National Geodetic Survey

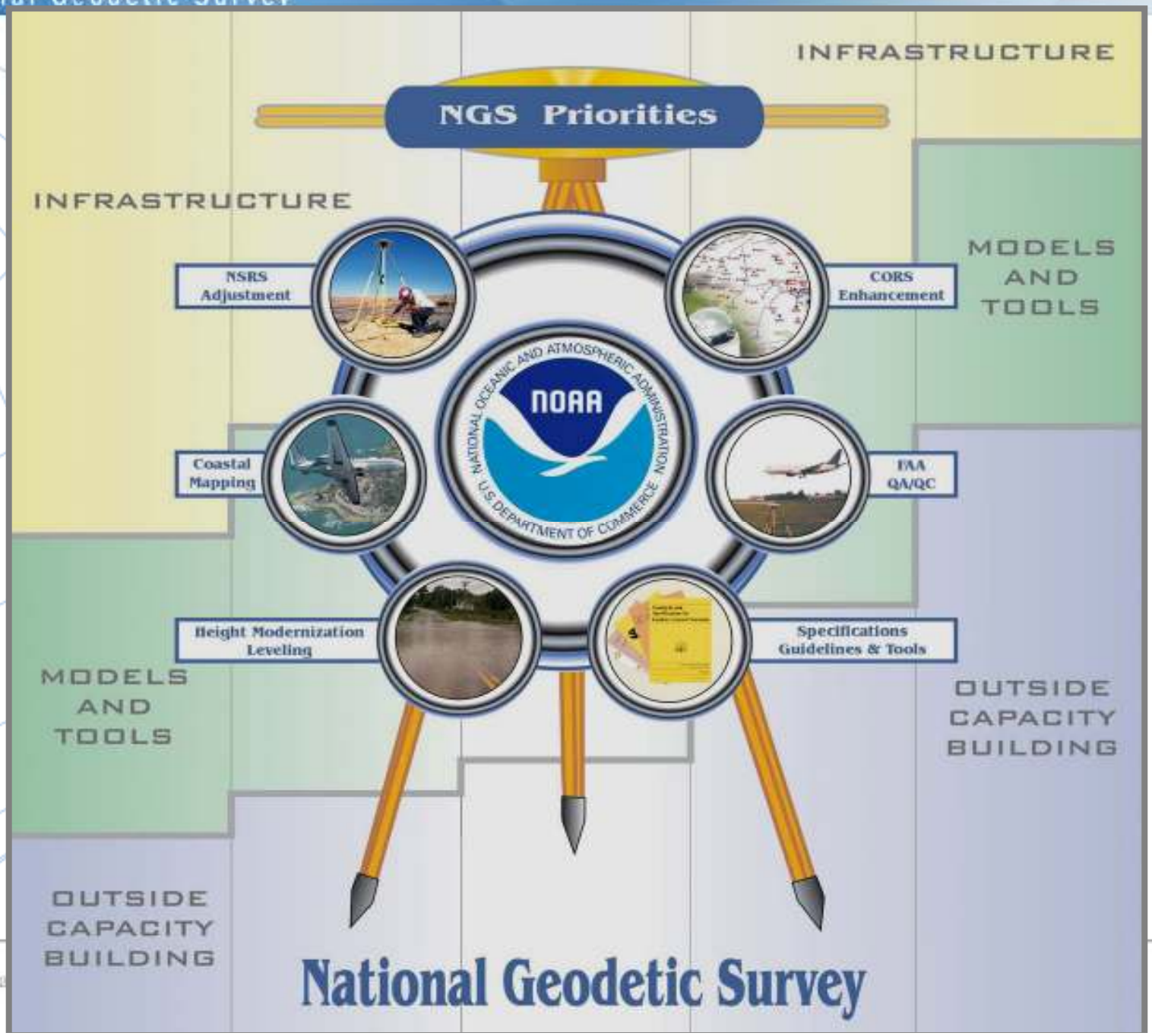
NGS Activities Update

NGS Products and Services, Ongoing and Future Initiatives

Daniel J. Martin
National Geodetic Survey
VT Geodetic Advisor

Maine Society of Land Surveyors
January 25, 2008

National Oceanic and Atmospheric Administration


INFRASTRUCTURE
NGS Priorities
INFRASTRUCTURE
MODELS AND TOOLS
NSRS Adjustment
CORS Enhancement
NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
Coastal Mapping
FAA QA/QC
Height Modernization Leveling
Specifications Guidelines & Tools
MODELS AND TOOLS
OUTSIDE CAPACITY BUILDING
OUTSIDE CAPACITY BUILDING
National Geodetic Survey

NATIONAL READJUSTMENT
NAD 83(NSRS2007)

- **WHAT?**
  - **WHY**
  - **HOW**
  - **WHEN**
  - **POST**

NATIONAL SPATIAL REFERENCE SYSTEM

- **A component of the National Spatial Data Infrastructure (NSDI) - http://www.fgdc.gov/nsdi/nsdi.html**

- **Contains all geodetic control contained in the National Geodetic Survey (NGS) Integrated Data Base:**
  - **Horizontal and vertical control points**
  - **Geoid models such as GEOID 03**
  - **Gravity**
  - **Precise GPS orbits**
  - **Continuously Operating Reference Stations (CORS)**
  - **National Shoreline data as observed by NGS**
  - **Standards and Specifications for data submittal**

NATIONAL READJUSTMENT

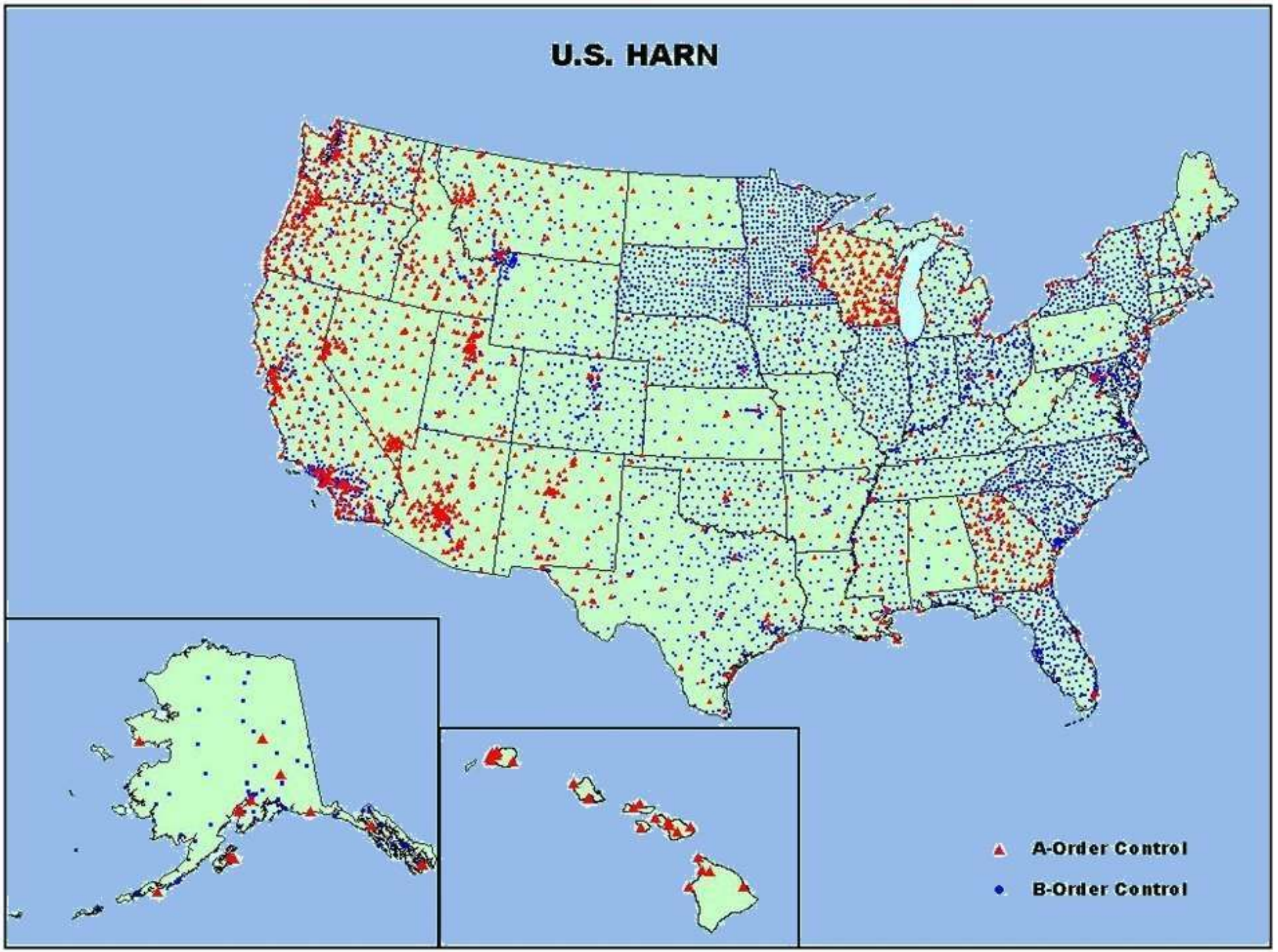
WHAT

WHY?

