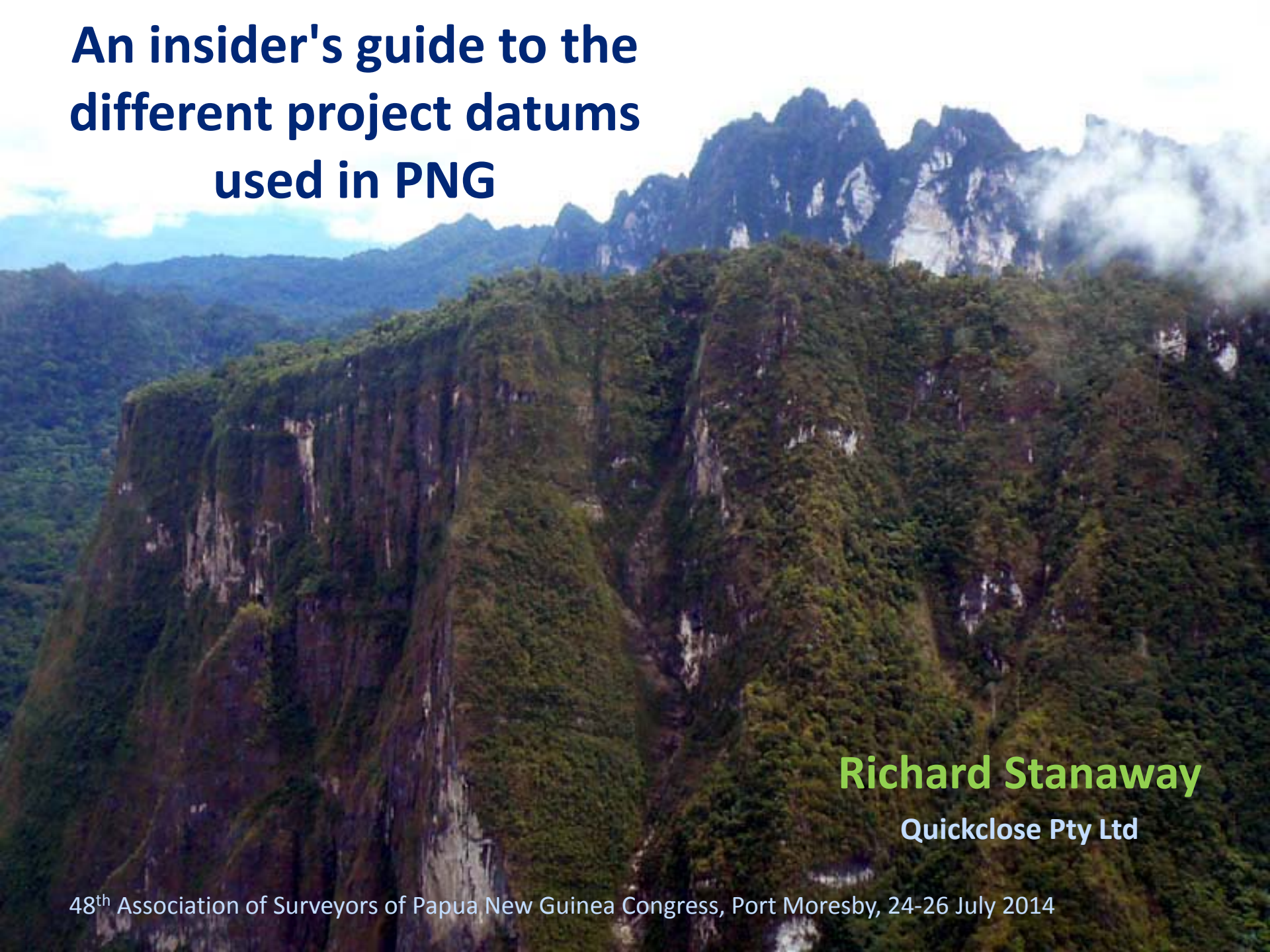
An insider's guide to the different project datums used in PNG



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Quickclose Pty Ltd

48th Association of Surveyors of Papua New Guinea Congress, Port Moresby, 24-26 July 2014

Overview of Horizontal and Vertical Datums in PNG

Horizontal Datums used in PNG

ITRF2008 - International Terrestrial Reference Frame 2008

WGS84 - World Geodetic System 1984

WSG72 – World Geodetic System 1972

PNG94 – Papua New Guinea Geodetic Datum 1994

AGD66 – Australian Geodetic Datum 1966

Local PNG Plane Datums

Vertical Datums used in PNG

Mean Sea Level (MSL) (various origins used)

Ellipsoid (various ellipsoids)

Commonwealth Department of Works (CDW)

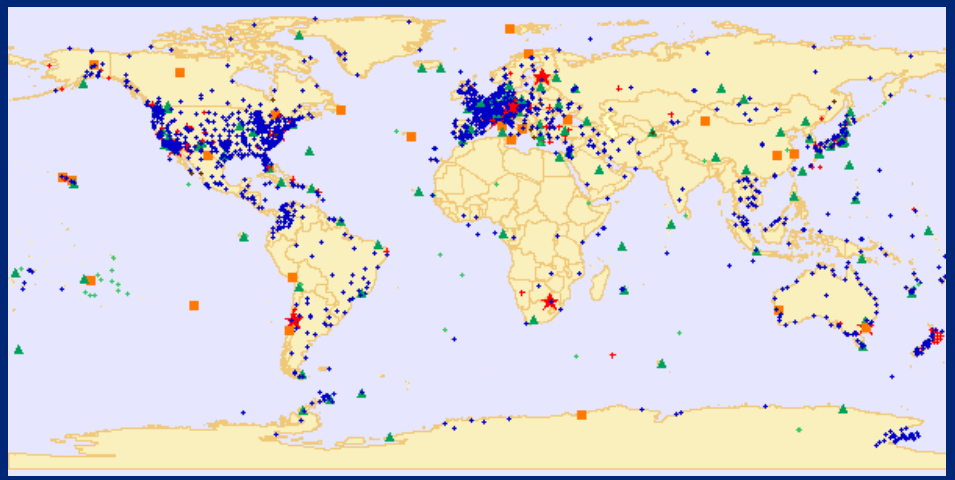
Lowest Astronomical Tide (LAT)

