

Nutrient Load Reductions: Policies for Diverse Perspectives

Tuesday Round Table



Agenda: Nutrient Load Reduction Policies

- Challenges facing Ohio stakeholders
 - **Water quality**
 - **Economic**
- Building communication across sectors
 - **Commonalities**
 - **Differences**

Water Quality - Adrienne Nemura, Geosyntec

State of Ohio Nutrient Reduction Strategy – Brian Hall, Ohio EPA

A Municipal Perspective – Frank Greenland, NEORSD

Agricultural Perspective:

Partnership for Ohio Grain Farmers – Kirk Merritt, Ohio Soybean Association & Council

Economics – Jeff Rexhausen, Adam Blandford, UC Economics Center

NUTRIENTS: WATER QUALITY

Adrienne Nemura, P.E.
Senior Principal
Geosyntec Consultants



engineers | scientists | innovators

Impairments of Designated / Beneficial Uses

LOCAL

Water crisis grips hundreds of thousands in Toledo area, state of emergency declared



By Tom Henry | BLADE STAFF WRITER

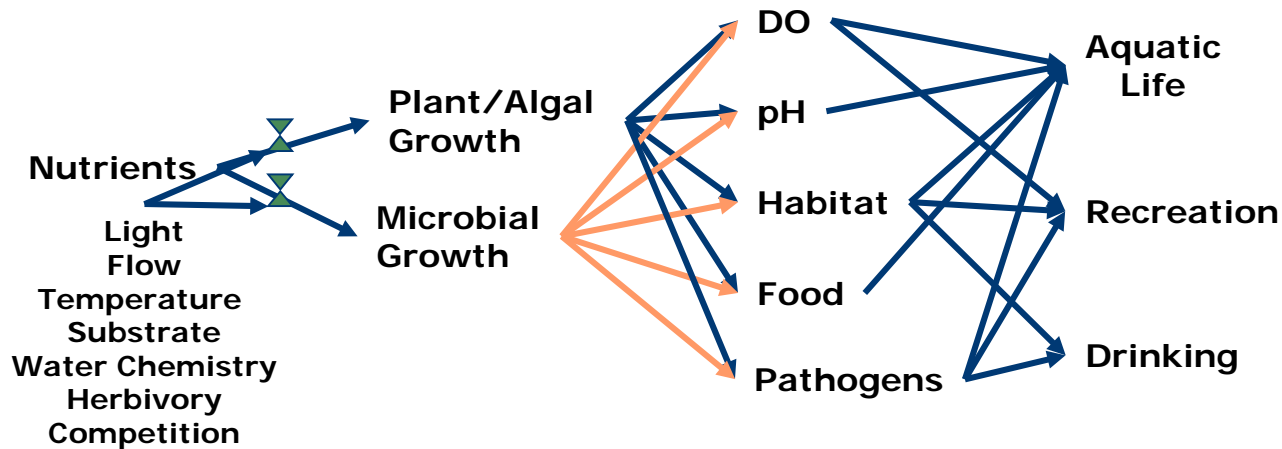
Published on Aug. 3, 2014 | Updated 8:03 p.m.



www.dispatch.com/content/stories/local/2015/10/03/algae-along-the-ohio.html

Complexity & Uncertainty

How to Go from Science to Clean Water Act “Designated Uses”?



Source: WEFTEC 2010, Watershed Workshop. US EPA.

Prohibitive Costs

- Florida
 - Agriculture -- \$900 million to \$1.6 billion
 - All Others – \$6 to \$8 billion
- Chesapeake Bay
 - Total region est. \$50 billion (or more)
- Montana
 - Cities -- \$1.4 billion in upgrades
 - Businesses -- \$370 to \$560 million per year (more than 2% of total revenue)
- Utah
 - TP=1 mg/l to TP=0.1 / TN=10 mg/l
 - 30 mechanical POTWs -- \$24 million to \$1.04 billion
 - 22 lagoon POTWs -- \$30 million to \$383 million

EPA Nutrients' Policy

1. Prioritize watersheds
2. Set watershed goals
3. Effective point source permits
4. Agriculture & targeted watersheds
5. Stormwater & septic systems
6. Accountability & verification
7. Reporting
8. Numeric nutrient criteria



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Related Topics: **Nutrient Policy and Data**

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Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions

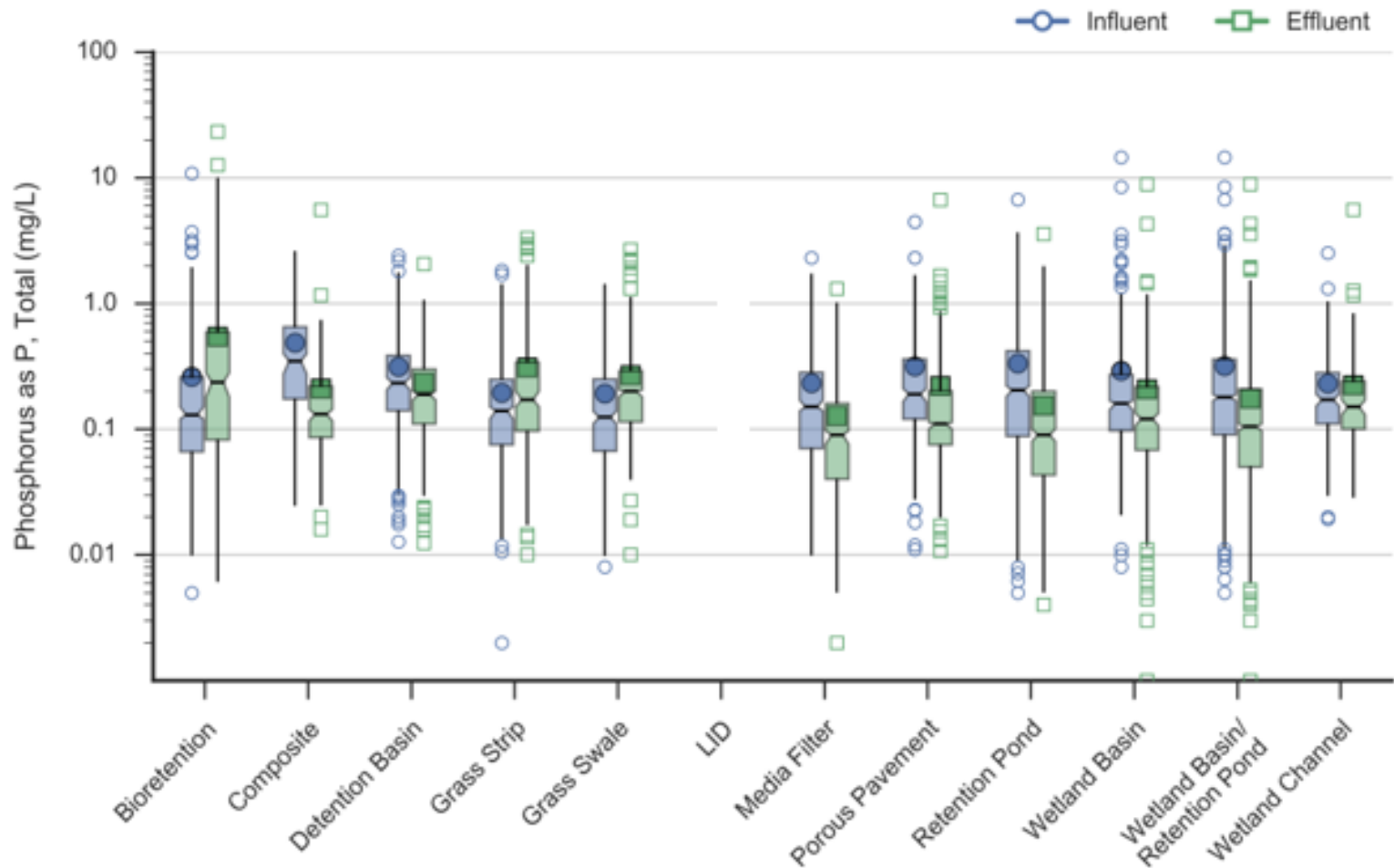
The memos below lay the foundation for a partnership among states, EPA and stakeholders to make greater progress in reducing nutrient pollution. The framework provides for: prioritizing watersheds on a statewide basis for nitrogen and phosphorus loading reductions, ensuring effectiveness of point sources permits, integrating innovative approaches onto agricultural practices, identifying and using government tools to assure reductions in stormwater and septic systems, verifying that load reductions are in place and the measures implemented are effective, and developing a plan for adoption of numeric nutrient criteria.

