Conservation Effects Assessment Project (CEAP) Watershed Assessment Studies

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CEAP Watersheds Assessments Leader,
USDA NRCS, Resource Assessment Branch,
Outcomes/CEAP Team

Meeting with VT Ag Water Quality Partnership
May 2, 2022

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CEAP Project Goals and Activities

- **CEAP is USDA's unprecedented effort to:**
  - quantify the effects of conservation practices and programs
  - develop the science base for managing the agricultural landscape for environmental quality
- **National and Regional Assessments (large scale)**
  - Cropland
  - Grazing Lands
  - Wetlands
  - Wildlife
- **Watershed Assessment Studies (smaller scale)**
  - ARS, NRCS, NIFA (prior)
  - 24 Active projects (52 total since 2003, including prior projects)
- **Bibliographies and Literature Reviews**
  - Targeting, Watershed Modeling
  - Climate Change and Drought, Water Availability
  - Great Lakes and HABs

Duriancik, et al., 2008. JSWC; doi:10.2489/jswc.63.6.185A
https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap/

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Goals of the CEAP Watershed Studies:

- **quantify the measurable effects** of conservation practices at the watershed scale
- **enhance understanding** of conservation effects in the biophysical setting of a watershed
- **inform local watershed conservation** strategies

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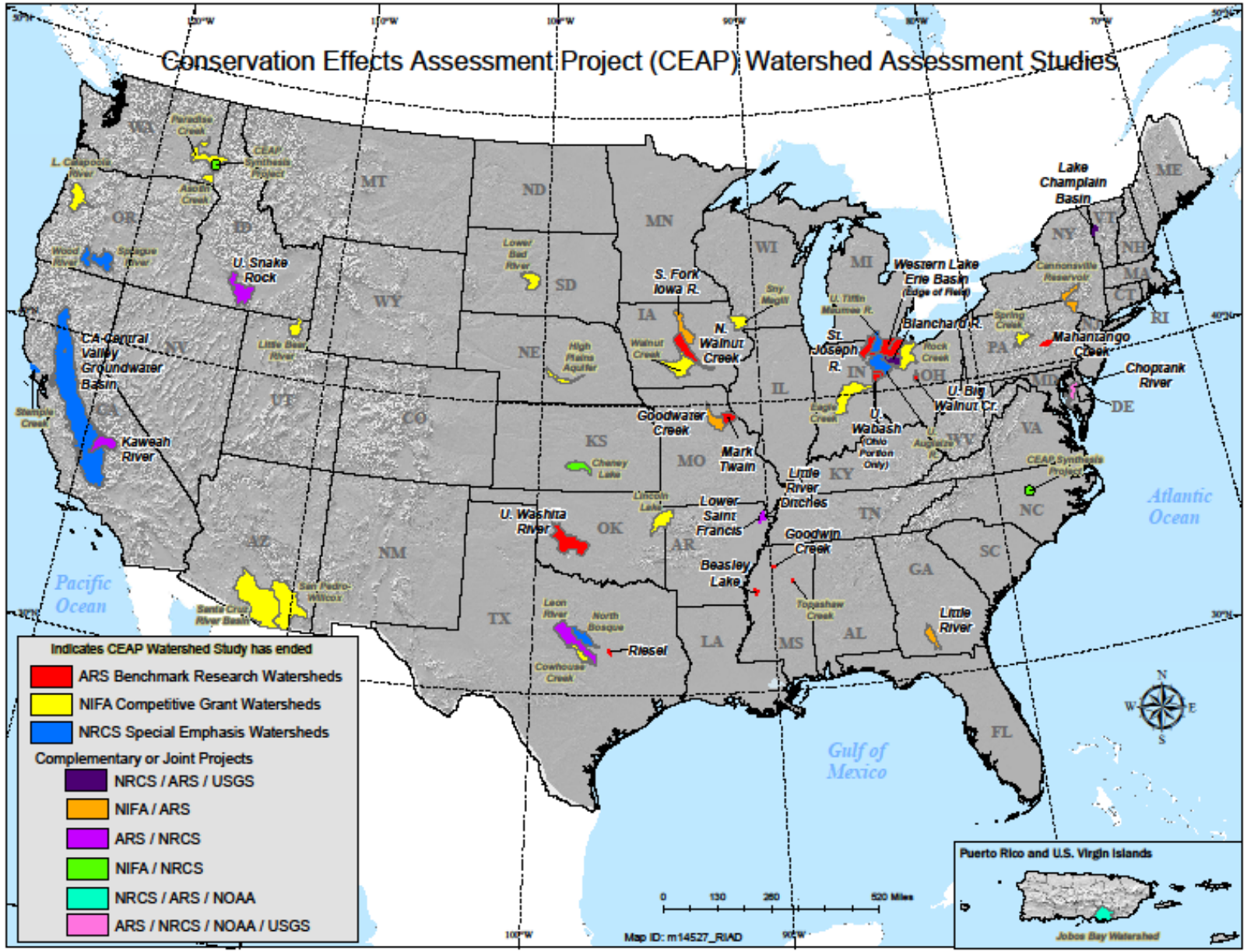

- National network
- Captures range of variability in conditions and practices
- Cropland, pasture, range
- Water quality, availability and soil health

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CEAP Watersheds Partnerships

NRCS partners to draw on missions, capacity and leverage resources of:

- USDA ARS, NIFA, FSA
- Land Grant Universities/Extension
- Other universities
- Producers
- Conservation groups
- Watershed councils
- USGS, NOAA, EPA
- State agencies

> The Champlain Valley Farmer Coalition "wants to drive adoption of new practices and implementation of new technology on scientifically measured outcomes. We want to know what is working, what is not, and how we can do better."
> — Marie Audet of Bridport's Blue Spruce Farm

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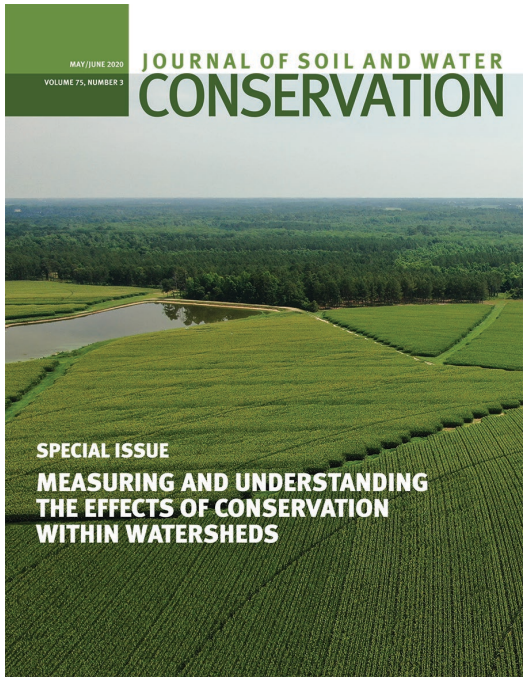
Award: 2021 Editor's Choice Award Honorable Mention

Daniel N. Moriasi, Lisa F. Duriancik, E. John Sadler, Teferi Tsegaye, Jean L. Steiner, Martin A. Locke, Timothy C. Strickland and Deanna L. Osmond

"Quantifying the impacts of the Conservation Effects Assessment Project watershed assessments: The first fifteen years."

