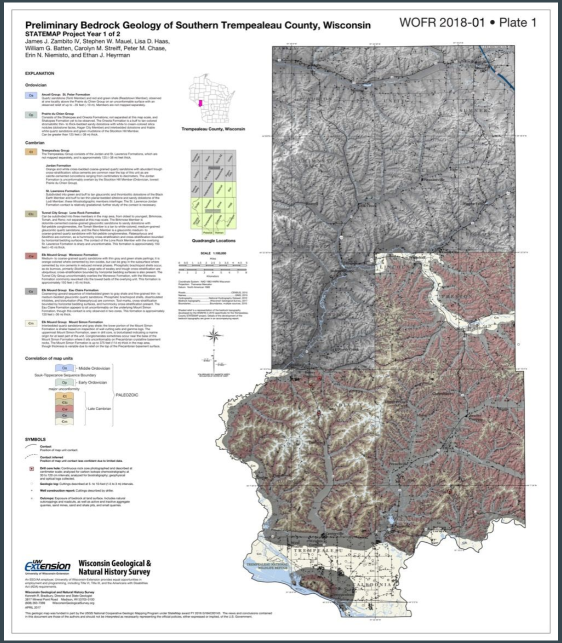
Designing for Scientists

Caroline Rose
Wisconsin Geological and Natural History Survey
caroline.rose@wgnhs.uwex.edu
@cmrRose

github.com/cmrRose/talks



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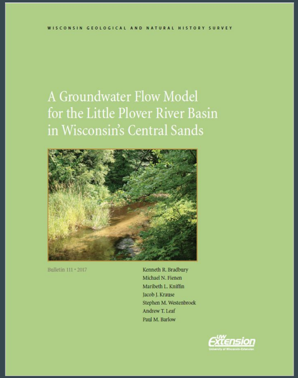
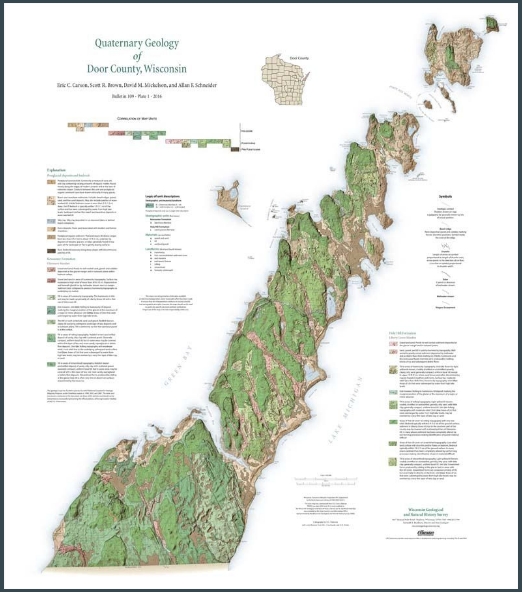
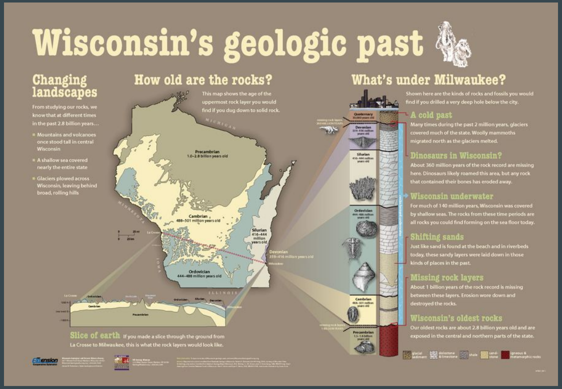
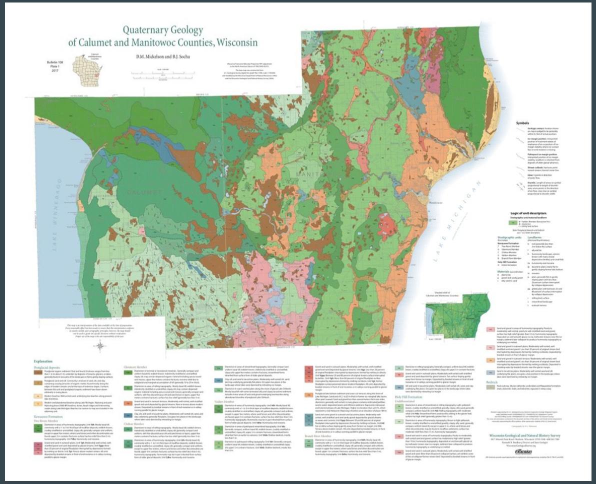
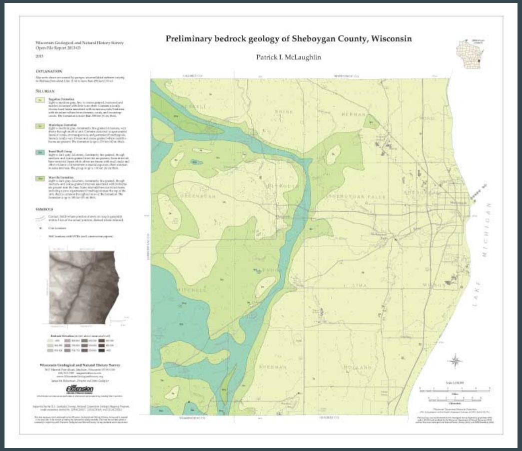












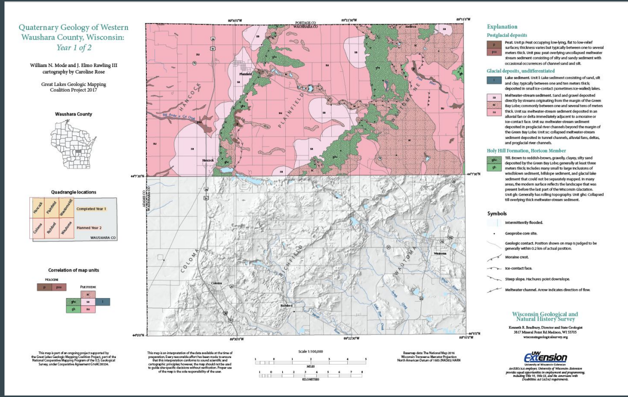

Mad River Canoe

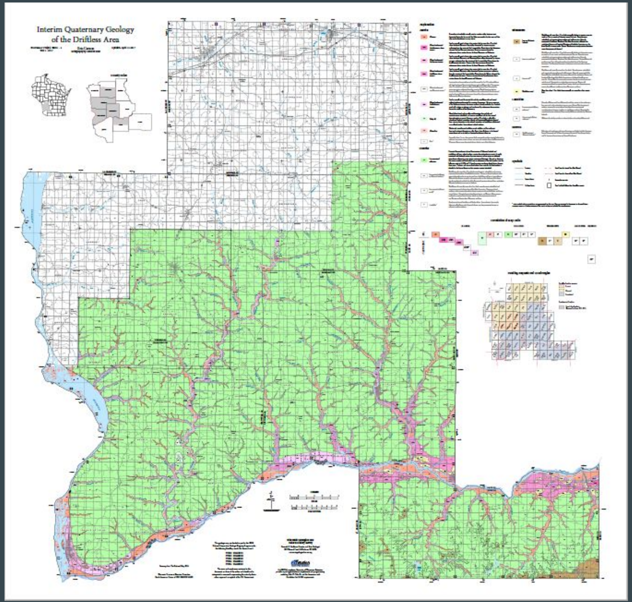


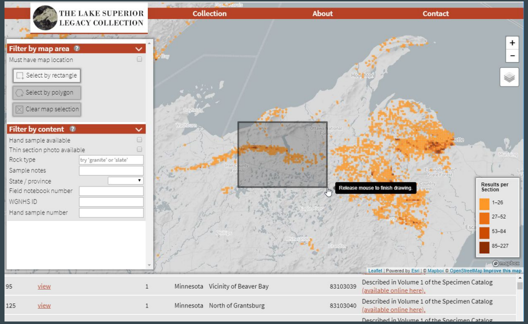


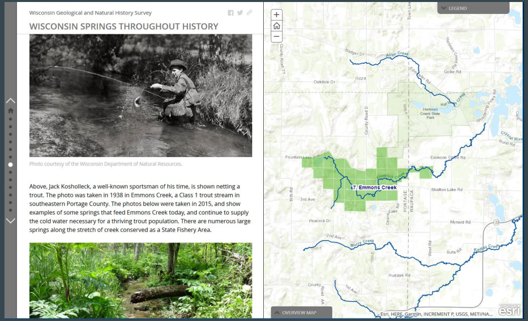


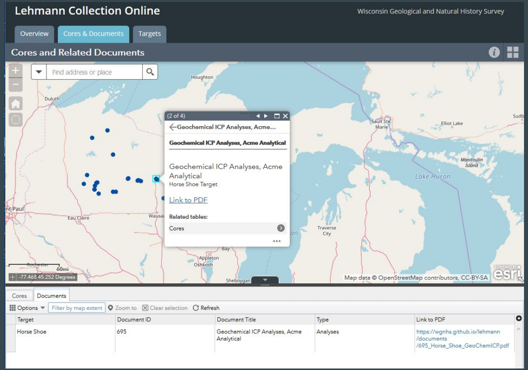
WI Geological & Natural History Survey
EAGLEVIEW
We're Hiring !

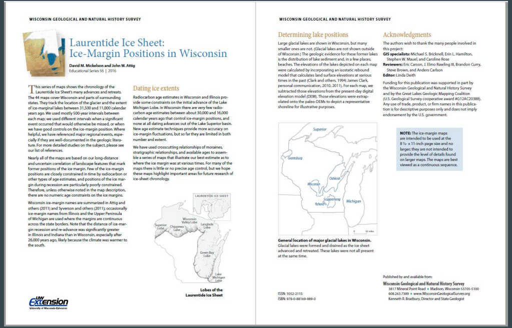

Quaternary Geology of Western Waushara County, Wisconsin:
Year 1 of 2
William N. Mode and J. Elmo Rawling III
cartography by Caroline Rose
Great Lakes Geologic Mapping Coalition Project 2017
Waushara County
Quadrangle locations
Correlation of map units
Explanation
Postglacial deposits
Glacial deposits, undifferentiated
Holy Hill Formation, Horicon Member
Symbols
Wisconsin Geological and Natural History Survey
Extension

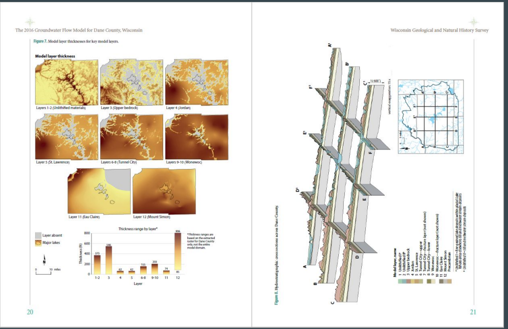

Interim Quaternary Geology of the Driftless Area

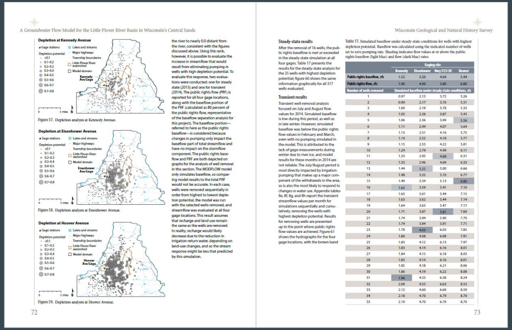

THE LAKE SUPERIOR LEGACY COLLECTION
Collection
About
Contact
Filter by map area
Must have map location
Select by rectangle
Select by polygon
Clear map selection
Filter by content
Hand sample available
Thin section photo available
Rock type
Sample notes
State / province
Field notebook number
WGNHS ID
Hand sample number
Release mouse to finish drawing.
Results per Section
1–26
27–52
53–84
85–227
95
view
1
Minnesota
Vicinity of Beaver Bay
83103039
Described in Volume 1 of the Specimen Catalog (available online here).
125
view
1
Minnesota
North of Grantsburg
83103040
Described in Volume 1 of the Specimen Catalog (available online here).

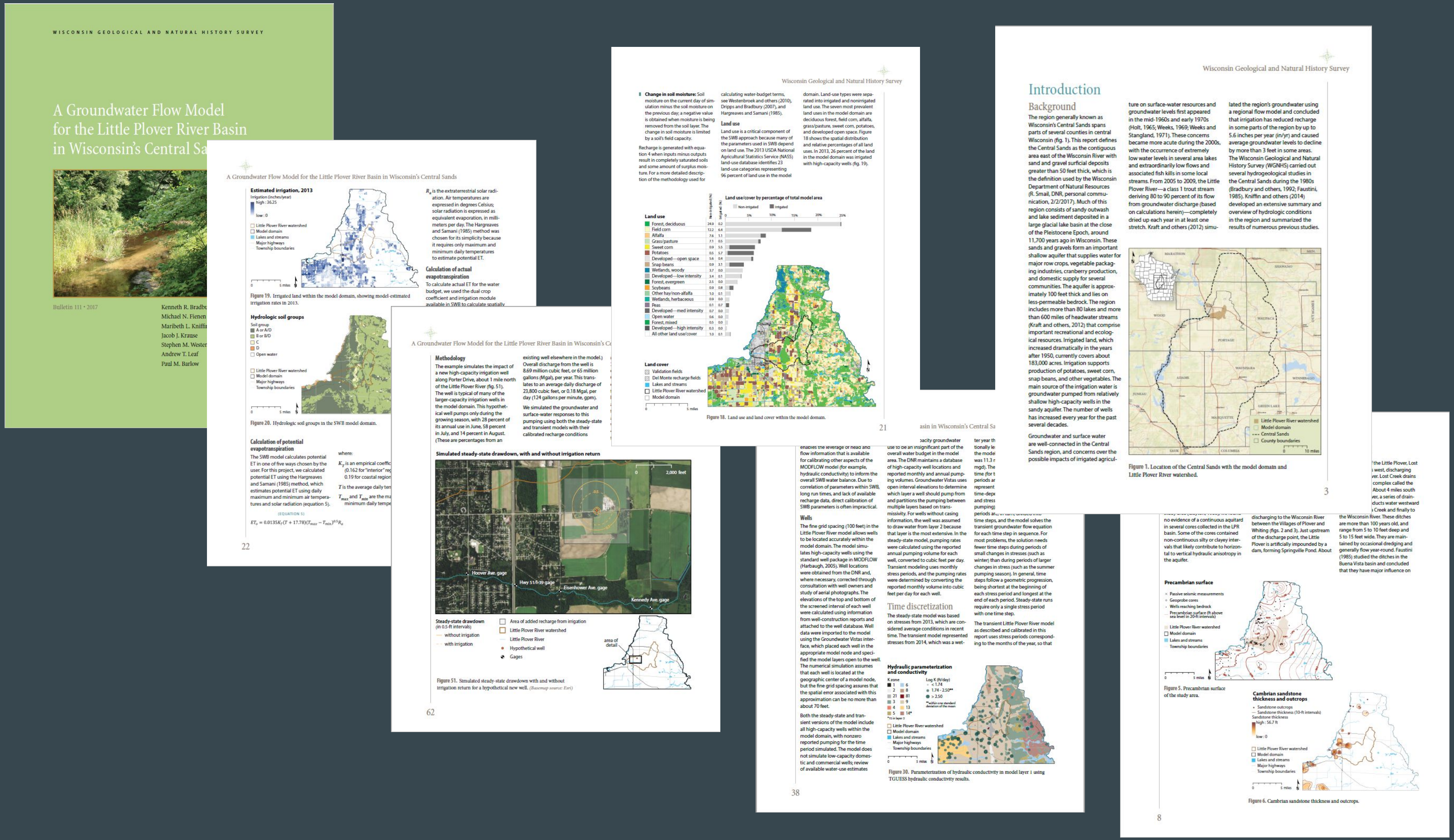

Wisconsin Geological and Natural History Survey
WISCONSIN SPRINGS THROUGHOUT HISTORY
Photo courtesy of the Wisconsin Department of Natural Resources.
Above, Jack Kosholleck, a well-known sportsman of his time, is shown netting a trout. The photo was taken in 1938 in Emmons Creek, a Class 1 trout stream in southeastern Portage County. The photos below were taken in 2015, and show examples of some springs that feed Emmons Creek today, and continue to supply the cold water necessary for a thriving trout population. There are numerous large springs along the stretch of creek conserved as a State Fishery Area.
LEGEND
Emmons Creek
OVERVIEW MAP


Lehmann Collection Online
Wisconsin Geological and Natural History Survey
Overview
Cores & Documents
Targets
Cores and Related Documents
Find address or place
(2 of 4)
Geochemical ICP Analyses, Acme...
Geochemical ICP Analyses, Acme Analytical
Geochemical ICP Analyses, Acme Analytical
Horse Shoe Target
Link to PDF
Related tables:
Cores
Lake Huron
Map data © OpenStreetMap contributors, CC-BY-SA
Cores
Documents
Options
Filter by map extent
Zoom to
Clear selection
Refresh
Target
Document ID
Document Title
Type
Link to PDF
Horse Shoe
695
Geochemical ICP Analyses, Acme Analytical
Analyses
https://wgnhs.github.io/lehmann/documents/695_Horse_Shoe_GeoChemICP.pdf


WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
Laurentide Ice Sheet:
Ice-Margin Positions in Wisconsin
Dating ice extents
Determining lake positions
Acknowledgments
Extension

