



# **Elk River Watershed**

## ***Update Report***

***April 2017***





# Outline

## ***Purpose***

- Examine current datasets
- Correlate with historical data
- Examine potential trends
- What does new data/trends tell us for planning purposes (e.g. Water Plan)?

## ***Parameters***

- Drivers (precipitation, land management)
- Transparency (stream and lake)
- Water chemistry (stream loads, lake concentrations)



# Topics for Further Investigation

*Land Management*

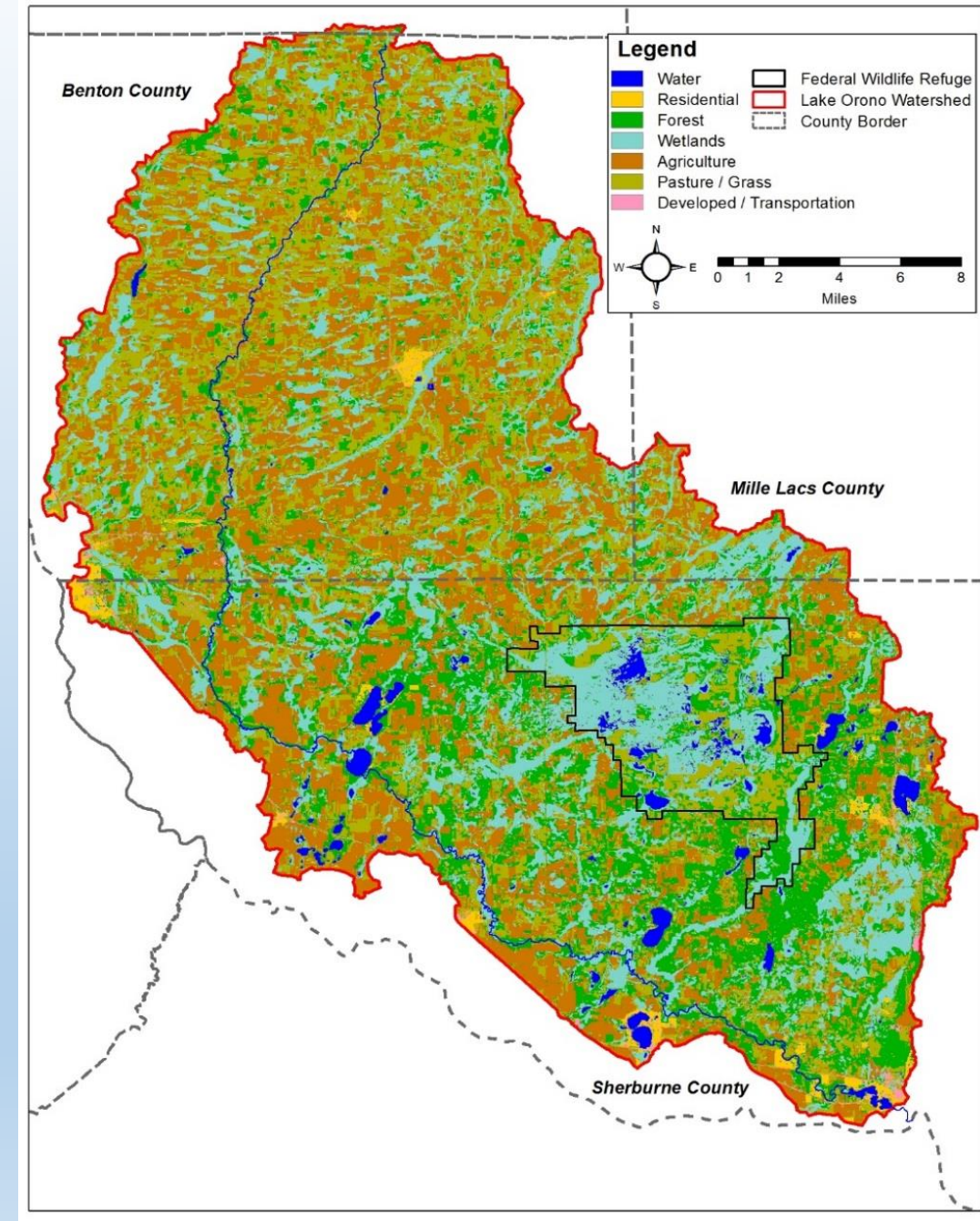
*Biological Indices*  
- *Stream insects*



