Extreme Events: States Adapt Water Supply Approaches

Flooding and Water Planning in Nebraska

AWRA's National Leadership Institute
5th Annual Workshop for State Officials

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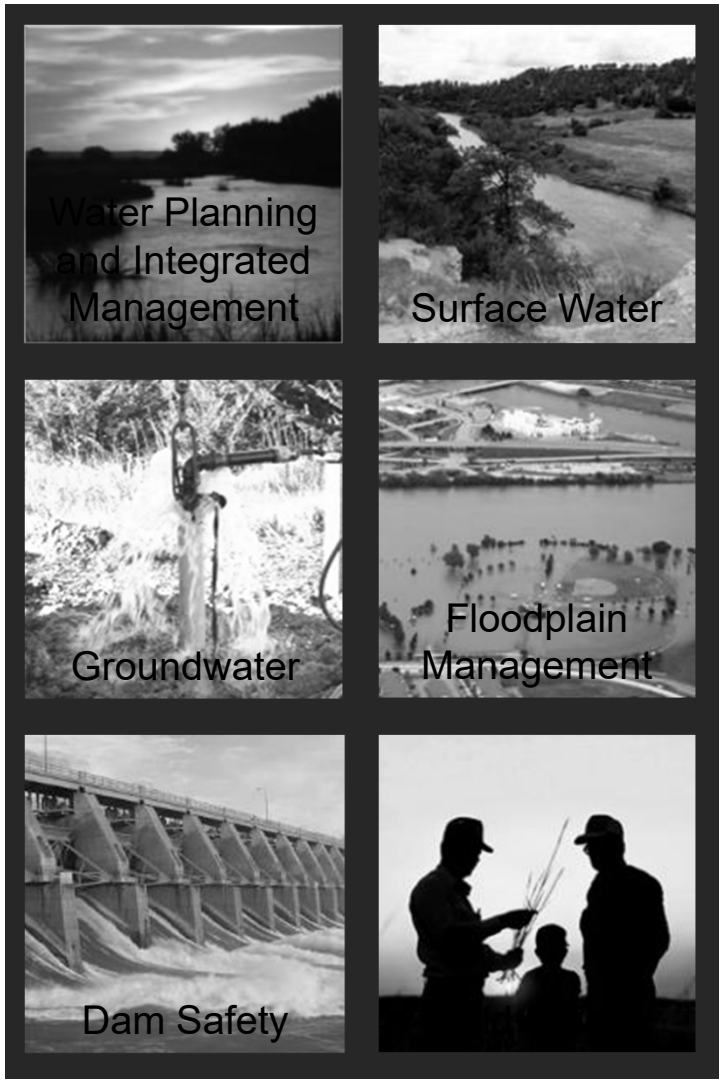
Providing the sound science and support for managing Nebraska's most precious resource



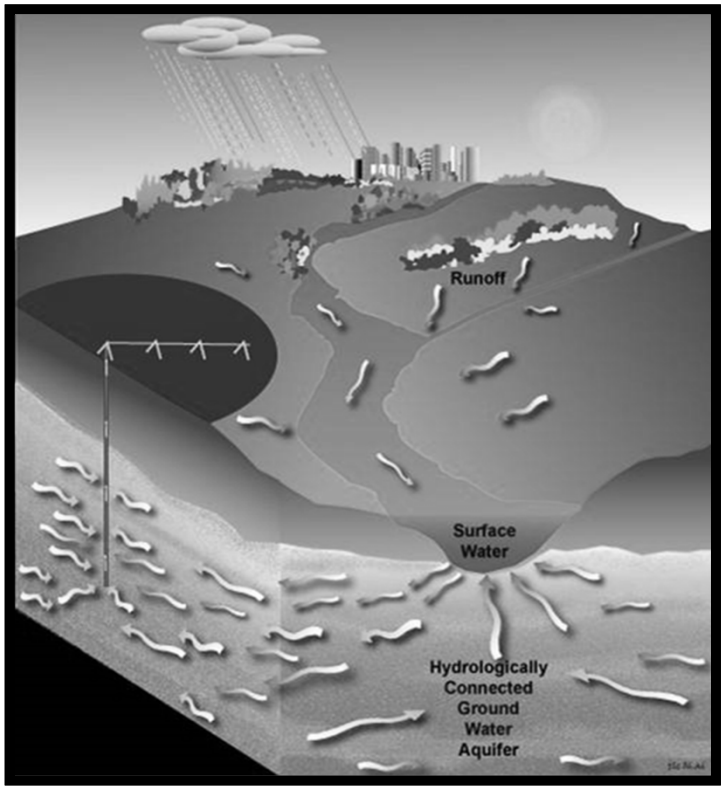
Providing the sound science and support for managing Nebraska's most precious resource

Water Planning in Nebraska

State water planning process

Integrated management plans & basin-wide plans

Regulation and administration of water supplies in Nebraska



Surface water

- Regulated by NeDNR
- Prior appropriations

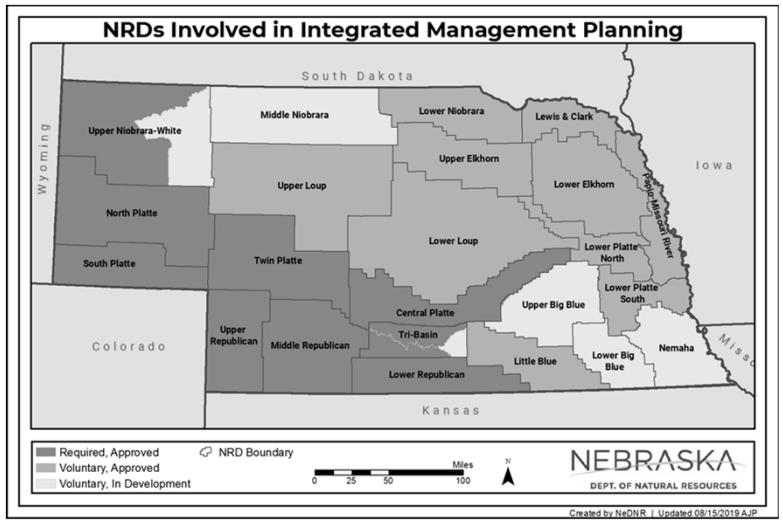
Integrated water management

Groundwater

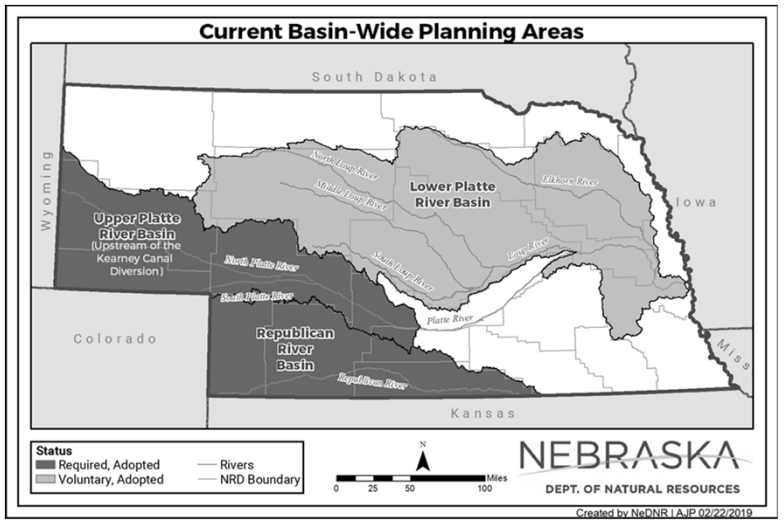
- Regulated by Natural Resources Districts (NRDs)
- Correlative rights

