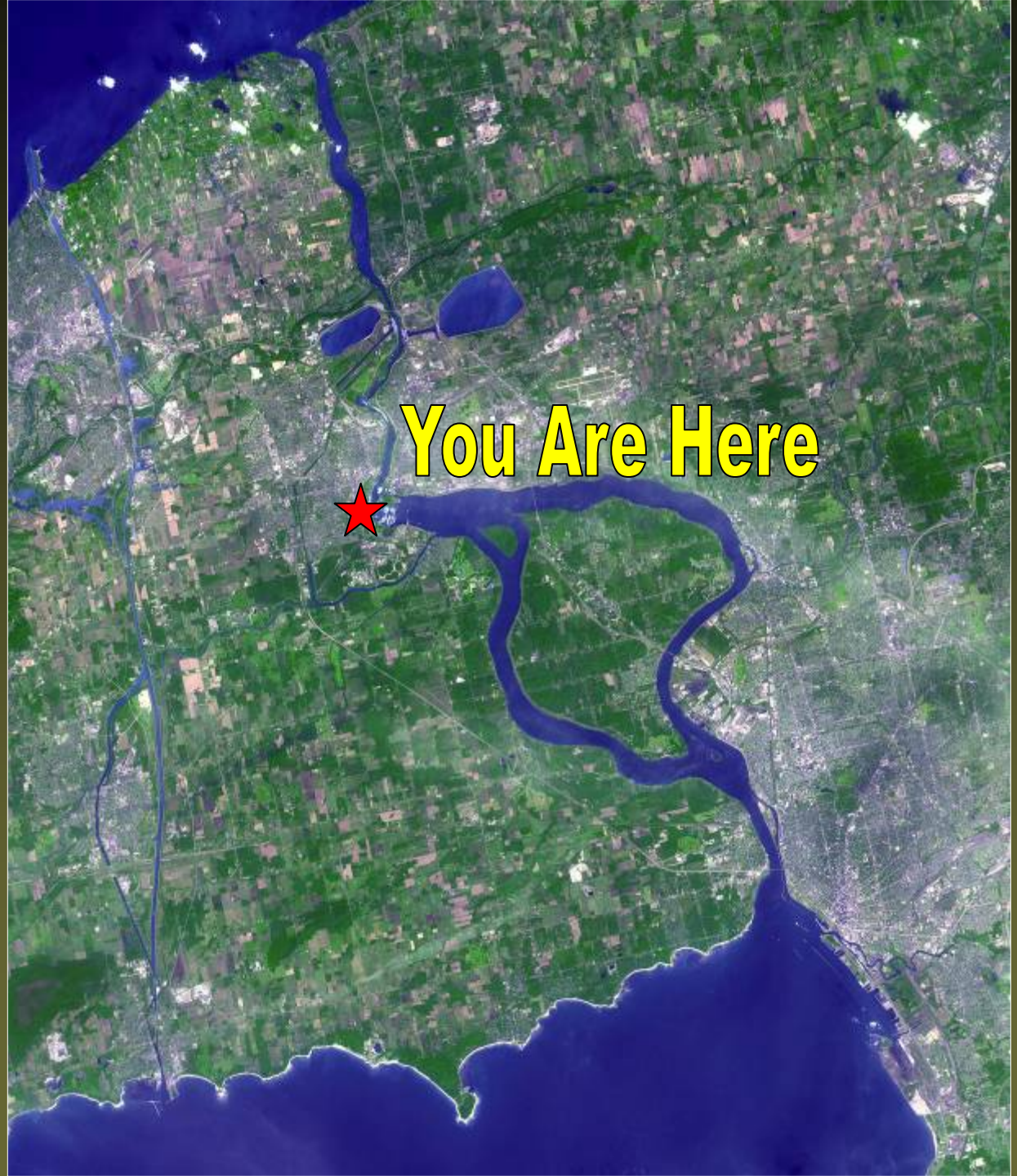
Brad Hill
Environment Canada

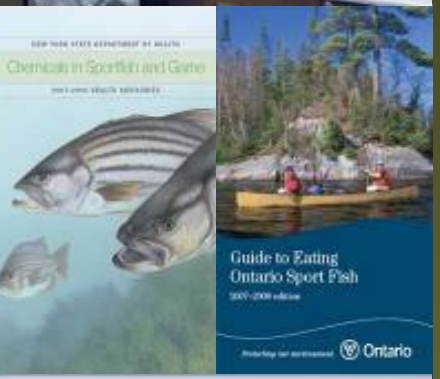

You Are Here

Background

- Created by Wisconsin glaciation, about 10,000 years ago
- Approximately 56 km (35 mi) long
- Peak season flow ~ 5,720 m^3/s (200,000 ft^3/s)
- Total drainage area ~ 684,000 sq km (264,000 sq mi)
- Empties approx. 2/5^{ths} of the fresh water in North America
- Currently divert 50% - 75% of flow for power generation

Historical Context

- 1950s: IJC reports on pollution problems
- 1973: IJC designates Niagara River as “Problem Area”
- Late 1970s: Love Canal
- 1980 & 1981: Canada/Ontario Review Board Baseline Reports summarize environmental conditions in the Niagara River
- 1981: IJC Special Report on Pollution of the Niagara River
- 1981 – 1983: Niagara River Toxics Committee report
- 1987: Niagara River Declaration of Intent - NRTMP
- 1996: “Letter of Support”



Programs

- 3 main components:
  - Upstream/Downstream
    - Water and suspended sediment
  - Biomonitoring
    - Mussels and fish
  - Tributary screening & trackdown
    - Sediment investigations in tributaries
- Additional components:
  - Point & Non-point Sources
    - Landfills, STPs, HWS

Objectives

- Establish the existence and relative concentrations of contaminants
- Distinguish between Niagara River contaminant sources and upstream sources
- Identify exceedences to existing criteria
- Examine long term trends
- Quantify loadings to Lake Ontario
- Measure concentrations in fish, mussels and other wildlife

1,3-Dichlorobenzene	1,4-Dichlorobenzene	1,2-Dichlorobenzene
1,3,5-Trichlorobenzene	1,2,4-Trichlorobenzene	1,2,3-Trichlorobenzene
1,2,3,4-Tetrachlorobenzene	Pentachlorobenzene	Hexachlorobenzene
Hexachlorobutadiene	Hexachlorocyclopetadiene	Heptachlor
Aldrin	Octachlorosytrene	p,p'-DDE
p,p'-DDD	o,p'-DDT	p,p'-DDT
DDT Total	Photomirex	Mirex
α-BHC	γ-BHC	Heptachlor Epoxide
Total Chlordane	α-Endosulfan	β-Endosulfan
Dieldrin	Endrin	Endrin Aldehyde
Methoxychlor	TCPCB	2-Methyl Naphthalene
1-Methyl Naphthalene	Naphthalene	Acenaphthylene
Fluorene	Phenanthrene	Anthracene
Beta-Chloronaphthalene	Atrazine	Metolachlor
Fluoranthene	Pyrene	Benz(a)anthracene
Chrysene/Triphenylene	Benzo(b+k)fluoranthene	Benzo(a)pyrene
Indeno(1,2,3-c,d)pyrene	Dibenzo(a,h)anthracene	Benzo(g,h,i)perylene
Aluminum	Antimony	Arsenic
Barium	Boron	Beryllium
Cadmium	Cobalt	Chromium
Copper	Gallium	Lanthanum
Iron	Lithium	Manganese
Molybdenum	Nickel	Lead
Rubidium	Selenium	Silver
Strontium	Tellurium	Uranium
Vanadium	Zinc	Mercury

Hexachlorobenzene

p,p'-DDE
p,p'-DDT
DDT Total
Mirex

Total Chlordane
Dieldrin

TCPCB

Benz(a)anthracene
Chrysene/Triphenylene
Benzo(b+k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-c,d)pyrene
Benzo(g,h,i)perylene
Aluminum