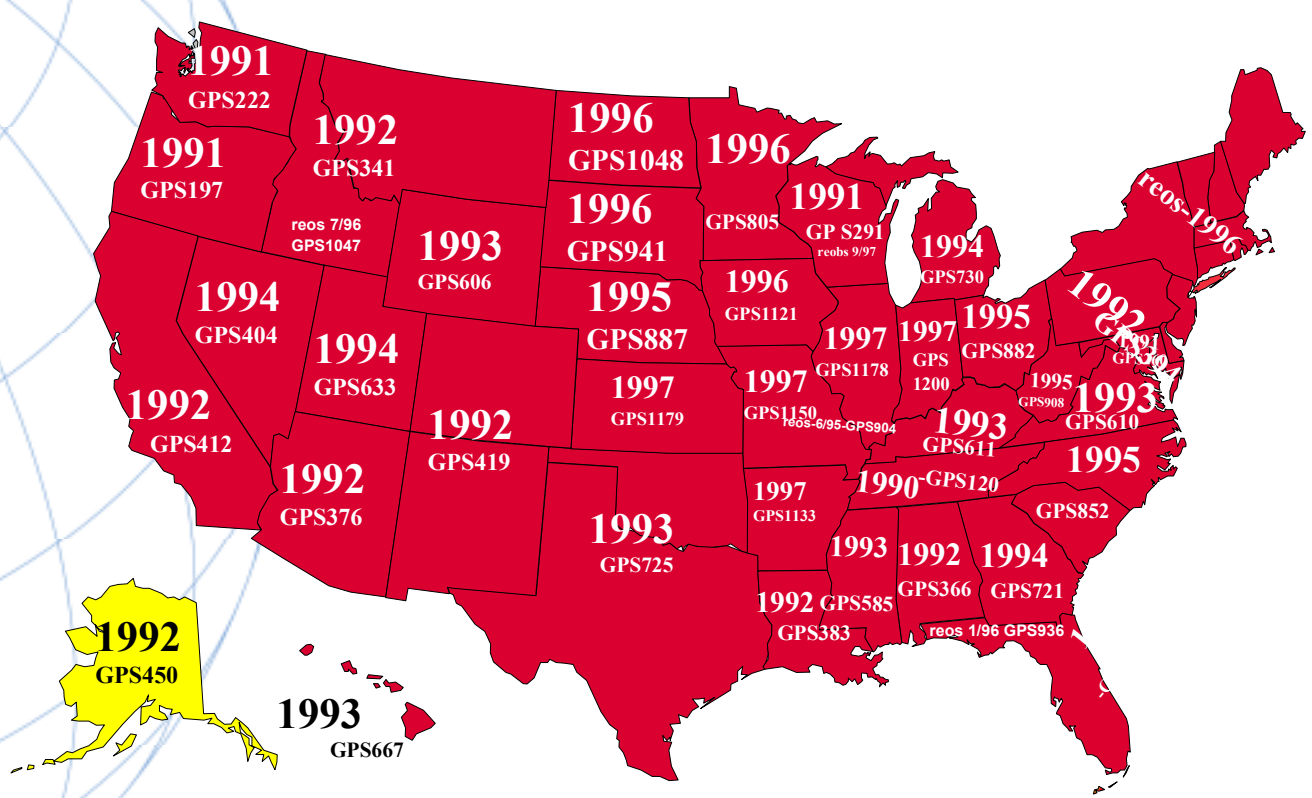
HOW

WHEN

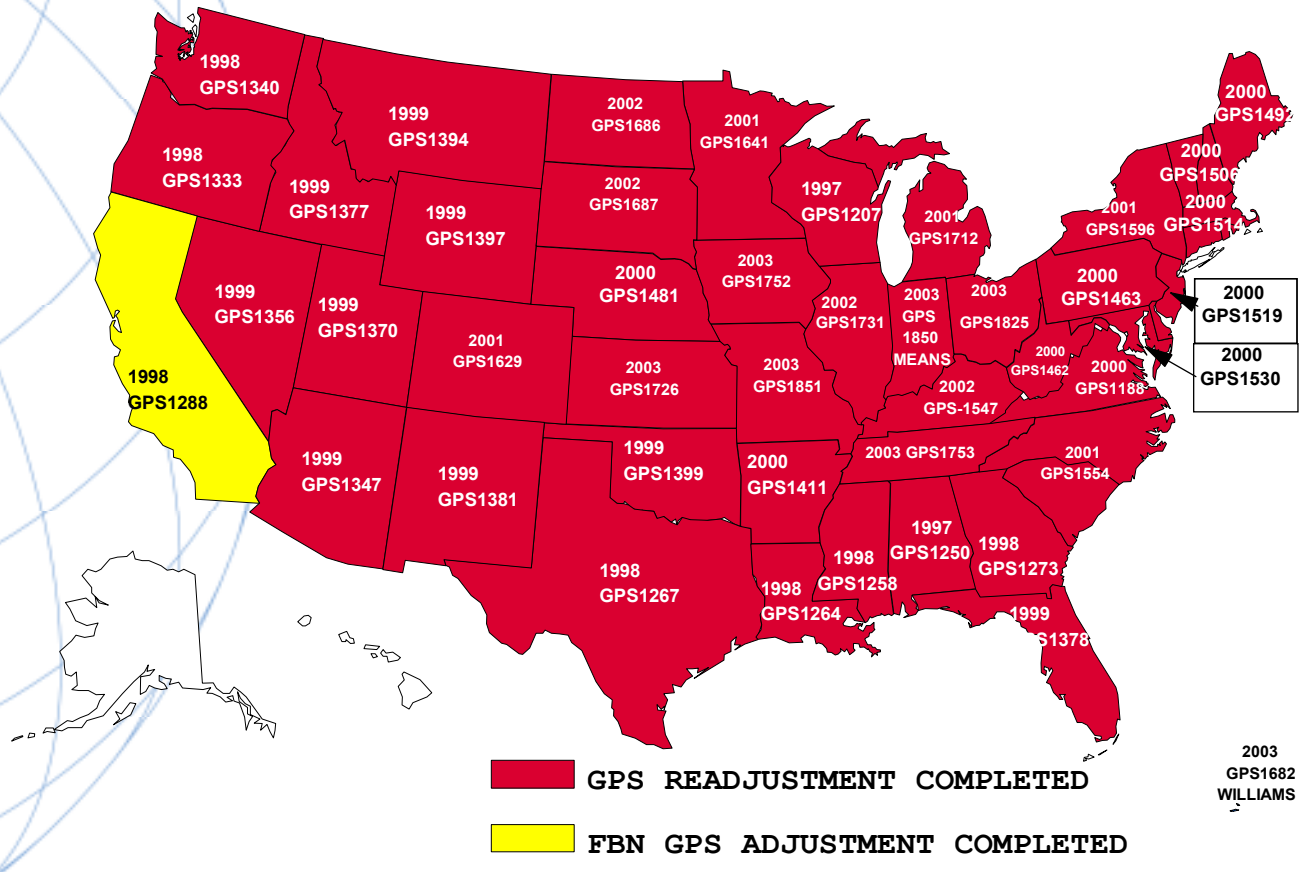
POST


U.S. HARN
A-Order Control
B-Order Control

NETWORK STATUS
HPGN/HARN & STATEWIDE



FBN/CBN SURVEYS



Reasons for Readjustment

- **Multiple epoch dates**
- **Inconsistencies between states**
- **Need to be Consistent with CORS**
- **Compute Network and Local accuracies**

September 24, 2003 NGS Executive Steering Committee approved a plan for the readjustment of the horizontal positions and ellipsoid heights for GPS stations in the contiguous United States.

Orthometric Height adjustment will not be attempted

NATIONAL READJUSTMENT

WHAT

WHY

HOW?

