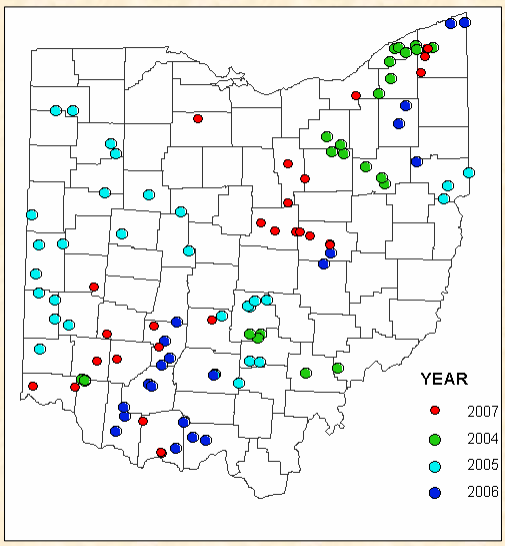
A Strategy for Agricultural Watersheds in Ohio

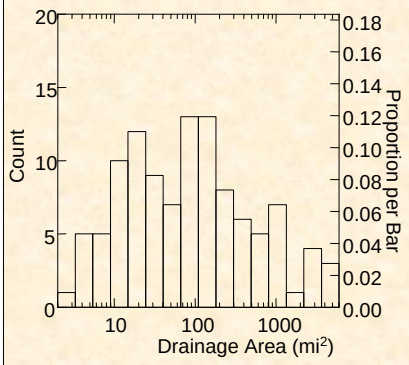
Using WQS uses, criteria and TMDL targets in concert with cropland management and drainage ditch design to reduce nutrients and improve biological stream health

Study Overview

- Four-year Study of Small Rivers and Streams
  - **109** benthic chlorophyll a, water column nutrients, canopy cover, land use, physical measures (drainage area, gradient, physical habitat quality)
  - **100** fish samples
  - **96** macroinvertebrate samples (55 quantitative)
  - **86** dissolved oxygen (hourly observations 24-48 h)
    - 77 minimum cell size between hourly D.O. and macroinvertebrates

Geographic Scope and Size Distribution of Study Sites

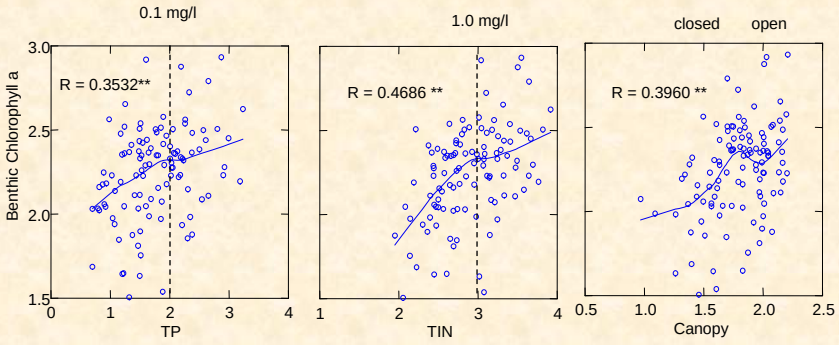




Lines of Evidence

- Relationship Between Nutrients and Productivity
  - Benthic Chlorophyll = TP + TIN
    - Other Factors: Light, Scour, Drainage area, Gradient
      - scour “controlled” by sampling 10 d post flood event
- Relationship Between Productivity and Biological Condition
  - Trophic
    - Shifts in Community Composition
  - Indirect
    - Dissolved Oxygen Regime

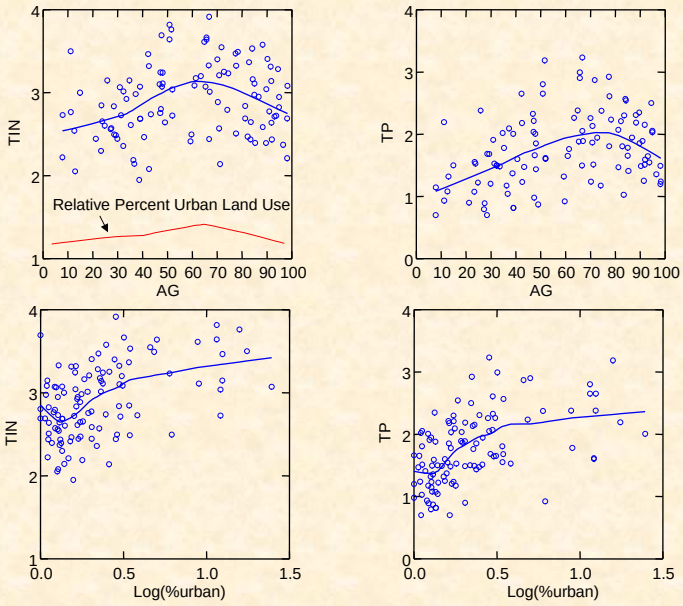
Relationship Between Benthic Chlorophyll a, Nutrients & Light



