Lessons Learned from the Hwy 407 ETR – How Coal Tar Free Asphalt & Street Sweeping Practices Could Minimize Municipal SWM Pond Sediment Removal Frequencies and Disposal Costs

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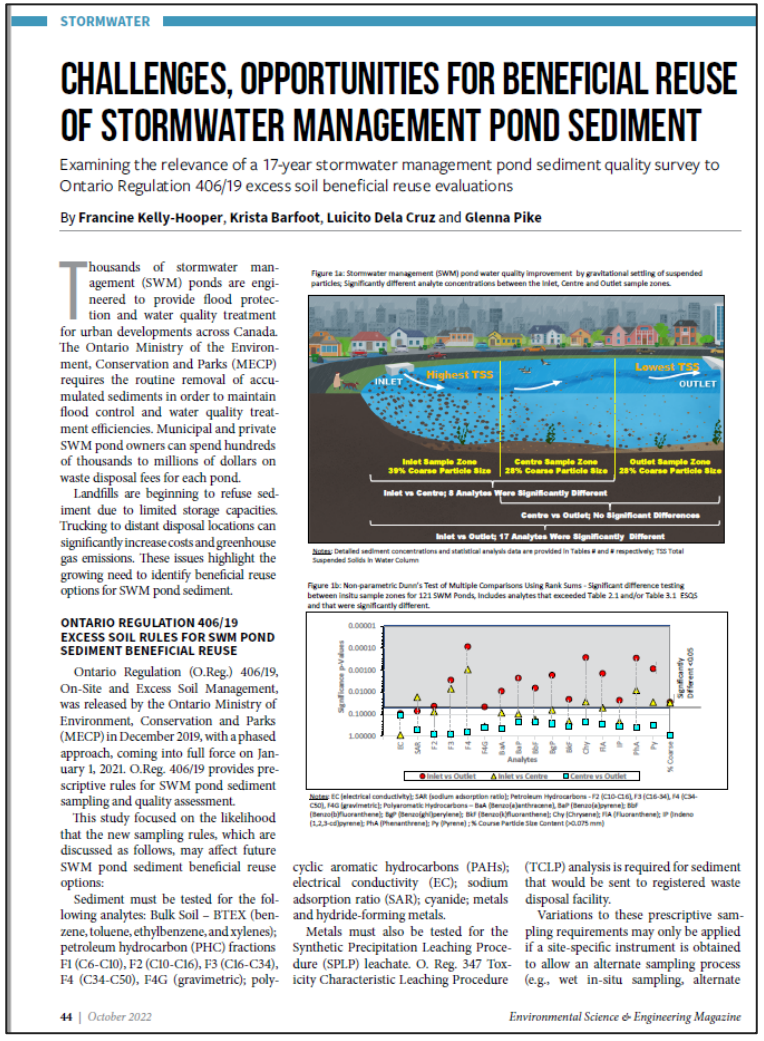
Discussion Topics

- Key findings from 2005-2024 Canada-wide SWM pond sediment chemistry survey.
- Comparison of municipal vs 407 ETR SWM pond sediment accumulation rates and contamination levels.
- Lessons learned for potential reductions in municipal SWM pond sediment cleanout frequences and disposal/reuse costs.

Why Is This An Important Topic?

- Ontario has thousands of municipal SWM ponds.
- Routine municipal sediment removal may be required every 10-15 years for flood control and protection of human lives, property and ecological systems.
- Each pond can contain hundreds to thousands of truckloads of sediment, with landfill tipping fees ranging from tens of thousands to millions of dollars per pond.
- Local landfills are beginning to refuse sediments. Trucking to distant locations is costly from financial and global warming perspectives.

2005-2022 Canada-wide SWM Pond Sediment Chemistry Article
371 Samples Collected from 121 Urban SWM Ponds



STORMWATER

CHALLENGES, OPPORTUNITIES FOR BENEFICIAL REUSE OF STORMWATER MANAGEMENT POND SEDIMENT

Examining the relevance of a 17-year stormwater management pond sediment quality survey to Ontario Regulation 406/19 excess soil beneficial reuse evaluations

By **Francine Kelly-Hooper**, **Krista Barfoot**, **Luicito Dela Cruz** and **Glenna Pike**

Thousands of stormwater management (SWM) ponds are engineered to provide flood protection and water quality treatment for urban developments across Canada. The Ontario Ministry of the Environment, Conservation and Parks (MECP) requires the routine removal of accumulated sediments in order to maintain flood control and water quality treatment efficiencies. Municipal and private SWM pond owners can spend hundreds of thousands to millions of dollars on waste disposal fees for each pond.