www.epa.gov/nutrient-policy-data/working-partnership-states-address-phosphorus-and-nitrogen-pollution-through

Urban Best Management Practices (BMPs) Performance



International Stormwater BMP Database



Can Water Quality Trading Provide Low-Cost Alternatives?

Control Practice	\$/lb Phosphorus	\$/lb Nitrogen
POTW Upgrades	5 to 106	6 to 11
MS4 Retrofits	--	200
Conservation Tillage	7	1.50
Agricultural Grass Buffer	20	1
Animal Waste/Runoff Control	31	4
Constructed Wetlands	2	2

Sources: Chesapeake Bay, EPA 2007; WERF 2005; WRI 2009

State of Ohio Nutrient Reduction Strategy

Brian Hall, P.E.

Assistant Chief, Division of Surface Water,
Ohio EPA

Water Impacts from Nutrients

- Increase in Harmful Algal Blooms (HABs)
 - Beach Advisories
 - Cost of Drinking Water Treatment and additional Regulations
- Changes in Aquatic Communities
- Anoxic Zones in Central Basin of Lake Erie and Gulf of Mexico
- Impact on Tourism

Ohio's Nutrient Reduction Strategy

- Published in 2013 and amended in 2016
- Outgrowth of Gulf Hypoxia Task Force
 - Each of 12 task force states to develop plan
 - US EPA reviewed and commented (but not approved)
- Collaboratively develop by Ohio EPA, Ohio Department of Natural Resources and Ohio Department of Agriculture

Ohio's Nutrient Reduction Strategy

- Six Part Plan
 - Focus on Specific Watershed
 - Set Nutrient Loading Targets
 - Ensure Effectiveness of Point Source and Nonpoint Source Reductions
 - Measure Effectiveness of Reductions
 - Report to Public
 - Develop Nutrient Water Quality Standards

Ohio's Priority Watersheds

Maumee River

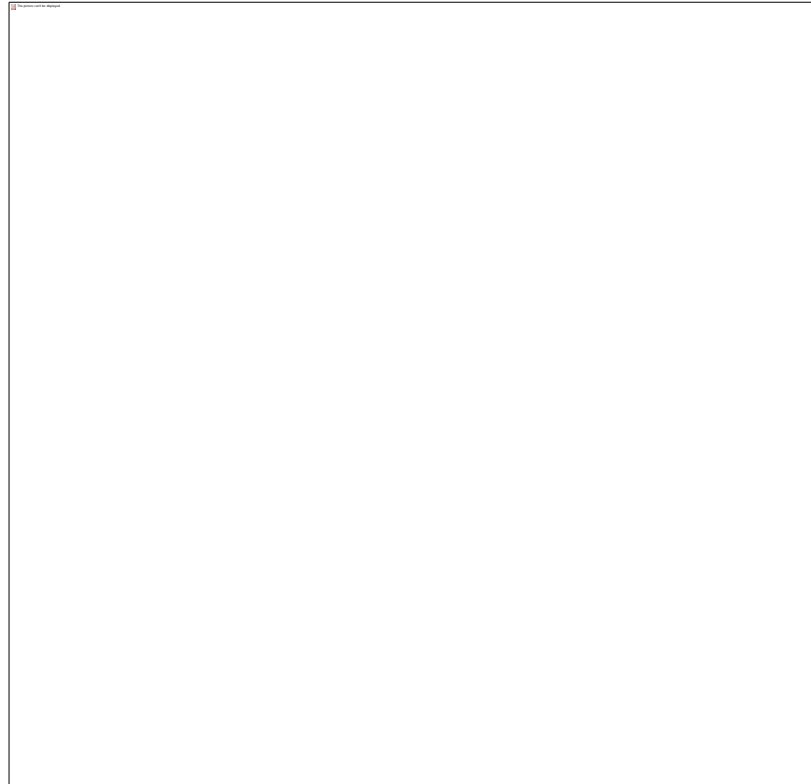
Sandusky River

Cuyahoga River

Great Miami River

Scioto River

Wabash River



Nutrient Loading Targets

- Great Lakes Water Quality Agreement Annex 4
 - Western Lake Erie Basin
 - Goal – HAB toxins and bloom equal to 2012, 9 years out of 10.
 - Target – Spring Loading of **860 tons Total Phosphorus** and **186 tons Dissolved Reactive Phosphorus**
 - Central Lake Erie Basin
 - Goal – Minimum Dissolved Oxygen of lake bottom waters of 2 mg/l
 - Target – Annual Load of **6,000 tons Total Phosphorus**
- Gulf Hypoxia Task Force
 - Goal – Hypoxia zone less than 5,000 km² (1930 mi²)
 - Target – 20% annual reduction of Total Nitrogen and Total Phosphorus

Ways to Ensure Effectiveness of Point and Nonpoint Source Reductions

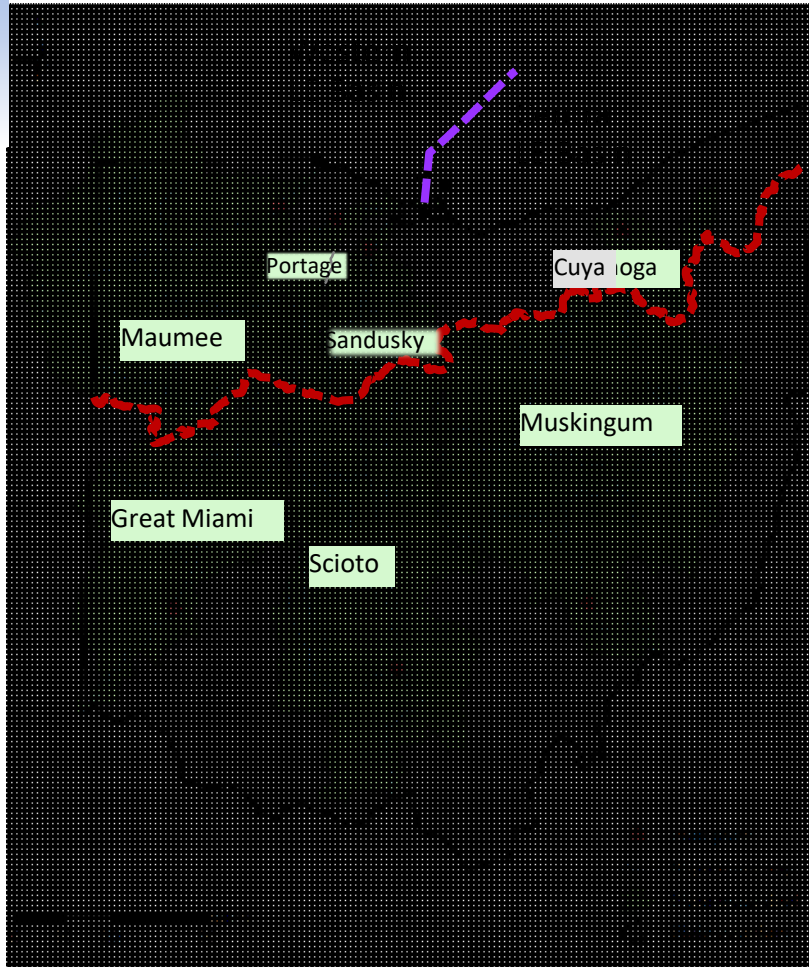
- Necessary to identify and track progress
- Reason for this discussion

