ThamesRiver
CLEAR WATER REVIVAL

Committed to a Healthy and Vital Thames River

www.thamesrevival.ca

Water Quality Assessment in the Thames River Watershed

Nutrient and Sediment Trends

Symposium: Showcasing Water Innovation for the Thames River
December 2-3, 2014



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

ThamesRiver
CLEAR WATER REVIVAL

Thames River Watershed

Area:
5,692 km^2

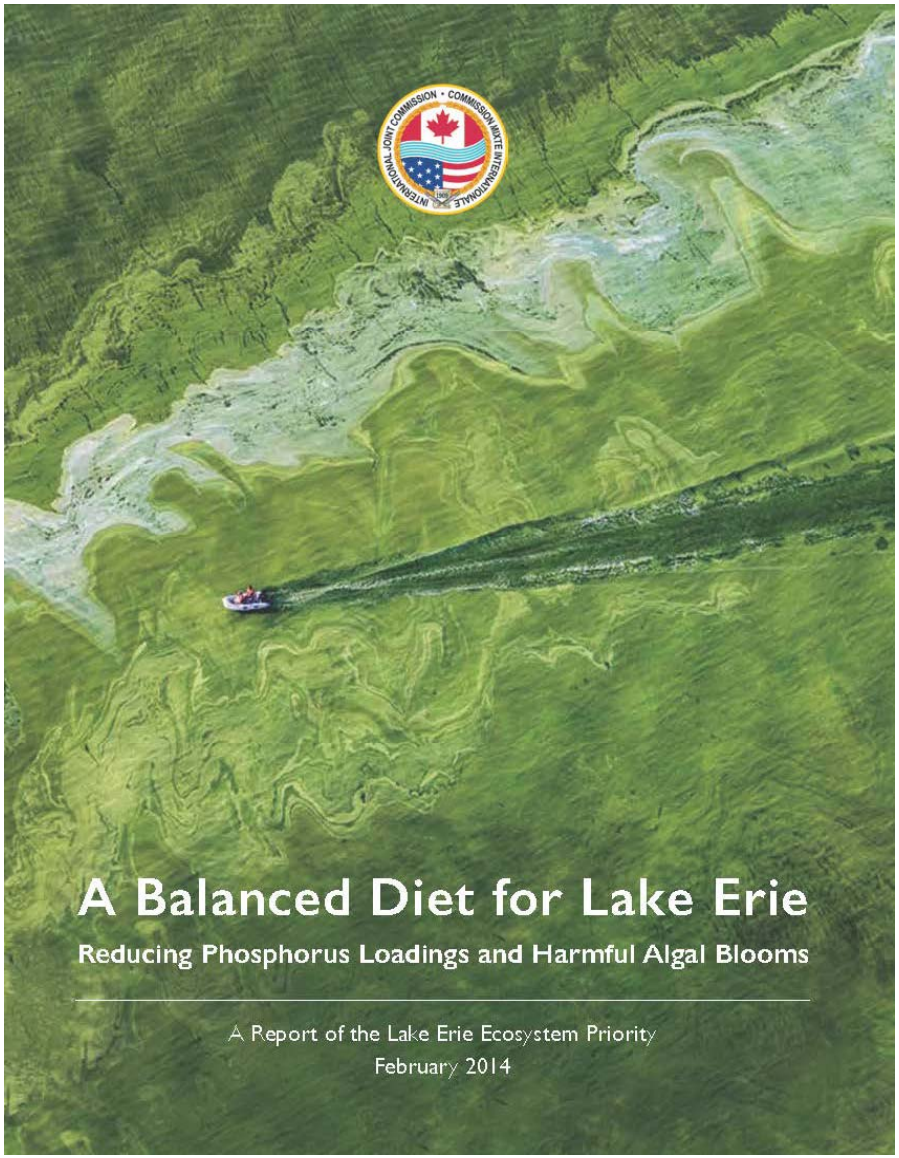
Land use:
80% Agriculture
7.8% Urban
5.1%Tree cover
4.6% Wetland

Current Situation: Lake Erie

- 2000's return of L. Erie algae – West Basin
- Phosphorus: Toxic forms
- Drinking water supplies affected ($$$): Water ban in Toledo August 2014

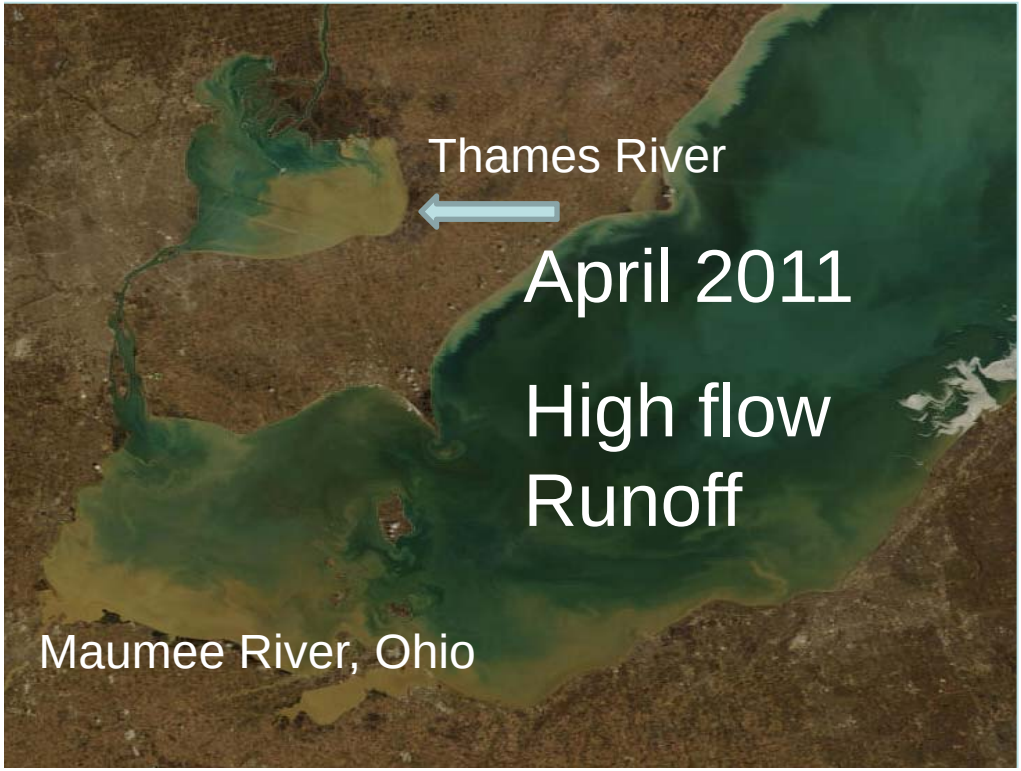
Sources:

