CLFLWD
WATERSHED DISTRICT

Floodplain Vulnerability Assessment

Board Workshop

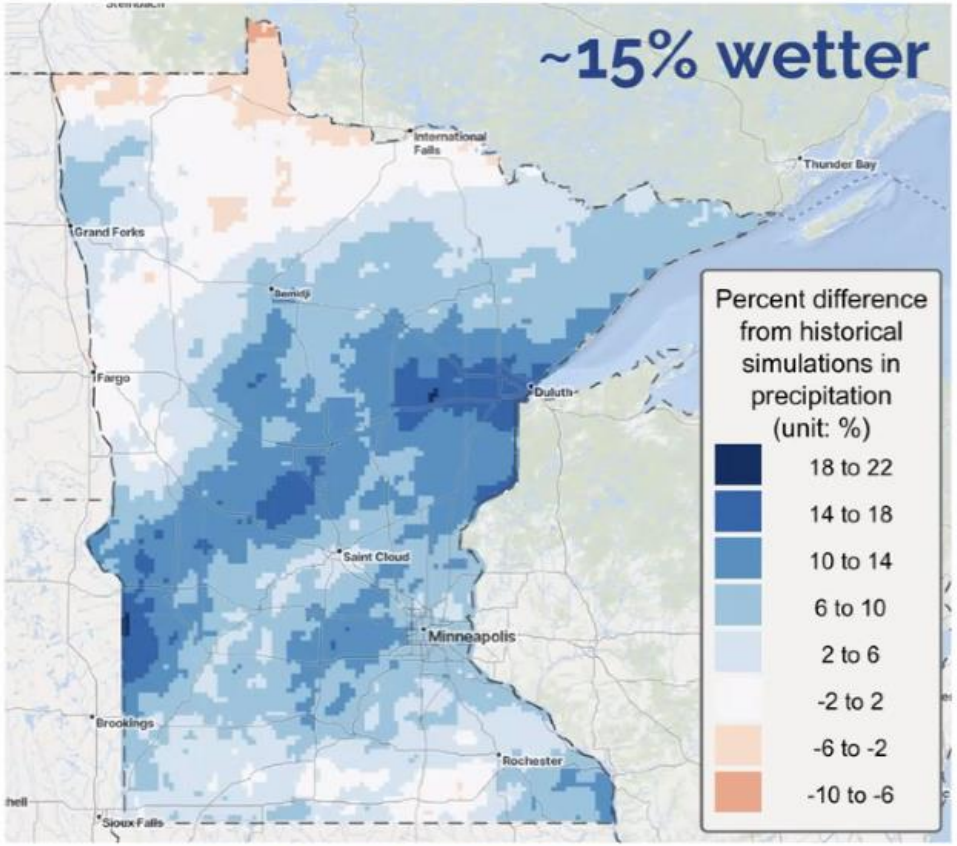
May 2, 3:30 pm

Sunrise River

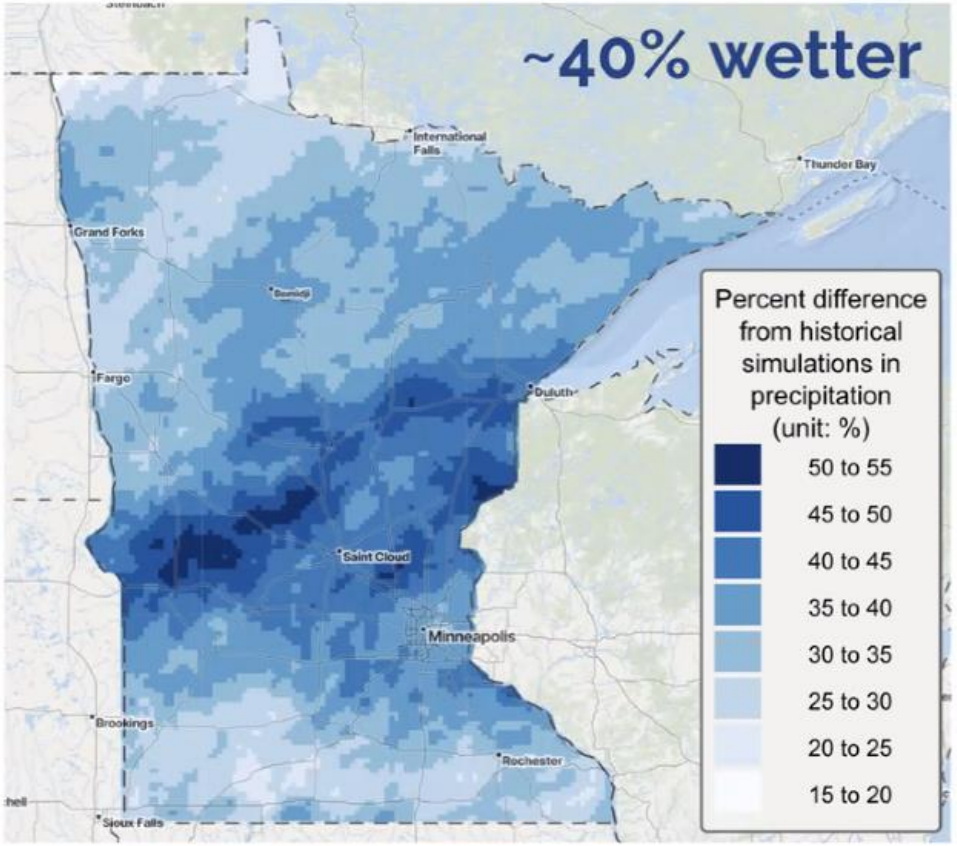
Climate change = wetter springs...

Average percent change in spring precipitation

Mid-century (2040-2059)



End-of-century (2080-2099)



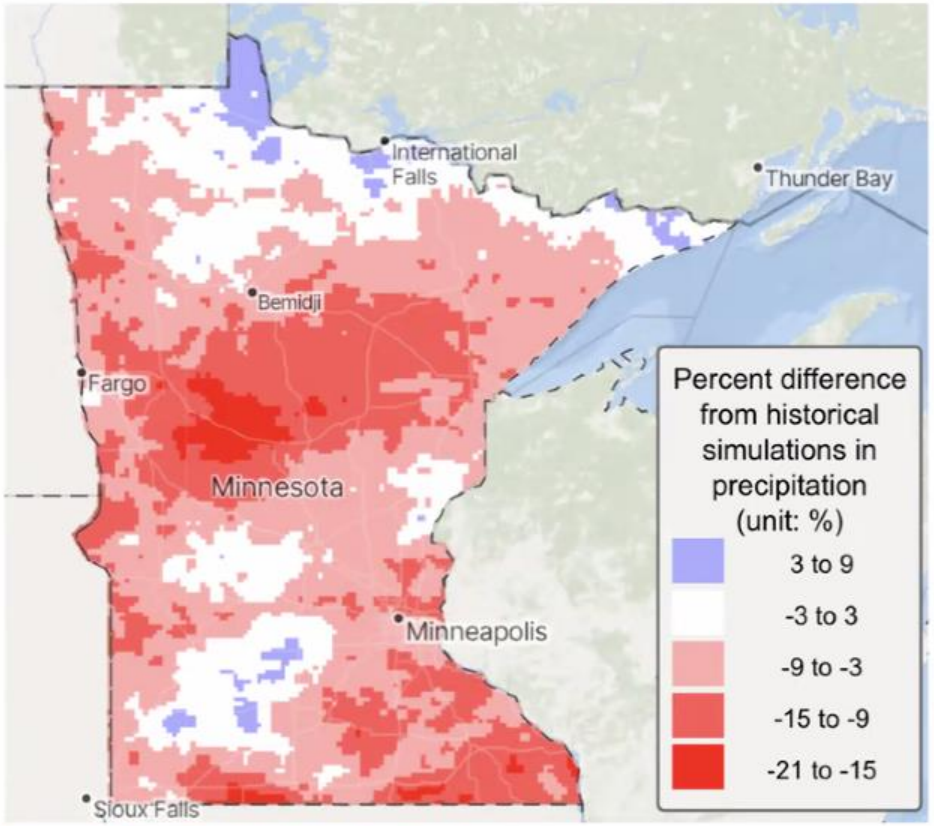
very high emissions (SSP585); relative to 1995-2014

Data: UMN Climate Adaptation Partnership, 2024

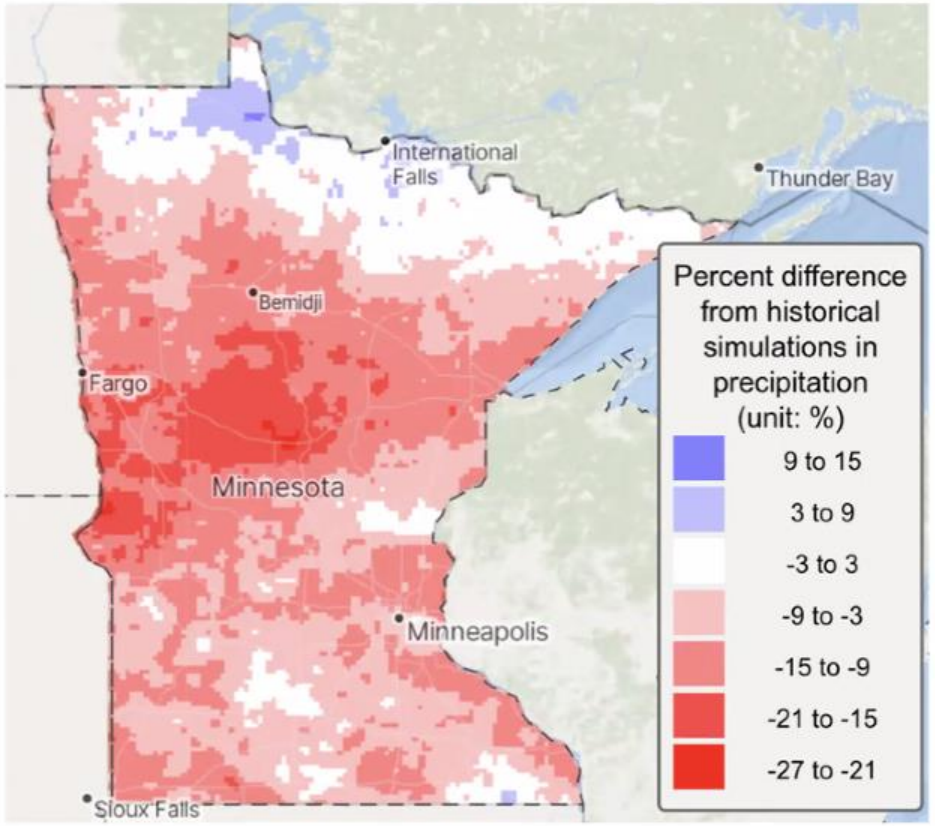
...and drier summers

Average percent change in summer precipitation

Mid-century (2040-2059)



End-of-century (2080-2099)



very high emissions (SSP585); relative to 1995-2014

Data: UMN Climate Adaptation Partnership, 2024

Minnesotans are concerned & want to see action

would like to see an **increase in the use of wind, solar, and other renewable energy** to power homes and businesses.

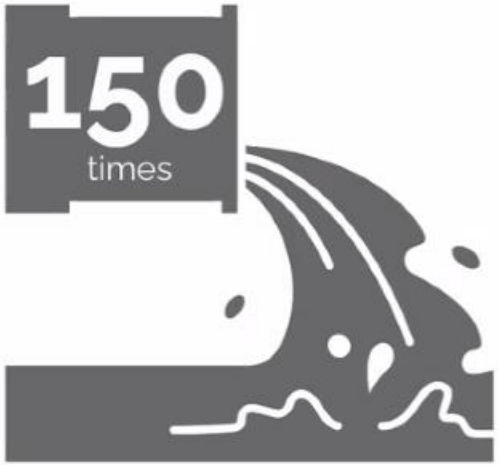
think we **should prepare for climate change** by preserving & conserving our state's **grasslands, forests, and wetlands**.

think **local, state and municipal governments are responsible** for addressing climate change in the state.

Source: UMN MCAP, CFANS, Caravan Climate Opinion Poll, Sept. 2022

Today's Extremes Bring Risks & Costs to Minnesotans

Wastewater overflows into Minnesota lakes & streams



on average per year due to wet weather

Current flood risks threaten

29,000
miles of roads

13,000
residential properties

across Minnesota.

Extreme weather events have caused insurance premiums to increase

across Minnesota since 1998

Insurance Federation of Minnesota, MPCA, 2024, NCA5, 2023

Adaptation Is Essential. Many Actions Bring Co-Benefits.

