
**A METHODOLOGY FOR
THE CAPTURE AND REGISTRATION
OF LAND RIGHTS
UNDER THE
COMMUNAL LAND RIGHTS ACT**

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requirements for the Degree of
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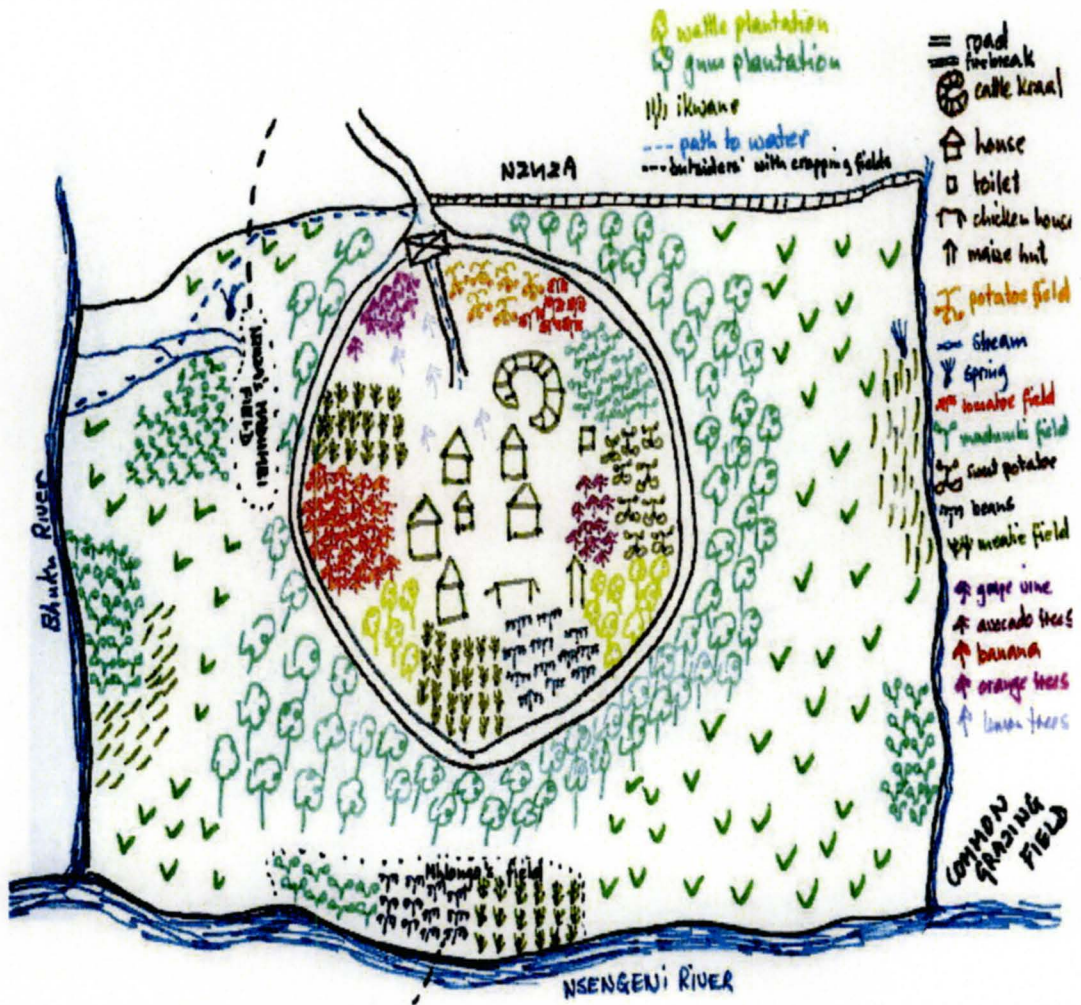
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Biyela Household, Ekuthuleni.

Courtesy AFRA.

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Alan Weston

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I, Alan C Weston, declare that this thesis entitled “A Methodology for the Capture and Registration of Land Rights under the Communal Land Rights Act” and submitted to the University of KwaZulu-Natal is my own work in design and execution. Information derived from the published or unpublished work of others has been duly acknowledged and a list of references is given. No portion of the work referred to in the thesis has been submitted in support of an application for another degree at this or any other university or institute of learning.

Alan Weston

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Abstract

One of the major policy objectives of the South African government is to reform land tenure and address the current inequitable dispossession of land. A key to the successful implementation of land reform in communal areas will be the recently enacted Communal Land Rights Act. This Act allows communities to be vested with juristic personality, and enables those communities to acquire and hold rights, incur obligations, and encumber the land by mortgage in the name of the community. Communities will now have a legal tenure recognized by and enforceable at law. The Act provides the mechanism for replacing old order rights with new order rights, which, in turn, may be upgraded to freehold title with community consent.

While the Communal Land Rights Act is clear in its approach to providing legal security of tenure, the implementation and linking of the internal land rights within these new legal collective ownership structures to the existing formal system is still uncertain. With the flexibility allowed under the Act, this dissertation offers a simple, cost-effective alternative for the registration of land rights using the envisioned Land Clerk of the Department of Land Affairs. This option involves placing suitably equipped Land Clerks into the communities in which they serve, operating as autonomous self-sustaining contractors.

Research for this project was conducted in the community of Ekuthuleni (KwaZulu-Natal), where two members of the community were equipped with a portable rig and trained to perform as Land Clerks. The author and others from the University trained them in the use of a computer, scanner, printer, handheld GPS receiver, and assorted software. In addition, to allow them to function autonomously, a photovoltaic power system was set up at their residence.

To assess their ability as Land Clerks, several field projects were undertaken within the community. Under the guidance of the author, these field tests involved contacting individual landowners, capturing personal and property information, and registering that data into a specially written database programme. Evidence of previous land ownership was noted and registered, GPS coordinates were collected and registered in the process of delineating the landowner's property, and a form reflecting all captured data was printed for the landowner's records.

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List of Abbreviations

~	Approximately	cm	Centimeter
Δ	GPS Survey Point	CODESA	Convention for a Democratic South Africa
>	Greater than		
<	Less than	COM1	1 st Serial Communications Port
'	Minutes	CPA	Communal Property Association
"	Seconds	CPAA	Communal Property Associations Act 28 of 1996
η	Number of Samples		
σ	Standard Deviation	CPSA	Communist Party of South Africa
2-D	Two Dimensions		
3-D	Three Dimensions	CPU	Central Processing Unit
A\$	Australian Dollars	CRLR	Commission on Restitution of Land Rights
A	Ampere		
A4	Standard Paper Size (210 x 297 mm)	D-255	Main road through Ekuthuleni
AA	Battery Size	DA	Democratic Alliance (Party)
AAA	Battery Size	DC	Direct Current
AC	Alternating Current	DC28	Uthungulu District Municipality Development Facilitation Act 67 of 1995
ACDSee	Digital Image Software	DFA	
AFRA	Association for Rural Advancement	DGPS	Differential Global Positioning System
Ah	Amp-hour	DLA	Department of Land Affairs
AIDS	Acquired Immunodeficiency Syndrome	DOA	Department of Agriculture
ANC	African National Congress	DoD	Department of Defense (US)
ASL	Above Sea Level	DOD	Depth of Discharge
B&B	Bed and Breakfast	DOP	Dilution of Precision
BBC	British Broadcasting Corporation	dpi	dots per inch
BMP	Windows Bitmap Format	DPOF	Digital Print Order Format
BRG	BioResource Group	DRG	Digital Raster Graphic Format
BRU	BioResearch Unit	DRMS	Distance Root-Mean-Square
°C	Celsius	DTLGA	Department of Traditional and Local Government Affairs
C/A	Coarse Acquisition Code	DVD	Digital Video Disk or Digital Versatile Disc
CAD	Computer Aided Design	DWAF	Department of Water Affairs and Forestry
CD	Compact Disc		
CDN\$	Canadian Dollar	DXF	Drawing Exchange Format (AutoCAD)
CDSM	Chief Directorate of Surveys and Mapping South Africa	E	East
CEP	Circular Error Probable (50 % confidence)	EDM	Electronic Distance Measurement
CGP	Communal General Plan	EEC	European Economic Community
CIA	Central Intelligence Agency	EGNOS	European Geostationary Navigation Overlay System
CLARA	Communal Land Rights Act 11 of 2004	EIA	Energy Information Administration
CLRA	Communal Land Rights Act 11 of 2004	ESA	European Space Agency
CLRB	Communal Land Rights Bill		

ESMG	Environmental Software and Modeling Group	JPG	Bitmap Image Format
ESTA	Extension of Security of Tenure Act 62 of 1997	KB	Kilobyte
ft	Feet	Kbps	Kilobit per Second
g	Gram	kg	Kilogram
GAR2RXN	GARmin TO RiNeX translator	km	Kilometer
GB	Gigabyte	kW	Kilowatt
GDOP	Geometric Dilution of Precision (3-D + Time)	kW/m ²	Kilowatt per square meter
GDP	Gross Domestic Product	kWh	Kilowatt-hour
GeoTIFF	Geographic Tagged Image Format	kWh/m ²	Kilowatt-hour per square meter
GHz	Gigahertz	KZ281	Mbonambi Municipality
GIF	Graphic Interchange Format	KZ282	uMhlathuze Municipality
GIS	Geographical Information System	KZ283	Ntambanana Municipality
GLONASS	GLOBAL NAVIGATION Satellite System	KZ284	uMlalazi Municipality
GMT	Greenwich Mean Time	KZ285	Mthonjaneni Municipality
GNP	Gross National Product	KZ286	Nkandla Municipality
GNSS	Global Navigation Satellite System	KZN	KwaZulu-Natal
GP	General Plan	L1	GPS L-band signal 1 (1575.42 MHz)
GPS	Global Positioning System	L2	GPS L-band signal 2 (1227.60 MHz)
ha	Hectare	L5	GPS L-band signal 5 (1176.45 MHz)
HDD	Hard Disk Drive	LAC	Land Administration Committee
HDOP	Horizontal Dilution of Precision (2-D)	LCC	Land Claims Court
HIV	Human Immunodeficiency Virus	LCD	Liquid Crystal Display
HP	Hewlett-Packard (Company)	LEAP	Legal Entity Assessment Project
hrs	Hours	LFTEA	Less Formal Township Establishment Act 113 of 1991
HSRC	Human Sciences Research Council	Li-ON	Lithium-ion
HWSETA	Health and Welfare Sector Education and Training Authority	LIS	Land Information System
Hz	Hertz	LPT1	Parallel Port Connection (1)
I/O	Input/Output	LRAD	Land Redistribution for Agricultural Development
ID	Identification	LRB	Land Rights Board
IDP	Integrated Development Plan	LRE	Land Rights Enquiry
IFP	Inkatha Freedom Party	LSA	Land Survey Act 8 of 1997
in	Inch	LTA	Land Reform (Labour Tenants) Act 3 of 1996
IPILRA	Interim Protection of Informal Land Rights Act 31 of 1996	m	Meter
IPX7	Waterproof Standard (IEC 60529 IPX7)	mA	Milliamp
ISS	Institute for Security Studies	mAh	Milliamp hour
IT	Information Technology	MB	Megabyte
JPEG	Bitmap Image Format	MDB	Municipal Demarcation Board/South Africa
		MFC	Multi-Function Center
		MHz	Megahertz
		MID	MapInfo Interchange Format
		MIF	MapInfo Interchange Format
		ml	Milliliter
		mm	Millimeter

MPNP	Multi-Party Negotiating Process	PV	Photovoltaic
MS	Microsoft	QA	Quality Assurance
MSAS	Multifunctional transport Satellite-based Augmentation System	QC	Quality Control
		R	Rand
MSRP	Manufacturer's Suggested Retail Price	RAM	Random Access Memory
		RDP	Reconstruction and Development Programme
N	North	RINEX	Receiver Independent Exchange Format
n.d.	No date		
NAVSTAR	Navigation Satellite Timing and Ranging	RMS	Root-Mean-Square
		ROM	Read Only Memory
NGO	Non-Government Organization	RRR	Request for Recognition of Old Order Rights (data- base programme)
NiCd	Nickel Cadmium		
NiMH	Nickel-Metal Hydride		
NLC	National Land Committee	RSA	Republic of South Africa
NMEA	National Marine Electronics Association	RT-DGPS	Real-Time Differential GPS
		RTK	Real-Time Kinematic
NNP	New National Party	RW	ReWritable (Disk)
NP	National Party	S	South
NQF	National Qualifications Framework	S/A	Selective Availability
		SA	South Africa
NW	Northwest	SADT	South African Development Trust
OS	Operating System		
PAC	Pan-Africanist Congress	SANAC	South African Native Affairs Commission
PC	Personal Computer		
P-Code	Precise or Protected Code	SAQA	South African Qualifications Authority
PCX	PC Paintbrush Bitmap Graphic Format	SAR	South African Republic
PDA	Personal Digital Assistant	SBAS	Satellite Based Augmentation Systems
PDF	Portable Document Format		
PDOP	Position Dilution of Precision (3-D)	SD	Secure Digital (Flash Memory)
		sec	Second
PIE	Prevention of Illegal Eviction from and Unlawful Occupation of Land Act 19 of 1998	SEP	Spherical Error Probable (50 % confidence)
		SG	Surveyor-General
PILAR	Pilot in Land Administration Records	SHP	Shape Format (ArcView)
		SLAG	Settlement and Land Acquisition Grant
PIMS	Parliamentary Information Management System	SNR	Signal to Noise Ratio
PLAAS	Programme for Land and Agrarian Studies	StatsSA	Statistics South Africa
		TDOP	Time Dilution of Precision
PNG	Portable (Public) Network Graphic Format	TIFF	Tagged Image Format
		TRANCRAA	Transformation of Certain Rural Areas Act 94 of 1998
PPDC	Provincial Planning and Development Commission (KwaZulu-Natal)	TTFF	Time to First Fix
		UKZN	University of KwaZulu-Natal
PPM	Pages per Minute	ULTRA	Upgrading of Land Tenure Rights Act 112 of 1991
ppm	Parts per Million		
PRN	Pseudorandom Noise	UN	United Nations
PTO	Permission to Occupy	UP	United Party

Abbreviations

US/USA	United States	VDOP	Vertical Dilution of Precision (1-D)
US\$	US Dollar	VGA	Video Graphics Array
USB	Universal Serial Bus	VIP	Ventilated Improved Pit(s)
USCG	US Coast Guard	VOC	Dutch East Indies Company (VOC in Dutch)
USDE	US Department of Energy	W	Watt or West
USGS	US Geological Service	W/m ²	Watt per square meter
UT	University of Texas	WAAS	Wide Area Augmentation System
UTC	Universal Time Coordinated	WGS84	World Geodetic System 1984
UTM	Universal Transverse Mercator	Wh	Watt hour
V	Volt		
VAT	Value-Added Tax		
VDC	Volts (Direct Current)		

1 Introduction

Land tenure in South Africa currently consists of a Western system of tenure (formal), and a traditional system of tenure (informal). The formal system is based on a long tradition of surveying and registration and is supported by both government and private sector institutions. Most importantly, the formal system is recognized by law. Conversely, the informal system is often unique to individual communities and subject to the rules and regulations as determined by local tribal authorities. The rules are often unwritten and dynamic, which means they are constantly being adapted over time to the community's requirements. Traditional tenure systems are perceived by their occupants as being secure within the context of their community, though they are not normally recognized by formal laws.

Unlike many African countries, South Africa's formal cadastral system covers the vast majority of the country, with remaining areas confined principally to the rural areas of the former homelands. The status of land tenure in South Africa's communal areas has left many people who have occupied the land for generations without legal tenure in law, without record in the land register and without a dispute resolution mechanism. Many communal areas have a weak form of tenure security under the previously issued Permission to Occupy (PTO) certificates, while other areas lack any form of legitimate (formal) ownership. With no security in their land, residents are hesitant to make major investments, banks are hesitant to provide capital to those with weak tenure, and municipal planning and infrastructure are often affected by land ownership issues. National, provincial, and municipal governments all recognize the need for improving tenure security in the communal areas. Reforming the tenure system will allow government agencies the means to better assess, manage, and develop their rural populations and provide municipalities with the basis for a fair and equal method of taxation.

As a direct result of previous apartheid policies, the geographical distribution of these tenure systems has given rise to a distinct spatial skewing of land ownership. Thus, one of the major policy objectives of the South African government has been to reform land tenure and address the current inequitable dispossession of land. One of the keys to the successful implementation of land reform will be the recently enacted Communal Land Rights Act (2004). This Act allows communities to be vested with juristic personality and enables communities to acquire and hold rights, incur obligations, and encumber the land by mortgage in the name of the community. Communities will now have a legal tenure, recognized and enforceable by law.

The Communal Land Rights Act applies to communal land of the former homelands created under the land laws of 1913 and 1936. The Act will provide a mechanism for replacing old order rights, as recognized by the White Paper on South African Land Policy (1997), with new order rights to be transferred to members of the community, so entitled by way of a Deed of Communal Land Right. These rights, in turn, may be upgraded to freehold title with community consent.

While the Communal Land Rights Act is clear in its approach to providing legal security of tenure, the implementation and linking of the internal land rights within these new legal collective ownership structures to the existing formal system is still uncertain.

1.1 Problem Statement

The problem is how existing de facto communal landowners can be provided with secure tenure under the Act, given the lack of government resources available, the high cost of traditional surveying methods, and a general lack of capacity in the surveying industry. Given the number of communal land residents and the cost to implement the Act using traditional survey methods, a significantly less-costly alternative is needed. This means that the successful implementation of land reform under the Communal Land Rights Act will require a relatively fast, simple and, most importantly, cost-effective alternative for the registration of communal land rights.

1.2 Research Question

The question this dissertation intends to answer is how to undertake the extensive land adjudication required in the communal areas of South Africa, as mandated in the Communal Land Rights Act, in a cost-effective manner.

The method of providing tenure security to the communal areas must be a process that is acceptable to current de facto landowners. The method cannot ignore existing customary (traditional) methods of land tenure; otherwise, it runs the risk of being rejected by those it is intended to protect. Considering the flexibility allowed under the Act, it must integrate and build on traditional methods that have been used for generations in maintaining land rights. Thus, the incorporation of traditional methods of land allocation, adjudication, and demarcation will make the system acceptable to current de facto landowners in the communal areas. In addition, the method must be able to be integrated into existing formal systems and be acceptable to those currently working in this system, that is, Conveyancers and Land Surveyors. Communal landowners will need legitimate records of their land holdings, which can at some future date be registered with the land titles office as stipulated under the Act. In addition, the process must be consistent with the Constitution and existing land policies and land legislation (and amendments). Most importantly, it must provide the security of tenure required by the current de facto owners, service providers, banking institutions, and the state.

Lastly, a prime consideration will be the costs of implementation, training, infrastructure requirements, and system maintenance. In short, the system must be affordable and sustainable by the state.

1.3 Hypothesis

With the flexibility allowed under the Communal Land Rights Act, this dissertation proposes a simple and cost-effective method for registering community land rights using the proposed "Land Clerk" of the Department of Land Affairs. This paper proposes placing Land Clerks into the communities in which they serve, operating as autonomous self-sustaining contractors. These "Community Land Clerks," would be equipped with portable rigs consisting of a laptop computer, scanner, printer, and handheld GPS receiver. With this toolset, the Land Clerk would be mobile and able to demarcate and register properties in the field on short notice. These community-based Land Clerks, acting as independent contractors, would not only be able to work as Land Clerks on

behalf of the Department of Land Affairs but also able to supplement their income by providing other services to the community. In addition, since many communal areas lack access to reliable power, they will need to be set up with photovoltaic (solar) power systems. This will allow them to operate autonomously and self-reliantly.

Suitably trained Community Land Clerks working under the supervision of a Land Administrator or possibly Land Surveyor would carry out most land related matters in the communal areas. Land Clerks would travel with their portable rigs throughout the community recording existing tenure and land transactions as needed. The registration of boundaries, many of which exist only as oral agreements between neighbours, would be completed by the Land Clerk. Required information regarding de facto boundaries, as they exist under current community practices, would be entered into a series of standardized data forms on a laptop computer. In addition, using a handheld GPS receiver, the Land Clerk will have the capability of delineating and registering property boundaries.

The process of delineating a property boundary would involve a Land Clerk, in the company of the current "owner" and adjoining "owners," walking the property perimeter recording GPS coordinates. For the landowner's records, the Land Clerk would print out all collected database fields in standardized pre-designed A4 forms. These forms, after verification by the parties of interest, would then subsequently be signed. Together with the agreed-upon GPS coordinates, these signed forms would thus form part of the "Deeds Package." Finally, the signed copies, and coordinates would be electronically transferred to the Land Administrator or Land Surveyor, who has the final authority.

1.4 Research Methodology

The methodology for this dissertation consists of several field projects conducted in the small rural community of Ekuthuleni, located near Melmoth, KwaZulu-Natal. The Ekuthuleni community has been proactive in the land reform process and, as part of the former homelands, will be one of the areas affected by the Communal Land Rights Act. The community has participated in previous land tenure projects and is therefore knowledgeable about the land reform process. The Ekuthuleni Committee, acting on behalf of the community, agreed to participate in this research project, and provided two members from the community to be trained as pseudo Land Clerks.

The two members (women) chosen by the Ekuthuleni Committee were set up with the tools and equipment as would be required by a Community Land Clerk. During several visits to the community in October and November 2004, the women were provided with a laptop computer, portable printer, scanner, digital camera, and handheld GPS receiver. These women, with no previous formal training, were subsequently provided with basic training by the author and others from the University. To provide them with AC power and allow them to operate from their residence, a photovoltaic system was installed on one of the residential dwellings.

As a proof of concept of this methodology, the two women, at the completion of training, traveled into the community to field test their abilities as pseudo Land Clerks. Several field exercises were conducted in which they would collect specific information from community landowners, register that data into a specially written database pro-

gramme, print paper copies of collected data fields for the landowner's personal records, and delineate property boundaries using a handheld GPS receiver.

1.5 Research Objectives

With the recent enactment of the Communal Land Rights Act in 2004 and in view of recent technological advances in the fields of spatial information acquisition, storage, and processing, the primary objective of this dissertation is to provide one possible scenario for the registration of community land rights under the Act. With the flexibility allowed under the Act, this paper proposes a simple and cost-effective method for registering community land rights using the envisioned Land Clerk of the Department of Land Affairs.

This dissertation aims to evaluate the premise that a Land Clerk can be equipped and trained at a reasonable cost, and that this process will be feasible and easy to implement. As such, this paper is primarily aimed at the Land Clerk's ability to collect and register relevant data, as opposed to perfecting the required equipment and software or determining which information would be deemed necessary to secure tenure.

The method proposed in this paper can easily be adjusted to meet accuracy requirements as stipulated under existing legislation and their anticipated amendments. Similarly, training can be modified to better suit the Land Clerk and Land Administrators as those roles become better defined. In essence, the method outlined in this paper, with the appropriate modifications, should provide an affordable mechanism for the collection and registration of land rights under the Communal Land Rights Act. This will allow members of communities to obtain the security of tenure they desire and provide the security required by government, service providers, mortgage institutions, and others.

1.6 Structure of Thesis

This dissertation is organized into 10 chapters and 7 appendices. Following this introductory chapter, Chapters 2 through 4 provide background information on various aspects of South Africa, including the historical basis for land reform and recent land reform legislation and policies. Chapter 5 provides information on the community of Ekuthuleni. Chapter 6 examines several methodologies for implementing communal land rights, most notably the proposed community-based Land Clerk. The subsequent chapters, Chapter 7 and 8, outline the implementation and logistics of the proposed Community Land Clerk. This includes the training of two pseudo-Community Land Clerks and their subsequent field-exercises in the Ekuthuleni community as a proof-of-concept. Chapter 9 reviews the equipment and procedures used and provides some analysis and recommendations, and, lastly, Chapter 10 provides a short summary. The following provides a short overview of each chapter and appendices:

Chapter 1: Introduction.

Chapter 2: Presents background information on selected issues that have previously influenced and will likely continue to shape land reform in South Africa. The chapter presents a general overview of the physical and political geography of the country, the

makeup of South African society, languages, government, economy, and the current HIV/AIDS pandemic and their implications for future land reform.

Chapter 3: Looks at the history of South Africa in the context of the current state of land reform. This chapter examines the causes and effects of South Africa's evolution into a country with one of the most skewed patterns of land distribution in the world controlled by a single racial group. The chapter looks at how this pattern developed under the broad headings of colonialism, segregation, and apartheid. As well, the chapter looks at how the previous systems have been dismantled over the past two decades and continue to be dismantled.

Chapter 4: Focuses on the land reform process in South Africa since the early 1990s, when land reform began in earnest. This chapter reviews the regulatory framework, and specific legislation involved in the land reform process. It looks at legislation broadly grouped under the 1991 land reforms, the Constitutions of 1993 and 1996, and the current redistribution, restitution and tenure reform programmes of the recent ANC governments. Most importantly, this chapter provides an overview of the recently enacted Communal Land Rights Act, which will be instrumental in the reform of tenure in the communal areas of South Africa, most notably the community of Ekuthuleni.

Chapter 5: Provides background information on the community of Ekuthuleni, where the field portion of this dissertation took place. This chapter provides the reader with a broader understanding on how the community developed, its physical geography, various social-economic aspects, cultural and historical land tenure, the prevailing land tenure situation in the community, and the steps undertaken by the community in their endeavor to secure tenure.

Chapter 6: Looks at a methodology for providing communal land rights under the Communal Land Rights Act. The chapter reviews the Department of Land Affairs' recently created Land Clerk and Land Administrator positions and their status at the time of writing. Using these new positions, this paper proposes outfitting Land Clerks with a portable rig and basing them in the communities they serve. The chapter explains how these Community Land Clerks will be equipped and the proposed methodology they will use for the registration of land rights under the Act.

Chapter 7: Expands on the implementation and logistics of the proposed Community Land Clerk. The chapter looks at some of the requirements that will be involved in this process, including the design of a Land Information System and a photovoltaic base-station. In addition, a review is presented of the required hardware and software used in the field exercises carried out under this dissertation.

Chapter 8: Outlines the field portion of this dissertation, particularly the processes involved in the training and implementation of a pseudo Community Land Clerk. The chapter describes how two women selected by the Ekuthuleni Committee were instructed in the use of a computer, printer, scanner, digital camera, and handheld GPS receiver. Using their newly acquired skills, the chapter describes how these pseudo Community Land Clerks performed in several practical field examples.

Chapter 9: Provides an overall look at the Community Land Clerk, as envisioned by this paper, and at the Land Clerk, as envisioned by the Department of Land Affairs. In

particular, this chapter looks at the equipment and procedures used in the field and offer some analysis, discussion and recommendations. Additionally, the chapter looks at the use of GPS for land registration, notably their accuracy and how handheld GPS receivers might attain the required accuracy. In addition, some of the problem areas like Quality Control and inaccessible points are examined, and some solutions and alternatives are suggested.

Chapter 10: Provides a short summary.

Appendix A: Provides short descriptions of selected legislation related to apartheid or other land related issues that have had a direct or indirect influence on the development of land tenure in South Africa.

Appendix B: Gives detailed information about the equipment used in this dissertation. It provides information on the equipment's physical characteristics and various other specifications, including manufacturer, model numbers, and purchase price.

Appendix C: Provides several tables listing GPS coordinates for the properties mentioned in this paper. Unless otherwise stated, all data is presented in unadjusted (i.e., no differential corrections) latitude/longitude for the various GPS receivers mentioned in the text.

Appendix D: Provides selected statistical coverage of the Ekuthuleni community. These may include all or part of the census regions of Mthonjaneni municipality, Uthungulu municipality, and South Africa as a whole.

Appendix E: Provides photographs of the Ekuthuleni community showing typical traditional dwellings, topography, and selected properties mentioned in the text.

Appendix F: Presents two computer screen images of the "Request for Recognition of Old Order Rights" (RRR) database programme. This programme, written in MS Access 2003 by the author, was used for the collection of data in the field exercises.

Appendix G: Contains various maps of South Africa, Uthungulu and Mthonjaneni municipalities, and the Ekuthuleni area.

Abbreviations and acronyms used in this dissertation are listed in the "List of Abbreviations" immediately preceding this chapter.

2 South Africa in Context

2.1 Physical Geography

South Africa is the southern most country on the African continent, bordering Mozambique and Swaziland to the northeast, Botswana and Zimbabwe to the north and Namibia to the northwest.¹ In addition, South Africa completely surrounds the small independent country of Lesotho. To the southwest and southeast lie the Atlantic and Indian Oceans, respectively. South Africa extends for approximately 1,400 km north-south and 1,600 km east-west, comprising an area of 1,219,912 km².

South Africa's landscape is dominated by a broad interior plateau, surrounded by a mountainous "Great Escarpment" and a marginal area (coastal plain) between the escarpment and the sea. The interior plateau consists of Highveld,² rolling grasslands over wide areas. The Great Escarpment ranges in elevation from 1,500 to 3,375 m ASL, reaching its greatest height in the Drakensburg Mountains. Between the Great Escarpment and the coast lies a coastal plain, ranging in width from 60 to 240 km.

South Africa's climate is generally considered warm-temperate with the eastern coast predominantly semiarid to subtropical, moderated by the Indian Ocean. Rainfall varies throughout the country from less than 200 mm in the northwest to more than 1,000 mm along the KwaZulu-Natal coast. Rainfall can be unreliable and unpredictable resulting in occasional droughts. As such, arable land is limited to about 10 % of South Africa's total land area.

Winters are warm and dry (averaging 23 °C), with some sub-zero temperatures in the higher elevations.³ Average daily sunshine during the winter often averages up to 7 hours/day. Summers are hot and humid (averaging 28 °C), with most of the annual rainfall occurring during this period (Berman, 2003a, 2003b, CIA, 2005).

2.2 Political Geography

Since 1994, South Africa has been divided into nine provinces: Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, North West, Eastern Cape, Northern Cape, and Western Cape.⁴ Before 1994,⁵ South Africa consisted of four provinces: Cape Province, Natal, Orange Free State, and Transvaal.⁶ In addition, during the apartheid years, quasi-independent homelands (Bantustans) were present: Bophuthatswana, Ciskei,

¹ See Map 3: South Africa 2005 (Appendix G/page 281) and Map 4: South Africa [Relief] (Appendix G/page 282).

² High-altitude grassland, in the general range of between 1,200 m and 1,800 m ASL.

³ i.e., Drakensburg Mountains.

⁴ See Map 3: South Africa 2005 (Appendix G/page 281).

⁵ 1910 - 1994.

⁶ See Map 2: South Africa 1986 (Appendix G/page 280).

Gazankulu, KaNgwane, KwaNdebele, KwaZulu, Lebowa, QwaQwa, Transkei, and Venda.⁷ These territories were never recognized internationally and were formally abolished and reincorporated into South Africa under the 1993 Constitution.⁸

2.3 Society

The current population of South Africa is estimated at 47 million⁹ (Berman, 2003a). Of this population, 79.0 % are considered Black African, 9.6 % White, 8.9 % Coloured, and 2.5 % Indian/Asian (StatsSA, 2003).¹⁰ Interestingly, since 1911, the percentage of the Coloured and Indian populations has remained fairly constant while the Black African population has increased from 67.3 % to 78.0 % and the White population has decreased from 21.4 % to 10.0 % of the total population (Berman, 2003a).

South Africa still suffers from the problems of large socio-economic inequalities left over from the apartheid regime, which continue to be manifest in the form of high rates of unemployment,¹¹ poverty, and crime. South Africa has long suffered from widespread poverty, with almost 57 % of its population living under the poverty line (HSRC, 2004). Of those living in poverty, an estimated 18.2 % live on less than US\$ 1 a day¹² (HWSETA, 2005). During the apartheid years, inequality in South Africa was defined along racial lines; today it is increasingly defined by the inequality within population groups. A racial breakdown of those considered living in poverty shows a large discrepancy with respect to race. While 61 % of Black South Africans are classified as poor, only 1 % of White South Africans are similarly characterized (HWSETA, 2005).

As with poverty, crime is another source of much consternation. Over the previous decade, South Africa has experienced high levels of violent crime. Consistently, the country has had some of the highest rates in the world for murders, rapes, robberies, violent thefts, and serious assaults (ISS, 2005). Crime is of considerable concern for the country and is often the main reason¹³ given by emigrating South Africans.¹⁴ To compound the problem, most of those emigrants are South Africa's most skilled and well educated.

⁷ See Map 2: South Africa 1986 (Appendix G/page 280).

⁸ Constitution of the Republic of South Africa Act 200 of 1993.

⁹ Estimates by Statistics South Africa for 2005 range between 46.0 - 47.0 million (StatsSA, 2005b).

¹⁰ Estimates by Statistics South Africa for 2005 are African 79.4 %, White 9.3 %, Coloured 8.8 %, and Indian/Asian 2.5 % (StatsSA, 2005b).

¹¹ 26.2 % (2004 estimate) (CIA, 2005).

¹² 1995 figures.

¹³ Together with the spread of HIV/AIDS.

¹⁴ Personal observation. A BBC Report in 2002 (quoting a University of South Africa Report), stated that 60 % left due to crime and AIDS (BBC, 2002). In addition, in a report of Nurse Emigration, crime was given as one of the main reasons for emigrating (Xaba et al, 2001).

2.4 Language

The South African Constitution¹⁵ recognizes and guarantees equal status to 11 official languages. The most widely spoken language is isiZulu,¹⁶ spoken by 23.8 % of the population, followed by isiXhosa¹⁷ (17.6 %), Afrikaans (13.4 %), Sepedi¹⁸ (9.4 %), English (8.2 %), Setswana¹⁹ (8.2 %), Sesotho²⁰ (7.9 %), Xitsonga²¹ (4.4 %), siSwati²² (2.7 %), Tshivenda²³ (2.3 %), and isiNdebele²⁴ (1.6 %) (RSA, 2005b). Each language is spoken in specific parts of the country to varying degrees, with most being concentrated in specific regions. For instance, Afrikaans is the predominant language in the Northern (68.0 %) and Western Cape (55.3 %); isiXhosa (83.4 %) is common in the Eastern Cape, and isiZulu is the dominant language in Gauteng (21.5 %) and KwaZulu-Natal (80.9 %)²⁵ (StatsSA, 2003). English speakers are concentrated in the Western Cape (19.3 %), KwaZulu-Natal (13.6 %), and Gauteng (12.5 %)²⁶ (StatsSA, 2003). While not dominant in any one region, English is generally understood across the country, being the most commonly used language in business and industry.

2.5 Political

South Africa gained its independence from the United Kingdom on May 31 1910, and was officially known as the “Union of South Africa.” On May 31 1961, following a 1960 referendum,²⁷ South Africa left the British Commonwealth and became a republic known as the “Republic of South Africa.”

Since the 1994 election, the African National Congress (ANC) has been the party in power, winning a majority government in 1994 (63.0 % of the vote), 1999 (66.5 %), and 2004 (69.7 %) (Berman, 2003b). The latest election in 2004 returned Thabo Mvuyelwa Mbeki for a second term as President. While the popular vote has increased slightly in

¹⁵ Constitution of the Republic of South Africa Act 108 of 1996.

¹⁶ Zulu.

¹⁷ Xhosa.

¹⁸ Northern Sotho (Sesotho sa Leboa).

¹⁹ Tswana.

²⁰ South Sotho.

²¹ Tsonga.

²² Swati (Swazi).

²³ Venda.

²⁴ Ndebele.

²⁵ Census 2001.

²⁶ Census 2001.

²⁷ In a Whites-only referendum on October 5 1960, 52 % of South Africans favored the establishment of a Republic.

each election for the ANC, the former governing National Party²⁸ went from winning 20.5 % of the vote in the 1994 election to 7.0 % in 1999 to 1.7 % in 2004 (Berman, 2003b). The party was officially dissolved in April 2005. With the fall of the National Party, the main opposition parties are the Democratic Alliance²⁹ (DA) and the Inkatha Freedom Party³⁰ (IFP), whose support is limited mainly to rural KwaZulu-Natal.

With the ANC receiving almost two-thirds of the vote³¹ for each of the last three elections, South Africa has become essentially a one party democracy. The likelihood of opposition parties being in a position to challenge, let alone win an election, seems a remote possibility for the near future.

2.6 Government

Until 1994, South Africa was governed by a White minority government. During this period, Parliament was supreme and could make any law it desired, even those that removed basic human rights. In 1994, under an Interim Constitution,³² South Africa held its first “fully interracial” election. The Interim Constitution required the drafting and approval by the Constituent Assembly of a new permanent Constitution by May 9 1996. This new final Constitution³³ was adopted May 8 1996, and, after some amendments, came into effect in February 1997.

The Constitution is the supreme law of the land. Under the Constitution, South Africa is a constitutional democracy, meaning all citizens (even the President) must abide by the Constitution. In addition, all laws must abide by the Constitution, and any change to the Constitution requires the approval of a significant majority³⁴ of members in Parliament.

The Constitution ensures the separation of powers by creating three separate branches of government: the Executive, the Legislature, and the Judiciary. The Executive branch is headed by the President and consists of the Cabinet, national government departments, and provincial executives and departments. The Executive branch is responsible

²⁸ Known as the New National Party in the 1999 and 2004 elections (In September 1998, the National Party renamed itself the New National Party to distance itself from its past).

²⁹ The DA received 12.4 % of the popular vote in the 2004 election (CIA, 2005). The DA was formed from the merger of the Democratic Party and the Freedom Alliance.

³⁰ The IFP received 7 % of the popular vote in the 2004 election (CIA, 2005).

³¹ On September 15 2005, 25 floor-crossings took place by the various parties. The remaining 7 members of the (New) National Party (NNP), 5 members of the Democratic Alliance, 5 members of the Inkatha Freedom Party, 3 members of the United Democratic Movement, 2 members of the Independent Democrats and 3 members of the Freedom Front Plus Party all crossed the floor to join other parties. Fourteen of those crossing the floor went to the ANC, which gave the ANC 293 seats, or 73.25 % of the popular vote (Parliamentary Monitoring Group, 2005).

³² Constitution of the Republic of South Africa Act 200 of 1993.

³³ Constitution of the Republic of South Africa Act 108 of 1996.

³⁴ Between 66.7 % and 75 %.

for running the country and making policy. Under the Constitution, the President (Thabo Mbeki) is both the Head of State and the Head of Government.

Legislature authority is vested in a bicameral Parliament, composed of the National Assembly and the National Council of Provinces. The National Assembly consists of between 350 and 400 members, with members elected to five-year terms using a proportional representation system. Seats are awarded to each political party in proportion to the number of votes received in the national election.

The Judicial System is based on Roman-Dutch law, altered by British rule and the Constitution(s). Judicial authority is vested in the courts,³⁵ with the Constitutional Court ensuring that laws comply with the Constitution.

Unlike most countries, the three branches of government in South Africa are located in three different cities (capitals). The Administrative Capital is located in Pretoria, where all government departments are headquartered. The Legislative Capital is in Cape Town, where Parliament meets, and the Judicial Capital is in Bloemfontein, where the Supreme Court of Appeal meets.

Government is divided into three tiers or levels by the Constitution. These are the national government, the provincial government, and local government. Powers and functions of each level are also defined by the Constitution.

Each province in South Africa has its own provincial government, and the legislative power of each province is vested in a provincial legislature with executive power vested in a provincial premier. A provincial legislature has between 30 and 80 members. Similar to the national legislature, members are elected to five-year terms with seats awarded to each political party in proportion to the number of votes received in the election. Elections are held every five years concurrent with national elections.

In addition to national and provincial governments, 284 Municipal governments are responsible for local affairs.³⁶ Moreover, the Constitution³⁷ allows traditional authorities and their communities to establish a "House of Traditional Leaders" at various levels of government. Their roles are to advise government on matters of indigenous and customary law, customs, and traditional leadership.

2.7 Economy

South Africa is the richest and most highly industrialized country in Africa, with well-developed communications, energy, financial, and transportation sectors. A first-world infrastructure of roads and rail networks allows for the efficient distribution of goods to export markets, as well as to domestic consumers. In addition, the country has the

³⁵ Subject to the laws of the Constitution.

³⁶ Subject to provincial and national legislation.

³⁷ Chapter 11: Traditional Authorities (Constitution of the Republic of South Africa Act 200 of 1993) and Chapter 12: Traditional Leaders (Constitution of the Republic of South Africa Act 108 of 1996).

added fortune of processing a wealth of natural resources, particularly minerals such as chromite, copper, diamonds, gold, iron ore, manganese, platinum, silver, and uranium. Two minerals in particular, gold and diamonds, have been a mainstay of the country's economic growth since they were initially discovered in the 1800's. Not surprisingly, mining³⁸ accounts for approximately 10 % of the GDP. South Africa exports US\$ 41.97 billion worth of goods annually and imports US\$ 39.42 billion.³⁹

South Africa experienced an exceptional period of economic growth from the 1950's through to the 1970's. During the 1980's, the country suffered a period of economic stagnation and international isolation. International opposition to apartheid and the resulting sanctions, boycotts, withdrawal of foreign investments, and a flight of capital all contributed to a severe economic slowdown. With the end of apartheid in the early 1990's, investment and foreign trade have again increased, though the country is still saddled with numerous daunting economic problems as a direct consequence of the apartheid era. These include, but are not limited to, widespread poverty, violent crime, unemployment, a poorly educated workforce, and a lack of any significant empowerment among the disadvantaged groups.

2.8 HIV/AIDS

Sub-Saharan Africa is the region most affected by the HIV/AIDS pandemic. The spread of this pandemic was fuelled by the widespread poverty throughout the region, the status of women, social instability, and the mobility of the population, as well as high levels of sexually transmitted diseases (AIDS Foundation South Africa, 2005). South Africa and several neighbouring countries have some of the highest infection and death rates from HIV/AIDS in the world. The HIV infection rate in South Africa is 21.5 %, ⁴⁰ the fifth highest rate in the world (CIA, 2005), meaning that some 5,300,000⁴¹ South Africans are living with the virus (RSA, 2003). Additionally, an estimated 370,000 South Africans are dying annually from AIDS, the highest death rate in the world (CIA, 2005).

Because of the HIV/AIDS pandemic, the life expectancy at birth has dropped dramatically. In 2000, life expectancy was 56 years. By 2010, this figure is expected to drop to 41 years (Berman, 2003b). The current life expectancy of 43.27 years (CIA, 2005) is dramatically different from the 68.2 years that would be anticipated in the absence of the AIDS epidemic (HWSETA, 2005).

In addition to the direct impact of HIV/AIDS on households, the effect on the economy, communities, society, and the greatly under-funded health-care system is significant.

³⁸ South Africa is the world's largest producer of chromium, gold, and platinum.

³⁹ 2004 estimate (CIA, 2005).

⁴⁰ The South African Department of Health reports HIV prevalence among pregnant women in 2003 to be 27.9 % nationally. The highest rate in the country was 37.5 % in KwaZulu-Natal (RSA, 2003). Estimates by Statistics South Africa for 2005 HIV-prevalence rate for adults aged 15 - 49 years range between 16.3 - 20.3 % (StatsSA, 2005b).

⁴¹ Estimated at 5,600,000 (2003 est.) by the South African AIDS Foundation.

Since the highest infection rates are in the economically active 20 to 34 age group (RSA, 2003), industry has seen reduced productivity and greater absenteeism and deaths among the workforce. In addition, the effects of AIDS are most severe among the poor and marginalized members of South Africa, a group that is also the most vulnerable to losing or forfeiting their land tenure rights. Over the coming years, this pandemic will place a significant drain on government funding, with the consequence that funding for projects such as land reform is likely to be affected. The HIV/AIDS pandemic has the potential to undermine economic growth as well as prevent any sustainable human development.

3 Historical Basis for Land Reform

3.1 Introduction

In order to understand the current state of affairs in South Africa, particularity in relation to land, one needs a good understanding of how history has influenced the present situation. In large part, South Africa's history has been one of racial divisiveness, with the competition for land and land dispossession an integral part of that history. Since the first Europeans arrived, the chief struggle has been over land, with the effect that South Africa now has one of the most skewed patterns of land distribution in the world with almost 87 % of the country controlled by a single racial group.

More than in most countries, South Africa's history of apartheid¹ and the resulting land dispossession has shaped the country's character. With such an unequal distribution of land, the current government is faced with the daunting task of trying to rectify this pattern. Because of the immensity of the problem, no short-term solution is foreseen and a concerted effort by several governments across several generations will be necessary. The ultimate test for the transformation of South Africa will be in the government's ability to successfully implement the needed land reform policies and programmes.

3.2 Colonialism (1652 - 1910)

3.2.1 Colonial South Africa

The first Europeans in the area that is now South Africa was the Portuguese explorer Bartholomeu Dias, who rounded the Cape of Good Hope in 1488. In 1497, his compatriot Vasco da Gama followed the same route on his journey to India (Oakes, 1992). At the time, the Portuguese showed little interest in settling the area, usually stopping only long enough to replenish ship supplies.²

The first settlement was not until 1652, when the Dutch East Indies Company (VOC)³ established a supply station at Table Bay on the Cape Peninsula for the refreshment of their fleets that were sailing to and from the Dutch East Indies (Spilhaus, 1966). The first settlers in the Cape area were men released from the VOC's service in 1657, given the status of "free burghers,"⁴ and granted blocks of land to farm (Byrnes, 1996). The Cape remained in Dutch hands until 1795, when it was seized by the British. At the time,

¹ Apartheid was the policy of racial segregation formerly practiced in the Republic of South Africa that involved political, legal, and economic discrimination against nonwhites.

² Portuguese trips to the Indian Ocean usually stopped at Mozambique on the way out, and at St. Helena or the Azores on the way home.

³ Vereenigde Oostindische Compagnie or VOC in Dutch.

⁴ Small number of Dutch released from their contracts and permitted to establish farms, with the intension of supplying their harvests to the VOC settlement.

the British were fearful that the strategic port of Table Bay might fall into the hands of Napoleon, which would have jeopardized their sea route to India (Welsh, 2000). Once peace with the French was re-established a short time later, the Cape was returned to the Dutch in 1803 under the Treaty of Amiens.⁵ The return to Dutch rule, however, would be short-lived. In the course of the renewed war against France and its allies, the British seized the Cape for a second and final time in 1806. This occupation was later legitimized when the British purchased the colony from the Dutch.

The imposition of British rule on the Dutch colonists coincided with the British Parliament outlawing British participation in the slave trade in 1807, which had consequences for all the British colonies. With an estimated 17,000 slaves, and being under British rule, this decision threatened the basis for the Cape's labour supply (Marlowe, 1976). Partly because of this decision, and the disaffection felt by many Dutch settlers about British rule would result in thousands of Boer⁶ families and large numbers of Khoikhoi⁷ and Black servants abandoning their farms and traveling by wagon into the Highveld⁸ interior to the north of the Eastern Cape frontier (Byrnes, 1996). These migrants were known as Voortrekkers⁹ and their migration later became known as the 'Great Trek.' Starting in 1836, over 15,000 people left the Cape Colony to settle in areas outside of British control (Welsh, 2000). The Voortrekkers went on to establish the states of Orange Free State¹⁰ between the Orange and Vaal Rivers and the South African Republic (SAR)¹¹ to the north of the Vaal River.

With the discovery of diamonds in Kimberly in the 1860's and the discovery of gold on the Witwatersrand¹² in the 1880's, the demand for labour was insatiable. The Prime Minister of the Cape Colony, Cecil John Rhodes, had a background as a mining magnate

⁵ The Treaty of Amiens was signed on March 25, 1802 as a "Definitive Treaty of Peace" between France, the United Kingdom, and other nations.

⁶ A Dutch colonist or descendant of a Dutch colonist in South Africa.

⁷ The Khoikhoi or Khoi are a division of the Khoisan ethnic group of southwestern Africa, closely related to the Bushmen.

⁸ The Highveld is a high plateau area of South Africa, which includes the city of Johannesburg, and encompasses an area of approximately 4 million km².

⁹ Voortrekkers (Afrikaans for pioneers, literally "those who move ahead"). They were White Afrikaner farmers who were then known as Boers.

¹⁰ The Orange Free State was an independent country during the latter half of the 19th century (1854 - 1900), and later a province in South Africa. It is the historical precursor to the present-day Free State Province.

¹¹ The South African Republic (SAR) (Dutch: Zuid-Afrikaansche Republiek) was an independent country during the latter half of the 19th century (1857 - 1877 and 1881 - 1900) occupying the area that later became the South African province of Transvaal. Not to be confused with the current Republic of South Africa (RSA).

¹² An area located in northeast South Africa, between the Vaal River and Johannesburg. Since its discovery in 1886, it has been one of the richest gold-mining areas in the world.

and viewed this as a chance to control labour by way of a “Natives Bill for Africa” (Oakes, 1992). Thus, the Glen Grey Lands and Local Affairs Act¹³ was enacted in 1894.

The Glen Grey Lands and Local Affairs Act was designed as a means to funnel more labour toward the industrial development of the country, to develop some permanence to the native land issue, and to prevent any future overflow of the native population into neighbouring White areas (Goodfellow, 1931). The Act was viewed by some as being a blatant attempt to force more Natives into the labour market by limiting their access to land (Oakes, 1992). This was partially accomplished by limiting the head of each family to four morgen,¹⁴ imposing a labour tax on non-title holders to control squatting, and converting the form of tenure to perpetual quitrent.¹⁵ This was one of the first legislative Acts attempting to create a native land shortage but it would not be the last.

3.2.2 Anglo-Boer War (1899 - 1902)

“A political equality of white and black is impossible. The white man must rule, because he is elevated by many, many steps above the black man; steps which will take the latter centuries to climb, in which it is quite possible that the vast bulk of the black population may never be able to climb at all.” Alfred Milner, British High Commissioner in South Africa, in a 1903 speech (Oakes, 1992).

The diamond and gold discoveries of the mid- to late-1800’s had a profound effect on the economic development and control of South Africa. Diamond discoveries north of the Cape colony were quickly annexed by the British and become a key to the economic fortunes of the colony. The discoveries drove the economic development of the colony and became the single largest source of export earnings (Byrnes, 1996). The importance of diamonds, however, was soon eclipsed by gold discoveries in the Witwatersrand (Transvaal), an area outside of British control.

Gold production in the early years of the Transvaal was limited and scattered over large areas. With the exploitation of the Witwatersrand, gold production for the Transvaal increased significantly from 0.16 % of the world’s output in 1886 to 27.55 % in 1898 (Richardson et al, 1980). At that time, large companies with substantial capital and financed mainly by British interests replaced the small-scale operations that previously dominated the region. The Transvaal was undergoing a major economic and political upheaval dictated by the demands of industrial capitalization. Consequently, the Transvaal began to replace the Cape Colony as the economic hub of Southern Africa (Porter, 1980).

The discovery of gold in the Witwatersrand created an insatiable need for a large and, more importantly, cheap supply of unskilled African labour. To meet the need, thousands of foreigners (non-Boers) and migrant Black labourers moved in to the area,

¹³ 25 of 1894. Enacted by the Colony of Cape of Good Hope.

¹⁴ ~3.43 ha (1 morgen = 0.856532 ha).

¹⁵ Perpetual Quitrent Tenure - an extension of the quitrent system by the British authorities in 1813, involving an annual rent payment, that depended on the quality of the land occupied (Davenport et al, 1974).

resulting in an explosive growth in the population of Johannesburg. By the 1890's, English-speaking immigrants constituted a majority of the White population. Although foreigners were required to pay taxes, they were not allowed to vote due to the state's Constitution. The vote was limited to males who had lived in the SAR for at least seven years, effectively ruling out most of the English-speaking immigrants (Byrnes, 1996).

The British soon began to pressure the government¹⁶ of President Paul Krueger to grant franchise rights to English-speaking immigrants who were working in the gold fields (Berman, 2003b). Under this pressure, and with an increasing fear of British designs on the region, the SAR government declared war on the British in October 1899. This war became known as the Anglo-Boer War¹⁷ (Farwell, 1976).

The Anglo-Boer War was fought by the British in part to consolidate their hold on Southern Africa and, more importantly, to control the enormous wealth of the Witwatersrand (Byrnes, 1996). The war commenced on October 11 1899 and appeared to be over in mid-1900, at which time, the British with their superior numbers, had taken control of most of the major urban areas including Bloemfontein,¹⁸ Johannesburg, and Pretoria.¹⁹ Instead of surrendering, however, the Boers turned to fighting a guerrilla war, essentially dragging the war on until 1902. After the British adopted a scorched earth policy, the Boers unconditionally surrendered on May 31 1902.

The war lasted almost three years and was costly to both sides. The Boers lost almost 10 % of their population during the initial fighting, the subsequent guerrilla campaign, and in the British concentration camps (Giliomee, 2003). At the same time, the dream of a true Afrikaner nation seemed to be unattainable.

As a condition of the Treaty of Vereeniging,²⁰ the Boers agreed to the incorporation of their territories under the British as the "Orange River Colony" and the "Transvaal." In this treaty, the British made several crucial concessions. The first was a deferral of the rights of Native Africans until the introduction of responsible government, when the local White population could decide the issue (Porter, 1980). The second was a promise of future self-government for the conquered territories. These two concessions would have a profound effect in later years.

3.2.3 South African Native Affairs Commission (1903)

At the termination of the war, the post-war rehabilitation and reconstruction was placed in the hands of Alfred Milner, the High Commissioner in South Africa and governor of the newly conquered Boer colonies. Milner's reconstruction programme was based

¹⁶ South African Republic (SAR).

¹⁷ Also known as the South African War or simply the Boer War (also known as the second Boer War, the first taking place from 1880 - 1881).

¹⁸ Capital of the Orange Free State.

¹⁹ Capital of the South African Republic.

²⁰ The Treaty of Vereeniging was a "Peace Treaty" signed by the Boers on May 31 1902 to end the war with the British.

almost entirely on the revenues accrued from the government's taxation of mining profits (Porter, 1980). With the labour shortage and the mining owners' insistence that labour costs be reduced, a new and efficient system of labour recruitment was needed.

In 1903, the South African Native Affairs Commission (SANAC)²¹ was created in an attempt to provide some sort of uniformity in native policy. Milner put the chairmanship of the commission into the hands of Sir Godfrey Yeatman Langden, who had previously served as the Minister of Native Affairs in the Transvaal (Giliomee, 2003). One of the key goals of this commission was to produce a "Native Policy" that would be acceptable to all four of the colonies. In 1905, the SANAC released a massive five-volume report that had an immense influence on later governments. Many of the SANAC recommendations were implemented, and later Acts were modeled on the recommendations of this commission.

The recommendations in the report called for a consistent system of White rule throughout South Africa and the separation of Blacks and Whites in political life, including a rejection of the Cape's non-racial franchise. The report called for all Cape Africans to be placed on a separate voter's role for electing a limited number of White representatives. Other proposals included the segregation of townships, a separate education system for Blacks that would be suitable for lower-level jobs, and a territorial separation of Blacks and Whites (Johns, 1972). The areas of concentrated African settlement should be reserved for Africans and Africans should not be allowed to purchase or lease sections of land among the White-owned farms (Wilson, 1971). To ensure permanency, the report stated that territorial separation should be brought about "by legislative enactment... with the view to finality" (Davenport, 1988). Concerning the so-called traditional homelands, such as the Xhosa²² and the Zulu,²³ the recommendation was that these areas should be "surveyed, gazetted and protected by legislation against further white encroachment" (Oakes, 1992). Essentially, by keeping the reserves small, a land shortage would develop that would, in turn, force more Africans to work as labourers for White industry and agriculture.

By 1910, in Natal, Africans owned almost 160,000 ha of land. The land was often obtained by the formation of groups and syndicates to buy farms, typically with missionary backing. Many of these areas became the "Black Spots"²⁴ of later years (Platzky et al, 1985).

²¹ Also known as the Langden Commission.

²² A member of the Bantu people located in the Eastern Cape Province.

²³ A member of the Bantu people located primarily in northeastern Natal.

²⁴ A term used to describe African freehold land outside the designated Black areas during the apartheid years.

3.3 Segregation (1910 - 1948)

3.3.1 Union of South Africa (1910)

Negotiations among White representatives of the two British Colonies²⁵ and the two former Boer Republics²⁶ were held in 1908 and 1909 with the aim to establish a unified state. The negotiations produced a Constitution,²⁷ under which South Africa would adopt a Westminster style of government, with both English and Dutch being official languages. The question of voting rights for Blacks was left up to the four self-governing colonies. At the time, the Cape and Natal Colonies based their franchise on property qualification, whereas the Orange River Colony and the Transvaal denied all Blacks the vote (Byrnes, 1996).

In 1910, the four colonies joined to form the Union of South Africa, a dominion of the British Empire. The capital of the new union was split between Pretoria and Cape Town, with the executive capital in Pretoria and the legislative capital in Cape Town. After the elections²⁸ in 1910, Louis Botha became the first Prime Minister. The first government of the new union, under Botha, was a party of industrial and, most importantly, mining interests. Consequently, native policy was strongly influenced by these special interest groups and their need for a stable labour supply (Platzky et al, 1985).

Not long after the formation of the union, the government's segregationist ideology, strongly influenced by the segregationist arguments of the Langden Commission (SANAC), began their legislative programme of segregation. Some of the key legislation included the Mines and Works Act²⁹ in 1911, which allowed the continuation of White monopolization of skilled jobs and the restriction of Africans to semi-skilled and unskilled labour in the mines. Also in 1911, the Black Labour Regulation Act³⁰ made it illegal for Africans, but not Whites, to break labour contracts. Two years later, in 1913, one of the most notorious of South Africa's segregationist Acts was introduced, the Black Land Act.³¹

3.3.2 Black Land Act (1913)

"Awaking on Friday morning, June 20 1913, the South African native found himself, not actually a slave, but a pariah in the land of his birth "Sol Plaatje (the first Secretary General of the African National Congress) in his 1916 book "Native Life in South Africa."

²⁵ The Cape of Good Hope Colony and the Natal Colony.

²⁶ The Orange Free State (Orange River Colony) and the Transvaal.

²⁷ The South Africa Act, commonly known as the Union Constitution. Drafted by a National Convention in South Africa, and passed by the British Parliament.

²⁸ Held September 15 1910. The election gave the South African Party - 67 seats, the Unionist Party - 37 seats, and 26 seats went to other parties.

²⁹ 12 of 1911.

³⁰ 15 of 1911, originally known as the Native Labour Regulation Act 15 of 1911.

³¹ 27 of 1913, originally known as the Natives Land Act 27 of 1913.

In 1913, Minister of Native Affairs J. W. Saucer introduced a new Bill dealing with native land issues. On June 16 1913, less than two months after its introduction, a considerably trimmed down Bill was passed into law as the Black Land Act³² (Johns, 1972). This Act, along with the Union Constitution³³ of 1909, and the later Blacks (Urban Areas) Act³⁴ of 1923, became the basis of policy towards Africans until almost the end of the century.

The Black Land Act,³⁵ in fact, was preceded by numerous land laws in the Boer Republics and the British Colonies that controlled squatting, regulated tenancies, imposed taxes, and escalated the penalties and punishments for any transgressions (Bundy, 1990). Nevertheless, this new Act, reflecting the thinking of the Langden Commission (SANAC), took the earlier legislation to a new level and established the principle of territorial segregation. The new Act was designed in part to replace Black sharecroppers with Whites and to control squatting and other unauthorized occupation of government and private lands by Africans. Under this Act, Africans were unable to buy land except from other Africans or land in existing native reserves. African land ownership was essentially restricted to specific areas, the "schedule areas" that later became known as the "homelands."³⁶ These areas had been reserved as tribal land before 1910 (Platzky et al, 1985), and comprised 10.5 million morgen³⁷ or approximately 7.5 % of the total land area of South Africa (Davenport et al, 1974). In essence, Africans, who comprised 67.3 % of the population, were restricted to 7.5 % of the land, and thus excluded from White areas and could only stay there to work as labourers.

3.3.3 Blacks (Urban Areas) Act (1923)

"It should be a recognized principle, that natives -- men, women and children -- should only be permitted within municipal areas in so far and for as long as their presence is demanded by the wants of the white population.... the masterless native in urban areas is a source of danger and a cause of degradation of both black and white..." Frederick Stallard - head of the Transvaal Local Government Commission (Oakes, 1992).

In 1922, Frederick Stallard headed the Transvaal Local Government Commission that produced a report on Urban Africans. This report stated that urban areas were the sole

³² 27 of 1913.

³³ The South Africa Act of 1909 was drafted by a National Convention in South Africa and passed by the British Parliament. The Act called for the unification of the British colonies of Cape of Good Hope, Natal, the Transvaal, and the Orange River Colony under one government in a legislative union under the crown of Great Britain and Ireland known as the Union of South Africa.

³⁴ 21 of 1923, originally known as the Natives (Urban Areas) Act 21 of 1923.

³⁵ 27 of 1913.

³⁶ See Map 2: South Africa 1986 (Appendix G/page 280).

³⁷ ~9 million ha (1 morgen = 0.856532 ha). The Development Trust and Land Act 18 of 1936 called for further land to be added to the reserves, which would effectively increase the size of the scheduled areas to ~13.6 % of the land in South Africa.

enclave of the White man and that Africans had no right to be there except to serve the White man's needs (Oakes, 1992). The report had considerable influence on the sitting Smuts³⁸ Government, leading to the Blacks (Urban Areas) Act³⁹ the following year. This Act, with its numerous amendments, would have a strong influence on the formation of native policy over the next several decades.

The Blacks (Urban Areas) Act⁴⁰ was designed to eliminate slums, control crime and disease, and clear Africans out of the mixed residential areas that had sprung up around some of the larger towns, particularly Johannesburg. Regulating the presence of Africans in urban areas was to be done by empowering local authorities who would have the responsibility and power to demarcate and establish African areas in the outskirts of White urban and industrial areas, the power to restrict access to these areas, and the responsibility for funding these areas. Native advisory boards had the power to forcibly remove Africans who were deemed excess to the labour needs of White households, commerce and industry or who were just considered undesirable (Horrell, 1971). Blacks could now be deported to the reserves, and the movement into urban areas was strictly controlled, in part, by the administration of tougher Pass laws.

3.3.4 Fagan and Saucer Reports

During the 1940's, the Afrikaner Nationalist movement grew in popularity, fuelled in part by a backlash against the English-speaking domination of industry, a fear of Black competition for jobs, and the impact of World War II.

Before the 1948 election, Prime Minister Smuts of the United Party⁴¹ set up the Fagan Commission to look into problems caused by the movement of Blacks into towns (African Urbanization), Native Pass Laws, and migratory labour related to employment in mines and other industries (Suzman, 1952). Conversely, Daniel Malan, leader of the National Party (NP), appointed his own commission, the Saucer Commission. Although both committees essentially looked into the same problems, their solutions were very different.

The Fagan Report, which became the policy of the United Party, stated that total segregation was utterly impractical because industry and commerce needed the Black population in towns close to their workplaces (Fagan, 1948). Migrant labour should be discouraged and Black families encouraged to make their homes in well-planned and controlled townships. Thus, the repatriation of urban Blacks to the overcrowded reserves was unrealistic.

The Saucer Report, on the other hand, which became the policy of the soon-to-be-elected National Party, had different conclusions. The key points of the report were that friction between the races could be prevented only by an enforced separation, total

³⁸ Jan Christiaan Smuts, Prime Minister of the Union of South Africa.

³⁹ 21 of 1923, originally known as the Natives (Urban Areas) Act 21 of 1923.

⁴⁰ 21 of 1923.

⁴¹ The United Party was South Africa's ruling political party from 1934 to 1948.

apartheid was the solution for the “Coloured” problem, channeling of sufficient labour to industry and farms should be accomplished, and the “surplus” Black labour should be eliminated (Eloff, 1990). The migrant labour system must continue (held in place by the Pass laws), reserves would continue to be the true home of the Blacks, and any Black who was living in the towns would be treated as a temporary visitor without political rights, and in numbers that would be strictly controlled. In essence, the report stated that these actions were necessary to “ensure the security of the European and the future existence of the European race and its civilization” (Saucer, 1945).

3.4 Apartheid (1948 - 1990)

3.4.1 Beginning of Apartheid (1948)

On May 26 1948, the (Reunited) National Party,⁴² under Malan⁴³ and the Afrikaner Party coalition, won a surprise victory over the ruling United Party. This election victory signified the start of a string of continuous election wins⁴⁴ for the National Party (NP), keeping them in power until the 1994 election. With this majority government, Malan and the NP had the mandate they needed to implement their apartheid policies. The election victory was not so much a White Community triumph over the Black Community as it was an Afrikaner Community triumph over the English Community. As Malan himself said, “Today South Africa belongs to us once more. South Africa is our own for the first time since Union” (Giliomee, 2003).

What made this election victory different from others was that this government was the first exclusively Afrikaner government and was a party that had preached total segregation since the mid-1930s. It was the party of the predominantly Afrikaans-speaking White workers and White farmers, standing for total racial segregation as well as Afrikaner domination. The party’s platform was known as apartheid, a term that literally means “apartness.” The basic premise of apartheid was that Whites are superior to Africans, Coloureds, and Indians. Later, Nelson Mandela stated that the NP campaign centered on the “swart gevaar” (the black danger) and was fought on the slogans “Die kaffer op sy plek” (the nigger in his place) and “Die koelies uit die land” (the coolies out of the country) (Mandela, 1994). The (Reunited) NP, with its 70 seats and the 9 seats of its ideologically similar Afrikaner Party, gave them a slim majority in the 153-seat House of Assembly. In 1951, these two parties formally merged to form the National Party.

The Afrikaner government was now able to set out on its path of White domination and was also in a position to determine which Whites would dominate. A new era of Afrikaner nationalism was born. In 1945, the NP had accepted apartheid as its official racial policy, and by 1947, Malan had turned apartheid into a comprehensive racial policy

⁴² During the 1948 election, the party was known as the “Reunited National Party.” In 1951, the Reunited National Party, under Daniel Malan, joined with the Afrikaner Party to form the “National Party.”

⁴³ Daniel Francois Malan.

⁴⁴ Starting in 1948, the National Party won the 1953, 1958, 1961, 1966, 1970, 1974, 1977, 1981, 1987 and 1989 elections.

(Giliomee, 2003). Apartheid did not differ much from the policy of segregation that had been practiced by previous governments, but the NP now made segregation part of the law. At a time when the rest of the world was moving away from racist policies, segregation in South Africa was becoming legally sanctioned. Fortunately, for the new government, the groundwork of apartheid was already in place. Previous governments had laid the building blocks of segregation with the Mines and Works Act⁴⁵ of 1911, the Black Land Act⁴⁶ of 1913, and the Blacks (Urban Areas) Act⁴⁷ of 1923. Building on this foundation, Malan and the NP began a string of new legislation.

The first new Act was the Prohibition of Mixed Marriages Act⁴⁸ of 1949, which outlawed marriage between Blacks and Whites. This was followed by an amendment⁴⁹ to the Immorality Act⁵⁰ that effectively outlawed sexual relations between Whites and non-Whites. With so many laws pertaining to race, classification of individuals according to race became necessary. With the Population Registration Act⁵¹ of 1950 and subsequent regulations and legislation, a system of racial classification was created. The Population Registration Act⁵² set criteria for how race was determined and led to the creation of a national register in which each individual's race was recorded. The Group Areas Act⁵³ of 1950 ensured physical separation between races by creating different residential areas for different races. This law would eventually lead to numerous forced removals of people living in the "wrong" areas. The Prevention of Illegal Squatting Act⁵⁴ of 1951 gave the government the power to remove Blacks from both public land and privately owned land. The Black Authorities Act⁵⁵ of 1951 provided for the establishment of Black homelands, and to ensure that Blacks did not aspire to any positions in society that they would not be allowed to hold, Blacks were educated under the Black Education Act⁵⁶ of 1953. To decrease racial contact, and presumably to minimize friction between the races, the Reservation of Separate Amenities Act⁵⁷ was passed in 1953 (Lemon, 1987). This Act required all races to use separate public amenities such as toilets, parks, entertainment, and beaches. Later, the Labour Relations Act⁵⁸ of 1956 allowed the

⁴⁵ 12 of 1911.

⁴⁶ 27 of 1913.

⁴⁷ 21 of 1923.

⁴⁸ 55 of 1949.

⁴⁹ Immorality Amendment Act 21 of 1950.

⁵⁰ 5 of 1927.

⁵¹ 30 of 1950.

⁵² 30 of 1950.

⁵³ 41 of 1950.

⁵⁴ 52 of 1951.

⁵⁵ 68 of 1951, originally known as the Bantu Authorities Act 68 of 1951. This was essentially the beginning of the "Homeland" system, or what became known as "separate development."

⁵⁶ 47 of 1953, originally known as the Bantu Education Act 47 of 1953.

⁵⁷ 49 of 1953.

⁵⁸ 28 of 1953, originally known as the Industrial Conciliation Act 28 of 1956.

Minister of Labour to reserve certain categories of work for members of specific racial groups.

The NP government attempted to remove Coloured voters in the Cape from the common roll via the Separate Representation of Voters Act.⁵⁹ Although the Supreme Court later declared this Act invalid on constitutional grounds, it was successfully re-enacted as the Separate Representation of Voters Amendment Act⁶⁰ of 1956.

Throughout this period, protests, demonstrations and riots⁶¹ protesting apartheid were present to varying degrees. The government used these protests to its advantage by introducing a series of new laws that effectively put a muzzle on protesters. The Criminal Law Amendment Act⁶² and the Public Safety Act⁶³ of 1953 essentially made protests against any law illegal, and gave the government the power to suspend all laws and declare a state of emergency. The Internal Security Act⁶⁴ of 1950 was so vaguely written that it allowed the police to deem any opponent of apartheid to be a supporter of the Communist Party. To control the press and other news media, the Official Secrets Act⁶⁵ of 1956 allowed for government censorship of books, films, and other materials.

By the time the NP's first term in office was ending, the Malan government had in place a series of laws that classified each individual by race, and used that classification to determine which rights each individual was entitled to.

