

## **2005-2010 Consumptive Use of Small Man-made Water Bodies in the Platte Surface Water Basin above Columbus**

**PRRIP Water Advisory Committee Meeting-May 6, 2014**

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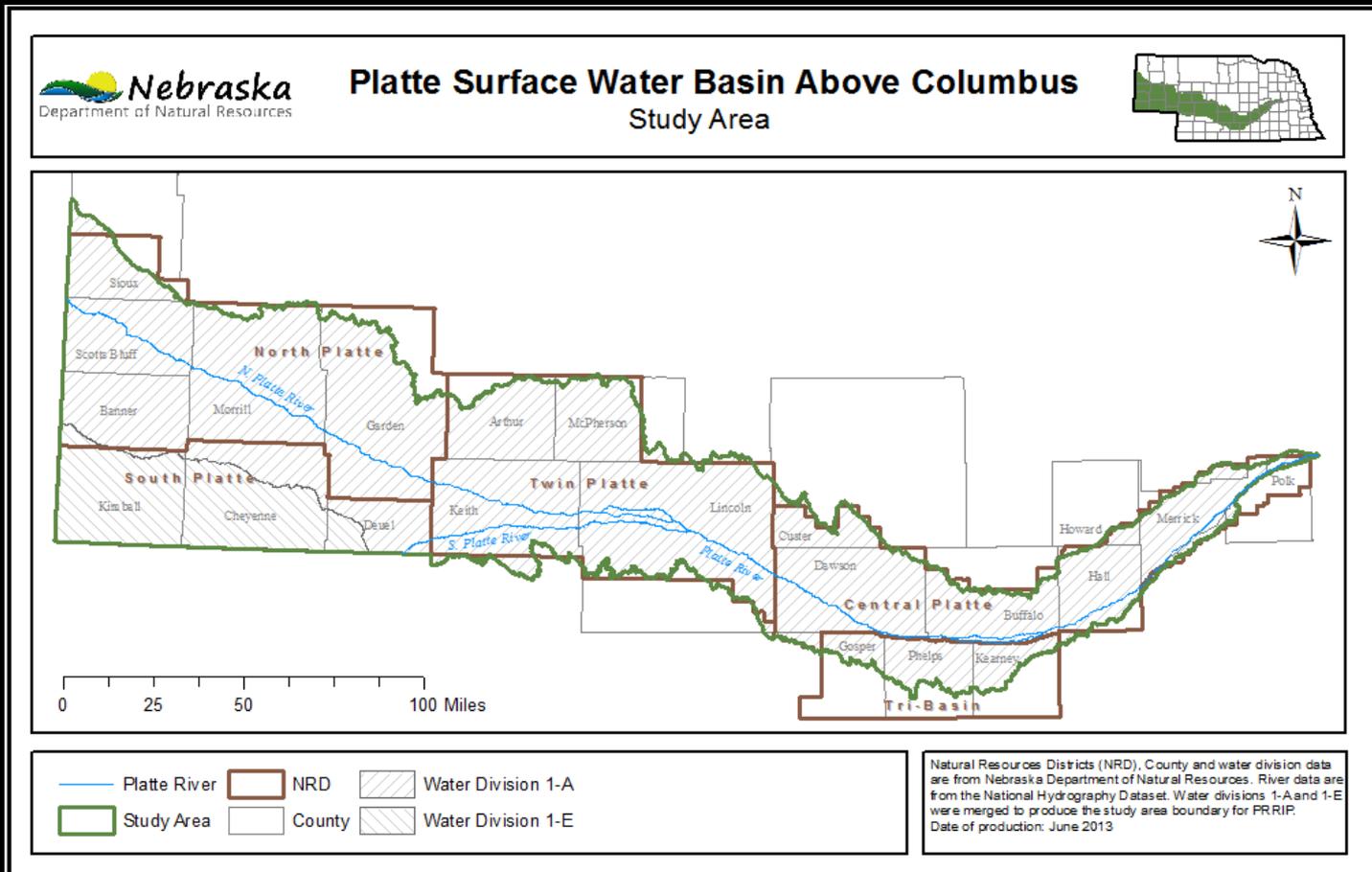
# Introduction

## Nebraska New Depletion Plan (NNDP) for the Platte River Recovery Implementation Program (PRRIP)

- The NNDP describes the actions Nebraska proposes to take to prevent or mitigate for new depletions to U.S. Fish and Wildlife Service (USFWS) target flows
- The Nebraska Department of Natural Resources (NDNR) has jurisdiction over surface water uses, and requires permits for
  - stream diversions, and
  - on-stream storage reservoirs greater than 15 AF
- For new or expanded sandpits, and new, small reservoirs that do not require permits, NDNR will estimate the cumulative impact on state-protected and target flows
  - Adverse effects will be mitigated by the state

# Introduction

- The goal of this work was to estimate cumulative effect of new or expanded sandpits, or new reservoirs on protected flows from 2005-2010



# Overview of Methods

- Create a 2005 water body inventory (baseline)
  - Create a 2010 water body inventory
  - Compare 2010 inventory to baseline
    - New or expanded sandpits
    - New reservoirs
  - Evaluate for permits/mitigation in place
  - Use the NRCS calculator to estimate consumptive use change due to new/expanded water bodies with no permits
- 
- GIS

## GIS Methods

### Create a baseline water inventory for 2005

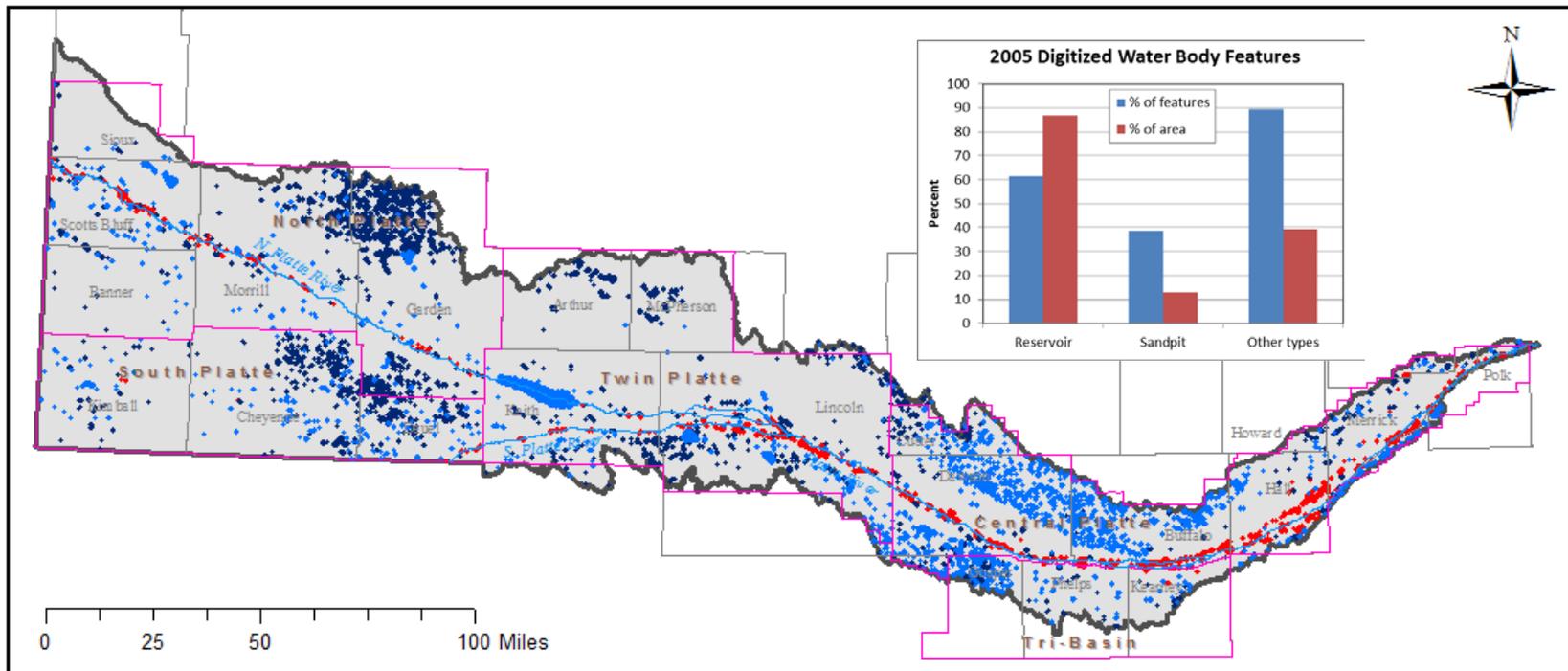
- In 2005, aerial imagery was scanned frame by frame and all water bodies were digitized/ categorized
- From this, the water bodies were categorized
  - Sandpits
  - Reservoirs
  - “Other”
- Resulted in roughly 11,500 features
- Whole inventory took 1200 hours to complete

# GIS Methods

## Create a baseline water inventory for 2005



### NNDP Water Body Inventory: 2005 Baseline



## GIS Methods: Create a 2010 water body inventory

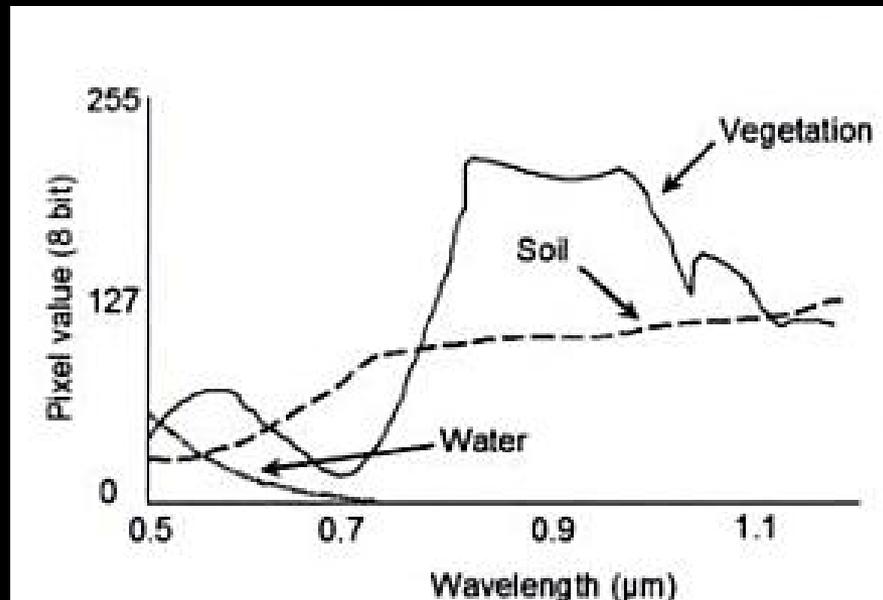
- In 2010, the 2005 baseline methods and final dataset were reviewed, as well as aerial imagery
- 2010 was a much more wet year, resulted in roughly 3-4 times as much water
  - potential for 4000 hours of labor if same methods were employed



