



# **The Floodplain Explorer**

**An Online GIS Tool  
for Floodplain Prioritization in the  
Mississippi River Basin**

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# The Problem

- The Mississippi R. basin no longer functions as a healthy system
- Widespread degradation, conversion, and hydrologic disconnection of natural floodplains
- Excess nutrient loading contribute to hypoxic conditions in Gulf & impaired local waters
- >\$50B in flood damage since ~1993



# (Part of) the Solution

- Floodplains have multiple benefits
  - Improving **water quality**
  - Supporting **fish** nurseries and **wildlife** habitat
  - Storing and conveying water to **mitigate flood damage**
- Protecting floodplain lands is **~2.5x cheaper** than anticipated property damage from flooding
- Resources are limited, and we must **target investments wisely**
- The **Floodplain Explorer** can help



# A Comprehensive U.S. Flood Model

- Based on high-precision terrain model
- Models flows based on thousands of USGS gaging stations + NOAA rainfall data
- Multiple return periods (1-in-5-year, -100-yr., -500-yr.)
- Explicit representation of Army Corps National Levee Database
- High validation rate against FEMA and USGS data
- No gaps!





# Floodplain Explorer Essentials

- Precision about **where** to work
- Transparency about **why** to work there
- Clarity about **how** to work there
- Key features:
  - Comprehensive **floodplain data**
  - Dynamic footprint of sites based on **multiple criteria**
  - Multiple spatial **scales**: basinwide, regional, local
  - Framework for building **locally relevant spinoffs**







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

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

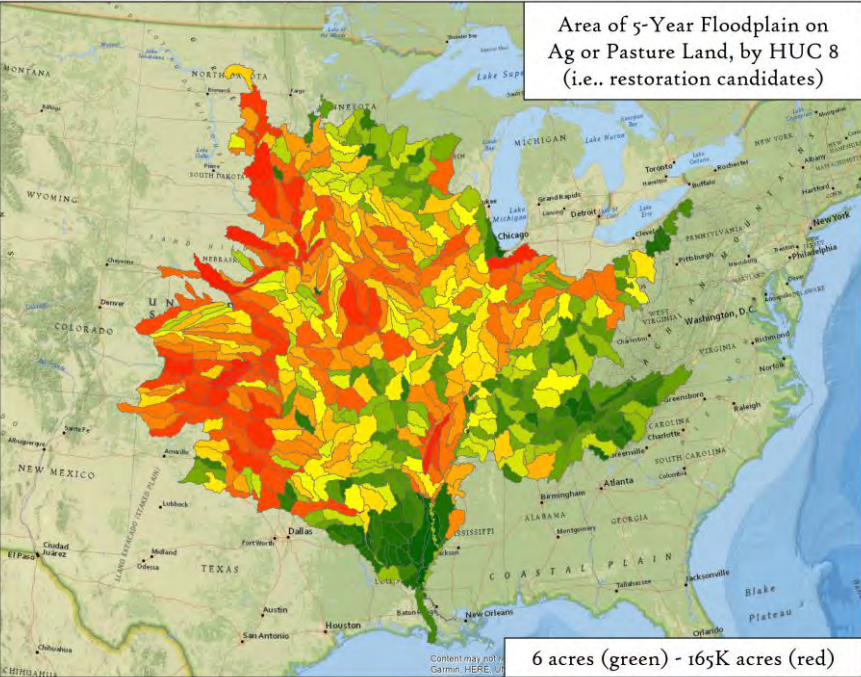
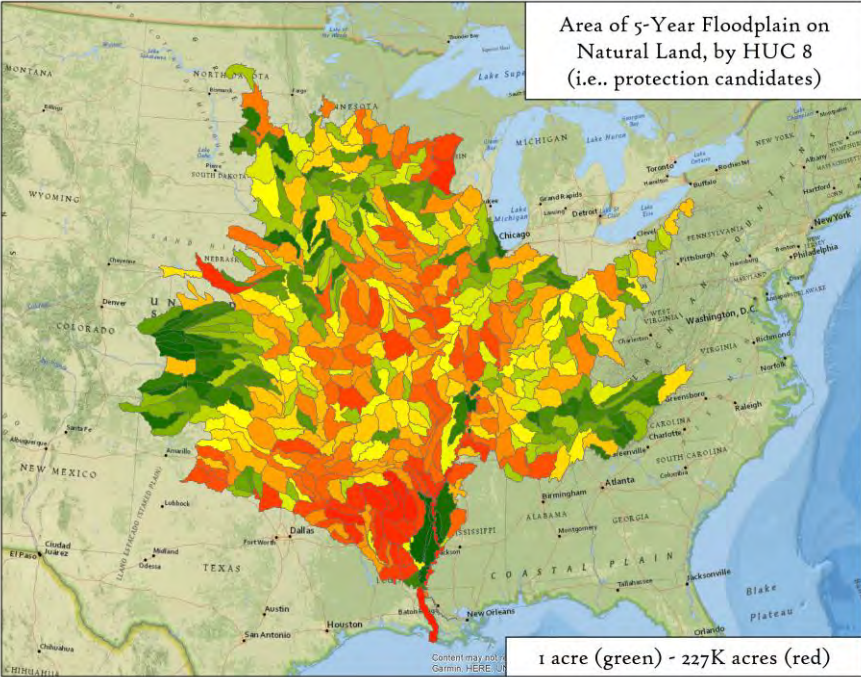
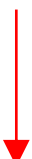
0 to 0.6

HOW MUCH FLOODPLAIN IS AVAILABLE FOR ...

Protection – In forest, wetland, or grassland



Restoration – In ag or pasture





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

Available Floodplain Area

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

Nutrients

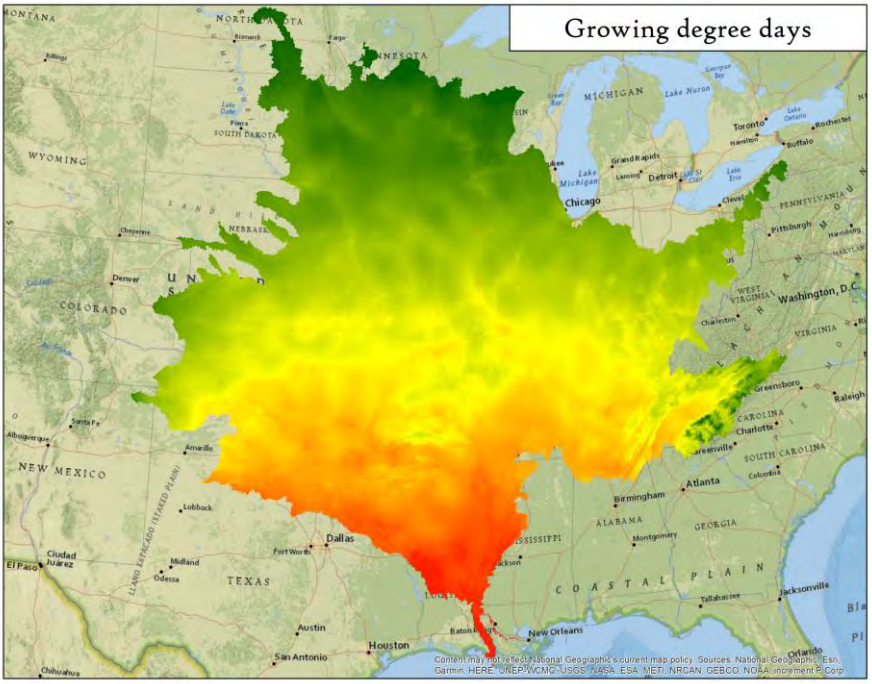
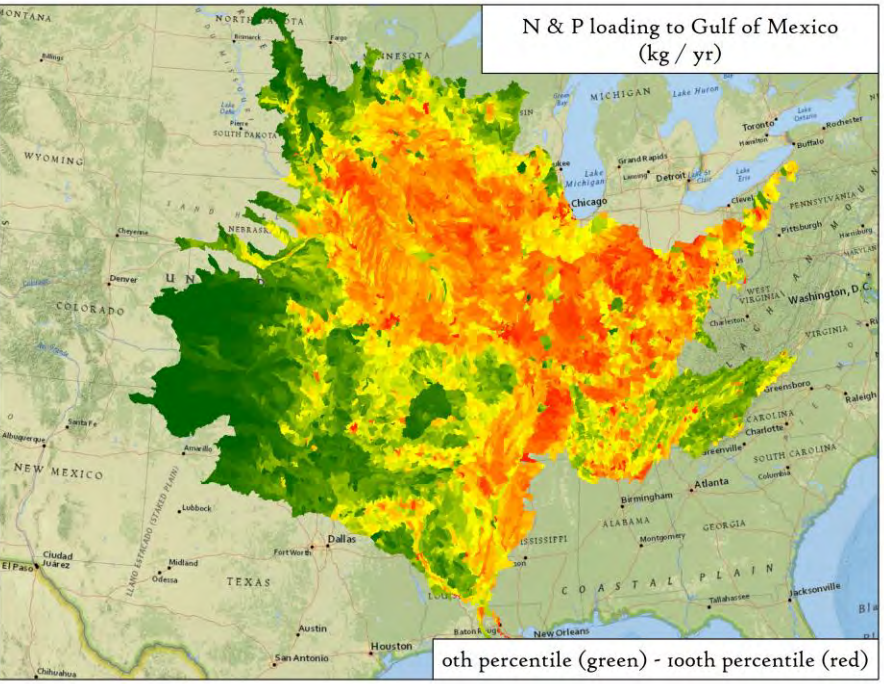
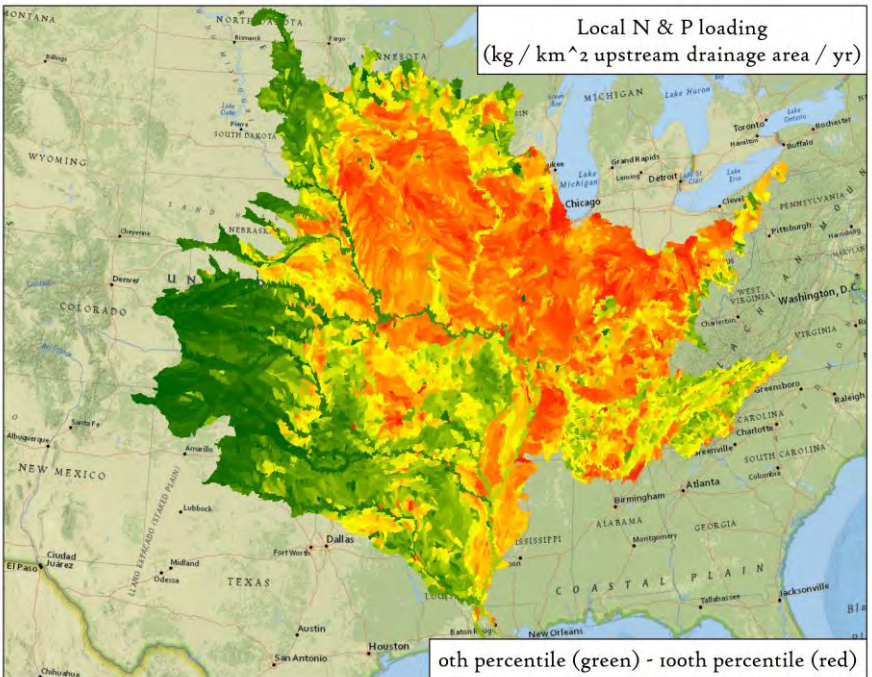
Local nutrient impact 50 to 100 %  
Nutrient contribution to the Gulf of Mexico 50 to 100 %  
Growing degree days 50 to 100 %