Nebraska's decentralized water planning framework

Integrated management plans (IMPs)



Basin-wide plans



A state water planning process, not a state water plan

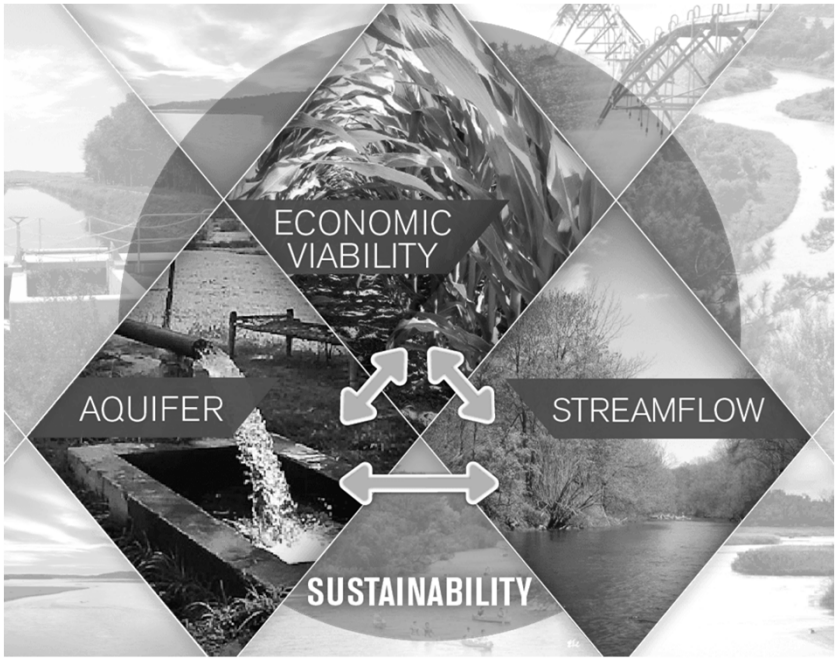
Purpose

…An integrated management plan shall include… Clear goals and objectives with a purpose of sustaining a balance between water uses and water supplies

so that the economic viability, social and environmental health, safety, and welfare of the river basin, subbasin, or reach

can be achieved and maintained for both the near term and the long term…

from *Neb. Rev. Stat.* § 46-715 (2)



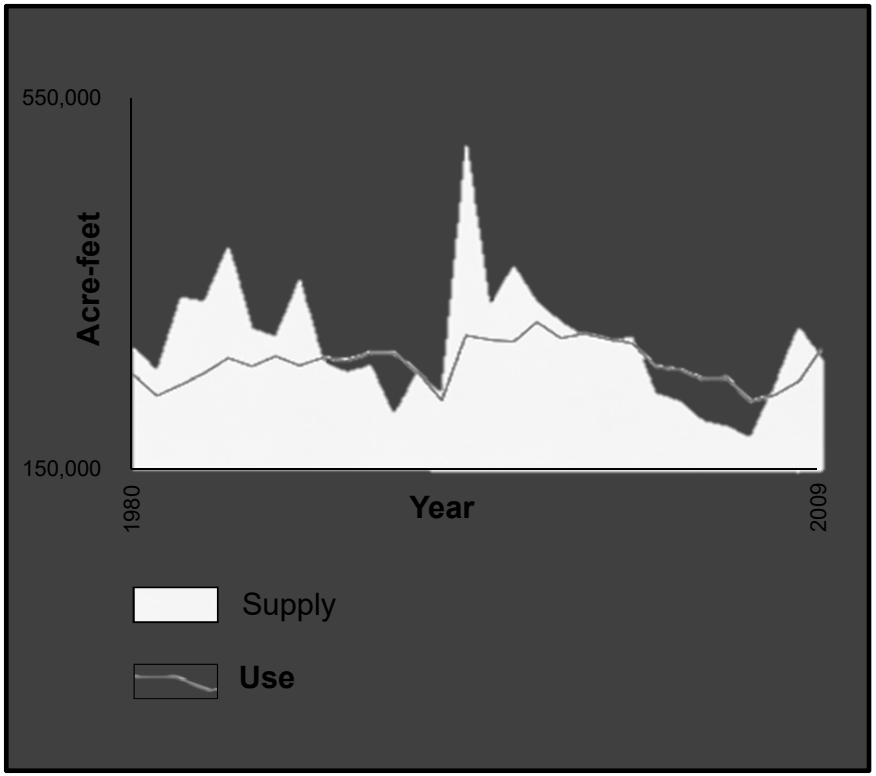
IMPs and basin-Wide plans are adaptive

Flooding and Conjunctive Management

Examples from the Platte River

Conjunctive water management

- What?
  - An adaptive process
  - Uses the connection between surface water and groundwater to maximize water use while minimizing impacts to streamflow and groundwater levels
- Why?
  - To increase the overall water supply of a region
  - To improve the reliability of that supply
- How?
  - Use or store surface water when plentiful
  - Rely more on groundwater when dry



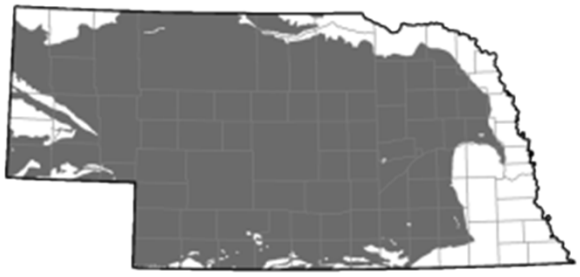
Examples of conjunctive water management projects

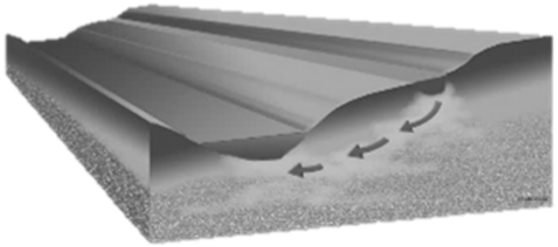
- Augmentation projects
- Water leasing arrangements
- Canal rehabilitation
- Capturing excess flows
- Broad scale recharge
- Slurry wall reservoirs

North Dry Creek Streamflow Augmentation Project, TBNRD

Upper Platte River

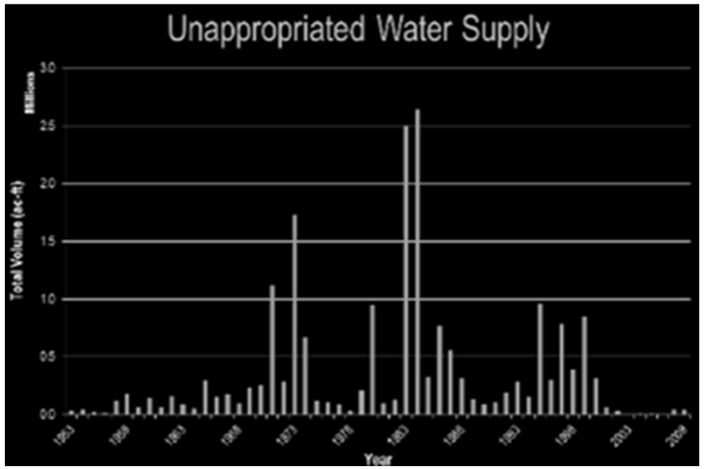
- Inflows from CO and WY
- Fully allocated
  - Offset depletions since 1997 and new uses
  - Instream flow needs
- Occasionally excess flows are available
- Underlain by Ogallala Aquifer and alluvial aquifers
- Extensive canal infrastructure (most are unlined)





