

Road Salt Pollution of Surface and Groundwater Resources in the Adirondacks

Dan Kelting
dkelting@paulsmiths.edu



PAUL SMITH'S
COLLEGE



ADIRONDACK
WATERSHED INSTITUTE
PAUL SMITH'S COLLEGE

Black River Watershed Management Plan

Stakeholder Outreach Meetings (July 2008) Environment Focus Group

What investment is needed to address environmental concerns in the region?

- 1) Inter-municipal cooperation for planning
- 2) Need better capacity to serve on boards
- 3) Improved road salting process and education

From report prepared by Bergmann Associates

Take Home Messages

- We use too much salt
- Resulted in:
 - Regional salinization of surface & groundwater
 - Impacts to ecosystems, human health, & property values
- If we care we need to act



Salinization - What Is Road Salt?



- Mineral = Halite
- Chemical = Sodium Chloride

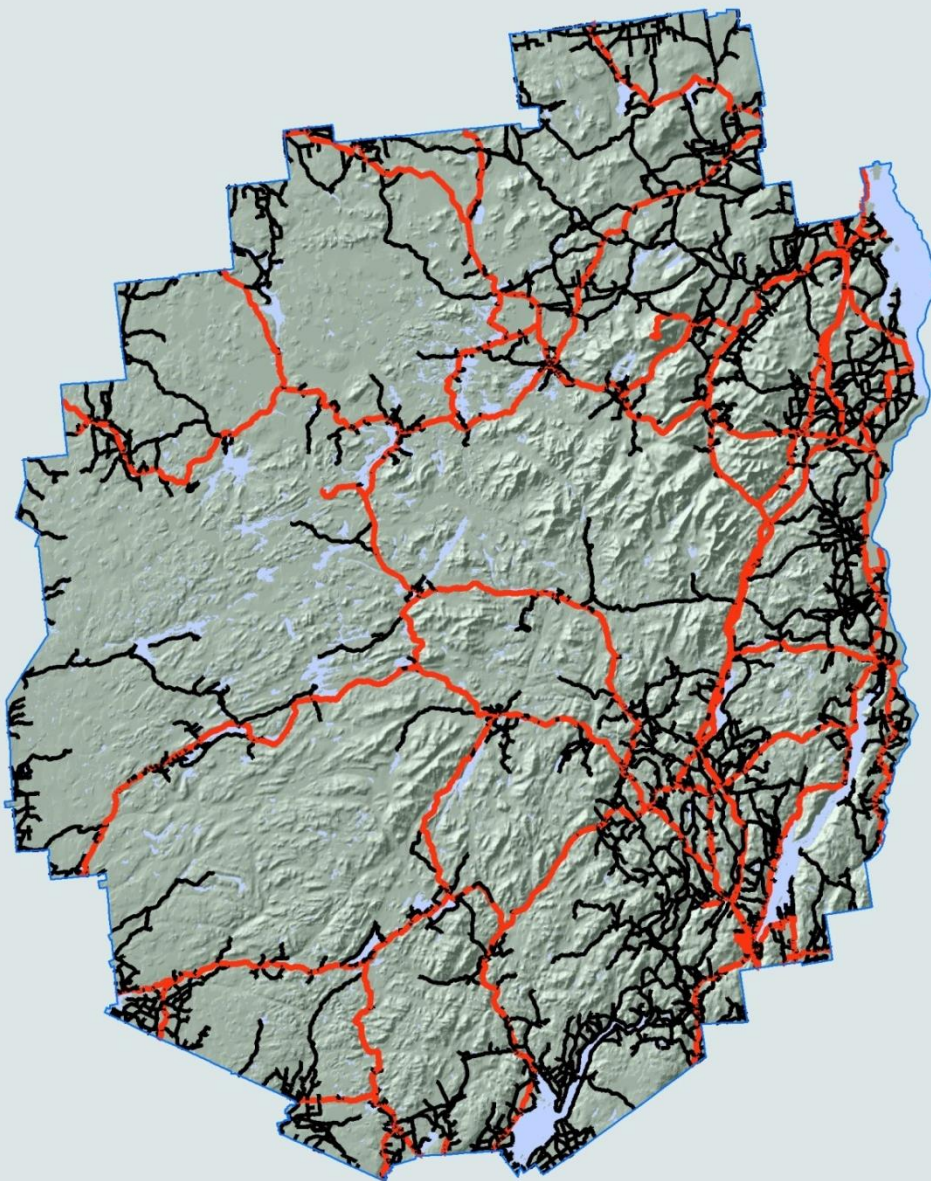
“Cheap” and “Effective”

NaCl

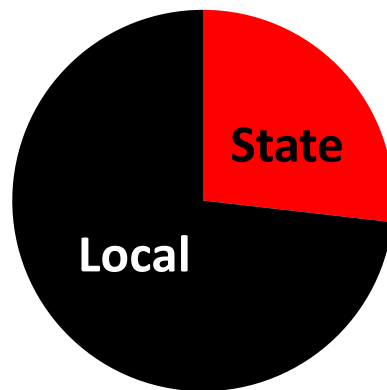


+ Ice/Snow =
 $\text{Na}^+ + \text{Cl}^- + \text{Water}$

Road Salt (NaCl) Use in the Adirondacks

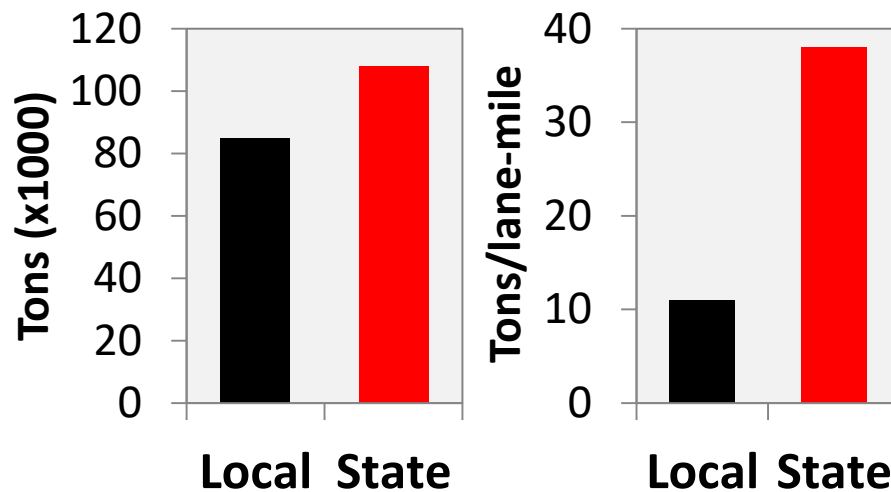


10,555 lane-miles of paved roads



- 2,830 lane-mile State & US highways Interstate 87
- 7,725 lane-miles County, Town, & Local Roads

Annual Salt Use (192,700 tons)



