

# **APPENDIX A: USEFUL GEODETIC AND MAP PROJECTION INFORMATION**

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## **TABLE OF GEODETIC FORMULAE**

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Listed below are the various Geodetic Formulae used in the computation to define the Fundamental Constants and Spheroidal Parameters:

Flattening:  $f = \frac{(a - b)}{a}$

Semi Minor Axis:  $b = a(1 - f)$

$$b = \sqrt{(1 - e^2)a^2}$$

$$b = \frac{a(1 - e^2)}{2}$$

Major Eccentricity squared:  $e^2 = \frac{a^2 - b^2}{a^2}$

Minor Eccentricity squared:  $e'^2 = \frac{a^2 - b^2}{b^2}$

Polar Radius of Curvature:  $c = \frac{a^2}{b}$

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## **ELLIPSOIDAL PARAMETERS**

Tabulated below are the Fundamental Constants for the various defined shapes of the Earth.

Listed in alphabetical order of Spheroids.

<b>Spheroid</b>	<b>Semi Major Axis - a (m)</b>	<b>Semi Minor Axis - b (m)</b>	<b>e<sup>2</sup></b>	<b>1/f</b>
Airy 1830	6377563.396	6356256.912	.006670539	299.325
Airy 1858	6377563.000	6356256.873	.006670428	299.330
Airy (Modified)	6377340.189	6356034.448	.006670540	299.324959
Andrea	6377105.000	6355847.982	.006655556	300.000
A.P.L. <sup>3</sup> (N.N.S.S.) <sup>5</sup>	6378144.000	6356757.339	.006694990	298.230
Australian National	6378160.000	6356774.719	.006694542	298.250
Bessel 1841	6377397.155	6356078.963	.006674372	299.152815
Bessel (Modified)	6377492.018	6356173.508	.006674372	299.152813
Bouguer Maupertus 1738	6397300.000	6367792.159	.009203817	216.800
Carte de France	6376985.000	6356323.436	.006469544	308.640
Clarke 1858 (Original)	6378293.000	6356620.241	.006784241	294.300
Clarke 1858 (Corrected)	6378293.645	6356617.938	.006785162	294.260
Clarke 1866	6378206.400	6356583.800	.006768658	294.978698
Clarke 1880	6378249.145	6356514.967	.006803481	293.466316
Clarke 1880F.	6378249.200	6356514.998	.006803488	293.465994
Clarke 1880 (Modified)	6378249.145	6356514.870	.006803511	293.464993
Clarke 1885	6378360.706	6356684.771	.006785162	294.260
Danish	6377103.965	6355846.952	.006655556	300.000
Danish (Degree)	6377019.260	6355762.528	.006655556	300.000
Delambre 1800	6375653.000	6356564.218	.005979060	334.000
Duplesis (Reconstituted)	6376523.340	6355863.271	.006469544	308.640
Everest 1830	6377276.345	6356075.414	.006637847	300.801698
Everest (Modified)	6377304.068	6356103.046	.006637846	300.8017
Fisher 1960	6378166.000	6356784.283	.006693422	298.300
Fisher 1960 S. Asia	6378155.000	6356773.320	.006693422	298.300
Fisher 1968	6378150.000	6356768.337	.006693422	298.300
Ghana National	6378295.000	6356746.706	.006745343	296.000
Hayford 1906	6378283.000	6356864.991	.006704641	297.800
Hayford 1910	6378388.000	6356909.000	.006723591	296.959263
Hayford 1910 (Modified) (also International)	6378388.000	6356911.946	.006722670	297.000
Heiskanen 1926	6378397.000	6356920.916	.006722670	297.000
Helmert 1906	6378200.000	6356818.170	.006693422	298.300
Hough 1956	6378270.000	6356794.343	.006722670	297.000
International (also Hayford 1910mod)	6378388.000	6356911.946	.006722670	297.000
I.R.G.G. <sup>7</sup> 1967	6378206.400	6356583.800	.006768658	294.978698
I.U.G.G. <sup>7</sup> 1967	6378160.000	6356774.719	.006694542	298.250
Jeffreys 1948	6378099.000	6356631.148	.006720411	297.100
Kaula 1961	6378165.000	6356783.287	.006693422	298.300
Kaula 1964	6378160.000	6356774.719	.006694542	298.245
Krasovsky 1936	6378210.000	6356849.635	.006686703	298.600
Krasovsky 1942	6378245.000	6356863.019	.006693422	298.300
Ledersteger 1951	6378298.000	6356822.249	.006722670	297.000

Spheroid	Semi Major Axis - a (m)	Semi Minor Axis - b (m)	e <sup>2</sup>	1/f
Malayan	6377304.063	6356103.039	.006637847	300.8017
N.N.S.S. <sup>5</sup> Guier 65	6378166.000	6356784.284	.006693422	298.300
N.W.L. <sup>2</sup> 8D/9D	6378145.000	6356759.769	.006694542	298.250
N.W.L. <sup>2</sup> 10D (WGS 72)	6378135.000	6356750.520	.006694318	298.260
Pratt 1863	6378245.000	6356645.798	.006761305	295.300
South American 1969ans	6378160.000	6356774.719	.006694542	298.250
S.A.O. <sup>1</sup> C-5	6378165.000	6356779.702	.006694542	298.250
S.A.O. <sup>1</sup> C-6	6378155.000	6356769.736	.006694542	298.250
S.A.O. <sup>1</sup> C-7	6378142.000	6356757.138	.006694430	298.255
S.A.O. <sup>1</sup> SE 111	6378140.400	6356755.616	.006694407	298.256
Stowe	6378297.000	6356655.847	.006774360	294.730
Struve	6378298.300	6356657.143	.006774360	294.730
Veis 1964	6378169.000	6356783.689	.006694542	298.250
Walbeck 1819	6376896.000	6355834.847	.006594548	302.780
W.D. Spheroid	6378300.000	6356751.690	.006745343	296.000
W.G.S. <sup>4</sup> 72 (NWL 10D)	6378135.000	6356750.520	.006694318	298.260
*W.G.S. <sup>4</sup> 84 (GRS 1980)	6378137.000	6356752.314	.006694380	298.257222

\*Reference: W.G.S. 84 (GRS 1980) The Fundamental Constants and Geodetic Values are defined as follows:

- a = 6 378 137.000 (exact)
- b = 6 356 752.314140347
- e<sup>2</sup> = 0.006694380022903416
- e = 0.08181919104283185
- 1/f = 298.2572221008827
- f = 0.003352810681183637

1. Smithsonian Astrophysical Observatory
2. Naval Weapons Laboratory
3. Applied Physics Laboratory
4. World Geodetic System
5. Navy Navigation Satellite System
6. Geodetic Reference System
7. International Union of Geodesy and Geophysics

## **GEODETIC DATUMS AND REFERENCE ELLIPSOIDS**

<b>Datum</b>	<b>Spheroid</b>	<b>Origin</b>	<b>Latitude</b>	<b>Longitude (E)</b>
Adindan (Ethiopia)	Clarke 1880 Mod.	Station 15 Adindan	22°10'07.110"	31°29'21.608"
American Samoa 1962	Clarke 1866	Betty 13 ECC	-14°20'08.340"	189°17'07.750"
African Arc-Cape S.Afr. 1950	Clarke 1880 Mod.	Buffelsfontein	-33°59'32.000"	25°30'44.622"
Aratu (Petrobras)				
Argentina	International	Campo Inchauste	-35°58'17"	297°49'48"
Ascension Island 1958	International	Mean of three stations	-07°57'	345°37'
Australian Geodetic	Australian National Ellipsoid 1967	Johnston Memorial Cairn	-25°56'54.55"	133°12'30.08"
Bermuda 1957	Clarke 1866	Ft. George B 1937	32°22'44.360"	295°19'01.890"
Berne 1898	Bessel	Berne Observatory	46°57'08.660"	07°26'22.335"
Betio Island, 1966 Secor Astro	International	1966 Secor Astro	01°21'42.03"	172°55'47.90"
Bogota				
Camp Area Astro, 1961-62				
Campo Inchauste				
Canton Island, Astro 1966	International	1966 Canton Secor Astro	-02°46'28.99"	188°16'43.47"
Christmas Island, Astro 1967	-----	-----	-----	-----
Chua Astro (Brazil-Geodetic)	International	Chua	-19°45'41.16"	311°53'52.44"
Corrego Alegre (Brazil-Mapping)	International	Corrego Alegre	-19°50'15.140"	311°02'17.250"
Djakarta				
Dutch Datum				
Easter Island Astro. 1967				
Eftate				
European 1950	International	Helmert Tower	52°22'51.45"	13°03'58.74"
Gizo, Provisional DOS	International	GUX 1	-09°27'05.272"	159°58'31.752"
Graciosa Island (Azores)	International	SW Base	39°03'54.934"	331°57'36.118"
Guam 1963	Clarke 1866	Togcha Lee No. 7	13°22'38.49"	144°45'51.56"
Heard Astro. 1969				
Hu-Tzu-Shan				
Iben Astro, Navy 1947 (Truk)	Clarke 1866	Iben Astro	07°29'13.05"	151°49'44.42"
Indian	Everest	Kalianpur	24°07'11.26"	77°39'17.57"
Isla Socorra Astro	Clarke 1866	Station 038	18°43'44.93"	249°02'39.28"
Johnston Island 1961	International	Johnston Island 1961	16°44'49.729"	190°29'04.781"

Datum	Spheroid	Origin	Latitude	Longitude (E)
Kusaie, Astro 1962, 1965	International	Allen Sodano Light	05°21'48.80"	162°58'03.28"
Liberia 64 (Revised 78)				
Luzon 1911 (Philippines)	Clarke 1866	Balanacan	13°33'41.000"	121°52'03.000"
Merchich				
Mercury 1960	Fisher 1960	Geocentric		
Mercury - Modified 1968	Fisher 1968	Geocentric		
Midway Astro 1961	International	Midway Astro 1961	28°11'34.50"	182°36'24.28"
M'Poraloko				
Nahrwan Datum 1976				
Nanking 1960	International			
Naparima				
New French				
New Zealand	International	Papatahi	-14°19'08.900"	175°02'51.000"
Nigerian				
North American 1927	Clarke 1866	Meades Ranch	39°13'26.686"	261°27'29.494"
*NAD 1927 (Cape Canaveral)	Clarke 1866	Central	28°29'32.364"	279°25'21.230"
*NAD 1927 (White Sands)	Clarke 1866	Kent 1909	32°30'27.079"	253°31'01.306"
NAD 83	GRS 80	Geocentric		
Old Bavarian	Bessel	Munich	48°08'20.000"	11°34'26.483"
Old Hawaiian	Clarke 1866	Oahu West Base	21°18'13.89"	202°09'04.20"
Ordnance Survey G.B. 1936	Airy	Herstmonceux	50°51'55.271"	00°20'45.882"
Ordnance Survey G.B. 1970				
Pico de las Nieves (Canaries)	International	Pico de las Nieves	27°57'41.273"	344°25'49.476"
Pitcairn Island Astro	-----	-----	-----	-----
Potsdam	Bessel	Helmert Tower	52°22'53.954"	13°04'01.153"
Provisional S. American 1956	International	Lacamoia	08°34'17.17"	296°08'25.12"
Provisional S. Chile 1963	International	Hito XVIII	-64°67'07.76"	291°23'28.76"
Pulkovo 1942	Krassovski 42	Pulkovo Observatory	59°46'18.55"	30°19'42.09"
Qornoq (kornak)				
Russian 1938	Krassovski 38	Pulkovo Observatory		
S.A.O. C-5				
S.A.O. C-6				
S.A.O. C-7				
South American 1969	IUGG 1967	Geocentric	-----	-----
South Asia	Fisher 1960	Geocentric		
Southeast Island (Mahe)				
South Georgia Astro.				
Strasbourg Observatory	-----	-----	-----	-----
Swallow Islands (Solomons)	International	1966 Secor Astro	-10°18'21.42"	166°17'56.79"



<b>Datum</b>	<b>Spheroid</b>	<b>Origin</b>	<b>Latitude</b>	<b>Longitude (E)</b>
Tananarive	International	Tananarive Observatory	-18°55'02.10"	47°33'06.75"
Tokyo	Bessel	Tokyo Observatory (Old)	35°39'17.51"	139°44'40.50"
Trinidad Re (Old)				
Tristan Astro. 1968				
Viti Levu 1961 (Fiji)	Clarke 1880	Monavatu (Lat. Only)	-17°53'28.285"	
		Suva (Long. Only)		178°25'35.835"
Wake-Eniwetok 1960	Hough 1956			
Wake Island, Astronomic 1952	International	Astro 1952	19°16'48.7"	166°38'46.8"
WGS 66				
WGS 72	WGS 72	Geocentric		
WGS 84	GRS 80	Geocentric		
Yacare				
Yof Astro 1967 (Dakar)	Clarke 1880 Mod.	Yof Astro 1967	14°44'41.62"	342°30'52.98"

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## **GEODETIC DATUM SHIFT WORKING GEODETIC DATUM TO WGS 84**

Listed below are the Datum Shift Parameters used in conversion from the Geodetic Datum to WGS 84.

