



# & GRIDS & DATUMS

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INDEPENDENT  
STATE OF

PAPUA

NEW GUINEA

The Grids & Datums column has completed an exploration of every country on the Earth. For those who did not get to enjoy this world tour the first time, *PE&RS* is reprinting prior articles from the column. This month's article on Independent State of Papua New Guinea was originally printed in 2005 but contains updates to their coordinate system since then.

**D**uring the 16<sup>th</sup> century, Portuguese and Spanish navigators visited the island. Annexed by Queensland in 1883, the region became a British Protectorate in 1884 and was annexed by Great Britain in 1888 as British New Guinea. Administration was passed to Australia in 1905, and the name was changed to the Territory of Papua. In 1949, it was united with the Territory of New Guinea to form Papua New Guinea.

The Independent State of Papua New Guinea became independent in 1975. The country is comprised of the Eastern part of New Guinea, the island of Bougainville, and the Bismarck Archipelago: a total area of 462,840 km<sup>2</sup> which is slightly larger than the State of California. The land area totals 820 km<sup>2</sup> and is mostly mountains with coastal lowlands and rolling foothills. The lowest point is the Pacific Ocean, and the highest point is Mount Wilhelm (4,509 m). According to the *CIA Factbook*, the "natural hazards include active volcanism; situated along the Pacific 'Ring of Fire'; the country is subject to frequent and sometimes severe earthquakes; mud slides; tsunamis. On 18 July 1998, a tsunami took the lives of 2,200 north shore residents of Papua New Guinea.

The first Australian Engineer Officer for mapping was posted to Rabaul on New Britain in 1914. Topographic mapping of the area began during World War II, and consisted mainly of one inch to the mile compilations with classical triangulation control. The Australian military mapping installations consisted of drafting and computation sections quartered in tents. Map printing services in Queensland were transferred to the U.S. Army 69<sup>th</sup> Engineer Topographic Battalion's lithographic detachment in Port Moresby. Supplemented by reconnaissance aerial photo mosaics, additional mapping control continued through the 1950s with assistance from the Royal Australian Survey Corps and the U.S. Army (Australia's Military Map-Makers, 2000).

The oldest "Astro station" serving as a local datum is Paga Hill 1939 near Port Moresby where:  $\Phi_0 = 9^\circ 29' 00.31''$  S,  $\Lambda_0 = 147^\circ 08' 21.66''$  E of Greenwich, and the ellipsoid of reference is the Bessel 1841 where:  $a = 6,378,397.155$  m., and  $1/f = 299.1528$ . The grid system commonly associated with the Paga Hill Datum of 1939 is the 1943 Southern New Guinea Lambert Zone where the Latitude of Origin,  $\phi_0 = 8^\circ$  S, Central Meridian,  $\lambda_0 = 150^\circ$  E, Scale Factor at Origin,  $m_0 = 0.9997$ , False Northing = 1,000 km, False Easting = 3,000 km. The original limits of the Zone were for the North: Parallel of  $7^\circ$  S, east to  $153^\circ 30'$  E, thence north along this meridian to  $5^\circ$  S, thence east along this parallel to  $165^\circ$  E. East: Meridian of  $165^\circ$  E. South: Parallel of  $12^\circ$  S, west to  $145^\circ$  E, thence west along this parallel to  $141^\circ$  E, thence south along this meridian to  $11^\circ$  S, thence west along this parallel to  $137^\circ$  E. West: Meridian of  $137^\circ$  E. Recent source data for Paga Hill Datum of 1939 now state the ellipsoid of reference as: International 1924 where:  $a = 6,378,388$  m and  $1/f = 297$ . When this supposed change occurred is unknown.

