Enhancements of the National Coastal Condition Assessment in the Great Lakes

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The Great Lakes are GREAT

Lake Superior

244k km² water (~area of UK)
522k km² basin (9 states, province)
17k km shoreline (half equator)
23k km³ water (21% global volume)
2,000 miles Duluth to Atlantic

**10% of U.S. &
30% Canadian
populations
live in basin.**

**Lake
Huron**

Lake Ontario

**Lake
Michigan**

Lake Erie

Local social, regional environmental, and global economic power.

The Great Lakes management model is integrative, pro-active, adaptive, and science-based. It links ecosystem protection & remediation to the restoration of ecosystem services & human prosperity.

That is a mouthful and rather boastful for the midwest. Good.

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Where did such a wonderful model come from?

- **Boundary Waters Treaty (1909)**
  - **International Joint Commission**
- **Great Lakes Water Quality Agreement (1972)**
  - **Research (CSMI) and management (LAMPS)**
- **Clean Water Act (1972)**
  - **Great Lakes water quality Research (Section 104)**
- **Great Lakes Compact (2008)**
- **Great Lakes Restoration Initiative (2009)**
  - **$3.5 B (FY10-FY20)**

All these are implemented with public, states, provinces, federal agencies, & universities.

EPA ORD is delivering the innovations needed to meet the model's ambitions and stakeholders' needs via multiple RAPs.

SHC.9.1

SSWR.5.4

SSWR.1.2

SSWR.5.3.

SSWR.1.1

SSWR.4.3

SSWR.6.1

SSWR.1.5

CSS

But, in the beginning there was

Environmental Monitoring and Assessment Program (EMAP)
Developing statistically-valid frameworks for status and trends in the condition of the nation's ecosystems

EMAP changed the "don't just stand there, measure something" approaches to environmental monitoring and assessment

- **Targeted.** Measure a few things at a few places
  - Site response
  - Biased and great for some questions
- **Survey.** Measure some things at a few places
  - Population response
  - unbiased and great for many questions
- **Census.** Measure something everywhere
  - Population and site response
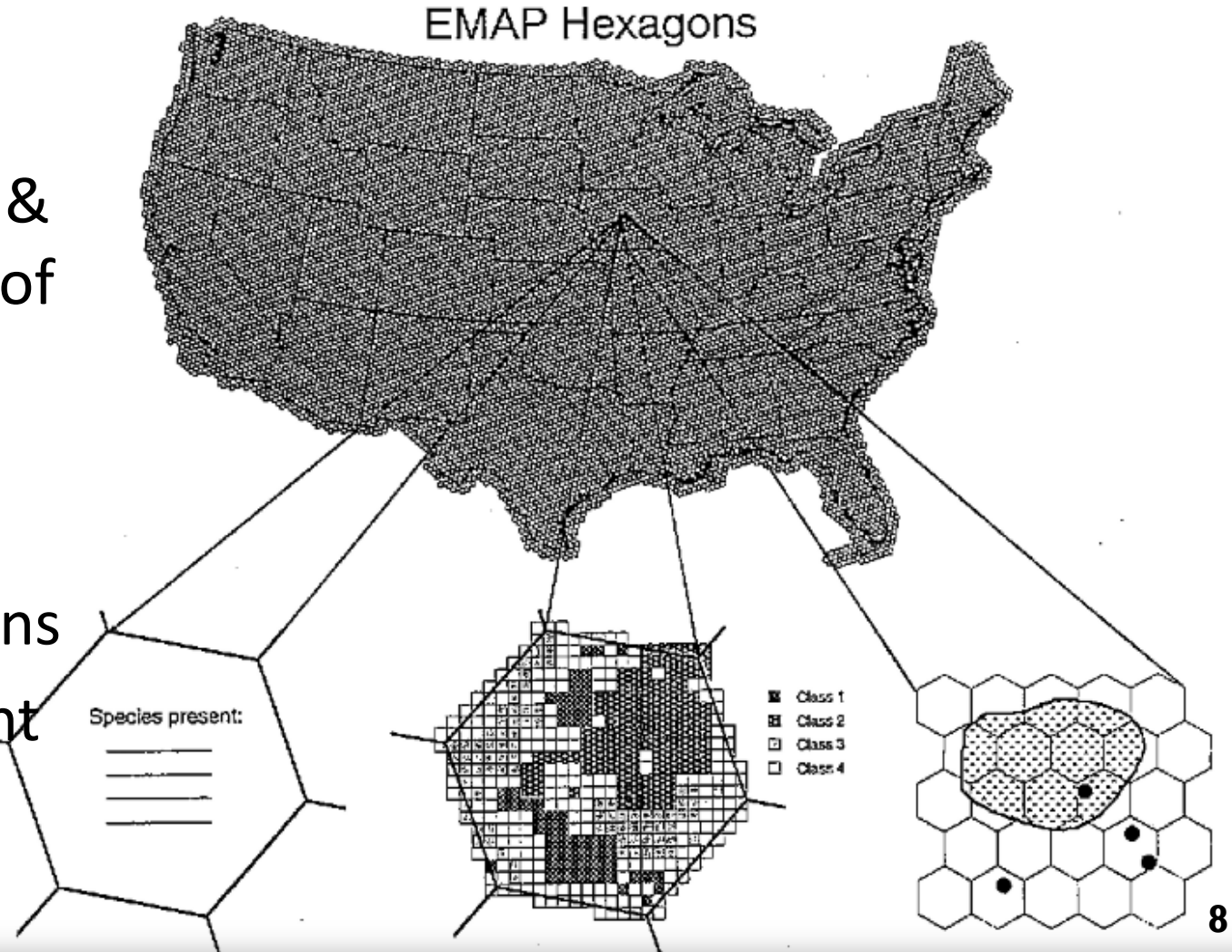 - unbiased and great for a few questions

EMAP brought us
Hexagons Across America!

Science and practice for national status & trends surveys of multiple resources.

