United States Department of Interior

USGS
science for a changing world

Environmental Effects of Agricultural Practices

Minnesota River Basin

USGS

Influence of Retired Agricultural Lands on Stream Water and Ecological Quality

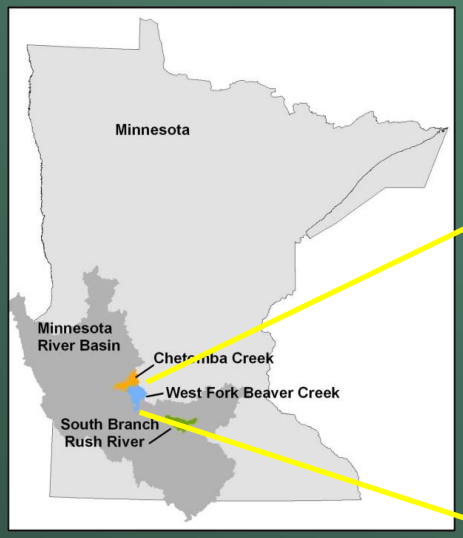
Follows MN River Basin study (Lee and others, 2009)

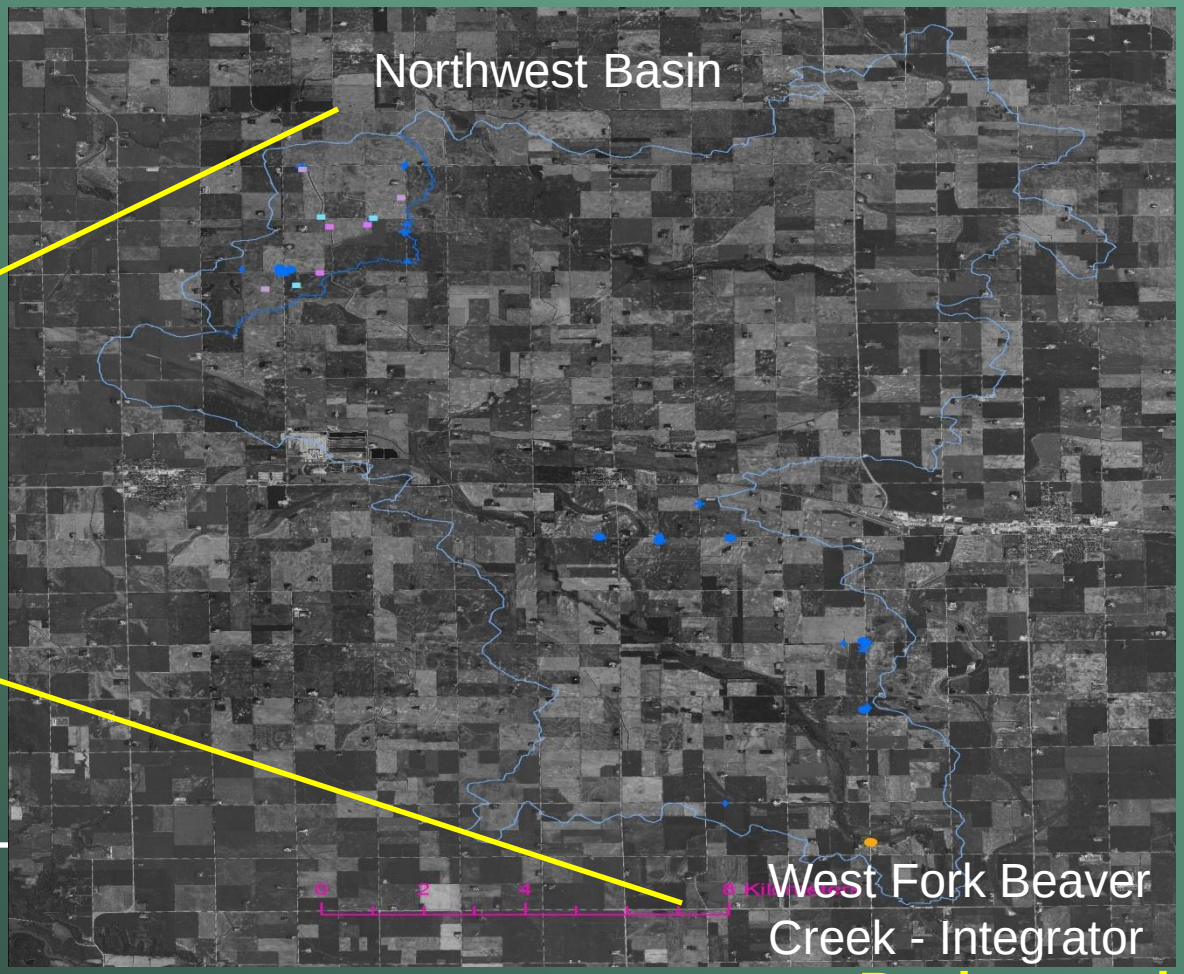
- **Increasing riparian buffer (CRP,CREP) lands led to:**
- **Decreasing suspended sediment, nitrate**
- **Improved biological condition (IBI, EPT metric)**
- **NOT RELATED TO PHOSPHORUS IN STREAMS! WHY?**

