



DNR Thresholds Project: Negative Impacts to Surface Waters -- Lakes





Use SW Thresholds to regulate GW appropriations from lakes

Key Statutes

MS 103G.287

- GW appropriations that will have negative impacts to SW subject to provisions of MS 103G.285

MS 103G.285

- **Quantity threshold** – ½ acre foot per acre of surface area
- **Establish Protection Elevation** below which appropriation is not allowed
 - Aquatic plant habitat
 - Surface water recreational uses
 - Changes in basin shape

MS 103G.261

- Discourage appropriation and use in lakes < 500 acres in size



Which lake types are most vulnerable?

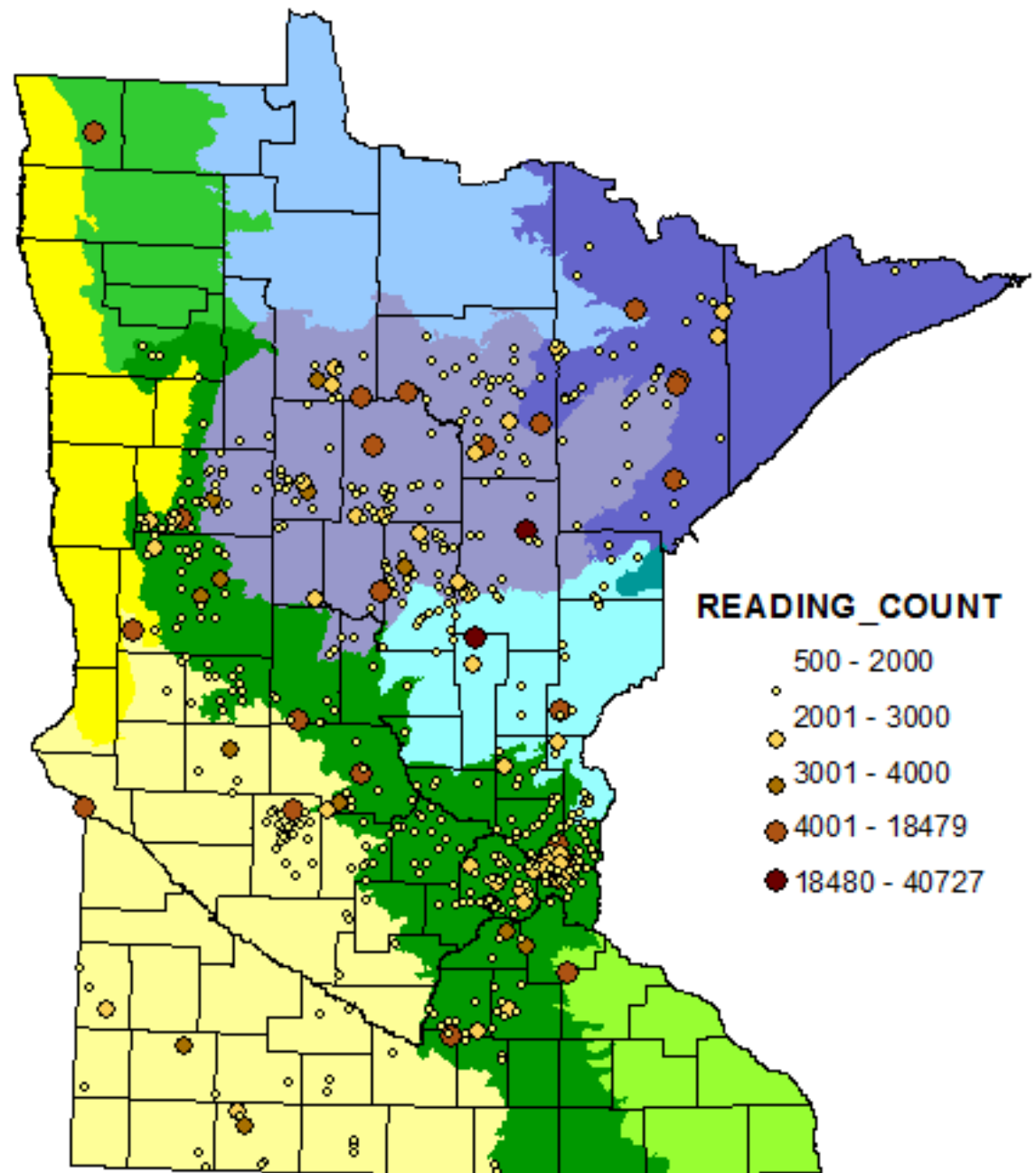
To a reduction inflow volume

To a change in lake elevation

Explore using available lake level data

- Extensive records to draw from
- Wide variation in water-level patterns
- Watershed area : lake area ratio
- Outflow type
- Location of lake in state
- Depth profile of lake (% < 15 feet deep)
- Resources, uses and values

Lake Gages:
> 500
readings





Lake level patterns in MN

Which lake types are most vulnerable?

- Extensive records to draw from
- **Wide variation in water-level patterns**
 - Annual range of change
 - Range of change over multi-year intervals
 - Percent of time above runout elevation
- Watershed area: lake area ratio
- Outflow type
- Location of lake in state
- Depth profile of lake (% < 15 feet deep)
- Resources, uses and values



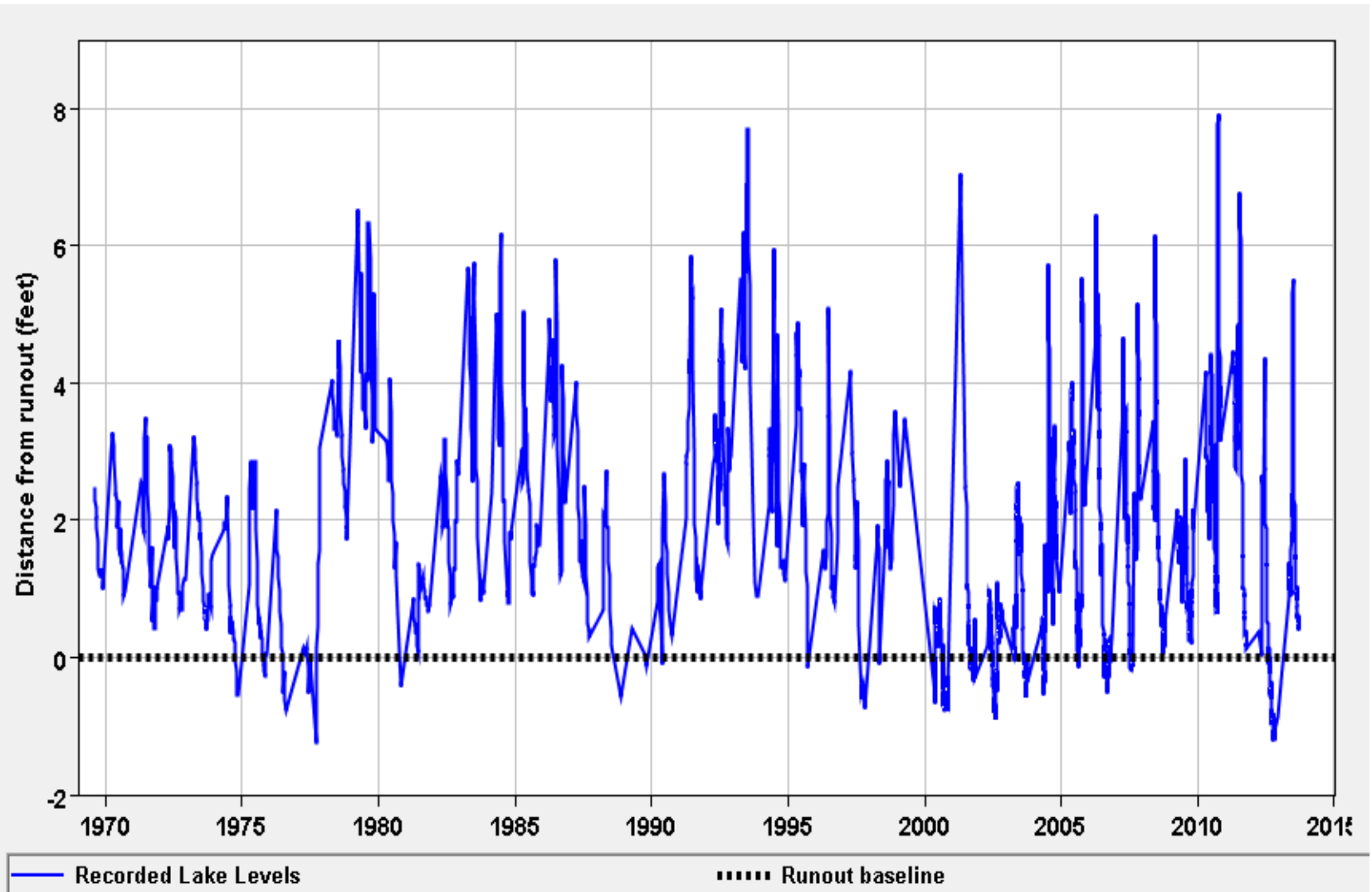
Lake "Runout"