✓ Statistically sound designs

✓ Management relevant indicators

EMAP Hexagons

Species present:

☒ Class 1
☒ Class 2
☐ Class 3
☐ Class 4

Designs
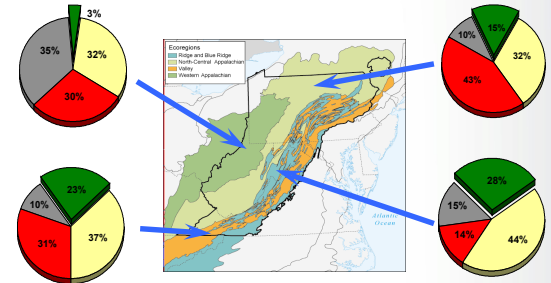
Panel Rotation

Spatial Balance

Variable Density

Frame Development

Population Definition

Indicators

Ecoregion Framework

Reference Condition

Regionalization

Validation

Assessments

Reporting

Data & Analysis

Field Sampling

Training

Partnerships

What % (±error) of [resource] in [unit] is in [condition] according to [indicator] ?

Resource	Unit	Condition	Indicator
coastal area wetland area estuary area streams length lakes (#)	U.S. State EPA Region Ecoregion Tribal lands	Good Fair Poor	Biotic integrity Water Quality Habitat integrity [Nutrient] [Contaminant]
Challenges			
Relevancy Data limited	Sample density Funding	Thresholds standards	Relevancy Variability / robustness

While this addresses mandates of GL model, it is not everyone's question.

EMAP was a huge success.

- 100s of publications from data collected 1990-2006.

- Exemplary cooperative federalism & research-for-management

- Science-based assessment approach for multiple resources

- Institutionalized by state and federal management agencies

- Adaptive and scalable to complement targeted programs

AND

- It spawned National Aquatic Resource Surveys (NARS)

National Aquatic Resource Surveys (NARS)

Nationwide state-partnered assessment program.

Nationally consistent designs & resource-specific indicators

	2015	2016	2017	2018	2019	2020
Rivers/Streams	Lab/Data Analysis	Lab/Data Analysis; Research	Report; Design	Field	Field	Lab/Data Analysis
Coastal	**Field**	**Lab/Data Analysis**	**Report**	**Research**	**Design**	**Field**
Wetlands	Design	Field	Lab/Data Analysis	Report	Research	Design
Lakes	Research	Design	Field	Lab/Data Analysis	Report	Research

National Coastal Condition Assessment

Originated in EMAP as National Coastal Assessment. NCCA since 2010.

Answers *The Question* for marine estuaries (by region) and Great Lakes nearshore waters (by lake + enhancements).
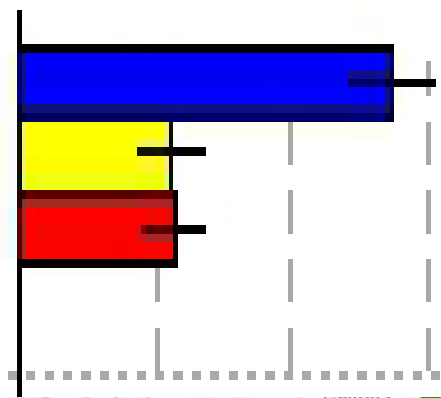
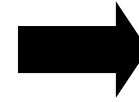**In 2015, 57 ($\pm$4)% of GL nearshore waters was in good condition for eutrophication.**
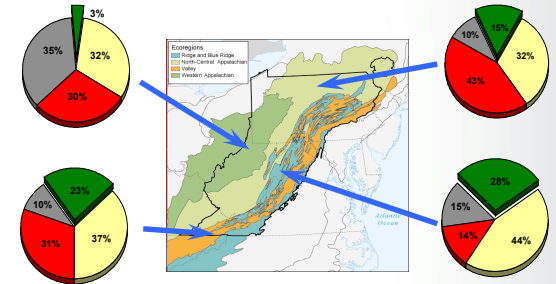
NCCA Great Lakes Approach
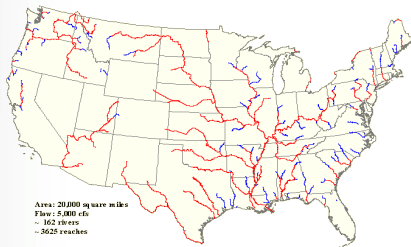
Designs + Indicators → **Assessments**

State CWA Reports
GLRI Reports
GLWQA LAMPs
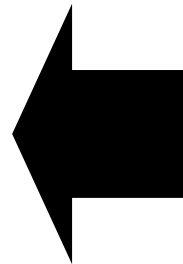
← **National and Regional Reports**
Scientific literature
Data Dashboards
Research/science support (ORD)
Training & Audits & QAPP
Centralized Logistics, IM, sample tracking
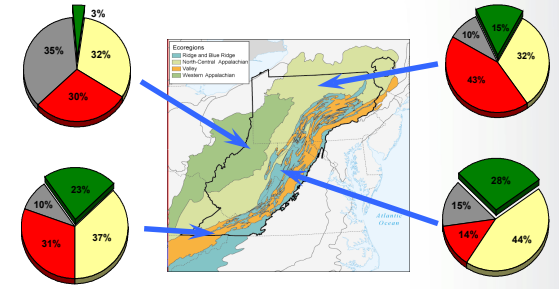**QAPP, Field & Lab Operations Manuals**

NCCA Great Lakes Approach

Designs + **Indicators** → Assessments

Enhancements
Phytoplankton
Nutrients,
Benthos & video
w/ crowd-sourced
analyses
Human health fish

Water Chemistry, nutrients, algal toxins, enterococci
Sediment toxicity, metals, contaminants
Fish contaminants & Hg
Benthic communities

NCCA Great Lakes Approach

Designs + Indicators → Assessments

Area: 20,000 square miles
Flow: 5,000 cfs
~ 162 rivers
~ 3625 reaches
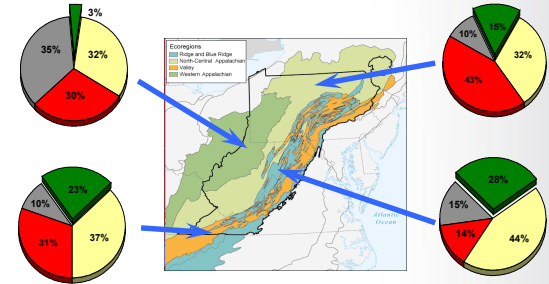
GRTS

⇑

Frame Development

⇑

Population definition

⇑

State & Partner Input

Enhancements
Embayments
Lake Erie basins
Connecting channels
Green Bay
NPS units
Island nearshore

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Enhancements complement base designs

Embayments (2010 & 2015)
Conditions in "sentinel" resources differ from nearshore.

