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Cadastral Information System for M.I. Wushishi Housing Estate.

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Abstract
This study presents the possibilities for efficient implementation of a Cadastral Information System for M. I. Wushishi Estate in a GIS environment. Logical and Physical models for the Cadastral Information System were built and utilized in the creation of the Cadastral Information System using an Entity relationship model.
Keywords: Cadastral, Information System, Estate

1.0 Introduction

Considering the fixed nature of land compared to the continually growing human population with her multiple interests in Land, it becomes pertinent that Land be properly managed by the government for the common good of all. Efficient Land administration and Management therefore begins with the creation and maintenance of an up-to-date record of all occupiers of Land and there interest in Land. Such as register of land occupiers, their boundary and interest in Land form a basis for a Cadastre.

The Cadastre is simply a public catalog that is arranged methodically which contains information of properties within a locality based on information that is gotten from Cadastral Surveying Data.

Cadastre is a system that exclusively connects a defined parcel of land (Ndukwu, 2013). Digital Cadastral Databases (DCDBs) are very dynamic since they are tied to daily changes in the cadastral framework through the subdivision and the land titling processes (Effenberg and Williamson, 1997). In essence, cadastre furnishes the public with both spatial and attributes information about a parcel of land.

The Food and Agricultural Organization (2006) describes cadastre as a 'scientific term for a set of records showing the degree, value and ownership (or the basis for use or occupancy) of land. It provides a ready means of precise description and identification of particular pieces of land and it acts as a continuous record of rights in land'

A cadastre (in Continental Europe), is perceived as a systematic and official description of land parcels, which includes for each parcel a unique identifier. The description includes text records on attributes of each parcel. The prototypical means of identification is a large-scale map that provides information on parcel boundaries (Silva and Stubkjaer, 2002).

Being an integral component of the overall Land administration process, computerisation of land records is therefore the first step towards making digital cadastre possible as far as Land record management is concerned (Tembo and Simela, 2004)

The Cadastral Information System therefore stands as the commencement point in the building of any relevant statewide cadastre. The Cadastral Information System contains the geometric description of the properties which forms the building block of the cadastral information system as well as additional information like: the people, occupants and the value of the property. The establishment of fully functional digital cadastral databases will help provide a proper information system that will facilitate development in an ever changing world of technology.

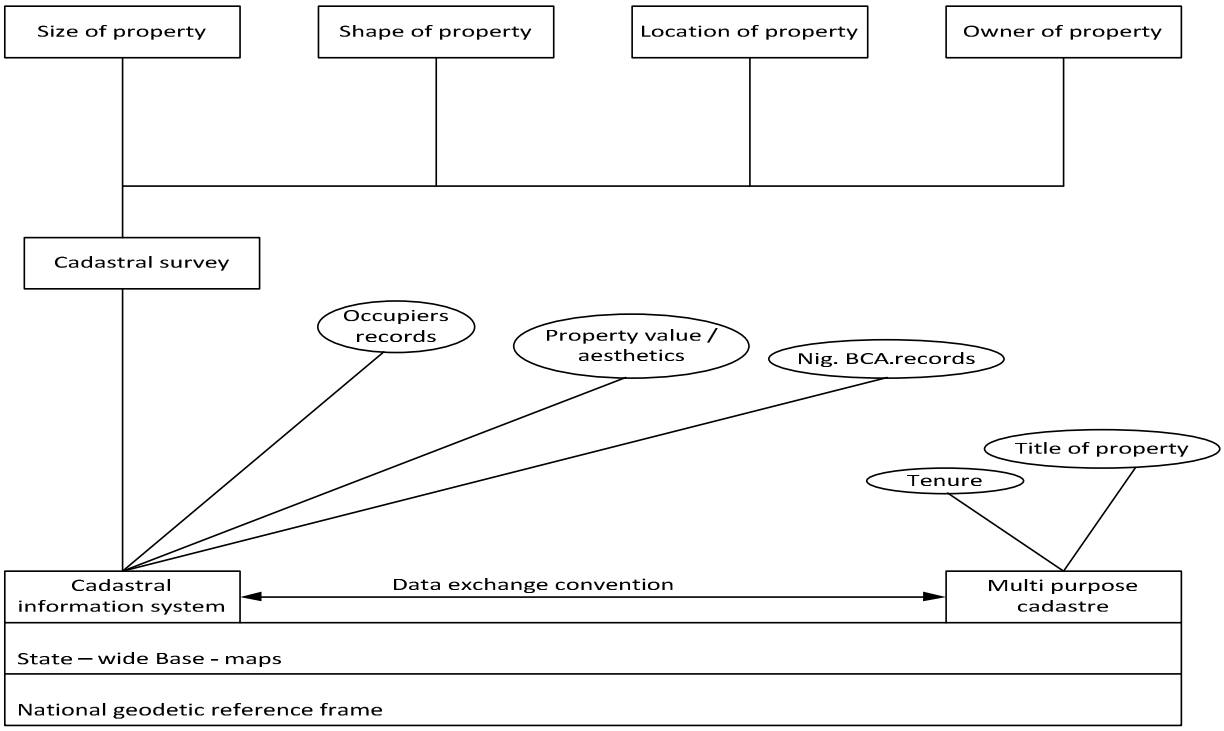


Figure 1 Schematic diagram showing the interconnectivity between a cadastral information system and a digital multipurpose cadastre. Modified after Binge (2002)

This paper presents a GIS based approach for the creation of a Cadastral Information System for M. I. Wushishi Housing Estate, along Eastern Bye-pass, Minna.