3.4.2 Tomlinson Commission (1954)

In October 1954, the Tomlinson Commission released a report examining the conditions of the reserves and how they might be developed to support the native population. At the time, the reserves had little industry or manufacturing, no urban areas of any significance, poor infrastructure and services, and essentially no mineral wealth. A sizable percentage of the population was composed of women, children, and the elderly who were living off the earnings of male family members outside the reserves.

The Commission's report clearly stated that little hope existed for the integration of the two racial groups. The Commission was convinced that "the separate development of the European and Bantu⁶⁶ communities should be striven for as the only direction in which racial conflict may possibly be eliminated and racial harmony possibly be maintained" (Union of South Africa, 1955). The report went on to state that no midway point

⁵⁹ 46 of 1951.

⁶⁰ 30 of 1956.

⁶¹ i.e., Port Elizabeth in October of 1952.

⁶² 8 of 1953.

⁶³ 3 of 1953.

⁶⁴ 44 of 1950, originally known as the Suppression of Communism Act 44 of 1950.

⁶⁵ 16 of 1956.

⁶⁶ Bantu was a term used by the apartheid regime that referred to Black South Africans. Successive governments originally referred to Black South Africans as "Native," which was replaced by "Bantu," which in turn was replaced by "Black" around 1978.

was possible between the two poles of total integration and ultimate separate development of the two racial groups (Union of South Africa, 1955).

The Tomlinson Commission proposed a plan for the full-scale development of the “Bantu Areas” or “Bantustans,”⁶⁷ stating that the homelands could become economically self-sufficient but would require considerable investment. One of the accepted recommendations of the Commission was a diversification of the economy that would allow reserves to house more of the surplus native population from the White farms and urban areas. The reasoning behind the economic development of the reserves was that a better economic situation within the homelands would lead to fewer “rights” being expected by Blacks outside the reserves. At the heart of the Bantustan policy lay the basic premise that, as citizens of their own homelands, Blacks could be stripped of their South African citizenship. When required, Blacks would be allowed to work in South Africa as “foreigners” but would then be forced to return to their homelands when no longer needed (Welsh, 2000). The development of the reserves was no longer part of the general economic improvement of the country but rather a way “to circumscribe and confine the African people as far as their economic rights and political aspirations are concerned to a small portion of the country” (Matthews et al, 1957).

The Commission also called for the consolidation of the homelands based on the historical centers of the principal ethnic groups (Houghton, 1956). The report reasserted the view that Blacks had no strong claim on land outside the reserves and that the Natives were composed of distinct ethnic groups each with their own territory (or Homeland). Essentially, the plan was a blueprint for the separate development of Blacks and Whites and later became known as “Grand Apartheid.” In part, this was to mute international criticism of South Africa’s racial policies while, at the same time, institutionalizing apartheid (Mandela, 1994). In addition, the Commission called for the revision of the land tenure systems and the granting of freehold title (in contradistinction to quitrent⁶⁸ titles) (Union of South Africa, 1955).

Due to the perceived cost estimates for developing the reserves, the fear of alienating White farmers, and the fact that the government still had to purchase the additional land required for the reserves,⁶⁹ many of the basic recommendations of the Tomlinson Commission were considered unrealistic and were rejected (Lemon, 1987).

3.4.3 Consolidating Apartheid

Until the 1940’s, race policies in South Africa were not that far out of step with those found in many of the other colonial areas of Africa. With the emergence of newly inde-

⁶⁷ Bantustan was the name given to the tribal homelands of Black South Africans during the apartheid era that were designed to become independent states. The term was later scrapped and supplanted by the terms “homeland,” “national state,” or “self-governing state.”

⁶⁸ Quitrent (erpacht) Tenure is the occupation of property for a limited term, which is renewable and subject to an annual rental in accordance with the quality of the land, payable to the government. This form of tenure was introduced in 1732 (Davenport et al, 1974).

⁶⁹ According to the terms of the Development Trust and Land Act 18 of 1936 (The Native Trust and Land Act 18 of 1936).

pendent Black African states by the 1950's and 1960's, however, World opinion about human rights was becoming dramatically opposed to those of South Africa. By the early 1960's, the Apartheid government was receiving a barrage of criticism from all corners. Events like those in Sharpeville,⁷⁰ where the police opened fire on demonstrators and killed 67, were forcing the international community to sit up and take notice (Karis et al, 1977). These kinds of events were also having an effect on the economy. After Sharpeville, foreign investors began selling off their South African holdings, share prices on the stock exchange fell dramatically, and immigration slowed while emigration increased. Still, this crisis, along with others, proved to be only temporary, as the government seemed to manage each new crisis and by 1961, the worst had passed.

Regardless of what may be said about the era of apartheid government, in most instances it was a time of strong economic growth. In the 40 years before 1960, the economy grew at a rate of more than 4 % a year (Oakes, 1992). Even though the economy sputtered a bit in the 1960's, in a few years it had returned to normal. The 1960's saw a growth rate of almost 6 % a year, a rate that few countries could exceed⁷¹ (Oakes, 1992). Imports, exports, and foreign investments all increased. The economy seemed to be in such good shape that the apartheid government could simply ignore or brush off criticism from the international community.

During this period, international condemnation regarding forced removals was intense. The removals were, in fact, part of the government's "homelands" policy that had been in place for more than 25 years. Under this policy, an estimated 3.5 million people⁷² were forcibly removed and relocated between 1960 and 1983 (Unterhalter, 1987). To streamline the process, the apartheid government armed itself with a plethora of laws. For example, the Prevention of Illegal Squatting Act⁷³ gave landowners, local authorities, and government officials numerous ways of evicting people or destroying their houses in order to get them off the land. The Minister of Native Affairs had the power to remove squatters from public or privately owned land and to establish resettlement camps to house the displaced people. Individuals had little or no recourse when it came to forced removals. Under the Blacks (Prohibition of Interdicts) Act,⁷⁴ victims of forced removals were forbidden to petition the courts even if it could be shown that the government had acted beyond its powers in authorizing or affecting a removal (Oakes, 1992). In fact, Courts could no longer issue-restraining orders on the government. The Self-governing Territories Constitution Act⁷⁵ allowed the Homeland borders to be adjusted almost at will, to include or exclude land to better facilitate removals (Oakes,

⁷⁰ Sharpeville was a Black township set up by the apartheid government south of Johannesburg (Gauteng). On March 21 1960, police opened fire on demonstrators who were protesting pass laws, killing 67 and wounding 178, with many of the protestors being shot in the back. The "Sharpeville Massacre" as it was known, signaled the start of armed resistance and condemnation from around the world.

⁷¹ Japan being one exception.

⁷² The DLA states "3.5 million and their descendants" (DLA, 1997).

⁷³ 52 of 1951.

⁷⁴ 64 of 1956.

⁷⁵ 21 of 1971, originally known as the Bantu Homelands Constitution Act 21 of 1971.

1992). Moreover, if any community decided to resist the government, the government had resources such as the police or the military at its disposal. Moreover, if the military was brought in, there could be no reporting of removals in accordance with the military movements' laws (Mandela, 1994). To fight against the removals was extremely difficult, as every avenue of recourse was blocked and any legal loopholes were fixed upon their discovery.

By the 1970's, international isolation was increasing as a British arms embargo, a sharp decrease in foreign investment, inflation, and ongoing violent strikes and demonstrations were having their effect. In 1973, the United Nations⁷⁶ declared apartheid as a "crime against humanity." The motion took on real meaning four years later in 1977 when the UN adopted a mandatory embargo on arms sales to South Africa. On June 13 1976, the worst racial violence in South African history broke out in the Black township of Soweto,⁷⁷ where schoolchildren were protesting against government regulations requiring the use of Afrikaans as the language of instruction. Police fired on the protesters, killing over 20 and setting off a wave of violent demonstrations that spread throughout the country and resulted in the deaths of hundreds (Riley, 1991). Pictures of dead children flashed around the world, causing universal denunciation and a condemnation from the UN Security Council (Welsh, 2000).

The early 1970's saw an acceleration of the institutional development of homelands that culminated in the quasi-independent self-governing territories of Bophuthatswana,⁷⁸ Ciskei,⁷⁹ Lebowa,⁸⁰ Venda,⁸¹ Gazankulu,⁸² QwaQwa,⁸³ and KwaZulu⁸⁴ (Dugard, 1978). Each of these self-governing territories had their own Constitution providing for a cabinet and legislative assembly. Their independence status, however, was not recognized by the international community and was condemned by the UN (Bindman, 1988).

By the latter half of the decade, South Africa was truly a country with few friends. Increased international isolation, continued sanctions and boycotts,⁸⁵ disinvestment, hostile frontline states, a tide of rising Black opposition, and industrial strife all contributed to the country's deep economic decline.

⁷⁶ In December 1973, the UN adopted a resolution that the South African government had no right to represent the people of that country and that representation should be vested in the African national liberation movements.

⁷⁷ Soweto is an urban area located 16 km southwest of Johannesburg.

⁷⁸ 1972.

⁷⁹ 1972.

⁸⁰ 1972.

⁸¹ 1973.

⁸² 1973.

⁸³ 1974.

⁸⁴ 1977 (proclamations of 1972 and 1976).

⁸⁵ i.e., in 1971 the UN General Assembly called for a full-scale embargo on arms supplies to South Africa and a boycott of all South African racist sporting organizations. In addition, the UN condemned the establishment of the Bantustans.

3.4.4 Limited Reforms

In September 1978, Defense Minister P.W. Botha⁸⁶ was elected by a NP caucus to succeed the outgoing John Vorster as Prime Minister. Botha was known to be committed to the creation of a new Constitution that would give Asians and Coloureds a bigger role in the country's affairs (Riley, 1991). With this change in government, some hope for reform was seen by many.

While apartheid may have actually boosted economic growth until the end of the 1960's while the economy was based largely on agriculture and mining, this situation was no longer the case (Giliomee, 2003). The period of high economic growth that had lasted for the previous 40 years was now at an end. Labour costs were beginning to exceed those of other countries, and South Africa was losing its competitive advantage. Apartheid was beginning to have an adverse effect on the economy. With limits on the training of Black and Coloured workers, a poorly educated Black workforce, poor productivity, and the long commutes that were forced onto the workforce because of the Group Areas legislation, the economy was faltering. By the late 1970's, the idea of economically viable homelands had lost most of its luster.

In 1984, a new South African Constitution⁸⁷ was implemented. Although it entrenched apartheid in the Constitution, Coloureds and Indians were given a limited role in government. The Constitution provided for the establishment of a Tricameral Parliament, which consisted of three race-based chambers: the House of Assembly (reserved for White people), the House of Representatives (reserved for Coloured people), and the House of Delegates (reserved for the Indian community).

In the following year, on August 15 1985, President Botha gave a major policy speech in Durban that later became known as the "Rubicon" speech. The speech attracted the world's media, who were expecting the announcement of major reforms in South Africa's racial policies. Instead, Botha defiantly rejected foreign and domestic calls for fundamental change and essentially ruled out any significant concessions to the country's Black population. The speech might best be described as a "public-relations disaster" because Botha came across as both arrogant and defiant (Riley, 1991). Economically, the speech was a turning point for the worse, triggering a flight of capital out of the country such as the country had never seen before.

Not only did the apartheid government have domestic problems during this period, the international community was becoming more active in its protests. France announced a freeze on new investment in South Africa, the US Chase Manhattan Bank called in all outstanding loans and refused to make new loans to the private sector, and townships in the country were becoming virtually ungovernable (Oakes, 1992). In the mid-1980's, the inflation rate was 18.4 % (the highest in 66 years), the ANC was enjoying a new surge of international support, White-owned businesses were targets of consumer boycotts, and

⁸⁶ Pieter Willem Botha.

⁸⁷ Republic of South Africa Constitution Act 110 of 1983, commonly known as the Tricameral Constitution.

calls for sanctions were made by the Commonwealth and the EEC.⁸⁸ The US also imposed limited economic sanctions with Congress pushing for a more comprehensive sanctions package (Oakes, 1992), and newspapers around the world were condemning South Africa's harsh regime on an almost weekly basis. By the end of the 1980's, apartheid was crumbling.

The election of May 1987 saw a marked shift to the political right. The NP under Botha won with a platform of equal rights for all and a promise to negotiate a settlement for joint decision-making and power sharing among all ethnic groups. While the NP held an overwhelming majority, the Conservative Party replaced the more liberal Progressive Federal Party as the official opposition. In fact, the Conservative Party was even more to the political right than the Nationalists were and had campaigned on the theme that the government was too lenient with Black opposition (Mandela, 1994).

Following the election, Botha set about removing some of the so-called petty apartheid. Hotels and restaurants, for example, were no longer required to seek permission before serving Black people, the central business districts of major cities were opened up to trading by all races, and several significant Acts were repealed, such as the Influx Control Laws,⁸⁹ the Mixed Marriages Act,⁹⁰ and the Pass Laws.⁹¹

In August 1988, Botha resigned after suffering a stroke and F.W. de Klerk⁹² then became the NP leader and acting state President in February 1989. He later became the President in September 1989 after the general election.

3.5 Dismantling of Apartheid (1990 - 1994)

In the September 6 1989 election, the NP suffered its biggest election setback since taking office, losing 29 seats. Even with this loss, however, the party was able to hold onto its majority in Parliament. With apartheid crumbling, the only remaining options seemed to be the continued repression of apartheid or the wholesale change required to create a democracy based on individual rights and civil liberties. Thus, on February 2 1990, President de Klerk announced a major policy shift that surprised even members of his own party. He announced a lifting of the 30-year ban on the ANC⁹³ and the PAC,⁹⁴ the legalization of the CPSA,⁹⁵ the lifting of restrictions on 33 other opposi-

⁸⁸ European Economic Community.

⁸⁹ The Blacks (Urban Areas) Consolidation Act 25 of 1945 was repealed by the Abolition of Influx Control Act 68 of 1986.

⁹⁰ The Prohibition of Mixed Marriages Act 55 of 1949 was repealed by the Immorality and Prohibition of Mixed Marriages Amendment Act 72 of 1985.

⁹¹ The Blacks (Abolition of Passes and Co-ordination of Documents) Act 67 of 1952 was repealed by the Identification Act 72 of 1986.

⁹² Frederik Willem de Klerk.

⁹³ African National Congress.

⁹⁴ Pan Africanist Congress.

⁹⁵ Communist Party of South Africa.

tion groups, an end to most news censorship, and the impending release of Nelson Mandela (Riley, 1991). A clear shift in government policy was taking place from repression to tolerance.

After Nelson Mandela's release from prison that year, the ANC elected him as Deputy President in March 1990. Soon afterwards, Mandela met with de Klerk in June 1990 to set the agenda for further talks. As part of the change, the government began to repeal many of the apartheid Acts. The Reservation of Separate Amenities Act⁹⁶ was repealed in October 1990, followed by repeals of the Black Land Act,⁹⁷ the Group Areas Act,⁹⁸ and the Population Registration Act⁹⁹ in June 1991. With the repeals of these Acts, many of the international sanctions were lifted, except for those of the UN that were not lifted until 1993 (Byrnes, 1996).

Formal constitutional negotiations between the leaders began in December 1991. In March 1992, to silence opponents who rejected negotiations, de Klerk gambled by calling for a referendum to determine whether or not the White voters supported his reform process. The referendum asked the somewhat ambiguous question: "Do you support the continuation of the reform process, which the state president began on February 2 1990 and which is aimed at a new Constitution through negotiation?" With a large turnout, de Klerk received a resounding 68.7 % "yes" from White South Africans (Walsh, 2000). Once de Klerk had the backing of the White electorate, it seemed only a matter of time before apartheid would be ended and a truly democratic South Africa would begin.

3.6 A New South Africa (1994 - 2006)

The first fully democratic elections in South African history began on April 26 1994. Eligible voters were estimated to number almost 22 million, 16 million of which had never voted before (Byrnes, 1996). Official results of the election were not released until May 6 1994 when the ANC was declared victorious with 63.0 % of the vote.¹⁰⁰ Several weeks later, on May 9 1994, the National Assembly in Cape Town unanimously elected Nelson Mandela President. Subsequent elections in 1999 and in 2004 both resulted in majority governments for the ANC.

One of the most difficult tasks facing the new ANC government was maintaining a balance between the expectations of its Black supporters and the economic realities. Nevertheless, the ANC-led government embarked on a programme to promote the reconstruction and development of the country and its institutions. Its policies called for the pursuit of democratization and socio-economic change and a strong commit-

⁹⁶ 49 of 1953.

⁹⁷ 27 of 1913.

⁹⁸ 41 of 1950.

⁹⁹ 30 of 1950.

¹⁰⁰ The National Party (NP) received 20.5 % and the Inkatha Freedom Party (IFP) 10.8 % of the vote (Berman, 2003a).

ment to improving the lives of all South Africans, especially the poor. A radical overhaul of the machinery of government at every level was required.

Since its beginning, one of the main platforms of the ANC has been a call for a major land reform overhaul. From its first days in office, the government set in motion a national programme of land reform and redistribution, as well as promising to address the legacy of forced removals. As a result, numerous land-related Acts have been implemented.

4 Land Reform in South Africa

4.1 Introduction

In South Africa under apartheid, land legislation has been one of the main tools for supporting territorial segregation. Some of the most notorious of the apartheid legislations were the Land Acts, which had far-reaching effects throughout South Africa. With the forced relocation of millions during the apartheid era, the Land Acts were often considered to be at the root of poverty in the rural areas.

Some of the Acts having the greatest effect on the current land distribution in South Africa include the 1913 Black Land Act,¹ which became the basis for the racial and territorial segregation of South Africa. Other significant Acts included the 1923 Blacks (Urban Areas) Act,² which controlled the presence of Africans in the urban areas. The Development Trust and Land Act³ in 1936 essentially placed all land title in the reserves into a trust and provided the basis for many of the later forced removals. In 1950, the Group Areas Act⁴ deemed certain areas of the country to be for the exclusive use of one particular racial group and made it compulsory for people to live in the area designated for their classification group. The unraveling of this territorial segregation would be no easy matter. What was started by the National Party governments⁵ was to be completed by the post-1994 ANC governments.

4.2 Land Reforms of 1991

4.2.1 Introduction

During the years when the National Party (NP) was in power, territorial and racial segregation continued as the government continued to increase its own powers. With increasing opposition over the years, gradual changes in policies pertaining to land and segregation took place. Not until the late 1980's and early 1990's, during the final terms of the NP, was real progress made.

In the early 1990's, the political transition of South Africa began under the NP government of F. W. de Klerk with the releasing of political prisoners, a repeal of some of the worst apartheid legislation and allowing a greater political freedom. During this period, considerable debate was taking place on issues pertaining to land. In 1991, a White Paper on Land Reform⁶ was tabled in Parliament. This White Paper made several

¹ 27 of 1913.

² 21 of 1923 (Originally known as Natives (Urban Areas) Act 21 of 1923).

³ 18 of 1936.

⁴ 41 of 1950.

⁵ Mainly the government of F. W. de Klerk, 1989 - 1994.

⁶ White Paper B-91.

significant proposals, such as the repeal of the notorious Land Acts,⁷ the Group Areas Act,⁸ and other racially based land legislation. The White Paper also set out new land policy objectives that included broadening access to land rights to the whole population, upgrading the quality and security of title, and promoting the utilization of land as a national asset. These policy objectives led to five new proposed statutes (Badenhorst et al, 2003),⁹ three of which eventually became law in 1991. These included the Abolition of Racially Based Land Measures Act,¹⁰ Upgrading of Land Tenure Rights Act,¹¹ and the Less Formal Township Establishment Act.¹²

4.2.2 Abolition of Racially Based Land Measures Act

In 1991, the legal process of abolishing segregation laws and addressing the land dispossession problems of South Africa began in earnest. This process started with the enactment of the Abolition of Racially Based Land Measures Act.¹³ This Act set about repealing 189 sections of various Acts that had supported racial discrimination with respect to land legislation. These represented most of the notorious Acts from the apartheid era. Prominent among these were the Black Land Act,¹⁴ the Development Trust and Land Act,¹⁵ the Group Areas Act¹⁶ and the Black Communities Development Act.¹⁷ Until the repeal of the Black Land Act,¹⁸ Africans were not normally entitled to own land outside the designated reserves. The implementation of this Act meant that land could be freely bought and sold, regardless of the race of the seller or buyer. The Act also provided for a Commission on Land Allocation. After the repeal of sections of the Act by the Restitution of Land Rights Act¹⁹ in 1994, all claims under that Commission were handled by the new Commission on Restitution of Land Rights.

4.2.3 Upgrading of Land Tenure Rights Act

Until 1991, most Black South Africans were not entitled to own land in areas that had not been designated for Black occupation. With the enactment of the previously men-

⁷ Black Land Act 27 of 1913 and the Development Trust and Land Act 18 of 1936.

⁸ 41 of 1950.

⁹ Abolition of Racially Based Land Measures Bill, Upgrading of Land Tenure Rights Bill, Residential Environment Bill, Less Formal Township Establishment Bill, and the Rural Development Bill.

¹⁰ 108 of 1991.

¹¹ 112 of 1991.

¹² 113 of 1991.

¹³ 108 of 1991.

¹⁴ 27 of 1913.

¹⁵ 18 of 1936.

¹⁶ 41 of 1950 and 36 of 1966.

¹⁷ 4 of 1984.

¹⁸ 27 of 1913.

¹⁹ 22 of 1994 (Section 41).

tioned Abolition of Racially Based Land Measures Act,²⁰ the segregation laws pertaining to land, its use, and occupation, were removed. In areas that had been previously designated as "Black" areas, any rights in land that had been granted were usually not freehold tenure but some lesser form.

During this period, land reform was perceived by the government as needing to return freehold title to de facto owners. As a means of doing this, the Upgrading of Land Tenure Rights Act²¹ was passed in 1991. This Act provides for the upgrading and conversion into ownership of certain rights granted with respect to land and for the transfer of tribal land into full ownership by the tribes. The Act provides for the procedure of upgrading these lesser tenure rights to full ownership. These are usually applied to areas of land that were previously vested in the South African Development Trust. As defined in the Act,²² these may be any leasehold, deed of grant, quitrent, or any other right to the occupation of land created by or under any law. With respect to tribal land, this included any right to the occupation of land under the indigenous law or customs of the tribe in question.

Under the Act,²³ tribes were able to obtain ownership of land that they had held by customary law. What proved to be a major hindrance to the successful implementation of the Act was the requirement that the land be surveyed. Due to this requirement, and particularly because of the associated costs of surveying the land, many tribal land rights were not upgraded under the terms of this Act (Hassim, 2002). Under the Act, any tribe that was successful in obtaining ownership of land could not sell the land for a period of 10 years²⁴ to any person who was not a member of a tribe.²⁵ This provision serves to prevent the land from being sold for short-term monetary gains.

Initial plans to convert all rights in communal areas to registrable tenure rights by March 2000 were far from successful. Some of the legislative inadequacies of the Act were addressed by introducing numerous amendments²⁶ and the newly developed Communal Land Rights Administration Bill,²⁷ which was submitted to Cabinet in June 2001 (Lawrence et al, 2002).

²⁰ 108 of 1991.

²¹ 112 of 1991.

²² Section 1.

²³ Section 19.

²⁴ From the commencement of the Act.

²⁵ Section 19 (2).

²⁶ General Law Amendment Act 139 of 1992, General Law Second Amendment Act 108 of 1993, Land Affairs General Amendment Act 11 of 1995, Development Facilitation Act 67 of 1995, Upgrading of Land Tenure Rights Amendment Act 34 of 1996, Land Affairs General Amendment Act 61 of 1998 and Transformation of Certain Rural Areas Act 94 of 1998.

²⁷ Eventually leading to the Communal Land Rights Act 11 of 2004.

4.2.4 Less Formal Township Establishment Act

In the early 1990's, the majority of South Africa's population resided in urban areas. The country was also suffering from a severe lack of affordable housing, a situation especially acute in the urban areas. Due to this lack of housing, informal settlements commonly known as shantytowns sprang up on vacant land in the outlying areas of most urban areas. These new settlements were areas where occupiers (squatters) created makeshift accommodation on land to which they had no legal title. With the removal of apartheid laws limiting Blacks to specific areas, a significant increase in migration took place from rural to urban areas that significantly compounded the problem. To address these problems and the increased need for housing, the Less Formal Township Establishment Act²⁸ (LFTEA) was enacted in 1991 (Miller, 2000).

LFTEA was introduced as a means to alleviate the shortage of land, eliminate squatting, and facilitate development by both the government and private sector in the establishment of townships. This piece of legislation proved useful when an urgent need for housing was identified and rapid development of such housing would require the suspension of various legislation. LFTEA provides for shortened procedures for the designation, provision and development of land, as well as the establishment of townships and other less formal forms of residential settlement. The Act essentially reduced the number of approving authorities needed for specific developments and shortened the application procedure. The Minister²⁹ was authorized³⁰ to suspend various restrictive conditions or provisions of law that may have a dilatory effect on establishing a township or development, or the settlement of persons onto designated lands. The Minister was able to suspend restrictive conditions of title on settlement³¹ and township establishment³² without becoming involved in court orders or having to comply with the provisions of the Removal of Restrictions Act³³ (DTLGA, 2003a). Previous legislation used for the development of housing projects placed financial burdens on the developer and procedures were often time-consuming. In some cases, provincial ordinances could take two or more years to be completed and were thus highly inappropriate for creating low-income housing (Royston, 1998).

One of the problems that this Act failed to address was the cost and availability of urban land. Although authorities could expropriate land for low-income housing developments, expropriation laws still required the payment of full market value for any expropriated land. The high costs of expropriating land in an urban environment, especially in the affluent and predominantly White towns, essentially limited such developments to the city outskirts (Royston, 1998).

²⁸ 113 of 1991. As amended by Proclamation R159 of 1994, Development Facilitation Act 67 of 1995, Prevention of Illegal Eviction from and Unlawful Occupation of Land Act 19 of 1998.

²⁹ Under the Act, 'Minister' means the Minister of Housing in the national government.

³⁰ Section 3 and 12.

³¹ Section 2.

³² Section 12.

³³ 84 of 1967. This Act empowered the Administrator of a province to alter, suspend, or remove certain restrictions and obligations in respect of land in the province.

4.3 Constitutional Basis for Land Reform

In 1991, representatives of most political parties, various political organizations, and the South African government signed a “Declaration of Intent” at the first meeting of the Convention for a Democratic South Africa (CODESA). This document outlined the signee’s intention to create a new democratic Constitution that would, inter alia, bring about an undivided South Africa with common citizenship, equality, and security where all citizens would enjoy universally accepted human rights, freedoms, and civil liberties (CODESA, 1991). The CODESA Declaration of Intent established a national consensus for the broad direction in which the political process should unfold.

4.3.1 The 1993 Constitution of South Africa

In March 1993, full negotiations that had been initiated by the previously mentioned parties, now called the Multi-Party Negotiating Process³⁴ (MPNP), began writing and adopting an Interim Constitution to outline how the government would govern after the upcoming election.³⁵ In addition, MPNP drew up and adopted 34 Constitutional Principles that would serve to guide the Constitutional Assembly in drawing up the final Constitution.

In November 1993, the new Constitution, commonly referred to as the “Interim Constitution,” was completed by MPNP. This Constitution³⁶ was adopted by the then Tricameral Parliament on December 22 1993, effectively bringing about the final demise of the Tricameral constitutional system and the apartheid order that it had upheld (Currie et al, 2001). Under this Constitution, South Africa would become a single united country³⁷ where all would have a common South African citizenship.³⁸ In addition, every South African citizen was accorded the right to exercise the franchise.³⁹

The Interim Constitution was the start of a fundamentally new constitutional order, as it was now the supreme law of the Republic and any law or Act that was inconsistent with its provisions would have no force and effect.⁴⁰ The Constitution bound all legislative, executive, and judicial organs of the state with all levels of government to ensure that

³⁴ Instead of CODESA.

³⁵ Set for April 27 1994.

³⁶ Constitution of the Republic of South Africa Act 200 of 1993. As amended by Constitution of the Republic of South Africa Amendment Act 2 of 1994, Constitution of the Republic of South Africa Second Amendment Act 3 of 1994, Constitution of the Republic of South Africa Third Amendment Act 13 of 1994, Constitution of the Republic of South Africa Fourth Amendment Act 14 of 1994, Constitution of the Republic of South Africa Fifth Amendment Act 29 of 1994, Constitution of the Republic of South Africa Sixth Amendment Act 24 of 1994.

³⁷ Section 1 (1).

³⁸ Section 5.

³⁹ Section 6.

⁴⁰ Section 4.

the Constitution would remain the supreme law.⁴¹ This effectively ended the old principle of parliamentary supremacy.

The Interim Constitution was never intended to be a final Constitution. As its name implies, it was a temporary Constitution expected to last for two years while the new democratically elected constitutional assembly drafted the final Constitution. Although this Constitution was short-lived,⁴² it is still significant for a number of reasons. With the Bill of Rights in both constitutions being similar, most judicial decisions on rights that were handed down under the Interim Constitution remain binding.

4.3.2 The 1996 Constitution of South Africa

After the 1994 elections, a new Parliament and Government of National Unity were established and were required to function in accordance with the Interim Constitution.⁴³ The constitutional assembly had two years to create a new “final” Constitution that would conform to the 34 Constitutional principles agreed upon during previous negotiations (Waal et al, 2001).

The new Constitution was drafted in terms of Chapter 5 of the Interim Constitution and was adopted by the constitutional assembly on May 8 1996. At this point, the Constitutional Court had to ensure that the final Constitution followed and included all 34 constitutional principles that MPNP had previously agreed to. The Constitutional Court initially refused to certify this initial version of the Constitution, however, the Court eventually agreed to its certification after some changes. The final Constitution⁴⁴ was passed by Parliament on December 18 1996 and was signed into law by President Nelson Mandela on February 4 1997 in Sharpeville. Sharpeville was chosen as a symbolic gesture to the memories of the Pass Law protesters who were killed in March 1960, and to serve as a statement marking the end of an era of racism and human rights violations (Currie et al, 2001).

⁴¹ Section 4 (2).

⁴² Succeeded by the Constitution of the Republic of South Africa Act 108 of 1996.

⁴³ Which had come into force April 27 1994.

⁴⁴ Constitution of the Republic of South Africa Act 108 of 1996. As amended by the Constitution of the Republic of South Africa Amendment Act 35 of 1997, Constitution of the Republic of South Africa Amendment Act 65 of 1998, Constitution of the Republic of South Africa Second Amendment Act 87 of 1998, Constitution of the Republic of South Africa Second Amendment Act 2 of 1999, Constitution of the Republic of South Africa Amendment Act 3 of 1999, Constitution of the Republic of South Africa Amendment Act 34 of 2001, Constitution of the Republic of South Africa Second Amendment Act 61 of 2001, Constitution of the Republic of South Africa Amendment Act 18 of 2002, Constitution of the Republic of South Africa Second Amendment Act 21 of 2002, Constitution of the Republic of South Africa Amendment Act 2 of 2003, and Constitution of the Republic of South Africa Second Amendment Act 3 of 2003.

4.3.3 The Property Clause of the Constitution

The protection of property rights in the Constitution⁴⁵ proved to be a contentious issue. Only in the last days before the deadline for agreement did the negotiating forum finally ratify the clause, now Section 28 of the Constitution⁴⁶ (Chaskalson, 1994). During the negotiations, the ANC was concerned that a constitutional right to property might impede legislative programmes addressing the disparities of wealth in South African society. The National Party, however, wanted to ensure that the property of existing owners would remain safe. Thus, Section 28 of the Interim Constitution (1993) represented a compromise between the two views (Chaskalson, 1995). Section 28 of the 1993 Interim Constitution would, in turn, lead to Section 25 of the 1996 Constitution.

Today, the basis of most land reform in South Africa is rooted in Section 25 of the Constitution.⁴⁷ To address South Africa's history of conquest and dispossession, of forced removals, and the racially skewed distribution of land resources, the drafters of the South African Constitution included three key clauses (DLA, 1997). These included a requirement for the state to enable citizens to gain access to land,⁴⁸ secure tenure,⁴⁹ and restitution of land for those disposed of property after June 19 1913.⁵⁰

To address the requirements of the Constitution,⁵¹ the key elements of the land reform programme fell under three main categories: redistribution, restitution, and tenure reform (DLA, 1997). The basis of the redistribution programme is Section 25 (5)⁵² of the Constitution, which requires the state to implement measures aimed at achieving land redistribution. The basis of the land reform programme is Section 25 (6)⁵³ and Section 25 (9),⁵⁴ which mandates the state to enact legislation to provide for the securing of land tenure that was made legally insecure as a result of past racially discriminatory laws or practices. The restitution programme is based on Section 25 (7),⁵⁵ which grants a right

⁴⁵ Section 28 (Constitution of the Republic of South Africa Act 200 of 1993). Succeeded by Section 25 (Constitution of the Republic of South Africa Act 108 of 1996).

⁴⁶ 1993.

⁴⁷ 1996.

⁴⁸ Section 25 (5). See Footnote 52.

⁴⁹ Section 25 (6). See Footnote 53.

⁵⁰ Section 25 (7). See Footnote 55.

⁵¹ 1996.

⁵² Section 25 (5): The state must take reasonable legislative and other measures, within its available resources, to foster conditions which enable citizens to gain access to land on an equitable basis.

⁵³ Section 25 (6): A person or community whose tenure of land is legally insecure as a result of past racially discriminatory laws or practices is entitled, to the extent provided by an Act of Parliament, either to tenure which is legally secure or to comparable redress.

⁵⁴ Section 25 (9): Parliament must enact the legislation referred to in subsection (6).

⁵⁵ Section 25 (7): A person or community dispossessed of property after 19 June 1913 as a result of past racially discriminatory laws or practices is entitled, to the extent provided by an Act of Parliament, either to restitution of that property or to equitable redress.

to restitution of property to persons or communities disposed of property as a result of discriminatory legislation after June 19 1913.

Other areas of significance to the land reform programmes include Section 25 (1)⁵⁶ of the Constitution, which states that no one may arbitrarily be deprived of property. Section 25 (2)⁵⁷ outlines expropriation procedures, and Section 25 (3)⁵⁸ pertains to compensation. Section 25 (4)⁵⁹ states that, for the purpose of the property section, public interest includes the nation's commitment to land reform and to reforms to bring about equitable access to all of South Africa's natural resources.

The implementation of land reform programmes, as mandated by the Constitution, has been an ongoing process involving existing legislation and the enactment of numerous new legislation.⁶⁰

4.4 Land Reform Programmes

4.4.1 Introduction

In addition to the previously mentioned constitutional basis for land reform, numerous other factors have shaped the current state of South African land reform. In particular, a

⁵⁶ Section 25 (1): No one may be deprived of property except in terms of law of general application, and no law may permit arbitrary deprivation of property.

⁵⁷ Section 25 (2): Property may be expropriated only in terms of law of general application—
(a) for a public purpose or in the public interest; and
(b) subject to compensation, the amount of which and the time and manner of payment of which have either been agreed to by those affected or decided or approved by a court.

⁵⁸ Section 25 (3): The amount of the compensation and the time and manner of payment must be just and equitable, reflecting an equitable balance between the public interest and the interests of those affected, having regard to all relevant circumstances, including—
(a) the current use of the property;
(b) the history of the acquisition and use of the property;
(c) the market value of the property;
(d) the extent of direct state investment and subsidy in the acquisition and beneficial capital improvement of the property; and
(e) the purpose of the expropriation.

⁵⁹ Section 25 (4): For the purposes of this section—
(a) the public interest includes the nation's commitment to land reform, and to reforms to bring about equitable access to all South Africa's natural resources; and
(b) property is not limited to land.

⁶⁰ The principal national land reform laws include: Upgrading of Land Tenure Rights Act 112 of 1991, Provision of Land and Assistance Act 126 of 1993, Restitution of Land Rights Act 22 of 1994, Land Administration Act 2 of 1995, Development Facilitation Act 67 of 1995, Land Reform (Labour Tenants) Act 3 of 1996, Communal Property Associations Act 28 of 1996, Interim Protection of Informal Land Rights Act 31 of 1996, Extension of Security of Tenure Act 62 of 1997, Prevention of Illegal Eviction from and Unlawful Occupation of Land Act 19 of 1998 and the recent Communal Land Rights Act 11 of 2004.

report by the World Bank,⁶¹ various policy documents (i.e., the Reconstruction and Development Programme),⁶² the Framework Document on Land Policy,⁶³ and the White Paper on South African Land Policy.⁶⁴

4.4.2 ANC Policy Document

Realizing that it was only a matter of time before they would form the next government, the ANC released the Ready to Govern⁶⁵ policy document at a National Conference in May 1992. The document stated that the dispossession and denial of rights to land had resulted in the present unequal division of land and landlessness, and legislative intervention would be required that was far beyond the mere repeal of apartheid land laws (ANC, 1992). The document went on to state that the crippling impact of past policies demanded an urgent implementation of a national programme of land reform and restitution. The view of the ANC was that the legacy of forced removals and dispossession had to be addressed as a fundamental issue in any future land policy in South Africa.

4.4.3 World Bank Report

In October 1993, the World Bank at the “Land Redistribution Options Conference” in Johannesburg released a strongly influential report: “Options for Land Reform and Rural Restructuring in South Africa” (Williams, 1996). This report presented selected options for the design and implementation of a comprehensive rural restructuring programme that included policy reform, land reform, and the provision of essential support services to newly empowered landowners (World Bank, 1993). As a key to any reform, World Bank economists explicitly linked agricultural policies to land reform. Two of the broad aspects of this land reform were to be restoration and redistribution.

The report became extremely influential to the ANC government in setting policy. The government selectively incorporated many of the key recommendations into their forthcoming land policies. From this report, the “aim” of transferring 30 % of land in the farming areas historically reserved for White ownership to Black ownership within five years later reappeared in the ANC’s “Reconstruction and Development Programme” (Williams, 1996).

4.4.4 Reconstruction and Development Programme

In 1994, the ANC released the “Reconstruction and Development Programme” (RDP) policy document. This document pertained to social-economic issues and stated that the government’s goal should be the final eradication of apartheid and the building of a democratic, non-racial, and non-sexist future (ANC, 1994). Several key principles were outlined in the document, including the realization that change had to be done as an

⁶¹ 1993. See Chapter 4.4.3 World Bank Report (page 41).

⁶² 1994 (ANC). See Chapter 4.4.4 Reconstruction and Development Programme (page 41).

⁶³ 1995 (DLA). See Chapter 4.4.5 White Paper on South African Land Policy (page 42).

⁶⁴ 1997 (DLA). See Chapter 4.4.5 White Paper on South African Land Policy (page 42).

⁶⁵ Ready to Govern: ANC Policy Guidelines for a Democratic South Africa.

integrated and sustainable programme. The attainment of these goals meant all available resources had to be brought to bear, and would involve all facets of government. The Reconstruction and Development Programme required the integration of growth, development, reconstruction, and redistribution into a unified programme (ANC, 1994).

RDP called for the implementation of a fundamental land reform programme, which would be the central and driving force of rural development. Such a programme would need to address the injustices of forced removals and ensure security of tenure for rural dwellers. Secure tenure rights for all South Africans were to be ensured by adopting a tenure policy recognizing the present diverse forms of existing tenure while supporting the development of new and innovative forms of tenure⁶⁶ (ANC, 1994).

RDP served to provide a set of guidelines and principles giving direction to the initial process of formulating an extensive land reform policy. This document outlined a much more market-driven programme than anything that the ANC had previously advocated. The main goals of the programme were to alleviate poverty and reconstruct the economy. Since these two objectives were interrelated, the ANC realized that without economic growth no development would be possible (Lodge, 2002). RDP called for an all-embracing effort to tackle the alleviation of poverty and reconstruction of the economy. As such, RDP meant different things to different people. During the 1994 elections, the ANC projected that the programme was designed to meet basic needs, and would provide a better living environment with improved services (Lodge, 2002).

4.4.5 White Paper on South African Land Policy

In 1995, the “Framework Document on Land Policy” was released by the DLA for public comment and input. After an extensive consultation process and the incorporation of comments from interested parties, the “Draft Statement of Land Policy and Principles” was released. This became the object of discussion at the National Land Policy Conference held in August and September of 1995. Taking into consideration input from this conference, as well as input from other stakeholders in the land reform process, the “Green Paper on South African Land Policy” was released in 1996. After further refinement of the Green Paper, the “White Paper on South African Land Policy” was released in 1997.

In the White Paper, the key points on land reform were stated as needing to address the following issues:⁶⁷

- *The injustices of racially-based land dispossession of the past;*
- *The need for a more equitable distribution of land ownership;*
- *The need for land reform to reduce poverty and contribute to economic growth;*
- *Security of Tenure for all; and*
- *A system of land management, which will support sustainable land use patterns and rapid land release for development.*

⁶⁶ Such as Community Land Trusts and other forms of group land-holdings.

⁶⁷ Chapter 2 (2.1): Strategic Goals and Vision of Land Policy (DLA, 1997).

To achieve these objectives, the government's response to land reform (as initially put forward in the 1994 RDP policy document) had three major elements: redistribution, restitution, and land tenure reform. The implementation of these reform programmes would entail enactment of numerous new land-related-legislation. Broadly speaking,⁶⁸ the major Acts in this implementation process include:

Redistribution

- *Provision of Land and Assistance Act*⁶⁹
- *Development Facilitation Act*⁷⁰

Restitution

- *Restitution of Land Rights Act*⁷¹
- *Restitution of Land Rights Amendment Act*⁷²

Tenure Reform

- *Land Reform (Labour Tenants) Act*⁷³
- *Communal Property Associations Act*⁷⁴
- *Interim Protection of Informal Land Rights Act*⁷⁵
- *Extension of Security of Tenure Act*⁷⁶
- *Prevention of Illegal Eviction from and Unlawful Occupation of Land Act*⁷⁷
- *Transformation of Certain Rural Areas Act*⁷⁸
- *Communal Land Rights Act*⁷⁹

⁶⁸ Although generally considered as three separate land reform programmes, the enacted legislation is not always limited to one programme. In some instances, considerable overlap may occur, for example, the Extension of Security of Tenure Act, is often seen as part of the redistribution programme and at other times, as part of the tenure reform programme.

⁶⁹ 126 of 1993. See Chapter 4.5.2 Provision of Land and Assistance Act (page 44).

⁷⁰ 27 of 1995. See Chapter 4.5.3 Development Facilitation Act (page 45).

⁷¹ 22 of 1994. See Chapter 4.6.2 The Restitution of Land Rights Act (page 46).

⁷² 48 of 2003. See Restitution of Land Rights Amendment Act (Appendix A/page 218).

⁷³ 3 of 1996. See Chapter 4.7.2 Land Reform (Labour Tenants) Act (page 52).

⁷⁴ 28 of 1996. See Chapter 4.7.3 Communal Property Associations Act (page 54).

⁷⁵ 31 of 1996. See Chapter 4.7.4 Interim Protection of Informal Land Rights Act (page 55).

⁷⁶ 62 of 1997. See Chapter 4.7.5 Extension of Security of Tenure Act (page 56).

⁷⁷ 19 of 1998. See Chapter 4.7.6 Prevention of Illegal Eviction from and Unlawful Occupation of Land Act (page 58).

⁷⁸ 94 of 1998. See Chapter 4.7.7 Transformation of Certain Rural Areas Act (page 59).

⁷⁹ 11 of 2004. See Chapter 4.8 Communal Land Rights Act (page 59).

4.5 Redistribution

4.5.1 Introduction

In the late 1980's, White commercial agriculture comprised 87 % of the agricultural land of South Africa (Skweviva, 1990). In 1994, 50 % of the farmland⁸⁰ in KwaZulu-Natal was under the control of a small minority of White owners (Lyne et al, 2004). Redistribution was, in part, a means to open up opportunities for people to acquire land and remove the domination by this small select group.

The stated goal of the land redistribution programme⁸¹ was to provide the poor with access to land for residential and productive uses in order to improve their income and quality of life. The redistribution programme was specifically targeted at the poor, labour tenants, farm workers, women, and emergent farmers. The ultimate goal of this programme was to produce a more equitable distribution of land, reduce land-related conflicts, and help solve the problem of landlessness. The alleviation of these issues would, in turn, contribute to the process of national reconciliation and stability, improve settlement conditions in urban and rural areas, and enhance employment and economic growth throughout the country (DLA, 1997). The White Paper⁸² is careful in noting that redistribution shall be based on a willing-buyer willing-seller arrangement. The White Paper also notes that this is to be done "where possible." If not possible, the state may need to expropriate land in the public interest, which, under the Constitution,⁸³ includes the nation's commitment to land reform.

4.5.2 Provision of Land and Assistance Act

The Provision of Land and Assistance Act⁸⁴ provided for the designation of certain land and regulated the subdivision and settlement of people onto that land. This Act is one of the key pieces of legislation governing the redistribution of land and forms the legal basis of redistribution in South Africa. With neither restitution nor tenure reform able to meet their objectives, much attention was focused on this Act. This Act is often seen as the principal means of transferring large areas of land to the historically landless, particularly farm workers, rural people, labour tenants, and emergent farmers.

The Act calls for the provision of financial assistance that can be used in the acquisition of land or as a means to secure tenure rights in land. The method of obtaining land is by

⁸⁰ Including provincial parks.

⁸¹ Section 4.3: Land Redistribution/Purpose (White Paper on South African Land Policy).

⁸² Section 3.1: Constitutional Issues to be addressed (White Paper on South African Land Policy).

⁸³ Section 25 (4) (a) (Constitution of the Republic of South Africa Act 108 of 1996).

See Footnote 59 (page 40).

⁸⁴ 126 of 1993. As amended by Development Facilitation Act 67 of 1995, Provision of Certain Land for Settlement Amendment Act 26 of 1998 and the Land Affairs General Amendment Act 11 of 2000. This Act was formally known as the Provision of Certain Land for Settlement Act 126 of 1993.

a government grant known as the “Settlement and Land Acquisition Grant” (SLAG).⁸⁵ A 1998 amendment⁸⁶ outlined the categories of persons who were eligible for this assistance. These included persons with no land or limited access to land, those who wished to gain access to land, and those who desire to secure or upgrade the conditions of tenure under which they currently live. Eligibility also includes persons disposed of a right in land but do not qualify under the Restitution of Land Rights Act.⁸⁷

The qualifications for these grants were based on household income. To qualify, a household must have a monthly income of less than R 1,500. The household can then apply for a grant up to the maximum of R 16,000. At this amount, grants generally are pooled to create significant funds for purchasing a farm or plot of land.⁸⁸ Once land is obtained, it may be used for agricultural purposes or simply as a place of residence.

The Act empowers the state to designate certain land for settlement. This may include state land or land made available by a property owner on by a willing-buyer willing-seller arrangement. Land designated in this way is not subject to the usual laws pertaining to the establishment of townships or to the subdivision of agricultural land. Under the terms of this Act, a developer can subdivide land into smaller plots suitable for residential purposes, for public use, or for small-scale farming.⁸⁹

4.5.3 Development Facilitation Act

After the 1994 elections and the reunification of South Africa, there was a maze of overlapping and conflicting legislation pertaining to planning in general and other development (Badenhorst et al, 2003). The result was a series of bureaucratic delays that hindered development and caused many to become bogged down in red tape. Developments became caught up in a myriad of laws and regulations that often led to lengthy administration procedures. In addition, there were problems caused by the duplication of regulations and procedures. A general concern was expressed that these hindrances were impeding the speedy release of land and were a threat to rural and urban development programmes. A nationally uniform set of norms and standards were needed with respect to land development. Furthermore, the process needed to be “fast-tracked” to accelerate land development, especially in delivering serviced land for low-income housing. The first step in this process was the enactment of the Development Facilitation Act⁹⁰ (DFA) in 1995.

DFA introduced measures to facilitate and speed up the implementation of reconstruction, development programmes, and projects in relation to land. This was done by

⁸⁵ See Chapter 4.9.2 Land Acquisition Grants (page 68).

⁸⁶ Provision of Certain Land for Settlement Amendment Act 26 of 1998.

⁸⁷ 22 of 1994.

⁸⁸ i.e., Ekuthuleni. See Chapter 5.16 Ekuthuleni CPA (page 90).

⁸⁹ In Ekuthuleni, for example, since the land obtained by the Ekuthuleni community is to be utilized for farming and residential purposes, it falls under the scope of this Act (Urban-Econ, 1999).

⁹⁰ 67 of 1995.

laying down some general principles governing land development throughout the country and the provision of uniform procedures for the subdivision and development of land in urban and rural areas. DFA does not replace existing laws but operates in unison with the current land development and planning legislation. The Act also provides for the upgrading⁹¹ of an existing settlement with informal or unregistered tenure arrangements to be converted into ownership.⁹²

4.6 Restitution

4.6.1 Introduction

During the apartheid era, an estimated 3.5 million people and their descendents became victims of racially based dispossessions in forced removals (DLA, 2005a). This process was carried out by a variety of laws. In rural areas, for example, these were dealt with in terms of the Black Land Act,⁹³ the Development Trust and Land Act,⁹⁴ and the Prevention of Illegal Squatting Act.⁹⁵ Conversely, in urban areas, removals were done predominantly under the Group Areas Act⁹⁶ or the Urban Areas Act.⁹⁷

In 1994, the situation in South Africa was such that almost 80 % of the population was still confined to only about 13 % of the land (Lyne et al, 2004). The restitution of this land, or adequate compensation to its original owners, was one of the major priorities for the new ANC government. Consequently, in 1994, the first Act promulgated by the new government under Nelson Mandela to deal with land reform was the Restitution of Land Rights Act.⁹⁸

4.6.2 The Restitution of Land Rights Act

The embodiment of the 1994 restitution legislation lies in the Interim Constitution⁹⁹ of 1993, which was still the Constitution in 1994. The Interim Constitution¹⁰⁰ called for an Act of Parliament to provide for matters relating to the restitution of land rights. The importance of the restitution programme can also be seen in the "Reconstruction and

⁹¹ Subject to certain conditions.

⁹² Section 7.

⁹³ 27 of 1913.

⁹⁴ 18 of 1936.

⁹⁵ 52 of 1951.

⁹⁶ 41 of 1950. The DLA estimates that more than 130,000 families, involving 73,000 properties, were dispossessed under the Group Areas Act 41 of 1950, the Community Development Act 3 of 1966, and the Blacks Resettlement Act 19 of 1954 (Natives Resettlement Act) (DLA, 1997).

⁹⁷ Blacks (Urban Areas) Act 21 of 1923.

⁹⁸ 22 of 1994.

⁹⁹ Sections 121 - 123 (Constitution of the Republic of South Africa Act 200 of 1993).

¹⁰⁰ Section 121 (1).

Development Programme” (RDP),¹⁰¹ which was the “policy framework” document adopted by the ANC government shortly after coming to power in 1994. This document also emphasized the need to redress the suffering caused by the policy of forced removals and to restore land to those disposed by discriminatory legislation.¹⁰² As such, restitution played (and continues to play) a critical role in the government’s land reform programmes. To address the restitution requirement, the Restitution of Land Rights Act,¹⁰³ was enacted in 1994.

As stated in the preamble, the Act provides for the restitution of rights in land to persons or communities disposed of such rights after June 19 1913 as a result of past racially discriminatory laws or practices. The June 19 1913 date was chosen as a compromise, as this was the date that the infamous Black Land Act¹⁰⁴ was promulgated. The enactment of the Black Land Act was significant for a number of reasons. Most significantly, it heralded the formal adoption of territorial segregation in South Africa that became the basis for separating the country into areas in which only Blacks or only Whites could hold freehold title. The Act prohibited Blacks from dealing in land, entering into agreements in terms of land, or acquiring any rights whatsoever in land outside the areas deemed for Black occupation without the approval from the Governor General. As well, sharecropping and rental tenancy outside the scheduled areas was abolished. Most land in the scheduled areas was registered in the name of the Minister of Native Affairs or a chief to hold in trust for a tribe (Durkje, 1998).

Although dispossession had taken place prior to this date,¹⁰⁵ the impracticality of addressing these issues was deemed unworkable. From the government’s point of view,¹⁰⁶ any attempt to make restitution that predated 1913 would be extremely difficult to implement due to the large demographic shifts that had taken place. The number of descendants of those displaced had increased at least eight times and were now scattered throughout the country. In addition, large sections of the country were subject to overlapping and competing claims where land had been occupied at different times by Trekkers, the British, or various tribes. This could have also stirred up or prolonged destructive ethnic and racial politics. In addition, given the length of elapsed time, little would exist in the way of written records to justify any claims.

The date might also be considered significant for other reasons. Before 1913, the dispossession of land was predominately rural, whereas after this date dispossession

¹⁰¹ See Chapter 4.4.4 Reconstruction and Development Programme (page 41).

¹⁰² Section 2.4.13: Land Restitution: To redress the suffering caused by the policy of forced removals, the democratic government must, through the mechanism of a land claims court, restore land to South Africans dispossessed by discriminatory legislation since 1913. This court must be accessible to the poor and illiterate. It must establish processes that enable it to make speedy decisions. In order for this court to function effectively, constitutional rights to restitution must be guaranteed (Reconstruction and Development Programme).

¹⁰³ 22 of 1994.

¹⁰⁴ 27 of 1913.

¹⁰⁵ June 19 1913.

¹⁰⁶ Section 4.14.2 (White Paper on South African Land Policy).

was predominantly in urban areas, essentially creating an urban bias in the design and implementation of the restitution process (Horn, 1998). In addition, a 1916 report¹⁰⁷ stated the number of Africans considered to be in the informal possession of land was only 1,850 (Union of South Africa, 1916).

Having said all this, the government acknowledged in its 1996 Green Paper¹⁰⁸ that numerous claims would likely pre-date the 1913 cut-off or fall outside the scope of the restitution Act. The Green Paper also states that the Department¹⁰⁹ was committed to actively seeking alternative remedies.

Since its enactment in 1994, the Act has been amended multiple times.¹¹⁰ Some of the significant amendments include those in 1995¹¹¹ and 1996,¹¹² in which some procedures and powers of the Land Claims Court were changed. Later, the 1997 amendment¹¹³ ensured compliance with the new Constitution¹¹⁴ and extended the cut-off date¹¹⁵ for claims. At the end of 1999, only about 3,000 claims had been settled out of some 62,455 registered claims (NLC, 2005). Thus, the 1999 amendment¹¹⁶ was an attempt to speed up and streamline the process.

4.6.3 Land Claims Commission and Court

The Restitution of Land Rights Act¹¹⁷ provided for the establishment of a Commission on Restitution of Land Rights¹¹⁸ (CRLR) as mandated in the Interim Constitution.¹¹⁹ This commission consists of a Chief Land Claims Commissioner and a Deputy Land Claims Commissioner, both appointed by the Minister,¹²⁰ as well as an unspecified number of Regional Land Claims Commissioners.¹²¹ The functions of the Commission are to accept and acknowledge receipt of all claims, mediate and settle disputes, prepare

¹⁰⁷ Report of the Natives Land Commission.

¹⁰⁸ Green Paper on South African Land Policy.

¹⁰⁹ Department of Land Affairs.

¹¹⁰ i.e., Restitution of Land Rights Amendment Act 84 of 1995, Land Restitution and Reform Laws Amendment Act 78 of 1996, Land Restitution and Reform Laws Amendment Act 63 of 1997, Land Affairs General Amendment Act 61 of 1998, Land Restitution and Reform Laws Amendment Act 18 of 1999 and Land Affairs General Amendment Act 11 of 2000.

¹¹¹ Restitution of Land Rights Amendment Act 84 of 1995.

¹¹² Land Restitution and Reform Laws Amendment Act 78 of 1996.

¹¹³ Land Restitution and Reform Laws Amendment Act 63 of 1997.

¹¹⁴ Constitution of the Republic of South Africa Act 108 of 1996.

¹¹⁵ To December 31 1998.

¹¹⁶ Land Restitution and Reform Laws Amendment Act 18 of 1999.

¹¹⁷ 22 of 1994.

¹¹⁸ Chapter 2.

¹¹⁹ Section 122 (1) (Constitution of the Republic of South Africa Act 200 of 1993).

¹²⁰ Minister of Land Affairs.

¹²¹ Section 4 (3).

reports on unsettled claims for submission as evidence to the Court, assist claimants, and investigate the merits of each claim.¹²²

The Act also provides¹²³ for the establishment of the Land Claims Court¹²⁴ (LCC), with the power to determine the restitution of any right in land, compensation payable with respect to the expropriation or acquisition of land, and persons entitled to ownership.¹²⁵ The court was established in 1996, serving as a specialist court with an independent adjudicatory function with respect to legal disputes under the government's land reform programme (DLA, 2005a).

4.6.4 Restitution Procedure

Applicants who feel they were disposed of their rights in land after 1913 due to racially discriminatory laws or practices have the right to claim restitution against the state. The land restitution programme was never designed to be an open-ended process, as all claims for restitution had to be given to the Land Claims Commission before April 30 1998. This was later extended¹²⁶ to December 31 1998. Applicants included individuals, their descendants, and even communities. Claims were initially sent to the Commission on Restitution of Land Rights, where the merits of each claim were determined and, if possible, a settlement was completed. If a settlement could not be resolved by the Land Claims Commission, the Commission was required to prepare a report and the claim was then referred to the Land Claims Court, which would decide the form of restitution that would be appropriate and fair. A successful claim could have been restoration of the original parcel of land, provision of alternate state-owned land, or monetary compensation.

4.6.5 Current State of Restitution

The restitution programme ran into numerous problems and delays after its inception in 1994. With the willing-buyer willing-seller approach, restoration often depended on the willingness of the current owner to sell. The 1997 White Paper¹²⁷ stated that the restitution policy was to be guided by the principles of fairness and justice and that any solution must not be forced on people. Hence, the expropriation of property was not always an option. In addition, if land was expropriated, the state was required to pay fair compensation. In KwaZulu-Natal, previous purchases of agricultural land by the state averaged R 25,000 per ha (Gwanya, 2005a). In many instances, considerable value was added to the property after the initial time of dispossession so restoration was often costly and difficult. This was particularly true in urban areas, as removals under the

¹²² Section 6 (1).

¹²³ Chapter 3.

¹²⁴ The Land Claims court has the same status as the High Court of South Africa,

¹²⁵ Section 22 (1).

¹²⁶ By the Land Restitution and Reform Laws Amendment Act 63 of 1997.

¹²⁷ Section 4.14 (White Paper on South African Land Policy).

Group Areas Act¹²⁸ generally happened in what were once the peripheral areas of cities and what are now areas of extensive development.

The number of claims to be settled in KwaZulu-Natal is 5,443 (Gwanya, 2005a). The Commission's stated goal was to settle all outstanding urban claims by the end of the 2005/2006 financial year and to settle all rural claims by March 31 2008 (Gwanya, 2005b). To date,¹²⁹ the total financial commitment for all settled claims is R 4.641 billion, which has entailed some 887,093 ha being delivered and 172,769 households benefiting from the restitution programme (DLA, 2005a).¹³⁰ Funding for the restitution programme is set to be increased for the next three years to a maximum of R 3.837 billion in the 2007/2008 fiscal year (Gwanya, 2005b).

4.7 Tenure Reform

4.7.1 Introduction

Reforming the land tenure system in South Africa is a complex process that has become a formidable task for the government. The first tenuous step of the land reform process was made in 1995 with the Land Reform Pilot Programme¹³¹ (DLA, 1997). Knowledge and experience gained from this programme was used in forming a national land reform policy.

Land tenure reform has needed to address a multitude of land ownership issues that are the direct result of past colonial and apartheid policies. Problems in land ownership and tenure issues in the old homelands are especially acute, as land rights were usually held in trust or permit-based. Thus, most land was (and still is) registered as state property or as part of the South African Development Trust (SADT). During the apartheid years, millions of Black South Africans were forcibly removed and resettled onto land to which others had prior rights. To compound the issue, many of those who were resettled were given documentation (i.e., PTO) by the government to the effect that they were now the owners, even though previous occupants (owners) were present. Thus, it is commonplace in the homelands for tenure rights to be overlapping and have various vested interests competing for the same parcel of land.

¹²⁸ 41 of 1950.

¹²⁹ 2005.

¹³⁰ At the recent Land Summit Conference (July 2005) the Minister of Agriculture and Land Affairs - Ms Thoko Didiza stated that 62,000 claims have been settled and a total of 916,000 ha restored, as of June 2005. In addition, the Minister stated that the aim is to finish all outstanding claims over next three years (Didiza, 2005).

¹³¹ The Land Reform Pilot Programme might best be described as the initial exploratory phase of the land redistribution programme. It was designed as a means of implementing an integrated development programme in selected areas of the country. It was viewed as a means to test various approaches that would improve access and control over resources and services by the poor, rural Black population.

In addition, the unlawful settlement (i.e., squatters) of millions of people had occurred in the previously deemed “Whites only” areas of South Africa (DLA, 1997). The effect of this has been a tenure system lying outside the ambit of the law. This legal insecurity results in residents having no means of proving their de facto ownership. Residents therefore have considerable difficulty in protecting their land from others and are often unable to secure housing subsidies or development financing from various organs of government. Many communities are in the same situation, thus Government departments and development agencies are reluctant to finance community projects in these areas. Consequently, many development initiatives and infrastructure developments are stymied by a lack of clarity about ownership of land.

In the process of reforming the tenure system, the government outlined a set of principles for tenure reform. According to the 1997 White Paper,¹³² tenure reform should include:

- (a) A move towards rights and away from permits.¹³³
- (b) The creation of a unitary non-racial system of land rights.¹³⁴
- (c) Allow people to choose the tenure system, which is appropriate to their circumstances.¹³⁵
- (d) Consistent with the Constitution’s commitment to basic human rights and equality.
- (e) Accommodation of de facto vested rights, as they exist on the ground.¹³⁶

Provisions for upgrading and recognizing land rights, as well as the formalization of de facto interests in land require a land tenure system within the ambit of the law. This required the enactment of a series of new legislation,¹³⁷ such as the Upgrading of Land Tenure Rights Act,¹³⁸ Land Reform (Labour Tenants) Act,¹³⁹ Communal Property Associations Act,¹⁴⁰ Interim Protection of Informal Land Rights Act,¹⁴¹ Extension of

¹³² Section 4.16: Guiding Principles of Tenure Reform (White Paper on South African Land Policy).

¹³³ The transformation of all “permit-based” and subservient forms of land rights into legally enforceable rights to land.

¹³⁴ A commitment to developing a system of land registration, support, and administration that accommodates flexible and diverse systems of land rights within a unitary framework.

¹³⁵ A commitment to supporting and developing a variety of tenure options, that people may then choose between.

¹³⁶ All tenure reform processes need to acknowledge and accommodate the de facto vested rights, which exist on the ground. These would include legal rights, as well as existing interests lacking formal legal recognition.

¹³⁷ Loosely falling (in whole or in part) under the banner of tenure reform.

¹³⁸ 112 of 1993.

¹³⁹ 3 of 1996.

¹⁴⁰ 28 of 1996.

¹⁴¹ 31 of 1996.

Security of Tenure Act,¹⁴² Prevention of Illegal Eviction from and Unlawful Occupation of Land Act,¹⁴³ and the recent Communal Land Rights Act.¹⁴⁴

Successful implementation of the tenure reform programme will have a number of desired results. In part, tenure reform is seen as a means of relieving the overcrowding in the former homelands (DLA, 1997). Reform would also mean the eradication of the permit-based system of land administration and provide those living¹⁴⁵ in the communal¹⁴⁶ areas with legally secure tenure. Essentially, the land tenure programme is the means to give effect to one's constitutional right¹⁴⁷ to gain access to land on an equitable basis, and to tenure that is legally secure.¹⁴⁸ It is hoped that the resolution of land issues will provide a legal environment conducive to (and a catalyst for) investment, economic growth and development.

4.7.2 Land Reform (Labour Tenants) Act

Labour tenants are a particularly vulnerable group within rural South Africa. This group was deemed by the government to require protection and considered to have specific land needs. The term "labour tenant" refers to tenants who are almost exclusively Black and reside on almost exclusively White-owned farms. In return for the right to use small portions of the land for personal purposes, such as for residence or cropping or grazing rights, the tenant agrees to work for the landowner for a specified period each year (usually 3 to 9 months). Thus, the labour tenant is essentially agreeing to pay for the use of land via the provision of labour to the owner as opposed to a cash payment.¹⁴⁹

South Africa has an estimated 6 million farm-dwellers¹⁵⁰ and an estimated 40,000 to 160,000 labour tenant families (Hlatshwayo, 2000). The labour tenant system was at one time the most widespread form of farm labour in the northern areas of South Africa (Hathorn et al, 1990). The emergence of this form of tenancy has often been attributed to the unequal distribution of wealth and power between Blacks and Whites and the severe restrictions that were previously placed on Black ownership (DLA, 1996). In addition to legislation preventing Blacks from owning land in White farming areas, other legislation prevented the leasing of land by White farmers to Black tenants or sharecroppers, thereby, forcing the exchange of labour for land (Lyne et al, 2004). The

¹⁴² 62 of 1997.

¹⁴³ 19 of 1998.

¹⁴⁴ 11 of 2004.

¹⁴⁵ i.e., individuals, communities, farm occupiers, and farm dwellers.

¹⁴⁶ The land reform programmes cover the former homelands and South African Development Trust lands, former Coloured areas, White farm areas, and peri-urban areas where farm workers, labour tenants and farm dwellers are mainly found (DC28, n.d.(d)).

¹⁴⁷ Section 25 (5) (Constitution of the Republic of South Africa Act 108 of 1996).

¹⁴⁸ Alternatively, to comparable redress. Section 25 (6) (Constitution of the Republic of South Africa Act 108 of 1996). See Footnote 53 (page 39).

¹⁴⁹ An important distinction under the Land Reform (Labour Tenants) Act 3 of 1996.

¹⁵⁰ Farm workers and their families.

previous NP government(s) had even attempted to outlaw labour tenancy from 1966 to 1980 (DLA, 1996). This form of labour tenancy as a form of labour supply to the commercial farms is widespread in KwaZulu-Natal¹⁵¹ (DC28, n.d.(c)).

A Labour tenant has always been in a precarious position, as the loss of employment would often mean eviction from the land, which would mean loss of residence, loss of cropping and grazing rights, and loss of community. To address the problem of tenure insecurity for labour tenants, particularly the prominence of unfair evictions by land-owners, the Land Reform (Labour Tenants) Act¹⁵² (LTA) was enacted in March of 1996. With a strong possibility of widespread evictions before the enactment of the legislation, the Act was made retroactive to June 2 1995, ensuring that all labour tenants were assumed to have legal rights to live on and use the farm on which they currently reside. A tenant who met all the statutory requirements on June 2 1995 would then have a vested right to occupy the land along with their family.¹⁵³

For LTA to be applied, requirements for “labour tenancy” had to be met. The Act draws a distinction between farm workers and labour tenants, where a farm worker¹⁵⁴ is defined as a person who is employed on the farm in terms of a contract of employment and is remunerated predominantly in cash. A labour tenant,¹⁵⁵ on the other hand, works for the owner of the farm but is paid in terms of land use, such as grazing or cultivation, and residential use. As such, labour tenants receive only minimal monetary compensation.

LTA essentially prohibits the arbitrary eviction of a tenant. Eviction now requires the landowner to follow a particular set of procedures and can only be carried out by way of an eviction order issued by the Land Claims Court.¹⁵⁶ Two of the key goals of the Act

¹⁵¹ Although widespread in KwaZulu-Natal, it is very limited in the Uthungulu District Municipality (DC28, n.d.(c)).

¹⁵² 3 of 1996. As amended by Land Restitution and Reform Laws Amendment Act 78 of 1996, Land Restitution and Reform Laws Amendment Act 63 of 1997, Land Affairs General Amendment Act 61 of 1998, Land Restitution and Reform Laws Amendment Act 18 of 1999, Land Affairs General Amendment Act 11 of 2000 and Land Affairs General Amendment Act 51 of 2001.

¹⁵³ Section 3 (1).

¹⁵⁴ Under the Act, a 'farm worker' means a person who is employed on a farm in terms of a contract of employment which provides that (a) in return for the labour which he or she provides to the owner or lessee of the farm, he or she shall be paid predominantly in cash or in some other form of remuneration, and not predominantly in the right to occupy and use land; and (b) he or she is obliged to perform his or her services personally;

¹⁵⁵ Under the Act, a 'labour tenant' means a person (a) who is residing or has the right to reside on a farm; (b) who has or has had the right to use cropping or grazing land on the farm, referred to in paragraph (a), or another farm of the owner, and in consideration of such right provides or has provided labour to the owner or lessee; and (c) whose parent or grandparent resided or resides on a farm and had the use of cropping or grazing land on such farm or another farm of the owner, and in consideration of such right provided or provides labour to the owner or lessee of such farm.

¹⁵⁶ Section 5.

were the provision of a secure form of tenure to labour tenants and their families and to assist them in acquiring rights in land. Acquisition of the rights in land could be done via a grant used in the purchase of land.¹⁵⁷

4.7.3 Communal Property Associations Act

The Communal Property Associations Act¹⁵⁸ (CPAA) was enacted in 1996 to allow communities to form juristic persons known as Communal Property Associations (CPA). The Act created a new form of registrable land tenure in South Africa, and, in the context of land reform, a CPA has a precise legal meaning. Communities could acquire, hold, and manage property with terms agreed upon by the community. The Act was designed specifically for disadvantaged communities as a means to acquire and manage property as a collective group. It was designed as another legal form option for the holding and managing of property because voluntary associations, share-block schemes, sectional titles, and trusts were often not appropriate due to complex administrative requirements (Cousins, T. et al, 2001).

Eligibility for creating a CPA required that a community meet certain conditions. The community had to either be entitled to restitution of land by order of the Land Claims Court,¹⁵⁹ entitled to (or receiving) property from the state, or have property that had been donated or sold under terms that required an association to be formed. A community wishing to form a CPA could then apply to the Director-General for the registration of that community.¹⁶⁰

One of the requirements for registration entailed the creation of a written Constitution, a legally binding agreement between the association and its members. The Constitution was viewed as a means of preventing abuse of power by members of the association; of ensuring that the association is managed in a non-discriminatory, equitable, and democratic fashion; and of creating accountability to the members of the association. With the Act's strong emphasis on equality, accountability, and democratic processes, there has been some objection to CPAs by chiefs who view them as institutions that undermine their traditional role and authority (Cousins, T., 2000).

