Depression-Filling Algorithms for Ditch Removal and Wetland Restoration

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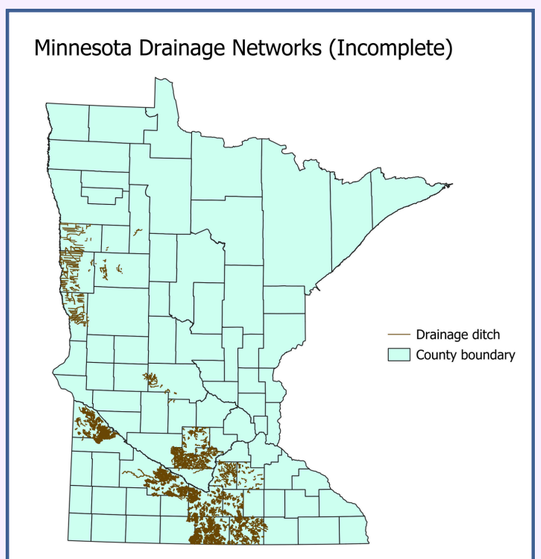
1. Background

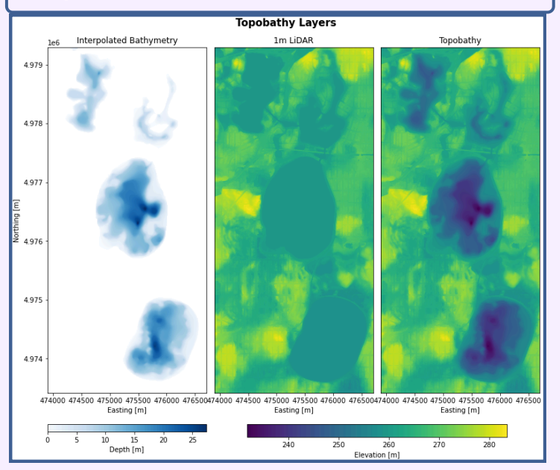
Ditch networks in Minnesota drain natural wetlands to create farmable land. We use computational GIS and depression-filling algorithms to quantify individual ditches' impacts on wetland extent.



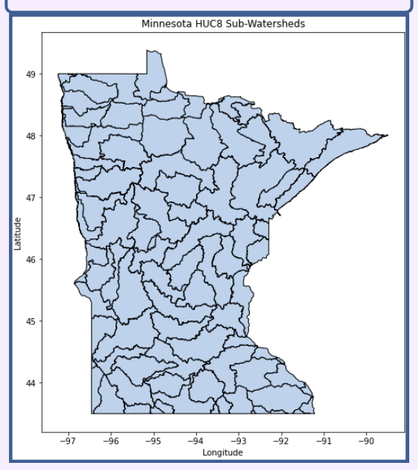
Modernized ditch mapping from 13 counties and watershed districts in Minnesota.

2. Topobathy DEM & Watershed Boundaries

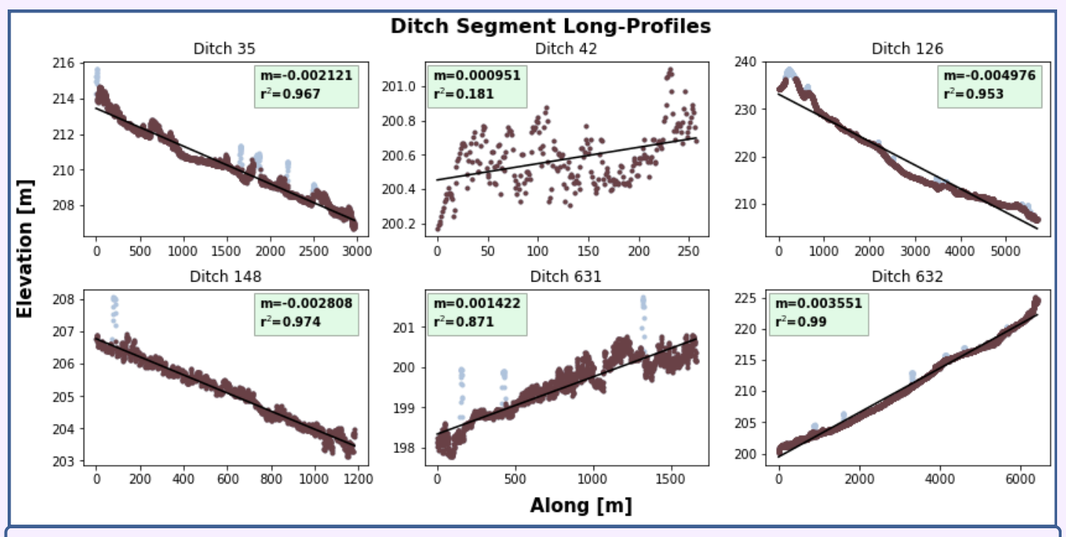
We created a topobathy DEM to account for lake depressions.



