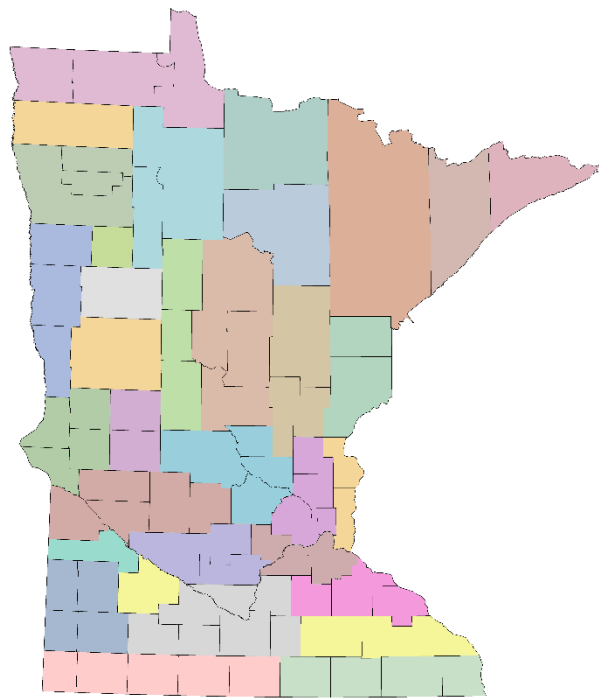




New Coordinate Systems for 2022

Proposal Current as of March 2021

Geoff Bitner, LS

MnDOT Office of Land Management | Designated NGS State Geodetic Coordinator

Geospatial Advisory Council Meeting

May 26, 2021

Some Things Worth Remembering

- Last update was in May of 2018
- The new datum, NATRF2022, is providing the opportunity to update coordinate systems
- NGS has developed new State Plane and UTM grids
- MnDOT has completed the replacement for the Minnesota County Coordinate System

Current Situation with State Plane & UTM

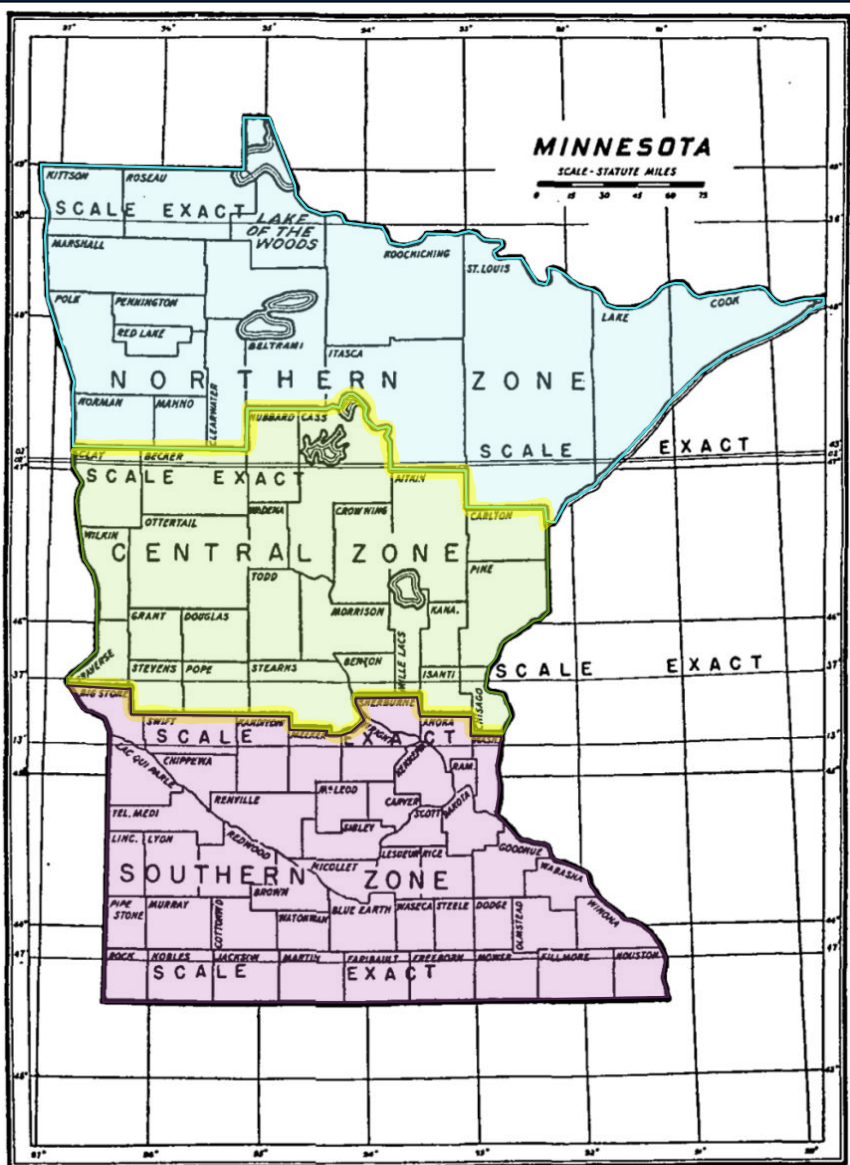


FIGURE 7.—Map of Minnesota with grid system outline.

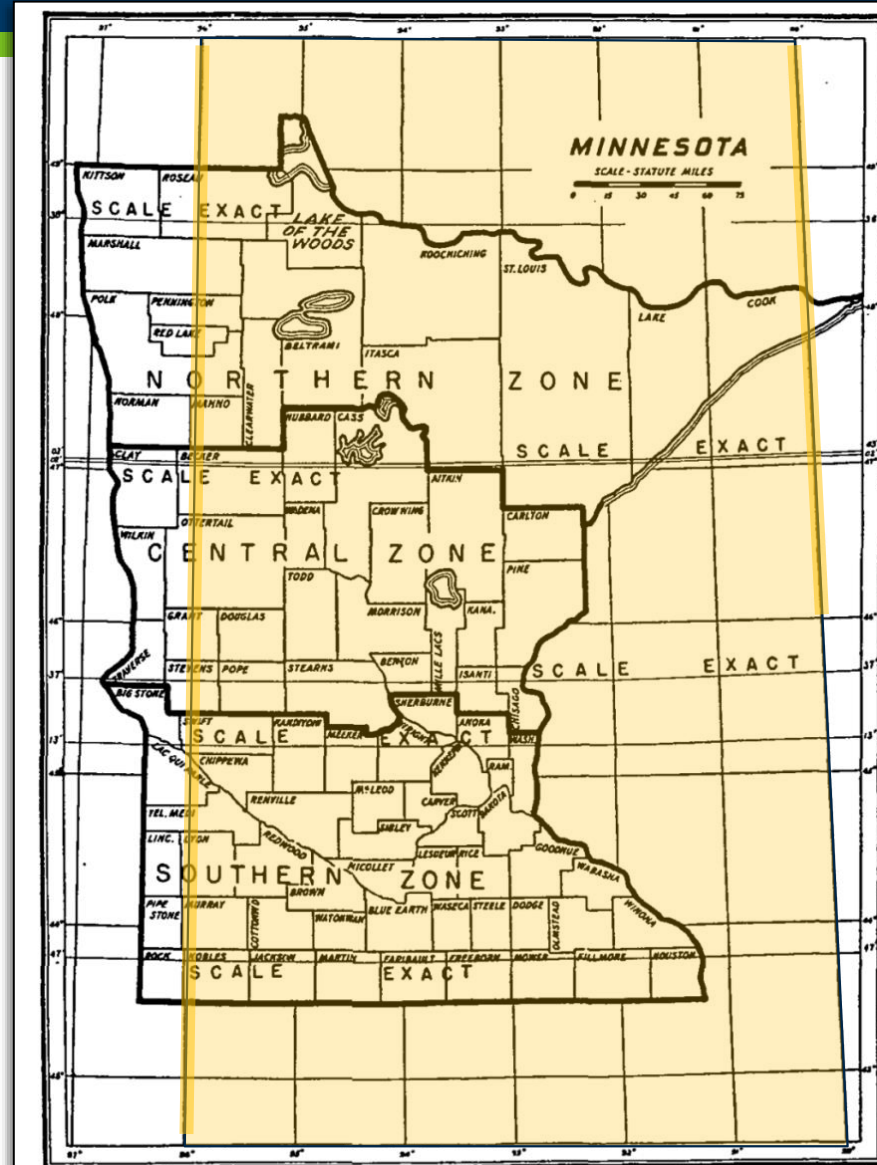


FIGURE 7.—Map of Minnesota with grid system outline.

Future of State Plane & UTM

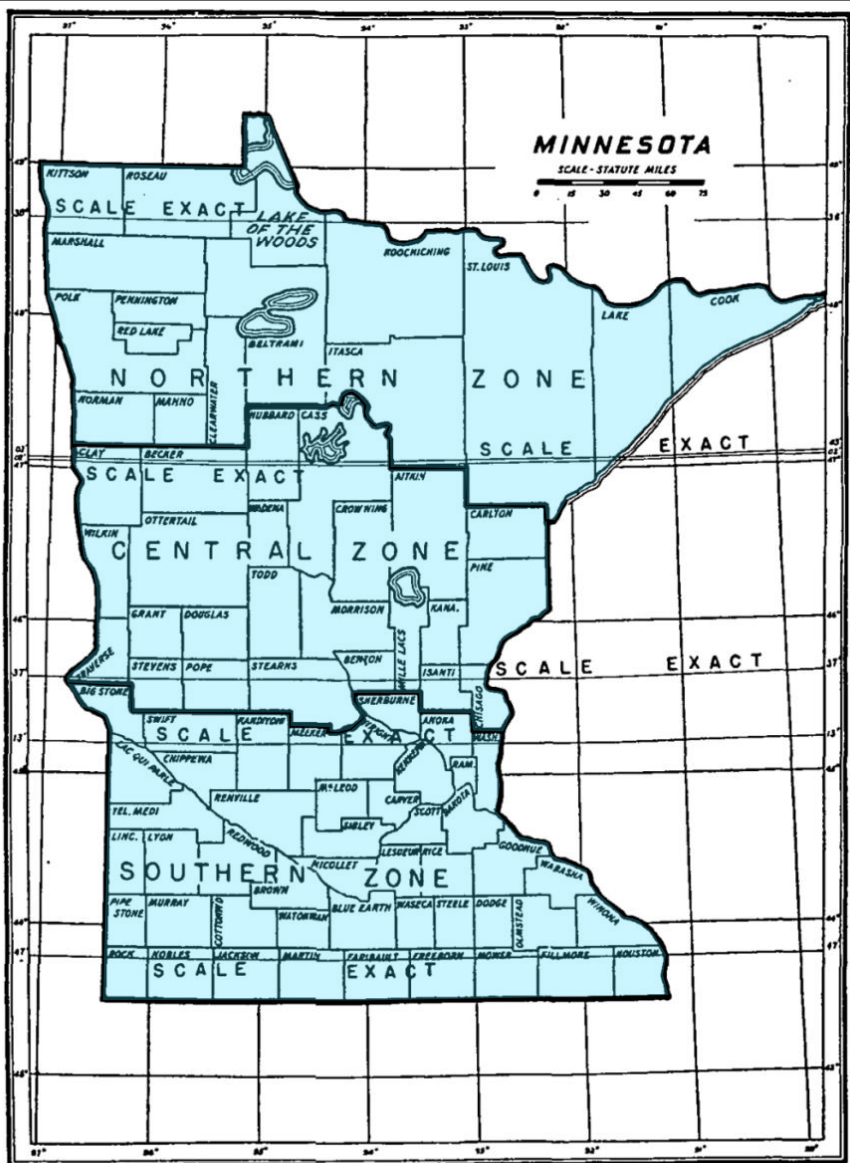


FIGURE 7.—Map of Minnesota with grid system outline.

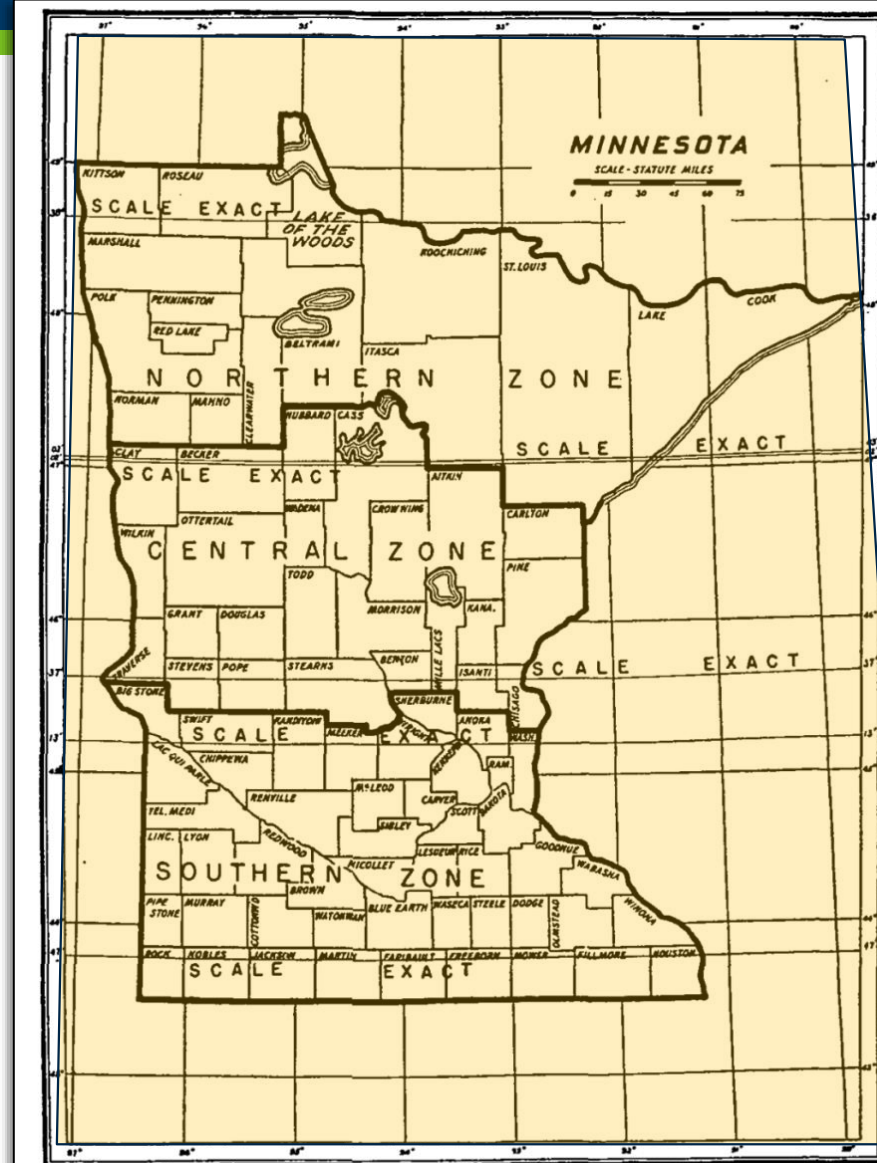
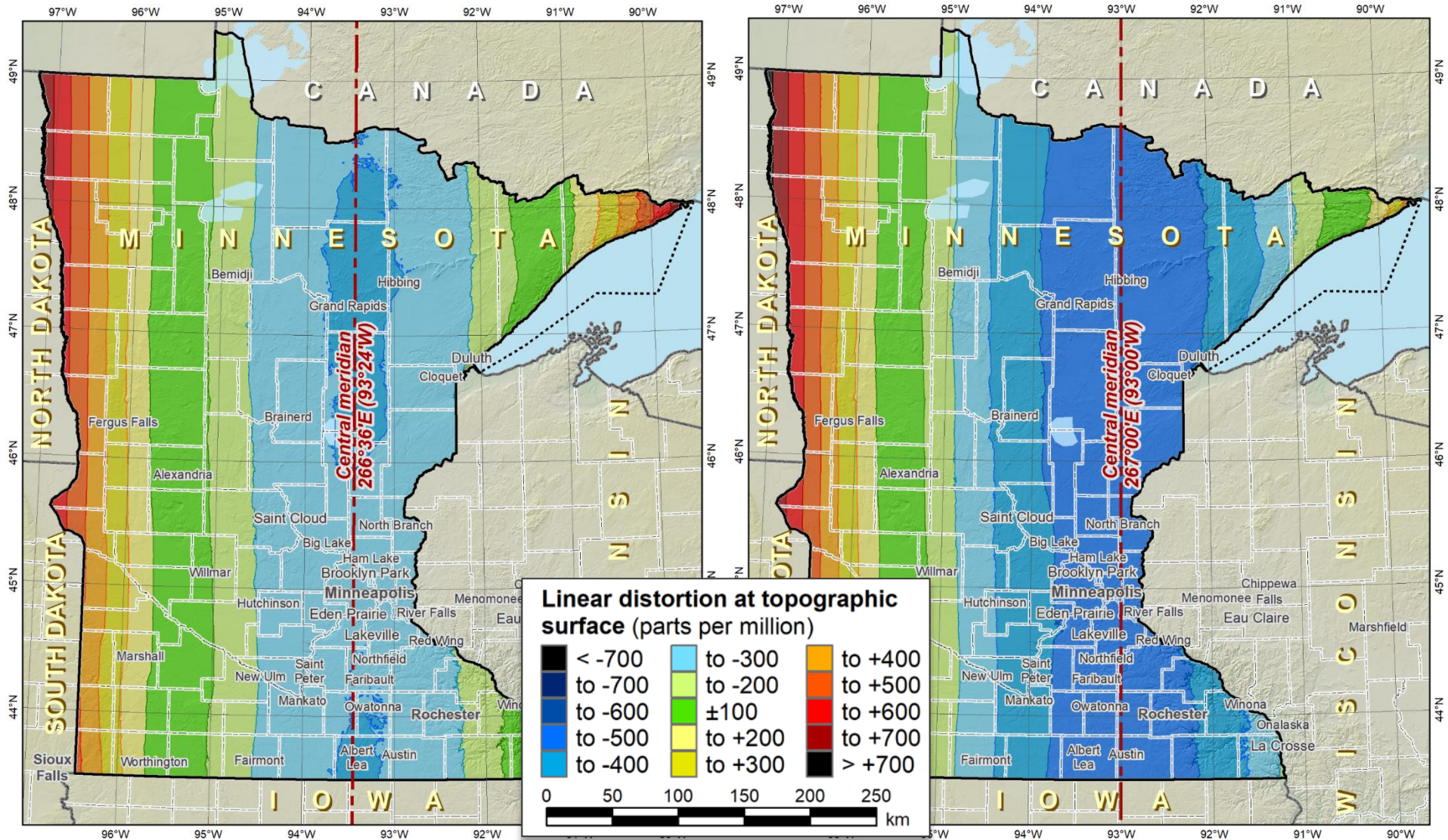


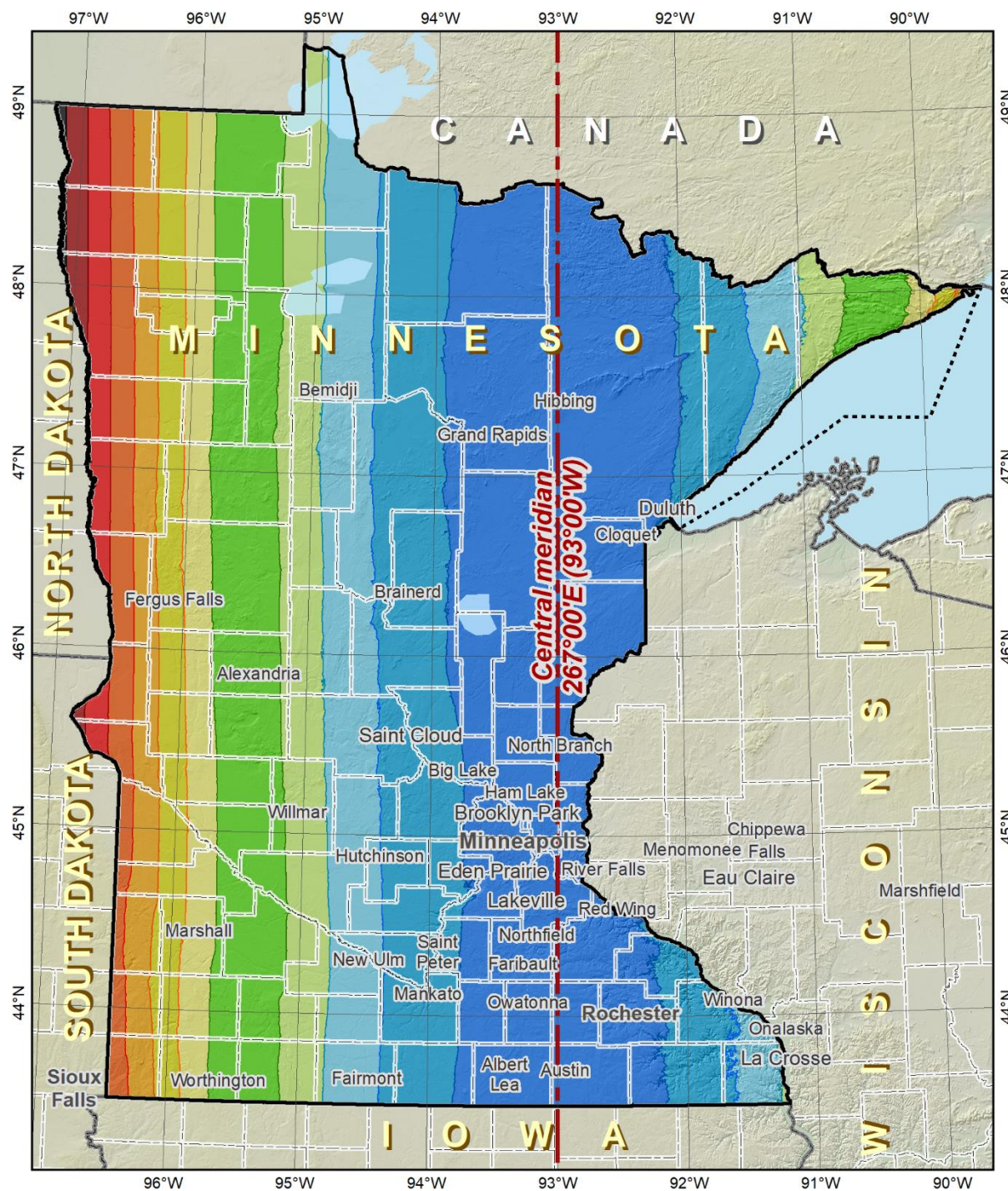
FIGURE 7.—Map of Minnesota with grid system outline.