The CPA Constitution primarily had to ensure that the CPA followed fair and democratic principles. No discrimination of any type¹⁶¹ would be acceptable.¹⁶² All members would have equal rights, democratic processes must be followed, and the committees and financial records had to be accountable and transparent. The Constitution had to outline the objectives of the association, the land or property to be owned by the association, specific qualifications for membership, procedures for resolving disputes, and

¹⁵⁷ See Chapter 4.9.2 Land Acquisition Grants (page 68).

¹⁵⁸ 22 of 1996.

¹⁵⁹ Under the Restitution of Land Rights Act 22 of 1994.

¹⁶⁰ See Chapter 5.16 Ekuthuleni CPA (page 90).

¹⁶¹ Namely, race, gender, sex, ethnic or social origin, colour, sexual orientation, age, disability, religion, conscience, belief, culture, or language.

¹⁶² Section 9 (1).

the basis for membership.¹⁶³ In addition, other requirements include the grounds and procedures for terminating membership, whether members may sell their rights (if so, to whom), how committees are elected, the powers of the association, how the Constitution may be changed or dissolved, and disciplinary matters.

Once the Constitution was completed, it would be submitted with a list of members to the DLA for registration. Following registration, the CPA was established as a juristic person. This meant that the CPA had the capacity to sue, or be sued, and could acquire rights and incur obligations in its own name. The association would have perpetual succession regardless of changes in its membership, and is able to acquire and dispose of immovable property and real rights and encumber those rights by lease, mortgage, or servitude.

4.7.4 Interim Protection of Informal Land Rights Act

The Interim Protection of Informal Land Rights Act¹⁶⁴ (IPILRA) was created to provide for the temporary protection of certain rights to and interests in land that are not otherwise adequately protected by law. IPILRA can be viewed as a means of protecting the de facto rights, as they existed at the time of enactment. The Act was designed as a means of maintaining the status quo for the duration of the land reform process. It was also intended to prevent existing landowners from asserting their rights over existing occupiers of land until the introduction of new laws that would strengthen their tenure rights. IPILRA applies to insecure rights that have no conventional legal basis or are not adequately protected in law. It was originally intended only as an interim mechanism that would lapse December 31 1997;¹⁶⁵ however, the application of the Act is now extended on an annual basis by proclamation in the Government Gazette. One would expect that the Act would continue to be extended annually while new land reform laws are enacted or the land reform programme is complete.

IPILRA provides for the provision of four distinct categories of what constitutes an informal right in land¹⁶⁶ and, consequently, its protection. These include:

- (a) Land associated with tribal, customary, or indigenous laws or practices of a tribe. These are typically areas that were previously deemed for Black occupation under the apartheid laws (i.e., the former homelands). Also included was land that at any time vested in the South African Development Trust,¹⁶⁷ the government of any area for which a legislative assembly was established in terms of the Self-governing Territories Constitution Act¹⁶⁸ or the governments of the former republics of Transkei, Bophuthatswana, Venda, and Ciskei.
- (b) Certain land held under specific trust arrangements.

¹⁶³ i.e., individuals or families.

¹⁶⁴ 31 of 1996.

¹⁶⁵ Section 5 (2).

¹⁶⁶ Section 1 (1) iii.

¹⁶⁷ Established by Section 4 of the Development Trust and Land Act 18 of 1936.

¹⁶⁸ 21 of 1971.

- (c) Land that has been beneficially occupied for a continuous period of not less than five years prior to December 31 1997. Where beneficial occupation means the occupation of land by a person, as if they were the owner, without force, openly and without the permission of the registered owner. This type of occupation is the essential basis for the occupation of title to property by prescription.
- (d) Rights to particular units of land deriving from a permission-based right. This might be the occupation by a person of an erf¹⁶⁹ as if they were the holder of the right¹⁷⁰ even though the right is not formally recorded in the register of land rights.

IPILRA specifically excluded two areas from protection. These include the right or interest of a tenant, labour tenant, sharecropper, or employee if that right was purely of a contractual nature. Many of these rights are covered under the Land Reform (Labour Tenants) Act.¹⁷¹ Also excluded was any right or interest in land based purely on temporary permission granted by the owner.

Under the Act, a measure of protection is given to the individual members of a community. No person may be deprived of any informal right to land without their consent,¹⁷² except under certain instances. Where land is held on a communal basis, a person may only be deprived of land in accordance with the custom and usage of that community. If the community has disposed a person of their informal right, the community must pay appropriate compensation. Eviction is also possible via any of the existing laws providing for the expropriation of land or rights in land.¹⁷³

IPILRA does not confer any real right to land nor does it provide any security of tenure or legal certainty as to who controls the land. Nevertheless, the Act presents communities that have strong underlying rights to the land a measure of protection.¹⁷⁴

4.7.5 Extension of Security of Tenure Act

With the enactment of the Land Reform (Labour Tenants) Act¹⁷⁵ (LTA) the previous year (1996), labour tenants could now acquire rights to land by virtue of being linked to a particular form of labour practice. LTA granted labour tenants the right to apply for ownership of that portion of the farm over which they historically have had rights. Still, a specific category of people was not protected by this Act or any other Act. Therefore, to

¹⁶⁹ As defined in Land Survey Act 9 of 1927.

¹⁷⁰ Schedule 1 or 2 rights under the Upgrading of Land Tenure Rights Act 112 of 1991.

¹⁷¹ 3 of 1996.

¹⁷² Section 2 (1).

¹⁷³ i.e., Expropriation Act 63 of 1975.

¹⁷⁴ For example, the community of Ekuthuleni, with most members of the community having lived on the land as if they were the owners without having used force to occupy the land for more than five years before December 31 1997, then according to IPILRA, they cannot be moved without their consent.

¹⁷⁵ 3 of 1996.

address this need, as well as to ensure that rights enshrined in Section 26 (3)¹⁷⁶ of the Constitution¹⁷⁷ were enforced, the Extension of Security of Tenure Act¹⁷⁸ (ESTA) was enacted in 1997.¹⁷⁹

As stated in the preamble to this statute “many South Africans do not have secure tenure of their homes and the land which they use and are therefore vulnerable to unfair eviction.” Due in part to past discriminatory laws and practices, and the realization that evictions lead to great hardship, conflict, and social instability, the statute’s intention was the promotion of long-term security of tenure. ESTA provides for measures with state assistance to facilitate long-term security of land tenure, and to regulate the conditions of residence on certain land and the conditions and circumstances under which a person may be evicted.

Application¹⁸⁰ of ESTA applies to all land (with certain exceptions) other than land in a Township. In essence, this means the Act is primarily restricted to rural areas. This would include any land designated for agricultural purposes and any land which has been established, approved, proclaimed, or otherwise recognized after February 4 1997,¹⁸¹ but only if that person was the occupier immediately prior to such establishment, approval, proclamation, or recognition. Land in issue in any civil proceedings is presumed to fall within the scope of the Act unless proven to the contrary. This means that the onus is on the party disputing the applicability of ESTA to prove that the contrary is true.

ESTA is essentially balancing the rights of occupiers with those of owners by clearly outlining the duties and rights of both occupiers and owners. For the purposes of this Act, an occupier¹⁸² is a person residing on land that belongs to another person who has, on February 4 1997 or thereafter, had consent or another right in law to do so. This excludes a labour tenant,¹⁸³ a person using or intending to use the land in question mainly for industrial, mining, commercial or commercial farming purposes (but including a person who works the land himself), and a person who has an income in excess of the prescribed amount.

¹⁷⁶ Section 26 (3): No one may be evicted from their home, or have their home demolished, without an order of court made after considering all the relevant circumstances. No legislation may permit arbitrary evictions.

¹⁷⁷ Constitution of the Republic of South Africa Act 108 of 1996.

¹⁷⁸ 62 of 1997. As amended by Prevention of Illegal Eviction from and Unlawful Occupation of Land Act 19 of 1998, Land Affairs General Amendment Act 61 of 1998, Land Affairs General Amendment Act 11 of 2000 and Land Affairs General Amendment Act 51 of 2001.

¹⁷⁹ ESTA was also designed as a means of discouraging land invasions (DC28, n.d.(d)).

¹⁸⁰ Section 2.

¹⁸¹ Date of the first publication of the Bill.

¹⁸² Section 1. Later amended by the Land Affairs General Amendment Act 61 of 1998 and Land Affairs General Amendment Act 51 of 2001.

¹⁸³ In terms of the Land Reform (Labour Tenants) Act 3 of 1996.

As previously mentioned, ESTA's primary purpose is the provision of security of tenure, implying that rights vested under the Act can only be removed in accordance with the Act. As such, the specific criteria for the eviction of a person are outlined in the Act. The rules governing eviction depend on whether they were occupiers as of February 4 1997¹⁸⁴ or occupiers after that date.¹⁸⁵ An occupier's right of residence may be terminated on any lawful ground, if such termination is just and equitable and certain factors are considered.¹⁸⁶

4.7.6 Prevention of Illegal Eviction from and Unlawful Occupation of Land Act

The Prevention of Illegal Eviction from and Unlawful Occupation of Land Act¹⁸⁷ (PIE) was passed in 1998. PIE afforded procedural protection in the case of eviction against unlawful occupiers¹⁸⁸ who had become established such that their structures could be said to have become their homes. The Act's stated purpose is to provide for the prohibition of unlawful eviction and to provide for procedures for the eviction of unlawful occupiers. Realizing that the previous Prevention of Illegal Squatting Act¹⁸⁹ had caused tragedy and considerable hardships to many people, this Act¹⁹⁰ was repealed in its entirety.

PIE now ensures that a fair set of guidelines is followed before eviction of unlawful occupiers. A landowner¹⁹¹ is now required to serve two notices on the occupiers. The first is an ordinary written notice and the second is a court petition where the landowner must outline the grounds upon which the eviction is sought. A landowner instituting legal action seeking an eviction must prove various set requirements¹⁹² to be successful. First, a real and imminent danger of substantial injury or damage must be present to any person or property if the unlawful occupiers are not evicted from the land. Second, the likely hardship to the owner if an order for eviction is not granted exceeds the likely hardship to the unlawful occupier. Finally, if no other effective remedy is available.

¹⁸⁴ Section 10.

¹⁸⁵ Section 11.

¹⁸⁶ Section 8.

¹⁸⁷ 19 of 1998.

¹⁸⁸ Unlawful occupier is defined in the Act as a person who occupies land without the express or tacit consent of the owner or person in charge, or without any other right in law to occupy such land, excluding a person who is an occupier in terms of the Extension of Security of Tenure Act, 1997, and excluding a person whose informal right to land, but for the provisions of this Act, would be protected by the provisions of the Interim Protection of Informal Land Rights Act, 1996.

¹⁸⁹ 52 of 1951.

¹⁹⁰ And other obsolete laws.

¹⁹¹ A "owner" means the registered owner of land, including an organ of state.

¹⁹² Section 5 (1).

4.7.7 Transformation of Certain Rural Areas Act

The Transformation of Certain Rural Areas Act¹⁹³ (TRANCRAA) provides for the removal of some restrictions on the alienation of land and the transfer of certain land to various legal entities. TRANCRAA was designed in part to deal with the dismantling of the rural land tenure regime provided for by the former Rural Areas (House of Representatives) Act¹⁹⁴ (Badenhorst et al, 2003).

TRANCRAA prescribes the process for the transfer of ownership to legal entities such as municipalities, CPA's,¹⁹⁵ or another body or person approved by the Minister. These entities then hold the land in the commonages in trust for the residents. In some instances, the process might be viewed as being similar to the Communal Land Rights Act¹⁹⁶ as both essentially transfer rights in land to the communities.

4.8 Communal Land Rights Act

4.8.1 Introduction

On July 14 2004, President Thabo Mbeki finally signed the Communal Land Rights Bill¹⁹⁷ (CLRБ) into law as the Communal Land Rights Act¹⁹⁸ (CLARA). This new piece of legislation would be administered by the Minister of Agricultural and Land Affairs, with various functions overseen by the DLA. Some of these functions, such as the Land Rights Enquirer, would be accountable to the DLA, who in turn is accountable to the Minister.

CLARA is applicable¹⁹⁹ to state land, predominantly comprising what used to be the old homelands. These areas still comprise a large proportion of the population.²⁰⁰ The Act provides for the legal security of tenure by transferring communal land, including KwaZulu-Natal Ingonyama land, to communities or by awarding comparable redress. The Act also provides for Land Rights Boards, the conduct of a Land Rights Enquiry to determine the transition from old order rights to new order rights, and to provide for the democratic administration of communal land by communities.

The Act, in many ways, was a compromise between the various special interest groups and has had to strike a balance between the democratic principles mandated by the

¹⁹³ 94 of 1998.

¹⁹⁴ 9 of 1987.

¹⁹⁵ Communal Property Associations in terms of the Communal Property Associations Act 28 of 1996.

¹⁹⁶ 11 of 2004.

¹⁹⁷ B-67.

¹⁹⁸ 11 of 2004.

¹⁹⁹ Section 2.

²⁰⁰ Contains an estimated resident population of approximately 21 million (almost 50 % of the population) (DLA & DOA, 2005).

Constitution²⁰¹ and the traditional and customary norms practiced within the communal areas. In addition, it needed to be done within the framework of a market-led land reform model.

4.8.2 Objectives of the Communal Land Rights Act

The areas that comprised the homelands or Bantustans during the apartheid years are now some of the most impoverished and marginalized areas of the country. They suffer from overcrowding, under development, poor infrastructure, and conflicts in the rights to land due in part to legally insecure tenure rights. All of these factors constrain investment by the local people, as well as outside industries. These communal areas are in dire need of development and investment, and CLARA is expected to address many of these legacies. As a direct consequence of the apartheid era and the various apartheid land Acts, areas of state land and particularly the old homelands are a hodgepodge of varying and overlapping rights.

The implementation of this Act will be directly applicable²⁰² to some 15 million people (Seria, 2002). Of these, an estimated 63 % have permission to occupy the land where they currently reside, 27 % lack any permission to occupy the land, and the remaining 10 % are uncertain whether they have permission or not (Ngaleka, 2004). One of the goals of CLARA is to grant land tenure rights, whether individually or communally, to some 2.4 million rural households currently on state land, mainly concentrated in the former homelands (Ngaleka, 2004).

In these areas, many different types of rights are present, with many rights conflicting or overlapping other rights. Under traditional systems, occupants of land can have many different levels of rights. The level of right may depend on the particular resource in question, and one type of right may overlap another type of right. The position of an individual in the hierarchy of the tribal structure can also influence their rights. A prime example of this is the rights of women vs. the rights of men. Women's rights have traditionally been weak and insecure, in many instances nonexistent. Under the apartheid laws, previous occupiers of land who may have purchased the land legally were in actuality forbidden to own the land if they were Black. In addition, depending on where one lived,²⁰³ a resident could be forcibly removed and dumped into the reserves, often onto land where existing occupants had prior rights.

With communal areas owned by the state, the occupiers of this land have a considerably weaker right and would be unable to register their rights in the Deeds Registry. They may have a strong right under the customary laws of a particular tribe or area but would have a weak basis in law. The current state of communal land often sees disputes between local governments and traditional authorities over who has actual authority

²⁰¹ Constitution of the Republic of South Africa Act 108 of 1996.

²⁰² See Table 1: Communal Land Rights Act [Population] and Table 2: Communal Land Rights Act [Area] (page 70).

²⁰³ i.e., Black Spots.

over the land. To further compound the issue, previous issuing of permits (i.e., PTO), and squatters who may have lived on the land for generations have to be considered.

The creation of this Act had to be consistent with the 1997 White Paper²⁰⁴ and with the concept of land reform as entrenched in the Bill of Rights of the Constitution.²⁰⁵ Tenure reform in South Africa is essentially mandated under the Constitution, specifically by Sections 25 (5) and (6).²⁰⁶

By providing legally secure, registrable, and tradable land tenure rights, social and economic development of the communal areas should follow. Tenure security will enhance the future investment and economic development of the communal areas. This development will, in turn, create employment opportunities, wealth, and a revenue base for taxation and lead to eventual integration of communal areas into the mainstream economy.

4.8.3 Land Rights Bill

The creation of a proposed Land Rights Bill was initiated in 1996, during the ANC's first term in office. It was designed to upgrade customary rights by giving statutory recognition without changing their essential customary character (Adams et al, 2000). Following the 1999 general election the proposed Land Rights Bill was scrapped, however, after significant changes, it was later reintroduced. This change in direction was meant to reduce the burden on the state by placing greater reliance for land administration on traditional authorities. Others viewed it as a response to changing political and vested interest groups, in particular, to secure the votes of traditional leaders in the upcoming election (Kariuki, 2004).

A third draft of the Bill was completed in May of 2001. Following release of this document, an extensive consultation process was undertaken, highlighted by the National Land Tenure Conference held in Durban in November of 2001. A direct result of this conference was the Land Tenure Bill (Portfolio Committee, 2003). This new land tenure Bill was gazetted²⁰⁷ by the DLA as the Communal Land Rights Bill²⁰⁸ in August 2002. Consultations and redrafting continued until a compromise was reached between the various groups. The term compromise is used loosely, as many continued to oppose the legislation. At one point, traditional leaders even threatened bloodshed in their constituencies if the Bill was passed (Kariuki, 2004).

²⁰⁴ White Paper on South African Land Policy.

²⁰⁵ Constitution of the Republic of South Africa Act 108 of 1996.

²⁰⁶ Section 25 (5): The state must take reasonable legislative and other measures, within its available resources, to foster conditions which enable citizens to gain access to land on an equitable basis.

Section 25 (6): A person or community whose tenure of land is legally insecure as a result of past racially discriminatory laws or practices is entitled, to the extent provided by an Act of Parliament, either to tenure which is legally secure or to comparable redress.

²⁰⁷ Gazette No 23740 (August 14, 2002).

²⁰⁸ B-67.

A re-edited version of the draft Bill was again published in the Gazette²⁰⁹ in October 2003. By some accounts, this was the 13th version of the Bill, with each version being dramatically different from others (Portfolio Committee, 2003).

In November 2003, the Portfolio Committee on Agriculture and Land Affairs held a series of public hearings over a period of four days. These meetings seemed to indicate that many of the groups making submissions²¹⁰ to the hearings had similar concerns about the new legislation.

Foremost was a strong concern about the rights of women and their access to land. Due to gender discrimination in the past, women did not qualify as holders of old order rights. Their tenure was linked to their status in relation to other male members of the family. Under customary law, the allocation of land is usually only to men and women are often excluded from inheriting land.

Second, many were concerned about the definition of a community. Some felt that the vagueness of the definition would in some instances divide members of their community. Some communities had been forced under one tribal Authority during the apartheid years, even though they historically and traditionally belonged to different tribes in the past (Madikwe Communities, 2003).

Third, considerable concern was expressed over the power given to chiefs. Even though safeguards were built in, many of those who made presentations were worried about the inability or the unwillingness of the DLA to protect tenure rights in the past. Many felt that some reluctance was being shown by the state to challenge traditional authorities. Political will was also lacking on behalf of the DLA to challenge and sanction previous human rights abuses and exploitation of the poor and vulnerable people on state land.

Finally, many felt that the Bill was being rushed and they needed more time for consultation and debate within their community. Others simply felt that the Bill should be scrapped altogether.

Controversy had followed the Bill over the years through its numerous drafts and re-drafts. One of the main issues of contention was the transferring of communal land rights to traditional leaders or authorities rather than awarding individual land rights (Seria, 2002). The last version of the Bill, however, reduced the powers given to traditional leaders in their function of land distribution (PIMS Monitor, 2003). On July 14

²⁰⁹ Gazette No 25492 (October 3 2003), Gazette No 25562 (October 17 2003).

²¹⁰ Portfolio Committee on Agriculture and Land Affairs: Communal Land Rights Bill Hearings, November 12, 13, 14, 15, 2003. Submissions by Commission on Gender Equality, COSATU/NUM, Greater Manyelethi Land Rights Group, Hlanganani Community Group, Kalkfontein Community, Kgalagadi Community, Madikwe/Moses Kotane, Central and West Regions, Madikwe/Moses Kotane, Mpumalanga Consultative Group, Ms Aninka Claassens, PLAAS/NLC Community Project, National House of Traditional Leaders, Nkuzi Development Association, Prof Ben Cousins, Programme for Land and Agrarian Studies, Royal Bafokeng Nation, Sekhukhuneland Ad Hoc Committee, TRAC Sustainable Livelihood Programme, Transkei Land Service Organisation (TRANSLO), Transkei Women's Land Rights, Ubumbano Lwabesifazane, Umbumbano Lwabesifazane, and Women's Legal Centre.

2004, the Communal Land Rights Bill was signed into law, becoming the Communal Land Rights Act 11 of 2004. As some have said, “Never in the history of the Department of Land Affairs has a single Bill been so widely and extensively consulted on” (DLA, 2004b).

Shortly after the Bill was signed into law, the legislation was challenged in the Constitutional Court (Mercury, 2004). The basis for the challenge stemmed from the sweeping powers granted to the Minister to grant constitutionally enshrined land rights. The DLA had previously obtained legal opinion on the constitutionality of the Bill after suggestions were made that the constitutional right to security of tenure was effectively being granted to the land affairs Minister as a discretionary power (Hartley, 2004).²¹¹

4.8.4 Old Order Rights

Under CLARA, an old order right²¹² can be a tenure or other right in or to communal land. This right does not need to be a formal right, nor does it need to be a registered right. It must be a right that is recognized by law, which may include a customary law or practice. Omitted from this list, however, is any right or interest of a tenant, a labour tenant, sharecropper, or employee if the right or interest is purely of a contractual nature or any right or interest based purely on a temporary permission granted by the owner of the land, on the basis that such permission can be withdrawn by the owner at any time.

Previously many South Africans were disposed of rights to land by various apartheid legislation and currently occupy land in informal arrangements that are not recognized by law. They often hold insecure tenure rights or the land is held communally and is unregistered, all resulting in a lower social and legal status. Legally it may be a weak form of tenure, but within their communities, they are perceived as the owners. The 1997 White Paper²¹³ recognizes these claims and under CLARA, legal content was collectively given as old order rights. CLARA provides the legal means of changing old order rights to new order rights, which effectively now become a legal tenure that is recognized and enforceable in law. Old order rights²¹⁴ include, but are not limited to, the following (Hlongwa, 2004):

- *Land allocated under a PTO (Permission to Occupy).*

²¹¹ Recently (April 2006) four rural communities (Dixie, Kalkfontein, Makgobistad, and Makuleke) have challenged the constitutionality of the Act. These communities argue that CLARA was “enacted in terms of the wrong parliamentary procedure and is therefore invalid. Furthermore it is argued that it breaches the tenure security and equality provisions in the Bill of Rights, and that the powers given to land administration committees and Traditional Councils constitute a fourth tier of government which is not authorised by the Constitution.” (Webber Wentzel Bowens, 2006).

²¹² Section 1.

²¹³ White Paper on South African Land Policy.

²¹⁴ Which are defined as “informal rights to land” in the Interim Protection of Informal Land Rights Act 31 of 1996.

- Land beneficially occupied (as defined in the Act).
- Land held under indigenous law and custom applied by the users.
- Freehold tenure.
- Lease, whether verbal or in writing, registered or unregistered.
- Servitude, whether verbal or in writing, registered or unregistered.

4.8.5 New Order Rights

New order rights are tenure or other right in communal or other land, which has been confirmed, converted, conferred, or validated by the Minister.²¹⁵ Once new order rights have been confirmed and validated by the Minister, they are to be recorded in a communal land register in terms of the Deeds Registries Act²¹⁶ (Kariuki, 2004). Subsequently, these rights are formally recognized with the creation of a “Deed of Communal Land Right” and may be upgraded to freehold at a future date (Kariuki, 2004).

Once land has been transferred to persons or communities, the land will no longer be held in trust by the state nor registered in the name of the state. The land essentially becomes privately owned by that community or person(s).

The status of women’s right to land has been clearly outlined in the Act. As mandated by the Constitution and other Acts,²¹⁷ CLARA protects the rights of women with respect to land issues. Under CLARA,²¹⁸ a woman’s right in, or to land, will now become legally secure. A woman is entitled to the same legally secure tenure, rights in, or to land and benefits from land, as is a man.²¹⁹ Single women, households headed by a woman, a married woman and her spouse,²²⁰ and a widow whose husband previously held old order rights may now hold new order rights.

4.8.6 Application of the Communal Land Rights Act

CLARA is applicable²²¹ to state land, which is considered beneficially occupied. The Act defines beneficial occupation as the occupation of land by a person for a continuous period of not less than five years prior to December 31 1997. In addition, the person occupying the land must have occupied the land as if they were the owner, without force, openly, and without permission of the owner.²²² Along with being beneficially occupied state land, the land at some stage must have vested in one of the homeland

²¹⁵ In terms of Section 18.

²¹⁶ 47 of 1937.

²¹⁷ i.e., Prevention of Unfair Discrimination Act 4 of 2000.

²¹⁸ And the Prevention of Unfair Discrimination Act 4 of 2000.

²¹⁹ Section 4 (3). A woman is entitled to the same legally secure tenure, rights in or to land and benefits from land as is a man, and no law, community or other rule, practice or usage may discriminate against any person on the ground of the gender of such person.

²²⁰ Irrespective of their marriage regime.

²²¹ Section 2.

²²² Section 1 (also as defined in the Interim Protection of Informal Land Rights Act 31 of 1996).

governments as contemplated in the Self-governing Territories Constitution Act.²²³ Included also was the former republics of Bophuthatswana, Ciskei, Transkei or Venda and any state land that at some point was listed in the schedules to the Black Land Act²²⁴ or the schedule of released areas in terms of the Development Trust and Land Act.²²⁵ CLARA also applies to all lands to which the KwaZulu-Natal Ingonyama Trust Act²²⁶ applied, land acquired by or for a community (whether or not registered in its name), and any other land designated as communal land by the Minister.

4.8.7 Juristic Personality

A community that has met the requirements of the Act and registered its rules²²⁷ will acquire juristic personality. Thus, the community becomes a legal entity recognized by law as having rights, duties, and the ability to carry out legal acts as if it were a natural person (LEAP, 2005). As such, a juristic person has the capacity to sue or be sued. A juristic person is different from the members that comprise it and has perpetual succession regardless of changes in its membership. The community can acquire and hold rights and incur obligations. They can also own or encumber the land by mortgage, servitude, or otherwise dispose of movable and immovable property. Members who act in the name of the juristic person have done so under the terms of a Constitution²²⁸ or set of rules with the juristic person being responsible for the actions of its members. Under the South African Constitution,²²⁹ a juristic person is entitled to the rights in the Bill of Rights to the extent required by the nature of the rights and the nature of that juristic person.²³⁰

4.8.8 Land Rights Enquiry

Before securing an old order right,²³¹ the Minister is required to institute a Land Rights Enquiry.²³² This enquiry is designated or appointed by the Minister who may be an officer of the Department or a non-state official.²³³ The enquirer is responsible for the investigation of all matters pertaining to the transfer. The enquirer then makes recommendations to the Minister, which the Minister will use in the final determination.

²²³ 21 of 1971.

²²⁴ 27 of 1913.

²²⁵ 18 of 1936.

²²⁶ 3 of 1994.

²²⁷ In terms of Section 19 (1).

²²⁸ Community Constitution.

²²⁹ Section 8 (4) (Constitution of the Republic of South Africa Act 108 of 1996).

²³⁰ Other examples of a juristic person may include a company, a municipality, or a Communal Property Association.

²³¹ In terms of Section 4 or transferring communal land to a community or person in terms of Section 6 or determining comparable redress in terms of Section 12.

²³² Section 14 (1).

²³³ Section 15.

These include, but are not limited to, the nature and extent of competing or conflicting interests, options available for legally securing rights, possible need for comparable redress, gender equality in allocation, and the interests of the state.²³⁴

The Minister, in consideration of the Report of the Land Rights Enquirer and that all requirements of the Act have been met, will then make the final determination of the location and extent of the land to be transferred and the nature and extent of the new order right.²³⁵ Having met all the required prerequisites, the rights are now recognized as “new order rights” which can be recorded in a communal land register in terms of the Deeds Registries Act.²³⁶ Through the creation of a “Deed of Communal Land Right,” the rights are formally recognized and eligible to be converted into freehold ownership subject to the consent of the community.

4.8.9 Land Administration Committee

Two key institutions established under this Act are the Land Administration Committee²³⁷ (LAC) and the Land Rights Board²³⁸ (LRB), both of which will be key to the successful implementation of the Act.

A Land Administration Committee represents the community owning communal land and has the powers and duties conferred on it by the rules of the community and CLARA.²³⁹ The total number of members comprising the committee is determined by the applicable community rules.²⁴⁰ The composition²⁴¹ of this committee, however, must be comprised of at least one-third women, with one member representing the interests of vulnerable community members and one member representing the following positions:

- *The Minister, in respect of the Department;*
- *The chairperson of the relevant Land Rights Board;*
- *The relevant provincial Member of the Executive Council responsible for agriculture;*
- *The relevant provincial Member of the Executive Council responsible for local government matters; and*
- *Every municipality in whose area of jurisdiction a land administration committee functions.*

²³⁴ Section 14 (2).

²³⁵ The Minister cannot make a determination that relates to land or a right in land that is affected by a dispute until that dispute is resolved.

²³⁶ 47 of 1937.

²³⁷ Section 21 - 24.

²³⁸ Section 25 - 30.

²³⁹ Section 24 (1).

²⁴⁰ Section 22 (1).

²⁴¹ Section 22.

The Land Administration Committee is tasked²⁴² with promoting and safeguarding the interests of the community and its members, assisting in the resolution of land disputes, establishing and maintaining registers and records of all new order rights and any transactions affecting these rights. The committee is expected to liaise with relevant local governments, institutions providing services and the planning and development of the communal land of the community.

4.8.10 Land Rights Board

The role²⁴³ of the Land Rights Board(s) (LRB) is principally to advise the Minister, to advise and assist the community in matters concerning sustainable land ownership, the development of land, and to liaise with all spheres of government and monitor their compliance with the Constitution²⁴⁴ and CLARA.

The Board is comprised²⁴⁵ of members appointed by the Minister in accordance with the prescribed nomination and selection process. The Board is required to consist of a representative from each organ of the state, two members nominated by each Provincial House of Traditional Leaders, a member from the commercial or industrial sector, and seven members from the affected communities representing different factions within the community. Of the total representation within the Board, at least one-third are required to be women.

4.8.11 Financial Implications for the State

Many of the tasks required for the implementation of this Act are expected to be time-consuming and complex. With the budget for land reform at less than 1% of the national budget, a lack of funds may be a major constraint to the successful implementation of CLARA.

Whether or not the state has the ability to implement CLARA has caused considerable consternation in South Africa. The DLA has publicly stated that the implementation of the Act will require the provision and training of departmental staff and members of the Land Rights Boards, the conducting of Land Rights Enquiries, the resolution of disputes, training of and support to communities and their Land Administration Committees, and the provision of logistical requirements. In 2003, the DLA estimated the cost for implementation of the Act would require an annual commitment of R 68.3 million (DLA, 2003). Estimated costs for setting up the Land Rights Board were R 8.7 million, with a further R 400,000 required for the training of staff (Agricultural and Land Affairs, 2003). Others have estimated the cost of the Act's implementation at 10 times the DLA's figure (Cousins, B., 2003). In 2004, the DLA revised its original estimate from R 68.3 million to R 500 million (Mercury, 2004).

²⁴² Section 24.

²⁴³ Section 28.

²⁴⁴ Constitution of the Republic of South Africa Act 108 of 1996.

²⁴⁵ Section 26.

4.9 Other Land Reform Legislation and Issues

4.9.1 Land Titles Adjustment Act

The Land Titles Adjustment Act²⁴⁶ was enacted to regulate the allocation or devolution of certain land²⁴⁷ with respect to one or more persons claiming ownership, but who do not have registered title deeds. The Act provides for the appointment of a Land Titles Adjustment Commissioner to investigate and make findings on who is rightfully entitled to land.

The Act can be used when previous owners have not transferred title to the current owner. This might include the hereditary succession of title, in which a person who had previously inherited land had not taken the necessary steps to have the land transferred into the applicant's name. This has been a common problem in areas of Black freehold land that were previously subject to apartheid and other laws.²⁴⁸

4.9.2 Land Acquisition Grants

The DLA has numerous grants available in its Land Reform Programme that provide financial assistance for the acquisition of land. These grants include the "Settlement and Land Acquisition Grant" (SLAG), "Grant for the Acquisition and Development of Land for Municipal Commonage," "Settlement Planning Grant," "Grant for the Purpose of Determining Land Development Objectives," and the "Restitution Discretionary Grant." All of these grants are made possible by one or more of the following Acts:²⁴⁹ Provision of Land and Assistance Act,²⁵⁰ Land Reform (Labour Tenants) Act,²⁵¹ Restitution of Land Rights Act,²⁵² and Extension of Security of Tenure Act²⁵³ (DLA, 2000).

Eligible applicants for the various land grants include landless people or people who have limited access to land, people who wish to gain access to land, farm workers and their families who wish to acquire land and improve their settlement and tenure conditions, labour tenants and their families wishing to acquire and improve the land in which they hold,²⁵⁴ and residents wishing to secure and upgrade the conditions of tenure under which they live.

The SLAG Grant was specifically designed to improve land tenure security and to extend property ownership to the historically disadvantaged and the poor. The Grant can be

²⁴⁶ 111 of 1993. As amended by Land Affairs General Amendment Act 11 of 1995.

²⁴⁷ The Act only applies to private land (DLA, n.d.).

²⁴⁸ i.e., Subdivision of Agricultural Land Act 70 of 1970.

²⁴⁹ And amendments.

²⁵⁰ 126 of 1993.

²⁵¹ 3 of 1996.

²⁵² 22 of 1994.

²⁵³ 62 of 1997.

²⁵⁴ In accordance with the Land Reform (Labour Tenants) Act 3 of 1996.

used to acquire land for residential purposes and various agricultural and business developments. It can be used for the purchase of capital items used in the development of the acquired land or applied to the acquisition of state land to secure, upgrade, and register tenure rights. In circumstances of insecure occupation of land, the grant can be used as a means to clarify and record the occupier's rights to that land.

SLAG was initially set at R 15,000 and later increased to R 16,000 for households that met the requirements. The main eligibility requirement for the Grant was that the gross monthly income of the household did not exceed R 1,500. Qualifying applicants were allowed to apply individually or as groups. In group applications, the average household income of the group had to be less than R 15,000 per month. Obtaining a grant required an application to the DLA, which included the submittal of a business plan outlining how the grant and the land are to be used. This is the process that would be followed by the residents of Ekuthuleni (DC28, n.d.(a)).

Due in part to the slow progress of the SLAG redistribution programme, the state created a new programme in 2001, known as the Land Redistribution for Agricultural Development (LRAD). This new programme, a sub-programme of the Redistribution programme, is jointly run by the Department of Agriculture and Department of Land Affairs. LRAD was designed to help previously disadvantaged people to access and use land specifically for agricultural purposes or better use of land already accessed.

The LRAD programme essentially ended means testing, and opted instead for a sliding scale of grants that depend on the amount of equity and debt capital an applicant was willing to invest. Grants range from R 20,000 to R 100,000. This programme effectively replaces the previous Settlement Land Acquisition Grant in so far as projects with an agricultural component are concerned (DLA, 2001).

Table 1: Communal Land Rights Act [Population]

Province	Province Population	Communal Land Population	Communal Land Population (%)
Eastern Cape	6,436,764	3,888,774	60.42 %
Free State	2,706,774	644,433	23.81 %
KwaZulu-Natal	9,426,015	8,418,836	89.31 %
Limpopo	5,273,639	4,674,309	88.64 %
Mpumalanga	3,122,991	1,701,636	54.49 %
North West	3,669,353	1,974,425	53.81 %
Total	30,635,536	21,302,413	

Source: DLA & DOA. (2005).

Table 2: Communal Land Rights Act [Area]

Province	Province Area (ha)	Communal Land Area (ha)	Communal Land Area (%)
Eastern Cape	16,742,326	4,432,914	26.48 %
Free State	12,979,793	336,167	2.59 %
KwaZulu-Natal	7,937,030	1,020,010	12.85 %
Limpopo	12,286,544	2,994,828	24.37 %
Mpumalanga	11,618,279	3,469,573	29.86 %
North West	9,476,380	3,504,545	36.98 %
Total	71,040,352	15,758,037	

Source: (DLA & DOA, 2005).

5 Ekuthuleni Community

5.1 Introduction

The present community of Ekuthuleni¹ originated from a farm known as Ekutuleni Farm 6124 [sic], which was originally granted in the late 1800's. The farm, covering an area of 1161 ha, is located in the province of KwaZulu-Natal near the town of Melmoth. This one-time farm had been controlled by the Lutheran Church from its purchase in the early 1890's (Register of Deeds, 1892) until its sale to the state in 1970 (Register of Deeds, 1971). Since that date, it has been controlled and administered by various state agencies.

5.2 Location and Accessibility

The Ekuthuleni community is located² in the province of KwaZulu-Natal³ in the area known as Zululand.⁴ Important towns in the area include Richards Bay and Empangeni to the southeast, both of which are a major source of employment for the surrounding areas. The Zulu capital of Ulundi is located approximately 40 km to the north of Ekuthuleni and is an important center for government services throughout the Zululand region. Eshowe, located at about the same distance to the south, is another important center providing government and administrative service, as well as employment opportunities.

The closest town to Ekuthuleni is Melmoth,⁵ located approximately 12 km to the north. Melmoth is located near the junction of Highway R-66 (Ulundi - Eshowe) and Highway R-68 to the northwest (Dundee). Melmoth is an important center for the region with a number of commercial and financial services that act as the economic center for the Mthonjaneni municipality (KZ285).⁶ Almost 10 % of the population within the Mthonjaneni municipality is concentrated in and around Melmoth with the remaining 90 % dispersed throughout the rural areas. Melmoth has the only hospital in the region, as well as a number of community facilities and most of the areas commercial services.

¹ Originally spelt Ekutuleni (Register of Deeds, 1892). Note: All statistical values given in this chapter are based on the 2001 (South African) census and generally pertain to the Mthonjaneni Municipality, unless otherwise stated.

² ~28° 41' S / 31° 25' E. See Map 6: Mthonjaneni Municipality (Appendix G/page 284), and Map 7: Melmoth/Ekuthuleni Area (Appendix G/page 285).

³ See Map 4: South Africa [Relief] (Appendix G/page 282).

⁴ Zululand covers a large part of central KwaZulu-Natal and extends in a rough triangle from the mouth of the Tugela River to Kosi Bay on the border of Mozambique, across to Vryheid in the West.

⁵ See Map 7: Melmoth/Ekuthuleni Area (Appendix G/page 285).

⁶ See Map 6: Mthonjaneni Municipality (Appendix G/page 284).

Access to Ekuthuleni by road is about a 3-hour drive northeast of Durban along the Coastal Highway (R-102 or N-2), exiting onto the Eshowe-Melmoth Highway (R-66). The main access route⁷ to the community is via an arterial road (D-255), which branches off the Eshowe-Melmoth Highway approximately 12 km south of Melmoth. From this junction, the arterial road runs essentially north-south through the center of the community, eventually reconnecting to the main Eshowe-Melmoth highway to the south. Another gravel road branching off road D-255 near its junction with the main highway provides access to the northeastern part of the community. Both of these roads are in good condition; however some of the roads become slippery in times of heavy rains and access can be a problem. Transportation within the community is in the form of local residents providing taxis services.

5.3 Regional Context

The community of Ekuthuleni lies within the Mthonjaneni Municipality (KZ285),⁸ which lies within the larger Uthungulu District Municipality (DC28).⁹ Each of these municipalities has different characteristics that determine their roles and responsibilities within their respective regions.

5.3.1 Background on Municipal Governments

In the early 1990's as the apartheid era ended, the government of South Africa set about on a major programme of overhauling local and regional governments throughout the country. Similar to other reform programmes, the aim of this programme was to address the inequalities created under apartheid and to establish a new democratic and non-racial municipal government system. This reforming of the system has been a slow transitional process. An initial phase (1993 - 1995), focused on the democratization and deracialising of local governments. As the national elections of 1994 took place, over 1,600 racially segregated and differentiated municipalities were in existence (Business Report, 2003). With Chapter 10 of the Interim Constitution¹⁰ and the promulgation of the Local Government Transition Act,¹¹ the process of restructuring government by removing undemocratic and discriminatory practices in municipal governments was put in motion.

The second phase saw the number of municipalities reduced to 843 for the 1996 municipal elections. The new Constitution,¹² the White Paper on Local Government,¹³ and several new Acts of legislation provided a further foundation for addressing the spatial inequalities that characterized South Africa at that time (Fast et al, 2004).

⁷ See Map 7: Melmoth/Ekuthuleni Area (Appendix G/page 285).

⁸ See Map 6: Mthonjaneni Municipality (Appendix G/page 284).

⁹ See Map 5: Uthungulu Municipality (Appendix G/page 283).

¹⁰ Constitution of the Republic of South Africa Act 200 of 1993.

¹¹ 209 of 1993.

¹² Constitution of the Republic of South Africa Act 108 of 1996.

¹³ March 1998.

The South African Constitution¹⁴ set in play some major reforms of the local government structures throughout the country. The Constitution defined the aims of local governments in terms of social and economic development, the environment, democratic principles, and accountability. In 1998, the White Paper on Local Government produced a template for legislation and the delineation of metropolitan, local, and district councils as the three forms of local government. The White Paper proposed that municipalities in South Africa be divided into two broad types: metropolitan and non-metropolitan (RSA, 1998).

As a means of giving substance to the Constitution's vision, municipal boundaries underwent a major redrawing. The first steps of the process of demarcating new boundaries for South Africa's municipalities began in 1998 with the promulgation of the Municipal Demarcation Act¹⁵ and the Municipal Structures Act.¹⁶ The Municipal Demarcation Board was established in February 1999 and immediately set about drafting a policy for the demarcation of new metropolitan and district municipalities (RSA, 2005a). The Municipal Demarcation Board was given the task of further reducing the overall number of local government bodies in South Africa. By the time of the municipal elections in December of 2000, the number of municipalities had been reduced from 843 to 284. This included six metropolitan, 231 local and 47 District municipalities (MDB, 2003c).

The Constitution¹⁷ called for the creation of three categories of municipalities:

- *Category A: A municipality that has exclusive municipal executive and legislative authority in its area.*
- *Category B: A municipality that shares municipal executive and legislative authority in its area with a category C municipality (within whose area it falls).*
- *Category C: A municipality that has municipal executive and legislative authority in an area that includes more than one municipality.*

The Municipal Structures Act¹⁸ clarified the status of municipalities and outlined the appropriate division of powers and functions between local and district municipalities. District municipalities¹⁹ (i.e., Uthungulu Municipality) facilitated the coordinated planning for the district, and delivered services that were district-wide (i.e., roads). Local municipalities (i.e., Mthonjaneni Municipality) were responsible for basic services such as water, sanitation, refuse removal, electricity distribution, and municipal healthcare services.

¹⁴ Constitution of the Republic of South Africa Act 108 of 1996.

¹⁵ 27 of 1998.

¹⁶ 117 of 1998.

¹⁷ Chapter 7: Local Government, Section 155: Establishment of Municipalities (Constitution of the Republic of South Africa Act 108 of 1996).

¹⁸ 117 of 1998 (and amendments).

¹⁹ Category C.

Development within the region and sub-regions was to be formulated in terms of the current legislation framework in KwaZulu-Natal. This includes the Development Facilitation Act²⁰ and the KwaZulu-Natal Planning and Development Act.²¹ In addition, all land reform projects must be undertaken within the framework provided by the regional and sub-regional development plans (DC28, n.d.(a)).

5.3.2 Uthungulu District Municipality

In the province of KwaZulu-Natal,²² ten District municipalities exist with the Ekuthuleni community located inside the Uthungulu District Municipality.

The Uthungulu District Municipality (DC28) came into being with the elections on December 5 2000, replacing the old Uthungulu District Council (DC28, n.d.(b)). This previous regional Council area of Uthungulu was divided into two new district municipalities consisting of Umkhanyakude and Uthungulu, with Uthungulu assuming most of the capacity of the formal regional Council (DTLGA, 2004).

The Uthungulu District Municipality is located²³ in the north-central part of KwaZulu-Natal along the Indian Ocean coast. The Municipality stretches from Kwambonambi in the north, inland to Nkandla, south to Gingindlovu, and bounded by the Indian Ocean to the east. The municipality covers an area of 8,215 km² (MDB, 2003a), of which approximately 71 % is tribal land falling under the jurisdiction of 44 different traditional authorities (DC28, n.d.(b)).

The municipality's functions include integrated development planning for the district as a whole, as well as playing an important role in bringing investment to the region. The municipality is also responsible for primary healthcare facilities, tourism, regulation and strategy for solid waste disposal, supply of water and sanitation services, electricity supply and municipal public works, regulation of passenger transport services, and the creation and control of fresh produce markets. The municipality also has the right for the imposition and collection of various taxes, levies, and duties, as well as the allocation and distribution of grants assigned to the District municipality by the provincial and national governments.

The Uthungulu District Municipality is further divided²⁴ into six local municipalities: Mbonambi (KZ281), uMhlathuze (KZ282), Ntambanana (KZ283), uMlalazi (KZ284), Mthonjaneni (KZ285), and Nkandla (KZ286). The Ekuthuleni community is located within the Mthonjaneni Municipality

²⁰ 67 of 1995.

²¹ 5 of 1998.

²² Excluding the eThekweni Metropolitan Municipality.

²³ See Map 5: Uthungulu Municipality (Appendix G/page 283).

²⁴ See Map 5: Uthungulu Municipality (Appendix G/page 283),
and Map 6: Mthonjaneni Municipality (Appendix G/page 284).

5.3.3 Mthonjaneni Municipality

The Mthonjaneni Municipality (KZ285) is located²⁵ in the north central part of the Uthungulu District Municipality, comprising an area of 1086 km² (DC28, n.d.(d)). The area is predominantly rural with significant areas devoted to commercial agriculture (45 %). The remainder is comprised predominantly of grasslands and indigenous forests. Small settlements are dispersed throughout the area with the largest town, Melmoth, serving as the economic center. Two tribal authorities are found in the area: the Entembeni and the Enseleni regional authorities.

5.4 Historical Context

By the late 1800's, Swedish missionaries and their German, Norwegian, and American counterparts were in the process of creating missions throughout Southern Africa. In 1876, the Swedish Lutheran Church set up its first mission in Natal (Church of Sweden, n.d.). One of the first Swedish stations, in what is now KwaZulu-Natal, was established in 1888 in Ekuthuleni (Fristedt, 1905). Shortly after this mission was established, the Church acquired²⁶ the farm known as Ekutuleni 6124 [sic].²⁷

In 1913, the first residents at Ekuthuleni were given permission by the Church to settle on the land. The missionaries gave 26 families permission to settle under the condition that they attend the Lutheran Church. However, several of these initial settlers were later evicted from the farm for not attending the Church services (Urban-Econ, 1999). New families wishing to settle at Ekuthuleni approached the missionaries directly or through the current residents who would then approach the missionaries for permission. The administration and settlement of new families was the responsibility of the local Induna²⁸ who, together with neighbours, allocated new land for settlement and grazing and determined new boundaries (DC28, n.d.(a)). For the right to reside on the mission land, residents were required to pay the Church a nominal rental fee (AFRA, 1998).

By the early 1920's, nine main Swedish Zulu missionary stations were located throughout southern Africa, along with 61 satellite stations and some 65 schools (Ollén, 1920). By the 1960's, many Lutheran missionary Churches, particularly in South Africa, were sold to the South African government (Urban-Econ, 1999). At that time, the small community of Ekuthuleni comprised about 75 resident families (AFRA, 1998).

In July 1970, the Ekuthuleni Farm was sold and transferred to the then South African Bantu Trust²⁹ for R 74,167 (Register of Deeds, 1971). In the transfer of title, the terms

²⁵ See Map 5: Uthungulu Municipality (Appendix G/page 283), and Map 6: Mthonjaneni Municipality (Appendix G/page 284).

²⁶ Deed of Transfer No. 11/1892. See also (Register of Deeds, 1892).

²⁷ See Map 7: Melmoth/Ekuthuleni Area (Appendix G/page 285).

²⁸ Induna is a Zulu name for a state official appointed by the king, or by a local chief.

²⁹ A trust set up in terms of the Native Trust and Land Act 18 of 1936 (later known as the Development Trust and Land Act 18 of 1936).

and conditions of the original Deed were carried forward. These included several servitudes, such as mining rights belonging to the Government of Zululand; the non-interruption of roads, thoroughfares, telegraphs and watercourses; and the right of the Governor of Zululand to expropriate land³⁰ without compensation for roads, railways, telegraphs, and stations, or watercourses (AFRA, 2000). After the sale, the Ekuthuleni Farm was expected to be incorporated into the former KwaZulu under the terms of the Development Trust and Land Act.³¹ This Act called for the creation of further areas for native occupation in addition to the scheduled reserves of the previous Black Land Act.³² However, this was never done.

As many of the Lutheran missionary Churches were sold to the South African government, provision was made that the residents would receive PTOs³³ for their land. PTOs were subject to various conditions, including that they not confer ownership and the holder is not allowed to sell, lease, assign, sublet, mortgage, or otherwise dispose of the land without the permission of the Governor-General. Improvements to the land would not be compensated, and the government had the right to withdraw the PTO for a variety of public purposes (Hornby, 2000a). At the time of the Ekuthuleni sale, a PTO was issued to the Church (Bourhill, 1998), giving the Church rights over the land on which the existing Church buildings and school had been built.

After the sale of the land to the state in 1971, residents continued paying rents for their residential, ploughing, and grazing land. The payment of rent³⁴ now went to the Department of Agriculture³⁵ at the Enseleni office (DC28, n.d.(a)). Rents were eventually discontinued after December 31 1978 (Urban-Econ, 1999).

In 1992, as the South African Development Trust³⁶ was phased out,³⁷ the land fell under the ownership of the Minister of Agriculture and Land Affairs (DLA) (Hornby, 2000a).

In the late 1990's, the community of Ekuthuleni desired a more secure form of tenure so they could continue with current developments that were already taking place on the land. These developments included forestry initiatives, which required new roads and access to credit (Bourhill, 1998). The community felt justified in this request as they had

³⁰ Subject to certain conditions.

³¹ 18 of 1936.

³² 27 of 1913.

³³ Permission to Occupy, or PTO, as they are commonly known, is a weak form of title deed. PTO's were the most common form of recording land rights in communal areas, and were established under the various regulations governing land rights (i.e., the Black Areas Regulations R 188 of 1969 (that was made under the Black Administration Act 38 of 1927) and the Development Trust and Land Act 18 of 1936). Under the Communal Land Rights Act 11 of 2004, PTO's would be an "old-order right."

³⁴ In terms of Proclamation 92 of 1949.

³⁵ The Department of Agriculture did the administration on behalf of the then Department of Regional Land Affairs.

³⁶ Originally known as the South African Bantu Trust.

³⁷ Following Proclamation R28 of 1992.

occupied the land for generations. Furthermore, the rents that were paid to the Church and then later paid to the state were viewed by the community as payment for the land (Bourhill, 1998).

In 1997, representatives from Ekuthuleni approached the DLA requesting them to upgrade their informal tenure rights on the Ekuthuleni Farm by providing them with PTOs (DC28, n.d.(a)). Consultants appointed by the DLA reported that the land rights of the Ekuthuleni community were already legally secure, protected by the Interim Protection of Informal Land Rights Act³⁸ or, alternatively, the Extension of Security of Tenure Act³⁹ depending on interpretations of consent (AFRA, 2003). Even though the rights of the community were secure, the community still desired individualized property rights. The community desired a means of recording their individual rights to the land that was affordable and, most importantly, legally binding. The cost of surveyed plots would require extensive surveying, something that was beyond the means of the vast majority of the community. The community also desired to remain a part of their tribal structure; a structure that defined their culture, membership, their existing mechanisms for land allocation, and the administration and resolution of disputes (AFRA, n.d.(b)). Conversely, some did not want ownership to be in the hands of the traditional authority structures and were afraid of what individualized ownership might entail.

Based mainly on economic considerations, it was decided that the community would proceed with the transfer to a legal entity such as a CPA.⁴⁰ Several benefits could be realized in following this route, namely that it would be far less expensive than creating individual rights and it would ensure that links were retained with the Entembeni tribe that currently administers them. In addition, the community would be eligible for the Settlement and Land Acquisition Grant. This was one of many grants that are available from the DLA under its Land Reform Programme specifically designed to provide financial assistance for land acquisition.⁴¹ Grants of R 15,000 to R 16,000 were available to qualifying households,⁴² and qualified applicants were allowed to apply individually or, as in the case of Ekuthuleni, apply as a group and purchase the land as a group.

An application was then made to the DLA that included about 240 households registered on the DLA's beneficiary list (AFRA, n.d.(a)). In 1999, under the terms of the Provision of Land and Assistance Act,⁴³ the application was processed as a redistribution of state land project. The DLA, the current owner of the land, agreed to provide the land reform grants to the approximately 240 households to purchase the Ekuthuleni farm and to establish a CPA to hold it on their behalf (Ziqubu et al, 2001). Approximately R 3.5 million was allocated in the budget and consultants were hired to

³⁸ 31 of 1996.

³⁹ 62 of 1997.

⁴⁰ Communal Property Association.

⁴¹ See Chapter 4.9.2 Land Acquisition Grants (page 68).

⁴² i.e., gross monthly income of the household did not exceed R 1,500 per month.

⁴³ 126 of 1993 (Originally known as Provision of Certain Land for Settlement Act).

produce the required Business Plan and develop a CPA to take ownership of the land. The CPA, along with a draft Business Plan, was completed at the end of March 2000 (Hornby, 2000b), and the CPA was registered in 2003 (AFRA, 2003).

5.5 Physical Geography

The Ekuthuleni Farm is an area of rolling hills and steep valleys ranging in elevation from approximately 550 to 772 m ASL. The steepest areas are located in the northwestern section of the farm in the area known as Nsense. The steepness of the slopes is a limiting factor for how the land can be used, so most of the non-residential or commercial areas are used for communal grazing or the cultivation of various crops. Cultivation on the steep slopes is somewhat limited and these areas are generally restricted to grazing. In a previous estimation, almost 80 % of Ekuthuleni was dedicated to grazing, 10 % to subsistence crops, 4 % residential, and 2 % timber, with the remainder consisting of roads, schools, waste areas, and sugarcane plantations (Bourhill, 1998).

The area has been classified as a BioResource Group⁴⁴ 10 (BRG 10: Moist Coast Hinterland, *Ngongoni* veld) (Urban-Econ, 1999) of the BioResource groups of KwaZulu-Natal. The typical vegetation in this area is secondary grassland dominated by *Ngongoni* (*Aristide Junciformis*),⁴⁵ along with small areas of planted forest as well as some natural forest (Urban-Econ, 1999).

Several intermittent rivers run through the Farm, including the Sigubudu, Mphukwini, Nsengeni, and Ntananzane Rivers, and the perennial Nsengeni River. The area is semiarid with rainfall ranging between 800 and 900 mm per year and subject to the occasional drought. The mean annual temperature is fairly constant between 17 and 20 °C. Summers can get quite warm up to 28 °C, and winter temperatures can be as low as 7 °C (Urban-Econ, 1999).

5.6 Geographical Divisions

The community of Ekuthuleni is comprised of five distinct areas known as the Mission, Mphukwini, Nsengeni, Nsense, and Sigubudu areas. These areas are not named on a legal basis, but are terms used by the community's residents to describe certain regions of the community. The community's residents are unevenly distributed throughout the community, with most being settled in close proximity to roads and other infrastructure while other areas remain sparsely populated.

⁴⁴ A Bioresource Group (BRG) is comprised of Bioresource Units (BRU). A Bioresource Unit is an area where the environmental factors such as climate, soil type, vegetation, and terrain have a degree of homogeneity. Each Bioresource Group has a specific range of altitude, precipitation, mean annual temperature, and vegetation (Camp, 1999). In KwaZulu-Natal, there are 590 Bioresource units (DC28, 2003a).

⁴⁵ A grass that is unpalatable to livestock (Hornby, 2000a).

Mission Area

The Mission Area is located in the south-central part of the community and is one of the most important, not to mention oldest, areas for the community. The land in this locality is considerably flatter than in the surrounding areas and, with its access to both water and electricity, many of the community's facilities are located here. These facilities include the Lutheran Church, a football field, a cemetery, a series of old hostels and/or boarding houses, and several nearby schools. The Church was first built in this area in the late 1800's, and a section of this land still belongs to the Lutheran Church. The area is easily accessible by a branch road off the main arterial road (D-255) or by a series of trails that radiate out in all directions.

Mphukwini Area

The Mphukwini area is located in the southeastern part of the community immediately to the northeast of the Mission area. This area contains the only primary school in the area, the "Ekuthuleni Primary School." Vehicle access to this area is via the main arterial road (D-255) or a branch road that passes through the Mission Area. The area is primarily used for communal grazing and minor cultivation of crops, including timber and wattle cultivation. Approximately 26 households can be found in this area (Urban-Econ, 1999).

Nsengeni Area

The Nsengeni area comprises the northeastern corner of the Ekuthuleni farm. Access to the area is available via a road branching off the main arterial road (D-255) near its junction with the Eshowe-Melmoth highway (R-34). Vehicle access to the rest of the community from this area requires a drive back to this junction. Consequently, the Church and schools in the Mission area are usually accessed by footpaths. Several of Eskom's electrical main lines pass through this area; however, few residents have access to electricity or telephones. Approximately 90 households are located in this area (Urban-Econ, 1999).

Nsense Area

The Nsense area comprises a large portion of the Ekuthuleni community. It comprises the area located to the north of the Sigubudu River and to the west of the main arterial road (D-255). This is one of the more remote and isolated areas of the farm and is often used for communal grazing and collecting firewood. The area is sparsely populated and inaccessible to vehicles. The area is steep and hilly, so all access to the area is via footpaths. Water is generally available from several small streams that transect the area, thus most housing is located in close proximity to the streams. Few residents in this area have access to electricity or telephones. Approximately 40 households can be found in this area (Urban-Econ, 1999).

Sigubudu Area

The Sigubudu area is located in the extreme southwestern corner of the community to the south of the Sigubudu River. This area is also steep and somewhat inaccessible. With no roads into the area, access to homesteads is usually via trails. This area is unique in that some of the residents appear to be orientated to the Entembeni traditional community to the south. In fact, some residents have indicated that they do not view the Ekuthuleni Induna as being theirs, but instead point to the Induna from Entembeni (DTLGA, 2004). Approximately 40 households can be found in this area (Urban-Econ, 1999).

5.7 Population

At the time of the 2001 census in South Africa, the population⁴⁶ of the Uthungulu District Municipality was 885,966; and the Mthonjaneni Municipality had a population of 50,383 (DTLGA, 2004). The population of the Ekuthuleni community (located within both the Uthungulu District Municipality and the Mthonjaneni Municipality) has been estimated to be approximately 1,600 people⁴⁷ residing in some 220 households.⁴⁸ The population of the municipality⁴⁹ is young, with 74.8 % of the population under the age of 34, and comprised of slightly more females than males (54.2 % vs. 45.8 %). The area is racially homogeneous, with 98.1 % of the municipality classified as African, and the predominant language is isiZulu (97.1 % consider isiZulu as their mother language) (MDB, 2003a, 2003b) (DTLGA, 2004).

5.8 Socio-Economic

Education is poor throughout the area,⁵⁰ with only 3.9 % of the adults⁵¹ having higher than a grade 12 education. A significant portion of the population (37.3 %) has had no schooling at all.

⁴⁶ See Table 16: Statistics [Mthonjaneni, Uthungulu Municipalities] (Appendix D/page 257), and Table 17: Statistics [Mthonjaneni, KwaZulu-Natal, South Africa] (Appendix D/page 258).

⁴⁷ Personal estimate. In 1999, the population was estimated at 1,410 (Urban-Econ, 1999) and 1,583 in 2000 (Hornby, 2000a). For planning purposes, the Uthungulu District Municipality estimates the Ekuthuleni population at 1,410 (DC28, n.d.(a)), though personal communication with residents often gave estimates that are considerably higher.

⁴⁸ For planning purposes, the Uthungulu District Municipality/Land Reform Inspection Report estimated 172 functional households with an estimated 216 beneficiary families (DC28, n.d.(a)). AFRA estimated 231 households (AFRA, n.d.(b)), and 240 households were registered on the DLA's beneficiary list for the Settlement and Land Acquisition Grant (AFRA, 2003).

⁴⁹ Mthonjaneni Municipality.

⁵⁰ See also Table 16: Statistics [Mthonjaneni, Uthungulu Municipalities] (Appendix D/page 257), and Table 17: Statistics [Mthonjaneni, KwaZulu-Natal, South Africa] (Appendix D/page 258).

⁵¹ Over the age of 20 years.

With little industry in the area, unemployment is high (24 %), and may be considerably higher if the proportion of the population that is not economically active is considered. With few employment opportunities, personal income is naturally very low. Some 77.9 % of the municipality⁵² has no income at all, and 94.4 % have a monthly income of less than R 1,600. The majority of residents (74.2 %) have an annual household income of less than R 9,600 (MDB, 2003a).

5.9 Households and Housing

Housing in Ekuthuleni usually consists of self-constructed traditional “Zulu-style” homesteads consisting of extended families. Most of the homesteads consist of several huts⁵³ concentrated in clusters.⁵⁴ These clusters are not concentrated in any one area but are dispersed throughout the community, usually in close proximity to roads and rivers. Many of the homesteads are surrounded by cultivated fields where vegetables and other agricultural products are grown for personal consumption. Huts are usually constructed from material found within the community, such as clay and grass (mud and thatch), and some concrete. The size of each homestead can be large, averaging eight people per homestead (DC28, n.d.(a)), with the majority having five to ten people per household (AFRA, 2000).

5.10 Infrastructure and Engineering

Two of Eskom’s main power lines (and several secondary lines) pass north-south through the eastern half of the community. Telephone lines also traverse the area running along the main arterial road. While some in the community have access to electricity, a significant proportion (70 %)⁵⁵ still has no access to electricity (MDB, 2003a). Without access to electricity, 66.9 % of the residents rely on candles as their main source for lighting and 58.8 % use wood burning as their main source for cooking (MDB, 2003a).

Access to water is through boreholes distributed in various areas throughout the region. For a significant proportion of the population (42.6 %), rivers and streams serve as the main water supply (MDB, 2003a).

No formal system of sanitation or waste removal exists in the area so; consequently, residents must dispose of solid waste by burial or disposal at various locations. A little more than a quarter of all residents (26.4 %), have no toilet facilities in their residence (MDB, 2003a). Over the past several years, however, this has changed somewhat in the Ekuthuleni region, where a recent government programme was begun to install hundreds of new toilets throughout the municipality.

⁵² Mthonjaneni Municipality.

⁵³ StatsSA defines ‘hut’ as one form of traditional dwelling found in non-urban (rural) areas. It is a round structure made of traditional materials such as mud, thatch, or grass.

⁵⁴ See Figure 9: Ekuthuleni Area (Appendix E/page 261), and Figure 11: Ekuthuleni Area (Appendix E/page 262).

⁵⁵ Statistics in this section refer to the Mthonjaneni Municipality as a whole.

Two schools, a primary and a secondary, are located in or near Ekuthuleni. The primary school is located in the Mission area with approximately 600 children from the community and surrounding areas attending. The “Entembeni Secondary School” is also located in the Mission area just outside the boundaries of Ekuthuleni on the neighbouring Goedertrow farm.⁵⁶ This area is under the jurisdiction of the Tribal Authority, and approximately 700 students from Ekuthuleni and neighbouring areas attend this high school. Both schools have access to electricity, telephones, water, and sanitation facilities (Urban-Econ, 1999).

5.11 Health

Although no health statistics pertain solely to Ekuthuleni or the Mthonjaneni Municipality, the HIV/AIDS status of the district⁵⁷ is considered one of the highest in the world. It is estimated that 30 % of the population is infected with the virus (DTLGA, 2004). With such a high rate of infection, HIV/AIDS is likely to have a significant influence on all aspects of life within the region.

5.12 Agriculture and Farming

Since the original allocation of land, the Ekuthuleni farm has become fragmented over the years. It now consists of numerous sub-economic units that do not allow for crop production on any kind of significant scale. The steepness of the land also has limited production, so most of the farmed areas are in close proximity to the individual households, with most sites being less than 1 ha (Urban-Econ, 1999). Crop cultivation for the area (10.3 %) is generally done by subsistence farmers, who mainly provide for household consumption (Bourhill, 1998).

The main crops of the subsistence farmers are maize, madumbes,⁵⁸ vegetables (beans, tomatoes, spinach, and cabbage), and various fruits such as avocado, pears, peaches, bananas, guava, oranges, lemons, paw-paw, mangoes, naartjies, and mulberries (AFRA, 2000). Cash crops include wattle trees,⁵⁹ gum trees, thatching reeds, and sugarcane.⁶⁰

A majority of the Ekuthuleni farm (80 %) could be considered grazing land, with cattle and goats as the main livestock (Bourhill, 1998). Generally, cattle are not kept as a means of income but instead as a store of wealth or for cultural purposes. The number of livestock is somewhat limited by the condition of the veld, which has deteriorated over the years because of continuous over-grazing (Urban-Econ, 1999). At Ekuthuleni, little internal fencing is used so cattle often damage the crops. The community overcomes this problem by making cattle owners restrict their cattle to certain areas during

⁵⁶ Goedertrow Farm 7806.

⁵⁷ Uthungulu District Municipality.

⁵⁸ An indigenous type of sweet potato.

⁵⁹ The bark from the wattle tree is used in tanning and is an important export.

⁶⁰ Sugarcane is one of the main agricultural products of the region.

the summer, and farmers are required to maintain their own fences during the winter (Urban-Econ, 1999).

5.13 Cultural Land Tenure

5.13.1 Introduction

Existing tenure rights at Ekuthuleni can be complicated and difficult to conceptualize by the outsider. As with many African land tenure systems, the Ekuthuleni system tends to be inclusive rather than exclusive, with rights and obligations being set at various levels within the tribal community. A resident of Ekuthuleni can have a multitude of varying rights in land as well as multiple ways of gaining access to land and resources. As an example, the head of the household could have residential rights on one person's land, rights to natural resources on another person's land, rights to a cropping field located within a third person's field, and rights of servitude across a totally different group of people's land that gives them access to water, firewood, schools, or the Church (AFRA, 1999). Many in the community have multiple plots of land (i.e., residential land and cropping land) that are often non-contiguous and may vary greatly in size. In addition, many boundaries are non-linear and no written record of land exists.⁶¹

Internal boundaries seem to be well known within the community, with each landowner able to clearly demarcate their particular plot(s) of land. While one person's interpretation may not always agree with that of the neighbours, each landowner is confident in their determination of boundaries and more than willing to outline their property boundaries. When asking a landowner's neighbour to point out adjacent lands, subtle differences are often seen in the perspectives. Most property owners reference their boundary lines to specific geographical markers. For example, a landowner may state, "My property goes from this 'specific' rock, to this 'specific' tree, along this stream, up this slope to this post, through this field to a specific point (that might be in the center of a featureless field), etc."

5.13.2 Customary Tenure

Land holdings in the Ekuthuleni community have changed considerably since the first settlers were given land by the Church in the early 1900's. The community has expanded significantly since the original settlers and, consequently, land was subdivided multiple times, as each generation subdivided the land to pass portions to a new generation. Conversely, landowners have sometimes consolidated their land holdings.

Generally, the community acknowledges that most residents in the community are accepted as "owners" of their land. These people were allocated land by the Induna in the presence of an Ibandla⁶² under the community's customary practices of land allo-

⁶¹ Personal communication.

⁶² An Ibandla is a Zulu name for a tribal council or assembly and its members. It can also refer to a group of respected men who are consulted by the tribal authority to make decisions.

cation (AFRA, 2003). They may also have implicit rights under some of the land tenure Acts.⁶³

Multiple types of land parcels are present in Ekuthuleni, including residential, cropping, grazing, and communal land used for public purposes (AFRA, 2000). The land on which a resident lives (residential), as well as some cropping land, can be described as the strongest form of tenure in the community. Land that has been previously allocated (involving the Induna and Ibandla) is the most highly exclusive.

Other rights to land involve land allocated “on a temporary basis.” For example, a resident who might be sick or elderly will sometimes be allocated land on a temporary basis to be closer to a road or to other family members. Some uncertainty exists, however, as to the rights these temporary residents really have. At times, these temporary landowners may appear to be in a tenuous situation because the residents often feel at the mercy of the allocator, who is the true landowner (AFRA, 2000).

At other times, families are not actually given land but the land is “loaned” to them. An example of this type of temporary loan might be a field that is loaned to another resident until the crop is harvested. Residents with little or no arable land might approach members of their residence or family members to request access to an arable field. This type of loan is usually an informal arrangement made between the concerned parties and generally bypasses any involvement of the Induna (AFRA, 2000). As a slight variation, a resident who intends to leave the area might get another resident or relative to watch over the land while they are away, in order to ensure that their existing rights are preserved (AFRA, 2000).