For every dollar **invested in natural climate solutions practices, Minnesota would receive**

$8.55

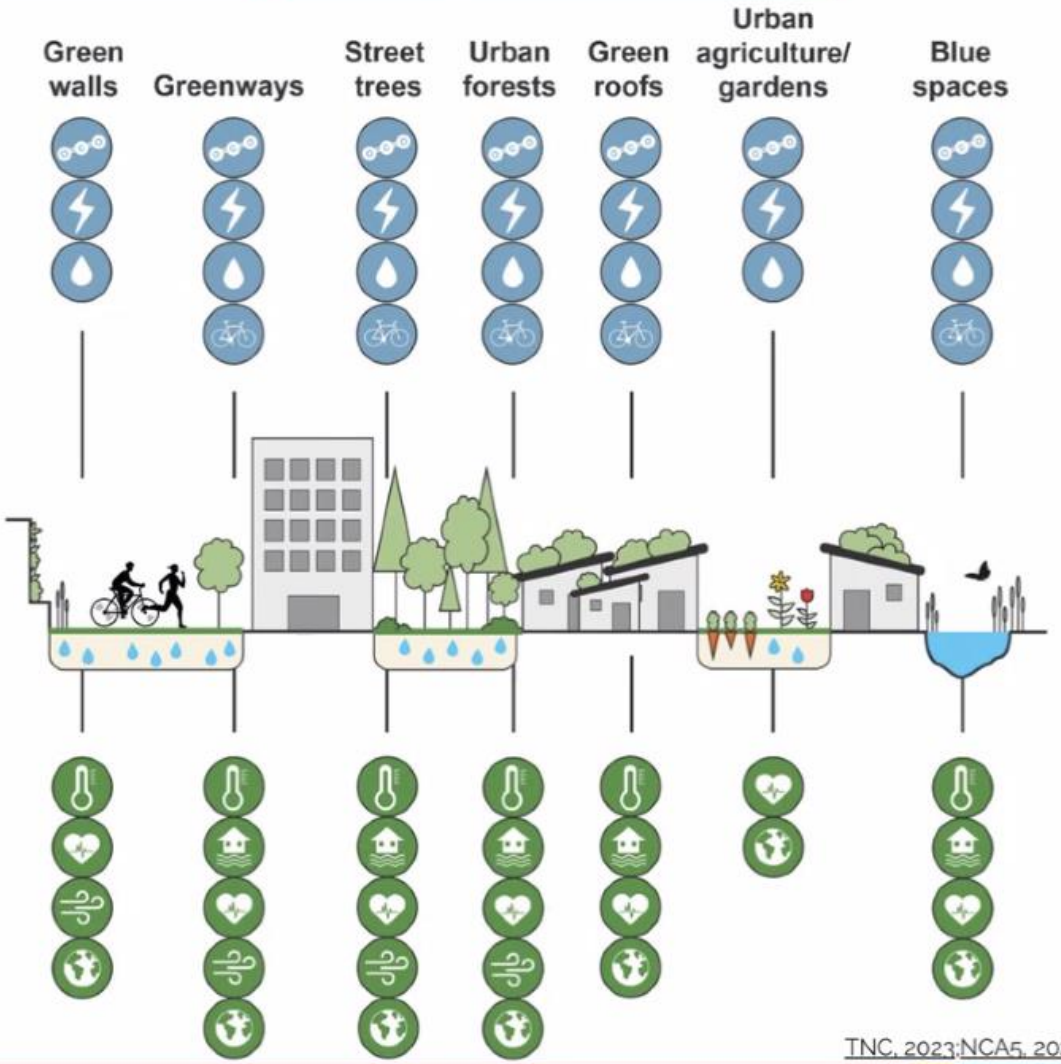
in public benefits by 2050

Mitigation benefits

- Sequester and store carbon
- Reduce building energy use
- Reduce municipal water use
- Facilitate active mobility

Adaptation co-benefits

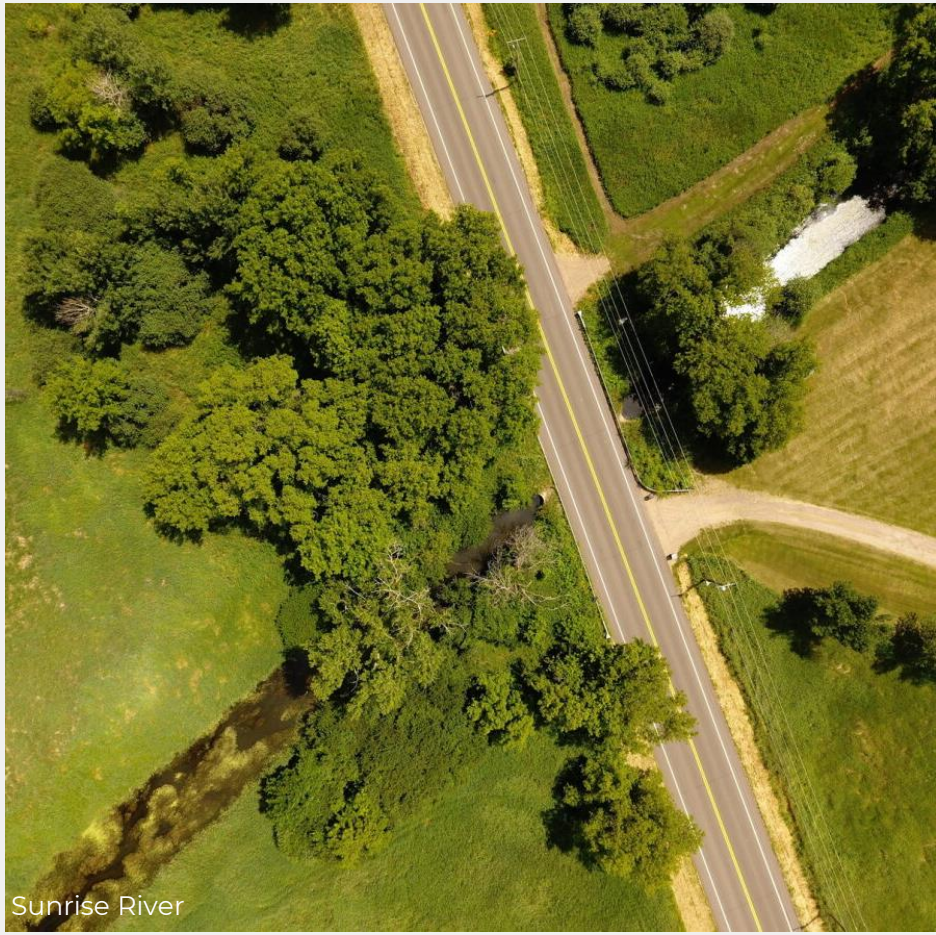
- Reduce heat stress
- Reduce flooding
- Improve health
- Improve air quality
- Promote biodiversity



TNC, 2023; NCA5, 2023

Introduction

- **CLFLWD Mission:** protect and improve its water resources through adaptive management and education of local stakeholders.
- **Priorities:** WMP, Section 2.3.2
  - Primary Issues – Lake water quality, stream water quality, and floodplain management
  - Secondary Issues – Wetlands, upland habitat, and groundwater
- **Floodplain Goals:**
  - Add 99 acre-feet of storage
  - Improve community preparedness and emergency response capacity to flooding by sharing modeling and mapping w/ communities


Sunrise River

Introduction

Assessment Purpose:

- Help target WHERE to add the needed 99 acre-feet and implement other mitigation strategies
- Help identify WHO/HOW to build community preparedness
- Inclusive process will build trust in the community and strengthen partnerships; CLFLWD is local technical expert/resource

Course

Level of Detail

Fine

Flood Hazard Mapping

Where the water collects.

Flood Vulnerability Mapping

Compare where water collects vs. who/what is impacted by that (evaluate infrastructural, social and environmental features in the CLFLWD). Establish CLFLWD priorities and compare to community priorities.

Flood Vulnerability Modeling

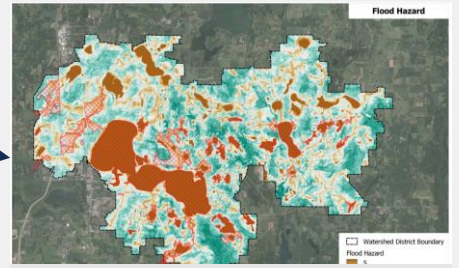
Dig deeper – what are the chokepoints in the system. Present results to community, identify blind spots, and get buy-in.

Project ID/Ranking

What do we do about the issues identified above?

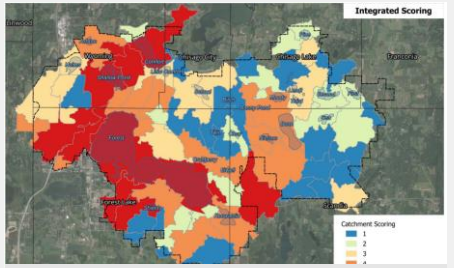
Refine w/ input from Community Engagement

Result



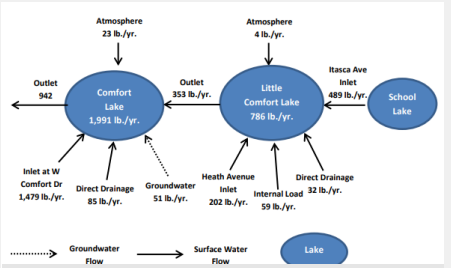
Flood Hazard Map

Result



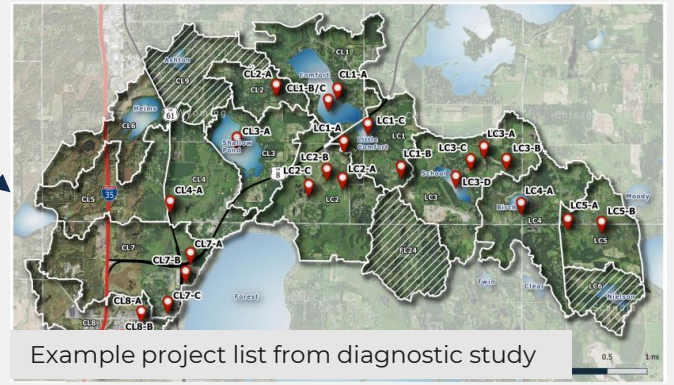
Integrated Scoring Map

Example



Example loading diagram from diagnostic study

Example



Example project list from diagnostic study

Assess Progress

Design

Implement projects & practices w/ partnerships using adaptive mgmt. approach

Implement

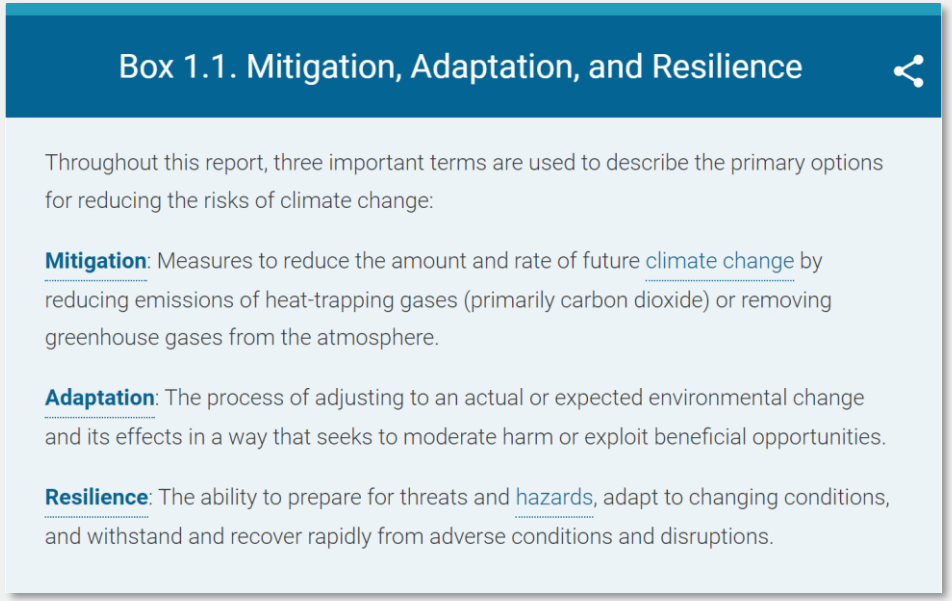
Monitor

Evaluate

Vulnerability Assessments

Why Conduct a Flood Vulnerability Assessment?

- Our climate is changing
- These changes have an impact on our infrastructure, people and the environment
- To become more resilient in the face of climate change, we need to adapt
- Adaptation requires collaboration with communities to identify goals, assess vulnerability, improve capacity, and address contextual factors, such as values, culture, risk perception, and historic injustices



Box 1.1. Mitigation, Adaptation, and Resilience

Throughout this report, three important terms are used to describe the primary options for reducing the risks of climate change:

Mitigation: Measures to reduce the amount and rate of future climate change by reducing emissions of heat-trapping gases (primarily carbon dioxide) or removing greenhouse gases from the atmosphere.

Adaptation: The process of adjusting to an actual or expected environmental change and its effects in a way that seeks to moderate harm or exploit beneficial opportunities.

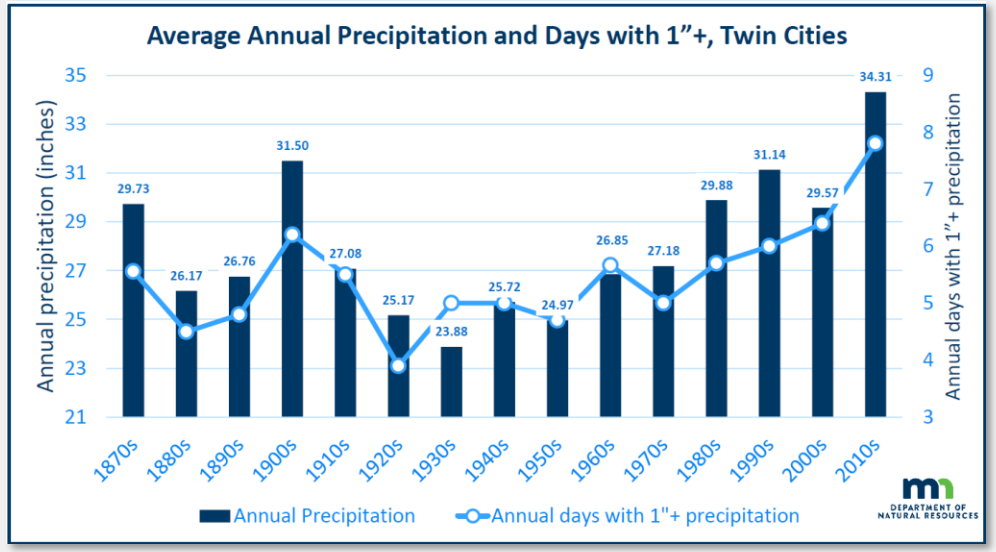
Resilience: The ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions.

