Geographic Information Coordinating Council
Issue Paper

Issue: Assistance to North Carolina counties that reference their horizontal spatial data using NAD 27 to convert to NAD 83

Issue

In 1974, the National Geodetic Survey (NGS) started working on redefining and readjusting the nation's horizontal control network, the North American Datum of 1927 (NAD 27). Five years later, the National Oceanic and Atmospheric Administration (NOAA) announced to the public via the Federal Register (44 FR 37969) that it was establishing a new datum *"…to which the geographic and plane coordinate values for the National Network of Horizontal Geodetic Control would be referenced."* In 1986, NGS released the new datum, the North American Datum of 1983 (NAD 83). Three years after the new datum was released, NOAA issued a second announcement to the public via the Federal Register (54 FR 25318) that affirmed NAD 83 as the *"official civilian horizontal datum for U.S. surveying and mapping activities performed or financed by the Federal Government."* and further stated that *"…all Federal agencies using or producing coordinate information should provide for an orderly transition from NAD 27 to NAD 83."* (Affirmation of Datum for Surveying and Mapping Activities, 1989).

In North Carolina, the State Legislature likewise updated § 102-1.1, which is the general statute on the State's Official Survey Base, to be based on NAD 83. At the county level, 97 of the state's 100 counties have switched from the previous official horizontal datum, NAD 27, to the current official horizontal datum, NAD 83, for referencing their mapping and photogrammetry products and the resulting coordinate-based Parcel Identification Number (PIN) determinations.

Although a county utilizing mapping products referenced to a different datum than its neighboring counties unnecessarily makes external relations with its neighboring counties more difficult (e.g. resolving an ambiguous county line), that county can still efficiently conduct internal mapping-based government tasks (e.g. property tax and PIN determinations). Yet, the mapping and photogrammetry products from the 2010 Statewide Orthoimagery Project (http://www.nconemap.net/NCOrthos/tabid/425/Default.aspx), which is being conducted to produce a seamless statewide dataset to expedite 911 responses, will be based on the latest NAD 83 adjustment, NAD 83(NSRS2007). Thus, the three (3) remaining counties that still utilize NAD 27 need to convert their spatial data and PIN determinations from NAD 27 to NAD 83 in order to utilize the statewide aerial imagery in their external and internal operations.

Purpose

The purpose of this issue paper is to assist the three remaining counties that still use NAD 27 for referencing their mapping products to convert to NAD 83 by providing the following information:

- Descriptive information of the NAD 27 and NAD 83 datums
- Datum shift information
- Datum shift ramifications [How NAD 83-based coordinates would affect the determination of a Parcel Identification Number (PIN)]
- Rationale for converting coordinates from NAD 27 to NAD 83
- Procedures for completing the conversion

Background

The first step to establishing a background is to refer to the NGS online Geodetic Glossary (http://www.ngs.noaa.gov/CORS-Proxy/Glossary/xml/NGS_Glossary.xml) in order to define the following terms (NGS, 2009):

Geodesy

1. The science concerned with determining the size and shape of the Earth. ….In practice, it is equivalent to determining, in some convenient coordinate system, the coordinates of points on the Earth's surface. For political and technological reasons, a large number of different coordinate systems are in use today.
2. The science that locates positions on the Earth and determines the Earth's gravity field.
3. The branch of surveying in which the curvature of the Earth must be taken into account when determining directions and distances.

Datum, horizontal control

A *geodetic datum* specifying the coordinate system in which horizontal control points are located.

Datums

Specific geodetic datums are usually given distinctive names. A name may consist of the name of the control station taken as the origin, the name of the region to which the datum applies, the name of the parallel or meridian along which the network controlled by the datum runs, etc. This is often followed by the year in which the datum was defined.

Datum, United States Standard

The name given on March 13, 1901 to the New England datum. Adjustment of geodetic networks in the United States had been done using a datum with origin at [the] MEADES RANCH [geodetic station, which is located in north central Kansas]. The final, adjusted coordinates differed so little from those in the earlier, New England datum, that the latter was retained but given a change of name. This name was later changed to North American Datum.

Datum, North American

The *horizontal control datum* that is defined by the following location and azimuth on the Clarke spheroid of 1866 [i.e. early mathematical model of the earth], with origin at [the] MEADES RANCH [geodetic station, which is located in north central Kansas]:

- Longitude: 98° 32’ 30.506” W
- Latitude: 39° 13’ 26.686 N
- Azimuth from MEADES RANCH to [station] WALDO: 75° 28’ 09.64”

North American Datum is identical with *United States standard datum:* the latter name was changed in 1913 when its adoption by the governments of Canada and of Mexico for their control surveys gave it an international character.

Background (continued)

Datum of 1927, North American (NAD 27)

The *horizontal control datum* that is defined by the following location and azimuth on the Clarke spheroid of 1866 [i.e. early mathematical model of the earth], with origin at [the geodetic station] MEADES RANCH [which is located in north central Kansas]:

- Longitude: 98° 32’ 30.506” W
- Latitude: 39° 13’ 26.686 N
- Azimuth from MEADES RANCH to [station] WALDO: 75° 28’ 09.64”

Geoidal height at MEADES RANCH is assumed to be zero.

Geodetic positions on the North American Datum of 1927 were derived from the above location and azimuth through a readjustment of the triangulation of the entire network….

Datum of 1983, North American (NAD 83)

The *horizontal control datum* for the United States, Canada, Mexico, and Central America based on a geocentric origin and the Geodetic Reference System 1980 [i.e. more recent mathematical model of the earth].

This datum, designated as NAD 83 …. [was implemented] in 1986 to replace the North American Datum of 1927. NAD 83 is based on the adjustment of 250,000 points including 600 satellite Doppler stations which constrain the system to a geocentric origin.

Ellipsoid, Reference

An ellipsoid of specified dimensions [i.e. mathematical model of the earth] and associated with a geodetic reference system or a geodetic datum.

Coordinates given in this system are said to be *"with respect to the reference ellipsoid."* Reference ellipsoids are most commonly ellipsoids of revolution (i.e., have two of three possible axes of equal length) and are sometimes called reference spheroids.

Background (continued)
Although NAD and NAD 27, which both had their origin at the MEADES RANCH geodetic station (Figure 1) and referenced the Clarke spheroid of 1866, sequentially served as the official horizontal datum for the United States, Canada, and Mexico for eight decades combined, the later datum (NAD 27) was replaced by a geocentric datum that referenced a more refined ellipsoid due to the following reasons (NGS, 2010):

- *"The horizontal control networks had expanded piecemeal since 1933 to cover much more of the countries and it was very difficult to add new surveys to the network without altering large areas of the previous network."*
- *"Field observations had added thousands of accurate Electronic Distance Measuring Instrument (EDMI) base lines, hundreds of additional points with astronomic coordinates and azimuths, and hundreds of Doppler satellite determined positions."*
- *"It was also recognized that the Clarke Ellipsoid of 1866 no longer served the needs of a modern geodetic network."*

Figure 1. The MEADES RANCH geodetic station. Left image: A brief explanation of the station's historical significance shown on its historical marker (NOAA, 1955). Right image: Two surveyors examining the actual station (NOAA, 1940 ca).