While a family might consider their residential land to be exclusively theirs, most land is communal to varying degrees. The community’s natural resources, such as grazing land, firewood and reeds (Ikwane),⁶⁴ mud, thatching, and water are generally considered communal, and may also be considered a function of location and time. Thus, the harvesting of some resources (i.e., firewood) is managed differently if it is taken from “truly” communal land rather than from somebody’s “owned land” (AFRA, 2000). In addition, the rights of cropland can vary from season to season. Each resource may have a somewhat different “strength of right.” Foremost is the implicit right of access to water, which overrides any other type of ownership so water can be collected anywhere in the community. A resident accessing water need not request permission from the landowner (AFRA, n.d.(b)). The harvesting of Muthi⁶⁵ from the local indigenous trees and the harvesting of Ikwane by women on private land also does not require any special permission (AFRA, n.d.(b)). Nevertheless, the procedure may not be quite that

⁶³ Such as the Upgrading of Land Tenure Rights Act 112 of 1991, the Interim Protection of Informal Land Rights Act 31 of 1996, and/or the Extension of Security of Tenure Act 62 of 1997.

⁶⁴ Ikwane are reeds for making mats (AFRA, n.d.(b)).

⁶⁵ Muthi is the Zulu word for medicine. The use and belief in muthi is central to African cultural and religious beliefs. It is the collective term for the complex mixtures of muthi, wild plants, and animal products that are gathered, prepared, and administered in various ways (UKZN, n.d.).

simple, as some forms of harvesting may not explicitly require permission but it is expected that the landholder's permission should be sought anyway (Urban-Econ, 1999). The rationale being that the landowner may require the resource for himself and thus has an implicit right of refusal (AFRA, n.d.(b)).

Grazing rights to communal land are open to and shared by everybody, whereas grazing rights on the cropping fields are only seasonal (AFRA, n.d.(b)). Restrictions on grazing land are limited only by the environmental impact of the cattle and goats. Because the veld has deteriorated since the first allocations by the Church, an upper limit is effectively placed on the number of cattle and goats that can be supported. Deterioration of the veld is due to overgrazing and the domination of *Ngongoni* (*Aristide Junciformis*).⁶⁶

Public uses of land may include cemeteries, churches, electrical lines, roads, schools, and telephone lines. The Church and its immediate surrounding area (the Church, School, and Cemetery) fall under the administration of the Church. Even though the Church holds a PTO for this area, some residents of Ekuthuleni dispute the boundaries of this mission land (DC28, n.d.(a)).

The strength of one's tenure is also somewhat time-dependent. Within the community, one's tenure can be secure on land that one uses but that security will diminish with time if the land is not used. The rights to cropping land are considered highly exclusive but can also be seasonal. A given field may be exclusively under the ownership of an individual during the planting season and either communal or under the ownership of a different individual at another time of the year. A crop planted by an individual will be considered theirs until harvested, at which point the land generally becomes common property again and other people have the right to use the land to graze their cattle (AFRA, 2000).

5.13.3 Land Allocation

The Ekuthuleni area is an Isigodi, which is a tribal ward under the authority of a single Induna (Cousins, T. et al, 2001). Thus, the area falls under the authority of the Entembeni Tribal Authority.

Throughout this tribal area, land allocation is done via customary means somewhat unique to this area. Ekuthuleni follows a clear procedure for land allocation, with a somewhat modified interpretation of the regional tribal practice. An Induna has authority over land allocation and any disputes pertaining to land (Cousins, T. et al, 2001). Allocation of land in previously allocated areas differs from the allocation of land in areas that are vacant or available. Previously allocated land is usually reallocated by the current residents, whereas vacant land is the responsibility of the Induna (Hornby, 1999).

Anyone who desires land may approach⁶⁷ an existing "owner" and request land for the building of a residence or for planting crops. Most requests for land are made from

⁶⁶ A grass that is unpalatable to livestock (Hornby, 2000a).

⁶⁷ Sometimes through an intermediary.

someone related in some way to the owner, and a non-relative runs a high risk of being refused. Traditionally, families with male children allocate portions of their land to their newly married sons, so land is often reserved for this purpose (Ziqubu et al, 2001).

If an existing owner agrees to give some land to a relative, the two parties first agree to a specific portion of land. The allocated land may be a single unit or several non-contiguous parcels of land with one parcel for residential use and another parcel for cultivation. After an agreement is reached about a particular parcel of land, the Induna is informed that the landowner intends to allocate land. The Induna then gathers an Ibandla,⁶⁸ which usually consists of the interested parties⁶⁹ who become “witnesses,” as the Induna identifies the boundaries of the allocated land (AFRA, 1999). The Induna, who is not usually paid a salary, is entitled to ask for a nominal fee (i.e., R 40) from the new land recipient as a fee for overseeing the allocation (AFRA, 2000). Once allocated, the Induna informs the chief of the Entembeni traditional community about the allocation and the details about the newcomer (Urban-Econ, 1999). In addition to the fee to the Induna, the new owner may give a “gift” such as meat or drink in appreciation to the original owner (AFRA, 1999).

Access to land within the community is contingent on tribal membership, with members of the tribe entitled to residential land and to commonage (Hornby, 2000b). If the new land recipient is not a member of the tribe, the tribal structure must give its approval and the newcomer must become a member of the tribe (AFRA, 1999). After allocation, the new land recipient is then considered the “land owner.” New owners have certain rights attached to the new land and, while they do not have the right to sell the land, they do have the right to allocate portions of the land to others (AFRA, 2000).

Allocation of land within the family (i.e., to relatives) may bypass involvement of the Induna altogether. The right to allocate privately held land belongs to the holder of the land rights and not to the Induna (Hornby, 1999). The head of the family will handle the allocation and any disputes that may result from this allocation (AFRA, n.d.(b)). Land disputes are usually adjudicated locally at little or no cost (Hornby, 2000b), with the Induna overseeing the resolution of most land disputes. On occasion, problems can arise with these arbitrations, especially if one of the parties involved does not agree with the ruling or does not abide by the ruling (AFRA, 1999).

5.14 Historical Land Tenure

5.14.1 Introduction

The current state of land tenure in Ekuthuleni is largely a product of South Africa’s apartheid laws, most notably the Black Land Act.⁷⁰ It was also heavily influenced by the Lutheran Church, which purchased the Ekuthuleni farm in 1889 and oversaw the allocation of land until relinquishing its control to the state in 1970.

⁶⁸ A group of neighbouring owners and/or a group of men or elders.

⁶⁹ i.e., current landowner, the potential new landowner, and the neighbouring owners.

⁷⁰ 27 of 1913.

5.14.2 Tenure under the Lutheran Church

During the years when the land was under the control of the Lutheran Church, the allocation of land by the Church was defined by a set of implicit rules. A resident of the community who was allocated land by the Church had to abide by rules that included no drinking, no pregnancy outside of marriage, and no polygamous marriages (AFRA, 2000). The tenure of resident families was only secure as long as these rules were followed and breaking these rules could result in eviction from the Church's land.

Any non-member of the Church who wished to make a request for land would first have to convert to the Lutheran Church. Residents and potential residents who met the church's criteria were then allocated parcels of land suitable for their residence and agricultural use. Once the Church granted permission, the Induna would settle the people on the land in the presence of the Ibandla. The Ibandla, who then consisted of respected male Church members, would witness the boundary demarcation during any land allocation. Residents who were allocated land would also have access to the community's communal land, indigenous forests for firewood and herbal medicines, and communal grazing land (AFRA, 2000).

In essence, the Church leased the property to the residents via an unwritten verbal agreement, requiring residents to follow the Church's rules and pay a nominal rental fee. Whether this fee was, in fact, a lease payment or a payment for ownership of the land as many residents contested is uncertain (AFRA, 2000).

5.14.3 State Controlled Tenure

In July 1970, the Ekuthuleni Farm⁷¹ was sold and transferred to the South African Bantu Trust.⁷² The Church stated that it made the sale because of its opposition to apartheid and its intentions to pull out of South Africa (AFRA, 2000). After the sale, residents continued to pay rent to the Department of Agriculture,⁷³ which administered the land on behalf of the Department of Regional Land Affairs. Rental payments were discontinued in December 1970 (AFRA, 2000).

5.14.4 Current Tenure

In 1997, the community of Ekuthuleni first approached the DLA concerning their lack of secure tenure. This initial visit would eventually lead to a request by the community to the DLA to transfer their land to a CPA. The DLA eventually agreed to this transfer and the Ekuthuleni CPA was registered in 2003 (AFRA, 2003).⁷⁴ As of 2005, the community was still awaiting transfer and thus the Ekuthuleni Committee has no legal authority over the land.

⁷¹ Ekuthuleni Farm 6124 [sic].

⁷² The South African Bantu Trust later became the South African Development Trust, which eventually fell under the ownership of the Minister of Agriculture and Land Affairs.

⁷³ Under terms of Proclamation 92 of 1949.

⁷⁴ See Chapter 5.16 Ekuthuleni CPA (page 90).

5.14.5 Servitudes

Servitudes registered against the Ekuthuleni Farm were carried forward from the original Deed of Grant (Register of Deeds, 1892), dated October 6 1892, that conveyed ownership to the Church of Sweden. A summary of these Servitudes include the following (Register of Deeds, 1971):

- *All public or authorized roads, thoroughfares, telegraphs, and watercourses should remain free and uninterrupted.*
- *The land shall be liable, without compensation to any proprietor, to have roads, railways, railway stations, telegraphs, telegraph stations, or watercourses, made over any part of them for the public use and benefit by order of the Governor of Zululand. Reasonable compensation shall be made by the said government.*
- *Mining and Quarry rights are reserved to the Government of Zululand.*
- *Travelers passing with their wagons and oxen shall have the right of outspan and pasture for a period not exceeding 24 hours.*

Two power transmission servitudes pass through the farm. One passes north-south through the central part of the farm (SG, 1980) and the other passes north-south near the eastern boundary (SG, 1985). Both of these servitudes are mainlines of the Eskom power grid.

5.15 Community Objectives

Most residents of Ekuthuleni are well aware of South Africa's history of land expropriation during the apartheid years. Many residents had seen people and communities evicted and, consequently, felt a strong desire for a more secure form of tenure. Primarily, a more secure form of tenure was viewed as a protection against the government. As many residents had occupied the land on which they lived for generations, a stronger legalized form of tenure would confirm their de facto rights of occupation. In addition, most residents considered their rental payments to the Church as payments for the land. Thus, with the uncertainty of their land "ownership," many residents have expressed a general unwillingness to invest in the land.

In 1997, when the chairperson of the Ekuthuleni Land Committee approached the Deputy Director for Tenure Reform in the DLA's Provincial Land Reform Office⁷⁵ (Hornby, 2004), the ongoing Ekuthuleni land reform process was set into motion. As part of a pre-feasibility study done by the DLA, and from community meetings held by AFRA, the reasons for the community's desire for a more secure tenure became known. These included fears by many women in the community that their rights were not protected. Widowed or separated mothers or women in polygamous marriages feared that they, or their children, could lose their land. This was particularly true for women with daughters only (Ziqubu et al, 2001). Others viewed a secure tenure as a way to access development and credit funding, by using land as an asset to borrow money for

⁷⁵ KwaZulu-Natal.

farming, agricultural development, forestry initiatives, and road construction (Hornby, 2000c).

While no major conflicts concerning boundaries in the community have developed, numerous misconceptions and a general lack of clarity about many aspects of the community's tenure exist. It was hoped that a stronger form of tenure could clarify many of the contradictory ideas, clarify internal boundaries, and reduce future conflicts. In addition, it was hoped that individual tenure status could be clarified in relation to the chief. Another area that needed to be clarified was the status of people who were allocated land by "owners." Could these "owners" allocate land without the headmen? Could owners pass land to their descendents with any degree of certainty? Further, many residents were unsure of their status once they got married. Could they retain the previously held land? People who left the community were also uncertain of the status of any previously held land. Some believe the land should revert to the family that gave it away while others believe the land returns to Inkosi (Hornby, 2000c).

The Induna, considered the final arbiter of land disputes, handles boundary disputes. If an involved party disputes or is dissatisfied with the outcome as determined by the Induna, no dispute resolution mechanism is in place, and the party that loses its claim has no avenue for recourse. Thus, some arbitrations are totally ignored by the losing party and such disputes continue to be unresolved (AFRA, 1999).

Disputes that exist within the community involve such things as who has the rights to fruit trees and their fruit. Disagreements occur over the boundaries of some cropping fields, with claims that some owners have shifted their boundaries. Some ancestral claims are also made by members of the neighbouring Isigodi, and residents that were previously allocated land felt that their rights were contingent on the good will of the original owner (AFRA, 1999).

Since the current system of allocation and the granting of rights to land is oral as opposed to written, some room is present for manipulation and abuse. Previous claims were made that the Induna had "illegally" taken land away from certain households (AFRA, 1999).

Even with the current uncertainty in their tenure, many members of the community still want to remain a part of their tribal structure and carry on with the tradition of respecting the traditional authority structures (AFRA, 1999). They did not want title to be in the name of the Entembeni Traditional Authority or the Inkosi, and they did not want strangers to have uncontrolled access to the area (Ziqubu et al, 2001).

A key to any new form of tenure would be affordability. The costs of implementing and maintaining such a system would be of critical importance, as most could never afford their own title deed. As an estimate, the cost to each family would be between R 3,000 and R 6,000 for creating their own title deed (Hornby, 2000c), which would essentially rule out traditional surveying methods as unaffordable.

The Ekuthuleni community had several options they could follow. These included individual ownership, a Community Trust, or form a Communal Property Association (CPA) (Urban-Econ, 1999). Individual ownership would be by far the most expensive approach, requiring each individual plot of land to be surveyed and transferred. A sec-

ond choice was a Community Trust,⁷⁶ where trustees would administer the land on behalf of the community. Unfortunately, this would be a considerably more complicated process and Community Trusts are generally a relatively inflexible legal entity. A third choice was a CPA, which would enable the community to acquire, hold, and manage the property based on an agreement⁷⁷ between members of the community.

At community meetings, the Ekuthuleni community decided to own the land communally rather than individually, in part because the members did not want ownership in the name of traditional authorities and they were concerned about the costs and future implications of individualized ownership (Ziqubu et al, 2001). At the time, given the uncertainty of the Land Rights Bill,⁷⁸ the community decided it would follow the redistribution route (Bourhill, 1998), and would use the DLA grants to buy the land together (Hornby, 2000c). Under the Provision of Land and Assistance Act,⁷⁹ the community applied to the DLA to buy the land from the Minister of Land Affairs.

The provincial office of the DLA then contracted consultants to evaluate the tenure situation and make recommendations. These consultants recommended that the DLA proceed with the application as a tenure test case (Hornby, 1999). The DLA and the National Tenure Directorate rejected their recommendations, however, stating that the community's tenure was already secure.⁸⁰ Regardless, the provincial office proceeded with the application as a redistribution of state land project (Hornby, 1999).

The land at Ekuthuleni was valued at R 260,000 and grant allocations for 224 beneficiaries brought the Settlement and Land Acquisition (SLAG) budget to R 3,584,000 (Hornby, 2000a). The community opted for a CPA and, under the Communal Property Associations Act,⁸¹ formed the Ekuthuleni Communal Property Association.

5.16 Ekuthuleni CPA

An application was made to the DLA, which was then also the owner of the farm. This application included about 240 households that were registered on the DLA's beneficiary list (AFRA, n.d.(a)). The DLA agreed that the applicants could apply their land reform grants to the purchase of the Ekuthuleni Farm that would then be held as a CPA on their behalf (Ziqubu et al, 2001). A budget of approximately R 3.5 million was allocated and consultants were hired to produce the required Business Plan and develop a CPA to take ownership of the land. In 1999, the application was processed as a redis-

⁷⁶ Under the Trust Property Control Act 57 of 1988.

⁷⁷ CPA Constitution.

⁷⁸ Communal Land Rights Bill (eventually becoming the Communal Land Rights Act 11 of 1994).

⁷⁹ 126 of 1993 (previously known as Provision of Certain Land for Settlement Act 126 of 1993).

⁸⁰ Via the Interim Protection of Informal Land Rights Act 31 of 1996 and/or the Extension of Security of Tenure Act 62 of 1997 (and amendments).

⁸¹ 28 of 1996.

tribution of state land project.⁸² The Ekuthuleni CPA was then established under the terms of the Communal Property Associations Act.⁸³

The Ekuthuleni Communal Property Association was essentially created for the specific purpose of holding and managing the Ekuthuleni property and other assets or rights in land on behalf of the members of that community. This met some of the needs of the community by, at a minimum, securing the land against the state. The Ekuthuleni CPA was registered in 2003 (AFRA, 2003).

5.17 Ekuthuleni CPA Constitution

One of the requirements in the formation of a CPA was the creation of a Constitution. The Ekuthuleni CPA Constitution, as with all CPA Constitutions, essentially defined the rules and regulations by which this new Association must abide.

The Ekuthuleni Constitution states that members of the Association will be comprised of households (instead of individuals) whose names appear in the register of membership and that each household will only have one vote at the general meeting. Members of the Association are entitled to various rights, including rights to residential plots, access to grazing land, ploughing fields, forestry uses, and arable land. A member can sell or bequeath their rights in property to a member of the community or to a non-member, subject to certain conditions. Members can also lease, transfer, or dispose of land subject to the community rules. The allocation of land to members is determined at the Association's general meeting (Ekuthuleni, 2000).

The running of the Association is to be done by a democratically elected committee that will be responsible for the management and administration of the affairs of that Association. The committee is composed of 11 members, at least three of which must be women. The committee is responsible for the general management of the affairs of the Association in accordance with the Constitution.⁸⁴ The Constitution also notes that the Association will continue to recognize the institution of Ubukhosi of the Entembeni tribe, under the Inkosi Zulu, in its role and status as was recognized and accepted by the majority of the members of the Association. The Constitution also takes great care to ensure the rights of women by stating that any rule within the Constitution pertaining to one gender automatically includes the other gender (Ekuthuleni, 2000).

⁸² Under the terms of the Provision of Land and Assistance Act 126 of 1993 (Provision of Certain Land for Settlement Act 126 of 1993).

⁸³ 29 of 1996.

⁸⁴ CPA.

6 Methodology for Capturing and Recording Communal Land Rights

6.1 Introduction

For the process of reforming land tenure in South Africa, the government outlined in its 1997 White Paper¹ a set of tenure reform principles. These included a move toward rights and away from permits, allowing people to choose the tenure system appropriate for their circumstances, and accommodating de facto vested rights, as they exist on the ground.² The key to successful implementation of land reform will be, in part, the roles played by institutions established under the Communal Land Rights Act³ (CLARA), including the Land Administration Committee⁴ (LAC) and the Land Rights Board⁵ (LRB). In addition, Land Surveyors and the newly created positions of Land Clerk and Land Administrator will also play prominent roles.

Before old order rights can be secured under CLARA, the Minister is required to institute a Land Rights Enquiry⁶ (LRE). The LRE will look at, inter alia, the nature and extent of competing or conflicting interests, the available options for legally securing rights, the possible need for comparable redress, ensuring gender equality in allocation, and the interests of the state.⁷ The LRE process will require a comprehensive audit of those rights deemed to be old order rights, and any other existing tenure rights. Significant amounts of data must be collected to fully identify the holder of the right and to provide details about the nature and extent of the tenure. Presumably, Land Clerks and Land Administrators working in the communities would complete most fieldwork involved in this process. The information they gather will be entered into the LRE process, allowing the Minister to make a decision regarding the transfer of new order rights to the person or persons entitled to such rights by means of a Deed of Communal Land Right or other appropriate deed.⁸

While CLARA is clear about its requirements, it is vague about how the Act is to be implemented. While numerous ideas have been proposed on how this might be done, this chapter looks at one possible scenario for recording existing land rights using the DLA's newly created position of Land Clerk. In this scenario, a suitably equipped Land Clerk, known as a "Community Land Clerk," will be the primary agent for collecting and recording land rights.

¹ White Paper on South African Land Policy.

² Section 4.16: Guiding Principles of Tenure Reform.

³ 11 of 2004.

⁴ Section 21 - 24.

⁵ Section 25 - 30.

⁶ Section 14 (1).

⁷ Section 14 (2).

⁸ Section 6.

6.2 Department of Land Affairs

6.2.1 Introduction

The design of systems to support land and tenure reform under CLARA is the responsibility of the Department of Land Affairs (DLA).⁹ A range of players having various levels of experience and education will carry out the implementation of these programmes. As part of the implementation process, the DLA proposed the creation of several new positions, including a Land Clerk and a Land Administrator. These new positions may be filled by multi-discipline specialists performing specific land-related duties as mandated by CLARA, as well as functions related to the provision of services to communities. In addition to their regular duties, they have the potential to become information specialists, collecting information for various organizations pertaining to the environment (i.e., water quality and biophysical degradation), health (i.e., HIV) and various community services (van den Berg et al, 2004).

The envisioned Land Clerk and Land Administrator positions are similar to the model used in Namibia, where, in 1996, the Polytechnic of Namibia created a certificate course in land measuring. This 3-year cadastral diploma programme graduates approximately 15 Land-Measurers every year (Federal Office of Topography, 2003). The Namibian programme is similar to the envisioned South African model in that a similar skill-set will be required, specifically basic knowledge of surveying, conveyancing, and registration.

Presently, no firm commitment by the DLA has been made as to how the new Land Clerk and Land Administrator positions will be incorporated into existing procedures and practices.¹⁰ It has been suggested that the Land Clerk will be a voluntary position, though this now seems unlikely. Alternatively, they might be new categories of private sector professionals paid by the state (Hornby, 2004). It does, however, seem likely that most of the fieldwork pertaining to the Communal General Plan¹¹ (CGP) will be carried out by these two new positions. A reasonable assumption is that the Land Clerk will be tasked with most of the footwork in the communities, collecting various data on

⁹ i.e., Land Reform Directorate of the DLA. The mandate of the Department of Land Affairs includes land and tenure reform as well as land planning and information (DLA, 2005b). The Department of Land Affairs has primary responsibility for the administration of, inter alia, Communal Property Associations Act 28 of 1996, Deeds Registries Act 47 of 1937, Development Facilitation Act 67 of 1995, Distribution and Transfer of Certain State Land Act 119 of 1993, Extension of Security of Tenure Act 62 of 1997, Interim Protection of Informal Land Rights Act 31 of 1996, Land Administration Act 2 of 1995, Land Reform (Labour Tenants) Act 3 of 1996, Land Survey Act 8 of 1997, Land Titles Adjustment Act 111 of 1993, Provision of Land and Assistance Act 126 of 1993, Restitution of Land Rights Act 22 of 1994, Sectional Titles Act 95 of 1986, State Land Disposal Act 48 of 1961, Town and Regional Planners Act 19 of 1984, Transformation of Certain Rural Areas Act 94 of 1998, and Upgrading of Land Tenure Rights Act 112 of 1991.

¹⁰ i.e., Section 6 (b) of CLARA requires that a Communal General Plan be prepared and approved in terms of the Land Survey Act 8 of 1997.

¹¹ Called for under CLARA.

boundaries and rights-holders, in the role of identifying the de facto rights over land. Thus, it may be more convenient for the Land Clerk to reside within the communities they work, which would allow records to be updated with the execution of each transaction (van den Berg et al, 2004).

6.2.2 Land Clerks

A Land Clerk will require a minimum educational level of Grade 10 and completion of a 3-month training programme at NQF¹² level 3 (DLA, 2004a). A Land Clerk will work at the level of a field worker for Land Rights Enquiries and act as a liaison between the community and various professionals. Land Clerks will be required to inform communities of relevant laws and policies applicable to their situation, therefore they will need to have a general knowledge of the various statutes and laws pertaining to land rights. Since they will often be working independently, they must be able to read, sketch, and update maps according to the various changes made and be able to convey this information to the community. Land Clerks will be in the field collecting property information to be directed to the Land Surveyor, possibly after verification by the Land Administrator.¹³

6.2.3 Land Administrators

Similar to Land Clerks, Land Administrators will need to have a comparable skill set, though to a greater extent. Land Administrators will require a minimum education level of grade 12 and completion of a 12-month training programme at NQF level 3 and 4 (DLA, 2004a). They will be advising communities on various legal issues involving land rights and recommending different forms of land tenure to communities. Thus, they need to have knowledge of statute and common law pertaining to land rights, as well as relevant land development laws.

Land Administrators may manage local land records offices and maintain local registers, which will require considerable experience in operating computer systems and databases. They must be proficient in reading and updating maps, interpreting aerial photographs, and demarcating relative positions on the ground. They will be respon-

¹² The National Qualifications Framework (NQF) came into being via the South African Qualifications Authority Act 58 of 1995. The NQF is a set of standards and qualifications agreed to by various stakeholders that enable the registration of a learners acquired skills and knowledge. It provides a national set of principles and guidelines allowing for national recognition. The NQF combines education and training into a single framework making it easier for learners to enter education and training programmes. Additionally, it is intended to improve the quality of education and training, and open up learning and work opportunities for the previously disadvantaged. Under this Act the South African Qualifications Authority (SAQA) was created, and would be responsible for overseeing the development and implementation of the NQF (SAQA, 2005a). [i.e., NQF (level 1) is equivalent to Grade 9, NQF (level 4) is equivalent to grade 12, NQF (levels 5 - 8) is equivalent to various Diplomas, and NQF (levels 7 and 8) are equivalent to Higher Degrees. The system is open-ended; both top and bottom (SAQA, 2005b)].

¹³ See Figure 1: Communal Land Registration (page 105).

sible for facilitating registration of the initial title for the land claimant and must be able to work independently.

Most fieldwork will be done by Land Clerks, with Land Administrators more involved in the administration of records. Each Land Administrator may have two or more Land Clerks working under their supervision. After property information is collected by the Land Clerk and Land Administrator, it is then directed on to the Land Surveyor.

6.2.4 The Role of Land Surveyors

Land Surveyors will also have a significant role in the implementation of CLARA as the mentors and as educators of Land Clerks and Land Administrators. Land Surveyors, possibly contracted by the state on tender, will be needed at the local level to help Land Administrators and Land Clerks build their skills to perform their required functions.

For transferring communal land, the Minister is required¹⁴ to have a Communal General Plan¹⁵ prepared and approved in terms of the Land Survey Act¹⁶ when satisfied that all requirements of the Act¹⁷ have been met. CLARA requires the survey of all rights to be done in terms of the Land Survey Act, thus the submission of Communal General Plans (CGP) to the Regional Surveyor General will be the responsibility of Land Surveyors. The CGP will be accessible to all stakeholders and will be stored as a continuous map in a national spatial database located in the Surveyor General's office (van den Berg et al, 2004). The Land Surveyor will be involved in the framing of the CGP, which would typically be attached to the Land Rights Enquirer's report (van den Berg et al, 2004).¹⁸ The role of Land Surveyors in maintaining the records is yet to be determined but may be contingent on their roles in supplying property information to municipalities and other service providers (Hornby, 2004).

6.2.5 Land Clerk and Land Administrator Training

The DLA set out a proposed training programme for the new positions of Land Clerk and Land Administrator in a 2004 Business Plan.¹⁹ This plan called for the creation of a curriculum outlining the education and training that various government structures will require for implementing land reform. Two key members in this process will be the previously mentioned Land Clerk and Land Administrator, who will be responsible for undertaking most of the basic demarcation and administration of land rights in rural

¹⁴ Section 6: Transfer of Communal Land (CLARA).

¹⁵ " 'general plan' means a plan which, representing the relative positions and dimensions of two or more pieces of land, has been signed by a person recognized under any law then in force as a land surveyor..." (Deeds Registries Act 47 of 1937 and Land Survey Act 8 of 1997 as amended by Communal Land Rights Act 11 of 2004.).

¹⁶ 8 of 1997.

¹⁷ CLARA.

¹⁸ As stipulated in Sections 17 (2) and 17 (3) of CLARA.

¹⁹ "Business Plan for the Pilot Project Education, Training and Capacity Building for Land Clerks and Land Administrators in South Africa" (DLA, 2004a).

areas (DLA, 2004a). The Land Clerk and Land Administrator will therefore need a basic set of skills in communication, use of computers, land laws, land use planning, mathematics, and surveying. Consequently, Land Administrators and Land Clerks will require some training in order to undertake their required functions.

The training of Land Administrators will be done by various educational institutes²⁰ or private providers, while the training of Land Clerks will be done internally by the DLA (DLA, 2004a). The majority of the training will be funded²¹ by the DLA, with an initial group of 60 Land Clerks and 60 Land Administrators to be educated beginning in August 2004.²² After a marketing campaign to inform communities of the process, candidates will be chosen from rural communities identified as high priority and from those communities where pilot projects were previously conducted. To ensure course completion, grants will be given to candidates to cover the cost of accommodation, tuition, supplies, and a monthly living allowance.

Training will consist of a 3-month course for Land Clerks, and a 12-month course for Land Administrators. Upon completion of training, the Land Clerk and Land Administrator will possess the following skill sets:²³

Land Clerk

- *Able to read maps, update maps according to identified changes, draw sketch maps, identify land use transgressions, and work independently.*
- *Knowledge of family law relating to land, relevant land development laws, and local custom and practice with respect to land rights.*
- *Able to educate the community on the role of Land Surveyors, Town Planners, and other government practitioners, and the value of land and water resources.*
- *Able to convey information to communities (i.e., spatial/map), liaise between community and various parties (i.e., professionals, administration and environmental groups).*
- *Advise community on legal issues regarding land rights (i.e., land law and land policy).*
- *Fluent in English and predominant local language.*

Land Administrator

- *Able to read and interpret aerial photographs, development maps, relate local register to aerial photographs and maps, update maps according to identified changes, conduct needs assessment, make recommendations on different forms*

²⁰ i.e., Technikon or Technical College.

²¹ Scheduled at R 1.6 million for 2004 and R 0.6 million for 2005 (DLA, 2004a).

²² As of April 2005 this has still not been done.

²³ Based on "Business Plan for the Pilot Project Education, Training and Capacity Building for Land Clerks and Land Administrators in South Africa" (DLA, 2004a).

of tenure, produce reports, identify land use transgressions and work independently.

- *Knowledge of relevant land law and policies, land development laws and functions of government.*
- *Able to educate and advise community on legal issues regarding land rights (i.e., land law and land policy), the principles of integrated planning, and the various service providers and their functions.*
- *Operate and maintain a local register, database, and computer system.*
- *Able to demarcate relative positions on the ground, and facilitate registration of initial title for land claimant.*
- *Able to resolve conflicts (i.e., facilitate negotiations and recommend mediator to resolve conflicts).*

Once the training programme has been completed, the Land Administrator will be competent enough to manage the local land records office. With their new skill set, Land Clerks and Land Administrators will be able to map and record existing land use, boundaries, and services, as well as record required information and evidence of granted documentation regarding existing residents and participate in the issuing of new tenure rights documents. They will be able to maintain and update records regarding changes resulting from adjudication and assist communities with land record information. Additionally, they will be able to advise government agencies regarding customary and local practices.

6.3 PILAR Project

One approach to the demarcation and registration of land in communal areas was the PILAR²⁴ project undertaken by AFRA.²⁵ Starting in 1998, this project examined the option of using 'orthophotos and GPS to complement conventional surveying for the Communal General Plan' (PPDC, 2004). This project was premised in part on the basis that orthophotos are commonly available,²⁶ are substantially more cost-effective than traditional surveying methods, and allow residents to graphically outline their land on plastic overlays.²⁷ In effect, orthophotos show "the land the way people who live on it know it" (Hornby, 2004).

For this research project, AFRA commissioned a set of 1:10,000 colour orthophotos²⁸ of the Ekuthuleni area. These orthophotos were taken into the community where residents physically drew boundaries on transparencies overlaying the orthophotos.²⁹ The boundaries were then digitized with each polygon (parcel of land) uniquely identified

²⁴ Pilot in Land Administration Records.

²⁵ Association for Rural Advancement (A land rights Non-Government Organization).

²⁶ Via the Department of Land Affairs.

²⁷ See Figure 25: Ekuthuleni Orthophotos (Appendix E/page 269), and Figure 26: Ekuthuleni Orthophotos [Ekuthuleni Committee] (Appendix E/page 269).

²⁸ See Figure 5: Jimmy Property [Orthophoto] (page 153).

²⁹ See Figure 25: Ekuthuleni Orthophotos (Appendix E/page 269).

with a set of corresponding attributes. The attributes included areas of commonage, public use land, areas of boundary disputes, areas of ababhekiwe,³⁰ and were linked to each grant holder on the DLA beneficiary list. The process of demarcating more than 200 sites required a total of four days (Hornby, 2004). Selected boundaries were later ground-truthed using GPS, with results being consistent with the digitized images (Hornby, 2004).

AFRA concluded that orthophotos, while not as accurate as surveyed plots, are sufficient for residents to identify their individual plots of land and how they stand in relation to other plots of land. Residents of Ekuthuleni were able to accurately depict land boundaries on the orthophotos in regions where visible geographical markers were present and where they know the land well (Hornby, 2004). Nevertheless, the difficulty lies in those areas where few visible geographical markers were present and the precision of the orthophotos may not be sufficient to resolve some boundary disputes.

Using orthophotos to map communal areas will, of course, require that all these areas have orthophoto coverage. Aerial photographs and orthophotos for the communal areas may be obtained in a number of ways. In South Africa, the Chief Directorate of Surveys and Mapping (CDSM) is the government agency responsible for aerial photography. CDSM has an archive of aerial photographs that began in the 1930's and has complete coverage of the country since the 1950's (CDSM, 2005). In addition, CDSM has orthophoto maps³¹ covering roughly 25 % of the country, including all metropolitan and peri-urban areas and growth areas (CDSM, 2005). CDSM has mapped most communal land using 1:30,000 scale aerial photography, from which orthophotos (at a scale of 1:5,000 or 1:10,000) can be produced (van den Berg et al, 2004). A scale of 1:5,000 orthophotos should be a sufficient scale for a base-map for the Land Rights Enquiry process and for the framing of communal layout plans (van den Berg et al, 2004).

In areas of inadequate orthophoto coverage, the tendering of aerial photography may be required. The expenditure required for this coverage will require a considerable initial capital investment by the DLA. Because the resulting aerial photos, maps, and digital images may also be of use to numerous other private and government organizations, it may be possible to defray up-front capital costs between various government agencies and private industry. In addition, CDSM has in place a significant budget to update mapping in areas prioritized for communal land rights allocations (van den Berg et al, 2004).

6.4 Community Land Clerk

6.4.1 Introduction

The Communal Land Rights Act³² (CLARA) has been designed to provide for the legal security of tenure by transferring communal land, including KwaZulu-Natal Ingonyama

³⁰ Non-paying tenants.

³¹ Available on CD-ROM in TIFF format (1:10,000).

³² 11 of 2004.

land, to communities.³³ Once land has been transferred to the community, the Act provides for the registration of those rights on behalf of a group of people or a community. While the Act is clear on the registration requirements, it is non-prescriptive on how this is to be done. The DLA, as part of their development of the technical components for implementing the legislation, is in the process of introducing the new positions of Land Clerk and Land Administrator. This dissertation looks at one possible scenario for the implementation of communal land rights using the newly created Land Clerk working as a Community Land Clerk.

6.4.2 Community Land Clerk

A key to the successful implementation of CLARA will be the roles performed by the Land Clerk and Land Administrator. At the time of writing, no consensus had been reached as to the eventual number of Land Clerks and Land Administrators nor how they will be distributed. One scenario would have Land Clerks and Land Administrators based at specific locations, such as a local land tenure office. A present day analogy might be the nine land registry offices, which are regionally distributed in urban areas throughout the country.³⁴ In this instance, members of a community seeking title for land under CLARA would be required to attend the nearest office (i.e., Vryburg) and make the necessary arrangements.

Another option would be to place Land Clerks in the communities they serve, as “Community Land Clerks.” Typically, Community Land Clerks³⁵ would work out of their residence, thus minimizing the need for any significant infrastructure requirements. With Land Clerks based in the community, residents could easily call on the Land Clerk whenever a service, such as a land demarcation, was required. Whether the individual Land Clerks represent specific communities or are shared between multiple communities will be a function of community size, the number of Land Clerks available, and how they are distributed throughout the country. The ratio of Land Clerks to Land Administrators will be in the order of two or three Land Clerks to each Land Administrator.³⁶

With access to computers and other equipment, Community Land Clerks will be able to provide additional services to the communities they serve. Operating under a Land Administrator, the Land Clerk may work as an employee or as an independent contractor to the DLA. This would be somewhat analogous to how a current Land Surveyor and/or Conveyancer work in the current formal land registration system of South Africa.

³³ CLARA defines “community” as a group of persons whose rights to land are derived from shared rules determining access to land held in common by such group.

³⁴ i.e., Bloemfontein, Cape Town, Johannesburg, Kimberley, King Williams Town, Pietermaritzburg, Pretoria, Umtata, Vryburg.

³⁵ Hereafter the term “Community Land Clerk” is used to distinguish it from the Land Clerk of the Department of Land Affairs.

³⁶ See Figure 1: Communal Land Registration (page 105).

In smaller communities, there may not be a need for a full-time Community Land Clerk. Thus, the Land Clerk may wish to supplement their income by providing other services to the community and community providers. These could include the preparation of legal documents, office and other government services, or data collection for service providers such as health, telephone, transportation, electricity, water, and sanitation. This would allow Land Clerks a secondary means to supplement their income, making it possible for the Land Clerk to become an autonomous self-sustaining contractor or employee.

Regardless of the method selected by the DLA, Land Clerks will likely spend significant portions of their time working in the field doing most of the legwork for the Land Administrator and Land Surveyor. They will be intimately involved in the community and, consequently, should have a good knowledge of community and tribal customs. Considering the number of languages in use throughout South Africa, communication skills will be vital. The Land Clerk must be fluent in English and at least one local language (DLA, 2004a).

6.4.3 Equipping the Community Land Clerk

The current status of land reform in South Africa is drastically under funded. Without taking into account other land reform programmes, recent estimates by the DLA suggest that it will cost R 1 billion a year over five years for the implementation of CLARA alone (Hall et al, 2004). Thus, budgetary constraints will be one of the primary constraining factors in the implementation of CLARA. The number of Land Clerk and Land Administrator positions created will also be constrained by, among other things, the cost of equipping each new position.

The outfitting of Community Land Clerks can be done almost entirely with off-the-shelf products. Most importantly, Land Clerks will require a portable laptop computer.³⁷ Considering the requirement for software programmes, hardware features, peripherals, and the expected useable field life of computers, it may be more cost-effective to use older model computers. In this instance, "older" would mean computers that have been on the market for 6 to 12 months, which would negate the initial high costs of purchasing new top-end models.

The Land Clerk will need to make copies of any documentation that verifies old order rights presented by residents, as well as print paper documents for an applicant's personal records. For printing and copying documents, a printer and scanner, or a multifunctional combination of the two, will be required. A GPS receiver will also be required to spatially link collected database information to each specific property. With the limited training of Land Clerks, simple handheld GPS receivers may be the most practical, the cost of which will be directly proportional to required accuracy.

³⁷ This computer and other equipment referred to in this chapter are covered in more detail in Chapter 7 Implementation and Logistics of the Land Clerk (page 107), and Appendix B: Equipment (page 239).

To further constrain costs, equipment for all Land Clerks should be standardized whenever possible to allow savings in bulk purchases. In addition, the standardization of equipment will greatly simplify training and reduce costs associated with repair and replacement. When possible, the equipment should be an off-the-shelf product to avoid any need for modifications and their associated costs. With Land Clerks working autonomously and spending a significant portion of their time in the field, their equipment will need to be durable and portable. Thus, proven and reliable equipment will be key.

With many rural areas lacking an electrical infrastructure, power supply to the equipment could be a problem. This may be overcome by providing Land Clerks with solar-powered (photovoltaic) base stations. With a sufficiently powered solar array, Land Clerks will be able to recharge equipment and provide basic power to their residence.

6.4.4 Proposed Methodology for Registering Communal Land Rights

A communal resident wishing to register land rights under CLARA and meeting all the requirements of the Act would initiate the process as they have traditionally done. Thus, in KwaZulu-Natal, traditional Zulu cultural methods of allocating land would be followed. These methods are similar across large tribal areas, though they are often modified for individual communities. In Ekuthuleni, the allocation of land traditionally may involve the allocator, allottee, members of the tribal authority, Ibandla, immediate neighbours, and possibly community representatives.³⁸ An agreement about the specifics of allocation would first be settled between those who are involved in the process. This could involve the resolution of any boundary disputes, and ensuring that a consensus is reached between neighbouring parties. After these details are finalized, the next step would then involve the Community Land Clerk.

Arrangements would be made with the Community Land Clerk and interested parties to meet at the property at a specified time. Before heading to the field, the Land Clerk would collect all documentation pertaining to the site in question and any other information that may be required. On the day in question, the Land Clerk arrives at the specified location with a case containing a computer, printer, scanner, and GPS. This suitcase-like container can be unfolded into a small table or folded back into a carrying case when not in use. At the site, the Land Clerk sets up the table, connects the computer to peripheral devices, and is essentially ready to work. With the computer set up and running, the Land Clerk opens a database programme so that the procedure is simply a matter of filling in the blanks. The Land Clerk systematically follows the steps in the database³⁹ and records required data, such as personal information, contact data, property details, and the names of all parties in the transaction. Any other information that may be beneficial to the application is noted, scanned, and filed.

³⁸ See Chapter 5.13 Cultural Land Tenure (page 83).

³⁹ See Chapter 7.6.5 RRR Database Programme (page 123).

At this stage, the allocator and other interested parties walk the perimeter of the boundary with the Land Clerk logging waypoints at each corner as they are pointed out by the landowner and interested parties. The Land Clerk may also collect a RINEX⁴⁰ file for later DGPS⁴¹ corrections by the Land Surveyor.

Many of the boundaries in Ekuthuleni are linear, consisting of linear lines between various features, for example from a specific tree to a specific rock. In these instances, the collection of waypoints at each vertice will be adequate for outlining property boundaries. Many residents of Ekuthuleni, however, define property properties by various curvilinear features, which may include roads, streams, valley bottoms, edges of trees, or other physical features. Such curvilinear boundaries will require a higher densification of GPS coordinates to clearly outline the boundary. In these instances, the real-time ability to visually project waypoints onto an orthophoto in the field can be beneficial.

In the process of collecting sufficient GPS waypoints to clearly delineate a property, the Land Clerk needs a means to check and verify the data. A software package (i.e., CAD) that graphically generates a property outline can provide a visual check for collected waypoints. Ideally, a programme would (in real-time) graphically display linked waypoints overlaid on an orthophoto so interested parties could verify its authenticity.⁴²

Upon verification by the applicant, all required documentation is completed and signed. Each attested document is then scanned and saved digitally. Finally, the Land Clerk prints out a document reflecting the collected data for the personal records of the applicant. At this point, the document is non-legal and nonbinding, as it serves simply as a record of collected information.

Upon completion of the field portion, the Land Clerk returns to their residence where the data is cleaned up and prepared for submittal. Land Clerks will digitally or graphically sign the completed document, scan it into a digital format if necessary, and transmit (i.e., Internet, CD/DVD, etc.) to the Land Surveyor. Depending on how the Land Clerk/Land Administrator structure is set up by the DLA, the Land Clerk may send data directly to the Land Surveyor or through the Land Administrator. In addition to the signed copy of the document, the Land Clerk will need to send a package of digital information including GPS coordinates (waypoints), possibly a RINEX file, and a database file of information pertaining to the applicant.

Upon receiving the information, the responsibility for the data becomes that of the Land Surveyor and a process of verification, post-processing, and finalizing the data begins.

With the Land Clerk collecting a RINEX file, the Land Surveyor has the option of using DGPS corrections to improve the accuracy of the original GPS coordinates. Post-processing of GPS data from low-cost Garmin GPS receivers can be done, but this may

⁴⁰ Receiver Independent Exchange Format.

⁴¹ Differential Global Positioning System.

⁴² i.e., similar to Figure 6: Jimmy Property [Orthophoto/Property] (page 154), and Figure 8: iPAQ PDA [Jimmy Property] (page 156).

involve the installation of specific software⁴³ onto the laptop computer. In the field, the GPS receiver is connected to the computer via a serial cable,⁴⁴ where carrier-phase and pseudorange positional data are collected and recorded to the computer in RINEX format. Differential corrections can then be calculated post-field and applied to the original data using various GPS software packages. For DGPS corrections, a reference observation file will be required that has been recorded simultaneously with the field receiver (the rover), as well as a satellite ephemeris file. The ephemeris file is easily obtained from various GPS Internet Web sites, and a reference observation file might be obtained from reference stations that archive data in RINEX format, such as TRIGNET.⁴⁵

A similar process is followed in some GIS applications, where a user can record positional data in shape format. In addition, both carrier-phase and pseudorange data are simultaneously recorded in RINEX format for post processing. After returning to the office, the user then applies differential corrections to the rover data and updates the GIS/LIS with differentially corrected shape files. While the Land Clerk may not use shape files, the process will be similar.

Once the field data has been corrected, verified, and finalized by the Land Surveyor, it is subsequently submitted to the Surveyor-General.

6.4.5 Proof of Concept

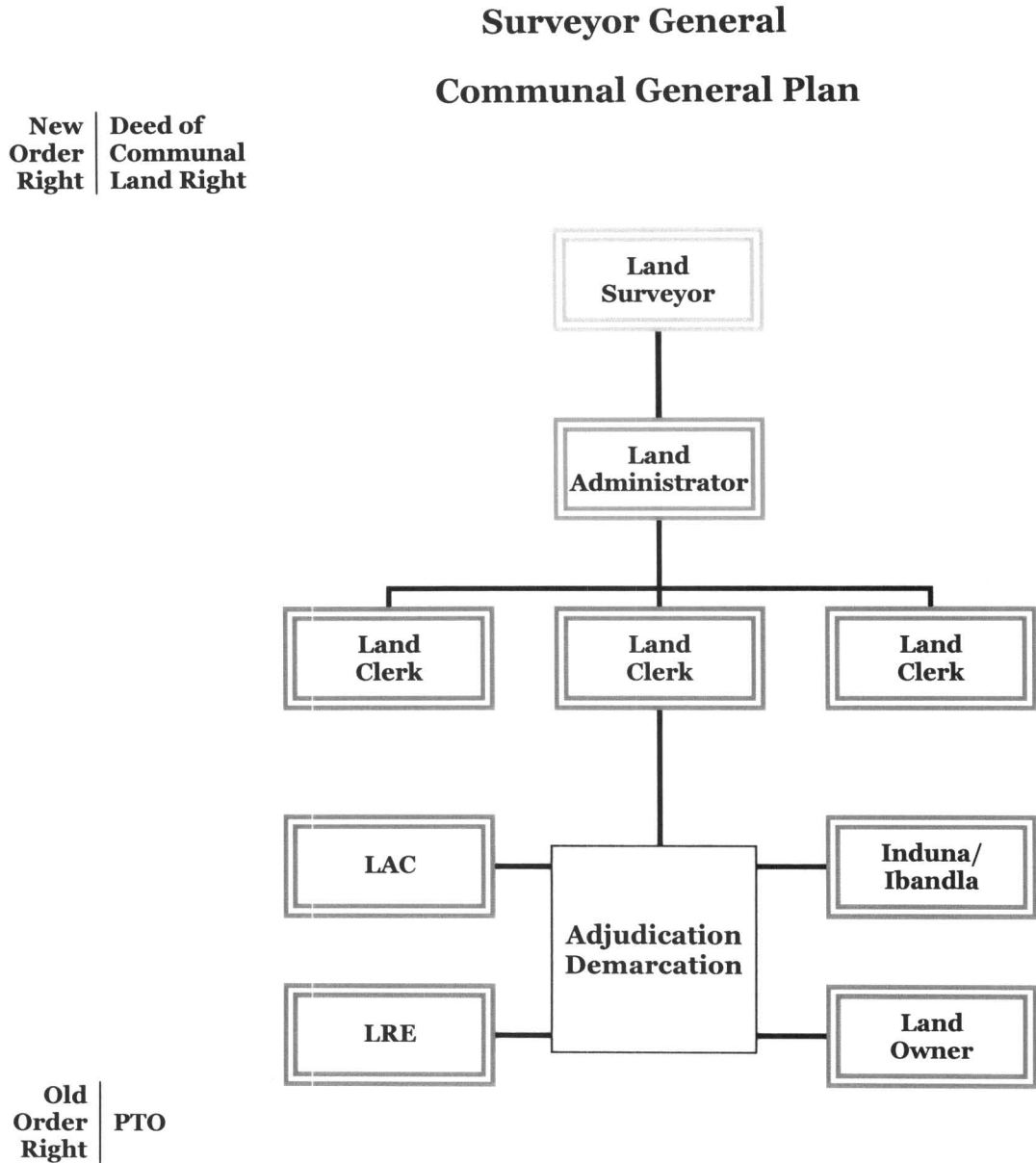
To demonstrate the viability of this concept, several field examples were carried out in the community of Ekuthuleni (KwaZulu-Natal). Two residents from the community, following a short training period, used the aforementioned procedure at several sites in the community. They followed the procedures of a Community Land Clerk, collecting personal information from applicants and GPS coordinates outlining property boundaries. This procedure is outlined in more detail in Chapter 8.

⁴³ i.e., Rhino Rover, Gringo, etc. See Chapter 9.6.5 High Accuracy GPS Surveying with Handheld Receivers (page 179).

⁴⁴ Or wireless.

⁴⁵ TRIGNET is a network of permanent continuously operating GPS base-stations located throughout South Africa at approximately 200 to 300 km spacing.

Figure 1: Communal Land Registration



7 Implementation and Logistics of the Land Clerk

7.1 Introduction

For Land Clerks to perform their anticipated duties, certain equipment and training is required. Considering the inevitable budgetary constraints, this chapter outlines the basic tool set as would be required by a Community Land Clerk.

Land Clerks will spend a considerable portion of their time in the field and therefore need to be self-reliant, and since they will be traveling to various sites, they must be mobile. This means their equipment must be durable, compact, portable, and relatively low-cost. As a minimum, Land Clerks should be equipped with a laptop computer, a portable printer and scanner, a handheld GPS receiver, and several software programmes for modifying and storing data.

Access to electric power will be required by Land Clerks to operate equipment at their residence and in the field. With large areas of KwaZulu-Natal lacking electric power, equipping Land Clerks with their own solar power source may be a feasible option. This could be done by installing a small solar array (PV array) at the residence of each Land Clerk, allowing them to use the equipment in their home, supply power to their residence, and recharge equipment for field use.

The Land Clerk will collect significant amounts of information in the field, that, at some point must be entered into a Land Information System (LIS), most likely by or under the direct supervision of Land Surveyors. For this project, a simple database (RRR Database) was created for data collection and storage.

7.2 Land Information System

A Land Information System (LIS) is simply a geographical or spatial information system containing data on land and land use. An LIS may be considered synonymous with a GIS,¹ although it can also be maintained that a LIS is but one component of a GIS. Occasionally, an LIS is referred to as a special-purpose GIS, a Land-Based Information System, or simply a Land Management System. With the increased capacities of computers to store, manipulate, and analyze large amounts of data, most of these systems are now computer-based. These systems allow for the capture, storage, retrieval, and display of spatial data relating to land features and characteristics. Various computer applications have improved the quality of information management, making this information easily accessible through database “query” processes. These systems, especially when accessible through the Internet, have greatly improved public access to land-

¹ Geographic Information System (GIS). A GIS is a computerized database management system that manages, analyzes, and displays data with an explicit geographical component. A GIS is best viewed as a process rather than simply a software or hardware product, i.e., a process that allows digital maps to be linked to attribute data, where that data is analyzed in a spatial context.

related information and have become an important tool in land management and the land reform process.

LIS's are often designed for specific purposes² and may be used as a way of enhancing land management planning and to mitigate competing land uses. This generally entails utilizing a database that describes various physical or legal characteristics of individual pockets of land. Many government agencies use LIS's, inter alia, to identify various land uses, land values, property ownership, tax assessments, environmental features, commercial and industrial uses, infrastructure, housing, and cultural aspects of land.

A significant challenge in the design of an LIS is in determining what information should be captured and how it can best be organized. The cost of collecting and managing the data is often an important determining factor in deciding what data is to be collected. To ensure a system's sustainability, the amount of information captured must also be limited. Information captured and the potential benefit of that information must be weighed against the cost of its collection and management. Excessive and inappropriate information could simply overwhelm the system, resulting in an ineffective, costly, and unsustainable LIS. A systematic approach to determine which information will be captured would ask a few structured questions: How will the information be used? What information is sufficient to uniquely identify a particular parcel of land? Does the state have the capacity to maintain all the information collected?

In a typical Western-style land tenure LIS, the records typically reflect a record of interests in land. Each parcel of land includes a geometric description of the land with attached attributes outlining the rights and restrictions applicable to that particular parcel. These may include, but are not limited to:

- *Ownership (i.e., current owner(s), current occupier(s), name, and address).*
- *Parcel boundaries and location (i.e., legal description, lot number, plan number, and cadastral data).*
- *Restrictions (i.e., caveats, covenants, mortgages, and zoning).*
- *Other (i.e., assessed land value, land use, cultural, water rights, and leases).*

Aspects that are considered important under the Western-style land tenure systems may be different from those for lands held under customary land tenure. In workshops conducted by AFRA in Ekuthuleni, residents of the community looked at ways to give members of the planned Ekuthuleni CPA records of their substantive land rights (Ziqubu et al, 2001). Residents wanted to ensure that enough information was collected to guarantee their current de facto tenure in land. They also wanted to ensure that land records would be valid in a court of law if that should ever become necessary (Ziqubu et al, 2001). Ekuthuleni residents are well aware of South Africa's history of land evictions, consequently the design of an LIS for Ekuthuleni must have a strong emphasis on

² i.e., Communal Land Register.

information for securing their tenure rights against the state.³ Residents proposed that records within their community should reflect the following (Hornby, 2000b):

- *Name and signature (ID number, name of household head, family (children, relatives, and wife)).*
- *Description of land parcel (size, extent, and use).*
- *Boundary markers (fencing, pegs, trees).*
- *Servitudes (electricity, roads, telephones, water).*
- *Correct procedures for land allocation (the headmen, Ibandla, owner and land recipient should be present at the demarcation of new boundaries).*
- *Unique number for each record.*

Like those in many areas of rural KwaZulu-Natal, the residents of Ekuthuleni have many different types of rights in land.⁴ Some rights are highly exclusive, such as a residence, where the right may be restricted to a single individual. Other rights may extend to the family or to an extended family. Some rights are shared throughout the community, such as the right to natural resources and some grazing rights. Other rights apply only during a specific period of the year, such as the time required to grow a particular crop (cultivation rights) or some grazing rights. With such an assortment of rights in land, this dissertation focuses only on a member's personal right to their residential land,⁵ as expressed by that resident. This is solely the expression of one individual landowner and does not take into account any conflicts that the resident may have with neighbouring lands.

7.3 LIS Data Capture

The collection of data (data capture) for the registration of rights will require Land Clerks to put in considerable time and effort in the field. Thus, for this dissertation, data capture is restricted to a workable amount and the selection of data is chosen to provide a representative sample, rather than to provide comprehensive coverage. The captured data is selected with the premise that it will be easily obtained from existing landowners, with no consideration as to the legitimacy of the stated claim of ownership. Thus, the data collected is the landowners' understanding of their holdings as expressed by that owner at that point in time.

To ensure that the residents are uniquely identified, their names and South African ID number⁶ would need to be captured. An ID number would be sufficient, but not every-

³ The Legal Entity Assessment Project (LEAP) in work they have done in KwaZulu-Natal has looked at the security of tenure for communities, and in particular ways of securing tenure in communal property institutions. Refer to "How do we know that Tenure is Secure?" at <http://www.leap.org.za/>.

⁴ See Chapter 5.13 Cultural Land Tenure (page 83).

⁵ i.e., a single homestead.

⁶ South Africa has a national identification system in which all citizens are issued national identification numbers and identification book. This number, simply referred to as ID number, is a 13-digit number in which the first 6 digits reflect the individual's birth date

body in the Ekuthuleni community has one. Therefore, since only adults have ID numbers, birth dates and sex were also collected. The registration process was set up so that single individuals⁷ would make a request for a new order right⁸ and others would join them in that request. The co-applicants would likely include a spouse (or spouses), immediate family members, extended family members, or simply a group of individuals wishing to apply collectively.

Once a person is uniquely identified, a means of contact is needed. Some members of the community have personal postal addresses,⁹ while others receive mail via a family member or other residents of the community.¹⁰ Alternatively, other members of the community, mainly younger residents, have e-mail addresses. Telephones (landlines) are restricted to areas along the main access road, so cell phones appear to be more prevalent even though reception is still localized to specific areas.¹¹ Other options of identifying residents may be through various service providers or government organizations operating in the community. These include providers of electrical power,¹² sanitation,¹³ water, the sugar industry, municipal or government roads (all of which are distinctly identified).¹⁴ Data chosen for capture would include community name, postal address, e-mail address, and residential or cell phone numbers.

Information regarding the asset (property) is also needed, such as the number of years the applicant had occupied the land, the present form of that occupation,¹⁵ number of dwellings, and a physical description of the property. This description could be an iden-

(yymmdd), digits 7 - 10 indicate gender (5000 + indicates male, < 5000 indicates female), and remaining digits reserved for other purposes (i.e., control digits). The ID number is usually displayed as 4 groups of numbers separated by spaces (i.e., 541221 5001 08 7).

This example would indicate a male born December 21 1954.

⁷ i.e., head of the household.

⁸ As defined by CLARA.

⁹ The Department of Land Affairs is currently working with Statistics South Africa in the creation of a National Address Database, which will enable all South Africans to have a postal address (as required by financial institutions) (DLA, 2005b).

¹⁰ Resident's mail is to a box number delivered to postal station located at the northern entrance to the community.

¹¹ i.e., higher elevation areas.

¹² i.e., Eskom.

¹³ i.e., VIP provision. A VIP (Ventilated Improved Pit) is a latrine consisting of a top structure over a pit. The Department of Water Affairs and Forestry (DWAF) was mandated (in the absence of local government structures) to ensure all South Africans have equitable access to water and sanitation services. This included providing each individual with 25 liters of water per day within 200 m of their home and the provision of basic sanitation in the form of at least a VIP toilet for every household (DWAF, 2002).

¹⁴ Similar to a street address.

¹⁵ i.e., PTO, rented, etc.

tification of landmarks defining the boundaries,¹⁶ coordinates of boundary corners,¹⁷ or other notes that could be used to re-establish or verify property boundaries.

Finally, the presence of any witnesses, most importantly any neighbouring property owners who share a common boundary, would be noted. It should also be noted whether the application has the support of tribal authorities, such as an Induna or Ibandla.¹⁸ To spatially tie in this property, a single GPS coordinate is registered in a central locality of the property.¹⁹ This coordinate (latitude and longitude) would act as a unique tie in, distinguishing it from other properties. It is to this coordinate that the previously mentioned attributes would be attached in our LIS (RRR Database).²⁰

7.4 Land Clerks-in-Training

The Ekuthuleni Community is well informed on the current state of land reform and land tenure in South Africa, especially the issues that directly affect the community. Ekuthuleni has been at the forefront of the land reform process for a number of years and has been actively involved with several NGO's. In particular, they have participated with AFRA in a "land tenure" pilot project²¹ and are currently involved in the process of finalizing the Ekuthuleni CPA.²²

In August 2004, a meeting was held with the Ekuthuleni Committee (representing the community of Ekuthuleni) and ourselves (University of KwaZulu-Natal) regarding a proposed land tenure research project²³ in the community. It was outlined to the Committee that this project would be somewhat analogous to work previously done by AFRA, that is, a similar method of demarcating and registering individual tenure²⁴ though different in its application. After meetings within the community, the Ekuthuleni Committee agreed to participate in the project, viewing it as beneficial to the community. As part of the agreement, the Committee agreed to select two representatives from the community to participate in the project. On behalf of the University, it was requested that these representatives:

- *Be fluent in both English and isiZulu. English would be required for their role as translators between members of the community and ourselves and for using various computer programmes (all in English). With isiZulu as the predominate language and few members of the community speaking English, they would re-*

¹⁶ i.e., streams, roads, hedge, etc.

¹⁷ i.e., GPS coordinates.

¹⁸ This was not done for this project.

¹⁹ For several properties, GPS coordinates were collected outlining the perimeter of the property.

²⁰ See Chapter 7.6.5 RRR Database Programme (page 123).

²¹ See Chapter 6.3 PILAR Project (page 98).

²² Under the Communal Property Associations Act 28 of 1996. See Chapter 5.16 Ekuthuleni CPA (page 90).

²³ This research paper.

²⁴ Under CLARA.

quire a good understanding of isiZulu. This was important since they would be closely interacting with members of the community, verbally collecting information in isiZulu, and registering it in English.

- *Have a strong motivation and willingness to learn. No monetary compensation would be given for this work, and they would be required to devote considerable time and effort into learning new technical procedures.*
- *Have a familiarity with the community, its land allocation and demarcation procedures and local tribal customs and traditions.*
- *Have previous experience with computers (if possible).*

To select suitable candidates from the community, the Committee formulated a written English test as a means of determining the candidate's English skills. Additionally, each candidate was interviewed by the Committee to ascertain their knowledge of communal land tenure as practiced in Ekuthuleni and their understanding of the work undertaken by the community to obtain a secure form of tenure and the processes²⁵ involved in this endeavor.

From this selection process, two young women²⁶ aged 24 and 27 were selected. Both were members of the community, having been born and raised in Ekuthuleni and having attended both the primary school and the nearby Entembeni Secondary School. They were both unemployed, which allowed them to devote their full time to this project. In addition, they were fluent in isiZulu and English and had good written English skills. Computer experience consisted of a single short introductory course limited to basic word processing and typing. Although they had not been actively involved, they were well versed in the development and status of the Ekuthuleni CPA, as well as other local land reform issues.

When queried about their knowledge and expectations of this research project and their future goals, both had clear expectations. Ultimately, their desire was to learn a skill set that would make them "employable." They both aspired to work for a government agency, such as the DLA, and believed that this new set of skills would give them a good chance to become candidates for the DLA's Land Clerk training programme.

They understood the Land Clerk position to be an intermediary between the community and other organizations. The responsibilities of a Land Clerk would involve educating the community about the people's rights under CLARA and other Land Reform Acts and about matters relating to the alienation of land. The Land Clerk would become the community's primary source of information pertaining to issues of land tenure. For example, a member of the community who wished to give land to a family member, to demarcate land, or to carry out another land-related matter would first go to the Induna (as is the current custom). After an agreement is reached between all affected parties, the next step would involve the Land Clerk, who would have the responsibility of delineating and registering property boundaries by various means including GPS. In the event of dispute, the Land Clerk would act with members of the community according to

²⁵ i.e., the creation of the Ekuthuleni CPA.

²⁶ Nonhlanhla Jiyane and Nobuhle Masondo.

community customs to mediate a satisfactory settlement. At the resolution of the dispute, the Land Clerk would record the mediated boundary and assist applicants in completing requirements for the registration of that land.

7.5 Equipment (Hardware)

7.5.1 Introduction

The selection of equipment for this dissertation had to conform to several basic requirements, most importantly cost. The cost to equip a significant number²⁷ of Land Clerks could be substantial and, consequently, this may be a determining factor in the number of Land Clerks hired. Since Land Clerks will typically work without direct supervision, the equipment must be of a proven technology. Thus, common off-the-shelf²⁸ products with good overall functionality and durability should serve as the basic minimum. Modifications of equipment would increase the cost and should therefore be avoided. With the Land Clerk collecting data from within the communities, the equipment will be taken into the field, so size, weight, and portability must be considered.

To outfit the Land Clerk, a portable computer system, such as a laptop, is needed. In addition, to print out various documents, a portable printer is required. When residents produce paper documents as proof of existing rights, the Land Clerk will need to make copies of those documents, thus requiring a scanner.²⁹ In order to register these rights to specific spatial coordinates, whether a single point identity³⁰ or a demarcation of the property boundaries will require a GPS receiver.

Several models of GPS receivers were used during this project, including two handheld receivers, the Garmin eTrex as the primary unit and the Garmin Foretrex-101 for comparison to the eTrex. Ashtech's ProMark 2, a considerably more accurate receiver, was also used to verify the accuracy of the handheld receivers.

With many areas of rural KwaZulu-Natal having no access to electrical power, Land Clerks need the capability to use and charge equipment at their residence with some form of Photovoltaic (PV) power. For this project, a single 10 W PV panel was used for charging batteries and equipment.

²⁷ At present, this is still unknown.

²⁸ Products or merchandise that is in common usage and easily replaced (usually carried as in-stock items vs. requiring special orders or custom manufacture).

²⁹ Or multifunctional scanner/copier/printer combination.

³⁰ i.e., Midpoint method, where instead of boundaries being registered, a single point at the approximate center of the property is registered. This single point serves as an initial start to the formalization of title in informal settlements (Fourie, 1994 and Jackson, 1996).

The following sections outline the equipment purchased or loaned by the University of KwaZulu-Natal for this dissertation. All equipment specifications were as provided by the manufacturer unless otherwise noted.³¹

7.5.2 Laptop Computer

For this project, a Compaq Presario 2100³² was purchased for R 8,499.95.³³ At the time of purchase, this model was a typical middle-range laptop computer, a pre-packaged model available from Compaq Computers. It was purchased from the Durban “Incredible Connection” store, which is one of a chain of 15 computer retail stores located throughout South Africa. This chain, as is common for most other computer retailers, only carries a limited number of the most common and best selling models.³⁴

In 2003, the Compaq Presario was available in several pre-packed configurations. While each computer was essentially identical externally, internally they differed in the amount of RAM memory, processor speed, and hard drive capacity. The preconfigured version purchased by the University was the very basic model, consisting of an Intel Celeron processor (1.8 GHz), 256 MB RAM,³⁵ 20 GB hard drive, 3.5-inch internal disk drive, and a CD/DVD player.³⁶ This model was thinner and lighter than most laptop computers on the market at the time, measuring 33 x 27 x 4 cm and weighing 3.6 kg. The computer screen was a 14-inch³⁷ active-matrix display with a maximum resolution of 1024 x 768 pixels.

Located on the top front of the computer are a touchpad³⁸ and two buttons that essentially replace the need for a mouse. This turned out to be a very practical feature for use in the field. Furthermore, the Presario came with a full assortment of ports and slots. At the rear of the computer were two USB ports,³⁹ RJ-45,⁴⁰ S-Video out jack, a parallel

³¹ For more detailed descriptions, see Equipment (Appendix B/page 239).

³² Reference Source: (Compaq, 2003). See Compaq Presario 2100 Computer (Appendix B /page 240).

³³ October 2003.

³⁴ Since its purchase in 2003, this model is no longer carried by Incredible Connection, and appears to be on the verge of being withdrawn from the market by Compaq Computers.

³⁵ 266 MHz DDR SDRAM.

³⁶ CD-RW/DVD-ROM combo.

³⁷ 35.6 cm.

³⁸ With scroll pad.

³⁹ USB 1.1.

⁴⁰ Connects a network cable.

port,⁴¹ a serial port,⁴² and an external monitor port. Located on the left side of the computer were a RJ-11,⁴³ PC Card and CardBus slot and button, and two audio jacks.

The Compaq Presario was powered by the standard AC adapter or via battery power. Included with the purchase was a single Li-ON⁴⁴ battery, requiring up to 4 hours to fully charge. Depending on how the computer is used, several other battery options were available. These include NiCd⁴⁵ and NiMH⁴⁶ options, each having specific advantages and disadvantages. The Li-ON battery had the advantage of no memory effect when charging, whereas the other two should be fully discharged before charging. The NiCd battery could be fully charged in only one hour, while the Li-ON and NiMH batteries require at least two to four hours. The NiCd battery had a relatively short lifespan of 500 charging cycles, whereas the Li-ON had 1,200 and the NiCd had 500 to 2,000 charging cycles.

The duration of a fully charged battery (Li-ON) was approximately three hours, though the connection of peripheral devices such as a scanner or printer could significantly reduce this time. Thus, an alternative power source was required for any computer work lasting more than a few hours in the field. Purchasing spare batteries was an option, but these can cost as much as R 800 each.⁴⁷

7.5.3 Printer

For printing in the field, a small portable printer with minimal power requirements is essential. Due to its portability and its ability to run on batteries, the HP DeskJet-450cbi colour printer⁴⁸ was purchased for R 2,999.95.⁴⁹ In 2003, this printer was one of the most compact and lightweight models on the market and one of HP's best-selling portable printers. The 450 series of printers were available in three models: the 450wbt, 450cbi, and 450ci. Each model was almost identical, with the difference being that the 450wbt included integrated Bluetooth wireless technology;⁵⁰ the 450cbi included a battery, while the 450ci does not.

The 450cbi model was very compact, measuring 34 x 8 x 17 cm and weighing 2 kg.⁵¹ Power consumption was approximately 25 W while printing and 5 W while idle.

⁴¹ LPT1 (connects a parallel printer).

⁴² COM1 (serial mouse, modem printer or other serial device).

⁴³ Connects a modem cable.

⁴⁴ Lithium Ion.

⁴⁵ Nickel Cadmium.

⁴⁶ Nickel-Metal Hydride.

⁴⁷ i.e., Li-ON battery (14.8 V 4400 mAh), at Laptop Accessories, Johannesburg (May 2005).

⁴⁸ Reference Source: (HP, 2005). See HP DeskJet 450cbi Printer (Appendix B/page 243).

⁴⁹ October 2003.

⁵⁰ Bluetooth is a short-range (~10 m) wireless networking protocol used mostly to connect one computer to another, as well as to peripherals like printers, pocket PCs, and cell phones.

⁵¹ 2.2 kg with print cartridges and battery.

Although this model came with a standard AC adapter, it also had an easily attachable Li-ON battery that allowed for printing up to 300 A4⁵² pages on a fully charged battery at a rate of nine pages per minute.⁵³

Print quality of the DeskJet 450cbi was 1,200 x 1,200 dpi resolution for black text and 4,800 x 1,200 “optimized” dpi for photo printing. The printer’s internal memory included 4 MB ROM and 16 MB RAM. As a colour printer, the DeskJet required both black and colour cartridges. The black cartridge was interchangeable with an optional photo colour cartridge designed for higher-quality colour printing. Depending on how often the printer was used, consumables could potentially become expensive. For example, the price⁵⁴ for a black cartridge⁵⁵ was R 205, for a colour cartridge⁵⁶ the price was R 300, and a photo cartridge⁵⁷ was R 280.

