2023 Spring Static Water Level Monitoring Program

LOWERLOUP
NATURAL RESOURCES DISTRICT

2023 Static Water Level Summary

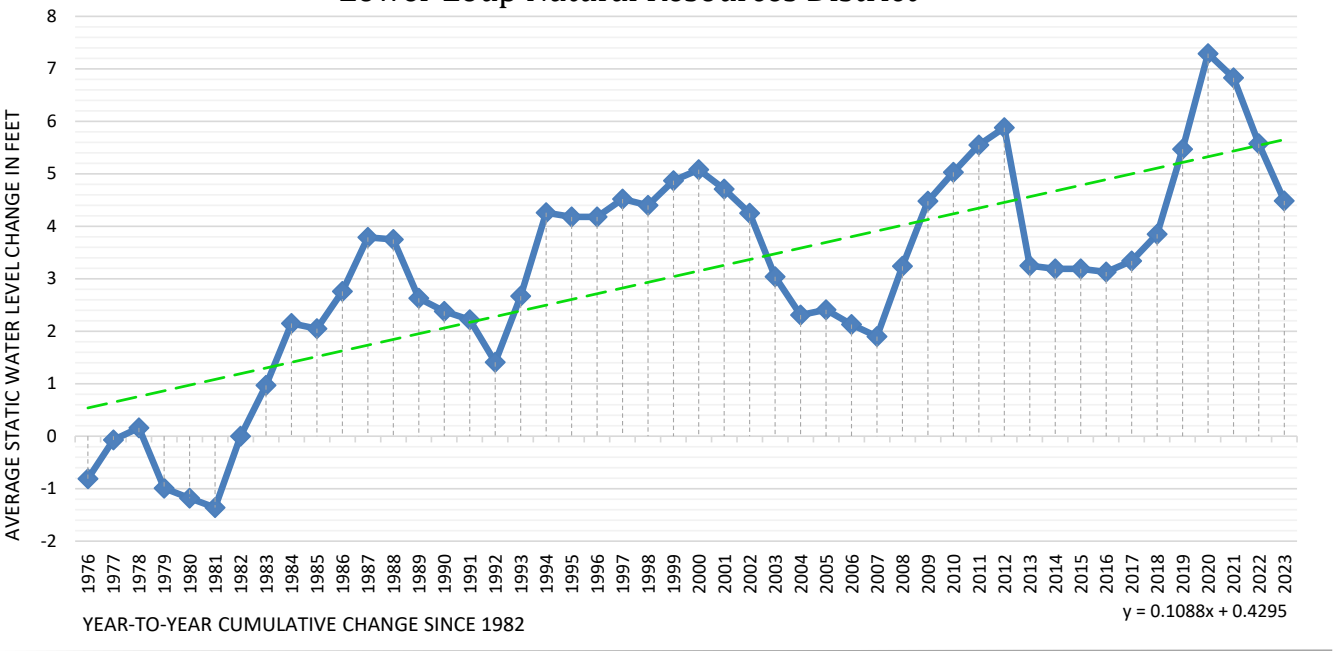
LLNRD staff collected static water levels on 453 irrigation and monitoring wells from March 15 – April 4, 2023. When compared to Spring 2022, a total of 362 wells (80%) reported a decline in water levels, with an average change of -1.63 feet. There were 87 wells (20%) had a higher water level reading compared to last year, with an average change of 1.24 feet. All counties in the district reported most locations with lower water levels than last year, including two counties with 100% of locations with lower levels, Buffalo (24/24) and Merrick (5/5). The largest single decrease in a single water level was -13.21 feet lower from a well in central Boone County, while the largest increase was 4.99 feet higher from a well in southeastern Greeley County.

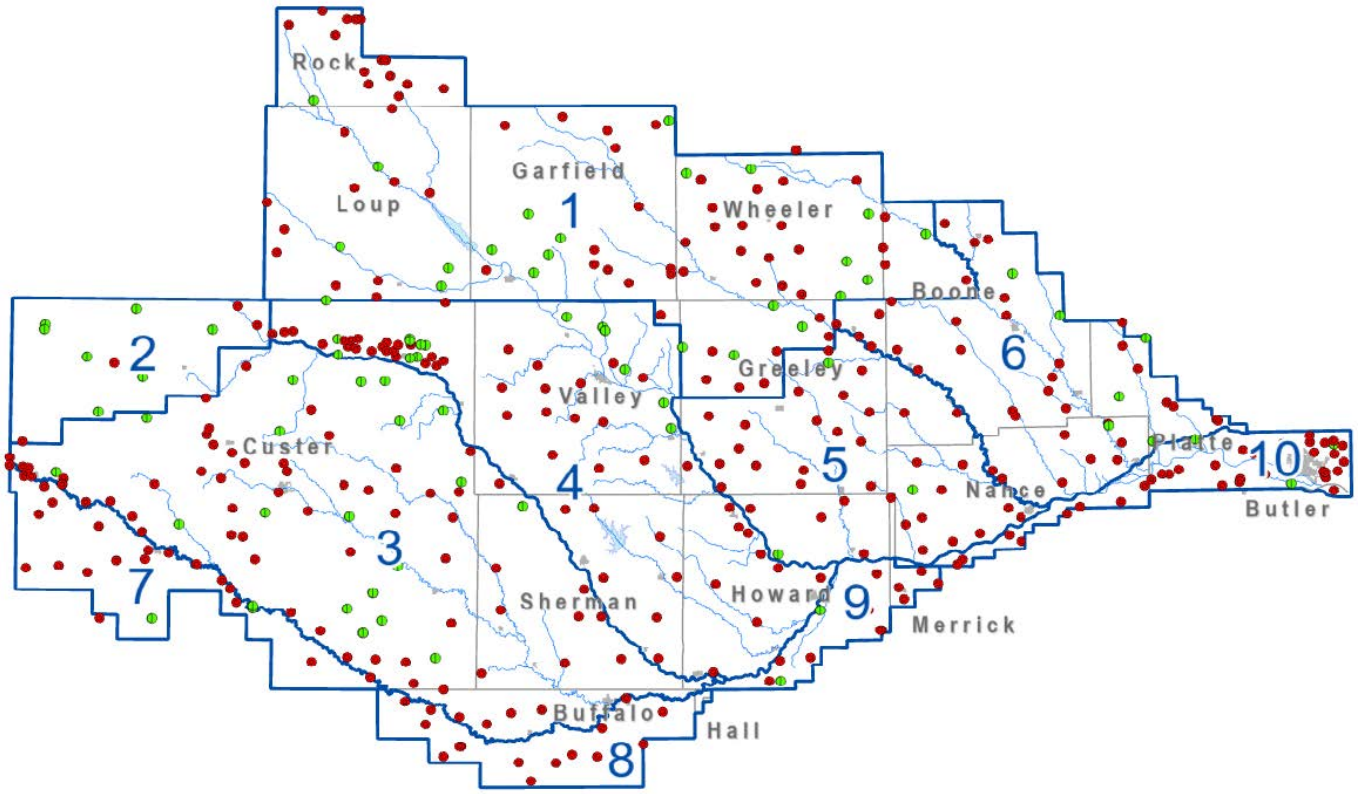
A total of 167 static water level locations measured in Spring 2023 have a historical record dating back to at least 1982, the baseline date for water level comparisons per the LLNRD Groundwater Management Plan. The largest concentration of decreasing water levels continues to be found in southern Custer County and northern Buffalo County, south of the South Loup River. Although a new area in Platte County is starting to show consistent downward levels when compared to 1982. Specifically, five water level locations around the Arnold and Broken Bow areas report declines of over 5 feet, and five water level locations around Pleasanton report declines ranging from 4 – 8 feet with one site showing a decline from 1982 over 18 feet. Conversely, major increases in water levels in Valley County continue to be reported on the magnitude of 35+ feet, where recharge from existing canals and surface water irrigation is abundant.

The “Static Water Level Change – All Years” map included with this report highlights the changes described above, as do the “Change – 1 Year”, “Change – 5 Years” and “Change – 10 Years” maps, which explore water level transitions on more recent measurements. Values from the map titled “Static Water Level Trend – All Years” represents the linear regression coefficient from the observed depth to static water level measurements plotted over time, going back to spring 1982 or when first available. Negative trend values indicate a decrease in depth to water, which represents an increase in water level over time. Furthermore, trend values can be interpreted as an expected increase or decrease in feet of water level. Static water level locations that did not report at least 8 readings (Spring and Fall) in the last 5 years (Fall 2018 through Spring 2023) were not used in the analysis of the “Trend – All Years” map, or the “Change – All Years”, “Change – 10 Years”, and “Change – 5 Years” maps.

Finally, the software used for the spatial interpolation of all static water level maps was Esri ArcGIS Pro v2.9.2 and Spatial Analyst extension. The maps were developed using the inverse distance weighted (IDW) GIS Interpolation method, with default settings. IDW assumes that wells close to one another have more similarities than those that are farther apart. The area between two measured points is assumed to be a value based on the trends calculated on all other wells in proximity.

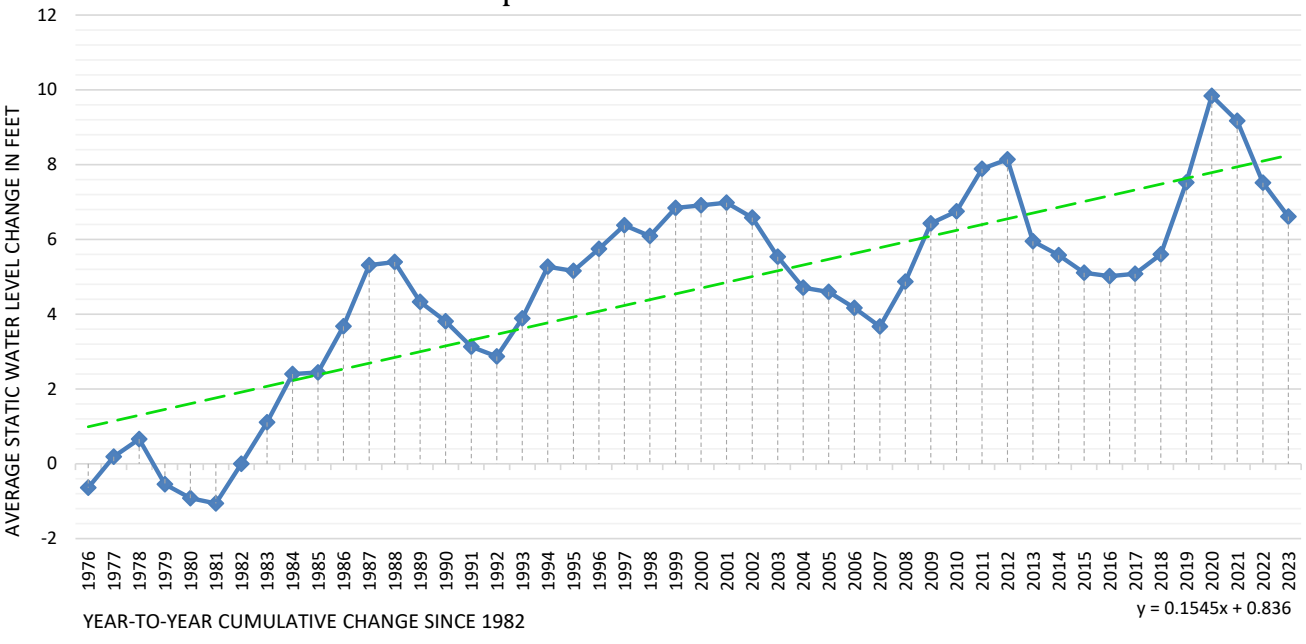
DISTRICT - Spring SWL Trends
Lower Loup Natural Resources District

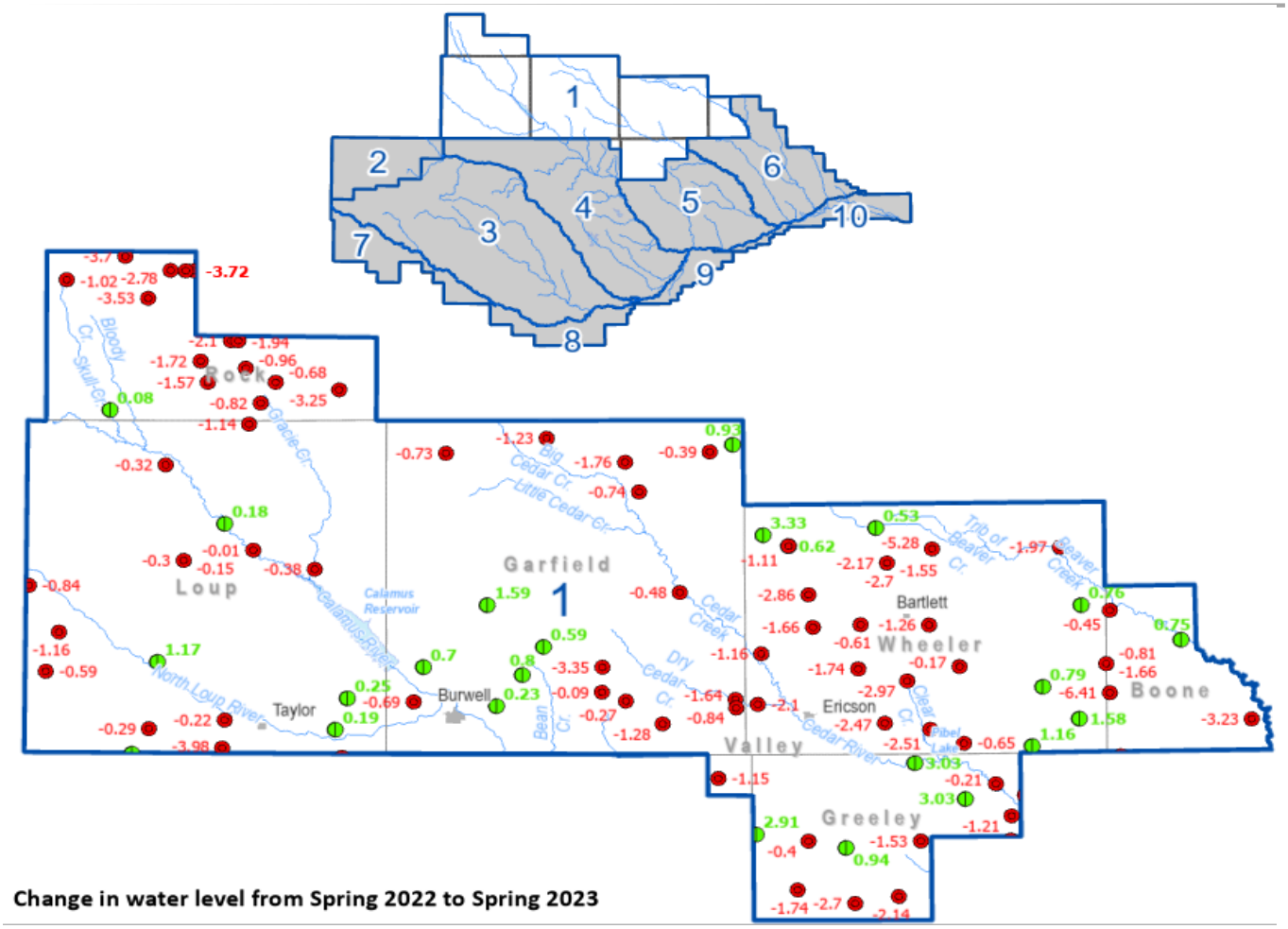




Change in water level from Spring 2022 to Spring 2023 (increasing / no change = green, decreasing = red)

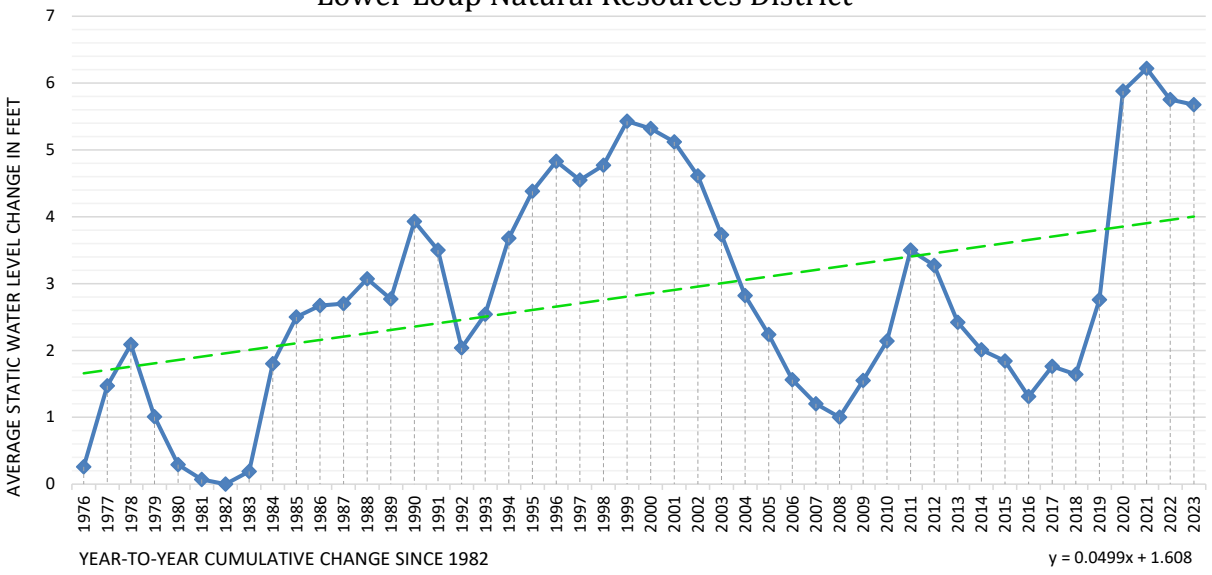
AREA 1 - Spring SWL Trends
Lower Loup Natural Resources District

