



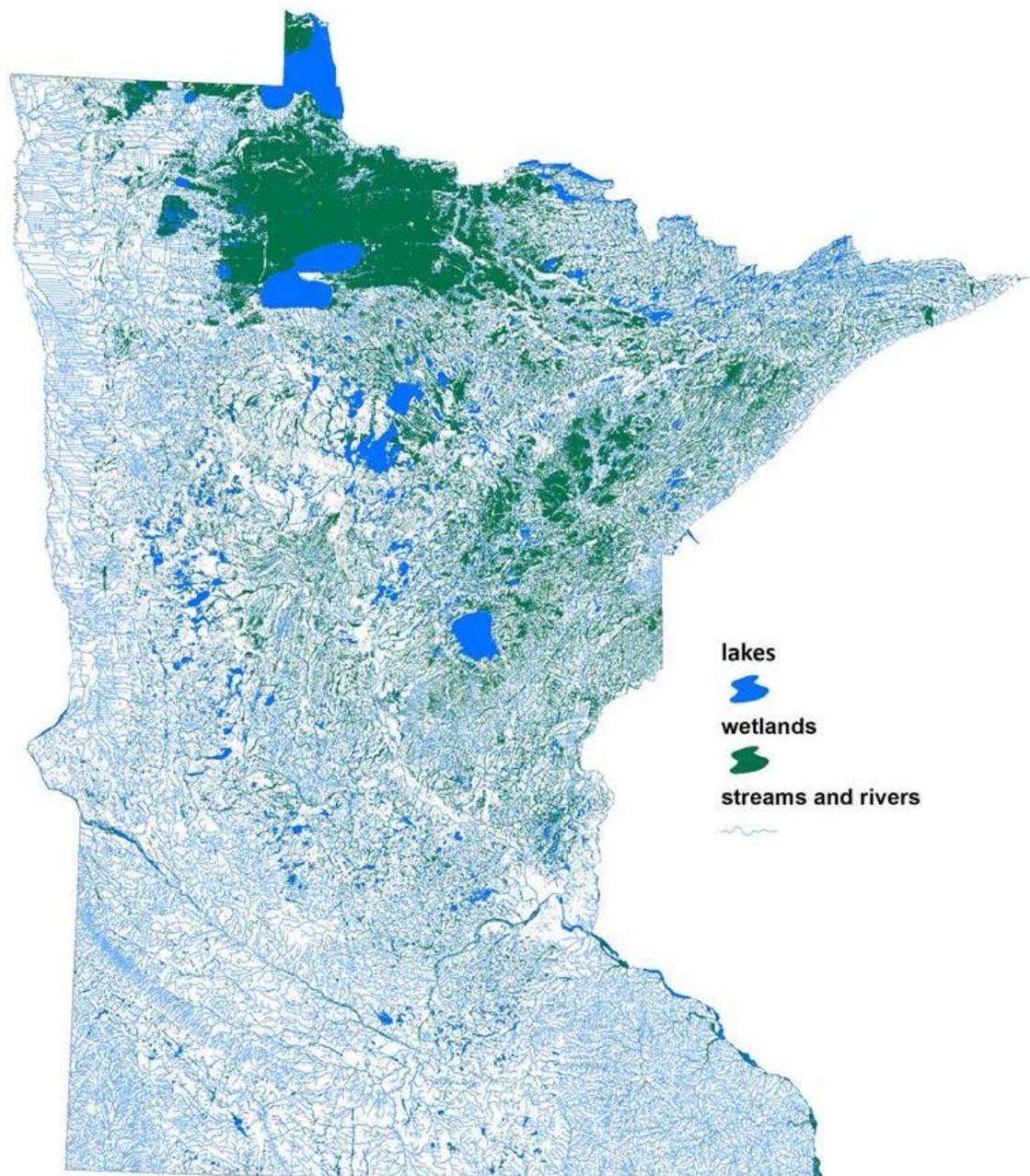
# Minnesota's Approach to Detecting Changes in Water Quality



Eileen Campbell & John Sandberg

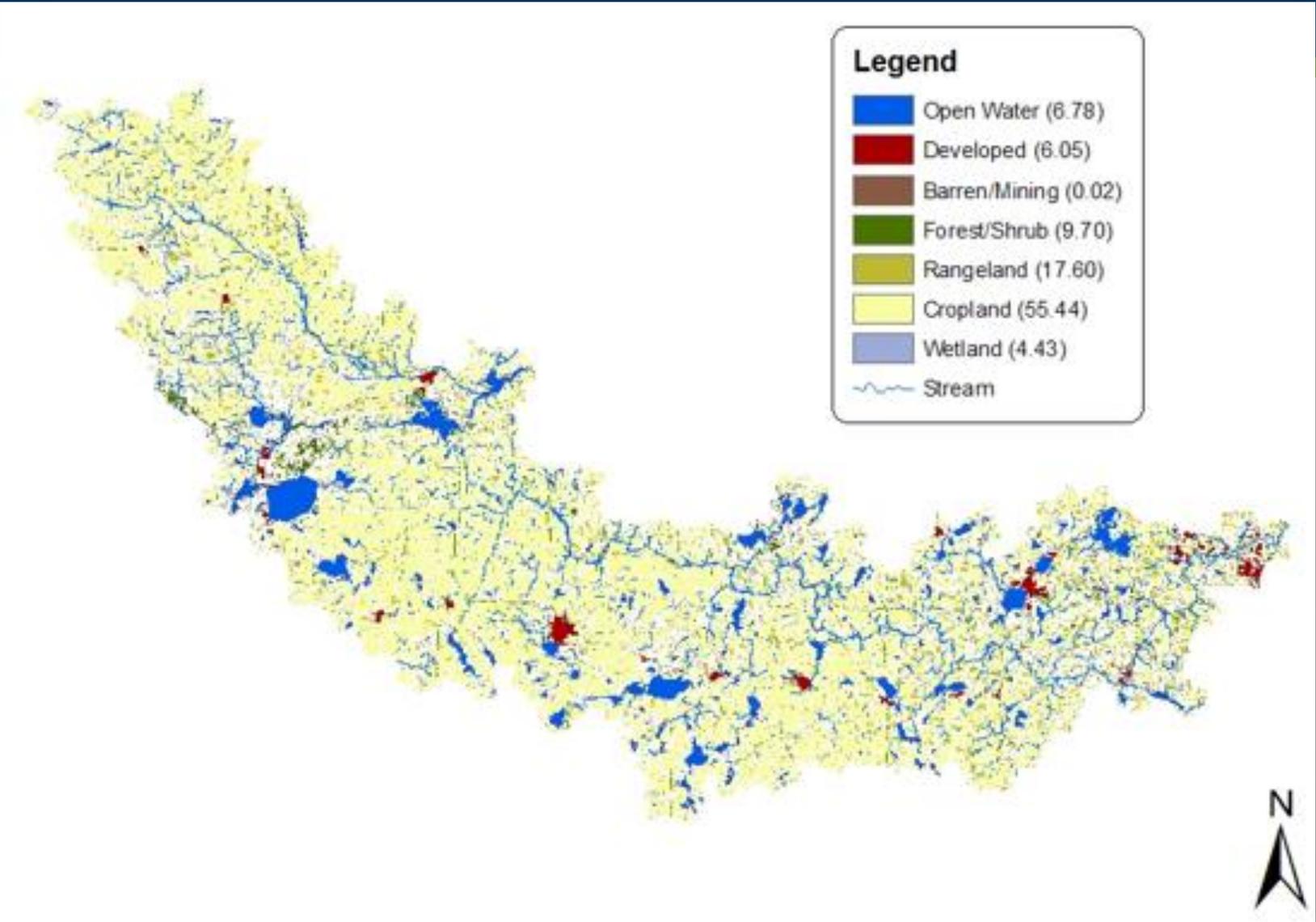
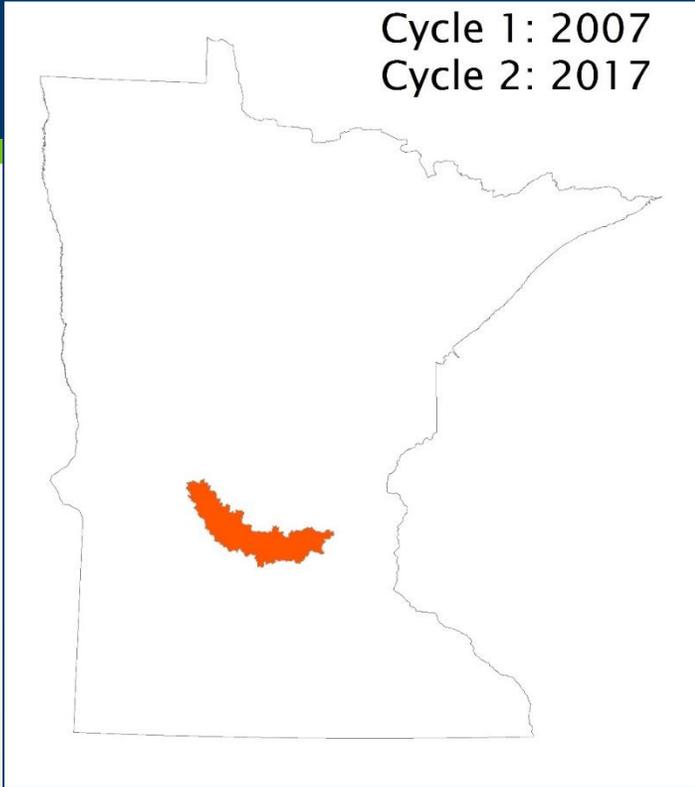
2019 National Water Quality  
Monitoring Conference