Tool development

- Analysis of unappropriated surface water
- Water leasing contract templates
- Conceptual design standard for a conjunctive management project



2011 pilot project

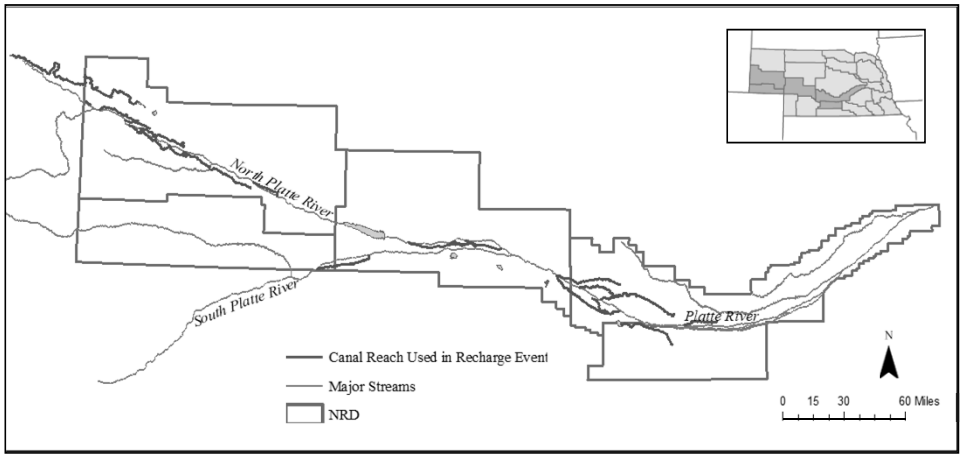
- High flows in spring through fall
  - Anticipated due to heavy snowpack
  - North Platte, South Platte, Platte
- NeDNR coordinated with NRDs, Irrigation Districts/Canal Companies to divert excesses
- Process
  - Acquisition of permits
  - Contracts
  - Monitor