** Pearson correlation significant at the P<0.01 level

Land Use and Nutrients

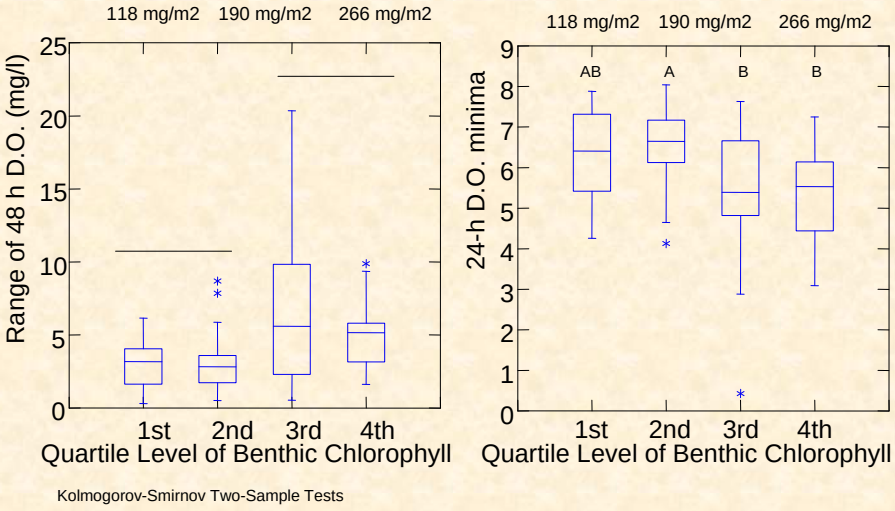
(i.e., nutrients loads follow an additive function)



Links Between Productivity and Biology Part I – Dissolved Oxygen

- Examine relationship between benthic chlorophyll and hourly dissolved oxygen
  - canopy, gradient
  - land use
  - nutrients

Categorical Levels of Benthic Chlorophyll and D.O. Range and Minima

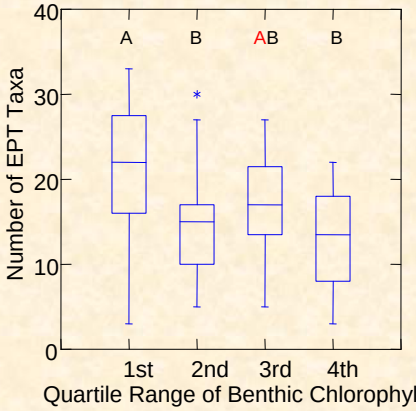


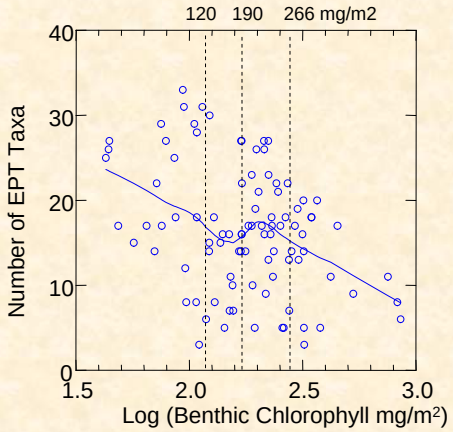
Kolmogorov-Smirnov Two-Sample Tests

Links Between Productivity and Biology Part II – Macroinvertebrates and Fish

- Examine Relationships Between Chlorophyll, D.O. and Fish and Bugs
  - stimulatory effect of enrichment
  - changes in community composition
  - link between trophic levels
  - secondary effect due to D.O.