Elevation that water just starts flowing out of a lake



Lake Miltona, Douglas County

Heron Lake (Jackson County)



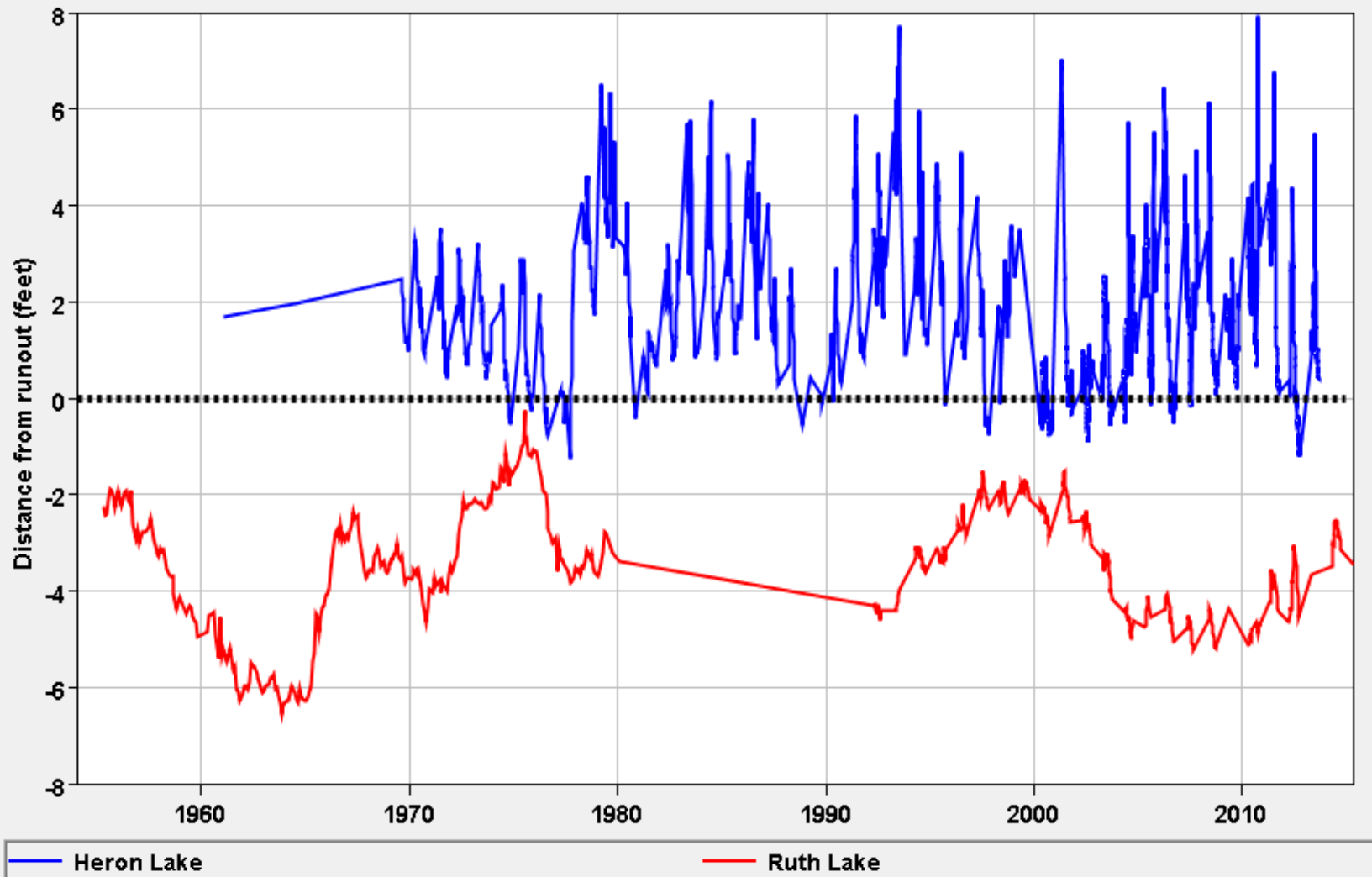
Ruth Lake (Crow Wing County)



Recorded Lake Levels

Runout baseline

Comparing Heron & Ruth Lakes



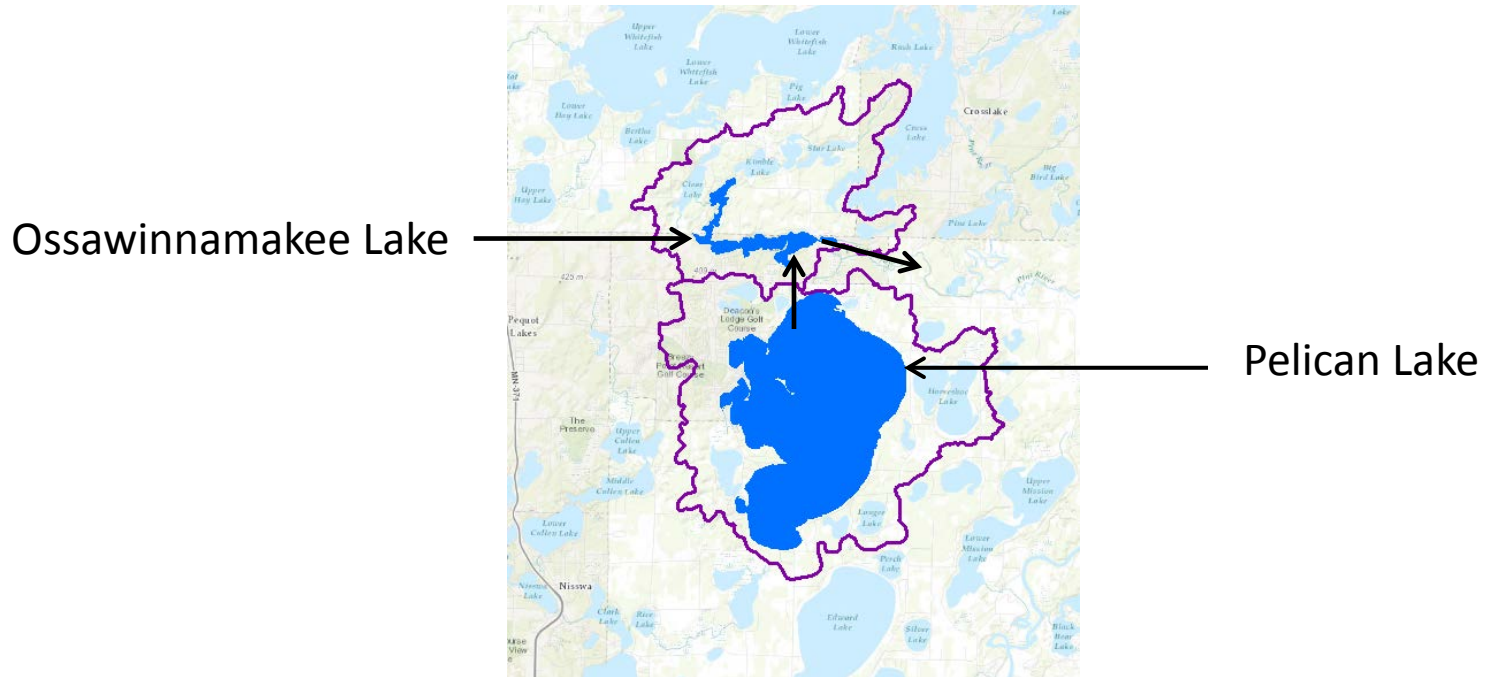


Lake level patterns in MN

Which lake types are most vulnerable?

