Frequently Asked Questions (FAQs) regarding NAD 83(NSRS2007)

1. Why is the readjustment important?

   The National Geodetic Survey (NGS) readjusted 67,693 GPS survey control points in the U.S. to the nationwide CORS network to:

   - Resolve inconsistencies between each state's statewide HARN adjustments.

   - Develop individual local and network accuracy estimates for each station in the network as required by the Federal Geographic Data Committee (FGDC) Draft Geospatial Positioning Accuracy Standards (FGDC 1998).

   Geospatial Positioning Accuracy Standards Part 2: Standards for Geodetic Networks (FGDC-STD-007.2-1998)
   http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part2/chapter2

2. What do the components "NAD 83", "NSRS", and "2007" mean in the name "NAD 83(NSRS2007)"?

   NAD 83(NSRS2007) is the readjustment of the North American Datum of 1983 (NAD 83) that was completed in 2007 that adjusted 67,693 GPS control points in the U.S. National Spatial Reference System (NSRS) to the Nationwide Continuously Operating Reference Stations (CORS) network.

   North American Datum of 1983:

   - Horizontal control datum (set of constants specifying the coordinate system used for calculating coordinates for points on the earth) for the United States, Canada, Mexico, and Central America

   - Based on a geocentric origin and the Geodetic Reference System of 1980 (GRS 80) ellipsoid

   - Based on 250,000 stations

   - Implemented in 1986 to be compatible with modern surveying techniques

   National Spatial Reference System (NSRS): The consistent coordinate system managed and defined by NGS that defines latitude, longitude, height, scale, gravity, and orientation throughout the U.S. In addition, the NSRS comprises:

   - Consistent, accurate, and up-to-date national shoreline

   - Network of Continuously Operating Reference Stations (CORS), which supports 3-dimensional positioning activities

   - Network of permanently marked points

   - Set of accurate models describing dynamic, geophysical processes that affect spatial measurements

   2007: The year that the readjustment was completed.

3. What datums are involved in the readjustment?

   The adjustment involves two different datums: NAD 83 and the International Terrestrial Reference Frame (ITRF). The origin of both datums is at the mass center of the Earth, including oceans and the atmosphere, but the definition of each datum's origin is different.

4. What is International Terrestrial Reference Frame (ITRF)?

   The International Terrestrial Reference Frame (ITRF) is a realization by a set of coordinates and velocities of reference points on the Earth. ITRF positions are generally determined with an accuracy of a few centimeters or better, even over continental or global distances. At this level of accuracy, tectonic plate motion (continental drift) and other forms of crustal motion must be taken into account. The use of ITRF positional coordinates is appropriate for those applications demanding the highest accuracy obtainable.

5. Were the NAVD 88 (North American Vertical Datum of 1988) elevations adjusted as part of the NAD 83(NSRS2007) adjustment?

   No, the NAVD 88 elevation was not adjusted as part of the NAD 83(NSRS2007) horizontal adjustment.

6. What is an ellipsoid height?

   An ellipsoid height is the vertical distance from a point to the reference ellipsoid along a line normal (perpendicular) to the ellipsoid.

