Grids & Datums

Territory of Guam

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The original inhabitants of Guam are believed to have been of Indo-Malayan descent originating from Southeast Asia as early as 2,000 B.C., and having linguistic and cultural similarities to Malaysia (PE&RS, April 2009), Indonesia, and the Philippines (*PE&RS*, August 1999). The Chamorro flourished as an advanced fishing, horticultural, and hunting society. They were expert seamen and skilled craftsmen familiar with intricate weaving and detailed pottery making who built unique houses and canoes suited to this region of the world. Ceded to the United States by Spain (*PE&RS*, July 2000) in 1898, Guam is located about three-quarters of the way from Hawaii to the Philippines. The island is about three times the size of Washington, D.C.: the lowest point is the North Pacific Ocean (0 m), and the highest point is Mount Lamlam (406 m). Guam is the largest and southernmost island in the Mariana Islands archipelago (*World Factbook*, 2009). About 35 years ago, a friend of mine, Don Eames, now retired from the Survey Section of the U.S. Army Corps of Engineers, New Orleans District, informed me that the Guamanian phrase for "Hello, how are you?" is pronounced, "Hafa tata manoa." We still greet each other with that phrase.

In 1904, the U.S. Coast and Geodetic Survey (USC&GS) performed telegraphic longitude determinations between Guam and both Manila and the Island of Midway (*USC&GS Annual Report 1904, Appendix Telegraphic Longitudes, pp. 257-312.*). The first geodetic survey of the island was by Butler of the U.S. Army Corps of Engineers from 1911-1913 in which station "Togcha (USE or U.S. Corps of Engineers)," (formerly "Lee No. 7") is where: Φ_o = 13° 22' 38.490" N, Λ_o = 144° 45' 51.560" East of Greenwich, and the ellipsoid of reference is the Clarke 1866 where: a = 6,378,206.4 meters, and b = 6,356,583.8 meters, or $^1/_f$ = 294.9786982. Additional triangulation network surveys were performed in 1945 and in 1949.

Upon the official request of the Territory of Guam, a completely new triangulation scheme was planned by the USC&GS, and in 1963 the observations for the survey were completed. The 1963 work superseded all previous surveys, although many of the old marked stations were incorporated in the new scheme. The main scheme was accomplished under the specifications of first-order class II, whereas the subsidiary work was accomplished under specifications for second-order classes I and II. The datum for the work officially designated as the Guam 1963 Datum was essentially astronomic. The geographic position of station "Togcha (USE)," formerly "Lee No. 7", as determined by the Butler Survey was used as the initial geographic position on which all other positions were based. The triangulation scheme was orientated by astronomic azimuths taken over the line "Togcha (USE)" – "Macajna (GG or Guam Geodetic)" in both directions. The mean of these two astronomic determinations, after accounting for the $\Delta\alpha$, was adopted as the azimuth of this line. (*The "$\Delta\alpha$" commonly refers to the convergence angle as computed on a Transverse Mercator projection – Ed.*) Length control for the main scheme consisted of 12 lines, measured with the Tellurometer (*A microwave electronic distance meter – Ed.*), distributed as follows: four lines in the northeast region of the island; five lines in the central area; and three lines in the southern mountainous region. All geographic positions were converted to plane rectangular coordinates based on a Modified Azimuthal Equidistant projection centered on station "Agana Monument 1945" where: φ_o = 13° 28' 20.87887" N, λ_o = 144° 44' 55.50254" E, and False Easting = False Northing = 50 Km. The ellipsoid of reference remained the Clarke 1866 (*State Plane Coordinates by Automatic Data Processing, Charles N. Claire, USC&GS Pub. No. 62-4, 1968, pp. 35-39*). There were 29 main scheme stations; 87 supplemental stations; 30 intersection stations; and 13 traverse stations, totaling 159 stations.

By 1993, the existing Guam 1963 Datum no longer met the needs of Guam in spatially locating the cadastre or supporting Guam's Land Information System. Much of the network had been destroyed over time, and there had been no extension of the network into new areas of development since 1963. Consequently the quality of cadastral surveys had been seriously affected with resultant gaps and overlaps. Aware of the recent developments in geodetic surveying and the Government of Guam Department of Land Management's (DLM) lack of experience, the South Australian Department of Environment & Natural Resources was contacted to provide the technical and administrative support for the DLM to establish the 1993 Guam Geodetic Network (1993 GGN). A total of 2,629 survey marks comprise the 1993 GGN, of which 2,203 new marks have been established. The network comprises 28 primary stations; 216 secondary stations; and 2,385 tertiary stations.

Guam Public Law 23-31 established the North American Datum of 1983 (NAD83) as the coordinate reference system for Guam, replacing the Guam 1963 Datum. The reference ellipsoid is the GRS 1980 where a = 6,378,137 m and $^1/_f$ = 298.257 222 101. The law also established the Guam Map Grid, replacing the 1963 map grid. The defining parameters of the Transverse Mercator projection are where: Central Meridian, λ_o = 144° 45' E, Latitude of
False Origin, φ_{FN} = 13° 30' N, False Easting = 100 km, False Northing = 200 km, and the scale factor at origin is equal to unity. It is reported that the maximum scale factor on the island is 1.000006 and that occurs at Point Pati on the northeast coast near Anderson AFB. The transformation parameters from Guam 1963 Datum to NAD83 are: ΔX = +201.686 m, ΔY = +66.350 m, ΔZ = +457.288 m, scale = $+2.327\times10^{-6}$, R_X = +2.925", R_Y = +6.188",
R_Z = –14.106". "Note that rotations are positive anti-clockwise about the axes of 1963 GGTN coordinate system when viewing the origin from the positive axes" (*The 1993 Guam Geodetic Network, Andrew Dyson, South Australian Dept. of Environmental and Natural Resources, November 1995*).

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