

# Nutrient Criteria for Lakes and Reservoirs in Missouri

Mark Osborn

Nov 20, 2008



Missouri  
Department of  
Natural Resources

# Lakes in Missouri

- Natural Lakes (very few)
  - Sinkhole ponds (in karst areas)
  - Ox-bow lakes, blew holes, wetland lakes
  - 1 tectonic
- Artificial Lakes and Reservoirs
  - ~2900  $\geq$  5 ac in area
  - 22  $\geq$  1000 ac in area
- 456 listed as waters of the state





# Approach to nutrient criteria

## ➤ Phosphorus





- Divide state into ecoregions
- Use reservoir morphology and watershed characteristics to determine gradient of predicted phosphorus concentrations
- Identify reference conditions within each ecoregion

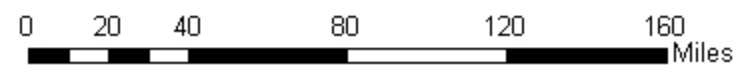
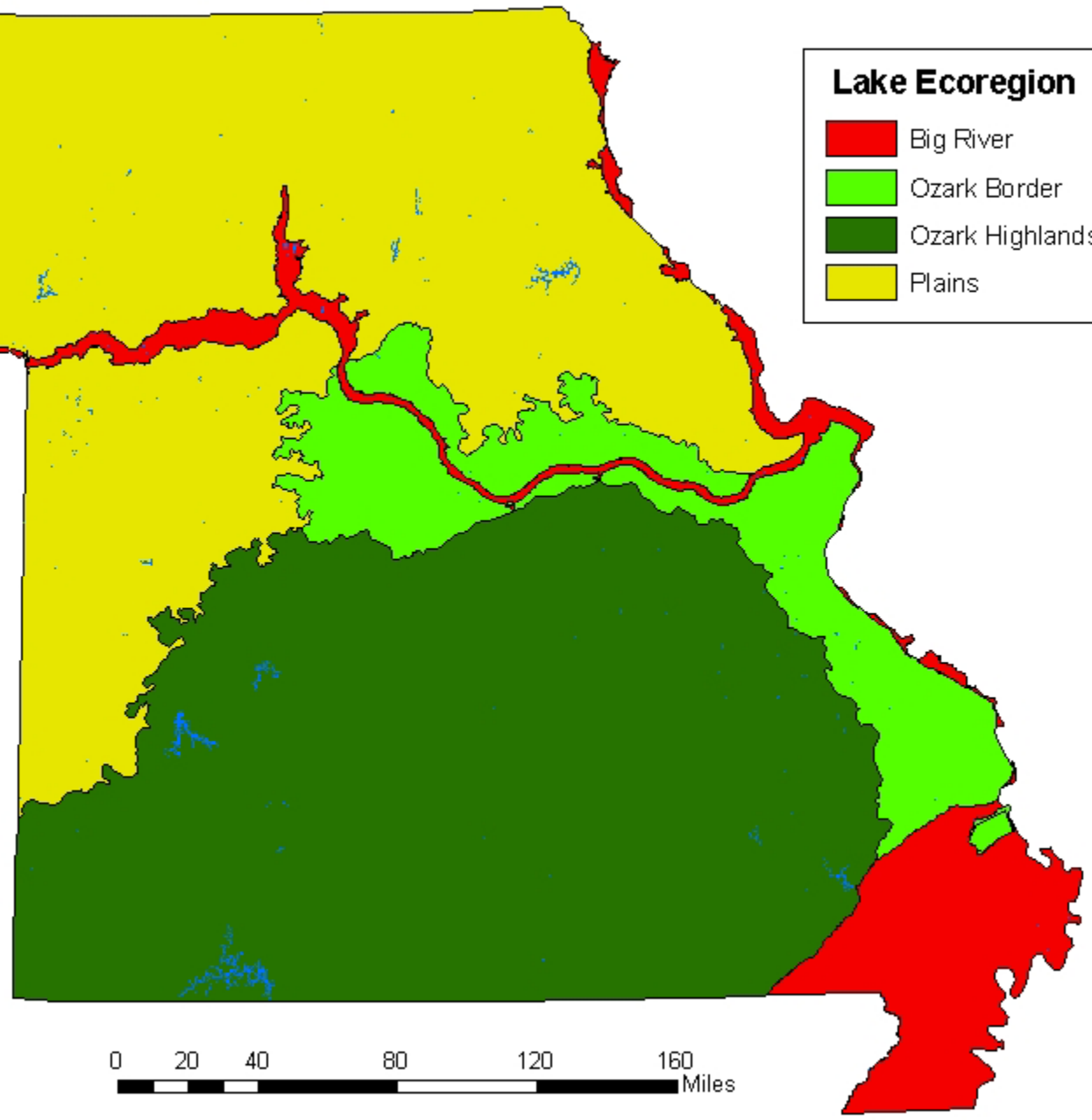
## ➤ Nitrogen and Chlorophyll