Source: 5th National Climate Assessment

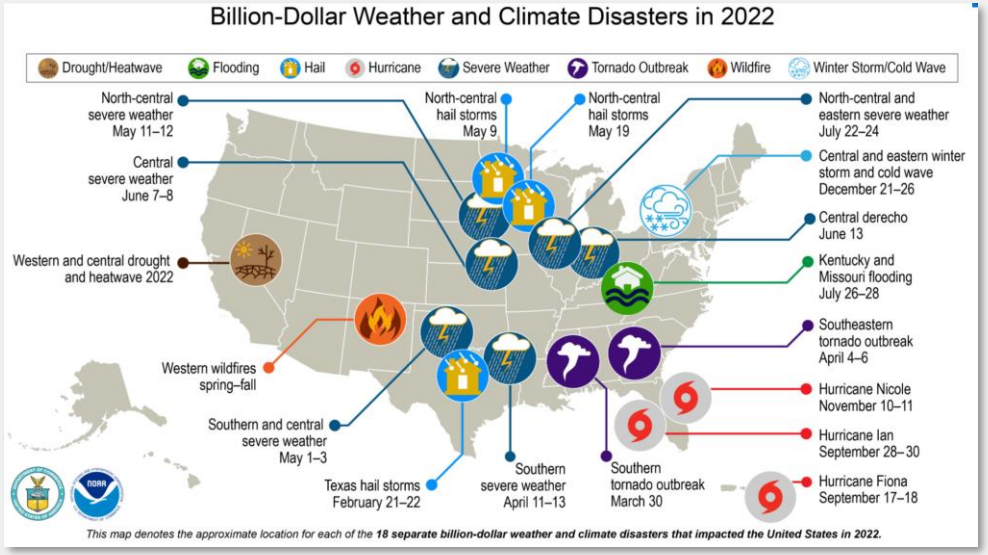
Vulnerability Assessments

Flood Vulnerability Assessments 101:

- "Climate data and information remain a limiting factor for adaptation" – 5th National Climate Assessment.
- Evaluation of Flood Mapping / Flood Risk Assessment Approaches and Tools for BCWD, CMSCWD, CLFLWD (2000)
  - Approaches to flood mapping using historical information and climate change projections
  - Methods for evaluating flood risk
  - Local efforts related to planning and design



Source: Kenny Blumenfeld, 2020 Water Consortium

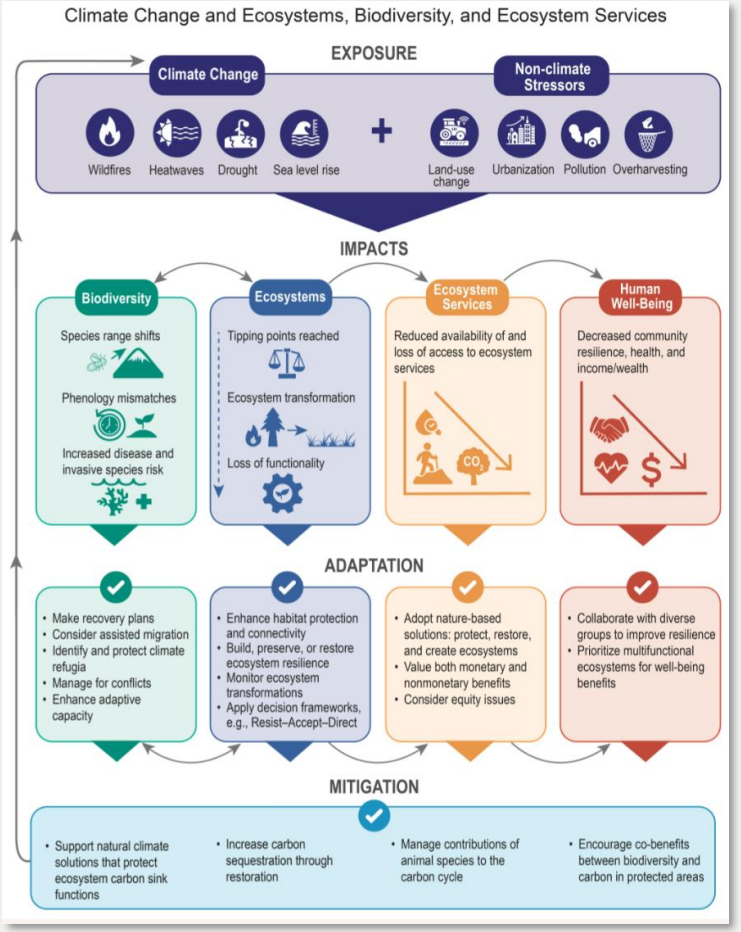


Source: 5th National Climate Assessment

Vulnerability Assessments

Flood Vulnerability Assessments 101:

- Topographic Analysis / Flood Hazard Mapping
- Infrastructure and Critical Facilities Assessment
- Social Vulnerability Assessment
- Environmental Assessment
- Hydrologic Analysis
- Stakeholder Engagement and Community Input
- Flood Reduction Evaluation / Structural and Non-Structural Improvement Projects



Source: 5th National Climate Assessment

Components of Floodplain Vulnerability Assessment	RCWD	City of Rochester, MN	CLFLWD
Topographic Analysis/ Flood Hazard Mapping	Identified vulnerable locations by using H/H model to map future conditions floodplain.	Identified vulnerable locations using Flood Hazard Layer (terrain analysis) followed by detailed H/H modeling.	Identified vulnerable locations using Flood Hazard Layer (terrain analysis) followed by detailed H/H modeling.
Infrastructural / Social / Env. Assessment	Screening process to identify wetland areas on public parcels that could be enhanced, and public parcels with a low crop productivity rating + proximity to known flooding locations.	Screening process to identify high priority areas included infrastructural, social and environmental components.	Screening process to identify high priority areas included infrastructural, social and environmental components.
Hydrologic Analysis: Future (projected) conditions	19% increase in the 100-year, 24-hour event [Source: EPA National Stormwater Calculator]	34% increase in the 100-year, 24-hour event [Source: NOAA Atlas 14 90% Confidence Interval]	33% increase in the 100-year, 24-hour event [Source: NOAA Atlas 14 90% Confidence Interval]
Stakeholder Engagement and Community Input	Community Resilience Building Workshops: Invited local community leaders to engage communities in climate adaptation and resiliency planning.	Community Resilience Building Workshops: Invited City Staff, Olmsted County, SWCD to engage communities in climate adaptation and resiliency planning. Invited local community leaders to engage in co-design of Resilience Hubs.	TBD
Structural and Non-Structural Imp. Projects	Capital improvement storage practices on the landscape	Combination of Green Infrastructure, storage and stormsewer infrastructure upgrades.	TBD

Workshop Objectives

Understand Mapping

Presentation on mapping done to date. Understand all the layers that went into the mapping and how they affect the final “Integrated Map.”

Gain Consensus on Priority Ranking & Modeling Subsheds

Even priority ranking for environmental vs infrastructure vs social vs flood hazard. Confirm which subwatersheds need a closer look using the H&H model.

Next Steps

Review next steps in planning process, including Community Engagement

CLFLWD Flood Risk Assessment

ENVIRONMENTAL

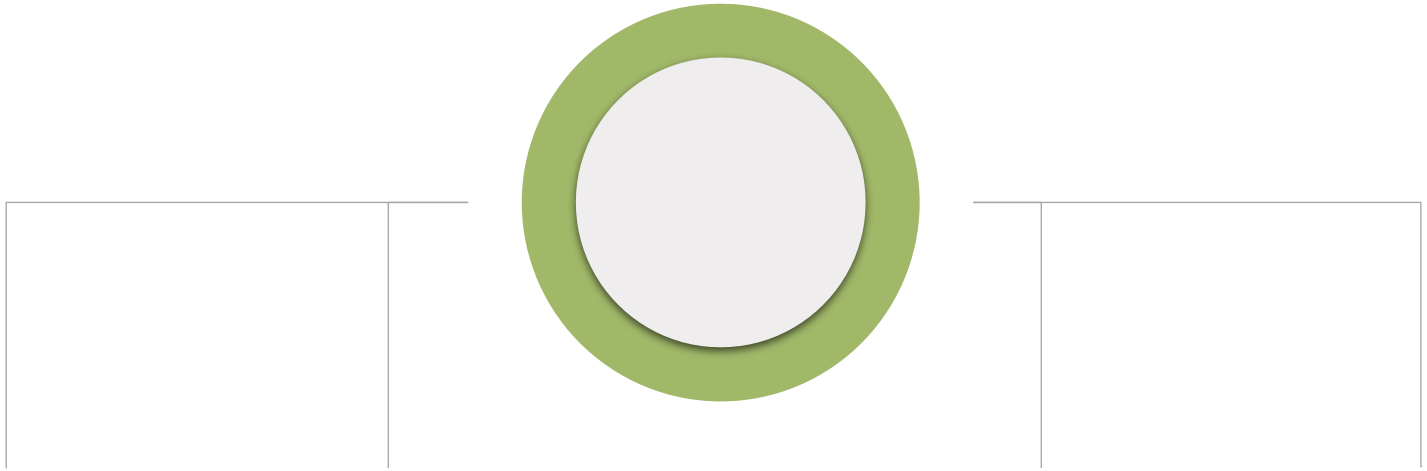
SOCIAL

INFRASTRUCTURAL

FLOOD HAZARD

Environmental Scoring

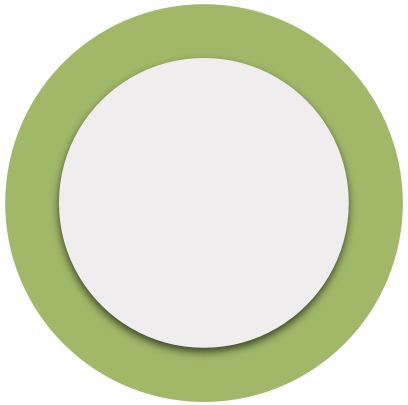
ENVIRONMENTAL



- Impaired Waters
- Native Plant Communities Connected with Groundwater
- Soil Erosion Risk
- Minnesota Biological Survey (MBS) Sites of Biodiversity Significance

Environmental Scoring

ENVIRONMENTAL



Impaired Waters

Native Plant Communities Connected with Groundwater

Soil Erosion Risk

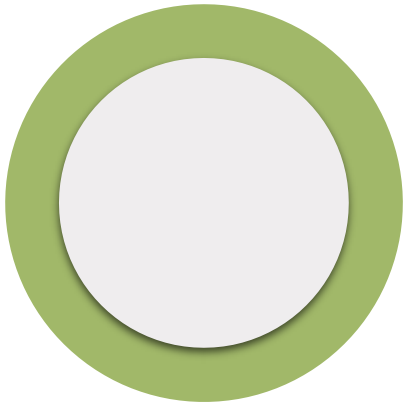
MBS Sites of Biodiversity Significance

Impaired Lakes/Streams

- ***Source:*** MPCA
- ***Description:*** Impaired waterbodies as determined by MPCA's surface water quality assessment process for the 2022 reporting cycle to US Environmental Protection Agency (EPA).
- ***Publication:*** 2022-05-04
- ***Scoring Process*:** Impaired Lakes/Streams intersect with the catchments. They are quantiled based on the area or length in each catchment, with scores ranging from 1 to 3.

Environmental Scoring

ENVIRONMENTAL



Impaired Waters

Native Plant Communities Connected with Groundwater

Soil Erosion Risk

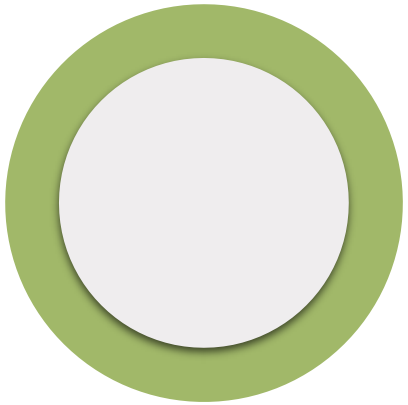
MBS Sites of Biodiversity Significance

Native Plant Communities Connected with Groundwater

- ***Source:*** DNR
- ***Description:*** The basic units of classification are the wetland native plant communities (NPC) as described in the series of Field Guides to the Native Plant Communities of Minnesota (MnDNR 2005a, 2005b, 2003). The NPCs are grouped into readily recognizable wetland type categories.
- ***Publication:*** 2019-01-18
- ***Scoring Process*:** Scoring the NPC index from 1 to 5 based on its type of groundwater dependence, calculating the average NPC index within each catchment, and then categorizing it into a 1 to 3 scoring system based on quartiles.

