

Oregon Coordinate Systems and NATF2022

OGIC TAC
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BACKGROUND

DECADE PLUS IN THE MAKING


Horizontal Datum

- North American Terrestrial Reference Frame of 2022 (NATRF2022)

Vertical Datum

- North American-Pacific Geopotential Datum of 2022 (NAPGD2022)
- GEOID 2022

National Geodetic Survey Positioning America for the Future geodesy.noaa.gov



New Datums Are Coming!

NOAA is Replacing NAD 83 and NAVD 88. NOAA's National Geodetic Survey (NGS) will be replacing the datums of the National Spatial Reference System (NSRS), including **the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88)**. NGS will provide the tools to easily transform between the new and old datums. Read the NGS Ten-Year Plan and visit the **New Datums Web page** on our site to learn more.

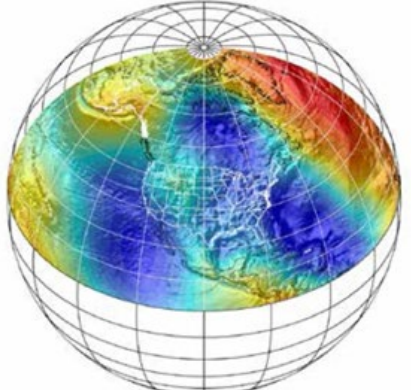
How You Can Prepare

- Learn if **legislation** or other formal documents referencing NAD 83 and NAVD 88 need to be changed in your state.
- **Transform existing data** to the latest NSRS datums and realizations; i.e. NAD 83 (2011), GEOID18, and NAVD 88.
- **Obtain precise ellipsoidal heights** on NAVD 88 bench marks, and visit the GPS on Bench Marks Web page to learn more.
- Require and provide **complete metadata** on all mapping contracts. See our website for more details.

Benefits
The new reference frames (geometric and geopotential) will rely primarily on **Global Navigation Satellite Systems (GNSS)**, such as the Global Positioning System (GPS), as well as on a gravimetric geoid model resulting from NGS' **Gravity for the Redefinition of the American Vertical Datum (GRAV-D)** Project.

The target accuracy of differential orthometric heights (heights relative to sea level) in the geopotential reference frame will be 2 centimeters over any distance, where possible.

What You Can Expect
The magnitude of change with the new datums will vary depending on the datum you are using and your geographic location. The new geometric datum will change latitude, longitude, and ellipsoid height between 1 and 4 meters. In the conterminous United States (CONUS), the new vertical datum will change heights on average 50 centimeters, with approximately a 1-meter tilt towards the Pacific Northwest.



The new datums will extend across CONUS and U.S. territories. The terrestrial reference frames replacing NAD 83 will be consistent with geocentric global reference frames defining latitude and longitude. The geopotential datum replacing NAVD 88 will be based on a gravimetric geoid model, enhanced by data from NGS' Gravity for the Redefinition of the American Vertical Datum (GRAV-D) Project.

New Datums

National Oceanic and Atmospheric Administration • National Geodetic Survey

STATE PLANE UPDATE

NEW DATUM = NEW SPCS

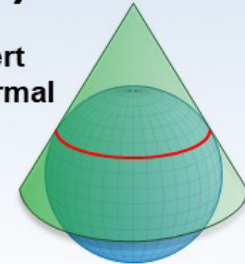
NOAA's **National Geodetic Survey** Positioning America for the Future

geodesy.noaa.gov

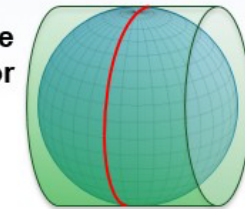
State Plane Coordinate System of 2022 (SPCS2022)

- Part of modernizing the *National Spatial Reference System (NSRS)*
- Third generation of State Plane
 - First in 1930s (SPCS 27), second in 1980s (SPCS 83)
 - Same 3 map projection types
 - Same ellipsoid as SPCS 83 (GRS 80)
- Same as existing State Plane, *but different...*
 - Based on new terrestrial reference frames instead of NAD 83
 - More zones, most designed by state stakeholders
 - Designed to reduce linear distortion at topographic surface (i.e., reduce difference between “grid” and “ground” distances)