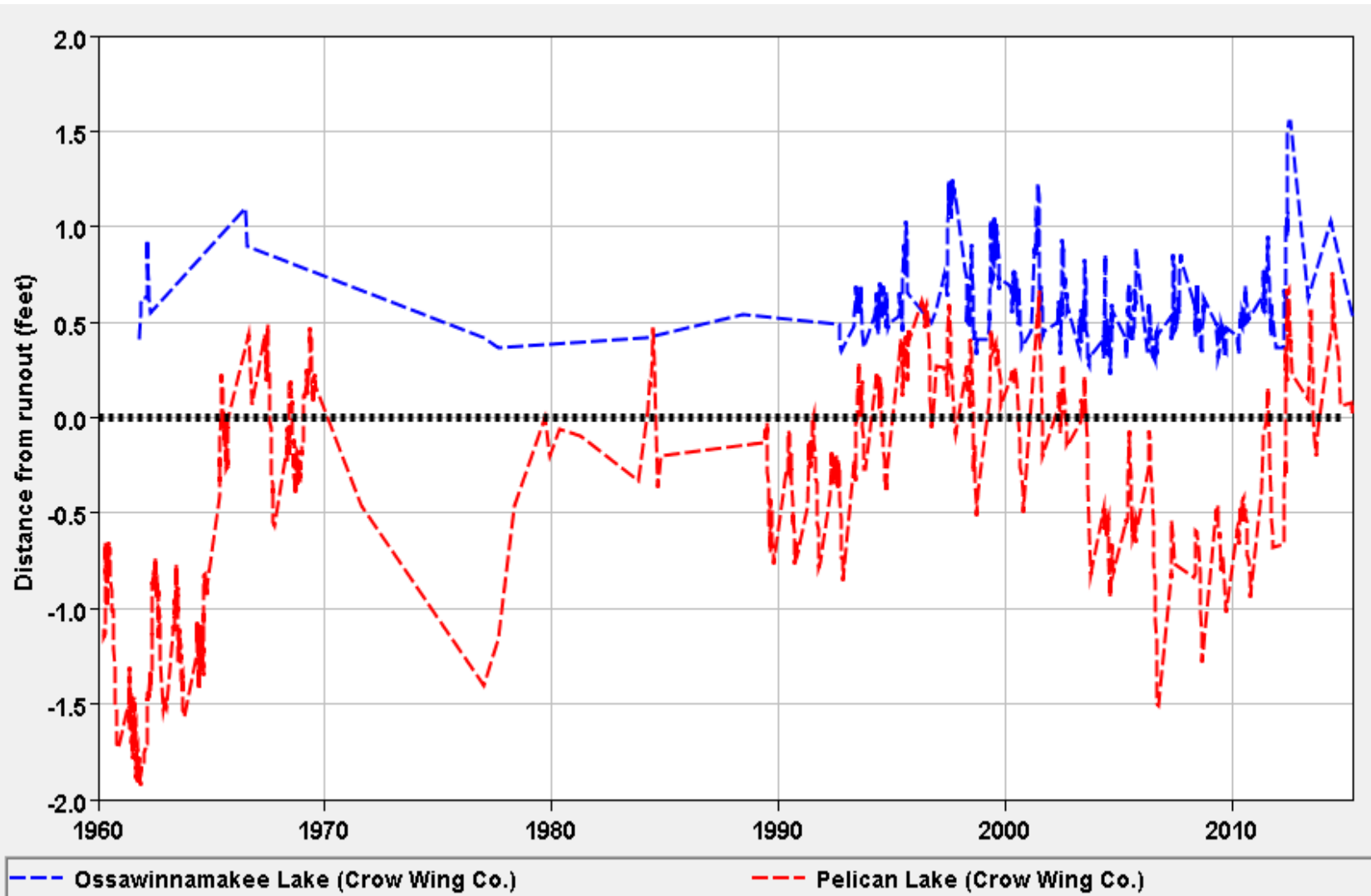
- Extensive records to draw from
- Wide variation in water-level patterns
- **Watershed area: lake area ratio**
- Outflow type
- Location of lake in state
- Depth profile of lake (% < 15 feet deep)
- Resources, uses and values

Watershed area to lake area ratio (Two deep lakes)

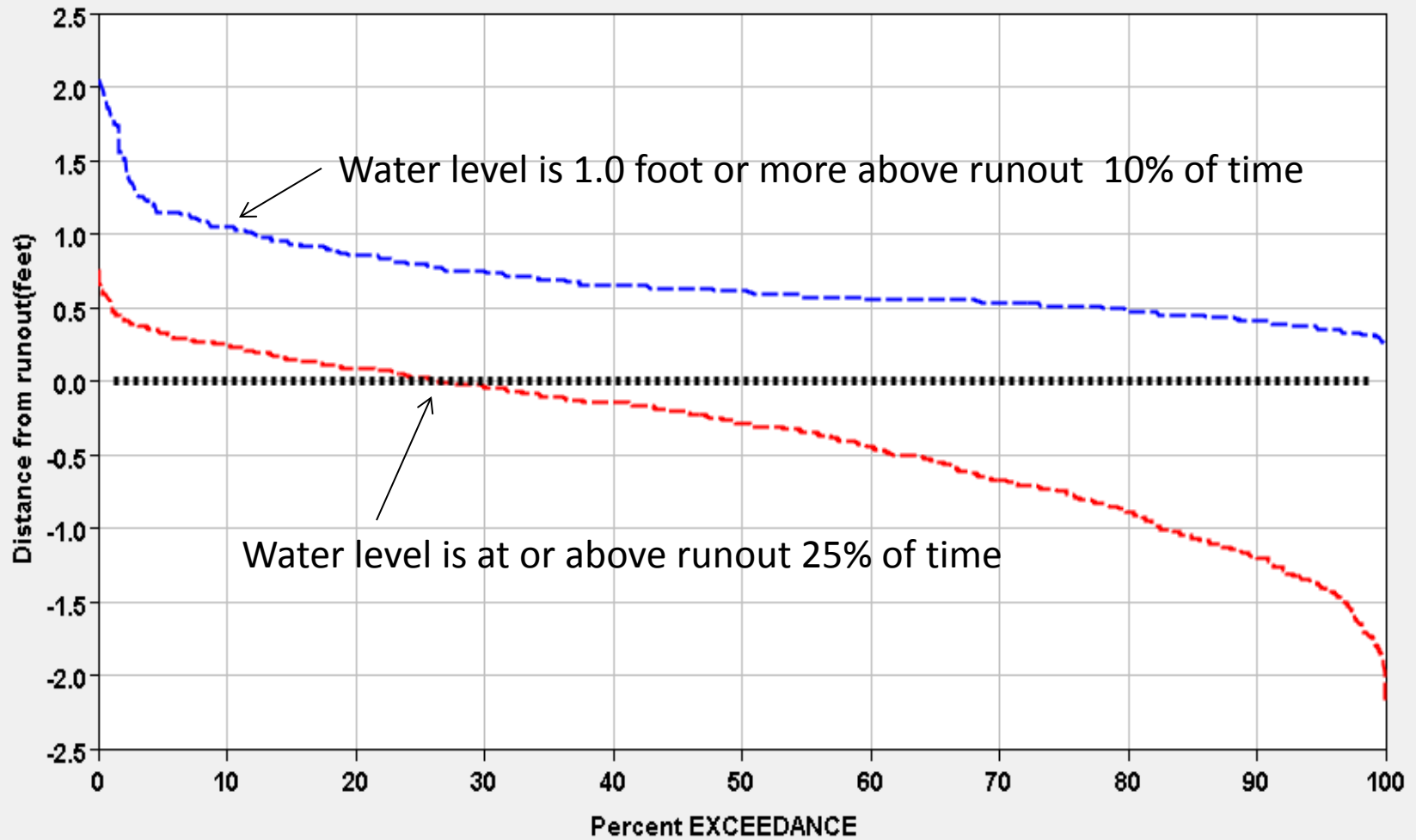


Watershed Size (acres):	30,000	20,200
Lake Size (acres):	690	8,370
W'shed : lake area ratio:	43 : 1	2.4 : 1
Maximum lake depth (ft):	63	104
% Littoral:	33	47

