LAND INFORMATION SYSTEM OF GOVERNMENT SECONDARY SCHOOL

AT MARABA OLD JEBBA ROAD, ILORIN

ILORIN EAST LOCAL GOVERNMENT AREA

KWARA STATE

BY

OLADITI ABDULMUHEEZ OLAYEMI

HND/23/SGI/FT/0092

SUBMITTED TO:

THE DEPARTMENT OF SURVEYING AND GEO-INFORMATICS,

INSTITUTE OF ENVIRONMENTAL STUDIES,

KWARA STATE POLYTECHNIC, ILORIN

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF HIGHER NATIONAL DIPLOMA IN SURVEYING AND GEO-INFORMATICS

JULY, 2025

CERTIFICATE

I hereby certify that the information contained in this project report was obtained as a result of the observations and measurements made by me on the field and that the survey was done in accordance with survey rules, regulations, and departmental instructions.

OLADITI ABDULMUHEEZ OLAYEMI	**HND/23/SGI/FT/0092**
NAME OF STUDENT	**MATRIC NUMBER**

CERTIFICATION

This is to certify that **OLADITI ABDULMUHEEZ OLAYEMI** with matriculation Number **HND/23/SGI/FT/0092** has satisfactory carried out the survey duties contained in this project report under our direct supervision.

I hereby declare that He had conducted himself with due diligence, and honest on the project.

MR. A.I ISAU **Project Supervisor**	**DATE**
MR. A.I ISAU **Head of Department**	**DATE**
SURV. R.S. AWOLEYE **Project Coordinator**	**DATE**
EXTERNAL SUPERVISOR	**DATE**

………………………………………………

Official Stamp

DEDICATION

This project is dedicated to Almighty God who has been there right from the beginning to this very point. Special dedication also to my ever supportive parents, **MR / MRS OLADITI,** for their relentless support and compassion towards me and during the course of my study.

AKNOWLEDGEMENTS

The dream of becoming an achiever in life comes true, not only by ones fortitude and hard work based or his knowledge, but it is also involving the positive influence of various factors and ideas of some people in his life.

All our dreams can come true, if we have the courage to pursue them. –Walt Disney

All praise and gratitude are due to almighty Allah, the Most Merciful and Benevolent, for guiding me throughout my academic journey and granting me the strength and wisdom to complete this project.

I firstly express my tremendous gratitude to my amiable project supervisor MR. ISAU A.I for his tireless assistance, expert guidance, patience, and constructive feedback which contribute deeply to the success of this project. May Almighty Allah not let his success elude him

Profound gratitude to Head of Department MR. ISAU A.I and the entire staff of the department for their moral support and valuable advice throughout my stay in school. May Almighty Allah reward you all abundantly.

I owe immeasurable gratitude to my parent MR & MRS OLADITI, who nurture and who has vowed not to leave no stone unturned in their quest to me for their unwavering support, love and encouragement towards the completion of my study throughout my academic journey. Your sacrifice has been invaluable.

My heartfelt gratitude to my group member for their cooperation and understanding while executing the project, especially Yunusa Ruqayyah and Samson Daniel. I pray we shall all meet at the top.

Finally. It will be a pitiable dismal and ingrate if I neglect the efforts and quintessential of family, friends, and leaders, who stood by me through the tough time of different challenges; My Siblings, TPL Oladiti Wahid, Bro Jamiu Orelope Jnr, Ustaz Idris, Ustaz Ahmad, Surv. Kazeem Williams, Surv. Bello Diran. Surv. Babatunde Kabir, Surv. Taiwo Wasiu, Olawas, Q.S Rasheed, Surv. Akin (Adron), Akinola Olamilekan, IBK, Timmy, Don Frenzy, HHK, FutureBoi, Alai Abdullah, Al-Aswadu, Zuglool, Idowu Abeeb, Ruqayyah, kabirah, Shukroh (Twin mother), Arowolo, Tife, Shuhaeeb Creativity, Almustapha, Class rep, Kewulere, All NISGS Executive and SGIMSA 2024/2025 Academic Session, entire course mate, and many other people that are precious to me but numerous to mention.

OLADITI ABDULMUHEEZ O.

ABSTRACT

This project focuses on developing a land Information System (LIS) designed to manage and analyze land-related data. The LIS integrates spatial and non-spatial data to provide comprehensive platform for land administration, planning, and decision making. Key feature includes data visualization and mapping capabilities. The system aims to enhance governance, reduce land dispute, and promote sustainable land use practices. As land is one of the most fundamental resources, with the above background, this highlight all information on land such as roads, buildings streets lights, electric poles, drainage the topology configuration of Government Secondary School Maraba old Jebba road, Ilorin South Local Government Area of Kwara State. All plans were produced using scale of 1:2500 in accordance to the survey rules and regulation.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Land has always played a pivotal role in the socio-economic and cultural development of human civilizations. As Dale (1988) highlights, land forms the foundation of agriculture, urban development, infrastructure, environmental management, and countless other aspects of society. Effective management and governance of land resources, therefore, are essential for sustainable development and growth. However, with the advent of rapid urbanization, growing populations, and technological advancements, traditional land management systems have struggled to keep pace with the complex demands of modern societies. This gap has given rise to the development and adoption of Land Information Systems (LIS) a revolutionary technology designed to integrate geospatial data, legal documents, and administrative procedures into a unified framework for effective land governance. The concept of Land Information Systems can be traced back to the advancements in Geographic Information Systems (GIS) in the mid-20th century.

As McLaughlin (1975) notes, GIS technology provided the foundation for analyzing and visualizing spatial data, enabling researchers and policymakers to make informed decisions about land resources. By the 1980s, the rise of personal computing and database management systems facilitated the transition from manual, paper-based systems to digital, automated systems for managing land-related data (McLaughlin &Dale, 1988). Over the years, LIS has evolved to become an indispensable tool for governments, private enterprises, and international organizations alike, with applications spanning urban planning, land registration, property taxation, dispute resolution, and environmental conservation.

At its core, a Land Information System is a comprehensive framework that integrates spatial and non-spatial data about land. Spatial data refers to the geographic characteristics of land, such as its boundaries, topography, and location (McLaughlin, 1985). Non-spatial data includes information about land ownership, legal rights, taxation, land use, and other administrative details. By combining these two dimensions, LIS provides a holistic view of land resources, enabling stakeholders to make informed decisions and ensure transparency, accountability, and efficiency in land governance. The importance of LIS in addressing contemporary challenges cannot be overstated. Across the globe, societies face a myriad of land-related issues, including land disputes, encroachments, urban sprawl, environmental degradation, and inefficient resource allocation (Dale, 1988). In Africa, for instance, the complexity and lack of documentation in land tenure systems have often led to conflicts, inequities, and underutilization of valuable resources (Berry, 1993). Similarly, in rapidly urbanizing countries such as Nigeria, the absence of reliable land information systems has hindered urban planning, infrastructure development, and economic growth. By leveraging LIS, countries can overcome these challenges and pave the way for sustainable development and equitable resource distribution.

The adoption of LIS has been particularly transformative in countries like Canada, Sweden, and Australia, where advanced land information systems have streamlined processes such as land registration, property taxation, and urban planning (Larsson, 1997). These systems have not only improved efficiency and reduced costs but have also enhanced public trust by ensuring transparency and reducing opportunities for fraud and corruption. In developing regions, where land administration is often plagued by inefficiencies and inequities, LIS holds immense potential as a tool for empowerment and progress (de Soto, 2000).

1.2 STATEMENT OF THE PROBLEM

Land administration and management in Government Secondary School Maraba continues to form critical inefficiencies, lack of coordination, and outdated systems in the study area.

These problems underscore a deeper need, the urgent implementation of a digital solution that can integrate spatial data, and land use details into a unified platform.

Therefore, this project seeks to address these challenges by designing and implementing a Land Information System that is intelligent, accessible, and tailored to support effective land administration and sustainable development in Government Secondary School Maraba.

1.3 AIM AND OBJECTIVES

1.3.1 AIM OF THE STUDY

The primary aim of this study is to design and implement a functional Land Information System (LIS) that enhances the efficiency, accuracy, and transparency of land management processes within Government Secondary School Maraba, Ilorin East Local Government, and Ilorin Kwara State. The system will serve as a digital platform for organizing, storing, retrieving, and managing land-related data, with the ultimate goal of supporting effective decision-making, reducing land disputes, improving access to land records, and promoting sustainable land administration at the institutional level.

1.3.2 OBJECTIVE OF THE STUDY

The specific objectives of this study are

1. Design a user-friendly Land Information System capable of managing land and usage data in a centralized digital format.
2. Geometric and attribute data acquisition
3. Implement core features of the system including data entry, spatial mapping, search and retrieval functions, and secure access control.
4. Integrate Geographic Information System (GIS) tools to visualize and enable location-based analysis and decision-making.

5. Evaluate the performance of the developed system in terms of accuracy, usability, responsiveness, and reliability.
6. To produce plans as graphical representation.

1.4 SCOPE OF THE PROJECT

The scope of this project covers the following major phases and activities:

1. Reconnaissance Survey: Preliminary field inspection to understand the area of study, identify existing features and determine control points needed for mapping.
2. Office Planning: Preparation of necessary materials, equipment checks, defining the workflow, and gathering existing maps or records for the project area.
3. Data Acquisition: Collection of spatial and non-spatial data through total station.
4. System Design and Implementation: Development of a functional Land Information System to address land management and decision making.
5. Documentation and Reporting: Compilation of project activities, methodologies, system features, and outcomes into a final technical report.

1.5 PERSONNEL

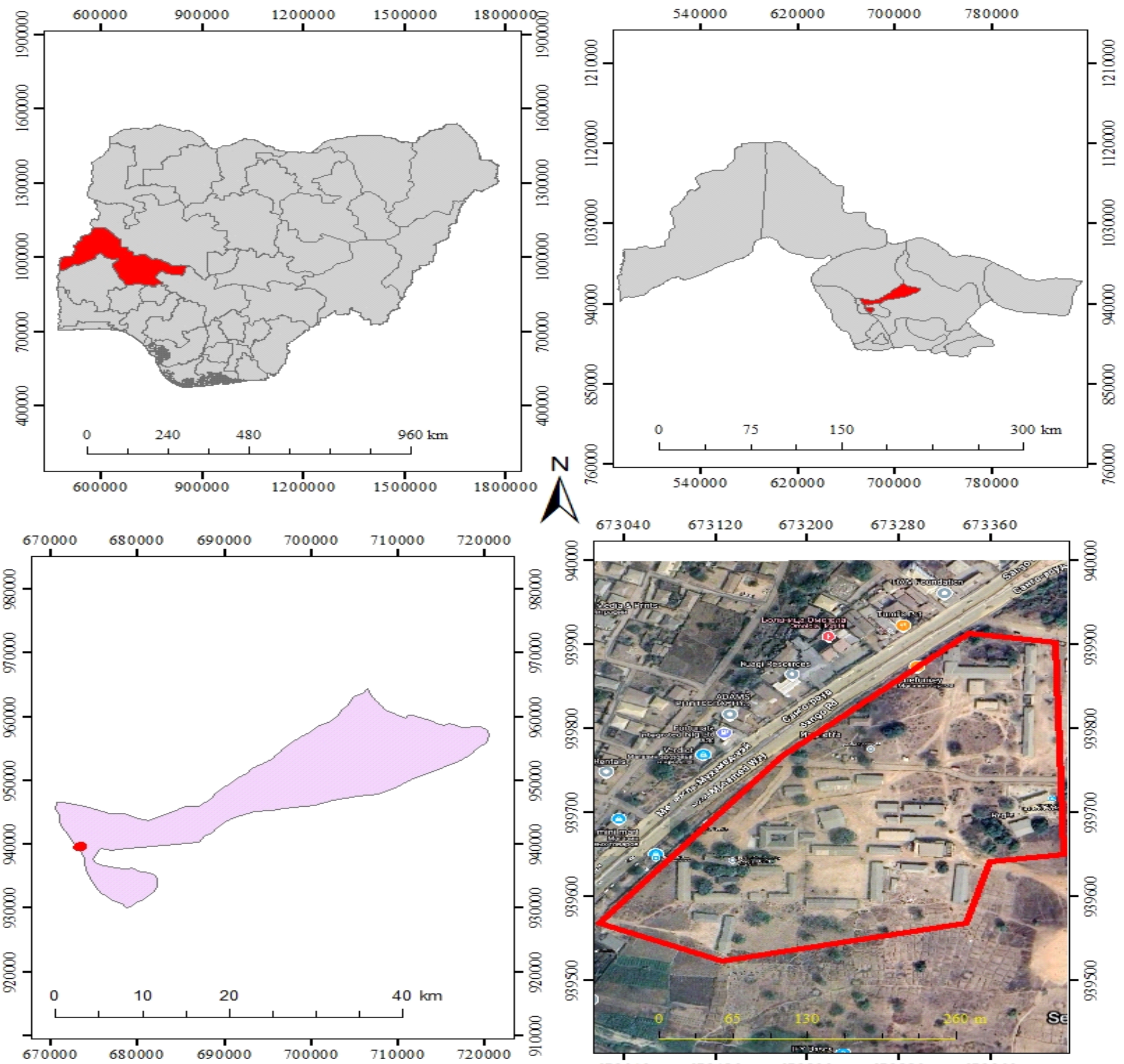
Table 1.1 shows the personnel involved in project

S/N	NAME	MATRIC NUMBER	REMARK
1	OLADITI ABDULMUHEEZ OLAYEMI	HND/23/SGI/FT/0092	AUTHOR
2	YUNUSA RUKAYAT	HND/23/SGI/FT/0090	MEMBER
3	FATOYINBO THERESA	HND/23/SGI/FT/0091	MEMBER
4	AREMU OLUWAFEMI VICTOR	HND/23/SGI/FT/0093	MEMBER
5	AGBALAYA OLAIDE MARGARET	HND/23/SGI/FT/0097	MEMBER
6	AJEORUN JAMIU OLUWADAMILOLA	HND/23/SGI/FT/0099	MEMBER
7	AJIDE ALICE OLUWATOYIN	HND/23/SGI/FT/0113	MEMBER
8	SAMSON DANIEL OLUWATOBILOBA	HND/22/SGI/FT/0121	MEMBER

1.6 STUDY AREA

Government Secondary School Maraba, Ilorin Kwara State., Ilorin East Local Government area (673384.7215E, 939882.4456)The project site is geographically defined by these parameters; 8^0 29′59”N 4^0 34′31” E

NIGERIA KWARA



ILORIN EAST LOCALGOVERNMENT GOVERNMENT SECONDARY SCHOOl

Source: Google Earth, April 2025.

Figure 1.6.1 shows the project study area

1.7 PROJECT SPECIFICATION

This project is aimed at building a Land Information System (LIS) to support effective land management. The system will combine both spatial (map-related) and non-spatial (text-based) information to help users register, retrieve, and visualize land records.

CHAPTER TWO

2.0 LITERATURE REVIEW

Definition and Concept

A Land Information System (LIS) is a technological framework designed to manage, store, analyze, and visualize land-related data. These systems integrate various sources of geographic and non-geographic data to help make informed decisions related to land management, land use, and land tenure. The primary purpose of an LIS is to improve the administration, control, and management of land resources.

LIS is an essential tool for land administration, which includes processes such as land registration, land valuation, property rights management, and zoning. In more developed applications, LIS may also extend to urban planning, environmental conservation, and disaster management. Unlike traditional manual systems that rely on paper maps and records, LIS leverages digital tools like Geographic Information Systems (GIS), remote sensing, databases, and advanced computational techniques to process and manage land data efficiently.

Historical Development of Land Information Systems

The history of Land Information Systems can be traced back to the early 20th century, when traditional methods of land survey and paper-based cadastral systems were the norm. Initially, land records were stored in physical formats such as paper maps, land deeds, and handwritten registers. These records were manually updated, and information retrieval was slow and prone to errors.