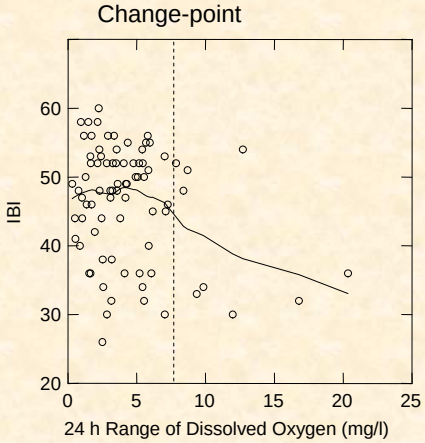
EPT Taxa and Benthic Chlorophyll Levels

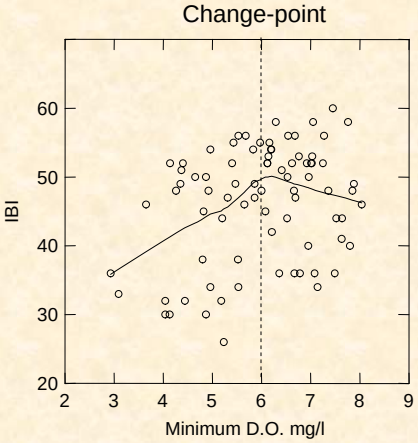




Distributions sharing a letter have similar means. Note that the differences between means within the 1st and 3rd quartiles were marginally significant (P=0.06)

Fish IBI Scores in Relation to Dissolved Oxygen – Trend Line Fitted by Locally Weighted Smoothing



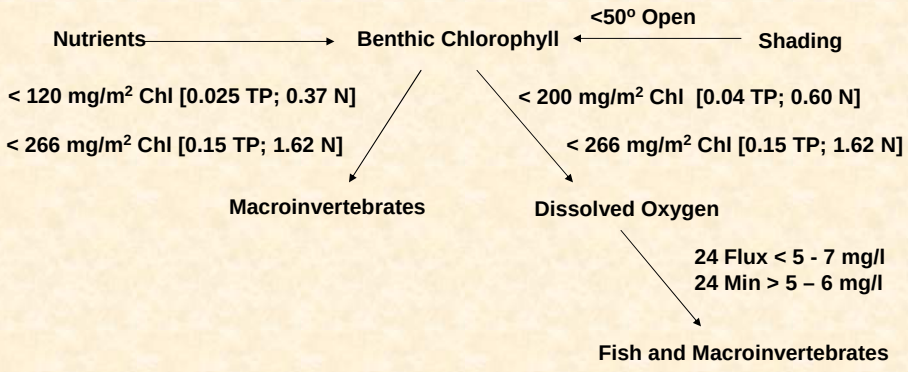


Summary

- Positive relationship exists between nutrients and benthic chlorophyll concentrations
  - mediated by light or shading
- Stream productivity influences macroinvertebrate community structure
  - increased abundance of nutrient tolerant organisms
  - loss of sensitive taxa
  - detectable at low levels of enrichment
- Secondary effects of eutrophication through D.O. most consequential
  - manifested in loss of aquatic life use

