



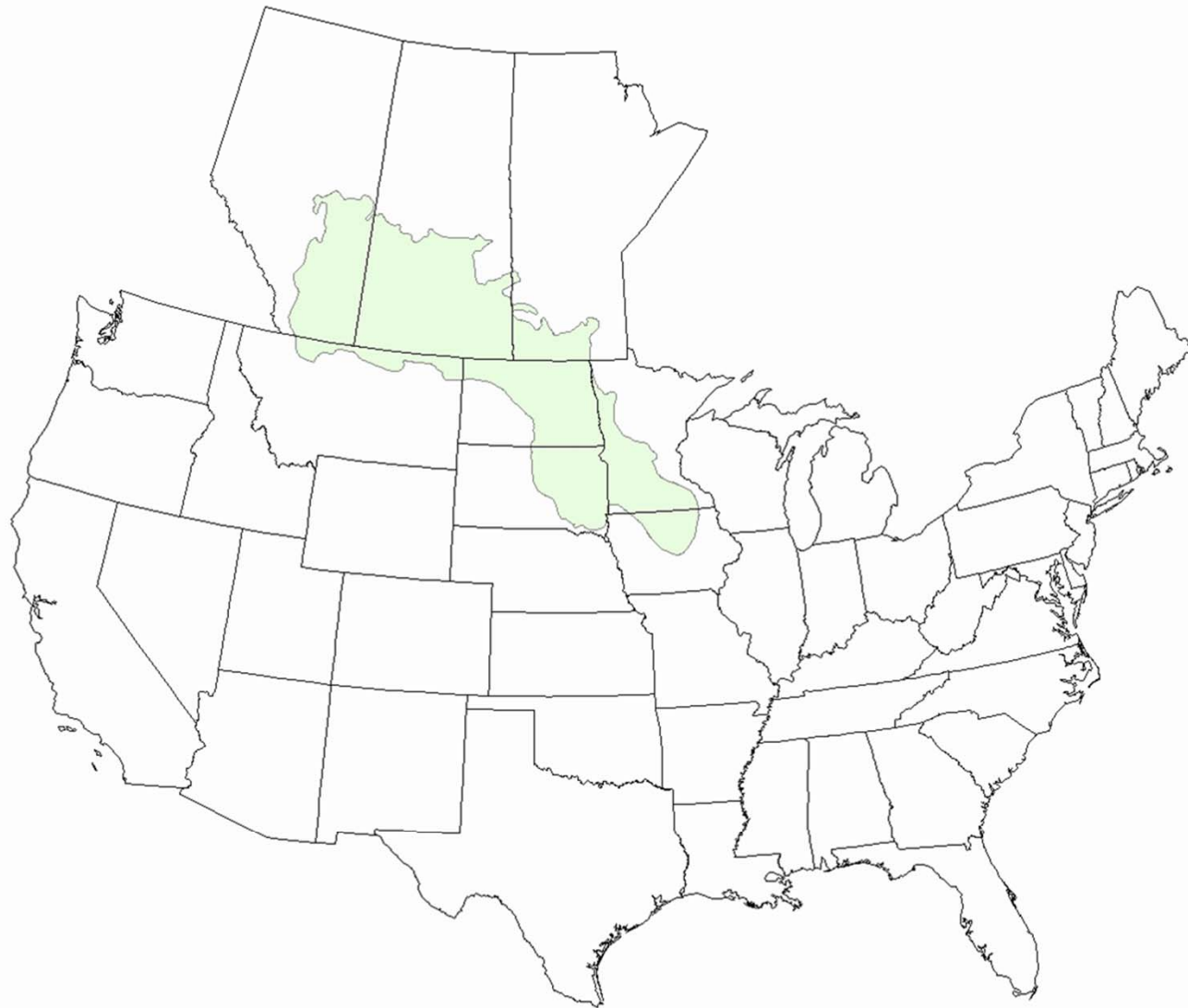
DEVELOPMENT OF A REFERENCE LAKE SCREENING TOOL FOR THE PRAIRIE POTHOLE LAKES BASED ON 2007 NLA LAND USE AND WATER QUALITY DATA

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 Traditional Prairie Pothole Region

Importance of the Prairie Pothole Region (PPR)

