# Action in Minnesota to Address PAH-Contaminated Stormwater Pond Sediments by Restricting Usage of Coal Tar-Based Sealants

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# Overview

- Why are we concerned about polycyclic aromatic hydrocarbons (PAHs) in stormwater pond sediments?
- How are the Minnesota Legislature, Minnesota Pollution Control Agency (MPCA), and municipalities addressing this issue?
- What are the most likely sources of PAHs to stormwater pond sediments in Minnesota?
- What actions have been taken to reduce usage of coal tar-based sealants in Minnesota?

LeVander Pond (SWP09 02) in South St. Paul, MN

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# Problem: Stormwater ponds in the Twin Cities are filling up with sediment, some of which are highly contaminated with PAHs.

Nonfunctioning stormwater ponds in Woodbury, MN

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# Removal of PAH-Contaminated Sediments Can be Expensive

- Most cities in Minnesota slowed maintenance dredging of their stormwater ponds after White Bear Lake, MN received cost estimates of $250,000 to clean out two stormwater ponds in 2007;
- Cities are hampered by limited reuse options and disposal cost issues; and
- Cities have requested a solution from the Minnesota Legislature and MPCA.

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# What are the Costs for Disposal?

- In Minnesota, the most contaminated Level 3 dredged material must be disposed of in specially lined landfills or other approved options.
- Disposal costs vary with landfill.

| Cost/cubic yard | Buffalo $12.00 | Elk River $10.50 | Rosemount $22.50 |
|---|---|---|---|

Wetland delineation and/or surveying costs not included.

Total cost = $40 to $50/cubic yard

(Testing + Mobilization/overhead + Excavation + Transportation + Disposal)

Tipping fees to dispose of sediment as waste instead of cover material is even more expensive.

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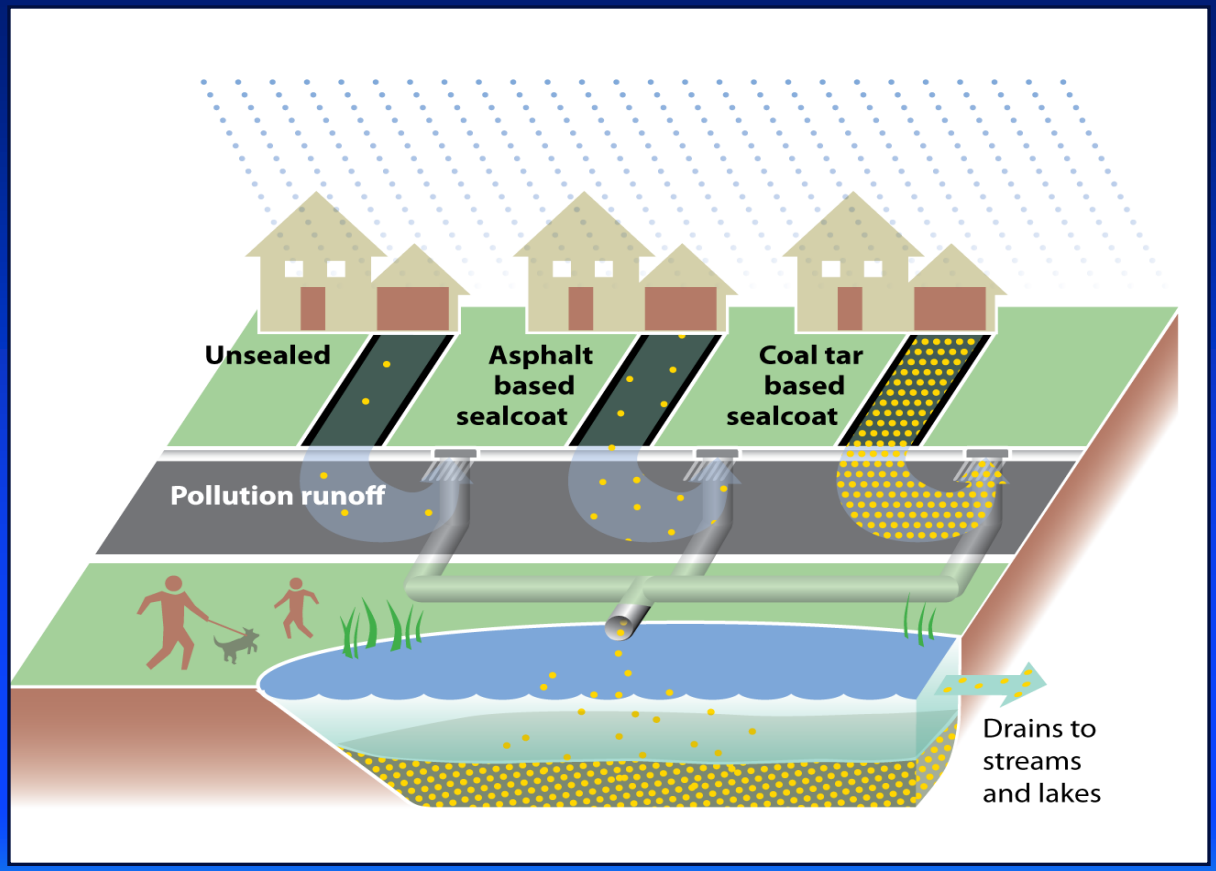
# Coal Tar-based Sealants have Emerged as an Important Source of PAHs to Stormwater Ponds