# GIS Methods

## Create a 2010 water body inventory

- Semi-automatic approach
- Classification of FSA imagery to identify water
  - Utilized Near-Infrared band values



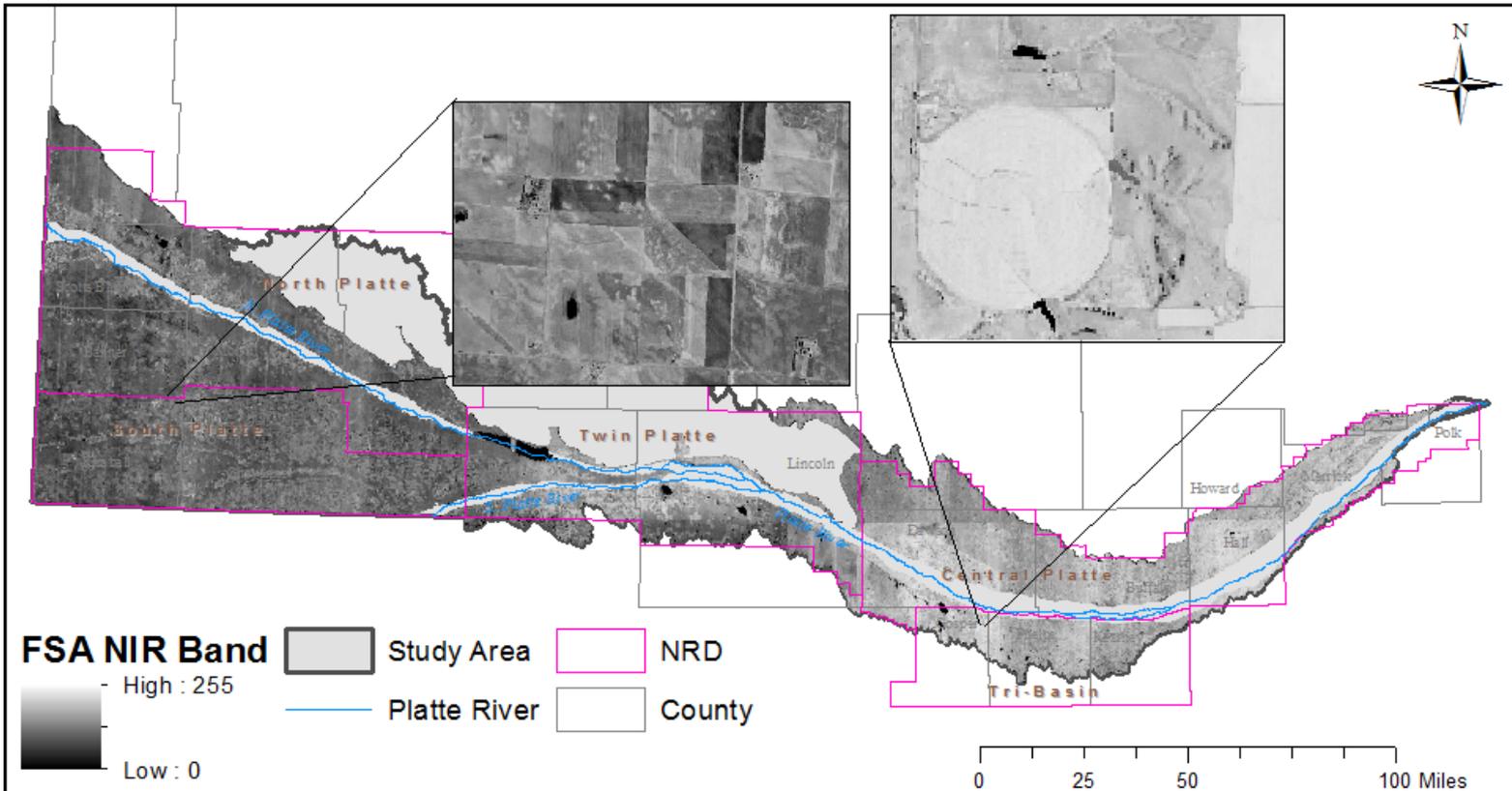
From Mather and Koch, 2011

# GIS Methods

## Create a 2010 water body inventory



### NNDP Water Body Inventory: Classification of 2010 FSA Imagery



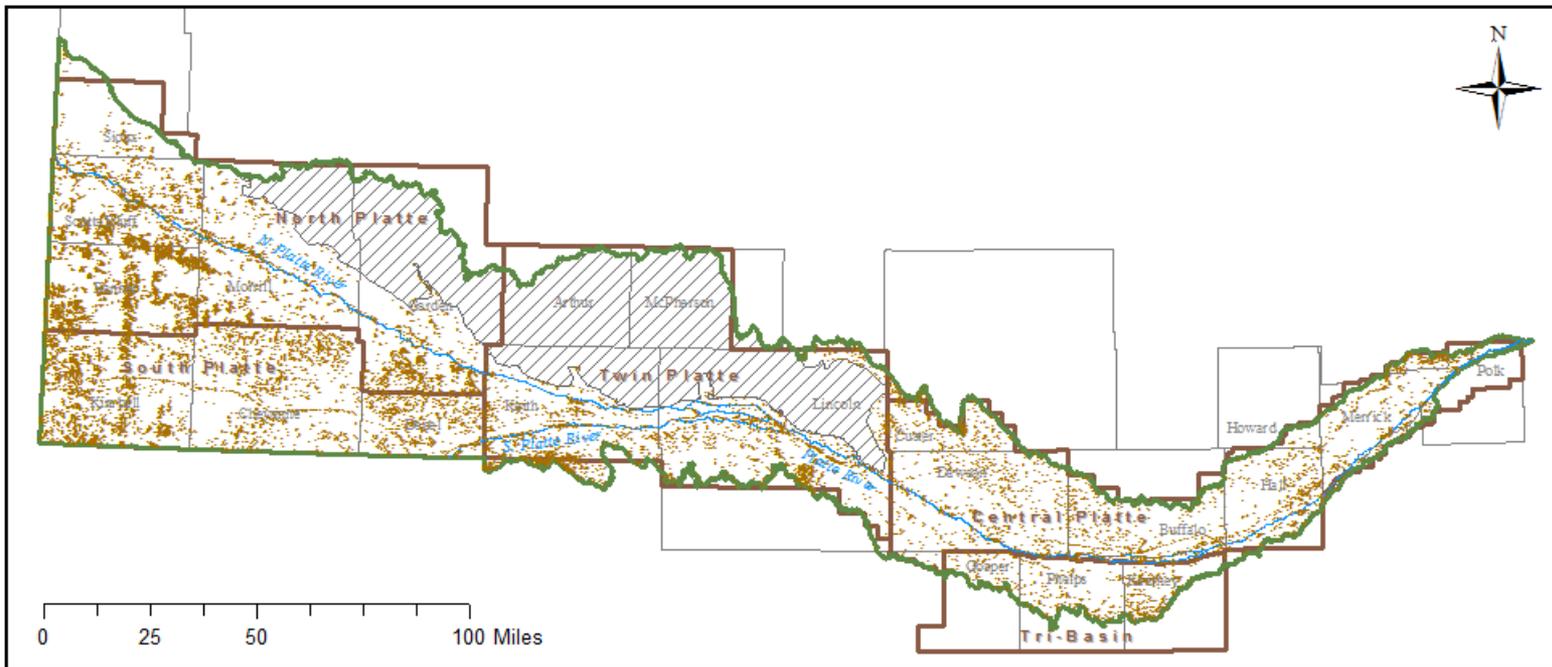
# GIS Methods

## Create a 2010 water body inventory



### Platte Surface Water Basin Above Columbus

2010 Water Bodies Over 1 Acre Identified by the Remote Sensing Process

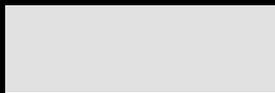
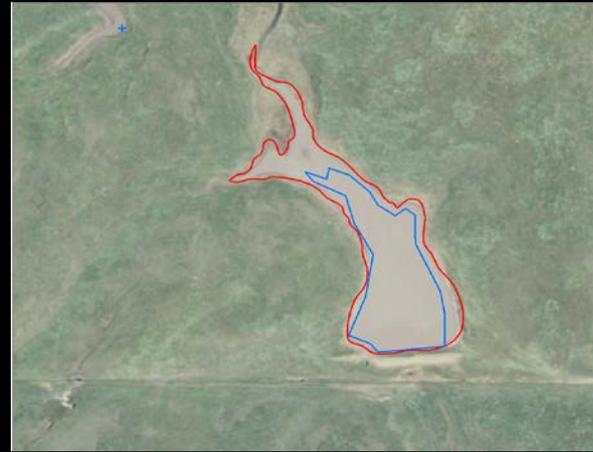
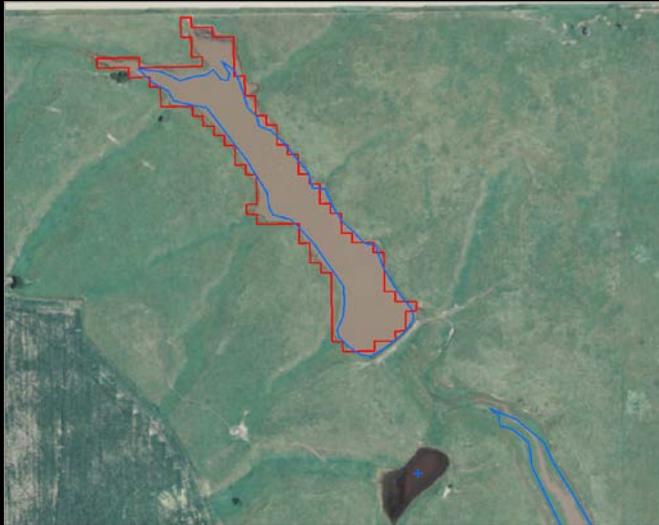