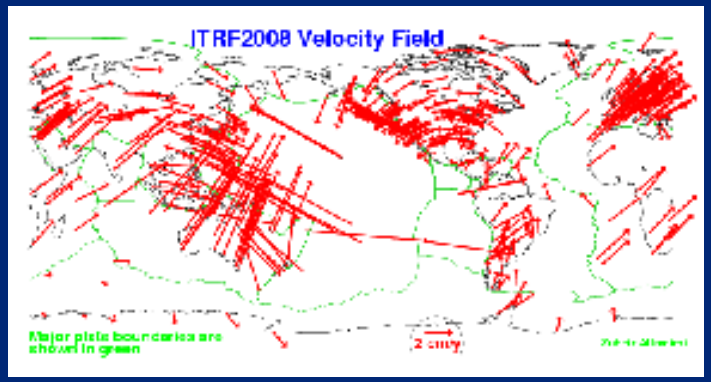
Chart Datum

ITRF2008 - International Terrestrial Reference Frame 2008

"Official" global reference frame
Defined by international network of geodetic stations
Dynamic datum (coordinates change by up to 10 cm a year)
Precision is approximately 3 mm at the reference epoch (2005.0)
Basis for regional reference frames (APREF) and national datums
ITRF Datum stations in PNG are LAE1 (Unitech LAE1) (IGS-GPS)
PNGM (Tide Gauge CORS Manus) (IGS-GPS Reference Frame Site) and
MOSB Port Moresby (DORIS)
WAIG (Lands Department CORS – Port Moresby) is an APREF site

Applications: Geodynamics studies, PNG94 datum maintenance, GNSS processing, LiDar acquisition





WGS84 - World Geodetic System 1984 (currently G1674)

Reference system for United States' GPS system orbit ephemeris
Defined by US Military tracking station network
Dynamic datum (coordinates change by up to 10 cm a year)
Since 2012 completely aligned with ITRF2008
Used as a standard "datum" for GIS and GIS transformations
No defined WGS84 datum station in PNG

Applications: Navigation (PNGASL and NAC Airports surveys), GIS mapping (> 1:10,000 scale), GPS processing

Used erroneously as a survey datum for many projects. (Unless epoch is specified the accuracy is only 1-2 metres)

WGS72 - World Geodetic System 1972

Precursor to WGS84

Accuracy – absolute (25 metres) relative (1 metre)

Approximate 24 metre East offset in Papua New Guinea

Applications: Earlier Airport geodetic control and navigation before 1986

PNG94 - Papua New Guinea Geodetic Datum 1994

Legal (gazetted) datum for Papua New Guinea

Defined by 14 fiducial stations in PNG

Coordinates fixed by ITRF92 at epoch 1994.0 (1st January 1994)

Original precision is 50 mm

Re-defined as a semi-dynamic datum in 2008 – precision 15 mm

Aligned with current ITRF and WGS84 at 1-2 metre precision

(difference is due to plate tectonics and earthquakes since 1994)

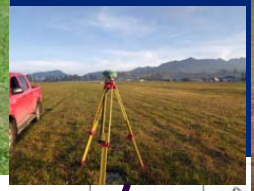
Applications: Land Surveys (Cadastral), planning, DCDB, national geodetic control. High precision GIS.

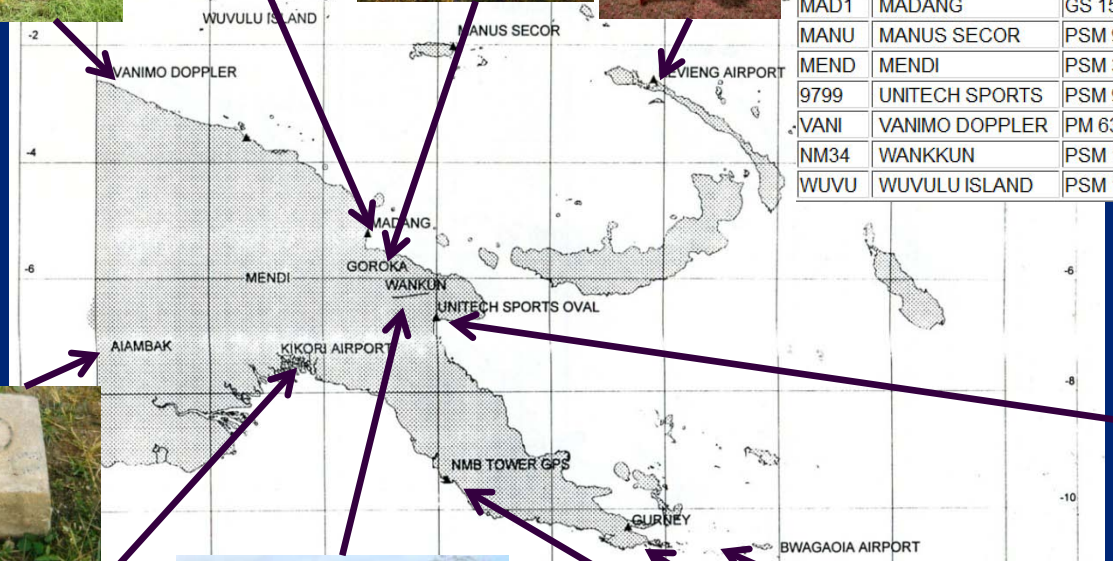
Most GIS software now adopts EPSG definition of PNG94