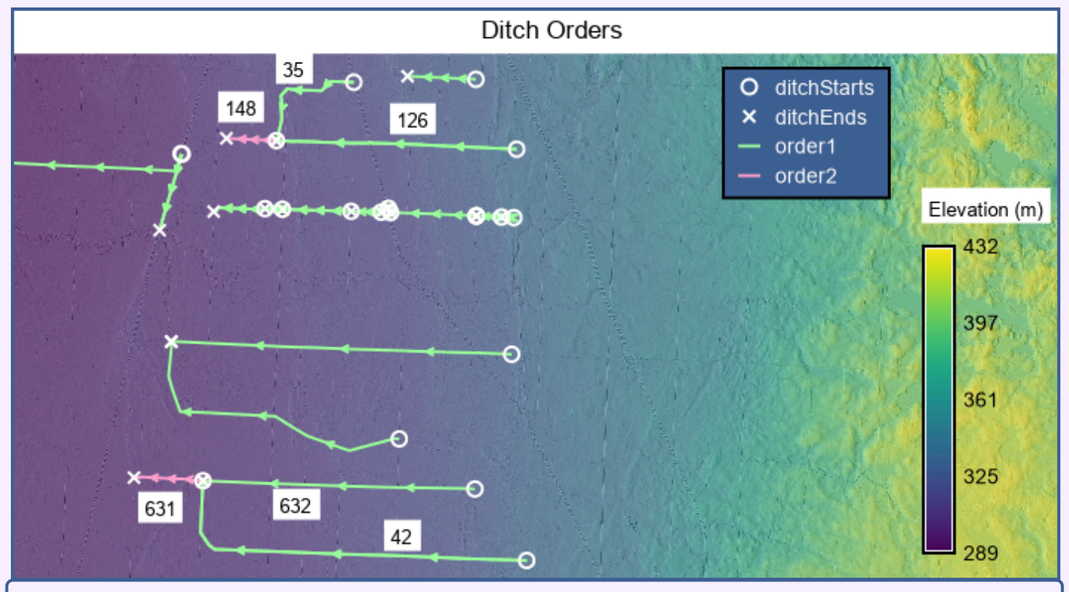
The DEM was split by HUC8 watershed boundaries.



3. Ditch-Network Construction



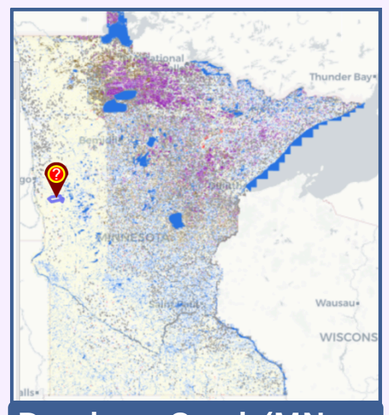
We determined flow directions of vectorized ditches.



Knowing flow directions enabled us to find junction locations and 'stream orders' for the ditches.

