

**DETAILING OF JUNIOR STAFF QUARTERS, UNIVERSITY OF BENIN  
UGBOWO, EDO STATE, NIGERIA**



BY

**OMOIKHUDU Jeffery Ojizuagbe**

**Mat. No: ENV1704628**

**UNIVERSITY OF BENIN**

**BENIN CITY**

**DETAILING OF JUNIOR STAFF QUARTERS,  
UNIVERSITY OF BENIN UGBOWO,  
EDO STATE, NIGERIA**

**A PROJECT REPORT SUBMITTED**

**BY**

**OMOIKHUDU Jeffery Ojjezuagbe**

**Mat. No: ENV1704628**

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**SUPERVISED BY**

**SURV. MS. M. O. EKUN**

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## **CERTIFICATION**

This is to certify that this project was carried out by OMOIKHUDU JEFFERY OJIEZUAGBE, with Matriculation Number ENV1704628, of the Department of Geomatics, Faculty of Environmental Sciences, University of Benin Edo State, Nigeria on the study of “**DETAILING OF JUNIOR STAFF QUARTERS, UNIVERSITY OF BENIN UGBOWO, EDO STATE, NIGERIA**”

.....  
**SURV. MS. M. O. EKUN**  
PROJECT SUPERVISOR

.....  
**DATE**

.....  
**SURV.O. S. OLADOSU**  
HEAD OF DEPARTMENT

.....  
**DATE**

.....  
EXTERNAL EXAMINER

.....  
**DATE**

## **DEDICATION**

I dedicate this project to God Almighty, my creator and unwavering support. He is the wellspring of my inspiration, wisdom, knowledge, and understanding. Throughout this program, it is His strength that has carried me, and only on His wings have I soared. Additionally, I offer my heartfelt dedication to my beloved parents, Mr. and Mrs. Omoikhudu, who have tirelessly encouraged me to strive for excellence.

I extend my dedication to my esteemed professor and lecturers, whose guidance has enriched my learning journey, pushing me to think critically and creatively. Lastly, a special acknowledgment goes to my dedicated colleagues for their teamwork and contributions. Together, we have achieved great milestones.

Lastly, I dedicate this to my future self, a reminder of the dedication, hard work, and sacrifices that brought me to this point. May this dedication inspire me to keep pushing my limits and striving for greater heights.

## **ACKNOWLEDGEMENT**

All thanks, honour, adoration and glory be unto Almighty God. For His unfeigned love towards me, His infinite mercy, grace, guidance and opportunity given to me to move forward against all odds and for the successful completion of this project and my B.Sc. program in the department of Geomatics, University of Benin.

My biggest appreciation goes to my loving parent MR. AND MRS. OMOIKHUDU and for their prayers and financial support and unrelenting commitments towards my academics.

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I want to express my deep gratitude to Engineer Osayuki of Yuki Computers. Sir, your mentorship and support have been invaluable in shaping my skills and broadening my horizons. Thank you for helping me become a more capable and knowledgeable individual.

## **ABSTRACT**

This project involves the Detailing of Junior Staff Quarters, University of Benin using GNSS receiver. Detail surveys are surveys made to determine the locations of natural and man-made (cultural) features on the Earth's surface. Once these features are located, they can be represented on maps and survey plans. The project site is the Junior Staff Quarters section of the University of Benin Ugbowo campus, located within three Local Government areas i.e. Egor, Ovia north-east and Ikpoba-okha local government area, Benin City Edo state, Nigeria. The project area is geographically located in Egor local government area within longitude  $5^{\circ}37'10.89''\text{E}$  and latitude  $6^{\circ}23'44.66''\text{N}$  and longitude  $5^{\circ}37'13.75''\text{E}$ , and latitude  $6^{\circ}23'38.10''\text{N}$ .

The GNSS equipment, specifically the Tersus David, played a pivotal role in accurately surveying both natural and man-made features within the project area. The total area covered encompassed 4.47 hectares, while the perimeter measured 1,009.89 meters. Subsequently, the perimeter and detailed plans were meticulously crafted using AutoCAD software, employing a scale of 1:1500, and presented on standard A3 paper. This meticulous approach ensured precision and clarity in the project's documentation and representation.

This research project is aimed at developing a survey plan for the study area. The primary objective is to facilitate seamless navigation within the study area for students, staff, and visitors, with a particular focus on supporting property and infrastructure development initiatives.