PNG94 zero order network

Site ID	Site Name	Monument number	PNG94 Latitude	PNG94 Longitude	PNG94 Ellipsoidal Height
MORE	NMB TOWER GPS	PSM 15832	-9°26'02.76968"	147°11'12.20017"	116.610
AIAM	AIAMBAK	PSM 9550	-7°20'51.81934"	141°16'01.44646"	95.465
MIS1	BWAGAOIA AIR	PSM 9195	-10°41'19.90490"	152°49'58.93878"	87.456
GOKA	GOROKA	PSM 9833	-6°04'53.07151"	145°23'30.44618"	1664.580
ALT2	GURNEY	PSM 9538	-10°18'37.50877"	150°20'18.09080"	94.871
KAVI	KAVIENG AIR	PSM 9513	-2°34'53.06528"	150°48'22.53578"	78.828
KIKO	KIKORI AIRPORT	PSM 5583	-7°25'24.65305"	144°14'55.76611"	88.965
MAD1	MADANG	GS 15495	-5°12'41.28824"	145°46'56.19305"	73.293
MANU	MANUS SECOR	PSM 9522	-2°03'02.29337"	147°21'37.63577"	129.751
MEND	MENDI	PSM 3507	-6°08'36.73422"	143°39'22.16540"	1815.154
9799	UNITECH SPORTS	PSM 9799	-6°40'16.96985"	146°59'52.37457"	130.389
VANI	VANIMO DOPPLER	PM 63/1	-2°41'05.28039"	141°18'15.65564"	80.516
NM34	WANKKUN	PSM 15029	-6°08'52.07208"	146°04'52.44226"	510.015
WUVU	WUVULU ISLAND	PSM 15456	-1°44'07.59465"	142°50'10.07846"	79.056





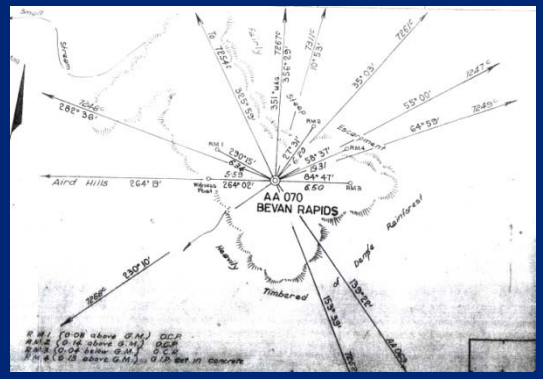








AGD66 - Australian Geodetic Datum 1966



Datum used in PNG until c. 1998

Defined by coordinates of primary control stations (NM/J and T series trigonometric stations)

National precision approximately 4- 5 metres,

Local accuracy typically 30-40 mm

Basis for 1:100,000 PNG Topographic Maps

Difference between AGD66 and PNG94 is

~120 metres in Eastings/Longitude and

~160 metres in Northings/Latitude

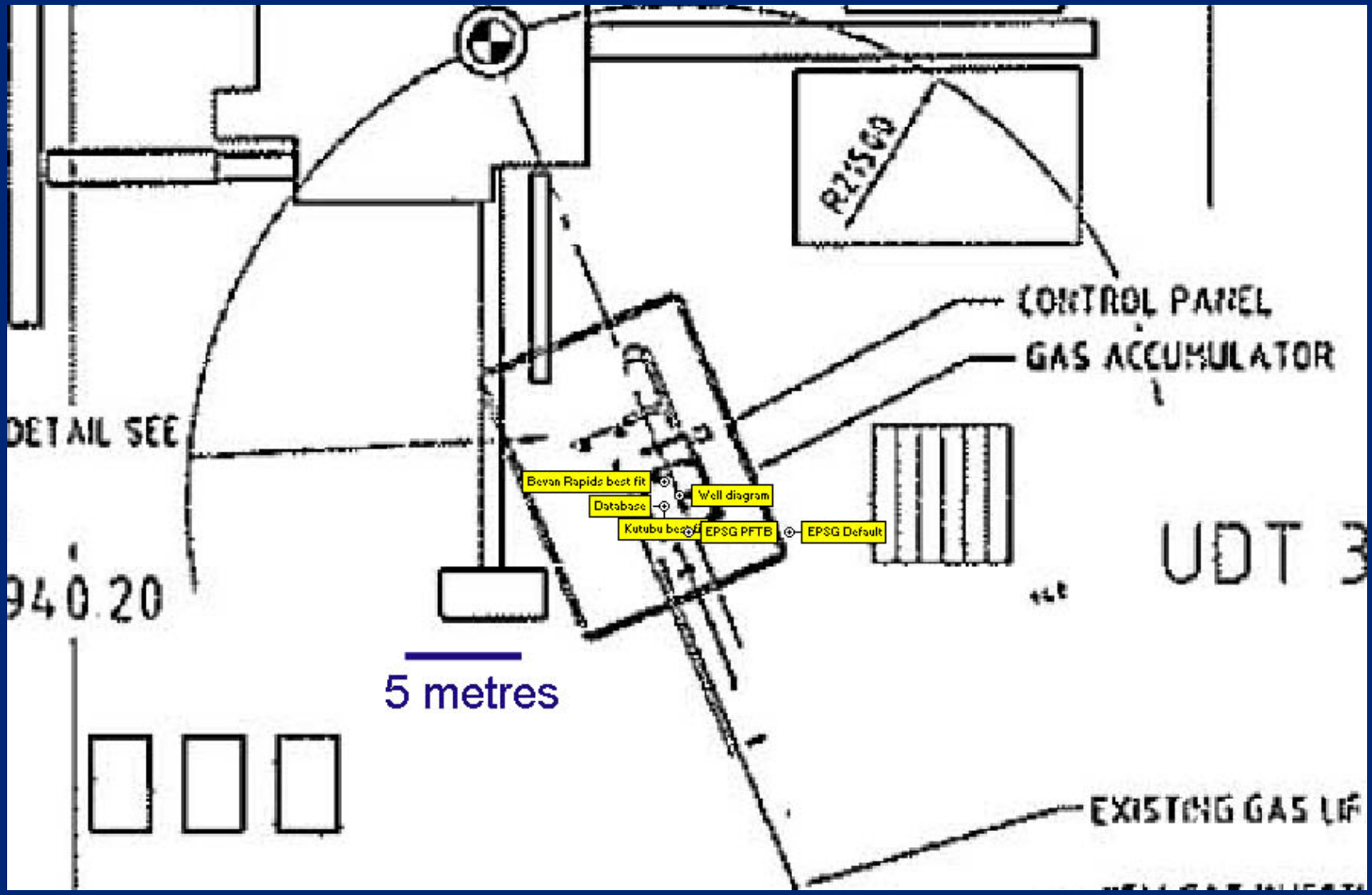
No precise set of transformation parameters have been estimated for AGD66 to WGS84 transformations (using default parameters leads to 5-8 metre inconsistencies with primary geodetic control)