Background (continued)
NAD 83 provides a vastly improved horizontal reference datum than NAD 27 due to the following reasons (NCGS, 1996):

Parameter	**NAD 27**	**NAD 83**
Reference ellipsoid	Clarke Ellipsoid of 1866	Geodetic Reference System of 1980 (GRS 1980)
Datum point	MEADES RANCH triangulation station	Geocentric reference system with no datum point
Adjustment	• 25,000 points • Several hundred baselines • Several hundred astro azimuths	• 250,000 points • 30,000 baselines • 5,000 astro azimuths • Doppler point positions • Very long baseline interferometry
Best fitting	North America	World-wide
Data format	Paper	Paper and digital

The NGS readjustment project that created NAD 83 was started in 1974 and completed in 1986 (NOAA, 1989). NGS assigned the year "1983" to the datum, because observations from different years were modeled as if they were observed on December 31, 1983. In addition, NGS assigned the adjustment tag of "1986", because that was the year when the adjustment was conducted. Thus, the datum is more precisely labeled as "NAD 83(1986)" or by its "NAD 83/86" abbreviated name. For additional information on NAD 27 and NAD 83, please read the NOAA report on NAD 83 entitled, *"North American Datum of 1983"* (http://www.ngs.noaa.gov/PUBS_LIB/NADof1983.pdf).

Although NAD 83 was a major improvement over the NAD 27 datum, NGS has readjusted NAD 83 the following three (3) times since it was created in 1986 as a classic horizontal network to further refine it:

- NAD 83(1995):
  - Created a High Accuracy Reference Network (HARN) (http://www.ngs.noaa.gov/faq.shtml#WhatHARN) in each state

    Note: For a map of HARN stations in North Carolina, please visit: http://portal.ncdenr.org/web/lr/geodetic/maps/harn
- NAD 83(2001):
  - Created the Federal Base Network (FBN) (http://www.ngs.noaa.gov/PROJECTS/FBN/) and the Cooperative Base Network (CBN) (http://www.ngs.noaa.gov/INFO/OnePagers/One-Pager_CBN.pdf)
  - Used GPS observations and control from the NGS Continuously Operating Reference Station (CORS) Network
  - Increased ellipsoid height accuracy
- NAD 83(NSRS2007):
  - Used only quality GPS projects and control from the NGS CORS Network, which has improved since the 2001 readjustment with more stations, stricter base station antenna siting requirements, and improved receivers.
  - Removed discrepancies between the separate state HARNs

Datum shift

The implementation of NAD 83 shifted NAD 27 coordinate values by 10s of meters across the U.S. (Figure 2). In North Carolina, latitude coordinates shifted by 10 to 20 meters and longitude coordinates shifted by 10 to 35 meters.

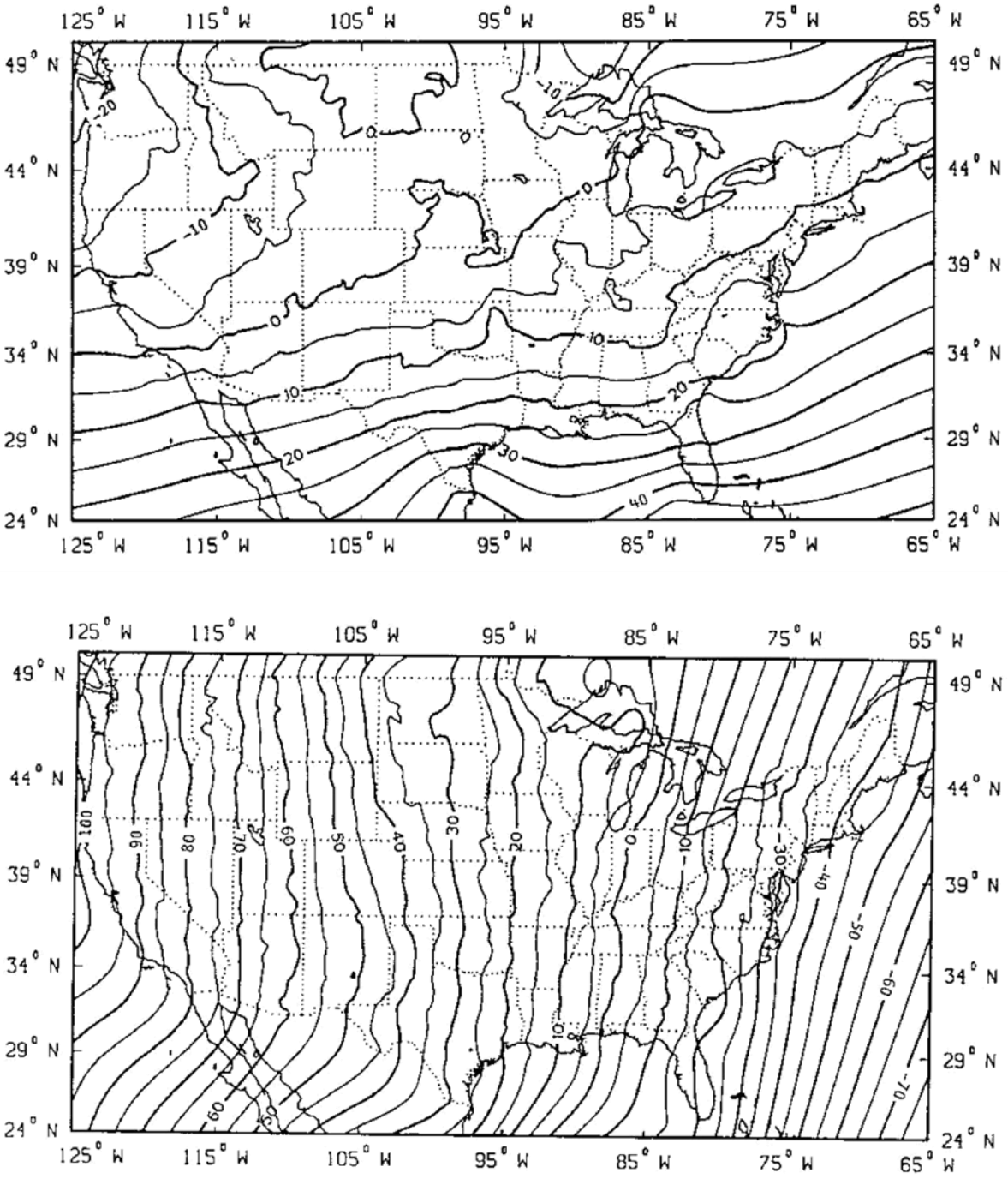


Figure 2. Datum shift (NAD 83 coordinates minus NAD 27 coordinates) across the conterminous U.S. (NOAA, 1989) Top image: Latitude datum shift in meters. Bottom image: Longitude datum shift in meters.