State Plane

UTM

<https://geodesy.noaa.gov/SPCS/download.shtml>





Existing UTM Zone 15 North used as statewide zone: Minnesota



Transverse Mercator projection

North American Datum of 1983

Central meridian: 267° 00' E
Cen merid scale: 0.999 6 (exact)

Areas within ± 300 ppm distortion
(1:3,333 = ± 1.58 ft per mile):

14% of population
36% of all cities and towns
42% of entire zone area

Distortion values (ppm)

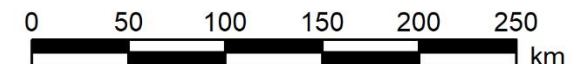
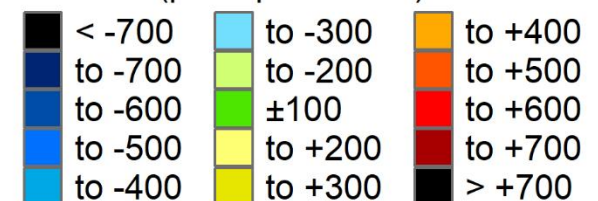
Entire zone:

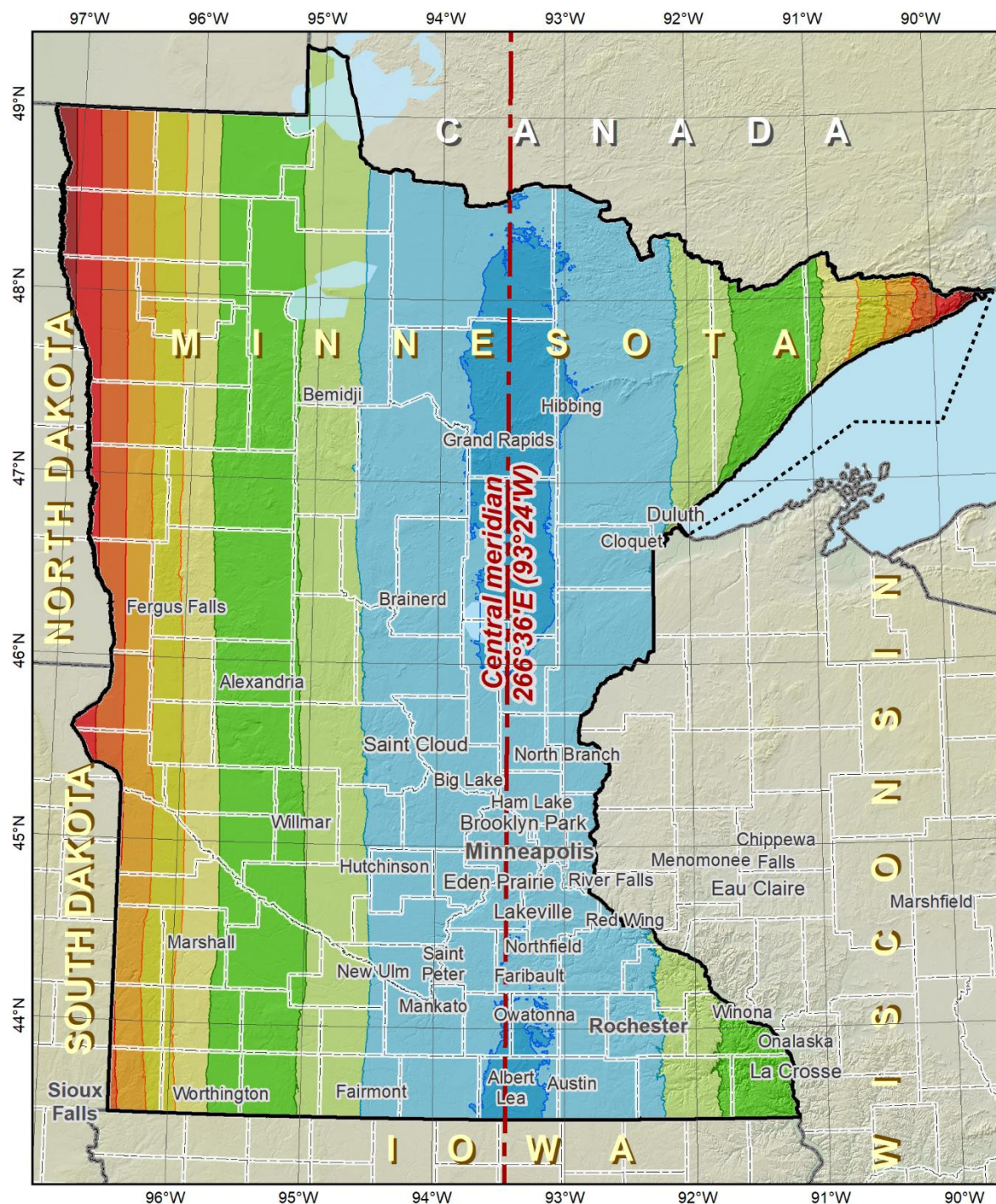
Min, Max = -476, +748
Range = 1224
Mean = -162
Weighted mean = -349
(weighted by population)

Cities and towns:

Min = -473
Max = +741
Range = 1214
Mean = -196

Linear distortion at topographic surface (parts per million)





Preliminary SPCS2022 statewide zone design: Minnesota



Transverse Mercator projection

North American Terrestrial Reference Frame of 2022

Central meridian: 266° 36' E

Cen merid scale: 0.999 75 (exact)

Areas within ± 300 ppm distortion
(1:3,333 = ± 1.58 ft per mile):

95% of population

86% of all cities and towns

83% of entire zone area

Distortion values (ppm)

Entire zone:

Min, Max = -320, +763

Range = 1083

Mean = -76

Weighted mean = -221

(weighted by population)

Cities and towns:

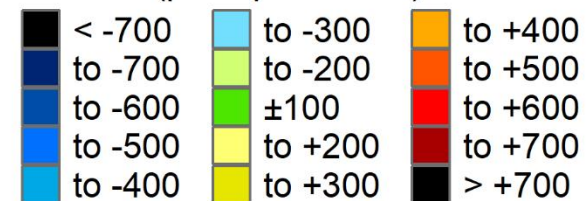
Min = -315

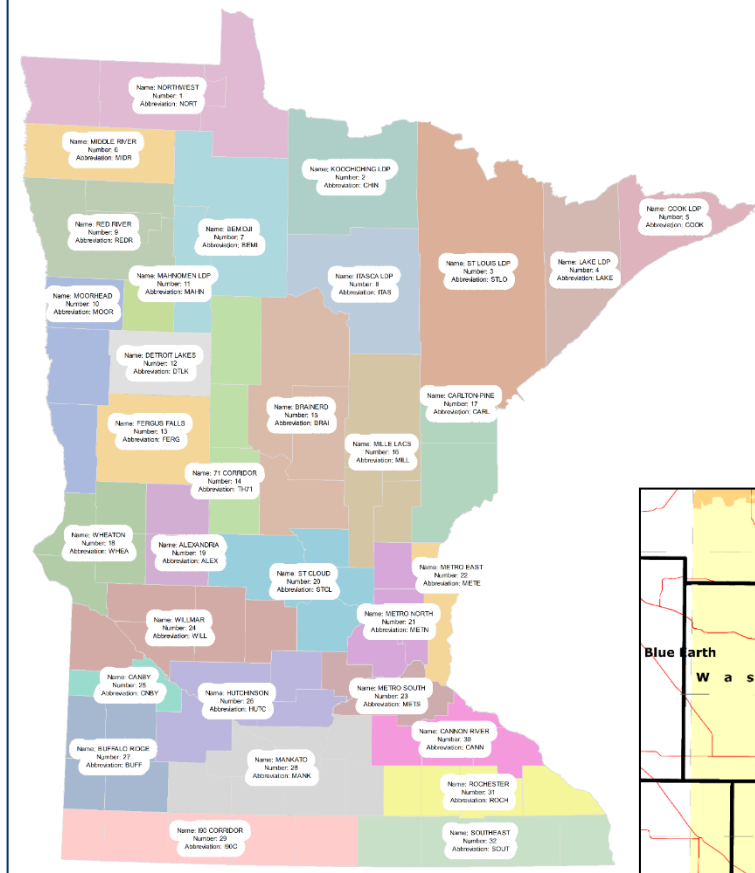
Max = +679

Range = 994

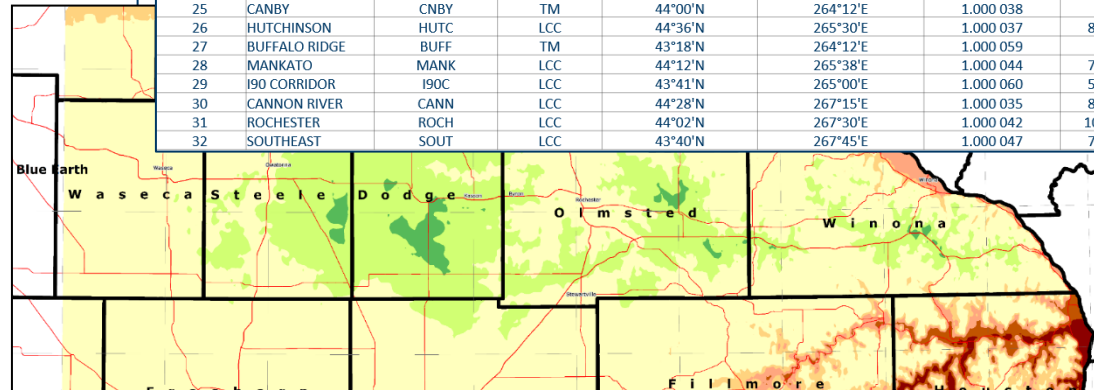
Mean = -104

Linear distortion at topographic surface (parts per million)





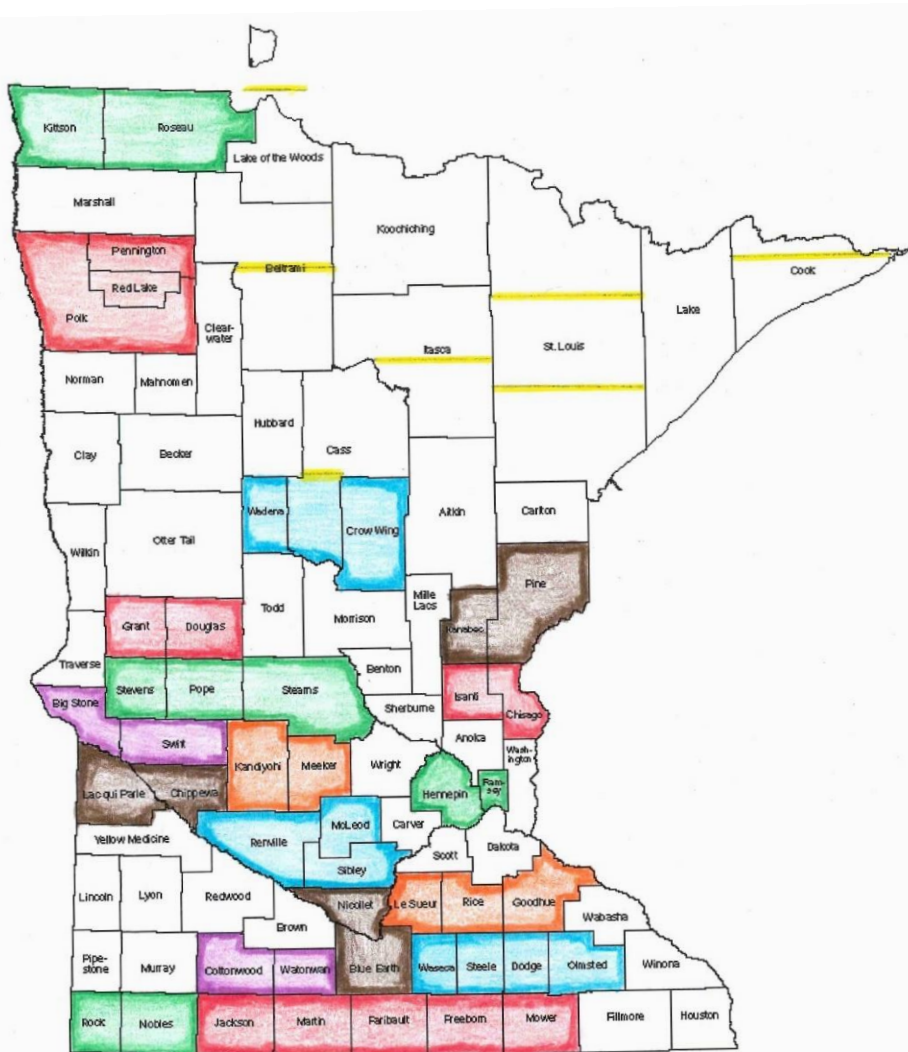
Zone number	Zone name	Zone abbreviation	Projection type	Origin latitude deg-min	Origin longitude deg-min	Projection axis scale	False northing	False easting
1	NORTHWEST	NORT	LCC	48°48'N	264°00'E	1.000 039	80,000	175,000
2	KOOCHICHING LDP	CHIN	LCC	48°20'N	266°14'E	1.000 041	100,000	225,000
3	ST LOUIS LDP	STLO	TM	46°18'N	267°31'E	1.000 050	0	360,000
4	LAKE LDP	LAKE	TM	46°30'N	268°30'E	1.000 066	0	220,000
5	COOK LDP	COOK	LCC	47°45'N	269°45'E	1.000 063	80,000	200,000
6	MIDDLE RIVER	MIDR	LCC	48°21'N	263°45'E	1.000 041	80,000	175,000
7	BEMIDJI	BEMI	TM	46°45'N	264°59'E	1.000 050	0	250,000
8	ITASCA LDP	ITAS	LCC	47°27'N	266°15'E	1.000 049	100,000	225,000
9	RED RIVER	REDR	LCC	47°51'N	263°45'E	1.000 039	100,000	230,000
10	MOORHEAD	MOOR	TM	45°15'N	263°22'E	1.000 041	0	250,000
11	MAHANOMEN LDP	MAHN	TM	46°45'N	263°58'E	1.000 057	0	170,000
12	DETROIT LAKES	DTLK	LCC	47°00'N	264°20'E	1.000 061	100,000	180,000
13	FERGUS FALLS	FERG	LCC	46°21'N	264°15'E	1.000 054	60,000	200,000
14	71 CORRIDOR	TH71	TM	45°15'N	265°10'E	1.000 062	0	270,000
15	BRAINERD	BRAI	TM	45°30'N	265°45'E	1.000 050	0	250,000
16	MILLE LACS	MILL	TM	45°15'N	266°36'E	1.000 048	0	250,000
17	CARLTON-PINE	CARL	TM	45°15'N	267°20'E	1.000 044	0	225,000
18	WHEATON	WHEA	TM	44°45'N	263°42'E	1.000 039	0	220,000
19	ALEXANDRIA	ALEX	TM	45°00'N	264°28'E	1.000 055	0	190,000
20	ST CLOUD	STCL	LCC	45°22'N	265°45'E	1.000 037	80,000	200,000
21	METRO NORTH	METN	TM	44°15'N	266°42'E	1.000 034	0	225,000
22	METRO EAST	METE	TM	44°15'N	267°09'E	1.000 036	0	225,000
23	METRO SOUTH	METS	LCC	44°45'N	266°40'E	1.000 036	80,000	200,000
24	WILLMAR	WILL	LCC	45°04'N	264°45'E	1.000 042	70,000	200,000
25	CANBY	CNBY	TM	44°00'N	264°12'E	1.000 038	0	250,000
26	HUTCHINSON	HUTC	LCC	44°36'N	265°30'E	1.000 037	80,000	220,000
27	BUFFALO RIDGE	BUFF	TM	43°18'N	264°12'E	1.000 059	0	230,000
28	MANKATO	MANK	LCC	44°12'N	265°38'E	1.000 044	70,000	210,000
29	I90 CORRIDOR	I90C	LCC	43°41'N	265°00'E	1.000 060	55,000	190,000
30	CANNON RIVER	CANN	LCC	44°28'N	267°15'E	1.000 035	80,000	200,000
31	ROCHESTER	ROCH	LCC	44°02'N	267°30'E	1.000 042	100,000	200,000
32	SOUTHEAST	SOUT	LCC	43°40'N	267°45'E	1.000 047	70,000	200,000



The New Grid System for Minnesota

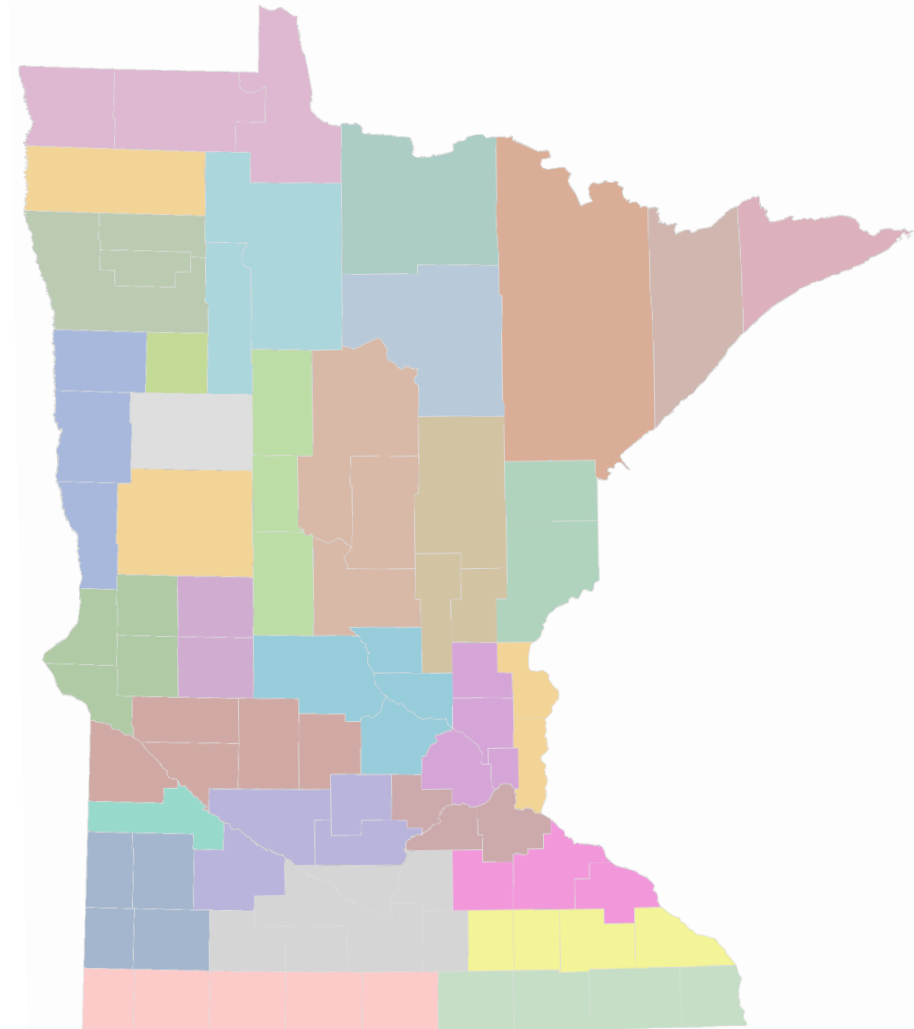
Existing County System

67 Unique Planes



New LDP Regions

32 Unique Planes

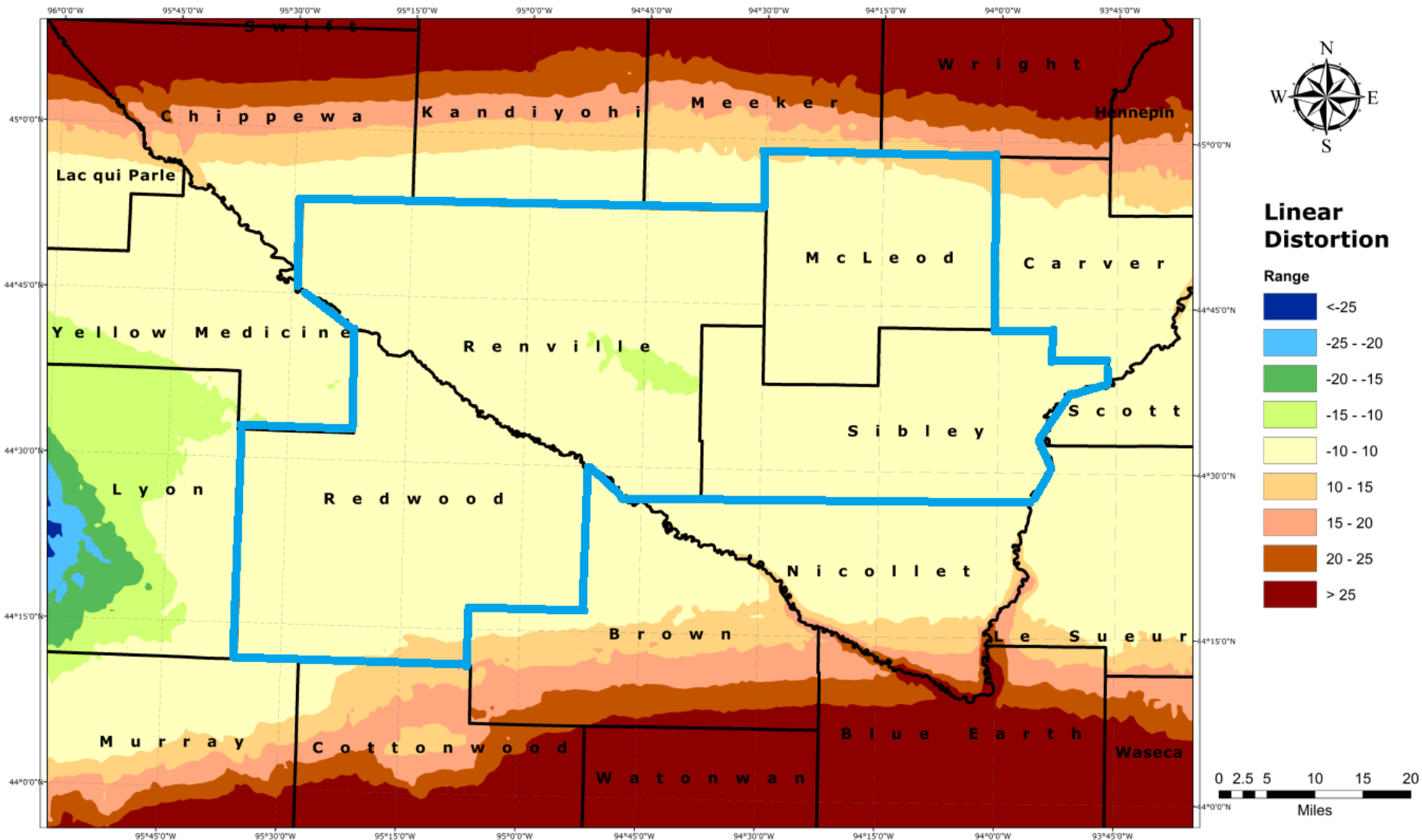


Overview of LDP Design Parameters

1. Use modern methods to flatten the sphere and control distortion
2. Keep it simple – Lambert and Transverse Mercator Proj.
3. Maximum distortions around 10 to 20ppm (with some exceptions)
 $10\text{ppm} \approx \pm 0.05\text{ft/mile} \approx 1:100,000$
 $20\text{ppm} \approx \pm 0.10\text{ft/mile} \approx 1:50,000$
4. Boundaries determined by counties, urban areas, and physical geography

