



*Presented at the FIG Working Week 2016,  
May 2-6, 2016 in Christchurch, New Zealand*



Jack McKenna, Director of Business Development, Africa and the Caribbean

FIG WORKING WEEK 2016

# Fit for Purpose Parcel Mapping Methodologies for a Seamless Cadastre Database





# Presentation Content



- Land Administration Systems and Their Role in Disaster Management
- FIG/World Bank Fit For Purpose Statement
- Torrens and de Soto
- HM Land Registry (England and Wales)
- General Boundary and Fixed Boundary Mapping
- Parcel Monumentation
- The Seamless Cadastre
- Best Fit To Orthophoto Mapping
- Parcel Area Calculation Accuracy
- The Surveyor Pin Cushion
- ASPRS Accuracy Standards
- Parcel Mapping Costs
- Conclusion

# Land Administration Systems and Disaster Management



Survey Plans



Registry Documents

# An Archived Document Management System



Scanned, Indexed and Georeferenced Survey Plan

**BELIZE**

## VALUATION ROLL

**FOR OFFICIAL USE**

VTD

Ref. 7

Notice.

(Prepared in terms of Section 12(1) of the Land Tax Act (1989))

MARTIN GERALD FRITSCHKE / RICHARD EDWIN BACHMANN

Volume 8/2003 Folio 1037-1052

1. Name of Owner \_\_\_\_\_

2. Nature of Interest \_\_\_\_\_

3. Name/s of Beneficial Owner/s \_\_\_\_\_

4. Name/s of Occupier/s \_\_\_\_\_

5. Area occupied by each \_\_\_\_\_

6. Location SITUATE IN ISLEDE SETTLEMENT (PAR 136 (4))

7. Description Agricultural Land | Village Land PAR 136 (4) (RUB) | Area of Land 430.051 ARES

8. Unimproved Value and (E) Tax Payable therefor

Effective Date	Unimproved Value	Tax Payable	Revised Unimproved Value	Revised Tax Payable	REMARKS
<u>2001</u>	\$ 68,814.00	\$ 3,440.80	\$	\$	SRB Vol 27 Fol 457-494 & 6/10/97
<u>2002</u>	<u>75,300</u>	<u>752.00</u>			<u>VOLUME 8/2003 FOLIO 1037-1052</u>

Scanned and Indexed Valuation Roll



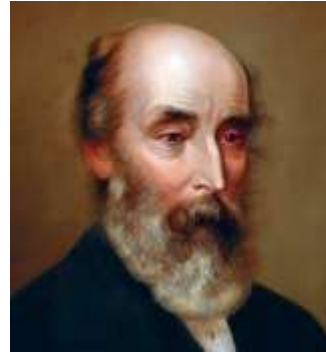
# Joint FIG/World Bank Statement

Build Appropriate Land Systems That Are:

- Fit-for-purpose
- Built Quickly
- Low and Affordable Cost

# Land Administration Visionaries

- Sir Robert Richard Torrens
- Hernando de Soto





# The Torrens System

- 1) The land titles Register accurately and completely reflects the current ownership and interests about a person's land.**
- 2) Because the land titles Register contains all the information about the person's land, it means that ownership and other interests do not have to be proved by long complicated documents, such as title deeds.**
- 3) Government guarantee provides for compensation to a person who suffers loss of land or a registered interest. (Victoria State, 2012)**



# De Soto's Message

Hernando de Soto's message to the developing countries of the world and their donors is a simple one:

*Enable poor people to register their property so that they can borrow against it to build businesses, buy farming equipment, seed and fertilizer and for other purposes.*





# HM Land Register Rules (1898 – England and Wales)

- Fixed Boundary Surveys
- General Boundary Surveys

# Fixed Boundary Surveys

**Rule 211. If it is desired to indicate on the filed plan, or otherwise to define in the register, the precise position of the boundaries of the land or any parts thereof notice shall be given to the owners and occupiers of the adjoining lands, in each instance, of the intention to ascertain and fix the boundary, with such plan, or tracing, or extract from the proposed verbal description of the land as may be necessary, to show clearly the fixed boundary proposed to be registered; and any question of doubt or dispute arising therefrom shall be dealt with as provided by these Rules.**