Land Conversion

Agricultural productivity potential of soils 0 to 0.6

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

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Select Management Action

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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 %

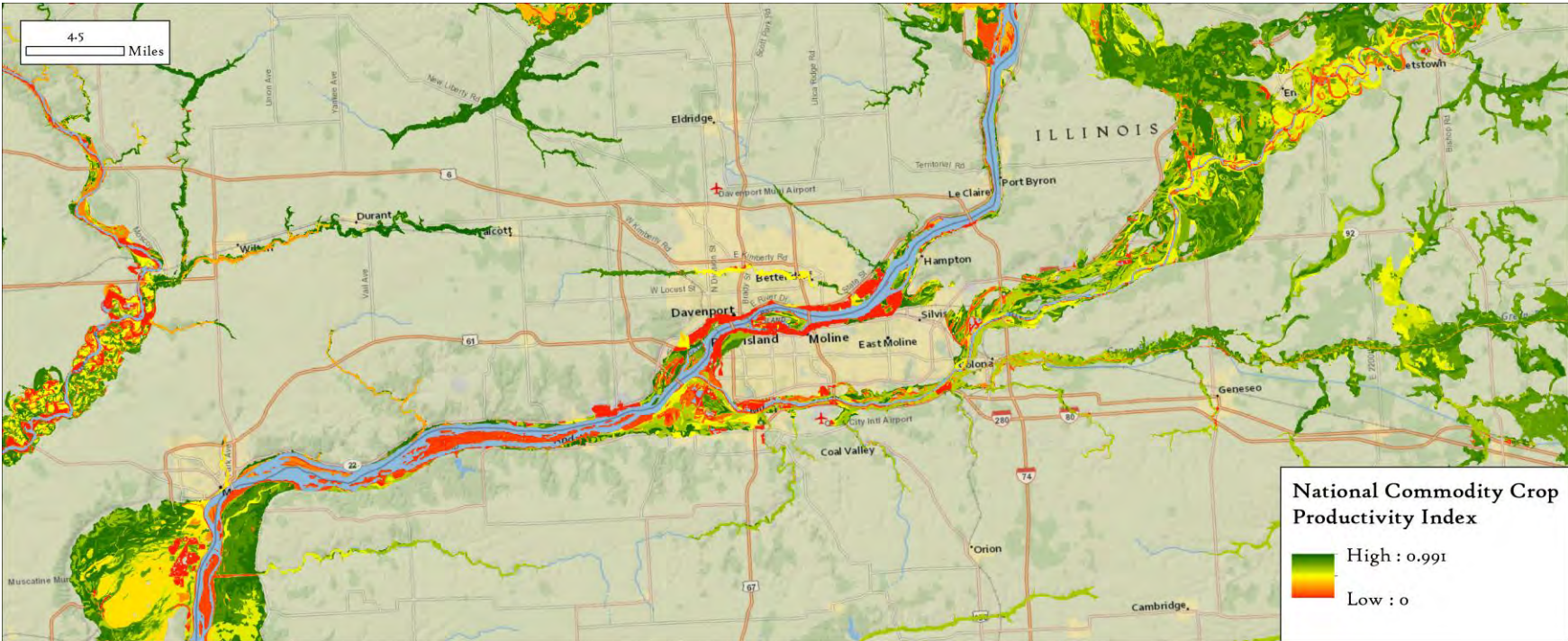
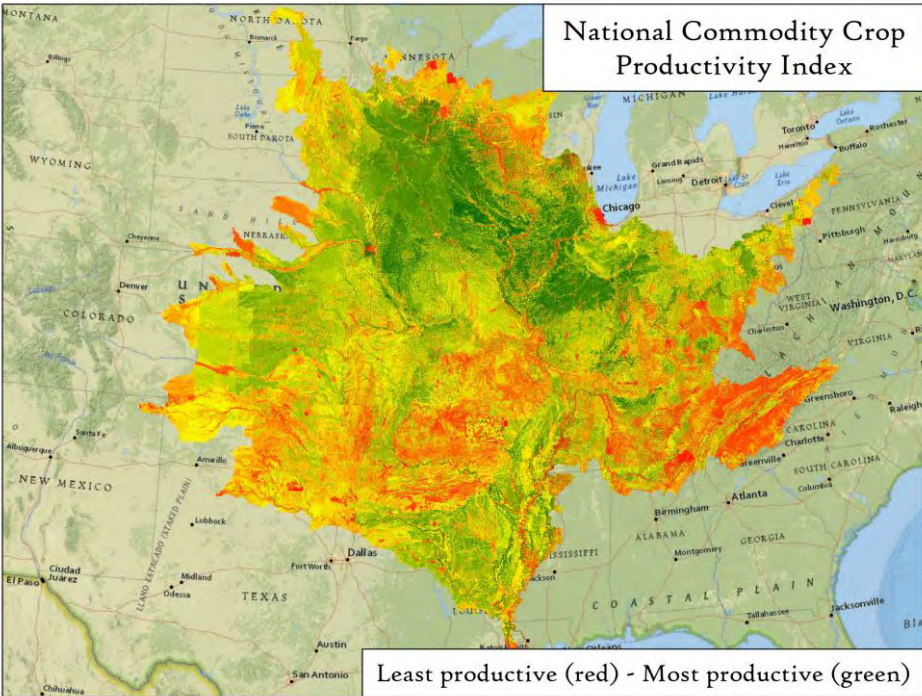
Land Conversion

☒ 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 desirable soils





**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**

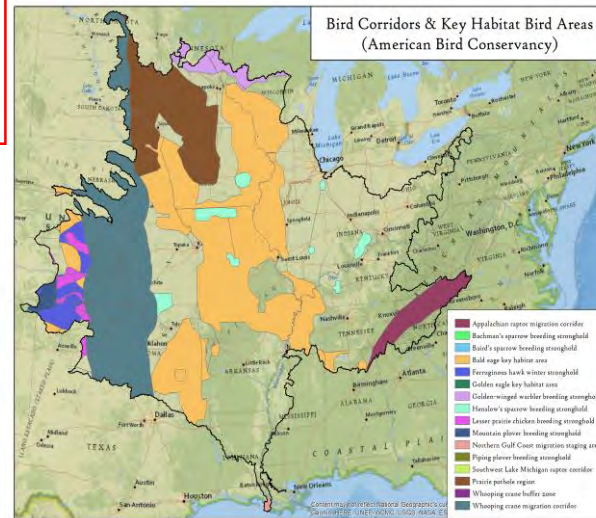
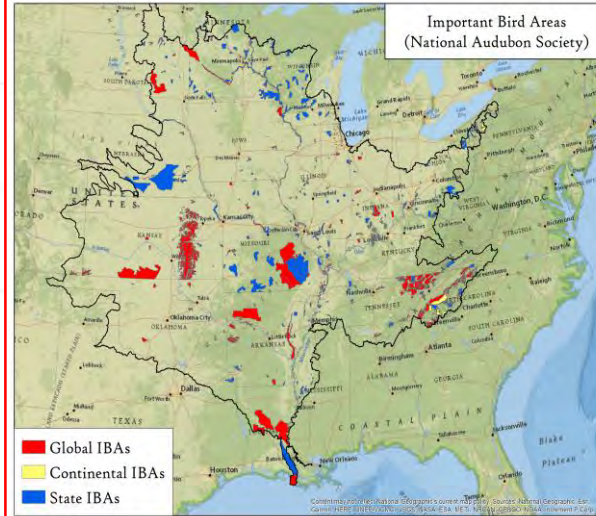
☐ Economic asset exposure (2050) (SSP2)

6 to 400

☐ Economic asset exposure (2050) (SSP5)