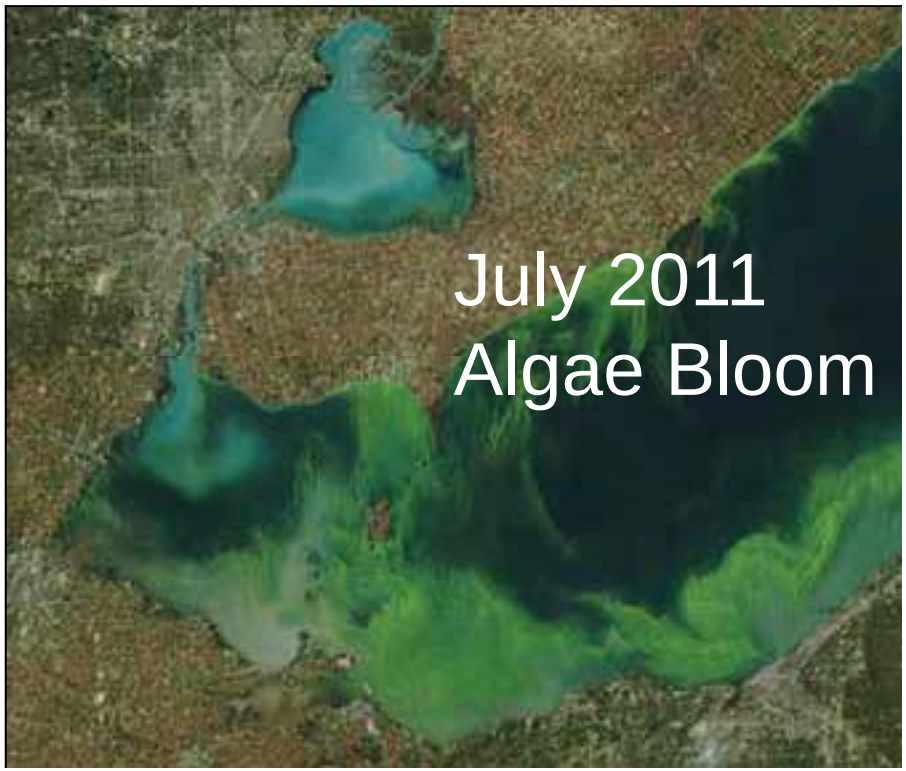
- Urban and Rural Non-point sources, Dissolved Phosphorus (eg. fertilizer)
- Climate – extreme flows and temperature



The Nutrient Issue – Lake Erie west basin

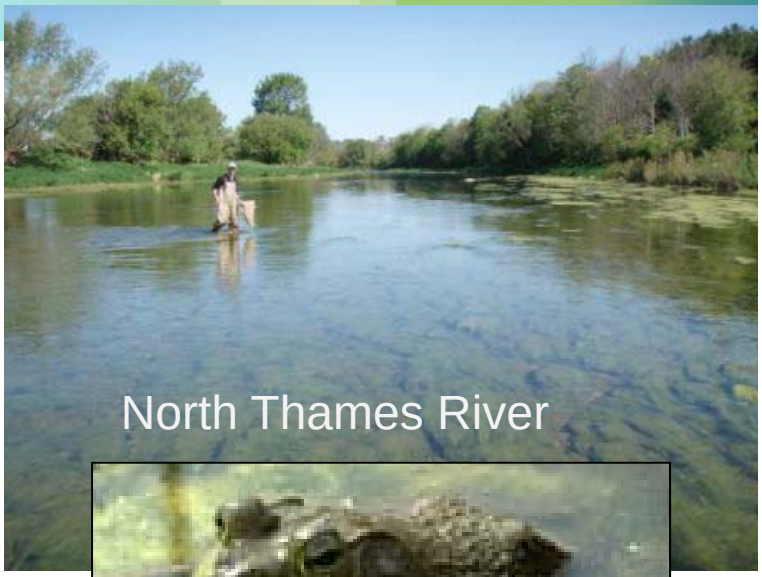
- L.Erie findings: March-May runoff determines scale of L. Erie algae blooms in July
- Tributaries major source – High flow delivery, spring
- Phosphorus attaches to sediment





The Nutrient Issue – local

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


North Thames River


Thames outlet
near L. St. Clair

Fanshawe Reservoir algae

Water Quality Assessment Project

Started in August 2013, Showcasing Water Innovation project
Freshwater Reseach (Gertrud Nürnberg, Ph.D., Bruce LaZerte, Ph.D.)
Project Team: MOECC, OMAFRA, City of London, Env. Canada, Western, LTVCA, UTRCA
Presenting DRAFT results