- State uses 2.5× more salt per lane-mile

Salinization Begins with Runoff

State Route 30


70 Tons Per Year

Runoff Event

March 12, 2015

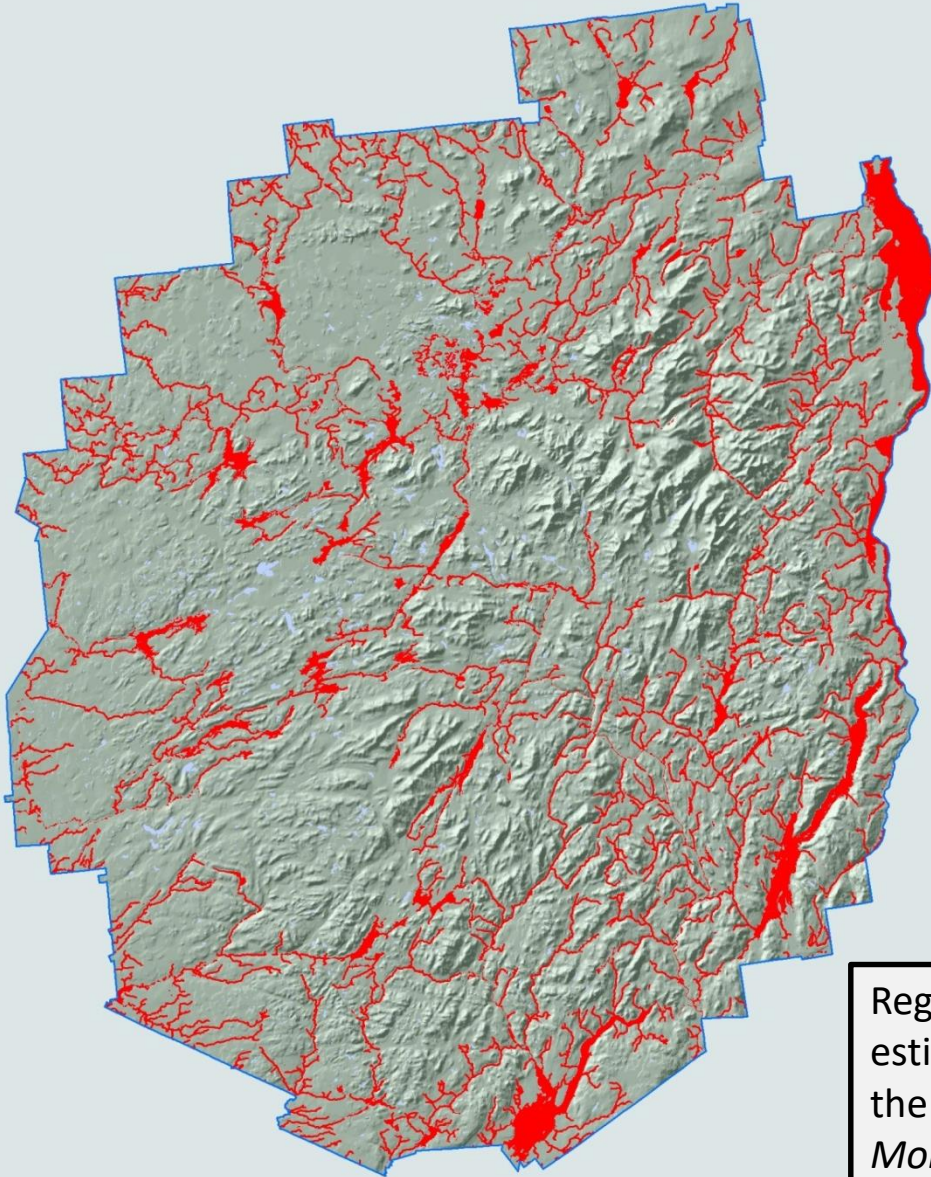
6,937,200 Tons of NaCl since 1980

192,700 Tons of NaCl Runoff per Year



Hayes Brook
Truck Trail

Streams & Lakes Impacted



- GIS-based road runoff model using topography
- 6,000 miles of **streams**
 - 52% of total length
- 195,000 acres of **lakes**
 - 77% of total acres
 - 820 waterbodies

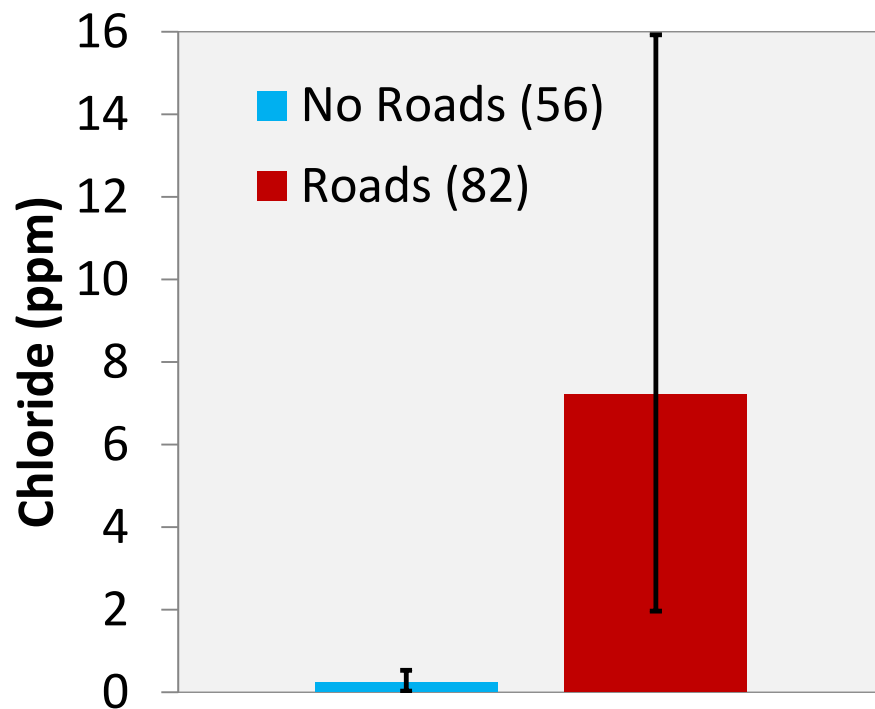
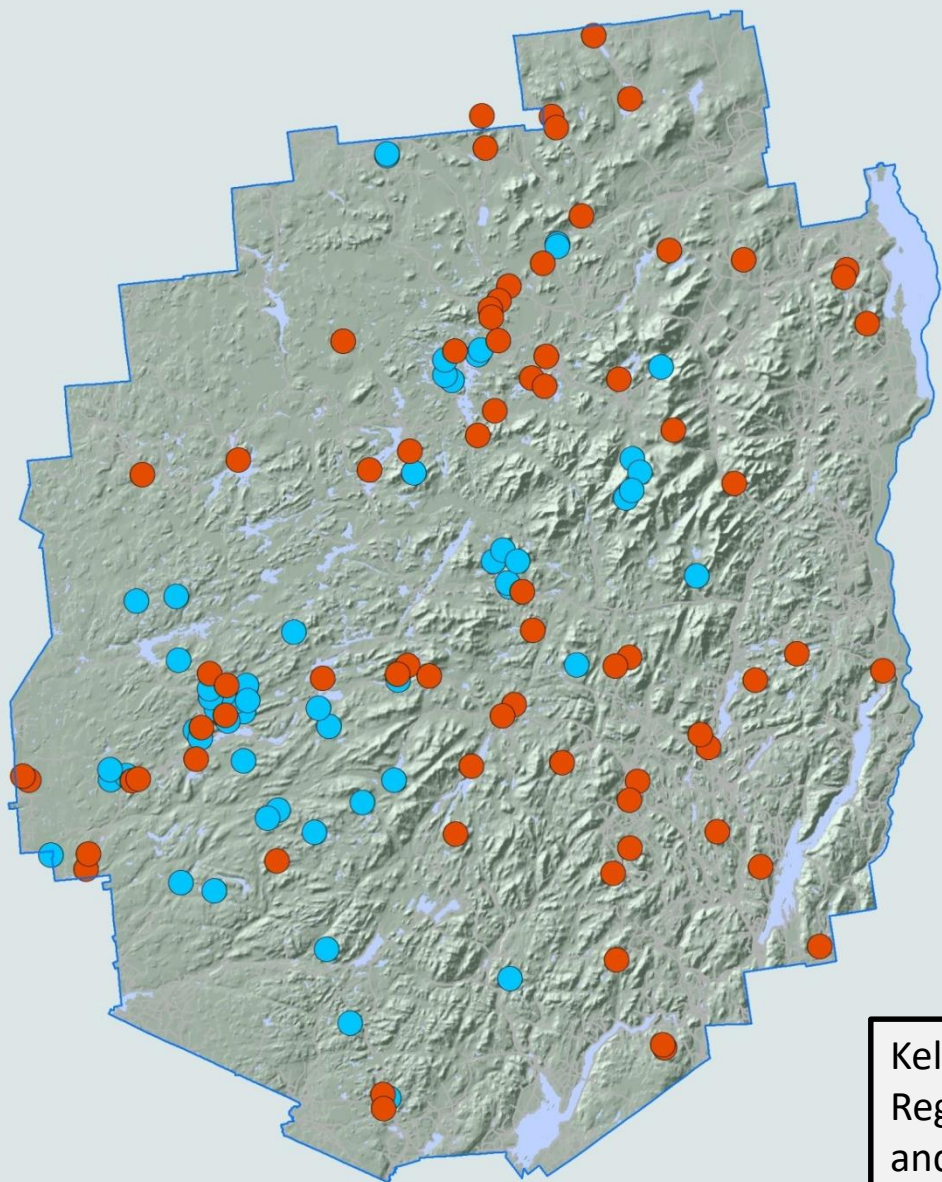
Potential Regional Salinization

Regalado, S. A., & Kelting, D. L. (2015). Landscape level estimate of lands and waters impacted by road runoff in the Adirondack Park of New York State. *Environmental Monitoring and Assessment*, 187(8), 1-15.

What About Lakes?



