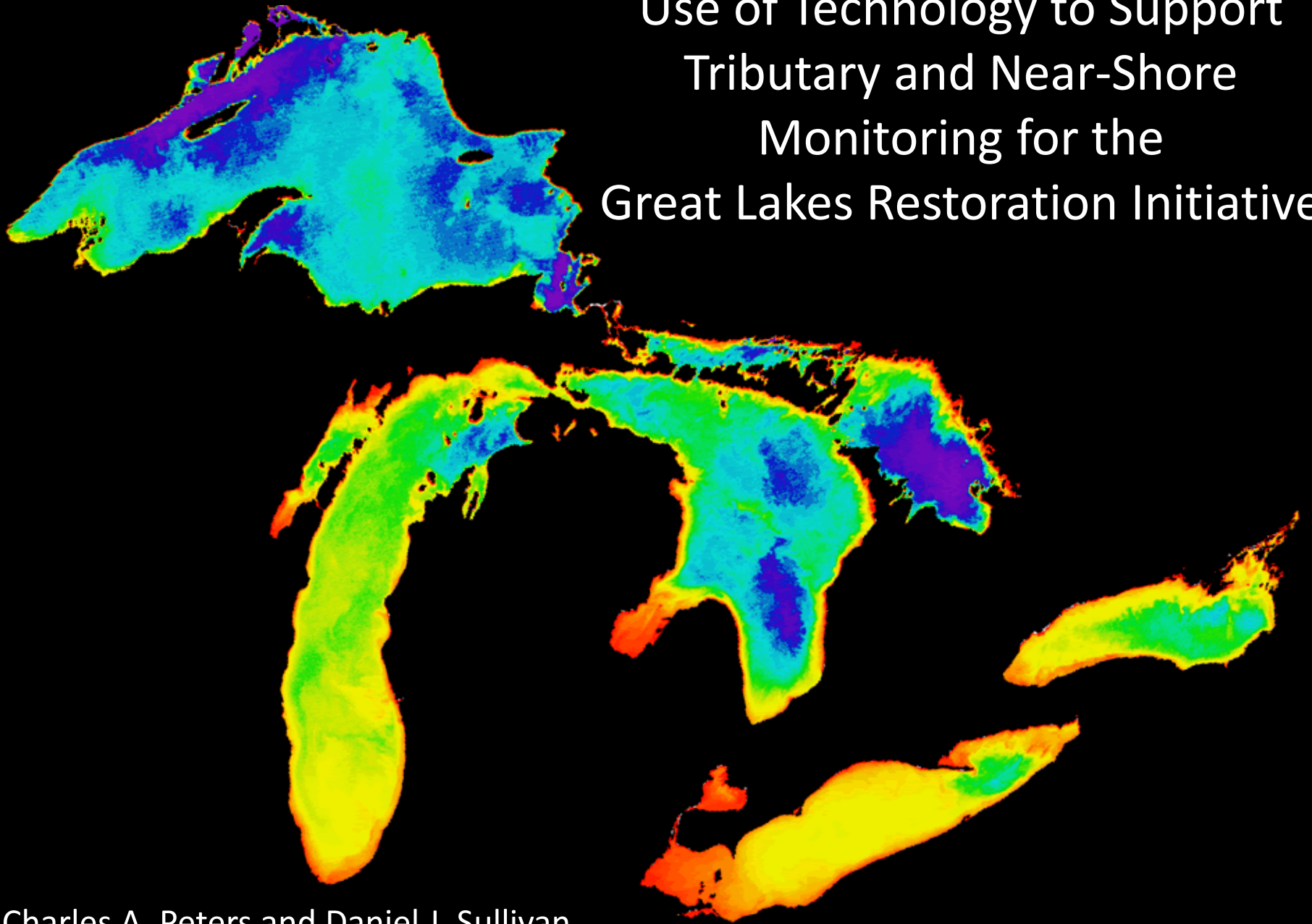# Use of Technology to Support Tributary and Near-Shore Monitoring for the Great Lakes Restoration Initiative