Lake Ontario
- 🟨 Base sites (45 per lake)
- 🔷 Enhancement (30 per basin)
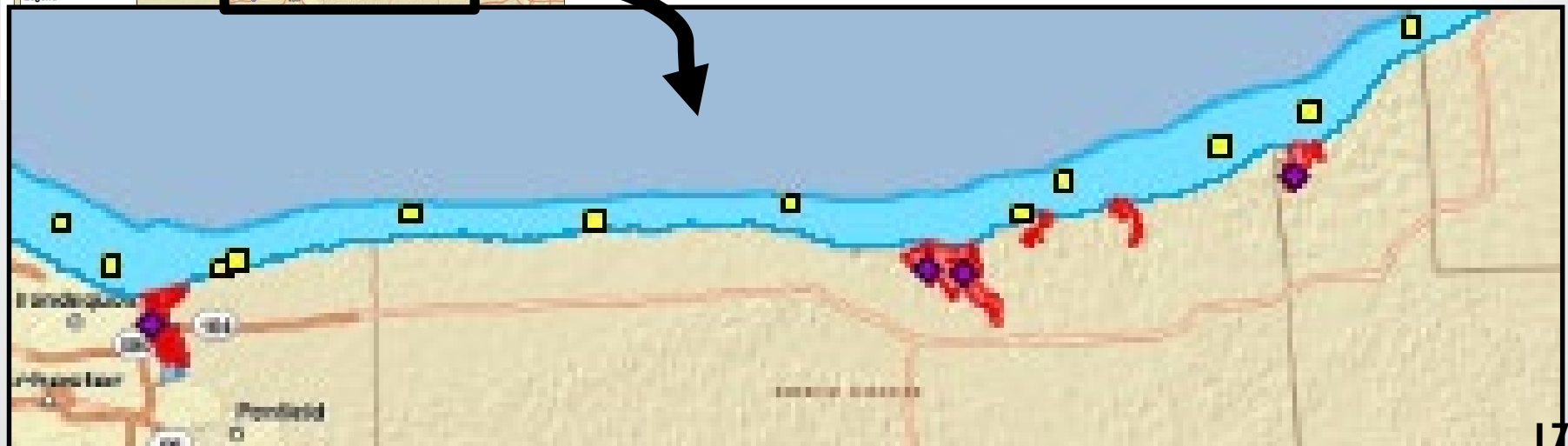
Enhancements complement base designs

Embayments (2010 & 2015)
### Conditions in "sentinel" resources differ from nearshore.

Indicator	All	LS	LM	LH	LE	LO
Water clarity	↓	↓	↓	↓		↓
Depth	↓	↓	↓	↓	↓	↓
[Dissolved oxygen]		↓	↓			↓
[Total phosphorus]	↑	↑	↑			↑
[Chlorophyll *a*]		↑				↑
[Cyanobacteria]		↑				↑
Mean PECQ (metals, pesticides)	↑	↑				↑
Benthic condition		↑				

