Upper Niobrara Basin Integrated Modeling Update

Niobrara Compact Meeting

October 8, 2013 – Conference Call

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Nebraska Department of Natural Resources

Department of Natural Resources

Overview

- Project Purpose & Goals
- Modeling Approach
- Project Status
- Results & Application

Purpose

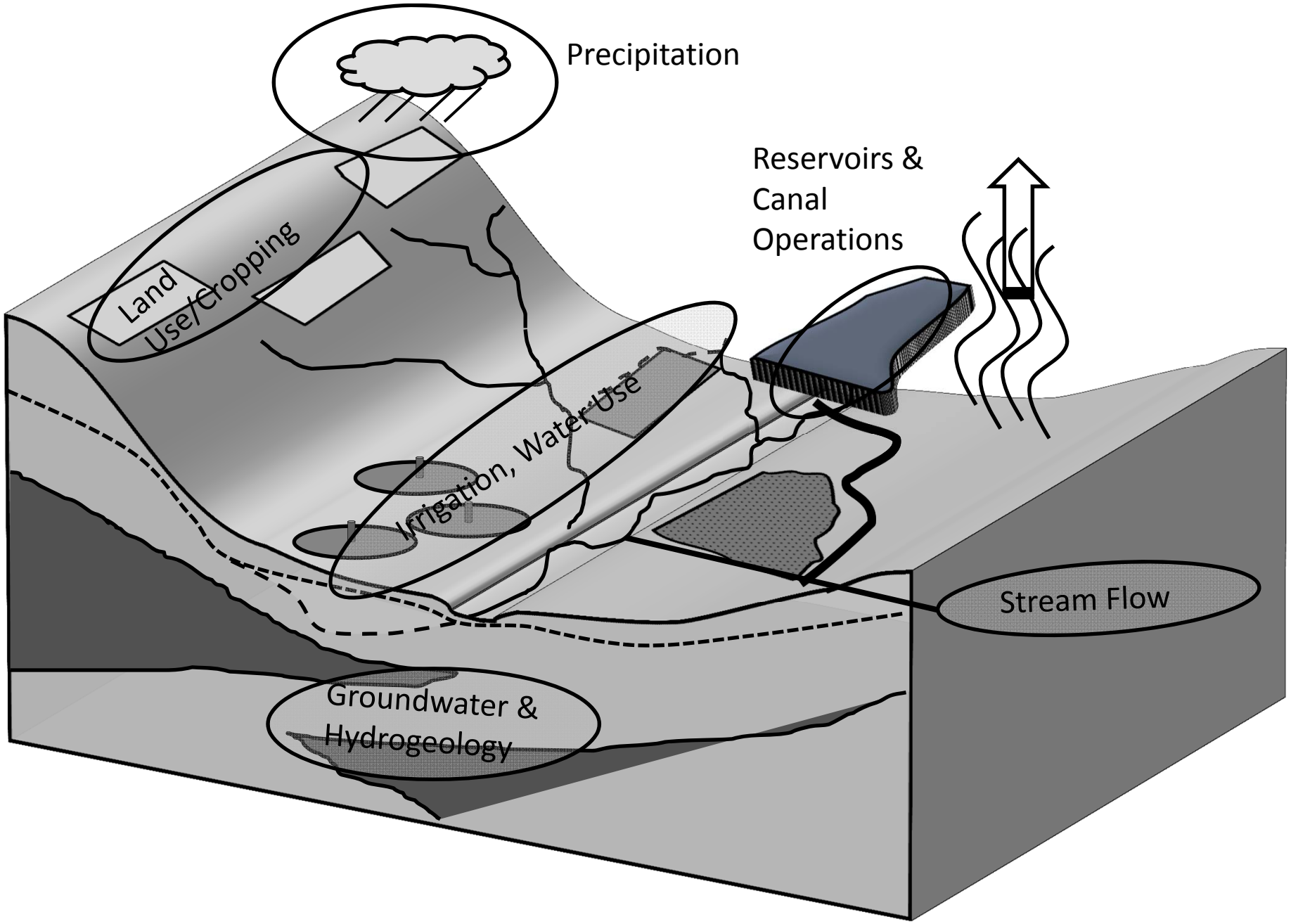
- A tool to inform management of groundwater and surface water
  - Needs to:
    - Establish base for forward-looking analysis
    - Be capable of evaluating conjunctive management scenarios
  - Requires such things as:
    - Quantifying uses, demands, supplies
    - Quantify and assess impacts to Niobrara River, groundwater from historic development

Additional Purposes

- Satisfy US Bureau of Reclamation WaterSMART grant
  - Modeling for upper Niobrara basin a part of basin-wide efforts
  - Tools to assess regional, basin water supply and management

Integrated Model:
Concept & Construction

MMM3

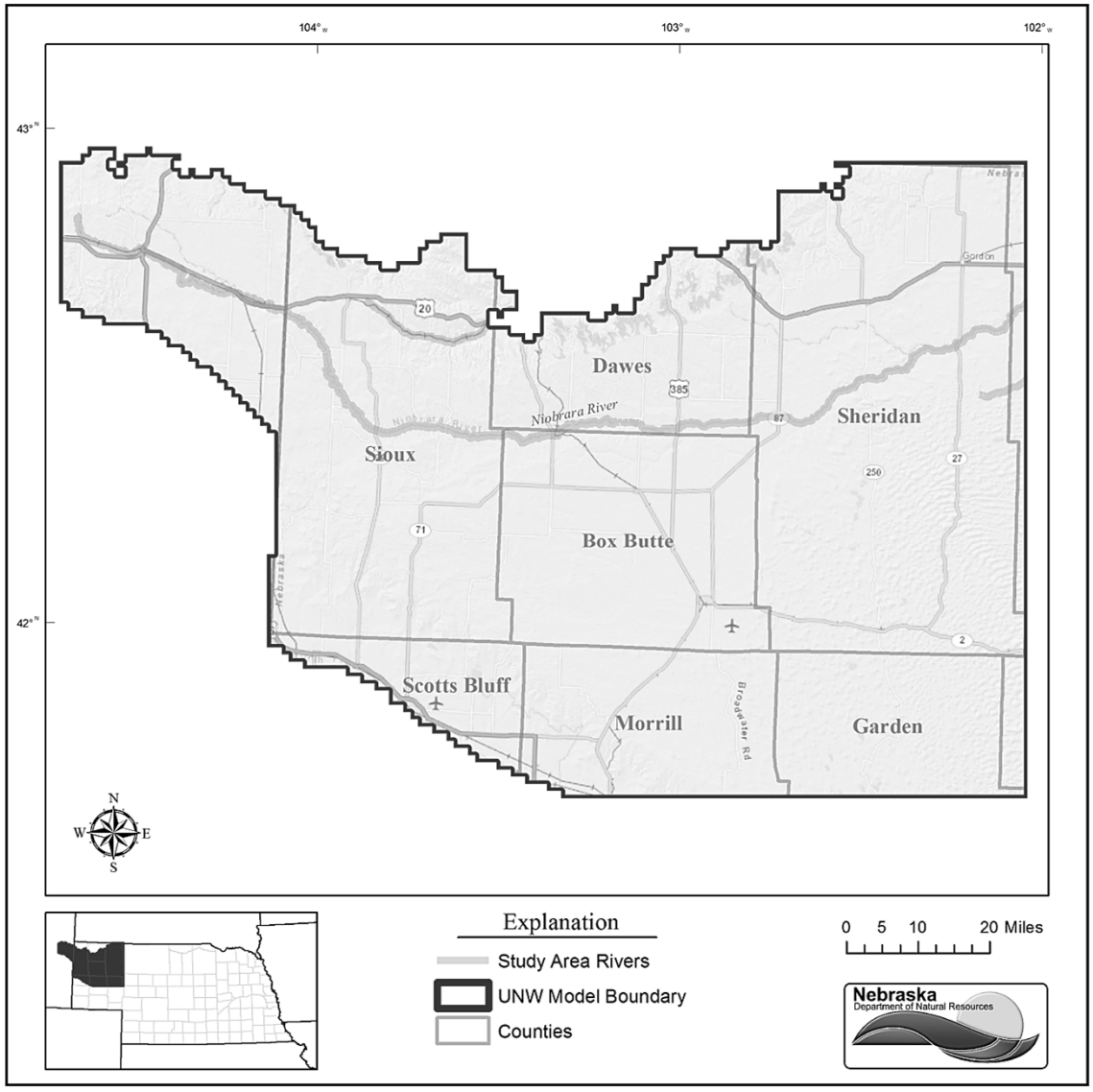

Precipitation
Reservoirs &
Canal
Operations
Land
Use/Cropping
Irrigation, Water Use
Stream Flow
Groundwater &
Hydrogeology