Charles A. Peters and Daniel J. Sullivan

USGS Wisconsin Water Science Center

Objectives & Outline

- Tributary monitoring objectives & design
- Connecting tributaries to the lakes
- Pathogens in Great Lakes tributaries
- Optical properties of water
- Web-based mapping and data compilation

Tributary Monitoring - Objectives

- Begin to implement the National Monitoring Network (NMN) design for the Great Lakes

- Contaminant loads (baseline)

- Provide quantifiable measures of restoration progress on major Great Lakes tributaries

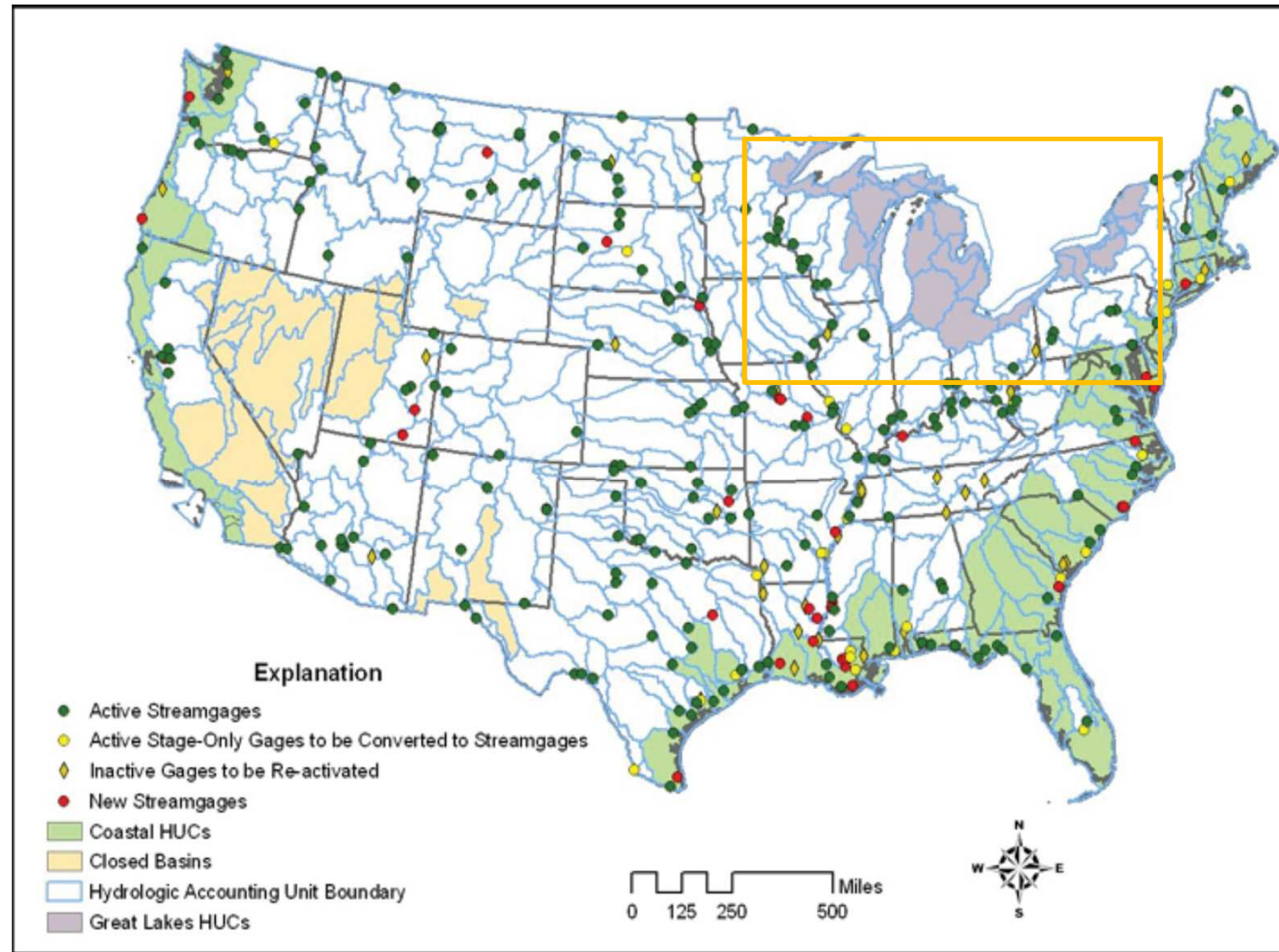- Model potential load changes throughout the Great Lakes