Zone: 26, Hutchinson, HUTC

Redwood, Renville, Mcleod, Sibley

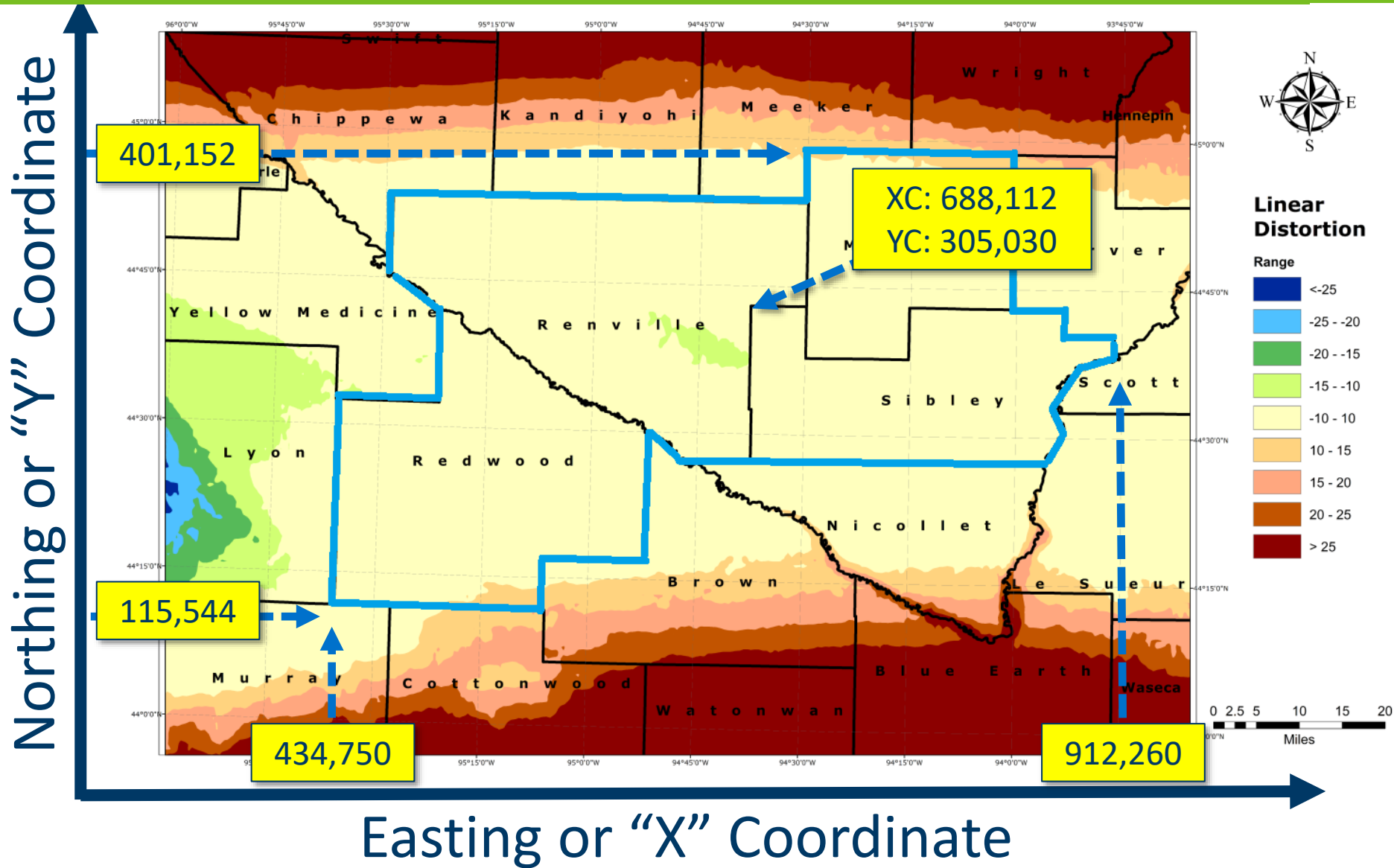


Grid Coordinate Considerations for Users

1. Avoid creating similar X,Y values as the new SPCS2022
2. Avoid values in the “millions” (XC/YC => 1,000,000)
3. Create different orders of magnitude for Northing and Easting, i.e., Easting larger than Northing

Zone: 26, Hutchinson, HUTC

Redwood, Renville, Mcleod, Sibley





Contact Information

geoffrey.bitner@state.mn.us

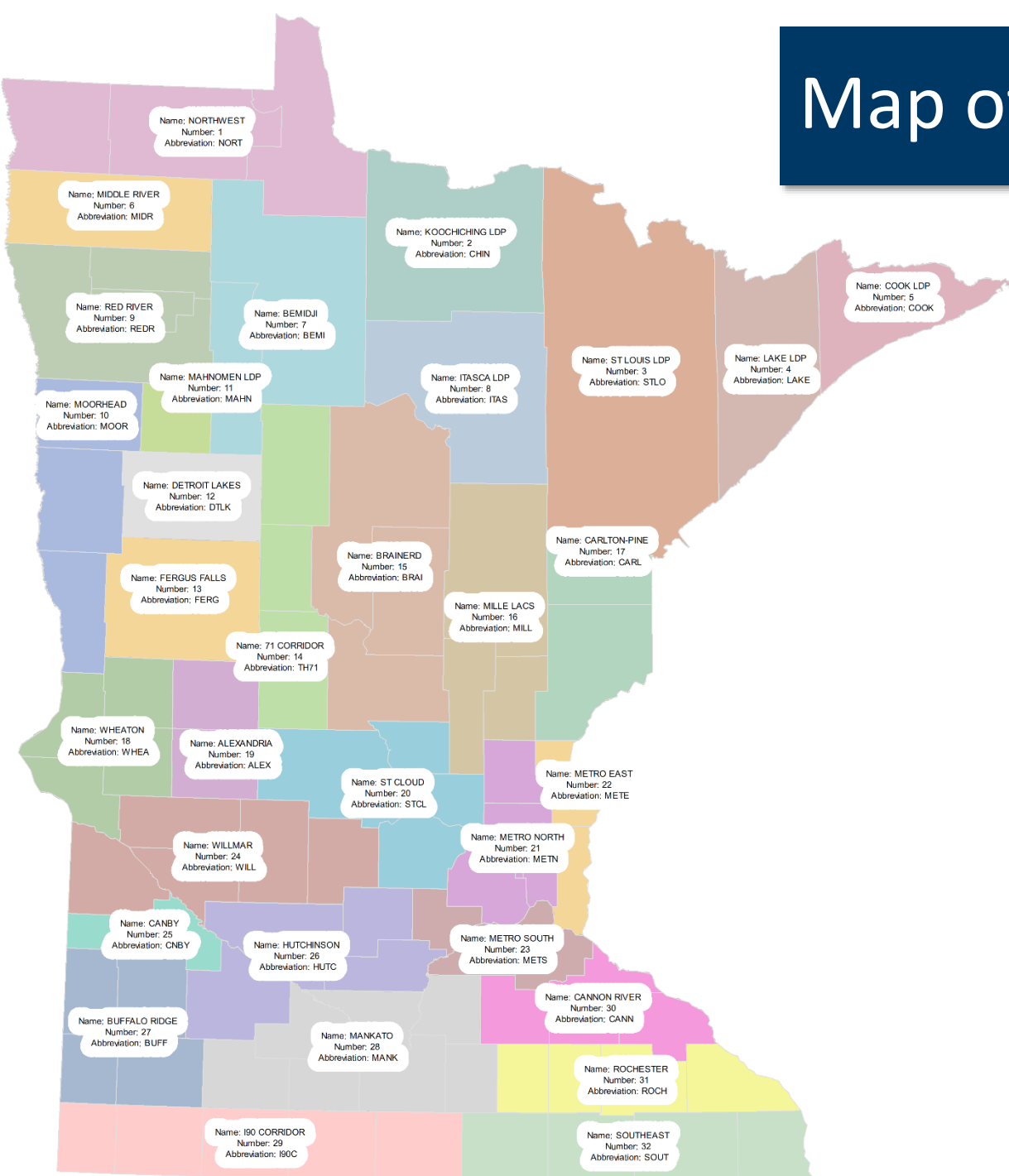
Appendix

Grid Zone Parameters and Maps

Preliminary Parameters (Version March 2021)

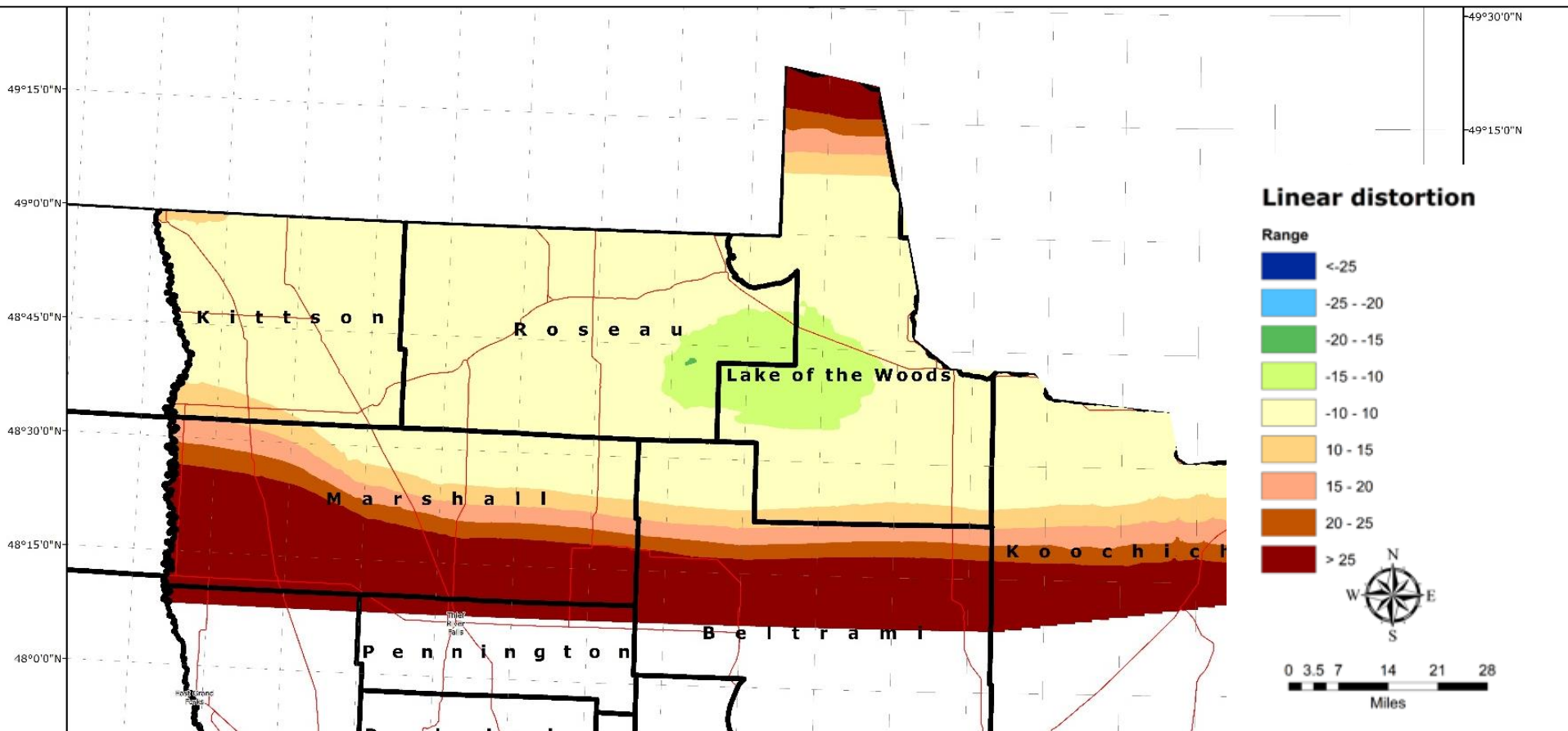
Zone number	Zone name	Zone abbreviation	Projection type	Origin latitude deg-min	Origin longitude deg-min	Projection axis scale	False northing	False easting
1	NORTHWEST	NORT	LCC	48°48'N	264°00'E	1.000 039	80,000	175,000
2	KOOCHICHING LDP	CHIN	LCC	48°20'N	266°14'E	1.000 041	100,000	225,000
3	ST LOUIS LDP	STLO	TM	46°18'N	267°31'E	1.000 050	0	360,000
4	LAKE LDP	LAKE	TM	46°30'N	268°30'E	1.000 066	0	220,000
5	COOK LDP	COOK	LCC	47°45'N	269°45'E	1.000 063	80,000	200,000
6	MIDDLE RIVER	MIDR	LCC	48°21'N	263°45'E	1.000 041	80,000	175,000
7	BEMIDJI	BEMI	TM	46°45'N	264°59'E	1.000 050	0	250,000
8	ITASCA LDP	ITAS	LCC	47°27'N	266°15'E	1.000 049	100,000	225,000
9	RED RIVER	REDR	LCC	47°51'N	263°45'E	1.000 039	100,000	230,000
10	MOORHEAD	MOOR	TM	45°15'N	263°22'E	1.000 041	0	250,000
11	MAHNOMEN LDP	MAHN	TM	46°45'N	263°58'E	1.000 057	0	170,000
12	DETROIT LAKES	DTLK	LCC	47°00'N	264°20'E	1.000 061	100,000	180,000
13	FERGUS FALLS	FERG	LCC	46°21'N	264°15'E	1.000 054	60,000	200,000
14	71 CORRIDOR	TH71	TM	45°15'N	265°10'E	1.000 062	0	270,000
15	BRAINERD	BRAI	TM	45°30'N	265°45'E	1.000 050	0	250,000
16	MILLE LACS	MILL	TM	45°15'N	266°36'E	1.000 048	0	250,000
17	CARLTON-PINE	CARL	TM	45°15'N	267°20'E	1.000 044	0	225,000
18	WHEATON	WHEA	TM	44°45'N	263°42'E	1.000 039	0	220,000
19	ALEXANDRIA	ALEX	TM	45°00'N	264°28'E	1.000 055	0	190,000
20	ST CLOUD	STCL	LCC	45°22'N	265°45'E	1.000 037	80,000	200,000
21	METRO NORTH	METN	TM	44°15'N	266°42'E	1.000 034	0	225,000
22	METRO EAST	METE	TM	44°15'N	267°09'E	1.000 036	0	225,000
23	METRO SOUTH	METS	LCC	44°45'N	266°40'E	1.000 036	80,000	200,000
24	WILLMAR	WILL	LCC	45°04'N	264°45'E	1.000 042	70,000	200,000
25	CANBY	CNBY	TM	44°00'N	264°12'E	1.000 038	0	250,000
26	HUTCHINSON	HUTC	LCC	44°36'N	265°30'E	1.000 037	80,000	220,000
27	BUFFALO RIDGE	BUFF	TM	43°18'N	264°12'E	1.000 059	0	230,000
28	MANKATO	MANK	LCC	44°12'N	265°38'E	1.000 044	70,000	210,000
29	I90 CORRIDOR	I90C	LCC	43°41'N	265°00'E	1.000 060	55,000	190,000
30	CANNON RIVER	CANN	LCC	44°28'N	267°15'E	1.000 035	80,000	200,000
31	ROCHESTER	ROCH	LCC	44°02'N	267°30'E	1.000 042	100,000	200,000
32	SOUTHEAST	SOUT	LCC	43°40'N	267°45'E	1.000 047	70,000	200,000