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## **CHAPTER ONE**

### **1.0 INTRODUCTION**

#### **1.1 BACKGROUND OF STUDY**

Since the inception of the University of Benin, limited survey plans and maps have been created to monitor the development in the ever-expanding university. There has been poor utilization of the school's land. The Junior Staff Quarters which is a part of the university's land mass, was developed to create suitable housing for the Junior Staff of the University. Hence there is a need for a perimeter and details survey of the Junior Staff Quarters in order to map out the physical features present in it and the vacant areas for infrastructure development.

Perimeter and detail surveys are fundamental processes in land surveying that involves the accurate measurement and mapping of land boundaries, topographic features, and other relevant details within a specific area. These surveys are crucial for a variety of purposes, including land development, property assessment, infrastructure design, and environmental management(Poulenard et al., 2020).

Accurate and comprehensive perimeter and detail surveys provide essential information for landowners, developers, and urban planners. They establish the legal boundaries of a property, ensuring clarity and certainty in land ownership (Rengifo et al., 2019). These surveys also enable land developers and infrastructure designers to plan and construct buildings, roads, utilities, and other facilities within the defined boundaries, ensuring proper land use and avoiding encroachments (Topp et al., 2021). Additionally, perimeter and detail surveys contribute to environmental mapping by providing data on topographic features, drainage patterns, and ecological characteristics of the area (Poulenard et al., 2020).

Technological advancements have significantly enhanced the accuracy and efficiency of perimeter and detail surveys. Global Navigation Satellite Systems (GNSS) such as the Global Positioning System (GPS) and the use of aerial and terrestrial Light Detection and Ranging (LIDAR) systems have revolutionized data collection and improved the precision of measurements (Padarian et al., 2021). Geographic Information Systems (GIS) have also played a vital role in data integration, visualization, and analysis, enabling surveyors and planners to make informed decisions based on geospatial information (Yildirim et al., 2019).

However, challenges still exist in conducting perimeter and detail surveys. Complex terrain, dense vegetation, and urban environments can pose difficulties in obtaining accurate measurements and mapping details (Lindenbergh et al., 2018). Additionally, factors such as survey accuracy standards, local regulations, and the selection of appropriate survey equipment and techniques must be considered to ensure reliable results (Alkhatib et al., 2020).

The findings of this study will also benefit land developers, urban planners, and other stakeholders involved in land and infrastructure projects. The results will form or inform decision-making processes, improve project outcomes, and facilitate sustainable land development within the Junior Staff Quarters.

## **1.2 STATEMENT OF PROBLEM**

From the investigation made, it was discovered that the University of Benin Junior Staff Quarters landed property was poorly utilized, as there was a significant amount of vacant area within its premises. This vacant area should have been used for more building housing to provide more accommodation for University Staff. Hence the need for a perimeter and detail survey plan, it was turned into farmlands. Hence the need for a digital plan, which would help the management to

have the whole details of the features both natural and artificial in the area in question, and help her make better decisions on effective utilization of the vacant parcel. This project is intended to map it out with great accuracy, by paying attention to the existing features within it. It will also serve as a viable document for development planning of the Junior Staff Quarters, University of Benin.

### **1.3 AIM AND OBJECTIVES**

#### **1.3.1 Aim**

The aim of the project is to carry out a Detail Survey of the University of Benin Junior Staff Quarters.

#### **1.3.2 Objectives**

The objectives of this project are;

- i. To carry out the perimeter survey of the study area.
- ii. To carry out detailing of both the natural and man-made features of the study area.
- iii. To produce perimeter and detail plans of the study area.

### **1.4 SCOPE OF THE PROJECT**

The scope of this project exercise comprised the following operations;

- i. Reconnaissance Survey.
- ii. Data acquisition (traversing, boundary survey, detailing).
- iii. Data downloading and editing.

- iv. Data processing and analysis.
- v. Data presentation.
- vi. Comprehensive report writing.

## **1.5 JUSTIFICATION OF STUDY**

Survey plans and maps are critical tools necessary for all institutions. A detailed survey plan is a plan showing all natural and man-made features which include roads, buildings, and other relevant things in the environment of the study area. This research is aimed at producing a detail survey plan of the study area so that Students, Staff, and Visitors can easily navigate the study area

- i. This is because perimeter and detailed

plans are essential for property development projects. The produced plans would provide accurate information about the boundaries and physical characteristics of the study area. The Management would need this data to determine the feasibility of her plans, understand any limitations or constraints, and ensure compliance with zoning and regulatory requirements.