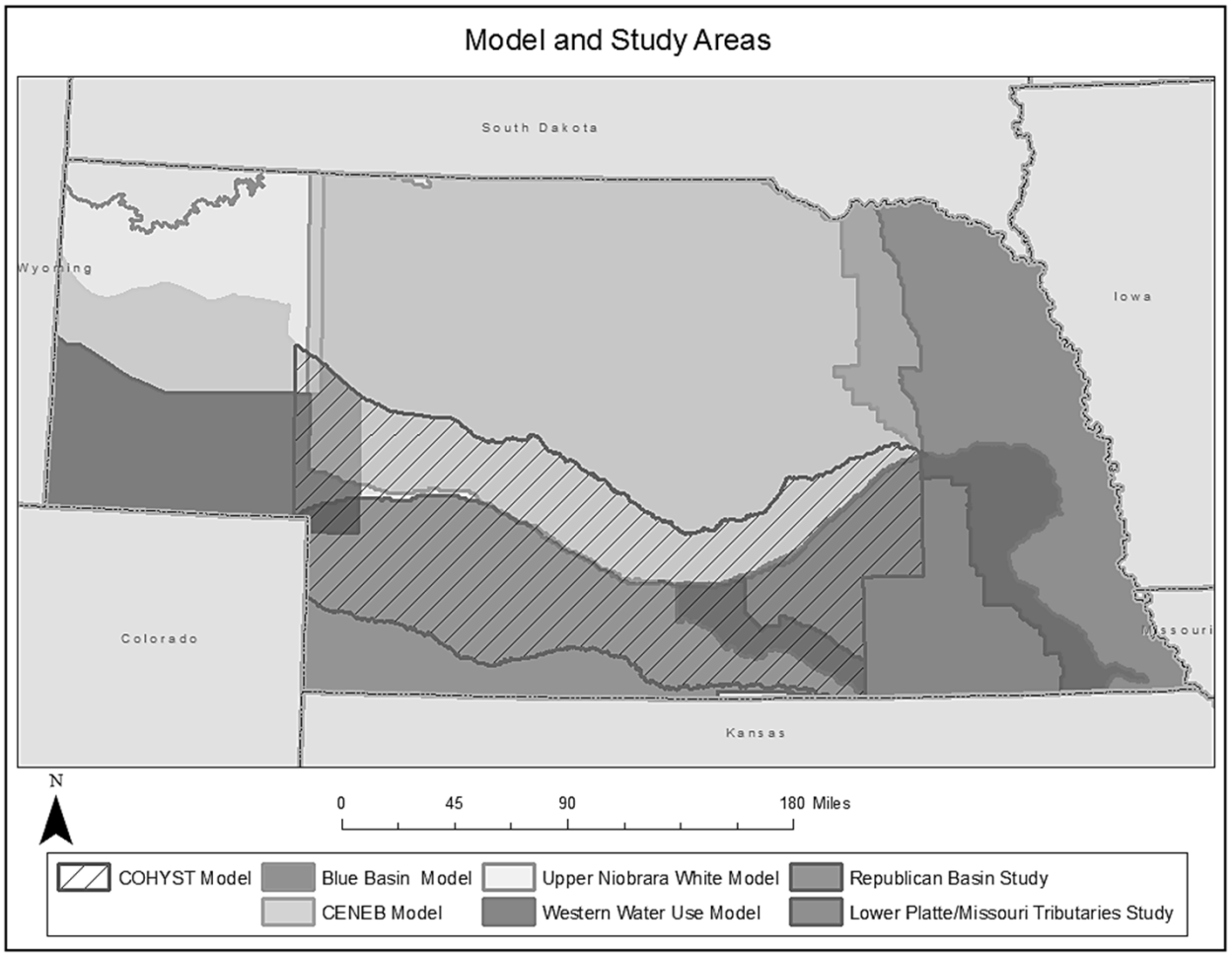
Slide 6

MMM3 delete slide

Mosier, Melissa, 10/7/2013

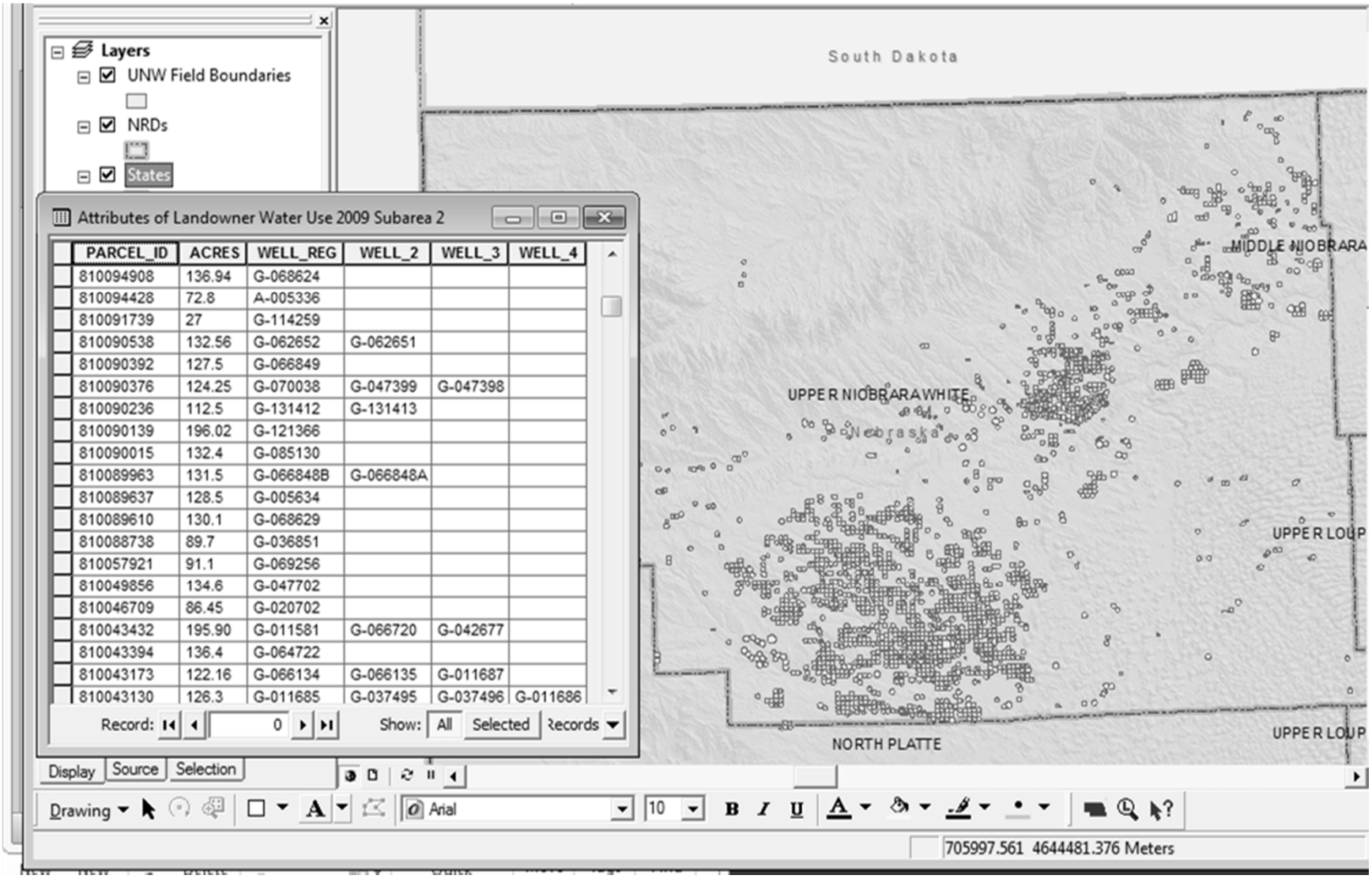
Upper Niobrara White Basin Model Area



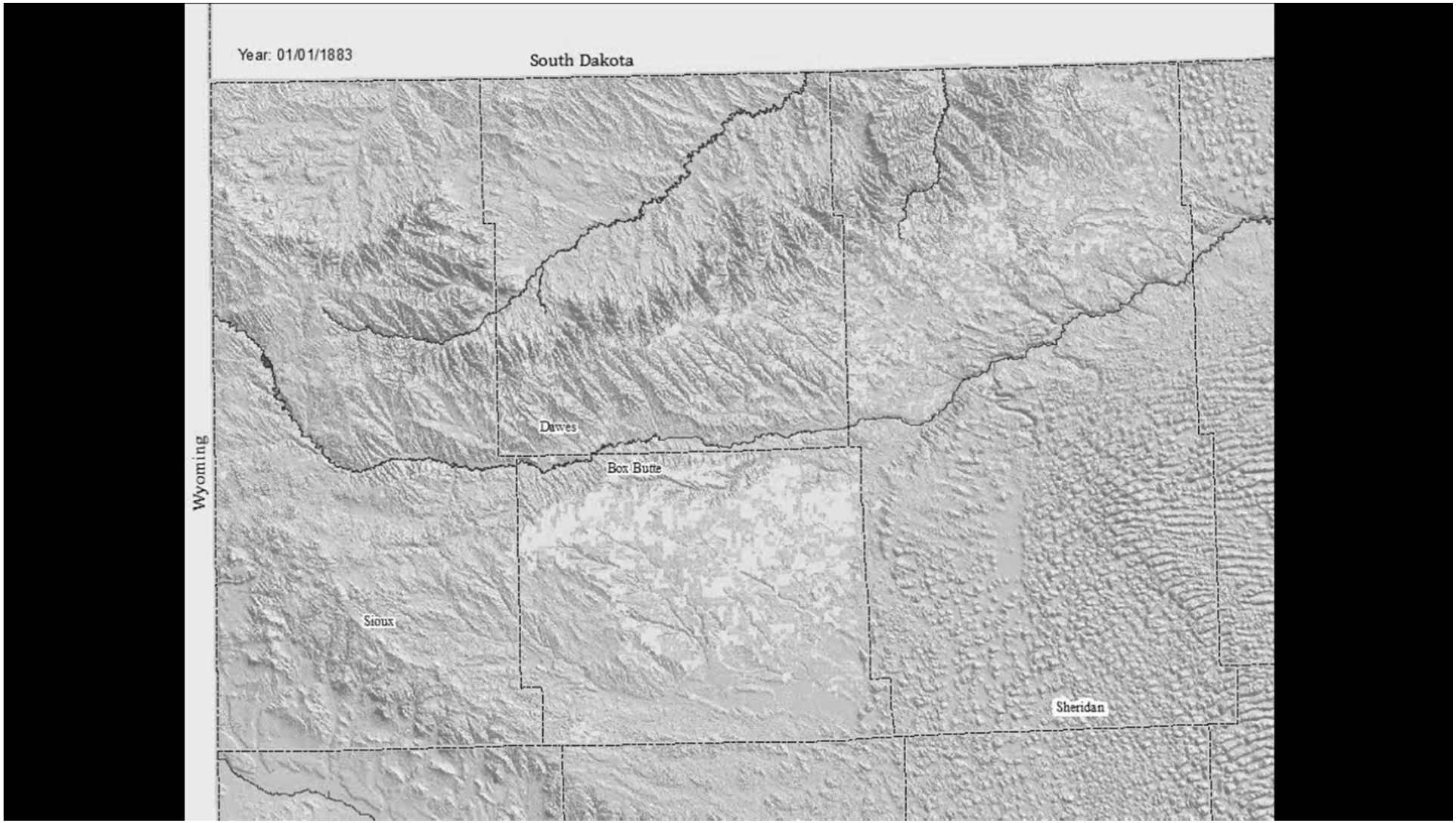


DNR Model Areas

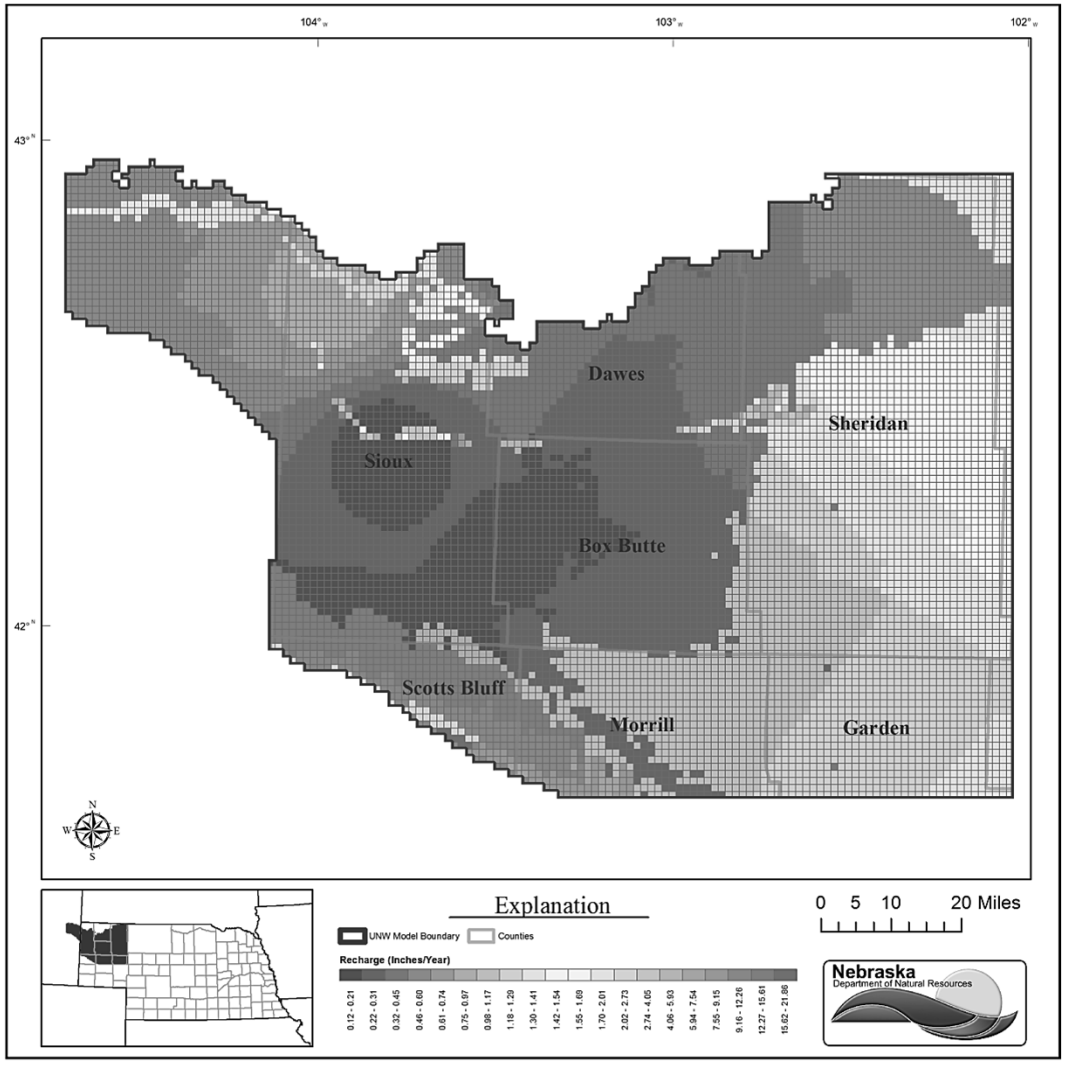
UNWNRD Certified Acres Dataset



Modeling Concept: At the Land Surface

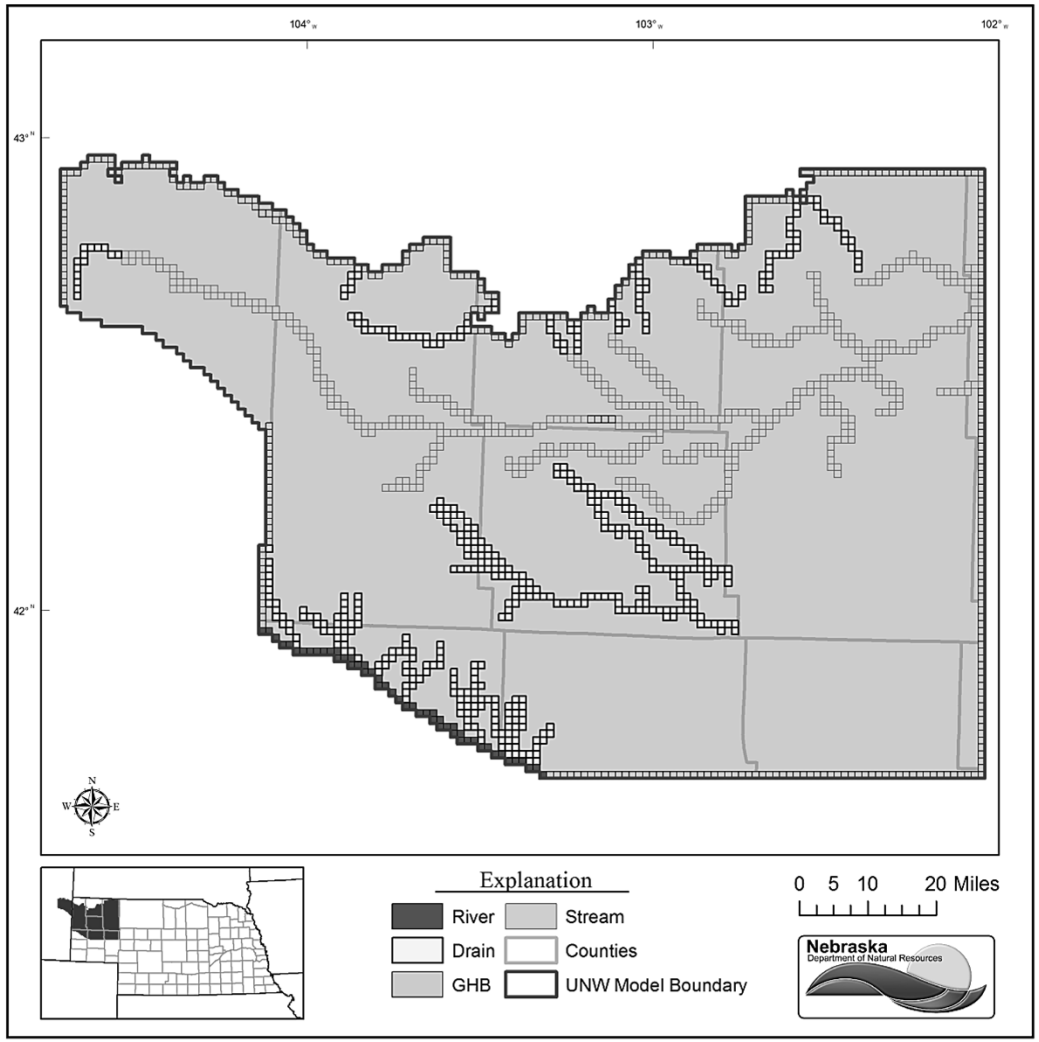


Recharge


104° W
103° W
102° W