# Water, Water, Every Where

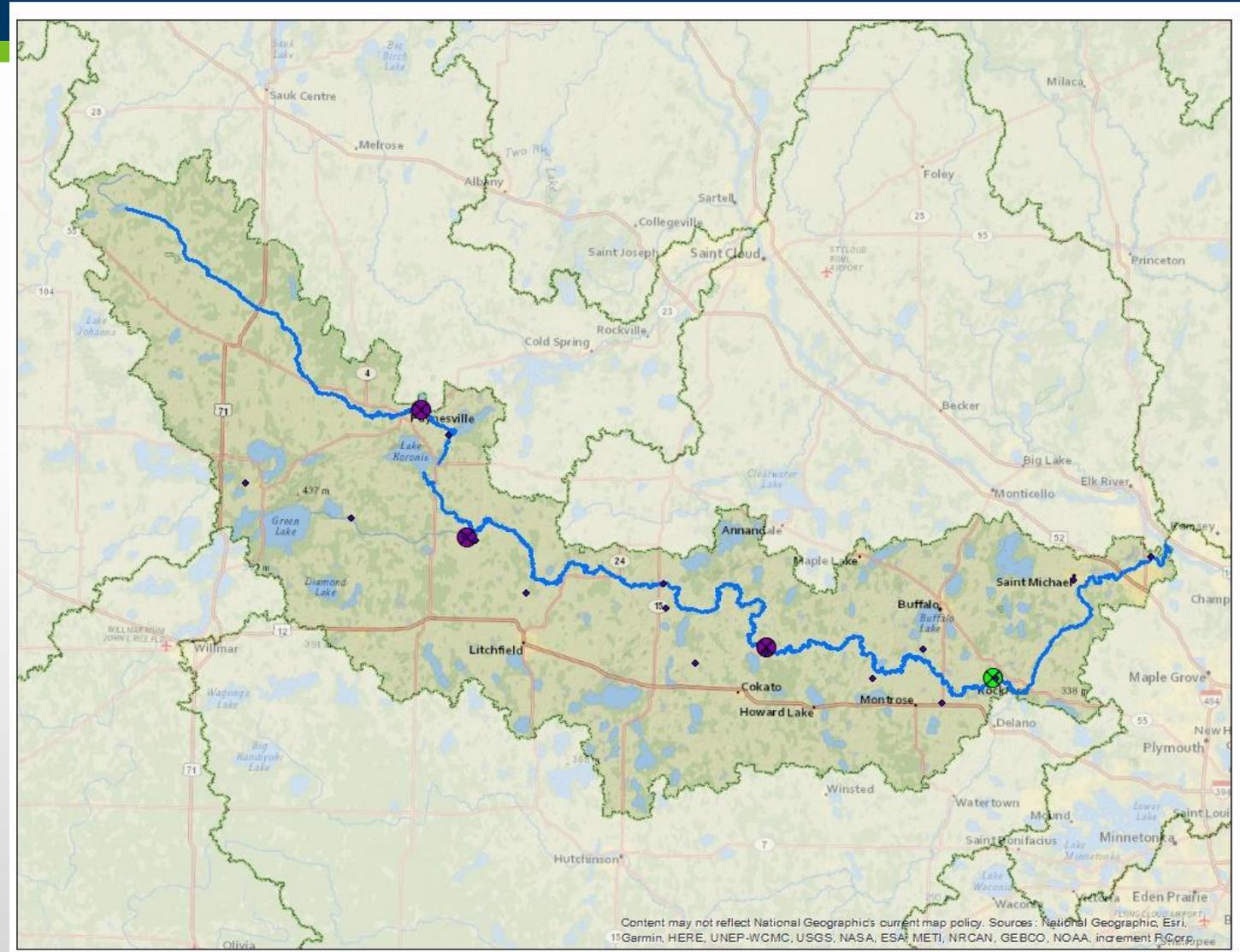
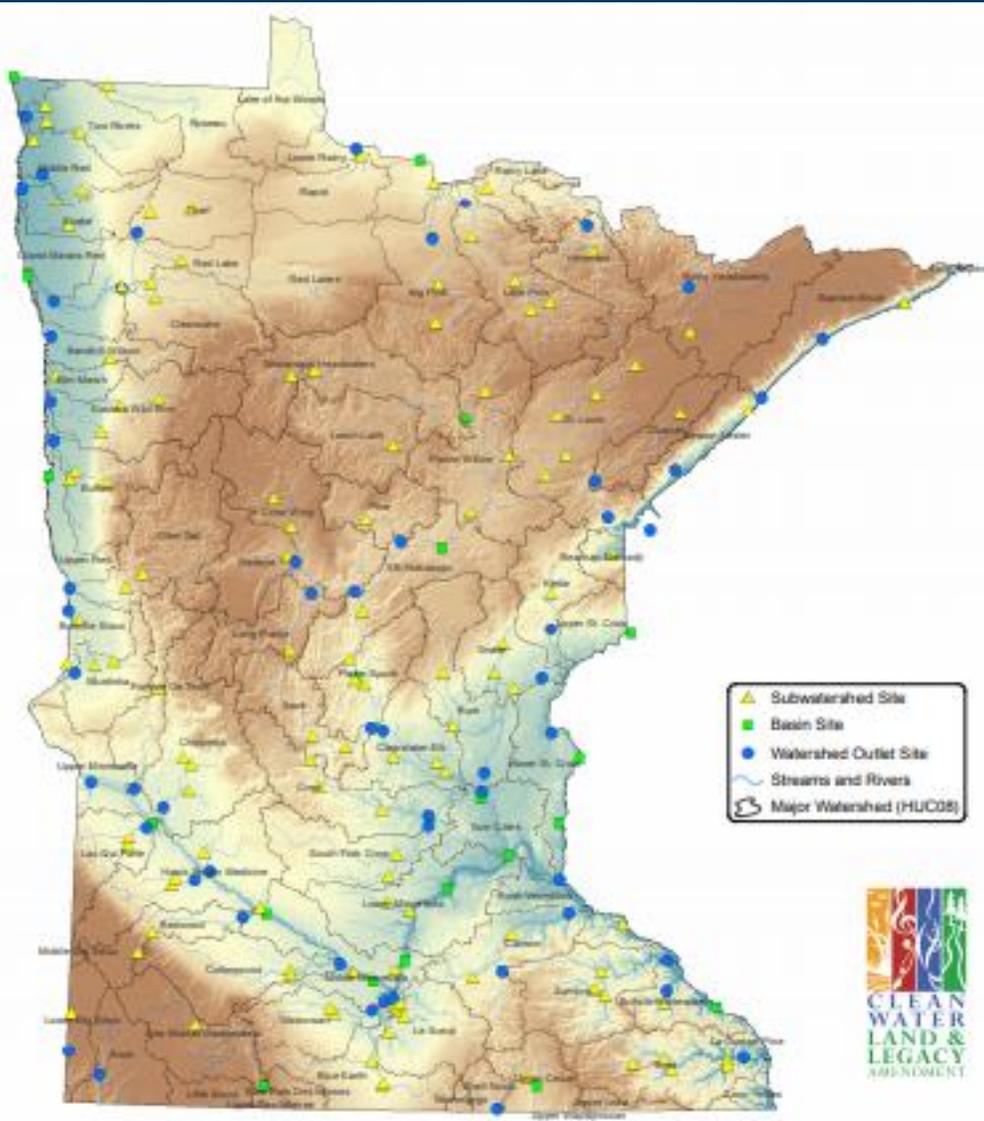


- Minnesota is a water-rich state
  - 10 major drainage basins
  - About 85,000 total stream miles
  - About 12,200 lakes >10 acres
  - 4.5 million total lake acres
  - 10.6 million wetland acres

