IOWA STATE UNIVERSITY
College of Engineering
College of Agriculture & Life Sciences
College of Liberal Arts & Sciences

Farmed prairie potholes – opportunities and challenges

Amy Kaleita
Hydrology

Michelle Soupir
Water Quality

Andy VanLoocke
Crop Development

Emily Heaton
Energy Crops

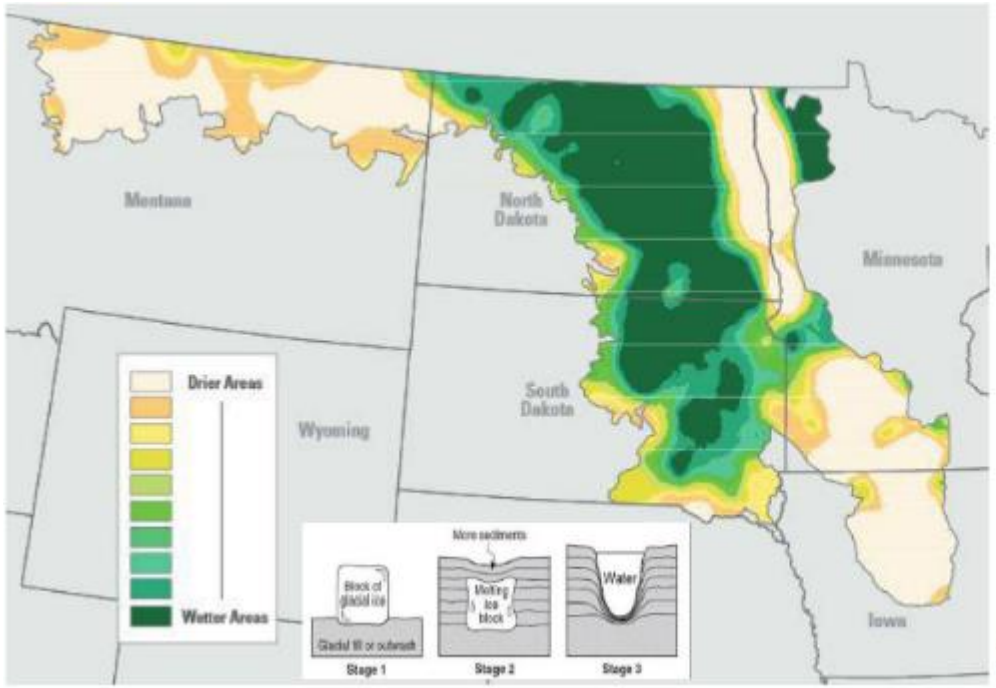
Steven Hall
Biogeochemistry

Adam Janke
Wildlife

Prairie Pothole Region

An expansive, deglaciated agriculturally-dominated, wetland-heavy region of southern Canada and north-central Midwestern US.