On the rear of the printer was a type II CompactFlash slot that could be used for memory disks,⁵⁸ allowing the user to print images from a digital camera⁵⁹ directly from the memory disk, bypassing the computer. This slot also allowed for the addition of an optional Bluetooth adapter.

Connectivity choices for this printer included computer/printer connections via a (supplied) parallel cable, a USB connection, infrared, or optional Bluetooth. Wireless printing could be done from a variety of wired and wireless devices, including laptops, PDAs,⁶⁰ mobile phones, and some digital cameras.

7.5.4 Scanner

For a scanner, the Canon CanoScan LiDE-20 colour scanner⁶¹ was purchased for R 599.95.⁶² This model was one of the new lines of slim-flatbed scanners recently put on the market, more compact (38 x 26 x 4 cm) and lighter (1.5 kg) than most comparable models. It was generally considered an entry-level scanner, designed mainly for home use. The scanner had an optical resolution of 600 x 1,200 dpi (48-bit colour) and was able to scan and copy A4 and legal size documents. Although this scanner was known as

⁵² 210 x 297 mm.

⁵³ Depending on the colours used.

⁵⁴ Average price from “DigitalPlanet” (<http://www.digitalplanet.co.za>), “Incredible Connections” (Durban, KwaZulu-Natal), and “Paper etc.” (Houghton, SA) (May 2005).

⁵⁵ HP No 56 Black Inkjet Print Cartridge (C6656AE).

⁵⁶ HP No 57 Tri-Colour InkJet Print Cartridge (17 ml).

⁵⁷ HP No 58 Photo InkJet Print Cartridge (C6658A).

⁵⁸ i.e., from a camera or PDA.

⁵⁹ Camera must support DPOF (Digital Print Order Format).

⁶⁰ Personal Digital Assistant. A portable (and typically much smaller than a laptop) handheld electronic device used to manage information. Also known as a Handheld or Palmtop.

⁶¹ Reference Source: (Canon, 2004). See Canon LiDE 20 Scanner (Appendix B/page 240).

⁶² October 2003.

a flatbed scanner, it could also be orientated and used vertically with a supplied “upright scanning stand.”

Canon’s LiDE line of scanners was “plug & play,”⁶³ connecting to the computer via a USB 2.0 connection.⁶⁴ This line of scanners required significantly less power than previous models, with power consumption of approximately 2.5 W when scanning and 1.25 W at standby. The scanner was powered via the computer through the USB port, so no AC adapter was required.⁶⁵

Three “EZ Buttons” were located on the front of the scanner: SCAN, COPY, and E-MAIL. These were programmable buttons that allow frequently used processes to be automated. For example, once programmed they could be used to scan a document and automatically print it or save it directly to a file (i.e., PDF file).

7.5.5 Carrying Case

A portable carrying case⁶⁶ was built at the University that allowed the computer, scanner, and printer to be carried around in a “suitcase-like” wooden case. This allowed the Clerk to have all equipment in one portable case. The case was designed to unfold into a small table or to be collapsed into a portable carrying case. The Clerk could pick up the case, travel to the required site, and then open and unfold it into a small table. Upon completion of the work, the table was collapsed back into a carrying case for transport to the next site.

7.5.6 GPS (Garmin eTrex)

The main GPS receiver used for this project was the handheld Garmin eTrex,⁶⁷ which is available in six models: Basic, Summit, Legend, Venture, Vista, and Camo.⁶⁸ While each had the same accuracy,⁶⁹ variations in models and their costs were determined mainly by display and memory options. For this project, the least expensive Basic model was used.

⁶³ Plug & play refers to the ability of certain operating systems to automatically detect and identify a new device added to the system, and install the required drivers and system files for that device.

⁶⁴ Limited by the Compaq Presario’s USB 1.1 port.

⁶⁵ Also meaning that the computer’s battery drains faster.

⁶⁶ See Figure 13: Training [Melmoth] and Figure 14: Training [Melmoth] (Appendix E/page 263).

⁶⁷ Reference Source: (Garmin, 2000, 2003a, 2003b, 2004a, 2004e). See Garmin eTrex GPS Receiver (Appendix B/page 241), and Figure 4: eTrex GPS Receiver (page 135).

⁶⁸ See Table 3: eTrex and Foretrex GPS Receivers (page 132), and Table 4: eTrex GPS Receivers (page 133)

⁶⁹ Garmin quotes accuracy of the Basic and Summit as “15 m,” and the Legend, Venture, Vista and Camo as “< 15 m.”

The eTrex⁷⁰ was a handheld GPS receiver, similar in size to a typical cell phone. It was small and light, measuring 11.1 x 5.1 x 3.0 cm and weighing 150 g,⁷¹ easily fitting in one's palm and making it ideal for fieldwork. It had a 12-channel receiver with a positional accuracy of approximately 15 m, which can be reduced to 1 - 5 m with differential GPS (DGPS) corrections.⁷² The antenna is built in, enclosed in a bright-yellow high-impact waterproof (IPX7)⁷³ case. The eTrex can store up to 500 waypoints and is powered by two - 1.5 V AA batteries that allow for approximately 22 hours⁷⁴ of use. The receiver can be connected directly to a computer, DGPS beacon receivers, or external NMEA⁷⁵ devices. Satellite acquisition time was approximately 45 seconds for a cold start and 15 seconds for a warm start.

Information was displayed on a small 4 - level grayscale screen measuring 2.7 x 5.4 cm (128 x 64 pixels). In periods of low light, a backlight feature could be turned on, automatically turning off after 30 seconds to conserve battery power. Running the eTrex was done via four screens (generally referred to as pages): the Satellite, Map, Menu, and Pointer pages.⁷⁶

The "Satellite" page⁷⁷ showed the receiver's status and whether the receiver was ready for use. This page could display up to 12 satellites, identifying each satellite by assigned number, the strength of each satellite signal being received, and whether that satellite has been locked onto (i.e., which ones have complete ephemeris data and which ones are still in the process). In addition, the approximate position of each satellite in the sky was graphically displayed and an estimated positional accuracy was shown. The receiver could not be used (i.e., coordinates collected) until the "Ready to Navigate" screen appeared, indicating that the receiver had located and was receiving signals from a minimum of three satellites. Once three satellites have been fixed, positional data was available for a 2-D fix. When four satellites have been fixed, positional data was available for a 3-D fix.

⁷⁰ Hereafter referring to the Basic model.

⁷¹ With batteries.

⁷² With optional Garmin Differential Beacon Receiver Import (such as Garmin GBR 21) (Garmin, 2003b).

⁷³ Can remain submerged at a depth of 1 m for 30 minutes.

⁷⁴ This refers to the eTrex running in the Battery Saver Mode.

⁷⁵ National Marine Electronics Association (NMEA) is a US standards committee that defines data message structure, contents, and protocols to allow the GPS receiver to communicate with other pieces of electronic equipment.

⁷⁶ See Figure 2: eTrex Screens [Satellite, Map, and Pointer Pages] (page 134), and Figure 3: eTrex Screens [Menu Pages] (page 134)

⁷⁷ See Figure 2: eTrex Screens [Satellite, Map, and Pointer Pages] (page 134).

The “Map” page⁷⁸ showed a graphical screen where the user was shown in relation to previously established waypoints. This screen could display tracks, routes, and waypoints using a scale that varies from 200 ft to 800 miles.⁷⁹

The “Pointer” page⁸⁰ used the display of a directional arrow in a compass ring for navigating to the waypoints. This page can be toggled to show speed, position coordinates, elevation, and bearing.

The “Menu” page⁸¹ allowed access to all other functions, including managing waypoints (marking and editing), routes and tracks, and setting various operational parameters of the receiver such as units of distance, map datum, and coordinate systems.

The previously mentioned pages were controlled by buttons located on each side of the eTrex. This allowed for one-handed operation of the receiver without obstructing the view of the display. Two buttons are found on the right side: a “Power” button that acted simply as an on/off switch and a “Page” button that allowed the user to scroll between the four previously mentioned pages. The left side had three buttons: an “Up” and a “Down” button to allow the user to move within pages and highlight menu items and the “Enter” button to confirm data entry or menu selections on the current page and to display options on the main pages.

The eTrex’s used for this dissertation were supplied for no cost by the University of KwaZulu-Natal. However, the purchase of a Basic model eTrex is approximately R 1,235.⁸²

7.5.7 GPS (Garmin Foretrex-101)

The Garmin Foretrex 101⁸³ GPS receiver was also a handheld unit comparable to the eTrex in most respects. The Foretrex was designed as a “wrist-mounted” GPS, marketed to outdoor recreationists at a cost of approximately R 1,486.⁸⁴ It was slightly smaller than the eTrex, measuring 4.3 x 8.4 x 2.3 cm and is almost half the weight at 78 g.

Internally, the Foretrex 101 also has a 12-channel receiver with a quoted GPS accuracy of “< 15 m.”⁸⁵ Satellite acquisition time was 45 seconds for a cold start and 15 seconds for a warm start. The Foretrex was enclosed in a high-impact case with a built-in

⁷⁸ See Figure 2: eTrex Screens [Satellite, Map, and Pointer Pages] (page 134).

⁷⁹ ~61 m to ~1,287 km.

⁸⁰ See Figure 2: eTrex Screens [Satellite, Map, and Pointer Pages] (page 134).

⁸¹ See Figure 3: eTrex Screens [Menu Pages] (page 134).

⁸² Average price from “TechShop” (Rooihuiskraal, SA (R 1,202.13)) and “Navstar SA” (Durban, KZN, SA (R 1,265.00)) (Price includes VAT) (April 2005).

⁸³ Reference Source: (Garmin, 2003c, 2004b, 2004c, 2004d). See Garmin Foretrex 101 GPS Receiver (Appendix B/page 242).

⁸⁴ Average price from “TechShop” (Rooihuiskraal, SA (R 1,472.88)) and “Navstar SA” (Durban, KZN, SA (R 1,550.00)) (Price includes VAT) (April 2005).

⁸⁵ Garmin quotes position accuracy as < 15 m (95 % typical), (15 m or less in normal GPS mode).

antenna and is waterproofed to the same standard⁸⁶ as the eTrex. Unlike the eTrex, the Foretrex is powered by two 1.5 V AAA batteries, limiting the battery life to approximately 15 hours.

Data was displayed on a small black-and-white LCD screen measuring 2.34 x 3.66 cm (64 x 100 pixels). The Foretrex was operated by six main pages: Satellite, Map, Navigation, Main Menu, Timer, and Trip. These pages are in turn, controlled by six buttons: Power, Goto, Page, Enter/Mark, Up and Down, all located on the bottom side of the screen. The “Goto” button was used to navigate to a specific destination (waypoint), “Page” switched between pages, and “Enter/Mark” confirmed data entry or menu selection and, when held, marked the waypoint. The “Up” and “Down” buttons were used to highlight options on the various pages and menus.

7.5.8 GPS (Ashtech ProMark 2)

A third GPS receiver, the Ashtech ProMark 2,⁸⁷ was used to check the accuracy of the handheld receivers. The ProMark supported 12 independent GPS channels providing meter-level navigation and centimeter-level survey accuracy. In kinematic mode, the ProMark had a horizontal accuracy of 0.012 m + 2.5 ppm and a vertical accuracy of 0.015 m + 2.5 ppm. In static mode, the ProMark had a horizontal accuracy of 0.005 m + 1 ppm and a vertical accuracy of 0.010 m + 2 ppm (RMS). The static data collection method⁸⁸ produces the most accurate and reliable results due to the extended observation periods required. Consequently, this method was used in Ekuthuleni to check on the results obtained by the eTrex and Foretrex.

7.5.9 Digital Camera

The 5-megapixel Pentax Optio-550 digital camera⁸⁹ was used in the field to document residential sites. This was a small pocket-size camera measuring 10 x 6 x 4 cm and weighing 250 g. It is powered by a single rechargeable Li-ION battery, which allowed for a minimum 100 photographs per charge, that were stored on removable SD memory

⁸⁶ IPX7.

⁸⁷ Thales Navigation Inc. Reference Source: (Thales, 2004). See Ashtech ProMark 2 GPS Receiver (Appendix B/page 239).

⁸⁸ In static mode, two GPS receivers are positioned stationary in separate locations where their receivers simultaneously collect raw data (pseudorange) from all available satellites. The length of time required for data collection is dependent on various factors such as satellite geometry, distance between receivers and any obstructions that may be present (i.e., trees, buildings, etc.). When data collection is complete at one point, the GPS receiver is moved to a new location to begin another data collection session. Once all the required data has been collected, the data is downloaded from the receivers to a computer for post-processing.

⁸⁹ Reference Source: (Pentax, 2003, 2005). See Pentax Optio 550 Digital Camera (Appendix B/page 243).

cards⁹⁰ in either JPEG or TIFF formats. Transferring photographs to a computer could be done in several ways. The camera could be plugged into the computer's USB port via a special cable and the computer's software used to transfer images directly to the hard drive or the memory card from the camera could be physically removed and inserted into an external card reader connected to the computer. Many of the newer computers have built-in digital media card readers that allow memory cards to be read directly by the computer. For example, the previously mentioned DeskJet-450 Printer has a built-in card reader that allowed for the printing of images directly from the memory card.

7.6 Equipment (Software)

7.6.1 Introduction

In addition to the previously mentioned equipment, a number of commercially available software programmes were necessary. Some of these programmes, such as the operating system, word processing, and scanner programme are generally pre-packaged with the purchase of the computer or scanner. Programmes that would enable downloading of the eTrex data, as well as allow the graphical viewing of data, include GPS Track-Maker and MapSource. The use of a database, however, required the writing of a specific database programme with safeguards to ensure the integrity of the data.

7.6.2 Packaged Programmes

The Compaq Presario's operating system (MS Windows XP),⁹¹ Microsoft Office 2003,⁹² and several other programmes were included in the purchase price of the computer. The MS-Office package included the latest versions (2003) of Access, Excel, FrontPage, Outlook, PowerPoint, and Word. While some of these programmes were not required, a word processing programme such as MS-Word should be a basic requirement for a Land Clerk. When purchasing a new computer, an option may be available to substitute scaled-down versions of some programmes, like the MS-Office Basic version that includes only Excel, Outlook, and Word. Alternatively, the programmes could be purchased individually, although the savings are not always cheaper than a packaged suite.

In addition to the MS programmes, the scanner⁹³ also included several software programmes. Most of these were designed for digital image editing or character recognition applications and were not used. One of the included programmes, however, was the CanoScan Toolbox quick-launch interface, which enabled the user to access individual modules of the various scanner applications by selecting a single icon on the menu bar. With a few clicks of the mouse, scans could be sent directly to a specific file directory or directly to the printer, greatly simplifying basic scanning routines.

⁹⁰ A SD (Secure Digital) card is a tiny memory card used to make storage portable among various devices, such as digital cameras, personal computers, cellular phones, and PDAs. SD cards are available in various sizes such as 128, 256, and 512 MB.

⁹¹ Home Edition.

⁹² Small Business Edition.

⁹³ CanoScan LiDE 20.

7.6.3 GPS TrackMaker

GPS TrackMaker⁹⁴ is a mapping programme specifically designed for GPS applications. The programme allows for communication between the computer and various commercial GPS receivers, most notably, the Garmin⁹⁵ and Magellan models. The programme is a non-proprietary (shareware) programme available for free download.⁹⁶ Features of the programme include NMEA-0183 protocol for real-time navigation, which is compatible with most brands of GPS currently available on the market. The programme allows the user to create and edit track logs, routes, and waypoints. Waypoints can be assigned simple attributes, such as names and comments, and can be draped onto various backdrops, such as air photos or scanned images. Datums are non-definable in the shareware version, but the programme includes 280 of the most common datums.

A professional version⁹⁷ of GPS TrackMaker is available at a cost of R 431,⁹⁸ from the dealer's Web site. The professional version is similar to the shareware version, with the addition of more advanced features like the ability to import and export into AutoCAD (DXF format), ArcView (SHP format), and MapInfo (MID/MIF format). This version also permits users to calculate areas, allows user-defined datums, includes support for GeoTIFF⁹⁹/DRG,¹⁰⁰ and can open and save various formats such as BMP, JPG, GIF, TIFF, PNG, and PCX.

The GPS TrackMaker programme proved to be ideal as a simple means to visualize relative positions of coordinates in the field. The programme was a basic, easy-to-learn programme that was a good introductory programme for beginners. Survey grade plotting, would of course, require a more intricate programme.

7.6.4 MapSource

The Garmin MapSource¹⁰¹ programme is similar to GPS TrackMaker in that it allows for an exchange of data between the computer and Garmin GPS receivers. The programme provides geographical data on a CD-ROM to augment information on the Garmin GPS base-map. Several versions of this programme are available, such as the WorldMap version that provides a base-map for worldwide coverage that includes political boundaries, cities, towns, major roads and highways, lakes, major streams and rivers, and

⁹⁴ Reference Source: (GPS TrackMaker, 2005). See GPS TrackMaker (Appendix B/page 242).

⁹⁵ i.e., eTrex and Foretrex.

⁹⁶ Available at http://www.gpstm.com/eng/download_eng.htm, as a 3.8 MB self-extracting executable file.

⁹⁷ GPS TrackMaker Pro.

⁹⁸ Quoted as US\$ 65 (July 2005).

⁹⁹ Geocoded TIFF (A standard for storing georeference and geocoding information in a TIFF compliant raster file. This raster image format allows coordinate values to be embedded within raster data).

¹⁰⁰ Digital Raster Graphic.

¹⁰¹ Garmin.

coastlines. Most of these are large scale and would be of no use for detailed work. However, Garmin does produce a series of accessory programmes that cover specific areas of the world in much greater detail. Many versions allow the user to load detailed map information such as addresses, business listings, restaurants, banks, and gas stations. At present, these are limited mainly to North America and Europe, with no versions yet available for South Africa at the same detailed resolution.

7.6.5 RRR Database Programme

To register the required information for each “new order right” application, a special database would be required. For this project, a simple database programme entitled “Request for Recognition of Old Order Rights” (RRR) was written by the author using Microsoft Access 2003. To simplify¹⁰² data entry for someone not familiar with databases, the “form” option of MS-Access was used to create three custom forms for data entry.¹⁰³

Since a Land Clerk would only have a rudimentary introduction to databases, it was therefore essential that the programme be completely foolproof. The user of the database would need to avoid any of the usual programming and debugging aspects of databases. Consequently, the RRR database programme was written with the basic premise that a user would be unskilled in database management. Accordingly, a stand-alone programme that bypasses the normal Access menu system was required. In MS-Access, options are available that allow programmers to create standalone database forms that greatly simplify data entry for end-users. Using these forms, data can be entered or edited without having to actually load the programme in the usual way. A user only requires negligible knowledge of databases, and the entry process involves simply filling in data-fields on the computer as one would fill out a paper form.

To open the database, the user runs the programme directly from a (created) desktop icon. Double-clicking this icon opens the programme and takes the user directly to one of three database entry forms. Each form fills the entire screen, omitting the “usual” MS-Access menu and any of the Windows taskbars. With the screen filled and the menus removed, the user is prevented from inadvertently losing the window or jumping to a different programme.¹⁰⁴ Entering data into these forms is done as data would be entered into a paper form; personal information is entered on page 1, contact information on page 2, and information pertaining to the asset (property) on page 3.

¹⁰² This research project is mainly interested in the process of “collecting data” than the “quality of data” collected. Thus, in many instances data collection has been limited to representative samples.

¹⁰³ See Figure 27: RRR Database Programme [Page 1], and Figure 28: RRR Database Programme [Page 3] (Appendix F/page 273).

¹⁰⁴ i.e., accidentally jumping to a different window, exiting the programme, minimizing the database window, etc.

Data Capture

As mentioned, the process of data capture, begins with a simple double-click on the “RRR Database” desktop icon to open the first of three pages. Pages are displayed in sequential order, allowing for data entry pertaining to one record at a time with each applicant stored as a single database record.

Page 1 (Form 1)¹⁰⁵ of the database allows data to be entered that pertains to personal information. The collection of data was set up under the premise that a family unit or group of people would collectively make a request for the recognition of their old order rights and for the transfer of those rights into new order rights. The request would be made in the name of a single individual, such as the head of a household or possibly a group representative. Other members of the group would then join this individual as co-applicants¹⁰⁶ in the request. The form was set up for data entry for a single applicant with space provided for five other co-applicants.¹⁰⁷ Name, ID number, sex and birth dates¹⁰⁸ were collected for each applicant. To allow for any additional information, an area was reserved at the bottom of the page (Notes) for written text. This was coded as a “Memo” field to allow for the entry of alphanumeric characters and long strings up to 64,000 characters.

Page 2 (Form 2) of the database was reserved for personal contact information. Data fields included community name,¹⁰⁹ address,¹¹⁰ e-mail, residential phone, cell phone, and notes.¹¹¹

Page 3 (Form 3)¹¹² of the database was for the collection of data pertaining to the asset under consideration.¹¹³ To support the applicant’s claim for new order rights, any information supporting that claim must be recorded. Data fields included the number of years that the applicant had occupied the land, the current form of that ownership,¹¹⁴ and the number of dwellings. Two text data-fields¹¹⁵ allowed for a written description of the asset and any other miscellaneous notes to be recorded. In addition, a data field was provided to note whether the applicant was supported in their request by the tribal

¹⁰⁵ See Figure 27: RRR Database Programme [Page 1] (Appendix F/page 273).

¹⁰⁶ i.e., family and/or extended family members.

¹⁰⁷ The choice of 5 was purely for reasons of space.

¹⁰⁸ Both sex and birth date are also reflected in the ID number (digits 1 - 6 indicate birth date and digits 7 - 10 indicate gender).

¹⁰⁹ i.e., Ekuthuleni.

¹¹⁰ In Ekuthuleni, these usually meant a postal box number or “care of ” another individual or family member.

¹¹¹ MS-Access Field Data Type: Memo (Stores up to 63,999 characters).

¹¹² See Figure 28: RRR Database Programme [Page 3] (Appendix F/page 273).

¹¹³ i.e., the property and/or the land in which the request was made.

¹¹⁴ i.e., PTO.

¹¹⁵ Both MS-Access Field Data Type: Memo.

authority,¹¹⁶ and any witnesses¹¹⁷ (to the transaction). To spatially tie in this request, a single GPS fix¹¹⁸ of the approximate center of the land parcel was noted. Another field allowed the user to record photo numbers of any digital photos taken.¹¹⁹ Finally, Clerks entered their name and verified the date,¹²⁰ thereby completing data entry for that applicant (record).

The record number¹²¹ and the surname¹²² of that applicant were displayed at the top right-hand corner of each page. This would be the surname of the applicant, as entered on the first line of page 1. This helped to prevent mistakenly entering data for one individual into the record of another.

At the bottom of each page,¹²³ a toolbar consisted of between two and ten different icons. These icons were links to database macros written specifically to move between pages or to move in and out of the database to use other programmes.¹²⁴ Two icons¹²⁵ located in the lower left of each page allowed the user to scroll between pages while remaining within the same record. Eight additional icons located at the bottom of page 3 links the user to frequently used programmes and procedures. Two icons¹²⁶ allowed the user to scroll between database records, that is, between different applicants. The six remaining icons¹²⁷ allowed the user to shell out¹²⁸ of the database and use various other programmes. The icon labeled “GARMIN” opened the MapSource programme, while the “W” icon allowed the user to access a word processing programme (MS Word). The “Scan” icon was linked to the CanoScan Toolbox quick-launch interface, where the user had access to all scanning features. The “Printer” icon sent data for the current record directly to the printer, where it was printed in a predefined A4 size form. Before printing, this form could be previewed by the “Preview” icon, which displayed the form on the computer screen in print-view.¹²⁹ Finally, the “TMaker” icon opened the GPS

¹¹⁶ i.e., the Induna.

¹¹⁷ i.e., immediate neighbours, other members of the tribal authority, etc.

¹¹⁸ Latitude and longitude.

¹¹⁹ Photo numbers as given by camera (i.e., photos 1234 - 1237).

¹²⁰ Automatically entered by programme.

¹²¹ i.e., 1, 2, 3, etc.

¹²² Each name would have a unique record number.

¹²³ See Figure 27: RRR Database Programme [Page 1], and Figure 28: RRR Database Programme [Page 3] (Appendix F/page 273).

¹²⁴ i.e., without having to access the usual MS-Access commands or to close the database.

¹²⁵ Previous page/next page [pointing hand icon].

¹²⁶ Previous record/next record [triangle icon].

¹²⁷ Labeled GARMIN, Word [W icon], Scan, Print [printer icon], Preview [notebook icon], and TMaker.

¹²⁸ To temporarily exit the database (without actually closing the programme), go to another application, perform a function, and then return to the database.

¹²⁹ i.e., exactly as the form would be printed out.

TrackMaker programme. As each of these programmes were used and exited, the macros returned the user to page 3 of the database's current record.

7.7 Photovoltaic Power

7.7.1 Introduction

The Ekuthuleni community, as with most areas of rural KwaZulu-Natal, had little or no access to electricity. Thus, a means of powering and charging equipment, as well as the ability to work at one's residence, would be highly advantageous. To address this requirement, a solar panel was purchased and set up at one of the Clerk's residence. This setup would allow the Clerk to charge batteries, work on the computer at night, and use excess power to light their residence.

The process of converting light into electrical energy is known as Photovoltaics (PV), and the collective system of components producing power by this means is known as a Photovoltaic system (PV system). A PV system, in turn, is comprised of various components, such as one or more solar panels (PV panels), charge regulator, batteries, an inverter, and wiring.

7.7.2 Basics of Photovoltaic Power

Of all the energy received from the sun, almost 35 % is reflected by clouds and a further 19 % is absorbed by the atmosphere (Wikipedia, 2005). The remaining energy received at the Earth's surface, known as the solar constant, is in the order of 1,400 W/m². This means that, on average, a surface one-meter square orientated perpendicular to the direction of the sun's rays receives approximately 1,400 W (Wikipedia, 2005).

The means of quantifying energy received in specific localities is usually expressed as energy per given area.¹³⁰ As a means of smoothing out the variation of intensity of solar radiation throughout the day into a daily average, the term Peak Sun Hours is often used. This term indicates the number of hours per day when solar irradiance¹³¹ averages 1,000 W/m². For example, four peak sun hours indicates the energy received during total daylight hours would equal the energy received had the irradiance for four hours been 1,000 W/m². South Africa, due in part to its geographical position and dry climate, has some of the highest levels of solar insolation¹³² in the world, ranging between 4.8 kWh/m² to 6.9 kWh/m² nationally (NW Province, 2002) and approximately 5 kWh/m² for the Ekuthuleni area (Advanced Energy Group, 2005).

¹³⁰ i.e., the previously mentioned value of 1,400 W/m² for the solar constant.

¹³¹ Irradiance is the amount of direct, diffuse, and reflected solar radiation striking a surface, usually expressed as kW/m² or W/m². Irradiance over a given length of time is known as Insolation.

¹³² Now commonly referred to as Irradiation. It is the amount of solar energy received by a given area over time, generally expressed as kilowatt-hours per square meter (kWh/m²). Equivalent to Peak Sun Hours.

The intensity of the sun's radiation changes throughout the day, throughout the year, and can be adversely affected by weather. As the sun moves across the sky, the daily radiation changes with maximum irradiance at solar noon.¹³³ At this point, the Sun's rays have the least amount of atmosphere to pass through, so this is the most productive time to generate power. Productivity decreases significantly before and after solar noon. Seasonally, insolation is lowest in winter due in part to the sun's lower position in the sky and the shorter length of days. In certain areas of South Africa, seasonal variations in weather, such as periods of extended cloud cover, can significantly decrease available solar radiation.

To compensate for these daily and seasonal variations, PV panels need to be optimally oriented. To maximize output, they need to be orientated in the direction that captures the most solar radiation. Each site is somewhat different, but the orientation of solar panels is generally a function of latitude and one's geographical locality. Over the course of a year, the sun's elevation changes by 47° from the summer solstice to the winter solstice.¹³⁴ In the northern hemisphere, panels are directed at solar South,¹³⁵ whereas, in the southern hemisphere they are directed at solar North. Most manufacturers of solar products have simple worksheets that allow clients to work out the correct orientation of PV panels. In addition, simple calculations can be used to optimize orientation and to account for seasonal variations. As a rule of thumb, the tilt of a PV panel should be equal to one's latitude. At Ekuthuleni, with latitude of approximately 29° S, the panel would be tilted 29° up from the horizontal. This would give the maximum annual energy production. This can be further optimized by subtracting an additional 15° in summer and adding an additional 15° in winter (Macslab, 2005). Depending on the amount of time and investment one wants to devote to this matter, numerous other adjustments can be made to further optimize orientation. For example, some of the more expensive arrays have built-in tracking systems that allow the panels to follow the sun across the sky. These tracking systems can increase energy production by as much as 35 % over the course of a year (USDE, 2005).

7.7.3 Designing a Photovoltaic Power System

In designing an autonomous and cost-effective PV system, many things need to be considered. Before any purchase, one must know which equipment will be powered, how long the equipment will have to be powered, and how often it will be used. Other factors for consideration include the number of sunless days, recharging inefficiencies, minimum temperature at which the batteries will be used, rate of battery self-discharge, and the built-in reserve capacity.

In initially determining the DC voltage, the inefficiencies and voltage losses in the system should be considered. A PV system needs to produce a voltage greater than the

¹³³ Defined as the midpoint (in time), between sunrise and sunset.

¹³⁴ As the sun moves from 23.5° S to 23.5° N.

¹³⁵ Solar south is the position of the sun midpoint (in time), between sunrise and sunset.
Synonymous with solar noon.

battery(s) to be charged. If the PV array is located too far from the battery bank,¹³⁶ the DC voltage may need to be increased. For example, if the panels are wired to charge a 12 V battery, a limit exists for the distance the charge can be carried. It may be more practical to have 24 V nominal charging since 24 V can be carried farther than 12 V over the same wire size.

A typical basic system of producing electricity via photovoltaic means requires four primary components: PV module(s),¹³⁷ a charge controller, battery(s), and an inverter. A basic PV system consists of the PV module(s) connected to a charge regulator (to ensure the correct charge), which is connected to the batteries. An inverter then takes the DC voltage from the battery converting it into a usable AC voltage. This interconnected system functions as a single unit to produce electricity via the Photovoltaics process and is known as a PV array or PV system.

7.7.4 PV Modules

The smallest semiconductor element in any PV system, that is, the component that converts light into electrical energy, is the PV cell. Multiple PV cells are connected together in an environmentally protected casing to form a PV module or PV panel, commonly referred to as a solar panel. The performance of a panel is measured in terms of its efficiency in turning sunlight into electricity. In most instances, this means the higher the efficiency, the higher the cost. PV modules also vary in their durability, size, and shape with each factor affecting the retail price. Depending on the various features, PV panels can account for up to 50 % of the total cost of any installed Photovoltaic energy system.

The number of PV modules required at any given location can be easily approximated. Generally, the number is a function of various factors such as the desired power output, amount of sunshine at the site, the length of time without backup that is required, and the peak electricity demand at any given time. The use of cheaper, less efficient panels will necessitate the use of larger arrays. If the system is required to provide electricity 24 hours a day, then modules are often combined with batteries into a single integrated energy system to allow the system to be fully independent.

To obtain the desired power, multiple panels are connected in series or in parallel to increase the voltage and/or amperage. Generally speaking, if two panels were connected in series, they would produce a voltage equal to the sum of the two panels with the amperage remaining the same. For example, two 12 V/0.8 A panels connected in series produce a voltage of 24 V/0.8 A. For two panels connected in parallel, the voltage would remain the same but the amperage would be equal to the sum of the number of panels. In the previous example, this would be 12 V/1.6 A. Panels can also be connected in various combinations of series and parallel to obtain almost any desired power. Table 5 (page 135) is an example of how a desired power could be obtained. For example, a

¹³⁶ A group of batteries wired together.

¹³⁷ Often used interchangeably with “PV panel” or “solar panel.”

PV system required to generate 100 W using 4 % efficient PV modules would require 2.8 m² of PV panels.¹³⁸

A typical PV system that is well designed and maintained can operate for more than 20 years. The basic PV module, which has no moving parts, has an expected lifetime in excess of 30 years (USDE, 2005), and many of the newer PV panels provide warranties of up to 20 years or more. Over time, however, and under conditions of prolonged exposure to sunlight, the electric-generating capacity (efficiency) decreases at a rate of slightly less than 1 % per year (USDE, 2003).

7.7.5 Batteries

The next step in the design of a PV system is the consideration of required storage capacity. Taking into account the maximum charge and discharge rates, the rate that requires the largest capacity will dictate the battery size. A group of batteries wired together, known as a Battery Bank, is generally used to store power. This allows the user to use stored power at night or on overcast days, and to use more power than the system can provide at any one time.

The most common batteries on the market are lead-acid because of their relative low cost, availability, and reliability. Generally, batteries are manufactured for two broad applications: those designed for starting and those referred to as deep cycle.

A starter battery, as its name implies, is designed to discharge a significant amount of energy quickly and for a short period. The most common example of this is starting a combustion engine in a car. A car battery will discharge a large current for a short time to start the car and is then immediately recharged as the car is driven. These batteries are not designed to be discharged deeply and will only tolerate being completely discharged a finite number of times before irreversible damage is done to the battery.

Batteries used in PV systems generally must discharge a smaller current for a longer period (i.e., all night), while being charged during the day. For this type of usage, deep cycle batteries are preferred. These batteries are designed with thicker lead plates that allow them to better tolerate deep discharges. They do not have the capacity to dispense a charge as quickly as would a starter battery, as they are more suited to situations that require frequent discharging and charging. They can be repeatedly discharged to an 80 % Depth of Discharge (DOD), meaning that 80 % of the battery can be effectively used (discharged),¹³⁹ and this can be done hundreds of times with minimal loss of capacity.

As with most batteries, deep cycle batteries are available in various sizes and designs to meet almost any need. These batteries are available as wet-cells or as sealed batteries. The sealed battery is preferential to a wet-cell because it is essentially maintenance-free. They do not need watering and can be mounted in any position. Their no-maintenance

¹³⁸ See Table 5: PV Modules (page 135).

¹³⁹ This means 80 % of the battery can be discharged while 20 % of full charge capacity remains.

feature is desirable for any user who has a minimal knowledge in maintaining batteries (i.e., Land Clerk).

Deep cycle batteries are rated in amp-hours (Ah), which is the amount of amperage that the battery can supply over a specified period. For example, a 100 Ah battery could continuously supply 10 A for 10 hours or supply 5 A for 20 hours.

To ensure that a battery bank has significant amp-hour capacity to meet required power needs, a preliminary analysis of the requirements should be done. Once a desired capacity is determined, batteries can be purchased and connected in various combinations¹⁴⁰ to obtain the desired voltage and amp-hours.

For this project, two 12 V batteries were purchased at a cost of R 107 per battery. These were small “motorcycle style” batteries measuring 9.6 x 6.5 x 15 cm and weighing 2.55 kg each. These batteries were compact enough (and sealed) that they could be carried into the field, if required, as a backup power source for the computer.

7.7.6 Charge Controller

To prevent damage to a battery, they must be operated within a specified range. Therefore, to prevent damage and to extend the life of a battery, a charge controller is required. This device essentially regulates and controls the flow of current to and from the battery to protect it from over-charging or over-discharging. Essentially, it is a smart switch that disconnects and reconnects power, as required, from the PV modules to the batteries. When the batteries are fully charged, the charge controller prevents current from the PV modules from further charging the batteries. Similarly, when the batteries have been drained to a specific level, the controller prevents more current from being drained from the batteries until they have been recharged.

For this project, a generic solar battery charge controller was purchased for R 260. This controller had four small indicator lights to indicate overcharge, full charge, trickle charge, and reversed polarity.

7.7.7 Power Inverter

Once energy in a PV system has been collected and stored in a battery bank, it needs to be converted to useable AC power. This process of converting stored battery voltage (DC) into standard 120 V/220 V AC electricity requires a power inverter, which is simply a device to convert power so that common AC appliances may be used.

Inverters are sized according to the loads that are likely to run at any given time. Input voltage is matched to the battery bank used in the system, and with a converter,¹⁴¹ 120 V AC can be stepped up to produce 120/240 V AC. For this project, a 2500 mA universal step-up converter was purchased for R 180.

¹⁴⁰ i.e., series or parallel.

¹⁴¹ Step-up converter.

7.7.8 Economic Considerations

One of the most obvious limitations with any PV system is that power is usually only produced intermittently (i.e., during daylight hours). In most instances, a stand-alone PV system, with adequate battery backup, is required. This may not be necessary if the PV system is also connected to a utility grid, where additional electricity can be drawn as needed (i.e., during the night). With PV-generated power usually more expensive than conventional utility-supplied power, the cost of installing a utility line over a short distance may be a viable option. While in most areas of rural KwaZulu-Natal, this may not be an option, other areas such as Ekuthuleni; it may be possible to tie into the existing Eskom grid.

Depending on the number of Land Clerks implemented, providing each Land Clerk with a PV system would require a significant up-front capital investment. The economic pay-back of such an investment would, of course, be a prime consideration. With respect to alternative energy sources, the capital outlay required for a single PV system may not make economic sense on a per capita basis. However, the economies of scale can make the installation of multiple systems a viable option. Loans amortizing costs over the expected life of a system (20 - 25 years) could significantly reduce initial capital outlay. Ideally, to help offset costs, the process would be tied into various market incentive programmes and existing or planned government-sponsored programmes. For example, assistance may be available under some of South Africa's rural electrification programmes, such as the South African government's 2004 invitation for bids to provide 40,000 rooftop solar power systems to rural areas. This is a major investment on the government's part, with financing for this project estimated at R 129 million¹⁴² (EIA, 2005).

¹⁴² Quoted as US\$ 19.4 million.

Table 3: eTrex and Foretrex GPS Receivers

	eTrex Basic	eTrex Summit	eTrex Legend	Foretrex 101
Receiver (channels)	12	12	12	12
Waypoints	500	500	1000	500
Built in Memory	N/A	N/A	8 MB	N/A
Battery Life (hrs)	22 (2 AA)	22 (2 AA)	18 (2 AA)	15 (2 AAA)
Display Size (cm)	5.4 x 2.7	5.4 x 2.7	5.4 x 2.7	2.3 x 3.6
Display Type (LCD)	4 level Grey	4 level Grey	4 level Grey	Black & White
Display (pixels)	128 x 64	128 x 64	288 x 160	64 x 100
Tracklog Points	1,536	3,000	10,000	10,000
WAAS Capability	N/A	N/A	Yes	Yes
Weight (g)	150	150	150	78
Size (cm)	11.2 x 5.1 x 3.0	11.2 x 5.1 x 3.0	11.2 x 5.1 x 3.0	4.3 x 8.4 x 2.3
Accuracy	15 m	15 m	< 15 m	< 15 m
Accuracy (DGPS)	-	-	< 3 m (WAAS)	< 3 m (WAAS)
MSRP (US\$)	\$ 106.24	\$ 214.27	\$ 182.13	\$ 138.65
TechShop, SA	R 1,202.13	R 2,101.02	R 2,804.97	R 1,472.88
Navstar, SA	R 1,265.00	R 2,212.00	R 2,953.00	R 1,550.00

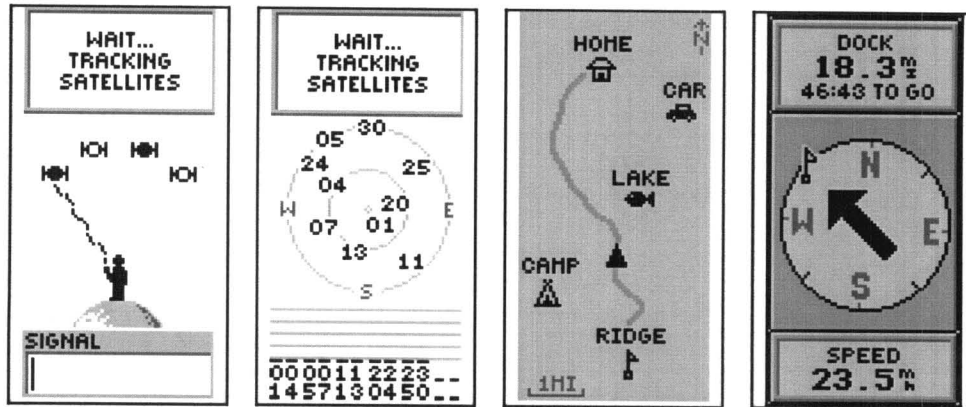
Source: (Garmin 2004a, 2004b, 2004d, 2004e, 2005), (TechShop 2005) and (Navstar 2005).

Table 4: eTrex GPS Receivers

	eTrex Basic	eTrex Venture	eTrex Vista	Foretrex Camo
Receiver (channels)	12	12	12	12
Waypoints	500	500	1000	500
Built in Memory	N/A	1 MB	24 MB	N/A
Battery Life (hrs)	22 (2 AA)	20 (2 AA)	12 (2 AA)	22 (2 AA)
Display Size (cm)	5.4 x 2.7	5.4 x 2.7	5.4 x 2.7	5.4 x 2.7
Display Type (LCD)	4 level Grey	4 level Grey	4 level Grey	4 level Grey
Display (pixels)	128 x 64	288 x 160	288 x 160	128 x 64
Tracklog Points	1,536	2,048	10,000	2,000
WAAS Capability	N/A	Yes	Yes	N/A
Weight (g)	150	150	150	150
Size (cm)	11.2 x 5.1 x 3.0	11.2 x 5.1 x 3.0	11.2 x 5.1 x 3.0	11.2 x 5.1 x 3.0
Accuracy	15 m	< 15 m	< 15 m	< 15 m
Accuracy (DGPS)	-	3 - 5 m	< 3 m (WAAS)	3 - 5 m
MSRP (US\$)	\$ 106.24	\$ 149.32	\$ 289.27	\$ 116.86
TechShop, SA	R 1,202.13	R 1,602.84	R 3,877.14	R 1,310.43
Navstar, SA	R 1,265.00	R 1,687.00	R 4,081.00	R 1,379.00

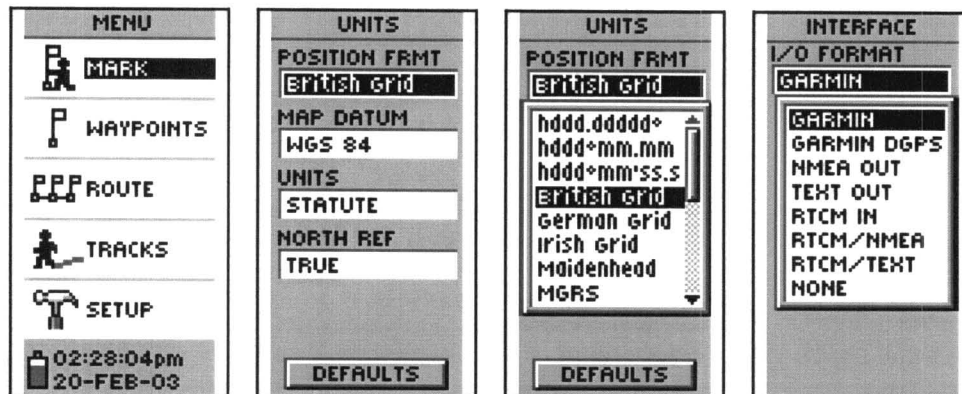
Source: (Garmin 2004a, 2004b, 2004d, 2004e, 2005), (TechShop 2005) and (Navstar 2005).

Figure 2: eTrex Screens [Satellite, Map, and Pointer Pages]



Satellite (Normal), Satellite (Advanced), Map, and Pointer Pages.

Figure 3: eTrex Screens [Menu Pages]



Menu (Main, Units-1, Units-2, Interface) Pages.

All Figures are Actual Size.

Table 5: PV Modules

PV Module Efficiency	PV Capacity Rating				
	100 W	250 W	500 W	1,000 W	10,000 W
4 %	2.8 m ²	7.0	13.9	27.8	278.7
8 %	1.4	3.5	7.0	13.9	139.4
12 %	0.9	2.3	4.6	9.3	92.9
16 %	0.7	1.9	3.7	7.4	74.3

PV Modules: Roof area needed in square meters.

Source: (USDE, 2003).

Figure 4: eTrex GPS Receiver



Garmin eTrex GPS Receiver/Basic Model [Actual Size]

8 Land Clerk Training and Implementation

8.1 Introduction

The field portion of this project was completed during several visits to the community of Ekuthuleni in October and November 2004. An initial visit in August 2004 with the Ekuthuleni Committee was used to outline how the project would work and to determine their interest in participating. Following this meeting, the Ekuthuleni Committee agreed to participate in the project and provide two representatives from the community for training as pseudo Land Clerks by the author and others from the University of KwaZulu-Natal.

A second visit to Ekuthuleni in October 2004 coincided with another research project undertaken by a fourth year Geomatics student, whose project involved mapping various features in the community using handheld GPS receivers. With the student's assistance, this provided an ideal opportunity to instruct the two chosen candidates (women) how to demarcate property boundaries using GPS. Over a period of four days, they were taught basic theory of GPS and were involved in several small mapping exercises using Garmin's handheld eTrex GPS receiver.

During a third and more extensive visit to the community in November 2004, the women were shown how the land reform process might work under CLARA using Land Clerks and Land Administrators. In particular, the women were shown how the Land Clerk might collect and register required information using a computer, selected peripherals and a handheld GPS receiver. Over a period of seven days, they were taught to use a computer, printer, scanner, and several software programmes. The object of this instruction was to provide them with the basic skills required by a Land Clerk. Once they were comfortable with using the equipment, several field exercises were conducted in which they went into the field as pseudo Land Clerks. These exercises involved collecting specific information from landowners, registering that information in a database, and delineating the property using a Garmin eTrex GPS receiver. In addition, to provide power for equipment use and charging batteries, a PV array was set up at one of the residences.

8.2 Instructional Philosophy

The instructional philosophy for training the women how to use a computer, selected peripherals, and handheld GPS was a linear presentation of content. Starting with the very basics, concepts became progressively more complex, with each new concept building on previously learnt material in a building block like fashion. There were no books or course material, and instruction consisted of one-on-one instruction. This entailed a hands-on approach, with course progress based on the women's interest and cognitive ability.

Instruction was in groups of three or four, involving the author and occasionally other members of the University.¹ Learning was all participatory, involving simple exercises and activities to reinforce previous learning sessions. To the extent that the limited time available would warrant, the goal of the instruction was to provide the women with a skill set that would allow them to operate as Land Clerks. This would include the ability to operate independently, run a computer, print and scan documents, and locate and register field positions using a handheld GPS receiver.

The learning outcome for this programme would use several field trials as a means of evaluation. The women, acting as pseudo Land Clerks, traveled to several localities in Ekuthuleni to field-test their newly acquired skills. They collected and registered all required information regarding the current property owner and demarcated the property boundaries using GPS.

8.3 Field Training

8.3.1 Introduction

In October and November 2004, the two women selected for this project by the Ekuthuleni Committee were trained in basic computer and GPS use. Training was done over a period of four days in October 2004 and seven days in November 2004. All training was in Ekuthuleni, except for the occasions when access to electrical power was needed and the training was at Jenny's B&B in Melmoth.

In October 2004, two full days and two partial days were spent working with the women and a fourth-year Geomatics student from the University of KwaZulu-Natal. This student was working on a similar GPS research project involving the collection of GPS coordinates at specific locations in the community. During this first visit, the women were taught the basics of GPS and how to use the Garmin eTrex GPS receiver.

In mid-November 2004, five full days and two partial days were spent with the women reviewing GPS use from the previous visit, and given additional instruction in using a computer, printer, and scanner. The women were taught how to use a laptop computer, how to print and scan documents, and how to use various software programmes, including a database programme² specially written for this project. In addition, each day the eTrex GPS receivers were used and reviewed.

Once they were comfortable with using the eTrex, the computer and peripherals, several field examples were undertaken in Ekuthuleni to field-test equipment and techniques. Similar to the envisioned Land Clerk, the object of this exercise was to collect relevant information from landowners and use GPS coordinates to delineate property boundaries.

¹ See Figure 12: Training [Melmoth] (Appendix E/page 262), Figure 13 and Figure 14: Training [Melmoth] (Appendix E/page 263).

² See Chapter 7.6.5 RRR Database Programme (page 123).

The field exercises involved taking equipment into the field to collect the required information and map several residential sites. The two women performed essentially as the envisioned Land Clerks would operate. With the minimal amount of training they received, the project was limited mainly to assessing their ability to collect, map, and register information and to function autonomously in the field.

8.3.2 Base-Station

One of the first priorities upon arriving in Ekuthuleni was setting up a PV system to provide electrical power. This would become a “Base-Station” providing, among other things, a source of AC power for using equipment and charging batteries.

One of the women chosen by the Ekuthuleni Committee for this project, resided in a typical Zulu-style homestead adjacent to the community’s main arterial road (D-255). This site was easily accessible by vehicle and was located on a small hill elevated above the surrounding terrain and vegetation. The site had a clear and unobstructed view of the sky in all directions providing an ideal location for a PV array. Thus, the site was chosen as a base of operations and simply became known as the “Base Station.”

The residence included their extended family, which allowed equipment to be set up and left unattended, as there was always somebody at the residence able to watch over the equipment. Leaving equipment at the site was considered safe during the day, but all equipment, including the PV panel, was moved indoors during the evening because of concerns about possible theft during the night. At the site, one of the main “communal” dwellings was raised above the surrounding huts and provided the clearest view of the sky in a northerly direction. Thus, a PV system consisting of a single 10 W PV panel was placed on the thatched roof of the dwelling. With the concern about possible theft at night, the PV panel was not secured but simply laid on the roof allowing easy removal at night. No attempt was made to optimize the orientation of the panel,³ other than to orientate in a general northerly direction and incline at 20° to 30°. Each morning, the panel was brought out and repositioned in the same location and orientation and each evening it was removed from the roof and stored indoors. The daily assembly and disassembly procedures were straightforward, requiring no more than 15 minutes for each operation.

From the rooftop PV panel, a wire was run through a window to an unused corner of the dwelling. At this location, a small table was set up so the computer, printer, and scanner could be easily accessed or recharged. The wire from the rooftop panel was connected to a charge controller located inside the dwelling on a nearby windowsill. The charge controller had four lights indicating overcharge, reverse polarity, full charge, or trickle charge. Located on the windowsill, it was clearly visible throughout the room and could be monitored for the current state of charge. During the daylight hours, the panel was connected (via charge controller) to two small (motorcycle-style) 12 V batteries located on the floor under the table.

³ See Chapter 7.7.2 Basics of Photovoltaic Power (page 126).

Connected to the batteries was a power inverter that converted DC power into usable AC power required by the computer and peripherals. During daylight hours, the computer and peripherals could be powered directly from the PV panel as long as the PV panel was producing power. At night, the computer could be powered for a limited time by the batteries, which were subsequently recharged during daylight hours. The usual procedure was to charge both batteries during daylight hours, though occasionally one was taken into the field as a backup power source for the computer.

In addition to the PV array, a beacon was placed in the ground to be used as a survey monument.⁴ This beacon would act as a reference point with known coordinates to verify consistency between the various GPS receivers. Located at their residence, this survey monument was also used each morning before proceeding to the field to check instrument settings.

8.3.3 Computer Skills

The women's previous computer experience consisted of a short basic computer course limited to introductory word processing and typing. They had minimal knowledge of computer hardware and were unable to set up a computer, printer, or scanner. In addition, they had a minimal understanding of MS-Windows and no experience with other software programmes. Their training thus began at the basics of computer use.

Training was done over a period of two partial days and five full days,⁵ following a systematic process beginning with the absolute basics of computers. As they became comfortable with one task, subsequent tasks became progressively more complicated and reinforced previously learnt skills. Each day began with reassembling and reconnecting the computer and peripherals and reviewing the previous day's work. To varying degrees, the training covered the following:

- *Introduction to Computers: A basic overview of computers and peripherals. How computers work, what hardware and software are, setting up the computer, and connecting to keyboard, mouse, printer, scanner, digital camera, and GPS. Basic care and maintenance of computers, overview of common computer terminology and specific buzzwords (i.e., RAM, USB, etc.). Computer start-up, "cold" boot vs. "warm" boot, and safe shutdown.*
- *Hardware: Identifying the internal and external components of a computer (i.e., floppy disks, keyboard, hard drive, monitor, mouse, etc.). The processing of data (i.e., Central Processing Unit (CPU)), the various types of memory (i.e., RAM/ROM), and how data is stored and accessed.*
- *Input & Output Devices: Basics of keyboard use, mouse, computer scroll pad, scanner, printer, ports (i.e., USB), connecting to external devices (i.e., digital camera/GPS), and other input/output devices.*

⁴ ΔMPENJATI.

⁵ November 2004.

- *Storage Devices: Data storage, floppy disk drives, hard disk drives, CD/DVD's, external USB storage devices, viewing storage device properties, copying files to various devices (i.e., diskette).*
- *Power: Running computer and peripherals using internal computer battery, or external 12 V batteries. How to check battery charge, changing and recharging internal and external batteries.*
- *MS-Windows: Operating systems, opening and closing Windows, resizing and moving within Windows, working with applications and Windows features, Windows accessories, shutting down Windows, changing users, changing and editing views, toolbars, folder options, working with multiple Windows, switching between Windows, changing views in a Window, and showing desktop, icons, shortcuts, and system tray.*
- *Customizing Windows: Customizing display, creating shortcuts and placing them on the desktop and taskbar, changing mouse and keyboard properties. Customizing the Start Menu by adding, removing and rearranging items, and changing settings and advanced settings.*
- *Windows Options: Using components of the Windows control panel such as adding/removing programmes, power options (specific to laptops), mouse options, administrative tools, add hardware, and accessibility options. Managing users, switching users, logging on and off, using Windows accessory programmes (i.e., Calculator), and using Windows clipboard. Opening, editing, and saving files in a text editor (i.e., Notepad, WordPad).*
- *Files and Folders: Working with files, folders, and the significance of file extensions. Organizing, copying, moving, renaming, and deleting files and folders. Searching for files using specific search options, changing options in Windows Explorer for viewing files and folders (i.e., details, thumbnails, etc.), sorting, folder options, using Undo, and selecting single and multiple items. Creating new folders, backing up files, creating shortcuts on the desktop to specific files and folders.*
- *Printer: Adding hardware (i.e., printer) to the computer, selecting default printer, changing printing preferences, pause or cancel printing using the print queue, printing documents from a word processor, loading paper, changing ink cartridges, fixing paper jams, determining printer's battery status, changing battery and troubleshooting printer operations.*
- *Scanner: Adding hardware (i.e., scanner) to the computer, using the CanoScan toolbox quick-launch interface to scan documents, scan and save documents in PDF format to specific directories, scan directly to printer, and troubleshooting scanner applications.*
- *Other Software: Opening and closing non-Windows programmes, basic introduction to several programmes including Adobe Reader, MS-Excel, GPS TrackMaker, MapSource, several utility programmes, and programmes for viewing digital images (i.e., ACDSSee).*
- *Request for Recognition of Old Order Rights (RRR) Database Programme: Using databases (i.e., fields, records), entering, editing and deleting data, potential sources of error, saving and backing up data, using macros, moving between pages (fields) and between specific individuals (records) in the database.*

- *Troubleshooting: Troubleshooting potential software and hardware problems, options for a system freeze or crash, using Windows Task Manager, accessing Help applications for each programme, looking at common Windows problems and how to rectify them, explanation of viruses and protecting data against viruses.*

At the completion of training, the women were able to set up a computer and make all necessary connections to the printer, scanner, GPS, and digital camera. They were able to open and do “very simple” operations in MS-Word, WordPad, NotePad, GPS Track-Maker, RRR database programme, and the CanoScan toolbox quick-launch interface. They could complete basic operations in Windows, including copying, moving, finding, and deleting files. With the scanner, they were able to scan documents into PDF format, save to specific folders, and scan directly to the printer. Using a word processing programme, they were able to find, open, write, and save simple documents. In addition, they could print documents using the word processing programmes and the RRR Database Programme.

It should be noted, however, that their computer skills were still very rudimentary. As discussed in later sections,⁶ simple errors had the potential to essentially shut down operations. With such limited instruction in computer use, they were unable to solve previously unencountered errors, and were therefore restricted to very basic operations.

8.3.4 GPS Skills

The two women serving as pseudo Land Clerks had no previous mapping experience, so their map-reading skills were limited. Although they had heard about GPS through the community’s involvement in previous land tenure projects, they had never actually seen or used one. They had no knowledge of how GPS receivers worked, what they were used for, or how they could be used to map land boundaries in the community.

An initial two-day visit to Ekuthuleni in October 2004 included an undergraduate student from the Surveying Department of the University. As part of a fourth-year Geomatics course, this student was working on analyzing the discrepancy between coordinates of specific property locations as derived from an eTrex GPS receiver and coordinates derived from orthophotos. This project involved the mapping of areas within the community, using the same eTrex model that the women were to be trained on. Consequently, this project would provide numerous field opportunities to map communal properties using the same eTrex GPS receiver.

Due to various time constraints and other requirements, the initial visit to Ekuthuleni restricted the women’s training to two partial days. Working with the undergraduate student, the two women learned the basics of GPS and how to use the basic model of Garmin’s eTrex line of handheld GPS receivers.

The first day consisted of a quick and general overview of GPS, with only minimal time spent on the theoretical aspects and much of that information was glossed over. At this

⁶ See Chapter 8.6 Personnel (page 150).

stage, the women needed to become comfortable with using the eTrex and accompany the undergraduate student in his mapping exercise. In addition, this would allow the eTrex to be left with the women between visits so they could use it at their own convenience. A more comprehensive overview of GPS would be done during a subsequent visit to the community.

For the first visit, instruction was concentrated on essential aspects of using a GPS receiver. This included such topics as satellite positioning, the effect of canopy cover on results, menu options, and accuracy constraints. The women needed to be aware of what circumstances might adversely affect their readings and how they could prevent and rectify these problems. They learned how the positioning of satellites affected accuracy and how they could graphically check satellite orientation using the satellite page⁷ of the eTrex. It was important to understand why it would be difficult to get readings in certain areas, such as deep ravines and forested areas, both of which were common in Ekuthuleni. They needed to understand the limitations of the eTrex and become comfortable navigating through the menu system. Since they would be working with multiple eTrex receivers, it was important that settings be consistent throughout the field mapping exercises. Special emphasis was placed on the initial setup of the eTrex and why they must keep track of what settings were being used. These settings included Time Format, UTC Offset,⁸ Position Format, Map Datum, Units, and North Reference. A specific group of settings was chosen and would remain constant throughout the project.⁹ These settings were noted in their field book and would be verified each morning before going into the field.

After the first day of training, they had become proficient in the basic operations of the eTrex and were able to record points (waypoints), set all required menu options, and navigate the eTrex menu system. The second day involved a relatively simple mapping exercise in a large open area near the Ekuthuleni primary school. The author, together with the undergraduate student, and the two women collected GPS coordinates (waypoints) outlining the perimeter of a specific property.¹⁰ The owner of this property was an elderly, incapacitated woman who agreed that her grandson "Shandy" would personally walk the boundaries and point out the property corners. The property was a simple, four-cornered rectangular parcel of land. Topographic relief was minimal, vegetation was sparse, and no obstacles to GPS satellite signal reception were present.

The two women, the student, and the author each collected waypoints with their own eTrex as Shandy walked the perimeter indicating property corners. Thus, four GPS coordinates were registered at each property corner. For this first exercise, results were compared as they were taken to ensure that each person had similar results. This

⁷ See Figure 2: eTrex Screens [Satellite, Map, and Pointer Pages] (page 134).

⁸ Universal Time Coordinated (same as GMT Offset).

⁹ See Table 6: eTrex Menu Settings (page 157).

¹⁰ See Figure 17: Shandy Property, and Figure 18: Shandy Property (Appendix E/page 265), Table 13: GPS Coordinates/Shandy Property 1, and Table 14: GPS Coordinates/Shandy Property 2 (Appendix C/page 252).

prevented any blunders and ensured that all were comfortable with the data collection procedure.

During a subsequent visit to the community in mid-November 2004, the women were given a more comprehensive overview of GPS. Over a period of five full days and two partial days, previous procedures were reviewed and new procedures were introduced. This visit emphasized that the correct results would be obtained, including the post-processing of data, and that the women could function independently. To varying degrees, this training covered the following:

- *Basic Map Reading Skills: Map scales, map coordinates (i.e., latitude and longitude), magnetic north vs. true north, magnetic declination, units (i.e., degrees/minutes/seconds).*
- *GPS Overview: Development of GPS, satellites, how GPS works, and what GPS will and will not do.*
- *eTrex Menu Options: Menu options (i.e., time format, UTC offset, position format (latitude/longitude, hddd° mm' ss.s"), map datum (WGS84), units (metric), north reference (true/magnetic)), backlight timer, and initializing.*
- *Sources of error: Common errors made by GPS users, how to avoid them, and understanding GPS receiver limitations.*
- *GPS Accuracy: Factors that decrease accuracy (i.e., vegetation, satellite signal reception problems caused by ionosphere interference, multipath interference) and factors improving accuracy (i.e., staying clear of tall buildings, overhead vegetation, cliff walls), and estimating error.*
- *Waypoints: Registering waypoints by several methods (i.e., holding down the Enter/Mark key, manually (selecting the coordinate numbers using receiver's keypad), name search, entering desired position into receiver, saving and editing waypoints.*
- *Field Preparation: Preparation for field (i.e., setting up a pack to keep all equipment in one place including GPS receiver, power cord, spare batteries, field book, pencils, cell phone, maps, map ruler, waterproof case, etc.).*
- *Troubleshooting: Correcting simple problems and errors, and using the owner's manual.*

Much of the November visit was devoted to working with the computer, printer, and scanner, but a limited amount of time each day was especially devoted to reviewing GPS and using the eTrex. Using previously collected data, the women were shown how to download waypoints, plot waypoints using GPS TrackMaker, and how waypoints can be draped onto a digital orthophoto.

8.3.5 Completion of Training

At the completion of training, the women now had a skill set that was comparable to that of a Land Clerk, though not nearly to the same degree. They could operate a computer, collect information pertaining to property owners, scan and print documents, traverse and delineate a property using an eTrex GPS receiver, and could register land-owner data in a database programme. Several practical field examples were then used to evaluate their abilities as potential Land Clerks. Several properties were chosen in the

community where ownership and property data were collected and registered in the specially written RRR database.

8.4 Jimmy Property

8.4.1 Introduction

At the completion of training, several field examples were undertaken to evaluate the women's abilities to function independently as pseudo Land Clerks. For these field tests, sites were sought that would typify the Ekuthuleni community yet would challenge the women's ability to function independently. Living within the community, the women were able to suggest a man who knew them well and would likely be willing to participate in this project. The man, known as "Jimmy," agreed to participate and his site became the prototypical example for following exercises.

The property,¹¹ which was known simply as "Jimmy's Place," (or the Jimmy Property) was in most respects typical of the Ekuthuleni community. It was a single-family residence consisting of two adults and six children. The residence was composed of five dwellings located on a small ridge, accessible by a dirt track off the main arterial road (D-255). Minor subsistence farming was done immediately adjacent to the residence, but most areas were too steep for any large-scale farming. The ridge top and slopes were predominantly grass-covered, while adjacent creek valleys were lightly to moderately forested. Other than a small creek valley, which defined the eastern boundary, a barbed-wire fence enclosed most of the property. This fence, in various stages of disrepair, provided the property with a clearly defined outer boundary. The exception being the previously mentioned eastern boundary which was a somewhat indistinct curvilinear boundary defined by a dried up creek bed.

The field exercise involved collecting personal and property information from the current occupant of the land and entering it into the RRR database.¹² Following this, the women traversed the property perimeter registering GPS coordinates in order to define the property boundary. Upon completion of the field portion, the GPS coordinates were downloaded to the computer and subsequently loaded into GPS TrackMaker, where they could be graphically viewed and verified.¹³ This exercise was undertaken on the morning of November 20 2004 and, as a check, was partially repeated on November 23 2004.¹⁴

¹¹ See Figure 5: Jimmy Property [Orthophoto] (page 153) and Figure 19 & Figure 20: Jimmy Property (Appendix E/page 266), Figure 21 & Figure 22: Jimmy Property (Appendix E /page 267).

¹² See Chapter 7.6.5 : RRR Database Programme (page 123), Figure 27: RRR Database Programme [Page 1], and Figure 28: RRR Database Programme [Page 3] (Appendix F /page 273).

¹³ Similar to Figure 6: Jimmy Property [Orthophoto/Property] (page 154), minus the property lines.

¹⁴ See Chapter 8.4.5 Field Mapping the Jimmy Property: Day 2 (page 148) and

8.4.2 Pre Mission Planning

The day before visiting the Jimmy Property, the women prepared for the following day's work. It was a typical Ekuthuleni summer day, with a clear sky and temperatures in the neighbourhood of 37 °C. This meant all equipment required for the following day could be charged using the PV array previously installed at their residence. This included the computer battery, printer battery, and the two 12 V external batteries. In addition, other equipment (i.e., laptop computer, pencils, spare eTrex batteries, etc.) was collected together in preparation for the following day's exercise.

The following morning, before leaving their residence, all GPS menu settings¹⁵ were checked to ensure that they conformed to settings previously recorded in their notes. Each eTrex was used, in turn, to verify the coordinates of the Beacon¹⁶ previously installed next to their residence to ensure consistency between receivers. Checking this monument each morning was a validation procedure to check for gross errors, such as an incorrect datum. Finally, after ensuring that everything was fully charged and working, the women packed all of the equipment into the carrying case.

8.4.3 Field Mapping the Jimmy Property: Day 1

Upon arrival at the Jimmy property, the first step was to contact the head of the household (Jimmy). The two women explained to Jimmy that this was a research project undertaken by the University of KwaZulu-Natal and asked if he would participate by providing personal information and point out his property boundaries. After agreeing to this request, the women unfolded their carrying case into a small table. They then repositioned the computer, printer, and scanner on the table and made the necessary connections for the computer and peripherals. As the computer was turned on and the windows desktop was displayed, they double-clicked on the RRR database icon, which immediately opened page one¹⁷ of the RRR database programme. At this point, they had all equipment and software up and running and were ready to collect and register required information. Using the 3 pages of the RRR database programme, the names of all property residents, ID numbers, sex, birthdates, contact information, and other assorted information pertaining to the property was entered. They also recorded a single GPS fix,¹⁸ which was manually entered (instead of digitally downloaded) into the RRR database. This coordinate was recorded in the area that was deemed the center of the residential dwellings. This single coordinate would act as a unique spatial tie-in, allowing for the attachment of attributes (i.e., in a GIS), and spatially locating the applicant on various maps and orthophotos.

Table 9: GPS Coordinates/Jimmy Property 2 (Appendix C/page 248) and
Table 10: GPS Coordinates/Jimmy Property 3 (Appendix C/page 249).

¹⁵ See Table 1: Communal Land Rights Act [Population] (page 70)

¹⁶ ΔMPENJATI.

¹⁷ See Figure 27: RRR Database Programme [Page 1] (Appendix F/page 273).

¹⁸ ΔJP-13.

Next, the women used a digital camera to record several photographs. This was done mainly as a means of recording various items and locations deemed important for their personal records. Once back at their residence, these photos provided a visual reminder that helped to distinguish one property from another. Once a photograph was taken, the first and last photo numbers (i.e., 1234 - 1237) as displayed by the camera were entered into the RRR database.

At this point, all personal and property information required for the database had been entered. The next step was to verify the current date, which was automatically inserted by the database, and the name of the Clerk recording the data. To provide the applicant with a copy of the recorded information, a paper copy was printed by clicking on the notebook icon located on the bottom toolbar (page 3) of the RRR database. This icon printed out a copy of all database fields in a pre-designed A4 size sheet for the personal records of the applicant.

With the completion of all database fields, the next step required the collection of GPS coordinates outlining the property boundaries. Thus, Jimmy was asked to walk the property perimeter and physically point out the property corners. As Jimmy walked around the perimeter indicating property corners, the women registered GPS coordinates using the eTrex GPS receiver, storing them as numbered waypoints.¹⁹ This process took approximately 1 hour to collect the required 12 points to fully demarcate the property.²⁰

The Jimmy property may be somewhat atypical of many of the properties in the area as it was largely enclosed by a barbwire fence, making later reidentification of points a straightforward matter. Linear lines defined all of the property boundaries, except for the eastern boundary, which was defined by a dry creek bed in a broad valley. This dry creek was quite wide and indistinct, making re-identification of boundary points at a later date problematic. For this exercise, the creek boundary was represented by three GPS coordinates (two linear boundary lines).

8.4.4 Post-field

Once all required database information and GPS coordinates were collected, the field portion was complete. The women then returned to their residence (base-station) to download data. The first step upon arrival at the residence was to connect the various batteries to the PV array to charge them for the remainder of the day in preparation for the following day's work. With the PV array being used to charge the batteries and therefore no available power for computer use, most of the post-field work was done at Jenny's B&B in Melmoth, where the author was staying.

¹⁹ See GPS Coordinates (Appendix C/page 247).

²⁰ See Figure 6: Jimmy Property [Orthophoto/Property] (page 154).

For comparison purposes, the Jimmy property had been simultaneously²¹ mapped using three different eTrex receivers.²² The downloading of data was done by each operator, in turn, connecting their eTrex to the computer via the serial port, to download and save positional fixes (waypoints) to the hard drive. Once downloaded, the data from each eTrex was loaded into an MS-Excel spreadsheet to be compared and subsequently cleaned up. The cleanup of data involved re-labeling of incorrectly labeled waypoints and removing any multiple entries for the same point.