2.0 Study Area

M. I Wushishi is located along the Eastern Bye-pass of Minna – Town in Niger state, with a land area of approximately 58.5 Hectares. Built by the Niger State Government to ease accommodation pressure amongst middle income earners within the state and the sale of the estate enjoys adequate patronage. Considering however the extent of the estate, appropriate and up-to-date geospatial-database of all residents and their occupation is essential to mitigate possibilities of in-security within the estate.

Figure 1: Google earth image of Study area.

3.0 Methodology

The design of the Cadastral Information System was done in stages as listed below:

3.1 Logical Design

Logical Design encapsulates both the logical design and data abstraction phases.

The process of logical design involves arranging data into a series of logical relationships called entities and attributes (Oracle8*i* Data Warehousing Guide

Release2; (8.1.6) Part Number A76994-01). An *entity* idealizes a piece of information while attributes are components of the entity that define the uniqueness of the entity.

In relational databases, an entity is depicted in tabular form with each entity recorded as a field and the attributes along the tuple. During Logical Design, an ER diagram is drawn to depict the workflow. Drawing an entity-relationship diagram aids understanding of the organization's data needs and can serve as a *schema* diagram for the required system's database.

All required attributes of the entity were thus identified and linked appropriately in the ER diagram to facilitate easy building of the database.

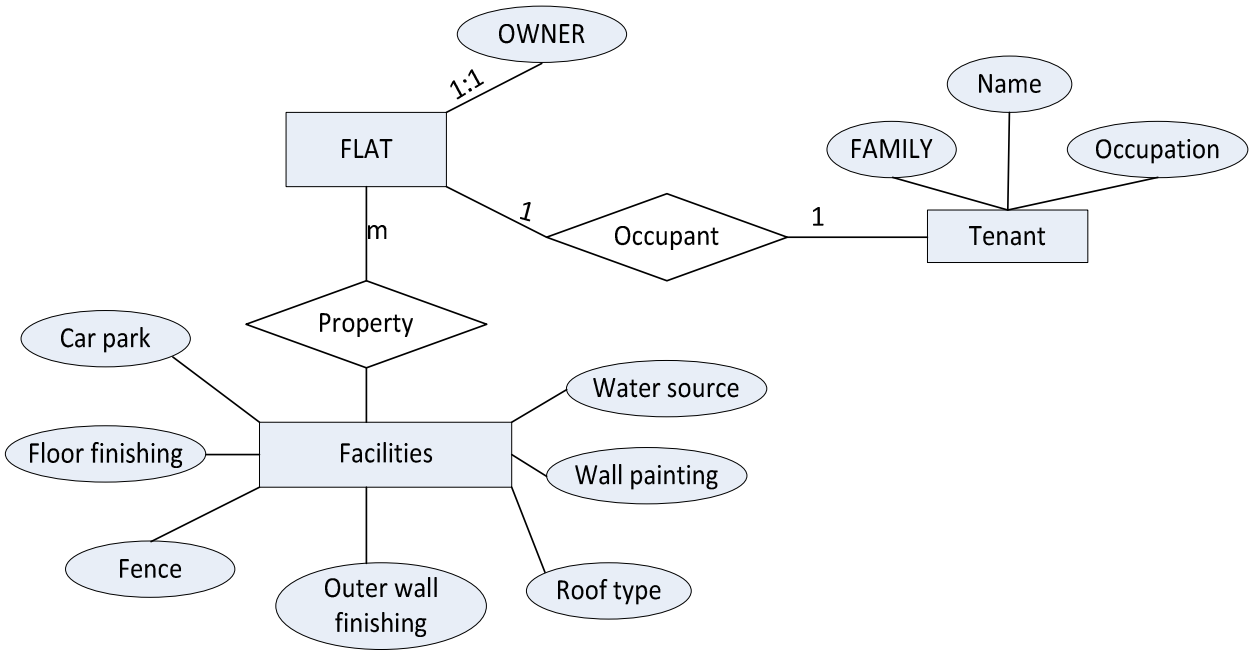


Figure 2: An E-R Diagram for the Conceptual Design.
Thereafter, the ER Model is mapped unto a relational database as shown in Figure 3:

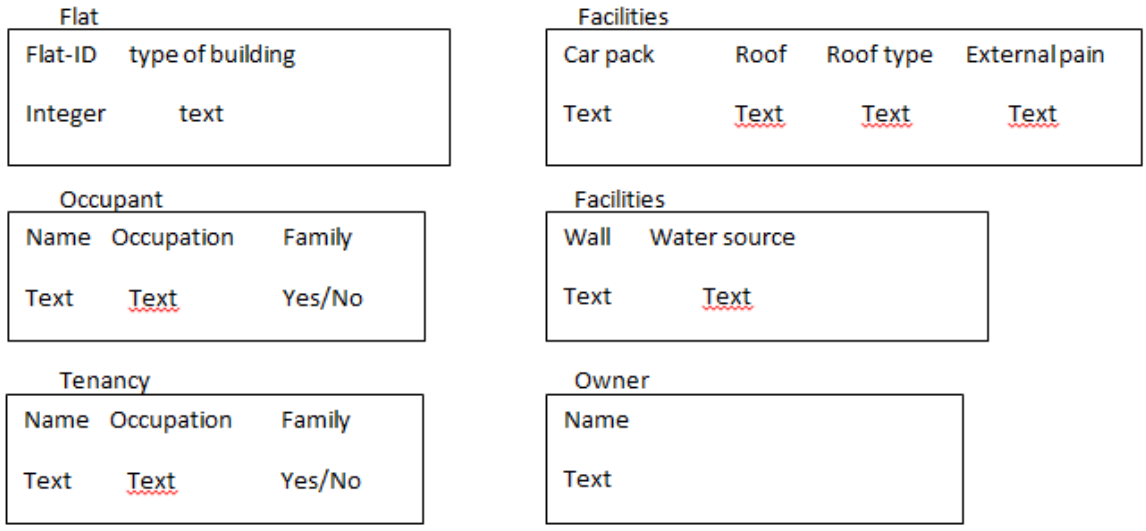


Figure 3: Mapping the E-R model to the Relational Database.

3.2 Physical Design

This is aimed at creating physical relational database tables to implement the database design (Haithcoat, 1999). The required hardware, software, file structures and system memory requirements for execution are put into consideration and implemented as appropriate.

In building a Cadastral Information System, the process involves the procedure of building every other data base systems i.e. software, hardware, data, procedures, database access language e.t.c.

To facilitate the database creation, real-time GPS was used to pick the co-ordinates of the bounding points of the entire area. With a base station established at L40, the rover was moved round the boundary points of the study area to determine precisely their co-ordinates to an acceptable accuracy level. Thereafter, a google-earth imagery covering the study area was acquired and geo-referenced with the boundary co-ordinates earlier determined using Simple Helmert Transformation. The fully geo-referenced image was then digitized as appropriate (flat by flat) to create the full spatial database of the study area.

Questionnaires were then circulated to all residents to fill in their personal information as regards their

full names, occupation, number of children, source of water e.t.c. An example of the circulated questionnaire is as shown in the appendix. Also, other non-spatial information as the type of roof, external wall painting e.t.c were observed and recorded accordingly.

3.3 Relational Database

A relational database is such which is perceived by the user as a collection of two- dimensional tables. They are manipulated a set at a time, rather than a record at a time and in advanced cases the SQL is used for its manipulation (Haithcoat, 1999). The ArcGIS software was used to build the spatial and aspatial database for the study area. With the spatial data represented in their appropriate geometric forms, the relational database table was used to link the spatial data with the attributes for each parcel.

4.0 Results

A parcel based Cadastral Information System for the study area was created comprising all parcels in their appropriate geometric representation viz-a-viz the entire land extent as shown in figure 4