Recorded Lake Levels – 2 deep lakes



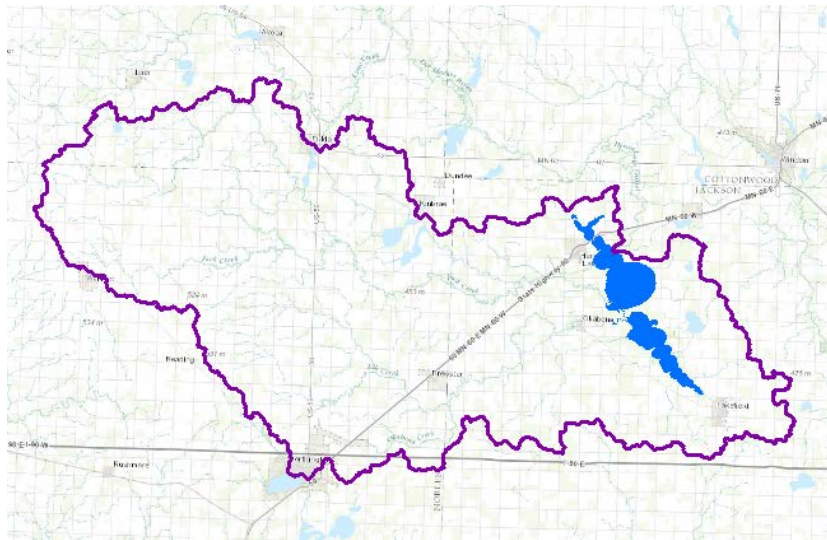
Lake Level Exceedance – 2 deep lakes



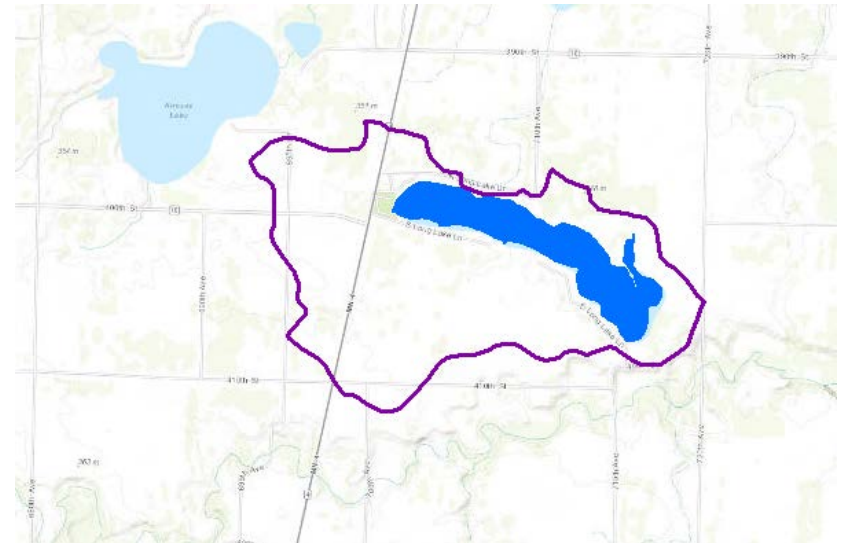
--- Ossawinnamakee Lake (Crow Wing Co.)

--- Pelican Lake (Crow Wing Co.)

Watershed area to lake area ratio (Two shallow lakes)



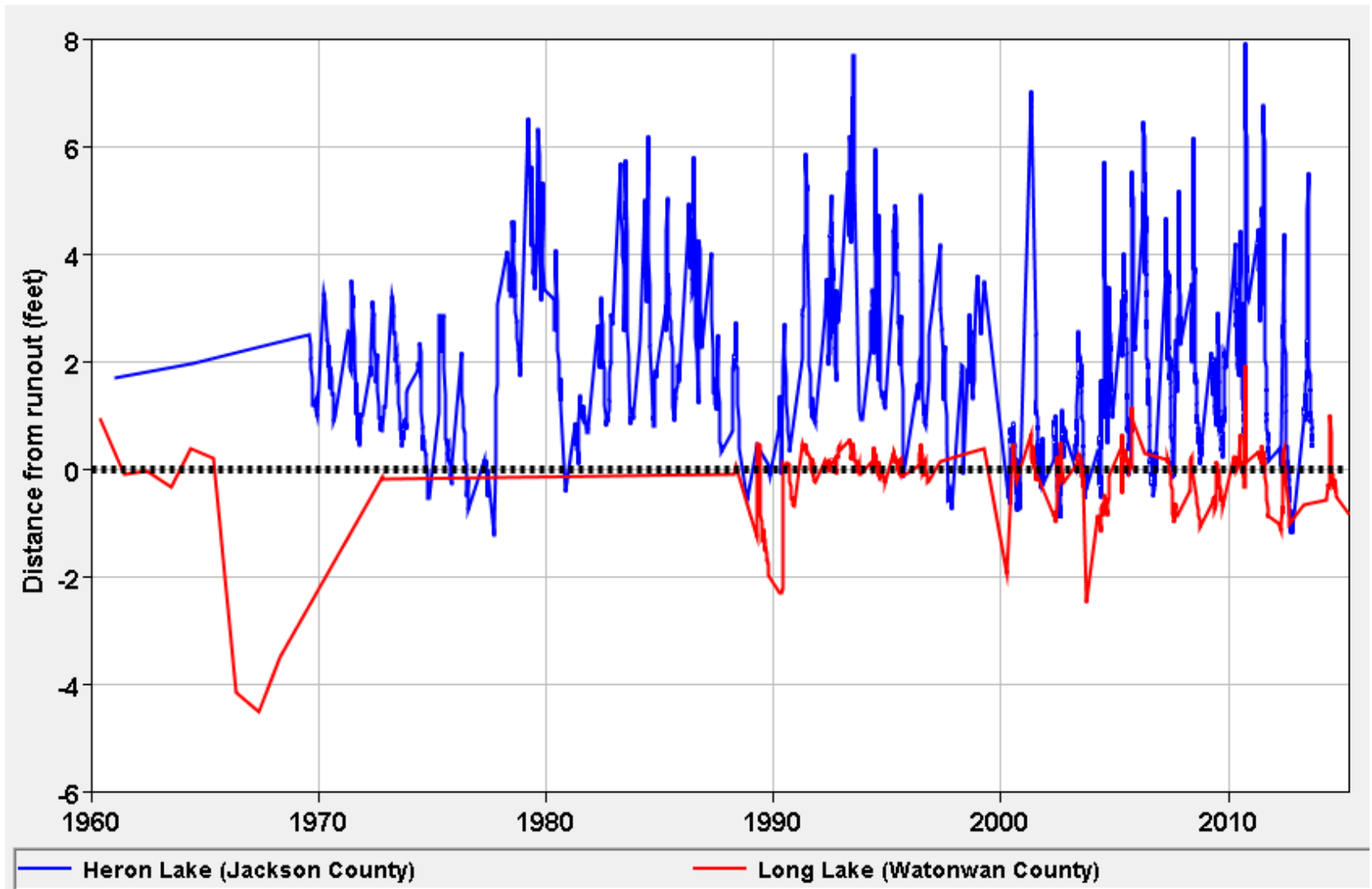
Heron Lake (Jackson County)