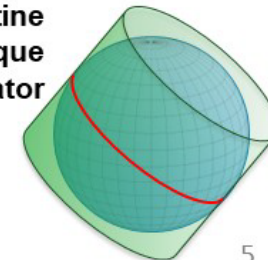
Lambert Conformal Conic



Transverse Mercator

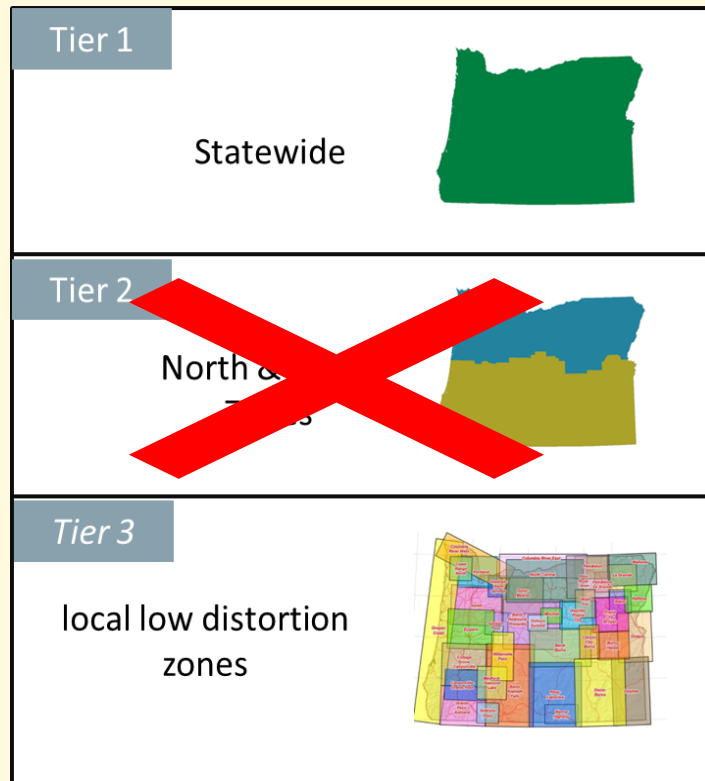


Hotine Oblique Mercator



SPCS2022 AND OREGON

DIRECTION TO NGS



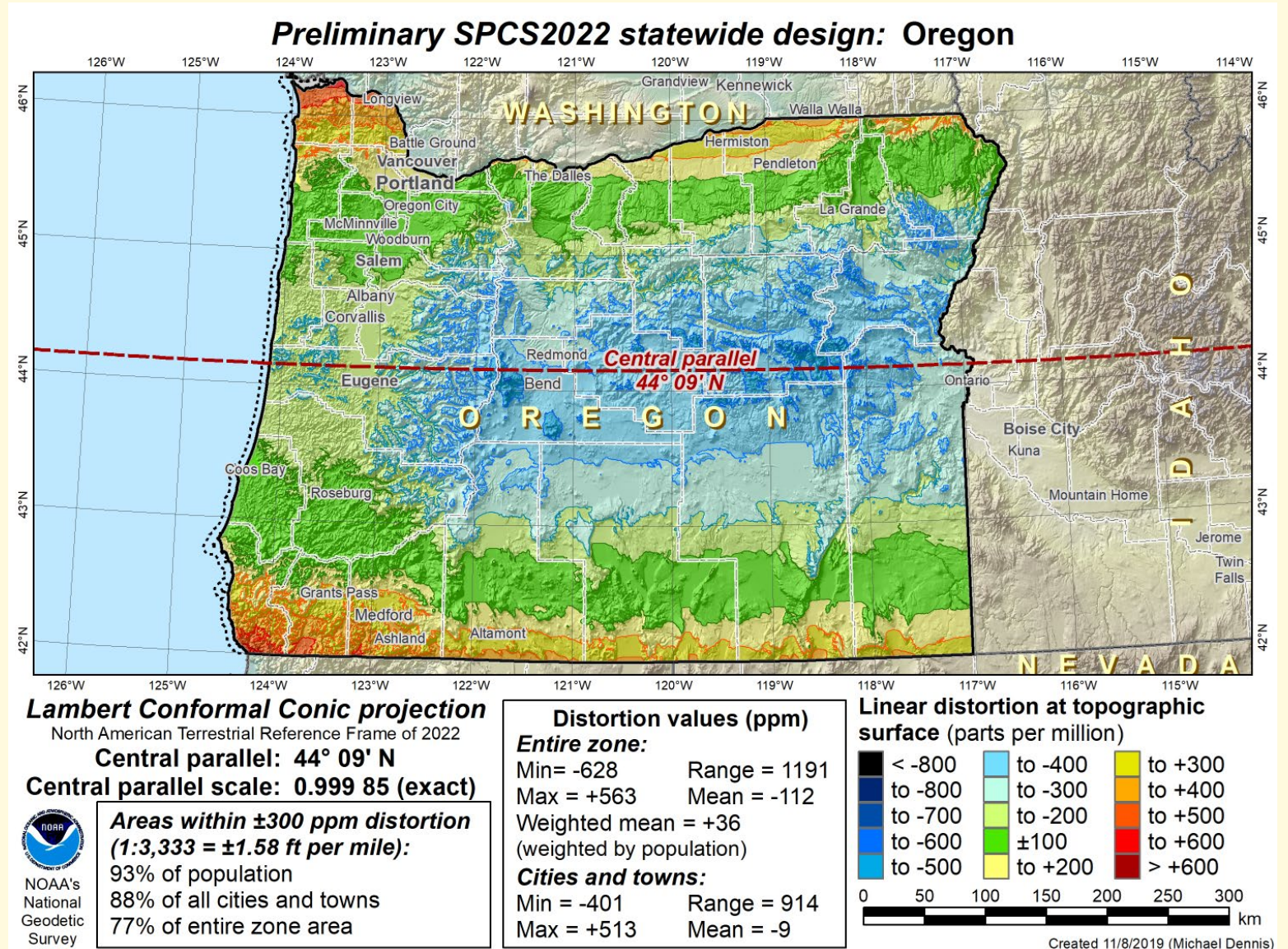
Oregon Tiered Proposal

- Initially – “Let’s have them all!”
 - ***NGS reminder-** “Pick any **two** but one MUST be the statewide zone”
- Modified Oregon proposal (accepted by NGS)
 - Tier 1 – Statewide
 - Tier 2 – Low distortion zones