Environmental Scoring

ENVIRONMENTAL



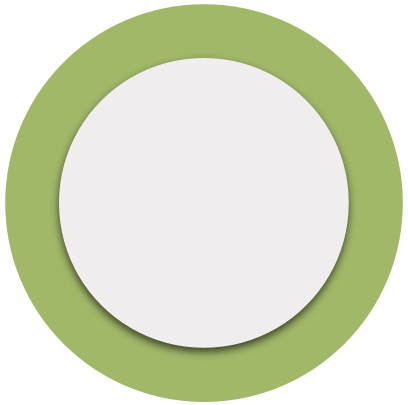
- **Impaired Waters**
- **Native Plant Communities Connected with Groundwater**
- **Soil Erosion Risk**
- **MBS Sites of Biodiversity Significance**

Soil Erosion Risk

- ***Source:*** BWSR
- ***Description:*** This data layer represents a general risk score for potential soil erosion on a 0-100 point scale, 100 being the highest risk. Larger values indicate soils that have a higher potential to erode if no conservation practices were in place and overland sheet or rill runoff was present.
- ***Scoring Process*:** Calculate the average soil erosion risk score within each catchment, and then categorize it into a 1 to 3 scoring system based on quartiles.

Environmental Scoring

ENVIRONMENTAL

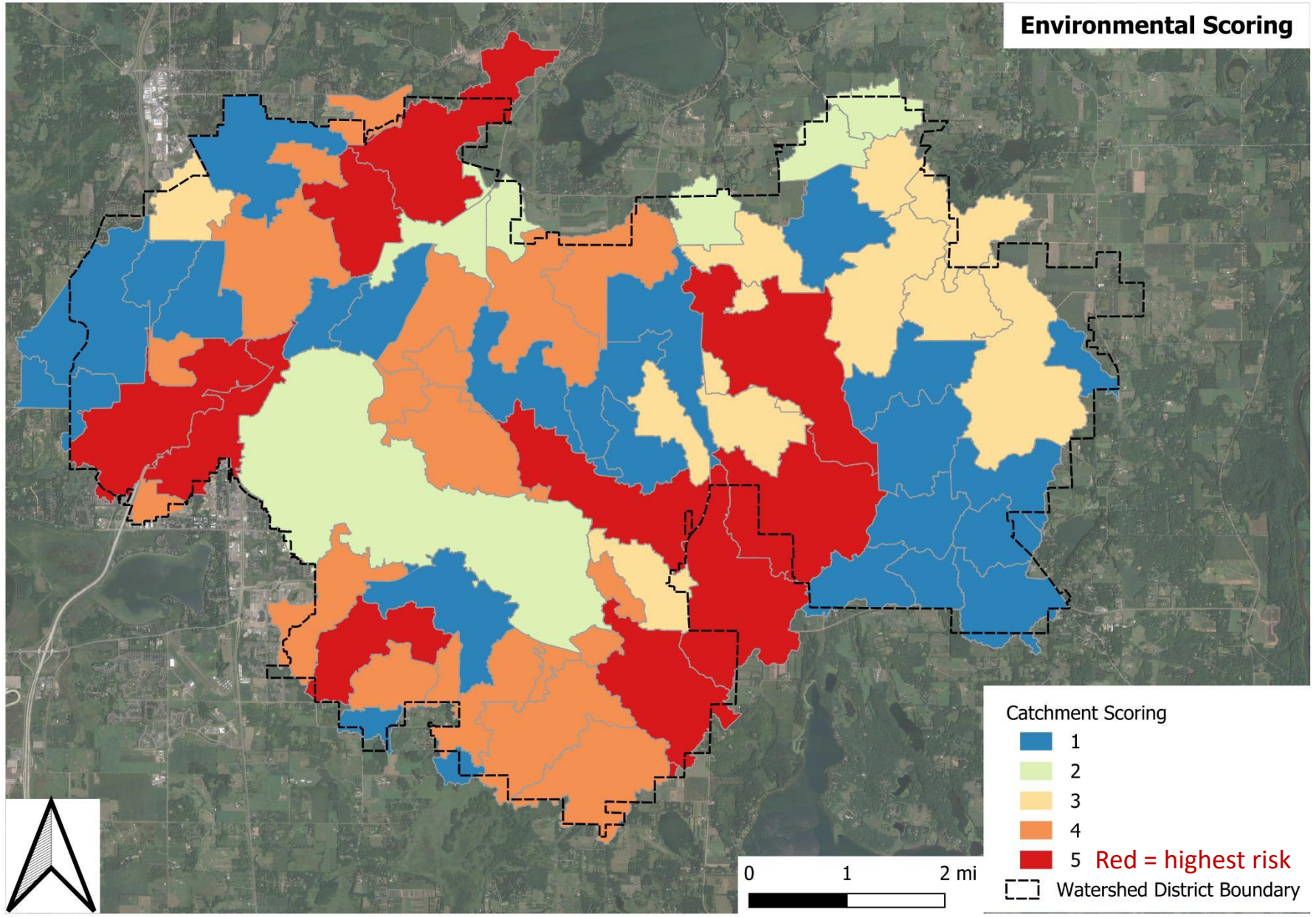


- Impaired Waters
- Native Plant Communities Connected with Groundwater
- Soil Erosion Risk
- **MBS Sites of Biodiversity Significance**

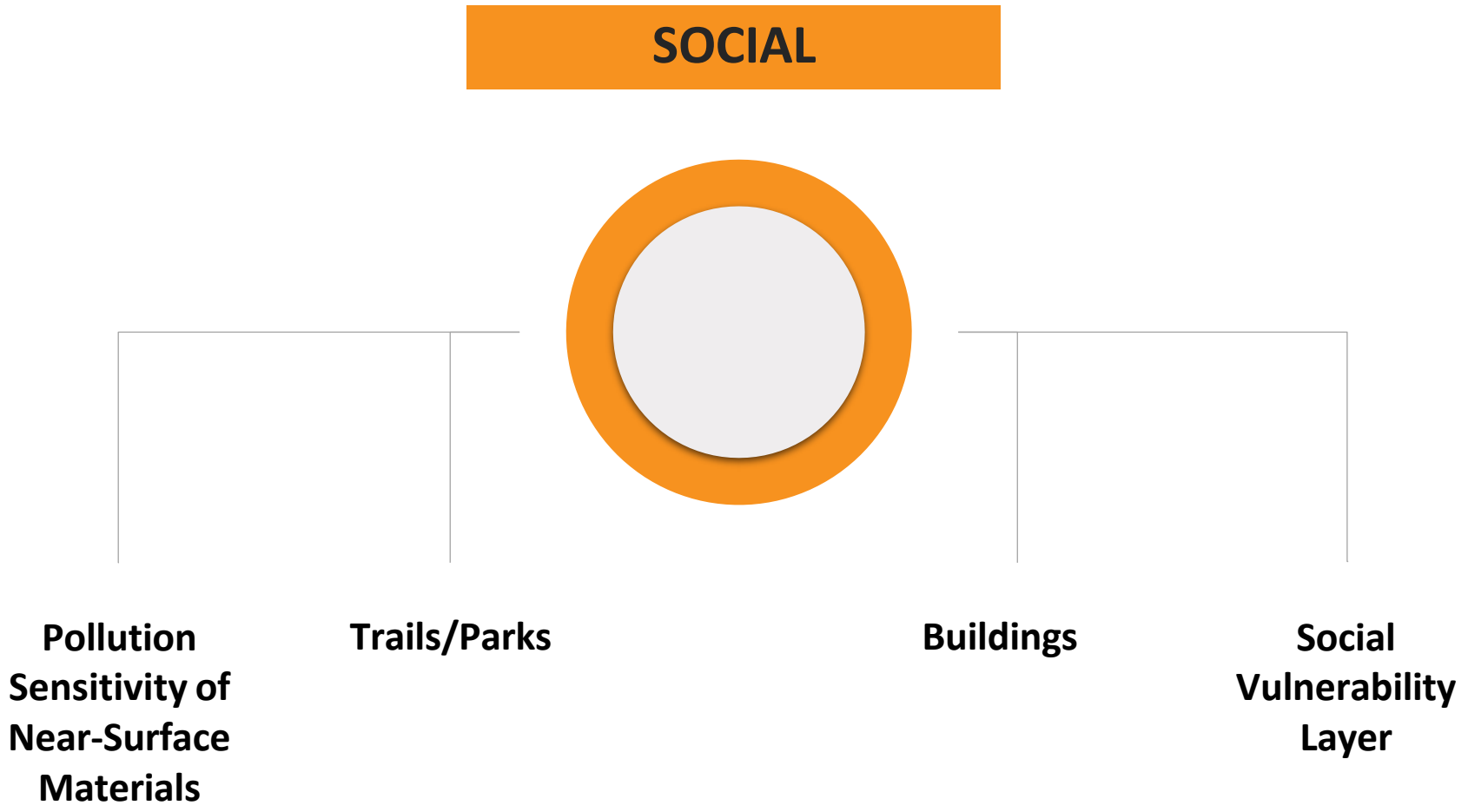
MBS Sites of Biodiversity Significance

- ***Source:*** DNR
- ***Description:*** This data layer represents areas with varying levels of native biodiversity that may contain high quality native plant communities, rare plants, rare animals, and/or animal aggregations.
- ***Publication:*** 2023-09-07
- ***Scoring Process*:** Score the biodiversity significance index from 1 to 4 based on its biodiversity significance rank, calculate the average significance index within each catchment, and then categorize it into a 1 to 3 scoring system based on quartiles.

Environmental Scoring

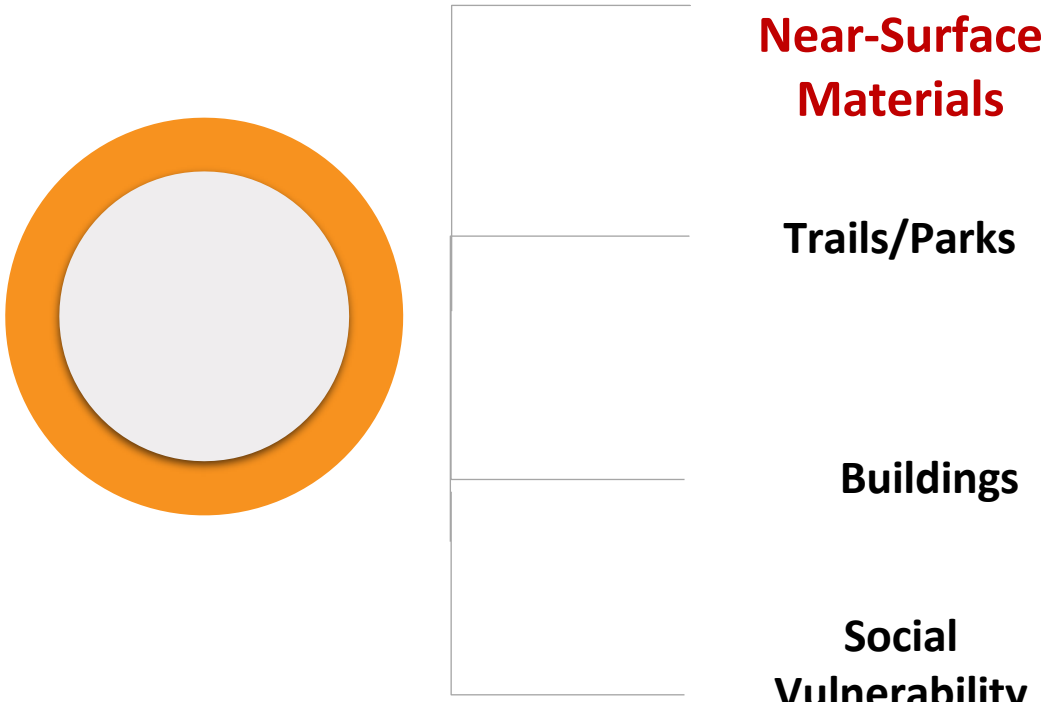


Social Scoring



Social Scoring

SOCIAL



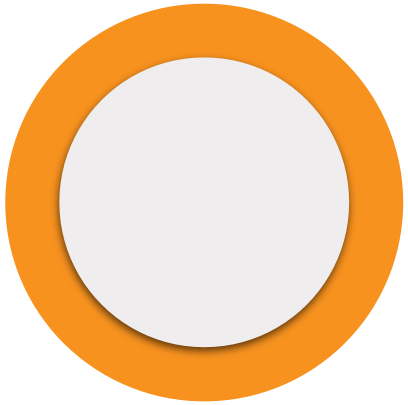
Note: Due to its overlapping information with drinking water quality, private well locations, and aquifer vulnerability layers, only this layer is used here for scoring.

Pollution Sensitivity of Near-Surface Materials

- ***Source:*** DNR
- ***Description:*** This dataset estimates the pollution sensitivity of near-surface materials from the transmission time of water through 3 feet of soil and 7 feet of surficial geology, to a depth of 10 feet from the land surface.
- ***Publication:*** 2018-10-31
- ***Scoring Process*:** Score the pollution sensitivity index from 1 to 5 based on its geologic sensitivity rating, calculate the average sensitivity index within each catchment, and then categorize it into a 1 to 3 scoring system based on quartiles.

Social Scoring

SOCIAL



Pollution Sensitivity of Near-Surface Materials

Trails/Parks

Buildings

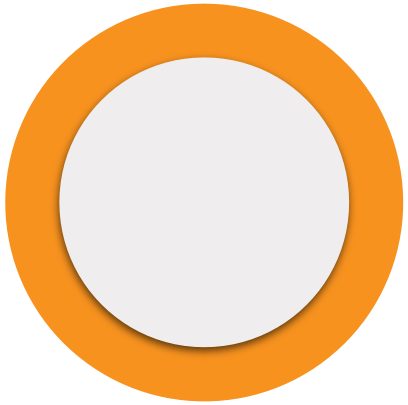
Social Vulnerability Layer

Trails/Parks

- ***Source:*** Proposed Greenway Strategy Presentation
- ***Description:*** This data layer was manually created based on a trails/parks priority map from the Proposed Greenway Strategy Presentation.
- ***Scoring Process*:** Count the number of trails and parks in each catchment and assign a score from 1 to 3 based on the quantile for catchments with trails or parks. Assign a score of 0 to catchments without any trails or parks.

