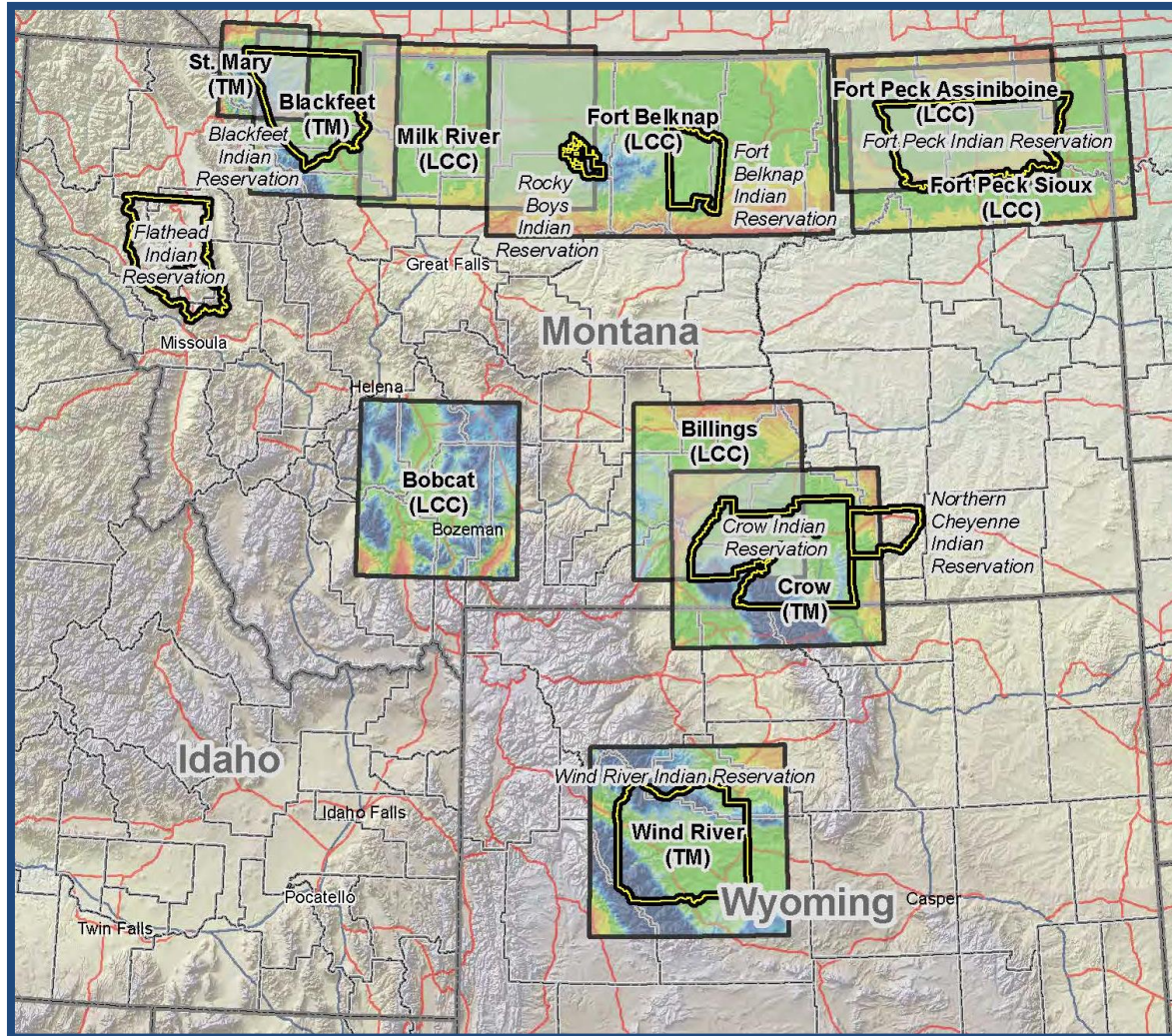


Mapping: NGS New Datums, SPCS 2022 Update

Rocky Mountain Tribal Mapping Project: 2009 – Present

By: Wallace J. Gladstone, PE, LS



Rocky Mountain Tribal Transportation Association

"Big" John Smith, President
John Healy, Vice President
Connie Thompson, Secretary

Board of Directors
Don White, Blackfeet
Curry Kirn, Fort Peck
Buddy Wind Boy, Crow



Survey Grade World meets the GIS World

Multi-phase Mapping Project

In 2009

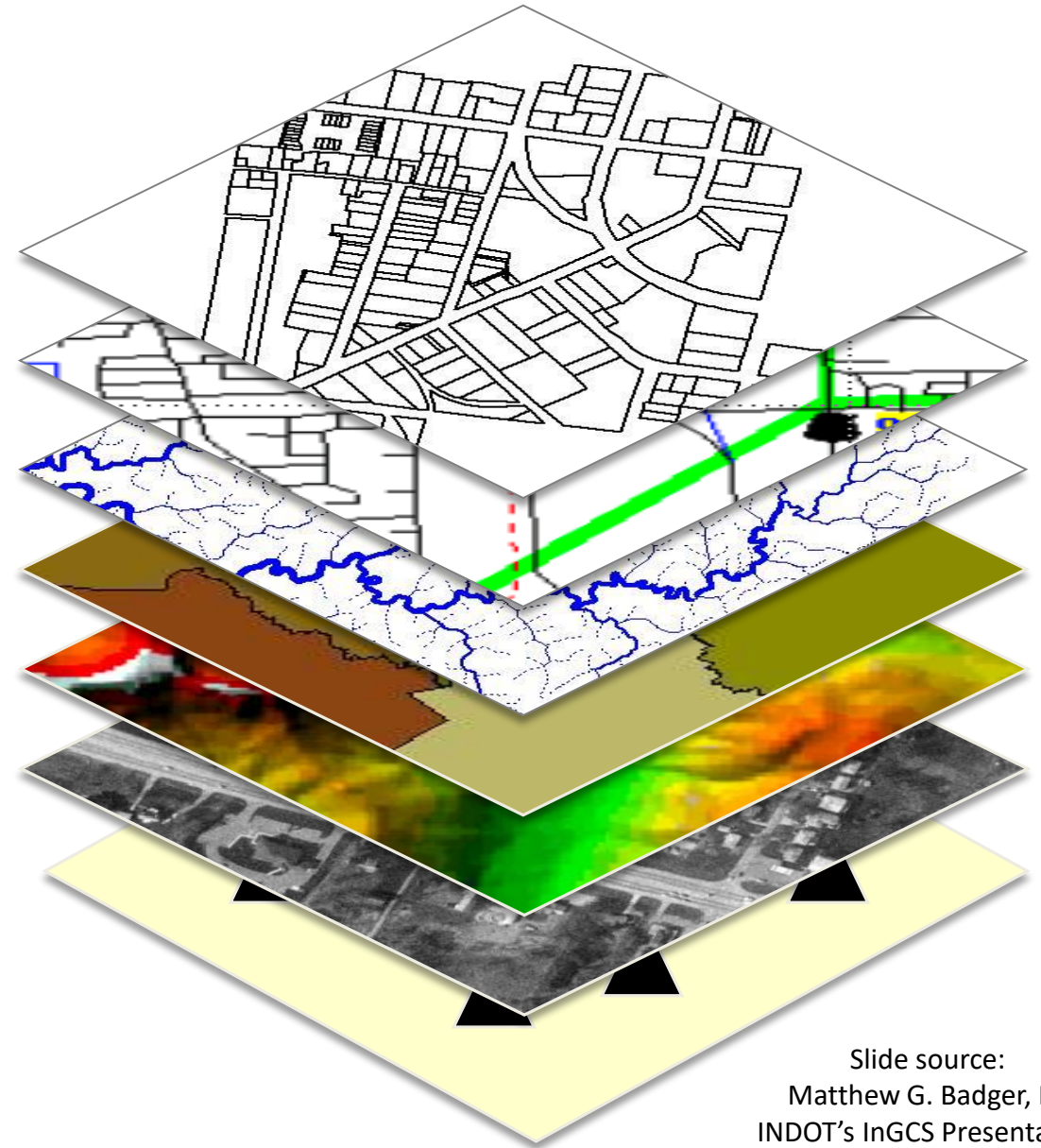
~~Imagine~~ A world that allows anyone doing surveying, engineering and GIS development to coordinate and associate all projects onto one simple mathematical base.

A world where the DOT, Land Department, Irrigation, Tribal Housing, DNR, Forestry, Utilities and all others involved with development and mapping ~~will be~~ are able to put all data onto one common survey grade base map.