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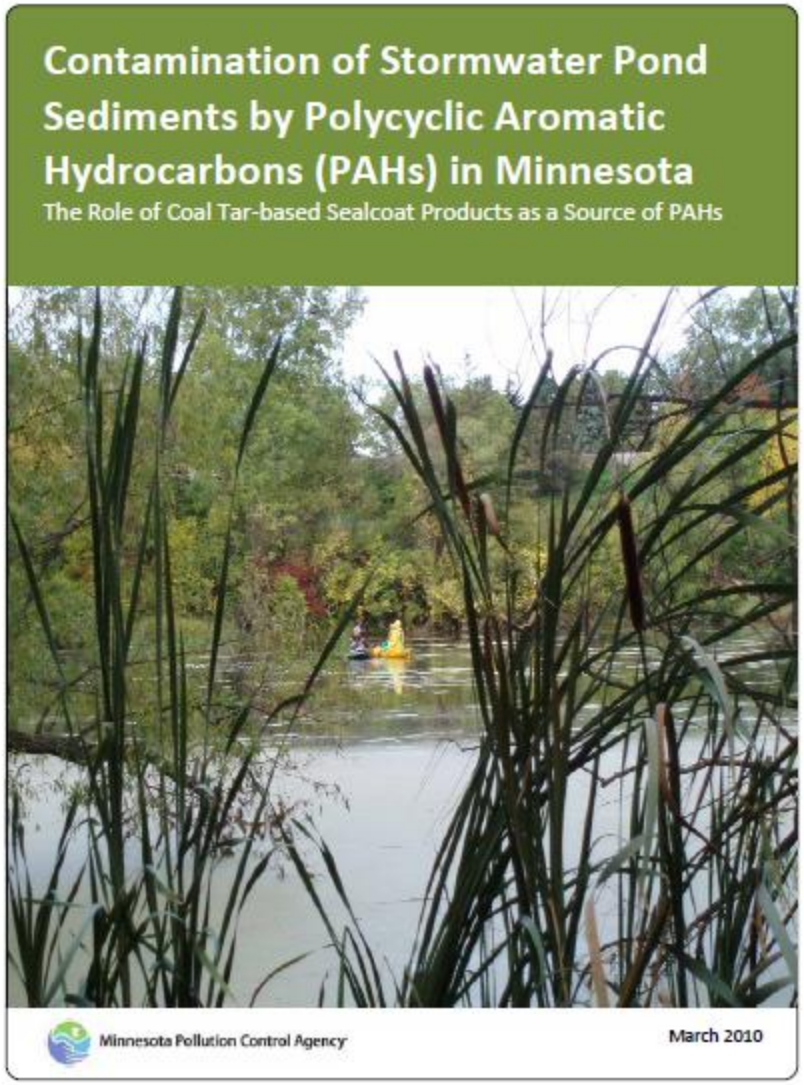
MPCA graphic by Scott Andre

PAH White Paper available at: http://www.pca.state.mn.us/publications/tdr-g1-07.pdf

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This report received a national award from the Legislative Research Librarians Section of the National Conference of State Legislatures.

# Asphalt-based Sealants are a Suitable Alternative to Coal Tar-based Sealants


Ace Hardware, Agway, Do It Best, Lowe's, Menards, The Home Depot, True Value, and United Hardware no longer sell coal tar-based sealants.

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# Legislative Response to Issue

- The Minnesota Legislature provided the MPCA with funding to study this issue on July 1, 2009.
- The legislation directed the MPCA to conduct several tasks as detailed at: http://www.pca.state.mn.us/ktqha7e.
- The Legislature banned state agencies from purchasing undiluted coal tar-based sealant after July 1, 2010.

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# Incentive for Municipalities from 2009 Legislation

Local units of government must pass an ordinance prohibiting and/or restricting the use of coal tar-based sealants to be considered for a grant to treat contaminated sediments in their stormwater ponds.

