



**FEASIBILITY STUDY FOR A  
COMPUTERIZED LAND INFORMATION  
MANAGEMENT SYSTEM**

Presented to  
USAID/Belize  
and the  
Government of Belize  
Ministry of Economic Development

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## 1.0 EXECUTIVE SUMMARY

Belize is confronted with the same types of problems as most local, state, and national governments throughout the world. It is a massive challenge to actively manage national lands, the most precious of resources. Dr. Raymond Stanley once stated, "Man cannot understand, nor can he manage, an estate he does not know." With large geographic areas, growing populations, and suffering economies, increased pressures are imposed upon land resources. Governments, with the mandate to preserve, protect, and manage land resources and to maintain land records, are striving toward improved information, planning, and management strategies. Governments everywhere, at all levels, are in the process of improving current land information management systems by using computers and specialized software. With these tools, they are afforded accurate, timely, and integrated information which permits them to begin to know and understand their "estate." Improved information is the very foundation for wise decision making and planning.

It is unknown at this time how many separate parcels of land exist in Belize. Growth in Belize creates an ever-increasing need to determine precise property boundaries, locations, and ownership. Growth and development are certain, but the major impediment to economic development in the country is the painfully slow process of acquiring title to land resources.

Taxes on privately owned property can provide new sources of revenue to offset the cost of the provision of governmental services to landowners. Governmental services in turn increase the productive value of property.

Recently the Ministry of Natural Resources, Belmopan, Belize, requested a study of the potential for establishing a computerized Land Information System in their offices to facilitate the Land Management processes and to accelerate the agricultural land distribution program. Implementation of such a system requires:

- a. The training of personnel to operate and maintain the system, and in the uses of the system.
- b. The expansion of the Ministry of Natural Resources building at Belmopan to accommodate the computerized Land Information System and provide adequate working areas for the Survey and Lands Sections of the Ministry.
- c. The provision of adequate transportation to improve the mobility of the Surveys and Lands Inspection/Valuation teams.

The purpose of this study was to determine the feasibility of implementing a computer-aided land information system (LIS) in Belize, as well as examining the need for training and for expansion of existing building facilities and transportation equipment.

The "needs assessment" required a cursory review of all departmental office procedures, paperwork, and linkages in order to determine whether a computer-aided land information system (LIS) would be a useful tool, or whether a manual system could be sufficient. Another element of the LIS needs assessment included a more detailed review of map data information requirements. All



information needed to perform daily business operations of the Ministry was reviewed. This included information stored in various files, forms, other records, as well as all information required in map form and the various scales required. This query primarily involved the Ministry of Natural Resources (Drawing Section, Survey Division, Lands Offices, National Estate Section, Land Registry, Tax Section, and Valuation Office), but other Ministries were consulted as well.

There is a need for a computer-aided land information system, and the current level of interest and commitment in implementing a computer-aided system is high. RDA recommends that the Ministry of Natural Resources establish a Land Information Center (LIC) for the purposes of:

- Information management and decision making in Belize which must consider development benefits, renewable resources, applicable technology, and geographic regions;
- Making information on known and potential resources and their uses accessible, incorporating the information generated by the United Kingdom-sponsored project which updated and revised maps and the FAO-sponsored project which classified agricultural and forestry lands using remote sensing; and
- Organizing and formatting data on land, sales, lease, tax, and valuation information for easy entry and access via terminals by each Lands Officer.

This report discusses the more salient features of implementing a much-needed, multipurpose, cadastral-based, computer-aided Land Information System for the improved management of map and lands records information. It also recommends that a Land Information Center be established for Belize to house this system. Estimated costs for the hardware systems, software systems, and new building facilities are US\$457,720. Transportation equipment consisting of twelve additional vehicles (four-wheel drive pickup trucks with high clearance) would be advisable, one each in all six districts, and six for use by the Belmopan staff. Transportation costs are \$180,000, making the total budget for building, computer equipment, software, maintenance, and vehicles, \$642,720. These are itemized in Appendix C. Recommended communications equipment was not budgeted due to the many available options for meeting this need, and the probability that other projects benefiting from general improvements in communication may also bear a part of the cost.

## 2.0 CONTEXT FOR IMPLEMENTING A LAND INFORMATION SYSTEM

Adaptation of the Lands Registration system to a computer-aided LIS is timely and well advised for the following reasons:

- a. Large expanses of land are uninhabited and still reasonably undeveloped. Now is the time to implement a land information system before the task becomes unmanageable.
- b. Current personnel are interested in converting to the system and being trained in its operation and various applications.
- c. A spatial data base of lands would permit coordination of future field activities of inspectors, surveyors, valuers, and others. This would save time and money.
- d. Land management could be greatly facilitated by rapid access for all departments to required information, including maps and all attribute data describing abstracts of title, land area, all information on the status of each application, names and addresses of owners of surrounding properties, and taxes paid, thus eliminating many of the current delays experienced in the title application process.
- e. A tremendous reduction in duplication of effort, the maintenance and storage of maps, and the maintenance and storage of numerous other documents can be realized. Space and labor can be used for more productive activities.

## 2.1 The Present Belizean Land Tenure System

The Belizean system of land tenure and Registration of Titles is founded in the British Torrens system which was introduced in 1889 (see Appendix A, Definition of Land Tenure Terms.). Belize fell under the Torrens classification category of "The Crown Colonies Group" (Simpson). Registration of land under this system was voluntary and sporadic as described by Perez (1988).

The Lands Office and the National Estate Section are responsible for management of (Crown) public lands. Through these offices, public lands can be leased to private interests, and leases of this type are issued and recorded by the National Estate Section and the Lands Registry offices. Few long-term leases have been registered, while historically registration of short-term leases have not been required. About the only situation that demands registration of leases is when a lessee seeks a loan against the property, and the lending institution investigates title. Since leases usually affect rather large tracts of land (greater than 100 acres), a considerable portion of the country could be involved.

Many of the records in the National Estate Section are quite dated and voluminous, with four-drawer filing cabinets dangerously stacked two high. Shaky six-foot stepladders are used by leery personnel to access files in these top cabinets. (It is altogether possible that with a drawer open, the weight could cause the cabinet to fall over forwards, atop the staff member.).



All past land registry systems are to be superseded by the Registry Lands Ordinance (RLO), which divides the country into forty-nine registration blocks, with each block containing several registration areas. A parcel of land in this system is identified by a parcel number, the registration block number, and the name of the registration section in which it lies. Registration of privately held lands within a given area becomes mandatory only when it is designated a "declared area."

Systematic adjudication is needed well in advance of declaring an area for registration. Adjudication is defined as "demarcation of boundaries, settlement of boundary disputes, recording of rights, survey of the parcels and production of the cadastral map" (Belisle, 1988). Registry Index Maps (RIMs) for each registration area are completed by the Drawing Section. All plans and legal descriptions must be drawn to scale to illustrate the survey boundaries, corner points, and standard Universal Transverse Mercator (UTM) coordinate control points.

Within a declared area, property owners are required to bring in their old titles and apply for new ones. The processes involved are extremely time consuming: adjudication requires title research and surveying; various signatures of approval must be obtained; and lost or misplaced files must be relocated. It is not unusual to hear of title applications taking up to three years to process. As titles are issued and recorded, newly recorded parcels are entered on the tax role. All dealings in a declared area have to be executed in accordance with the RLO. (If an estate protrudes beyond the declared area boundaries, only that part of the estate that falls within the declared area need be registered.).

Most of the lands currently in the new registry were completed during a two-year land registration pilot project (1975-1976). After several modifications, the Registration Titles Act was implemented in 1977. The Act required that privately held land be registered. It also provided that the Government of Belize (GOB) would guarantee title. To make this Act effective, determination of precise property boundaries, locations, and ownership has been initiated. As a result of this act, lands are placed on the tax role, many for the first time.

The government offices implementing the different activities prescribed by the new Land Registry system have numerous record keeping forms. Copies of selected forms can be seen in Attachment A. All Offices use similar Block/Parcel identifiers, rather than street addresses, to locate the parcels in the community. Each form contains simple, basic, and consistent information. For example, an entry number (instrument) is given to each land registration transaction as it is recorded. This includes the date (i.e., 1989) and a sequential entry number beginning with 0001 the first of each year and running consecutively until December 31. Also, each document contains a block number and parcel number for each Registration Section, as well as the property owner's name and address. Combined, these identifiers serve as common threads existing among and between offices, and link to all other documents associated with land registration activities. This includes "Mutations," or any modification to land parcels such as subdividing or lot line removal.



The forms from all offices are subsequently entered into a master file where they are permanently maintained. During the application process, this file is moved from desk to desk, office to office, and between Belmopan and District Offices. Receipt of the file by an office prompts appropriate action to be taken. The amount of time required to complete the application process is directly proportional to the type and number of actions to be taken, as well as the number of applications also in queue at the time of application. At the completion of each step of an application process, a routing form is signed, and the folder proceeds on its way to the next appropriate step. One form, the "Land Register," summarizes each transaction, mutation, instrument, and any clouds over title or incumbrances. The summary sheet shows an abstract of title, and a complete file folder is compiled for each recorded cadastre.

Following inspections, a survey, and various approvals toward reaching a final Fiat (land grant), the lands must then be entered into the Land Registry, and are thereby placed on the tax role. The effect is that two systems of conveyancing and record keeping exist and must be maintained.

