

3D Geologic Modeling Tool for Watershed Planning

Cannon River Watershed

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Minnesota Geological Survey

3/2/2023, Southeast GIS User Group Meeting



UNIVERSITY OF MINNESOTA

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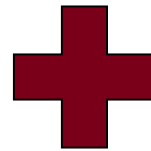
Outline

- GRAPS program
- County Geologic Atlas Mapping Program
- MGS & MDH GRAPS Pilot Projects
- Project watersheds and products
- Mapping and compilation methods for Quaternary and Bedrock
- Compiled watershed maps and texture dot models
- Model discussion
- Questions and answers





Minnesota Department of Health
(MDH)



Minnesota Geological Survey
(MGS)

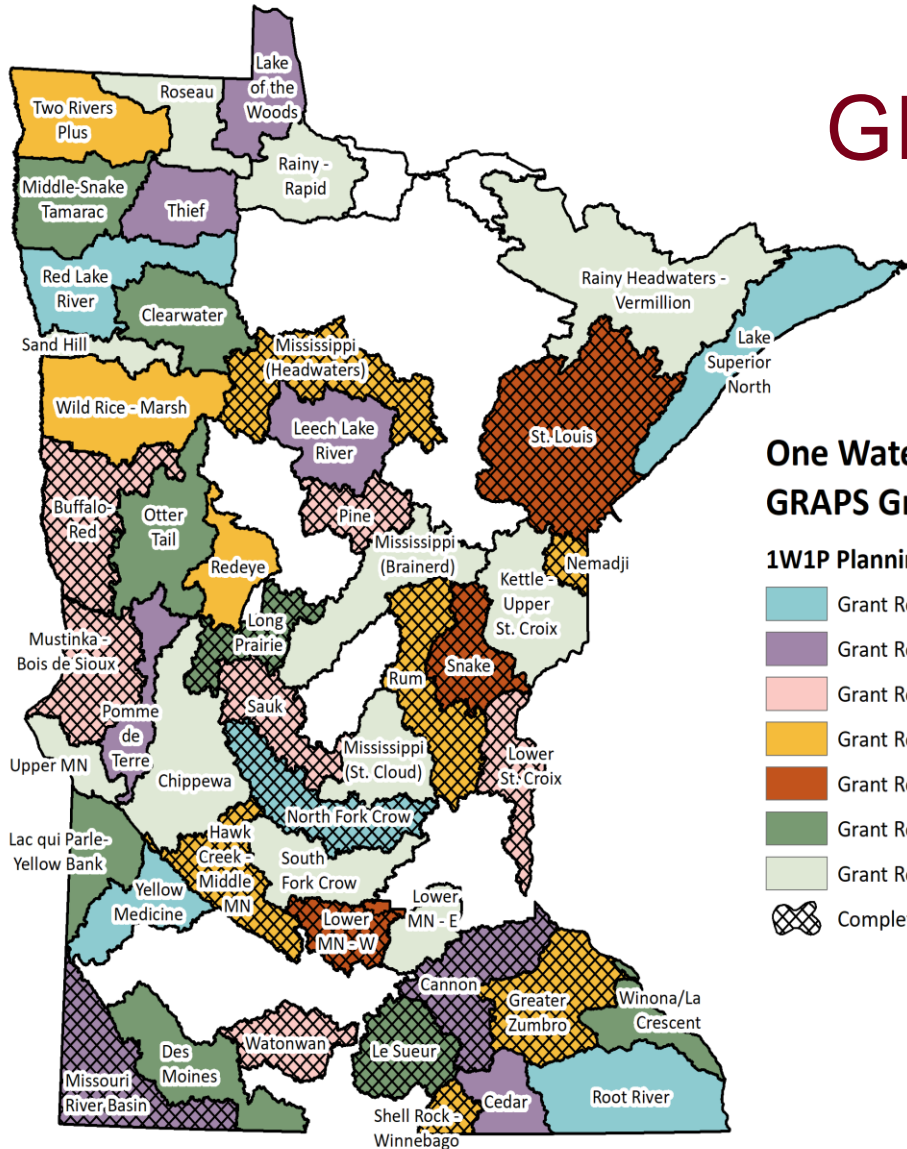
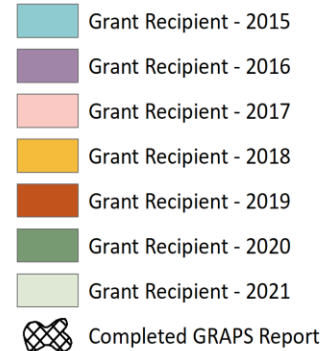


GRAPS

- What is GRAPS?
- What is GRAPS for?
- Who participates in the GRAPS program?