↑ More or higher in EM than NS

↓ Less or lower in EM than NS

Enhancements complement base assessments

Enhancement does not change overall assessment because conditions not *very* different and only 5% of pop area. But gives context for management.
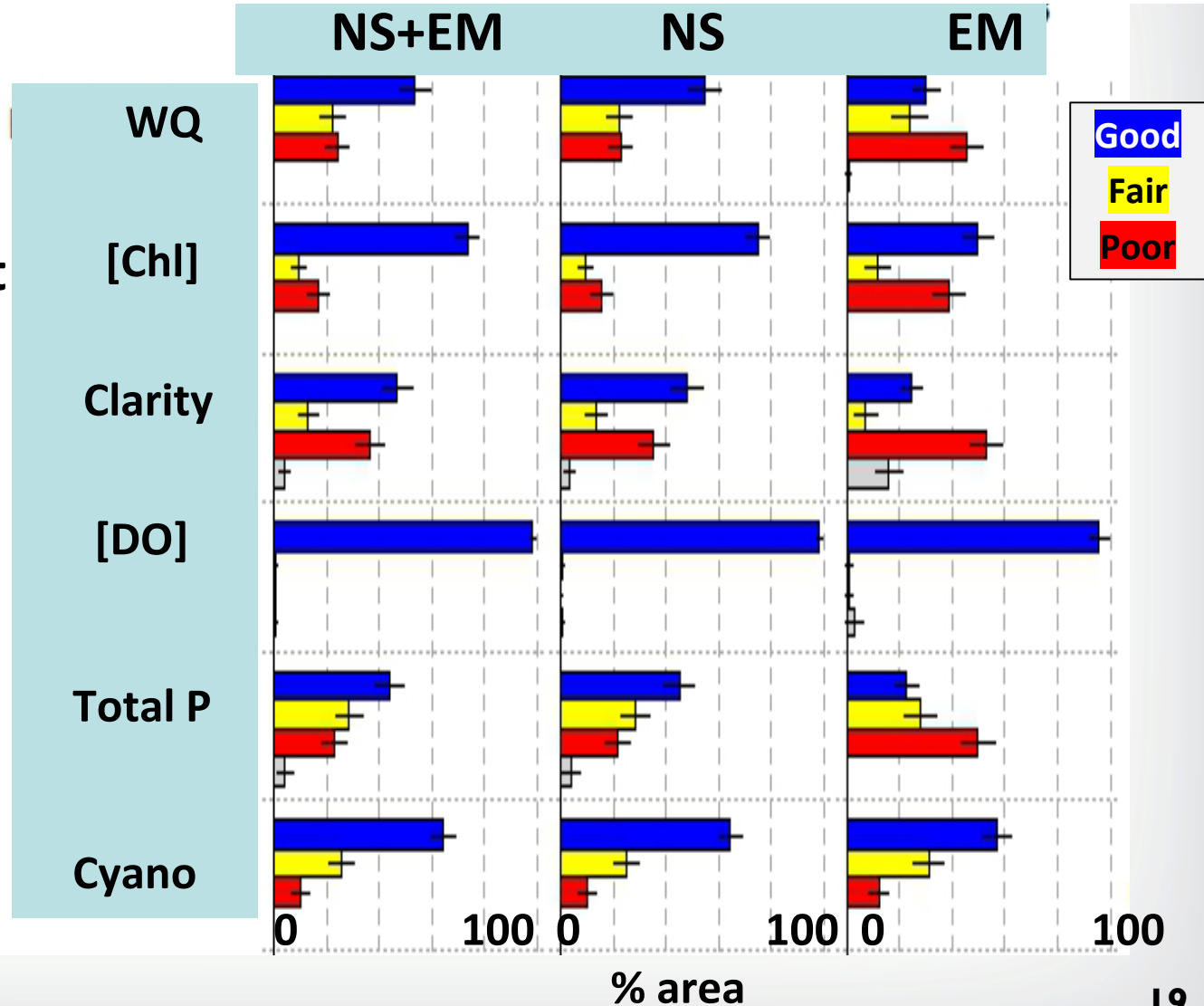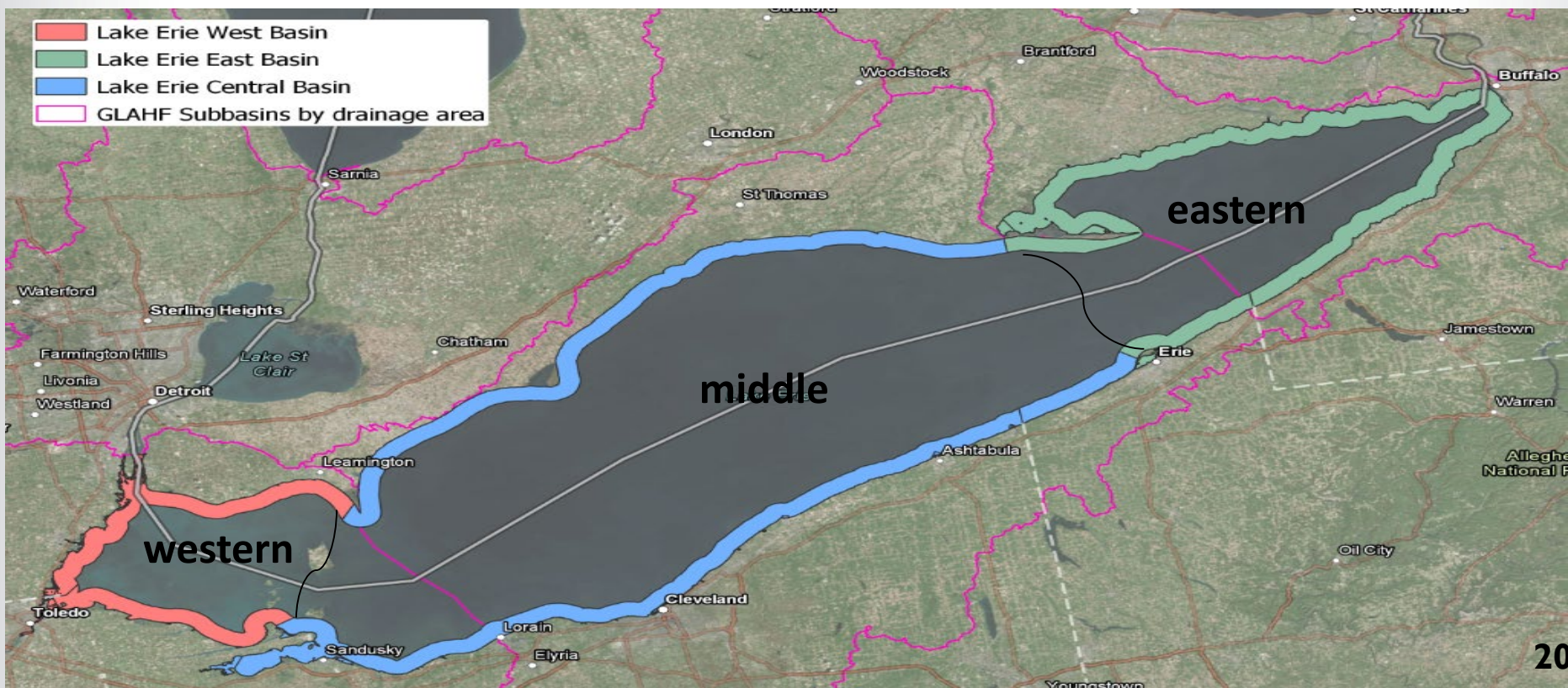
Lake Erie Basins (2015 & 2020)
Algal blooms, some producing toxins, have basin-specific responses to conditions and impacts.

