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Committed to a Healthy and Vital Thames River

Water Quality Assessment in the Thames River Watershed

Nutrient Trends

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Outline

- Thames River watershed, nutrient issue
- The project: Data, methods
- Nutrient trends: Over time, across watershed
- Export to Lake St. Clair
- Using the information: Implementation

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Thames River Watershed

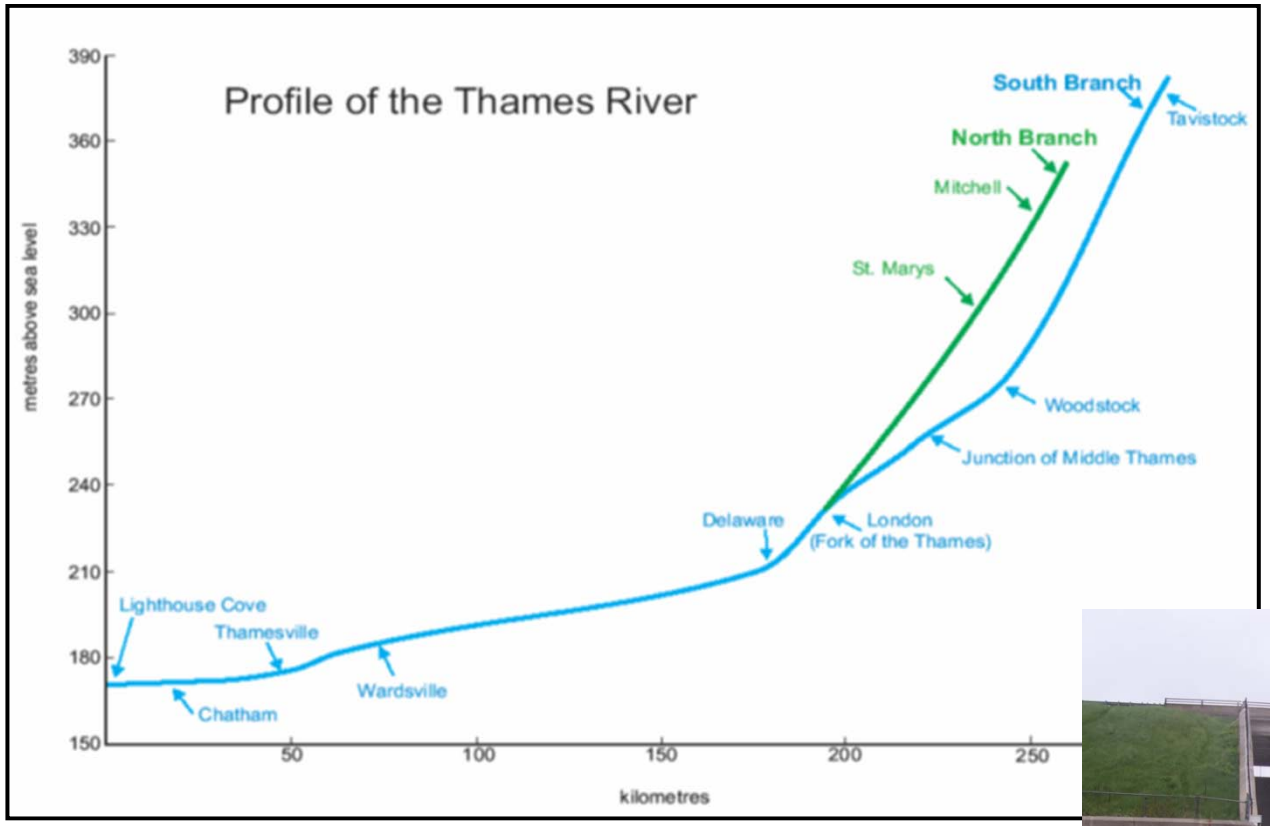
Area: 5,692 km^2

Length: 280 km

Land use:
82% Agriculture
7.8% Urban
8.7% Tree cover

Population:
600,000

Thames River Watershed



- 4-10 days from headwaters to Lake St. Clair
- River elevation change: 210 m
- Major dams and flood control structures
- 50% tile drained

The Nutrient Issue – locally in the Thames

- Over time phosphorus concentrations have improved in the river
- Healthy aquatic life – 94 fish species
- Natural river processes important
- Some local effects of excess phosphorus