One Watershed, One Plan: GRAPS Grant and Report Status

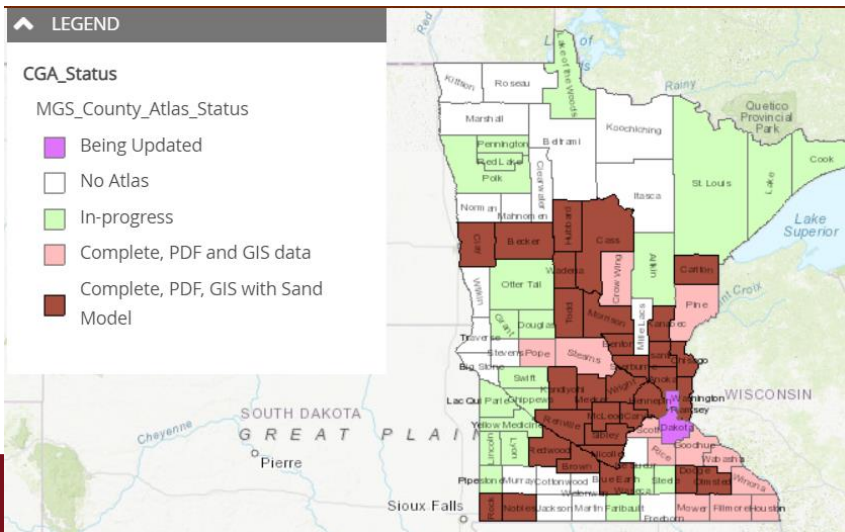
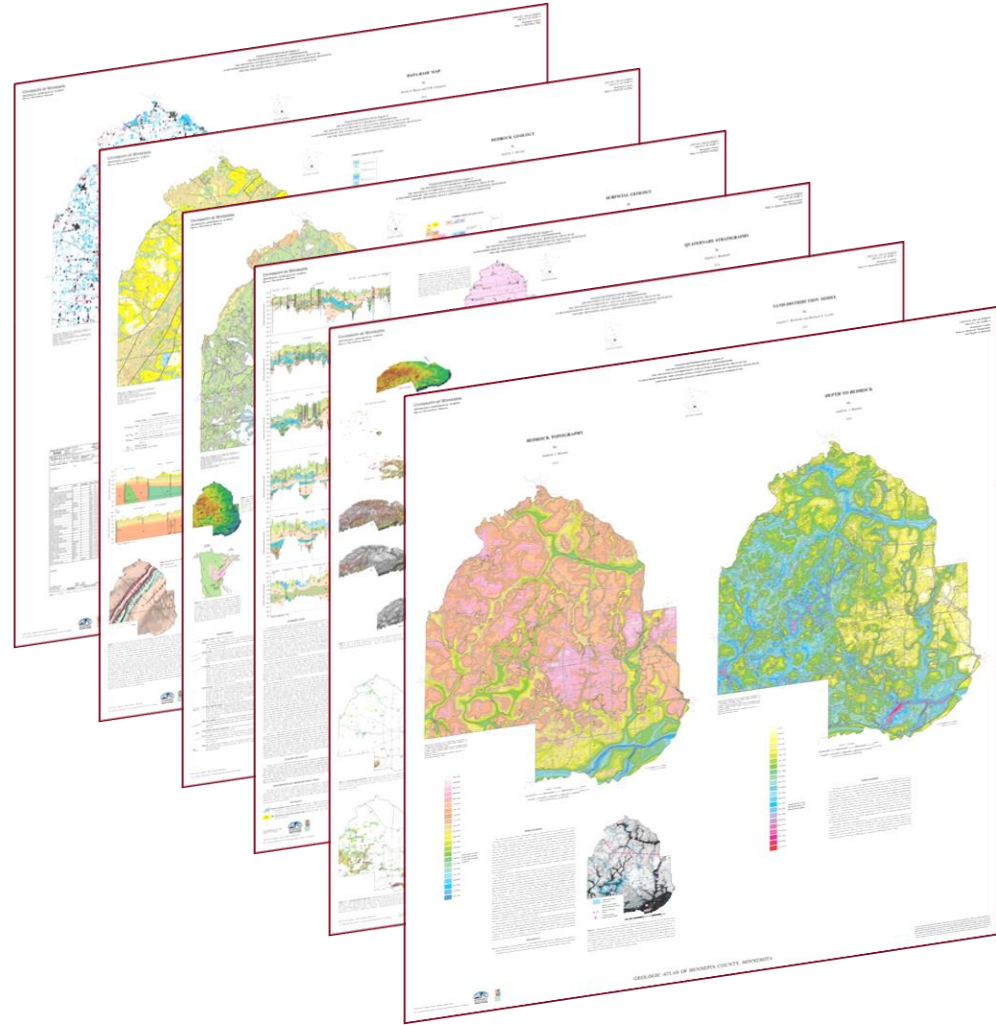
1W1P Planning Areas



County Geologic Atlas Mapping Program

Part A: Geology (by MGS)

- Database
- Bedrock geology
- Surficial geology
- Quaternary stratigraphy
- Sand distribution model
- Bedrock topography and Depth to bedrock
- Supplemental data (GIS data used in project, GIS products created and 3D geologic surfaces)

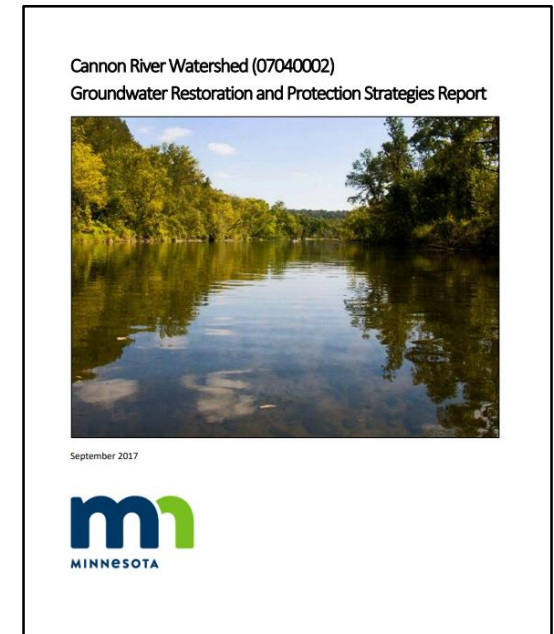


<https://conservancy.umn.edu/handle/11299/57196>



GRAPS Pilot Project

- Goals of our project:
 - Provide a compilation of surface and subsurface geologic data within selected watersheds in a format for modelers, planners and general public
 - 3D model of surficial, bedrock and unconsolidated deposits
 - Establishes a physical setting at watershed planning scale, both for education and outreach, and groundwater modeling.
 - Depict aquifers and confining units
 - Can be viewed in a browser, **does not require GIS software**