As a means to graphically view the data, waypoints for one eTrex were loaded into the GPS TrackMaker programme and visually inspected for any large anomalies. Ideally, this step is done in the field where any errors can be immediately corrected or resurveyed. With waypoints loaded in GPS TrackMaker, a digital orthophoto²³ was loaded as a backdrop.²⁴ This allowed waypoints to be superimposed (draped) onto a digital image of the surrounding terrain.²⁵ This initially proved unworkable due to the insufficient RAM memory in the computer. The Compaq Presario, under its existing configuration, had considerable difficulty in loading large digital images, so the images had to be compressed, trimmed, and converted to smaller JPEG files for graphical display. Thus, viewing waypoints draped onto digital orthophotos worked well as long as the images were of manageable size.

8.4.5 Field Mapping the Jimmy Property: Day 2

To check the initial mapping results, the property was remapped again three days later.²⁶ This exercise was simply a look at the reproducibility of the GPS coordinates of the previous exercise, so no database information was collected nor was the landowner present during any of the exercise. This exercise involved walking around the property perimeter and recollecting the same 13 GPS coordinates that had been previously collected. Since a barbed wire fence enclosed the majority of the property, reidentification of most points was straightforward.

Following the same procedure, the property was remapped by the women using the same model eTrex GPS receiver²⁷ and a Garmin Foretrex-101 for comparison purposes.

²¹ GPS waypoints were taken simultaneously (\pm several minutes). Readings were registered as close as possible to each other (spatially), yet maintaining a minimum separation to ensure that the receivers do not interfere with each other.

²² eTrex 1, eTrex 2, eTrex 4 (November 20 2004). See Table 8: GPS Coordinates/Jimmy Property 1 (Appendix C/page 247) and Table 9: GPS Coordinates/Jimmy Property 2 (Appendix C/page 248).

²³ i.e., TIFF/JPEG format.

²⁴ See Figure 5: Jimmy Property [Orthophoto] (page 153).

²⁵ Similar to Figure 6: Jimmy Property [Orthophoto/Property] (page 154), minus the property lines.

²⁶ November 23 2004.

²⁷ eTrex 1 and eTrex 4 (November 23 2004). See Table 9: GPS Coordinates/Jimmy Property 2 (Appendix C/page 248) and Table 10: GPS Coordinates/Jimmy Property 3 (Appendix C/page 249).

Along with the handheld GPS receivers, the property was also mapped with an Ashtech ProMark 2²⁸ by the author and a technician from the University. GPS coordinates of the property perimeter were collected concurrent with the women collecting the same points using the handheld GPS receivers. The intention was to compare the results obtained by the eTrex and the Foretrex-101 to results obtained by the Ashtech ProMark 2. Unfortunately, this data and the computer on which it was installed went missing before it could be processed.

8.4.6 Overview of Data Collection and Procedure

Over a period of three days, the Jimmy property was mapped with five sets of coordinates using the eTrex, once using the Foretrex-101 and once using the Ashtech ProMark 2 GPS receivers.²⁹ As coordinates were collected in the field, no attempt was made to prevent blunders nor was any attempt made to compare previous and current GPS readings. Waypoints were registered as they were collected without any verification. This was done specifically to perform a post-field comparison of results and to determine any possible sources of error.

8.5 PV Array

The PV array used in this project consisted of a single 10 W PV panel, which was intended to provide power to run the computer and peripherals, and recharge batteries. Unfortunately, for this application the system proved to be inadequate. Running the computer with either the printer or scanner tended to run down the batteries very quickly. With the current setup, there was no means of monitoring the current battery charge so there was no warning of imminent shutdown. There was no time for the computer to switch to hibernation mode and no time for the user to save open documents. However, a larger battery bank (i.e., greater storage capacity) and a simple gauge to monitor battery charge could easily rectify this problem.

In the design of a PV array, one needs to consider which products will be required, when and how often they will be used, and their rate of power consumption. The design and installation of PV systems has evolved to the point that rooftop solar technology has a large market in the installation of household systems. Many PV retailers currently offer PV kits specially designed for residential sites or isolated stand-alone locations. These kits specifically take into account required power demands, peak current, and maximum load requirements, all of which are easily determined with simple retailer-supplied worksheets. Using these worksheets, the user simply lists all appliances to be used and the number of hours they will be used per day to determine the amp-hours required per day. Once the typical daily power consumption has been determined, a specific kit is chosen to meet that requirement. Most kits are rated by typical output in amp-hours/day and are specifically designed to make installation fast and simple. Since most kits are modular, the system is never obsolete and it is a simple matter to expand the

²⁸ Using the static data collection method, the ProMark 2 provides for centimeter level survey accuracy. See Chapter 7.5.8 GPS (Ashtech ProMark 2) (page 120).

²⁹ See GPS Coordinates (Appendix C/page 247).

system by adding new components. These kits have minimal infrastructure requirements and require no special expertise in setting up, though they would need to be secured against possible theft. Costs of these systems vary considerably depending on factors such as size, efficiency, and quality.

A major limitation of any PV system is that power is only produced intermittently (i.e., during daylight hours). Thus, in most instances, a stand-alone PV system will require a battery bank enabling power to be stored for later use. This may not be necessary if the PV system is also connected to a utility grid, where additional electricity can be drawn as needed (i.e., at night). With PV-generated power usually more expensive than conventional utility-supplied power, the cost of installing a utility line over a short distance may be a viable alternative. In Ekuthuleni, where several power lines traverse the community, it may be possible to tie into the existing Eskom grid. However, there may not be any similar options for many areas of rural KwaZulu-Natal.

Another option for areas that can be linked to existing power grids may be installing a grid tie system, in which excess power is sold back to the electrical utility company. These systems work by an inverter that synthesizes power generated during the day with that supplied by the utility. Locally generated PV power is used first, with additional electrical requirements drawn from the utility grid as needed (i.e., at night). During daylight hours, the system converts PV power into AC power, which can be fed directly into the home or stored as reserve battery power. Tracking systems ensure that all generated power is utilized. These systems are often designed to maintain a battery reservoir (i.e., 10 kWh), such that if the grid power fails the system has enough power to run essential loads (i.e., computer) for a limited number of hours or days. This is an ideal system for areas prone to power outages. These systems have the option of not only reducing power consumption by prioritizing the locally generated PV power versus that of the utility supplied power, but also subsidizing the use of used power by the sale of all excess power back to the utility.

To the author's knowledge, this system is not currently available in South Africa. In other areas of the world (i.e., Canada, US), public utility companies have buyback programmes in which excess power from residential PV systems or wind generation systems is purchased by the utility. For smaller PV systems, these programmes will help offset costs. For larger systems that generate more power than they use can generate income for homeowners by the purchase of excess power by the utility.

8.6 Personnel

The two candidates selected for this project were chosen by the Ekuthuleni Committee with no input from the author or the University³⁰ to prevent "personal bias" from influencing the decision in any way. Although, the two women selected by the Committee for this project lacked a formal education (other than some High School), they nonetheless proved more than capable of working as a Land Clerk given adequate education and training. With their obvious lack of education and training, it became evident during the

³⁰ See Chapter 7.4 Land Clerks-in-Training (page 111).

field exercises that they lacked much of the basic foundation courses that would be expected of a Land Clerk. Although, they proved during the field exercises that they were quite capable of completing surveys on their own, there was a considerable propensity for certain types of errors. It is understood that most of these errors can be directly attributed to lack of adequate training.

One of the most notable shortfalls was, as expected, that they had a poor understanding of the basic underlying principles of GPS. This was particularly evident in certain instances, such as their attempts to register GPS coordinates in steep ravines under thick foliage or adjacent buildings. Although they realized that the instrument was reading from satellites somewhere in the sky, they had little understanding of why some readings (i.e., PDOP) would be acceptable while others might be considered unacceptable.

Other seemingly insignificant, but potentially damaging, problems also presented themselves during the fieldwork. For example, while in the field, five identical eTrex GPS receivers were used at different times by different people. Although the eTrex settings were checked each morning, at some point during the course of the day the setting of one eTrex was mistakenly changed to degrees/decimal minutes³¹ instead of degrees/minutes/decimal seconds.³² Although the receiver was used throughout the day, this error was not discovered until the downloading of data that evening. While the error is in part a user error, a contributing factor is also the receiver itself. The eTrex has a small screen that makes it difficult to read at the best of times. With the small text size and poor contrast between characters,³³ the screen can be rather difficult to read on bright sunny days.

Another problem encountered during the field exercises was the registration of waypoints. As a frequent user of a handheld GPS receiver knows, there is a measurable delay between one's initial arrival at a point and the ability of that receiver to lock on to a new positional fix. This delay time is site-specific, subject to satellite geometry and factors restricting satellite visibility (i.e., canopy cover). Hence, if one registers a reading before the eTrex has a lock on the new position, then the registered waypoint would in actuality be the previous reading that has been carried forward. Though this was rarely a problem with the author's previous experience with students, it nonetheless seemed to happen with considerable regularity during the first few days of this project. Over short distances when readings changed by only a decimal point,³⁴ it was quite easy to miss. Unless the user is aware of the previous reading, it can be difficult to determine if the displayed reading is still the previous fix or if the reading is the new fix. Since the field exercises involved multiple receivers, checking for potential blunders in the field and post-field was problematic. However, a practicing Land Clerk with only one instrument

³¹ hddd° mm.mmm'.

³² hddd° mm' ss.s".

³³ Four-level grayscale screen measuring 2.7 x 5.4 cm (128 x 64 pixels). See Figure 2: eTrex Screens [Satellite, Map, and Pointer Pages] (page 134), Figure 3: eTrex Screens [Menu Pages] (page 134), and Figure 4: eTrex GPS Receiver (page 135).

³⁴ i.e., [31° 24' 56.3"] to [31° 24' 56.4"].

may not have this luxury. Obviously, part of this problem is the poor resolution of the screen and small size and contrast of text characters, all making for difficult reading. On the other hand, these types of error are easily preventable with training and experience.

Other errors revealed during the mapping exercises included some discrepancy between mapped property boundaries and actual boundaries. During the initial visit to the Jimmy property, everyone involved in the process understood that this exercise involved mapping the “outer” property perimeter encompassing the entire property. During the second visit, in the process of remapping the property using the eTrex, Foretrex, and Ashtech ProMark receivers, the owner matter-of-factly stated that his property actually extended an additional 50 to 70 m to the West. Even though the women spoke the same language as the landowner and the process was explained to the owner during the initial visit multiple times, somehow a misunderstanding occurred. After prolonged discussions with the landowner, it appeared that the previously mentioned additional land might best be described as “owned by him” but under a somewhat different form of tenure. As the owner explained, the land may in most respects be considered his, though only for specific uses.³⁵ Obviously, this problem could be prevented if all adjacent property owners were present during demarcation and all property boundaries had been previously identified and agreed to by the interested parties before the Land Clerk arrived. Moreover, one would expect that issues of tenure types would be sorted out before actual field mapping had commenced, possibly as part of the various audits conducted under the LRE process of CLARA.

What conventional wisdom told us before this project started, and what the field mapping exercises reinforced, was that the training carried out under the auspice of this project was wholly inadequate for the requirements of a Land Clerk. While the two women were able to successfully go through the motions of the Land Clerk, the slightest deviation from what they had been taught was fraught with potential problems. Thus, any Land Clerk and Land Administrator training programme may need to be of extended duration commensurate with anticipated duties. This training programme would require, in part, a strong background in specific components (i.e., land law, surveying, etc.), balanced with a practical hands-on field segment. The field training would need to be more context and job specific than the education component and care must be taken so that the training is not just rote procedural training.

Whatever the duration and extent of the Land Clerk and Land Administrator training programmes,³⁶ a support infrastructure will need to be implemented. As these field exercises showed, there will need to be a support structure in place able to assist and support those in the field encountering technological and other problems. Hopefully, adequately trained Land Clerks would be able to operate autonomously and to solve computer and software problems in the field. However, IT specialists will be needed for those times when errors cannot be rectified in the field.

³⁵ See Chapter 5.13 Cultural Land Tenure (page 83).

³⁶ i.e., the expected three months training for a Land Clerk, and 12 months for the Land Administrator (DLA, 2004a).

Figure 5: Jimmy Property [Orthophoto]



Jimmy Property/Orthophoto.

Approximate Scale 1:1000.

Figure 6: Jimmy Property [Orthophoto/Property]



Jimmy Property/Orthophoto. Including GPS coordinates (Mean Values) from Table 12: GPS Coordinates/Jimmy Property 5 (Appendix C/page 251).

Approximate Scale 1:1000.

Figure 7: Jimmy Property [Orthophoto/Property/Contours]



Jimmy Property/Orthophoto. Including GPS coordinates (Mean Values) from Table 12: GPS Coordinates/Jimmy Property 5 (Appendix C/page 251), and 2 m contours.

Approximate Scale 1:1000.

Figure 8: iPAQ PDA [Jimmy Property]



Actual Size PDA (Jimmy Property/Orthophoto).

Table 6: eTrex Menu Settings

Menu	Setting
Time Format	24 hour
UTC offset	+02:00
Position Format	hddd° mm' ss.s"
Map Datum	WGS84
Units	metric
North Reference	true

Table 7: Land Clerk Costs

Equipment	Cost (Rand)
Batteries (two - 12 V) (Forbatt)	214.00
Case (estimate)	~300.00
Charge Controller (2500 mA)	260.00
Computer (Compaq Presario 2100)	8,499.95
Digital Camera (estimate)	~1,200.00
GPS Receiver (eTrex) (estimate)	~1,235.00
GPS TrackMaker 12.3	0
Misc. (i.e., wiring) (estimate)	~100.00
Power Inverter	180.00
Printer (HP DeskJet 450cbi)	2,999.95
PV Panel (Generic - 10 W)	1,067.00
Scanner (Canon LiDE 20)	599.95
Total	R 16,655.85

9 Analysis, Discussion and Recommendations

9.1 Introduction

Traditional methods of land surveying and registration are notoriously expensive to implement and maintain. Therefore, the successful implementation of the Communal Land Rights Act will need to consider alternative methods. That is, the general lack of state resources and the DLA's capacity constraints will require the use of substantially less costly methods. This dissertation thus presents the "Community Land Clerk" option, which equips a Land Clerk with a laptop computer, printer, scanner, and hand-held GPS receiver to enable them to register land under the Act. The Ekuthuleni field exercises demonstrated that the equipment and processes are generally adequate for the task. However, with the benefit of hindsight and lessons learned during the field exercises, this chapter looks at the equipment and processes discussed in previous chapters and offers some analysis, discussion, and recommendations.

9.2 Field Computer

The Compaq Presario 2100 laptop computer¹ used in this project proved to be adequate for basic operations like simple word processing, printing, and scanning. The more complicated operations, however, such as multitasking or viewing larger graphic files often resulted in computing problems. Programmes tended to freeze or hang while being run, often requiring a system reboot. This was especially true when multiple programmes were open or when large orthophotos were viewed in TIFF or JPEG format. In fact, loading large graphic files over a given size was simply not possible. This problem could possibly be rectified by using a faster CPU or by increasing RAM memory from 256 MB to 512 MB or more.

Another concern with using the Presario was the screen resolution. On sunny days, the glare of the sun makes viewing the computer screen difficult and images hard to see. This was especially true with the RRR database programme, where the contrast between text in the data fields and the surrounding colours was poor. This unanticipated error could be easily rectified, however, by rewriting the MS-Access programme using a larger text size and different colours to increase the contrast between data fields.

Although great care was taken with the computer, the computer was subject to considerable amounts of fine dust in the field. Although this never actually resulted in any problems during the field exercise, the dust could eventually affect internal components with extended use in similar situations. A second computer used in this project, though rarely taken into the field, later malfunctioned due to dust inside the computer, causing a HDD failure that required installation of a new HDD. Consequently, rotating hardware components such as HDD's, CD/DVD's, and floppy disks should be avoided alto-

¹ See Compaq Presario 2100 Computer (Appendix B/page 240).

gether. This might be accomplished by using a computer with an alternative memory source, such as flash memory or even a PDA if a suitable one could be found.²

In addition to dust problems, the Presario proved to be too large and cumbersome to carry around in the field. As a possible alternative, the new mini-notebook³ computers could be more practical. For example, the “ultraportable” Toshiba Libretto U100⁴ is significantly smaller (21.0 x 16.5 x 3.0 cm) and lighter (2.7 kg) than the Presario.⁵ Being about the size of a small book, the Libretto is suitably compact and portable.

The Libretto differs from most standard notebook computers in that its optical drive resides in an optional⁶ detachable module. This module or “Docking Station” contains a built-in DVD±RW drive that allows the Libretto to be taken into the field while leaving the docking-station (and optical drive) in the office. In addition, compared to the Presario and other similar computers, the Libretto has the advantage of a longer battery life,⁷ SD and PC slots for removable storage, and Bluetooth wireless connectability.

As expected, a notebook computer of this size has some limitations. While the Libretto is similar to the Presario with respect to internal computing capacity,⁸ its keyboard and screen size are significantly different. The keyboard is smaller than a regular computer⁹ and can be inconvenient for extended periods of typing. Since the intended use of this computer would mainly be field data-entry (i.e., RRR database), that would not be a significant problem. For office use, an external keyboard can easily be added.

The screen size of the Libretto, at 18.3 cm,¹⁰ will be a challenge for users because of the smaller size of text and icons. Nevertheless, since a specially written database (i.e., RRR database) will be the prime field application, the programme can be written as a series of multiple pages, with large high-contrast text suitable for the smaller screen. Other MS-Windows-based programmes can similarly be adjusted for size and contrast using the “Accessibility Options” in the Windows “Control Panel.”

² See Chapter 9.8 PDA and Handheld GPS Receiver (page 185).

³ Not all available in South Africa.

⁴ Toshiba Libretto U105 (Select Specifications): Processor - Intel Pentium M Processor (Ultra Low Voltage) 1.20 GHz, Memory - 512 MB DDR SDRAM, Mass Storage - 60 GB (4200 RPM) HDD, Optical Drive - via the libretto DVD Dock, Display - 18.3 cm (7.2 in) 1280 x 768 pixels, Physical Description - 21 x 16.5 x 3.0 cm, Weight - 0.98 kg, Battery - 6 cell (3400 mAh) rechargeable, Battery Life - up to 5 hrs, Recharge Time - approximately 3.0 hrs (Toshiba, 2005, 2006).

⁵ 33.0 x 27.4 x 4.1 cm, 3.6 kg (Compaq Presario 2100).

⁶ Available for ~R 2,296 (US MSRP ~US\$ 380).

⁷ Rated at 5 hrs (normal use) (Toshiba, 2006).

⁸ Intel Pentium M Processor - 1.2 GHz (Toshiba Libretto U100)/Celeron - 1.8 GHz (Compaq Presario 2100).

⁹ ~73 % the size of a full-size keyboard.

¹⁰ 18.3 cm (7.2 in) 1280 x 768 pixels.

In addition to the aforementioned Toshiba Libretto, numerous other products are available that are each designed for specific applications and are generally available with a myriad of options, configurations, and price tags. Several computer manufacturers have specially designed computers for field use that are able to avert many of the problems encountered with using a laptop computer (i.e., Presario) designed for the office in the field. One such example is the “Panasonic Toughbook” line of notebook computers.¹¹ These computers are enclosed in an environmentally sealed magnesium-alloy protective case. As field computers, they have many enhancements over standard laptops, including increased water resistance, drop-shock resistance, shock mounting for major components,¹² and sealed components¹³ to protect against moisture and dust. These computers also include an anti-reflective daylight-viewable screen, which is available with optional touch-screen capability. The Toughbook also has a broad range of simultaneously available communications and connectivity options, various card reader options, removable hard drive, and integrated GPS capability (Panasonic, 2005).

Finally, the option of a field computer may be avoided altogether by possible non-computer alternatives. There has been an introduction in recent years of a whole new generation of Data Collectors and Personal Digital Assistants (PDA’s).¹⁴ Unlike the traditional Data Collectors, newer versions have become considerably easier to learn, simpler to use, and allow for easy integration with GIS/GPS applications. While a Data Collector or PDA is another option, database capability will still be necessary.

9.3 Field Printer/Scanner

The printer chosen for this project was the HP DeskJet 450cbi.¹⁵ This portable inkjet printer proved to be an excellent choice, as it was compact,¹⁶ lightweight,¹⁷ well-constructed, and provided excellent print quality.¹⁸ The Canon LiDE 20 scanner,¹⁹ however, presented a problem. This was not so much an issue of performance as an issue of size, construction, and portability. Considering its size²⁰ and fragile “glass” scanner cover, it was awkward to carry around in the field. As a result, an alternative should be found.

¹¹ i.e., Toughbook CF-29 (Select Specifications): Processor - Pentium M Processor (1.6 GHz), Memory - 512 MB DDR-SDRAM, 80 GB HDD, Display - 33.8 cm (13.3 in) 1024 x 768 pixels XGA anti-reflective, daylight viewable display (optional touchscreen), Physical Description - 5.8 x 30.0 x 24.1 cm, Weight - 3.6 kg, Integrated options (GPS Receiver, Wide Area Wireless, Smartcard Reader, Bluetooth) (Panasonic, 2005).

¹² i.e., HDD.

¹³ i.e., ports, connector covers, etc.

¹⁴ See Chapter 9.8 PDA and Handheld GPS Receiver (page 185).

¹⁵ See HP DeskJet 450cbi Printer (Appendix B/page 243).

¹⁶ 33.8 x 8.2 x 16.4 cm.

¹⁷ 2.1 kg.

¹⁸ Black (Maximum 1200 x 1200 dpi), Colour (4800 x 1200 optimized dpi).

¹⁹ See Canon LiDE 20 Scanner (Appendix B/page 240).

²⁰ 38.4 x 25.7 x 3.6 cm, 1.5 kg.

Possible substitutions for the scanner (and printer) might be some of the newer “multi-functional” machines that are currently available. These machines combine the previously separate copier, fax, printer, and scanner components into a single multifunctional-machine. Several companies now produce these machines, with a well-known example being the MFC²¹ series manufactured by Brother.²² Most of these are designed primarily for home or office use and would be unsuitable for field use. Nevertheless, one machine that could be considered is the Brother MFC-110C/210C series,²³ which are some of the least expensive models available. As with other multifunctional machines, the copier, fax, printer, and scanner components are combined into one semi-compact unit.²⁴ The printer component of these models has a colour inkjet printer, though other models are available with a more expensive laser printer. The power consumption²⁵ of the MFC-110C/210C is similar to the combined consumption of both the HP DeskJet printer and the Canon LiDE-20 scanner. Several key features of this machine are its ability to scan directly to a SD memory card,²⁶ wireless connectability, and low cost.²⁷ The convenience of portability and lightweight are the result of these machines being manufactured with lightweight plastic parts, so that their durability in the field may be an issue.

9.4 Aerial Photogrammetry/Orthophotography

For covering large areas, aerial photogrammetry and subsequent data capture from orthophotos can be a cost-effective method for land registration. This is especially true for general boundaries, when compared to traditional surveying methods (i.e., EDM). Aerial photogrammetry allows wide areas to be mapped quickly and relatively cost-effectively. The data can subsequently be integrated into municipal GIS/LIS systems and can easily be adapted to meet accuracy and cost requirements. The precision of any survey is flexible and generally commensurate with scale, and with numerous contractors in South Africa, this method is readily available. In addition, the resulting aerial photography, digital images, and maps may also be useful for unrelated purposes by both government and private organizations,²⁸ thereby providing a potential for cost sharing.

While orthophotography has many advantages, some of the difficulties lay in areas with few recognizable landmarks, minimal relief, or poor contrast such as a field or desert. In addition, areas of thick forest cover can obstruct a clear view of the ground and limit the success of data acquisition. To make this method economically viable, larger areas for

²¹ Multi-Function Center (MFC).

²² Brother Industries Ltd., Nagoya, Japan.

²³ Similar models include Brother MFC-420CN and MFC-640CW.

²⁴ 37.3 x 45.3 x 13.5 cm, 5.5 kg (Brother, 2005a, 2005b, 2005c).

²⁵ ~20 Wh (operating), 7 Wh (standby) and < 3 Wh (off mode) (Brother, 2004).

²⁶ i.e., in various formats such as JPEG and PDF.

²⁷ MSRP of the MFC-210C is ~R 900 (US\$ 129.99/CDN\$ 149.99), actual selling price is usually lower. Not all models available in South Africa.

²⁸ i.e., multipurpose cadastre.

data collection will typically be necessary before photogrammetry becomes competitive with other methods. Depending on the project, photogrammetry will not be the most cost-effective method for areas under a specified amount (i.e., ~50 ha). In fact, photogrammetry can be prohibitively expensive if the updating of small areas requires the area to be re flown each time. Furthermore, all aerial surveys will require ground truthing to some extent. Should this entail extensive ground surveys involving professional Land Surveyors, the costs would likely increase dramatically. Finally, the acceptance of land registration using photogrammetric methods may require changes in existing legislation and survey regulations (i.e., for the use of general boundaries).

The use of digital orthophotos for registering land has been applied in several areas of the developing world. In Gaza, for example, the Minister for Foreign Affairs in Finland has funded a pilot project since 1998 using digital orthophotos for the registration of land (Mikkonen et al, 2005). Farmers and their families who have farmed the land for decades occupy the project area, covering some 7,000 ha. During this period, land was passed between generations or privately bought and sold, though rarely recorded in the land register.

The registration of land in Gaza using digital orthophotos followed a well defined legal process in which claims were studied, potential disputes solved, and proven cases registered in the land register. The process consisted of an initial stage of “first registration” with clearly defined steps, beginning with a publicity campaign to announce the new registration and followed by official claim applications, demarcation, determination of claim validity, adjudication, registration, and appeal to the High Court if necessary.

As shown by the above example, and by the PILAR²⁹ project conducted by AFRA, the registration of land rights using photogrammetric methods (i.e., orthophotos) can be done successfully. The land claimants in both of these examples were predominantly rural and often illiterate farmers, though they generally had minimal difficulty understanding an orthophoto. While they may have been uncomfortable about or unable to read a regular map, orthophotos showing their residence, crops, and fences generally presented minimal problems.³⁰

9.5 Global Positioning Systems

9.5.1 Introduction

GPS surveying is a process by which 3-D point positions can be determined using signals received from satellites. This satellite-based navigation system is commonly known as the Global Navigation Satellite System (GNSS) and consists predominantly of

²⁹ See Chapter 6.3 PILAR Project (page 98).

³⁰ Having said that, when shown orthophotos of their residence by the author, residents of Ekuthuleni did occasionally confuse ridge tops with valley bottoms.

the US controlled Global Positioning System (GPS).³¹ Although initially designed for military use, it has now become an important tool in all facets of surveying and navigation. The GPS system consists of a constellation of 24 satellites operated and maintained by the US Department of Defense (DoD) that provide passive real-time 3-D navigational and positioning capabilities.

Practitioners of cadastral surveys have been slow to embrace GPS technology due in part to the high costs of the GPS receivers needed to attain the accuracy required under existing land legislation. Nevertheless, the increasing use of GPS by industry and the private sector has led to the introduction of a multitude of GPS receivers covering all levels of accuracy and affordability. Accordingly, it is now an important tool for the private sector, industry, and government in the collection of spatial information. GPS, as with traditional surveying methods, is a tool that can be used alone or combined with other methods in the demarcation of land boundaries.

9.5.2 Land Registration using GPS

The use of GPS in the registration of land under the Communal Land Rights Act³² offers some advantages over traditional surveying methods. With the appropriate equipment, GPS has the ability to meet accuracy requirements mandated by existing land legislation³³ and, most importantly, offers the potential for a significantly less costly method of registering land rights.

GPS is a passive system that is able to provide real-time 3-D positioning 24 hours a day throughout South Africa. In addition, many of the GPS shortcomings that afflict some countries, such as steep mountains, dense foliage, and high latitudes, are not significant problems in South Africa. GPS surveys offer great flexibility in technique and accuracy, and can easily be adjusted to suit most requirements. When compared to traditional surveying methods (i.e., EDM), GPS is generally less affected by weather, topography, and the need for inter-visibility over long distances. While errors in a conventional traverse accumulate throughout the traverse, errors in GPS positions do not. In fact, they are independent of each other in both space and time. Positional errors are independent of each other, regardless of whether the survey is 1 km or 10 km. Errors are constrained to each captured point subject to the local conditions of GPS satellite reception.

GPS measurements are used to generate coordinates that are inherently geo-referenced and usually referenced to specific datums (i.e., WGS84). They can easily be integrated into municipal cadastral mapping systems, digital orthophotos, and most mapping systems using common CAD/GIS/LIS programmes. In addition, to improve accuracy in the field, the option exists for real-time adjustments of data as it is collected in the field. A real-time adjustment of data allows for quick integration into existing GIS systems

³¹ Others include the Russian GLONASS (GLObal NAVigation Satellite System), and the future European Galileo system.

³² 11 of 2004.

³³ i.e., Land Survey Act 8 of 1997.

(i.e., Municipal GIS/LIS), which allows the LIS system to be updated and maintained in a timely manner.

Unlike conventional survey traverses that generally require a minimum two-man crew, GPS surveys can often be done by a single individual. GPS also reduces (other than as redundancy checks), the time-consuming task of tying into photo ID points and survey monuments. Consequently, GPS surveys have the potential for considerable cost-savings compared to traditional surveying methods. On the other hand, there are inherent risks that field operators need to be aware of when using GPS technology. Thus, Land Clerks using GPS technology will require an appropriate level of training, education, and experience to avoid potential errors.

As with all surveying methods, GPS is not appropriate for all situations. Since GPS receivers need a clear view of the sky, and this may not always be possible, some limitations may arise. Difficult terrain conditions, such as areas of steep slopes, built-up areas, and forest canopies can significantly degrade positional accuracy to the point where the minimum accuracy requirements cannot be met. Additionally, sites where satellite reception is not possible or significantly degraded, may require longer occupation times or the use of alternative or hybrid methods.³⁴ In some instances, the choice of appropriate GPS equipment can help to ensure adequate accuracy, though this usually involves another level of complexity and significantly more expensive equipment. The required accuracy of a survey will play a significant part in the kind of GPS equipment being used and methods employed. Required costs are often a direct function of required accuracy.

Although this section has listed some of the advantages and disadvantages of using GPS, the situation may not be simply a matter of using one method rather than another method. In fact, the ideal situation may be to use a hybrid method of GPS in combination with other methods. For example, using GPS and orthophotography would allow the benefits of one system to be used in combination with the benefits of the other system. Such a combination could potentially allow GPS coordinates to be draped onto digital orthophotos in the field as they are being registered. This would then allow the more accurate coordinates, as derived via GPS, to be used in combination with orthophotos. Together, these methods could potentially provide a means for landowners to visually inspect and verify positions, in real-time, as boundaries are registered.

The use of GPS for registering land under CLARA must meet specific requirements. Any survey performed using GPS technology would need to be repeatable (within a specified tolerance) to the required accuracy, legally defensible, and compliant with all relevant laws. Unfortunately, however, GPS is not yet the method of choice for most operating cadastral Land Surveyors.

9.5.3 GPS Accuracy

Depending on the intended application, GPS accuracy can be viewed in many different ways. Accuracy, as distinguished from precision, might best be described as the close-

³⁴ See Chapters 9.9 Point Offsets (page 188), and 9.10 Laser Range-Finder (page 189).

ness of an estimated quantity to a true but unknown value. Precision, on the other hand, relates to the tendency of those values to cluster about a number determined by the set itself, thus representing the repeatability of that value. Land Clerks, working autonomously in the field, will need to be aware that the GPS coordinates they register may be precise yet inaccurate. The repeatability of positions over a short time may constitute precise measurements, yet they may be offset from the “correct” position by an unknown distance and, consequently, would be inaccurate.

With reliable service, positioning accuracy can be defined as “the percentage of time over a specified time interval that the difference between the measured and expected user position or time is within a specified tolerance at any point on or near the Earth.” (DoD, 1995). For example, the accuracy of a measurement would be the statistical difference (i.e., at a 95 % probability) between an observed horizontal position measurement and a surveyed benchmark. Most GPS manufacturers provide the accuracy of their receivers in various forms, such as Root-Mean-Square (RMS),³⁵ Circular Error Probable (CEP),³⁶ or Spherical Error Probable (SEP).³⁷ These values indicate the dispersion of the obtained coordinates about their mean, including the random errors obtained in repeated measurements. The most realistic estimate of accuracy, however, should be determined by a validation procedure, using a rigorous testing protocol in which test results are compared against known control points. When results do not compare favorably with estimated results, it must be assumed that errors exist and should be corrected.

Dilution of Precision

The accuracy with which a GPS position can be determined depends on, inter alia, the geometrical configuration of satellites used and the accuracy of the individual pseudo-range measurements.³⁸ Most GPS receivers indicate their quality of satellite configuration (geometry) in terms of the scalar quantity “Dilution of Precision” (DOP). DOP is a numerical value indicating the quality of the satellite configuration, or where the satellites are in relation to each other and to the GPS receiver. Essentially, these figures indicate how the constellation geometry affects the accuracy of the computed position, and are highly dependent on the number of satellites visible. A low DOP value indicates a better relative geometry and therefore, a higher probability of accuracy. Conversely, a high DOP value indicates poor relative geometry and therefore, a lower probability of accuracy. Typically, with six satellites observed, DOP values remain below three.

³⁵ RMS is a value at one Standard Deviation (1σ), where 68.3 % of measurements are acceptable and 31.7 % are not acceptable.

³⁶ CEP is a value defined by a circle's radius, centered at the true position, where the probability is 50 % that the position is inside the circle.

³⁷ SEP is a value defined by a sphere's radius, centered at the true position, where the probability is 50 % that the position is inside the sphere.

³⁸ GPS receivers use the timing signals from at least four satellites to establish their position, and each is subject to its own errors.

The three primary DOP values of interest in surveying are PDOP,³⁹ HDOP,⁴⁰ and VDOP.⁴¹ The PDOP is related to the suitability of the constellation for 3-D positioning, the HDOP is related to the suitability for 2-D positioning, and the VDOP is related to the suitability for vertical (height) positioning. Since cadastral surveys are primarily concerned with the horizontal dimensions, HDOP is usually the most relevant figure. It is important to note that while a PDOP above a specified value (i.e., 8) may be acceptable, positions with a HDOP above a different value (i.e., 5) may not be acceptable. The accuracy of a measurement is proportionally dependent on the DOP value, so as the DOP value doubles the error in position determination also doubles.

GPS Error Sources

The accuracy of a point position using GPS technology is complex and highly variable. The process is subjected to a wide variety of potential errors, some easily preventable while others are significantly more difficult. These errors are broadly grouped into three general classes: “gross errors,” “systematic errors,” and “random errors.”

Gross errors or “blunders” usually result from avoidable mistakes.⁴² With GPS positions, these types of errors can be generated as a result of signal tracking problems by the GPS receiver. In general, they will differ significantly from surrounding readings, that is to say they will be quite large and of short duration (i.e., 1 or 2 seconds). As they generally differ significantly from adjacent positions, an experienced user can easily identify them by visual inspection.⁴³ To ensure that gross errors are identified, additional “redundant” measurements should also be collected.

Many gross errors can be prevented by using field validation procedures. In the Ekuthuleni field exercises, the process of checking the GPS receivers against the known coordinates of the base-station each morning identified and prevented the use of an incorrect datum prior to field work. Also, consider the operator who has mistakenly misidentified a property corner as being 20 m from its actual position. Even though the corner has been determined using very precise GPS measurements and processing techniques, the operator has misrepresented the accuracy due to poor feature interpretation. Although a precision of 50 cm was indicated, the “blunder” of misidentifying the point means that its accuracy is limited to 20 m. The precise position of a wrong point is ultimately useless.

Systematic errors are those that influence the position (bias) of the mean value and, as such, cannot be considered entirely random. These errors will usually follow a pattern creating a bias in measurements or calculations that will have the same magnitude, the same direction, or follow an obvious trend. If the cause of the error is not known, they

³⁹ PDOP (Positional Dilution of Precision) - position in 3-D space.

⁴⁰ HDOP (Horizontal Dilution of Precision) - position in 2-D space.

⁴¹ VDOP (Vertical Dilution of Precision) - height only.

⁴² A simple example would be transposing numbers, such as writing 91 when actually the number was 19.

⁴³ Most GPS software packages now include blunder detection (i.e., outliers $> 3 \sigma$).

can be difficult to detect, possibly only detected by recognizing the conditions under which they were created. These errors may result from an instrument that is not in calibration or a user that fails to apply required corrections.⁴⁴ Systematic errors can be modeled and removed through differential techniques, that is, differential GPS (DGPS).⁴⁵

Measurements that have an error but are free from gross and systematic errors are considered to have random errors. These measurements are related to the “true” value by the simple expression: Measurement + Random Error = True Value. They are essentially residual noise in the data, resulting from unavoidable effects such as the measurement resolution of equipment or environmental effects. More often than not, random errors will be small, easily identified visually, and have an equal chance of being negative or positive.⁴⁶ While random errors cannot be totally eliminated, their influence on measurements can be minimized by a redundancy in measurements, such as averaging measurements over time. The best estimate for redundant measurements will simply be the mean of these measurements. Dealing with random errors is a straightforward matter of using various GPS software packages that use the least squares method of minimizing the sum of the squares of the residuals.

Operator errors, or interpretive errors, are due to the interpretation and definition of features on the ground. These errors are essentially an indication of the ability of the operator to determine features in the field. The delineation and interpretation of some features will, of course, require considerably more operator skill and experience than others will.⁴⁷ In some instances, the largest error in the registration of land using GPS may be due to how well the operator has interpreted a particular feature. Features subject to interpretation, such as a meandering stream, will require specialized training for Land Clerks similar to that undergone by a Land Surveyor. In the Ekuthuleni field exercise, the eastern boundary of the Jimmy property was a broad, indistinct dry creek bed. As such, its measurement was subject to the operator’s skill in interpreting a correct boundary. A second visit to this site clearly illustrated this difficulty, as determining and re-establishing the previously registered points was a challenge.

9.5.4 Differential GPS

GPS-derived positions are typically achieved by means of two general operating modes, “absolute positioning” and “differential” or “relative positioning.” The most common of these is absolute positioning, which involves the use of a single passive GPS receiver. Most commonly, this technique is carried out using any number of the commercial handheld GPS receivers currently available on the market.⁴⁸ Absolute positioning

⁴⁴ i.e., ignoring effects of the ionosphere on GPS measurements.

⁴⁵ See Chapter 9.5.4 Differential GPS (page 168).

⁴⁶ i.e., normally distributed with a mean of zero.

⁴⁷ i.e., General boundaries.

⁴⁸ i.e., Garmin eTrex, Foretrex, etc.

involves a single receiver using the pseudorandom noise code (PRN) in the GPS signal to determine a geo-referenced coordinate of the user's position.

With the removal of Selective Availability (S/A),⁴⁹ the positional accuracy for handheld receivers in the absolute positioning mode has increased considerably. Yet the system is still generally considered to have low positional integrity. The accuracy of autonomous GPS receivers can vary significantly depending on receiver quality, DOP, observation time, and environmental conditions. The manufacturer's stated claim of accuracy is invariably optimistic and based on ideal conditions without considering the effects of adverse conditions, such as a forest canopy, steep terrain, and environmental factors. While suitable for many applications,⁵⁰ these receivers do not provide the required accuracy for most surveying applications. On the other hand, accuracies of < 1 m are possible using "static" long-term measurements employing special equipment and the post-processing of data.⁵¹

Since most errors encountered using autonomous GPS are spatially correlated, they can be removed by simultaneously surveying with two receivers. This technique, referred to as "differential positioning," (DGPS) is used to eliminate or significantly reduce inherent errors that affect the GPS measurements.⁵² The removal of these errors significantly improves the positional integrity of GPS-derived positions compared to uncorrected absolute positions obtained from a single receiver. When the corrections are applied post-field, the technique is referred to as "post-processing." When corrections are applied in the field, while the rover receiver is in use, it is known as "Real-Time Differential GPS" (RT-DGPS). Considering the accuracy attainable, DGPS methods have become the method of choice for most surveying applications using GPS technology.

The basis of DGPS is that at any given instant in time, the absolute positioning errors of two receivers within a given distance will be approximately the same. In comparing the distances between receivers and a satellite, the distance between two receivers is relatively insignificant. As a result, the satellite signal reaching two adjacent receivers⁵³ will effectively have traveled through the same portion of atmosphere and consequently be subject to the same delays. Hence, the errors at a known point (i.e., the reference receiver) can be applied to an unknown point (i.e., the rover receiver). Differential corrections can remove most errors associated with GPS signals, which are common to both the rover and reference receivers. Nevertheless, the method is not able to correct errors localized to each receiver,⁵⁴ therefore the reference receiver must be positioned to minimize possible sources of error, including multipath errors.

⁴⁹ S/A was discontinued, effective midnight May 1 2000.

⁵⁰ i.e., recreational use, simple navigation, etc.

⁵¹ See Chapter 9.6.5 High Accuracy GPS Surveying with Handheld Receivers (page 179).

⁵² i.e., atmospheric, ephemeris or satellite position, timing, etc.

⁵³ i.e., < 200 km.

⁵⁴ i.e., multipath, receiver error.

Typically, DGPS is performed by positioning one receiver (the base or reference receiver) on a previously surveyed location⁵⁵ where the receiver continuously collects data.⁵⁶ A second receiver (the rover or mobile receiver) is then positioned, in turn, at each of the unknown (uncoordinated) points to be surveyed.⁵⁷ The reference receiver uses the measured pseudorange at each epoch and compares that to the calculated absolute position based on the known coordinates. Any difference between these values is then applied to its own determined position and that of the rover. The rover correction can be done by post-processing or with a communication link between the rover and the reference station can be done in real-time.

GPS technology also offers users a number of operational modes including Absolute, Carrier, Code, Differential, Static, Kinematic, Post-processed, Real-Time Kinematic (RTK), Real-Time Differential (RT-DGPS), and combinations thereof. Each method has advantages and disadvantages, and each observation technique is capable of specific levels of accuracy. The most accurate results are obtained by using Static surveying techniques, followed by Rapid Static surveys. Kinematic and RTK surveys are usually less accurate due to their shorter occupation periods.

9.5.5 Real-Time Differential GPS

The ability to apply differential corrections in the field in real-time (RT-DGPS) can be advantageous to a Land Clerk. The ability to attain high accuracy GPS coordinates in the field would allow Land Clerks to verify existing boundaries and other features in the field in real-time. Ideally, a Land Clerk would be able to upload spatial data (i.e., orthophotos) to a mobile device (i.e., PDA, portable computer) as a background image for the capture of field data. As the GPS coordinates are collected, they can be accurately draped onto these images to allow the Land Clerk and the property owner to graphically visualize and verify the coordinates in the field before registration.⁵⁸

The process of RT-DGPS starts at the reference receiver, where pseudoranges for each satellite are observed and computed. They are subsequently formatted, sent to a radio modem, modulated, and transmitted⁵⁹ to the rover. As the rover radio modem receives this signal it is demodulated, sent to the GPS receiver, reformatted, and then applied to the pseudorange measurement of the rover to compute a final positional fix. The amount of time required for this process means that real-time corrections would always have some latency built into them.

The process of applying differential corrections requires the use of a second receiver as the reference station. The need to purchase two receivers can sometimes be avoided by

⁵⁵ With known coordinates.

⁵⁶ See Figure 23: GPS Surveying [Reference Receiver] (Appendix E/page 268).

⁵⁷ See Figure 24: GPS Surveying [Rover Receiver] (Appendix E/page 268).

⁵⁸ See Figure 8: iPAQ PDA [Jimmy Property] (page 156).

⁵⁹ Various mediums can be used to allow operators to access corrections in real-time, such as beacons, the Internet, radio, or satellites.

the use of government or privately run terrestrial reference stations (i.e., TrigNet,⁶⁰ OmniSTAR⁶¹). TrigNet, for example, provides a network of continuously operating GPS base-stations⁶² located on precisely known positions spaced approximate 200 - 300 km apart throughout South Africa (TrigNet, 2006). While TrigNet makes data from some stations⁶³ available within 30 minutes after each hour, data from the remaining stations are only available the day after observations (TrigNet, 2006). Unfortunately, with these delays, real-time corrections are not possible.

In reality, the use of RT-DGPS is never as easy as it might seem. Even when real-time service is available, the coverage is not necessary homogenous for all areas. This may be the result of gaps in the existing coverage or a baseline distance that is simply too long.⁶⁴ With long baselines, significantly more errors are introduced⁶⁵ and broadcast constraints may limit the baseline distances. Thus, new infrastructure such as the densification of base-stations might be required. Furthermore, access to a real-time service usually means added expense, since most reference station data is sold for a fee or requires subscription fees.

Another obstacle in using RT-DGPS is the requirement for a “reliable” radio link between the rover receiver and the reference receiver. The correction of data in real-time means that whenever field operators receive a GPS signal, they also must be able to receive the correction signal. Furthermore, if quality assurance and quality control requirements cannot adequately be met by RT-DGPS, then post-processing may be the only option.

For RT-DGPS, after the reference receiver receives the satellite signal, the error value is computed for all visible satellites and transmitted (in real-time) to the rover receiver via a radio telemetry link. The corrections for each satellite used by the rover are then applied. However, a lag time (latency) occurs between the reference station observations and the subsequent corrections that are applied at the rover, during which time the observations may have changed and are no longer completely valid. The corrections applied to the rover receiver are predictions based on the reference receiver’s broadcasted corrections from several seconds previously. Post-processing, on the other hand, is able to use more powerful software to achieve a better accuracy. For experienced operators, post-processing can be a fast and simple process with a full day’s work only requiring a few minutes of processing time.

⁶⁰ Operated by the Chief Directorate Surveys and Mapping, South Africa.

⁶¹ A subscription-based service, which transmits corrections from a network of reference stations to subscribers via satellite. The service provides for worldwide coverage at submeter accuracy.

⁶² All stations record 1 sec epoch data on L1 and L2 frequencies using geodetic standard choke ring antennas.

⁶³ Bloemfontein, Cape Town, Durban, Mafikeng, Nelspruit, Port Elizabeth, Pretoria, Springbok, and Thohoyandou.

⁶⁴ Atmospheric conditions become harder to model with distances > 200 km.

⁶⁵ This is the ppm (parts per million) component of the accuracy specification for a receiver.

If accuracy and reliability are the main consideration when using GPS, and real-time corrections are not required, then post-processing DGPS may be the route to follow. As previously mentioned, post-processing will have a higher accuracy by utilizing the reference receiver observations collected both before and after each measurement to increase accuracy. In addition, with no need for real-time corrections, post-processing also has advantages for quality control. Data can be reprocessed multiple times, to ensure that the quality control specifications are met and that the highest accuracy is attained. The added quality control afforded by this method can also ensure that all derived positions are in a standardized reference frame, regardless of which base-station source was used, and subsequently matched with the intended GIS/LIS format.

Finally, depending on various factors, RT-DGPS systems may not be able to meet accuracy specifications for all situations. When real-time corrections are not possible,⁶⁶ a post-processing capability will be required. Furthermore, the post-processing option will always be required as a backup option and to fill in the gaps for areas with poor results. While RT-DGPS may have considerable advantages for Land Clerks, avoiding RT-DGPS altogether would remove one added level of complexity.

9.6 GPS Receivers

9.6.1 GPS Receiver Selection

The selection of the correct GPS receiver(s) for registering land rights is critical to its success. Currently, a myriad of GPS receivers are available in the marketplace that differ greatly in their accuracy and cost. These receivers can be loosely categorized into three broad types:

- *Navigation (recreational/consumer-grade) (i.e., eTrex)*
- *Differential GPS (resource mapping grade)*
- *Carrier-phase GPS (professional/survey/geodetic-grade).*

In addition to the various types and grades of GPS receivers, operators must take into account the receiver's intended application. Each receiver will be suitable to a particular surveying technique⁶⁷ and may or may not have the capability to perform other survey techniques with the required accuracy.

The choice of receiver will be primarily dictated by accuracy requirements, surveying technique, and cost. Of course, a considerable temptation will be present to purchase the least costly receiver that can meet the minimum requirements, but diligence must be taken in analyzing the cost and the receiver's ability to meet requirements in all environments.

One of the first and most important questions to ask is whether the GPS receiver, technique, and software can achieve the required accuracy. Accuracy requirements are

⁶⁶ i.e., interruption of broadcast.

⁶⁷ i.e., static, rapid static, continuous kinematic, real-time kinematic (RTK) stop and go kinematic, etc.

paramount in determining the type of receiver selected and will limit the options by ruling out most of the recreational-grade receivers.⁶⁸ In selecting a GPS receiver, one must consider that not all receivers can meet their stated accuracy values in all conditions. Specifications provided by manufacturers are usually marketing claims and possible only under optimal conditions.⁶⁹ Moreover, the specifications may not consider errors due to factors such as multipath and forest cover. Specifications given by the manufacturer are typically not credible unless the testing was performed independent of the manufacturer and rigorous scientific procedures were followed.

Each high-end GPS receiver⁷⁰ offers different levels of accuracy and has different requirements to attain those accuracies. Carrier-phase receivers can provide a high level of accuracy (< 0.5 m),⁷¹ but the actual accuracy will depend on variables like occupation time and baseline length. For longer baselines,⁷² a dual-frequency receiver may be required. These receivers use two frequencies simultaneously to allow the receiver to determine very precise positions and thus provide subcentimeter accuracy.⁷³ C/A code receivers can provide submeter accuracy⁷⁴ under the right conditions like longer occupation times.

The cost of a GPS receiver will invariably be dictated by the accuracy requirements. Higher levels of accuracy generally cost more because of the level of complexity needed to attain those accuracies. The purchase of a receiver may also require some secondary costs, including software, training, or other auxiliary requirements.

In addition, the appropriateness to the task must be considered. That is, the GPS receiver must be within the means of Land Clerks, Land Administrators, and local Land Surveyors. Given that the expected field operators for these systems will be Land Clerks with only three months of training, and Land Administrators with 12 months of training (DLA, 2004), the systems must be easy to learn, easy to operate, and adaptable to variable field conditions.

The configuration options for the receiver must ensure that the data will meet the minimum conditions⁷⁵ for each GPS point registered. The receiver⁷⁶ will need a capacity to store a large number of position fixes and their associated attributes. The receiver will need to store data so that it can be differentially corrected post-mission or in real-time, depending on the method chosen. For Land Clerks in particular, the system must allow for simple data collection and simple downloading. While some receivers may be simple

⁶⁸ In autonomous mode.

⁶⁹ i.e., open sky, ideal satellite geometry, etc.

⁷⁰ i.e., Coarse Acquisition (C/A) code, Carrier-Phase or Dual Frequency receivers.

⁷¹ With differential correction.

⁷² i.e., > 20 km.

⁷³ With differential correction.

⁷⁴ With differential correction.

⁷⁵ i.e., HDOP < 5, PDOP < 8, minimum number of satellites 4, mask angle 15°, etc.

⁷⁶ /data collector.

to operate, they may require extra time and effort after the survey to download and process the data.

Although somewhat pricey, a receiver with an ability to use existing and future Global Navigation Satellite Systems (GNSS) should be considered. For instance, some available receivers can use and process both the US-based GPS and the Russian GLONASS.⁷⁷ Unfortunately, GLONASS has fallen into disrepair in recent years, however, it is currently in the process of being improved and expanded. In addition to GLONASS, Europe's new Galileo GNSS is expected to be operational by 2008. This new system will be interoperable with both GPS and GLONASS and will deliver real-time positioning accuracy to the meter level (ESA, 2006).

For difficult terrains where the frequent loss of lock will likely occur, such as under forest canopies, a receiver's Time-to-First-Fix (TTFF) and signal re-acquisition times will be an important consideration. The time required for re-acquisition of satellites can vary considerably between receivers, and loss-of-lock can be a problem with some low-cost receivers. There are additionally many other features to consider in the purchase of a GPS receiver, including its size, weight, power consumption, external antenna capability, and operator display.

9.6.2 eTrex GPS Receiver

A key to the success of the eTrex,⁷⁸ as with many other handheld GPS receivers, is its portability and low cost.⁷⁹ It is one of the most affordable receivers on the market, easy to obtain, durable, reliable, useable in all weather conditions, and compact. With its small size⁸⁰ and weight,⁸¹ the eTrex can be carried in a pocket and can easily fit into the user's palm to permit simple one-handed operation. The eTrex runs on common AA batteries that can operate all day.⁸² The eTrex is simple to learn, simple to use, and intuitive for first-time users. In this project, the two women trainees had little trouble in learning and using the eTrex. Both women had access to cellular phones and were comfortable with setting and adjusting their phone's menu systems so it was a small step to learn how to operate the eTrex.

The benefits of the eTrex's low cost and small size are offset by some limitations. The size of the screen, coupled with its low resolution,⁸³ provides only a coarse display and makes it difficult to see fine detail. During the field exercises, for example, the eTrex position format settings were accidentally changed from "Degrees-Minutes-Seconds" to

⁷⁷ GLObal NAVigation Satellite System (GLONASS).

⁷⁸ See Garmin eTrex GPS Receiver (Appendix B/page 241).

⁷⁹ ~R 1,235 (Average price from "TechShop" (Rooihuiskraal, SA)) and "Navstar SA" (Durban, KZN, SA) (Price includes VAT) (April 2005)).

⁸⁰ 11.1 x 5.1 x 3.0 cm.

⁸¹ 150 g.

⁸² Garmin states 22 hrs.

⁸³ 27 x 54 mm, 128 x 64 pixels, 4-level grey screen.

“Degrees-Decimal Minutes.”⁸⁴ Under the bright glare of the sun, this subtle difference easily escaped the operator’s notice. Editing text on the small screen of the eTrex could be a time-consuming process. This was especially true for editing waypoint names, where the operator was required to scroll through the entire list of characters to find the desired one and enter each in turn. Although the eTrex can store up to 500 waypoints, managing the list of waypoints can be a nightmare unless they are carefully named. Moreover, changing the name of each waypoint as it is saved can be a long and tedious process.

Although the eTrex has a map option,⁸⁵ the small size and poor resolution of the screen makes it too granular to be useful. The maximum zoom is 50 m, and with its inability to pan, it is only practical for simple navigation. The basic model eTrex does not have the advanced features of the other eTrex models,⁸⁶ so it cannot upload or display background maps.⁸⁷ In addition, the eTrex is not DGPS-compatible, so that users must forgo any differential correction capabilities.⁸⁸

Acquisition times for the eTrex⁸⁹ can be slow compared to other handheld receivers. On several occasions in the field, after allowing the receiver to download initial ephemeris data, the unit was turned off and turned on again to determine the time required for a warm start.⁹⁰ Under ideal conditions (no terrain masking), the eTrex acquired 3-D lock in approximately 15 - 25 seconds and reception was always excellent with no loss of tracking. Perhaps a more appropriate test for areas where satellite tracking will likely be a problem would be the receiver’s signal re-acquisition performance. After a satellite signal is lost and then reacquired, one must consider how long it takes before the receiver can use that signal for measurement. While high-end receivers have almost instantaneous signal re-acquisition times, recreational/consumer-grade receivers may not. In areas of “dense” forest canopy, the eTrex would often lose the satellite signal with reacquisition times of up to several minutes.

⁸⁴ From hddd° mm’ ss.s” to hddd° mm.mmm’.

⁸⁵ i.e., track plot.

⁸⁶ See Table 3: eTrex and Foretrex GPS Receivers (page 132), and Table 4: eTrex GPS Receivers (page 133).

⁸⁷ Including Garmin's MapSource.

⁸⁸ Garmin does, however, state a positional accuracy of 1 - 5 m with differential GPS corrections using an optional Garmin Differential Beacon Receiver Import (such as Garmin GBR 21) (Garmin, 2003b). See Chapter 9.6.5 High Accuracy GPS Surveying with Handheld Receivers (page 179).

⁸⁹ ~15 sec (warm start), 45 sec (cold start), 5 min (First Time/AutoLocate) (Garmin 2004a, 2004b, 2005).

⁹⁰ i.e., receiver has an estimate of current time, position, and recent satellite almanac data.

9.6.3 eTrex GPS Receiver Accuracy

Garmin's stated positional accuracy⁹¹ for the eTrex GPS receiver is < 15 m (95 % typical),⁹² but significantly improved accuracy can be attained using Satellite Based Augmentation Systems (SBAS)⁹³ such as the currently operating WAAS⁹⁴ in North America. The eTrex records latitude and longitude readings to the nearest 0.1", which, in the area of Ekuthuleni,⁹⁵ equates to approximately 3.0 m in latitude and 2.7 m in longitude.⁹⁶ Positional accuracy, as given by the eTrex on the days of survey, ranged from 4 m to 8 m.

A comparison of (uncorrected) coordinates using three different eTrex receivers ($\eta = 5$) in the Ekuthuleni field exercises⁹⁷ showed a variation of ± 0.1 " from the mean value.⁹⁸ An exception was Δ JP-13, which was a general reference to the residential dwellings taken in the "approximate" center of habitation and therefore not unexpected. Although the 12 points outlining the Jimmy property were within 0.1" of the mean, any specific value could vary up to 0.2" between maximum and minimum values. The field exercises indicated that, under ideal conditions, and with no post-processing, any specific property point could be reproduced to ± 0.2 ".

Accuracy for the eTrex and similar handheld GPS receivers can be degraded significantly in any environment where satellite tracking becomes less than ideal. The internal eTrex settings for PDOP and SNR are set to allow maximum data logging, and because the eTrex did not allow for user configuration, "noisier" data could not be prevented from being logged under poor conditions. Research to evaluate the accuracy of the eTrex GPS receiver has shown that a considerable discrepancy occurs between the accuracy obtained under ideal conditions and the accuracy in less than ideal conditions. Research conducted in Oregon (US), using the eTrex GPS receiver indicated accuracies

⁹¹ GPS < 15 m (95 % typical), DGPS (USCG) 3 - 5 m (95 % typical), and DGPS (WAAS) < 3 m (95 % typical) (Garmin, 2003d).

⁹² Subject to accuracy degradation to 100 m (2 DRMS) under the U.S. Department of Defence imposed Selective Availability Programme.

⁹³ Satellite-Based Augmentation Systems (SBAS) are networks of geostationary satellites and ground relay stations designed to receive satellite navigation signals and transmit corrected distance and time measurements to significantly improve accuracy. There are three SBAS in current operation or under development including WAAS (Wide Area Augmentation System) in North America, EGNOS (European Geostationary Navigation Overlay System) in Europe, and MSAS (Multifunctional Transport Satellite-based Augmentation System) in Asia.

⁹⁴ WAAS corrections require an SBAS capable GPS receiver. It is a free service providing submeter accuracy, though it is limited to specific geographical areas.

⁹⁵ $\sim 28^{\circ} 41.5' S / 31^{\circ} 25.0' E$.

⁹⁶ This does not imply an accuracy of 2.7 - 3.0 m.

⁹⁷ Jimmy Property.

⁹⁸ See Table 11: GPS Coordinates/Jimmy Property 4 (Appendix C/page 250).

of 14 m at a control site under ideal conditions compared to 64 m at a test site under forest canopy⁹⁹ (Mancebo et al, 2000).

A low-end receiver like the eTrex has limitations on the attainable accuracy; therefore, the eTrex cannot distinguish small jogs in property boundaries. While mapping the Jimmy property in Ekuthuleni, for example, the eTrex was unable to resolve small 3 - 4 m jogs in the property boundary. Hence, when an eTrex or similar receiver encounters boundary lengths that are an order less than 2 - 3 times the maximum expected precision, an approximate central GPS position would be needed. A property boundary line of less than 3 m may be registered by using a single GPS position with 1 m precision.

While the eTrex has many advantages, they come at a cost. The advantages of portability and low cost that make the eTrex such a popular model are offset by its low accuracy. Even though the eTrex is extremely popular as an introductory system to GPS, it can be best described as an entry-level GPS and not suitable¹⁰⁰ for registering land under CLARA. A better grade GPS receiver, or possibly differential processing of the eTrex data, would be needed.

Numerous other handheld GPS receivers are currently available on the market that vary considerably in specifications and price. Many of these, while more expensive, are also considerably more accurate. For example, the Garmin eTrex,¹⁰¹ Geko,¹⁰² and GPSMap¹⁰³ receivers have stated horizontal accuracies of ~15 m, while the Magellan Meridian¹⁰⁴ and the SporTrak¹⁰⁵ have stated horizontal accuracies of < 7 m (Burrows, 2003).

9.6.4 Recreational vs. Professional Grade GPS Receivers

The US Department of Defense removed the artificial degradation of GPS signals, referred to as Selective Availability (S/A), in May 2000. This had the immediate effect of increasing civilian accuracy by an order of magnitude. Unfortunately, it still may not be enough for many autonomous GPS surveying applications, and most survey applications still require the technique of differential positioning (DGPS) to achieve the required accuracy. The decision of whether to use unaugmented GPS or DGPS will depend on the user's application and requirements.

The ability to obtain high accuracy measurements usually requires an investment in equipment that can be expensive. While survey grade receivers using carrier-phase and pseudorange measurements provide the greatest accuracy, they are also the most

⁹⁹ All values at 2 DRMS, Selective Availability (S/A) off, moderate to heavy timber canopy, flat terrain.

¹⁰⁰ In autonomous mode.

¹⁰¹ Models: eTrex (Basic), Camo, Legend, Summit, Venture, and Vista.

¹⁰² Models: 101, and 202.

¹⁰³ Models: 76, and 76S.

¹⁰⁴ Models: Colour, Gold, GPS, Marine, and Platinum.

¹⁰⁵ Models: Basic, Map, and Pro.

expensive. Receivers that accept DGPS corrections in real-time generally require the user to carry additional equipment that can receive the DGPS broadcasts. One option to the costly investment in separate DGPS receiving equipment or even more costly survey grade receivers is the use of low-cost handheld receivers.

Current research¹⁰⁶ suggests that the use of low-cost handheld GPS receivers¹⁰⁷ rather than the high end/high cost GPS receivers¹⁰⁸ is possible. This option, however, should be carefully evaluated. As most experienced GPS operators are aware, the significant difference in price between recreational and professional grade receivers is warranted, since they have been designed for fundamentally different purposes.

Recreational GPS receivers are specifically targeted at that segment of the market looking to acquire GPS positions quickly, without the need for high accuracy and at a reasonable price. Without the need for high accuracy, recreational receivers are able to quickly generate a locational fix, regardless of whether the value is good or bad. For surveying purposes, however, little or no quality control is available to the end-user. Even newer receivers that support SBAS corrections do not allow users to distinguish values that have been SBAS-corrected, and values that have not been SBAS-corrected. Consequently, an operator may receive a reading with SBAS-corrected 5 m accuracy one moment and an SBAS-uncorrected 20 m accuracy the next, with no means of distinguishing the two.

Professional GPS receivers, on the other hand, are targeted at that segment of the market looking to acquire high accuracy GPS positions. To achieve this higher level of performance, the receivers have better electromagnetic shielding, pseudorange resolution, multipath rejection capabilities, significantly improved antennas, and better quality control methods. The improved electromagnetic shielding on these receivers minimizes the effects of stray electromagnetic interference from other peripheral devices.¹⁰⁹ Better antennas¹¹⁰ and quality control methods¹¹¹ allow users to distinguish between high quality and low quality signals, and permit improved operation in adverse environments. While most recreational GPS receivers are generally limited to using a proprietary operating system, most professional GPS receivers allow the user to choose or even create their own software on a Windows-based operating system.

¹⁰⁶ See Chapter 9.6.5 High Accuracy GPS Surveying with Handheld Receivers (page 179).

¹⁰⁷ i.e., Recreational grade receivers.

¹⁰⁸ i.e., Survey/professional grade receivers.

¹⁰⁹ i.e., PDA, computer, etc.

¹¹⁰ i.e., increased sensitivity, better gain pattern.

¹¹¹ i.e., better operator control of tracking SNR (allows rejection of weak/inaccurate pseudoranges), Mask Angle (allows rejection of low elevation pseudoranges), DOP (allows rejection of weak geometric fixes), positioning mode (allows rejection of 2D positioning), etc.

9.6.5 High Accuracy GPS Surveying with Handheld Receivers

The prime deterrent for using a high-end GPS system¹¹² is cost. Ideally, a tool of choice would be a low-cost handheld GPS receiver; however, these receivers do not currently meet accuracy requirements. Recently, the search for alternative low-cost survey methods has turned to the possibility of using single frequency handheld GPS receivers to attain centimeter level accuracy. Numerous research articles on the topic have been published as a result.¹¹³

Gringo/P4

Generally, post-processing of data is not possible using handheld GPS receivers like the eTrex, as they lack the ability to log raw measurements. Recently, several software programmes were developed that can extract the pseudorange and carrier-phase data from some of the common handheld GPS receivers. One such example is the Gringo¹¹⁴ programme, developed at the University of Nottingham.¹¹⁵ This programme is able to record pseudorange and carrier-phase data in a standard RINEX format for several models¹¹⁶ of Garmin's 12-channel handheld GPS receivers. The advantage of a RINEX-formatted observation file is that most commercial GPS post-processing software can easily import and post-process.

Communication protocols in Garmin's handheld GPS receivers¹¹⁷ use both industry-standard protocols and a proprietary data format for exchanging data between receiver and computer. Some of these "undocumented" protocols contain the raw carrier-phase and pseudorange data, which is decoded by the Gringo programme. Since most handheld receivers have no capacity to log raw measurements, the data must be logged in real-time by connecting a computer (or data-collector) to the receiver's data port. The raw data is captured from the Garmin receiver and decoded by Gringo for post-processing off-line. The resulting RINEX pseudorange data file can then be combined with the reference receiver data so that the necessary corrections can be made.

¹¹² i.e., Survey/professional grade receivers.

¹¹³ See References (Cosser et al, 2004), (El-Mowafy, 2003), (Galán, 2002), (Hill et al, 2001, 2002), (Hobbs, 2006), (Schweiger, 2003), (Schweiger et al, 2005), and (US Positioning, 2003).

¹¹⁴ Gringo (GPS RINEX generator), including P4 programme. The pseudorange version of the Gringo programme retails for ~R 700 (UK £ 65), and ~R 1075 (UK £ 100) for the combined pseudorange/carrier-phase version. A demo version is available for download from the Gringo Web site (<http://www.nottingham.ac.uk/iessg/gringo/#HowdoyouDemo>), which can later be activated for the mentioned costs (Gringo, 2002).

¹¹⁵ Institute of Engineering Surveying and Space Geodesy, University of Nottingham, UK.

¹¹⁶ i.e., eTrex series.

¹¹⁷ i.e., Garmin Models G12, 12XL, II+, III+, eTrex, EMAP, and G76 (Harris, 2006).

Using the Gringo programme to access the raw measurement data of Garmin's handheld receivers¹¹⁸ can significantly improve accuracy. By post-processing the measurements in a differential mode with the known coordinates of a reference receiver, the produced accuracies are approximately 5 m using pseudorange measurements and approximately 10 cm using carrier-phase measurements from a static receiver (Hill et al, 2002).

Other examples that use the Gringo programme have looked at the possibility of using Garmin handheld receivers for bridge monitoring (Cosser et al, 2004). In this project, various tests were conducted to compare the results from a Leica geodetic receiver¹¹⁹ to Garmin's 12-channel handheld receivers. Test results indicated that the post-processing of data from these receivers using Gringo could attain accuracies that were, on average, approximately 50 % of those attained using a geodetic receiver. That is, the geodetic receiver was still twice as accurate as the Garmin receivers for short baselines. This, as the author stated, is "a good outcome considering the price difference for each receiver" (Cosser et al, 2004).

A German research project¹²⁰ looked at static and kinematic positioning using low-cost handheld GPS receivers together with geodetic receivers for precise positioning. The research project used a Garmin eTrex Vista¹²¹ GPS receiver with data post-processed with that of a Leica SR 530 receiver.¹²² Under ideal conditions, the author concluded that accuracies of < 10 cm were attainable using the static mode and accuracies of approximately 1 m were attainable when conditions are less than ideal (Schweiger et al, 2003, 2005).

In the Maldives, an interim low-cost land registration system was sought, while a "delayed" network of accurately fixed reference points could be established throughout the atolls.¹²³ This interim process used the Garmin eTrex Venture¹²⁴ GPS receiver and the Gringo/P4 programme to record satellite data¹²⁵ in RINEX form on a portable computer for later post-processing. Using a precise ephemeris and placing the receiver in a shallow container¹²⁶ to reduce multipath effects, accuracies of 4.79 m were attained.¹²⁷ As the first step to building a GIS covering all the atolls, the results were

¹¹⁸ 12-channel receivers.

¹¹⁹ Leica system 500 survey grade GPS dual frequency receiver and Leica 510 single frequency GPS receiver.

¹²⁰ University of Stuttgart, Germany.

¹²¹ The phase and code data quality is identical for all receivers in the eTrex series (i.e., eTrex (Basic), Summit, Legend, Venture, Vista, and Camo).

¹²² Leica SR 530 dual-frequency, geodetic, real-time-kinematic receiver.

¹²³ 20 atoll capitals.

¹²⁴ The phase and code data quality is identical for all receivers in the eTrex series (i.e., eTrex (Basic), Summit, Legend, Venture, Vista, and Camo).

¹²⁵ Pseudorange.

¹²⁶ Frying pan.

¹²⁷ Results were 4.79 m (95 %) as compared to previously established first-order coordinates.

deemed adequate and the system has since been adopted by the Survey Unit of the Ministry of Atolls Administration for each new island survey (Hobbs, 2006).

Another research project looked at the feasibility of using handheld GPS receivers to generate planimetric and topographic base-maps for a GIS. This research project used carrier-phase data from Garmin handheld GPS receivers¹²⁸ and differentially post-processed with measurements from an Ashtech dual-frequency geodetic-grade reference receiver. Field-testing in static and kinematic modes provided accuracies¹²⁹ of < 12 cm (planimetric) and 24.6 cm (height positioning)¹³⁰ (El-Mowafy, 2003).

