

Program GEOCON
Version 1.0
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Operating Instructions

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1. Introduction

GEOCON performs three-dimensional coordinate transformations between NAD 83 (HARN) coordinates and NAD 83(NSRS2007) coordinates. GEOCON also issues information about the quality of the transformation at each point, and notifications regarding poor quality results.

GEOCON is written as a simple demonstration program that recognizes the NGS Blue Book *80* and *86* position records. The coordinate transformation and the associated quality values are obtained through biquadratic interpolation within a series of grids. Third party applications may obtain identical results if they use the same grids and algorithms.

GEOCON employs high resolution grids (1' by 1') to obtain unprecedented fidelity in modeling coordinate differences. Frequently, one may see that the reported quality is extremely high (e.g. 1 cm or better), and could be considered comparable to a geodetic readjustment of survey measurements. Nonetheless, the National Geodetic Survey considers actual readjustment of survey measurements, and not coordinate transformations, as "best practice".

2. Example GEOCON Session

```
C>geocon
  program geocon - v1.0 - 2012jul06
-----
input  80/86 file  (input)  : bb8086
output 80/86 file (output)  : zout
quality file name (output)  : zqual
clip file name    (output)  : zclip
notification file (output)  : znote
  Region number 1 -- CONUS
  Region number 2 -- Alaska
  Region number 3 -- Puerto Rico/Virgin Islands
-----
Enter region number 1 through 3 : 1
Convert from HARN into NSRS2007? (Y/N): n
  Program will convert from NSRS2007 into HARN
-----
  transformation grids successfully loaded
           29 points interpolated
           2 notifications issued

Press ENTER key to stop program:
```

3. Operation

Assume that `geocon.exe` and its supporting grid files have been installed in a folder (or subdirectory) named “MyDir” on a PC with a Windows operating system. Open the “MyDir” folder. Copy or move a file of *80* and *86* position records into the “MyDir” folder. Assume, for the sake of this example, that the *80* and *86* records are named “bb8086”. Simply double left click on the “geocon” file in “MyDir” (full file name is “geocon.exe”). This will create a command prompt console window, and will automatically start GEOCON in the console window.

GEOCON will ask for a series of file names. The first file name is the input file of the *80* and *86* records to be transformed. The remaining file names are output files that will be created by GEOCON. Note, do not use an output file name of your grid or info files. These files are write-protected, and can not be overwritten. On output, GEOCON will overwrite a file if you reuse a file name and it is not write-protected. File names use standard Windows OS conventions, but are limited to 88 characters. File name extensions (e.g. “zout.txt”) are supported if the user provides them.

After prompting for the file names, GEOCON will prompt for the region to be used for the coordinate transformation. The regions are:

- | | | |
|---|----------------------------|------------------|
| 1 | CONUS | 24-50N, 66-125W |
| 2 | Alaska | 46-77N, 128-194W |
| 3 | Puerto Rico/Virgin Islands | 17-20N, 62-68W |

Enter the region number for the points in the “bb8086” file. They are in the conterminous U.S., so enter a “1”. Points in the selected region will be transformed, and points outside the region will be written to the clip file. If the wrong region is selected, then all of the input points will be clipped, and no points will be transformed or written into the output file.

The last prompt is for the direction of the coordinate transformation. The prompt is “Convert from HARN into NSRS2007? (Y/N):”. If you wish to transform in that sense, then respond with a “y” or “Y”. If, on the other hand, you wish to transform from NSRS2007 into HARN, then respond with an “n” or “N”. GEOCON will then confirm the direction of the transformation in the subsequent line.

GEOCON will then issue a message indicating that it has successfully loaded the coordinate transformation grids. GEOCON will transform the points in the input file and write them into the output file. For each transformed point, an associated transformation quality record will be written into the quality file. If a point is clipped, due to falling outside the designated region boundaries, the untransformed point will be written into the clip file. Supplemental information regarding potential sources of poor quality results will be listed in the notification file if appropriate.

Finally, GEOCON will indicate its completion by issuing the prompt:

```
Press ENTER key to stop program:
```

When you press the enter key, GEOCON will stop, and the command prompt console window will close. The output files created by GEOCON are formatted, ASCII text files, and may be inspected by any suitable application, such as Notepad.

