Using Critical Aquifer Recharge Areas For Planning, Funding and Drought Mitigation

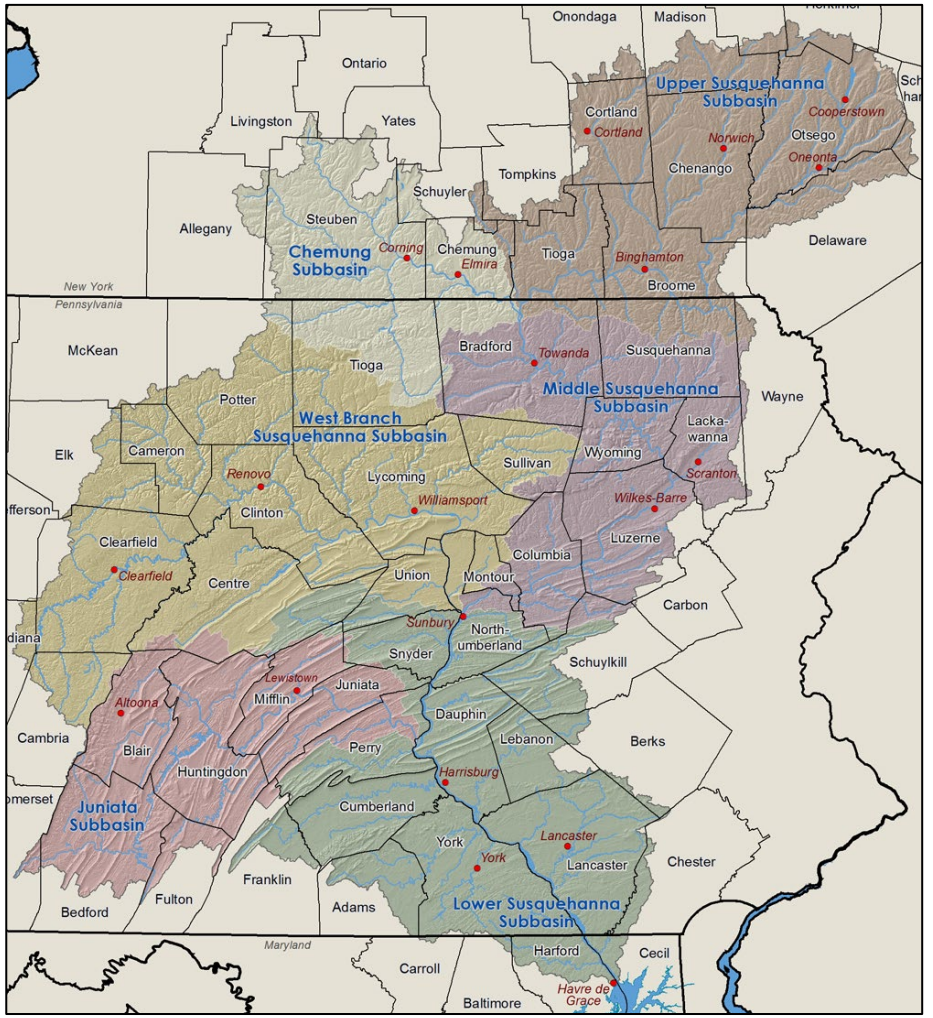
SOUTH MOUNTAIN PARTNERSHIP
CONSERVATION NETWORK

South Mountain Partnership Presentation

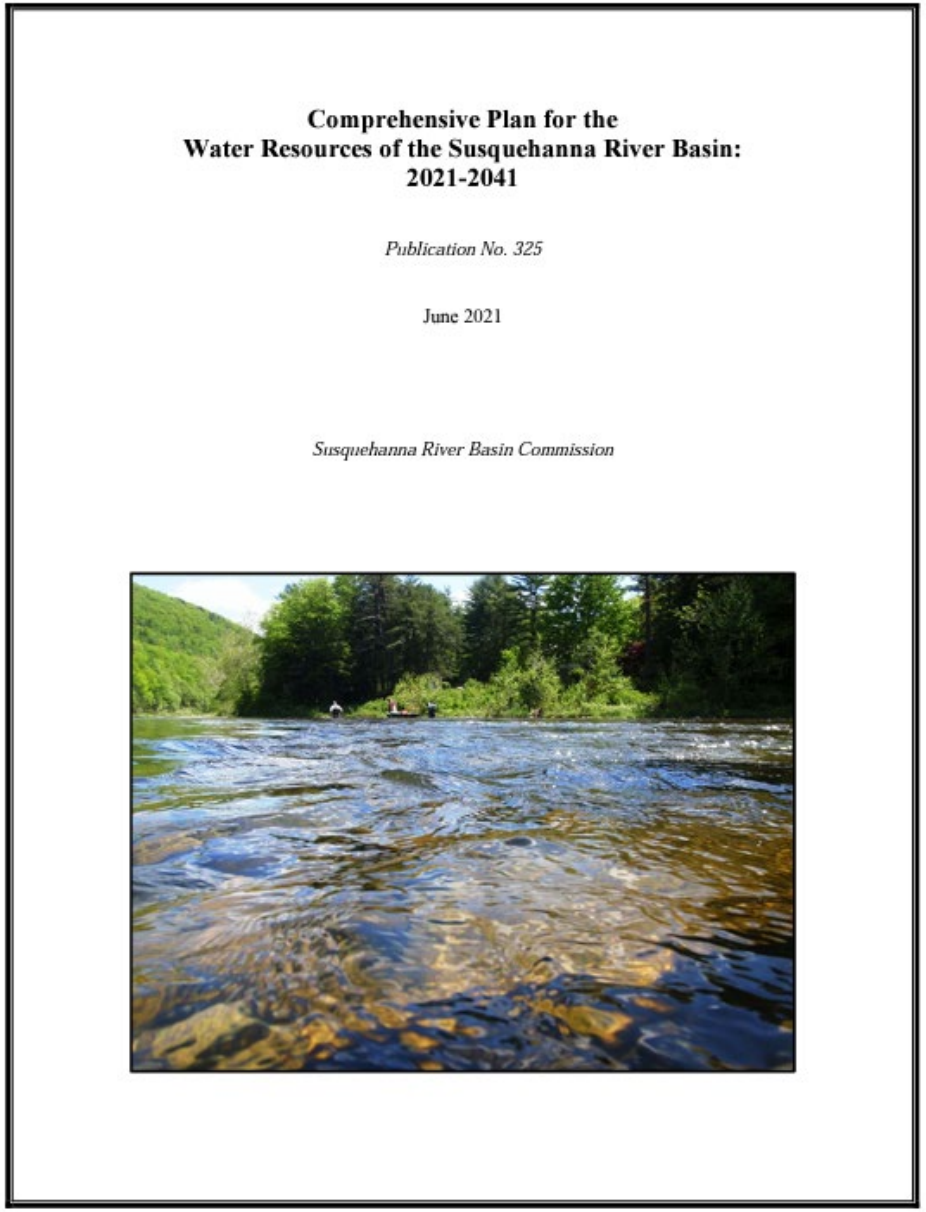
January 30th , 2026

SUSQUEHANNA RIVER BASIN COMMISSION

- FEDERAL-INTERSTATE COMPACT COMMISSION
- NEW YORK, PENNSYLVANIA, MARYLAND & UNITED STATES
- MISSION: ENHANCE PUBLIC WELFARE THROUGH COMPREHENSIVE PLANNING, WATER SUPPLY ALLOCATION & MANAGEMENT OF WATER RESOURCES OF BASIN

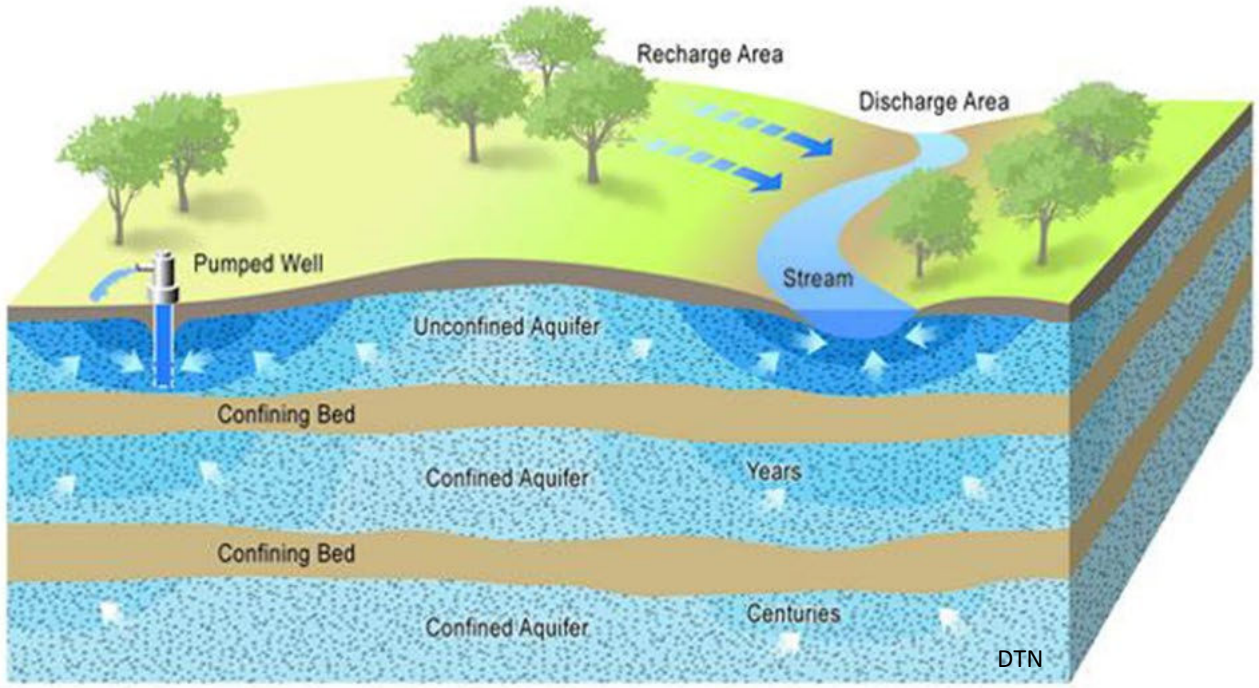


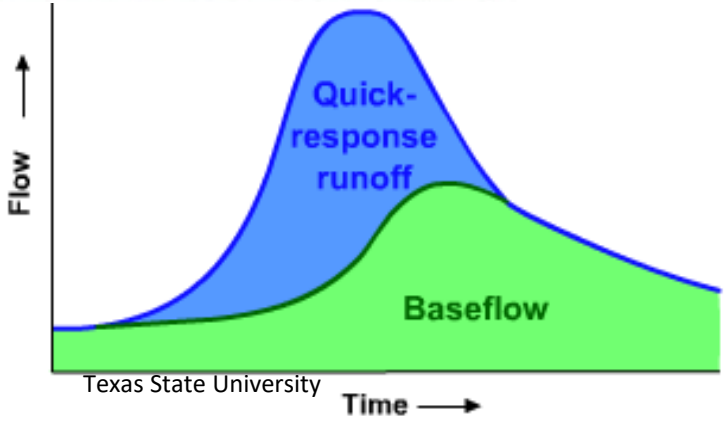
Planning Context



- Comprehensive Plan Objective D-1
  - Protect critical aquifer recharge areas
    - Identify and promote open space and other land uses that provide for increased groundwater recharge to enhance the resiliency of water supply, stream baseflow, and water temperatures.

DEFINITIONS





Texas State University

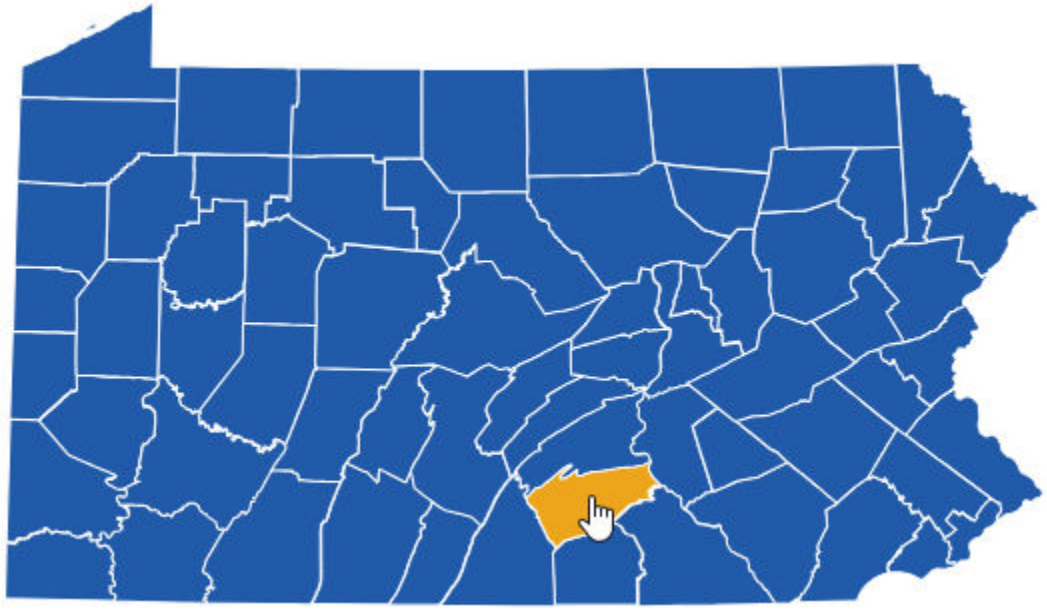
- <u>RECHARGE:</u> *THE ADDITION OF WATER FROM THE LAND SURFACE TO UNDERGROUND WATER-BEARING ZONES*
  - TYPICALLY FROM PRECIPITATION BUT COULD ALSO BE ARTIFICIAL
- <u>BASEFLOW:</u> *NON-RUNOFF PORTION OF STREAMFLOW SUSTAINED BY GROUNDWATER*
  - OFTEN USED AS AN APPROXIMATION OF RECHARGE
  - CAN BE MEASURED / ESTIMATED USING HYDROGRAPH SEPARATION TECHNIQUES

Why is Preserving Recharge/Baseflow Important?