- ii. Also, perimeter and detailed survey plans are important for the planning and development of infrastructure projects. Whether her transportation networks, utility corridors, or telecommunications systems, accurate survey data is needed to assess the feasibility of the project, determine optimal routes, and understand any potential challenges or constraints related to the existing landscape and surrounding properties within the Junior Staff Quarters.

## **CHAPTER TWO**

### **2.0 LITERATURE REVIEW**

#### **2.1 SURVEYING**

Since the beginning of recorded history, geomatics has been regarded as a tool in the development of the human environment. It is crucial to the planning and execution of engineering and other types of construction. It can be used to determine who owns a piece of land by defining the legal boundaries, as well as in other aspects of life like communication, mapping, and transportation. According to reports, it is a crucial tool for research across numerous different scientific fields. Engineers are expected to have a thorough awareness of the limits of accuracy possible in the building and manufacturing processes because surveying is crucial to the planning, designing, and implementation of a project. The engineer will be able to execute the project successfully in the most time- and cost-effective manner by using this information in conjunction with a proper grasp of the capabilities and constraints of surveying instrumentation and processes (Breach and Schofield, 2007).

The term of surveying, which is now occasionally referred to as geomatics, is the science, art, and technology of establishing such locations or of identifying the relative positions of points above, on, or beneath the Earth's surface (Ghilani and Wolf, 2012). In general, surveying (geomatics) can be defined as the branch of science that encompasses all techniques for measuring and gathering data about the physical earth and our environment, analyzing that data, and producing a wide range of outputs for a huge clientele. Ever since the dawn of civilization, surveying has been a crucial area of study. One of the first uses of surveying has been thought to be measuring and identifying property lines. The necessity for the establishment of extremely accurate lines and grades to serve

as the final guide for building projects is growing along with the demand for a variety of maps and other spatially linked forms of information. Over time, the value of surveying has continuously grown (Ghilani and Wolf, 2012).

It is crucial to periodically conduct accurate measurements and environmental monitoring. With the use of contemporary ground equipment, aerial and satellite technology, and computer data processing, surveyors can now measure and monitor the earth and its natural resources on a global scale. To estimate the dimensions or relative position of the earth's surface, the surveyor must make the necessary angular and linear measurements, which must then be plotted on a plane sheet to an appropriate scale. For any physical development to be completed successfully, surveying is essential. To generate a rough route plan, surveying is considered to be the first and last activity completed on a project. This is because the developer needs to be aware of the terrain's characteristics. Surveying is therefore the cornerstone of all building projects (Schofield and Breach, 2007).

According to Adoga (2022), In general, surveying is the science, art, and technology of locating points above, on, or below the surface of the ground. Surveying is founded on a few guiding principles, including;

- i. Working From Whole to Part:** This concept states that it is always advised to do survey work with reference to a precise control point. This implies that to survey an area, you must first set up a system of control points that covers the whole region to be surveyed. These control points also needed to be extremely precise. Smaller details can then be located using less accurate methods. We work in this manner to prevent errors from compounding and to manage and restrict minor errors, which are likely to grow to higher enormities if the opposite procedure is used, making the task ultimately uncontrollable (Adoga, 2022).

### 2.1.1 Types of Surveying

This is used to achieve the desired and necessary precision. Greater accuracy can be attained by using an instrument and technique that have been perfected. Among the different surveying kinds, categories, or branches are;

- i. **Geodetic Surveys:** It is a form of survey that primarily focuses on figuring out the size, shape, and physical forces that affect the earth. Establishing a network of horizontal and vertical control monuments, which act as a framework for other surveys, is the major task of a geodetic survey (Agor, 2015). A scientific technique known as geodetic survey is used to precisely measure and ascertain the geometrical size, shape, and orientation of the Earth as well as the locations of particular points on its surface. It entails taking accurate measurements of distances, angles, and elevations using cutting-edge surveying methods and equipment (Ghilani and Wolf, 2012). To create control networks, or networks of reference points with known positions and elevations, geodetic surveys are carried out. The foundation for mapping, land surveying, engineering, building, and other geospatial applications is provided by these control points. They offer a standard framework for integrating and matching data from various sources (Aylmer,2004).
- ii. **Hydrographic Surveys:** The surveys which deal with the mapping of large water bodies for the purpose of navigation, construction of harbour works, prediction of tides and determination of mean sea-level, are called Hydrographic surveys. Hydrographic surveys consist of preparation of topographical maps of the shores and banks, by taking soundings and determining the depth of water at a number of places and ultimately surveying bathymetric contours under water (Agor, 2015).