Support from OACES, OGIC, URISA

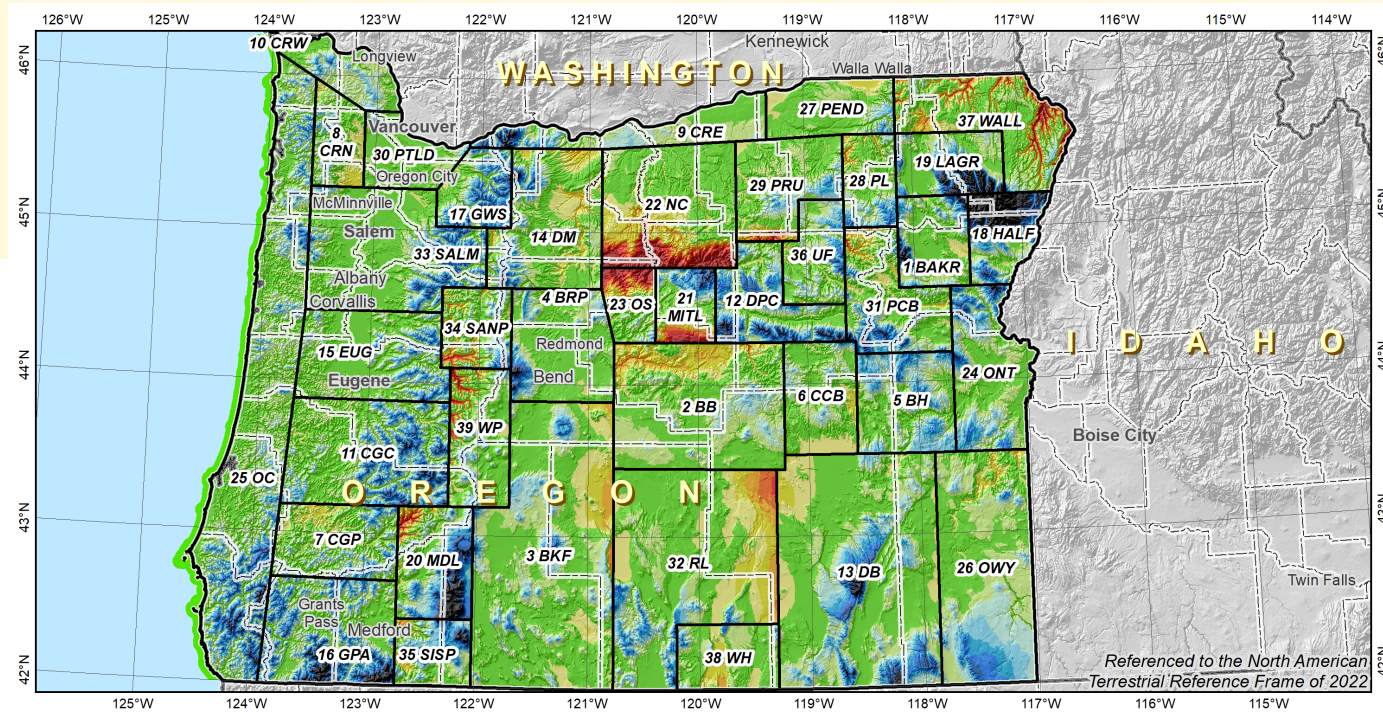
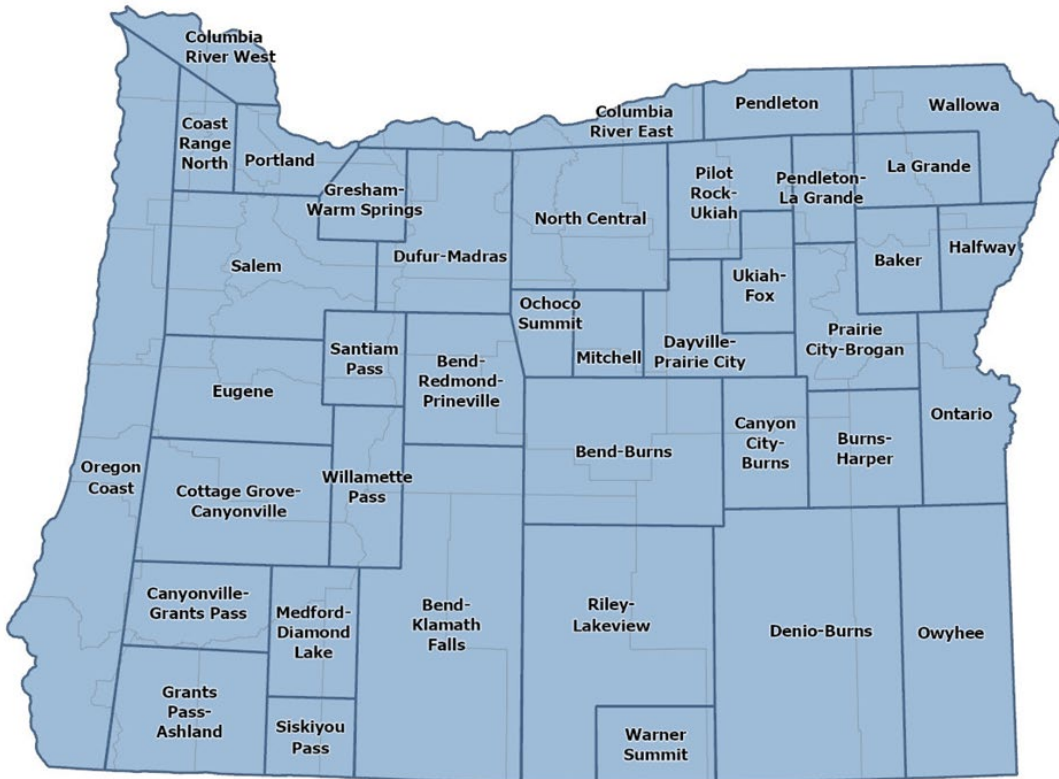
SPCS2022 AND OREGON