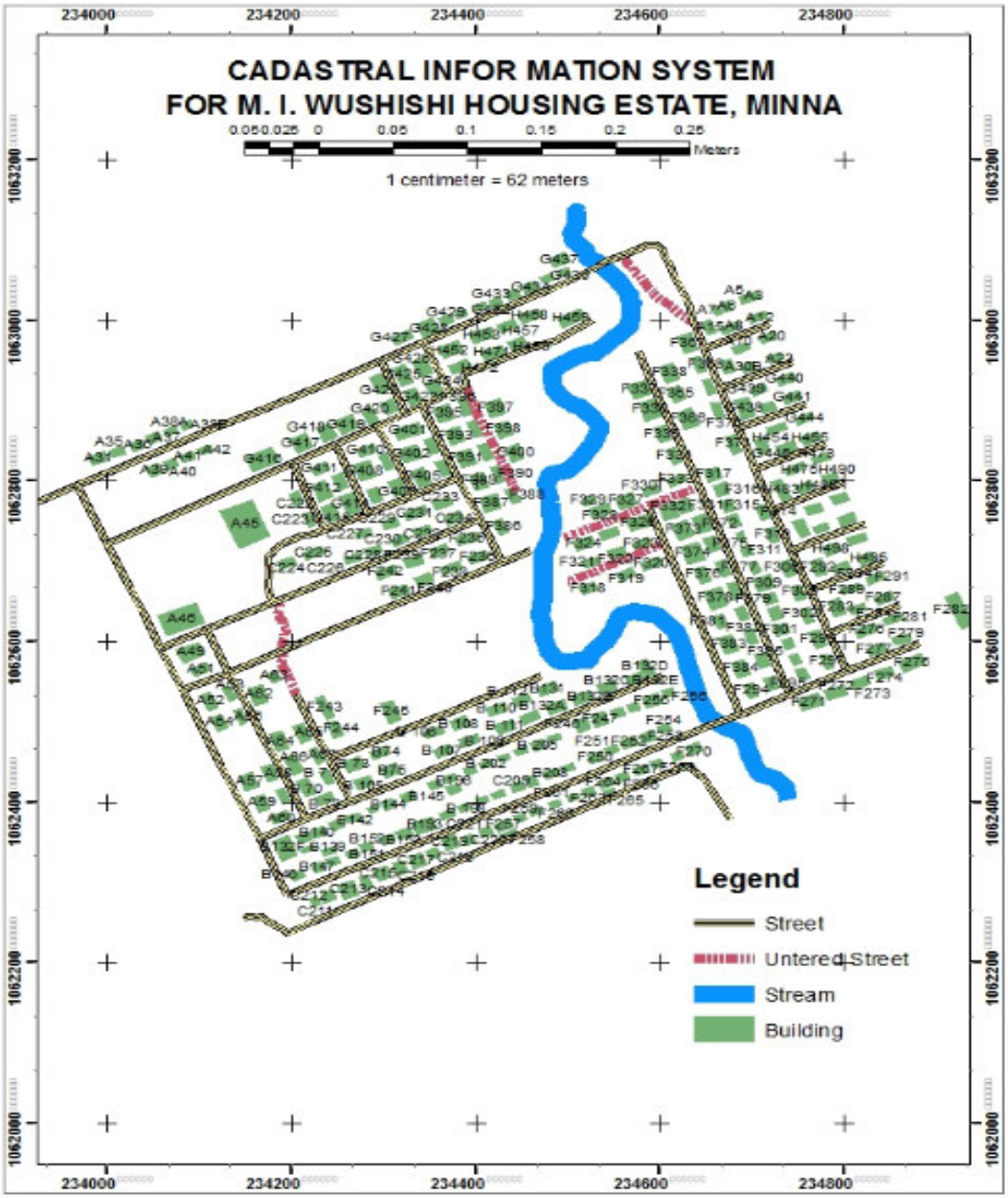
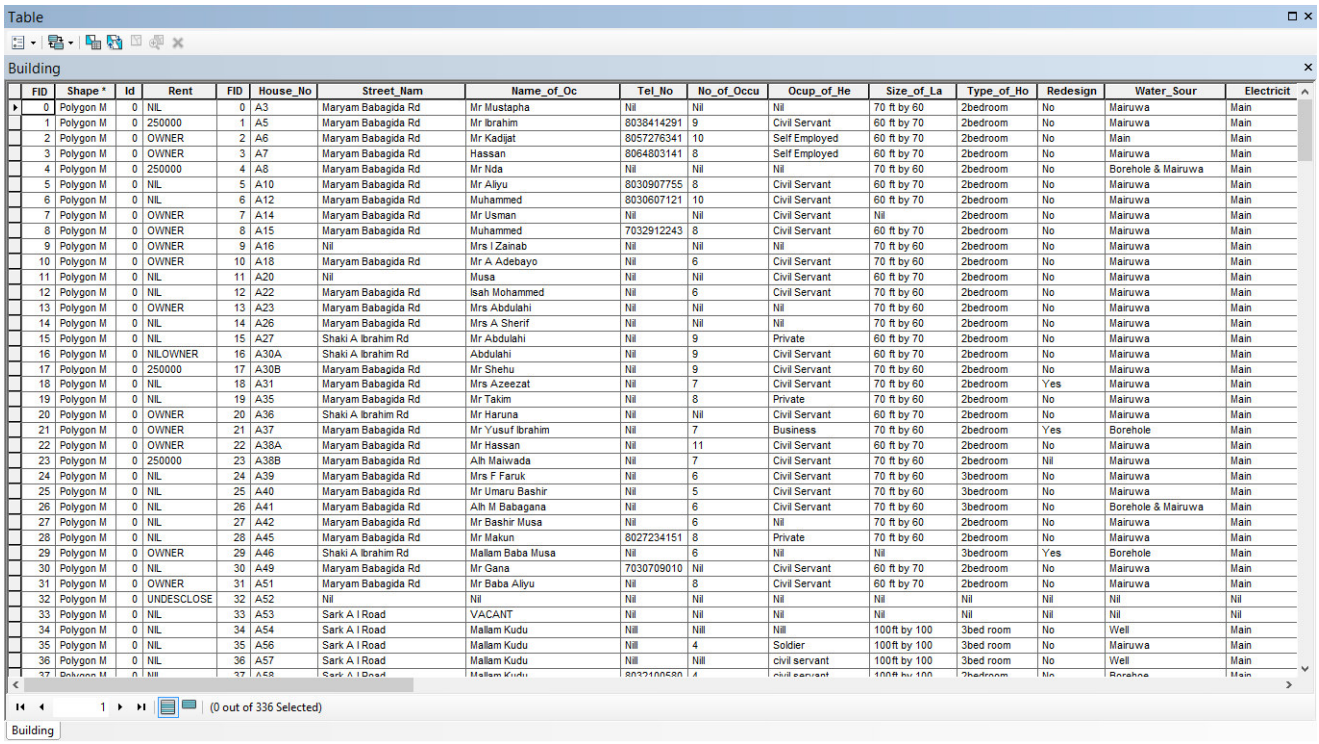


Figure 4: Map showing the spatial details within the study area.