- Water quality benefits
  - more infiltration/filtering and less runoff, erosion, sediment (phosphorus)
- Increased recharge = increased baseflow
  - cold-water contributions from groundwater/springs
  - Provides thermal refuge and sustained habitat (wetted area & depth) for cold-water species during hot/dry periods
- Increased drought resiliency
  - Ensures water is available in aquifers and streams for water supply during droughts

Why is Preserving Recharge/Baseflow Important?

- Increased recharge = increased water for streams and wells
  - Water quality benefits
  - Drought resiliency
  - Dairy cows drink 30-50 gallons of water a day – 100 head = 3,000 - 5,000 gallons a day = 1,095,000 - 1,825,000 gallons/year



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Farms (#): 149
Cows (#): 19,798
Average Herd Size: 133
Economic Impact (In Mil $): $475
Number of Jobs: 1,980

Recharge Potential vs. Recharge (rates)

- Recharge Potential
  - The **likelihood** of any land surface area accepting or limiting infiltration, regardless of available precipitation
    - Assessed relative to surrounding areas within user-defined area
- Recharge (rates)
  - The **amount** of water reaching underground water-bearing zones over a period of time (i.e. inches per year)
  - Ranges from 25.6 to 2.5 in/yr, on average, Basin-wide
  - Largely dependent upon climatic factors (precipitation and evapotranspiration)

Assessing Groundwater Recharge Potential

- GIS dataset developed to identify areas of greater and lesser recharge potential throughout the basin
- Composite layer includes:
  - Land Cover / Impervious Area
  - Land Surface Slope
  - Sand and Clay Content in Soils
  - Depth to Bedrock (Soil Thickness)
  - Drainage Density
  - Karst Features
  - Faults / Fractures

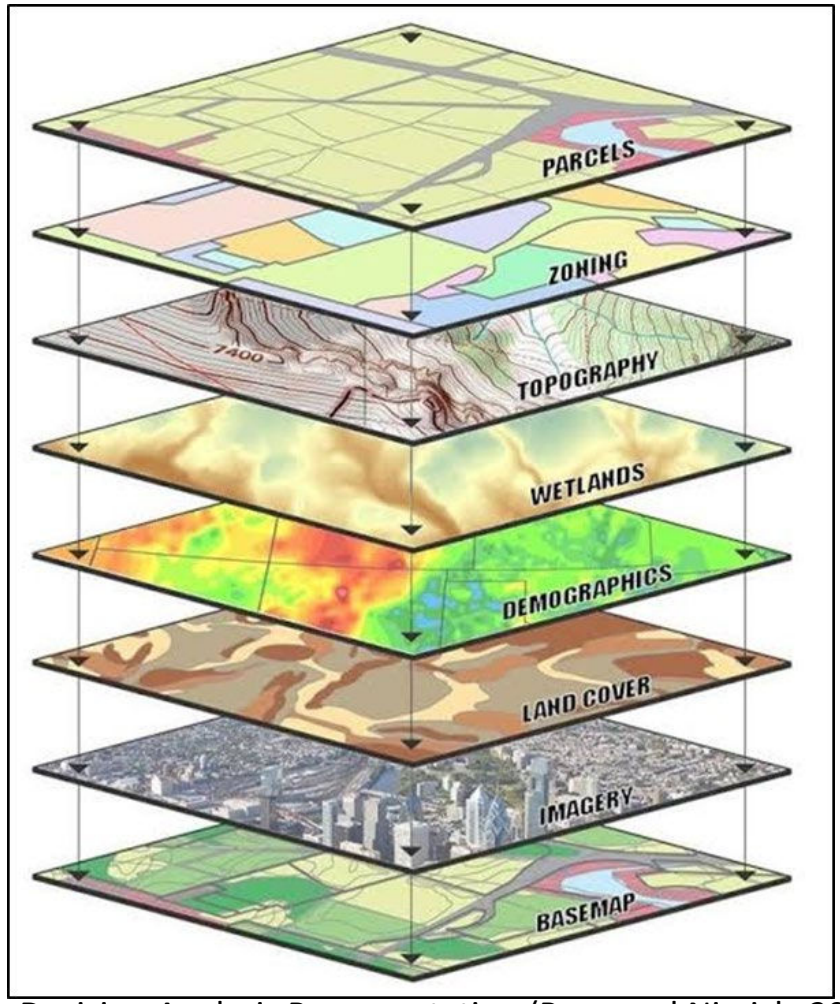
Study Goal(s)

- Develop a Geographic Information Systems (GIS) framework to identify areas of greater and lesser recharge potential throughout the basin

- Use the framework to delineate **Critical Aquifer Recharge Areas**
  - i.e. land surface areas that are responsible for a large fraction of recharge
    - by virtue of high aquifer permeability, soil characteristics, vegetative cover, and location with respect to discharge areas and/or withdrawals, topographic setting, or a combination of these

GIS Framework: Multi-Criteria Decision Analysis

- Each data layer's (raster) cell/pixel (standardized) value is multiplied by the weight or "percent influence"
- Values are summed for each overlapping cell/pixel for a composite output/index
  - I.E. "recharge potential"



Multi-Criteria Decision Analysis Representation (Ryan and Nimick, 2019)

Variables Used in Assessing Recharge Potential

Informed by physical basin characteristics used in regional regression equations to predict baseflow (recharge) in ungaged watersheds

Requirements:

- Geospatial coverage for the entire basin
- Data accessible without site visit, or proprietary information
- Consistent spatial scale (30x30 m) fine enough to identify discrete areas

First-Level Factors	Weight	Second-Level Factors	Weight	Data Source
Land Cover / Terrain	40	Impervious Area	25	USGS (2019) National Land Cover Dataset
		Land Surface Slope	15	USDA NRCS SSURGO Database
Shallow-Subsurface Geology	20	Percent Sand	15	USDA NRCS SSURGO Database
		Percent Clay	2.5	USDA NRCS SSURGO Database
		Depth to Bedrock	2.5	USDA NRCS SSURGO Database
Structural / Bedrock Geology	40	Drainage Density	25	SRBC calculated from USGS (2019) National Hydrology Dataset (NHD)
		Karst Density	10	DCNR-PGS (2003) Density of Mapped Karst Features
		Fault Density	5	Isachsen and McKendree (1977); Berg and others (1980)

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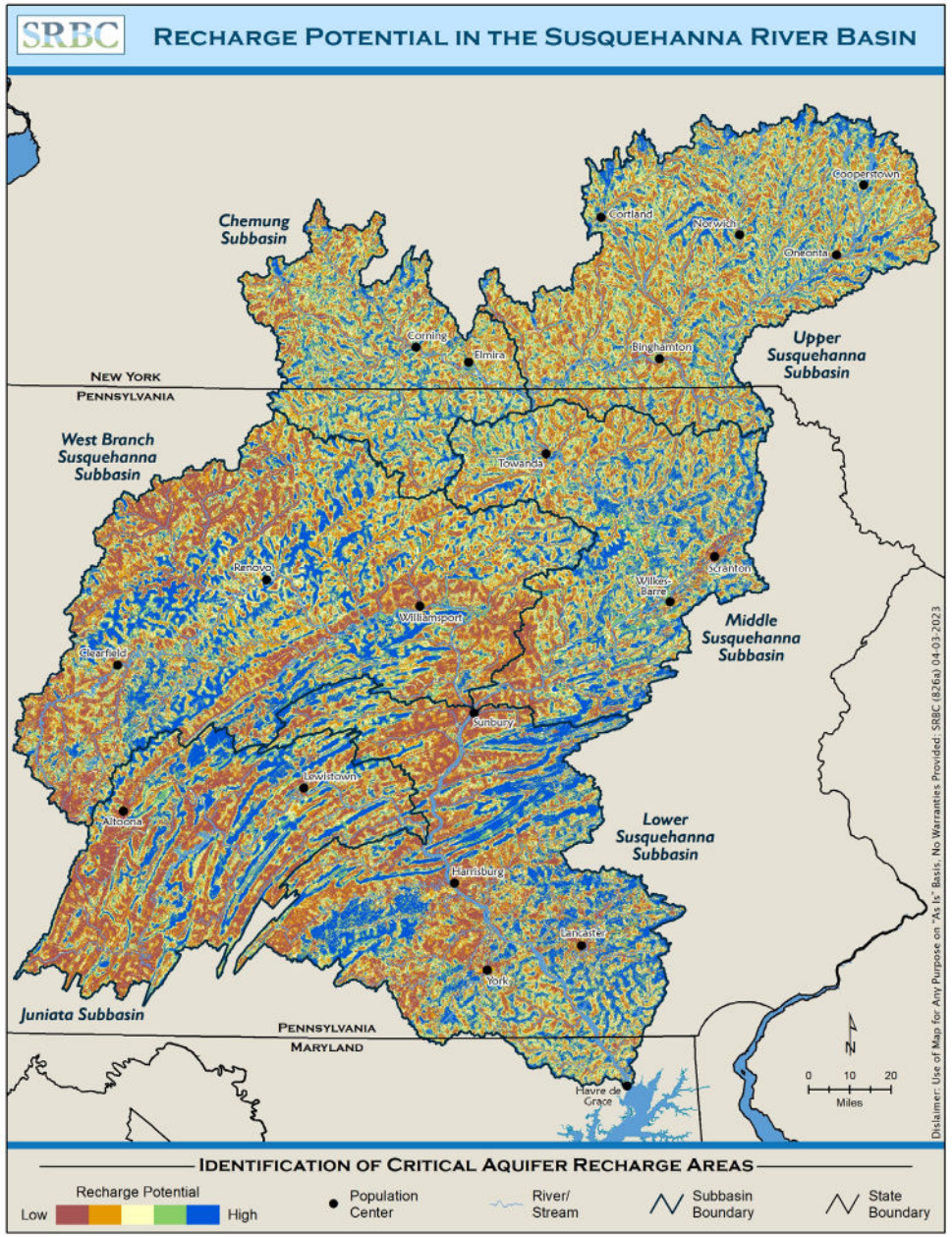
- Each pixel has a recharge potential index value ranging from 100 (low) to 500 (high)



