http://LakeSuperiorStreams.org

Making stormwater and stream data come alive for citizens, students, teachers, contractors, resource agencies, decision-makers, and scientists

Presented by Rich Axler at 5th International National Water Quality Monitoring Council Conference, May 11, 2006, San Jose, CA

DuluthStreams.org → LakeSuperiorStreams.org

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Nate Meyer

Cooperators

WLSSD

Minnesota Pollution Control Agency

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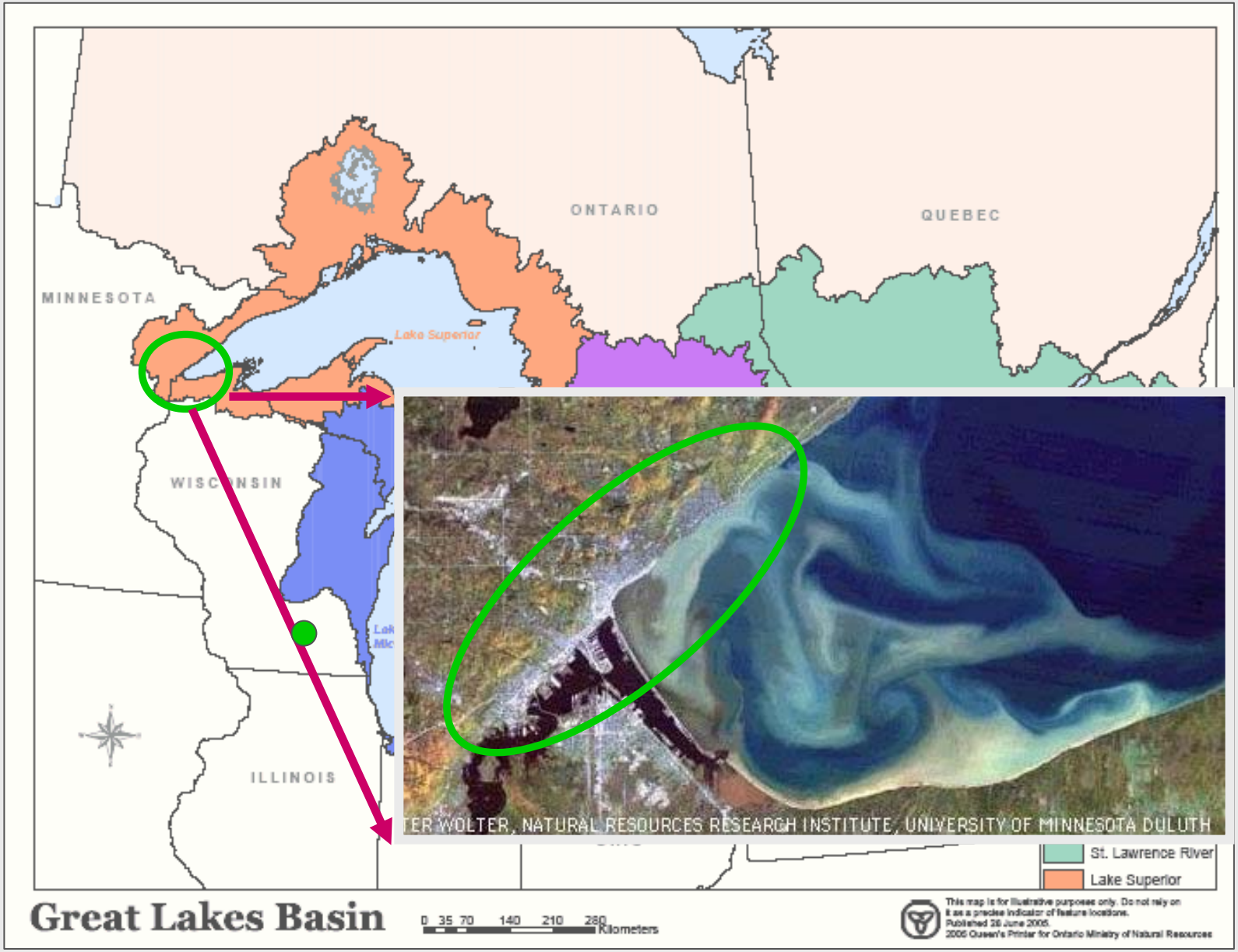
UMD Duluth

South St. Louis Soil & Water Conservation District

Mindy Granley

Zoo Lake Superior Zoo - Duluth

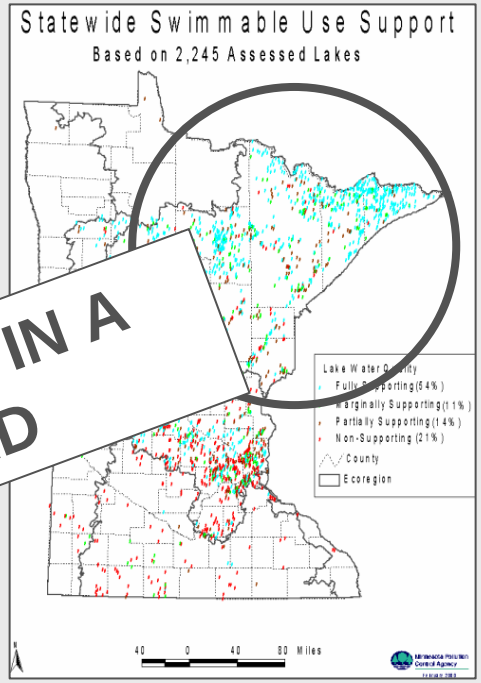
Northeastern MN – Western Lake Superior



Northeastern Minnesota waters

A very sensitive region

- >5000 high quality lakes
- thin, nutrie poor soils
- high gradient, high-DO, cold and “clear” water streams
- Lake Superior



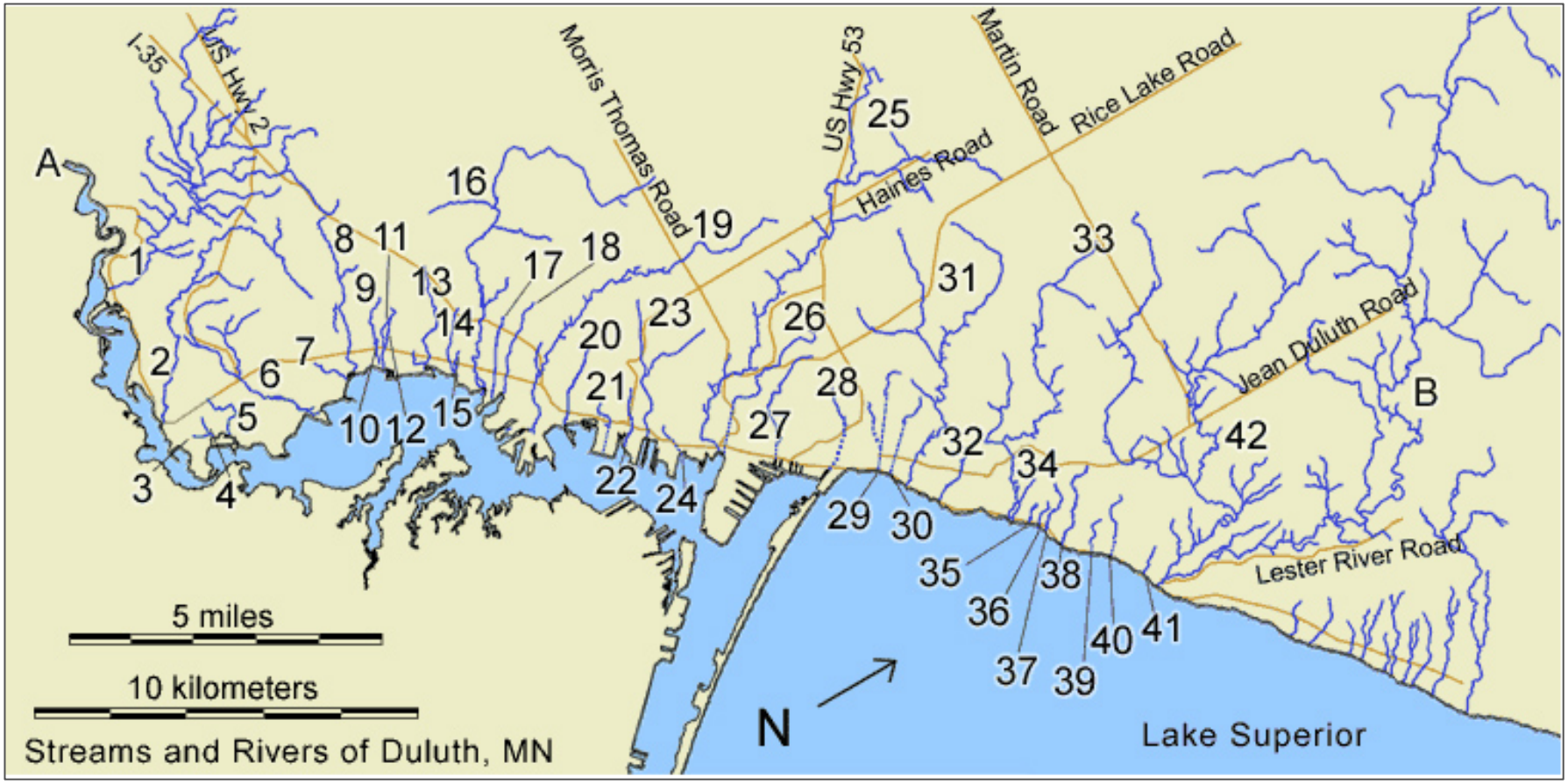
A PROTECTION MESSAGE IN A RESTORATION WORLD

Surface and stormwater quality

As in many urban areas, northeastern MN streams face environmental threats related to stormwater

DuluthStreams "Rationale"

- Duluth alone has 42 named streams
- High density for size of urban area



12 are designated trout streams

Mission

- Enhance public understanding of aquatic ecosystems and their connections to watershed land use

<u>Focus on</u>

- Economic and environmental sustainability
- People actions

… using near real-time data

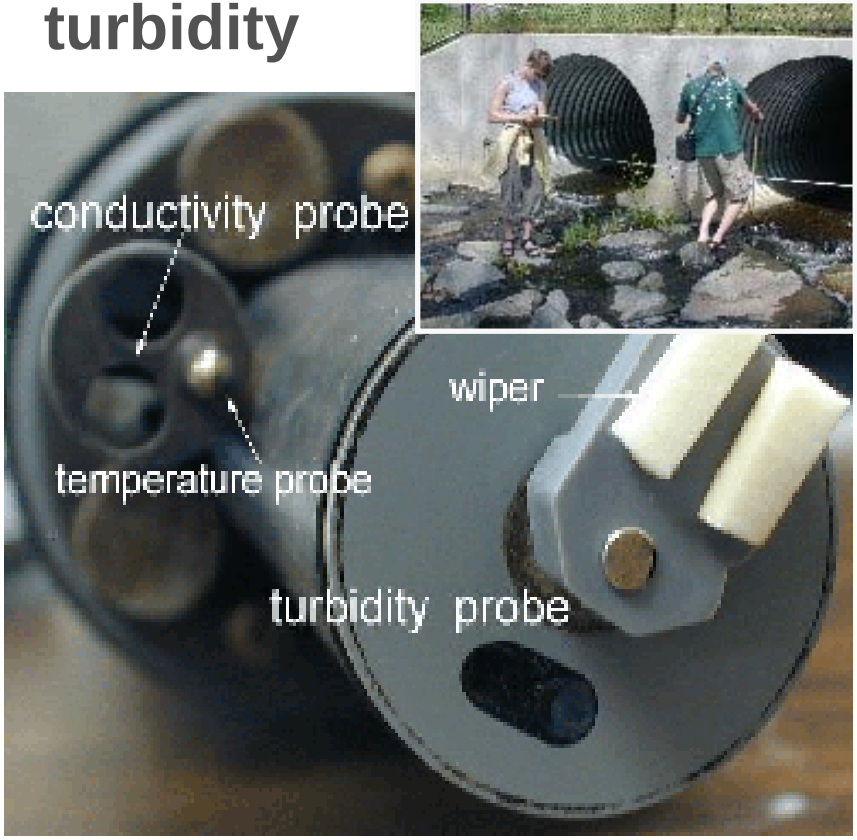
- **The "*easy*" part:**
  - Data collected and on the Web
  - Data visualization tools
  - Explanatory materials
- **The hard part:**
  - Making the data understandable and interesting for everyone!
    - General public
    - Students and teachers
    - Contractors and consultants
    - Decision makers
    - Agencies
    - Scientists