Thanks to John W. Hager for the following: other astro positions in Papua New Guinea include: Brown Island, East New Britain Province  $\Phi_0 = 5^\circ 01' 40''$  S,  $\Lambda_0 = 151^\circ 58' 54''$  E; Cay, Panaeati & Deboyne Island, Milne Bay Province  $\Phi_0 = 14^\circ 41' 14''$  S,  $\Lambda_0 = 152^\circ 22' 14''$  E; Dedele Point, Central Province  $\Phi_0 = 10^\circ 14' 14''$  S,  $\Lambda_0 = 148^\circ 45' 14''$  E; Dobodura Astro Fix, Northern Province,  $\Phi_0 = 8^\circ 45' 50.13''$  S,  $\Lambda_0 = 148^\circ 22' 38.8''$  E; Dumpu. Madang Province,  $\Phi_0 = 5^\circ 50' 34.4''$  S,  $\Lambda_0 = 145^\circ 44' 29.55''$  E; Guadagasal Astro Fix, Gulf Province,  $\Phi_0 = 7^\circ 15' 33.6''$  S,  $\Lambda_0 = 146^\circ 58' 42.0''$  E; Guasopo B. Woodlark Island, Milne Bay Province,  $\Phi_0 = 9^\circ 13' 39''$  S,  $\Lambda_0 = 152^\circ 57' 03''$  E; Hetau Island Naval Astro, Buka Island, North Solomons Province,  $\Phi_0 = 5^\circ 09' 57''$  S,  $\Lambda_0 = 154^\circ 31' 12''$  E;

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Hong Astro (1947), Manus Island, Manus Province, West Base,  $\Phi_0 = 1^\circ 58' 03.930''$  S,  $\Lambda_0 = 147^\circ 22' 03.320''$  E, azimuth  $\alpha_0 = 111^\circ 55' 58.00''$  to Azimuth Mark from north, Clarke 1866 ellipsoid, elevation = 6.0 ft.; Jammer Bay, Milne Bay Province,  $\Phi_0 = 9^\circ 58' 28''$  S,  $\Lambda_0 = 152^\circ 11' 15''$  E; Kavieng, New Ireland Province,  $\Phi_0 = 2^\circ 36''$  S,  $\Lambda_0 = 150^\circ 50''$  E; Keila Island Astro, East New Britain Province,  $\Phi_0 = 4^\circ 48' 28''$  S,  $\Lambda_0 = 152^\circ 11' 15''$  E; Kieta, North Solomons Province, Ashton,  $\Phi_0 = 6^\circ 12' 42.68''$  N,  $\Lambda_0 = 155^\circ 37' 43.69''$  E; Koiaris, North Solomons Province, Koiaris Astro 1947,  $\Phi_0 = 6^\circ 18' 06.11''$  S,  $\Lambda_0 = 155^\circ 11' 47.32''$  E, azimuth  $\alpha_0 = 322^\circ 19' 42.4''$  to Azimuth Mark #1 from south, International ellipsoid, established by 657th Engineering Astronomic Determination, March 1947; Losuia, Milne Bay Province, Losuia,  $\Phi_0 = 8^\circ 32' 33.825''$  S,  $\Lambda_0 = 151^\circ 03' 59.466''$  E; Matupi, East New Britain Province, Matupi Astronomic Station 1957,  $\Phi_0 = 4^\circ 14' 12.210''$  S,  $\Lambda_0 = 152^\circ 11' 26.54''$  E, International ellipsoid, Elevation = 2.4 meters; Popondetta, Astro fix,  $\Phi_0 = 8^\circ 46' 07.76''$  S,  $\Lambda_0 = 148^\circ 12' 51.55''$  E; St. Matthais, New Ireland Province, South Base,  $\Phi_0 = 1^\circ 40' 30''$  S,  $\Lambda_0 = 149^\circ 54' 54''$  E; Salankaua, Morobe Province,  $\Phi_0 = 6^\circ 33' 28.4''$  S,  $\Lambda_0 = 147^\circ 51' 07.2''$  E; Torokina, North Solomons Province, Naval Astronomic Station,  $\Phi_0 = 6^\circ 12' 18''$  S,  $\Lambda_0 = 155^\circ 02' 02.5''$  E; Wabutina, Milne Bay Province, Wabutin (spelling may be Wabutima),  $\Phi_0 = 8^\circ 30' 54.628''$  S,  $\Lambda_0 = 151^\circ 03' 24.947''$  E; Wau, Morobe Province,  $\Phi_0 = 7^\circ 20' 28.12''$  S,  $\Lambda_0 = 146^\circ 42' 55.6''$  E; Wewak.  $\Phi_0 = 3^\circ 32' 52''$  S,  $\Lambda_0 = 143^\circ 37' 37''$  E.