National Monitoring Network

Site selection is based on the National Monitoring Network design

Great Lakes are based on HUC8 basins

(Coastal basins are HUC6)

Explanation

- Active Streamgages
- Active Stage-Only Gages to be Converted to Streamgages
- Inactive Gages to be Re-activated
- New Streamgages
- Coastal HUCs
- Closed Basins
- Hydrologic Accounting Unit Boundary
- Great Lakes HUCs

Miles
0   125   250   500

Determine Baseline of Toxic Contaminants

- At all 59 NMN sites:
- POCIS (Polar Organic Chemical Integrative Sampler): potentially endocrine disrupting or acutely toxic hydrophilic contaminants
- SPMD (Semi-permeable membrane devices): designed to mimic biological membranes, such as the gills of fish.
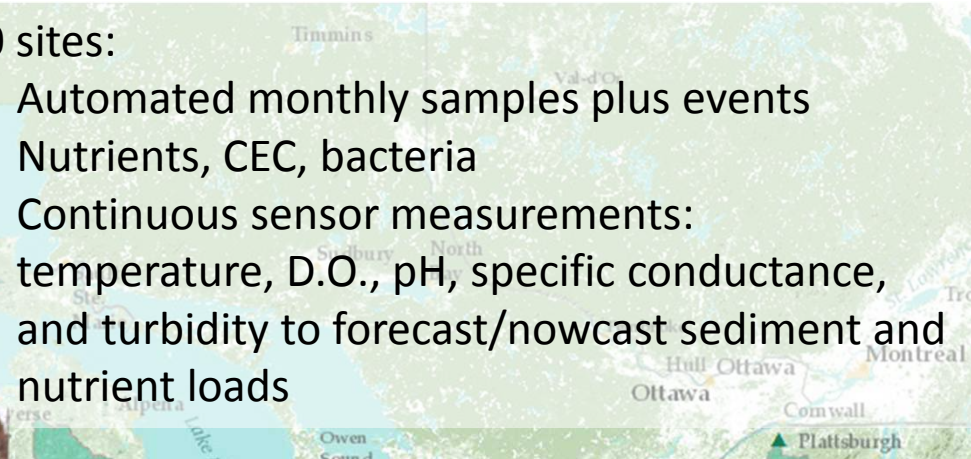- Water Samples for mercury and CEC organic contaminants collected twice
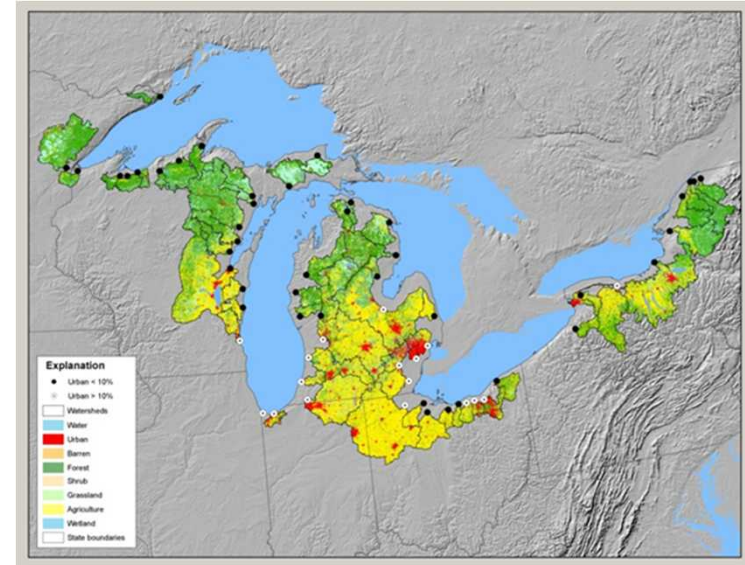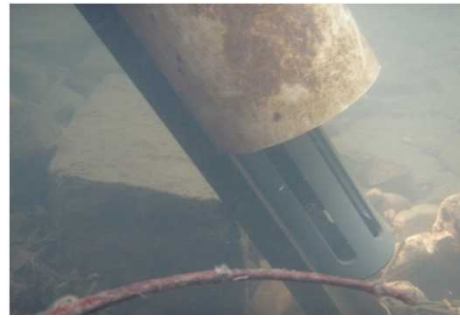
Tributary Monitoring
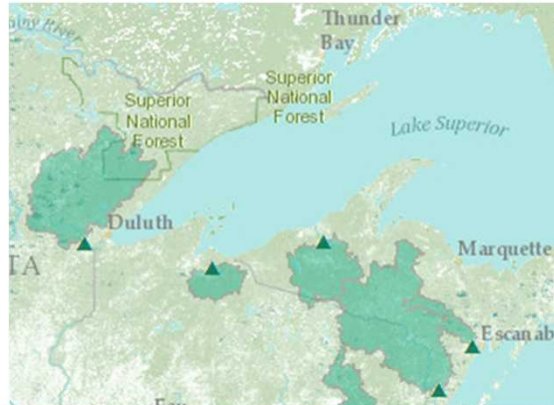
30 sites:
- Automated monthly samples plus events
- Nutrients, CEC, bacteria
- Continuous sensor measurements: temperature, D.O., pH, specific conductance, and turbidity to forecast/nowcast sediment and nutrient loads

