



Runoff Risk: A Decision Support Tool for Nutrient Applications

*Current & Planned Ecosystem IDSS Utilizing NWS Modeling
to Help Improve the Nation's Water Quality*

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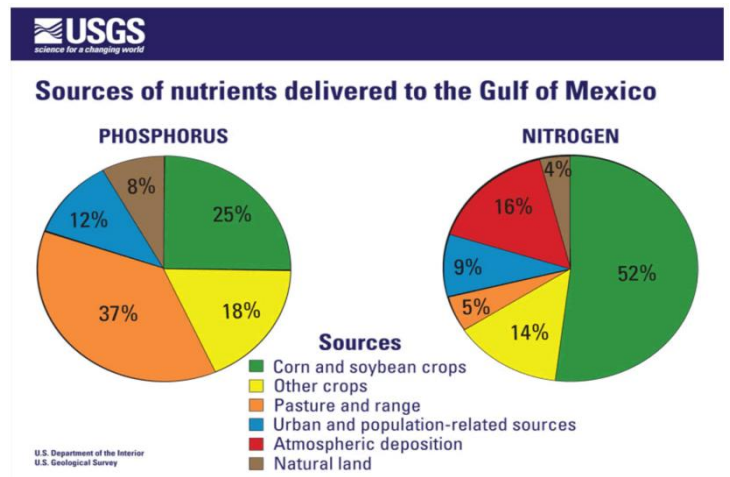
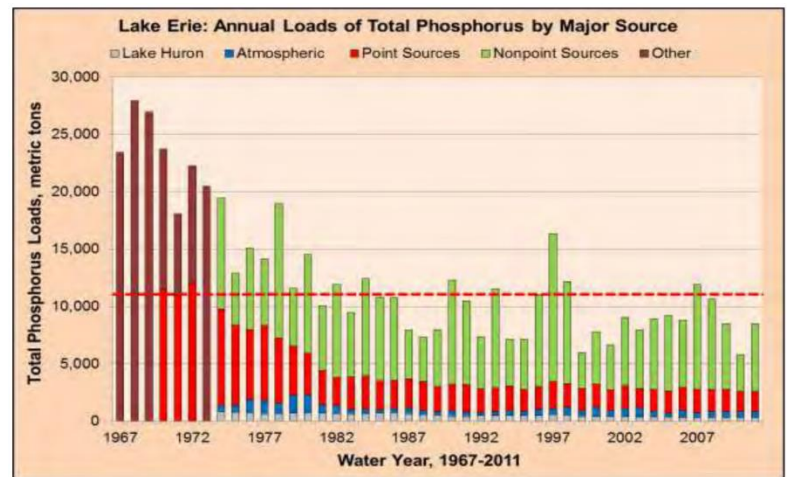
*Upper Mississippi River Basin Association
Water Quality Executive Committee & Water Quality Task Force Joint Meeting
2 June 2016*