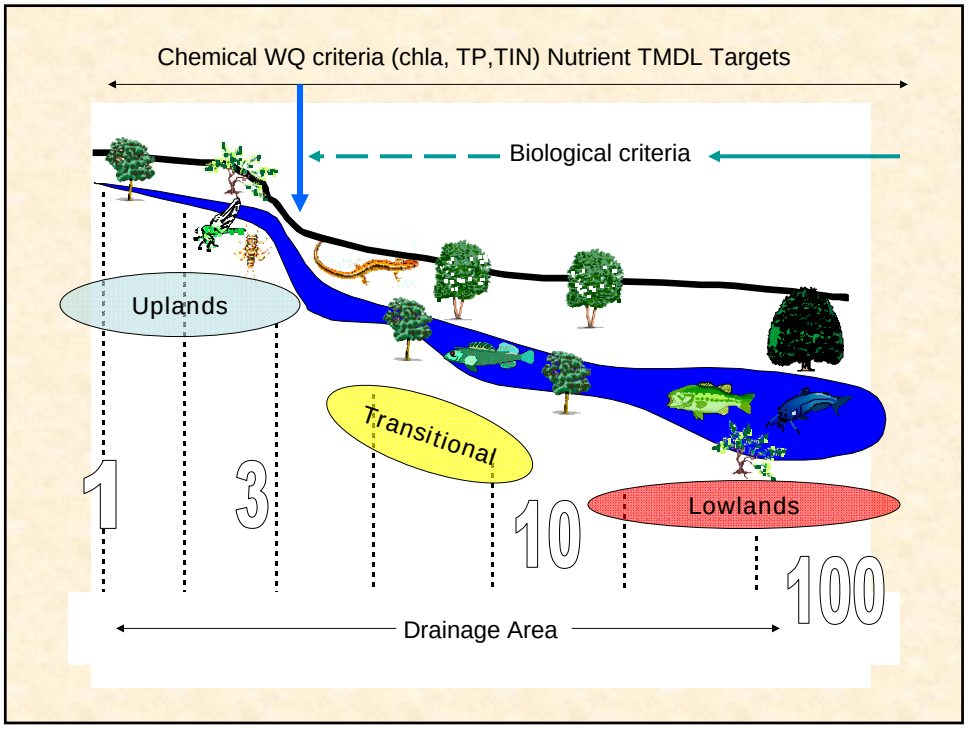
Cause-Effect Matrix

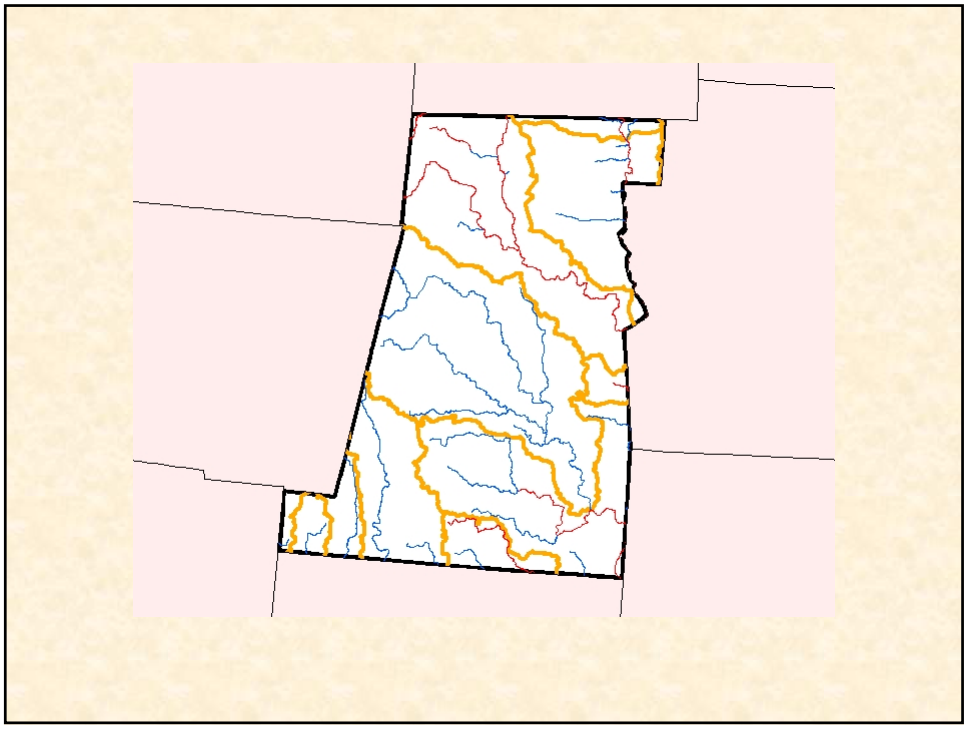
Identifying Target Nutrient Concentrations