- Platte River
- NRD
- Water bodies from Remote Sensing Over 1 Acre
- Study Area
- County
- Sandhills

Date of Production: June 2013

# GIS Methods

## Manual Editing of Classified Features

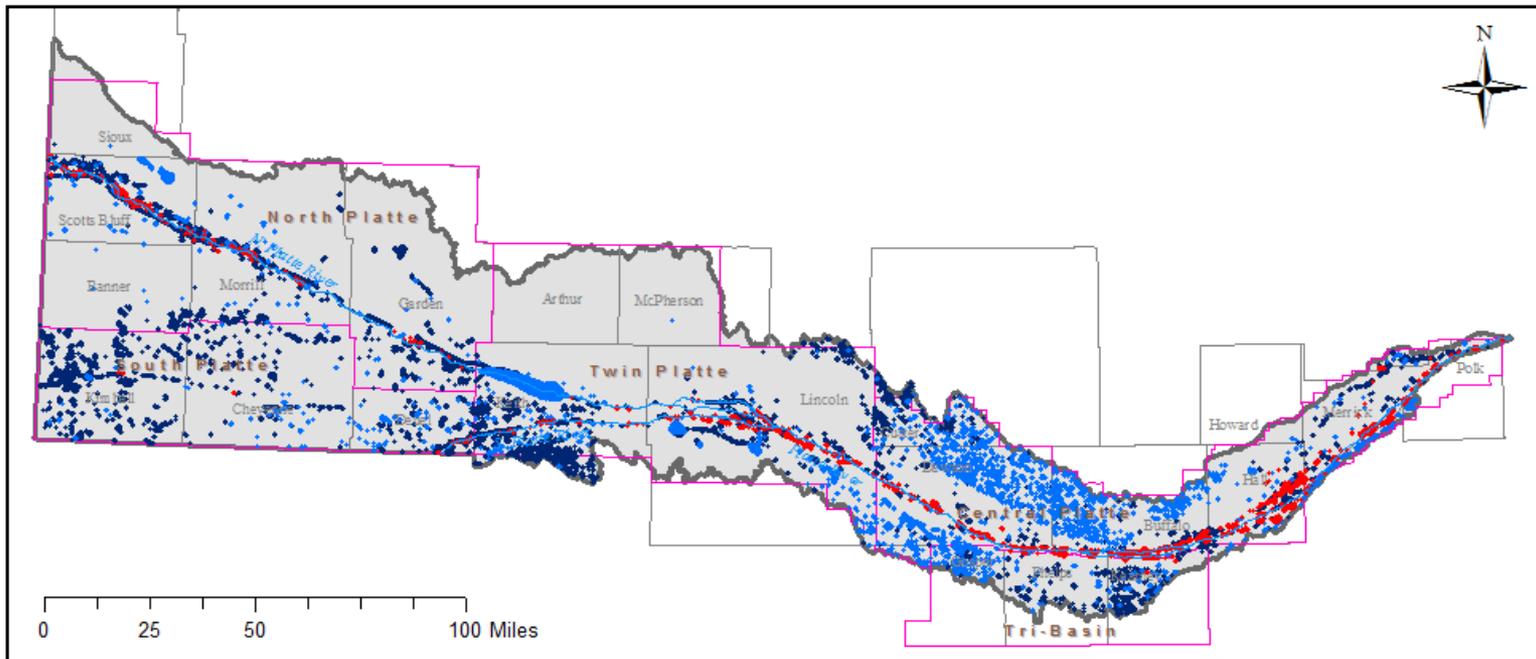


# GIS Methods

## Classification of 2010 water body inventory



### NNDP Water Body Inventory: 2010 Water Bodies



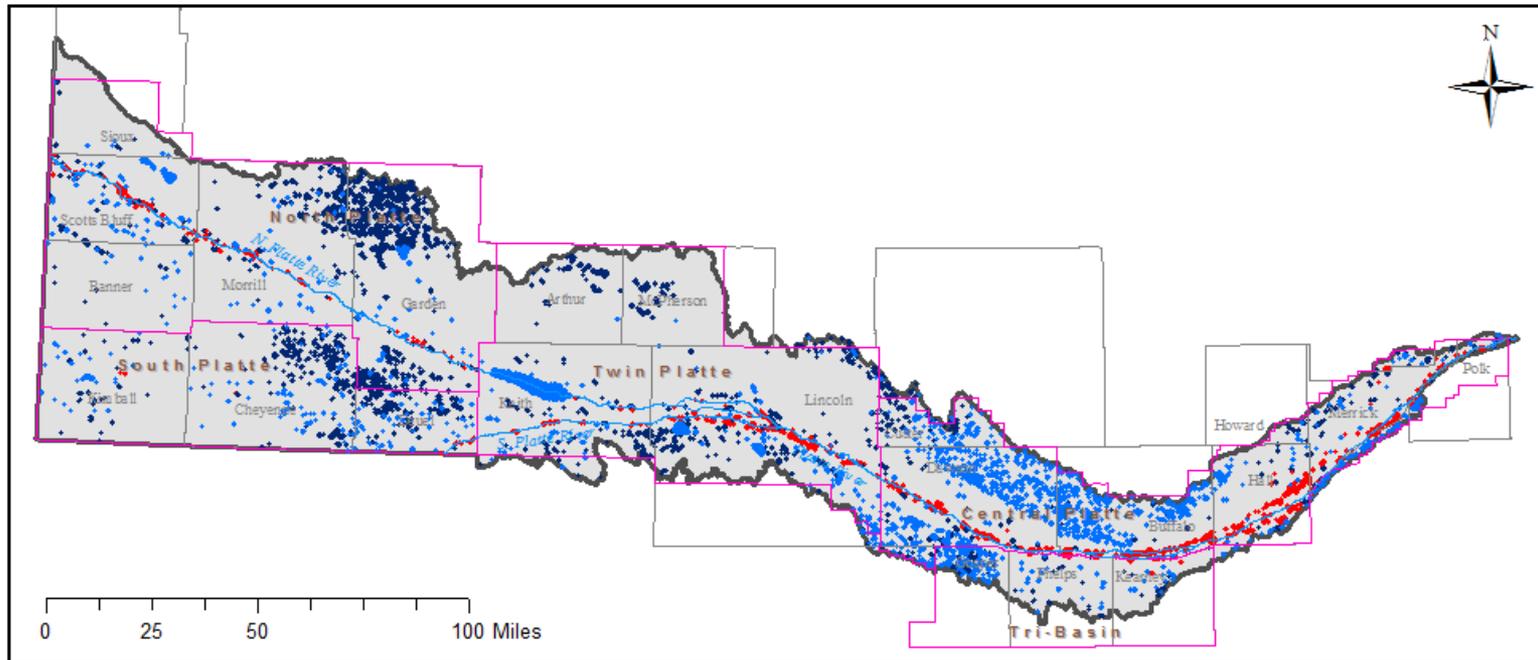
2,583 water bodies classified as sandpits or reservoirs (53,557 acres)

# GIS Methods

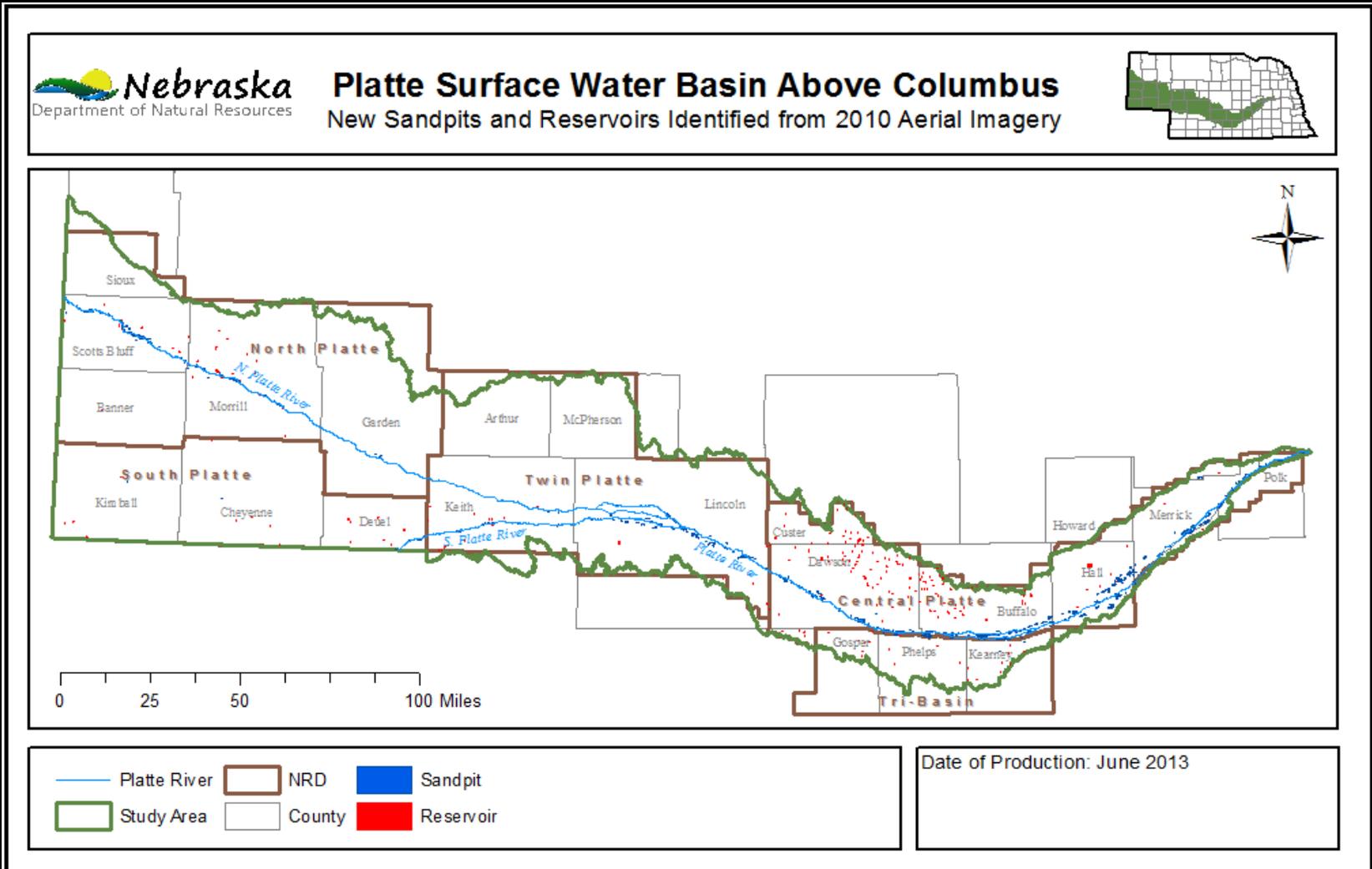
## Overlay with 2005 water body inventory