7. Were the ellipsoid height of each mark involved in NAD 83(NSRS2007) readjustment adjusted?
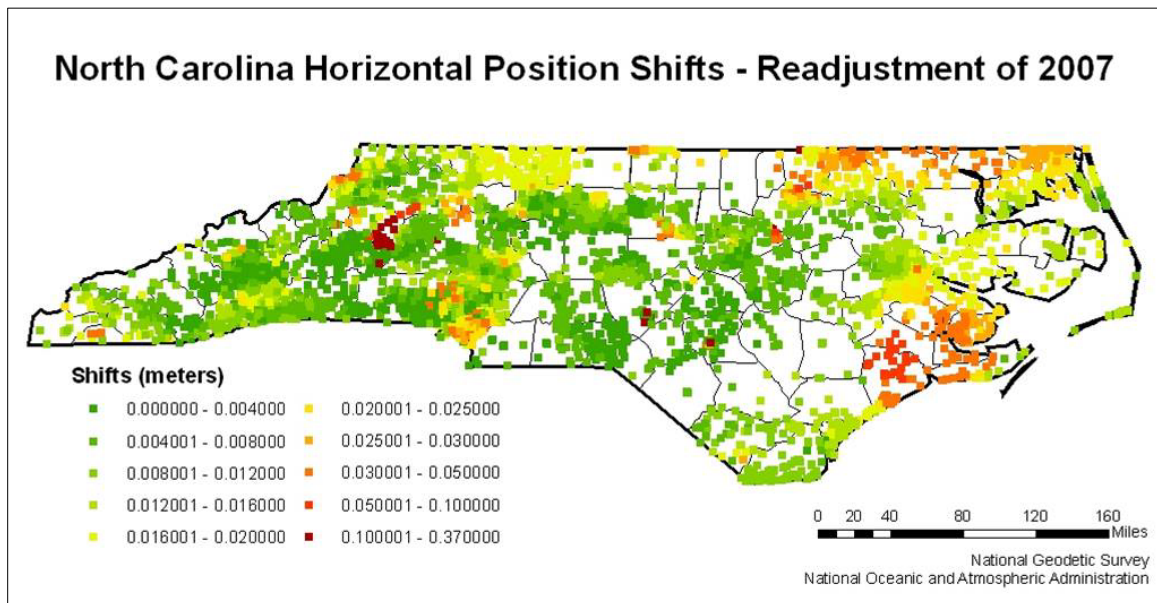
   Yes, the ellipsoid height of each mark involved in the readjustment was adjusted.

8. What is the horizontal positional shift in the NC State Plane Coordinate System between: NAD 83/86, NAD 83/95, NAD 83/2001, and NAD 83(NSRS2007)?

At station SMITHPORT (EZ5525) in Johnston County, the differences range from 0.004 m to 0.330 m.

Station: SMITHPORT (EZ5525)					
		Difference Northing (m)			
Adjustment		83/86	83/95	83/2001	83 (NSRS2007)
	Northing (m)	199,354.569	199,354.397	199,354.384	199,354.377
83/86	199,354.569	0.000			
83/95	199,354.397	0.172	0.000		
83/2001	199,354.384	0.185	0.013	0.000	
83 (NSRS2007)	199,354.377	0.192	0.020	0.007	0.000
		Difference Easting (m)			
Adjustment		83/86	83/95	83/2001	83 (NSRS2007)
	Easting (m)	665,067.183	665,067.513	665,067.503	665,067.499
83/86	665,067.183	0.000			
83/95	665,067.513	-0.330	0.000		
83/2001	665,067.503	-0.320	0.010	0.000	
83 (NSRS2007)	665,067.499	-0.316	0.014	0.004	0.000

Note: The above table is an example for one (1) mark only. On a statewide scale, the differences between NAD 83/2001 and NAD 83(NSRS2007) can be seen on the following map:

North Carolina Horizontal Position Shifts - Readjustment of 2007

Shifts (meters)
- 0.000000 - 0.004000
- 0.004001 - 0.008000
- 0.008001 - 0.012000
- 0.012001 - 0.016000
- 0.016001 - 0.020000
- 0.020001 - 0.025000
- 0.025001 - 0.030000
- 0.030001 - 0.050000
- 0.050001 - 0.100000
- 0.100001 - 0.370000

0 20 40   80   120   160 Miles

National Geodetic Survey
National Oceanic and Atmospheric Administration

9. How are coordinates produced for the new adjustment?

National Geodetic Survey (NGS) publishes coordinates in NAD 83(NSRS2007) and will later in both NAD 83(NSRS2007) and ITRF. NGS will use published transformation methods to transform each station's coordinates from the assumed stationary-based NAD83 datum to the dynamic, plate tectonic-based ITRF by adding a velocity vector component to the coordinates. Therefore, even a station on the stable North American plate will have a velocity vector component in its ITRF set of coordinates, because the North American plate moves in the global reference frame.