Datum shift (continued)
After the implementation of NAD 83/86, each succeeding readjustment shifted the coordinates from the previous datum by smaller and smaller amounts as the succeeding adjustments further refined the datum as shown in the following table (Table 1), which uses station SMITHPORT (EZ5525) in Johnston County as an example:

Datum	Northing (m)	Easting (m)	Northing difference (m) from the preceding datum	Easting difference (m) from the preceding datum
NAD 27	199,331.219	665,043.613		
NAD 83/86	199,354.569	665,067.183	23.350	23.570
NAD 83/95	199,354.397	665,067.513	-0.172	0.330
NAD 83/2001	199,354.384	665,067.503	-0.013	-0.010
NAD 83(NSRS2007)	199,354.377	665,067.499	-0.007	-0.004

Datum	Northing (USFT)	Easting (USFT)	Northing difference (USFT) from the preceding datum	Easting difference (USFT) from the preceding datum
NAD 27	653,972.51	2,181,897.25		
NAD 83/86	654,049.12	2,181,974.58	76.61	77.33
NAD 83/95	654,048.55	2,181,975.67	-0.56	1.08
NAD 83/2001	654,048.51	2,181,975.63	-0.04	-0.03
NAD 83(NSRS2007)	654,048.49	2,181,975.62	-0.02	-0.01

Table 1. Northing and easting datum shift (coordinates in a particular datum minus coordinates from the preceding datum) for station SMITHPORT (EZ5525) in Johnston County. Top table: Datum shift in meters. Bottom table: Datum shift in U.S. feet.

Across North Carolina, the coordinate shift from NAD 83/86 to NAD 83(NSRS2007) shifted the coordinates from 0.1 m (0.33 USFT) to 1.26 m (4.1 USFT) (Figure 3).

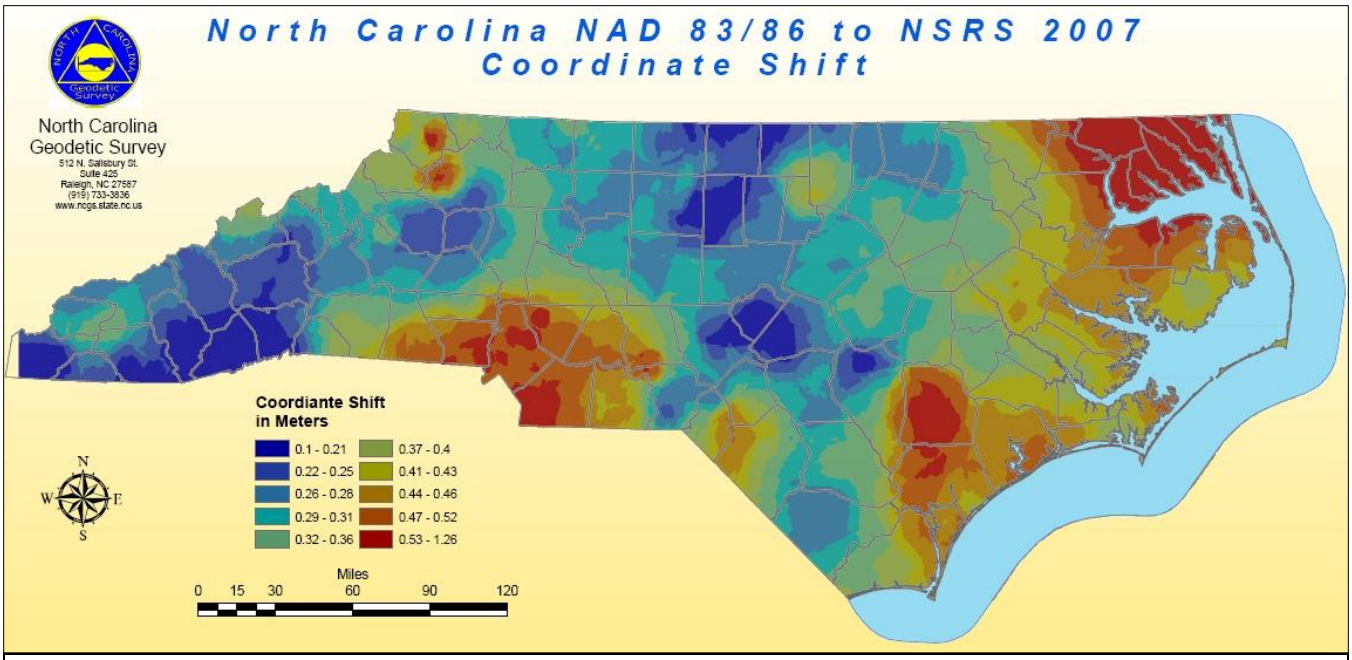


Figure 3. Coordinate shift (m) from NAD 83/86 to NAD 83(NSRS 2007) across North Carolina.

Datum shift ramifications

If the datum shift from NAD 27 to NAD 83 is measured in tens of meters while the datum shift from one NAD 83 adjustment to another NAD 83 adjustment is measured in tenths or hundredths of a meter, then the NAD 27 to NAD 83 datum shift would shift a parcel's center point coordinates beyond the extent of most home lots (Figure 4) and dramatically alter the determination of a Parcel Identification Number (PIN) (Table 2). In contrast, the datum shift from one NAD 83 adjustment to another NAD 83 adjustment would only further affect PIN determination in the ones position (i.e. 20 - 1685 - 13 - 8997 - XX), but would definitely be significant for land surveying applications.