Tributary Monitoring

Specific conductance (sensor measured)
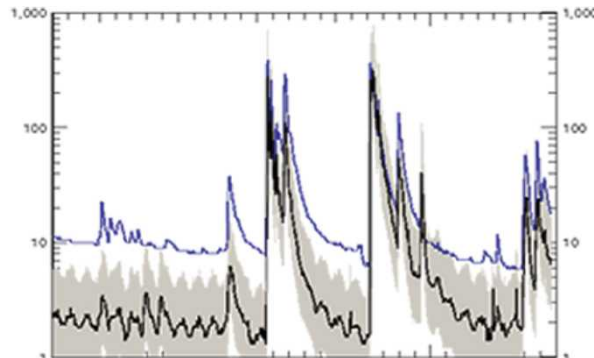vs. Chloride (lab measured)
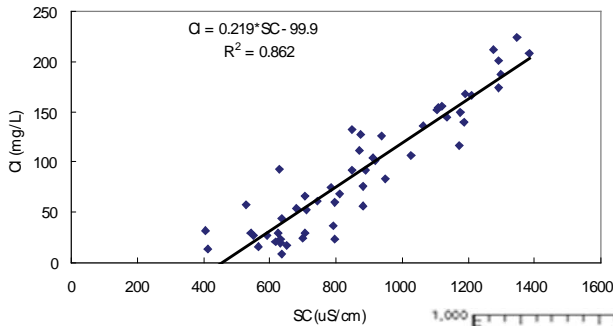
$Cl = 0.219 * SC - 99.9$
$R^2 = 0.862$

Sensor data will be used to develop regression models to predict other water-quality analytes. Modeled analytes may include:

- Suspended sediment
- Phosphorus
- Nitrogen
- Emerging contaminants
- Mercury

http://nrtwq.usgs.gov/wi/

Outline

- Tributary monitoring objectives & design
- **Connecting tributaries to the lakes**
- Pathogens in Great Lakes tributaries
- Optical properties of water
- Web-based mapping and data compilation

