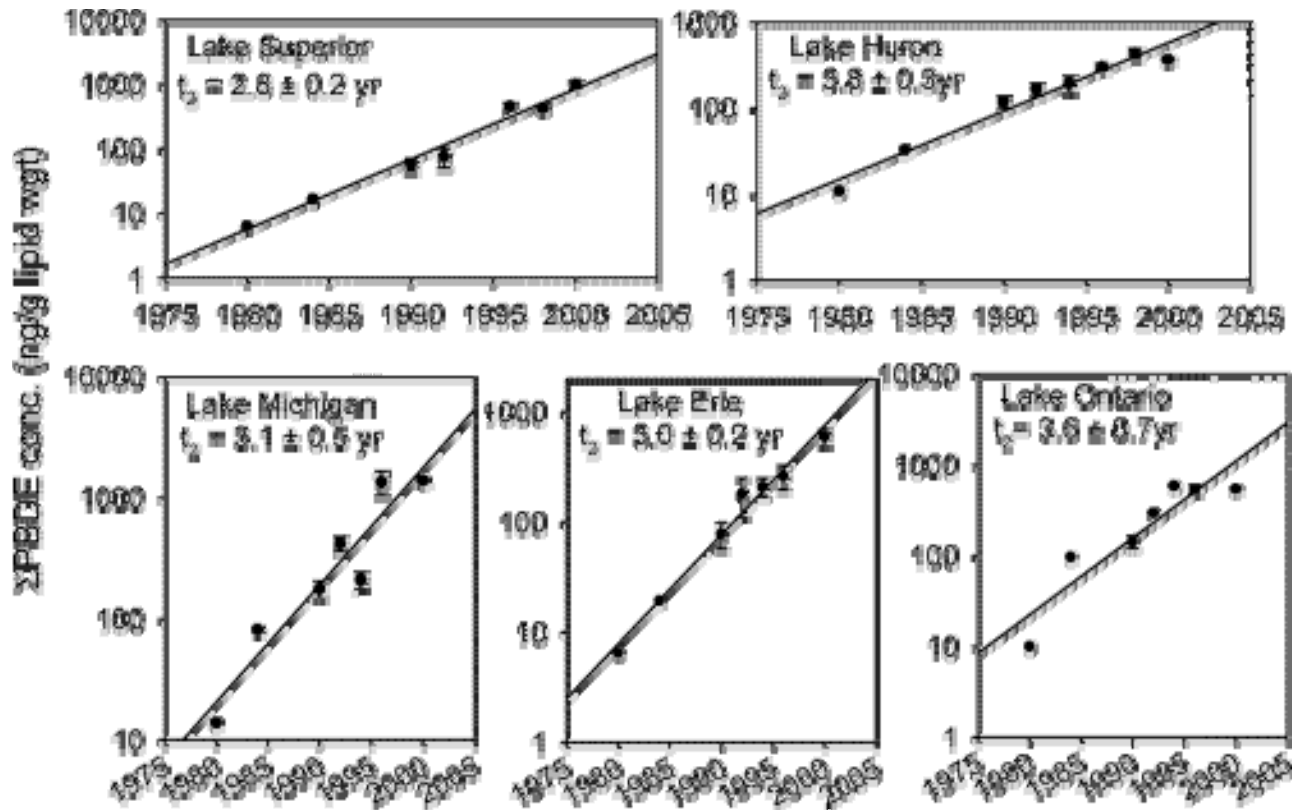
- Both Canada and the US analyze PBDEs in Great Lakes fish.
- US analyzes for PBDEs in IADN.
- PBDEs are analyzed in Canada's Herring Gull Egg Monitoring Program and sediment monitoring programs.