Median Lake Chloride



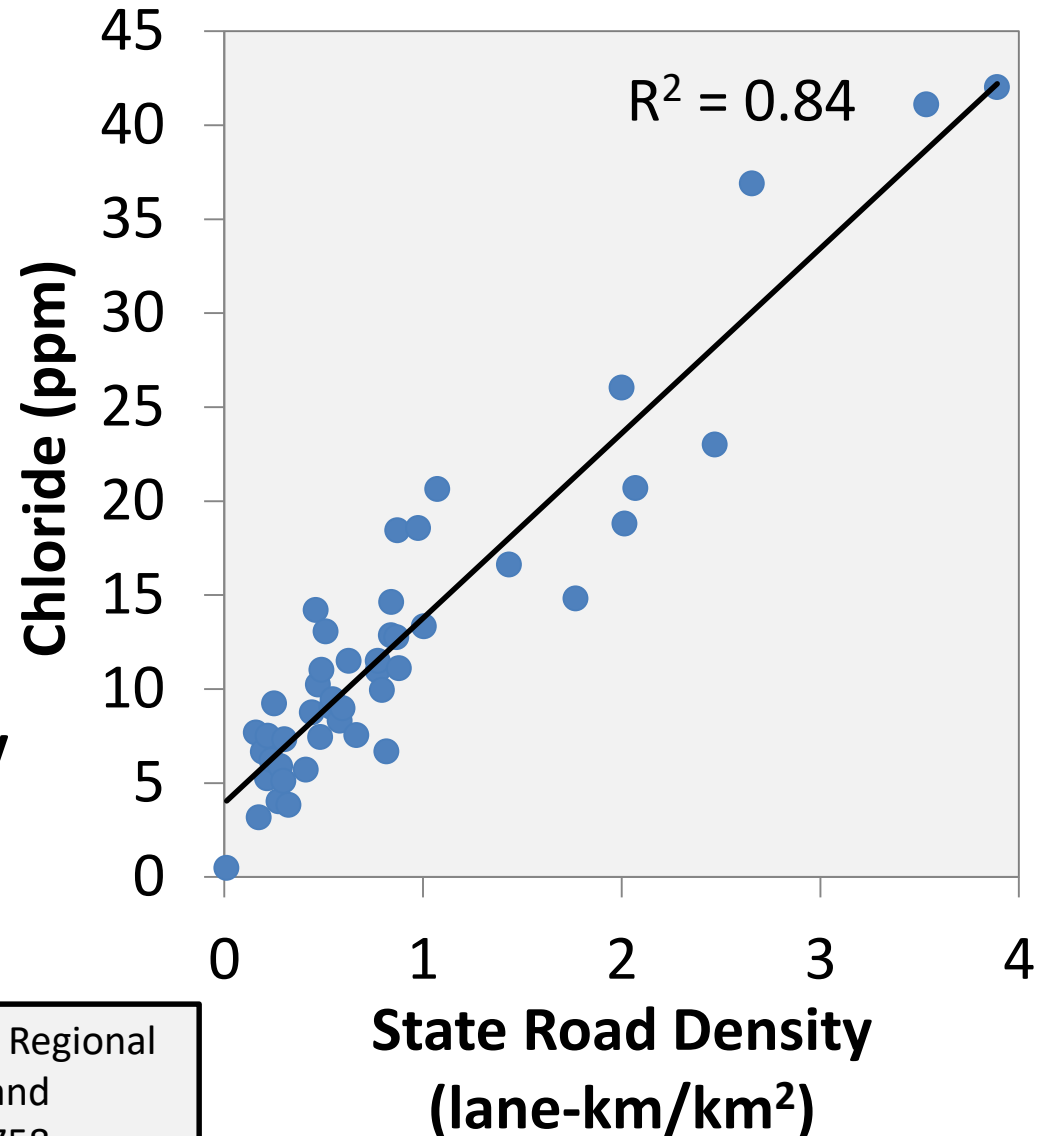
- <0.5ppm w/**no roads**
- 14× higher w/**roads**

Regional Salinization

Kelting, D. L., Laxson, C. L., & Yerger, E. C. (2012). Regional analysis of the effect of paved roads on sodium and chloride in lakes. *Water Research*, 46(8), 2749-2758.

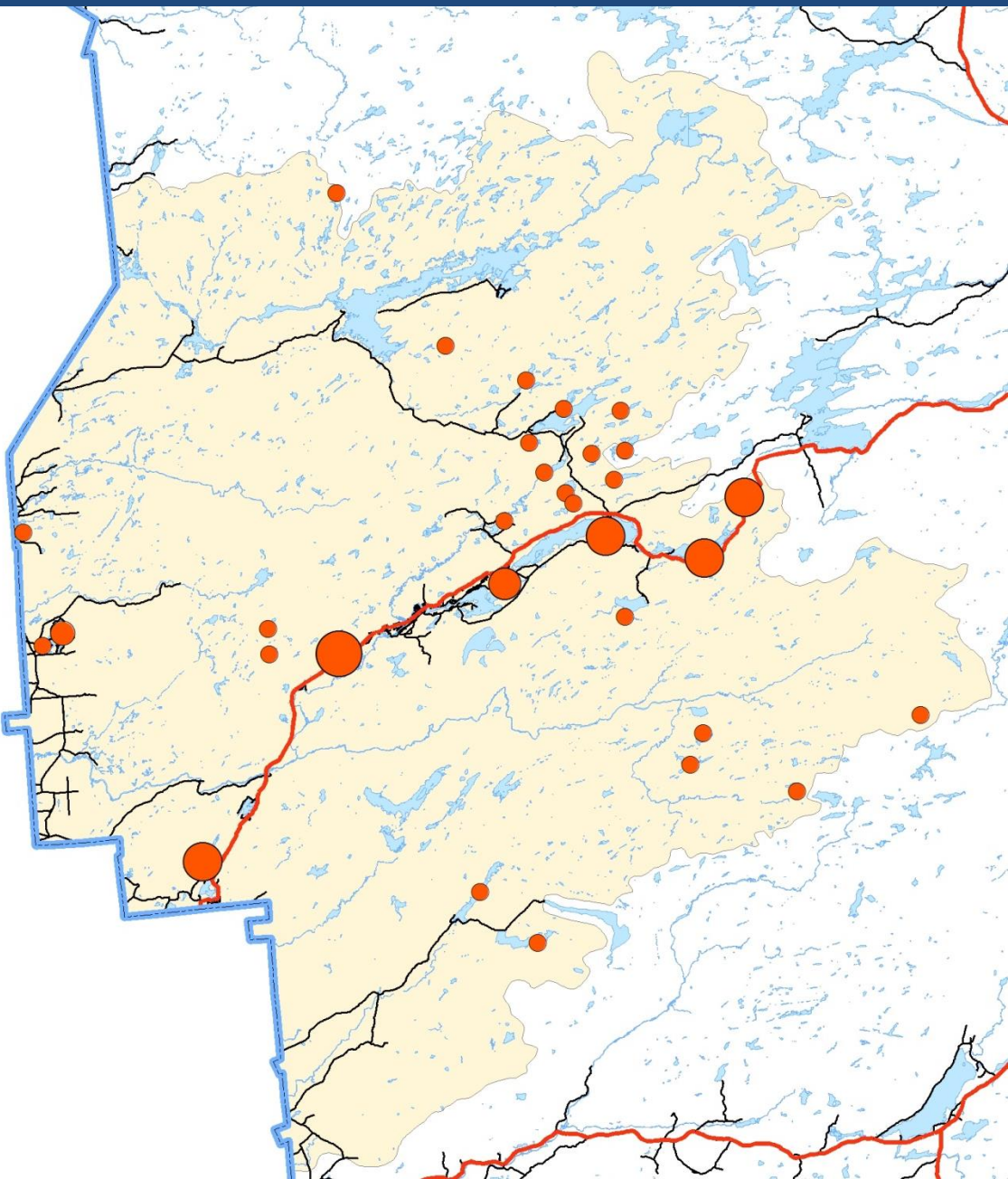
Lake Chloride and State Road Density

- State road density explained 84% of the variation in Cl
- Higher state road density equals higher salt load
- No relationship between local road density and Cl
- **Regional salinization is largely from state roads (NYS DOT)**



Kelting, D. L., Laxson, C. L., & Yerger, E. C. (2012). Regional analysis of the effect of paved roads on sodium and chloride in lakes. *Water Research*, 46(8), 2749-2758.