Map Projections

With the Earth's surface being curved, we turn to map projections to provide us with flat surfaces to represent our products:

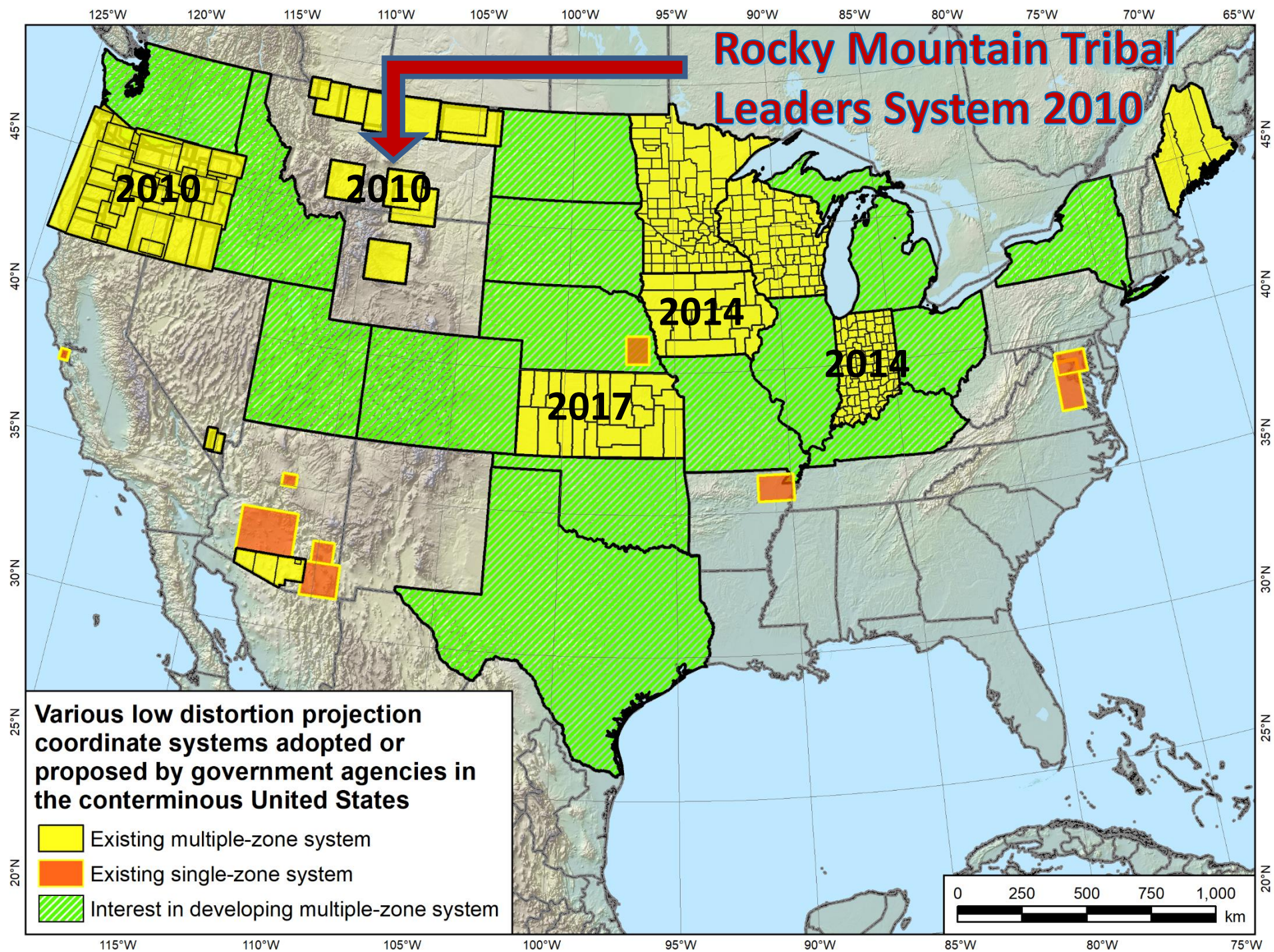
- Geodetic Control
- Land Survey Plats
 - ROW Maps
 - Easements
 - Plats
- Topographic Maps
 - Survey grade (design from)
- Aerial Photography - Orthorectified
- Design Plans
 - Road
 - Waterline
 - Subdivisions
 - Building Site



Slide source:
Matthew G. Badger, PS
INDOT's InGCS Presentation

National Geodetic Survey (NGS)