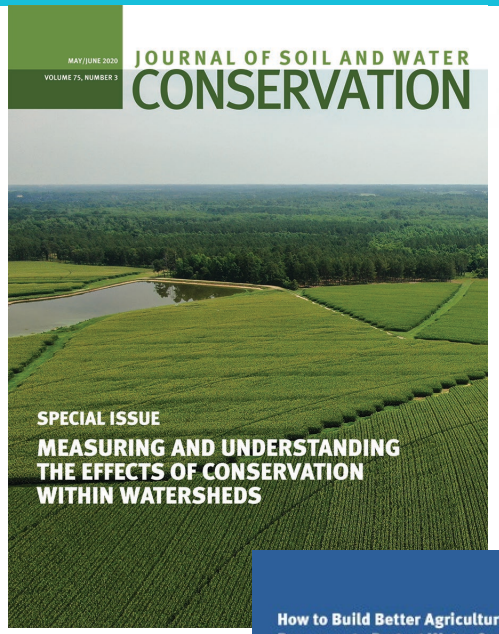


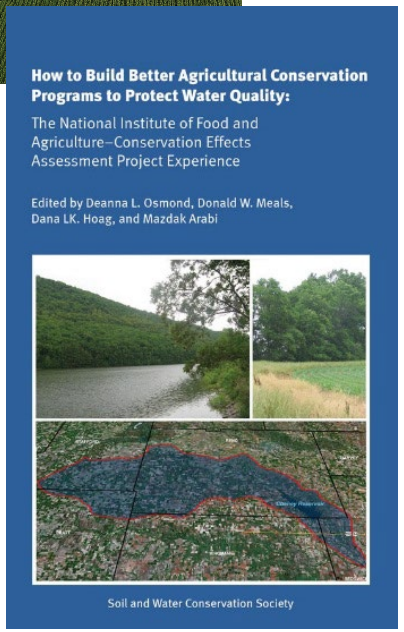
Journal of Soil and Water Conservation
May 2020, 75 (3) 57A-74A; DOI:
https://doi.org/10.2489/jswc.75.3.57A

May 28, 2020 – "Measuring and Understanding the Effects of Conservation within Watersheds" - Archived webinar

Bottom Line: Watershed Outcomes

Over 55% of long-term CEAP watersheds have measured water quality benefits from conservation at the small watershed scale, despite the difficulty of isolating the impacts of conservation practices from the wide range of factors affecting water quality.





- 13 of 21 ARS Benchmark CEAP Watersheds demonstrated measurable water quality improvements at sub-watershed or watershed scales for at least one item monitored (Moriasi et al. 2020, doi:10.2489/jswc.75.3.57A).

- 6 of 13 NIFA-CEAP Watersheds attributed water quality improvements to conservation practice implementation (Osmond et al. 2012, SWCS book).

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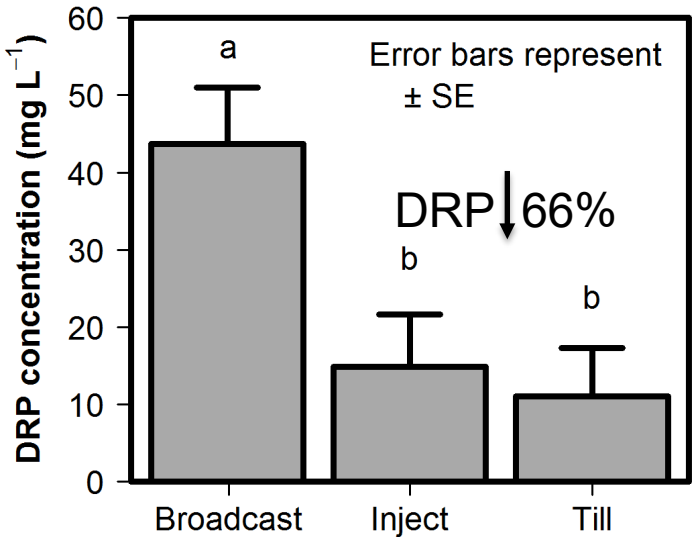
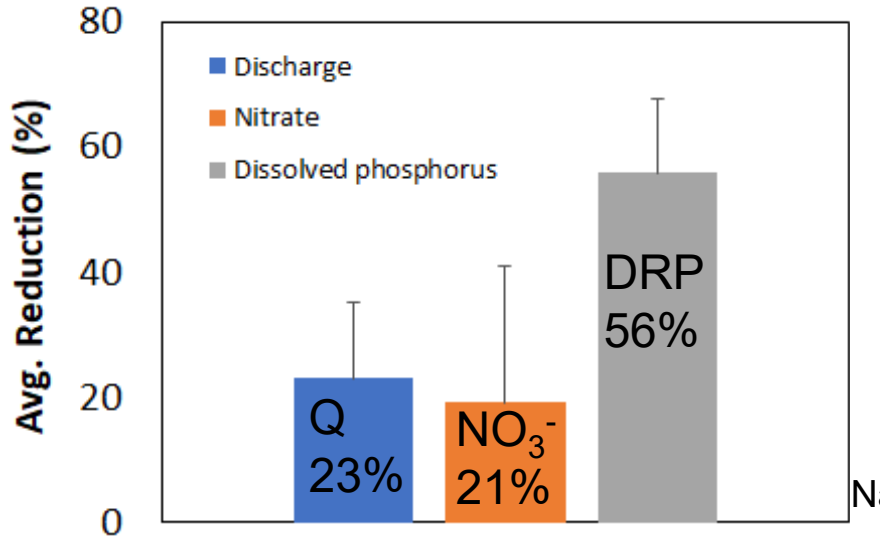
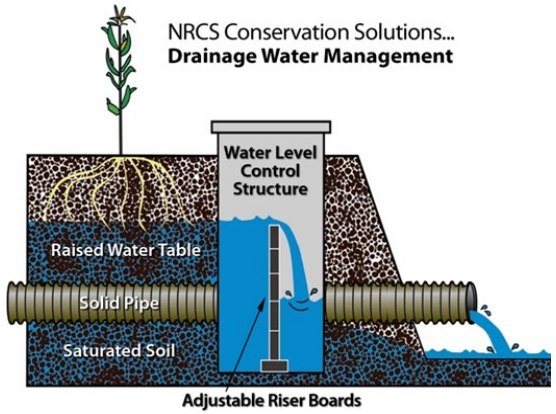
Examples of Measured Conservation Effects at Edge-of-Field Scale