# North Fork Crow River



# Long Term Water Quality Monitoring

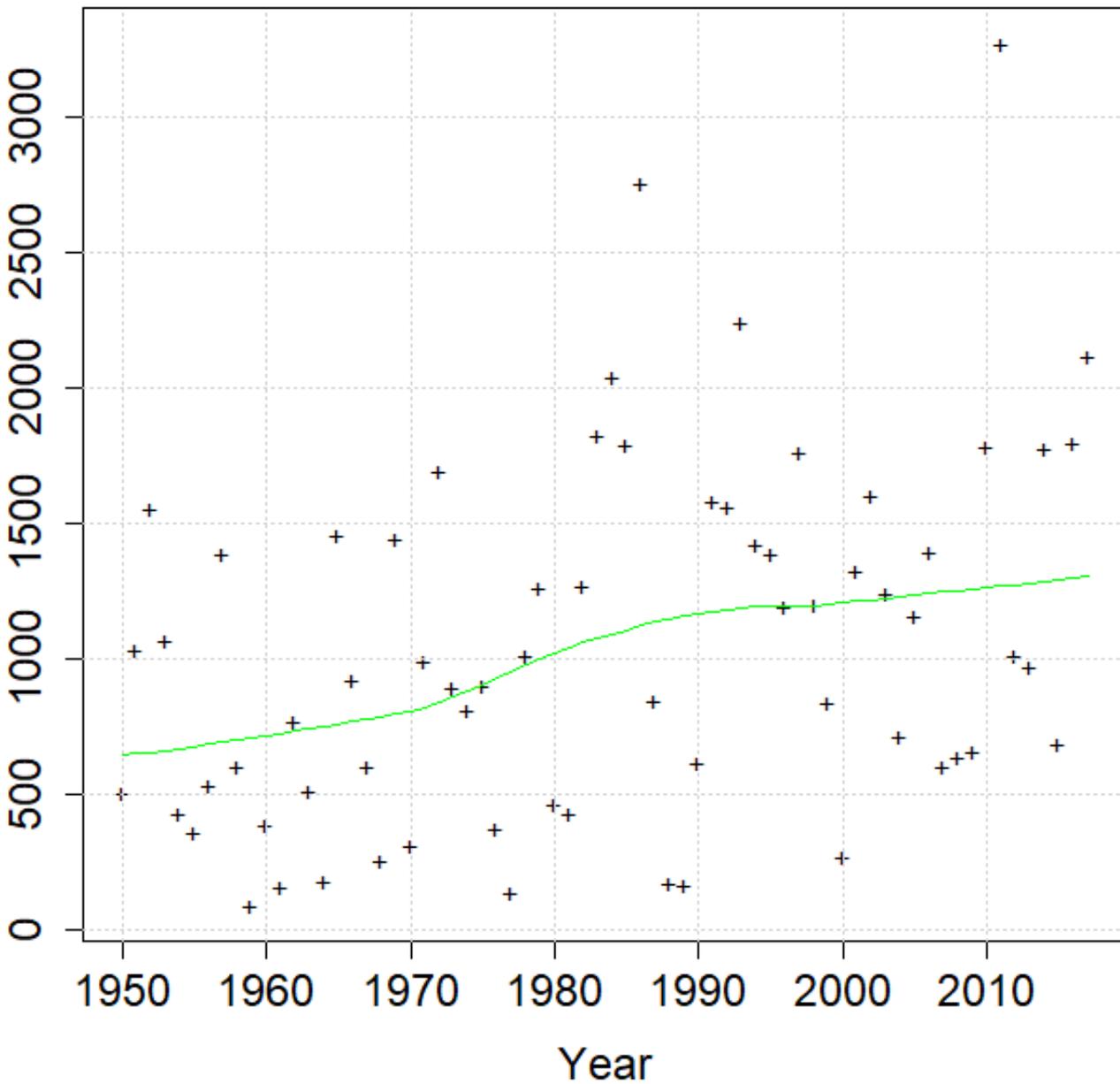


# Crow River Flow 1950-2017

## Discharge

3000  
2500  
2000  
1500  
1000  
500  
0

Mean Monthly Flow (cfs)



1935

1939

2003

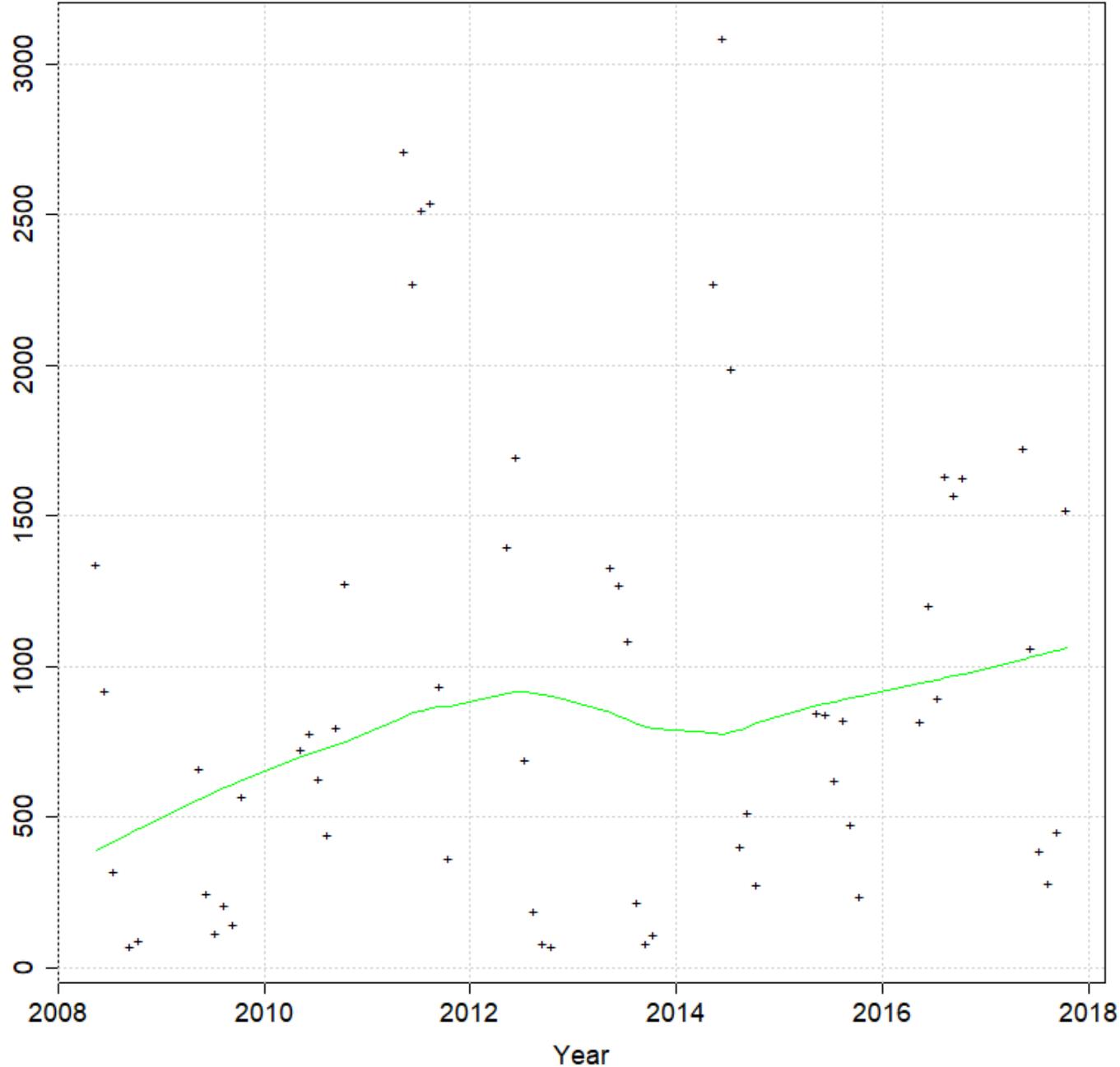
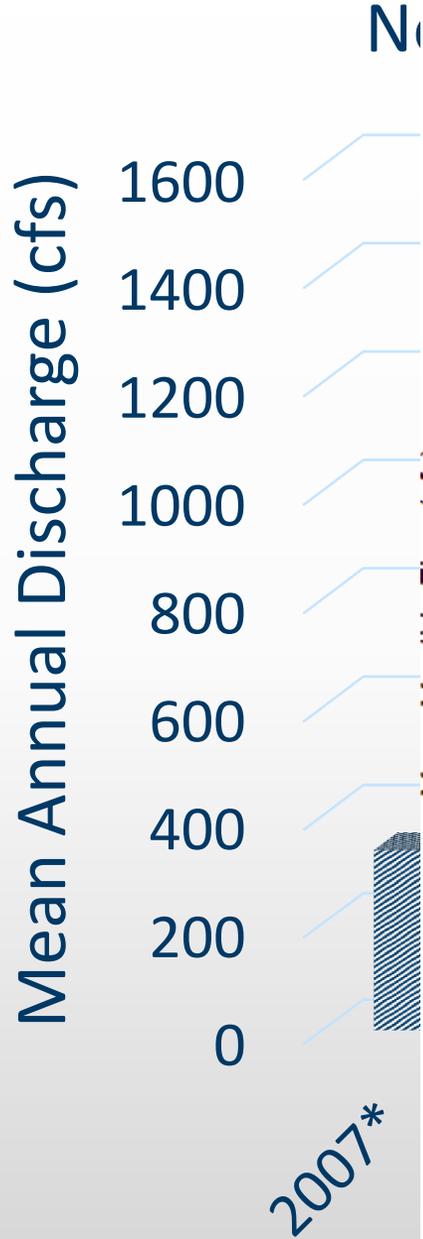
2007