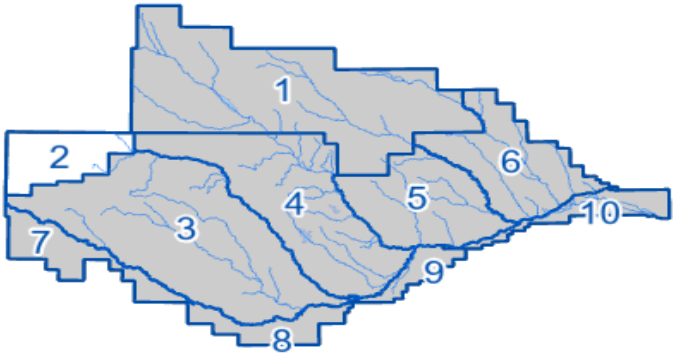


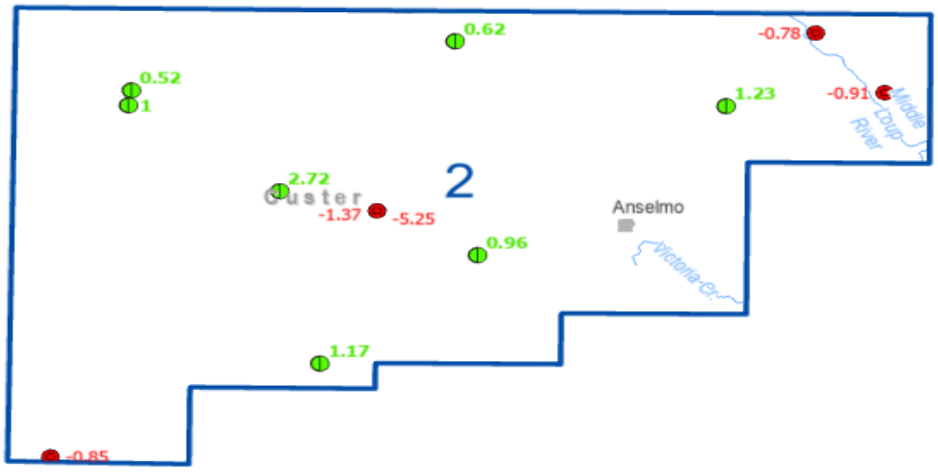


Change in water level from Spring 2022 to Spring 2023

AREA 2 - Spring SWL Trends
Lower Loup Natural Resources District

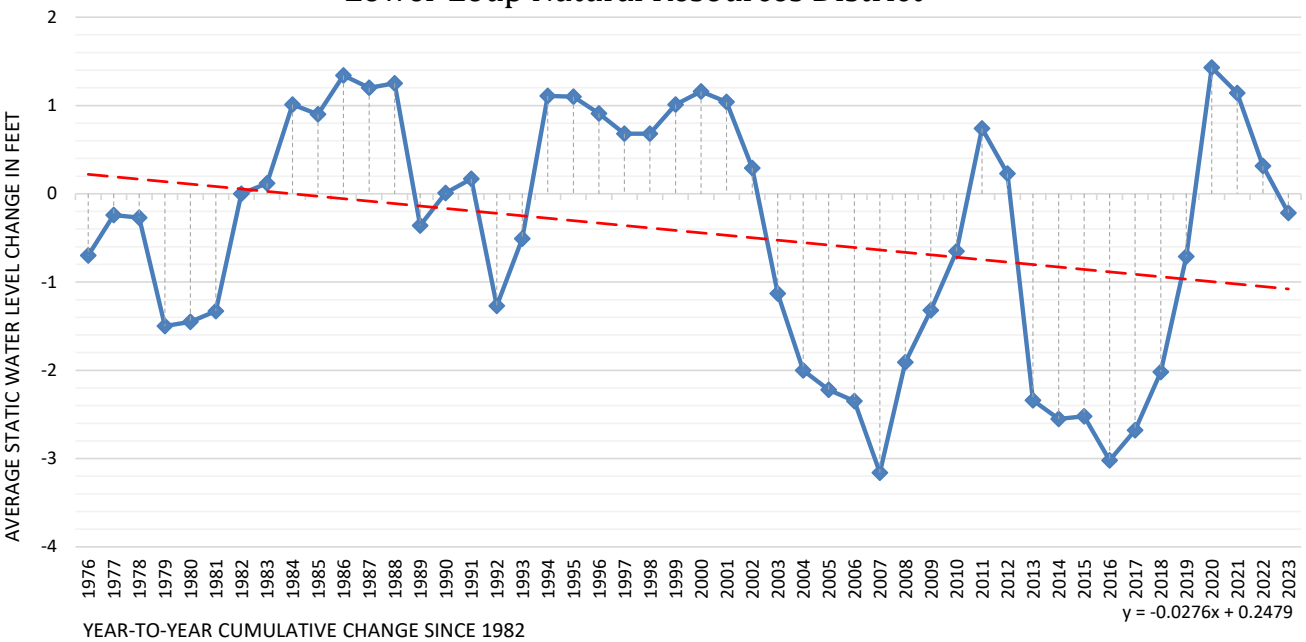


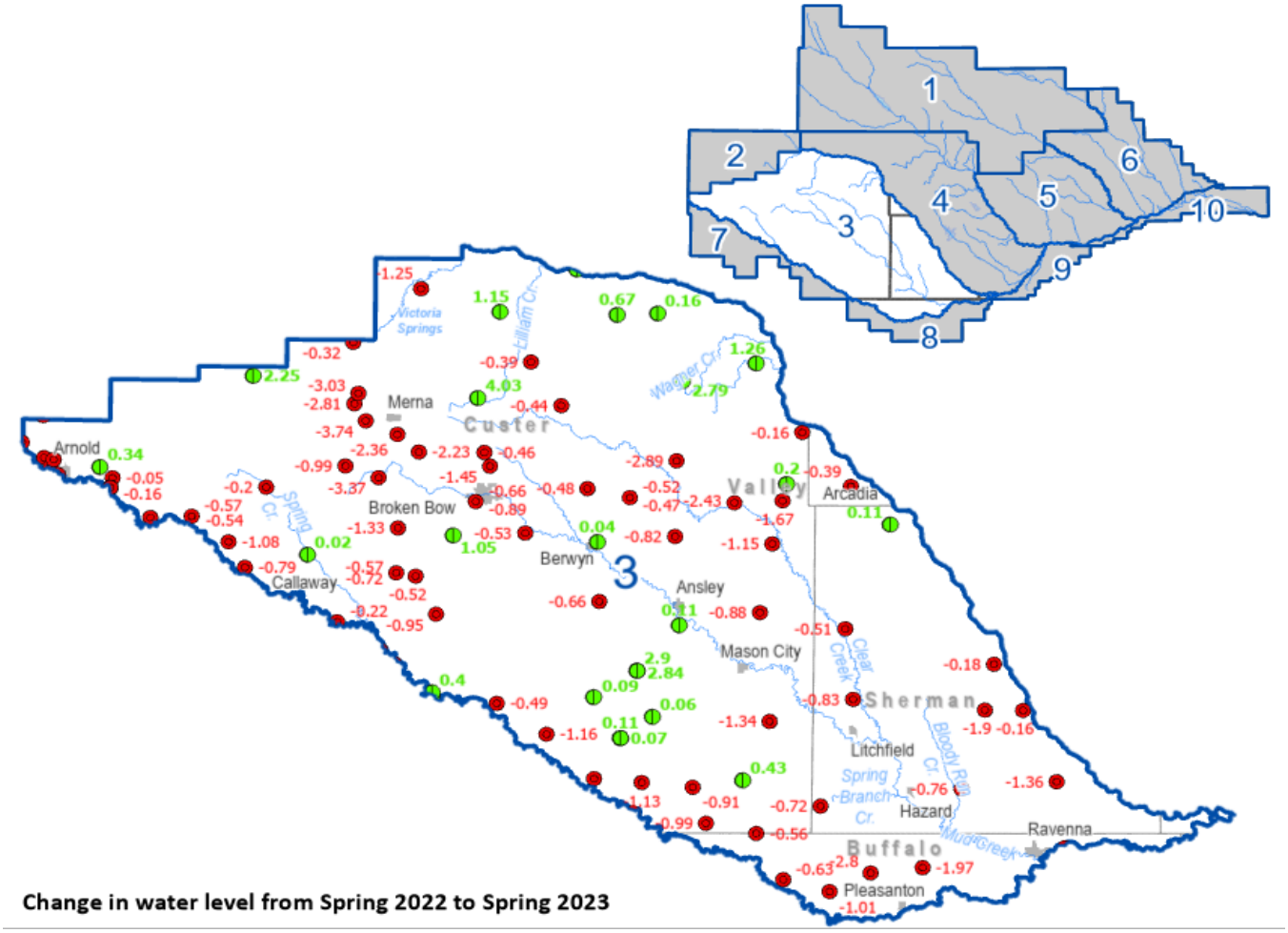




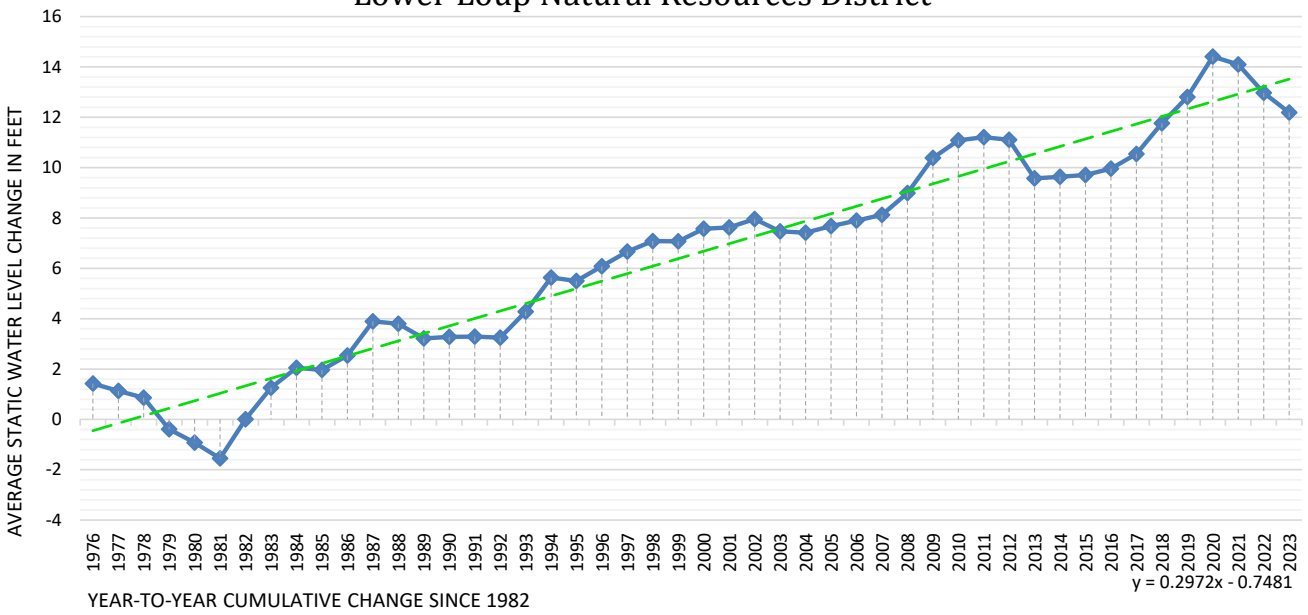
Change in water level from Spring 2022 to Spring 2023

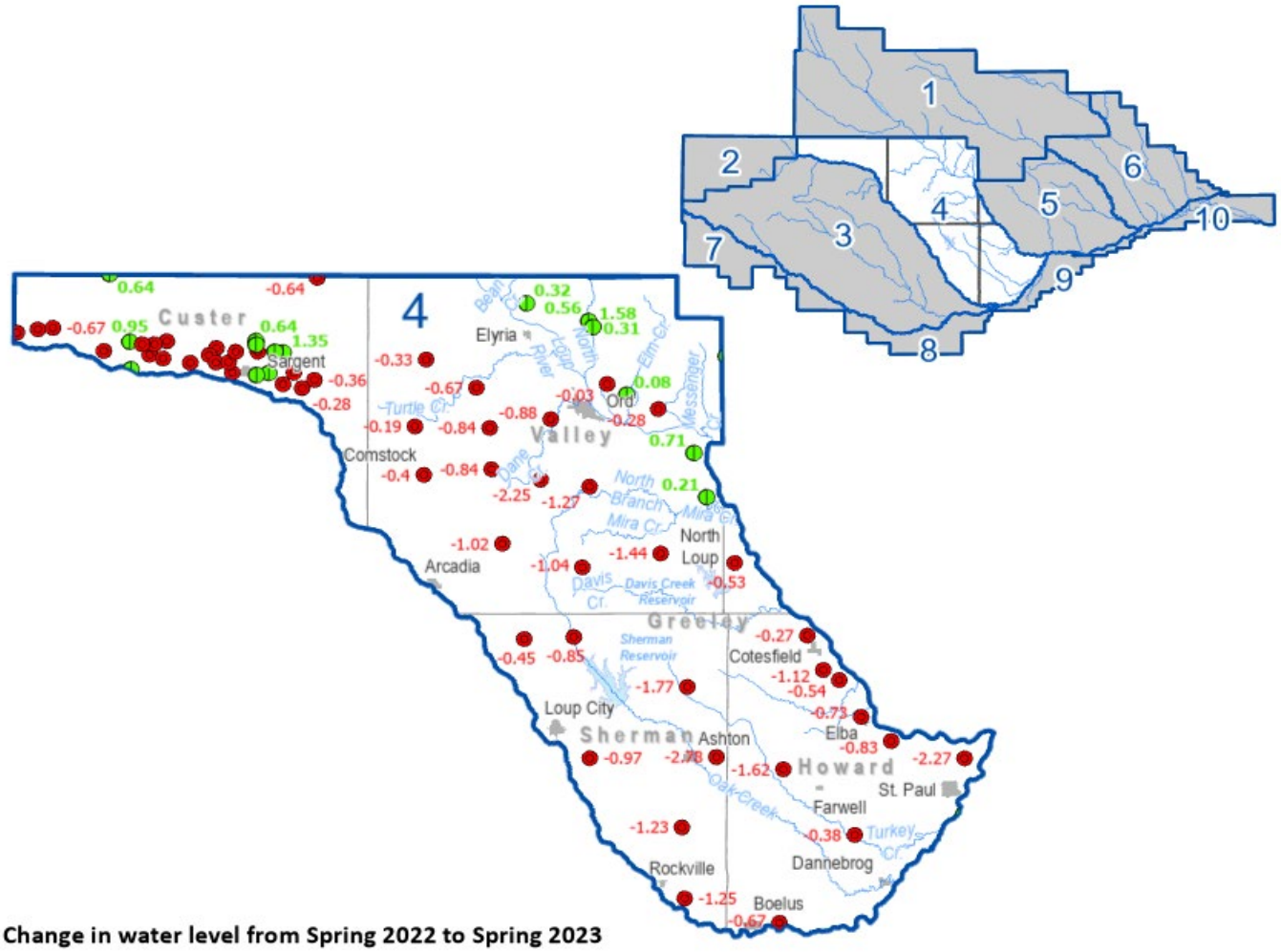
AREA 3 - Spring SWL Trends
Lower Loup Natural Resources District





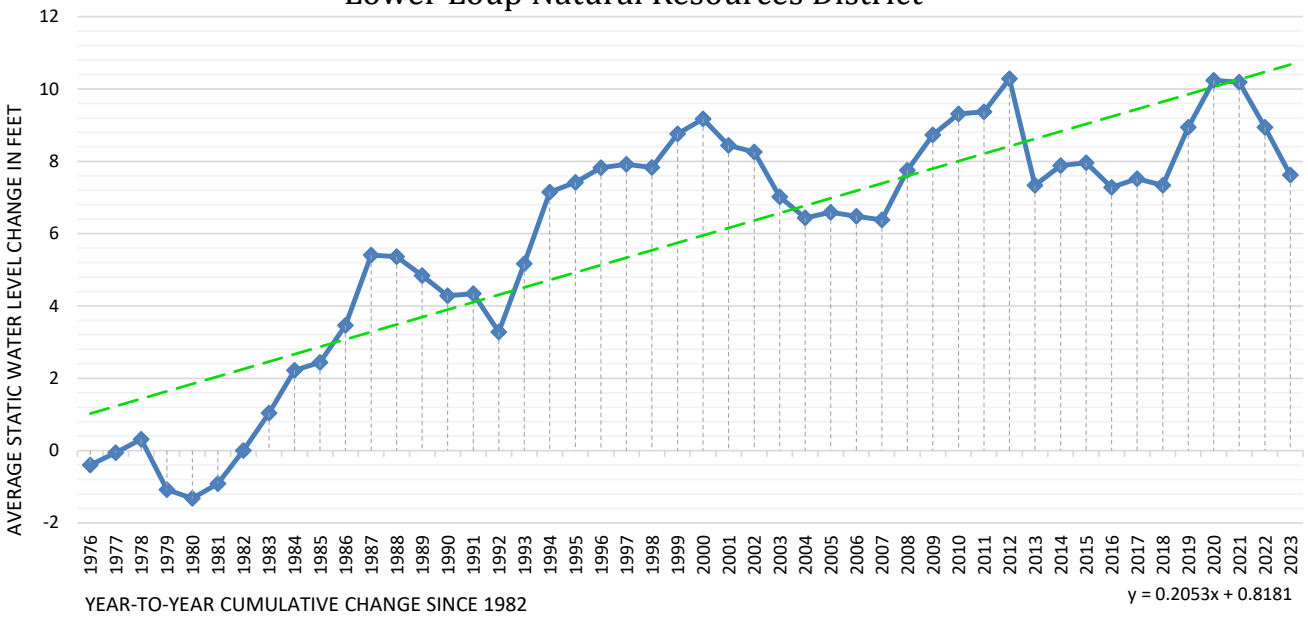
AREA 4 - Spring SWL Trends
Lower Loup Natural Resources District

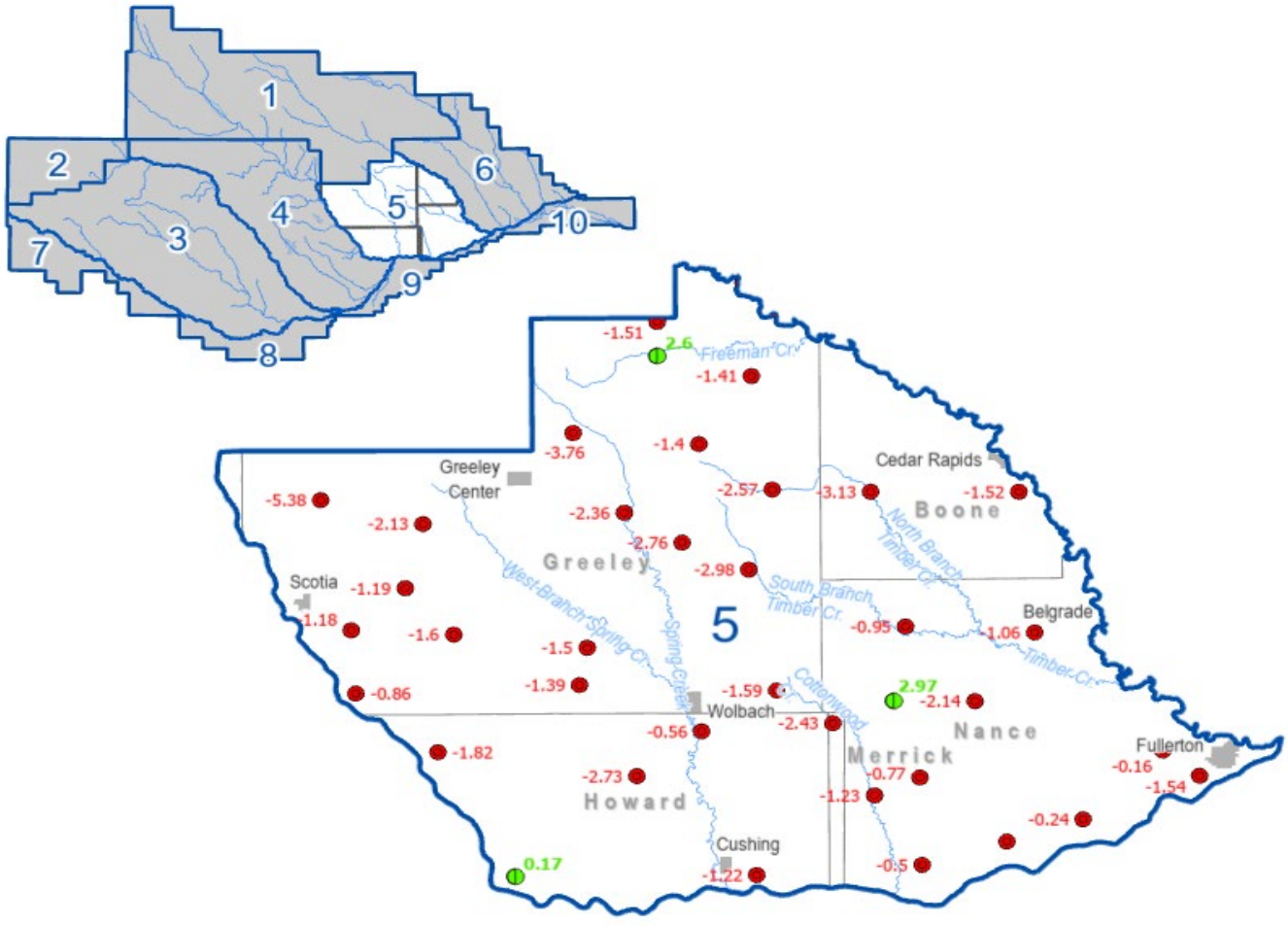




Change in water level from Spring 2022 to Spring 2023

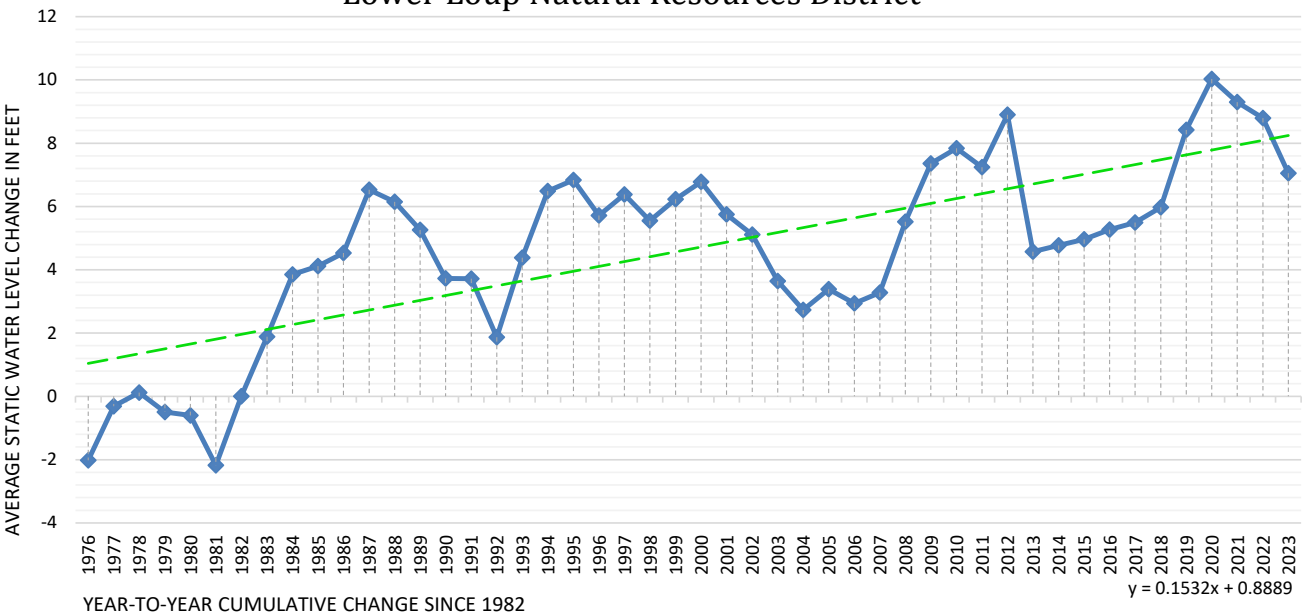
AREA 5 - Spring SWL Trends
Lower Loup Natural Resources District