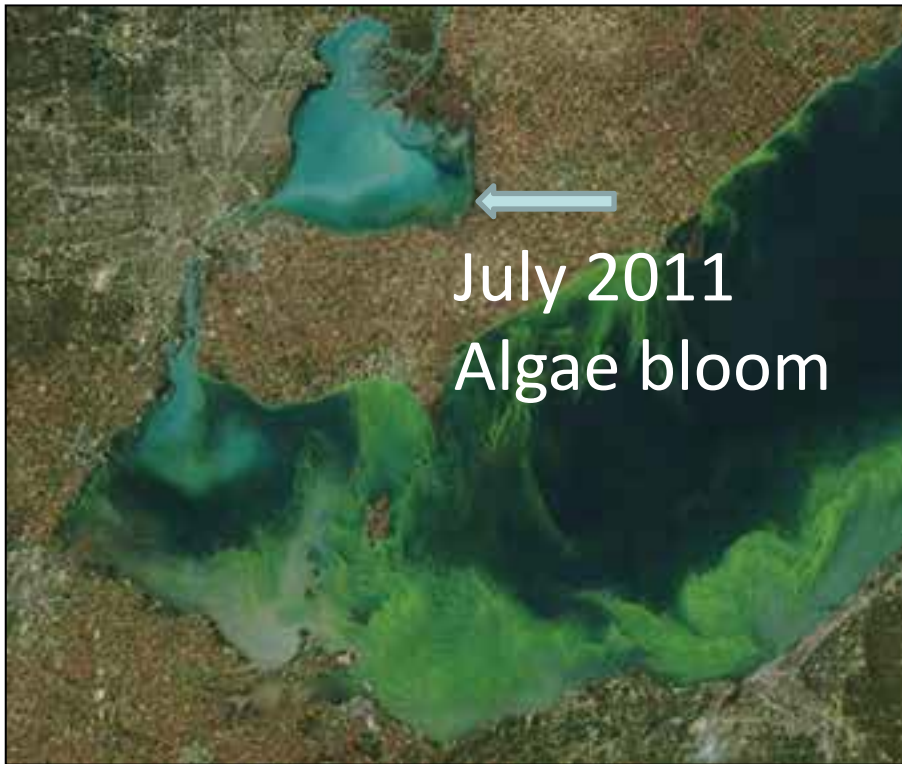

North Thames River


Thames outlet near Lake St. Clair


Fanshawe Reservoir algae

The Nutrient Issue
Lake St. Clair and Lake Erie West Basin

- Lake Erie findings: March-May runoff determines scale of Lake Erie algae blooms in July
- Tributaries are major source – High flow delivery, spring
- Phosphorus attaches to sediment



Water Quality Assessment Project

- Project started in 2013 through Showcasing Water Innovation
- **Freshwater Research (Gertrud Nürnberg, Ph.D., Bruce LaZerte, Ph.D.)**
- Project team:
  - Ontario Ministry of the Environment & Climate Change
  - Ontario Ministry of Agriculture, Food and Rural Affairs
  - City of London
  - Environment Canada
  - Western University
  - Lower Thames Valley Conservation Authority
  - Upper Thames River Conservation Authority

Goals: To better understand:

- What areas and sources contribute nutrients in the Thames watershed
- When are most nutrients getting to the river
- Delivery to Lake St. Clair – effect of reservoirs, flows
- Climate and extreme weather impacts