Building a Weather-Ready Nation



Excess Nutrients are Causing Water Quality Impairment on National Scale

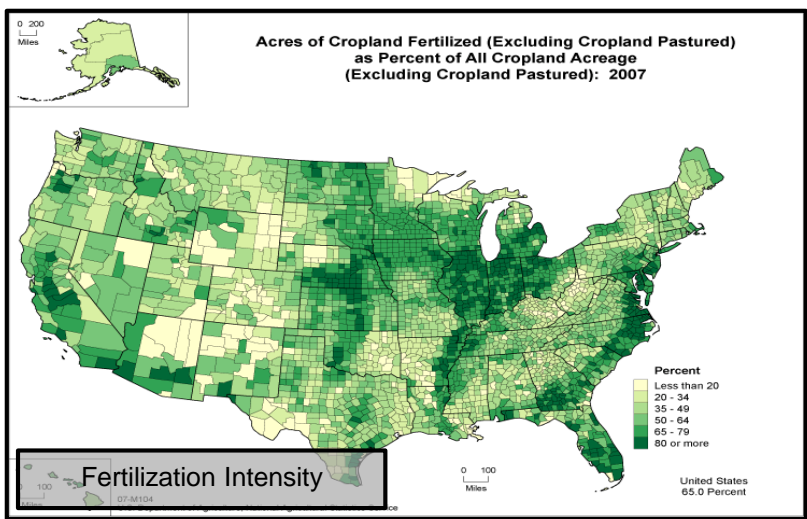
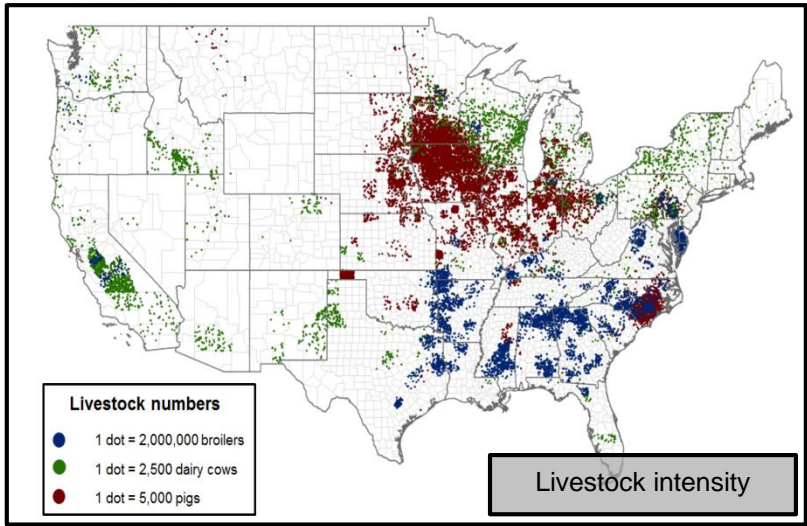


Ohio Lake Erie Phosphorus Task Force II Final Report Nov 2013





Agriculture is Vital Industry with Many Nutrient Management Challenges





Excess Nutrient Impacts Increasingly in the News



The Des Moines Register
PART OF THE USA TODAY NETWORK

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Des Moines water quality suit slated for trial in 2016



City of Toledo
Aug 2014



EPA United States Environmental Protection Agency

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News Releases By Date

Governments of Canada and the United States Announce Phosphorus Reduction Targets of 40 percent to Improve Lake Erie Water Quality and Reduce Public Health Risk

Release Date: 02/22/2016
Contact Information: Robert Daguillard (Media Only), daguillard.robert@epa.gov, 202-564-6618

New targets to reduce toxic and nuisance algae blooms affecting Lake Erie

WASHINGTON.- U.S. Environmental Protection Agency Administrator Gina McCarthy and Canada's Environment and Climate Change Minister Catherine McKenna today announced that Canada and the U.S. have adopted targets to reduce phosphorus entering affected areas of Lake Erie by 40 percent. The targets announced today will minimize the extent of low oxygen "dead zones" in the central basin of Lake Erie; maintain algae growth at a level consistent with healthy aquatic ecosystems; and maintain algae biomass at levels that do not produce toxins that pose a threat to human or ecosystem health.

- ❑ Highly visible events driving support for action
- ❑ What combination of practices will enable reduction goals to be met?





NOAA and NWS Strategic Plans and Goals



NOAA's INTEGRATION OFFICE Office of Program Planning and Integration

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NOAA's Goals

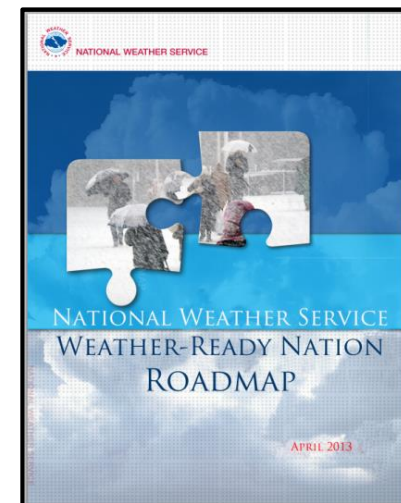
Climate Adaptation and Mitigation **Weather-Ready Nation** Healthy Oceans Resilient Coastal Communities and Economies