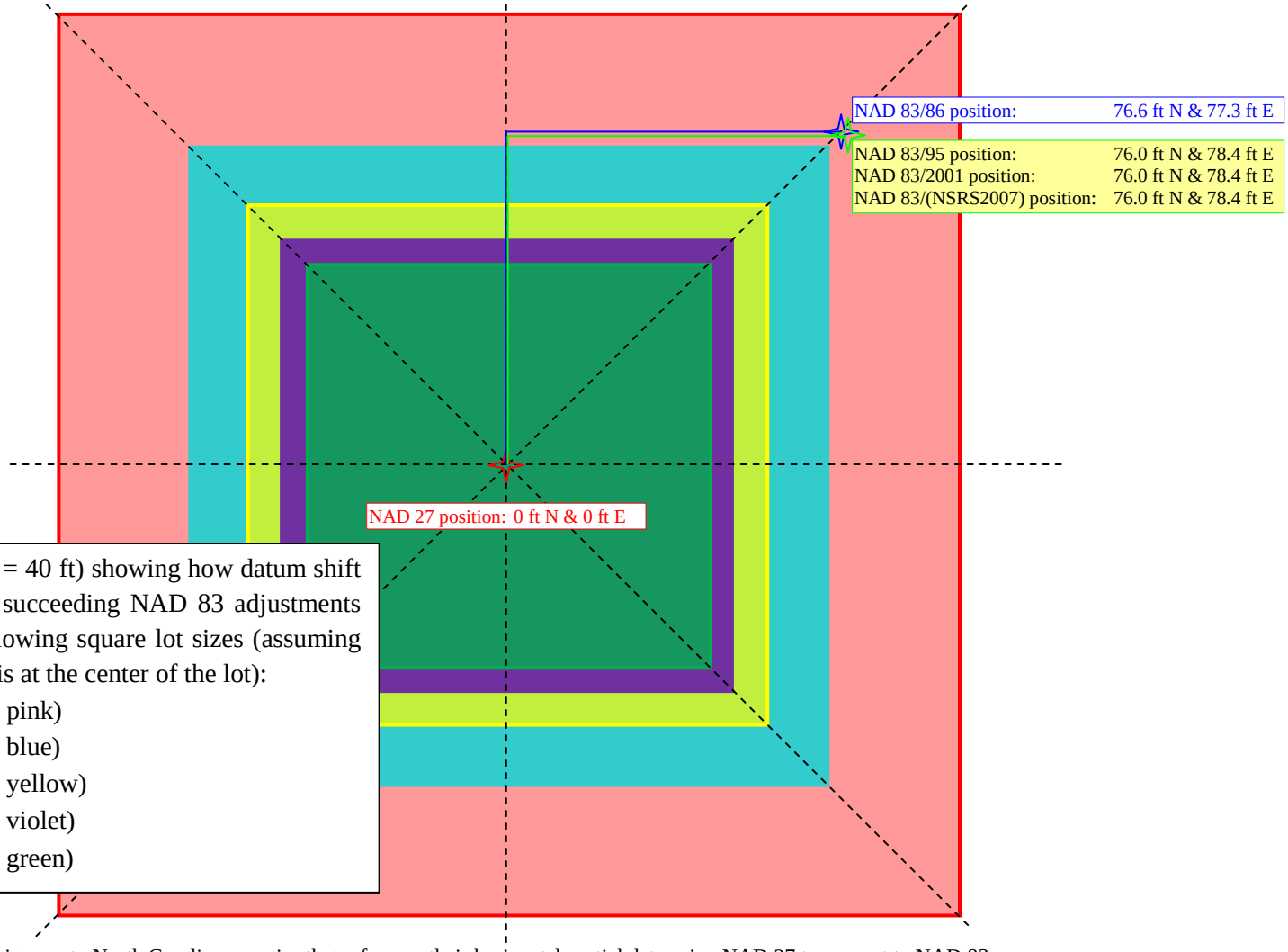


Figure 4. Scale drawing (1 inch = 40 ft) showing how datum shift from NAD 27 to the succeeding NAD 83 adjustments would plot on the following square lot sizes (assuming station SMITHPORT is at the center of the lot):

- 1 acre (shown in pink)
- 1/2 acre (shown in blue)
- 1/3 acre (shown in yellow)
- 1/4 acre (shown in violet)
- 1/5 acre (shown in green)

Datum shift ramifications (continued)

Station SMITHPORT (EZ5525)		Coordinate (2 decimal places)	Coordinate (whole number with leading 0 on northing) separated by the "|" symbol for PIN breakdown	PIN breakdown (based upon a digit's position in the easting and northing coordinate measured in U.S. feet)					PIN
				Millions position	100 thousands and 10 thousands positions	Thousands position	Hundreds and tens positions	Ones position	
NAD 27	Easting (X)	2,181,897.25	2|18|1|89|7	20	1685	13	8997	73	20 - 1685 - 13 - 8997 - 73
	Northing (Y)	653,972.51	0|65|3|97|3						
NAD 83/86	Easting (X)	2,181,974.58	2|18|1|97|5	20	1685	14	9074	59	20 - 1685 - 14 - 9074 - 59
	Northing (Y)	654,049.12	0|65|4|04|9						
NAD 83/95	Easting (X)	2,181,975.67	2|18|1|97|6	20	1685	14	9074	69	20 - 1685 - 14 - 9074 - 69
	Northing (Y)	654,048.55	0|65|4|04|9						
NAD 83/2001	Easting (X)	2,181,975.63	2|18|1|97|6	20	1685	14	9074	69	20 - 1685 - 14 - 9074 - 69
	Northing (Y)	654,048.51	0|65|4|04|9						
NAD 83(NSRS2007)	Easting (X)	2,181,975.62	2|18|1|97|6	20	1685	14	9074	68	20 - 1685 - 14 - 9074 - 68
	Northing (Y)	654,048.49	0|65|4|04|8						

Table 2. How datum shift from NAD 27 to the succeeding NAD 83 adjustments would affect Parcel Identification Number (PIN) determination [using station SMITHPORT (EZ5525) as an example]. The sections of the PIN that changed due to datum shift are highlighted.

For additional information on PIN determination, please visit the following web page:
http://www.hendersoncountync.org/ca/howpins.html

Datum shift ramifications (continued)
Since each county's GIS and Computer-Assisted Mass Appraisal (CAMA) are somewhat unique systems, there may be other factors beyond the ubiquitous PIN issue that need to be considered before implementing a conversion. Therefore, before a county that still utilizes NAD 27-based spatial data converts its NAD 27-based PINs to NAD 83-based PINs, it should thoroughly answer the following questions concerning the structure and data holdings of both its GIS and CAMA:

1. Does the CAMA store the GIS PIN attribute?
2. Does the CAMA store the GIS map number?
3. Does the PIN contain 2 digits for the map number (i.e. 1234-01-56-6789 where "1234-01" is 1"=100' map sheet/tile)?
4. Does the CAMA store a PIN reference to CONDOS, boat slips, double-wides, leaseholds, etc. (i.e. 1234-56-7890.**001**)?
5. Does the GIS store a point feature for the location of each parcel PIN and is that location based on the PIN?
6. Does the GIS store condos, boat slips, double-wides, leasholds, etc. as polygon features?
7. Does the county wish to retain tax map numbers in old (NAD 27) and/or new (NAD 83) grid system?
8. Does the county need to produce paper/hardcopy maps to North Carolina state specifications?
9. Does the GIS store each parcel as a single record (i.e. multipart polygons can exist)?
10. Does the GIS parcel polygon layer contain attribute for a CAMA primary key (or another parcel ID) as well as a PIN?
11. Is the county more rural than urban? What is the percentage of parcels greater than 5 acres?
12. Are PINs referenced in deeds?
13. Does the northing and/or easting extent of the county straddle a 1,000,000 USFT block? For additional information, please peruse the figure and table in the Appendix.