Environmental Levels and Trends

Fish and Gull Eggs

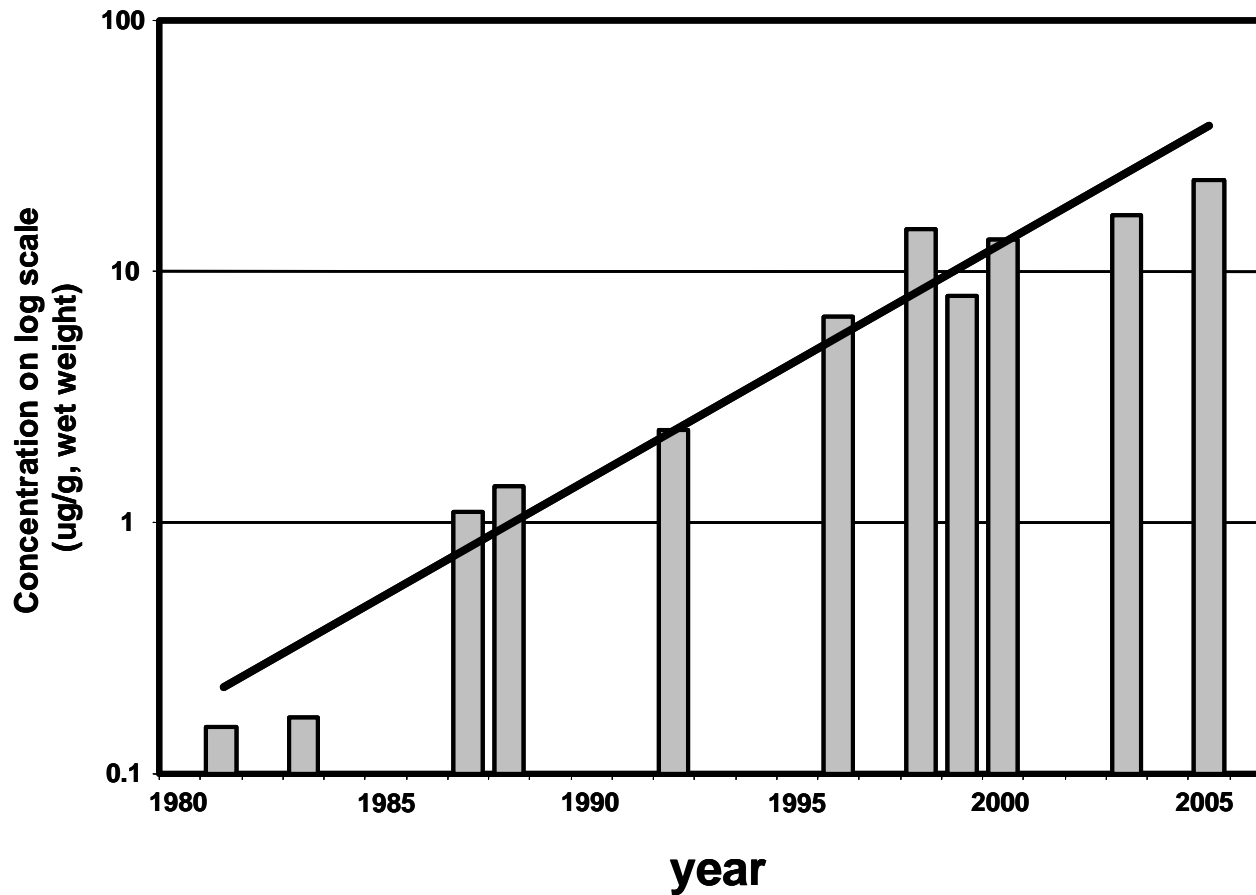
- Concentrations of pentaBDE in lake trout from Lake Ontario increased exponentially from 0.54 ng/g in 1988 to 190 ng/g wet weight in whole fish samples collected in 2002 (Whittle et al., 2004).
- BDE-209, in pooled samples of herring gull (*Larus argentatus*) eggs from seven colonies spanning the Laurentian Great Lakes. BDE-209 concentrations in 2006 egg pools ranged from 4.5 to 20 ng/g. From 1982 to 2006, the BDE-209 doubling times ranged from 2.1 to 3.0 years (Weseloh et al., 2008)