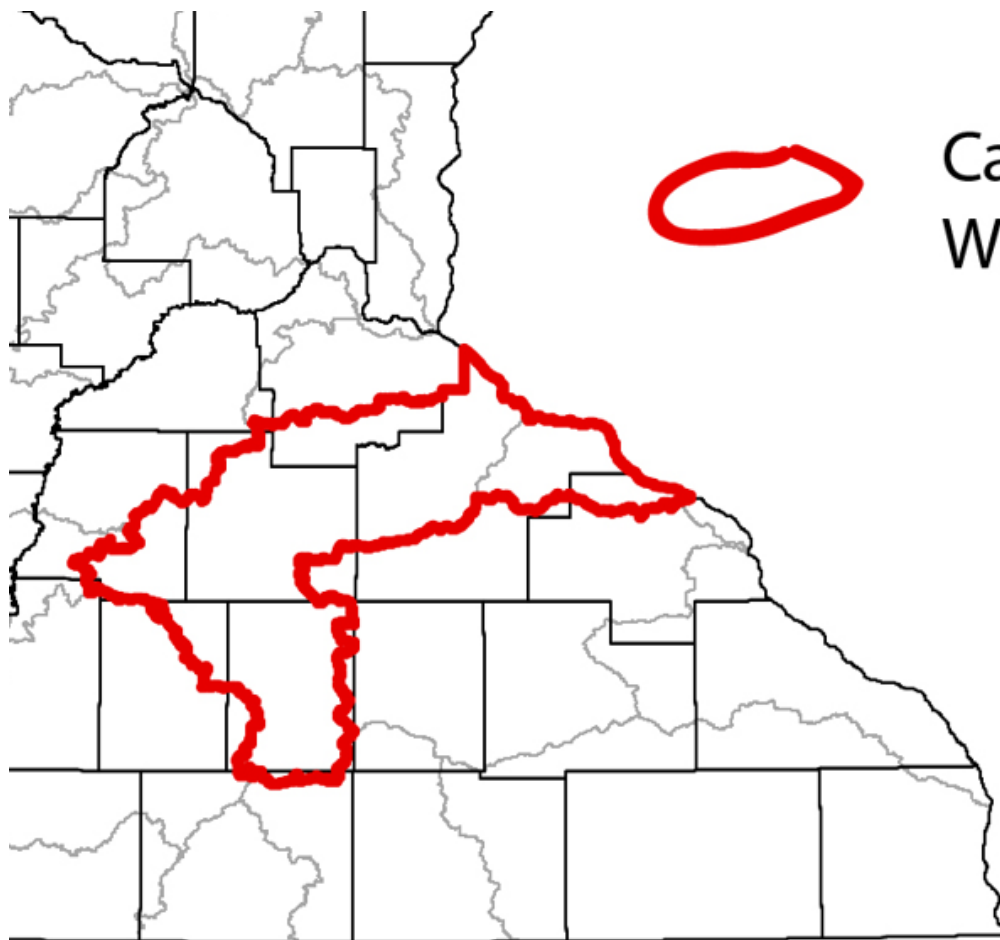
[GRAPS report](#)



MGS Modeling Strategies

- Surficial Model
- Subsurface Quaternary Model
 - Subsurface with data
 - Subsurface without data (interpolated)
- Bedrock Model