Iron

Mercury

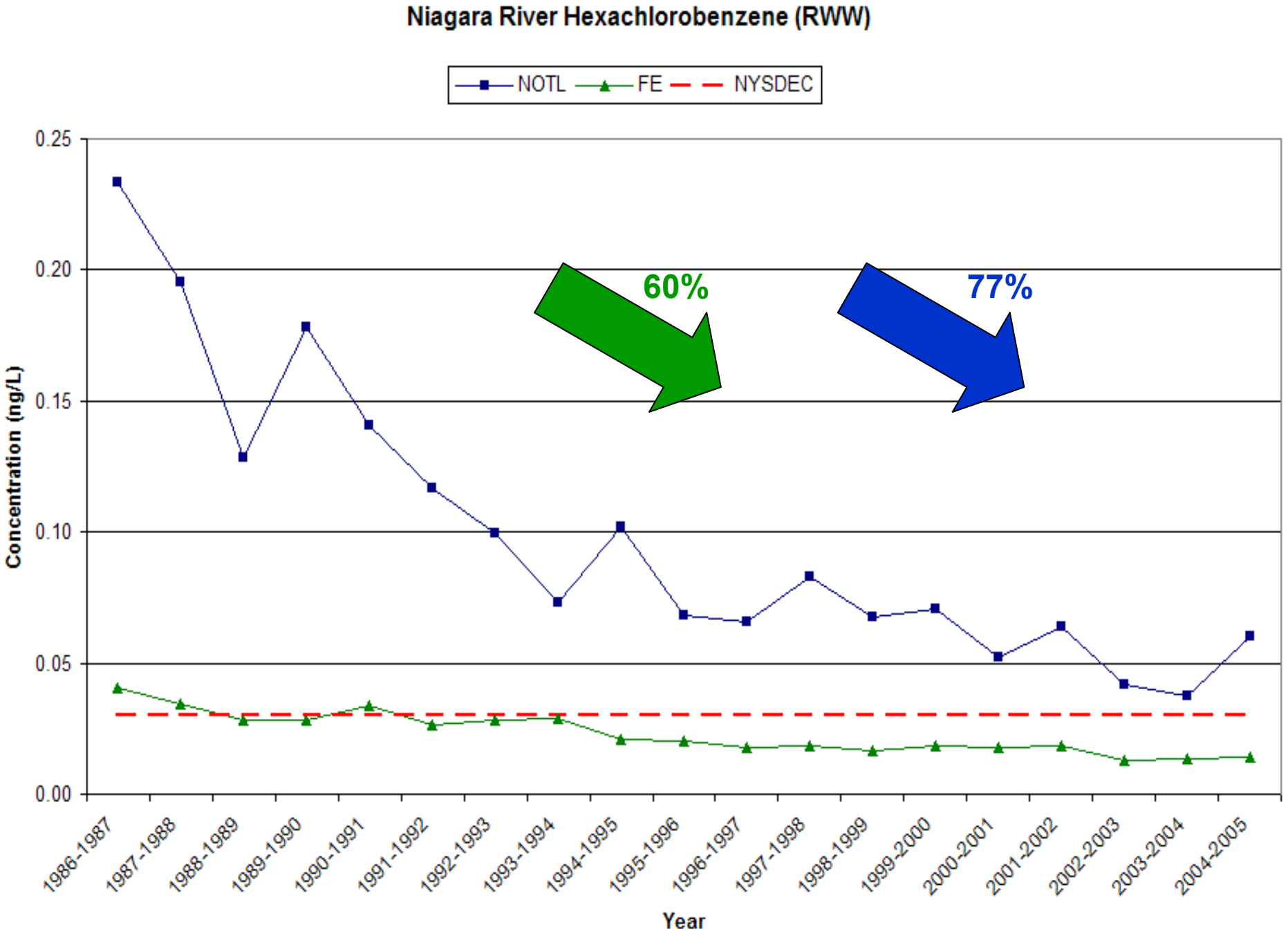
Hexachlorobenzene

Mirex

Chrysene/Triphenylene

Benzo(a)pyrene

Iron


Niagara River Hexachlorobenzene (RWW)
NOTL
FE
NYSDEC
60%
77%
Concentration (ng/L)
0.25
0.20
0.15
0.10
0.05
0.00
1986-1987
1987-1988
1988-1989
1989-1990
1990-1991
1991-1992
1992-1993
1993-1994
1994-1995
1995-1996
1996-1997
1997-1998
1998-1999
1999-2000
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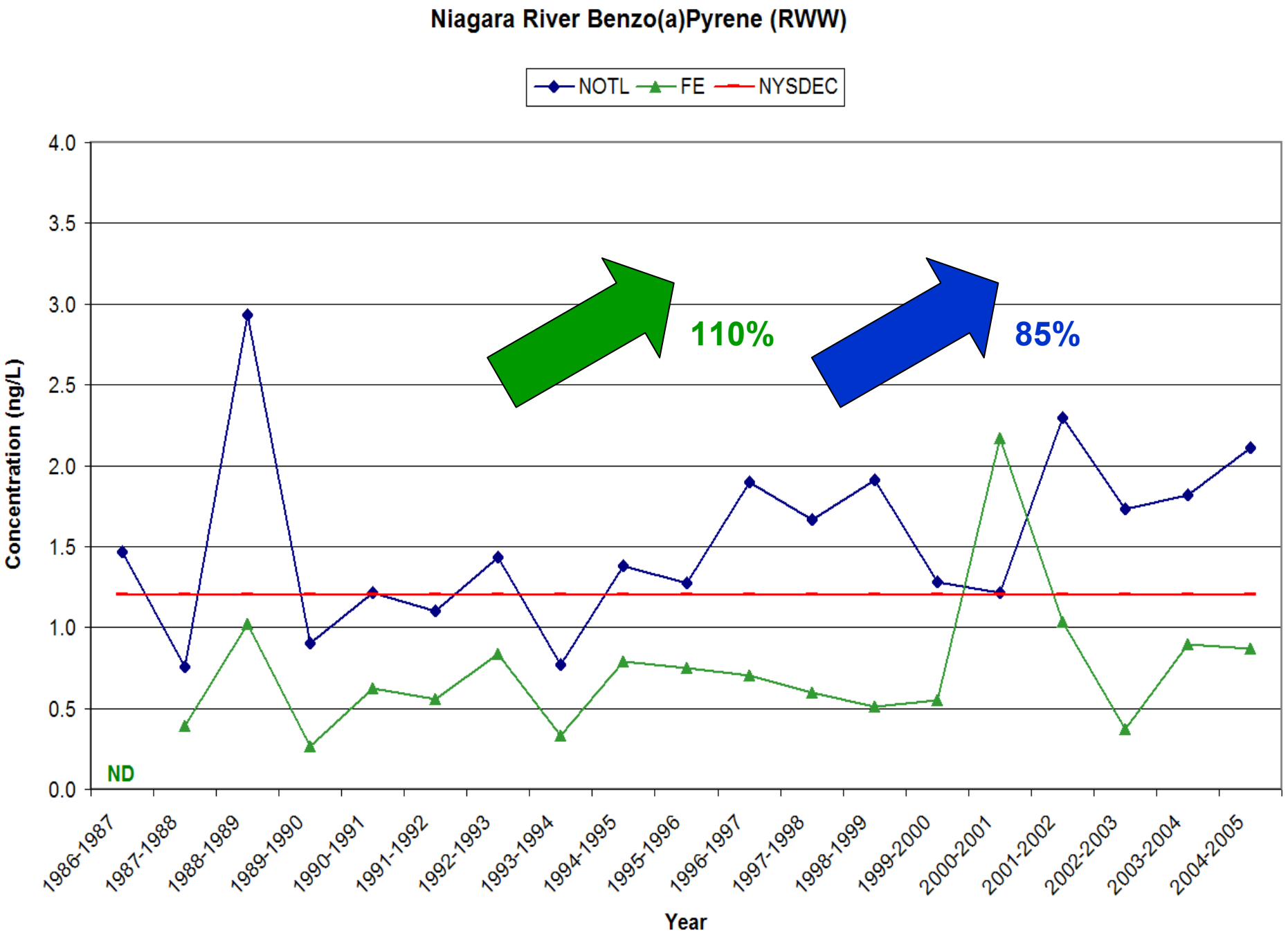
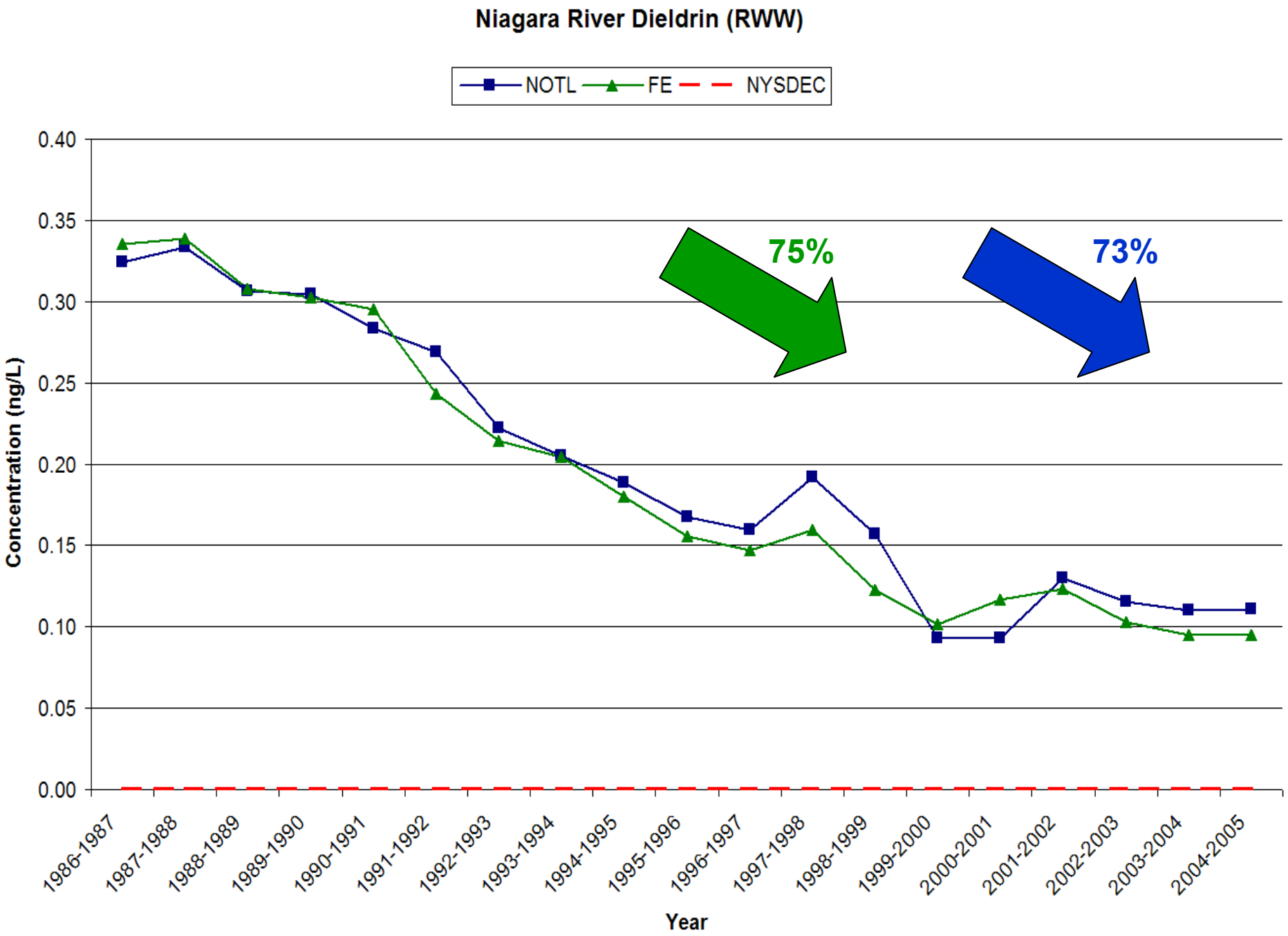
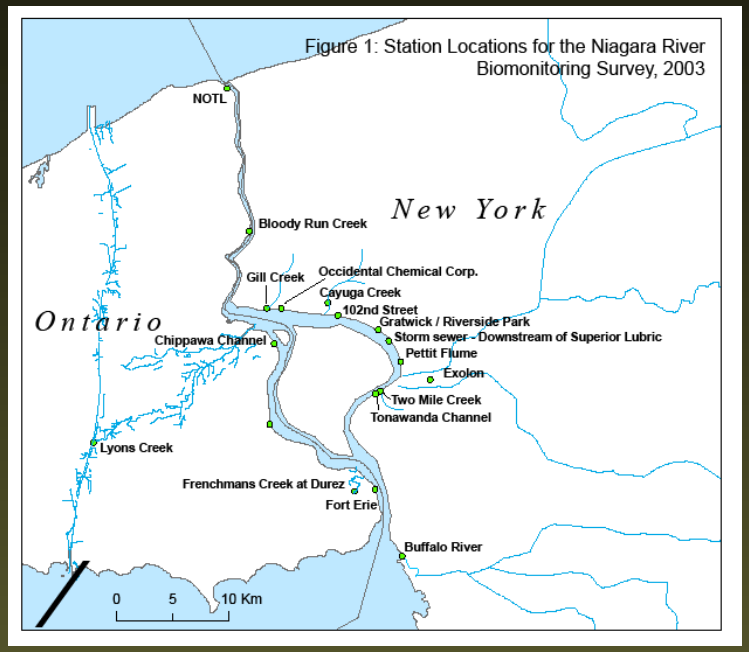
2001-2002
2002-2003
2003-2004
2004-2005
Year