2011

2015

2017

# North Fork Crow River nr Rockford Mean Monthly Flow May-October

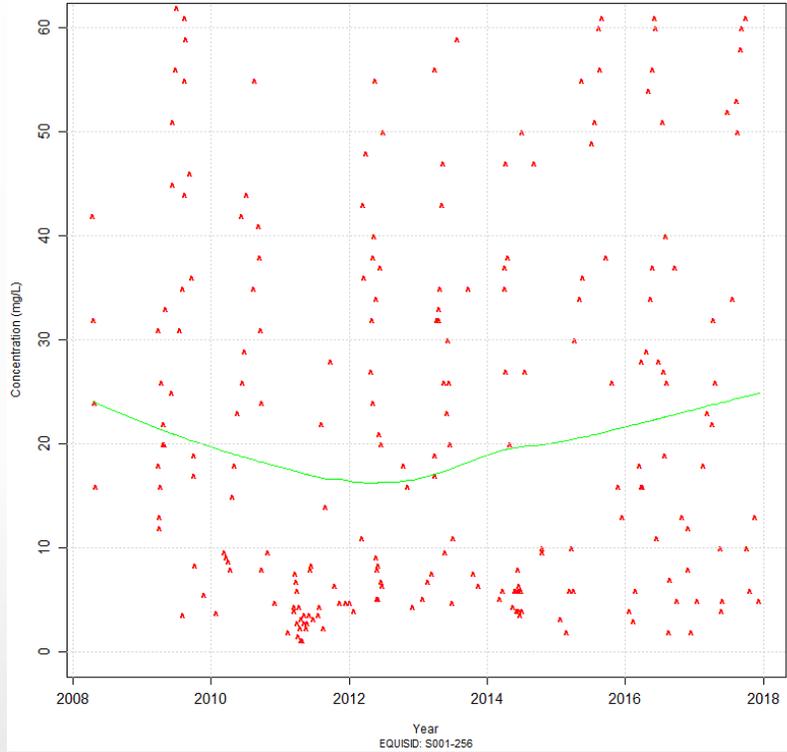


is)

2016

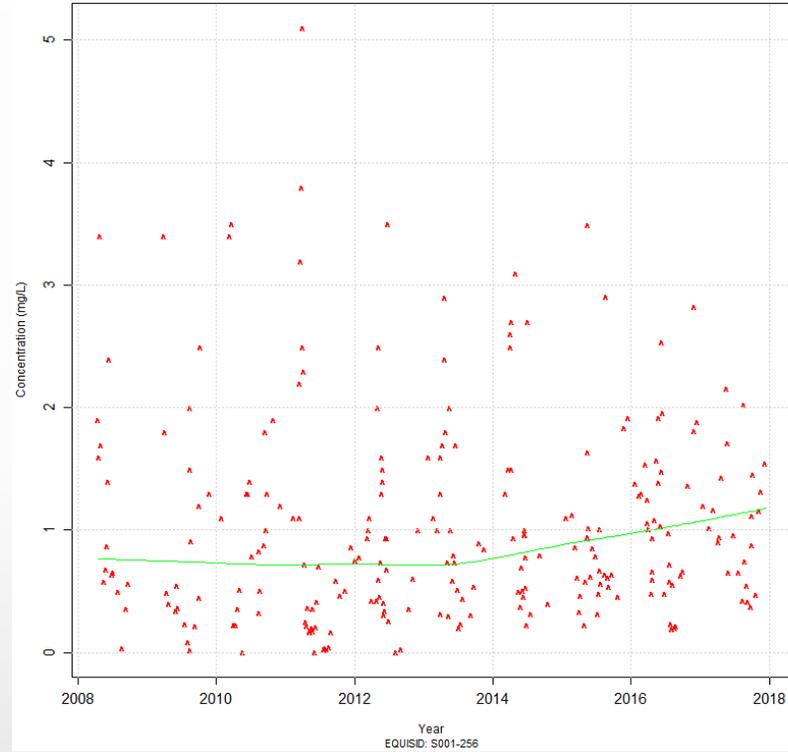
2017

# Total Suspended Solids



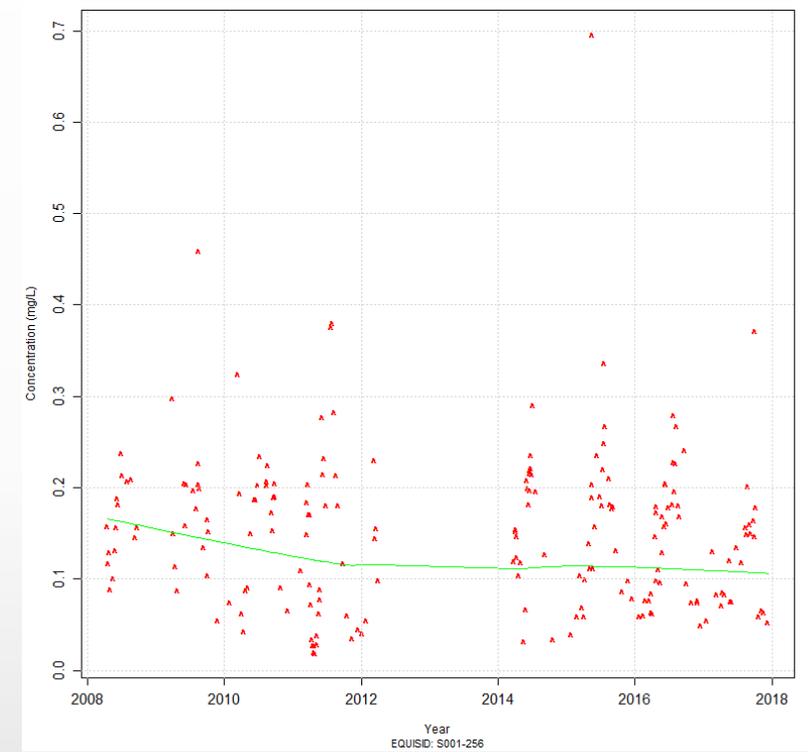
No Trend

# Nitrate + Nitrite



Increasing Trend

# Total Phosphorus

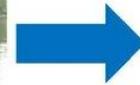


Decreasing Trend

# Biological Indicators in Streams



field sampling



sorting and ID



raw biological data

CommonName	Number
creek chub	78
longnose dace	50
fathead minnow	48
golden redhorse	30
common shiner	28
sand shiner	23
spotfin shiner	14
bigmouth shiner	11
common carp	10
white sucker	7
hornyhead chub	5
johnny darter	5
northern pike	4
rock bass	4

community metrics based on species' attributes

Metric	MetricValue
Total number of fish	334
Total number of species	26
Number of Darter species	2
Number of Gravel-spawning species	9
Number of Round-bodied Sucker species	3
Percent Exotic species	3.0
Percent Minnows	80.2
Percent Piscivorous individuals	3.3
Percent Sensitive individuals	18.6
Percent Benthic Insectivore individuals	30.5