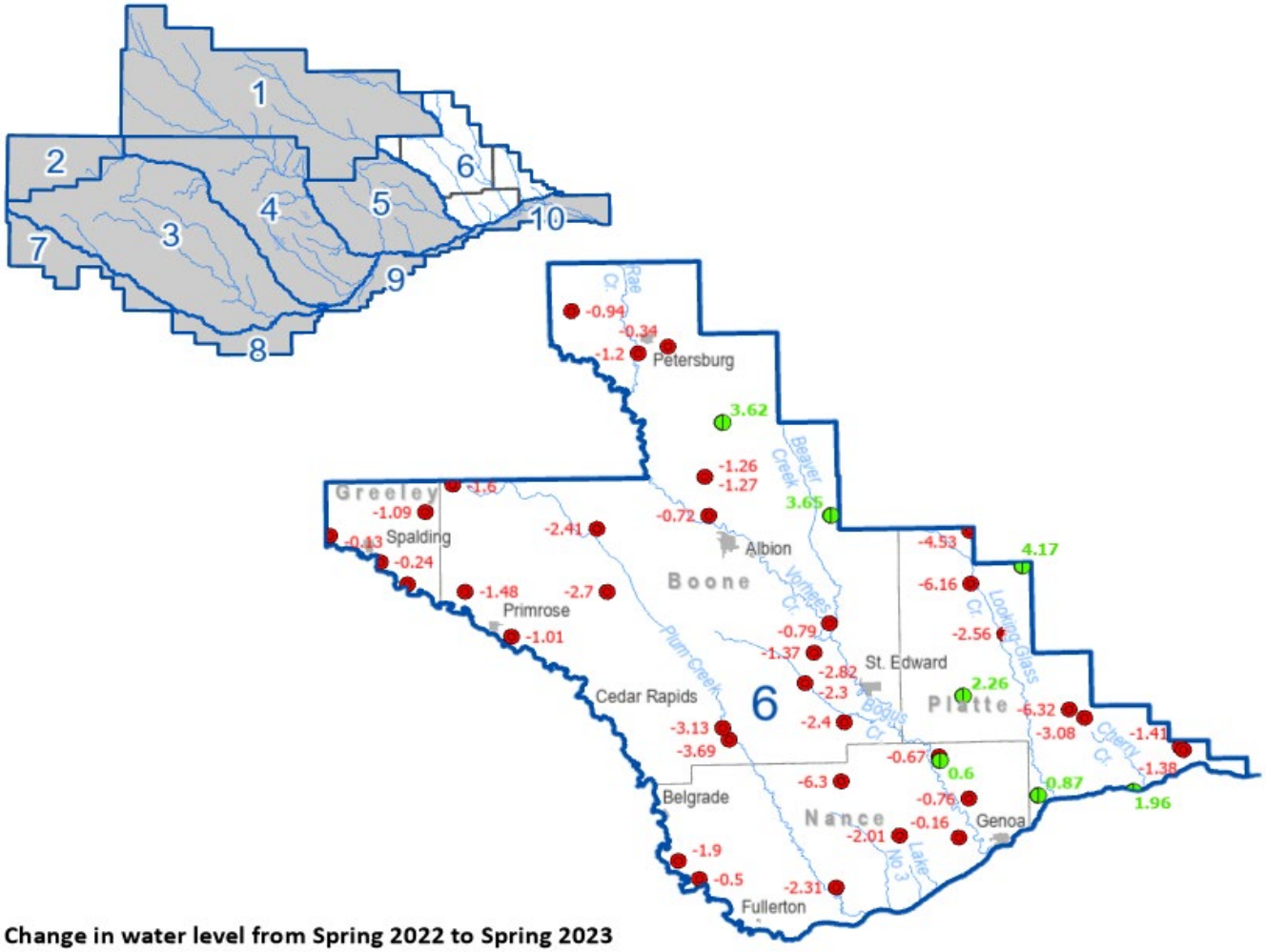




Change in water level from Spring 2022 to Spring 2023

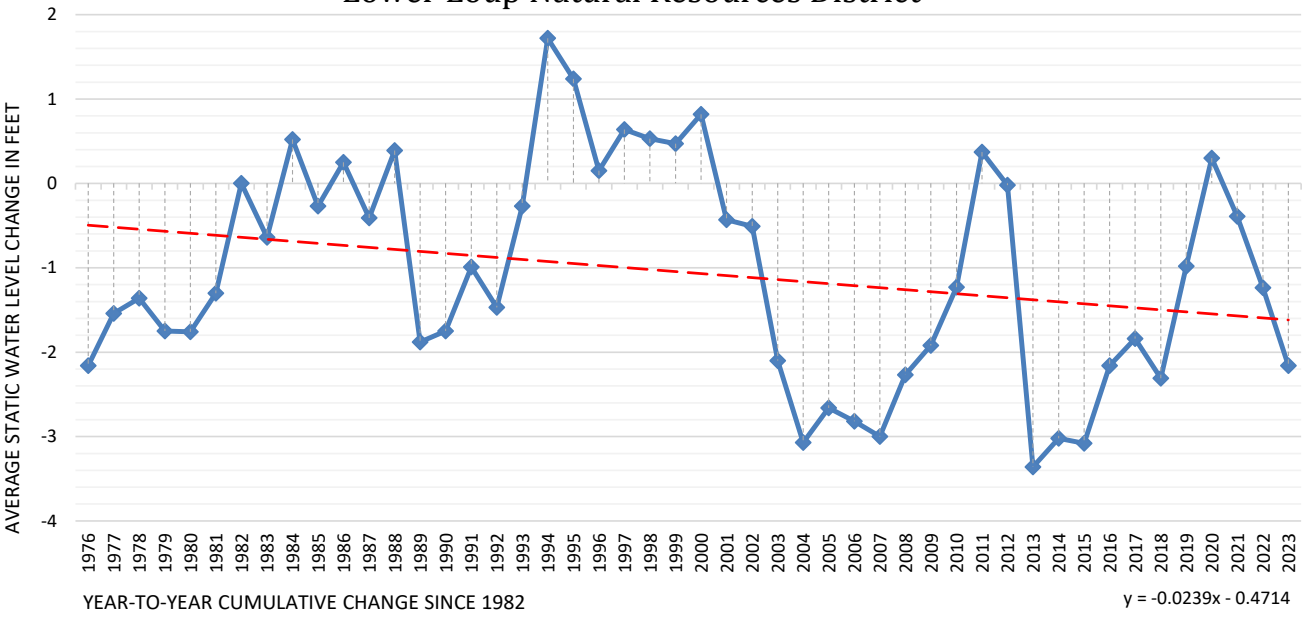
AREA 6 - Spring SWL Trends
Lower Loup Natural Resources District

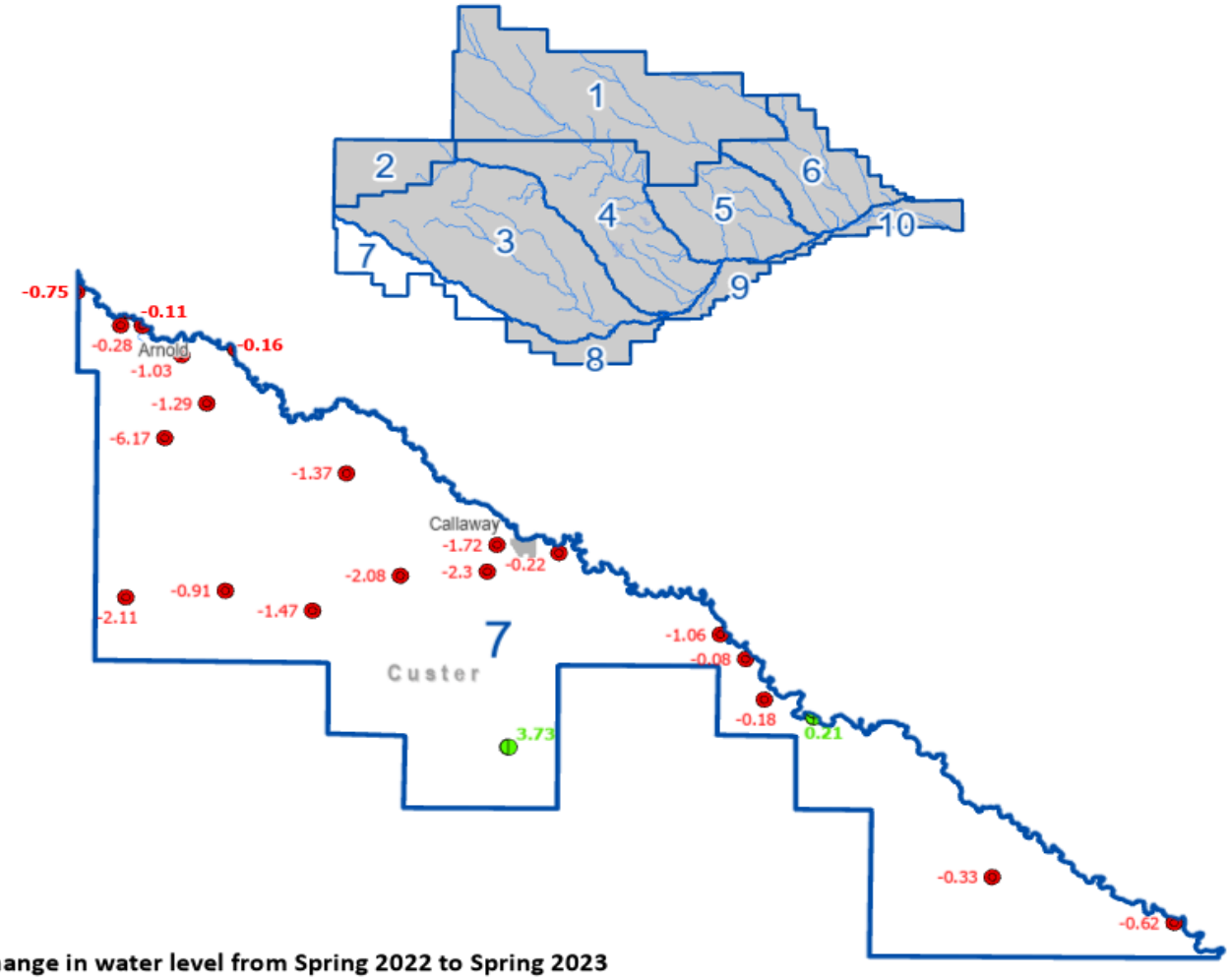




Change in water level from Spring 2022 to Spring 2023

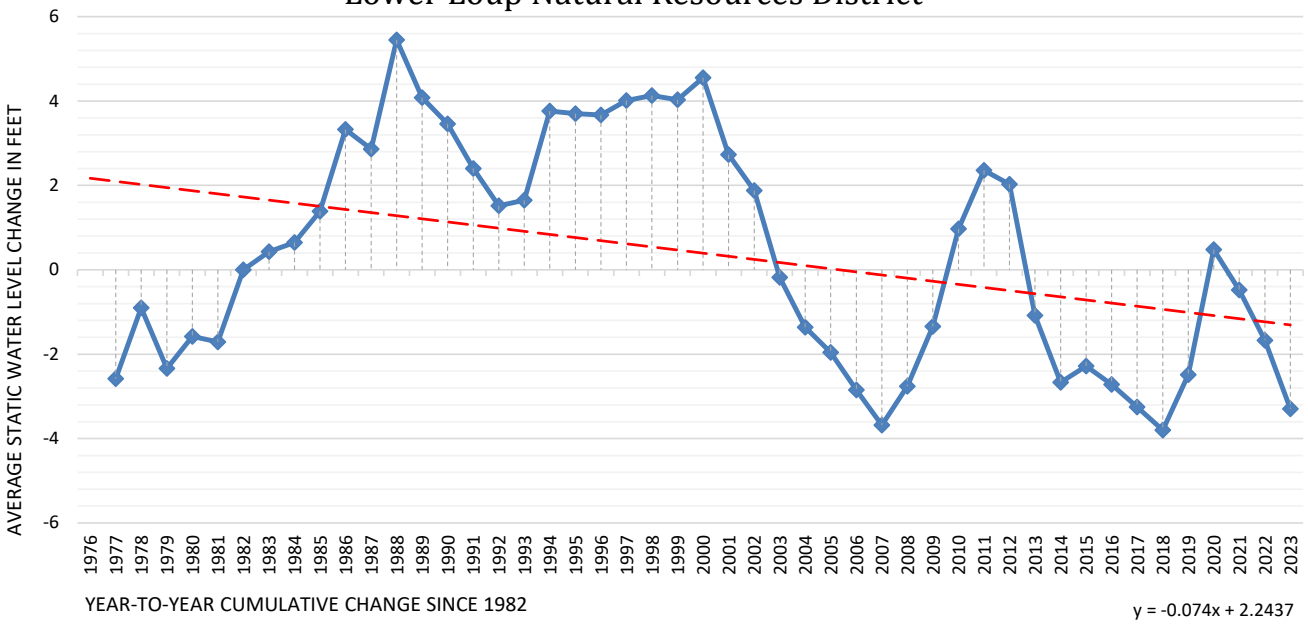
AREA 7 - Spring SWL Trends
Lower Loup Natural Resources District