# General Boundary Surveys

**Rule 213. Except in cases in which the fixed boundary of the land has been thus ascertained the map shall be deemed to indicate the general boundaries only. In such cases the exact line of the boundary will be left undetermined (as for instance whether it runs along the centre of a wall or fence, or its inner or outer or how far it runs within or beyond it; or whether or not the land registered extends to the centre of an adjoining road or stream). When a general boundary only is desired to be entered in the register, notice to the owners of the adjoining lands need not be given. The result of this Rule is that, where the boundary is left undetermined, no indemnity will be given if the dispute is confined to the general boundary line.**

# The Seamless Cadastre Database

Compelling reasons for surveying a property parcel that will become part of a comprehensive fiscal cadastre:

- Problems with inadequate cadastres, lax and inequitable tax policies and practices hinder the revitalization and maintenance of neighborhoods and prevent local governments from collecting revenue needed to support public services.
- Provide documentation in the form of a parcel survey to help citizens achieve secure land tenure.
- A property owner desires to know as accurately as possible the value of his or her asset when selling a property or seeking a mortgage on it, and;
- A taxing agency needs to know the area of a parcel in order to apply the correct property tax rate to it.

# Deferred Monumentation

In his paper “*Deferred Monumentation and the Shakedown Factor*”, D. Goodwin raised two questions. First, whether it would be better for surveyors to place boundary marks after the erection of physical boundaries, roads and services;

Or:

Second, whether it is necessary to place boundary marks at all, or whether these should be placed only to resolve conflict where this arises.

About 20% of physical boundaries are built in the first year of occupation  
Approximately 50% of the properties are enclosed by about four years  
Approximately 66% of the properties are enclosed after about seven years  
After 17 years, 90% of properties are enclosed by physical occupation lines.

What form is the physical boundary?

Fence 63%

Hedge 16%

Concrete wall 9%

Brick wall 3%

Other 3%

No physical boundary 6%

# Parcel Corner Monumentation and Survey

The urban area around, for example, Nairobi, contains approximately 1.5 million parcels. How long would it take and how much would it cost to install and survey boundary marks to each of those parcels? Maybe \$50, more likely \$100 per parcel, and very likely more than that. This is too much time and money for government agencies who urgently desire to have a functioning and affordable revenue-generating fiscal cadastre as soon as possible. Digital orthophotography will provide the means to create as many as 75% of those parcels at a fraction of the cost (\$10 approximately per parcel) required for general boundary parcels compared to the cost of fixed boundary parcels. Well-defined boundary marks can be installed and surveyed for those parcels that cannot be mapped using general boundary mapping techniques.

# Best Fit to Ortho General Boundary Mapping

The best-fit-to-ortho mapping technique involves use of geo-referenced images (digital orthophotos) that have been created for a given jurisdiction (for example a municipality). Using this mapping technique, cadastral maps are completed to the same level of accuracy as the digital orthophotos based on the visual fit of the parcel boundaries to photo identifiable features that appear in the digital orthophoto image.

Per UK standards, at scales of 1:1,250, 1:2,500, 1:5,000 and 1:10,000.

# Best Fit to Ortho Mapping

Antigua  
1:2,500  
Ortho  
Backdrop to  
Parcel  
Database





# Area Calculation of Fixed and General Boundary Parcels

Fixed Boundary Parcel Area  
2 Ha

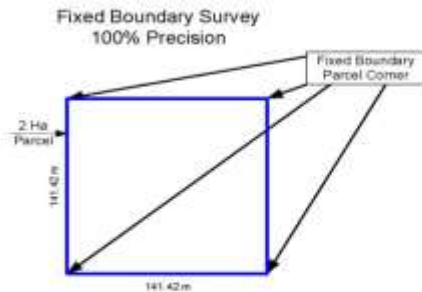


Fig. 1. Fixed Boundary Survey Parcel. This 2 ha parcel has been surveyed to a theoretical 100% accuracy.