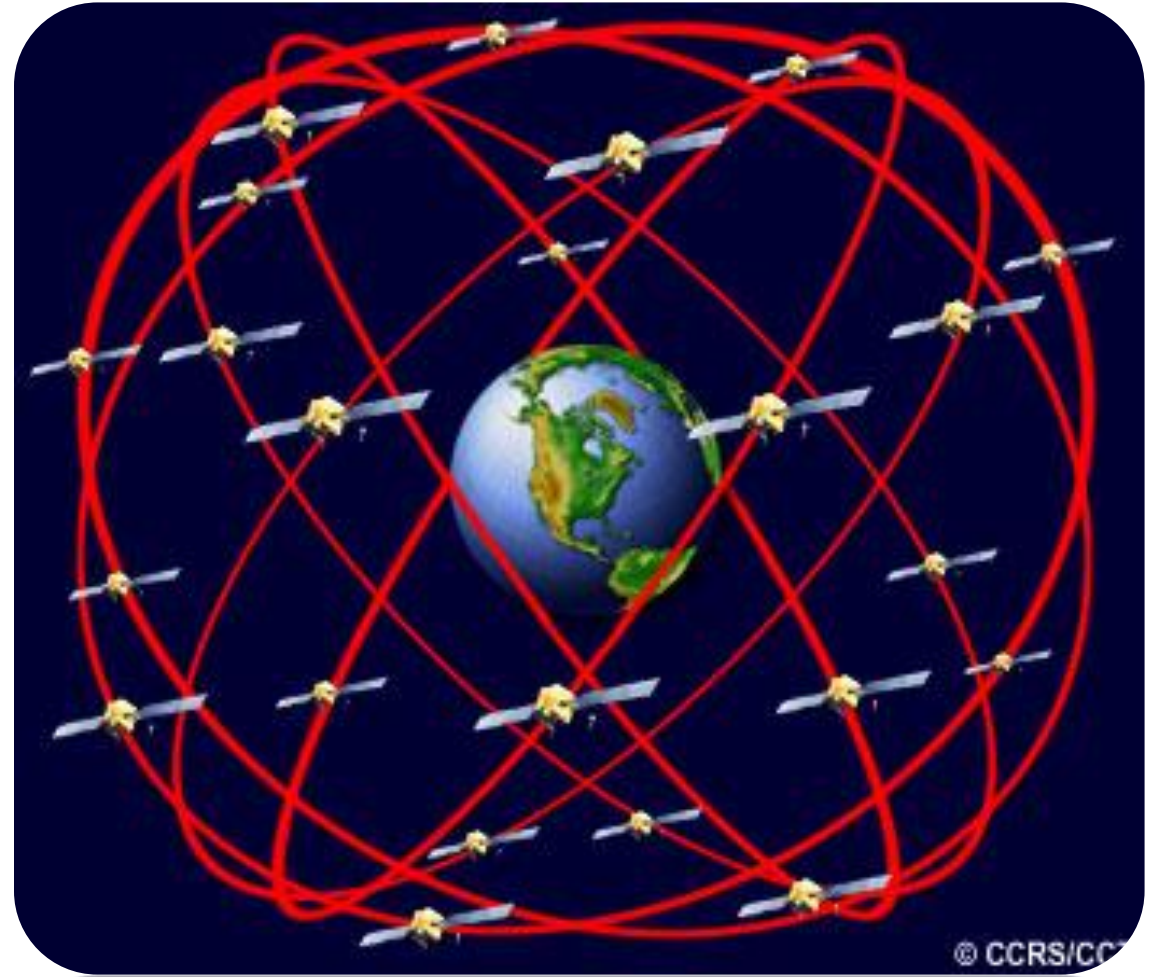
Datum Update 2022



The problem with GPS

■ Map Distortion

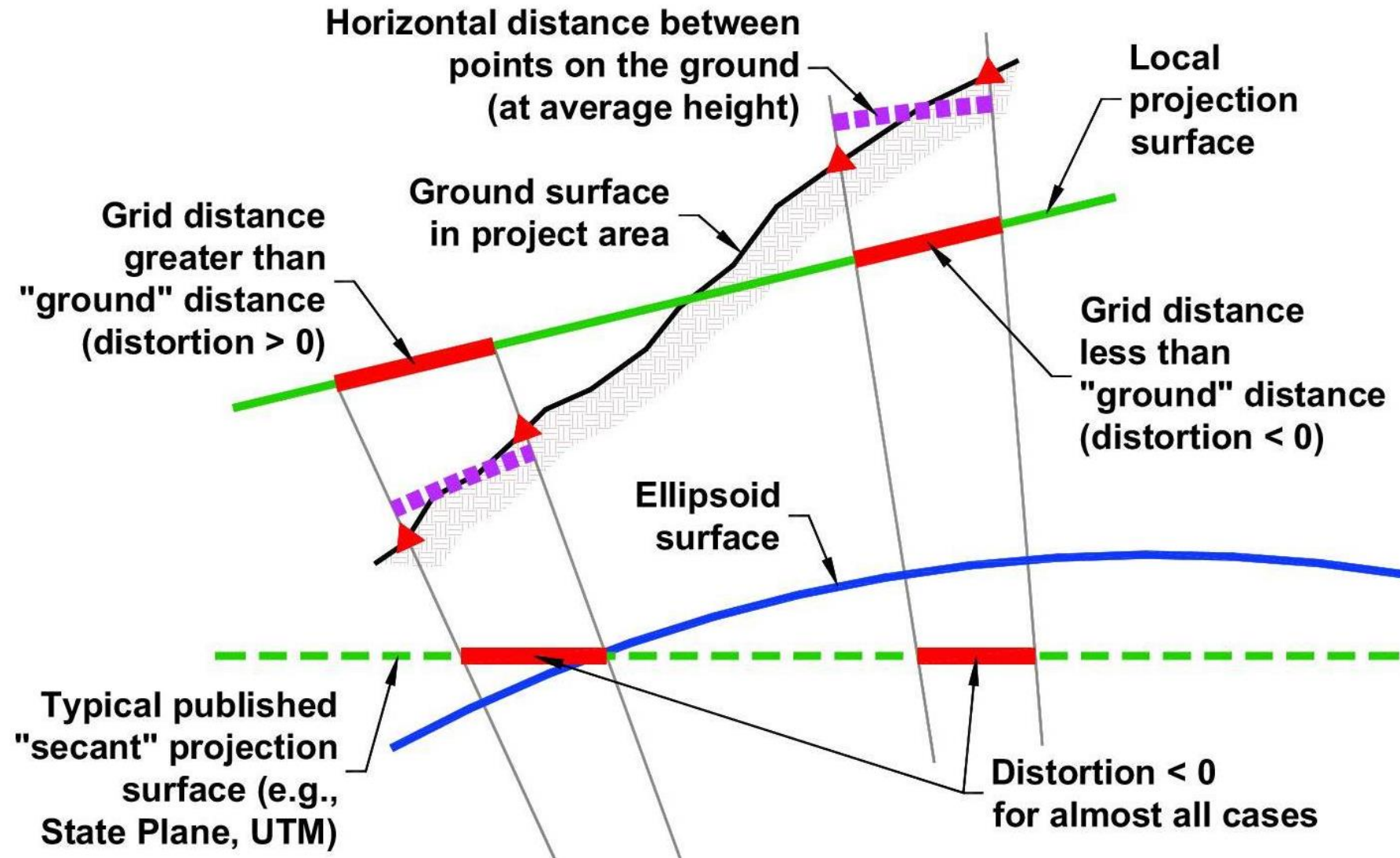
- Earth is round, maps are flat
- If you want to use GPS to survey
 - Distortion is a Fact of Life

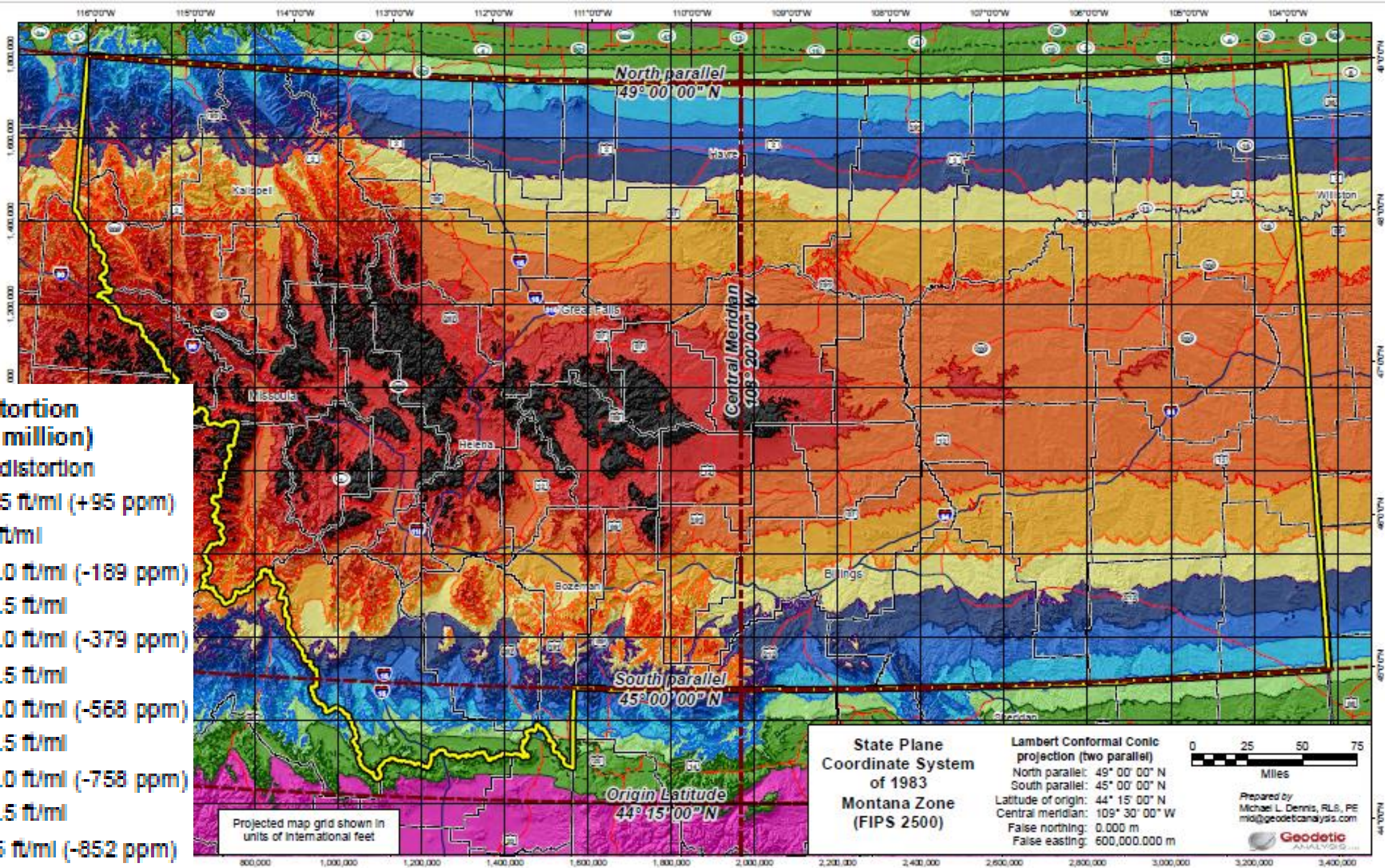


What is “Distortion”?



Linear distortion due to ground height above ellipsoid





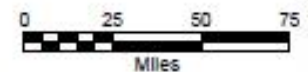
Linear distortion (parts per million)

- Zero distortion
- > +0.5 ft/mi (+95 ppm)
- ±0.5 ft/mi
- To -1.0 ft/mi (-189 ppm)
- To -1.5 ft/mi
- To -2.0 ft/mi (-379 ppm)
- To -2.5 ft/mi
- To -3.0 ft/mi (-568 ppm)
- To -3.5 ft/mi
- To -4.0 ft/mi (-758 ppm)
- To -4.5 ft/mi
- < -4.5 ft/mi (-852 ppm)