Measure Effectiveness of Reductions and Report to Public

- Ohio Integrated Water Quality Reports (IR)
 - Sent to US EPA even number years
 - List of impaired waters
 - Schedule for corrective actions (i.e. TMDLs)
- Ohio Statewide Nutrient Mass Loading Report
 - Established by HB 64 (July 2015) - ORC 6111.03(U)
 - Report due at same time as IR
 - First Report Published in December 2016
 - Know Stream Loadings and Point Source Loadings (includes combined sewer est.)
 - Estimate Home Sewage
 - Remainder is Nonpoint Source (urban and rural)

$$\textit{Total Load} = \textit{PS} + \textit{HSTS} + \textit{NPS}$$

Ohio EPA's Nutrient Mass Balance Study for Ohio's Major Rivers



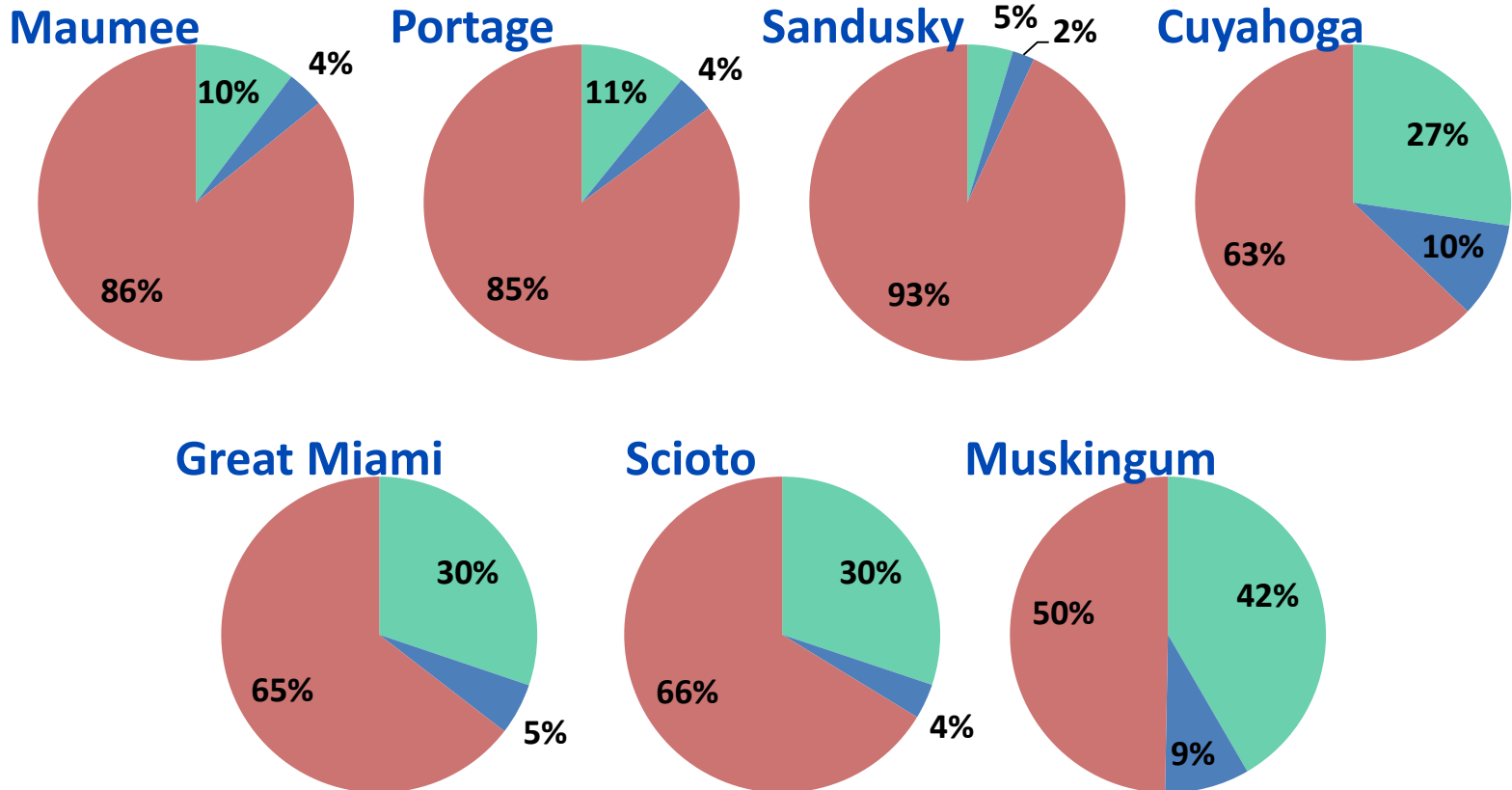
↑ Lake Erie Basin
↓ Ohio River Basin

Study Area Covered

- 7 major watersheds
- 26,000 sq. mi. (in Ohio)
- 63% of Ohio's land area

Total Phosphorus Loads by Source:

Major Ohio Watersheds (average wy13-14)



NPDES Home Sewage Treatment System Nonpoint Source

Develop Ohio's Nutrient Water Quality Standard (WQS)

- Ohio has been working on a WQS since early 2000's
- Different Nutrient Criteria for different media
 - *Small to Medium Sized Rivers* – Stream Nutrient Assessment Protocol (SNAP)
 - Technical Advisory Committee
 - Two Parts to SNAP – Water Quality Standard & Implementation
 - *Large Rivers*
 - Data collection and theory developed
 - Technical Advisory Committee being put together
 - *Inland Lakes*
 - Part of proposed 2011 Inland Lakes Rule
 - Reassessing Inland Lakes Criteria as part of Agency Triennial Rule Review



Northeast Ohio Regional Sewer District

Nutrient Reduction Efforts

Frank Greenland, P.E.
Director of Watershed Programs
OWEA Annual Conference
June 27, 2017

@neorsd

1952 Cuyahoga River



@neorsd



@neorsd

1960s Cuyahoga River



Lake Erie

Toledo

Cleveland

Fort Wayne

Akron

Youngstown

Mansfield

NEORSD Sewer District Service Area

Pittsburgh

355
square miles

OHIO

Columbus

Dayton

Cincinnati



Northeast Ohio Regional Sewer District

Who we are . . .

- Political subdivision of the State of Ohio
- Created by court order in 1972
- Regional agency separate and distinct from municipalities and counties



What we do . . .

