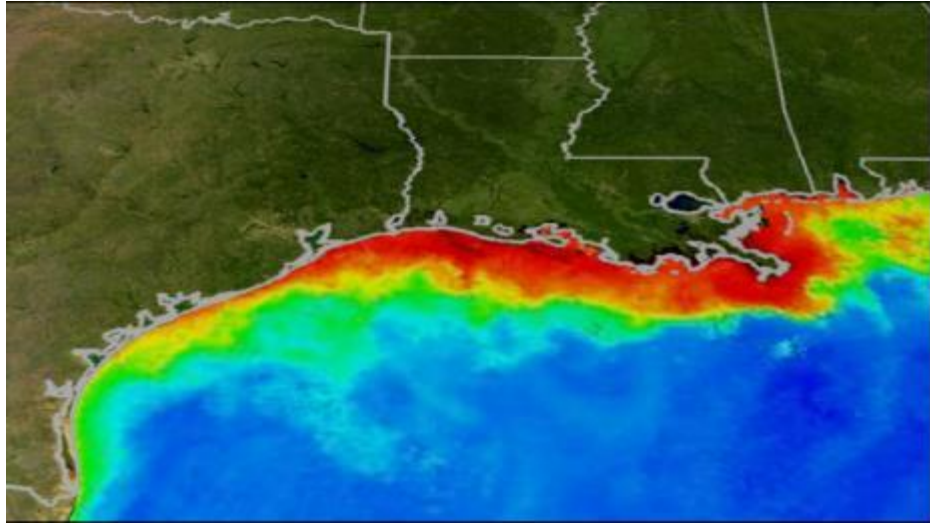


Science & Decision Tools to Guide Floodplain Protection & Restoration in the Mississippi River Basin

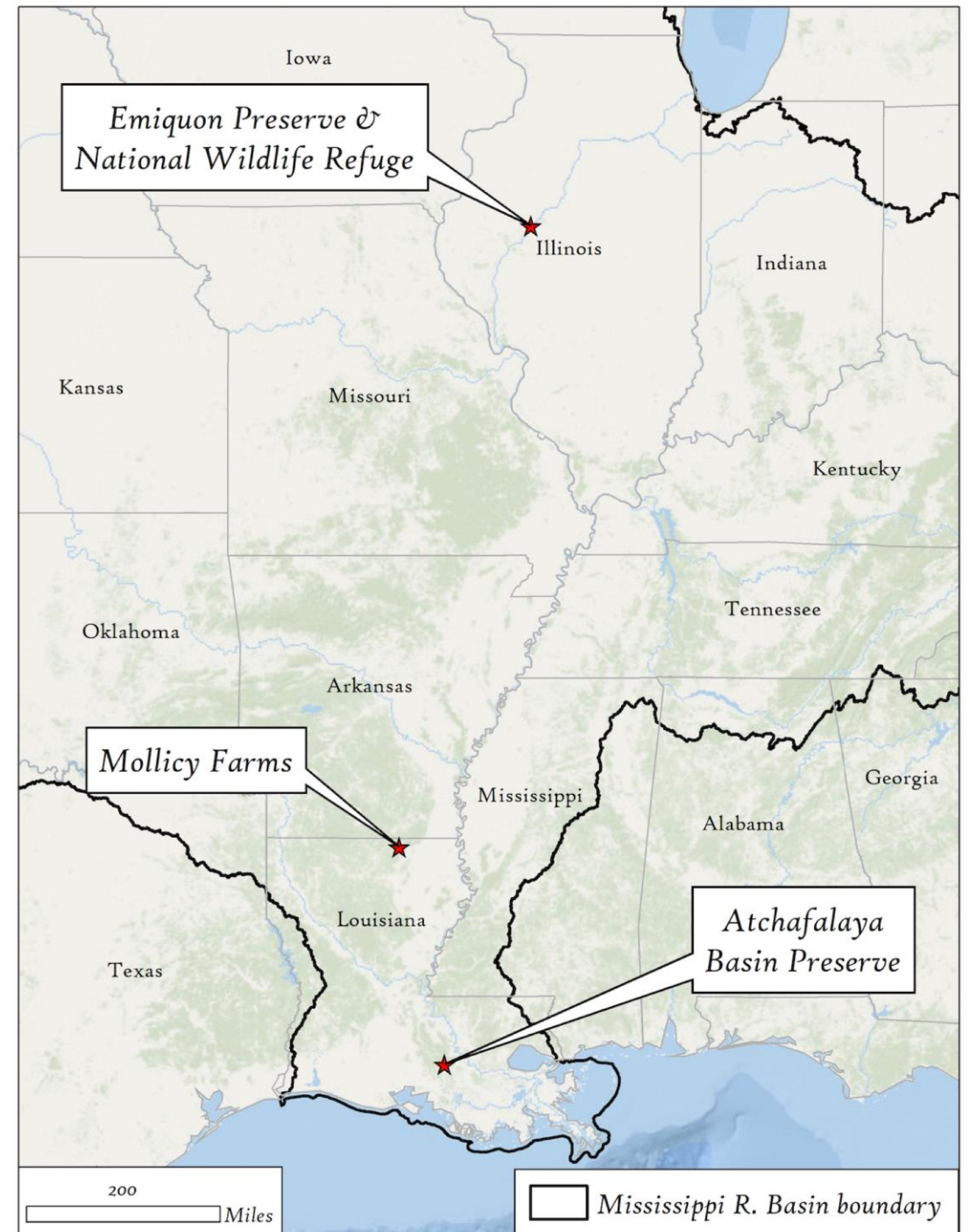
Kris Johnson
Eugene Yacobson

Natural Floodplain Functions Alliance webinar
June 4, 2019

Multiple Benefits of Floodplains



Successful Floodplain Projects



Floodplain Prioritization

How do we scale up?

Where to invest?



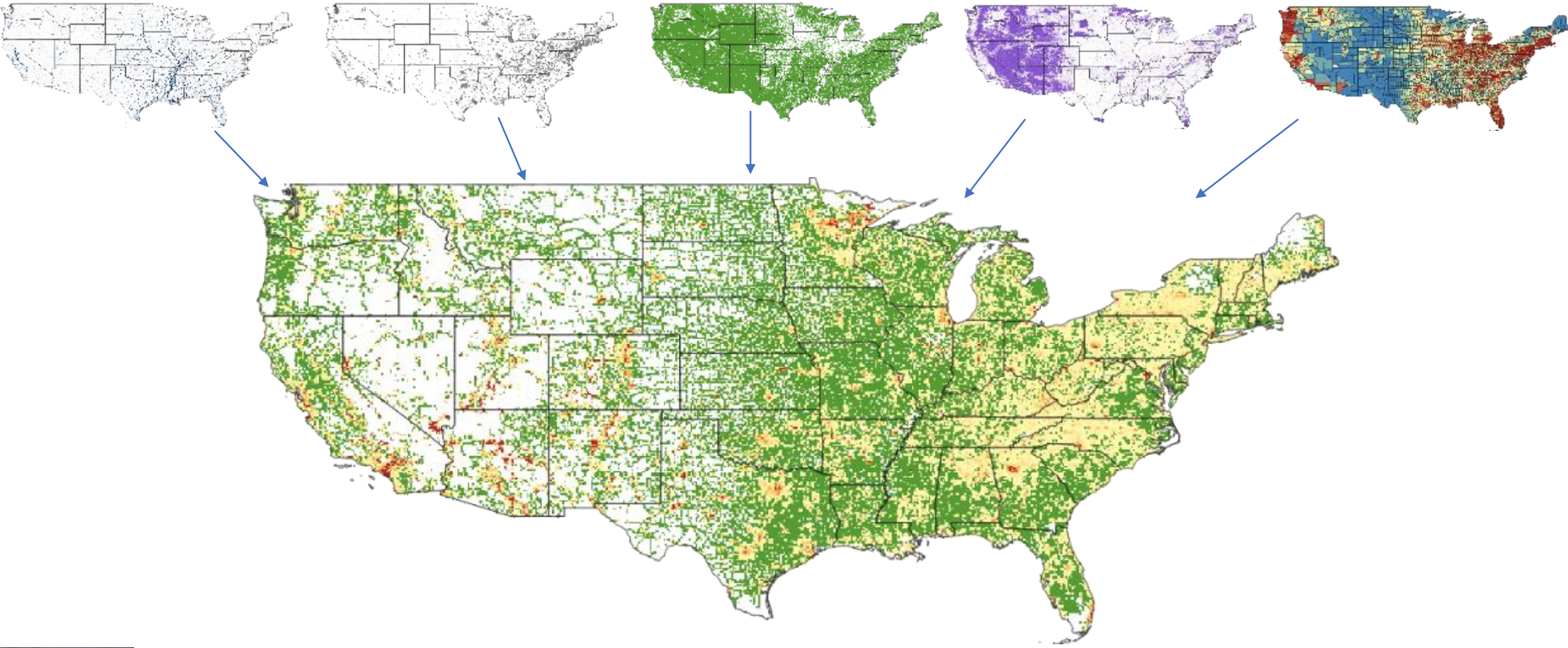
US Floodplain Analysis

NEW US model

- LISFLOOD-FP routes flows through channels delineated by HydroSHEDS
- Regionalized flood frequency analysis
- 10 return periods from 5 to 1000 yrs
- Explicit representation of USACE NLD
- Validated with FEMA and USGS data
(*Wing et al. 2017*)