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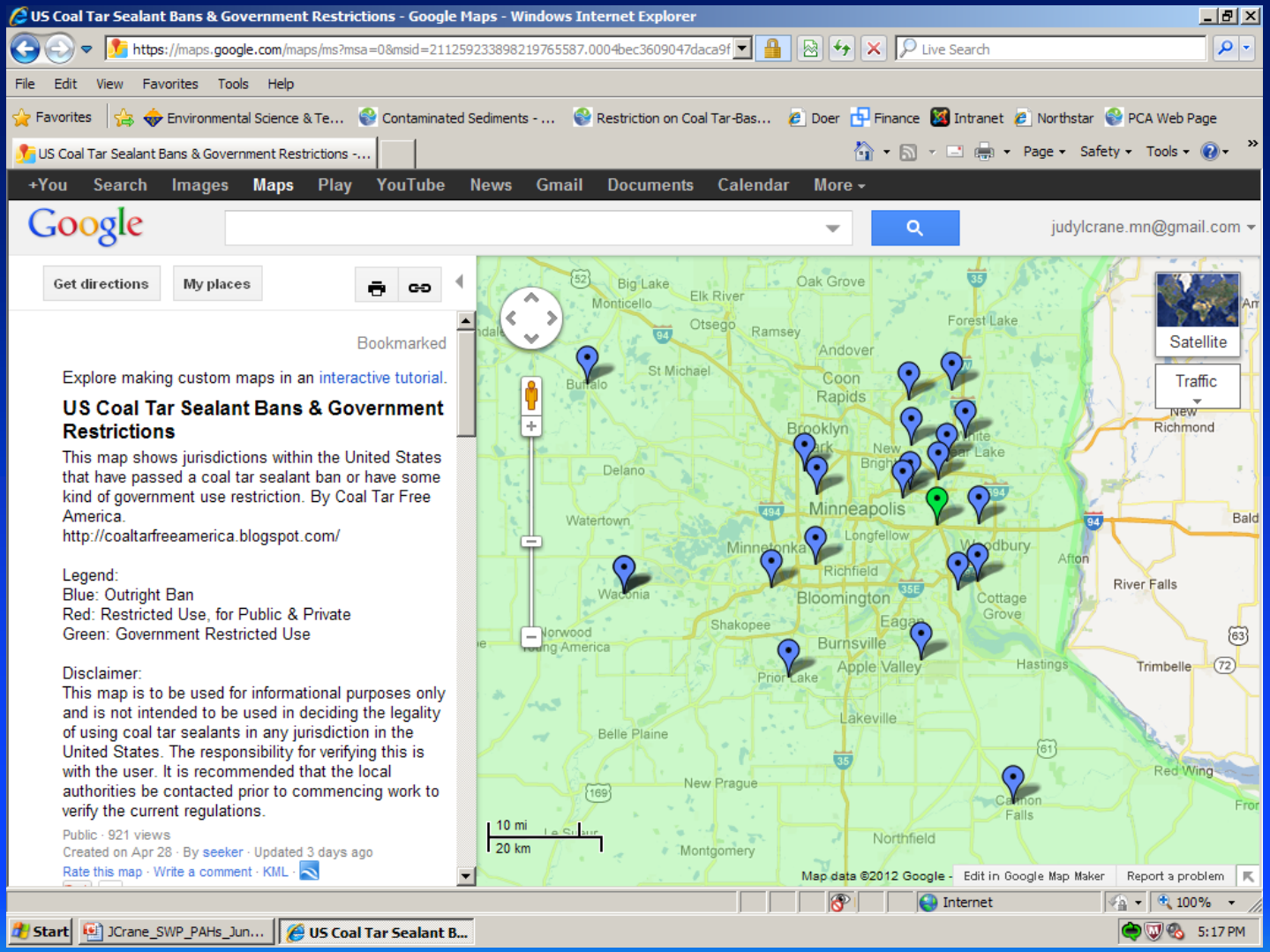
# 20 Municipalities in Minnesota have Passed Ordinances

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From: Coal Tar Free America Website (http://coaltarfreeamerica.blogspot.com/p/cts bans.html)

# Legislative Funding for Stormwater Pond Sediment Study

- Part of the 2009 legislative funding related to developing best management practices. This included funds for a study of stormwater pond sediments in different land use categories (residential, commercial, and industrial areas) for PAHs and other contaminants of potential concern.
- Another component of this study included evaluating sampling and screening methods for good, cost-effective techniques.