If a county that still utilizes NAD 27-based spatial data answered "Yes" to any of the above questions, it should first evaluate the impact of changing to NAD 83 and develop a solution to the issue before converting. For assistance on developing a solution to any of the above questions, please contact either:

Gary W. Thompson
North Carolina Geodetic Survey
20323 Mail Service Center
Raleigh, NC 27699-0323

Tele: 919-733-3836
Fax: 919-733-4407
Email: gary.thompson@ncdenr.gov
Web: http://portal.ncdenr.org/web/lr/geodetic

Tom Morgan
Land Records Management Section
P. O. Box 29626
Raleigh, NC 27626-0626

Tele: 919-807-2219
Fax: 919-807-2210
Email: tmorgan@sosnc.com
Web: http://www.secretary.state.nc.us/land/

The conversion process can be automated with a script that examines each parcel in the county's database, computes the northing and easting coordinates of the parcel's centroid from its NAD 27-based PIN, converts the PIN-derived centroid coordinates from NAD 27 to NAD 83, and then determines if the NAD 83 PIN-derived centroid coordinates plot within the parcel's NAD 83 polygon. The script would then flag any rejected PIN for manual review and editing.

Rationale for a county to convert its spatial data from NAD 27 to NAD 83

Due to the inadequacies of the nation's former horizontal control network (NAD 27), NGS spent 12 years from 1974 to 1986 creating the vastly improved horizontal datum (NAD 83). In 1989, the Federal Government formally adopted this new datum, which caused agencies at the federal, state, county, and municipal level as well as private organizations and companies to follow suit:

- The Federal *Geographic Information Framework Data Content Standard: Part 2 Digital Orthoimagery* (http://www.fgdc.gov/standards/projects/FGDC-standards-projects/framework-data-standard/GI_FrameworkDataStandard_Part2_DigitalOrthoimagery.pdf/view) stipulated either NAD 83 or the World Geodetic System 1984 (WGS84) as the horizontal datum for framework digital orthoimagery (FGDC, 2008).
- The Official Survey Base of North Carolina (§102) is referenced to NAD 83 (Official Survey Base, 2005)
- The North Carolina Geographic Information Coordinating Council (NCGICC) established NAD 83 as the state standard horizontal reference datum in 1998 (NCGICC, 2006)
- The North Carolina Technical Specifications for Digital Ortho Base Mapping (http://www.ncgicc.org/Portals/3/documents/Tech_Specs_Digital_Orthophoto_Base_Map_100109.pdf), which was adopted by the North Carolina Department of the Secretary of State on October 1, 2009, is a NAD 83(NSRS2007) based document (Land Records Management Division, 2009).
- Ninety seven (97) North Carolina counties have adopted NAD 83 as the reference datum for their respective county's horizontal spatial data.

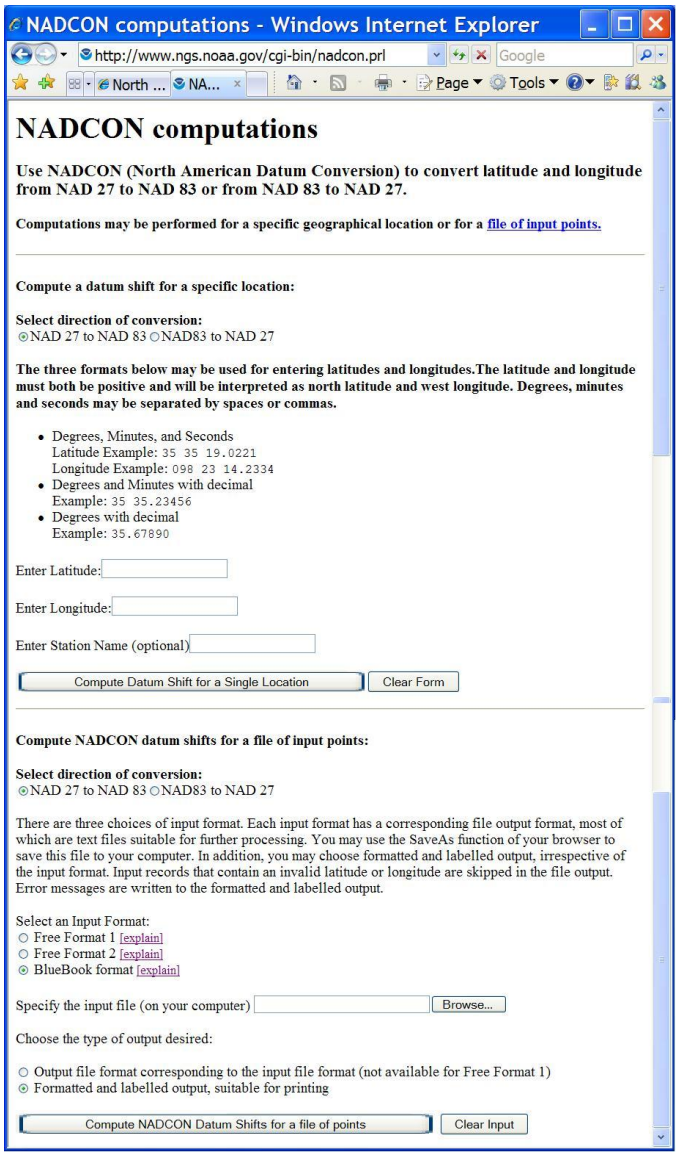
Thus, if a county that had previously referenced its spatial data to NAD 27 made the transition to NAD 83, then it could easily use/share (without performing a datum transformation) mapping and photogrammetry products from:

- Adjoining counties
- Federal agencies
- State agencies including the 2010 Statewide Orthoimagery Project
- Land surveyors

Available tools to convert spatial data from NAD 27 to NAD 83

A North Carolina county may use the following three (3) free resources to convert its NAD 27-based spatial data to NAD 83/86 and NAD 83(1995) (i.e. the North Carolina HARN):

- **North American Datum Conversion Utility (NADCON)**
  - Developed by NGS
  - Online coordinate conversion (http://www.ngs.noaa.gov/TOOLS/Nadcon/Nadcon.shtml) from either:
    - NAD 27 to NAD 83/86 or NAD 83/86 to NAD 27 (http://www.ngs.noaa.gov/cgi-bin/nadcon.prl) (Figure 5 left image)
    - NAD 83/86 to a state's High Precision Geodetic Network (HPGN) (i.e. HARN) or HPGN to NAD 83/86 (http://www.ngs.noaa.gov/cgi-bin/nadcon2.prl) (Figure 5 right image)
  - Spatial data format: Only Geographic coordinates in Degrees Minutes Seconds (DMS), Degrees Decimal Minutes (DDM), or Decimal Degrees (DD)
  - Input: Single point (station) or multiple points using an input file