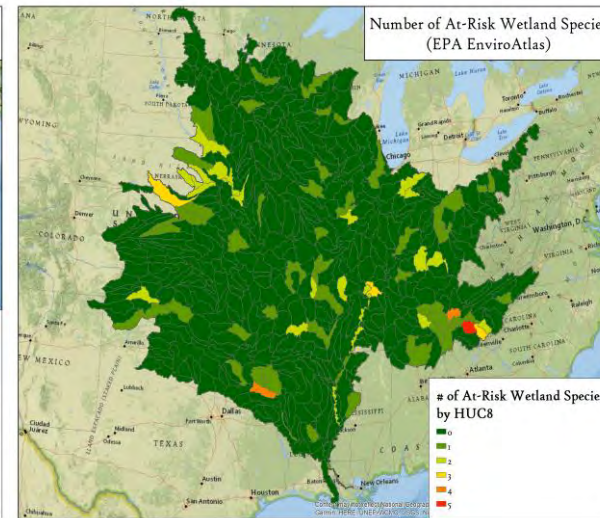
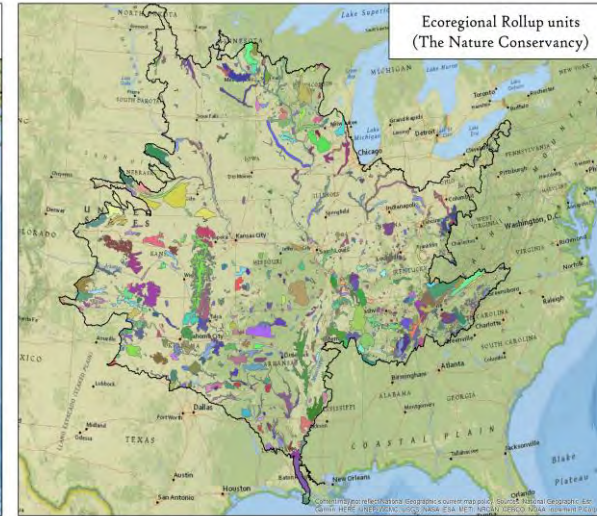
0 to 400

## Important Bird Areas (Audubon)



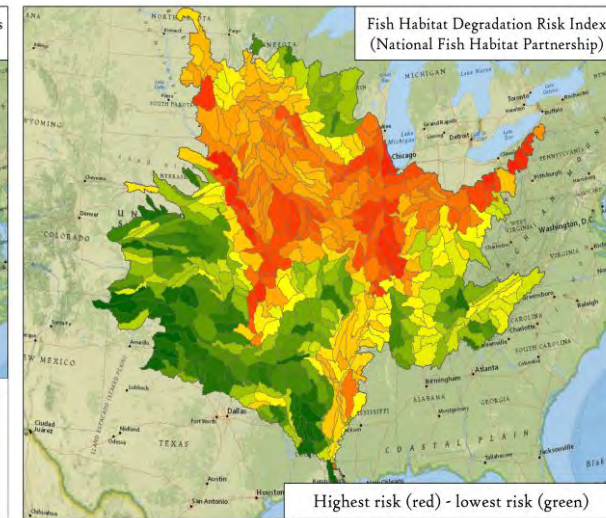
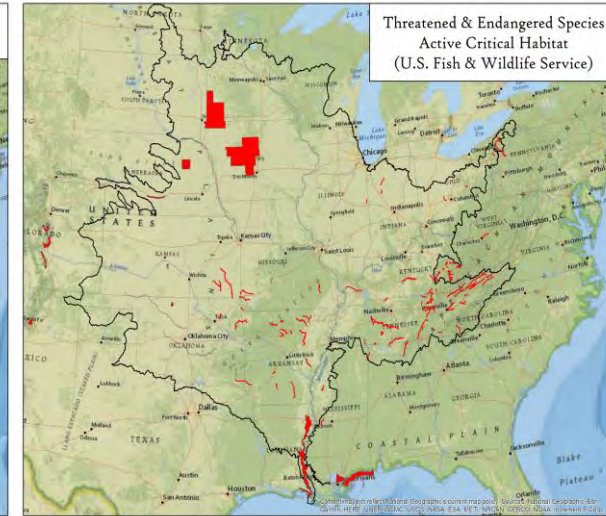
## Bird Corridors & Key Habitat Areas (American Bird Conservancy)

## TNC Ecoregional Rollup Units



## Number of At-Risk Wetland Species (EPA)

## USFWS Threatened & Endangered Species



## Fish Habitat Degradation Risk Index (NFHP)



# HUMAN EXPOSURE TO FLOODING ...

## 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 ☐

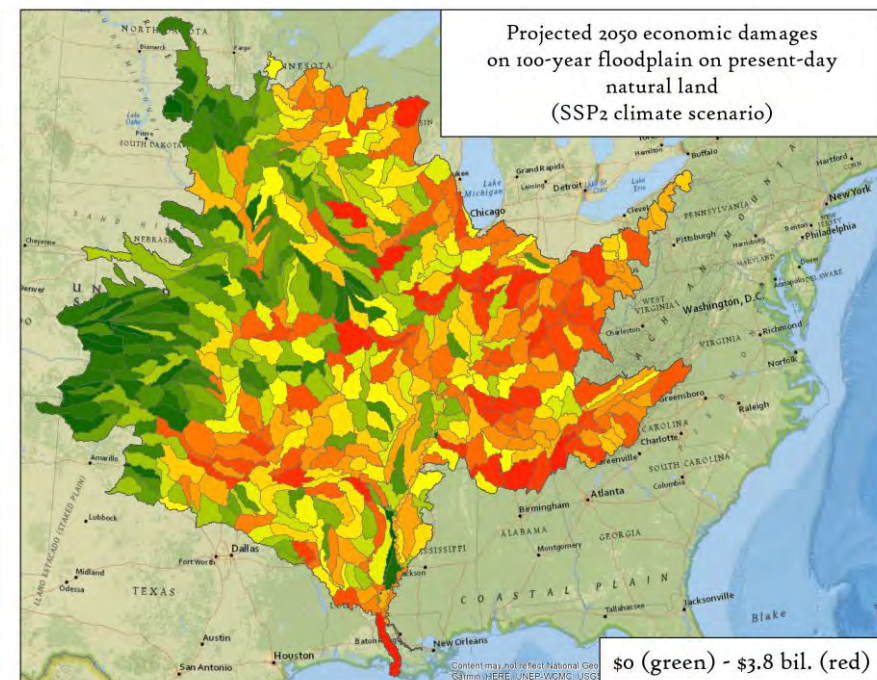
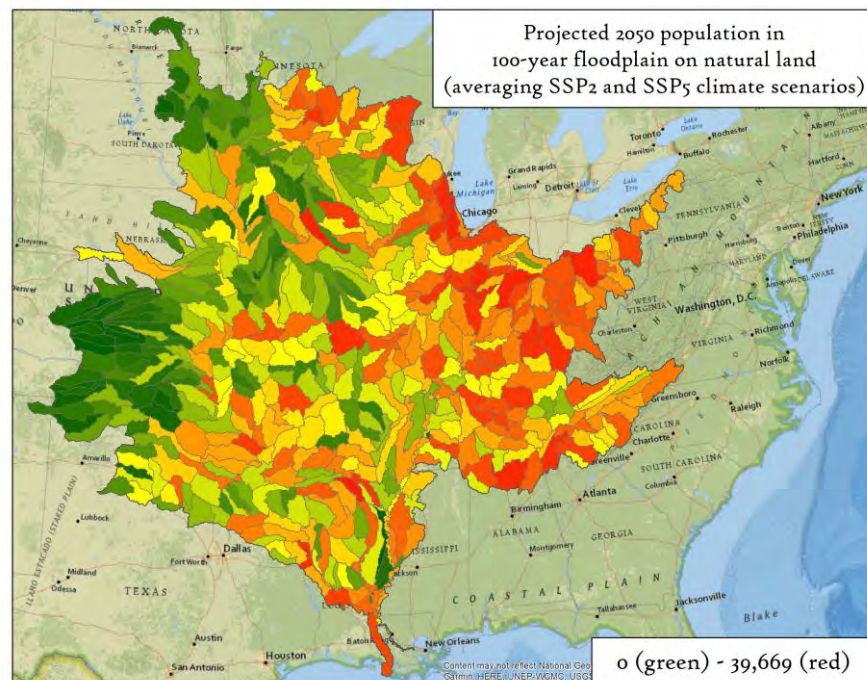
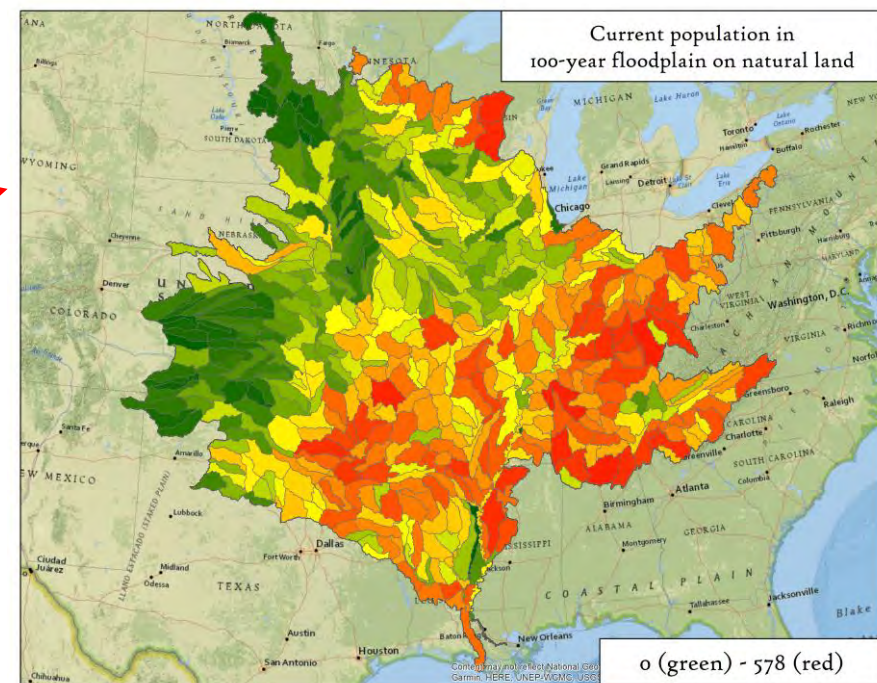
☐ Projected population (2050) ☒ 121 to 400 ☐