WHEN

POST

NGS Adjustment Team (2005)

NAD 83 READJUSTMENT

ONLY GPS DATA WAS USED

CONTINUOUSLY OPERATING REFERENCE STATIONS

FEDERAL BASE NETWORK

COOPERATIVE BASE NETWORK

USER DENSIFICATION NETWORK

AIRPORT SURVEYS

Network Accuracy

- Network accuracy of a control point
  - A value that represents the uncertainty of its coordinates with respect to the geodetic datum at the 95-percent confidence level
  - Datum is considered to be best expressed by the Continuous Operating Reference Stations (CORS)
- Local and Network accuracy values at CORS sites are considered to be infinitesimal (approach zero)
- These accuracies will be implemented with the National Readjustment

Local 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-percent confidence level**
  - **An approximate average of the individual local accuracy values between this control point and other observed control points used to establish its coordinates**

AVERAGE SHIFTS
USA Wide

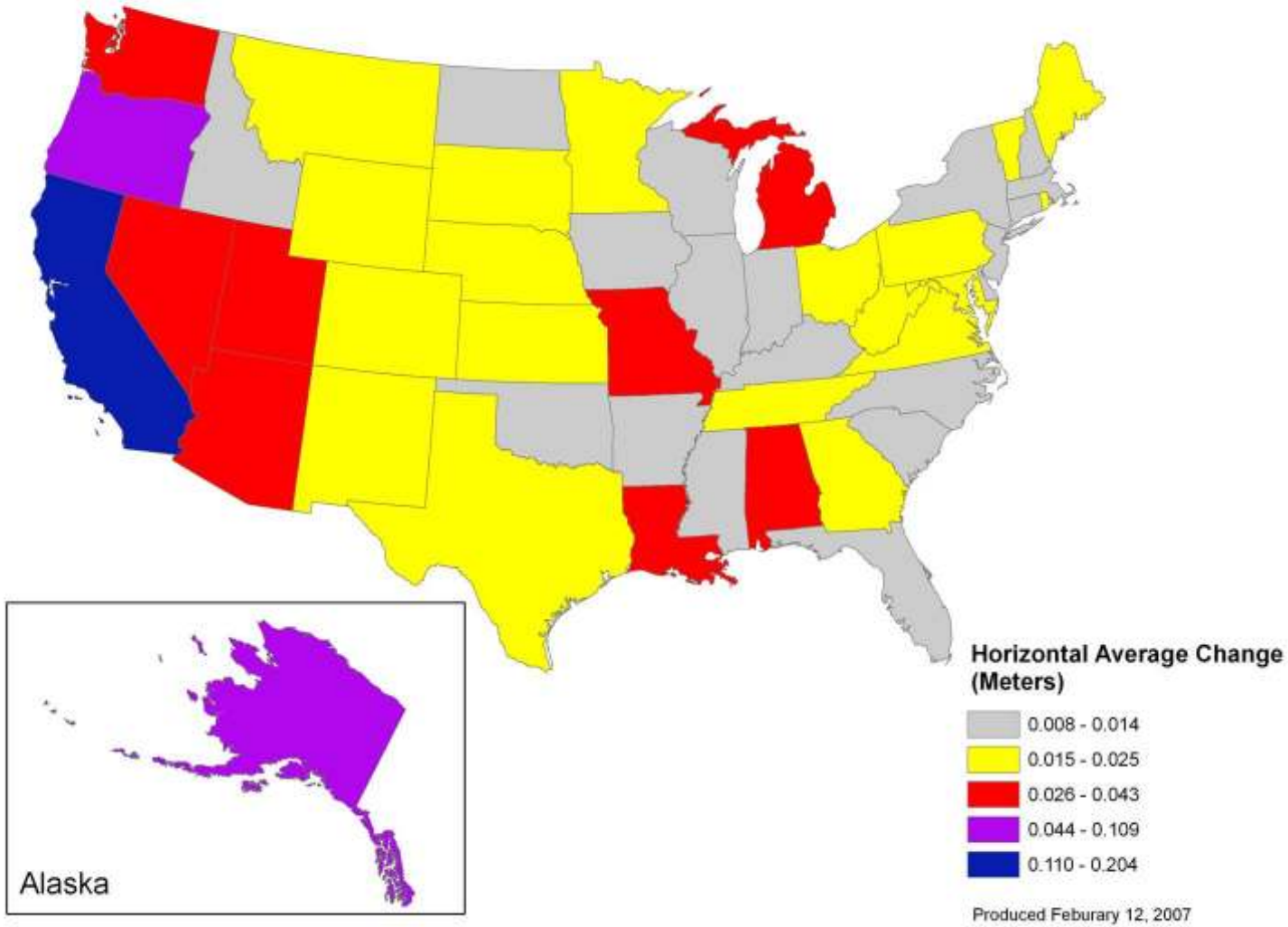
- **Based on the final adjusted results from the original published positions and ellipsoid heights**

< Average horizontal shift: 2.5 cm.

< Average ellipsoid height shift: 2.7 cm.

Improving Positional Accuracy

NETWORK	TIME SPAN	NETWORK ACCURACY	LOCAL ACCURACY
NAD 27	1927-1986	10 METERS	(1 part in 100,000)
NAD83(86)	1986-1990	1 METER	(1 part in 100,000)
HARN	1990-2007	0.1 METER	B-order (1 part in 1 million) A-order (1 part in 10 million)
CORS	1996 -	0.01 METER	0.01 meter
NAD83(2007)	2007-	0.01-??? METER(s)	0.01 meter +/-


Alaska
Horizontal Average Change
(Meters)
0.008 - 0.014
0.015 - 0.025
0.026 - 0.043
0.044 - 0.109
0.110 - 0.204
Produced Feburary 12, 2007

FINAL STATISTICS (ME)

Free adjustment

No. of Stations = 446
No. of rejected vectors = 132
Standard error of unit weight = 1.03

Constrained adjustment

No. of Stations = 446
No. of rejected vectors = 132
Min Horz Shift = 0.000 (m)
Max Horz Shift = 0.056 (m)
Ave Horz Shift = 0.017 (m)
Min Vert Shift = 0.000 (m)
Max Vert Shift = 0.131 (m)
Ave Vert Shift = 0.010 (m)
Standard error of unit weight = 1.03