Also relational table was created to link the spatial and aspatial components of the database.



FID	Shape *	Id	Rent	FID	House_No	Street_Nam	Name_of_Oc	Tel_No	No_of_Occu	Ocup_of_He	Size_of_La	Type_of_Ho	Redesign	Water_Sour	Electricit
0	Polygon M	0	NIL	0	A3	Maryam Babagida Rd	Mr Mustapha	Nil	Nil	Nil	70 ft by 60	2bedroom	No	Mairuwa	Main
1	Polygon M	0	250000	1	A5	Maryam Babagida Rd	Mr Ibrahim	8038414291	9	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
2	Polygon M	0	OWNER	2	A6	Maryam Babagida Rd	Mr Kadijat	8057276341	10	Self Employed	60 ft by 70	2bedroom	No	Main	Main
3	Polygon M	0	OWNER	3	A7	Maryam Babagida Rd	Hassan	8064803141	8	Self Employed	60 ft by 70	2bedroom	No	Mairuwa	Main
4	Polygon M	0	250000	4	A8	Maryam Babagida Rd	Mr Nda	Nil	Nil	Nil	70 ft by 60	2bedroom	No	Borehole & Mairuwa	Main
5	Polygon M	0	NIL	5	A10	Maryam Babagida Rd	Mr Aliyu	8030907755	8	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
6	Polygon M	0	NIL	6	A12	Maryam Babagida Rd	Muhammed	8030607121	10	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
7	Polygon M	0	OWNER	7	A14	Maryam Babagida Rd	Mr Usman	Nil	Nil	Civil Servant	Nil	2bedroom	No	Mairuwa	Main
8	Polygon M	0	OWNER	8	A15	Maryam Babagida Rd	Muhammed	7032912243	8	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
9	Polygon M	0	OWNER	9	A16	Nil	Mrs I Zainab	Nil	Nil	Nil	70 ft by 60	2bedroom	No	Mairuwa	Main
10	Polygon M	0	OWNER	10	A18	Maryam Babagida Rd	Mr A Adebayo	Nil	6	Civil Servant	70 ft by 60	2bedroom	No	Mairuwa	Main
11	Polygon M	0	NIL	11	A20	Nil	Musa	Nil	Nil	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
12	Polygon M	0	NIL	12	A22	Maryam Babagida Rd	Isah Mohammed	Nil	6	Civil Servant	70 ft by 60	2bedroom	No	Mairuwa	Main
13	Polygon M	0	OWNER	13	A23	Maryam Babagida Rd	Mrs Abdulahi	Nil	Nil	Nil	70 ft by 60	2bedroom	No	Mairuwa	Main
14	Polygon M	0	NIL	14	A26	Maryam Babagida Rd	Mrs A Sherif	Nil	Nil	Nil	70 ft by 60	2bedroom	No	Mairuwa	Main
15	Polygon M	0	NIL	15	A27	Shaki A Ibrahim Rd	Mr Abdulahi	Nil	9	Private	60 ft by 70	2bedroom	No	Mairuwa	Main
16	Polygon M	0	NILOWNER	16	A30A	Shaki A Ibrahim Rd	Abdulahi	Nil	9	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
17	Polygon M	0	250000	17	A30B	Maryam Babagida Rd	Mr Shehu	Nil	9	Civil Servant	70 ft by 60	2bedroom	No	Mairuwa	Main
18	Polygon M	0	NIL	18	A31	Maryam Babagida Rd	Mrs Azeezat	Nil	7	Civil Servant	70 ft by 60	2bedroom	Yes	Mairuwa	Main
19	Polygon M	0	NIL	19	A35	Maryam Babagida Rd	Mr Takim	Nil	8	Private	70 ft by 60	2bedroom	No	Mairuwa	Main
20	Polygon M	0	OWNER	20	A36	Shaki A Ibrahim Rd	Mr Haruna	Nil	Nil	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
21	Polygon M	0	OWNER	21	A37	Maryam Babagida Rd	Mr Yusuf Ibrahim	Nil	7	Business	70 ft by 60	2bedroom	Yes	Borehole	Main
22	Polygon M	0	OWNER	22	A38A	Maryam Babagida Rd	Mr Hassan	Nil	11	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
23	Polygon M	0	250000	23	A38B	Maryam Babagida Rd	Alh Maiwada	Nil	7	Civil Servant	70 ft by 60	2bedroom	Nil	Mairuwa	Main
24	Polygon M	0	NIL	24	A39	Maryam Babagida Rd	Mrs F Faruk	Nil	6	Civil Servant	70 ft by 60	3bedroom	No	Mairuwa	Main
25	Polygon M	0	NIL	25	A40	Maryam Babagida Rd	Mr Umaru Bashir	Nil	5	Civil Servant	70 ft by 60	3bedroom	No	Mairuwa	Main
26	Polygon M	0	NIL	26	A41	Maryam Babagida Rd	Alh M Babagana	Nil	6	Civil Servant	70 ft by 60	3bedroom	No	Borehole & Mairuwa	Main
27	Polygon M	0	NIL	27	A42	Maryam Babagida Rd	Mr Bashir Musa	Nil	6	Nil	70 ft by 60	2bedroom	No	Mairuwa	Main
28	Polygon M	0	NIL	28	A45	Maryam Babagida Rd	Mr Makun	8027234151	8	Private	70 ft by 60	2bedroom	No	Mairuwa	Main
29	Polygon M	0	OWNER	29	A46	Shaki A Ibrahim Rd	Mallam Baba Musa	Nil	6	Nil	Nil	3bedroom	Yes	Borehole	Main
30	Polygon M	0	NIL	30	A49	Maryam Babagida Rd	Mr Gana	7030709010	Nil	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
31	Polygon M	0	OWNER	31	A51	Maryam Babagida Rd	Mr Baba Aliyu	Nil	8	Civil Servant	60 ft by 70	2bedroom	No	Mairuwa	Main
32	Polygon M	0	UNDESCLOSE	32	A52	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
33	Polygon M	0	NIL	33	A53	Sark A I Road	VACANT	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
34	Polygon M	0	NIL	34	A54	Sark A I Road	Mallam Kudu	Nill	Nill	Nill	100ft by 100	3bed room	No	Well	Main
35	Polygon M	0	NIL	35	A56	Sark A I Road	Mallam Kudu	Nill	4	Soldier	100ft by 100	3bed room	No	Mairuwa	Main
36	Polygon M	0	NIL	36	A57	Sark A I Road	Mallam Kudu	Nill	Nill	civil servant	100ft by 100	3bed room	No	Well	Main