- iii. **Topographical Surveys:** Are surveys which are carried out to depict the topography of the mountainous terrain, rivers, water bodies, wooded areas and other cultural details such as roads, railways, townships etc., (Agor, 2015). Topographic surveys determine locations of natural and artificial features and elevations used in map making (Ghilani and Wolf, 2012).
- iv. **Engineering Surveys:** This survey which is carried out for the determination of quantities or to afford sufficient data for designing engineering works, such as roads, reservoirs, sewage disposal, water supply, etc. Three broad steps are to collect requisite data for planning, design and execution of engineering projects (Mani and Hakkim, 2017).
- v. **Detail Survey:** The features and improvements on a piece of land are identified and located via a detailed survey. The term "features" in this context refers to both natural and man-made elements on a piece of land, including vegetation, buildings, utilities, fences and boundaries, roads, landmarks, and so on. Typically, the boundaries of the piece of property are the only thing that are surveyed in this way. However, access to trustworthy and necessary geo-information, which is becoming crucial to comprehending what is happening and what will happen in geographic space, is what propels growth and sustainable development in any nation on the planet. The survey will frequently contain information like the land's elevation, or how high the land is above a predetermined level datum level. A commonly used arbitrary level is the Mean Sea Level which is taken as zero meters high. The Easting and Northing coordinates of the land (exact position in relation to the earth's surface) may have to be taken too (Jurovich Surveys, 2023).
- vi. **Perimeter Survey:** Perimeter survey, a part of cadastral survey, was carried out to ascertain the locations of boundary lines on the ground, their distances and directions, and

the regions of the tract they encircle. Perimeter survey is one of the components of cadastral survey. The registration of land ownership is based on such designs, which are determined by perimeter survey, all over the world. (Schofield and Breach, 2007).

Human activities on land, which they have created with their inventiveness and brainpower, are clearly affecting the physical landscape of the earth. To create a sustainable atmosphere for pleasant living, perimeter determination of the earth's landscape's boundary is essentially required. The borders must be delineated on the ground such that anyone standing on or close to the property can see them clearly. Additionally, surveying is meant to give the title insurer the proof they need to eliminate some common exceptions to coverage and offer "extended coverage" against off-record title issues, such as those that would be discovered by an accurate survey (Punmia et al.,2014).

**Mine Surveys:** Are performed above and below ground to guide tunneling and other operations associated with mining. This classification also includes geophysical surveys for mineral and energy resource exploration (Ghilani and Wolf, 2012). The surveys which are carried out for exploration of mineral wealth beneath the surface of the ground i.e. coal, copper, gold, iron ores etc., are called Mine surveys (Agor, 2015).

- vii. **Astronomic surveys:** This is the survey which is carried out for determining the absolute locations i.e., latitudes of different places on the earth surface and the direction of any line on the surface of the earth by making observations to heavenly bodies, i.e., stars and sun. In northern hemisphere, when night observations are preferred to, observations are usually made to the Polaris, in other words the pole star (Agor, 2015). To determine the latitude, longitude (of the observation station) and azimuth (of a line through observation station) from astronomical observation (Mani and Hakkim, 2017).

## **2.2 SURVEYING PRINCIPLE**

### **2.2.1 Traversing**

A traverse is a collection of sequential lines, the ends of which have been marked in the field, and the lengths and bearing of which have been successfully calculated from field observations. The act or process of traversing is the marking of traverse lines, which involves creating a traverse station and making the necessary observations. The parameters that are typically observed during traversing are the traverse line's length and bearing, which are obtained from angular observation using survey equipment. One of the simplest and most popular ways to ascertain the distances between two points is traversing (Ghilani and Wolf, 2012).

In engineering surveying, traversing is thought to be one of the simplest and most common ways to establish control networks. While it lends itself perfectly to control surveys in civil engineering where only a few intervisible points surrounding the site are needed, it is the only method of control applicable in underground mining (Agor, 2015).

### **2.2.2 The Purpose of Traversing**

The purpose of traversing, as given by Mani and Hakkim(2017), are highlighted below.

- i. The establishment of a horizontal control system is one of the purposes of traversing, which is also used to carry out various surveying tasks.
- ii. They are employed in the layout of various engineering design structures, including roads, drainage systems, and buildings.
- iii. During detailed surveying, they are utilized in the selection of both natural and man-made features.