43° N
42° N
Dawes
Sheridan
Sioux
Box Butte
Scotts Bluff
Morrill
Garden
N
W
E
S
Explanation
UNW Model Boundary
Counties
Recharge (Inches/Year)
0.12 - 0.21
0.22 - 0.31
0.32 - 0.45
0.46 - 0.60
0.61 - 0.74
0.75 - 0.97
0.98 - 1.17
1.18 - 1.29
1.30 - 1.41
1.42 - 1.54
1.55 - 1.69
1.70 - 2.01
2.02 - 2.73
2.74 - 4.05
4.06 - 5.93
5.94 - 7.54
7.55 - 9.15
9.16 - 12.26
12.27 - 15.61
15.62 - 21.86
0 5 10 20 Miles
Nebraska
Department of Natural Resources

Models:
MODFLOW & Stella

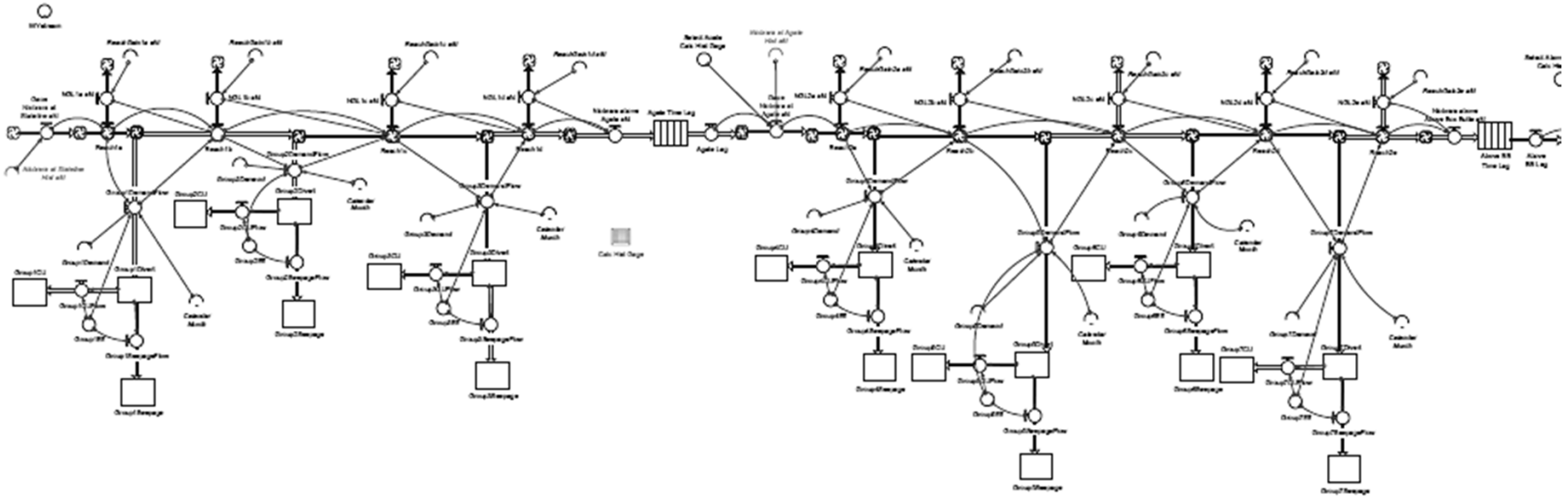
Model Boundaries



Modeling Concept: In the Rivers, Canals

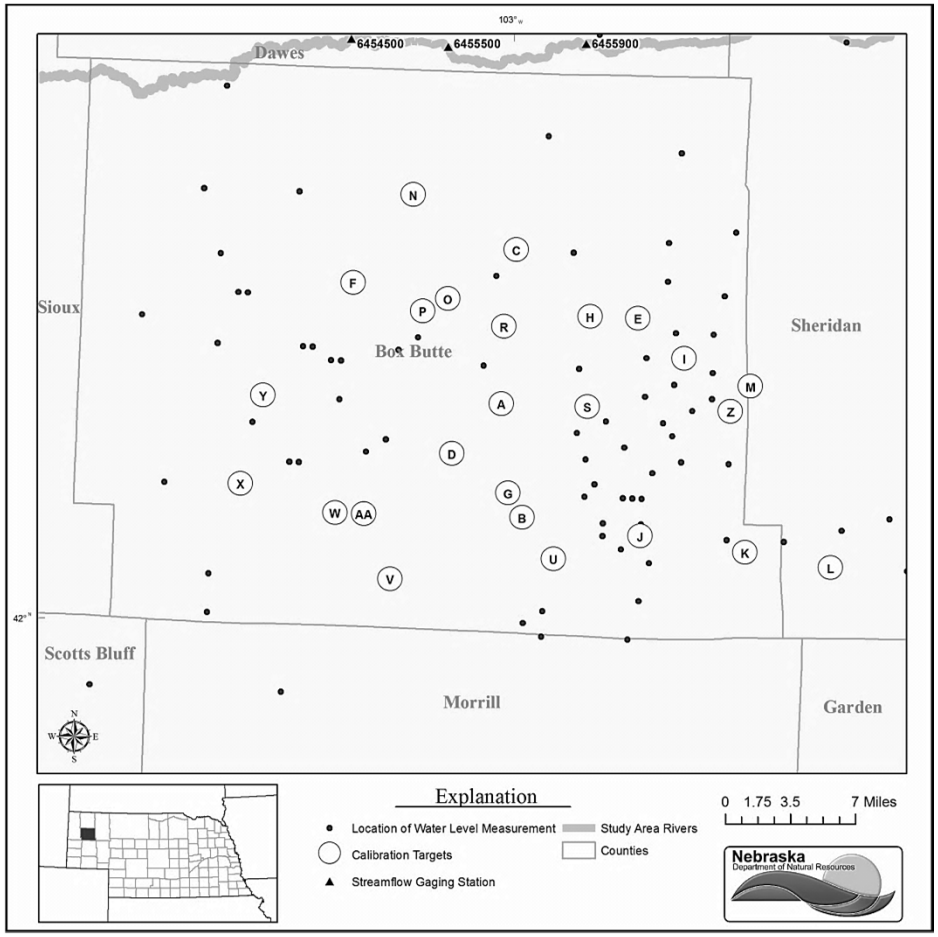
- STELLA operations
  - Track how surface water is stored and moved through canal and reservoir infrastructure
    - *Track/simulate diversions*
    - *Estimate Box Butte Reservoir operations*
  - Feedback to CROPSIM, groundwater models