Note it is also possible to manually launch a command prompt console window within Windows. If this is done, then use the “cd” command to maneuver to the “MyDir” subdirectory. One may then start GEOCON by typing “geocon” at the command prompt. If a console window is manually created, then it will not close when GEOCON stops.

A footnote about Hawaii:

There is no official NSRS2007 coordinate for Hawaii. However, a control point, KOKEE, (PID = TT3487) was inadvertently published in the NGS database as NSRS2007. This NSRS2007 position was subsequently removed from the NGS database in 2012. Hence, there are no GEOCON coordinate transformations for Hawaii.

4. The Input *80* and *86* File

This file must be provided by the user. The file consists solely of *80* and *86* records as described in Chapter 2, Horizontal Observation (HZTL OBS) Data, of the Input Formats and Specifications of the National Geodetic Survey Data Base (the NGS Blue Book), Volume I - Horizontal Control. Further detail may be found below in the sections “Format of Blue Book *80* Control Point Record” and “Format of Blue Book *86* Orthometric Height, Geoid Height, Ellipsoid Height”

GEOCON requires the input file to consist solely of *80* and *86* records, entered pair wise. That is, *80* will always be the odd numbered records, and *86* records will always be the even numbered records. And, any given *86* record will be associated with the horizontal position of the *80* record immediately preceding it.

It is required that all the records in the input file be in the same coordinate set. And, those input coordinates must be either NAD 83(NSRS2007) or NAD 83(HARN). It is absolutely critical that the response to the prompt

```
Convert from HARN into NSRS2007? (Y/N):
```

is correct. If your input coordinates are HARN, you must respond “y” (or “Y”). And, if your input coordinates are NSRS2007, you must respond “n” (or “N”).

It is not required that all of the input records be in the same geographic region. However, it may be useful to organize data in that way. Any record pairs that do not fall in the geographic regions defined above will be clipped, and written to the clip file.

5. The Output *80* and *86* File

This file is generated by GEOCON, and consists of the transformed *80* and *86* records. Provided that all the input data were in the selected geographic region, and that there were no clipped points, then there will be a one-to-one correspondence between the input records and the output records. GEOCON does not modify the orthometric height or the geoid height in the *86* record.

Each specific transformation is obtained through biquadratic interpolation from the associated coordinate transformation grid (latitude, longitude, and height). Those grids were obtained by fitting splines in tension to sets of coordinate differences in the various regions. In cases of clusters of points that fell within 1' x 1' cells, a modified median filter was used to select the point passed to the spline model. More detail on the fitting process may be found in the GEOCON Users Guide.

6. The Transformation Quality File

This file is generated by GEOCON, and its records express the quality of the coordinate transformation. While these records (*94*) appear to be Blue Book records, they are not defined as Blue Book records. The format of these records may be found below in the section, "Format of *94* Transformation Quality Record".

There will be a one-to-one correspondence between each *94* record and each *80*/*86* pair in the output 80/86 file. And, assuming that SSN's (Station Serial Numbers) were provided in the input *80* records, those SSN's can be used to distinguish each *94* record.

The quality values in latitude, longitude, and height are obtained through biquadratic interpolation from the associated transformation error grids. Those grids were obtained by fitting splines in tension to sets of cross-validation errors in the various regions.

Cross-validation is a statistical technique to assess how accurately a model may predict. Imagine a data set of 69540 latitude differences. One could withhold one difference, and model a unique grid with the remaining 69539 differences. One can then compare the withheld difference with the predicted difference interpolated from the unique grid. While it is prohibitive to do this for every single point in a large data set, one may use this process and randomly select disjoint sets of points to reduce the computational effort. The GEOCON errors were obtained from 69-fold cross-validation

on sets of 69540 coordinate differences. More detail on the cross-validation may be found in the GEOCON Users Guide.

In cases of clusters of cross-validation errors that fell within 1' x 1' cells, a worst case algorithm was used to select the point passed to the spline model. First, a modified median filter was used to select the most likely error. Then, the error in the cluster with the greatest difference in magnitude from the median error was passed to the error spline model. More detail on the error fitting process may be found in the GEOCON Users Guide.

Note that for the coordinate transformations, a median condition is used to develop the grids. But, for the transformation quality, a worst-case condition is used to develop the grids. This provides the most likely transformation and a conservative estimate of its error.