Map of Zone Names



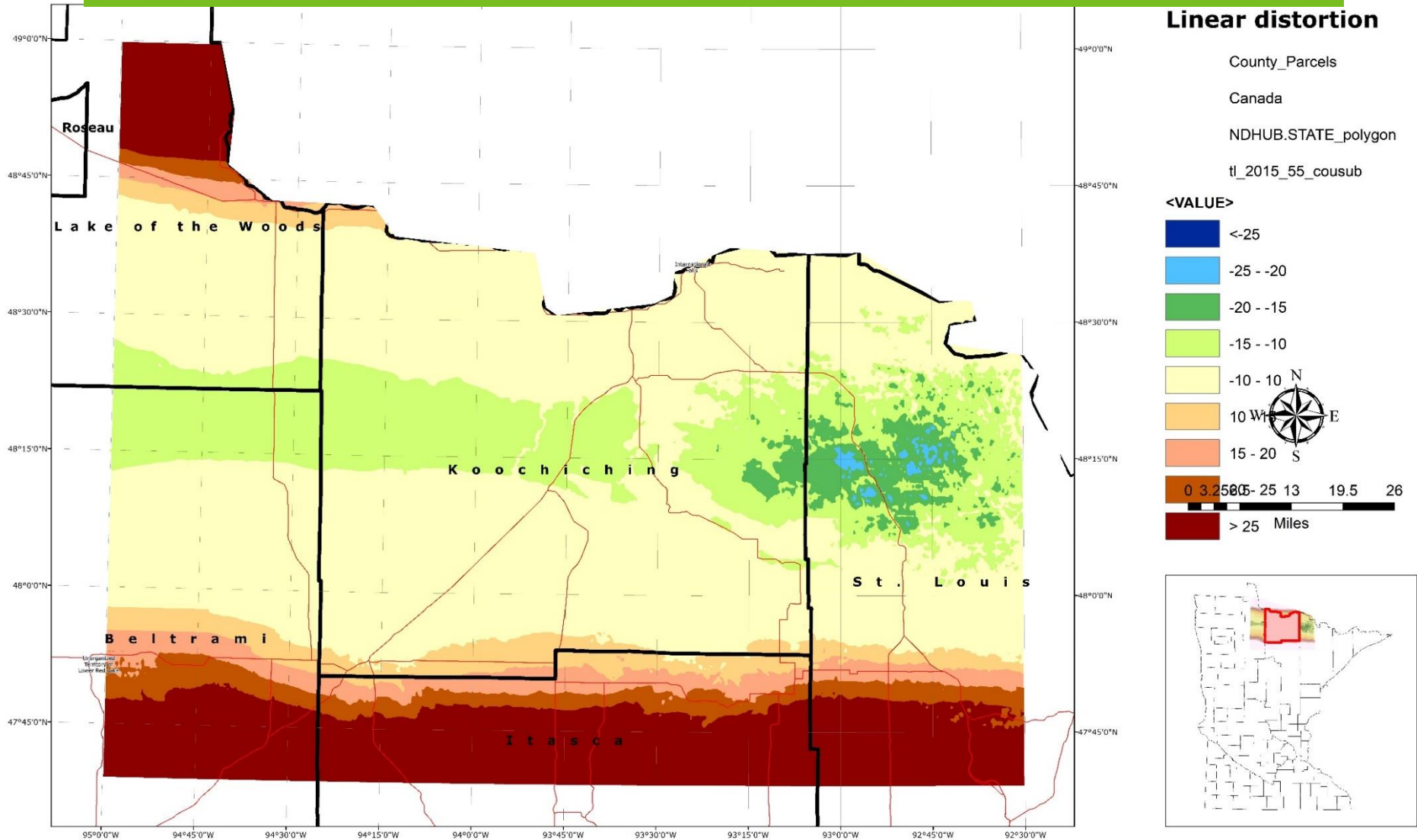
Zone: 1, Northwest, NORT

Kittson, Roseau, and Lake of the Woods

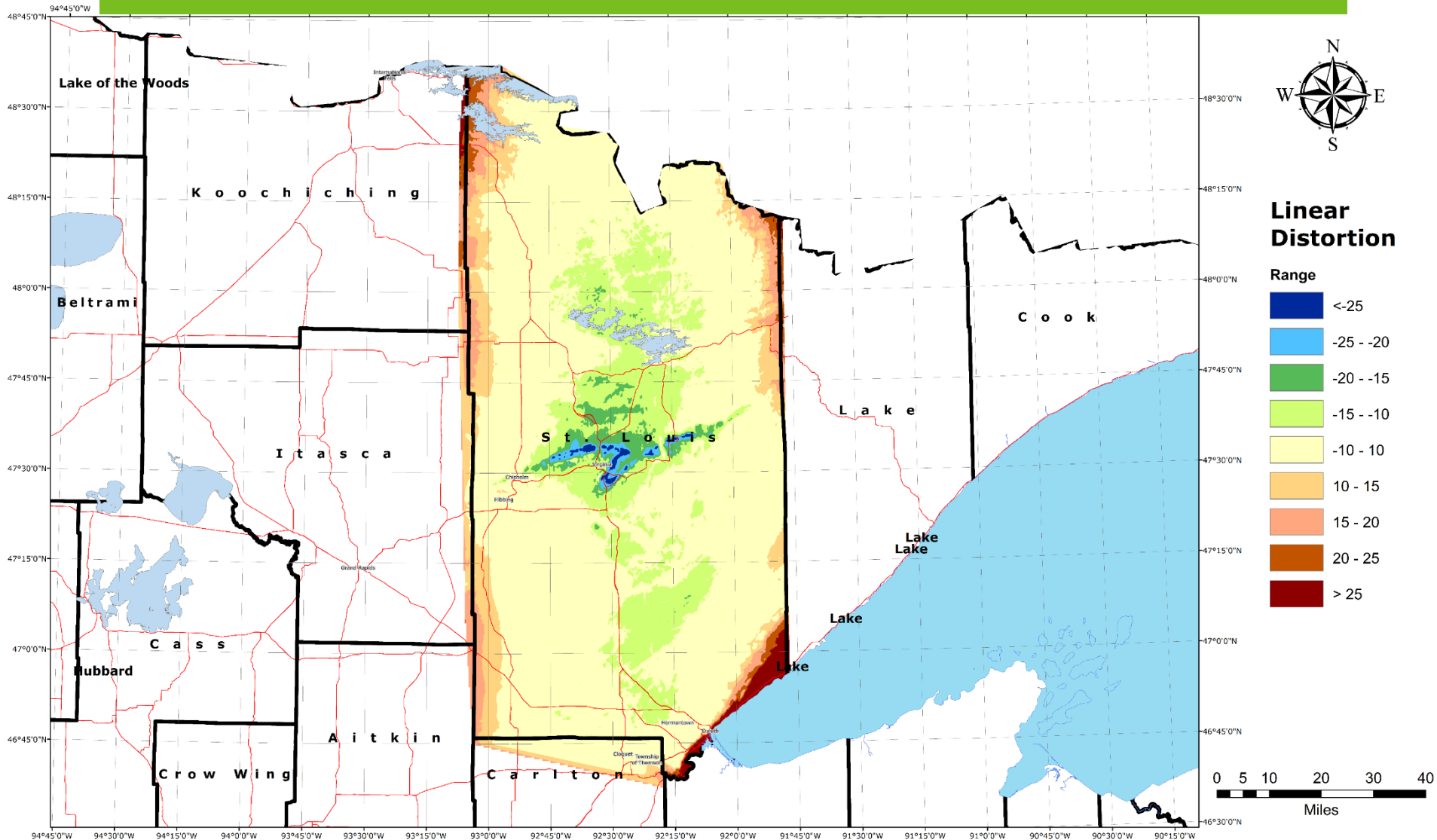


Zone: 2, Koochiching LDP, CHIN

Koochiching

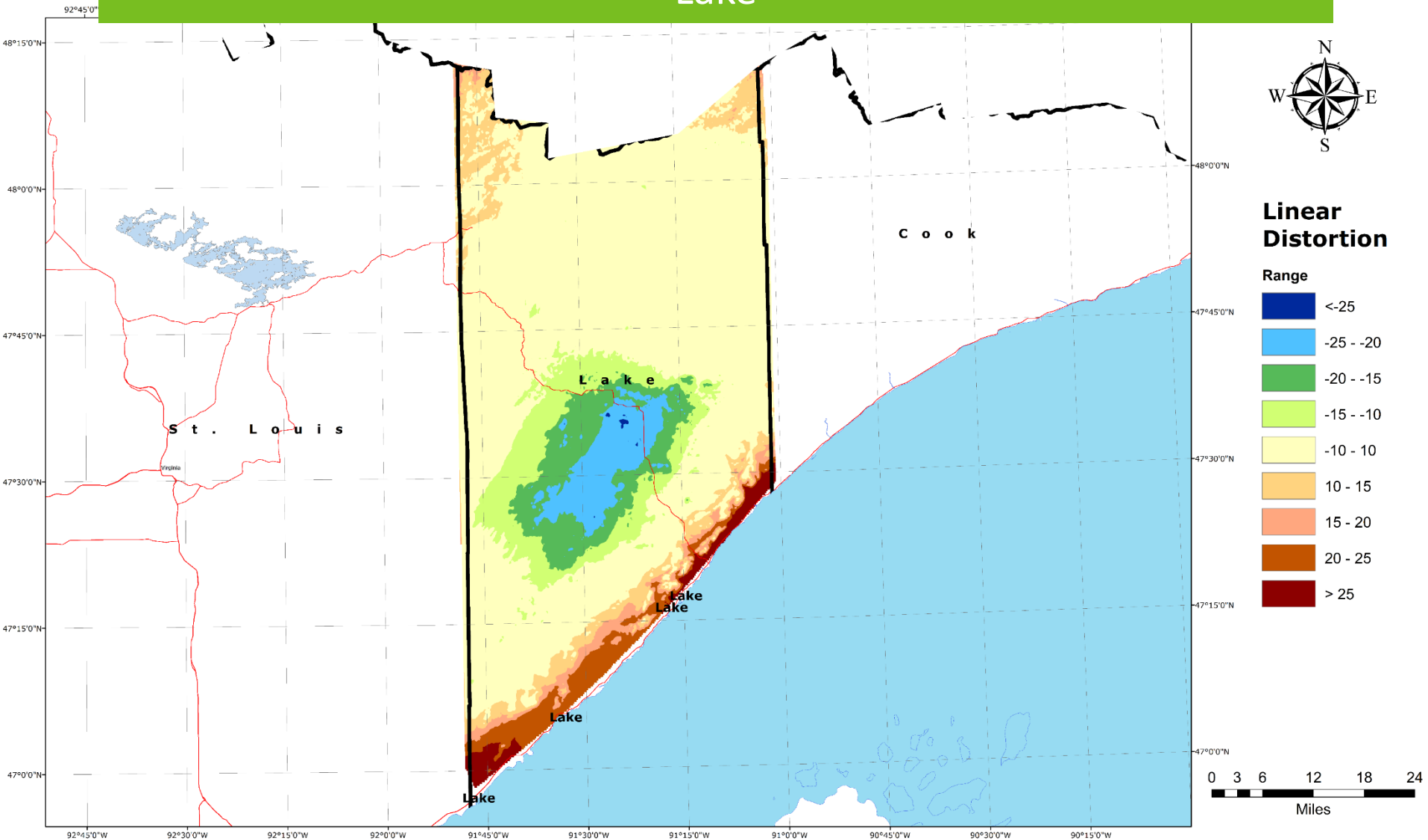


St Louis



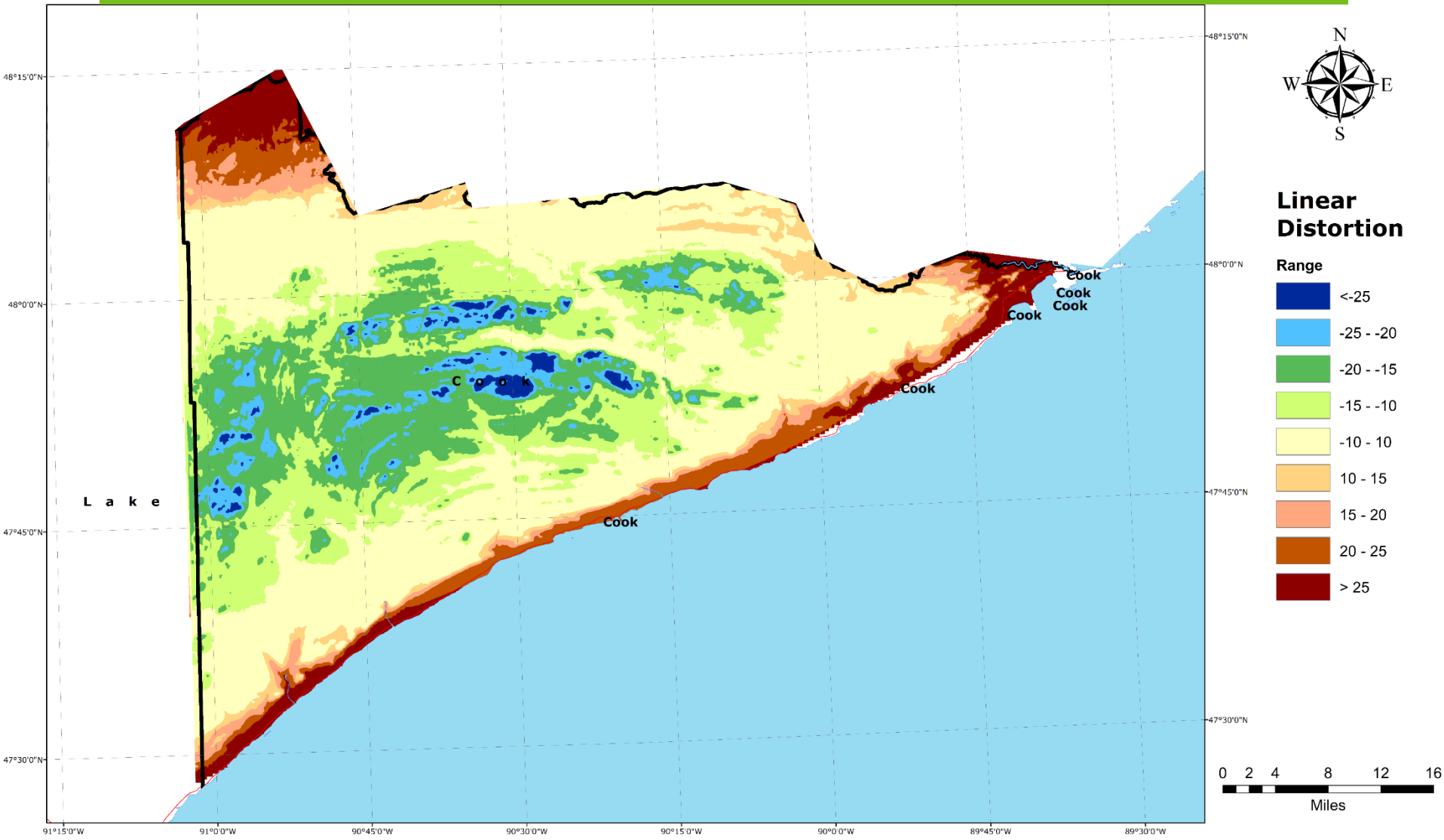
Zone: 4, Lake, LAKE

Lake



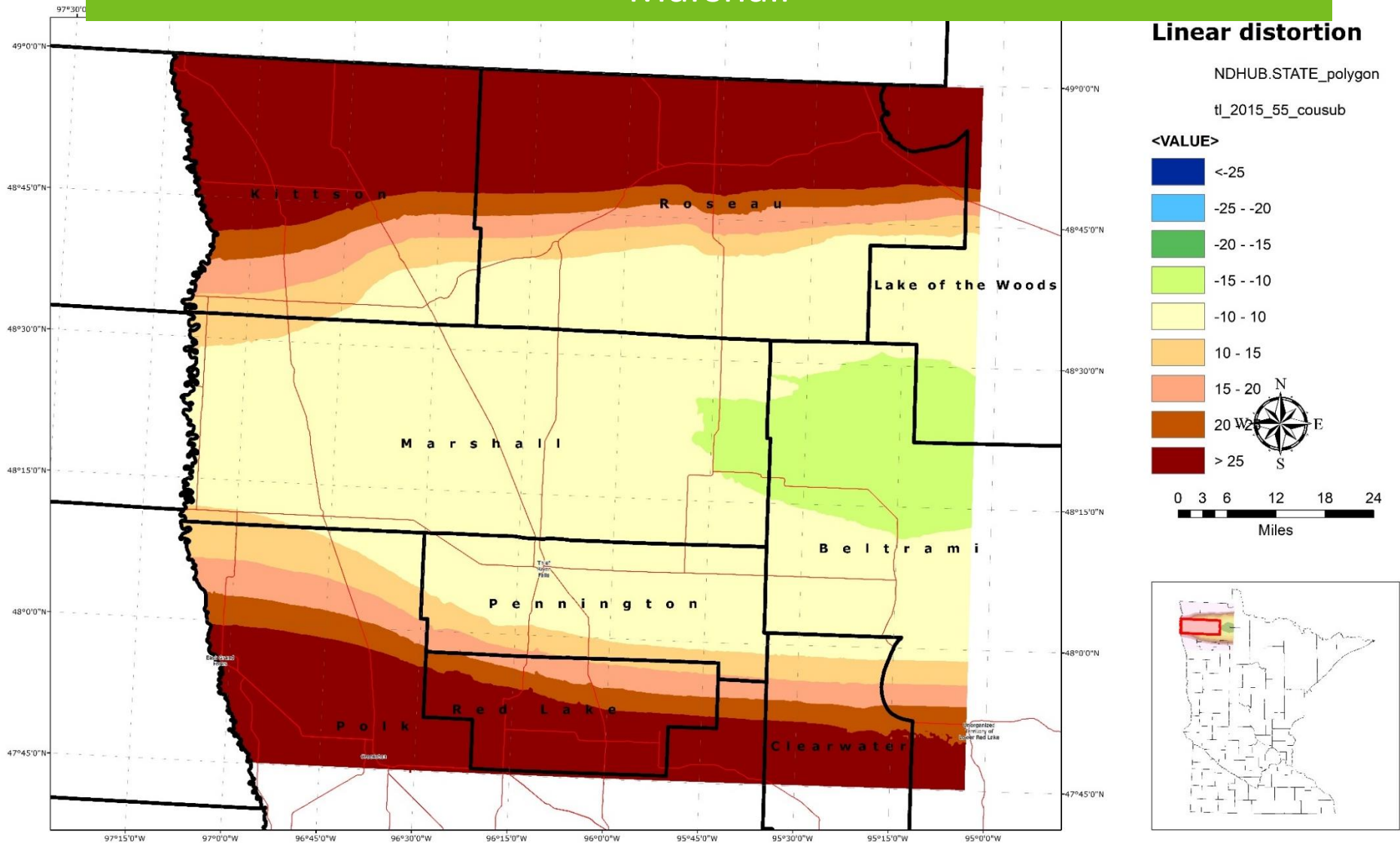
Zone: 5, Cook LDP, COOK

Cook



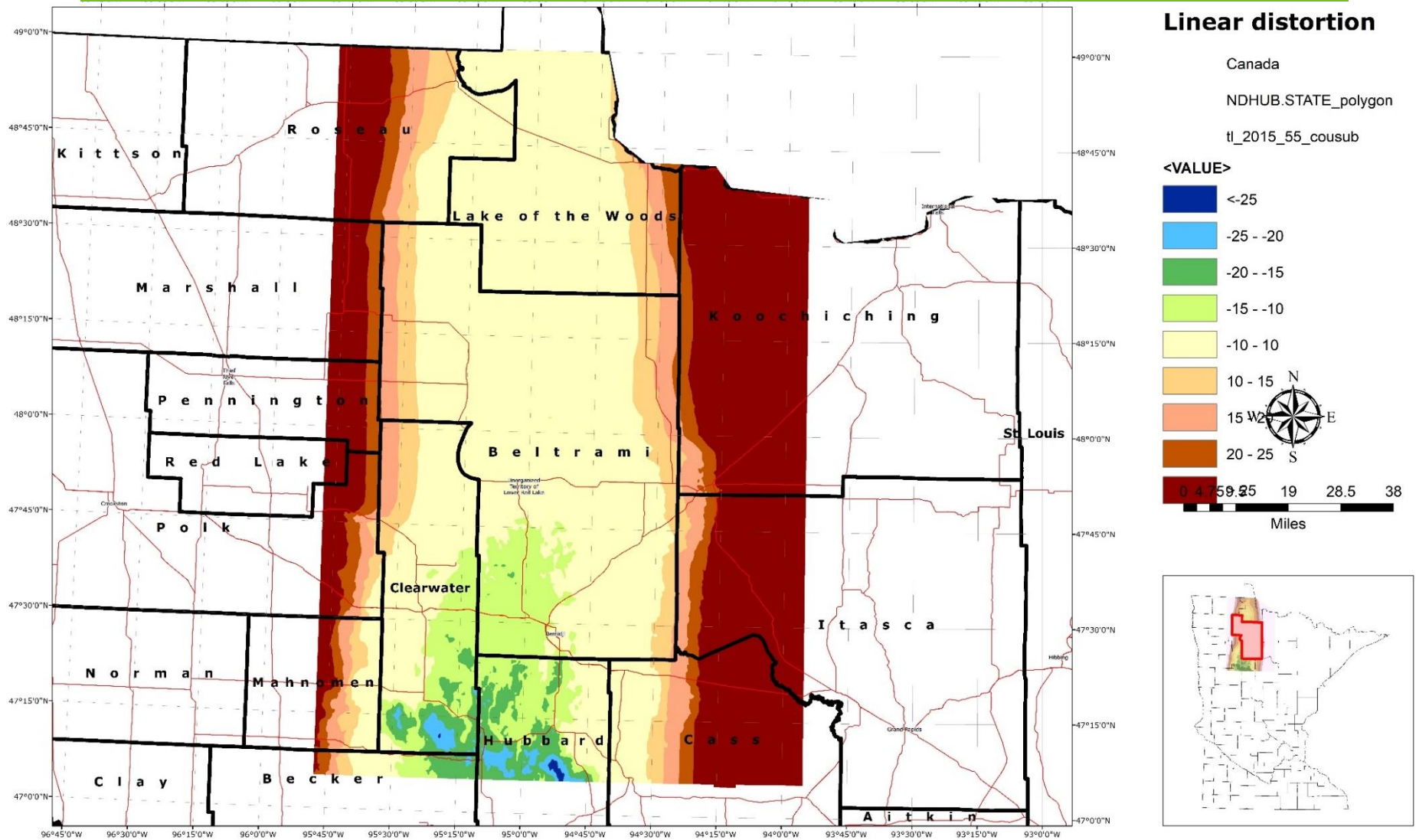
Zone: 6, Middle River, MIDR

Marshall



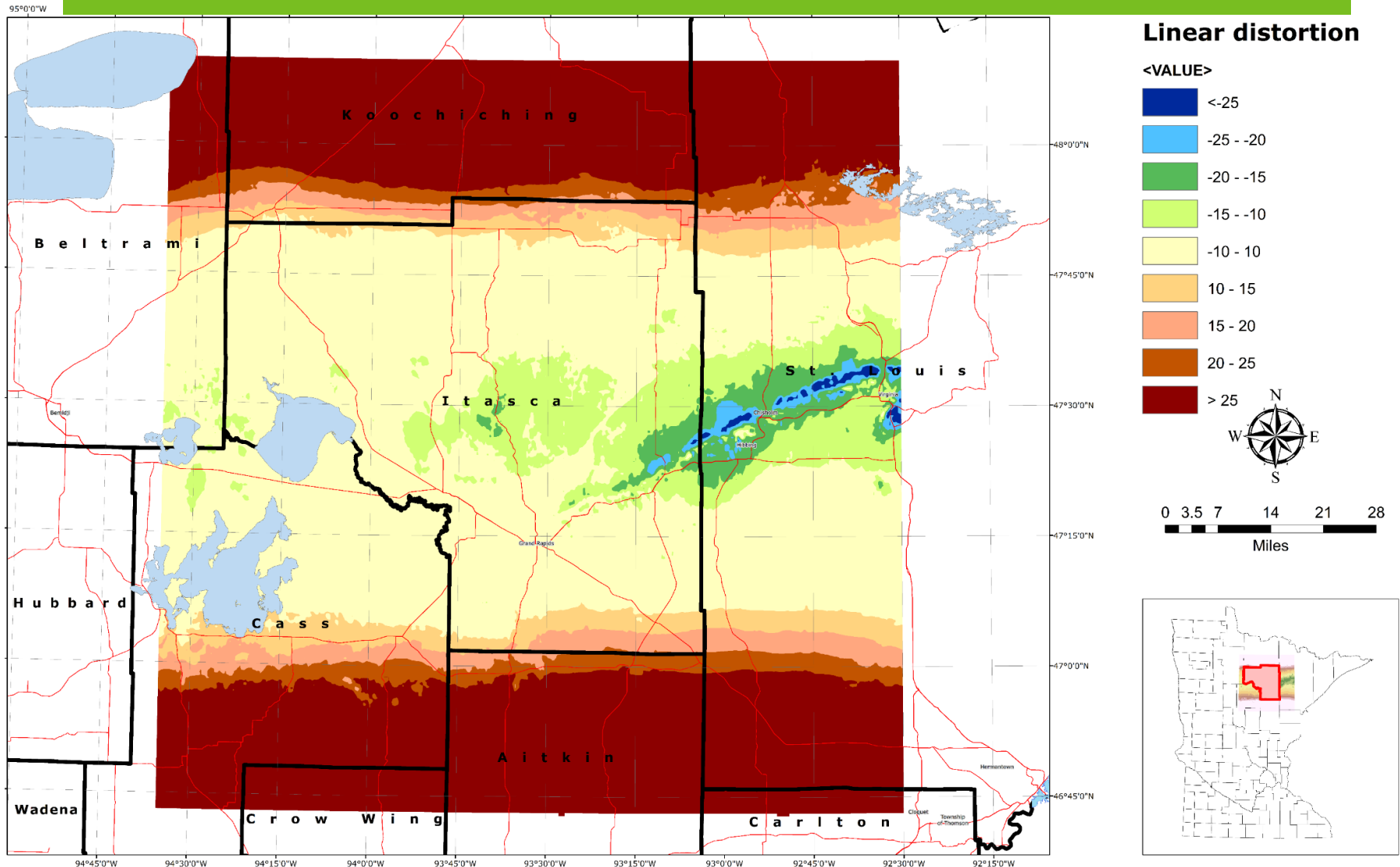
Zone: 7, Bemidji, BEMI

Beltrami, Clearwater



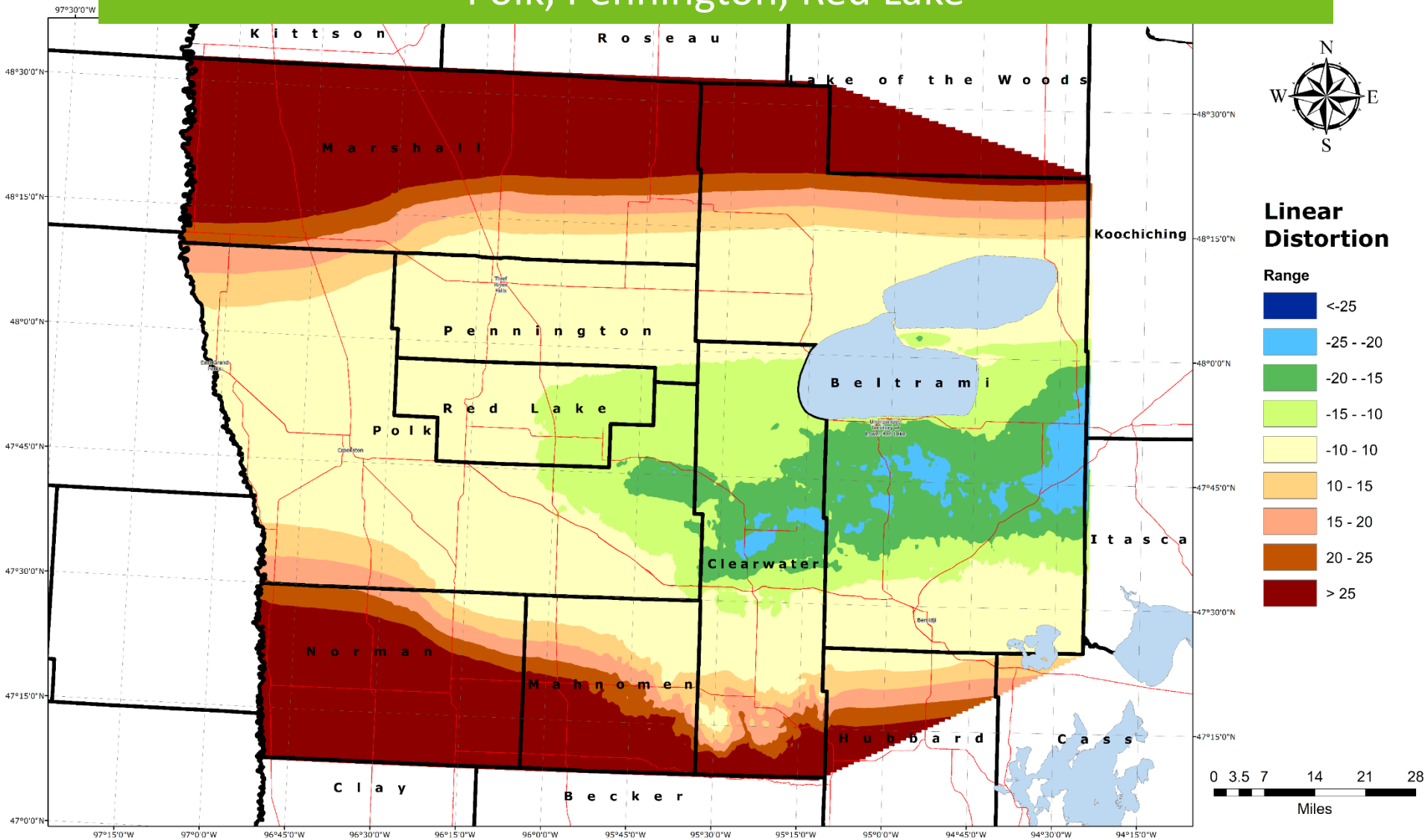