Niagara River Benzo(a)Pyrene (RWW)
NOTL
FE
NYSDEC
110%
85%
ND
Concentration (ng/L)
Year
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1986-1987
1987-1988
1988-1989
1989-1990
1990-1991
1991-1992
1992-1993
1993-1994
1994-1995
1995-1996
1996-1997
1997-1998
1998-1999
1999-2000
2000-2001
2001-2002
2002-2003
2003-2004
2004-2005


Niagara River Dieldrin (RWW)
NOTL
FE
NYSDEC
75%
73%
Concentration (ng/L)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1986-1987
1987-1988
1988-1989
1989-1990
1990-1991
1991-1992
1992-1993
1993-1994
1994-1995
1995-1996
1996-1997
1997-1998
1998-1999
1999-2000
2000-2001
2001-2002
2002-2003
2003-2004
2004-2005
Year

Biomonitoring

- Contaminant sources within the River as well as basin-wide
- Potential watershed sources for:
  - HCB, PAHs, Dioxins/Furans
- Wildlife criteria exceedences of:
  - PCB, DDT, Mirex and Photomirex
  - Most likely related to residual sediment contamination
- Fish consumption advisories continue
  - Species and location specific (PCBs, Dioxins/Furans, Mirex, Mercury)
- Total PCBs and total DDT levels are declining
- Mercury was detected at concentrations similar to other sites in the Great Lakes



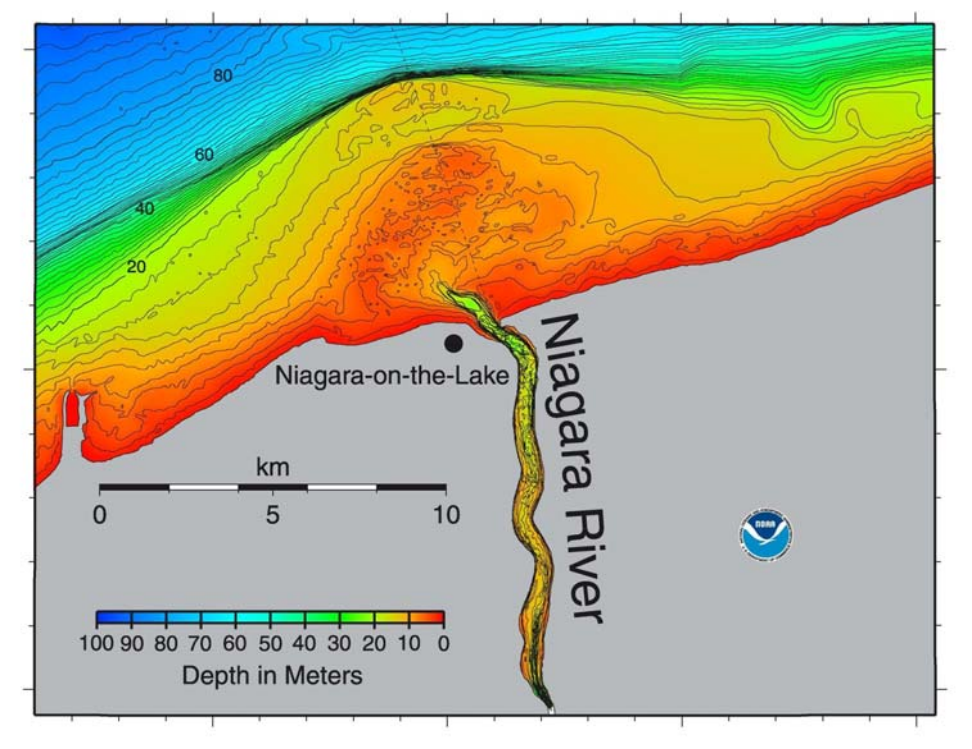
Tributary Screening

- DEC/EPA study of 4 tributaries in 2004
- No “hot spots” found that trigger immediate action
- Certain areas may deserve further attention
  - Guideline exceedences of PCBs, Mercury, Lindane and Zinc
  - Low levels and non-detects validate effectiveness of remediation
- On going monitoring by MOE and assessment by RAP show some tributaries may no longer be sources of contaminants