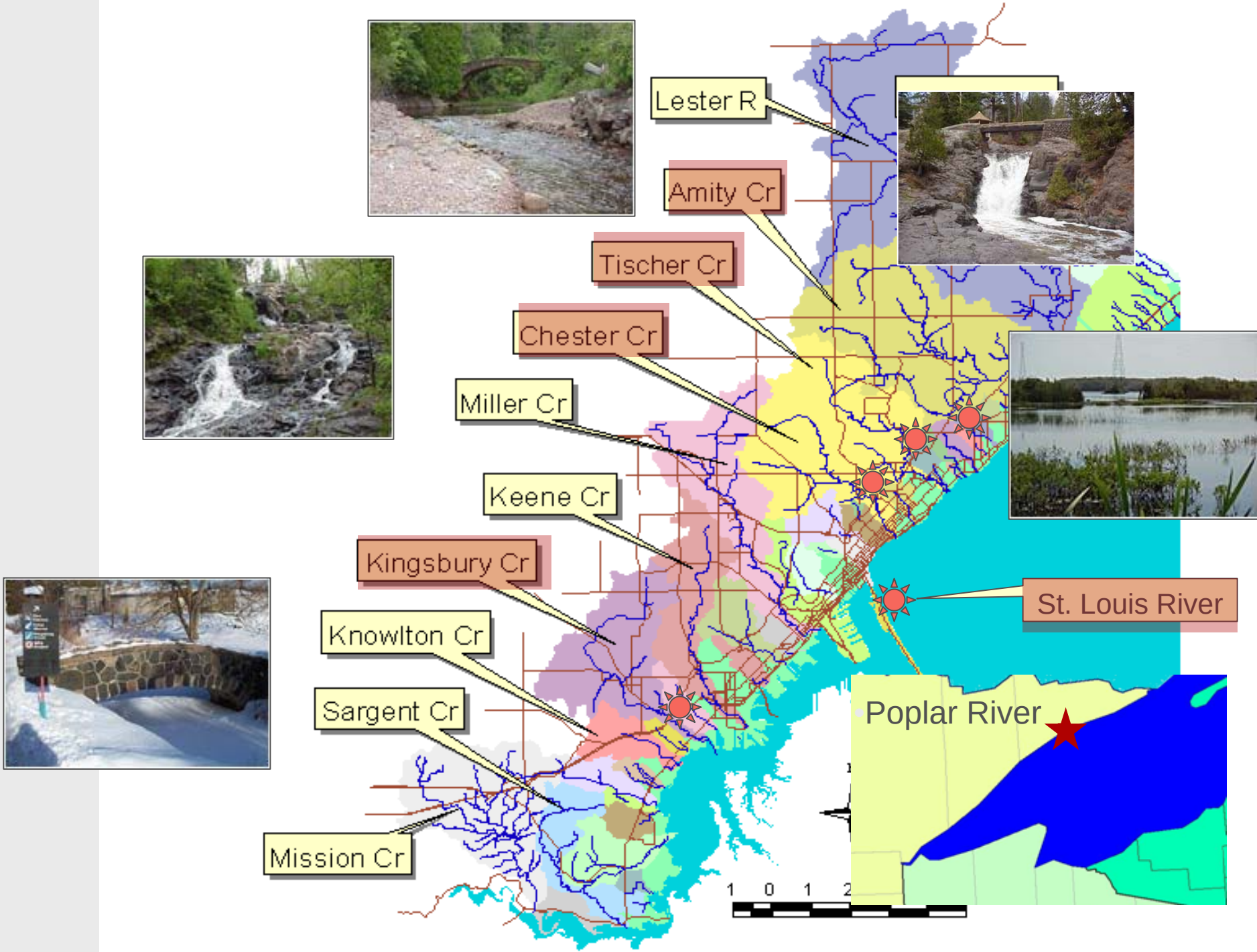
More specific original objectives:

- Install real-time remote WQ sensors in Tischer, Chester, Kingsbury, Amity Creeks and the St. Louis R.
- Deliver information using advanced data visualization tools over the Internet and at public kiosks (Great Lakes Aquarium and Duluth Zoo)
- Link data for 12 trout streams with GIS technology to current and historical WQ and biological databases
- Incorporate visually engaging interpretive text, animations and videos into the website to illustrate the nature and consequences of degraded stormwater and real costs to society

Automated stream sampling

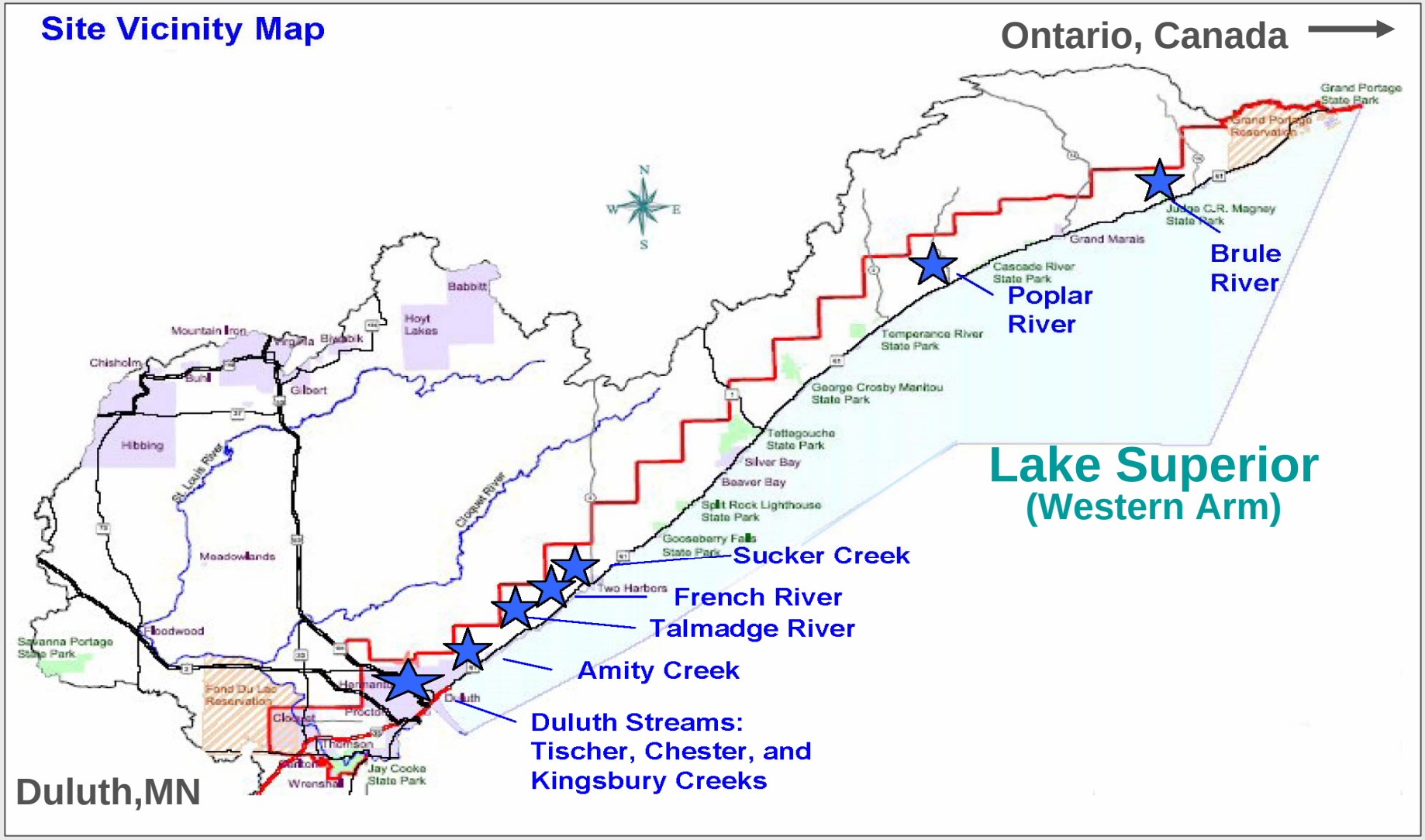
- Instruments log data every 15 minutes for daily delivery to web-site and data visualization tools
- Flow, temperature, specific conductivity (EC25), turbidity