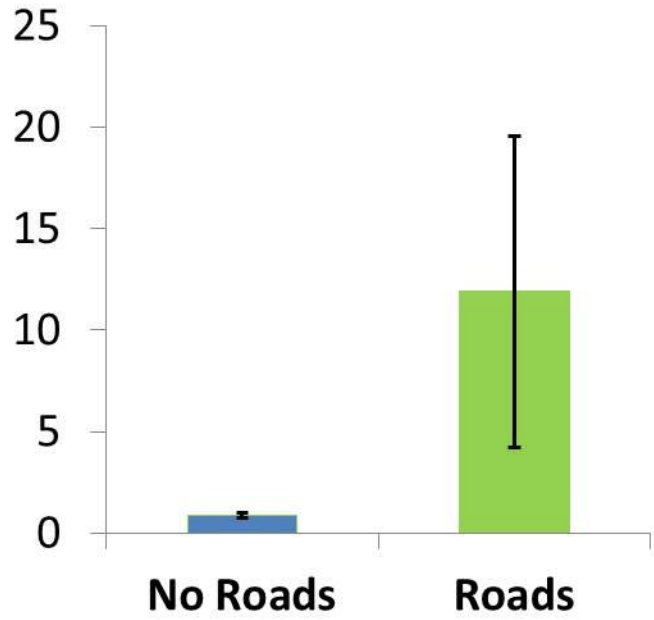
Chloride in BR Watershed Lakes



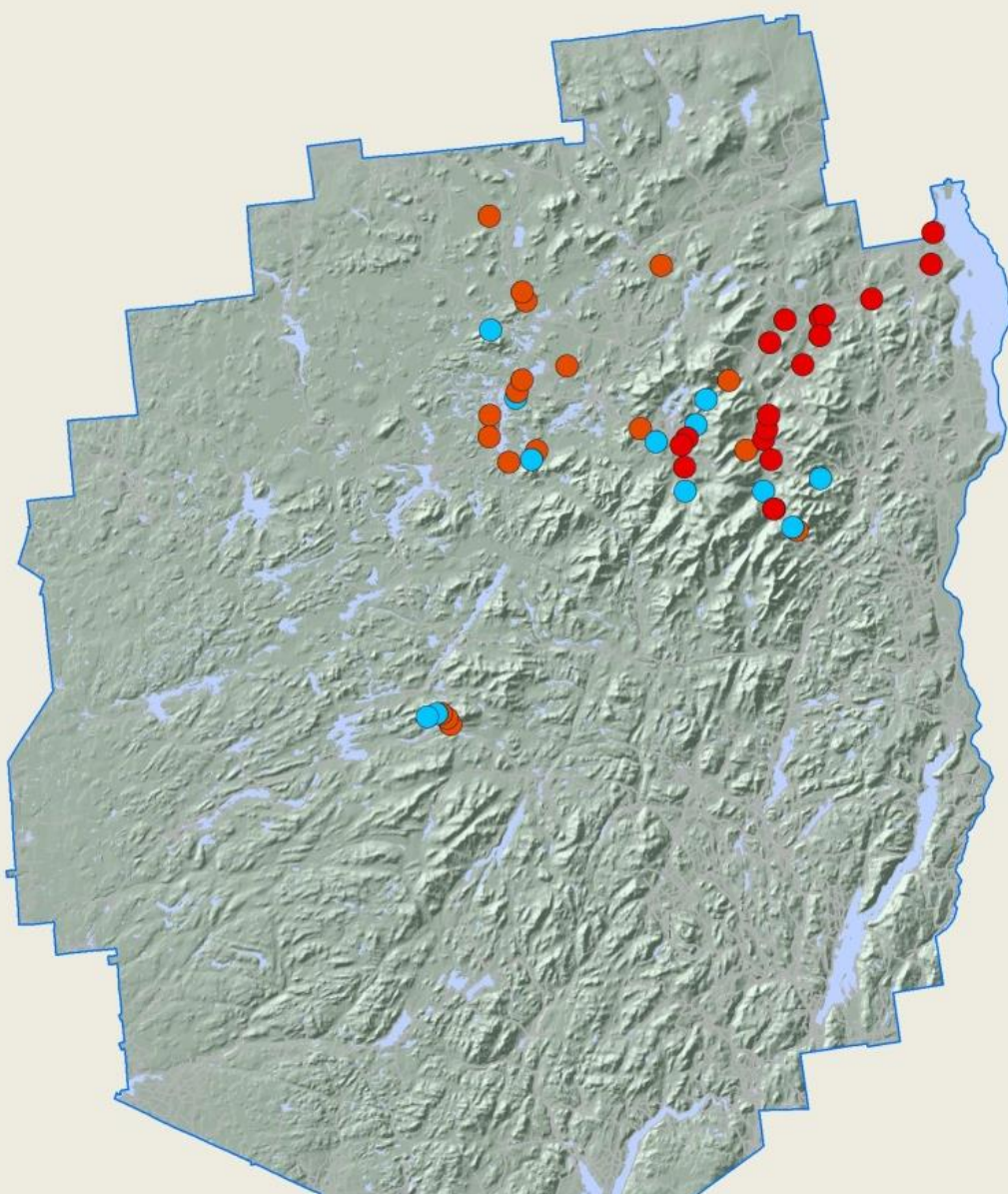
Chloride (mg/L)

- < 1
- 1 to 5
- 6 to 10
- 11 to 20
- > 20

Chloride (mg/L)

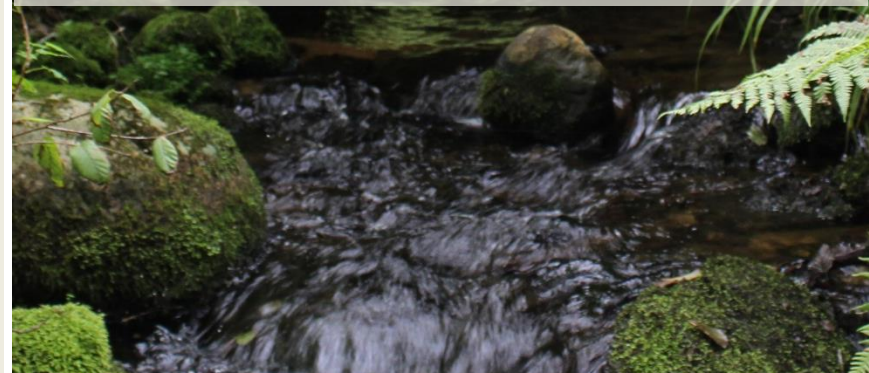


What About Streams?