Other Software

An alternative to the Gringo programme that follows a similar process is the GAR2RNX¹³¹ programme, developed by the Environmental Software and Modeling Group (ESMG)¹³² in Spain. This programme generates RINEX¹³³-compliant files using Garmin's undocumented binary protocol by the logger utility (Galán, 2002). Test results¹³⁴ using this method have a stated accuracy of < 1 m for a computed position in a single session and 10 - 20 cm for averaging and adjusting, over several sessions¹³⁵ (Galán, 2002).

Other independent tests using similar methods have produced similar accuracies. One such test using an eTrex Summit as the rover receiver and a Garmin GPS III+ as the reference receiver obtained results of 4.4 - 7.5 cm (US Positioning, 2003). This project used the software programmes "Rhino BaseStation" to collect reference data, "Rhino Rover" to simultaneously collect static observational data, and "Rhino Post-Processor" for post-processing.

Cautionary Note

It should be noted that while Garmin provides detailed descriptions of most protocols, it does not document those used by the above-mentioned programmes and others. Garmin states that undocumented protocols are for internal testing purposes only and subject to change at any time. Furthermore, they should not be considered safe and should not be used by third-party applications for any purpose (Garmin, 2004f). In addition, previous research on this process determined that the carrier-phase from the Garmin receivers was subject to slip by half-cycle amounts requiring the resolution of

¹²⁸ Garmin 48 (Single frequency (L1) receiver).

¹²⁹ Subject to conditions.

¹³⁰ Results are 95 % probability (< 6 cm RMS).

¹³¹ GARmin TO RiNeX translator (GAR2RNX).

¹³² Technical University of Madrid, Spain.

¹³³ Version 2 format.

¹³⁴ Conditions apply (i.e., no external antenna, 10 - 15 minute sessions, differentially corrected, etc.), Garmin GPS12 and GPS12XL models used.

¹³⁵ Subject to conditions (i.e., external antenna).

ambiguities to the nearest half-cycle (Cosser et al, 2004). However, the latest Gringo programme addresses this issue and can log the full integer plus the fractional part carrier-phase to allow for centimeter-type accuracies under the right conditions (Gringo, 2002).

In summary, these programmes offer users of inexpensive handheld GPS receivers, such as the eTrex, the possibility of post-processing to obtain accuracies of approximately 5 m using pseudorange or several centimeters using carrier-phase (Hill et al, 2001). Naturally, inherent risks are involved in using these methods, and considerable testing and validation would be necessary before they could be put into practice. In all of the previously mentioned research papers, the authors clearly state that the programmes and procedures were thoroughly tested and present results to validate their claims. Though still at a preliminary stage, the results look promising. Once perfected, these methods may negate the need for expensive survey grade receivers and reduce the cost of the GPS option.

9.7 GPS Field Methodology

9.7.1 Quality Control and Quality Assurance

Implementing Quality Control (QC) and Quality Assurance (QA) methods will be vital to the successful registration of land by Land Clerks under CLARA. A clearly defined set of QC and QA guidelines must be implemented before a Land Clerk steps into the field. For a Land Clerk, QC will involve the procedures they perform to ensure that their final product is accurate, correct, and complete. On the other hand, QA will involve the procedures performed by those having more responsibility, such as the Land Administrator or Land Surveyor, who will accept the Land Clerks' products and must ensure that the final submission is accurate, correct, and complete.

The first steps in ensuring adequate QC procedures will be to ensure that Land Clerks have adequate education, training, and experience. As the primary GPS field operators, they will need to have a strong foundation in GPS theory and field procedures. Whether or not the DLA's 3-month training programme for Land Clerks will be able to provide an adequate foundation is debatable, and Land Clerks may require extended training. As there is no substitute for experience, Land Clerks should be required to work for a minimum period under the direct supervision of an experienced GPS operator. An experienced GPS operator with a solid understanding of GPS theory and field procedures will be able to perform simple QC on most field data just by visual inspection. As the main field operators, Land Clerks should also have this capability.

Land Administrators, in turn, will be responsible for implementing and monitoring QA procedures to ensure that Land Clerks are following the correct procedures. They must ensure that Land Clerks are provided with a clear set of target standards (i.e., accuracies), have a clear definition of deliverables, and practice good GPS methodology. All requirements will need to be clearly quantified for GPS end-users to ensure that the submission of data is in a standard and acceptable format. Land Administrators may have to perform periodic audits or ongoing evaluation procedures of Land Clerks at various levels and frequencies. Land Clerks will need to be objectively evaluated for their skills, perhaps by performing validation survey tests against known standards.

Furthermore, Land Administrators will need to ensure that all data collected at all phases of the process, including reference station and rover files, original field notes, and electronic forms (i.e., database), are adequately stored and archived. In addition, all GPS receivers will need to undergo a GPS system validation process to ensure accuracy requirements can be met in all foreseeable conditions.

The creation of minimum GPS data collection and data documentation standards and the assurance that they are followed will, of course, have important consequences. Agencies that use the GPS data must have confidence in the data's quality, and Land Clerks or other contractors who collect GPS data must know exactly what is required. In this way, the costs can be reduced by eliminating any need to recollect data due to poor accuracy.

9.7.2 Receiver Settings

The accuracy of a point position derived from GPS observations is a function of many factors. While some of these factors may be beyond the operator's control, other factors will be within the operator's control. To ensure that the required accuracies are attained, control must be maintained over quality parameters during the GPS data collection process. Many GPS receivers, and certainly all receivers acceptable for registering land tenure, will permit some user configuration. Key among these will be the DOP Mask, SNR Mask (Signal-to-Noise Ratio), Mask Angle (Satellite Elevation Mask), and Minimum Number of Satellites. Configuration settings for these values can have a direct effect on the quality of data, and the selected values are usually a trade-off between productivity and accuracy. Most field survey operations and procedures should be performed using the recommended receiver settings and observation times, according to the manufacturer. In areas where satellite acquisition is difficult, however, these settings may need to be adjusted.

DOP Mask

Since the accuracy with which a GPS position can be determined is directly related to the geometrical configuration of satellites used, most receivers will allow the operator to set a DOP threshold value. Field data should be collected with the lowest possible DOP threshold and never greater than the maximum allowable.¹³⁶ This DOP threshold value, or DOP Mask, can be set to alert the operator when the DOP is unacceptable. Since cadastral surveying is mainly concerned with horizontal coordinates, the HDOP should be monitored. Also, for QC and troubleshooting purposes, DOP values should generally be recorded with the measurements.

SNR Mask (Signal-to-Noise Ratio)

A measure of the strength of a satellite's signal is known as the Signal-to-Noise Ratio (SNR). Ultimately, as the SNR decreases, so does the accuracy. As a result, many GPS

¹³⁶ i.e., HDOP = 5, PDOP = 8.

receivers allow for the setting of a minimum signal strength, or SNR Mask value.¹³⁷ This provides the means to reject weak pseudoranges that may have been distorted or corrupted by multipath. The minimum SNR value can be lowered to increase satellite tracking in adverse conditions, but care must be taken when changing these settings. Increasing the minimum SNR to a larger value will often require the operator to remain at positions for longer periods to ensure that the receiver has adequate signal strength. Alternatively, the reduction of the SNR value may produce better DOP values, though positional accuracy will be degraded.

Mask Angle (Satellite Elevation Mask)

A major source of error in GPS observations is atmospheric propagation. Using satellites at low angles in the sky will generally result in less accurate results. This is due, in part, to the signal's extended path through the atmosphere and a weakening of the signal strength due to multipath signal degradation. The removal of low-angle satellite signals is done by choosing a minimum elevation below which satellites are not accepted. This cut-off method, referred to as "Satellite altitude mask angle" or simply "Mask Angle," is a compromise between DOP effects and signal quality. Typically, this value¹³⁸ is 15° and can be further increased during post-processing (i.e., 20° - 30°) to reduce the effects of multipath.

Minimum Number of Satellites

Even though an elevation may not be required, an accurate positional fix will require a minimum of four satellites, and more would be highly desirable for observation redundancy. In order to compute a horizontal position many handheld GPS receivers will assume an elevation in order to allow for a 2-D mode. These receivers, including the eTrex, often fluctuate between the 2-D and 3-D mode in areas where satellite acquisition is difficult. This mode is subject to errors and, consequently, would not be acceptable. Thus, GPS receivers should be set to record a minimum number of satellites (i.e., 4).¹³⁹

9.7.3 Land Clerk Deliverables

GPS surveying projects can generate enormous quantities of data. How this data is managed and archived will be essential to its future usefulness. When the first boundary dispute arises, the first question asked will be whether the original survey was done correctly and whether the GPS positions were accurate. In other words, all raw GPS data must be kept and archived for a specified time for QC purposes. This will include all data from the field receiver and the reference receiver in its original unedited form, as

¹³⁷ i.e., SNR Mask = 6.

¹³⁸ i.e., reference receiver = 10°, rover receiver = 15°. For navigation grade receivers this may be set as low as 5°.

¹³⁹ Minimum number of satellites = 4 (3-D solution).

well as the final edited versions. This will allow a re-evaluation should questions arise pertaining to a survey's authenticity.

The Land Clerk should have a standard set of "deliverables" for each project that will be submitted to the Land Administrator/Land Surveyor for approval and eventual archiving. These would include the previously mentioned GPS data, copies of all field notes, and various data files.

9.8 PDA and Handheld GPS Receiver

An alternative to using a somewhat ungainly laptop computer in the field may be using the considerably more portable Personal Digital Assistant (PDA).¹⁴⁰ Similar to a laptop, these small devices¹⁴¹ can easily process satellite data from an external GPS receiver and display that data in a digital mapping programme.¹⁴² Compared to most handheld GPS receivers, PDAs have the advantage of larger, high-resolution colour screens. They can also upload detailed maps,¹⁴³ whereas handheld GPS receivers are usually limited to the manufacturer's proprietary software and maps. PDAs have a simple user interface with a touch screen and stylus to enter commands and data. Many newer versions use a Windows OS¹⁴⁴ and are able to run many Windows-based and other custom-written programmes. Most new PDAs have easily expandable memory with plug-in SD cards to allow for easy exchange of data and files with other devices using similar memory cards.¹⁴⁵ An eTrex or other external GPS receiver is easily connected to a PDA via a serial or USB cable, and newer models now support Bluetooth wireless technology.¹⁴⁶

What makes the PDA particularly useful is its versatility and ability to display digital maps. Numerous mapping programmes are available that run on specific PDAs,¹⁴⁷ though most of these are designed for recreational use or road navigation. Other PDA mapping programmes,¹⁴⁸ however, are able to display aerial photographs and topographical maps as background raster images. In the US and Canada, for example, certain PDA models can display full-colour topographic maps. In the US, this may be done with the USGS¹⁴⁹ 1:24,000 digital topographical map series.¹⁵⁰ In Canada, certain

¹⁴⁰ i.e., Pocket PC, Palm, iPAQ, etc.

¹⁴¹ ~7.0 x 1.5 x 10.0 cm (approximate dimensions).

¹⁴² See Figure 8: iPAQ PDA [Jimmy Property] (page 156).

¹⁴³ i.e., digital aerial photos, orthophotos, topographic, etc.

¹⁴⁴ i.e., Microsoft Windows CE.

¹⁴⁵ i.e., digital cameras, computers, other PDAs, etc.

¹⁴⁶ A wireless communications standard (~10 m range).

¹⁴⁷ i.e., Destinator, Fugawi, Intellinav, Mapopolis Navigator, Microsoft Pocket Streets, TomTom Navigator.

¹⁴⁸ i.e., SkyEye (shareware), TeleType GPS, etc.

¹⁴⁹ US Geological Service.

¹⁵⁰ i.e., USGS Digital Raster Graphics topographical maps.

PDA's using the correct software¹⁵¹ are able to display 1:50,000 seamless colour digital maps,¹⁵² and can be interfaced with Garmin GPS receivers to provide real-time navigation and mapping capabilities.

In the field, a PDA can display a topographic map or orthophoto image overlain with grid positions¹⁵³ and elevations,¹⁵⁴ allowing the user to plot points or freehand draw directly onto the map. Furthermore, since most digital maps are stored on the PDA memory card, the number and size of available maps can be increased simply by adding additional or higher capacity SD memory cards.

While PDA's can be very useful for field mapping, they are not intended for use in adverse weather conditions, since they are not waterproof and can be fragile. Nevertheless, third party "waterproof" cases are available that can permit the stylus to be used in all weather conditions. Currently, most PDA's use internal batteries that require recharging through a docking cradle, so a secondary power source and a means of recharging would be required for any extended use in the field. Moreover, any add-on pieces of hardware (sleeves) connected by the expansion slot tend to deplete the PDA battery quickly. In addition, when combining PDA's and some low-cost GPS receivers, there is the potential for electrical interference. While high-end GPS receivers have shielding to minimize the effects of electromagnetic interference, low-cost GPS receivers do not. This means that the already weak satellite signal can be significantly degraded by the electronic noise generated by a PDA or similar electronic device (Trimble, 2005).

The use of a PDA and handheld GPS receiver has become common in many GIS applications. For example, a PDA running the ESRI¹⁵⁵ ArcPad 7.0 programme, together with a handheld GPS is often used to collect GIS data in the form of an ESRI shapefile.¹⁵⁶ Data in this format allows for the post-field seamless integration with existing GIS/LIS systems. A similar process could be easily modified to meet the requirements of a Land Clerk for the registration of land.

Numerous examples may be found in the available literature of PDA's and handheld GPS receivers used in land registration. For example, in Tanzania,¹⁵⁷ a research project involved village members mapping their village boundary and adjacent forest. This project involved digitally demarcating specific boundaries¹⁵⁸ for subsequent provision to district authorities. Demarcation was done using a Garmin eTrex GPS receiver inter-

¹⁵¹ i.e., FUGAWI GPS software.

¹⁵² i.e., FUGAWI Canada Maps.

¹⁵³ i.e., UTM, latitude/longitude, etc.

¹⁵⁴ Similar to Figure 7: Jimmy Property [Orthophoto/Property/Contours] (page 155).

¹⁵⁵ Environmental Systems Research Institute.

¹⁵⁶ A shapefile is a digital vector (non-topological) storage format for storing geometric locations and their associated attribute information. Commonly used by GIS software (i.e., ArcView, ARC/INFO, ArcGIS, etc.)

¹⁵⁷ Village of Kisanga, near the capital Dar es Salam.

¹⁵⁸ i.e., determining the GPS coordinates of boundary corners.

faced¹⁵⁹ with a Compaq Ipaq 3850 PDA using the ArcPad 6.0 software programme. The ArcPad programme permitted the loading of digital maps and images, their associated attributes, and the addition and editing of those attributes in the field. This setup allowed operators to have a graphical display on the PDA screen of their position draped onto LandSat satellite images¹⁶⁰ at a 30 m resolution, all in real-time (Verplanke et al, 2003). The project did encounter some hardware problems,¹⁶¹ though these seem to have been corrected in newer PDA models.¹⁶² Positional accuracy for this project was 5 - 10 m under optical conditions and up to 50+ m under forest canopy cover (Verplanke et al, 2003).

A second example of using a PDA and handheld GPS receiver was undertaken by the Office of the Surveyor General¹⁶³ in Australia. This project examined the use of low cost GPS systems for coordinating cadastral surveys in Tasmania, where the “proposed” required accuracies were ± 0.05 m¹⁶⁴ in urban areas and ± 0.50 m¹⁶⁵ in rural areas (Bowden, 2002). Tests were conducted to evaluate the option of using low-cost Garmin handheld GPS receivers to meet these required accuracies. These tests involved the use of a survey grade receiver as the reference receiver and a Garmin 12XL GPS receiver¹⁶⁶ with an external antenna as the rover receiver. The raw Garmin binary data was downloaded in the field via specially written programmes onto a Psion 3mx PDA or Psion Workabout mx¹⁶⁷ for later decoding by the previously mentioned Gringo programme.¹⁶⁸ The tests encountered some software errors, but the latest version of Gringo¹⁶⁹ has addressed these issues. From this exercise, the authors concluded that in the majority of cases the resulting accuracy would satisfy the proposed ± 0.50 m requirements (Bowden, 2002). Initial costs of running such a system¹⁷⁰ in a field environment were estimated to be R 15,800,¹⁷¹ although options are given to reduce this amount (Bowden, 2002).

¹⁵⁹ Via Windows CE.

¹⁶⁰ LandSat Thematic Mapper.

¹⁶¹ i.e., problems with limited battery life, RAM memory, and connector cables.

¹⁶² i.e., longer battery life, SD memory cards for data storage, and wireless connections.

¹⁶³ Tasmania.

¹⁶⁴ At 95 % confidence level.

¹⁶⁵ At 95 % confidence level.

¹⁶⁶ Handheld 12-channel receiver, internal patch antenna, accuracy - 15 m RMS, dimensions - 15.6 x 5.1 x 3.1 cm, weight - 269 g (As stated by Garmin).

¹⁶⁷ Handheld computer designed for use in all types of environments.

¹⁶⁸ See Chapter 9.6.5 High Accuracy GPS Surveying with Handheld Receivers (page 179).

¹⁶⁹ Version 2.0.0.

¹⁷⁰ Two each of (Garmin 12XL GPS receiver, external antenna, Psion Nmx3 PDA, data/power cables), one each of (logging software for the Psion, and Gringo programme).

¹⁷¹ Quoted as A\$ 3541 (Australian Dollars).

Some of the newer PDAs¹⁷² on the market can be purchased with built-in (integrated) GPS receivers. Although only a recreational grade receiver, similar to the eTrex, these could be useful in the field for locating or navigating to specific features. Consider the example of a Land Clerk equipped with a PDA loaded with the applicable digital orthophoto. Although this kind of integrated GPS/PDA would not meet accuracy requirements, it would nonetheless provide the Land Clerk with the ability to provide real-time information to landowners. Landowners could graphically view their property draped onto a digital orthophoto.¹⁷³

9.9 Point Offsets

In most situations, GPS technology will involve a straightforward procedure. Some instances, however, will occur when GPS technology will not be suitable or simply may not work. In areas of difficult reception, obtaining static GPS measurements and meeting minimum DOP requirements may be difficult or impossible. Since the signal between a satellite and receiver is essentially line-of-sight, it can be obstructed by solid objects, which in turn affect the quality of the computed position. Such obstructions are often terrain features such as mountains, steep ravines, and forest canopies. In areas of forest canopies, the signals are weakened or attenuated by the branches and foliage, making the accurate measuring of pseudoranges difficult. The obstruction of signals results in fewer satellites being available to the receiver, which increases the DOP and causes a corresponding loss of accuracy. In instances of extreme signal obstruction, GPS use may need to be restricted to certain times of the day when satellite geometry is better or when more satellites are available. In these circumstances, GPS observations at a static feature (i.e., a property corner), undergo slow changes in the relationship between the receiver, satellites, and the objects blocking signal reception. As a result, these observations are susceptible to a certain level of error. In contrast, for applications involving mapping line features, this problem is overcome by the changing relationship between a “moving” receiver, satellites, and blocking objects. The difficulty with static points can often be corrected by the occupation of points for longer periods, thereby allowing time for the relationship between receiver and blocking objects to change and errors to average out. Alternatively, in these situations, changing the receiver settings such as the DOP cut-off value might be considered, though this might entail a trade-off between accuracy and productivity. The requirement of longer point occupation times would mean longer field times. Moreover, changing any settings must still ensure that the minimum survey accuracy requirements can be met.

In situations, where portions of a property cannot be surveyed using GPS technology, GPS may still be used to do the control work with the remainder to be completed by traditional methods (i.e., EDM). At the Jimmy property in Ekuthuleni, several property corners were located in a steep sided valley with thick foliage. Though signal reception was possible, an extended occupation time was necessary, with some positioning degradation. Had the reception not been possible, an alternative would have been to put in

¹⁷² i.e., iQue 3600, available for R 6,779 (TechShop, SA).

¹⁷³ Similar to Figure 6: Jimmy Property [Orthophoto/Property] (page 154).

survey points¹⁷⁴ along the fence line, which has an open clear view of the sky. The bearing between these two points could easily be determined and used to orient the remainder of the survey using an EDM. The determination of which sites can be wholly done using GPS technology will require some training and experience on the part of the Land Clerk. Unfortunately, having to do this procedure too often would mean longer field times and increased costs, possibly negating any cost advantage from using GPS.

GPS techniques will be the fastest, most efficient, and least costly method available for most situations. Unfortunately, situations may occur where it will be impossible to occupy a point feature directly, such as sites that are too dangerous (i.e., very steep), inaccessible (i.e., lake), or simply occupied (i.e., structure). In these situations, the options are usually limited to traditional surveying methods. One alternative may be a point-offset method that involves taking a GPS fix at a nearby location that is accessible and where satellite signal reception is adequate. From this position, the direction and distance to the desired point is recorded.

The difficulty with using point-offsets is that the opportunity for confusion and blunders can increase substantially if not done correctly. This is especially true when manual methods are used, making totally automated procedures more preferable; for example, GPS receivers that support offsets, or totally automated laser range-finders. Still, field operators who use offsets would need to have a clear understanding of basic surveying principles, including magnetic vs. true bearings and slope vs. horizontal distances. In addition, a rigid set of field specifications for point-offsets that describes maximum acceptable offset distance (i.e., 10 m), accuracy of directions (i.e., $\pm 1^\circ$), and accuracy of distance (i.e., ± 0.5 m) would be required. Whether or not this method could meet the minimum accuracy requirements under the various Acts would also need to be established beforehand.

9.10 Laser Range-Finder

The coordinates derived from GPS observations are, in fact, only the location at which the GPS antenna is placed and may not necessarily be the intended feature to be mapped. GPS technology has an inherent problem of requiring one, specifically, the antenna to occupy a point feature directly. As previously mentioned, for situations where point occupation is not possible, alternative methods are required. For example, a hybrid method could be used that combines GPS technology with other tools, such as a “laser range-finder.”

In recent years, laser range-finders have significantly improved in their performance and price. Depending on the model, they can be used for distance measurements without a reflector, are able to attain an accuracy of 5 cm - 1.5 m, have maximum ranges of

¹⁷⁴ i.e., using Static DGPS Method.

150 m - 600 m, and can provide both a vertical angle¹⁷⁵ and a horizontal azimuth reading.¹⁷⁶

Laser range-finders can easily be attached to a GPS antenna (range-pole), where distance and azimuth readings are sent to the GPS receiver¹⁷⁷ and converted to latitude/longitude based on the position of the GPS antenna. Alternatively, a laser range-finder can be used independent of the GPS receiver, that is, the process in reverse. The range-finder is located in a nearby area,¹⁷⁸ and used to shoot back to the GPS receiver determining distance and azimuth. The data is subsequently sent to the GPS receiver where the latitude/longitude of the range-finder is calculated and stored.

9.11 Software

GPS software for field data collection is often pre-packaged with the purchased GPS receiver. However, this software often includes a limited number of features, and may limit the user to using only the manufacturer's proprietary data formats. In selecting software, users should consider some of the advantages with the "new generation" GIS/GPS software¹⁷⁹ and whether they warrant the extra expense. Many of these new software packages allow for greater flexibility and are compatible with all types of GPS receivers, from the survey grade receiver to the low-cost recreational receivers. In addition, many can read from multiple serial ports to allow a GPS receiver to be combined with an additional sensor like a digital camera or the previously mentioned laser range-finder. When combined with a digital camera, the operator can collect not only location data but also a digital image of the feature. When combined with a laser range-finder, feature coordinates that are inaccessible to the GPS can be collected.

In the field, the software should allow users to view and monitor data quality,¹⁸⁰ to create and edit features,¹⁸¹ provide a navigation capability to locate known points, and upload digital orthophotos and other raster images as background maps. In the office, the software must be able to use common exchange formats¹⁸² and have conversion routines to allow import/export of GPS and feature data into CAD/GIS/LIS software, such as ArcView, AutoCAD, and MapInfo.

¹⁷⁵ Built in tilt sensor.

¹⁷⁶ Optional digital fluxgate compass or angle encoder.

¹⁷⁷ /data collector

¹⁷⁸ Where the GPS antenna is unable to receive adequate reception.

¹⁷⁹ i.e., ArcPad, Fieldworker, Patchworks, Site Mate, and TDS Solo CE.

¹⁸⁰ i.e., DOP value.

¹⁸¹ i.e., Data dictionary.

¹⁸² i.e., RINEX.

9.12 Conclusion

The significant improvement in GPS technology in recent years will undoubtedly increase the utilization of GPS for the registration of land. The price of GPS equipment continues to drop due to competition among vendors and to economies of scale. The removal of Selective Availability in 2000 and other technological improvements have significantly improved the accuracy of GPS surveying, particularly autonomous GPS. The potential for high-accuracy autonomous GPS surveying with low-cost handheld receivers means that considerably less skilled operators, such as Land Clerks, can work autonomously in the field collecting data and feeding information to the land professionals. In addition, the GPS receiver components and data collectors have become smaller, lighter, and less expensive, and with the introduction of new software, many of the tasks have become easier to learn and less expensive to perform.

In areas where GPS technology may be inadequate, new technologies such as laser range-finders are becoming available to supplement GPS systems. In addition, the new Galileo Global Navigation Satellite System and the EGNOS¹⁸³ Satellite-Based Augmentation System are expected to be operational in several years. Together with enhanced code and carrier processing techniques, the introduction of better technology, alternative methods, and new satellite systems will collectively make field data collection tasks simpler, more accurate, and more cost-effective.

¹⁸³ European Geostationary Navigation Overlay System (EGNOS). Three geostationary satellites will provide some coverage to South Africa.

10 Conclusion

Land is often regarded as the prime means from which a state can derive wealth. To derive this wealth, a state can tax the land but only if it knows who owns and controls that land. Thus, the land parcel becomes the basis for the access and control of land.

Since the end of the apartheid era in South Africa, the enduring inequalities in land distribution have become a key political issue. The creation of a national land policy and the ongoing process of land reform under the various land Acts has become both complex and problematic. Despite the desire to resolve the land tenure issue, the sheer scope of the endeavor seems to have been underestimated by the state. Currently, land policy is aimed at correcting the inequitable distribution of land and the abject poverty resulting from previous apartheid-era land policies. In addition, land reform is all to be done within the state's limited resources and within a market-oriented willing-buyer willing-seller process.

The spatial data-gathering component of land titling is generally considered one of the main impediments to its implementation. This is due in part to its requirement for high accuracy surveys and the associated high costs to attain that accuracy. Formal land tenure systems are generally implemented using traditional survey methods, and require considerable time and expense in attaining very precise boundary surveys. For the communal areas of South Africa, high accuracy surveys are often unnecessary and simply too expensive to implement. For much of Africa, high precision surveys and a total insensitivity to existing customary tenure methods have become a chronic hindrance to land titling. Thus, monetary and social constraints have become the prime impetus for alternative economical surveying and mapping methods in the registration of land.

While no ideal land tenure system is available, the recent enactment of the Communal Land Rights Act is intended to address the issue of tenure reform in the communal areas of South Africa. In part, the goal of this Act and land reform in general is to redress historical imbalances and injustices in the control and ownership of land. Most importantly, the Act is intended to provide communal landholders a secure tenure in land.

The public's perception of the Communal Land Rights Act covers a broad spectrum. While some view the Act as a panacea for the abject poverty and underdevelopment of the communal areas, others have the opposite opinion. With previous land reform programmes moving at a sluggish pace, and few targets met, some view the Act with apathy. Some feel that the Act has not dealt with many of the contentious issues and is based on the unrealistic and flawed assumption that the state has the resources to implement such an immense undertaking.

Certainly, the state's interest would best be served by a "successful" implementation of communal land reform under the Communal Land Rights Act. A systematic establishment of a land register for the communal areas would bring considerable benefits to not only government and communities, but also to the individual landowners. The Ekuthuleni community, with its land registered under the Communal Land Rights Act, will have a secure form of tenure and an improved certainty in law. With secure title to land,

community residents are more willing to invest in the land. They will have easier access to formal credit institutions, and the secure title will provide stimulation for investment. With new investments come a corresponding improvement in individual livelihoods and, expectantly, a reduction in poverty. For the state, secure tenure for communities will provide a basis for land taxation, land use planning, and infrastructure development.

The purpose of this dissertation is not intended to serve as a blueprint for land registration under the Act. Instead, my hope is that this report will present one possible scenario and serve as a basis for discussion.

While the Communal Land Rights Act is clear in its approach to providing legal security of tenure, the process of implementation is not. With the latitude permitted under the Act, this dissertation offers a simple and cost-effective alternative for the registration of land rights using the envisioned Land Clerk of the Department of Land Affairs. This paper proposes placing suitably equipped Land Clerks into the communities in which they serve to operate as autonomous self-sustaining contractors. These community-based Land Clerks would be equipped with a toolset consisting of a laptop computer, printer, scanner, and handheld GPS receiver. The cost of these items when purchased in late 2003 was R 13,335. With the addition of a PV array and a digital camera, the total cost was approximately R 16,656.

Considering the lessons learned during the Ekuthuleni field exercises, and with the benefit of hindsight, the previously mentioned toolset of the Land Clerk can be somewhat modified to better suite their expected roles. Keeping in mind the state's financial constraints, a Land Clerk would be equipped with a small ultraportable computer or a PDA. A newer model PDA would allow the Land Clerk to load background raster images, such as an orthophoto of the region being mapped. A PDA with integrated GPS would enable the Land Clerk to provide real-time property information to communal landowners. Even though these integrated GPS/PDAs would not meet accuracy requirements, they would still be a useful tool for informational purposes. A PDA using a Windows OS could run a database programme similar to the RRR database to collect relevant landownership information. In addition, a PDA would allow for freehand sketching on digital orthophotos and the storing of those images and meet other data acquisition requirements.

As mentioned, the registration of property information will require a database capability. A foolproof and user-friendly database similar to the RRR database described in this paper will need to be written to run on a PDA/computer. The printer and scanner machines used in this project would be replaced with a multifunctional printer/scanner combination. To eliminate the need for cables and wires, the printer/scanner and the PDA/computer would ideally have wireless capability. In addition, to document evidence and other noteworthy items, the Land Clerk would carry a simple 3 - 4 megapixel camera in the field.

Although programmes such as Gringo provide a capability for handheld GPS receivers like the eTrex to attain high accuracy measurements, these programmes are still at a preliminary stage. As such, their use would require considerable testing and due diligence on the user's behalf. Therefore, to attain required accuracy, considerably more

expensive, differentially capable, handheld GPS receivers would be required. If a real-time, differential GPS capability were available, the Land Clerk would be able to register land in the presence of all interested parties. Accurate GPS coordinates draped onto a digital orthophoto would allow for verification by the landowner at the time of registration and greatly reduce the chance of error. If real-time GPS capability is not available, then a Land Clerk might use an integrated PDA/GPS unit. This would enable the Land Clerk to provide landowner information on an “unofficial” informational basis.

The process of demarcating plots of land using handheld GPS receivers could be supplemented with other tools and methods. Hybrid methods involving offset procedures or laser range-finders would be used where GPS reception is not possible or simply inadequate.

To provide Land Clerks with power, a PV array would be set up at their residences. With a suitable PV array, the Land Clerk would not only be able to power and recharge all equipment required for field use, but also provide power for residential use.

Finally, the techniques and procedures discussed in this dissertation are intended to meet the basic cadastre requirements as contemplated under the Communal Land Rights Act. The previously mentioned toolset would provide Land Clerks the means for the initial registration of areas never previously registered. These would then serve as a basis for more extensive and more accurate cadastres in the future as resources and demands dictate. The long-term economic and social benefits anticipated by a successful implementation of the Communal Land Rights Act will greatly exceed the required investment costs for Land Clerks and Land Administrators.

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Appendix A: Selected South African Legislation

Introduction

Over the years, many pieces of legislation have undergone various name changes. In many instances, the name in common use today is different from the Act's original name at the time of enactment. This is particularly true with respect to the terms used to describe people of differing races. For example, successive governments referred to South Africans of African descent as "Natives." After the passage of the Bantu Authorities Act¹ in 1951, however, the National Party Government began using the term "Bantu" as a substitute for "Native," while continuing to use the term "Native" in many of the legislative measures. By 1962, the term "Native" was officially phased out and replaced by the term "Bantu." By 1978, the government decided to cease using the term "Bantu" and started using the term "Black" instead.² As a consequence, Acts such as the Land Act³ of 1913 were initially referred to as the Natives Land Act and then later became known as the Bantu Land Act, while current usage⁴ refers to it as the Black Land Act. Thus, the name of any particular Act, referred to in the literature, will depend on the date of publication.

In this appendix, the name of an Act using racial terms⁵ follows the current nomenclature⁶ as used by Juta's Statutes of South Africa.⁷ In addition, wherever possible, the original name of the Act is given if different from the current name. Not all names of the Acts are included, particularly Acts using the term "Bantu." The names of repealing Acts are also noted. In some instances, however, the repealing Act may not have repealed the original Act in its entirety.

The following pages chronologically list selected Acts and other pieces of legislation dealing with apartheid and land-related issues. In many instances, apartheid legislation over the years has had a direct effect on the current land tenure situation in South Africa. Consequently, a Land Clerk or Land Administrator would need a good understanding of the legislation outlined in this appendix.

¹ 68 of 1951.

² Other terms that were used to distinguish race include "European" and "Non-European," which were later replaced by "White" and "Black," respectively.

³ Black Land Act 27 of 1913.

⁴ Juta's Statutes of South Africa.

⁵ i.e., Native, Bantu, or Black.

⁶ i.e., Black.

⁷ Juta's Statutes of South Africa, 13th edition, 2004, Juta Law, Lansdowne, South Africa.

Chronological Listing of Legislation

- 2004 **Communal Land Rights Act (CLARA):**⁸ This Act provides for legal security of tenure by transferring communal land, including KwaZulu-Natal Ingonyama land, to communities or awarding comparable redress. In addition, the Act provides for the conduct of a Land Rights Enquiry to determine the transition from old order rights to new order rights.
- 2003 **Spatial Data Infrastructure Act:**⁹ This Act is designed to achieve co-ordination with respect to the gathering, managing, and dissemination of spatial data and information to enable spatial-information-driven planning and decision making.
- 2003 **Restitution of Land Rights Amendment Act:**¹⁰ This Act empowers the Minister of Land Affairs to purchase, acquire in any other manner, or expropriate land for the purpose of restoration or for any related land reform purpose.
- 2003 **Traditional Leadership and Governance Framework Act:**¹¹ This Act provides for the recognition of traditional communities, the establishment and recognition of traditional councils, and statutory framework for leadership positions within the institution of traditional leadership.
- 2000 **Promotion of Administrative Justice Act:**¹² This Act is designed to give effect to the right to administrative action that is lawful, reasonable, and procedurally fair and to the right to written reasons for administrative actions as contemplated in Section 33 of the Constitution of the Republic of South Africa Act.¹³
- 1998 **Municipal Structures Act:**¹⁴ This Act provides for the establishment of municipalities in accordance with the requirements relating to categories and types of municipality. The Act establishes criteria for determining the category of municipality to be established in an area and the appropriate division of functions and powers between categories of municipalities.
- 1998 **Transformation of Certain Rural Areas Act (TRANCRAA):**¹⁵ This Act provides for the transfer of certain land to municipalities and certain other legal entities and the removal of restrictions on the alienation of land.

⁸ 11 of 2004.

⁹ 54 of 2003.

¹⁰ 48 of 2003.

¹¹ 41 of 2003.

¹² 3 of 2000.

¹³ 108 of 1996.

¹⁴ 117 of 1998.

¹⁵ 94 of 1998.

- 1998 **Prevention of Illegal Eviction from and Unlawful Occupation of Land Act (PIE):**¹⁶ This Act is designed to protect both landowners and occupiers of land. It provides procedures for the eviction of unlawful occupiers as well as the prohibition of illegal eviction.
- 1998 **Municipal Demarcation Act:**¹⁷ This Act provides procedures for the determination of municipal boundaries by an independent authority (Municipal Demarcation Board). The Board determines functional municipal boundaries, addresses remaining apartheid municipal boundaries, aligns municipal boundaries with other government administrative boundaries, and establishes financially and administratively viable municipalities.
- 1997 **White Paper on South African Land Policy:** The White Paper outlines the government's response to land reform in three major elements: redistribution, land restitution, and land tenure reform. The implementation of these reform programmes would entail the enactment of numerous pieces of land-related legislation.
- 1997 **Extension of Security of Tenure Act (ESTA):**¹⁸ This Act is designed to protect occupiers of rural land¹⁹ against arbitrary eviction and to protect people who live on land with the consent of the owner or person in charge against unfair eviction. The Act also calls for the state to provide assistance to facilitate long-term security of land tenure, to regulate the conditions of residence on certain land, and to regulate the conditions on and circumstances under which the rights of a person to reside on land may be terminated.
- 1997 **Land Survey Act (LSA):**²⁰ This Act regulates the survey of land, such as the preparation of diagrams and plans by registered Land Surveyors. The Land Surveyor would be more affected by the Survey Act and its ensuing regulations than any other piece of legislation.
- 1996 **Green Paper on South African Land Policy:** The Green Paper outlines the Department of Land Affairs' current state of progress in developing a comprehensive land reform programme. This was a precursor to the 1997 "White Paper on South African Land Policy."
- 1996 **Constitution of the Republic of South Africa Act:**²¹ The Constitution was drafted in terms of Chapter 5 of the Interim Constitution²² and was first adopted by the constitutional assembly on May 8 1996. After some modifications, the

¹⁶ 19 of 1998.

¹⁷ 27 of 1998.

¹⁸ 62 of 1997.

¹⁹ Other than Labour Tenants.

²⁰ 8 of 1997.

²¹ 108 of 1996.

²² Constitution of the Republic of South Africa Act 200 of 1993.

final Constitution was passed by Parliament on December 18 1996 and signed into law by President Nelson Mandela on February 4 1997.

- 1996 **Interim Protection of Informal Land Rights Act (IPILRA):**²³ This Act was created to provide protection for certain categories of people who had insecure tenure in land. The Act was originally envisioned as a temporary protection of certain rights and interests in land not formerly registered or inadequately protected by law for the duration of the land reform process, in particular, the former “homelands,” where rights to land had no conventional legal basis.
- 1996 **Communal Property Associations Act (CPAA):**²⁴ This Act provides a legal mechanism that enabled communities to form juristic persons to be known as Communal Property Associations (CPA). These associations were then able to acquire, hold, and manage property on a basis agreed to by members of the community in terms of a written Constitution. The Act is designed for communities benefiting from various Acts such as the Restitution of Land Rights Act.²⁵
- 1996 **Land Reform (Labour Tenants) Act (LTA):**²⁶ This Act provides for the protection of the rights of Labour Tenants. It is designed to protect Labour Tenants from eviction and to give them the right to acquire ownership of the land that they live on or use. The Act grants Labour Tenants the right to apply for ownership of that portion of the farm over which, historically, they have had rights. The Land Claims Court decides whether such ownership rights should be granted, whether lesser rights will be granted or an appropriate compensation will be paid. Land Claims can either be adjudicated in the Land Claims Court or the Department of Land Affairs can provide support to negotiate out-of-court settlements.
- 1995 **Development Facilitation Act (DFA):**²⁷ This Act is designed to introduce measures to facilitate and speed up the implementation of reconstruction and development programmes and projects in relation to land, and to lay down general principles governing land development. Its main purpose was to facilitate the development of hundreds of thousands of houses for low-income families as well as to upgrade the thousands of informal settlements in South Africa.
- 1995 **Land Affairs General Amendment Act:**²⁸ This Act attempted to make land legislation uniform throughout South Africa, essentially dealing with the problems of differing legislation in the previous “Bantustans.”
- 1995 **Land Administration Act:**²⁹ This Act provided for the delegation of powers and the assignment of the administration of laws regarding land matters to the provinces and to provide for the creation of uniform land legislation.

²³ 31 of 1996.

²⁴ 28 of 1996.

²⁵ 22 of 1994.

²⁶ 3 of 1996.

²⁷ 67 of 1995.

²⁸ 11 of 1995.

- 1994 **Restitution of Land Rights Act:**³⁰ This Act provides for the restitution of rights in land to persons or communities disposed of such rights after June 19 1913³¹ as a result of past racially discriminatory laws or practices. The Act called for the establishment of a Commission on Restitution of Land Rights and the creation of a Land Claims Court. The Interim Constitution³² of South Africa served as the source and embodiment of restitution, whereby the Legislature was instructed to put into place a law to provide redress for the victims of dispossession.
- 1994 **KwaZulu-Natal Ingonyama Trust Act:**³³ This Act transferred 93 % of the land in KwaZulu (approximately 2.9 million ha) to a specially created trust, the Ingonyama Trust. This included all urban townships in KwaZulu, government buildings, nature reserves, forestry projects, roads, public spaces, and commercial and industrial sites (Hanekom, 1996).
- 1993 **Constitution of the Republic of South Africa Act:**³⁴ This Constitution was formally adopted as an Act of the Tricameral Parliament. The purpose of the Act was to set out the procedures for the negotiation and drafting of a “final” Constitution. After the 1994 elections, the new Parliament would function in accordance with this new Interim Constitution. Since the Bill of Rights from this Interim Constitution is similar to the Bill of Rights in the 1996 Constitution,³⁵ most of the judicial decisions on rights handed down under the Interim Constitution remain binding. The Act was repealed by the Constitution of the Republic of South Africa Act.³⁶
- 1993 **Provision of Land and Assistance Act:**³⁷ This Act provided for the designation of certain land, the regulation of the subdivision of land and the settlement of persons thereon. The Act was amended³⁸ in 1998 to provide for financial assistance for the acquisition of land and to secure tenure rights. Originally known as the Provision of Certain Land for Settlement Act.³⁹
- 1993 **Distribution and Transfer of Certain State Land Act:**⁴⁰ This Act regulated the distribution and transfer of certain land belonging to the state.

²⁹ 2 of 1995.

³⁰ 22 of 1994.

³¹ Enactment of the Black Land Act 27 of 1913.

³² Sections 121 - 123 (Constitution of the Republic of South Africa Act 200 of 1993).

³³ 3 of 1994, enacted by the KwaZulu Legislative Assembly.

³⁴ 200 of 1993 (commonly known as the “Interim Constitution”).

³⁵ Constitution of the Republic of South Africa Act 108 of 1996.

³⁶ 108 of 1996.

³⁷ 126 of 1993.

³⁸ Provision of Certain Land for Settlement Amendment Act 26 of 1998.

³⁹ 126 of 1993.

⁴⁰ 119 of 1993.

- 1993 **Land Titles Adjustment Act:**⁴¹ This Act was designed to regulate the allocation or devolution of certain land in which one or more persons claimed ownership, but did not have registered title deeds.
- 1992 **Abolition of Racially Based Land Measures Amendment Act:**⁴² This Act amended the Abolition of Racially Based Land Measures Act⁴³ so as to make further provision for the extension of the period within which the Registrar of Deeds would be authorized to register land acquired on behalf of a principle by a nominee owner in the name of the principle.
- 1992 **KwaZulu Land Affairs Act:**⁴⁴ This Act provided for the disposal of government land, for certain rights of tenure to land, for the registration of certain forms of title in respect of land, and for the development, use and subdivision of land. As the South African government handed land to the self-governing territories, the legislation that was formally applicable to such land was no longer applied. Most of the self-governing territories enacted their own legislation, with the former KwaZulu government enacting the KwaZulu Land Affairs Act in 1992. Under this Act, it was possible to issue deeds of grants and PTO's as the main form of tenure (DC28, n.d.(b)).
- 1991 **Less Formal Township Establishment Act (LFTEA):**⁴⁵ This Act provided for shortened procedures for the designation, provision, and development of land, the establishment of townships, and to regulate the use of land by tribal communities for communal forms of residential settlement.
- 1991 **Upgrading of Land Tenure Rights Act (ULTRA):**⁴⁶ This Act provided for the upgrading and conversion into ownership of certain rights granted in respect of land and for the transfer of tribal land in full ownership to the tribes concerned.
- 1991 **Abolition of Racially Based Land Measures Act:**⁴⁷ This Act provided for the repeal of 189 sections of various Acts that had supported racial discrimination in respect of land legislation, such as the Black Land Act,⁴⁸ the Development Trust and Land Act,⁴⁹ the Group Areas Act,⁵⁰ and the Black Communities Devel-

⁴¹ 111 of 1993.

⁴² 133 of 1992.

⁴³ 108 of 1991.

⁴⁴ 11 of 1992 (enacted by the KwaZulu Legislative Assembly).

⁴⁵ 113 of 1991.

⁴⁶ 112 of 1991.

⁴⁷ 108 of 1991.

⁴⁸ 27 of 1913.

⁴⁹ 18 of 1936.

⁵⁰ 36 of 1966.

- opment Act.⁵¹ The implementation of this Act meant that land could be freely bought and sold no matter what the race of the seller or buyer.
- 1991 **Black Communities Development Amendment Act:**⁵² This Act amended the Black Communities Development Act⁵³ to regulate the granting and transfer of leasehold and the conversion of leasehold to ownership. Repealed by Abolition of Racially Based Land Measures Act.⁵⁴
- 1991 **White Paper on Land Reform:** The White Paper made several significant proposals, such as the repeal of the notorious Land Acts,⁵⁵ the Group Areas Act⁵⁶ and other racially based land legislation. The paper also set out new land policy objectives.
- 1986 **Borders of Particular States Extension Amendment Act:**⁵⁷ This Act amended the Borders of Particular States Extension Act⁵⁸ to make new provision relating to the land that may become part of certain states. It allowed for the removal of land from the Republic, including certain Black Spots, to be incorporated into the territory of the independent Bantustans. Repealed by Constitution of the Republic of South Africa Act.⁵⁹
- 1986 **Sectional Titles Act:**⁶⁰ This Act provided for the division of buildings into sections and common property and for the acquisition of separate ownership in sections coupled with joint ownership in common property. Along with the Deeds Registries Act,⁶¹ it forms the foundation of land registration in South Africa.
- 1986 **Black Communities Development Amendment Act:**⁶² This Act provided for the designation of development areas, the establishment and development of townships by development boards, and provided that Blacks may acquire ownership of land and development areas in addition to rights of leasehold. The Act also made provision for the conversion of rights of leasehold in respect of immovable property into ownership, the registration of such ownership and the alienation of leasehold and ownership. Basically, the Act introduced freehold rights in urban Black townships and extended the definition of competent

⁵¹ 4 of 1984.

⁵² 77 of 1991.

⁵³ 4 of 1984.

⁵⁴ 108 of 1991.

⁵⁵ i.e., Black Land Act 27 of 1913, and Development Trust and Land Act 18 of 1936.

⁵⁶ 41 of 1950.

⁵⁷ 112 of 1986.

⁵⁸ 2 of 1980.

⁵⁹ 200 of 1993.

⁶⁰ 95 of 1986.

⁶¹ 47 of 1937.

⁶² 74 of 1986.

- person such that certain citizens could now acquire leasehold or ownership. Repealed by Abolition of Racially Based Land Measures Act.⁶³
- 1986 **Restoration of South African Citizenship Act:**⁶⁴ This Act granted South African citizenship to a limited number of citizens of the Republics of Bophuthatswana, Ciskei, Transkei, and Venda. Repealed by Restoration and Extension of South African Citizenship Act.⁶⁵
- 1986 **Abolition of Influx Control Act:**⁶⁶ This Act repealed the Blacks (Urban Areas) Consolidation Act⁶⁷ and the Native Labour Regulation Act.⁶⁸ It gave freedom of movement to all South African citizens, excluding the citizens of the independent Bantustans. It also established a common identity document for all South Africans and made permission to remain in urban areas conditional on residency in approved housing.
- 1984 **Professional and Technical Surveyors Act:**⁶⁹ This Act provided for the establishment of a South African Council for Professional and Technical Surveyors and the registration of professional surveyors, professional surveyors in training, surveyors, survey technicians, and survey technicians in training.
- 1984 **Black Communities Development Act:**⁷⁰ This Act introduced freehold ownership. Development boards were empowered to register 99-year leasehold rights for township residents. The Act also stated that only a competent person could rent or lease property, where competent meant that a person had Section 12 rights in terms of the Blacks (Urban Areas) Consolidation Act.⁷¹ The Act also provided for purposeful development of some Black communities outside the national states. Repealed by Abolition of Racially Based Land Measures Act.⁷²
- 1983 **Republic of South Africa Constitution Act:**⁷³ This Act called for the establishment of a Parliament, which consisted of separate legislative houses for Whites, Coloureds, and Indians. Matters before parliament were divided into either 'general affairs' or 'own affairs'. General affairs were discussed by all houses and would apply to all South Africans whereas own affairs were relevant to only one particular race group. P.W. Botha was made both the formal and executive head of state and commander-in-chief of the South African Defense

⁶³ 108 of 1991.

⁶⁴ 73 of 1986.

⁶⁵ 196 of 1993.

⁶⁶ 68 of 1986.

⁶⁷ 25 of 1945.

⁶⁸ 15 of 1911.

⁶⁹ 40 of 1984.

⁷⁰ 4 of 1984.

⁷¹ 25 of 1945.

⁷² 108 of 1991.

⁷³ 110 of 1983 (commonly known as the Tricameral Constitution).

- Force. The Act went into effect Sept 22 1984, and was repealed by the Constitution of the Republic of South Africa Act.⁷⁴
- 1981 **Alienation of Land Act:**⁷⁵ This Act was designed to regulate the alienation of land in certain circumstances.
- 1979 **Slums Act:**⁷⁶ This Act consolidated the law relating to the elimination of slums within the areas of jurisdiction of certain local authorities. It was later repealed by the Housing Act.⁷⁷
- 1975 **Expropriation Act:**⁷⁸ This Act provided for the expropriation of land and other property for public and certain other purposes.
- 1971 **Self-governing Territories Constitution Act:**⁷⁹ This Act provided for the establishment of legislative assemblies and executive councils in Black areas and outlined the powers, functions, and duties of such assemblies and councils and the declaration as self-governing of areas for which legislative assemblies had been established. Essentially, it granted more powers to the homeland governments to facilitate their eventual independence. This Act was also known as the National States Constitution Act,⁸⁰ and was originally known as the Bantu Homelands Constitution Act.⁸¹ The Act was repealed by the Constitution of the Republic of South Africa Act.⁸²
- 1970 **Subdivision of Agricultural Land Act:**⁸³ This Act was designed to control the subdivision of agricultural land. Its primary intention was to prevent the subdivision of farms into uneconomic units.
- 1970 **National States Citizenship Act:**⁸⁴ This Act required all Blacks to become citizens of one of the homelands corresponding to their ethnic group, regardless of whether or not they had ever lived there. In the act of becoming a citizen of one of the homelands, they would no longer be citizens⁸⁵ of South Africa, and therefore had none of the rights⁸⁶ that came with citizenship. The Act was origi-

⁷⁴ 200 of 1993.

⁷⁵ 68 of 1981.

⁷⁶ 76 of 1979.

⁷⁷ 107 of 1997.

⁷⁸ 63 of 1975.

⁷⁹ 21 of 1971.

⁸⁰ 21 of 1971.

⁸¹ 21 of 1971.

⁸² 200 of 1993.

⁸³ 70 of 1970.

⁸⁴ 26 of 1970.

⁸⁵ They were now considered aliens of South Africa under the Aliens Act 1 of 1937.

⁸⁶ Such as the right to work in South Africa.

- nally known as the Bantu Homelands Citizenship Act,⁸⁷ and was repealed by the Constitution of the Republic of South Africa Act.⁸⁸
- 1969 **Proclamation R188 of 1969:** This Proclamation contained measures to regulate land administration, the control, maintenance and development of land, land allocation, issuing of occupational permits, quitrent and PTO rights, and registration of quitrent and PTO rights (DLA, 1997).
- 1969 **Prescription Act:**⁸⁹ This Act consolidated and amended the laws relating to prescription.
- 1966 **Group Areas Act:**⁹⁰ This Act consolidated the law relating to the establishment of group areas, and control of the acquisition of immovable property and the occupation of land and premises. Although generally considered a nondiscriminatory Act, in practice, the Group Areas Act was implemented in a grossly discriminatory manner⁹¹ to the advantage of Whites (Dugard, 1978). The Act was repealed by the Abolition of Racially Based Land Measures Act.⁹²
- 1966 **Land Tenure Act:**⁹³ This Act called for the establishment of a Land Tenure Board and provided for the acquisition and development of land for use in connection with farming purposes. The Act was repealed by the Second Community Development Amendment Act.⁹⁴
- 1963 **General Law Amendment Act:**⁹⁵ This Act provided for the detention⁹⁶ of certain persons for interrogation, for declaring certain places or areas to be protected places or areas. Police officers were empowered to detain any person without a warrant on the grounds of suspicion of a political crime. They could be detained for 90 days after which it could be extended indefinitely (Horrell, 1978). Those arrested could be detained without access to a lawyer, charge, or subject to trial.
- 1962 **General Law Amendment Act:**⁹⁷ This Act was designed to amend several Acts and to define and prohibit sabotage.⁹⁸ The Act further increased the

⁸⁷ 26 of 1970.

⁸⁸ 200 of 1993.

⁸⁹ 68 of 1969.

⁹⁰ 36 of 1966.

⁹¹ By the end of 1975: 58,834 Coloured families; 30,646 Indian families and 142 Chinese families had been moved from their homes and resettled in group areas while only 1,594 White families had been moved (Dugard, 1978).

⁹² 108 of 1991.

⁹³ 32 of 1966.

⁹⁴ 68 of 1982.

⁹⁵ 37 of 1963.

⁹⁶ The Act was commonly known as the 90-Day Detention Law (Mandela, 1994).

⁹⁷ 76 of 1962.

⁹⁸ The Act was commonly known as the Sabotage Act (Mandela, 1994).

government's power to declare organizations illegal, impose banning orders, and restrict movement. Once it had been proven by the prosecution that the accused had willfully committed one of the various acts listed in the Act, the onus was then placed on the accused to prove that they were not guilty of sabotage. If convicted of sabotage they would be liable to the penalties for the offense of treason, which might include the death penalty (Horrell, 1978).

- 1961 **State Land Disposal Act:**⁹⁹ This Act provided for the disposal of certain state land and to prohibit the acquisition of state land by prescription.
- 1961 **Provincial Government Act:**¹⁰⁰ On May 31 1961, the Union of South Africa consisting of the provinces of Cape of Good Hope, Natal, Transvaal, and Orange Free State became a Republic under the name Republic of South Africa. The Act was originally known as the Republic of South Africa Constitution Act,¹⁰¹ and was repealed by the Constitution of the Republic of South Africa Act.¹⁰²
- 1959 **Representation between the Republic of South Africa and Self-governing Territories Act:**¹⁰³ This Act provided for the gradual development of self-governing Bantustans and for direct consultation between the Government of the Union and the Bantustans in matters affecting them. It effectively called for the transformation of reserves into fully-fledged independent Bantustans. It divided Blacks into eight ethnic groups and meant the end of their parliamentary representation. The Act was designed to eventually grant independence to the homelands,¹⁰⁴ which would effectively deprive Blacks of their South African citizenship. The Act was originally known as the Promotion of Bantu Self-Government Act,¹⁰⁵ and was repealed by Constitution of the Republic of South Africa Act.¹⁰⁶
- 1959 **Trespass Act:**¹⁰⁷ This Act prohibited the entry or presence upon land and the entry of, or presence in buildings in certain circumstances. The Act was used extensively against squatters (Keightley, 1990).
- 1957 **Group Areas Act:**¹⁰⁸ This Act consolidated the law relating to the establishment of group areas, control of the acquisition of immovable property and the occupation of land and premises. It was repealed by the Group Areas Act.¹⁰⁹

⁹⁹ 48 of 1961.

¹⁰⁰ 32 of 1961.

¹⁰¹ 32 of 1961.

¹⁰² 200 of 1993.

¹⁰³ 46 of 1959.

¹⁰⁴ Bophuthatswana, Ciskei, Gazankulu, KaNgwane, KwaNdebele, KwaZulu, Lebowa, QwaQwa, Transkei, and Venda.

¹⁰⁵ 46 of 1959.

¹⁰⁶ 200 of 1993.

¹⁰⁷ 6 of 1959.

¹⁰⁸ 77 of 1957.

- 1956 **Blacks (Prohibition of Interdicts) Act:**¹¹⁰ This Act prohibited the granting of Interdicts and other dilatory orders of court having the effect of staying or suspending the removal of Natives in certain cases. It removed the option for Natives of appealing to the courts against forced removals. The Act was originally known as the Natives (Prohibition of Interdicts) Act,¹¹¹ and was repealed by the Abolition of Influx Control Act.¹¹²
- 1956 **Separate Representation of Voters Amendment Act:**¹¹³ This Act amended the Separate Representation of Voters Act¹¹⁴ to remove Coloureds from the common roll. The Act was repealed by the Separate Representation of Voters Amendment Act.¹¹⁵
- 1956 **Labour Relations Act:**¹¹⁶ This Act consolidated and amended the law relating to the registration and regulation of trade unions and employers' organizations. It also regulated terms and conditions of employment, and provided safeguards against inter-racial competition. The Act was originally known as the Industrial Conciliation Act,¹¹⁷ and was repealed by the Labour Relations Act.¹¹⁸
- 1956 **Official Secrets Act:**¹¹⁹ This Act provided for the protection from disclosure of official secrets. It was repealed by the Protection of Information Act.¹²⁰
- 1955 **Blacks (Urban Areas) Amendment Act:**¹²¹ This Act amended the Natives (Urban Areas) Constitution Act,¹²² and gave the Minister the authority to direct a local authority to curtail or abolish a Native location, village, or hostel (Horrell, 1978). The Act was originally known as the Natives (Urban Areas) Amendment Act,¹²³ and was repealed Abolition of Influx Control Act.¹²⁴

¹⁰⁹ 36 of 1966.

¹¹⁰ 64 of 1956.

¹¹¹ 64 of 1956.

¹¹² 68 of 1986.

¹¹³ 30 of 1956.

¹¹⁴ 46 of 1951.

¹¹⁵ 50 of 1968.

¹¹⁶ 28 of 1956.

¹¹⁷ 28 of 1956.

¹¹⁸ 66 of 1995.

¹¹⁹ 16 of 1956.

¹²⁰ 84 of 1982.

¹²¹ 16 of 1955.

¹²² 25 of 1945.

¹²³ 16 of 1955.

¹²⁴ 68 of 1986.

- 1954 **Blacks Resettlement Act:**¹²⁵ This Act provided for the removal of Natives from any area in the magisterial district of Johannesburg and adjoining districts and their resettlement elsewhere. It called for the creation of a resettlement Board whose function would be to remove Blacks from townships, and gave the government the power to move entire communities that had been established for years. It was designed primarily to effect the destruction of Sophiatown¹²⁶ (Unterhalter, 1987). The Act was originally known as the Natives Resettlement Act,¹²⁷ and was repealed by the Black Communities Development Act.¹²⁸
- 1953 **Reservation of Separate Amenities Act:**¹²⁹ This Act provided for the reservation of public premises and vehicles for the exclusive use of persons of a particular race or class. This Act, essentially forced segregation in all public amenities, public buildings, and public transport with the aim of limiting contact between Whites and other races. It was repealed by the Discriminatory Legislation regarding Public Amenities Repeal Act.¹³⁰
- 1953 **Black Education Act:**¹³¹ This Act provided for the transfer of the administration and control of native education from the provincial administrations to the government of the Union. The Act established a Black Education Department in the Department of Native Affairs. Its aim was expressly designed to reduce the level of education attainable by Blacks, in particular to prevent Blacks from receiving an education that would put them in a position of competing for jobs that they would not be allowed to hold in society. Their education was designed to equip them with skills to work in labouring jobs under Whites or serve other Blacks in the homelands (Ocampo, 2004). The Act was originally known as Bantu Education Act,¹³² and was repealed by Education and Training Act.¹³³
- 1953 **Criminal Law Amendment Act:**¹³⁴ This Act provided for increased penalties for offenses committed under certain circumstances and prohibited the offer or acceptance of financial or other assistance for any organized resistance against the laws of the Union. It was repealed by the Internal Security Act.¹³⁵
- 1953 **Public Safety Act:**¹³⁶ This Act made provision for the safety of the public and the maintenance of public order in cases of emergency. It was originally passed

¹²⁵ 19 of 1954.

¹²⁶ Sophiatown was one of several freehold townships outside of the city of Johannesburg.

¹²⁷ 19 of 1954.

¹²⁸ 4 of 1984.

¹²⁹ 49 of 1953.

¹³⁰ 100 of 1990.

¹³¹ 47 of 1953.

¹³² 47 of 1953.

¹³³ 90 of 1979.

¹³⁴ 8 of 1953.

¹³⁵ 74 of 1982.

¹³⁶ 3 of 1953.

in response to the civil disobedience campaign of the ANC, and was later repealed by the State of Emergency Act.¹³⁷

- 1952 **Blacks (Abolition of Passes and Co-ordination of Documents) Act:**¹³⁸ This Act repealed the laws relating to the carrying of passes by Natives, and provided for the issue of reference books to Natives, and amended several Acts. This Act forced Blacks to carry identification with them at all times, containing their identity card, population classification as well as stamps registering their residence and employment in a particular area. It was a criminal offense not to produce a Pass when required to do so by the police. No Black person from a rural area could go to an urban area without a permit from the local authorities. Upon arrival in an urban area, a permit to seek work had to be obtained within 72 hours. These would become known as the Pass Laws. The Act was originally known as Natives (Abolition of Passes and Co-ordination of Documents) Act,¹³⁹ and was repealed by the Identification Act.¹⁴⁰
- 1951 **Black Authorities Act:**¹⁴¹ This Act placed the administration of certain aspects of rural Africans into the hands of tribal authorities, as well as regional and territorial authorities. It was originally known as the Bantu Authorities Act.¹⁴²
- 1951 **Prevention of Illegal Squatting Act:**¹⁴³ This Act provided for the prevention and control of illegal squatting on public or private land. It made it an offense for a person to enter land or buildings, to settle on land, or remaining there without the permission of the owner. Magistrates were granted powers to order squatters out of urban areas, demolish their dwellings and to move them to a place as might be determined. The Minister of Native Affairs now had the power to remove Blacks from privately owned land or public land and to establish resettlement camps to house those displaced. The amended Act¹⁴⁴ gave the Department of Community Development, the Bantu Administration Board, and individual landowners the power to demolish buildings that had been erected and it became a punishable offense to obstruct these demolitions. The Act was repealed by Prevention of Illegal Eviction from and Unlawful Occupation of Land Act.¹⁴⁵

¹³⁷ 86 of 1995.

¹³⁸ 67 of 1952.

¹³⁹ 67 of 1952.

¹⁴⁰ 72 of 1986.

¹⁴¹ 68 of 1951.

¹⁴² 68 of 1951.

¹⁴³ 52 of 1951.

¹⁴⁴ Prevention of Illegal Squatting Amendment Act 92 of 1976.

¹⁴⁵ 19 of 1998.

- 1951 **Separate Representation of Voters Act:**¹⁴⁶ This Act made provision for the separate representation in Parliament and in the provincial council of the province of Cape of Good Hope of Europeans and non-Europeans. It amended the law relating to the registration of Europeans and non-Europeans as voters for Parliament.¹⁴⁷ Together with the 1956 amendment,¹⁴⁸ this Act led to the removal of Coloureds from the common voters' role. This Act was repealed by the Separate Representation of Voters Amendment Act.¹⁴⁹
- 1950 **Internal Security Act:**¹⁵⁰ This Act outlawed communism and the Communist Party in South Africa and made provisions for declaring other organizations promoting communistic activities to be unlawful. Communism was defined so broadly that anyone who opposed the government in any way could be charged and convicted of being a "statutory communist" even without ever having been a member of the party. The Act was originally known as the Suppression of Communism Act,¹⁵¹ and was repealed by the Internal Security and Intimidation Amendment Act.¹⁵²
- 1950 **Group Areas Act:**¹⁵³ This Act called for the declaration of certain areas for the exclusive use of one particular racial group and made it compulsory for people to live in the area designated for their classification group.¹⁵⁴ Property ownership, residence, industry, commerce, and education in each group area were limited to the members of that specified group. It was repealed by the Group Areas Act.¹⁵⁵
- 1950 **Population Registration Act:**¹⁵⁶ This Act provided for the compilation of a Register of the Population for the issuing of Identity Cards for persons whose names were included in the Register. All residents of South Africa were required to be identified and registered from birth as belonging to specific racial groups. In areas of discrepancy, a Race Classification Board would make the final decision on that person's race according to a combination of skin colour, descent,

¹⁴⁶ 46 of 1951. The Supreme Court declared this attempt by the National Party to remove Coloured people from the common voter's roles, invalid. The National Party, later introduced the South Africa Act Amendment Act in 1956 by increasing the number of Appellate Division judges from 5 to 11, and increasing the Senate from 48 to 49 (Dugard, 1978).

¹⁴⁷ The Act also amended the law relating to the registration of non-Europeans and Natives in the province of Natal as voters for Parliament and for the provincial council of Natal.

¹⁴⁸ Separate Representation of Voters Amendment Act 30 of 1956.

¹⁴⁹ 50 of 1968.

¹⁵⁰ 44 of 1950.

¹⁵¹ 44 of 1950.

¹⁵² 138 of 1991.

¹⁵³ 41 of 1950.

¹⁵⁴ As defined under the Population Registration Act 30 of 1950.

¹⁵⁵ 77 of 1957.

¹⁵⁶ 30 of 1950.

- and language. The Act was repealed by the Population Registration Act Repeal Act.¹⁵⁷
- 1950 **Immorality Amendment Act:**¹⁵⁸ This Act amended the Immorality Act¹⁵⁹ so as to prohibit sexual relations between Europeans and non-Europeans. It was repealed by the Sexual Offences Act.¹⁶⁰
- 1949 **Prohibition of Mixed Marriages Act:**¹⁶¹ This Act prohibited marriages between people classified as Europeans and people classified as non-Europeans. It was repealed by the Immorality and Prohibition of Mixed Marriages Amendment Act.¹⁶²
- 1945 **Blacks (Urban Areas) Consolidation Act:**¹⁶³ This Act was a consolidation of the laws pertaining to the Africans' presence in urban areas. The Act specified the conditions in which Africans could live and work in urban areas, defined, and limited the sections of urban areas in which Africans could live and allowed for the removal or abolishment of African townships by the Minister. There were strict rules on which Africans could remain in urban areas for more than 72 hours. Local authorities were empowered to remove from the urban areas Africans deemed "redundant" and "idle and undesirable." The Act was originally known as the Natives (Urban Areas) Consolidation Act,¹⁶⁴ and was repealed by the Abolition of Influx Control Act.¹⁶⁵
- 1943 **Prescription Act:**¹⁶⁶ This Act amended and consolidated the laws relating to prescription and was later repealed by the Prescription Act.¹⁶⁷
- 1937 **Deeds Registries Act:**¹⁶⁸ This Act consolidated and amended the laws in force relating to the registration of deeds. Along with the Sectional Titles Act,¹⁶⁹ it forms the foundation of land registration in South Africa. The Act has been extensively amended since its enactment.

¹⁵⁷ 114 of 1991.

¹⁵⁸ 21 of 1950.

¹⁵⁹ 5 of 1927.

¹⁶⁰ 23 of 1957.

¹⁶¹ 55 of 1949.

¹⁶² 72 of 1985.

¹⁶³ 25 of 1945.

¹⁶⁴ 25 of 1945.

¹⁶⁵ 68 of 1986.

¹⁶⁶ 18 of 1943.

¹⁶⁷ 68 of 1969.

¹⁶⁸ 47 of 1937.

¹⁶⁹ 95 of 1986.

- 1937 **Black Laws Amendment Act:**¹⁷⁰ This Act amended the laws relating to Natives in urban areas, and the regulation of the recruiting and employment of Native labourers and the acquisition of land by Natives. The Act prohibited Africans from acquiring land in urban areas except with the Governor General's consent. It also limited schools, churches, and other institutions attended by Africans to the townships. It placed severe restrictions on the mobility of Blacks, and set a limit on the size of the Black urban population to a minimum number required for "reasonable" labour requirements (Simons et al, 1969). The Act was originally known as the Native Laws Amendment Act,¹⁷¹ and was repealed in part by the Abolition of Influx Control Act¹⁷² and the Abolition of Racially Based Land Measures Act.¹⁷³
- 1936 **Development Trust and Land Act:**¹⁷⁴ This Act specified further areas for Native occupation in addition to the scheduled reserves of the Black Land Act.¹⁷⁵ The Act called for a further 6.2 million ha of land to be added to the reserves, which would effectively increase the size of the scheduled areas to 13.6 % of the land in South Africa (Horrell, 1978). The South African Development Trust was established and could in terms of the Act acquire land in each of the provinces for Black settlement. This Act authorized the Department of Bantu Administration and Development to eliminate the so-called Black Spots, and provided the basis for future forced removals. The Act was originally known as the Native Trust and Land Act,¹⁷⁶ and was repealed by the Abolition of Racially Based Land Measures Act.¹⁷⁷
- 1936 **Representation of Blacks Act:**¹⁷⁸ This Act made provisions for the representation of Natives in Parliament and in the provincial council of the province of Cape of Good Hope. It amended the law that was currently in force in that province relating to the registration of Natives as voters for Parliament or provincial council. The Act essentially removed Black voters in the Cape of Good Hope from the common roll and placed them on a separate roll. The Act was originally known as the Representation of Natives Act,¹⁷⁹ and was repealed by the Representation between the Republic of South Africa and Self-governing Territories Act.¹⁸⁰

¹⁷⁰ 46 of 1937.

¹⁷¹ 46 of 1937.

¹⁷² 68 of 1986.

¹⁷³ 108 of 1991.

¹⁷⁴ 18 of 1936.

¹⁷⁵ 27 of 1913.

¹⁷⁶ 18 of 1936.

¹⁷⁷ 108 of 1991.

¹⁷⁸ 12 of 1936.

¹⁷⁹ 12 of 1936.

¹⁸⁰ 46 of 1959.