The second system of conveyancing and record keeping in the land management cycle is maintained by the the Valuation Division and Tax Division. Land lease rent determinations and valuations (assessments) on unimproved land are conducted by the Valuation Division. Information compiled by the Valuation Division is then conveyed to the Tax Division, where tax statements are mailed to property owners and to the National Estate Section for revenue collections. Land taxes, now under the Land Tax Act of 1982, are based on unimproved value of land (improvements are not considered). The present rate is 1% of unimproved value of parcels, and minimum annual tax payable is BZ\$5.00. There are fees charged for each step of the titling process: applications (BZ\$5-20), authenticated survey plans (BZ\$5-100), and stamp duty (3-5%, depending on value of land, with land valued over BZ\$15,000 carrying a 5% fee).

## 2.2 Problems with Present Land Management Information

The entire process of land management is fraught with problems, beginning with the fact that the extent and location of much of the privately held and government owned lands are not precisely known. General estimates of the characteristics of lands are described in Table 1. Evidence suggests there are several cases where two or more private citizens hold title to the same land parcel, and that this same parcel is also leased to yet another party by the government. This condition is perpetuated by the absence of mandatory procedures, standards, regulations, and enforcement to control and facilitate all land transactions.



TABLE 1  
ESTIMATES OF PUBLIC AND PRIVATE LAND HOLDINGS IN BELIZE

District	National * Lands (acs)	Private Lands (acs)	Forest Reserves (acs)	Total Area(acs)
Corozal	85,604	300,725	73,191	459,520
Orange Walk	915,139	230,461	-----	1,145,600
Belize	620,323	330,789	113,208	1,064,320
Cayo	285,990	307,495	690,355	1,283,840
Stann Cr.	271,146	108,146	251,748	631,040
Toledo	379,713	140,039	500,531	1,090,550**
Totals	2,557,915	1,417,655	1,629,033	5,674,880

\* Includes leased national lands which totals 638,156 acres.

\*\* Includes Indian reservations which accounts for 70,277 ac.

Source: Lindsay L. Belisle, The Development of a Land Registration and Information System in Belize, Master's Thesis, North East London Polytechnic, December 1988.

It is estimated that a rather large number of land parcels are not registered (80,000) and, hence, possibly are not on the tax roles. It is possible that millions of dollars in land tax revenues are not accounted for, and with delays in acquiring title to land, investment and economic development have suffered. This opportunity lost is a significant potential source of revenues which could conceivably bring millions of new dollars to the government.

Historically, for all offices within the Ministry of Natural Resources, the land-related records that exist have been extremely detailed, well maintained, clear, and complete. The major problems encountered center around the fact that numerous private land transactions occur annually and pass unrecorded. In 1972 Lawrance and McMaster noted that "unregistered conveyancing is increasing in relation to registered conveyancing. Mandatory registration of lands has impacted this condition, however, transactions in land between private citizens apparently continues to this day." The consequence of this practice leaves the government not only ignorant of the transaction and the identity of the new owner, but also the value of the land, and any uncertainty as to unknown property boundaries, precise locations of land parcels, and other important information.

The Ministry of Natural Resources in Belize has struggled with a broad spectrum of land management issues and a desperately needed new Lands Registry program for several years with little progress. To date, in spite of this new program,

three registration and two land records systems continue. Daily work activities are attempted with insufficient staff and funds, in inadequate facilities, and with outdated equipment.

To successfully tax privately owned lands, research into ownership history is imperative, and adjudication and surveys must be performed when necessary.

The program of land lease rent determinations and valuations (assessments) on unimproved land has fallen behind. "These objectives have not yet been realized as management apparently has so far failed to see the root cause of the problem -- the need for a sufficient amount of trained and knowledgeable people in the area, and the proper facilities and equipment to undertake the task" (Belisle, p. 40). Improvements have been realized during the past ten years, but the vast majority of property in Belize remains to be registered.

The absence of forceful Land Adjudication Legislation is a serious obstacle to land registration and getting properties onto the tax roles. The present land registration procedures are into their twelfth year. Currently, however, only 5% of the lands have been converted to this new system (See Table 2).

Title searches and adjudication procedures were to precede land registration so disputes over ownership and property lines could be settled in advance. New surveys were to accompany these activities, and new large-scale Registry Index Maps were to be prepared to support the registry process. Unfortunately, this has not been done consistently.

Difficulty in finding the land parcel is one of the normal problems suffered by Ministry staff, complicating the survey, inspection, and valuation efforts. These problems are largely created by the hand-sketched maps (Plans) offered by the land owners, who have few cartographic skills, and the lack of adequate transportation. The time required to find the parcel, conduct inspections and surveys, and approve the application for conveyance often involves several years. This point alone is responsible for severe negative impacts in the economic development of the nation, and encourages the continued use of unregistered conveyancing.

If a land owner requires a loan on their business or home during the application process, extended delays in issuance of title could certainly lead to the loss of a loan, a business, and perhaps even property. Equally important is the loss of investment for Belize, as numerous prospective investors simply "give up the struggle" and invest their money elsewhere. Investment brings jobs and income to Belize, and income has a multiplier effect throughout the economy. Many lost opportunities have occurred simply because of the painfully slow procedures associated with land transactions. The economic development of Belize is impacted severely, and improvements in the process must be achieved before overall improvements can be realized.

**TABLE 2**  
**EXISTING REGISTERED PARCELS**

BLOCK NUMBER	SECTION NAME	NUMBER OF EXISTING PARCELS REGISTERED
4	Ann Sabourel	734
* 20	Belmopan	1666
23	Benque Viejo Del Carmen	1241
* 16	Caribbean Shores/Belize	1681
1	Caledonia/Buena Vista	413
1	Conception/Aventura	353
1	Consejo Rd. S.E.	157
1	Consejo Rd. S.W.	149
1	Conception Village	362
1	Corozal Central	1131
1	Corozal North	2212
4	Doublas Rural	277
45	King's Park	1003
45	Lake Independence	817
1	Libertad Rural	203
1	Libertad Village	674
47	Long Caye	124
20	Meditation	6
1	Paraiso/Santa Rita	438
42	Punta Gorda	1219
45	Queen's Square	634
1	Ramonal Zapote N.	166
* 1	Ramonal Zapote S.E.	400
* 1	Ramonal Zapote S.W.	395
1	San Andres/Ranchito	481
* 4	San Jose Palmar	136
* 1	Santa Elena	245
* 23	Santa Elena/Cayo	929
* 24	Society Hall	1710
* 45	St. Martin De Pones	647
1	Ten Pound Caye	156
4	Tower Hill	1060
1	Xaibe Rural	482
1	Xaibe Village	392
* 19	Young Gal/McRae	306
<b>TOTAL</b>		<b>22,869</b>

\* Implies registration incomplete.

Belisle (1988, p. 164) offered a critical review of related issues:

"To compound the problem, three large areas comprising of over 157,000 acres were declared as compulsory registration areas in 1981 in an apparent attempt to impress upon a visiting team from the Directorate of Overseas Surveys that Belize is continuing with the



land registration project. These said declared areas, contrary to the basic fundamental requirement of having a good control survey network in the area and Registry Index Maps (RIM's) prepared before declaration, did not have, and still do not have an adequate control survey network and consequently many RIMs cannot be prepared for these areas.

It can be seen that from a very early stage in the life of the land registration project administrative decisions have operated to abort the project and consequently have defeated the whole purpose of the RLO which was intended to offer cheap, fast, and secure titles to land. These same decisions have turned around to haunt the Lands and Survey Department as the Land Registry is unable to issue titles to land in these areas in an efficient and effective manner. This delay of dealings in land, causes great frustration and anxiety to landowners, and stagnates development of the individual and the community. This is definitely not a healthy situation for a system that is fighting for survival as it erodes any confidence the public may have in the system and without the support of the public, the land registration project will be doomed to failure. Better administrative decisions by people who understand how the system operates is therefore of paramount importance if the system is to survive and offer its many benefits to the people and country of Belize.

It seems that administration has so far failed, or is unable to recognize the importance and benefits of the land registration programme to Belize. Apparently, because the Land Registry is already set up and functioning there seems to be a general feeling that the land registration problem is solved — that the Land Registry is the panacea for land registration and that there is no need for any support services. Since the inception of the land registration programme in Belize, no separate provision for funding the project was made. The project had to survive off funds diverted from the meager financial resources allotted to the Lands and Surveys Department for its normal operations."

A visit to the District Offices in Cayo also revealed problems. If San Ignacio District offices are representative of the remaining five District offices, then these same problems range throughout the country. The small staff must attempt not only to perform their professional tasks in the field of inspection, surveying, valuations, etc., but must also be in the office as much as possible to serve the public. The Survey Division is located in one building, and the Lands Office is located in another building halfway across town. Communication is difficult, and coordination is almost impossible. They suffer from a lack of adequate and appropriate transportation, and the problem of not being able to find files, largely because of numerous exchanges of single files with Survey (across town) and with Belmopan.



One of the most commonly expressed problems by staff in most offices is "not being able to locate a given file." It could be misfiled, on a desk in Belmopan, somewhere in the District Office, or somewhere in between. Due to these problems, delays are typically experienced in processing applications, as well as for inquiries as to the status of the application, or current use of a parcel of land.

### **2.3 Possibility and Benefits of Coordination with Geographic Information System Activities**

Current geographic information system (GIS) activities of the United Kingdom involving information acquired in and for Belize have promoted a strong internal interest in implementing a natural resources GIS.

The GIS applications envisioned by the Ministry of Agriculture, Forestry, and Fisheries, the Ministry for Economic Development, and the Department of Archaeology are broad in scope and deeply rooted in current problems and proposed resources. The Ministries of Public Works and Tourism could also benefit from the introduction of a system.