Landfills are beginning to refuse sediment due to limited storage capacities. Trucking to distant disposal locations can significantly increase costs and greenhouse gas emissions. These issues highlight the growing need to identify beneficial reuse options for SWM pond sediment.

Figure 1a: Stormwater management (SWM) pond water quality improvement by gravitational settling of suspended particles; Significantly different analyte concentrations between the Inlet, Centre and Outlet sample zones.

Notes: Detailed sediment concentrations and statistical analysis data are provided in Tables # and # respectively; TSS Total Suspended Solids in Water Column

Figure 1b: Non-parametric Dunn's Test of Multiple Comparisons Using Rank Sums - Significant difference testing between insitu sample zones for 121 SWM Ponds, Includes analytes that exceeded Table 2.1 and/or Table 3.1 ESQS and that were significantly different.

Notes: EC (electrical conductivity); SAR (sodium adsorption ratio); Petroleum Hydrocarbons - F2 (C10-C16), F3 (C16-34), F4 (C34-C50), F4G (gravimetric); Polyaromatic Hydrocarbons – BaA (Benzo(a)anthracene), BaP (Benzo(a)pyrene); BbF (Benzo(b)Fluoranthene); BghiP (Benzo(ghi)perylene); BkF (Benzo(k)Fluoranthene); Chy (Chrysene); FlA (Fluoranthene); IP (Indeno (1,2,3-cd)pyrene); PhA (Phenanthrene); Py (Pyrene) ; % Course Particle Size Content (>0.075 mm)

ONTARIO REGULATION 406/19 EXCESS SOIL RULES FOR SWM POND SEDIMENT BENEFICIAL REUSE

Ontario Regulation (O.Reg.) 406/19, On-Site and Excess Soil Management, was released by the Ontario Ministry of Environment, Conservation and Parks (MECP) in December 2019, with a phased approach, coming into full force on January 1, 2021. O.Reg. 406/19 provides prescriptive rules for SWM pond sediment sampling and quality assessment.

This study focused on the likelihood that the new sampling rules, which are discussed as follows, may affect future SWM pond sediment beneficial reuse options:

Sediment must be tested for the following analytes: Bulk Soil – BTEX (benzene, toluene, ethylbenzene, and xylenes); petroleum hydrocarbon (PHC) fractions F1 (C6-C10), F2 (C10-C16), F3 (C16-C34), F4 (C34-C50), F4G (gravimetric); polycyclic aromatic hydrocarbons (PAHs); electrical conductivity (EC); sodium adsorption ratio (SAR); cyanide; metals and hydride-forming metals.

Metals must also be tested for the Synthetic Precipitation Leaching Procedure (SPLP) leachate. O. Reg. 347 Toxicity Characteristic Leaching Procedure (TCLP) analysis is required for sediment that would be sent to registered waste disposal facility.

Variations to these prescriptive sampling requirements may only be applied if a site-specific instrument is obtained to allow an alternate sampling process (e.g., wet in-situ sampling, alternate

- Compared contaminant levels to O.Reg. 406/19 excess soil beneficial reuse requirements
- >80% of samples would not be classified as “excess soil” due to petroleum hydrocarbons (PHCs) from asphalt and >40% polycyclic aromatic hydrocarbons (PAHs) from coal tar used to bind/seal asphalt pavements.

What are PHCs and PAHs?

- PHCs contain hundreds of non-toxic and highly toxic compounds
- PAHs are among the most toxic (e.g. carcinogenic, mutagenic, etc.)