Social Scoring

SOCIAL



Pollution Sensitivity of Near-Surface Materials

Trails/Parks

Buildings

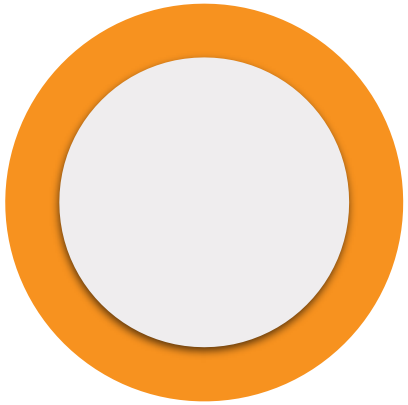
Social Vulnerability Layer

Buildings

- ***Source:*** FEMA
- ***Description:*** This layer is created using structure (building) polygons (exclude any critical infrastructure) for the state of Minnesota
- ***Scoring Process*:** Count the number of buildings within each catchment and assign a score from 1 to 3 based on the quantile of the numbers. Assign a score of 0 to catchments without any buildings in the floodplain.

Social Scoring

SOCIAL



Pollution Sensitivity of Near-Surface Materials

Trails/Parks

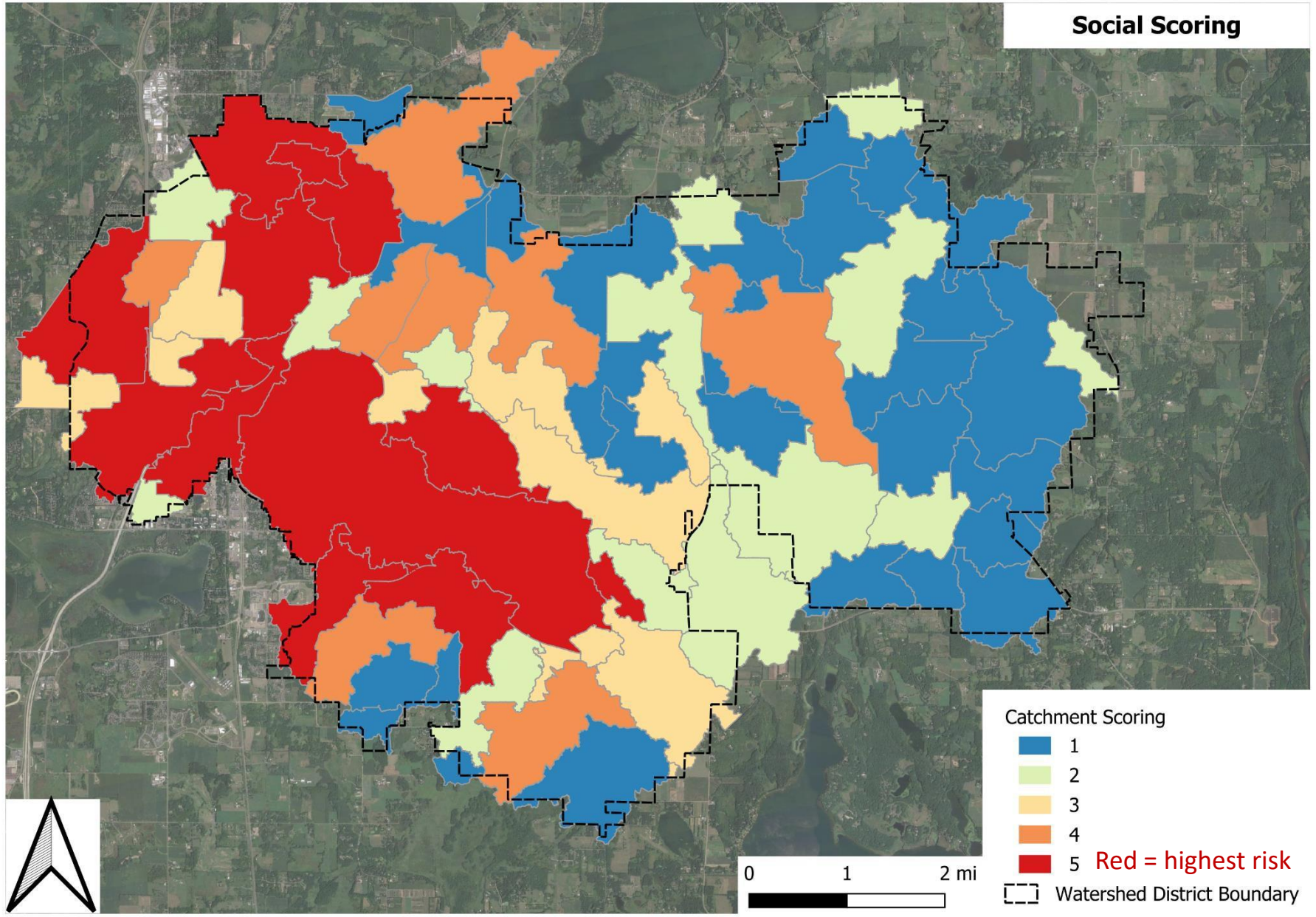
Buildings

Social Vulnerability Layer

Social Vulnerability Layer

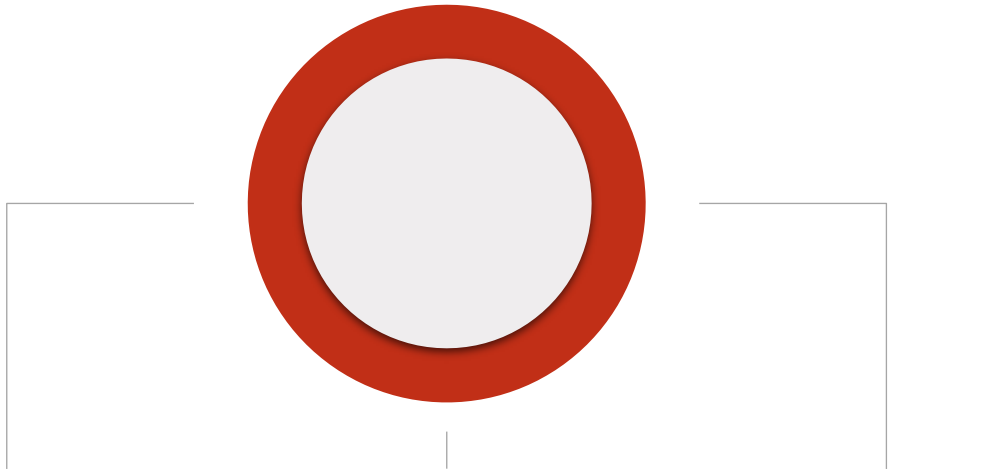
- ***Source:*** EOR
- ***Description:*** This data layer is created from a series of Census data, including 1) lone parents, 2) children aged 4 years and younger, 3) people aged 75 years and older, 4) population density, 5) renter households, 6) individuals below the poverty line, 7) individuals without a high school diploma, and 8) persons who speak English less than well.
- ***Scoring Process*:** The layer is indexed from 1 to 5, and the average is calculated within each catchment, after which it is categorized into a 1 to 3 scoring system based on quartiles.

Social Scoring



Infrastructural Scoring

INFRASTRUCTURAL



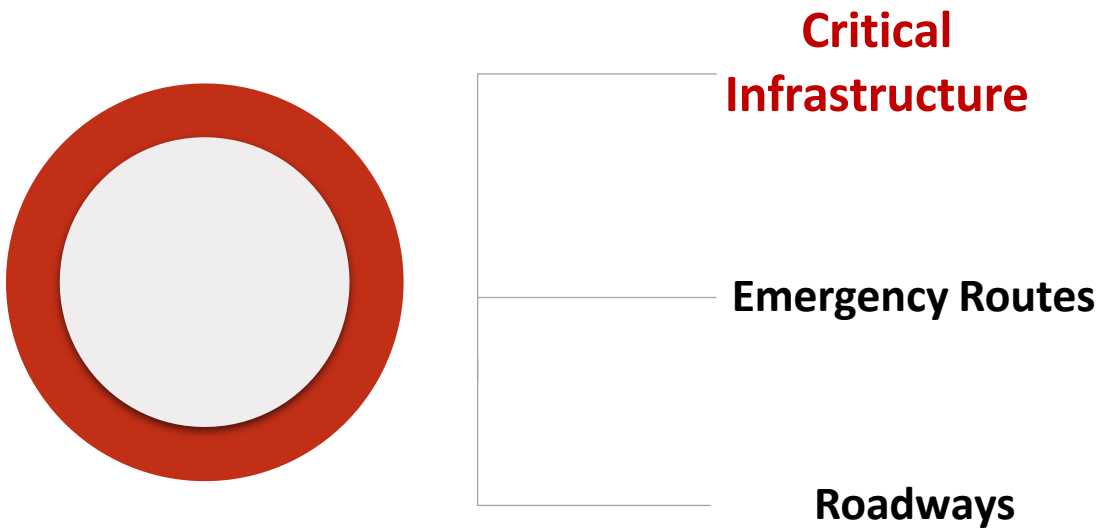
Critical Infrastructure

Emergency Routes

Roadways

Infrastructural Scoring

INFRASTRUCTURAL

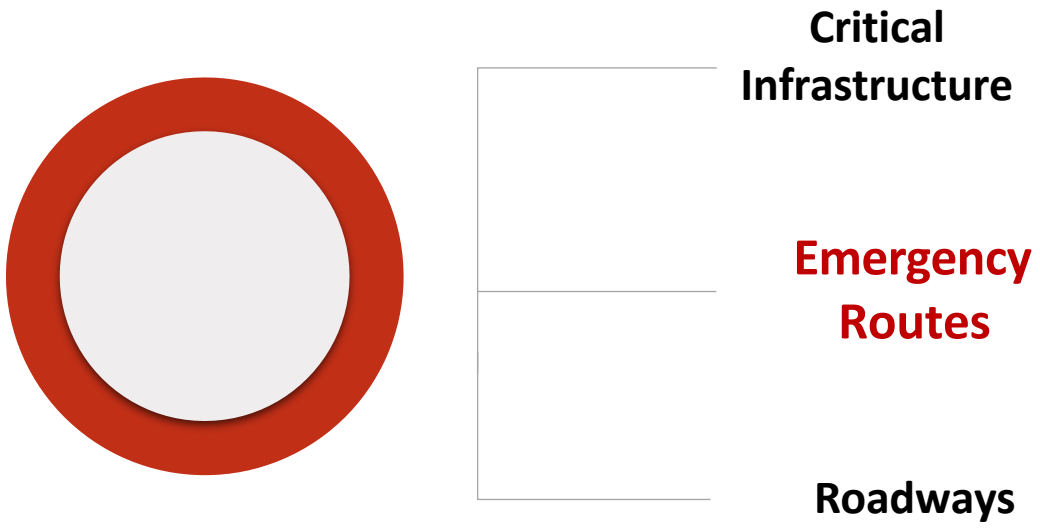


Critical Infrastructure

- ***Source:*** EOR
- ***Description:*** This data layer is created based on the locations of fire departments, hospitals, places of worship, police stations, schools, electrical substations, and wastewater facilities.
- ***Scoring Process*:** Count the number of critical infrastructure facilities within each catchment and assign a score from 1 to 3 based on the quantile of critical infrastructure. Assign a score of 0 to catchments without any critical infrastructure.

Infrastructural Scoring

INFRASTRUCTURAL

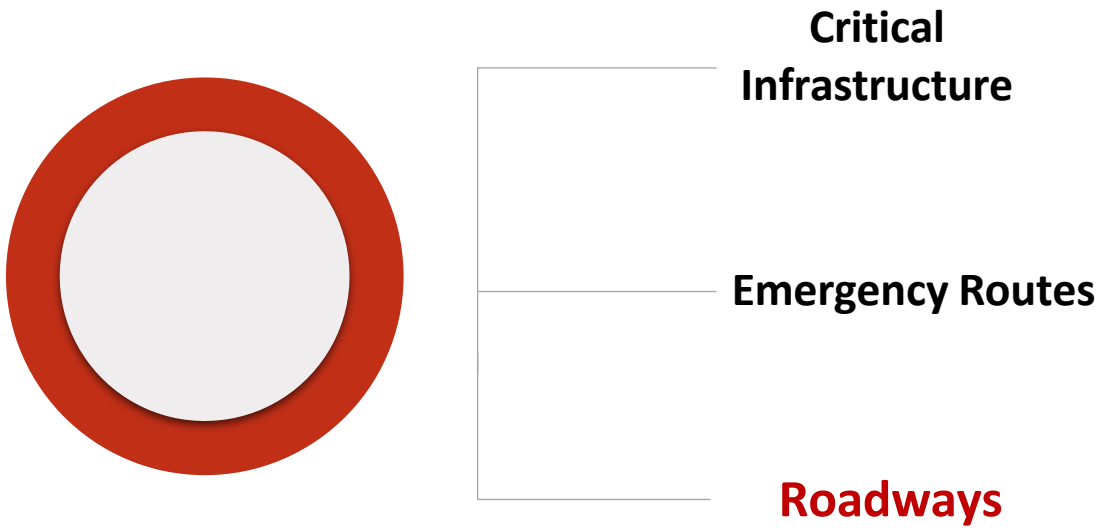


Emergency Routes

- ***Source:*** EOR
- ***Description:*** Truck routes was used as a proxy for emergency routes, which is estimated from the MnDOT road layer
- ***Scoring Process*:** The layer is intersected with each catchment to calculate its length, and then it is categorized into a 1 to 3 score based on quantiles.