- ▶ Ecologically and Economically important
 - 50 to 80% of North American Duck production (van der Valk and Pederson 2003)
 - Benefit surface-groundwater retention (Batt et al, 1989)
 - Waterfowl hunting produces Est. \$2.3 Billion in total industry output (USFWS Report 2006-2)



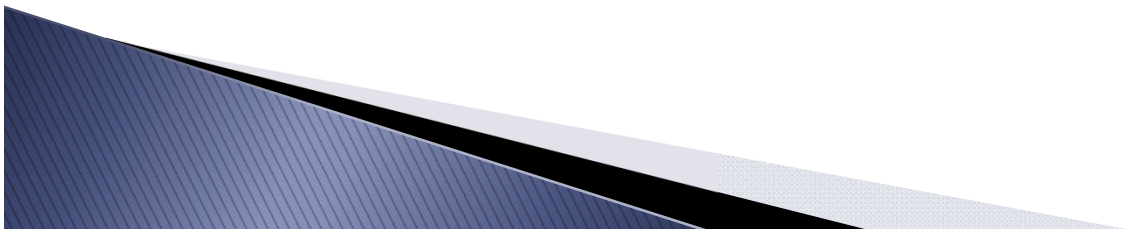
Source: USFWS
http://www.fws.gov/waubay/images/landscape_pics/potholes2.JPG



Source: Association of State Wetland Managers
<http://www.aswm.org>

WHAT ARE REFERENCE LAKES

