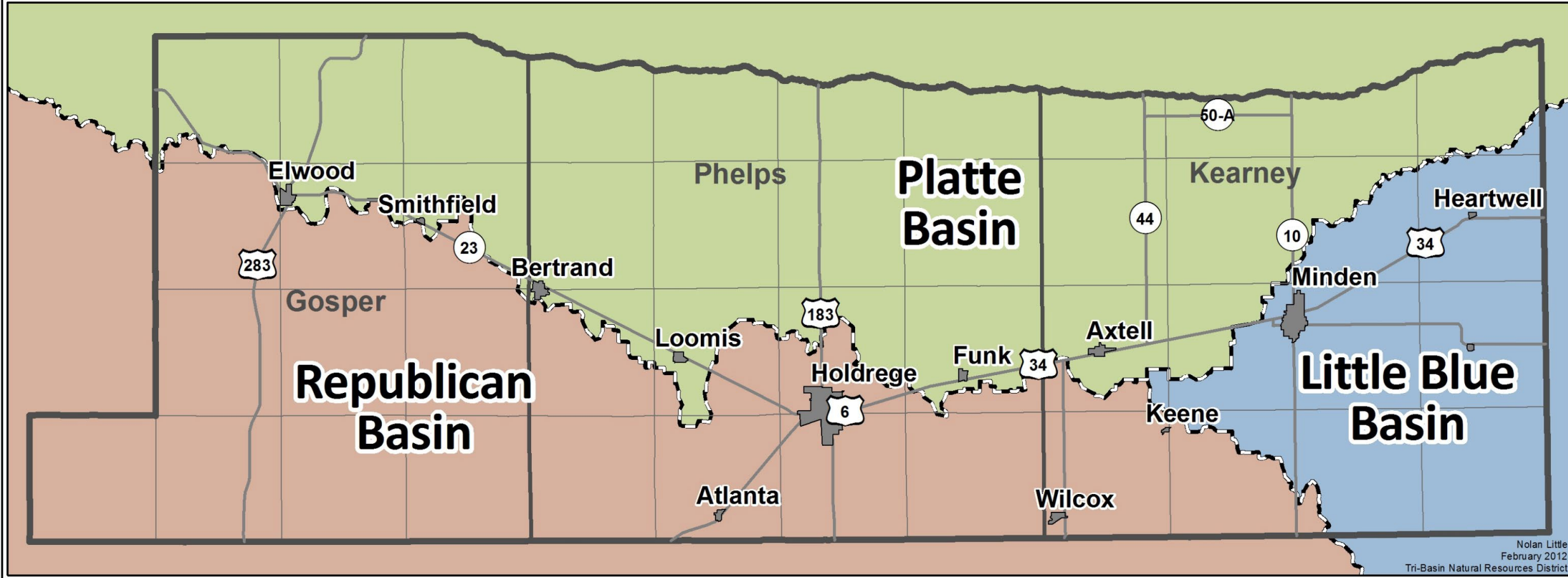


Tri-Basin NRD Groundwater Management



Tri-Basin Natural Resources District

Basin Boundaries



What does Tri-Basin do?



We plant trees and shrubs



We create and maintain wildlife habitat



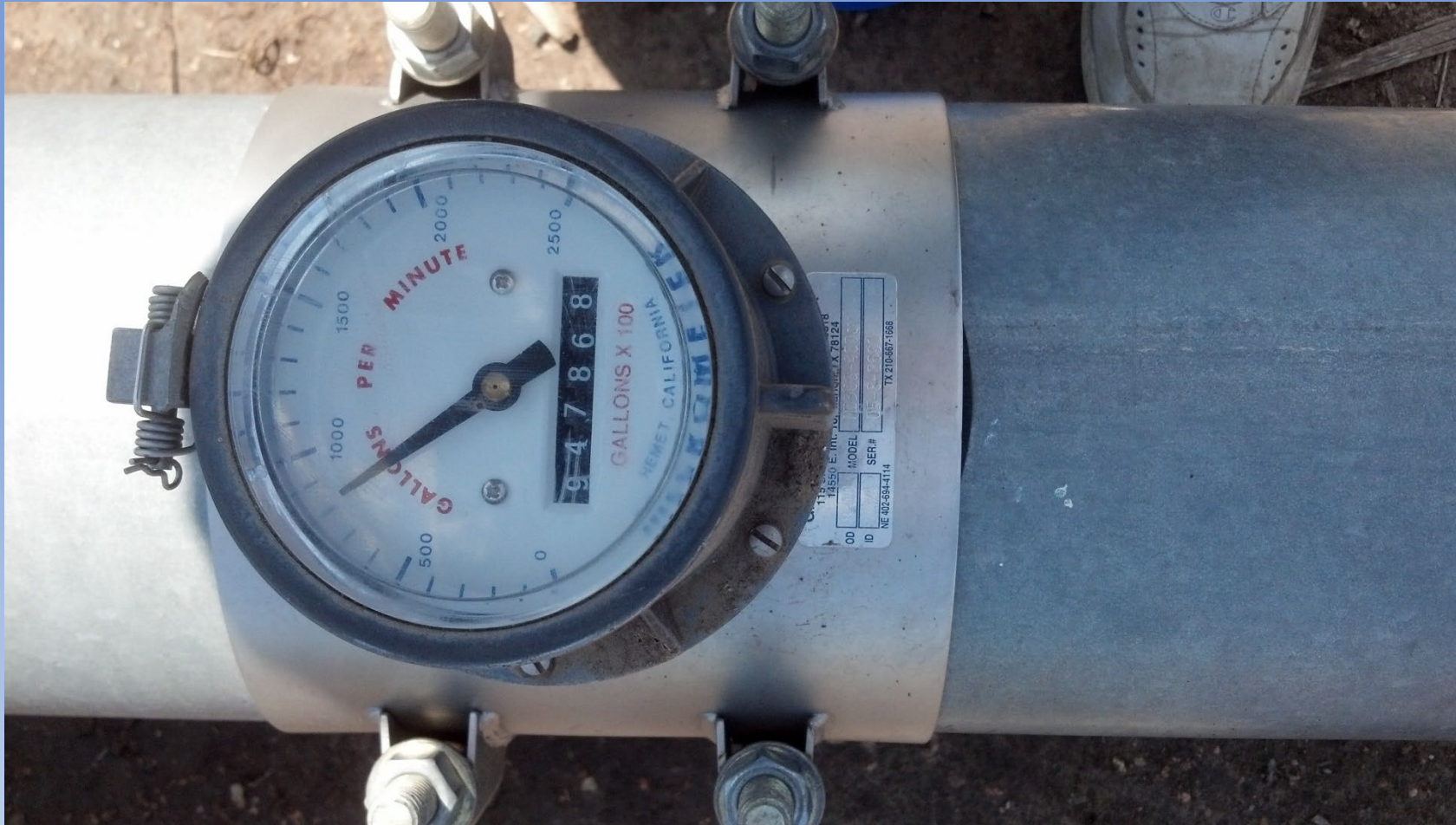
We operate seven drainage improvement projects (IPAs)



We educate students and the public about natural resources conservation



We provide cost-share to landowners for soil and water conservation practices



We enforce state laws prohibiting human-caused erosion damage



We enforce state laws prohibiting excessive irrigation runoff



We protect groundwater



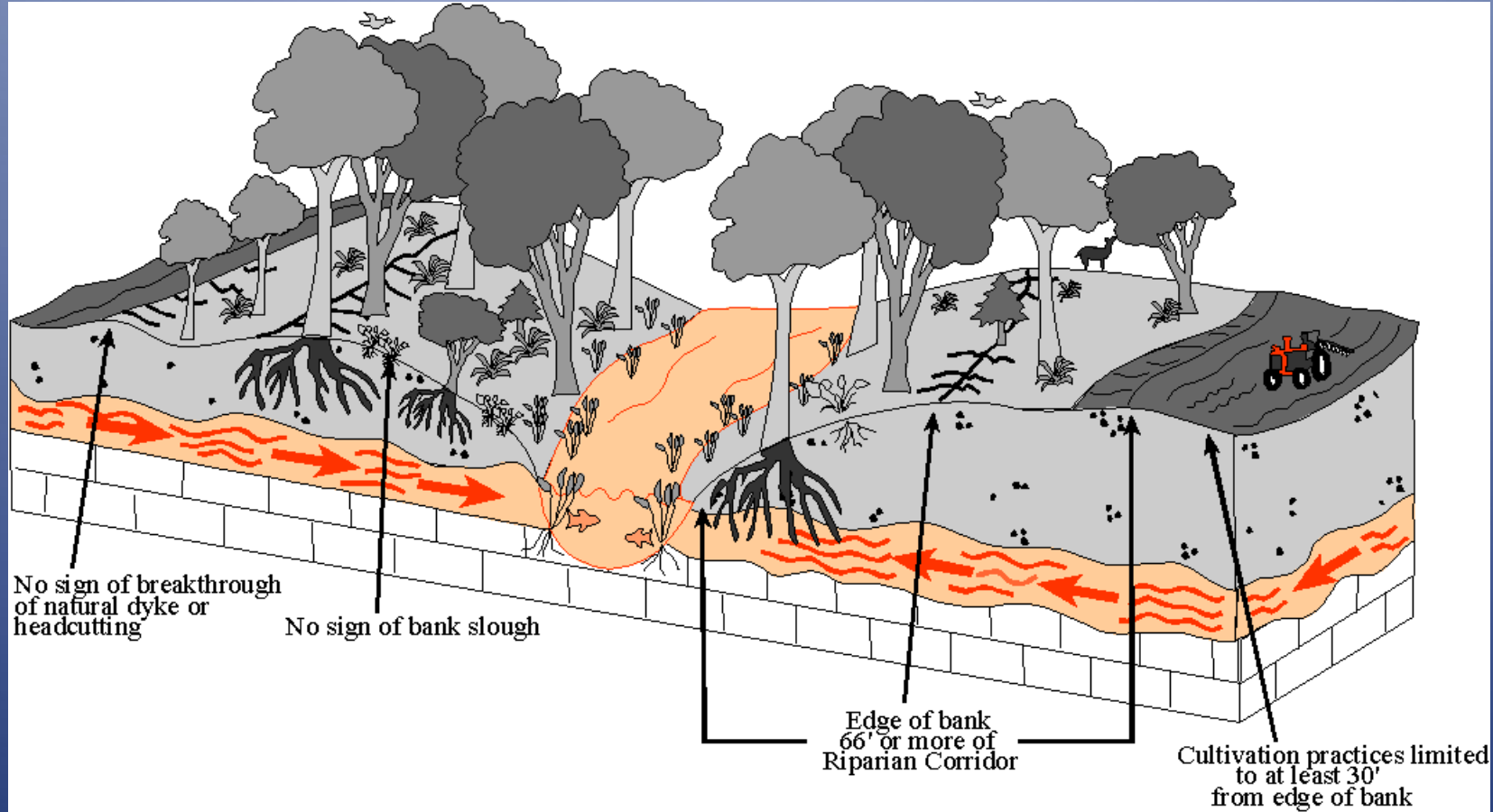
We protect it from contamination



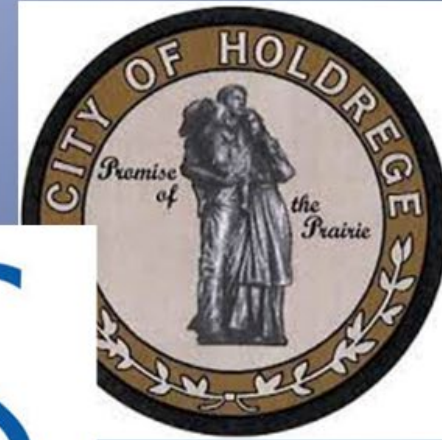
We protect it from diminishment



We protect streamflows



We do all this with help
from many partners



Natural Resources Conservation Service

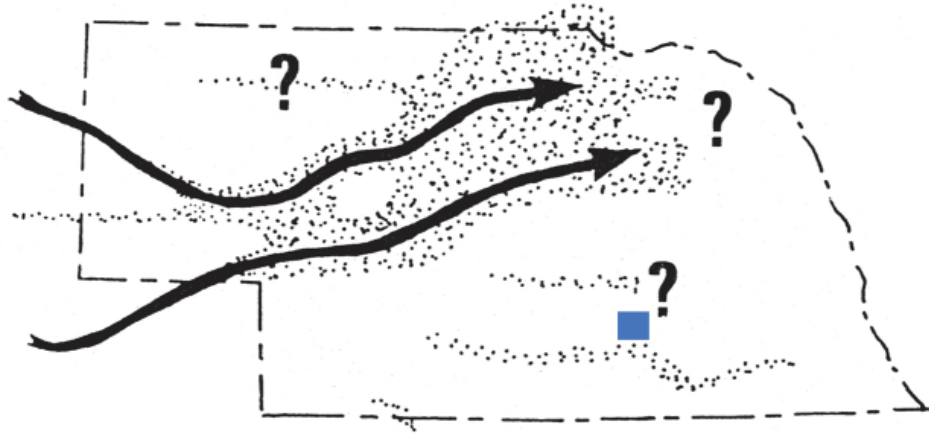


Tri-Basin NRD

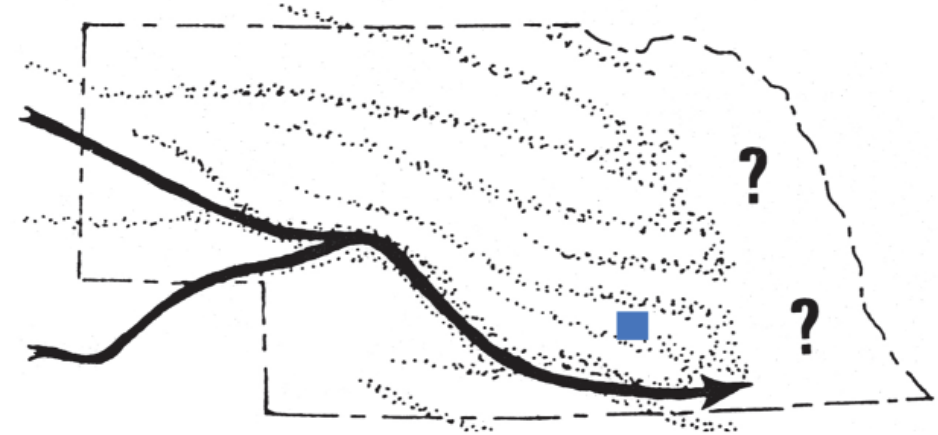
- Vision statement (1996): “Tri-Basin NRD will work cooperatively with district residents to promote good stewardship of land and water resources.”
- Mission statement (1996): “Manage, conserve and protect the District’s land and water resources.”
- Groundwater reservoir life goal (1979, revised 1995): “All groundwater supplies within the Tri-Basin NRD will be used in a beneficial manner, efficiently managed and properly utilized to preserve the present quantity of this vital resource forever.”

Groundwater Quantity Management

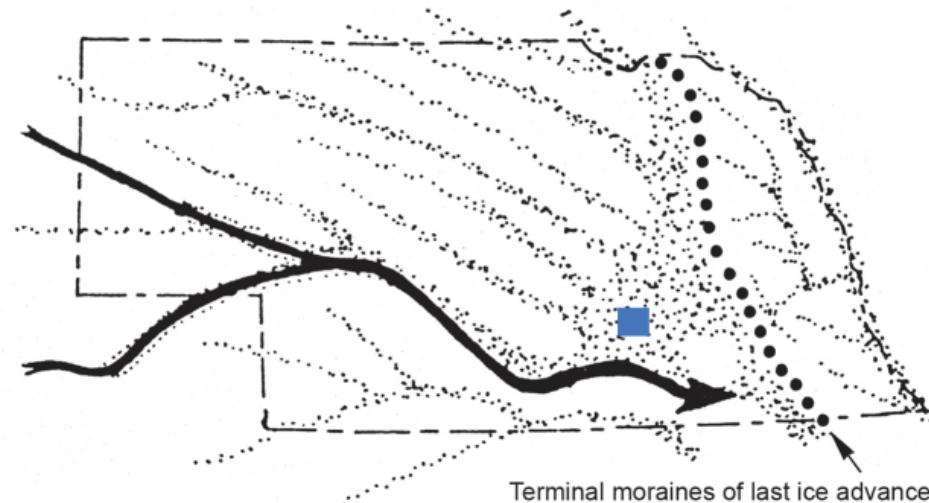
1. Late Pliocene (~2,500,000 yrs. ago)