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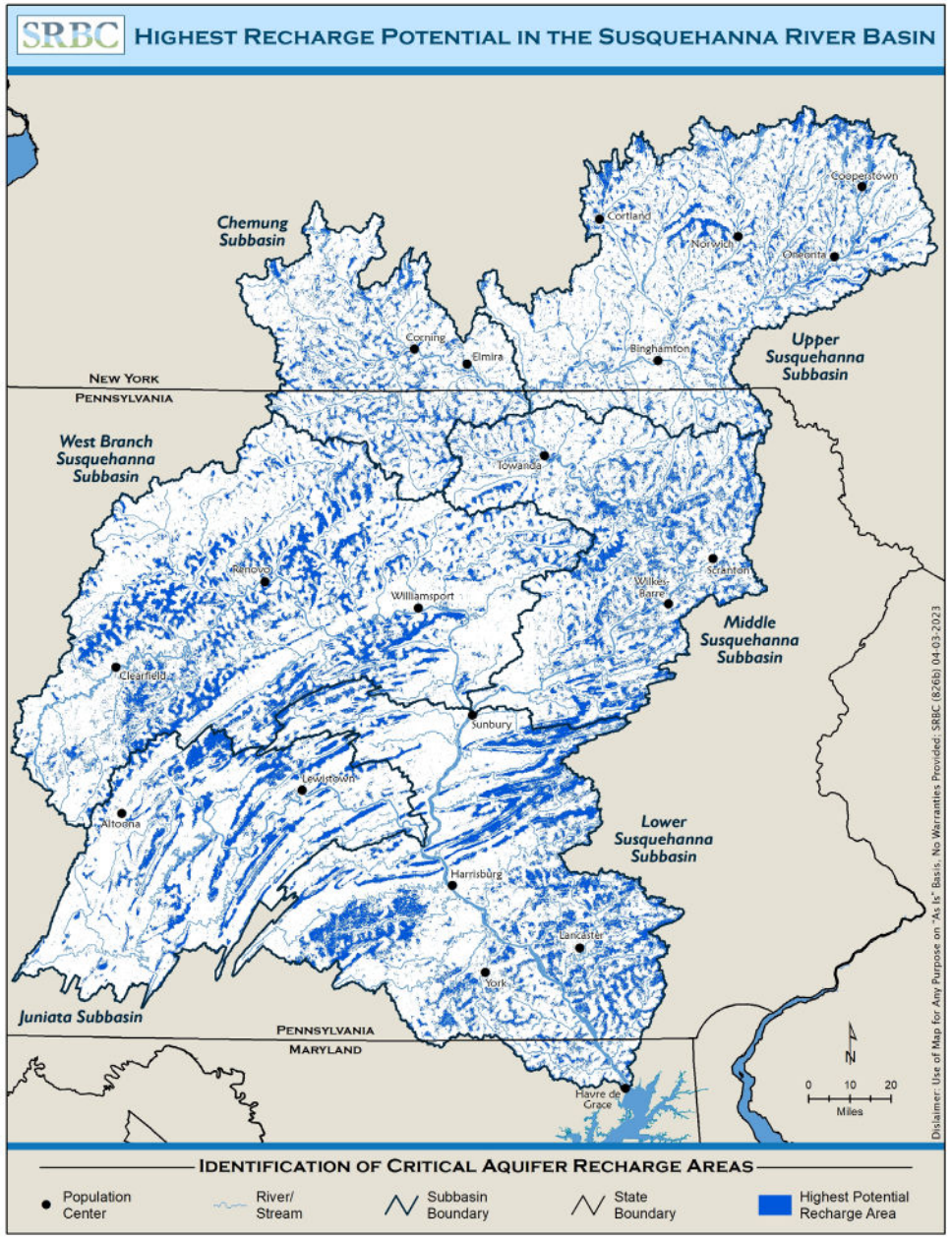
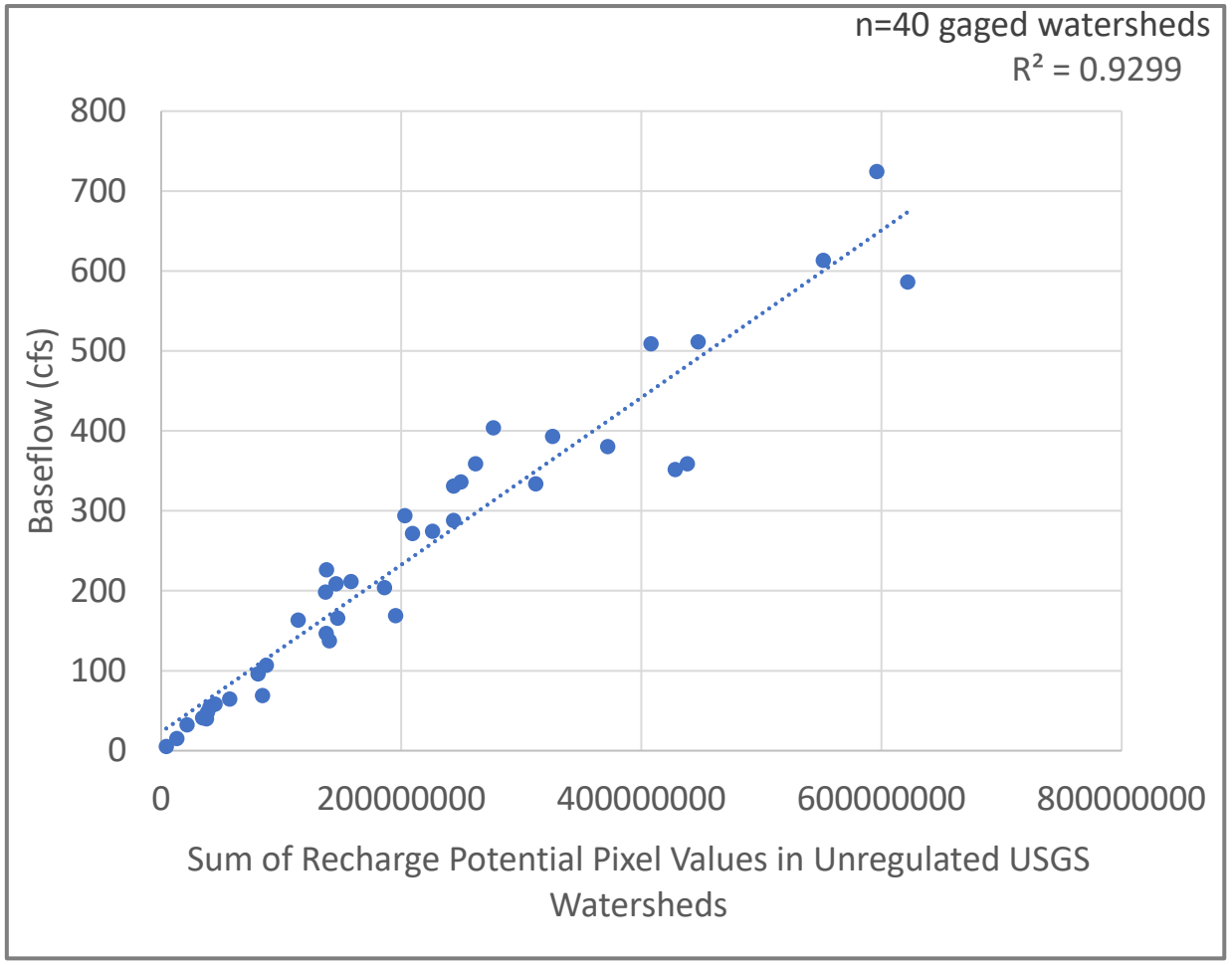
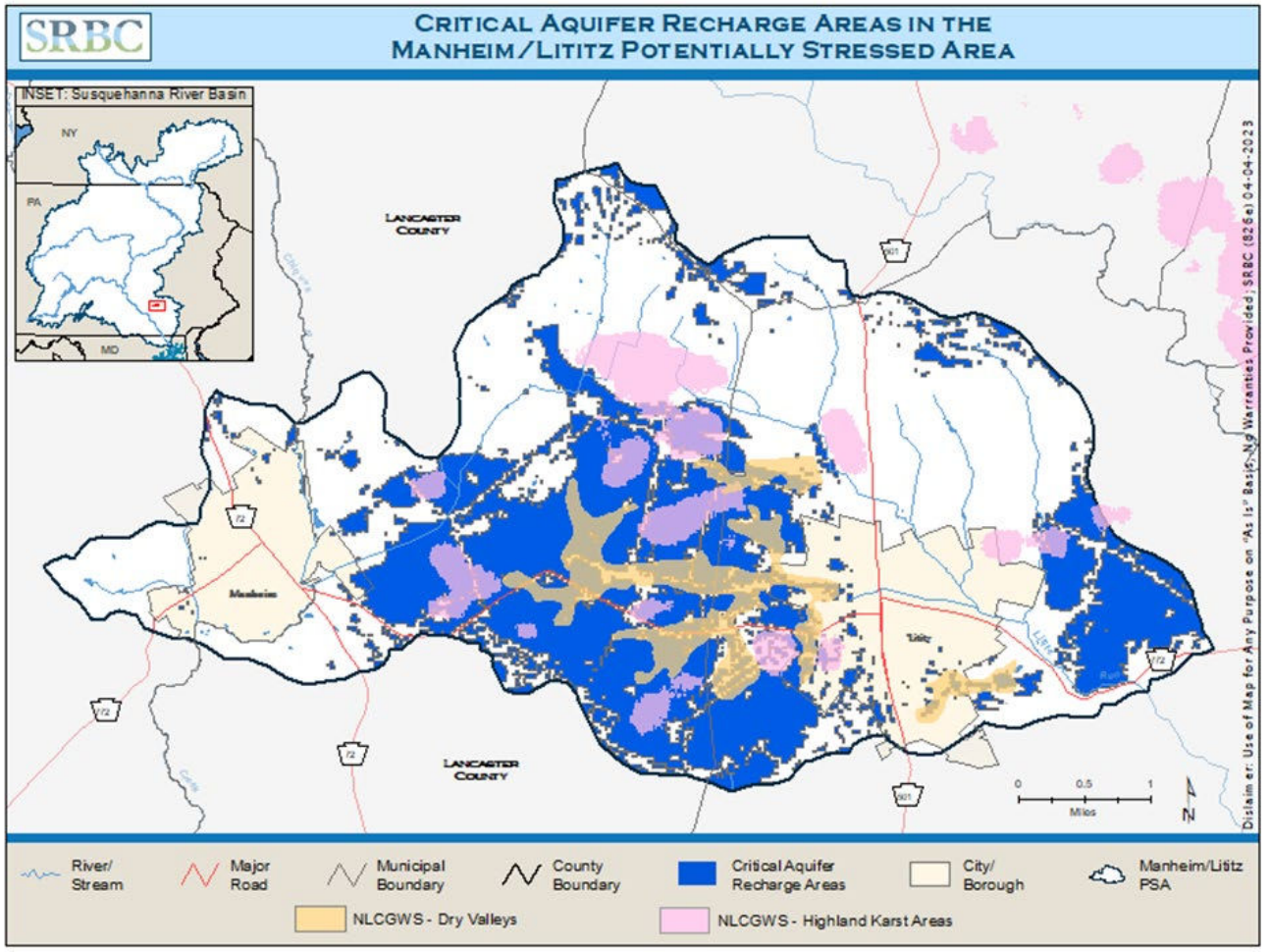
- Highest recharge potential described by upper 20% of pixel values.



Desktop Verification

- The sum of all "recharge potential" pixels within a watershed can predict average annual baseflow (recharge) within 19.7% (average standard error)
- Comparison of High Recharge Potential Areas and Critical Aquifer Recharge Areas Identified in Northern Lancaster Groundwater Study (Edwards and Pody, 2005)





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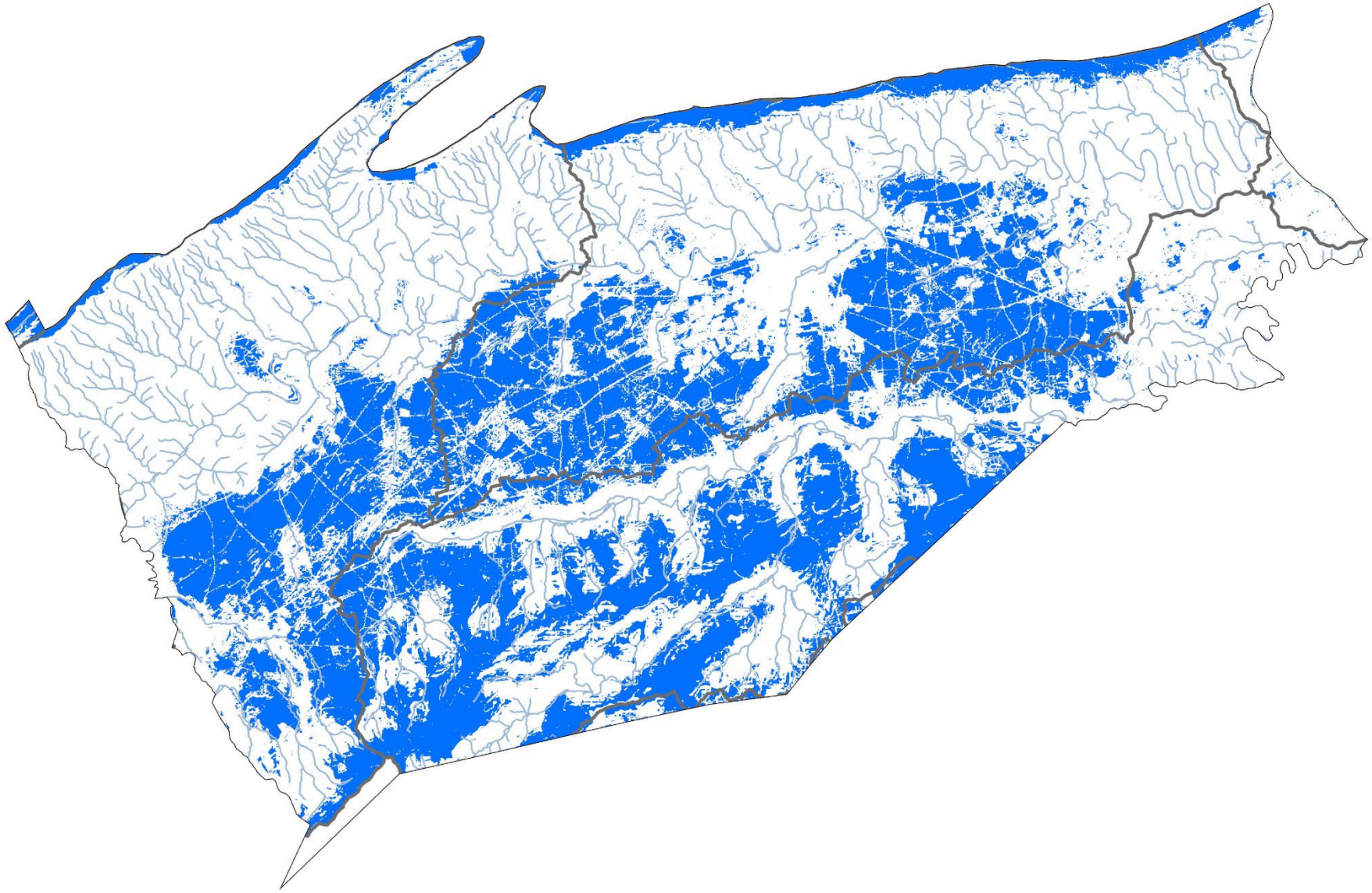