- ▶ EPA – A lake (either natural or artificial) with attributes that come as close as practical to those expected in a natural state, *i.e., least-disturbed lake environment*. (NLA 2007)
- ▶ Least-disturbed condition can be defined as the best available chemical, physical, and biological habitat conditions given the current state of the landscape – or “the best of what’s left” (Stoddard et al. 2006).



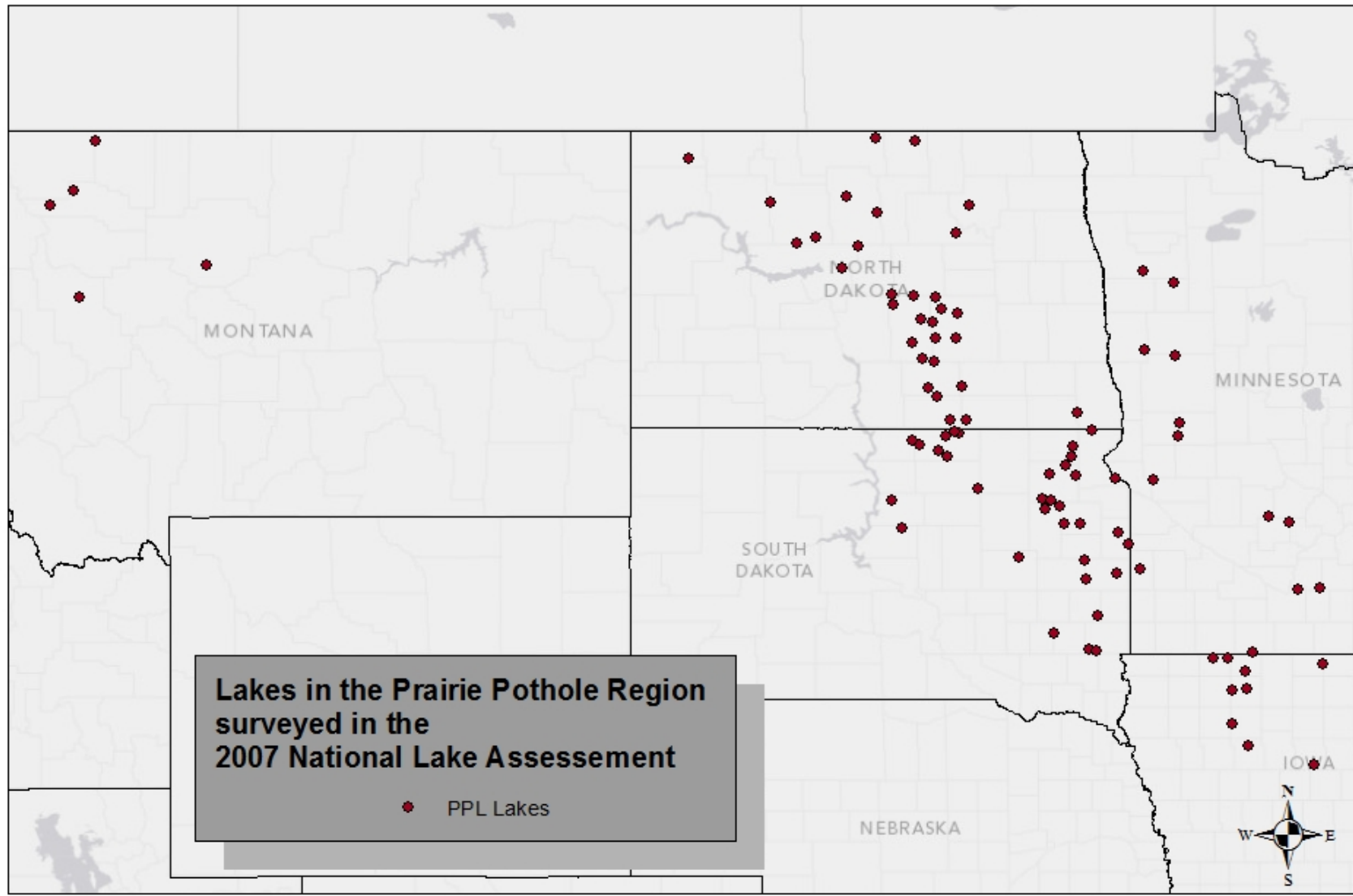
Need for establishment of reference lakes in the Prairie Pothole region