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

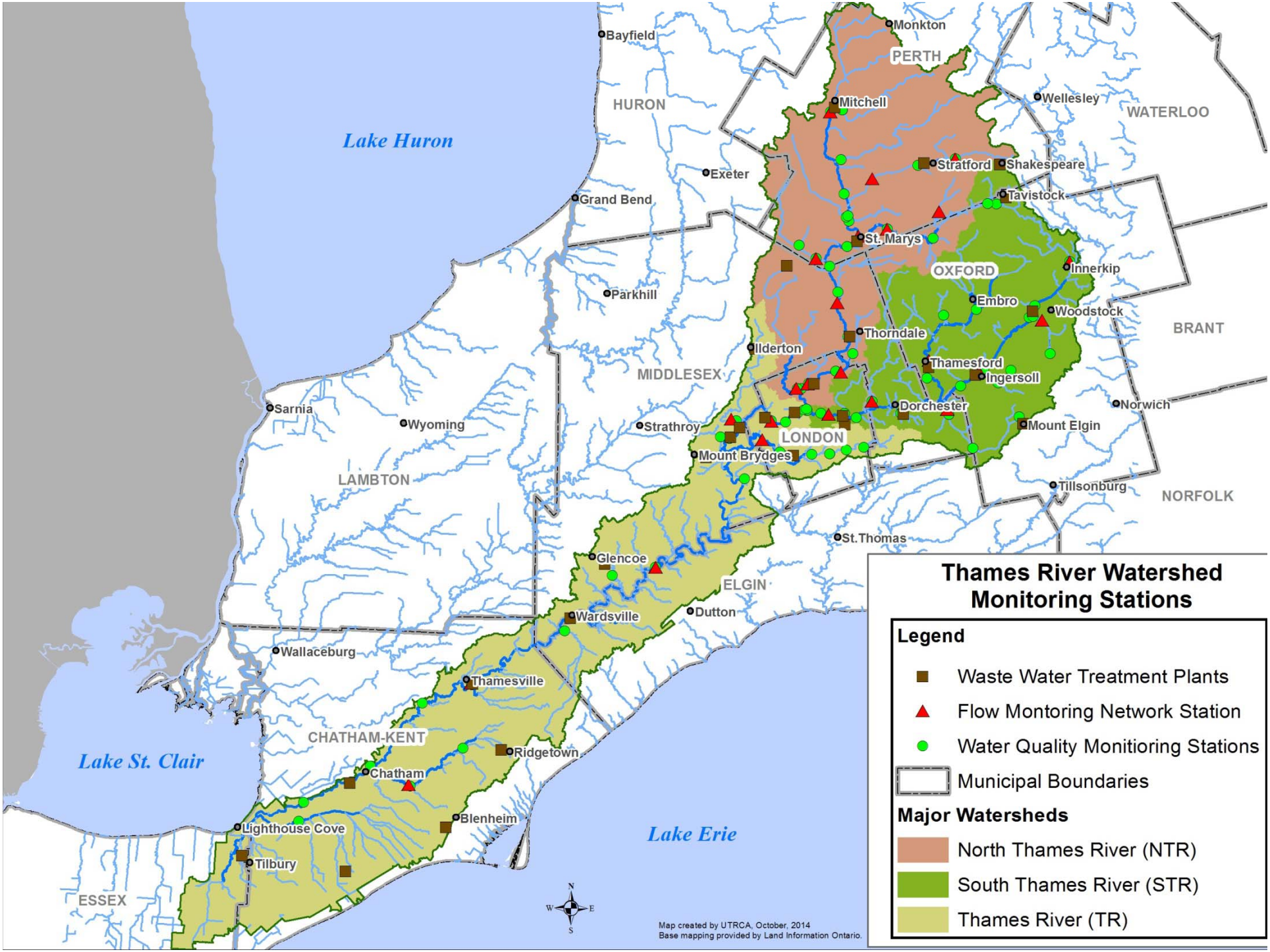
Monitoring data for the Thames

- 83 Water Quality Stations
- 26 Stream Gauge Stations
  Water Survey Canada– daily flow
- 30 Wastewater Treatment Plants

Time period used: 1986-2012
Annual, Monthly, Seasonal - Mar-Apr, May-Sep,

Variables:
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
Stratford
Shakespeare
Exeter
Grand Bend
Tavistock
St. Marys
OXFORD
Innerkip
Parkhill
Embro
Woodstock
BRANT
Thorndale
Ilderton
Thamesford
Ingersoll
MIDDLESEX
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)

ThamesRiver
CLEAR WATER REVIVAL

Findings: Trends over Time

- Total Phosphorus concentrations decreased significantly with time (1986 to 2012)
  - Forks in London to mouth of Thames
  - South Thames River Woodstock to London
  - Less so in North Thames river

- No consistent improvement for other nutrients and sediment (Dissolved phosphorus, Sediment, Total nitrogen)

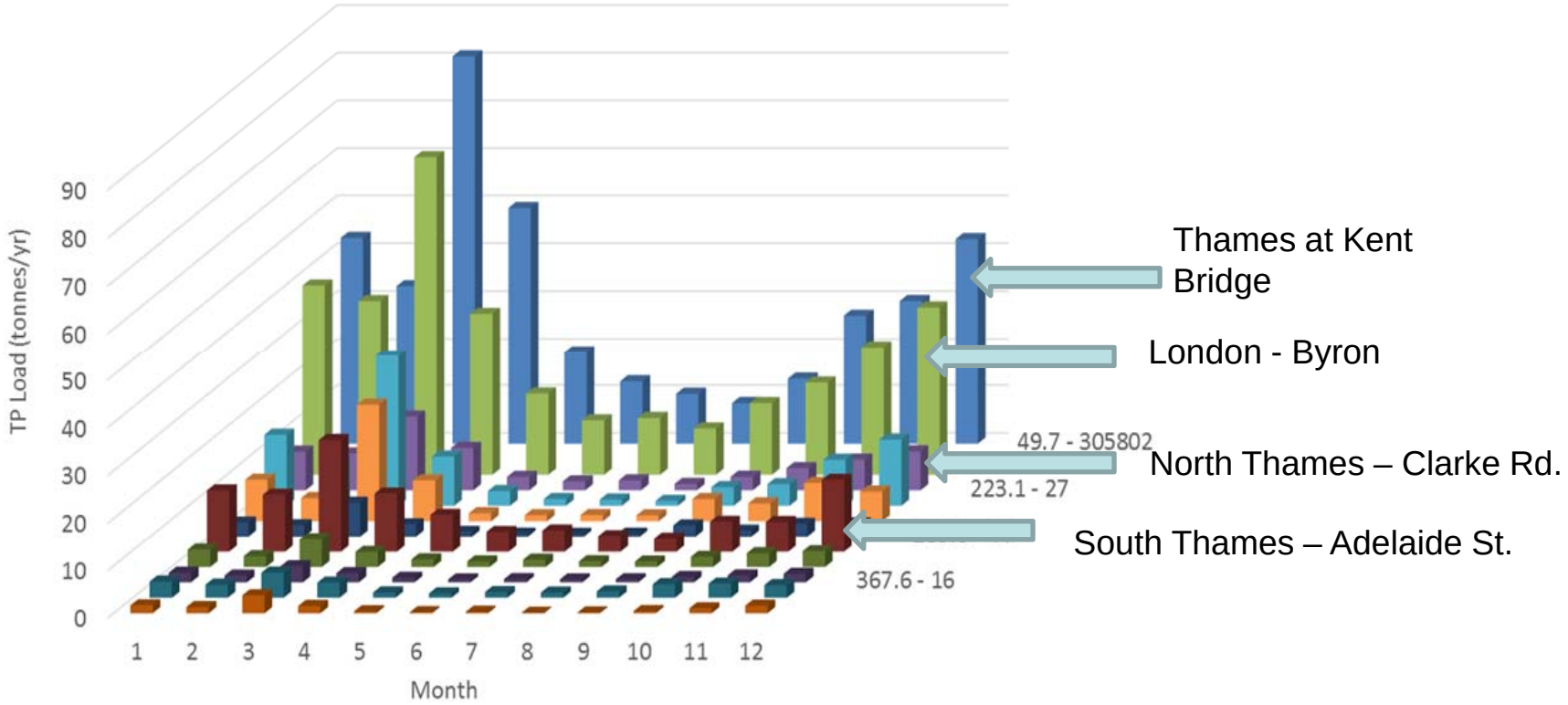
- Flows: no temporal trend (1986-2012)