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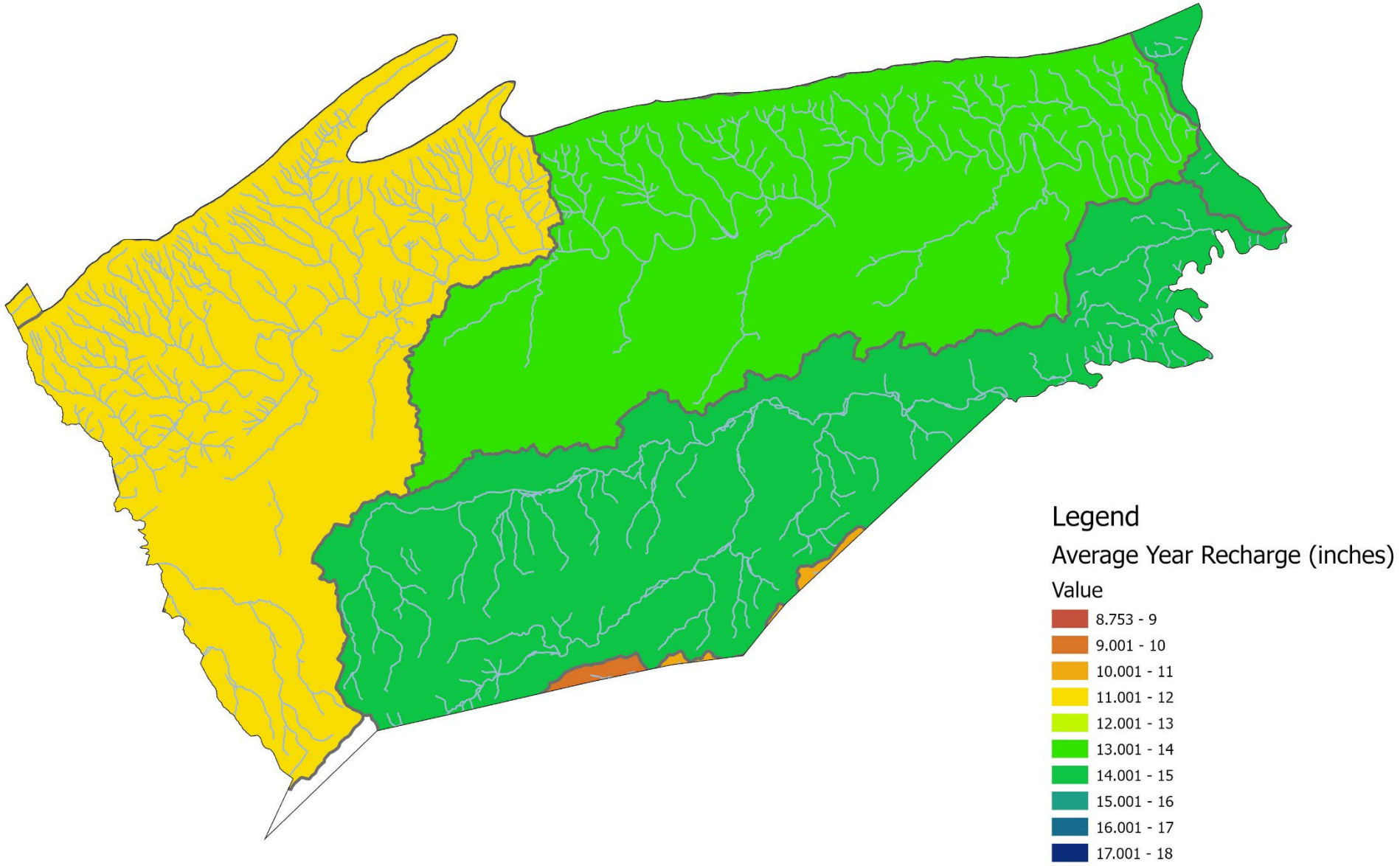

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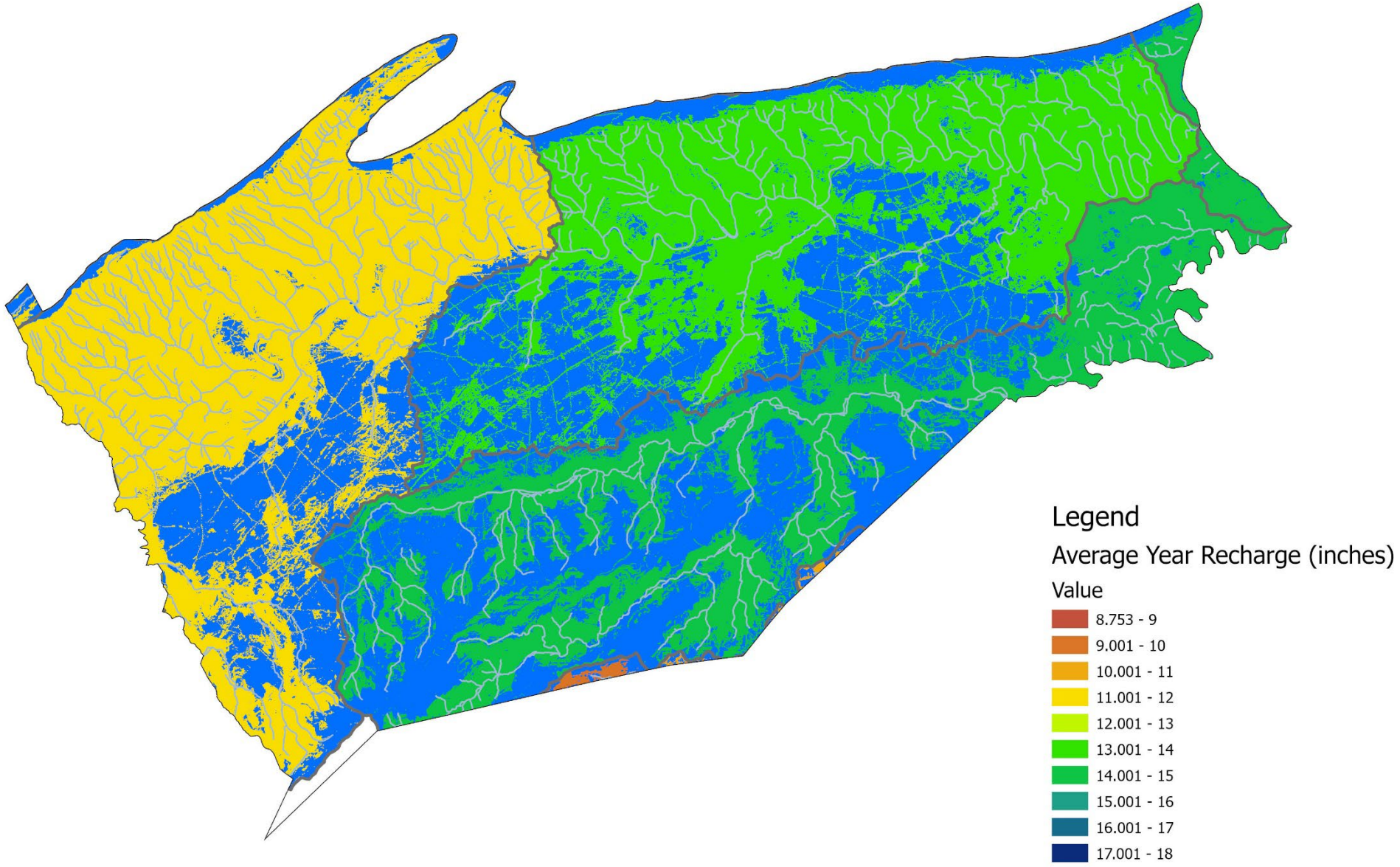

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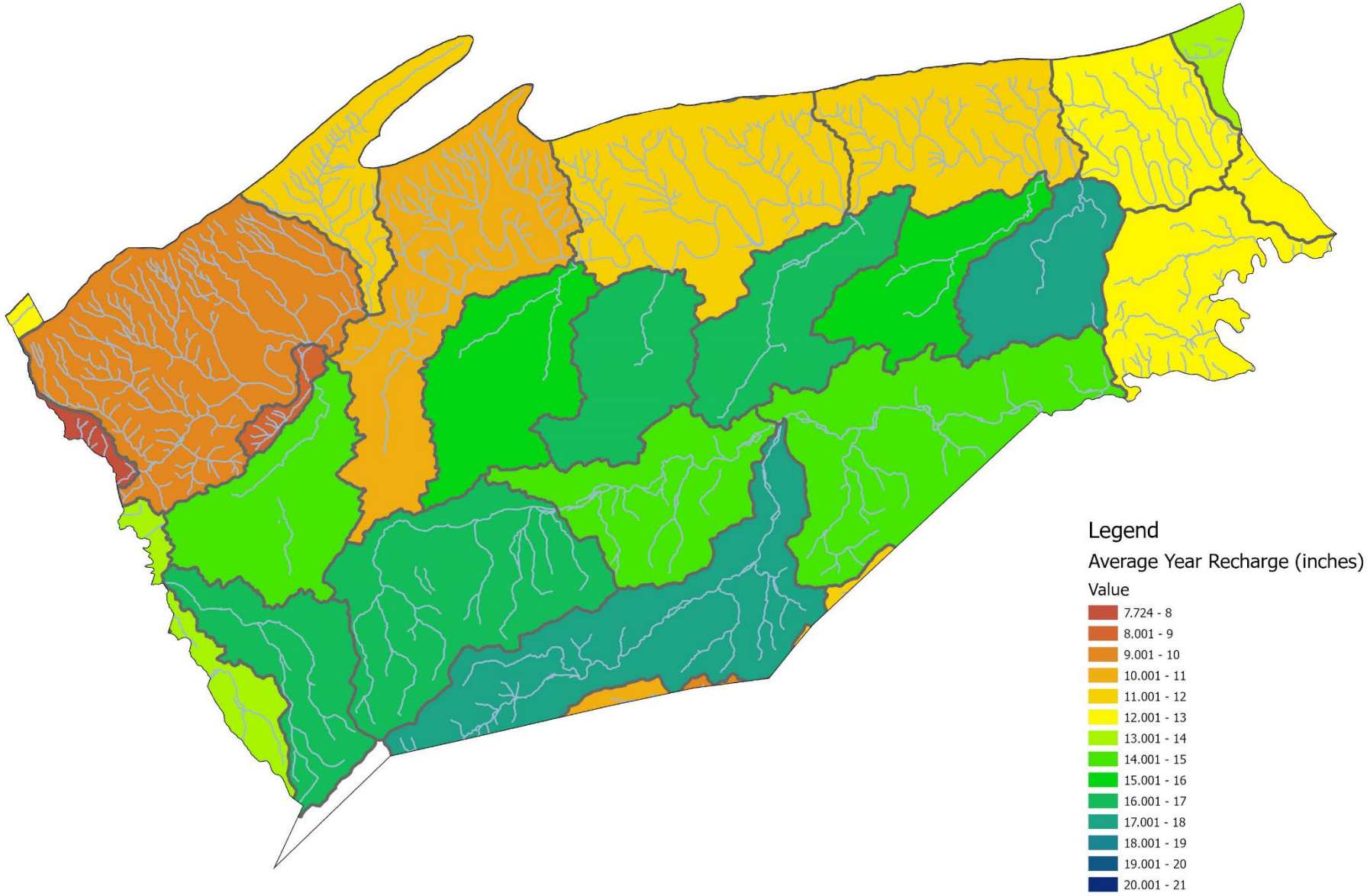