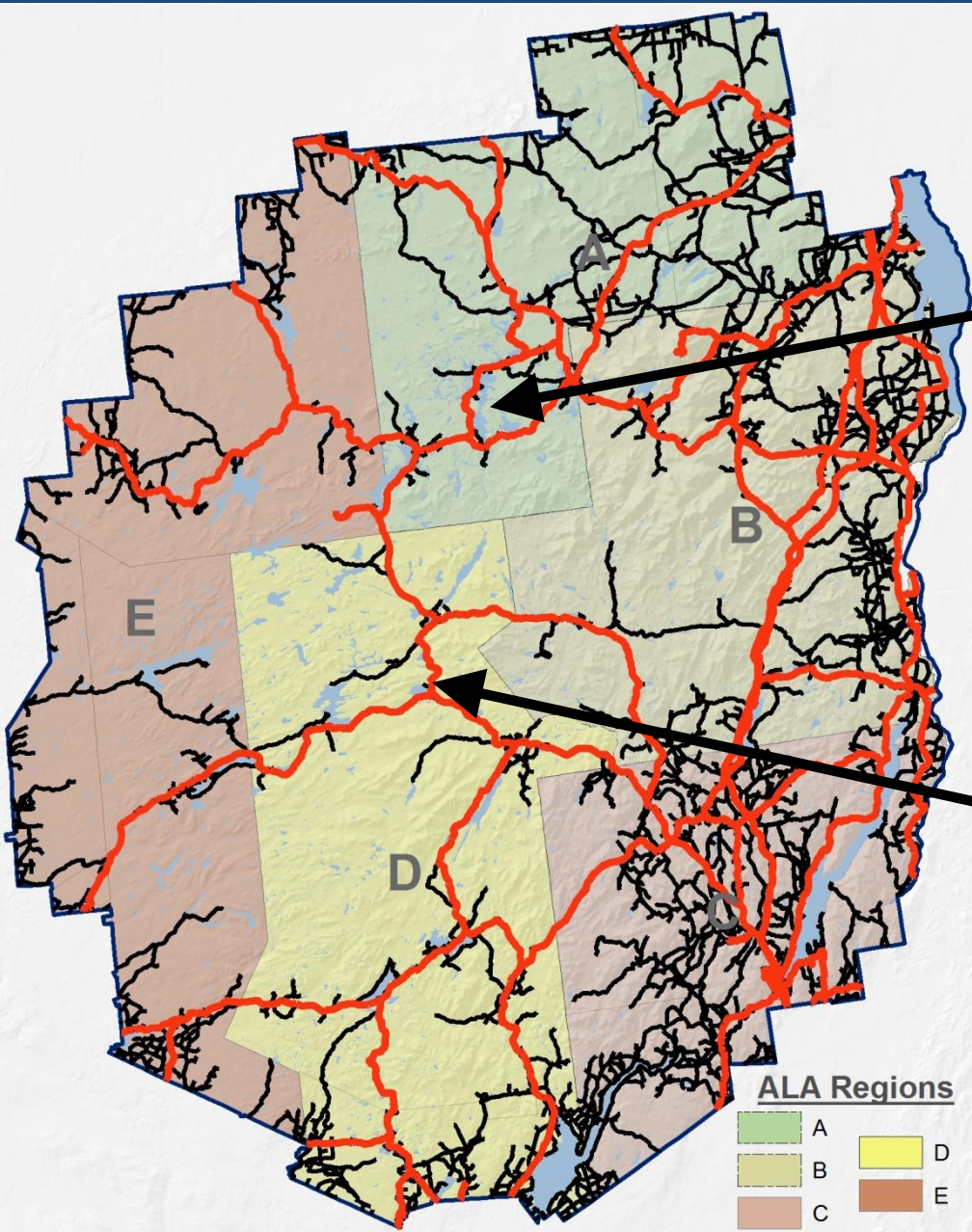


51 Streams

- 11 no paved roads
- 40 paved roads



Stream Chloride Loadings

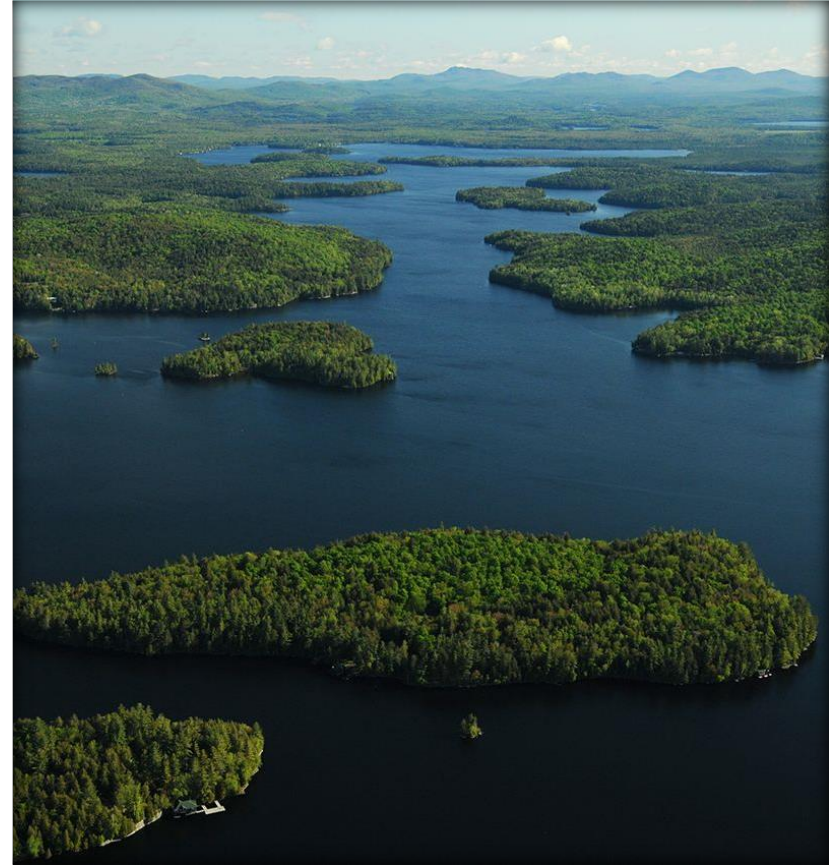


Upper Saranac Lake Watershed

Blue Mountain Lake Watershed

Upper Saranac Lake

- May to Oct 2015/16
- Black Brook (*no roads*)
 - 1 lb Cl per acre
- Cranberry Brook (*SR 3*)
 - 44 lbs Cl per acre



Laxson, C.L., Yerger, E.C., and D.L. Kelting. 2017. Upper Saranac Lake Watershed Monitoring Project: Program Update, Year 2016. Report No: PSCAWI 2017-06.

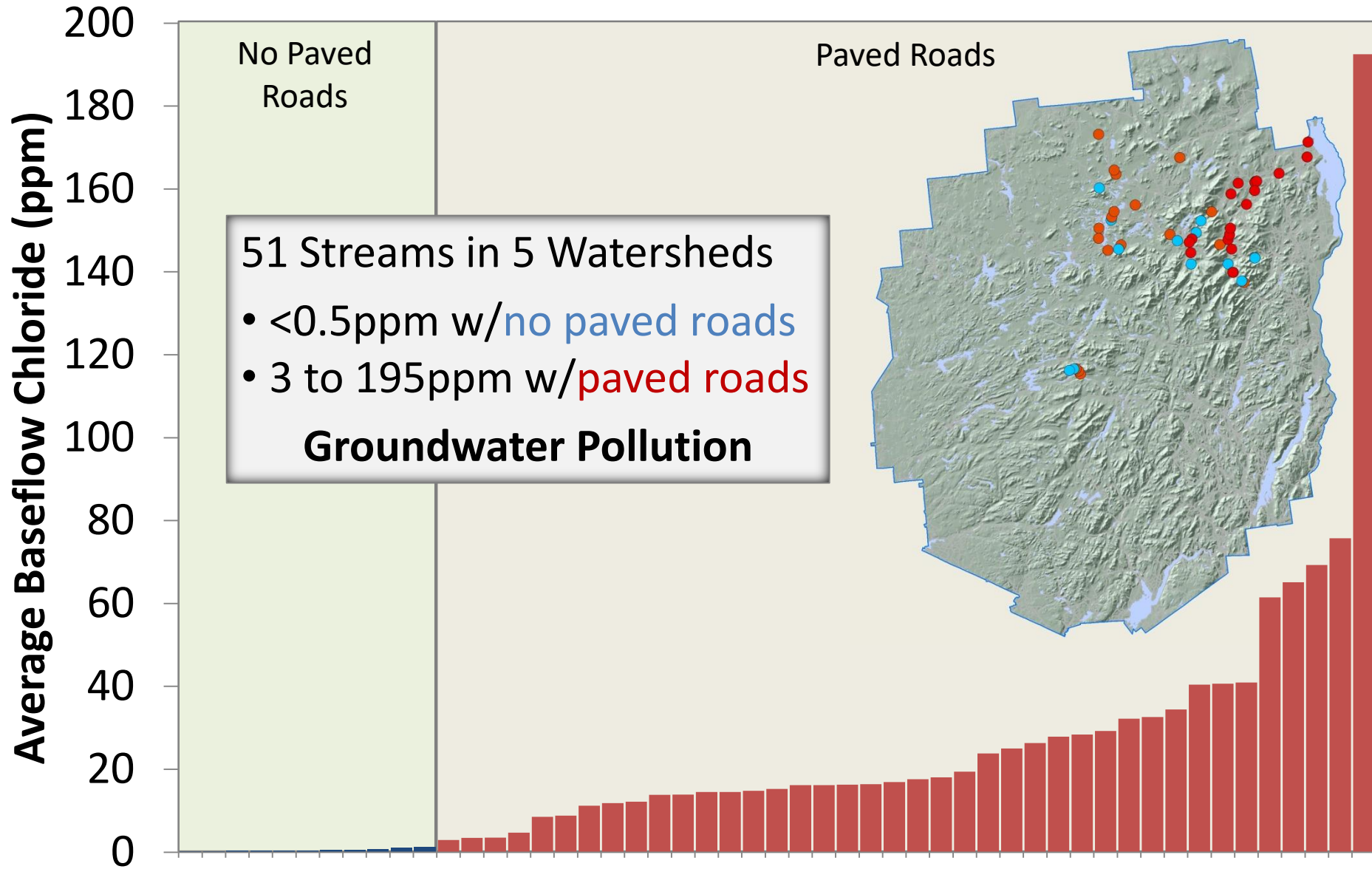
Blue Mountain Lake

- May to Oct 2015/16
- Beaver Brook (*no roads*)
 - <1 lb Cl per acre
- Museum Brook (*SR 28N*)
 - 22 lbs Cl per acre



Laxson, C.L., Yerger, E.C., and D.L. Kelting. 2017. Blue Mountain Lake Watershed Monitoring Project: Program Update, Year 2016. Report No: PSCAWI 2017-05.

Stream Baseflow Chloride



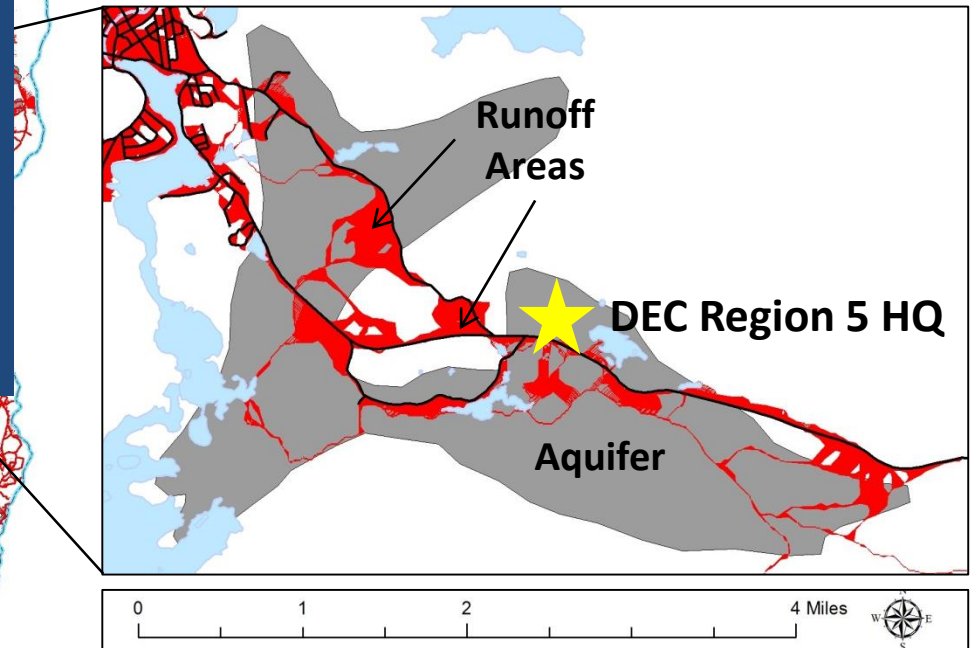
What About Groundwater?