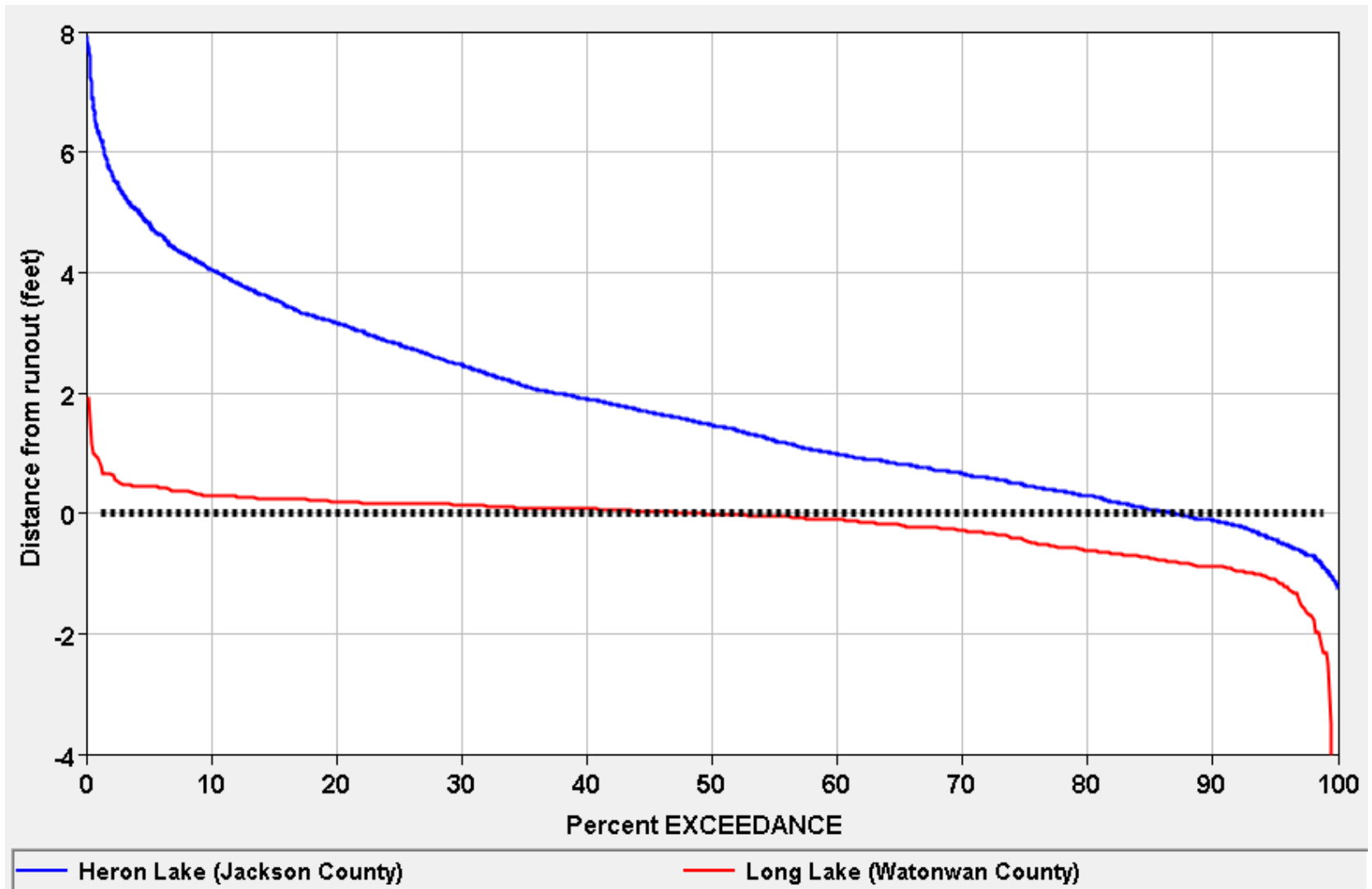
Long Lake (Watonwan County)

Watershed Size (acres):	284,000	1,750
Lake Size (acres):	8,000	271
W'shed : lake area ratio:	36 : 1	5 : 1
Maximum lake depth (ft):	5	13
% Littoral:	100	100

Recorded Lake Levels – 2 shallow lakes



Lake Level Exceedance – 2 shallow lakes





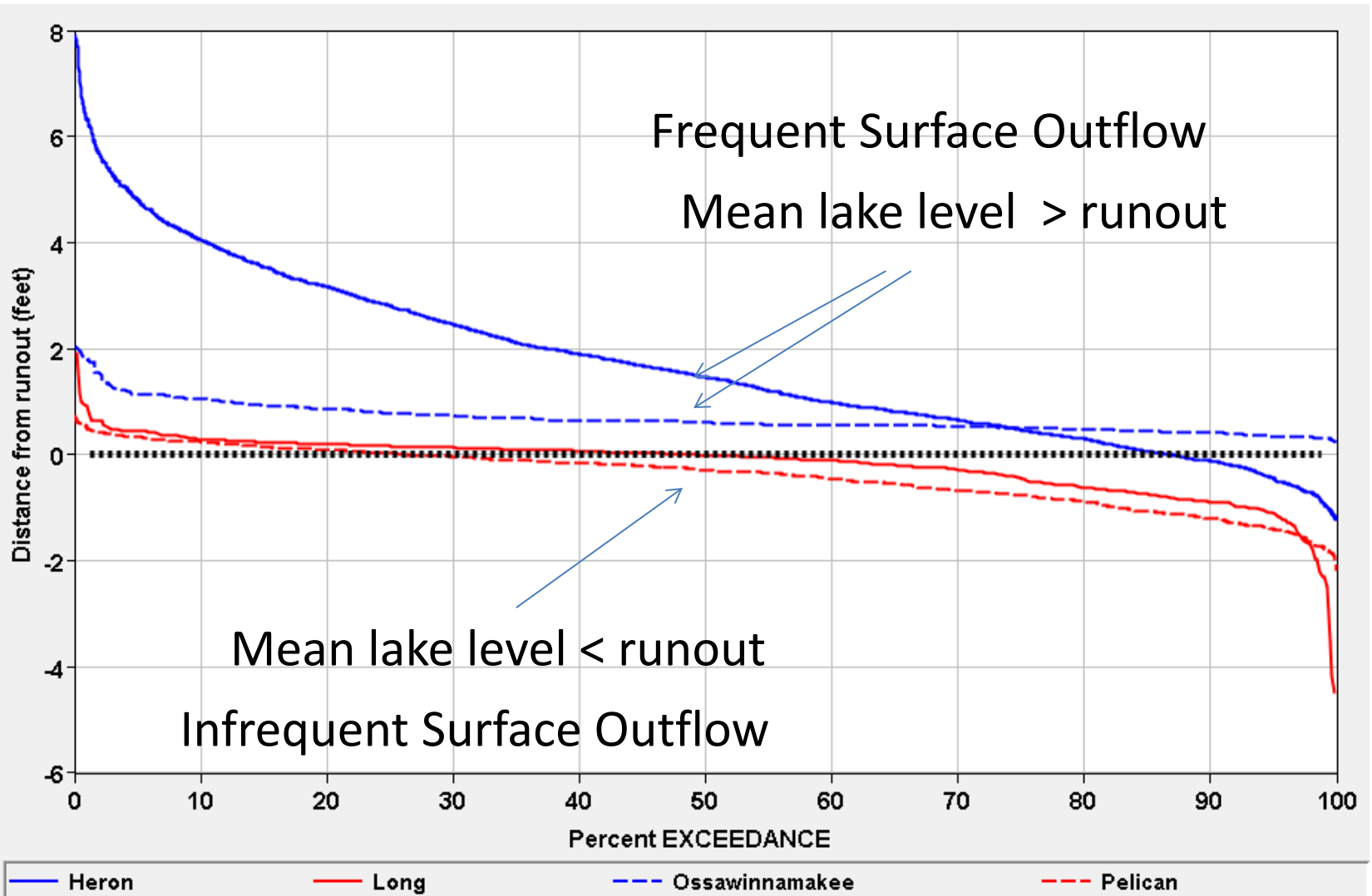
Lake level patterns in MN

Which lake types are most vulnerable?