10. What are the overall goals of the new readjustment?

- Replace the current state-by-state HARN adjustment system, which produced a bewildering number of adjustment tags, with a nationwide adjustment system, so that all survey points in the NSRS will have the same adjustment tag.

- Remove any residual differences between NAD83 (CORS) positions that are produced by the NGS OPUS (Online Positioning User Service) utility and the various statewide HARN adjustments.

- Allow implementation of FGDC standards requiring each station to have individual estimates of local and network accuracies.

11. What is the difference between Local Accuracy and Network Accuracy?

Local accuracy of a control point

- A value that represents the uncertainty of its coordinates relative to other directly connected, adjacent control points at the 95% confidence level.

- An approximate average of the individual local accuracy values between a particular control point and other observed control points used to establish its coordinates.

Network accuracy of a control point

- A value that represents the uncertainty of its coordinates with respect to the geodetic datum, which is best expressed by the Continuously Operating Reference Stations (CORS) network at the 95% confidence level

NOTE: Both Local and Network accuracy values at CORS sites are considered to be infinitesimal (approaching zero). These accuracies will be implemented with the National Readjustment.

12. What control was used for the NAD 83(NSRS2007) adjustment?

Control for the NAD 83(NSRS2007) adjustment was provided by the CORS in each state in NAD 83 (epoch 2002.0), except for the following states that are located over unstable tectonic plates: Alaska (AK), Arizona (AZ), California (CA), Nevada (NV), Oregon (OR), and Washington (WA).

- In California, control for the readjustment was provided by the California CORS (CGPS) and the National CORS in epoch 2007 and is currently available online from the California Spatial Reference Center (CSRC) website: **(http://csrc.ucsd.edu)**.

- As for the remaining active tectonic plates listed (e.g. AK, AZ, NV, OR, and WA), control was provided by the CORS in NAD 83 (epoch 2007.0) by using Horizontal Time Dependent Positioning (HTDP) to convert from the previously published NAD 83 positions to NAD 83 (epoch 2007.0).

  NOTE: For future projects located in AZ, AK, CA, NV, OR, WA, HTDP will still be required to correct any velocities associated with the published control.

13. What is Horizontal Time Dependent Positioning (HTDP)?

Horizontal Time Dependent Positioning (HTDP): An NGS developed software package **(www.ngs.noaa.gov/TOOLS/htdp/htdp.html)** that enables users to predict horizontal displacements and/or horizontal velocities related to crustal motion in the United States and its territories. The software also enables users to update positional coordinates and/or geodetic observations to a user-specified date. HTDP supports these activities for coordinates in:

- North American Datum of 1983 (NAD 83)

- All official realizations of the International Terrestrial Reference Frame (ITRF).

- All official realizations of the World Geodetic System of 1984 (WGS-84)

Thus, this software may be used to transform geodetic coordinates between any pair of these reference frames (NAD 83, ITRF, or WGS 84) in a manner that rigorously addresses differences among the definitions of their respective velocity fields.

14. The Online Positioning User Service (OPUS) provides horizontal positions in North Carolina in which datum?

The Online Positioning User Service (OPUS) provided horizontal position information in both NAD 83 (CORS 96) (EPOCH:2002) $\cong$ NAD 83(NSRS2007) in North Carolina and ITRF 00 (EPOCH: current date).

OPUS provides height information in two forms (please see the OPUS output on the next page)

- Ellipsoid Height referenced to the NAD 83 ellipsoid

- Orthometric Height Referenced to the North American Vertical Datum of 1988 (NAVD 88)

FILE: ncbe326a.07o 000261349

 1008   NOTE: Antenna offsets supplied by the user were zero. Coordinates
 1008   returned will be for the antenna reference point (ARP).
 1008
                        NGS OPUS SOLUTION REPORT
                        ========================

USER: gary.thompson@ncmail.net   DATE: December 04, 2007
RINEX FILE: ncbe326a.07o   TIME: 03:48:15 UTC