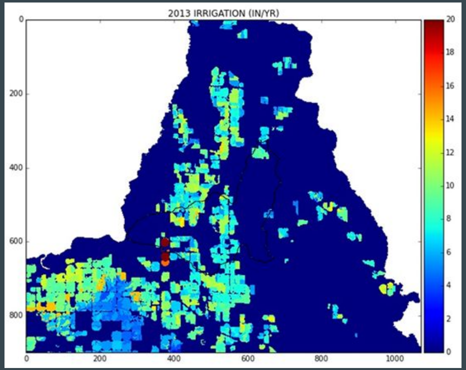

The 2016 Groundwater Flow Model for Dane County, Wisconsin
Wisconsin Geological and Natural History Survey
Model layer thickness
20
21

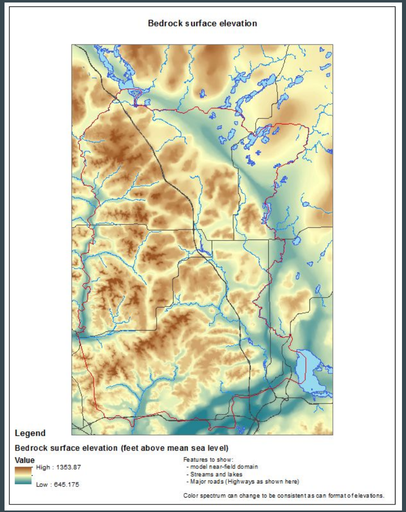

A Groundwater Flow Model for the Little Plover River Basin in Wisconsin's Central Sands
Wisconsin Geological and Natural History Survey
Depletion at Kennedy Avenue
Depletion at Eisenhower Avenue
Depletion at Hoover Avenue
Steady-state results
Transient results
72
73


WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
A Groundwater Flow Model for the Little Plover River Basin in Wisconsin's Central Sa
Bulletin 111 • 2017
Kenneth R. Bradb
Michael N. Fienen
Maribeth L. Kniffi
Jacob J. Krause
Stephen M. Wester
Andrew T. Leaf
Paul M. Barlow
A Groundwater Flow Model for the Little Plover River Basin in Wisconsin's Central Sands
Estimated irrigation, 2013
Figure 19. Irrigated land within the model domain, showing model-estimated irrigation rates in 2013.
Hydrologic soil groups
Figure 20. Hydrologic soil groups in the SWB model domain.
Calculation of potential evapotranspiration
Calculation of actual evapotranspiration
Methodology
Simulated steady-state drawdown, with and without irrigation return
Hoover Ave. gage
Hwy 51/I-39 gage
Eisenhower Ave. gage
Kennedy Ave. gage
Figure 51. Simulated steady-state drawdown with and without irrigation return for a hypothetical new well. (Basemap source: Esri)
Wisconsin Geological and Natural History Survey
Land use
Land use/cover by percentage of total model area
Land cover
Figure 18. Land use and land cover within the model domain.
Introduction
Background
Figure 1. Location of the Central Sands with the model domain and Little Plover River watershed.
Wells
Time discretization
Hydraulic parameterization and conductivity
Figure 30. Parameterization of hydraulic conductivity in model layer 1 using TGUESS hydraulic conductivity results.
Precambrian surface
Figure 5. Precambrian surface of the study area.
Cambrian sandstone thickness and outcrops
Figure 6. Cambrian sandstone thickness and outcrops.
22
62
21
3
38
8

design

to do or plan something with a
specific purpose or intention in mind





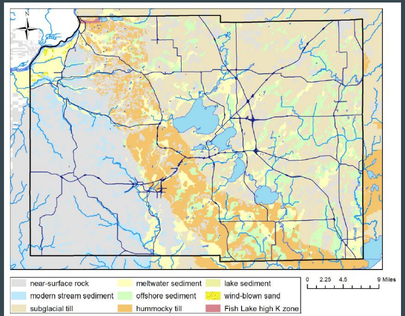
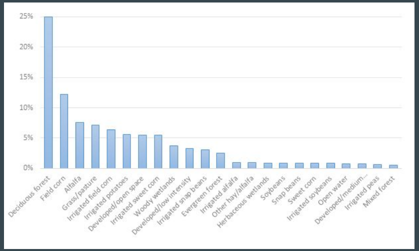
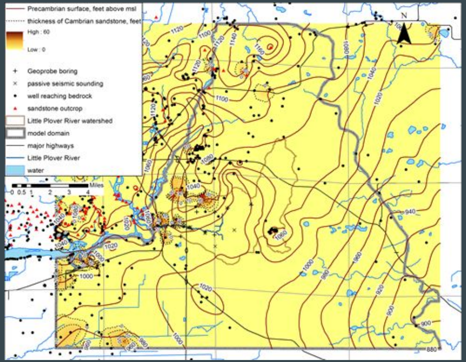
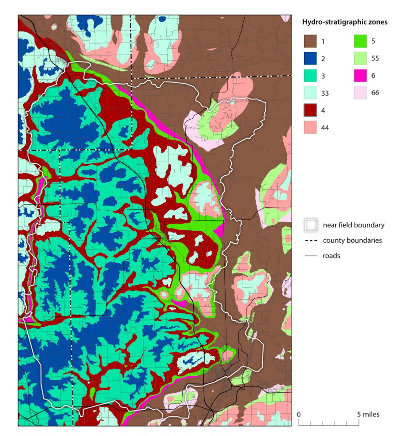


Figure 9. Distribution of unlithified materials and near-surface rock in model layers 1 and 2.







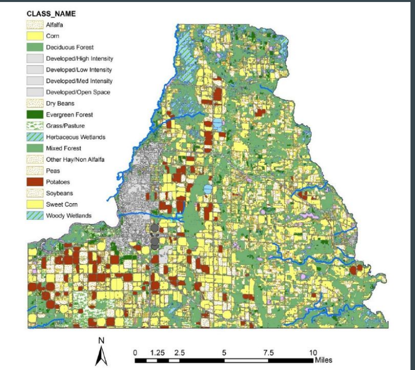


Figure 19. 2013 NASS CDL land use classification over the model domain. Validation fields are in blue. Del Monte recharge fields are in grey.

what should the reader understand about this data?

a sense of the highs and lows?

areas of clustering or dispersion?

identify specific data values?

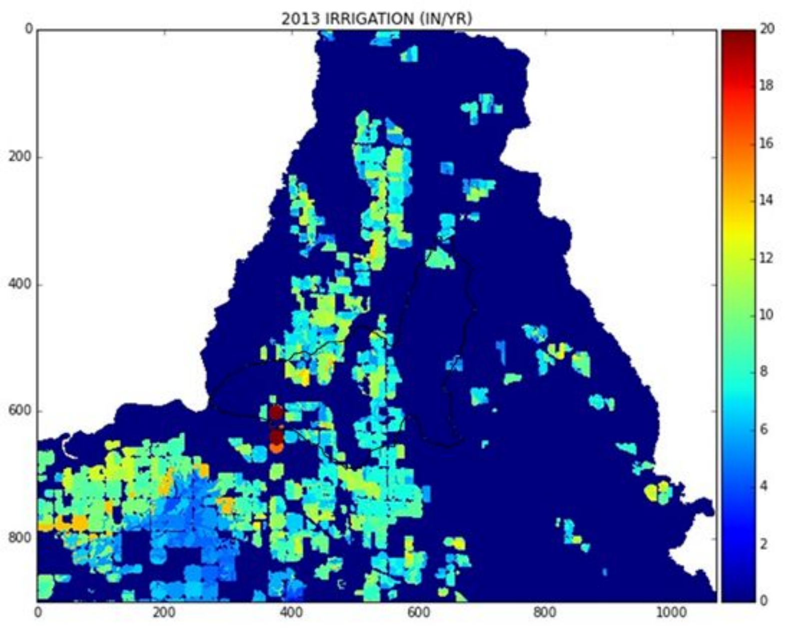
how?

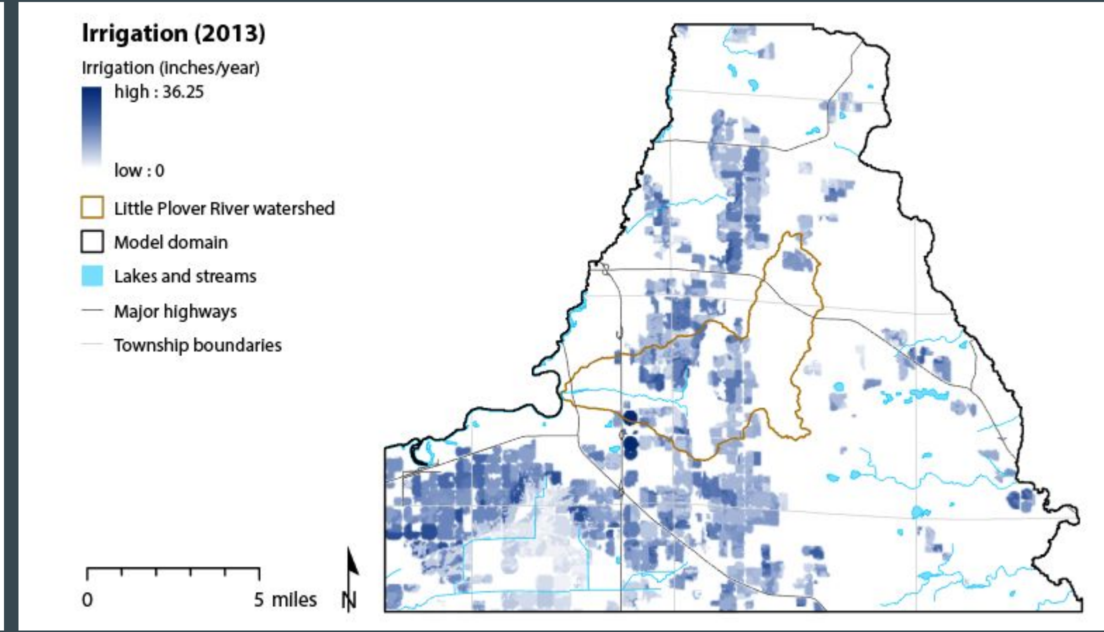
1. focus attention
2. illustrate data structure
3. facilitate comparison

1 focus attention

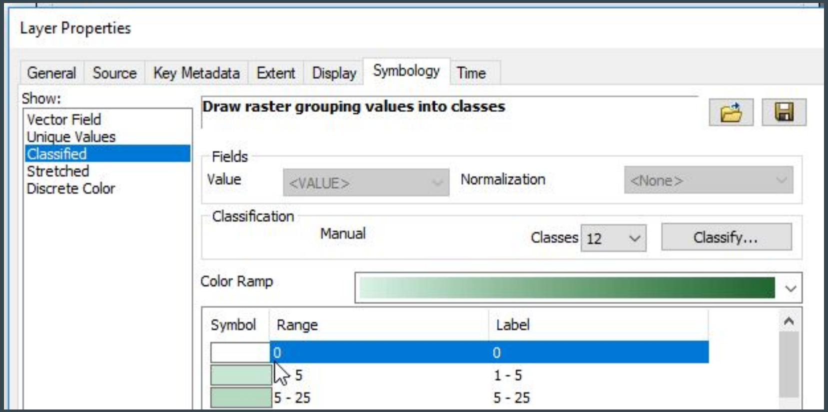
focus attention:

represent nothing with nothing

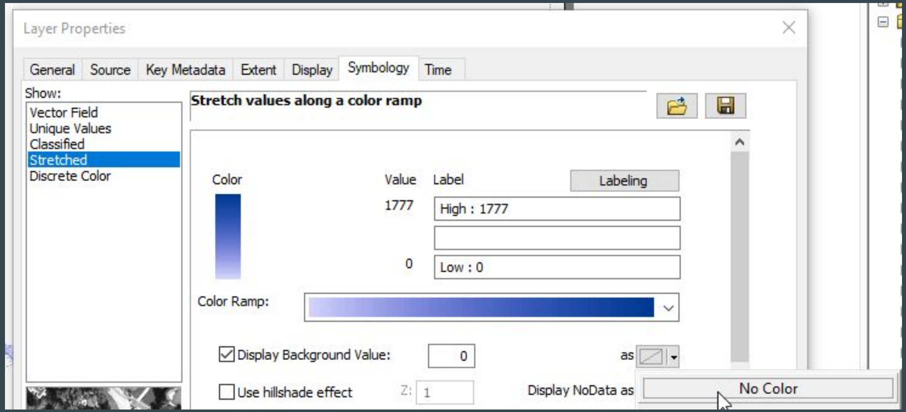

2013 IRRIGATION (IN/YR)
0
200
400
600
800
0
200
400
600
800
1000
20
18
16
14
12
10
8
6
4
2
0


Irrigation (2013)
Irrigation (inches/year)
high : 36.25
low : 0
Little Plover River watershed
Model domain
Lakes and streams
Major highways
Township boundaries
0
5 miles
N

Arcmap symbology



class set to background color

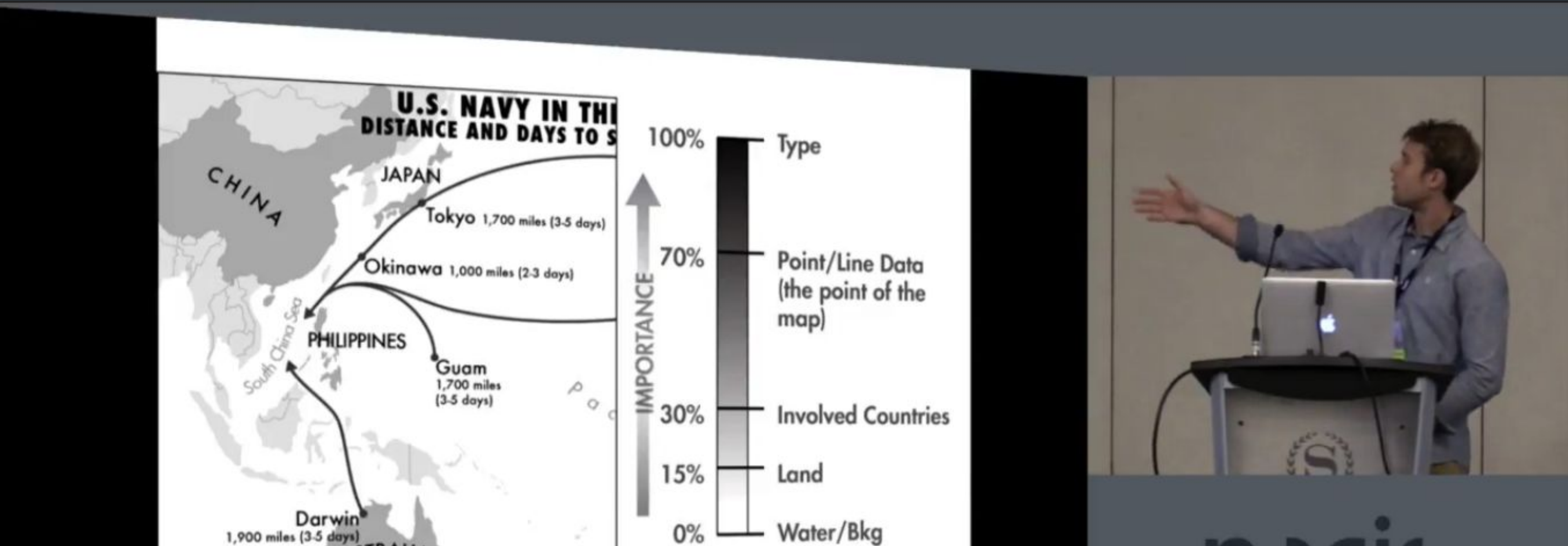


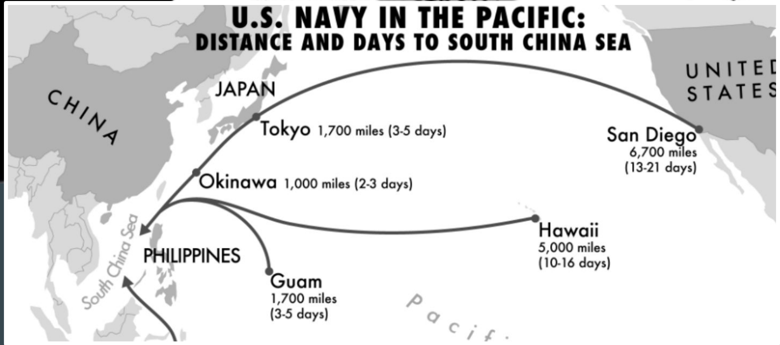
background value as no color

focus attention:

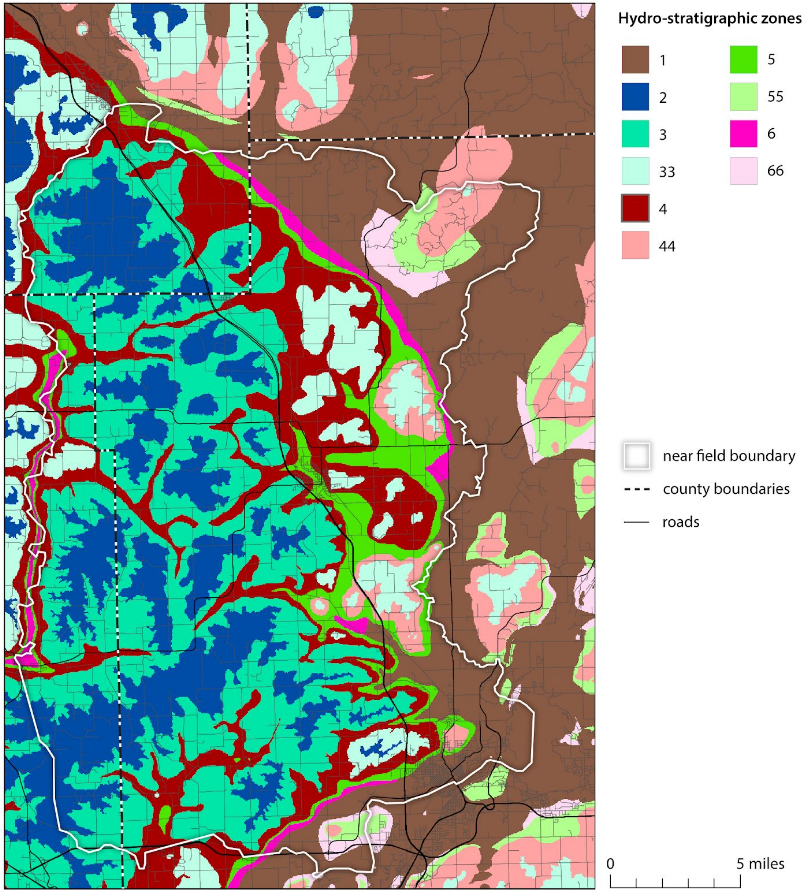
visual hierarchy

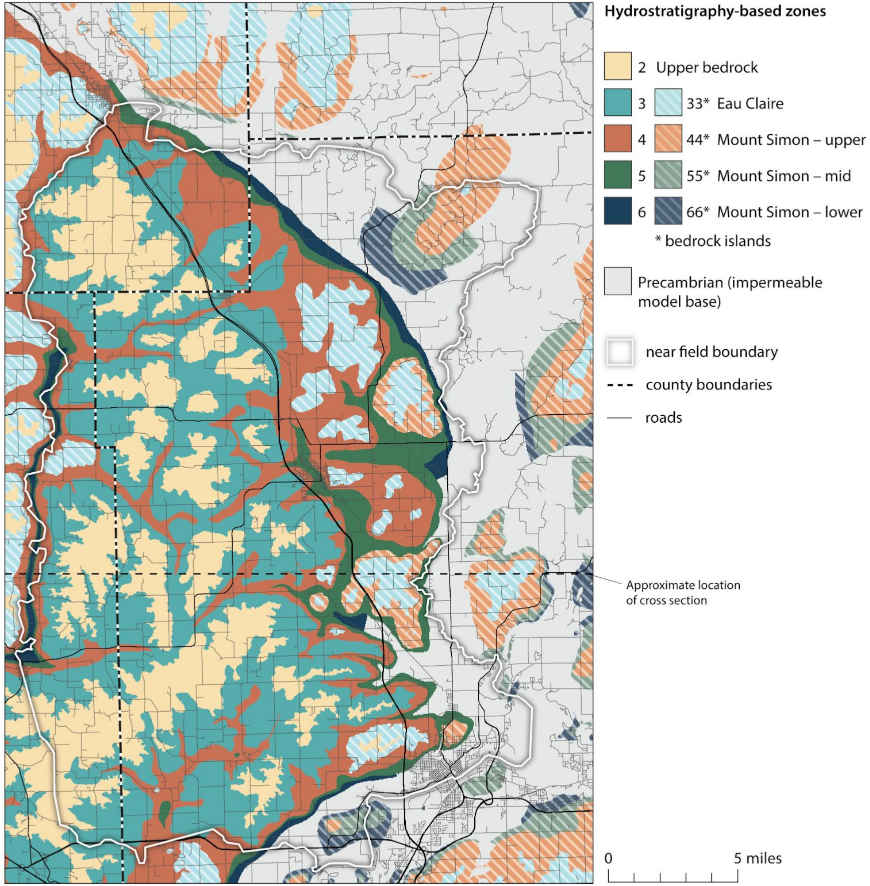
the arrangement or presentation of elements
in a way that implies importance





Soren Walljasper
NACIS 2017 (on youtube)


Hydro-stratigraphic zones
1
2
3
33
4
44
5
55
6
66
near field boundary
county boundaries
roads
0
5 miles


Hydrostratigraphy-based zones
2 Upper bedrock
3 33* Eau Claire
4 44* Mount Simon – upper
5 55* Mount Simon – mid
6 66* Mount Simon – lower
* bedrock islands
Precambrian (impermeable model base)
near field boundary
county boundaries
roads
Approximate location of cross section
0
5 miles

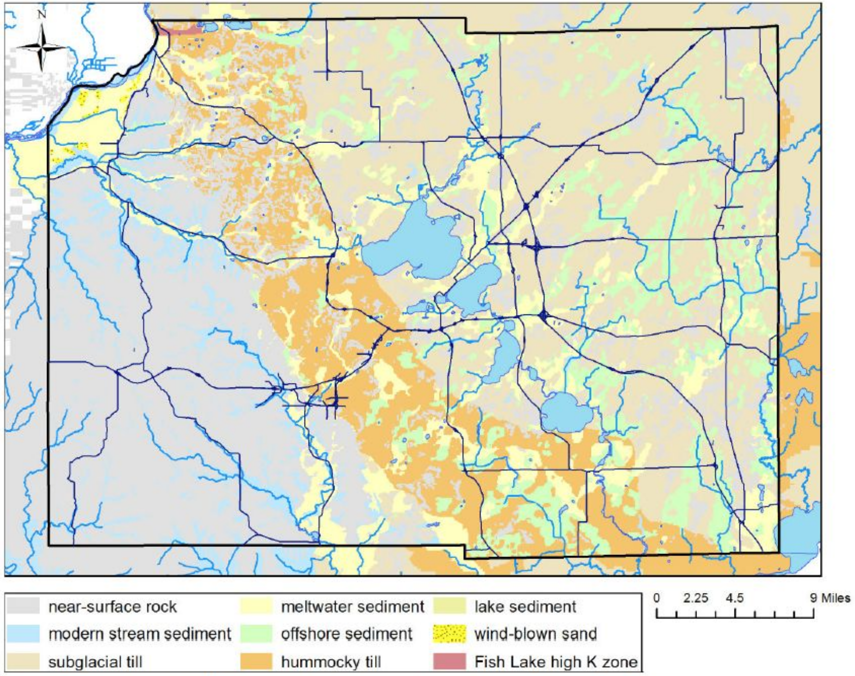
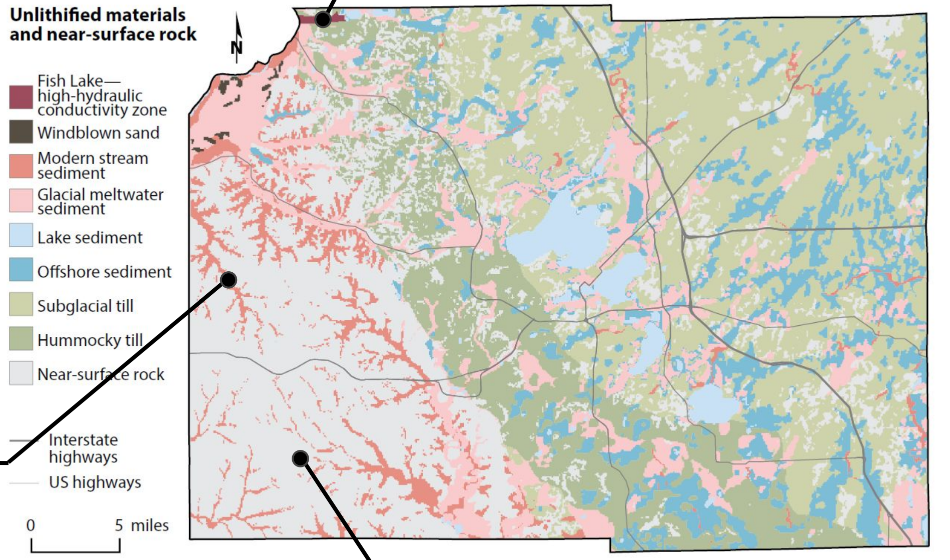


Figure 9. Distribution of unlithified materials and near-surface rock in model layers 1 and 2.

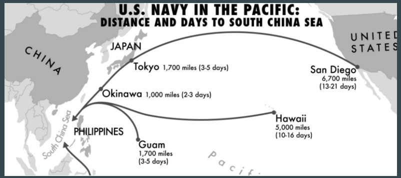
small features - bold colors

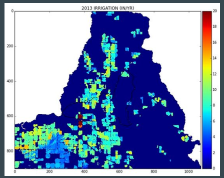
Figure 9. Distribution of unlithified materials and near-surface rock in model layers 1 and 2.

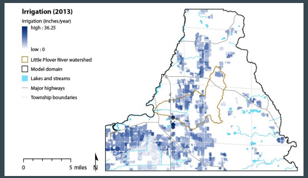


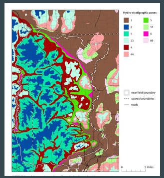
important contrast

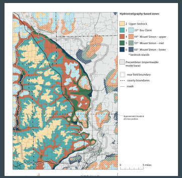
large features - dull, neutral colors

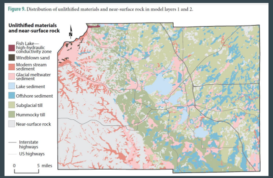












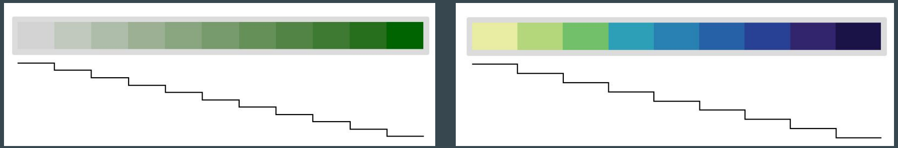
zoom way out, or look at it from across the room

② illustrate data structure

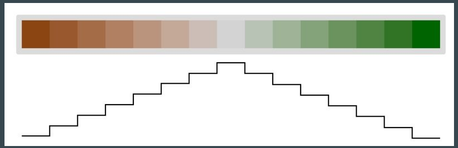
illustrate data structure:

color schemes

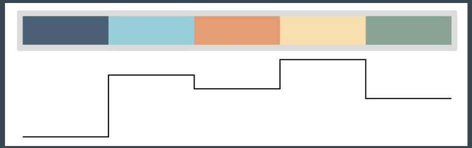
sequential



diverging

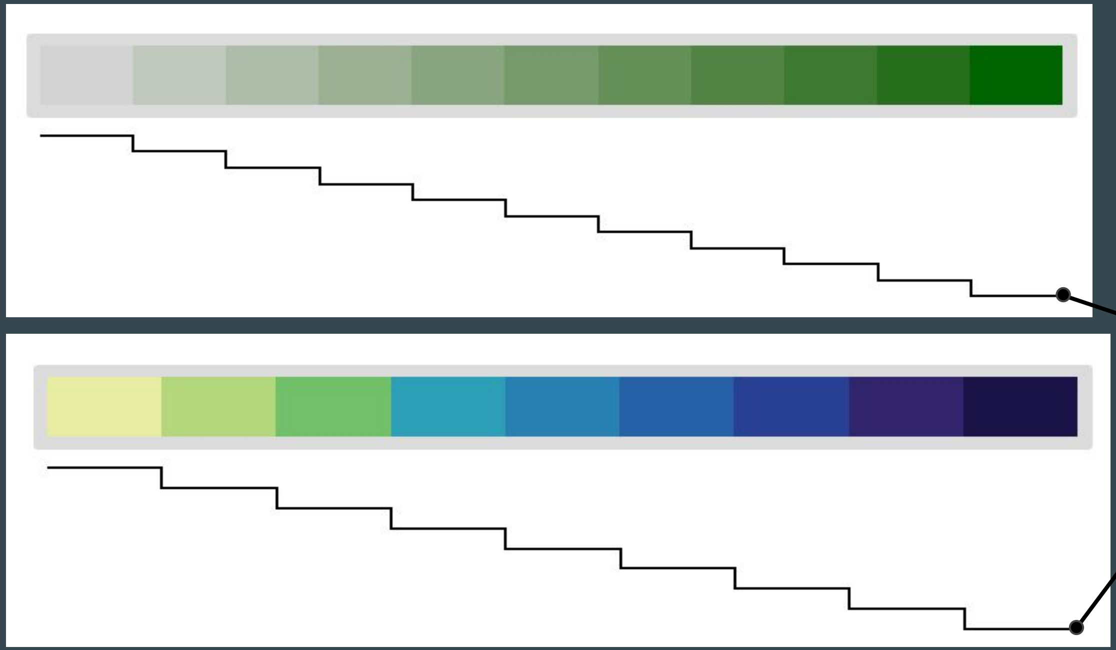


qualitative



sequential

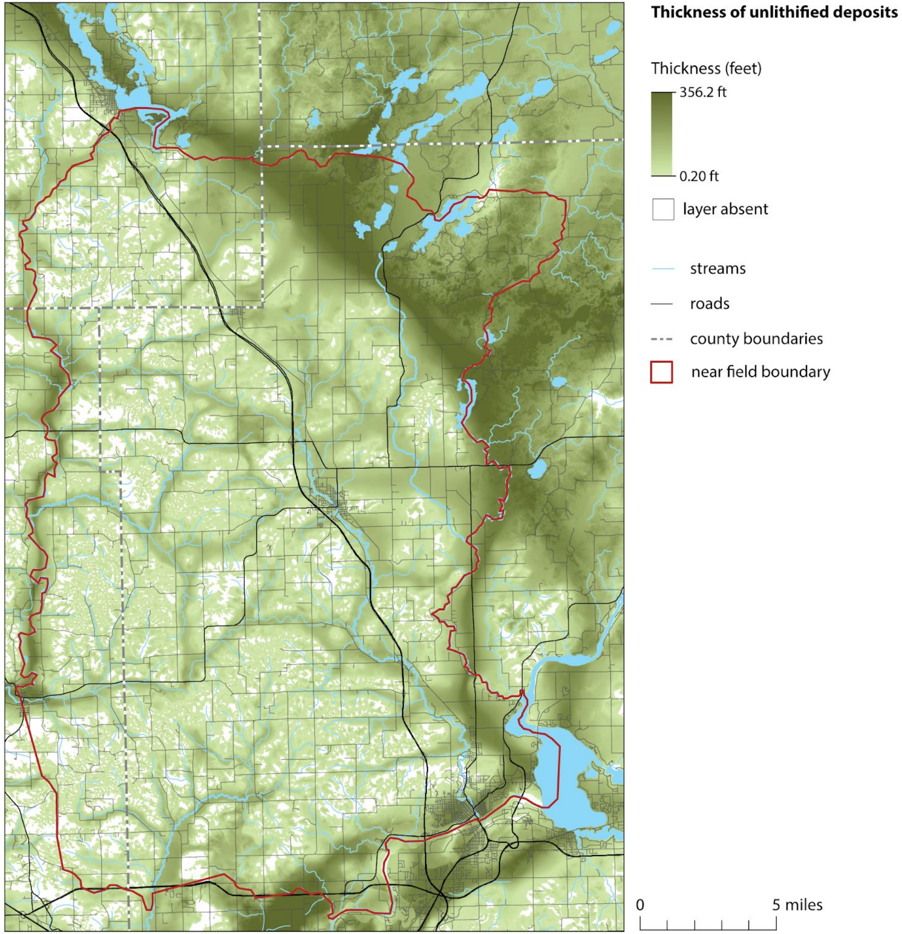
less of something



more of something

relative lightness*

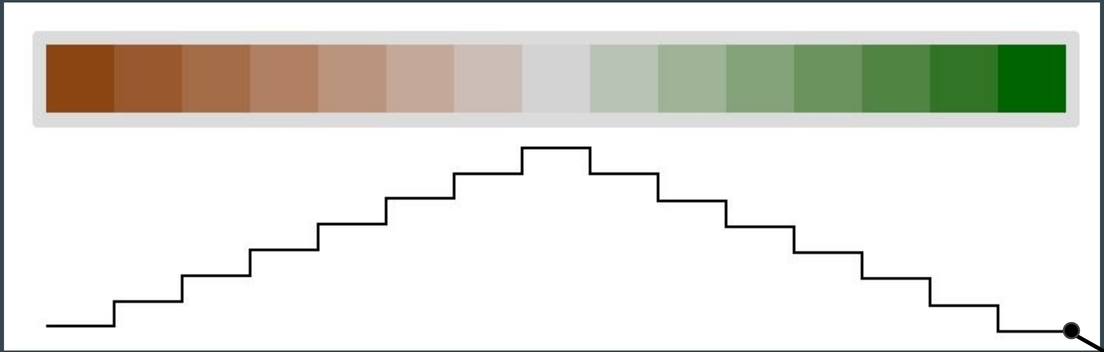
* see further reading at the end of this presentation for a comparison of lightness, brightness/value, and luminance



Thickness of unlithified deposits (feet).