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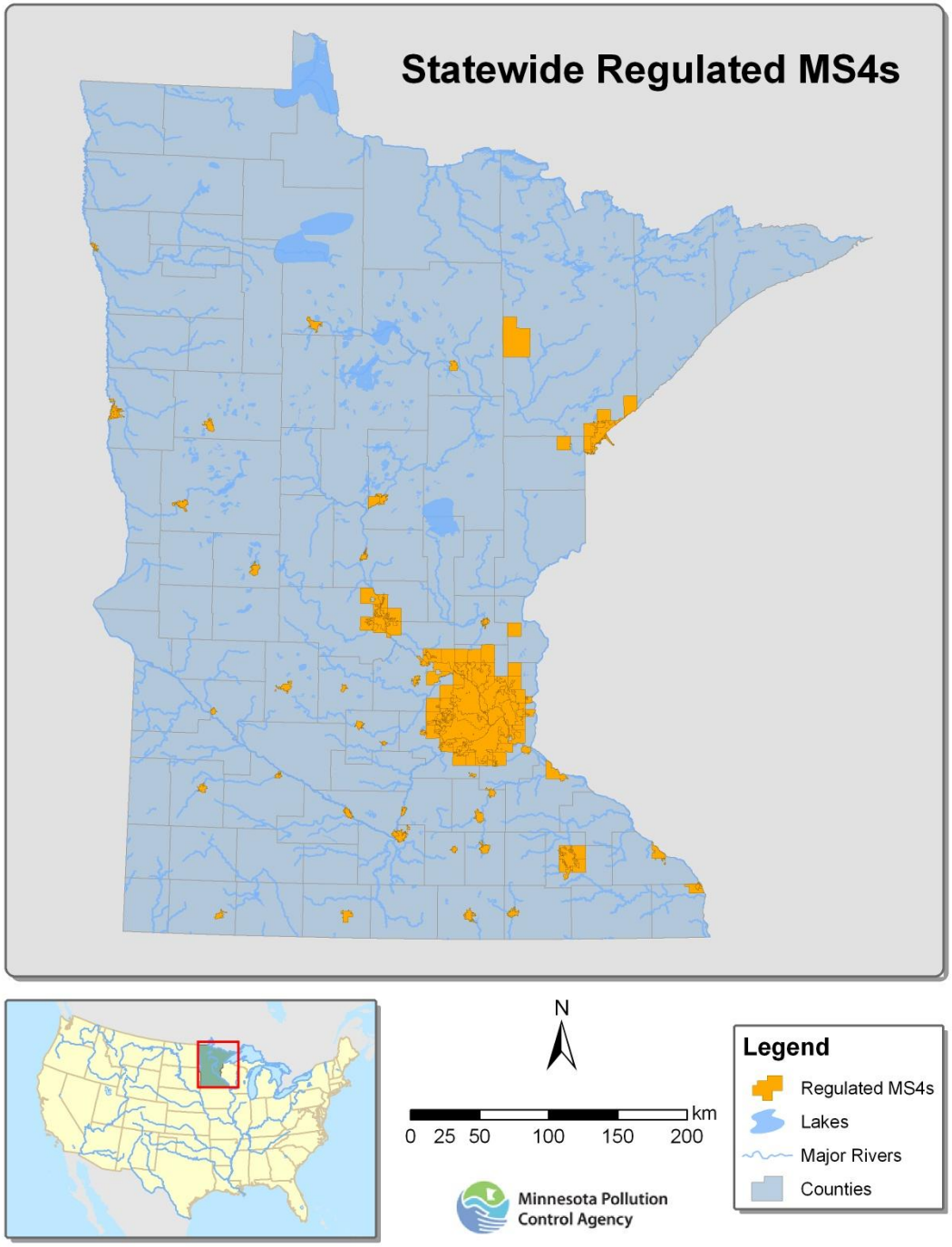
# Municipal Separate Storm Sewer System (MS4) Areas Regulated by the MPCA

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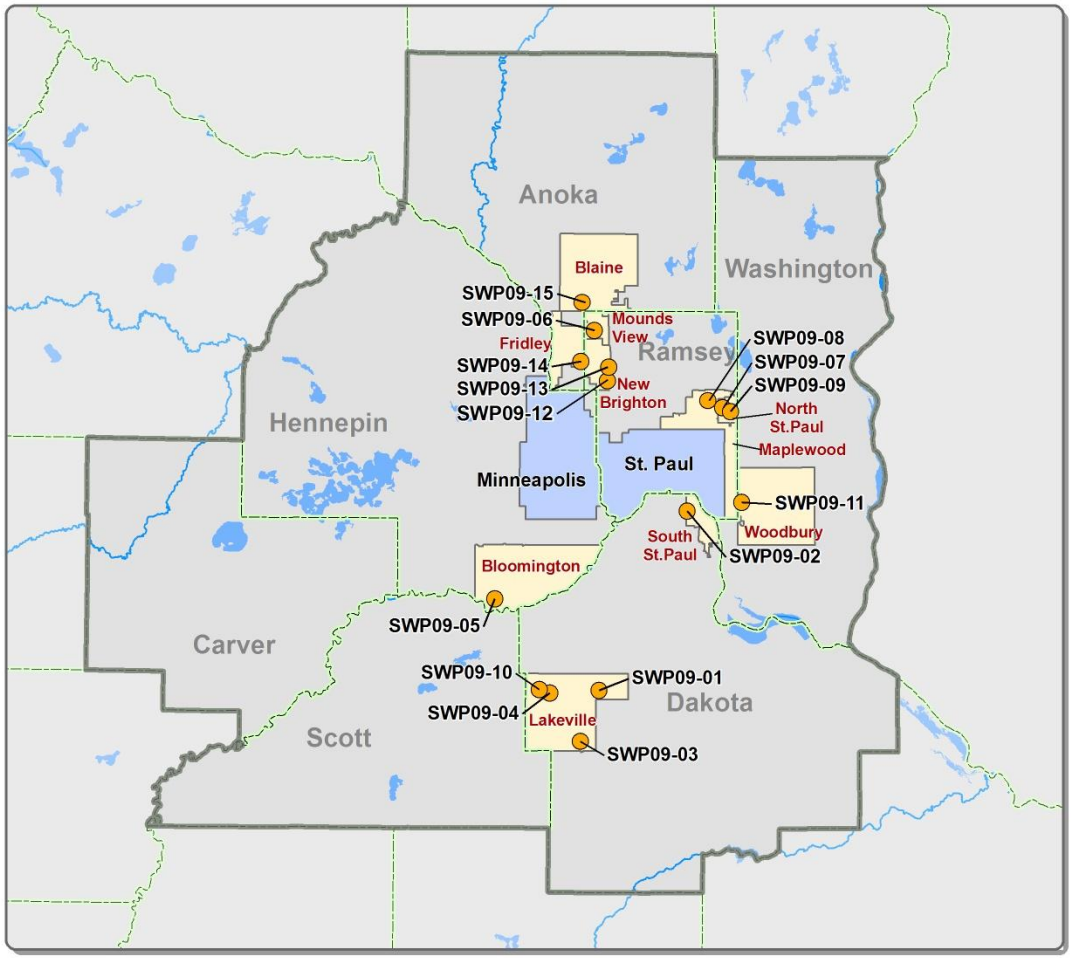
Residential Land Use