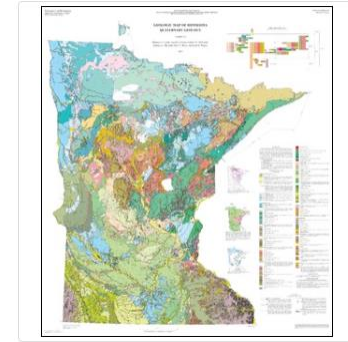
Cannon River Watershed Boundary

Nine Counties within the watershed

1. Goodhue
2. Dakota
3. Rice
4. Steele
5. Le Sueur
6. Waseca
7. Freeborn
8. Scott
9. Blue Earth

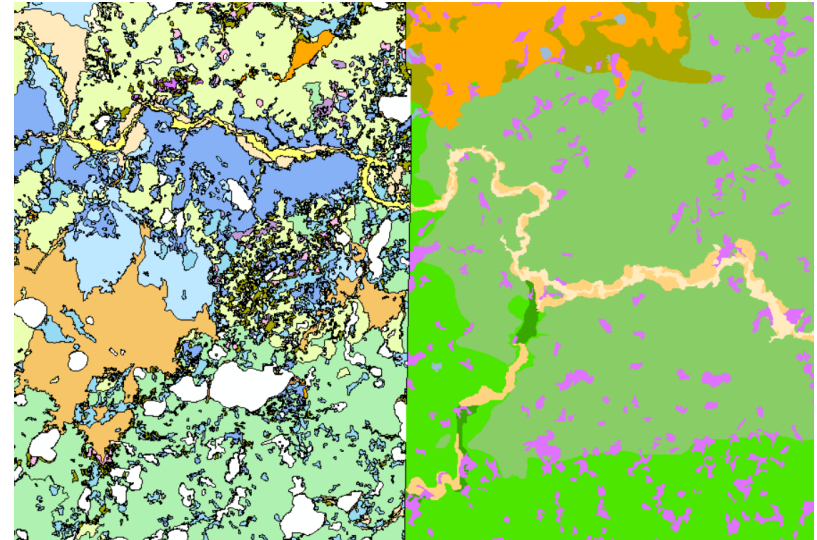


Surficial Quaternary Compilation Methods

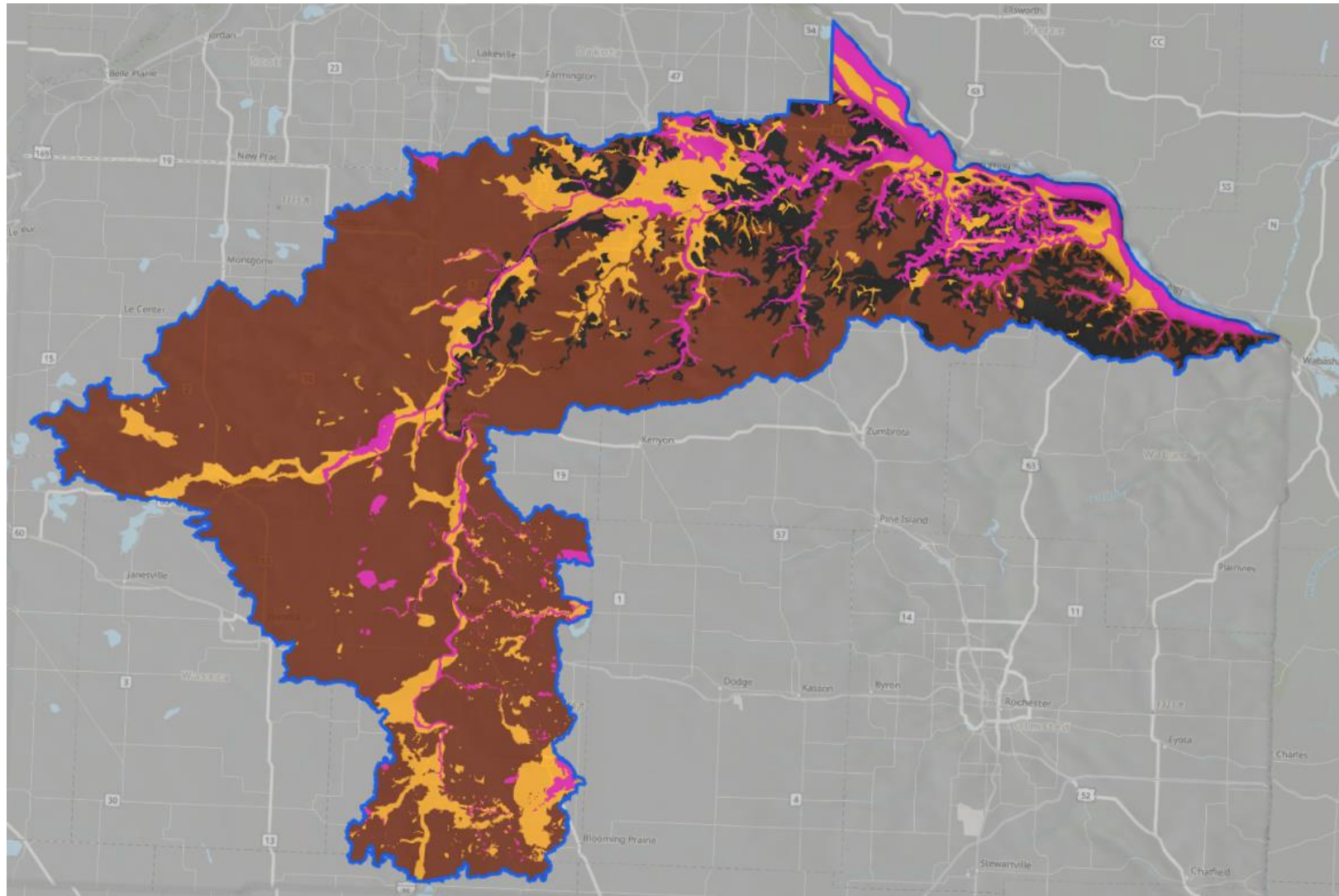


Statewide Surficial Map S-23

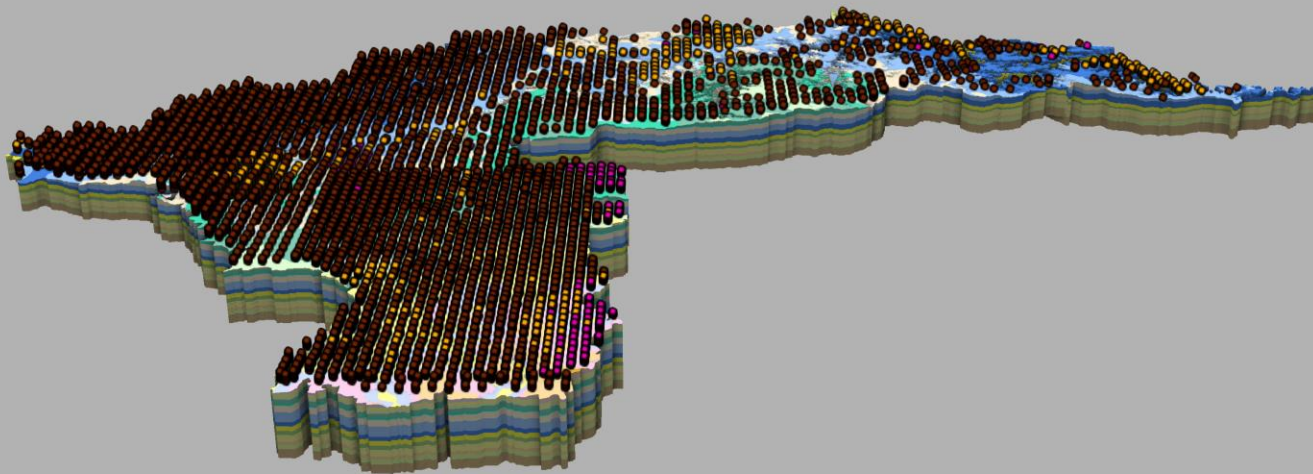
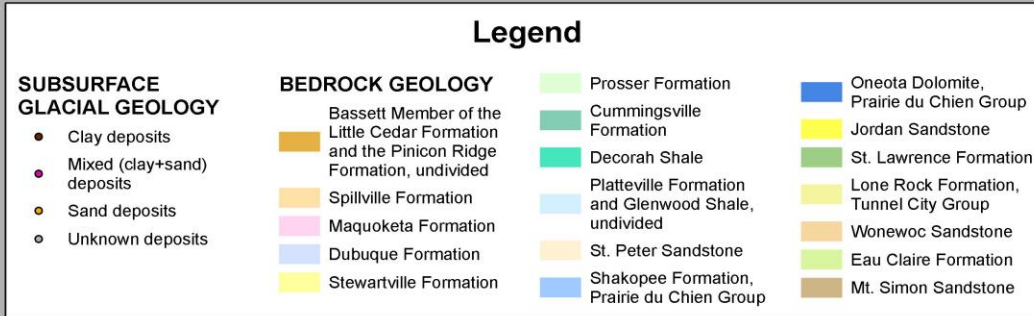
- Goodhue, Dakota, Rice, Steele, Scott and Blue Earth counties have been mapped as part of the CGA program, however, they have been individually published over several decades ranging from 1990 to present day and vary in GIS data availability.
- 1:100,000 scale GIS files of the statewide digital database D-1 were combined with GIS data from more recent maps.