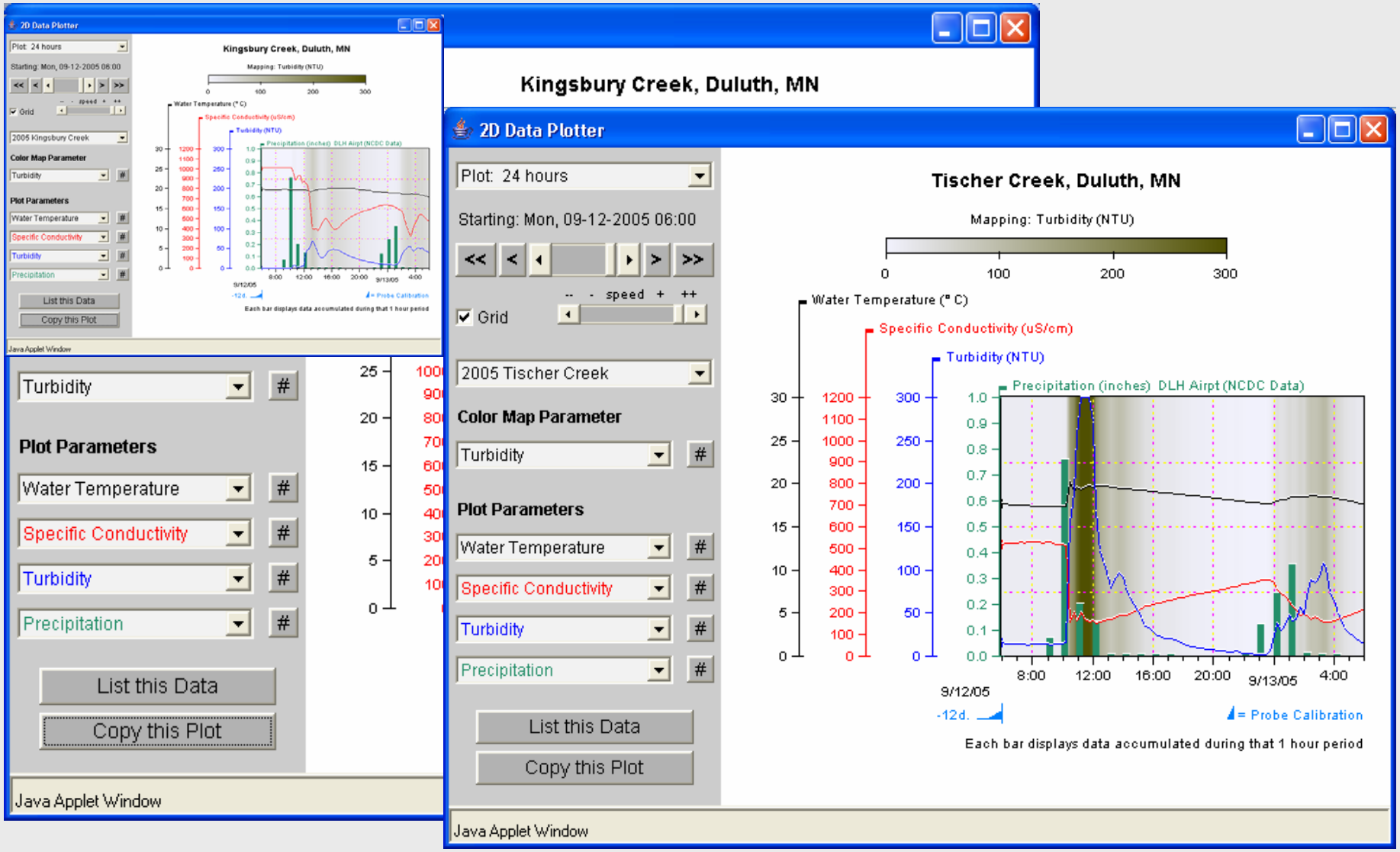

Lester R
Amity Cr
Tischer Cr
Chester Cr
Miller Cr
Keene Cr
Kingsbury Cr
Knowlton Cr
Sargent Cr
Mission Cr
St. Louis River
Poplar River
1 0 1 2

Future sites: Wish list – MPCA long-term sites ★

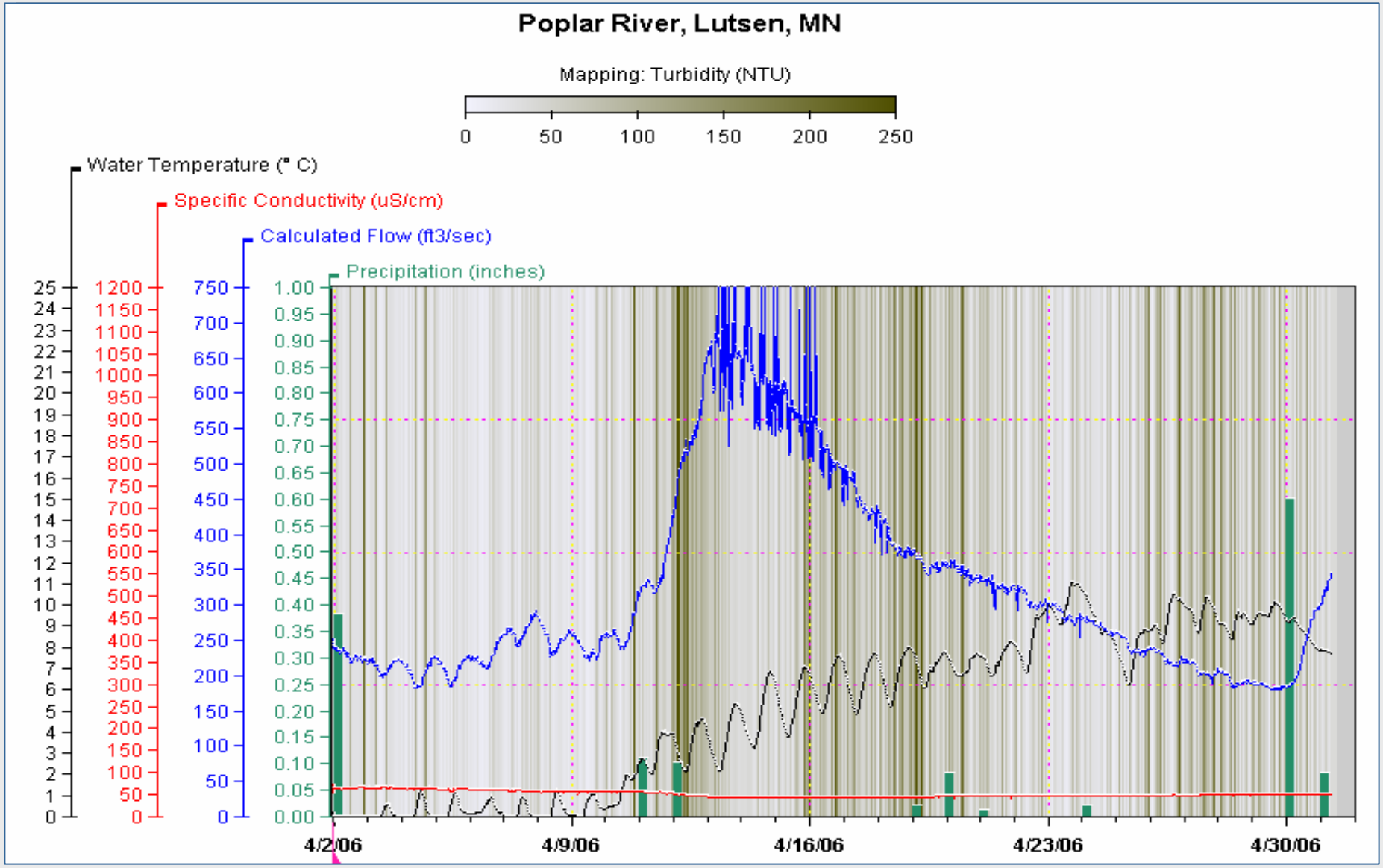
+ Impairments (TMDLs), Parks (pristine ?), multiple sites in more urbanized streams



Data visualization and animation tools: September - October 2005 gully washers



Rain on top of snow – Poplar River April 2006 (turbidity TMDL)



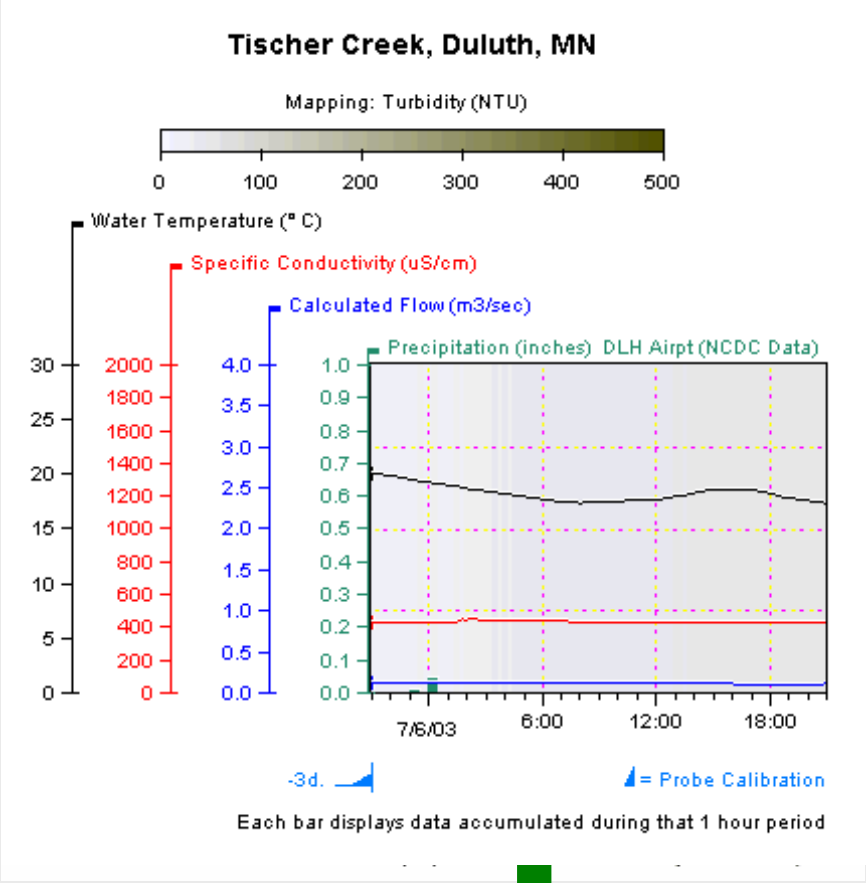
Examples of other data “vignettes”

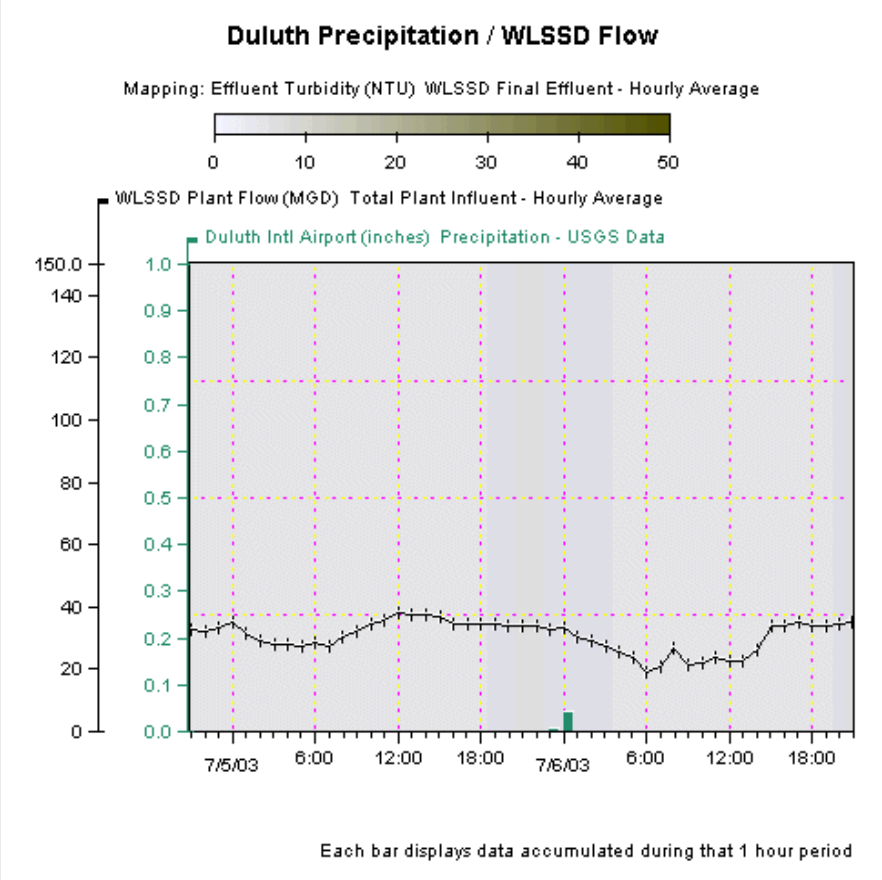
- Increased turbidity from high runoff and erosion
- Flashy stream flow surges and Inflow and Infiltration (*I & I)* events causing sewage overflows and spills
- Temperature “spikes” from rain water running across hot roads and parking lots
- Short-term (hours) increases in salt concentration during early winter snowfalls from de-icers
- Longer-term (weeks) increases in salt and turbidity levels during early stages of spring runoff
- Seiche effects between Lake Superior and the St. Louis River Estuary (Duluth-Superior Harbor)