2. Early Pleistocene (~1,500,000 yrs. ago)

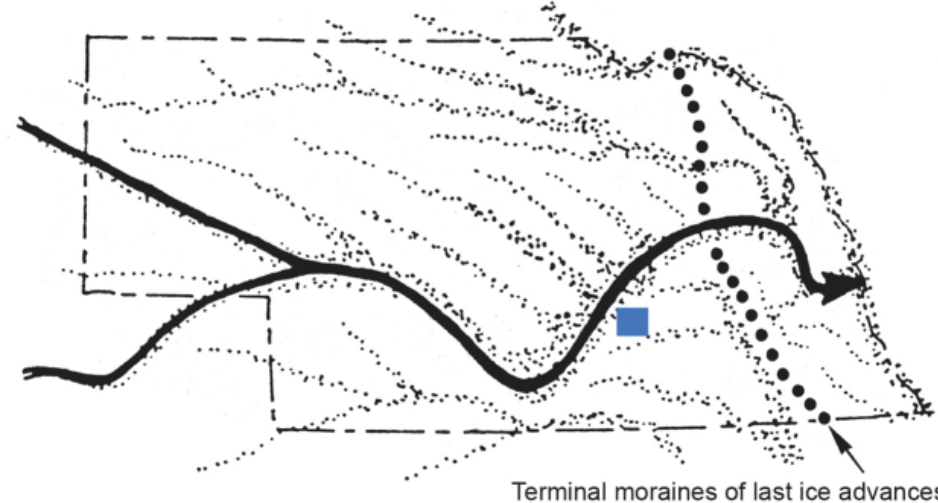


3. Illinoian (~200,000 yrs. ago)



Terminal moraines of last ice advances

4. Late Wisconsin (~30,000 yrs. ago)



Terminal moraines of last ice advances

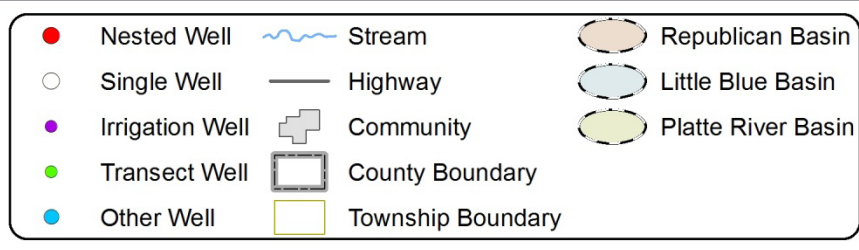
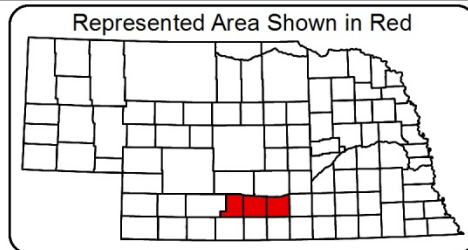
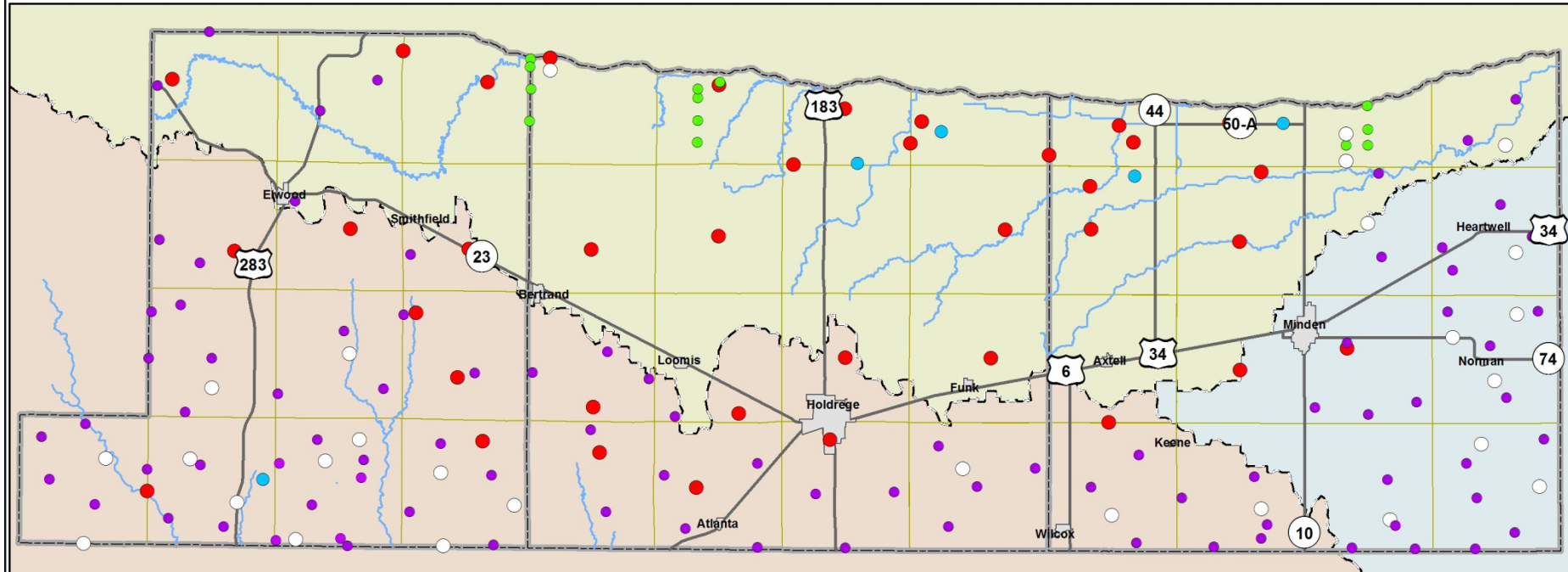
Fig. 6- Evolution of the Platte River Valley over the Nebraska landscape from the Pliocene through present. Blue squares approximate area shown in Fig. 1. Image reproduced from Swinehart et. al. 1994.

Nebraska Groundwater Law

- Groundwater and surface water are owned by The People (the state)
- Landowners have the right to use groundwater for beneficial purposes on their own property
- Groundwater use is governed by correlative rights (all users share in a shortage) and regulated by NRDs
- Surface water use is governed by prior appropriation (first in time, first in right) and regulated by state Department of Natural Resources

Tri-Basin Natural Resources District

Observation Well Network



Nolan Little
July 2015

Tri-Basin Natural Resources District



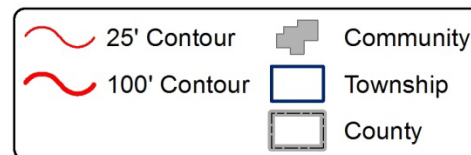
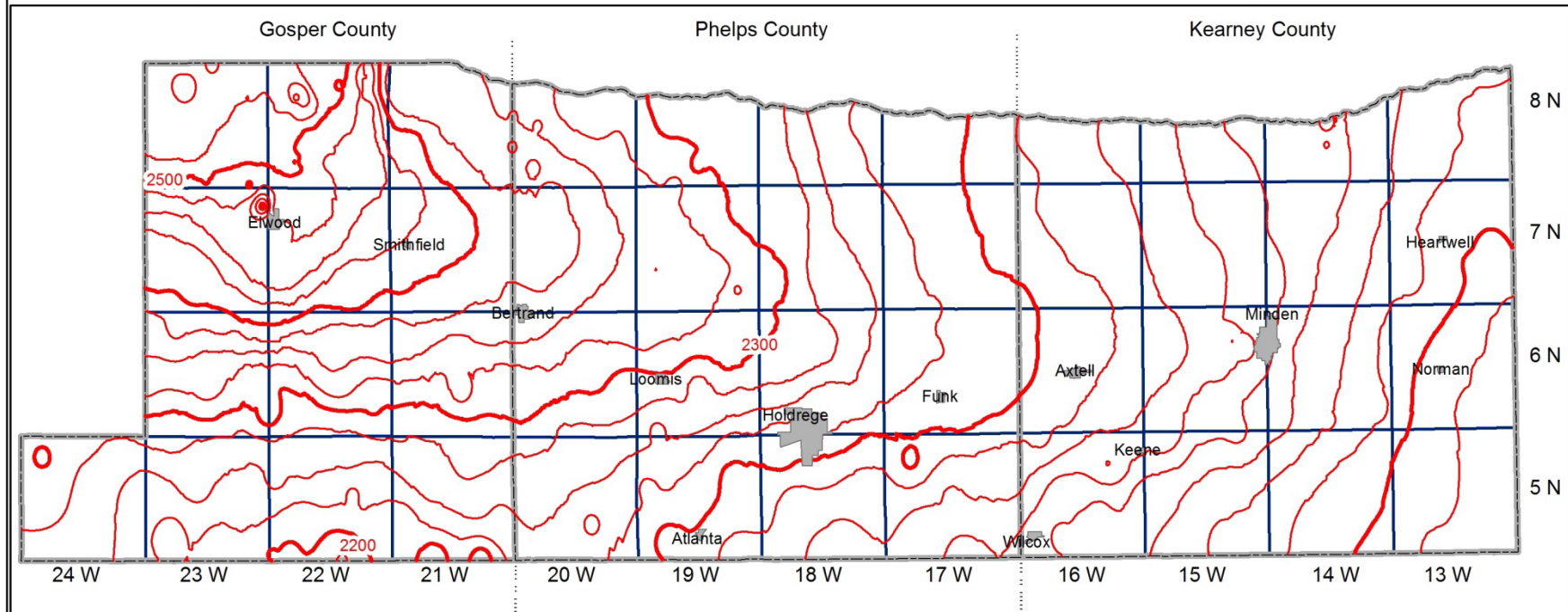






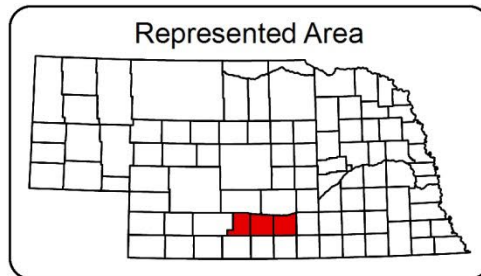
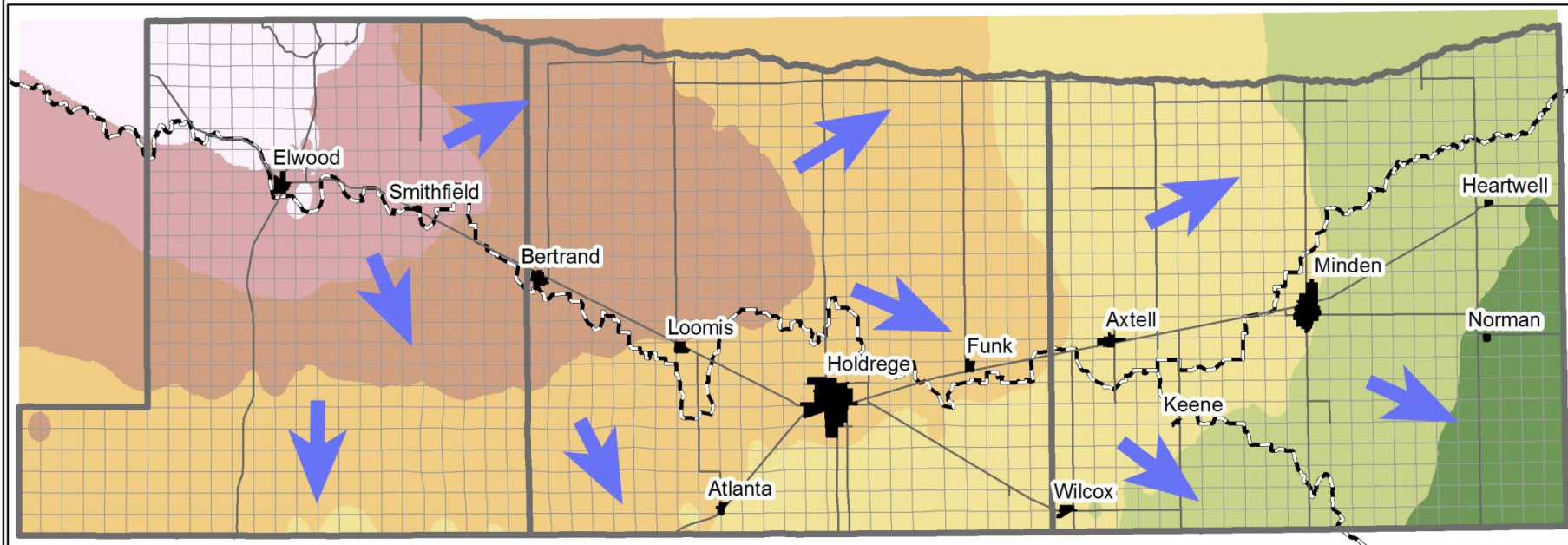
Tri-Basin Natural Resources District

2007-2009 Groundwater Elevation Contour



Tri-Basin Natural Resources District

Groundwater Elevation



Groundwater Elevation in Feet



- Community
- Paved Road
- Drainage Basin
- Section
- County Boundary



Nolan Little
January 2013

Tri-Basin Natural Resources District



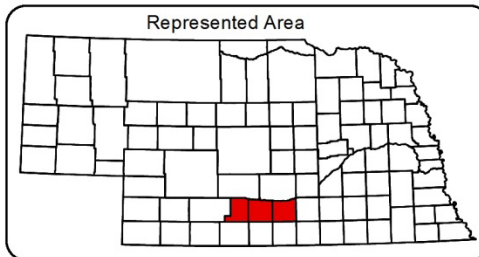
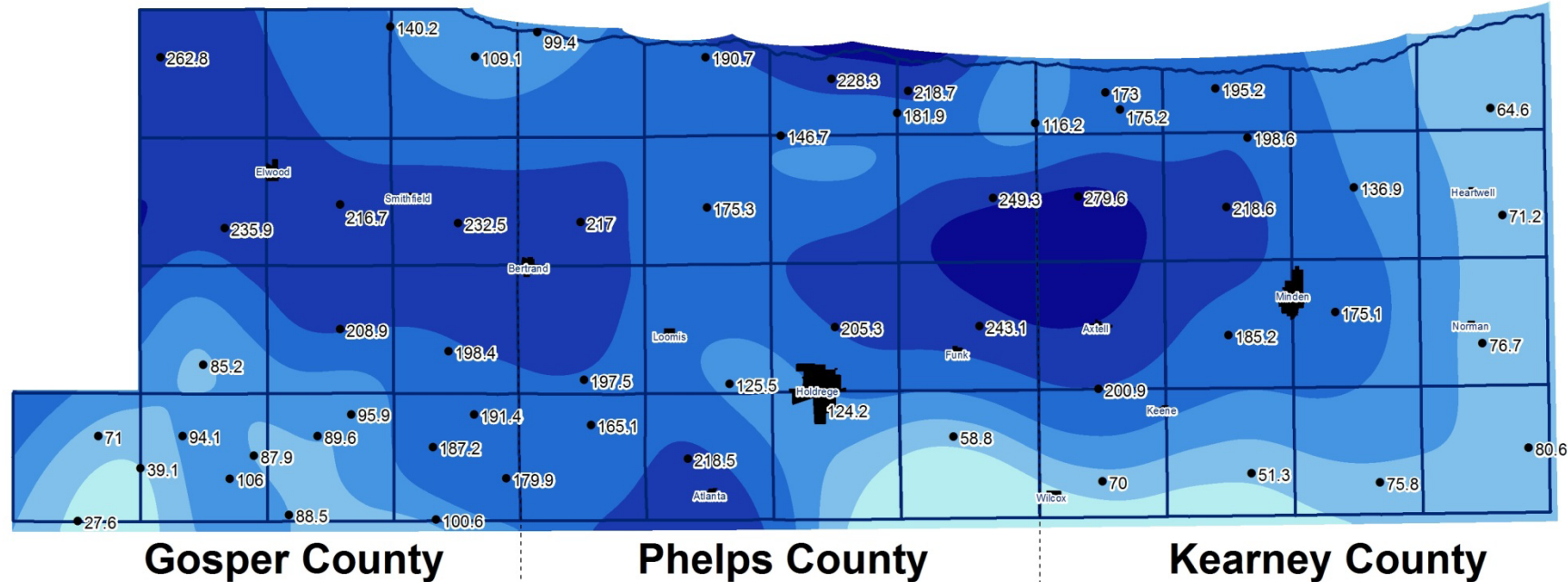
DRAFT

Tri-Basin Natural Resources District

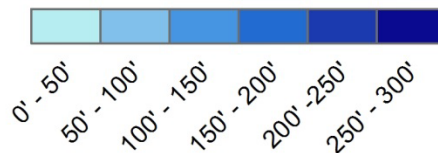
Aquifer Saturated Thickness



DRAFT



Saturated Thickness



- Observation Well
- Community
- Township

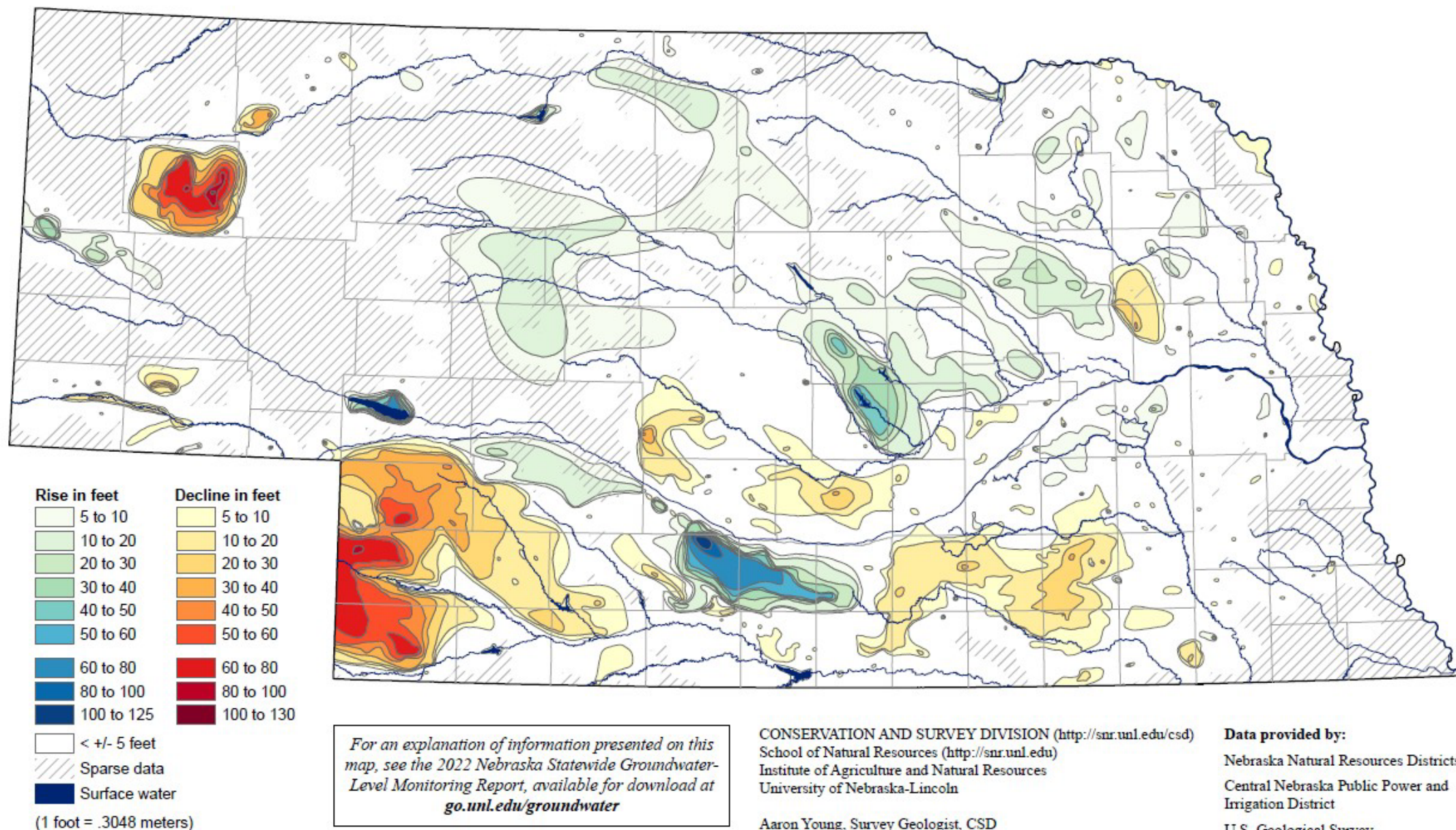
Saturated Thickness determined using 2012-2014 average Spring static water measure measurement.