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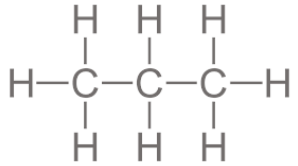
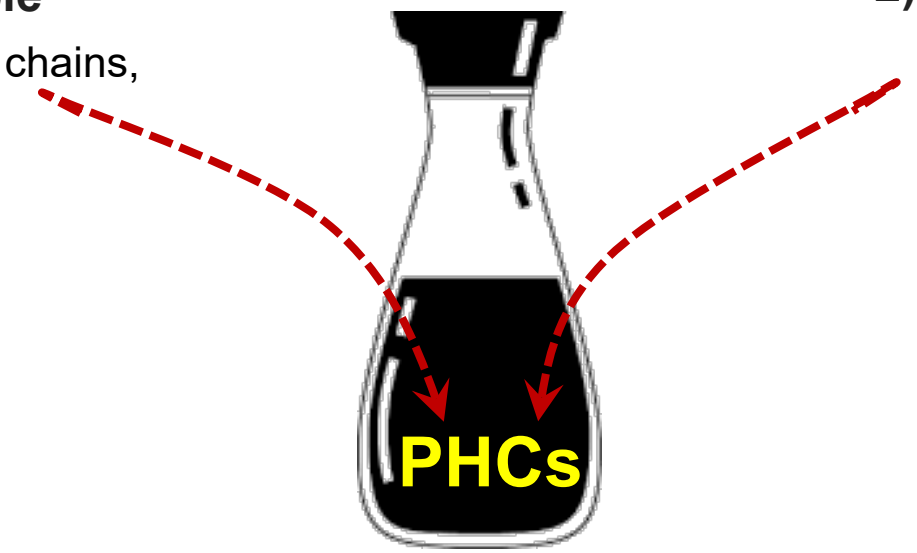
1) Aliphatic PHC Example