assessment decision

IBI Score  
40.2



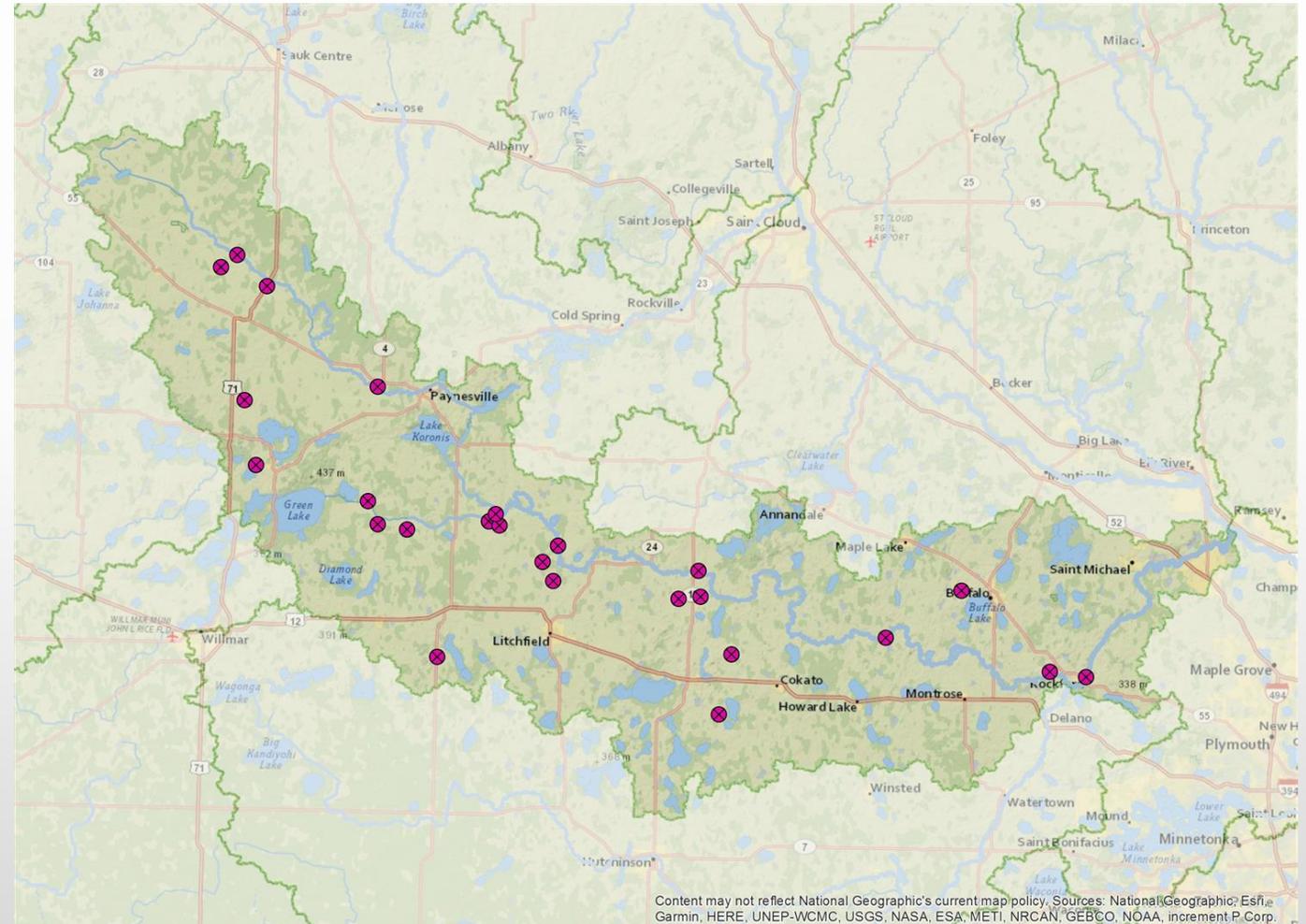
# Biological Indicators Evaluating Change Over Time

- Approach:
  - Evaluate condition at the HUC8 scale
  - Compare IBI scores at re-monitored sites, 10 years later
  - Paired t-test



# North Fork Crow River Biological Monitoring

- Cycle 1 (2007)
  - HUC-14 monitoring design
  - 49 sites
- Cycle 2 (2017)
  - HUC-12 monitoring design
  - 34 sites
- 25 sites monitored both cycles



# North Fork Crow River Near Litchfield, MN

6/28/2007

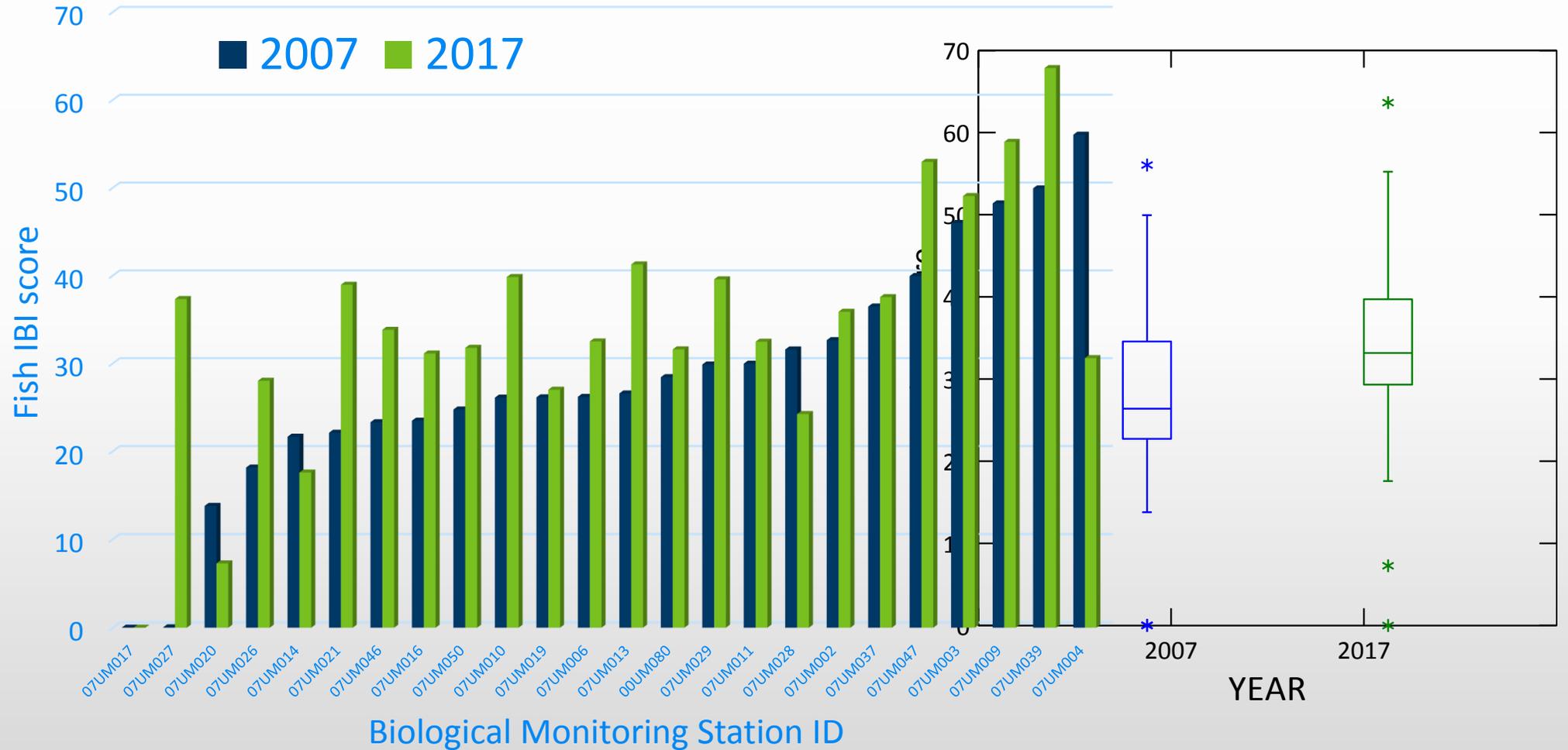
CommonName	Number
sand shiner	133
bluntnose minnow	122
common carp	79
spotfin shiner	73
shorthead redhorse	52
johnny darter	31
hornyhead chub	26
black crappie	26
blackside darter	17
bigmouth shiner	16
channel catfish	15
green sunfish	8
white sucker	7
northern hogsucker	6
golden redhorse	5
bluegill	5
pumpkinseed	2
blacknose dace	2
yellow perch	1
walleye	1
tadpole madtom	1
silver redhorse	1
northern pike	1
hybrid sunfish	1
fathead minnow	1
common shiner	1
central mudminnow	1
black bullhead	1