Infrastructural Scoring

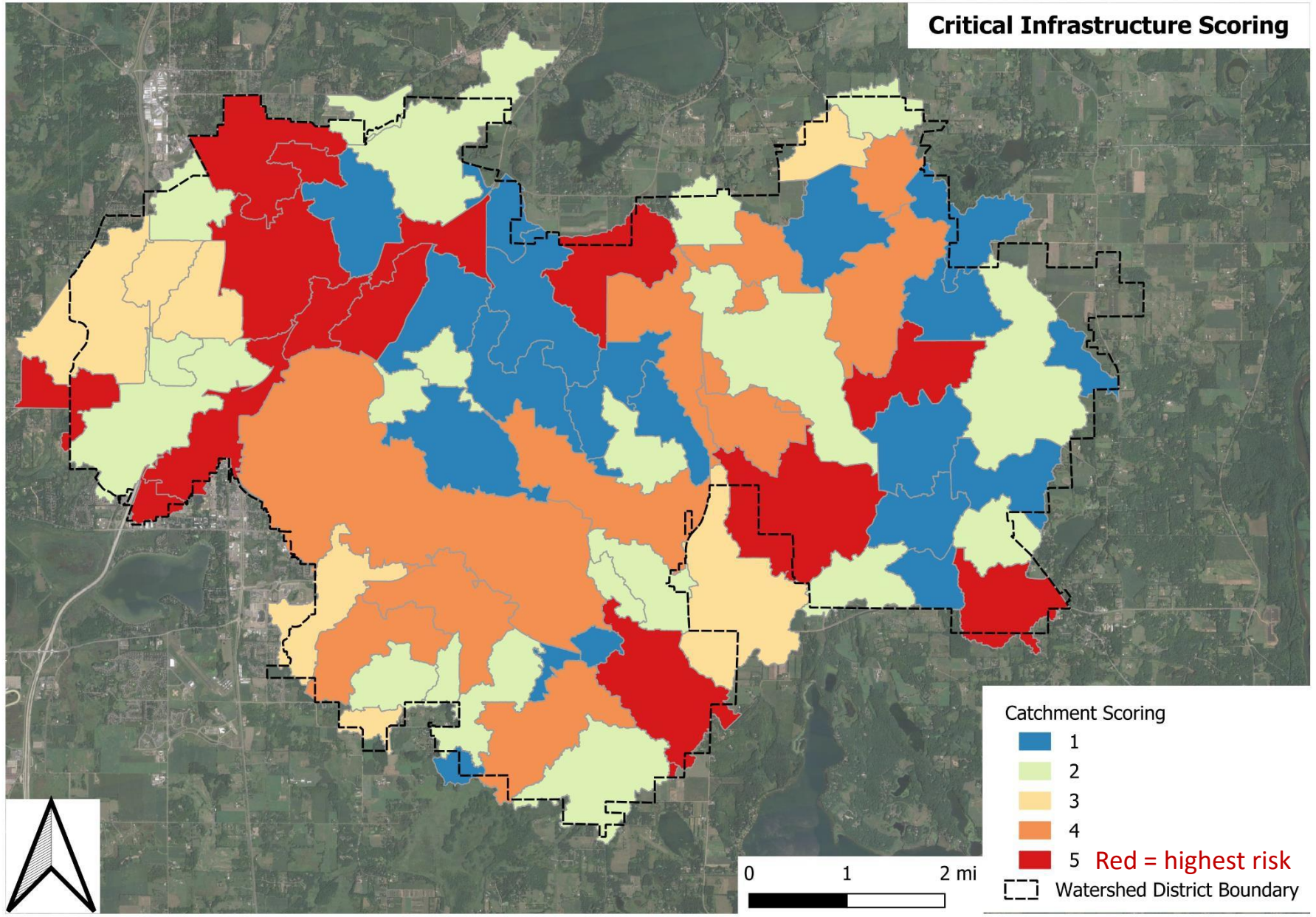
INFRASTRUCTURAL



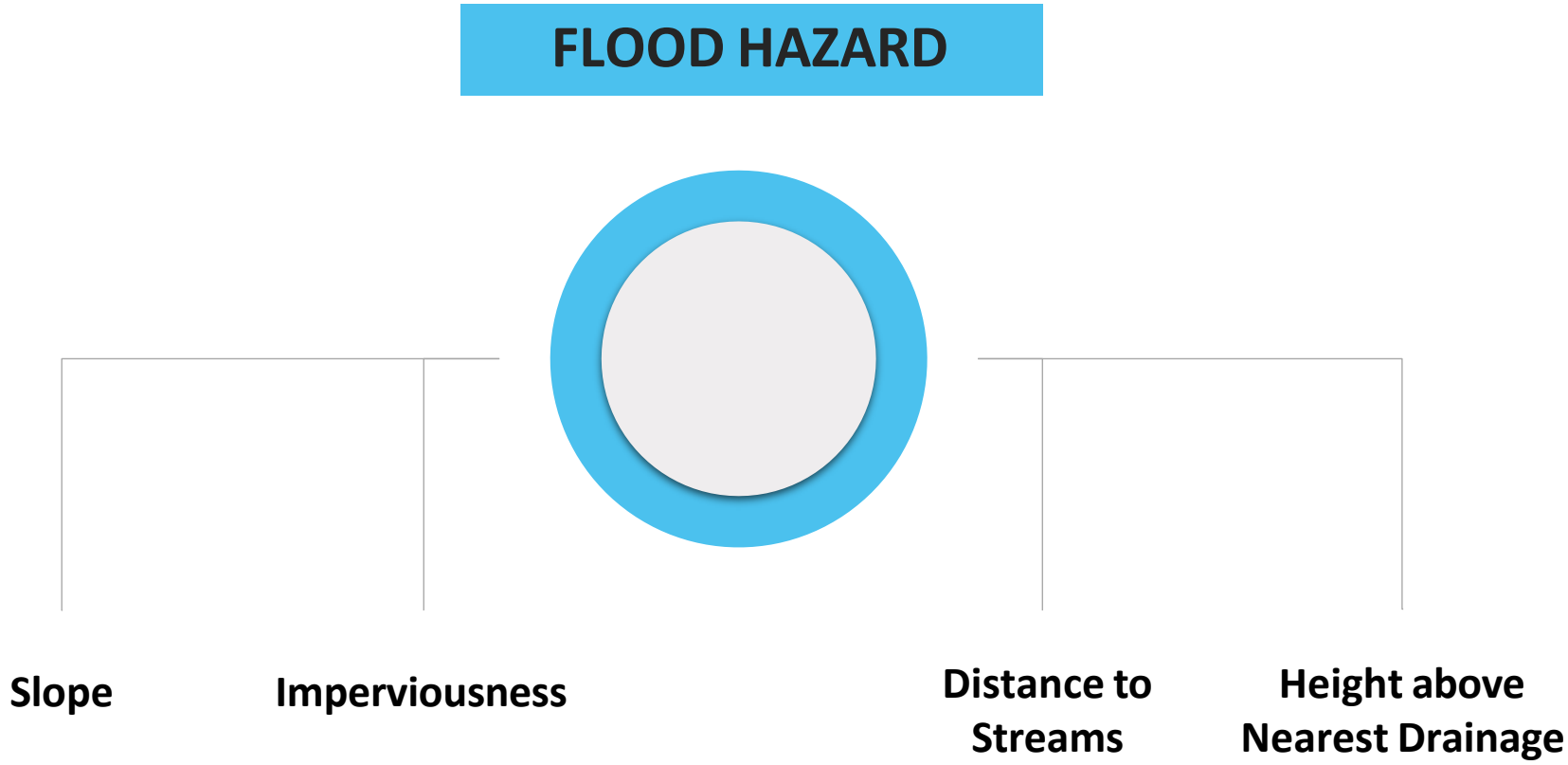
Roadways

- ***Source:*** EOR
- ***Description:*** This layer includes all the roadways, with the exception of the emergency routes.
- ***Scoring Process*:** The layer is intersected with each catchment to calculate its length, and then it is categorized into a 1 to 3 score based on quantiles.

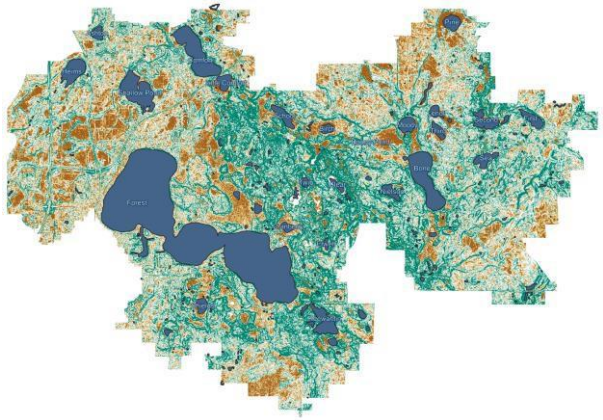
Infrastructural Scoring



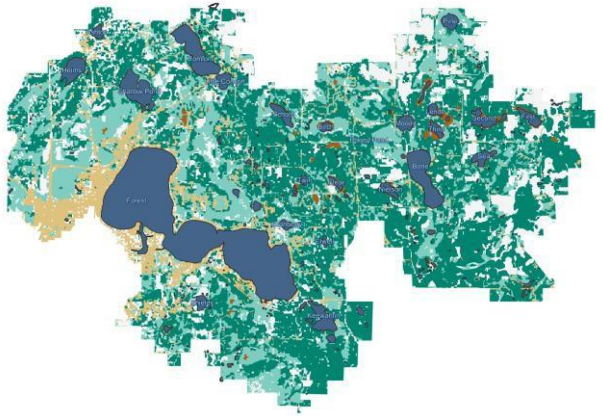
Flood Hazard Scoring



Flood Hazard Scoring



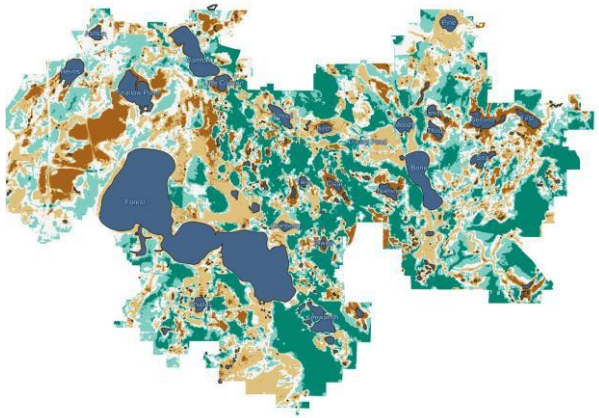
Slope



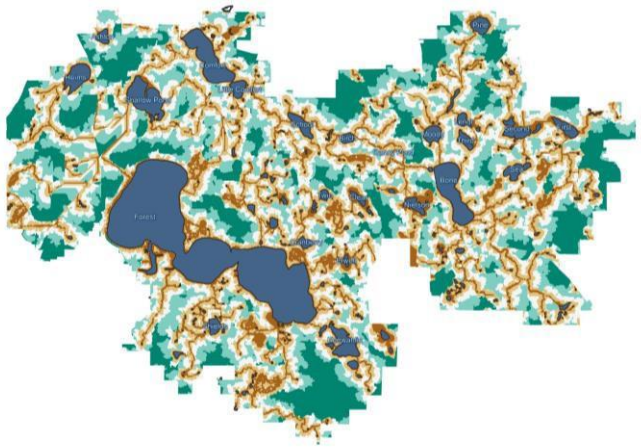
Curve Number

+

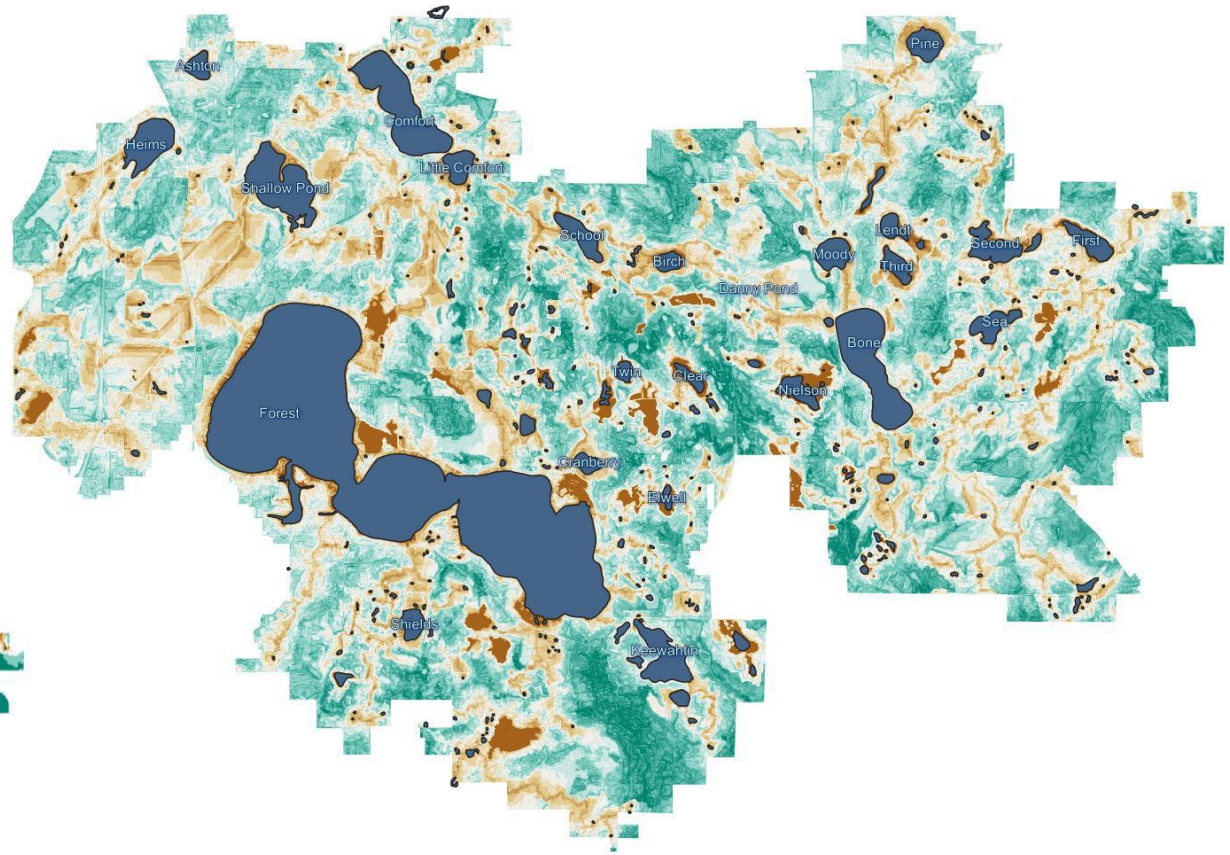
=



Height Above Nearest Drainage (HAND)