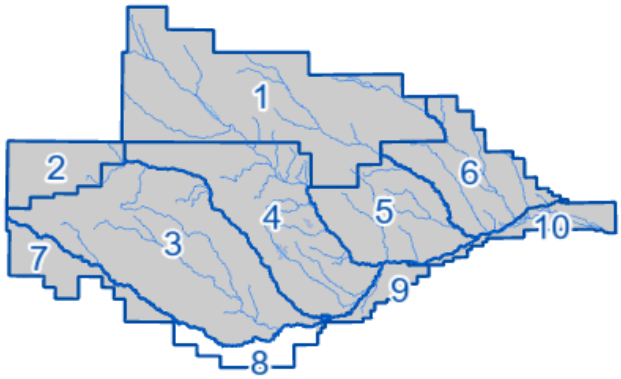


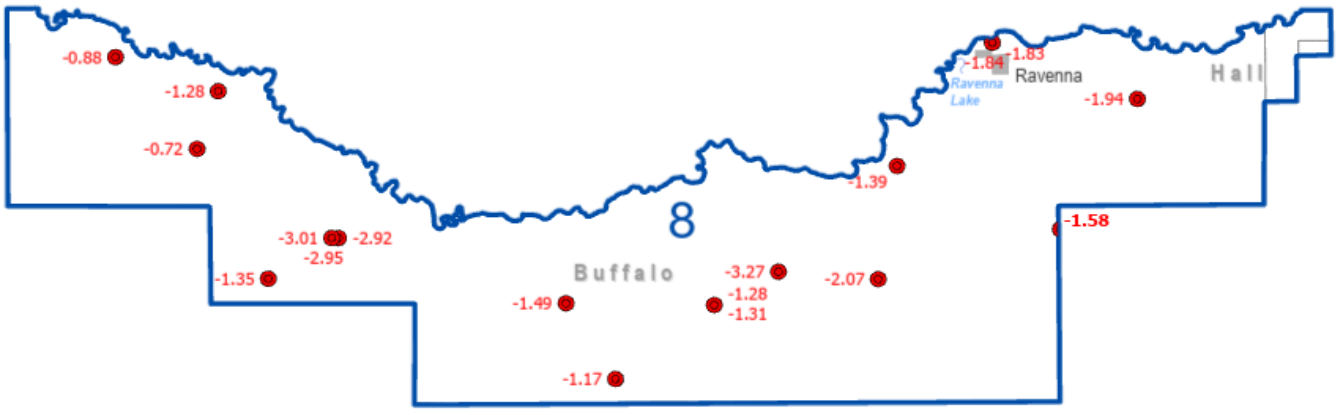


Change in water level from Spring 2022 to Spring 2023

AREA 8 - Spring SWL Trends
Lower Loup Natural Resources District

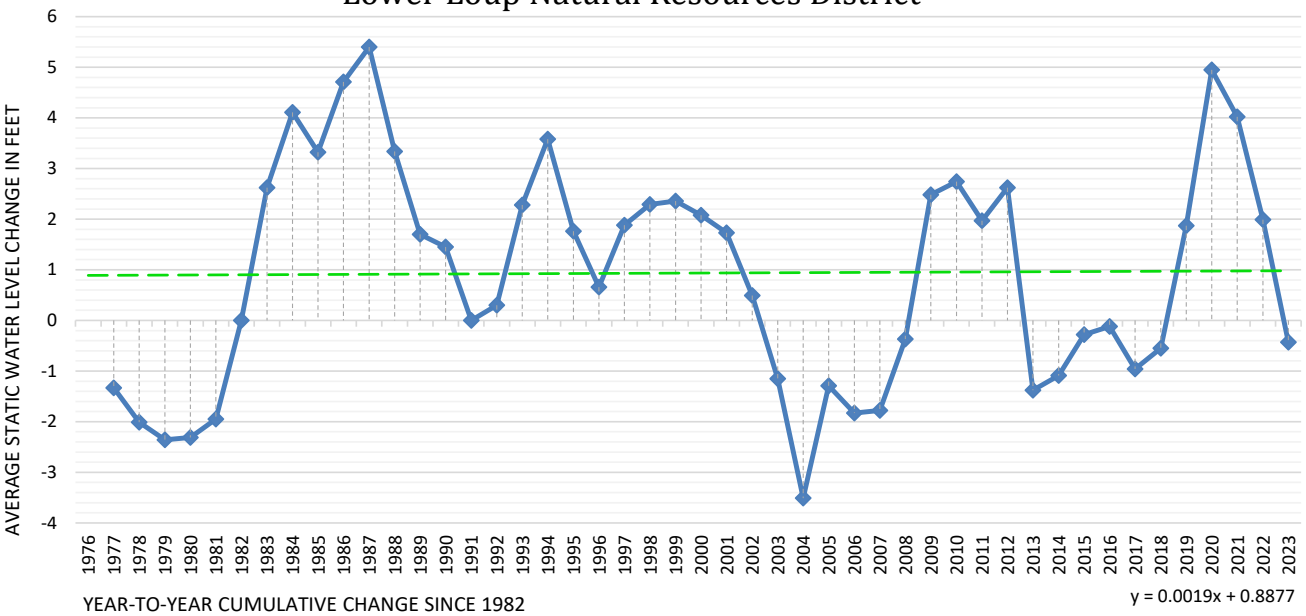


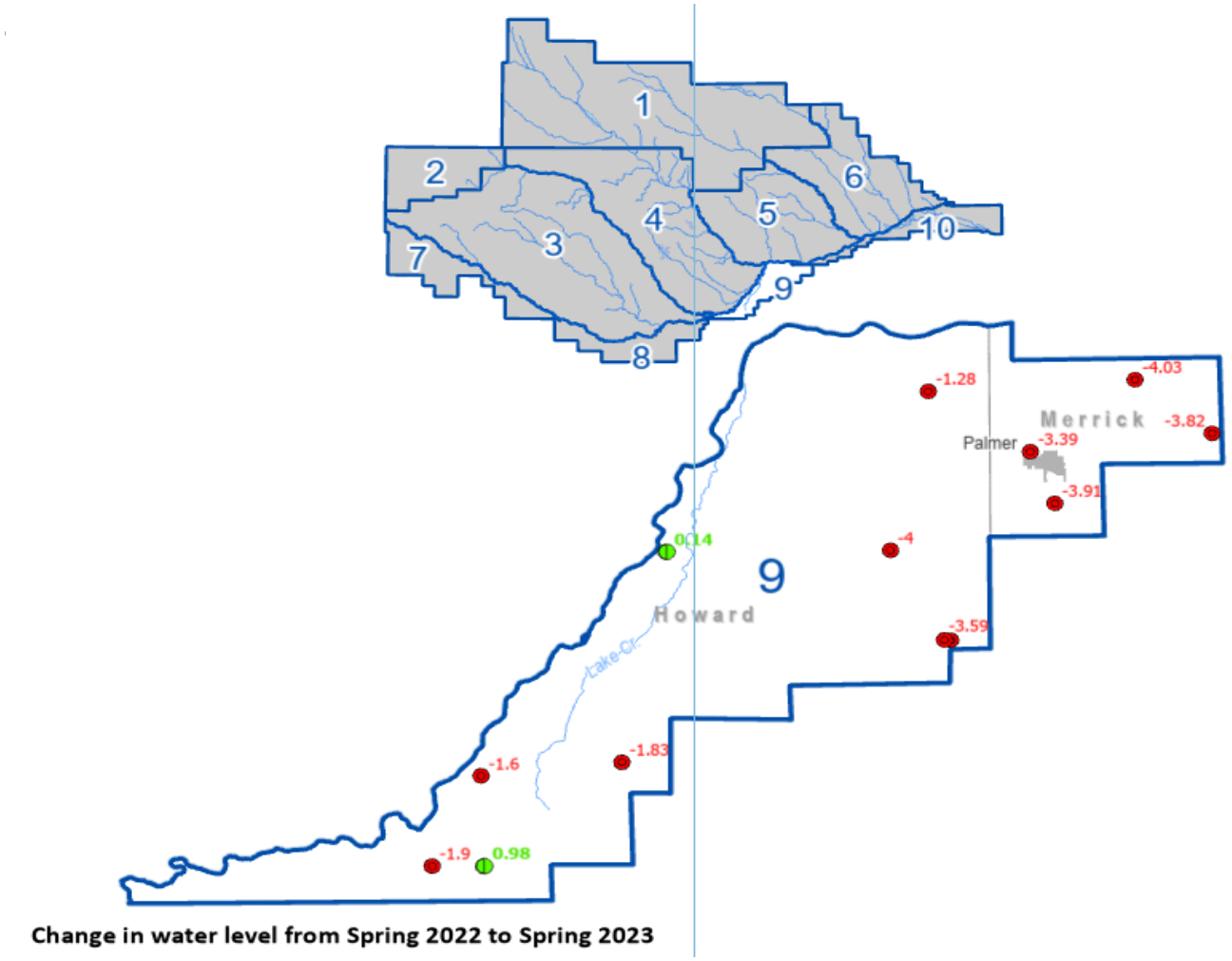




Change in water level from Spring 2022 to Spring 2023

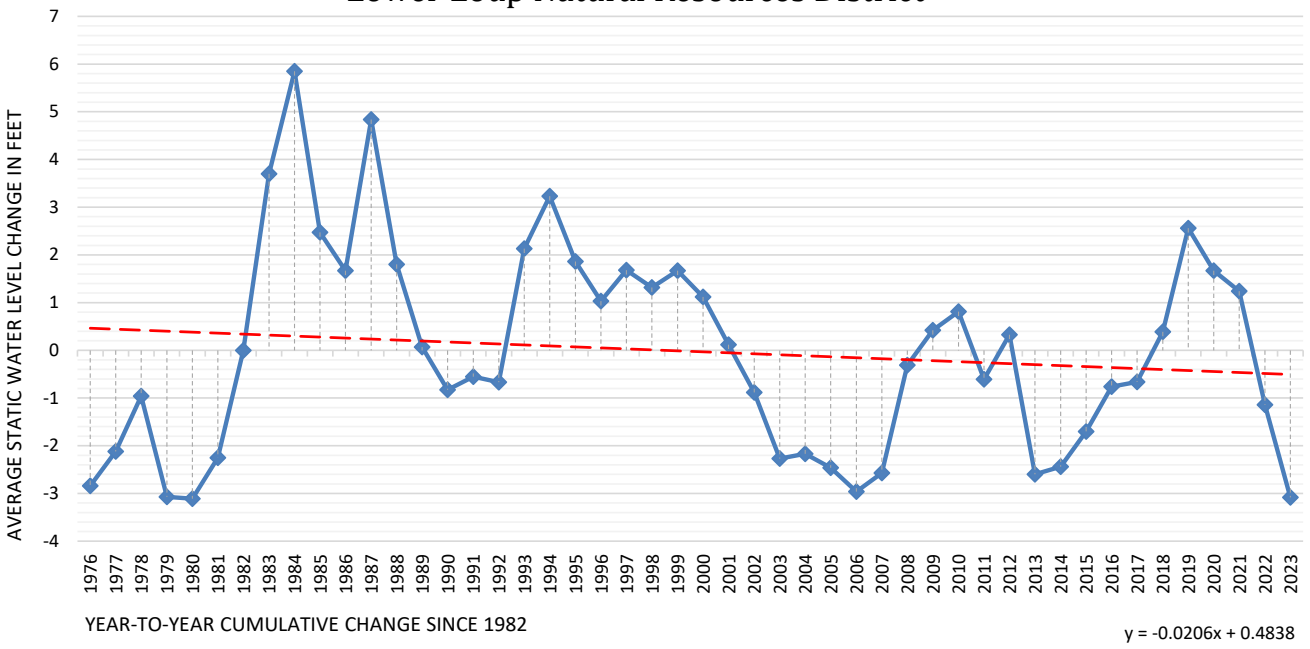
AREA 9 - Spring SWL Trends
Lower Loup Natural Resources District





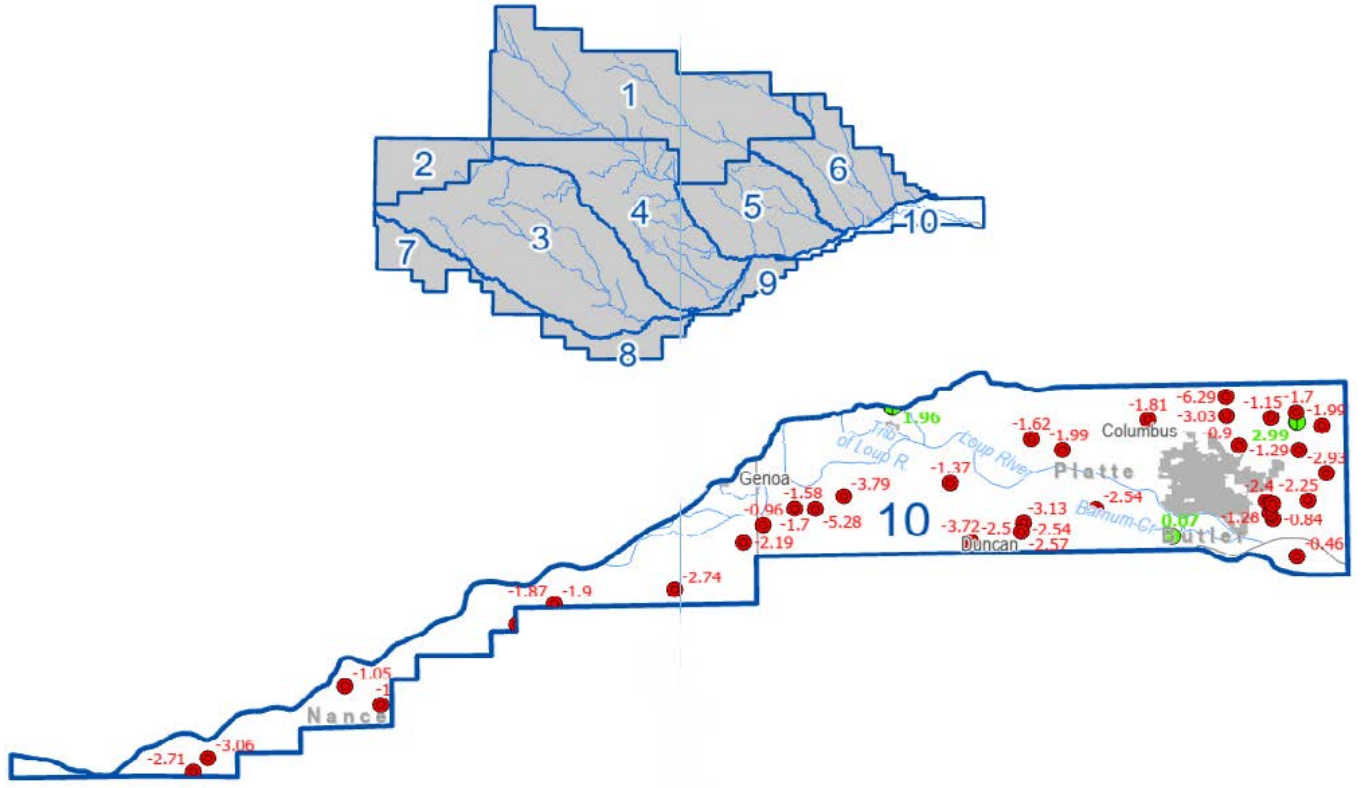
Change in water level from Spring 2022 to Spring 2023

AREA 10 - Spring SWL Trends
Lower Loup Natural Resources District



YEAR-TO-YEAR CUMULATIVE CHANGE SINCE 1982

y = -0.0206x + 0.4838



Change in water level from Spring 2022 to Spring 2023

N

LOWER LOUP NATURAL RESOURCES DISTRICT

All-Years SWL Locations

All-Years SWL Change 1982 - 2023
in feet

- ≤ -5
- -5 to -2.5
- -2.5 to -1
- -1 to 1
- 1 to 2.5
- 2.5 to 5
- > 5

Rock
Loup
Garfield
Wheeler
Boone
Platte
Nance
Merrick
Butler
Custer
Sherman
Valley
Greeley
Howard
Hall
Buffalo

Gracie Creek
Calamus Reservoir
Pibel Lake
Victoria Springs
Arnold Lake
Sherman Reservoir
Davis Creek Reservoir
Ravenna Lake

Petersburg
Albion
Primrose
Cedar Rapids
St. Edward
Belgrade
Genoa
Fullerton
Monroe
Columbus
Duncan
Spalding
Elyria
Ord
Comstock
North Loup
Scotia
Greeley Center
Wolbach
Arcadia
Cotesfield
Elba
Cushing
Loup City
Ashton
Farwell
St. Paul
Dannebrog
Rockville
Boelus
Litchfield
Mason City
Anselmo
Merna
Sargent
Berwyn
Callaway
Ansley
Broken Bow
Arnold
Taylor
Burwell
Ericson
Barlett
Palmer
Pleasanton
Ravenna

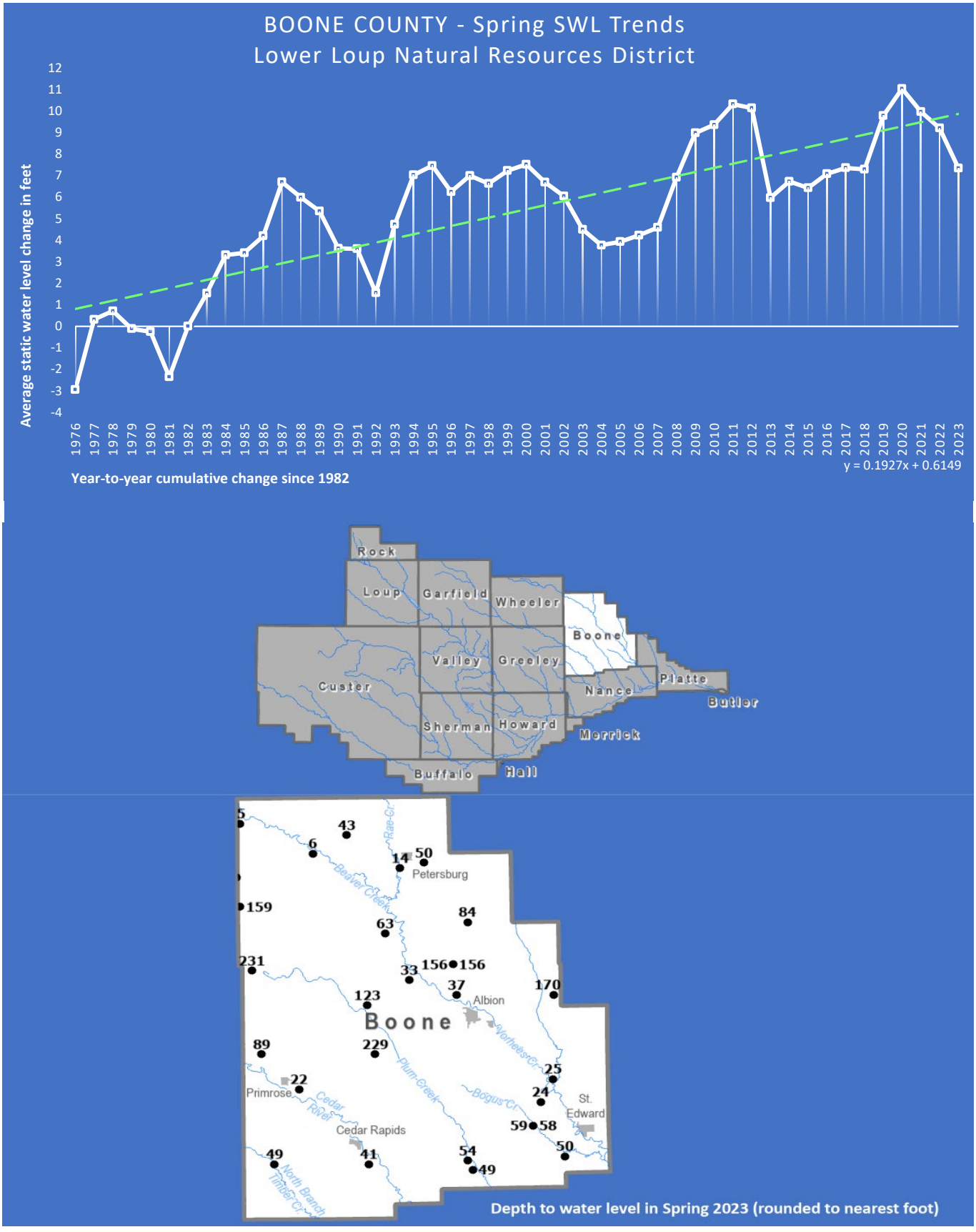
Notes:
Change in depth to water values were calculated by subtracting Spring 2023 from Spring 1982.
Static water level locations that did not report at least 8 readings (Spring and Fall) in the last 5 years (Fall 2018 through Spring 2023) were not used in the interpolation.
Spatial interpolation = inverse distance weighted (IDW), default settings.

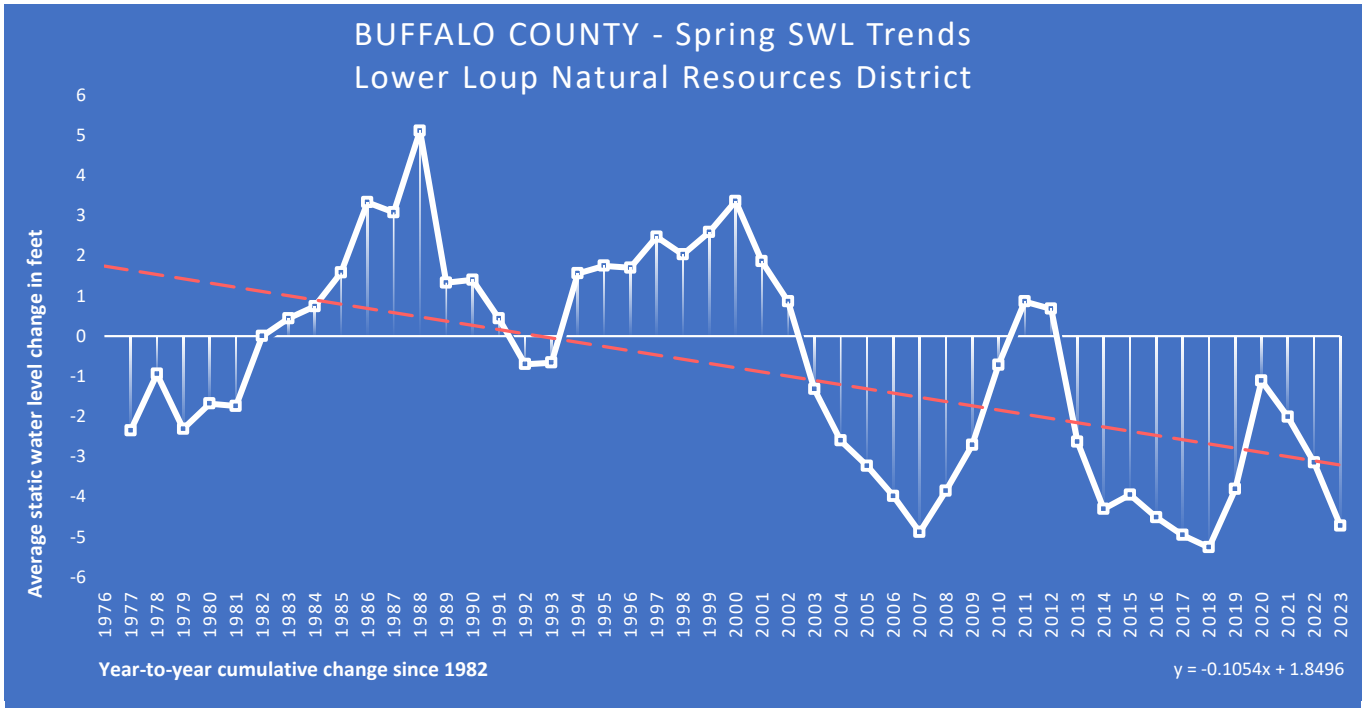
1:625,000

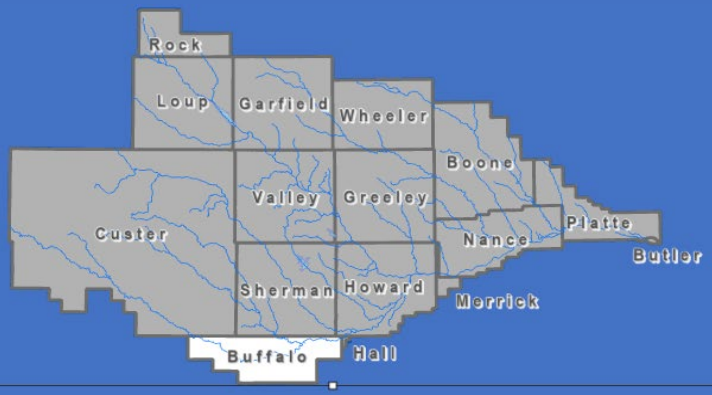
0 5 10 20 30 40 50 Miles

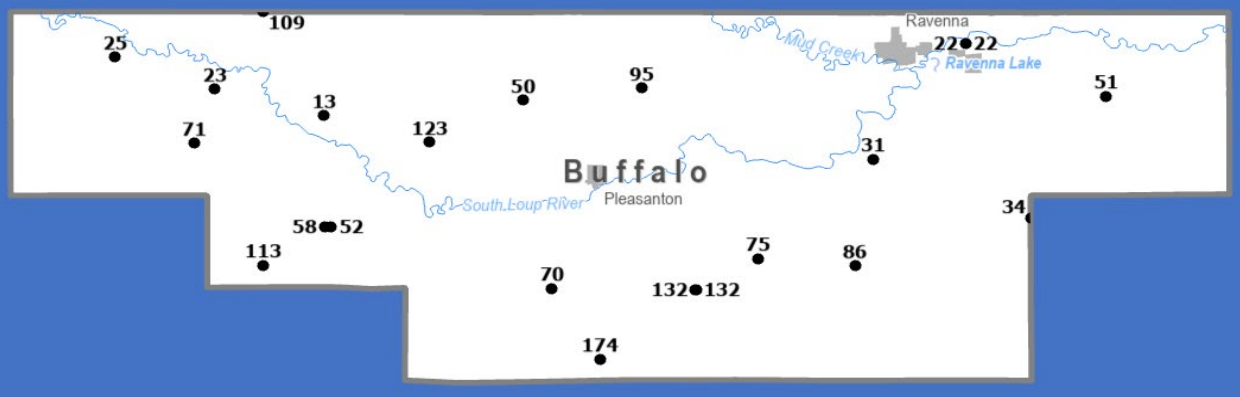
\GIS_Projects\WaterQuantity\StaticWaterLevel

STATIC WATER LEVEL CHANGE
ALL YEARS
SPRING 1982 TO SPRING 2023
Lower Loup Natural Resources District