diverging

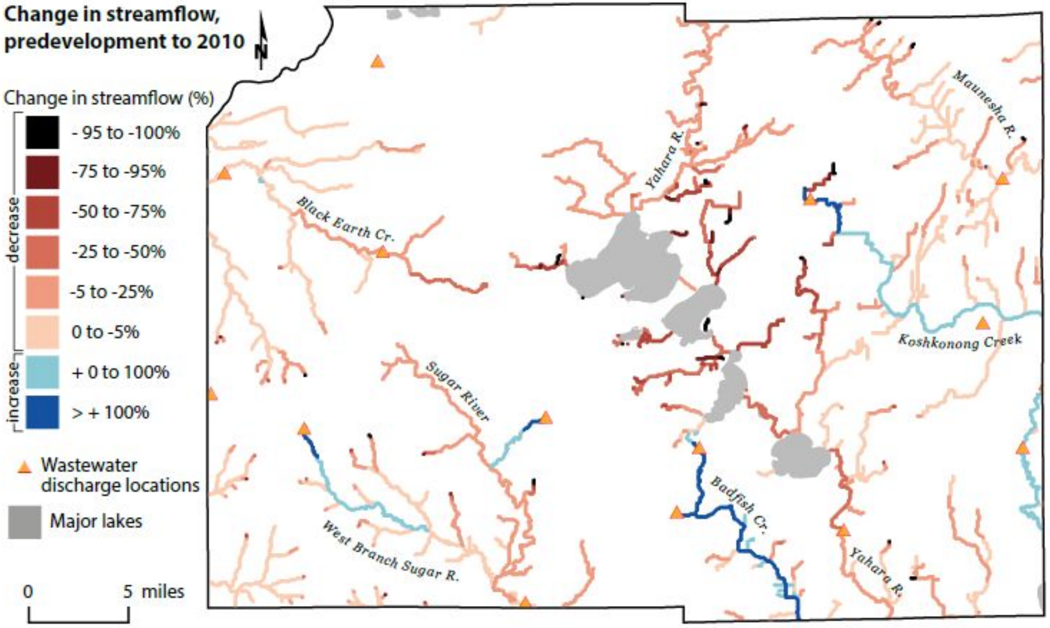
below a critical midpoint

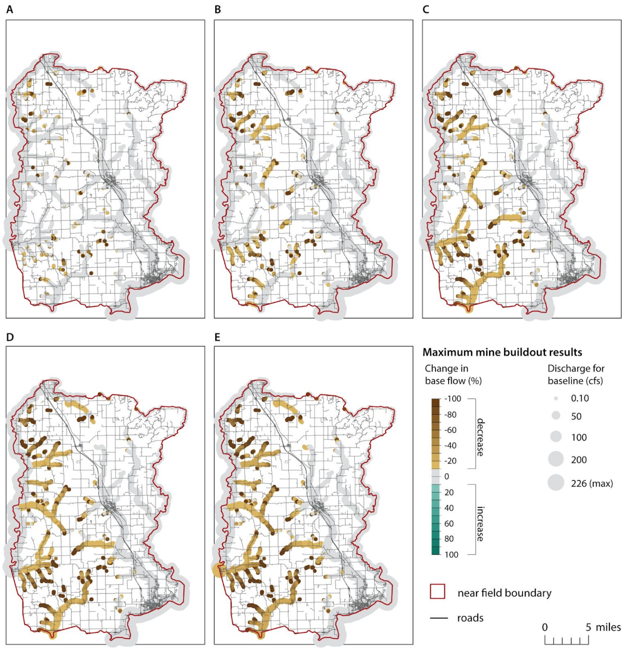


above a critical midpoint

relative lightness

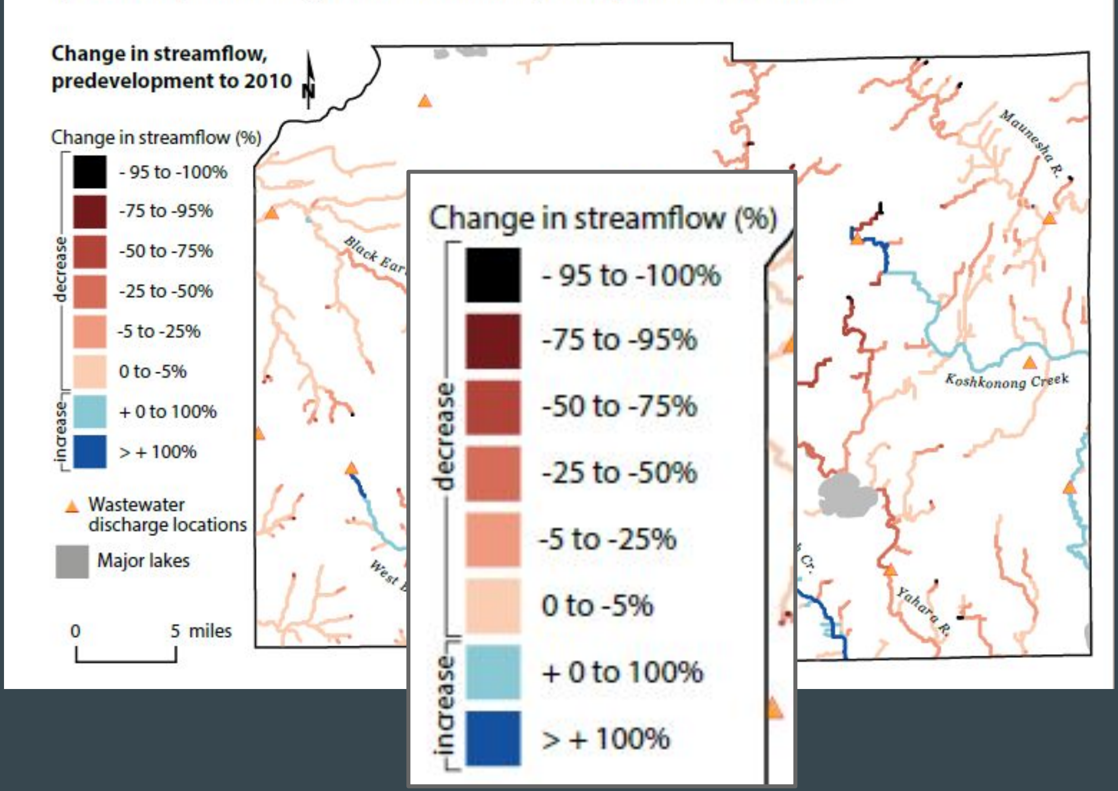
Figure 25. Comparison of changes in streamflow between predevelopment and 2010 conditions.

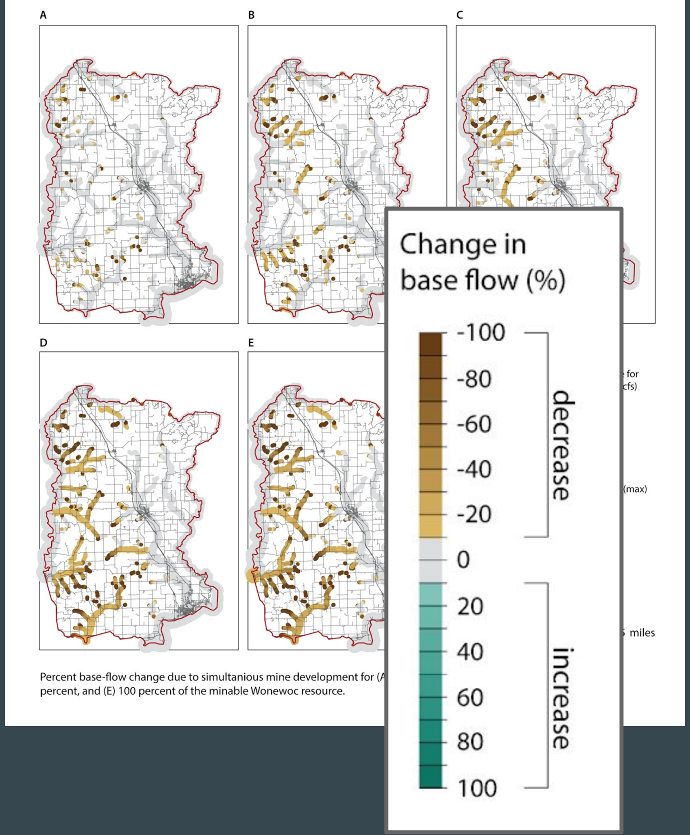




Percent base-flow change due to simultanious mine development for (A) 10 percent, (B) 25 percent, (C) 50 percent, (D) 75 percent, and (E) 100 percent of the minable Wonewoc resource.

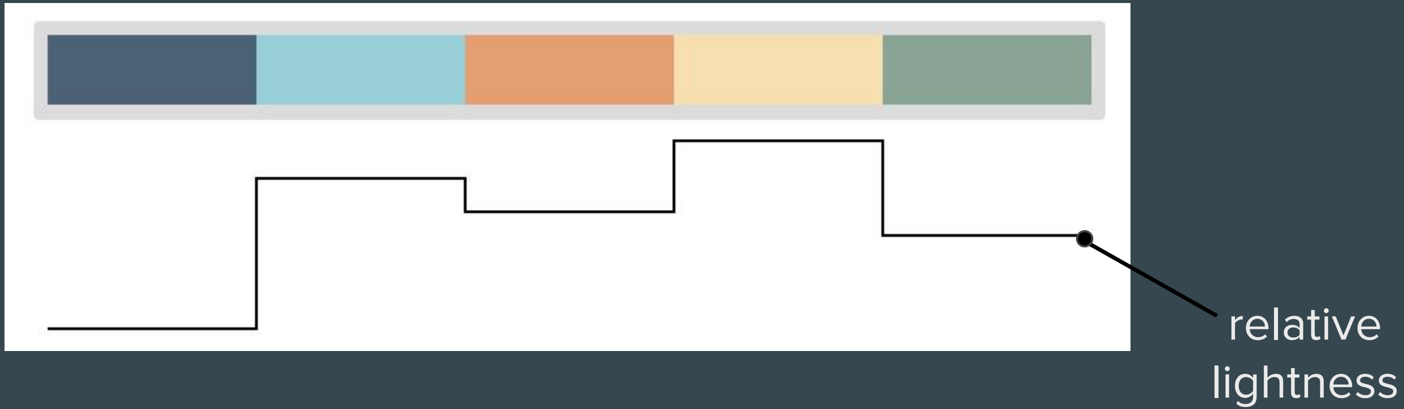
Figure 25. Comparison of changes in streamflow between predevelopment and 2010 conditions.



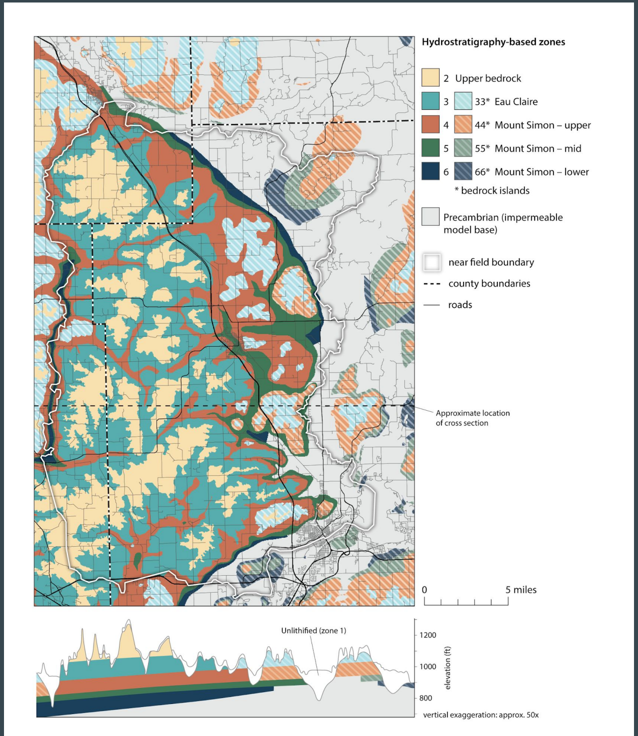


Percent base-flow change due to simultanious mine development for (A
percent, and (E) 100 percent of the minable Wonewoc resource.

qualitative



different, but no implied order


Hydrostratigraphy-based zones
2 Upper bedrock
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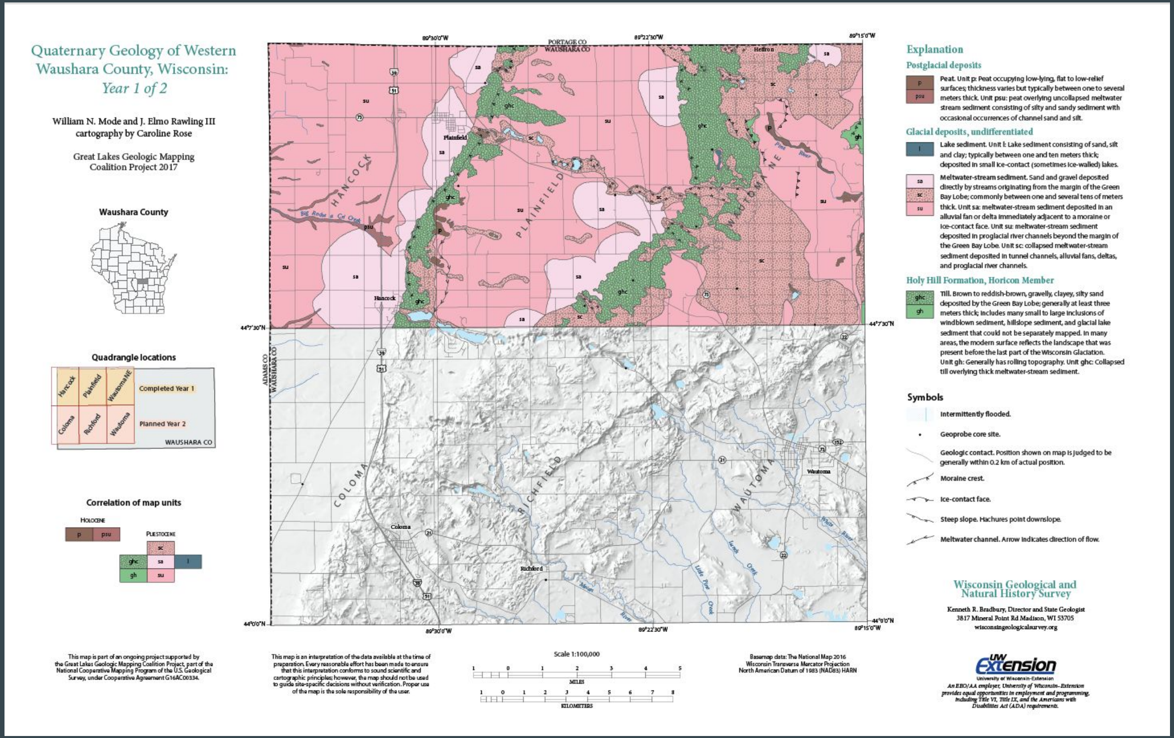
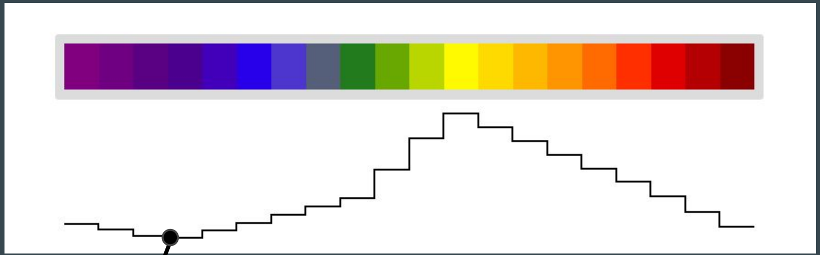
6 66* Mount Simon – lower
* bedrock islands
Precambrian (impermeable model base)
near field boundary
county boundaries
roads
Approximate location of cross section
0 5 miles
Unlithified (zone 1)
1200
1000
800
elevation (ft)
vertical exaggeration: approx. 50x