This version is an initial draft.



Nolan Little
May 2015
Tri-Basin Natural Resources District

Groundwater-Level Changes in Nebraska - Predevelopment to Spring 2022



CONSERVATION AND SURVEY DIVISION (<http://snr.unl.edu/csd>)
School of Natural Resources (<http://snr.unl.edu>)
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

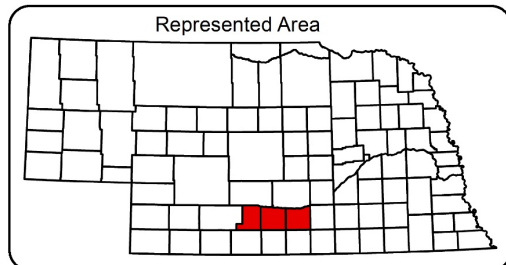
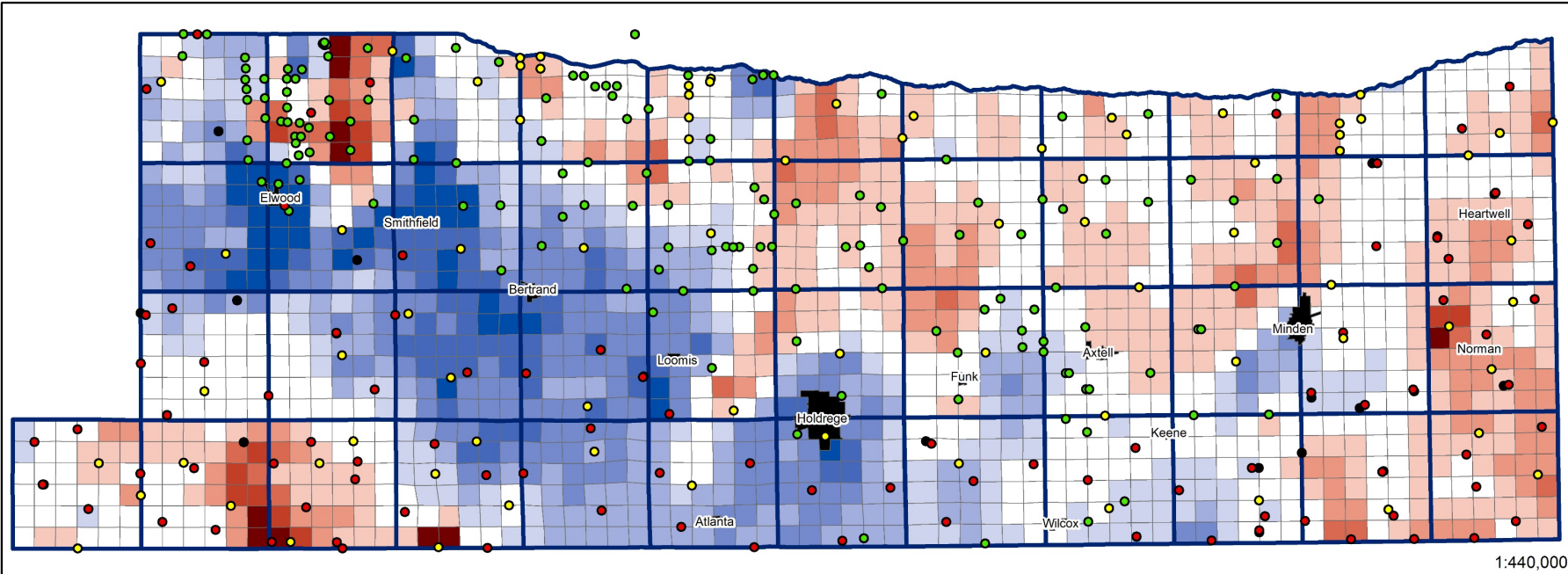
Aaron Young, Survey Geologist, CSD
Mark Burbach, Water Levels Program Supervisor, CSD

Data provided by:

Nebraska Natural Resources Districts
Central Nebraska Public Power and
Irrigation District
U.S. Geological Survey
Nebraska Water Science Center
U.S. Bureau of Reclamation

Tri-Basin Natural Resources District

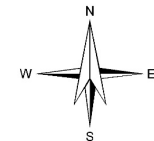
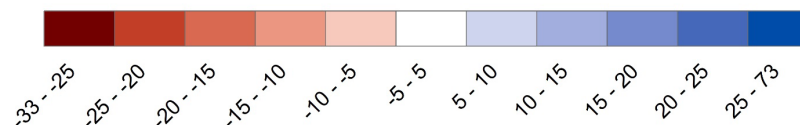
Change in Groundwater Elevation 2018-2020 Average vs 1981-1985 Average



Well

- CNPPID
- Irrigation
- Observation
- Abandoned

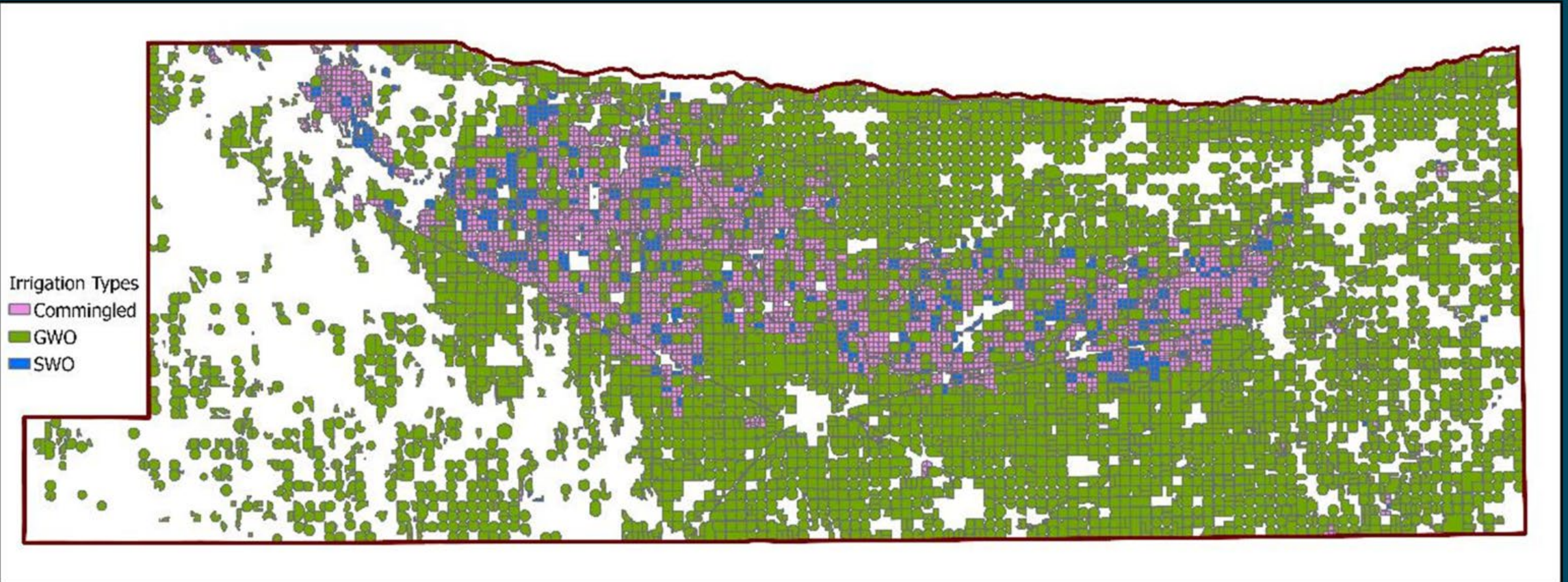
Groundwater Elevation Change in Feet



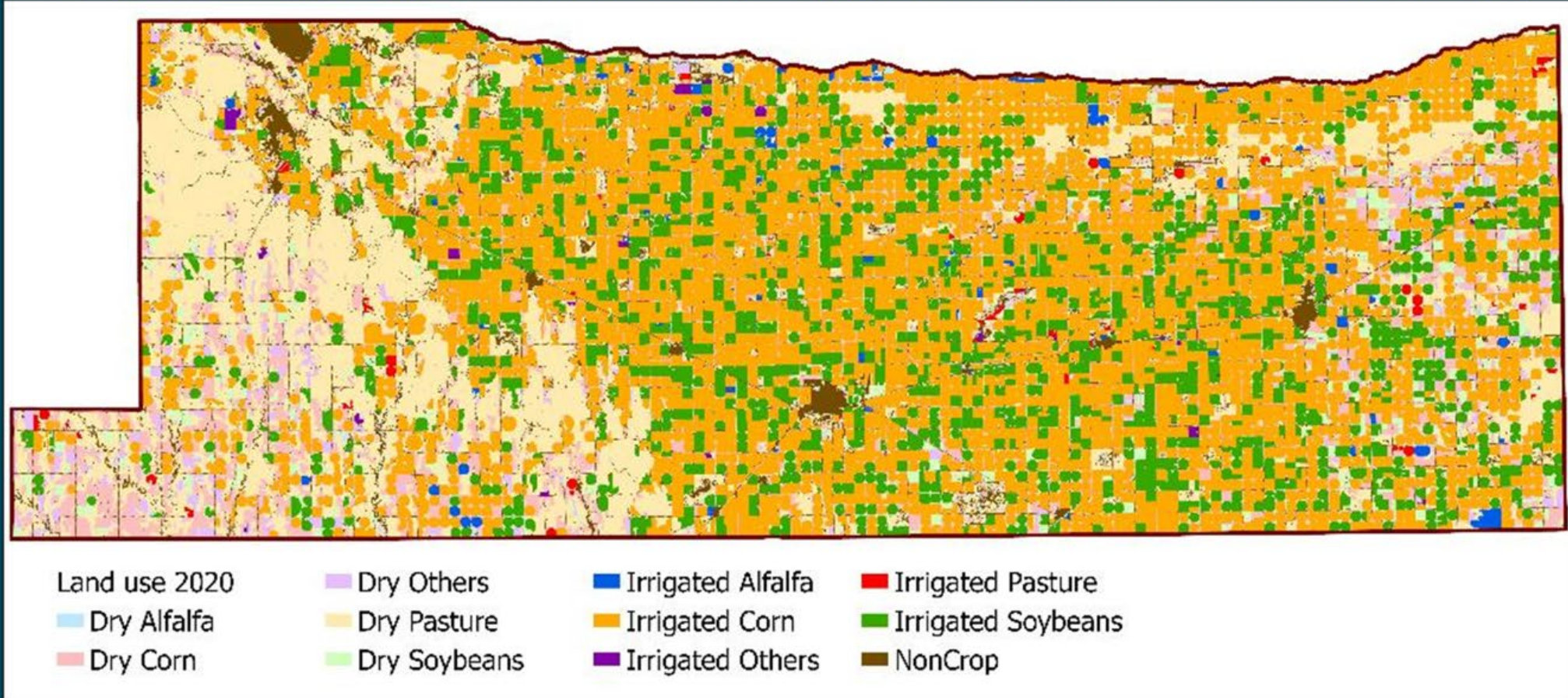
Groundwater Supplies in TBNRD

- 580,000 certified irrigated acres in TBNRD
- Over 5000 irrigation wells
- COHYST model runs by DNR estimate that annual groundwater pumping in TBNRD averages 343,000 acre-feet

2020 GW & SW (NeDNR 2020) Irrigable lands in TBNRD



Annual Actual Irrigated Acres – TBNRD SW and GW land-use of 2020 from method 1



Groundwater Supplies in TBNRD

- Annual average natural recharge= 203,000 acre-feet
- CNPPID diversions for irrigation average 110,000 a-f/Yr. (about half of diverted water is consumed)
- Excess flow diversions average 7350 a-f/Yr.

Groundwater Supplies in TBNRD

- Net recharge = Natural recharge + Supp. Recharge
– GW pumping
- $203,000 + 72,350 = 275,350$ a-f/Yr. (Total recharge)
- $275,350 - 343,000 = -67,650$ a-f/Yr. (Net recharge)
- These are very broad ESTIMATES of credits and debits (more detailed analysis is planned)