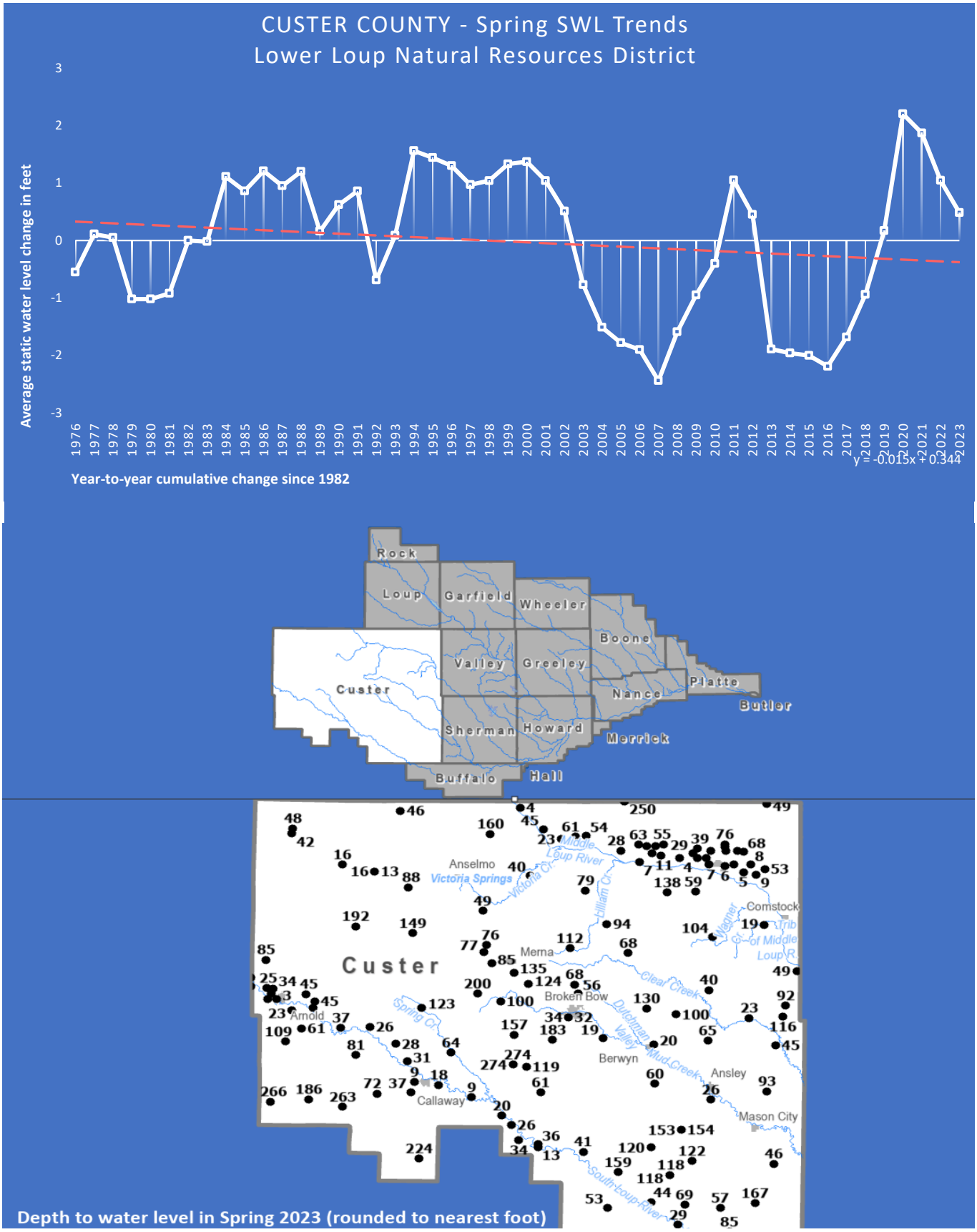

BOONE COUNTY - Spring SWL Trends
Lower Loup Natural Resources District
Average static water level change in feet
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
y = 0.1927x + 0.6149
Year-to-year cumulative change since 1982
Rock
Loup
Garfield
Wheeler
Boone
Valley
Greeley
Custer
Nance
Platte
Butler
Sherman
Howard
Merrick
Buffalo
Hall
Petersburg
Albion
Boone
Primrose
Cedar Rapids
St. Edward
Beaver Creek
Plum Creek
Cedar River
Bogus Cr.
Vorhees Cr.
North Branch Timber Cr.
5
43
6
14
50
159
84
63
231
33
156
156
37
170
123
89
229
25
22
24
59
58
50
49
41
54
49
Depth to water level in Spring 2023 (rounded to nearest foot)

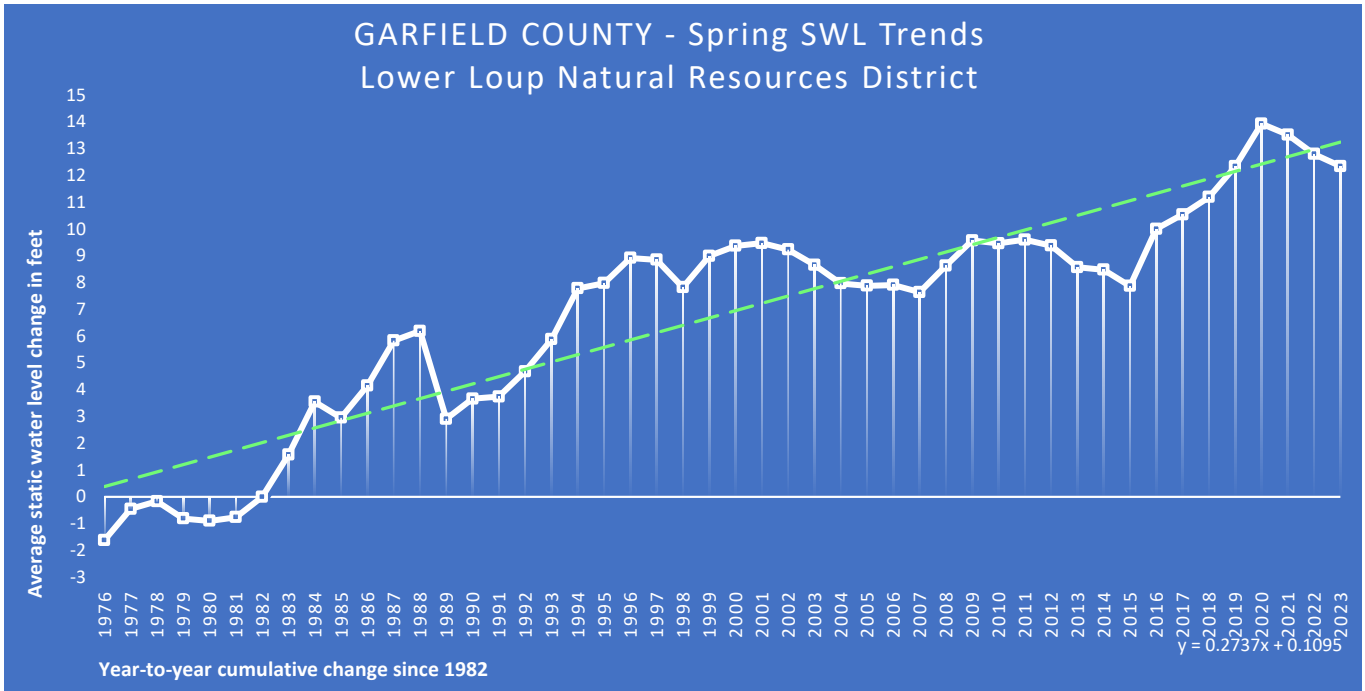


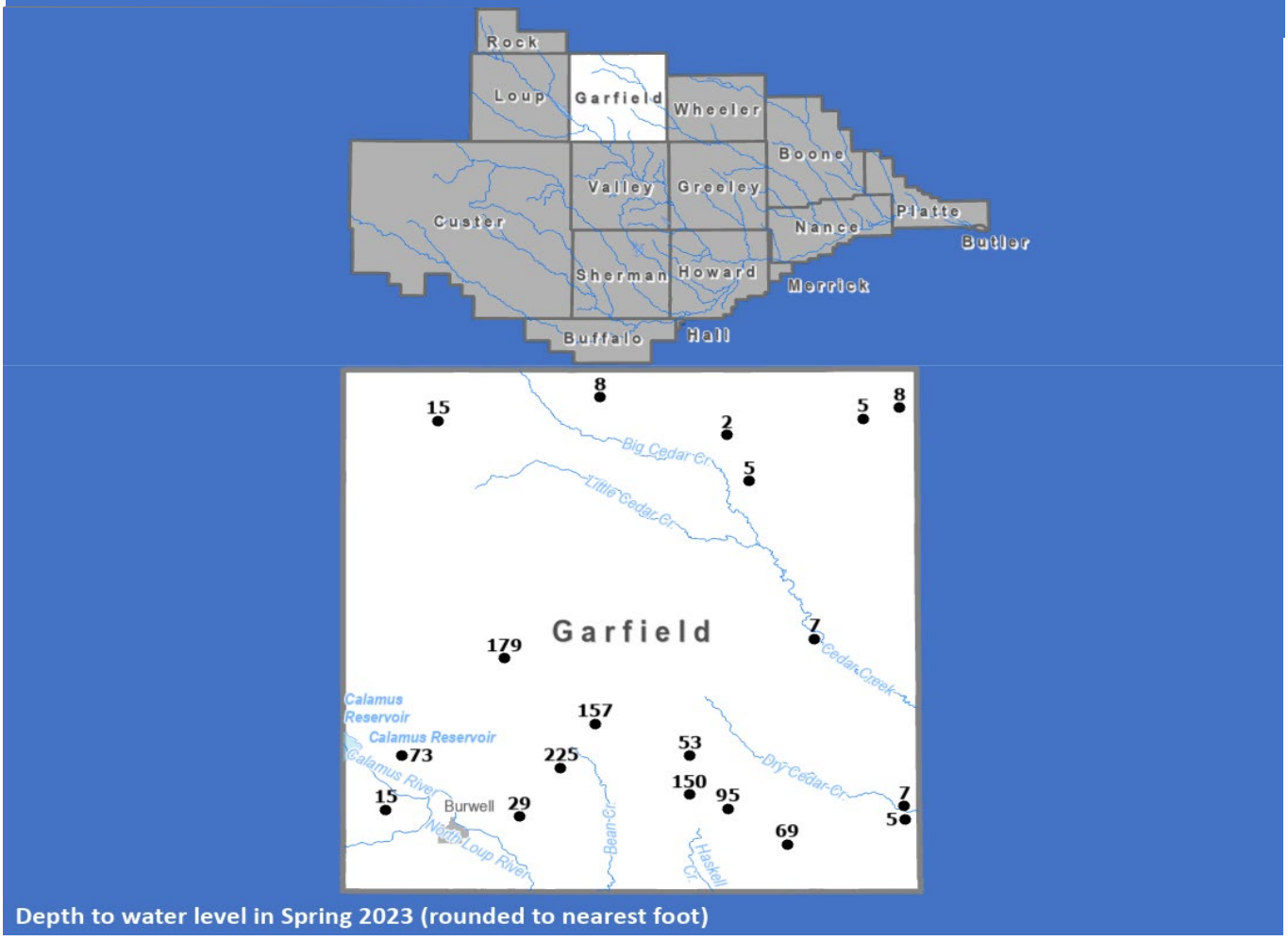


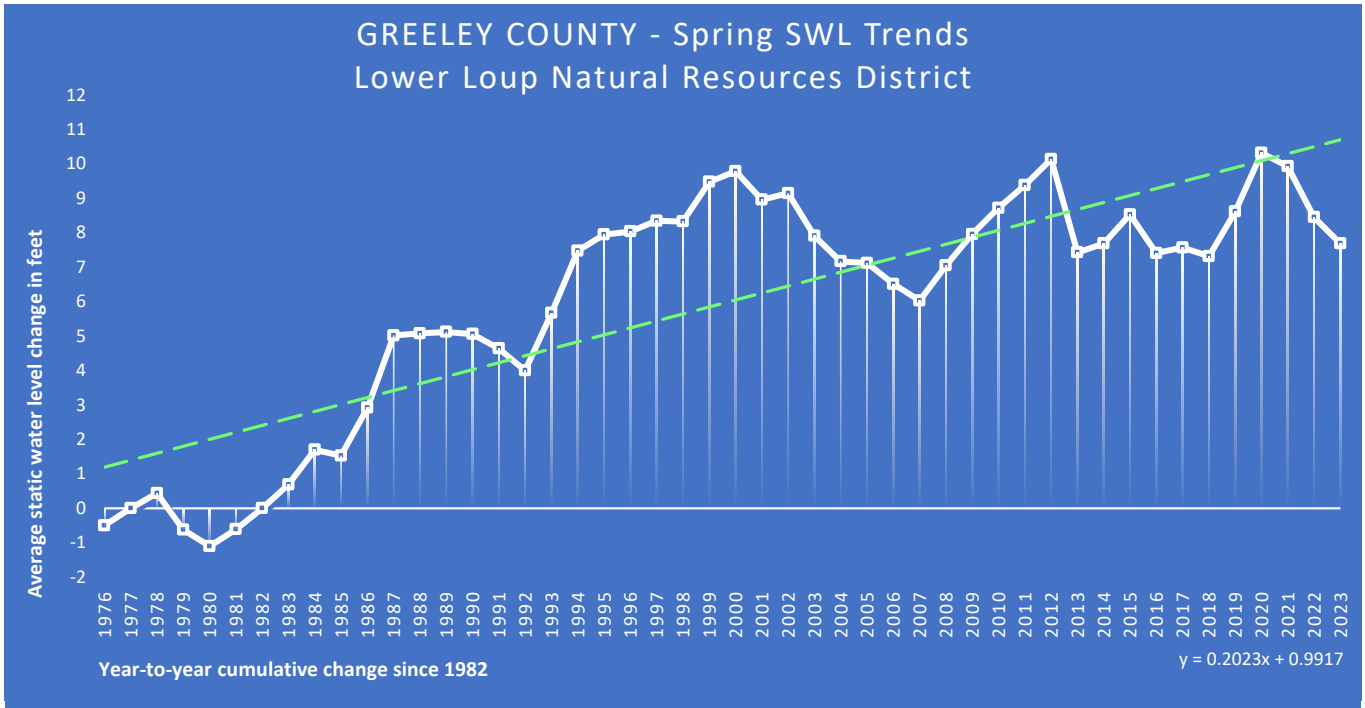


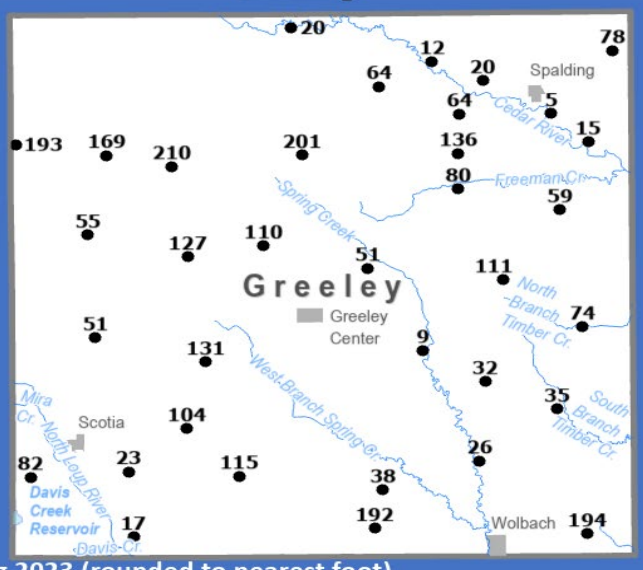
Depth to water level in Spring 2023 (rounded to nearest foot)


CUSTER COUNTY - Spring SWL Trends
Lower Loup Natural Resources District
Average static water level change in feet
3
2
1
0
-1
-2
-3
1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
y = -0.015x + 0.344
Year-to-year cumulative change since 1982
Rock
Loup
Garfield
Wheeler
Boone
Valley
Greeley
Custer
Nance
Platte
Butler
Sherman
Howard
Merrick
Buffalo
Hall
Custer
Anselmo
Victoria Springs
Victoria Cr
Middle Loup River
Dilliam Cr
Comstock
Wegner Cr
Trib of Middle Loup R
Merna
Clear Creek
Broken Bow
Spring Cr
Dutchman Valley
Mud Creek
Arnold
Berwyn
Ansley
Callaway
Mason City
South Loup River
Depth to water level in Spring 2023 (rounded to nearest foot)

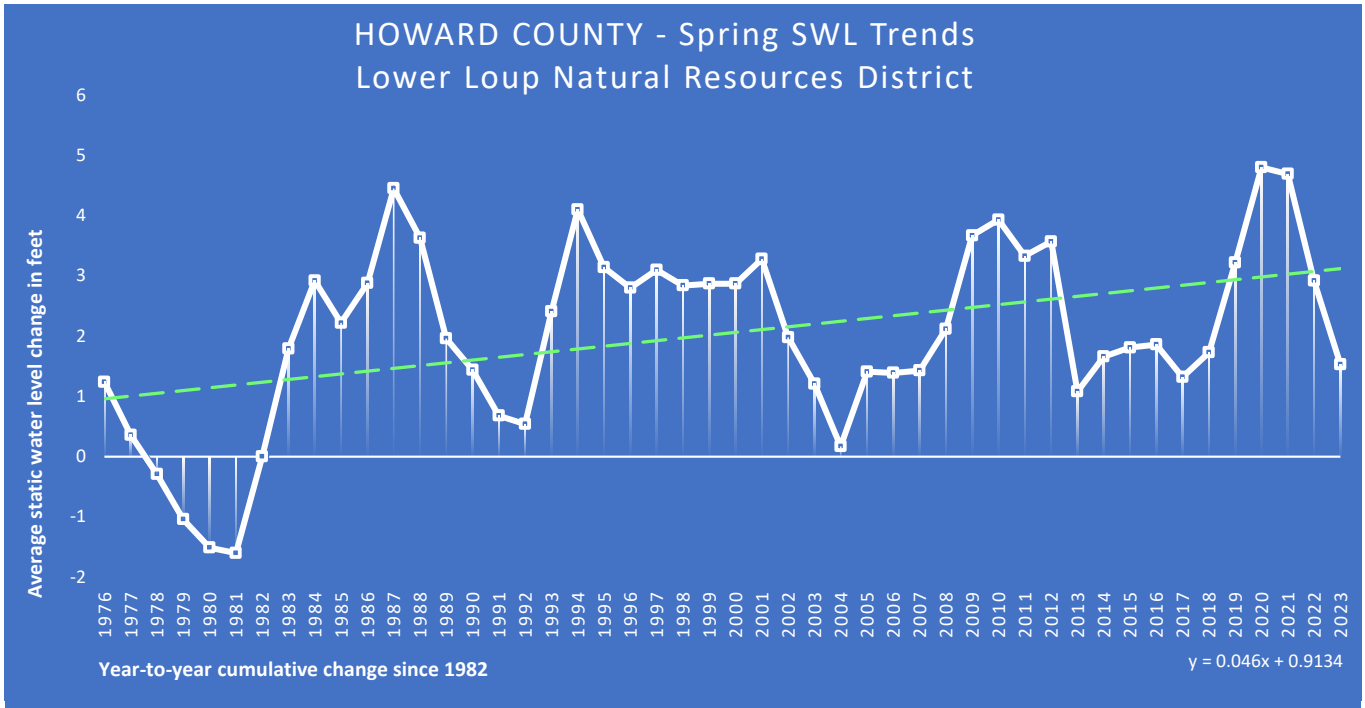

GARFIELD COUNTY - Spring SWL Trends
Lower Loup Natural Resources District
Average static water level change in feet
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
y = 0.2737x + 0.1095
Year-to-year cumulative change since 1982

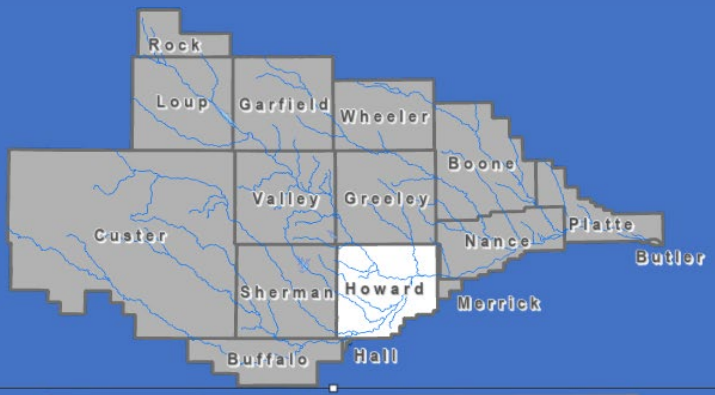

Rock
Loup
Garfield
Wheeler
Boone
Valley
Greeley
Custer
Nance
Platte
Butler
Sherman
Howard
Merrick
Buffalo
Hall
Garfield
Big Cedar Cr
Little Cedar Cr
Cedar Creek
Dry Cedar Cr
Calamus Reservoir
Calamus Reservoir
Calamus River
Burwell
North Loup River
Bean Cr
Haskell Cr
8
15
2
5
8
5
179
7
157
73
225
53
150
95
15
29
69
7
5
Depth to water level in Spring 2023 (rounded to nearest foot)