For the work of all of these Ministries, it would be very useful to be able to determine, for each parcel of land in Belize, the suitability for a given crop, the most suitable crop, its current land use, physiographic unit and subunit, soils and limiting factors, elevation, slope, aspect, and several other variables. Similarly, information such as this is highly suitable to support national agricultural and forestry management and assist in policy development. It is apparent that the integration of various types of physical, economic, and political information which will eventually reside in the LIS/GIS will greatly enhance the economic development capability of Belize.

There are several requests each day at the Ministry of Natural Resources for information regarding what vegetation should be grown on a given land parcel to ensure maximum production and profit. Members of the public must pore over maps to gather information about their property or prospective sites for investment. Concerns about flood hazards, ownership, elevation, slope, soils, crop growing potential, proximity to water, transportation, services, etc., are met through this primitive and inadequate procedure. To date, no comprehensively organized set of data exists to provide this type of information.

Exemplary natural resources and environmental data have been gathered and mapped by the United Kingdom team, headed by Dr. Bruce King. Information compiled for the U.K. project is the most useful, current, and most accurate information of its type to date. It was compiled at a map scale of 1:50,000. Except for the recent work of Dr. King and others for Stann Creek and Toledo Districts, land use and land capability maps are outdated, and no mechanism exists to tie any of these data to land parcel information. Development of useful agro-climatic zones which would guide prospective investment in this way has been absent. These data will be extremely useful for the enhancement of efforts in conservation, planning, ecology, environment, and other purposes.

The LIS/GIS can facilitate the desired applications if efforts are made to standardize all mapping projects so all current and future data can be integrated. This is a necessary achievement if information is to be overlaid,



combined, and interpreted. New and extended information, such as that recently acquired by the study entitled "Land Resources Assessment of Stann Creek District, Belize" (King, and others, 1988) is highly suitable for such purposes.

The potential for integration of the U.K. data base with the proposed LIS data base was investigated in terms of establishing merged comprehensive information management and planning systems in the future for all of Belize. This involved, in part, examining all maps and data in terms of the ARC/INFO system already in use. Portions of the U.K. map information have been input to the ARC/INFO Geographic Information System at the University of Edinburg, England, by Mr. David Gray of the Department of Geography. Apparently, however, the U.K. project data was not digitized utilizing the UTM coordinate system, or if it was, no evidence exists to suggest so. The development of a GIS data base to manage various resource information for Stann Creek and Toledo Districts, such as land use, crop types, soils, elevation, slope, aspect, and other types of data, occurred prior to the recently observed need for standardization of data to a common coordinate system. It is imperative that the LIS data base and the GIS data base be compatible so information can be integrated in the future. (When maps are placed on a digitizing tablet, the units that are recorded are in digitizer inches. They have no relationship with map scale or any coordinate system. Only when data conversion is conducted according to some common coordinate system can data at various scales, and information of various themes, be combined.)

#### 2.4 Reasons for Selecting the ARC/INFO System over other Systems

1. The system is already in use for Belize for the GIS element of land management activities. Compatibility will thereby be insured by acquiring the same software system for the LIS project.
2. This software system has the demonstrated flexibility to allow easy integration with other application hardware and software; for example, statistical analysis functions, word processing, data base management systems, and user-developed software routines.
3. The system is relatively user friendly, not requiring operators to know programming and electronics.
4. This software system is well documented, including training manuals, videos, and other materials.
5. Excellent technical support is readily available.
6. There is a wide user community, including numerous developing countries in Mexico, Central America, and South America. User groups could be formed in order to stimulate interest, solve problems, and share useful information and custom software.
7. This software system operates on a number of hardware platforms, including mainframe and personal computers, with compatibility between them, fostering easy communications. This aspect implies that a variety of less expensive machines can be considered for our purposes here.



8. ARC/INFO is now compatible with the Earth Resources Data Analysis System (ERDAS), which produces land cover maps from various space orbiting satellites such as: Landsat MSS and TM, SPOT, and COSMOS. Through ERDAS, remotely sensed data, including the FAO agricultural and forestry land images, can be registered to the LIS data base.

9. Members of U.K. team and others working on GIS/LIS projects all have experience with the ARC/INFO software system.

Lands surveyed under the new Act after 1977 have all been keyed to the UTM coordinate system. It is this common coordinate system which will serve as a common framework to which all of the geography of Belize will be associated. Standardization to UTM for all mapping projects, not only land records, will insure that information will: a) be properly located, and b) "fit" with all other map information, regardless of the scale of the information mapped.

Careful attention was given the types of information appearing on each of the forms currently being used by government offices to determine if these sets of information would be compatible with the ARC/INFO system. Although not all-inclusive, the following types of information could be easily tabulated for computer-aided management:

1. First name of property owner.
2. Last name of property owner.
3. City of property owner.
4. District of property owner.
5. Registration Section.
6. Block number.
7. Parcel number.
8. Lot number.
9. Plan number.
10. Grant or Fiat number.

These types of information are fundamental items stored in the attribute tables of the ARC/INFO system. This system, during the process of creating a topological data structure from digitized map information, constructs a Polygon Attribute Table (PAT). Information such as that noted above can be attached to the PAT, forming customized tables for each Division's purposes. (See sample ARC/INFO table.) This approach ensures that each office has the appropriate information available. Access to these custom forms can be controlled and limited as one method of providing information confidentiality and security.

## 2.5 Characteristics of the Land Information System Database

The map scale of the LIS will largely be derived from maps at a scale of 1:1,000, although other map scales exist. Different map scales will cause detail to be different between the LIS and GIS map bases. According to ESRI (Guevara, May 19, 1989) "basically, the resulting data base would have two levels of detail." Scale differences can cause, on the one hand, "holes" or slivers in the map, or overlap on the other hand. Manual cleanup of all boundaries between the LIS and GIS data bases will be necessary, even after all GIS data have been converted to UTM.



SAMPLE ARC/INFO TABLE

LAND REGISTRY SAMPLE TABLE

REG. SECT.	BLOCK NO.	PARCEL NO.	REG. DATE	TENURE	CAUTION
45	167	47	05/23/89	3	6

LAND VALUER SAMPLE TABLE

PARCEL NO.	AREA	\$ IMPRV.	LAND VALUE	TOT. VALUE	OCCUPANT NAME
47	5.66	55,000	14,500	69,500	JOHN WILSON

TOT. VALUE	AVAIL. SVC.	TAX RATE	TAXES DUE	OWNER'S NAME	ADDRESS
69,500	1,4,5,9	1%	695	ROBERT BROWN	ROARING CREEK ...



A limitation to the use of two quite different map scales is that when the land use information (1:50,000) is overlaid with the cadastral base (1:1,000), one can not be sure that the appropriate land use is matching up with any given parcel of land. It would make an infinitely better system to complete the cadastral data base first, then determine land use and all the other variables for each land parcel by means of field work and high resolution remotely sensed data gathering techniques similar to those employed by the U.K. team. Details should be coordinated immediately between the GIS and LIS teams and all Ministries.

The Central Statistics Office maintains significant amounts of information, some of which is computerized, which must be aggregated to the enumeration district, urban, suburban, district, or national levels. Current statistical methods have provided good descriptive and inferential information of "how much" and "how many." The proposed LIS, with its parcel boundary base, will extend these capabilities by allowing complete control of the spatial analysis of these data sets and access to data directly for statistical analyses, modeling, and simulations.

In the near future, the 1990 census data will be gathered, adding data which are rich in practical and research potential. These data can be input, stored, accessed, analyzed, and used to generate reports with the LIS. The LIS land parcel and roads data layers will become very useful information to several Ministries. These data layers serve as a scale model of Belize, to which all data can be associated, and on which the various political and enumeration boundaries can easily be superimposed.

By associating census data to the LIS framework, all statistics can be generated according to the aggregate unit desired. System security, access to data, and confidentiality can easily be controlled. Furthermore, the data can be queried in various ways and the results generated both in map and tabular form. As one example, the LIS could create a map which will illustrate the locations and spatial distributions of the number of children in each school district between the ages of one and five years old to determine whether the current facilities will be adequate in the next few years, or if teaching staff and classroom facilities expansion will be necessary.

## 2.6 Potential Uses of LIS/GIS Database

Leased lands can be registered to prove clear title, primarily for purposes of securing loans against the property. Lessees, after meeting the terms defined in the lease, can apply to purchase such lands.

In a similar vein, an investor, industry, or business seeking to locate in Belize will normally have an extensive list of locational requirements. These criteria might include such factors as proximity to an available labor force of a certain age, within six kilometers of an airport with 300 meters of runway, immediate access to a major highway, groundwater capacity of 2,000 gallons per minute, 25-40 acres of land, and within a certain price range. Identifying the various parcels of land which meet all of these requirements would take months of manual work. However, the LIS/GIS can be queried, with these criteria serving as constraints, and land parcels meeting all or most of these criteria are quickly and easily identified and mapped.



A recent study for the Ministry of Agriculture recommended that a Conservation Data Center be created. This Center would serve as a focal point for conservation and ecological information for Belize, with data overlapping most Ministries. A principal focus would be ecological and habitat research, performing various classifications, identifying areas to be left as reserves to insure samples of ecosystems remain intact, data gathering, and data merging. It is clear that the information being acquired by Dr. King would be essential to these types of activities. Computerization and standardization of these data would be a key requirement for this Center.