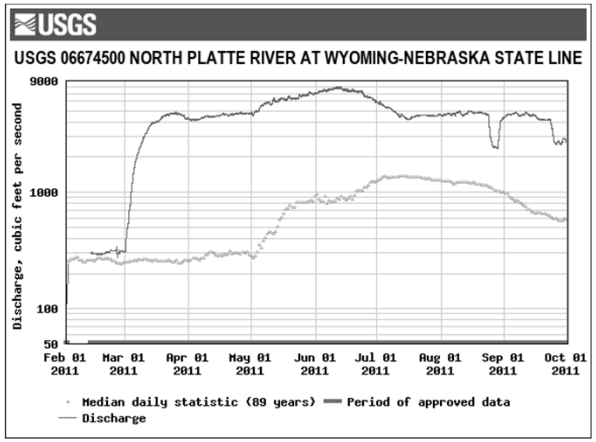
2011 pilot project

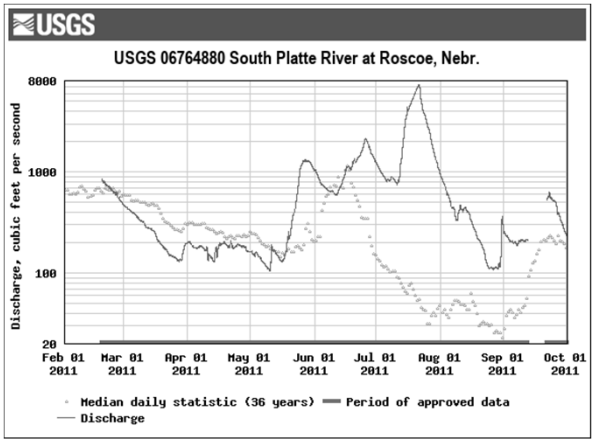
23 Canals and 5 NRDs

- **Diversion Total 145,500 acre-ft**
- **Recharge Total 96,000 acre-ft**

Also helped mitigate flooding impacts in the basin







Fall 2013 flood flows

South Platte River at North Platte, NE

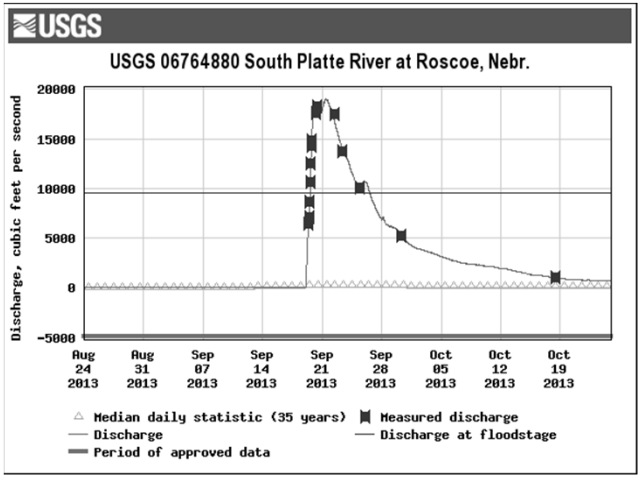
24 hours

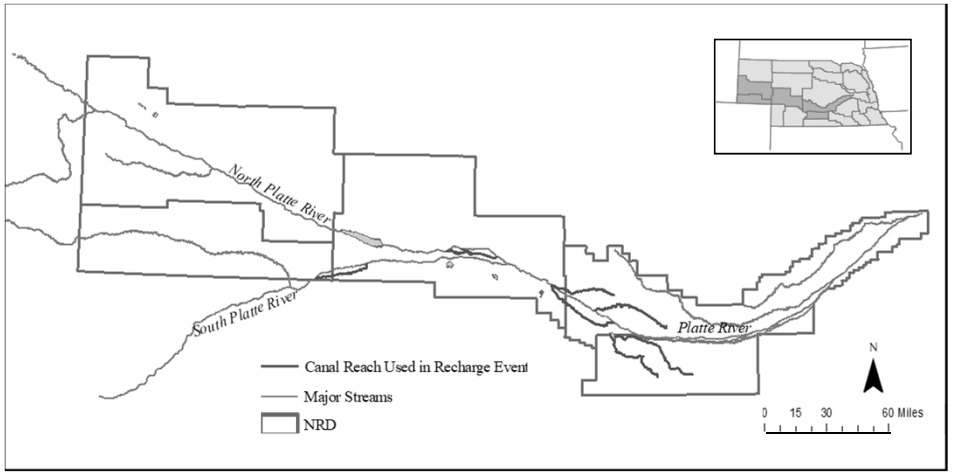
Fall 2013 flood flows

9 Canals and 4 NRDs

Diversion Total **27,300 acre-ft**

Recharge Total **21,800 acre-ft**



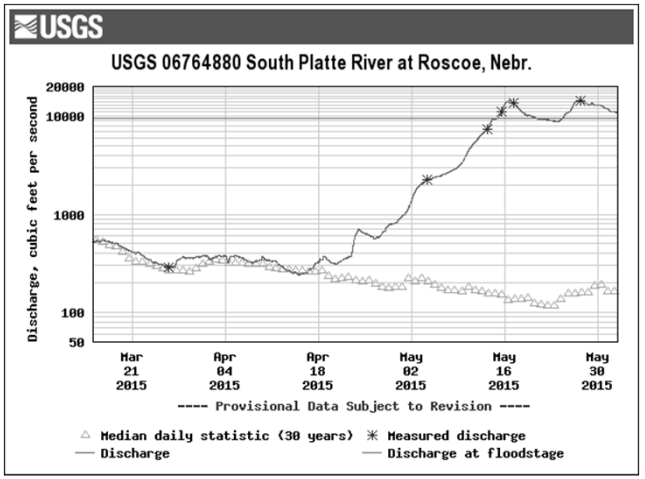


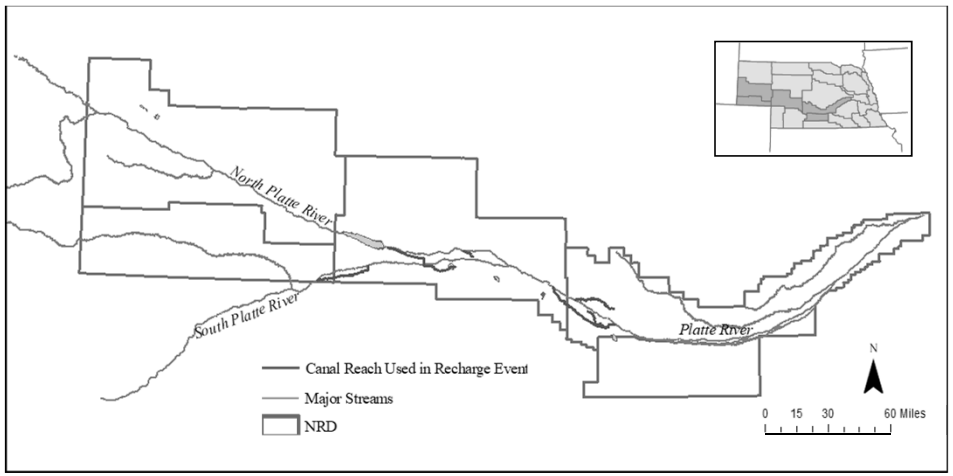
Spring 2015 flood flows

7 Canals and 4 NRDs

Diversion Total **17,600 acre-ft**

Recharge Total **11,100 acre-ft**





Additional recharge diversions

Canal Name	Total Diversion (AF) 2016	Total Diversion (AF) 2017	Total Diversion (AF) 2018
Western Canal	14826		
North Platte Canal	9246		
Paxton-Hershey Canal	7828		
Suburban Canal	6045		
Phelps Canal	6909	4916	4259
E65 Canal	1368	1665	1393

Summary of excess flow diversions

- Process in place
- Totals since 2011:
  - Over 260,000 af diverted
  - Over 176,000 af of recharge
- Benefits
  - Reduces the need for additional regulations
  - Creates greater resiliency in future periods
  - Accretions will benefit Platte River flows for many years into the future

Conjunctive water management – future activities

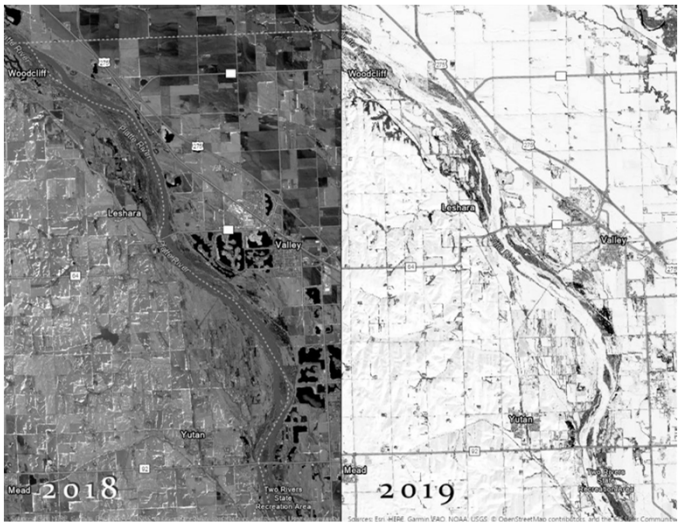
- Expand implementation
- Adapt strategies based on management goals
- Support continued investment in maintaining and enhancing infrastructure
- Sound science and monitoring to support management decisions
- Decision Support System to maximize excess flow recharge benefits

2019 Flooding

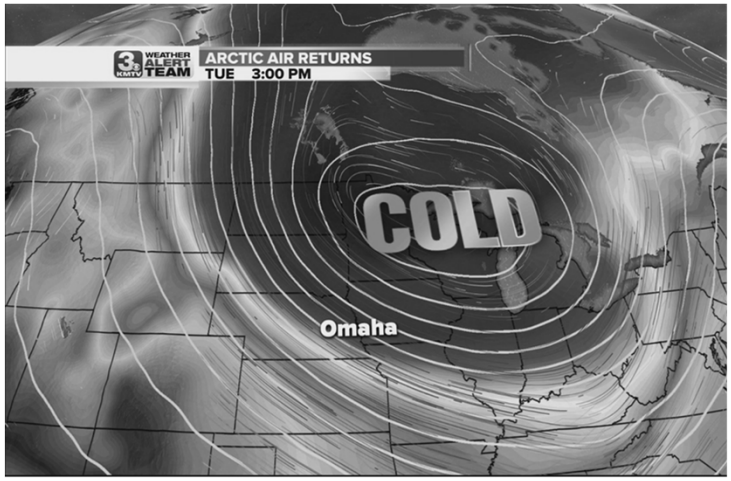
Winter Storm Ulmer

Bomb Cyclone

Conditions before the storm

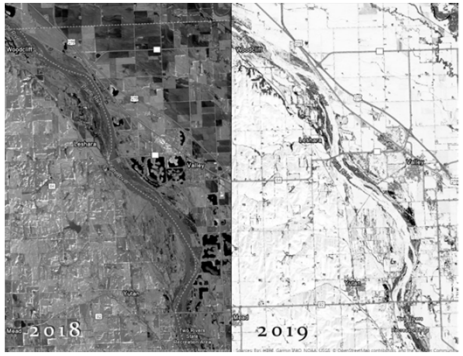


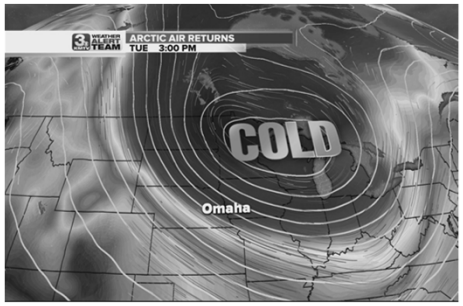
Record snowfall across much of Nebraska
January – March 2019



Prolonged below-average temperatures
February 2019 – one of the 10 coldest on record
Colder than average temperatures continued until March 12
Led to **deep frost depth**