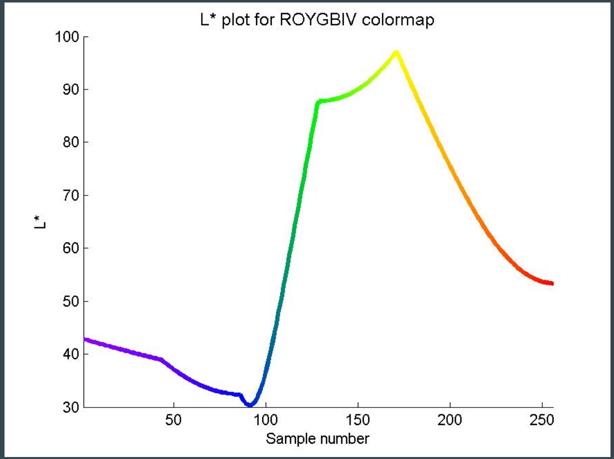

Quaternary Geology of Western Waushara County, Wisconsin: Year 1 of 2
William N. Mode and J. Elmo Rawling III
cartography by Caroline Rose
Great Lakes Geologic Mapping Coalition Project 2017
Waushara County
Quadrangle locations
Hancock
Plainfield
Wautoma NE
Coloma
Richford
Wautoma
Completed Year 1
Planned Year 2
WAUSHARA CO
Correlation of map units
Holocene
Pleistocene
p
psu
sc
ghc
sa
l
gh
su
PORTAGE CO
WAUSHARA CO
ADAMS CO
89°30'0"W
89°22'30"W
89°15'0"W
44°7'30"N
44°0'0"N
Explanation
Postglacial deposits
Peat. Unit p: Peat occupying low-lying, flat to low-relief surfaces; thickness varies but typically between one to several meters thick. Unit psu: peat overlying uncollapsed meltwater stream sediment consisting of silty and sandy sediment with occasional occurrences of channel sand and silt.
Glacial deposits, undifferentiated
Lake sediment. Unit l: Lake sediment consisting of sand, silt and clay; typically between one and ten meters thick; deposited in small ice-contact (sometimes ice-walled) lakes.
Meltwater-stream sediment. Sand and gravel deposited directly by streams originating from the margin of the Green Bay Lobe; commonly between one and several tens of meters thick. Unit sa: meltwater-stream sediment deposited in an alluvial fan or delta immediately adjacent to a moraine or ice-contact face. Unit su: meltwater-stream sediment deposited in proglacial river channels beyond the margin of the Green Bay Lobe. Unit sc: collapsed meltwater-stream sediment deposited in tunnel channels, alluvial fans, deltas, and proglacial river channels.
Holy Hill Formation, Horicon Member
Till. Brown to reddish-brown, gravelly, clayey, silty sand deposited by the Green Bay Lobe; generally at least three meters thick; includes many small to large inclusions of windblown sediment, hillslope sediment, and glacial lake sediment that could not be separately mapped. In many areas, the modern surface reflects the landscape that was present before the last part of the Wisconsin Glaciation. Unit gh: Generally has rolling topography. Unit ghc: Collapsed till overlying thick meltwater-stream sediment.
Symbols
Intermittently flooded.
Geoprobe core site.
Geologic contact. Position shown on map is judged to be generally within 0.2 km of actual position.
Moraine crest.
Ice-contact face.
Steep slope. Hachures point downslope.
Meltwater channel. Arrow indicates direction of flow.
Wisconsin Geological and Natural History Survey
Kenneth R. Bradbury, Director and State Geologist
3817 Mineral Point Rd Madison, WI 53705
wisconsingeologicalsurvey.org
This map is part of an ongoing project supported by the Great Lakes Geologic Mapping Coalition Project, part of the National Cooperative Mapping Program of the U.S. Geological Survey, under Cooperative Agreement G16AC00334.
This map is an interpretation of the data available at the time of preparation. Every reasonable effort has been made to ensure that this interpretation conforms to sound scientific and cartographic principles; however, the map should not be used to guide site-specific decisions without verification. Proper use of the map is the sole responsibility of the user.
Scale 1:100,000
MILES
KILOMETERS
Basemap data: The National Map 2016
Wisconsin Transverse Mercator Projection
North American Datum of 1983 (NAD83) HARN
UW Extension
University of Wisconsin–Extension
An EEO/AA employer, University of Wisconsin–Extension provides equal opportunities in employment and programming, including Title VI, Title IX, and the Americans with Disabilities Act (ADA) requirements.

spectral



relative lightness

relative lightness



“The Rainbow is Dead... Long Live the Rainbow!” by Matteo Niccoli

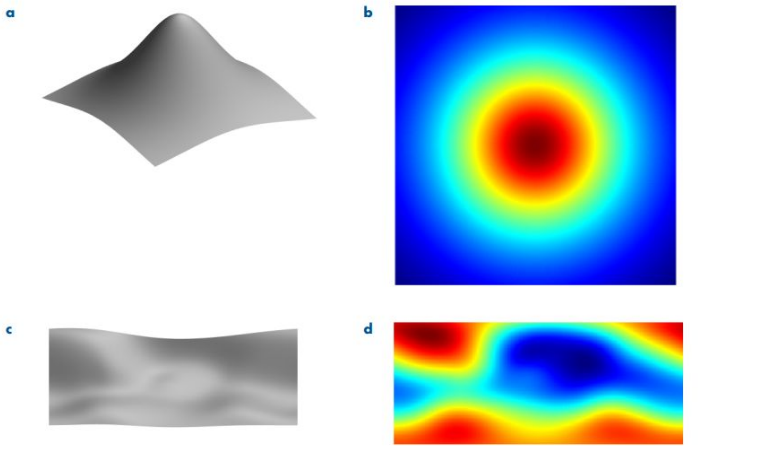


Figure 5. False bands caused by the rainbow color map for smooth data: a) Synthetic surface with a single peak; b) 2D visualization with rainbow color map; c) Earth's magnetic field intensity; d) 2D visualization with rainbow color map.

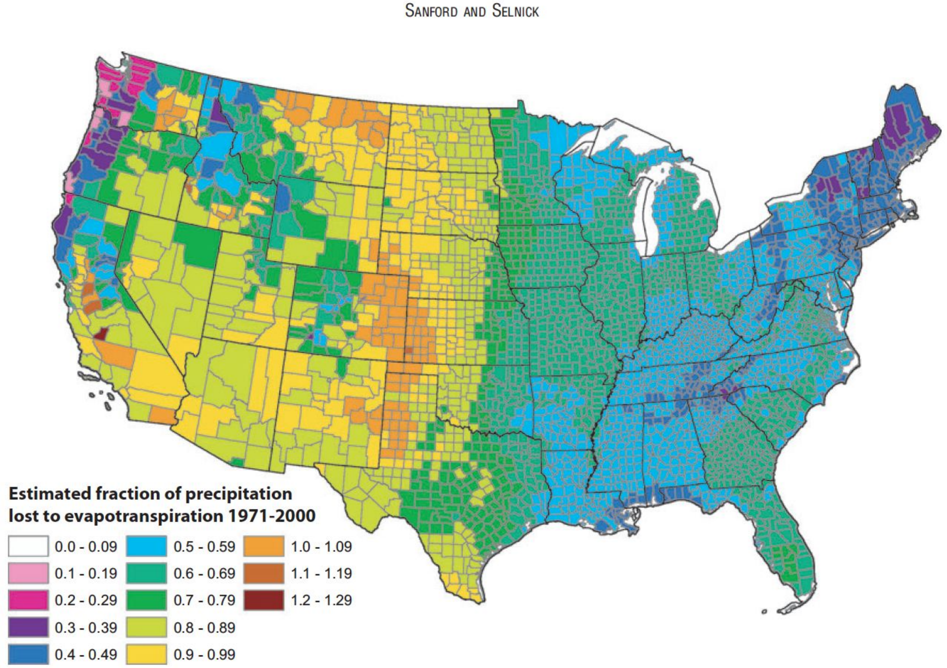
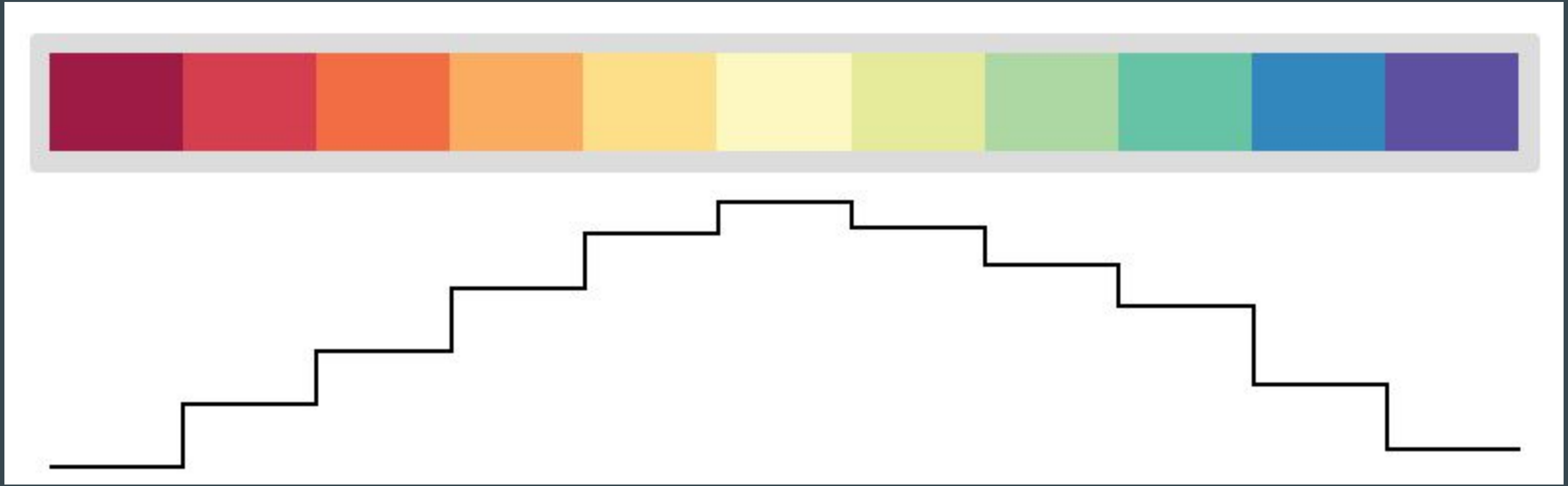
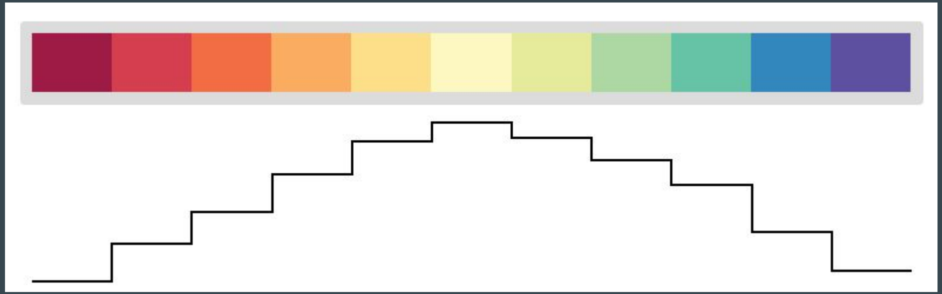


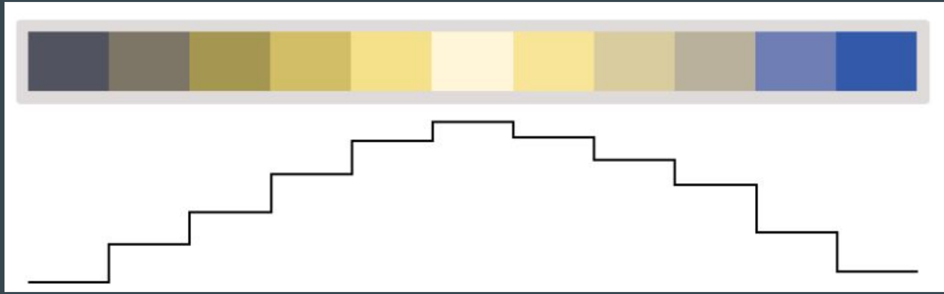
FIGURE 13. Estimated Mean Annual Ratio of Actual Evapotranspiration (ET) to Precipitation (P) for the Conterminous U.S. for the Period 1971-2000. Estimates are based on the regression equation in Table 1 that includes land cover. Calculations of ET/P were made first at the 800-m resolution of the PRISM climate data. The mean values for the counties (shown) were then calculated by averaging the 800-m values within each county. Areas with fractions >1 are agricultural counties that either import surface water or mine deep groundwater.

"Rainbow Color Map Critiques: An Overview and Annotated Bibliography" by Steve Eddins

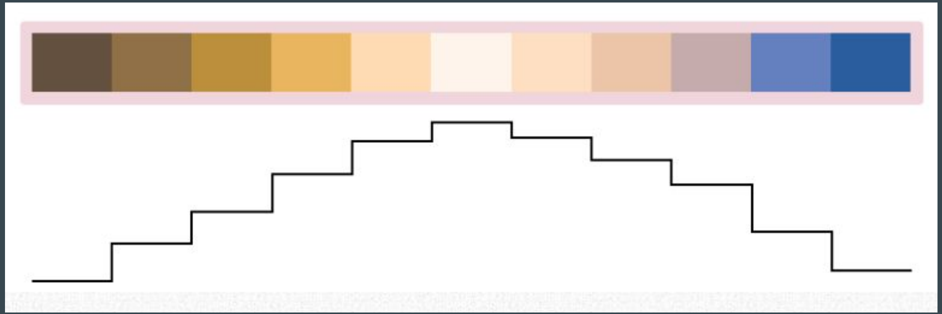
"How The Rainbow Color Map Misleads" by Robert Kosara





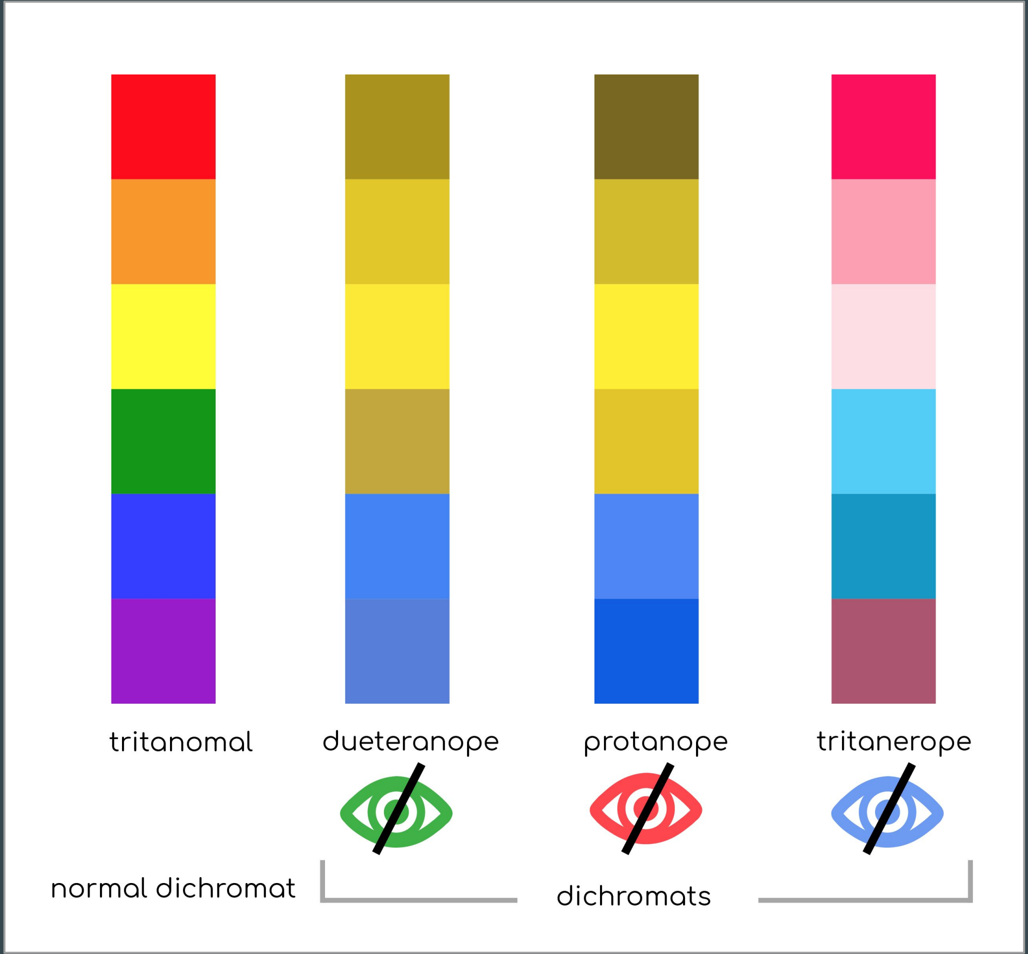


Protanopia



Deuteranopia

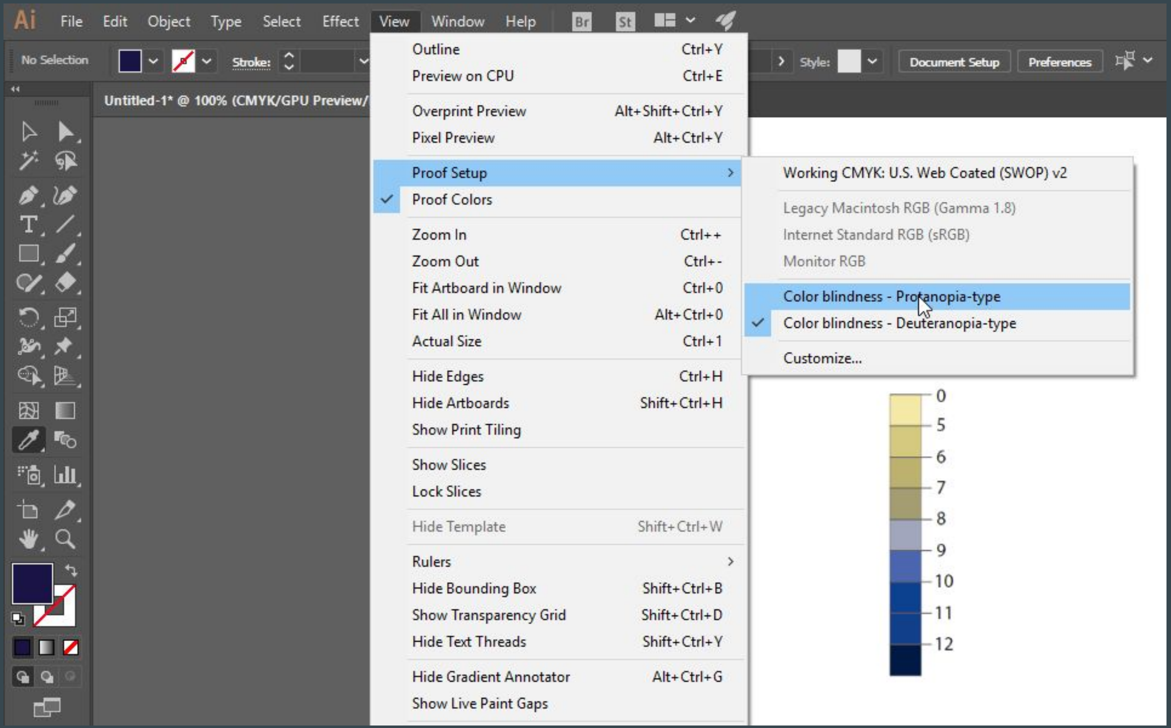

CAUTION



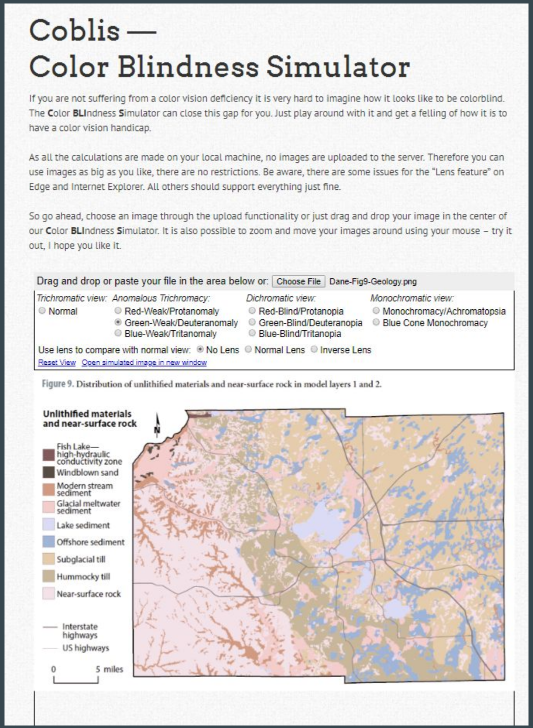
blog.usabilla.com

8% of men (1 in 12)