SOFTWARE: page5 0612.06 master10.pl   START: 2007/11/22 00:00:00
EPHEMERIS: igr14544.eph [rapid]   STOP: 2007/11/22 04:59:00
  NAV FILE: brdc3260.07n   OBS USED: 12568 / 12986 :
97%
   ANT NAME: TRM55971.00   NONE   # FIXED AMB: 65 / 65 :100%
ARP HEIGHT: 0.0   OVERALL RMS: 0.017(m)

   REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)   ITRF00(EPOCH:2007.8907)

X: 1209852.559(m)   0.016(m)   1209851.851(m)   0.016(m)
Y: -5106864.755(m)   0.013(m)   -5106863.255(m)   0.013(m)
Z: 3612274.171(m)   0.007(m)   3612274.026(m)   0.007(m)

LAT: 34 43 8.50917   0.011(m)   34 43 8.53530   0.011(m)
E LON: 283 19 41.00794 0.017(m)   283 19 40.99446   0.017(m)
W LON: 76 40 18.99206 0.017(m)   76 40 19.00554   0.017(m)
EL HGT: -27.844(m)   0.004(m)   -29.261(m)   0.004(m)
ORTHO HGT: 9.631(m)   0.025(m) [Geoid03 NAVD88]

                        UTM COORDINATES   **STATE PLANE COORDINATES**
                        UTM (Zone 18)   **SPC (3200 NC)**
Northing (Y) [meters]   3843157.754   **109995.829**
Easting (X) [meters]   346905.135   **822811.690**
Convergence [degrees]   -0.95244413   1.34368569
Point Scale   0.99988889   0.99991552
Combined Factor   0.99989326   0.99991989

US NATIONAL GRID DESIGNATOR: 18SUD4690543158(NAD 83)

                        BASE STATIONS USED
PID   DESIGNATION   LATITUDE   LONGITUDE
DISTANCE(m)
AM7011 CASL CASTLE HAYNE CORS ARP   N342040.707 W0775231.382
118027.2
AJ2915 WASR WASHINGTON CORS ARP   N353334.802 W0770331.543
99701.2
DI4788 NBR6 NEW BERN 6 CORS ARP   N351029.898 W0770259.335
61236.6

            NEAREST NGS PUBLISHED CONTROL POINT
EA1896   PIVERS ISLAND   N344309.338 W0764021.256
63.0

This position and the above vector components were computed without any
knowledge by the National Geodetic Survey regarding the equipment or
field operating procedures used.

15. What is metadata?

A metadata record of information, usually presented as an XML document, which captures the basic characteristics of a data or information resource. It represents the who, what, when, where, why and how of the data resource. Geospatial metadata are used to document geographic digital resources such as Geographic Information System (GIS) files, geospatial databases, and earth imagery. A geospatial metadata record includes the following:

- Core library catalog elements such as Title, Abstract, and Publication Data;

- Geographic elements such as Geographic Extent and Projection Information

- Database elements such as Attribute Label Definitions and Attribute Domain Values.

(http://www.fgdc.gov/metadata)

16. Are NAD 83(CORS 96) Epoch 2002 and NAD 83(2007) the same?

NGS has adopted a realization of NAD 83 called NAD 83(NSRS2007) for the distribution of coordinates at ~ 70,000 passive geodetic control monuments. This realization *approximates* the more rigorously defined NAD 83(CORS 96) realization in which Continuous Operating Reference Station (CORS) coordinates are distributed. NAD 83(NSRS2007) was created by adjusting GPS data collected during various campaign-style geodetic surveys performed between the mid-1980s and 2005. For the 2007 adjustment, NAD 83(CORS 96) positional coordinates for ~700 CORS were held fixed (predominantly at the 2002.0 epoch for the stable North American plate, but 2007.0 epoch in Alaska and western CONUS) to obtain consistent positional coordinates for the ~70,000 passive marks. **NAD 83(NSRS2007) positional coordinates will be consistent with corresponding NAD 83(CORS 96) positional coordinates to within the accuracy of the GPS data used in the adjustment and the accuracy of the corrections applied to these data for systematic errors, such as refraction.**