Subsurface injection or incorporation of fertilizer in tile-drained fields **reduced dissolved reactive P loss by 66%** compared to broadcast application (Williams et al. 2018)



On average **drainage water management (DWM) decreased annual tile drainage discharge, NO_3-N, dissolved P by 23%, 21%, and 56%,** respectively (Williams et al. 2015).





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CEAP Watersheds Media:

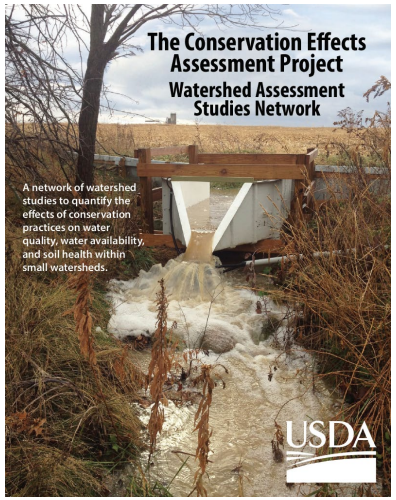
- **Conservation Outcomes Webinar Series**

- **CEAP Story Maps:** https://nrcs.maps.arcgis.com/apps/Cascade/index.html?appid=9381879cefa2475a98f932c61e98aa74
  - Being updated now!

- **CEAP Watersheds Booklet:**
  - **New!**
  - Contains overview information and 2-page reviews of each CEAP watershed and key findings/conservation insights
  - Online version available

- **CEAP Watersheds Videos:**
  - South Fork Iowa River, IA
  - Upper Snake Rock Creek, ID
  - WLEB New!

https://www.youtube.com/watch?v=-LB8qg97pfw



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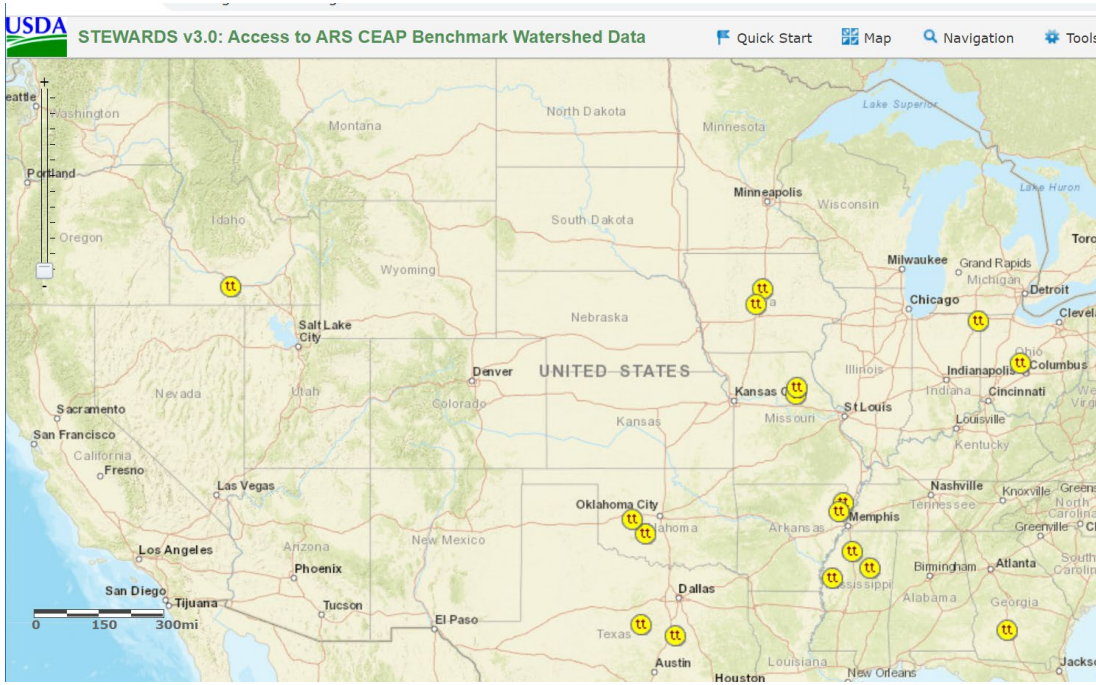
Open Databases Available:

- STEWARDs database (Sustaining the Earth's Watersheds-Agricultural Research Data System); Sadler et al. JSWC 2020: doi:10.2489/jswc.75.3.50A
- CoPE database (Conservation Practice Effectivenss Database) Smith et al. JSWC 2019: doi: 10.2489/jswc.74.6.554
- MANAGE nutrient loss database (Measured Annual Nutrient loads from AGricultural Environments) Harmel et al, 2016. doi:10.1111/1752-1688.12438
- Supplemental Tables of Conservation Practice Effects Across Scales; Moriasi et al. JSWC 2020: doi:10.2489/jswc.75.3.57A



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Applying Insights to Programs

- **NRCS program design**
  - Priority watershed approach
  - Small watershed scale
- **Program delivery approaches**
  - Precision conservation approaches
  - Watershed assessment basis
- **Program guidance**
  - Identifying critical source areas and pollutants of concern
  - Planning ACT Systems of practices
  - Screening and ranking criteria
- **Locally-driven watershed conservation strategies**
  - One-on-one technical assistance
  - Leveraging local conservation leaders and Farmer-to-farmer networks
  - Greater consideration for producer preferences
- **Outcome estimation procedures and reporting**

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Duriancik et al. 2018 JSWC: doi:10.2489/jswc.73.1.11A

CEAP in Vermont

Watersheds Component

Projects include:

- Paired Watershed Assessment Study (UVM)
- Stacked Practices Assessment (UVM)
- MAPHEX project (ARS &UVM)
- ACPF evaluation (ARS with UVM support for VT)
- Legacy P assessment (ARS with UVM support for VT)