- iv. During cadastral survey work, they are utilized for the proper installation of survey beacons.
- v. They are employed to set up controls for the mapping of sizable areas.

### 2.2.3 Types of traverses

There are two types traverse and these are: close and open traverses.

- i. **Close traverse:** A close traverse is simply defined as one that begins at a known control point and ends there or at another known control point. A close traverse can be easily checked and adjusted to fit precisely between these known control points because it can close back on its starting control or on another control point (Ghilani and Wolf, 2012).

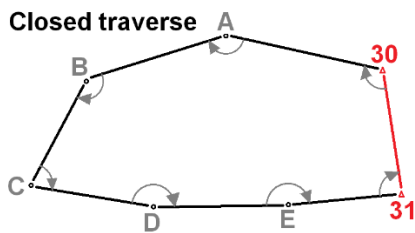


Figure 2.1: Closed Traverse (Source: Structural-Analyser, 2023)

**Open traverse:** A traverse type known as an open traverse begins at a known control point and ends at an unknown point. A set of connected lines that do not terminate at the starting control point or on another control point make up an open traverse. Because there is no way to check for observational errors and mistakes, an open traverse is not advised. To create a collection of precise and accurate observation data, the observation must be repeated if it is to be used in any situation (Ghilani and Wolf, 2012).

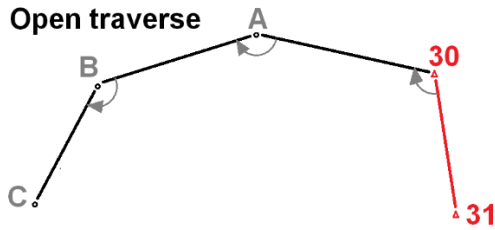


Figure 2.2: Open Traverse (Source: Structural-Analyser, 2023)

### 2.3 SURVEYING EQUIPMENT

Equipments Used for perimeter and detailing include: total station, 3D laser scanners, theodolite and measuring tape, GNSS receivers.

- i. Total station: A total station is a sophisticated surveying instrument that integrates the functions of a theodolite (for measuring angles) and an electronic distance measuring device (for measuring distances). It plays a crucial role in perimeter and detail surveys due to its ability to provide accurate measurements of both angles and distances. It can measure angles with an error of less than 1 arcsecond and achieve distance measurement accuracy ranging from a few millimeters (mm) to a few centimeters (cm).
- ii. 3D Laser Scanners: Laser scanners capture detailed 3D point clouds of objects and surfaces, allowing for highly detailed and accurate representations of structures and terrain.
- iii. Theodolite and measuring tape: A theodolite is an optical instrument used for measuring horizontal and vertical angles. It helps in setting out reference points and establishing angles for accurate measurements. Measuring tapes come in various lengths and are used to measure linear distances on the ground. They are essential for perimeter surveys.
- iv. GNSS receivers: GNSS receivers use signals from satellites to determine accurate coordinates of survey points. They are useful in obtaining coordinates for both perimeter and detail survey.

The Differential GNSS Receiver Was chosen for the project because of its user-friendly interface, rapid data acquisition, and its exceptional accuracy compared to other survey equipment. One significant advantage it offers over other equipment is its ability to cover large study areas efficiently, reducing the time and effort required for detailing and perimeter surveys.

## **2.4 GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)**

The global navigation satellite system (GNSS) is a space-based radio positioning system that consists of one or more satellite constellations that may be supplemented as needed to support the intended operation. It offers suitably equipped users anywhere on or near the surface of the earth real-time three-dimensional position, velocity, and time information (Bensky, 2008).

The general term "GNSS" refers to a number of current and future constellations of satellites as well as related infrastructure systems that are used to pinpoint locations around the world. They play a crucial role in the operation of robust, integrated information management and control systems with a variety of applications that affect many aspects of the national and regional economies, the coordination of data communications technologies like radio or the internet, and the use of these technologies (Bensky, 2008).

One of the most recent and important tools, the Global Navigation Satellite System (GNSS), has revolutionized almost all applications that require extremely precise positioning, navigation, and timing in the frequency domain. Since this development, high-accuracy stations have been put in place all over the world (Ogaja, 2022).

Now, differential (relative) positioning or point positioning can be used for GNSS positioning. The use of global navigation satellite systems (GNSS) is among the most common. There are billions of smartphones and other devices with satellite navigation applications. GNSS have become a

crucial part of daily life, assisting us in a wide range of tasks like surveying, surveying, and precise machine control. According to Carlo des Dorides (2019), the number of GNSS devices installed worldwide for the year 2020 was predicted to be close to 6.5 billion.