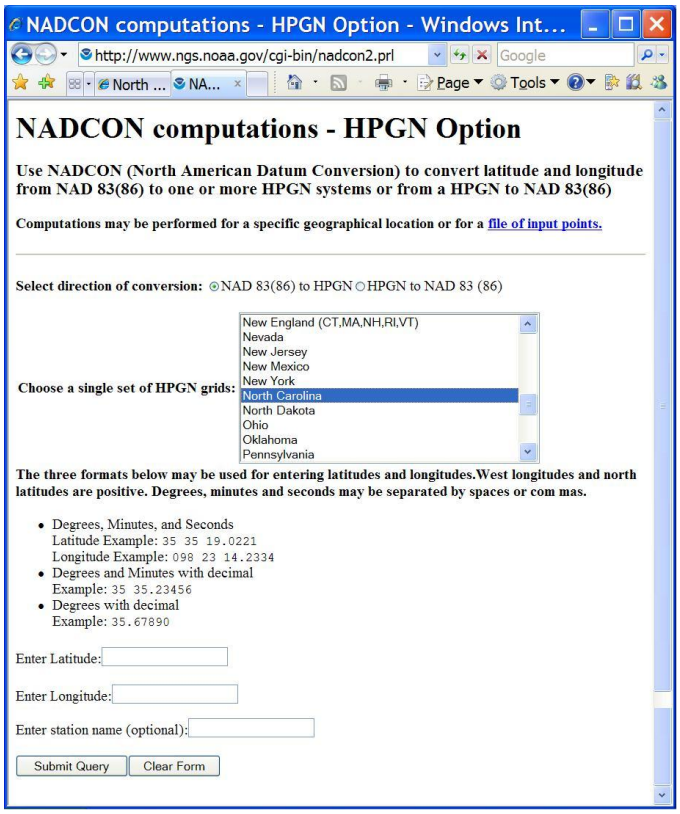


Figure 5. The online North American Datum Conversion (NADCON) coordinate conversion program. Left image: Screen shot for converting from either NAD 27 to NAD 83 or NAD 83 to NAD 27. Right image: Screen shot for converting from NAD 83/86 to a state's High Precision Geodetic Network (HPGN) (i.e. HARN) or a state's HPGN to NAD 83/86.

Available tools to convert spatial data from NAD 27 to NAD 83 (continued)

- **ShapeNADCON or the Shapefile Datum Conversion Tool**
  - Developed by the NOAA Coastal Services Center (http://www.csc.noaa.gov/products/shapenadcon/)
  - Stand-alone Windows program (Figure 6) and an ArcView 3.x extension that converts Environmental Systems Research Institute (ESRI) shapefiles from NAD 27 or a designated island datum to NAD 83(86) or vice versa.
  - Spatial data format: Only Geographic coordinates. Note: The native format for an ESRI shapefile is decimal degrees (DD).
  - Utilizes NADCON grids and interpolation methods

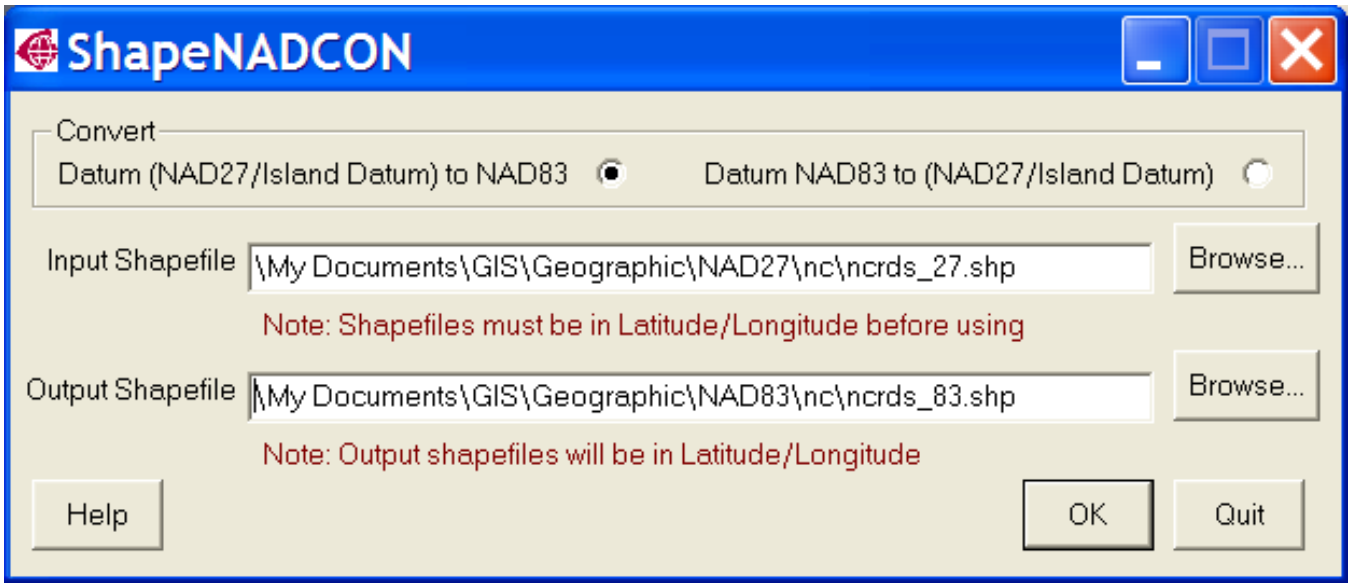
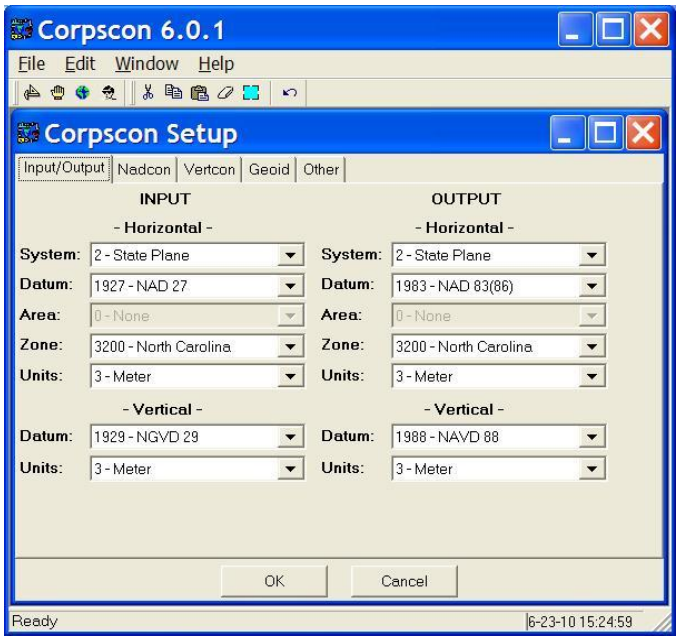
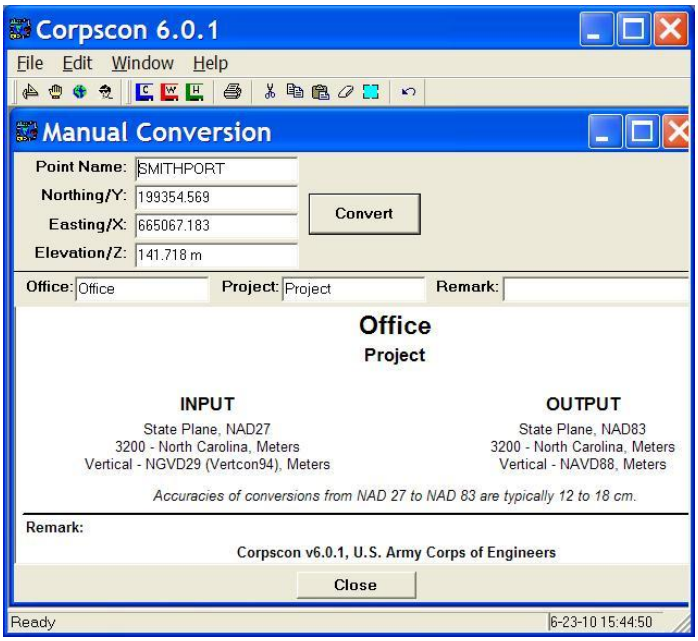