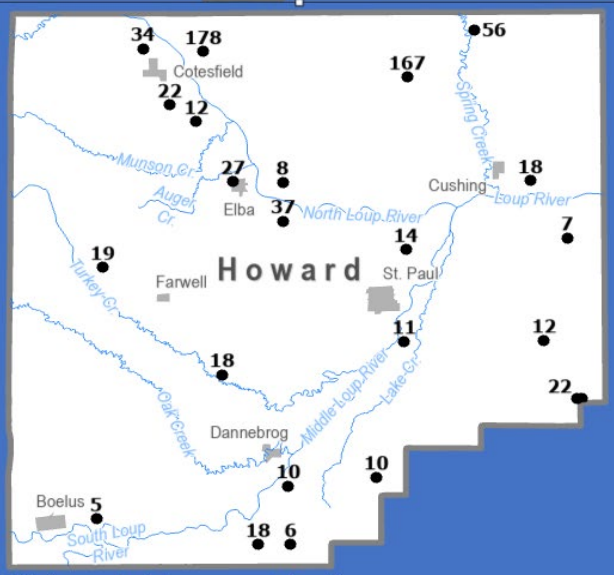




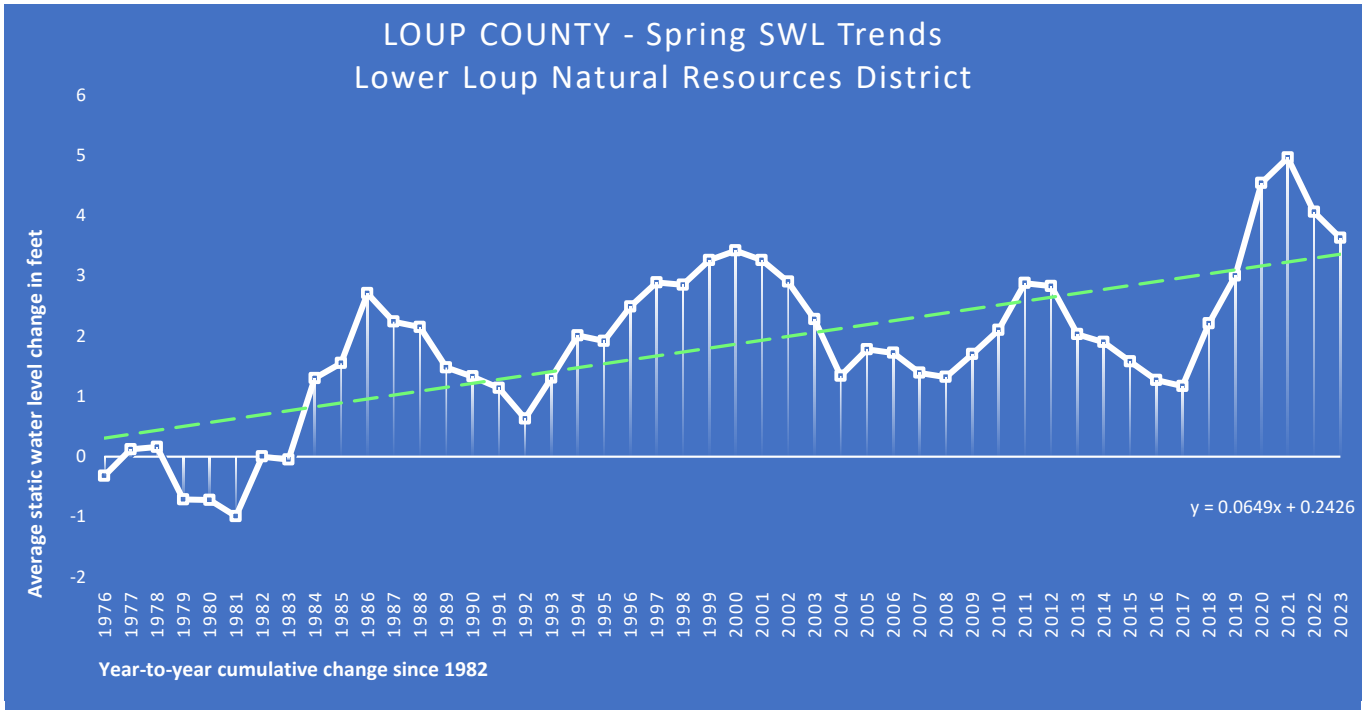
Depth to water level in Spring 2023 (rounded to nearest foot)

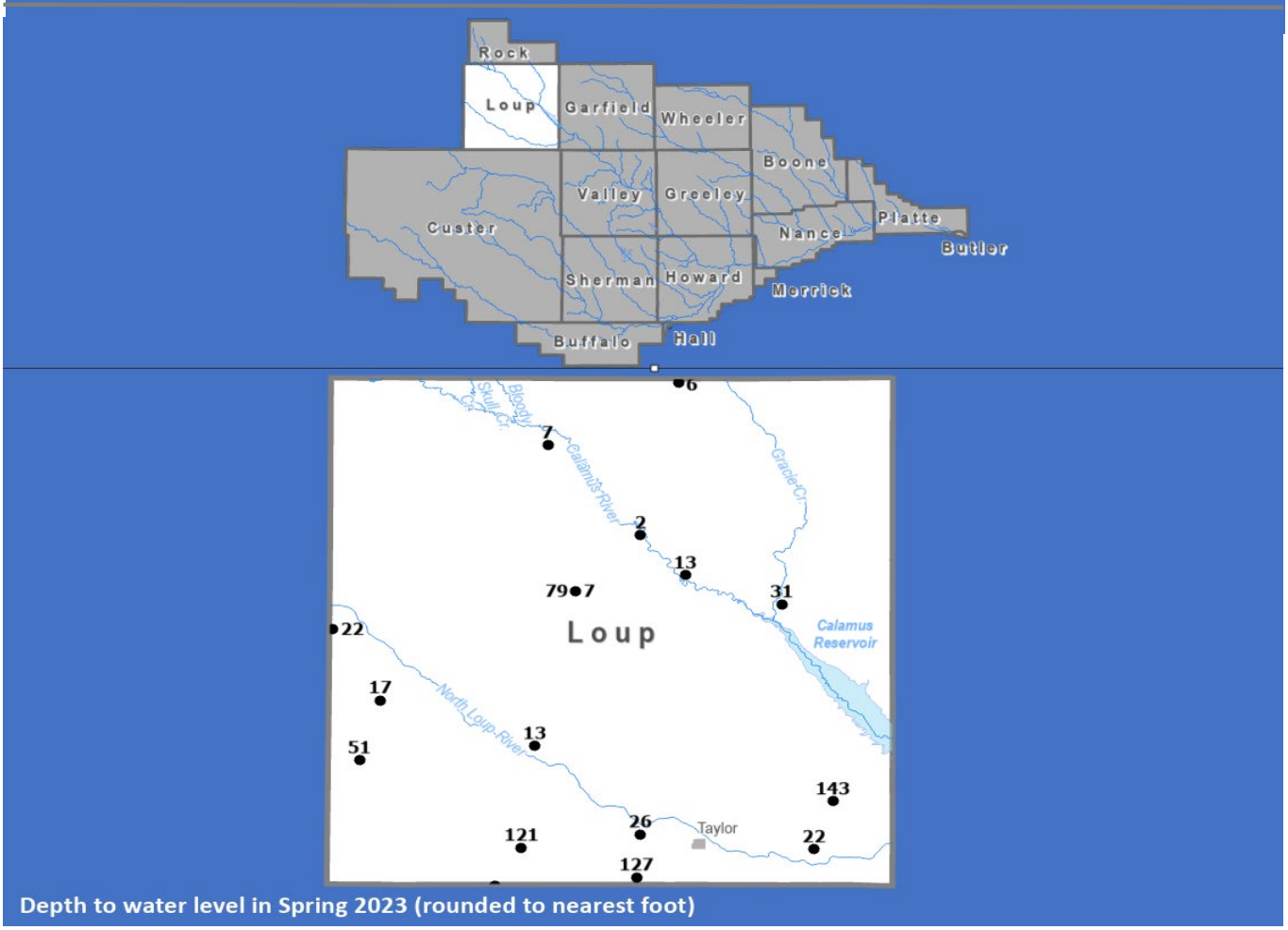


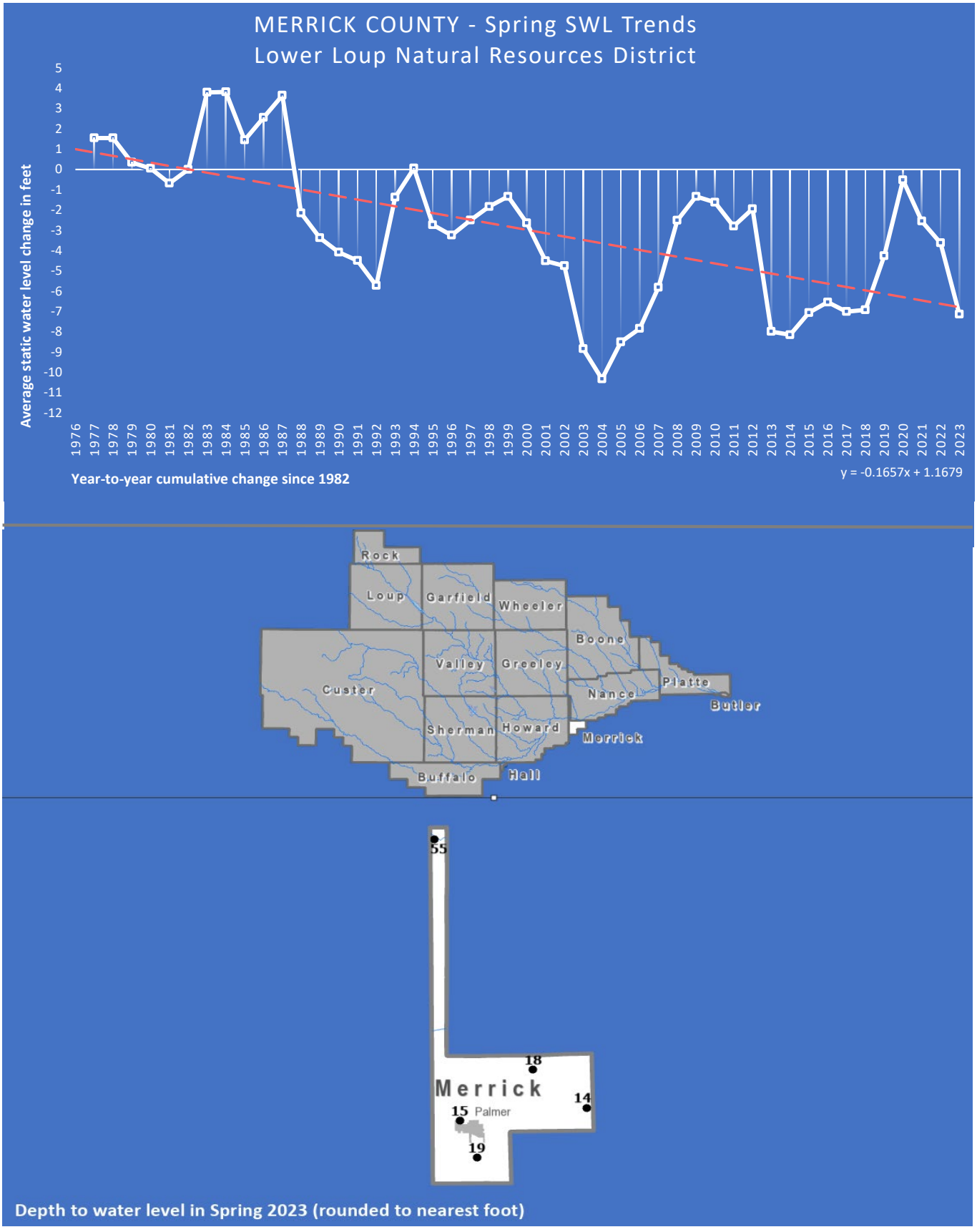


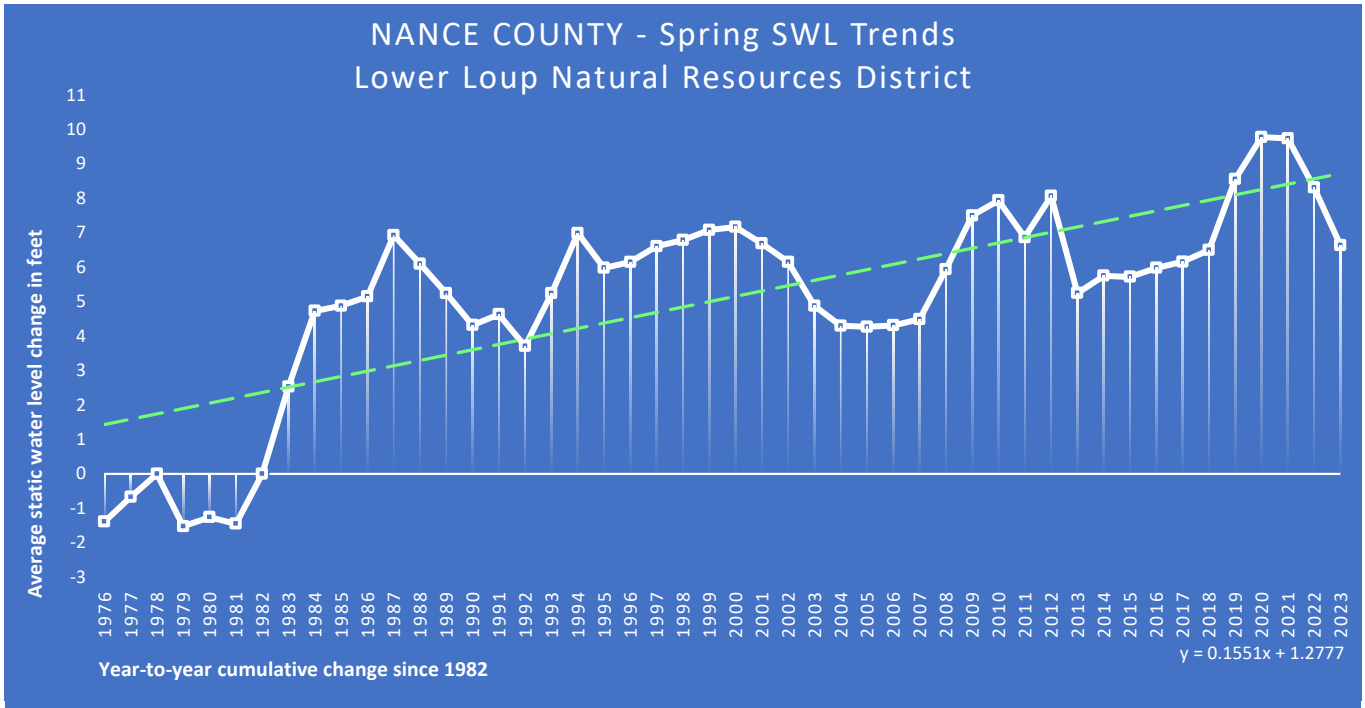


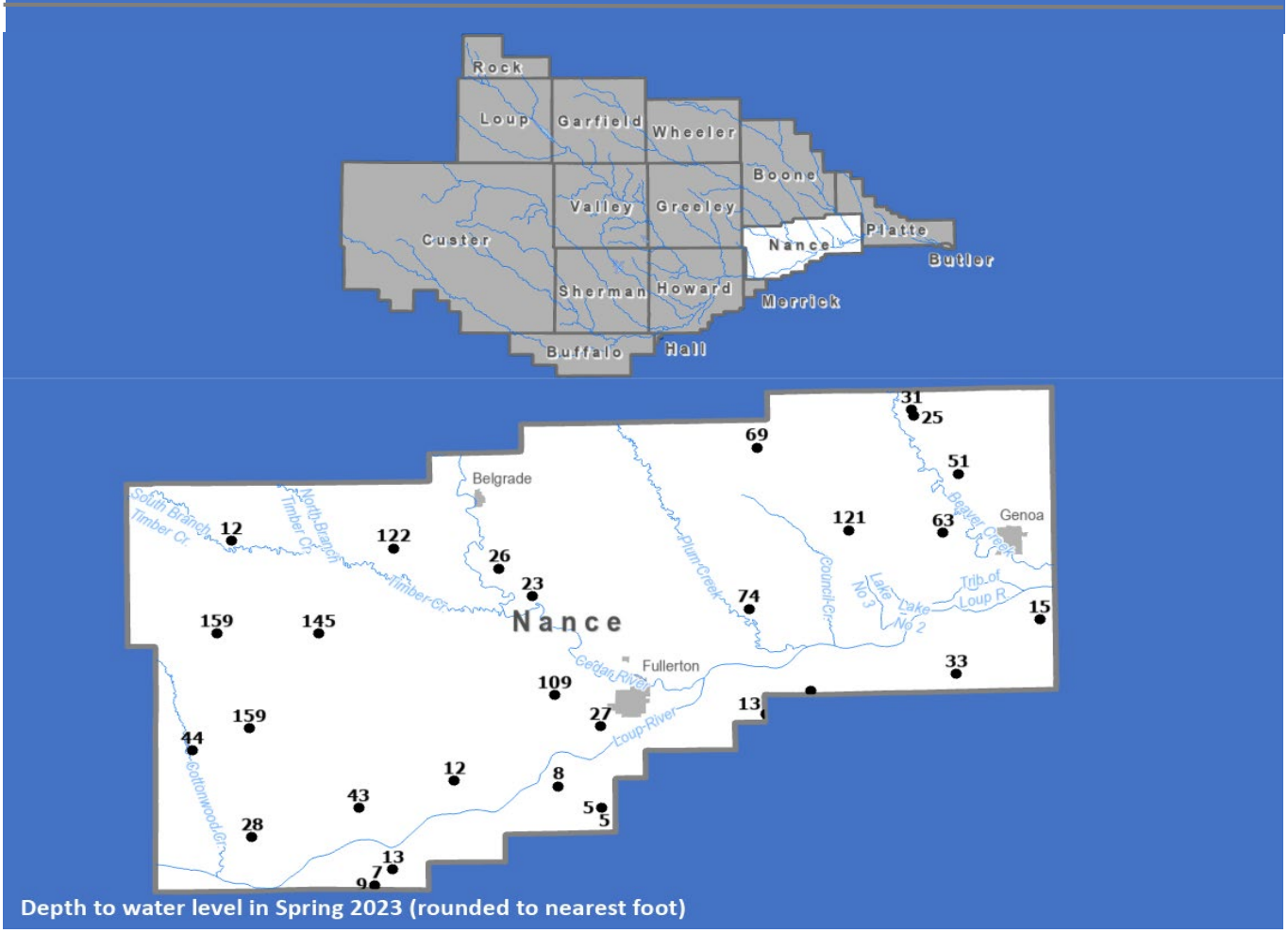
Depth to water level in Spring 2023 (rounded to nearest foot)


LOUP COUNTY - Spring SWL Trends
Lower Loup Natural Resources District
Average static water level change in feet
6
5
4
3
2
1
0
-1
-2
1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
y = 0.0649x + 0.2426
Year-to-year cumulative change since 1982