Surficial Geologic Model for the GRAPS project



Subsurface Geologic Model for the GRAPS project



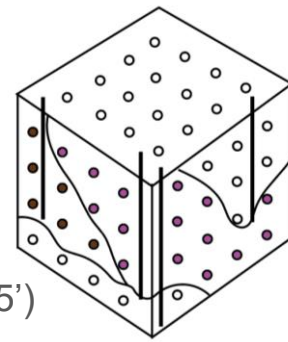
-Quaternary deposits are depicted with a texture-based point model

-Bedrock layers are depicted with unit surfaces

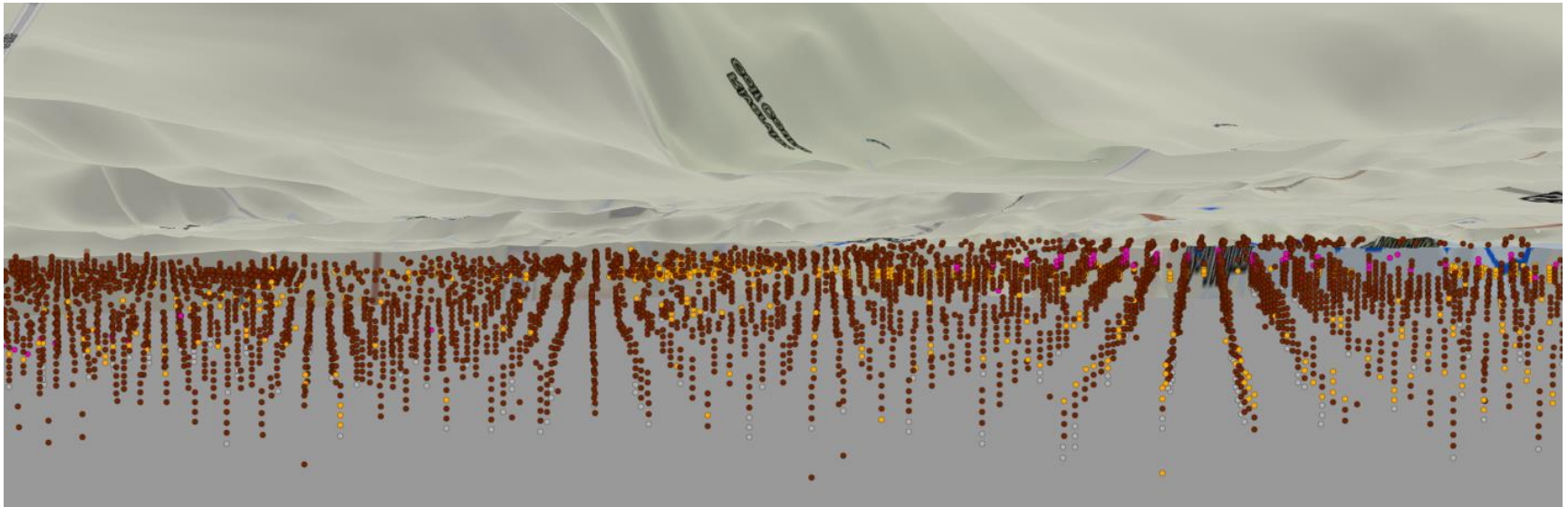
Web model can be accessed here: <https://arcg.is/09OS1L0>