8/2/2017

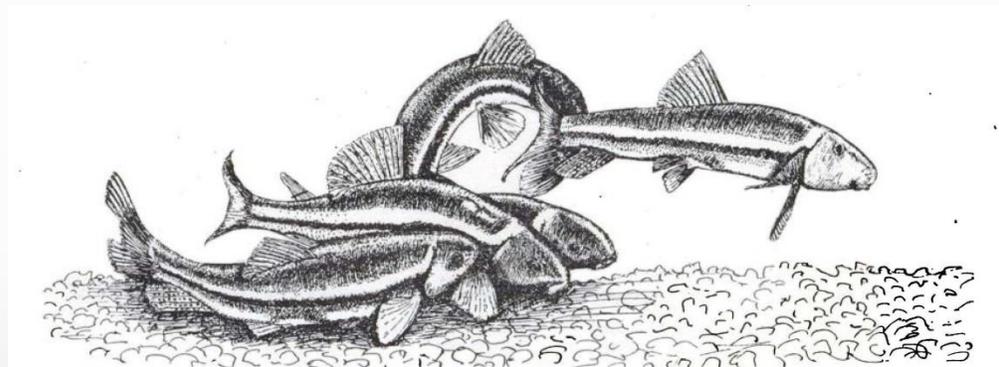
CommonName	Number
johnny darter	112
green sunfish	95
bluegill	82
white sucker	35
blackside darter	33
spotfin shiner	32
pumpkinseed	32
shorthead redhorse	26
hornyhead chub	23
common carp	16
tadpole madtom	14
black crappie	12
central mudminnow	11
bluntnose minnow	10
yellow perch	9
longnose dace	7
hybrid sunfish	6
creek chub	6
blacknose dace	4
black bullhead	4
largemouth bass	3
common shiner	3
walleye	2
smallmouth bass	2
northern hogsucker	2
logperch	2
fathead minnow	2
bigmouth shiner	2
yellow bullhead	1
northern pike	1
brown bullhead	1
brook stickleback	1

# North Fork Crow River Watershed Preliminary Results

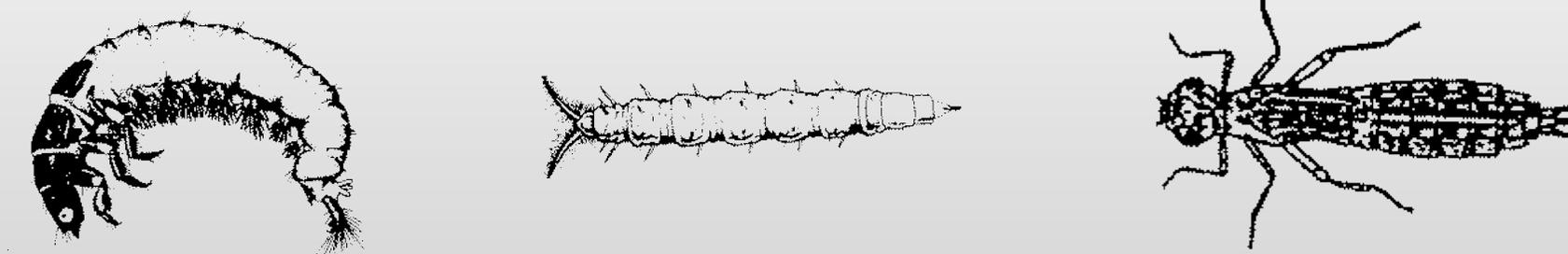


# North Fork Crow River Watershed Preliminary Results: Fish and Bugs

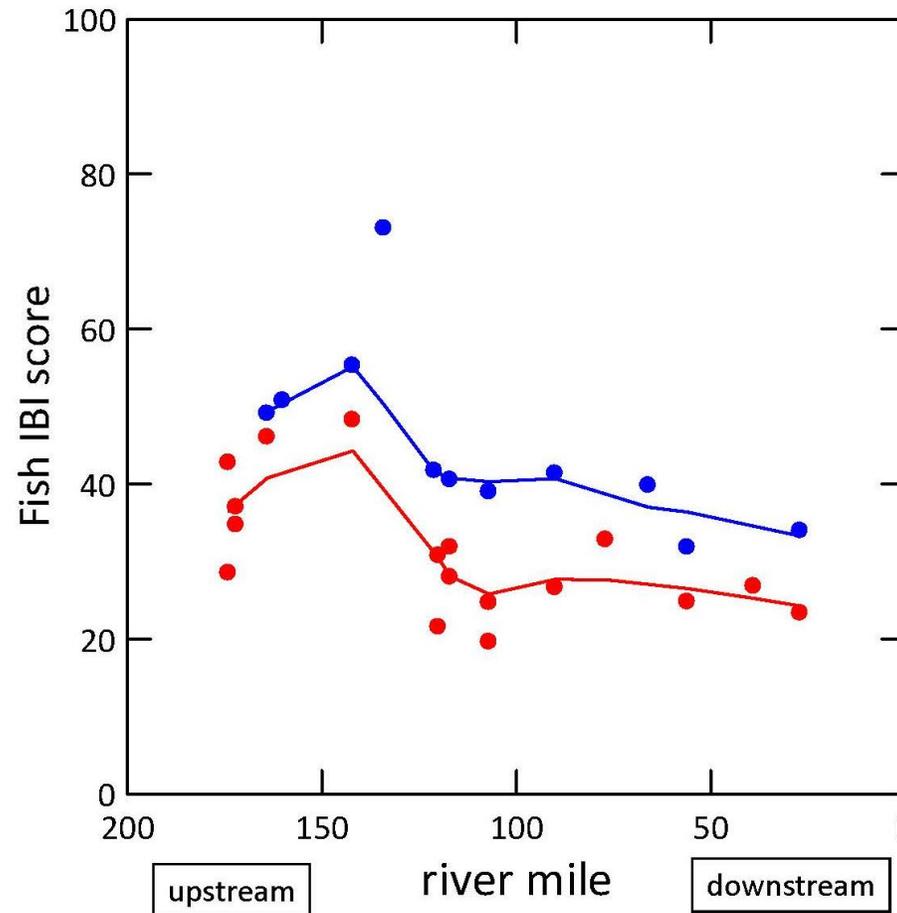
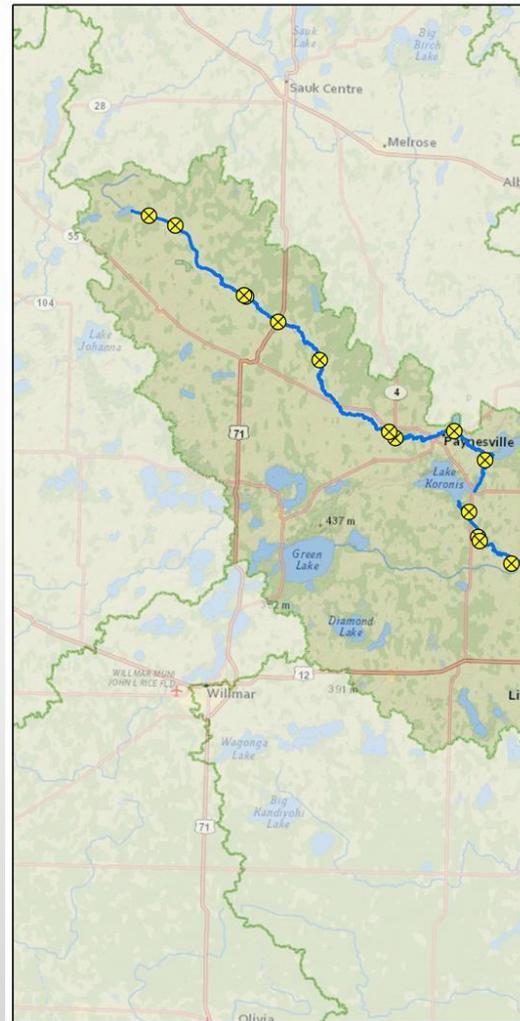
Average change in FIBI score for the watershed was 5.7 points