Still legal datum for Oil and Gas (specifically for licence boundaries and well locations)

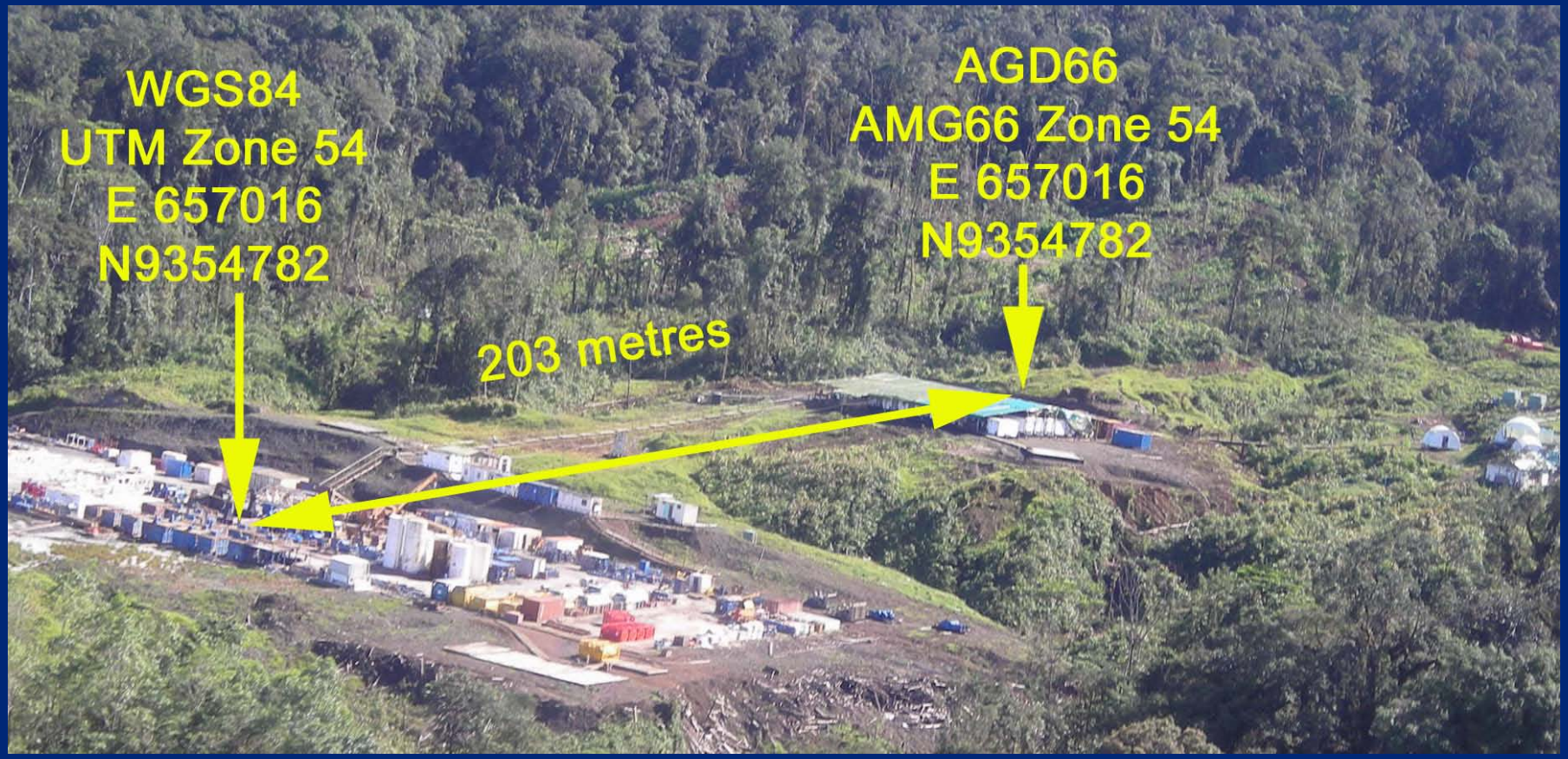
Applications: Existing 1:100,000 topographic map series, Petroleum Exploration, Retention and Production lease boundaries, well locations.