NOTE: These values are not definitive and should be checked/changed in accordance with the local requirements and/or client approval.

Listed in alphabetical order of Datum.

The user should refer to the important notes following this table before using the data.

<b>Geodetic Datum</b>	<b>Spheroid</b>	<b>diff X m.</b>	<b>diff Y m.</b>	<b>diff Z m.</b>	<b>Country/Area</b>
Adindan	Clarke 1880 Mod.	-162	-12	206	Sudan
Aratu (Petrobras)*	International	-181	294	-149	Brazil (offshore)
ARC (Cape) 1950	Clarke 1880 Mod.	-143	-90	-294	Africa
Ascension Island Astro. 1958*	International	-214	91	48	
Austral. Geodetic	Austral. National	-133	-48	148	Australia
Bogota*	International	277	291	-328	Columbia
Bukit Rimpah	Bessel	-384	664	-48	**
Camp Area Astro	International	-104	-129	239	**
Campo Inchaupé	International	-148	136	90	Argentina
Canton Island Astro. 1966*	International	294	-288	-382	
Djakarta	Bessel	-377	681	-50	Indonesia
Eur. Datum 1950	International	-87	-98	-121	Europe
Geod. Datum 1949	International	84	-22	209	
Ghana	WGS 84	0	0	0	
Guam 1963	Clarke 1866	-100	-248	259	
G.Segara	Bessel	-403	684	41	**
G.Serindung	WGS 84	0	0	0	
Herat North	International	-333	-222	114	**
Hjorsey 1955	International	-73	46	-86	
Hu-Tzu-Shan	International	-634	-549	-201	Taiwan **
Indian	Everest 1830	173	750	264	India **
Indian	Everest 1830	208	841	295	Thailand Area**
Ireland (EIRE) 1965	Airy Mod.	506	-122	611	
Johnston Island Astro. 1961*	International	192	-59	-211	
Kertau (Malayan Rev. Triangulat.)	Everest Mod.	-11	851	5	
Liberia 64 (Rev78)	Clarke 1880 Mod.	-90	40	88	Liberia
Local Astro	?	0	0	0	?
Luzon	Clarke 1866	-133	-77	-54	
Luzon*	Clarke 1866	-129	-136	-39	S.Palawan Only
Luzon*	Clarke 1866	-95	-113	-60	NW.Palawan Only
Merchich	Clarke 1880 Mod.	31	146	47	Morocco
Mercury 1960*	Fisher 1960	-25	46	-49	NAD 27 Area
Mercury 1960*	Fisher 1960	13	-88	-5	ED Area
Mercury 1960*	Fisher 1960	18	-132	60	TD Area

Geodetic Datum	Spheroid	diff X m.	diff Y m.	diff Z m.	Country/Area
Montjong Lowe	WGS 84	0	0	0	
Mod. Mercury 1968*	Fisher 1968	-4	12	-7	NAD 27 Area
Mod. Mercury 1968*	Fisher 1968	-3	1	-6	ED Area
Mod. Mercury 1968*	Fisher 1968	22	34	2	TD Area
M'Poraloko*	Clarke 1880 Mod.	-52	-155	27	Gabon
Nahrwan Datum*	Clarke 1880 Mod.	-225.4	-158.7	378.9	Middle East
Nanking 1960*	International	-131	-347	0	
Naparima	International	-2	374	172	Trinidad
New French*	Clarke 1880 Mod.	-166	-66	313	France
Nigerian (Minna)	Clarke 1880 Mod.	-92	-93	122	Nigeria
N.A.D. 27 (Old)*	Clarke 1866	-22	157	176	North & Central
N.A.D. 27 (New)*	Clarke 1866	-22.5	154	173.4	America
N.A.D. 27	Clarke 1866	-5	135	172	Alaska
N.A.D. 27	Clarke 1866	-4	154	178	Bahamas (excluding San Salvador Island)
N.A.D. 27	Clarke 1866	1	140	165	San Salvador Island
N.A.D. 27	Clarke 1866	-10	158	187	Canada (including Newfoundland)
N.A.D. 27	Clarke 1866	0	125	201	Canal Zone
N.A.D. 27	Clarke 1866	-7	152	178	Caribbean (Barbados, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Leeward Islands, and Turks Islands)
N.A.D. 27	Clarke 1866	0	125	194	Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua)
N.A.D. 27	Clarke 1866	-9	152	178	Cuba
N.A.D. 27	Clarke 1866	11	114	195	Greenland (Hayes Peninsula)
N.A.D. 27	Clarke 1866	-12	130	190	Mexico
N.A.D. 27	Clarke 1866	-8	160	176	Conus (Mean Value)
Old Hawaiian	Airy	210	-230	-357	Maui **
Old Hawaiian	International	201	-224	-349	Oahu **
Old Hawaiian	International	190	-230	-341	Kauai **
Ordnance Survey G.B. 1936	International	375	-111	431	Gt.Britain-Land
P.S.A.D. 1956 (Old)*	WGS 84	-294	104	-366	S. America
P.S.A.D. 1956 (New)*	International	-288	175	-375	S. America
Qornoq (Kornak)	International	164	138	-189	Greenland
Sierra Leone 1960	Fisher 1960 S.Asia (155)	0	0	0	
S. American (Corrego Alegre)	International	-206	172	-6	
S. American (Chua Astro)	Bessel	-134	229	-29	
South Asia*	Bessel	21	-61	-15	
Tananarive Observatory 1925	?	-189	-242	-91	**
Timbalai	Clarke 1858 corr.	-639	583	-55	
Tokyo	Bessel	-128	481	664	Japan
Tokyo Special	Hough 1956	-128	491	664	?