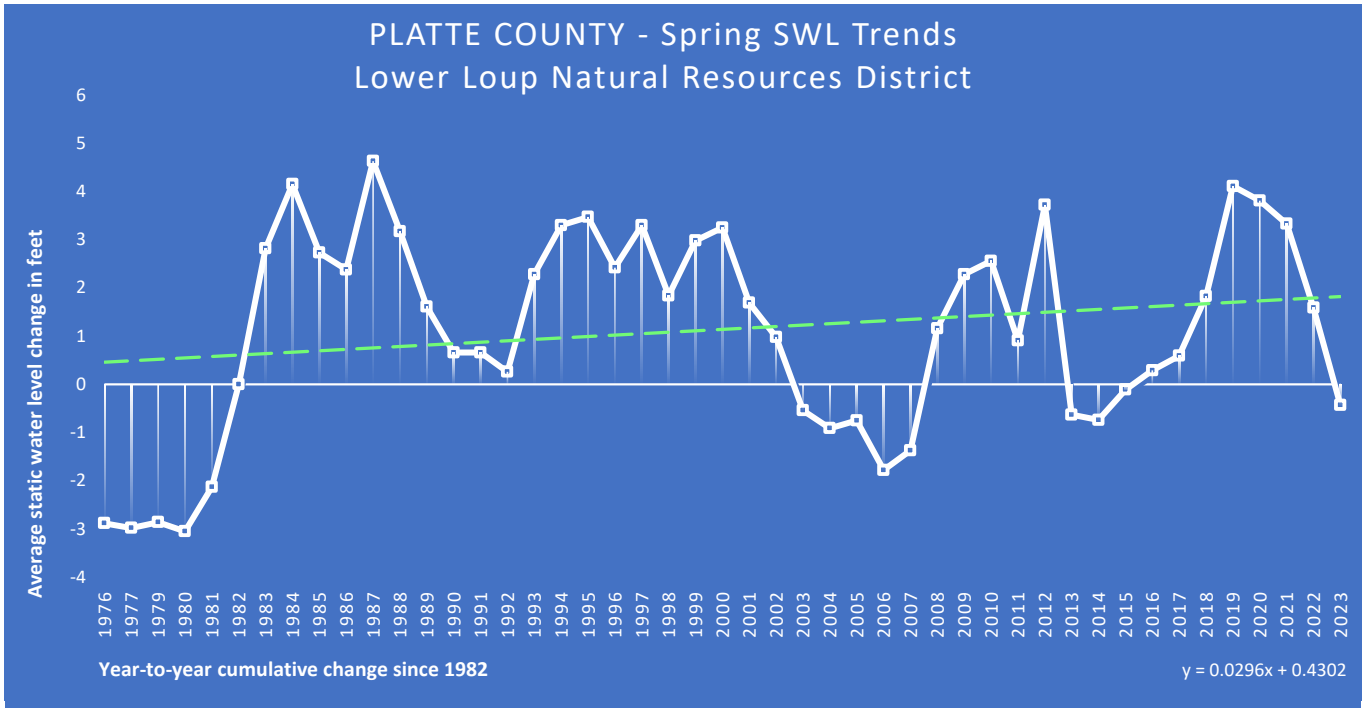

Rock
Loup
Garfield
Wheeler
Boone
Valley
Greeley
Custer
Nance
Platte
Butler
Sherman
Howard
Merrick
Buffalo
Hall
Skull Cr.
Bloody Cr.
Cedar Cr.
Cedar River
Gracie Cr.
Loup
Calamus Reservoir
North Loup River
Taylor
6
7
2
13
79
7
31
22
17
13
51
143
26
121
22
127
Depth to water level in Spring 2023 (rounded to nearest foot)

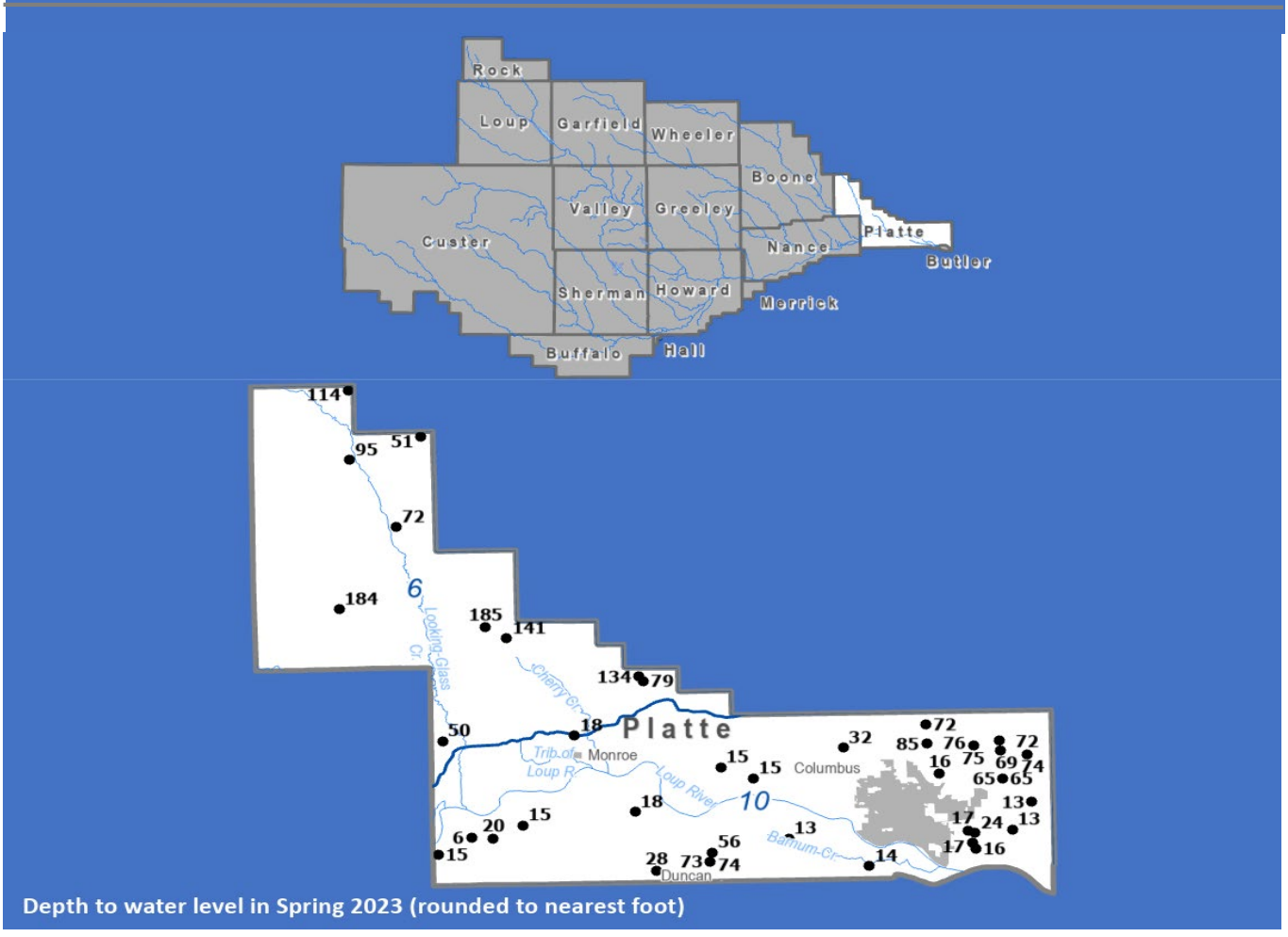

MERRICK COUNTY - Spring SWL Trends
Lower Loup Natural Resources District
Average static water level change in feet
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year-to-year cumulative change since 1982
y = -0.1657x + 1.1679
Rock
Loup
Garfield
Wheeler
Boone
Valley
Greeley
Custer
Nance
Platte
Butler
Sherman
Howard
Merrick
Buffalo
Hall
55
18
Merrick
14
15
Palmer
19
Depth to water level in Spring 2023 (rounded to nearest foot)

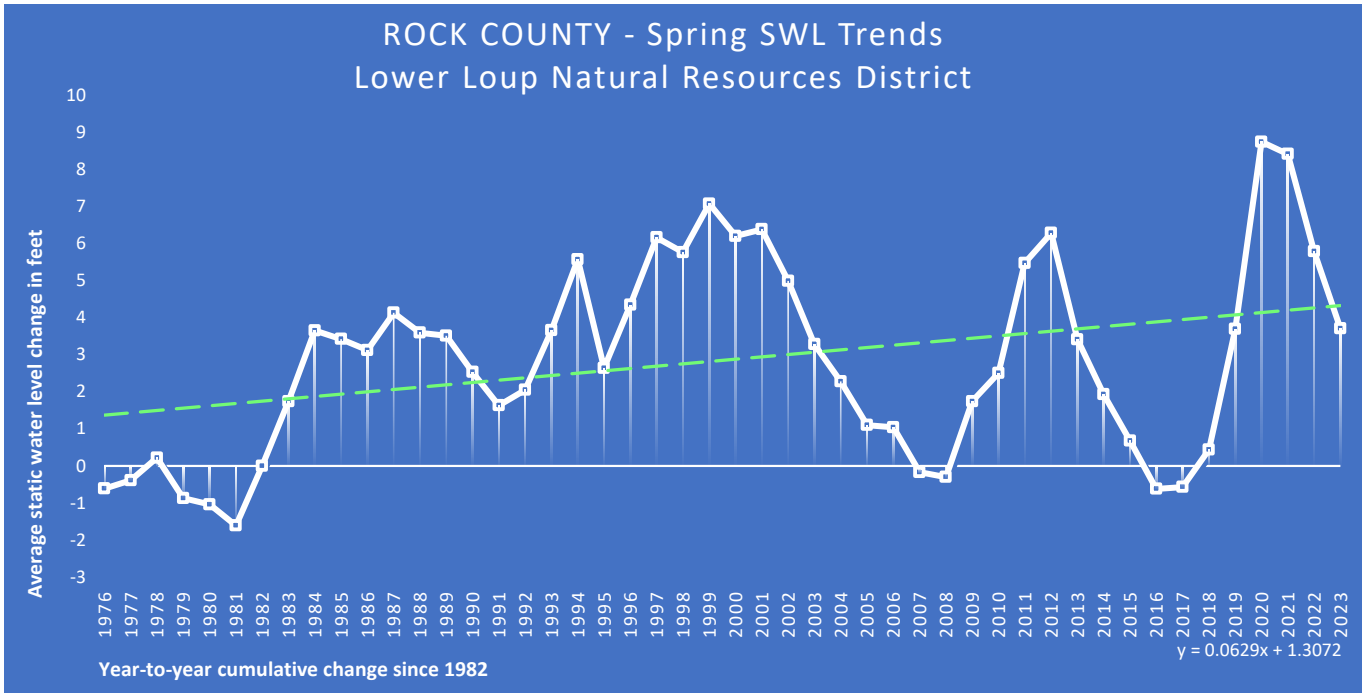


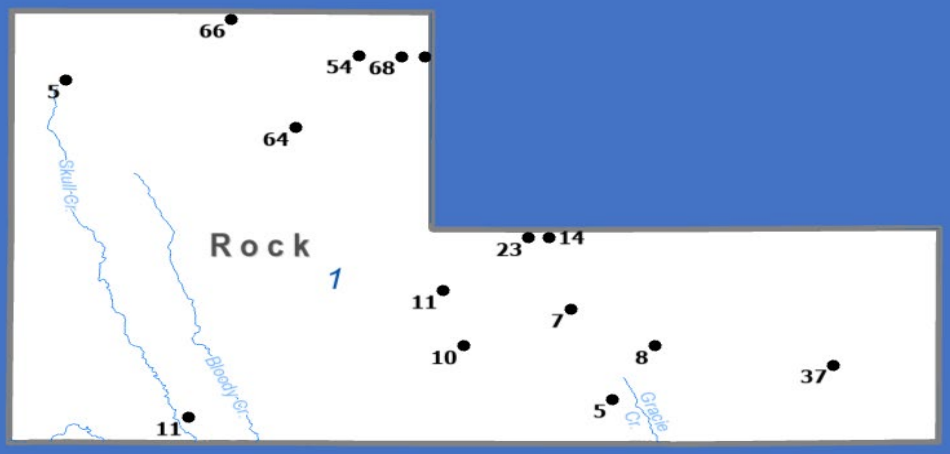


Depth to water level in Spring 2023 (rounded to nearest foot)

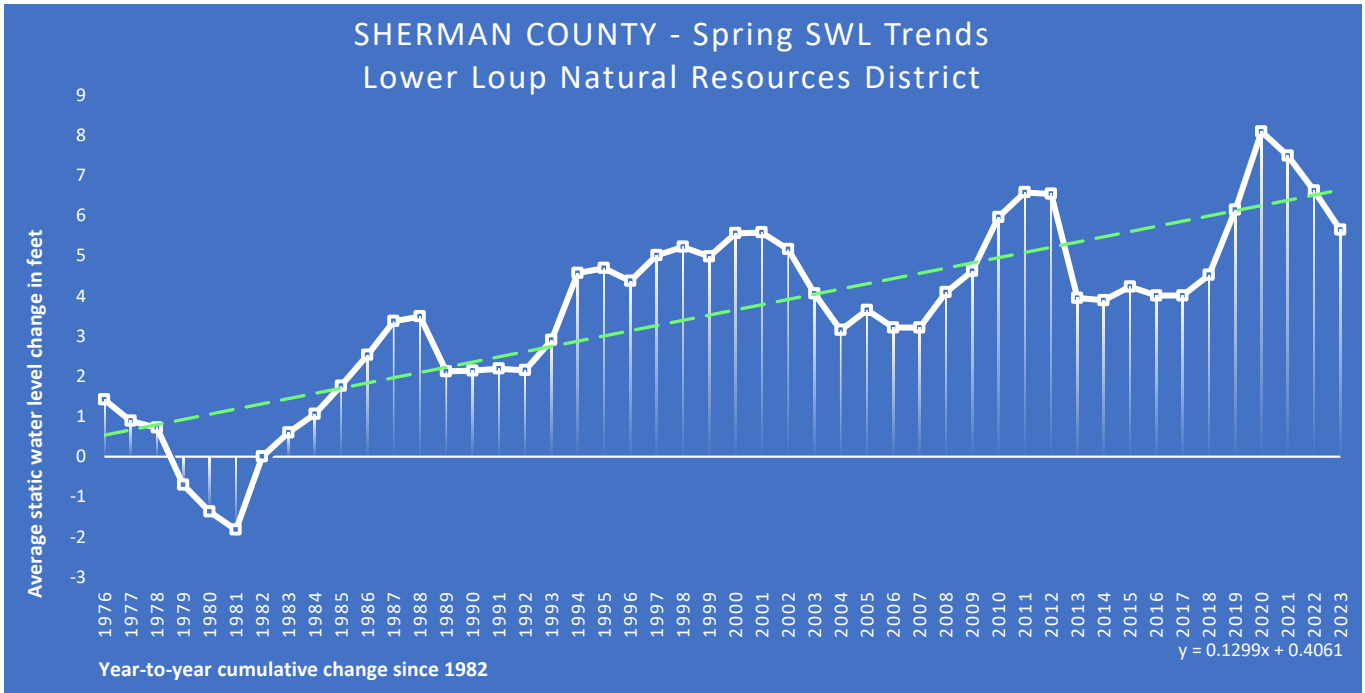

PLATTE COUNTY - Spring SWL Trends
Lower Loup Natural Resources District
Average static water level change in feet
6
5
4
3
2
1
0
-1
-2
-3
-4
1976 1977 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year-to-year cumulative change since 1982
y = 0.0296x + 0.4302


Rock
Loup
Garfield
Wheeler
Boone
Valley
Greeley
Custer
Nance
Platte
Butler
Sherman
Howard
Merrick
Buffalo
Hall
114
95
51
72
184
6
185
141
Looking Glass Cr
Cherry Cr
134
79
50
18
Platte
Trib of Loup R
Monroe
32
72
85
76
72
16
75
69
74
65
65
15
15
Columbus
Loup River
10
18
13
17
24
13
20
15
6
13
17
16
15
56
Bismum Cr
28
73
74
14
Duncan
Depth to water level in Spring 2023 (rounded to nearest foot)

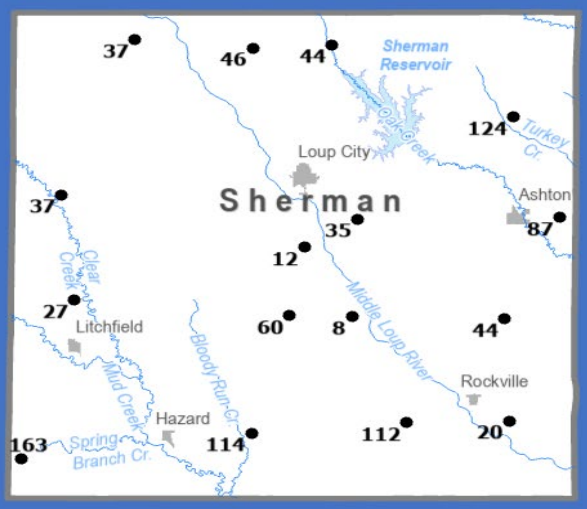




Depth to water level in Spring 2023 (rounded to nearest foot)

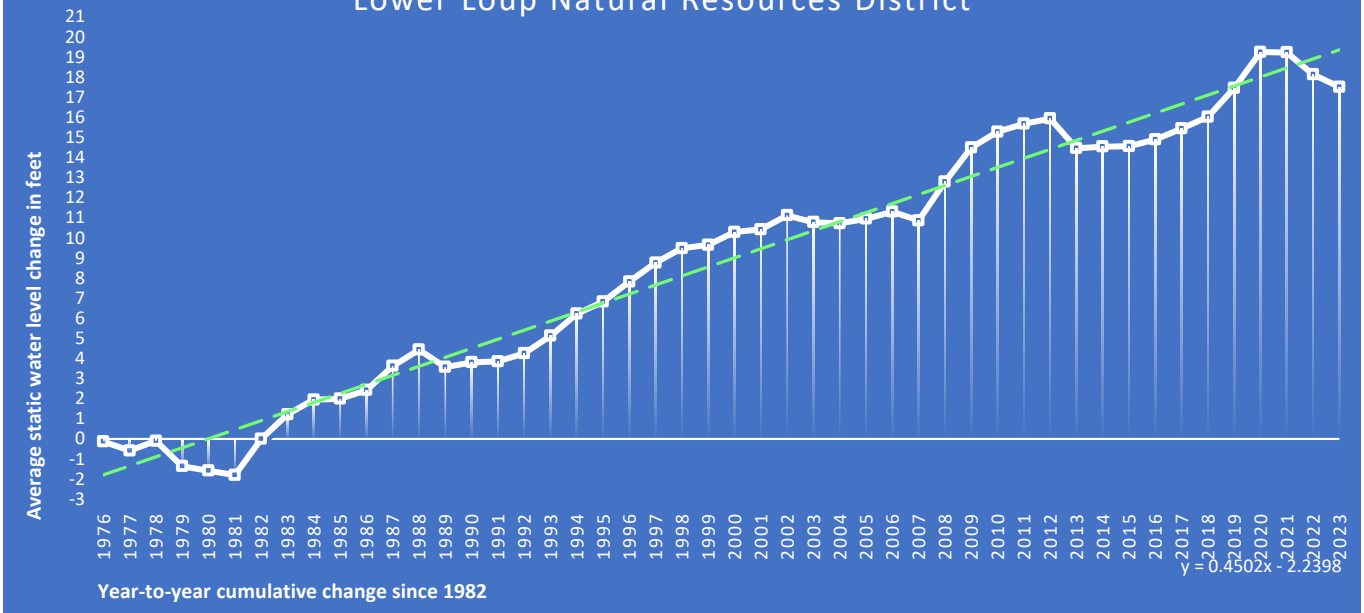


Year-to-year cumulative change since 1982

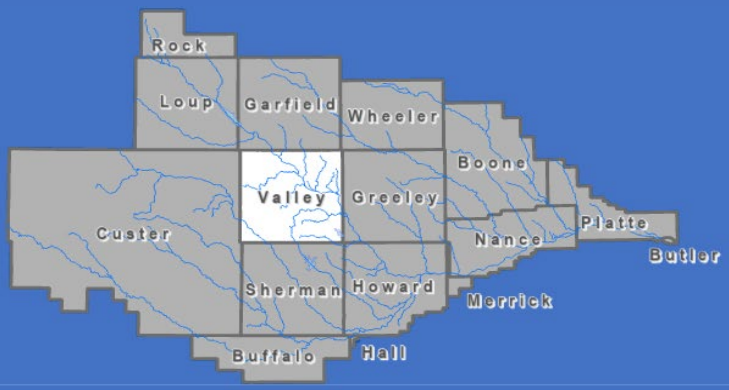


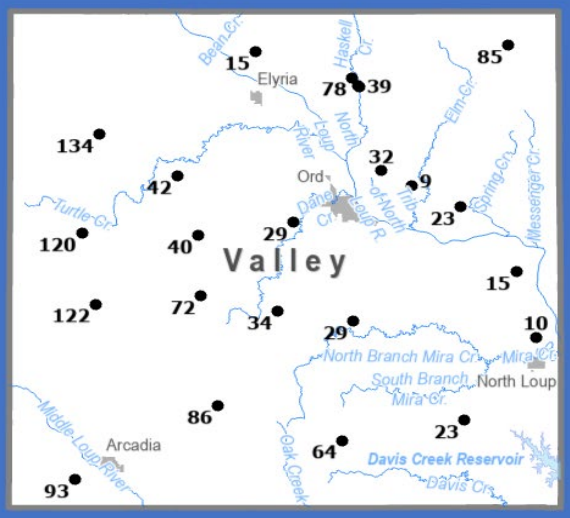
Depth to water level in Spring 2023 (rounded to nearest foot)