Monitoring Summary

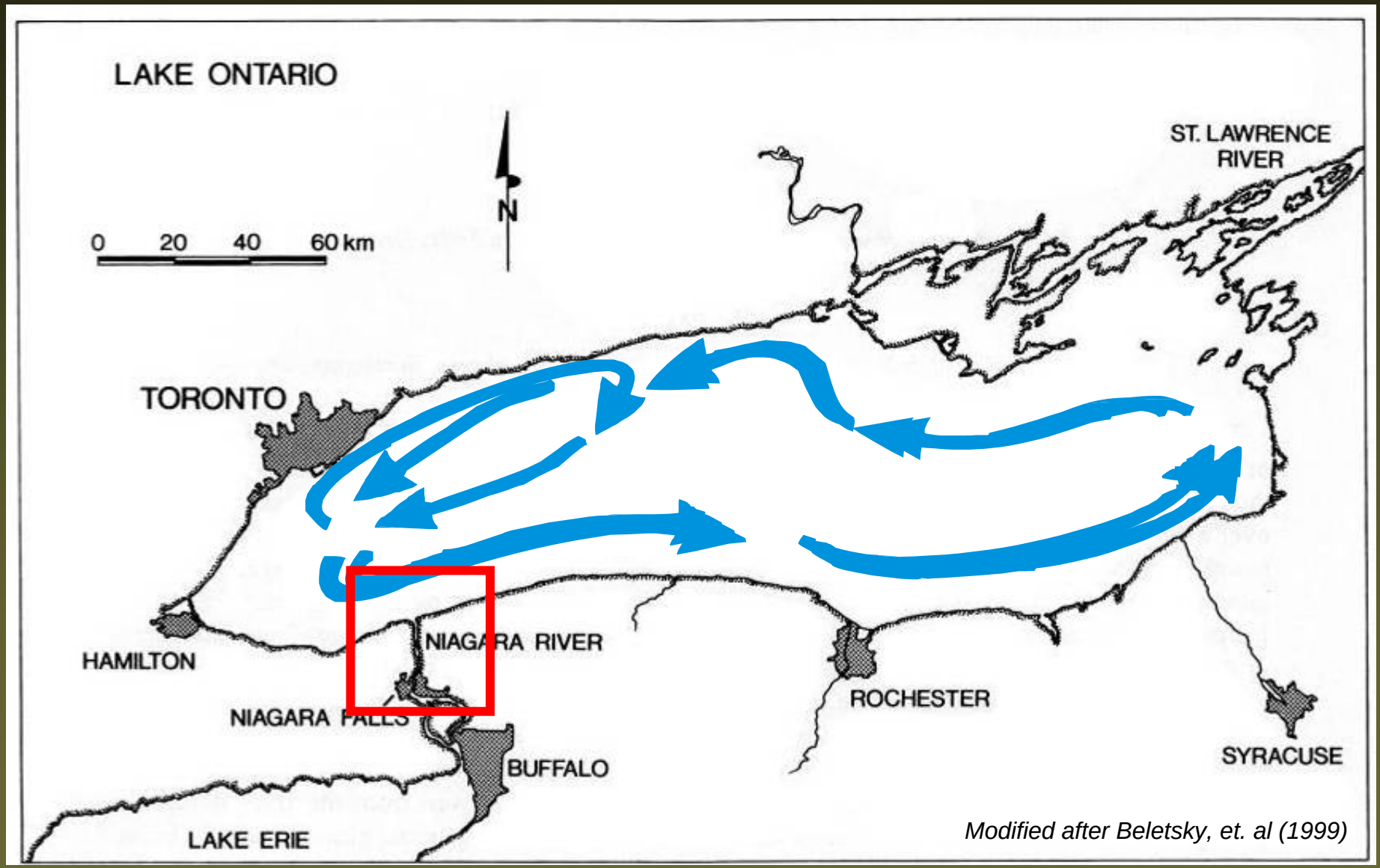
- Significant decreases in concentrations for most compounds between 1986 and 2005
- Some compounds still exceed strictest agency criteria
- Local sources continue to contribute contaminants to the Niagara River
- Upstream and/or basin-wide sources may be more significant for certain chemicals

Niagara's Influence On Lake Ontario

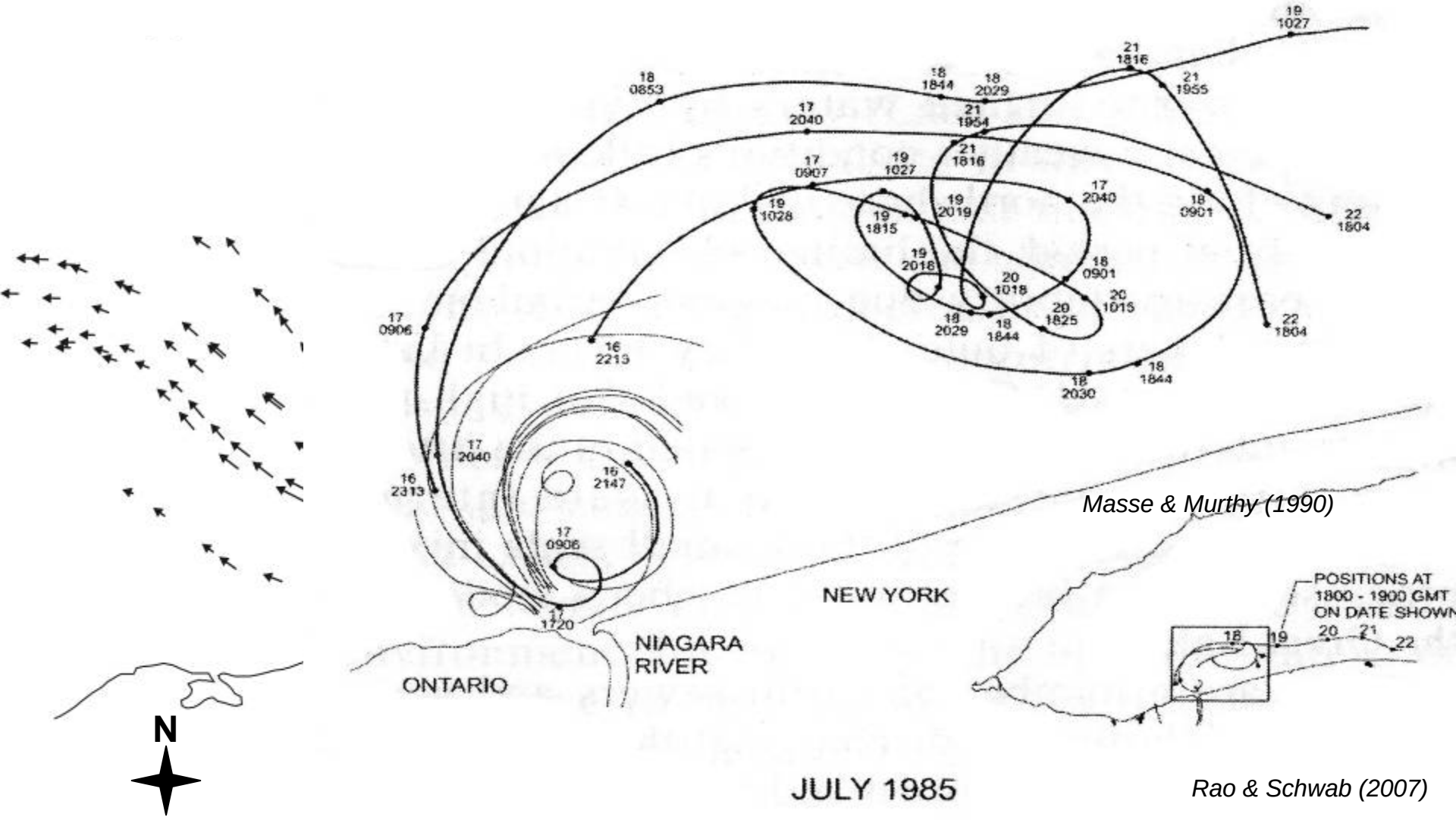


- *>80% input water budget*
- *~50% incoming fine grain sediment*
- *a primary source of contaminants*