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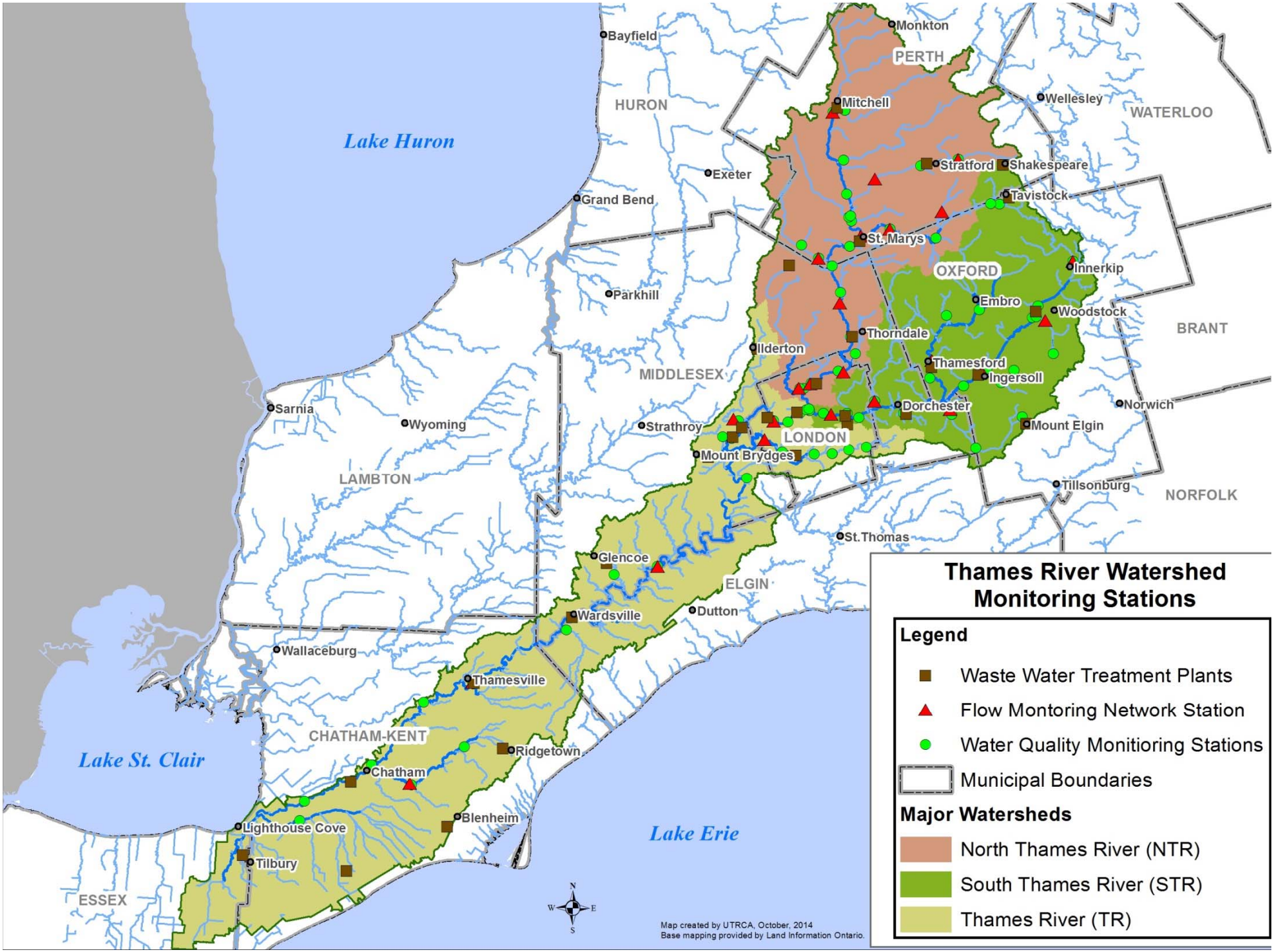
Monitoring data for the Thames

- 83 water quality stations
- 26 stream gauge stations - Water Survey Canada
- 30 wastewater treatment plants

Time period used: 1986-2012
Annual, Monthly, Seasonal
<u>Variables</u>:

- Total phosphorus
- Dissolved phosphorus
- Suspended solids: Measure of sediment
- Nitrogen, nitrate

Average concentrations (flow weighted)
Loads (three models)


Lake Huron
Lake St. Clair
Lake Erie
Bayfield
Monkton
PERTH
HURON
Mitchell
Wellesley
WATERLOO
Exeter
Stratford
Shakespeare
Grand Bend
Tavistock
St. Marys
OXFORD
Innerkip
Parkhill
Embro
Woodstock
BRANT
Thorndale
Ilderton
Thamesford
MIDDLESEX
Ingersoll
Sarnia
Wyoming
Strathroy
Dorchester
Norwich
Mount Elgin
LONDON
Mount Brydges
LAMBTON
Tillsonburg
NORFOLK
St.Thomas
Glencoe
ELGIN
Wardsville
Dutton
Wallaceburg
Thamesville
CHATHAM-KENT
Ridgetown
Chatham
Blenheim
Lighthouse Cove
Tilbury
ESSEX
N
W
E
S
Map created by UTRCA, October, 2014
Base mapping provided by Land Information Ontario.
Thames River Watershed Monitoring Stations
Legend
Waste Water Treatment Plants
Flow Montoring Network Station
Water Quality Monitioring Stations
Municipal Boundaries
Major Watersheds
North Thames River (NTR)
South Thames River (STR)
Thames River (TR)

Estimating Nutrient and Sediment Loads

Determined 3 methods for load calculations and used based on data availability for locations:

- EGRET (Exploration and Graphics for RivEr Trends – U.S. Geological Survey program)
  - Weighted regressions on time, discharge, season the most reliable model
- GAM (General Additive Model)
  - Available for all stations that can be combined with flow data, optimally weighted regression with smoothing
- LINEAR (non-flow-weighted loads)

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Trends across the Watershed

<u>Phosphorus (FWC)</u>

From the headwaters of the North and South Thames to the Forks in London:

- DRP decreasing, no trend for TP

In lower reach of Thames River:

- TP decreasing, no trend for DRP

<u>Sediment (TSS)</u>

- Decreases in the North Thames River
- Increases in the Thames River (London to Mouth)
- No trend in the South Thames River