Commercial (up); Industrial (down)

# Stormwater Pond Sample Locations



# Field Sampling During October 2009

Photo by Anna Kerr (MPCA)


Photo by Judy Crane (MPCA)

Photo by Tim Nelson (Minnesota Public Radio)

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# PAH Analyses

- Parent and 24 carcinogenic PAHs (cPAHs) were analyzed on all samples by Pace Analytical Services, Inc.; and
- Parent and alkylated PAHs (p-alkPAHs) were analyzed on composite samples by Battelle.

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# Results

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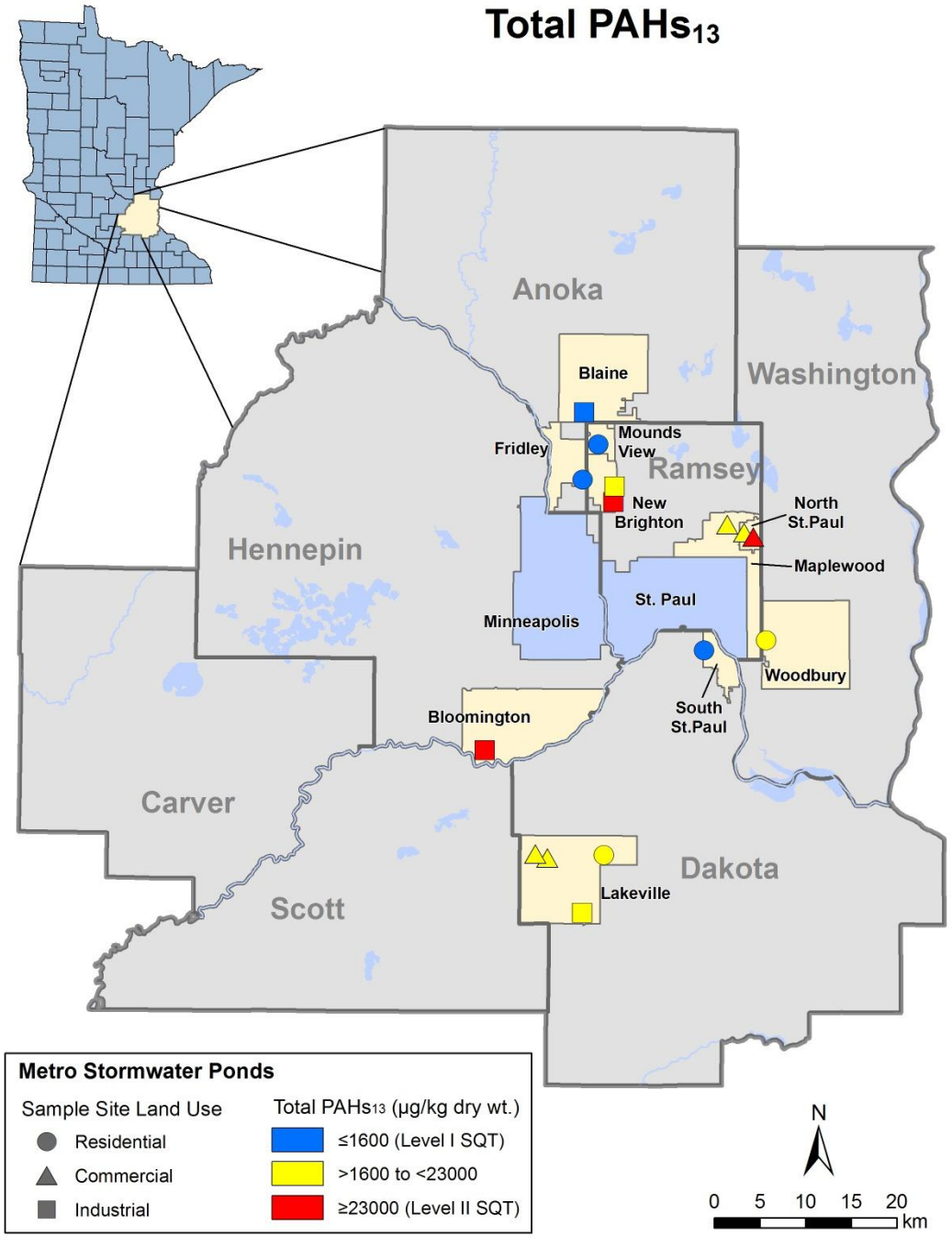
Two industrial ponds and one commercial pond exceeded the Level II sediment quality target (SQT) value for total $PAH_{13}$. These three ponds also exceeded ESB toxic units of 1.0, indicating detrimental impacts to bottom-dwelling invertebrates.