Enclosed depressions that often retain water for some portion of the year

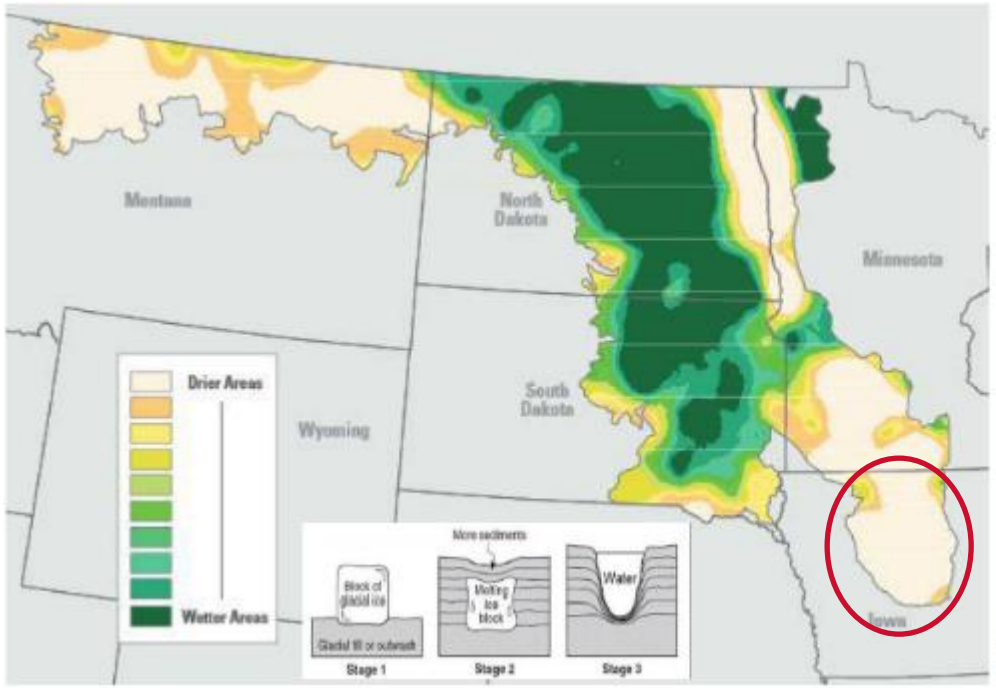


Stevens and Salman, 2015.
Wade, 2013.

Prairie Pothole Region

An expansive, deglaciated agriculturally-dominated, wetland-heavy region of southern Canada and north-central Midwestern US.

Enclosed depressions that often retain water for some portion of the year



Stevens and Salman, 2015.
Wade, 2013.

Hydrology Basics

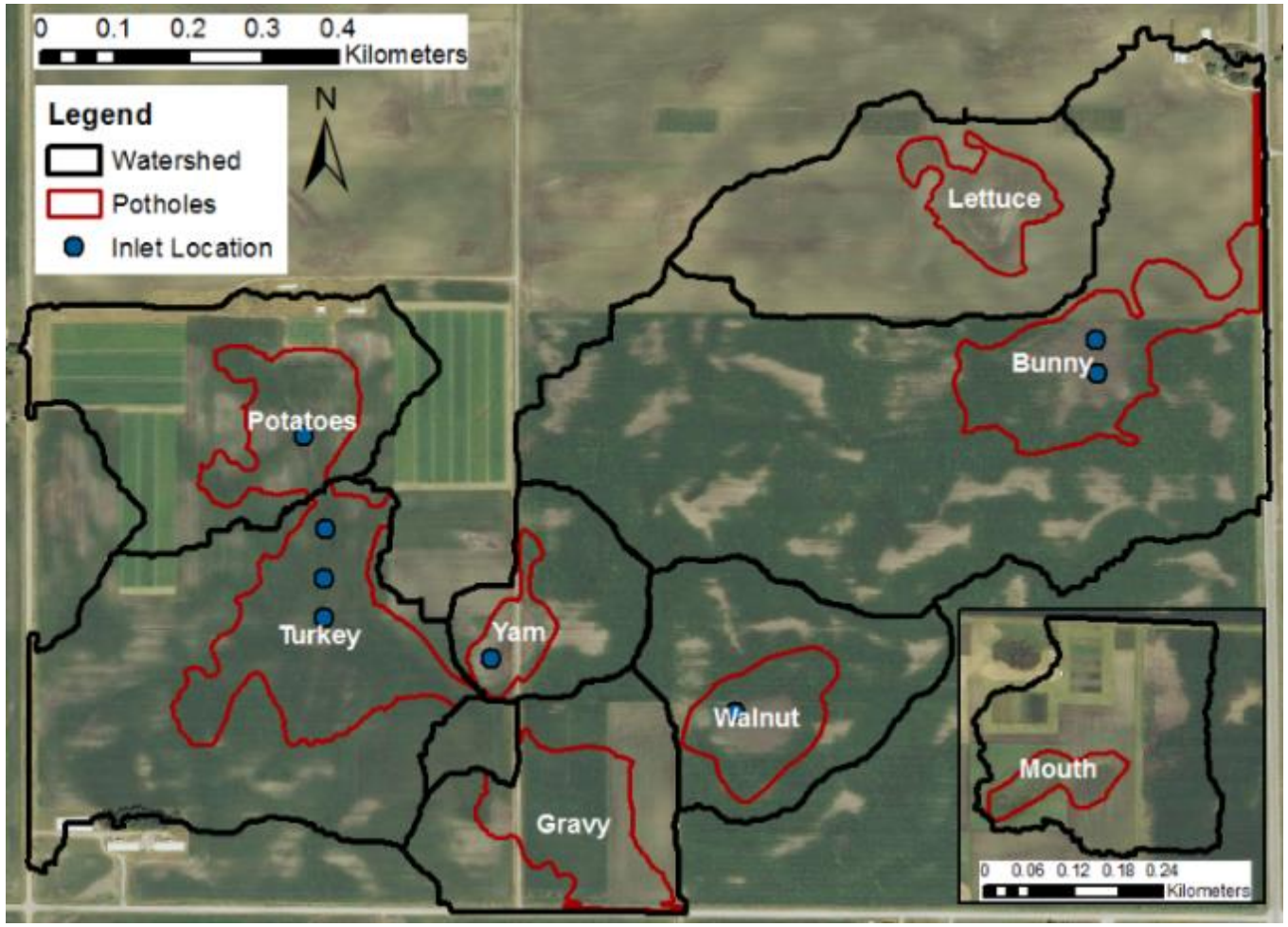
- 44% of Des Moines Lobe drains to potholes
- Ponding causes crop loss
  - 3-5 days of ponded water drowns young row crops
- Inflows: rainfall, runoff, and interflow
  - Rising water table appears to have little influence
- Outflows: evapotranspiration, overflow, surface drainage, and infiltration