- Improvement in WWTP phosphorus levels over time

Seasonal Trends

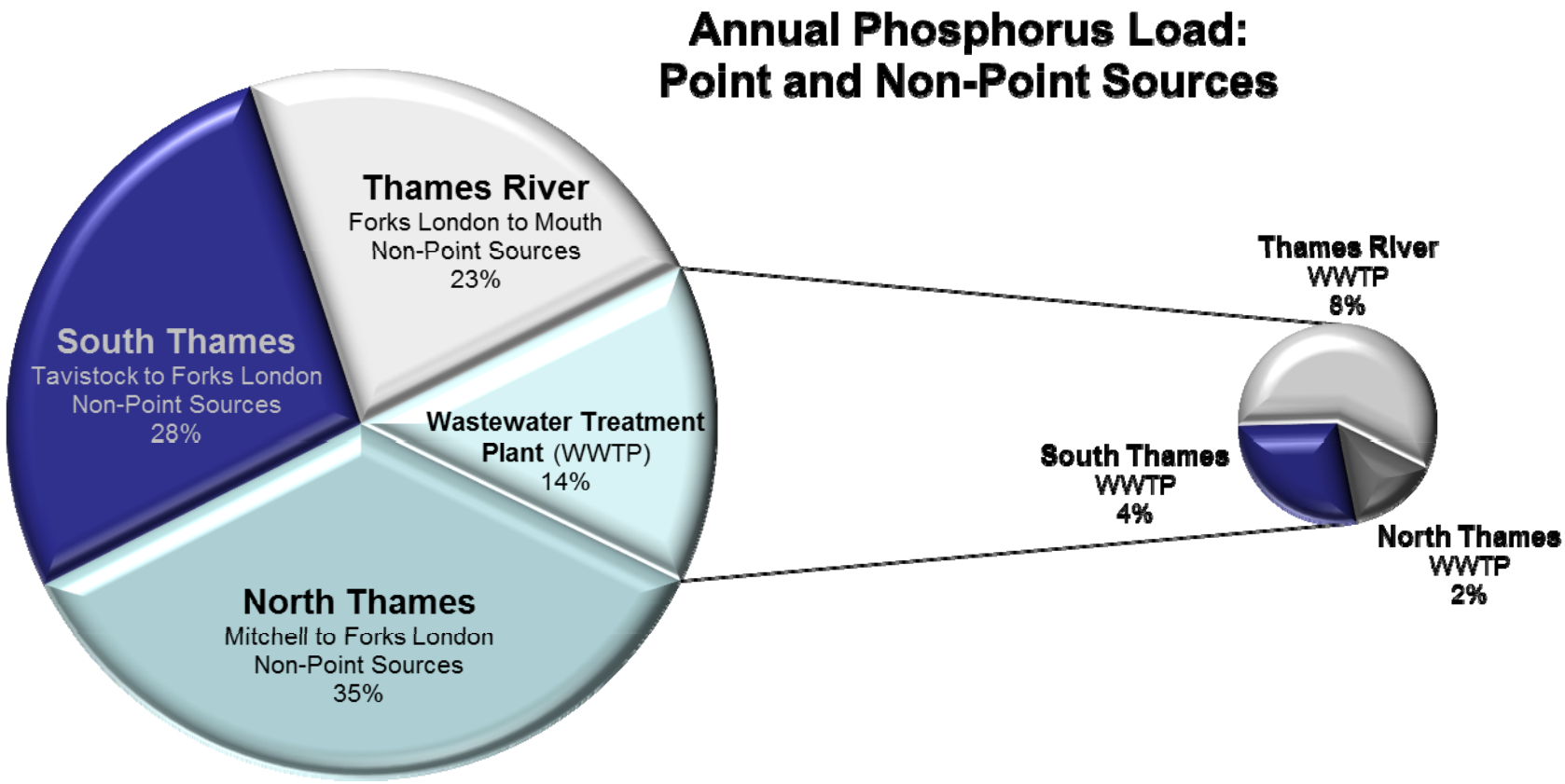
- Phosphorus and sediment loads highest in spring (March-April)
- River flows seasonally distinct: High flow (Mar-Apr) decreasing (May-Sept)