Upper Thames – 40,000 tonnes/year
Lower Thames – 74,000 tonnes/year

= 5400 Truck Loads

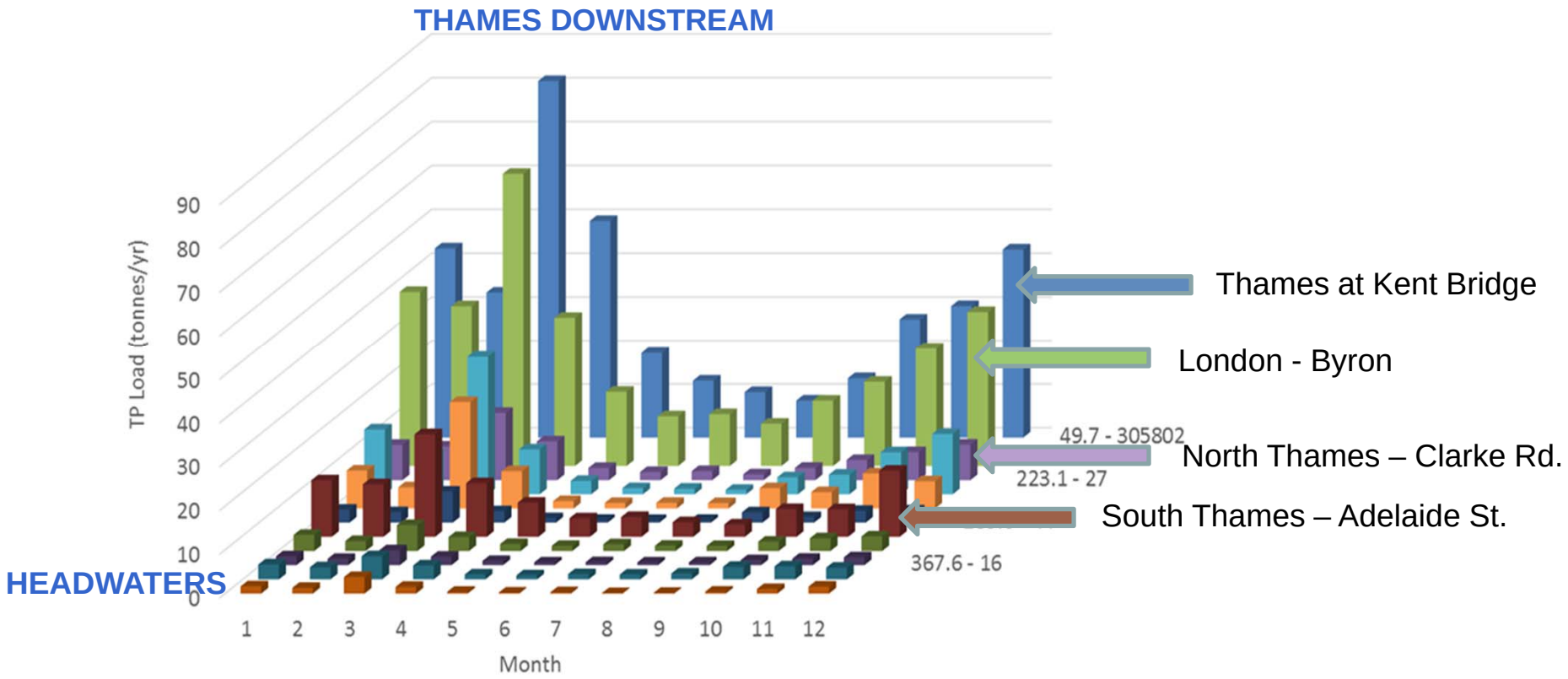
Findings: Trends over Time (1986-2012)

- Total Phosphorus flow-weighted concentrations decreased significantly with time
  - Sites across the Thames watershed
- No consistent improvement for dissolved phosphorus, sediment, total nitrogen
- Improvement in WWTP effluent phosphorus levels over time