Straight chains, branched chains, non-aromatic rings

Propane



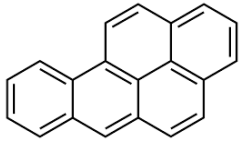


2) Aromatic PHC Example

Single and Multiple Benzene Rings

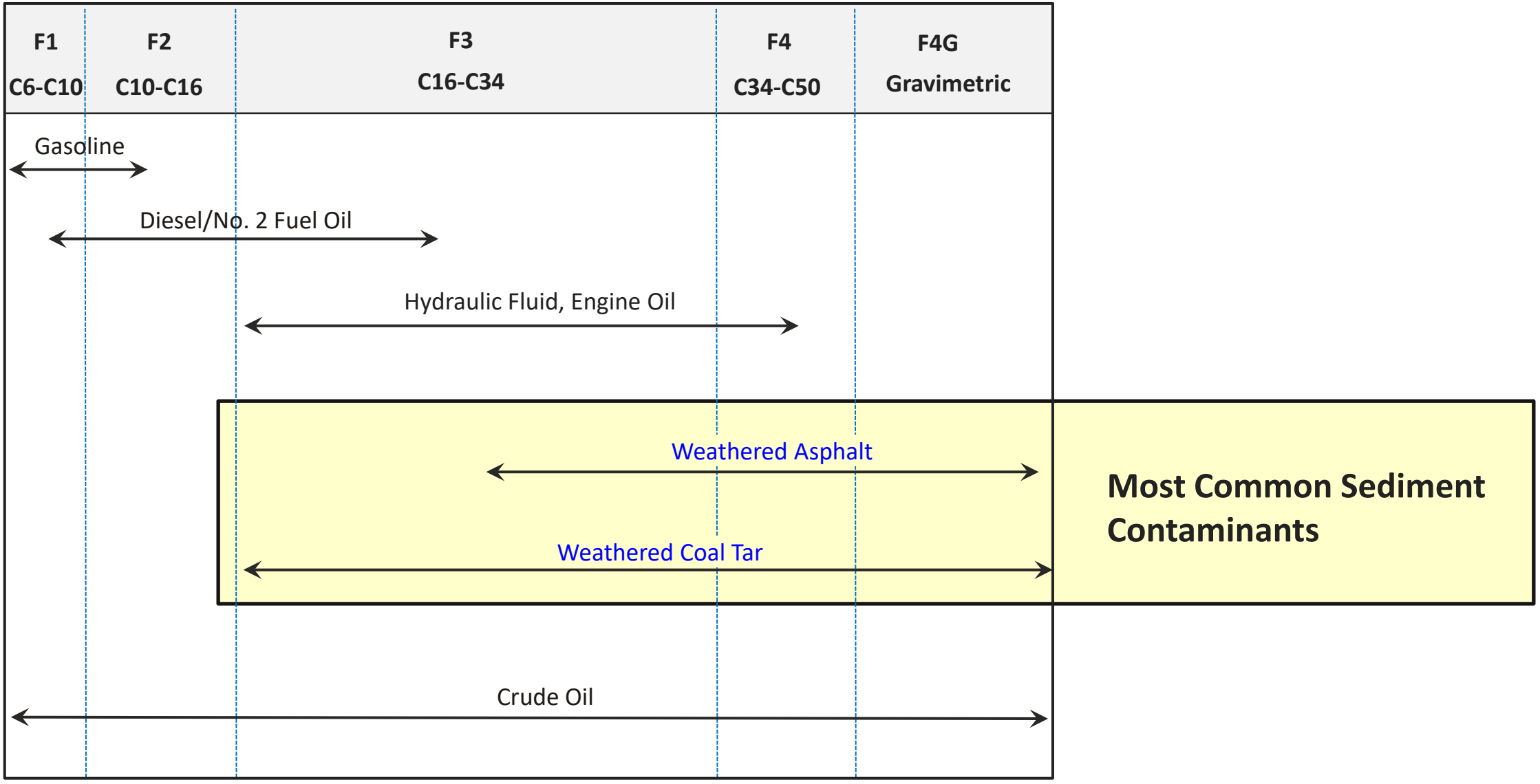
PAHs

Multiple Benzene Rings



Benzo(a)pyrene

MECP Regulated PHC Carbon Ranges & Select Sources



Remember! Liquid vs Solid PHCs Have Different Leachability & Toxicity Risks

Higher Risk (Liquids)

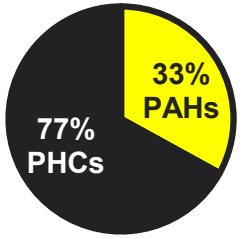
e.g. gasoline, diesel, jet fuel, creosote, etc.

Lower Risk (Solids)

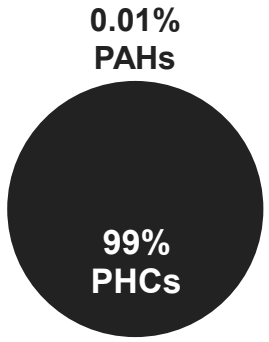
e.g. asphalt, solidified coal tar sealants, etc.