Connecting Tributaries to the Lakes

Connecting Tributaries to the Lakes

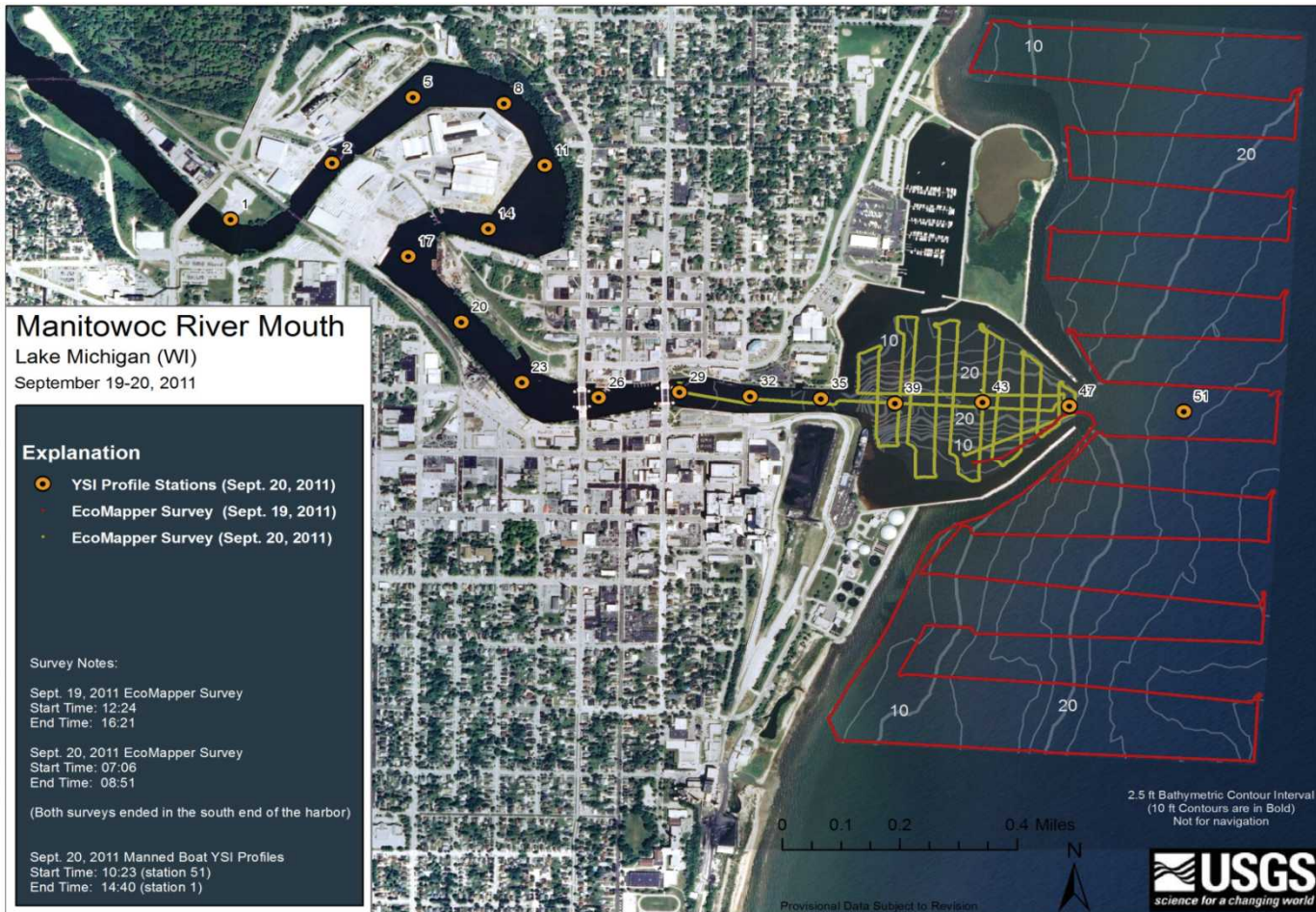Manitowoc River Mouth
Lake Michigan (WI)
September 19-20, 2011

Explanation
- YSI Profile Stations (Sept. 20, 2011)
- EcoMapper Survey (Sept. 19, 2011)
- EcoMapper Survey (Sept. 20, 2011)

Survey Notes:

Sept. 19, 2011 EcoMapper Survey
Start Time: 12:24
End Time: 16:21

Sept. 20, 2011 EcoMapper Survey
Start Time: 07:06
End Time: 08:51

(Both surveys ended in the south end of the harbor)

Sept. 20, 2011 Manned Boat YSI Profiles
Start Time: 10:23 (station 51)
End Time: 14:40 (station 1)

Connecting Tributaries to the Lakes

Synoptic mapping of the near-shore mixing zone gives insight into mixing processes, circulation, and contaminant transport.