Regional Groundwater Pollution?

Impacts:

- Human Health
- Homeowner Expenses
- Property Values

- 1,600 square miles of unconfined aquifers¹, most receiving **runoff from paved roads**²

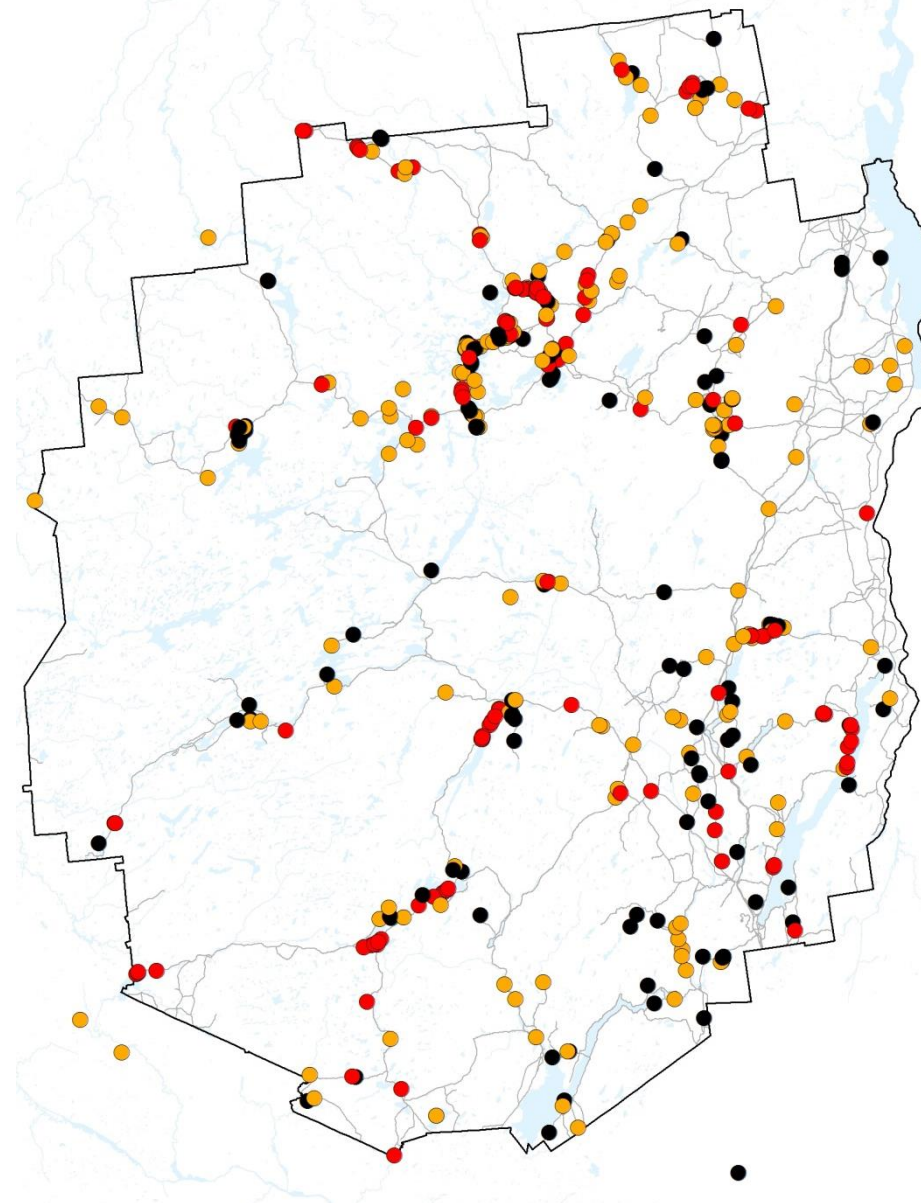
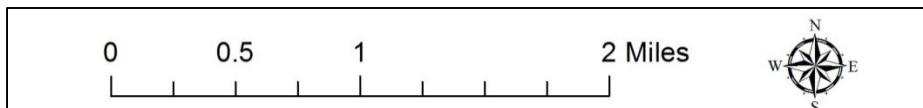
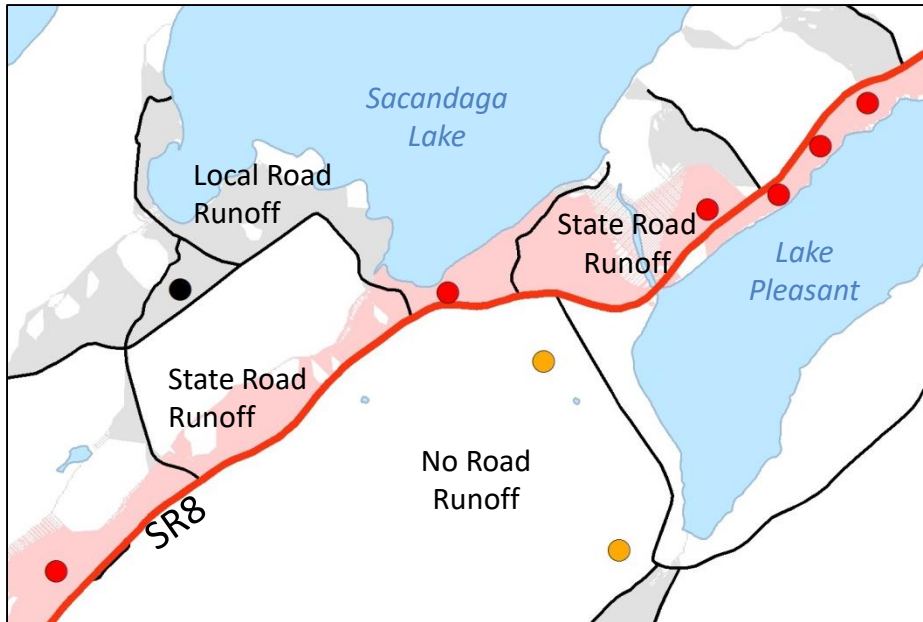


¹NYSAPA, 2016; ²Regalado & Kelting, 2015

Private Well Study

489 private wells

- 206 no road runoff = None
- 126 local road runoff = Local
- 157 state road runoff = State



Sodium & Chloride by Runoff Type

Sodium

Parameter	None	Local	State
Median (ppm)	3	6	33
Maximum (ppm)	17	403	1,917
Exceed Guidance ¹	0%	20%	64%