Still used as datum for most projects started pre-1998

AGD66 Transformation Problems



AGD66 and WGS84 or PNG94 differences



Local Plane Datums

Not necessarily connected to a geodetic datum

(e.g. Defined by arbitrary coordinates of two stations)

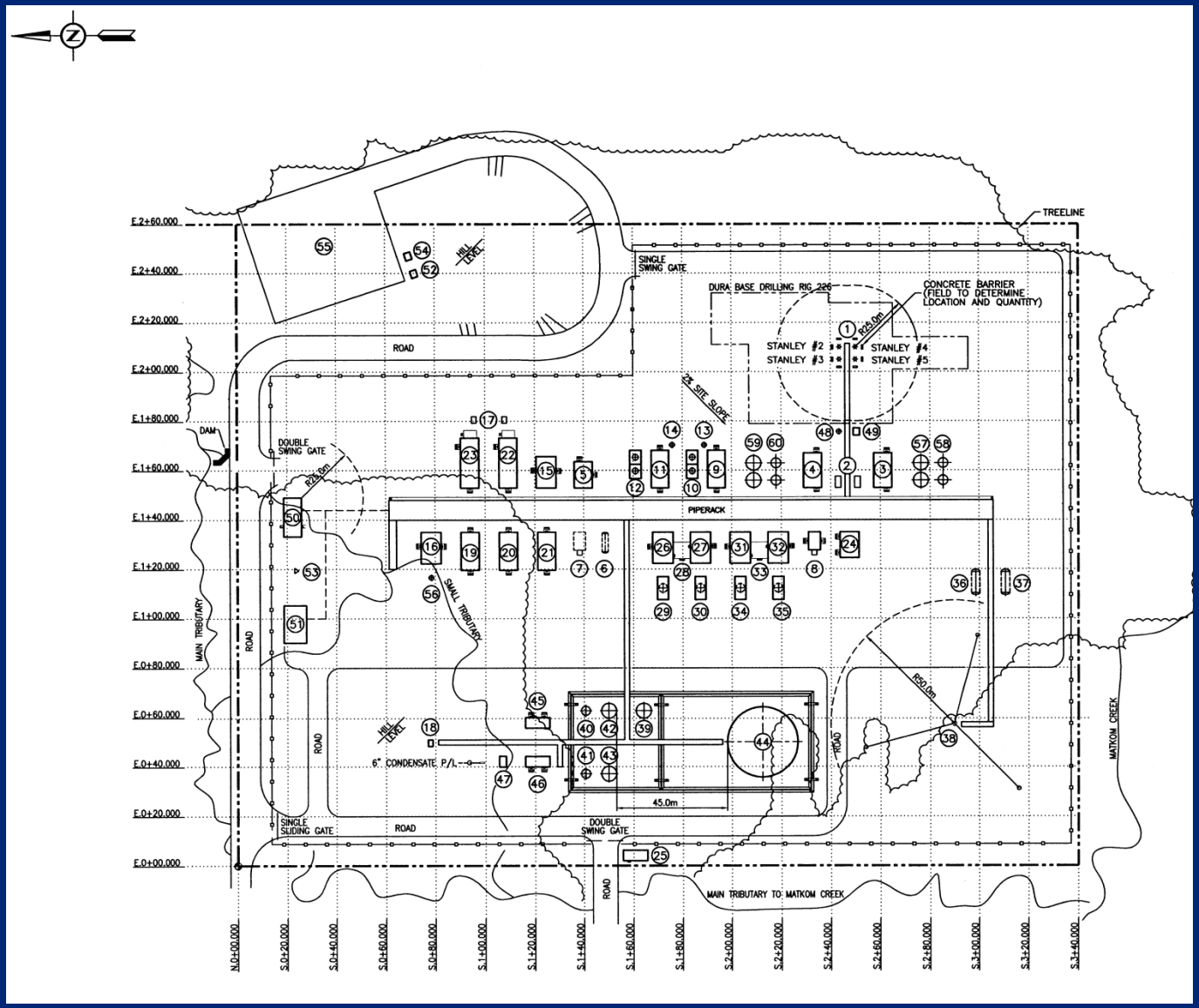
Often used for engineering and construction

Often used for cadastral and site surveys

Cannot be used in GIS unless a geodetic connection is made

Cannot be used with GPS (e.g. RTK) unless a site transformation or calibration is done.