Projected map grid shown in
units of International feet

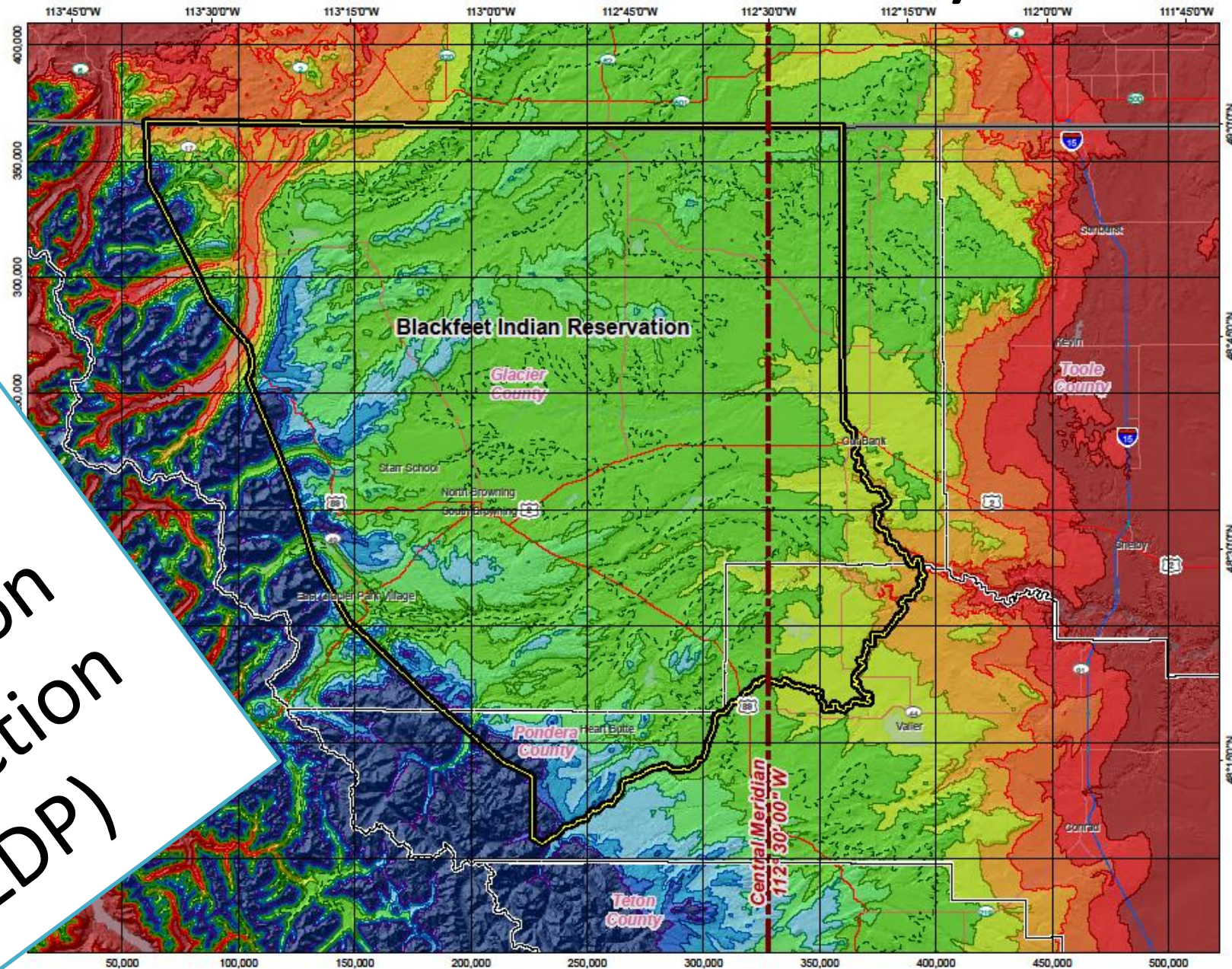
**State Plane
Coordinate System
of 1983
Montana Zone
(FIPS 2500)**

**Lambert Conformal Conic
projection (two parallel)**
 North parallel: 49° 00' 00" N
 South parallel: 45° 00' 00" N
 Latitude of origin: 44° 15' 00" N
 Central meridian: 109° 30' 00" W
 False northing: 0.000 m
 False easting: 600,000.000 m



Prepared by
Michael L. Dennis, RLS, PE
mlid@geodeticanalysis.com
**Geodetic
ANALYSIS**

Blackfeet Coordinate System



Blackfeet Coordinate System

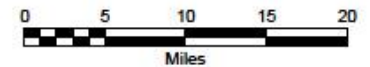
Transverse Mercator Projection
North American Datum of 1983

Latitude of grid origin: 48°00'00" N
Central meridian: 112°30'00" W
False northing: 0.000 m
False easting: 100,000.000 m
Central meridian scale: 1.000 190 (exact)

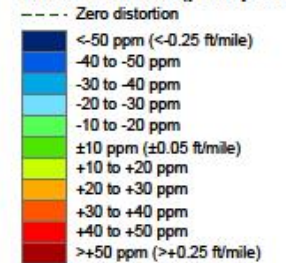


Projected map grid
shown in units of
international feet

Scale 1:500,000
(when printed on 11" x 17" sheet)



Linear distortion (parts per million)



Designed and prepared by

Michael L. Dennis, RLS, PE
mlid@geodeticanalysis.com

**Geodetic
ANALYSIS**

**NORTHERN ENGINEERING
CONSULTING, INC.**

Low Distortion Projections

Advantages of LDP's over "scaling each project to ground":

- » Time savings
 - Quick selection of system in software
 - No design time
 - No design-validation time
 - Not constantly verifying office & field devices are up-to-date
 - Documentation (internal and public record) time reduced to the same as documenting UTM or State Plane
 - Subsequent practitioners time reduced to the same as following UTM or State Plane projects



Indiana Geospatial Coordinate System (InGCS)

Low Distortion Projections

Advantages of LDP's over "scaling each project to ground":

- » Project Coordinates are directly referenced to the National Spatial Reference System (NSRS)
- » Not anchored/dependent upon local, physical monuments
- » Intended to cover much larger regions

~~»~~ **Can be Commercially available**



Indiana Geospatial Coordinate System (InGCS)

Low Distortion Projections

PARAMOUNT ADVANTAGE OF LDP's TO THE GEOSPATIAL COMMUNITY

When included in geospatial software platforms, LDPs offer future geospatial users a quick and easy way to fit all the different pieces (projects) of the geographic puzzle together.