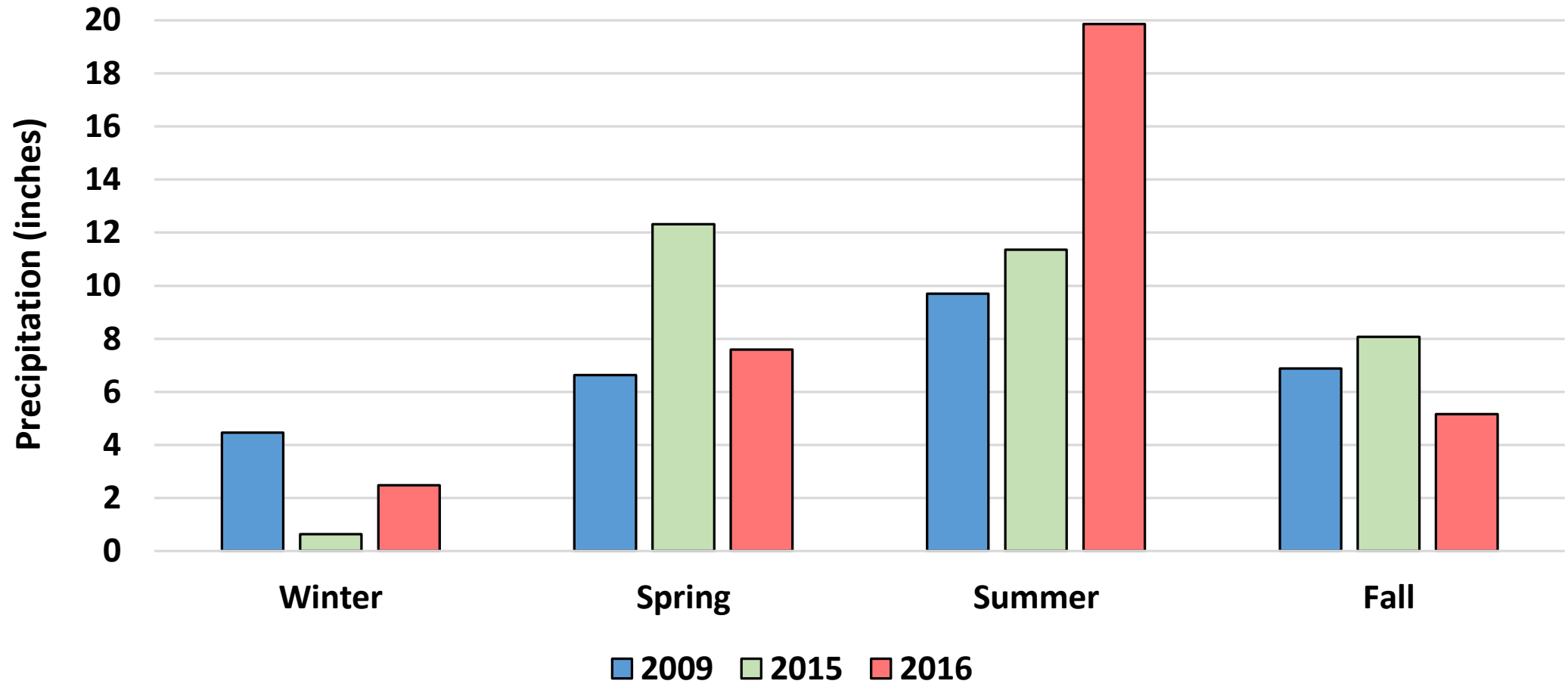


# Watershed

- 613 square miles
- 27% ag, 20% forest, 18% grass, 17% wetland
- Elk River
  - Annual volume 140,000 – 210,000 ac-ft
  - Phosphorus load 40,000 – 60,000 lbs / yr
  - Sediment load 3-7 million lbs / yr