NATIONAL READJUSTMENT

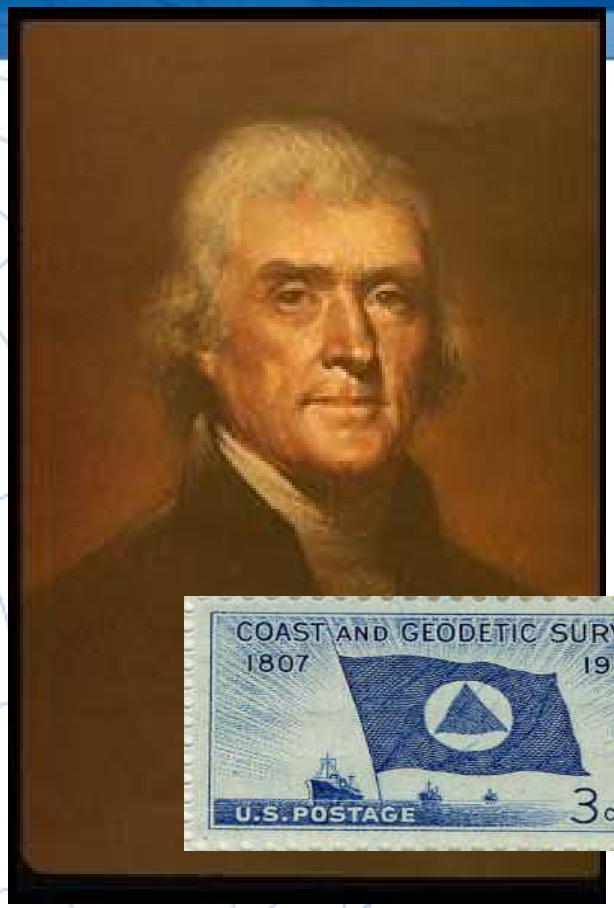
WHAT

WHY

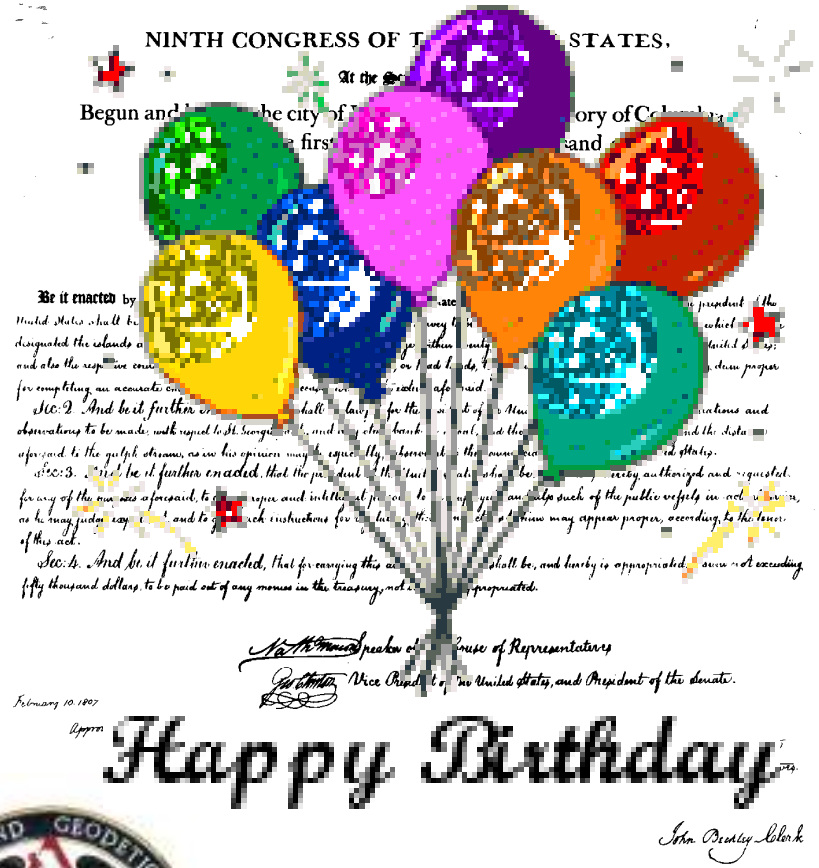
HOW

WHEN?