Software:
Example: Carlson Survey Data Collector

SurvCE

Job Settings

Format Options Stake

New Job System

Distance: US Survey Feet

Decimal Feet

Angle: Degrees, Minutes, Secs

North

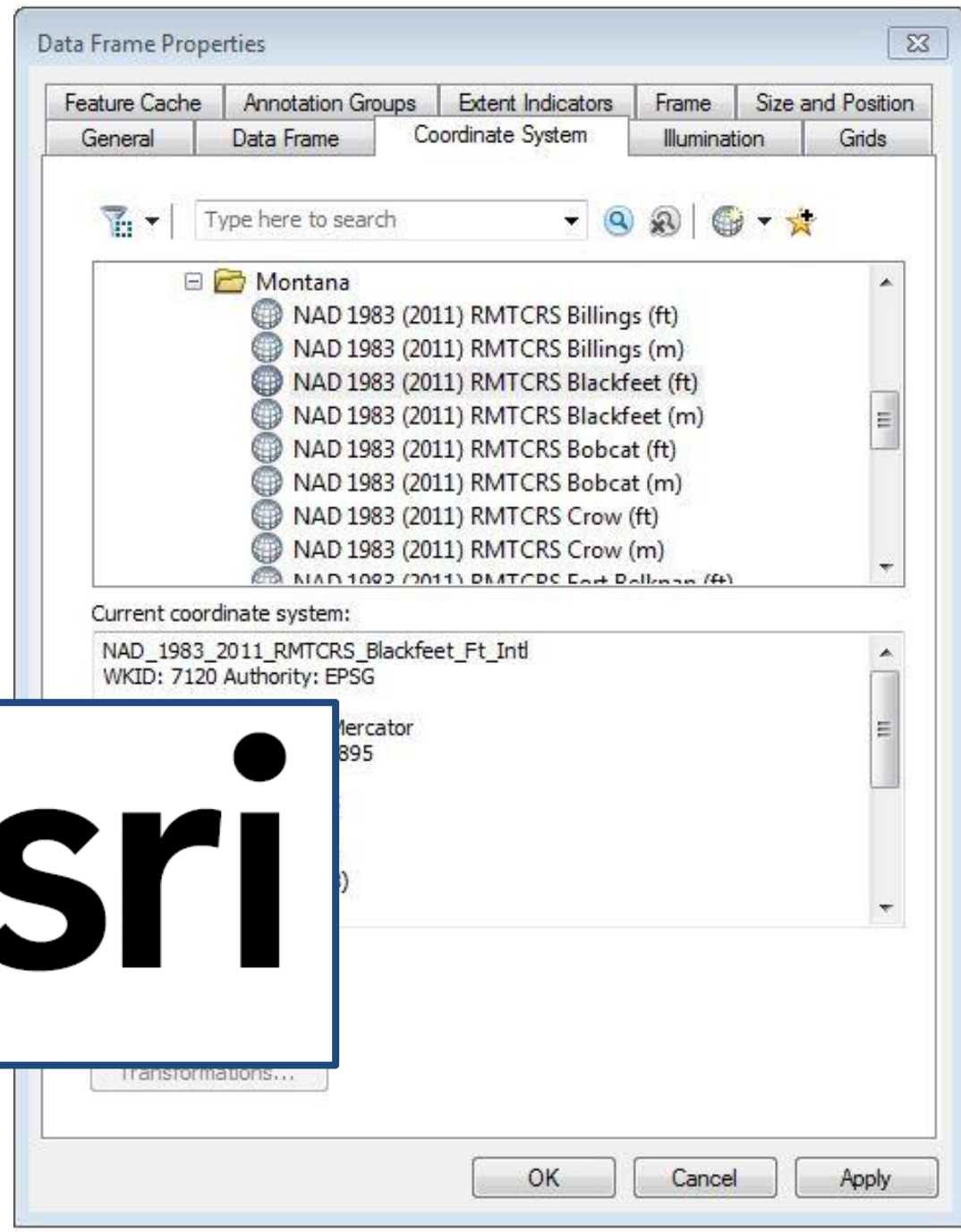
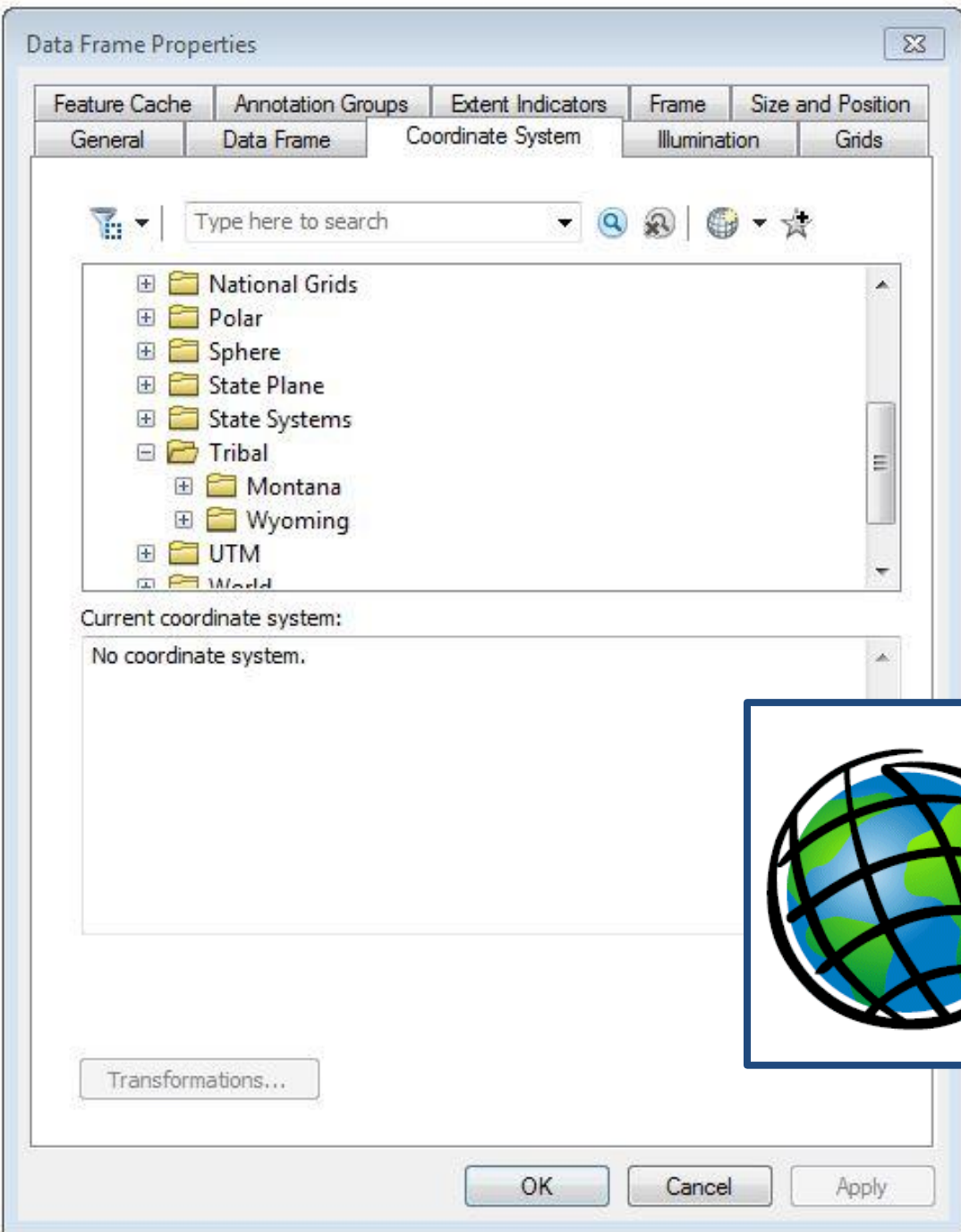
WIND RIVER