Texture-based Point Model



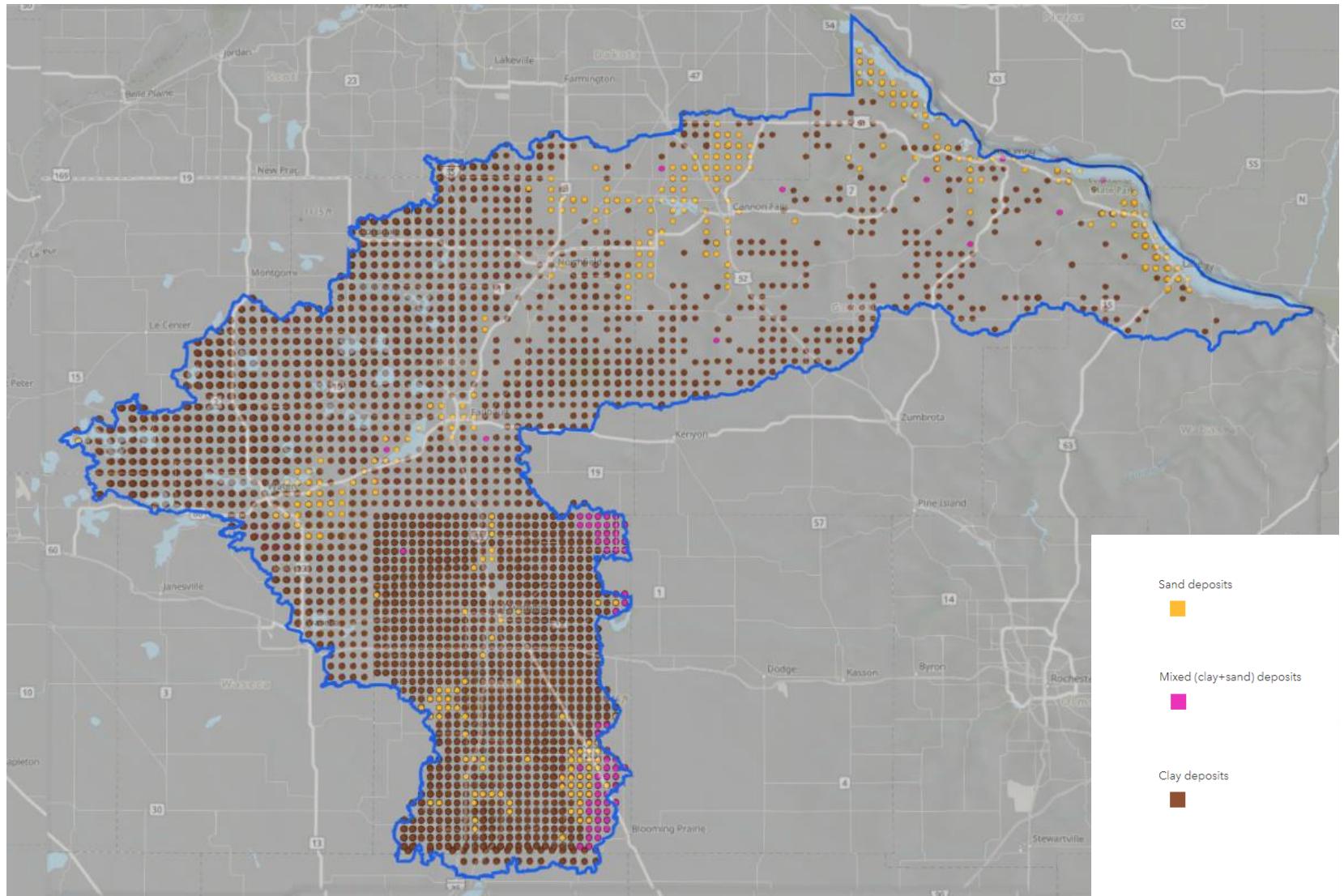
- Three methods to define sand, mixed or clay (250m x 5')
 - Surficial Model
 - Subsurface Model (existing CGA data)
 - Interpolation Model (Tipping, 2019)