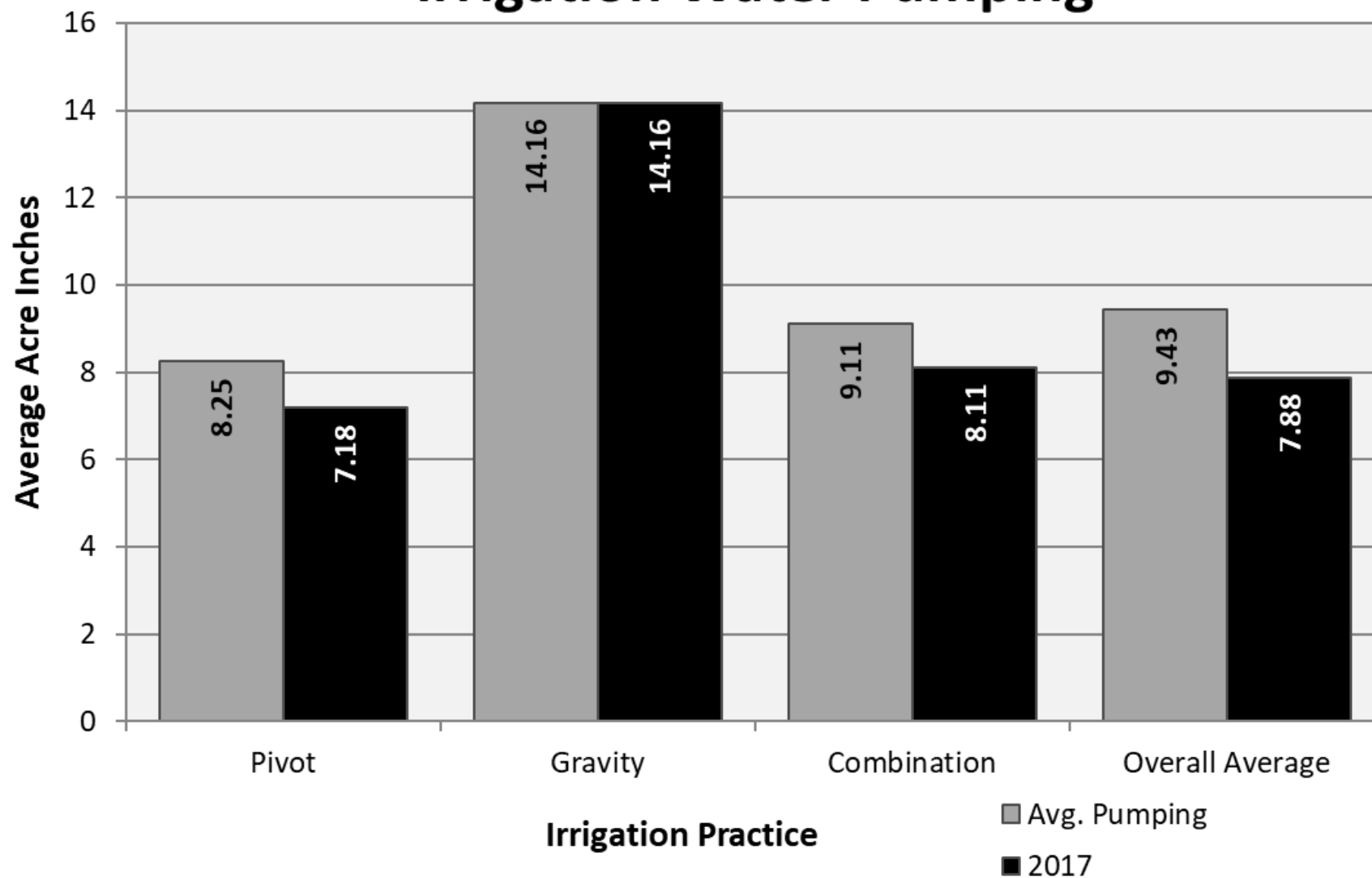




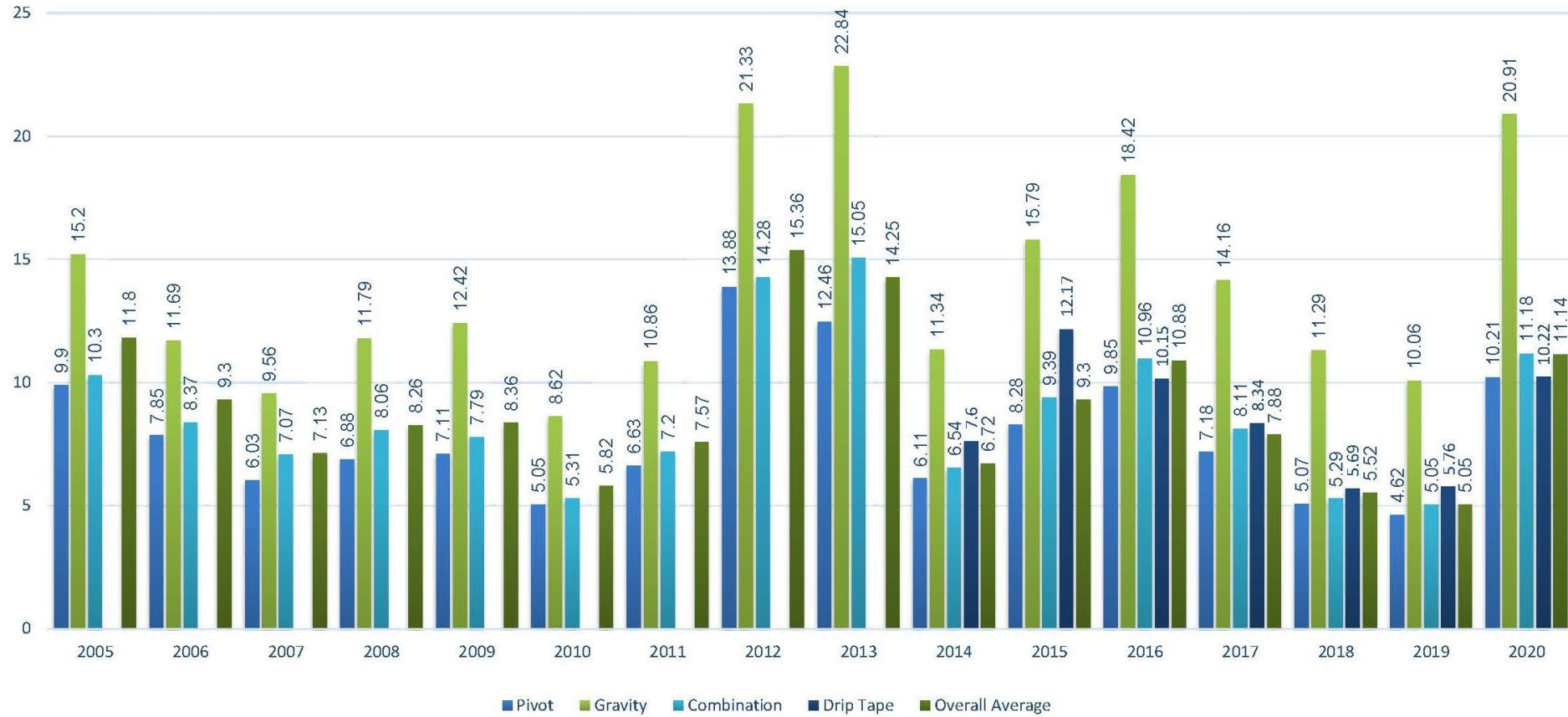




Tri-Basin NRD Republican Basin Irrigation Water Pumping

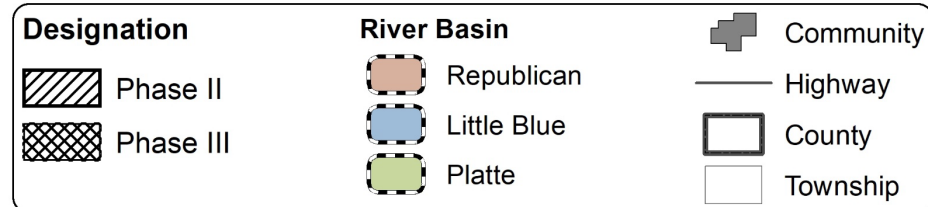
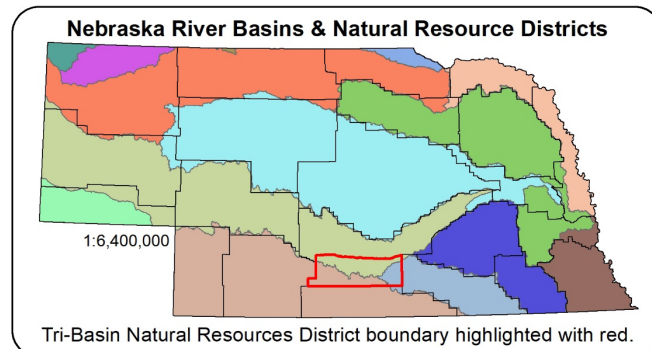
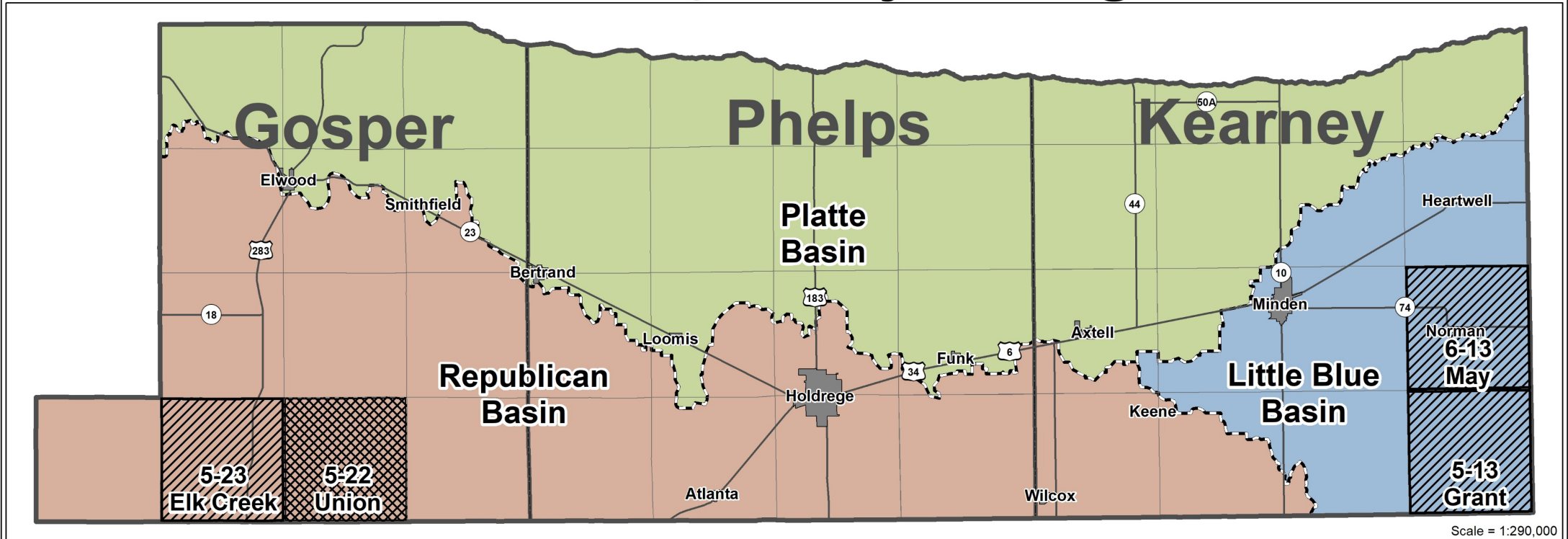


Tri-Basin NRD Republican Basin Average Irrigation Water Pumping



Tri-Basin Natural Resources District

Groundwater Quantity Management



*The entire district is regulated under Phase I regulations.



Groundwater Quality Management

Main TBNRD focus before 2003

- TBNRD established groundwater quality management area in 1989
- Groundwater quality management authority divided between state, NRDs
- NRDs responsible for non-point source contamination
- NDEQ responsible for point source contamination

Potential Point Source

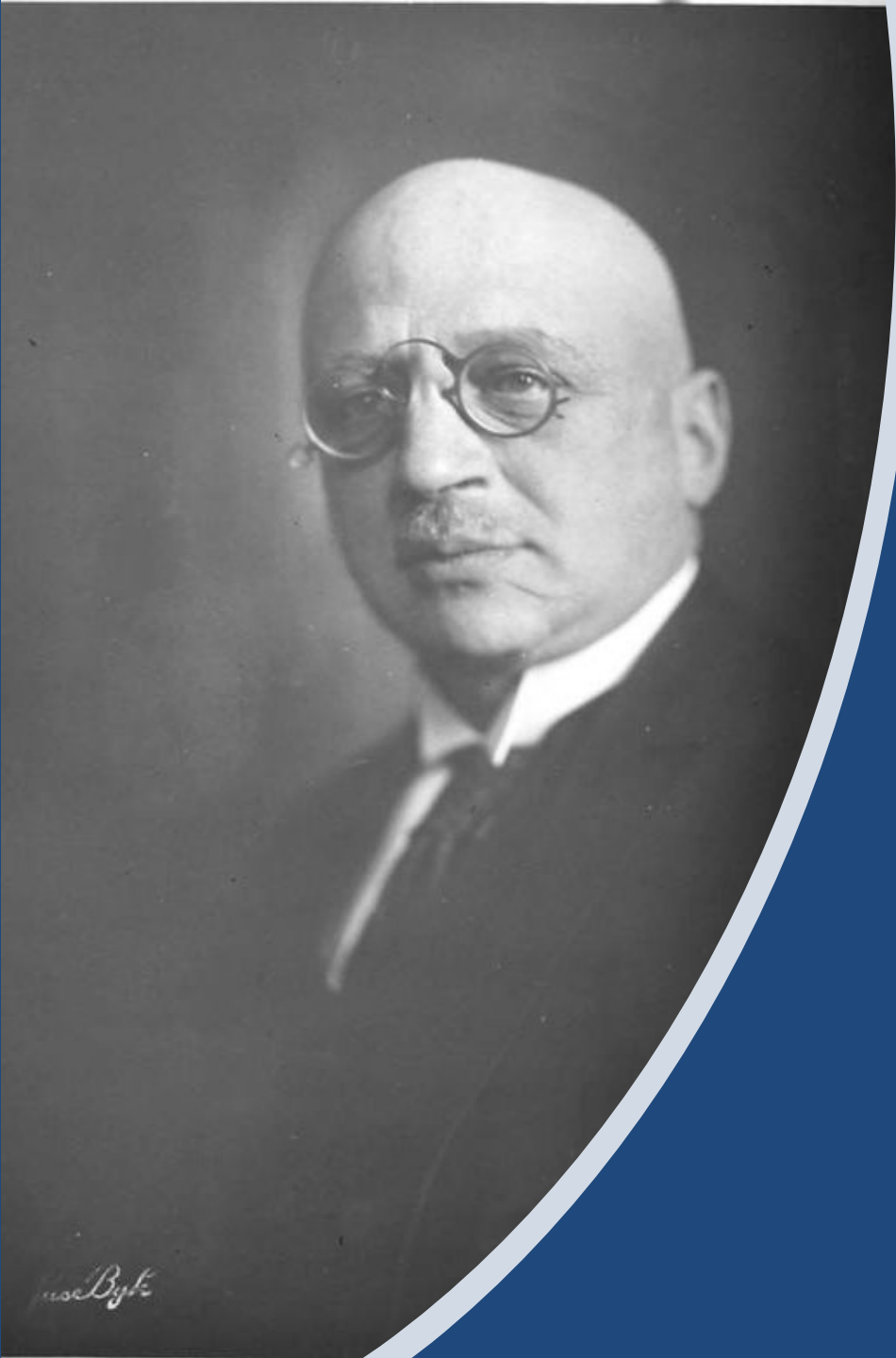


Multiple Point Sources



Non-Point Sources





Ultimate Source Point

Nitrate-nitrogen

- Primary groundwater contaminant
- Sources are commercial fertilizer, manure
- 10 parts per million (ppm) is USEPA drinking water limit
- Primarily affects small children (“Blue Baby Syndrome”) and people with compromised immune symptoms

Other contaminants

- Herbicides and insecticides are potential contaminants
- Atrazine has been detected in a few samples
- Repeated testing in TBNRD has NEVER produced results higher than 3 parts per billion (ppb)
- Isolated detections of other industrial chemicals (Carbon Tetrachloride)

Three Management Phases

- Phase One (entire district)= No Nitrogen fertilizer for spring-planted crops before March 1 on sandy soils (Nov. 1 on all other soils)
- Free domestic well sampling for nitrates, bacteria
- If groundwater Nitrate levels in any township average higher than 9ppm for four years, then Phase Two

Phase Two

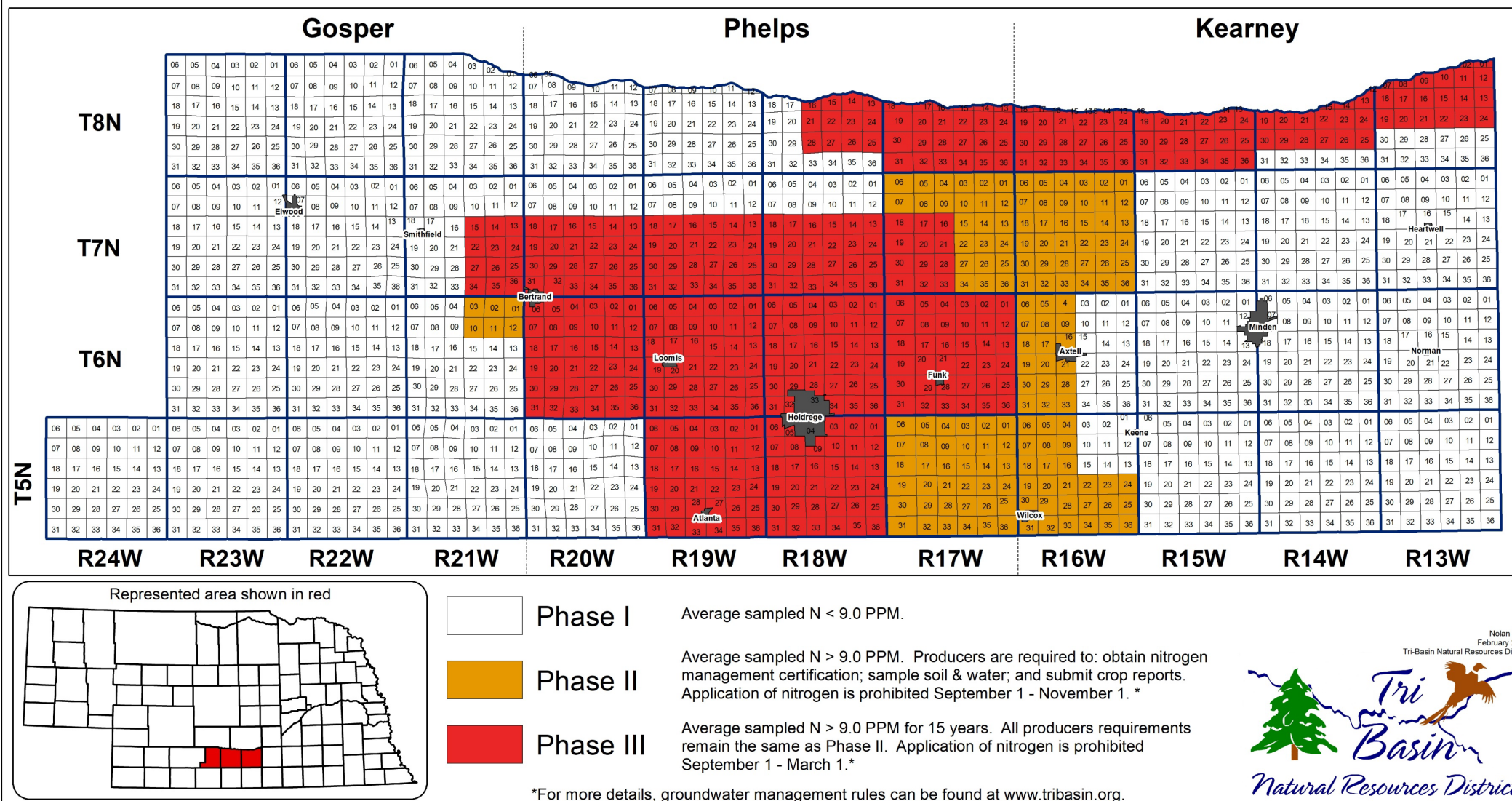
- Phase one controls continue
- Mandatory certification class every four years
- Mandatory deep soil sampling
- Mandatory irrigation water sampling
- Mandatory annual crop reports
- Unless nitrates decline more than one ppm in 15 years, Phase Two townships advance to Phase Three

Phase Three

- No nitrogen fertilizer application > 60Lbs. Per acre before March 1 on any soils
- Fertilizer must be split-applied if a crop requires more than 80 Lbs. actual N

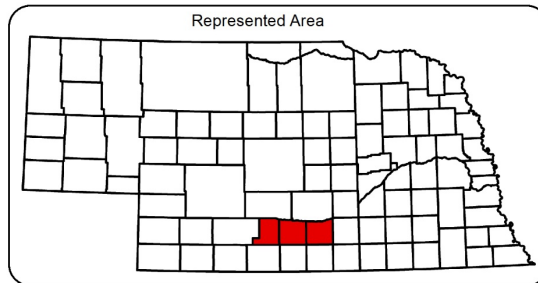
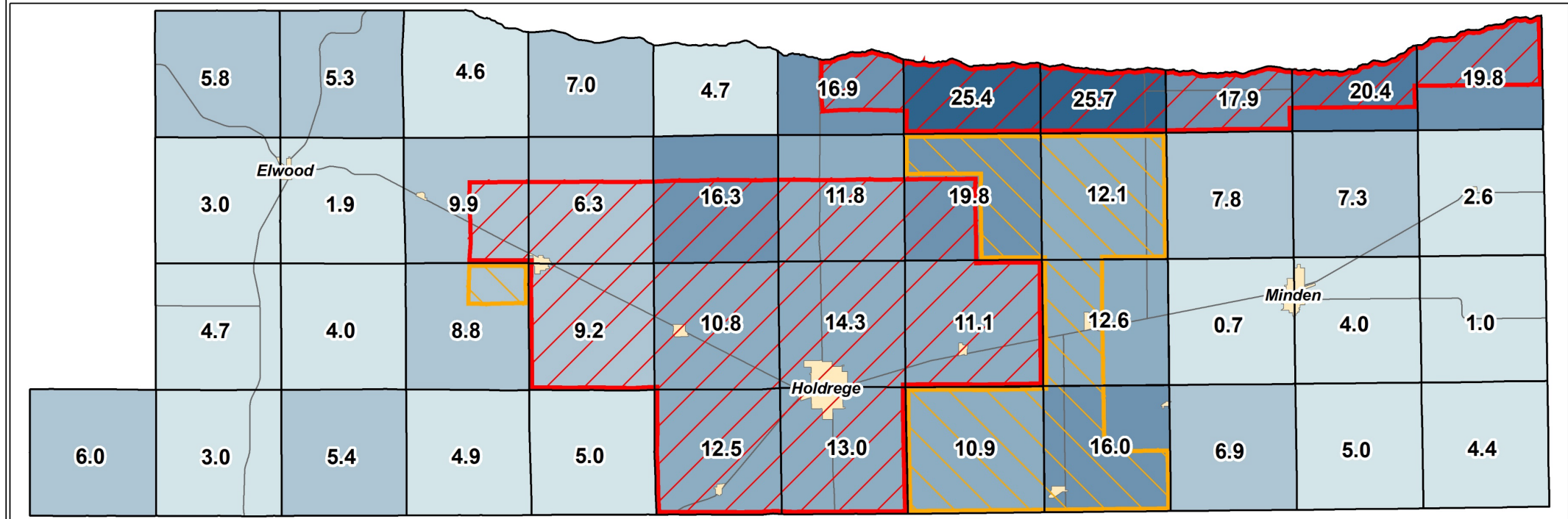
Tri-Basin Natural Resources District