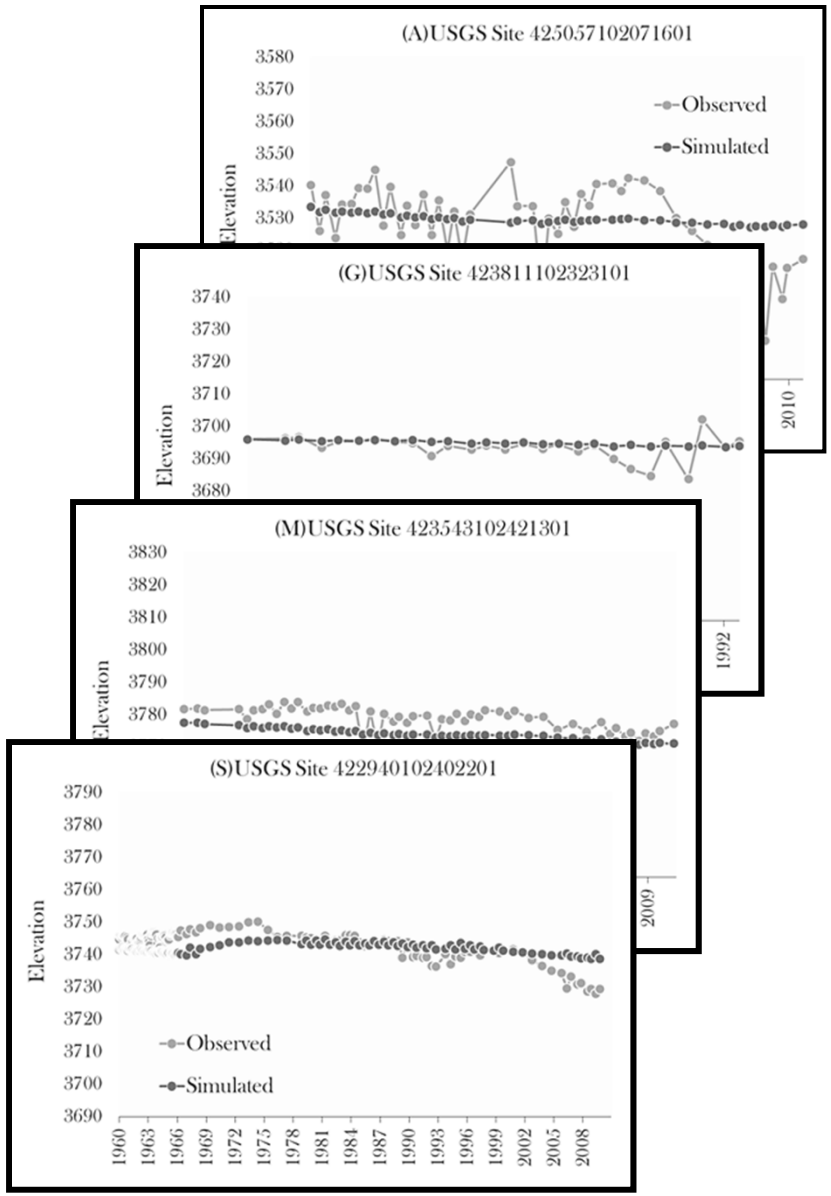
Modeling Concept: In the Rivers, Canals



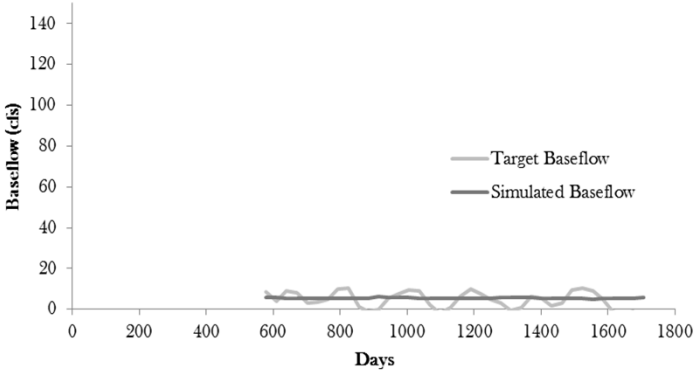
Model & Project Status

Calibration

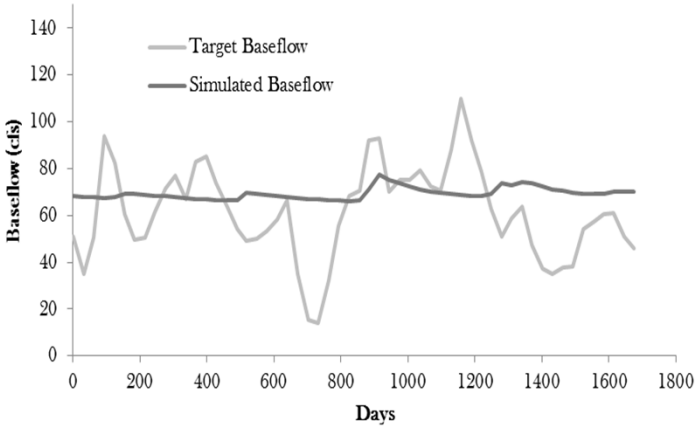




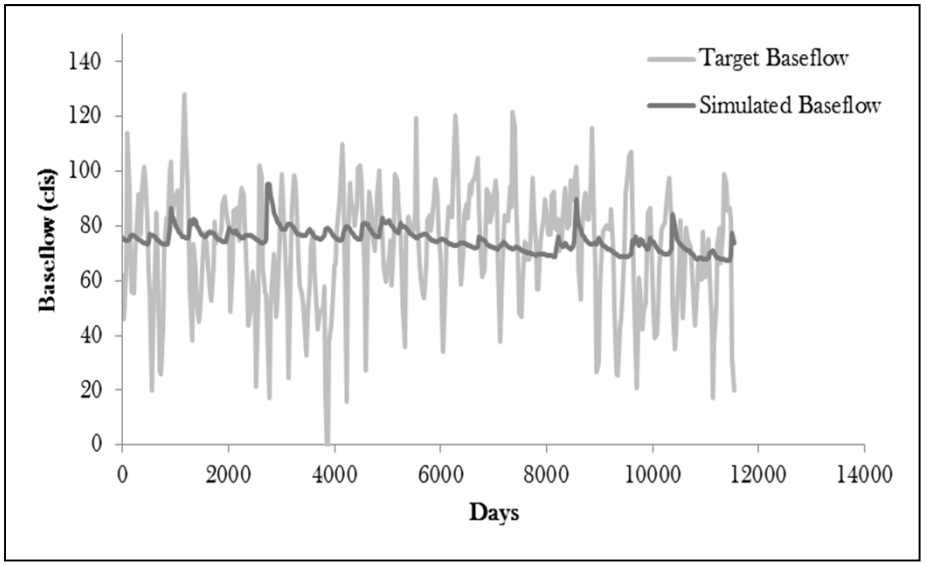
Calibration



Simulated baseflow versus target baseflow gain in the Duncan to Hay Springs reach