Monthly average total Phosphorus Loads



Sources of Phosphorus – Point and Non-Point

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



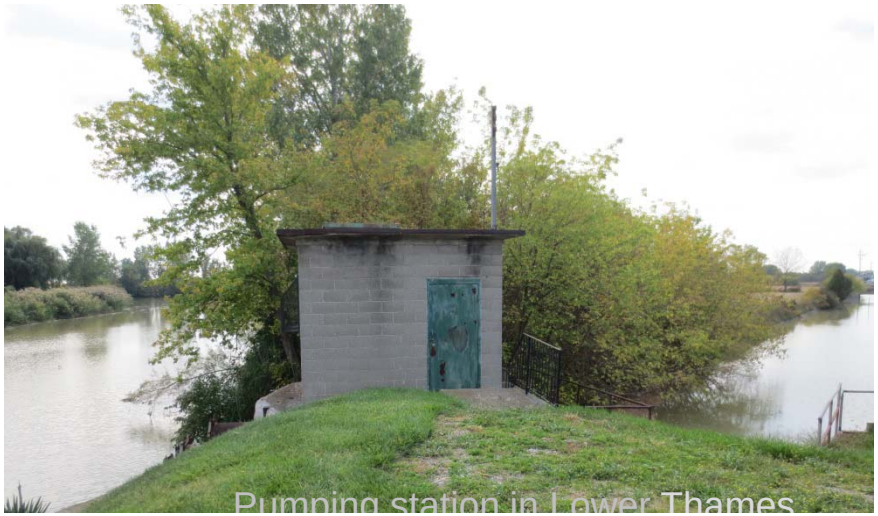
Reservoirs and Impoundments

Internal Phosphorus Load: release from bottom sediments during warm, low-oxygen conditions

Impoundments and slow moving sections of the Thames

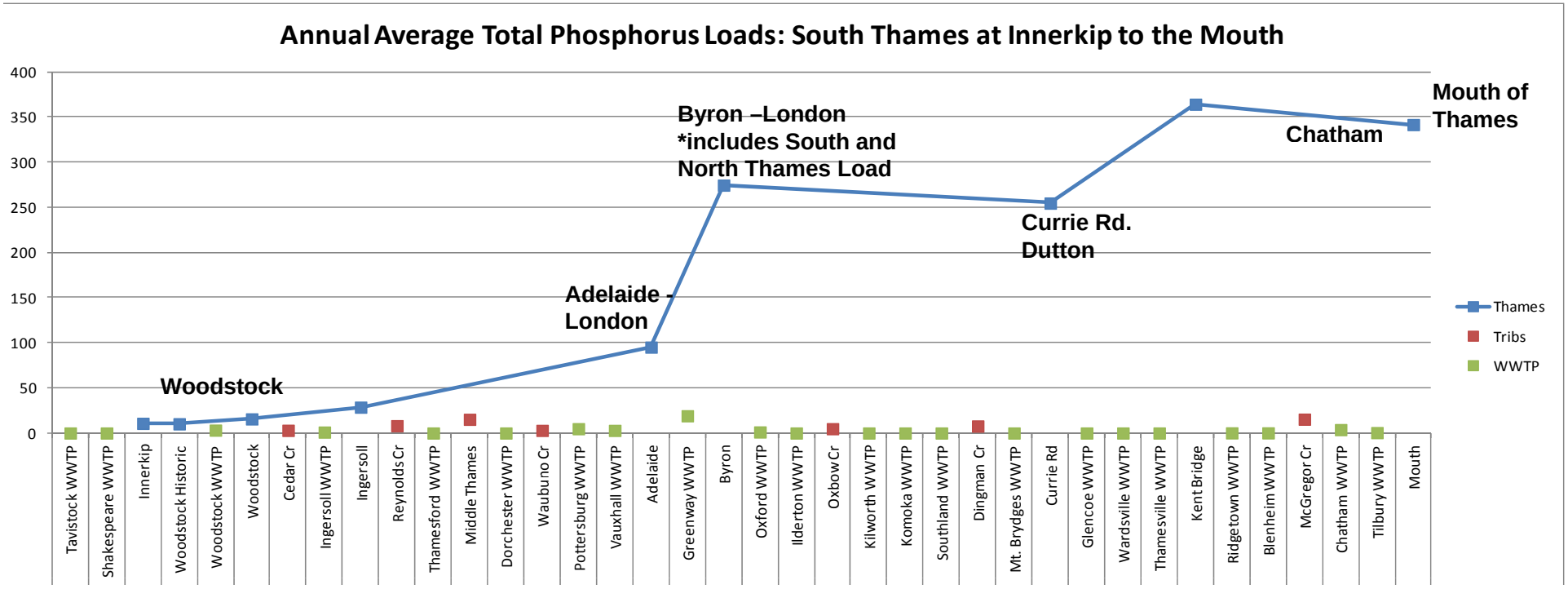
Highest in the summer. Contributes a more biologically available phosphorus (phosphate - similar to fertilizer)

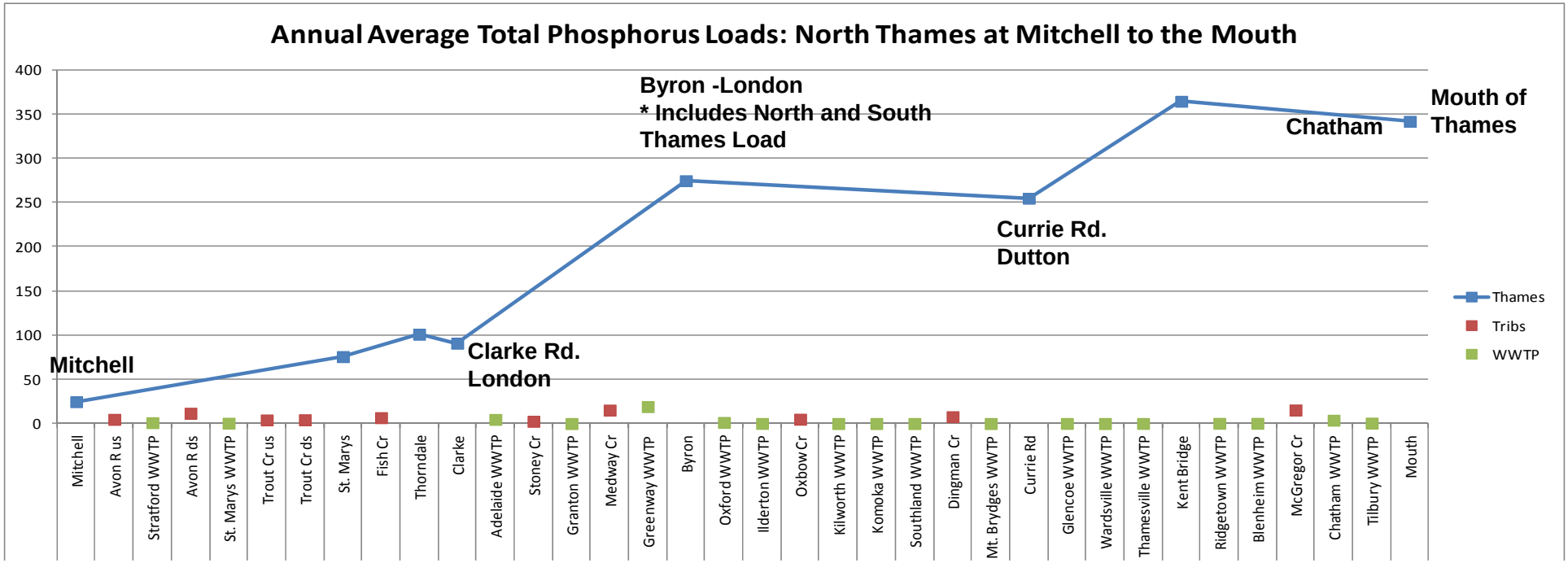
Example: Fanshawe Reservoir's internal load is 4 to 16 t/summer (4 to 16% of downstream load