PAH Concentrations are 1000x Higher in Coal Tar than in Asphalt

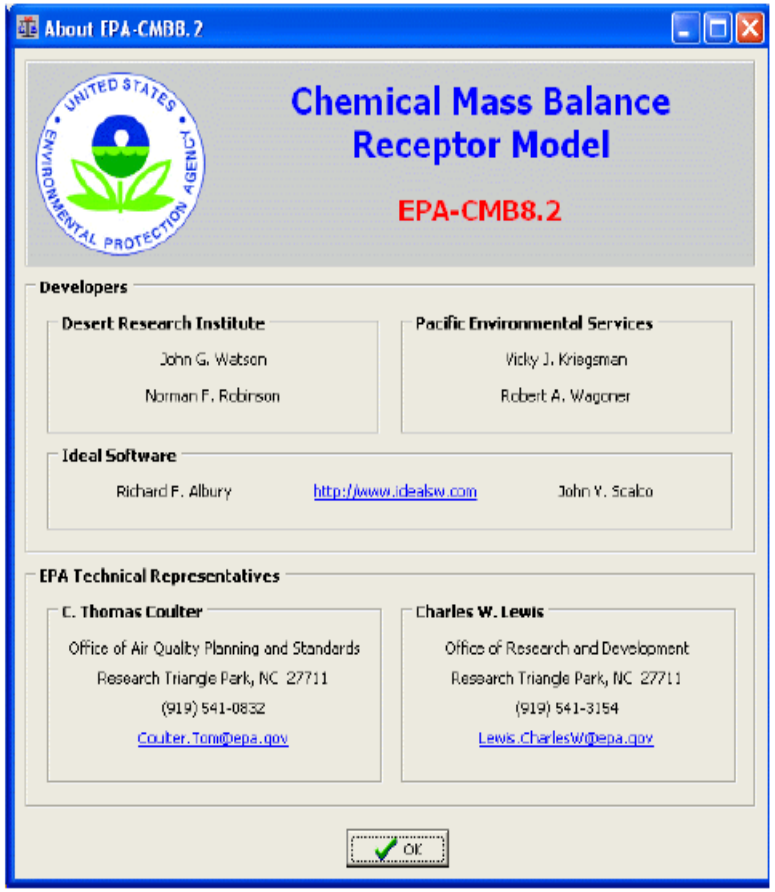
Coal Tar Sealant



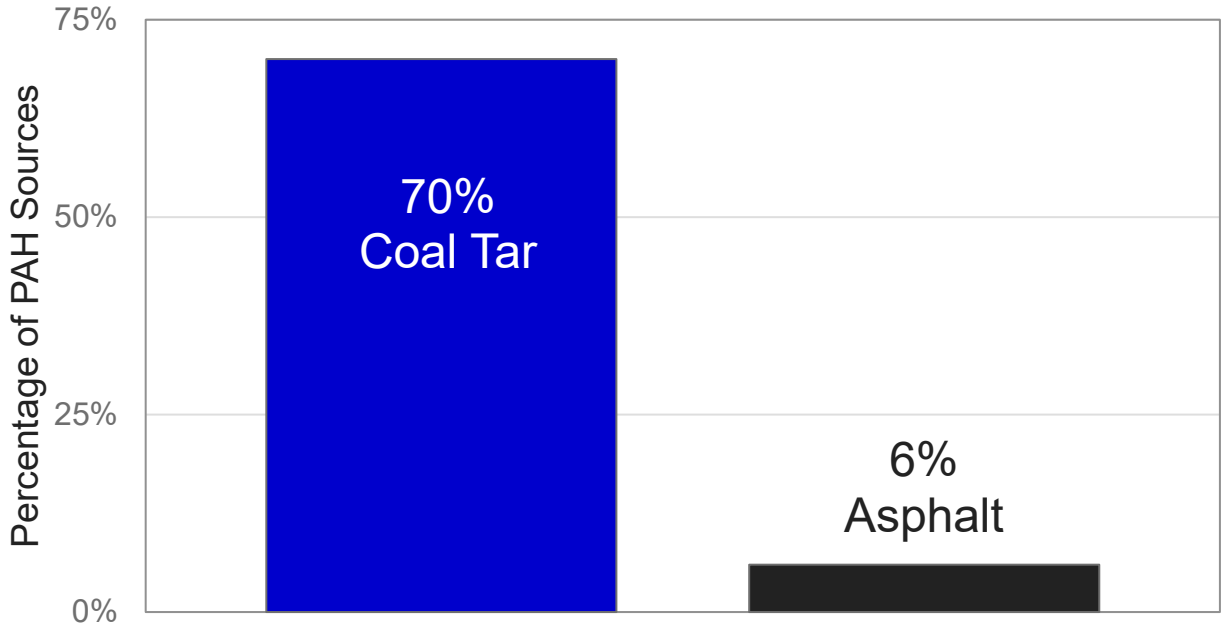
Asphalt



2016 MOE Funded Study to Evaluate Coal Tar vs Asphalt PAH Sources in Urban SWM Pond Sediments



180 Sediment Samples collected from 61 SWM Ponds



407 ETR Examples of Street Sweeping Practices & Coal Tar Free Asphalt

Hwy 407 ETR SWM Pond Sediment Depth Measurements & Road Maintenance Program

- 72 wet SWM ponds across 108 km corridor
- 55 are over 25 years old (1997-1999)
- Rest of ponds are on average 20 years old.
- Total pond area is 26.62 Hectares
- Sediment bathymetry found <15 cm layers in every pond.

407 ETR Sweeping and Catchbasin Maintenance

Routine annual sweeping program collects approximately 1500 tonnes of material:

- Daily sweeping operations along the entire 108 km corridor from May to October.
- Entire corridor is swept 8-10x/year
- Culvert flushing and catch basin sump cleanup of 1/3 of the corridor each year.

Additional Insights:

- 407 ETR uses no sand for winter ops at temperatures lower than -12C. Deviating from prior MTO standards, preference is given to low temperatures anti/de-icing materials.

407 ETR Sweeping and Catchbasin Maintenance

- 407 sweeping program diverts 1500 tonnes/year of sediment from SWM ponds.
- Pond sediment cleanout frequencies are approximately every 50 years

Hwy 407 ETR Asphalt Mixes are Coal Tar Free

407 ETR Hot Mix Asphalt follows MTO Standards:

- Asphalt mix facilities under NAICS Code 324121, does not include coal tar manufacturing.
- No coal tar mixes or surface treatments or bi-product used along the corridor (including granular sealing, or overlays).
- Mixes follow MTO standards for PGAC polymer modified asphalt mixes for higher performance at high and lower temperatures.
- Uses Recycled Asphalt Product (RAP) Pavement material from tested equivalent freeway mixes. Sampled and tested by manufacturers.