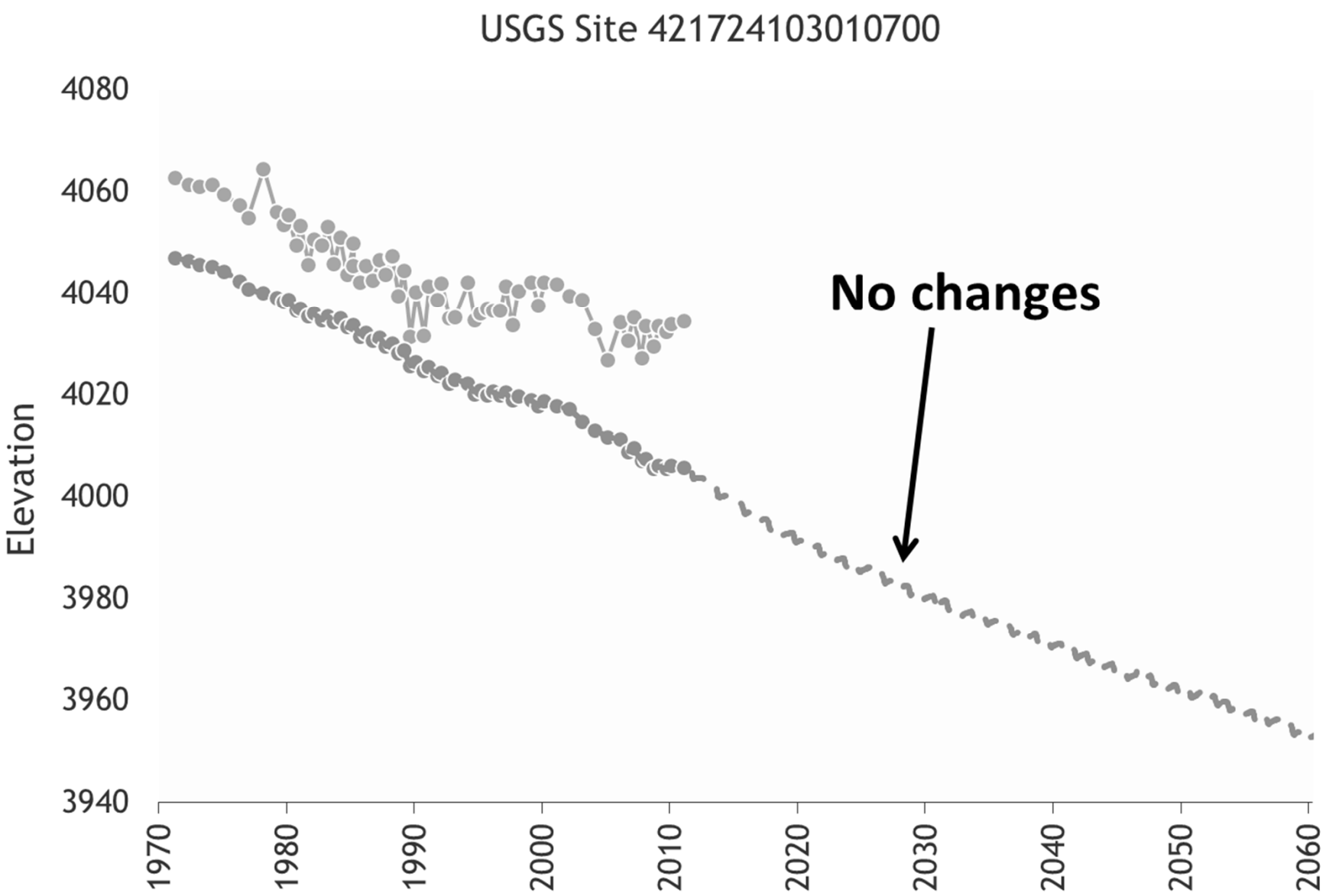


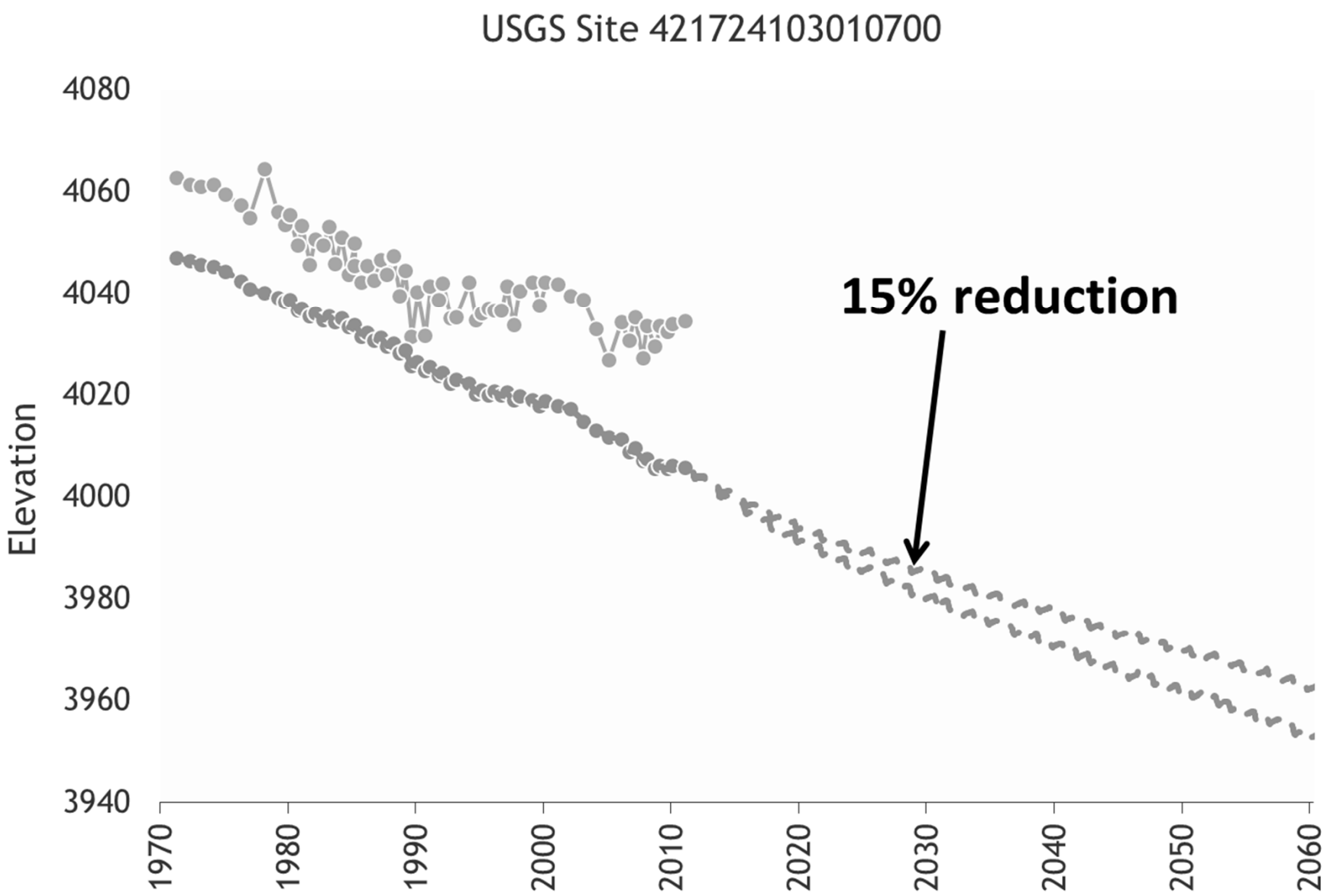
Simulated baseflow versus target baseflow gain in the Hay Springs to Gordon reach



Simulated baseflow versus target baseflow gain in the above Box Butte to above Gordon reach

Analysis:
Ok, so what does it mean?


USGS Site 421724103010700
Elevation
4080
4060
4040
4020
4000
3980
3960
3940
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
No changes


USGS Site 421724103010700
Elevation
4080
4060
4040
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4000
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1970
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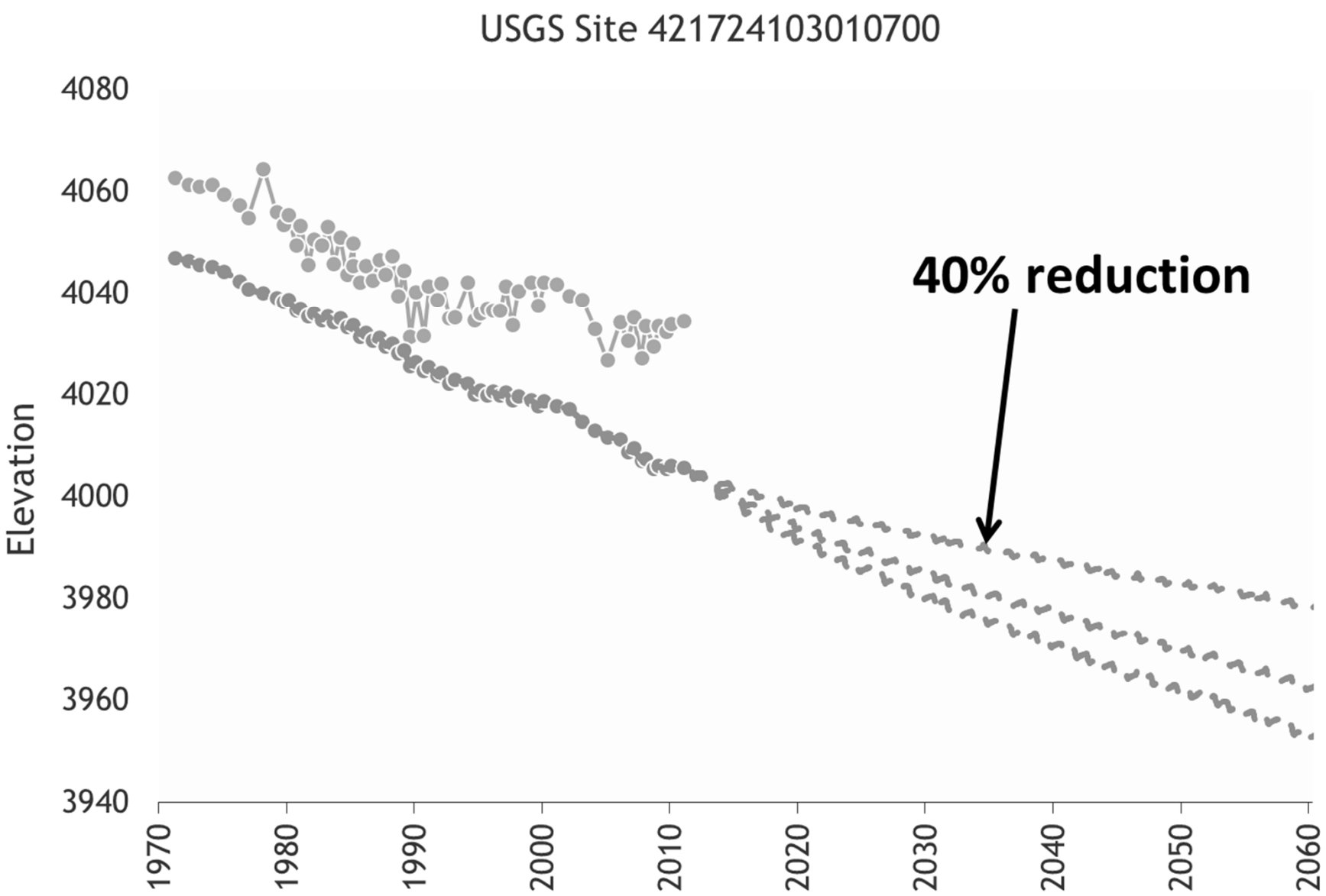
2030
2040
2050
2060
15% reduction