VALLEY COUNTY - Spring SWL Trends
Lower Loup Natural Resources District

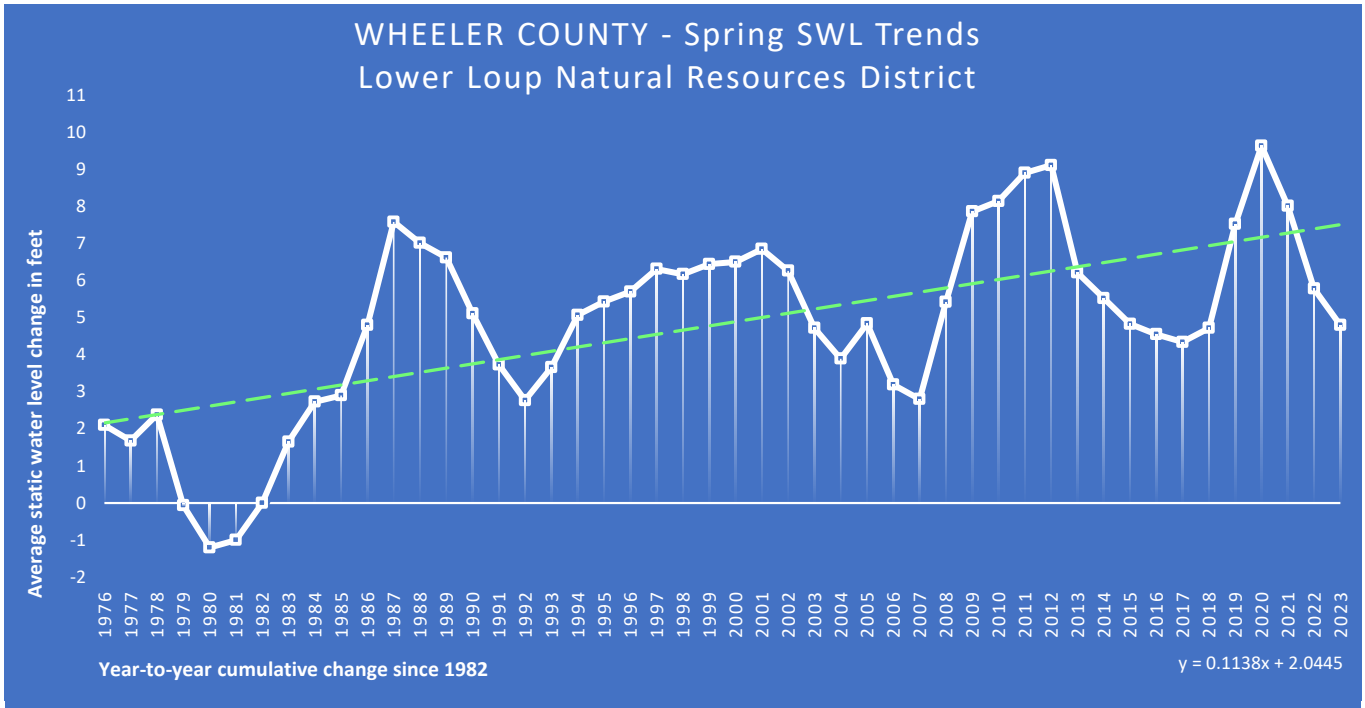


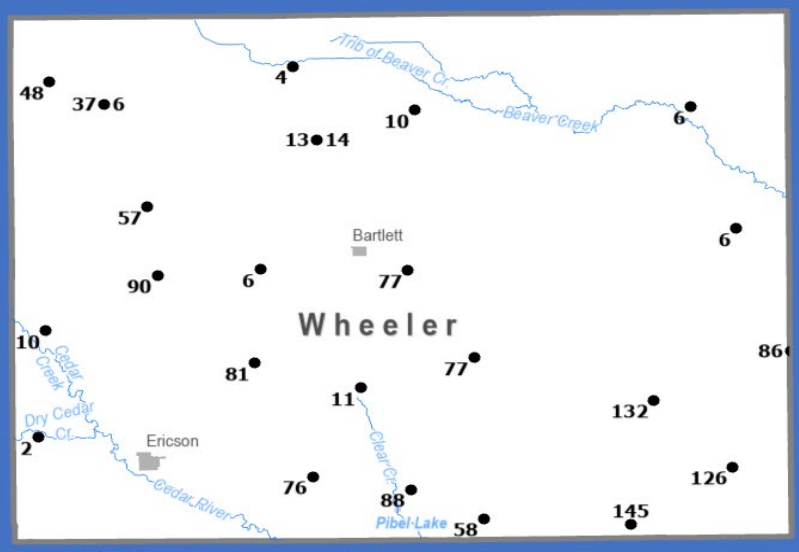
Year-to-year cumulative change since 1982





Depth to water level in Spring 2023 (rounded to nearest foot)





Depth to water level in Spring 2023 (rounded to nearest foot)

N

LOWER LOUP NATURAL RESOURCES DISTRICT

10-Year SWL Locations

10-Year SWL Change 2013 - 2023
in feet

- ≤ -5
- -5 to -2.5
- -2.5 to -1
- -1 to 1
- 1 to 2.5
- 2.5 to 5
- > 5

Rock
Loup
Garfield
Wheeler
Boone
Platte
Nance
Merrick
Valley
Greeley
Howard
Sherman
Hall
Buffalo
Custer
Butler

Gracie Creek
Calamus Reservoir
Bartlett
Ericson
Pibel Lake
Petersburg
Albion
Spalding
Primrose
Cedar Rapids
St. Edward
Monroe
Belgrade
Genoa
Fullerton
Columbus
Duncan
Elyria
Ord
Sargent
Anselmo
Victoria Springs
Comstock
North Loup
Scotia
Greeley Center
Davis Creek Reservoir
Wolbach
Merna
Arnold
Arnold Lake
Broken Bow
Arcadia
Berwyn
Callaway
Ansley
Mason City
Loup City
Sherman Reservoir
Ashton
Cotesfield
Elba
Cushing
Farwell
St. Paul
Palmer
Litchfield
Rockville
Dannebrog
Hazard
Boelus
Ravenna
Ravenna Lake
Pleasanton

Notes:
Change in depth to water values were calculated by subtracting Spring 2023 from Spring 2013.
Static water level locations that did not report at least 8 readings (Spring and Fall) in the last 5 years (Fall 2018 through Spring 2023) were not used in the interpolation.
Spatial interpolation = inverse distance weighted (IDW), default settings.

1:625,000

0 5 10 20 30 40 50 Miles

\GIS_Projects\WaterQuantity\StaticWaterLevel

STATIC WATER LEVEL CHANGE
10 YEARS
SPRING 2013 TO SPRING 2023
Lower Loup Natural Resources District

N

LOWER LOUP NATURAL RESOURCES DISTRICT

5-Year SWL Change 2018 - 2023
in feet
- ≤ -5
- -5 to -2.5
- -2.5 to -1
- -1 to 1
- 1 to 2.5
- 2.5 to 5
- > 5
- 5-Year SWL Locations

Rock
Loup
Garfield
Wheeler
Boone
Platte
Nance
Merrick
Hall
Howard
Greeley
Valley
Sherman
Custer
Buffalo
Butler

Gracie Creek
Calamus Reservoir
Bartlett
Ericson
Pibel Lake
Petersburg
Albion
Spalding
Primrose
Cedar Rapids
St. Edward
Monroe
Belgrade
Genoa
Fullerton
Columbus
Duncan
Burwell
Taylor
Elyria
Sargent
Ord
Comstock
North Loup
Greeley Center
Scotia
Davis Creek Reservoir
Wolbach
Arcadia
Anselmo
Victoria Springs
Arnold
Arnold Lake
Merna
Broken Bow
Berwyn
Ansley
Mason City
Callaway
Sherman Reservoir
Loup City
Ashton
Litchfield
Rockville
Cotesfield
Elba
Cushing
Farwell
St. Paul
Dannebrog
Boelus
Palmer
Ravenna
Ravenna Lake
Pleasanton

Notes:
Change in depth to water values were calculated by subtracting Spring 2023 from Spring 2018.
Static water level locations that did not report at least 8 readings (Spring and Fall) in the last 5 years (Fall 2018 through Spring 2023) were not used in the interpolation.
Spatial interpolation = inverse distance weighted (IDW), default settings.

1:625,000

0 5 10 20 30 40 50 Miles

\GIS_Projects\WaterQuantity\StaticWaterLevel

STATIC WATER LEVEL CHANGE
5 YEARS
SPRING 2018 TO SPRING 2023
Lower Loup Natural Resources District

N

LOWERLOUP
NATURAL RESOURCES DISTRICT

1-Year SWL Locations
SWLChange2022_2023_1
in feet
≤ -5
-5 to -2.5
-2.5 to -1
-1 to 1
1 to 2.5
2.5 to 5
> 5

Rock
Loup
Garfield
Wheeler
Boone
Platte
Nance
Merrick
Howard
Greeley
Valley
Sherman
Custer
Buffalo
Hall
Butler

Gracie Creek
Calamus Reservoir
Burwell
Taylor
Ericson
Bartlett
Pibel Lake
Petersburg
Albion
Spalding
Primrose
St Edward
Cedar Rapids
Monroe
Genoa
Columbus
Duncan
Fullerton
Belgrade
Palmer
Cushing
St Paul
Farwell
Elba
Cotesfield
Dannebrog
Boelus
Greeley Center
Scotia
Davis Creek Reservoir
Wolbach
North Loup
Ord
Elyria
Sargent
Victoria Springs
Anselmo
Merna
Arnold
Arnold Lake
Broken Bow
Comstock
Arcadia
Berwyn
Ansley
Callaway
Mason City
Litchfield
Loup City
Sherman Reservoir
Ashton
Rockville
Hazard
Ravenna
Ravenna Lake
Pleasanton

Notes:
Change in depth to water values were calculated by subtracting Spring 2023 from Spring 2022.
Spatial interpolation = inverse distance weighted (IDW), default settings.

1:625,000

0 5 10 20 30 40 50 Miles

STATIC WATER LEVEL CHANGE
1 YEAR
SPRING 2022 TO SPRING 2023
Lower Loup Natural Resources District

\GIS_Projects\WaterQuantity\StaticWaterLevel

All-Years SWL Trend Locations 2023

All-Years SWL Trend 2023

in feet

- ≤ -0.5 rise
- -0.5 to -0.25
- -0.25 to -0.1
- -0.1 to 0.1
- 0.1 to 0.25
- 0.25 to 0.5
- >0.5 drop

Rock
Loup
Garfield
Wheeler
Valley
Greeley
Boone
Platte
Custer
Sherman
Howard
Nance
Buffalo

Anselmo
Sargent
Merna
Broken Bow
Arnold
Callaway
Taylor
Burwell
Ericson
Bartlett
Petersburg
Albion
Spalding
Primrose
Cedar Rapids
St. Edward
Elyria
Ord
Comstock
North Loup
Greeley Center
Scotia
Arcadia
Wolbach
Belgrade
Genoa
Monroe
Columbus
Duncan
Fullerton
Berwyn
Ansley
Mason City
Loup City
Ashton
Cotesfield
Elba
Farwell
St. Paul
Cushing
Palmer
Litchfield
Rockville
Hazard
Boelus
Dannebrog
Pleasanton
Ravenna
Grand Island
Norfolk

Notes:
Values represent the linear regression coefficient from the observed depth to static water measurements plotted over time, going back to Spring 1982, or when first available.
Static water level locations that did not report at least 8 readings (Spring and Fall) in the last 5 years (Fall 2018 through Spring 2023) were not used in the interpolation.
Spatial interpolation = inverse distance weighted (IDW), default settings.
Values in this dataset can be interpreted as an increase or decrease in feet of water level.
E.g. 0.5 indicates a trend of water level loss of 1/2 ft.

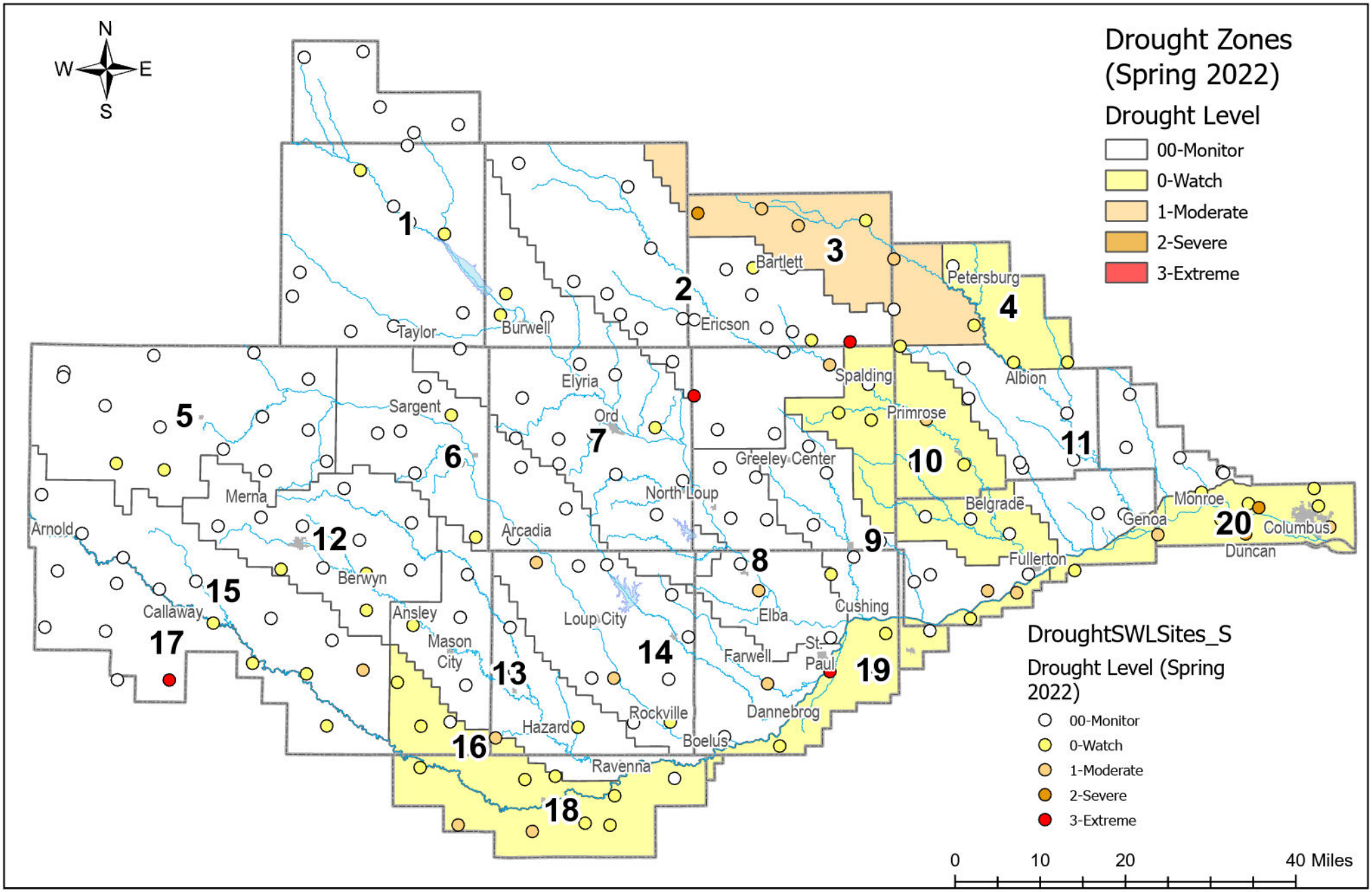
1:621,479

0 5 10 20 30 40 50 Miles

Nebraska Game & Parks Commission, Esri, HERE, Garmin, Sa... [illegible]

STATIC WATER LEVEL TREND
ALL YEARS
SPRING 1982 TO SPRING 2023
Lower Loup Natural Resources District

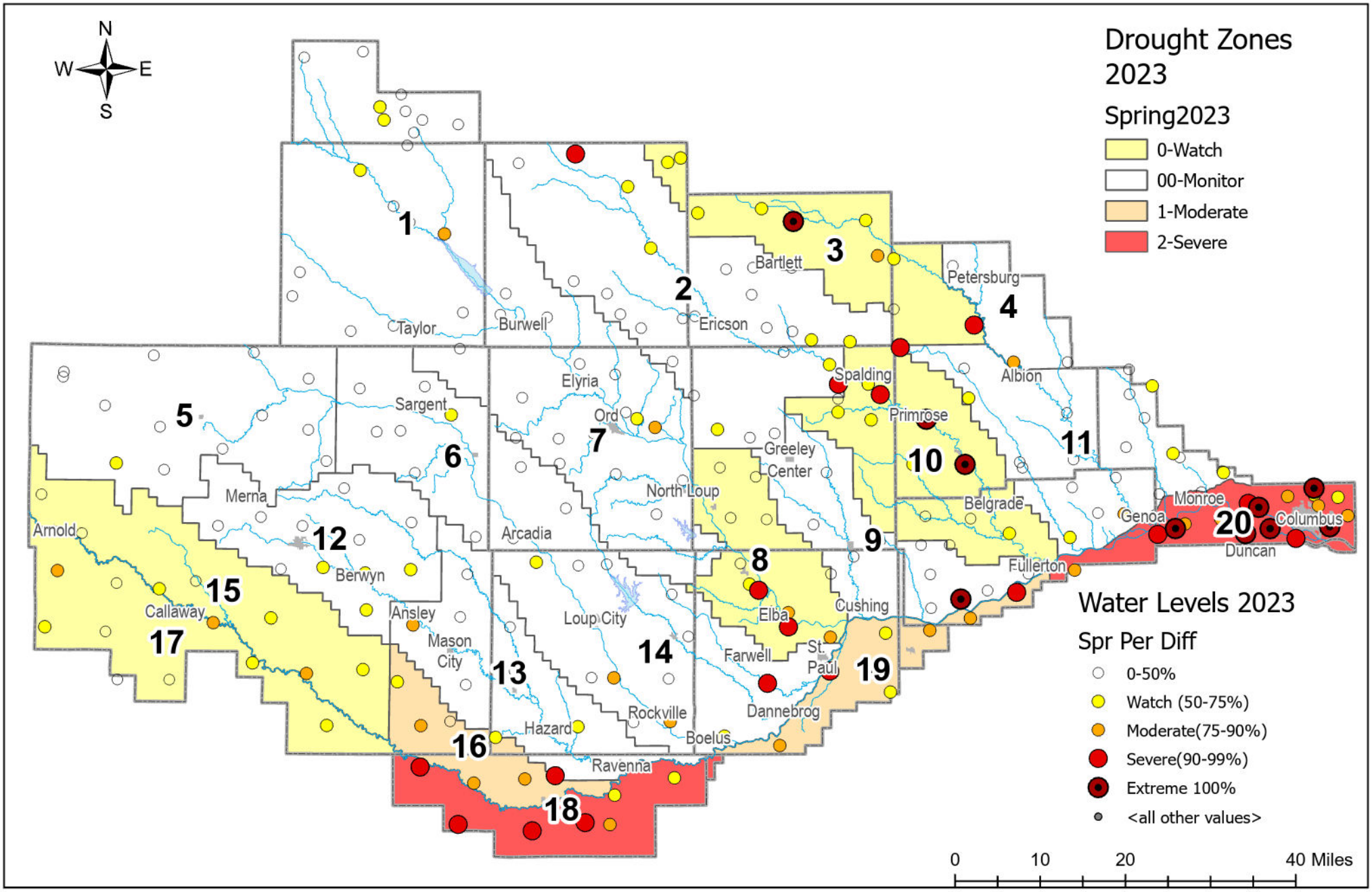
\GIS_Projects\WaterQuantity\StaticWaterLevel



LOWERLOUP
NATURAL RESOURCES DISTRICT

2022 Drought Zones and Spring Water Levels

4/21/2023
Ord, NE



LOWERLOUP NATURAL RESOURCES DISTRICT

2023 Drought Zones and Spring Water Levels

4/21/2023
Ord, NE