The evolution of LIS began with the introduction of computers in the 1960s and 1970s. Early computerized systems were primarily focused on storing cadastral data, such as land ownership, boundaries, and land use. However, these systems were limited in scope and lacked integration with other spatial data types.

The 1970s and 1980s saw the advent of Geographic Information Systems (GIS), which allowed for the digital mapping and spatial analysis of land data. GIS transformed land information management by enabling the representation of land features in a spatial format, facilitating analysis of spatial relationships and patterns. This shift made it possible to better understand and manage land resources, leading to more informed decision-making in land administration and urban planning.

By the 1990s, the rapid advancements in computing power, data storage, and software development spurred further progress in LIS. Governments and private sector organizations began implementing sophisticated LIS for urban planning, zoning, resource management, and environmental monitoring. With the rise of satellite-based technologies and remote sensing, LIS also began to incorporate environmental data, such as land cover changes, vegetation, and natural resources.

Importance of Land Information Systems

LIS are crucial for managing land resources effectively and ensuring secure land tenure. The efficient management of land data is fundamental for governments, developers, property owners, and businesses. Without a reliable LIS, it is nearly impossible to keep track of land ownership, boundaries, land use, and development rights.

Some key reasons why Land Information Systems are essential include:

Legal and Administrative Efficiency: LIS ensures that land records are accurate, up-to-date, and easily accessible. This facilitates the management of land titles, deeds, and property rights, thus minimizing disputes and enhancing legal certainty.

Urban Planning: In rapidly urbanizing regions, LIS enables planners and government officials to manage land use effectively, zoning areas for residential, commercial, agricultural, or industrial purposes. It helps in making informed decisions regarding infrastructure development and environmental sustainability.

Environmental Management: LIS allows for the monitoring of land use changes over time. This is crucial for environmental management, as it provides insights into issues such as deforestation, land degradation, and urban sprawl. By analyzing this data, governments can implement policies to preserve natural resources and mitigate the effects of climate change.

Public Services and Disaster Response: A properly maintained LIS can be instrumental during natural disasters. For example, during floods or earthquakes, an LIS can provide real-time data on affected land areas, infrastructure, and vulnerable populations. This enables effective disaster management and resource allocation.

Economic Development: By providing detailed information on land ownership and use, LIS supports property markets, land valuation, and land transactions. It also facilitates land taxation, which is a significant source of revenue for governments. Moreover, businesses and investors use LIS to identify potential development sites, assess land values, and mitigate risks.

Role of Technology in Advancing LIS

Technology plays a pivotal role in the functionality and evolution of Land Information Systems. With the continuous advancements in technology, LIS has been able to integrate diverse datasets and support sophisticated analyses. The key technological components that support modern LIS include:

Geographic Information Systems (GIS): GIS allows for spatially referenced data storage and analysis. It helps in visualizing land data, conducting spatial analysis, and identifying patterns that inform decision-making.

Remote Sensing: Satellite imagery and aerial photography provide invaluable insights into land use patterns, environmental changes, and resource distribution. Remote sensing data can be integrated into LIS to offer updated and accurate land information.

Database Management Systems (DBMS): LIS relies on databases to store large volumes of land-related data, including cadastral records, property rights, and land use data. A DBMS ensures that this information is accessible, secure, and easily retrievable.

Mobile Technologies: Mobile devices and applications have transformed how field data is collected and updated in real time. This is particularly useful for land surveying and property inspections, ensuring that land data is up-to-date and accurate.

Cloud Computing: Cloud-based platforms are increasingly being used for storing and managing land data. Cloud solutions make it easier for governments and private organizations to share data across regions, improving collaboration and accessibility.

Blockchain Technology: In recent years, blockchain technology has emerged as a tool to enhance the transparency, security, and immutability of land transactions. Blockchain can ensure that land titles and ownership records are tamper-proof, reducing fraud and disputes.

Components of Land Information Systems (LIS)

Land Information Systems (LIS) are complex systems that consist of various components working together to collect, store, analyze, and manage land-related data. These components include data, software, hardware, and people who interact with the system. Each component plays a crucial role in ensuring that the LIS functions effectively, allowing for informed decision-making regarding land use, management, and administration.

Data Types in Land Information Systems

A fundamental component of any Land Information System is the data it manages. LIS typically handles a diverse array of data types, each contributing to the overall understanding and management of land resources.

Cadastral Data: This is the most critical type of data within an LIS. Cadastral data includes information about land parcels, boundaries, ownership, and rights. It typically involves:

Parcel Boundaries: Geographic coordinates and physical boundaries of land parcels.

Ownership Records: Information about who owns the land, including details such as name, address, and legal status.

Title Deeds and Land Rights: Legal documents that confirm ownership and the rights attached to the land, such as use, transfer, or lease.

Topographic Data: This data includes detailed information about the land's physical features, such as:

Elevation: Height of the land above sea level, which is critical for flood modeling, construction, and agriculture.

Slope: The steepness of the land's surface, which affects land use, especially for farming and infrastructure.

Water Bodies: Rivers, lakes, and wetlands, which are vital for environmental management and planning.

Land Use Data: This refers to the current use of land, including residential, commercial, agricultural, industrial, and recreational areas. Understanding land use is essential for urban planning, zoning, and environmental management.

Environmental Data: Environmental data involves information about the ecological features of the land, such as vegetation, biodiversity, and land degradation. This data helps monitor and protect natural resources and plan for sustainable land development.

Infrastructure Data: Includes information about existing infrastructures, such as roads, bridges, power lines, sewage systems, and telecommunication networks. Infrastructure data is vital for urban development, transportation planning, and resource management.

Socioeconomic Data: This type of data focuses on the human aspect of land use, including population density, land value, housing conditions, and socioeconomic status of landowners or residents.

Geospatial Data: Geospatial data refers to information tied to specific geographic locations. This includes all mapping data that enables spatial analysis and visualization in GIS, such as coordinates, maps, and satellite images.

Software and Tools in Land Information Systems

The software used in a Land Information System is a key component in enabling data processing, analysis, and visualization. The functionality and capability of the LIS depend significantly on the software applications integrated into the system.

Geographic Information Systems (GIS): GIS is the backbone of any modern LIS. GIS software allows users to input, store, analyze, and visualize spatial data in a map-based environment. It integrates multiple layers of information (such as land use, ownership, and topography) and performs various spatial analyses to derive insights about land patterns and relationships. Examples of GIS software include:

ArcGIS: One of the most widely used GIS platforms, known for its comprehensive tools for spatial analysis, mapping, and data management.

QGIS: An open-source GIS platform that is highly customizable and supports a wide range of GIS functionalities.

Database Management Systems (DBMS): An LIS stores a vast amount of data, making robust database management systems essential for efficient data storage, retrieval, and manipulation. DBMS software ensures that land data is well-organized, secure, and easily accessible. Examples include:

Oracle Spatial: A powerful database that allows the storage and retrieval of geospatial data.

PostGIS: An extension for PostgreSQL, which provides spatial database capabilities for GIS data management.

Remote Sensing Software: Remote sensing software is used to analyze data collected through satellite imagery and aerial photography. This software helps extract useful information, such as land cover, vegetation health, and urban growth patterns, which can be integrated into the LIS. Common remote sensing software includes:

ENVI: A popular software for processing and analyzing remote sensing data, used extensively in environmental monitoring and land management.

ERDAS Imagine: A remote sensing software known for its spatial modeling and image processing capabilities.

Land Administration Systems (LAS): LAS software is tailored to support land management processes such as land registration, title deed management, and property transactions. It integrates cadastral data, ownership records, and legal documents, enabling efficient land administration and ensuring transparency in land ownership. Notable examples include:

Landfolio: A comprehensive land administration platform used by governments to manage land registration, cadastral records, and land titles.

SOLA (State Online Land Administration): A software solution for automating and modernizing land registration systems.

Web and Mobile Applications: With the rise of mobile and web technologies, many modern LIS now offer mobile apps and web-based platforms to collect, access, and manage land data in real-time. These applications allow field workers to gather and upload data from remote locations, improving the efficiency of land surveys and inspections.

Hardware and Infrastructure for Land Information Systems

The hardware infrastructure for an LIS is essential for ensuring that the system operates effectively, especially when handling large volumes of data. Proper hardware ensures data processing, storage, and accessibility.

Servers and Storage: Large-scale servers and cloud-based storage solutions are necessary to store and manage the vast amounts of land-related data in an LIS. These systems ensure the scalability of the LIS, allowing it to grow as more data is accumulated.

Cloud Servers: Cloud storage solutions, like Amazon Web Services (AWS) and Microsoft Azure, are increasingly popular for managing LIS data due to their scalability, reliability, and cost-effectiveness.

Field Equipment: Data collection in the field often requires specialized equipment such as:

GPS Devices: For accurate location tracking and mapping of land boundaries.

Total Stations: Used for surveying land parcels and measuring distances and angles for precise boundary mapping.

Drones: Unmanned aerial vehicles (UAVs) are used for high-resolution aerial photography and mapping, particularly in remote or inaccessible areas.

Workstations: GIS and remote sensing software require powerful workstations with high-performance processors, large memory capacities, and advanced graphics processing units (GPUs) for handling complex spatial analysis tasks.

People and Expertise in Land Information Systems

The success of a Land Information System depends not just on the technology, but also on the people who design, manage, and use it. These include:

System Administrators: Professionals responsible for the installation, maintenance, and troubleshooting of the hardware and software systems. They ensure the LIS runs smoothly and securely.

GIS Analysts: These experts are skilled in working with GIS tools to analyze spatial data, create maps, and derive insights that can guide land-related decisions. Their expertise is crucial in extracting meaningful information from land data.

Land Surveyors: Professionals who conduct field surveys to gather precise geographic data, such as land boundaries, topography, and infrastructure. They ensure that the data entered into the LIS is accurate and reliable.

Legal Experts: In the context of land registration and administration, legal professionals help ensure that the land information complies with legal frameworks and supports secure property rights.

End Users: Government officials, urban planners, environmental specialists, developers, and citizens who use the LIS for various land management activities.

CHAPTER THREE

3.0 METHODOLOGY

This explained the method and techniques used to pursue the objectives and to realize the aims of this project work, the execution of this project was based on the following basic principle of surveying

- Working from whole to the part.
- The principle of choosing the method of survey most appropriate to meet the desired result.
- The principle of provision for adequate checks to meet the required accuracy

3.1 PROJECT PLANNING

Effective planning is essential before initiating any survey project. This process begins with a thorough inspection of the project area, allowing the researchers to gain a clear understanding of the site prior to commencing fieldwork, known as “RECONNAISSANCE”. Reconnaissance typically consists of two main components: (i) Office Planning (ii) Field Reconnaissance

Effective surveying begins with comprehensive project planning, a systematic process that establishes the foundation for accurate data collection. This preparatory stage involves:

- Thorough research on the targeted land parcel
- Clear definition of survey objectives and deliverables
- Precision assessment to determine methodology and equipment.

3.1.1 OFFICE PLANNING

Office planning which could be termed as office reconnaissance involved knowing the type of instruments, purpose, specification and accuracy require of the survey to be carried out. These led to the choosing of appropriate equipment and method to be employed, also costing of the survey operation was done in the office. Information related to the project was collected from various sources, the coordinate (x, y, and z) of the initial and that of the three choosing controls used for orientation were all obtained from survey department office (KWGIS).

3.1.2 FIELD RECONNAISSANCE

The project site was visited by all the group members to have the true picture of the site for the better planning. The recce diagram was drawn alongside the carrying out and the reasonable artificial features were fixed along and within the traverse lines, the traverse was fixed to maintain perfect indivisibility.

3.2 DATA BASE DESIGN

The design of any database involves three stages namely;

- Conceptual design
- Logical design
- Physical design

VIEWOF REALITY

In database design, there is need for reality which is referred to as the phenomenon that actually exists, including all aspects which may or may not be perceived by individuals. The view of reality however, is the mental abstraction of the reality for a particular application or group of applications.

For this application, the view of reality is made of the topography of the project. Since it is not possible to represent the real world, the only option is to conceptualize and model it in a specified manner to represent the real world. The area of interest to use in this project includes; Green Reserve, Roads, Electric poles, Trees, Water Facilities, Buildings, Football pitch, Streams.

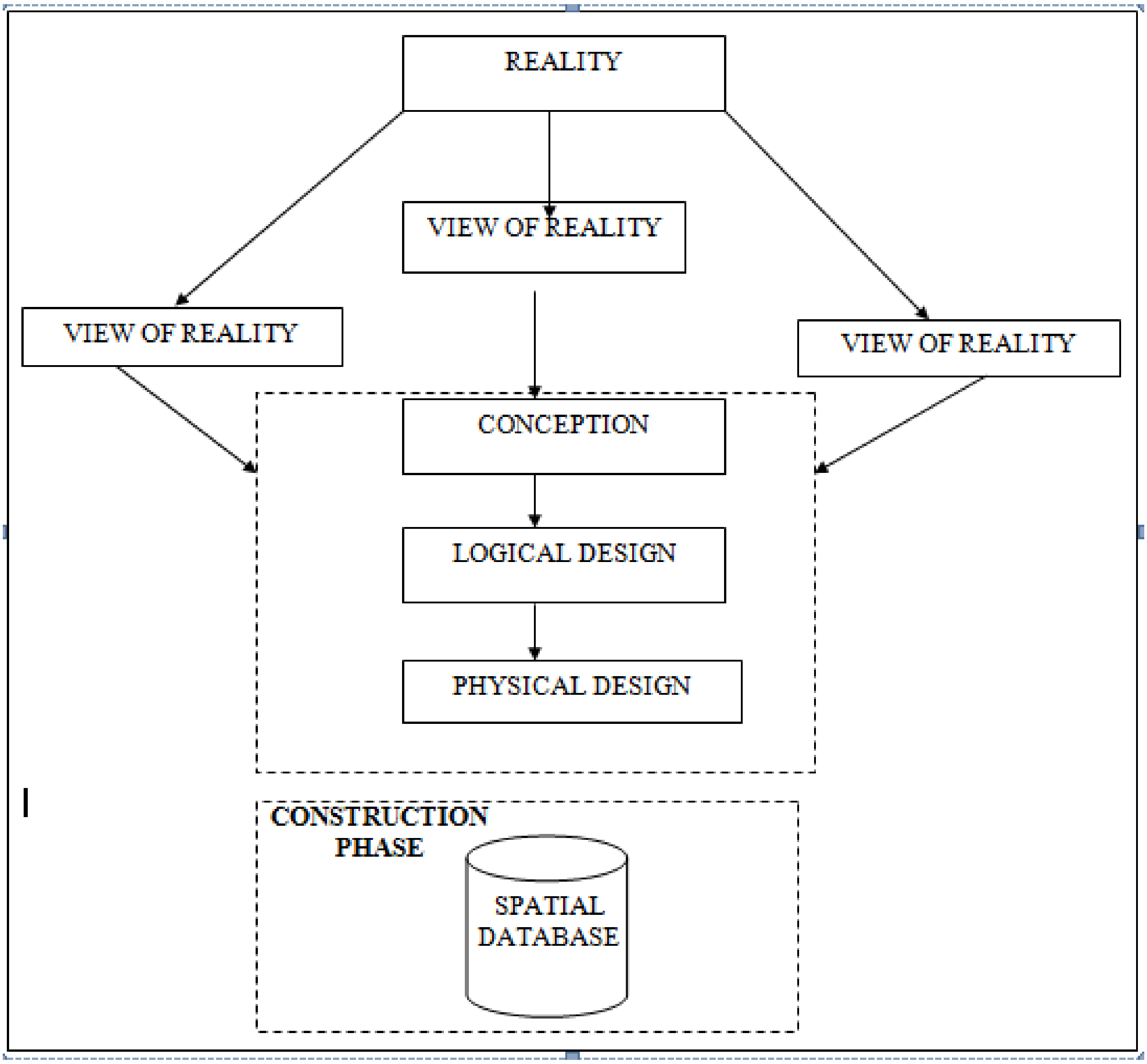


Fig.3.1Design and Construction Phases in Spatial Database (R Sobh, C Perry,. 2006)

3.2.1 LOGICAL DESIGN

This is the design aspect of the database refers to the process of creating a conceptual framework or model that represents the structure and organization of spatial data within the system. It involves defining the data element, their relationship, and the rules for data manipulation and analysis. In this phase, the entities, their attributes and their relationships are represented in a single uniform manner in form of relation in such a way that would be no information loss and at the same time no unnecessary duplication of data. In this study, the logical database design is employed to generate a geo-relation database structure. Each entity has unique identifier in bold type. An attribute type or combination of attribute types that serves to identify an entity type is termed an identifier.

i Building (B_ID,B_Area, B_Name, B_Easting, B_Northing)

ii Roads (R_ID,R_Width, R_Type, R-Condition, R_Easting, R_Northing)

iii Vegetation (V_ID,GR_Area,)

iv Tree (TR_ID,TR_spp,TR_Importance,TR_Easting,TR_Northing)

v Electric Pole (EP_No,EP_Type,EP_Height,EP_Easting,EP_Northing)

vi Football Pitch FP_ID, FP_Area,FP_Status)

3.3 EQUIPMENT USED

3.3.1 HARD WARE

- Total Station (South
- Reflector Pole
- Hand-held GPS
- Steel tape
- Nails and bottle cover

- Field book
- 1 cutlass

3.3.2 SOFTWARE

- AutoCAD 2007
- Arc-GIS 10.2
- Google Earth
- Note pad
- Excel

3.4 INSTRUMENTTEST

To ensure data quality, the Total Station used for this project was tested for both vertical index and horizontal collimation errors. It was also to ascertain the efficiency and reliability of the instrument. The procedure used is described below.