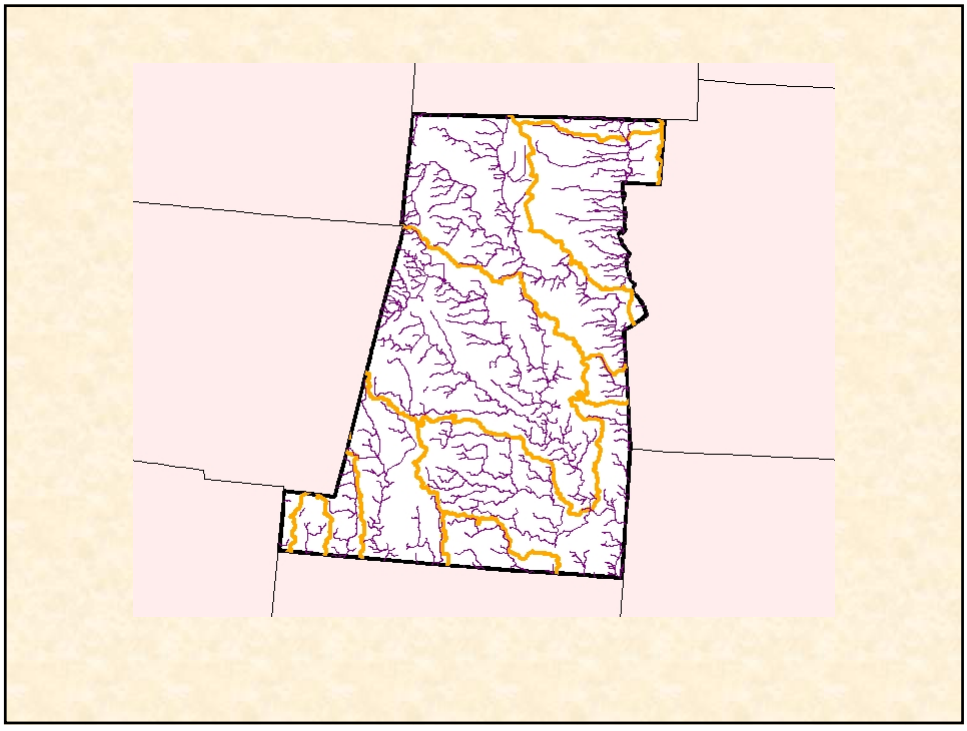


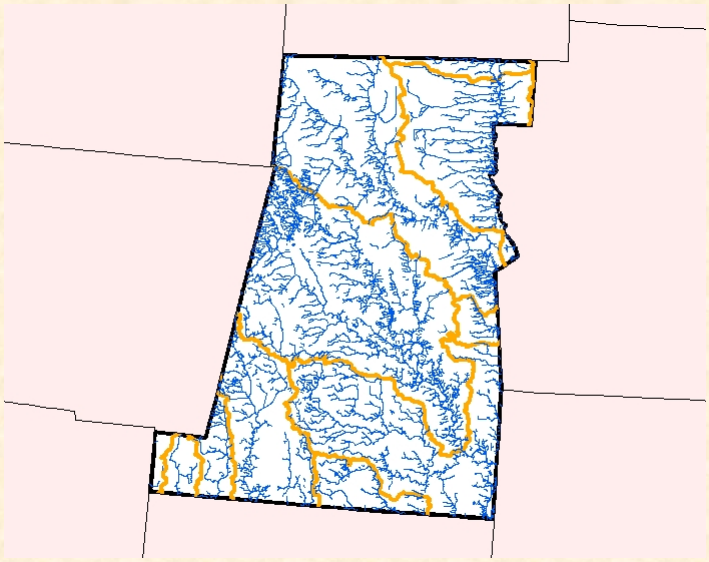
Part 2
TMDLs in Ag Watersheds

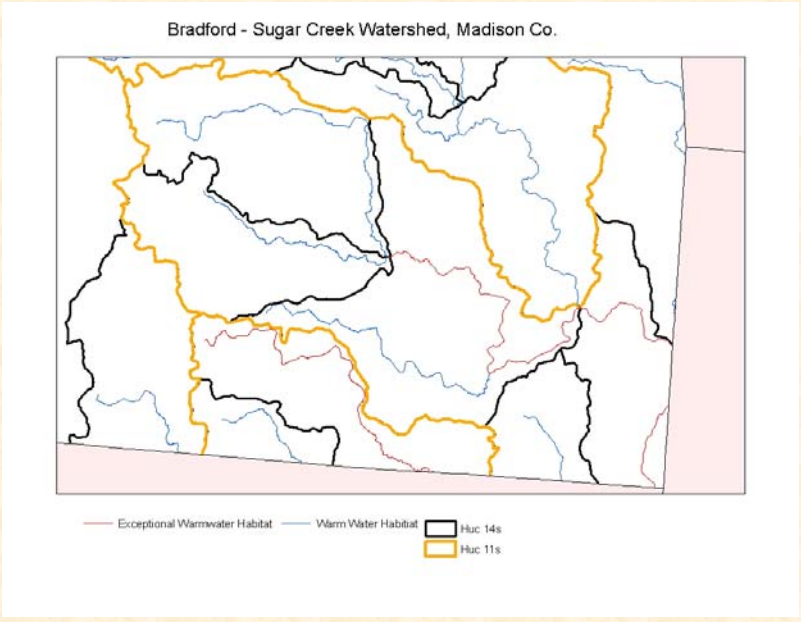
Conceptual Approach