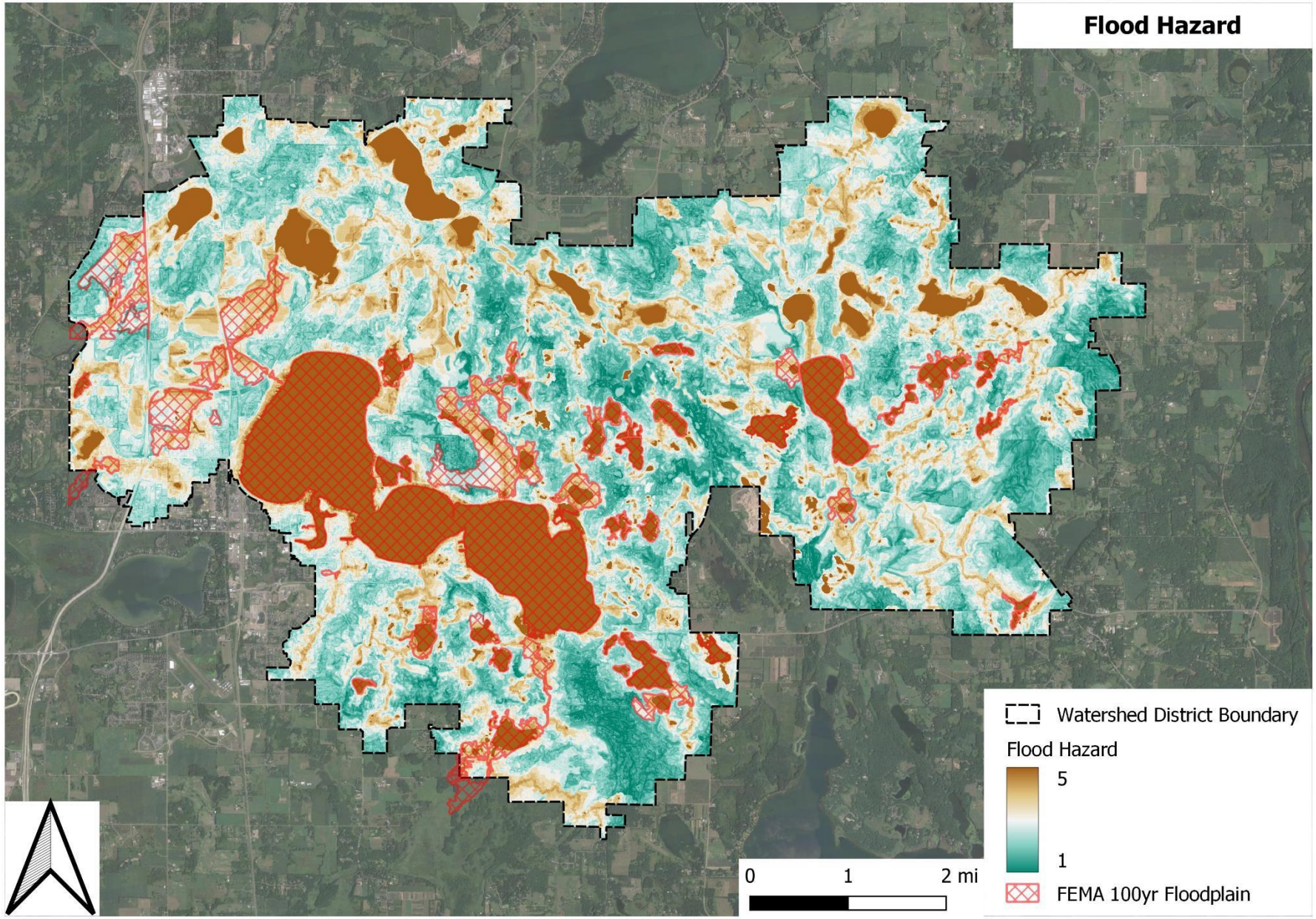
Distance to Streams (DS)