Figure 5: Screen-shot showing the database created for the buildings within the study area.

4.1 Multi – Criteria Queries

The database created is then used for implementing several selection queries in determination of user-defined requirements such as parcels whose occupiers are actual owners, occupier's occupation, number of residents in each flat, selection of unoccupied flats and other such security – related questions.

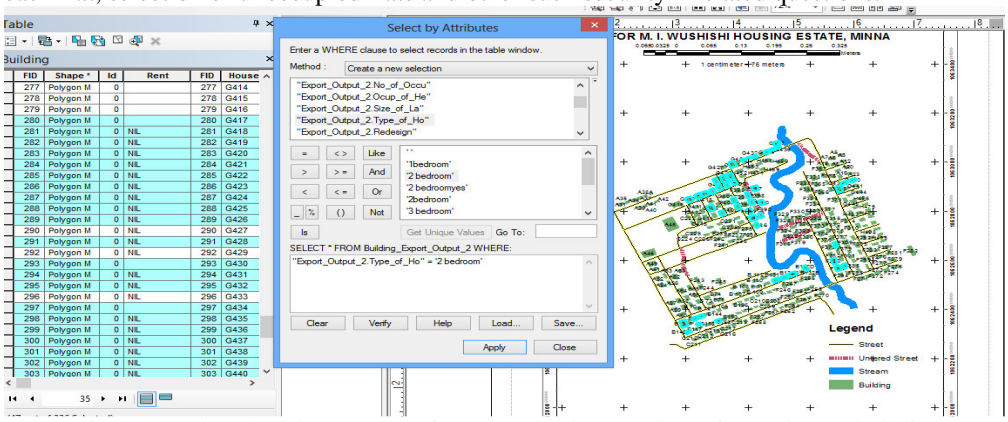


Figure 6: Screen-shot showing results of query selecting number of 2 Bedroom buildings.