# Precipitation



# Elk River - Transparency

9 locations with data  
6 with recent data  
5 with recent & consistent data

## Locations:

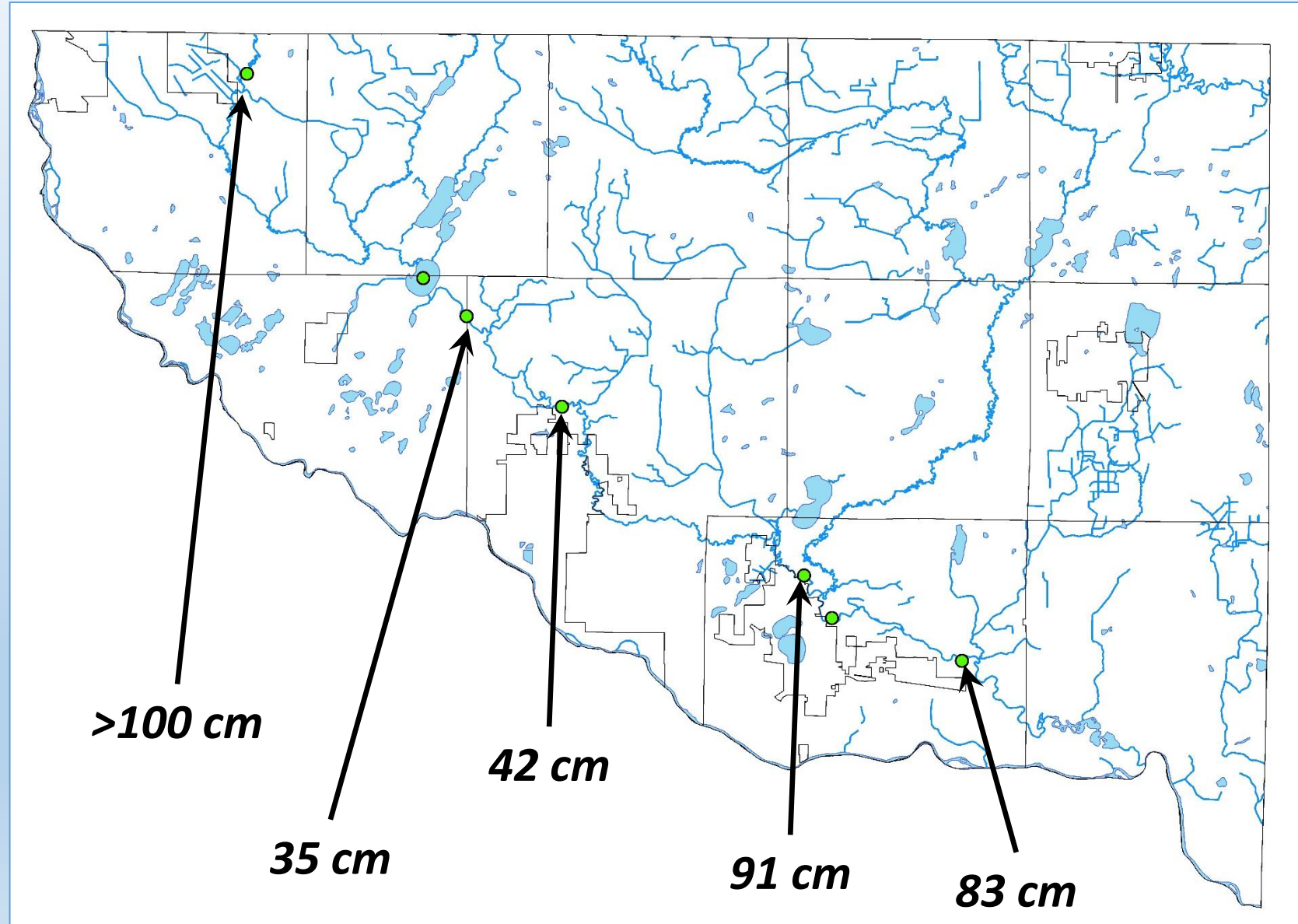
Cty Rd 62  
Cty Rd 53/54  
Cty Rd 23  
Cty Rd 5  
Cty Rd 15