POST



COAST AND GEODETIC SURVEY
1807
1957
U.S. POSTAGE
3 CENTS


NINTH CONGRESS OF T STATES,
Happy Birthday


U.S. COAST AND GEODETIC SURVEY
1807
200th ANNIVERSARY

NATIONAL READJUSTMENT

WHAT

WHY

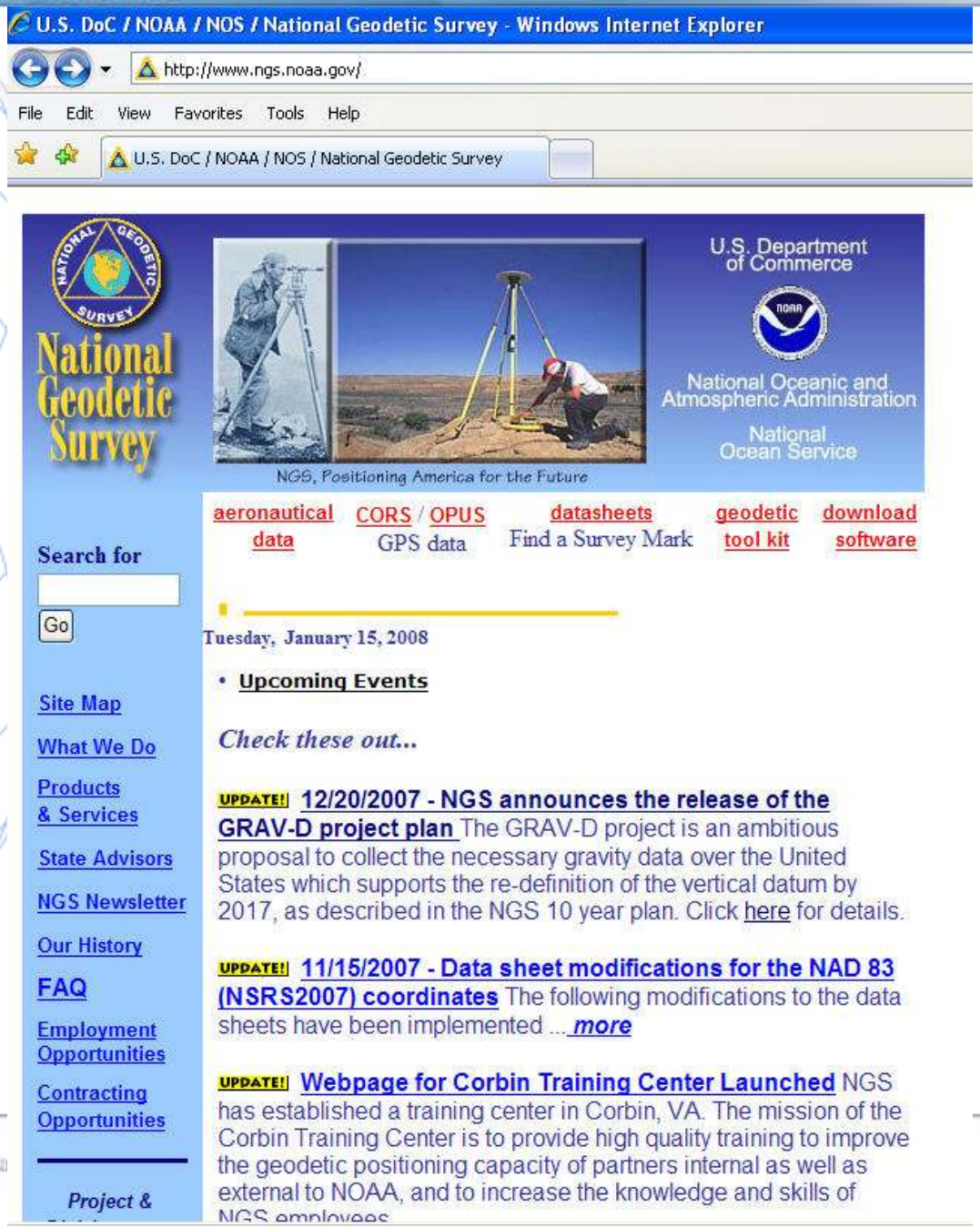
HOW

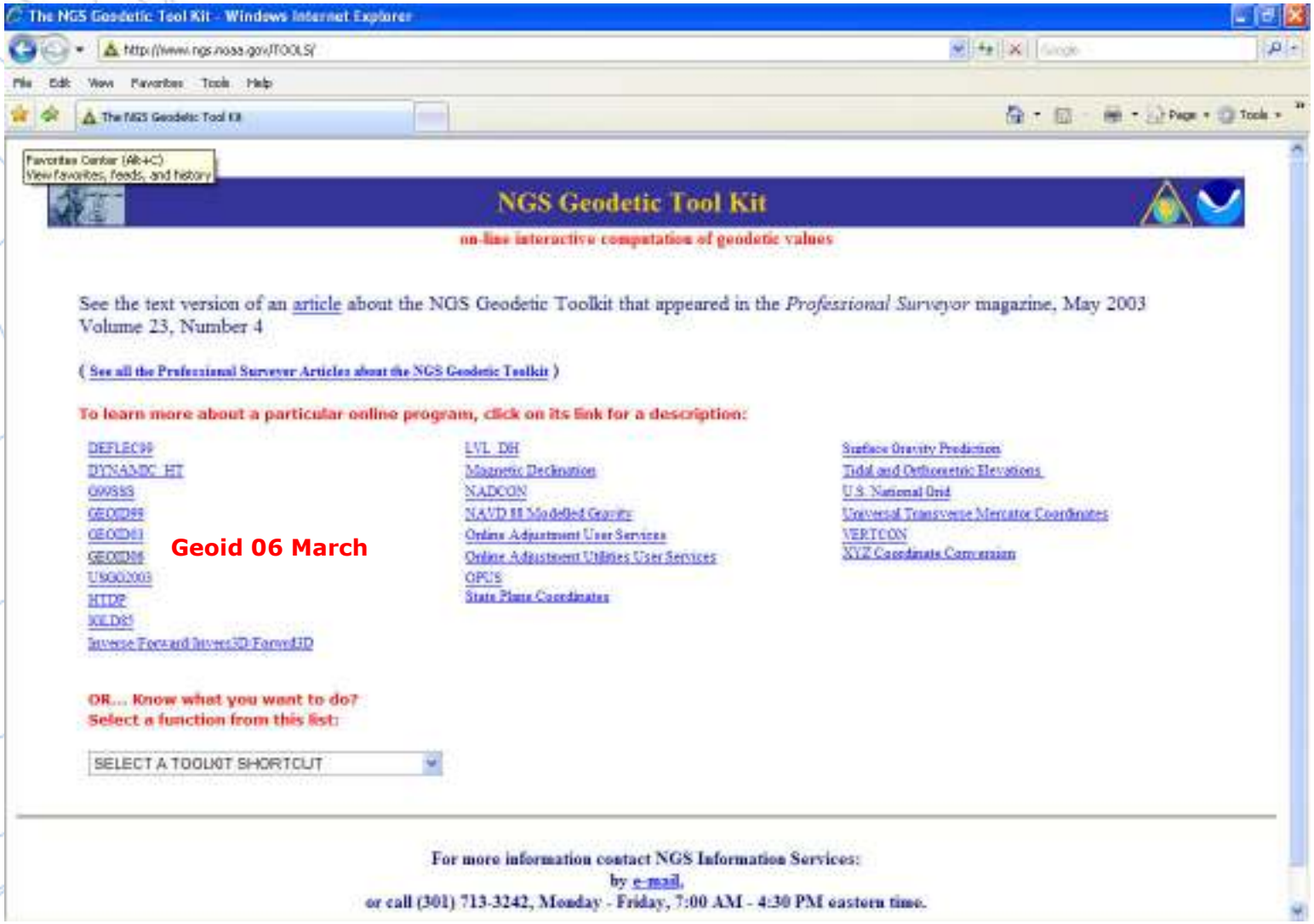
WHEN

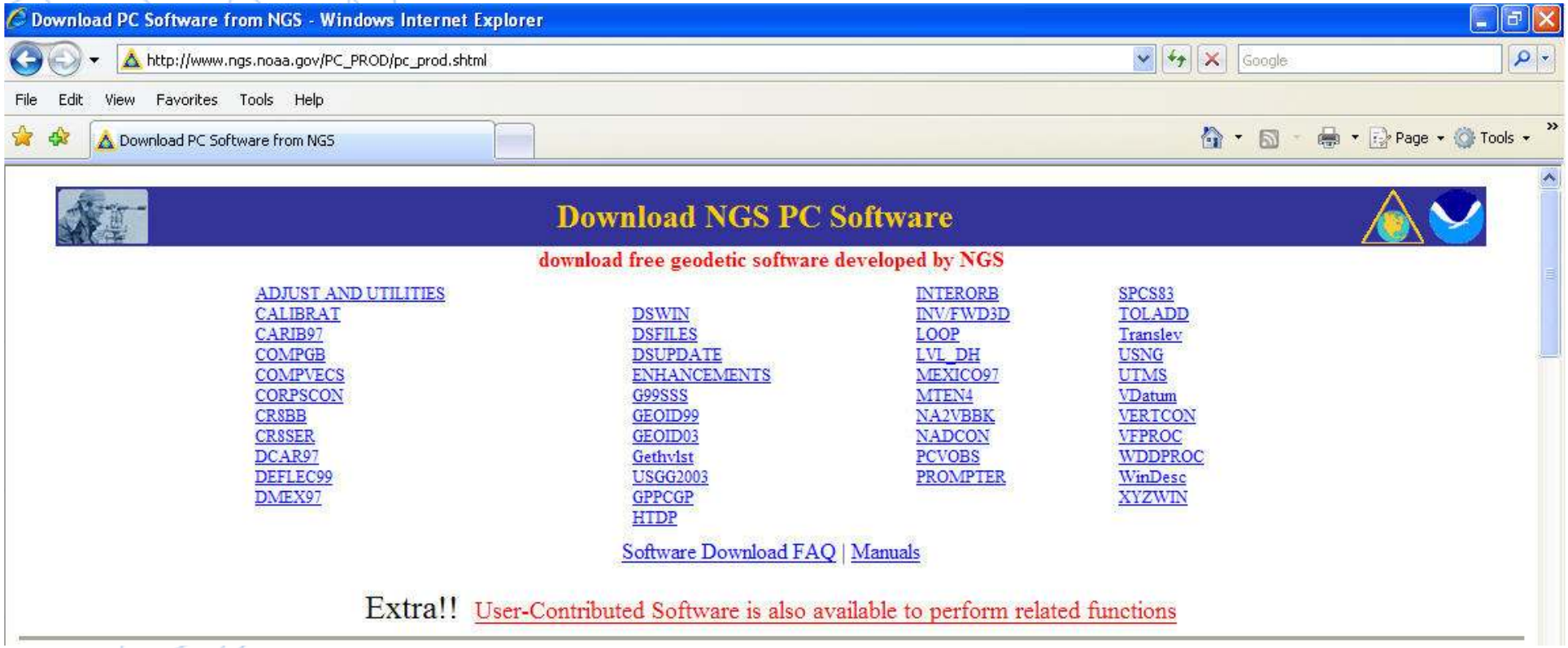
POST?