Society is prepared for and responds to weather-related events

Long-term goal: Weather-Ready Nation

- Objective: Reduced loss of life, property, and disruption from high-impact events
- Objective: Improved freshwater resource management
- Objective: Improved transportation efficiency and safety
- Objective: Healthy people and communities due to improved air and water quality services
- Objective: A more productive and efficient economy through environmental information relevant to key sectors of the U.S. economy

NOAA Partnerships for a Weather-Ready Nation

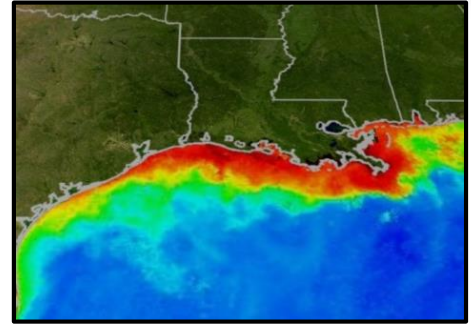


- Nutrient reduction, and the runoff risk concept, support numerous goals and objectives in both NOAA and NWS strategic plans:
 - Improving water quality
 - HAB and hypoxic zone reductions
 - Decision support tools
 - Building collaboration on local-regional-national levels
 - Leveraging existing NWS capabilities in new ways with new partnerships





Runoff Risk Supports Ecological Focus for NOAA



The goal is to utilize NWS modeling to warn farmers of future conditions unsuitable for application, with the intention of reducing nutrient transport from fields over time.





The Importance of Nutrient Application Timing



- Many studies have shown the timing of applications relative to runoff can have significant impact on nutrient transport
 - A few large events can transport majority of annual load from fields
 - Applying before significant events could negate year-long adherence to BMPs
- Importance of runoff risk even more apparent during critical periods:
 - Winter and early spring is most vulnerable time
 - Frozen soils, snow on ground, rain-on-snow events, rapid warm-ups, unprotected soils
- Many practices exist for where and how to apply or landscape modification
 - No organized assistance exists to help farmers with the when (*not to*) apply

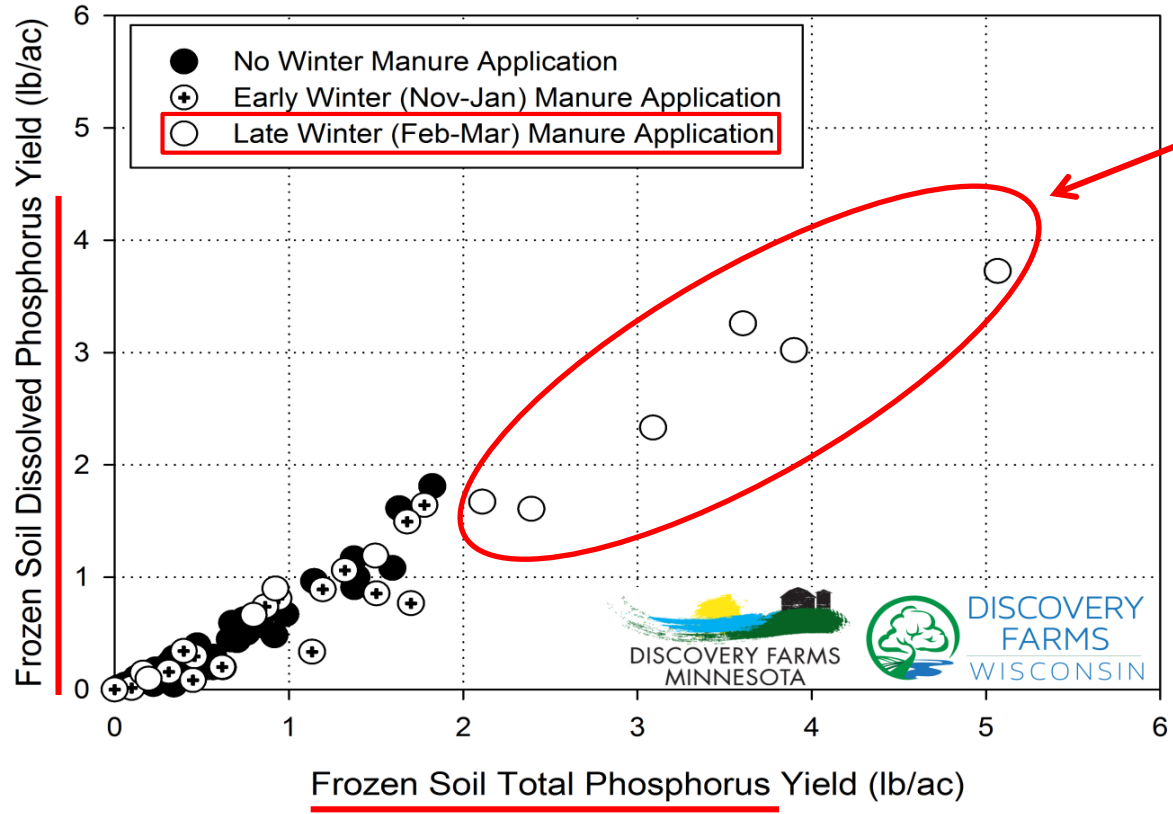
Timing: Concentrate on the Critical Periods