## Future Economic Asset Exposure

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

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

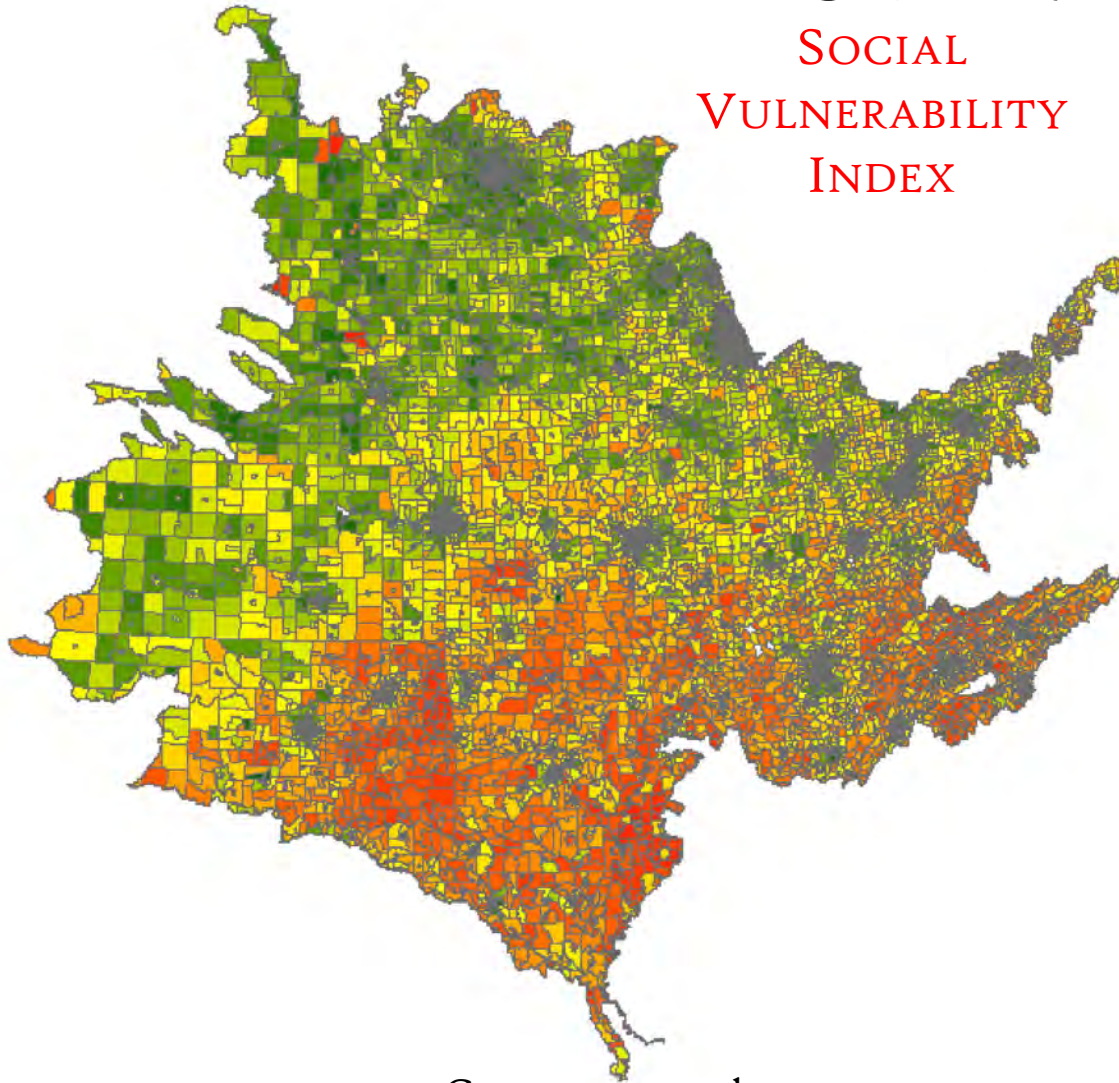
- Current population in the floodplain
- Future population (2050) in the floodplain
- Future property damage (2050) from flooding





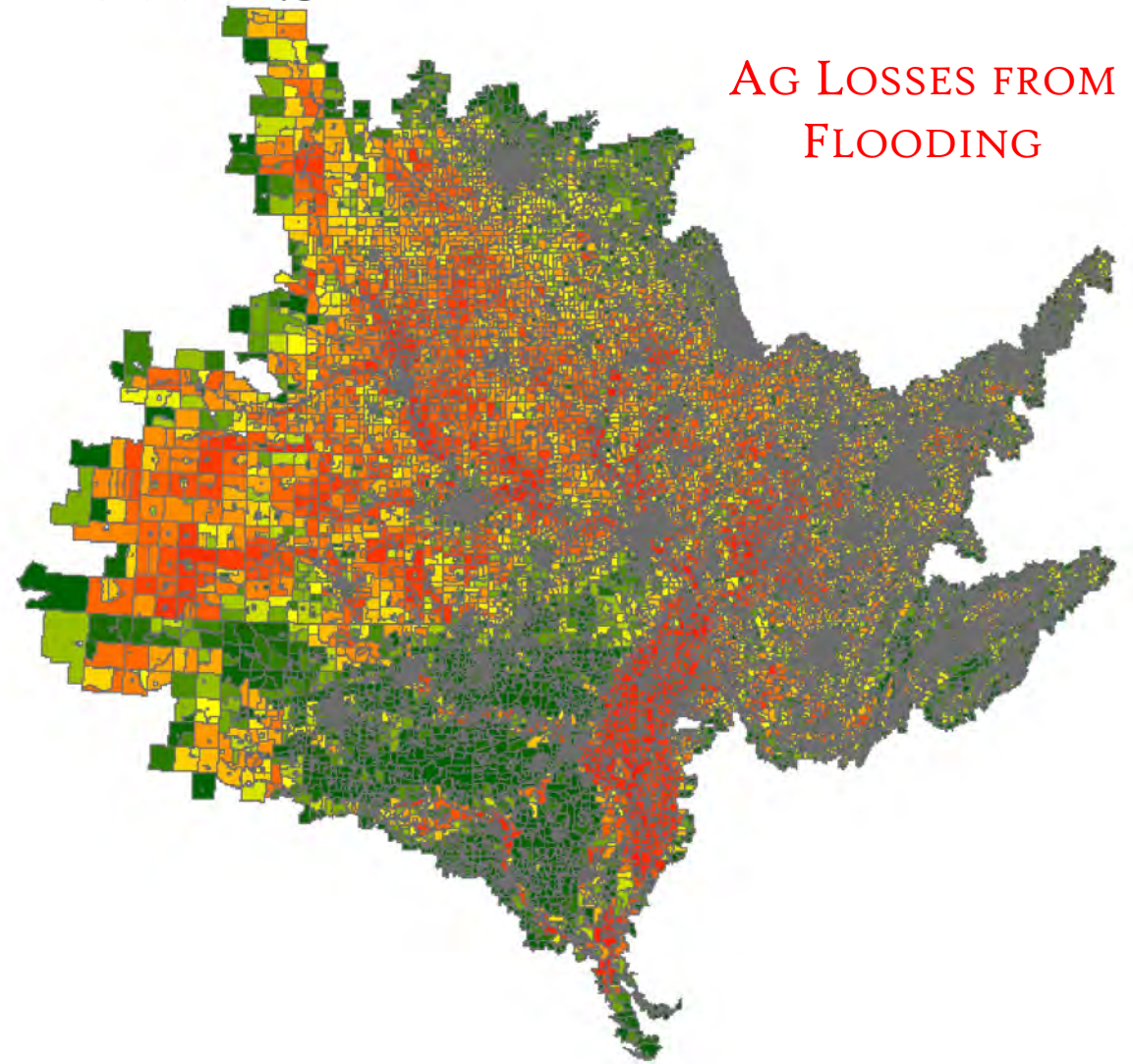
# OTHER RISK LAYERS

## SOCIAL VULNERABILITY INDEX



- Census tract scale
- Index of social vulnerability to disaster based on 22 variables from American Community Survey
  - E.g. **per-capita income**, % pop. **<20 and >64 yrs. old**, % **Native American**, % with **less than 12<sup>th</sup>-grade education**, % **Hispanic**, etc.