Figure 6. The ShapeNADCON user-interface to select a datum conversion direction (either NAD 27/Island Datum to NAD 83(86) or NAD 83(86) to NAD 27/Island Datum) and the field to select an input shapefile and field to place the resulting output shapefile.

Available tools to convert spatial data from NAD 27 to NAD 83 (continued)

- **Corpscon**
  - Developed by the U.S. Army Corps of Engineers (USACE)
  - Free Windows program (http://crunch.tec.army.mil/software/corpscon/corpscon.html) that converts (Figure 7):
    - Horizontal coordinates between Geographic, State Plane, Universal Transverse Mercator (UTM), and US National Grid systems on either NAD 27, NAD 83, or HARN.
    - Elevation values between the National Geodetic Vertical Datum of 1929 (NGVD 29) and the North American Vertical Datum of 1988 (NAVD 88)





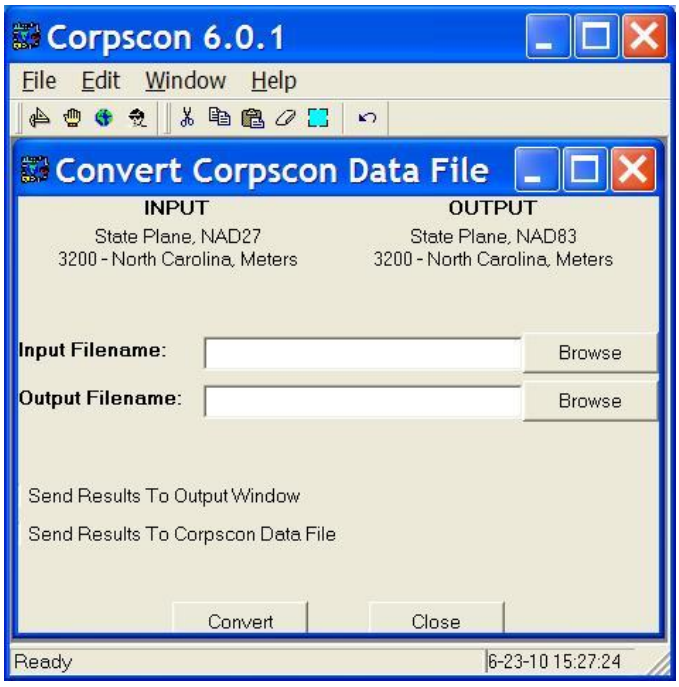


Figure 7. Dialog boxes from Corpscon 6.0.1:
- Top left: Setup dialog box to convert coordinates from NAD 27 horizontal and NGVD 29 vertical to NAD 83(86) horizontal and NAVD 88 vertical.
- Top right: Manual conversion dialog box to convert the coordinates one station at time
- Lower left: Data file dialog box to convert the coordinates from multiple stations at a time.

Available tools to convert spatial data from NAD 27 to NAD 83 (continued)

- **Corpscon** (continued)
  - Utilizes the NGS NADCON program for the horizontal conversions

    Note: USACE did not include the North Carolina and South Carolina HPGN files (i.e. NAD 83/2001), because these coordinates were not being published when the program was released. However, NCGS has since published the NAD 83/2001 positions and has recently requested USACE to include the North Carolina HPGN files (NCHPGN.LAS & NCHPGN.LOS) in their download package. In the meantime, these grid files (NCHPGN.LAS & NCHPGN.LOS) can be downloaded from either:

    - NGS NADCON PC Software download page (www.ngs.noaa.gov/PC_PROD/NADCON/), and then extracted with a Zip program
    - NCGS ftp site (ftp://geodetic.ncdenr.org/requests/Corpscon/)

    These downloaded files then need to be placed into the following directory:

    C:\Program Files\Corpscon6\Nadcon

    If the missing North Carolina or South Carolina grid files are added to a Corpscon's NADCON subdirectory (C:\Program Files\Corpscon6\Nadcon), the Corpscon program will need "North Carolina" and "South Carolina" added to the file that provides the dropdown list of state HARNs (hpgn_areas.dat), which can be downloaded from the NCGS Corpscon ftp folder (ftp://geodetic.ncdenr.org/requests/Corpscon/) and inserted into the following directory:

    C:\Program Files\Corpscon6

    Note: At the present time, NGS does not plan to provide the models needed by Corpscon to obtain NAD 83(NSRS2007) positions. However, NCGS will provide assistance to local governments wanting to convert coordinates to NAD 83(NSRS2007) positions.

References:

Affirmation of Datum for Surveying and Mapping Activities. 54 Federal Register 25318 (June 14, 1989). Retrieved from http://www.ngs.noaa.gov/PUBS_LIB/FedRegister/FRdoc89-14076.pdf