Subsurface Drainage

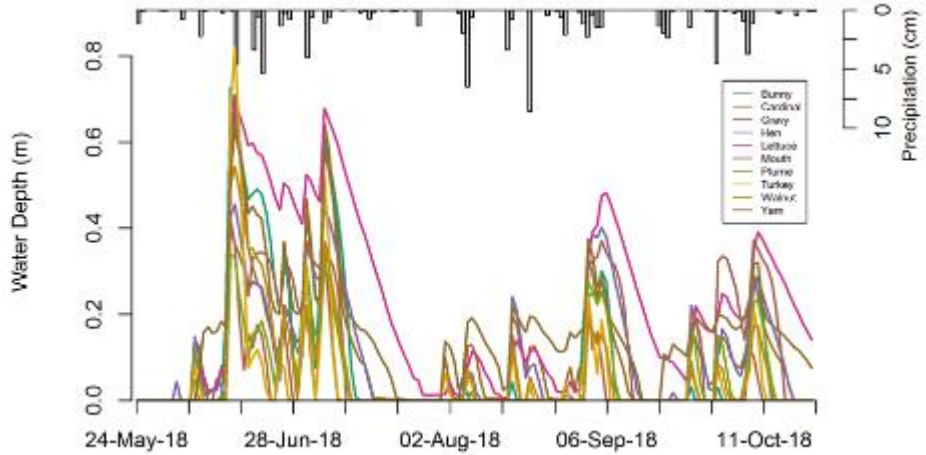
- 95-99% of potholes in Iowa are drained
- Earlier work on water balance
  - Did not estimate infiltration
  - Did not account for any “diminished capacity” of the drainage system (partial clogging; back-up)
  - Ignored surface risers

Study Site (2016-present)

- Two+ HUC-12 Watersheds
- Varying levels of subsurface drainage (none to intense)
- Varying levels of surface inlets (none to three)
- Seven conventional C/S management; one CRP



Every pothole flooded.