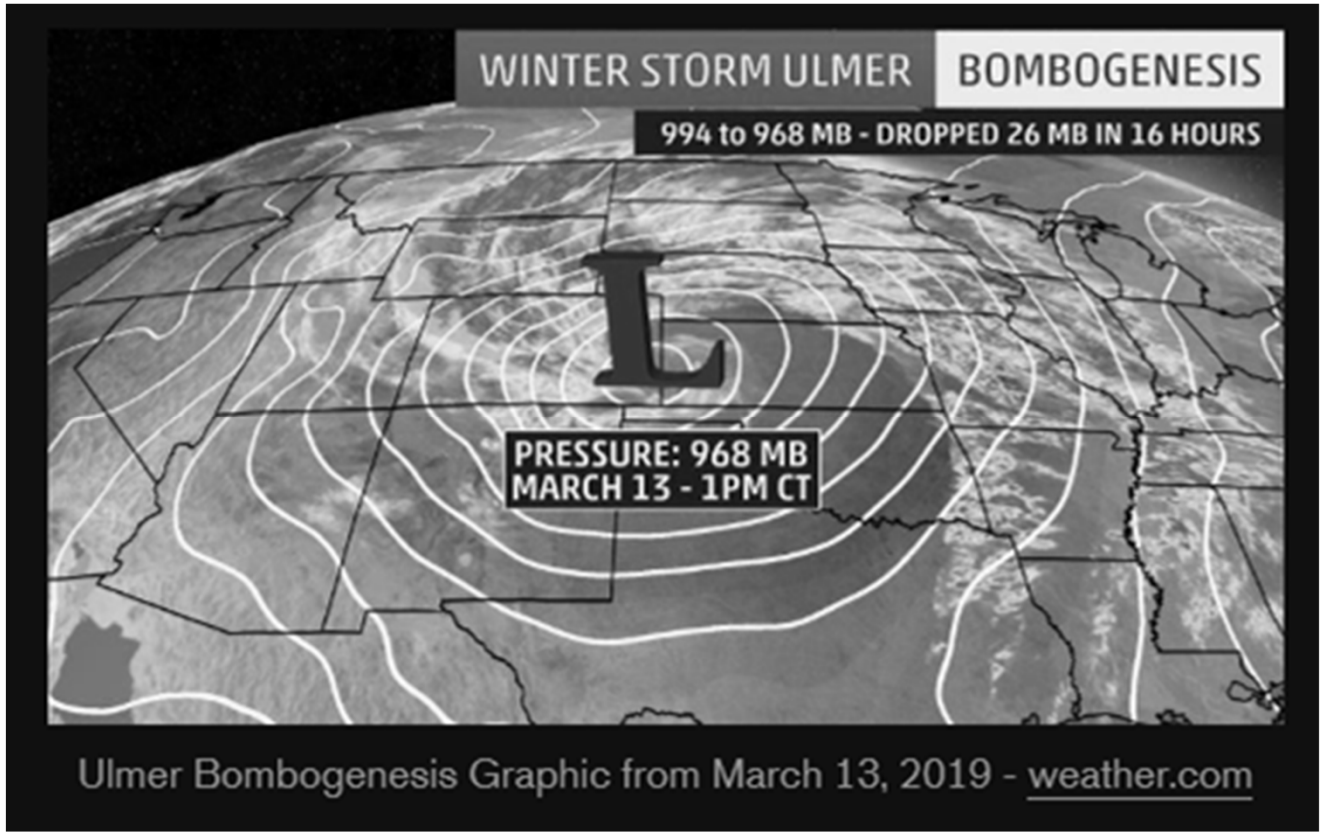
Rapid warming March 13





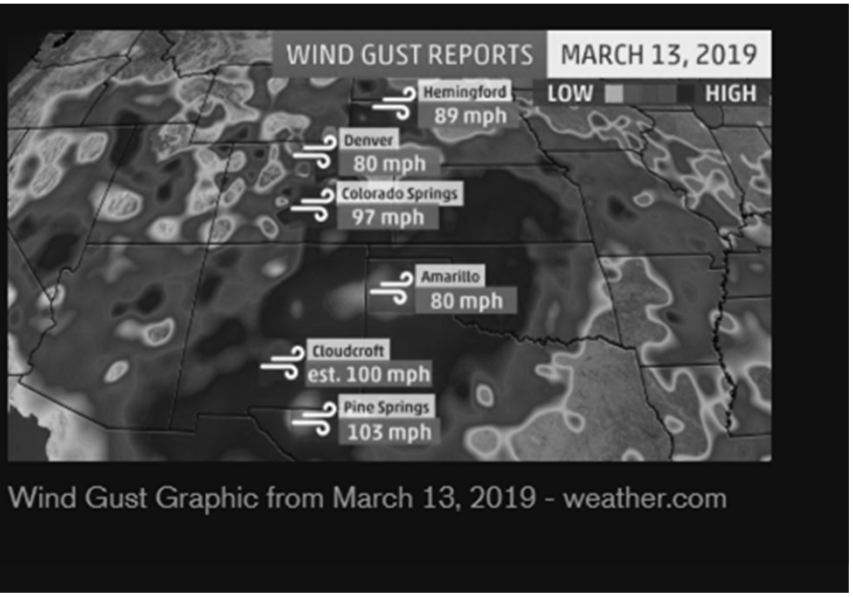
Accelerated thawing and melting

Bombogenesis



Winter Storm Ulmer, March 13 – 14

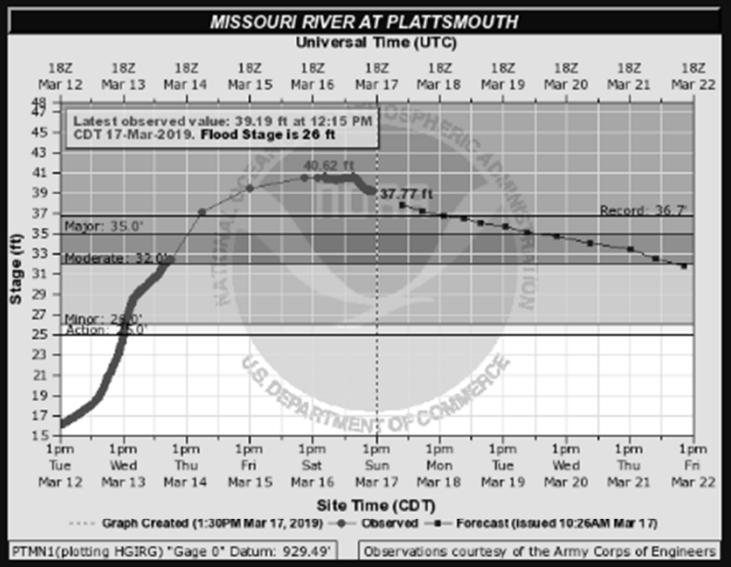
Winter Storm Blizzard Conditions from March 13, 2019 - weather.com



Wind Gust Graphic from March 13, 2019 - weather.com

Across the state: wind, widespread rainfall, and heavy snow

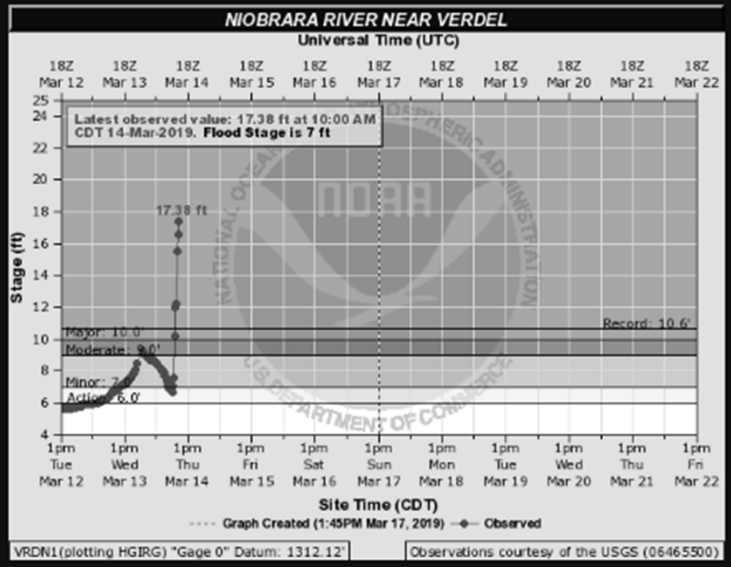

30 stream gages in Nebraska reached all-time record levels.
Yankton Reservation
Spencer
Valentine
Yankton
Storm Lake
Ainsworth
Sioux City
Winnebago Reservation
Omaha Reservation
Norfolk
Carroll
Columbus
Fremont
Omaha
North Platte
Grand Island
Lincoln
Kearney
Hastings
McCook
UNITED STATES
Nebraska Game & Parks Commission, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS | Esri, National Atlas of the United States and the United States Geological Survey | NWS, USACE, USGS, NeDNR
Powered by Esri



NWS Advanced Hydrologic Prediction Stage Chart - Missouri River at Plattsmouth, NE

The Missouri River at Plattsmouth (above) recorded a crest of 40.62 feet.