- Own, operate 3 wastewater treatment plants
- 1 million customers
- 330 miles of sewers
- \$3 billion, 25-year combined sewer overflow control program
- 420+ mile regional stormwater system

Easterly

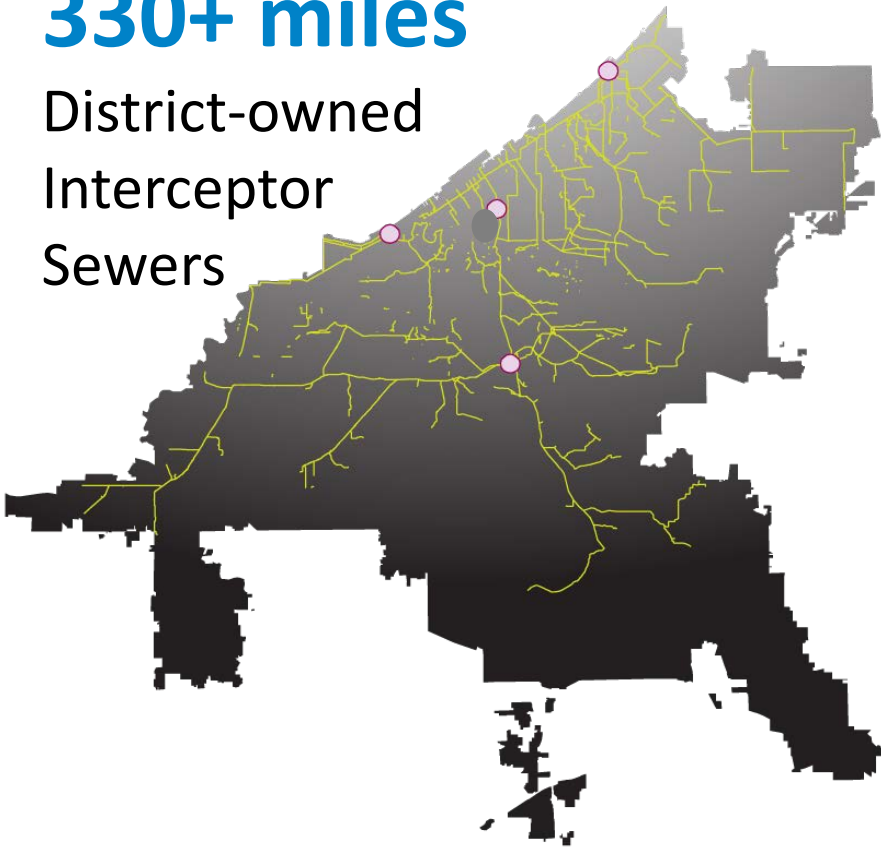
 District

Southerly

Westerly

330+ miles

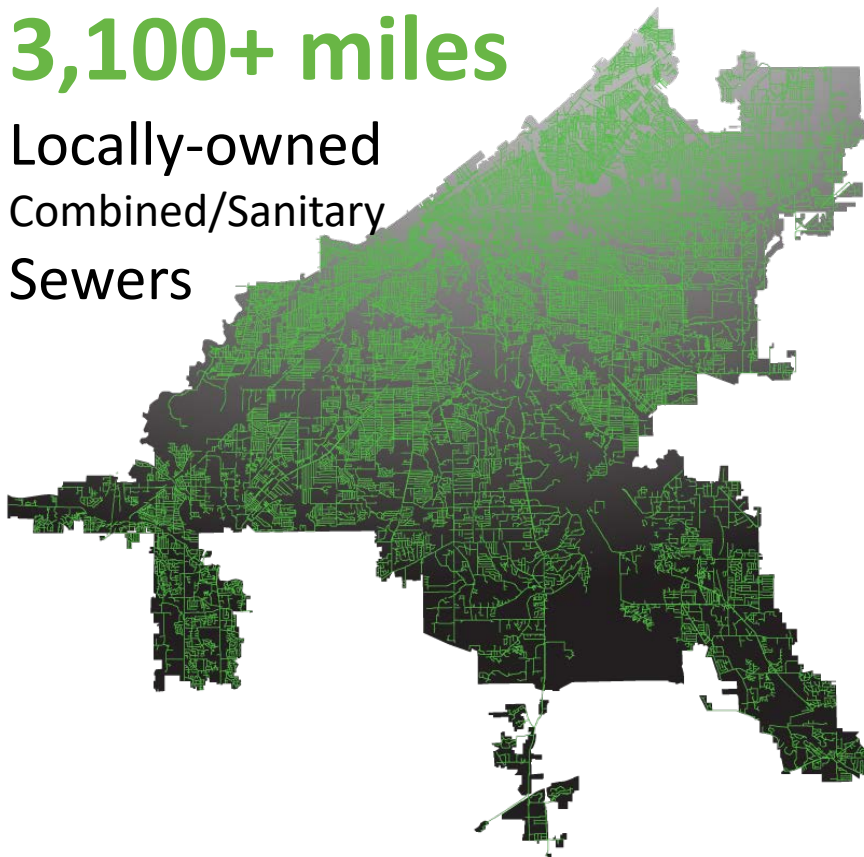
District-owned
Interceptor
Sewers



NEORSD CWA Obligations:
CSO, WWTPs

3,100+ miles

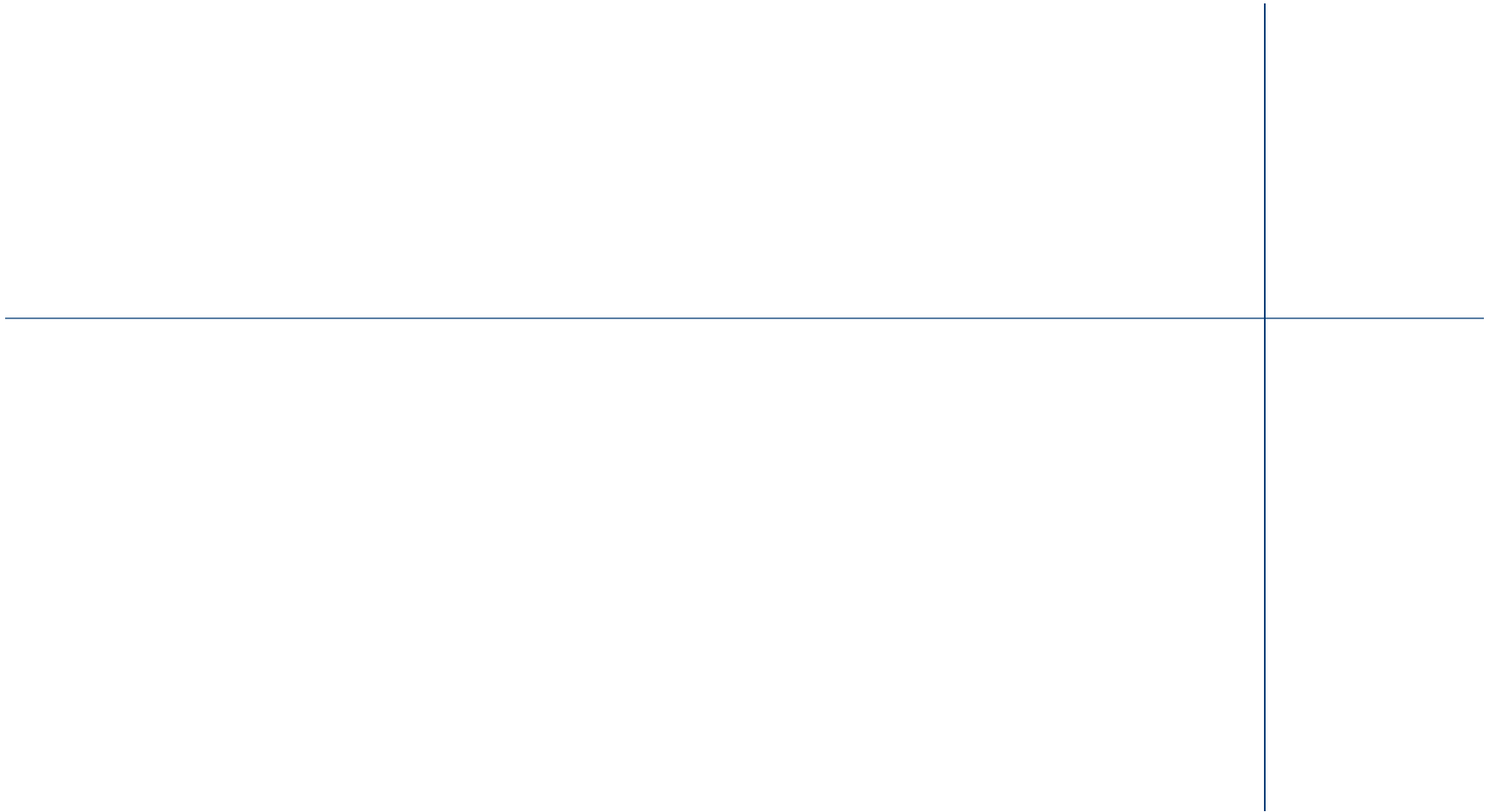
Locally-owned
Combined/Sanitary
Sewers



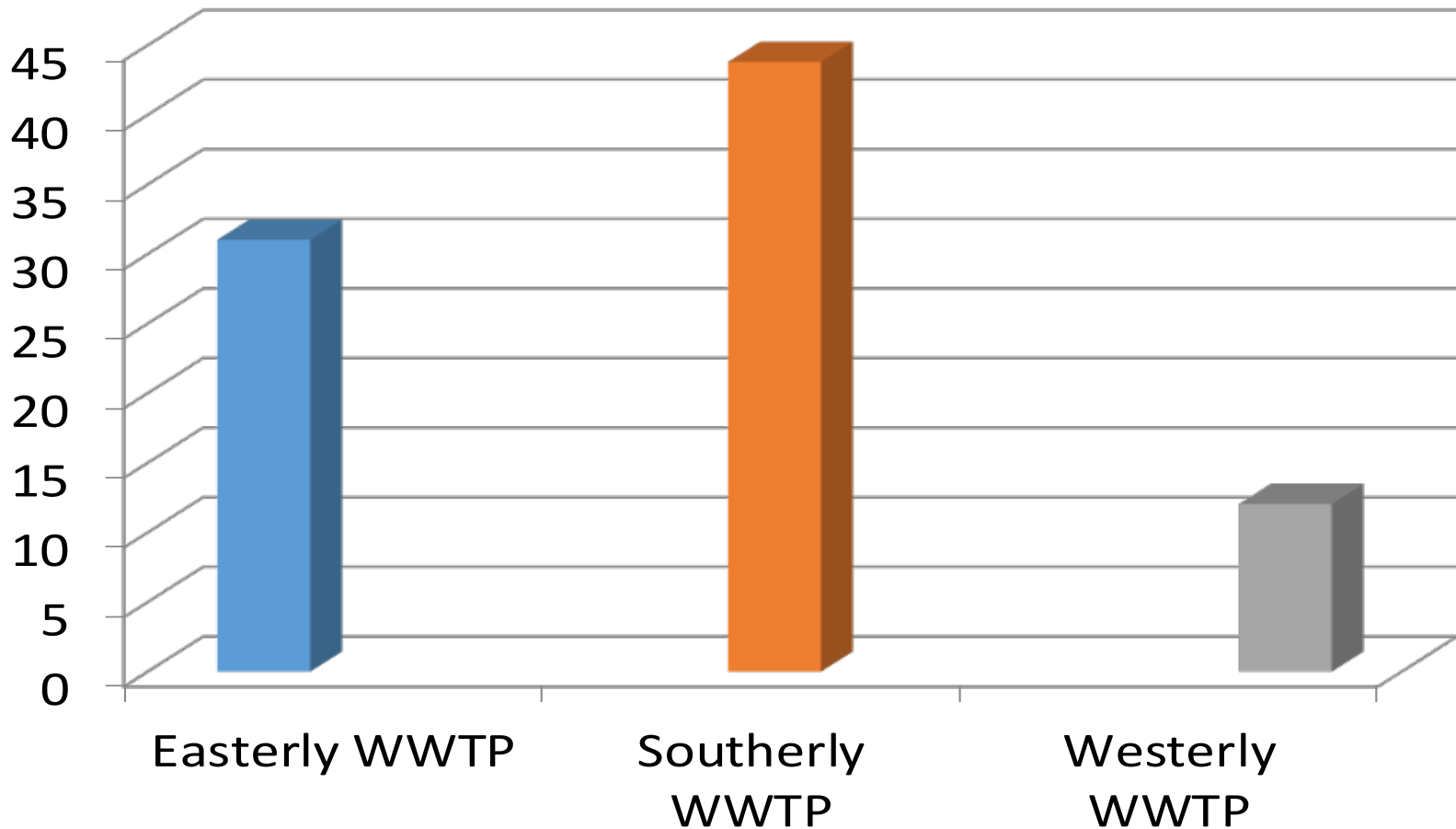
Local CWA Obligations:
SSOs, Illicit Discharges,
Stormwater outfalls, Septic tanks

Over 40 years of investment

- Since 1972: **\$5+ billion**
 - Wastewater treatment plants
 - Interceptor and relief sewers
 - CSO control and interceptor rehab
 - Other facility upgrades



90 Billion Gallons Treated Annually



Wastewater Treatment Plant Phosphorus Reduction History

Current WWTP NPDES Phosphorus Permit Limits

WWTP	Weekly Average (mg/l)	Monthly Average (mg/l)
Easterly	1.5	1.0
Southerly	1.1	0.7 (TMDL based)
Westerly	1.5	1.0

Existing NPDES Permit Requirement:

Evaluation for Low Cost Phosphorus Removal

“...Begin an evaluation of the capability of the existing treatment facilities to reduce the final effluent concentration of total phosphorus below the current limitation...”

Existing NPDES Permit Requirement:

Evaluation for Low Cost Phosphorus Removal

“...Implement measures identified in the evaluation...to reduce the final effluent total phosphorus concentration”

Results of Low Cost Phosphorus Reduction Evaluation

- Ferric chloride addition reduced effluent phosphorus concentrations
 - Easterly: < 0.5 mg/l Annual Average Achieved
 - Southerly: < 0.5 mg/l Annual Average Achieved
 - Westerly: < 0.7 mg/l Annual Average Achieved
- Nominal cost: \$200,000 - \$250,000/year for ferric
- Cost benefit good: \$0.24/lb P Removed (2016)

Incremental Future Phosphorus Reduction Costs

WWTP	Phosphorus Limit (monthly) mg/l	Capital Cost	O&M Cost
Easterly	0.5	\$90 - \$160M	\$1.7 - \$5.5M
Easterly	0.3	\$150 - \$340M	\$2.5 - \$8.6M
Westerly	0.5	\$50 - \$90M	\$0.9 - \$2.4M
Westerly	0.3	\$80 - \$150M	\$1.1 - \$3.3M

Incremental Future Phosphorus Reduction Costs

WWTP	Phosphorus Limit (monthly) mg/l	Capital Cost	O&M Cost
Southerly	0.5	\$20 - \$180M	\$2.5 - \$9.2M
Southerly	0.3	\$30 - \$230M	\$3.4 - \$12M
Southerly	0.15	\$270 - \$360M	\$11 - \$14M

Incremental Reductions in WWTP Phosphorus Discharges

- Will require plant modifications
- Costs significant: \$160M-\$850M
(capital)
- Cost/benefit questionable

Incremental “P” Removal Cost Benefit (Capital Only)

WWTP	\$/Incremental lb of additional “P” Removed
Easterly	\$4,500 - \$10,100
Westerly	\$4,600 - \$36,450
Southerly	\$500 - \$3,860