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# Ranges of Human Health-based Benzo[a]Pyrene (B[a]P) Equivalents for Study Ponds*

| Calculation Procedure | B[a]P Equivalents (mg/kg) | | | |
|---|---|---|---|---|
| | ND | ≤2.0 (Level 1 Dredged Mat'l) | >2.0 to ≤3.0 (Level 2 Dredged Mat'l) | >3.0 (Level 3 Dredged Mat'l) |
| Using MPCA Potency Equivalency Factors** | 4 | 2 | 0 | 9 |

ND = not detected

*Based on the 24 cPAHs analyzed in composite samples by Pace Analytical; field replicate data were excluded; n = 15 ponds.

**Kaplan-Meier statistics were used when ≤50% of samples had nondetect data.

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# Identifying Sources of PAHs with Environmental Forensic Techniques


Solving Mysteries

# Source Apportionment of p-alkPAH Data from Composite Samples

| Statistical Summary | % Diagenic (natural) PAHs | % Petrogenic (oil-based) PAHs | % Pyrogenic (combustion) PAHs |
|---|---|---|---|
| Mean | 2.4 | 15.0 | 82.6 |
| SD | 2.7 | 7.2 | 9.6 |
| Minimum | 1.1 | 7.4 | 50.0 |
| Maximum | 12.0 | 38.0 | 91.3 |

N = 15 composite samples analyzed by Battelle for 34 p-alkPAHs.
Yellow shading denotes results for SWP09-02-C (LeVander Pond).

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**Quantitative techniques, like the U.S. EPA's contaminant mass balance model (CMB) version 8.2, provide a rigorous method for apportioning sources of PAHs.**

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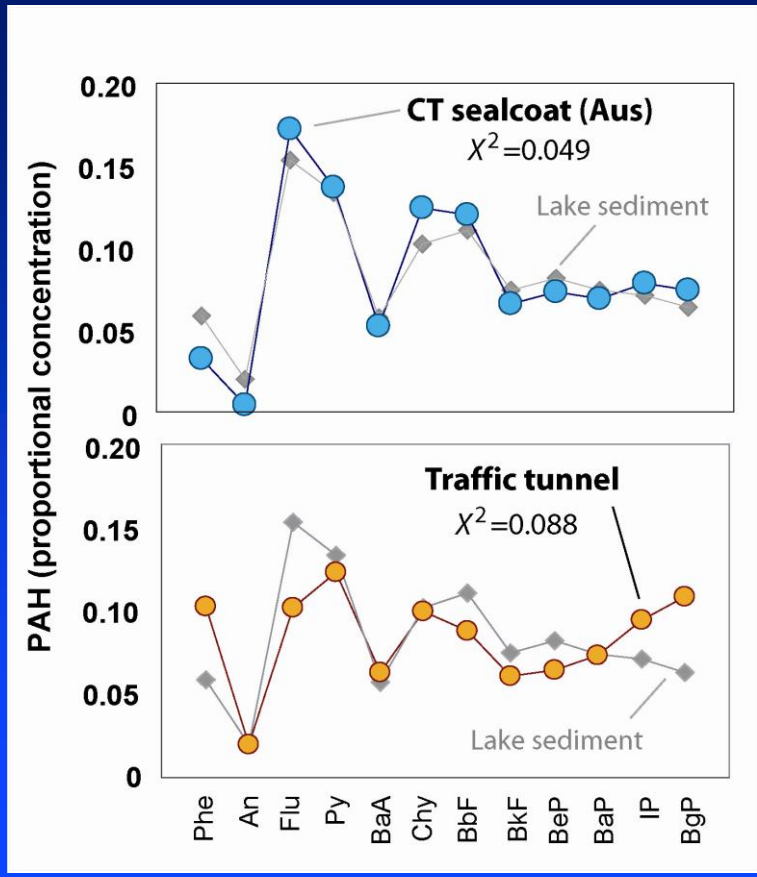
# How does the CMB8.2 Model Work?