	Pothole	Bunny	Gravy	Lettuce	Mouth	Potatoes	Turkey	Walnut	Yam
2016 (Medium)	Inundation Days	13	5	55	35	4	6	15	
	Days Monitored	173	173	173	173	173	173	173	
	Inundation Percent	8%	3%	32%	20%	2%	3%	9%	
2017 (Dry)	Inundation Days	2	0	1	11	0	2	3	48
	Days Monitored	171	171	171	171	171	171	171	171
	Inundation Percent	1%	0%	1%	6%	0%	1%	2%	28%
2018 (Wet)	Inundation Days	40	18	123	52		24	40	115
	Days Monitored	148	148	151	165		148	151	151
	Inundation Percent	27%	12%	81%	32%		16%	26%	76%

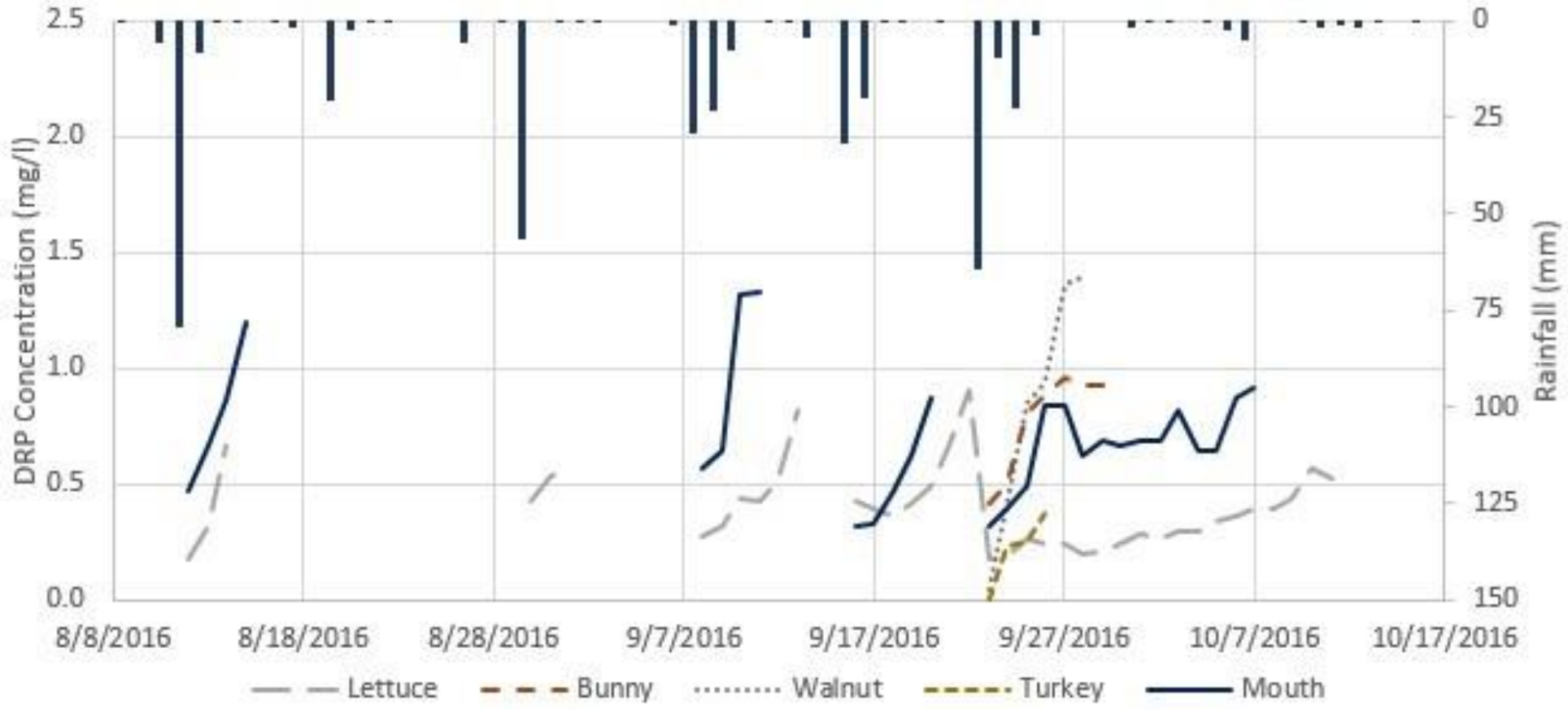
Sometimes for a long time.

- Over half of the ponding events were 2 or less days, but …
- Two events (both 2018) were over 50 days
- 6 of 8 potholes had at least one event of 5 or more days in two of the three years

Nitrate flushed into the potholes in early season events.