US Floodplain Analysis

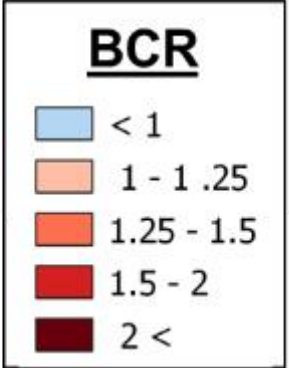
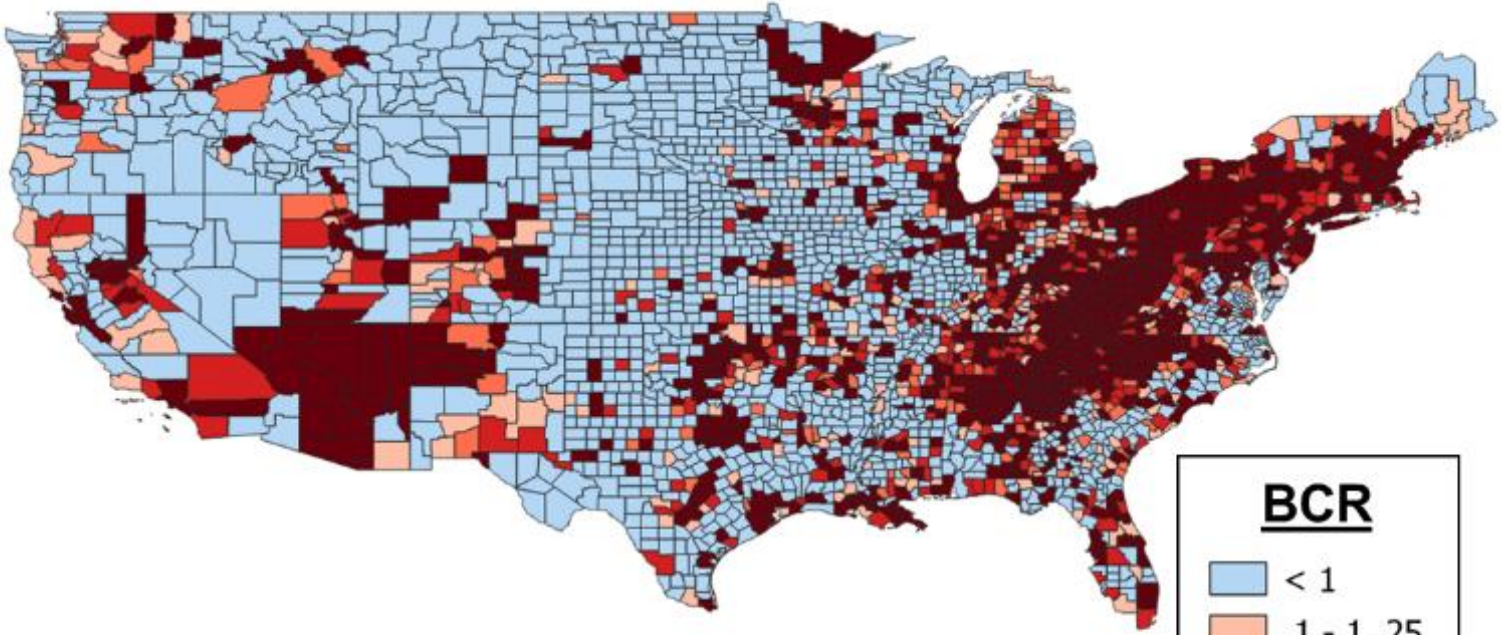
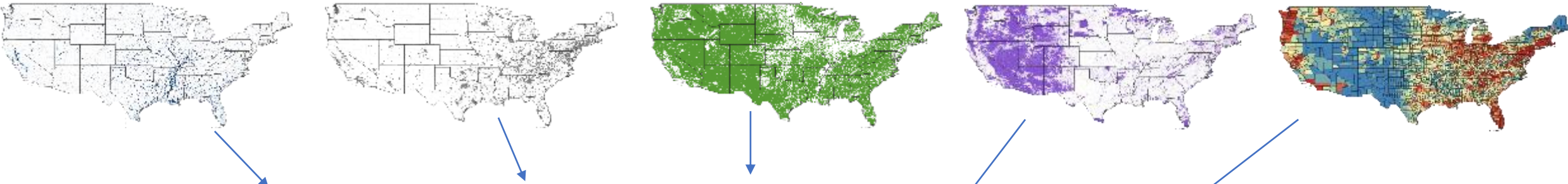