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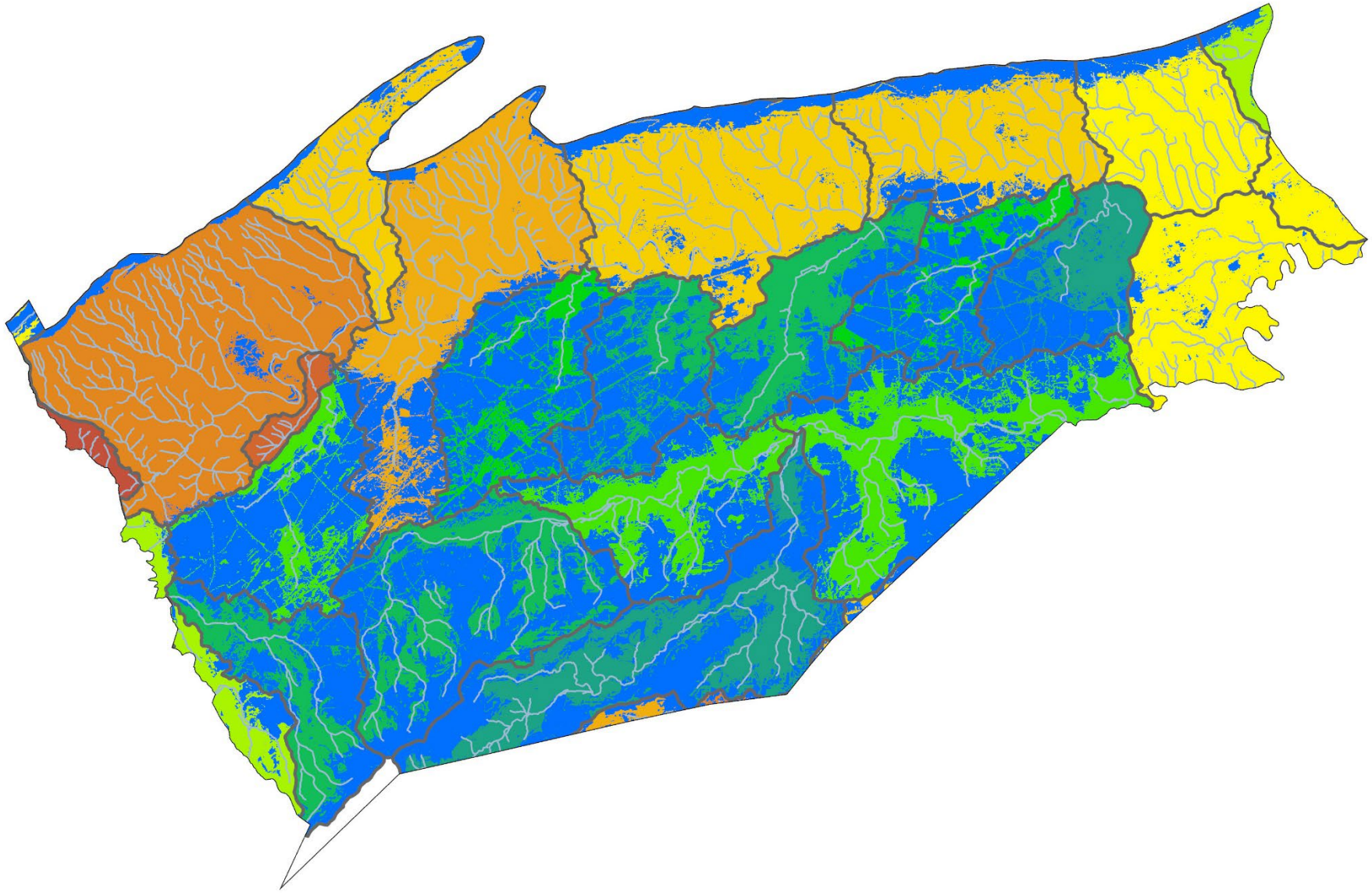
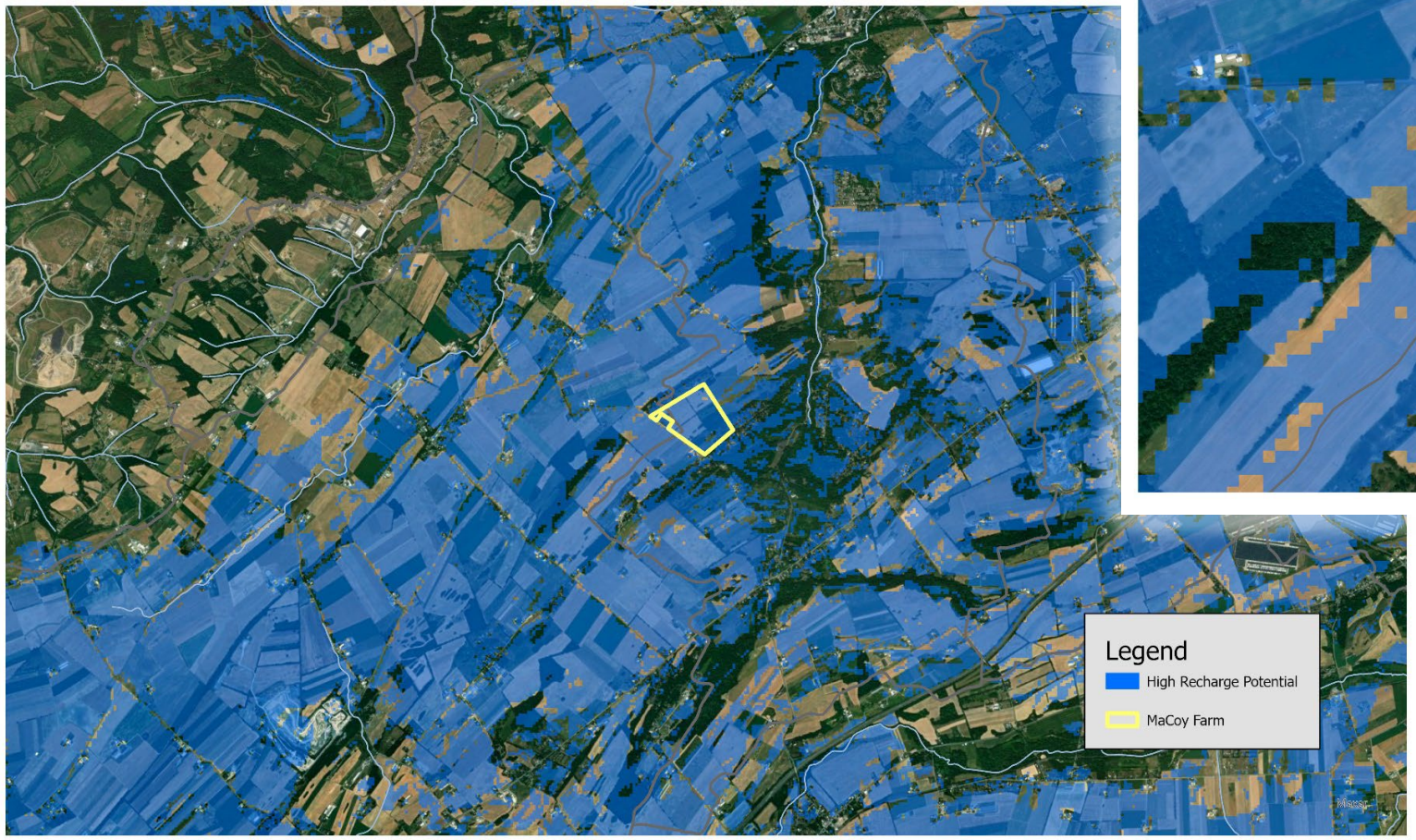
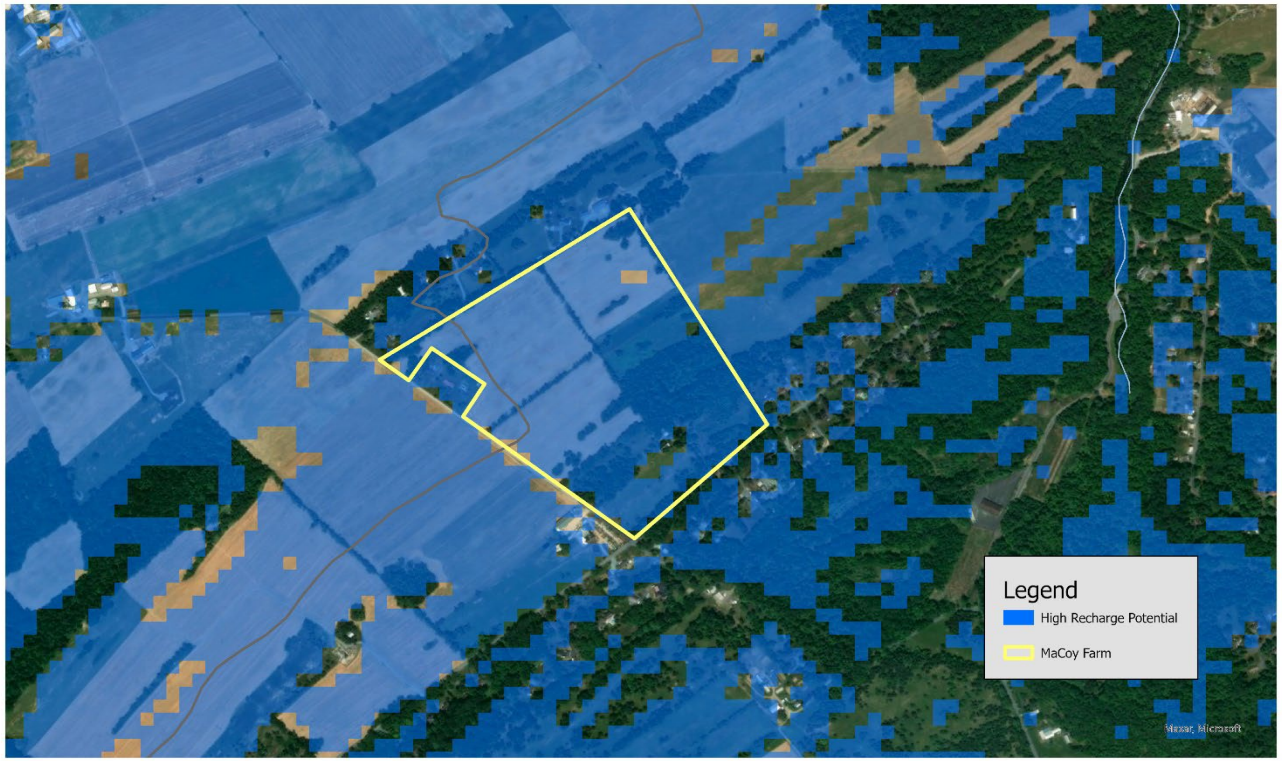


Local Applications: Big Spring Creek Watershed

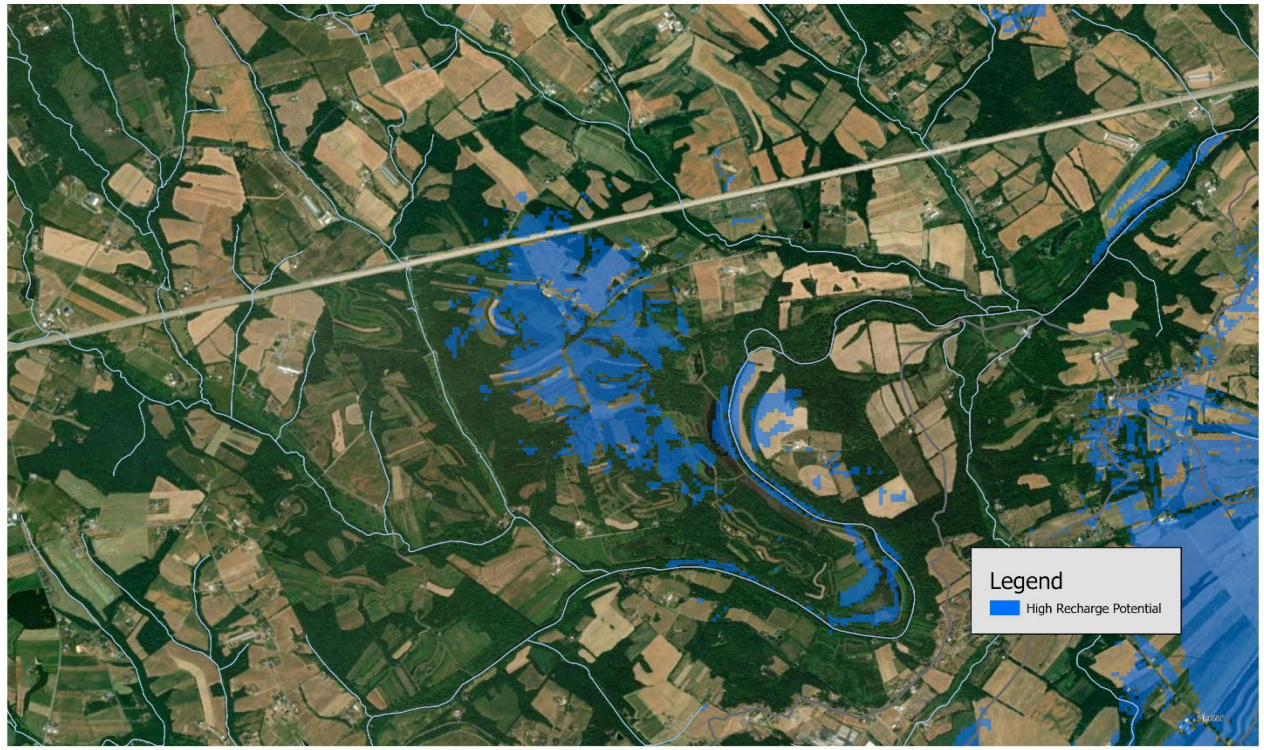
- MaCoy Farm – 80 Acres
- LOCATED IN THE VALLEY PROVIDING CRITICAL GROUNDWATER RECHARGE FOR WELLS AND STREAMS USED IN AGRICULTURE AND WATER SUPPLY





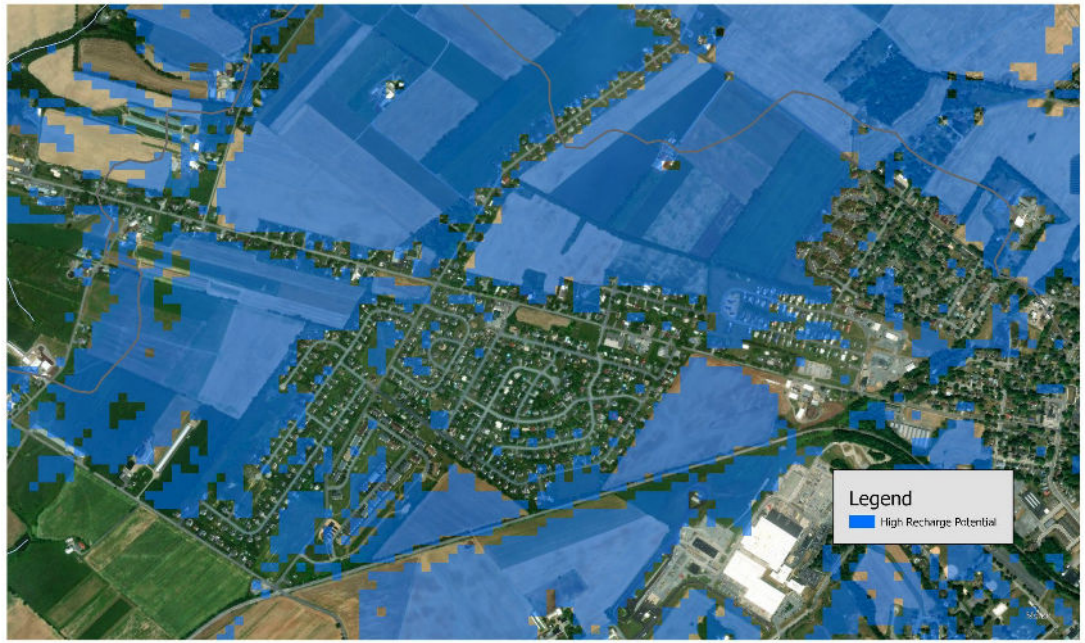
Local Applications: Conodoguinet Creek Watershed

- Isolated recharge areas
- Provide a majority of recharge



Local Applications: Developed Areas

- Developed areas need more recharge focused stormwater plans to maintain recharge capacity. Water quality may be an issue