STATEWIDE ZONE



SPCS2022 AND OREGON

LOW DISTORTION ZONES



**Preliminary SPCS2022 design
Oregon complete
coverage layer (39 zones)**



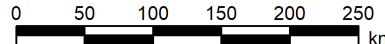
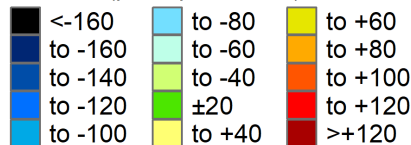
Distortion statistics (ppm)

| | Cities | Area |
|-----------------------|--------|------|
| Min | -129 | -365 |
| Max | +186 | +241 |
| Range | 315 | 606 |
| Mean | +7 | -22 |
| Mean weighted by pop: | -2 | |

Percent within distortion ranges

| Range | Pop | Cities | Area |
|----------|---------|--------|-------|
| ±20 ppm | 90% | 81% | 43% |
| ±25 ppm | 93% | 85% | 50% |
| ±30 ppm | 95% | 88% | 56% |
| ±40 ppm | 97% | 92% | 66% |
| ±50 ppm | 98.7% | 96% | 74% |
| ±75 ppm | 99.6% | 98% | 86% |
| ±100 ppm | 99.9% | 98% | 92% |
| ±150 ppm | 99.98% | 99.6% | 98% |
| ±200 ppm | 99.996% | 100% | 99.5% |

Linear distortion at topographic surface (parts per million)



SPCS2022 AND OREGON

EXISTING COORDINATE SYSTEMS

- Oregon Statewide Lambert
 - Oregon Coordinate Reference System Standard
 - OGIC Endorsed
- Oregon Coordinate System (ORS 93.312)
 - a) Oregon State Plane 1927
 - b) Oregon State Plane 1983
 - c) **Oregon Coordinate Reference System**
- Implemented under Oregon Administrative Rule (734-005-0010)
 - Three Systems (SPCS 1927, 1983, **OCRS**)
 - Description for development of **OCRS**

SPCS2022 AND OREGON EXISTING COORDINATE SYSTEMS

Oregon Coordinate System (ORS 93.312)

Planned to be updated to include the zones from SPCS 2022

- Add 39 low distortion projections (aka "O CRS")
 - New datum
 - Different coordinate ranges
 - Add single statewide zone
 - Different than current statewide OGIC Lambert
-
- New systems to be approved by ODOT OAR Committee (Summer 2024)
 - New systems to be defined and published in OAR 734-005-0015



The screenshot shows the Oregon Secretary of State website. The header includes the Oregon Secretary of State logo and a navigation menu with links for Home, Business, Voting, Elections, State Archives, and Audits. The main content area is titled "Department of Transportation Highway Division - Chapter 734". It lists "Division 5 OREGON COORDINATE SYSTEMS" and "734-005-0005 Purpose". The purpose is defined as "The purpose of this administrative rule is to define the Oregon Coordinate System projection coordinate systems that are authorized for use in the State of Oregon". It also lists "Statutory/Other Authority: ORS 184.616, 184.619 & Ch.179 OL 2011" and "Statutes/Other Implemented: ORS 209.130, 209.155, 209.250, 390.770 & C". The history is listed as "History: HWD 13-2011, f. 12-22-11, cert. ef. 1-1-12". At the bottom, it lists "734-005-0010 Oregon Coordinate Systems".