- 20 multiday events
  - Concentrations high in early season “first flush” conditions
  - Concentrations low in later-season events.
  - 17 had nitrate reduction (and 2 were non-detects throughout)

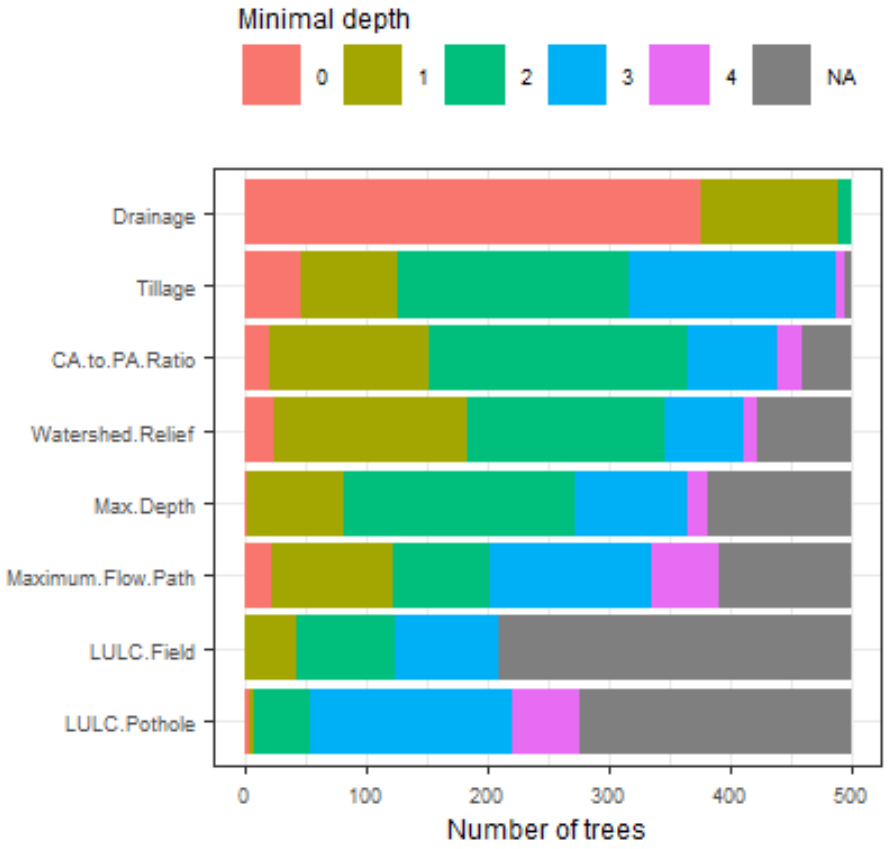
Dissolved reactive phosphorus concentration increased over the course of an inundation event