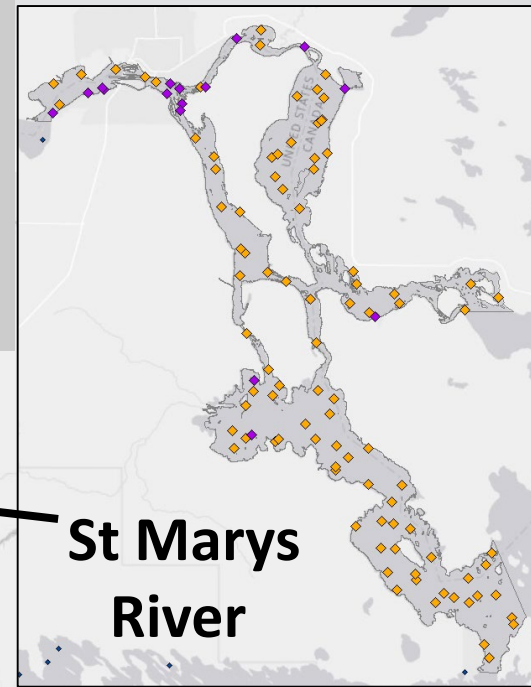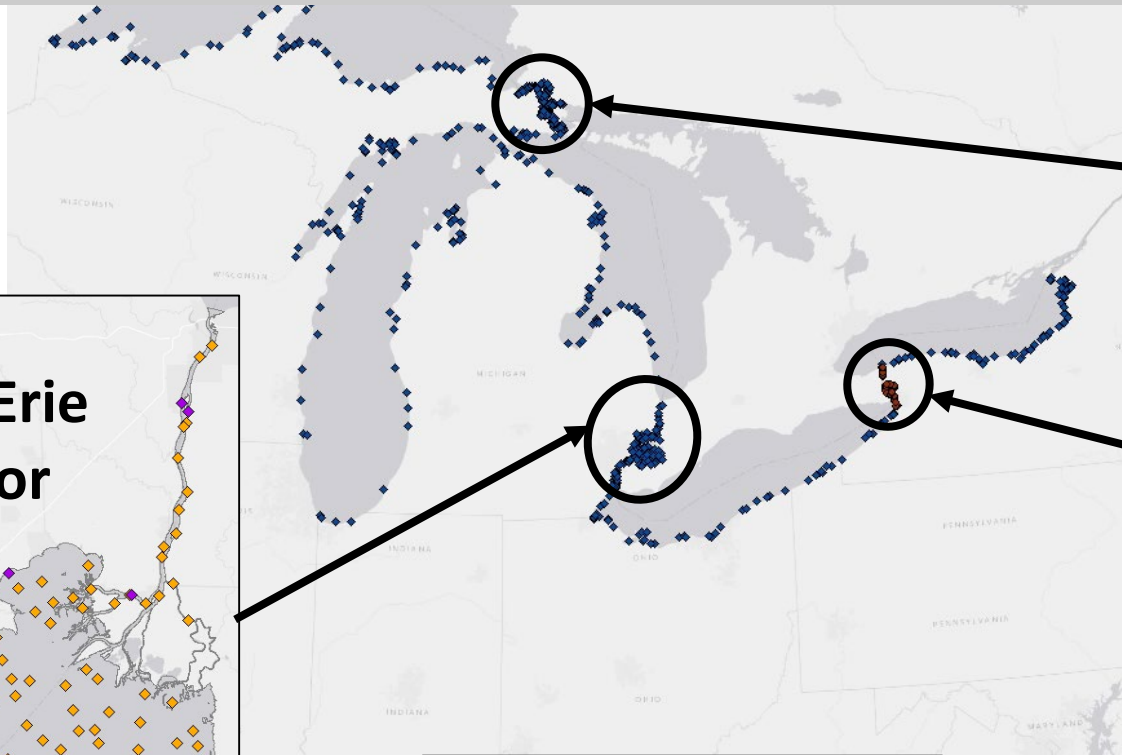## Lake Erie Basins (2015 & 2020)
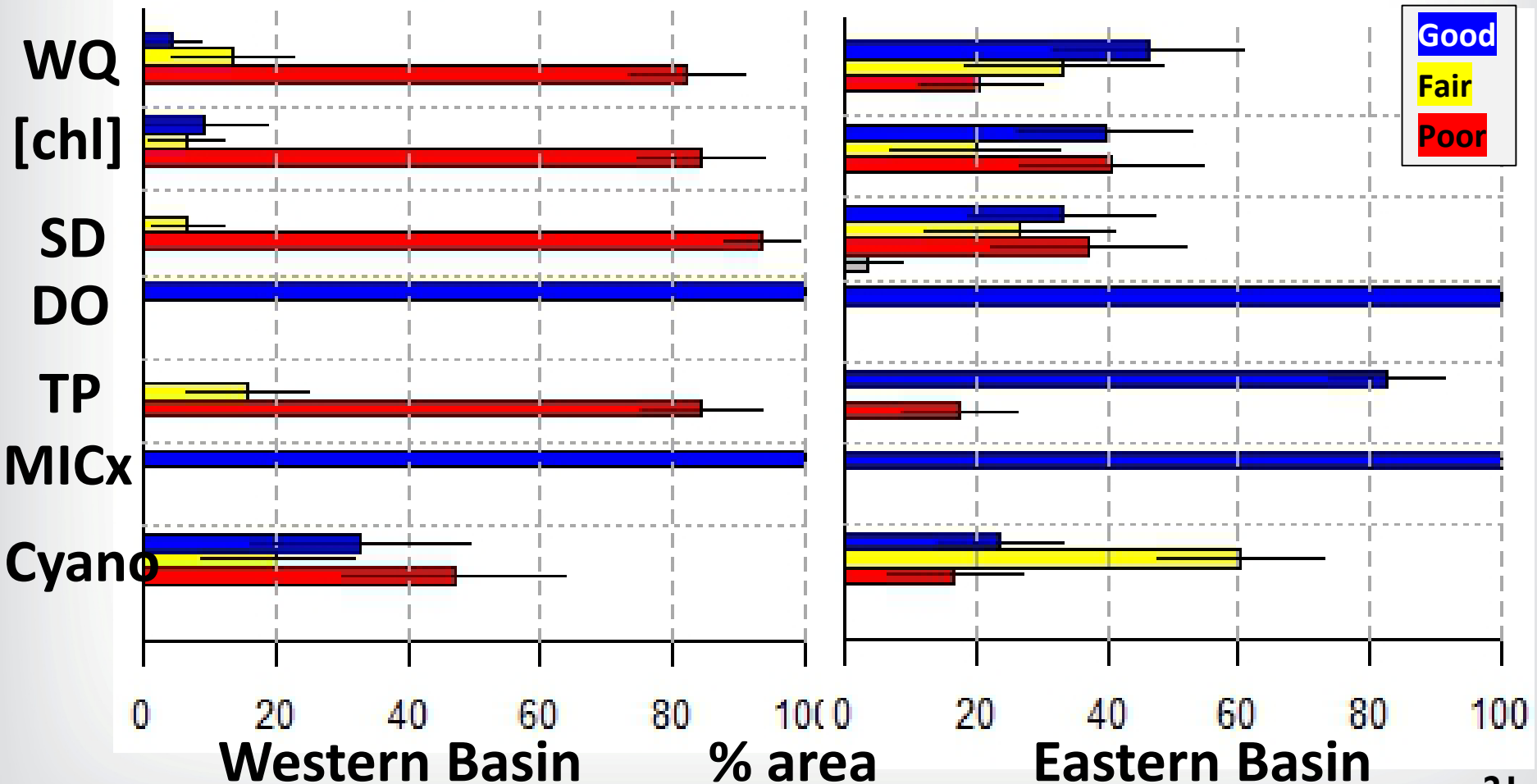