US Floodplain Analysis

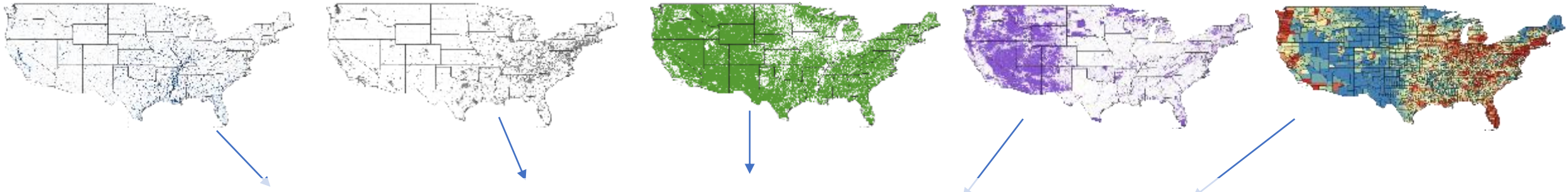


Wing et al 2018

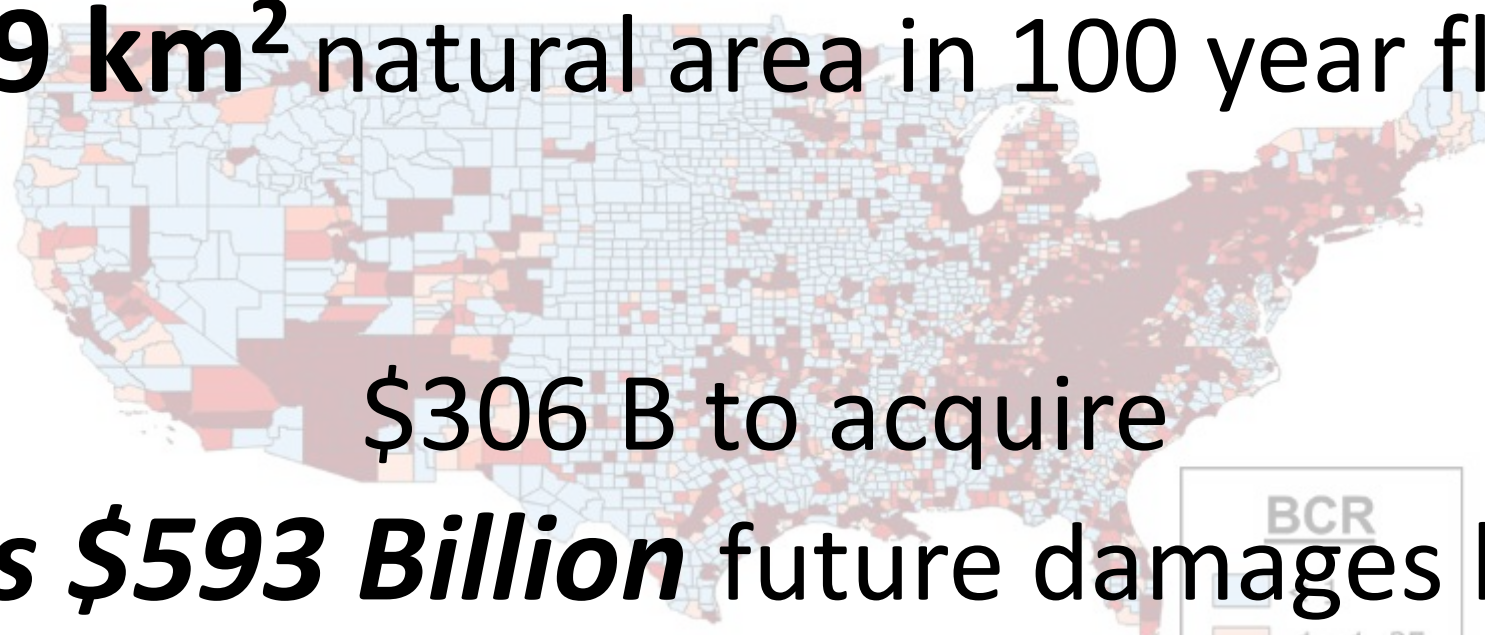
US Floodplain Analysis



US Floodplain Analysis

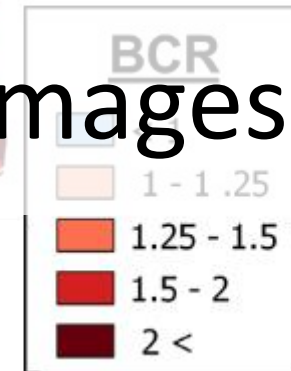


675,919 km² natural area in 100 year floodplain



\$306 B to acquire

avoids \$593 Billion future damages by 2070



Johnson et al *in review*

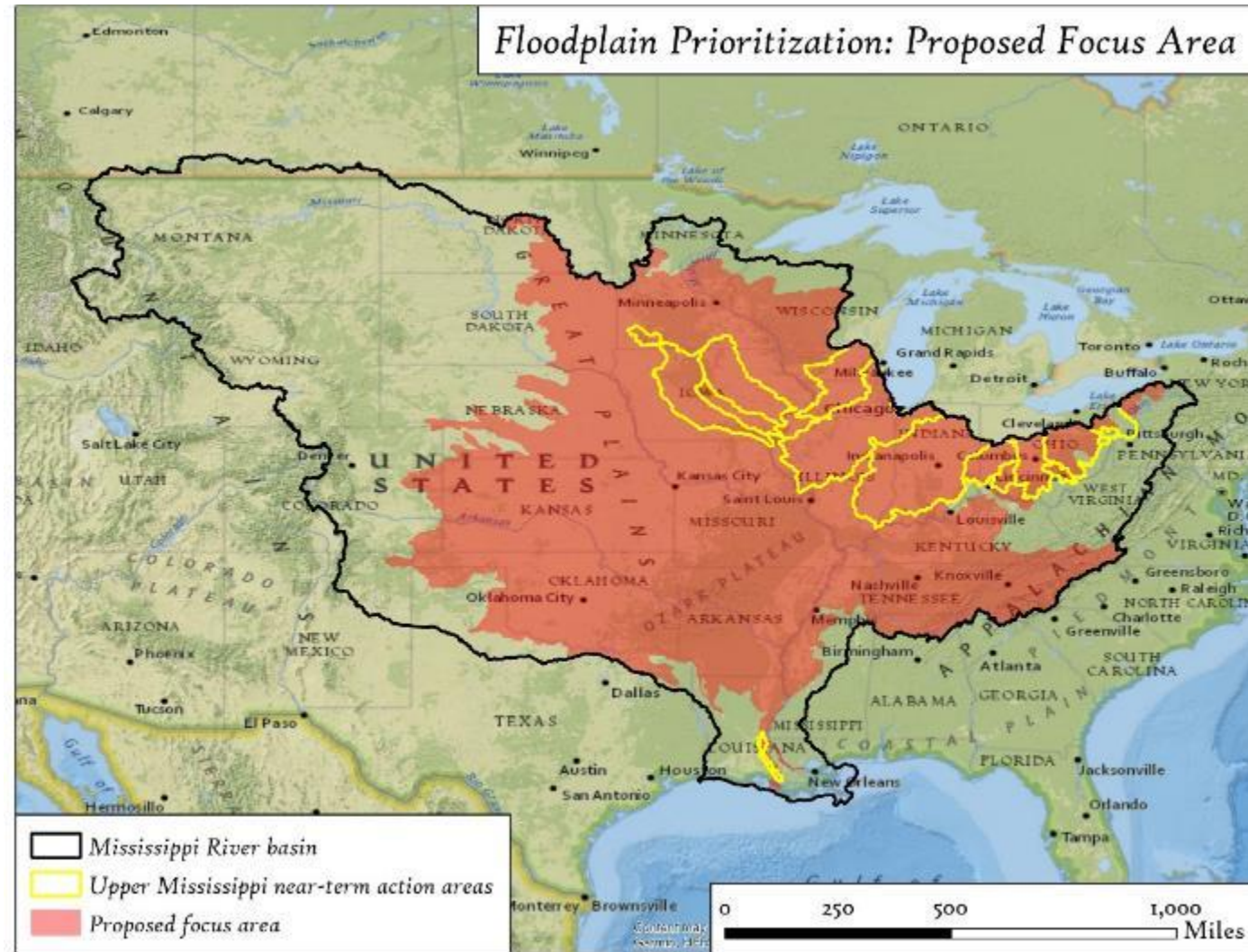


Floodplain Prioritization

Nutrients: Gulf of Mexico & Local water quality

Flooding: exposure, damages & social vulnerability

Biodiversity: species, habitat priorities & landscape connectivity





Identify Floodplain Units

Select Flood Frequency

1-in-5-year

1-in-100-year

1-in-500-year

View Floodplains By Watershed

HUC-8

HUC-12

Catchment

Select Management Action

Protection

Restoration

Restoration/Reconnection

Available Floodplain Area

Area of floodplain qualifying for restoration

0 to 85,000 acres

Nutrients

Local nutrient impact

0 to 100 %

Nutrient contribution to the Gulf of Mexico

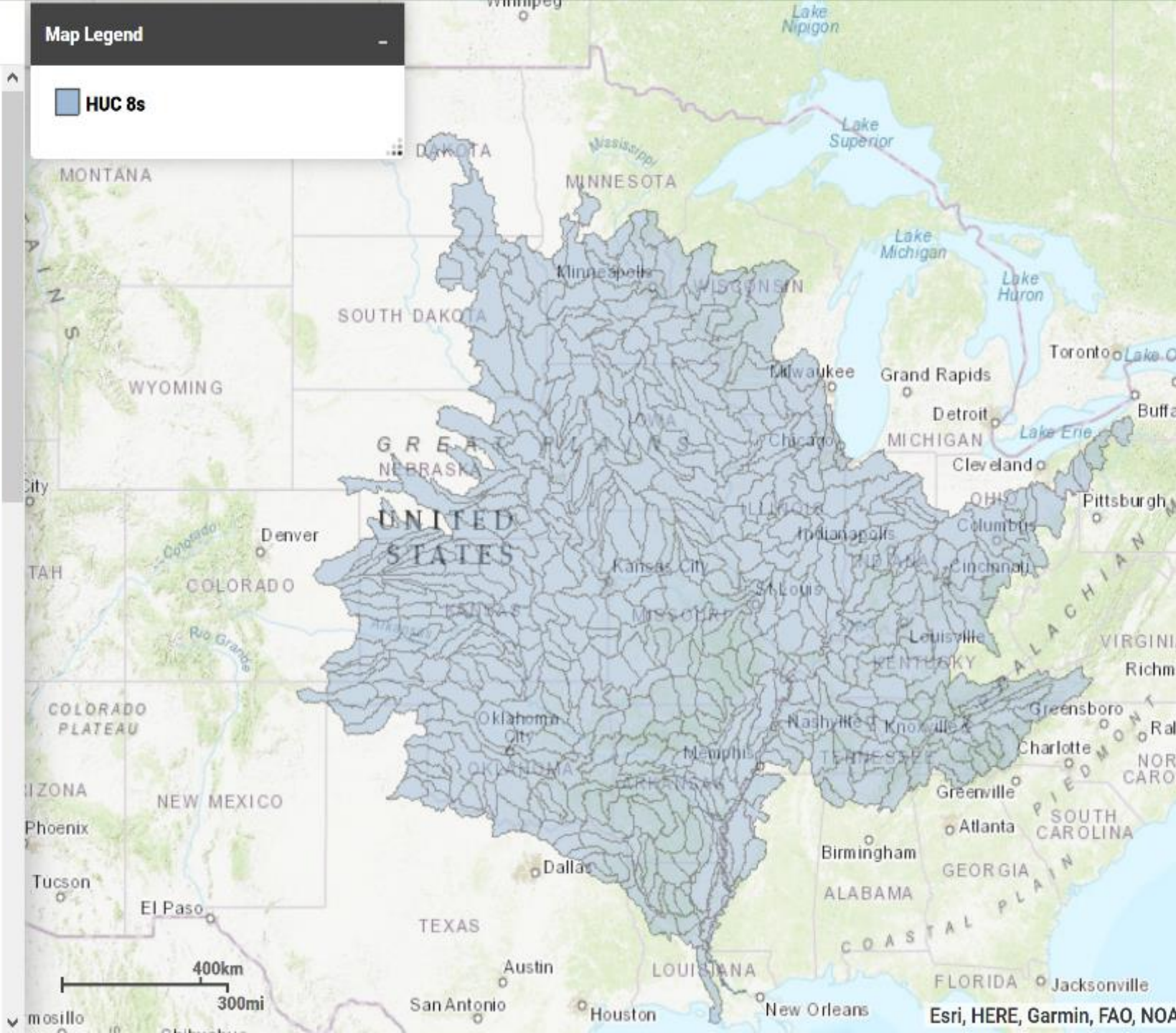
0 to 100 %

Growing degree days

0 to 100 %

Land Conversion

HUC 8s



Identify Floodplain Units

Select Flood Frequency

1-in-5-year 1-in-100-year 1-in-500-year

View Floodplains By Watershed

HUC-8 HUC-12 Catchment

Select Management Action

Protection Restoration Restoration/Reconnection

Available Floodplain Area

Area of floodplain in agriculture or pasture land 500 to 2,500 acres

Nutrients

Local nutrient impact 50 to 100 %

Nutrient contribution to the Gulf of Mexico 50 to 100 %

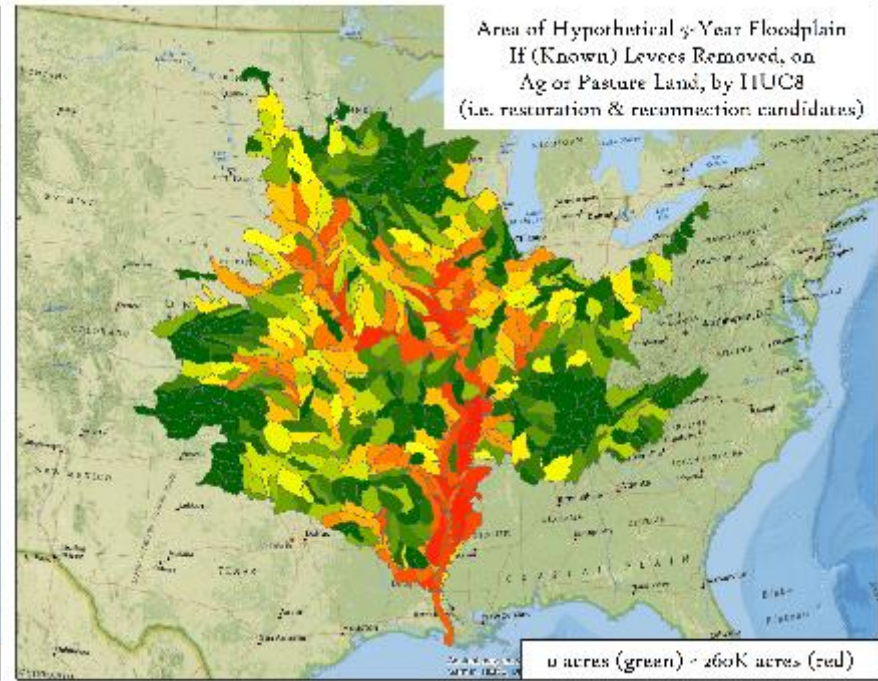
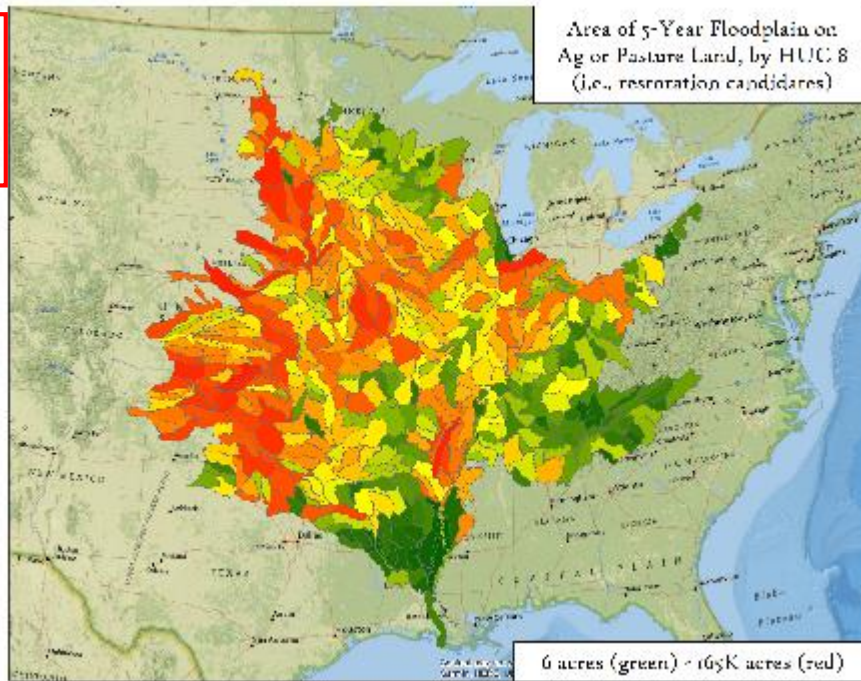
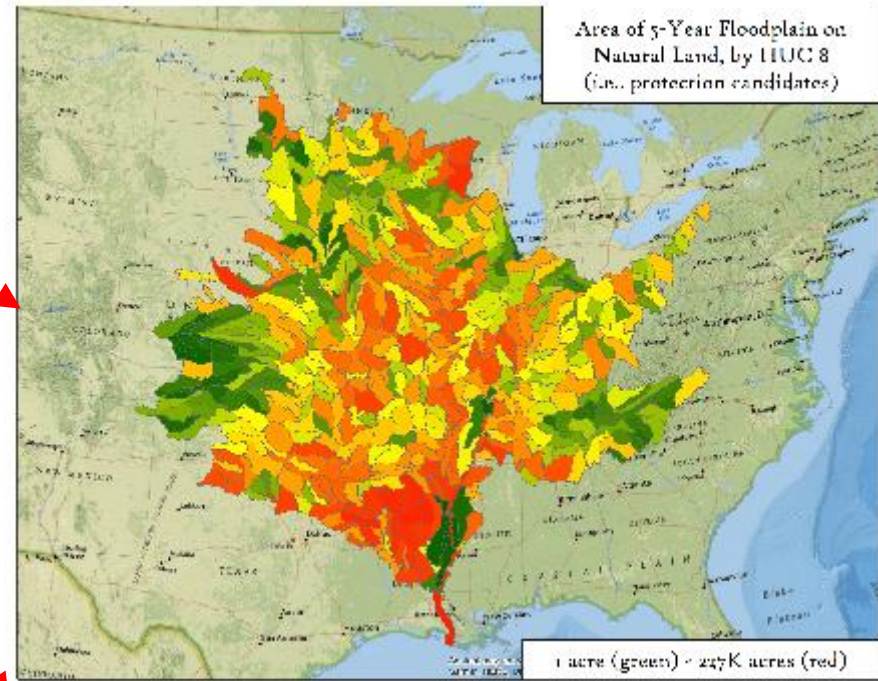
Growing degree days 50 to 100 %