Lake Ontario Circulation



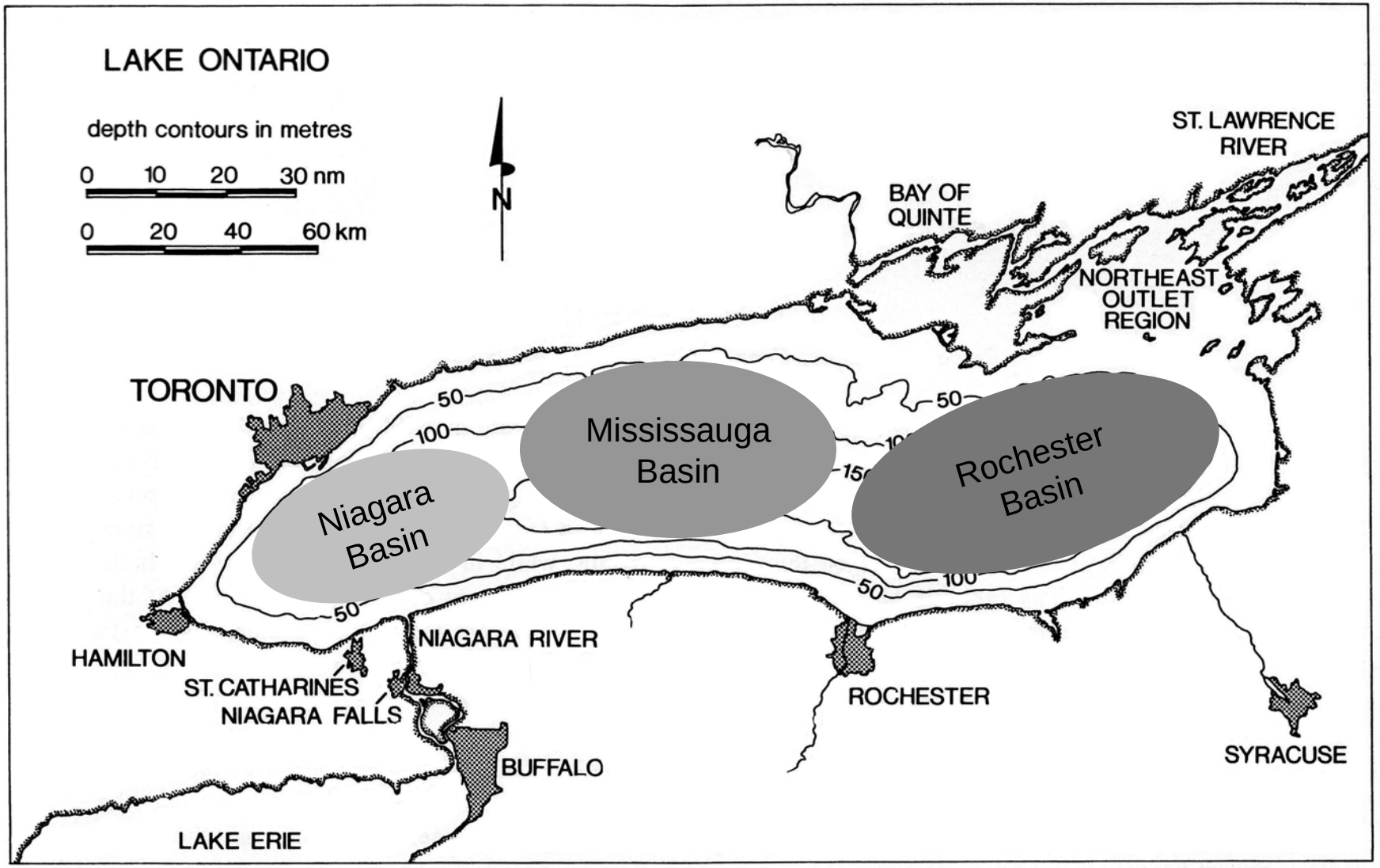
Lake Ontario Circulation



Masse & Murthy (1990)

Rao & Schwab (2007)