Partnerships:

- ARS, VT DEC, VT Agency of Ag, USGS, VA Tech, Penn State, NC State

Wetlands Component

Projects include:

- CEAP Wetlands Assessment Study (UVM)

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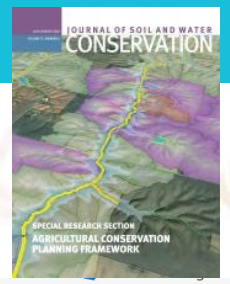
Applying Insights to Planning Tools

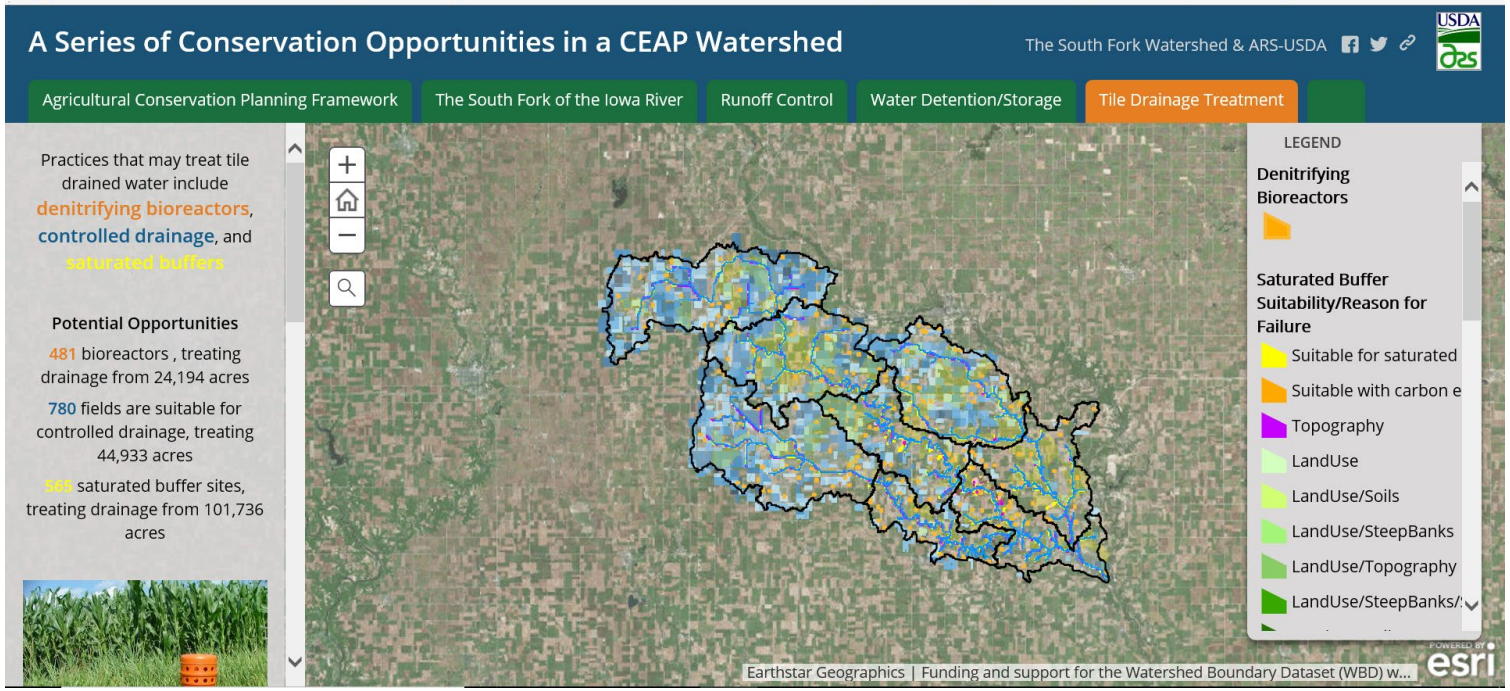


ACPF

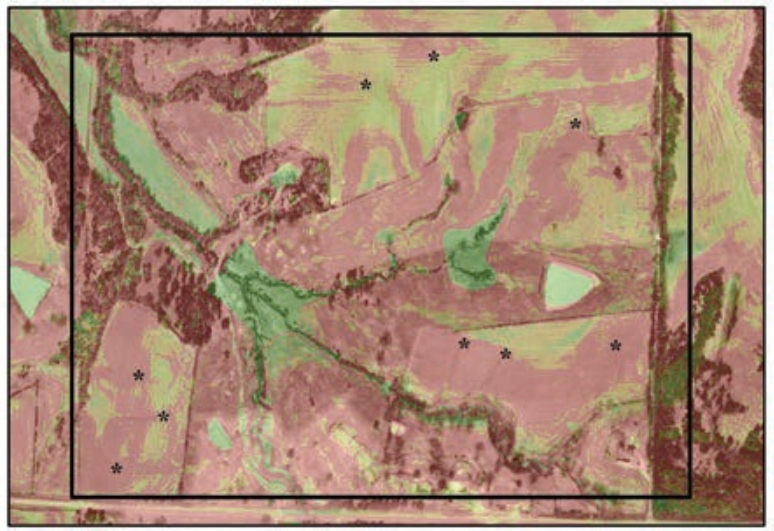
Developing, evaluating, improving:

- watershed assessment decision tools
- indices
- and models

for enhanced watershed and field-scale planning



SVI



- Some tools are challenging for conservationists to use (Ranjan et al.: doi:10.2489/jswc.75.3.387)
- Tools should produce conservation outcomes information that planners *need,* and landowners want (doi:10.2489/jswc.2020.00072)

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Assessing the Agricultural Conservation Planning Framework for local watershed planning in Vermont

Jon Duncan, Penn State

Zach Respess, NC State

Deanna Osmond, NC State

Pete Kleinman, USDA-ARS

Contact jmduncan@psu.edu

ACPF Enhancement Project

John Baker (ARS), David James (ARS), Sarah Porter (ARS), Lisa Duriancik (NRCS)

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Conservation Assessment and Effective Planning for Water Resources

- **NRCS plans primarily at field scale and that is the mode of CART**
- **Field by field approach can (and does when fields are not "known" to us) miss conservation treatment need priorities**
- **Concomitant use of "area-wide planning" assessment products, like ACPF watershed output, is critical to identify broad view of conservation opportunities**
  - where to go to assess and plan at field scale
- **ACPF results can be brought into NRCS planning tools.**

Further Development and Expansion of ACPF (Phase 1): New Tools and Expanded Partnerships

Objectives:

1) Improve the interpretations and applications of ACPF outside the Upper Midwest.
2) Develop tools for innovative water quality practices not currently represented in ACPF.
3) Foster new ACPF connections between ARS and NRCS and key university partners to encourage broader application and testing of the tool.
4) Establish coordination and collaboration with new ACPF Hub.