- Based on N/P and Chl/P relationships



**Lake Ecoregion**

-  Big River
-  Ozark Border
-  Ozark Highlands
-  Plains



# Predicted TP concentrations

- Hydrologic factors
  - Depth (dam height)
  - Residence time
- Watershed Characteristics
  - Portion in area that was originally prairie



# Regional Equations for predicting Total Phosphorus ( $\mu\text{g/L}$ )

## ➤ Plains

$$\text{TP} = (\% \text{ prairie}/4) + (16/ \text{ residence time (yrs)}) + (570/ \text{ dam height (ft)})$$

## ➤ Ozark Border

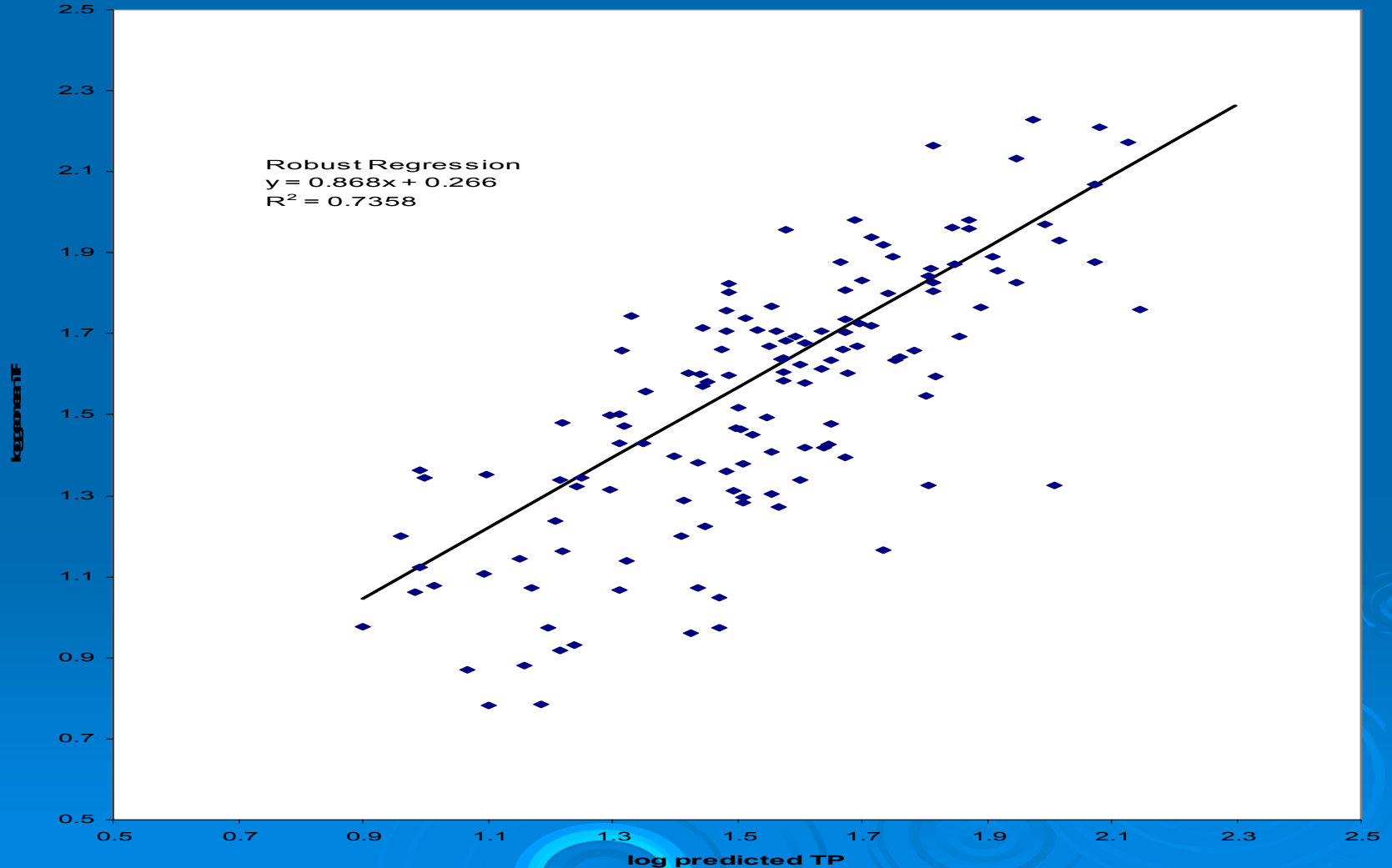
$$\text{TP} = 15 + (740/ \text{ dam height (ft)})$$