SPCS2022 AND OREGON

EXISTING COORDINATE SYSTEMS

Oregon Statewide Lambert

- Planned replacement with single zone SPCS2022/OCRS
- Tied to OAR (ORS)

ENTERPRISE
information services

Oregon Geospatial Enterprise Operations

ABOUT GEOSPATIAL ENTERPRISE OPERATIONS ›

- Geospatial Enterprise Operations Home ›
- State Agency Resources ›
- Frequently Asked Questions ›
- Contact Us ›

GIS DATA & RESOURCES ›

- Statewide Data Initiatives ›
- Coordinate System ›

FRAMEWORK PROGRAM ›

- Framework Goals and Performance ›
- Framework Grant Program ›
- Framework Forums ›

GIS COMMUNITY & COORDINATION ›

ABOUT OREGON GEOGRAPHIC INFORMATION COUNCIL ›

Oregon Coordinate Systems

Ten different major map projections have been commonly used in Oregon and all have varied error across the state. A common projection for statewide data display, analysis, publishing, and transfer was needed so the [Oregon Geographic Information Council](#) endorsed the use of Oregon Lambert as a standard for state agencies.

Oregon Lambert is registered in the [EPSG Geodetic Parameter Dataset](#) by the International Association of Oil and Gas Producers (IOGP) Geomatics Committee, which maintains and publishes an international coordinate reference system database. The EPSG spatial reference ID for Oregon Lambert is [2992](#).

Oregon also supports the use of the [Oregon Coordinate Reference System](#) which is a low distortion projection system stewarded by the Oregon Department of Transportation. See the [OCRS Handbook and User Guide](#) for more information.

 **Coordinate System Description**

 **Oregon Lambert History**

 **Oregon Lambert Methodology**

NEW COORDINATE SYSTEMS/DATUM

GETTING READY

1. Familiarize yourself with the different datums and realizations in use in Oregon
2. Understand the quality of your data and how the spatial location was generated
3. Document the process of coordinate system/datum conversion including the transformations and assumptions

NEW COORDINATE SYSTEMS/DATUM

NAD83 PITFALL

“Our data is NAD83. So, we’ll be fine”

- NAD83 has multiple realizations that are different
- Sometimes data providers have used the generic “NAD83” datum tag or some other realization as opposed to including the correct one.

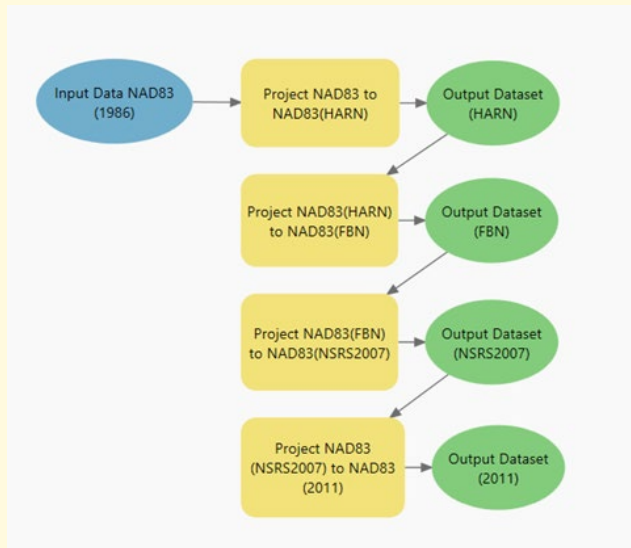
Seen occasionally in wide area remote sensing data (orthophotography, lidar) that is most typically controlled with GNSS and tied to NGS control

NEW COORDINATE SYSTEMS/DATUM

NGS RECOMMENDATION

Migrate data to SRS based on NAD83(2011)

- Step through all intermediate realizations (no “jump over transforms”)