Temporal Trend of Total PBDE Concentrations in Fishes from the Great Lakes, 1975-2005



Source: Zhu and Hites, 2004

PBDE in Herring Gull Eggs, Gull Island, Lake Michigan, 1981-2005



Source: Norstrom et al. 2002; Canadian Wildlife Service

Environmental Levels and Trends

Air

- Total PBDE concentrations in air at IADN stations during 2003-2004 were in the single pg/m³ range for the rural master stations and in the 50-100 pg/m³ range for the urban stations (Venier et al., 2006).
- BDE-209 (decaBDE) levels were not decreasing at any of the five IADN sites analyzed. Concentrations of BDE-47 and BDE-99 in the atmosphere were decreasing rapidly, except at the Chicago site, with half-lives of ~2 years (Venier and Hites 2008).

Environmental Levels and Trends (*cont'd*)

Human Exposure

- PBDEs were analyzed in the blood of the general US population through NHANES. The highest levels were found for BDE-47 (20.5 ng/g lipid) and were significantly associated with age.
- Anderson et al. 2008 investigated PBDEs in GLs consumers of sport-caught fish. BDE-47 was found in 98% of samples, and BDE-99 in 62% of samples.

Source/Use/Release/Exposure Information

Source/Use

- The sole U.S. manufacturer of penta- and octaPBDEs phased out production in 2004, but decaPBDE is still produced.
- PBDEs are not manufactured in Canada. Commercial decaBDE is imported into Canada.
- PentaBDE production in the EU ceased in 1997.
- The main historic use of pentaBDE was in flexible polyurethane foam, but it has also been used in epoxy resins, PVC, and other materials.
- The main use of commercial octaBDE is in ABS polymers (70% of global use).
- Total market demand for commercial pentaBDE in the Americas was 7100 metric tons in 2001.
- Approximately 1300 tonnes of PBDEs were imported into Canada in 2000, with commercial pentaBDE imported in the greatest volume.
- Reported U.S. production of octaBDE was approximately 450 to 4,500 tonnes for 2002; none was reported for 2006, following a voluntary phase out of production.

Source/Use/Release/Exposure Information (*continued*)

Release

- PentaBDE is primarily released from in-service use of polyurethane foam and to a lesser extent from disposal of the foam at the end of its lifecycle.
- The majority of octaBDE releases are estimated to be associated with product disposal and materials handling before resin compounding
- Components of octaBDE are unintentionally formed through debromination of higher substituted congeners, including commercial decaBDE.
- PBDEs are released to the environment through wastewater discharges, landfill leachate, municipal incineration and directly to air, land, and surface water during manufacture & use of products.
- Releases of decaBDE from plastics are mainly associated with product disposal, whereas releases of decaBDE from textile applications primarily occur during product service life (releases to wastewater during washing).

Exposure:

- Pathways of human exposure include food, house dust, and indoor air.

Environmental Benchmarks

- There are no environmental quality benchmark criteria available from Canada and the United States.

Environmental and Health Data

- Available animal data indicate neurobehavioral developmental toxicity following pre- and neonatal oral exposure to BDE-99 in mice.
- Neonatal exposure to DecaBDE (BDE-209) also found to cause developmental neurotoxic effects in mice.
- No information is available on the carcinogenicity of decaBDE in humans. The weight of evidence suggests that decaBDE shows “suggestive evidence of carcinogenic potential.”
- In Europe the FIRE project (Flame retardants Integrated Risk assessment for Endocrine effects; see www.rivm.nl/fire) completed a 28-day toxicity study of decaBDE in rats.
 - Results suggested that the endocrine effects of decaBDE may present a reproductive human health hazard.
 - The study also reported body burdens in children, with upper values as high as 233 ng/g lipid and 23 ng/g blood.
- Turyk et al. 2008 linked PBDE exposure with changes in thyroid antibodies and thyroid hormone homeostasis in men, reporting that “PBDE exposure, at levels comparable to the general US population, was associated with increased thyroglobulin antibodies and increased thyroxine in adult males.”