Also note that the reported transformation quality values are signed quantities. These are reported in the sense of: actual coordinate difference – gridded coordinate difference. (As described above, the gridded coordinate difference is obtained when the point in question is withheld from the grid computation.) It was decided to retain the signs to show cases of systematic under or over prediction which may help in data problem diagnosis.

The transformation quality values should be treated as systematic error. One should add the absolute value of the quality number to the network accuracy of the pre-transformed point. A coordinate transformation never improves the quality of the underlying data.

7. The Clip File

The clip file contains copies of input *80*/*86* record pairs that fall outside the selected region. If all points are within the selected region, the file will be empty. The number of records in the clip file plus the number of records in the output transformed point file should equal the number of records in the input file.

Note that if the input file has points from a mixture of regions, then one may use the generated clip file as input to a subsequent run of GEOCON with a different selected region. In this way, one may easily transform all the input points.

8. The Notification File

This file contains supplemental information that explains the source of large transformation errors. This information is not issued for all instances of lower quality transformations. Rather, it is issued when a cluster of points is nearby, and one member of that cluster is a worst-case contributor to the transformation quality grid. Thus, most

members of a cluster of points may be very well modeled by the coordinate transformation. But, if there is an outlier in the cluster, that error will be expressed in the error grid. The notification file gives specific information on the reason why.

For example, consider the transformation of:

```
003480*80*5084NOT METOMEN GPS 40115697143N104433324639W 31273AWIBA
*86*5084 312725A N88 -35761W 1503844A32A
```

This generates a transformation quality record:

```
*94*5084 0.00137 4.22 0.01766 41.66 -9.54
```

Where one can see sizable longitude and vertical error values (41.66 cm and -9.54 cm).

The notification file issues the messages:

```
003480*80*5084NOT METOMEN GPS 40115697110N104433324608W 31273AWIBA
Note - poor quality due to LL1465 - unmodeled hztl. error: 72.8 cm.
*86*5084 312725A N88 -35761W 1503865A32A
Note - poor quality due to LL1477 - unmodeled vert. error: -12.6 cm.
```

Thus, one can see the longitude transformation quality of 41.66 cm was issued due to the 72.8 cm coordinate modeling problem at LL1465. And the height transformation quality of -9.54 cm was due to LL1477.

Notification file messages are informational in nature. There is no specific action a user need take due to them. However, if the transformation error exceeds the desired error budget, then the user is strongly encouraged to investigate exactly how the user's input data were connected to the geodetic control network. More detail on this issue may be found in the GEOCON Users Guide.

Notification messages are generated through input *80*/*86* records, the appropriate transformation error grid, and the appropriate information file. Information files are provided by NGS, and their format is described below in the section, "Format of Information File Records". The information files are plain ASCII files that list troublesome points that are members of clusters. These points were dropped when creating the coordinate transformation grids. And, they were retained when creating the transformation quality grids.

Notification messages are issued when an input point has horizontal or vertical error of 5 cm or more and is within about 5 km of a troublesome point.

9. Format of Blue Book *80* Control Point Record

These records are standard ASCII text with fixed column formatting. They are a legacy format more fully described in Chapter 2, Horizontal Observation (HZTL OBS) Data, of the Input Formats and Specifications of the National Geodetic Survey Data Base

(the NGS Blue Book), Volume I - Horizontal Control. This information is available online at <http://www.ngs.noaa.gov/FGCS/BlueBook/>

GEOCON only considers columns 7 through 14 and 45 through 69 of this format. It is possible to not fill the remaining fields at all, or to fill them with alternative information. However, it will be difficult or impossible to interpret transformation quality and any supplemental vertical notification messages without a Station Serial Number (SSN).

GEOCON requires the input file to consist solely of *80* and *86* records, entered pairwise. That is, *80* will always be the odd numbered records, and *86* records will always be the even numbered records. And, any given *86* record will be associated with the horizontal position of the *80* record immediately preceding it.