0.5% of women (1 in 200)



View > Proof Setup in Adobe Illustrator or Photoshop

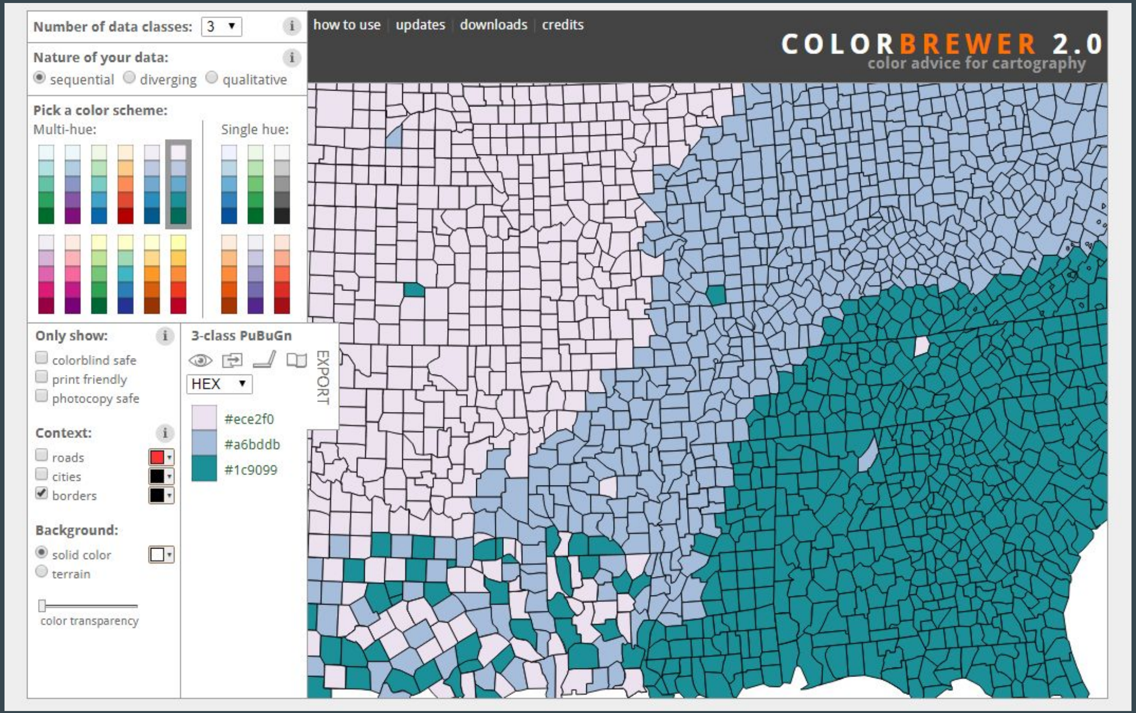


color-blindness.com/coblis-color-blindness-simulator/

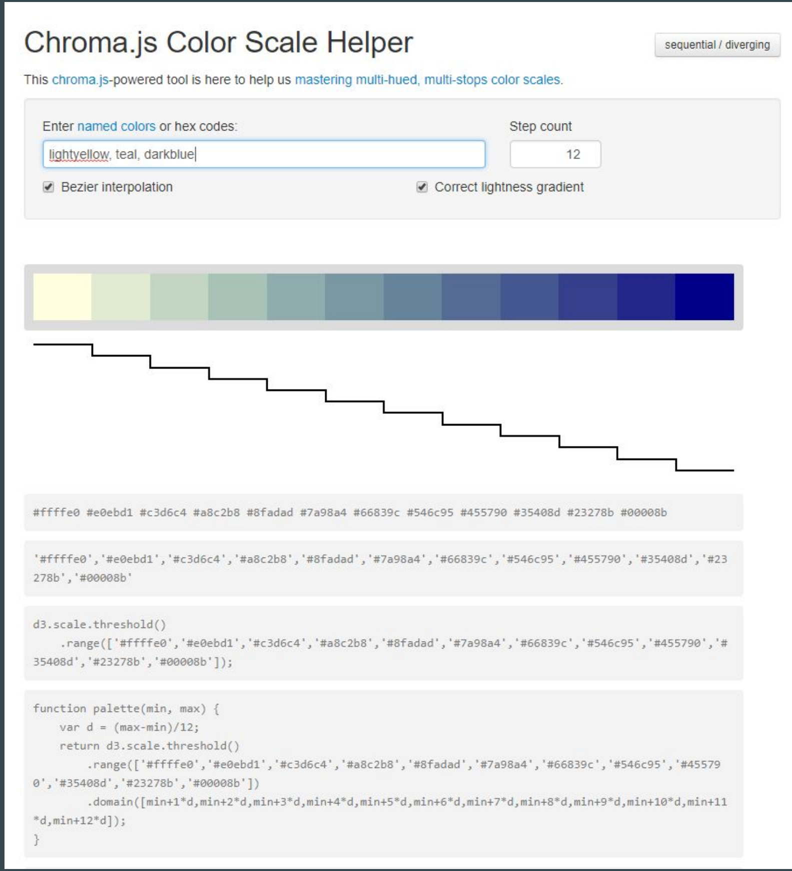
tools for color schemes

colorbrewer2.org

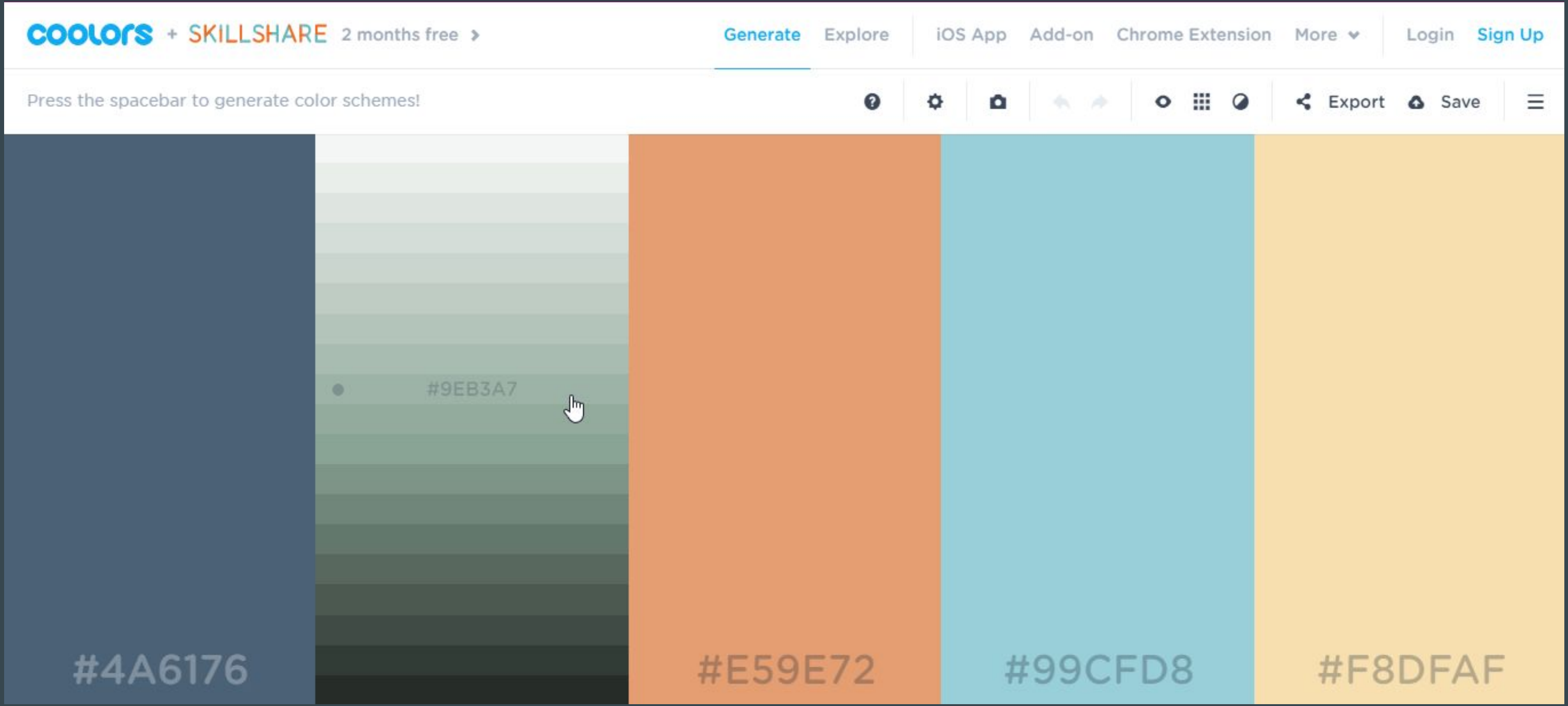
carto.com/carto-colors



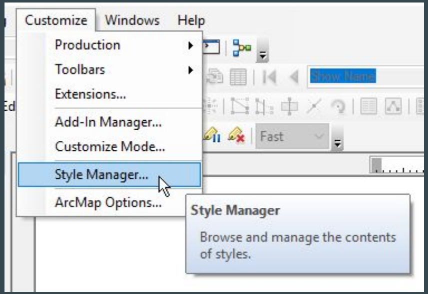
gka.github.io/palettes

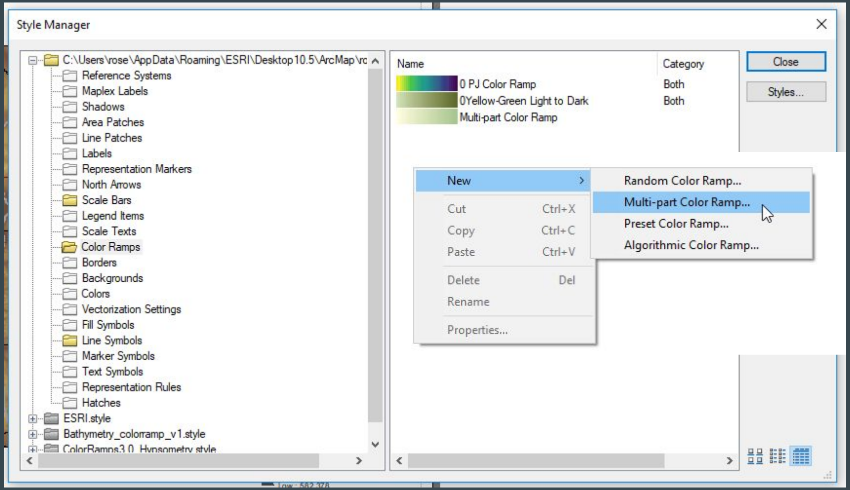


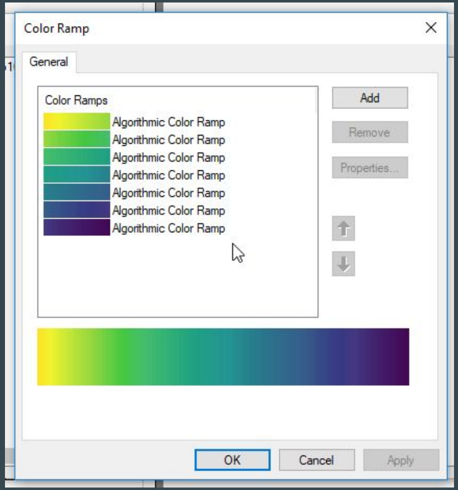
coolors.co/app



ArcMap: Style Manager

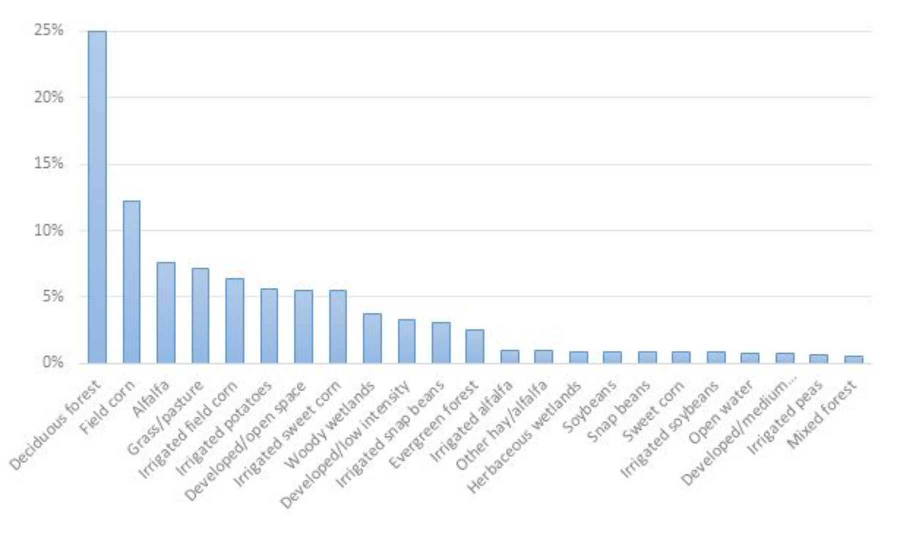






illustrate data structure:

use other visualizations



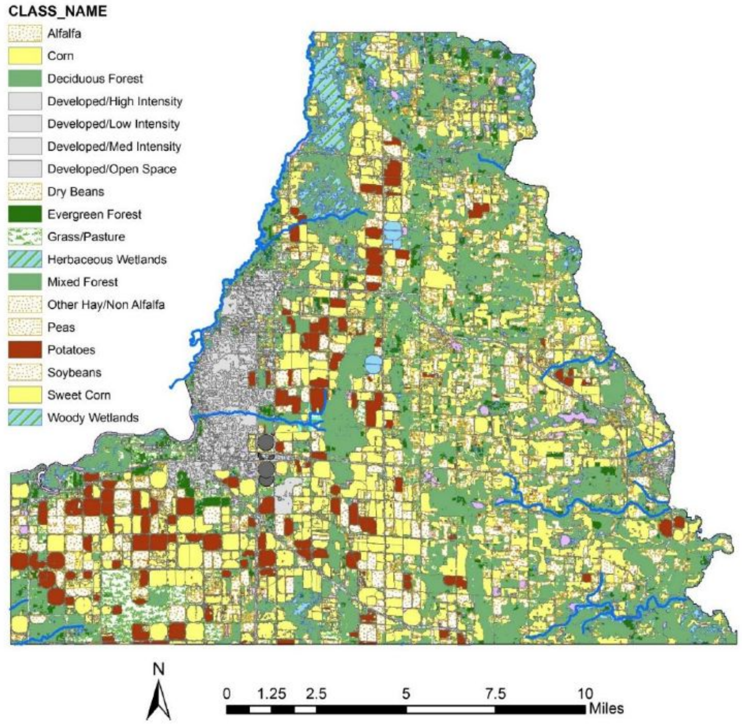
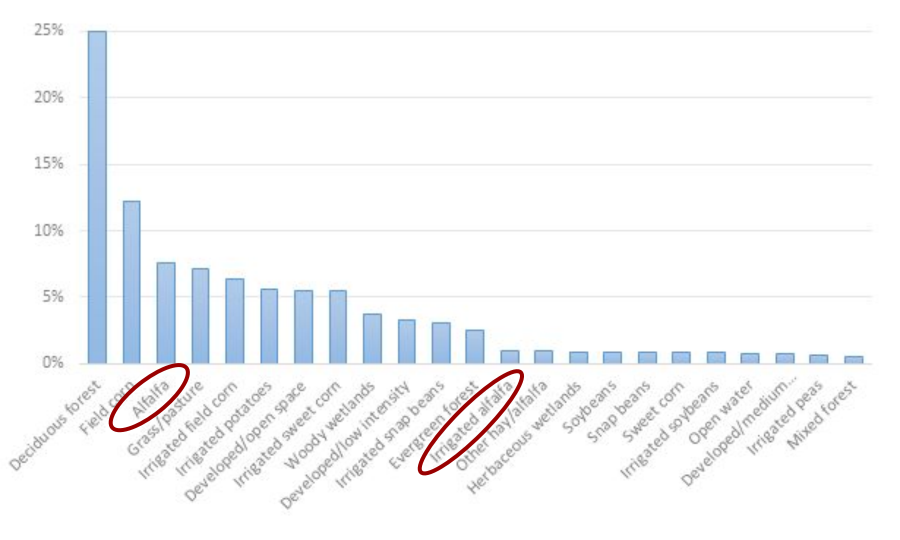


Figure 19. 2013 NASS CDL land use classification over the model domain. Validation fields are in blue. Del Monte recharge fields are in grey.