- Incorporates published source profiles (fingerprints) for 12 PAHs;
- Figures out the best combination of sources to best match the sediment sample by minimizing Chi-squared; and
- Provides estimated mass loading and uncertainty for each source.




**PAHs, low to high molecular weight; graphic from Peter Van Metre (USGS).**

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# Coal Tar-based Sealants and Traffic Tunnel Air are the Most Prevalent Sources of PAHs in Metro Stormwater Pond Sediments (n = 15)

| Summary Statistics | Coal Tar-based Sealant Sum (%) | Traffic Tunnel Air (%) |
|---|---|---|
| Mean | 70.5 | 17.8 |
| SD | 17.9 | 12.9 |

Model includes 12 of the 34 p-alkPAHs measured by Battelle.
Statistical results of model: $R^2 = 0.981$, Chi-squared = 0.213, % Mass = 100.6%; T value >2 for 10 ponds for coal tar sealant scrapings.

Mean relative percent difference between measured and calculated total $PAH_{12}$ concentrations was 0.87%.

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# Ran the CMB8.2 Model on the Met Council's Twin Cities Stormwater Pond Sediment Data Set (Polta *et al*. 2006)

- Excluded samples that either didn't meet their data quality objectives or were from a pond that had completely filled in (i.e., were soil samples);
- Used PAH data from 26 of the 50 sediment samples collected from 10 stormwater ponds in the Twin Cities metropolitan area; and
- The depth of individual sediment samples in this study varied from 15.2 – 45.7 cm.

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# Source Apportionment of Total $PAHs_{12}$ for Acceptable Met Council Data

| Summary Statistics* | Coal Tar-based Sealant Sum % | Pine Wood Combus. % | Coal % | Traffic Tunnel Air % | Oil Burner % | Residen. Air % |
|---|---|---|---|---|---|---|
| Weighted Mean | 69.4 | 10.0 | 7.0 | 6.0 | 3.9 | 2.9 |
| SD | 14.7 | 10.7 | 11.7 | 8.6 | 6.6 | 4.2 |

*n = 26 samples

Statistical results of model: $R^2 = 0.970$, Chi-square = 0.422, % Mass = 93.1;
T value >2 for 13 samples for coal tar-based sealant sources.

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Mean relative percent difference between measured and calculated total $PAH_{12}$ concentrations was 7.8%.

# Coal Tar-based Sealants are the Biggest Source of PAHs to Stormwater Pond and Lake Sediments in the Twin Cities

| Study | Mean % Coal Tar-based Sealant Source* |
|---|---|
| MPCA Study | 70.5 |
| Met Council Study | 69.4** |
| Palmer Lake in Brooklyn Center, MN (Van Metre and Mahler 2010) | 72.2 |
| Lake Harriet in Minneapolis, MN (Van Metre and Mahler 2010) | 51.9 |

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*determined using EPA CMB8.2 model

**results are for a weighted mean

# CMB8.2 Model Results Provide a Better Estimate of Pyrogenic (Combustion) Sources of PAHs

- Used the results of the model and the mean percent pyrogenic PAHs (82.6%) calculated from the total $PAH_{34}$ data set to calculate the percent of total $PAHs_{34}$ from:
  - Coal tar-based sealant sources = 0.705 x 82.6% = **58.2%**
  - Traffic tunnel source = 0.178 x 82.6% = **14.7%**
  - Other model sources = 0.117 x 82.6% = **9.7%**

