



Reference Frame in Practice

Status of Geodetic Infrastructure in Tonga – Case Studies

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Background-Surveying in Tonga

- All surveyors in the kingdom are under the Surveying and Geodesy section of the Ministry of Lands, Environment, Climate Change and Natural Resources. Geodesy part is **dead** (not officially but physically)
- Two private practices but they are both in there 70s.
- No Survey Act and Legislation. All Survey is directed by Minister of Lands under the Land Act.
- Tonga Cadastral Grid was created in the 1950s as the basis of land registration survey throughout the kingdom.
- The Tonga Geodetic Datum was established in 2005 under the CERMP, (Cyclone Emergency Recovery and Management project).

Geodetic Datum and Map Projection

The Tonga Geodetic Datum (TGD2005), was created in 2005 based on international geodetic standards.

- Geocentric origin
- Reference spheroid: GRS80 ellipsoid (= WGS84)
- Static datum based on International Terrestrial Reference Frame (ITRF2000) as at 1 Jan 2005

Map Projection

A new national map projection was also created called the Tonga Map Grid (TMG), based on international mapping standards.

- Transverse Mercator
- Reference spheroid = GRS80
- Meridian of origin = 177W
- Latitude of origin = The Equator
- Central meridian scale factor = 0.9996
- False origin = 1,500,000E 5,000,000N

All topographical maps and international land boundaries are based on the Tonga Map Grid.

Existing Geodetic Infrastructure

- Geodetic control network:
 - These were the existing marks chosen and observed for the development of the new datum.

- Cadastral Control Network:
 - Cadastral surveying and mapping still use the old Tonga Cadastral Grid. The application of our new geodetic datum to the cadastral survey circuit has not been implemented.

- Continuous GPS Tracking Stations:
 - CGPS Vava'u, est. 1999 (*SW Pacific GPS project*)
 - CGPS station, est. 2002, (*South Pacific Sea Level and Climate Monitoring Project*)

Existing Geodetic Infrastructure

- Vertical Control Network: Datum MSL1990 (Main island only)
 - Network distributed on the main island only, not complete.
 - Tide gauge and deep BMs-Precise Differential Leveling Survey (*South Pacific Sea Level and Climate Monitoring Project*)

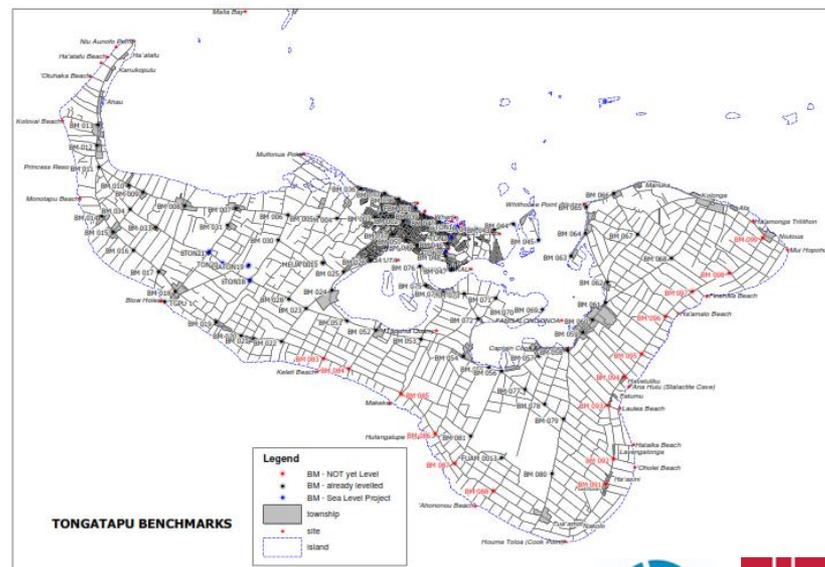


FIG Commission 5 Position and Measurement

Surveying Capacity

- Level of knowledge:
 - 6 surveyors with university degree.
 - 3 assistant surveyors without university degree.
 - 4 survey trainees.
- Experience:
 - The large percentage our experience focuses on cadastral surveying and only graduated surveyors with engineering and control survey experience but limited.
 - All surveyors except trainees have more than 15 years of experience

Surveying Capacity

- Resources:
 - Geodetic Database-needs to be updated;
 - TonCord excel for conversion from TCG to TMG;
 - Hard and soft copy of Vol 1 and Vol 2 with both TCG and TMG coordinates;
 - Nearly all of our old cadastral maps and survey plans are still in paper format.

Surveying Capacity

- Equipments:
 - 5 Nikon total stations;
 - 3 sets of Trimble 5700 GPS with accessories, 2 sets of RTK plus radio and repeater. These GPS are no longer operational, it needs service, repair, and upgraded:
 - 1 Automatics Level and accessories
- Softwares:
 - One license of Civilcad.
 - 12d.
- Calculators:
 - HP33s & 35s



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Land information datasets and the new datum

- Satellite imageries;
- Lidar image (Tongatapu, Lifuka and Foa);
- Environment datasets for conservation of endangered birds vegetation;
- Tsunami and flood models;
- Land parcels;



Geodetic and Positioning we would like provide.

- Densification of geodetic network and upgrading and updating the cadastral control network to the Tonga Map Grid (TMG).
- Annual control survey programme to meet needs of cadastral surveyors, national mapping and measurements of crustal dynamics and other users.
- Observe existing vertical control network with GPS/GNSS.
- The geodetic system should continue to be upgraded and enhanced, it enable consistent spatial positioning in Tonga.

Issues in developing Geodetic and Positioning system

- Inefficient number of surveyors;
- Roles of surveyors in the ministry focuses on cadastral survey and less emphasis on the geodetic system. Limited experience in geodetic and control survey:
- No Survey Act, Regulation and institution in place;
- Equipments needed to be repaired and upgraded;
- Government and Ministry do not recognised the importance of geodetic system, therefore no extra fund in the annual budget for geodetic work;



How to solve these Issues

- The Survey Act , Regulation and institution should be in place to empower and control the work of surveyors:
- Need overseas assistance & consultant in geodesy to assist ministry.
- Building the surveying capacity: need more surveyors & send for further trainings;
- Service, repair and upgrade existing GPS to GNSS;
- Inform government and related stakeholders in the importance of geodetic and positioning system for the overall development of Tonga.
- Increase the budget for surveyors or by overseas donors through projects;

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What do we need to solve these issues?

- We need the technical support of FIG and international communities of surveyors through consultation and visitation.
- Need technical and financial assistance from international bodies for occasional maintenance of equipment .
- Overseas working attachments;
- We need to work close with university to offer scholarship for our young surveyors through FIG and donor agencies.



What do we need to solve these issues?

- More involvement in FIG working groups to discuss global issues such as climate change.
- More exposure to global development in surveying discipline, its changing roles, capabilities of modern and a wider area surveying profession.
- Partnership and networking with surveyors throughout the region.

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The End

Malo 'Aupito