Example – Plant Grid



Considerations:

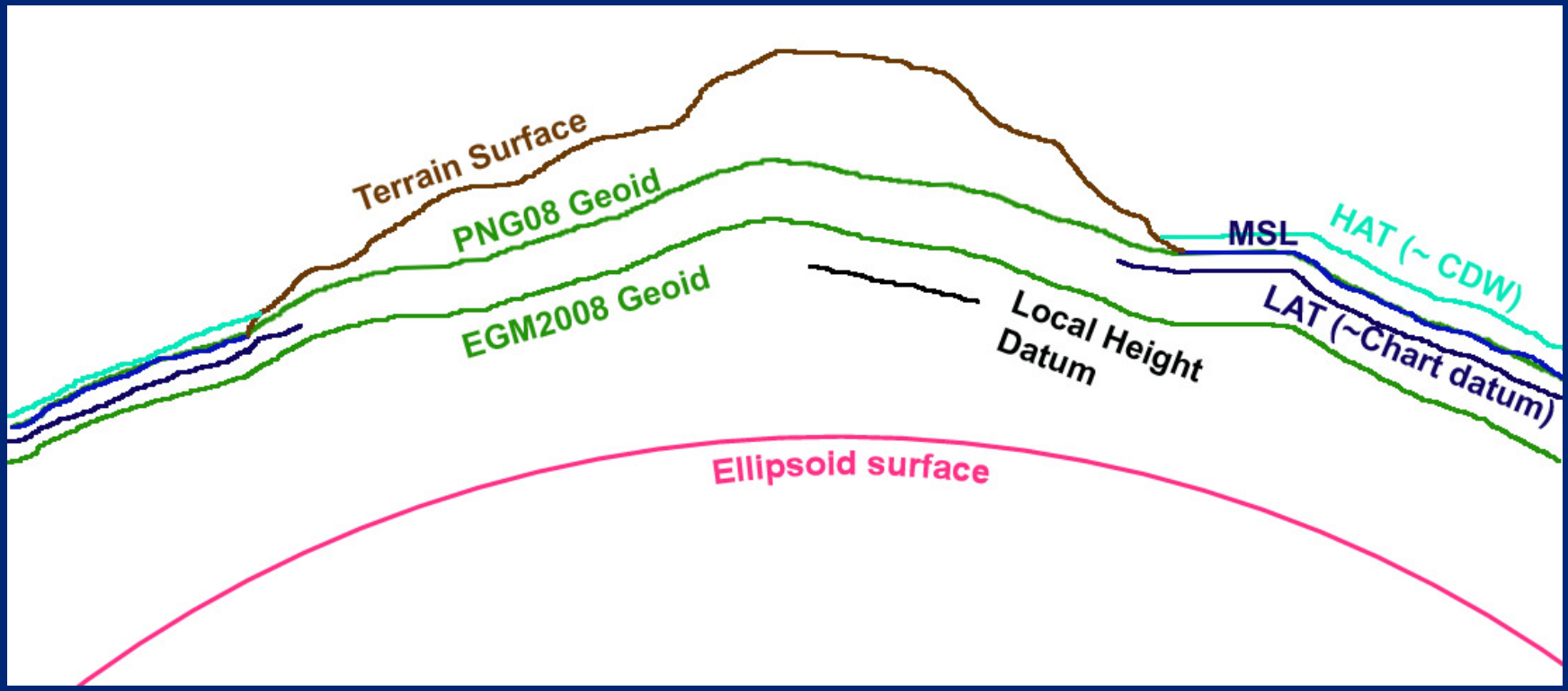
Connection to geodetic control

Use different Easting & Northing origin

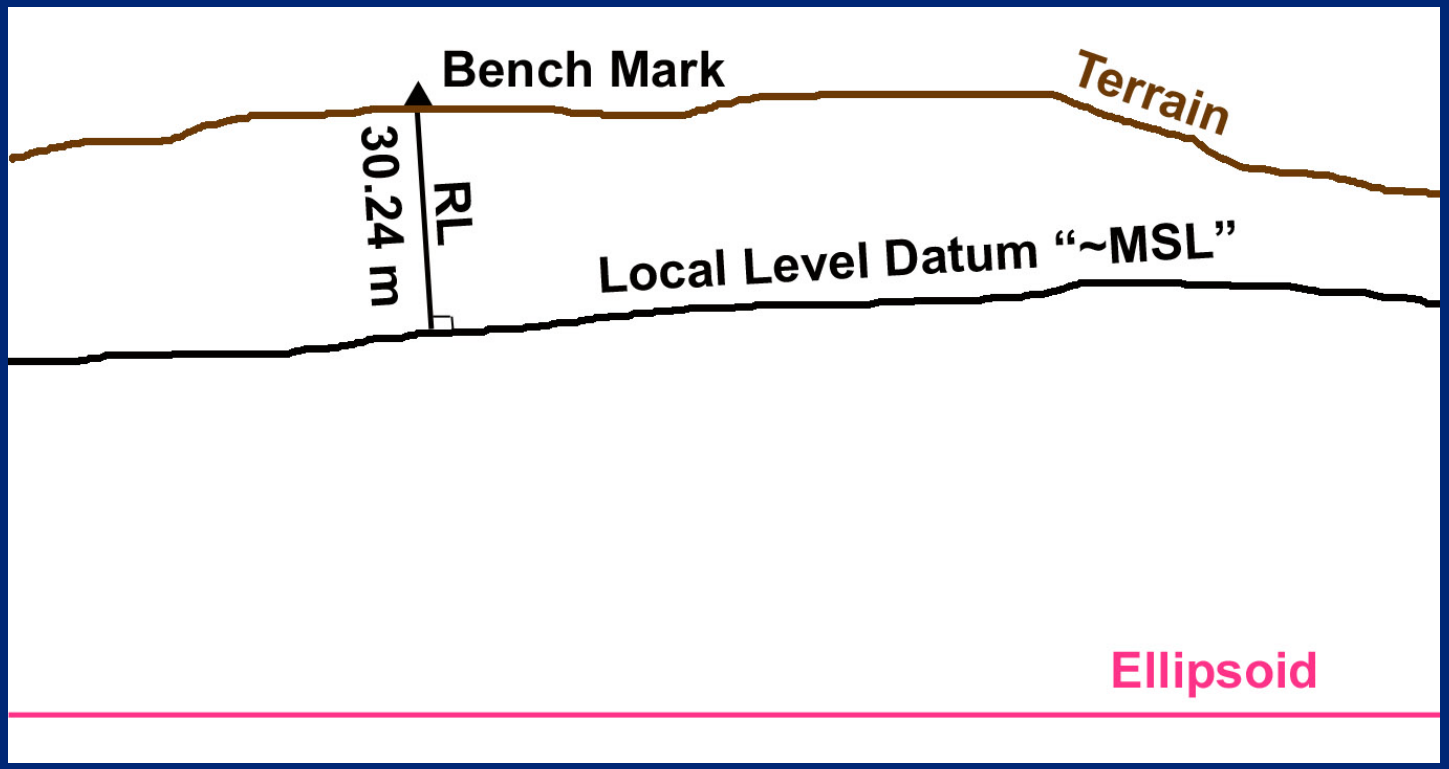
Project Horizontal Datums in PNG

Lands Department (Cadastral & Planning):	PNG94
Department of Petroleum and Energy:	AGD66 Bevan Rapids
PNG LNG Project:	PNG94
Oil Search (inherited from Chevron)	AGD66 (PNG) & PNG94