When it rains hard in Duluth… July 2003

Stream flashiness
Flow and turbidity (sediment)

Sewage plant flashiness
Inflow & Infiltration (I&I)

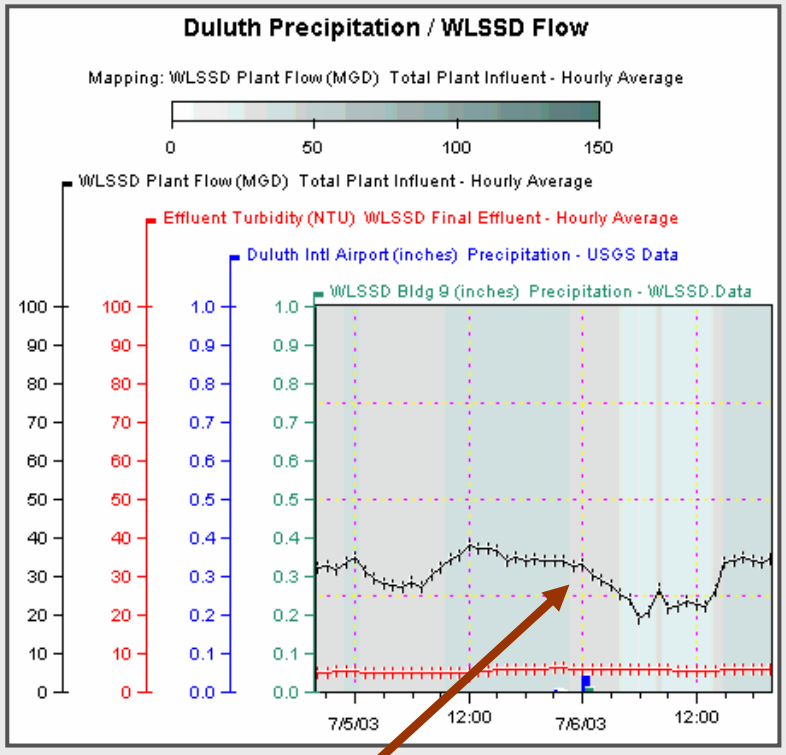




Look for increased rain, muddy **brown** water and WLSSD discharge

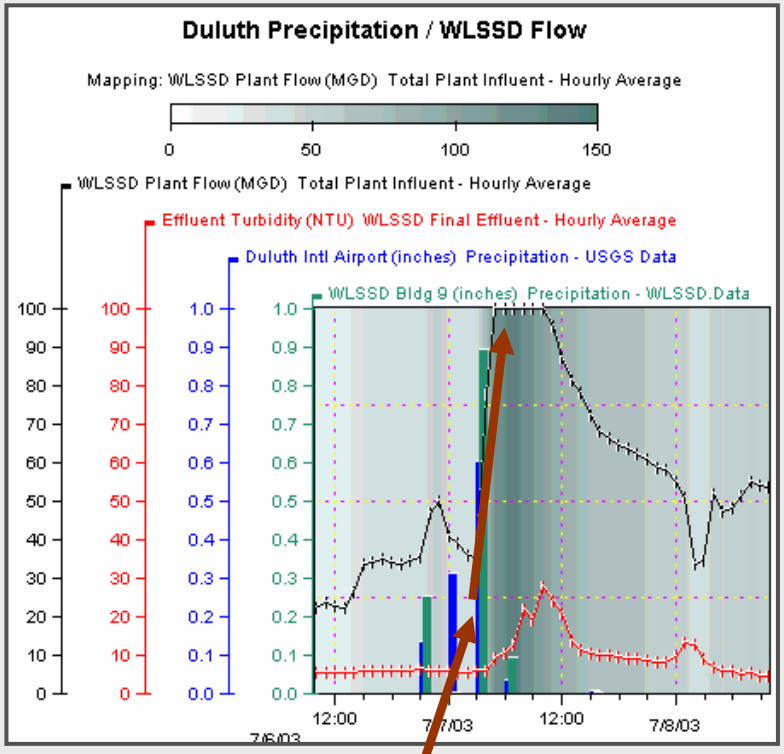
When it rains hard in Duluth 2003…

July 6, 2003 - cloudy



Plant running @ 25-40 mgd

July 7, 2003 – 1- 2 “ rain



Plant running @ 140 mgd

Eight overflows in WLSSD’s collection system released roughly one million gallons of untreated sewage.

A lot happens from all this “extra” water

- About 5.8 mgd in sewage overflows
- Elevated coliform bacteria (health risks)
- Pollutant loads to Lake Superior

LakeSuperiorStreams and the new Lake Superior Beach Monitoring Program

NEWS RELEASE

Minnesota Pollution Control Agency

www.pca.state.mn.us

Toll-free and TDD 1 (800) 657-3864

Saint Paul • Brainerd • Detroit Lakes • Duluth • Mankato • Marshall • Rochester • Willmar

FOR IMMEDIATE RELEASE August 5, 2003

Teachable Moment!!

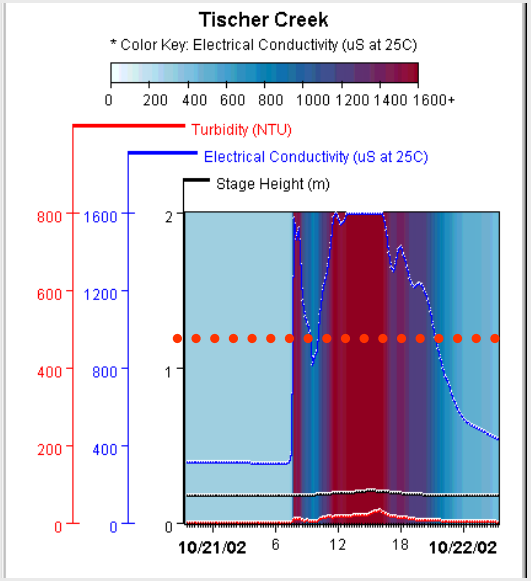
Warnings on the waterfront

Source: JOHN MYERS NEWS TRIBUNE
Duluth News Tribune
CLEAN WATER: Sewage spills
changed perceptions of
St. Louis River se
Superior h
som
con
thou
have shocked
an unexpected
en't as pristine as we

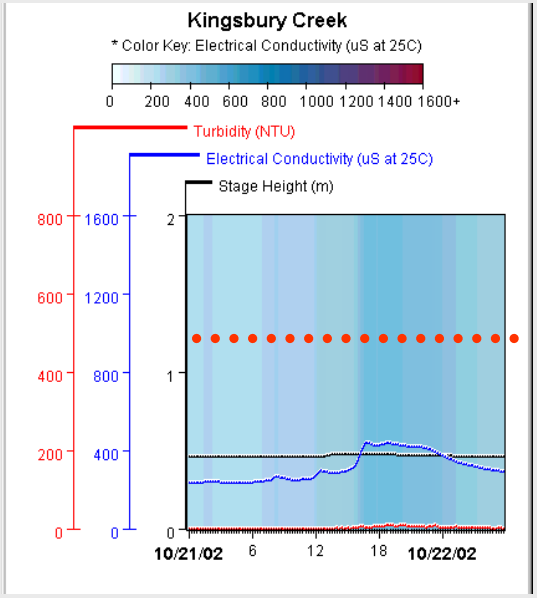
"NO WATER CONTACT" ADVISORY SIGNS PLACED today at three public beaches

FOUR WATERFRONT AREAS OFF-LIMITS

Stream data visualization tool: Salt loading, October, 2002



Tischer



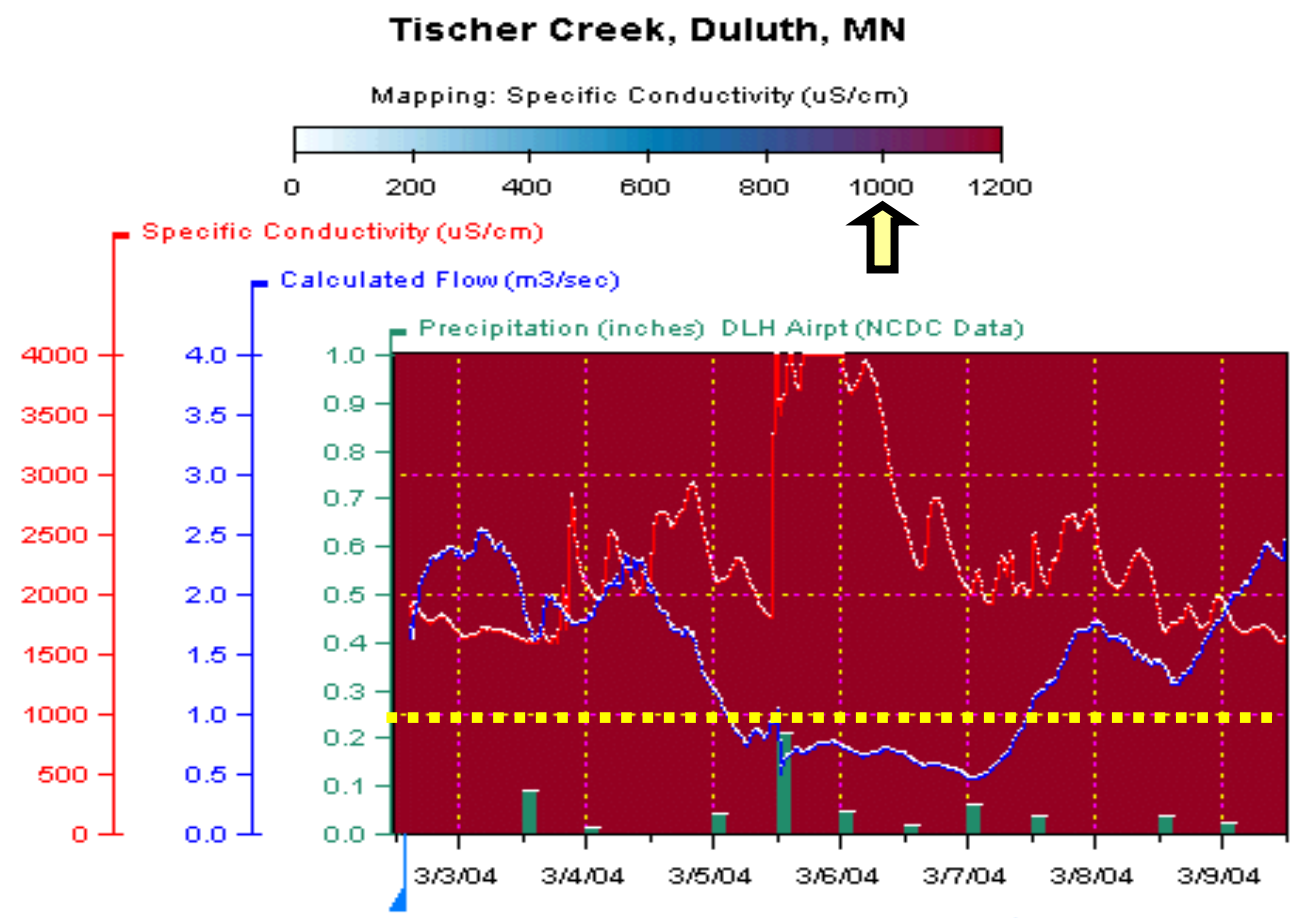
Kingsbury

Higher salt level = higher electrical conductivity

(Look for darker blue to magenta changes)