Zone: 8, Itasca LDP, ITAS

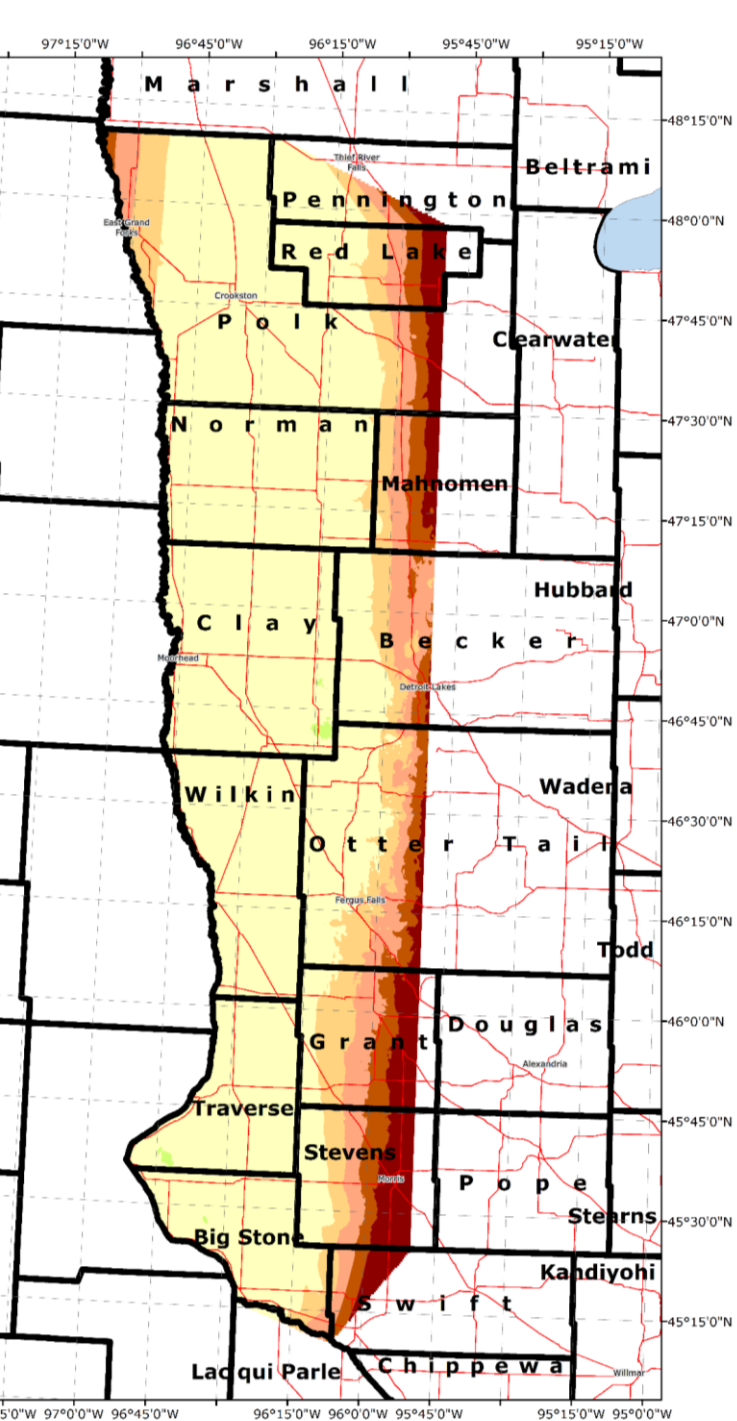
Itasca



Zone: 9, Red River, REDR

Polk, Pennington, Red Lake



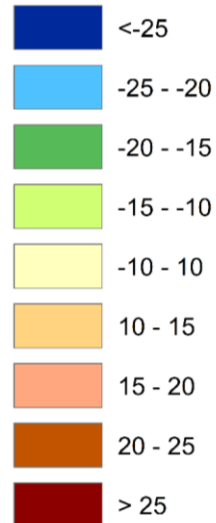


Zone: 10, Moorhead, MOOR

Norman, Clay, Wilkin

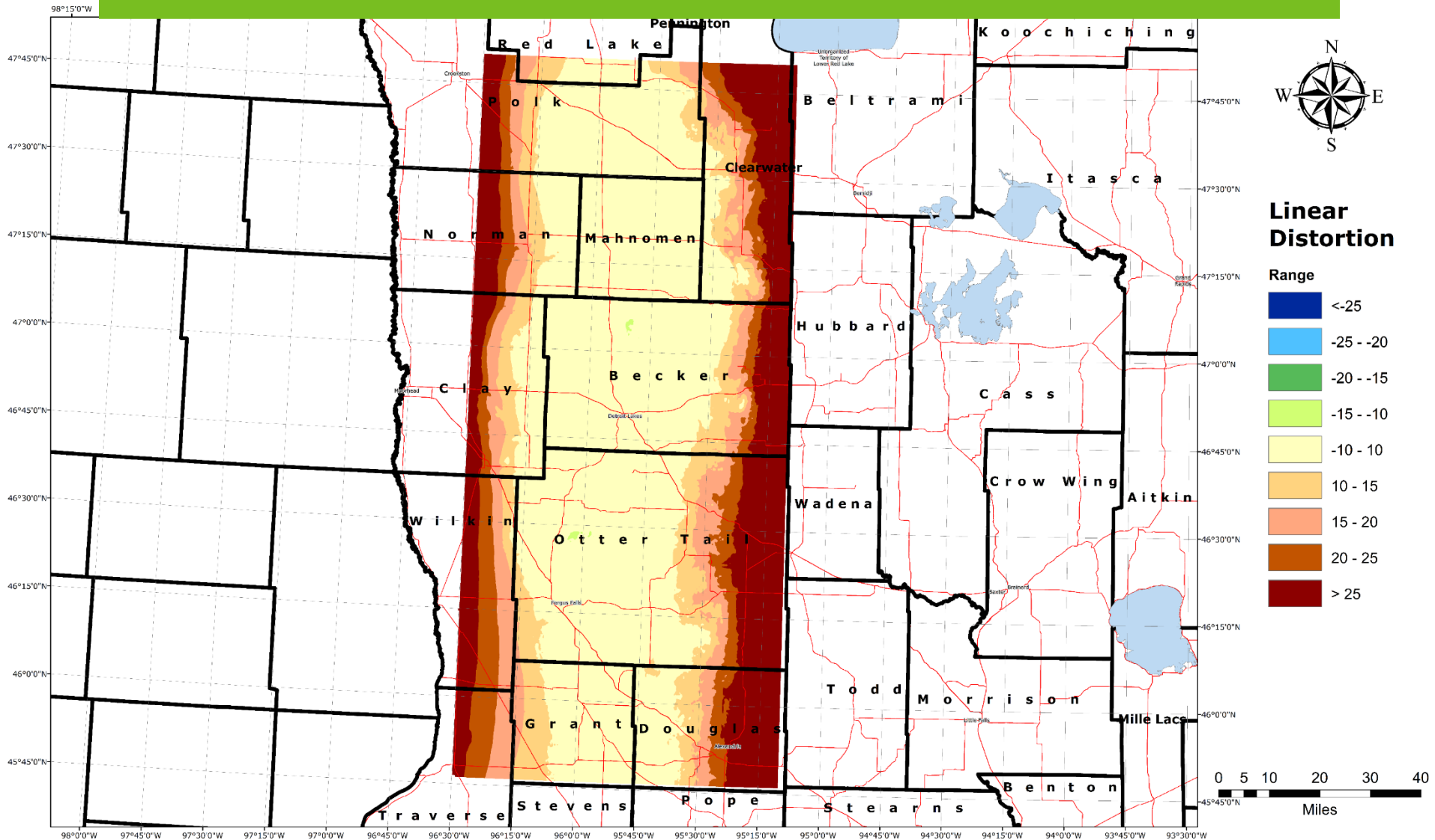
Linear Distortion

Range



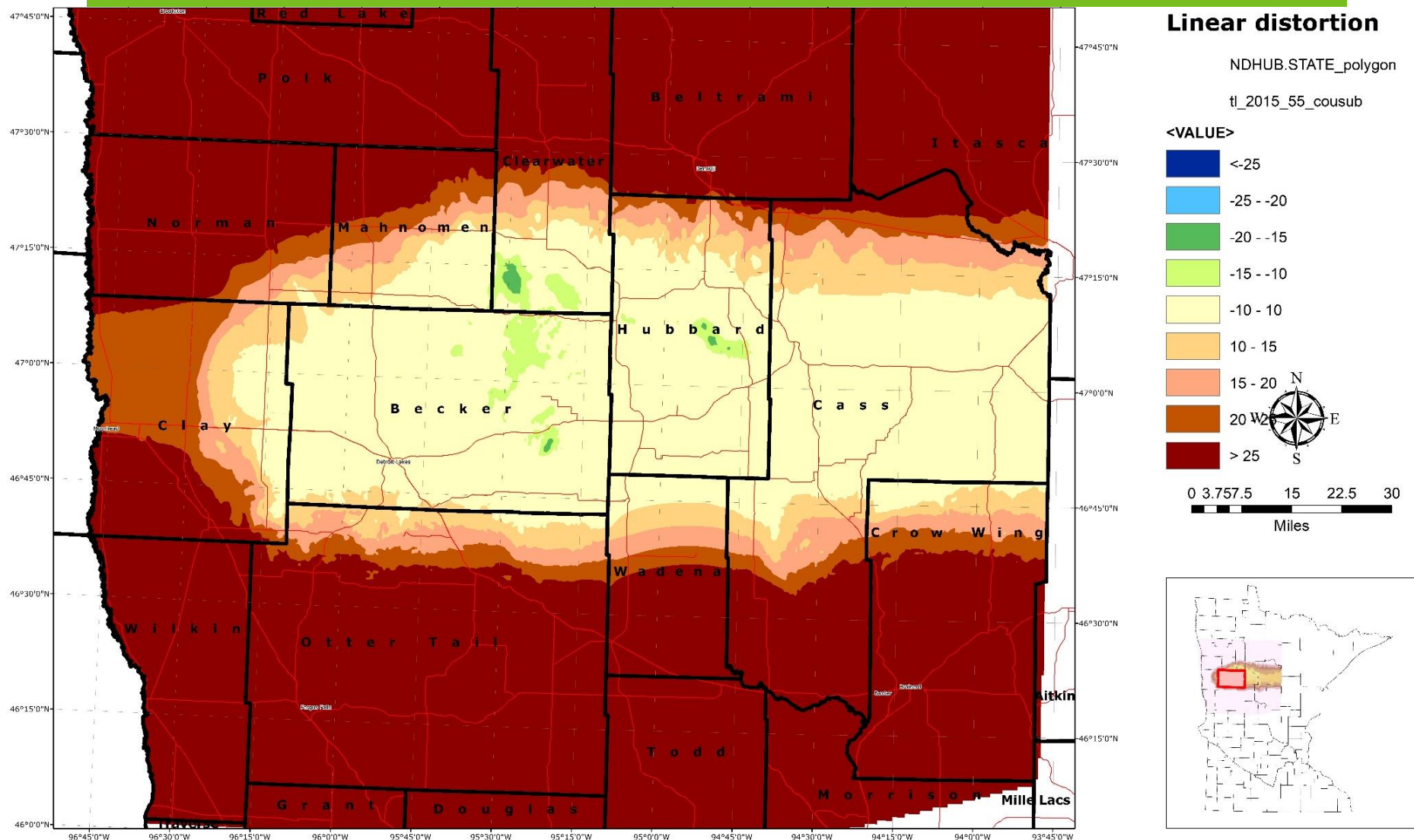
Zone: 11, Mahnomen LDP, MAHN

Mahnomen



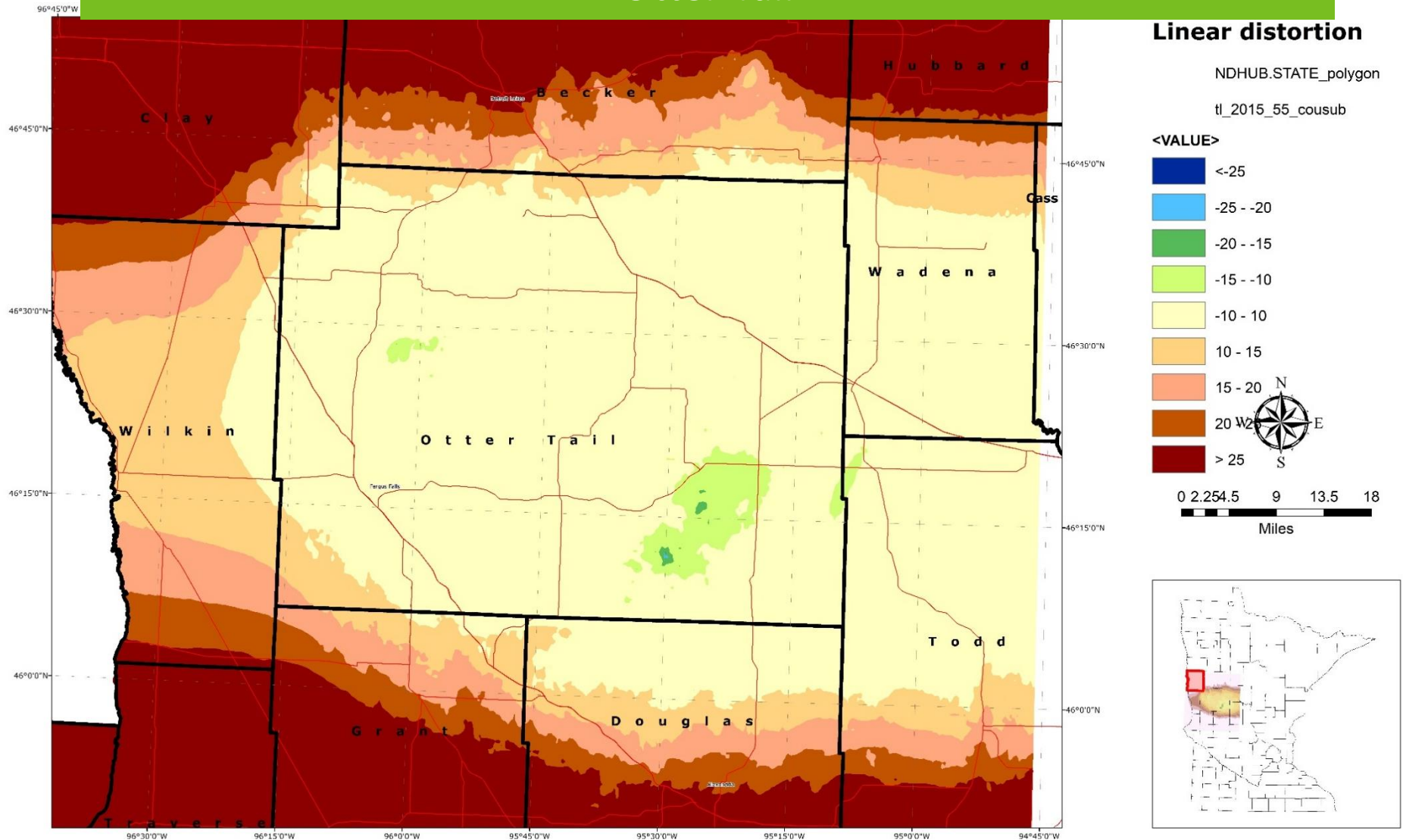
Zone: 12, Detroit Lakes, DTLK

Becker



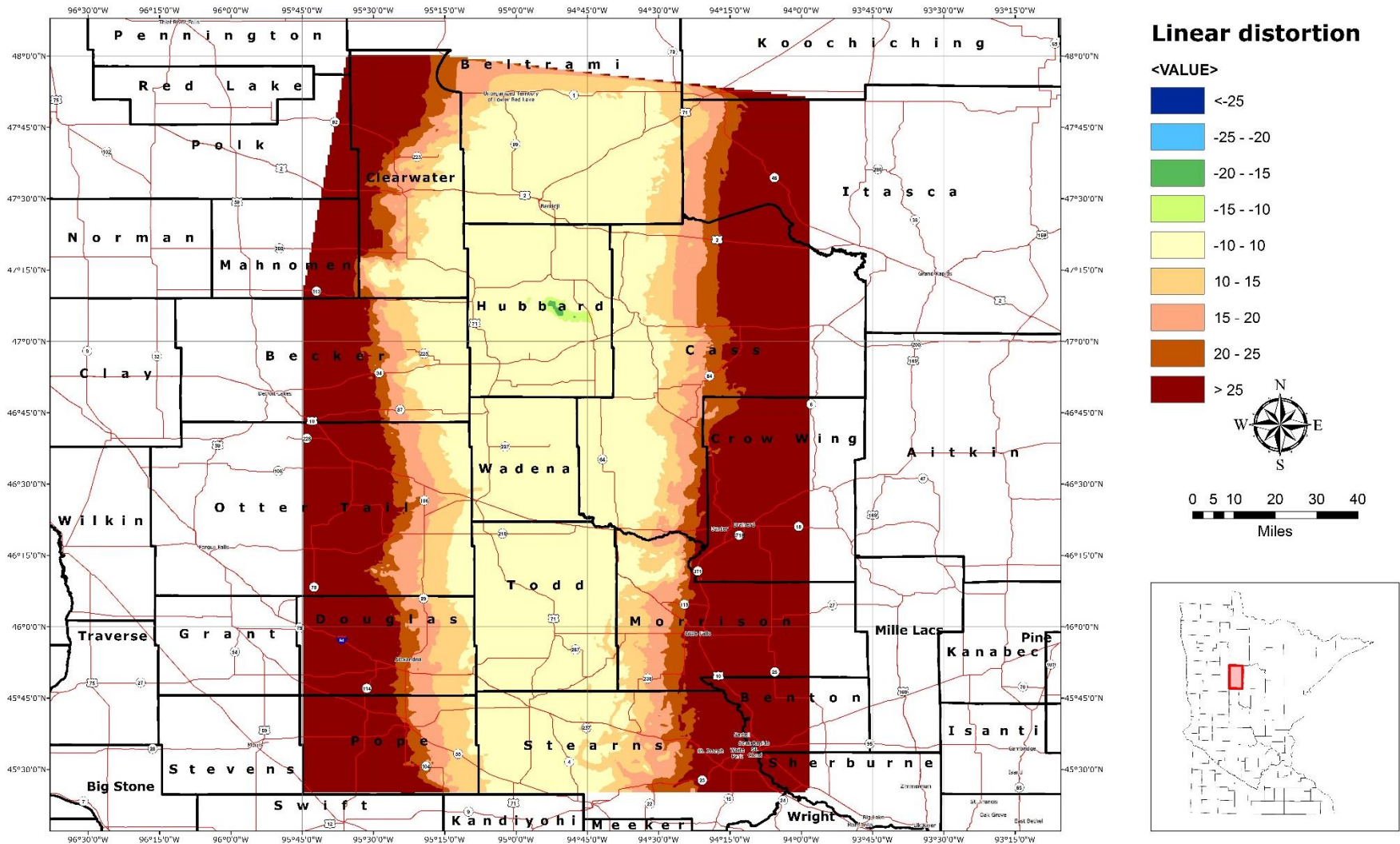
Zone: 13, Fergus Falls, FERG

Otter Tail



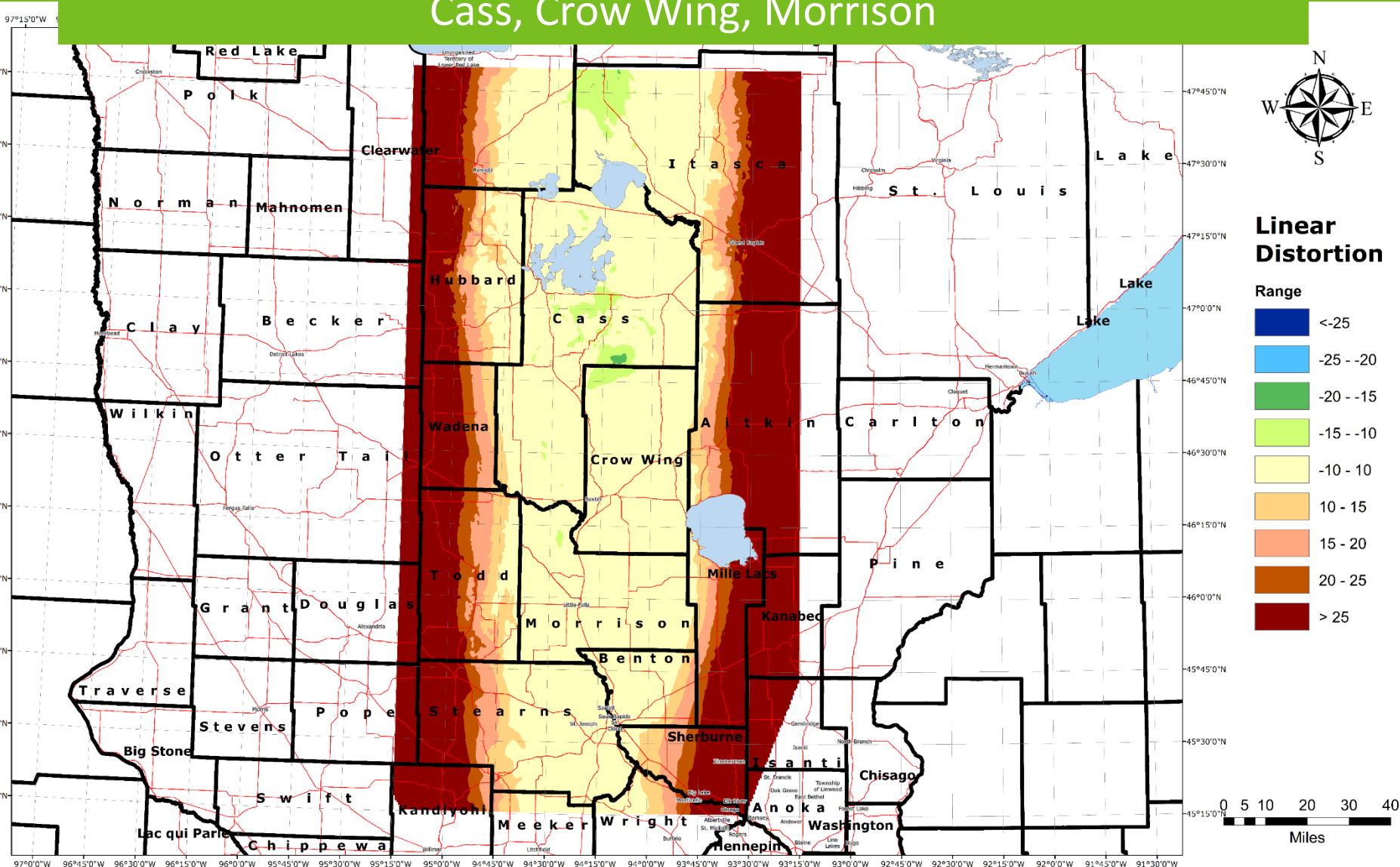