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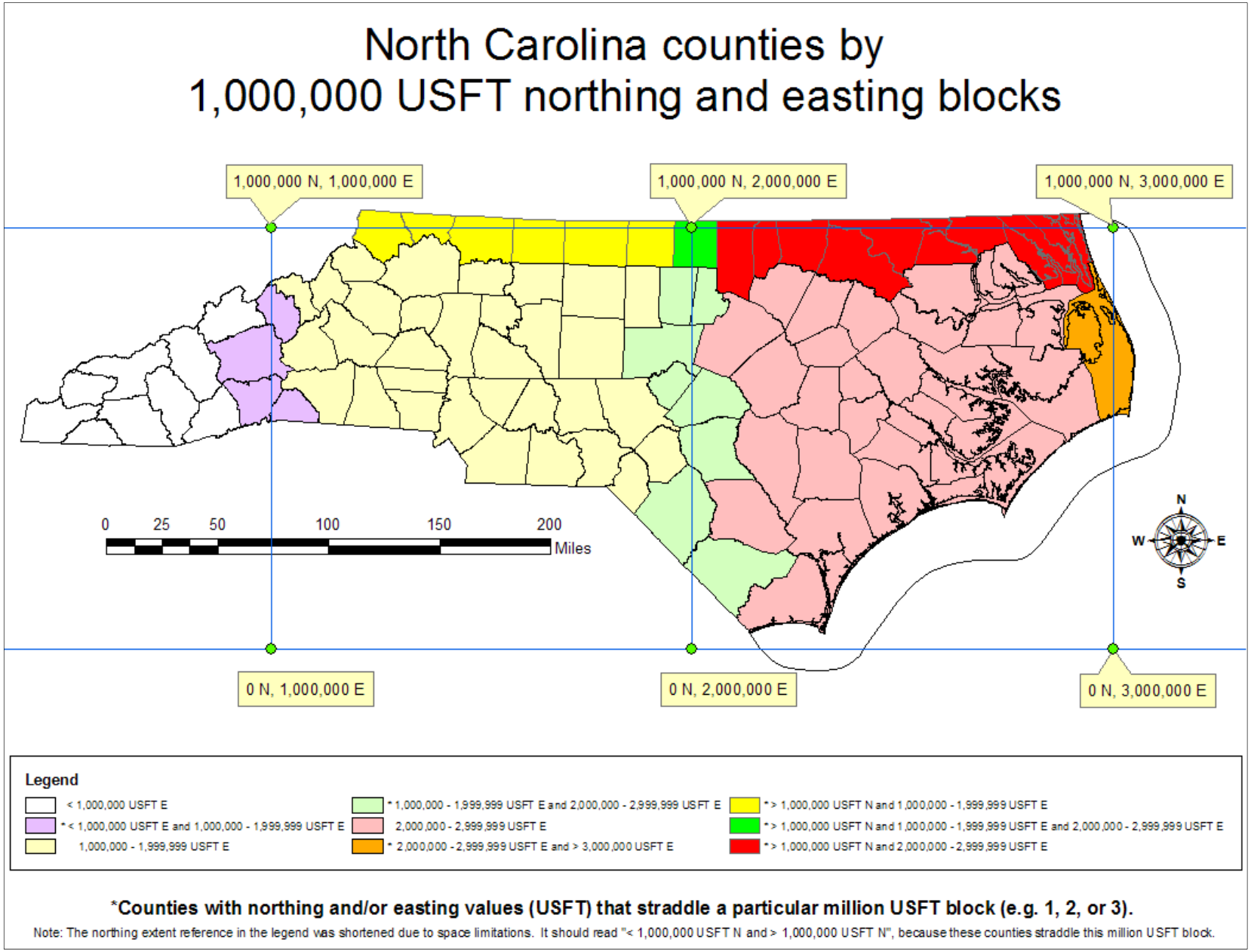
Appendix

Does the northing and/or easting extent of a county straddle a 1,000,000 USFT block?

Figure 1. North Carolina counties that straddle a 1,000,000 USFT block (e.g. 1, 2, or 3) in northing and/or easting extent.



***Counties with northing and/or easting values (USFT) that straddle a particular million USFT block (e.g. 1, 2, or 3).**

Note: The northing extent reference in the legend was shortened due to space limitations. It should read "< 1,000,000 USFT N and > 1,000,000 USFT N", because these counties straddle this million USFT block.

Table 1. The northing and easting extent of North Carolina counties by 1,000,000 USFT block (e.g. 1, 2, or 3).

	Northing		**Easting**			
County	**≥ 1,000,000**		**< 1,000,000**	**1,000,000 - 1,999,999**	**2,000,000 - 2,999,999**	**≥ 3,000,000**
< 1,000,000 USFT E						
Cherokee			Y			
Clay			Y			
Graham			Y			
Haywood			Y			
Jackson			Y			
Macon			Y			
Madison			Y			
Swain			Y			
Transylvania			Y			
***< 1,000,000 USFT E and 1,000,000 - 1,999,999 USFT E**						
Buncombe			Y	Y		
Henderson			Y	Y		
Polk			Y	Y		
Yancey			Y	Y		
1,000,000 - 1,999,999 USFT E						
Alamance				Y		
Alexander				Y		
Anson				Y		
Avery				Y		
Burke				Y		
Cabarrus				Y		
Caldwell				Y		
Catawba				Y		
Cleveland				Y		
Davidson				Y		
Davie				Y		
Forsyth				Y		
Gaston				Y		
Guilford				Y		
Hoke				Y		
Iredell				Y		
Lincoln				Y		
McDowell				Y		
Mecklenburg				Y		
Mitchell				Y		
Montgomery				Y		
Moore				Y		
Randolph				Y		
Richmond				Y		
Rowan				Y		
Rutherford				Y		
Scotland				Y		
Stanly				Y		
Union				Y		
Watauga				Y		
Wilkes				Y		
Yadkin				Y		

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	Northing		Easting			
County	**≥ 1,000,000**		**< 1,000,000**	**1,000,000 - 1,999,999**	**2,000,000 - 2,999,999**	**≥ 3,000,000**
***1,000,000 - 1,999,999 USFT E and 2,000,000 - 2,999,999 USFT E**						
Chatham				Y	Y	
Columbus				Y	Y	
Cumberland				Y	Y	
Durham				Y	Y	
Harnett				Y	Y	
Lee				Y	Y	
Orange				Y	Y	
Robeson				Y	Y	
2,000,000 - 2,999,999 USFT E						
Beaufort					Y	
Bertie					Y	
Bladen					Y	
Brunswick					Y	
Carteret					Y	
Chowan					Y	
Craven					Y	
Duplin					Y	
Edgecombe					Y	
Franklin					Y	
Greene					Y	
Hyde					Y	
Johnston					Y	
Jones					Y	
Lenoir					Y	
Martin					Y	
Nash					Y	
New Hanover					Y	
Onslow					Y	
Pamlico					Y	
Pender					Y	
Perquimans					Y	
Pitt					Y	
Sampson					Y	
Tyrrell					Y	
Wake					Y	
Washington					Y	
Wayne					Y	
Wilson					Y	

Table continued on the next page.

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	Northing		Easting			
County	**≥ 1,000,000**		**< 1,000,000**	**1,000,000 - 1,999,999**	**2,000,000 - 2,999,999**	**≥ 3,000,000**
***2,000,000 - 2,999,999 USFT E and > 3,000,000 USFT E**						
Dare					Y	Y
***> 1,000,000 USFT N and 1,000,000 - 1,999,999 USFT E**						
Alleghany	Y			Y		
Ashe	Y			Y		
Caswell	Y			Y		
Rockingham	Y			Y		
Stokes	Y			Y		
Surry	Y			Y		
***> 1,000,000 USFT N and 1,000,000 - 1,999,999 USFT E and 2,000,000 - 2,999,999 USFT E**						
Person	Y			Y	Y	
***> 1,000,000 USFT N and 2,000,000 - 2,999,999 USFT E**						
Camden	Y				Y	
Currituck	Y				Y	
Gates	Y				Y	
Granville	Y				Y	
Halifax	Y				Y	
Hertford	Y				Y	
Northampton	Y				Y	
Pasquotank	Y				Y	
Vance	Y				Y	
Warren	Y				Y	