USGS Site 421724103010700
Elevation
4080
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4000
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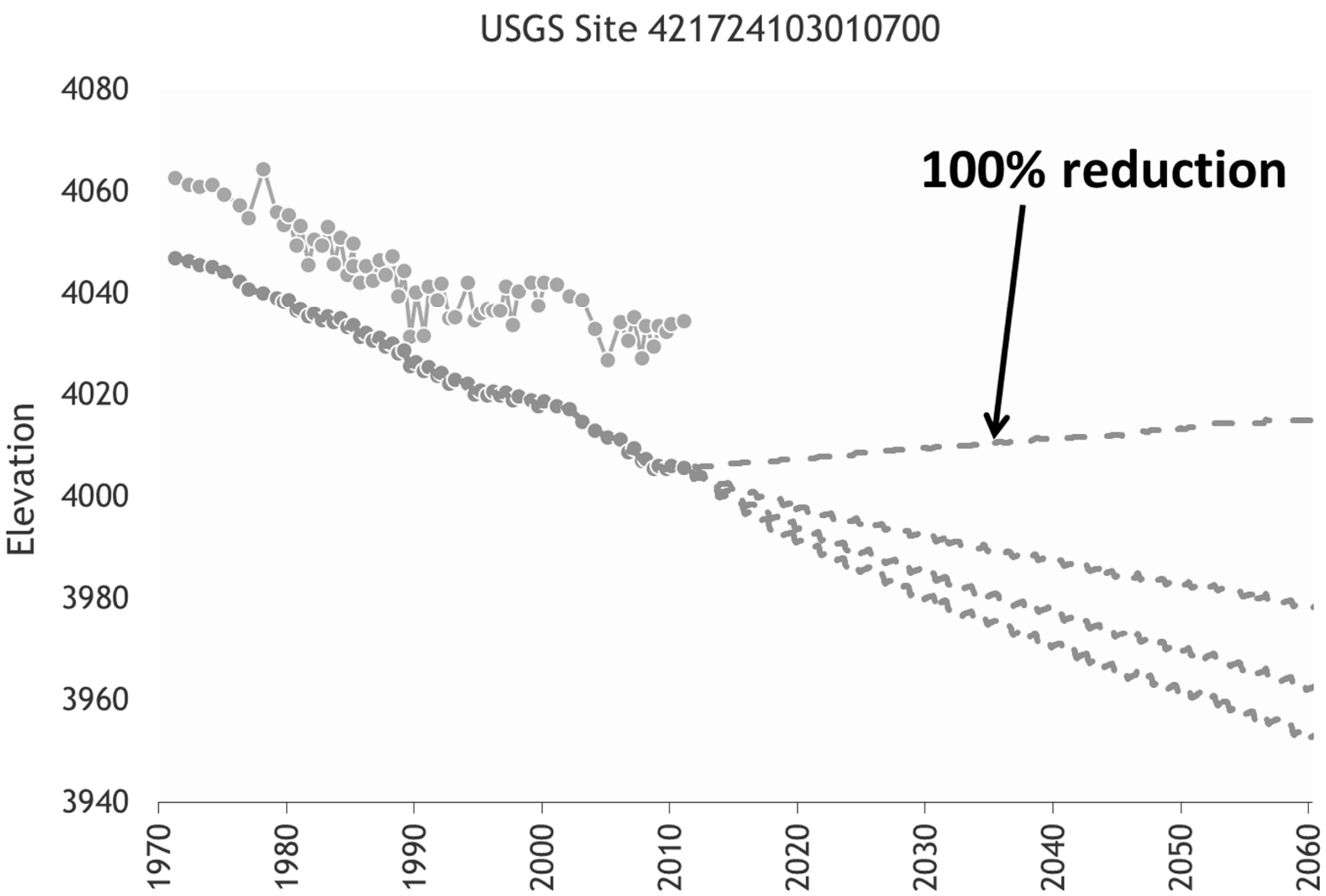
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
40% reduction

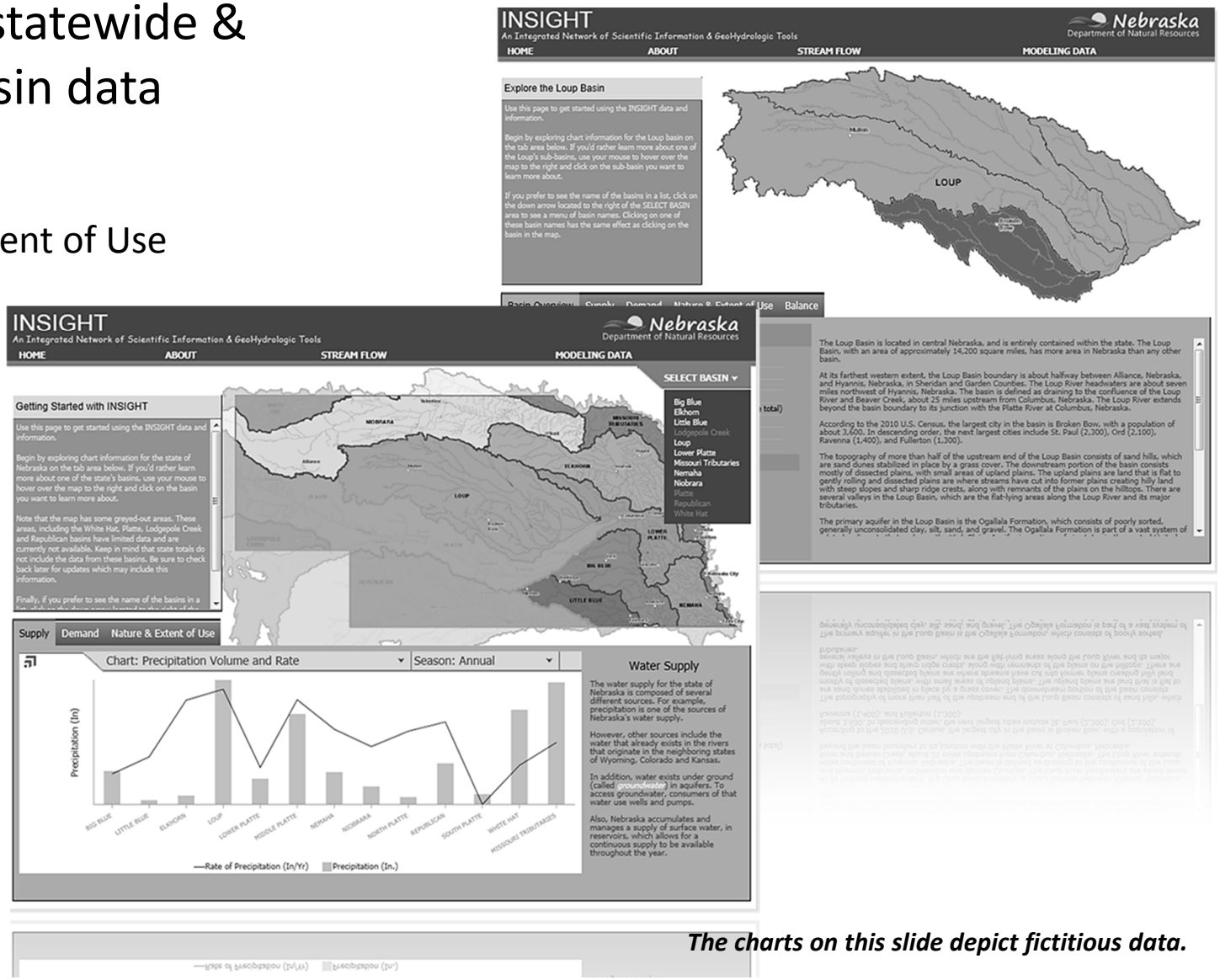

USGS Site 421724103010700
100% reduction
Elevation
4080
4060
4040
4020
4000
3980
3960
3940
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060