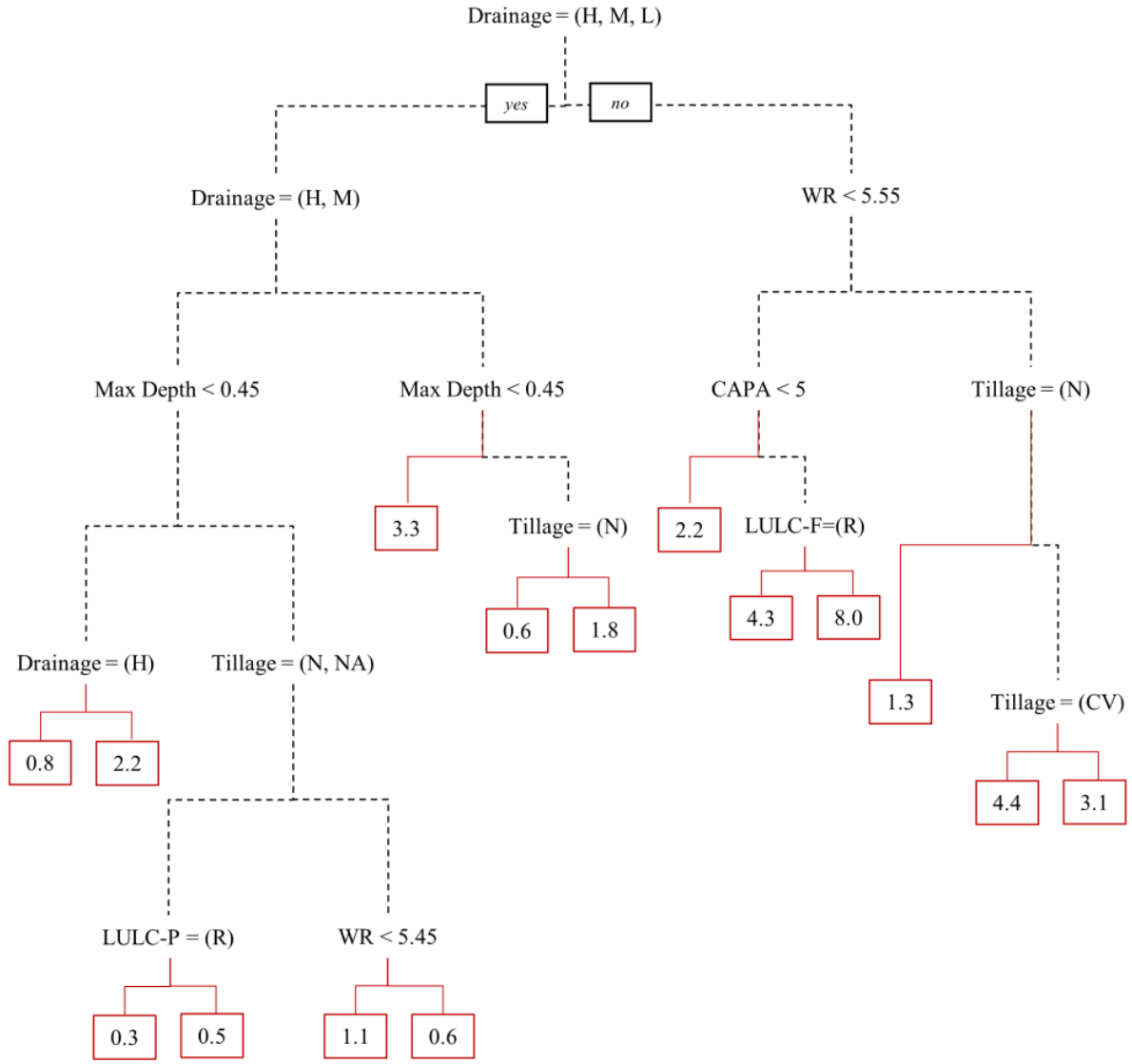


Modeling Pothole Inundation

- AnnAGNPS models for six potholes to generate longer-term dataset (25 years) of daily inundation estimates
- Look at changes to
  - Drainage intensity (no subsurface drainage, subsurface drainage with and without surface inlets)
  - Land cover in the pothole (cropped or retired)
  - Land cover in the microwatershed (cropped or retired)
- Develop a “risk metric” that incorporates probability of drowning the crop, of being too wet to plant or harvest

Building a Risk Assessment Tool





Prairie Pothole Management Support Tool | Baseline Assessment | Analysis | Disclaimer

User Manual

1. Enter your County

Story

2. Enter a personal field ID

MyFieldID

3. What is the land use of the pothole?

- (•) Corn-Soybean Rotation
- ( ) Perennial Cover (Conservation Reserve, Grassed, etc.)

4. What is the land use of the field?

- (•) Corn-Soybean Rotation
- ( ) Perennial Cover (Conservation Reserve, Grassed, etc.)

5. Specify existing drainage

No drainage

6. Specify current tillage

Conventional

7. Estimate the maximum land extent of the pothole (acres)

0 — 3.2 — 25

8. Estimate the contributing flow area to the pothole (acres)

1 — 20 — 500

9. Estimate the maximum flooding depth of the pothole (Feet)

0 — 1.6 — 15

Amy Kaleita, kaleita@iastate.edu

https://bnahkala.shinyapps.io/ppmst/