Groundwater Quality Management

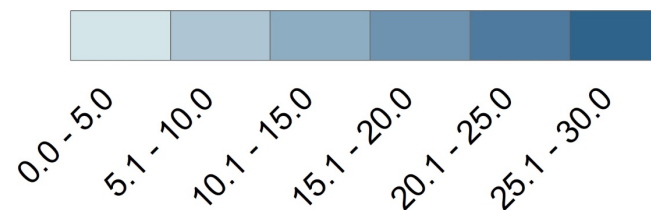


Tri-Basin Natural Resources District

2022 Average Sampled Nitrate Level by Township



Nitrate Level

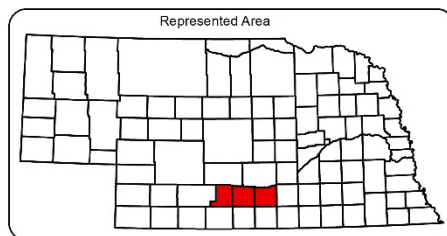
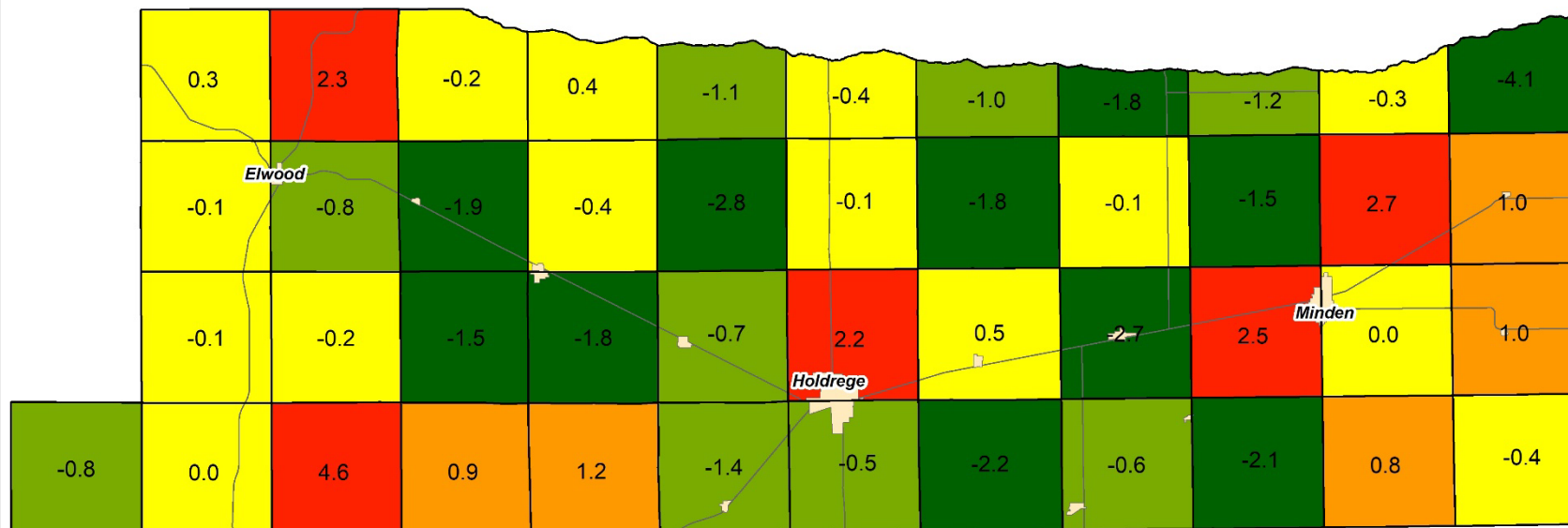


Phase Area

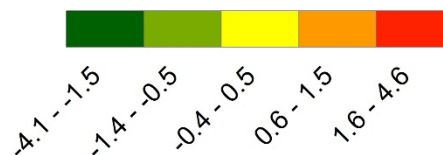


Tri-Basin Natural Resources District

Change in Average Sampled Nitrate Level: 2016-2017

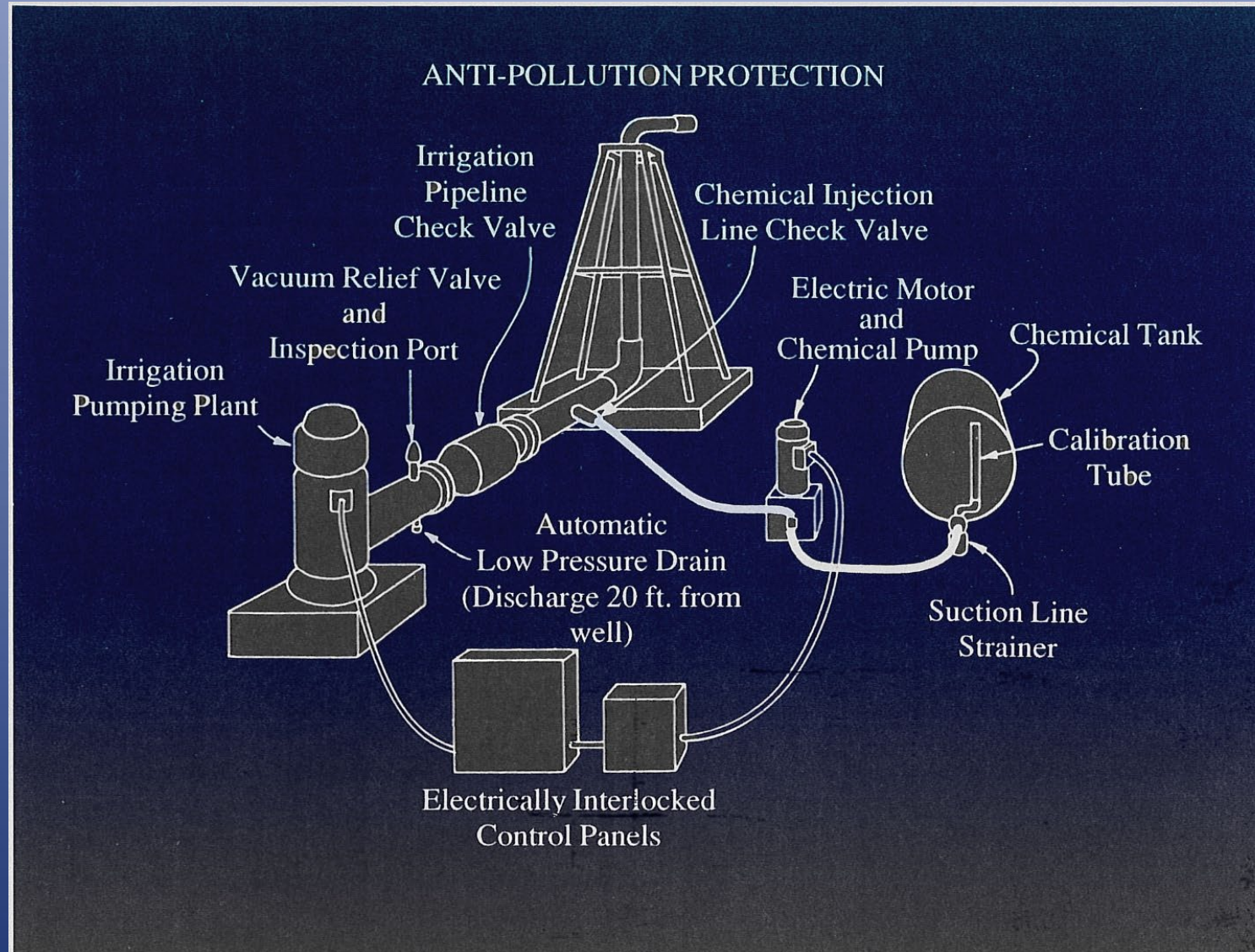


Change in Nitrate Level



Nolan Little
July 2019
Tri-Basin Natural Resources District

Chemigation and Fertigation



Integrated Water Management

A photograph of a small, muddy pool of water in a dry, grassy field. The pool is located in the upper left quadrant of the image. A small stream flows from the pool towards the right, creating a winding path through the dry, cracked earth. The surrounding area is covered with sparse green grass and patches of bare soil. The overall scene suggests a dry, arid environment.

Turkey Creek West Branch

Integrated water resources management

- Managing groundwater to protect streamflows.
- Required by state law (LB 962-2004)
- Also required to help Nebraska meet requirements of interstate agreements (e.g., Republican River Compact)

Integrated water resources management (continued)

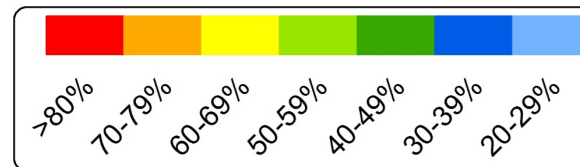
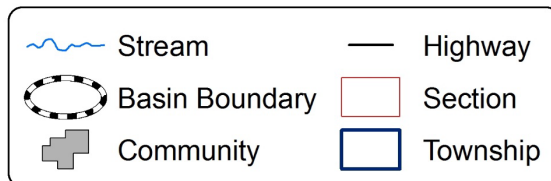
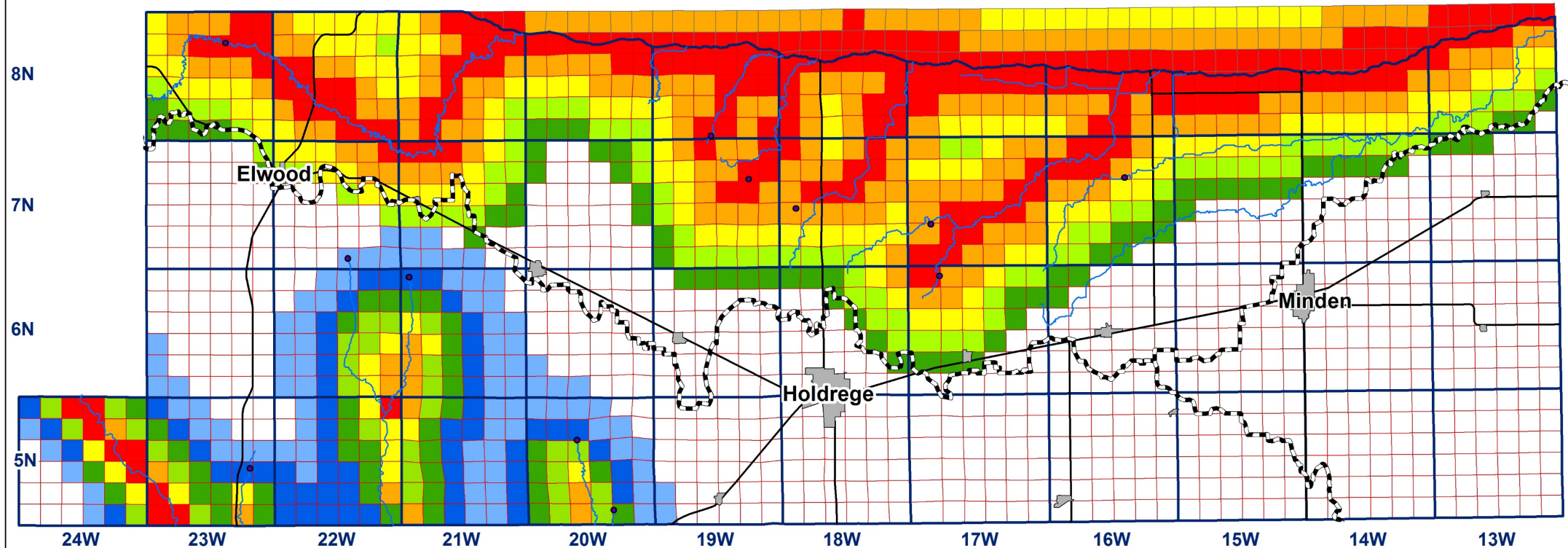
- Regulation is based on meeting requirements of joint integrated management plans (IMPs) in Platte and Republican basins.
- Current Platte IMP runs through 2019.
- Current Rep. Basin IMP runs through 2021.

TBNRD regulatory actions to protect streamflows

- All groundwater-irrigated acres must be certified.
- Transfers of certified irrigated acres are regulated.
- Transfers of certified irrigated acres are pro-rated if the destination field has higher rate of stream depletion than originating field.
- Increases in water use for large commercial and industrial uses are also regulated and must be offset.
- TBNRD agrees to offset depletions to streamflows resulting from groundwater pumping as part of our IMPs.

Tri-Basin Natural Resources District

River Depletions



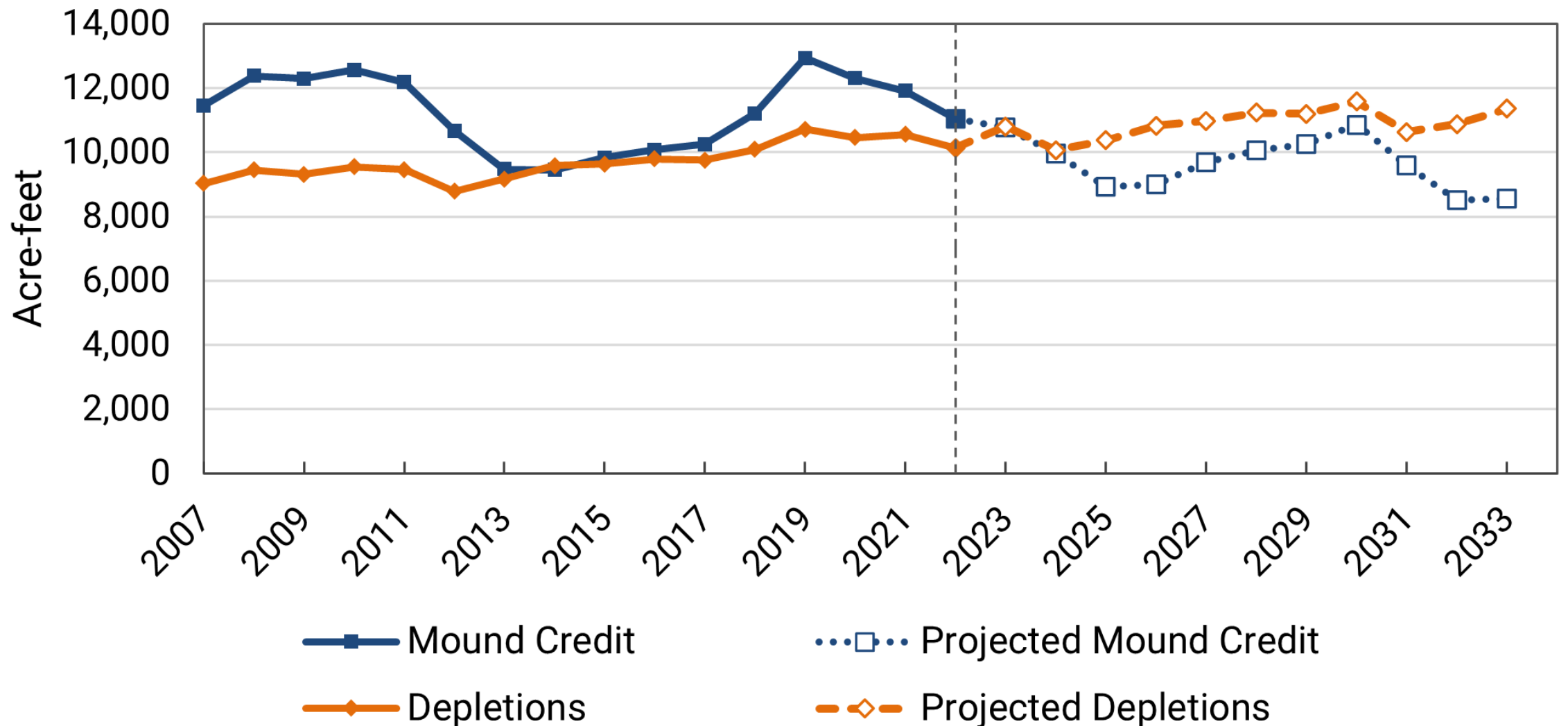
TBNRD Platte Basin IMP requirements

- TBNRD includes both overappropriated and fully appropriated portions of Platte basin.
- TBNRD IMP streamflow depletion reduction requirements to return to 1997 levels of depletions:
 - **OA Basin** (W of US Hwy. 183) **1775 a-f/Yr.** by 2020
 - **FA Basin** (E of US Hwy. 183) **1760 a-f/Yr.** by 2020
 - **Total** offset requirement= **3535 a-f/Yr.** by 2020