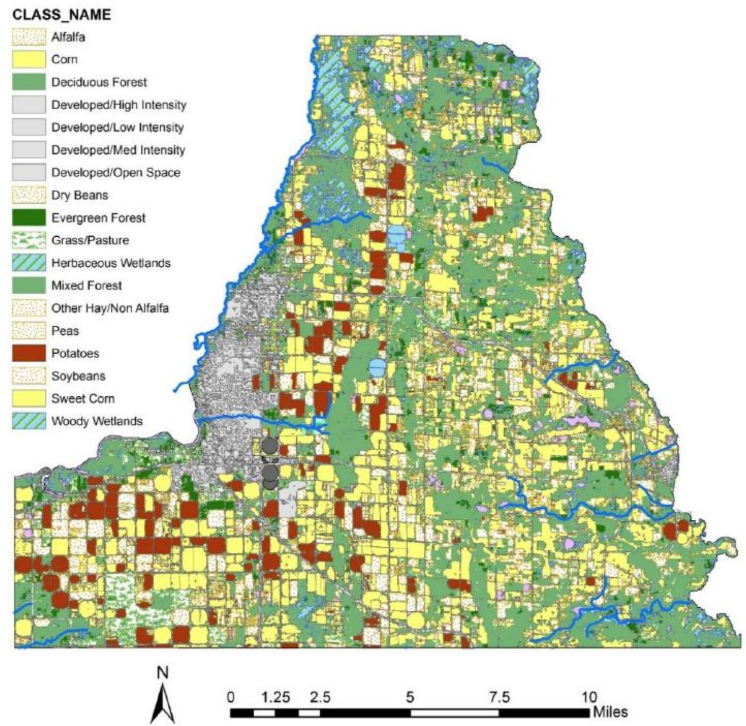
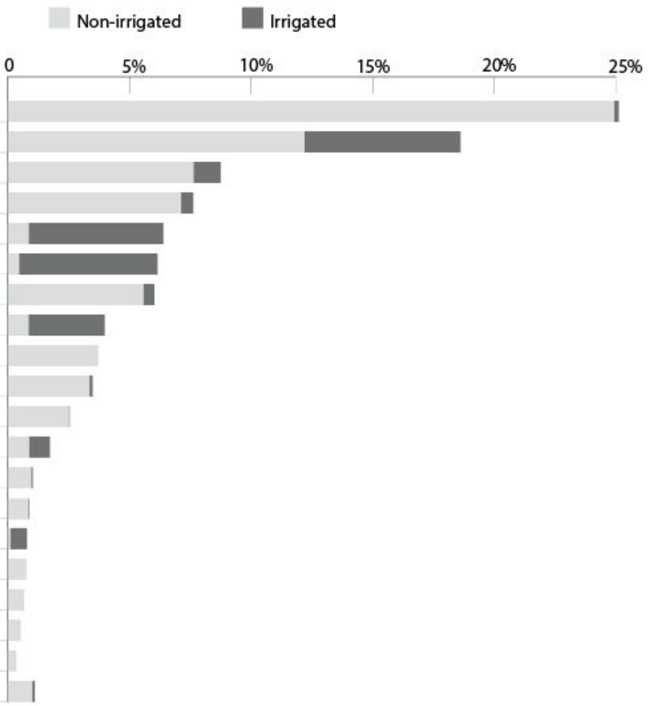
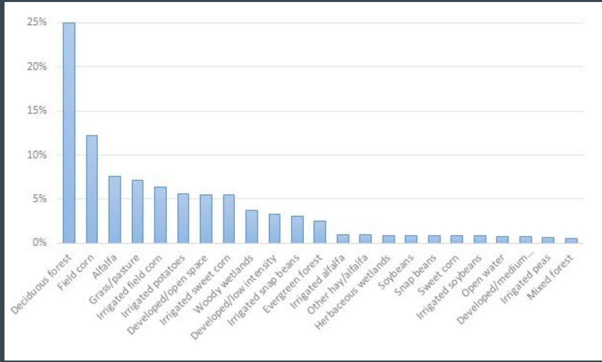


Figure 19. 2013 NASS CDL land use classification over the model domain. Validation fields are in blue. Del Monte recharge fields are in grey.

Land use/cover by percentage of total model area

	Non-irrigated (%)	Irrigated (%)
Forest, deciduous	24.9	0.2
Field corn	12.2	6.4
Alfalfa	7.6	1.1
Grass/pasture	7.1	0.5
Sweet corn	0.9	5.5
Potatoes	0.5	5.7
Developed—open space	5.6	0.4
Snap beans	0.9	3.1
Wetlands, woody	3.7	0.0
Developed—low intensity	3.4	0.1
Forest, evergreen	2.5	0.0
Soybeans	0.9	0.8
Other hay/non-alfalfa	1.0	0.1
Wetlands, herbaceous	0.9	0.0
Peas	0.1	0.7
Developed—med intensity	0.7	0.0
Open water	0.6	0.0
Forest, mixed	0.5	0.0
Developed—high intensity	0.3	0.0
All other land use/cover	1.0	0.1





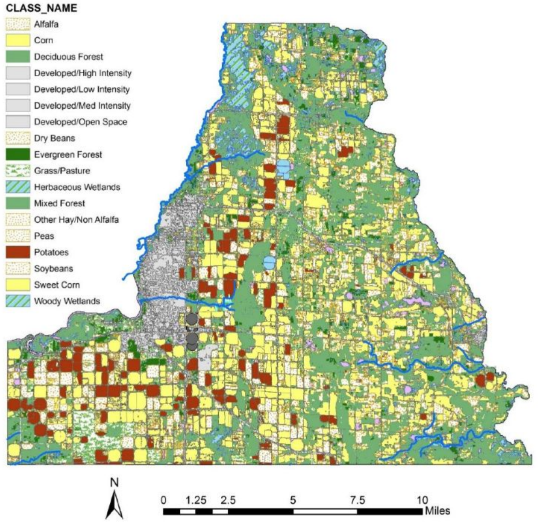
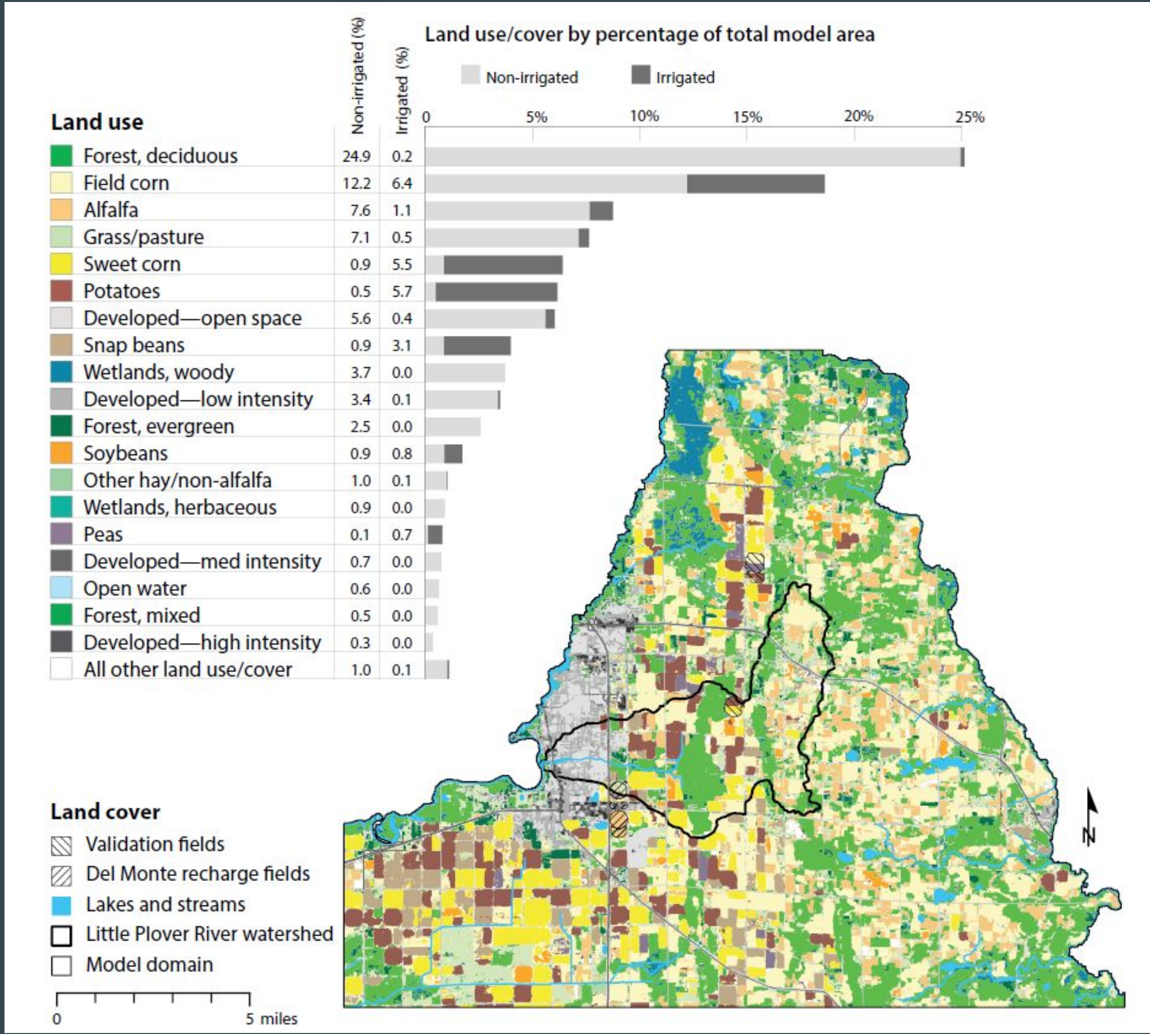
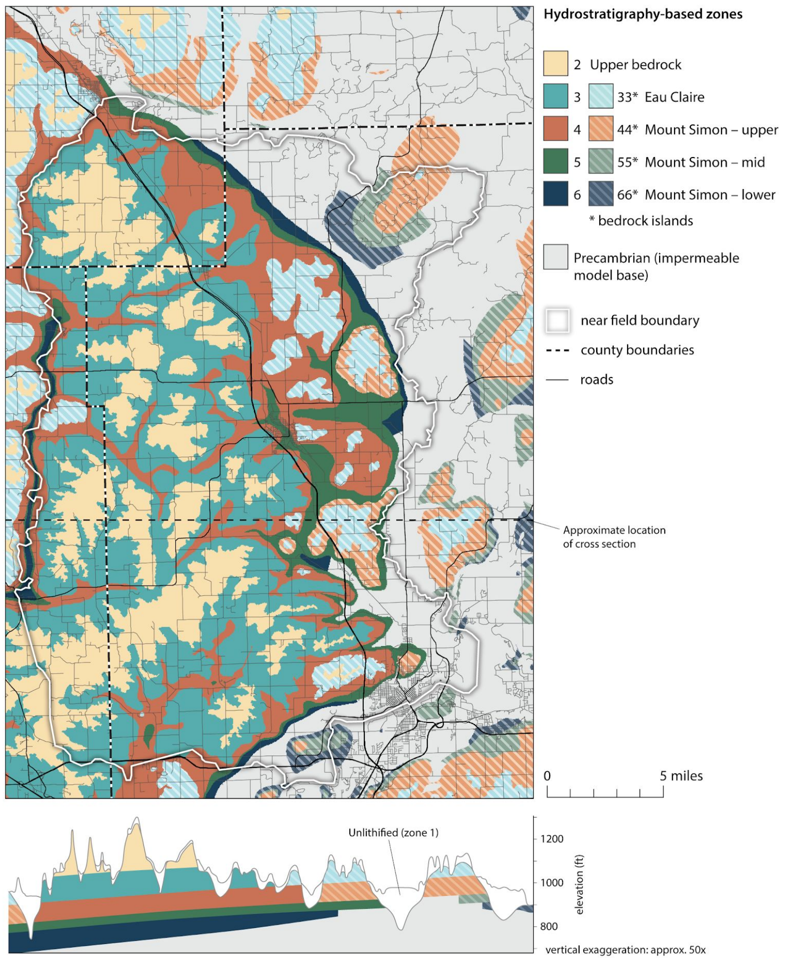


Figure 19. 2013 NASS CDL land use classification over the model domain. Validation fields are in blue. Del Monte recharge fields are in grey.




Hydrostratigraphy-based zones
2 Upper bedrock
3 33* Eau Claire
4 44* Mount Simon – upper
5 55* Mount Simon – mid
6 66* Mount Simon – lower
* bedrock islands
Precambrian (impermeable model base)
near field boundary
county boundaries
roads
Approximate location of cross section
0
5 miles
Unlithified (zone 1)
1200
1000
800
elevation (ft)
vertical exaggeration: approx. 50x

3 facilitate comparison

facilitate comparison:

consistent symbology

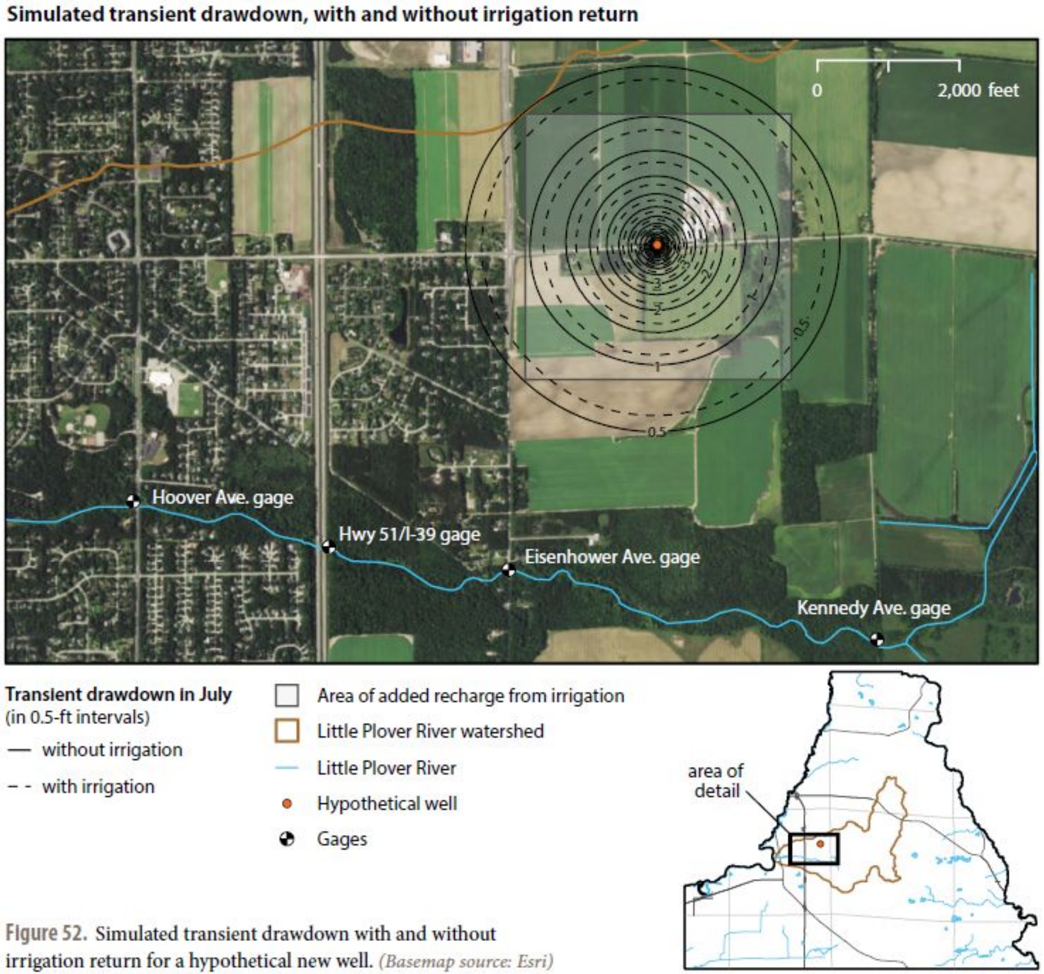


Figure 52. Simulated transient drawdown with and without irrigation return for a hypothetical new well. *(Basemap source: Esri)*

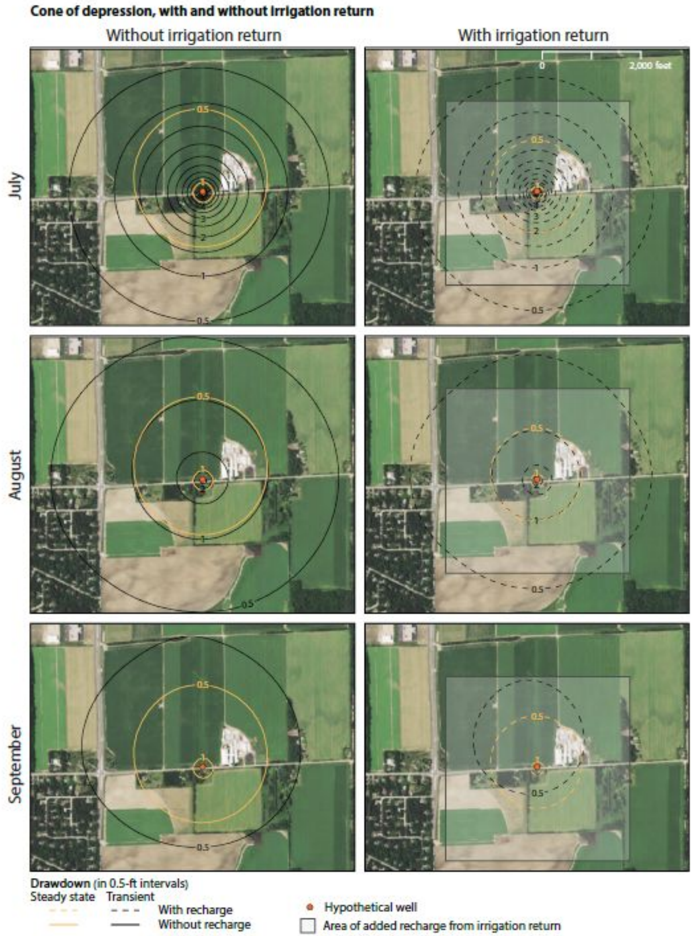


Figure 53. Expansion and contraction of cone of depression through time at the hypothetical new well, with (right) and without (left) irrigation return. *(Basemap source: Esri)*

facilitate comparison:

stretch to overall min/max

range of data
for this figure

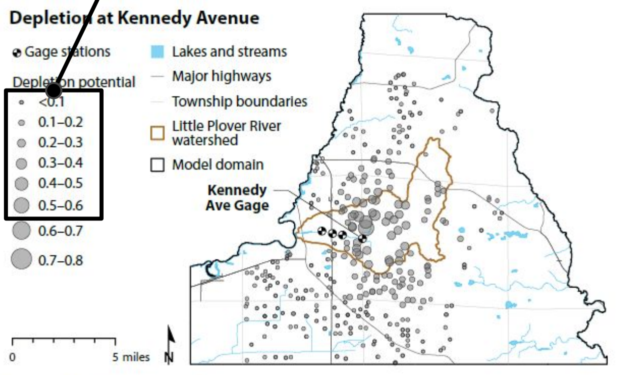


Figure 57. Depletion analysis at Kennedy Avenue.