3.4.1 HORIZONTALCOLLIMATIONTEST

This test was conducted to ensure that the line of sight was perpendicular to the trunnion axis. The Total Station was positioned over a specific point, and initial adjustments were made to ensure proper alignment, leveling, and focus (to eliminate parallax in the telescope). A vertical target was placed at a distance of 100 meters from the Total Station. To access the configuration menu of the Total Station, the menu key was pressed and held for approximately 2 seconds. From the main menu, the calibration sub-menu was selected, and within that, the horizontal collimation test option was chosen. The target was then observed and divided into two halves, with horizontal readings recorded for Face left and Face right. The readings are shown in Table 3.4.1 below.

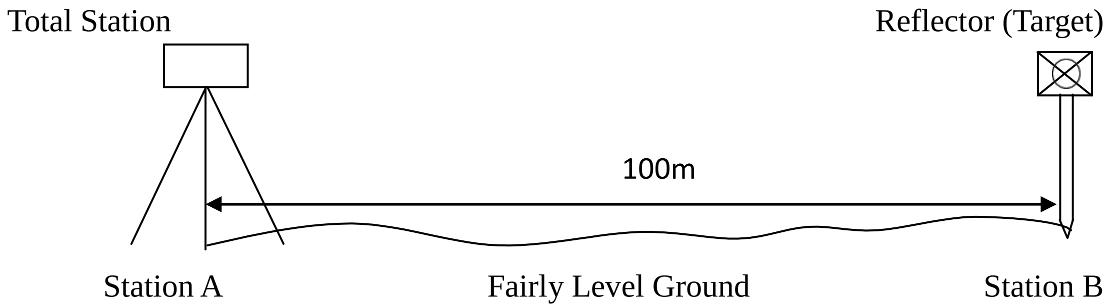


Fig3.4.1.1; Horizontal Collimation and Vertical Index error test

Table3.4.1.1: Horizontal Collimation Data

Station	Target	Face	Horz. Reading	Difference	Error
A	B	L	025˚ 32‟ 32”		
		R	205˚ 32‟ 35”	180˚ 00’ 03”	00˚ 00’ 03”

3.4.2 VERTICAL INDEX ERROR TEST

This test was conducted to verify the accuracy of the vertical reading when the line of sight is horizontal. The desired measurement for this test is exactly ninety degrees (90˚), any deviation from this value is referred to as the vertical index error.

The Total Station was positioned over a specific point, and necessary temporary adjustments were made to ensure proper alignment and functionality. A target was placed approximately100 meters away from the Total Station, and the instrument

was aimed at the target. The target was bisected by aligning the instrument on the face left, and the corresponding reading was recorded. Similarly, the target was then bisected on the face right and the respective reading were also recorded. The recorded readings are provided below:

Table3.4.2.1: Vertical Index Data

Instrument Station	Target Station	Face	Vertical	Sum	Error
A	B	L	95˚ 00‟ 00”		
		R	275˚ 00‟ 02”	360˚ 00‟ 02”	02”

3.4.3 ANALYSIS OF COLLIMATION AND VERTICAL INDEX DATA

The readings obtained during calibration were reduced to obtain new collimation and vertical errors.

Horizontal collimation = {(FR–FL) –180} /2 ={(00˚00‟03”} /2 =1.5”

Vertical collimation = {(FL+FR) –360} = (95˚00‟00” + 275˚00‟02”) -360} =

02” The result shows that the instrument is still in good working condition.

3.5 CONTROL CHECK

3.5.1 Control Check Procedure Using Total Station

To ensure the accuracy and reliability of the Total Station observations used for spatial data acquisition, control checks were carried out before and during the main survey. The procedure involved setting up the instrument over a known control point, performing temporary adjustments, executing angular and distance observations (back sight and foresight), and validating the computed coordinates against known values.

Step 1: Instrument Setup and Centering.

The Total Station was mounted securely on a tripod placed directly over the first known control point.

Centering was done using the built-in optical plummet to align the vertical axis of the instrument precisely over the ground mark.

Fine adjustments were made by shifting the tripod legs or using the sliding base plate to achieve perfect alignment.

Step 2: Temporary Adjustments (Leveling and Elimination of Instrumental Error)

Leveling: The circular bubble was first centered using the tripod legs. Then, the tubular (or electronic) level was used with the foot screws to achieve fine leveling in two perpendicular directions.

Collimation Check: An internal calibration (collimation) check was performed using the instrument's self-diagnosis function to ensure the vertical and horizontal axes were perpendicular.

The horizontal circle was then set to zero after selecting the backsight direction.

Step 3: Back sight Observation

The telescope was rotated to face a second known control point (backsight).

The instrument was focused accurately on the backsight prism, and both horizontal and vertical coordinates (XYZ) were measured.

Step 4: Foresight Observation and Coordinate Validation

The telescope was then turned to observe a third point (foresight). The horizontal and vertical coordinates (XYZ) were measured. The observed coordinates were then compared to the known coordinates of the foresight control point already established.

Coordinate difference (ΔX, ΔY, ΔZ) was calculated to assess positional accuracy. The difference was within the allowable tolerance (typically ±2cm for X/Y and ±3cm for Z), the instrument was considered properly calibrated.

Step 5: Repeat Check at another Station

The same procedure was repeated for every station setup across the site to ensure uniform accuracy across the network.

All three control stations showed closure errors and coordinate differences well within the accepted tolerance for third-order survey work. This control check procedure ensured that the Total Station data used for plotting school boundaries, buildings, and topography in the Land Information System were precise and trustworthy.

Once the control points were verified and validated, they were used as reference locations for the detailed survey of the school facilities.

Table 3.5.1: Coordinate of the observed and the original values of K654AD

PILLAR	NORTHING	EASTING	STATUS	REMARKS
SC/KW K654AD	939792.896	673354.040		ORIGINAL
SC/KW K654AD	939792.886	673354.020	FIXED	OBSERVED
DISCREPANCY	0.010	0.020		

Table 3.5.2: Coordinate of the observed and the original values of K656AD

PILLAR	NORTHING(m)	EASTING(m)	STATUS	REMARKS
SC/KW K656AD	939837.818	673334.688		ORIGINAL
SC/KW K656AD	939837.797	673334.666	FIXED	OBSERVED
DISCREPANCY	0.021	0.022		

Table 3.5.3: Coordinate of the observed and the original values of K657AD

PILLAR	NORTHING(m)	EASTING(m)	STATUS	REMARKS
SC/KW K657AD	939803.143	673366.311		ORIGINAL

SC/KW K657AD	939803.132	673366.291	FIXED	OBSERVED
DISCREPANCY	0.011	0.020		

3.6 GEOMETRIC DATA ACQUISITION

The total station instrument was set carefully on control point SC/KW K6546AD back sight taken to K SC/KW K654AD after necessary station adjustments has been carried out on it. The adjustments include; centering, leveling and focusing. The following procedures were then followed to determine the position of the next point (NL1) and the same procedure were repeated until all we come close to the site. The method used in acquiring data on site was radiation method where two or more points are coordinated from one instrument station.

i. Having setup the instrument and temporary adjustment carried out, the instrument was powered „on" and a job file was created under job menu in the internal memory of the instrument. The job file created was named GSSGR4C.

ii. On the job, the coordinates of the three (3) control points were keyed in to the memory of the instrument and some codes were also saved. The codes include RD" for road, SP" for spot height, BD for buildings, etc.

iii. The height of the instrument was measured and saved on the memory of the instrument as well as their reflector height.

iv. On coordinate menu, orientation was set by inputting the coordinates of the instrument station and back sight. The reflector at the back station was perfectly bisected before the orientation was confirmed by clicking yes.

Having done the orientation, the reflector at the next station was bisected and observe option was clicked. The three-dimensional coordinate of the point (E N, H) were displayed on the display unit of the instrument and record button was clicked to save the data into the memory of the instrument. For subsequent observation after this, all options were used instead of pressing observation (“obs”) and pressing record later.

v. It was ensured that the center of the prism of the reflector was bisected and that it was set perfectly on the tripod in order to minimize the error on height determination.

vi. The instrument is been shifted to another station after all details, spot height and boundary point visible from the instrument station have been picked, The instrument was set over new station and temporary adjustments carried out.

However, the above operations were repeated until all the boundary points with heights were coordinated.

In this project all spot height were not in grid intervals but randomly acquired. At the end of data acquisition process all details were observed and properly recorded to be shown in their respective positions on the plan.

3.7 DETAILED SURVEY

The detailed survey focused on mapping the internal structures and facilities within the school, including:

- Classrooms
- Staff rooms and administrative offices
- Laboratories and libraries
- Playgrounds and sports fields
- Roads, parking lots, and walkways

Geometric data for every feature were acquired using Total Station, and the collected spatial data were stored in a structured format. Screenshots of the Total Station data interface were captured to illustrate the data collection process. The observations were carried out systematically to ensure complete coverage of all features within the project area.

3.7.1 Non-Spatial Data Collection

In addition to spatial data, non-spatial data (attribute data) were collected to provide descriptive information about each observed feature. These data were gathered through field observations, school administrative records, and structured interviews with key personnel.

Types of Non-Spatial Data Collected

- Building Information: Name, number of floors, year of construction, type of usage (classroom, staff office, laboratory, etc.).
- Staff Room and Office Details: Departmental functions, number of staff, office occupants.
- Infrastructure Information: Type of roads (paved or unpaved), water supply, power supply.

A field book was used to record the collected data, ensuring uniformity and easy integration into the LIS database. The completed forms were reviewed for accuracy before entering the data into a spreadsheet for GIS processing. Screenshots of the attribute data collection forms were taken and included in the documentation.

3.8 Data Download and Storage

Once the field surveyed was completed, all collected data were transferred to a computer system for further processing and storage. The following steps were taken to ensure proper data management:

1. Downloading Total Station Data: The surveyed X, Y, Z coordinates were extracted from the Total Station's internal memory using instrument software. The data were

saved in a CSV (comma-separated values) file format for compatibility with GIS and AutoCAD software.

2. Organizing Non-Spatial Data: The collected attribute data were entered into an Excel spreadsheet, ensuring proper formatting for easy integration with spatial data. The file structure was reviewed to ensure consistency and completeness.
3. Data Backup: Copies of all data files were stored in an external flash drive to prevent data loss. File versions were properly labeled to maintain organization.

The downloaded spatial and non-spatial datasets were prepared for further processing and integration into the LIS.

3.8.1 Data Validation and Accuracy Assessment

To ensure the accuracy and reliability of the collected data, a rigorous validation process was conducted. This involved cross-checking the surveyed coordinates, attribute data, and instrument readings to identify and correct any errors.

3.8.2 Validation of Spatial Data

- Coordinate Cross-Check: The surveyed points were compared with known control points to verify accuracy.
- Boundary Accuracy Check: The surveyed boundary was overlaid on an existing satellite image in Arc=GIS to detect any misalignment.

Figure 3.3: Satellite Imagery of the study area

3.8.3 Validation of Non-Spatial Data

- Attribute Consistency Check: The recorded building and facility details were compared with official school records.
- Correction of Data Entry Errors: Any discrepancies or incorrect attribute entries were identified and corrected before finalizing the dataset.

3.9 DATA PROCESSING AND INTEGRATION

The data processing and integration phase is a critical step in transforming the raw data collected from the field survey into a structured Land Information System (LIS). This stage involves cleaning, organizing, and integrating both spatial and non-spatial data into a geodatabase, ensuring seamless access, analysis, and visualization.

The processing workflow consists of multiple steps, including spatial data processing in AutoCAD and Surfer, non-spatial data structuring in Excel, geodatabase creation in ArcGIS, and data integration for LIS development. The structured integration of these datasets enables effective querying, mapping, and decision-making for the secondary school management system.

3.9.1 Spatial Data Processing in AutoCAD

AutoCAD was used to plot the observed coordinates, (Geometric data) ensuring accurate representation of school facilities such as classrooms, staff rooms, administrative offices, roads, and playgrounds. The following steps were carried out:

1. Importing Surveyed Points:
    - The CSV file containing surveyed coordinates was imported into AutoCAD.
    - The points were plotted based on their real-world X and Y coordinates, while the Z values were retained for elevation analysis.
2. Plotting of Boundaries and Features:
    - The boundary points were connected using polyline tools, forming a closed polygon to define the extent of the school premises.
    - Each school building was mapped as a separate layer, and unique identifiers were assigned to distinguish classrooms, staff rooms, laboratories, and other structures.