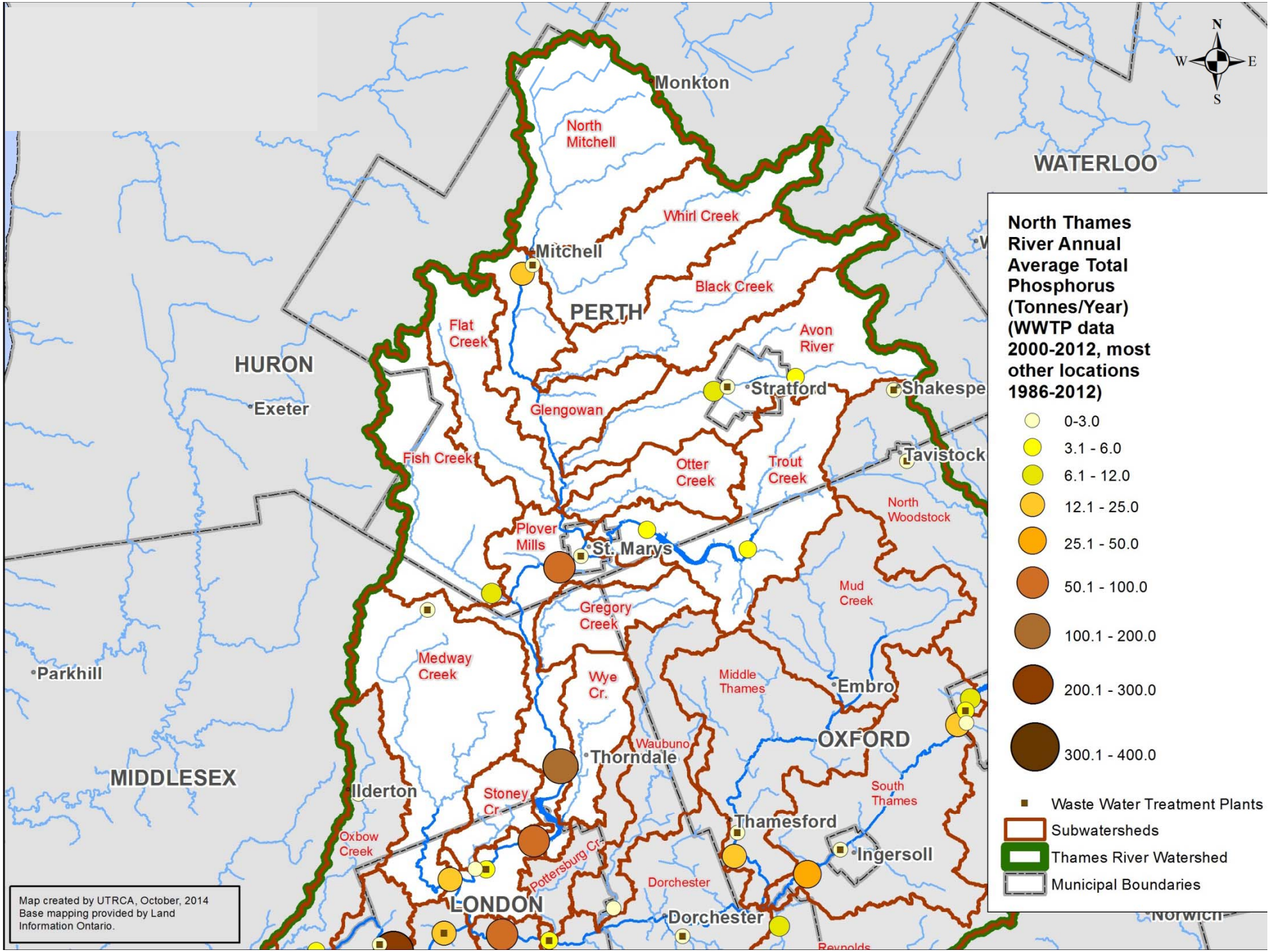


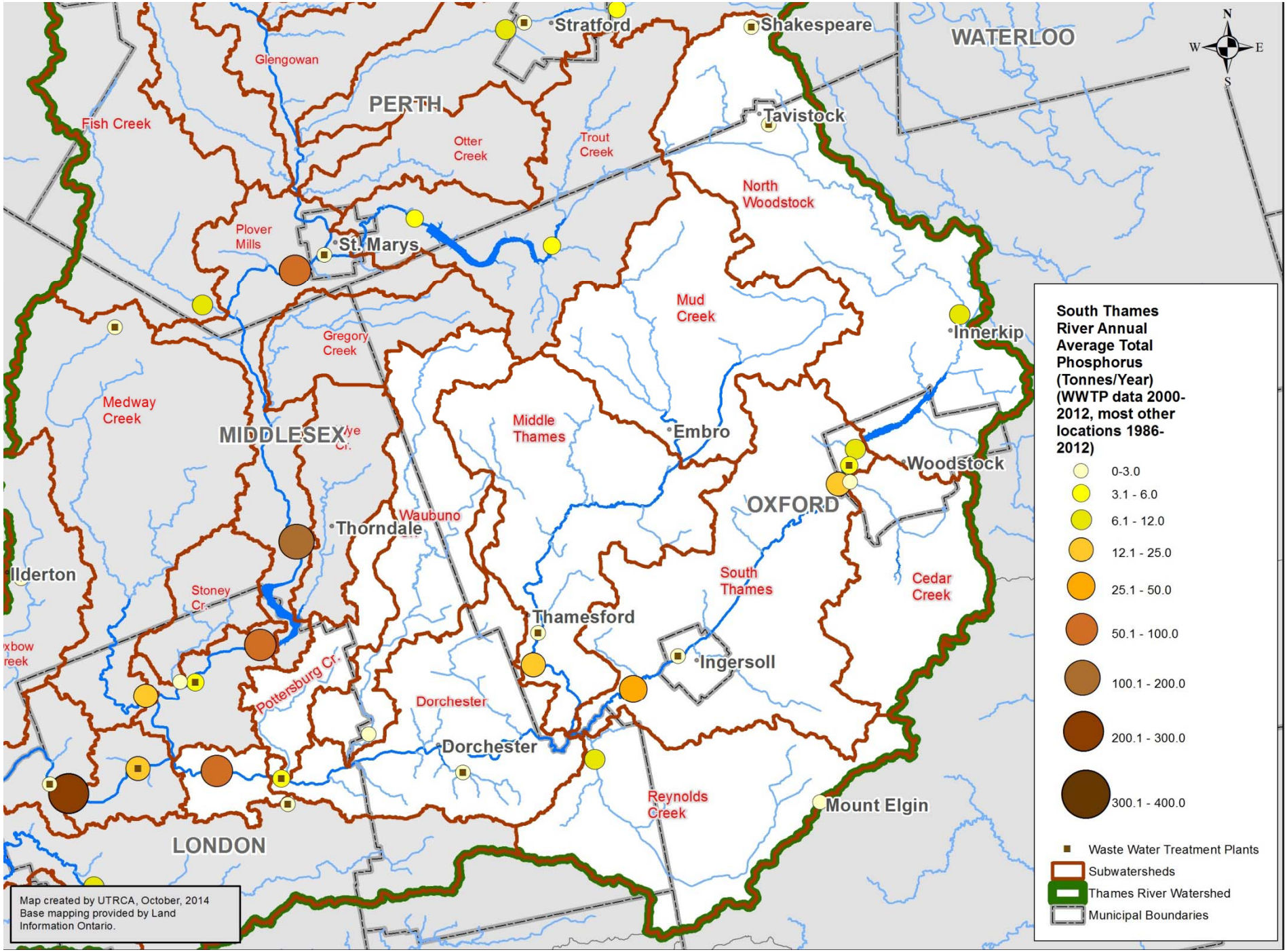
Pumping station in Lower Thames

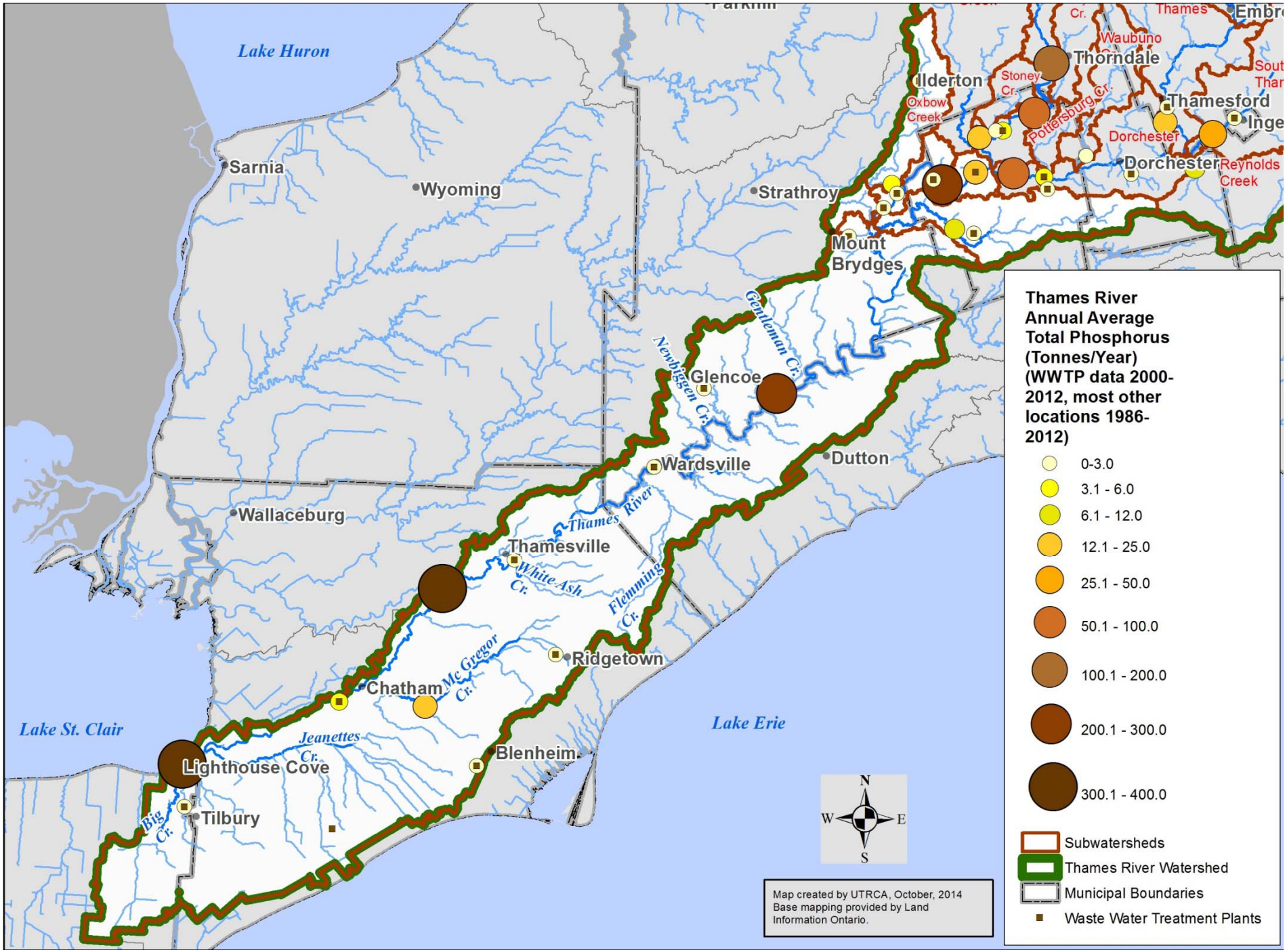
Wildwood Reservoir on Trout Creek


Annual Average Total Phosphorus Loads: South Thames at Innerkip to the Mouth
400
350
300
250
200
150
100
50
0
Woodstock
Adelaide - London
Byron –London *includes South and North Thames Load
Currie Rd. Dutton
Chatham
Mouth of Thames
Thames
Tribs
WWTP
Tavistock WWTP
Shakespeare WWTP
Innerkip
Woodstock Historic
Woodstock WWTP
Woodstock
Cedar Cr
Ingersoll WWTP
Ingersoll
Reynolds Cr
Thamesford WWTP
Middle Thames
Dorchester WWTP
Waubuno Cr
Pottersburg WWTP
Vauxhall WWTP
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


Annual Average Total Phosphorus Loads: North Thames at Mitchell to the Mouth
400
350
300
250
200
150
100
50
0
Mitchell
Clarke Rd. London
Byron -London * Includes North and South Thames Load
Currie Rd. Dutton
Chatham
Mouth of Thames
Thames
Tribs
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
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


Monkton
North Mitchell
WATERLOO
Whirl Creek
Mitchell
Black Creek
PERTH
Flat Creek
Avon River
HURON
Stratford
Shakespe
Exeter
Glengowan
Fish Creek
Otter Creek
Trout Creek
Tavistock
North Woodstock
Plover Mills
St. Marys
Mud Creek
Gregory Creek
Medway Creek
Parkhill
Wye Cr.
Middle Thames
Embro
OXFORD
Waubuno
Thorndale
MIDDLESEX
Ilderton
Stoney Cr.
South Thames
Thamesford
Oxbow Creek
Pottersburg Cr.
Ingersoll
Dorchester
LONDON
Dorchester
Reynolds
Norwich
N
W
E
S