Incremental Reductions in WWTP Phosphorus Discharges

- Impacts NEORSD sewer rates (1% rate increase per \$100M capital)
- NEORSD WWTP “P” load to Lake Erie
= 2% of total load

Permitting Strategy is Key

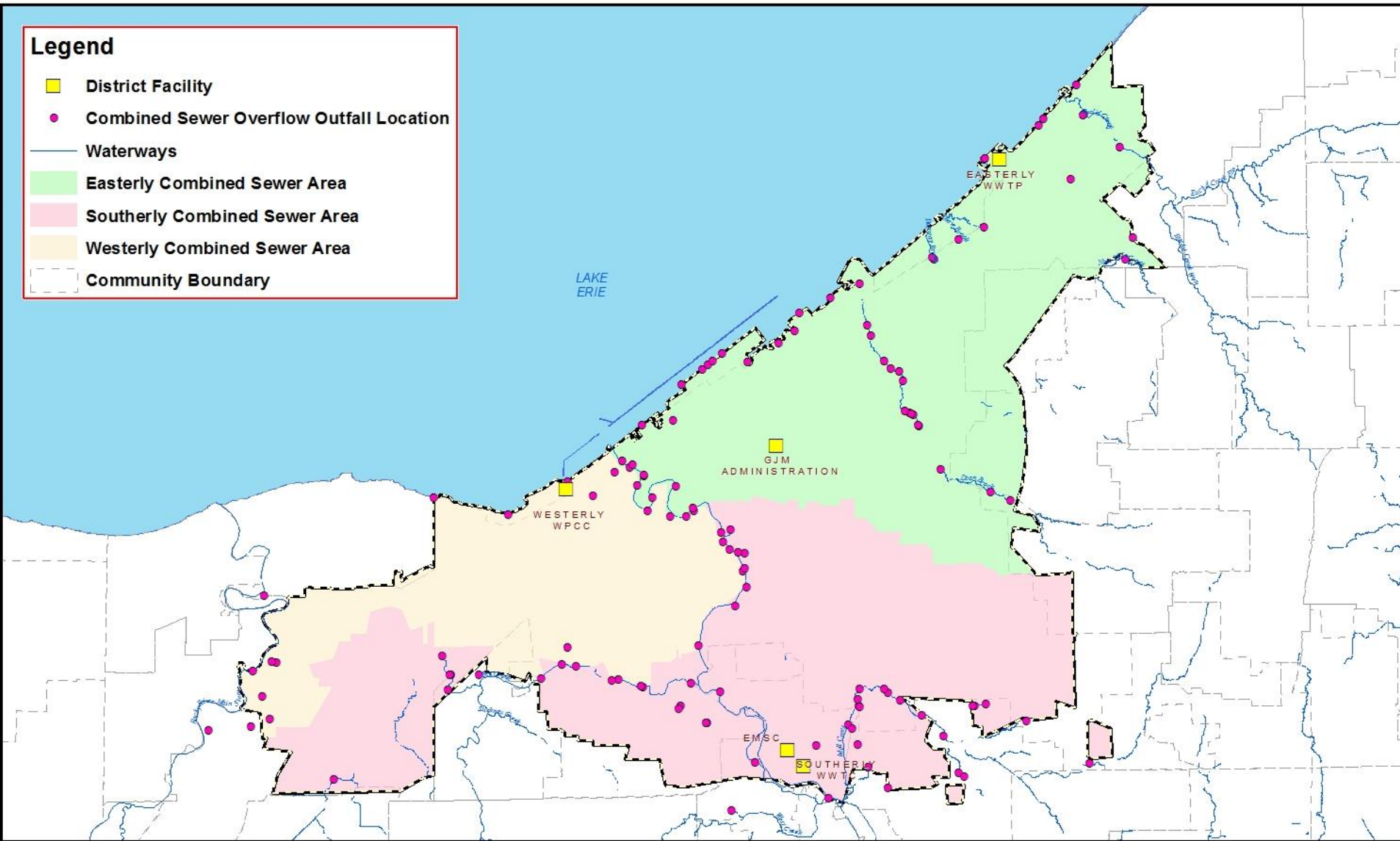
- Weekly average?
- Monthly average?
- Growing season average?
- Annual average?



- Combined Sewer Overflow Control
- \$3 billion investment by 2036
- Gray and green infrastructure investment
- Accomplished through sewer fees
- Not targeted on phosphorus removal

Legend

-  District Facility
-  Combined Sewer Overflow Outfall Location
-  Waterways
-  Easterly Combined Sewer Area
-  Southerly Combined Sewer Area
-  Westerly Combined Sewer Area
-  Community Boundary



Consent Decree Significant CSO Reduction in 25 years

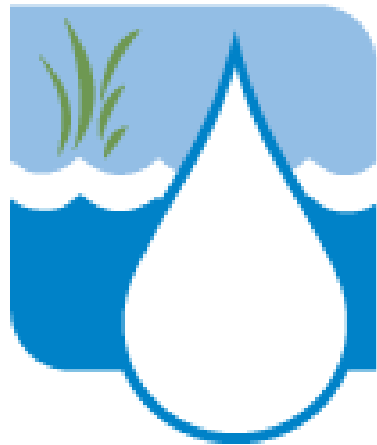


98%
CAPTURE

NEORSD CSO Phosphorus Contribution to Lake Erie (% of Total “P” Load)