NNDP Water Body Inventory: 2005 Baseline



# Potential Sandpits and Reservoirs for Change Analysis



758 sandpits and reservoirs preliminarily designated as changed (3,723 acres)

# Criteria for Inclusion in Change Analysis

## Reservoirs

- New embankment
- No permits
  - Surface water right or dam safety plan
  - If a right or plan exists, check for depletions and mitigation already in place

## Sandpits

- Active gravel pit
- No estimated depletions or mitigation
- Account for land reclamation

# Reservoir Change Analysis Criteria: New Embankment

- New embankment physically present after 2005



2005



2006



2010

# Sandpit Change Analysis Criteria: Activity

- Sandpit criteria
  - Sand around new/expanded sandpits
  - Looked at expanded portions, accounted for reclaimed portions



2005



2010



Reduced Areas  
Expanded Areas

# NRD Review

- Features Identified as new or expanded were sent to NRDs for review
- A few features had not changed due to man's activities,
- A few features had been mitigated
- These were removed from subsequent analyses

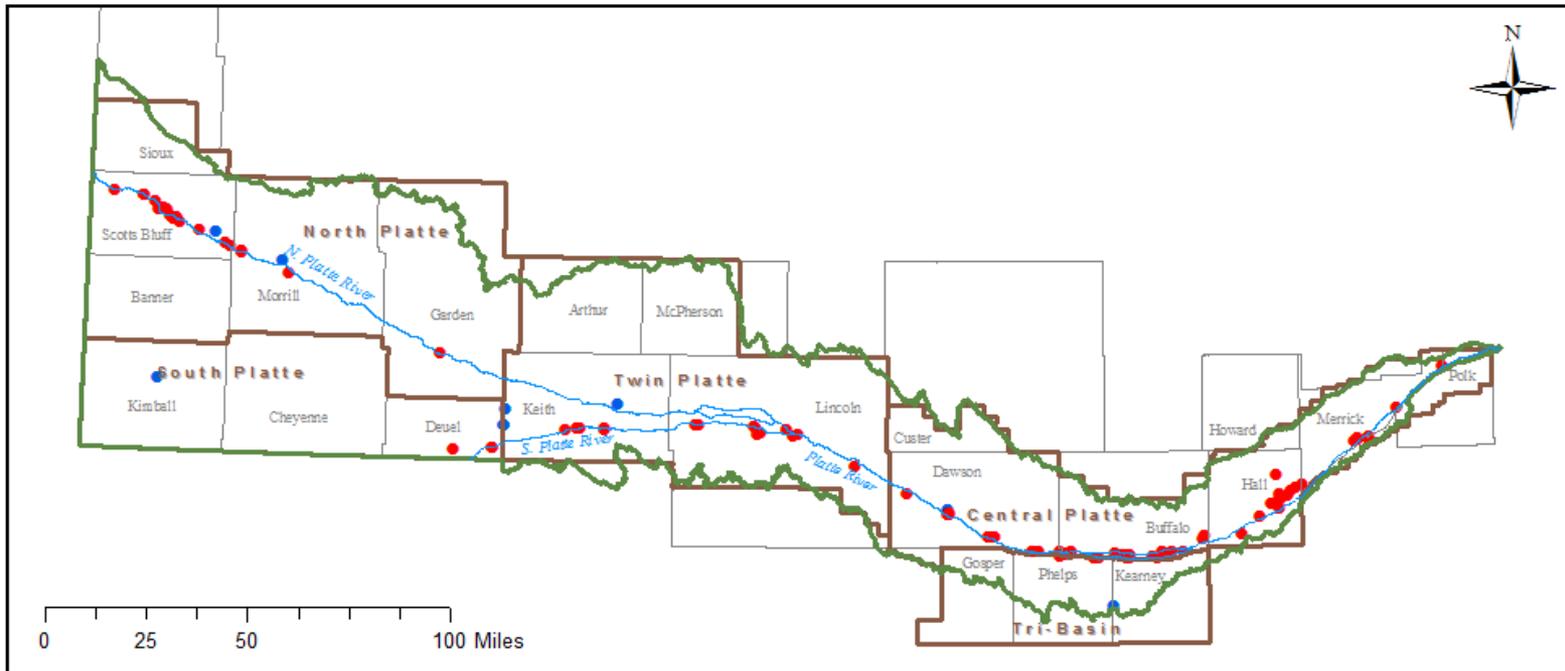


# Sandpits and Reservoirs for ET Change



## Platte Surface Water Basin Above Columbus

New or Expanded Water-bodies Between 2005 and 2010



- Platte River
- NRD
- New or Expanded Sandpits
- Study Area
- County
- New Unpermitted Reservoirs

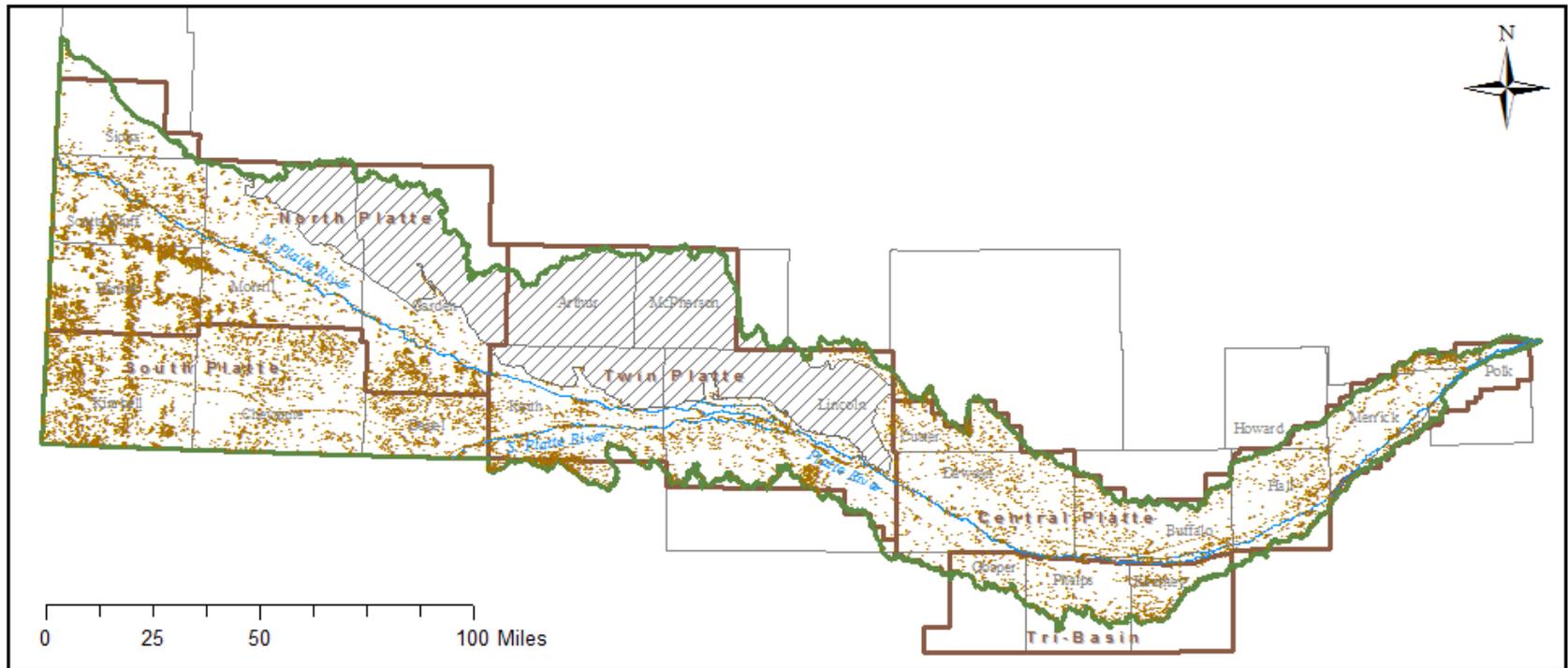
94 sandpits, and 9 reservoirs for change analysis