According to Bensky(2008), the major Satellite Constellations are:

- i. GPS (Global Positioning System) - created by the United States of America (USA)
- ii. GLONASS - created by the Russia federation
- iii. Galileo -created by the European Union
- iv. BeiDou (BDS) - created by the Republic of China

#### **2.4.1 GNSS SEGMENT**

The four primary satellite systems that make up the GNSS are GPS, Glonass, BeiDou and Galileo.

A space segment, a control segment, and a user segment make up the majority of each of them.

- i. **Space Segment:** The constellation of satellites that orbit the Earth and give users on the ground information about positioning, navigation, and timing is referred to as the space segment for Global Navigation Satellite Systems (GNSS). The United States' Global Positioning System (GPS) and other GNSSs like GLONASS (Russia), Galileo (European Union), and BeiDou (China) are the most well-known GNSS systems. Multiple satellites in geostationary orbit (GEO) or medium Earth orbit (MEO) make up the space segment of GNSS in most cases. Every satellite in the constellation sends out signals that are precisely timed and positioned. Ground-based GNSS receivers pick up these signals, and they use the data to calculate the user's position, speed, and time (Lekkerkerk, 2017).
- ii. **Control Segment:** The management, control, and monitoring of the satellite constellation are the responsibilities of the control segment for Global Navigation Satellite Systems

(GNSS). The GNSS system's proper operation and accuracy are ensured by a network of control centers, tracking networks, and ground-based control stations. The satellite orbits and their clock correction parameters are precisely predicted by the master control station using this data for the near future. Receivers can use this data to forecast satellite positions and clock biases (systematic errors) by uploading it to the satellites, which then transmit it as part of their broadcast message (Lekkerkerk, 2017).

- iii. **User Segment:** The user segment of Global Navigation Satellite Systems (GNSS) refers to the receivers and devices used by individuals or organizations to receive and process GNSS signals for positioning, navigation, and timing purposes. The user segment is the part of the GNSS system that directly interacts with end-users and applications. The user segment of GNSS is diverse and continually expanding as new applications and devices are developed. It enables individuals, industries, and organizations to leverage GNSS technology for a wide range of positioning, navigation, and timing requirements (Lekkerkerk, 2017).

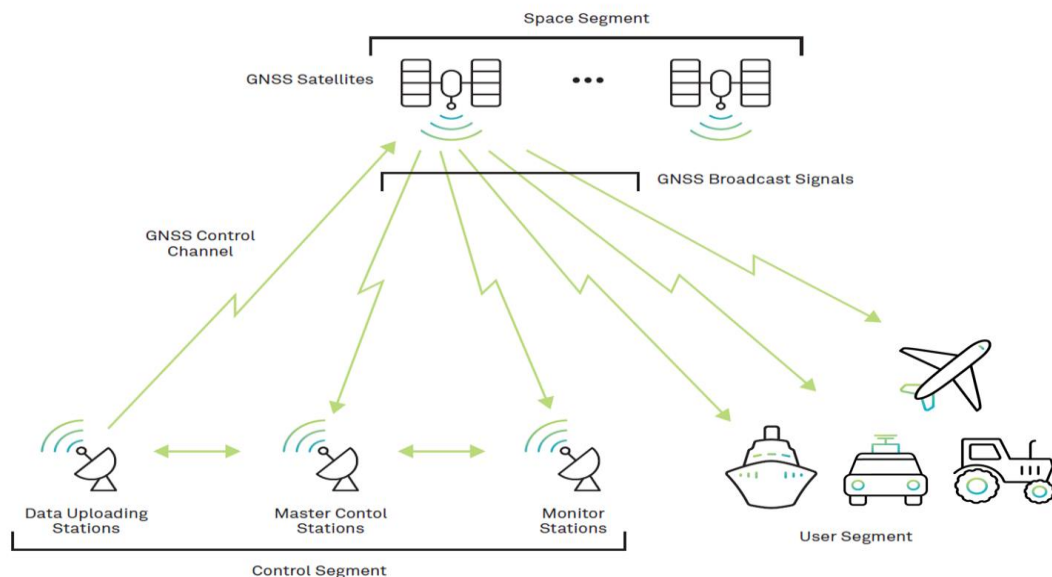


Figure 2.3: Various Segments in GNSS (Source: Novatel, 2023)