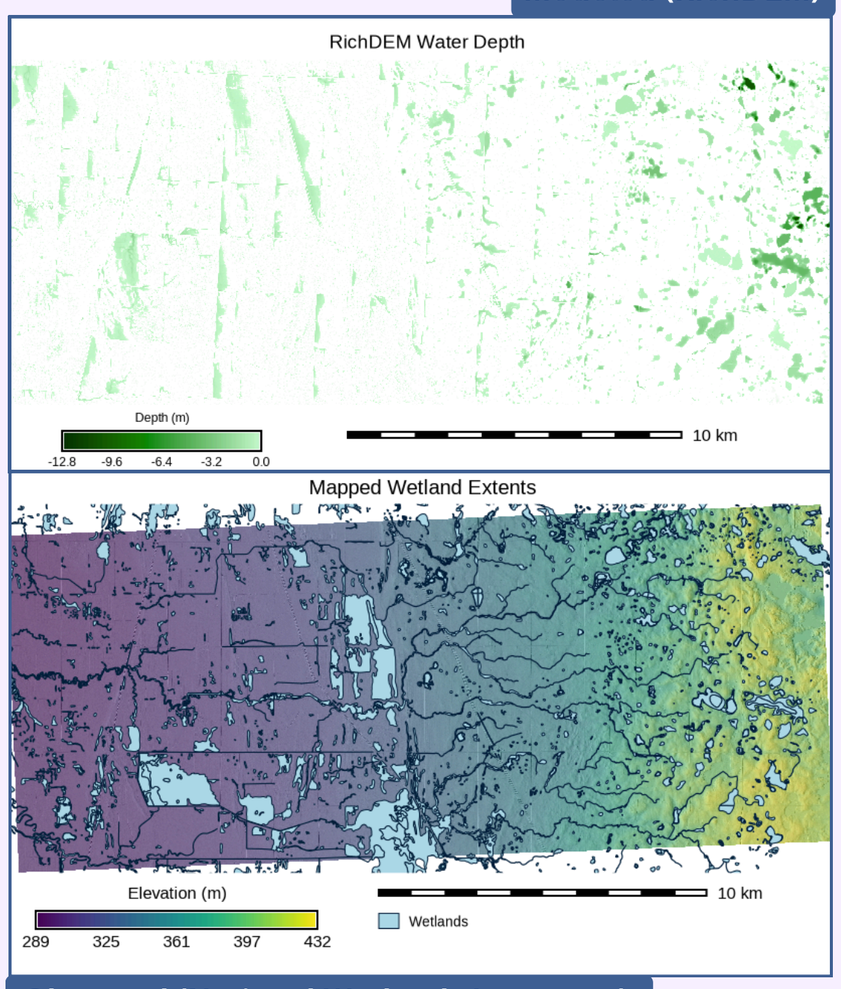
4. Method & Results

We tested four depression-filling models on the Deerhorn Creek watershed in western Minnesota. We wanted to evaluate model results against known wetland extents; this site has extensive wetland cover.



Deerhorn Creek (MN Natural Resource Atlas)

Modeled (RichDEM)



Observed (National Wetlands Inventory)

Model results reproduced the observed wetlands in the east and north, but groundwater modeling may be needed for wetlands in the west.

Three models showed strong agreement in water volumes. RD had the most efficient performance metrics.

	Time (min)	Mem. (GB)	Results (km^3)
GRASS	1563	low	.000365
RD	<1	2.64	.0239
DH	18	6.17	.0239
FSM	21	6.67	.0237

5. Future Work

We will digitally plug ditches directly upstream of junctions in the directed graph and run models on the altered DEMs to assess changes in water volume. Groundwater will be simulated in select regions using the Water Table Model.

References

Barnes et al. (2016). *RichDEM: Terrain Analysis Software.*
Barnes et al. (2020). *Earth Surface Dynamics, 8.*
Barnes et al. (2021). *Earth Surface Dynamics, 9.*
Callaghan et al. (2025). *Geosci. Model Dev., 18.*

Acknowledgements

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