Zone: 14, 71 Corridor, TH71

Hubbard, Wadena, Todd



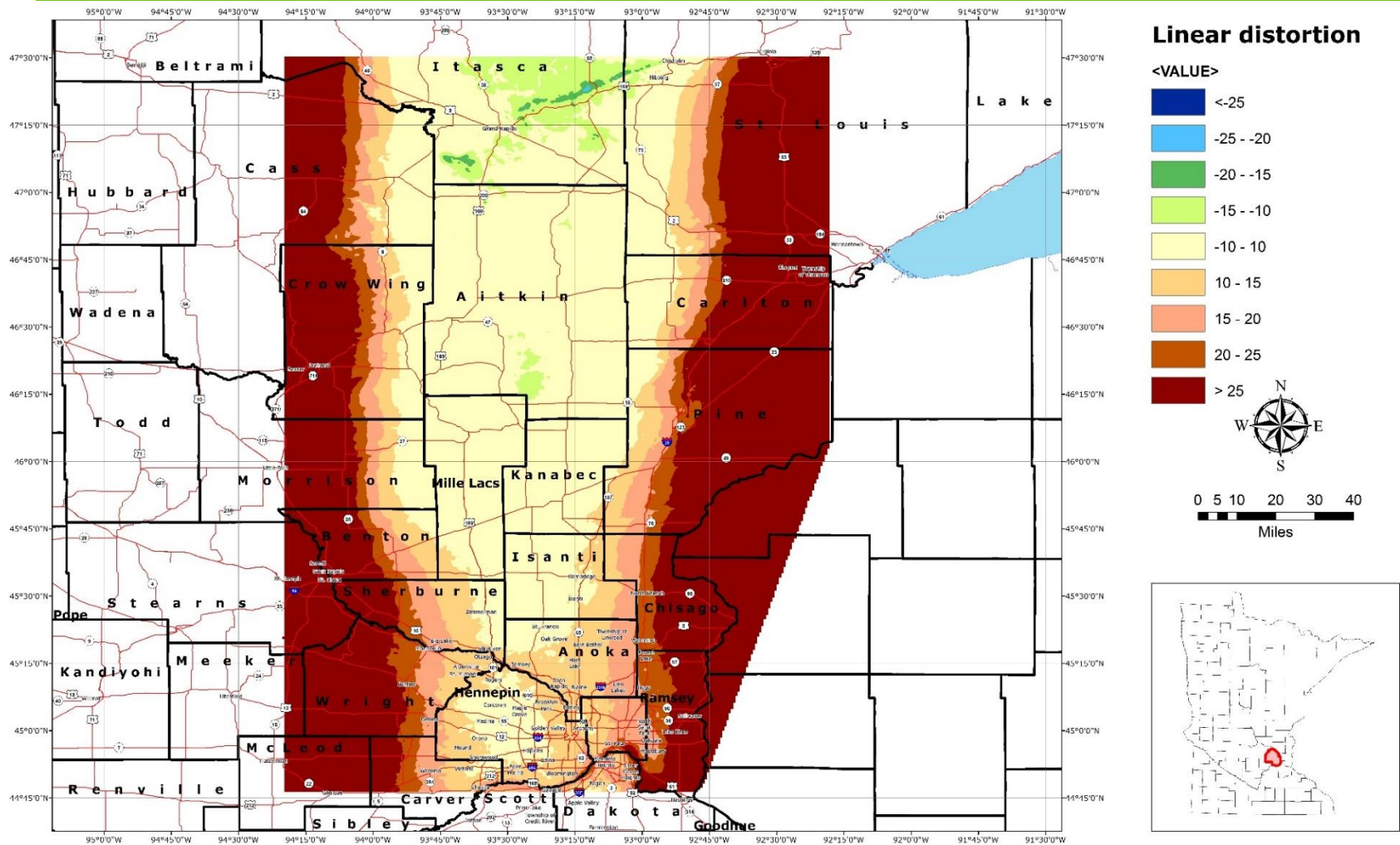
Zone: 15, Brainerd, BRAI

Cass, Crow Wing, Morrison



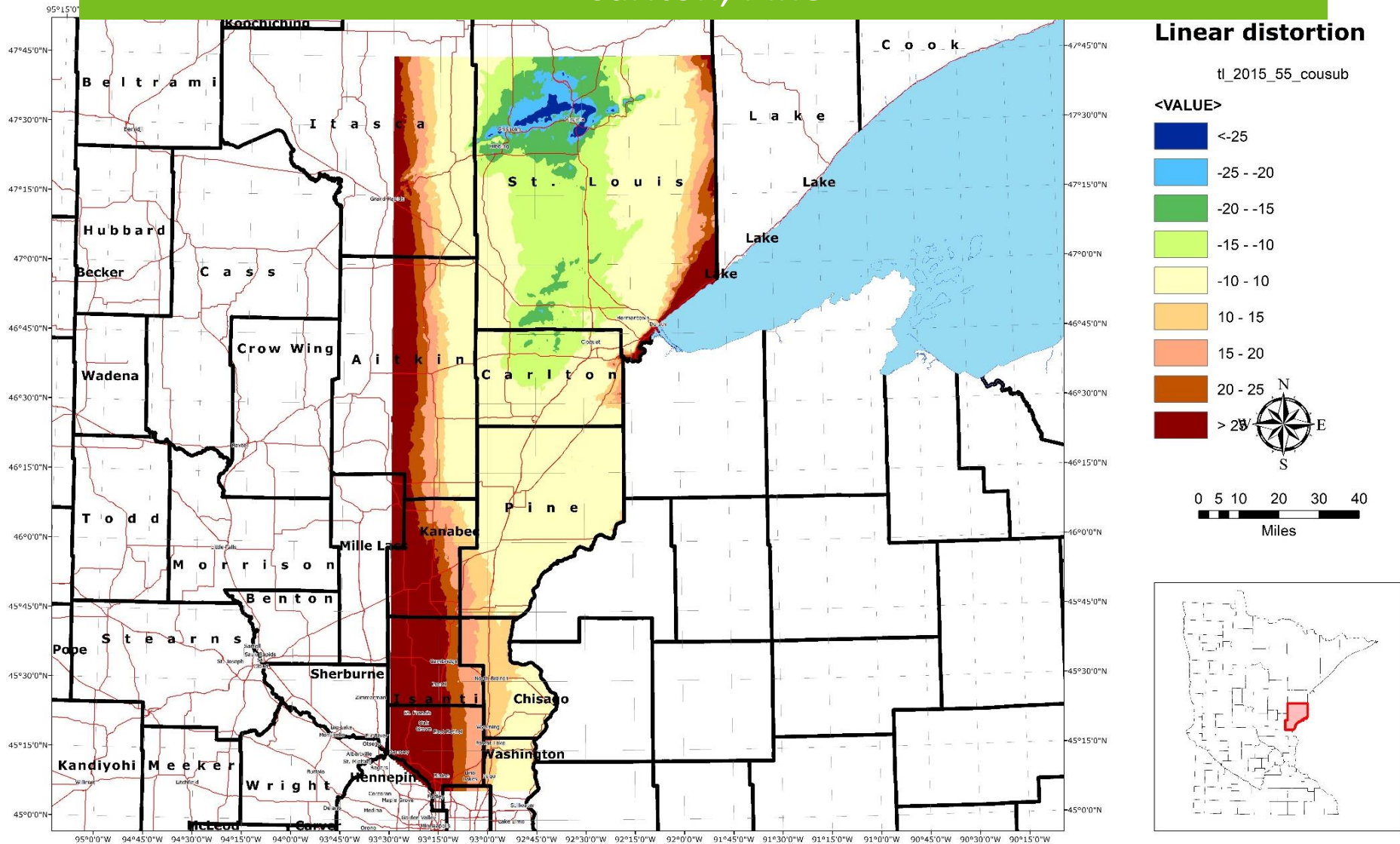
Zone: 16, Mille Mille Lacs, MILL

Aitkin, Mille Lacs, Kanabec



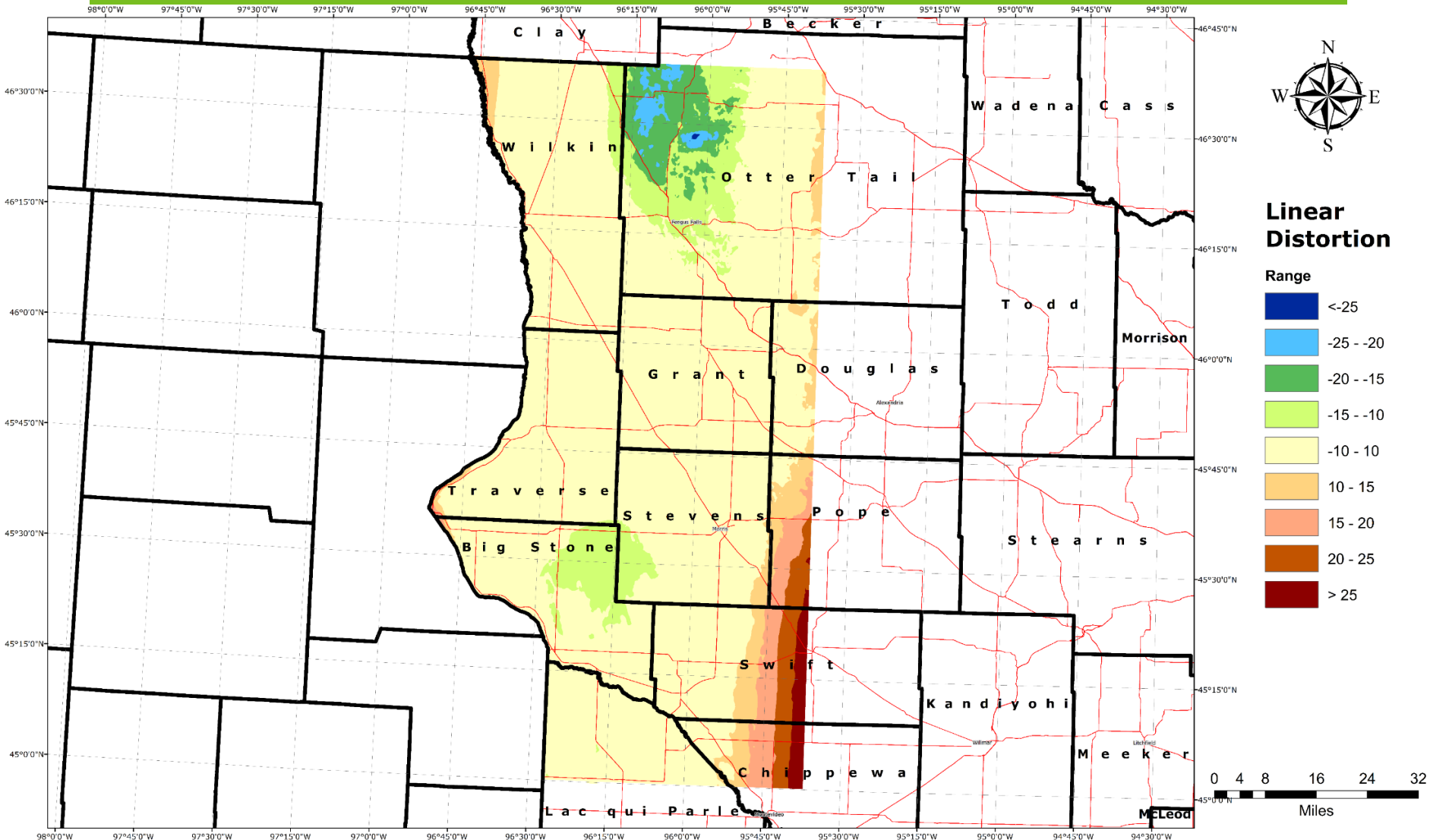
Zone: 17, Carlton-Pine, CARL

Carlton, Pine



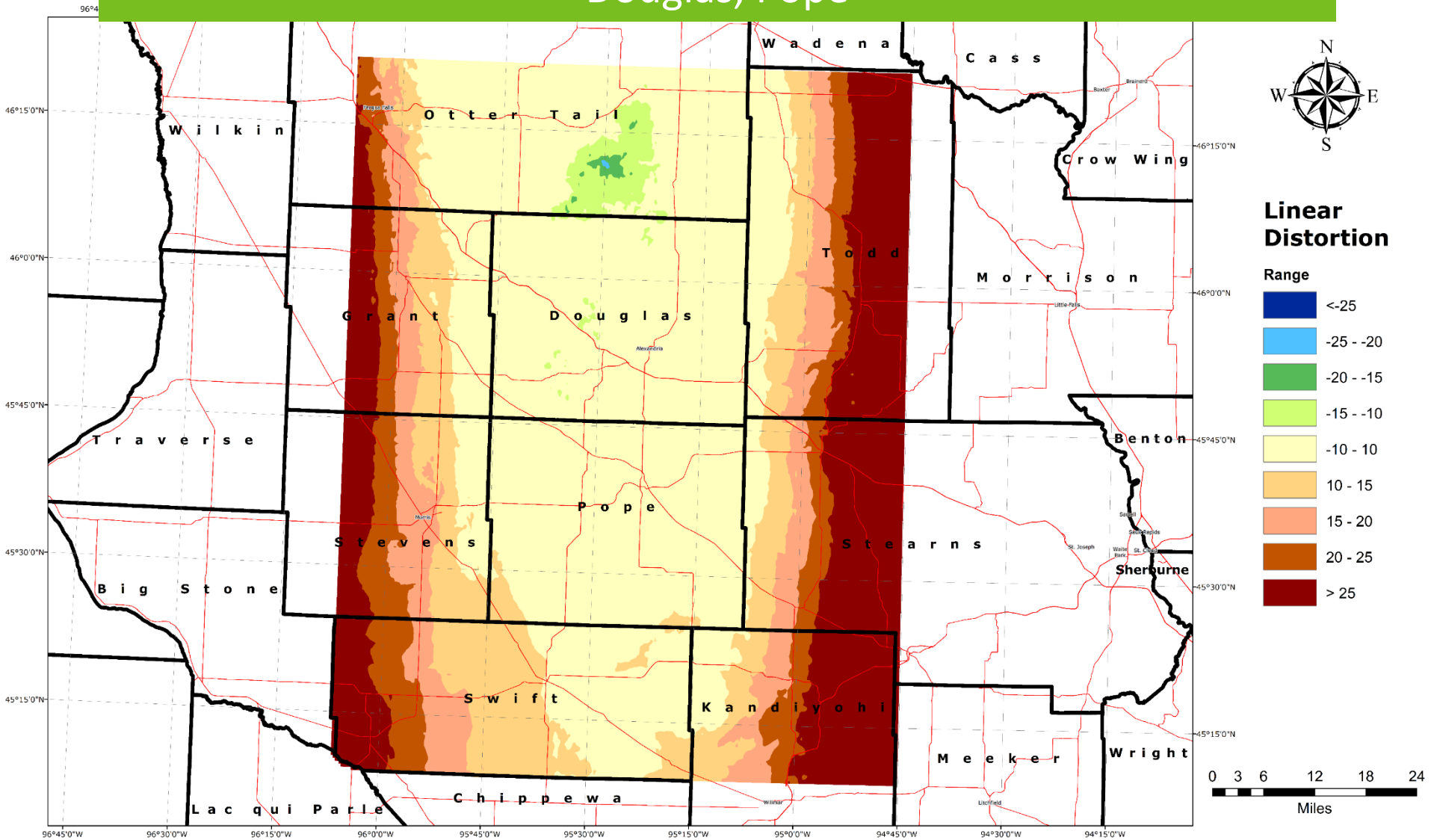
Zone: 18, Wheaton, WHEA

Traverse, Big Stone, Grant, Stevens



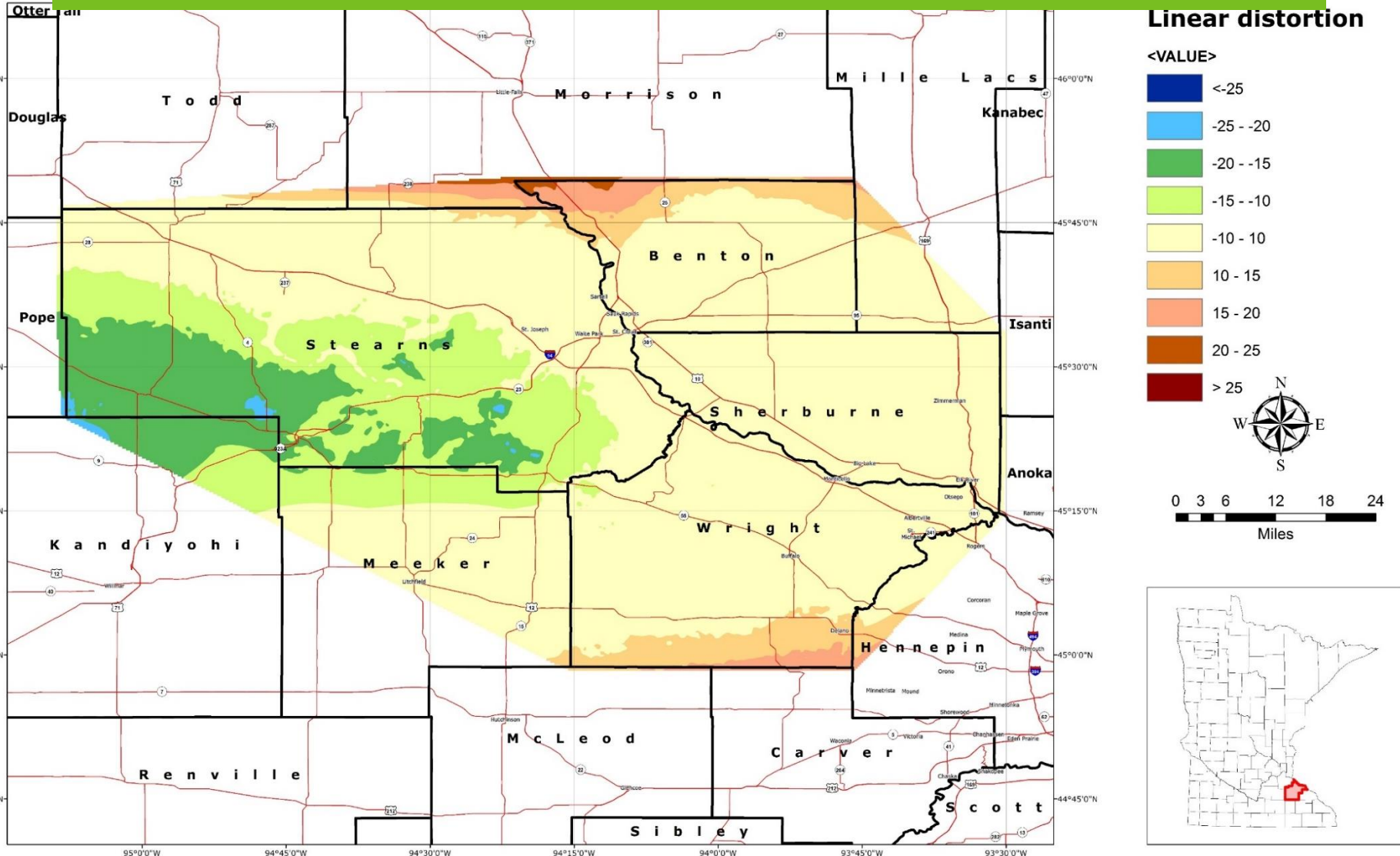
Zone: 19, Alexandria, ALEX

Douglas, Pope



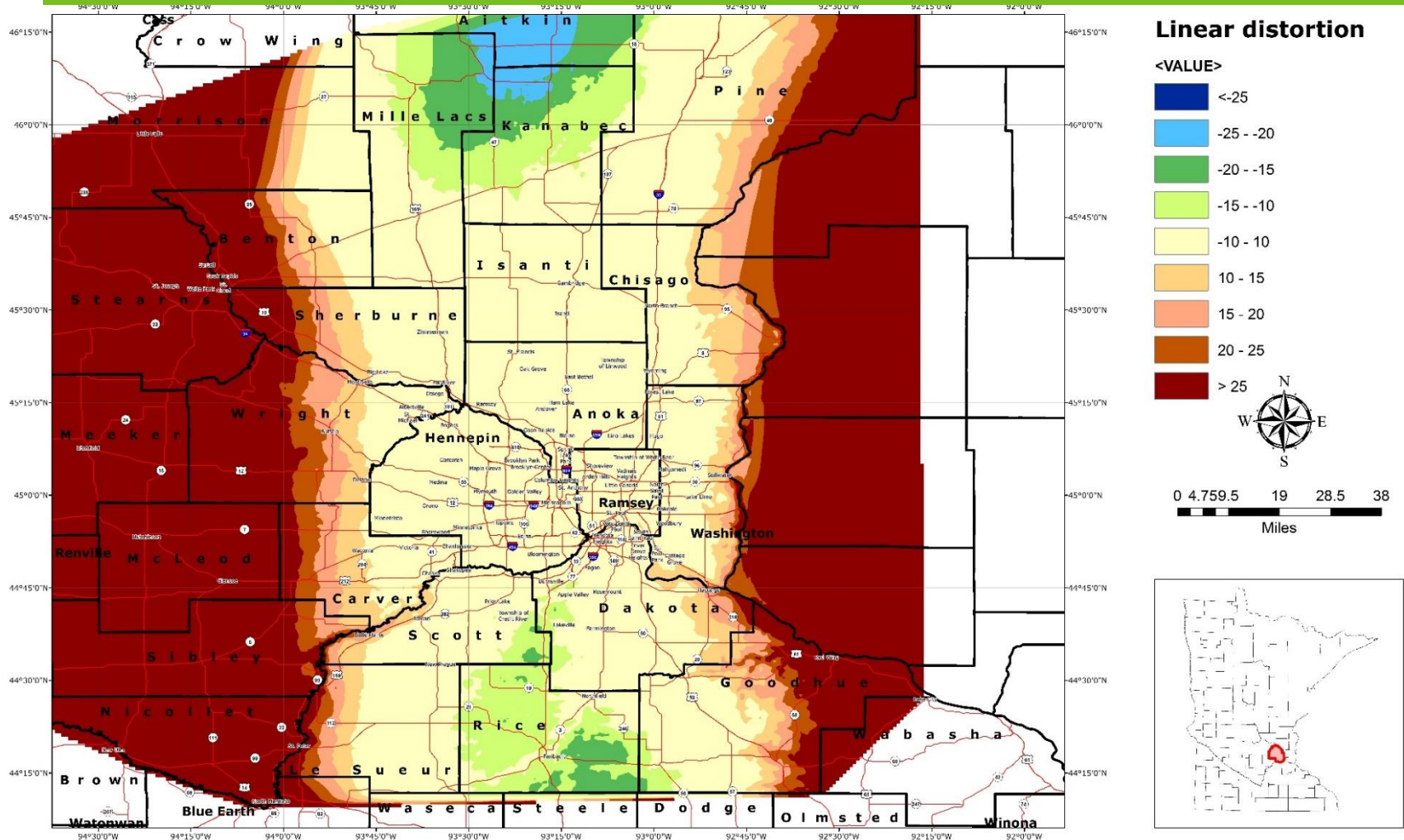
Zone: 20, St Cloud, STCL