- Extensive records to draw from
- Wide variation in water-level patterns
- Watershed area: lake area ratio
- **Outflow type (a summary of 1350 lakes)**
 - Frequent (mean lake level > runout elevation) – 49%
 - Infrequent (mean lake level < runout elevation) – 26%
 - Unknown/mixed – 25%
- Location of lake in state
- Depth profile of lake (% < 15 feet deep)
- Resource, uses and values



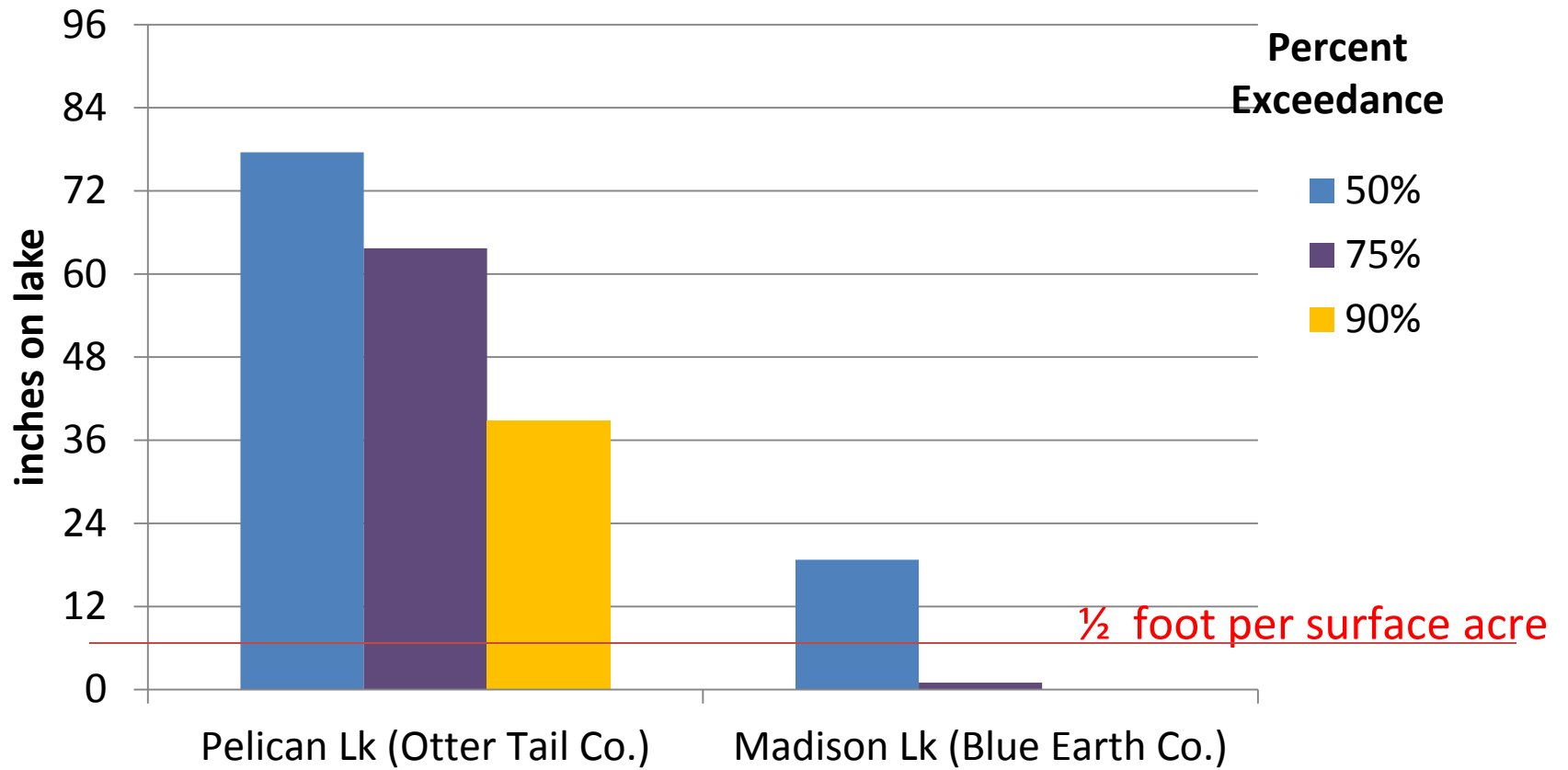
Outflow type





Relative amount of water flowing through two lakes

May thru July Outflow Volume