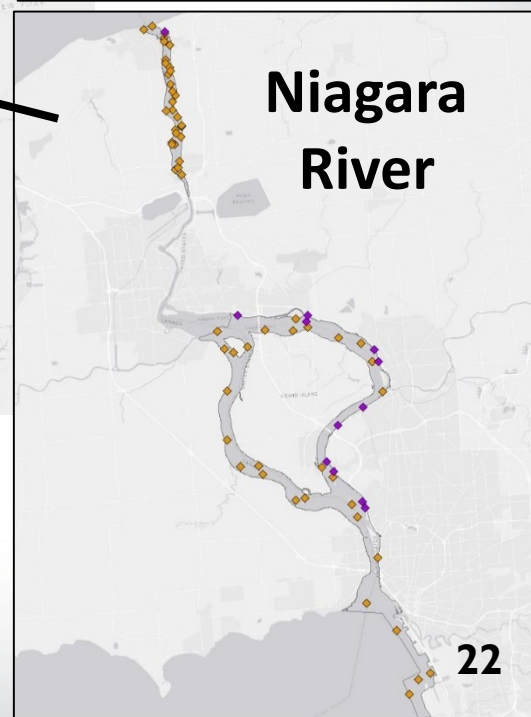# Enhancements add new resources for assessment
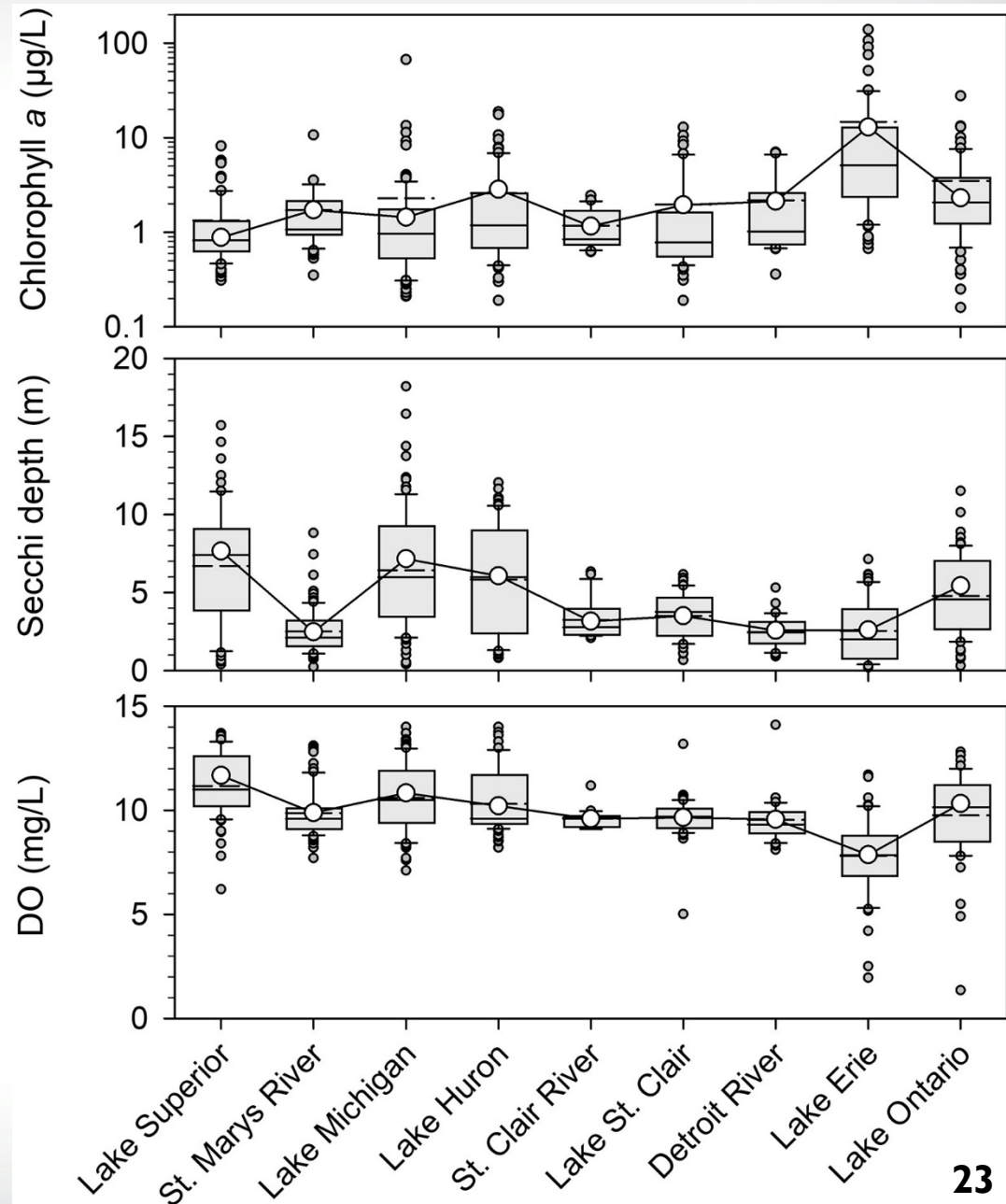## Connecting Channels important on their own and as downstream contributors