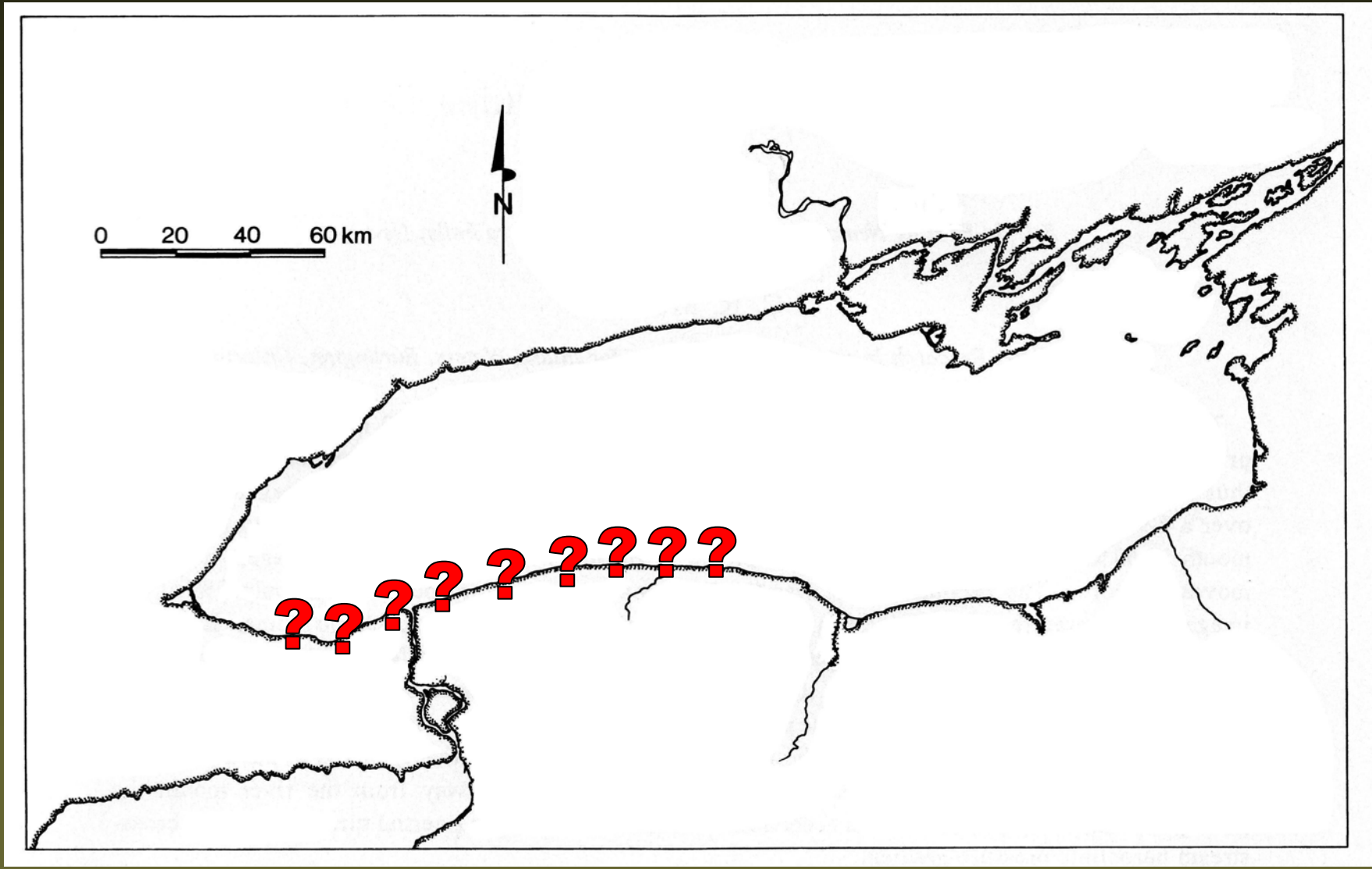
Lake Ontario Bathymetry

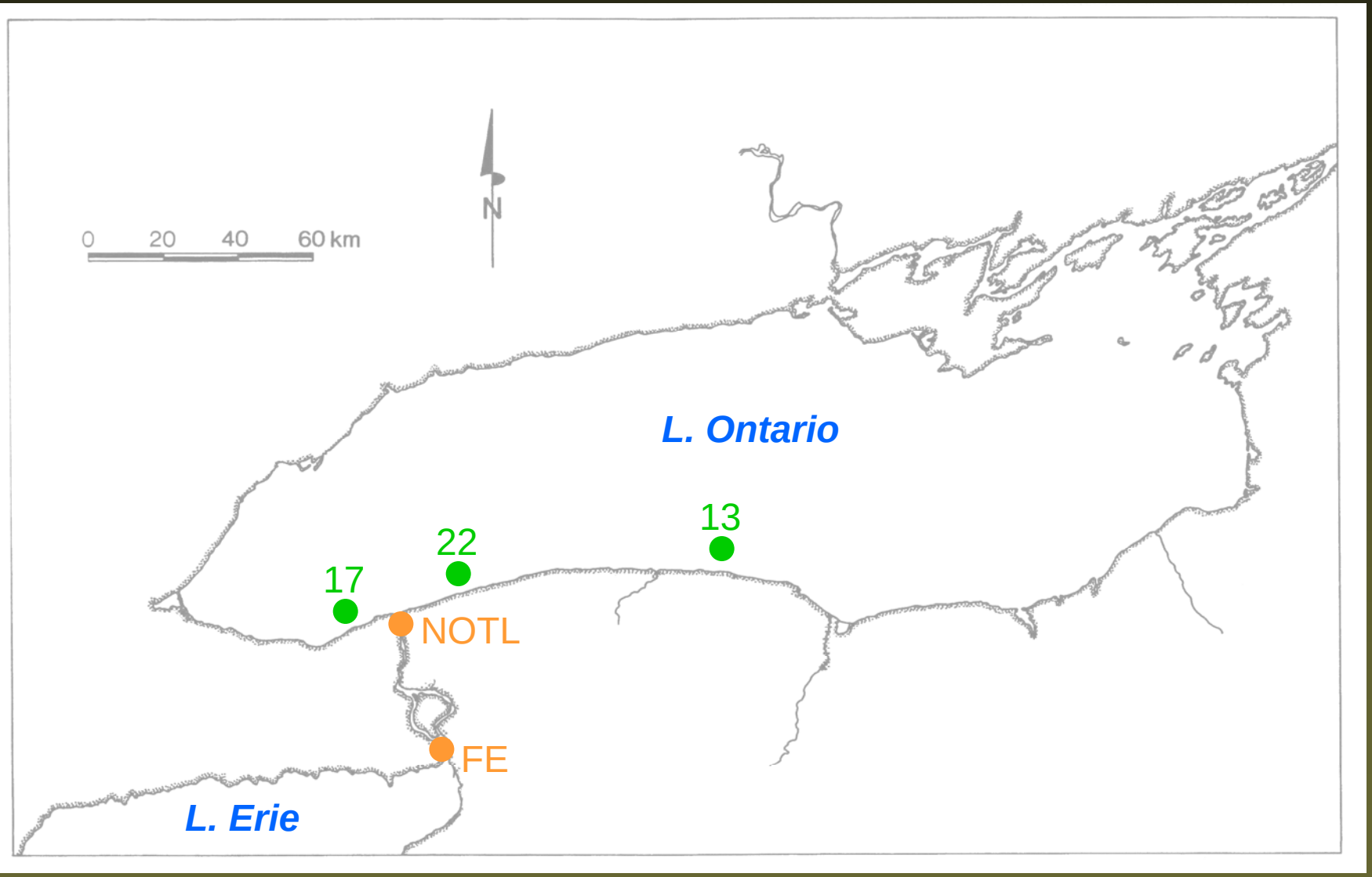


Phase Distribution

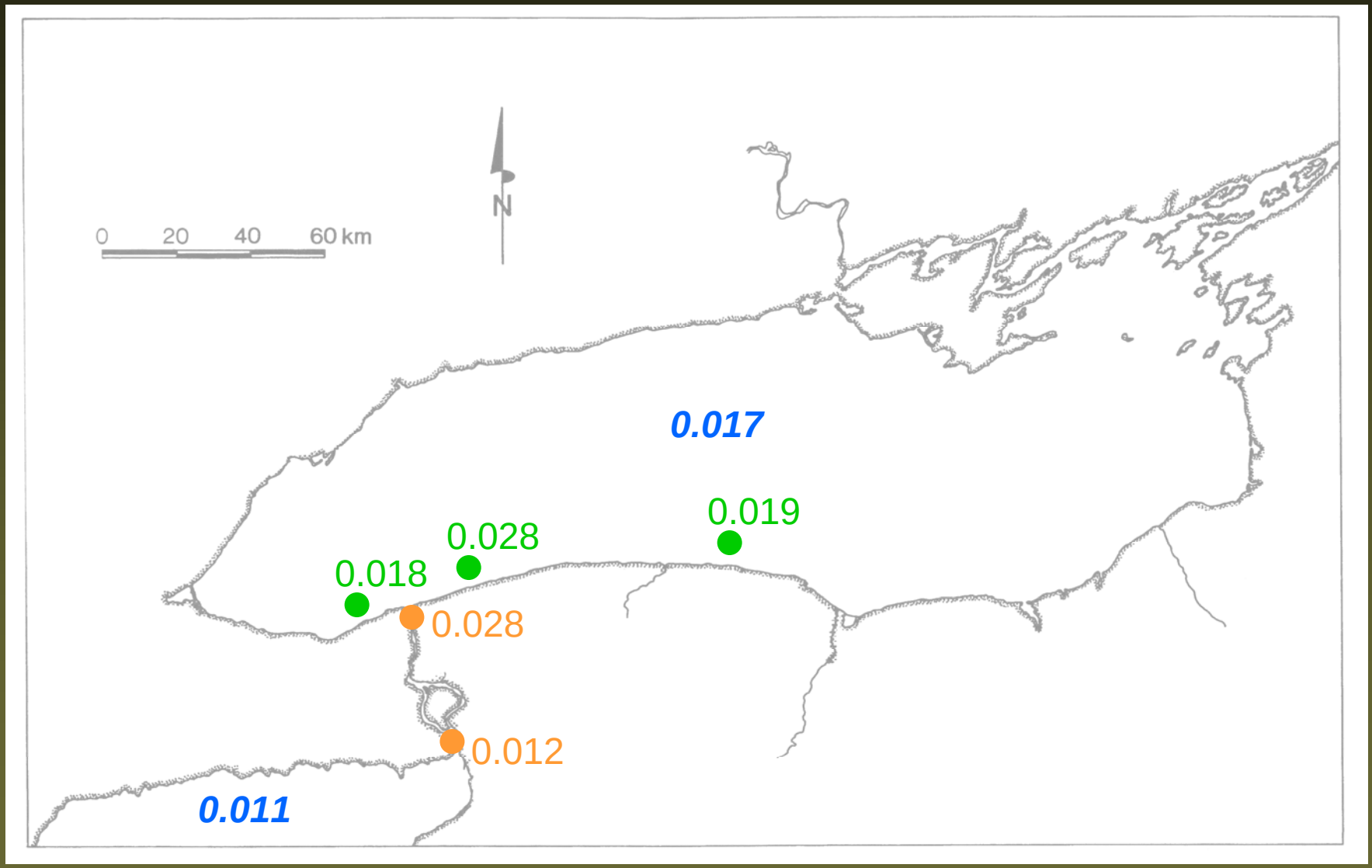
Compound	% in dissolved phase	% in particulate phase
Mirex	0	100
Benzo(a)pyrene	6	94
1,2,4-TCB	90	10
Dieldrin	94	6
1,2,3,4-TTCB	95	5
Atrazine	100	0
Metolachlor	100	0