# Synopsis of steps to create water body layer for change analysis



## Platte Surface Water Basin Above Columbus

2010 Water Bodies Over 1 Acre Identified by the Remote Sensing Process



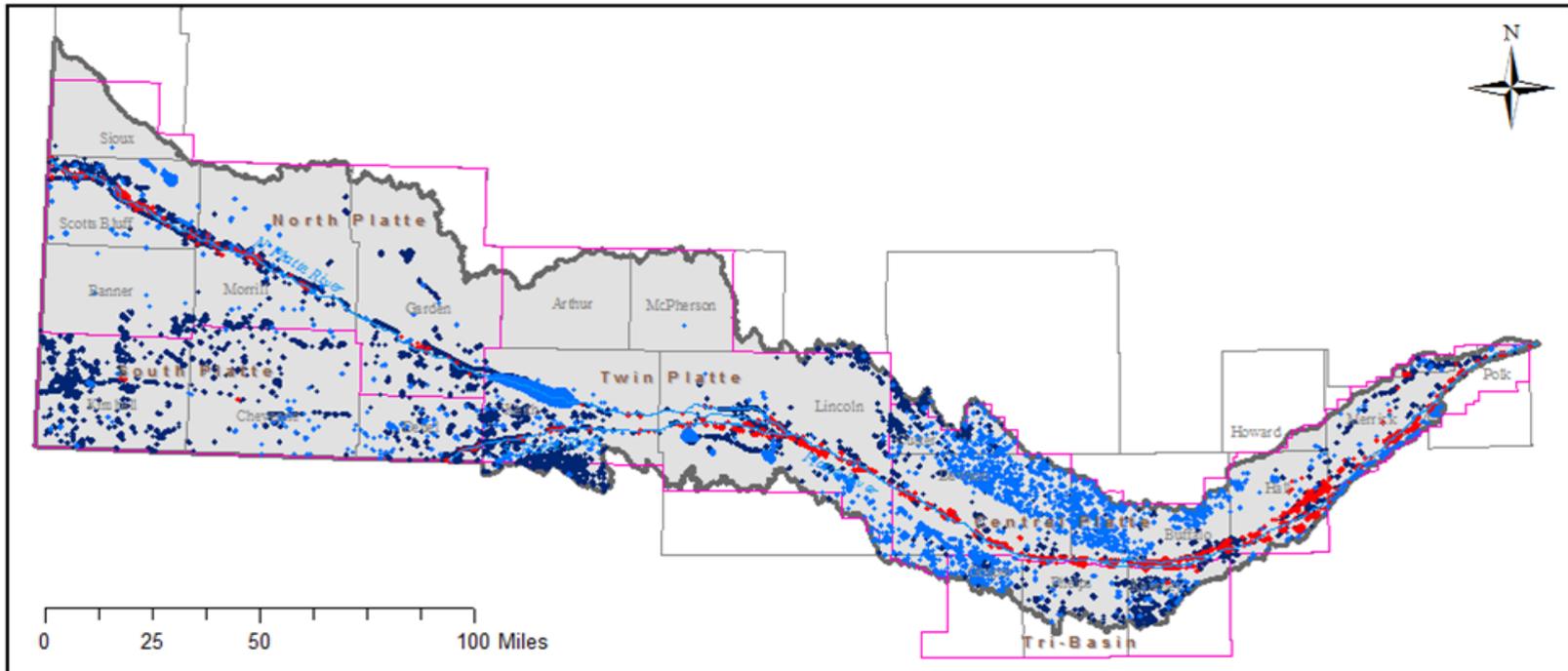
Date of Production: June 2013

19,043 features (122,431 acres)

# Synopsis of steps to create water body layer for change analysis



## NNDP Water Body Inventory: 2010 Water Bodies

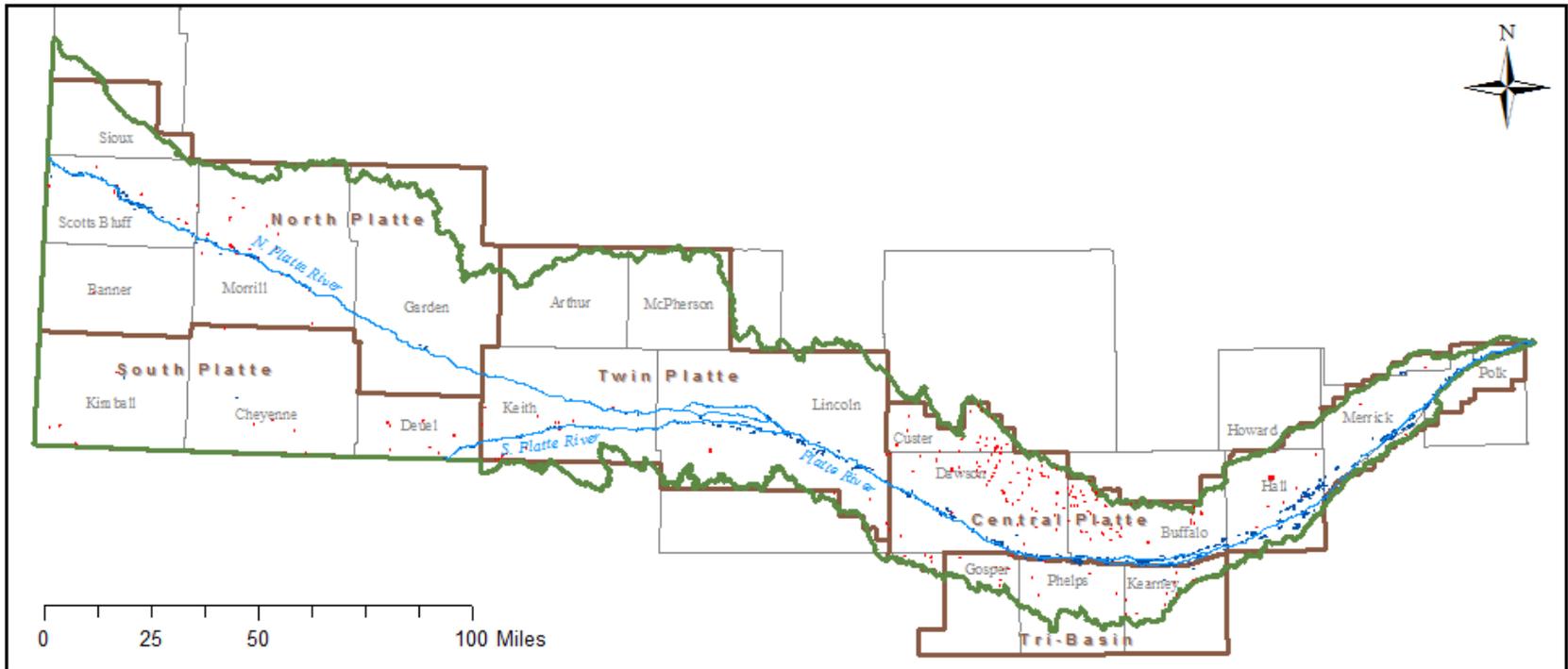


2,583 sandpits and reservoirs (53,557 acres)

# Synopsis of steps to create water body layer for change analysis



## Platte Surface Water Basin Above Columbus New Sandpits and Reservoirs Identified from 2010 Aerial Imagery



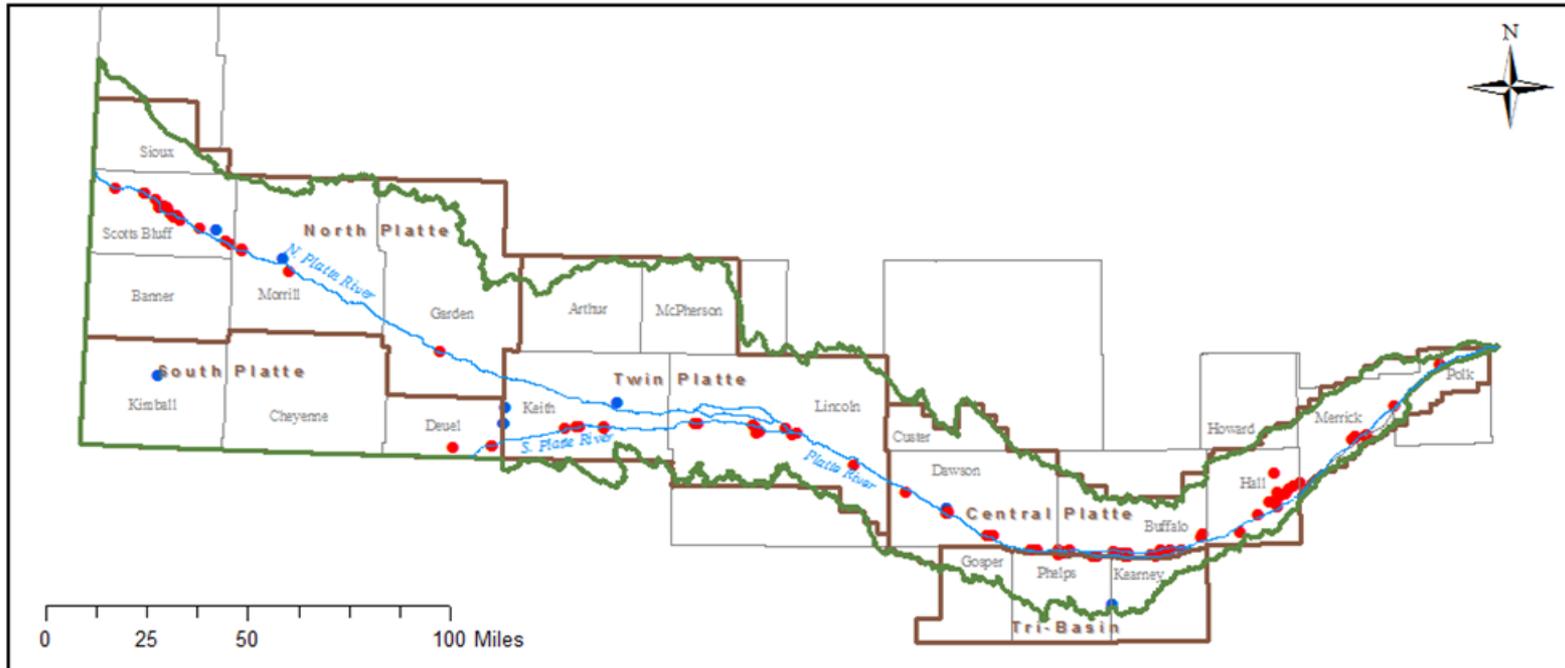
Date of Production: June 2013

758 sandpits and reservoirs (3,723 acres)