Under Development

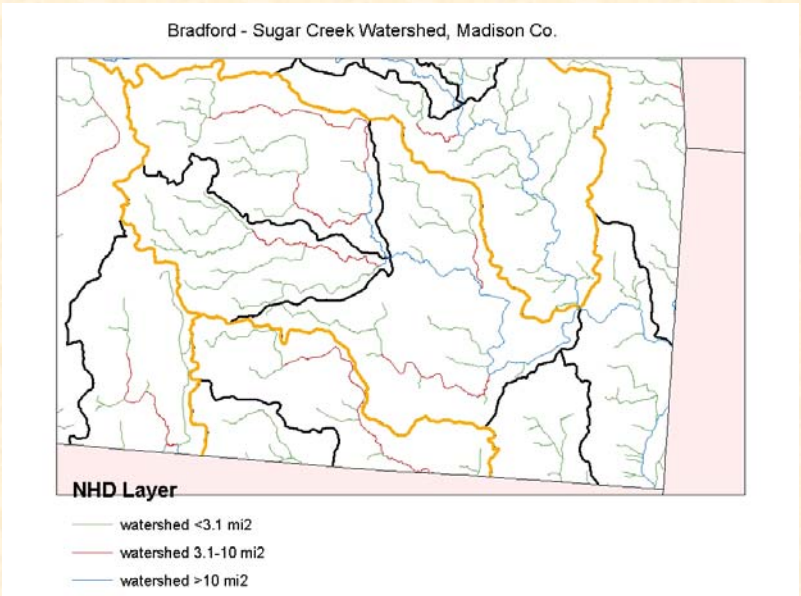


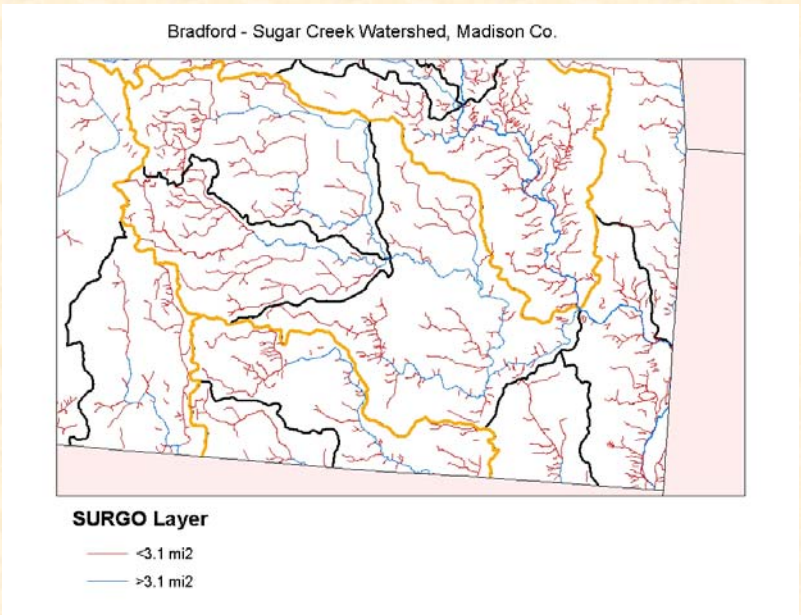


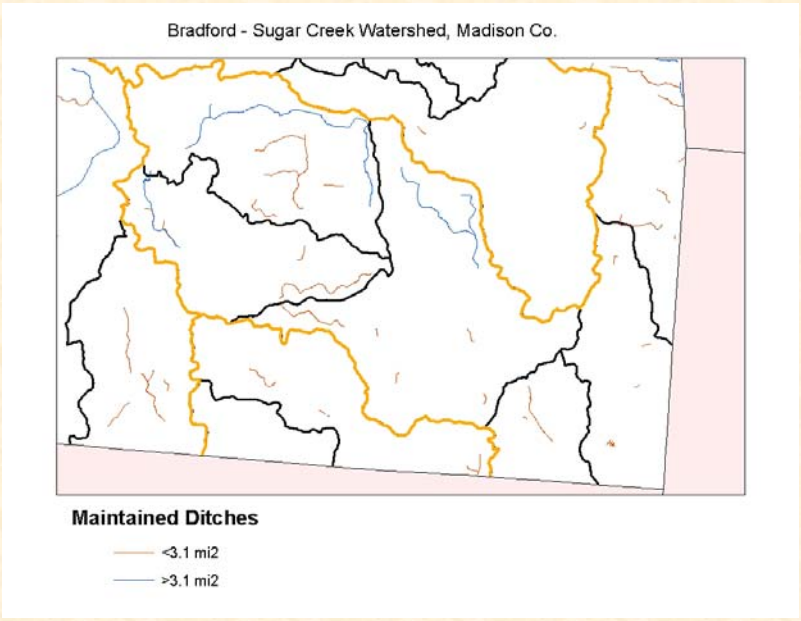


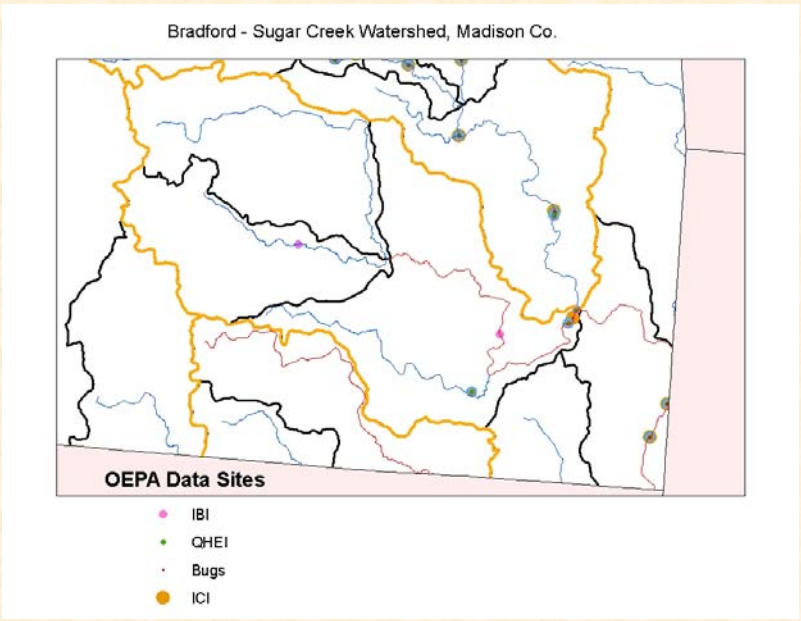