Unique Lake Characteristics

- Shallow Lakes (max depth of 4.5m)
- Non- Stratified, well mixing lakes
- Limited coverage of submerged aquatic vegetation
- Estimated 7900+ Prairie Pothole Lakes



92 Prairie Pothole Lakes – 2007 NLA



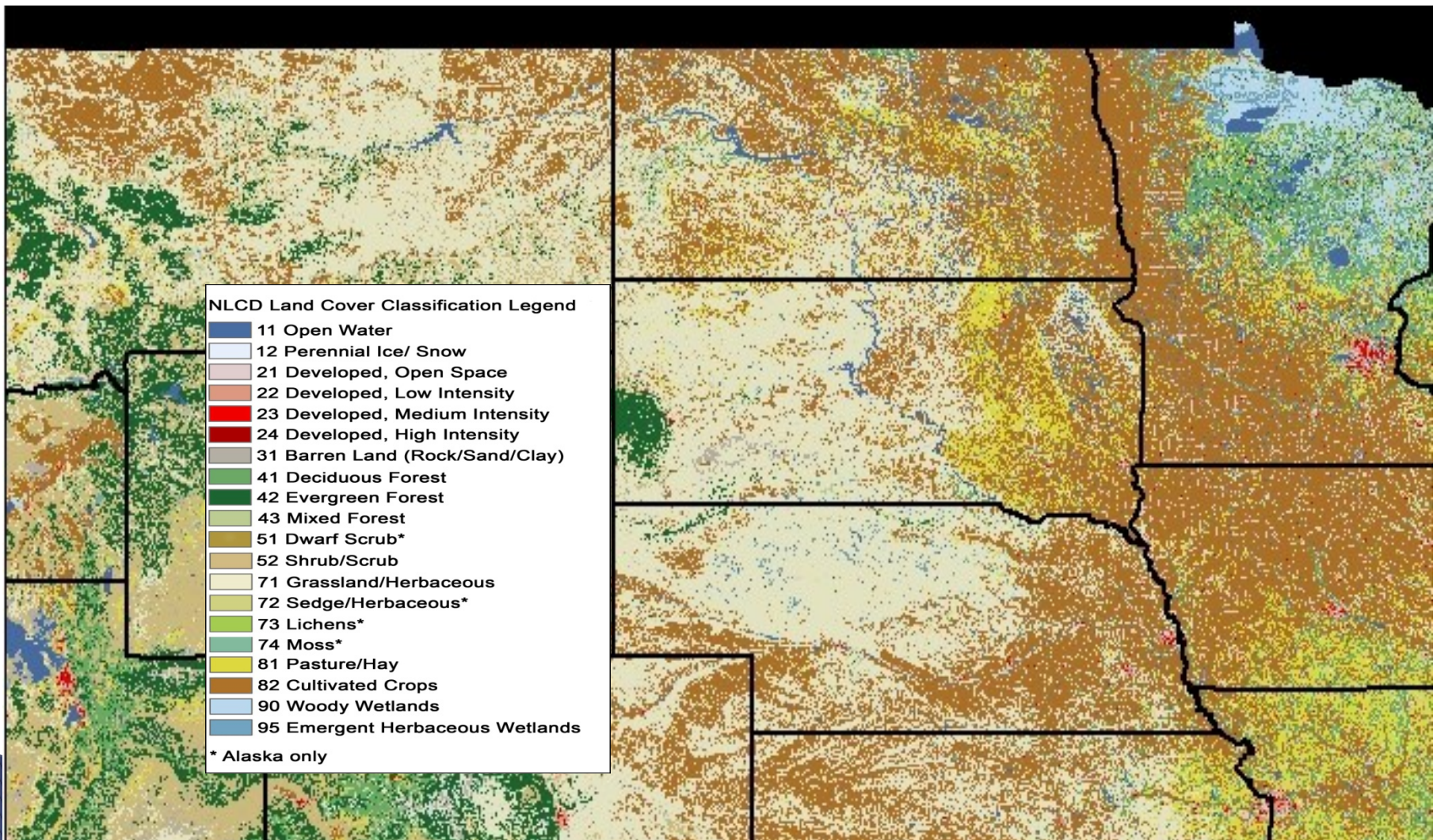
OBJECTIVE

To identify Potential Reference Lakes in the Prairie Pothole Region (PPR) based on Land Use in the Watershed.



Source: Prairie Pothole Joint Venture (<http://www.ppjv.org>)

2006 National Land Cover Database



PPR Screening Process

Step 1

• *Stage 1 – Watershed disturbance screen*

Step 2

• *Stage 2 – Aerial photograph screen*

Step 3

• *Stage 3 – Potential Reference Lake Evaluation*

Stage 1 – Watershed disturbance screen

1. < 15% *Row Crop* land use in the watershed
2. < 15% *Developed* land use in the watershed
3. < 5% *Developed* land use in the 200 m buffer area
4. < 5% *Row Crop* land use in the 200 m buffer area

*Percentages calculated with EPA Software ATtILA
Developed (NLCD21 + NLCD22 + NLCD23 + NLCD24)
Row crops (NLCD82)