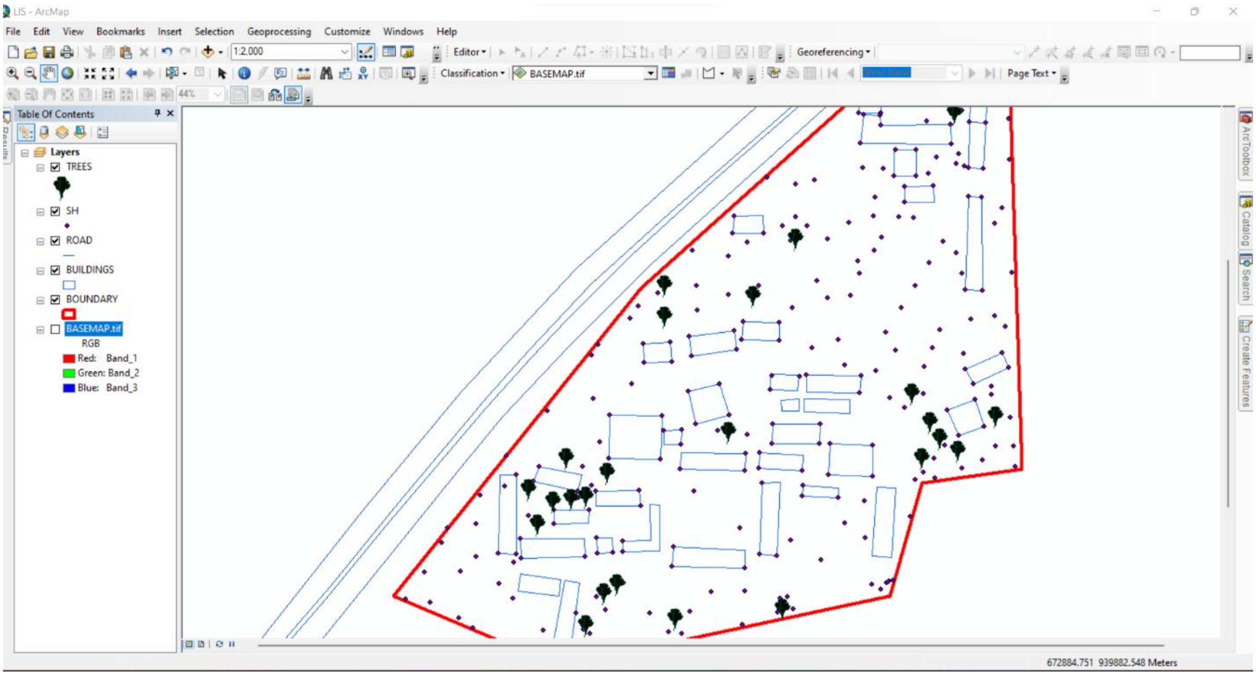


Figure 3.5 Screenshot of boundary digitization and features

3.9.2 Topographic Data Processing in Surfer

Surfer software was used for topographic analysis and terrain modelling based on the surveyed elevation data (Z values). The following procedures were followed:

1. Importing Surveyed Data:

    - The X, Y, and Z coordinates were loaded into Surfer as a point dataset.

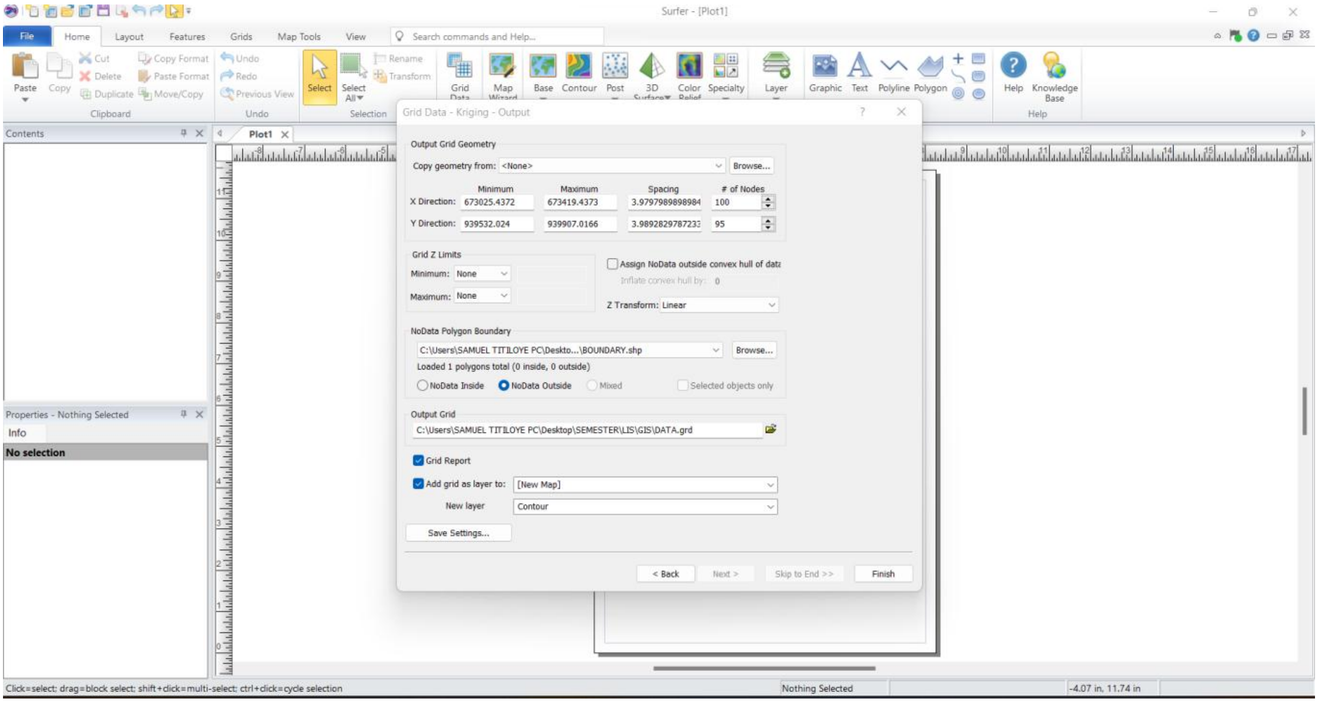


Figure 3.6: Screenshot of the imported dataset.

2. Generation of Digital Elevation Model (DEM):

- A grid-based interpolation technique was applied to generate a Digital Elevation Model (DEM) of the school area.
- The DEM provided insight into the elevation variations across the school premises, assisting in drainage and flood risk assessment.

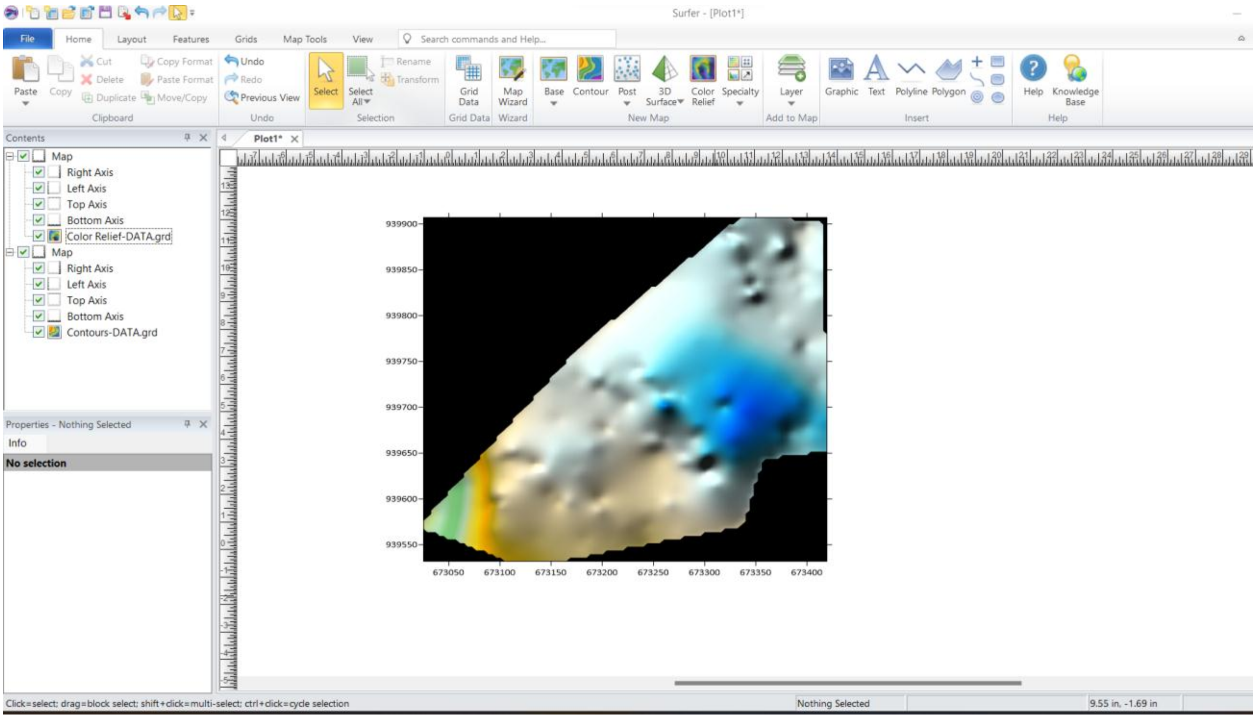


Figure 3.7: Screenshot of the generated DEM.

3. Creation of Contour Maps:

   - Contour lines were generated at specific intervals to visualize terrain variations.
   - The contour map was exported in Geo-TIFF format for integration into Arc-GIS.

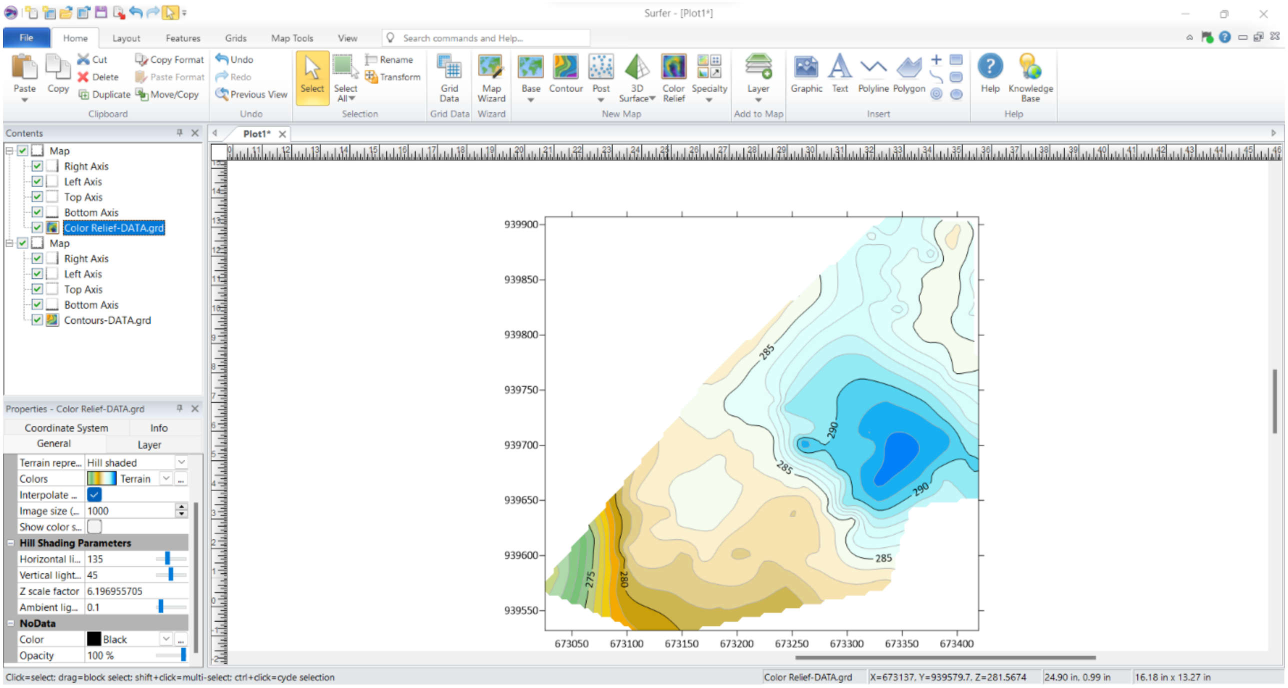


Figure 3.8: Screenshots of the contour generation process.

3.9.3 Non-Spatial Data Processing in Excel

Non-spatial data collected through field observations and school administrative records were structured and formatted in Excel to ensure consistency and ease of integration into Arc-GIS.

1. Data Entry and Formatting:

    - Each facility was assigned a unique ID corresponding to its spatial location.
    - Attributes such as building type, year of construction, and available amenities were recorded.

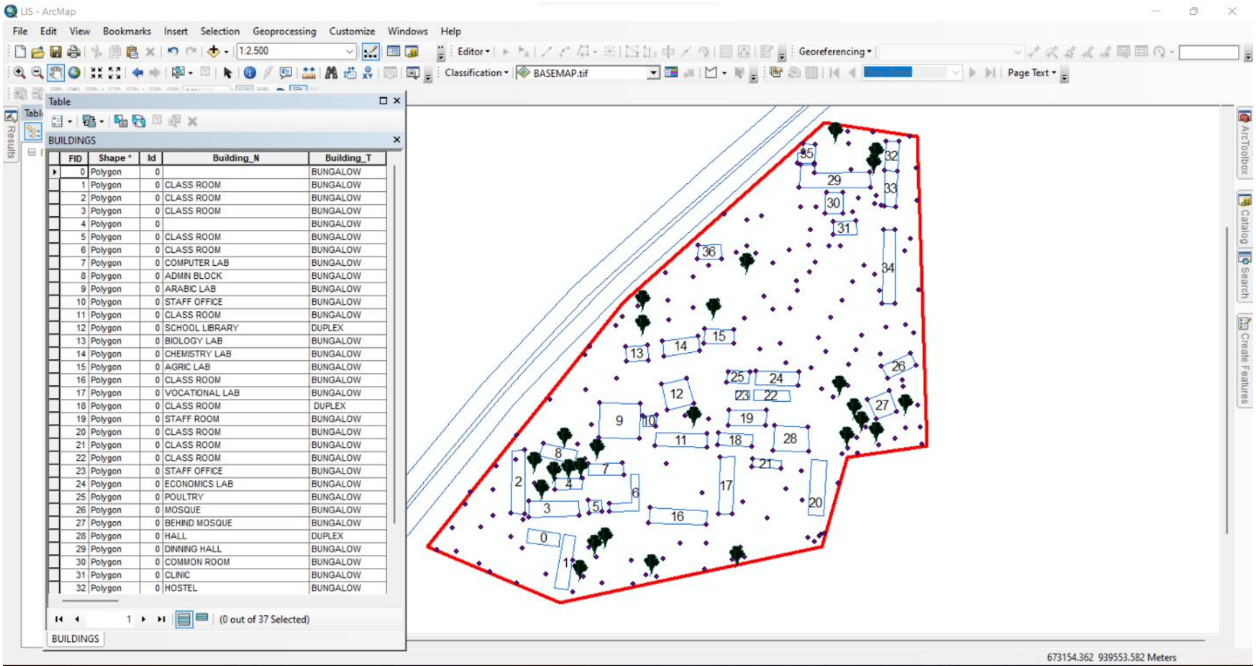


Figure 3.9: Screenshot of the structured attribute table.

3.9.4 Geo-database Creation in Arc-GIS

A geo-database was created in Arc-GIS to integrate both spatial and non-spatial data, allowing efficient storage, retrieval, and analysis of school infrastructure data. The following steps were taken:

1. Creating a New Geo-database:
    - A file geo-database was created in Arc-GIS to store all spatial data layers and attribute tables.
2. Importing Spatial Data:
    - The DXF file from Auto-CAD (containing school boundaries and building layouts) was imported into Arc-GIS.
    - The Geo TIFF file from Surfer (containing the DEM and contour data) was also loaded.
3. Defining Feature Classes:
    - Separate feature classes were created for classrooms, staff rooms, offices, laboratories, roads, and other infrastructure.

- Each feature class was assigned relevant spatial properties (e.g., polygon for buildings, polyline for roads).

4. Importing Non-Spatial Data and Linking to Spatial Features:
   - The CSV file containing attribute data was imported into ArcGIS.
   - A one-to-one relationship was established between the spatial features and their corresponding attribute records using the unique ID field.