Average change in MIBI score for the watershed was 6.4 points



# North Fork Crow River Watershed Preliminary Results

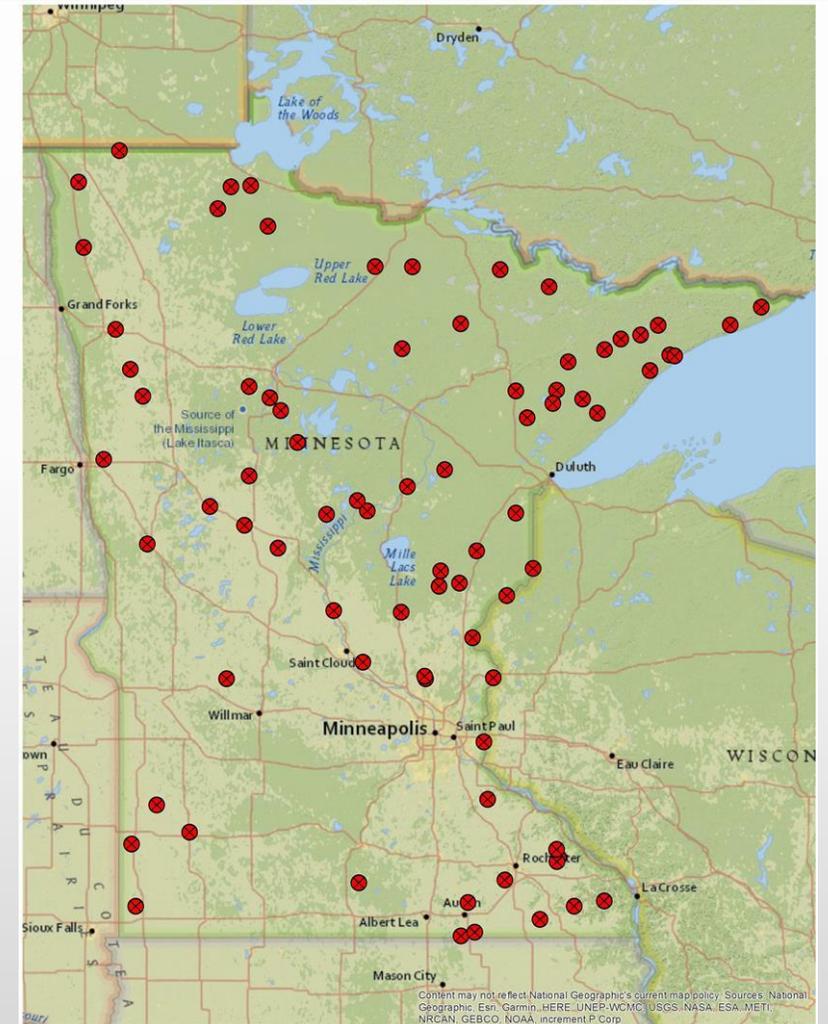


Crow River, North Fork  
FIBI scores  
2007 vs 2017

Year  
● 2007  
● 2017

# Additional Long-Term Monitoring

- 60 reference streams
- 25 Sentinel Lakes
- 12 depressional wetlands

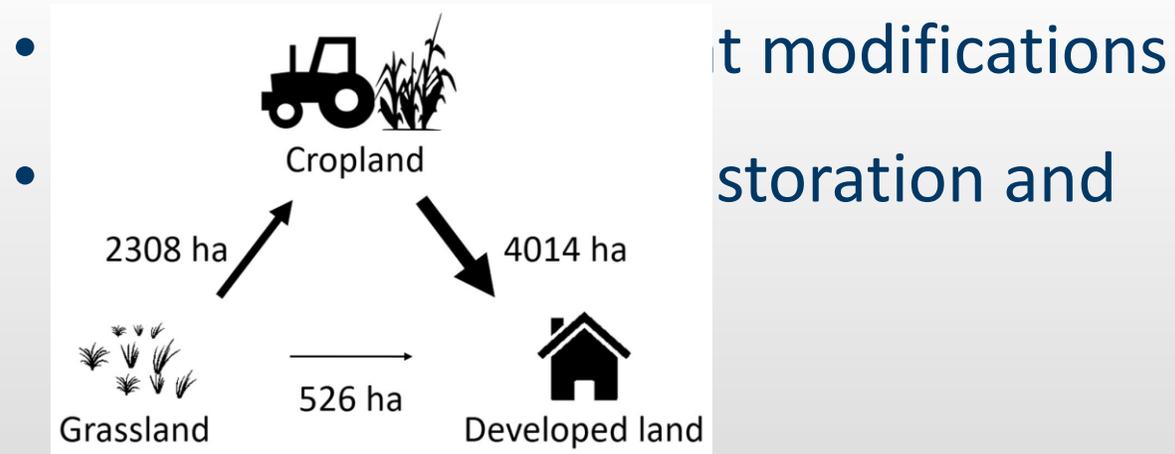


- Why are things changing?
  - Weather and climate change



- Why are things changing?

- Weather and climate change
- Land use



Images used with permission: Lark et al. 2018



**Eileen Campbell**

*eileen.campbell@state.mn.us*

507-344-5244



**Thank  
you!**



**John Sandberg**

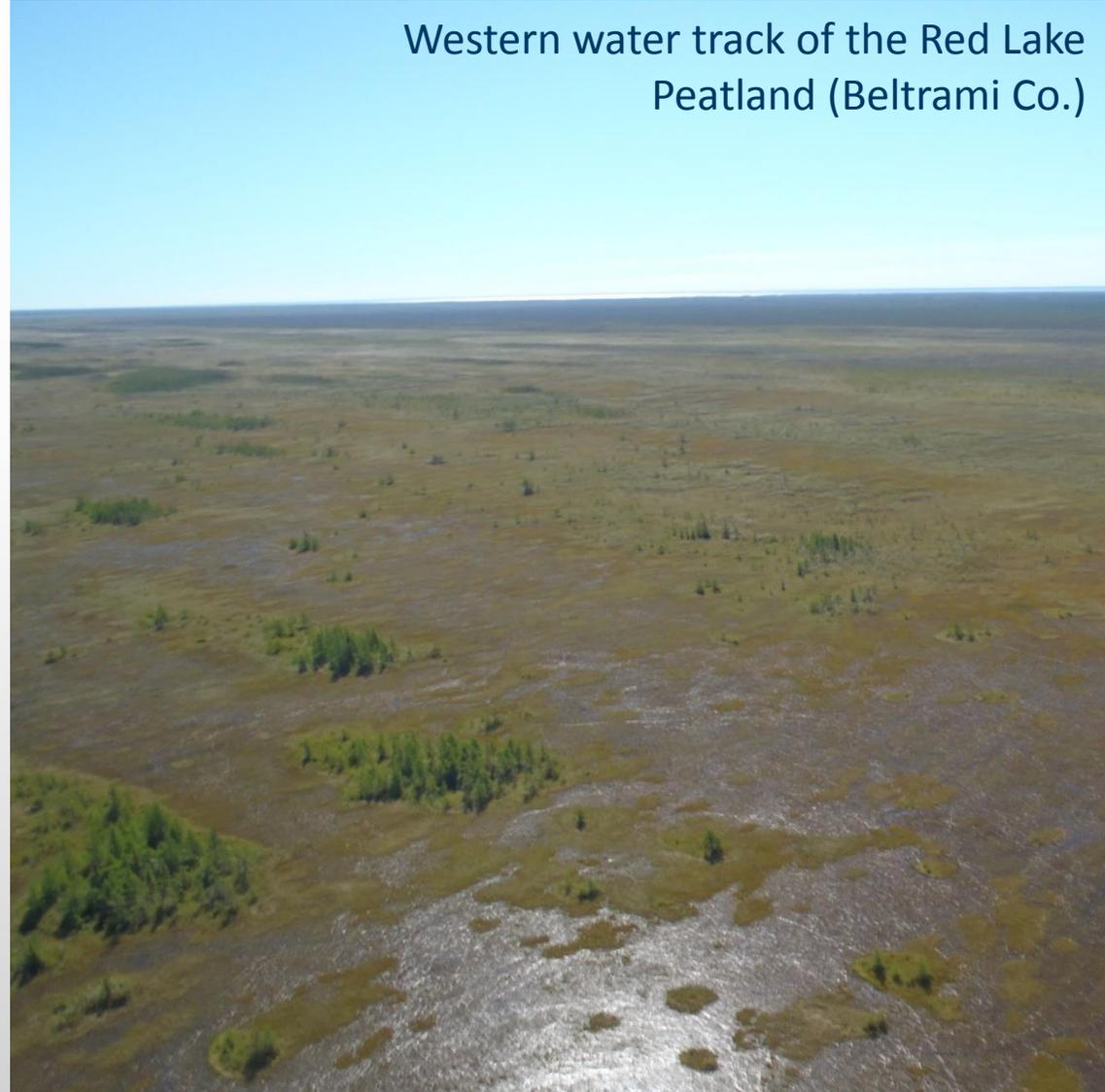
*john.sandberg@state.mn.us*

218-316-3913

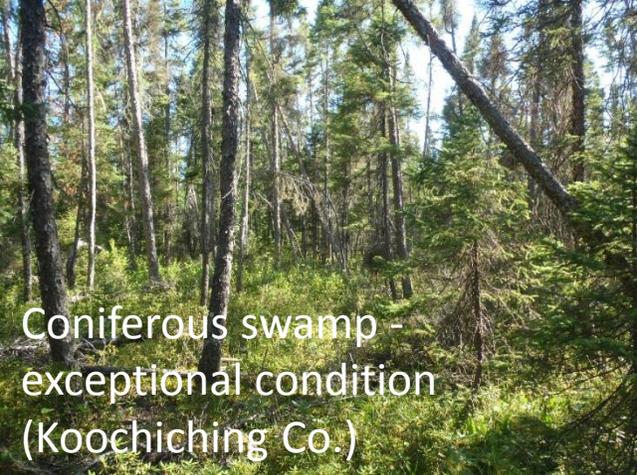
# MPCA Wetland Monitoring

- Wetlands—MN's largest surface water type (10.6 million acres)
- No-net-loss in wetland quantity and *quality*
- Focus is on probabilistic monitoring
- Goal: Statewide & regional wetland status & trends
- Two surveys done in conjunction with EPA's National Wetland Condition Assessment
- Minnesota Wetland Condition Assessment (2011-16)
  - Statewide/all wetlands
  - Vegetation condition is the primary indicator
- Depressional Wetland Condition Assessment (2006 – 17)
  - Central/western MN/prairie potholes
  - Vegetation, macroinvertebrates, water chemistry

Western water track of the Red Lake Peatland (Beltrami Co.)