INSIGHT

Integrated Network of Scientific Information & GeoHydrologic Tools

INSIGHT

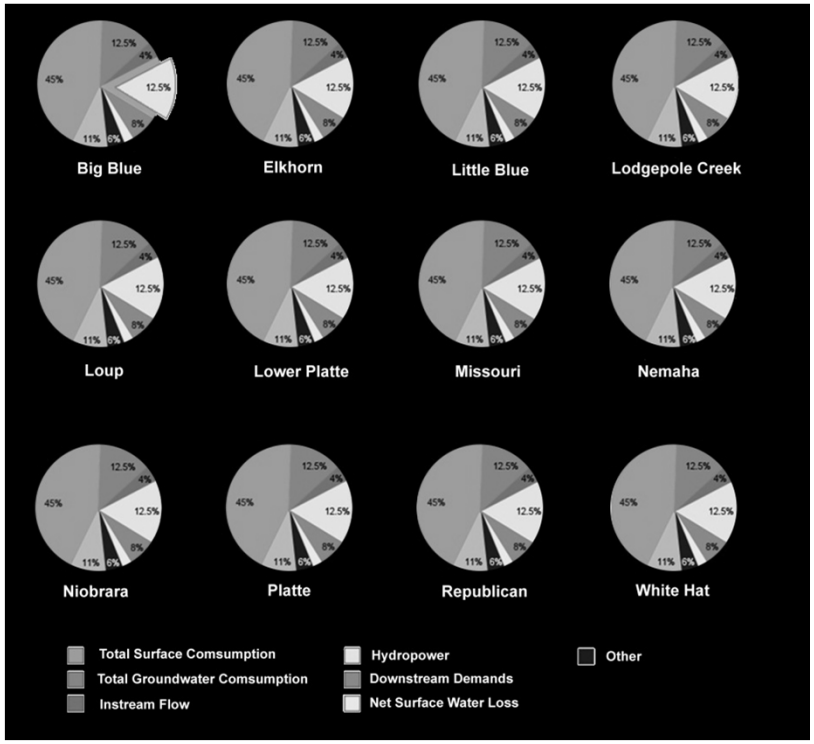
- Summary of statewide & basin/sub-basin data
  - ✓ Supply
  - ✓ Demand
  - ✓ Nature & Extent of Use
  - ✓ Balance



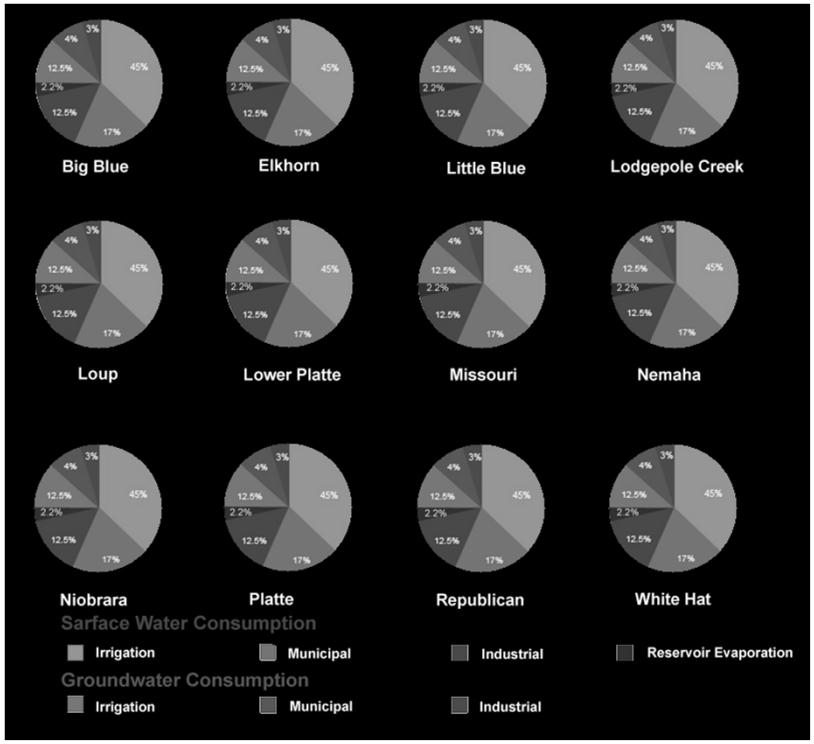
The charts on this slide depict fictitious data.

INSIGHT

Average Long-Term Total Demand by Basin by Category



Average Long-Term Surface Water Consumption and Groundwater Consumption by Basin by Category



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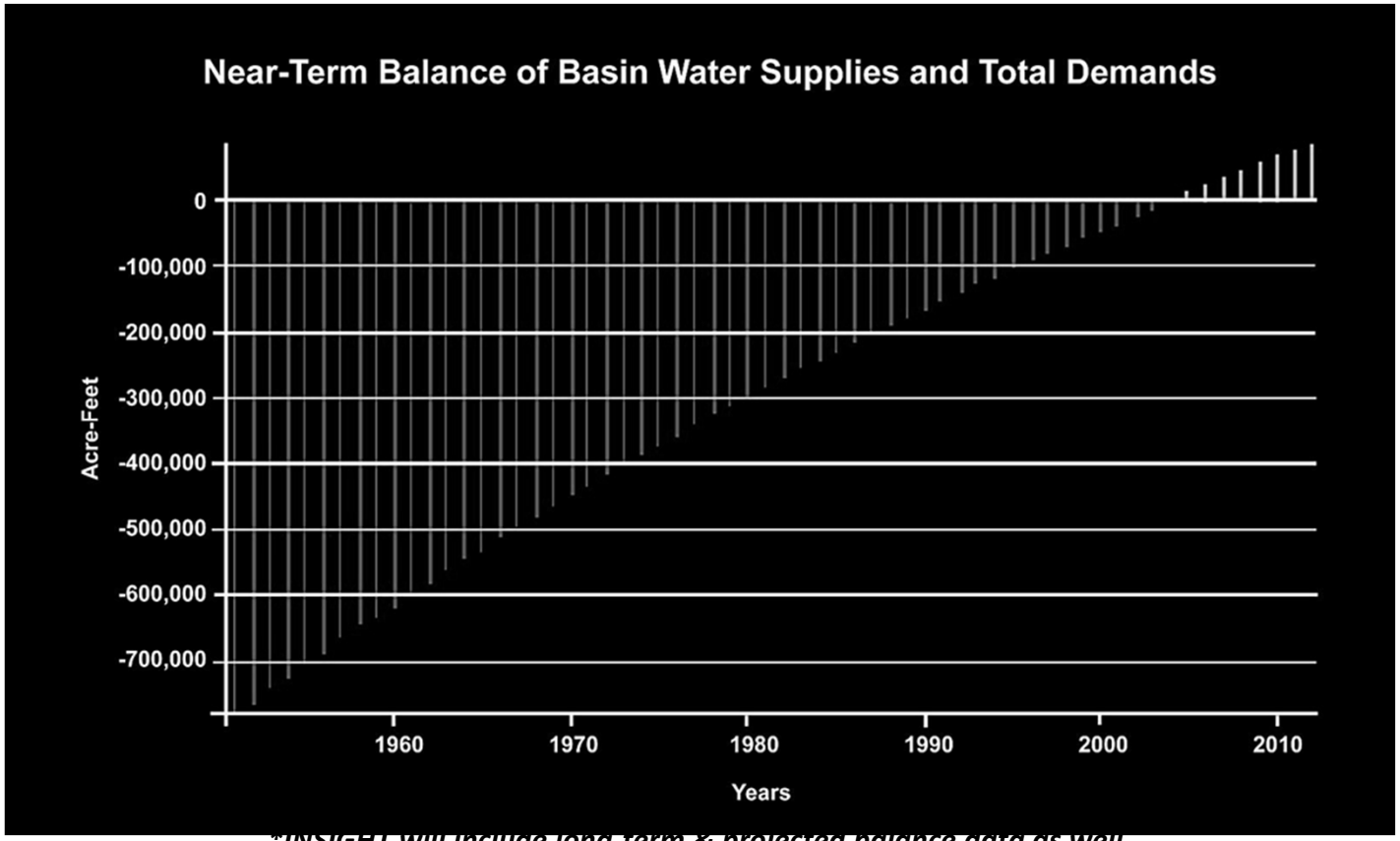
INSIGHT



INSIGHT will include long-term & projected balance data as well.

The chart on this slide depicts fictitious data.

Project Status

- Peer Review--Complete
- Final Report--Available prior to end of year
- WaterSMART--Alternative identification
- INSIGHT Web Portal
  - Assess Data, Summaries, and Information