

**BOTSWANA'S COUNTRY REPORT TO THE 27<sup>TH</sup> INTERNATIONAL  
CARTOGRAPHIC CONFERENCE TO BE HELD IN RIO DE JANEIRO  
BRAZIL FROM 23<sup>RD</sup> TO 28<sup>TH</sup> AUGUST 2015**

**SURVEYS AND MAPPING DEPARTMENT**

**Gaborone, Botswana**

August, 2015

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## **1.0 BACKGROUND INFORMATION**

### **1.1 Department of Surveys and Mapping**

Surveys and Mapping is a national mapping organisation under the Ministry of Lands and Housing which is responsible for the management of land and related functions as well as delivery of housing. The Department was established in 1962 as the Surveyor General's Office stationed in Mafikeng, the then capital of British Bechuanaland. The Department moved to Botswana in 1969 and was re-named the Department of Surveys and Lands. The name was later changed in 1993 to Department of Surveys and Mapping following departmental restructuring which resulted in the formation of three fully fledged Departments of Lands, Housing and Surveys and Mapping. This was done as part of an organisation and methods management exercise mounted by the Government of Botswana to create more efficient structures by, among other things, streamlining the responsibilities of the various departments for more effective service delivery. The Department was established through the Land Survey Act of 18<sup>th</sup> December 1959.

### **1.2 Mandate of the department**

The mandate of the Department of Surveys and Mapping (DSM) is to provide basic geospatial information and services. The Department's role is to collect, manage and disseminate geospatial information using surveying and mapping technologies such as Remote Sensing, Global Positioning System (GPS), Geographic Information Systems (GIS) and so forth. It also provides professional services and advice to government institutions and parastatals on all matters related to land in Botswana.

### **VISION**

Sustainable Human Settlements

### **MISSION**

Management of land and delivery of housing for socio-economic development

### **1.3 Structure of the department**

The department comprises three technical divisions, namely Surveying, Mapping and Geo-informatics.

#### **1.3.1 Surveying Division**

This Division is responsible for provision of national control framework, cadastral surveying in township areas, administration of Land Survey Act and regulations, demarcation of national and International boundaries, showings of beacons (plot corners) for the already allocated plots in Botswana's townships.

#### **1.3.2 Mapping Division**

This Division is responsible for the national mapping programme. It provides digital database, topographic maps, aerial photographs, satellite images and thematic maps (tourist maps, city/town maps, election maps, etc.) at small, medium and large scales in digital format and hard copy. Sections under this division include:

- Cartography
- Photogrammetry
- Remote sensing
- Geographical names (Place names)

#### **1.3.3 Geoinformatics Division**

The Division is responsible for examination and approval of all cadastral surveys as well as capturing and dissemination of geospatial information. It is also responsible for development, management and maintenance of geographical database. It has three sections

- Examination
- Data management and dissemination
- Data capture

#### **1.3.4 Departmental Management and Regional Offices**

In addition to the above technical divisions, there is a division called Departmental Management which provides resources to the technical divisions. The department also has a division responsible for Regional Offices which are located in Francistown, Selebi-Phikwe and Maun. The three regional offices are basically performing the same type of work done in Gaborone in order to decentralize and take services nearer to the customers.

## **2.0 MAPPING ACTIVITIES**

DSM, as a core business, for decades has been preparing and publishing reliable maps for variety of users through National Mapping Programmes under the Botswana National Plans (NDP). The users range from government, non-government, private entities to public users. This is achieved by using various computerised mapping or GIS systems.

Since 1987, with the assistance of Swede Survey, the department has been modernising its mapping technology and is now producing all maps in digital format. .

The National Mapping programme of Botswana is intended to provide base maps in form of topographic and thematic maps at varying scales. This project entails several mapping components, which are Acquisition of Aerial Photography, Production of Small and Medium scale maps, Land cover/land use maps and large scale settlement mapping. The demand for mapping coverage over the entire country by the stakeholders has necessitated the need to undertake this as an independent project during NDP 10

Since 2000, mapping processes and workflows were engineered to enable migration from analogue to digital. This was undertaken through the Integrated Geographic Information Systems (IGIS) project.

IGIS is a project which was financed through a co-operation between Botswana government and Sida. The long-term or development objectives in the IGIS project have been:

- To improve access to cadastral, topographic and geodetic information for users of such information as a means to speed up the land delivery and Land Information process in Botswana
- To cope with the demands for up-to-date mapping of the society
- To improve production through improved management at DSM

The department uses international and national standards, classifications and guidelines in its work. These include:

- Land Survey Act

- Workflows and Specifications developed from – Digital Geographic Information Exchange Standard DIGEST
- Metadata adopted from International Organization for Standardization (ISO)
- Botswana Bureau of Standards (BOBS)

However, it was observed that data quality among producers of geospatial information has been compromised by:

- Non adherence to existing policies, Land Survey Act and national standards.
- Lack of metadata on geo-information products due to shortage of manpower and inadequate appreciation of the importance of metadata.