The various local astro datums listed above represent the fixes used for navigational charts. In regard to how these various datums are related to the WGS 84 Datum, the Australian Maritime Safety Authority comments: "For some charts, particularly in Papua New Guinea, the correction to be applied to GPS cannot be calculated and these charts display a specific warning to this effect. Use of GPS alone on these charts is hazardous."

For the most part, cartographic products of Papua New Guinea have been on the Australian Geodetic Datum of 1966 with its origin at Johnston Cairn where:  $\Phi_0 = 25^\circ 56' 54.5515''$  S,  $\Lambda_0 = 133^\circ 12' 30.0771''$  E,  $h_0 = 571.2$  m., and the ellipsoid of reference is the Australian National Spheroid:  $a = 6,378,160$  m, and  $1/f = 298.25$ . A new system is the Papua New Guinea Geodetic Datum 1994 (PNG94), which is a geocentric datum defined by a widespread network of geodetic stations around PNG. There are three permanent GPS base stations operating in PNG. The Papua New Guinea Map Grid 1994 (PNGMG) is the UTM grid on the GRS80 ellipsoid. According to the Department of Surveying and Land Studies of the Papua New Guinea University of Technology, "A very approximate relationship between AGD66 and PNG94 coordinates is as follows: PNG94 Latitudes are approximately 5" north of AGD66 latitudes, PNG94 Longitudes are approximately 4" east of AGD66 longitudes, PNGMG Eastings are approximately 120 m greater than AMG66 Eastings, and

PNGMG Northings are approximately 160 m greater than AMG66 Northings."

There is a caveat to this approximate relation between AGD66 and PNG94. Again, according to the Department of Surveying and Land Studies, "Tectonic motion is unaccounted for in the realization of the datum. Relative motion between different tectonic regions in PNG is often in excess of 8 cm per year. There are inconsistencies of up to 12 m between tabulated PNG94 coordinates and those derived from high precision GPS survey network adjustments...."

Thanks to John W. Hager for his patience with my requests and his generous help.

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## Update

"Existing PNG94 already 21+ years old now (i.e. Possibly past its coming of age) PNG2020? (ITRF2014 at epoch 2020.0) would remove any uncertainty arising from 26 years of earthquakes (co-seismic and post-seismic deformation). Coordinates closer to current ITRF, but up to 2 m different to PNG94. Requires gridded distortion model for PNG94 to PNG2020 transformations (e.g. legacy data such as DCDB, project datums, GIS data).. 50 Years (and +) of Geodesy in PNG, Richard Stanaway, 2016.

The Association of Surveyors of Papua New Guinea, Inc. has numerous technical papers and notes available for download in pdf format at: <http://www.aspng.org/techinfo.htm>

## Geodetic and Vertical Datums Used in Papua New Guinea – An Overview

[https://www.searchanddiscovery.com/pdfz/documents/2020/70410stanaway/ndx\\_stanaway.pdf.html](https://www.searchanddiscovery.com/pdfz/documents/2020/70410stanaway/ndx_stanaway.pdf.html)

## A Semi-Dynamic Geodetic Datum For Papua New Guinea

<https://www.semanticscholar.org/paper/A-SEMI-DYNAMIC-GEODETIC-DATUM-FOR-PAPUA-NEW-GUINEA-Stanaway/49f1c8a765a39ddf672da0c89a4109a0b6df9f79>

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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<sup>4</sup>G).

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