- WI USGS studies: ~50% of runoff occurred in Feb & March (frozen ground)
 - Nitrogen & Phosphorus yields also highest during these two months
 - Vegetation based conservation practices to limit soil/nutrient loss not applicable
→ **Timing major factor during this period**
 - Timing of field-management practices strongly influenced nutrient yields
 - *Application of manure and/or tillage (incorporation) within week of runoff were significant factors for increased nutrient loss*





Application Timing Impacts During Critical Periods



50-60% of Late Winter application losses are **higher than ALL** Non-applied or Early Winter applications

Late Winter ≠ higher losses

Unique circumstances drive the risk, and weather has role

Some years no snowpack or heavy rains

- 83% of Total P loss was in the form of dissolved P when manure was applied to frozen ground
- Late winter applications can increase P loss by 2 to 4 times



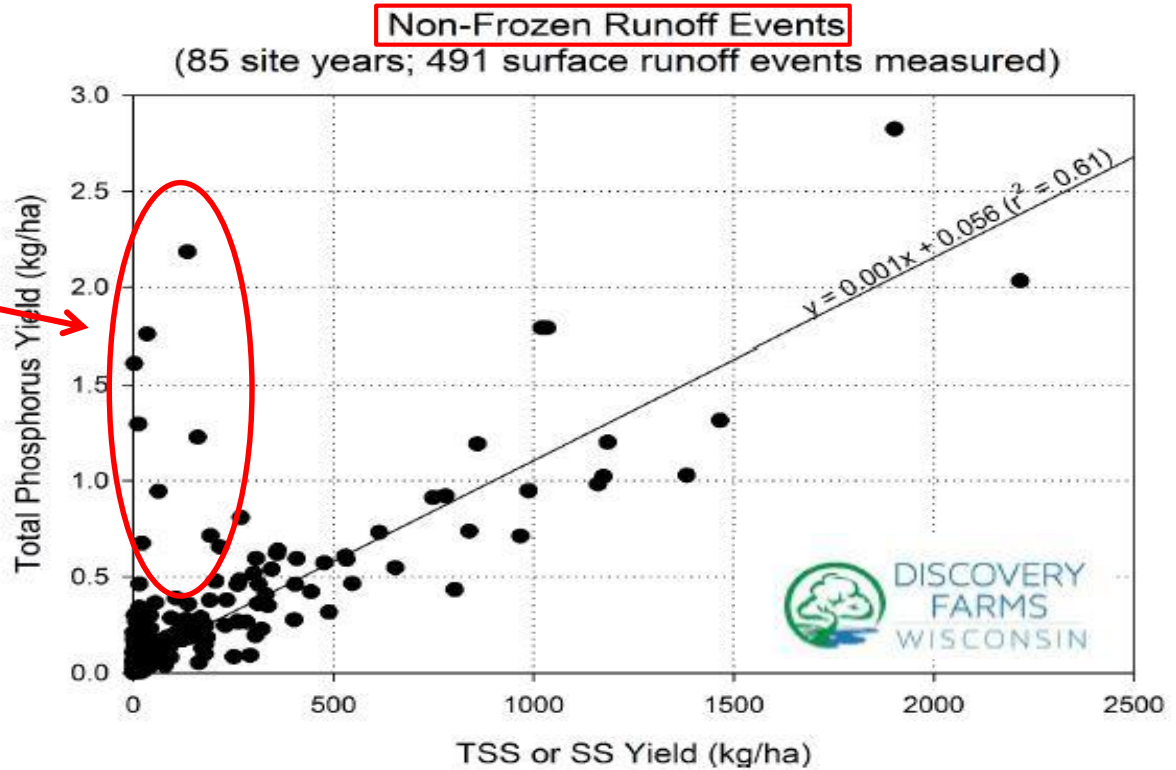


Application Timing Impacts During Non-Frozen Periods



High P Losses but very low sediment losses.