Land Conversion

Agricultural productivity potential of soils 0 to 0.6

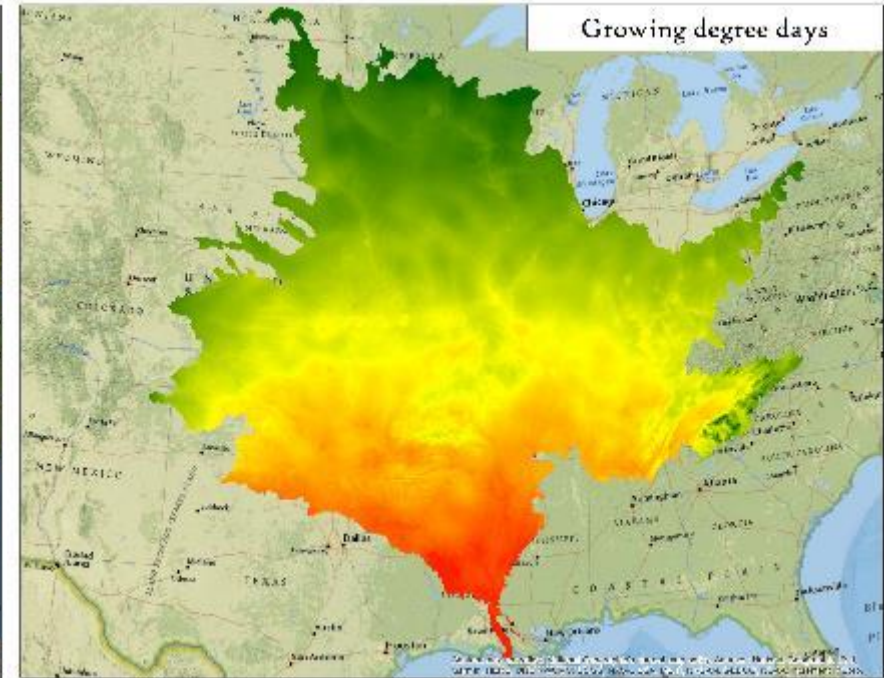
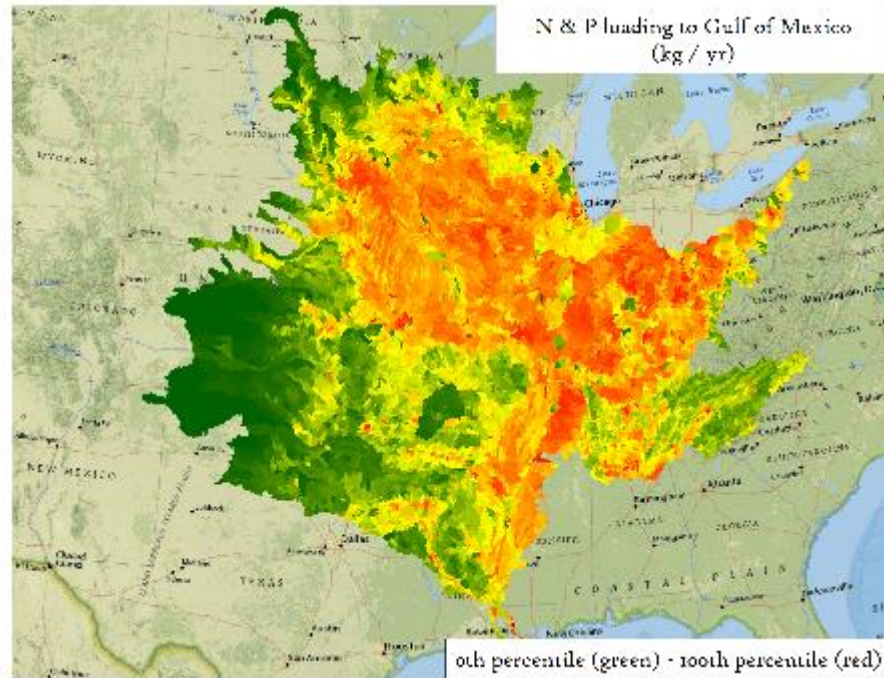
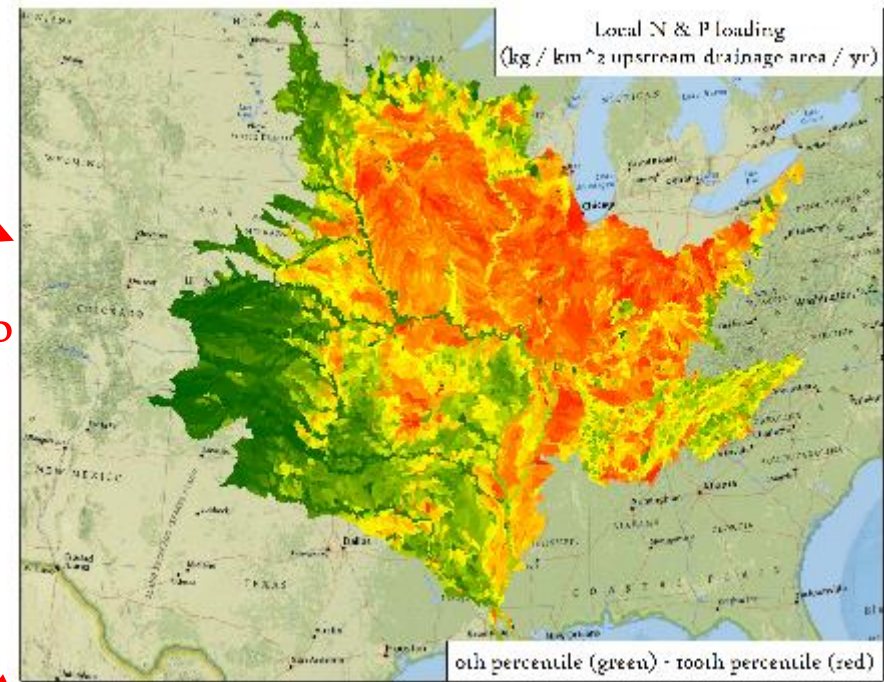
HOW MUCH FLOODPLAIN IS AVAILABLE FOR ...

- Protection? – in forest or wetland
- Restoration? – in ag or pasture
- Restoration & reconnection? – in ag or pasture and behind levees



WATER QUALITY

- Nutrient loading to **local waters**
- Nutrient loading to **Gulf of Mexico**
- Growing degree days – In conjunction with higher loading, facilitates **denitrification**