2018 407 ETR SWM Pond Sediment Chemistry Study

20+ Year Old Ponds Have Never Been Cleaned Out & Had <0.15 cm of Sediment

Concrete Runoff

Pond #1

Pond #2

Asphalt Runoff

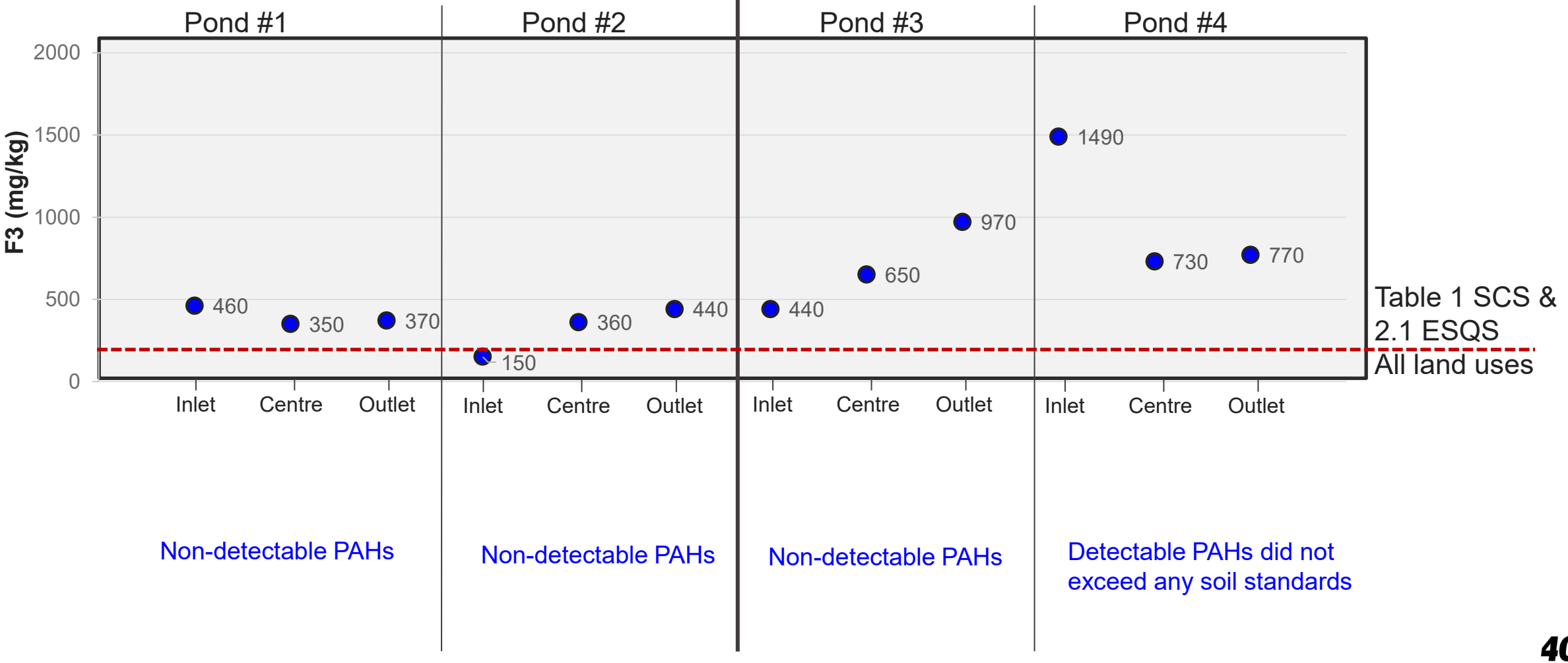
Pond #3

Pond #4

407 ETR SWM Pond Sediment - F3 PHC Exceedances of SCS & ESQS

Concrete Highway

Asphalt Highway



Non-detectable PAHs

Non-detectable PAHs

Non-detectable PAHs

Detectable PAHs did not exceed any soil standards

Conclusions

- SWM ponds located in coal tar free areas are less likely to exceed Excess Soil standards for PAHs, which improves beneficial reuse options.

- Sweeping programs can significantly reduce cleanout frequencies and costs

Questions?