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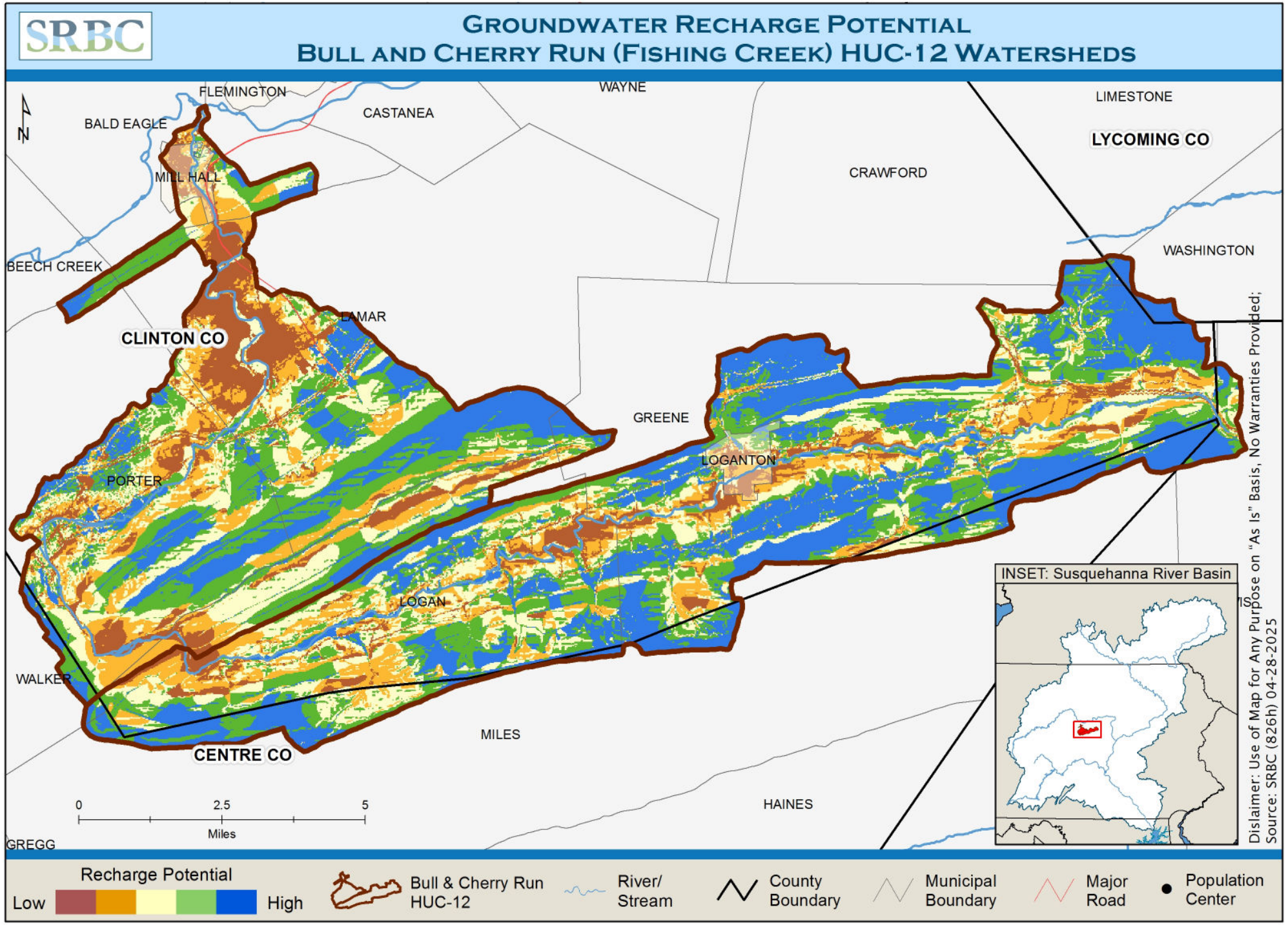
Groundwater Recharge Potential
Bull and Cherry Run (Fishing Creek) HUC-12 Watersheds



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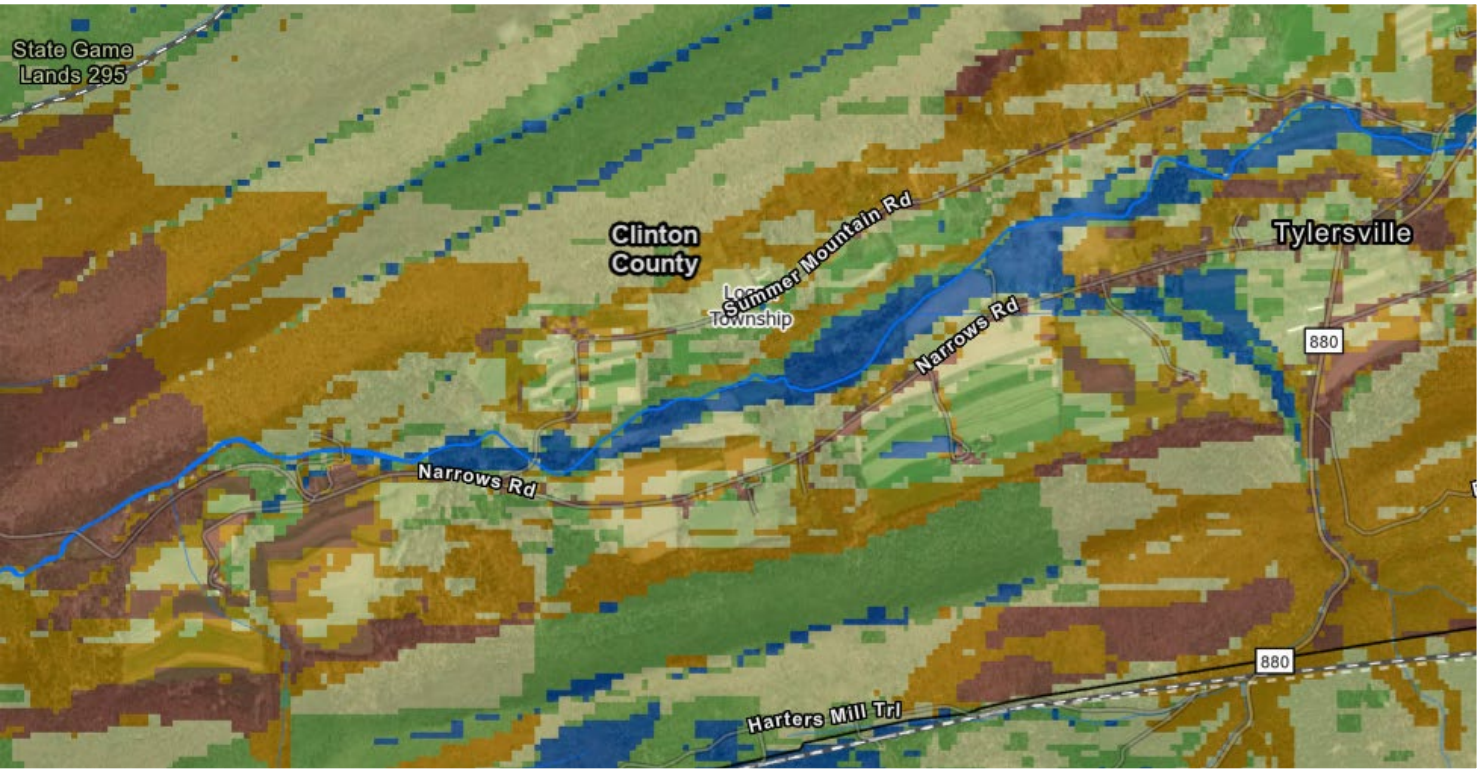
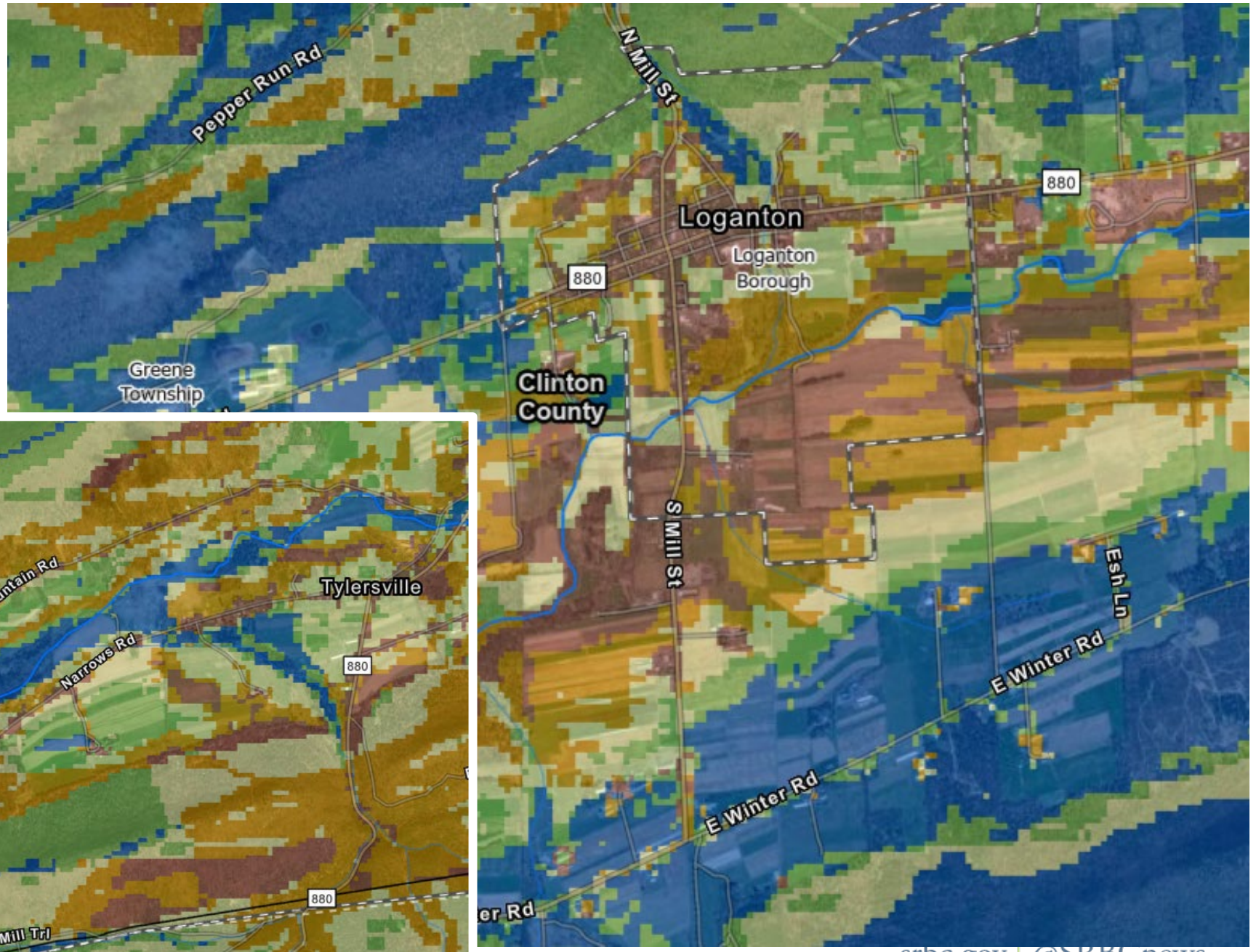
Recharge Potential at Local Scale

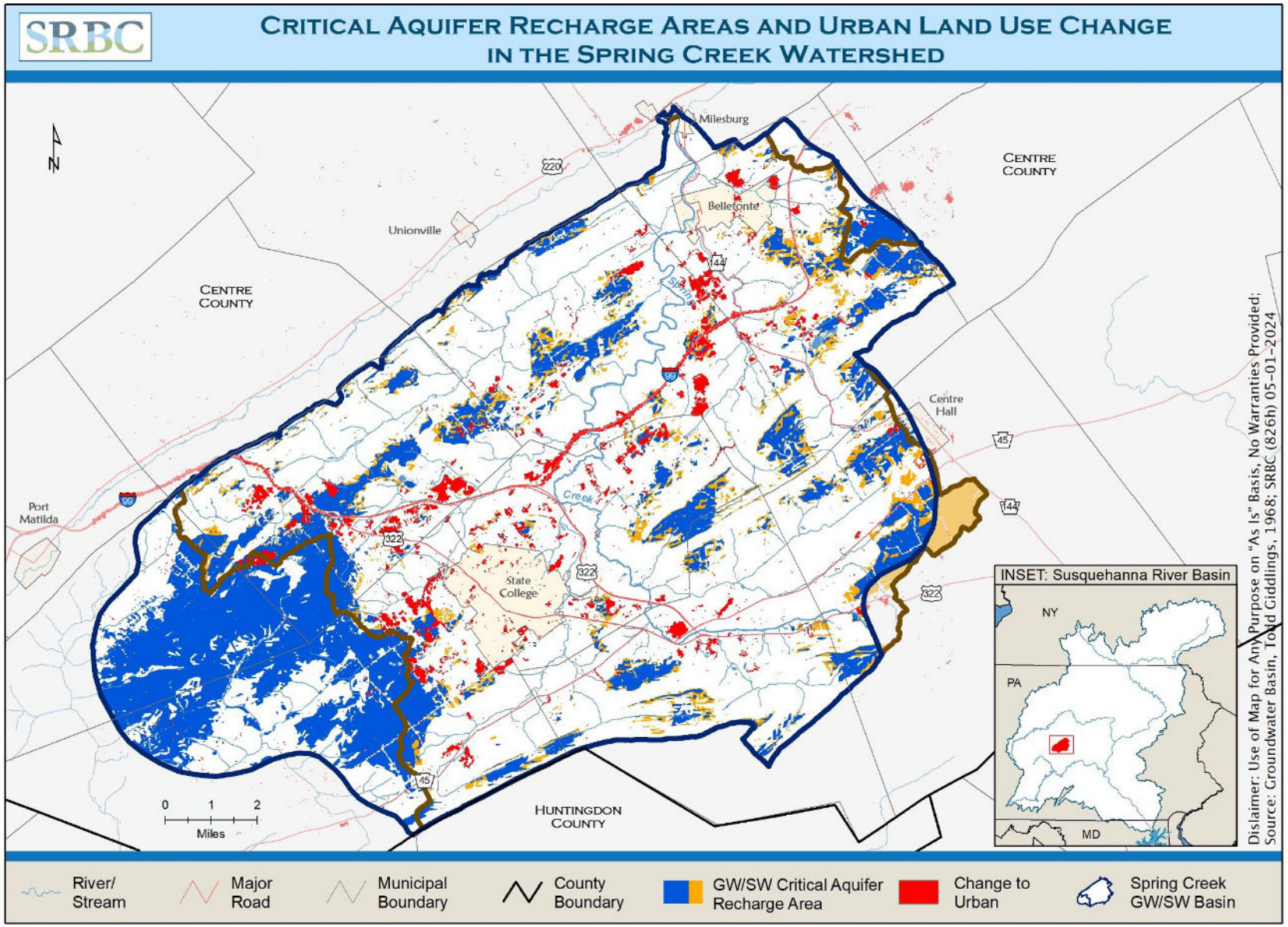
- Karst features become important





Local Applications: Critical Aquifer Recharge Area (CARA) Delineation

- Resampling in smaller user-defined areas where water supply has become more-limited amid development and increasing impervious cover
- Results are relative to all areas/characteristics within boundary
- Identify highest recharge potential in areas with otherwise limited, or increased recharge potential