These events are the result of P fertilizer or manure applications shortly before runoff and were dominated by dissolved P.



- During non-frozen periods P loss generally tied to soil loss.
 - Many practices aimed at holding soil in place for this reason
- Application timing important during spring/summer as well



NWS Can Add Value to Timing Decisions



- NWS has unique capability of national scale real-time atmospheric and hydrologic forecasting to drive decision support tools in natural resources
 - Capable of meeting the increasing desire for tools in multiple regions
- Specifically: focused on week-to-10 day short-term window
- NWS, via runoff risk, supplements the 4-R Approach

Right Source

Right Rate

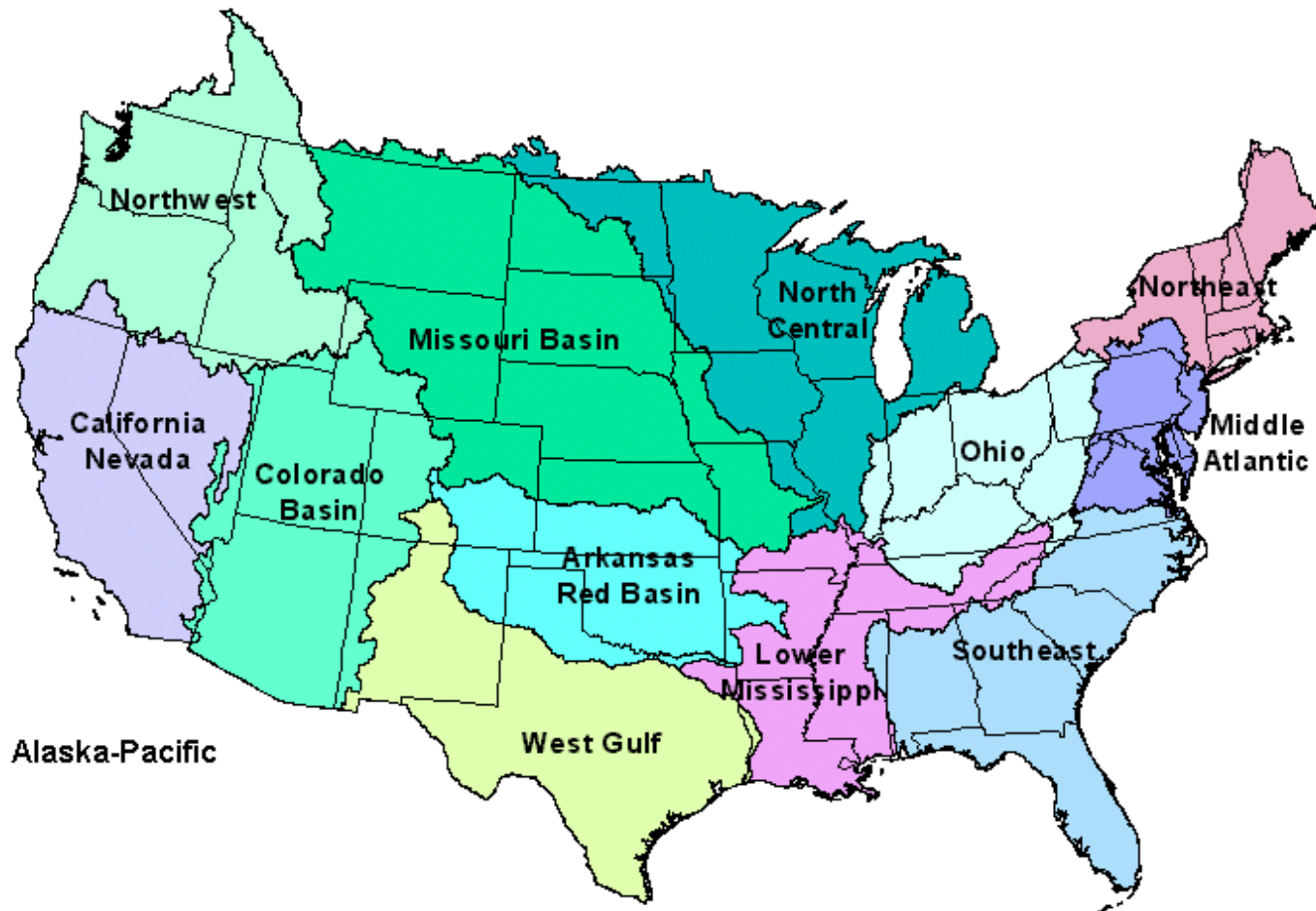
Right Time

Right Place

Warn when risk is high

- Reduce applications before runoff
- Potentially reduce nutrient losses





- ❑ 13 River Forecast Centers across U.S.
- ❑ Focus on real-time modeling & forecasting of river flow & stage



What is the Runoff Risk Tool?



- ❑ Decision support tool that identifies threat of significant future runoff in both space and time
 - → **Not** modeling nutrient transport/loads
- ❑ Developed in collaboration with states and partners to incorporate state specific application rules and guidelines
- ❑ Partnering States make an investment and act as the tool owner and presenter to the public
- ❑ Currently produced multiple times daily with forecast out 10 days into future



How Runoff Risk Started