CC 01-06 SEQUENCE NUMBER. OPTIONAL. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
 CC 07-10 DATA CODE. MUST BE *80*.
 CC 11-14 SSN. SEE PAGES 1-1, JOB CODE AND SURVEY POINT NUMBERING AND 2-12, ASSIGNMENT OF STATION SERIAL NUMBERS.
 CC 15-44 STATION NAME. MUST NOT EXCEED 30 CHARACTERS. THE NAME OF A HORIZONTAL CONTROL POINT WITH PERIPHERAL REFERENCE MARKS AND/OR AZIMUTH MARKS MUST NOT EXCEED 24 CHARACTERS TO ALLOW FOR ADDING RM 1, RM 2, AND/OR AZ MK TO THE NAME WITHOUT EXCEEDING THE 30-CHARACTER LENGTH LIMIT.
 CC 45-55 LATITUDE. DEGREES, MINUTES, SECONDS (DDMMSSsssss).
 CC 56 DIRECTION OF LATITUDE. RECORD CODE "N" FOR NORTH OR CODE "S" FOR SOUTH.
 CC 57-68 LONGITUDE. DEGREES, MINUTES, SECONDS, (DDDMMSSsssss).
 CC 69 DIRECTION OF LONGITUDE. RECORD CODE "E" FOR EAST OR CODE "W" FOR WEST.

THE *86* RECORD IS TO BE USED FOR THE ELEVATION (ORTHOMETRIC HEIGHT) AND ELEVATION CODE, WHICH WERE FORMERLY DISPLAYED IN THE FOLLOWING TWO FIELDS.

CC 70-75 BLANK.
 CC 76 BLANK.
 CC 77-78 STATE OR COUNTRY CODE. IF THE CONTROL STATE IS LOCATED IN THE UNITED STATES/CANADA, ENTER THE CODE FROM ANNEX A FOR THE STATE/PROVINCE OR TERRITORY WHICH CONTAINS THE STATION. IF NOT, ENTER THE CODE FROM ANNEX A FOR THE COUNTRY WHICH CONTAINS THE STATION. SEE ANNEX A.
 CC 79-80 STATION ORDER AND TYPE. REFER TO PAGES 2-35 THROUGH 2-38, STATION ORDER AND TYPE AND SEE ANNEX E.

Example:

```
003650*80*5120FRIENDSHIP S GPS          43500699703N088295718725W 24000KWI1A
      *86*5120 240003K N88             -35880W 204115A32A
003660*80*5121VAN DYNE GPS             43521622332N088301532627W 24358KWI1A
      *86*5121 243581K N88             -35960W 207618A32A
```


10. Format of Blue Book *86* Orthometric Height, Geoid Height, Ellipsoid Height

These records are standard ASCII text with fixed column formatting. They are a legacy format more fully described in Chapter 2, Horizontal Observation (HZTL OBS) Data, of the Input Formats and Specifications of the National Geodetic Survey Data Base (the NGS Blue Book), Volume I - Horizontal Control. This information is available online at <http://www.ngs.noaa.gov/FGCS/BlueBook/>

GEOCON only considers columns 7 through 10 and 46 through 52 of this format. It is possible to not fill the remaining fields at all, or to fill them with alternative information. However, it will be difficult or impossible to interpret transformation quality and any supplemental vertical notification messages without a Station Serial Number (SSN).

GEOCON requires the input file to consist solely of *80* and *86* records, entered pairwise. That is, *80* will always be the odd numbered records, and *86* records will always be the even numbered records. And, any given *86* record will be associated with the horizontal position of the *80* record immediately preceding it.

CC 01-06 SEQUENCE NUMBER. OPTIONAL. RIGHT JUSTIFIED. INCREMENT BY 10 FROM THE PREVIOUS RECORD.
CC 07-10 DATA CODE. MUST BE *86*.
CC 11-14 SSN OF CONTROL POINT.
CC 15-16 BLANK
CC 17-23 ORTHOMETRIC HEIGHT. IN METERS (MMMMmmm).
CC 24 ORTHOMETRIC HEIGHT CODE. SEE FOLLOWING TABLES.
CC 25-26 ORTHOMETRIC HEIGHT ORDER AND CLASS. USE PUBLISHED VERTICAL ORDER AND CLASS, OTHERWISE LEAVE BLANK.
CC 27 ORTHOMETRIC HEIGHT NGSIDB INDICATOR. SEE FOLLOWING TABLES.
CC 28-29 ORTHOMETRIC HEIGHT DATUM. SEE FOLLOWING TABLES.
CC 30-35 ORGANIZATION WHICH ESTABLISHED AND/OR MAINTAINS THE ORTHOMETRIC HEIGHT OF THE CONTROL POINT. ENTER THE ABBREVIATION LISTED IN ANNEX C OR ON THE DATASET IDENTIFICATION RECORD.
CC 36-42 GEOID HEIGHT. ABOVE (POSITIVE) OR BELOW (NEGATIVE) THE REFERENCE ELLIPSOID. IN METERS (MMMMmmm).
CC 43 GEOID HEIGHT CODE. SEE FOLLOWING TABLES.
CC 44-45 BLANK.
CC 46-52 ELLIPSOID HEIGHT. IN METERS (MMMMmmm).
CC 53 ELLIPSOID HEIGHT CODE. SEE FOLLOWING TABLES.
CC 54-55 ELLIPSOID HEIGHT ORDER AND CLASS. SEE ANNEX G.
CC 56 ELLIPSOID HEIGHT DATUM. SEE TABLE, P. 2-85.
CC 57-80 COMMENTS.