NGS NADCON 5 Technical Report

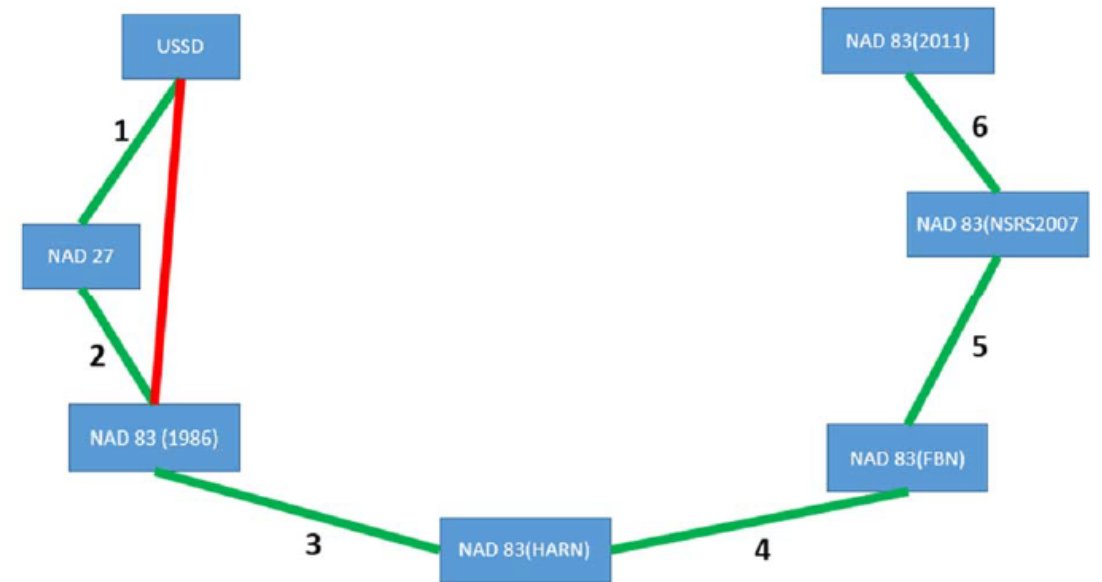


Figure 3-1: Chronological chain of transformations in CONUS (green), with potential realization skipping transformation (red)

Consider a potential transformation from USSD to NAD 83(1986), shown as a red line. Because each transformation is built by pairs of coordinates, there is absolutely no way to ensure (in fact, it's a ridiculous assumption) that the points with USSD/NAD 27 pairs, and the points with NAD 27/NAD 83(1986) pairs are the same, or that either one would align with the points with USSD/NAD 83(1986) pairs. As such, knowing the very data itself can not be identical, it is a simple matter to predict that a grid created along the red line will not be identical to that created by going through the two green lines (1 and 2). Therefore, with non-uniqueness being an issue, NGS chose not to create

NEW COORDINATE SYSTEMS/DATUM

TRANSFORM REQUIREMENTS

Esri software users need to install the supplemental **ArcGIS Coordinate Systems Data** available from My Esri

ESRI Transformation Names for CONUS

- NAD_1927_To_NAD_1983_7 (WKID::8555)
- NAD_1983_To_NAD_1983_HARN_47 (WKID::8556)
- NAD_1983_HARN_To_FBN_NADCON5_3D_CONUS_1 (WKID::8861)
- NAD_1983_FBN_To_NSRS2007_NADCON5_3D_CONUS_1 (WKID::8862)
- NAD_1983_NSRS2007_To_2011_NADCON5_3D_CONUS_1 (WKID::8559)

NEW COORDINATE SYSTEMS/DATUM

WHAT TO DO ABOUT WEB MERCATOR

- WGS 1984 Web Mercator (auxiliary sphere) – EPSG:3857
 - GCS is WGS 1984 – EPSG:4326
 - Datum is WGS 1984 – EPSG:6326
 - Generic datum tag for 'current' WGS 1984 realization
...includes all realizations