Tipping, 2019:
<https://conservancy.umn.edu/handle/11299/219591>

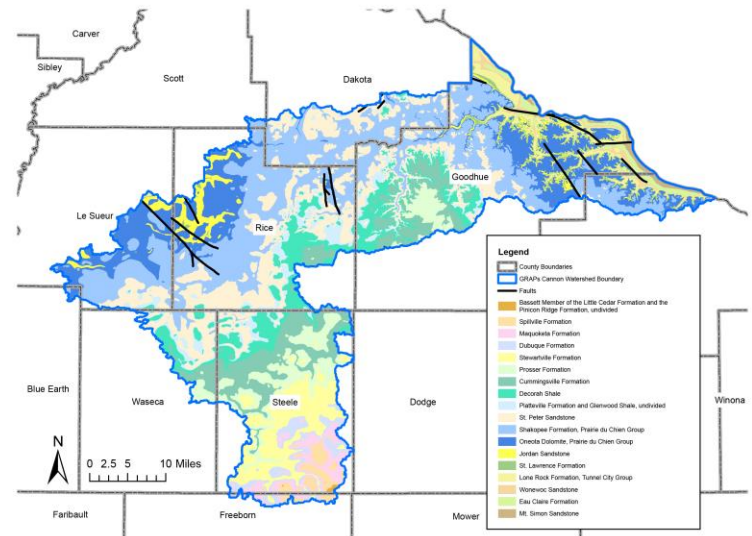


Texture-based Point Model



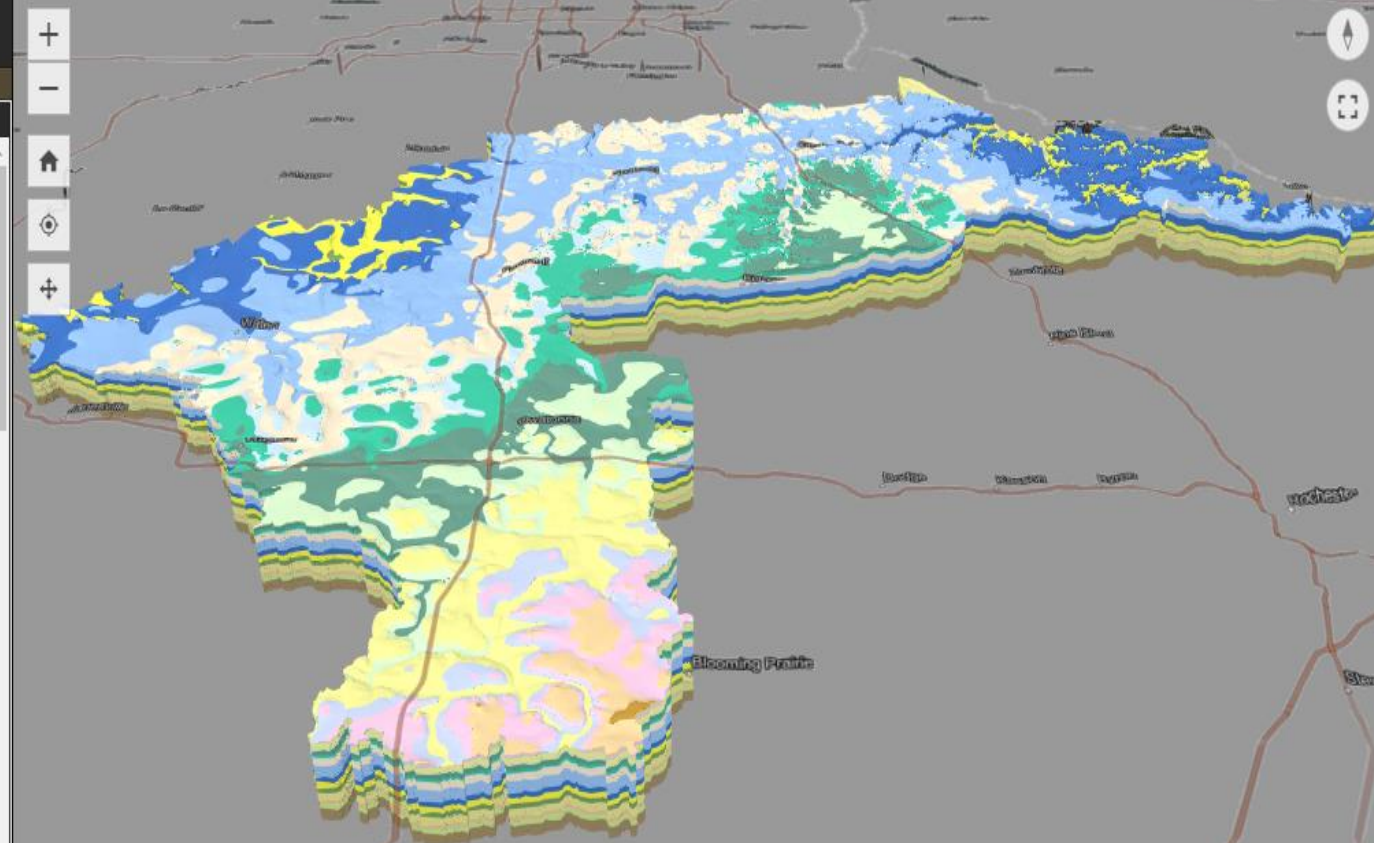
Bedrock Topography and Geology

- Bedrock topography (elevation of the bedrock surface) and unit surfaces are created from contours from geologic data in GIS using the Topo to Raster tool.
- Existing 25-to-50-foot contours were edited to match along county boundaries.
- Unit surfaces are calculated by adding or subtracting their estimated thicknesses.
- For units with thickness variations, isopachs are created and used to derive surfaces.
- New mapping was needed in parts of Wabasha, Goodhue and Rice Counties to more accurately depict the geologic structure in the faulted area.





- Layer List
- Cannon River Watershed Boundary
 - Geographic References
 - BASEMAPS
 - Depth To Bedrock (50-ft. intervals)
 - SURFICIAL GLACIAL GEOLOGY
 - SUBSURFACE GLACIAL GEOLOGY
 - BEDROCK GEOLOGY



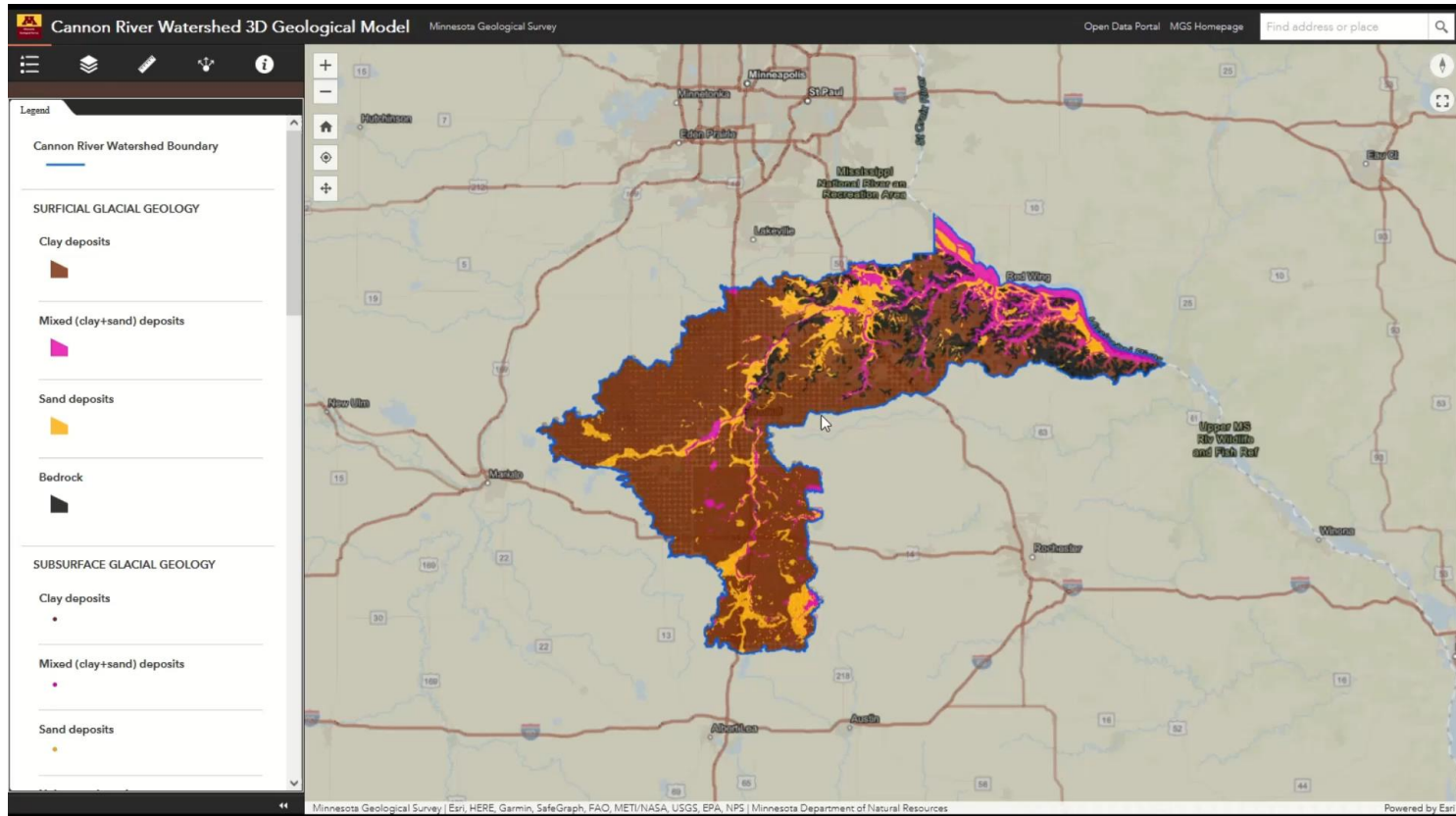
- Legend**
- County Boundaries
 - GRAPs Cannon Watershed Boundary
 - Faults**
 - Bassett Member of the Little Cedar Formation and the Pinicon Ridge Formation, undivided
 - Spillville Formation
 - Maquoketa Formation
 - Dubuque Formation
 - Stewartville Formation
 - Prosser Formation
 - Cummingsville Formation
 - Decorah Shale
 - Platteville Formation and Glenwood Shale, undivided
 - St. Peter Sandstone
 - Shakopee Formation, Prairie du Chien Group
 - Oneota Dolomite, Prairie du Chien Group
 - Jordan Sandstone
 - St. Lawrence Formation
 - Lone Rock Formation, Tunnel City Group
 - Wonevoc Sandstone
 - Eau Claire Formation
 - Mt. Simon Sandstone