USGS

Location of the EEAP Study

West Fork Beaver Creek





USGS

Hypothesis 1

The source, amount, and quality of suspended sediments (and sediment-bound phosphorus) in streams within basins of similar geomorphology are related to patterns of:

- ***Hydrology (transport pathway)***
- ***Retired agricultural lands, and***
- ***Land management***

USGS

Hypothesis 1 - Testing

Identify source of sediment to streams (instream vs fields) using soils from:

- ***Ag fields***
- ***Retired lands***
- ***Stream bottom and channel***
- ***Tile drains***

- ***Differences distinguished using:***
  - ***Metals***
  - ***C and N isotopes***
  - ***Particle size***
  - ***Forms of P: dissolved, total***

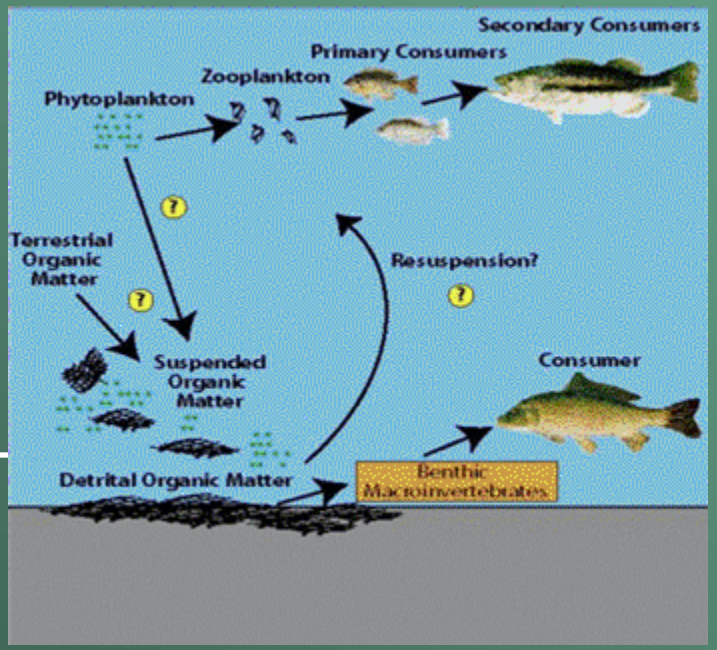
Walling tube
for sediment

Hypothesis 2a

Increases in extent of retired riparian land results in:

- *improved biological community structure,*
- *increased food-chain length, and*
- *improved organism health*

All through influences on water quality, habitat, and sediment sources, quantity, and quality