Example:

```
003650*80*5120FRIENDSHIP S GPS          43500699703N088295718725W 24000KWI1A
      *86*5120 240003K N88              -35880W 204115A32A
003660*80*5121VAN DYNE GPS              43521622332N088301532627W 24358KWI1A
      *86*5121 243581K N88              -35960W 207618A32A
```

11. Format of *94* Transformation Quality Record

These output records are standard ASCII text with fixed column formatting. They are a new format. While they follow the general structure of the HZTL OBS Blue Book, they are not Blue Book records. The Station Serial Number (SSN) of this record is obtained from the ASCII contents of columns 11 through 14 of the input *80* record.

This record expresses the quality of the coordinate transformation by use of cross-validation errors. In cases of clusters, the worst-case error is reported. These values should be used to increase the base network accuracy of the pre-transformed coordinates.

```
cc 01-06 Sequence number. Optional. See Blue Book
cc 07-10 Data Code. Must be *94*
cc 11-14 SSN. See Blue Book
cc 15-20 BLANK
cc 21-30 Latitude Error, arc-sec          9999.99999 f10.5
cc 31-40 Latitude Error, cm              9999999.99 f10.2
cc 41-50 Longitude Error, arc-sec       9999.99999 f10.5
cc 51-60 Longitude Error, cm            9999999.99 f10.2
cc 61-70 Ellipsoid Height Error, cm     9999999.99 f10.2
```

Example:

```
*94*5120      0.00000      0.00  0.00001      0.02   -0.07
*94*5121     -0.00005     -0.16 -0.00011     -0.25  -0.06
```

12. Format of Binary Grid Files

These input files are unformatted files, written as FORTRAN unformatted sequential files. As such, these FORTRAN records automatically contain prefix and suffix information that indicate the lengths of each record. The binary files were created on a PC, and have the “little-endian” representation of x86 architectures. The binary grid files are provided by NGS. They are a legacy form that has been used internally.

The first record is a header record that defines and georeferences the remaining grid data.

Header record elements:

glamn	geodetic latitude, positive N., deg., double precision floating point
glomn	geodetic longitude, positive E., deg., double precision floating point
dgla	delta latitude, positive N., deg., double precision floating point
dglo	delta longitude, positive E., deg., double precision floating point
nla	number of rows, integer
nlo	number of columns, integer
ikind	type code of grid data, integer
	ikind = 0 indicates the grid data are unformatted integer
	otherwise, the grid data are unformatted single precision floating point

Note that for the GEOCON files, $ikind = 1$ has been used throughout.

Grid records:

Each record corresponds to a row in the geographic raster grid. Thus, one will always have exactly “ nla ” unformatted sequential records. Each record will contain exactly “ nlo ” elements. And, since $ikind = 1$ for the GEOCON grids, each element will be a single precision (32 bit) floating point value.

Records are written sequentially from South to North. And, within each record, the elements are written sequentially from West to East (row major, column minor order). Thus, all the elements of the first row correspond to the geodetic latitude of $glamn$. Elements of the second row correspond to latitude $glamn + dgla$, and so on. Similarly, the first element of any given row corresponds to a geodetic longitude of $glomn$. The second element corresponds to a longitude of $glomn + dglo$, and so on. One may see that the maximum latitude of the grid is $glamn + (nla - 1) * dgla$. And, the maximum longitude of the grid is $glomn + (nlo - 1) * dglo$.