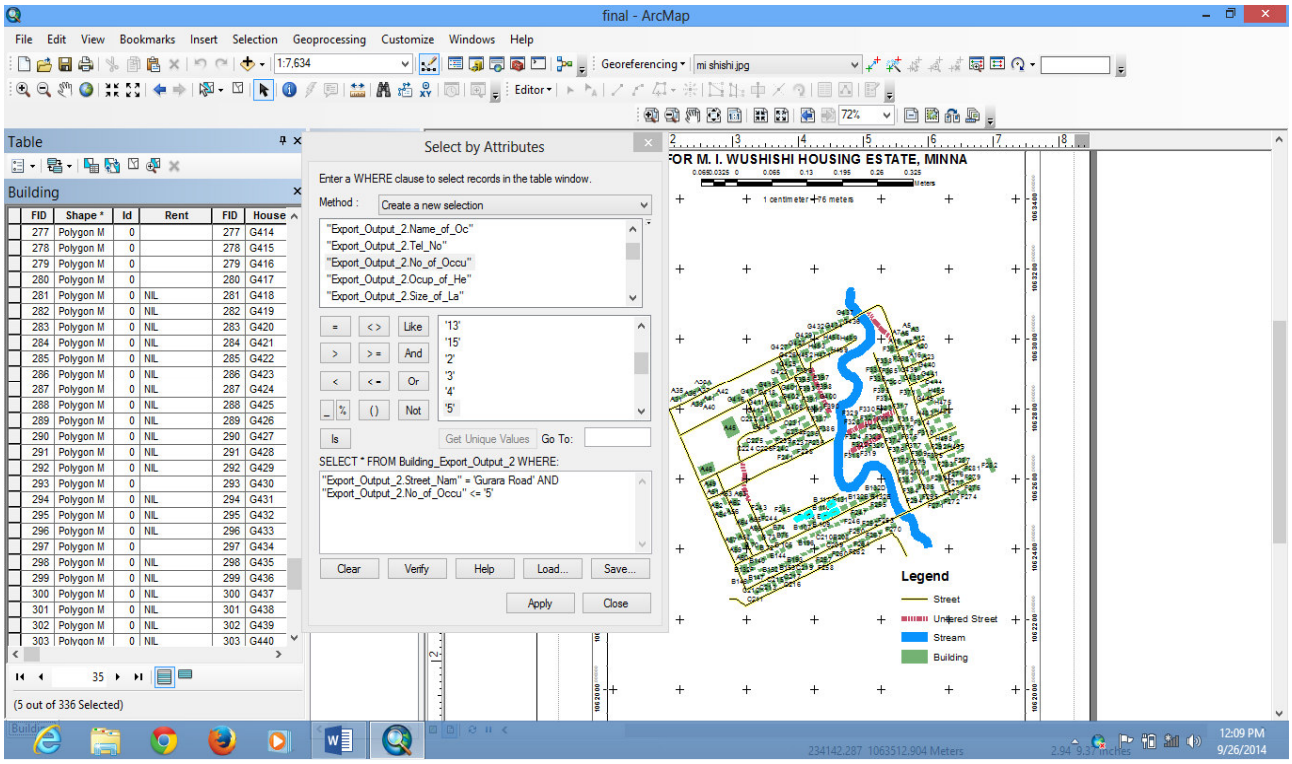


Figure 7: Screen-shot showing results of multi-criteria query selecting number of 2 Bedroom buildings on Gurara Road with occupants less than or equal to 5.