St Marys River
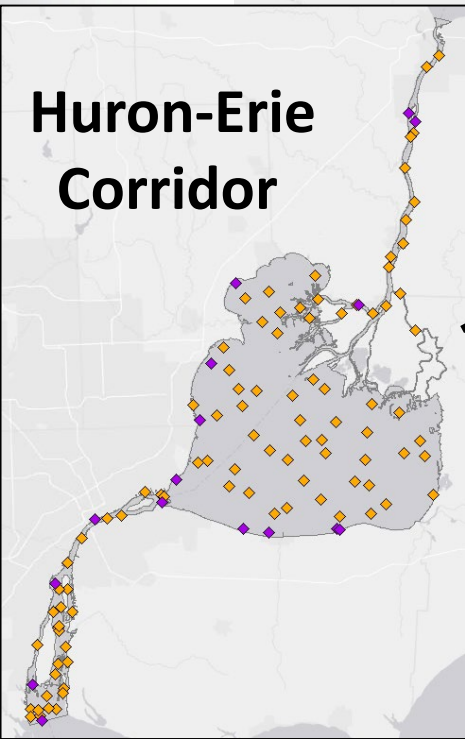
Huron-Erie Corridor

Niagara River

Both survey and targeted sites used.

Enhancements reveal differences in conditions through the system but what about assessment?

An assessment of water quality in two Great Lakes connecting channels
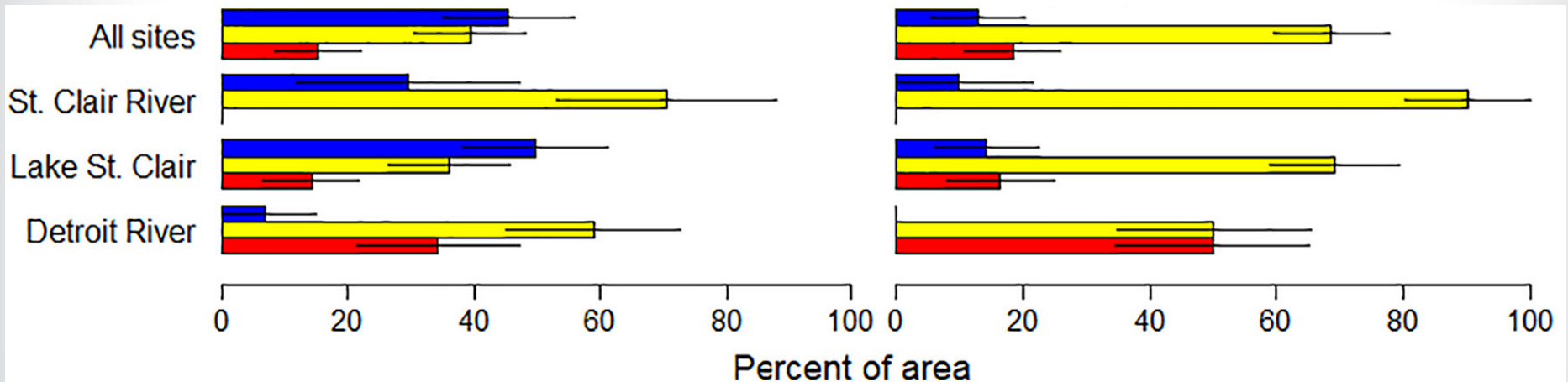Wick et al (JGLR 2019)

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Need coupled design and indicator enhancements

EPA

Assessment of Huron-Erie corridor varied with thresholds used (but same data)

WQ looks good using central Lake Erie thresholds.
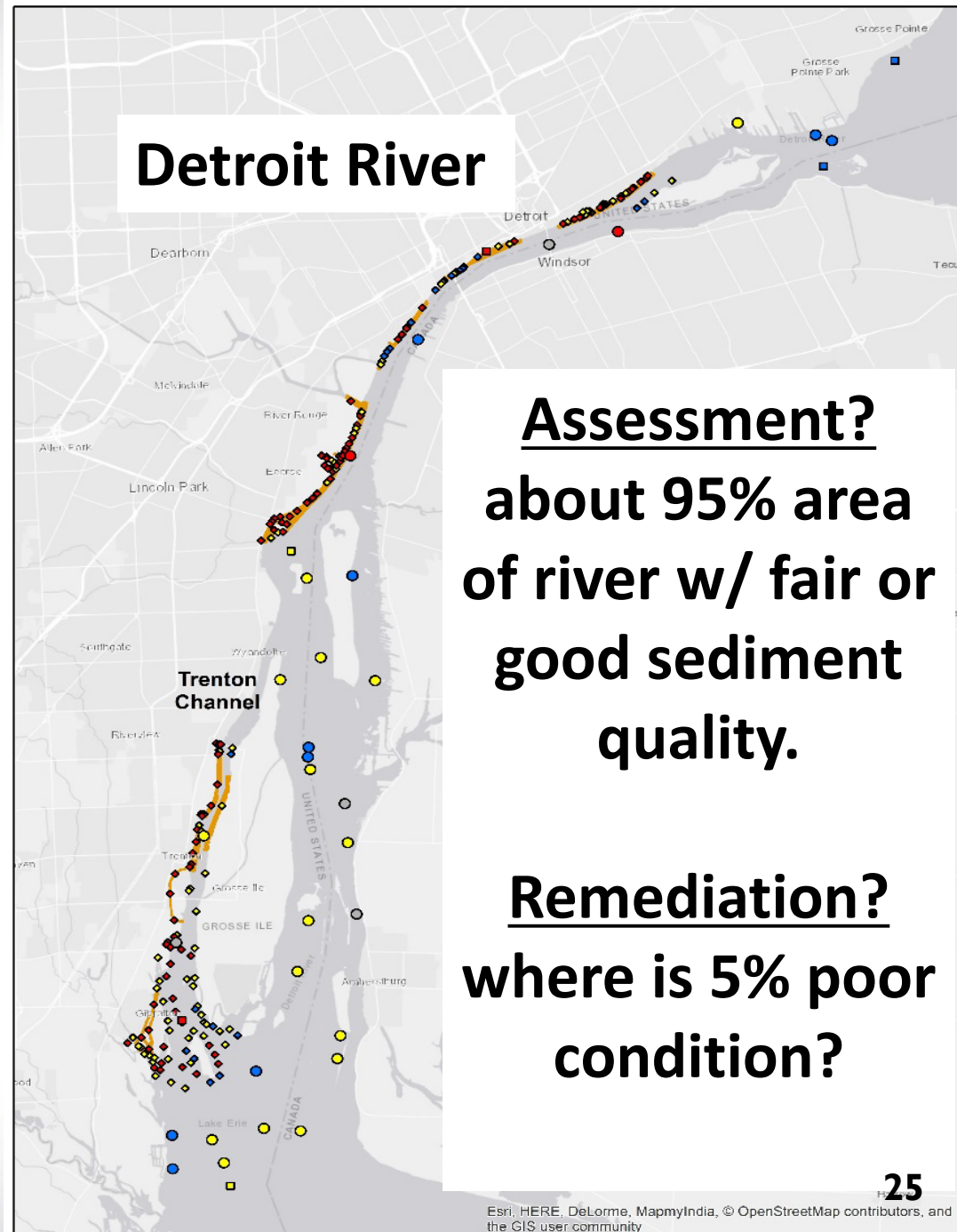
WQ looks fair using Lake Huron thresholds.

