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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 the Republic of Botswana was originally printed in 2004 but contains updates to their coordinate system since then.

**T**he Boskop People inhabited southern Africa for thousands of years during the Middle Stone Age, and their descendants include the present-day San (Bushman) People of Botswana. Most of the present population (95%) is known as the “Batswana.” The region was occupied by the British at the instigation of the colonial administrator, Sir Cecil Rhodes in 1884. It was organized as a British Protectorate the following year, and was divided into the British Bechuanaland and the Bechuanaland Protectorate. Botswana gained independence in 1966 and is a member of the British Commonwealth. The discovery of diamonds and copper has allowed Botswana to become one of the most economically stable countries in Africa.

The Republic is landlocked and is slightly smaller than the State of Texas: bordered by Namibia (1,360 sq. km), by South Africa (1,840 sq. km), and by Zimbabwe (813 sq. km) (*PE&RS*, November 2003). The terrain of Botswana is predominately flat to gently rolling tableland with the Kalahari Desert in the southwest. The lowest point is the confluence of the Limpopo and Shashe Rivers (Elevation: 513 m), and the highest point is Tsodilo Hill (Elevation: 1,489 m).

In *GIM International*, September 1994, B.B.H. Morebodi, director of Surveys and Lands reported: “The history of cadastre in Botswana can be traced back to 1890 when the Foreign Jurisdiction Act in Great Britain established and regulated the power of Queen Victoria’s Government in the then territory of British Bechuanaland.” Subsequently, various acts defined the boundaries of the Crown Lands in Botswana, the territories occupied by tribes and land vested in the British South Africa Company. The earliest registration of deeds was put into effect at Vryburg in South Africa, but was moved to Mafeking in 1908 following the establish-

## REPUBLIC OF BOTSWANA



ment of the Office of Registrar of Deeds for the Bechuanaland Protectorate in 1907. From 1908 to independence in 1966, the Registrar of Deeds Office remained in Mafeking.

Throughout its history, the cadastre has been numerical. Surveying was under the control of the Surveyor General in Cape Town until the 1959 Land Survey Act established the Office of Director of Surveys and Lands in Botswana. In 1960, an act was passed establishing the Office of Registrar of Deeds to regulate the transfer of land in Botswana. The Department of Surveys and Lands was physically moved from Mafeking to Gaborone in 1969.

There is no cadastral mapping in Botswana as such. The registration of title to property is affected by a system of registration of deeds. To be capable of registration, a deed must be supported by a survey diagram (deed plan) approved by the Director of Surveys. Data from numerical cadastral surveys is compiled into a number of plans called “Compilations” which are regularly updated to show the current land parcel situation. This is not however equivalent to a registry index map.

The Department of Surveys and Mapping exercises statutory control over all surveying for cadastral purposes and

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national mapping but not over surveying for engineering purposes. Surveys for the cadastre re-effected in two ways:

- a. New township surveys in which a large number of new stands are surveyed simultaneously. This is generally done by the Department but sometimes registered surveyors are given this work on contract.
- b. Surveys of single plots and mutations. In this case, most of the work is done by private surveyors.

The Land Survey Act of 1959 provides that all data generated for cadastral purposes whether by government surveyors or private surveyors must be subjected to an examination approval process by the Department. Only approved diagram and general plans are accepted by the Registrar of Deeds for registration.”

The Mapping Division is responsible for the National Mapping Program, and tasks are carried out in-house as well as through contract services. The Division provides topographic maps at small, medium, and large scales in hardcopy and digital formats. The first maps by the British Directorate of Colonial Surveys were published in 1955 at a scale of 1:125,000. By the time the series was discontinued in 1966, a total of 104 sheets had been printed in two colors with black for detail and blue for hydrographic features. Contours were not compiled, but formlines were used to depict prominent features. The British Directorate of Overseas Surveys published the first map series at a scale of 1:50,000 in 1967. This edition was conventional line and symbol topographic maps with a contour interval of 50 feet, covered the more densely populated eastern portion of the Country, and were printed in five colors. These map sheets are referenced to the Gauss-Krüger Transverse Mercator projection. The astronomic coordinates of the initial point of the Cape Datum near Port Elizabeth are for Buffelsfontein where  $\Phi_0 = 33^\circ 59' 32.000''$  S and  $\Lambda_0 = 25^\circ 30' 44.622''$  E. In 1944, D.R. Hendrikz of the South African Trigonometrical Survey wrote, “For the computation of the geographical coordinates of the stations of the Geodetic Survey, Sir David Gill adopted the numerical values of the semi-major and semi-minor axes of Clarke’s 1880 figure or  $a = 20,926,202$  ft and  $b = 20,854,895$  ft. At that time this result was the most recent determination of the figure of the Earth. But, because the baselines were reduced to S.A.G. (*South African Geodetic* – ed.) feet, the computations were really carried out on a ‘Modified Clarke 1880 Spheroid’ defined by  $a = 6,378,249.145$  326 int metre and  $b = 6,356,514.966$  721 int metre. It may be remarked that this value of the flattening for this spheroid is  $1/f = 293.466$  307 656 which differs slightly from the value 293.465 given by Clarke himself.” There are five belts for the Botswana Transverse Mercator Projection where the Central Meridians are: 21°E, 23°E, 25°E, 27°E, and 29°E. The scale factor is unity, and there appears to be no False Easting or False Northing for any of these belts.

In April 1990, Professor Merry and J. Rens of the Univer-

sity of Cape Town published a paper in Survey Review that described their solution for datum shift parameters in southern Africa that included Botswana. Although they achieved a seven-parameter solution for nine points in Botswana, they found that a combined solution of 28 points for Botswana, Lesotho, the eastern half of South Africa, and Swaziland yielded a simpler solution. They recommended three transformation parameters for the region that includes the Republic of Botswana from the Cape Datum to the WGS 84 Datum is  $\Delta X = -136.0$  m  $\pm 0.4$  m,  $\Delta Y = -105.5$  m  $\pm 0.4$  m,  $\Delta Z = -291.1$  m  $\pm 0.4$  m. The Hartebeesthoek 94 Datum is now the official coordinate system of the Republic of South Africa and presumably, may someday become official for the Republic of Botswana.

## Botswana Update

In regards to the Botswana National Geodetic Reference System 2002 (BNGRF 2002), “A new Geodetic Reference System WGS584 was established in 2002 as a necessary step to ensure not only that the cadastral survey, and mapping were based on it, but also that for Global and regional environment and other purposes, seamless topographic and cadastral mapping could be attained. The Geodetic System whilst established on already monumented old Trigonometrical stations was carried out systematically across the country to allow for a strong network that would allow minimal deviations and progressive densification. Suffice it to say that whilst the cadastral survey is still being compiled in both WGS84 and the old datum system, the conversion to WGS84 has been fully provided for. An integrated system will thus ensure dexterity in information enhancement through over laying of variable data sets, especially as the high accuracy of the system, gained through the use of GPS and modern sophisticated software, far surpasses that of the past. The Land Survey Act requires that each parcel of land for cadastral survey in both urban and rural areas be tied to the Geodetic Network. The resultant erection of reference marks and Geodetic Stations in and around all settlements and other areas across the country, has also acted in favour of increased surveying for registration of title especially in rural areas” (*Botswana – Department of Surveys and Mapping (DSM) Cadastral Information System*, Bryson B. H. Morebodi, Promoting Land Administration and Good Governance 5th FIG Regional Conference Accra, Ghana, March 8-11, 2006).

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