Stage 2– Aerial photograph screen

Ranking values applied to aerial photograph

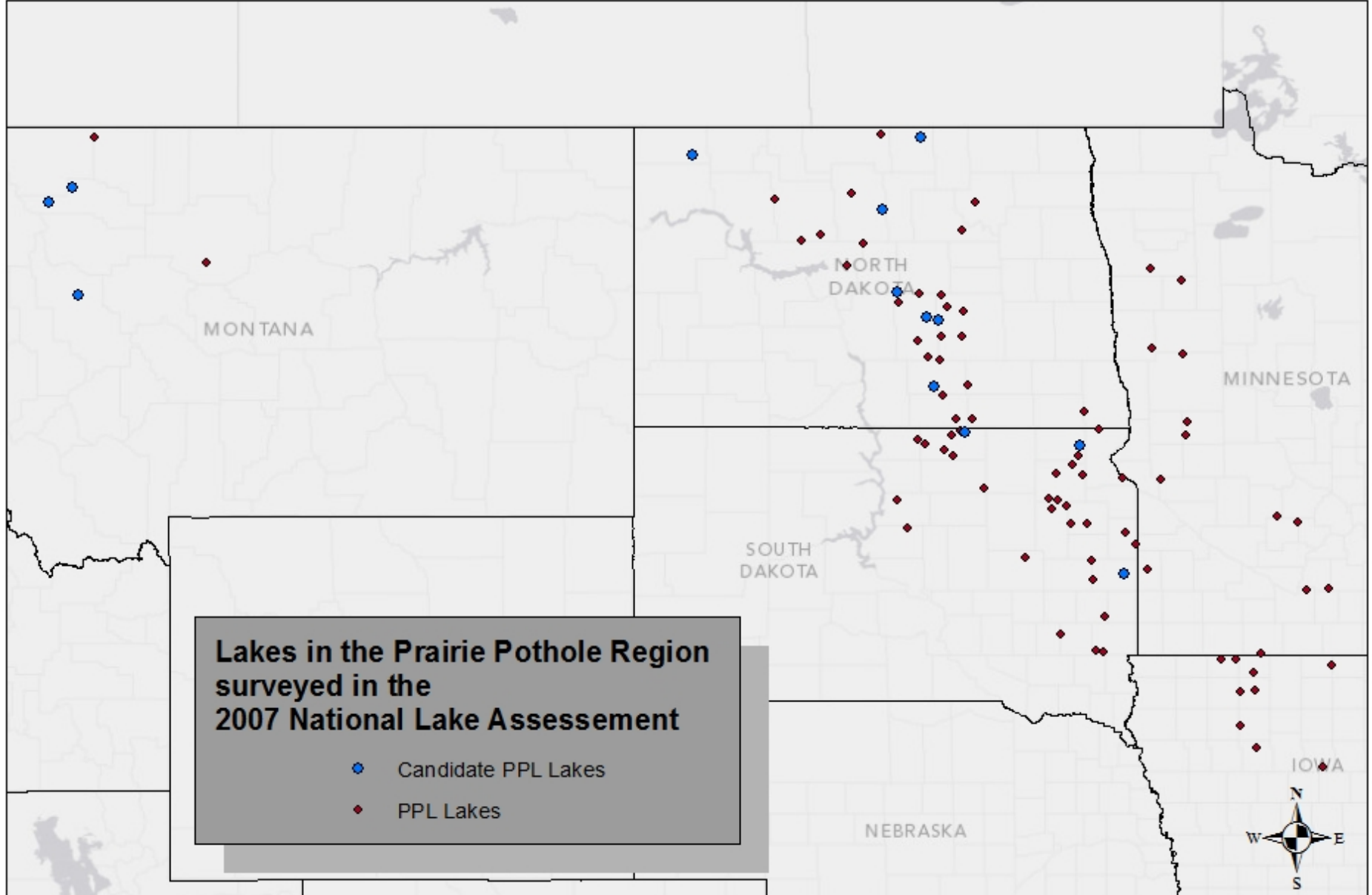
- | | <u>Score</u> |
|---|--------------|
| ▶ No visual evidence of disturbance ----- | →0 |
| ▶ Disturbance feature occurs, but appears to impact only a small percentage of the lakeshore area (< 10%) ----- | →1 |
| ▶ Disturbance feature appears to impact 10 to 25% of lakeshore ----- | →2 |
| ▶ Disturbance feature appears to impact more than 25% of lakeshore ----- | →3 |

Source; Herlihy et al, In review



Turtlefoot Lake, SD. >>

NLA06608-2007
Disturbance Score 1



Potential Reference Lake (PRL) Evaluation

Matrix	p value <0.05 sign diff	PRL Mean n=13	Assessment Pop. Mean n=79
PTL (µgP/L)	0.03	184	392
CHL-A (µg/L)	0.0001	17	101
Turb (NTU)	0.03	16	32
TSI-TP (Carlson's TSI TP)	0.03	70	81
DOC (mg/L)	0.04	36	22
ANC (µeq/L)	0.02	11047	6324
CA_ppm (mg/L)	0.003	32	63
p-Hab_Sub **	0.04	1.44	1.76