- Current: <0.5%
- Post Project Clean Lake: 0.1%

NORTHEAST OHIO REGIONAL SEWER DISTRICT



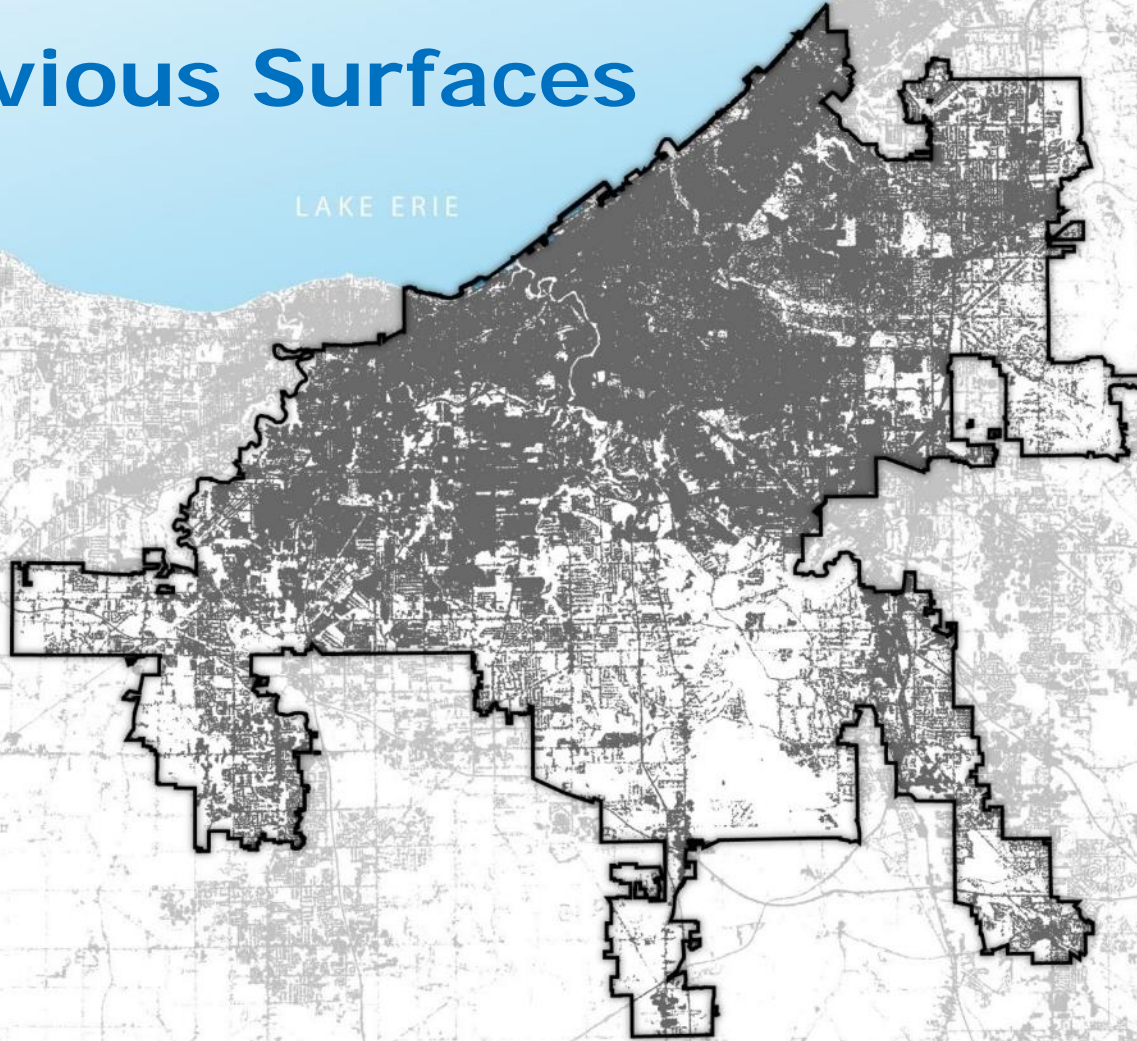
REGIONAL
STORMWATER
MANAGEMENT
PROGRAM



Northeast Ohio
Regional Sewer District

Impervious Surfaces

LAKE ERIE



Development of RSMP NEORSD Court Order

- Judge McMonagle mandated the District to:
*“develop a detailed integrated capital improvement plan for regional management of wastewater collection and storm drainage to identify a capital improvement program **for the** solution of all intercommunity drainage problems (both storm and sanitary) in the District”*



**Northeast Ohio
Regional Sewer District**

Challenges of Urban Stormwater Phosphorus Reduction

- Regional Stormwater Management Program
 - \$42M annual revenue for erosion, flooding, and water quality projects (\$5.15/month/ERU)

Challenges of Urban Stormwater Phosphorus Reduction

- Member Community NPDES Phase 2 Permit responsibility
- Magnitude of “P” load to Lake Erie?
- Cost/benefit of stormwater BMPs?

Rate/Fee Impacts for Future Phosphorus Reduction Efforts

- Stormwater fee does not include wholesale phosphorus reduction efforts

Rate/Fee Impacts for Future Phosphorus Reduction Efforts

- Significant Capital/O&M costs for “P” removal will increase wastewater rates
 - 1% rate increase/\$100 million increase in capital expense
 - 1% rate increase/\$5 million increase in O&M expense

Rate/Fee Impacts for Future Phosphorus Reduction Efforts

- Existing NEORSD wastewater rates are significant
 - 2012-2016: 12% annual increases
 - 2017-2021: 8.3% annual increases
 - Current NEORSD debt service : \$1.5 billion

Investing Wisely

- Best use of scarce environmental dollars
- Both point and non-point sources need to make investments

Investing Wisely

- Scale/timing of investments critical to overall success
- Sound science should drive needed investments

Agricultural Perspective: Partnership for Ohio Grain Farmers

Kirk Merritt
Executive Director



What are Ohio's farmers doing?

Edge of Field Research

- On Field Ohio!
- Led by The Ohio State University and USDA
- Research program started in 2012, to better understand and mitigate the impact of nutrient runoff on water quality
- Evaluate the relationship between on-field conditions and nutrients leaving the fields
- Ohio Phosphorus Index score re-evaluation and future integration in to the Tri-State Fertility Guidelines

Edge of Field Research



Edge of Field Research

- 29 fields monitored, 14 in WLEB
- Edge of field testing
- Evaluation of different practices
- On the ground results
- Data from 1993 through 2015 shows soil test phosphorus levels holding steady or trending down in 80% of Ohio's counties

Revising Ohio Fertilizer Recommendations

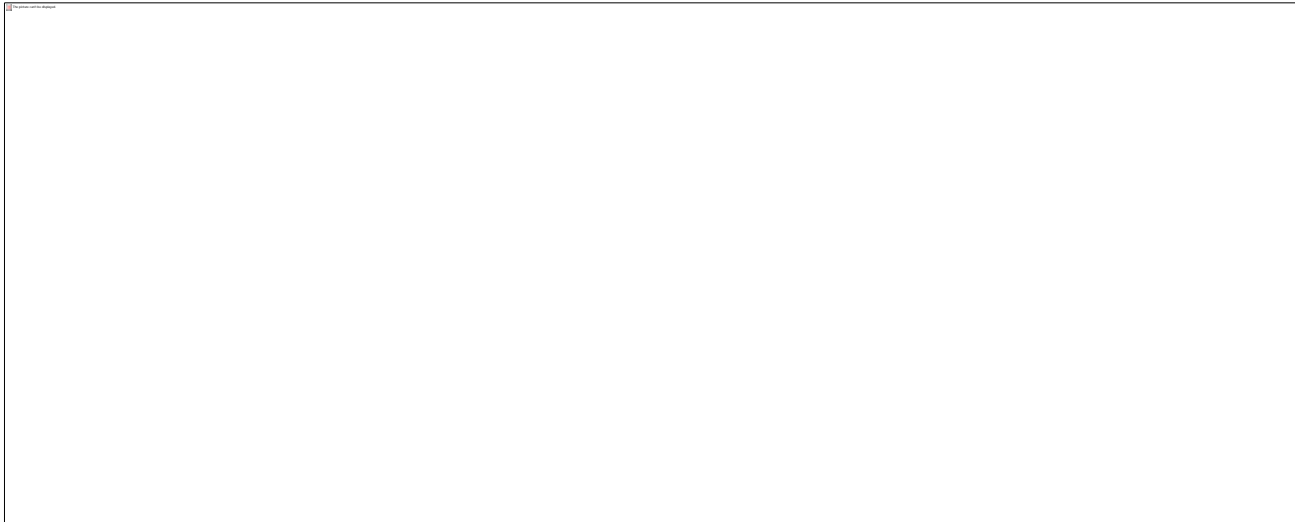
- Revising Nitrogen, Phosphorus and Potassium recommendations for corn, soybeans and wheat
- Project led by OSU – Dr. Steve Culman
- Mostly on-farm strip trials
 - Diversity of soil types and management histories across state
 - All trials are replicated and randomized
- Public-private partners: Working directly with growers and also through OSU extension and private crop consultants
- Data include: Soil sampling, R1 tissue test, grain yields and nutrient concentrations, management survey
- New fertilizer recommendations to be released in summer 2018 (this is first revision since 1995)

Promoting 4R Nutrient Stewardship

A graphic titled "4Rs OF NUTRIENT STEWARDSHIP" with the subtitle "Economically, Environmentally & Socially Sustainable Crop Nutrition". The graphic features a red tractor on the left and a row of wheat stalks on the right, set against a light blue sky and green grass. Below the tractor and wheat is a brown soil layer containing text.