## Data Summary

Median values

2008-2015

Sample range n=77-232



# Elk River Flow, Nutrient and Sediment Loads

2009						
	Flow duration (days)	Mean flow (cfs)	Total flow volume (ac-ft)	Mass (lb)	Flow-weighted Concentration (mg/L)	C.V.
Total Phosphorus	251	283.2	141,019	41,661	0.109	0.138
Ortho-Phosphorus				11,998	0.031	0.276
Total Suspended Solids				3,139,604	8.19	0.176
Nitrites + Nitrates				264,277	0.689	0.139
Total Kjeldahl Nitrogen				445,707	1.16	0.088

2015						
	Flow duration (days)	Mean flow (cfs)	Total flow volume (ac-ft)	Mass (lb)	Flow-weighted Concentration (mg/L)	C.V.
Total Phosphorus	238	358.0	169,023	40,936	0.089	0.079
Ortho-Phosphorus				9,709	0.021	0.139
Total Suspended Solids				4,544,611	9.89	0.135
Nitrites + Nitrates				242,010	0.527	0.152
Total Kjeldahl Nitrogen				542,231	1.18	0.048

2016						
	Flow duration (days)	Mean flow (cfs)	Total flow volume (ac-ft)	Mass (lb)	Flow-weighted Concentration (mg/L)	C.V.
Total Phosphorus	255	422.8	213,865	56,035	0.096	0.094
Ortho-Phosphorus				16,724	0.029	0.221
Total Suspended Solids				6,701,706	9.13	0.134
Nitrites + Nitrates				367,557	0.632	0.190
Total Kjeldahl Nitrogen				623,317	1.07	0.078

## Summary

### Flow volume

- Considerably higher each year

### Phosphorus

- 2015/2016 concentrations below WQ standard
- Large increase in 2016 mass due to high volume