## AG LOSSES FROM FLOODING



- Census block group scale
- **\$ value of row-crop losses** assuming 100-year flood of 24 hrs. duration on June 1, modeled with HEC-FIA



## 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

### Available Floodplain Area

☒ Area of floodplain in agriculture or pasture land

25,000 to 60,000 acres

### Nutrients

☒ Local nutrient impact

50 to 100 %

☒ Nutrient contribution to the Gulf of Mexico

50 to 100 %

☒ Growing degree days

35 to 100 %

5-year floodplain in ag or pasture land totaling 1 million acres

### Criteria:

- At least 25,000 acres in watershed
- Top 50% for nutrient loading
- Top 65% for growing degree days

Flood frequency

Spatial scale

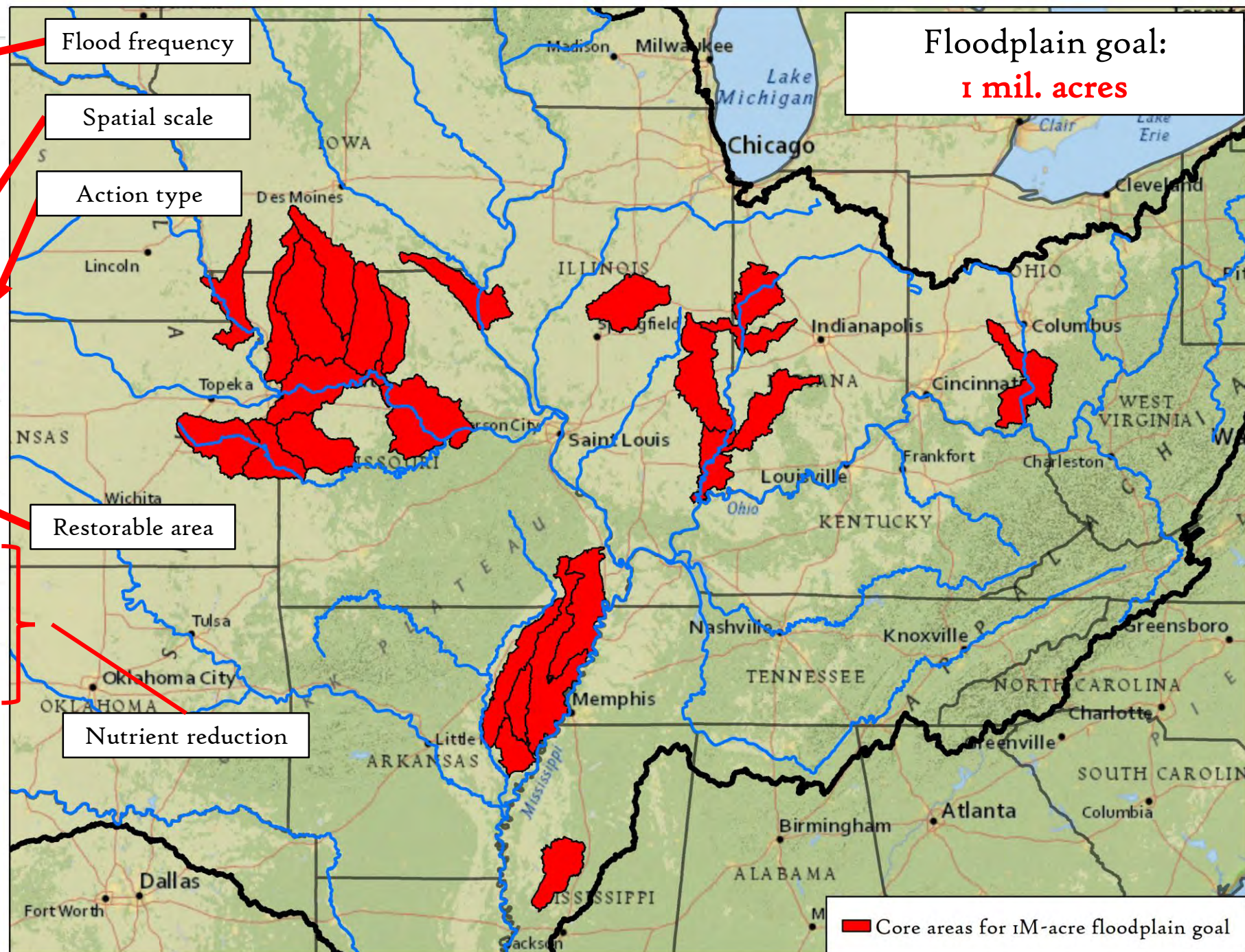
Action type

Restorable area

Nutrient reduction

Floodplain goal:  
1 mil. acres

Core areas for 1M-acre floodplain goal





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

Available Floodplain Area

Area of floodplain in agriculture or pasture land 6,200 to 60,000 acres

Nutrients

Local nutrient impact 60 to 100 %

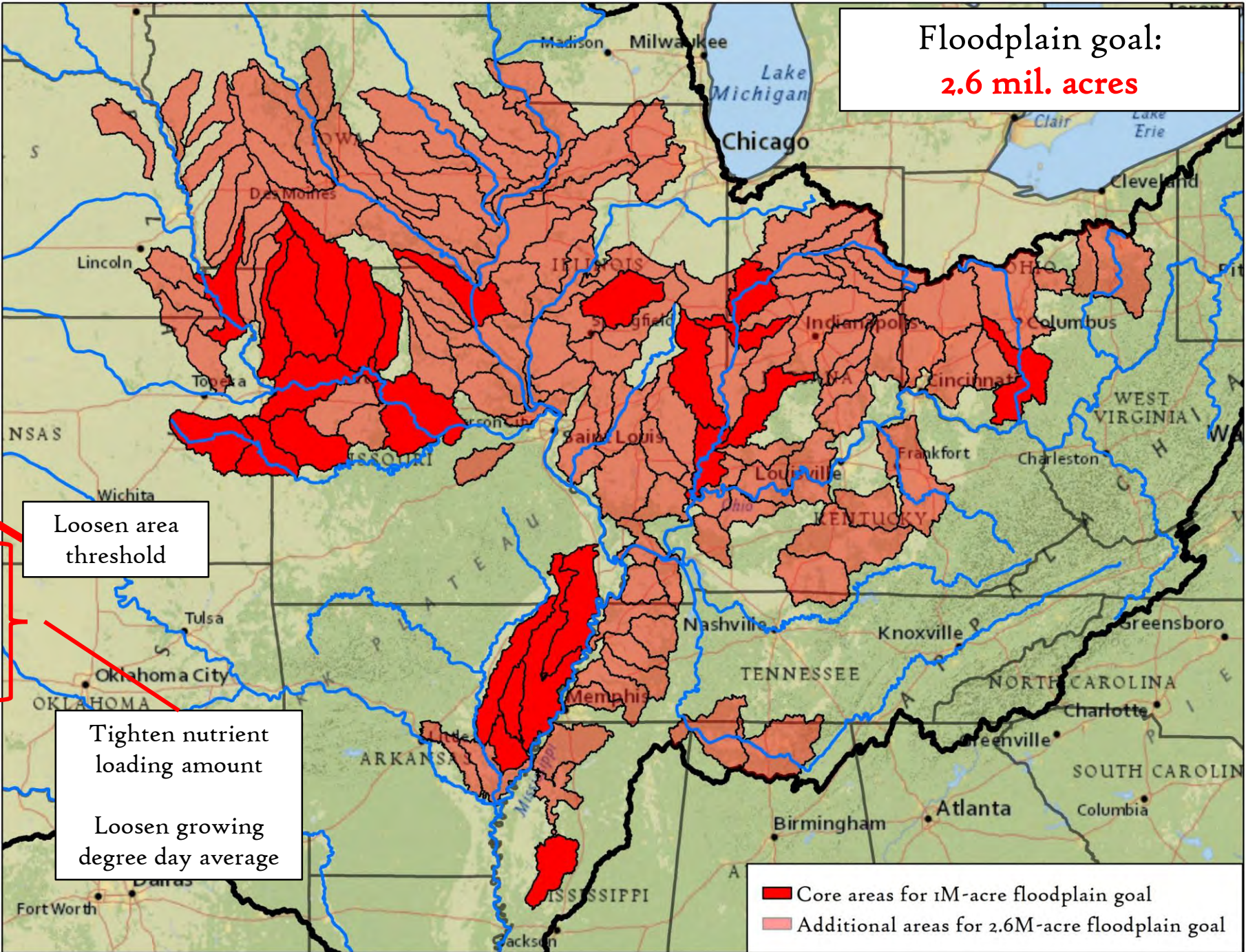
Nutrient contribution to the Gulf of Mexico 60 to 100 %

Growing degree days 15 to 100 %

5-year floodplain in ag or pasture land totaling 2.7 million acres

Criteria:

- At least 6,200 acres in watershed
- Top 40% for nutrient loading
- Top 85% for growing degree days





Available Floodplain Area

☒ Area of floodplain in agriculture or pasture land

6,200 to 60,000 acres

Nutrients

☒ Local nutrient impact

60 to 100 %

☒ Nutrient contribution to the Gulf of Mexico

60 to 100 %

☒ Growing degree days

15 to 100 %

Land Conversion

☒ Agricultural productivity potential of soils

0 to 0.8

Population Exposure

☐ Current population

0 to 150

☒ Projected population (2050)

1,000 to 6,000

Future Economic Asset Exposure

☒ Economic asset exposure (2050) (SSP2)

\$10M to \$200M

☐ Economic asset exposure (2050) (SSP5)