** Number of substrate classes

t-Test at 95th confidence level 21 matrices evaluated

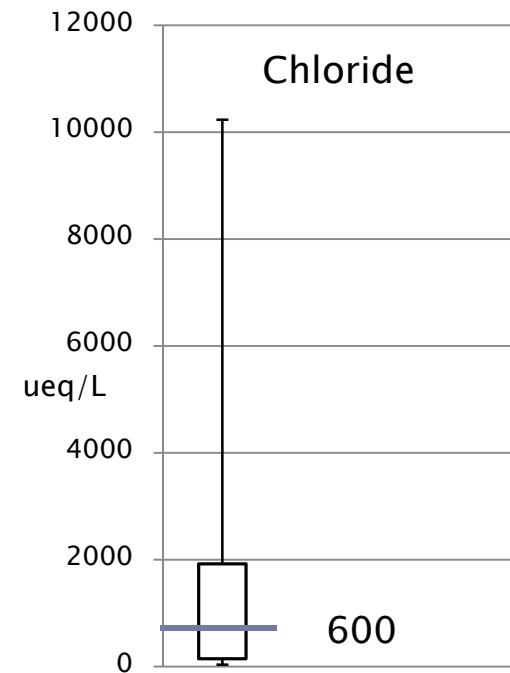
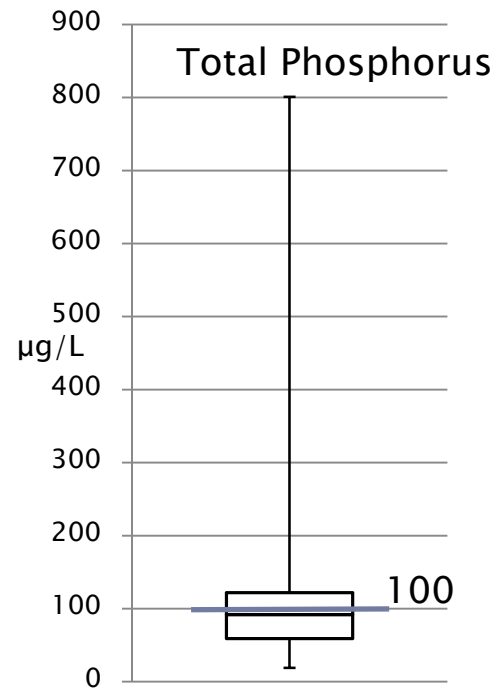
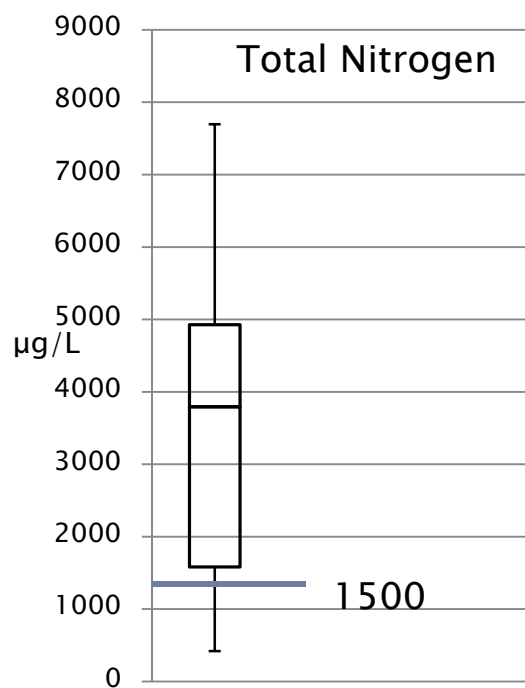
PRL compared to Most Disturbed Lakes

Matrix	p value <0.05 sign diff	PRL Mean n=13	Most Disturbed Mean n=11
CHL-A ($\mu\text{g/L}$)	0.01	17	130
TSI-TP(Carlson's TSI TP)	0.03	70	84
TOC (mg/L)	0.03	39	19
ANC ($\mu\text{eq/L}$)	0.002	11047	4304
DOC (mg/L)	0.02	36	17
NA_ppm (mg/L)	0.05	404	57
K_ppm (mg/L)	0.05	51	19
Ca_ppm (mg/L)	0.01	32	67

Most disturbed lakes identified by 75th percentile of developed and row crop land use