Seasonal Trends

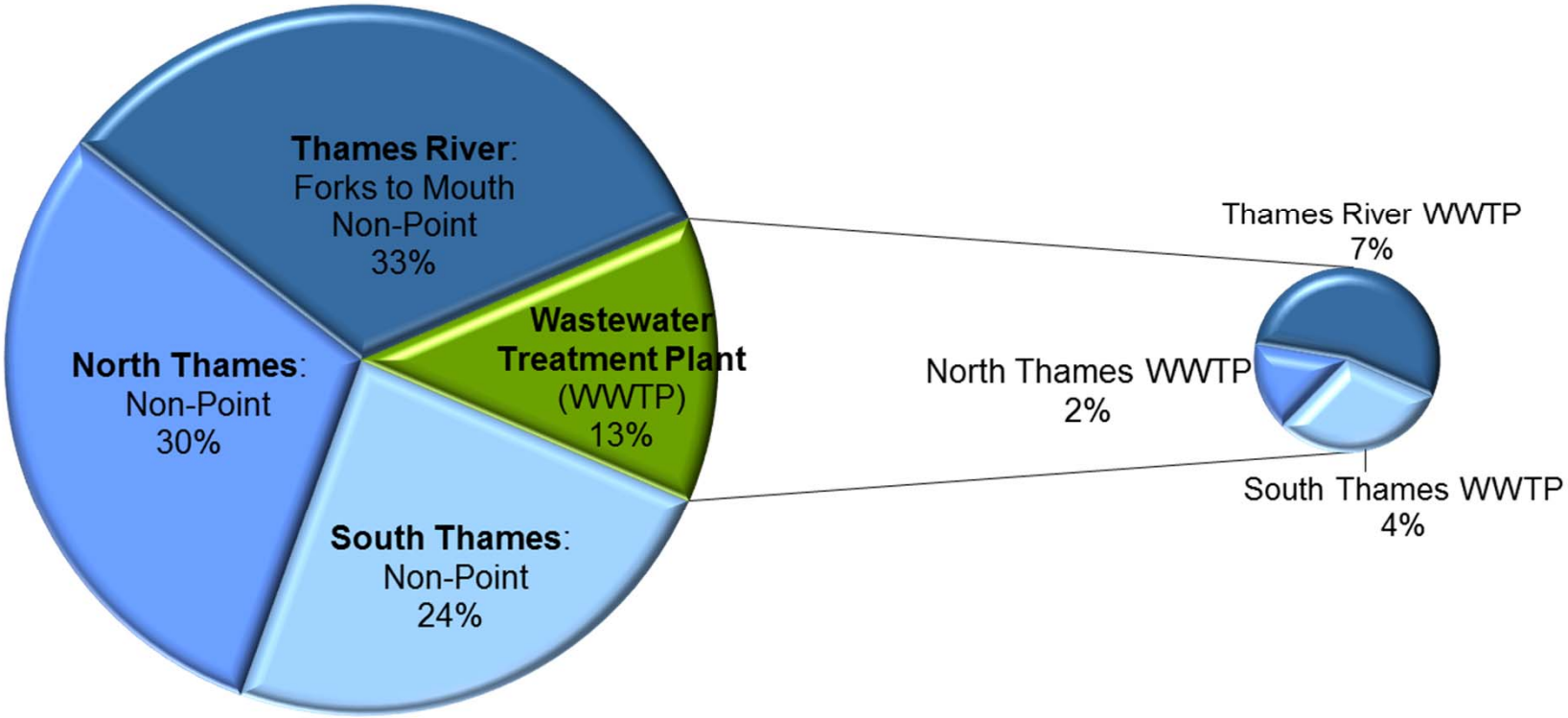
- Phosphorus and sediment loads highest in late winter and spring
- River flows seasonally distinct: High flow (Mar-Apr) decreasing (May-Sept)

Monthly Average Total Phosphorus Loads (1986-2012)



Sources of Phosphorus – Point and Non-Point

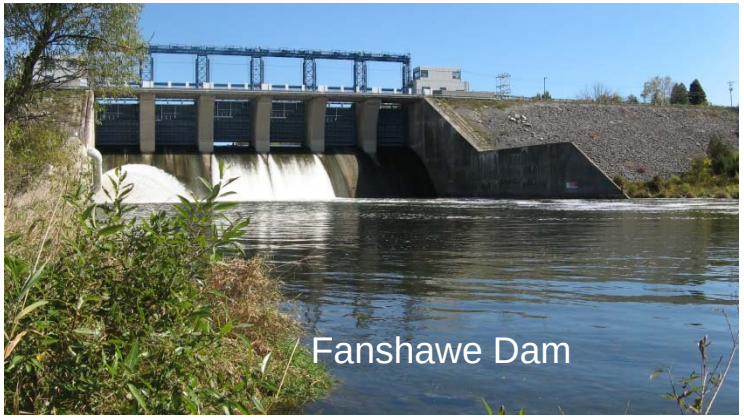
- Non-point sources dominate loads – runoff from areas across the watershed (e.g., fertilizer, waste, detergents)