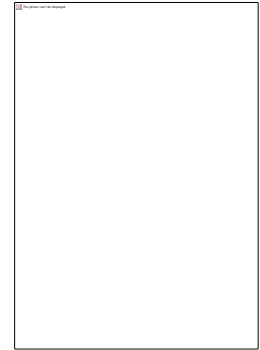
4Rs OF NUTRIENT STEWARDSHIP
Economically, Environmentally & Socially
Sustainable Crop Nutrition

The 4Rs promote best management practices (BMPs) to achieve cropping system goals while minimizing field nutrient loss and maximizing crop uptake.



4R Nutrient Stewardship Certification

- Audit process for fertilizer retailers
- Certifies that they are following 4R principles when working with farmers
- 4Rs = Right Source / Right Rate / Right Time / Right Place
- Led by Ohio AgriBusiness Association and The Nature Conservancy
- Initially focused in Western Lake Erie Basin, but now statewide





OHIO

37 Certified

Branch Facilities

2,515,000

Total Acres

5,550

Clients Serviced

WLEB

34 Certified

Branch Facilities

1,880,000

Total Acres

3,780

Clients Serviced

**Note: Ohio numbers include WLEB numbers

Precision Farming & Nutrient Mgmt

- Soil sampling / grid sampling
- Variable rate nutrient application
- Fertilizer incorporation
- GPS technology



Fertilizer Incorporation

- Current research is showing fertilizer placement can be very effective at reducing nutrient loss
 - Disk injection
 - Chisel injection
 - Surface banding
 - High pressure injection
- Requires specialized equipment

Photo Credit: Crops and Soils Magazine,
May-June 2011

Best Management Practices

Cover Crops

- To increase organic material
 - Sorghum, cereal rye, oats, wheat, barley
- To increase soil nitrogen
 - Legumes, clover, alfalfa
- Capture excess nutrients
 - Oilseed, radish, turnips, buckwheat
- Natural herbicides
 - Mustard, oats, rye, sorghum
- Alleviate soil compaction
 - Radish, turnips



Buffer Strips

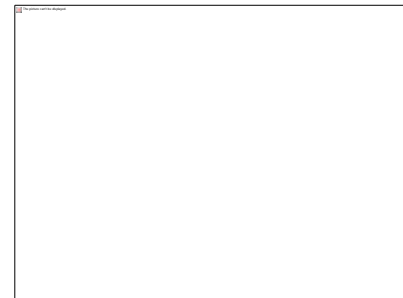
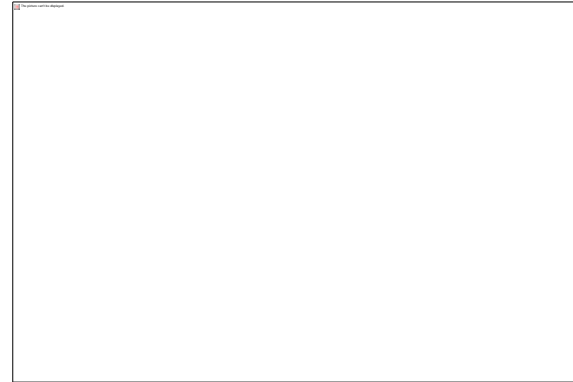
- Unplanted land between crops and streams, rivers
- Filters nutrients before they enter waterways

Blanchard River Demonstration Farms

- Project led by Ohio Farm Bureau and USDA
- 3 demonstration farms in the Blanchard River watershed
 - Stateler Family Farms
 - Kurt Farms
 - Kellogg Farms
- Serve as models for other farmers
 - Research and evaluate innovative practices to reduce nutrient run-off
 - Results will be widely shared with other farmers, management agencies, and the public

Blanchard River Demonstration Farms

- Practices Being Evaluated
 - Variable Rate Nutrient Application
 - Cover Crops
 - Drainage Water Management
 - Wetland with Pollinator Habitat
 - Home Septic System Replacement
 - Two-stage ditch
 - Phosphorus Removal Beds
 - Filter Strips
 - Subsurface Nutrient Placement
 - Reduced Tillage



Are Farmers Applying Too Much Phosphorus?

- USDA research on active Ohio fields
- Every field is different
- Plant removal exceeds application for most sites
- *OSU: 80 of 88 counties have declining soil test P*

Credit: Kevin King, USDA, ARS, SDRU

Surface Drainage / Tile Drainage

- Inconsistent data interpretation regarding impacts of surface drainage and tile drainage on watershed nutrient levels
- Should not address issues associated with drain tile discharges at the expense of the progress that has been made reducing surface water runoff and the associated nutrient load
- Erosion still matters

New Regulation

Senate Bill 150

- Signed in May 2014
- Requires farmers and contractors to be certified to apply fertilizer
- Initial deadline Sept. 2017, and then every 3 years
- Education component – half-day training workshop
- Farm organizations worked with legislators on this bill & have promoted participation in workshops
- Nearly 18,000 certifications have been issued

New Regulation

Senate Bill 1

- Signed April 2015
- No fertilizer or manure application on frozen, snow covered ground or saturated soils
- No manure application when forecast calls for 50% chance of one-half inch of precipitation over 24 hours
- No fertilizer application when forecast calls for 50% chance of one inch of precipitation over 12 hours
- Exception when nutrients are incorporated, injected or applied to a growing crop

Many Remaining Questions

Questions

- Impact of legacy P in farmland?
- Impact of surface drainage and tile drainage?
- How much particulate/erosion runoff is becoming dissolved/bioavailable?
- Impact of N on algal blooms?
- Impact of fertilizer placement?
- Impact of heavy rain events?

More research needed on all of these questions and more

Farmer Perspective on Water Quality

- Farmers want to be good environmental stewards
- Farmers are continually adapting farming practices to improve water quality
- Farmer decision-making should be based on the best science and research available
- Farmers are actively participating in research projects, and providing funding through their organizations
- There are still important research questions that need to be answered

ECONOMIC CONSIDERATIONS

Jeff Rexhausen
Senior Research Associate

Adam Blandford
Research Associate

Economics Center at University of Cincinnati

Two Basic Principles of Economics

- Resources are Limited
- Choices have Consequences

Corollaries

- No one can afford to waste money
- When we invest in something that doesn't move the needle, we can't put that money where it will make a difference

Reducing Nutrients and Other Forms of Pollution

- How do we find the most cost-effective solutions?
- There are differences between point and nonpoint sources in ...
 - Approach
 - Cost
 - Ability to pass on costs
- Application: How do we act?
 - Historically – regulation
 - Emerging – markets

Market for Trading Pollution/Clean Water Credits

- What should a market do?
 - Facilitate voluntary transactions that increase the well-being of both parties
- What are the characteristics of an effective/efficient market?
 - Transparency; low friction (few barriers); maximizes surpluses (win-win)
- Why are markets regulated?
 - Create certainty and a level playing field (set rules that are fair to all)

Barriers/Obstacles to Change

- Sewer agencies/residents don't directly receive non-economic benefits (location of WQ improvements)
- Tenant farmers lack control: inhibits investment
- Some farmers lack trust: the carrot may become a stick
- Farmers operate in a national market, not a state market
- Poor marketing fosters misperceptions

Other Challenges

- Many direct water quality beneficiaries are free riders
- Misalignment between basic regulatory and market purposes
 - Regulatory – certainty, uniformity
 - Market – efficiency, cost-effectiveness
- Regulators afraid of losing power
- Environmental groups afraid of losing power

Other Approaches: Tinkering v. Innovation

- Tinkering
 - Maryland: “trading” among point sources
 - Ohio: point sources & USDA grant → non-point sources
 - Ontario: new development fees
- Innovation
 - North Carolina: group compliance permits
 - Lower cost technology v. costly improvements
 - Keeping nutrients out of waters

For Further Information

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