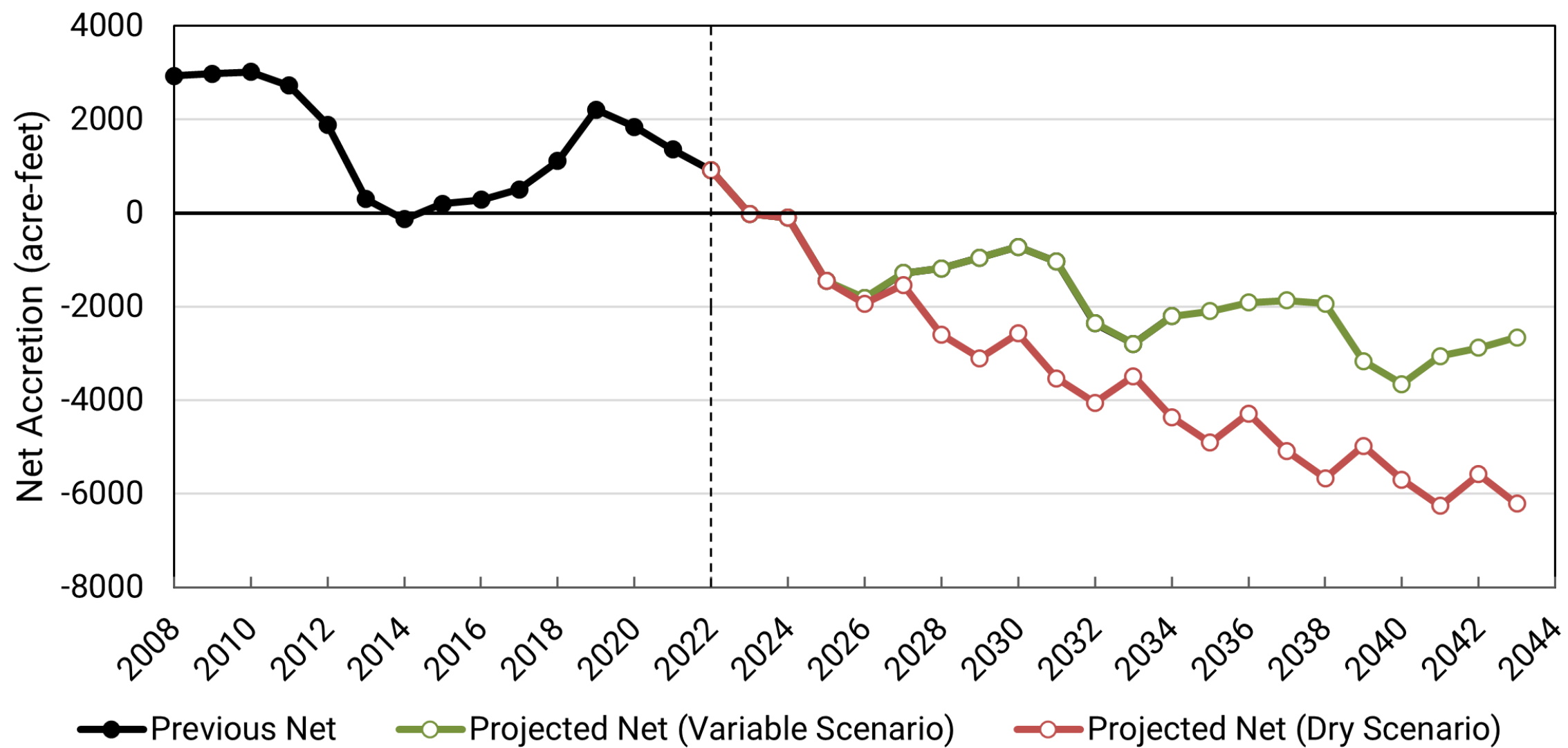
TBNRD Republican Basin IMP Requirements

- TBNRD needs to maintain positive balance between imported water and depletions to streamflows
- TBNRD maintains this balance in three ways:
 - Maintain GW levels at or above 1981-85 levels
 - Regulate irrigated crop production
 - Augment streamflows

Mound Credit and Streamflow Depletions at the TBNRD Southern Boundary - Variable Scenario

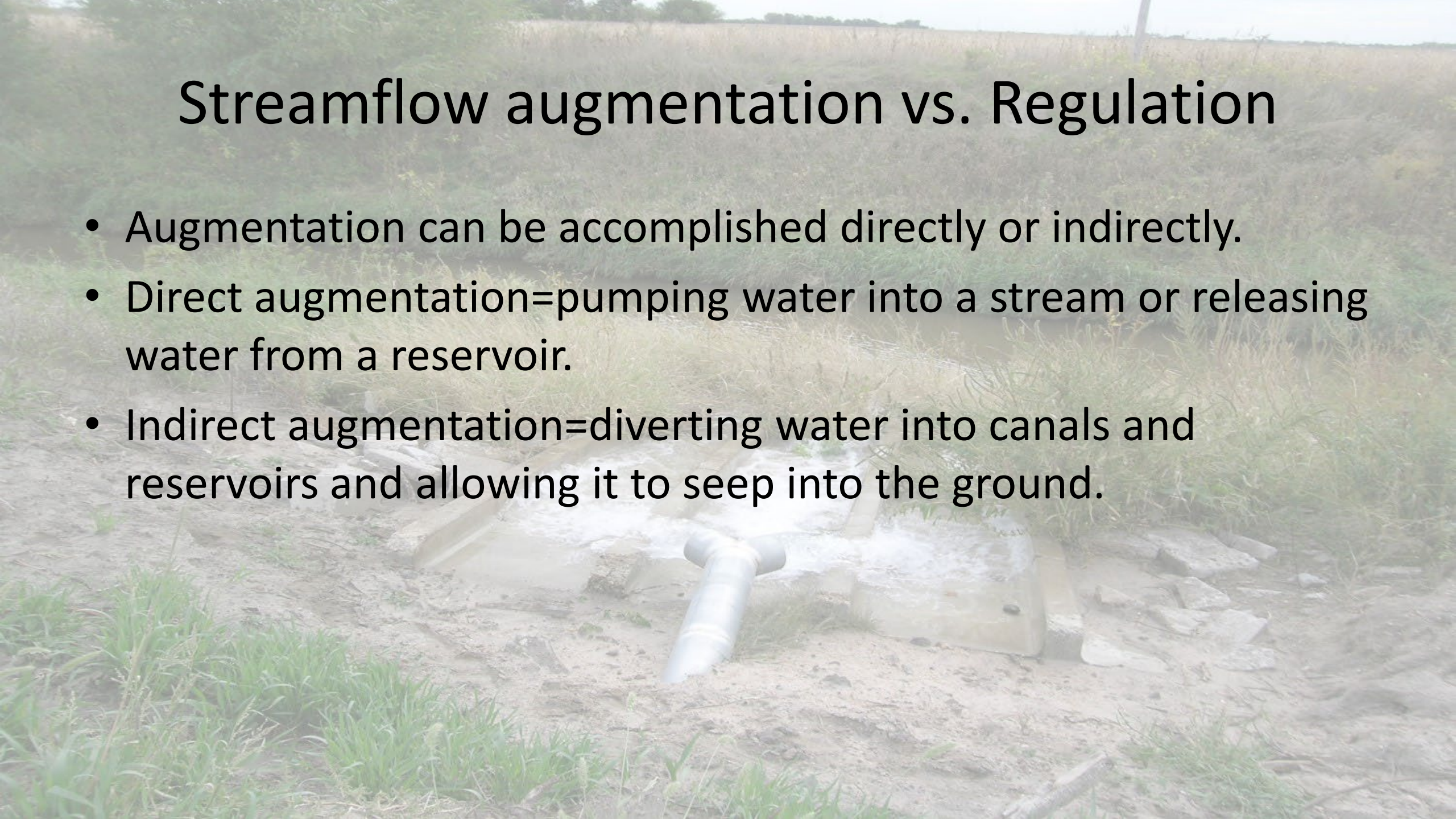


Annual Net Accretion under Variable and Dry Scenarios



Streamflow augmentation vs. Regulation

- Augmentation can be accomplished directly or indirectly.
- Direct augmentation=pumping water into a stream or releasing water from a reservoir.
- Indirect augmentation=diverting water into canals and reservoirs and allowing it to seep into the ground.



What are alternatives to augmentation?

- Pay farmers not to irrigate
 - Needed reductions can be achieved by acquiring easements
 - Easements can be acquired from willing sellers or by eminent domain (using condemnation enables targeting areas of greatest benefit)
 - NRD would need to retire irrigation on at least 50,000 acres in Platte basin and 10,000 acres in Rep. Basin
 - Cost=at least \$4000/ acre, \$24 million total

A photograph of a narrow, shallow stream flowing through a field of tall, dry grass. The stream is the central focus, winding from the foreground towards the background. The grass on either side is tall and dry, with a golden-brown hue. The sky is overcast with soft, grey clouds. The overall tone is muted and naturalistic.

Tri-Basin depletion offset projects

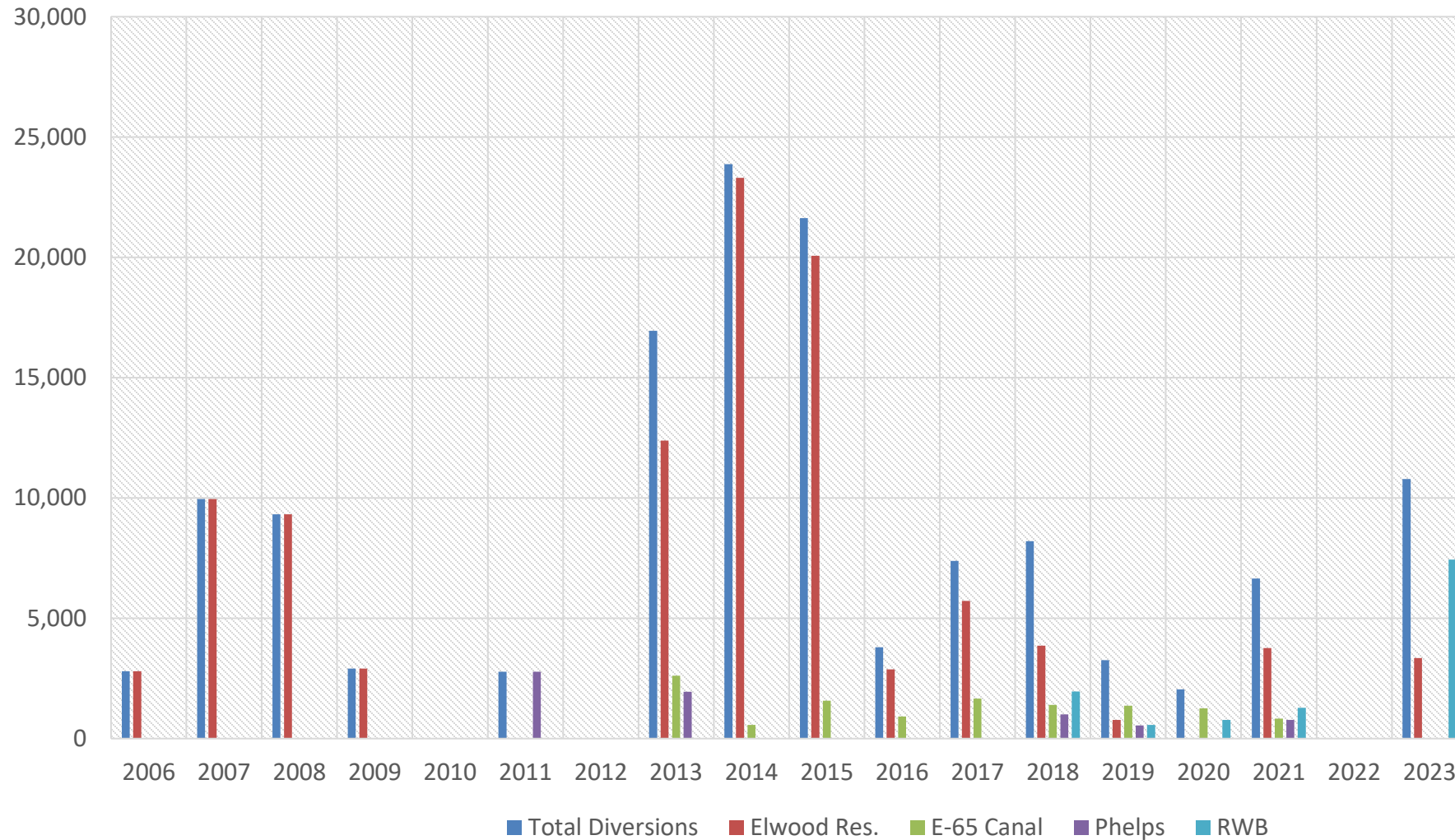
CNPPID High Flow Diversions

- TBNRD works with CNPPID to divert high Platte flows into canals, Elwood reservoir.
- Over 107,800 acre-feet diverted since first diversions in 2006.
- Over 80,800 creditable a-f at NRD cost of \$12-\$22 per a-f (DNR pays half cost).
- Diversions into Elwood Reservoir and E-65 Canal benefit both Platte and Republican Basins.