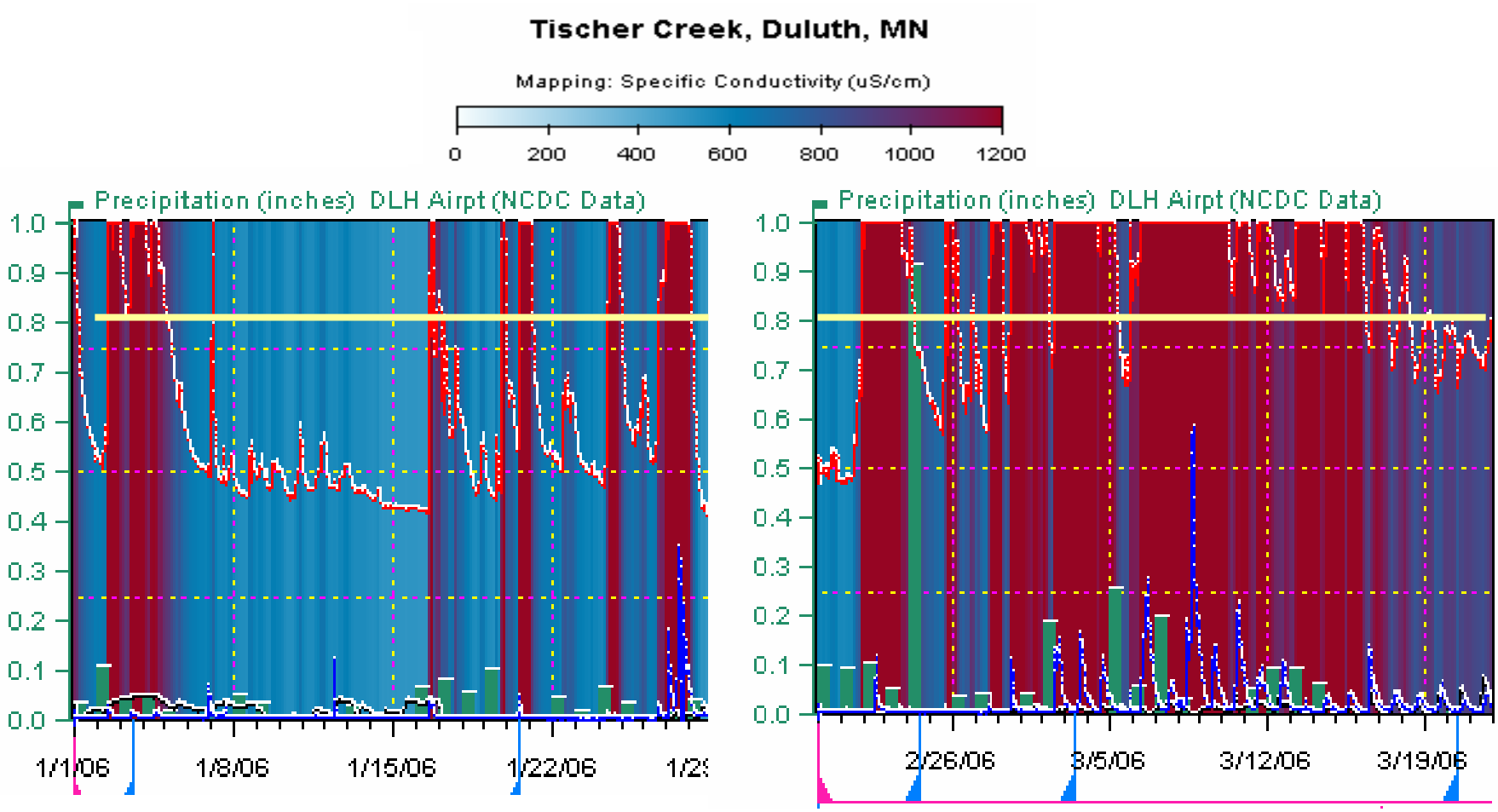
• • • •

Spring runoff 2004 – 3 weeks of salt exceeding chronic adult brook trout criterion



= chronic toxicity to brook trout

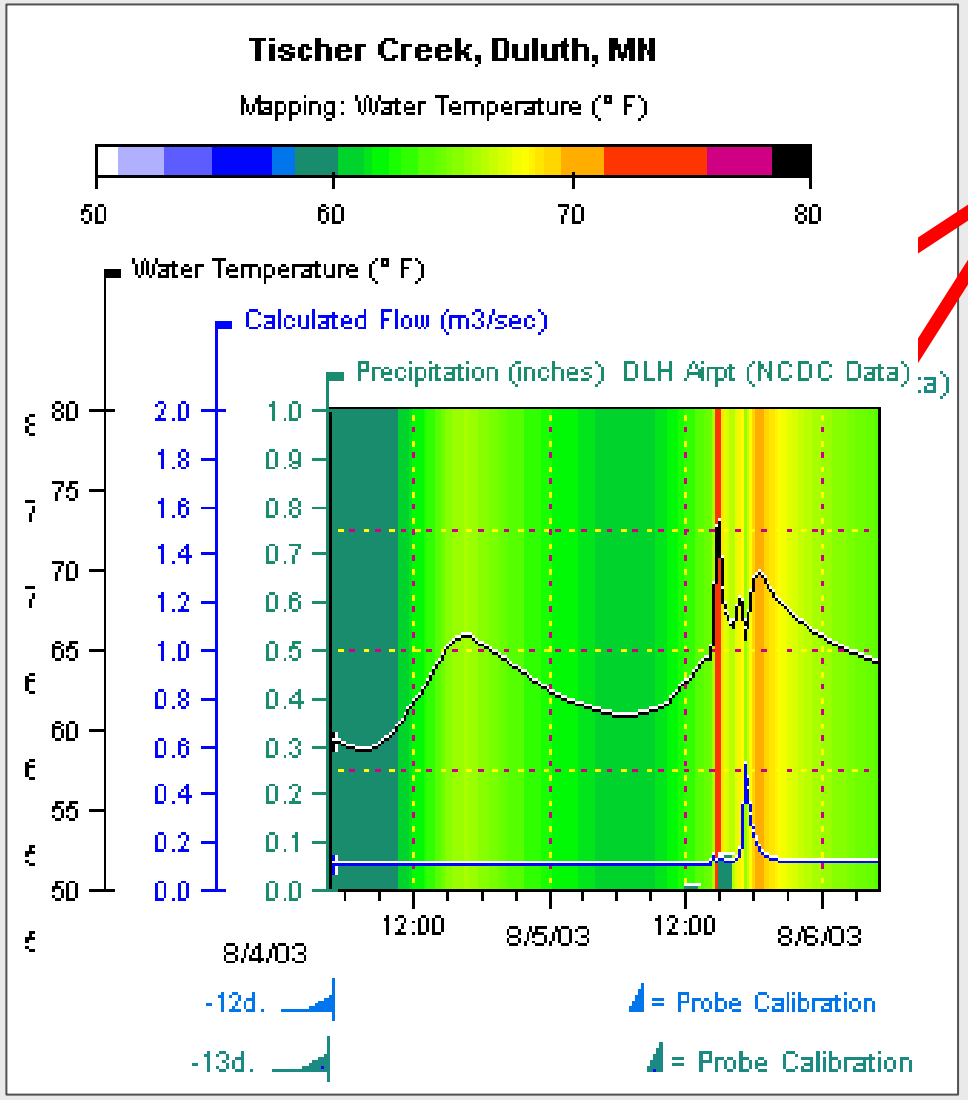
Winter-Spring 2006 …



The warmest January in >150 yrs

The main snowmelt in early March

Middle of the night spikes of 3-6ºC from stormwater road/lot runoff



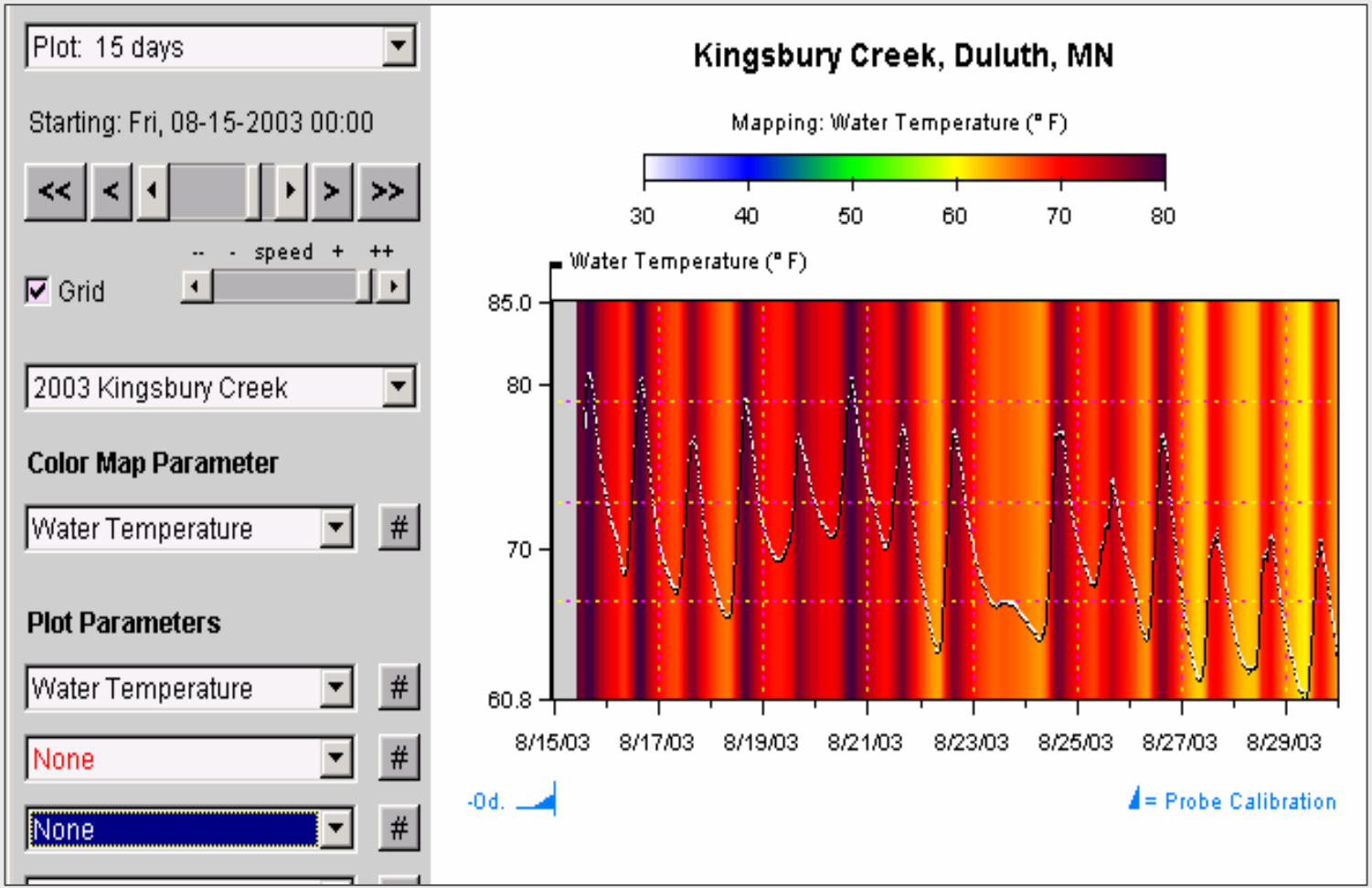
Stream temperature is a major stressor of Duluth trout. See how roads and lots warm the water by >5 ºF

Lesson – even moderate rain can cause a 5-11 ºF jump as water moves across warm asphalt.