Identify Floodplain Units

Select Flood Frequency

1-in-5-year

1-in-100-year

1-in-500-year

View Floodplains By Watershed

HUC-8

HUC-12

Catchment

Select Management Action

Protection

Restoration

Restoration/Reconnection

Available Floodplain Area

Area of floodplain in agriculture or pasture land

500 to 2,500 acres

Nutrients

Local nutrient impact

50 to 100 %

Nutrient contribution to the Gulf of Mexico

50 to 100 %

Growing degree days

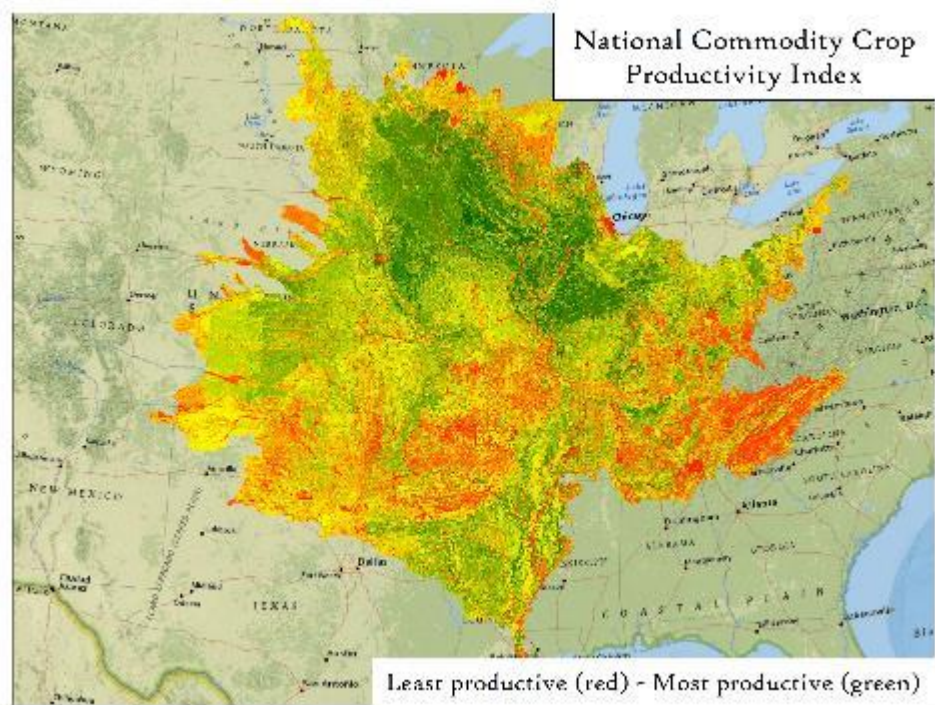
50 to 100 %

Land Conversion

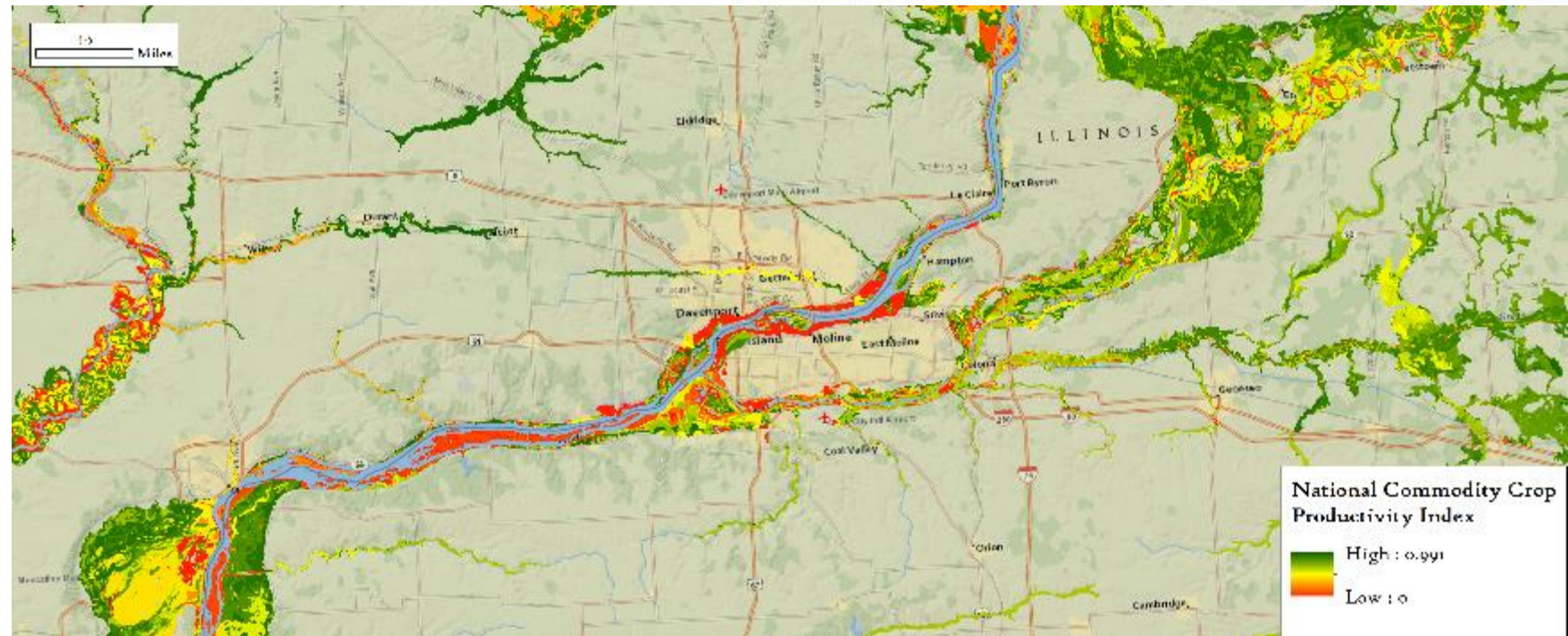
Agricultural productivity potential of soils

0 to 0.6

SOIL QUALITY



- National Commodity Crop Productivity Index – A measure of soils’ inherent capacity to produce commodity crops
- Draw restoration efforts to relatively less productive soils



Identify Floodplain Units

Select Flood Frequency

1-in-5-year

1-in-100-year

1-in-500-year

View Floodplains By Watershed

HUC-8

HUC-12

Catchment

Select Management Action

Protection

Restoration

Restoration/Reconnection

Available Floodplain Area

Area of floodplain in agriculture or pasture land

500 to 2,500 acres

Nutrients

Local nutrient impact

50 to 100 %

Nutrient contribution to the Gulf of Mexico

50 to 100 %

Growing degree days

50 to 100 %

Land Conversion

Agricultural productivity potential of soils

0 to 0.6

Habitat

Important Bird Areas Present Absent

TNC Ecoregional Assessment Units Present Absent

At-Risk Wetland Species 0 to 8

USFWS Threatened & Endangered Species Active Critical Habitat Present Absent

American Bird Conservancy Corridors & Key Habitat Bird Areas Present Absent

National Fish Habitat Partnership Cumulative Habitat Condition Index 0 to 5

Population Exposure

Current population 0 to 700

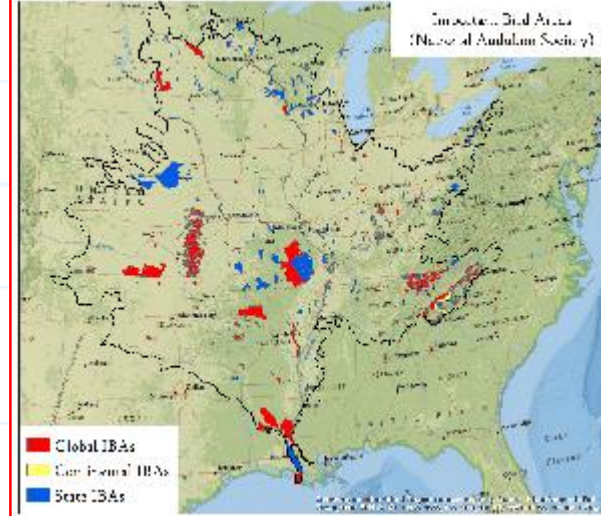
Projected population (2050) 121 to 400

Future Economic Asset Exposure

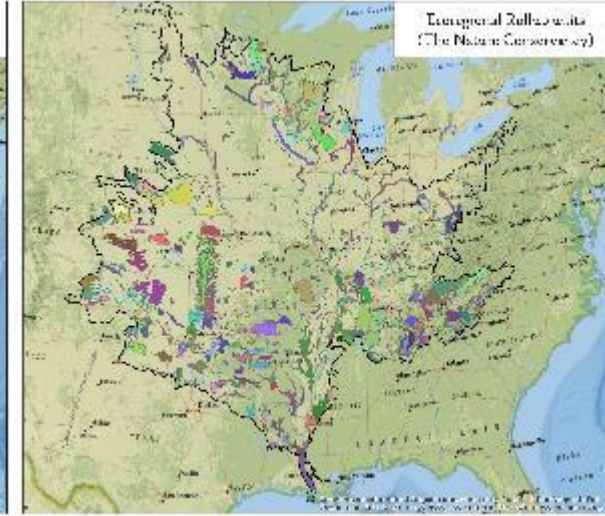
Economic asset exposure (2050) (SSP2) 6 to 400

Economic asset exposure (2050) (SSP5) 0 to 400

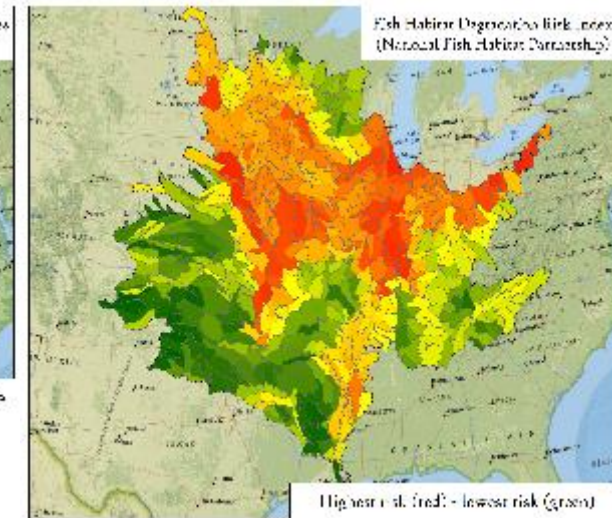
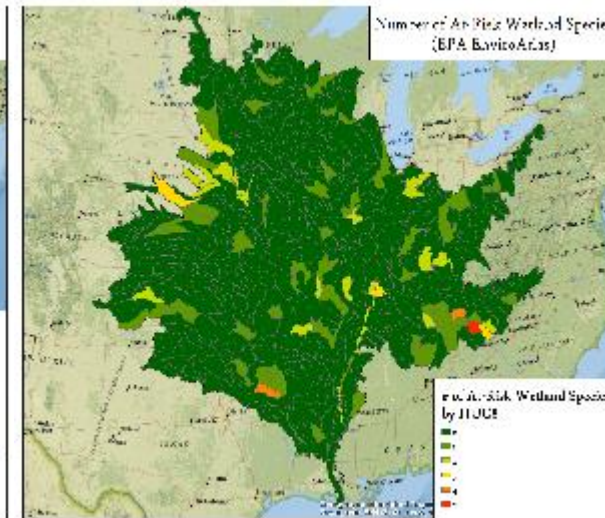
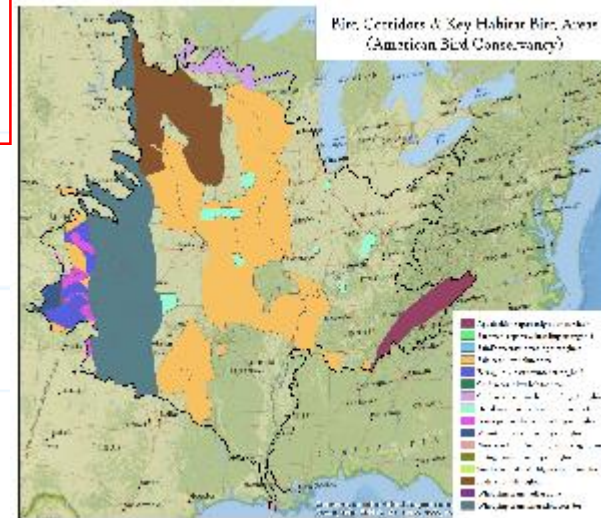
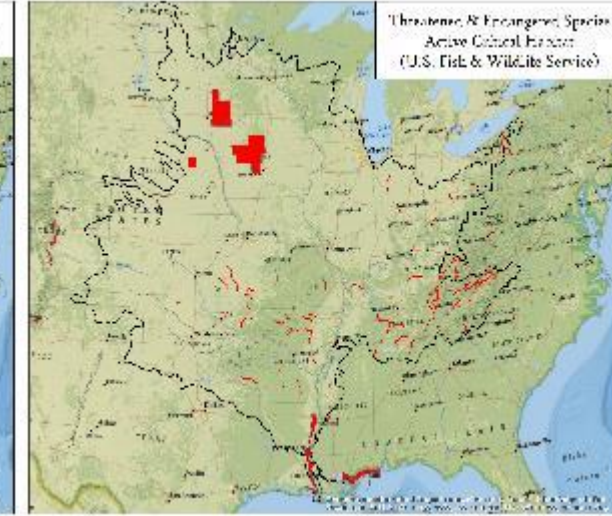
Important Bird Areas (Audubon)



TNC Ecoregional Rollup Units



USFWS Threatened & Endangered Species



Bird Corridors & Key Habitat Areas (American Bird Conservancy)

Number of At-Risk Wetland Species (EPA)

Fish Habitat Degradation Risk Index (NFHP)