Nearly 4 feet over the previous record set in 2011.

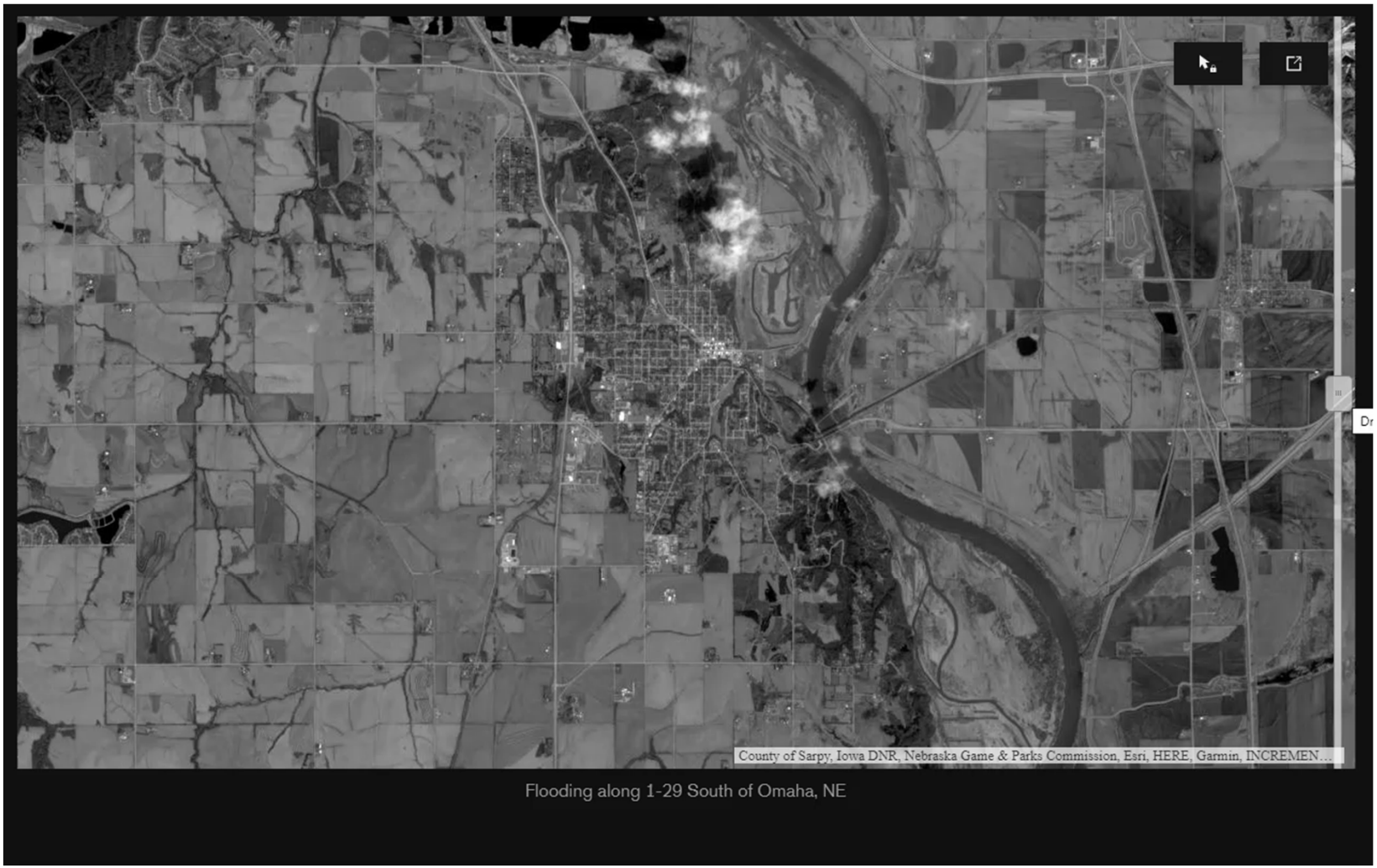


NWS Advanced Hydrologic Prediction Stage Chart - Niobrara River near Verdel, NE

The Niobrara River crested at 6.8 feet above the previous record stage near Verdel, NE.

Flooding near Valley, NE

Flooding near Peru, NE



Flooding along 1-29 South of Omaha, NE

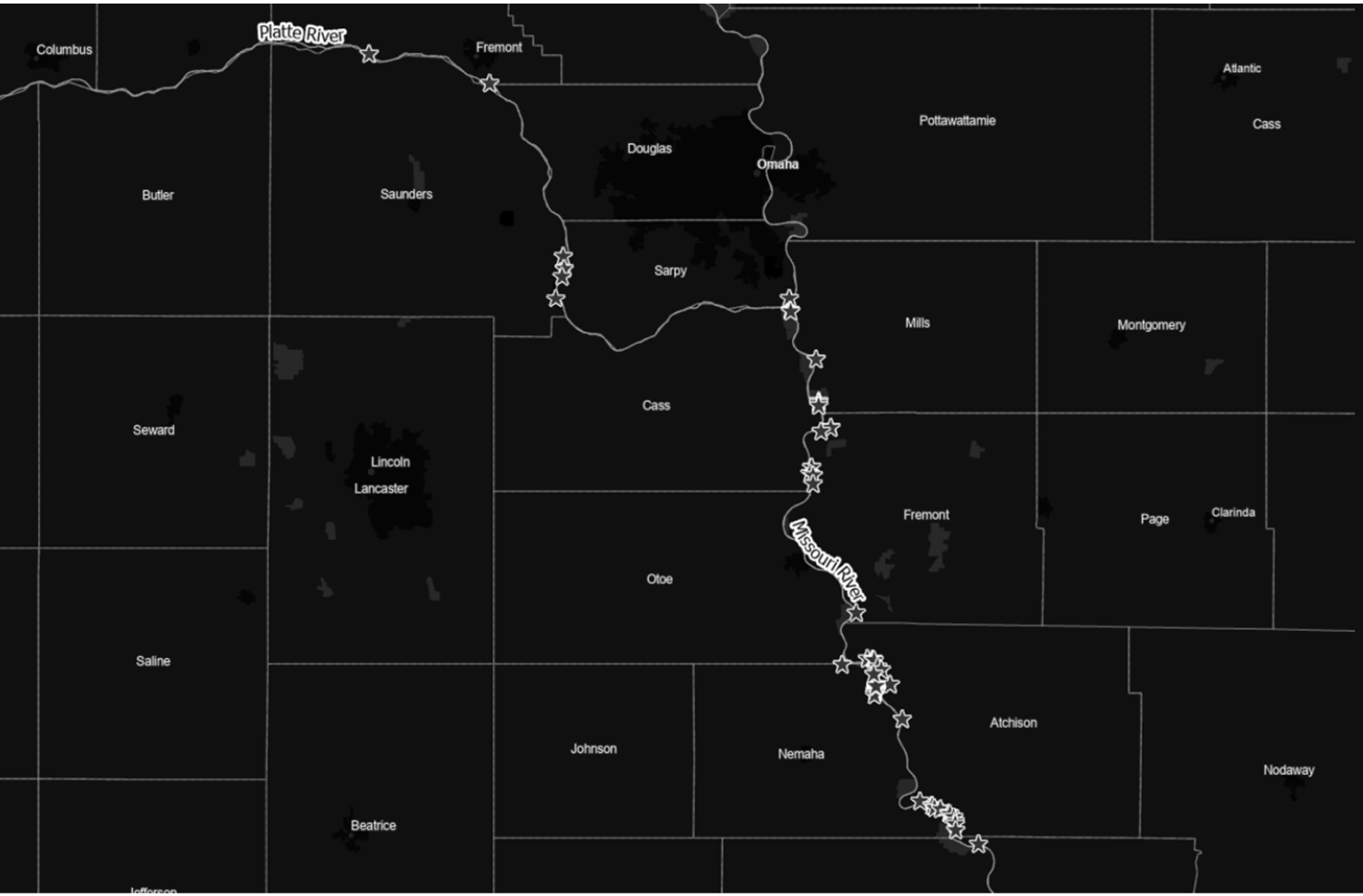
> Large sheets of ice and sediment destroyed roads, levees and bridges that came in contact.