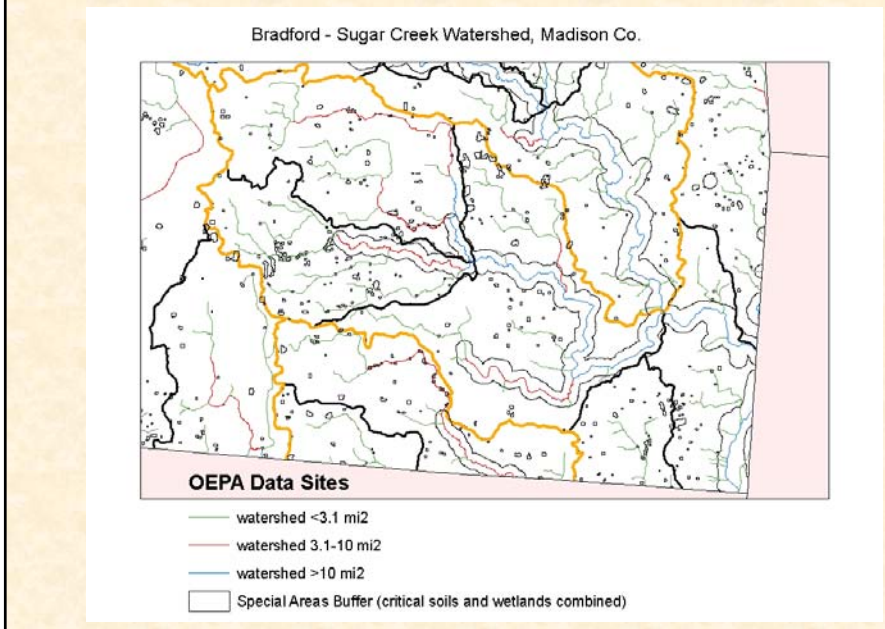

Bradford - Sugar Creek Watershed, Madison Co.
Exceptional Warmwater Habitat
Warm Water Habitat
Huc 14s
Huc 11s