Other Reasons for Concern

- An animal model (Mazdai, et al, 2003) indicates a potential for concern for early lifetime exposure (i.e., fetal or infant exposure). The identification of BDE-99 in human maternal and cord serum, milk, and children's serum implies that humans are exposed to BDE-99 during a period of rapid development of the brain, a critical window of development, thus indicating the potential for susceptibility.
- Riu et al. 2008 found that DecaBDE in late gestation rats is absorbed and reaches the fetus.
- Association between pre and neo natal exposure to BE-99 and neurobehavioral dysfunction has not been established (EPA – IRIS Tox Review of Penta, 2008).

Summary of Environmental Considerations

- Concentrations of pentaBDE in Great Lakes top predator fish & herring gull eggs increased exponentially through 2004. May be leveling off or declining, except Chicago.
- PBDEs are found in air at IADN stations, with higher levels at urban sites than rural sites. BDE-209 not declining.
- PBDE human body burdens result from exposure to house dust, food, air.
- Potential health risk for adverse neurodevelopmental effects in children.
- DecaBDE shows “suggestive evidence of carcinogenic potential.”
- Components of octaBDE may be produced in the environment by debromination of decaBDE.
- Sufficient data to proceed to section III?

III

Present Management Actions

Canada

- PBDE Regulations (2008)
 - prohibit the manufacture of tetra, penta, hexa, hepta, octa, nona and decaBDEs in Canada.
 - prohibit the manufacture, use, sale, and import of tetra, penta and hexaBDEs.

U.S.

- Penta- and octaBDE voluntarily phased out of production (2004).
- EPA issued a Significant New Use Rule (SNUR) for pentaBDE and octaBDE commercial mixtures (2006).
- DecaBDE subject to TRI
- EPA PDBE Project Plan (status reports posted at <http://www.epa.gov/opptintr/pbde/>).

III

Present Management Actions

EPA Project Plan

- Objective 1: Assess Substitutes for Penta/OctaBDE
- Objective 2: Assess/Evaluate DecaBDE
- Objective 3: Assess Risks of Penta/OctaBDE
- Objective 4: Track Other BFRs of Interest (not relevant to this presentation)

III

Present Management Actions

Objective 1: Assess Substitutes for Penta/OctaBDE

- DfE - Furniture Flame Retardancy Partnership (BFRIP).
- PentaBDE screening assessment completed in September 2005 and available at <http://www.epa.gov/opptintr/dfe/pubs/projects/flameret/index.htm>.
- Octa alternatives not currently looked at. Monitoring developments under Stockholm and LRTAP RMEs.

III

Present Management Actions

Objective 3: Assess Risks of Penta/OctaBDE

- EPA's National Center for Environmental Assessment (NCEA) preparing paper on exposure – public comment Fall 2008, final mid-2009.
- IRIS assessments tetra, penta, hexaBDE completed 2008.
- Need 2-gen repro tox studies for both penta and octa. May seek from NTP in future.
- Generally reviewing information on penta and octa including especially NHANES data.