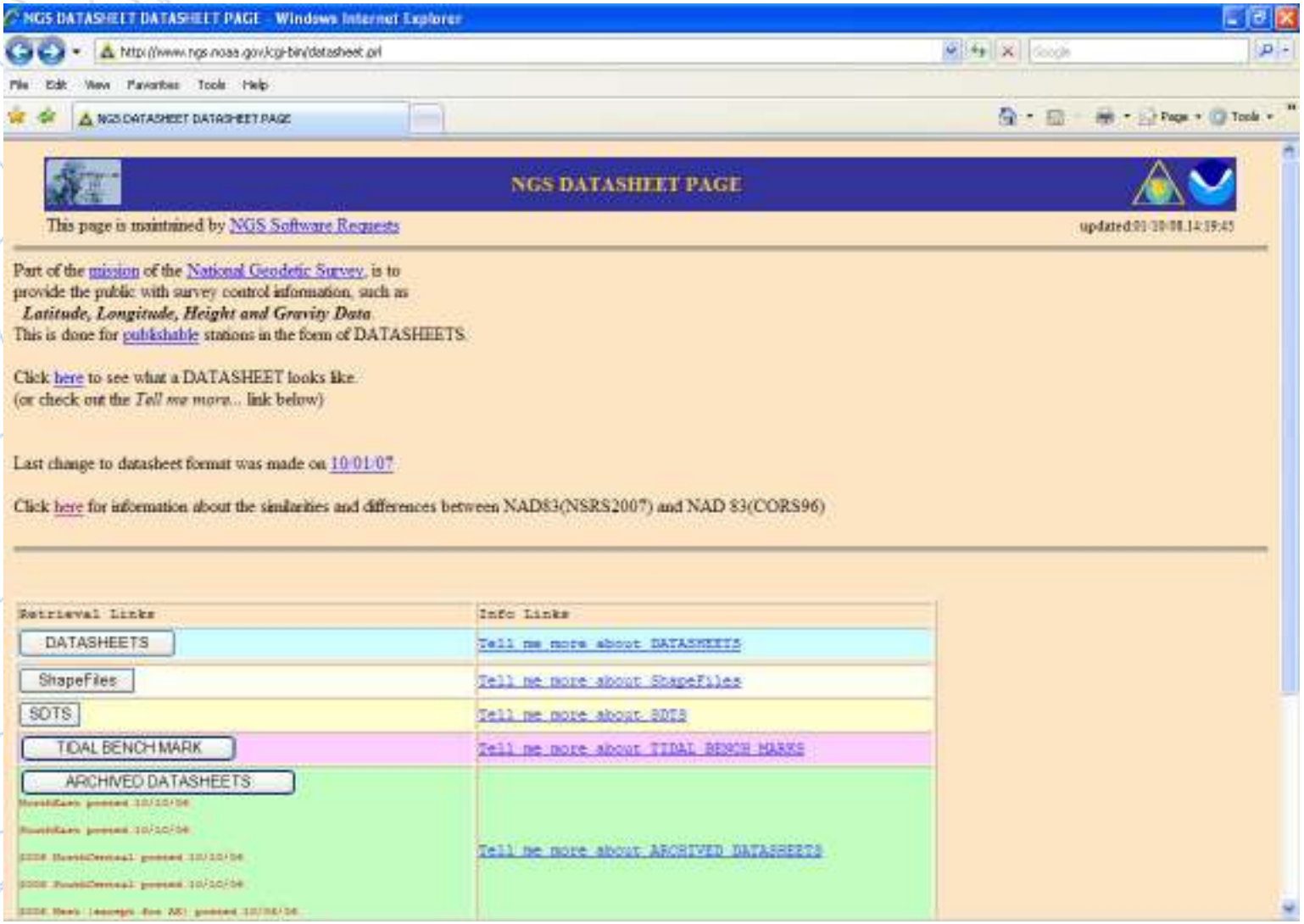
Readjustment Implementation Team

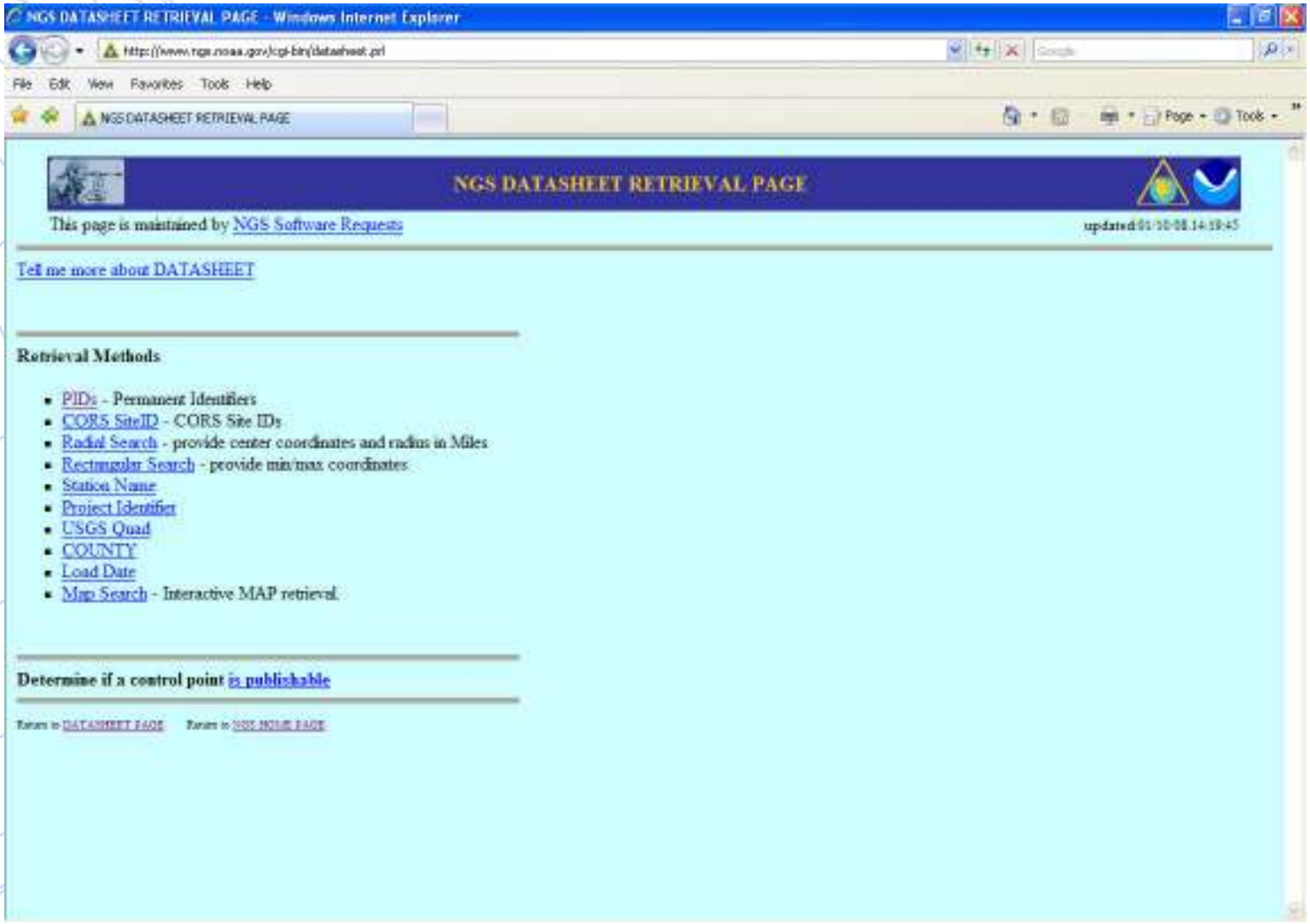
- Recently formed to work out the details
  - Datasheets
  - Implementing accuracies (new projects)
  - Education
  - Future adjustments


U.S. DoC / NOAA / NOS / National Geodetic Survey - Windows Internet Explorer
http://www.ngs.noaa.gov/
File Edit View Favorites Tools Help
U.S. DoC / NOAA / NOS / National Geodetic Survey
National Geodetic Survey
NGS, Positioning America for the Future
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
aeronautical data
CORS / OPUS GPS data
datasheets Find a Survey Mark
geodetic tool kit
download software
Search for
Go
Site Map
What We Do
Products & Services
State Advisors
NGS Newsletter
Our History
FAQ
Employment Opportunities
Contracting Opportunities
Project &
Tuesday, January 15, 2008
• Upcoming Events
Check these out...
UPDATE! 12/20/2007 - NGS announces the release of the GRAV-D project plan The GRAV-D project is an ambitious proposal to collect the necessary gravity data over the United States which supports the re-definition of the vertical datum by 2017, as described in the NGS 10 year plan. Click here for details.
UPDATE! 11/15/2007 - Data sheet modifications for the NAD 83 (NSRS2007) coordinates The following modifications to the data sheets have been implemented ... more
UPDATE! Webpage for Corbin Training Center Launched NGS has established a training center in Corbin, VA. The mission of the Corbin Training Center is to provide high quality training to improve the geodetic positioning capacity of partners internal as well as external to NOAA, and to increase the knowledge and skills of


The NGS Geodetic Tool Kit - Windows Internet Explorer
http://www.ngs.noaa.gov/TOOLS/
File Edit View Favorites Tools Help
The NGS Geodetic Tool Kit
Favorites Center (Alt+C)
View favorites, feeds, and history
NGS Geodetic Tool Kit
on-line interactive computation of geodetic values
See the text version of an article about the NGS Geodetic Toolkit that appeared in the Professional Surveyor magazine, May 2003 Volume 23, Number 4
(See all the Professional Surveyor Articles about the NGS Geodetic Toolkit)
To learn more about a particular online program, click on its link for a description:
DEFLEC99
DYNAMIC_HT
GPSBS
GEOID99
GEOID03
GEOID96
USGG2003
HTDP
XELD85
Inverse Forward Inverse3D Forward3D
LVL_DH
Magnetic Declination
NADCON
NAVD 88 Modelled Gravity
Online Adjustment User Services
Online Adjustment Utilities User Services
OPUS
State Plane Coordinates
Surface Gravity Prediction
Tidal and Orthometric Elevations
U.S. National Grid
Universal Transverse Mercator Coordinates
VERTCON
XYZ Coordinate Conversion
Geoid 06 March
OR... Know what you want to do?
Select a function from this list:
SELECT A TOOLKIT SHORTCUT
For more information contact NGS Information Services:
by e-mail,
or call (301) 713-3242, Monday - Friday, 7:00 AM - 4:30 PM eastern time.


Download PC Software from NGS - Windows Internet Explorer
http://www.ngs.noaa.gov/PC_PROD/pc_prod.shtml
Google
File Edit View Favorites Tools Help
Download PC Software from NGS
Page Tools
Download NGS PC Software
download free geodetic software developed by NGS
ADJUST AND UTILITIES
CALIBRAT
CARIB97
COMPGB
COMPVECS
CORPSCON
CR8BB
CR8SER
DCAR97
DEFLEC99
DMEX97
DSWIN
DSFILES
DSUPDATE
ENHANCEMENTS
G99SSS
GEOID99
GEOID03
Gethvlst
USGG2003
GPPCGP
HTDP
INTERORB
INV/FWD3D
LOOP
LVL_DH
MEXICO97
MTEN4
NA2VBBK
NADCON
PCVOBS
PROMPTER
SPCS83
TOLADD
Translev
USNG
UTMS
VDatum
VERTCON
VFPROC
WDDPROC
WinDesc
XYZWIN
Software Download FAQ | Manuals
Extra!! User-Contributed Software is also available to perform related functions


NGS DATASHEET DATASHEET PAGE - Windows Internet Explorer
http://www.ngs.noaa.gov/cgi-bin/datasheet.prl
File Edit View Favorites Tools Help
NGS DATASHEET DATASHEET PAGE
NGS DATASHEET PAGE
This page is maintained by NGS Software Requests
updated 01/10/08 14:19:45
Part of the mission of the National Geodetic Survey, is to provide the public with survey control information, such as
Latitude, Longitude, Height and Gravity Data
This is done for publishable stations in the form of DATASHEETS.
Click here to see what a DATASHEET looks like.
(or check out the Tell me more... link below)
Last change to datasheet format was made on 10/01/07
Click here for information about the similarities and differences between NAD83(NSRS2007) and NAD 83(CORS96)
Retrieval Links
Info Links
DATASHEETS
Tell me more about DATASHEETS
ShapeFiles
Tell me more about ShapeFiles
SOTS
Tell me more about SOTS
TIDAL BENCH MARK
Tell me more about TIDAL BENCH MARKS
ARCHIVED DATASHEETS
Tell me more about ARCHIVED DATASHEETS