BLACKFEET

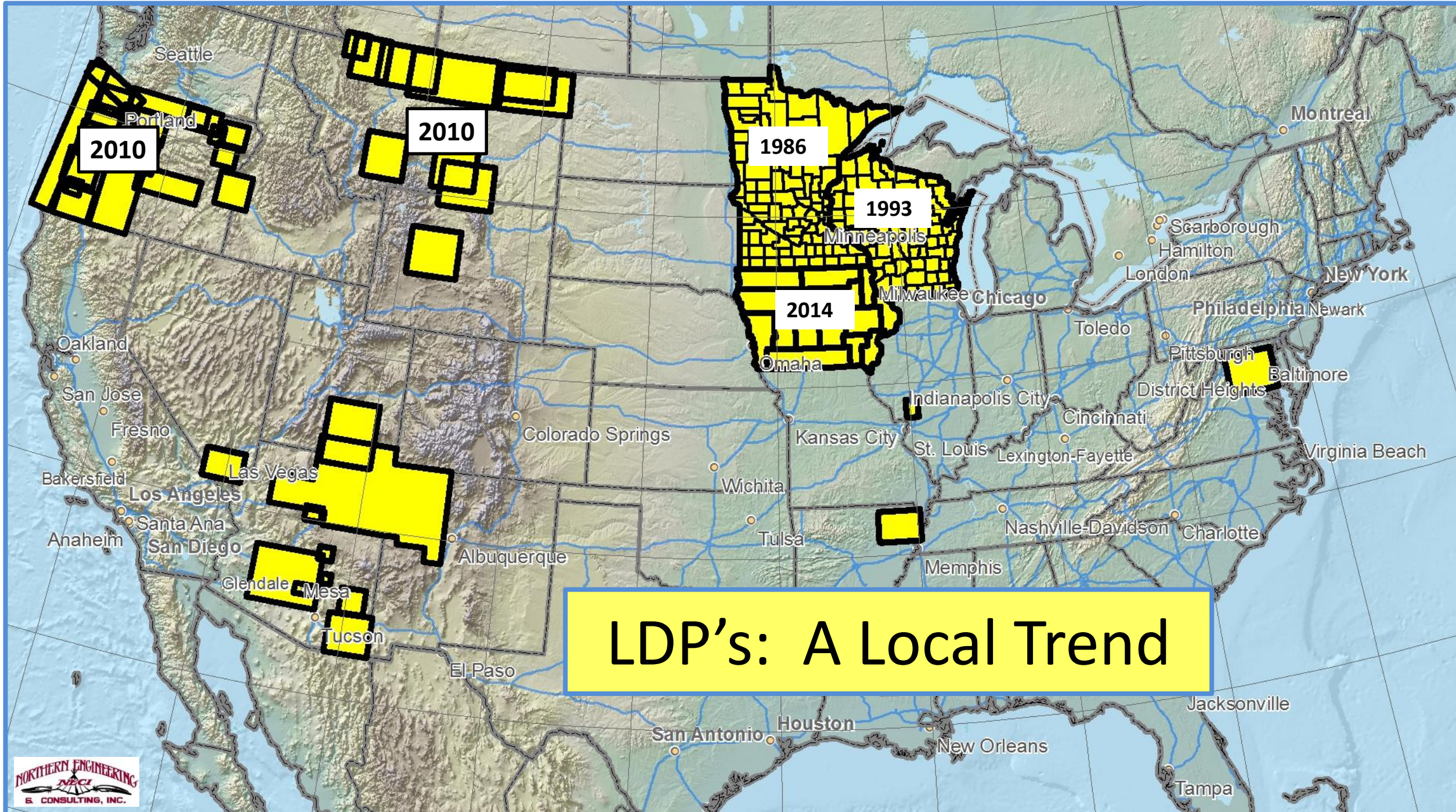
ASSINIBOINE PLAINS

SIOUX RIVER

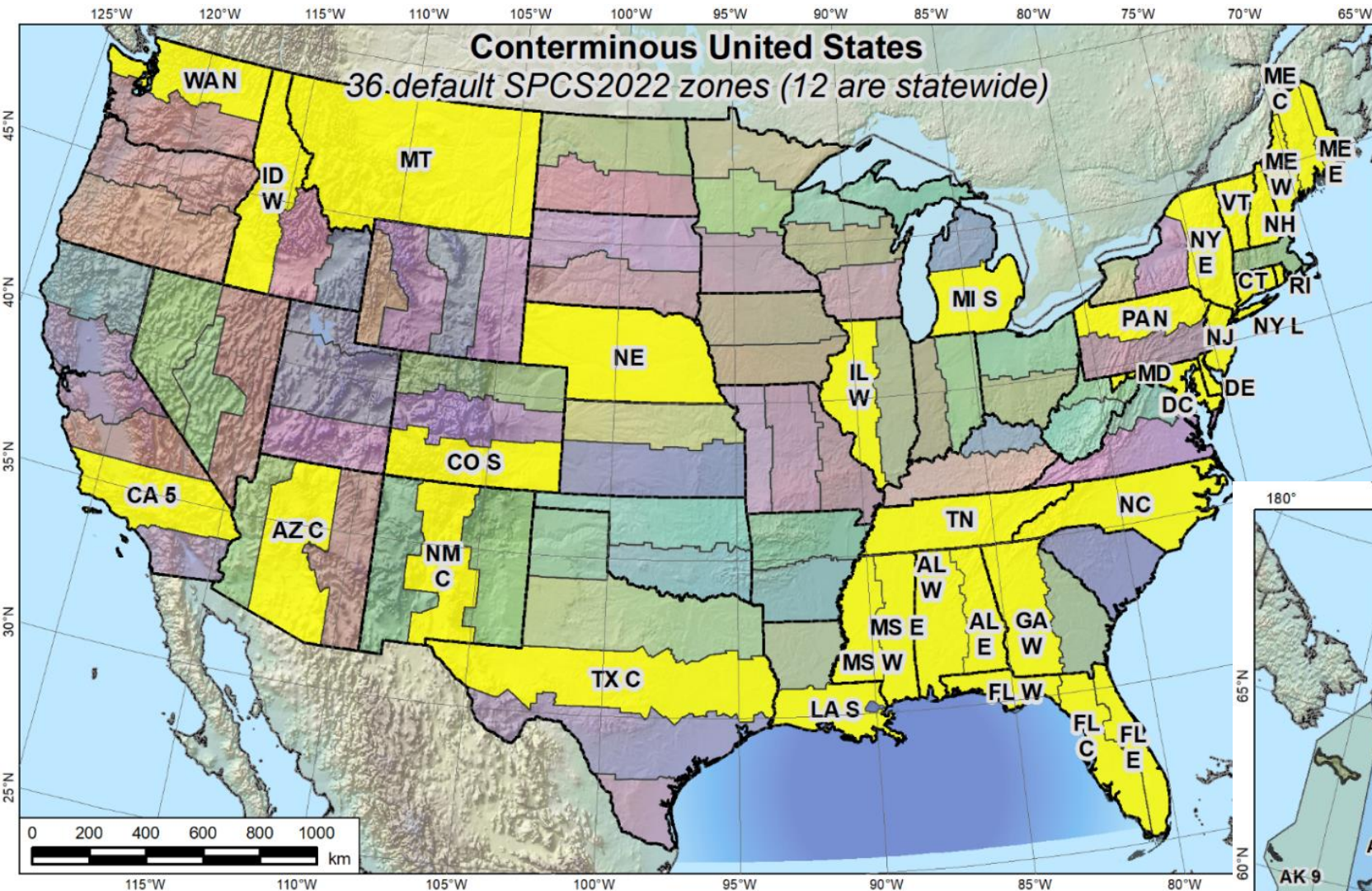
WIND RIVER







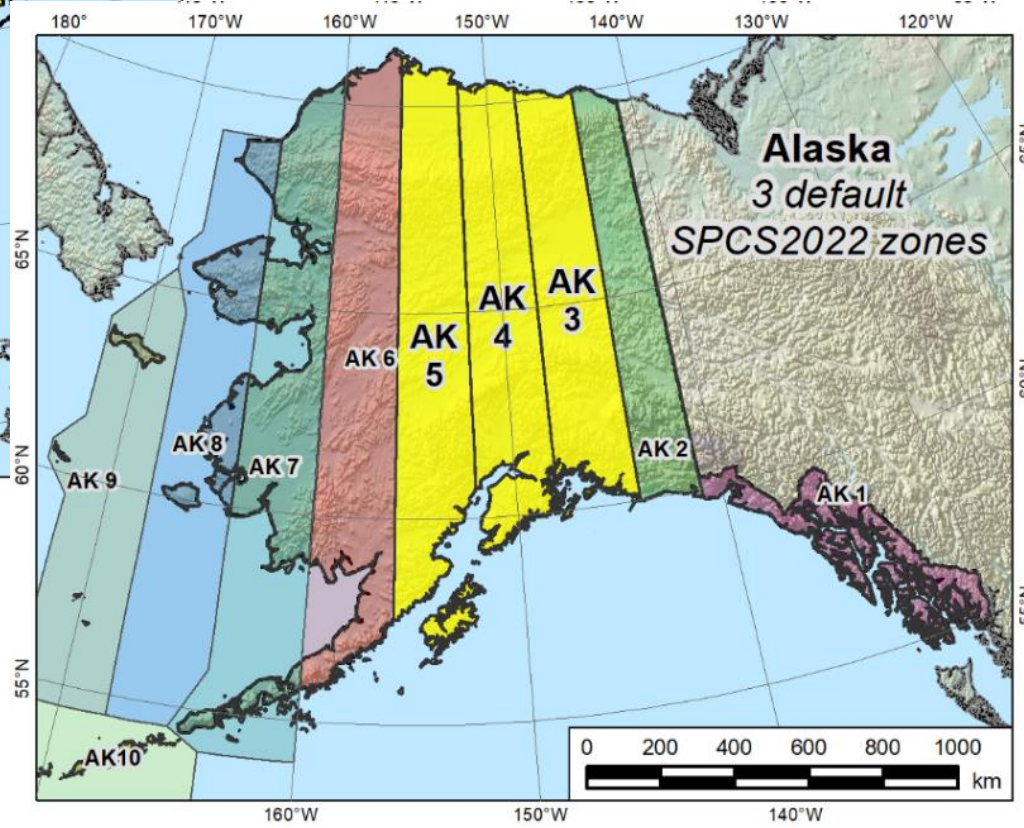
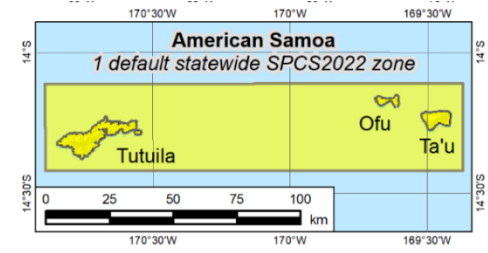
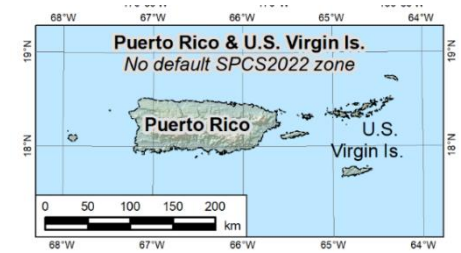
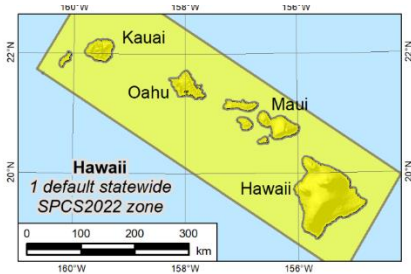
LDP's: A Local Trend