### **3.0 COORDINATE REFERENCE SYSTEMS (CRS)**

There are two CRS used in Botswana. Up until 2002 all national mapping were based on Botswana Terrestrial Reference System (BTRS). Mapping by then were mainly analogue and the accuracy requirements were moderate, from 0.1 to 1-5 m depending on the purpose and the map scale.

BTRS was established in a conventional way i.e. direction and distance measurements for the position in the plane and precise levelling for heights. Primary control network consists of traverses observed by the Directorate of Overseas Surveys (DOS) in the 1960s. Computation was based on Modified Clarke 1880 ellipsoid with Cape Datum.

Since 2002, national mapping adopted Geodetic Reference System 1980 which was tied to national control points and renamed Botswana National Geodetic Reference System02 (BNGRS02). Digital technique development and high accuracy requirements on reference frame due to computerised procedures led to introduction of BNGRS02

BNGRS02 was established by carrying out GPS campaign on 25 stations equally distributed over Botswana. Final computation is presented in the International Terrestrial Reference frame (ITRF2000). Based on GRS80 Ellipsoid

### **3.1 Relationship between BTRS and BNGRS02**

BNGRS02 and BTRS will co-exist parallel in a foreseeable future in Botswana. The relationship is established by transformations. Two transformations, forward and backward, have been developed from the same set of data and kept together.

Development and documentation of transformation formulas have been organised and supervised by DSM and done by experienced personnel.

## **4.0 MAPPING ACHIEVEMENTS 2010 – 2015**

### **4.1 Topographical Map**

DSM has since the IGIS project started produced new series of topographical maps with the scales of 1:50 000, large scale settlement mapping with the scale of 1: 5 00 and 1:1 000 000 map to replace the older map series.

The specification for the new map series introduces new characteristics to the Topographical maps, among others are:

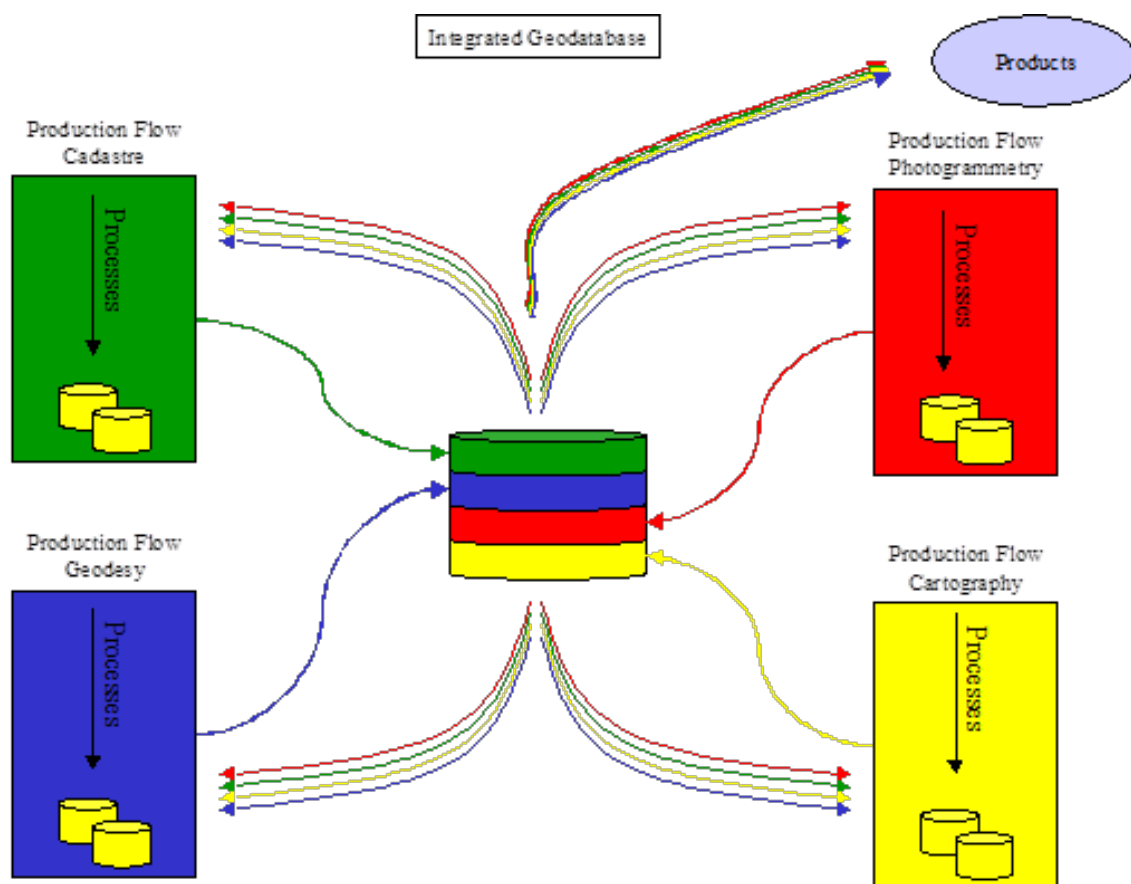
- (i) Adaptation of the new mapping datum
- (ii) New numbering of map sheets
- (iii) Introduction of map templates
- (iv) New representation for features in terms of colours and symbolizes
- (v) Ground coverage of 25km by 25 Km as opposed to 15 by 15 minutes format of the old sheets.