General Boundary Parcel Area (from 1:5,000 orthophoto)  
2.16 Ha – off by 8%

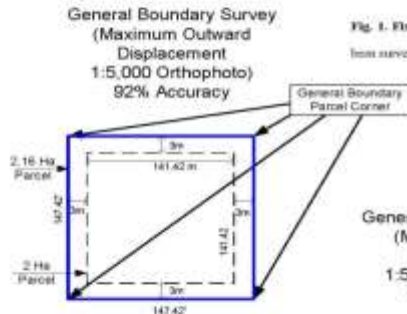


Fig. 2. This graphic shows a general boundary 2 ha parcel (located on a 1:5,000 scale orthophoto) with the maximum outward displacement of 3 meters applied to the parcel corners. As a result, the parcel area calculation of 2.16 Ha is off by 8% approximately.

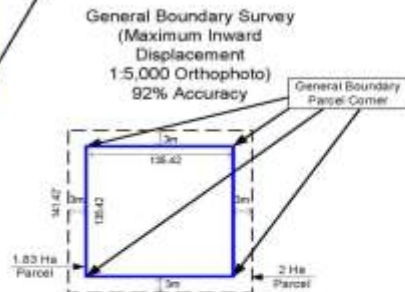


Fig. 3. This graphic shows a general boundary 2 ha parcel (located on a 1:5,000 scale orthophoto) with the maximum inward displacement of 3 meters applied to the parcel corners. As a result, the parcel area calculation of 1.83 Ha is off by 8% approximately.

General Boundary Parcel Area (from 1:5,000 orthophoto)  
1.83 Ha – Off by 8%

# The Surveyor Pin Cushion



Photo Dietz Surveying, Maryland, USA

# If American Society for Photogrammetry and Remote Sensing Accuracy Specs are Applied for Orthophoto Mapping

Map Scale	Class 1	Class 2	Class 3	Map Type
1:5,000	99%	98%	97%	(20 Ha parcel)
1:5,000	98%	96%	93%	(5 Ha parcel)
1:5,000	97%	93%	90%	(2 Ha parcel)
1:2,000	97%	95%	92%	(0.5 Ha parcel)
1:2,000	94%	88%	83%	(0.1 Ha parcel)
1:1,250	88%			(0.1 Ha parcel)



# Cost of Parcel Creation

- **Fixed Boundary Parcel Survey**

Field survey using total station or GPS - \$50 to \$1,500 (can be \$1,000 per acre)

- **General Boundary Parcel Survey**

Using digital orthophotography - \$10

# In Conclusion.....

The cost for cadastre creation should be a hybrid of two surveying methodologies:

- General boundary parcels using photogrammetric data (topographic mapping or digital orthophotography);
- Fixed boundary for the parcels that cannot be derived by any means other than field surveying;
- Implementation of a modern land administration system is the opportunity to create an electronic archive of all existing land records, a crucial disaster management strategy
- This model is the quickest way to achieve internally generated revenue; and
- It is time to stop thinking of parcel corner accuracy exclusively in terms of survey accuracy: Per FIG and the World Bank, it is time to create affordable revenue-generating cadastre databases, based on HM Land Registry model (England and Wales), which comply with the mapping accuracies of 1:1,250, 1:2,500, 1:5,000 and 1:10,000 and put the cost savings to good use on other aspects of land administration and disaster management activity.



# Thank You!

Jack McKenna

Trimble Land Administration Solutions

Director of Business Development

Africa and the Caribbean

Cell: 210-416-9234

[Jack\\_mckenna@trimble.com](mailto:Jack_mckenna@trimble.com)

Website: [www.trimble.com/land-admin](http://www.trimble.com/land-admin)