# Synopsis of steps to create water body layer for change analysis



## Platte Surface Water Basin Above Columbus New or Expanded Water-bodies Between 2005 and 2010



- Platte River
- NRD
- New or Expanded Sandpits
- Study Area
- County
- New Unpermitted Reservoirs

Sandpits: 94 (728 acres); Reservoirs: 9 (19 acres)

# Breakdown of evaluated water bodies

| <b>CHANGE ANALYSIS RESERVOIR IDENTIFICATION PROCESS</b> |                           |                     |
|---|---------------------------|---------------------|
| <b>Procedure</b>  | <b>Number of Features</b> | <b>Area (acres)</b> |
| Reservoirs classified from 2010 imagery                 | 1,578                     | 45,507              |
| Reservoirs not included in 2005 inventory               | 573                       | 1,521               |
| Reservoirs with new embankments between 2005 and 2010   | 11                        | 405                 |
| New reservoirs with permits between 2005 and 2010       | (2)                       | 386                 |
| New unpermitted reservoirs between 2005 and 2010        | 9                         | 19                  |

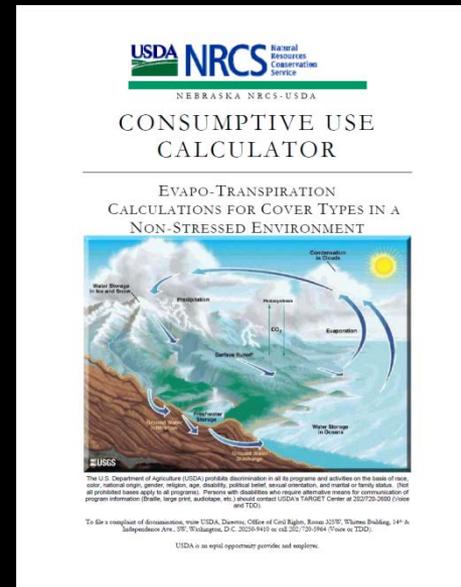
| <b>CHANGE ANALYSIS SANDPIT IDENTIFICATION PROCESS</b> |                           |                     |
|---|---------------------------|---------------------|
| <b>Procedure</b>                                      | <b>Number of Features</b> | <b>Area (acres)</b> |
| Sandpits classified from 2010 imagery                 | 1,005                     | 8,050               |
| Sandpits with area change from 2005                   | 185                       | 2,202               |
| New/expanded sandpits identified from visual analysis | 98                        | 736                 |
| New sandpits with mitigation                          | (4)                       | 8                   |
| New/expanded sandpits between 2005 and 2010           | 94                        | 728                 |

# Methods

Evapotranspiration (ET) estimation using NRCS  
ET calculator

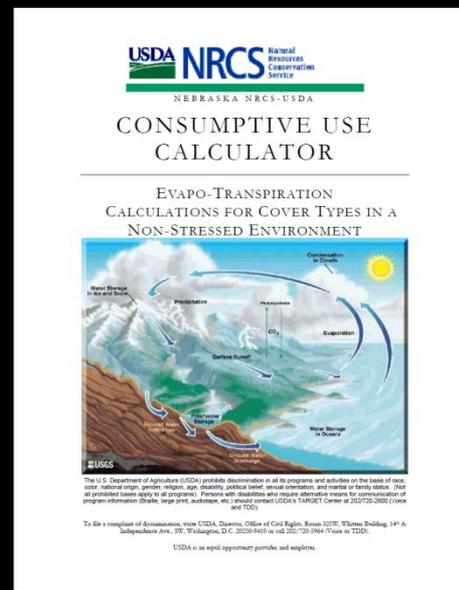
# NRCS ET Calculator

- Created by Natural Resources Conservation Service (NRCS)
- Consumptive use change assessment in Platte basin
- Average monthly ET of 46 land covers
  - Grasslands
    - grass cool mid; grass cool short; grass cool tall; grass warm mid; grass warm short; grass warm tall; grass pasture good; grass pasture bad
  - Wetlands
    - wet tall grasses; wet cattail/bulrush moist; wet cattail/bulrush standing water; wet linear; wet short veg moist; wet short veg standing water
  - Water
    - water shallow; water deep
- March to November ET



# Methods: ET Calculation

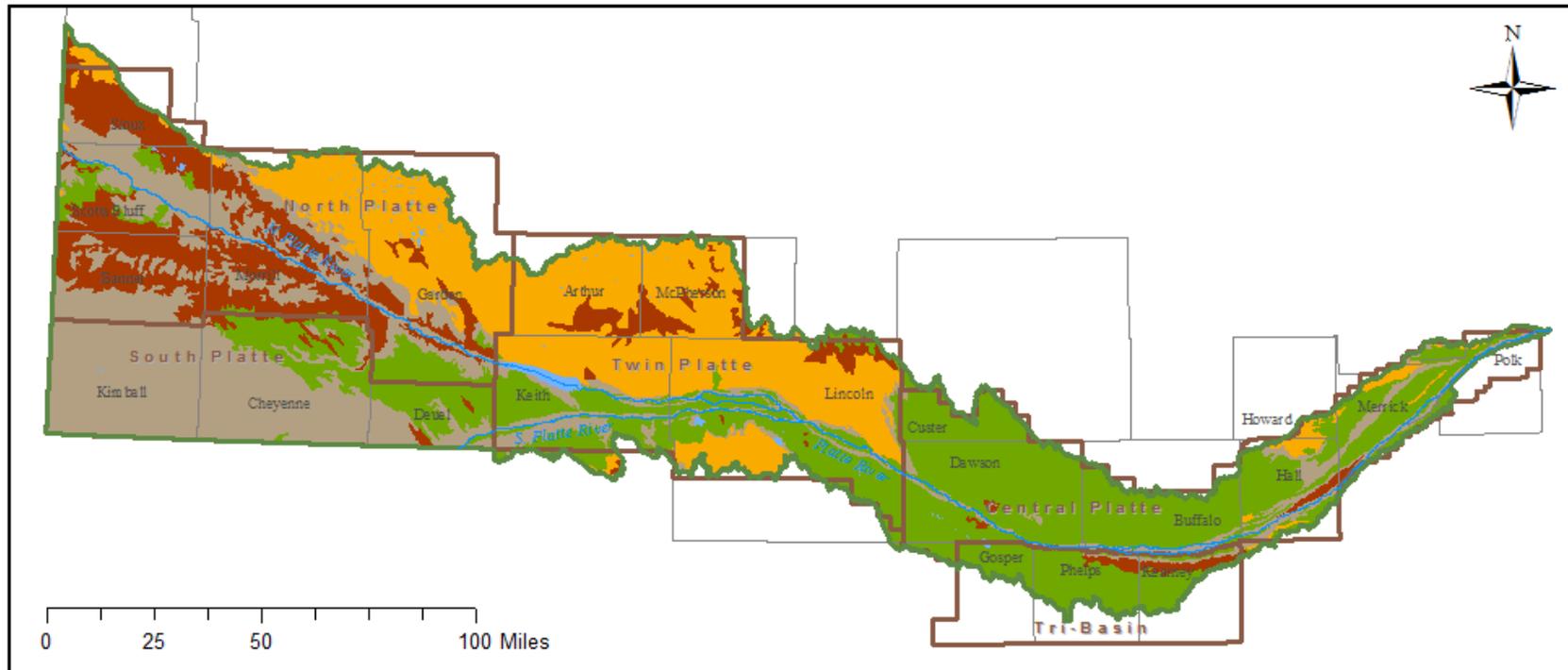
- Data for ET Calculator
  - Location and acres
    - GIS process
  - Soil type
    - STATSGO (horizon 1)
  - Land cover
    - CALMIT 2005 land cover dataset
    - UNL CSD native vegetation
  - Location in ET climate areas
    - NRCS consumptive use calculator guide



# Methods: ET Calculation



## Platte Surface Water Basin Above Columbus Soil Texture Classes

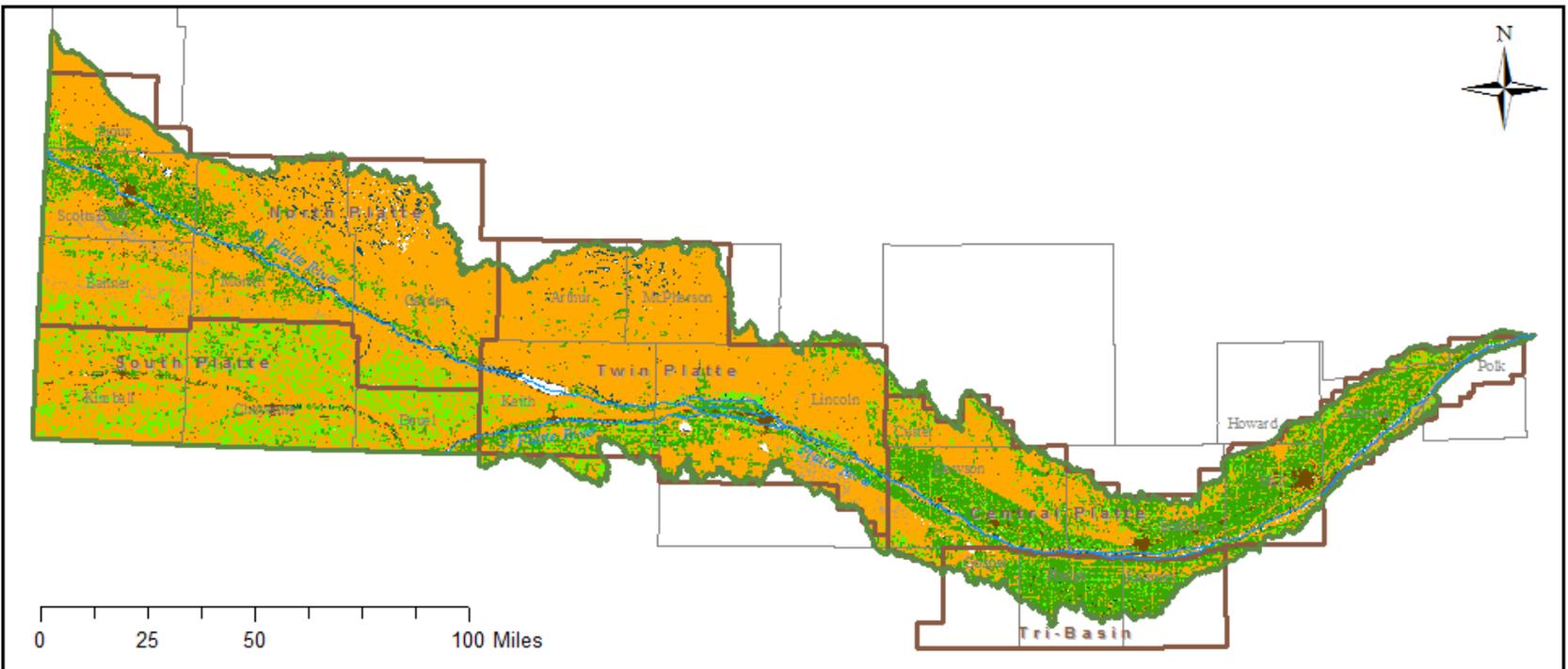


Soil texture data from STATSGO, reclassified to match NRCS soil classes.  
Date of production: June 2013.