OTML:	AGD66 with ISG Projection
Hidden Valley / Wafi:	PNG94 and AGD66 (geology)
Lihir Mine:	Lihir Grid (~ AGD66)
Frieda River:	PNG94 and AGD66 (geology)
Yandera:	PNG94 and AGD66 (geology)
Horizon Oil:	PNG94
Port Moresby city	Local Plane Grid – Paga Grid
FSM Grids	Fourmil Plane Grids ~AGD66

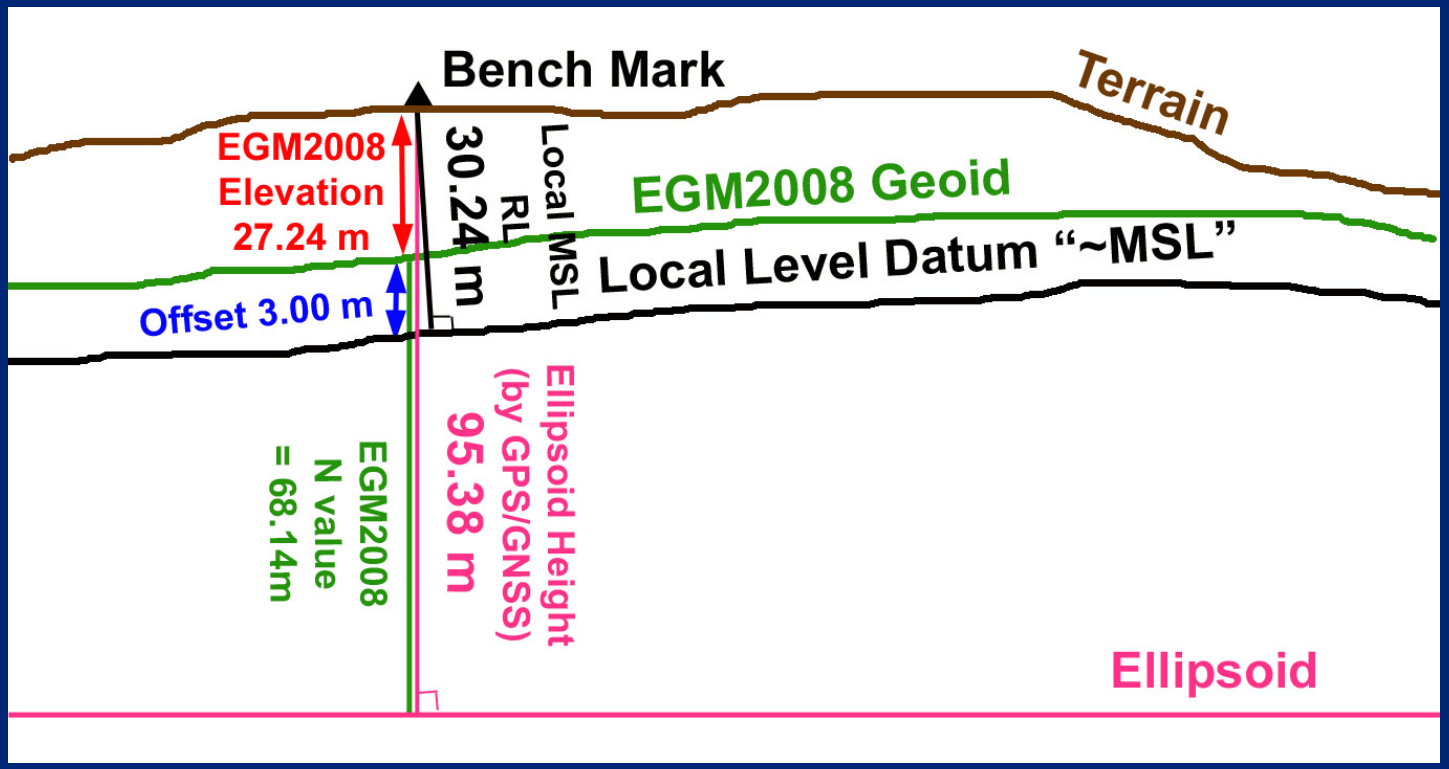
Vertical Datum overview (PNG perspective)