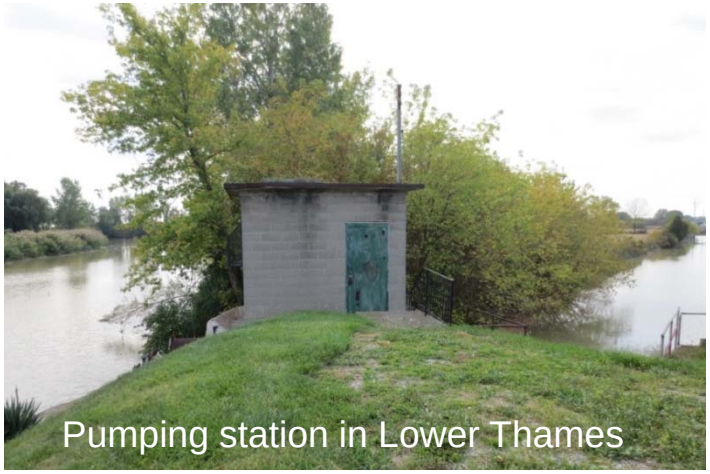


Reservoirs and Impoundments

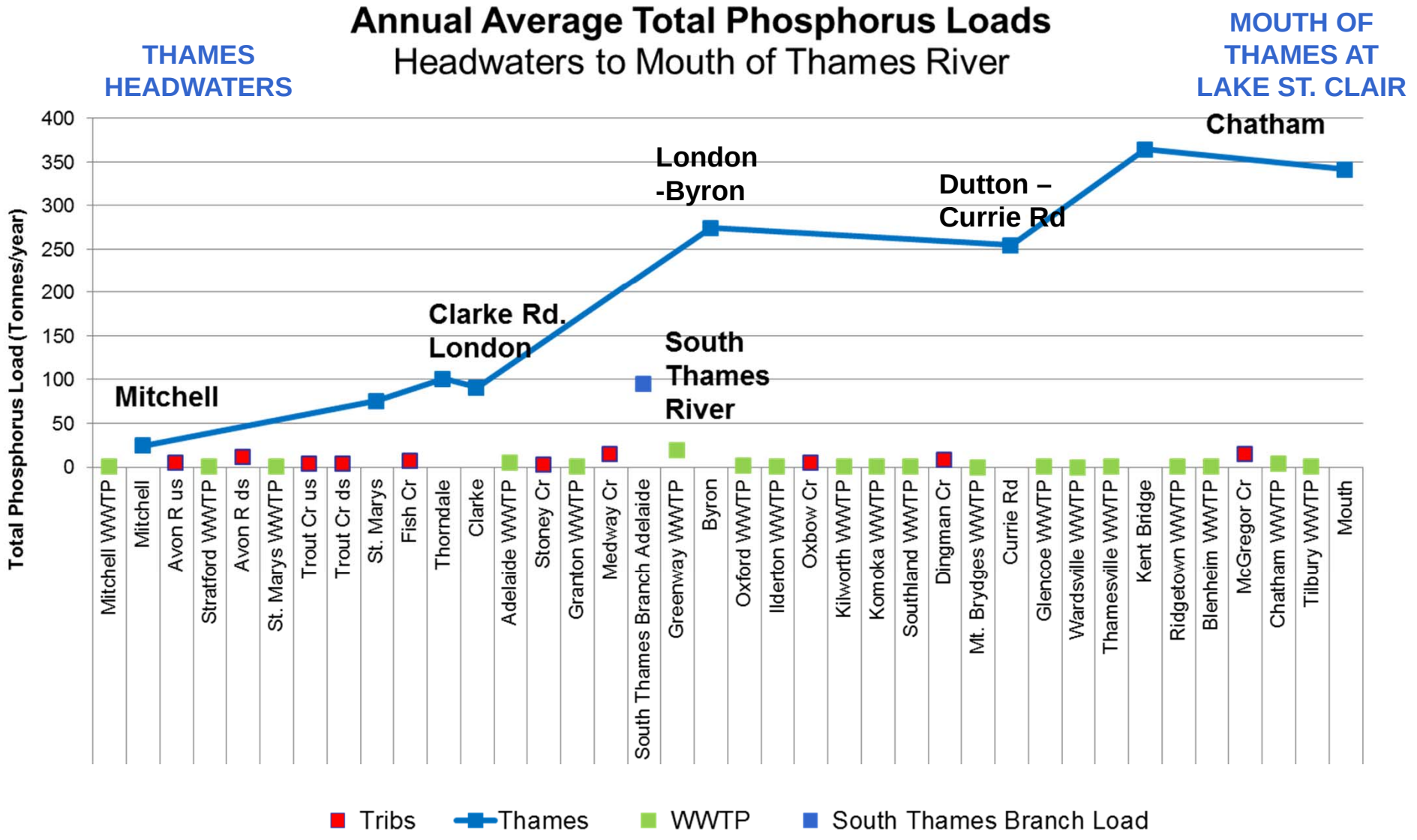
- Decrease load in spring, high flows
- Increase in summer through internal phosphorus load: Release phosphate from bottom sediments during warm, low-oxygen conditions