In this river, significant mixing occurs in the lower 2 miles, yet river water is only 40% diluted upon reaching the harbor.

Connecting Tributaries to the Lakes

Example results:

Observed circulation patterns suggest that river water, and the contaminants therein, may be mixed along the shorelines both north and south of the mouth by interaction of near-shore currents with local bathymetry.

In addition, AUV data indicates a large anomaly in water quality south of the harbor along the lake shore in the vicinity of a sewer outfall and another anomaly north of the mouth at the seawall separating the spoil disposal area from the lake.
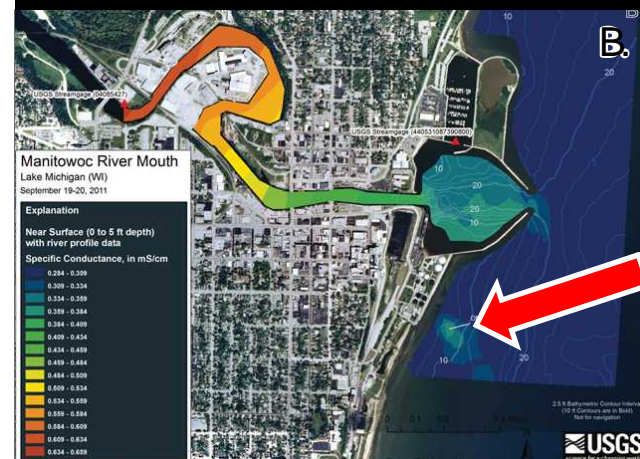
Outline

- Tributary monitoring objectives & design
- Connecting tributaries to the lakes
- **Pathogens in Great Lakes tributaries**
- Optical properties of water
- Web-based mapping and data compilation