## 2.4.2 Error In GNSS Observations

- i. Ionospheric Delay:** When the sun's ultraviolet and x-ray radiations interact with the gas molecules in the atmosphere, a lot of free, negatively charged electrons are produced. This process is known as gas ionization, and the area of the atmosphere where it occurs is known as the ionosphere (Hofmann et al. 2001). The electron density within the ionosphere varies with altitude and ranges from about 50 km to about 1000 km. As a result, the ionospheric region is divided into subregions based on the electron density. The density of free electrons and the refractive index ( $n$ ) of microwaves can both be expressed as first-order approximations, and the ionosphere has the property of dispersion as a result. The region of the atmosphere that is electrically neutral and reaches up to 50 kilometers above the earth's surface is known as the troposphere. A non-dispersive medium for radio frequencies below 15 ghz is the troposphere (Ogaja, 2022).
- ii. Tropospheric Delay:** The tropospheric delay cannot be eliminated by combining GPS waves L1 and L2 observations, in contrast to the ionospheric delay. This is primarily due to the frequency independence of the tropospheric delay. Temperature, humidity, pressure, and tropospheric delay are signal route. The tropospheric delay is minimized at the user's zenith and maximized at the horizon through the troposphere. According to Kouba et al. (2000), the tropospheric delay yields values of 2.30 m at the zenith, 9.30 m at  $150^\circ$  elevation angle, and 20–28 m at  $50^\circ$  elevation angle. The satellite elevation angle and the receiver's altitude both affect tropospheric delay. However, defining it in terms of the refractive index, integrated along the signal ray path, is a good place to start (Ogaja, 2022).

- iii. GPS Orbital Biases:** The coordinates of the GPS satellites with respect to the WGS84 reference system must be continuously determined through the analysis of tracking data as the motion of the satellites is perturbed by forces of gravitational and non-gravitational origin (Alves 2004). The difference between a satellite's actual position and velocity and its known value is known as the satellite ephemeris bias. There are numerous ways to parameterize this discrepancy, but one popular method uses the three orbital components: along track, cross track, and radial. The component along track has the biggest error in the case of GPS satellites (Ogaja, 2022).
- iv. Selective availability** When GPS was first developed, it was intended for civilian C/A code receivers to provide less accurate real-time autonomous positioning and navigation than military P-code receivers. Surprisingly, the accuracy obtained from both receivers was essentially the same. The United States Department of Defense (U.S. DoD) implemented so-called selective availability (SA) on Block II GPS satellites to prevent unauthorized users from receiving precise real-time autonomous positioning in order to protect national security. On March 25, 1990, SA became formally operational (Hofmann et al. 2001). Two types of errors are introduced by SA (Georgiadou, 1990). The first one, known as delta error, is experienced by all users worldwide and is brought on by the satellite clock dithering. Another orbital error with a slowly varying value is the second one, known as the epsilon error. Nominal horizontal and vertical errors with SA activated can reach up-to 100m and 156m, respectively, at the 95% probability level (Ogaja, 2022).
- v. Multipath Error:** Multipath is a major source of errors for both carrier-phase and pseudo range measurements. This happens when the GPS signal reaches the receiver antenna through different paths, such as the direct line of sight signal and reflected signals from

objects surrounding the receiver antenna (Wells et al, 1987). This distortion of the original signal is caused by interference with the reflected signals at the GPS antenna, and it affects both the carrier-phase and pseudo range measurements. The maximum size of the carrier-phase multipath can reach up to a quarter of a cycle (about 4.8 cm for the L1 carrier phase). The pseudo range multipath can theoretically reach several tens of meters for the C/A-code measurements. However, with the introduction of new technologies, such as the Strobe correlator (Ashtech, Inc.) and the MEDLL (NovAtel, Inc.), the pseudo range multipath error is significantly reduced, even in highly reflective environments (Ogaja, 2022).

- vi. **Receiver Measurement Noise:** The performance of a GPS receiver can be evaluated by two tests: zero baseline and short baseline tests. In a zero baseline test, one antenna/preamplifier is used, and the baseline solution should be zero. Any nonzero value is attributed to the receiver noise. This test is useful for detecting receiver problems such as inter channel biases and cycle slips. However, it does not provide any information on the antenna/preamplifier noise. The receiver measurement noise is a result of the limitations of the receiver's electronics, and the contribution of this noise to the range error will depend on the quality of the GPS receiver. For high-cost precise GPS systems, it is important for the user to perform the system evaluation. A good GPS system should have a minimum noise level (Lekkerkerk, 2017).