Trout in more developed watersheds are already near the upper range of their temperature tolerance in the summer.

Brook trout stress

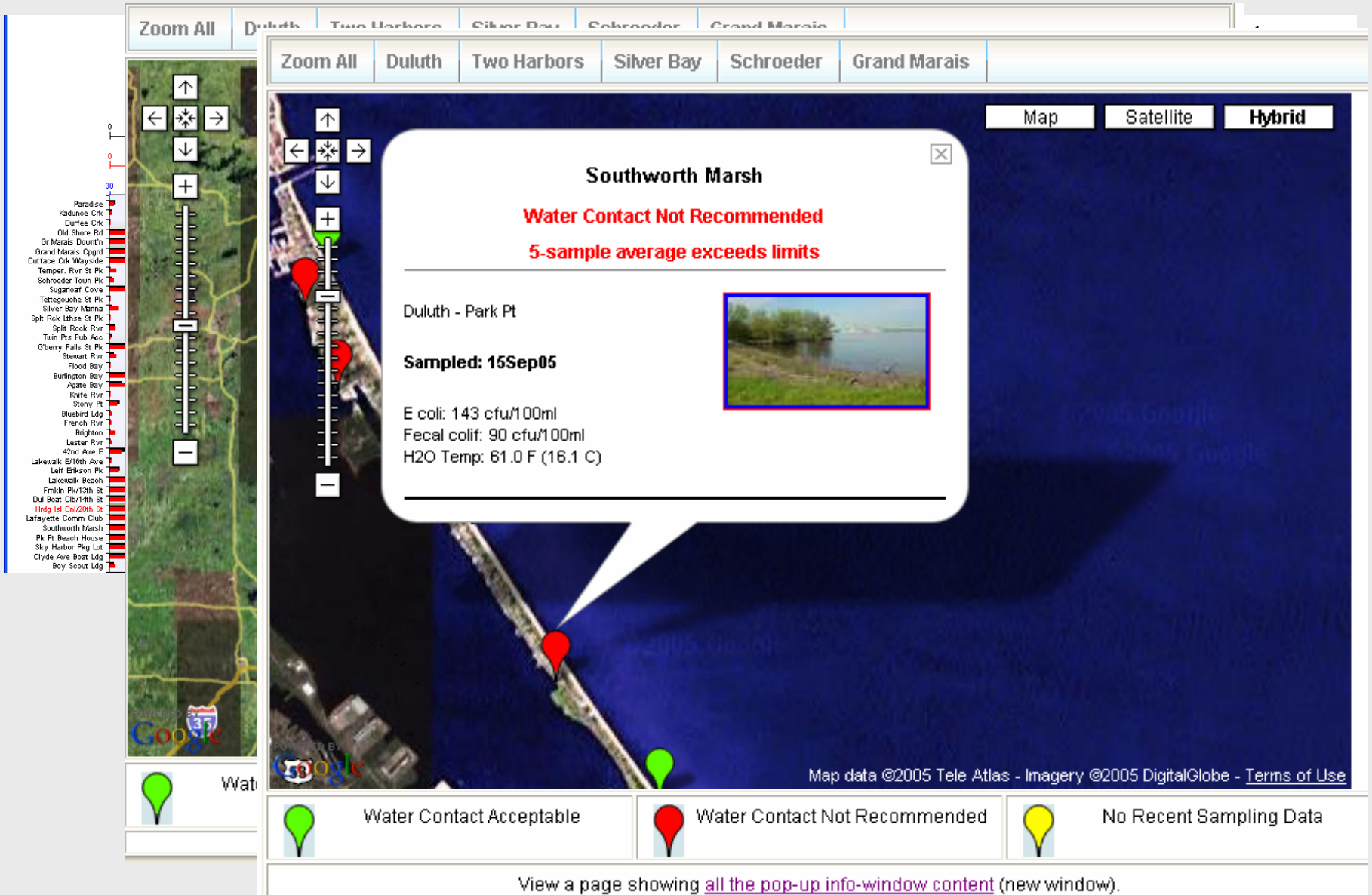
- 15 days continuously over the optimal temperature range for brook trout; exceeding upper limit 10 times



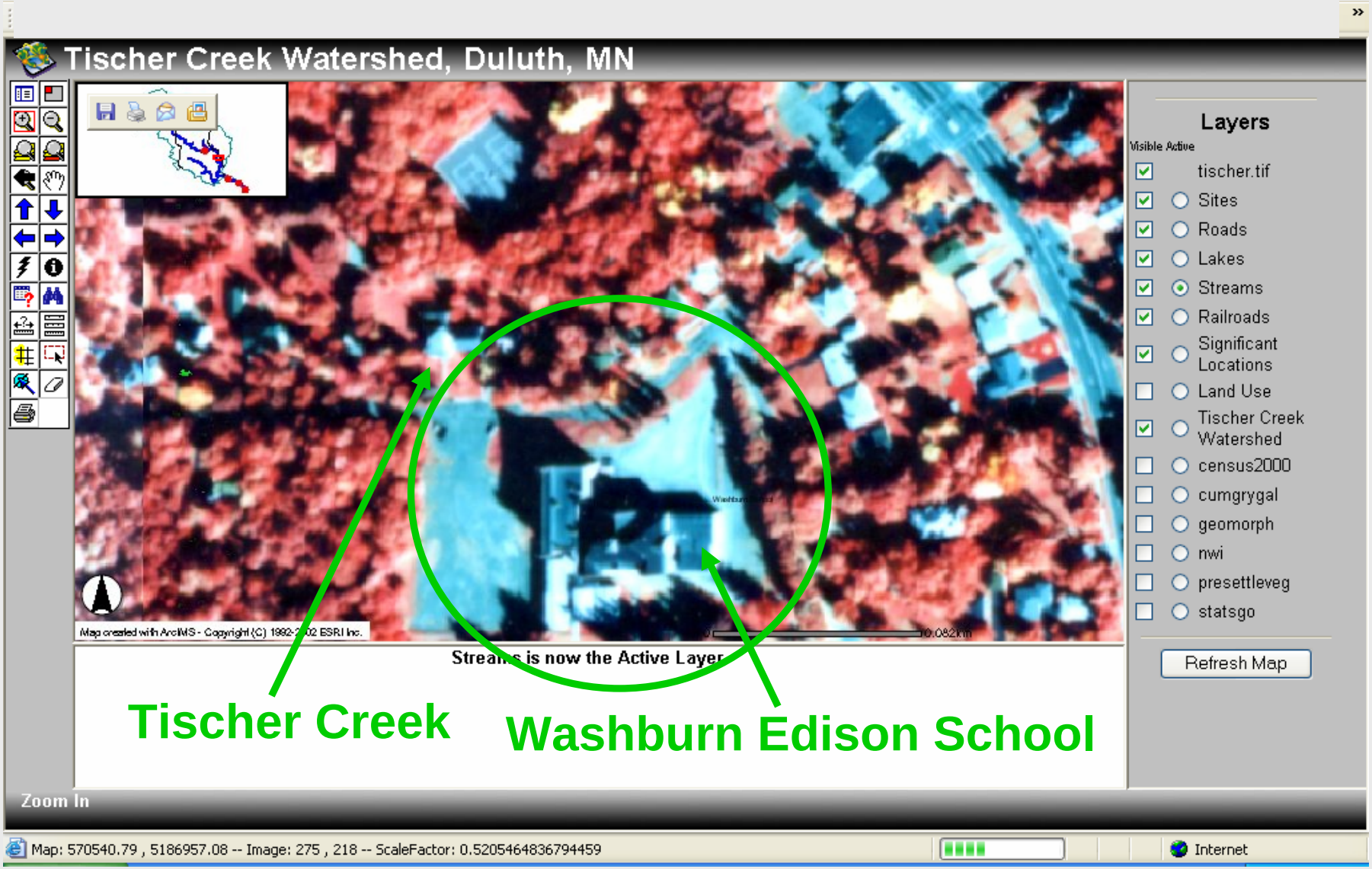
New bacteria dataviewer and map utility

www.lakesuperiorstreams.org/bacteria

www.mnbeaches.org

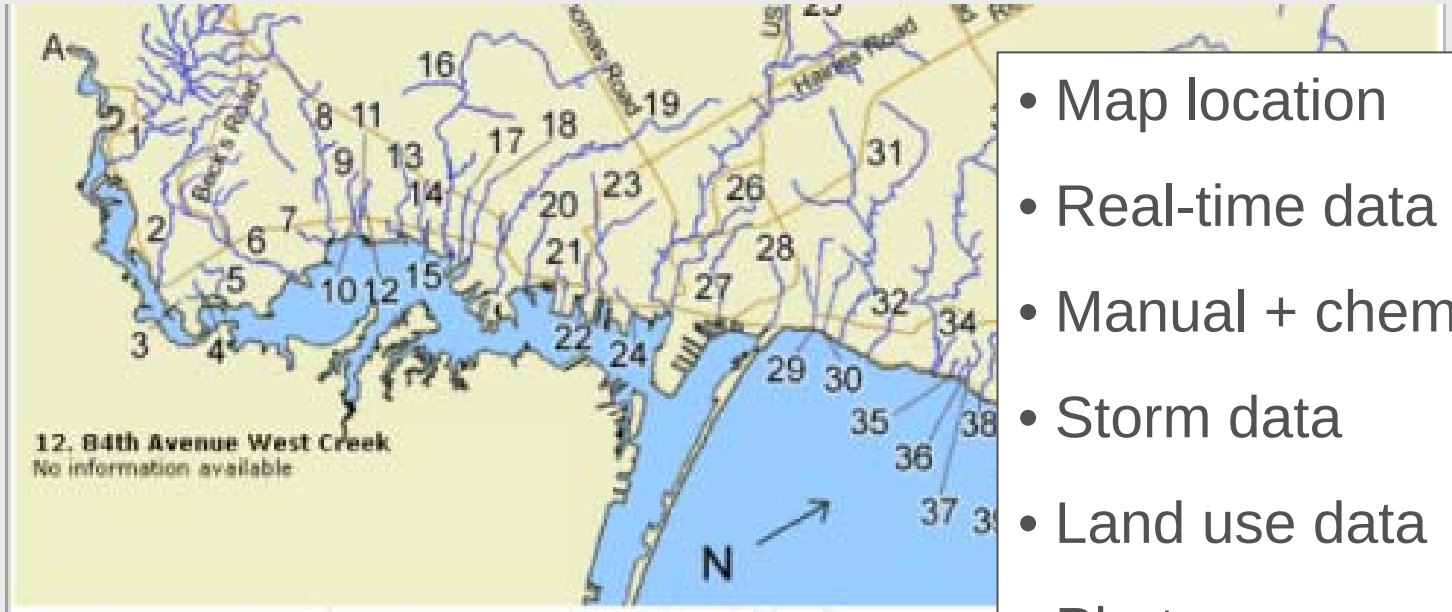


Other *DuluthStreams* Data – Check out the GIS-IMS Utility



You can zoom in and overlay streams, roads, land uses, etc.