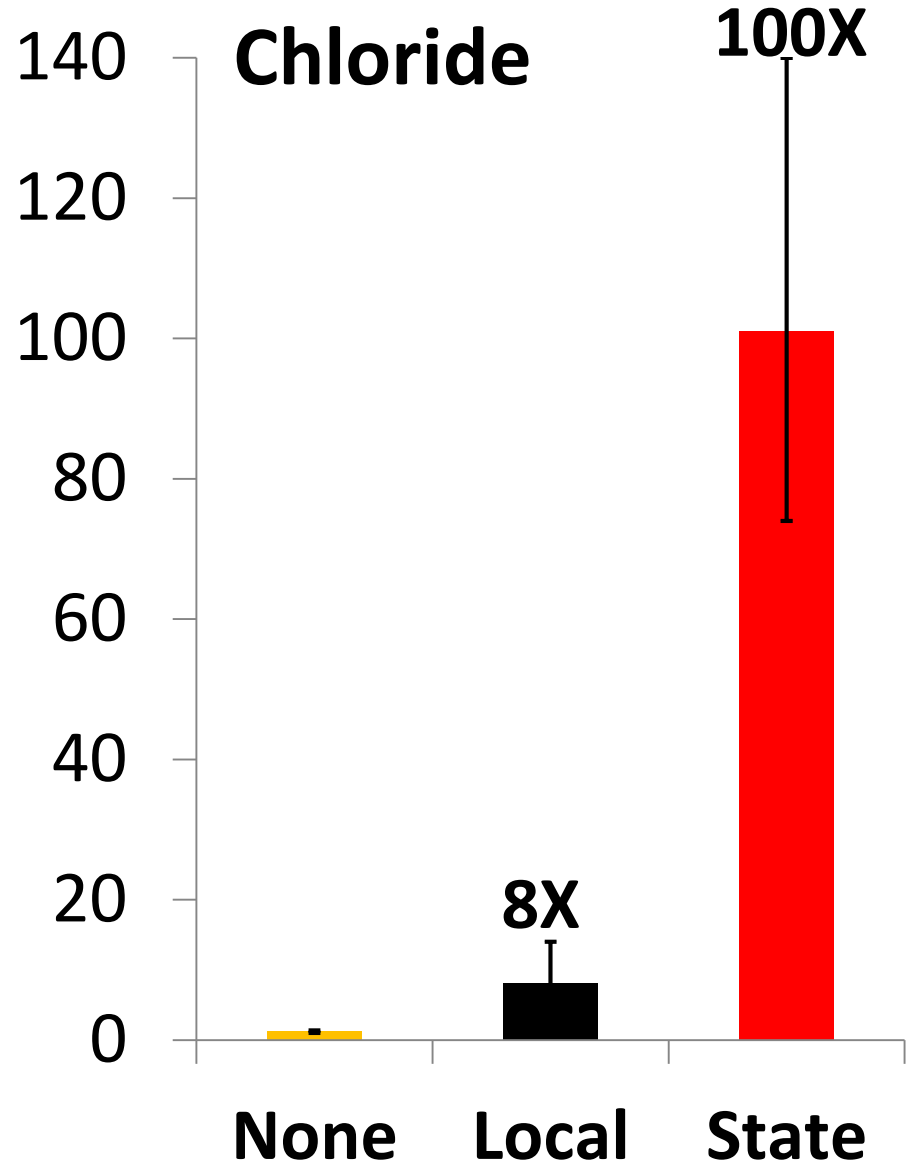
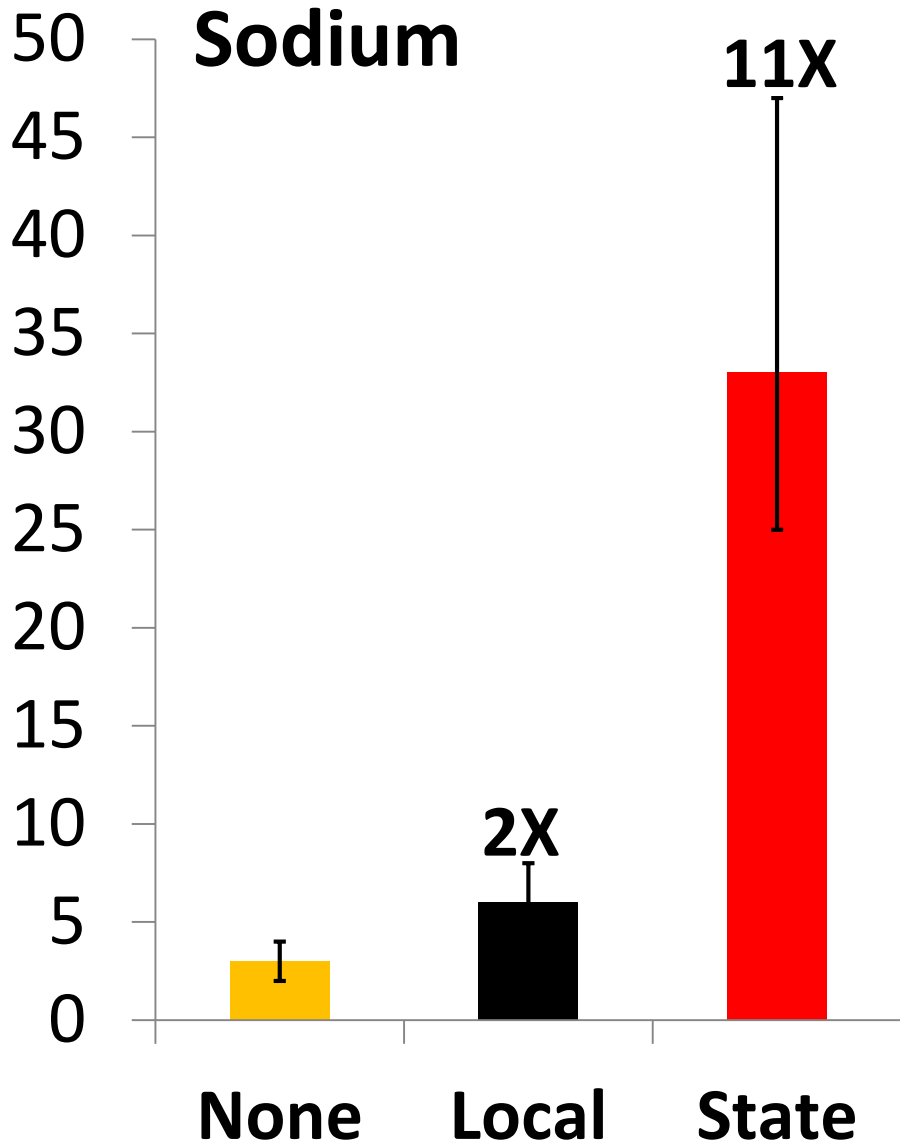
Chloride

Parameter	None	Local	State
Median (ppm)	1	8	100
Maximum (ppm)	64	390	1,680
Exceed Guidance ²	0%	3%	29%