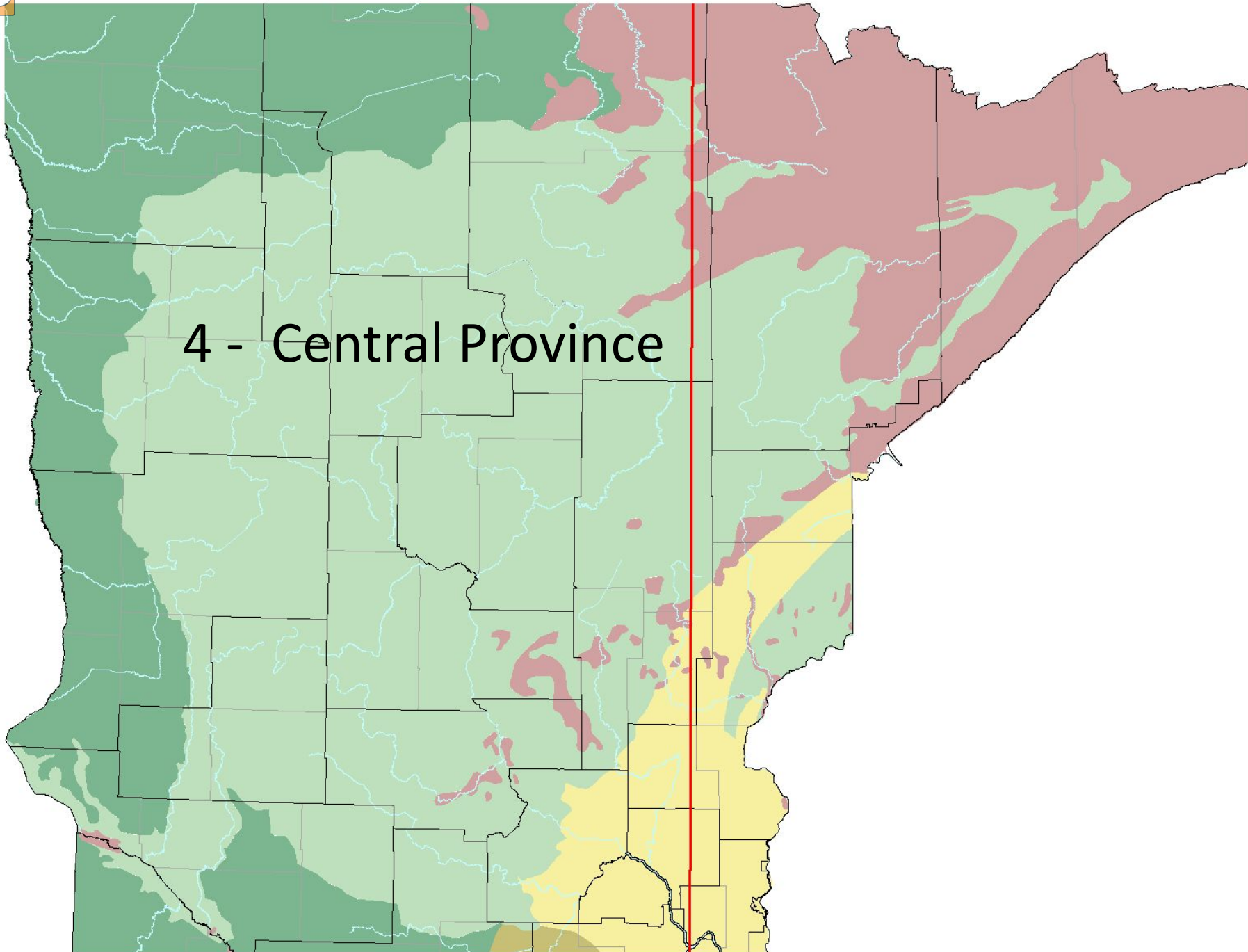


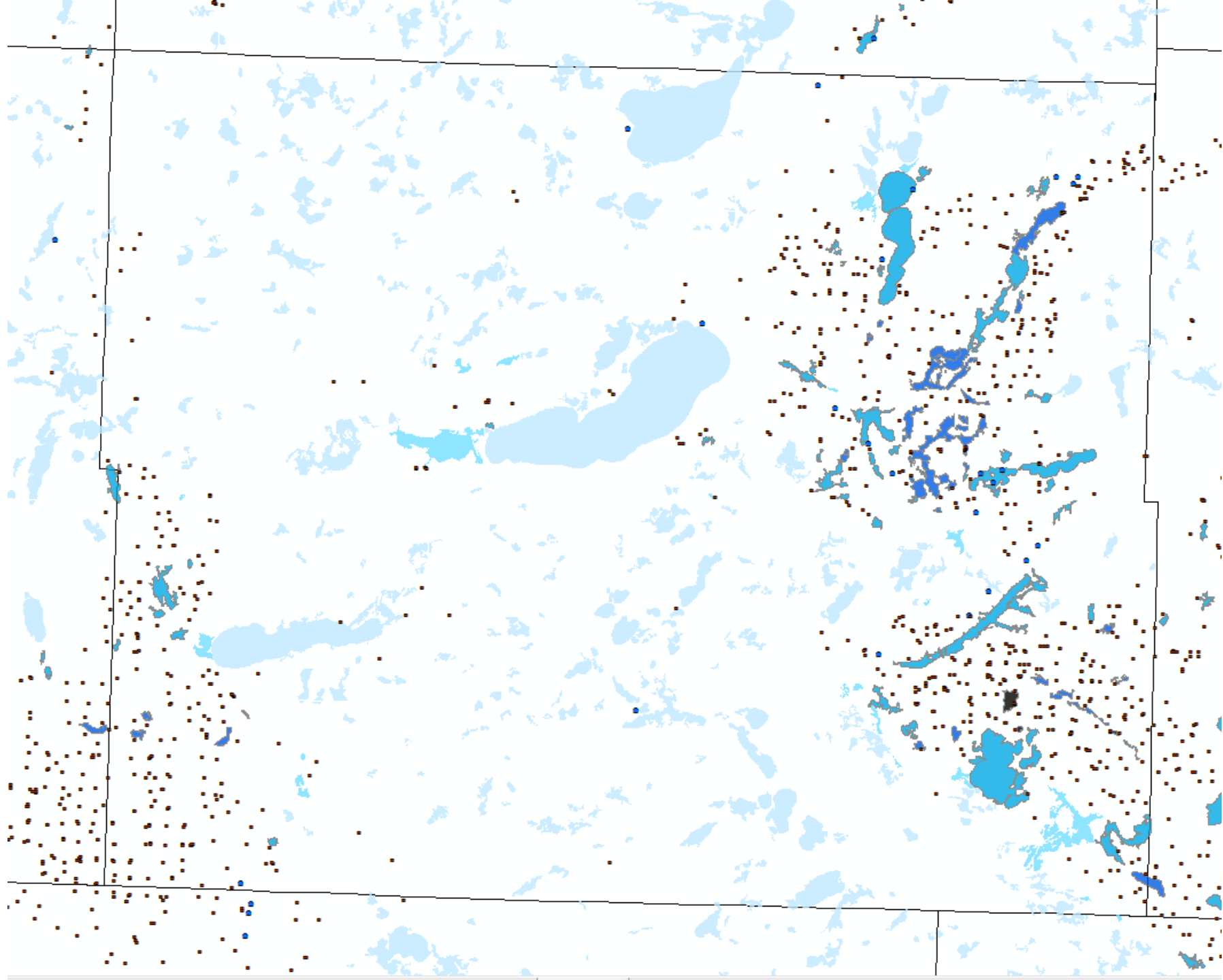
Lake level patterns in MN

Which lake types are most vulnerable?

- Extensive records to draw from
- Wide variation in water-level patterns
- Watershed area: lake area
- Outflow type
- **Location of lake in state**
 - Central Groundwater Province (Province 4)
 - GW use intensity estimated to identify at risk lakes
 - Most lakes with high GW use intensity < 100 acres in size
- Depth profile of lake (% < 15 feet deep)
- Resources, uses and values