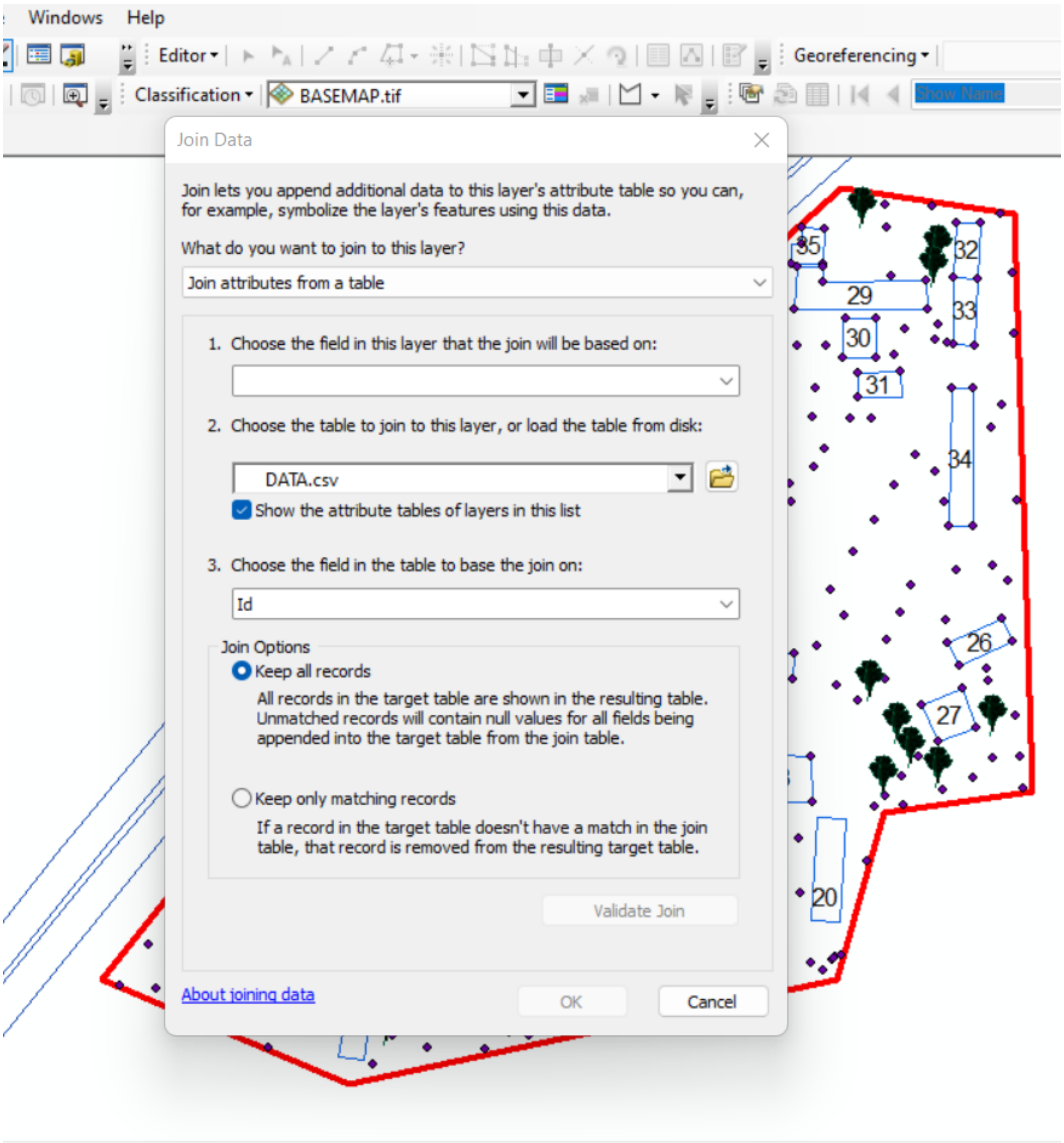


Figure 3.11: Screenshot of the data join process.

3.9.5 Data Integration and Finalization for LIS

The final stage involved ensuring seamless integration between spatial and non-spatial data within the LIS environment.

1. Verification of Data Integrity
    - The attribute data were cross-checked to ensure they matched their respective spatial locations.
    - Any mis-linked records were corrected, and missing attributes were updated.
2. Symbolization and Visualization:
    - Each feature class was assigned unique symbols and colors for better visualization in Arc-GIS.
    - Thematic maps were created to represent building categories, classroom capacities, and road networks.

3.9.6 Perimeter Plan of the Project Area

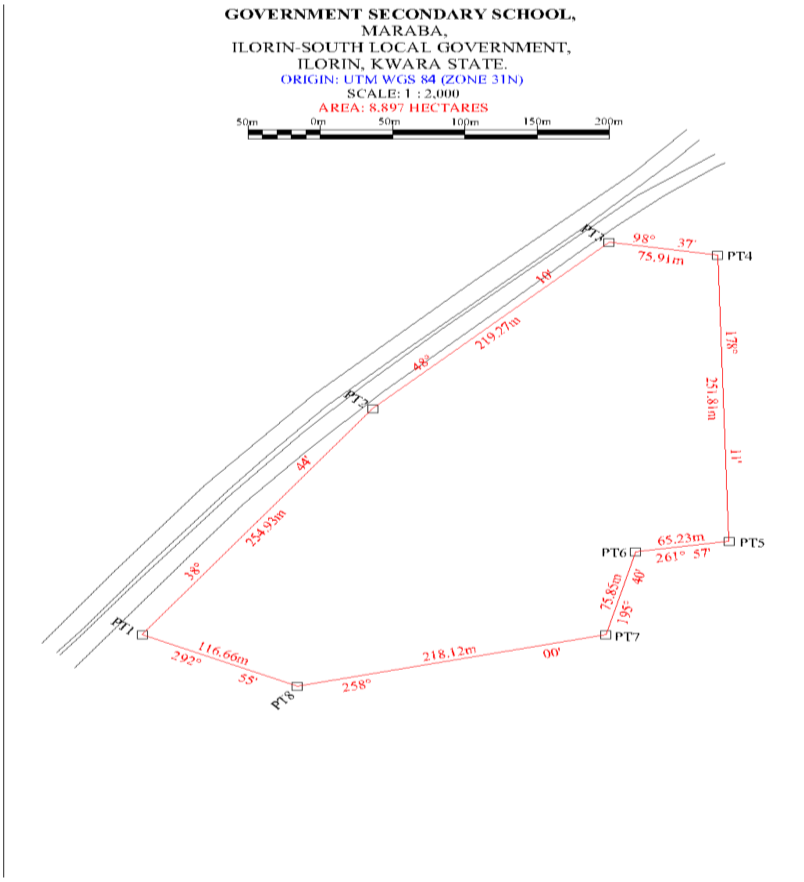


Figure 3.7.1: A screenshot of the boundary in AutoCAD.

3. Boundary Digitization and Feature Mapping:

- The boundary points were connected using polyline tools, forming a closed polygon to define the extent of the school premises.
- Each school building was mapped as a separate layer, and unique identifiers were assigned to distinguish classrooms, staff rooms, laboratories, and other structures

3.9.7 Detailing

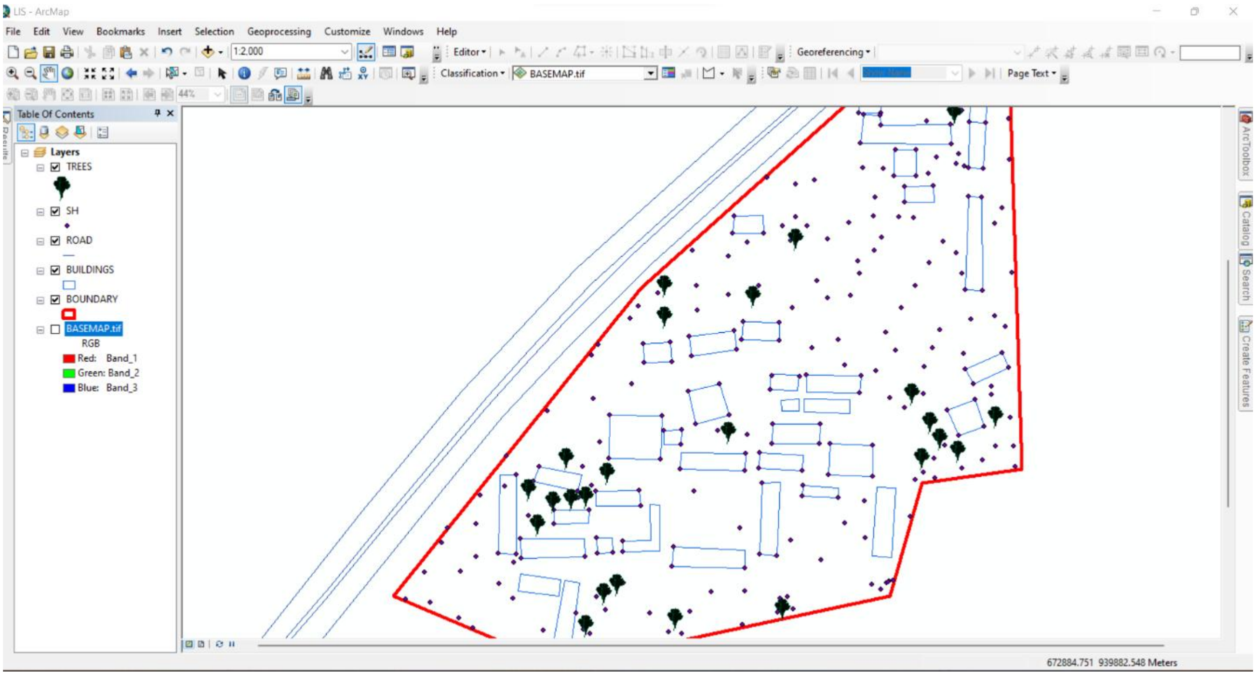


Figure 3.7.2 Screenshot showing the digitization process and layer management.

3.9.8 Attribute Data Acquisition

Attribute data is information about spatial features. They provide the characteristics, description and nomenclature about spatial objects. Thus, the attributes data acquired includes names of buildings and their uses such as classrooms, roads, water facilities and prominent natural features Likes River and trees found and vegetation were properly identified within and around the study area.

3.10 Database Creation / Implementation

This is the database creation phase. Having completed the three stages of design phase (i.e Reality, Conceptual and Logical design), the data base was created using ArcGIS10.2 software. It involves the combination and storage of acquired graphic data and attributes data in creating the database for the purpose of spatial analysis and query.

Database is an organized integrated collection of data stored so as to be capable of use by revenant application with data being accessed by different logical part. After the Attribute table was populated via the keyboard, some attributes such as areas of settlements were automatically displayed by special command in the ArcGIS 10.2 version. The ArcGIS software was used to link the graphic data and table for query generation.

3.11 Database Management System (DBMS)

Data base management is a collection of software for creating, storing, manipulating, updating, organizing and querying of information in a database (Kufoniyi, 1998). It is a software package whose function is to manipulate a data base on behalf of the user.

A good DBMS must provide the following functions:

a. Storage and retrieval of data.
b. Access to by several users at a time.
c. A standardized interface between data base and application programmed.
d. Standardized access to data and separation of data storage and retrieval functions from the program using the data.
e. Maintenance of data security and integrity.

3.12 Data Quality

Having created the database, proper maintenance practice was made to meet its stated objectives. The ability to include more data and remove irrelevant data was possible by way of maintenance. There is every need for the data to be updated regularly because of the physical changes that may occur on the landscape with time. Both security and integrity were also exercised to ensure maintenance and to meet its stated objectives.

Proper observance, updating and management of database ensure its currency and quality to stand a profound chance in Spatial Decision Support System (SDSS). The quality of any database depends on the currency and fitness for use as a decision support system (SDSS). The quality of database depends on its ability to generally fit and use as a decision system(DSS). The storage media should be from time to time justified if otherwise could necessitate data inaccessibility or physical deterioration of the storage media. Also, care must be taken during populating any database system, as a database is only good as the data supplied. In archiving stable media should be used. Examples of these are

- Computer compatible tape reader
- Magnetic tape
- Optical disc and compact disc.

CHAPTER FOUR

4.0 ANALYSIS AND RESULTS

4.1 Introduction

This chapter presents the results obtained from the data acquisition, processing, and integration procedures described in the previous chapter. The findings provide a comprehensive spatial and non-spatial representation of the school environment, including the layout of buildings, topographical features, and attribute information related to school facilities. The results are structured to demonstrate how the Land Information System (LIS) can enhance school management by providing accurate, well-organized, and easily accessible data.

The results are categorized into different sections for clarity. The spatial data results include mapped school boundaries, building footprints, and access networks, all of which were digitized using GIS tools. The topographical results analyze elevation variations using Digital Elevation Models (DEM) and contour maps, which are crucial for site planning and infrastructure development. The non-spatial data results contain attribute information such as classroom capacity, staff room assignments, and building conditions, all integrated into the LIS database. The data integration and query results demonstrate how the LIS functions as an interactive tool for retrieving, analyzing, and visualizing school-related data.

This chapter also includes analyses that reveal important insights into building distribution, infrastructure conditions, environmental constraints, and potential areas for school expansion. The results are presented using maps, tables, and screenshots from GIS and related software to illustrate how data were processed and visualized. The goal of this chapter is to demonstrate the practical application of an LIS in school facility management and to highlight the benefits of integrating spatial and non-spatial data for decision-making.

4.2 Spatial Data Results

The spatial data results provide a detailed representation of the school's geographical layout, including its boundaries, buildings, access roads, and pathways. These results were derived from Total Station survey data, processed in AutoCAD and ArcGIS to create an accurate Land Information System (LIS) for the school. This section highlights the steps taken to map the school boundary, digitize building footprints, and visualize access routes.

The spatial data results are essential for effective school management, as they provide a georeferenced framework that helps in planning expansions, monitoring infrastructure, and optimizing resource allocation. The outputs presented in this section form the foundation for further topographical, non-spatial, and LIS-based analysis discussed in subsequent sections.

4.2.1 School Boundary and Building Layout

The school boundary and building layout were mapped using surveyed coordinates (X, Y, Z) collected with the Total Station. The acquired data were processed in AutoCAD to generate a structured boundary map and building footprints, which were then imported into ArcGIS for further spatial analysis and integration into the LIS database.

The final processed spatial data were visualized in ArcGIS, where the school boundary, building footprints, and access roads were symbolized appropriately to enhance readability.