Geodetic Datum	Spheroid	diff X m.	diff Y m.	diff Z m.	Country/Area
Trinidad Re (Old)*	Hough 1956	-87	276	462	Trinidad
Voirol	Hough 1956	0	0	0	
Wake-Eniwetok 1960*	International	112	68	-44	Kwajalein Atoll
Wake-Eniwetok 1960*	International	121	62	-22	Wake Island
Wake-Eniwetok 1960*	WGS 72	144	62	-38	Eniwetok Atoll
Wake Island Astro. 1952*		283	-44	141	
Yacare		-155	171	37	Uruguay **
WGS 72		0	0	4.5	***

- \* Marion Speidel Keen Listed Transformation parameters are referenced to the WGS 72 geodetic datum and not WGS 84.
- \*\* Listed Transformation parameters were determined utilizing previously developed WGS 72 to local Geodetic Datum Transformation Parameters. These Parameters are of questionable accuracy due to lack of adequate doppler stations (if any) and/or appropriate information on either Geodetic connections or the local Geodetic System itself.
- \*\*\* The Transformation achieved using these Parameters is not precise and is an approximation only.
- \*\*\*\* No determined Transformation Parameters to date.

## ***UNIVERSAL TRANSVERSE MERCATOR CONSTANTS***

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The Universal Transverse Mercator grid has the following specifications:

- a. Projection: Transverse Mercator (Gauss-Kruger type), in zones 6° wide.
- b. Spheroid: See Index to Spheroids.
- c. Longitude of origin: Central meridian of each zone.
- d. Latitude of origin: 0° (the Equator).
- e. Unit: Meter.
- f. False northing: 0 meters (10,000,000 for Southern Hemisphere).
- g. False easting: 500,000 meters.
- h. Scale factor at the central meridian: 0.9996.
- i. Zone numbering: Starting with 1 on the zone from 180°W. to 174° W., and increasing eastward to 60 on the zone from 174° E. to 180° E.
- j. Latitude limits of system:
  - North: 84° N.
  - South: 80° S.
- k. Limits of zones and overlap: The zones are bounded by meridians whose longitudes are multiples of 6°W. or E. of Greenwich. On large-scale maps and in trig lists an overlap of approximately 25 miles on either side of the junction is provided for engineer surveyors and for artillery survey and firing. This overlap is never used, however, in giving a grid reference.

## **UNIVERSAL TRANSVERSE MERCATOR ZONE TABLE**

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The following tables show the U.T.M. Zone - Central Meridian (C.M.) and Longitudinal borders of the zones:

<b>West of Greenwich Meridian</b>		<b>Longitudinal Borders</b>	
<b>U.T.M. Zone</b>	<b>Central Meridian (C.M.)</b>	<b>From</b>	<b>To</b>
30	3 Degrees West	0 Degrees West	006 Degrees West
29	9 --- West	006 --- West	012 --- West
28	15 --- West	012 --- West	018 --- West
27	21 --- West	018 --- West	024 --- West
26	27 --- West	024 --- West	030 --- West
25	33 --- West	030 --- West	036 --- West
24	39 --- West	036 --- West	042 --- West
23	45 --- West	042 --- West	048 --- West
22	51 --- West	048 --- West	054 --- West
21	57 --- West	054 --- West	060 --- West
20	63 --- West	060 --- West	066 --- West
19	69 --- West	066 --- West	072 --- West
18	75 --- West	072 --- West	078 --- West
17	81 --- West	078 --- West	084 --- West
16	87 --- West	084 --- West	090 --- West
15	93 --- West	090 --- West	096 --- West
14	99 --- West	096 --- West	102 --- West
13	105 --- West	102 --- West	108 --- West
12	111 --- West	108 --- West	114 --- West
11	117 --- West	114 --- West	120 --- West
10	123 --- West	120 --- West	126 --- West
9	129 --- West	126 --- West	132 --- West
8	135 --- West	132 --- West	138 --- West
7	141 --- West	138 --- West	144 --- West
6	147 --- West	144 --- West	150 --- West
5	153 --- West	150 --- West	156 --- West
4	159 --- West	156 --- West	162 --- West
3	165 --- West	162 --- West	168 --- West
2	171 --- West	168 --- West	174 --- West
1	177 --- West	174 --- West	180 --- West

See accompanying Index to spheroids.

West of Greenwich Meridian		Longitudinal Borders	
U.T.M. Zone	Central Meridian (C.M.)	From	To
31	3 Degrees East	0 Degrees East	006 Degrees East
32	9 --- East	006 --- East	012 --- East
33	15 --- East	012 --- East	018 --- East
34	21 --- East	018 --- East	024 --- East
35	27 --- East	024 --- East	030 --- East
36	33 --- East	030 --- East	036 --- East
37	39 --- East	036 --- East	042 --- East
38	45 --- East	042 --- East	048 --- East
39	51 --- East	048 --- East	054 --- East
40	57 --- East	054 --- East	060 --- East
41	63 --- East	060 --- East	066 --- East
42	69 --- East	066 --- East	072 --- East
43	75 --- East	072 --- East	078 --- East
44	81 --- East	078 --- East	084 --- East
45	87 --- East	084 --- East	090 --- East
46	93 --- East	090 --- East	096 --- East
47	99 --- East	096 --- East	102 --- East
48	105 --- East	102 --- East	108 --- East
49	111 --- East	108 --- East	114 --- East
50	117 --- East	114 --- East	120 --- East
51	123 --- East	120 --- East	126 --- East
52	129 --- East	126 --- East	132 --- East
53	135 --- East	132 --- East	138 --- East
54	141 --- East	138 --- East	144 --- East
55	147 --- East	144 --- East	150 --- East
56	153 --- East	150 --- East	156 --- East
57	159 --- East	156 --- East	162 --- East
58	165 --- East	162 --- East	168 --- East
59	171 --- East	168 --- East	174 --- East
60	177 --- East	174 --- East	180 --- East

See accompanying Index to spheroids.