## ➤ Ozark Highland

$$\text{TP} = 5 + (740/ \text{ dam height (ft)})$$



# Comparison of predicted and actual TP concentrations



# Reference Lakes

## ➤ Reference Conditions

- No point sources or CAFOs within the watershed
- <20% of watershed in combined crop and urban coverage
- >50% of watershed in dominant historic land cover (Ozark highlands = forest, Plains = grassland)

# Reference Lakes

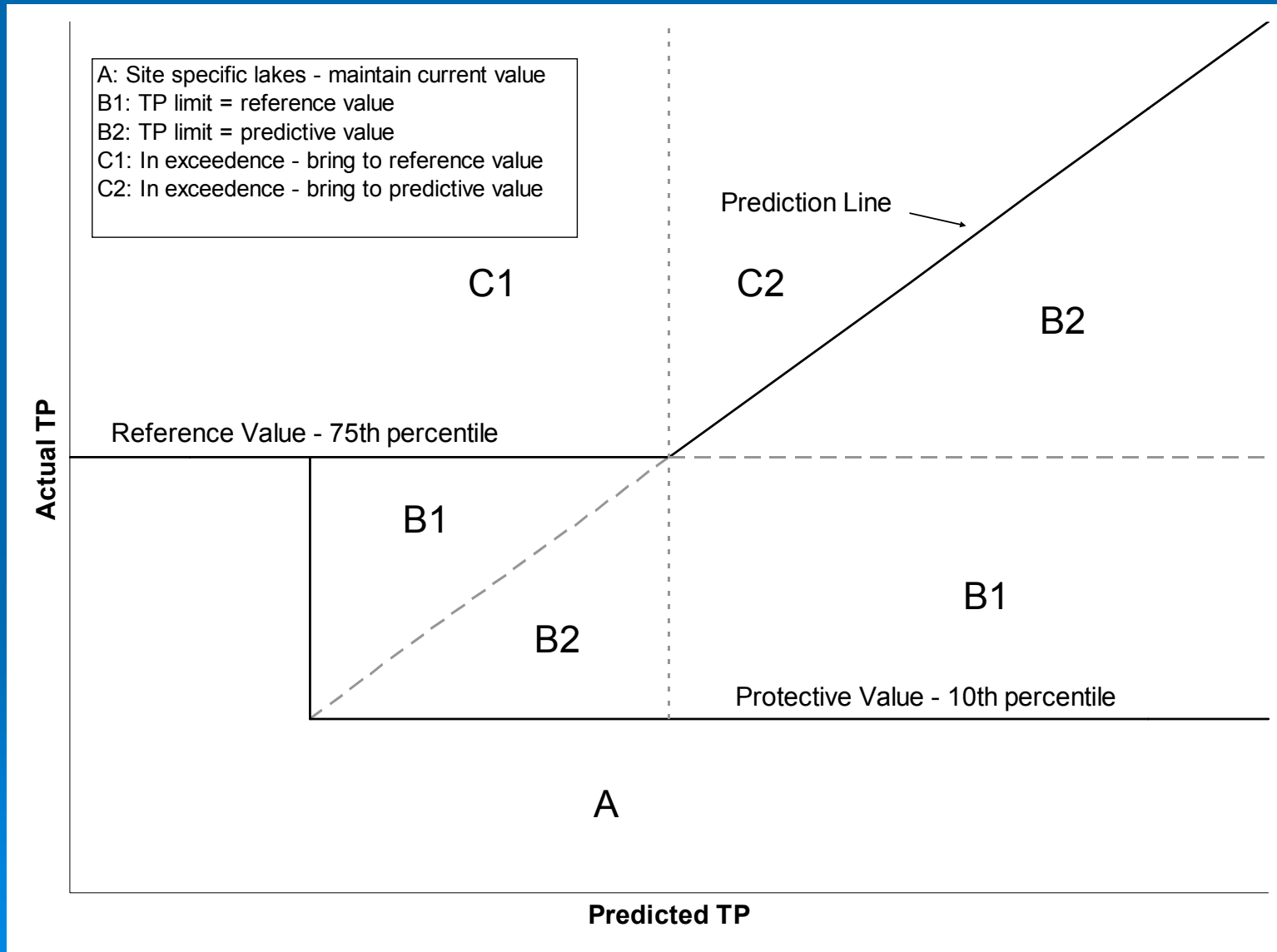
- Identification of ecoregional reference criteria
  - 75<sup>th</sup> percentile of reference lakes within each eco-region

Ecoregion	# reference lakes	TP ( $\mu\text{g/L}$ )
Plains	7	58
Ozark Border	7	41
Ozark Highland	23	26

# Site Specific Criteria

- Applicable to lakes with TP concentration at 10 % or less of range of reference values within each ecoregion
- Also applicable to lakes with TP concentration less than reference value and predicted value below 10%
- Lakes in this category are held to a maximum of current geomean value for TP
  - Plains – 20
  - Ozark Border – 16
  - Ozark Highland – 9

# TP criteria schematic



# Total Nitrogen Criteria

- Proportional to TP criteria for a maximum TN:TP ratio of 20
- Not applicable to lakes with site specific criteria. Maintain current levels.

# Chlorophyll Criteria

- Proportional to TP criteria as follows:
  - Plains:  $\text{Chl:TP} = 0.44$
  - Ozark Border:  $\text{Chl:TP} = 0.42$
  - Ozark Highland:  $\text{Chl:TP} = 0.42$
- Not applicable to lakes with site specific criteria. Maintain current levels.

# Assessment of Lake Trophic Status

- Geometric mean from a minimum of 4 years worth of data, 4 samples per year
- Samples to be taken between May 1 and August 31
- Samples to be drawn from near outlet of lake or reservoir



# TP Criteria for tributary arms of major reservoirs

- 10 reservoirs > 1,500 ac in size
- Criteria at outlet may not be protective of WQ in tributary arms
- TP criteria for tributary arms based on predictive approach, treats them as individual lakes
- Data at this point is limited

Questions?