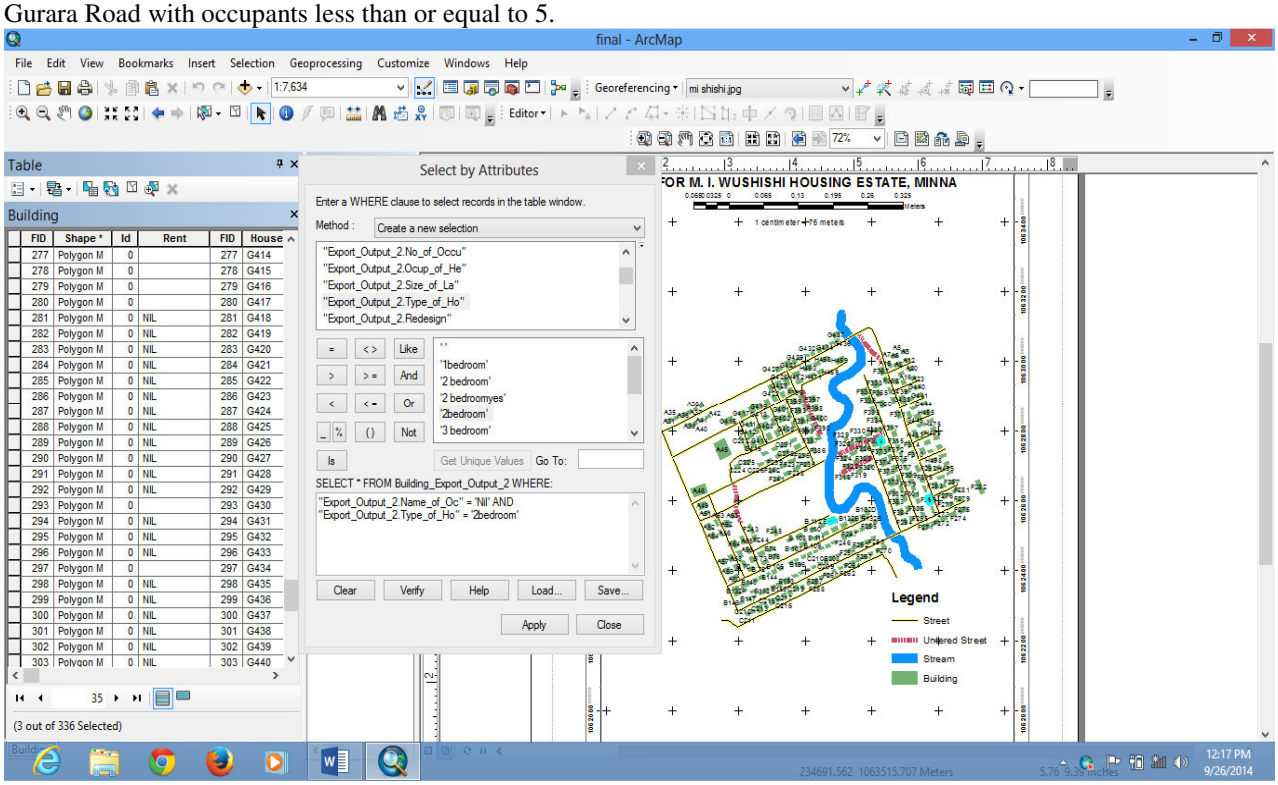


Figure 8: Screen-shot showing results of multi-criteria query selecting number of Unoccupied 2 Bedroom buildings within the estate.

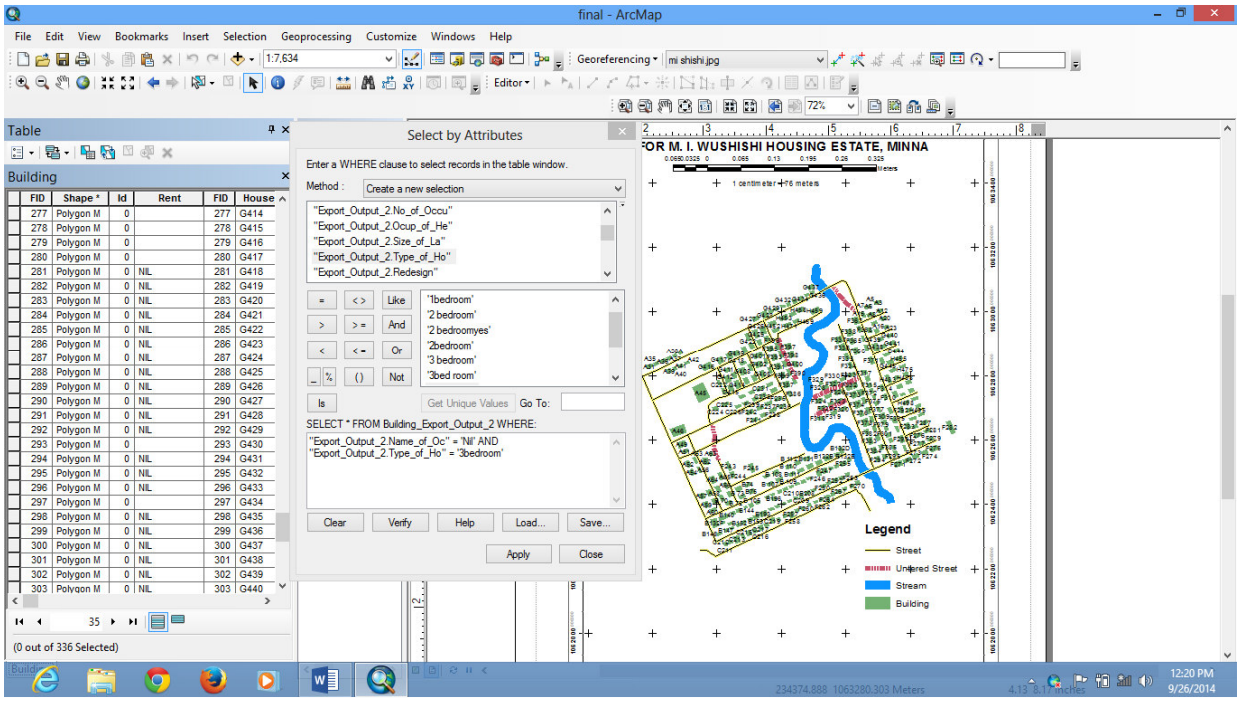


Figure 9: Screen-shot showing results of multi-criteria query selecting number of Unoccupied 3 Bedroom buildings within the estate.

The result shows that there are no un-occupied 3-bedroom buildings within the estate. This will inform the authorities of the estate that subsequent developments within the area should focus more on 3-bedroom building rather than 2-bedroom buildings.

5.0 Conclusion

This study has presented the possibilities for efficient implementation of a Cadastral Information System for M. I. Wushishi Estate in a GIS environment. Logical and Physical models for the cadastral Information System have been effectively built and utilized in the creation of the Cadastral Information System using an Entity relationship model. Such Information System has proven efficient for:

1. Property Valuation within the estate.
2. Residents Inventory for efficient security maintenance.
3. Miniature Digital Cadastre of title and interests in land within the estate.
4. Property leasing analysis.

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