Grids & Datums

The Islands of Samoa

by Clifford J. Mugnier, C.P., C.M.S.

Thanks to information from *American Samoa Tourism 2009* and *Samoan Sensation 2011*, we know that the islands of independent Samoa are comprised of nine islands: Savai'i and Upolu with the most inhabitants, and with only two others, Manono and Apolima being inhabited. The other five are: Fanuatapu, Namu'a, Nuutele, Nuulua, and Nuusafee. American Samoa, a territory of the United States, is comprised of five volcanic islands: Tutuila, Ta'u, Ofu, Olosega, Aunu'u, and of two atolls: Rose Atoll and Swain's Island. Polynesians first migrated to the Samoan Islands more than 3,000 years ago. In 1722, the Dutch explorer Jacob Roggeveen became the first European to arrive in Samoa, but for most of the 18th century European influence was limited to occasional trading with ships that passed through the islands. In 1872 the U.S. Navy established a harbor in Pago Pago on the island of Tutuila. In 1899, Western Samoa was passed into German hands while the U.S. took control of what is now American Samoa. In 1914, New Zealand took control of Western Samoa and it was the first Polynesian state to gain independence in 1962.

The current new datum for American Samoa is NAD83 (2002–HARN) where the U.S. National Geodetic Survey has computed NADCON tables for Ofu, Olosega, and Ta'u Islands listed as the **eshpgn Grid Pair File Prefix, and for Tutuila, and Aunu'u Islands listed as the **wshpgn Grid Pair File Prefix, thanks to Dave Doyle of the National Geodetic Survey.

American Samoa is slightly larger than Washington, D.C. The lowest point is the Pacific Ocean and the highest point is Lata Mountain (964 m). Samoa is slightly smaller than Rhode Island, the lowest point is the Pacific Ocean and the highest point is Mount Silisili (1,857 m).

"During the German's Administration of Samoa early in the 20th century, German surveyors started the first ever surveying system in 1914 and it was used as the basis for all surveys in Samoa. This triangulation system was established and called the Observatory Origin. Between 1921 and 1927 the circuit traverse was carried out for the entire area of Apia based on the Observatory Origin established in 1914. In 1941 the German Triangulation was recalculated and shifted to the north pier of some meters from the first origin established in 1914 and called it the Lemuta Origin. This shift from the first origin in 1914 to the one established in 1941 formed the now so called Lemuta Datum as the datum used for all cadastral survey within the country up till now. All control traverses based on this datum called Lemuta were completed between 1953 and 1954" (*Polutea, et al, Improving Samoa's Geographic Information Services through the Upgrade of its National Geodetic Survey Network, Government of Samoa, 2004*).

"The Lemuta datum was established in 1953 by traverse survey, and has an arbitrary origin located near the Observatory on Mulenu'u Peninsular. The Observatory datum, which also has its origin somewhere near the Observatory, is an even older datum that is sometimes used. A preliminary attempt at this was done in 1995 by New Zealand resident surveyors without the benefit of high precision GPS to eliminate errors in the primary control. It is understood from anecdotal information that there may be differences in the Lemuta datum [sic] over different parts of the Islands." (*Infrastructure Asset Management Project – Phase II, Government of Samoa, 2004*). Thanks to John W. Hager, "Apia Observatory Transit House is the same as Lemuta. Lemuta at Apia Observatory Transit Pillar, Φ_o = S 13° 48' 26" ± 0.4" probable error (1911), Λ_o = W 171° 46' 30", ± 2" probable error (1921), referenced to the International ellipsoid where a = 6,378,388 meters and $^1/_f$ = 297. Latitude was observed by the German Government, surveyor Lammert. Longitude was observed by the New Zealand government. The pillar is in the garden of the observatory. Based on the above values, Matautu Point F.S. is ϕ = S 13° 49' 01.6", λ = W 171° 45' 09.6". The reference is a Hydrographic Report, Apia Harbor. I observed a grid on 1:20,000 topo sheets for Western Samoa which I called the Lemuta Datum Grid. TM, International, ϕ_o = S 13° 48' 26", λ_o = W 171° 46' 30", FN = FE=0, scale factor = 1.0."