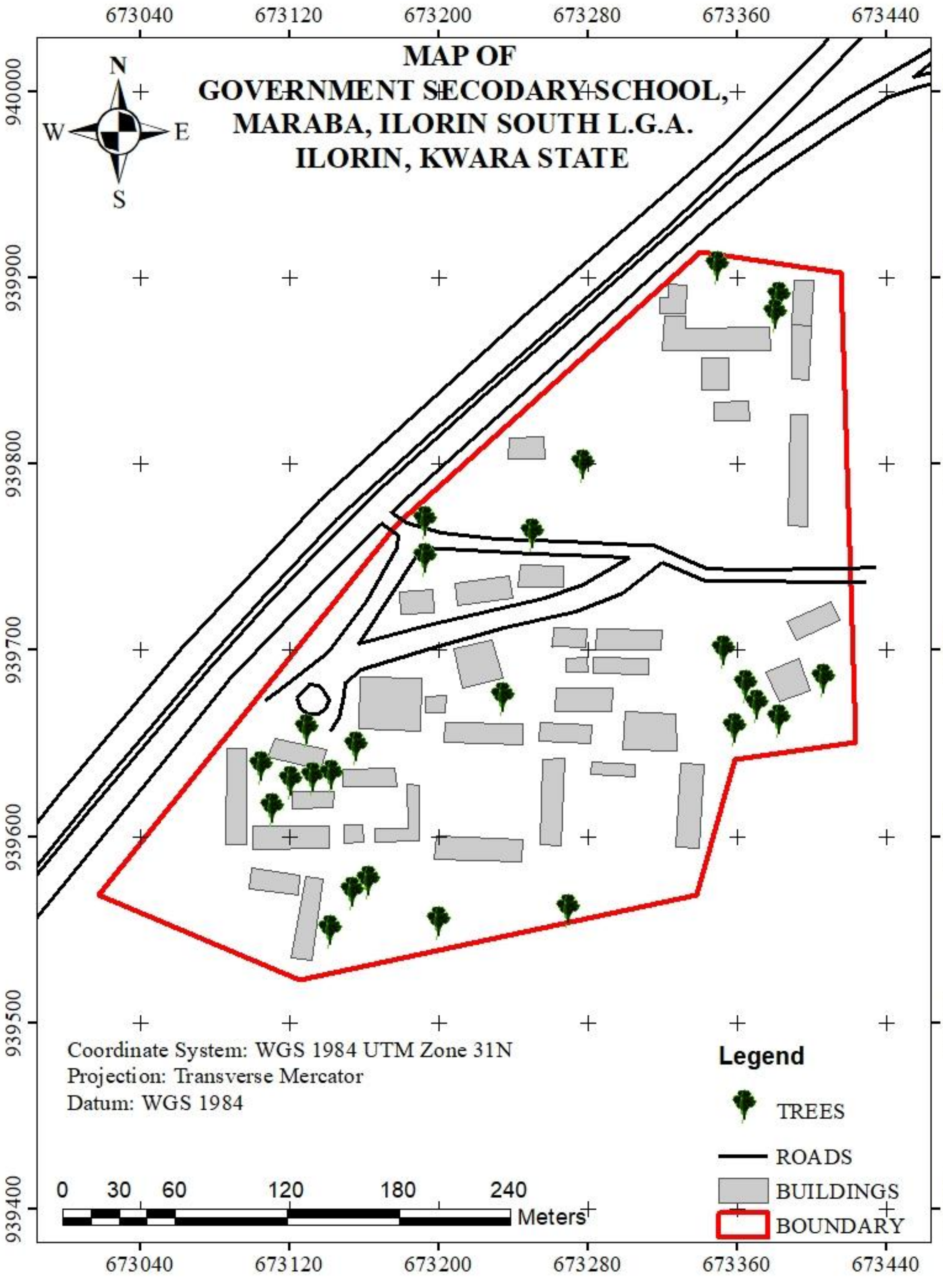


Figure 4.2.1: Mapped School Boundary and Buildings in ArcGIS

- The school boundary is represented as a bold polygon to define the outer limits of the school.
- Buildings are shown in different colors based on their usage (e.g., classrooms in blue, administrative offices in green, laboratories in red).
- Roads are displayed as lines, with roads marked in black.

This spatial data representation serves as the primary framework for the LIS database, allowing users to visualize, analyze, and manage school infrastructure efficiently.

4.2.2 Significance of the Spatial Data Results

The school boundary and building layout play a crucial role in:

- Infrastructure Planning: Ensuring optimal land use by identifying available spaces for future construction and expansion.
- Facility Management: Helping administrators monitor the condition, usage, and location of various school buildings.
- Navigation and Accessibility: Enhancing movement planning for students, staff, and visitors by identifying clear pathways and access points.
- Disaster Management: Providing accurate spatial information to plan for emergency exits, assembly points, and safety zones.

The spatial data results form the foundation for further analysis, including topographical evaluation, attribute data integration, and advanced GIS-based queries, which will be presented in the subsequent sections of this chapter.

4.3 Topographical Analysis Results

Topographical analysis provides crucial information about the elevation, slope, and terrain variations within the school environment. Understanding these features is essential for site planning, infrastructure development, drainage design, and environmental management. This section presents the results of topographical data processing and analysis, including the creation of Digital Elevation Models (DEM), contour maps, and slope analysis.

The topographical data were obtained using Total Station measurements, which captured X, Y, and Z coordinates of various points within the school premises. These data were processed in Surfer to generate elevation models and later integrated into ArcGIS for spatial analysis.

4.3.1 Digital Elevation Model (DEM)

The Digital Elevation Model (DEM) was created to provide a 3D representation of the school's terrain. Using Z-coordinates from the Total Station survey, a gridded elevation surface was generated in Surfer and later exported to ArcGIS for further analysis.

Key Features of the DEM:

- The DEM visually represents variations in land elevation within the school compound.
- Areas of higher elevation are highlighted, aiding in infrastructure planning and water drainage management.
- The DEM serves as the base for further slope, aspect, and contour analysis.

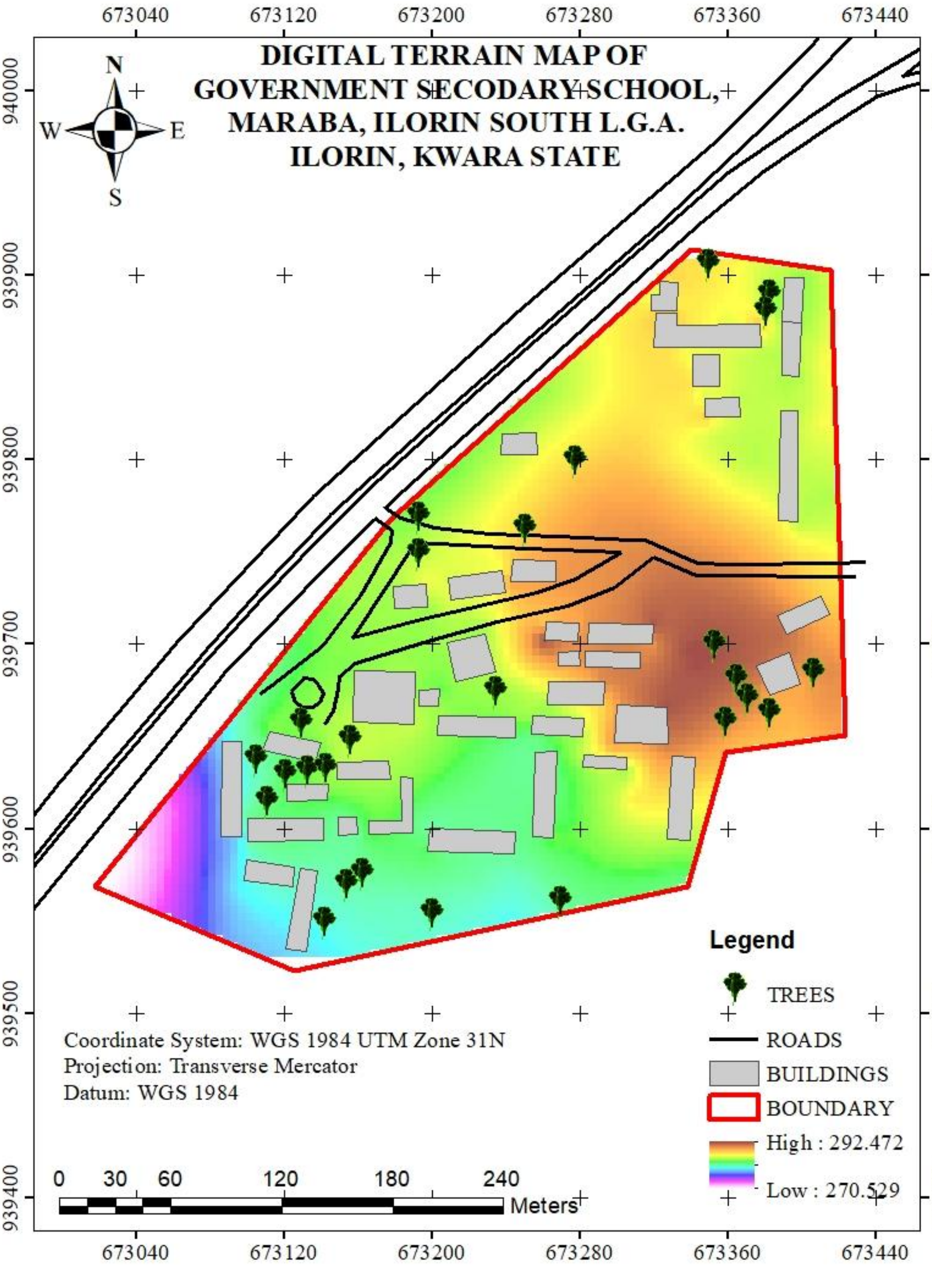


Figure 4.3.1: Digital Elevation Model (DEM) of the School Premises

4.3.2 Contour Mapping

Contour mapping was conducted to visualize elevation changes and terrain gradients within the school environment. The surveyed elevation data were processed in Surfer to generate contour lines, which were later imported into Arc-GIS for spatial overlay and analysis.

Key Results from Contour Analysis:

- The contour interval was set based on the range of elevation variations in the study area.
- Closely spaced contour lines indicate steep slopes, while widely spaced lines represent gentler slopes.
- The contour map helps in identifying low-lying areas that may be prone to water logging or flooding.
- The results assist in drainage planning by identifying natural water flow paths.

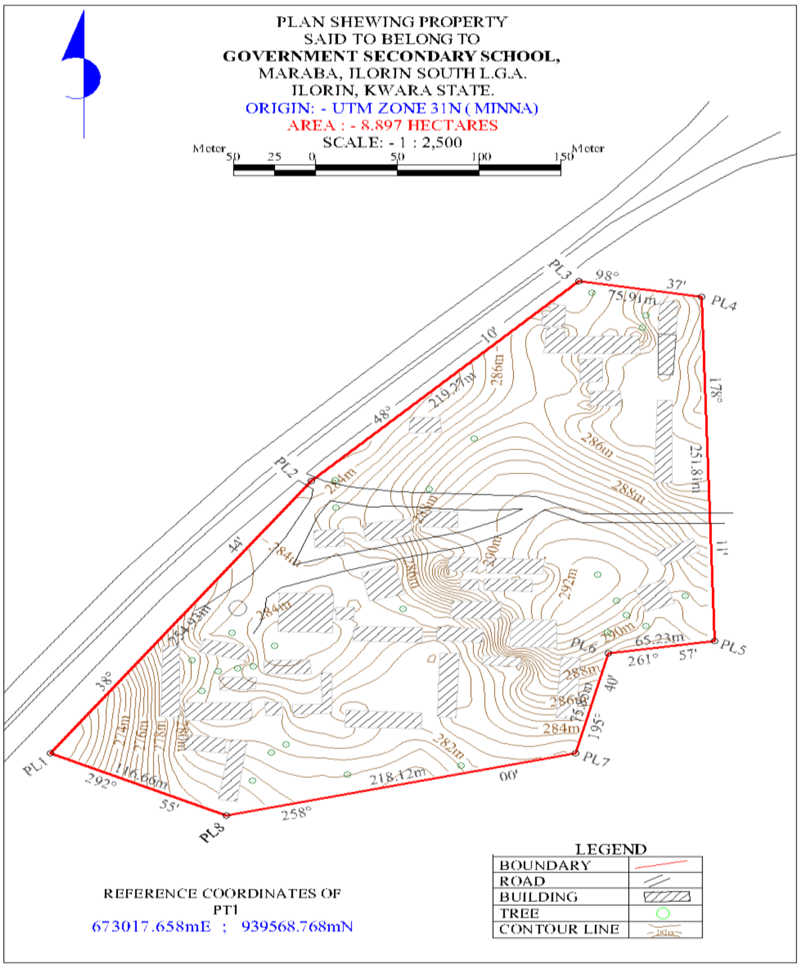


Figure 4.3.2: Contour Map of the School Premises

4.3.3 Slope and Terrain Analysis

A slope analysis was conducted to determine variations in land steepness across the school environment. The slope was computed using the DEM in ArcGIS, with results classified into different slope categories to assess terrain usability.

Key Findings from Slope Analysis**:**

- Flat areas (0-5 degrees) are suitable for classroom blocks, play areas, and other infrastructure.
- Moderate slopes (5-15 degrees) are manageable for footpaths and minor construction projects.

- Steeper slopes (above 15 degrees) may require erosion control measures or retaining walls to prevent land degradation.

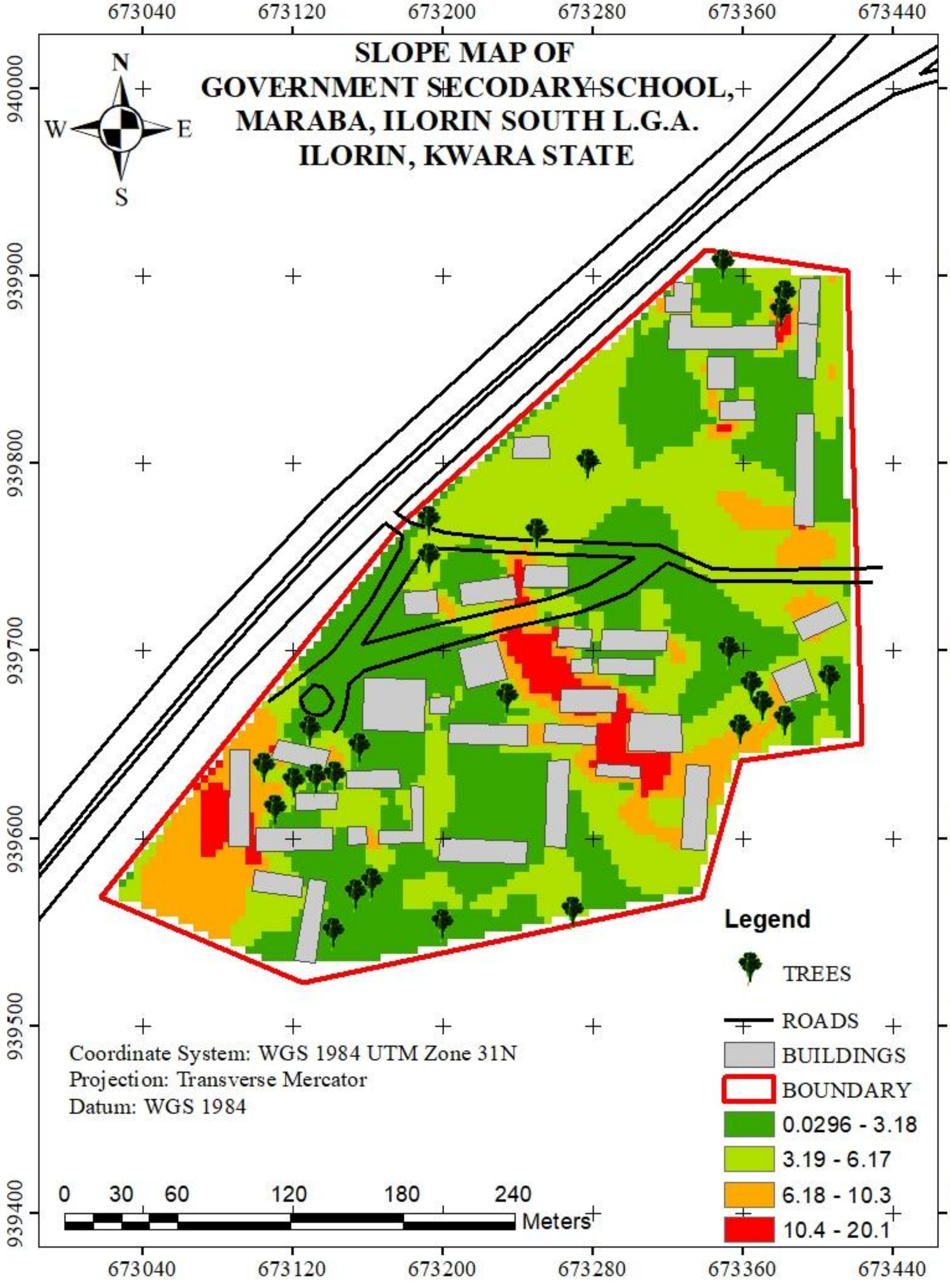


Figure 4.3.3: Slope Analysis Map of the School Premises

4.3.4 Significance of Topographical Analysis Results

The results of the topographical analysis provide essential insights for school management, infrastructure development, and environmental sustainability. These findings contribute to:

- Better infrastructure planning: Ensuring that new buildings and roads are constructed on stable ground.
- Improved drainage management: Reducing the risk of flooding and water stagnation within the school premises.
- Enhanced safety measures: Identifying steep areas that may require protective barriers or adjustments in land use planning.
- Sustainable land use: Helping decision-makers optimize space utilization while considering terrain constraints.