- Numerous well-publicized manure spills caused fish kills and well contamination in Wisconsin during the winter of 2005-2006
 - State Legislature directs Department of Agriculture (DATCP) to implement online advisory system to assist farmers and applicators
- WI Dept of Ag, Trade and Consumer Protection contacts NWS
 - NCRFC meets with taskforce
 - Runoff Risk Advisory Forecast (RRAF) Working Group formed
 - *Federal, state, academic, and farming community representatives*
- DATCP and UW built, own, maintain the website (Public Face)
- Started collaborating in 2009, went live in 2011



Current RRAF in Wisconsin



- Runoff Risk incorporates factors already used by farmers
 - Modeled soil moisture, precip, snowpack, temperatures
 - Provides farmers with second opinion → back-up perspective
- RRAF is first-generation tool using operational lumped model
- RRAF approach is conditioned by reality
 - Front-loaded analysis of historical model runs & observed EOF runoff
 - Algorithm includes selected model states & thresholds based on basin specific historical biases
- Spatial scale was always a concern in implementation
 - Average lumped-model basin in WI = 300 mi² vs. 10s of acres (0.01% area)
 - Validated model with EOF runoff:
 - *Model hit 80% EOF events*
 - *Thresholds help reduce false alarms → focus attention on largest events*

*“No one trusts a model except the man who wrote it;
everyone trusts an observation, except the man who made it.” -- Harlow Shapely*