Applying Insights to Practice Standards

Denitrifying Bioreactors CP 747

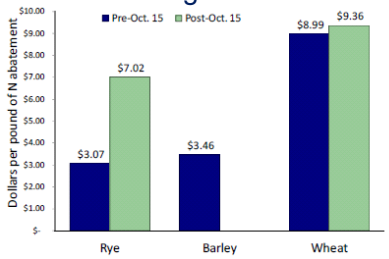
T. Moorman, et al., 2015. Ecol. Eng. 75: 441-448.

Gypsum Curtains

Bryant, R., et al., 2012.

EOF WQ Monitoring (CA 201, 202)

Cover Crops: Species and Planting Dates

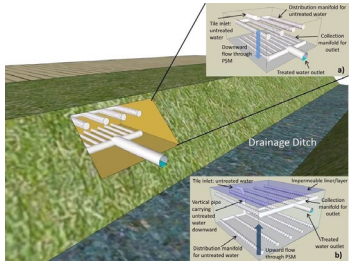


Nutrient Management- 4Rs (CP 590)

Blind Inlets CP 620

Smith and Livingston. 2013.

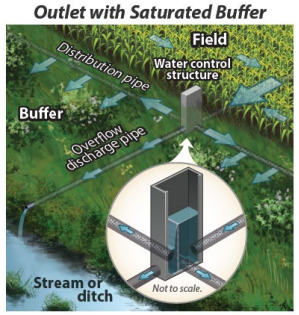
Phosphorus Removal Structure



C. Penn and J. Bowen. 2017.

Drainage Water Management

Saturated Riparian Buffer (CP 739)



Jaynes and Isenhart (2019)

Amending Soils with Gypsum (CP 333)

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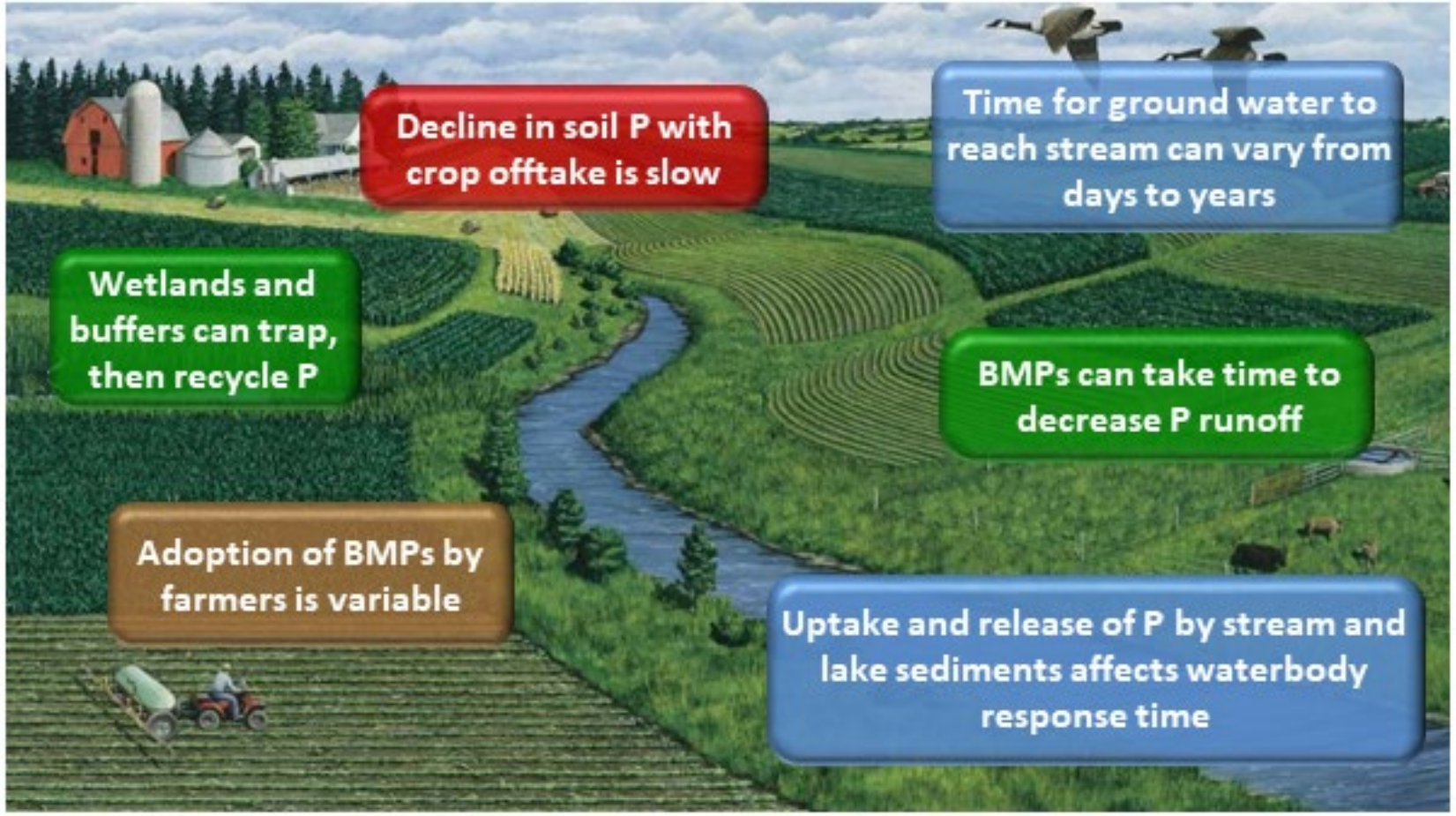
Dealing with Lag Time and Legacies