The department, with the new map series has completed a seamless national datasets and topographic map sheets of the country comprising 1012 map sheets at 1:50 000. To date there are about 197 large scale settlements which have been mapped. The 1: 1 000 000 map of Botswana has a revision cycle of 2 years

Topographic datasets comprised the following data themes, Transportation, Hydrography, Building and Habitation, Elevation, administration and Land cover/ Land use. The basic source of information are aerial photographs and satellite images complemented by survey data and existing sources.

## 4.2 Geodatabase

The aim of the Integrated Geo-database is to integrate cadastral, geodetic, and topographic data in order to facilitate the provision of geographic information for cost-effective use in society. Figure 1 below gives the concept in general for the structure of the integrated geo-database where different workflows together feeds the database, thus making the data available to all divisions of the Department of Surveys and Mapping. The geo-database is also the main source of data for the products of the Department.



**Figure 1.** The integrated geo-database is fed by the different production flows and the data stored centrally. The different production flows can then benefit from the data stored in the database (back-flow) through direct access (read or read/write). Products can be derived based on all data available



### **4.3 Ortho Photos**

All topographic mapping is based on remotely sensed imagery. It is normally in the form of aerial photography and satellite imagery. The photography and imageries are rectified and geo-referenced to produce ortho-photos.

To date, there are the following ortho photos, derived from either aerial photography or Satellite imagery.

- (i) 1 metre cell resolution black and white ortho photos covering the whole country, derived from aerial photographs.
- (ii) 25 cm cell resolution coloured ortho photos covering 200 settlements, derived from high resolution aerial Photography.
- (iii) 60 cm cell resolution coloured ortho photos derived from satellite imageries used for map revision.

### **4.4 Thematic Maps**

The department as a national mapping organisation, prepares thematic maps on request. These maps covers topics on socio economic activities and environment. Since 2010 to date, the department has published the following thematic maps:

- (i) National Land Use Map of Botswana
- (ii) Election Maps consisting of 57 constituencies
- (iii) Street maps for all eight auburn centres at scale 1:5000 derived from Cadastral database
- (iv) Guide maps for all two cities at scale 1:15 000 derived from street maps
- (v) House of Chiefs regions

### **4.5 Global Mapping**

Botswana has been participating on Global Mapping Project since 2000. And it has

Published Global maps of Botswana version 1 and 2.

The global map of Botswana version 2 was released on December 12, 2012. It consists of four data themes namely Roads under Transportation, Water

courses and Water body under Hydrography and Settlements under Building and Habitation.

#### **4.6 Geographical Place Names**

The Botswana Place Names Commission (PNC) was established in 1967 by a presidential directive CAB.51/67. The establishment was in line with the recommendations of the United Nations resolution of 1959 which established the United Nations Group of Experts on Geographical Names (UNGEGN). The main objective of the PNC was to examine all the Geographical Place Names in the country and verify their correct spelling following specified criteria. Due to some spelling challenges the commission has not been functional for some time. To date four report has been published.

However an Interim committee has been established to work on the resuscitation of the commission and also an enactment of a Geographical names Act, for the commission to have a legal backing.

#### **4.7 Enterprise License Agreement ELA**

The Botswana government has signed a three year Enterprise License Agreement contract with ESRI Southern Africa in December 2013. The contract will provide unlimited access to ESRI GIS mapping software products.

The ELA was negotiated through the GIS Cluster under the e-Government initiative. It envisions the provision of one source of authoritative information through the government portal that is synchronized between Central government and districts offices

#### **4.8 Geomatics Conference**

One of the most important activities and comprehensive gathering within the geographic information producers and users in Botswana is the Geomatics conference.

All organisations, academic centres, private sectors and individual specialist in all related subjects gather together within this great occasion to share their knowledge and experiences with each other.

The last conference was held in February 2014 and it is schedule to be held every two years. The next one will be 2016.

#### **4.9 Ongoing Projects**

1. Cadastral Information Systems
2. Land Information Systems
3. Botswana National Reference Frame work
4. Acquisition of Aerial photography for 100 settlements
5. Revision of medium scale 1: 50 000 map sheets
6. Revision of Large scale settlement mapping for 10 settlements
7. International and National boundaries

#### **5.0 Future Activities for National development Plan (NDP11)**

- Botswana National Data Infrastructure (BNSDI)
- Revision of Botswana National Atlas