Pathogens in Great Lakes Tributaries
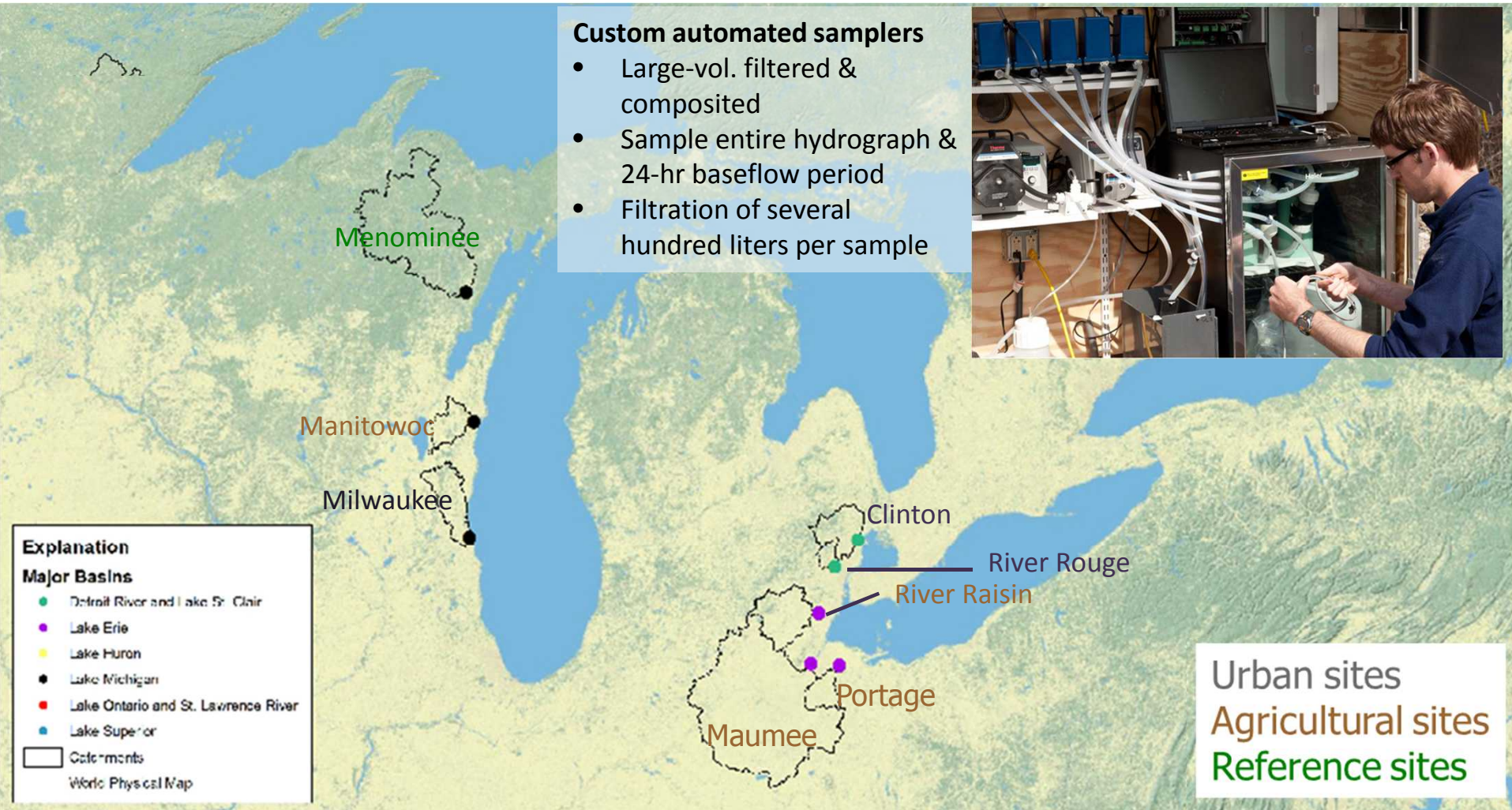
Custom automated samplers
- Large-vol. filtered & composited
- Sample entire hydrograph & 24-hr baseflow period
- Filtration of several hundred liters per sample

Menominee

Manitowoc

Milwaukee

Clinton

River Rouge

River Raisin

Portage

Maumee

Explanation

Major Basins
- Detroit River and Lake St. Clair
- Lake Erie
- Lake Huron
- Lake Michigan
- Lake Ontario and St. Lawrence River
- Lake Superior
- Catchments
- World Physical Map

Urban sites
Agricultural sites
Reference sites

USGS
science for a changing world

Great Lakes
RESTORATION

Outline

- Tributary monitoring objectives & design
- Connecting tributaries to the lakes
- Pathogens in Great Lakes tributaries
- Optical properties of water
- Web-based mapping and data compilation

Optical Properties of Water

- Fluorescence/absorbance and chromophoric dissolved organic matter (CDOM)
- Continuous measurement of CDOM in rivers as an indication of organic matter and the relation with contaminants
  - Relate specific optical signals to treated and untreated wastewater contamination
    - Pathogens and fecal indicator bacteria
    - Wastewater chemicals
- Optical measurements in the Great Lakes to study transport from tributaries
  - Transport of contaminants in the near shore environment

Outline

- Tributary monitoring objectives & design
- Connecting tributaries to the lakes
- Pathogens in Great Lakes tributaries
- Optical properties of water
- Web-based mapping and data compilation