### Sediment

- Large increase each year
- Avg. concentrations remain similar

### Nitrogen

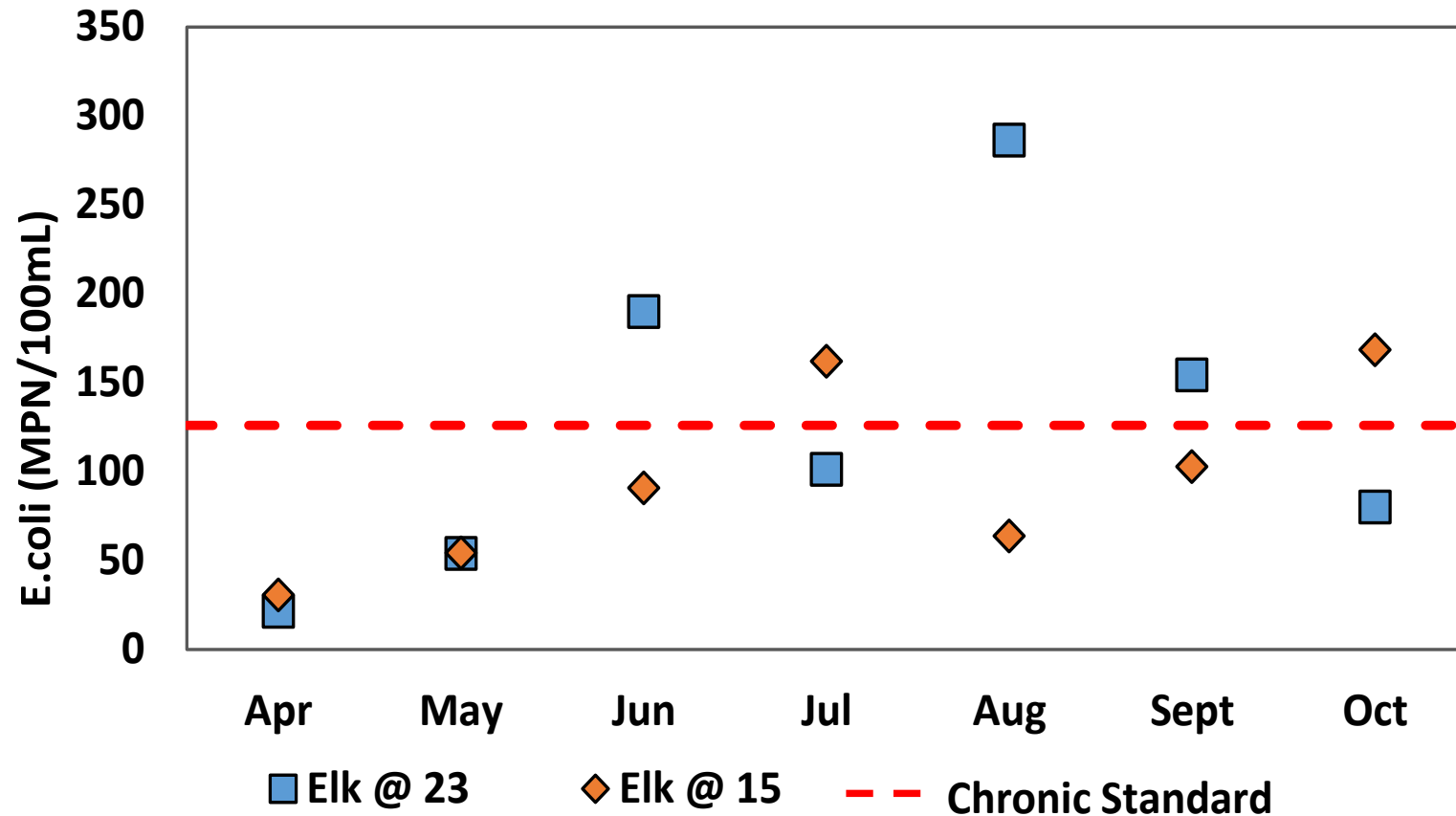
- Increase each year, within WQ drinking standard
- NO<sub>2</sub>+NO<sub>3</sub> (inorganic) not event-driven
- TKN (organic) largely event-driven

### Trends

- Interesting observations made, but no trends able to be determined at this point

# Water Quality – Elk River Fecal Coliform

2016 Monthly Geomean



2012-2016:

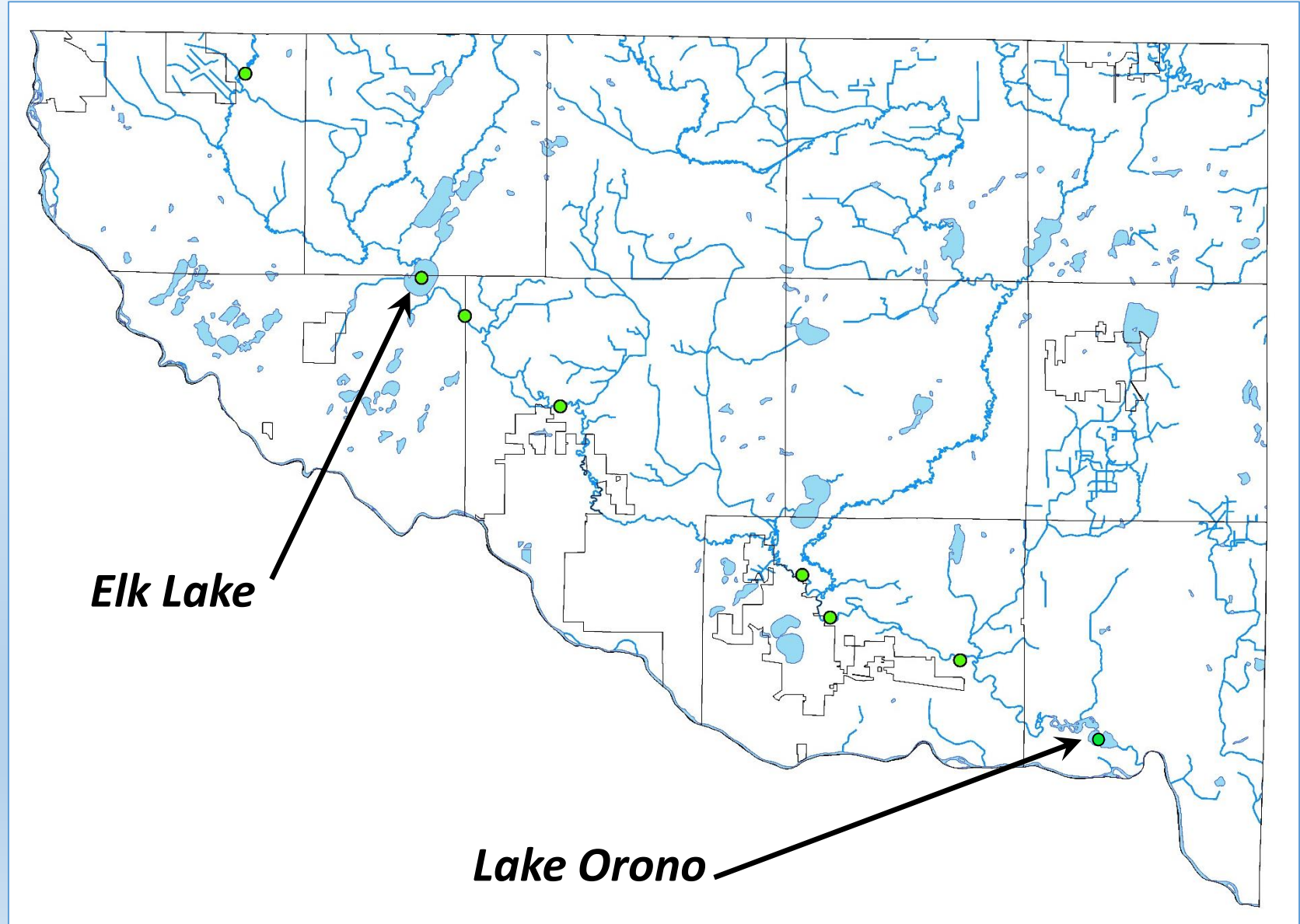
- No apparent trends
- 65% geomean monthly exceedance at Elk @ 23
- 35% geomean monthly exceedance at Elk @ 15