Samoa used the Western Samoa Integrated Grid, WSIG, which was adopted in 1988. The grid was based on the WGS72 Datum with the Western Samoa Integrated Grid, (WSIG): Projection: Transverse Mercator, ellipsoid: WGS72 where a = 6,378,135 meters and $^1/_f$ = 298.26, Central Meridian: 188° E (–172°) Scale Factor = unity, False Easting = 700,000, and False Northing = 7,000,000.

The Samoan Geodetic Network is comprised of 34 survey marks, of which 19 new marks have been established. The network comprises 26 primary stations and 8 secondary stations. The horizontal datum for Samoa is defined as the Samoan Geodetic Reference System 2005 (SGRS2005). The following high precision fundamental geodetic stations referred to the GRS80 ellipsoid where a = 6,378,137 meters and 1/f = 298.257222101 are: 102 – Faleolo CGPS ϕ = S 13° 49' 55.95916", λ = W 171° 59' 58.32189", h = 47.600 m, and 104 – Fagalii CGPS ϕ = S 13° 50' 57.14900", λ = W 171° 44' 18.34120", h = 76.875 m. This

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datum is defined within the International Terrestrial Reference Frame 2000 (ITRF2000) at the epoch of 2006.00. The Samoan Map Grid is defined as UTM Zone 2. The shift from WGS72 to SGRS2005 is: ΔX = 0.460 m, ΔY = –13.615 m, ΔX = 5.786 m. The SGRS2005 coordinates of Observatory Doppler are: ϕ = S 13° 48' 52.903267", λ = W 171° 46' 50.92481", H = 1.41 m (*The Samoan Geodetic Network, Government of Samoa, December 2005*).

Again thanks to John W. Hager, "America Samoa 1962 (code AMA) at Betty 13 ecc (USGS), ϕ_o = 14° 20' 08.34" S ± 0.13" (Φ_o = same), λ_o = 170° 42' 52.25" ± 0.08" (Λ_o = ... 52.15"), α_o = 184° 15' 07.47" ± 0.21" to Betty 13 ecc Azimuth mark measured from south, Clarke 1866 (*where a = 6,378,206.4 meters, b = 6,356,583.8 meters – Ed.*), H_o = 5.43 meters. The reference is *United States Department of the Interior, Geological Survey, Horizontal Control Data*. This was also the position of Doppler 10655.

"Rose Atoll (1939) (no code) at Observation Spot, Φ_o = 14° 32' 51.91" S, Λ_o = 168° 08' 33.7" W, α_o = 37° 25' 11.29" to Lan from south. Astro observation by astrolabe, using chronograph and radio time signals, U.S.S. Bushnell. Taken from NOS chart 83484. Swains (1939) (code ASP), at Astro Pier (U.S.S. Bushnell), Φ_o = 11° 03' 35.97" S, Λ_o = 171° 04' 24.99" W, α_o = 232° 54' 21.76" Gagie to Teleapa from South. Astro observation by astrolabe, using chronograph and radio time signals, U.S.S. Bushnell. Swains Island (code SWS) at Observation Spot, Φ_o = 11° 03' 18" S, Λ_o = 171° 05' 53" W. The existence of this datum was from a request from the UK in 1994 for a datum code. Tutuila 1962 (code TUT), at Tutuila Astro Sta. USGS (unadjusted) or AMS 10-62 Astro Station, Φ_o = 14° 19' 50.530" S, Λ_o = 170° 42' 45.767" W, α_o = 89° 02' 33.6" to Betty 13 ecc. From the same source file as American Samoa 1962 there are values of Tutuila 1962 based on American Samoa 1962 datum of ϕ_o = 14° 20' 08.334" S, λ_o = 170° 42' 51.882" W, α_o = 89° 02' 35"." According to TR 8350.2, **from** American Samoa Datum of 1962 to WGS84 Datum: ΔX = –115 m ±25 m, ΔY = +118 m ±25 m, ΔX = +426 m ±25 m.

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The contents of this column reflect the views of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the American Society for Photogrammetry and Remote Sensing and/or the Louisiana State University Center for GeoInformatics (C^{4}G).