The topographical analysis results form an integral part of the Land Information System (LIS), ensuring that spatial data is not only stored but also analyzed for informed decision-making in school infrastructure management.

4.4 Non-Spatial Data Results

Non-spatial data results refer to the descriptive information associated with various school facilities, buildings, and infrastructure. Unlike spatial data, which provides geometric representations of features (such as school boundaries, buildings, and roads), non-spatial data includes textual and numerical attributes that help in facility management and decision-making.

The non-spatial data collected in this study were integrated into the Land Information System (LIS) to enhance school administration, infrastructure monitoring, and resource planning. The data were structured in tabular format and linked to corresponding spatial features in ArcGIS using unique identifiers.

4.4.1 Attribute Data for School Buildings

The non-spatial attributes for classrooms, staff rooms, laboratories, and administrative offices were recorded and organized in a database. Each building was assigned a unique identifier (Building ID), allowing for easy retrieval of information in GIS.

Key Attributes for Buildings:

- Building Name/ID (e.g., Classroom Block A, Staff Room 1)
- Building Type (Classroom, Laboratory, Office, Library, Hall)
- Primary Use (Teaching, Administration, Storage, Utility)

This information was stored in ArcGIS attribute tables and linked to the digitized building footprints, allowing users to perform queries such as identifying underutilized classrooms or buildings in need of maintenance.

Table

BUILDINGS

FID	Shape *	Id	Building_N	Building_T	Use
0	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
1	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
2	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
3	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
4	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
5	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
6	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
7	Polygon	0	COMPUTER LAB	BUNGALOW	Teaching
8	Polygon	0	ADMIN BLOCK	BUNGALOW	Administration
9	Polygon	0	ARABIC LAB	BUNGALOW	Teaching
10	Polygon	0	STAFF OFFICE	BUNGALOW	Adminstration
11	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
12	Polygon	0	SCHOOL LIBRARY	DUPLEX	Utility
13	Polygon	0	BIOLOGY LAB	BUNGALOW	Teaching
14	Polygon	0	CHEMISTRY LAB	BUNGALOW	Teaching
15	Polygon	0	AGRIC LAB	BUNGALOW	Teaching
16	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
17	Polygon	0	VOCATIONAL LAB	BUNGALOW	Teaching
18	Polygon	0	CLASS ROOM	DUPLEX	Teaching
19	Polygon	0	STAFF ROOM	BUNGALOW	Administration
20	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
21	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
22	Polygon	0	CLASS ROOM	BUNGALOW	Teaching
23	Polygon	0	STAFF OFFICE	BUNGALOW	Admistration
24	Polygon	0	ECONOMICS LAB	BUNGALOW	Teaching
25	Polygon	0	POULTRY	BUNGALOW	Utility
26	Polygon	0	MOSQUE	BUNGALOW	Utility
27	Polygon	0	BEHIND MOSQUE	BUNGALOW	Storage
28	Polygon	0	HALL	DUPLEX	Utility
29	Polygon	0	DINNING HALL	BUNGALOW	Utility
30	Polygon	0	COMMON ROOM	BUNGALOW	Utility
31	Polygon	0	CLINIC	BUNGALOW	Utility
32	Polygon	0	HOSTEL	BUNGALOW	Utility
33	Polygon	0	HOSTEL	BUNGALOW	Utility
34	Polygon	0	FULANI HOUSE	BUNGALOW	Utility
35	Polygon	0	KITCHEN	BUNGALOW	Utility
36	Polygon	0	ACCOMMODATION	BUNGALOW	Utility

0 (0 out of 37 Selected)

BUILDINGS

Figure 4.4.2: Sample Attribute Table for School Buildings

4.4.2 Linking Non-Spatial Data with GIS

All non-spatial datasets were linked to their corresponding spatial features in ArcGIS. This integration allows for interactive queries and visual analysis of school facilities. Some of the key functionalities include:

- Clicking on a building footprint to view its attributes (e.g., building name, building type, & use).
- Running queries to find classrooms that exceed their maximum student capacity.
- Generating reports on the maintenance history of infrastructure.

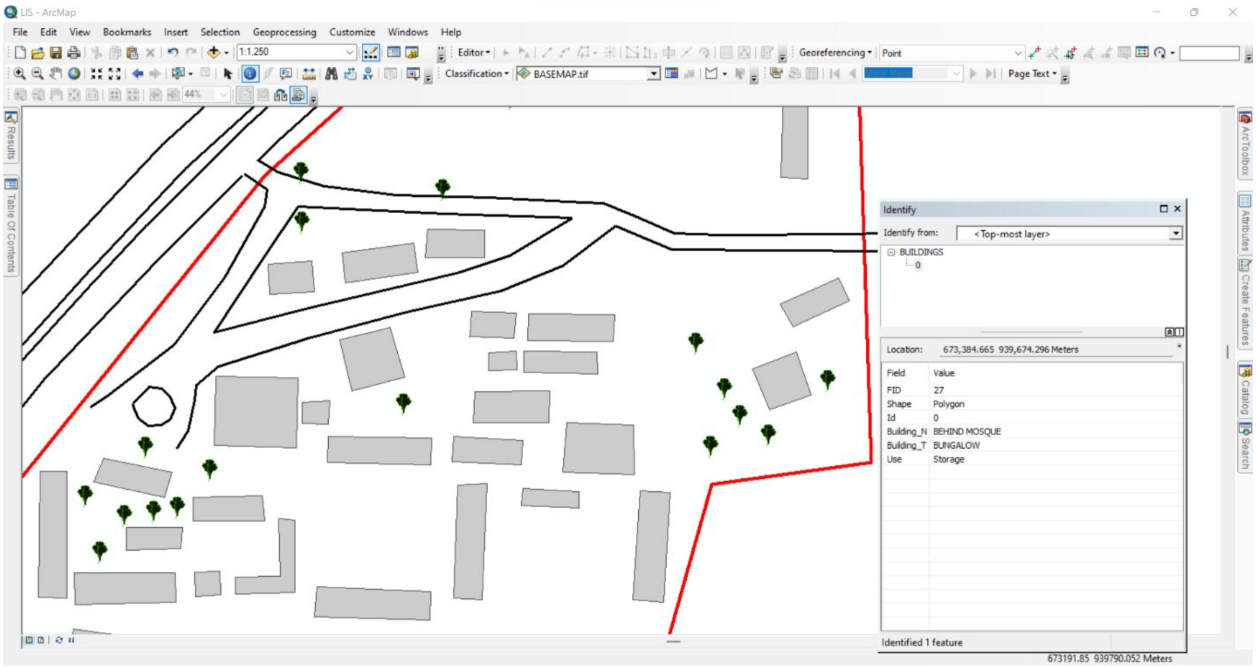


Figure 4.4.3: Linking Non-Spatial Data to Spatial Features in ArcGIS

4.4.3 Significance of Non-Spatial Data in LIS

The integration of non-spatial data into the LIS enhances decision-making by providing comprehensive attribute information for school management. These results contribute to:

- Effective Resource Allocation: Ensuring that classrooms, offices, and other facilities are optimally utilized.
- Infrastructure Maintenance Planning: Monitoring facility conditions and scheduling necessary repairs.

- Improved School Administration: Tracking staff distribution, student population trends, and room assignments.
- Emergency Preparedness: Identifying critical infrastructure that requires regular inspections and safety measures.

The non-spatial data results demonstrate how a Land Information System (LIS) can support school facility management by combining spatial visualization with detailed attribute data. This information is essential for long-term planning, policy-making, and efficient school operations.

4.5 Query Execution and Results

With the integrated database, queries were performed in ArcGIS to extract specific information about the school environment. These queries help in analyzing building usage, staff distribution, facility conditions, and space utilization.

Example Query Results:

Mapping Distribution of Staff Offices:

Query: "Show all staff offices"

Result: A spatial representation of staff office locations was displayed, ensuring adequate office space allocation.

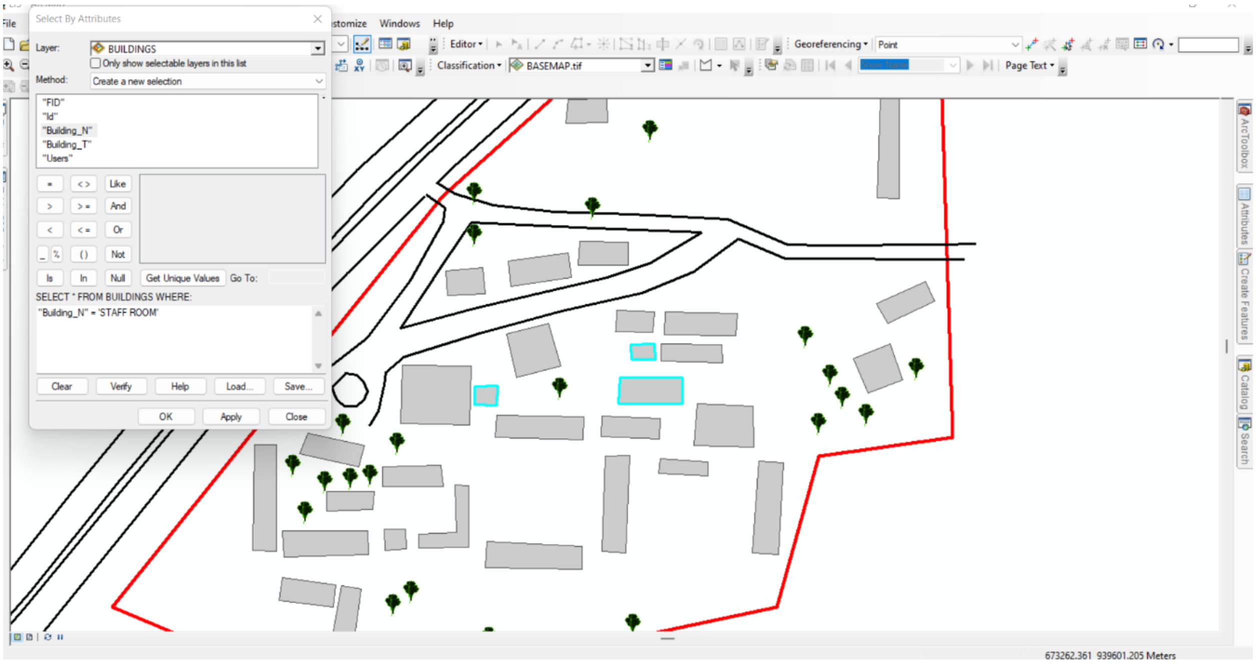


Figure 4.5.1: Sample Staff room Query Results in Arc-GIS

1. Mapping Distribution of Class rooms:

   Query: "Show all Class rooms"

   Result: A spatial representation of class room locations was displayed, ensuring adequate office space allocation.

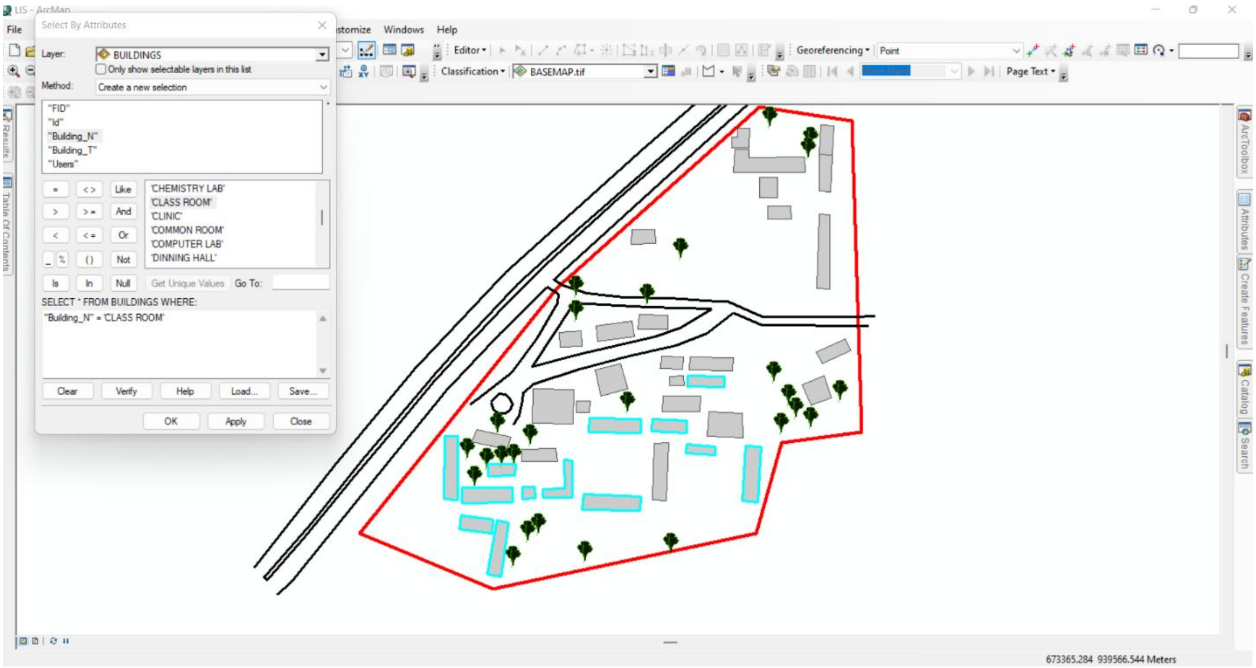


Figure 4.5.2: Sample Class room Query Results in ArcGIS

CHAPTER FIVE

5.0 COSTING, REFERENCE, SUMMARY, PROBLEMS ENCOUNTERED, CONCLUSION AND RECOMMENDATION

5.1 COSTING

The costing of this project was done using the Nigeria Institution of Surveyor's (NIS) professional scale of fees for consultant in the construction industry. This stage shows the total cost that was spent on the project from day one to the final stage.

5.1.1 RECCI

PERSONAL/QUALITY	DAY(S)	UNITRATE(N)	TOTAL AMOUNT(₦)
1 Senior Surveyor	1	20,000.00	20,000.000
Assistant Surveyor	1	8,000.00	8,000.00
Transportation	1	7,000.00	7,000.00
Basic Equipment	1	8,000.00	7,000.00
TOTAL			#42,000.00

5.1.2 BEACON= 2,100 × 5

= #10,500

5.1.3 BEACONING

PERSONAL/QUALITY	DAY(S)	UNITRATE(N)	TOTALAMOUNT(₦)
1Assistant Surveyor	1	8,000.00	8,000.00
Basic Equipment(6)	1	8,000.00	8,000.00
Transportation	1	7,000.00	7,000.00
TOTAL			#23,000.00

5.1.4 TRAVERSING

PERSONAL/QUALITY	DAY(S)	UNITRATE(N)	TOTALAMOUNT(₦)
1 Assistant Surveyor	2	8,000.00	16,000.00
Basic Equipment	2	8,000.00	16,000.00
Transportation	2	7,000.00	14,000.00
TOTAL			#46,000.00

5.1.5 DOWNLOADING DATA AND PLOTTING

PERSONAL/QUALITY	DAY(S)	UNITRATE(N)	TOTALAMOUNT(₦)
1Senior Surveyor	2	15,000.00	30,000.00
1AssistantSurveyor	2	8,000.00	16,000.00
Transportation	2	7,000.00	14,000.00
Consumables	2	7,000.00	14,000.00
TOTAL			#74,000.00

5.1.6 INFORMATION PRESENTATION

PERSONAL/QUALITY	DAY(S)	UNITRATE(N)	TOTALAMOUNT(₦)
1Assistant Surveyor	1	8,000.00	8,000.00
Transportation	1	7,000.00	7,000.00
TOTAL			#15,000.00

(1) # 42,000.00

(2) # 10,500.00

(3) # 23,000.00

(4) # 46,000.00

5) #74,000.00

(6) # 15,000.00

TOTAL # 210,500.00

5.1.7 CONSTIGENCIES=5%

210,500.00×5%÷ 100

= #10,525.00

5.1.8 V. A. T = 7.5%

210,500.00×7.5%÷100

= #15,787.50

5.1.9 MOBILIZATION AND DEMOBILIZATION =10%

2o10, 500.00 × 10%. ÷ 100

= #21,050.00

5.1.10 ACCOMODATION = 1.5%

210,500.00 ×1.5%÷100

= 3,157.50

TOTAL = 210,500.00

10,525.00

15,787.50

21,050.00

3,157.50

GRAND TOTAL = 261,020.00

5.2 SUMMARY

This study focused on the development of a Land Information System (LIS) for a secondary school, integrating spatial and non-spatial data to improve infrastructure management and decision-making. The research employed Total Station for data acquisition, AutoCAD for spatial data processing, Surfer for topographical analysis, and ArcGIS for data integration and query-based analysis. These tools were used to collect, analyze, and interpret information on the school's physical structures, terrain characteristics, and facility attributes.