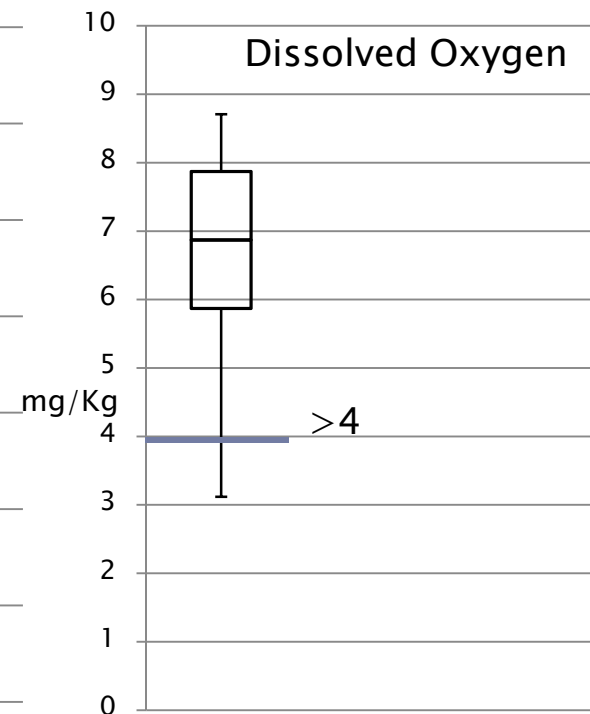
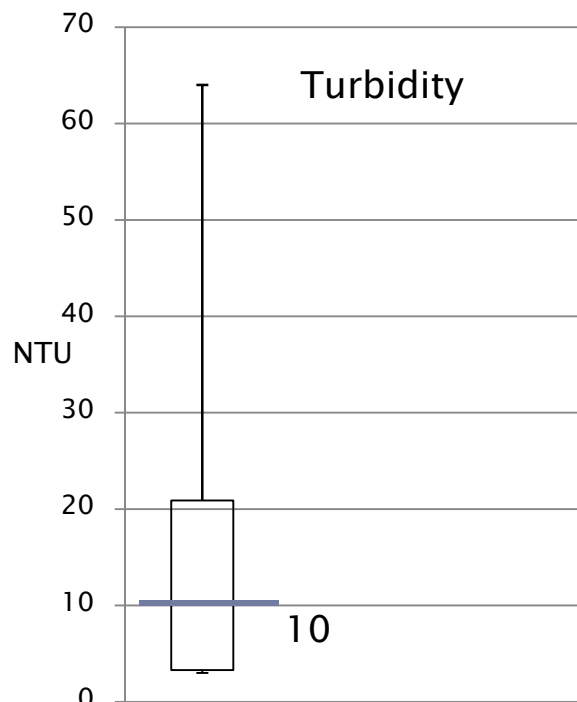
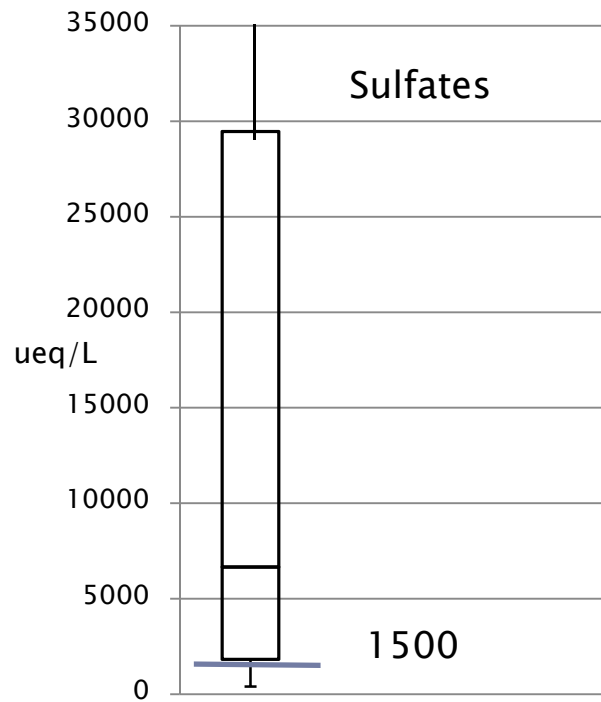
Box Charts for Potential Reference Lakes

Plotted values include minimum, 25th percentile, median, 75th percentile and maximum of PRL.