Each element corresponds to the exact latitude and longitude implied by the row and column order in the set of sequential records. There are no cells, nor is there any registration to a cell corner. The elements are associated to an exact point. Of course, grid elements may be point values, or they may be obtained from some area averaging process.

For all coordinate shift grids, the shift is stored as NAD 83(NSRS2007) – NAD 83(HARN). For all transformation error grids, the error is stored as actual coordinate difference – gridded coordinate difference. Latitudes are considered positive North, longitudes are positive East, and heights are positive up. For latitude and longitude, the shifts and errors are in units of 0.00001 arc seconds. For heights, the shifts and errors are in units of 1 cm.

13. Format of Information File Records

These input records are standard ASCII text with fixed column formatting. They are provided by NGS. They are a new format. The records may be in any order. These records report points in clusters, where the coordinate shifts of those points do not match their neighbors. Information records are used to generate the GEOCON notification messages.

cc 01-15	Longitude, positive E., deg,	99999.999999999	f15.9
cc 16-30	Latitude, positive N., deg	99999.999999999	f15.9
cc 31-40	Value, see note for units	9999999.99	f10.2
cc 42-47	PID. (Permanent Identifier)	ASCII characters	

Note: Value represents the difference between the actual coordinate shift and the predicted coordinate shift obtained from biquadratic interpolation from the gridded coordinate shifts. Units of “value” are 0.00001 arc seconds for horizontal information files, and 1 cm for vertical information files.

Example (fragment from infoh.txt):

256.197346503	40.330059214	-331.58	LK0770
255.274098225	40.182492064	2357.81	LL1465

14. HARN Coordinates

There is no single HARN coordinate realization. The coordinate computations of the NSRS (National Spatial Reference System) underwent an explosion in the early GPS years. The name, HARN, itself, underwent evolution from High Precision Network (HPN) to High Precision Geodetic Network (HPGN) to High Accuracy Geodetic Network (HARN). Despite the name changes, they refer to a GPS backbone campaign observed to the highest standards. As the effort approached completion, GPS reduction software and models improved to the level that significantly better ellipsoid heights were obtained. This led to an additional cycle of nationwide GPS HARN surveys, referred to as the FBN/CBN (Federal Base Network/Cooperative Base Network).

From the geodetic network standpoint, it would have been ideal to complete all the observations and re-observations, and then issue a new set of national coordinates. However the public demand for higher accuracy geodetic control could not be met if NGS waited for all the surveys to be completed. So, in 1990 distinct coordinate sets for least squares adjustments of one or more states began to be issued. NGS continued this process through the 15 year HPN, HPGN, HARN, HARN FBN/CBN evolution.

The coordinates in this period are expressed as a datum tag in the form: NAD 83(nnnn), where “nnnn” is a notional date of the GPS survey observations. It is important to note that the datum tag NAD 83(1994) in Utah refers to a different realization than NAD 83(1994) in Michigan.

In addition, a majority of the states were re-observed as part of the HARN FBN/CBN. To reduce the impact of the inevitable coordinate changes, a flexible, 5 centimeter horizontal coordinate tolerance was adopted. If newer horizontal coordinates did not change by more than 5 cm, then the old horizontal coordinates were retained. In these cases the older datum tag was retained, even though the ellipsoidal heights were *always* updated with the latest GPS surveys and reductions. In other cases, all horizontal and vertical coordinates were updated, and a new datum tag was issued. Note that one can not look at an older datum tag, such as NAD 83(1994) in Ohio, and immediately tell if the associated coordinates are traceable to an earlier HARN adjustment, or to the later HARN FBN/CBN phase.

GEOCON was developed with the latest coordinates available in the NGS database in both the NSRS2007 and the HARN coordinate sets.

To assist users in understanding HARN coordinate sets, and to help track the variety of coordinates, the principal datum tags are listed below. In some cases, more than one datum tag is listed. These are cases where a significant number of points were found in a secondary coordinate set. In these cases, the first coordinate entry represents the majority of the points, and the second coordinate entry represents the lesser number of points.