NGS DATASHEET RETRIEVAL PAGE - Windows Internet Explorer
File Edit View Favorites Tools Help
NGS DATASHEET RETRIEVAL PAGE
NGS DATASHEET RETRIEVAL PAGE
This page is maintained by NGS Software Requests
Tell me more about DATASHEET
Retrieval Methods
PIDs - Permanent Identifiers
CORS SiteID - CORS Site IDs
Radial Search - provide center coordinates and radius in Miles
Rectangular Search - provide min/max coordinates
Station Name
Project Identifier
USGS Quad
COUNTY
Load Date
Map Search - Interactive MAP retrieval
Determine if a control point is publishable

The NGS Data SheetSee file dsdata.txt for more information about the
datasheet.DATABASE = Sybase ,PROGRAM = datasheet, VERSION = 7.58
1 National Geodetic Survey, Retrieval Date = JANUARY 14, 2008
PE1052
****

PE1052 DESIGNATION - Y 151
PE1052 PID - PE1052
PE1052 STATE/COUNTY- ME/KNOX
PE1052 USGS QUAD - ROCKLAND (1979)
PE1052
PE1052 *CURRENT SURVEY CONTROL
PE1052

PE1052* NAD 83(2007)- 44 03 38.27673(N) 069 05 36.90789(W) ADJUSTED
PE1052* NAVD 88 - 18.581 (meters) 60.96 (feet) ADJUSTED
PE1052

PE1052 EPOCH DATE - 2002.00
PE1052 X - 1,638,189.075 (meters) COMP
PE1052 Y - -4,288,552.412 (meters) COMP
PE1052 Z - 4,412,930.830 (meters) COMP
PE1052 LAPLACE CORR- 2.88 (seconds) DEFLEC99
PE1052 ELLIP HEIGHT- -6.509 (meters) (02/10/07) ADJUSTED
PE1052 GEOID HEIGHT- -25.11 (meters) GEOID03
PE1052 DYNAMIC HT - 18.580 (meters) 60.96 (feet) COMP

$H = h - N$

$18.581 = -6.509 - (-25.11)$

$18.581 \neq 18.601$

PE1052
PE1052 ------- Accuracy Estimates (at 95% Confidence Level in cm) --------
PE1052 Type PID Designation North East Ellip
PE1052 --
PE1052 NETWORK PE1052 Y 151 1.06 0.55 1.57
PE1052 --
PE1052 MODELED GRAV- 980,530.9 (mgal) NAVD 88
PE1052
PE1052 VERT ORDER - SECOND CLASS 0
PE1052
PE1052.This mark is at Knox Co Regional Airport (RKD)
PE1052
PE1052.The horizontal coordinates were established by GPS observations
PE1052.and adjusted by the National Geodetic Survey in February 2007.
PE1052
PE1052.The datum tag of NAD 83(2007) is equivalent to NAD 83(NSRS2007).
PE1052.See National Readjustment for more information.
PE1052.The horizontal coordinates are valid at the epoch date displayed above.
PE1052.The epoch date for horizontal control is a decimal equivalence
PE1052.of Year/Month/Day.
PE1052
PE1052.The orthometric height was determined by differential leveling
PE1052.and adjusted in June 1991.
PE1052
PE1052.The X, Y, and Z were computed from the position and the ellipsoidal ht.
PE1052
PE1052.The Laplace correction was computed from DEFLEC99 derived deflections.

PE1052
PE1052.The ellipsoidal height was determined by GPS observations
PE1052.and is referenced to NAD 83.
PE1052
PE1052.The geoid height was determined by GEOID03.
PE1052
PE1052.The dynamic height is computed by dividing the NAVD 88
PE1052.geopotential number by the normal gravity value computed on the
PE1052.Geodetic Reference System of 1980 (GRS 80) ellipsoid at 45
PE1052.degrees latitude (g = 980.6199 gals.).
PE1052
PE1052.The modeled gravity was interpolated from observed gravity values.
PE1052
PE1052; North East Units Scale Factor Converg.
PE1052;SPC ME E - 43,940.306 252,444.002 MT 0.99992781 -0 24 46.1
PE1052;SPC ME E - 144,160.82 828,226.70 sFT 0.99992781 -0 24 46.1
PE1052;UTM 19 - 4,878,611.443 492,504.509 MT 0.99960069 -0 03 54.3
PE1052
PE1052! - Elev Factor x Scale Factor = Combined Factor
PE1052!SPC ME E - 1.00000102 x 0.99992781 = 0.99992883
PE1052!UTM 19 - 1.00000102 x 0.99960069 = 0.99960171
PE1052
PE1052 SUPERSEDED SURVEY CONTROL
PE1052
PE1052 ELLIP H (02/06/02) -6.521 (m) GP( ) 4 2
PE1052 NAD 83(1996)- 44 03 38.27729(N) 069 05 36.90764(W) AD( ) 1
PE1052 ELLIP H (06/17/97) -6.550 (m) GP( ) 4 2
PE1052 NAVD 88 (06/17/97) 18.58 (m) 61.0 (f) LEVELING 3
PE1052 NGVD 29 (??/??/92) 18.793 (m) 61.66 (f) ADJ UNCH 2 0

GPRA County Scorecard - Windows Internet Explorer

http://www.ngs.noaa.gov/scorecard/

GPRA County Scorecard

Home · Print · Page · Tools

How Well is NOAA Meeting Local Positioning Needs?

National Geodetic Survey (NGS), has developed a new performance metric to evaluate how well it is enabling counties with accurate positioning capacity to the centimeter level relative to the National Spatial Reference System (NSRS). This metric makes use of NOAA's Online Positioning User Service (OPUS), as well as a County Scorecard, to assess county positioning capability and the success of NOAA's products and services.

FY 2008 GPRA Action Plan

We Need Representatives!

Are you interested in becoming a County Geospatial Representative?
We are looking for County Surveyors, GIS Professionals and others who can speak for the needs of individual Counties to fill out a brief web-based County Scorecard.
If so, please fill out the form below and send it to us.

Fields marked with (*) are required

*Email

*Name

*Position

*US County

GPRA Results

NGS began tracking its progress toward "fully or substantially" enabling counties with accurate positioning. The maps below are the quarterly updates of the percentage of U.S. counties rated as enabled or substantially enabled with accurate position capacity. It is a graphical representation of NGS' Government Performance and Results Act (GPRA) performance measure. The Government Performance and Results Act of 1993 seeks to improve Federal program effectiveness and public accountability by promoting a new focus on results, service quality and customer satisfaction. For more information on GPRA click here. NGS's GPRA measure tracks progress in facilitating the capacity of state and local governments and the private sector to utilize accurate positioning information. NOAA will track county level use of its Online Position User Service (OPUS), submitted accepted bluebook data, county scorecard submissions, and indentification of county representatives and State Advisors/Coordinators to determine how well it is enabling state and local governments and the private sector with accurate positioning capacity. Click the maps below for the full image and slide show feature. Just click the 'close' link when you are done viewing to return to this page. Also below is a file containing month by month progress and GPRA targets.

Done · Internet · 100%

start · Microsoft Power... · GPRA County S... · 5:27 PM

What Does NGS Do?? What is Our Mission??
The NGS Year Plan
Excerpts from the Executive Summary

- To define, maintain and provide access to the **National Spatial Reference System** to meet our nation's economic, social, and environmental needs, and
- To be a world leader in geospatial activities, including the development and promotion of **standards, specifications, and guidelines.**

In order to achieve the vision of the future, five technical improvements have been identified. They are:

- Modernize CORS
- Improve Gravity Field Modeling
- Migrate the Coastal Mapping Program toward Integrated Ocean and Coastal Mapping (IOCM)
- Add and Improve Core Capabilities
- Implement a Global Leadership Strategy

Cont….

Bold initiatives will be required in all of these areas. One common theme for all of them is ***change for the better***. NGS will transform CORS into a fully GNSS-capable system which best serves the mission of defining the NSRS. The geoid modeling efforts will include new theory and data collection at levels not seen at NGS since the NAD 83 and NAVD 88 efforts. Time dependencies will be both acknowledged and tracked in all components of the NSRS, from the shoreline to the gravity field, from heights to latitude and longitude. Coordinates which are epoch tagged and tracked for motion will be the foundation of the NSRS.

So what does this mean?