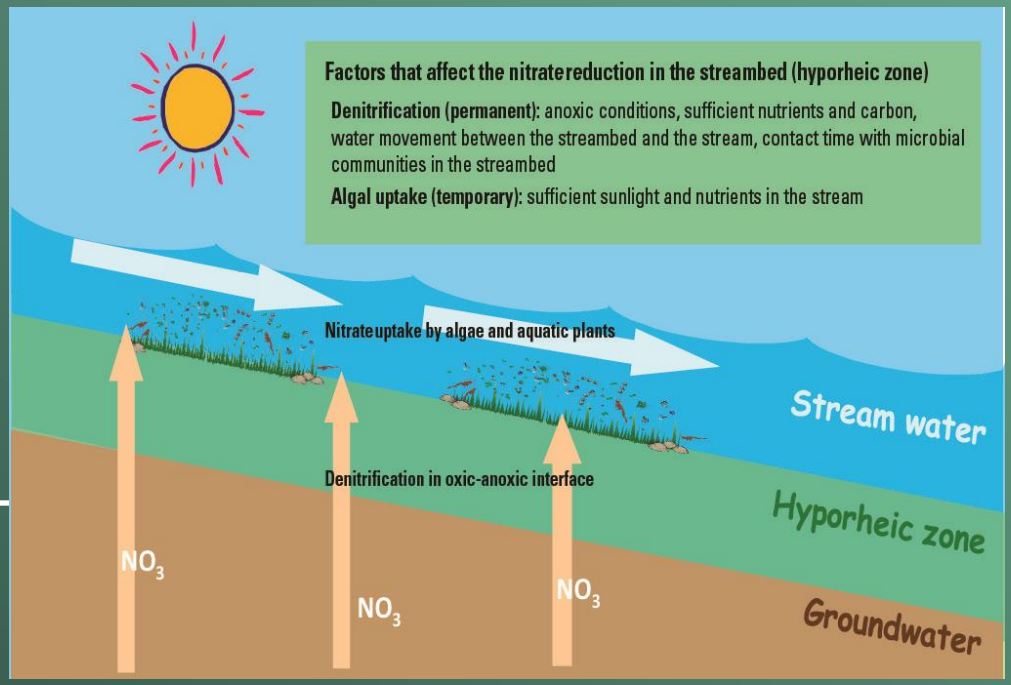


USGS

Hypothesis 2b

The amount of vegetation and accumulated organic matter in ditches strongly affects nutrient concentrations and organism health, food quality, and biodiversity.

- ***Promotes nitrate removal and retention of sediment-bound phosphorus.***
- ***In-stream processes may improve RRC impacts and off-set effects of tile-delivered N, P, and sediment through riparian buffers.***



USGS

Hypotheses 2a and 2b - Testing

Contrast three ditches - varying amounts of retired lands:

- ***One with retired lands on both banks***
- ***Retired lands on one bank only***
- ***No retired lands***

Study design:

- **Water quality: Streams and Groundwater (piezometers)**
  - **Nutrients and suspended sediment**
- **Invertebrates, fish, and periphyton algae**
  - **Lipids (fatty acids and total lipids)**
  - **Stable C and N isotopes**

USGS

Hypothesis 3

The amount and type of tile drain system within the watershed greatly affects the transport and type of nutrient and sediment in the stream, specifically:

- ***surface connected vs. sub-surface inlets***
- ***density of tile drain system: patterned or topographic***

Subsurface

Surface

Hypothesis 3 - Testing

Contrast pairs of tile drains on the same side of the three tributaries.

- *minimize differences in agricultural management*
- *focus on variability between surface and subsurface connected tiles*

Tiles will be sampled:

- *bi-monthly for water quality (nutrients and SSC)*
- *seasonally with a passive sediment sampler to get a measure of storm transport*

USGS

Hypothesis 4

The link between the extent of Retired Riparian Corridor and water quality improvement is a function of the amount of retired lands and hydrogeology in individual basins.

- ***Links this field scale study with larger, longer term results from the earlier study***