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### 3.0 IMPLEMENTING A SUCCESSFUL LAND REGISTRY PROGRAM

Implementation of the LIS carries with it an entirely new way of thinking, new perceptions, and new operations. Information which has not been integrated in the past will now be available. New types of information will be created from combinations of other types of information. In addition to using the LIS to answer the "who," "what," "when," and "how much" questions, the spatial aspect of the data base will permit asking "where" questions. Some examples of "where" questions include, "Where are the locations of all the property owned by James Jones?"; "Where are all the land parcels suitable for the production of mahogany?"; "Where are the locations of land parcels that are not on the tax role?" The types of applications which are possible are limited only by data and one's imagination. At some time in the future, these and many other uses will be served by the system, but first several small problems must be solved, a system implemented, and a steadfast commitment made.

The entire Land Registration Project in Belize depends on appropriate legislation, and adequate staff, budgets, and transportation. Regions planned as declared areas must be surveyed and adjudications completed. After these conditions are met, the map information which used to be hand drafted on the RIMs can be placed directly into a computerized LIS. The maps, legal ownership, legal descriptions, parcel area, unique parcel identifier, and related information would then be accessible by the Lands Registry Office the minute an area is declared and the glut of new applications start pouring in.

Currently, UTM coordinates of all parcels are transferred to Registry Index Maps (RIMs). This step can be completely eliminated once the LIS is in place. Rather than drawing the land parcel boundaries to scale on paper or mylar film, coordinate geometry functions of the ARC/INFO system can input the legal descriptions directly to the computer data base. Hardcopy maps can be plotted as required, at any desired scale, covering any size of geographic area. (It must be noted that digitizing should never be done from paper maps. Humidity and temperature greatly distort the size of a sheet of paper. Hence, any map information digitized from paper will have serious errors and even hand drafted mylar RIMs should be avoided as they are not nearly as accurate as the COGO function.) This procedure also eliminates the need to create a master index by the Drafting Section, as well as the need to calculate area of each land parcel, as the system automatically calculates area. It will be interesting to compare the "old" area which has been calculated by manual methods and the "new" area as determined by the LIS. Frequently tax revenues are impacted by this improvement in the accuracy of area calculation.

With all necessary information available to each Officer, processing time could realistically be reduced to six weeks, five of which would be involved in printing the notice in the Gazette. In addition, access and system security can be designed so that confidentiality of certain types of information is protected.

Thus, parallel with the establishment of a Land Information Center, an examination of procedures, activities, and associated enabling legislation should proceed. The Surveyor's needs must be met first or there will be no data to enter into a computerized system. The following are observations and recommendations



which can serve as an outline for discussion purposes and for implementing a practical strategy within the Ministry of Natural Resources for establishing and implementing a Land Information System.

Legislation should include:

1. Implementation of a new mandatory policy establishing procedures for land transfer, possibly involving an "escrow" which would demand new surveys, verifications of price and verification of title, followed by issuance of new title, and final registration. Abstracts of this information will be input to the proposed LIS. Escrows can be conducted by newly formed private businesses. Over time, a history is accumulated on each land parcel so the system can be queried to confirm ownership and other information. This will greatly speed up land transactions, registration, title research, and other activities.
2. Empowerment, in the absence of the Minister of Lands, of the Commissioner of Lands to sign and approve applications. Due to the heavy demand on the Minister's time, he is frequently required to be away from his office. This adds days of delays for applicants which could be remedied by the Commissioner taking over the tasks in the Minister's absence.
3. Allocation of funds to the project. New funds are needed to support these efforts. Surveying is expensive, as are the other elements of the adjudication activities. The possibility of taxing improvements on the land should be investigated. Perhaps a new fee can be charged to foreign property investors to generate more revenue to help offset the cost of serving the public. The stamp fee for land transactions is paid to the Postal Service, enriching their budget. Consider using the official Ministry of Natural Resources stamp and charge the same fees. In this manner, the fees collected become a source of revenue for the Ministry of Natural Resources (MNR).
4. Adjudication legislation to address all legal matters of land title. Adjudication legislation is essential to give validity, authority, and effect the adjudication process. It is imperative that adjudication process be greatly enhanced, as this appears to be a major bottleneck in Land Registry.

A receipt for the stamp fee should be issued. In many cases, when a file is misplaced or lost and applicants must start the process anew, they are required to pay the stamp fee once again. People complain that they have had to pay these fees up to five times.

Staff and budget priority should be allocated to:

5. Proceed with all necessary haste to complete the geodetic control system throughout Belize. This precise geodetic control system is the vital framework to which property boundaries are tied and serves as the basic structure to which all other geographic information is attached. All mapping for land management is keyed to this locational system and must be in place prior to declaring areas for registration. Coordination of land survey activities is needed in order to precisely locate corner points, in UTM coordinates, of every land parcel. Proceed with monumentation, concentrating efforts in highly settled areas, but with a parallel focus to establish controls for more remote areas as well. In order to expedite this process, new types of equipment



(ADP/ADT and GPS) should be acquired and staff trained in their use. The rugged terrain and low-hanging clouds often cause delays of weeks to take a single survey measurement in the field. All possible resources must be rallied to assist in this vital effort. Perhaps an alliance could be encouraged between the military and the Ministry of Natural Resources, so helicopters could be used to place teams in the field during good weather.

6. Execute title searches, surveys, and settling of boundary disputes prior to "declaring areas" to remove serious delays and greatly enhance the registration activities. Additional staff in the Survey Division will be necessary for this purpose. It would be worthwhile to consider having all surveys for leases, grants, and transfer of title of private lands performed by private surveyors. Surveyors for the Ministry could more effectively be used to verify the work of private surveyors and continue with establishing geodetic control points.

### 3.1 Specific System Recommendations

The most practical arrangement would be the establishment of a Land Information Center within the Ministry of Natural Resources. It is here that the greatest interest lies, and here that the most appropriate skills and the most knowledgeable individuals in the country are available. Although expansion plans have been approved for the Department of Natural Resources building, these plans consider only current needs and do not address the needs for the space required for a Land Information Center. In addition to the demand for additional space, discussed later, special electrical, communications, environmental controls, and security must be considered. Also, a backup power supply must be included for the system installed, in case of power failure.

The Survey Division, in conjunction with the Drawing Division, offers the skills and backgrounds most suitable to undertake such an endeavor. The single most knowledgeable person within the GOB suited to manage the LIS Center is Lindsay L. Belisle. The organization should do its best to find someone to fill his role as a surveyor so that he may undertake this new task. With support staff consisting of at least ten persons trained in the use of the LIS software system, the project could assume immediate momentum, direction, and address basic day-to-day problems. Over time, more and more cartographers, as well as other staff members, will be trained on the system, broadening the expertise and widespread use of the system.

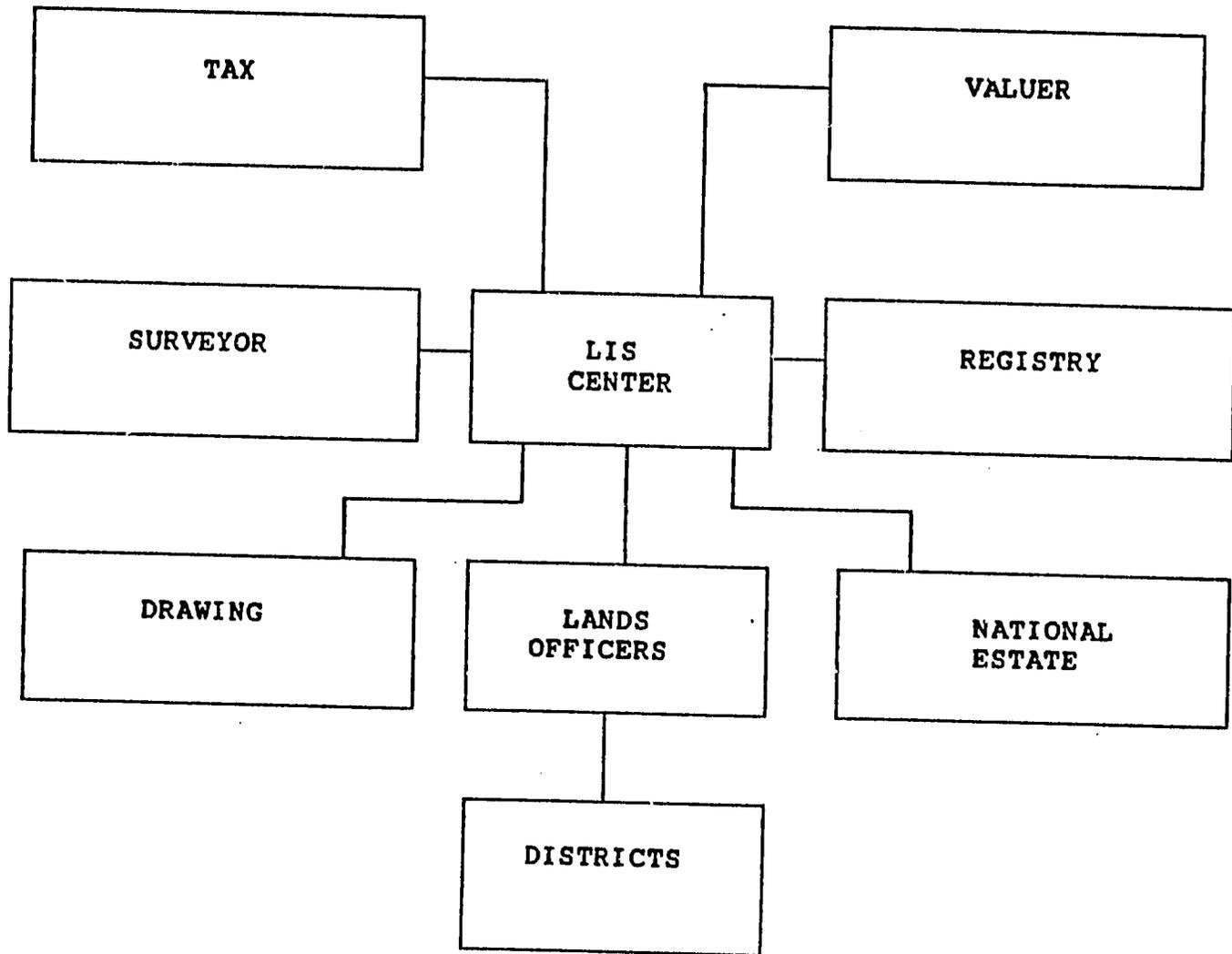
#### 3.1.1 Buildings and Infrastructure

1. Current building facilities should be expanded to accommodate the LIC, but remain attached to, or in close proximity to, existing offices to permit networking and the provision of services in a timely and effective manner (See Diagram of Linkages.)