# Methods: ET Calculation



## Platte Surface Water Basin Above Columbus CALMIT 2005 Land Cover

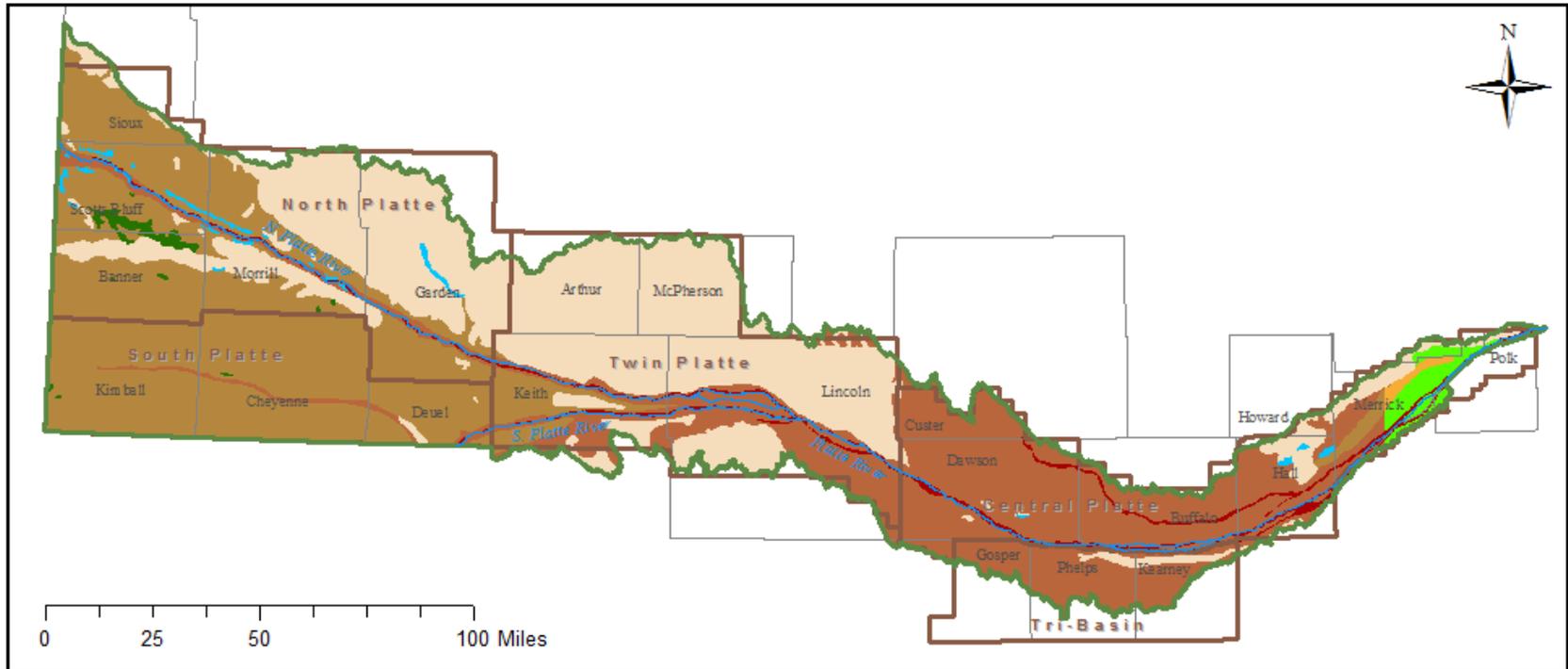


Land cover classes from the University of Nebraska Lincoln (UNL) Center for Advanced Land Management Information Technologies (CALMIT) 2005 Nebraska Land Use Patterns, County and water division data are from Nebraska Department of Natural Resources. River data from the National Hydrography Dataset  
Date of Production: June 2013

# Methods: ET Calculation



## Platte Surface Water Basin Above Columbus Native Vegetation Types



|              |                  |                  |                  |
|--------------|------------------|------------------|------------------|
| Platte River | County           | Grass Warm Mid   | Riparian Forests |
| Study Area   | Grass Cool Short | Grass Warm Short | Conifers         |
| NRD          | Grass Cool Tall  | Grass Warm Tall  | Wetlands         |

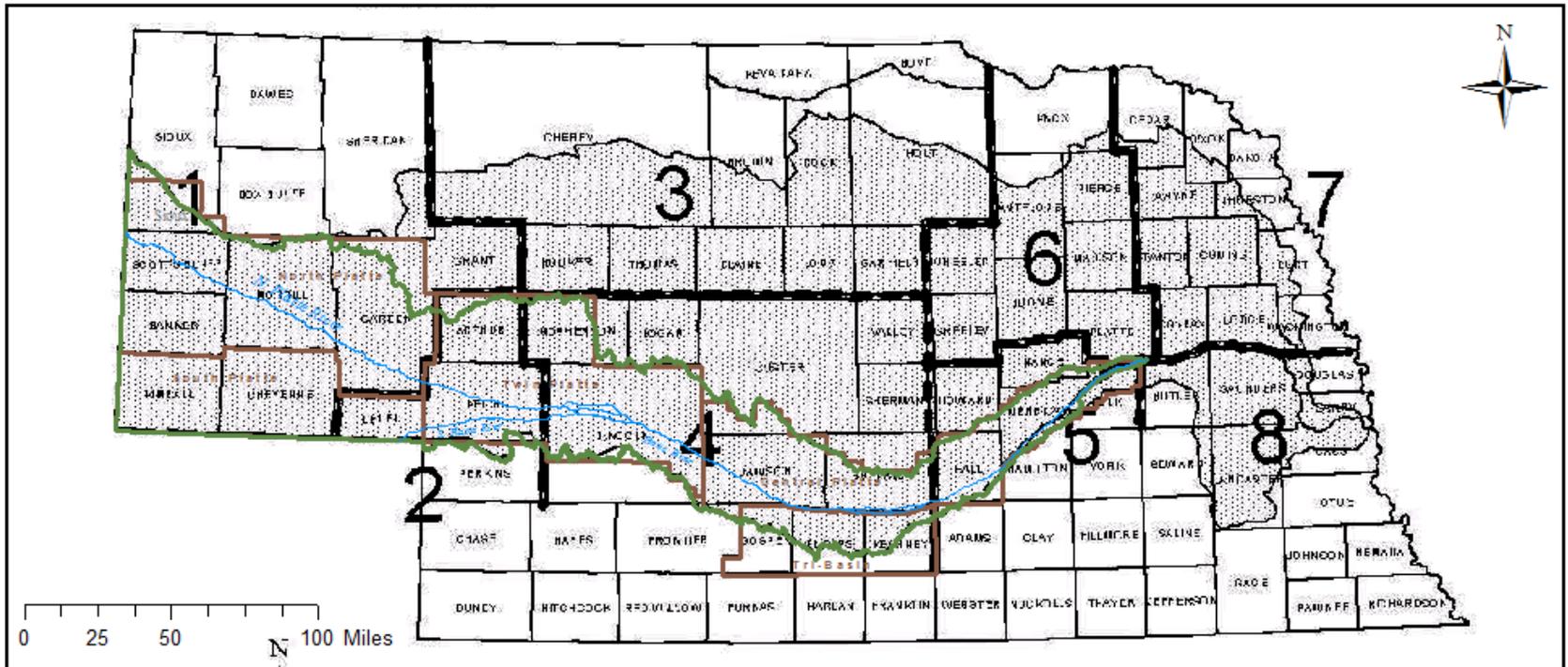
Native vegetation data from University of Nebraska Conservation and Survey Division, reclassified to match NRCS vegetation classes.  
Date of production: June 2013