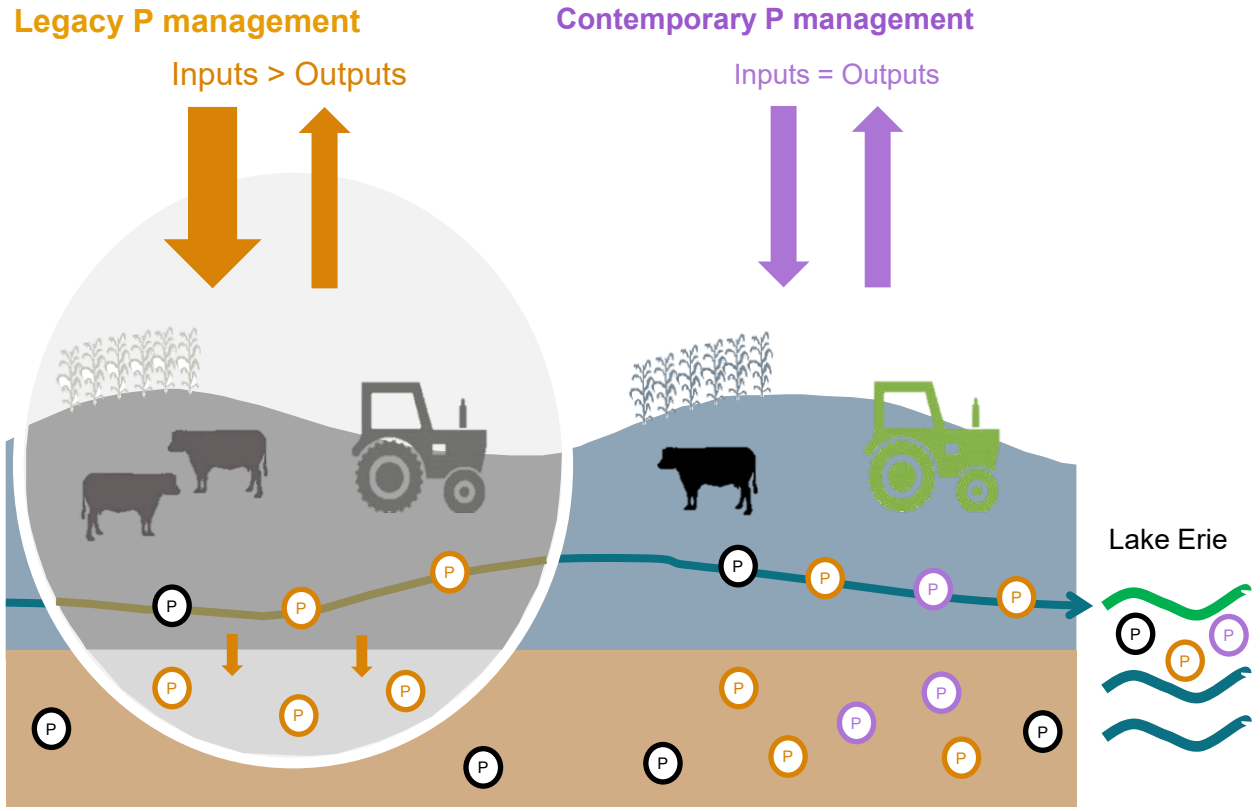
Modified from Sharpley et al. 2013. JEQ

Accounting for legacy and lag time helps with:

- Managing expectations of stakeholders and stewards
- Risk of mis-interpretation of impact of efforts
- Risk of disincentive for adoption and conservation action

Looking Forward: Legacy Sources Matter

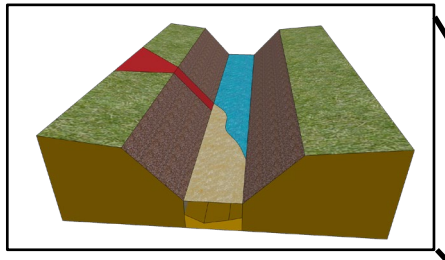
- **A chronic source of pollution to surface waters for decades**
- **Untreated sources mask the effects of present-day conservation**
- **P management strategies will vary depending on the primary source of P – legacy vs. contemporary, in-field vs. instream**

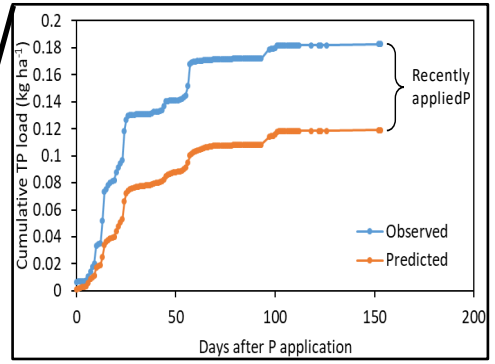


Graphic from Mark Williams, USDA ARS

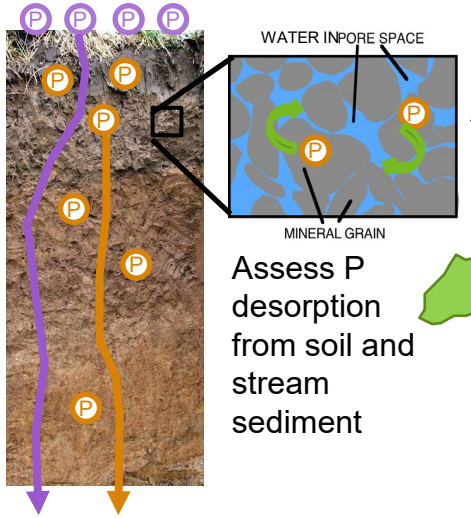
WLEB Legacy Sources: Soil Particle to Watershed

In-stream P uptake rate and residence time



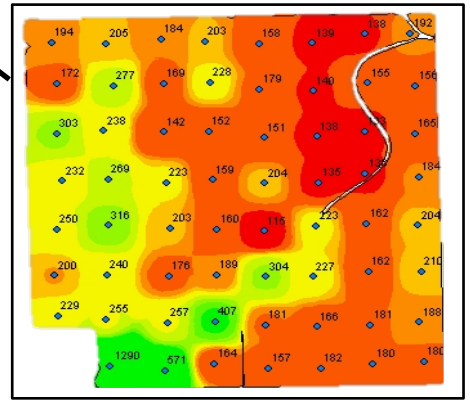


Utilize edge-of-field dataset to estimate legacy P losses



Assess P desorption from soil and stream sediment

Separate **legacy** and contemporary P sources using tracers



Evaluate high soil test P concentrations or 'hotspots' on field and watershed P losses