Identify Floodplain Units

Select Flood Frequency

1-in-5-year **1-in-100-year** 1-in-500-year

View Floodplains By Watershed

HUC-8 **HUC-12** Catchment

Select Management Action

Protection Restoration Restoration/Reconnection

Available Floodplain Area

Area of floodplain qualifying for restoration & reconnection

1,000 to >2,500 acres

Nutrients

Accumulated yield of N & P

0 to 50 %

Delivered incremental yield of N & P

0 to 50 %

Flood frequency

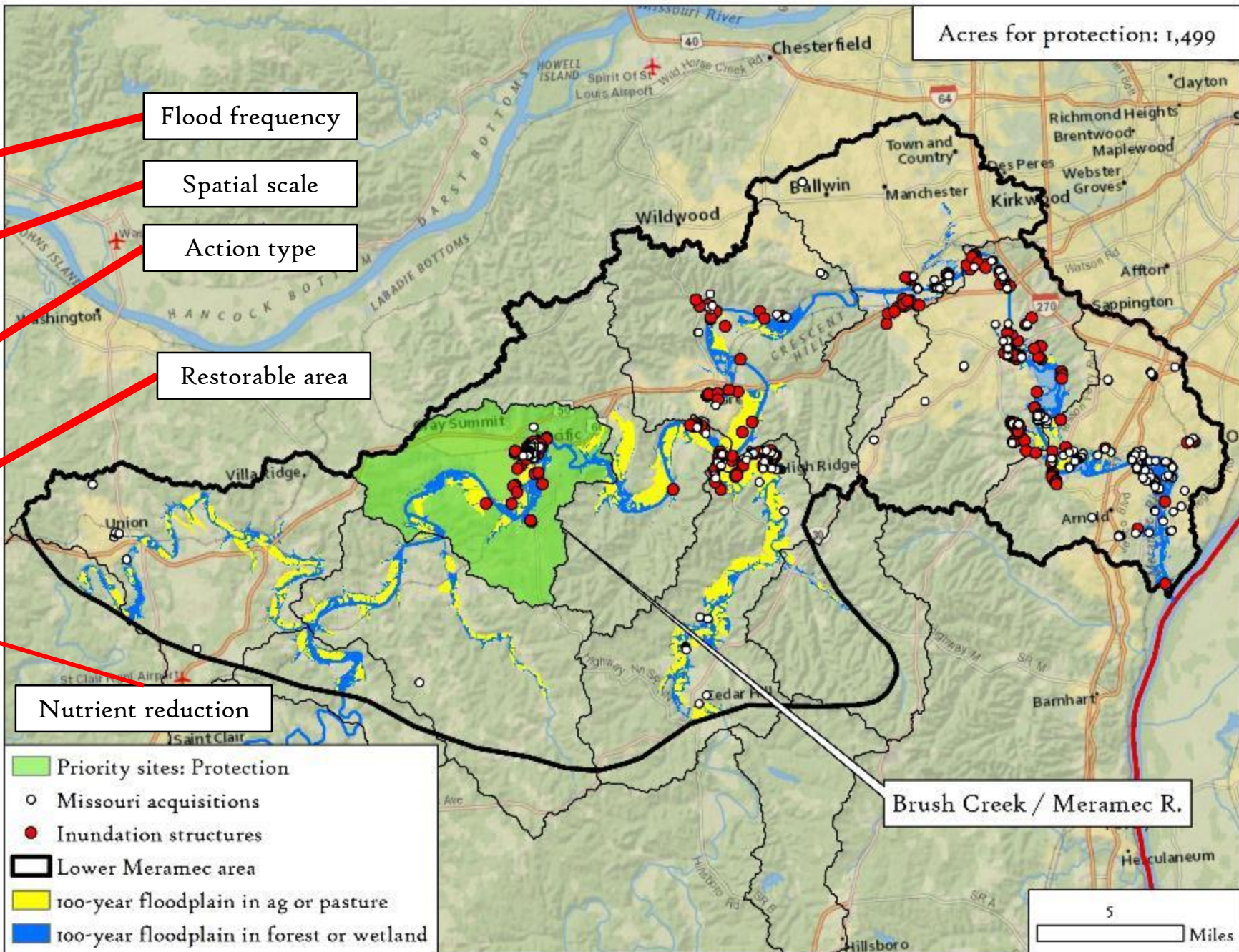
Spatial scale

Action type

Restorable area

Nutrient reduction

Acres for protection: 1,499



Brush Creek / Meramec R.

5

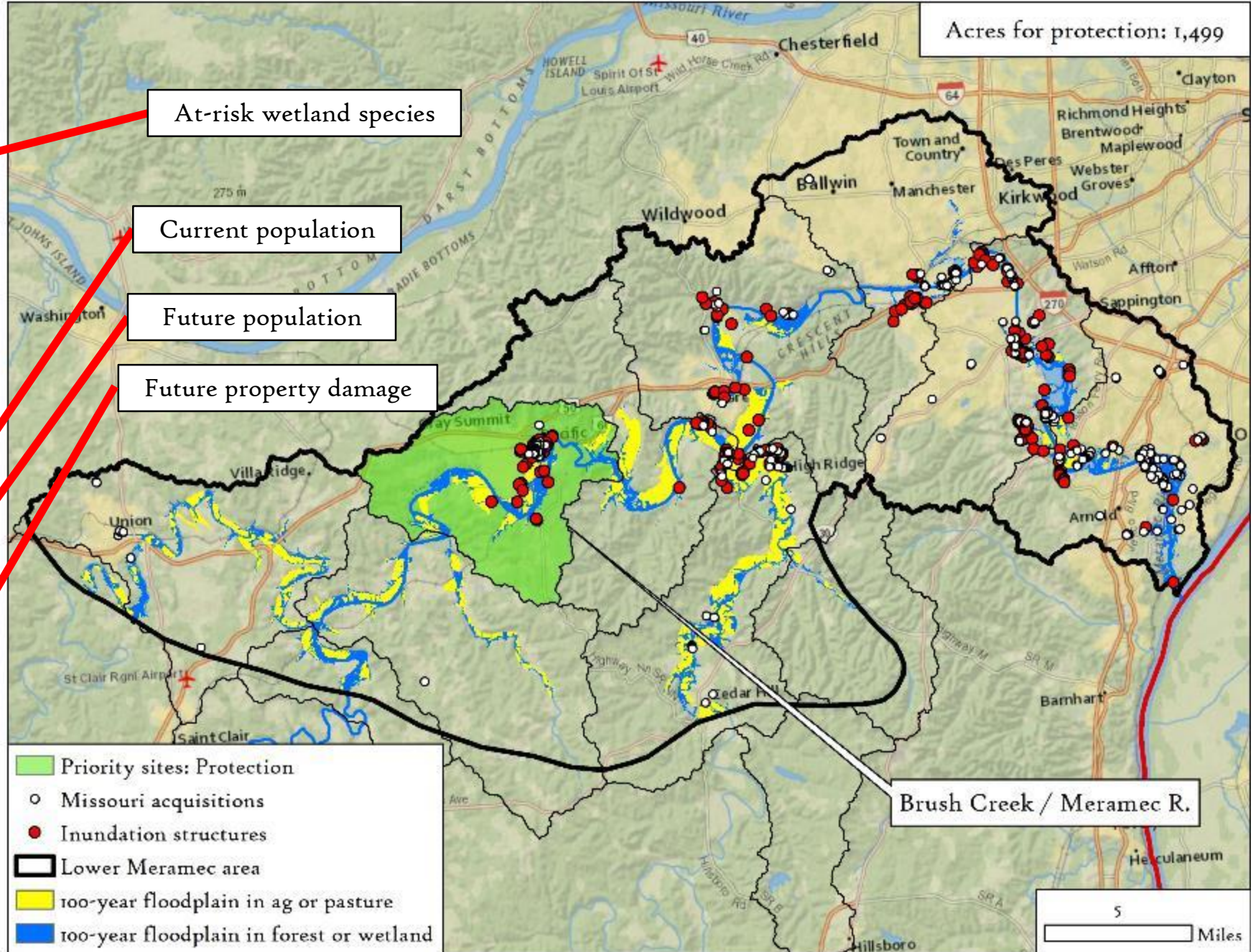
Miles

Criteria for PROTECTION:

- At least **1,000 acres** of floodplain in **forest** or **wetland**
- **Bottom 50%** for nutrient loading
- Nonzero **current pop.** & **projected 2050 pop.** >100 ppl.
- Projected 2050 flood damage **>=\$10,000,000**
- Presence of **at-risk wetland species**

Habitat

- Important Bird Areas Present Absent
- TNC Ecoregional Assessment Units Present Absent
- At-Risk Wetland Species 1 to 8
- USFWS Threatened & Endangered Species Active Critical Habitat Present Absent
- American Bird Conservancy Corridors & Key Habitat Bird Areas Present Absent
- National Fish Habitat Partnership Cumulative Habitat Condition Index 0 to 5
- Population Exposure**
- Current population 1 to > 10
- Projected population (2050) 100 to > 1,000
- Future Economic Asset Exposure**
- Economic asset exposure (2050) (SSP2) 10M to > 50M



At-risk wetland species

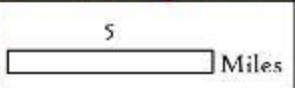
Current population

Future population

Future property damage

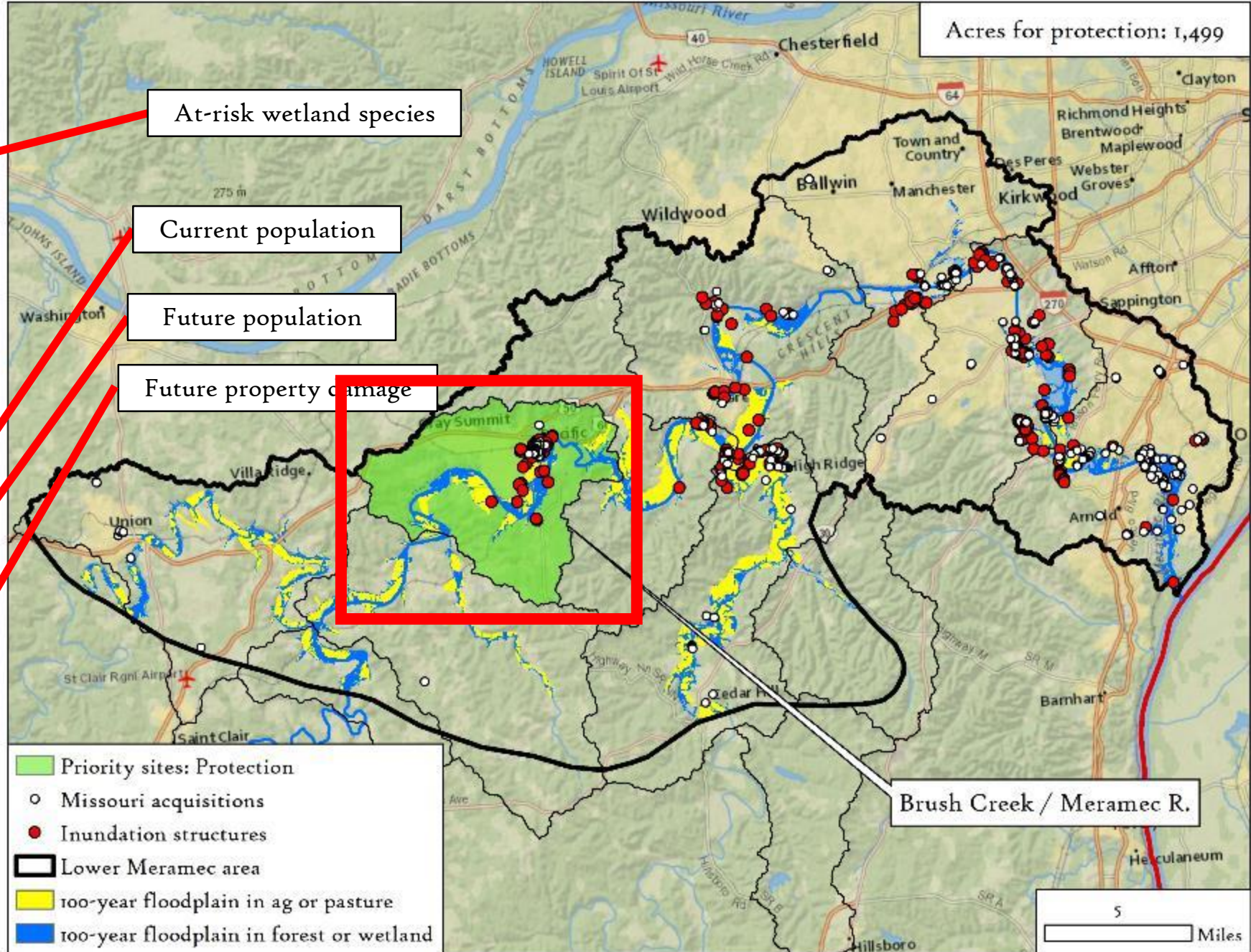
- Priority sites: Protection
- Missouri acquisitions
- Inundation structures
- Lower Meramec area
- 100-year floodplain in ag or pasture
- 100-year floodplain in forest or wetland