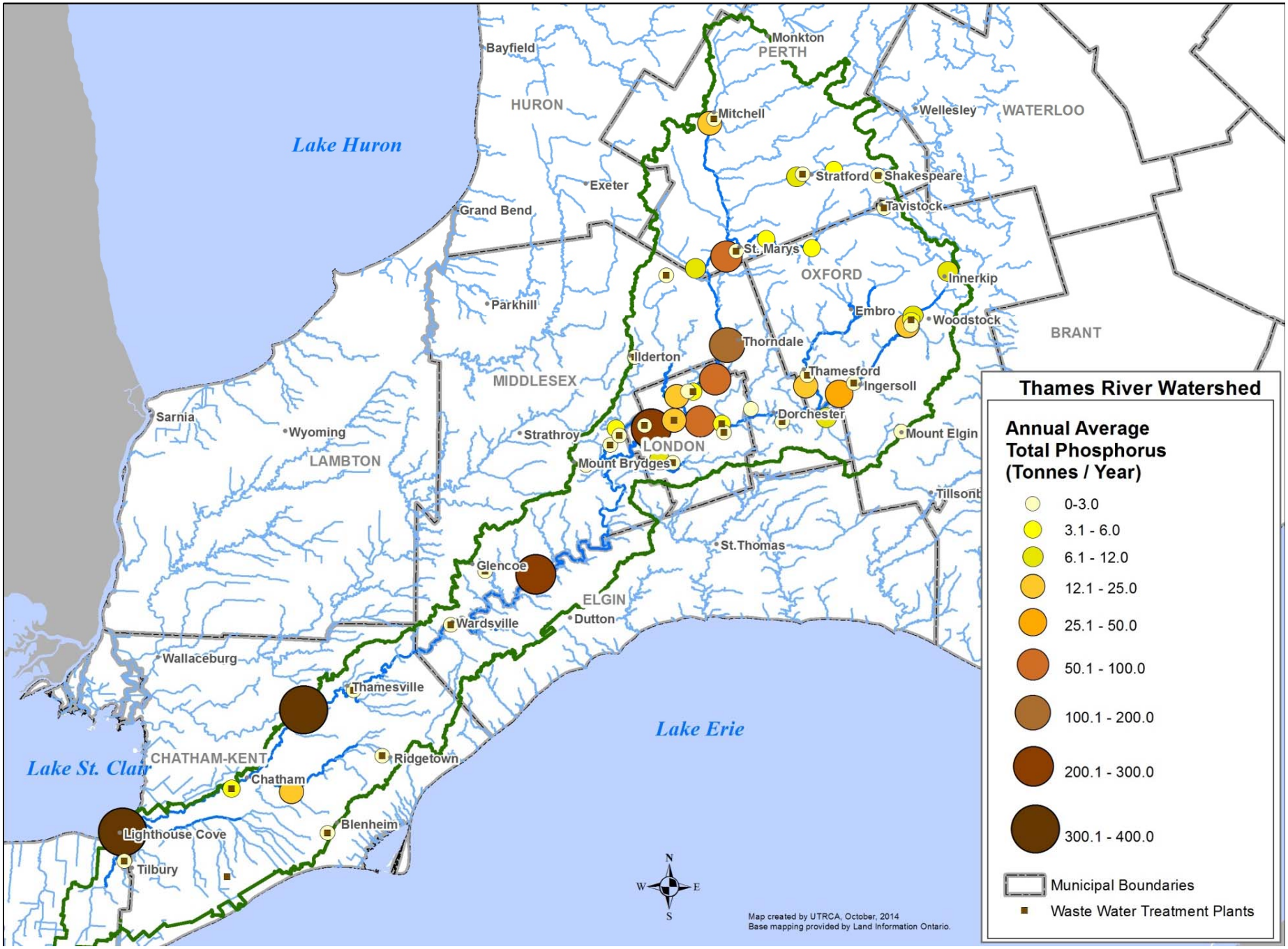
- Aged impoundments become source of nutrients including legacy nutrients
- Example: Fanshawe Reservoir's internal load is 4-16 t/summer