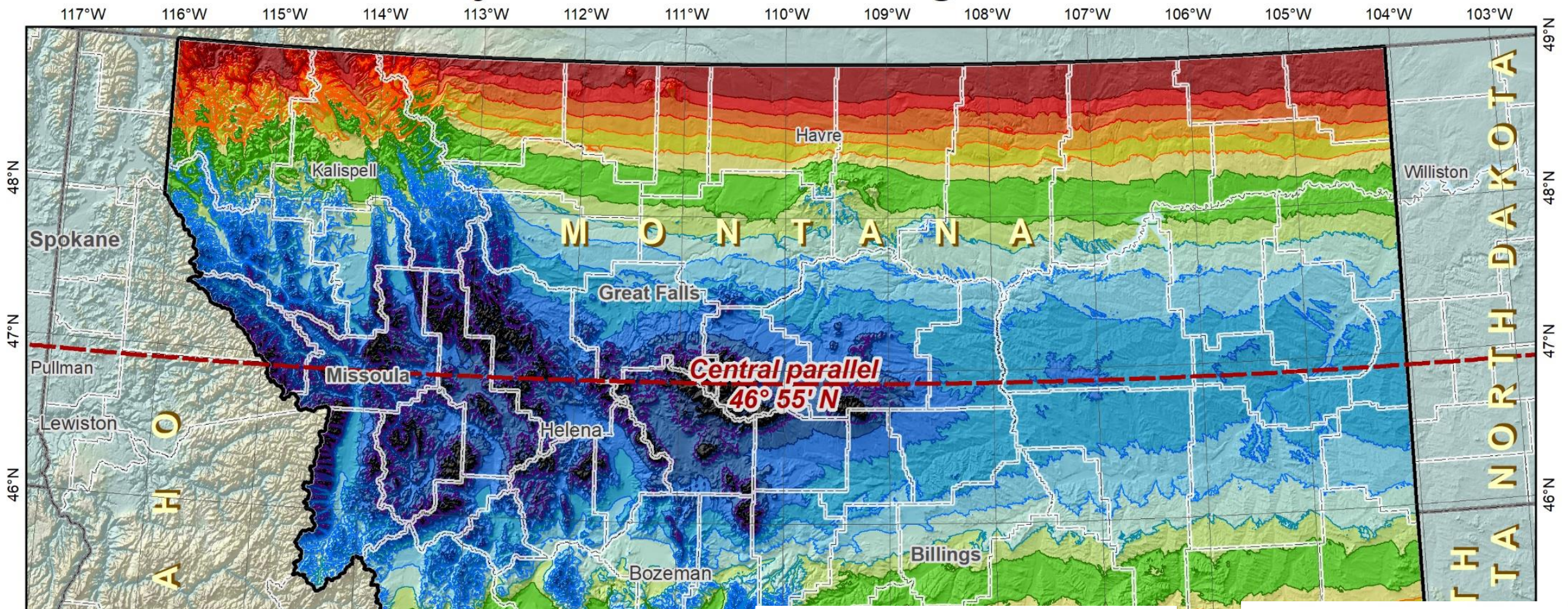
State Plane Coordinate System of 2022

Preliminary default zone designs (as of 1/14/2019)

42 zones (15 are statewide)



Preliminary SPCS2022 default design: Montana Zone



Lambert Conformal Conic projection

North American Terrestrial Reference Frame of 2022

Central parallel: 46° 55' N

Cen parallel scale: 0.999 9 (exact)

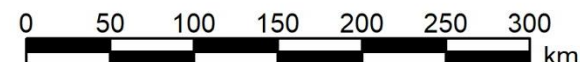
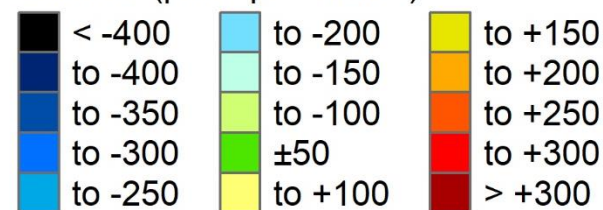
Areas within ±300 ppm distortion (±1.58 ft per mile):

- 98% of population
- 90% of all cities and towns
- 83% of entire zone area



NOAA's
National
Geodetic
Survey

Linear distortion at topographic surface (parts per million)



Distortion values (ppm)

Entire zone:

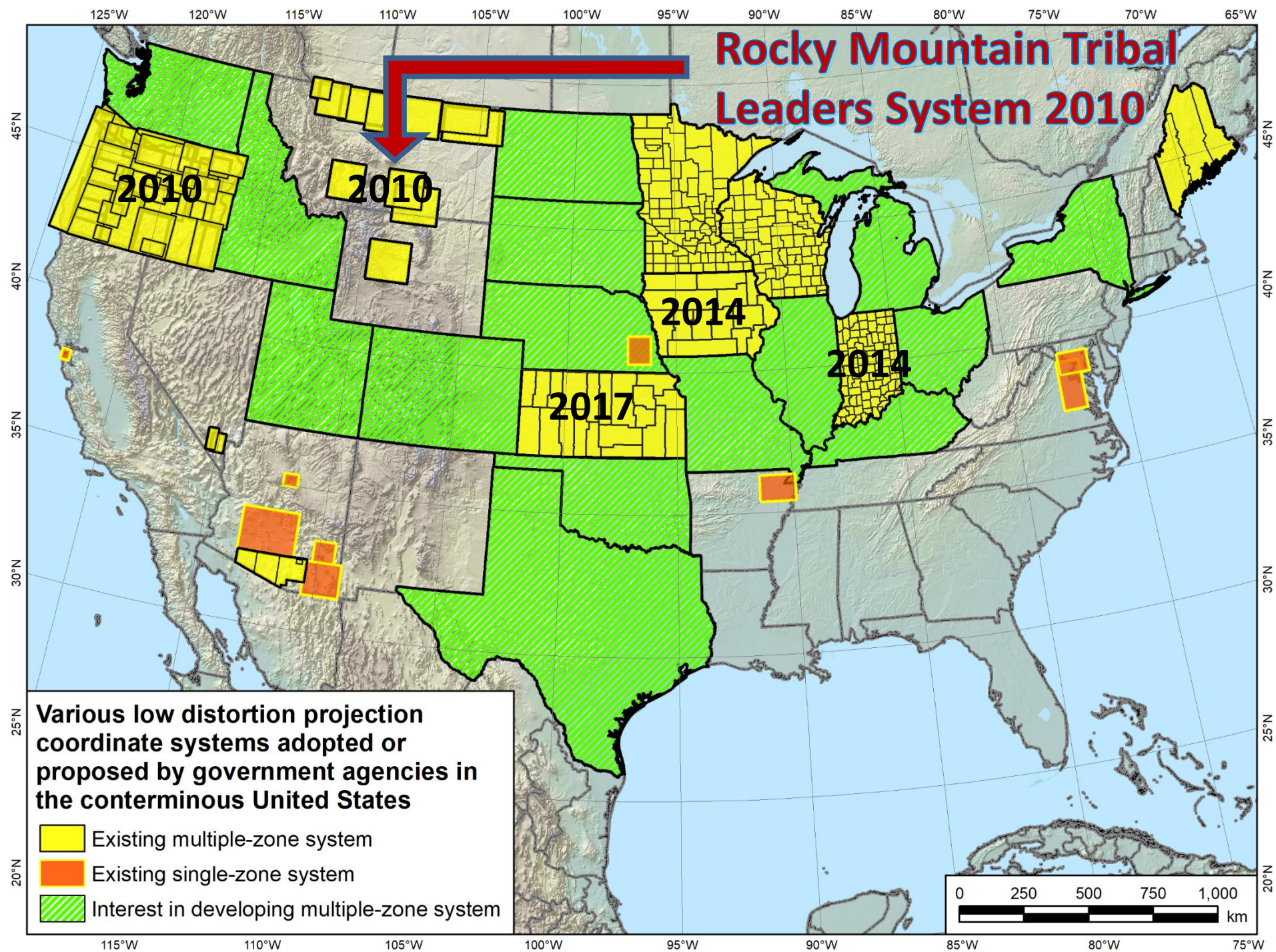
Min = -534 Range = 1000
Max = +467 Mean = -79