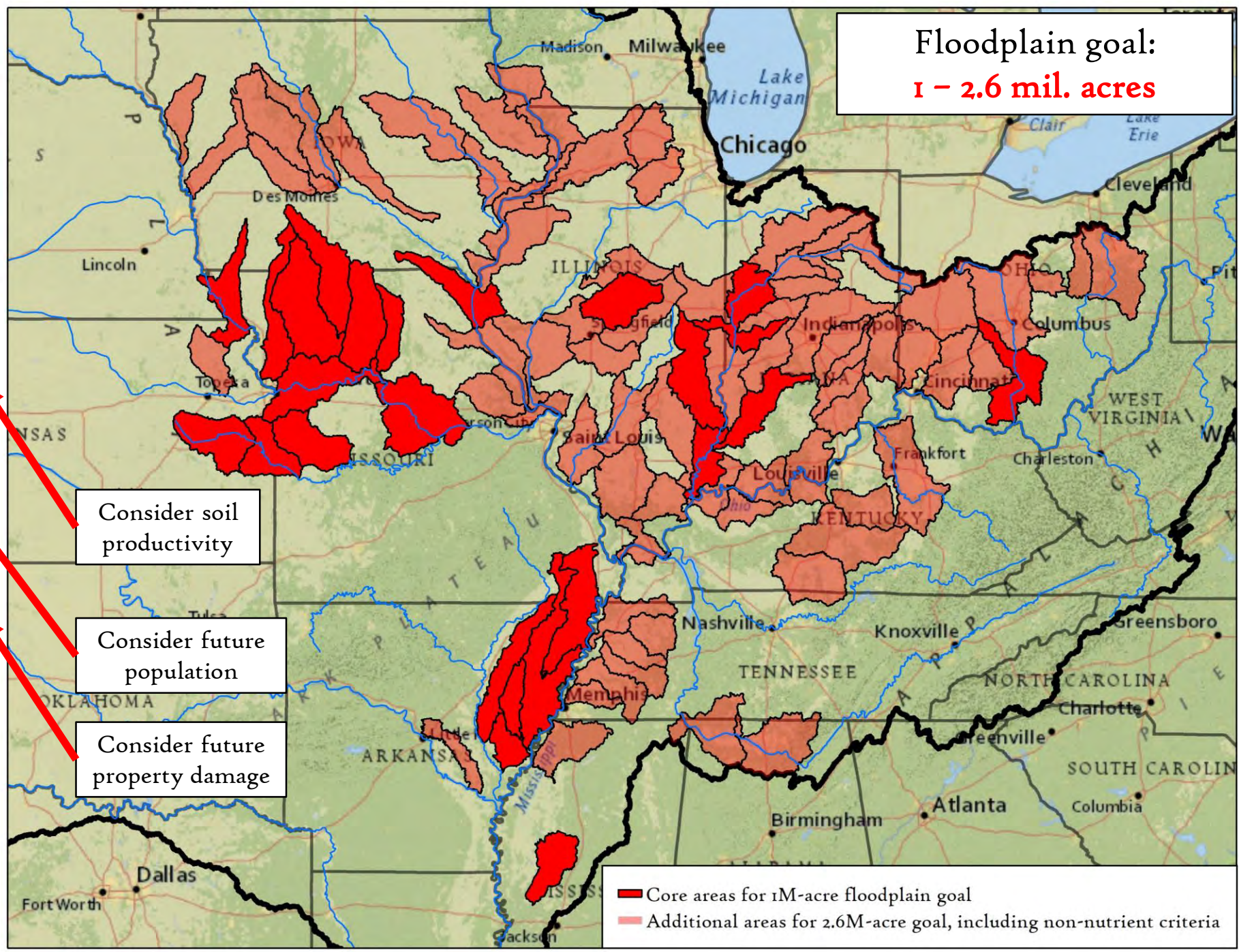
\$0 to \$200M

5-year floodplain in ag or pasture land totaling 1.8 million acres

Criteria:

- At least 6,200 acres in watershed
- Top 40% for nutrient loading
- Top 85% for growing degree days
- Soil productivity index  $\leq 0.8$
- 1,000+ ppl. in 5-yr. floodplain by 2050
- \$10M+ projected damage by 2050

Floodplain goal:  
1 – 2.6 mil. acres





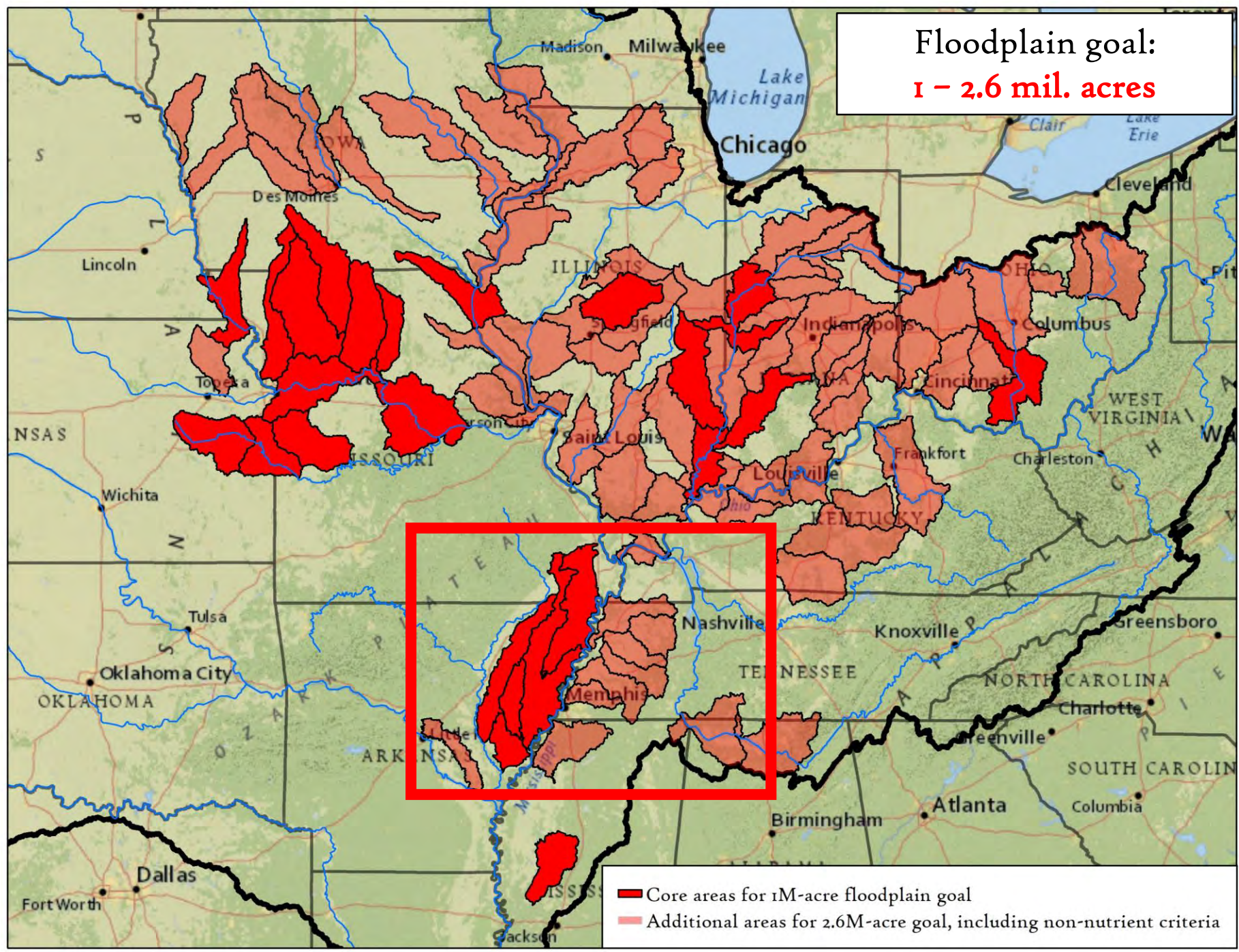
Available Floodplain Area



5-year floodplain in ag or pasture land totaling 1.8 million acres

Criteria:

- At least 6,200 acres in watershed
- Top 40% for nutrient loading
- Top 85% for growing degree days
- Soil productivity index  $\leq 0.8$
- 1,000+ ppl. in 5-yr. floodplain by 2050
- \$10M+ projected damage by 2050





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

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 %

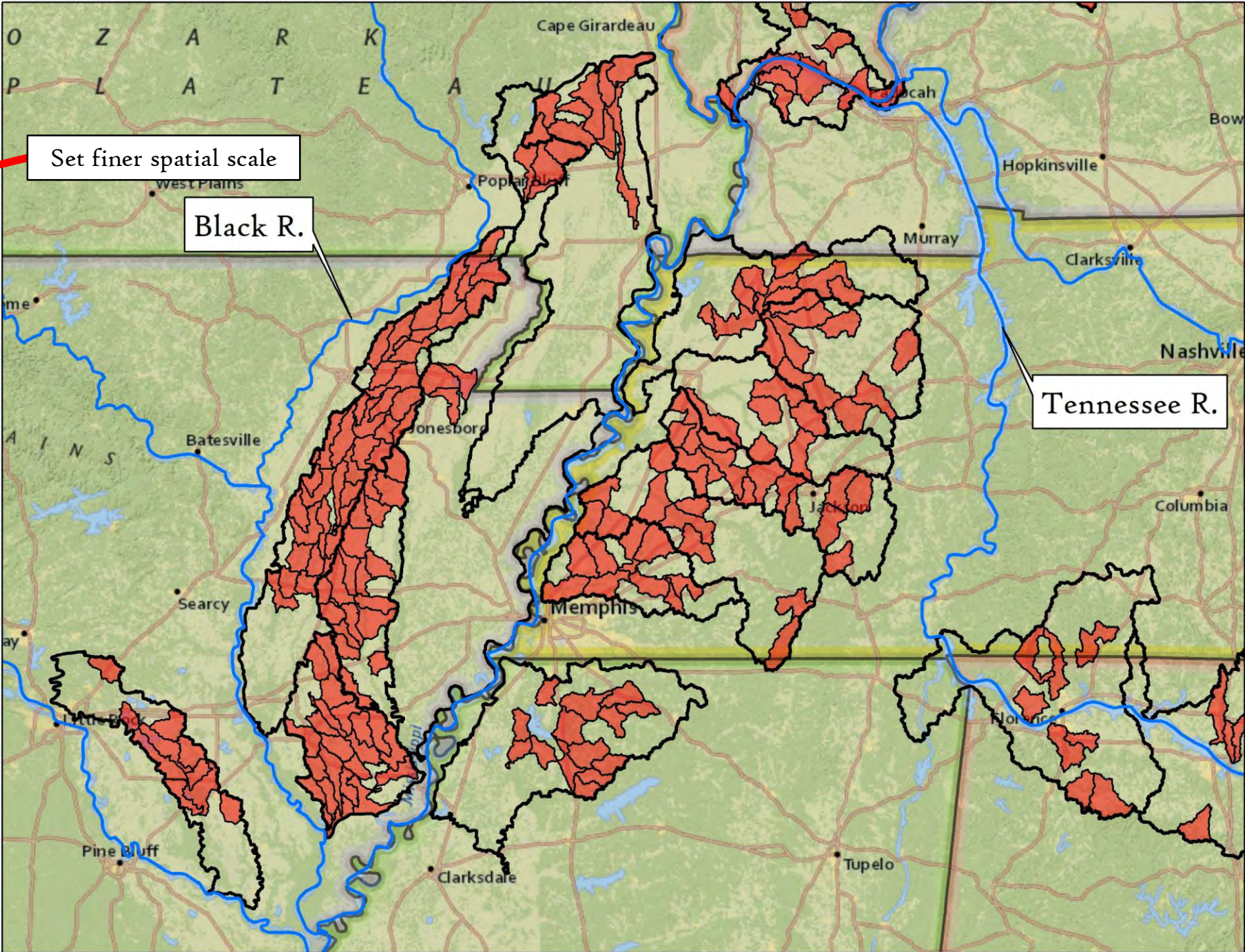
☒ Growing degree days

35 to 100 %

5-year floodplain in ag or pasture land totaling 340,000 acres

Criteria:

- At least 500 acres in watershed
- Top 50% for nutrient loading
- Top 65% for growing degree days





Available Floodplain Area

☒ Area of floodplain in agriculture or pasture land



Nutrients

☒ Local nutrient impact



☒ Nutrient contribution to the Gulf of Mexico



☒ Growing degree days



Land Conversion

☒ Agricultural productivity potential of soils



Population Exposure

☐ Current population



☒ Projected population (2050)

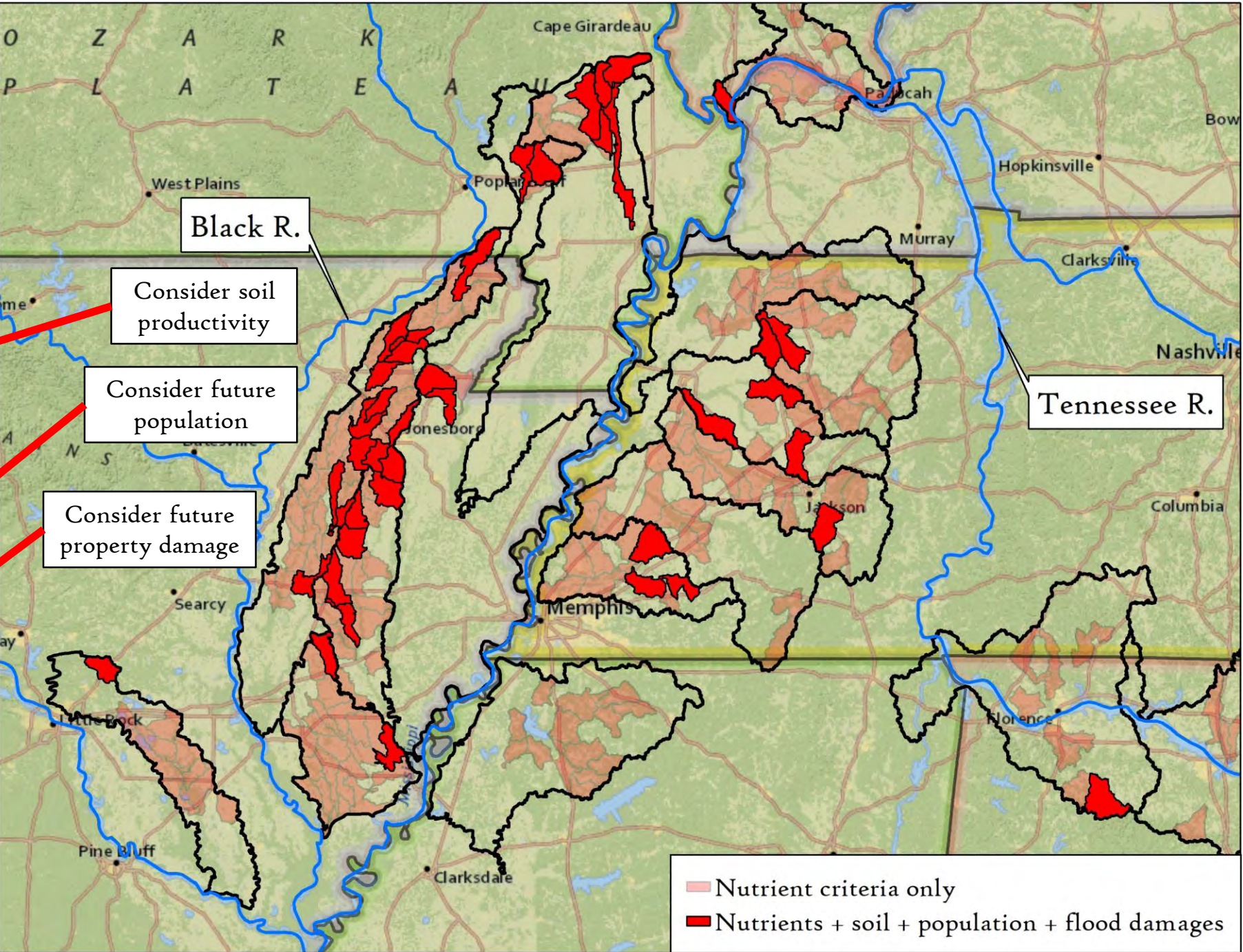


Future Economic Asset Exposure

☒ Economic asset exposure (2050) (SSP2)



☐ Economic asset exposure (2050) (SSP5)



5-year floodplain in ag or pasture land totaling 200,000 acres

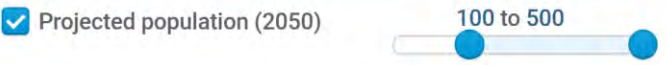
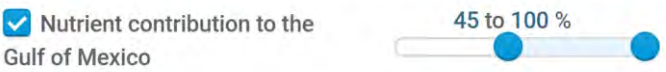
Criteria:

- At least 500 acres in watershed
- Top 50% for nutrient loading
- Top 65% for growing degree days
- Soil productivity index  $\leq 0.6$
- 100+ ppl. in 5-yr. floodplain by 2050
- \$10,000+ projected damage by 2050

Nutrient criteria only  
 Nutrients + soil + population + flood damages



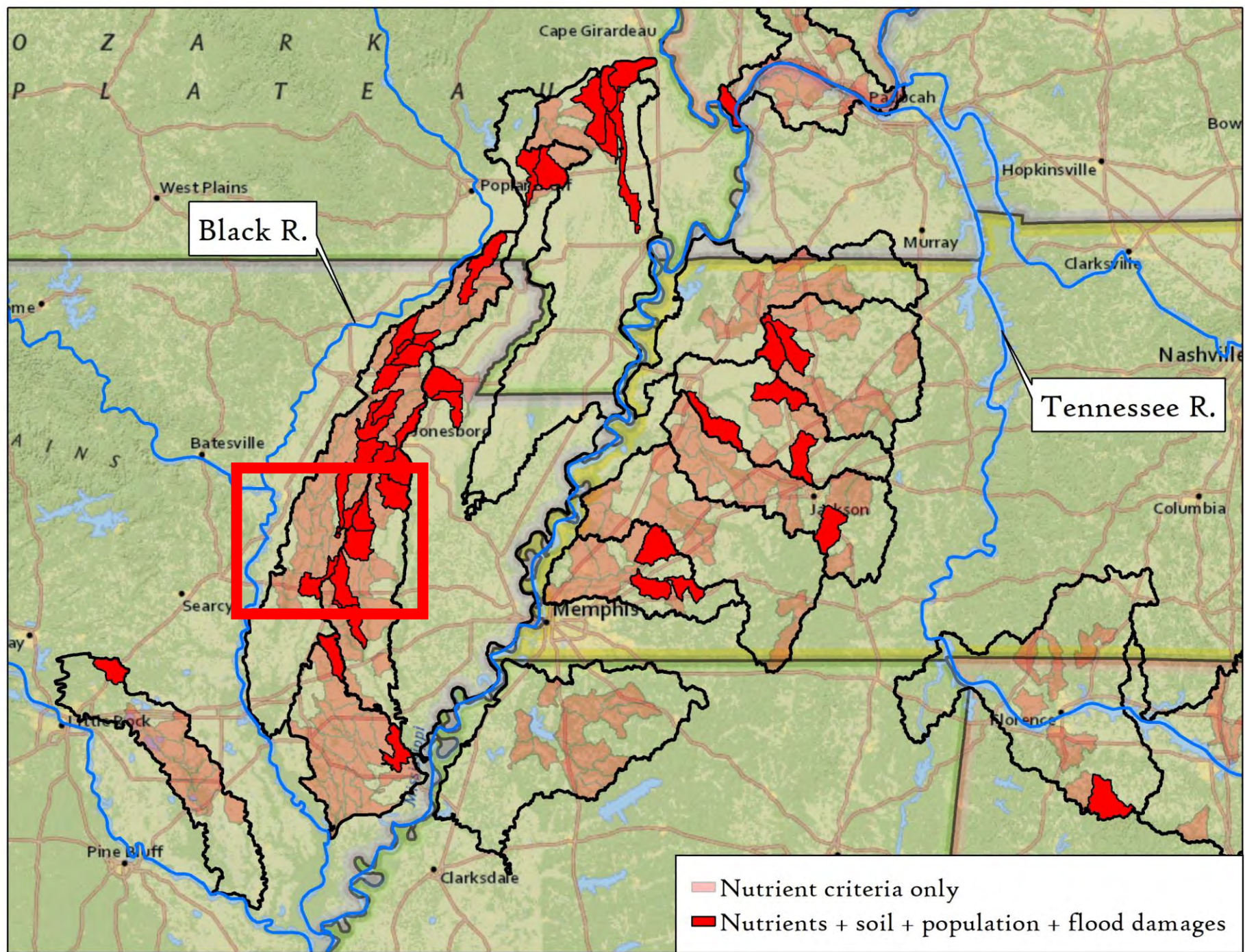
Available Floodplain Area



5-year floodplain in ag or pasture land totaling 200,000 acres

Criteria:

- At least 500 acres in watershed
- Top 50% for nutrient loading
- Top 65% for growing degree days
- Soil productivity index  $\leq 0.6$
- 100+ ppl. in 5-yr. floodplain by 2050
- \$10,000+ projected damage by 2050





## 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

### Available Floodplain Area

☒ Area of floodplain in agriculture or pasture land

250 to 25,000 acres

### Nutrients

☒ Local nutrient impact

50 to 100 %

☒ Nutrient contribution to the Gulf of Mexico

50 to 100 %

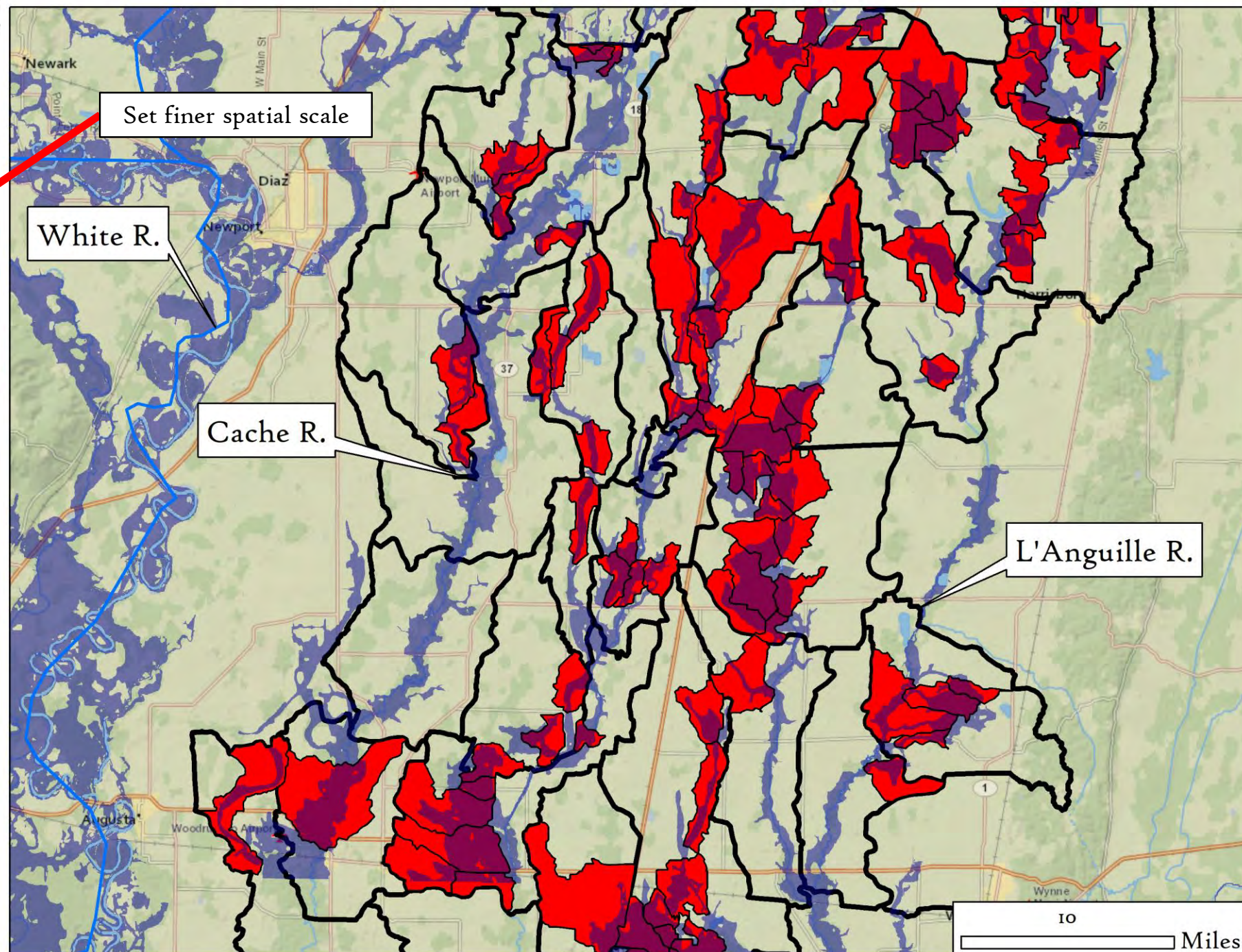
☒ Growing degree days

35 to 100 %

5-year floodplain in ag or pasture land totaling 44,000 acres

#### Criteria:

- At least 250 acres in watershed
- Top 50% for nutrient loading
- Top 65% for growing degree days





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 250 to 25,000 acres

Nutrients

☒ Local nutrient impact 50 to 100 %

☒ Nutrient contribution to the Gulf of Mexico 50 to 100 %

☒ Growing degree days 35 to 100 %

Land Conversion

☒ Agricultural productivity potential of soils 0 to 0.6

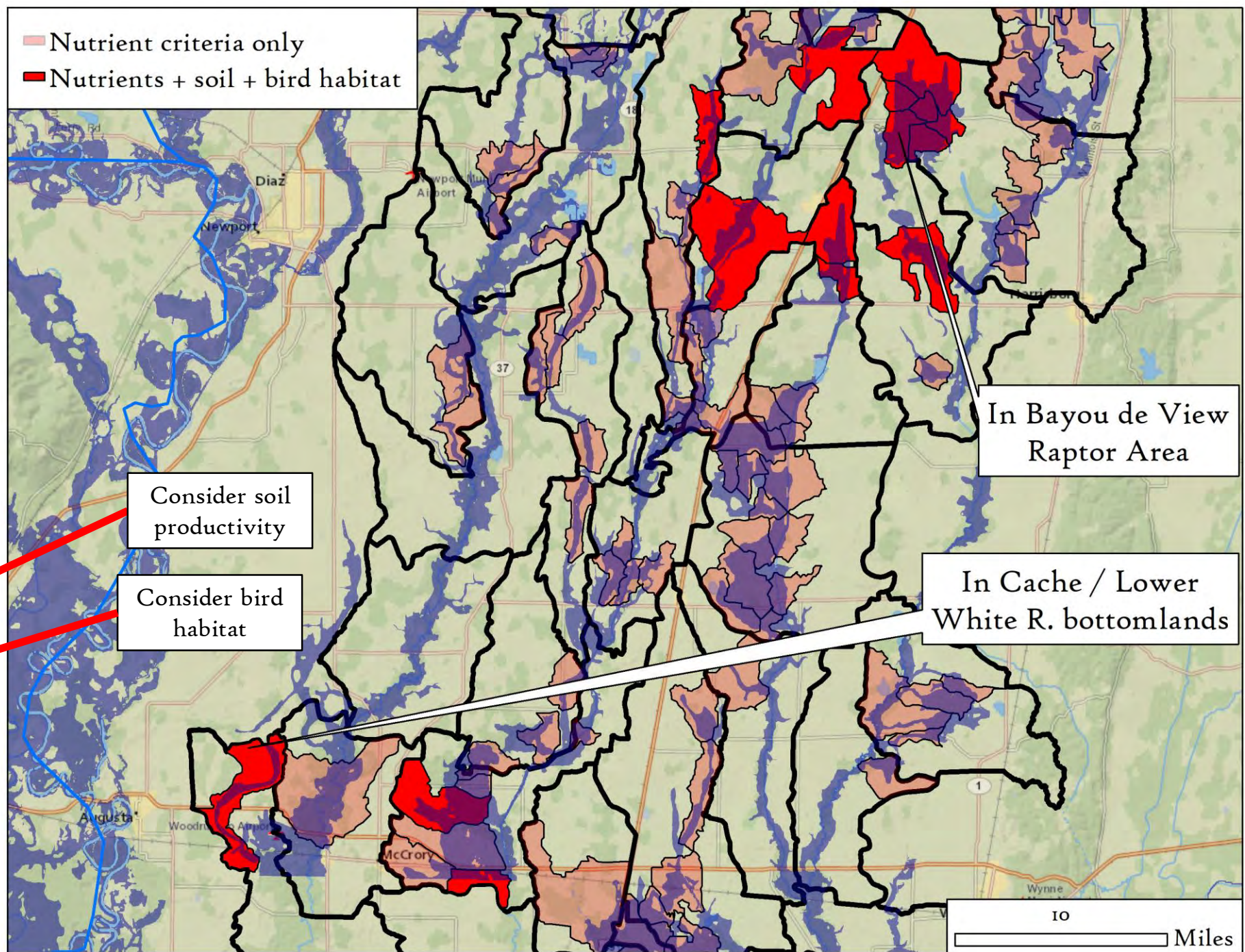
Habitat

☒ Important Bird Areas Present Absent

5-year floodplain in ag or pasture land totaling 44,000 acres

Criteria:

- At least 250 acres in watershed
- Top 50% for nutrient loading
- Top 65% for growing degree days
- Soil productivity index  $\leq 0.6$
- In an Important Bird Area





# UPCOMING DATA AND DEVELOPMENT

- This tool will be a “living” product, growing and changing as we work hand in hand with partners across the basin in floodplain conservation planning
- Updated data from USGS SPARROW model
- Places resilient to climate change
- Improved dataset of levee locations – beyond NLD, using remote sensing
- Estimate of C sequestration in floodplain
- Development of spinoff tools for local geographies – e.g. lower Meramec River in Missouri