- 1934 **Abolition of Quitrent Act:**¹⁸¹ This Act abolished certain quitrents, other taxes, and certain debts in respect of land.
- 1934 **Slums Act:**¹⁸² This Act made provisions for the elimination of slums within the areas of jurisdiction of certain local authorities. Thus, by proclaiming certain non-White areas as “slums,” areas could be condemned and people moved. It was repealed by the Slums Act.¹⁸³
- 1927 **Black Administration Act:**¹⁸⁴ This Act was the first step toward a uniform native administration throughout the union. It was designed to provide for the better control and management of native affairs. The Act allowed the Minister whenever he deemed it in the public interest, to order any tribe or individual Black person to move from one place to another within the Republic of South Africa without any prior notice to any of the persons concerned. It also limited the powers of the regular courts to intervene in African affairs, and was used extensively to carry out forced removals (Platzky et al, 1985). The Act was originally known as the Native Administration Act,¹⁸⁵ and was repealed in part by the Abolition of Influx Control Act,¹⁸⁶ and repealed in full by the Abolition of Restrictions on Free Political Activity Act.¹⁸⁷
- 1927 **Land Survey Act:**¹⁸⁸ This Act amended the laws relating to the survey of land, and was repealed by Land Survey Act.¹⁸⁹
- 1927 **Immorality Act:**¹⁹⁰ This Act prohibited sexual relations between Europeans and Natives with jail terms up to five years. The Act was amended¹⁹¹ in 1950 to include Coloureds and Asians. It was repealed by the Sexual Offenses Act.¹⁹²
- 1923 **Blacks (Urban Areas) Act:**¹⁹³ This Act was designed to regulate the presence of Africans in the urban areas. It gave local authorities the responsibility and power to demarcate and establish African areas on the outskirts of White urban and industrial areas, restrict the access to, and the responsibility for funding these areas. Native advisory boards now had the power to forcibly remove people not employed in that area, the so-called “surplus people.” Movement into

¹⁸¹ 54 of 1934.

¹⁸² 53 of 1934.

¹⁸³ 76 of 1979.

¹⁸⁴ 38 of 1927.

¹⁸⁵ 38 of 1927.

¹⁸⁶ 68 of 1986.

¹⁸⁷ 206 of 1993.

¹⁸⁸ 9 of 1927.

¹⁸⁹ 8 of 1997.

¹⁹⁰ 5 of 1927.

¹⁹¹ Immorality Amendment Act 21 of 1950.

¹⁹² 23 of 1957.

¹⁹³ 21 of 1923.

urban areas was now strictly controlled. One of the critical functions of the Act given to local authorities was the administration of tougher Pass laws. Africans deemed excess to the labour needs of White households, commerce, and industry or those just deemed undesirable could now be deported to the reserves. The Act was originally known as the Natives (Urban Areas) Act,¹⁹⁴ and was repealed by the Blacks (Urban Areas) Consolidation Act.¹⁹⁵

- 1920 **Black Affairs Act:**¹⁹⁶ This Act established a commission that became known as the Native Affairs Commission, and set up separate tribal councils for the administration of the reserves. The Act was originally known as the Native Affairs Act,¹⁹⁷ and was repealed by the Black Affairs Act.¹⁹⁸
- 1913 **Black Land Act:**¹⁹⁹ This Act was the basis for separating South Africa into areas in which either Blacks or Whites could hold Freehold Land. It effectively froze existing tribal areas as exclusively reserved for African occupation. These reserves were primarily in Ciskei,²⁰⁰ Transkei,²⁰¹ and Zululand²⁰² and comprised approximately 7 % of South Africa. This essentially stopped Africans from owning, renting or acquiring land outside the scheduled areas and halted White acquisition of land held by Black farmers. It was now illegal for Blacks to purchase or lease land from Whites except in these reserves. The Act was originally known as Natives Land Act,²⁰³ and was repealed by the Abolition of Racially Based Land Measures Act.²⁰⁴
- 1911 **Black Labour Regulation Act:**²⁰⁵ This Act regulated the recruiting and employment of Native labour and provided for compensation to Native labourers in certain cases. The Act was originally known as the Native Labour Regulation Act,²⁰⁶ and was repealed by the Black Labour Act.²⁰⁷

¹⁹⁴ 21 of 1923.

¹⁹⁵ 25 of 1945.

¹⁹⁶ 23 of 1920.

¹⁹⁷ 23 of 1920.

¹⁹⁸ 55 of 1959.

¹⁹⁹ 27 of 1913.

²⁰⁰ Ciskei was located in the southeastern part of South Africa. It would later become a Bantustan, consisting of two separate blocks of land, designated as one of the homelands for the Xhosa-speaking people.

²⁰¹ Transkei was located in what is now southeastern Eastern Cape Province. It would later become a Bantustan, designated as one of the homelands for the Xhosa-speaking people.

²⁰² Zululand was located in what is now northern KwaZulu-Natal Province. It would later become a Bantustan (KwaZulu), designated as one of the homelands for the Zulu-speaking people.

²⁰³ 27 of 1913.

²⁰⁴ 108 of 1991.

²⁰⁵ 15 of 1911.

²⁰⁶ 15 of 1911.

- 1911 **Mines and Works Act:**²⁰⁸ This Act amended the laws relating to the operating of mines, works, and machinery. The Act forced Blacks into the role of cheap labour, essentially reserving a wide range of skilled jobs for Whites only. With later amendments,²⁰⁹ the Act permitted the granting of certificates of competency for a number of skilled mining occupations to Whites and Coloureds only (Dugard, 1978). It was repealed by the Mines and Works Act.²¹⁰
- 1909 **South Africa Act:**²¹¹ This Act, passed by the British Parliament, called for the unification of the British colonies of Cape of Good Hope, Natal, Orange River Colony, and Transvaal under one government in a legislative union under the crown of Great Britain and Ireland known as the Union of South Africa. The Act was repealed by Republic of South Africa Constitution Act,²¹² South Africa Act Amendment Act,²¹³ Pre-Union Statute Law Revision Act²¹⁴ and the Attorneys Act.²¹⁵
- 1894 **Glen Grey Lands and Local Affairs Act:**²¹⁶ This Act provided for the disposal of lands and for the administration of local affairs within the district of Glen Grey.²¹⁷

²⁰⁷ 67 of 1964.

²⁰⁸ 12 of 1911.

²⁰⁹ i.e., Acts 25 of 1926 and 27 of 1956.

²¹⁰ 27 of 1956.

²¹¹ Commonly known as the Union Constitution. Drafted by a National Convention in South Africa, and passed by the British Parliament.

²¹² 32 of 1961.

²¹³ 26 of 1969.

²¹⁴ 43 of 1977.

²¹⁵ 53 of 1979.

²¹⁶ 25 of 1894, enacted by the Colony of Cape of Good Hope.

²¹⁷ In the Colony of Cape of Good Hope.

Appendix B: Equipment

Ashtech ProMark 2 GPS Receiver

- Manufacturer:** Ashtech.
Model: ProMark 2.
Dimensions: Receiver 15.8 x 5.1 x 3.3 cm, External Antenna 19 x 9.6 cm.
Weight: Approximately 140 g, Receiver 0.14 kg, External Antenna 0.45 kg, Batteries 0.05 kg.
Temperature Range: -10 to 60 °C.
Receiver: 12 independent GPS and WAAS/EGNOS channels. L1 C/A Code and Carrier.
GPS Survey Modes Supported: Static, Stop-and-go, and Kinematic.
Position Accuracy: Real-time Accuracy 1 - 3 m, Post-mission Accuracy < 1 cm, Real-time position accuracy (autonomous) 3 m.
Accuracy Specifications: (Static) Horizontal 0.005 m + 1 ppm, Vertical 0.010 m + 2 ppm, Observation Time 20 - 60 min (Kinematic) Horizontal 0.012 m + 2.5 ppm, Vertical 0.015 m + 2.5 ppm.
Interfaces: Display 5.6 x 3.4 cm, Keyboard 12 buttons, and communications RS232 port for PC interface at 2,400 - 115,200 baud.
Antenna: Internal and ProAntenna.
Power Input: 2 AA - 1.5 VDC alkaline or lithium, external power port for extended operation life.
Battery Life: Internal (2 AA): Up to 8 hrs with alkaline/13 hrs with lithium, External (+internal) (8 AA): Up to 32 hrs with alkaline/52 hrs with lithium.
Source: (Ashtech, 2004).

Batteries

- Manufacturer:** Forbatt (Fortune Battery Corporation) Taiwan.
Model: FB12-7.2, 12 V 7.2 AN (Maintenance-free Lead Acid Rechargeable Battery) (Motorcycle Style Battery).
Dimensions: 9.6 x 6.5 x 15 cm.
Voltage: 12 V.
Weight: 2.55 kg.
Charging Voltage (20 °C): Standby Use: 13.5 ~13.8 V, Cycle Use: 14.4 ~15.0 V, Initial Current: 2.16 A Max.
Purchase Price: R 214 (R 107 x 2).
Source: (Forbatt, 2005).

Canon LiDE 20 Scanner

Manufacturer: Canon.

Model: LiDE 20 (Flatbed).

Dimensions: 38.4 x 25.7 x 3.6 cm.

Weight: 1.5 kg.

Scanner Type: Flatbed, Colour, and Monochrome.

Scanning Element: Contact Image Sensor (CIS).

Maximum Resolutions: Optical - 600 dpi, Hardware - 600 x 1200 dpi,
interpolated 9600 x 9600 dpi.

Colour Depth: 48-bit internal/24-bit external, Grayscale: 16-bit internal/
8-bit external, Black & White, and Text Enhanced.

Maximum Document Size: 21.6 x 29.7 cm (8.5" x 11.7").

Interfaces: USB.

Operating System Compatibility: Windows 98/Me/2000/XP.

System Requirements: Colour monitor with 800 x 600 pixels or higher display
and 256 or more colours; CD-ROM drive (2x or faster); USB port
(excludes add-on board); Windows: Windows 98/Me/2000
Professional: Pentium 150 MHz processor or higher/64 MB RAM;
Windows XP: Pentium 300 MHz processor/128 MB RAM.

Software: CanoScan Setup CD-ROM (includes CanoScan Toolbox).

Power Source: powered by USB port, no AC adapter required.

Maximum Power Consumption: 2.5 W (1.25 W standby).

Environmental Conditions: 5 - 35 °C, Operating Humidity 10 % - 90 % RH.

Purchase Price: R 599.95 includes 14 % VAT (October 2003).

Source: (Canon, 2004).

Compaq Presario 2100 Computer

Manufacturer: Compaq.

Model: Presario 2100.

Type: Laptop/Notebook.

Dimensions: 33.0 x 27.4 x 4.1 cm.

Weight: 3.6 kg.

Memory: RAM - 256 MB RAM DDR SDRAM (Memory speed 266 MHz),
Cache size - 512 KB.

Processor: Celeron 1.8 GHz.

Input Devices: Keyboard, Touchpad.

Display: 35.6 cm (14 in.) TFT active matrix, maximum resolution
1024 x 768 pixels, Video Output AGP 4x, Graphics Processor ATI
Mobility Radeon.

Power: 1 Lithium ion battery (estimated battery life 3 hrs), external 75 W power adapter.

Operating System/Software: Microsoft Windows XP Home Edition.

Connectivity: 2 USB (USB 1.1), 1 Parallel IEEE 1284 (EPP/ECP),
1 Serial RS-232.

Storage: 20 GB HDD, CD/DVD ROM.

Optical Storage: CD/DVD/DVD-ROM combo.

Modem Type: Fax/Modem - 56 Kbps.

Mainboard: Data bus speed - 400 MHz.

Interface Provided: 2 USB 1.1, Display/video VGA, Modem phone line,
network Ethernet 10Base-T/100Base-TX, Headphone output,
microphone input, IEEE 1394 (FireWire), Infrared.

Purchase Price: R 8,499.95 includes 14 % VAT (October 2003).

Source: (Incredible Connection, 2004).

Garmin eTrex GPS Receiver

Manufacturer: Garmin, Kansas, USA.

Model: eTrex (Personal Navigator/Basic Model).

Dimensions: 11.1 x 5.1 x 3.0 cm.

Weight: Approximately 150 g with batteries.

Temperature Range: -15 to 70 °C (operating), maybe limited by operating range of batteries.

Receiver: 12 parallel channel.

Acquisition Time: Approximately 15 sec (warm start), 45 sec (cold start), 5 min (First Time/AutoLocate).

Update Rate: 1/sec, continuous.

Position Accuracy: 1 - 5 m (3 - 15 ft) with DGPS corrections (with optional Garmin Differential Beacon Receiver input), 15 m (49 ft) RMS (was subject to accuracy degradation to 100 m 2 DRMS under the US DoD-imposed S/A programme).

Interfaces: NMEA 0183 (versions 2.00 - 2.30), RTCM 104 (for DGPS corrections) and RS-232 for PC interface.

Antenna: Built-in patch.

Power Input: Two 1.5-volt AA batteries.

Battery Life: 22 hrs (using Battery Saver Mode).

Display: 4 level grey LCD, 128 x 64 pixels.

Display Size: 27 x 54 mm.

Waterproof Standard: IPX7 (An IPX7 designation means the GPS case can withstand accidental immersion in 1 m of water for up to 30 min).

Number of Waypoints: 500 (with name and graphic symbol).

Built in Memory: N/A.

Map Datums: More than 100.

Position Format: Lat/Long, UTM/UPS, Maidenhead, MGRS and others.

Settings: Time Format - 24 hrs, UTC offset +02:00, Position Format (units) -
hddd° mm' ss.s", Map Datum - WGS84, Units - metric,
North Ref - True.

Source: (Garmin 2004a, 2004b, 2005).

Garmin Foretrex 101 GPS Receiver

Manufacturer: Garmin, Kansas, USA.

Model: Foretrex 101.

Dimensions: 8.4 x 4.3 x 2.3 cm.

Weight: Approximately 74 g.

Temperature Range: -20 to 60 °C.

Receiver: 12 parallel channel.

Acquisition Time: Approximately 15 sec (warm start), 45 sec (cold start), 5 min
(First Time/AutoLocate).

Update Rate: 1/sec, continuous.

Position Accuracy: < 15 m (95 % typical), (15 m or less in normal GPS mode,
3 m or less when WAAS-enabled).

Interfaces: RS232 with NMEA 0183 and proprietary Garmin.

Antenna: Built-In patch.

Power Input: Two AAA batteries.

Battery life: 15 hrs (typical use) on 2 AAA batteries.

Display: Monochrome display with backlighting, 100 x 64 pixels.

Display Size: 36.6 x 23.4 mm.

Waterproof Standard: IPX7 (An IPX7 designation means the GPS case can
withstand accidental immersion in 1 m of water for up to 30 min).

Number of Waypoints: 500 (with name and graphic symbol).

Map Datums: More than 100.

Position Format: Lat/Long, UTM/UPS, Maidenhead, MGRS, and other grids.

Settings: UTC offset +02:00, Position Format (Units) - hddd° mm' ss.s",
Map Datum - WGS84, Units - Metric.

Source: (Garmin 2004c, 2004d).

GPS TrackMaker

Version: 12.3 (Shareware Version).

Features: A mapping programme specifically geared to GPS applications,
providing communication between PC and GPS units.

Purchase Price: Shareware.

Source: (GPS TrackMaker, 2005).

HP DeskJet 450cbi Printer

Manufacturer: HP (Hewlett-Packard).
Model: DeskJet 450cbi (Portable Printer).
Dimensions: 33.8 x 8.2 x 16.4 cm (Maximum Dimensions).
Printer Weight: 1.9 kg (without print cartridges and battery), 2.1 kg (without print cartridges but with battery).
Print Technology: HP Thermal Inkjet.
Print Speed (letter): 8 - 9 PPM (Fast), 3 - 5 PPM (Normal), 1 - 1.6 PPM (Best).
Print Resolution: Black (Maximum 1200 x 1200 dpi), Colour (4800 x 1200 optimized dpi).
I/O Interface: USB, parallel, Infrared, Bluetooth, CompactFlash (Type I and II).
Printer Memory: 16 MB RAM, 4 MB ROM.
Power Requirements: 100 to 240 AC, 50/60 Hz, 19 VDC, 3.16 A (AC adapter).
Power consumption: maximum printing 20 W, maximum non-printing 5 W, maximum consumption while battery is charging 53 W, off < 2 W.
Battery: Lithium-ion ~1800 mAh (11.1 VDC).
Consumables: Black Ink Cartridge, Colour Ink Cartridge.
Media Type/Size: US letter (21.6 x 27.9 cm), US Legal (21.6 x 35.6 cm), ISO A4 (21.0 x 29.7 cm), ISO A5 (14.8 x 21.0 cm).
Purchase Price: R 2,999.95 includes 14 % VAT (October 2003).
Source: (HP 2002, 2003, 2004, Referenceguide.com 2004).

Microsoft Office

Version: 2003.
Features: Access, Excel, FrontPage, Outlook, PowerPoint, Word.
Purchase Price: Packaged with Computer Purchase.

Microsoft Windows

Version: XP Home Edition.
Features: Computer Operating System.
Purchase Price: Packaged with Computer Purchase.

Pentax Optio 550 Digital Camera

Manufacturer: Pentax.
Model: Optio 550 (Fully automatic compact-type digital still camera with built-in 5x zoom lens).
Dimensions: 10.0 x 5.9 x 4.0 cm.
Weight: 250 g (with battery and memory card).

Lens: 7.8 mm - 39 mm (equivalent to 37.5 mm - 187.5 mm in 35 mm format),
Aperture: f/2.8 - f/4.6.
Shutter: Approximately 1/4000 - 4 sec.
Power Supply: Rechargeable lithium-ion battery D-L17.
Battery life: Approximately 400 photographs with 50 % of shooting using flash,
LCD monitor on in accordance with Pentax measuring conditions.
Effective Pixels: 5.0 megapixels.
File Format: Still - JPEG (Exif2.2), DCF, PRINT Image Matching II,
DPOF, TIFF.
Storage Medium: SD Memory Card, Multimedia Card (i.e., 256 MB, 512 MB).
Source: (Pentax 2003, 2005).

PV Panel

Manufacturer: Generic (No-Name).
Model: N/A.
Power: 10 W.
Output: 0.70 A.
Dimensions: 93.0 x 31.5 x 2.0 cm.
Purchase Price: R 1067.

2500 mA Universal Step-up Converter

Manufacturer: Minwa Electronics Co., Ltd. (Hong Kong).
Model: MW 2171 ComOn (DC/DC Converter for Notebook Computer).
Dimensions: 12.2 x 7.6 x 6.0 cm.
Name: 2500 mA Universal Step-up IC Regulated DC/DC Converter for Notebook
Computer.
Rated supply voltage: 12 V - 13.8 VDC.
Rated output voltage: 12/15/18/21/24 VDC Regulated.
Rated output current: 2500 mA.
Rated output: 60 VA (max).
Type: DC/DC Converter.
Function: Step-up.
Input method: Car-plug.
Output plug: 6 MC (NG, NH, NAA, NAB, NE, NJ).
Application: Notebook.
Purchase Price: R 260.
Source: (Minwa, 2004).

Appendix C: GPS Coordinates

Table 8: GPS Coordinates/Jimmy Property 1

Survey Pt#	eTrex 1		eTrex 2	
	Latitude	Longitude	Latitude	Longitude
ΔJP-01	28° 41' 35.4" S	31° 24' 56.3" E	28° 41' 35.3" S	31° 24' 56.2" E
ΔJP-02	28° 41' 35.4" S	31° 24' 56.4" E	28° 41' 35.3" S	31° 24' 56.4" E
ΔJP-03	28° 41' 35.8" S	31° 24' 56.4" E	28° 41' 35.7" S	31° 24' 56.2" E
ΔJP-04	28° 41' 36.0" S	31° 24' 58.7" E	28° 41' 35.9" S	31° 24' 58.6" E
ΔJP-05	28° 41' 37.4" S	31° 24' 58.1" E	28° 41' 37.2" S	31° 24' 58.2" E
ΔJP-06	28° 41' 39.5" S	31° 24' 58.1" E	28° 41' 39.5" S	31° 24' 58.1" E
ΔJP-07	28° 41' 39.6" S	31° 24' 55.6" E	28° 41' 39.6" S	31° 24' 55.5" E
ΔJP-08	28° 41' 37.3" S	31° 24' 55.6" E	28° 41' 37.3" S	31° 24' 55.6" E
ΔJP-09	28° 41' 36.7" S	31° 24' 54.1" E	28° 41' 36.8" S	31° 24' 54.2" E
ΔJP-10	28° 41' 34.5" S	31° 24' 55.1" E	28° 41' 34.5" S	31° 24' 55.2" E
ΔJP-11	28° 41' 34.6" S	31° 24' 55.7" E	28° 41' 34.5" S	31° 24' 55.6" E
ΔJP-12	28° 41' 35.0" S	31° 24' 55.8" E	28° 41' 34.9" S	31° 24' 55.7" E
ΔJP-13	28° 41' 36.0" S	31° 24' 55.8" E	-	-
ΔJP-14	28° 41' 39.4" S	31° 24' 57.7" E	28° 41' 39.5" S	31° 24' 57.8" E

eTrex 1, eTrex 2 (November 20 2004).

WGS84.

Table 9: GPS Coordinates/Jimmy Property 2

Survey Pt#	eTrex 4		eTrex 1	
	Latitude	Longitude	Latitude	Longitude
ΔJP-01	28° 41' 35.3" S	31° 24' 56.3" E	28° 41' 35.3" S	31° 24' 56.1" E
ΔJP-02	28° 41' 35.5" S	31° 24' 56.4" E	28° 41' 35.4" S	31° 24' 56.3" E
ΔJP-03	28° 41' 35.9" S	31° 24' 56.3" E	28° 41' 35.8" S	31° 24' 56.4" E
ΔJP-04	28° 41' 36.0" S	31° 24' 58.5" E	28° 41' 36.1" S	31° 24' 58.7" E
ΔJP-05	28° 41' 37.3" S	31° 24' 58.2" E	28° 41' 37.3" S	31° 24' 58.2" E
ΔJP-06	28° 41' 39.4" S	31° 24' 58.1" E	28° 41' 39.4" S	31° 24' 58.1" E
ΔJP-07	28° 41' 39.5" S	31° 24' 55.5" E	28° 41' 39.6" S	31° 24' 55.6" E
ΔJP-08	28° 41' 37.4" S	31° 24' 55.5" E	28° 41' 37.3" S	31° 24' 55.6" E
ΔJP-09	28° 41' 36.7" S	31° 24' 54.2" E	28° 41' 36.7" S	31° 24' 54.3" E
ΔJP-10	28° 41' 34.6" S	31° 24' 55.2" E	28° 41' 34.5" S	31° 24' 55.2" E
ΔJP-11	28° 41' 34.6" S	31° 24' 55.6" E	28° 41' 34.6" S	31° 24' 55.7" E
ΔJP-12	28° 41' 35.1" S	31° 24' 55.7" E	28° 41' 35.0" S	31° 24' 55.8" E
ΔJP-13	28° 41' 36.0" S	31° 24' 55.7" E	28° 41' 36.2" S	31° 24' 56.0" E
ΔJP-14	28° 41' 39.5" S	31° 24' 57.8" E	-	-

eTrex 4 (November 20 2004), eTrex 1 (November 23 2004).

WGS84.

Table 10: GPS Coordinates/Jimmy Property 3

Survey Pt#	eTrex 4		Mean	
	Latitude	Longitude	Latitude	Longitude
ΔJP-01	28° 41' 35.3" S	31° 24' 56.3" E	28° 41' 35.3" S	31° 24' 56.2" E
ΔJP-02	28° 41' 35.4" S	31° 24' 56.3" E	28° 41' 35.4" S	31° 24' 56.4" E
ΔJP-03	28° 41' 35.8" S	31° 24' 56.3" E	28° 41' 35.8" S	31° 24' 56.3" E
ΔJP-04	28° 41' 36.0" S	31° 24' 58.5" E	28° 41' 36.0" S	31° 24' 58.6" E
ΔJP-05	28° 41' 37.3" S	31° 24' 58.2" E	28° 41' 37.3" S	31° 24' 58.2" E
ΔJP-06	28° 41' 39.5" S	31° 24' 58.1" E	28° 41' 39.5" S	31° 24' 58.1" E
ΔJP-07	28° 41' 39.6" S	31° 24' 55.6" E	28° 41' 39.6" S	31° 24' 55.6" E
ΔJP-08	28° 41' 37.3" S	31° 24' 55.6" E	28° 41' 37.3" S	31° 24' 55.6" E
ΔJP-09	28° 41' 36.7" S	31° 24' 54.2" E	28° 41' 36.7" S	31° 24' 54.2" E
ΔJP-10	28° 41' 34.6" S	31° 24' 55.1" E	28° 41' 34.5" S	31° 24' 55.2" E
ΔJP-11	28° 41' 34.6" S	31° 24' 55.6" E	28° 41' 34.6" S	31° 24' 55.6" E
ΔJP-12	28° 41' 35.1" S	31° 24' 55.7" E	28° 41' 35.0" S	31° 24' 55.7" E
ΔJP-13	28° 41' 36.2" S	31° 24' 55.9" E	28° 41' 36.1" S	31° 24' 55.8" E
ΔJP-14	-	-	28° 41' 39.5" S	31° 24' 57.8" E

eTrex 4 (November 23 2004).

Mean ((ΔJP-01 to ΔJP-12, η = 5), (ΔJP-13, η = 4), (ΔJP-14, η = 3)).

WGS84.

Table 11: GPS Coordinates/Jimmy Property 4

Survey Pt#		Minimum	Maximum	Difference
ΔJP-01	Latitude	28° 41' 35.3" S	28° 41' 35.4" S	0.1"
	Longitude	31° 24' 56.1" E	31° 24' 56.3" E	0.2"
ΔJP-02	Latitude	28° 41' 35.3" S	28° 41' 35.5" S	0.2"
	Longitude	31° 24' 56.3" E	31° 24' 56.4" E	0.1"
ΔJP-03	Latitude	28° 41' 35.7" S	28° 41' 35.9" S	0.2"
	Longitude	31° 24' 56.2" E	31° 24' 56.4" E	0.2"
ΔJP-04	Latitude	28° 41' 35.9" S	28° 41' 36.1" S	0.2"
	Longitude	31° 24' 58.5" E	31° 24' 58.7" E	0.2"
ΔJP-05	Latitude	28° 41' 37.2" S	28° 41' 37.4" S	0.2"
	Longitude	31° 24' 58.1" E	31° 24' 58.2" E	0.1"
ΔJP-06	Latitude	28° 41' 39.4" S	28° 41' 39.5" S	0.1"
	Longitude	31° 24' 58.1" E	31° 24' 58.1" E	0.0"
ΔJP-07	Latitude	28° 41' 39.5" S	28° 41' 39.6" S	0.1"
	Longitude	31° 24' 55.5" E	31° 24' 55.6" E	0.1"
ΔJP-08	Latitude	28° 41' 37.3" S	28° 41' 37.4" S	0.1"
	Longitude	31° 24' 55.5" E	31° 24' 55.6" E	0.1"
ΔJP-09	Latitude	28° 41' 36.7" S	28° 41' 36.8" S	0.1"
	Longitude	31° 24' 54.1" E	31° 24' 54.3" E	0.2"
ΔJP-10	Latitude	28° 41' 34.5" S	28° 41' 34.6" S	0.1"
	Longitude	31° 24' 55.1" E	31° 24' 55.2" E	0.1"
ΔJP-11	Latitude	28° 41' 34.5" S	28° 41' 34.6" S	0.1"
	Longitude	31° 24' 55.6" E	31° 24' 55.7" E	0.1"
ΔJP-12	Latitude	28° 41' 34.9" S	28° 41' 35.1" S	0.2"
	Longitude	31° 24' 55.7" E	31° 24' 55.8" E	0.1"

Minimum and Maximum GPS coordinates ($\eta = 5$).

WGS84.

Table 12: GPS Coordinates/Jimmy Property 5

Survey Pt#	Mean		Horizontal Distance
	Latitude	Longitude	
ΔJP-01	28° 41' 35.3" S	31° 24' 56.2" E	
ΔJP-02	28° 41' 35.4" S	31° 24' 56.4" E	6.2 m
ΔJP-03	28° 41' 35.8" S	31° 24' 56.3" E	12.6 m
ΔJP-04	28° 41' 36.0" S	31° 24' 58.6" E	62.6 m
ΔJP-05	28° 41' 37.3" S	31° 24' 58.2" E	41.6 m
ΔJP-06	28° 41' 39.5" S	31° 24' 58.1" E	68.0 m
ΔJP-07	28° 41' 39.6" S	31° 24' 55.6" E	67.8 m
ΔJP-08	28° 41' 37.3" S	31° 24' 55.6" E	71.0 m
ΔJP-09	28° 41' 36.7" S	31° 24' 54.2" E	42.2 m
ΔJP-10	28° 41' 34.5" S	31° 24' 55.2" E	73.2 m
ΔJP-11	28° 41' 34.6" S	31° 24' 55.6" E	11.3 m
ΔJP-12	28° 41' 35.0" S	31° 24' 55.7" E	12.6 m
ΔJP-01	28° 41' 35.3" S	31° 24' 56.2" E	16.4 m

Mean ($\eta = 5$).

WGS84.

Table 13: GPS Coordinates/Shandy Property 1

Survey Pt#	eTrex 1		eTrex 3	
	Latitude	Longitude	Latitude	Longitude
ΔSP-101	28° 41' 59.0" S	31° 25' 19.0" E	28° 41' 58.9" S	31° 25' 18.9" E
ΔSP-102	28° 41' 57.2" S	31° 25' 17.4" E	28° 41' 57.3" S	31° 25' 17.5" E
ΔSP-103	28° 41' 55.3" S	31° 25' 21.2" E	28° 41' 55.3" S	31° 25' 21.1" E
ΔSP-104	28° 42' 03.6" S	31° 25' 25.7" E	28° 42' 03.6" S	31° 25' 25.6" E
ΔSP-105	28° 42' 05.8" S	31° 25' 23.2" E	28° 42' 05.8" S	31° 25' 23.2" E
ΔSP-106	28° 41' 57.5" S	31° 25' 20.2" E	28° 41' 57.6" S	31° 25' 20.2" E

eTrex 1, eTrex 4 (November 24 2004).

WGS84.

Table 14: GPS Coordinates/Shandy Property 2

Survey Pt#	eTrex 4		Mean	
	Latitude	Longitude	Latitude	Longitude
ΔSP-101	28° 41' 59.0" S	31° 25' 19.0" E	28° 41' 59.0" S	31° 25' 19.0" E
ΔSP-102	28° 41' 57.3" S	31° 25' 17.5" E	28° 41' 57.3" S	31° 25' 17.5" E
ΔSP-103	28° 41' 55.3" S	31° 25' 21.1" E	28° 41' 55.3" S	31° 25' 21.1" E
ΔSP-104	28° 42' 03.6" S	31° 25' 25.6" E	28° 42' 03.6" S	31° 25' 25.6" E
ΔSP-105	28° 42' 05.8" S	31° 25' 23.2" E	28° 42' 05.8" S	31° 25' 23.2" E
ΔSP-106	28° 41' 57.5" S	31° 25' 20.1" E	28° 41' 57.5" S	31° 25' 20.2" E

eTrex 4 (November 24 2004), Mean $\eta = 3$.

WGS84.

Table 15: GPS Coordinates/Miscellaneous

Survey Pt#	Latitude	Longitude	Receiver
ΔMPENJATI	28° 41' 29.3" S	31° 24' 59.5" E	eTrex/ProMark
ΔSIER-287	28° 39' 35.7" S	31° 45' 20.1" E	eTrex
ΔIN-NA63	28° 43' 26.4" S	31° 27' 12.6" E	eTrex

WGS84.

Appendix D: Statistics

Table 16: Statistics [Mthonjaneni, Uthungulu Municipalities]

Categories	Mthonjaneni Municipality	Uthungulu Municipality
Area	1,086/km ²	8,215/km ²
Population	50,383	885,966
Population - Density	41/km ²	106/km ²
Population - Group (African)	98.1 %	94.7 %
Population - Sex ratio (female)	54.2 %	54.0 %
Population over 20 years old (with no schooling)	37.3 %	31.6 %
Individual monthly income (no income/month)	77.9 %	75.0 %
Individual monthly income (less than R 1,600/month)	94.4 %	90.6 %
Annual household income (less than R 9,600/year)	74.2 %	58.5 %
Type of dwelling (traditional)	55.5 %	42.1 %
Energy source for lighting (candles)	66.9 %	44.2 %
Main water supply (river/stream)	42.6 %	26.6 %
Telephone access (no access)	39.1 %	14.2 %
Sanitation (no toilet facility)	26.4 %	29.9 %
Employment (unemployed)	24 %	24 %
Education level (with at least grade 12)	17 %	22 %
People with no access to water	56 %	45 %
People with no access to sanitation	65 %	57 %
People with no access to electricity	70 %	47 %

Statistics are for the year 2001.

Source: (MDB, 2003a, 2003b), (DTLGA, 2004).

Table 17: Statistics [Mthonjaneni, KwaZulu-Natal, South Africa]

Selected Statistics	Mthonjaneni Municipality	KwaZulu-Natal	South Africa (National)
Population (under the age of 34)	74.8 %	71.4 %	69.0 %
Population - Home language (isiZulu)	97.1 %	80.9 %	23.8 %
Population - Sex ratio (female)	54.2 %	53.2 %	52.2 %
Population over 20 years old (with no schooling)	37.3 %	21.9 %	17.9 %
Type of dwelling (traditional)	55.5 %	27.9 %	14.7 %
Energy source for cooking (wood)	58.8 %	27.0 %	20.4 %
Energy source for lighting (candles)	66.9 %	35.0 %	22.7 %
Main water supply (river/stream)	42.6 %	12.9 %	6.5 %
Telephone access (no access)	39.1 %	8.3 %	6.0 %
Sanitation (no toilet facility)	26.4 %	16.2 %	13.5 %

Statistics are for the year 2001.

Source: (StatsSA, 2005a).

Appendix E: Photographs

Figure 9: Ekuthuleni Area

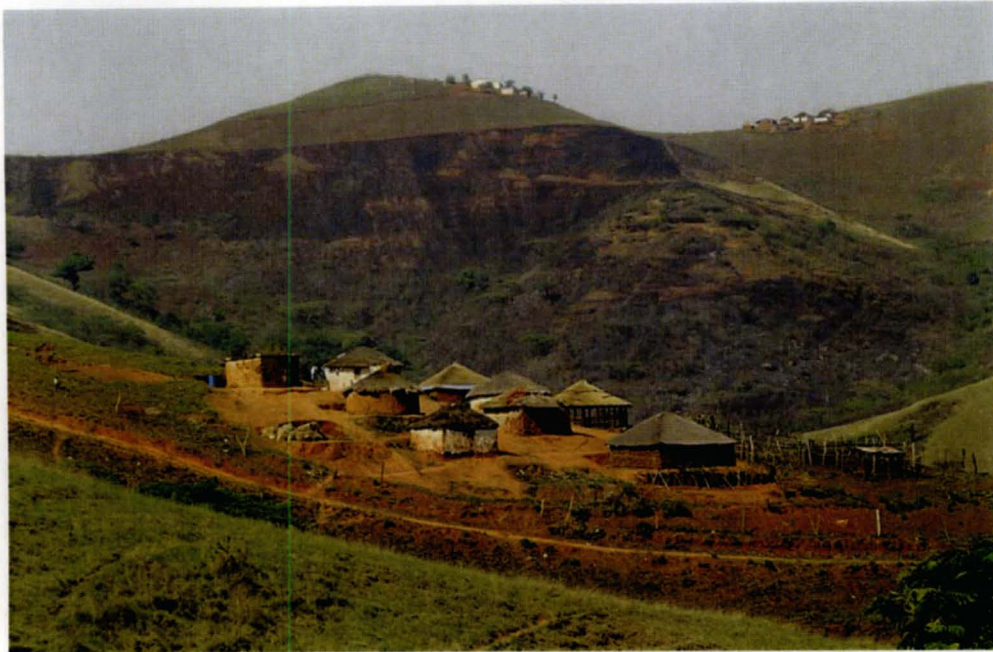


Figure 10: Ekuthuleni Area

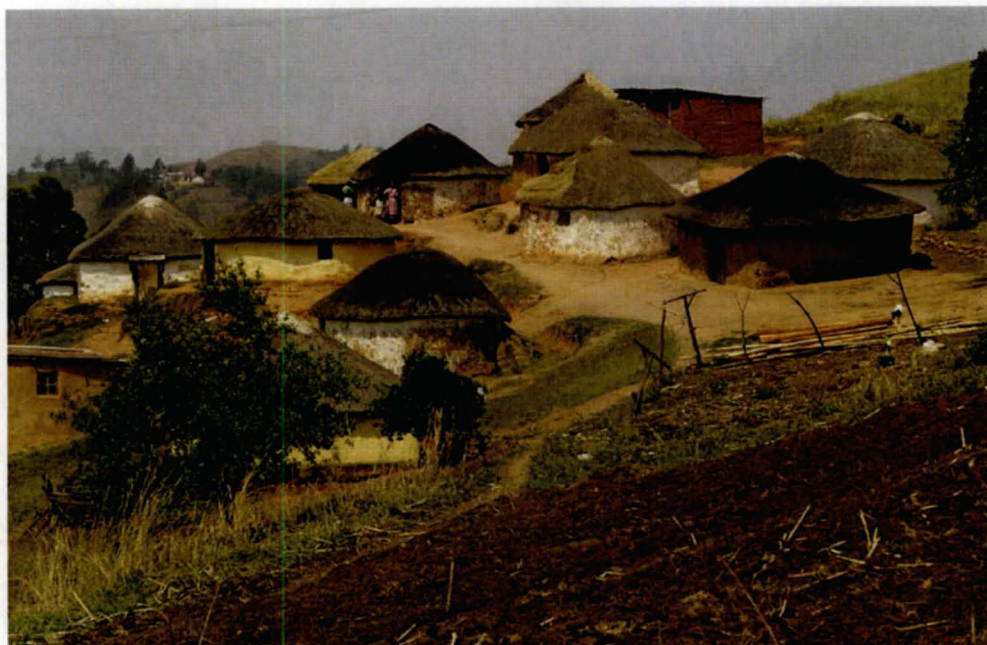


Figure 11: Ekuthuleni Area



Figure 12: Training [Melmoth]



Figure 13: Training [Melmoth]



Figure 14: Training [Melmoth]



Figure 15: Contacting Landowners



Figure 16: Contacting Landowners



Figure 17: Shandy Property

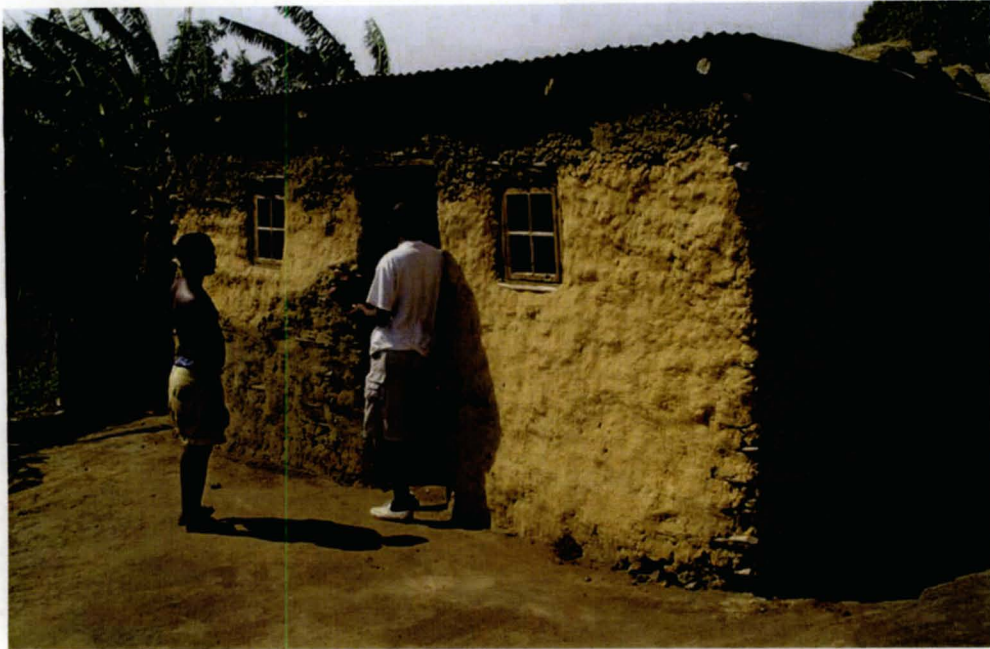


Figure 18: Shandy Property

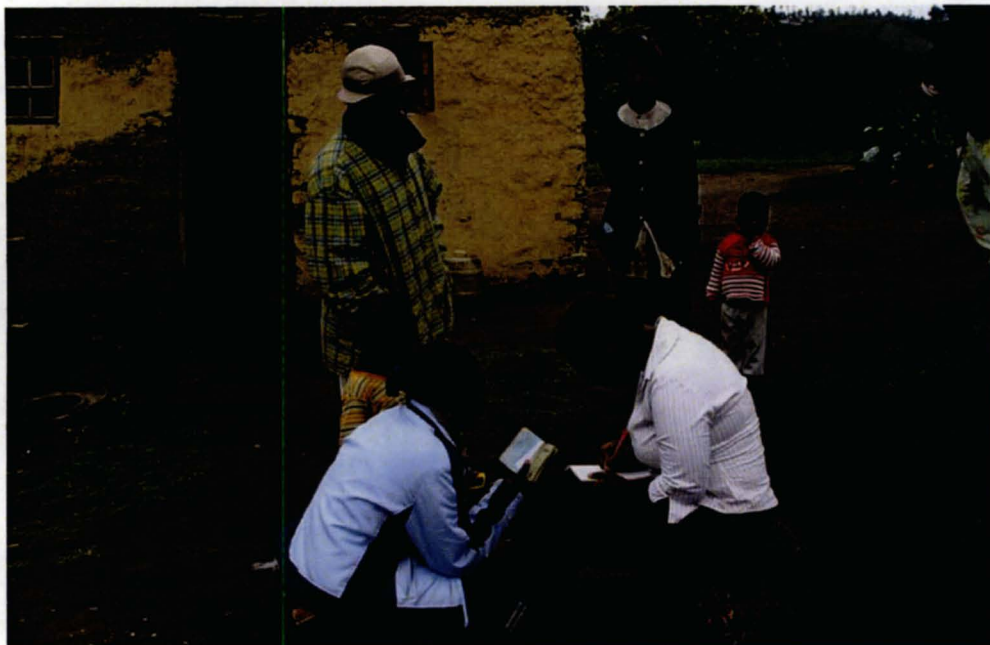


Figure 19: Jimmy Property



Figure 20: Jimmy Property



Figure 21: Jimmy Property



Figure 22: Jimmy Property



Figure 23: GPS Surveying [Reference Receiver]

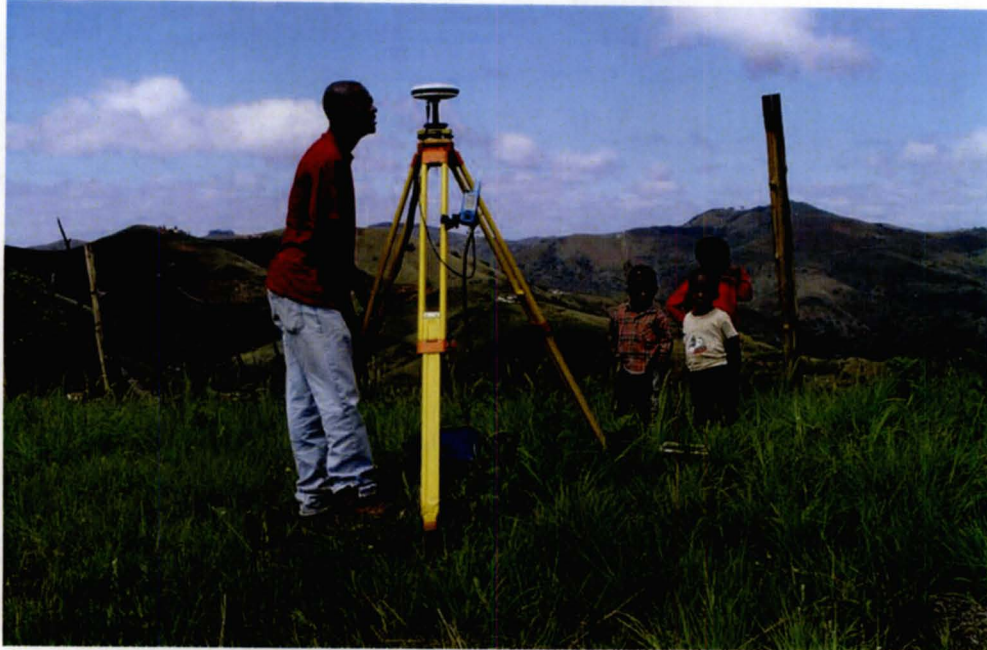


Figure 24: GPS Surveying [Rover Receiver]



Figure 25: Ekuthuleni Orthophotos

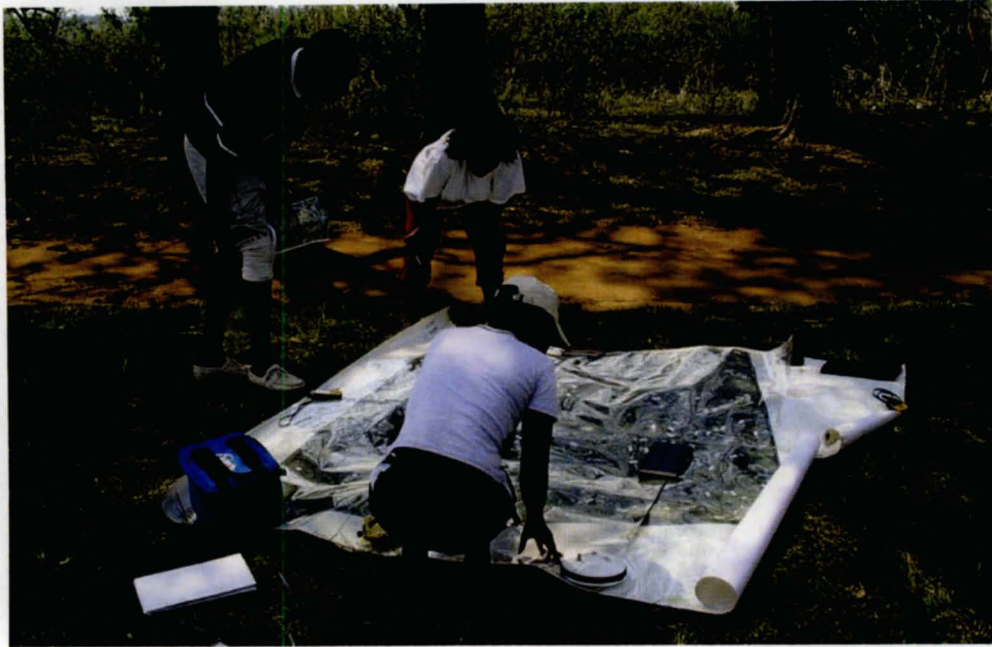


Figure 26: Ekuthuleni Orthophotos [Ekuthuleni Committee]



Appendix F: RRR Database Programme

Figure 27: RRR Database Programme [Page 1]

Request for Recognition of Old-Order rights 1

Page1: Personal masondo

Requested by.....

Name:	ID#	M / F	Birth Date
john masondo	441 106 880 7888	<input checked="" type="checkbox"/> <input type="checkbox"/>	11/06/1944

Joined in request by.....

fikile shandu	391 011 818 8083	<input type="checkbox"/> <input checked="" type="checkbox"/>	10/11/1939
c.b. masondo	440 606 060 6880	<input type="checkbox"/> <input checked="" type="checkbox"/>	06/06/1944
p.m. makhaye	750 803 238 8083	<input checked="" type="checkbox"/> <input type="checkbox"/>	08/03/1975
		<input type="checkbox"/> <input type="checkbox"/>	
		<input type="checkbox"/> <input type="checkbox"/>	

Notes:
This is just a example.

Figure 28: RRR Database Programme [Page 3]

Request for Recognition of Old-Order rights 1

Page3: Asset masondo

Asset.....

Years at Location	2	Supported By:	Todd Bertuzzi
Form of Ownership	pto	Witness1:	Mark Messier
No Of Dwellings:	7	Witness2:	Wayne Gretzky
		Witness3:	Steve Nash

Description of Asset:

Description.....

Latitude: 023-23-23.3
Longitude: 023-23-23.3

Photo No: (1234)-(1237)

Notes:
A few notes

Date: 03/04/2005
Clerk:

Garmin Scan TMaker

Table 18: RRR Database Programme [Fields]

Page Number	Field Name	Data Type	Display
Page 1	NameFirst1	Text	john
	NameLast1	Text	masondo
	ID1	Number	441 106 880 7888
	Male1	Yes/No	Yes
	Female1	Yes/No	No
	BirthDate1	Date/Time	11/06/1944
	NameFirst2	Text	fikile
	NameLast2	Text	shandu
	ID2	Number	391 011 818 8083
	Male2	Yes/No	No
	Female2	Yes/No	Yes
	BirthDate2	Date/Time	10/11/1939
	NameFirst3	Text	c.b
	NameLast3	Text	masondo
	ID3	Number	440 606 060 6880
	Male3	Yes/No	No
	Female3	Yes/No	Yes
	BirthDate3	Date/Time	06/06/1944
	NameFirst4	Text	p.m
	NameLast4	Text	makhaye
	ID4	Number	750 803 238 8083
	Male4	Yes/No	Yes
	Female4	Yes/No	No
	BirthDate4	Date/Time	08/03/1975
	NameFirst5	Text	-
	NameLast5	Text	-
	ID5	Number	-
Male5	Yes/No	-	
Female5	Yes/No	-	
BirthDate5	Date/Time	-	
NameFirst6	Text	-	
NameLast6	Text	-	
ID6	Number	-	

Table 19: RRR Database Programme [Fields]

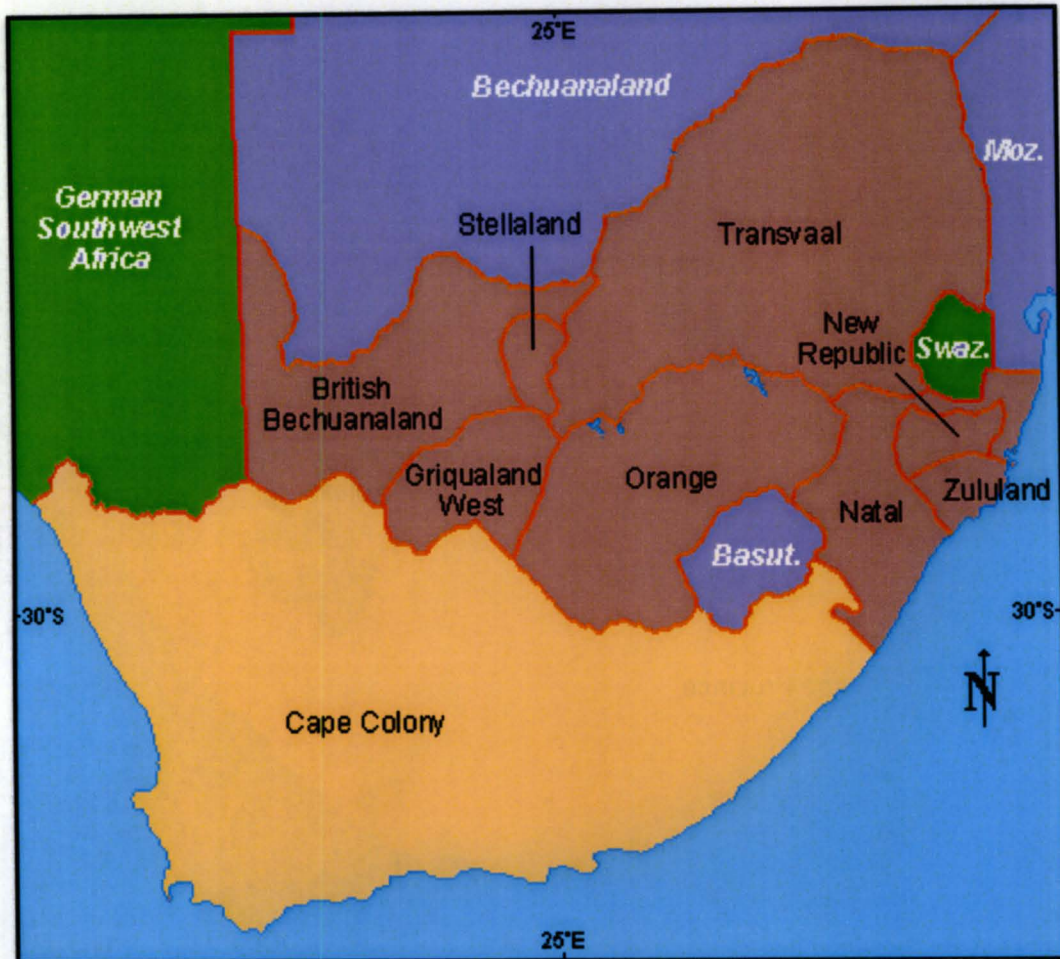
Page Number	Field Name	Data Type	Display
Page 1 (cont)	Male6	Yes/No	-
	Female6	Yes/No	-
	BirthDate6	Date/Time	-
	Notes1	Memo	This is just a example
Page 2	Community	Text	Ekuthuleni
	Address	Text	-
	Notes2	Memo	r1
	Email	Text	-
	PhoneLand	Number	-
	PhoneCell	Number	-
Page 3	YrsAtLocation	Number	2
	FormOfOwnership	Text	pto
	NoOfDwellings	Text	7
	DescriptionAsset	Memo	Description.....
	Notes3	Memo	A few notes
	SupportedBy	Text	Todd Bertuzzi
	Witness1	Text	Mark Messier
	Witness2	Text	Wayne Gretzky
	Witness3	Text	Steve Nash
	Latitude	Number	023-23-23.3
	Longitude	Number	023-23-23.3
	PhotoNoSTART	Number	1234
	PhotoNoEND	Number	1237
	Date	Date/Time	03/04/2005
	Clerk	Text	-
Page 1,2, & 3	RecordNUM	AutoNumber	1
	NameLast1	Text	masondo

Microsoft Access 2003 (RRR Database Programme).

Display Column: As shown in Figure 27: RRR Database Programme [Page 1] and Figure 28: RRR Database Programme [Page 3] (Appendix F/page 273) [Page 2: Not Shown].

Appendix G: Maps

Map 1: South Africa 1885

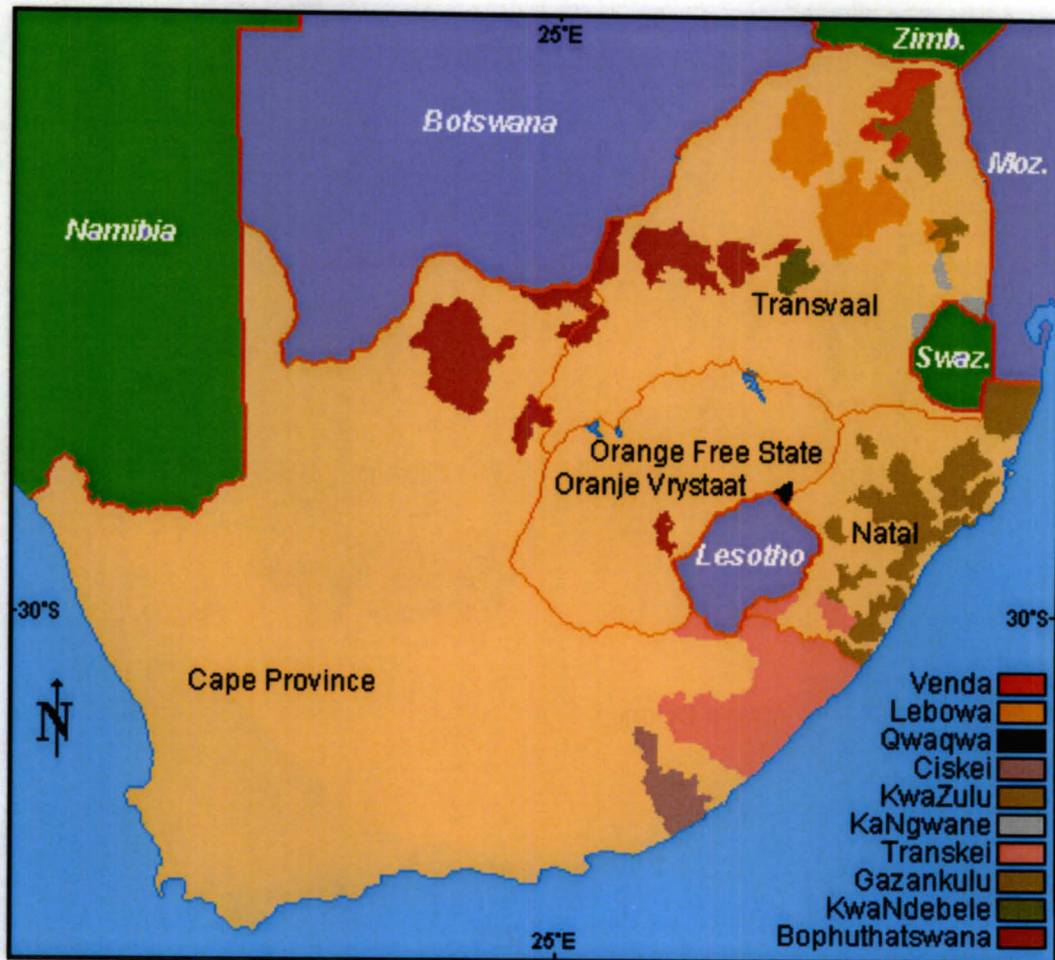


South Africa (Political) 1885.

Approximate Scale 1:13,000,000.

Source: (University of Texas, 2004).

Map 2: South Africa 1986



South Africa (Political) 1986: Black Homelands.

Approximate Scale 1:13,000,000.

Source: (University of Texas, 2004).

Map 3: South Africa 2005



South Africa (Political) 2005: Provinces.

Approximate Scale 1:13,000,000.

Source: (University of Texas, 2004).

Map 4: South Africa [Relief]

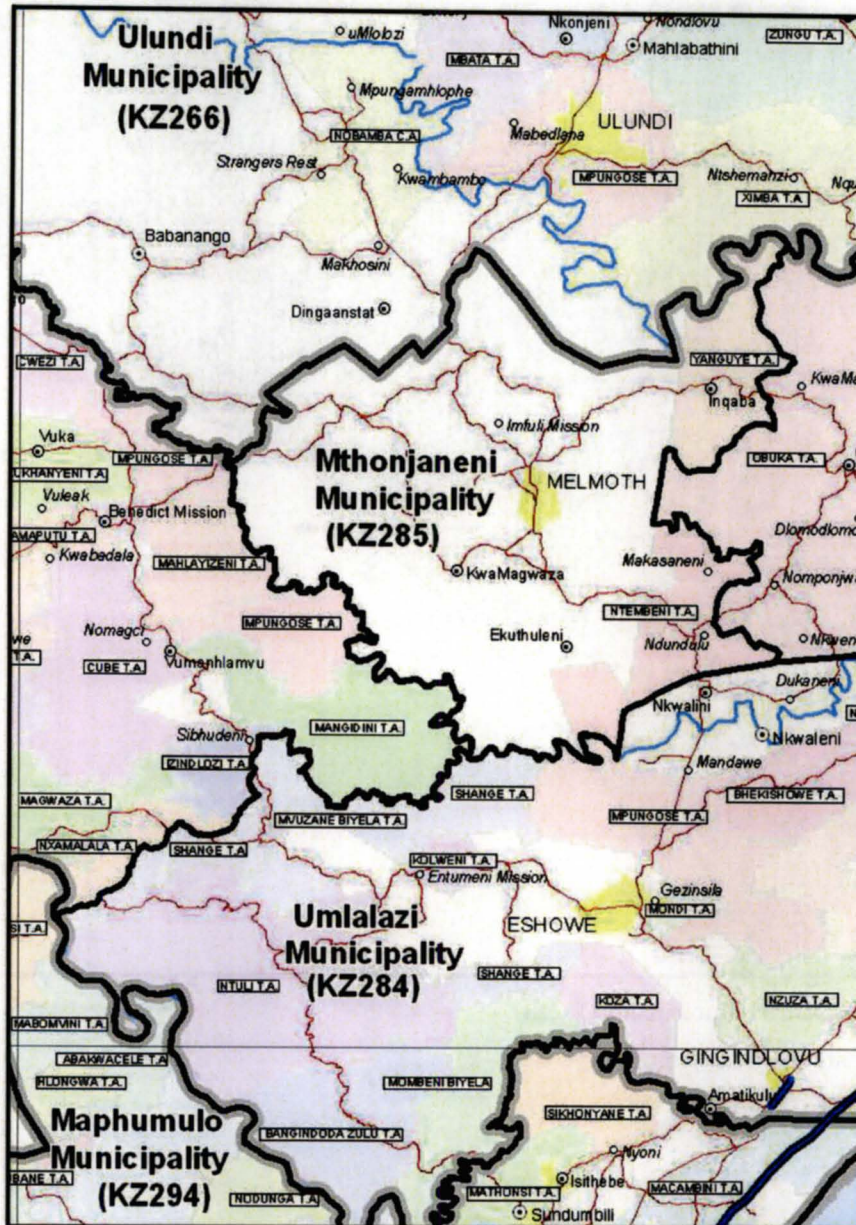


South Africa (Shaded Relief).

Approximate Scale 1:13,000,000.

Source: (University of Texas, 2004).

Map 6: Mthonjaneni Municipality

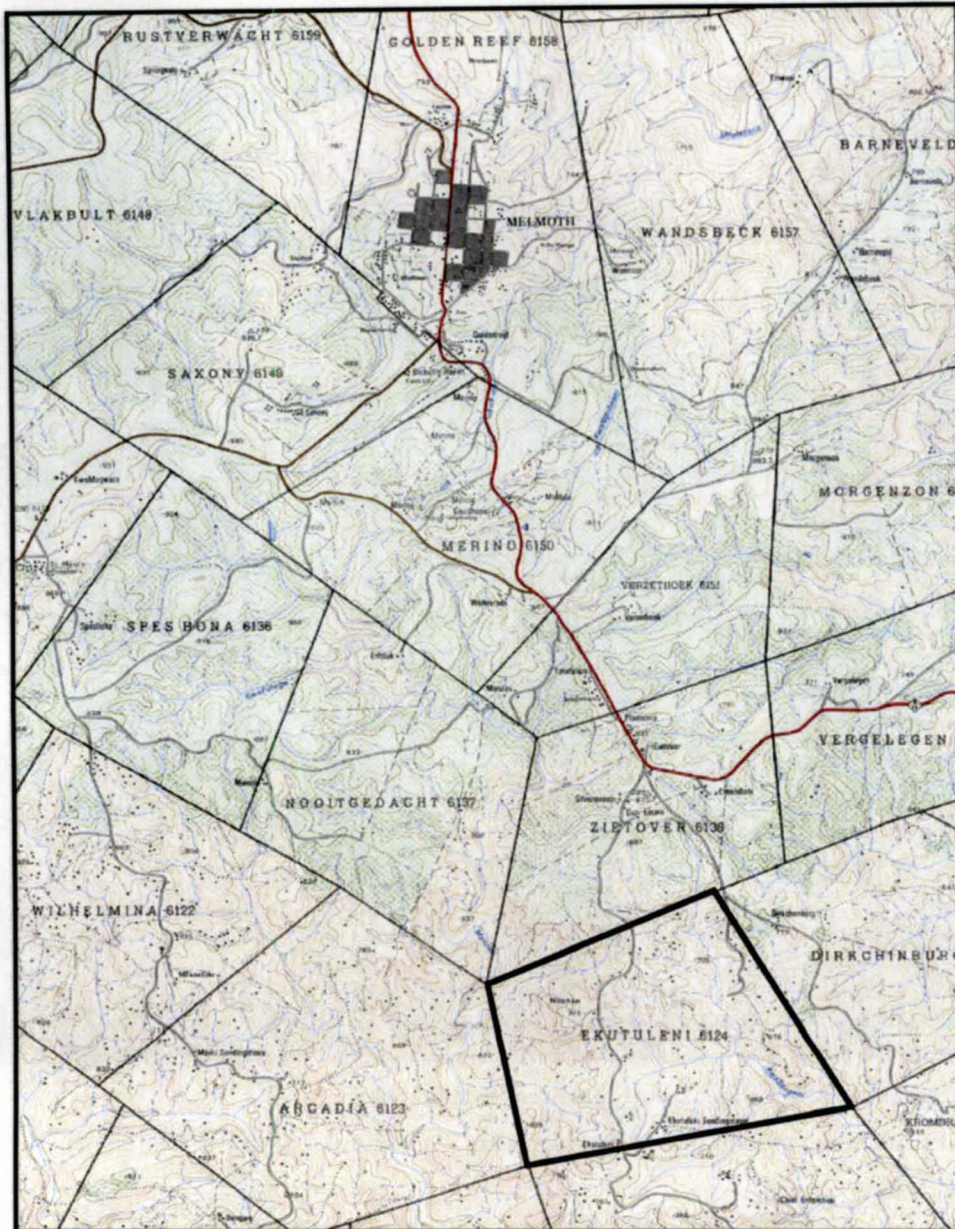


Mthonjaneni Municipality (KZ285).

Approximate Scale: 1:550,000.

Source: (DTLGA, 2003b).

Map 7: Melmoth/Ekuthuleni Area

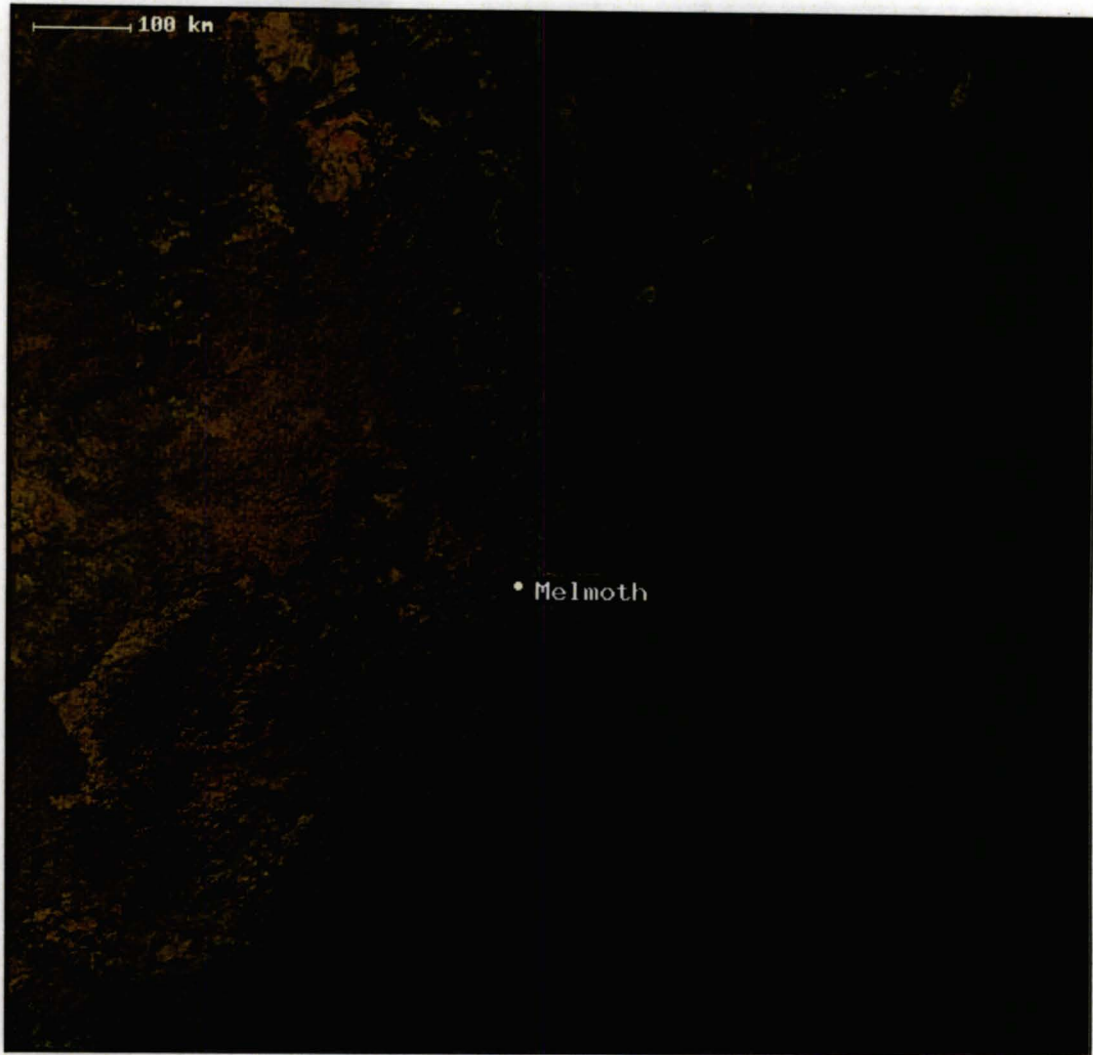


Melmoth Topographic Map Sheet (1:50,000, 2831CB) 2nd Edition, 1981.

Approximate Scale: 1:88,000.

Source: (Chief Directorate: Surveys and Mapping, DLA: Surveyor-General).

Map 8: KwaZulu-Natal Area



Northeast South Africa / KwaZulu-Natal Area (Satellite View).

Approximate Scale: 1:7,000,000 (Altitude 700 km, Centered at $\sim 28^{\circ} 15' S / 31^{\circ} 23' E$).

Source: NASA.

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