2. The new Center should be outfitted with state-of-the-art communications lines for high-speed linkages with all Ministry Departments. Communication facilities are included to allow a minimum of eight remote graphic terminals, one for each Department.

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**LAND INFORMATION CENTER LINKAGES TO DIVISIONS**



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3. Appropriate 110-220 volt electrical power systems with backup generators and an uninterruptable power supply battery are essential. Electrical power fails regularly in Belmopan. Such outages will not only disrupt daily business activities once dependent on computers, but continual power downs weaken internal electronics of computer hardware.

4. Install air conditioning and dehumidifiers in rooms which will house the new system. Computer equipment and storage media demand tight limits of temperature and humidity to optimally perform. (Furthermore, air conditioned workspaces, presently lacking in current facilities, can contribute to increased personnel productivity. Heat and humidity can disrupt concentration; open windows and fans often blow papers off desks.)

5. Install special security devices. Due to the large dollar investment and the sensitivity of the information maintained in the computers, special security devices will be required to restrict unauthorized persons from entry. Only authorized personnel should enter the Center.

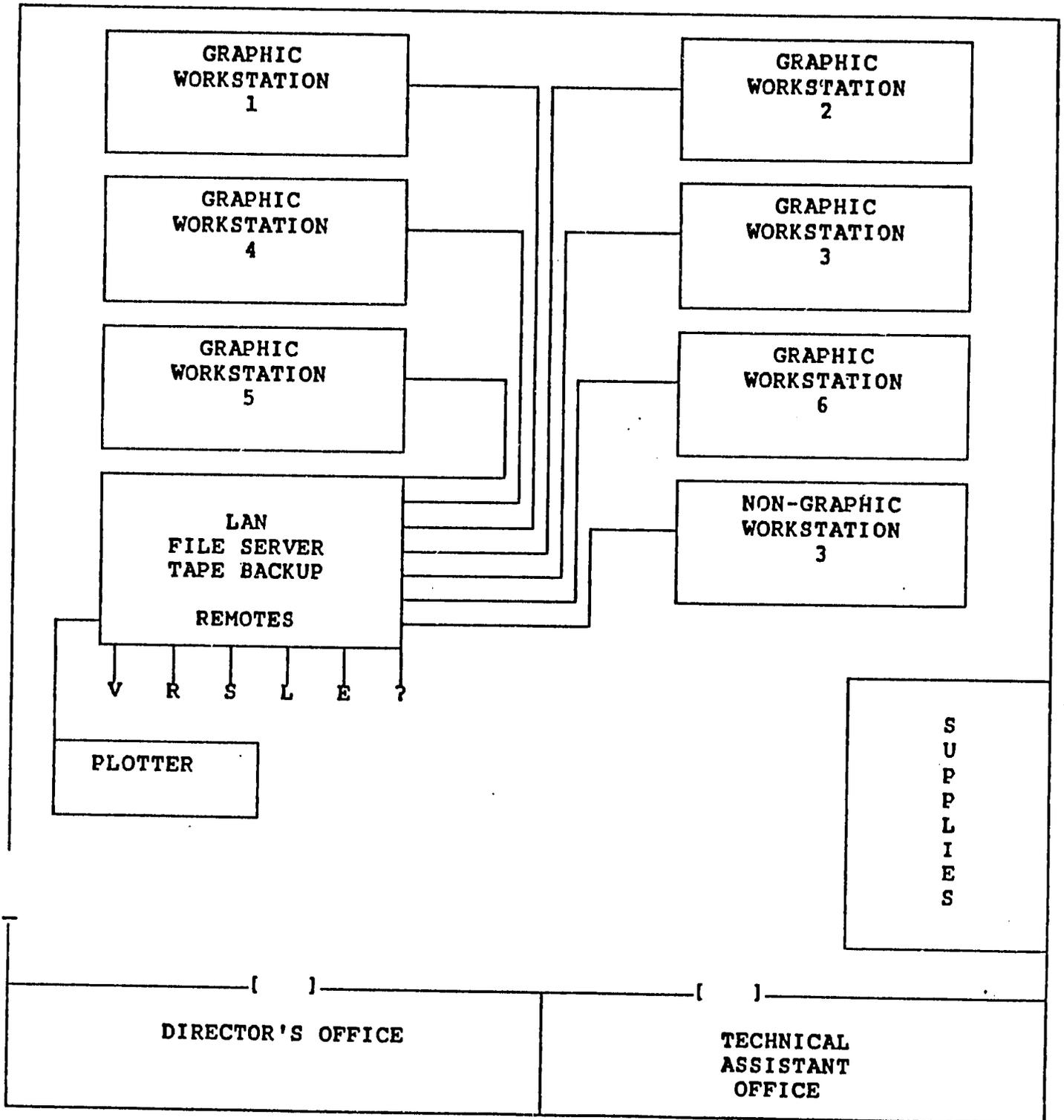
6. Minimize entry and exit from computer facilities to protect the equipment environment. Each time the door opens, humidity, dust, and smoke can enter the room, having a deteriorating effect on microcircuits and disk and tape storage media. Smoking should not be permitted in the Center.

One possible arrangement of the LIS floor plan follows. Approximately 1,200 square feet of floor space will be required. This diagram illustrates the need for a Local Area Network arrangement to link all workstations in a synergistic manner within the Center itself. Two administrative offices are planned as well.

7. In each district, one office building should be acquired to adequately and more comfortably house Lands and Surveys personnel. This will minimize building rentals or purchases. More importantly, it will set the stage for cooperative and coordinated activities and the sharing of transportation, building, and other costs.

8. Additional transportation is absolutely required. Transportation for inspectors is lacking, greatly slowing that process. All new titles are dependent upon speedy inspections, valuations, and surveys. The existing fleet should be doubled. Heavy-duty, high-clearance, four-wheel drive vehicles with modern radio communications equipment are needed. Belize is a rugged country with few paved roads, all severely lacking maintenance. During the rainy season, deep mud, flooding, and a general hazardous condition exists, further crippling movement about the country for the purposes of surveying and inspecting. It must be noted that the surveyors are often the first people to reach any remote jungle or mountainous site, dealing with the high risks of malaria-bearing mosquitoes, deadly snakes, and other hazards. Life threatening situations are frequently faced, and good, dependable transportation and communications are essential.

**TYPICAL LAND INFORMATION CENTER FLOOR PLAN**



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### 3.1.2 Protocols for Organization of Data

Cooperation fosters more success than does competition in this type of project. Only by sharing data, resources, and maintaining the common spirit to push Belize into this high-tech status, will the project succeed. The GIS system can become an integral part of the Land Information Center activities. Likewise, the proposed Conservation Data Center could become an appropriate Division within the Center. Additional interdisciplinary staff could be brought into the Center as it expands. As the center expands by the addition of other professionals, additional funds can be acquired to expand the hardware and software appropriately. To accomplish these objectives, all information gathered and all maps prepared in Belize should be done in a standard manner to permit data sharing in a direct, simple, and open fashion.

Special mention must be given to the first nationwide LIS/GIS conference on physical planning, held in Belmopan on June 2, 1989, at the Convention Hotel conference room. The conference was attended by thirty-five people representing several groups and six Ministries which stand to benefit the most from this technology. Conferences of this nature will greatly assist in providing understanding of the applications benefits of a LIS/GIS, as well as gaining popular support for their implementation. USAID should be invited to attend any future conferences of this nature and both the Technical Committee and Data Board meetings. A strong interest exists within USAID to support this project and their inclusion is very important to its success. Additionally, it would be extremely useful to bring in Public Works, as they have a high level of interest and will soon be purchasing equipment of the LIS type.

It is of paramount importance that LIS and GIS planning be done now, that standards be set, agreements reached, and a practical strategy established. At the Ministry level, all mapping projects, both foreign and domestic, must be standardized. Strict adherence to these standards must be required, and copies of all map and/or other information resulting from all projects must be received both in ARC/INFO machine readable and in hard copy formats.