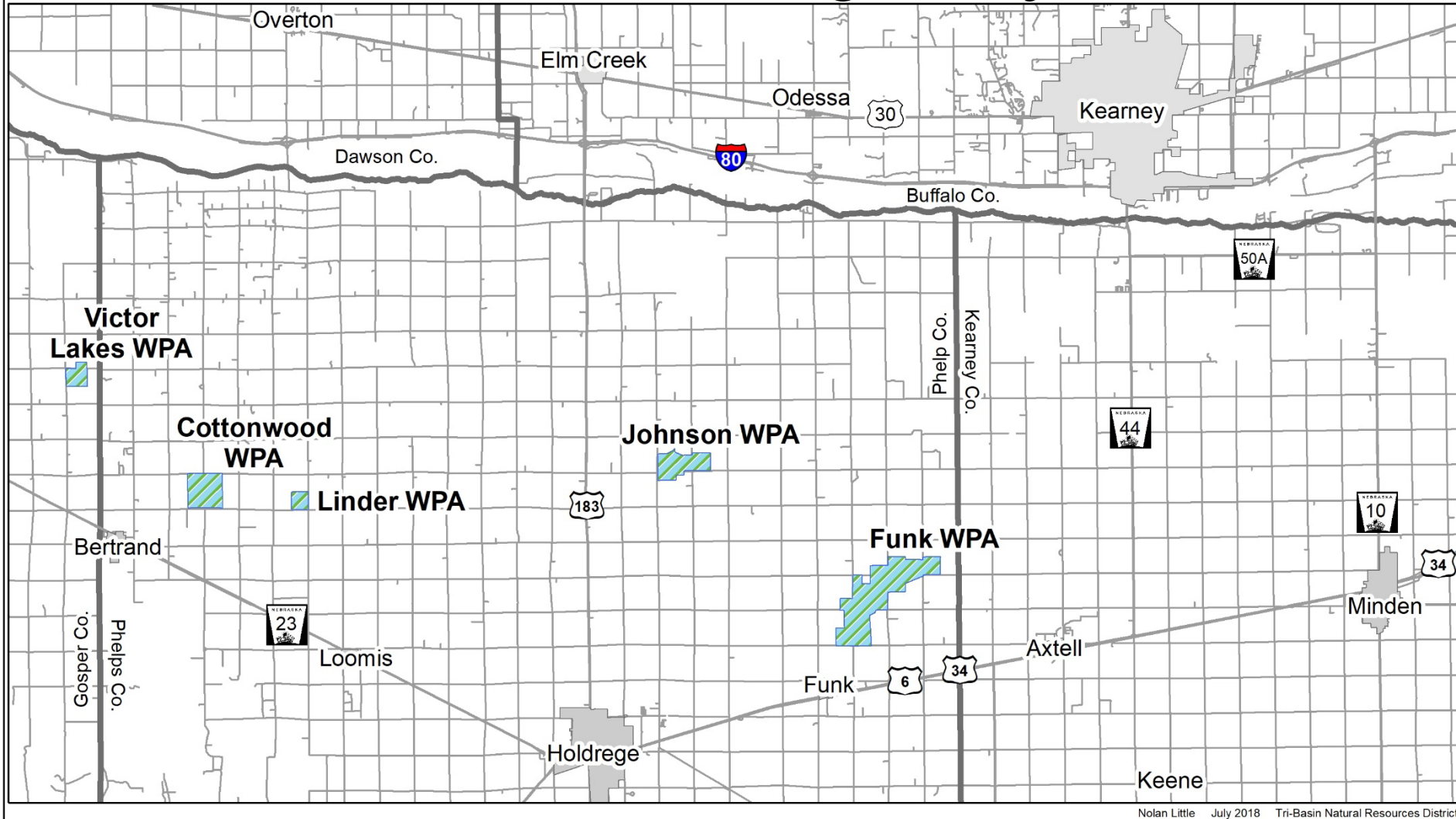
Elwood Reservoir



Platte Excess Flow Diversions by CNPPID for TBNRD and NDNR



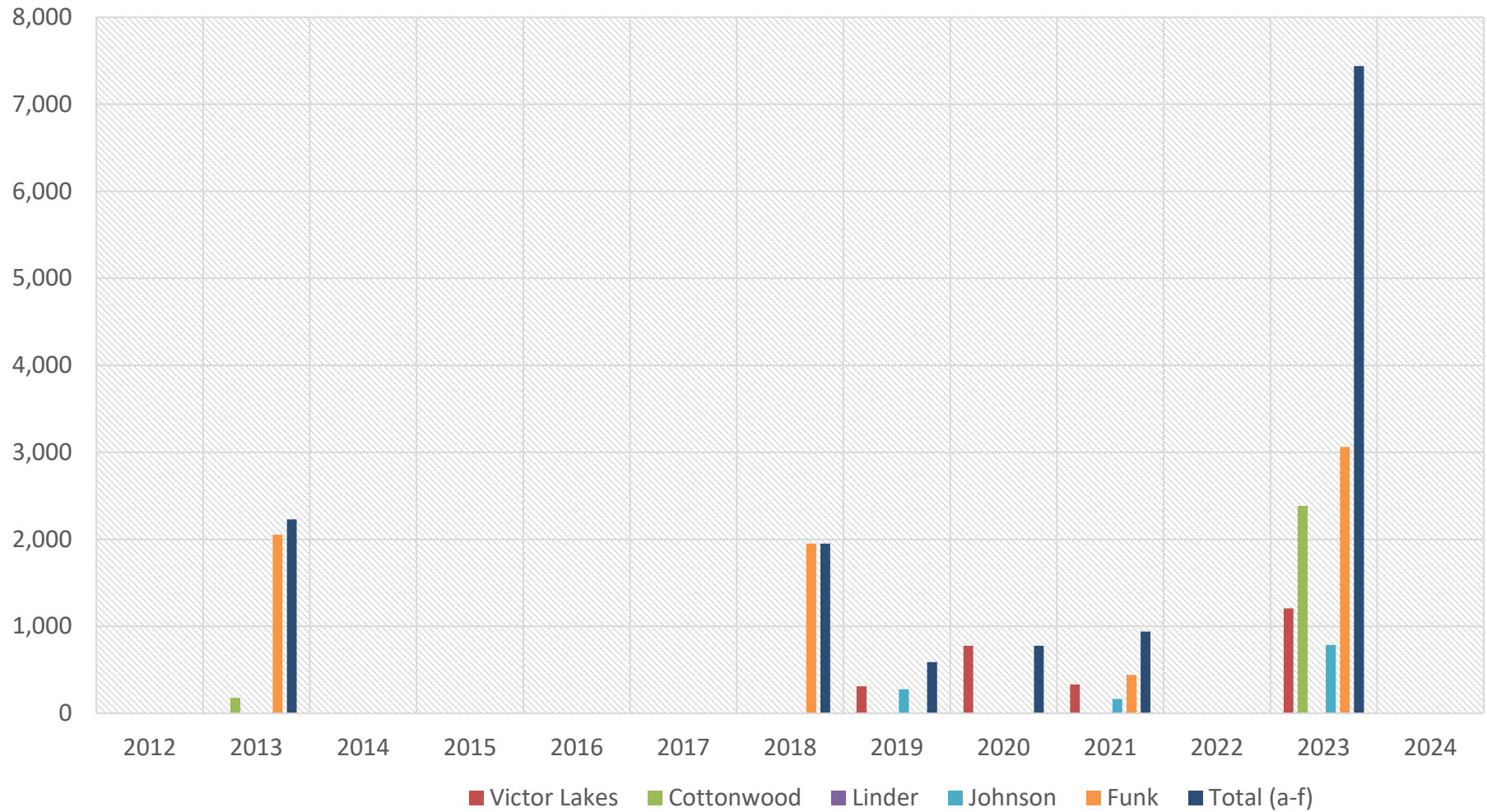
Wetland Recharge Project







Platte Excess Flow Diversions to WPAs by CNPPID for TBNRD and NDNR

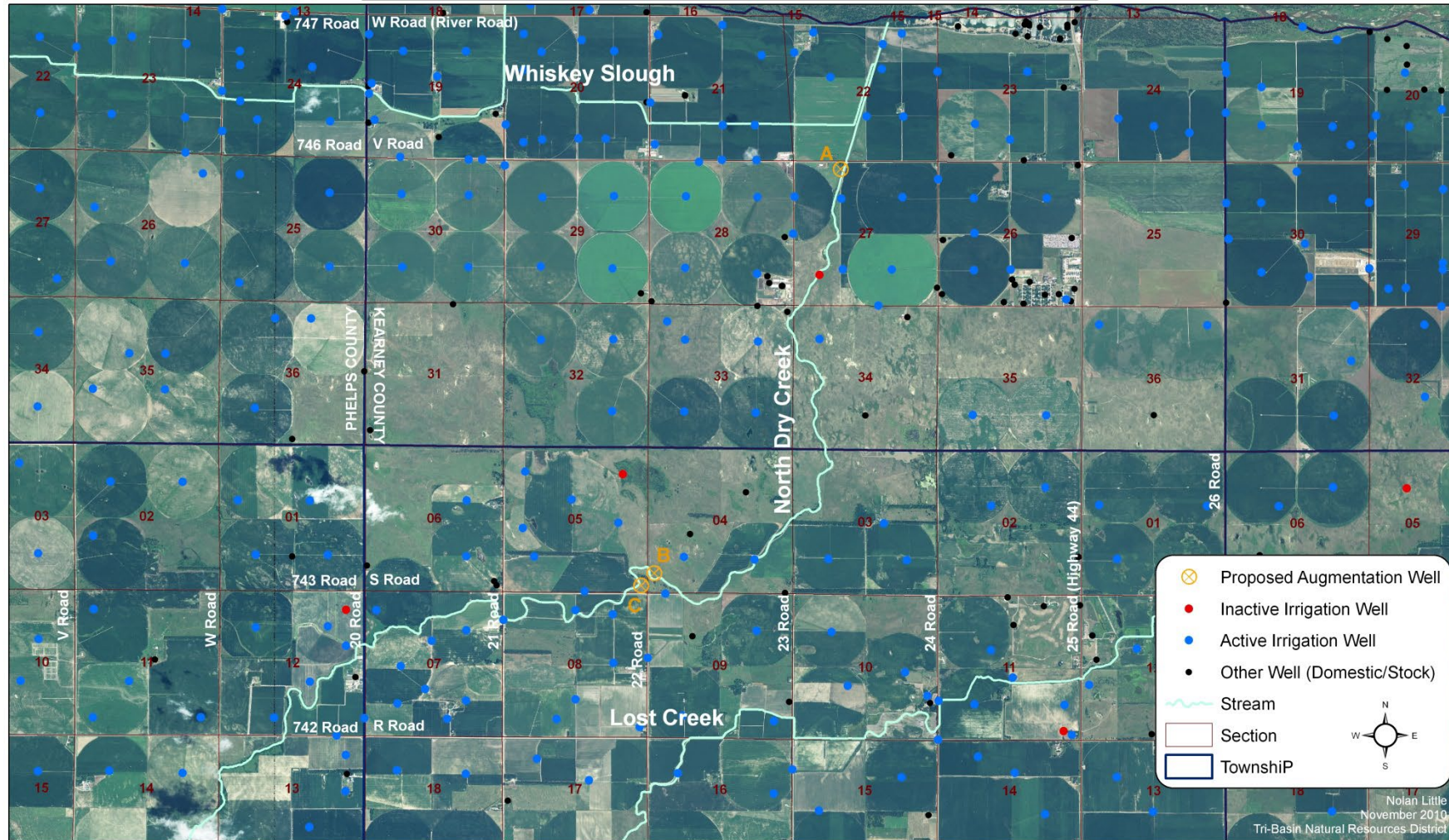


North Dry Creek Streamflow Augmentation Project



Tri-Basin Natural Resources District

North Dry Creek Streamflow Augmentation Project



North Dry Creek Streamflow Augmentation Project

- TBNRD developed first streamflow augmentation well project in Nebraska.
- Located on North Dry Creek (Platte Trib. Near Kearney).
- First well completed in 2011, second well in 2014.
- DNR paid 50% of construction cost.
- \$11-15 per creditable a-f cost, depending on volume pumped.

Rep. Basin Aug. Project

- Current plan is to drill two pumping wells which will be located along Turkey Creek in Gosper County.
- Each well will be accompanied by at least one observation well.
- First observation well was drilled spring 2015
- First production well was drilled winter (2015-16).

Holen Augmentation Well

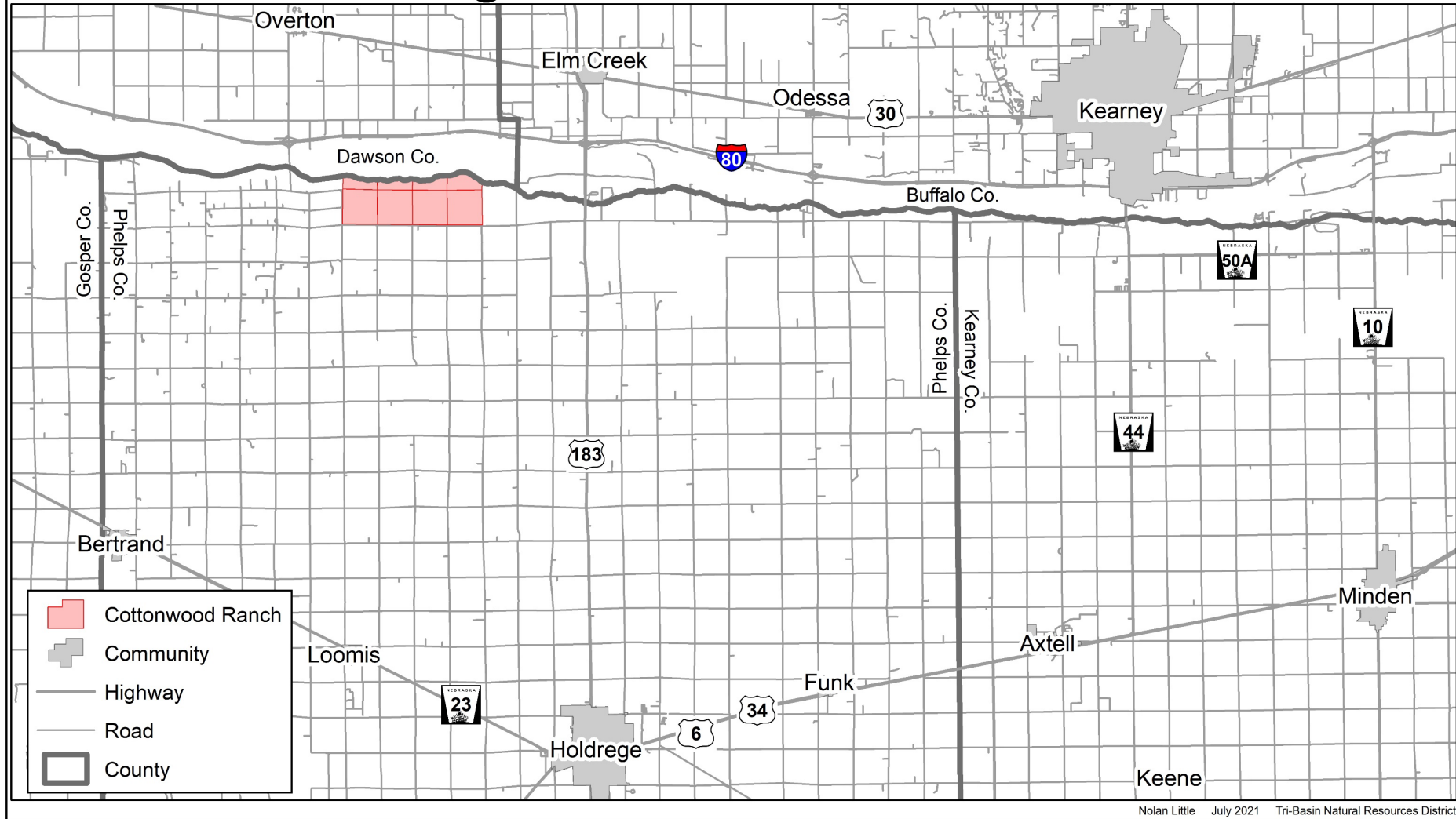


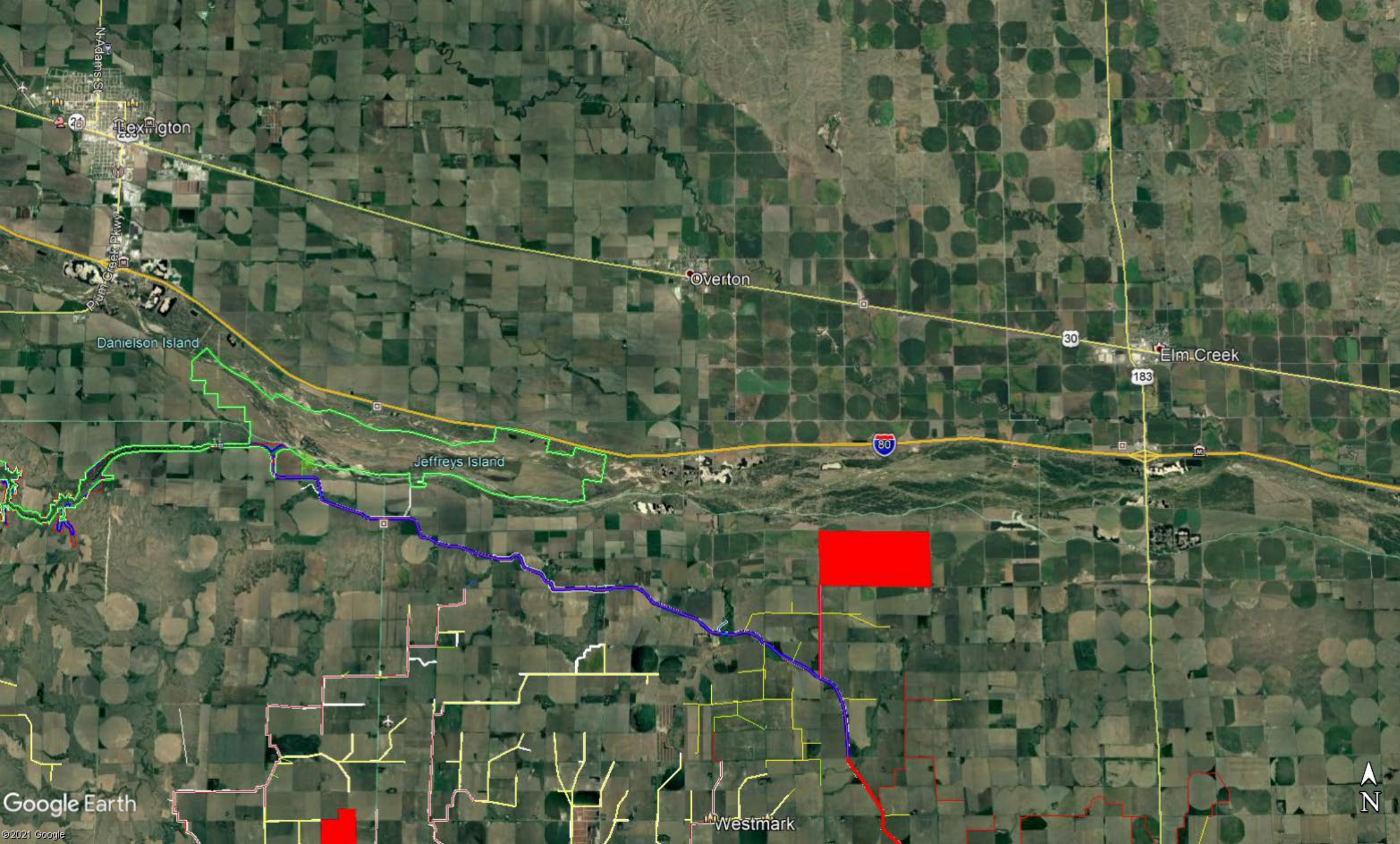


Rep. Basin Aug. Project (Cont.)

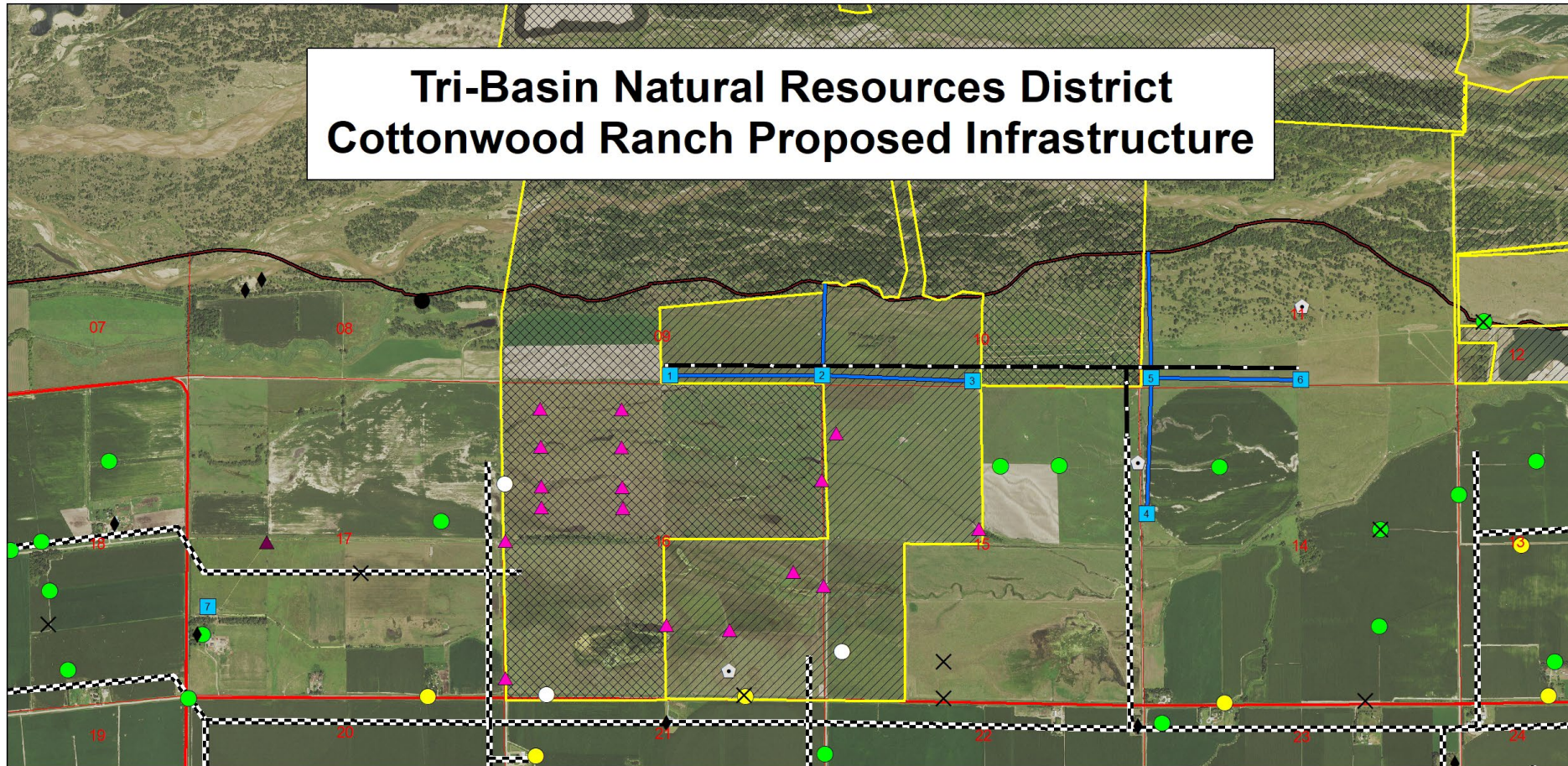
- A second production well is planned when needed.
- Expected pumping rate is 1200 gpm per well.
- Expected Max. output is 1000 acre-feet per well per year.
- Pumped water will be replaced by recharge into Elwood reservoir and E-65 canal.
- Most pumping will occur during spring and fall.
- NRD will assist with maintaining Turkey Creek in immediate vicinity of wells.