Ice on the Niobrara River measured 18 inches to 24 inches thick before the storm. Some Ice chunks were estimated to have weighed as much as 3 tons.

Collapsed bridge along the Niobrara River South of Naper, Nebraska

Infrastructure damage

Highway 281 after historic flooding on March 16 in Niobrara, Nebraska (Office of Governor Pete Ricketts)



41 Breaches and nearly 350 miles of levees were damaged during the flood event.

National Guard Equipment becomes stranded after levee is breached.

Levees along the Platte and Missouri rivers received the most damage as both river systems reached record heights.

Infrastructure damage

High rainfall and more flooding through summer and fall

Future benefits

- Very little groundwater pumped this year
- Extensive groundwater recharge during the flooding
- Long-term benefits to the aquifer, for many years to come

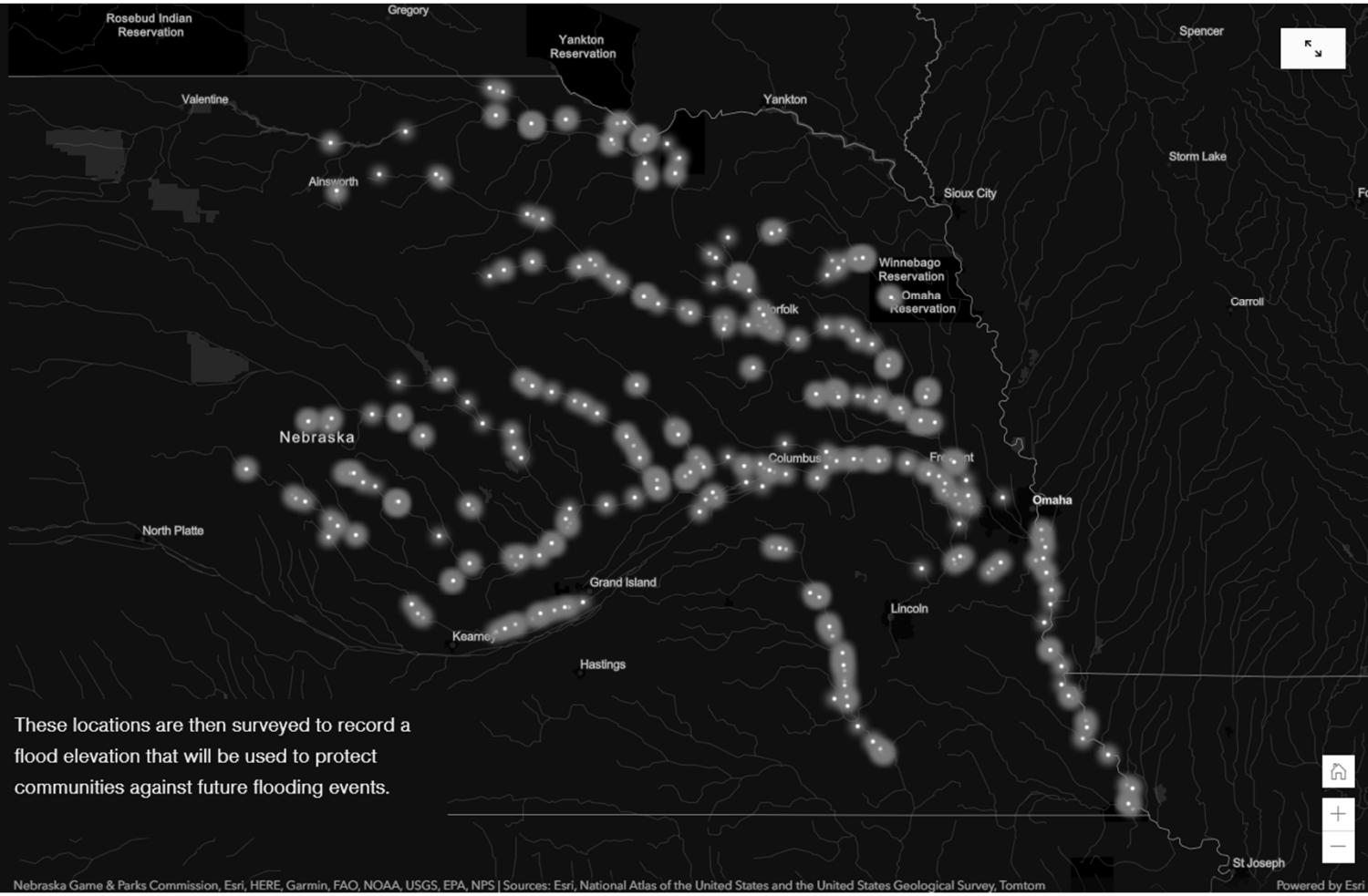
Flooding and future water planning efforts

- Develop new flood maps and specifications

Visual evidence left behind by the high flood waters was recorded in a collaborative effort by several agencies.