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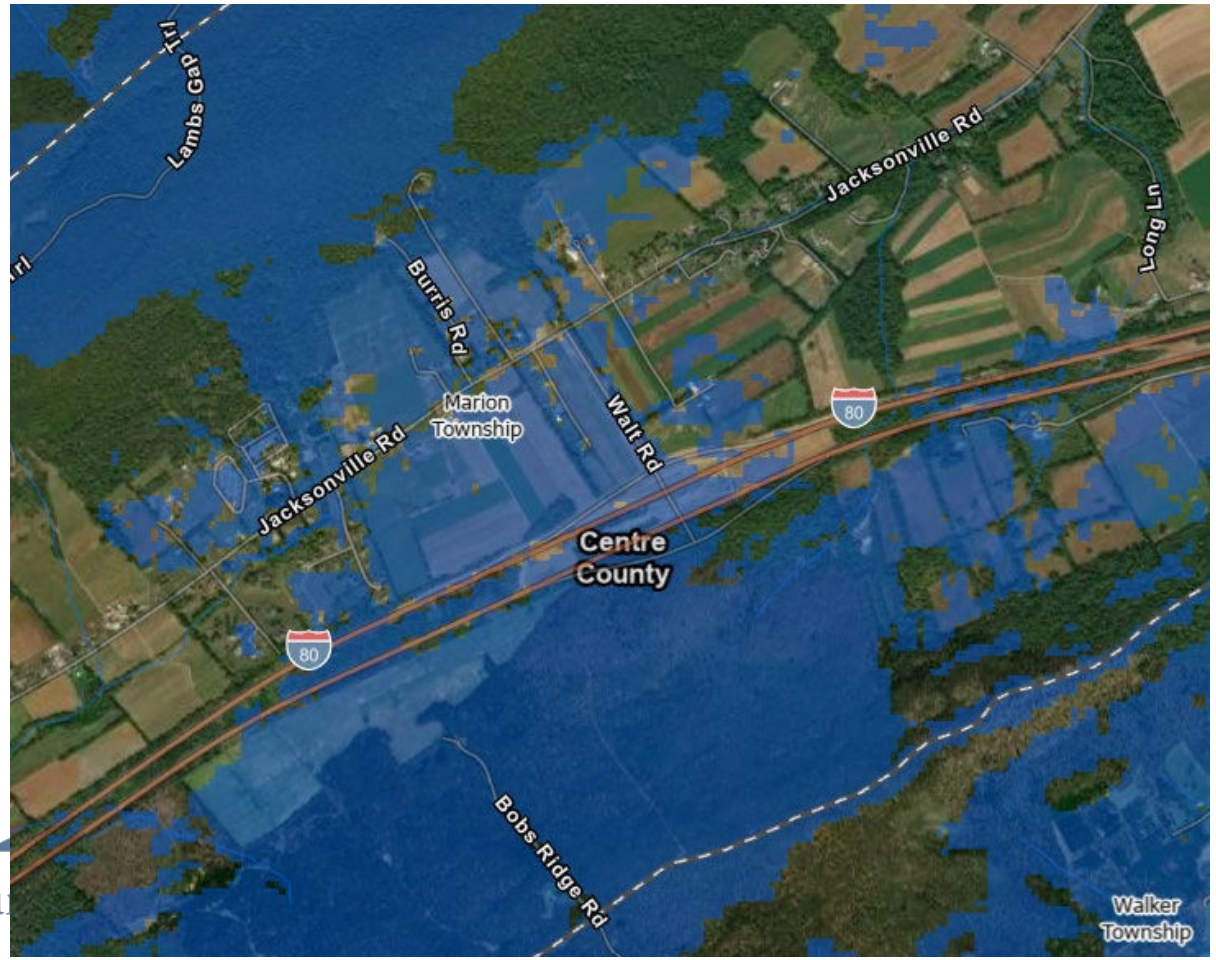
Use Cases: Centre County

- Centre Region Planning Agency – CARA Integration into (updated) Future Land Use Map
  - Used to inform "growth"

- Centre County Planning – informing local zoning/land-use decisions
  - Proposed re-zoning from agriculture to commercial for local access (I-80) interchange



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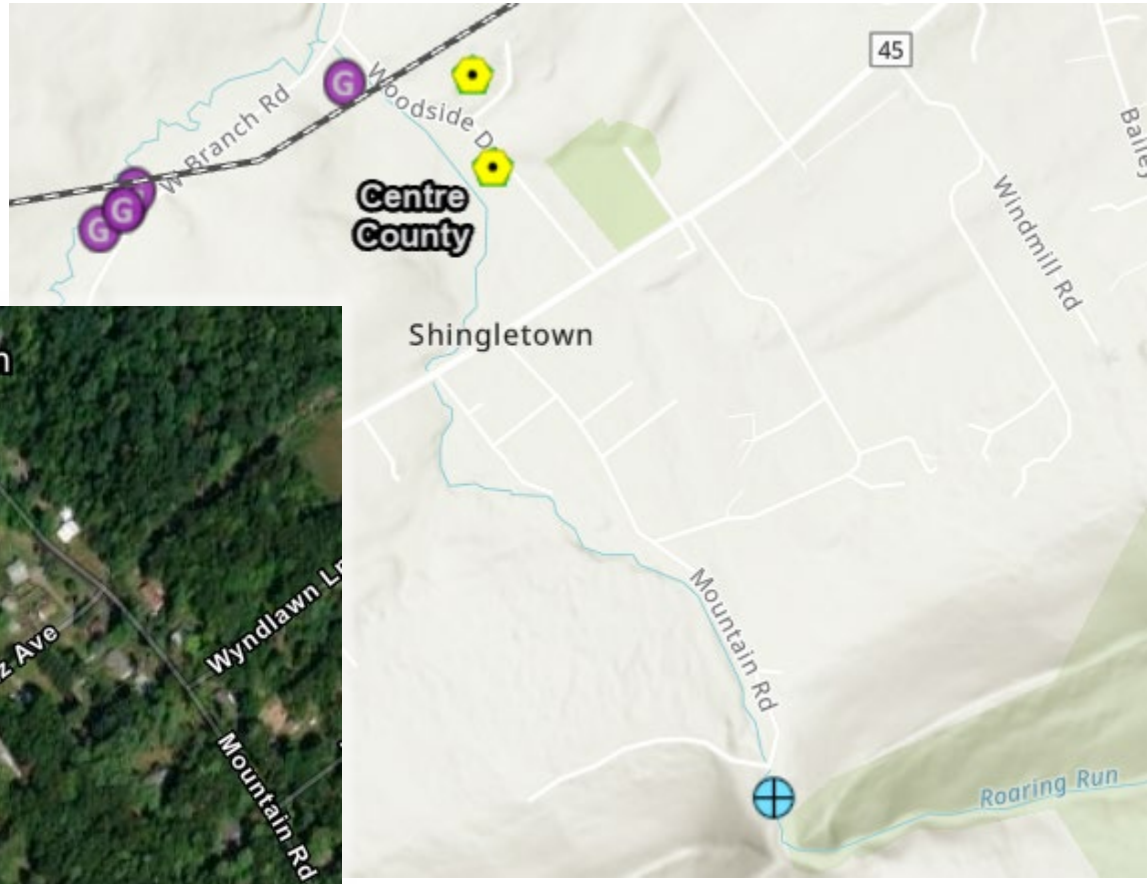
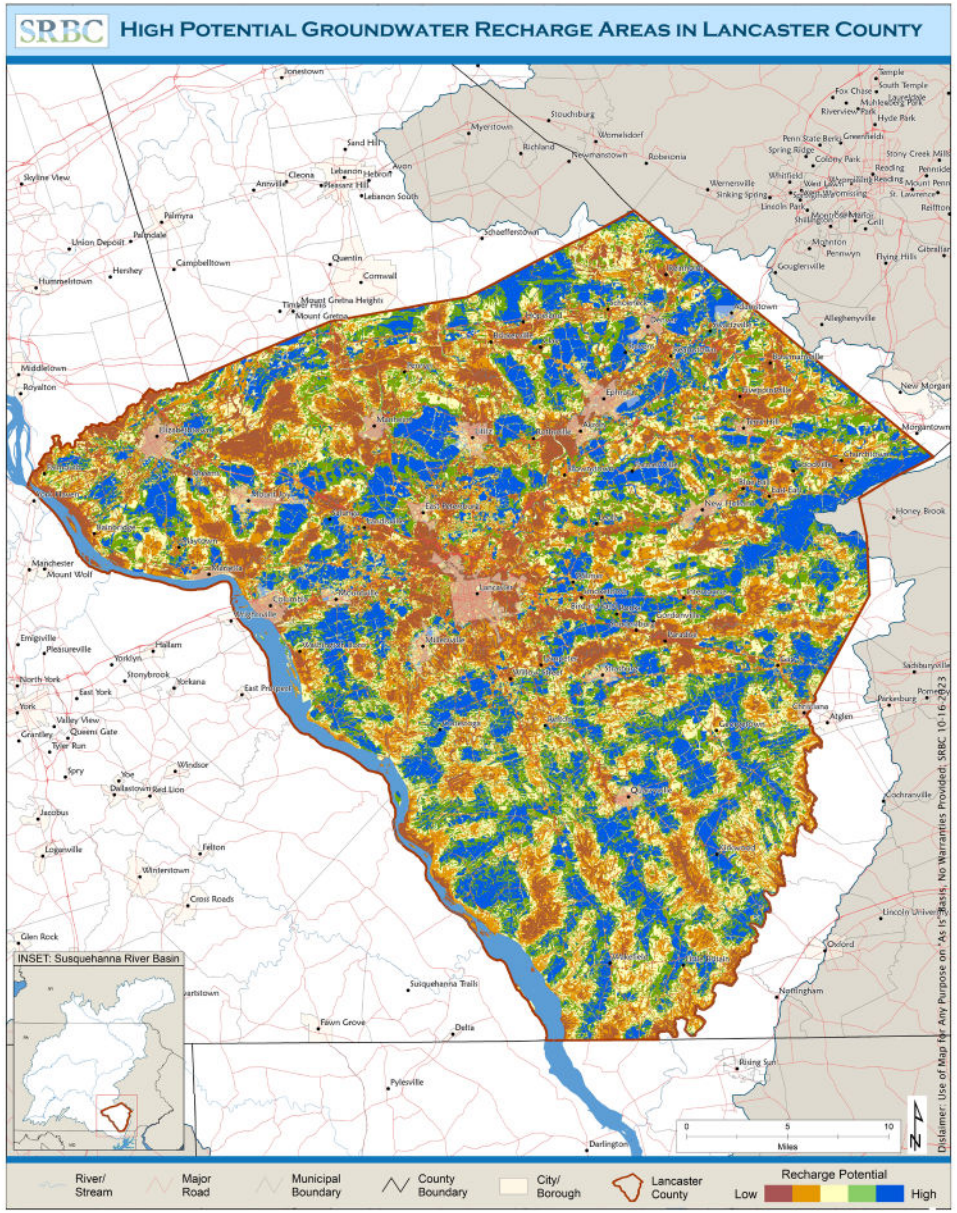
Use Cases: Hess Farm, Spring Creek Watershed