Stearns, Benton, Sherburne, Wright



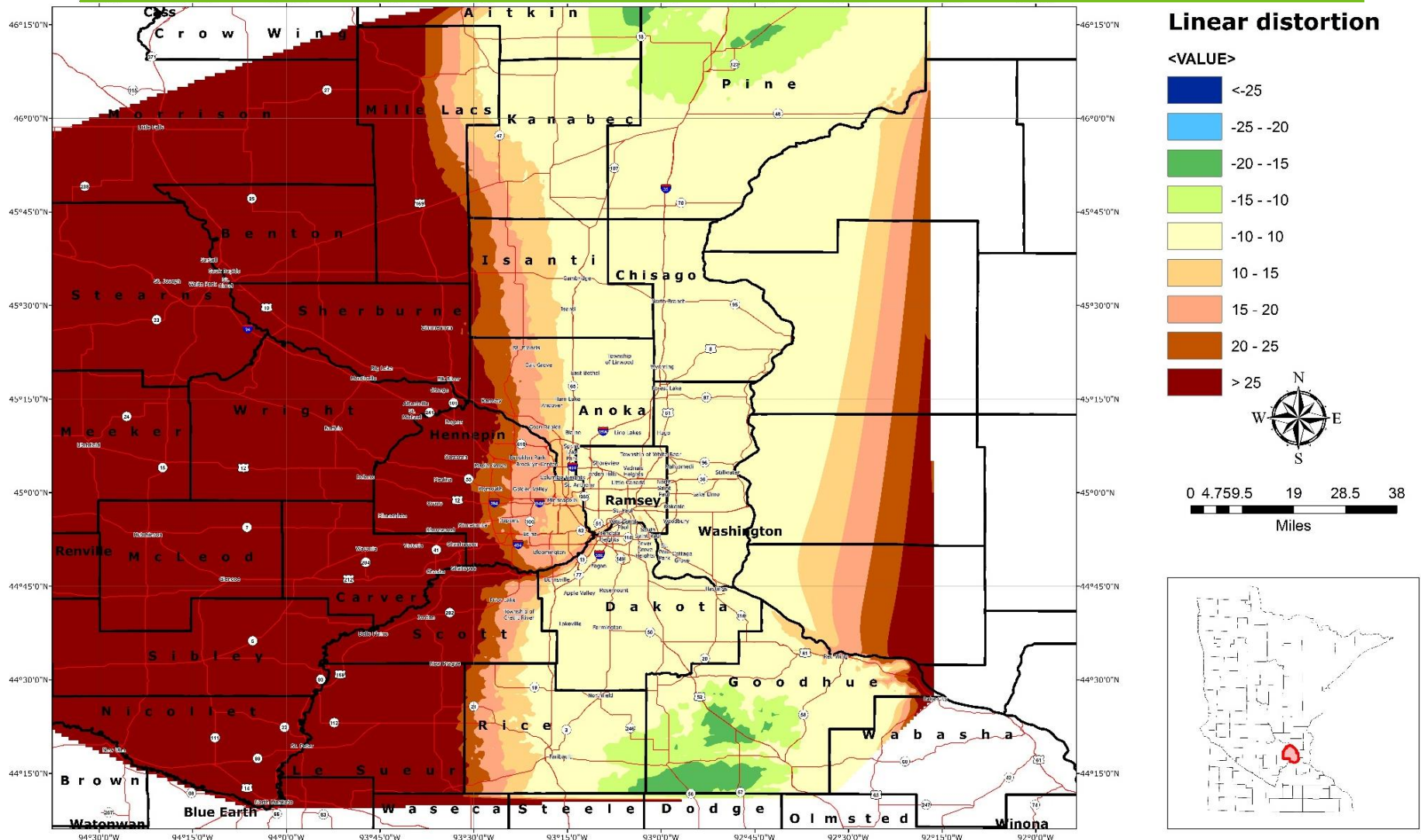
Zone: 21, Metro North, METN

Hennepin, Ramsey, Anoka, Isanti



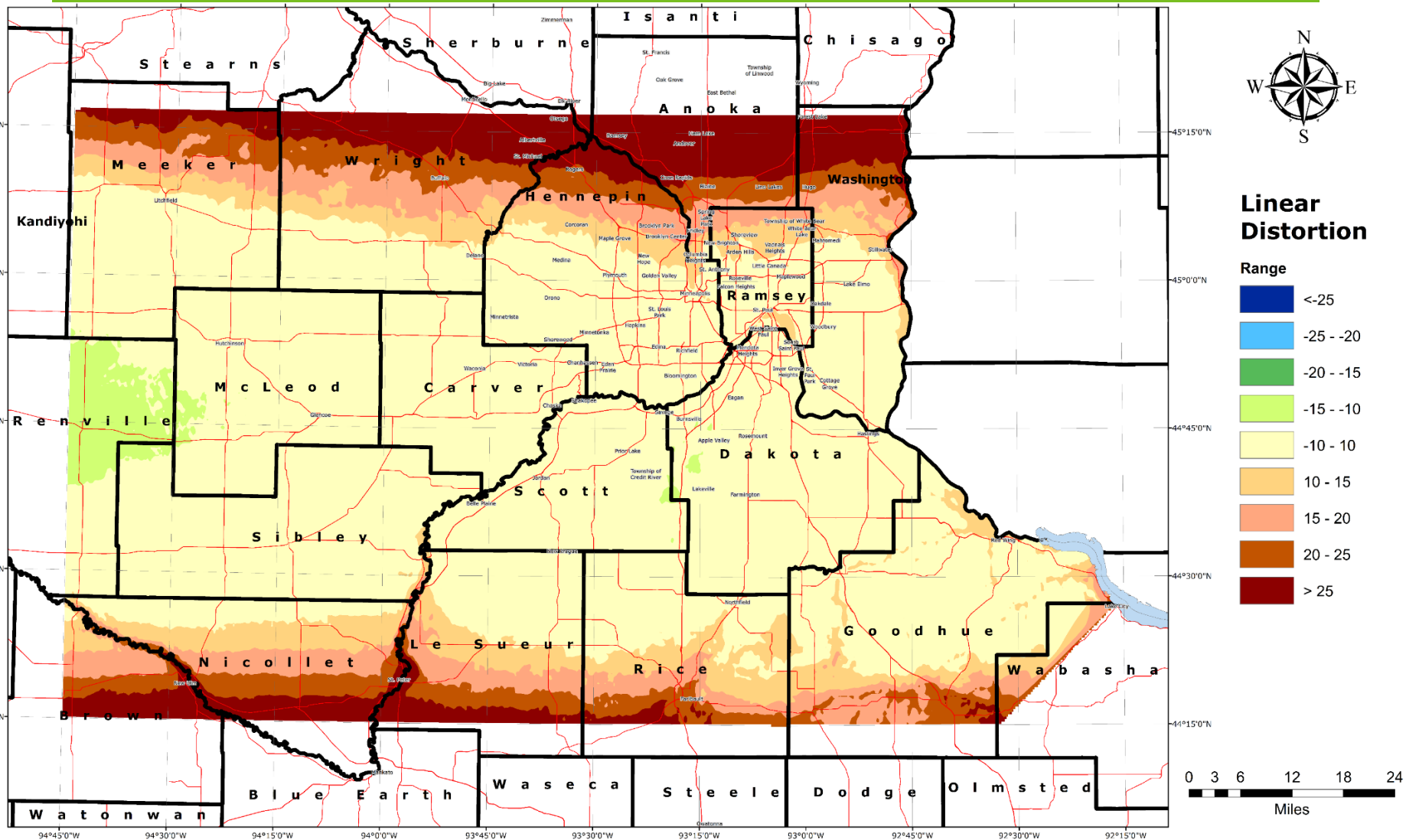
Zone: 22, Metro East, METE

Chisago, Washington



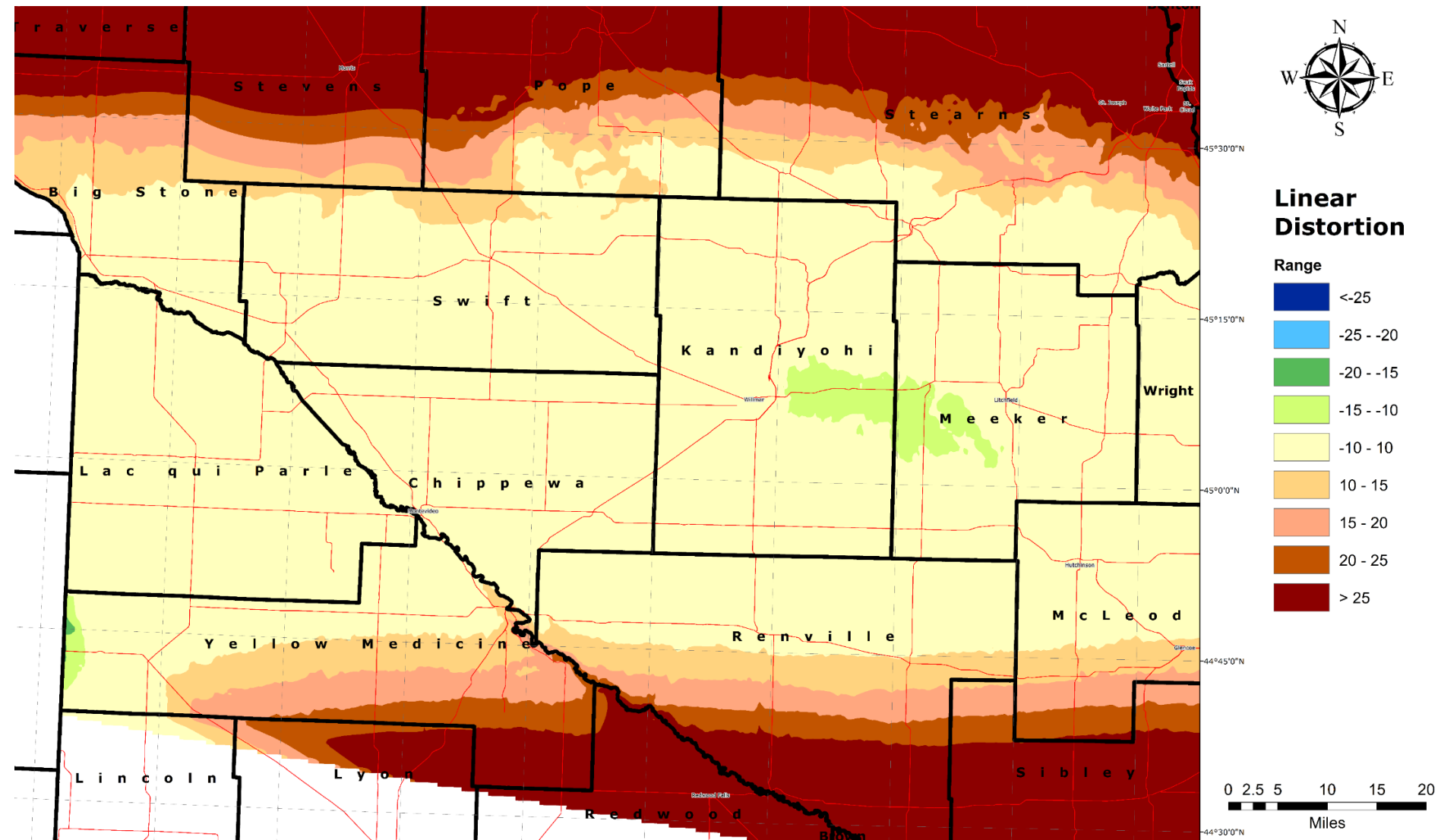
Zone: 23, Metro South, METS

Carver, Scott, Dakota



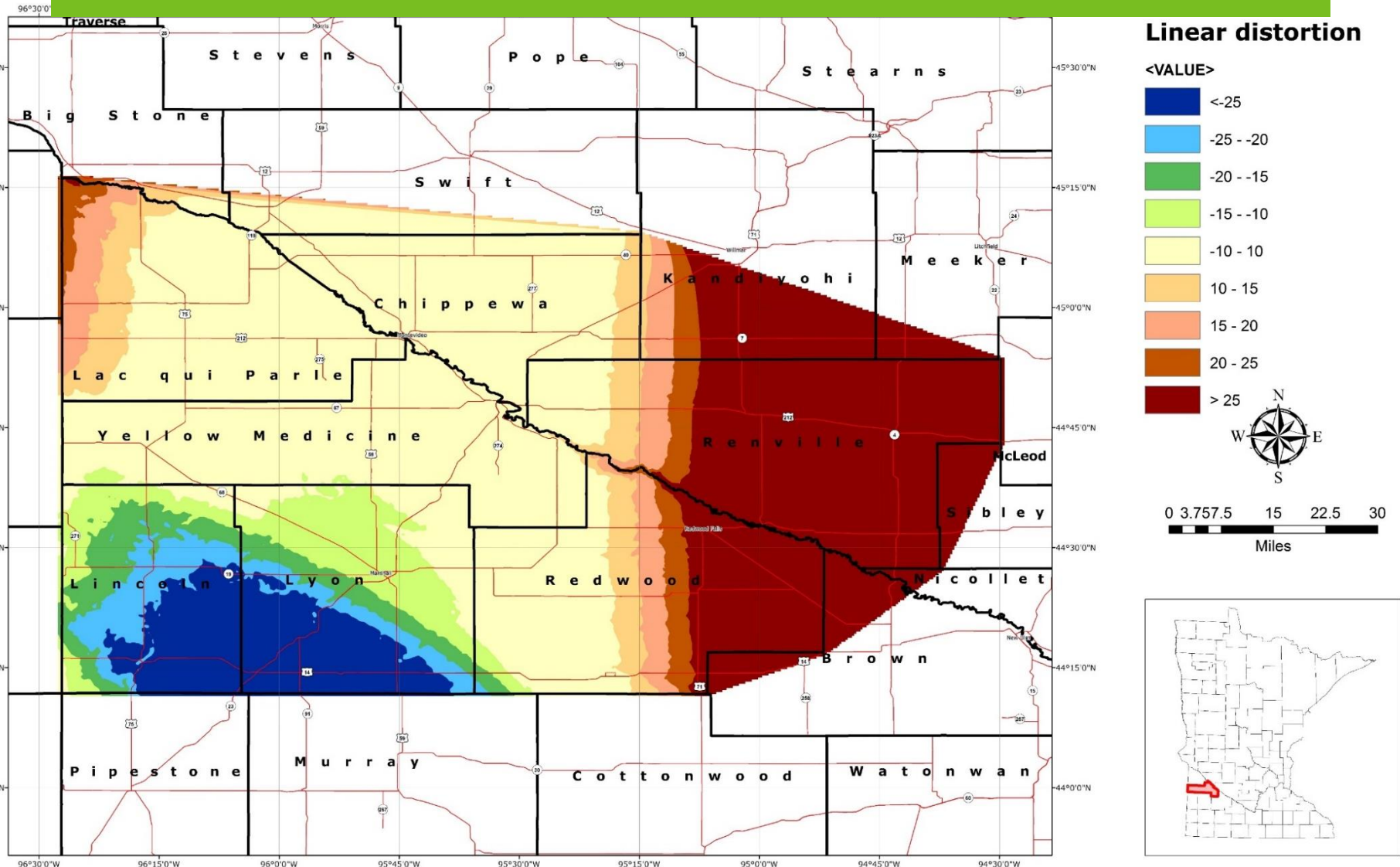
Zone 24, Willmar, WILL

Lac Qui Parle, Swift, Chippewa, Kandiyohi, Meeker



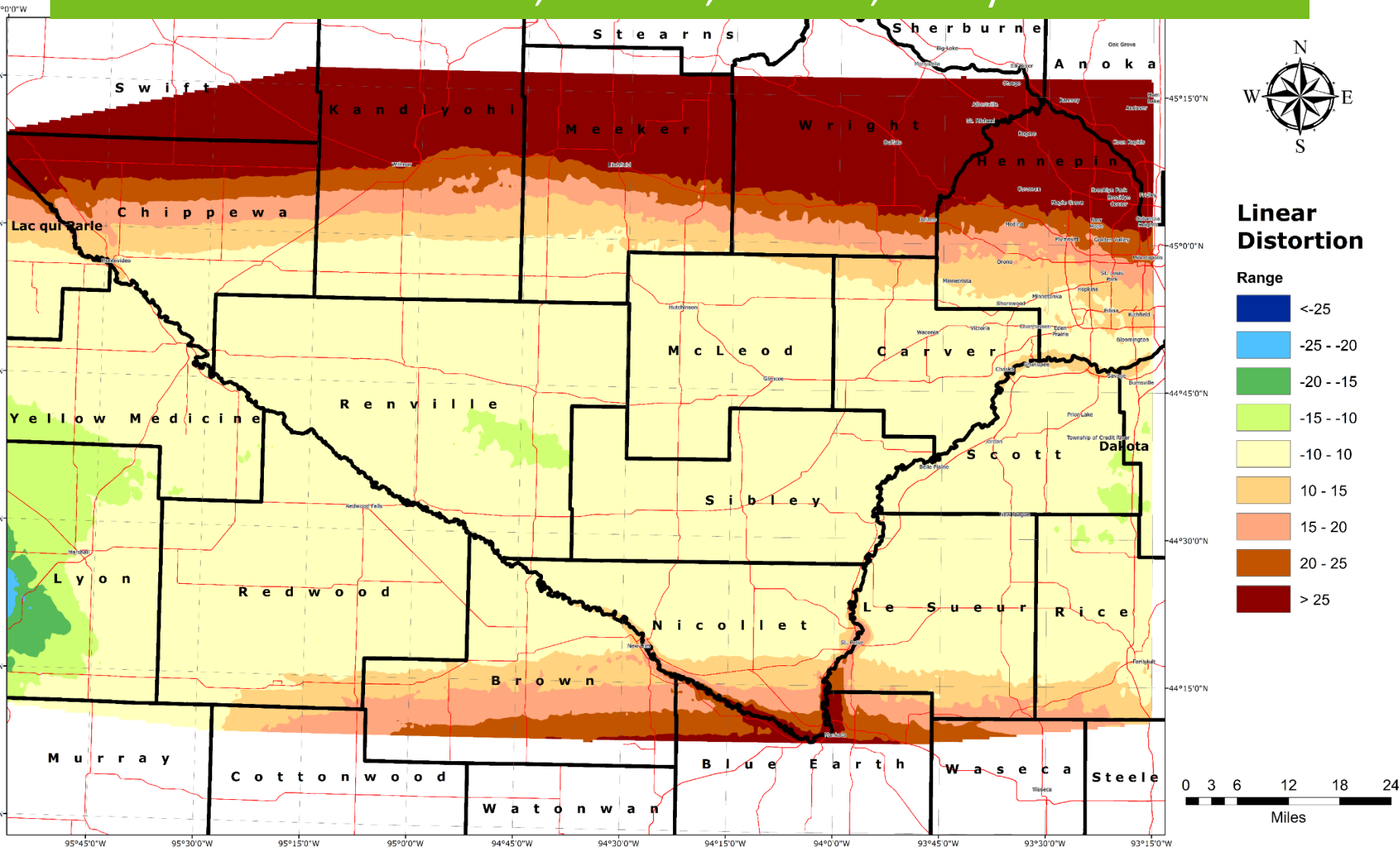
Zone: 25, Canby, CNBY

Yellow Medicine



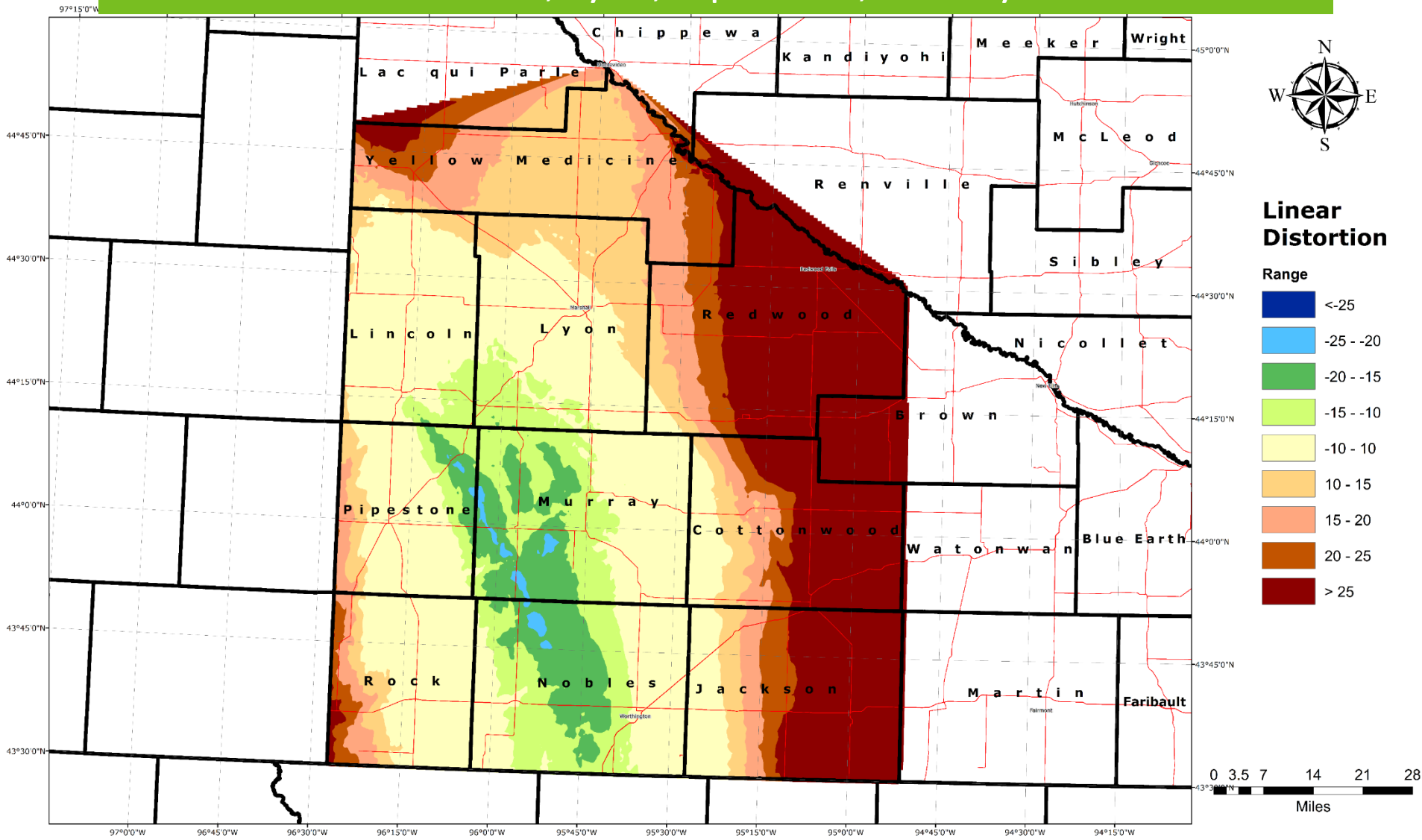
Zone: 26, Hutchinson, HUTC

Redwood, Renville, Mcleod, Sibley