1. All future digitizing of map information for the GIS, as well as the LIS, should be done using the standard Universal Transverse Mercator (UTM) coordinate system. Apparently, much of the GIS work, and various other mapping projects throughout Belize, do not make use of this system which would standardize all such research projects and make them compatible, one with another, as well as with the LIS and GIS systems. If the United Kingdom team could switch to the UTM base, which is probably already on their base maps, for all the rest of the Districts, only the Toledo and Stann Creek Districts would have to be redigitized. In addition, a recent project entitled "The Application of Geographical Information Systems in Defining a Zonation Framework for the Development of the Mangrove Ecosystem in Belize," being conducted by Cambridge University student Mr. Simon Zisman, may provide useful information to integrate into the LIS/GIS data base.

2. A Parcel Identification Numbering Scheme should be developed which assigns a new and unique number to each and every land parcel. This may require an amendment to Chapter 157, Section 18, of The Laws of Belize. For computer purposes, this is much more practical than having to consider three identifiers: the Section Name, Block number, and Parcel number in order to



identify each land parcel. A typical identifier number which may be useful is: 04-0091-419823. The first two digits can be used as regional identifiers, such as a District, census enumeration district, phone prefix, or many others. The other digits are the unique parcel identifier. Also, a program should be implemented with the Town Boards to establish a standard method of assigning street names and street addresses for each land parcel on each street throughout the country. Street addresses can effectively be used for many purposes of government, such as postal delivery and planning schools, health care facilities, and others. With the LIS, street addresses are very useful in associating information with their proper geographic location, especially with census and other socioeconomic information.

As the population grows and villages, towns, and cities expand, the traditional methods of locating a home, business, church, or some other site becomes more complicated. It is no longer possible to know everyone in town, and to prepare for this inevitability, the process of standardizing street names, their spelling, and assigning street addresses to each parcel must soon begin. Homes not located along roadways must be considered in some simpler manner as well. Street addresses are easy to use, and even small children can be taught their home address. This is much more practical than expecting the general population to memorize a unique parcel identifier, block number, or lot number. Emergency vehicles would know exactly where to go in advance, strangers can better find their way around in a city, and a number of other advantages accrue from this system. Geographic encoding of information into the LIS by street address is straightforward. It is unfortunate that street addresses will not be in place prior to the 1990 census.

3. A number of models are available to serve as guides for the planning and organization of land information data bases. One of the more flexible and effective models is that of the Indianapolis Mapping And Geographic Infrastructure System (IMAGIS). This model is recommended for the LIC project. In this model, a consortium is formed of interested members, and membership is achieved by paying a proportional share of the overall project costs. The more participants, the less cost. One member takes the lead by expressing a willingness to acquire equipment and software, train staff, and begin data base construction, as well as to assume the responsibility for continuing updates to the data base over time.

There are several layers to the design of the data base. First is the "corporate" or consortium data base which is all the data absolutely required as a minimum by each member. The lead member is responsible for maintaining this data base. Each member has access to this common data base which contains map and descriptive information on roads, land parcels, building "foot prints," power poles, water hydrants, manhole covers, elevation, and other types of infrastructure data. By adhering to this common geographic structure, each member can then add their own required information most of which can be shared by all or selected members.

All information is registered spatially, permitting map overlays, and enriching the information to all concerned. This model provides "shared" data and "protected" data, while minimizing system costs.



### 3.1.3 Personnel and Training Requirements

1. Two committees should be formed to assist and support the Land Information Center and its Director, with representatives from at least the following three Ministries:

- a. The Ministry of Agriculture, Forestry, and Fisheries
- b. The Ministry of Economic Development
- c. The Ministry of Natural Resources

(Proposed members for these two committees are found in Appendix B.)

First, a LIS Technical Committee consisting of representatives from each Department should be formed to determine the precise data needs and appearance of ARC/INFO tables required by each Department. This committee will address issues such as system security, data integrity, mapping accuracy, mapping scale, and format of each Departmental "table." The committee may also be involved in naming of staff to be trained on the ARC/INFO system from each Department and decisions on which data to convert to the LIS first.

Second, an Executive Data Board should be formed to provide support to the Technical Committee, to establish general system guidelines and priorities, and to maintain a government-wide perspective for the future of the Center. Additionally, a major objective would be to assess the needs of the broad base of governmental users of geographic information, to prepare a plan for the organization of map and tabular information required, to suggest standards for all data which will permit their integration and synthesis, and, very importantly, establish a cooperative high-level management group which can operate well beyond the typical feeling of "ownership" of information.

2. Current staff members, familiar with the operations within each Department, must be trained to staff the Center. Training requires two intensive weeks, with adequate access to a graphic workstation for practice and completing training exercises. Most importantly, training must be scheduled after the hardware and software have been installed and tested. Training should emphasize work with "your" data, using "your" maps. The training sessions will help to set up "your" system, as well as providing an opportunity to learn the software system itself. Training before the equipment arrives is not acceptable. Training should take place in the LIC. It is much less expensive to bring one ARC/INFO instructor to Belize than to fund foreign travel and per diem for ten persons. Those attending the training must have no other responsibilities during the two-week training period. Ten days is a rather short period of time to learn how to use a very complex and sophisticated system. This cannot be accomplished with outside interruptions and responsibilities. This cadre of trained staff can then train others in the future, not only within the MNR, but also in other Ministries.

3. Trainees for the Ministry would be much more effective in their role if they were allowed the opportunity to understand the basic functions of, and problems encountered by, each Division. Several problems currently exist within and between Departments which center around the need for providing or sharing information of various types. Several workshops could provide a forum



for Departments to express the problems they encounter when dealing with other Departments. It is recommended that meetings of this nature begin in parallel with meetings of the Technical and Data Board committees.

Additionally, monthly meetings where all ministry staff could present their successes, problems, and suggestions for discussion might provide insights into how all the application processes might be simplified and the time period between application and award greatly shortened. Obviously, the person who solves these problems would be held in high regard by all citizens.

4. The Land Registry office should increase the number of its staff. As new areas become declared, there is a glut of applications which require considerable amounts of Registry personnel time with members of the public. The current staff will not be able to meet these increases in activity in an adequate manner.

The LIS may be viewed by some individuals as a threat to individuals and Departments. The Drawing Section may be most impacted. It must stressed in the beginning, and reinforced over time, that the system is not replacing people, it is only replacing old manual techniques. With change comes uncertainty, fear, and anxiousness. It will require at least one year for each individual to master the system and appreciate it. Encouragement must occasionally be provided.

### 3.2 Hardware Procurement

The system should be configured to allow for up to two terminals per Department. Remote terminals in each Department where direct access to data is possible is much preferred over having all terminals in the Center, and all requests for information taken to the Center for processing. The latter would undermine the very efficiency a computer-aided system provides.

Maintenance agreements are essential on all items purchased. These agreements provide a type of insurance, so when hardware develops a problem, it is repaired at fixed cost. It is important to remember that once complete dependency upon a computer-aided Land Information System is achieved and the computer fails to operate, the Ministry is "out of business." This can also be minimized by having redundant systems. Relative to the software, every software system is evolving, continually expanding the features and capabilities, and the benefits to the user. Maintenance agreements assure continued technical support, and very importantly, all updates to the software system.

1. The ARC/INFO multipurpose cadastral and LIS software system should be acquired for the LIC. Several software systems are available which would meet the current needs. However, the ARC/INFO system is already in use and is one of the finest available.

Caution must be advised when acquiring computer systems which have generous upgrade capabilities but do not allow for buy-back or conversion to a completely new computer technology when existing systems become out of date, or if the decision is made to halt the project. It is often possible to include a downgrade clause in a purchase contract allowing for sale of old machines to recover much of the original costs.

2. Several hardware configurations could be appropriate for this Center. For this project it is recommended that six "disk-full" SPARC workstations be networked via ETHERNET with a SPARC 390 Server. The Server must be equipped with a 1/2-inch tape-drive backup unit, a Plotter, and a Printer. This is the latest in graphic workstation technology and, oddly enough, one of the least expensive arrangements. Each workstation would be outfitted with digitizers and a mouse, while the plotter and printer could easily be shared. Projected prices of this hardware and software (which will be available in the third quarter of this year) and a total project budget can be found in Appendix C.

This configuration offers the most flexibility and wisest use of computational facilities. Because the system is required to meet the needs of the entire Ministry, this hardware configuration is also suitable for the installation of workstations in each of the offices where they are available to the officers or their appointed staff members. This will reduce the physical running about presently required, while maximizing data access. These workstations provide all information necessary for each office to do their work. Special forms will be created on the system which will allow each office to access all the information they use, check the status of all land transactions, update the status of information, such as applications, and minimize the need to pass paper files from one office to another for title applications and other purposes.

Six workstations will provide a reasonable degree of redundancy if one workstation fails. Six complete workstations would be ideal, considering the amount of records to be converted and the large amount of mapping to be done. One or more workstation should be configured to support other application software (e.g., ERDAS for remote sensing) when needed. The workstation configuration must include hardware that is currently supported by the desired ARC/INFO and ERDAS software systems. It would be extremely wise to purchase equipment sold and maintained in Belize if possible.

3. In later phases, additional workstations and Servers can be readily added to the network as needs dictate, and "disk-free" and "disk-less" operations should be considered, as well as an increase in graphic workstations.

If and when required, one workstation should be acquired which is configured in such a way as to accept the ERDAS system which is necessary to classify remotely sensed data, such as Landsat TM, and SPOT data, into land cover imagery. Because ERDAS is compatible with ARC/INFO, files can be interchanged, thereby facilitating the addition of the remotely sensed data sets to the ARC/INFO data base. ARC/INFO can also read the popular DXF files structure from CAD/CAM systems. This will be useful in the future as well.