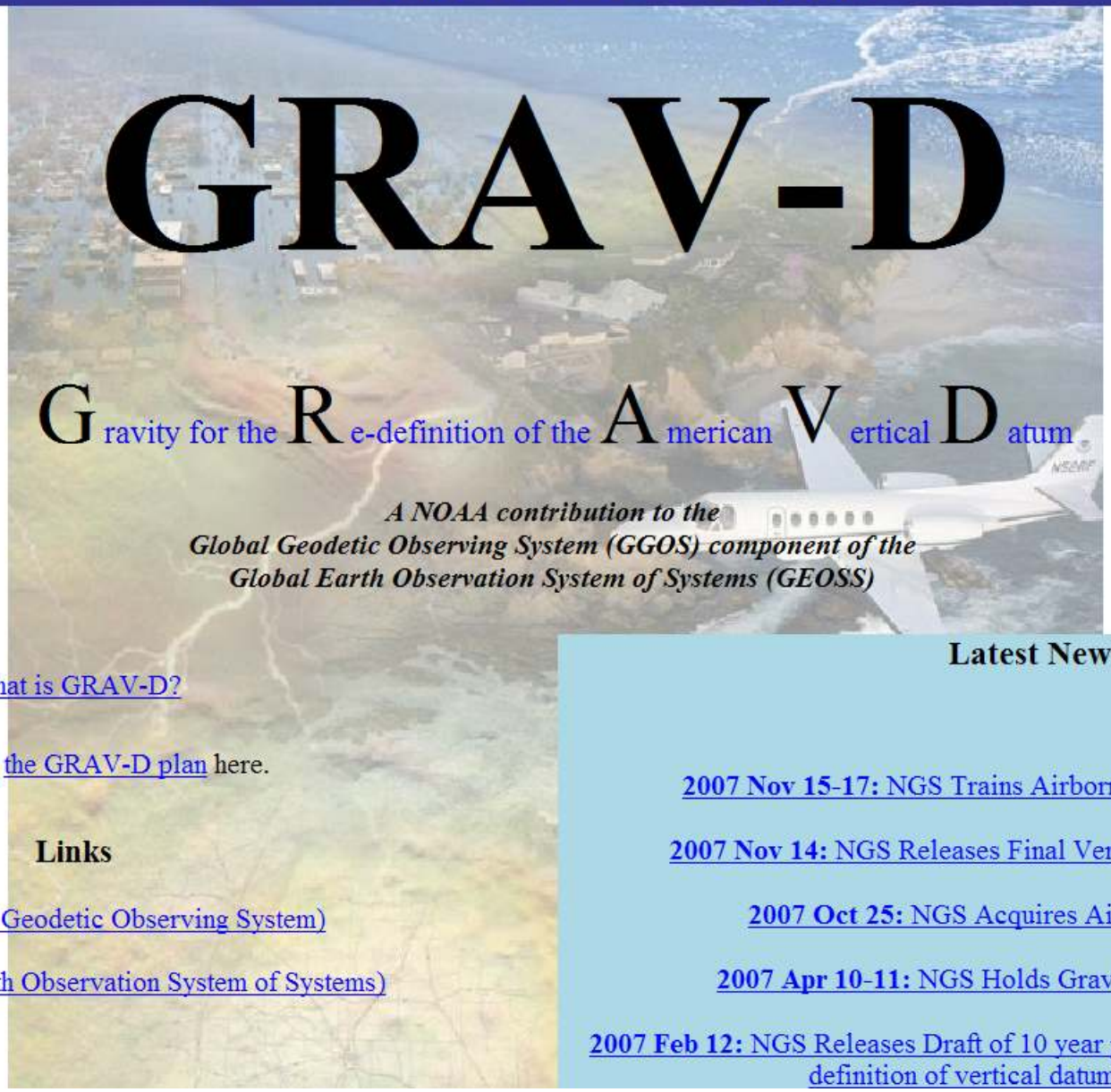
Changes for the Better
Modernize CORS

- NGS provides 1-cm access to the geodetic latitude, longitude and height components of the NSRS for all GPS-exclusive users (with geodetic quality receivers) with *less than 15 minutes* of data anywhere in the United States or her territories
- NGS provides 1-cm access to geodetic latitude, longitude and height to all GNSS (generic) users, without regard to constellation, with *less than 4 hours of data* anywhere in the United States or her territories
- All existing NWLON sites are collocated with a CORS antenna
- NGS provides 1-cm orbits for GPS, GLONASS and Galileo
- NGS products and services directly support real-time access to all components of the NSRS without competing with private industry

Changes for the Better
Improve Gravity Field Modeling

- NGS will compute a pole-to-equator, Alaska-to-Newfoundland geoid model, preferably in conjunction with Mexico and Canada as well as other interested governments, with an accuracy of 1 cm in as many locations as possible
- NGS redefines the vertical datum based on GNSS and a gravimetric geoid
- NGS redefines the national horizontal datum to remove gross disagreements with the ITRF

The official page of the GRAV-D project



GRAV-D

G ravity for the R e-definition of the A merican V ertical D atum

A NOAA contribution to the
Global Geodetic Observing System (GGOS) component of the
Global Earth Observation System of Systems (GEOSS)

What is GRAV-D?

Download the GRAV-D plan here.

Links

GGOS (Global Geodetic Observing System)

GEOSS (Global Earth Observation System of Systems)

Latest News

2007 Nov 15-17: NGS Trains Airborne Gravimeter Operators

2007 Nov 14: NGS Releases Final Version of the GRAV-D plan

2007 Oct 25: NGS Acquires Airborne Gravimeter

2007 Apr 10-11: NGS Holds Gravity Seminar at Corbin

2007 Feb 12: NGS Releases Draft of 10 year plan (first public reference t
definition of vertical datum redefinition)

Changes for the Better

Migrate the Coastal Mapping Program toward Integrated Ocean and Coastal Mapping (IOCM)

- A highly automated system for extracting a delineated shoreline is in place
- NGS coastal missions are strongly integrated with Integrated Ocean and Coastal Mapping (IOCM), and Global Geodetic Observing System (GGOS) and Global Earth Observation System of Systems (GEOSS)

Changes for the Better

Add and Improve Core Capabilities

- All NGS standards, specifications and guidelines are updated to the latest technologies, and available digitally with an annual status check and potential update cycle.

Changes for the Better
Implement a Global Leadership Strategy

- NGS develops strong ties to multiple Universities, funding research, and applying said research for application to the mission.
- NGS strongly holds a position as world leader in geospatial activities
- NGS provides technical support to at least two other countries in developing critical geodetic infrastructure

What Will This Look Like for station Y 151??

HTDP Output

```
*****************************************
HTDP (version 2.9) OUTPUT

TRANSFORMING POSITIONS FROM NAD_83(CORS96)    (EPOCH = 01-15-2008)
                        TO ITRF2000           (EPOCH = 01-01-2017)

             INPUT COORDINATES    OUTPUT COORDINATES     INPUT VELOCITY

Y 151
 LATITUDE     44 03 38.27673 N     44 03 38.31288 N     -2.70 mm/yr  north
 LONGITUDE    69 05 36.90789 W     69 05 36.92362 W     -0.40 mm/yr  east
 ELLIP. HT.            -6.509              -7.690 m     -1.10 mm/yr  up
 X                1638189.075       1638188.168 m      0.01 mm/yr
 Y               -4288552.412      -4288551.019 m     -1.16 mm/yr
 Z                4412930.830       4412930.810 m     -2.71 mm/yr
```

Output from USGG2003

```
                                    latitude          longitude          N
 Station Name                  ddd mm ss.sssss  ddd mm ss.sssss   meters
USER LOCATION                   44  3 38.31288   69  5 36.92362   -26.203
```

My Crystal Ball Looking to 2017

Output from INVERS3D

```
First  Station : Old Y 151
----------------
X =    1638189.0746 m  LAT =  44  3 38.27673 North
Y =   -4288552.4119 m  LON =  69  5 36.90789 West
Z =    4412930.8301 m  EHT =       -6.5090  Meters

Second Station : New Y 151
----------------
X =    1638188.1678 m  LAT =  44  3 38.31288 North
Y =   -4288551.0192 m  LON =  69  5 36.92362 West
Z =    4412930.8106 m  EHT =       -7.6900  Meters

Forward azimuth        FAZ = 342 34 45.9236 From North
Back azimuth           BAZ = 162 34 45.9127 From North
Ellipsoidal distance     S =         1.1694 m
Delta height            dh =        -1.1810 m
Mark-to-mark distance    D =         1.6620 m

DX =        -0.9068 m   DN =         1.1158 m
DY =         1.3927 m   DE =        -0.3501 m
DZ =        -0.0195 m   DU =        -1.1810 m

Zenith (mk-to-mk)       ZD = 135 16 58.02
Apparent zenith distance   = 135 16 58.01
```

$H_{17}=h_{ITRF}-N_{USGG}$

H_{17} = -7.690m – (-26.203m)=

H_{17} 18.513m

NAVD17 – NAVD88 = -0.068m

Contact Information

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