Platte River Augmentation - Cottonwood Ranch





Tri-Basin Natural Resources District Cottonwood Ranch Proposed Infrastructure



- ◆ Domestic, Active Registered Well
- ✕ Irrigation, Decommissioned Well
- ⬢ Livestock, Active Registered Well
- ▲ Monitoring (Ground Water Quality), Active Registered Well
- ▲ Observation (Ground Water Levels), Active Registered Well
- Other, Active Registered Well

- Proposed Well
- ▨ NPPD Property
- ▧ PRRIP Property
- Section
- Three-Phase Power
- Tri-Basin Paved Road

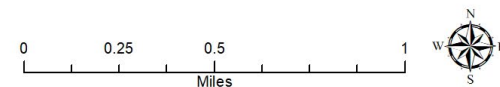
Pumping Rate

- 0
- <1000
- 1001-1500
- >1501

Spacing

- 600'
- 1320'
- 2640'

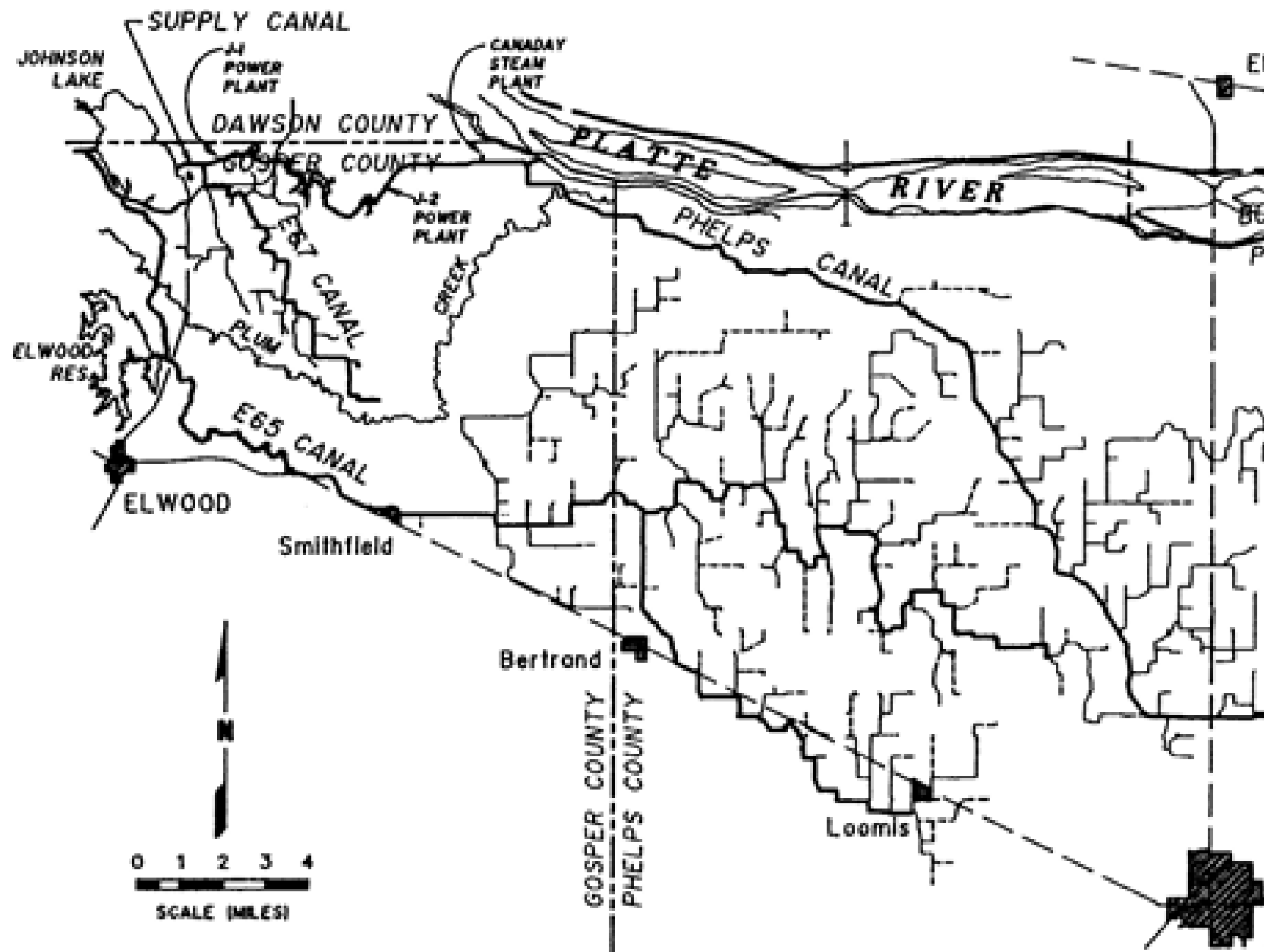
- Proposed Electrical 11,750'
- Proposed Pipeline 13,425'



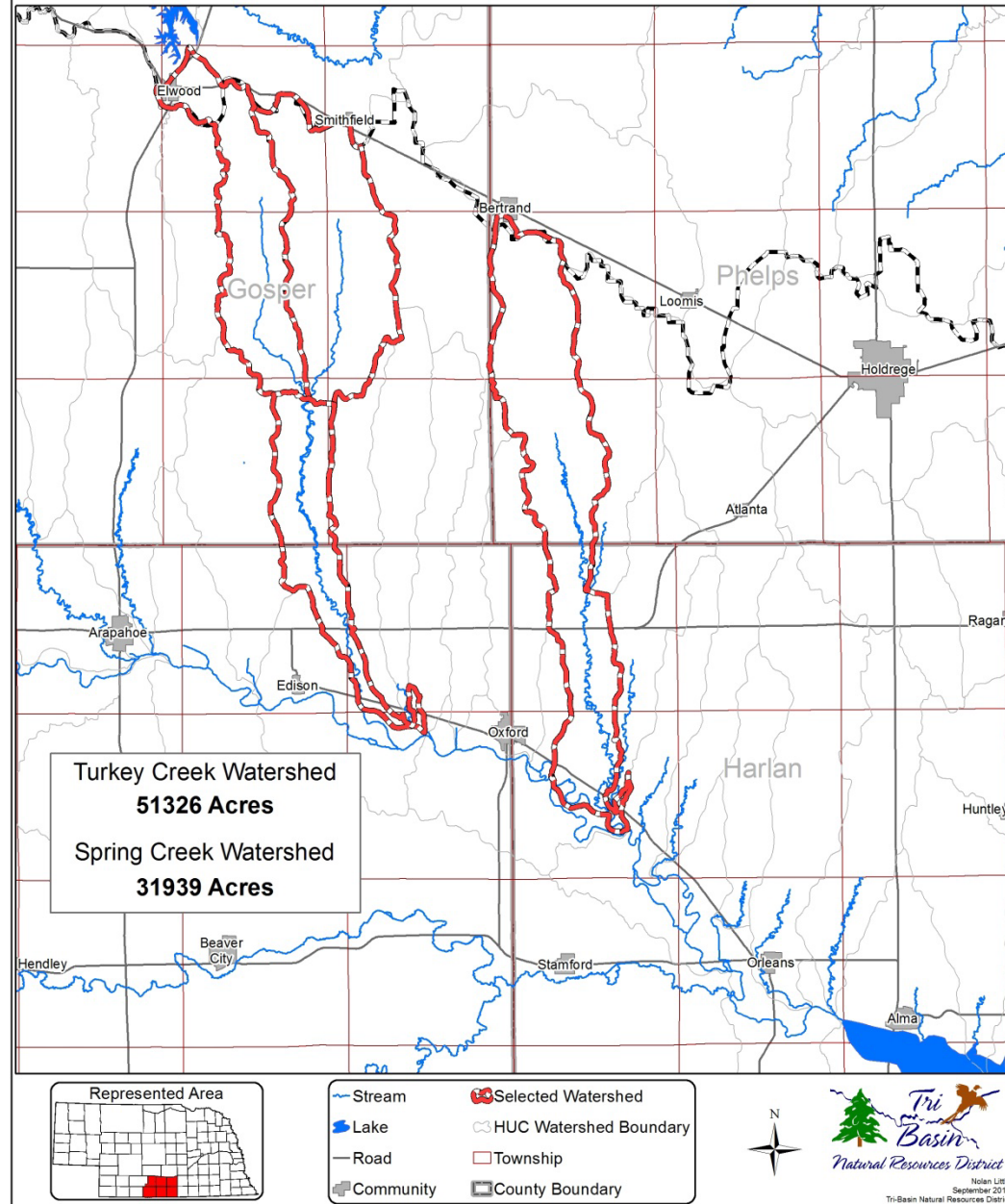
Nolan Little
December 2020
Tri-Basin Natural Resources District

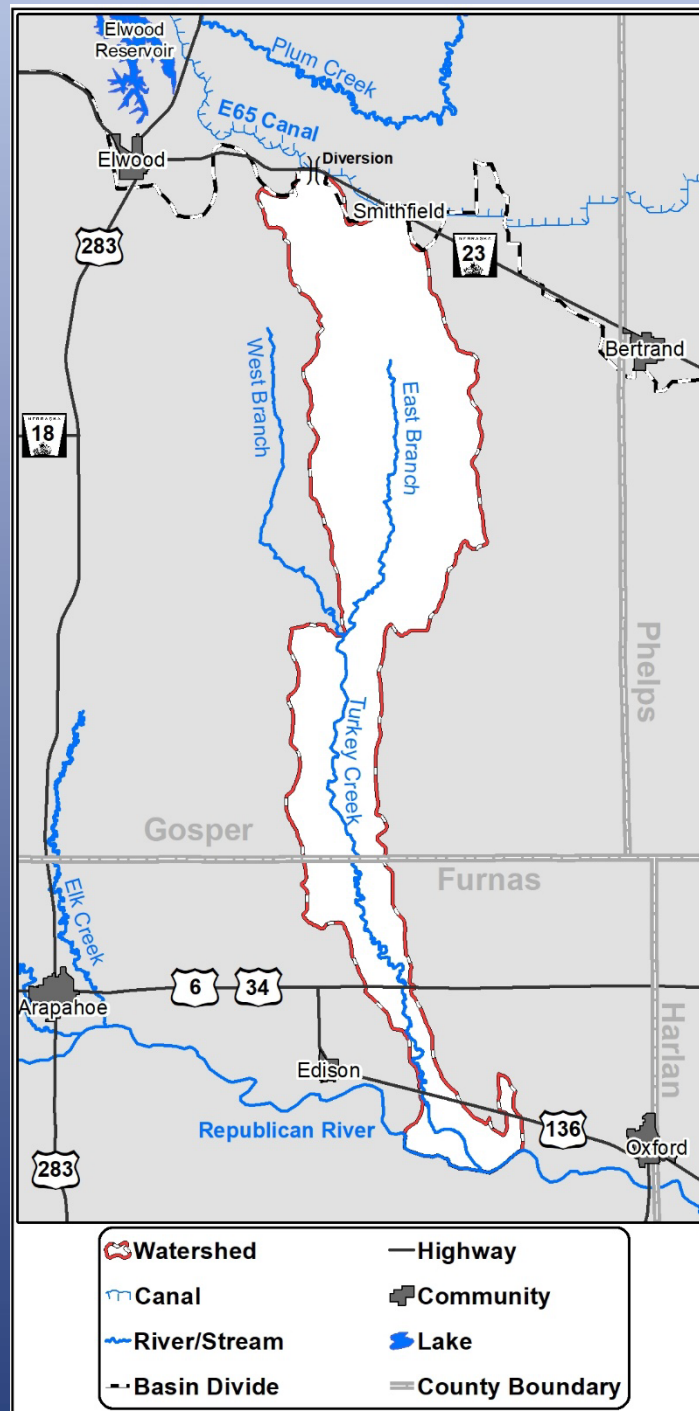
Platte-Republican Diversion

- Originally conceived by former State Sen. Mark Christensen (2006)
- High Platte flows in 2015 led to evaluation of potential diversion sites
- Now a cooperative project of Tri-Basin NRD, Lower Republican NRD and Central NE Public Power and Irrigation District



Spring and Turkey Creek Watersheds







MARCH 2017

OLSSON PROJECT NO. 016-1500

PLATTE REPUBLICAN DIVERSION PROJECT FEASIBILITY REVIEW

PREPARED FOR:

PLATTE REPUBLICAN DIVERSION LOWER REPUBLICAN NATURAL RESOURCES DISTRICT
AND TRI-BASIN NATURAL RESOURCES DISTRICT



Platte-Republican Diversion Project Feasibility Study

- Available on the Tri-Basin NRD website at:

www.tribasinnrd.org

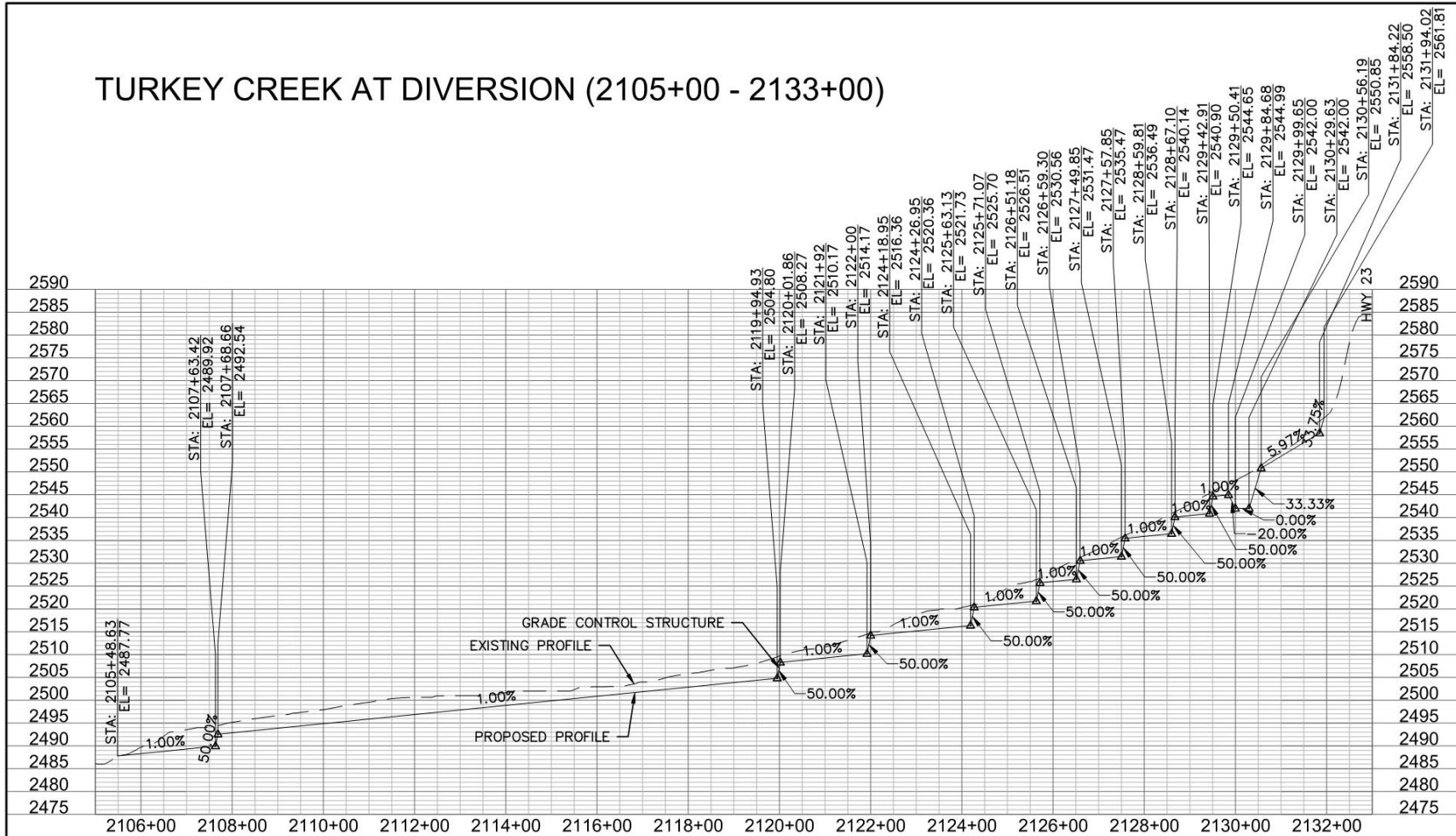
Feasibility Study Results

- Diversion rates of 40 cfs and 100 cfs analyzed
- Estimate of up to 11,000 acre-feet of divertable high flows in average year
- Use of pipe versus check dams in upper end analyzed
- Overall cost estimate (2017) = \$1.4-\$1.8 million
- Cost per acre-foot= \$32-\$81/a-f
- Overall cost-benefit ratio= at least 3.4:1





TURKEY CREEK AT DIVERSION (2105+00 - 2133+00)



DATE: 12/23/2016

UPPER REACH CHANNEL PROFILE OF TURKEY CREEK



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EXHIBIT

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Next Steps

- Jointly apply for water right with CNPPID (ongoing)
- Final design, cost estimate
- Secure permanent easements from landowners
- Construct diversion
- Construct pipeline and check dams to minimize erosion

Questions?