### 3.3 Land Information System Funding Sources

Mr. David Gibson, Permanent Secretary, and Mr. David Aguilar, Commissioner of Lands, both recommended that a single funding source is highly desirable, resulting in a more cohesive project, improved continuity, and more practical follow-on support. The United States Agency for International Development (USAID) was his preference for funding, in spite of the recent gestures by CIDA, Canada, the United Kingdom, New Zealand, and others. USAID is more likely to assist if some serious level of commitment has been shown in country (i.e., the commitment of personnel, convening planning and organizational



meetings, and any other display of support). Perhaps a cost sharing type of arrangement with Ministries and other groups using the data would be the most acceptable. Ministry departments including Public Works, Agriculture, Forestry, and Fisheries, Economic Development, Archaeology, Tourism, Statistics, National Defense, and Police may find funds from internal sources. Additionally, real estate, utility companies, and other quasi government or private agencies may be sources of recurrent funds for continued operation. Sale of new information can also generate new sources of funds.

### 3.4 Implementation Schedule

It is most practical that the system be implemented in phases, with each follow-on phase allowing for the upgrading of both hardware and software, the increased development of the data base, and the training of additional personnel.

#### 3.4.1 Phase One

The first phase brings about acquisition of the new RISC architecture graphic workstation technology. The heavy demands placed on current technologies for image processing and high-resolution color graphics associated with LIS and GIS have fostered development of this RISC architecture. Six SPARC workstations will enable the Ministry of Natural Resources to immediately begin:

- a. Personnel training
- b. Data conversion
- c. Required database management
- d. Required mapping
- e. Spatial analysis
- f. Statistical analysis

With this hardware/software base, conversion of land records to the system, as well as RIMs, can proceed with alacrity. This assumes, however, that the necessary systematic adjudication legislation is enacted to complete land title and land boundary verification, and association to existing geodetic controls and the Universal Transmercator coordinate system as described by Belisle (1988).

Phase One will require approximately one year to convert existing RIMs and related information on the current 23,000 parcels to ARC/INFO files. This figure considers that all six workstations are utilized eight hours per day, completing a minimum of thirty-two parcels and all required information. This allows fifteen minutes for each operator to locate all required information in the proper file, input those data, input map coordinates, and store each new entry. If needed, an additional shift could be added to the work force to keep up with survey and attribute data being generated during that year's activities. Staff will become comfortable with the new system, and productivity would be expected to increase thereafter. Areas throughout the country where high rates of activity occur could be made priority areas. Low priority areas will be deferred until last.

Leased land will be the last to be surveyed, the last to be identified in terms of the UTM system, and the last to be associated with all the other information in the LIS.



Due to the tremendous amount of time required to convert all existing data to a LIS, the Ministry might consider contracting this work to an outside firm. Data conversion represents, on the average, 80% of the cost of a LIS. If current staff members attempt to perform the data conversion, it will take many more years to complete. Data conversion "shops" usually have a large experienced staff with three shifts, working around the clock. The advantage of contracting for this work is that the GOB will quickly have information to begin work. The disadvantage is cost.

Once the backlog of data conversion is under control, operators can shift their attention to researching leased lands and reserves. Slowly, all government owned lands can be identified, surveys can be completed, and the new legal descriptions and ownership information entered into the system.

Once existing data for Belize are identified, acquired, and converted to the system, an inventory of data will identify data which must be gathered for additional applications. It is normal to increase the number of possible applications several fold with the addition of each new "layer" of data.

It is important to verify all data that are input to a LIS for two major reasons. First, decisions reached by dependence on the information in the system are only as good as the data. Secondly, it will only be a matter of time until the accuracy and validity of the information in the system will be challenged in a court of law. One loss in the courtroom could discredit the entire program.

Updating the database on a regular schedule is necessary. Daily backups of work should be scheduled. The Technical Committee must establish, in advance, protocols for all updating, maintenance, and data security. Once the system is "complete," updating can be done in "real time." Some cities throughout the world will now only accept architectural plans in digital form, usually in DXF format, rather than plans on paper. The recorder, therefore, uses the LIS to process the same information as is currently done, except now it is interactively performed on the system. The architect submits the plans on a floppy disk to the surveyor, who inputs the maps exactly where they "fit," verifies their content, and the database is current in two regards: planned construction, and as-built construction.

#### 3.4.2 Phase Two

The second phase of the project, which will require approximately two years, will involve an expansion of hardware and software to link all designated offices to the system. Server disk expansion of over one gigabyte will be required to handle data, software, and communication loads, and permit a "disk free" or "disk-less" operating environment. Graphic terminals will be extended to each office and linked to the ETHERNET network.

During this phase, the project of converting National Estate Section records to the LIS begins. Properly surveyed and previously adjudicated parcels can be the first priority. This will be followed by the identification of parcels which have only hand sketched plans or maps and require proper title searches and surveys.



During the latter part of this time period, District personnel must be thoroughly trained in the use of the system in anticipation of their own equipment and electronic linkages to Belmopan, and hence, all other Districts.

Likewise, the Data Board could be instrumental in promoting interest among other Ministries to select appropriate personnel for ARC/INFO training to begin the GIS component. These individuals could collaborate with Dr. Bruce King and David Gray in constructing the GIS data base. When completed, the GIS and LIS data bases should be merged, cleaned, and verified where practical. Some type of benchmark tests should be run to determine the degree of mapping error when using the GIS data at the land parcel level.

This committee should also consider the issues of whether the Land Information Center is the appropriate site to house the GIS activities and the proposed Conservation Data Center, or if some other arrangement must be made. It must be apparent that "adding to" an existing Center is often much less expensive than creating a completely new similar one. It is worth considering, since the Ministries which stand to gain tremendously from these new tools might also stand to benefit by being relocated to the same building to permit working more closely and effectively.

#### 3.4.3 Phase Three

In phase three, six additional workstations are to be acquired, one for each centralized District Office (another major reason for having all District personnel in one building). Through this centralization, improved communications among personnel and Divisions is greatly improved and cooperative projects on a daily basis are fostered. Communications systems are required to permit electronic mail, data exchanges, and regularly scheduled updates of the District's data base. Field work, in the form of surveys, inspections, valuations, and other business, can be handled on a daily basis. Microcomputer automated survey data can be transmitted to Belmopan through the link to enter directly into the COGO plotting programs and expedite automated construction of the RIMs.

#### 3.4.4 Phase Four

This final phase involves establishing formal linkages with other Ministries to provide the sharing of data, technology, information, and services. The Land Information Center (LIC) may be the only office which works directly with the computer system, both inputting data and generating reports as requested. On the other hand, each Ministry may want a computer terminal and a link to the LIC. Another alternative is to have two main centers, one for LIS information and one for GIS information, with linkages established between the two.



## APPENDIX A

### DEFINITION OF LAND TENURE TERMS

**National lands:** "This category of land accounts for a total of 75% of all lands in the country. Forest and Indian reservations, and land being saved for future generations accounts for 30% of the land area. Some logging permits and annual tenancy permits are issued to the Indians in this area. A further 11% of the land is leased to private individuals and corporations for development purposes. About 63% of this leased land is issued in parcels less than 2 acres which are mostly used for residential and commercial developments. Another 33% is issued in parcels of between 5 and 100 acres which are mostly used for farming and industrial purposes, and only a few parcels of over 1000 acres are issued." (all quoted from pages 19 and 20 of Belisle)

**Private Lands:** Mostly in freehold title. Usually larger parcels of land (foreign, nonresident), as a result it is estimated that 86% of all private lands is owned by 2% of private landowners.

**Registered Title:** Discontinued in 1954, Land Titles Register was used to register majority of freehold properties.

**Certificate of Title:** Began in 1954, First Certificate issued upon first application, Transfer Certificate of Title was issued when property transfer is effected and gave absolute title.

**Land Certificate:** Issued by Land Registry in accordance with the Registered Land Ordinance of 1977. Land certificates can only be issued in areas that have been declared as compulsory registration areas, and title is guaranteed by the government. It is the intention of government to eventually have all lands registered in accordance with this ordinance.

**Private Lease:** Leases of registered freehold property for a term of ten years and upwards are registrable under the General Registry Ordinance. Under the Registered Land Ordinance, leases for a period of two years and over are registrable. These leases are legal and binding on the land from the date of registration.

**Aliens Landholding:** Two conditions: 1. Development scheme can contribute tremendously to the economy of the country and is desirable, and suitable private lands can not be obtained; 2. Confined to depressed areas of the country so as to stimulate development of those areas.

## APPENDIX B

## RECOMMENDATIONS FOR LIC DIRECTOR AND STAFFING OF COMMITTEES

Mr. Lindsay Belisle should be considered to serve as Director of the Center. His growing knowledge and understanding of LIS/GIS technologies makes him valuable to serve in this leadership capacity. His knowledge and understanding of the current record keeping methods and filing procedures will be a valuable asset, as is his essential understanding of mapping and surveying.

Selected members from the Belmopan conference may be suitable for inclusion on either the Technical Committee and/or the Data Board Committee. Permanent Secretary Mr. David Gibson did a commendable job as spokesperson at the conference. He would make an appropriate moderator for future conferences and for the Data Board. Likewise, perhaps Mr. Ray Davis might serve as moderator for the Technical Committee.