Stream data “library” index



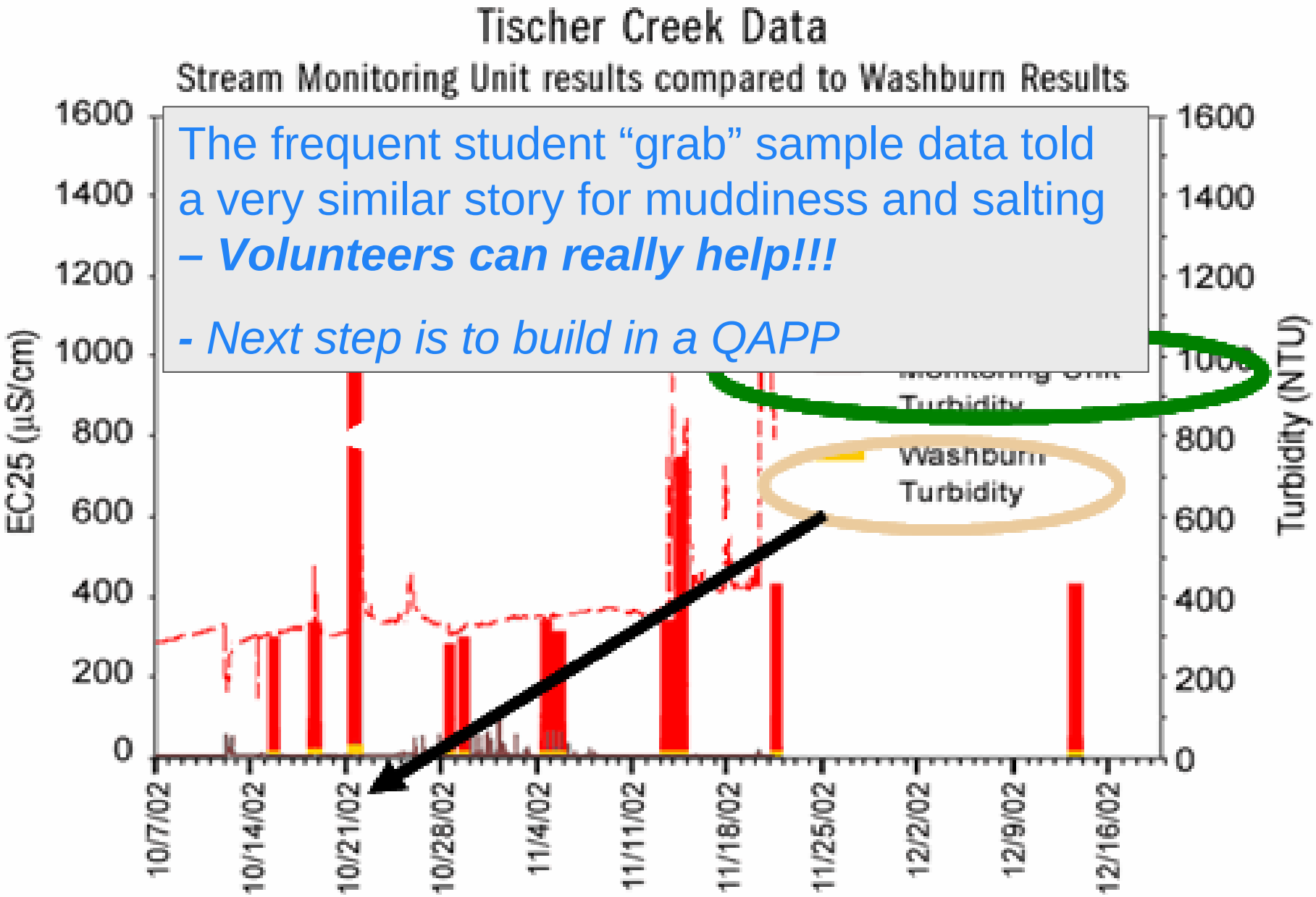
mouse over stream number to see stream name and available information

Data and information available for the Duluth Streams:

Stream	Map location	Real-time data	Manual & chemistry data	Trout stream	Storm data	Land use data	Ph			
Amity Creek	42	yes	yes	yes		yes	y			
Bowser Street Creek	4									
Brewery Creek	29					yes				
Buckingham Creek	27					yes	y			
Chester Creek	31	yes	yes	yes	yes	yes	y			
Clarkhouse Creek	28					yes	yes	yes		
Coffee Creek	26					yes	yes			

- Map location
- Real-time data
- Manual + chemistry data
- Storm data
- Land use data
- Photos
- Historical photos
- GIS Map utility
- Reports (links + pdfs)

School Curricula and Volunteer Monitoring



The frequent student "grab" sample data told a very similar story for muddiness and salting

– Volunteers can really help!!!

- Next step is to build in a QAPP

Stormwater: Site Design Toolkit, RSPT, permits…

lake superior duluth streams.org

lake superior communities understanding the streams citizens and schools

stormwater

Stormwater Plan | Inflow and Infiltration | Regional Stormwater Protection Team | Site Design Toolkit

Site Design Toolkit

This "toolkit" includes information associated with a new, comprehensive land planning and engineering design approach that aims to minimize stormwater impacts associated with water quality, hydrology (volume of water and peak flows), water supply, flooding and physical effects. A primary goal is to maintain and enhance the pre-development hydrologic regime of urban and developing watershe
management schemes and includes Low Impact Development (LID)
Growth, and probably some others. DuluthStreams is collaborating
Pollution Prevention staff and others to include information from th
homeowners, contractors, developers, contractors, realtors and go
the goal of reducing stormwater flows and pollutant loads in order
resources. Although these techniques are most effective in terms
planning and design stage, they are also effective at any stage of
repair.

Example of Alternative Paving webpage

HOME | ABOUT US | CONTACT US | DATA VIEWER | SEARCH | GL

SITE DESIGN TOOLKIT

SITE EVALUATION

TOOLS FOR SITE DESIGN

Rain Gardens
Grassed Swales
Pervious Pavement
Parking Lot Filter Strips
Bioretention Basins
Underground Storage
Green Roofs
Rain Barrels

APPLICATION
Single Unit
Subdivision
Commercial

POLICY
Community Planning
Implementing Pollution Prevention

CONTRACTOR TRAINING

CASE STUDY INDEX

RESOURCES

Rain Gardens

Rain Gardens are gardens containing flowering plants and grasses (preferably native species of both) that can survive in soil soaked with water from rain storms. However they are not gardens that have standing water. Rain Gardens collect and slow stormwater run off and increase its infiltration into the soil.

These attractive gardens help reduce the rapid flow of stormwater from homes and businesses to storm drains and thus protect streams and lakes from pollutants that are washed from house roofs and paved areas.

Applications

1. Provide a low maintenance, attractively landscaped property with minimum cost.
2. Reduce the amount of household or business stormwater and associated pollutants to area streams and lakes-improve local water quality.
3. Reduce potential of basement flooding.
4. Improve or eliminate wet spots in yard.
5. Increase habitat for beneficial insects, butterflies and birds.

Examples

City of Superior Rain Gardens
Superior, WI

The purpose of this project was to demonstrate the effectiveness of rain gardens in a region with heavy clay soils, harsh winters, and deep frost.

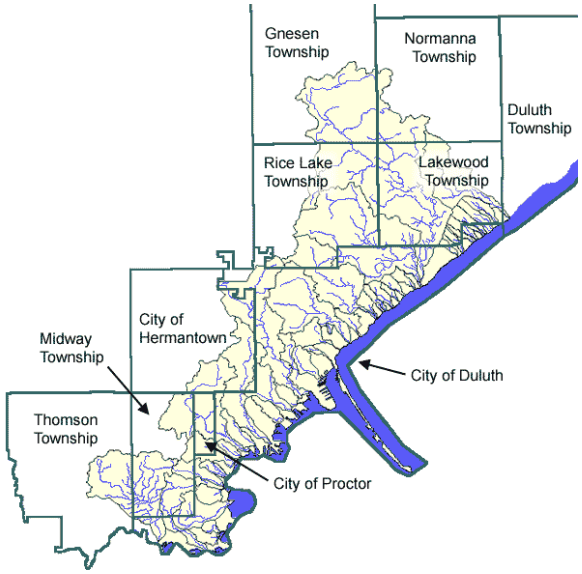
City of LaPoint
Apostle Islands, WI

Development of a Stormwater Management plan and a stormwater demonstration project, all in an effort to protect the Lake Superior shoreline and coastal wetlands.

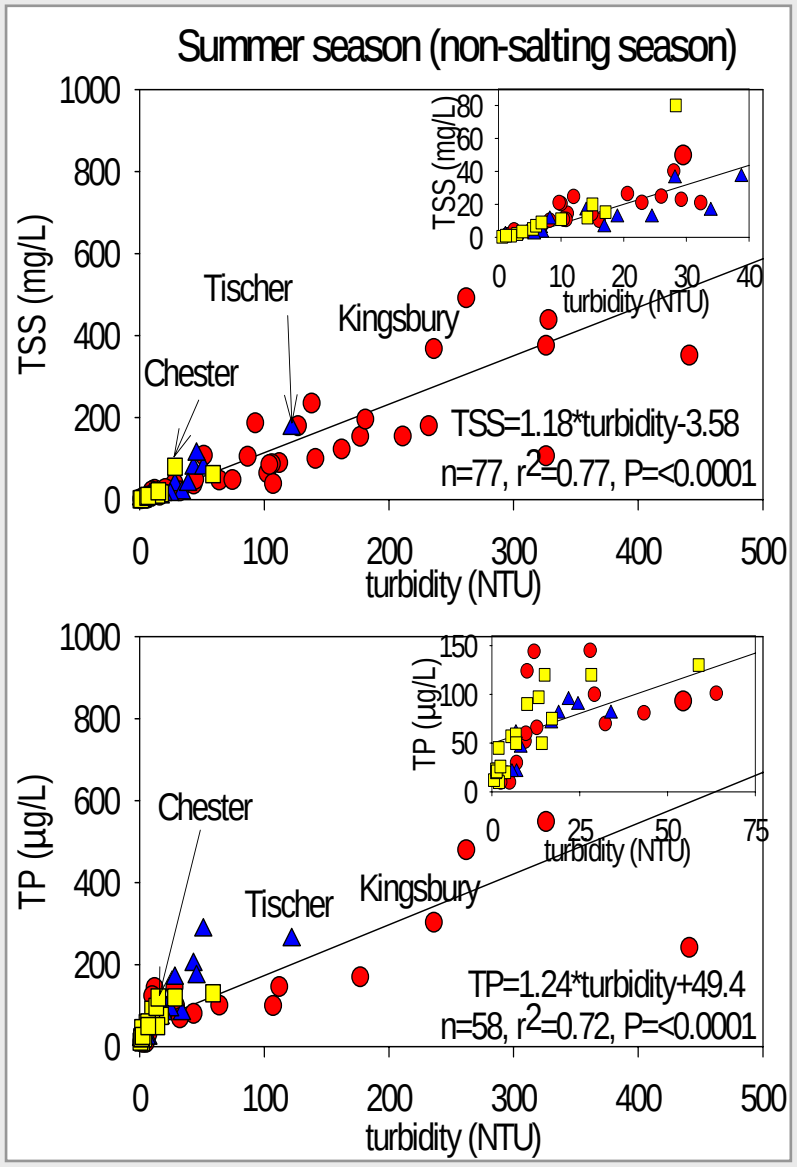
Focus: Low impact and conservation designs, regional case studies and contractor training