# Methods: ET Calculation



## Platte Surface Water Basin Above Columbus

Climate Zones from the NRCS ET Calculator

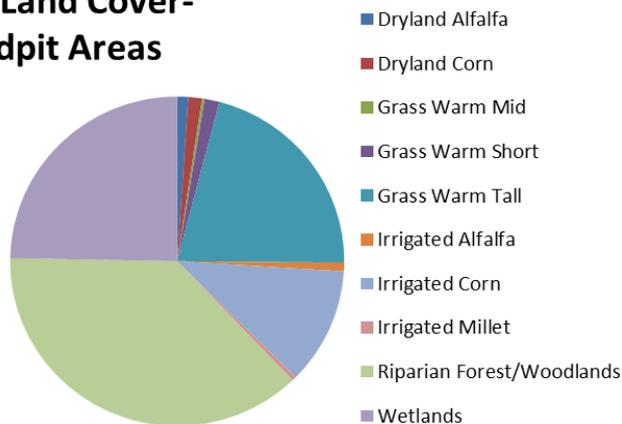


— Platte River     NRD  
 Study Area

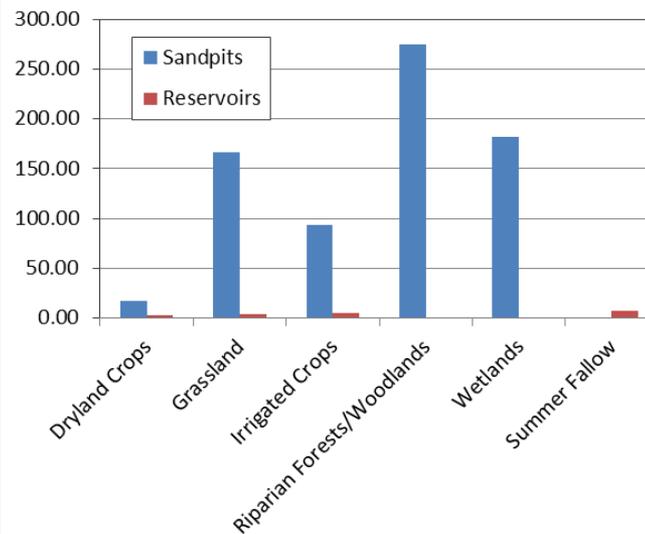
Source: Platte River watershed and ETo areas map from 'USDA Assessment of Agency Actions within the Platte River Watershed of Nebraska which Individually Result in Site-Specific Annual Changes of Consumptive Water Use of 25 Acre-Feet or Less' (2001).  
 Date of Production: June 2013

# Methods: Prior Land Use for ET Calculation

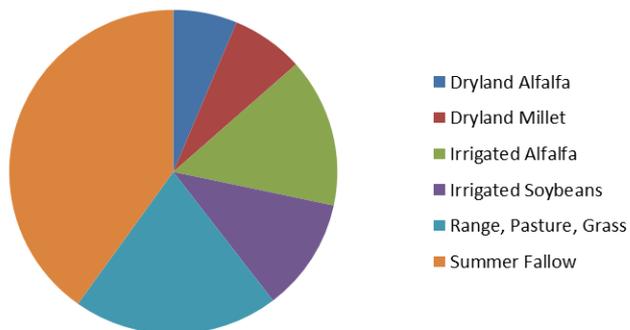
## 2005 Land Cover-Sandpit Areas



## Former Land Cover for New/Expanded Water Bodies



## 2005 Land Cover-Reservoir Areas

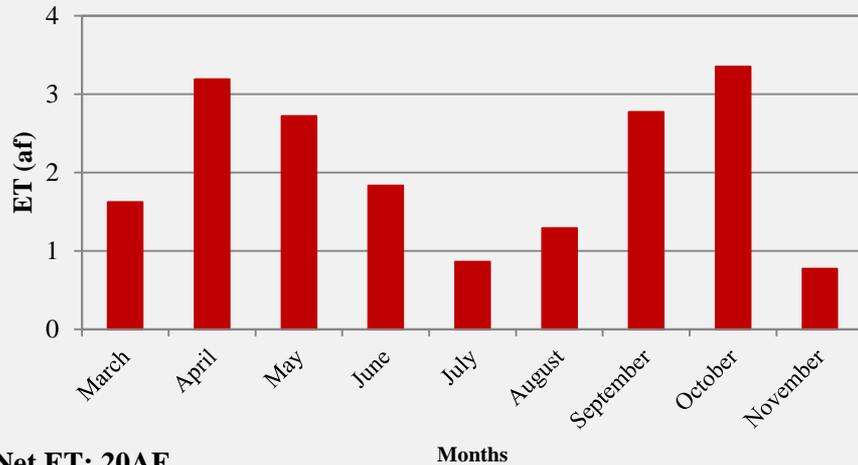


# Methods: ET Calculator Assumptions/Decisions

- 2005 land cover
  - CALMIT land cover
    - UNL CSD native grasses
  - Wet tall grasses for wetlands
  - Average ET of cottonwoods and willows for riparian trees
- 2010 land cover
  - Shallow water (<1m) for reservoirs
  - Deep water (>1m) for sandpits
- Reclaimed sandpit land
  - 2010 land cover: Sand
- Irrigation application timeframe: May to September

# Results: ET Change 2005 to 2010

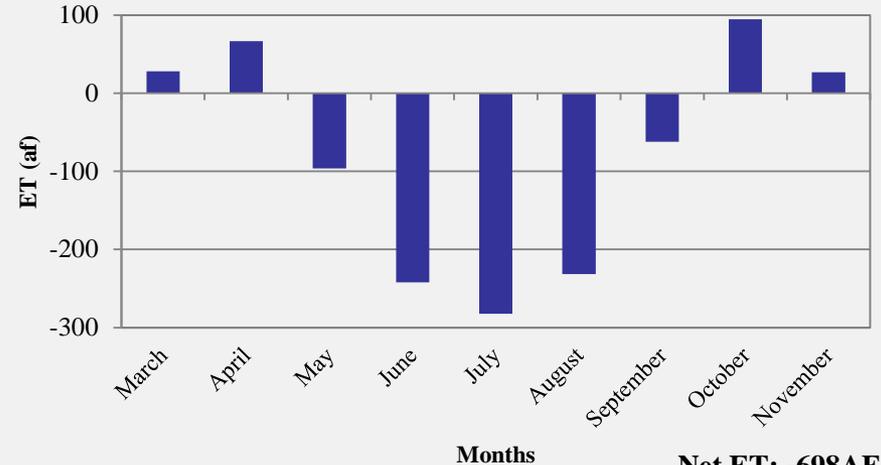
**Study Area Reservoirs ET**  
ET Change from 2005 to 2010



**Net ET: 20AF**

20af ET increase from new unpermitted reservoirs

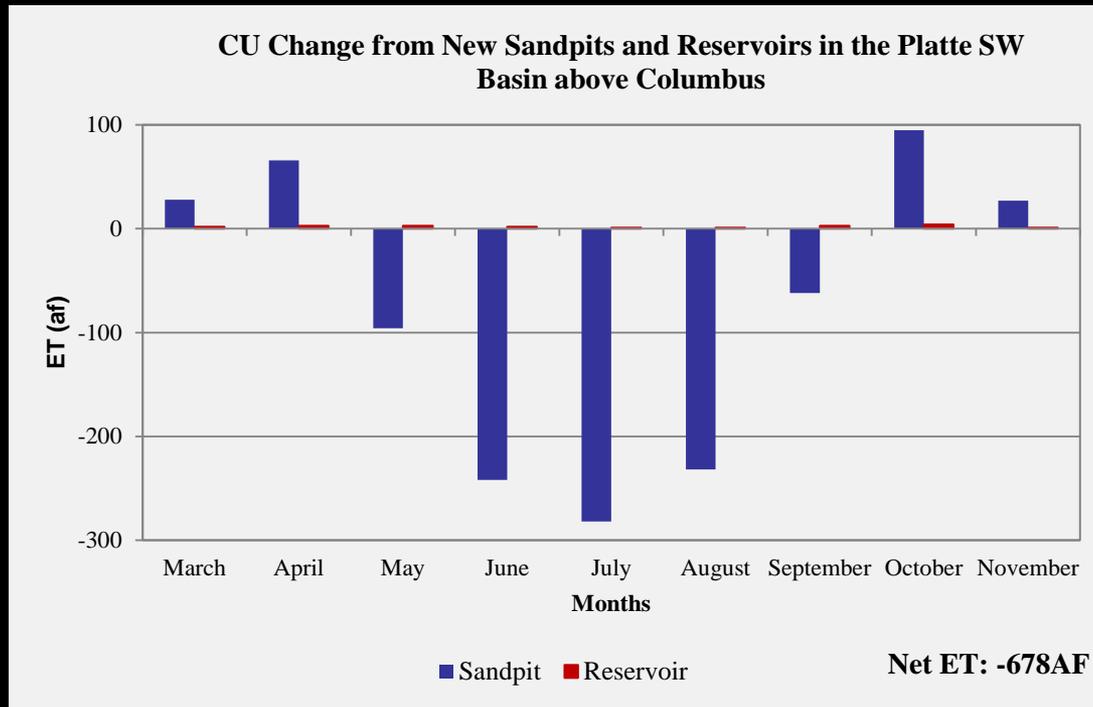
**Study Area Sandpits ET**  
ET Change from 2005 to 2010



**Net ET: -698AF**

698af ET decrease from new or expanded sandpits

# Results: ET Change 2005 to 2010



Overall ET decrease of 678af per year from sandpits and reservoirs

# Summary

- Used geospatial technologies to identify small man-made water bodies
- Used NRCS calculator to estimate ET due to changed land cover.
- 747 acres of new reservoirs and new/expanded sandpits
- Increase in ET during all months for reservoirs
- ET increase in non-irrigation months and decrease in irrigation months for sandpits
- Overall annual decrease of 678af in consumptive use via ET
- 2500 hours to create inventory and run ET calculations

Thank you



## References

Mather and Koch, 2011. Computer Processing of Remotely-Sensed Images: An Introduction, Fourth Edition. John Wiley & Sons, Ltd, Chichester, UK. p. 142.

NRCS Consumptive Use Calculator, online at <http://dnr.nebraska.gov/iwm/prrip-nrcs-consumptive-use-calculator-report>

## Data Sources

- 2005 Farm Service Agency Digital Aerial Imagery: <http://dnr.ne.gov/databank/DigitalImagery.html>
- CALMIT 2005 Statewide Land Use Dataset: <http://calmit.unl.edu/2005landuse/statewide.php>
- UNL CSD Native Vegetation Dataset: <http://snr.unl.edu/data/geographygis/NebrGISland.asp>
- National Hydrography Dataset: <http://dnr.ne.gov/databank/nhd.html>
- STATSGO Soil Data: <http://www.dnr.ne.gov/databank/statsgo1.html>
- NRCS ET Areas: NRCS Consumptive Use Calculator <http://dnr.nebraska.gov/iwm/prrip-nrcs-consumptive-use-calculator-report>