**SPCS 27**  
**Lambert Conformal Conic Projection**

<b>Zone</b>	<b>First Standard Parallel</b>	<b>Second Standard Parallel</b>	<b>Longitude of Origin</b>	<b>Latitude of Origin</b>	<b>False North</b>	<b>False East (US Survey Feet)</b>
Alaska 10	N51 50	N53 50	W176 00	N51 00	0	3,000,000
Arkansas North	N34 56	N36 14	W 92 00	N34 20	0	2,000,000
Arkansas South	N33 18	N34 46	W 92 00	N32 40	0	2,000,000
California 1	N40 00	N41 40	W122 00	N39 20	0	2,000,000
California 2	N38 20	N39 50	W122 00	N37 40	0	2,000,000
California 3	N37 04	N38 26	W120 30	N36 30	0	2,000,000
California 4	N36 00	N37 15	W119 00	N35 20	0	2,000,000
California 5	N34 02	N35 28	W118 00	N33 30	0	2,000,000
California 6	N32 47	N33 53	W116 15	N32 10	0	2,000,000
California 7	N33 52	N34 25	W118 20	N34 08	4,160,926.74	4,186,692.58
Colorado Central	N38 27	N39 45	W105 30	N37 50	0	2,000,000
Colorado North	N39 43	N40 47	W105 30	N39 20	0	2,000,000
Colorado South	N37 14	N38 26	W105 30	N36 40	0	2,000,000
Connecticut	N41 12	N41 52	W 72 45	N40 50	0	600,000
Florida North	N29 35	N30 45	W 84 30	N29 00	0	2,000,000
Iowa North	N42 04	N43 16	W 93 30	N41 30	0	2,000,000
Iowa South	N40 37	N41 47	W 93 30	N40 00	0	2,000,000
Island (Massachusetts)	N41 17	N41 29	W 70 30	N41 00	0	200,000
Kansas North	N38 43	N39 47	W 98 00	N38 20	0	2,000,000
Kansas South	N37 16	N38 34	W 98 30	N36 40	0	2,000,000
Kentucky North	N37 58	N38 58	W 84 15	N37 30	0	2,000,000
Kentucky South	N36 44	N37 56	W 85 45	N36 20	0	2,000,000
Long Island (New York)	N40 40	N41 02	W 74 00	N40 10	100,000	2,000,000
Louisiana Offshore	N26 10	N27 50	W 91 20	N25 40	0	2,000,000
Louisiana South	N29 18	N30 42	W 91 20	N28 40	0	2,000,000
Louisiana North	N31 10	N32 40	W 92 30	N30 40	0	2,000,000
Mainland (Massachusetts)	N41 43	N42 41	W 71 30	N41 00	0	600,000
Maryland	N38 18	N39 27	W 77 00	N37 50	0	800,000
Michigan Central	N44 11	N45 42	W 84 20	N43 19	0	2,000,000
Michigan North	N45 29	N47 05	W 87 00	N44 47	0	2,000,000
Michigan South	N42 06	N43 40	W 84 20	N41 30	0	2,000,000
Minnesota Central	N45 37	N47 03	W 94 15	N45 00	0	2,000,000

**SPCS 27**  
**Lambert Conformal Conic Projection**

<b>Zone</b>	<b>First Standard Parallel</b>	<b>Second Standard Parallel</b>	<b>Longitude of Origin</b>	<b>Latitude of Origin</b>	<b>False North</b>	<b>False East (US Survey Feet)</b>
Minnesota North	N47 02	N48 38	W 93 06	N46 30	0	2,000,000
Minnesota South	N43 47	N45 13	W 94 00	N43 00	0	2,000,000
Montana Central	N46 27	N47 53	W109 30	N45 50	0	2,000,000
Montana North	N47 51	N48 43	W109 30	N47 00	0	2,000,000
Montana South	N44 52	N46 24	W109 30	N44 00	0	2,000,000
Nebraska North	N41 51	N42 49	W100 00	N41 20	0	2,000,000
Nebraska South	N40 17	N41 43	W 99 30	N39 40	0	2,000,000
North Carolina	N34 20	N36 10	W 79 00	N33 45	0	2,000,000
North Dakota North	N47 26	N48 44	W100 30	N47 00	0	2,000,000
North Dakota South	N46 11	N47 29	W100 30	N45 40	0	2,000,000
Ohio North	N40 26	N41 42	W 82 30	N39 40	0	2,000,000
Ohio South	N38 44	N40 02	W 82 30	N38 00	0	2,000,000
Oklahoma North	N35 34	N36 46	W 98 00	N35 00	0	2,000,000
Oklahoma South	N33 56	N35 14	W 98 00	N33 20	0	2,000,000
Oregon North	N44 20	N46 00	W120 30	N43 40	0	2,000,000
Oregon South	N42 20	N44 00	W120 30	N41 40	0	2,000,000
Pennsylvania North	N40 53	N41 57	W 77 45	N40 10	0	2,000,000
Pennsylvania South	N39 56	N40 58	W77 45	N39 20	0	2,000,000
Puerto Rico & Virgin Islands 1	N18 02	N18 26	W 66 26	N17 50	0	0
Puerto Rico & Virgin Islands 2 (St. Croix)	N18 02	N18 26	W 66 26	N17 50	0	0
Samoa	N14 16	N00 00	W170 00	N00 00	0	2,000,000
South Carolina North	N33 46	N34 58	W 81 00	N33 00	0	2,000,000
South Carolina South	N32 20	N33 40	W 81 00	N31 50	0	2,000,000
South Dakota North	N44 25	N45 41	W100 00	N43 50	0	2,000,000
South Dakota South	N42 50	N44 24	W100 20	N42 20	0	2,000,000
Tennessee	N35 15	N36 25	W 86 00	N34 40	100,000	2,000,000
Texas Central	N30 07	N31 53	W100 20	N29 40	0	2,000,000
Texas North	N34 39	N36 11	W101 30	N34 00	0	2,000,000
Texas North Central	N32 08	N33 58	W 97 30	N31 40	0	2,000,000
Texas South	N26 10	N27 50	W 98 30	N25 40	0	2,000,000
Texas South Central	N28 23	N30 17	W 99 00	N27 50	0	2,000,000
Utah Central	N39 01	N40 39	W111 30	N38 20	0	2,000,000