Regional Stormwater Protection Team

- **Coordinated educational programs and technical assistance**
- **Entities involved include both Minnesota and Wisconsin MS4s, education/outreach, agencies**
- **Organizations involved (21):**
  - City
  - County
  - MNDOT
  - Township
  - Tribal
  - State agency
  - SWCDs
  - University
  - Nonprofits
  - Wastewater treatment facilities



Further data analysis in progress to link sensor data with other parameters



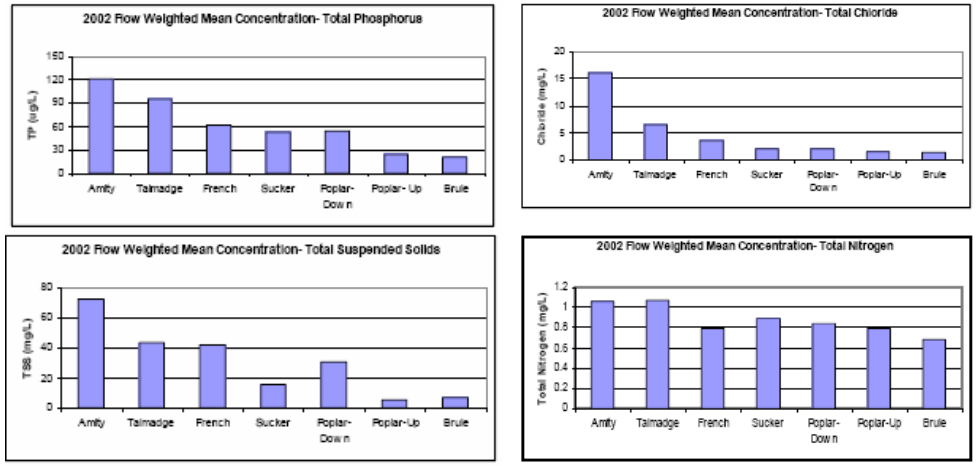
Turbidity appears to correlate well with:

- TSS
- Total - P
- Total - Hg

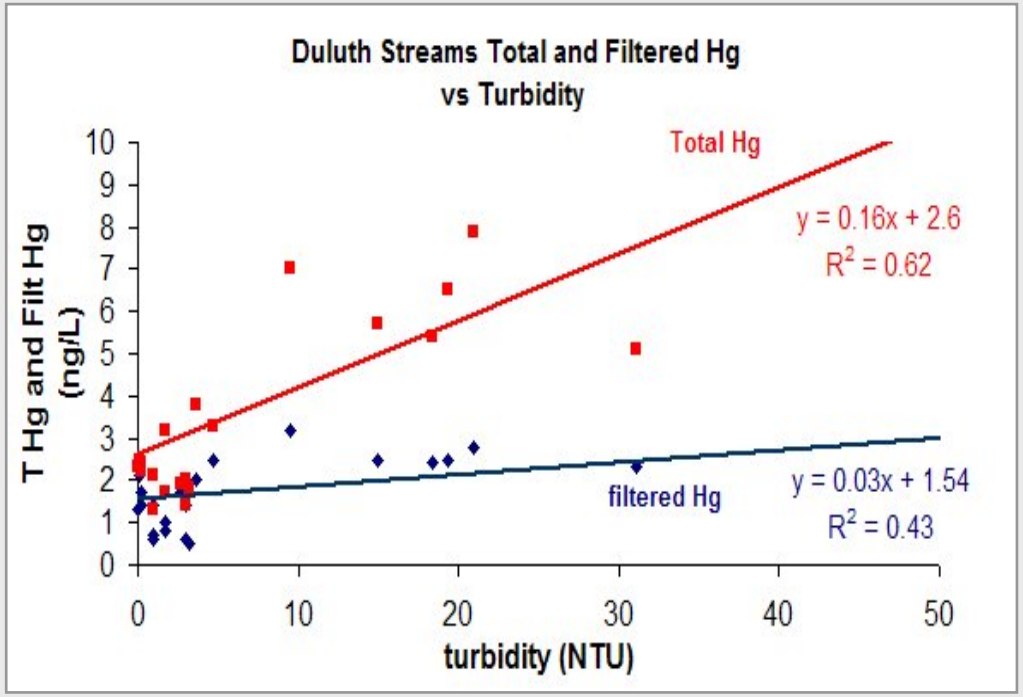
Specific conductivity correlates with:

- TDS
- Cl^- (Not shown)

To generate annual loads for comparison with event-based grab sample estimates



Clean hands, dirty hands Hg: 2005-06



Turbidity appears to also correlate well with Total – Hg and so provides a way to estimate seasonal Hg loads from Duluth and Northshore Streams

Website page requests/month (Aug 2005)

Seasonal peaks probably related to student and teacher use

Activity closely linked to our WaterontheWeb.org on-line Water Science Curriculum that is generating ~ 1.5 M “hits”/month

Science based: Linking text book information to data to reality to what can you do to help fix it

lake superior duluth streams.org

lake superior communities understanding the streams citizens and schools

stormwater

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There is also a new State of Minnesota Stormwater Manual (November, 2005) that has received national attention and provides a wealth of valuable information. Particular attention should be paid to Minnesota Factors (appendix A), Chapter 12 (BMP details) and Chapter 13 (Additional Guidance for Karst, Shallow Bedrock, Ground Water, Soils with Low Infiltration Capacity, Potential Stormwater Hotspots (PSHs) and Sediment Disposal Areas).

3 main steps for protecting local water resources from stormwater impacts:

1. **Planning and Policy (read the policies you have and revisit them if**

Summary

- Flow, temperature, electrical conductivity, turbidity can tell us a lot about water quality and habitat condition
- We need data during storm events to really understand impacts to streams and their health
- Data can help provide the link between people's actions in the watershed and the condition of our water resources
- Partnerships between scientists, teachers, agencies, NGOs, and the private sector are essential
- Please take time to explore

lakesuperiorstreams.org

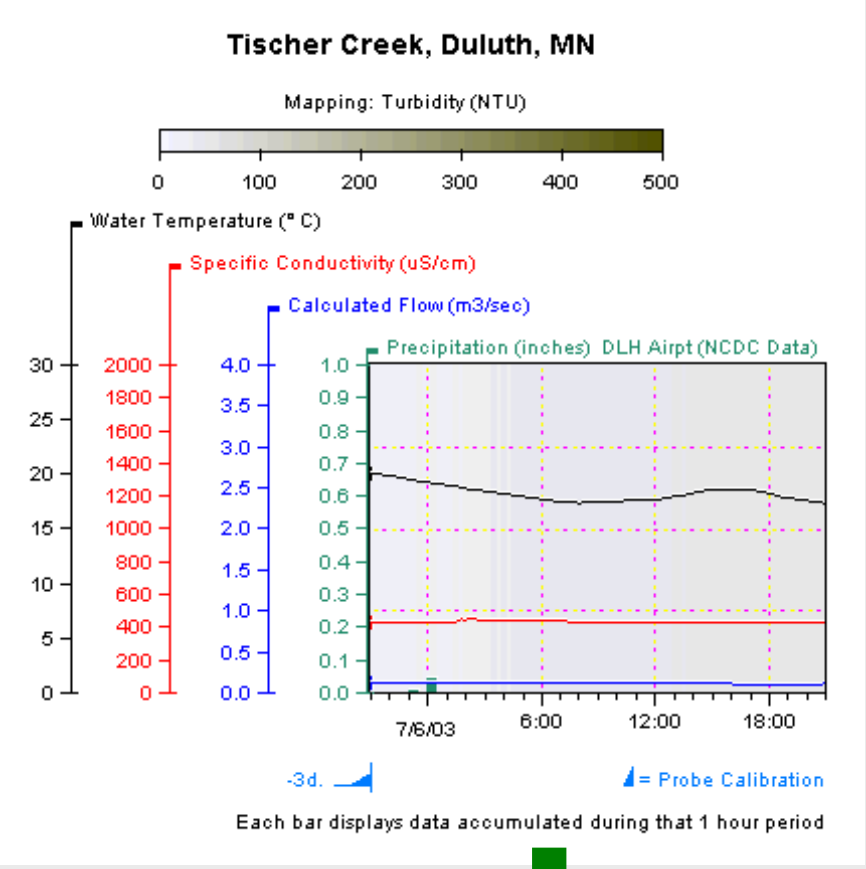
Lake Superior Streams: Focus on education and data

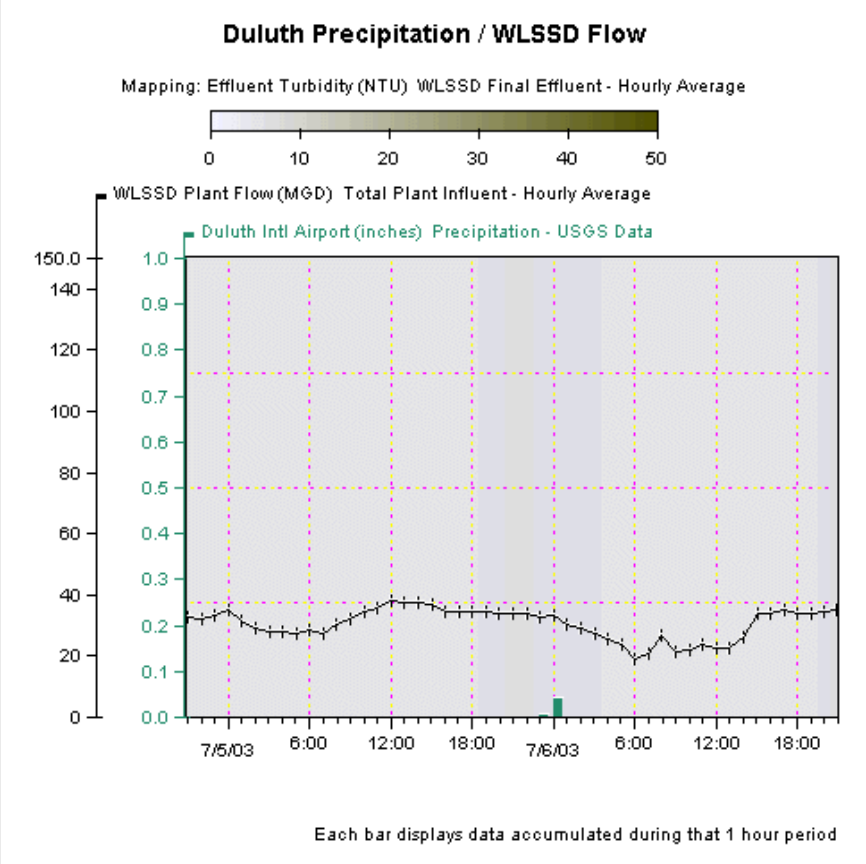
Poster children for controlling pet wastes

When it rains hard in Duluth… July 2003

Stream flashiness
Flow and turbidity (sediment)

Sewage plant flashiness
Inflow & Infiltration (I&I)





Look for increased rain, muddy **brown** water and WLSSD discharge