USGS

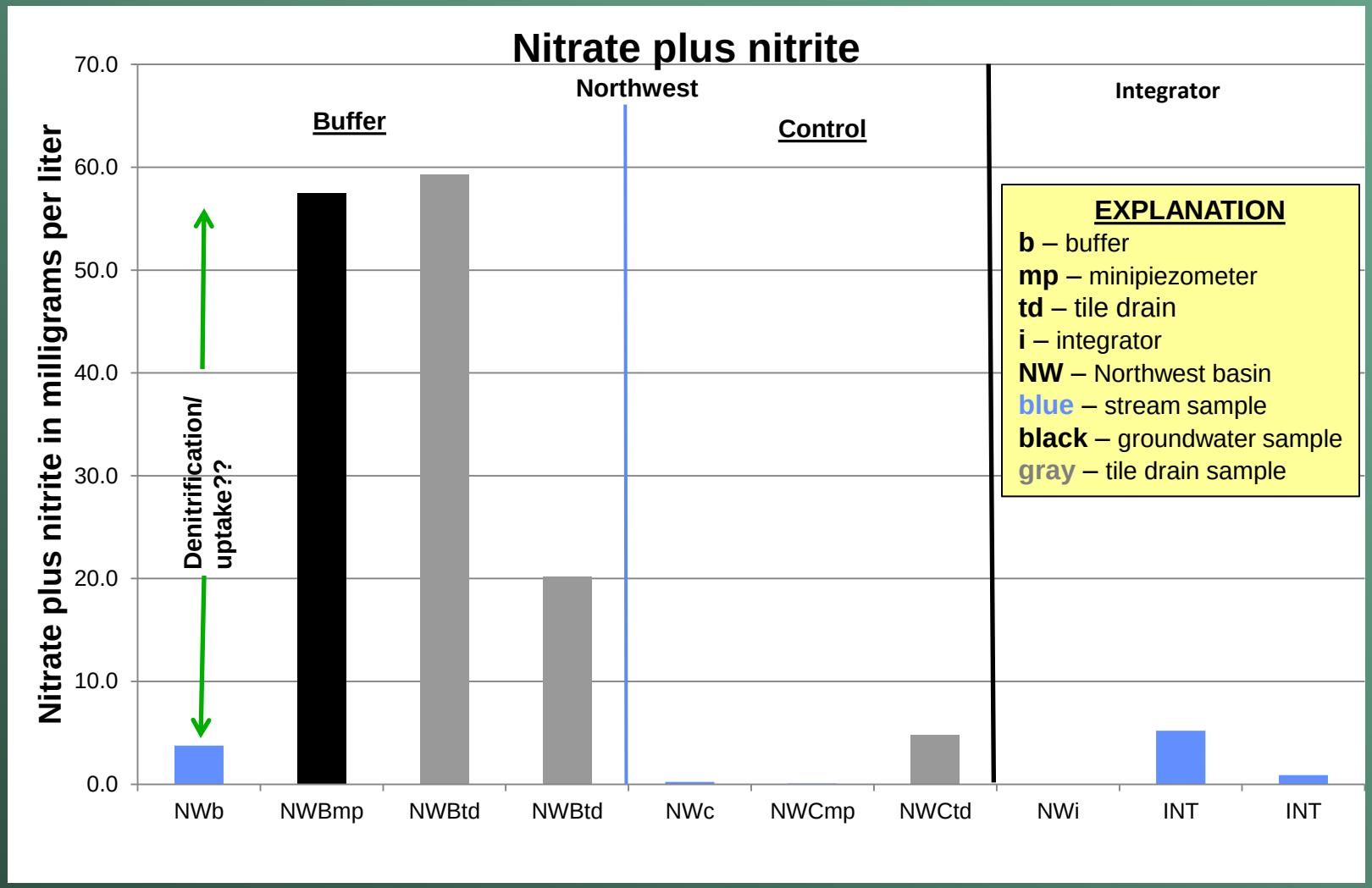
Hypothesis 4 - Testing

Contrast water quality and biological community data from current study to earlier study.

- ***Nutrients***
- ***Suspended sediment***
- ***IBI***
- ***EPT Index***

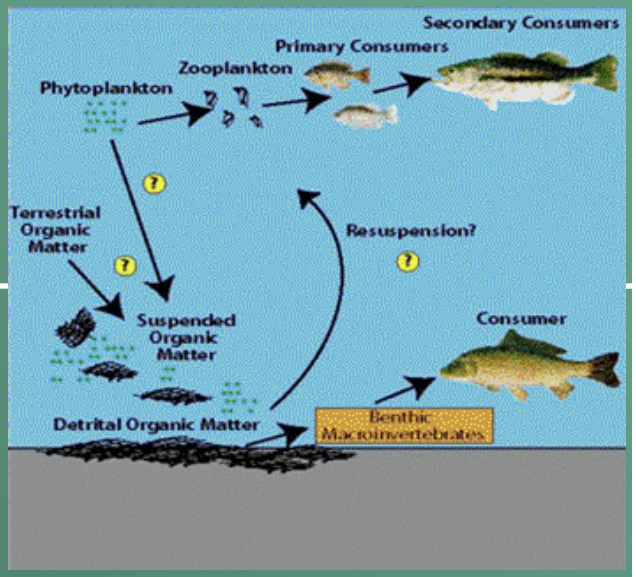
USGS

Nitrate Concentrations - Initial



Differences in nitrate sources are seen between Northwest sites – response opposite as expected between buffer and control