Current Knowledge

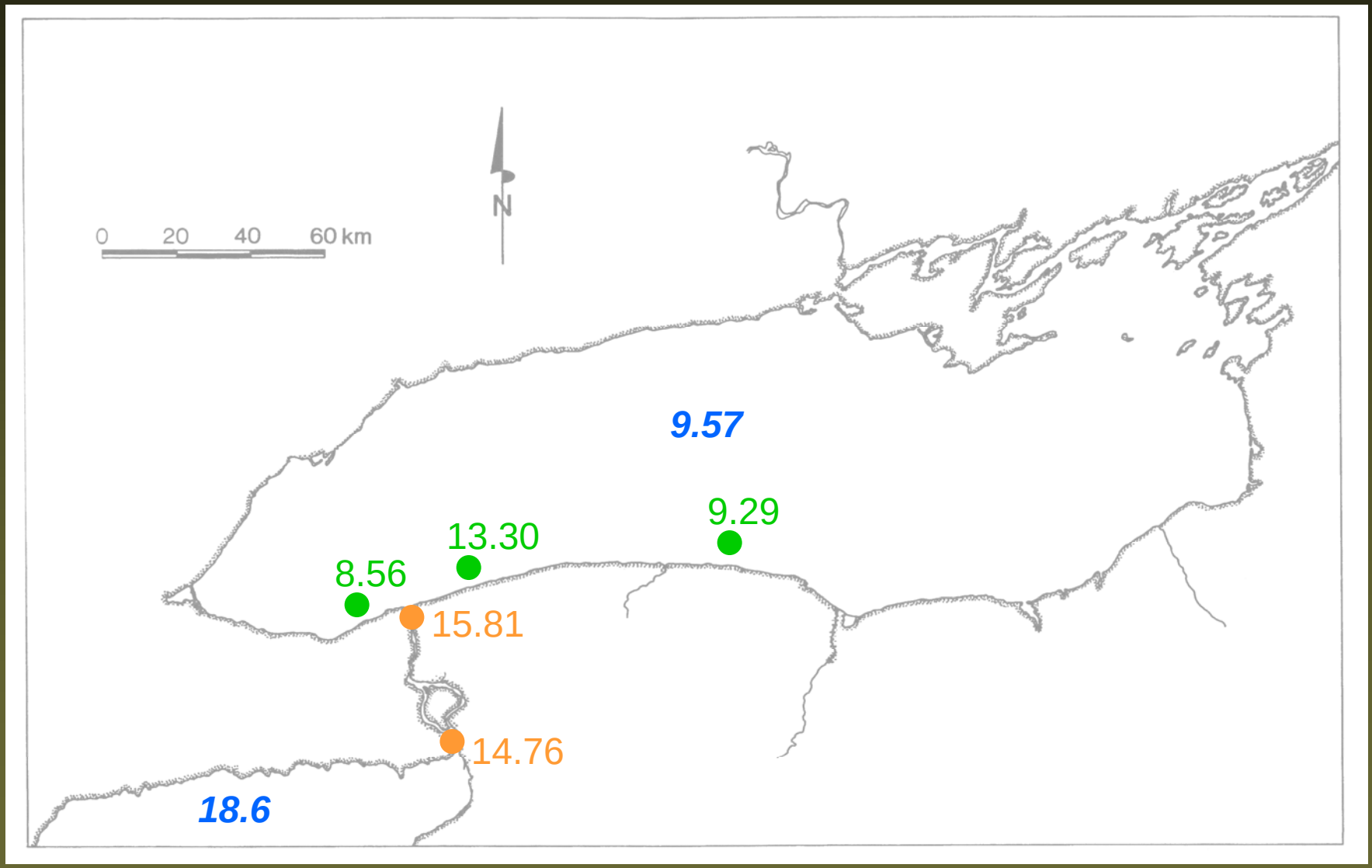



0 20 40 60 km
N
L. Ontario
13
22
17
NOTL
FE
L. Erie

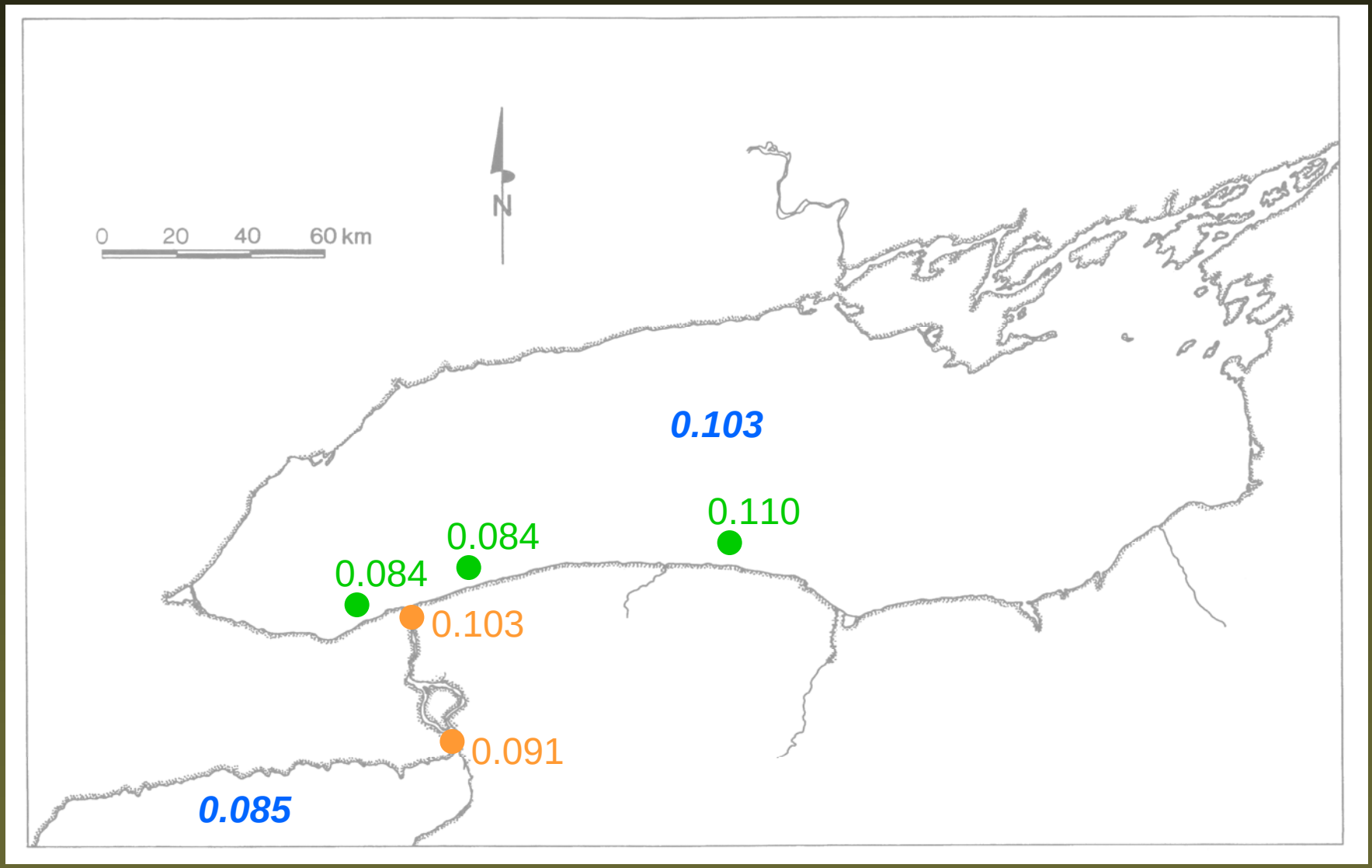
Hexachlorobenzene (ng/L)



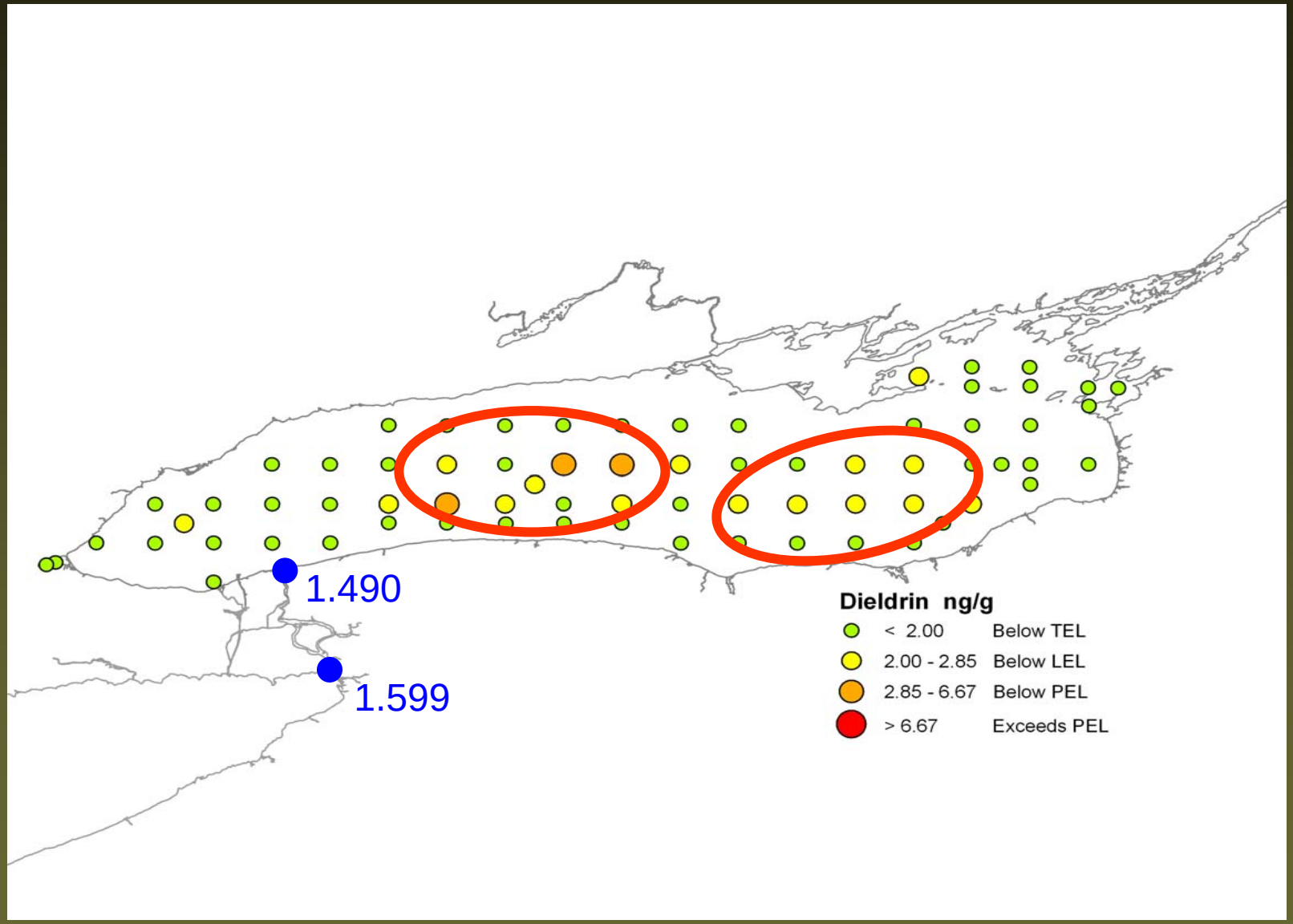
Metolachlor (ng/L)