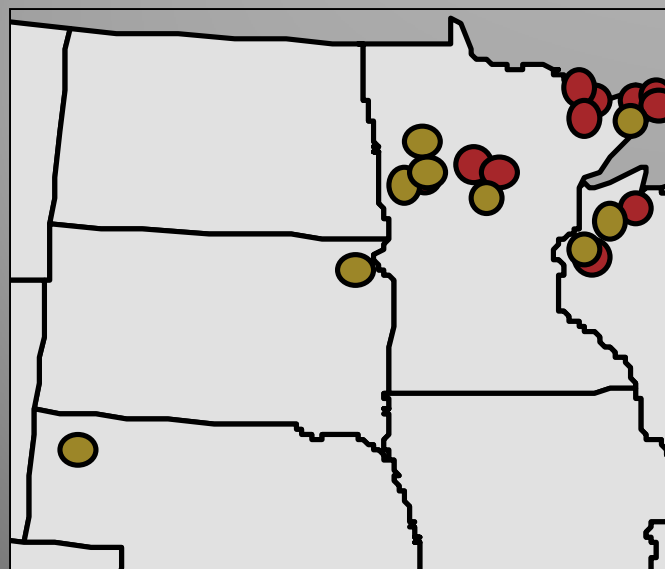


Blue line indicates the Regional Biological Reference Thresholds for Region E from the 2007 NLA

Box Chart continue



Blue line indicates the Regional Biological Reference Thresholds for Region E from the 2007 NLA



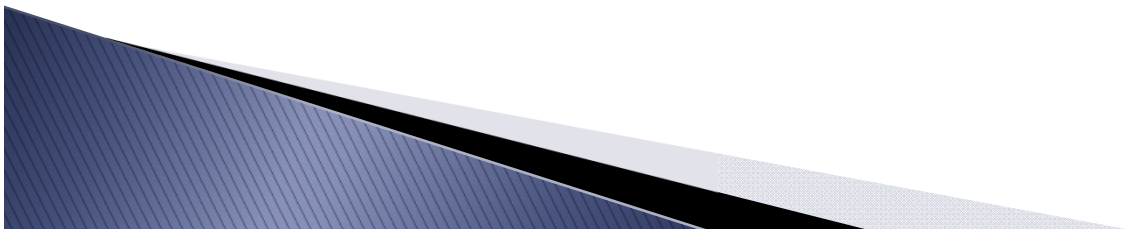
Regional Cluster E ●
Regional Cluster C ●

EPA Regional Biological Reference Lakes . >>>

(NLA Technical Index 2010)

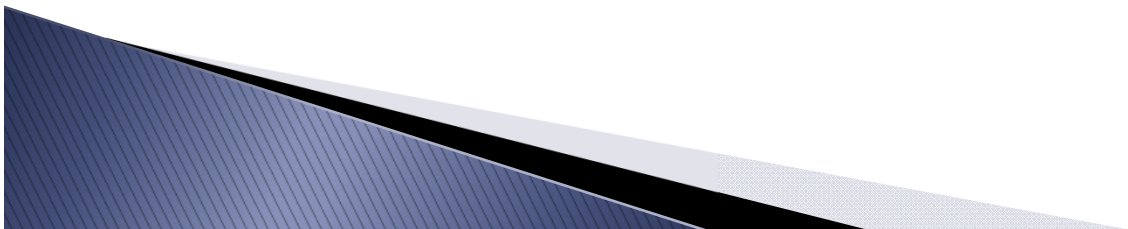
Summary

- ▶ PPR lakes have unique characteristics and require own set of reference lakes
- ▶ Needs more research and development.
- ▶ Advantages of using land use as a screening tool
 - Done with limited resources
 - Adaptability
 - Strengths with increase GIS technology
 - Avoid circular nature when developing nutrient thresholds
- 2012 NLA + re-sampling Potential Reference Lakes



Acknowledgments

- ▶ We would like to thank Richard Mitchell, USEPA Office of Wetlands, Oceans, and Watersheds and Alan Herlihy, Oregon State University, Corvallis, Oregon for their insights and data sharing on reference lake development. Philipp Nagel, Department of Geography, Minnesota State University, Mankato for his technical assists with ArcView 10 software. The North Dakota Department of Health, Division of Water Quality and the Minnesota Pollution Control Agency for providing data and resources for this study. And Minnesota State University, Mankato Graduate School for making available and supplying travel funds for this conference.



Questions?



Source: United States Global Change Research Program.
<http://www.usgcrp.gov/usgrcp/library>

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