Graphic modified from Mark Williams, ARS

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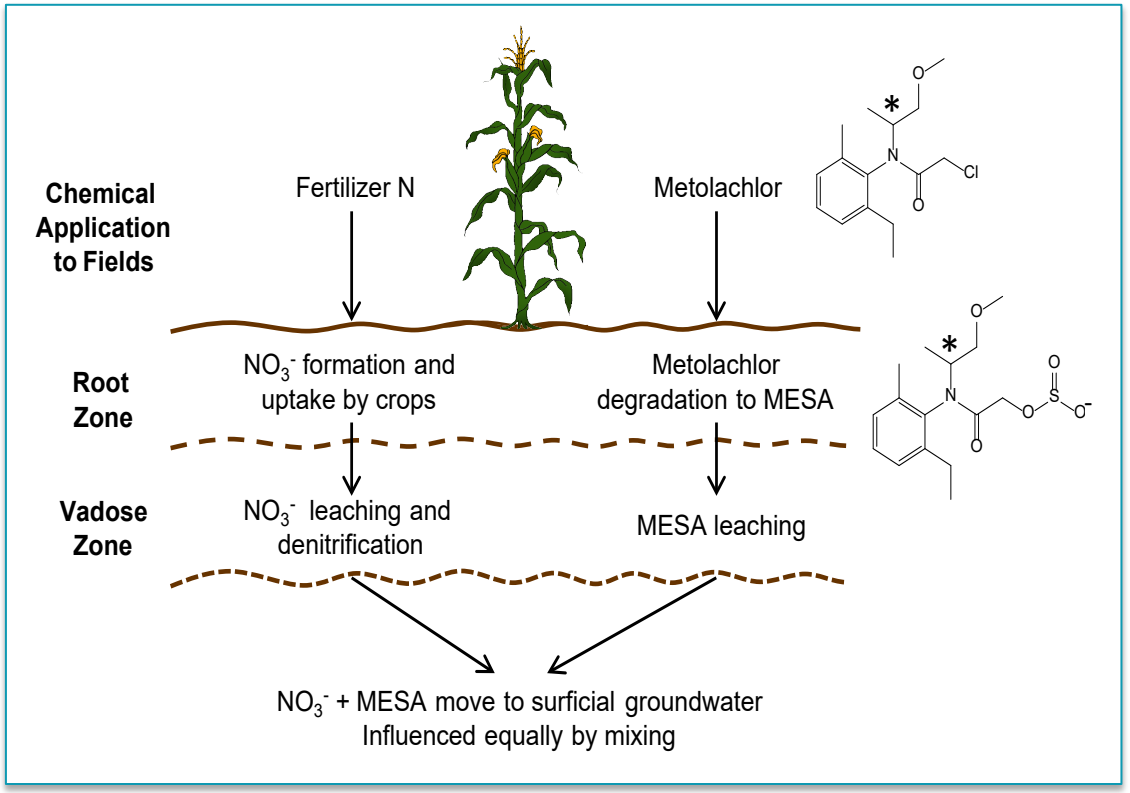
Factors Affecting Outcomes: Lag Time

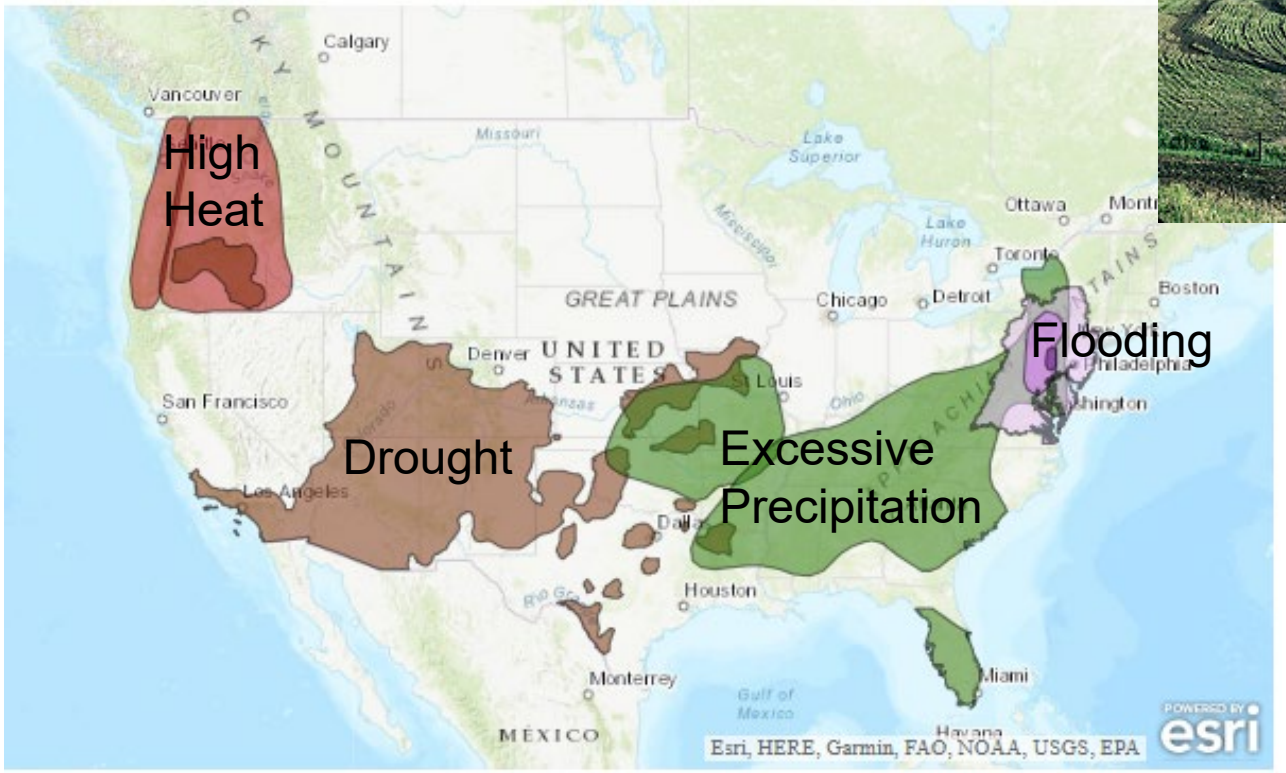
- How long does it take for effects of conservation practices to be expressed in stream chemistry?
- The time from when a parcel of water infiltrates the soil to when it exits to the surface water
- Scale effects
- Natural hydrology effects (e.g., karst)
- Altered hydrology (artificial drainage – tile or ditch)