**SPCS 27**  
**Lambert Conformal Conic Projection**

<b>Zone</b>	<b>First Standard Parallel</b>	<b>Second Standard Parallel</b>	<b>Longitude of Origin</b>	<b>Latitude of Origin</b>	<b>False North</b>	<b>False East (US Survey Feet)</b>
Utah North	N40 43	N41 47	W111 30	N40 20	0	2,000,000
Utah South	N37 13	N38 21	W111 30	N36 40	0	2,000,000
Virginia North	N38 02	N39 12	W 78 30	N37 40	0	2,000,000
Virginia South	N36 46	N37 58	W 78 30	N36 20	0	2,000,000
Washington North	N47 30	N48 44	W120 50	N47 00	0	2,000,000
Washington South	N45 50	N47 20	W120 30	N45 20	0	2,000,000
West Virginia North	N39 00	N40 15	W 79 30	N38 30	0	2,000,000
West Virginia South	N37 29	N38 53	W 81 00	N37 00	0	2,000,000
Wisconsin Central	N44 15	N45 30	W 90 00	N43 50	0	2,000,000
Wisconsin North	N45 34	N46 46	W 90 00	N45 10	0	2,000,000
Wisconsin South	N42 44	N44 04	W 90 00	N42 00	0	2,000,000

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**SPCS 27**  
**Transverse Mercator Projection**

State Zone	Central Meridian	False Northing (ft)	False Easting (ft)	Scale Factor @ CM	Latitude of Origin
Alabama East	85°50'	0	500,000	0.999960	30°30'
Alabama West	87°30'	0	500,000	0.999933	30°00'
Alaska Zone 2	142°00'	0	500,000	0.999900	54°00'
Alaska Zone 3	146°00'	0	500,000	0.999900	54°00'
Alaska Zone 4	150°00'	0	500,000	0.999900	54°00'
Alaska Zone 5	154°00'	0	500,000	0.999900	54°00'
Alaska Zone 6	158°00'	0	500,000	0.999900	54°00'
Alaska Zone 7	162°00'		700,000	0.999900	54°00'
Alaska Zone 8	166°00'	0	500,000	0.999900	54°00'
Alaska Zone 9	170°00'	0	600,000	0.999900	54°00'
Arizona Central	111°55'	0	500,000	0.999900	31°00'
Arizona East	110°10'	0	500,000	0.999900	31°00'
Arizona West	113°45'	0	500,000	0.999933	31°00'
Delaware	75°25'	0	500,000	0.9999950281	38°00'
Florida East	81°00'	0	500,000	0.9999411765	24°20'
Florida West	82°00'	0	500,000	0.9999411765	24°20'
Georgia East	82°10'	0	500,000	0.999900	30°00'
Georgia West	84°10'	0	500,000	0.999900	30°00'
Hawaii Zone 1	155°30'	0	500,000	0.9999666667	18°50'
Hawaii Zone 2	156°40'	0	500,000	0.9999666667	20°20'
Hawaii Zone 3	158°00'	0	500,000	0.999990	21°10'
Hawaii Zone 4	159°30'	0	500,000	0.999990	21°50'
Hawaii Zone 5	160°10'	0	500,000	0.9999999999	21°40'
Idaho Central	114°00'	0	500,000	0.9999473684	41°40'
Idaho East	112°10'	0	500,000	0.9999473684	41°40'
Idaho West	115°45'	0	500,000	0.9999333333	41°40'
Illinois East	88°20'	0	500,000	0.999975	36°40'
Illinois West	90°10'	0	500,000	0.9999411765	36°40'
Indiana East	85°40'	0	500,000	0.9999666667	37°30'
Indiana West	87°05'	0	500,000	0.9999666667	37°30'
Maine East	68°30'	0	500,000	0.999900	43°50'

**SPCS 27**  
**Transverse Mercator Projection**

State Zone	Central Meridian	False Northing (ft)	False Easting (ft)	Scale Factor @ CM	Latitude of Origin
Maine West	70°10'	0	500,000	0.999966667	42°50'
Michigan Central (1934)	85°45'	0	500,000	0.9999090909	41°30'
Michigan East (1934)	83°40'	0	500,000	0.9999428571	41°30'
Michigan West (1934)	88°45'	0	500,000	0.9999090909	41°30'
Mississippi East	88°50'	0	500,000	0.999960	29°40'
Mississippi West	90°20'	0	500,000	0.9999411765	30°30'
Missouri Central	92°30'	0	500,000	0.9999333333	35°50'
Missouri East	90°30'	0	500,000	0.9999333333	35°30'
Missouri West	94°30'	0	500,000	0.9999411765	36°10'
Nevada Central	116°40'	0	500,000	0.999900	34°45'
Nevada East	115°35'	0	500,000	0.999900	34°45'
Nevada West	118°35'	0	500,000	0.999900	34°45'
New Hampshire	71°40'	0	500,000	0.999966667	42°30'
New Jersey	74°40'	0	2,000,000	0.9999750295	38°50'
New Mexico Central	106°15'	0	500,000	0.999900	31°00'
New Mexico East	104°20'	0	500,000	0.9999090909	31°00'
New Mexico West	107°50'	0	500,000	0.9999166667	31°00'
New York Central	76°35'	0	500,000	0.999937500	40°00'
New York East	74°20'	0	500,000	0.999966667	40°00'
New York West	78°35'	0	500,000	0.999937500	40°00'
Rhode Island	71°30'	0	500,000	0.999937500	41°05'
Vermont	72°30'	0	500,000	0.9999642857	42°30'
Wyoming Zone I	105°10'	0	500,000	0.9999411765	40°40'
Wyoming Zone II	107°20'	0	500,000	0.9999411765	40°40'
Wyoming Zone III	108°45'	0	500,000	0.9999411765	40°40'
Wyoming Zone IV	110°05'	0	500,000	0.9999411765	40°40'