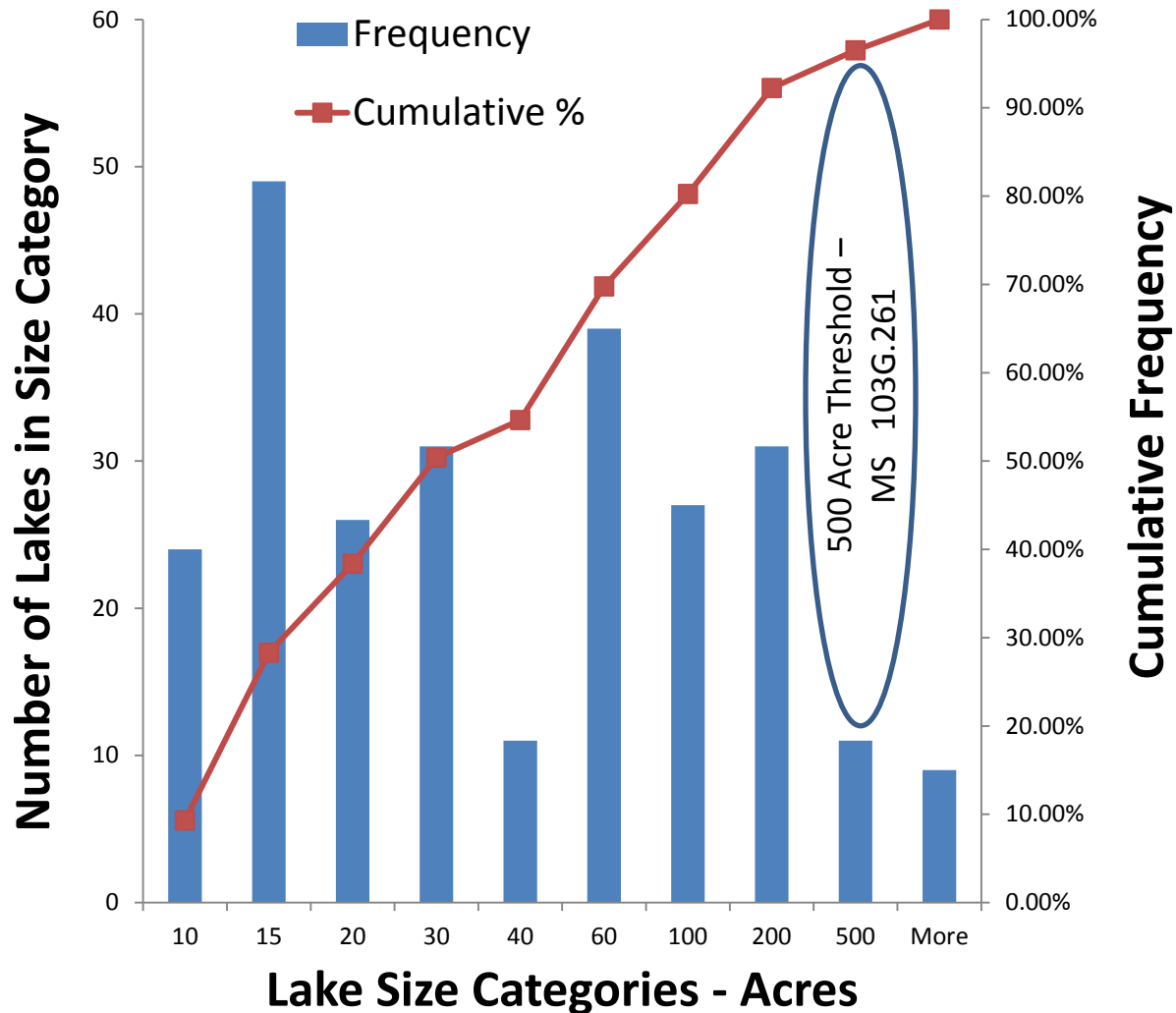
4 - Central Province







Size Distribution of Lakes with sizeable GW interaction



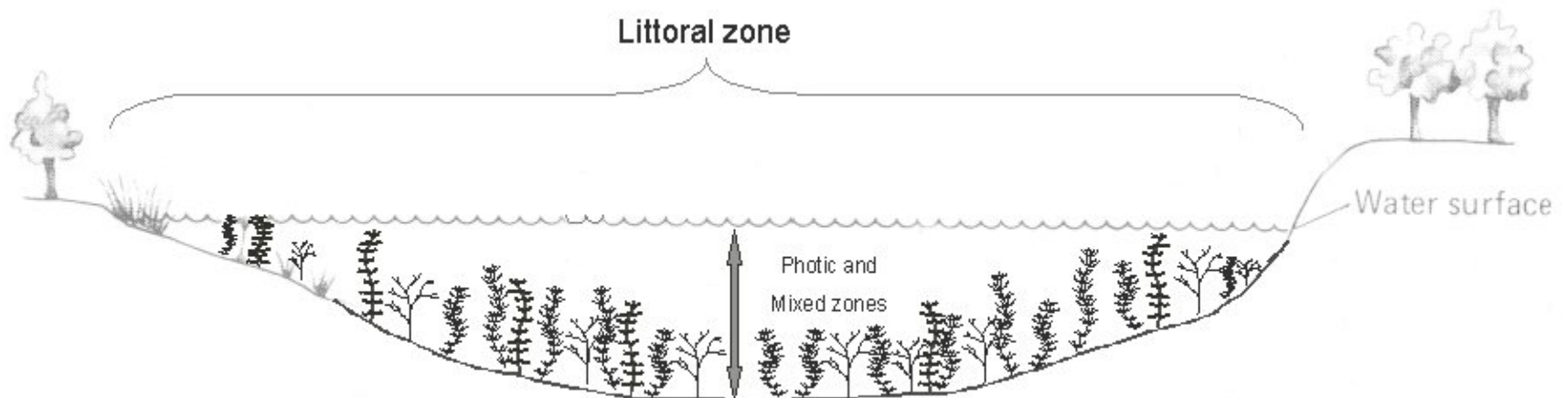
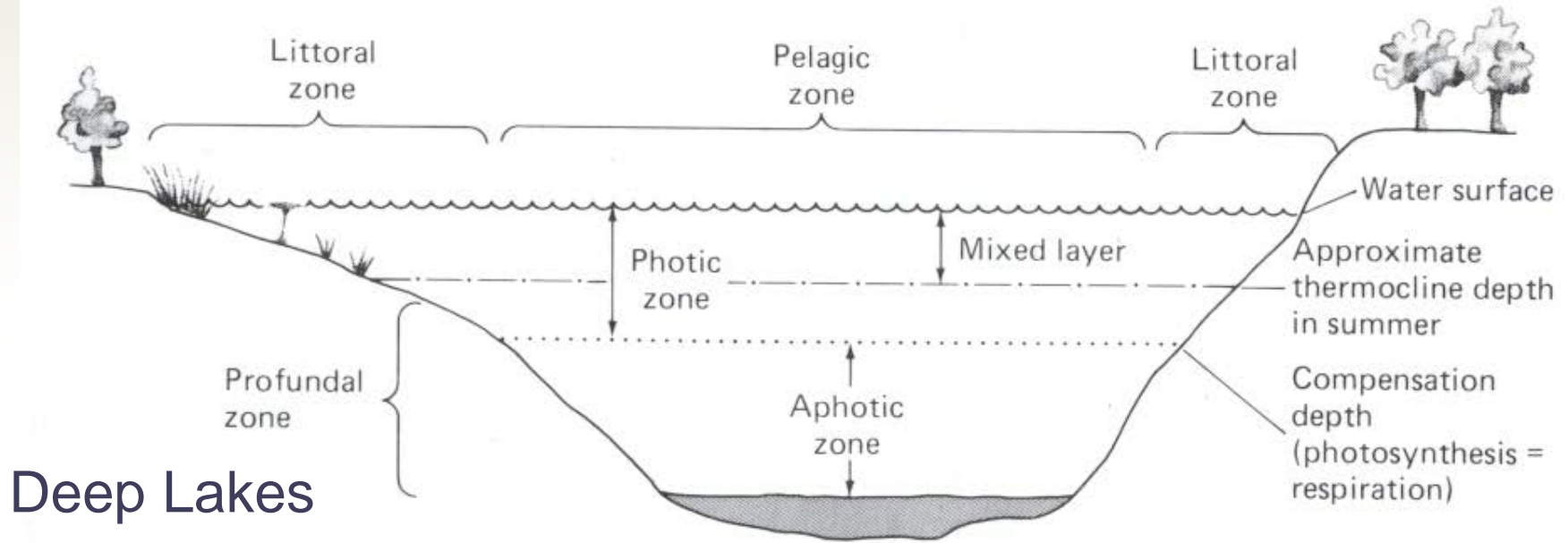


Lake level patterns in MN

Which lake types are most vulnerable?

- Extensive records to draw from
- Wide variation in water-level patterns
- Watershed area: lake area ratio
- Outflow type
- Location of lake in state
- **Depth profile of lake (% < 15 feet deep)**
 - Shallow lakes (100% < or = 15 feet deep)
 - Deep lakes (portion of lake > 15 feet deep)
- Resources, uses and values

Shallow Lakes vs. Deep Lakes







Lake level patterns in MN

which lake types are most vulnerable?

	Shallow Lakes	Deep Lakes
Frequent Surface Outflow	Moderate	Lowest
Infrequent Surface Outflow	Highest	High



Lake level patterns in MN

Which lake types are most vulnerable?

- Extensive records to draw from
- Wide variation in water-level patterns
- Watershed area: lake area ratio
- Outflow type
- Location of lake in state
- Depth profile of lake (% < 15 feet deep)
- Resources, uses and values (M.S. 103G.285)
 - Aquatic plant habitat for fish & wildlife
 - Surface water recreational uses
 - Changes in basin shape

Using SW Thresholds to regulate GW appropriations from lakes

Surface Water

MS 103G.287

- GW appropriations that will have negative impacts to SW subject to provisions of MS 103G. 285

MS 103G.285

- Quantity threshold – ½ acre foot per acre of surface area
- Establish Protection Elevation below which appropriation is not allowed
 - Aquatic plant habitat
 - Surface water recreational uses
 - Changes in basin shape

MS 103G.261

- Discourage appropriation and use in lakes < 500 acres in size

Ground Water (an option)

- Use ground-water models to estimate quantity of lake water appropriated – compare to ½ acre foot per acre threshold
- DNR would set protection elevations on a lake-by-lake basis
 - Vary by outflow type?
 - Vary based on shallow vs. deep depth status?
 - Vary based on predominant uses?
- Need to clarify how appropriations are modified if lake level is below protection elevation
- Population of lakes currently in close proximity to GW wells are predominantly < 500 acres in size