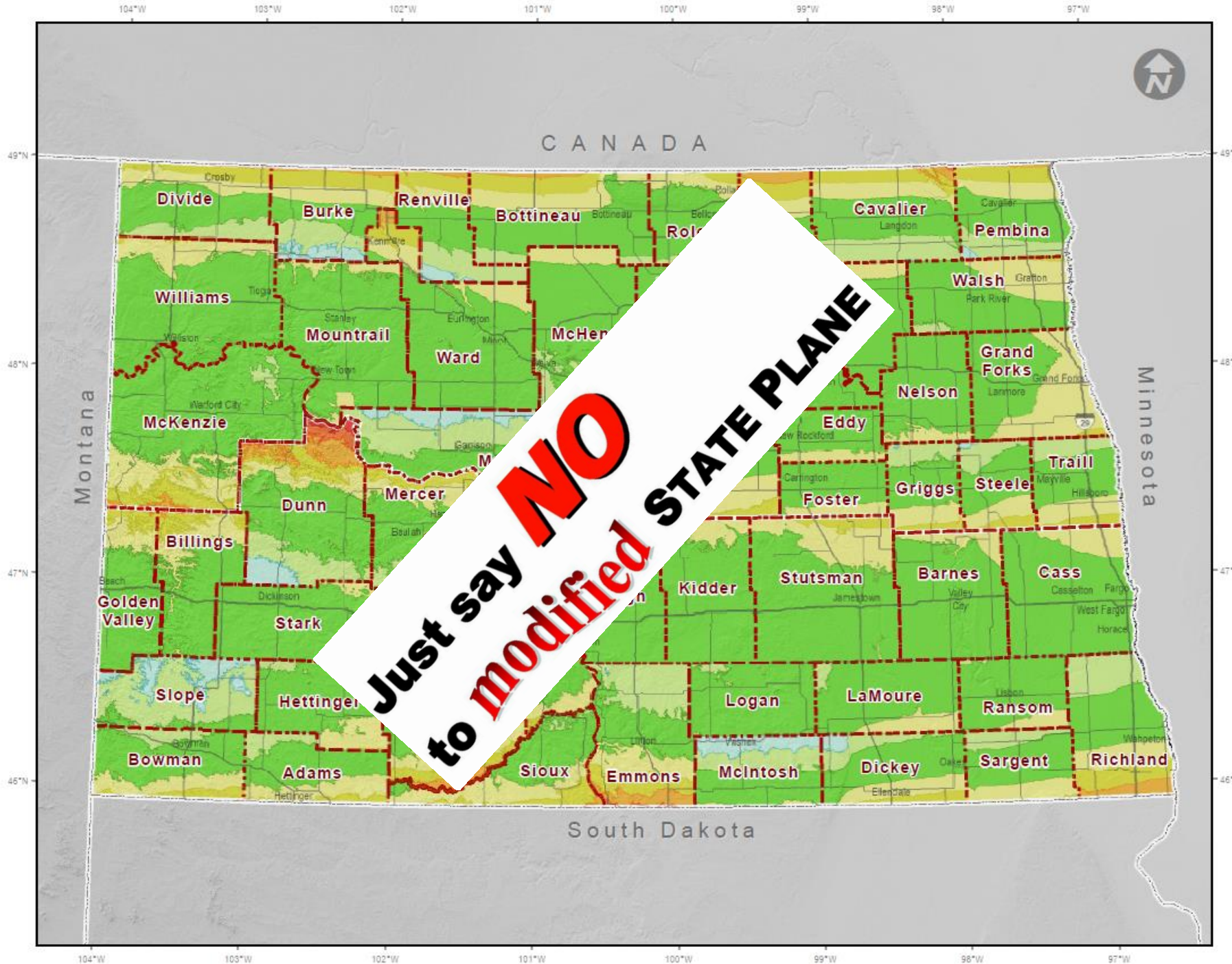
Cities and towns:

Min = -380 Mean = -113
Max = +441 (weighted by
Range = 822 population)

National Geodetic Survey (NGS)

Datum Update 2022





North Dakota Counties Topographic surface linear distortion

State Plane Coordinate System 1983
using NDDOT county coordinate
conversion factors (3 arc-sec resolution)

Linear Distortion at the Topographic Surface in parts per million (ppm)



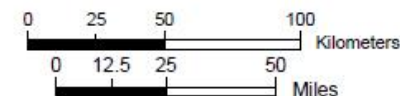
Distortion Values for All Zones in parts per million (ppm)

Min: -63 Range: 194
Max: +131 Mean: +5.7

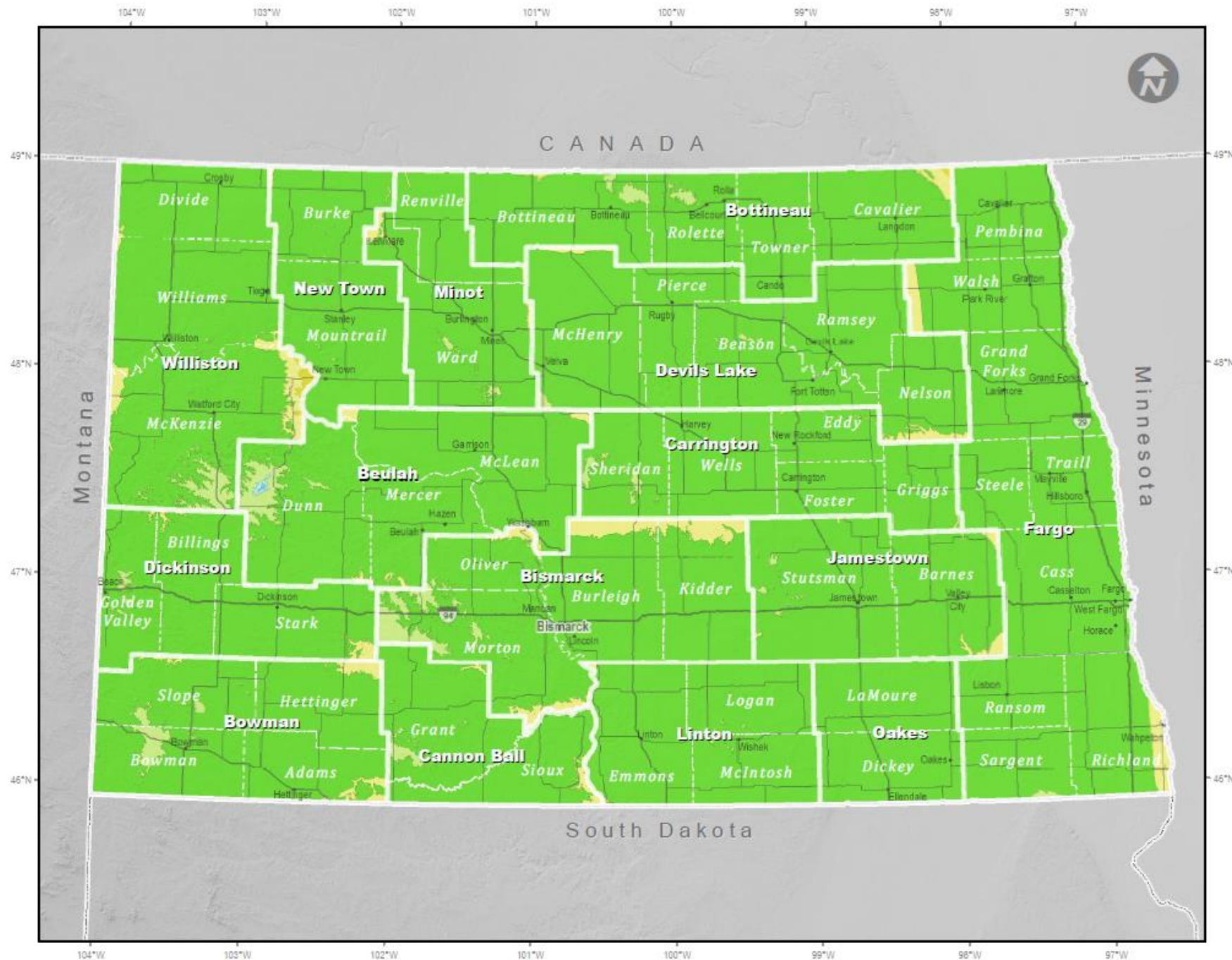
Area of the state that is within:

± 10ppm: 38% ± 25ppm: 75%
± 20ppm: 66% ± 30ppm: 82%

— Interstate — State
— US Route - - - County
— State Route



NDDOT
North Dakota
Department of Transportation



North Dakota Preliminary LDP Zones

**- 8/1/2019 DRAFT -
FOR REVIEW PURPOSES**

Linear Distortion
at the Topographic Surface
in parts per million (ppm)



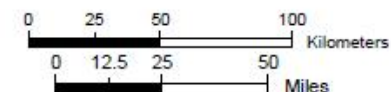
Distortion Values for All Zones
in parts per million (ppm)

Min: -65 Range: 127
Max: +62 Mean: -0.9

Area of the state that is within:

± 10ppm: 64% ± 25ppm: 98%
± 20ppm: 95% ± 30ppm: 99%

— Interstate — State
— US Route **County**
— State Route **LDP Zones**



NDDOT
North Dakota
Department of Transportation

Tribal Coordinates on NGS Data Sheets

See file [dsdata.pdf](#) for more information about the datasheet.

PY0802
 PY0802.The modeled gravity was interpolated from observed gravity values.
 PY0802
 PY0802. The following values were computed from the NAD 83(2011) position.

| | | | | | | |
|-----------------|---|-------------|---|--------------|---|-----------------|
| PY0802! | - | Elev Factor | x | Scale Factor | = | Combined Factor |
| PY0802!SPC WY W | - | 0.99964790 | x | 0.99997966 | = | 0.99962757 |
| PY0802!UTM 12 | - | 0.99964790 | x | 0.99960255 | = | 0.99925059 |

| | |
|--------|---------------------------|
| PY0802 | |
| PY0802 | SUPERSEDED SURVEY CONTROL |