Web mapping application

http://wim.usgs.gov/LaMP/LaMPMapper.html
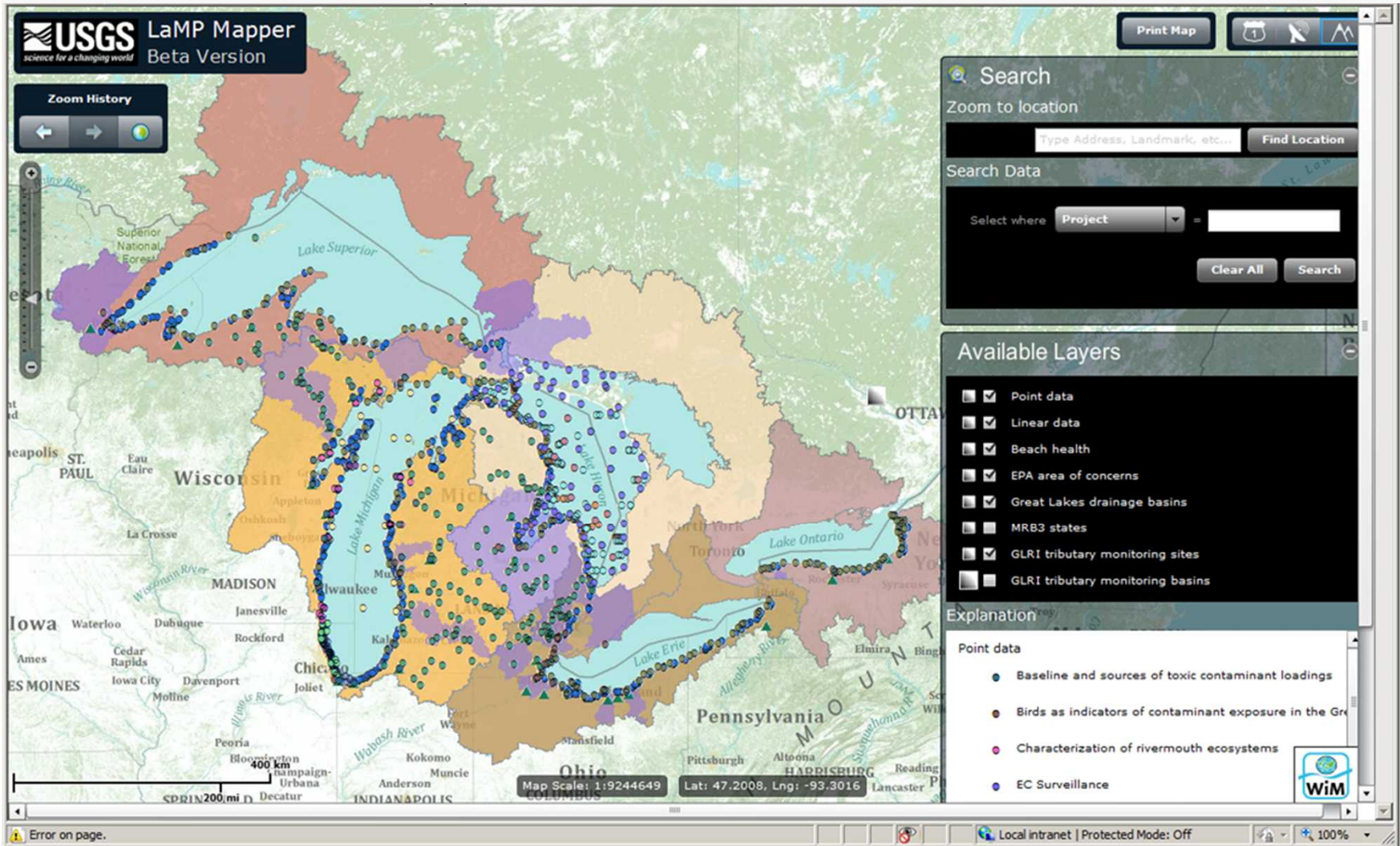
Web compilation of data

- Environmental Data Discovery and Transformation (EnDDaT)
  - Web tool to combine data from multiple sources
  - Originally developed for beach projects; especially useful for watershed/stream studies
  - Data compilation and aggregation
  - Model implementation

Questions?

- GLRI Tributary Monitoring
  - Dan Sullivan[1]
- Pathogens
  - Steve Corsi[1]
- cDOM testing
  - Paul Reneau[1] & CA WSC

- AUV
  - Ryan Jackson[2]
- LaMP Mapper
  - Gary Latzke[1]
- EnDDaT
  - Dave Sibley[3]