GPS height datum (ellipsoid) and local - 1

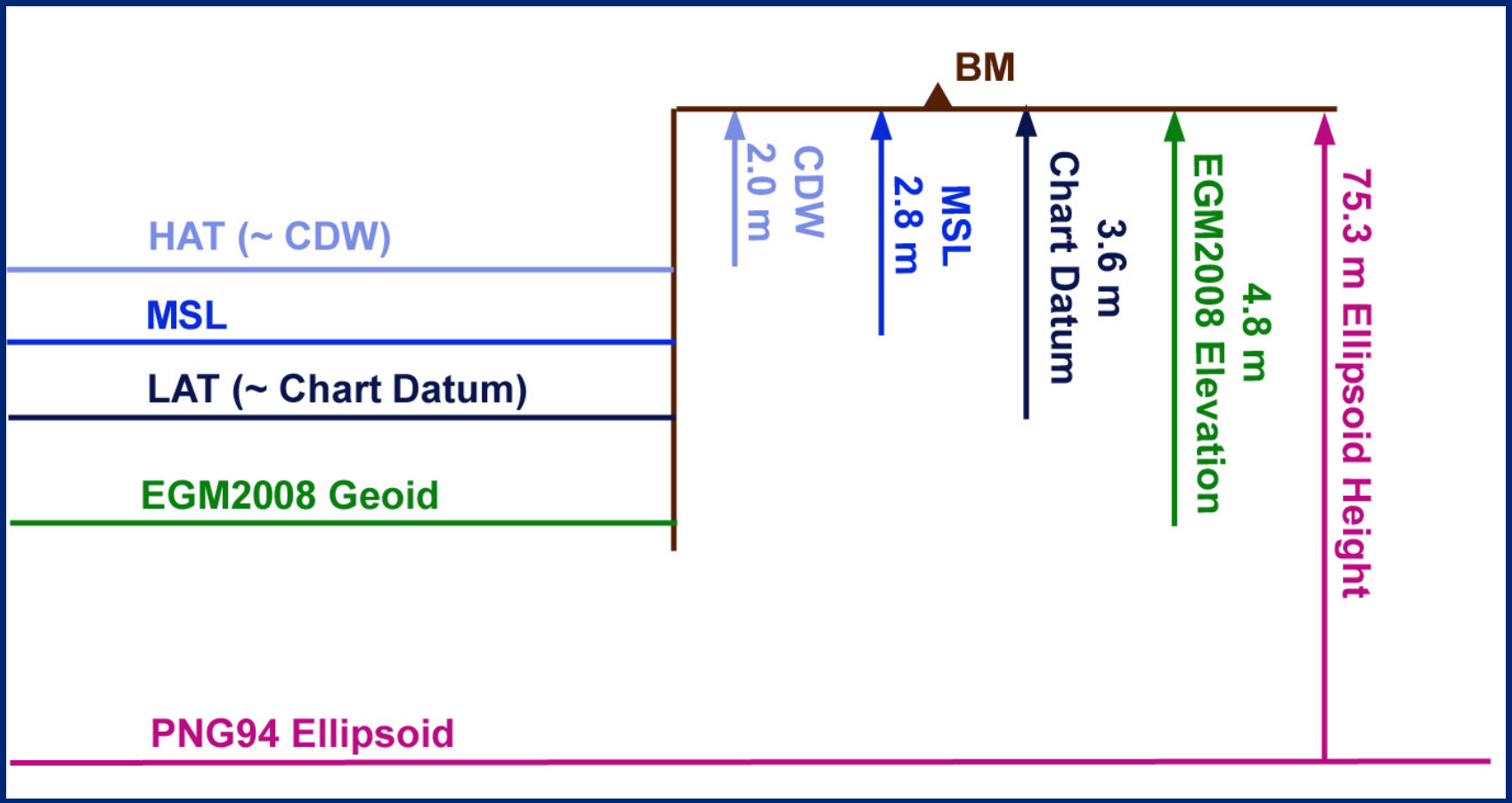


GPS height datum (ellipsoid) and local - 2



Local RL = Ellipsoid Ht – EGM2008 N value + local datum offset

Tidal Datums in Practice – Typical example



Project Vertical Datums in PNG

Lands Department (Cadastral & Planning):	PNG08 elevation (geoid)
PNG LNG Project	EGM96 elevation – 0.87 m (MSL Kumul)
Oil Search Construction	Local MSL (no geoid)
Oil Search sub-surface	Local MSL – 18.5 metres ! (Chevron Datum)
OTML:	Local MSL (no geoid)
Hidden Valley :	EGM2008 el. – 0.63 m (MSL MMJV)
Interoil exploration:	EGM2008 el. – 0.93 m (MSL POM)
Frieda River:	EGM2008 el. – 1.42 m (MSL Aitape)
Woodlark Mining:	EGM2008 el. – 0.75 m (MSL Woodlark)
Yandera:	EGM2008 el. – 1.12 m (MSL Madang)
POM MSL:	EGM2008 el. – 0.93 m (MSL POM)
POM CDW:	EGM2008 el. – 2.00 m (CDW POM)

Conclusion – General Requirements

Traceability to a datum – PNG94 zero or 1st order

Alignment with other datums (e.g. AGD66 for Oil and Gas)

Choice of Grids – Projection system – Scale Factor?

UTM (PNGMG94/AMG66) up to 40 mm scale error every 100m

(so not suitable construction, engineering, cadastral)

User-defined Projection scale error close to zero

Transformation or Site Calibration options (e.g. Using GNSS/GPS)

Set up GIS parameters – putting survey data into a GIS

Choice of height datum - CDW/HAT for drainage or sewerage

MSL (using PNG08) or local offset

LAT/Chart Datum – for Hydrographic Surveys