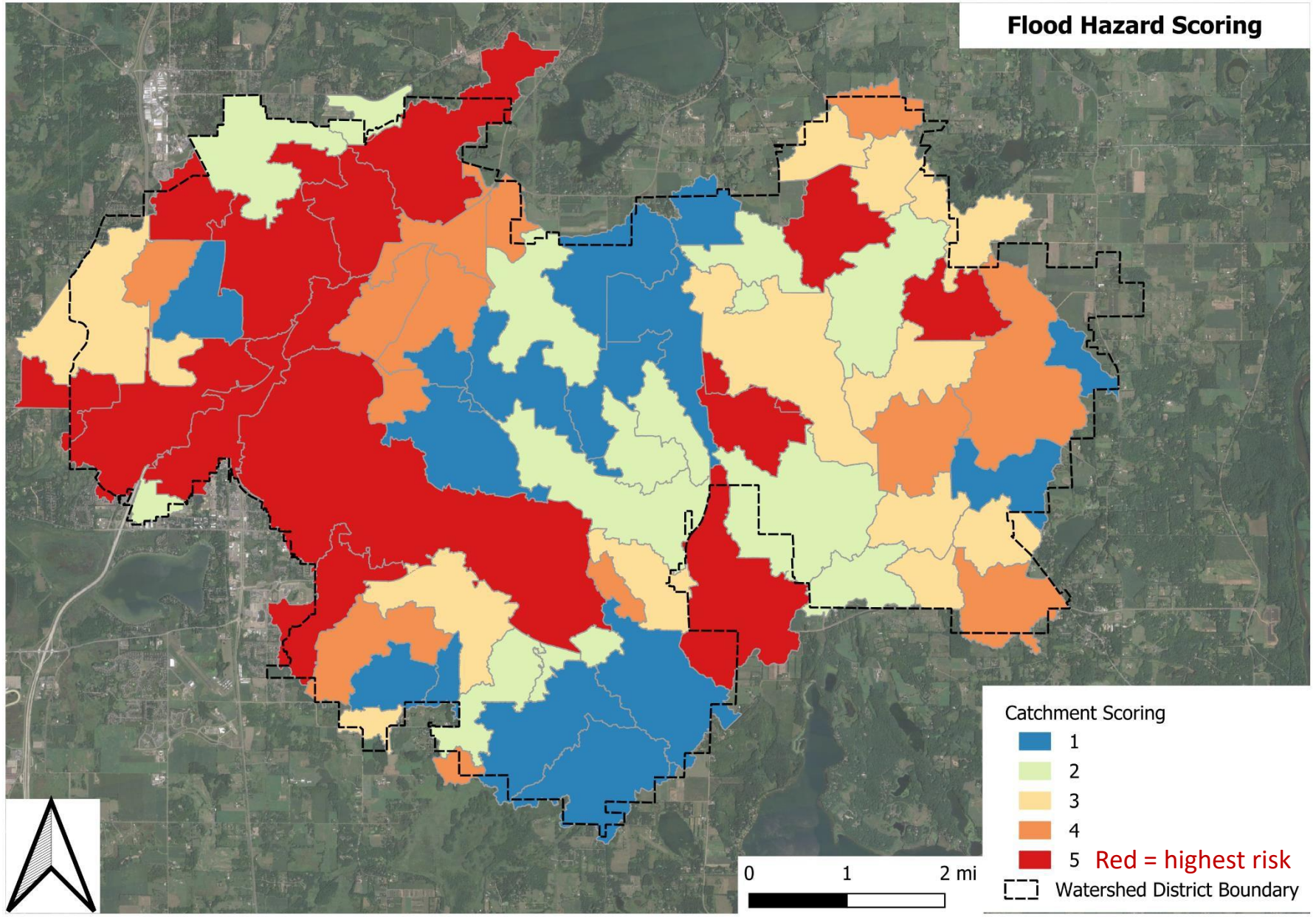
Flood Hazard

Lowest — Highest

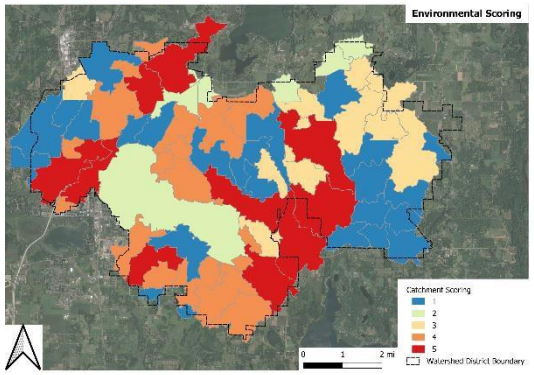
Flood Hazard Scoring



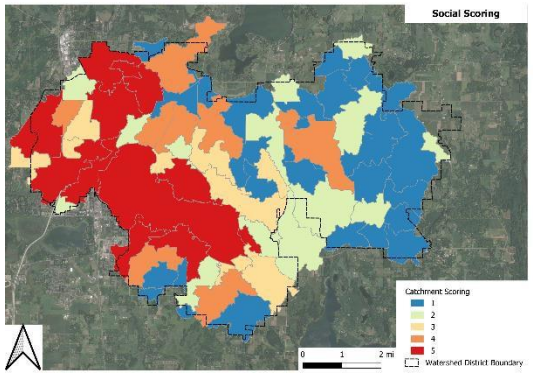
Flood Hazard Scoring



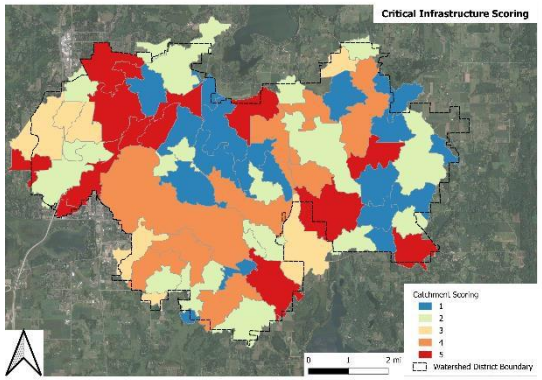
Integrated Scoring



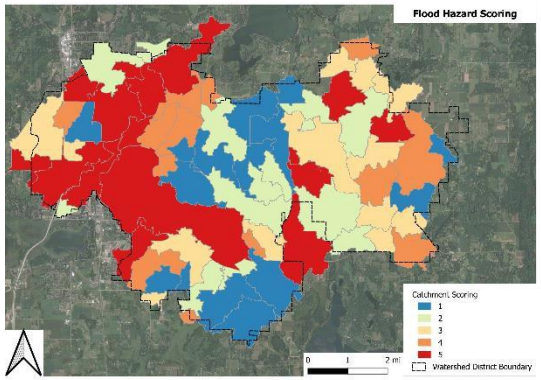
Environmental



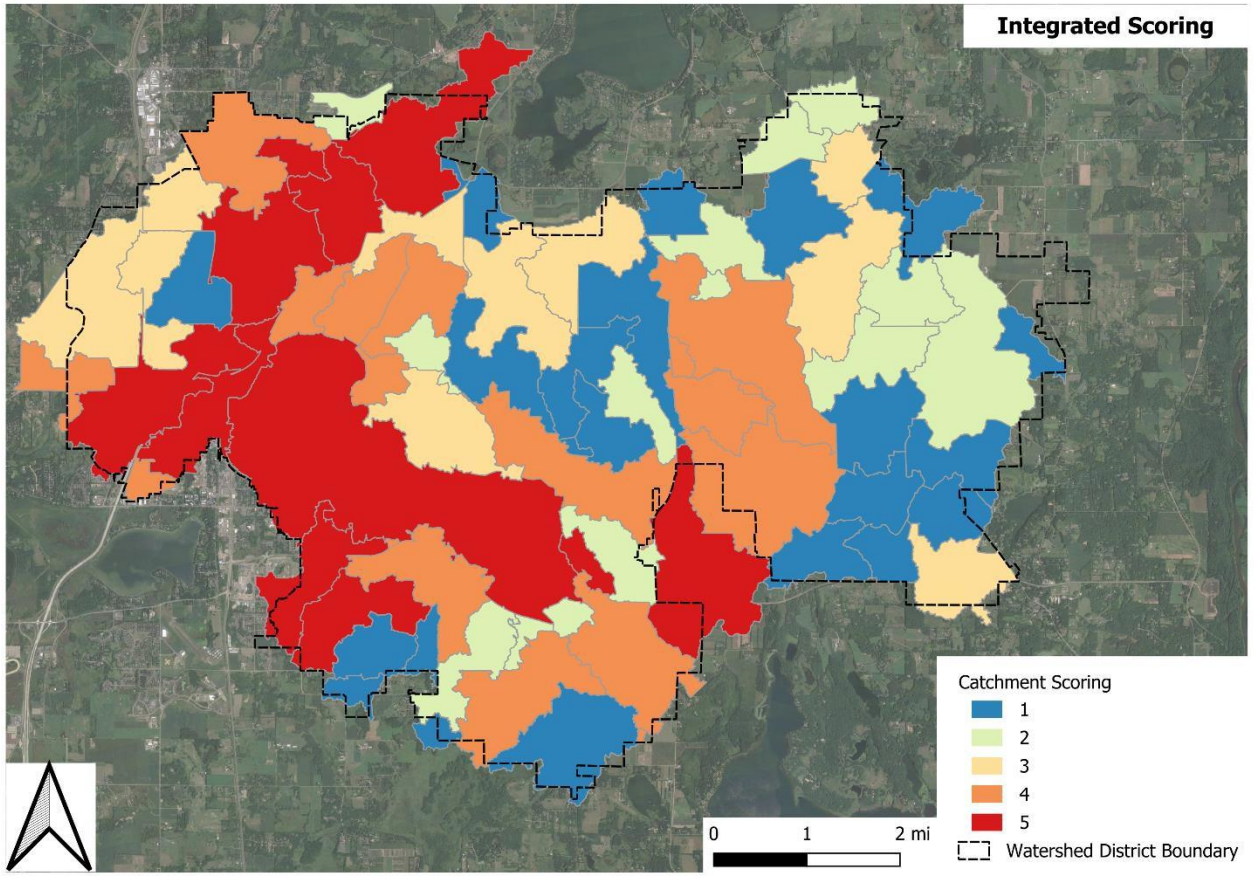
Social



Infrastructural



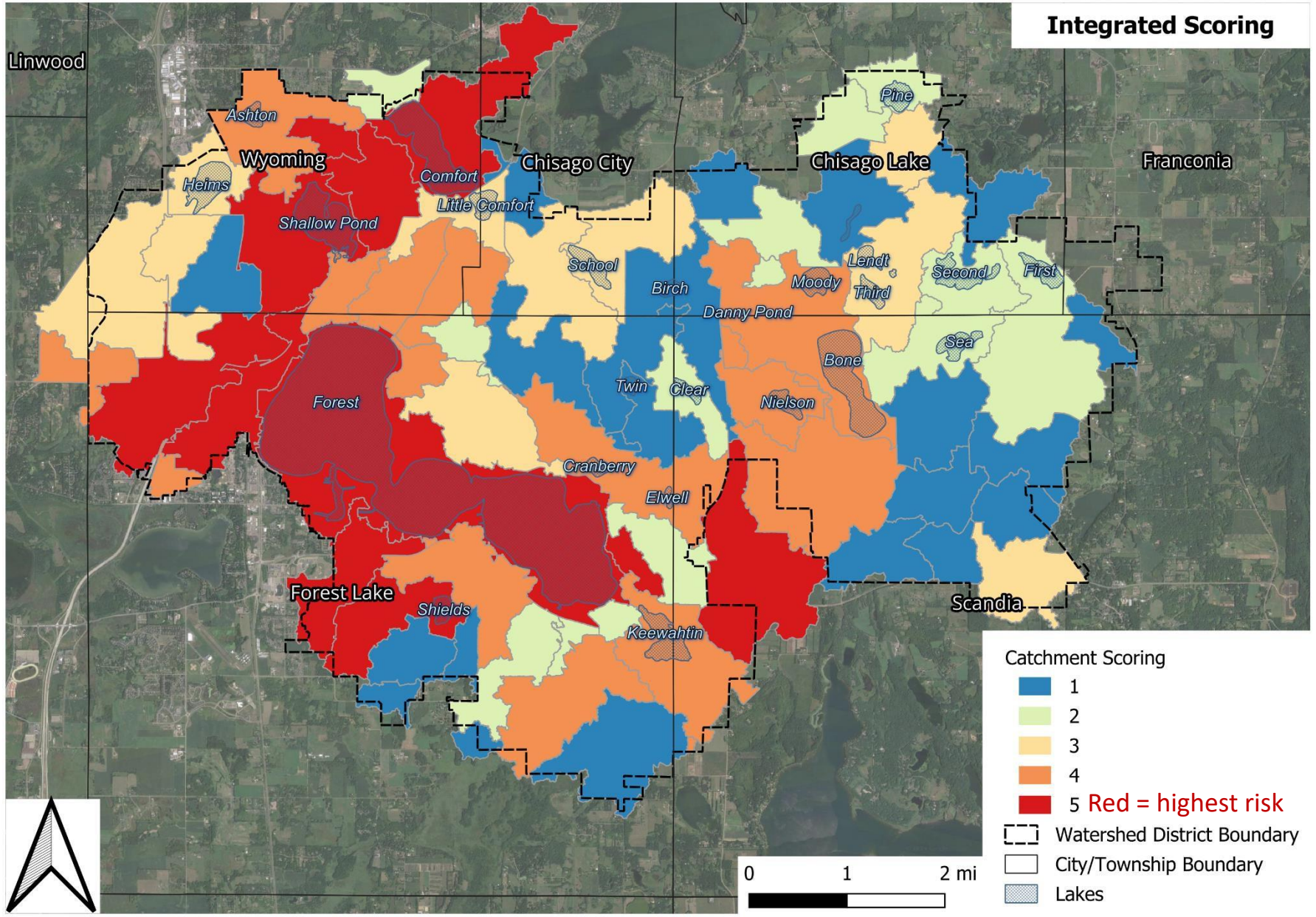
Flood Hazard



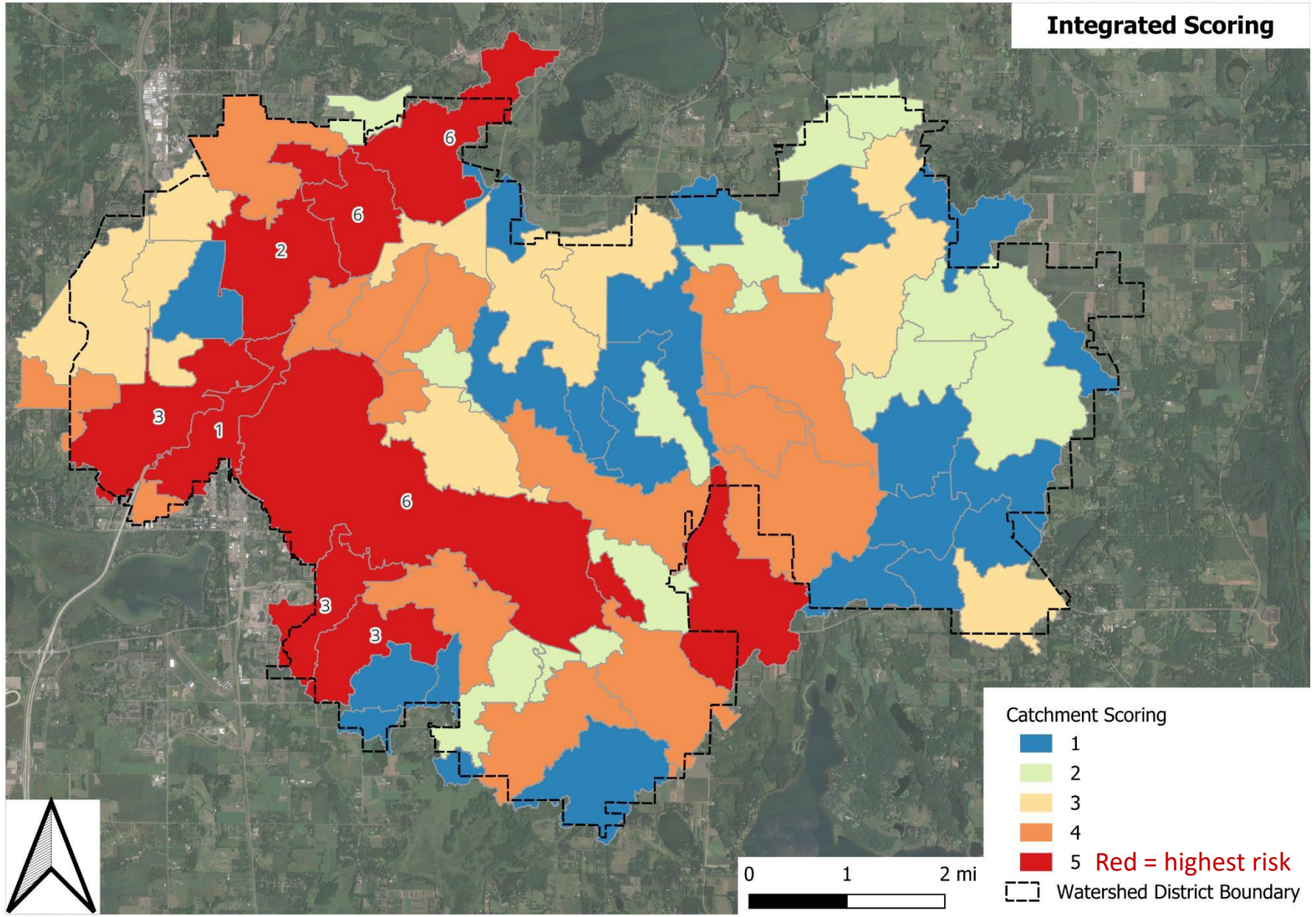
Integrated

Red = highest risk

Integrated Scoring



Integrated Scoring



Discussion Questions

1. Currently, the weight assigned to each category and its sub-components is uniform (equally distributed). Would the board like to see these priorities adjusted (i.e., NOT equally distributed)? This could result in a different-looking Integrated Scoring Map than the one presented.

2. After there is agreement on priority ranking and the resulting Integrated Scoring Map, discuss where to focus modeling efforts next.

Infrastructural Prioritization Factors	Concern	Score
Accessibility / Emergency Routes	During flooding events, emergency routes should always remain accessible and predesignated alternative routes should provide redundancy to the system, so people have multiple options to get around.	
Public Safety / Roadways	During flooding events, roadways should have minimal flooding to allow for safe passage of vehicular traffic and/or pedestrian traffic.	
Critical Infrastructure	During flood events, critical infrastructure (fire departments, hospitals, places of worship, police stations, schools, electrical substations, and wastewater facilities) should be protected from flooding.	
Others?		
Others?		
Others?		

Social Prioritization Factors	Concern	Score
Drinking Water / Pollution Sensitivity	During flooding events, important to consider vulnerability of drinking water resources to contamination from polluted surface water.	
Trails/Parks	Parks and trails are popular recreational areas that attract visitors for activities such as walking, jogging, cycling, and picnicking. They also serve as public transportation routes and emergency evacuation routes, staging areas, or temporary shelters during flood events. . During flood events, these areas can pose significant risks to public safety if they become inundated with water or debris.	
Buildings	During flooding events, it is important to consider the number of buildings subject to inundation from a public safety, property damage, infrastructure impact, economic consequence and community resilience standpoint.	
Social Vulnerability Layer	Vulnerable populations, such as low-income communities, ethnic minorities, elderly individuals, and people with disabilities, often bear a disproportionate burden of flood impacts. Failing to address social vulnerability can exacerbate existing inequalities and perpetuate social injustice. By incorporating social vulnerability into flood risk analysis, decision-makers can identify and prioritize interventions to reduce disparities and promote equitable outcomes.	
Others?		
Others?		
Others?		

Environmental Prioritization Factors	Concern	Score
Impaired Waters	Floods can have significant adverse effects on natural resources, including wetlands, forests, wildlife habitats, and aquatic ecosystems. Assessing impaired resources helps identify vulnerable ecosystems and species that may be at risk of harm due to flood-related disturbances. This information is essential for developing strategies to mitigate environmental damage, restore degraded habitats, and preserve biodiversity in flood-prone areas.	
Native Plant Communities	Flooding can have various impacts on native plant communities, depending on the severity, duration, and frequency of the flood events, as well as the specific characteristics of the plants and ecosystems involved.	
Soil Erosion Risk	Soil erosion during flooding can have widespread and long-lasting impacts on natural and human environments, affecting soil fertility, water quality, habitat integrity, infrastructure resilience, and socio-economic well-being.	
Sites of Biodiversity Significance	Flooding can have profound and long-lasting impacts on sites of biodiversity significance, altering ecosystem structure and function, disrupting ecological processes, and threatening the survival of native species and habitats.	
Others?		
Others?		
Others?		

Other Prioritization Factors	Concern	Score
Agricultural Lands	Agricultural land may be negatively impacted by several climate-related hazards, including drought and extreme precipitation.	
Greenway Corridors	Preserve floodplain, woodlands, and wetlands – restrict building in these and other vulnerable areas.	
Known Areas of Flooding	Previous studies have identified areas that are more vulnerable to flooding.	

Next Steps


Board Workshops
Model Refinement
Community Engagement Workshops
Final Report
Project Prioritization, Feasibility, Grant Seeking