## PROPOSED MEMBERS OF THE LAND INFORMATION CENTER TECHNICAL COMMITTEE

Dr. Joseph Palacio, Center for Statistics, Ministry of Economic Development.  
Dr. Marla Holder, Officer in Charge, Central Farms, Ministry of Agriculture.  
Mr. Lindsay Belisle, Director, Land Information Center, Ministry of Natural Resources.  
Mrs. Petzold, Deputy Registry Officer, Ministry of Natural Resources.  
Mr. Richard Belisle, Ministry of Forestry, Agriculture, and Fisheries.  
A representative from the Ministry of Public Works.  
Mr. Norman Arnold, Ministry of Natural Resources, Lands Officer.  
Mr. Ray Davis, Drawing Section, Ministry of Natural Resources.  
Mr. Harriot Topsey, Commissioner of Archaeology, Ministry of Education.  
Mr. Tyrone Edwards, National Estate Section, Ministry of Natural Resources.  
Mr. Berrisford Emmanuel, Chief Valuation Officer.  
Mr. John McGill, Physical Planner, Ministry of Natural Resources.

These are names of people appearing to be suitable for these activities, but the final committee selection should be performed by Mr. David Gibson, Mr. David Aguilar, and Mr. Belisle.

## PROPOSED MEMBERS OF THE LAND INFORMATION CENTER EXECUTIVE DATA BOARD

Efrain Alpuche, Chief Surveyor, Ministry of Natural Resources.  
Rodney Neal, Permanent Secretary, Ministry of Agriculture, Forestry, and Fisheries.  
Wendell Param, Policy Analyst, Ministry of Agriculture, Forestry, and Fisheries.  
David Aguilar, Commissioner of Lands and Surveys, Ministry of Natural Resources.  
David Gibson, Permanent Secretary, Ministry of Natural Resources.  
Mrs. Hyde, Permanent Secretary, Ministry of Economic Development.  
Liborio Gonzeles, Chief Agricultural officer, Ministry of Agriculture, Forestry, and Fisheries.  
Mr. Lindsay Belisle, Director, Land Information Center.



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These are merely suggested persons, and by no means a comprehensive list. Committee membership could best be decided by the Honorable Charles Wagoner, Minister of Natural Resources, Mr. David Gibson, and Mr. David Aguilar.

*DL*



## APPENDIX C

PHASE ONE LAND INFORMATION CENTER COST BUDGET  
AND RECOMMENDED HARDWARE/SOFTWARE CONFIGURATION

Quantity	Description	Cost Each
6	Spark (RISK) workstations, 208 Mb disk, 5 Mb RAM, 19" Color Monitor Keyboard and Mouse, 12.5 MIPS.	20,000
1	Spark Server Model 390, 1 Gb. Disk, 1/2" Tape Unit, 16 MIP, 32 Mb. RAM.	87,000
1	50 foot ETHERNET cable	300
1	Spark workstation annual maintenance agreement (1st year is free)	1,920
1	Spark server annual maintenance agreement (1st year is free)	8,100
1	ARC/INFO workstation primary software system.	18,000
5	ARC/INFO workstation secondary software systems.	9,900
1	ARC/INFO primary workstation service agreement.	3,000
5	ARC/INFO secondary workstation service agreements.	1,200
***	Subtotal Hardware and Software Costs	\$366,720
1	Two-week ARC/INFO training program.	5,000
1200	Additional square feet of building space at \$37.50/sq. ft.	78,000
1	Central air conditioning unit for the above structure.	6,000
1	Stand-by electrical generation plant.	7,000
***	Subtotal Building, Facilities, Training	96,000
12	4-Wheel Drive Pick-up Trucks . . . . .	15,000
***	Subtotal For Transportation Equipment. .	180,000
***	Total Land Information Center Costs . .	<u>\$642,720</u>

## PC ARC/INFO MINIMUM HARDWARE CONFIGURATION

- a. IBM-PC/AT, IBM PS/2, Compaq 386, or compatible computer running MS/DOS. \*
- b. High density floppy disk drive.
- c. MS/DOS version 3.3.
- d. 2 Mb. RAM.
- e. 70 Mb. or more of hard disk space.
- f. 80387 math coprocessor.
- g. One parallel and two serial communications ports (one for digitizer, one for plotter and/or host communications), and several expansion ports for ERDAS software and other applications software.
- h. 48" eight pen plotter. \*
- i. 48" by 60 digitizer with 16 button cursor. \*
- j. Tape back-up unit. \*
- k. Appropriate cables, accessories, and maintenance agreements.
- l. Training.

Approximate cost each, US\$32,500. Only one plotter would be necessary, however, reducing unit costs for workstations by \$7,000. Because the cost differential between the Spark workstation and the PC workstation is so close, but performance is far superior on the Spark workstation, it is recommended that the PC and PC ARC/INFO not be considered.

\* Attention should be paid to the availability of local hardware distributors and providers of service and maintenance.

Source: ESRI: PC ARC/INFO Technical Guide to Hardware Options, February, 1989.

APPENDIX D

SELECTED REFERENCES

- Belisle, Lindsay L. 1988. The Development of a Land Registration and Information System in Belize, Master's Thesis, North East London Polytechnic.
- Guevara, J. Armando 1989. Environmental Systems Research Institute (ESRI).
- King, R.B., et al. 1989. Land Resource Assessment of Stann Creek District, Belize, Volume 1 main report, Overseas Development Natural Resources Institute, Bulletin No. OB-18.
- King, R.B., et al., 1986. Land Resource Survey of Toledo District Belize, Land Resources Development Center, Surrey, England.
- Lawrance, J.C.D. and P. McMaster 1972. Report On Land Registration in British Honduras (Belize) Foreign and Commonwealth Office, Overseas Development Administration.
- Perez, Gilberto A. 1988. "The Lands and Survey Department In Belize — Its Present Role." Final year land surveying course thesis, College of Arts, Science, and Technology, Belize.
- Simpson, S.R. Land, Law, and Registration, p. 80.



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**ATTACHMENT A**

**EXAMPLES OF FORMS USED IN THE MINISTRY OF NATURAL RESOURCES, BELIZE**





**B E L I Z E**  
**Lands Registry**  
**PARCEL SHEET**

1. Property No.

REGISTRATION SECTION

BLOCK NO .....

PARCEL NO .....

NAME OF PARCEL  
(if any)

APPROX. AREA .....

2. *List of Documents produced to and retained by the Lands Registry*

3. *Manner of Acquisition*  
(Where there is more than one owner, each name be serially numbered)

4. *National / Private*  
(Where parcel is National Land, paras 5,6,9, and 10 are not completed)

5. *Nature of Title, Absolute/Provisional*

6. *Where Title is provisional give:*
- a) Date upon which possession by provisional owner (s) commenced
  - b) Particulars of any document by virtue of which a right adverse to the title of the provisional owner(s) might exist.
  - c) Any other qualifications affecting the title.

7. *Appurtenances*  
(Record in full any easement and/or restrictive agreements which benefit the property; if more than one, number serially).

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BELIZE

Registered Land Ordinance, 1977

Section 21 (2)

APPLICATION TO COMBINE/SUB-DIVIDE PARCELS OF LAND

REGISTRATION SECTION BLOCK PARCEL

I/WE

of

HEREBY APPLY to combine/sub-divide the above parcel/parcels as follows:

SKETCH

State how the boundaries of the parcel are demarcated (i.e. Hedges, fences, survey beacons etc.)
A precise survey is/is not required\*

Applicant

Surveyor

\*Delete if not applicable

- Note : 1. In place of a sketch a plan may be submitted of the proposed sub-division. Sub-divisions falling within the requirements of any planning law in force must be certified by the appropriate authority.
2. To be submitted in duplicate.

FOR OFFICE USE

Registry Fees Paid. Rec. No.

Mutation Form No.

Register amended

New Parcel Nos.

Registrar of Lands

Remarks.

SCHEDULE A  
(LAND TAX ACT, 1982)  
SECTION 13, 18(1)

A return of taxable land belonging to

situate at

Submitted on the

day of

19

<i>Owner's name and name of property</i>	<i>Name of Occupier</i>	<i>Situation of property</i>	<i>Title under which property is held</i>	<i>Total No. of acres</i>	<i>No. of acres Developed (type) of development</i>	<i>No. of acres Undeveloped</i>	<i>Owner's Assessment of Market Value (value of improvements and Value of Land)</i>

I, \_\_\_\_\_, do solemnly and sincerely declare that the above return is to the best of my knowledge and belief in all respects a true and just return of all land in my possession or under my charge, in this country on the \_\_\_\_\_ day of \_\_\_\_\_ 19\_\_\_\_.

Subscribed this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_.

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# VALUATION SHEET

AGRICULTURE, SUB-URBAN, BEACH LAND

PLAN No _____	NAME OF OWNER _____	
PARCEL No _____	ADDRESS _____	
AREA _____ LANDFORM _____	LOCATION: _____	DESCRIPTION: SUB-URBAN LAND SUB-URBAN LOT
CLASSIFICATION _____	ACCESS _____	AGRICULTURAL LAND VILLAGE LOT
POTENTIAL USE _____		FRONTAGE TO _____
OBJECTION No _____	DECLARED _____	
TITLE REF. _____		
	ASSESSMENT _____	
CONSIDERATION _____		
RATE OF TAX _____		

**CALCULATION OF TAX**

	₹	₹
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	W.E.F.	AMOUNT	REVISED AMT.
UNIMPROVED VALUE			

DETAILS OF OBJECTION: \_\_\_\_\_

Basic rate on Main Rd	₹
Adjustments:— Acreage	₹
: Situation (Land 5 Acs. & Over)	₹
Land less than 5 Acs	₹
Specific Details	₹
Specific Rate of Value	₹

ORDERS UNDER SECTION: II \_\_\_\_\_

REMARKS: \_\_\_\_\_

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