LIST OF PRINCIPAL DATUM TAGS FOR THE HARN'S

AK	Alaska	NAD 83 (1992)	
AL	Alabama	NAD 83 (1992)	
AR	Arkansas	NAD 83 (1997)	
AZ	Arizona	NAD 83 (1992)	
CA	California	NAD 83 (1998)	NAD 83 (1992)
CO	Colorado	NAD 83 (1992)	
CT	Connecticut	NAD 83 (1996)	
DC	Dist. Columbia	NAD 83 (1993)	NAD 83 (1991)
DE	Delaware	NAD 83 (1991)	
FL	Florida	NAD 83 (1999)	
GA	Georgia	NAD 83 (1994)	
HI	Hawaii	NAD 83 (1992)	
IA	Iowa	NAD 83 (1996)	
ID	Idaho	NAD 83 (1999)	
IL	Illinois	NAD 83 (1997)	
IN	Indiana	NAD 83 (1997)	
KS	Kansas	NAD 83 (1997)	
KY	Kentucky	NAD 83 (1993)	
LA	Louisiana	NAD 83 (1992)	
MA	Massachusetts	NAD 83 (1996)	
MD	Maryland	NAD 83 (1991)	
ME	Maine	NAD 83 (1996)	
MI	Michigan	NAD 83 (1994)	
MN	Minnesota	NAD 83 (1996)	
MO	Missouri	NAD 83 (1997)	
MS	Mississippi	NAD 83 (1993)	
MT	Montana	NAD 83 (1999)	
NC	North Carolina	NAD 83 (2001)	
ND	North Dakota	NAD 83 (1996)	
NE	Nebraska	NAD 83 (1995)	
NH	New Hampshire	NAD 83 (1996)	
NJ	New Jersey	NAD 83 (1996)	
NM	New Mexico	NAD 83 (1992)	
NV	Nevada	NAD 83 (1999)	
NY	New York	NAD 83 (1996)	
OH	Ohio	NAD 83 (1995)	
OK	Oklahoma	NAD 83 (1993)	
OR	Oregon	NAD 83 (1998)	
PA	Pennsylvania	NAD 83 (1992)	NAD 83 (1996)
PR	Puerto Rico	NAD 83 (2002)	
RI	Rhode Island	NAD 83 (1996)	
SC	South Carolina	NAD 83 (2001)	
SD	South Dakota	NAD 83 (1996)	

TN	Tennessee	NAD 83 (1995)	
TX	Texas	NAD 83 (1993)	
UT	Utah	NAD 83 (1994)	
VA	Virginia	NAD 83 (1993)	
VI	Virgin Is.	NAD 83 (2002)	NAD 83 (1997)
VT	Vermont	NAD 83 (1996)	
WA	Washington	NAD 83 (1998)	
WI	Wisconsin	NAD 83 (1997)	
WV	West Virginia	NAD 83 (1995)	
WY	Wyoming	NAD 83 (1993)	NAD 83 (1992)

15. Inventory of GEOCON Support Files

del.a.b	binary grid, transformation error, latitude, CONUS region
delaa.b	binary grid, transformation error, latitude, Alaska region
delap.b	binary grid, transformation error, latitude, PR/VI region
delo.b	binary grid, transformation error, longitude, CONUS region
deloa.b	binary grid, transformation error, longitude, Alaska region
delop.b	binary grid, transformation error, longitude, PR/VI region
dev.b	binary grid, transformation error, vertical, CONUS region
deva.b	binary grid, transformation error, vertical, Alaska region
devp.b	binary grid, transformation error, vertical, PR/VI region
dsla.b	binary grid, coordinate transformation, latitude, CONUS region
dslaa.b	binary grid, coordinate transformation, latitude, Alaska region
dslap.b	binary grid, coordinate transformation, latitude, PR/VI region
dslo.b	binary grid, coordinate transformation, longitude, CONUS region
dsloa.b	binary grid, coordinate transformation, longitude, Alaska region
dslop.b	binary grid, coordinate transformation, longitude, PR/VI region
dsv.b	binary grid, coordinate transformation, vertical, CONUS region
dsva.b	binary grid, coordinate transformation, vertical, Alaska region
dsvp.b	binary grid, coordinate transformation, vertical, PR/VI region
infoh.txt	information file, horizontal, CONUS region
infoha.txt	information file, horizontal, Alaska region
infohp.txt	information file, horizontal, PR/VI region
infov.txt	information file, vertical, CONUS region
infova.txt	information file, vertical, Alaska region
infovp.txt	information file, vertical, PR/VI region