North Thames River Annual Average Total Phosphorus (Tonnes/Year) (WWTP data 2000-2012, most other locations 1986-2012)
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
Waste Water Treatment Plants
Subwatersheds
Thames River Watershed
Municipal Boundaries
Map created by UTRCA, October, 2014
Base mapping provided by Land Information Ontario.


Stratford
Shakespeare
WATERLOO
Glengowan
PERTH
Fish Creek
Otter Creek
Trout Creek
Tavistock
North Woodstock
Plover Mills
St. Marys
Mud Creek
Innerkip
Gregory Creek
Medway Creek
MIDDLESEX
Middle Thames
Embro
Woodstock
OXFORD
Waubuno
Thorndale
Ilderton
Stoney Cr.
South Thames
Cedar Creek
Thamesford
Ingersoll
Pottersburg Cr.
Dorchester
Dorchester
Reynolds Creek
Mount Elgin
LONDON
N
W
E
S
South Thames River Annual Average Total Phosphorus (Tonnes/Year) (WWTP data 2000-2012, most other locations 1986-2012)
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
Waste Water Treatment Plants
Subwatersheds
Thames River Watershed
Municipal Boundaries
Map created by UTRCA, October, 2014
Base mapping provided by Land Information Ontario.


Lake Huron
Lake St. Clair
Lake Erie
Sarnia
Wyoming
Strathroy
Wallaceburg
Thamesville
Wardsville
Glencoe
Dutton
Ridgetown
Chatham
Blenheim
Lighthouse Cove
Tilbury
Mount Brydges
Ilderton
Thorndale
Thamesford
Dorchester
Reynolds Creek
Oxbow Creek
Stoney Cr.
Pottersburg Cr.
Waubuno
Thames River
White Ash Cr.
Flemming Cr.
McGregor Cr.
Jeanettes Cr.
Big Cr.
Newbiggen Cr.
Gentleman Cr.
Thames River Annual Average Total Phosphorus (Tonnes/Year) (WWTP data 2000-2012, most other locations 1986-2012)