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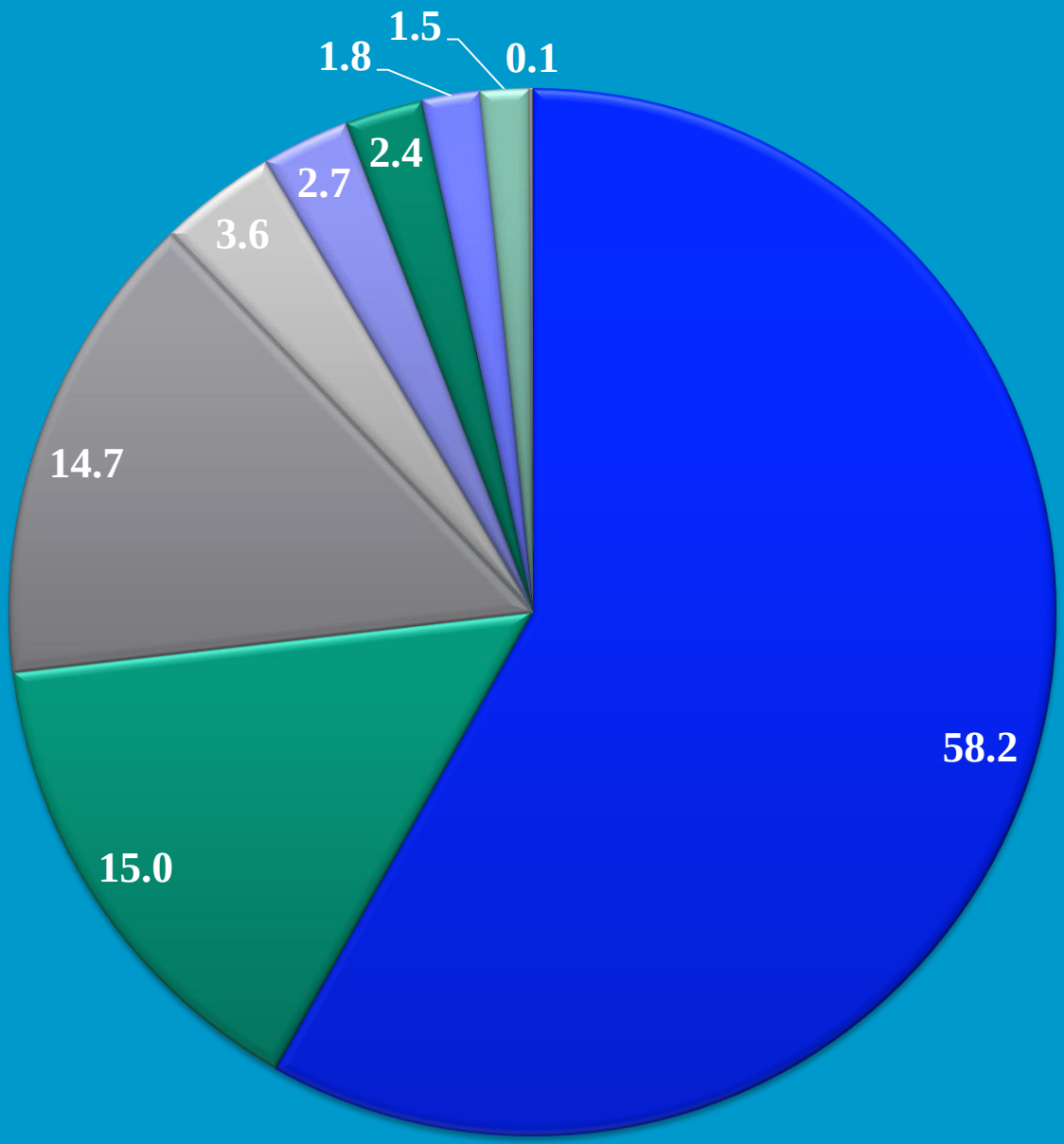
# MPCA Study: PAH Sources (mean %)




- Coal Tar Sealant Sum
- Petrogenic Sources
- Tunnel Air
- Coal
- Diesel
- Diagenic Sources
- Pine Combustion
- Oil Burner
- Gasoline

# Other Efforts by the MPCA to Reduce Usage of Coal Tar-based Sealants

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# Great Lakes Restoration Initiative Grant to Promote Phase-out of Coal Tar-based Sealants

- MPCA lead (Al Innes) with Michigan and Wisconsin collaboration;
- Grant duration: 10/1/2011 to 9/30/2014;
- Work tasks:
  - Implement voluntary phase-out of the product in Minnesota in partnership with coatings and asphalt associations (partnerships could not be negotiated),
  - Contact retailers to determine where the product is still sold and promote voluntary phase-outs (in progress),

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# Other Grant Work Tasks in Progress

- Promote switch in sealant products by applicators (Jet-Black has committed to switch from coal tar-based to asphalt-based sealants in 2012-13 in MN/WI and is promoting in 10 other states),
- Work with other users (cities, property managers, schools/colleges, airports, etc.) to phase out coal tar-based sealants where still in use,
- Work with suppliers/researchers to promote feasible low or no PAH alternatives, and
- **Share strategies and products with other states.**

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# For Further Information

- Scientific technical issues: Judy Crane, Ph.D. , Research Scientist 3 (MPCA), 651-757-2293 (phone) or judy.crane@state.mn.us.
- Policy/management issues: Marni Karnowski, Supervisor of Municipal Stormwater Unit (MPCA), 651-757- 2495 (phone) or marni.karnowski@state.mn.us.
- Pollution prevention issues: Al Innes (MPCA), 651-757-2457 (phone) or alister.innes@state.mn.us.
- MPCA webpage on "Restriction on Coal Tar-Based Sealants" at: http://www.pca.state.mn.us/ktqha7e.

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