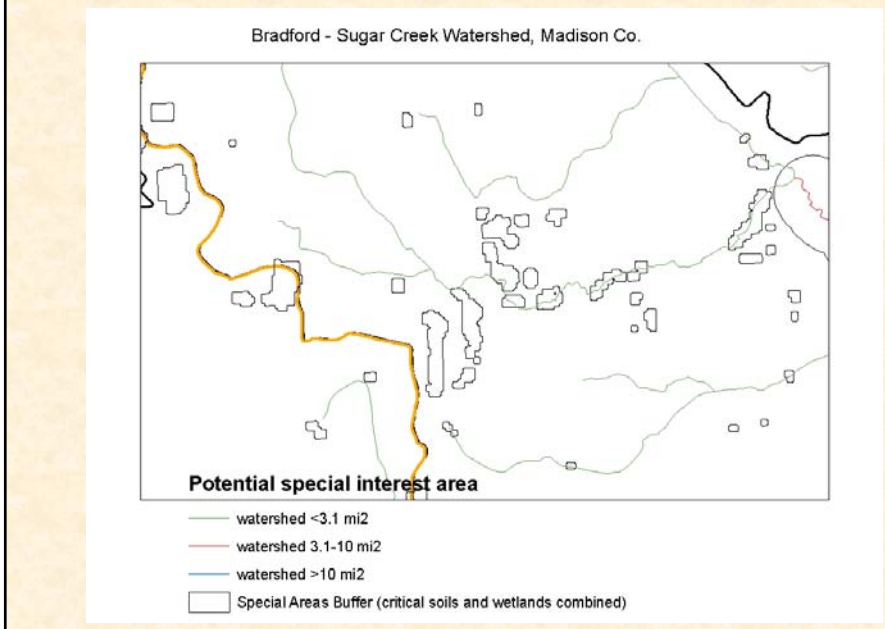

Bradford - Sugar Creek Watershed, Madison Co.
NHD Layer
watershed <3.1 mi2
watershed 3.1-10 mi2
watershed >10 mi2

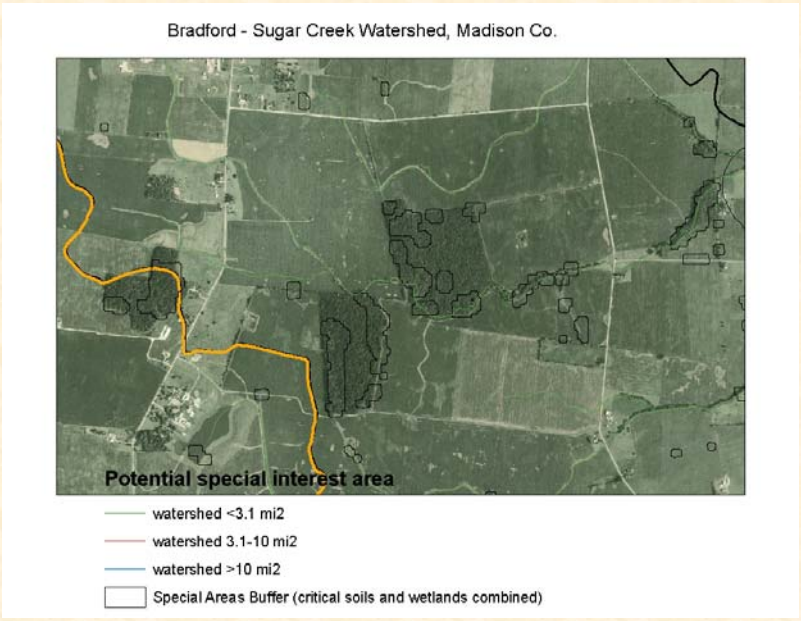

Bradford - Sugar Creek Watershed, Madison Co.
SURGO Layer
<3.1 mi2
>3.1 mi2


Bradford - Sugar Creek Watershed, Madison Co.
Maintained Ditches
<3.1 mi2
>3.1 mi2


Bradford - Sugar Creek Watershed, Madison Co.
OEPA Data Sites
IBI
QHEI
Bugs
ICI


Bradford - Sugar Creek Watershed, Madison Co.
OEPA Data Sites
watershed <3.1 mi2
watershed 3.1-10 mi2
watershed >10 mi2
Special Areas Buffer (critical soils and wetlands combined)


Bradford - Sugar Creek Watershed, Madison Co.
Potential special interest area
watershed <3.1 mi2
watershed 3.1-10 mi2
watershed >10 mi2
Special Areas Buffer (critical soils and wetlands combined)


Bradford - Sugar Creek Watershed, Madison Co.
Potential special interest area
watershed <3.1 mi2
watershed 3.1-10 mi2
watershed >10 mi2
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