McCarty et al., 2014

Climate and Extreme Events

Conservation strategies for building resilience



NOAA U.S. Hazards Outlook, week of July 23, 2018

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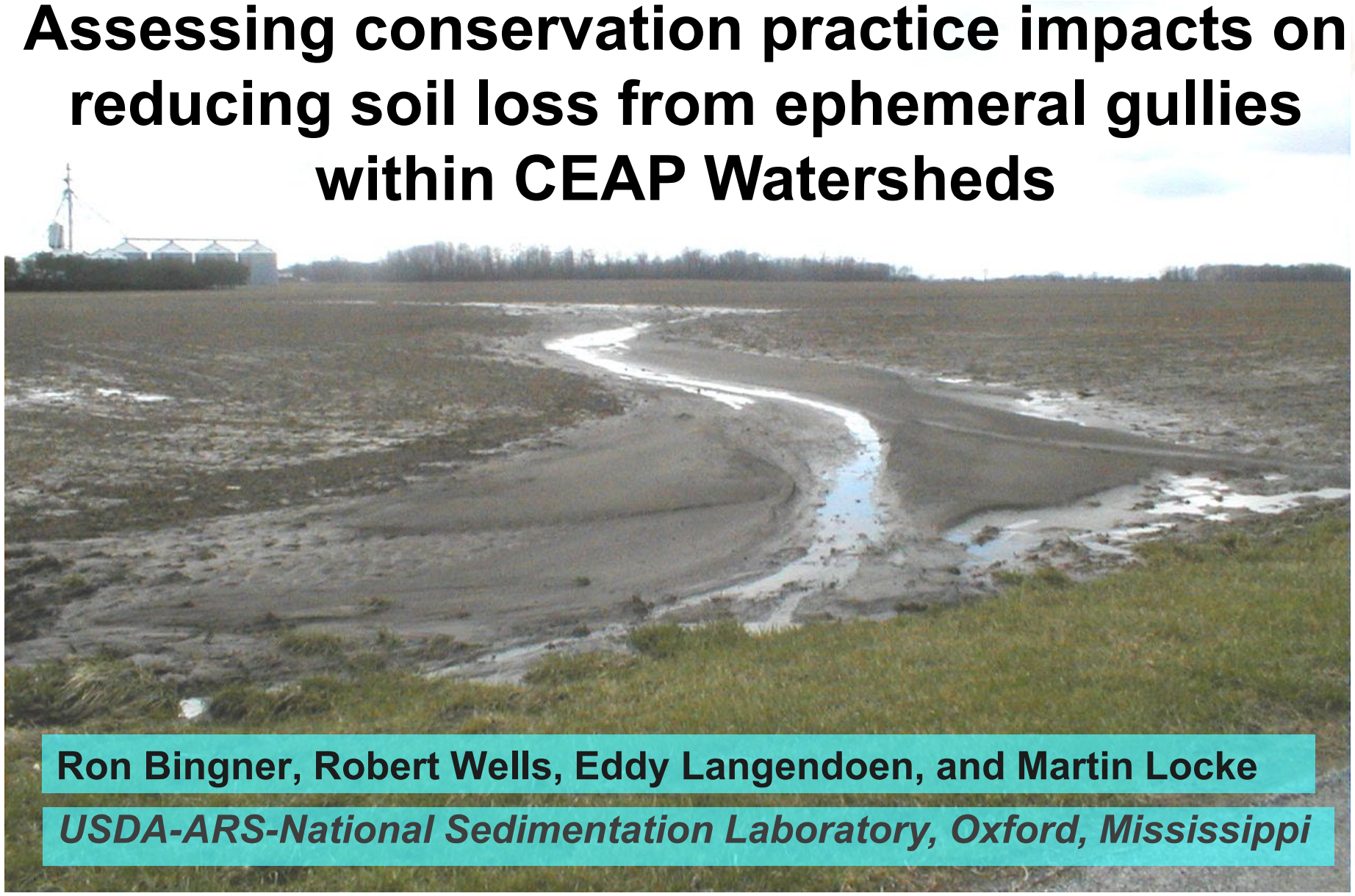
Assessing conservation practice impacts on reducing soil loss from ephemeral gullies within CEAP Watersheds



Ron Bingner, Robert Wells, Eddy Langendoen, and Martin Locke

USDA-ARS-National Sedimentation Laboratory, Oxford, Mississippi

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MAnure PHosphorus EXtractor System (MAPHEX): Design, Demonstration and Evaluation of an Innovative Mobile Phosphorus Removal System

USDA Agricultural Research Service

PI- Dr. Clinton Church

Additional Partner: University of Vermont

Funding: $500,000 + $251,791 = $751,791

Purpose

modify design to increase capacity

innovative mobile system that can be moved within watershed from farm to farm

evaluate nutrient reduction potential on a watershed basis (with modeling) and economics

Goal: design and evaluate efficacy of the novel MAPHEX manure phosphorus reduction system in VT CEAP Watershed or other priority watersheds

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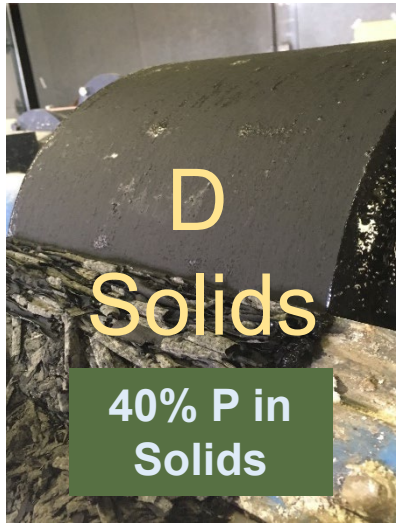
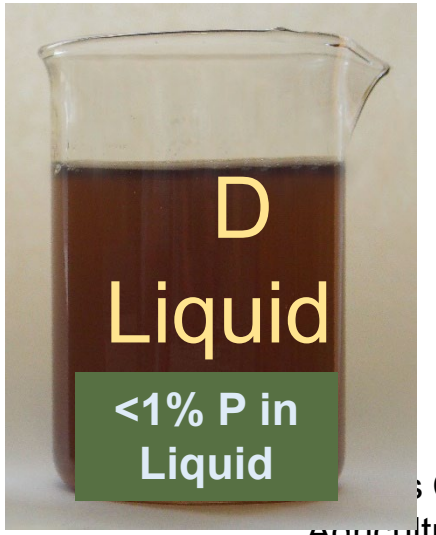
VT MAPHEX PROJECT

MAPHEX Lite (but much larger)

- Funding Source- NRCS
- Under Construction
- consists of the first two MAPHEX stages
- Will remove 50-60% of P
- Capable of 125,000 gallons/day
- Demonstrations in PA and VT CEAP watersheds
- Modelling (U. of Vermont) to be used for extrapolation
- Direct comparison to Screw Press-DAF System





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