# 2016 Vegetation Quality Status



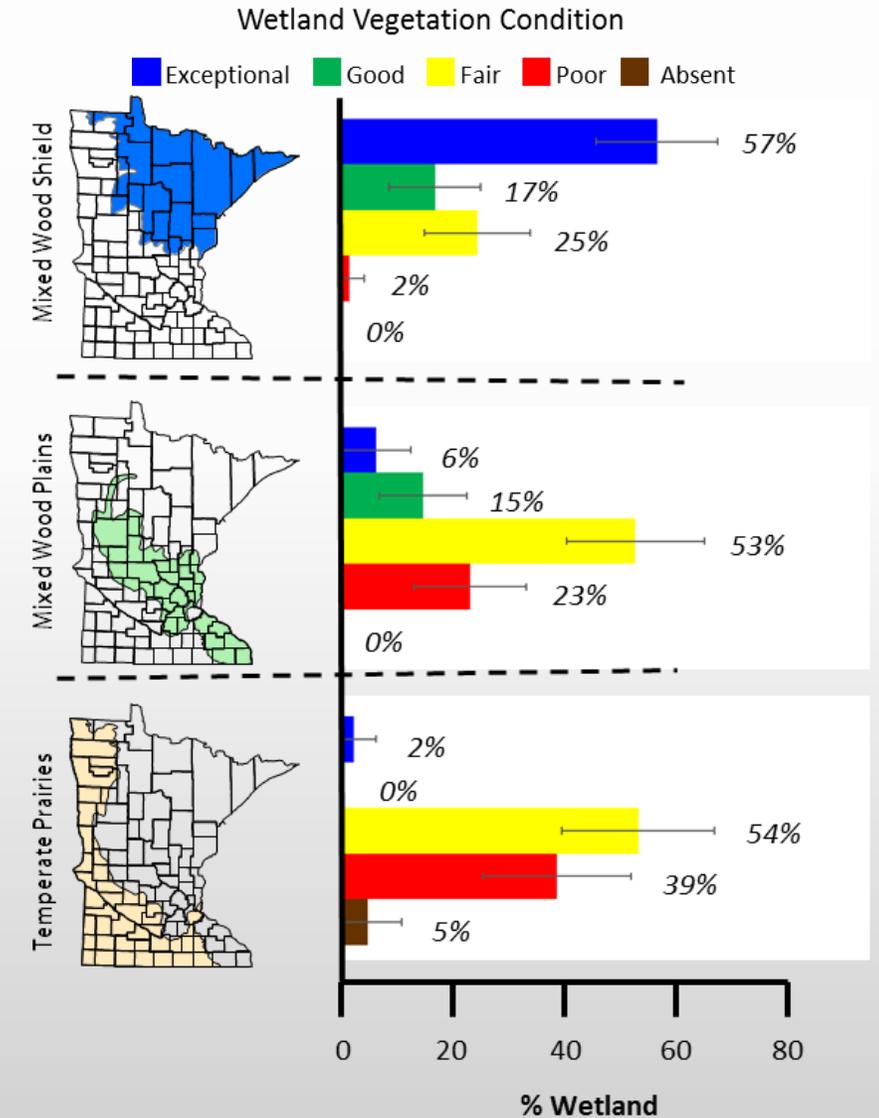
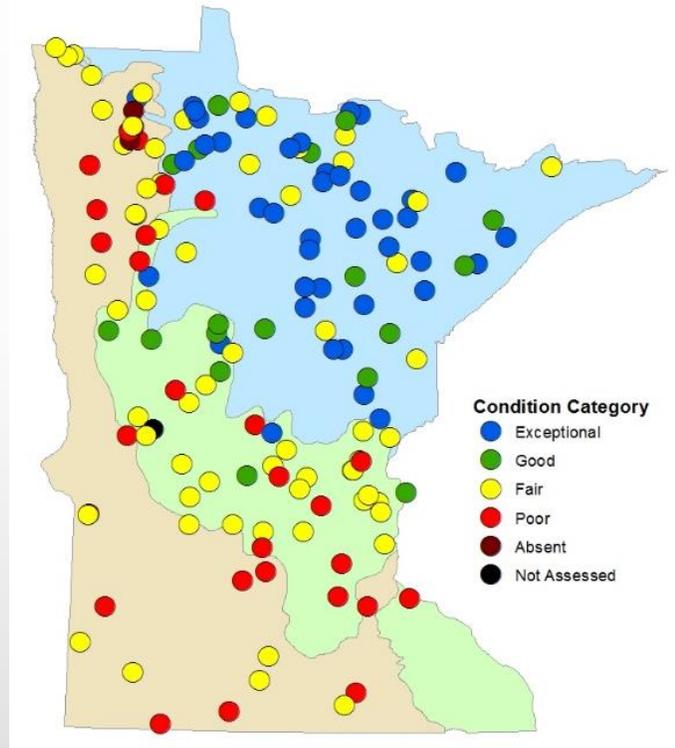
Coniferous swamp - exceptional condition (Koochiching Co.)



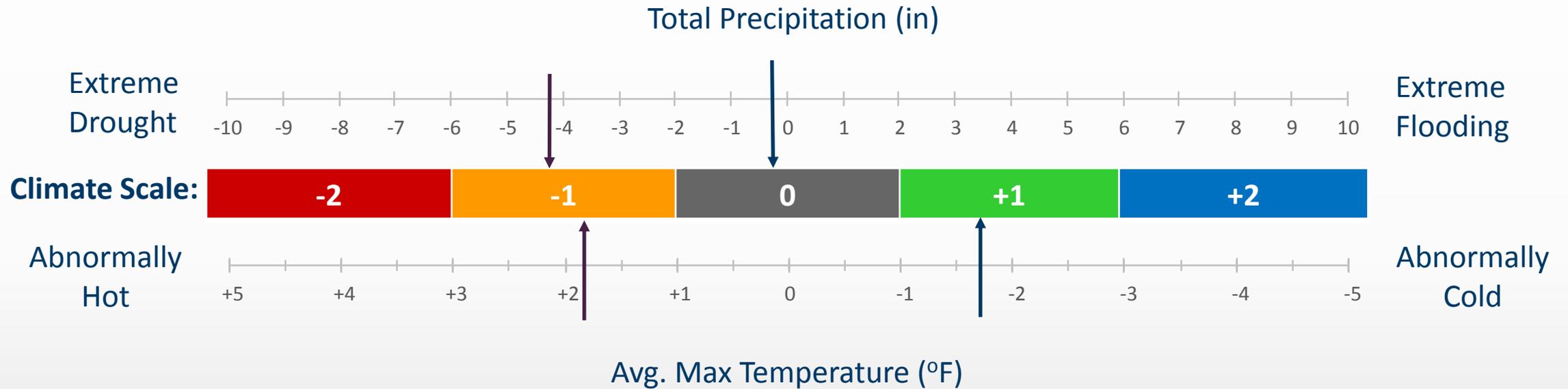
Logged coniferous swamp - fair condition (Koochiching Co.)



Coniferous swamp invaded by narrow leaved cattail - fair condition (Pope Co.)



# Example: North Fork Crow Watershed 2007 & 2017



## 2007:

Total May-Sep Precip: 14.9 in (**-4.2**)  
Avg. May-Sep Max Temp: 78.1 °F (**1.8**)

## 2017:

Total May-Sep Precip: 18.7 in (**-0.3**)  
Avg. May-Sep Max Temp: 74.5 °F (**-1.8**)

## Norms for Watershed (1981-2010):

Total May-Sep Precip: 19.0 in  
Avg. May-Sep Max Temp: 76.3 °F

# Cycle2 Monitoring Design: Biological Indicators