**SPCS 83**  
**Lambert Conformal Conic Projection**

<b>Zone</b>	<b>First Standard Parallel</b>	<b>Second Standard Parallel</b>	<b>Longitude of Origin</b>	<b>Latitude of Origin</b>	<b>False North (metres)</b>	<b>False East (metres)</b>
Alaska 10 - 5010	N51 50	N53 50	W176 00	N51 00	0	1,000,000
Arkansas North - 0301	N34 56	N36 14	W 92 00	N34 20	0	400,000
Arkansas South - 0302	N33 18	N34 46	W 92 00	N32 40	400,000	400,000
California 1 - 0401	N40 00	N41 40	W122 00	N39 20	500,000	2,000,000
California 2 - 0402	N38 20	N39 50	W122 00	N37 40	500,000	2,000,000
California 3 - 0403	N37 04	N38 26	W120 30	N36 30	500,000	2,000,000
California 4 - 0404	N36 00	N37 15	W119 00	N35 20	500,000	2,000,000
California 5 - 0405	N34 02	N35 28	W118 00	N33 30	500,000	2,000,000
California 6 - 0406	N32 47	N33 53	W116 15	N32 10	500,000	2,000,000
Colorado Central - 0502	N38 27	N39 45	W105 30	N37 50	304,800.610	914,401.829
Colorado North - 0501	N39 43	N40 47	W105 30	N39 20	304,800.610	914,401.829
Colorado South - 0503	N37 14	N38 26	W105 30	N36 40	304,800.610	914,401.829
Connecticut - 0600	N41 12	N41 52	W 72 45	N40 50	152,400.305	604,800.610
Florida North - 0903	N29 35	N30 45	W 84 30	N29 00	0	600,000
Iowa North - 1401	N42 04	N43 16	W 93 30	N41 30	1,000,000	1,500,000
Iowa South - 1402	N40 37	N41 47	W 93 30	N40 00	0	500,000
Kansas North - 1501	N38 43	N39 47	W 98 00	N38 20	0	400,000
Kansas South - 1502	N37 16	N38 34	W 98 30	N36 40	400,000	400,000
Kentucky North -1601	N37 58	N38 58	W 84 15	N37 30	0	500,000
Kentucky South - 1602	N36 44	N37 56	W 85 45	N36 20	500,000	500,000
Louisiana North - 1701	N31 10	N32 40	W 92 30	N30 30	0	1,000,000
Louisiana Offshore - 1703	N26 10	N27 50	W 91 20	N25 30	0	1,000,000
Louisiana South - 1702	N29 18	N30 42	W 91 20	N28 30	0	1,000,000
Maryland - 1900	N38 18	N39 27	W 77 00	N37 40	0	400,000
Massachusetts Island - 2002	N41 17	N41 29	W 70 30	N41 00	0	500,000
Massachusetts Mainland - 2001	N41 43	N42 41	W 71 30	N41 00	750,000	200,000
Michigan Central - 2112	N44 11	N45 42	W 84 20	N43 19	0	6,000,000
Michigan North - 2111	N45 29	N47 05	W 87 00	N44 47	0	8,000,000
Michigan South - 2113	N42 06	N43 40	W 84 20	N41 30	0	4,000,000
Minnesota Central - 2202	N45 37	N47 03	W 94 15	N45 00	100,000	800,000
Minnesota North - 2201	N47 02	N48 38	W 93 06	N46 30	100,000	800,000

**SPCS 83**  
**Lambert Conformal Conic Projection**

<b>Zone</b>	<b>First Standard Parallel</b>	<b>Second Standard Parallel</b>	<b>Longitude of Origin</b>	<b>Latitude of Origin</b>	<b>False North (metres)</b>	<b>False East (metres)</b>
Minnesota South - 2203	N43 47	N45 13	W 94 00	N43 00	100,000	800,000
Montana - 2500	N45 00	N49 00	W109 30	N44 15	0	600,000
Nebraska - 2600	N40 00	N43 00	W100 00	N39 50	0	500,000
New York Long Island - 3104	N40 40	N41 02	W 74 00	N40 10	0	300,000
North Carolina - 3200	N34 20	N36 10	W 79 00	N33 45	0	609,601.220
North Dakota North - 3301	N47 26	N48 44	W100 30	N47 00	0	600,000
North Dakota South - 3302	N46 11	N47 29	W100 30	N45 40	0	600,000
Ohio North - 3301	N40 26	N41 42	W 82 30	N39 40	0	600,000
Ohio South - 3302	N38 44	N40 02	W 82 30	N38 00	0	600,000
Oklahoma North - 3501	N35 34	N36 46	W 98 00	N35 00	0	600,000
Oklahoma South - 3502	N33 56	N35 14	W 98 00	N33 20	0	600,000
Oregon North - 3601	N44 20	N46 00	W120 30	N43 40	0	2,500,000
Oregon South - 3602	N42 20	N44 00	W120 30	N41 40	0	1,500,000
Pennsylvania North - 3701	N40 53	N41 57	W 77 45	N40 10	0	600,000
Pennsylvania South - 3702	N39 56	N40 58	W77 45	N39 20	0	600,000
Puerto Rico & Virgin Islands - 5200	N18 02	N18 26	W 66 26	N17 50	200,000	200,000
South Carolina - 3900	N32 30	N34 50	W 81 00	N31 50	0	609,600.000
South Dakota North - 4001	N44 25	N45 41	W100 00	N43 50	0	600,000
South Dakota South - 4002	N42 50	N44 24	W100 20	N42 20	0	600,000
Tennessee - 4100	N35 15	N36 25	W 86 00	N34 40	0	600,000
Texas Central - 4203	N30 07	N31 53	W100 20	N29 40	3,000,000	700,000
Texas North - 4201	N34 39	N36 11	W101 30	N34 00	1,000,000	200,000
Texas North Central - 4202	N32 08	N33 58	W 97 30	N31 40	2,000,000	600,000
Texas South - 4205	N26 10	N27 50	W 98 30	N25 40	5,000,000	300,000
Texas South Central - 4204	N28 23	N30 17	W 99 00	N27 50	4,000,000	600,000
Utah Central - 4302	N39 01	N40 39	W111 30	N38 20	2,000,000	500,000
Utah North - 4301	N40 43	N41 47	W111 30	N40 20	1,000,000	500,000
Utah South - 4303	N37 13	N38 21	W111 30	N36 40	3,000,000	500,000
Virginia North - 4501	N38 02	N39 12	W 78 30	N37 40	2,000,000	3,500,000
Virginia South - 4502	N36 46	N37 58	W 78 30	N36 20	1,000,000	3,500,000
Washington North - 4601	N47 30	N48 44	W120 50	N47 00	0	500,000
Washington South - 4602	N45 50	N47 20	W120 30	N45 20	0	500,000