- Criteria for PROTECTION:**
- At least **1,000 acres** of floodplain in **forest** or **wetland**
 - **Bottom 50%** for nutrient loading
 - Nonzero **current pop.** & **projected 2050 pop.** >100 ppl.
 - Projected 2050 flood damage **>=\$10,000,000**
 - Presence of **at-risk wetland species**



Habitat

- Important Bird Areas Present Absent
- TNC Ecoregional Assessment Units Present Absent
- At-Risk Wetland Species 1 to 8
- USFWS Threatened & Endangered Species Active Critical Habitat Present Absent
- American Bird Conservancy Corridors & Key Habitat Bird Areas Present Absent
- National Fish Habitat Partnership Cumulative Habitat Condition Index 0 to 5
- Population Exposure**
- Current population 1 to > 10
- Projected population (2050) 100 to > 1,000
- Future Economic Asset Exposure**
- Economic asset exposure (2050) (SSP2) 10M to > 50M



At-risk wetland species

Current population

Future population

Future property damage

- Criteria for PROTECTION:**
- At least **1,000 acres** of floodplain in **forest** or **wetland**
 - **Bottom 50%** for nutrient loading
 - Nonzero **current pop.** & **projected 2050 pop.** >100 ppl.
 - Projected 2050 flood damage **>=\$10,000,000**
 - Presence of **at-risk wetland species**

- Priority sites: Protection
- Missouri acquisitions
- Inundation structures
- Lower Meramec area
- 100-year floodplain in ag or pasture
- 100-year floodplain in forest or wetland

Identify Floodplain Units

Select Flood Frequency

1-in-5-year

1-in-100-year

1-in-500-year

View Floodplains By Watershed

HUC-8

HUC-12

Catchment

Select Management Action

Protection

Restoration

Restoration/Reconnection

Available Floodplain Area

 Area of floodplain qualifying for restoration & reconnection

0.1 to >250 acres

Nutrients

 Accumulated yield of N & P

0 to 50 %

 Delivered incremental yield of N & P

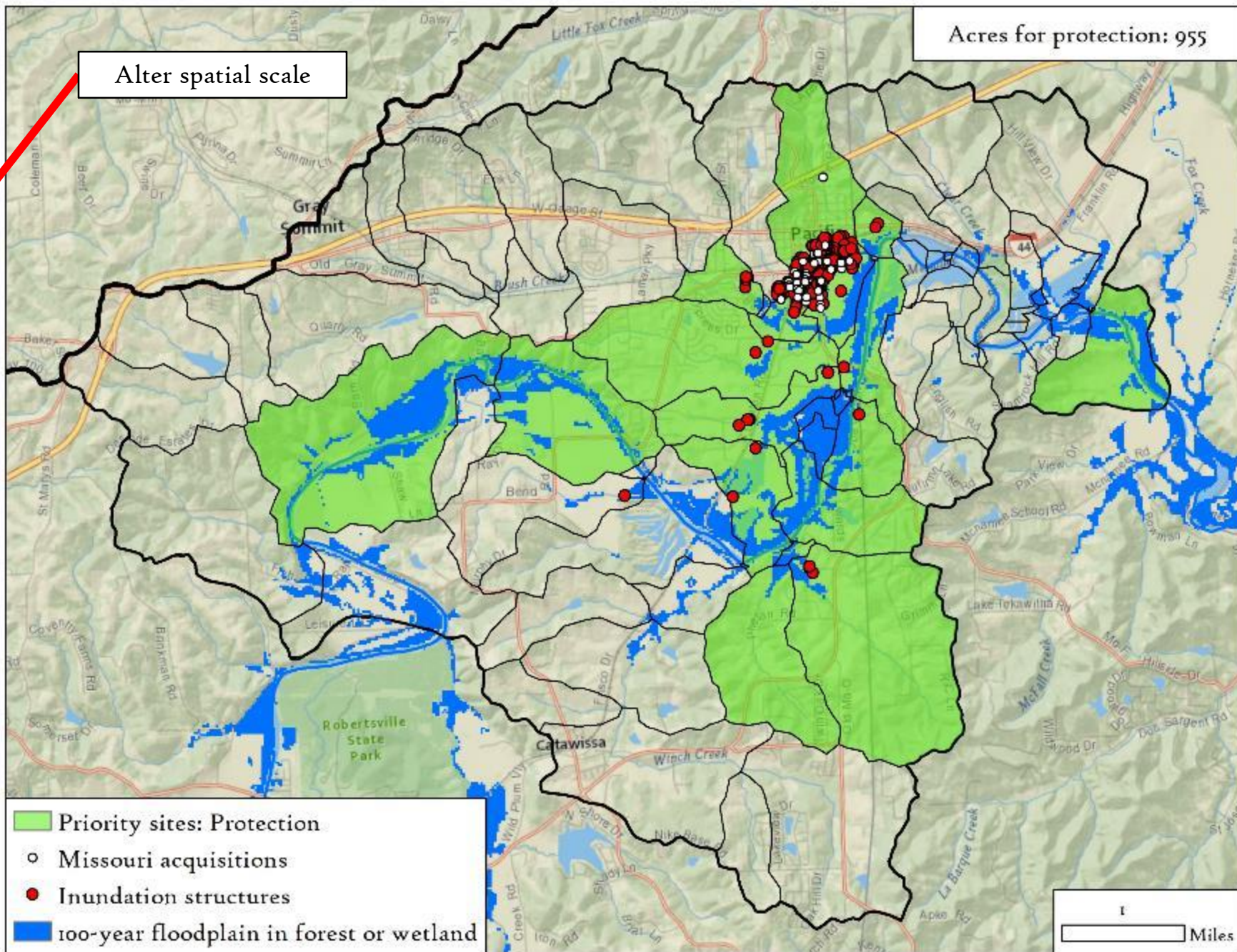
0 to 50 %

Criteria for PROTECTION:

- Nonzero acreage of floodplain in forest or wetland
- Bottom 50% for nutrient loading
- Nonzero current & 2050 population
- Projected 2050 flood damage $\geq \$10,000,000$
- Presence of at-risk wetland species

Alter spatial scale

Acres for protection: 955



Identify Floodplain Units

Select Flood Frequency

1-in-5-year **1-in-100-year** 1-in-500-year

View Floodplains By Watershed

HUC-8 **HUC-12** Catchment

Select Management Action

Protection **Restoration** Restoration/Reconnection

Available Floodplain Area

Area of floodplain qualifying for restoration & reconnection 1,000 to >6,000 acres

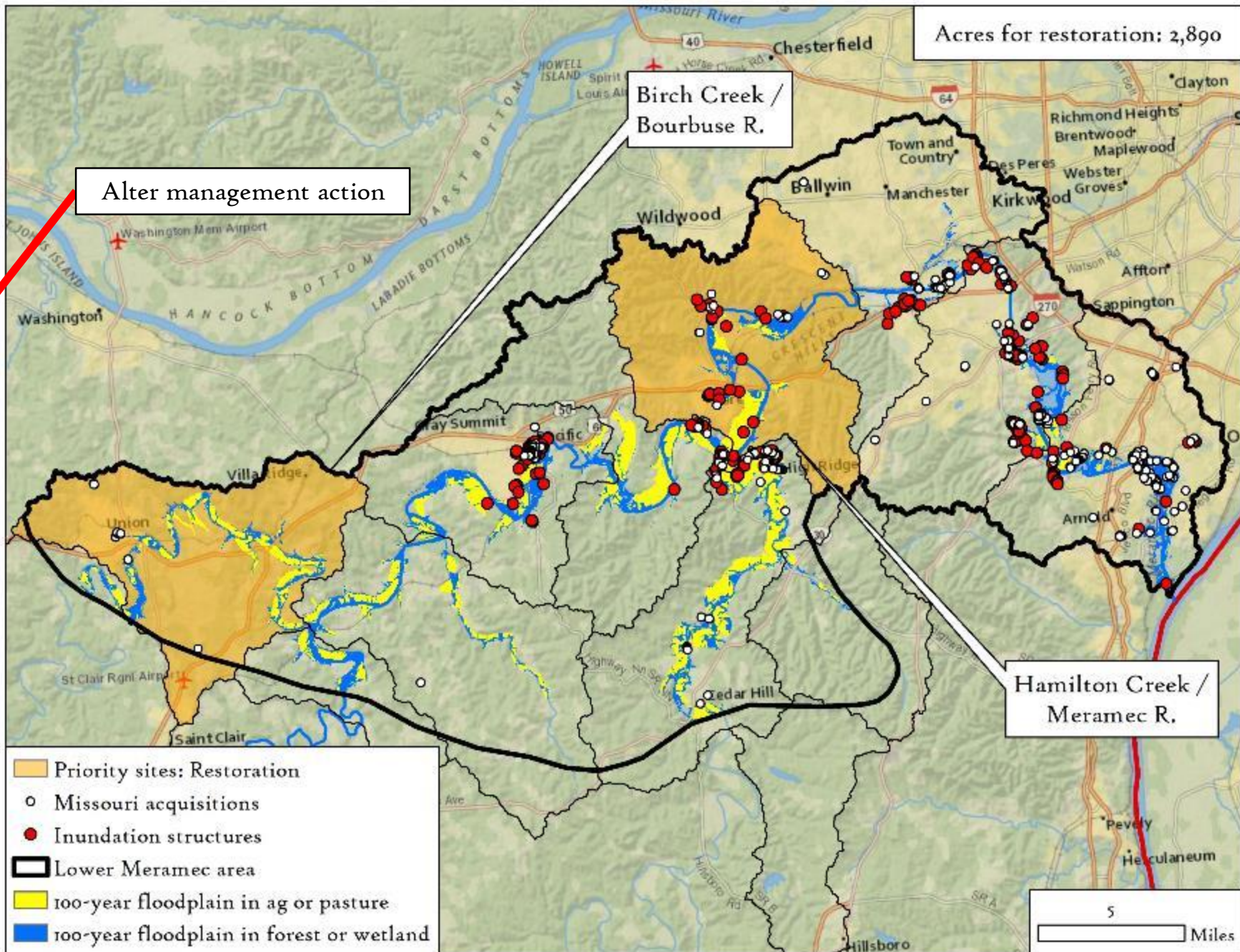
Nutrients

Accumulated yield of N & P 50 to 100 %

Delivered incremental yield of N & P 50 to 100 %

Criteria for RESTORATION:

- At least **1,000 acres** of floodplain in **forest** or **wetland**
- **Top 50%** for nutrient loading
- Nonzero **current pop.** & **projected 2050 pop.** >200 ppl.
- Projected 2050 flood damage **>=\$10,000,000**
- In an **Important Bird Area**, **bird habitat corridor**, contains **at-risk wetland species**, or **relatively stressed fish habitat**



Identify Floodplain Units

Select Flood Frequency

1-in-5-year **1-in-100-year** 1-in-500-year

View Floodplains By Watershed

HUC-8 **HUC-12** Catchment

Select Management Action

Protection **Restoration** Restoration/Reconnection

Available Floodplain Area

Area of floodplain qualifying for restoration & reconnection 1,000 to >6,000 acres

Nutrients

Accumulated yield of N & P 50 to 100 %

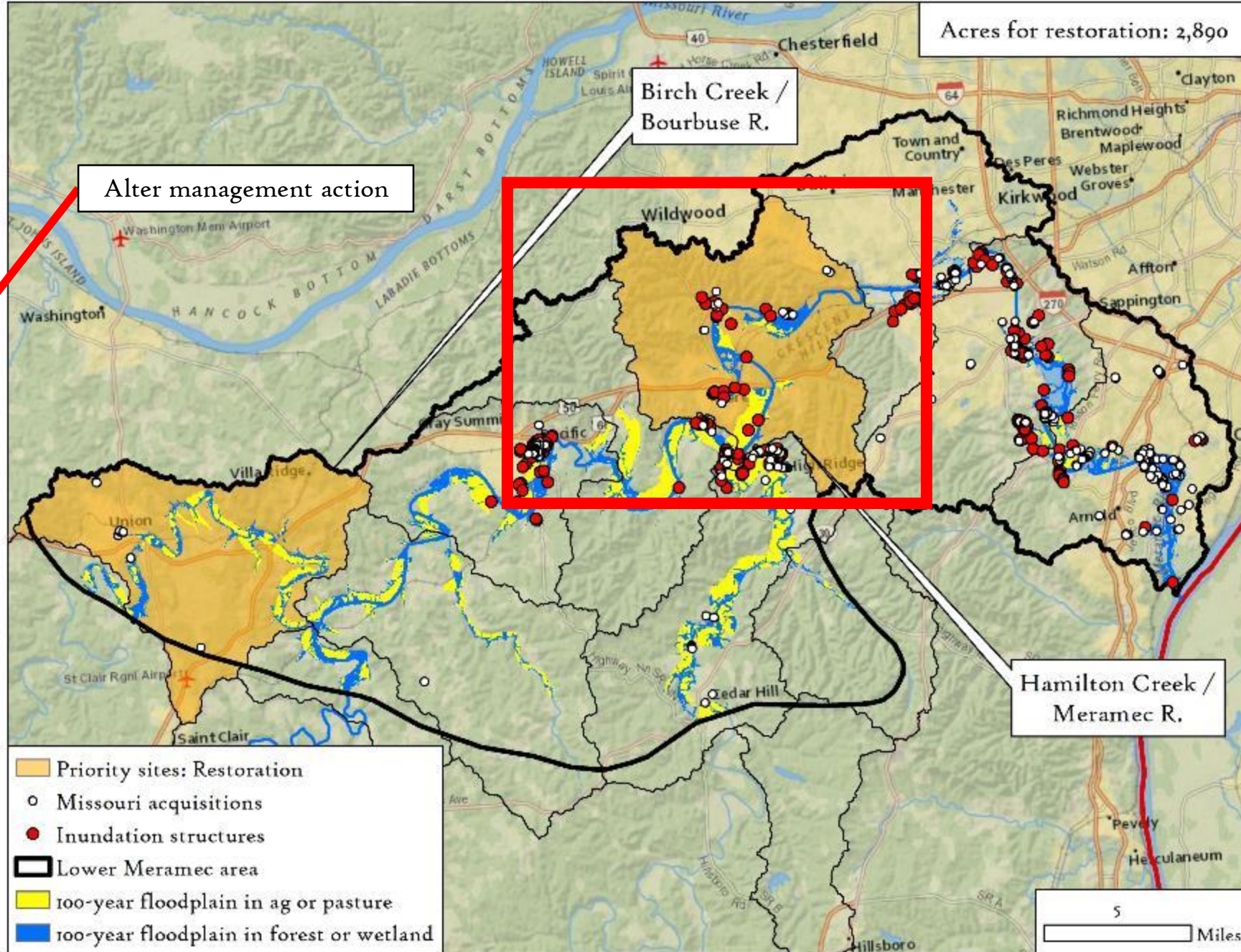
Delivered incremental yield of N & P 50 to 100 %

Acres for restoration: 2,890

Alter management action

Birch Creek /
Bourbuse R.

Hamilton Creek /
Meramec R.



Criteria for RESTORATION:

- At least 1,000 acres of floodplain in forest or wetland
- Top 50% for nutrient loading
- Nonzero current pop. & projected 2050 pop. >200 ppl.
- Projected 2050 flood damage >=\$10,000,000
- In an Important Bird Area, bird habitat corridor, contains at-risk wetland species, or relatively stressed fish habitat

5 Miles

Identify Floodplain Units

Select Flood Frequency

1-in-5-year

1-in-100-year

1-in-500-year

View Floodplains By Watershed

HUC-8

HUC-12

Catchment

Select Management Action

Protection

Restoration

Restoration/Reconnection

Available Floodplain Area

Area of floodplain qualifying for restoration & reconnection

10 to >250 acres

Nutrients

Accumulated yield of N & P

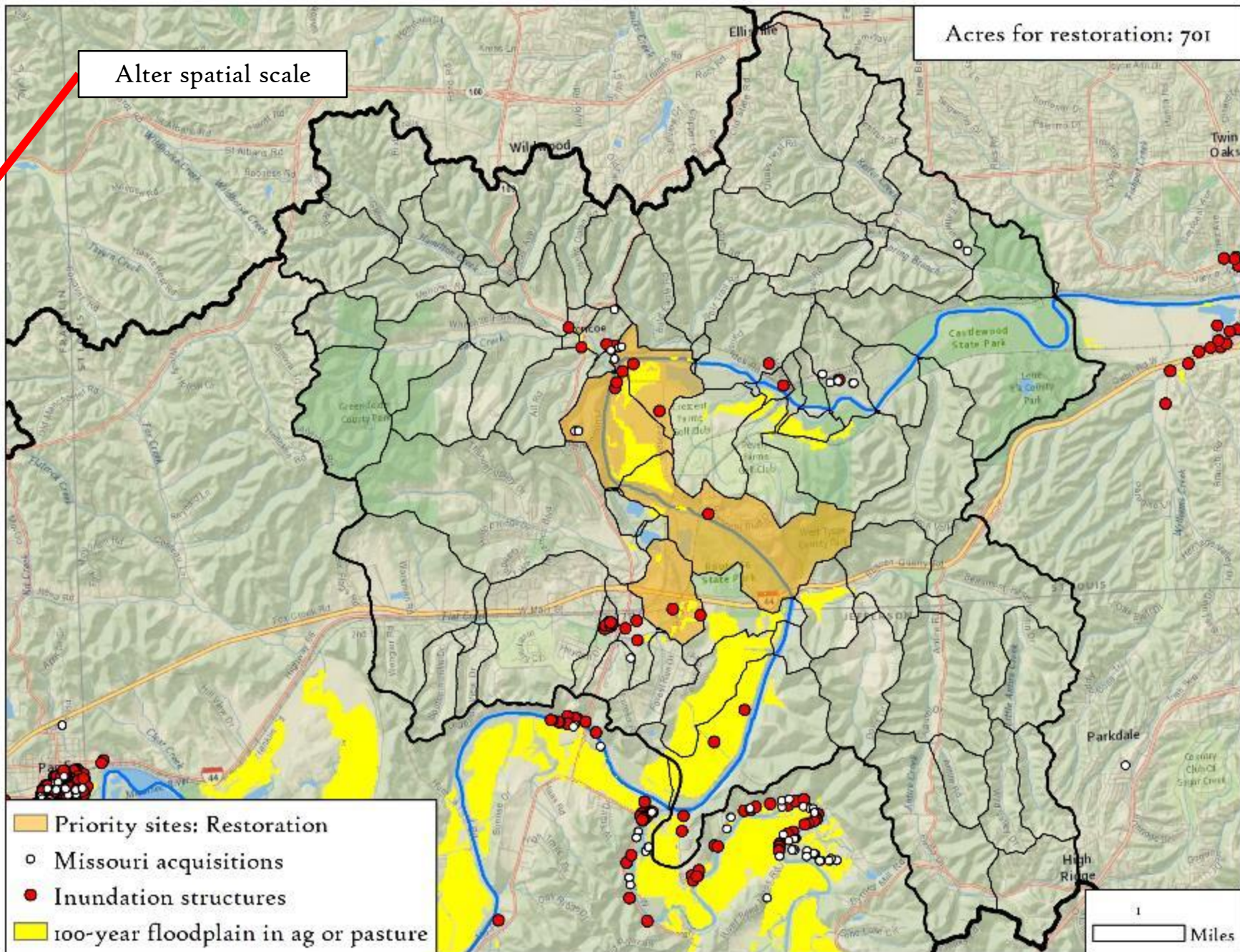
50 to 100 %

Delivered incremental yield of N & P

51 to 100 %

Acres for restoration: 701

Alter spatial scale



Criteria for RESTORATION:

- At least 10 acres of floodplain in forest or wetland
- Top 50% for nutrient loading
- Nonzero current pop. & projected 2050 pop.
- Projected 2050 flood damage >=\$100,000
- In an Important Bird Area, bird habitat corridor, contains at-risk wetland species, or relatively stressed fish habitat



Questions?

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