Fanshawe Dam


Pumping station in Lower Thames


Wildwood Reservoir on Trout Creek


Annual Average Total Phosphorus Loads
Headwaters to Mouth of Thames River
THAMES HEADWATERS
MOUTH OF THAMES AT LAKE ST. CLAIR
Total Phosphorus Load (Tonnes/year)
400
350
300
250
200
150
100
50
0
Mitchell
Clarke Rd. London
London -Byron
South Thames River
Dutton – Currie Rd
Chatham
Mitchell WWTP
Mitchell
Avon R us
Stratford WWTP
Avon R ds
St. Marys WWTP
Trout Cr us
Trout Cr ds
St. Marys
Fish Cr
Thorndale
Clarke
Adelaide WWTP
Stoney Cr
Granton WWTP
Medway Cr
South Thames Branch Adelaide
Greenway WWTP
Byron
Oxford WWTP
Ilderton WWTP
Oxbow Cr
Kilworth WWTP
Komoka WWTP
Southland WWTP
Dingman Cr
Mt. Brydges WWTP
Currie Rd
Glencoe WWTP
Wardsville WWTP
Thamesville WWTP
Kent Bridge
Ridgetown WWTP
Blenheim WWTP
McGregor Cr
Chatham WWTP
Tilbury WWTP
Mouth
Tribs
Thames
WWTP
South Thames Branch Load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Innerkip
Parkhill
Embro
Woodstock
BRANT
Thorndale
Ilderton
MIDDLESEX
Thamesford
Ingersoll
Dorchester
Sarnia
Wyoming
Strathroy
LONDON
Mount Elgin
LAMBTON
Mount Brydges
Tillsonb
St. Thomas
Glencoe
ELGIN
Dutton
Wardsville
Wallaceburg
Thamesville
CHATHAM-KENT
Ridgetown
Chatham
Blenheim
Lighthouse Cove
Tilbury
N
W
E
S
Map created by UTRCA, October, 2014
Base mapping provided by Land Information Ontario.
Thames River Watershed
Annual Average
Total Phosphorus
(Tonnes / Year)
0-3.0
3.1 - 6.0
6.1 - 12.0
12.1 - 25.0
25.1 - 50.0
50.1 - 100.0
100.1 - 200.0
200.1 - 300.0
300.1 - 400.0
Municipal Boundaries
Waste Water Treatment Plants

Thames River Export into Lake St. Clair

Thames estimated annual export

- 342 t/yr Total Phosphorus
- 187 t/yr Dissolved P
- 113 10^3 t/yr Suspended Sediment

Lake Huron's TP load upstream of Lake St. Clair:

- 419 (321-560) t/yr

Detroit River to Lake Erie estimated TP load:

- 3,500 - 4,300 t/yr, or 10 fold

Maumee River TP load

- 3800 t/yr

Water levels between Lake St. Clair and the Thames River are close enough to permit flow exchange. Export was computed from known and modelled contributions from various tributaries with the gauged and monitored Thames River station closest to the mouth.

Considerations for Implementation

Loads in the spring and late winter are highest and most significant to summer algae blooms

- *Target BMPs to minimize phosphorus and sediment runoff in winter-spring*

Phosphorus and sediment loads for the Thames are significant, mainly non-point source, and contributed watershed-wide

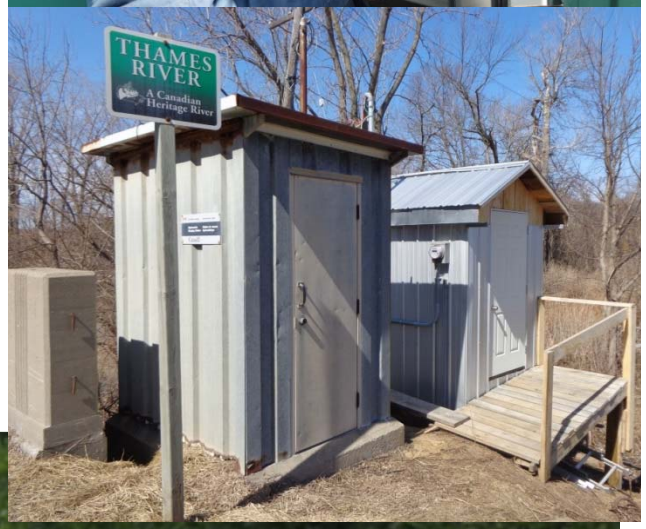
- *Enhance urban and rural non-point source implementation across the watershed with BMPs specific to minimizing runoff in high and extreme flow conditions*

Some subwatersheds have proportionally higher phosphorus and sediment loads

- *Target some added implementation to these areas*

Recommendations for Additional Monitoring

- Importance of continued monitoring at key locations to measure future progress in load reductions
- Better monitoring of extreme flow conditions, all seasons, where flow gauges are available; use of continuous samplers



Moving Forward in the Thames Watershed

- Nutrient issue has been a target since PLUARG, and have been implementing programs locally for 30+ years
- Making steady but gradual progress as seen in river trends, despite increases in population, wastewater volumes, row cropped acres and livestock numbers, combined with changing weather patterns

- It takes time with non-point sources to achieve and measure improvement, but it can be done
- Extension (people), knowledge transfer, BMPs with multiple benefits

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Thank you

Karen Maaskant
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