Attention & Awareness in Runoff Risk is Growing



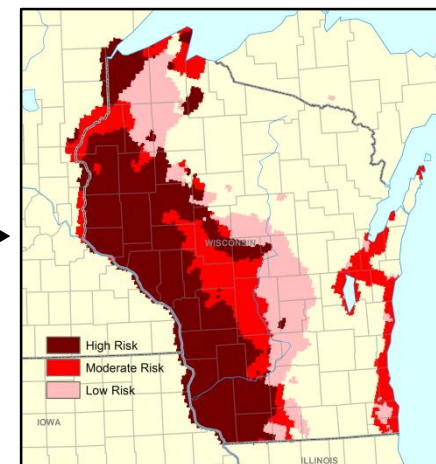
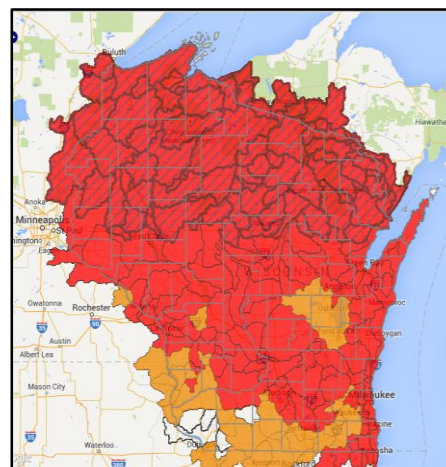
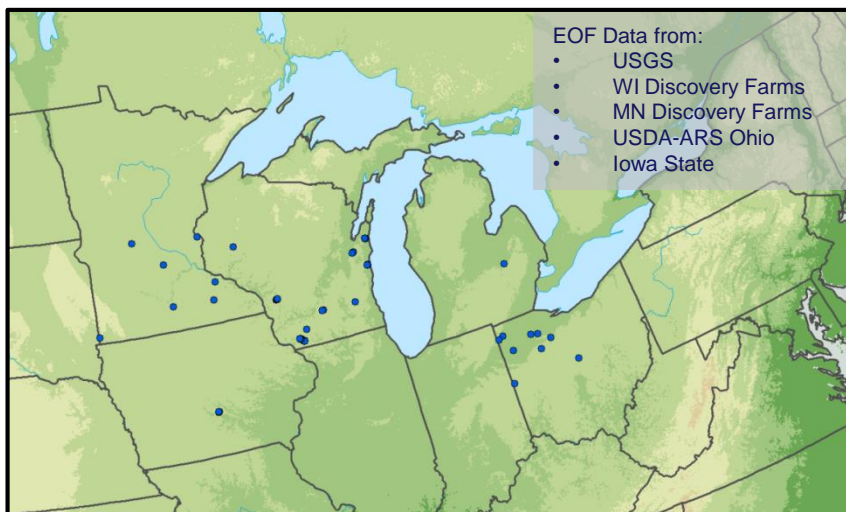
- ❑ Government Accountability Office (GAO) 2014 Report
- ❑ Briefed Federal partners at 2015 Hypoxia Task Force Meeting
- ❑ Briefed senior scientists at USDA-NRCS
- ❑ Inquiries from additional States (MN, OH, MI, IN, IL, IA, KY, NE)
- ❑ Formed partnership with EPA and the Great Lakes Restoration Initiative (GLRI)
- ❑ Partner in NRCS Conservation Innovation Grant (CIG) to investigate runoff risk type tools in different areas of the U.S.



MN, MI, OH → Then Great Lakes



- GLRI funds used to hire contractor and purchase equipment to spur development in MI and OH first, then rest of Great Lakes
- Goal :: Use consistent model framework across the region
 - Allow individual states to build websites and tailor tool for their needs
- Transition to new 4km x 4km gridded model to address scale concerns
 - Requires new setup and analysis (ongoing)





Long-term Plans



- ❑ Social Science evaluation of Runoff Risk
 - UW Environmental Resources Center Evaluation Unit
- ❑ NRCS CIG Project
 - Compare and evaluate 4 runoff risk tools across multiple states
 - Led by Nichole Embertson, Whatcom Conservation District, WA
- ❑ Quantify effect of Runoff Risk usage on water quality
 - GLRI FY17 funding to work with Ohio State and Maumee SWAT model
- ❑ Study agronomic & economic benefit of Runoff Risk usage?
 - GLRI FY18 funding to work with Michigan State and MI partners
- ❑ Always open for new improvements, techniques, or models
 - Are there regional methods that are better?
 - NWS National Water Center (NWC) and transition to National Water Model?



Multi-Agency Partnerships are Essential



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USGS
science for a changing world



Great Lakes RESTORATION

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Natural Resources Conservation Service

NOAA NOS

Sea Grant Michigan

Sea Grant
Ohio Sea Grant College Program

MICHIGAN STATE UNIVERSITY EXTENSION

Michigan **Department of AGRICULTURE & Rural Development**





Questions?



- ❑ Wisconsin RRAF
 - Google “Wisconsin RRAF”
 - www.manureadvisorysystem.wi.gov/app/runoffrisk
 - Background Information
 - *NOAA Tech Report NWS 55*
 - http://docs.lib.noaa.gov/noaa_documents/NWS/TR_NWS/

- ❑ Further Questions & Comments
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