The Geospatial Reference System of PNG.

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Abstract

- The Geospatial Reference System is a mathematical grid that connects all the ground marks which are the Permanent Survey Markers that provides the reference platform for referencing the spatial phenomena or features on the ground. The reference system is also called a **"Datum".**
- As per the theme of the Congress, **"Traversing the future: An evolutionary look at the survey industry- past, present and future,** the paper will outline the reference system that was used in the past, what is being used now and what is anticipated to be used from then on. The paper will also try to clarify their difference and how they affect the positioning of the features on the ground.
- The three reference systems that are being used in PNG are;
- AGD66- still is being used by the Oil and Gas sector.
- PNG94- used by the surveying and mapping industry.
- PNG2020- still in the development phase.

- The paper will try to explain to some extent the differences and the similarities of the reference systems and how they affect the positions on the ground.
- All the reference systems in PNG will be featured including the WGS84 system used for positioning by the non-surveying industry and featured on Google maps.

Introduction

- A Geospatial phenomenon is a physical feature that exists in space. It has a geographical location. Its geographical location is described by the science of geodesy.
- Better to understand the concept of the underlying science that has influenced the birth of surveying and Cartography.
- Cartography then emerged into the Geographic Information Systems and Geomatics.
- In this presentation, we will discuss the underlying science and how other sciences emerged and the birth of the Geospatial Technology.

Terminologies in the Geospatial Realm

- **Geodesy** is the science of accurately measuring and understanding three fundamental properties of the earth. They are the geometric shape, its orientation and how the gravitational force is exerted on its surface in time.
- **Geomatics** is a combination of Geodesy, surveying, GIS and Remote Sensing.
- **Geographic Information System** (GIS) is a computerized tools that are used to manipulate the Geospatial data.
- All combined is the Geospatial Technology.

The importance of the Geospatial Reference System

- The geospatial reference system is a mathematically defined grid that underpins the spatial phenomena onto the surface of the earth.
- The datum system uniquely defines the position of a feature on the ground. The examples of the datum of the world would be the World Geodetic Systems 1984 (WGS84). It is the reference datum used by the world for mapping and navigation. All the GNSS equipment that we use for positioning use the WGS84 reference system.
- The previous reference system that was used to map the older 100K maps we have in National Mapping Bureau is the AGD66 datum that was adopted from the Australian Geodetic Datum of 1966 which is not a geocentric datum.
- This gave rise to ACLMP to create the Papua New Guinea geodetic Datum of 1994 (PNG94) which was geocentric and was similar to Australian Geodetic Datum of 1994.
- We are now working on a new Geodetic Datum which will be called PNG2020.

The Geodetic Infrastructure

- The Geodetic Control Network of PNG (PSMs).
- The CORS stations.
- The GNSS equipment and software.
- The PSM sketches and Control Diagrams.
- The Geodetic experts and personnel.
- The Geodetic database-

-Millinch, Fourmil, and other Map Grids.

Importance of Geodetic Infrastructure

- Scientific Research.
- It provides the data needed to monitor and understand various geophysical phenomena such as sea level rise and earthquake deformation.
- Engineering and Infrastructure.
- It is essential for accurate surveying, mapping and navigation which are crucial for infrastructure development and planning.
- Disaster management.
- Supports monitoring and predicting natural disasters such as earthquakes, floods and landslides.
- Geospatial Applications.
- It provides the foundation for GIS and other geospatial technologies. Examples of geospatial technologies in action includes; a). Monitoring sea level rises, b). Mapping earthquakes and volcanoes and, c). Tracking ice sheet changes.
- The backbone of many scientific and engineering endeavors that rely on precise spatial data.

AGD66 DATUM AND MAPGRID

- Australia developed its Datum's from AGD66 which was not geocentric and later developed to the Geocentric datum of Australia 1994 (GDA94) and later developed to a more recent Geocentric Datum of Australia 2020 (GDA2020). Since PNG is very close to Australia and shared the previous non geocentric datum, it has to follow the footsteps of Australia which is a more developed neighbor.

- The Australian Geodetic Datum 1966 (AGD66) was the geodetic datum used in Papua New Guinea (PNG) until October 1997 and through 1998 when it was replaced by PNG94. But the Oil and Gas industries still uses the AGD66 datum. Even the millinch grid and the Fourmil grids still uses the AGD66 datum together with some 1:100 000 map sheets we have today.

- AGD66 served as the reference for national mapping and surveying in Papua New Guinea until PNG94 was introduced in October of 1997.

WORKING WITH THE PNGMG.

- In 1996, the PNG government gazette the new geodetic datum for the country which was called PNG94.
- PNG94 was an earth centered datum and there are no simplified manuals to help PNG Survey Practitioners to do calculations on the spheroid.

- Papua New Guinea Map Grid (PNGMG) is a plane horizontal rectangular coordinate system adopted by the National Mapping Bureau in 1996 for the purpose of small and medium scale mapping within PNG.
- The datum is PNG94. The figure of the earth is known to be and oblate spheroid which is a solid of revolution generated by rotating and ellipse around its minor axis.