![EPA logo]

Enhancements provide system-wide context for targeted sampling programs.

Like embayments, important to know extent of stressors to target R2R2R efforts.

Detroit River

Assessment?
about 95% area of river w/ fair or good sediment quality.
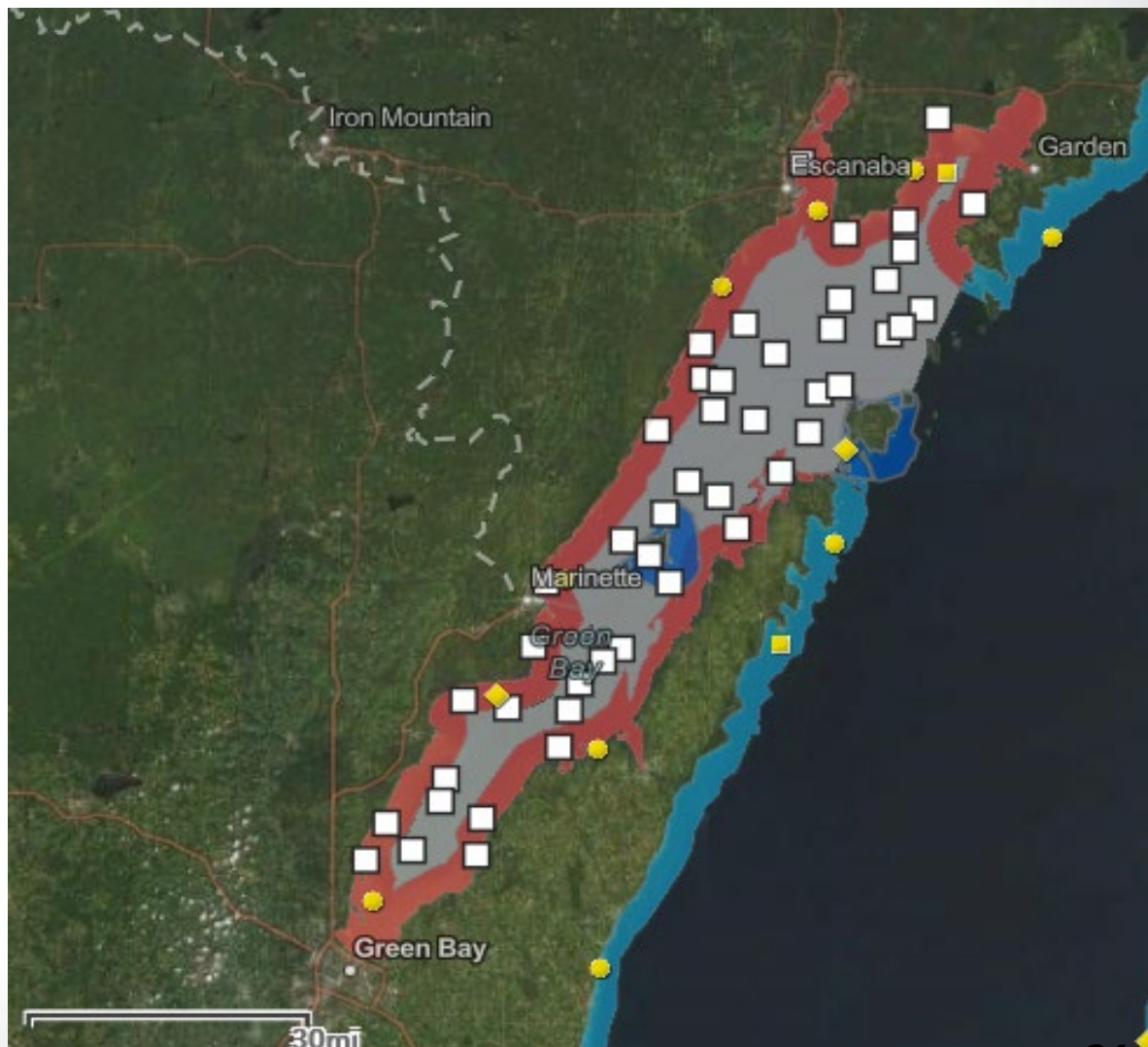
Remediation?
where is 5% poor condition?

Region 5 & GLNPO solicited enhancement ideas from states.

WI and MI proposed "doing" all of Green Bay (2020).

OW base + GLRI supplement + ORD support + Region assessment

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Enhancements create synergies for other agencies

Isle Royale NP

Apostle Islands NL

Indiana Dunes NP

Sleeping Bear Dunes NL

LAKE SUPERIOR

Partnering with NPS to repeat 2010 survey of National Parks and Lakeshores in 2020 and 2021.

Base design supplemented with more sites. Hybrid of survey and targeted sampling.

Enhancements create opportunities for new assessments.

LAKE MICHIGAN

There are 35k islands (<1 to 277k ha).
Largest are managed for conservation and development.

WI and MI asked whether conditions differ from mainland coastal.

Designed for Lake Michigan islands >1000 ha

Wrap-up

Via EMAP, NARS, & NCCS, ORD has partnered to deliver science needed for a demanding GL management model.

Survey Design Enhancements

✓ Complement base designs and assessments

✓ Allow finer-scale assessments to address finer-scale questions

✓ Create synergies with and context for targeted management programs

✓ Inform on high priority, under-assessed resources

✓ Drive research on indicator thresholds.

Thank you to EMAP, NARS, and NCCA scientists, managers, and crews for giving us this view of the Great Lakes.

Questions?

No.