¹20ppm

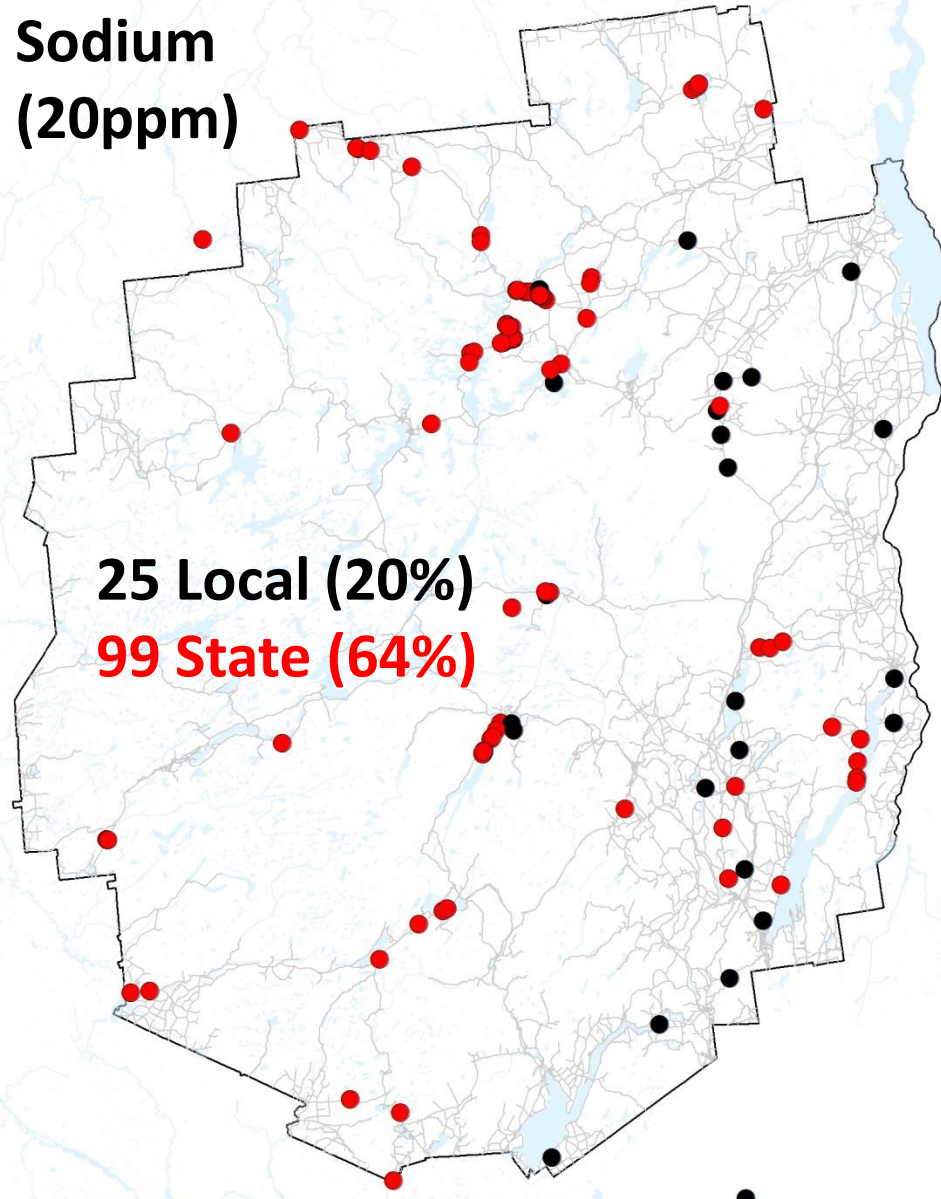
²250ppm

Sodium & Chloride (ppm) by Runoff Type

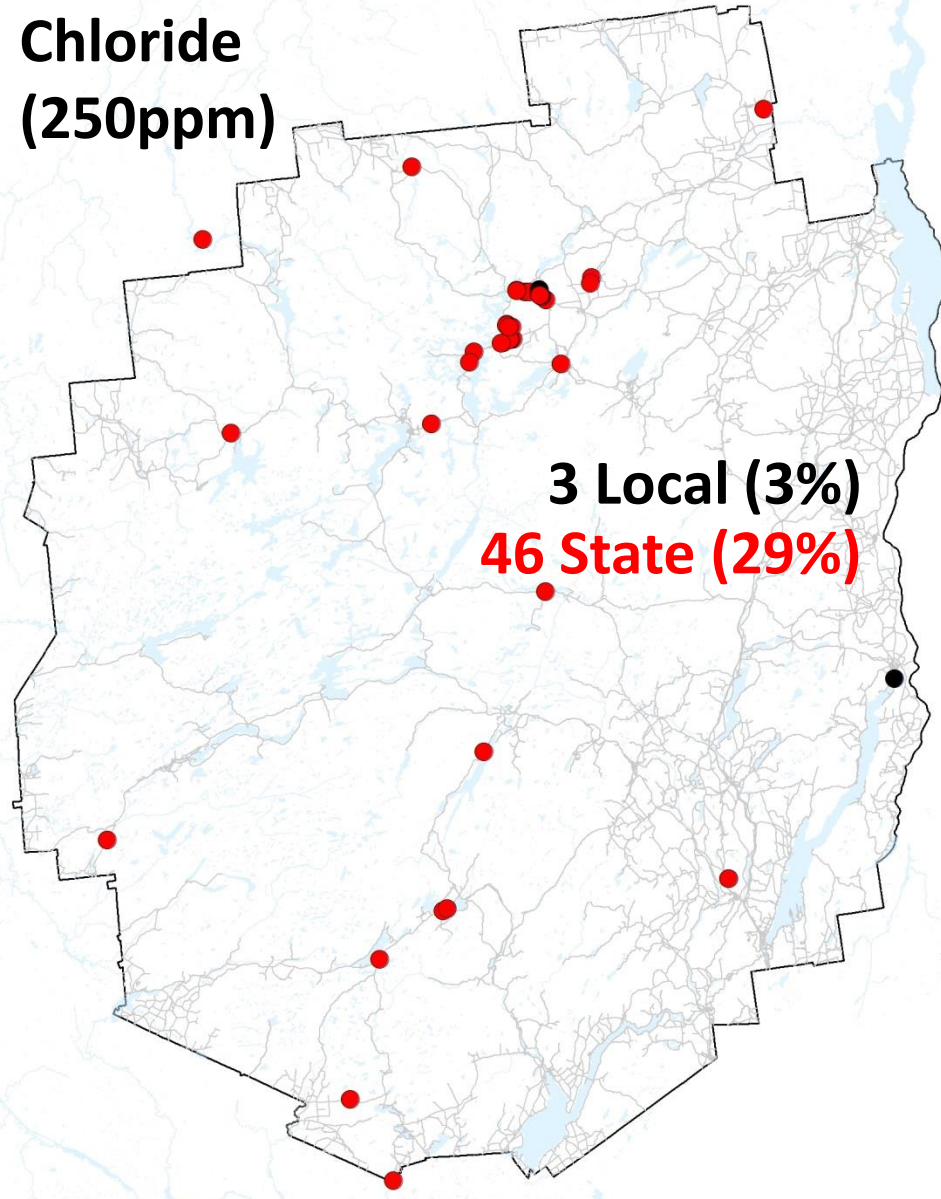


Distribution of Wells Exceeding Guidance

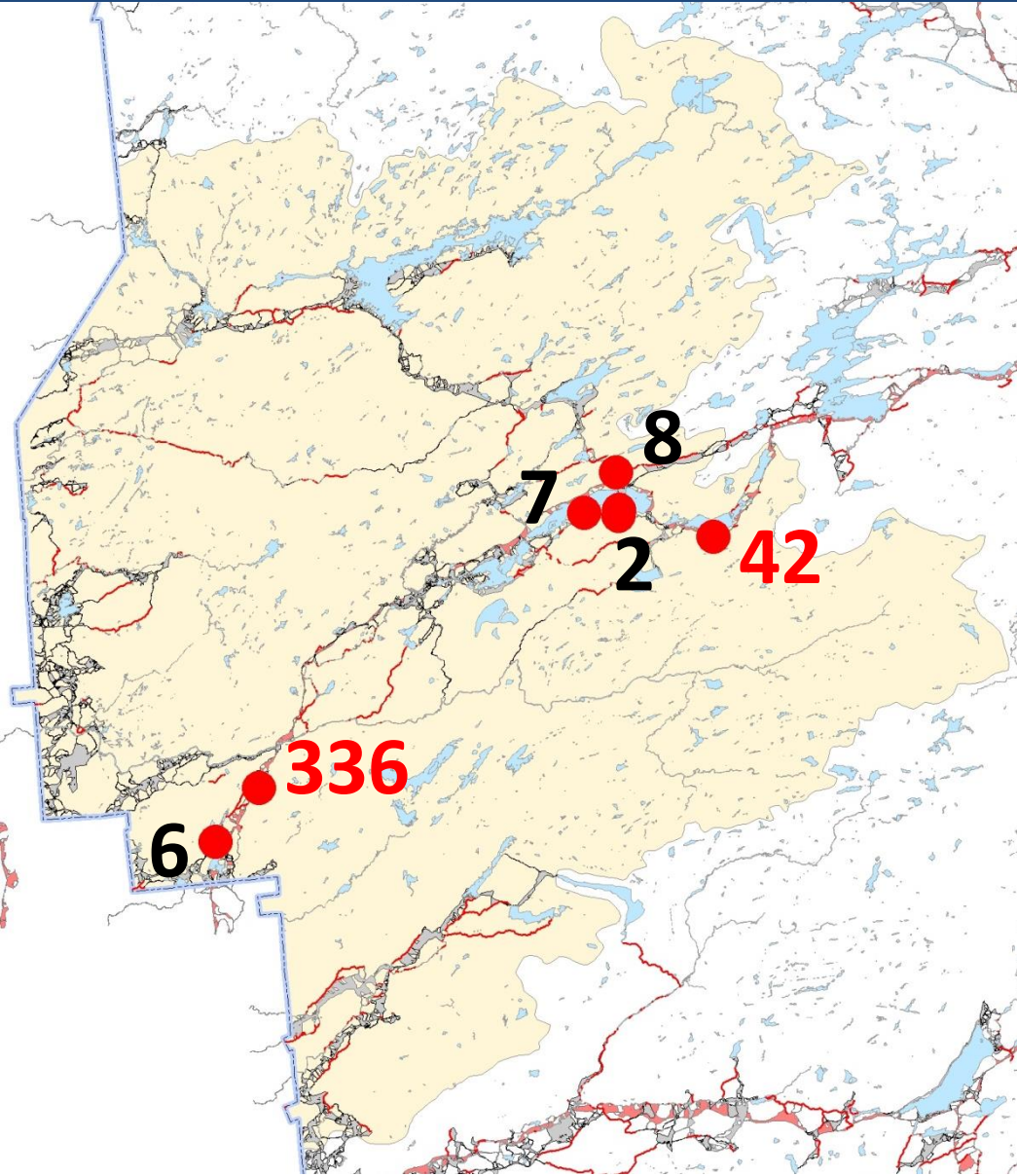
**Sodium
(20ppm)**



**Chloride
(250ppm)**



Well sodium (ppm) in Black River Watershed



- 2 State Runoff
 - 42 – 336ppm
 - 2/2 exceeded
- 3 Local Runoff
 - 6 – 8ppm
 - None exceeded
- 1 No Runoff
 - 2ppm

Multiple Stressors



Take Home Messages

- We use too much salt
- Resulted in:
 - Regional salinization of surface & groundwater
 - Impacts to ecosystems, human health, & property values
- If we care we need to act



Road Salt Pollution of Surface and Groundwater Resources in the Adirondacks

Dan Kelting
dkelting@paulsmiths.edu



PAUL SMITH'S
COLLEGE



ADIRONDACK
WATERSHED INSTITUTE
PAUL SMITH'S COLLEGE