- The three surfaces to be considered were;
- The solid earth surface which was roughly spheroidal in shape due to localized departures such as mountains and valleys.

- The mean sea level surface or “geoid” as it is called. This surface is more spheroidal and is described as being that surface coinciding with the mean sea level in the oceans and lying under the land at the level to which the sea would reach if admitted by small frictionless channels. This surface is at the right angles to the gravitational pull or force.

- The reference spheroid. Since the computations of the surveys on the irregular geoid surface, a mathematically defined figure such as spheroid is chosen so as to fit the geoid surface or some part of it as closely as possible.

REFERENCE ELLIPSOID AND DATUM

- The current international practice is to move away from local ellipsoids and to adopt a global geocentric reference system. The two main Reference ellipsoids that are used internationally are:
- WGS84 Semi major axis 6378137m Flattening 1/298.257223563, and
- GRS80 Semi major axis 6378137 m Flattening 1/298.257222101

Stations that define PNG94 datum.

Station	Station Name	Latitude (S)	Longitude (E)	Ellip. Height
PSM 15832	NMB BASE	9°26' 02.76968"	147°11'12.20017"	116.610m
PSM 9550	AIAMBAK	7°20' 51.81934"	141°16'01.44646"	95.465m
PSM 9195	BWAGAOIA	10°41' 19.90490"	152°49'58.93878"	87.456m
PSM 9833	GOROKA	6°04' 53.07151"	145°23'30.44618"	1664.580m
PSM 9538	GURNEY	10°18' 37.50877"	150°20'18.09080"	94.871m
PSM 9513	KAVIENG	2°34' 53.06528"	150°48'22.53578"	78.828m
PSM 5583	KIKORI	7°25' 24.65305"	144°14'55.76611"	88.965m
PSM 15495	MADANG	5°212' 41.28824"	145°46'56.19305"	73.293m
PSM 9522	MANUS	2°03' 02.29337"	147°21'37.63577"	129.751m
PSM 3507	MENDI	6°08' 36.73422"	143°39'22.16540"	1815.154m
PSM 9799	UNITECH	6°40' 16.96985"	146°59'52.37457"	130.389m
PSM 63/1	VANIMO	2°41' 05.28039"	141°18'15.65564"	80.516m
PSM 15029	WANKKUN	6°08' 52.07208"	146°04'52.44226"	510.015m
PSM 25486	WUVULU	1°44' 07.59465"	142°50'10.07846"	79.056m

Stations that define the Vertical Datum.

PSM 15384	**PORT MORESBY**	**2.688**
TG_ALOTAU	ALOTAU	2.061
KAV1	KAVIENG	1.012
NMB 5/25	LOMBRUM	33.124
TG_MADANG	MADANG	-1.390
TG_MANUS	MANUS	1.873
PSM 9799	UNITECH	57.508
TG_WEWAK	WEWAK	-1.113

THE COORDINATE SYSTEMS OVERVIEW

- The PNGMG map projection is a UTM projection with these three zones;
- PNG UTM Zones:

● Zone 54: Covers areas west of 144°E

● Zone 55: Covers areas between 144°E and 150°E

● Zone 56: Covers areas between 150° and 156° E

- UTM Zone overlap:

● while each zone is generally defined by 6 degrees of Longitude, a 0.5 degree overlap is sometimes permissible for projects beyond the zone boundaries.
http:www.aspng.org