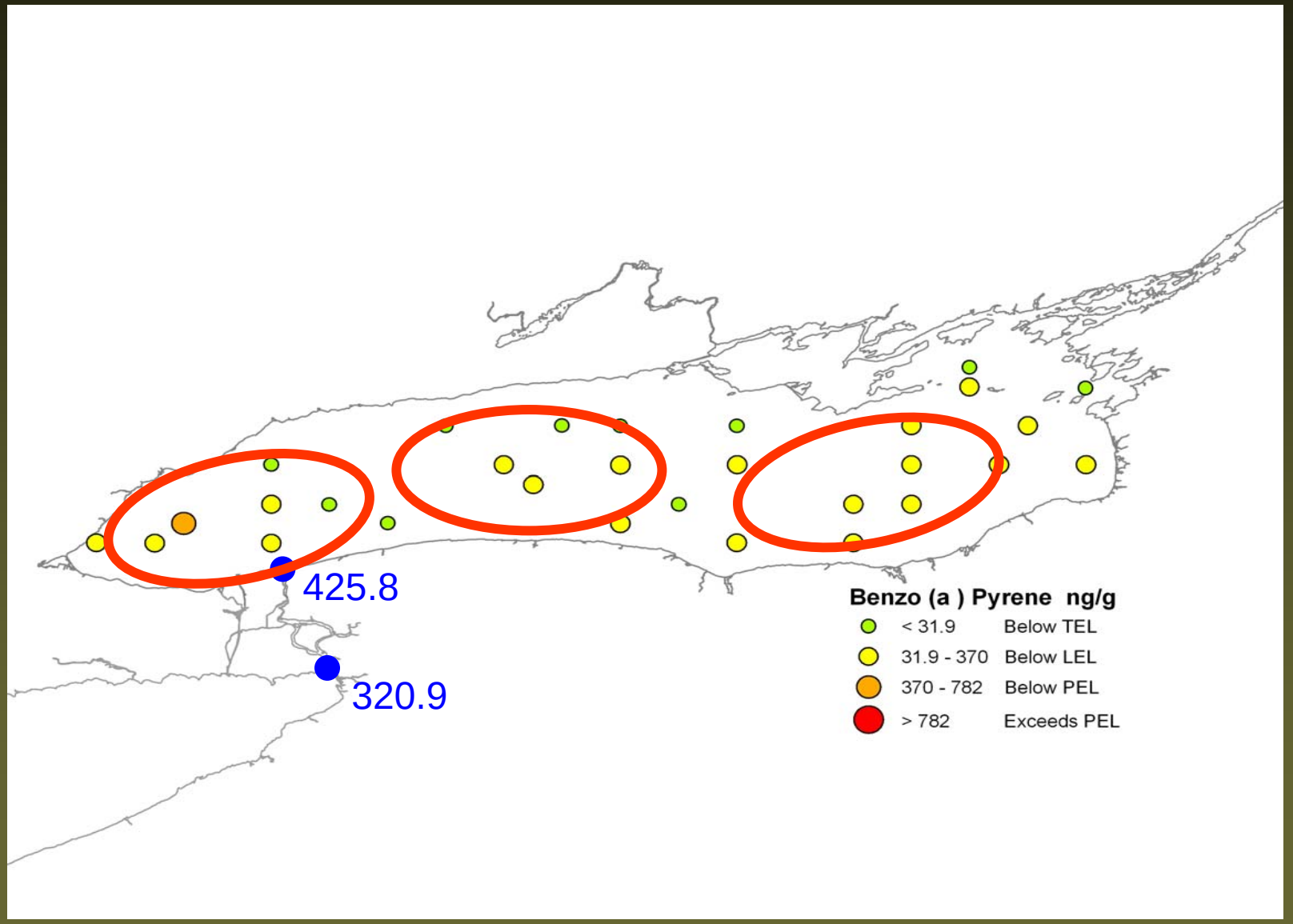
Dieldrin (ng/L)



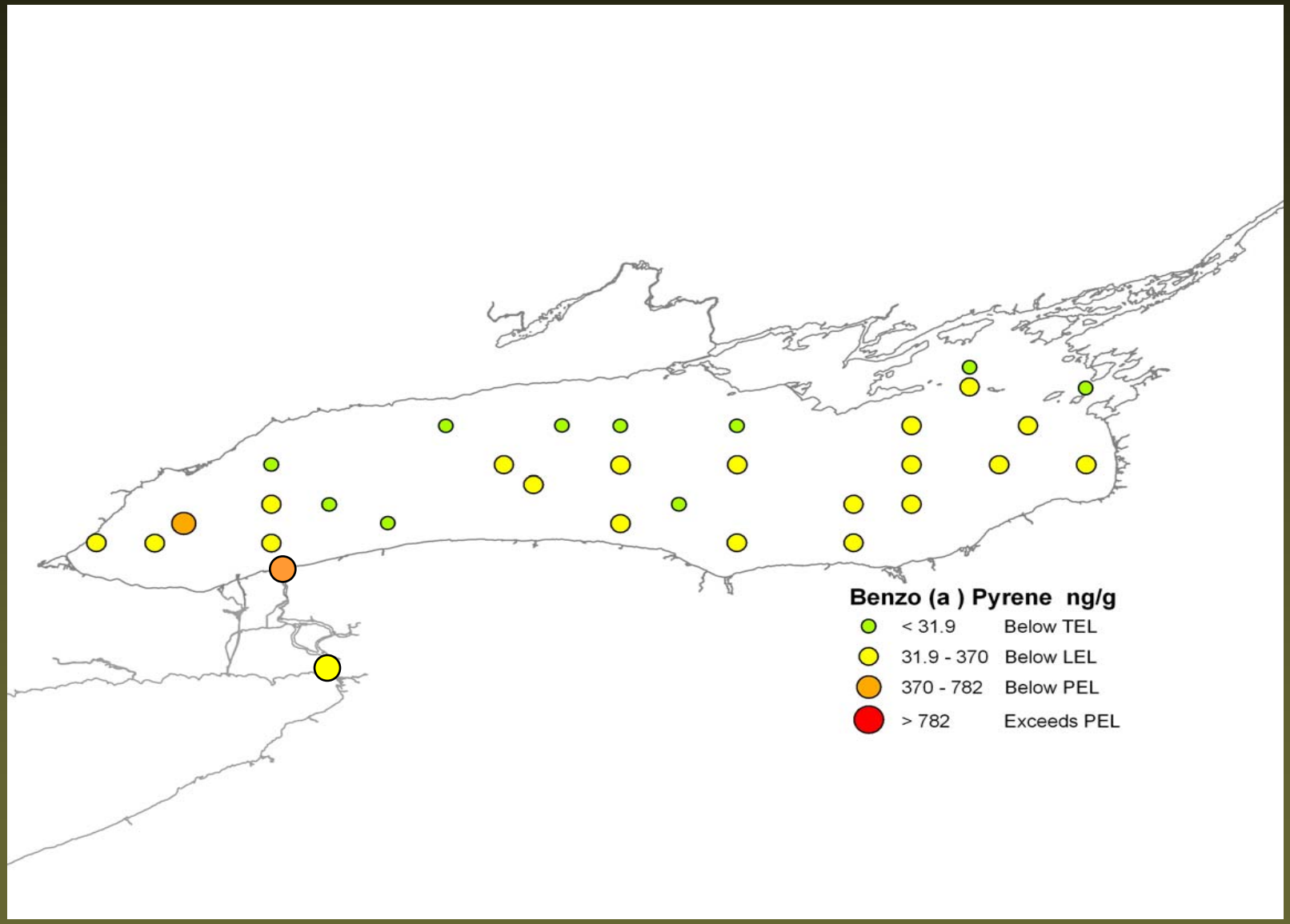
Dieldrin (ng/g)



Benzo(a)pyrene (ng/g)



Benzo(a)pyrene (ng/g)



Conclusions

- Niagara River is the primary source of water and a significant source of fine grain sediment for Lake Ontario
- Niagara River has been significantly impacted by contaminants
- Contamination levels in the Niagara River have been reduced over the past two decades
- There is insufficient data to establish a firm influence of the Niagara River on nearshore contaminant levels
- Dissolved phase contaminants appear to show higher concentrations in the nearshore zone
- Evidence suggests majority of sediment bound contaminants are found in offshore depositional areas

Future Directions

- More analysis with existing data sources
- Nearshore monitoring
- Current suite of compounds
- New & emerging compounds
- Future of the NRTMP

Acknowledgements

- Water Quality Monitoring & Surveillance
- EC, OMOE, NYSDEC, USEPA, DFO
- Niagara River Secretariat
- River Monitoring Committee