- Prioritizing purchasing/acquisition of conservation easements

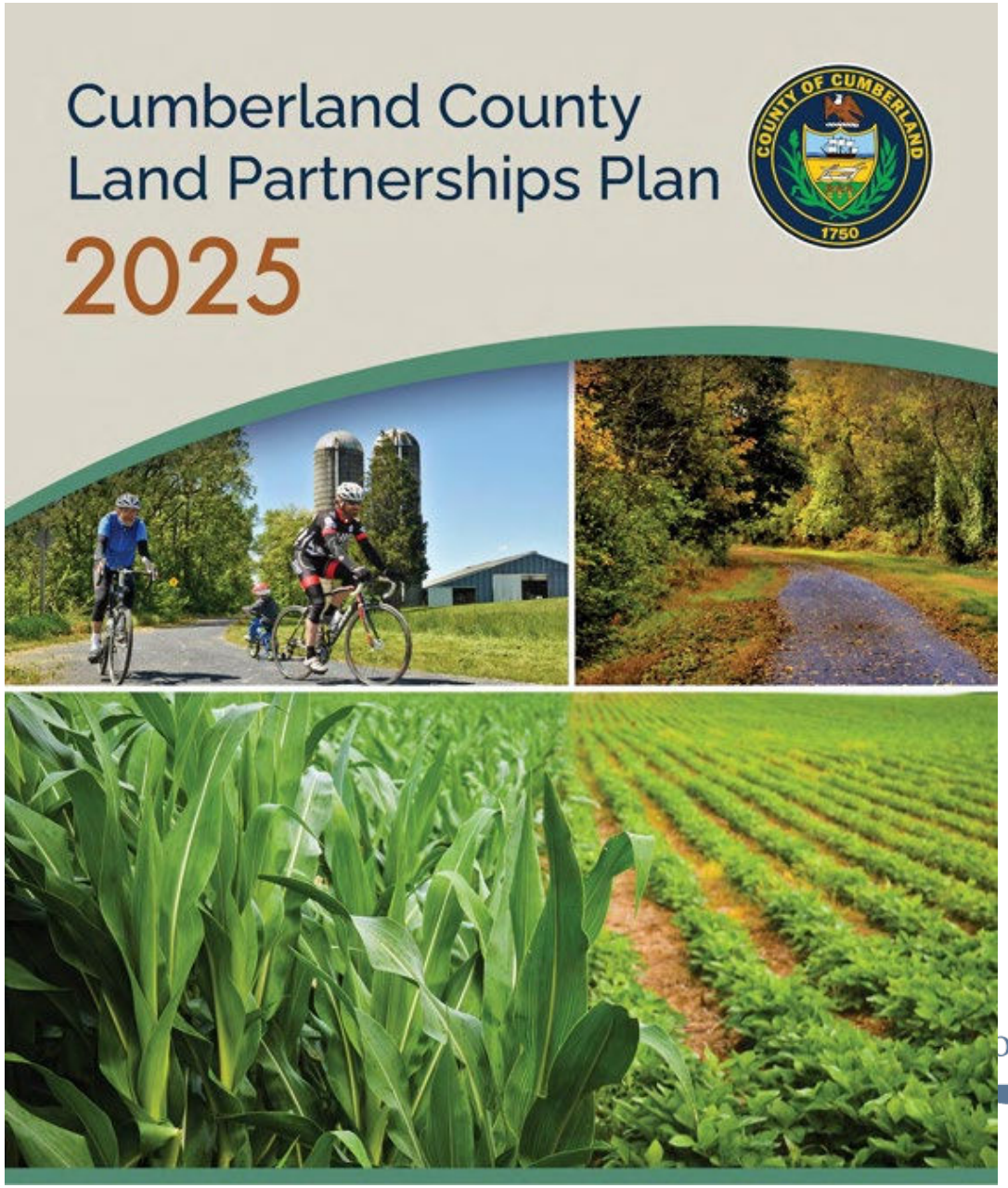


Use Cases: Lancaster County

- Lancaster County Agricultural Preserve Board
  - Prioritization of easements
- Little Conestoga Integrated Water Resource Management Study
  - Identification of:
    - Large Parcels for CARA conservation
    - Aquifer/stormwater recharge enhancement projects



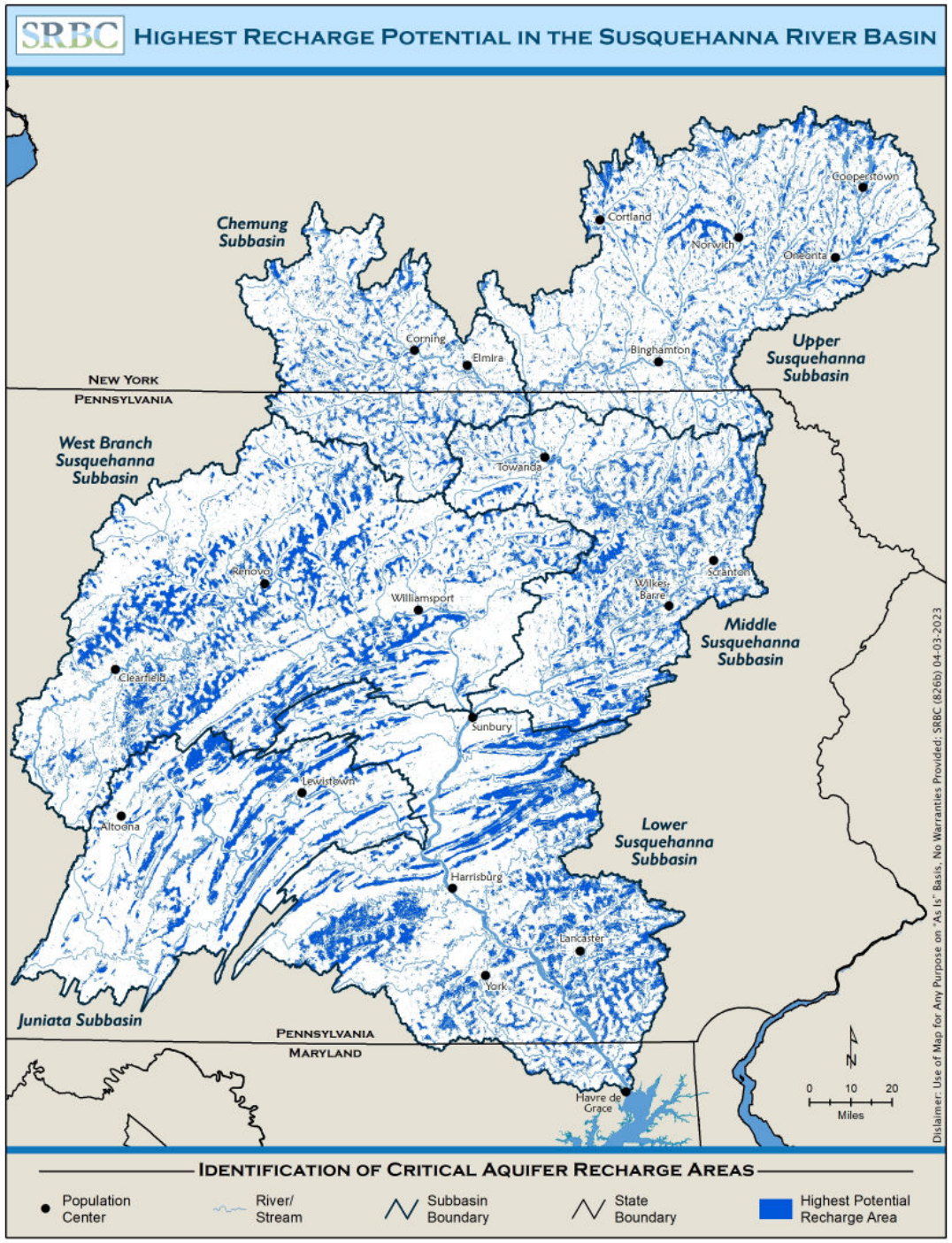
Use Cases: Cumberland County



- **Strategy 4: Preserve the County's Critical Aquifer Recharge Areas**
  - Identify priority recharge areas with SRBC and pursue preservation funding
  - Develop model ordinances to guide land use
  - Integrate CARA into Agriculture Conservation Easement Purchase Program
  - Educate municipalities and residents on recharge area protection

Use Cases: Rock Lititz, Lancaster County

- Leveraging/enhancing dry stream valleys for stormwater infiltration
  - Alternative BMP for NPDES permitting - Stormwater Discharges Associated with Construction



- HIGHEST RECHARGE POTENTIAL DESCRIBED BY UPPER SUBSET (20%) OF PIXEL VALUES
- PROVIDES THE MAJORITY OF RECHARGE
- AREAS OF CRITICAL RECHARGE
- STORMWATER IS AN ASSET TO RECHARGE AQUIFERS

PRESERVING CRITICAL AQUIFER RECHARGE AREAS WILL SECURE WATER SUPPLY FOR COMMUNITIES, FARMERS AND INDUSTRY

Product Availability

- Datasets available for download at the Pennsylvania Spatial Data Access (PASDA) geospatial data portal
  - Groundwater Recharge Potential
  - Highest Groundwater Recharge Potential Areas
- Additional information available on the Commission's website
  - Preview layers on the Susquehanna Atlas
- If a local assessment of recharge potential in any region, county, watershed, or other scale is desired, a request can be made through the Commission's website

Funding Opportunities

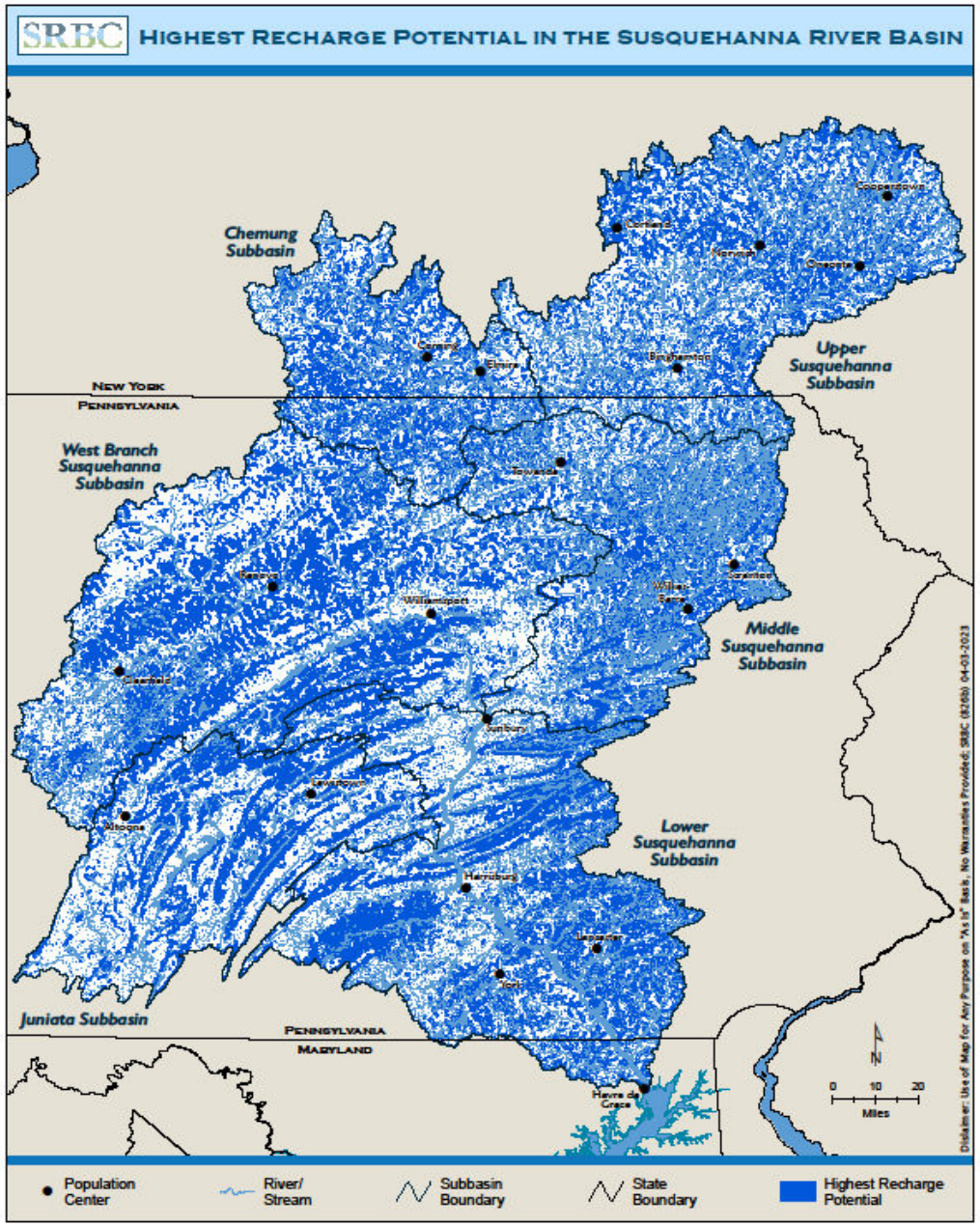
Consumptive Use Mitigation Grant

Purpose

- Attract & fund projects that help mitigate consumptive use or otherwise improve drought resilience in the Susquehanna River Basin.

What's New

1. Applications are limited to one per organization.
2. A primary water quantity benefit must be submitted.
3. The Groundwater Replenishment Alternatives (GRAs) project type has replaced the Environmental and Water Quality Alternatives (EWQAs) category.



Eligible Applicants

- Project Sponsors
- Local, State, and Federal Government Entities
- Tax-Exempt Non-Profit Organizations
- Institutions of Higher Education

LCSWMA

Penn State

Eligible Projects

- **Water Supply Alternatives.**
  - Impoundments, quarries, mine pools, interconnections.
- **Project Operation Alternatives.**
  - Conservation releases, aquifer storage & recovery, conjunctive use management, drought response actions.
- **Demand Modification Alternatives.**
  - Water conservation, water reuse, or recycling.
- **Groundwater Replenishment Alternatives.**
  - Groundwater recharge, critical aquifer recharge areas preservation, stormwater management (infiltration).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Example Project: Water Supply

- Billmeyer Quarry, Lancaster County, PA.
- Inactive flooded limestone quarry.
- 425 Mgal of water supply storage for low flow management.
- Public-private partnership.

Example Project: Project Operations

- Public or private reservoir.
- Operations revised to implement low flow augmentation and/or acceptable conservation release.
- More natural flow regime restored in downstream reach.

Montour Preserve

Example Project: Demand Modification

- Industrial water user with cooling towers.
- Implement water conservation technology to reduce evaporative losses.
- Improved water savings and plume abatement.

Example Project: Groundwater Replenishment

- 100-acre property acquisition.
- 30-acre wetland and riparian buffer restoration.
- Property to be dedicated as state land.
- Multi-agency/conservation group partnership.

Funding

- Total grant funding: $4M - $6M.
- Individual project funding: $100k or more.
- **Minimum cash match: 20%.**
- Grant period of performance: 3 years.


Talen Energy


USACE

Schedule

Grant Application Opens:	November 3, 2025
Grant Application Closes:	January 30, 2026
Grant Application Review:	February - March 2026
Grant Awards Announced:	April 2026
Grant Agreements Executed:	July 2026

Questions

For more information visit SRBC's website: www.srbc.gov

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