Biological Condition – Initial Results

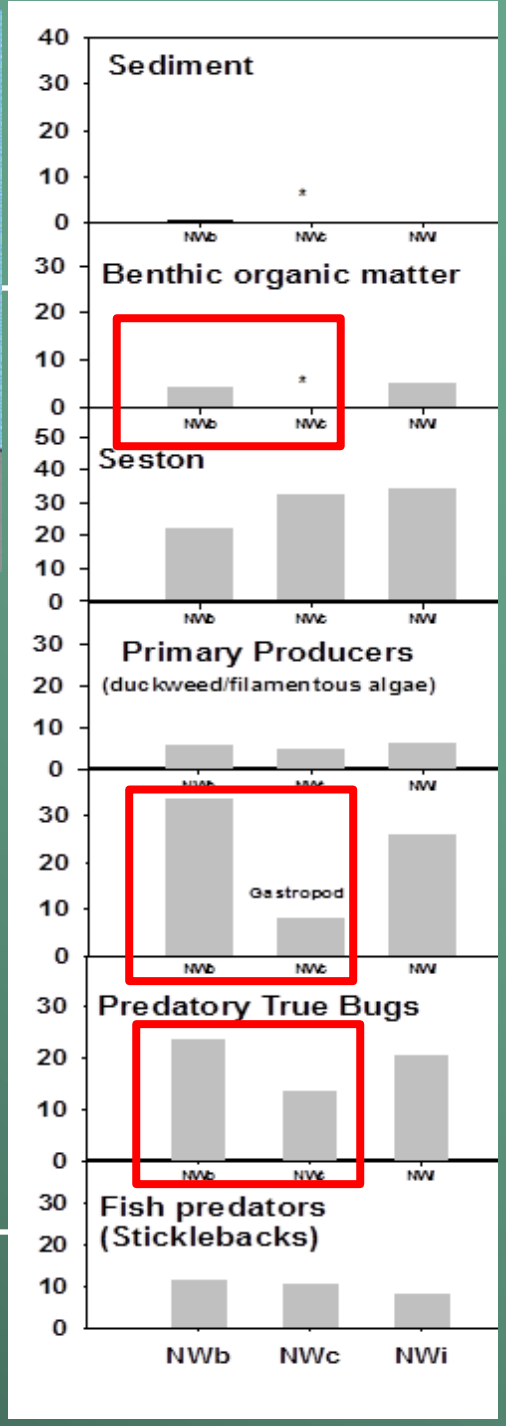


1. Primary consumers deriving lipids from variety of sources – NOTE: very high tissue percent lipid.

2. Predatory bugs deriving lipids from available prey (corixids or gastropods)

3. Fish likely deriving lipids from a variety of prey

4. Fatty acid data will be much more indicative of specific food sources and land use.



USGS

Upcoming work

- Refine investigation of identified factors
  - Comparing tile-drain impacts
  - Distinguishing impact of ditch management
  - Evaluating buffer management
- Identify more sites with different
  - Hydrology
  - Climate
  - Soils

USGS

Study Team and Cooperators

- **USGS Science Team:**
- Vicki Christensen – Minnesota Water Science Center (WSC)
- Faith Fitzpatrick – Wisconsin WSC
- Jeff Frey – Indiana WSC
- Sheridan Haack – Michigan WSC
- Bill Richardson – Upper Midwest Environmental Sciences Center
- Tanja Williamson – Kentucky WSC
- **Involved Cooperators:**
- Eric Mohring – MN Board of Soil and Water Resources
- Cory Netland – MN DNR - Hawk Creek Watershed Project
- Tom Kalahar – Renville County Soil and Water Conservation District
- Jeff Kjorness – NRCS

USGS

Questions?

USGS