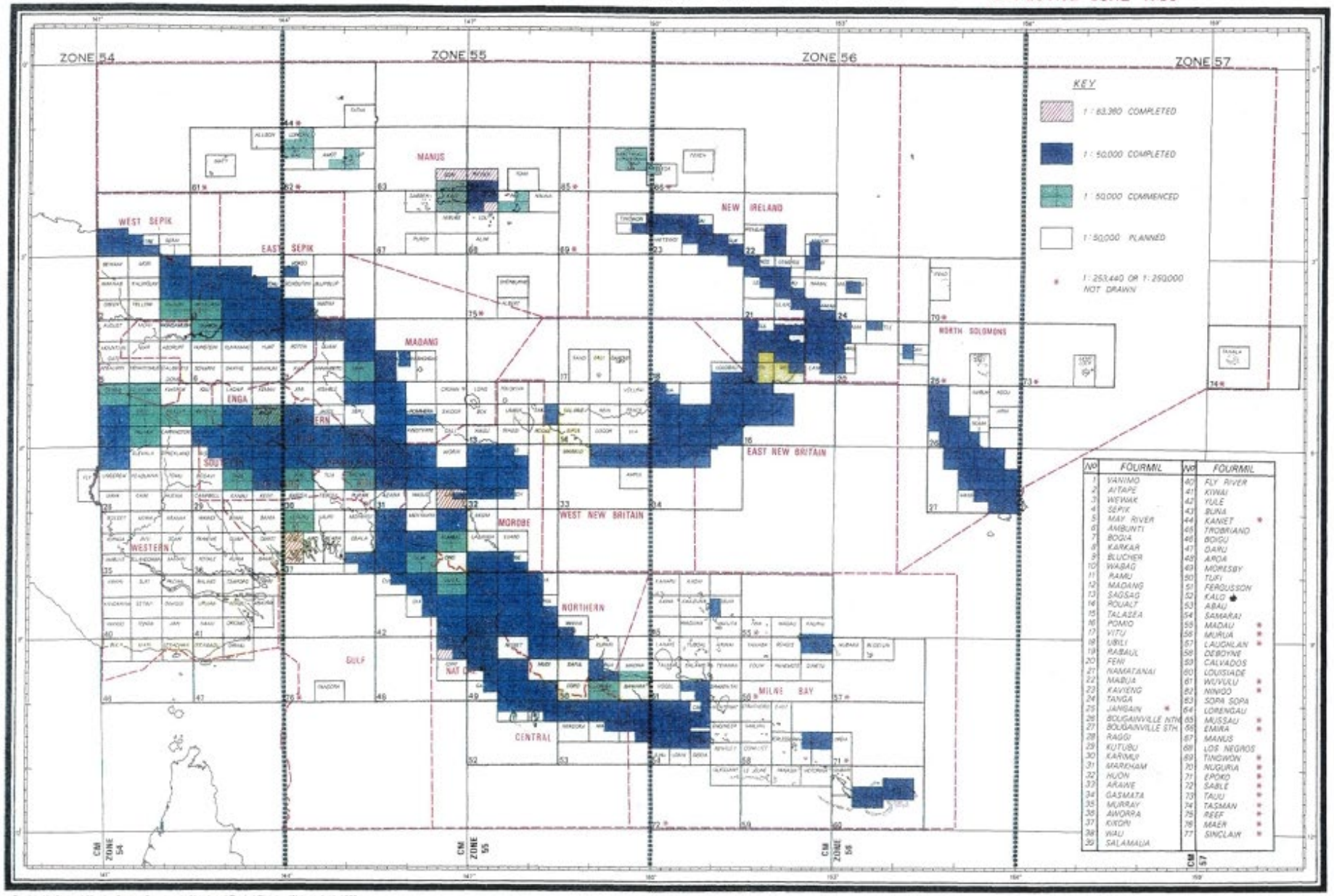
●a PNGMG UTM coordinate is unique only when accompanied by its zone number.

PAPUA NEW GUINEA

LANDS AND PHYSICAL PLANNING CADASTRAL MAPPING

INDEX TO MILINCH & FOURMIL SERIES & UTM ZONES

EFFECTIVE JUNE 1988



NO	FOURMIL	NO	FOURMIL
1	VANIMO	40	FLY RIVER
2	AITAPE	41	KIWAI
3	WEWAK	42	YULE
4	SEPIK	43	BUNA
5	MAY RIVER	44	KANIET *
6	AMBUNTI	45	TROBRIAND
7	BOGIA	46	BOIGU
8	KARKAR	47	DARU
9	BLUCHER	48	ARIA
10	WABAG	49	MORESBY
11	RAMU	50	TUFI
12	MADANG	51	FERGUSSON
13	SAGSAG	52	KALO *
14	ROUALT	53	ABAU
15	TALASEA	54	SAMARAI
16	POMIO	55	MADAU *
17	VITU	56	MURUA *
18	UBILI	57	LAUGHLAN *
19	RABAUL	58	DEBOYNE
20	FENI	59	CALVADOS
21	NAMATANAI	60	LOUISIADE
22	MABUA	61	WUVULU *
23	KAVIENG	62	NINIGO *
24	TANGA	63	SOPA SOPA
25	JANGAIN *	64	LORENGAU
26	BOUGAINVILLE NTH	65	MUSSAU *
27	BOUGAINVILLE STH	66	EMIRA *
28	RAGGI	67	MANUS
29	KUTUBU	68	LOS NEGROS
30	KARIMUI	69	TINGWON *
31	MARKHAM	70	NUGURIA *
32	HUON	71	EROKO *
33	ARAWE	72	SABLE *
34	GASMATA	73	TAUU *
35	MURRAY	74	TASMAN *
36	AWORRA	75	REEF *
37	KIRORI	76	MAER *
38	WAU	77	SINCLAIR *
39	SALAMAUA		

Reprinted by National Mapping Bureau, Department of Lands and Physical Planning, Waigani, June, 1988.

SCALE 1 : 5000,000

Miles 0 50 100 150 200 250

Kilometres 0 50 100 150 200 250 Kilometres

The need for PNG2020

- PNG94 is about 30 years old.
- Coordinates have been shifted by now.
- New Datum is needed in PNG.

Conclusion

- The geodetic framework underpins the geography, land resources and the cadastres of PNG in its position. Understanding the geospatial framework will enable the manipulation of spatial data easier.

- The technological conformities should not deviate from the underlying science of surveying and mapping. Surveying, mapping and the geospatial technology should simply be known as “APPLIED GEODESY.”