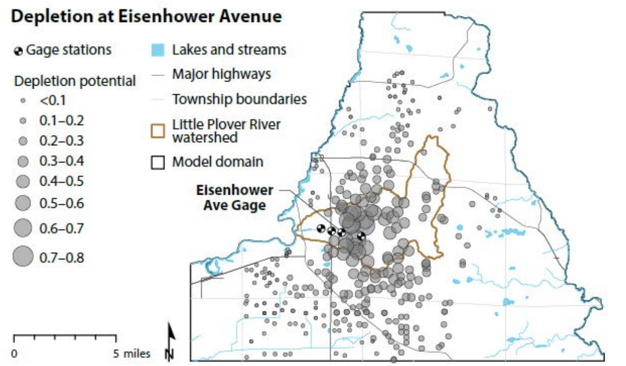


Figure 58. Depletion analysis at Eisenhower Avenue.

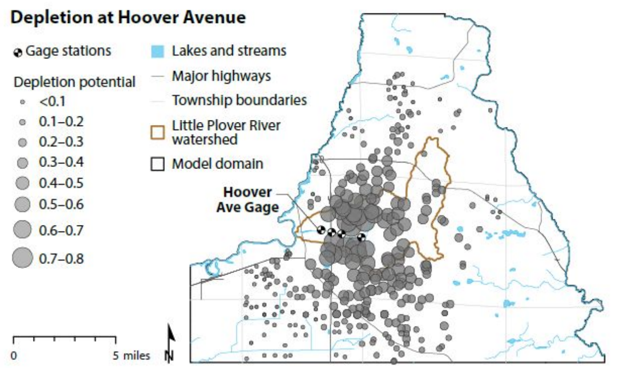
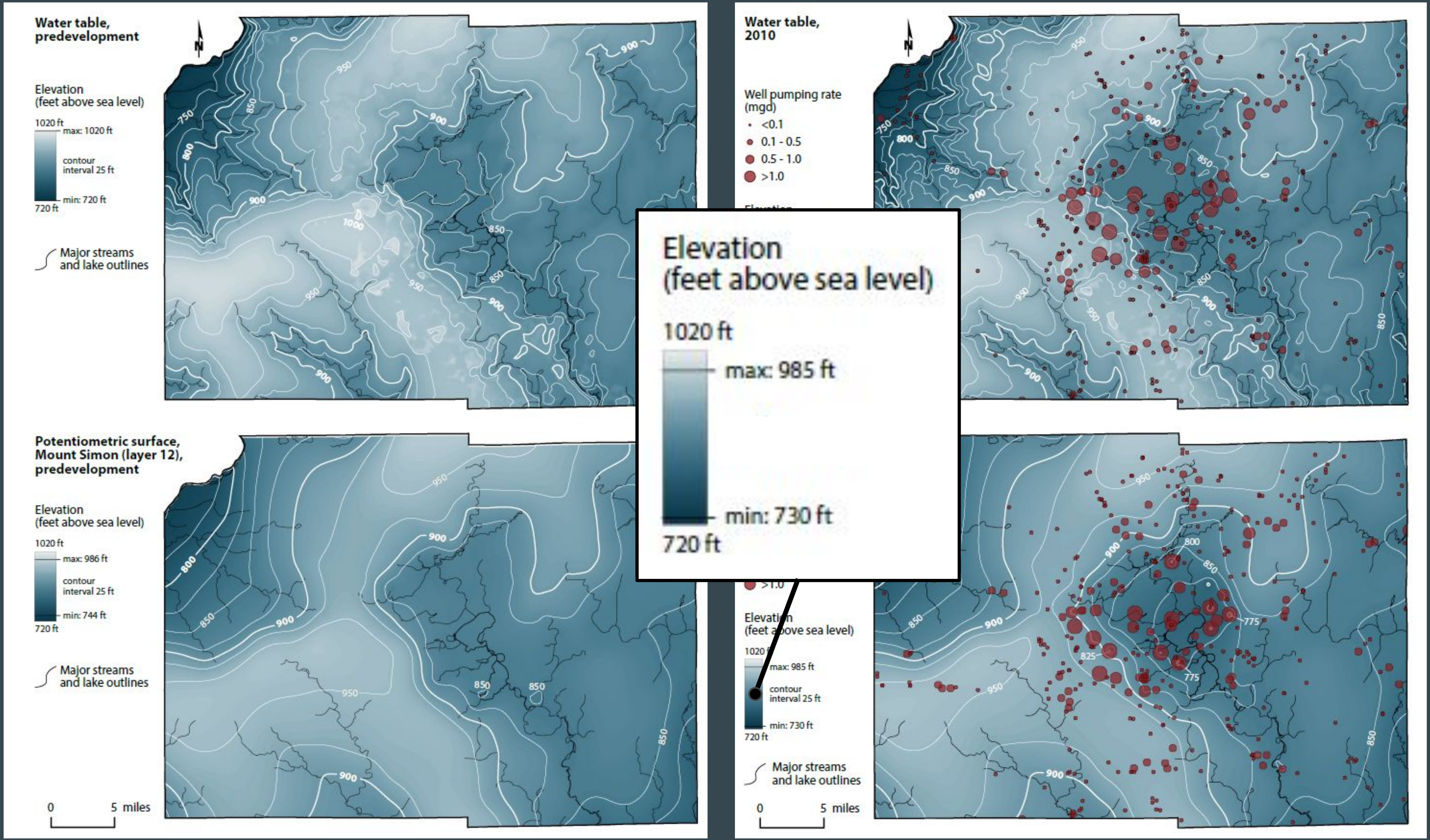


Figure 59. Depletion analysis at Hoover Avenue.


Water table, predevelopment
Elevation (feet above sea level)
1020 ft
max: 1020 ft
contour interval 25 ft
min: 720 ft
720 ft
Major streams and lake outlines
750
800
850
900
950
1000
Water table, 2010
Well pumping rate (mgd)
<0.1
0.1 - 0.5
0.5 - 1.0
>1.0
Elevation (feet above sea level)
1020 ft
max: 985 ft
min: 730 ft
720 ft
Potentiometric surface, Mount Simon (layer 12), predevelopment
Elevation (feet above sea level)
1020 ft
max: 986 ft
contour interval 25 ft
min: 744 ft
720 ft
Major streams and lake outlines
0 5 miles
775
800
825
850
900
950
Elevation (feet above sea level)
1020 ft
max: 985 ft
contour interval 25 ft
min: 730 ft
720 ft
Major streams and lake outlines
0 5 miles

recap

what should the reader learn from this image?

design purpose

1 focus attention

represent nothing with nothing

create a visual hierarchy

② illustrate data structure

choose color schemes to match data

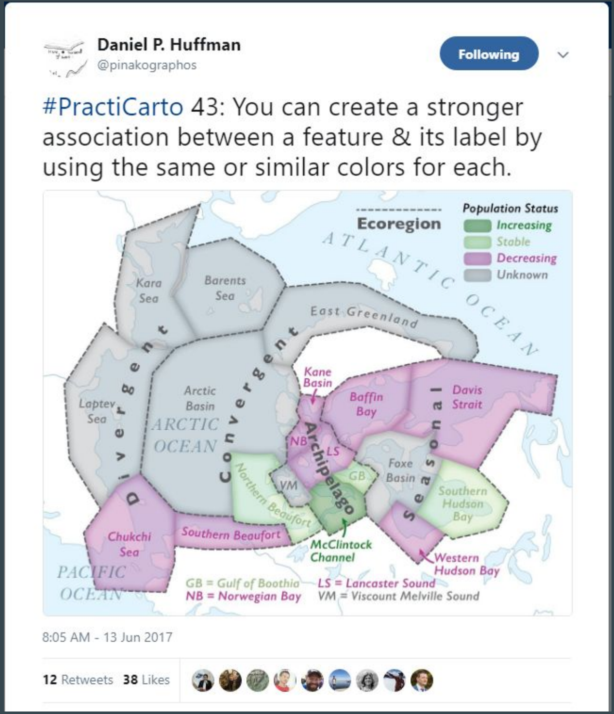
use other visualizations

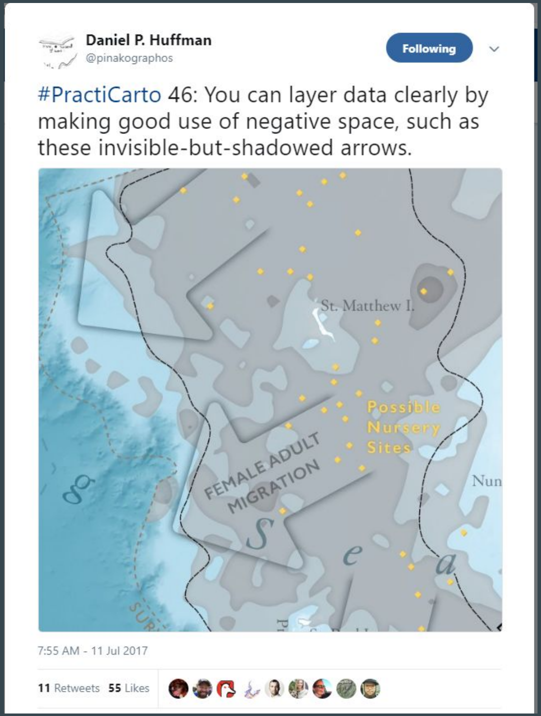
③ facilitate comparison

use consistent symbology for the same dataset

stretch different datasets to the same min/max

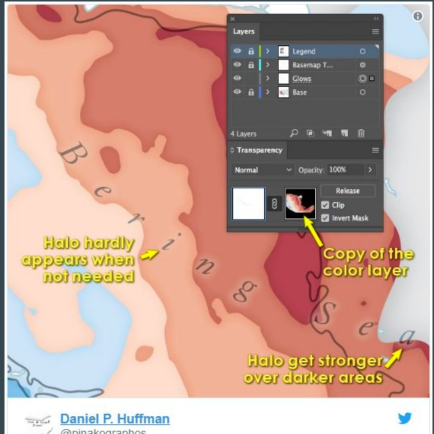
learn and share

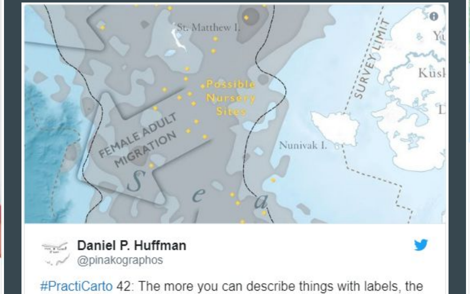


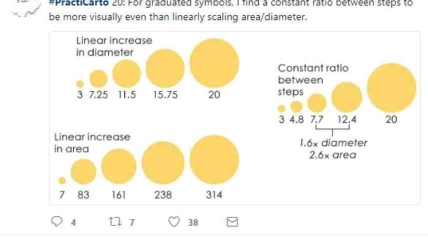


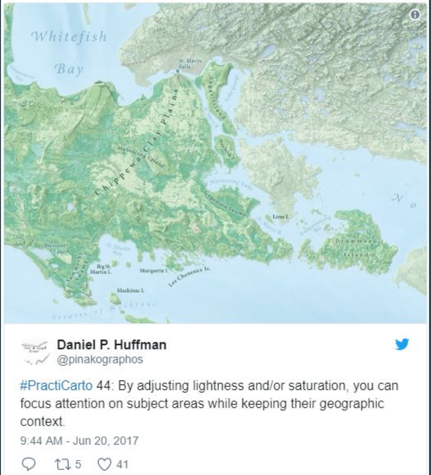
#practicarto

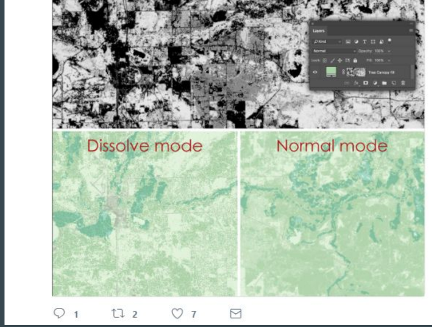
#practicarto

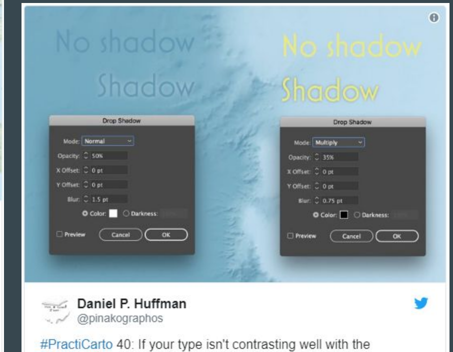








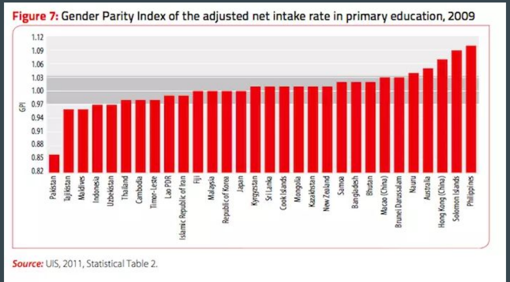


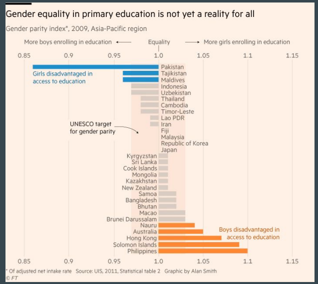


Further reading

“Design and Redesign in Data Visualization” by Fernanda Viégas & Martin Wattenberg
https://medium.com/@hint_fm/design-and-redesign-4ab77206cf9

“Data visualisation mistakes — and how to avoid them” by Alan Smith
https://www.ft.com/content/3b59f690-d129-11e7-b781-794ce08b24dc





Further reading

lisacharlotterost.github.io

“Why Do We Visualise Data?” by Lisa Charlotte Rost:
https://lisacharlotterost.github.io/2017/03/10/why-do-we-visualize-data/

“What to consider when creating stacked column charts” by Lisa Charlotte Rost:
https://blog.datawrapper.de/stacked-column-charts/

“How The Rainbow Color Map Misleads” by Robert Kosara
https://eagereyes.org/basics/rainbow-color-map

“Anscombe's quartet” https://en.wikipedia.org/wiki/Anscombe%27s_quartet

Further reading

“Why Luminance Is The Key Component Of Color” by Stephen Bradley
http://vanseodesign.com/web-design/color-luminance/

“The Rainbow is Dead… Long Live the Rainbow!” by Matteo Niccoli
https://mycarta.wordpress.com/2012/05/29/the-rainbow-is-dead-long-live-the-rainbow-series-outline/

“Rainbow Color Map Critiques: An Overview and Annotated Bibliography” by Steve Eddins
https://www.mathworks.com/tagteam/81137_92238v00_RainbowColorMap_57312.pdf

“Perceptually Driven Visibility Optimization for Categorical Data Visualization” by Sungkil Lee, Mike Sips, and Hans-Peter Seidel
http://ieeexplore.ieee.org/document/6365630/figures

Thank you!

github.com/cmrRose/talks

caroline.rose@wgnhs.uwex.edu
@cmrRose