The results of the study provided valuable insights into the spatial organization of school infrastructure, land use efficiency, and facility conditions. The school boundary and building footprints were successfully mapped, distinguishing various structures such as classrooms, staff rooms, laboratories, and administrative offices. The topographical analysis revealed areas prone to waterlogging due to low elevation, highlighting the need for better drainage solutions.

The study demonstrated how a LIS framework can support facility management, enhance accessibility planning, and optimize resource distribution. The integration of these datasets into a spatial database provided a structured and efficient system for managing school infrastructure, ensuring better decision-making and long-term planning.

5.3 CONCLUSION

The study successfully developed a Land Information System (LIS) tailored for secondary school management, demonstrating the importance of GIS-based analysis in educational infrastructure planning. The integration of spatial and non-spatial datasets allowed for a comprehensive understanding of the school's facilities, land use patterns, and terrain variations. The findings confirmed that GIS is a powerful tool for managing school environments, enabling authorities to make informed decisions on infrastructure development and maintenance planning.

One of the key conclusions drawn from the study is that spatial analysis can identify infrastructure challenges, such as classroom congestion, poor accessibility, and drainage issues, which might otherwise go unnoticed. The topographical analysis helped assess elevation variations, revealing areas requiring drainage improvements. Furthermore, the integration of non-spatial data with GIS facilitated efficient facility tracking, maintenance scheduling, and infrastructure optimization.

Query-based spatial analysis provided critical insights into facility allocation and emergency response planning. By analyzing building conditions, accessibility networks, and spatial distributions, decision-makers can develop strategic plans for sustainable school management. The results of this research demonstrate that GIS-based LIS is a valuable tool that can be adopted by educational institutions for improving facility management, enhancing infrastructure planning, and ensuring effective land use utilization.

5.4 RECOMMENDATIONS

Based on the findings and conclusions of this research, several recommendations are proposed to improve school infrastructure and enhance the application of Land Information Systems (LIS) in facility management.

In terms of facility maintenance and planning, the study recommends the adoption of a preventive maintenance strategy using GIS for real-time monitoring of building conditions and infrastructure deterioration. A structured maintenance plan should be developed based on the LIS database, prioritizing buildings that require urgent repairs. Additionally, the use of GIS-based tracking will help optimize resource allocation, ensuring that maintenance efforts are distributed effectively across the school premises.

To further enhance LIS adoption, the school should consider expanding the database to include real-time data collection tools such as IoT sensors, drones, or mobile GIS applications for continuous monitoring of school infrastructure. Future research should also focus on integrating advanced spatial models and automation techniques to improve decision-making and infrastructure management.

By implementing these recommendations, the school will not only enhance infrastructure planning and management but also ensure sustainable facility development and optimal resource utilization. The findings of this research emphasize the importance of GIS-based LIS in school management, serving as a model for improving infrastructure planning in other educational institutions.

REFERENCE

Williamson, I., Enemark, S., Wallace, J., & Rajabifard, A. (2010). *Land Administration for Sustainable Development*. ESRI Press.

Rajabifard, A., & Williamson, I. P. (2001). Spatially enabling government: land administration reform. *Computers, Environment and Urban Systems*, 25(4-5), 375–390. https://doi.org/10.1016/S0198-9715 (01)00013-6

A. Adedamola Fisayo, O Babajide… - Journal of Built …, 2024 - africanscholarpub.com A lot of government personnel are still not aligned with modern land information systems, Previous efforts to create a hub of land information across the state in Nigeria

S. Enemark - … Forum on Building **Land Information** Policies in the …, 2004 –homes plan aau dk. These trends supports establishment of multifunctional information systems with regard to land rights and land-use regulations. A third global driver is sustainable development

DL Tulloch - Transactions in GIS, 1999 - Wiley Online Library. It suggests that as a land information system is in its earliest stage of use, it system is used for analytical purposes.

SD Musa, T Shabu - Jàmbá: Journal of Disaster Risk Studies, 2019 - journals.co.za. Land use and land cover affected by flooding along Benue River in Adamawa State, Nigeria. Image processing geographic information system software.

I. Williamson, L Ting - Computers, environment and urban **systems**, 2001 – Elsevier. This paper reviews the need for a new land administration management of land administration and cadastral systems in the engineering land administration system

APPENDIX

S/N	EASTINGS	NORTHINGS	Elevation
PT1	673384.7	939882.4	284.324
PT2	673368.3	939852.6	284.974
PT3	673406	939809.5	285.418
PT4	673328.8	939826.6	286.878
PT5	673277.2	939835	285.121
PT6	673258.7	939839.1	283.911
PT7	673298.3	939799.4	288.005
PT8	673328.2	939792.3	287.552
PT9	673312.6	939762.8	289.926
PT10	673211	939791.9	283.435
PT11	673176	939756.2	283.922
PT12	673192.6	939752.9	284.652
PT13	673304.7	939734.3	290.222
PT14	673416.3	939684.2	290.247
PT15	673262	939711.3	288.105
PT16	673150	939731.4	284.378
PT17	673146.7	939696.4	283.653
18	673227.3	939675.6	284.134
19	673246.1	939672.8	284.316
20	673321.7	939630.2	288.378
21	673117.2	939688.4	282.391
22	673294	939592	283.783
23	673337.8	939578.5	283.019
24	673272	939568.4	282.117
25	673104.7	939620.4	281.182
26	673073.4	939634.1	276.58
27	673071.2	939615.2	275.123
28	673242.9	939550.3	280.075
29	673203.9	939544.3	280.735
30	673148.8	939568.4	281.263
31	673052.7	939612.9	272.448
32	673140.3	939546.8	280.215
33	673159.3	939539.3	280.517
34	673136	939532	279.591
35	673114.2	939546.4	279.556
36	673037.9	939584.1	270.915
37	673025.4	939566.5	270.677
38	673037.9	939584.1	270.915
39	673048.7	939603.2	272.177
40	673145.4	939724.6	283.813
41	673170.7	939748.4	284.45
42	673188.6	939764.6	283.773
43	673320.9	939845.5	287.18
44	673362.2	939875.4	285.746

45	673385.9	939892.8	284.152
46	673372.8	939797.9	284.644
47	673363.7	939784.4	286.123
48	673354.6	939769.4	288.129
49	673345.7	939755.1	289.742
50	673090.2	939538.8	278.481
51	673341.7	939727.3	291.403
52	673417.2	939777.8	284.558
53	673403.7	939704.2	289.927
54	673373.8	939666.3	290.383
55	673366.7	939657.7	289.8
56	673359.7	939648.9	289.387
57	673354.7	939644.1	289.178
58	673322.5	939606.4	286.048
59	673144.6	939544.4	280.276
60	673154.8	939560	281.098
61	673166.3	939577	281.907
62	673335.6	939739	291.06
63	673409.7	939902.9	285.097
64	673344	939813.6	285.841
65	673333	939800.4	286.532
66	673317.5	939785.4	288.656
67	673275.5	939754.9	289.562
68	673155.4	939649.3	284.999
69	673153.1	939647.9	284.914
70	673145.9	939640.2	284.266
71	673136.9	939632	283.646
72	673095.5	939590.5	279.358
73	673085.9	939576.8	278.209
74	673068.7	939548	275.907
75	673041.6	939564.6	272.021
76	673061	939584.5	273.936
77	673071.1	939593.9	275.368
78	673171.3	939705.6	284
79	673234	939763.5	286.572
80	673274.2	939798.6	287.23
81	673284.9	939807.8	287.065
82	673360.2	939896.9	286.454
83	673379.6	939906.3	285.363
84	673415.1	939877.3	285.558
85	673385	939777	285.683
86	673370.4	939740.7	289.914
87	673366	939728.9	290.9
88	673360.4	939716.8	291.697
89	673347.6	939690.5	292.448
90	673267.4	939567.2	281.818

91	673249.8	939761.5	287.673
92	673253.6	939769.1	287.673
93	673289.4	939837.7	285.923
94	673359.1	939907	286.683
95	673309.1	939718.2	290.864
96	673386.5	939846.5	284.751
97	673381.1	939847.9	284.798
98	673311.7	939810.2	287.49
99	673214.1	939753.6	285.594
100	673151.2	939668	284.273
101	673298.3	939761.6	289.834
102	673410.6	939819.5	286.064
103	673412.8	939743.1	286.98
104	673386	939725.4	289.89
105	673338.4	939696.8	292.455
106	673094.8	939567.3	279.722
107	673060.1	939554.7	274.721
108	673308.9	939615.9	286.747
109	673367.4	939644.7	288.332
110	673384.7	939651.2	288.549
111	673397.8	939656.6	288.644
112	673418	939665.7	289.824
113	673222.9	939571.6	281.678
114	673209	939559	281.109
115	673195.2	939545.6	280.87
116	673184.7	939538.6	280.999
117	673419.4	939652.4	289.44
118	673406.3	939665.7	289.634
119	673135.8	939557.7	280.436
120	673183.4	939557.6	281.026
121	673265.8	939558.1	281.327
122	673275.6	939560.4	282.041
123	673326.7	939576.1	282.93
124	673336.1	939577.2	282.915
125	673337.2	939577.8	282.96
126	673340.2	939579.1	283.101
127	673332.5	939572.9	282.561
128	673244.5	939571.8	280.976
129	673279.8	939710.7	289.235
130	673329.3	939714.1	291.661
131	673291	939772.5	289.507
132	673213.4	939769.2	285.037
133	673363.1	939841.6	285.29
134	673415.4	939850.6	286.503
135	673382.8	939854.7	284.659
136	673268.8	939807.9	286.262

137	673381.1	939790.3	285.169
138	673404.1	939698.9	290.112
139	673359.7	939699.5	292.101
140	673211.9	939636.4	283.159
141	673241.3	939612.7	282.141
142	673274.4	939604.9	282.939
143	673119.8	939627.5	282.657
144	673089.5	939639.6	279.492
145	673351.4	939620.1	286.705
146	673139.7	939652.3	284.027
147	673090.5	939659.4	280.094
148	673288	939729.3	289.918
149	673390.6	939747.4	287.987
150	673406.2	939749.5	286.834
151	673318.7	939777.2	289.241
152	673353.4	939813.4	285.219
153	673327.9	939814.1	286.716
154	673276.9	939802.7	287.085
155	673233.8	939788.3	285.237
156	673246.2	939797.5	285.454
157	673277.4	939813.8	286.407
158	673333.9	939845	287.321
159	673121.2	939624.5	283.071
160	673121.1	939615.1	282.792
161	673143.9	939624.5	283.815
162	673100.3	939592.9	281.442
163	673085.4	939596	278.194
164	673096.8	939595.6	279.372
165	673149.2	939596.2	281.843
166	673159.5	939597	281.78
167	673141.2	939594	282.01
168	673099.8	939605.7	282.096
169	673148.7	939606.2	282.084
170	673165.5	939604.1	283.126
171	673096.8	939647.3	281.218
172	673108	939642.9	281.375
173	673136.6	939636.5	282.179
174	673111.8	939652.6	283.596
175	673148.2	939636.5	284.471
176	673176.3	939637.2	284.381
177	673177.4	939627	284.25
178	673165.5	939597.3	283.212
179	673197.6	939587.9	282.967
180	673244.4	939586.8	282.022
181	673198.4	939600.3	281.592
182	673254.1	939595.6	282.376

183	673265.5	939594.9	283.309
184	673255.8	939641.6	282.017
185	673281.4	939633.4	283.739
186	673305.1	939632.2	284.123
187	673282.1	939640.3	285.194
188	673327.4	939646	290.763
189	673298.4	939647	289.971
190	673327.1	939666.1	292.244
191	673254	939661.3	284.252
192	673281.6	939649.9	284.438
193	673244.8	939649.7	282.435
194	673253.5	939651.3	282.443
195	673245.2	939660.8	283.997
196	673262.1	939667.2	284.253
197	673262.6	939679.7	286.756
198	673292.7	939667.2	287.534
199	673156.8	939657.7	284.797
200	673190.1	939656.9	284.931
201	673190.9	939685.2	284.021
202	673207.8	939700.8	284.134
203	673212.7	939679.8	283.992
204	673234.3	939685.5	284.829
205	673157.5	939685.9	283.582
206	673203.3	939666.4	284.044
207	673192.5	939675.4	283.893
208	673203.7	939675.9	283.133
209	673202.6	939650.8	283.871
210	673228.2	939705.8	284
211	673178.7	939731.5	284.127
212	673197.5	939720.1	284
213	673179.3	939719.3	284.169
214	673208.6	939736.3	285.441
215	673210	939723.9	285.565
216	673239.3	939728.1	287.38
217	673196.5	939732.8	285.965
218	673237.7	939740.2	285.981
219	673243.3	939745.8	287.908
220	673266.6	939745.3	289.626
221	673260.8	939702.2	292.324
222	673293.1	939679.9	290.403
223	673299.9	939667.1	289.403
224	673399.1	939678.4	289.269
225	673382.5	939672.3	289.093
226	673392	939705.9	291.205
227	673375.3	939688.7	291.609
228	673393.3	939695.9	290.854

229	673414.7	939716.5	288.314
230	673386.7	939715.5	290.931
231	673410.5	939726	287.665
232	673319.6	939710.9	292.093
233	673318.9	939700.1	289.855
234	673284.5	939711.5	289.939
235	673266.6	939734.1	289.765
236	673236.8	939802.9	284.509
237	673237.8	939814.4	283.996
238	673256.7	939803.2	285.935
239	673347.6	939823.1	287.83
240	673242.5	939734.1	289.519
241	673386.9	939766.8	286.751
242	673397.8	939766.3	284.723
243	673388.8	939826.9	284.968
244	673397.5	939826.6	284.746
245	673347.6	939833.6	285.377
246	673366.2	939833.9	284.881
247	673341.1	939840.1	286.99
248	673355.4	939840.2	285.718
249	673355.4	939857.2	285.598
250	673342	939857	285.635
251	673319.4	939861.2	287.356
252	673321.1	939879.7	287.56
253	673332	939879.4	287.867
254	673332.3	939873.1	287.697
255	673377.3	939873.8	287.932
256	673378.1	939860.8	284.921
257	673332.4	939880.9	286.766
258	673332.7	939896.3	287.526
259	673389.4	939875.3	284.306
260	673400	939874.5	284.067
261	673389.1	939845.7	284.362
262	673398.5	939845.2	284.514
263	673390.4	939899.1	284.735
264	673401	939898.6	283.725
265	673318.2	939880.8	287.29
266	673323	939896.6	286.94
267	673322.9	939889.5	285.163