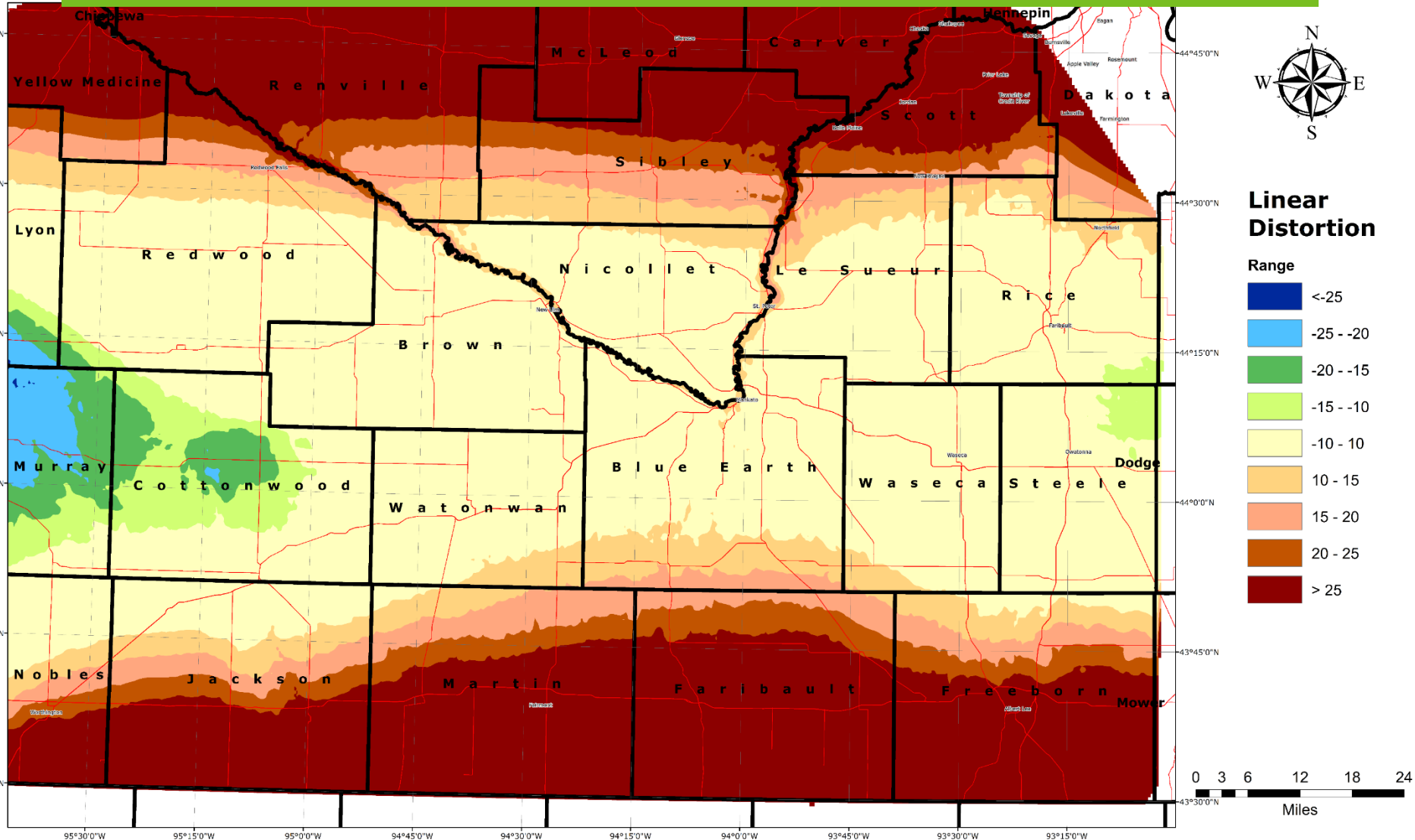
Zone: 27, Buffalo Ridge, BUFF

Lincoln, Lyon, Pipestone, Murray



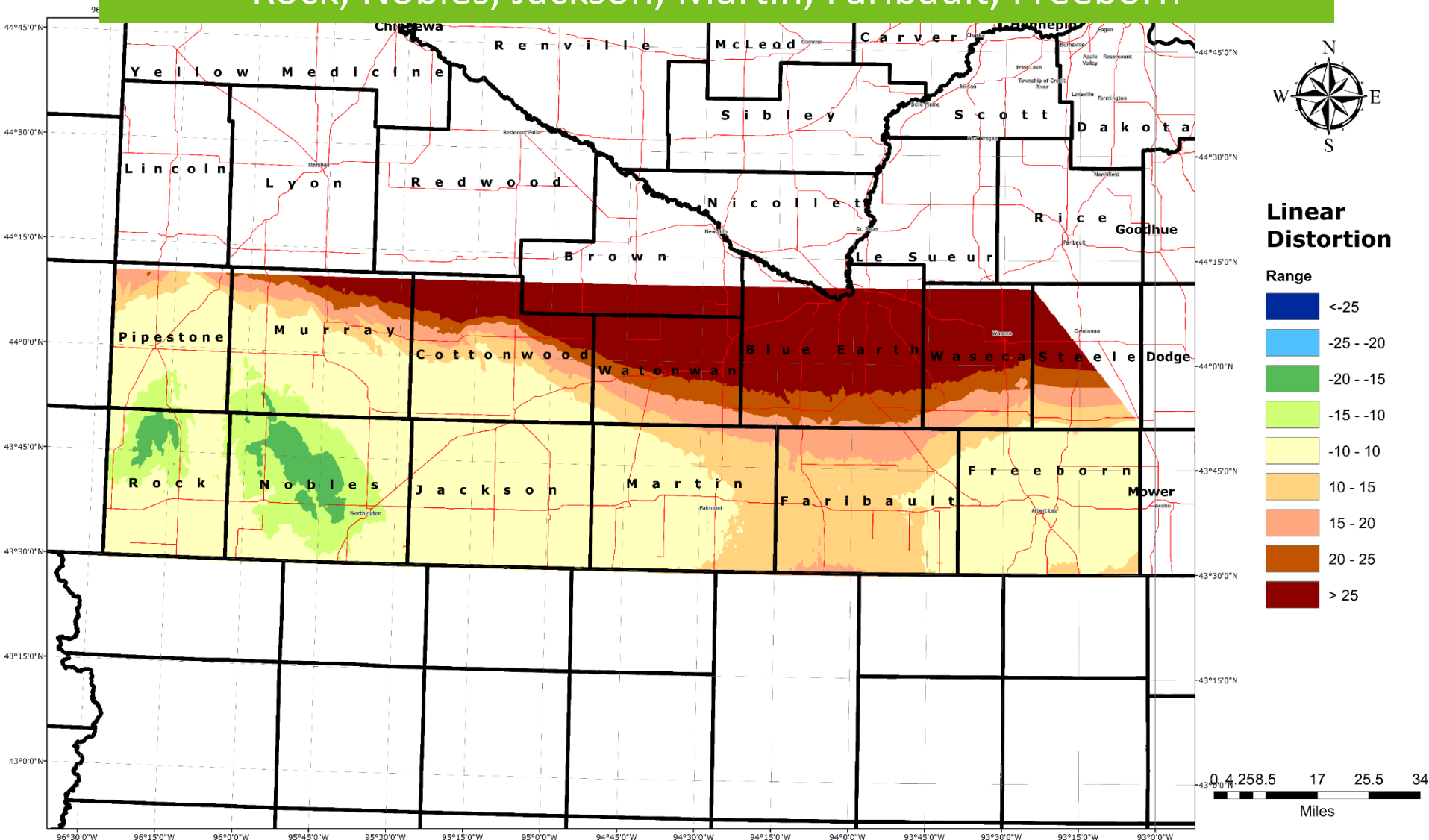
Zone: 28, Mankato, MANK

Cottonwood, Brown, Watonwan, Nicollet, Blue Earth, Le Sueur, Waseca



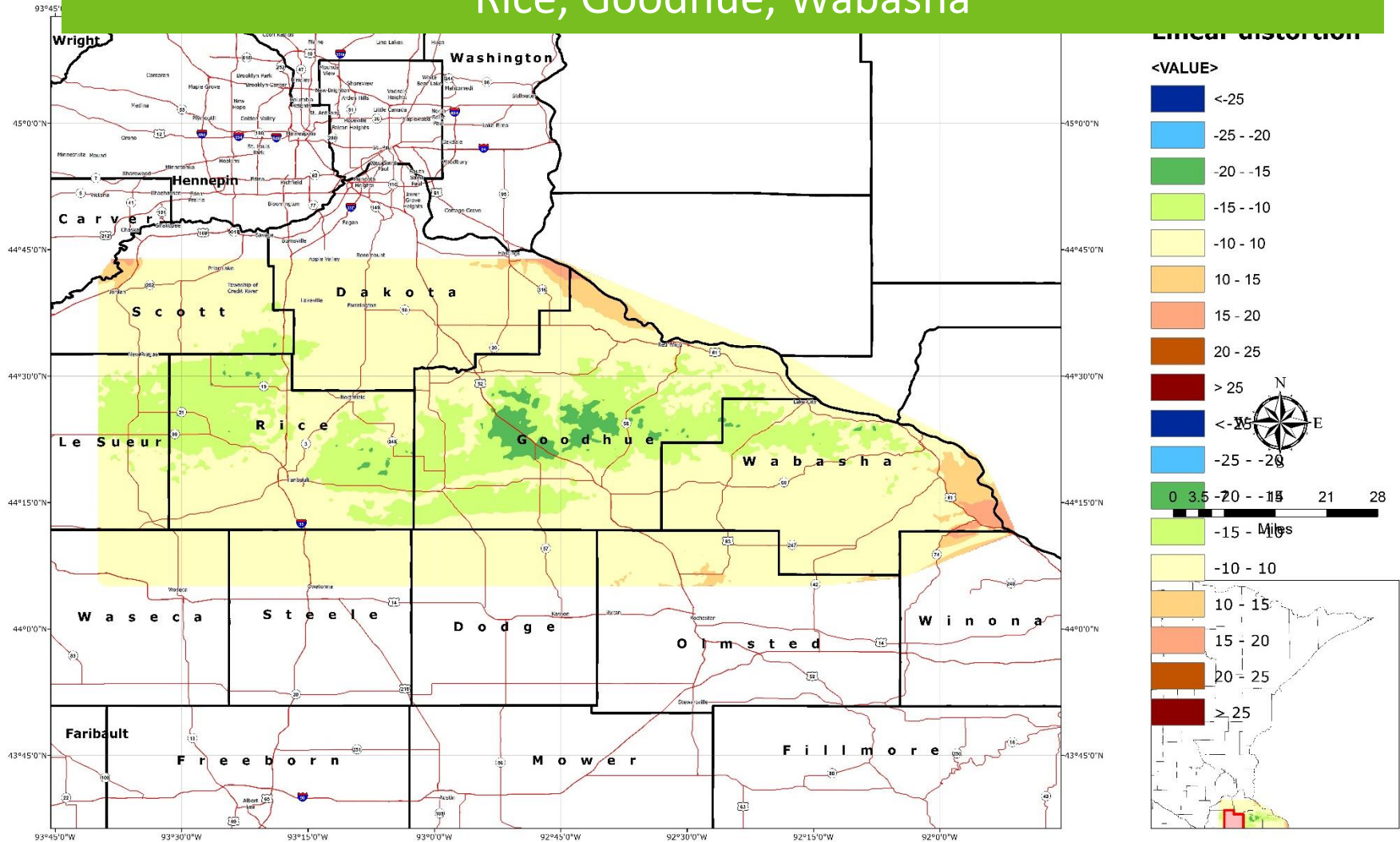
Zone: 29, I90 Corridor, I90C

Rock, Nobles, Jackson, Martin, Faribault, Freeborn



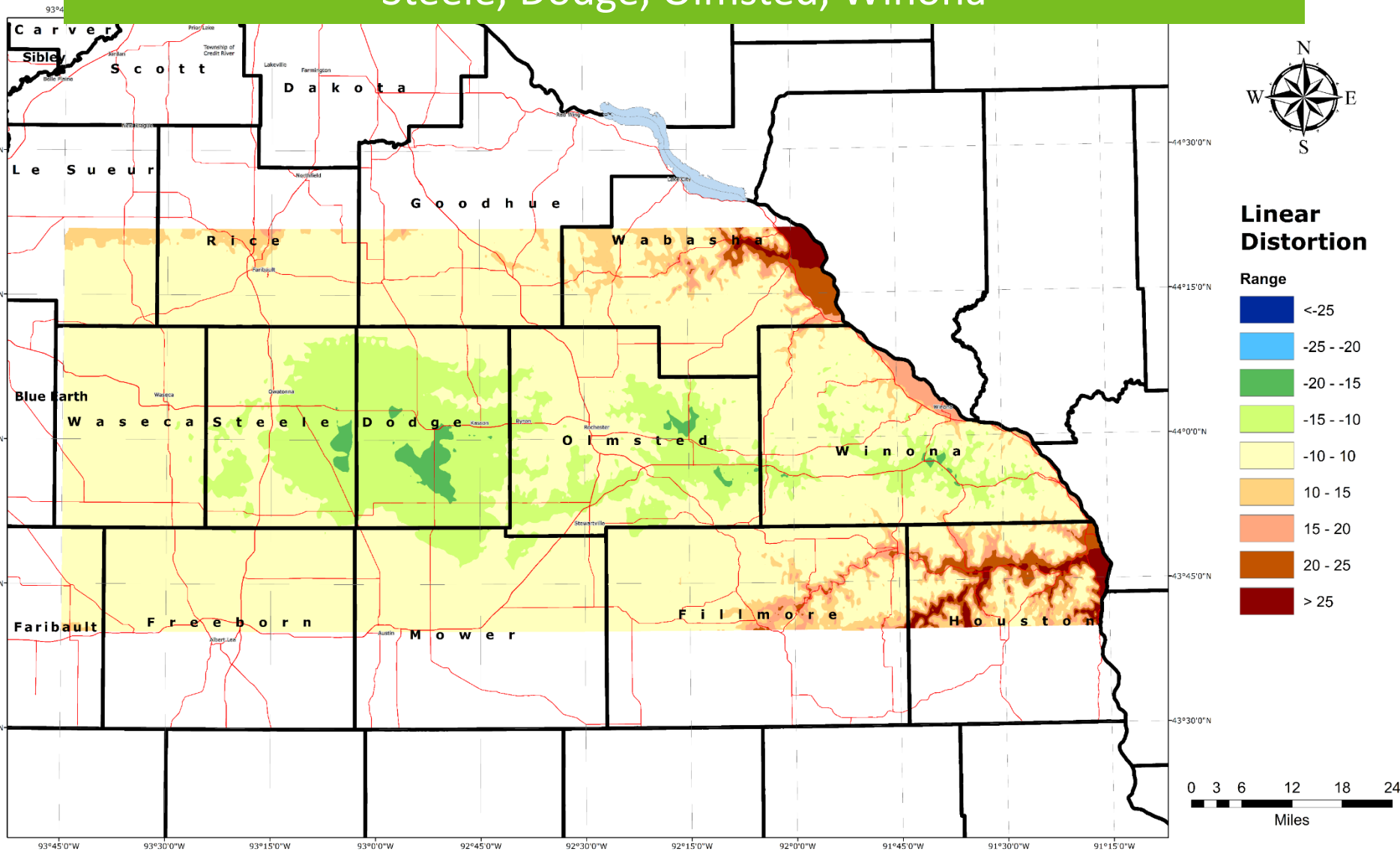
Zone: 30, Cannon River, CANN

Rice, Goodhue, Wabasha



Zone: 31, Rochester, ROCH

Steele, Dodge, Olmsted, Winona



Zone: 32, Southeast, SOUT

Freeborn, Mower, Fillmore, Houston