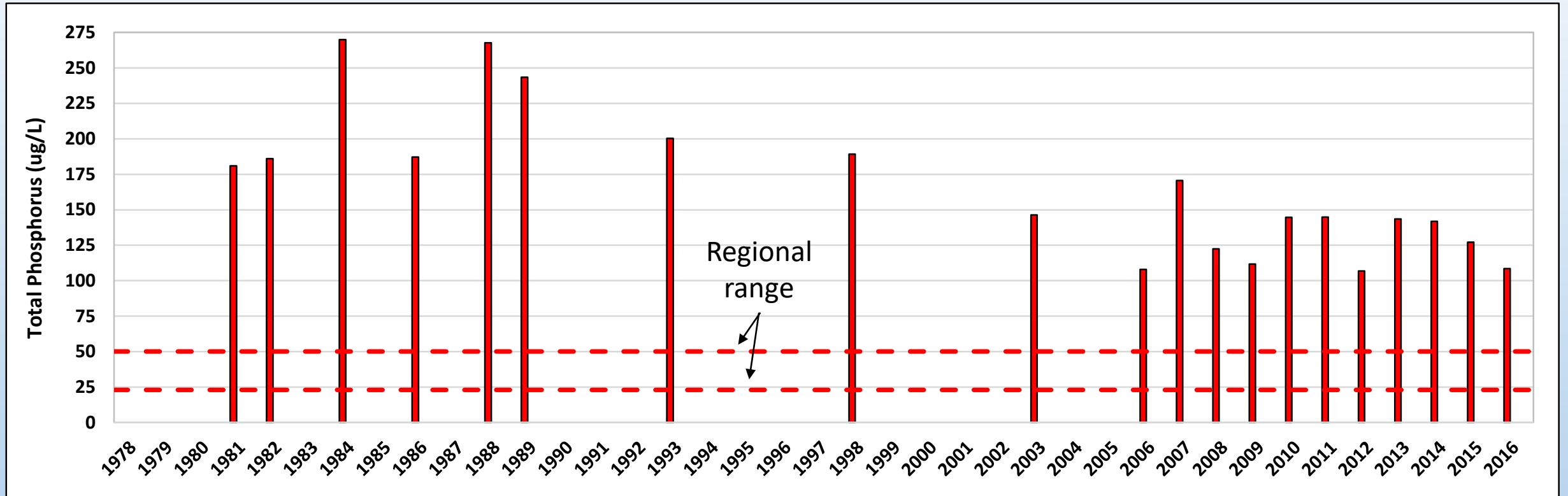
# Elk Lake and Lake Orono

## Parameters

- Clarity (transparency)
- Chlorophyll (algae)
- Phosphorus (nutrient)



# Elk Lake and Lake Orono



## Elk Lake

- Clarity (32 years)
- Chlorophyll (21 years)
- Phosphorus (20 years)

## Lake Orono

- Clarity (17 years)
- Chlorophyll (12 years)
- Phosphorus (12 years)

# Statistical Analysis

	Secchi Disk Clarity	Chlorophyll-a	Total Phosphorus
Range	1978 to 2016	1978 to 2016	1981 to 2016
n	32	21	20
Variance(S)	3802.67	1096.67	950.00
Z <sub>s</sub>	3.583836141	-2.808313754	-3.406649844
Z <sub>crit,.05</sub>	1.96	1.96	1.96
Interpretation	<i>Sig. Increasing</i>	<i>Sig. Decreasing</i>	<i>Sig. Decreasing</i>

## Elk Lake:

- Improving water quality
- Higher degree of certainty

	Secchi Disk Clarity	Chlorophyll-a	Total Phosphorus
Range	1994 to 2016	1994 to 2016	1994 to 2016
n	17	12	12
Variance(S)	589.33	212.67	212.67
Z <sub>s</sub>	3.418988101	-2.811474473	-2.537184281
Z <sub>crit,.05</sub>	1.96	1.96	1.96
Interpretation	<i>Sig. Increasing</i>	<i>Sig. Decreasing</i>	<i>Sig. Decreasing</i>

## Lake Orono:

- Improving water quality
- Lesser degree of certainty (but still statistically significant!)



# Summary / Conclusions

## Precipitation / Land Use Factors

- Climate is predicted to change, large events will have negative impact
- Need to accommodate climate shifts

## Elk River

- Volume has increased greatly, partially due to increased precipitation
- Phosphorus concentrations have remained stable, mass correlates with flow
- E. Coli continues to impair the river

## Lakes

- Internal factors in Elk Lake continue to impact downstream quality
- Water quality appears to be improving in Elk Lake and Lake Orono