Bedrock rasters can be viewed in 2D or 3D in a GIS environment or through our online 3D browser.

<https://arcg.is/09OS1L0>



Cannon River Watershed 3D Model



<https://arcg.is/09OS1L0>

[MGS Twitter Cannon 3D](#)



Minnesota Geological Survey links

[MGS GRAPS Projects](#)

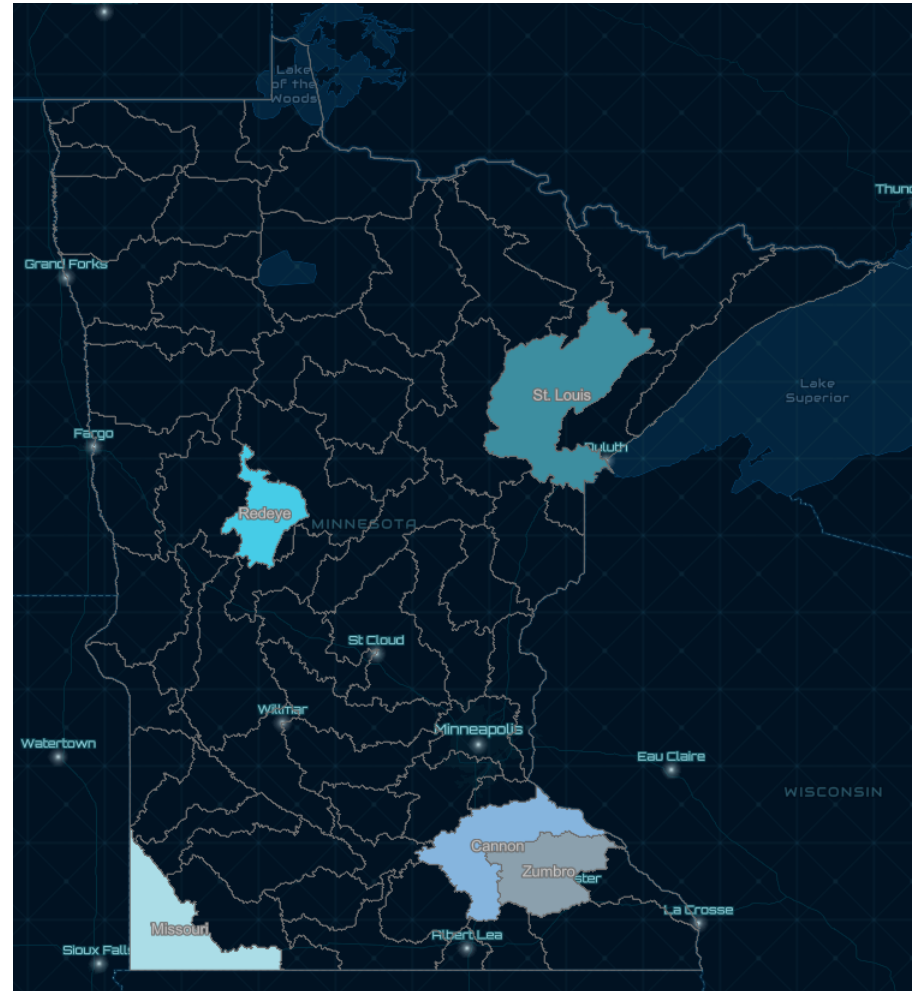
(<https://cse.umn.edu/mgs/news/new-3d-geologic-models-published-graps-pilot-project>)

[3D Geology for Watershed Planning](#)

(<https://mngs-umn.opendata.arcgis.com/apps/25e6260fe5744de3a49cd4f615730dc6>)

[Compilation Geologic Model for Cannon River Watershed: A Pilot Project](#)

(<https://hdl.handle.net/11299/231040>)



Thank You

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