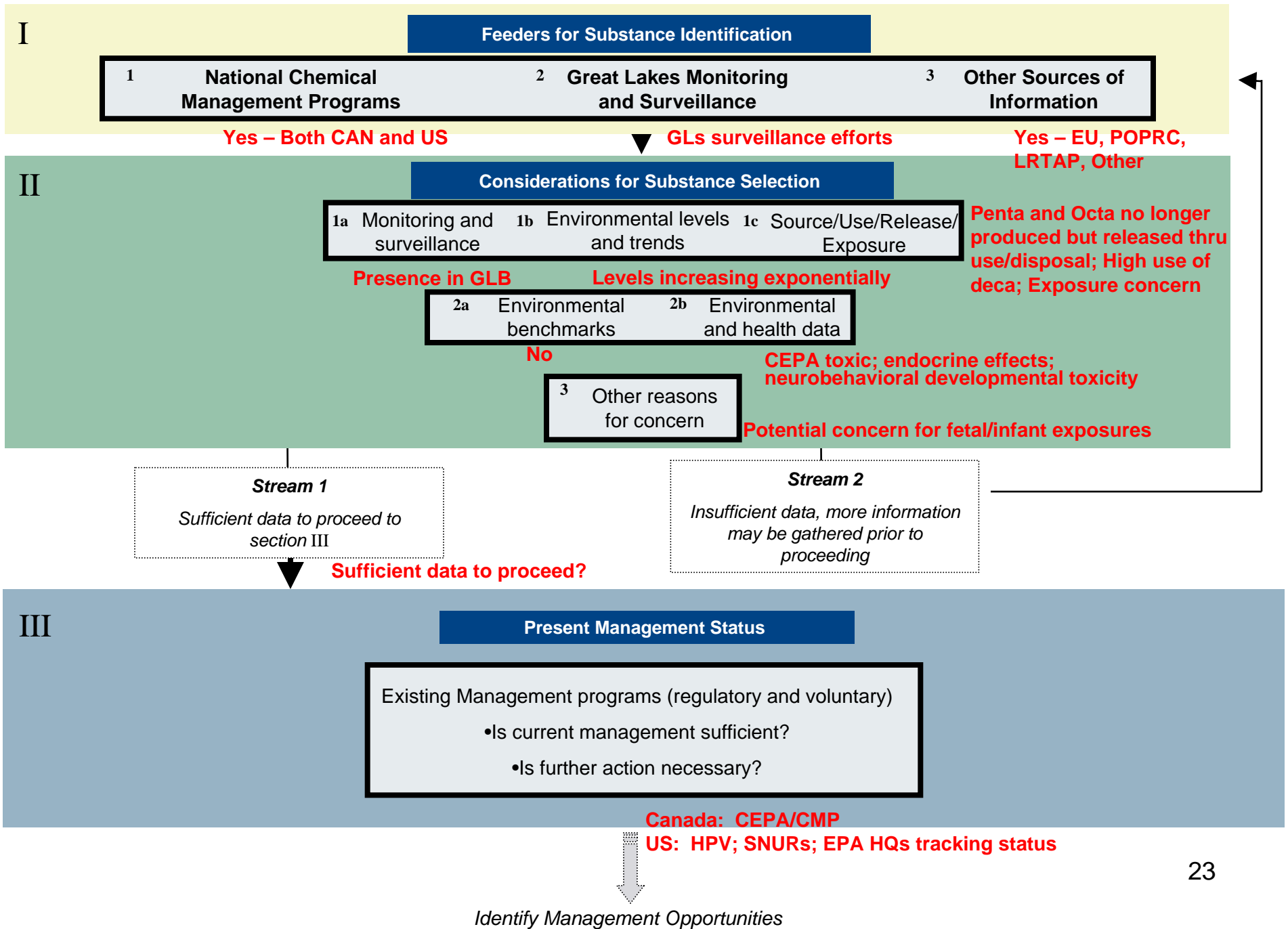
III

Present Management Actions

Objective 2: Assess/Evaluate DecaBDE

- IRIS assessment decaBDE completed 2008, (<http://www.epa.gov/ncea/iris/subst/0035.htm>.)
- EPA will monitor ongoing and planned research on the toxicity of decaBDE and its metabolites. FIRE Study - Industry to provide a report to EPA February 2009.
- BFRIP/EPA developing TSCA Section 4 ECA to investigate the environmental fate and metabolism of decaBDE, including the potential for formation of lower-brominated congeners by debromination of decaBDE in the environment – early 2009.
- EPA's National Center for Environmental Assessment (NCEA) preparing paper on environmental fate – mid 2009.
- CPSC Proposed Rulemaking on Furniture Flame Retardant Standards – announced February 2008.

Binational Framework for Identifying Substances of Potential Threat to the GLB - PBDE



Discussion

- Are PBDE congeners a threat to the basin?
- Are current management actions sufficient?
- Is further action necessary?