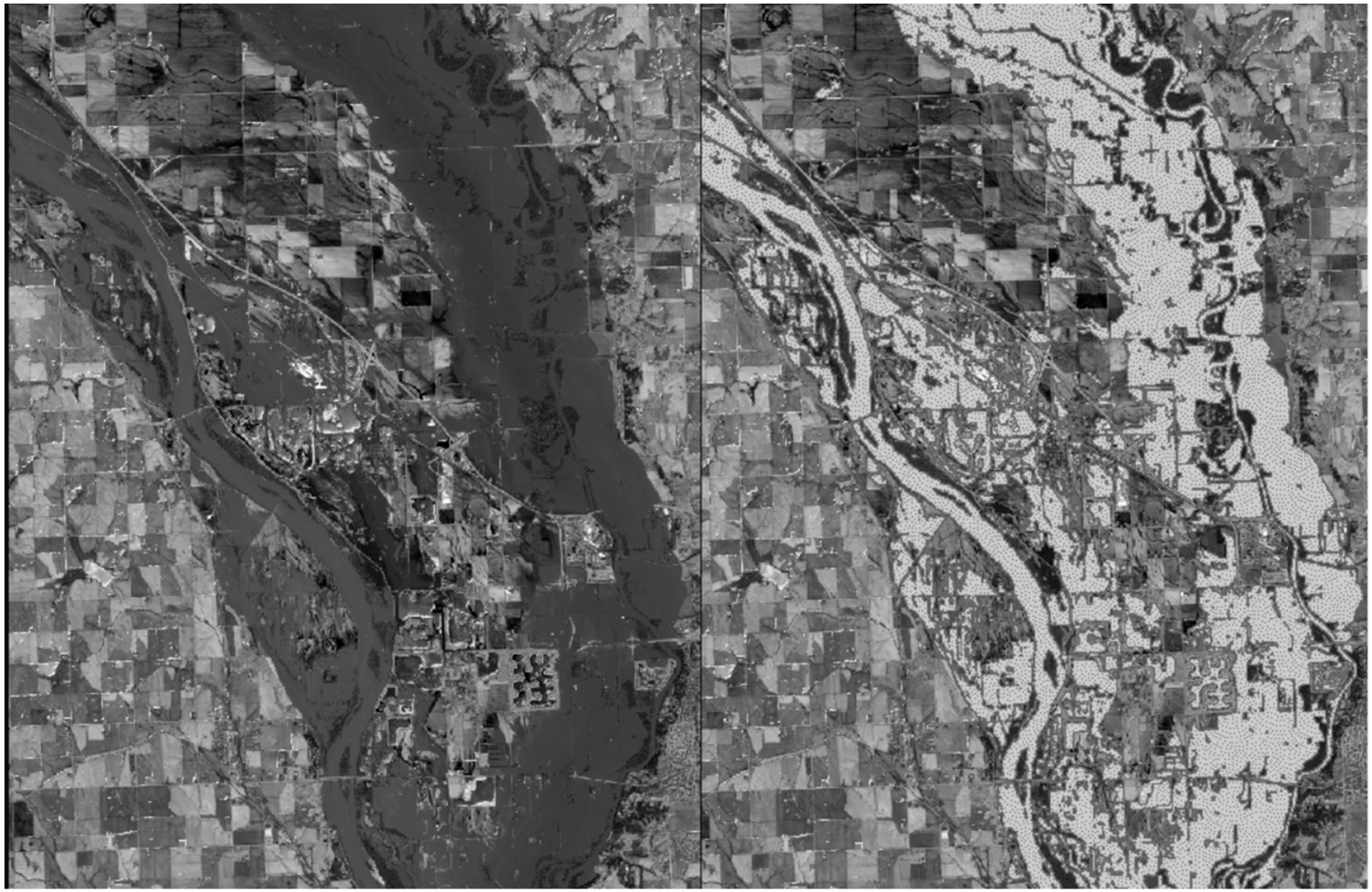
High Water Mark observed in Nebraska City, Nebraska.

More than 700 High Water Marks were collected by the Nebraska Department of Natural Resources (NeDNR), USGS, USACE, NRCS, Lower Loup NRD and several local communities.



These locations are then surveyed to record a flood elevation that will be used to protect communities against future flooding events.

Created flood inundation digital boundaries to record the extent of the flood



Compared actual flooding with existing floodplain maps

Flooding and future water planning efforts

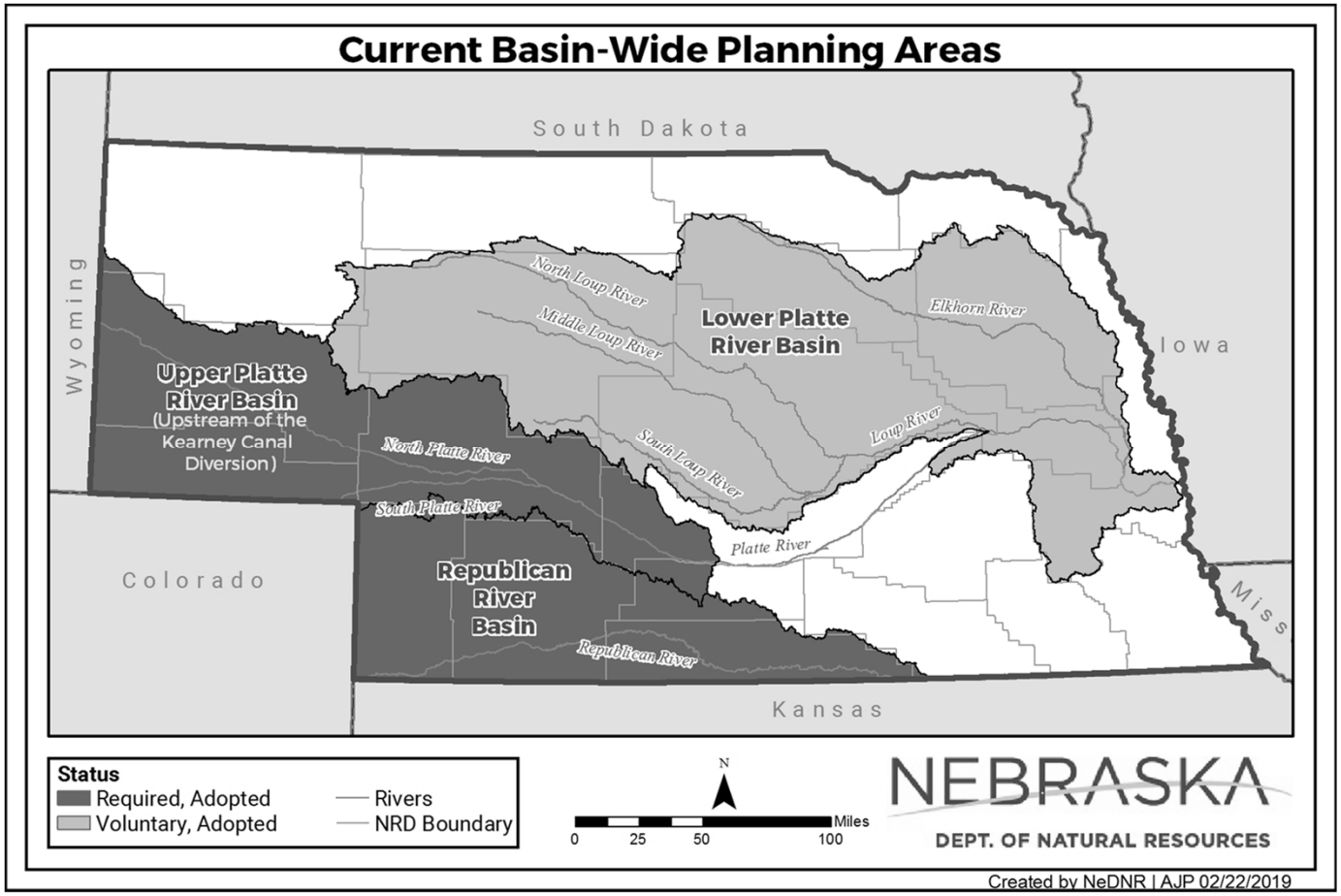
- Develop new flood maps and specifications

- Consider the potential for increased climate variability
  - What if floods become more frequent?
  - What if we experience prolonged drought?

- Diversify water sources

- Missouri River management
  - Governor seeking greater state role in river management and policies
  - Increasing coordination and dialog with neighboring states

Drought Planning in Nebraska


Current Basin-Wide Planning Areas
South Dakota
Wyoming
Iowa
Colorado
Kansas
Miss
Lower Platte River Basin
Upper Platte River Basin (Upstream of the Kearney Canal Diversion)
Republican River Basin
North Loup River
Middle Loup River
Elkhorn River
Loup River
South Loup River
North Platte River
South Platte River
Platte River
Republican River
Status
Required, Adopted
Voluntary, Adopted
Rivers
NRD Boundary
N
0 25 50 100 Miles
NEBRASKA
DEPT. OF NATURAL RESOURCES
Created by NeDNR | AJP 02/22/2019

THANK YOU

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Story map

- https://storymaps.arcgis.com/stories/9ce70c78f5a44813a326d20035cab95a