**SPCS 83**  
**Lambert Conformal Conic Projection**

<b>Zone</b>	<b>First Standard Parallel</b>	<b>Second Standard Parallel</b>	<b>Longitude of Origin</b>	<b>Latitude of Origin</b>	<b>False North (metres)</b>	<b>False East (metres)</b>
West Virginia North - 4701	N39 00	N40 15	W 79 30	N38 30	0	600,000
West Virginia South - 4702	N37 29	N38 53	W 81 00	N37 00	0	600,000
Wisconsin Central - 4802	N44 15	N45 30	W 90 00	N43 50	0	600,000
Wisconsin North - 4801	N45 34	N46 46	W 90 00	N45 10	0	600,000
Wisconsin South - 4803	N42 44	N44 04	W 90 00	N42 00	0	600,000

**SPCS 83  
Transverse Mercator Projection**

State Zone	Central Meridian	False Northing (metres)	False Easting (metres)	Scale Factor @ CM	Latitude of Origin
Alabama East - 0101	85°50'	0	200,000	0.999960	30°30'
Alabama West - 0102	87°30'	0	600,000	0.99993333	30°00'
Alaska Zone 2 - 5002	142°00'	0	500,000	0.999900	54°00'
Alaska Zone 3 - 5003	146°00'	0	500,000	0.999900	54°00'
Alaska Zone 4 - 5004	150°00'	0	500,000	0.999900	54°00'
Alaska Zone 5 - 5005	154°00'	0	500,000	0.999900	54°00'
Alaska Zone 6 - 5006	158°00'	0	500,000	0.999900	54°00'
Alaska Zone 7 - 5007	162°00'		500,000	0.999900	54°00'
Alaska Zone 8 - 5008	166°00'	0	500,000	0.999900	54°00'
Alaska Zone 9 - 5009	170°00'	0	500,000	0.999900	54°00'
Arizona Central - 0202	111°55'	0	213,360	0.999900	31°00'
Arizona East - 0201	110°10'	0	213,360	0.999900	31°00'
Arizona West - 0203	113°45'	0	213,360	0.99993333	31°00'
Delaware - 0700	75°25'	0	200,000	0.99999500	38°00'
Florida East - 0901	81°00'	0	200,000	0.99994118	24°20'
Florida West - 0902	82°00'	0	200,000	0.99994118	24°20'
Georgia East - 1001	82°10'	0	200,000	0.999900	30°00'
Georgia West - 1002	84°10'	0	700,000	0.999900	30°00'
Hawaii Zone 1 - 5101	155°30'	0	500,000	0.9999666667	18°50'
Hawaii Zone 2 - 5102	156°40'	0	500,000	0.9999666667	20°20'
Hawaii Zone 3 - 5103	158°00'	0	500,000	0.999990	21°10'
Hawaii Zone 4 - 5104	159°30'	0	500,000	0.999990	21°50'
Hawaii Zone 5 - 5105	160°10'	0	500,000	1.0	21°40'
Idaho Central - 1102	114°00'	0	500,000	0.9999473700	41°40'
Idaho East - 1101	112°10'	0	200,000	0.9999473700	41°40'
Idaho West - 1103	115°45'	0	800,000	0.9999333333	41°40'
Illinois East - 1201	88°20'	0	300,000	0.999975	36°40'
Illinois West - 1202	90°10'	0	700,000	0.99994118	36°40'
Indiana East - 1301	85°40'	250,000	100,000	0.999966667	37°30'

**SPCS 83**  
**Transverse Mercator Projection**

State Zone	Central Meridian	False Northing (metres)	False Easting (metres)	Scale Factor @ CM	Latitude of Origin
Indiana West - 1302	87°05'	250,000	900,000	0.999966667	37°30'
Maine East - 1801	68°30'	0	300,000	0.999900	43°40'
Maine West - 1802	70°10'	0	900,000	0.999966667	42°50'
Mississippi East - 2301	88°50'	0	300,000	0.999950	29°30'
Mississippi West - 2302	90°20'	0	700,000	0.999950	29°30'
Missouri Central - 2402	92°30'	0	500,000	0.9999333333	35°50'
Missouri East - 2401	90°30'	0	250,000	0.9999333333	35°50'
Missouri West - 2403	94°30'	0	850,000	0.99994118	36°10'
Nevada Central - 2702	116°40'	6,000,000	500,000	0.999900	34°45'
Nevada East - 2701	115°35'	8,000,000	200,000	0.999900	34°45'
Nevada West - 2703	118°35'	4,000,000	800,000	0.999900	34°45'
New Hampshire - 2800	71°40'	0	300,000	0.999966667	42°30'
New Jersey - 2900	74°30'	0	150,000	0.9999	38°50'
New Mexico Central - 3002	106°15'	0	500,000	0.999900	31°00'
New Mexico East - 3001	104°20'	0	165,000	0.9999090909	31°00'
New Mexico West - 3003	107°50'	0	830,000	0.9999166667	31°00'
New York Central - 3102	76°35'	0	250,000	0.999937500	40°00'
New York East - 3101	74°30'	0	150,000	0.9999	38°50'
New York West - 3103	78°35'	0	350,000	0.999937500	40°00'
Rhode Island - 3800	71°30'	0	100,000	0.9999937500	41°05'
Vermont - 4400	72°30'	0	500,000	0.9999642857	42°30'
Wyoming East - 4901	105°10'	0	200,000	0.9999375	40°30'
Wyoming East Central - 4902	107°20'	100,000	400,000	0.9999375	40°30'
Wyoming West - 4904	108°45'	100,000	800,000	0.9999375	40°30'
Wyoming West Central - 4903	110°05'	0	600,000	0.9999375	40°30'

**SPCS 83**  
***Oblique Mercator Projection***

<b>State Zone</b>	<b>Longitude of Origin</b>	<b>False Northing (metres)</b>	<b>False Easting (metres)</b>	<b>Scale Factor @ CM</b>	<b>Latitude of Origin</b>	<b>Central Line Azimuth</b>
Alaska Zone 1 - 5001	85°50'	0	200,000	0.999960	30°30'	323°07'48.368475"

## ***NOAA TECHNICAL PUBLICATIONS***

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NGS engages in research and development for the improvement of knowledge of the shape of the Earth and its gravity field. The NGS also has the responsibility to procure geodetic data from all sources, process these data, and make them generally available to users through a central database.

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