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
Subwatersheds
Thames River Watershed
Municipal Boundaries
Waste Water Treatment Plants
N
W
E
S
Map created by UTRCA, October, 2014
Base mapping provided by Land Information Ontario.

Lower Thames Export into Lake St. Clair

Thames estimated annual export Phosphorus (metric tonnes/year:

- 342 t/yr Total Phosphorus
- 187 t/yr dissolved P
- 113 10^3 t/yr suspended sediment

Lake Huron's Phosphorus load into the Detroit River upstream of Lake St. Clair:

- 419 (321-560) t/yr

Phosphorus load of the Detroit River out of Lake St. Clair at the entry to Lake Erie estimated:

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

Water levels between Lake St, Clair and the Thames River are close and 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

.

Recommendations for Additional Monitoring

- Additional locations where monitoring gaps
- Better monitoring of extreme flow conditions, all season monitoring, where flow gauges are available; use of automated continuous samplers

Some Considerations for Implementation

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

- *Target BMP's to minimize phosphorus and sediment runoff in winter-spring*

Phosphorus and sediment loads for the Thames are significant 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*

.

ThamesRiver
CLEAR WATER REVIVAL

Committed to a Healthy and Vital Thames River

www.thamesrevival.ca

Thank you

Karen Maaskant
Upper Thames River Conservation Authority
www.thamesriver.on.ca