### 2.4.3 Principle of Operation of GNSS

Each Satellite broadcast two signals that consist of carrier waves that change in a specific pattern at precise rates and times. A receiver will generate a copy of the phase-change pattern and move it back and forth in time, trying to match it with the signals it receives. If the signal is being received, the patterns will eventually match and the correlator circuit will generate a large output.

This is called lock-on to a satellite, and it provides a pattern generator in the receiver that is in sync with the received signal. Knowing how much the generator was shifted in time tells the receiver when the signal arrived at the receiver compared to its own internal clock. If the receiver can figure out how its clock is adjusted to true GPS time, it can calculate how long it took the signal from the satellite to reach the receiver. Multiplying this time by the speed of light gives the receiver the distance from the satellite. In addition to the phase-change pattern, the signal also contains the Navigation Message, which includes the current time to the nearest second and the information needed to calculate the satellite's location at the time of transmission. This allows the receiver to set its clock to the correct second and compute the satellite's current position (Petrovski, 2012).

Using simple geometry, the receiver knows it is somewhere on the surface of a sphere centered on the satellite with a radius equal to the distance from the satellite. To sum up, several satellites are broadcasting their unique patterns which arrive at the receiver's antenna at different times depending on the distance between the receiver and the satellite. The receiver looks for specific satellites by generating and shifting the pattern for each satellite that might be broadcasting. When matches are found, the receiver can calculate the pseudo range to each satellite. If the receiver's clock is synchronized to GPS time, the receiver can immediately calculate its position. However, the receiver's clock is usually not set to GPS time, so the pseudo range includes the time it took the signal to travel to the receiver plus the amount that represents how far the receiver clock and GPS time differ, which is called clock offset. This time error is common to all of the pseudo ranges since the receiver uses the same clock to measure all pseudo ranges (Petrovski, 2012).

When a receiver acquires a satellite, it monitors the navigation message from the satellite. This message contains the current GPS time, which is the number of seconds since midnight between January 5 and 6, 1980. The receiver uses this information to set its own time indication to the exact

whole second, and then computes fractions of a second later. Additionally, the navigation message includes a set of numbers called the ephemeris, which together describe the satellite's orbit in space and where the satellite is in that orbit at a particular time. The receiver uses the ephemeris and the current time to compute the exact location of the satellite in space. This gives (Ogaja, 2022).

#### 2.4.4 GNSS Positioning Modes

- i. **Static positioning:** A relative positioning method that depends on carrier-phase measurements is static GPS surveying (Hofmann et al. 2001). It makes use of two (or more) stationary receivers that track the same satellites simultaneously. A survey monument or another point with precisely known coordinates serves as the base receiver, which is also referred to as the known point. The other receiver, known as the remote receiver, is placed over the unknown point, a point whose coordinates are sought. Any number of remote receivers can be supported by the base receiver as long as both the base and the remote sites can see at least four common satellites (Hofmann et al. 2001).

The basic idea behind this technique is to gather measurements simultaneously at the base and remote receivers for a predetermined amount of time. These measurements are then processed to produce the coordinates of the unknown point. The duration of the observation, or occupation, varies from about 20 minutes to a few hours, depending on the baseline length—the distance between the base and the remote receivers—the number of discernible satellites, and the geometry of the satellites. The measurements are typically made every 15 or 20 seconds, or once every sample measurement, respectively. The gathered data is downloaded from the receivers into the PC for processing after the field measurements are finished. Various processing options may be chosen based on the needs of the user, the baseline length and others factors (Langley, 1993).

- ii. **GNSS Real Time Kinematics (RTK):** real-time kinematics (RTK). In a differential global navigation satellite system (DGNSS) procedure, real-time carrier-phase corrections are transmitted from a reference receiver at a known location to one or more distant receivers. Although it is the most effective survey technique, it is also the least reliable. A carrier phase is RTK surveying. Based on relative positioning, this technique, like the earlier ones, uses two or more receivers to track the same satellites at the same time. This method works well when there are a lot of unknown points in the survey that are close to a known point (up to about 10.15 km away), when the coordinates of the unknown points must be obtained instantly, and when the propagation path, or line of sight, is largely unobstructed (Langley, 1994). This method is favored by many users due to its simplicity of use and ability to determine the coordinates in real time. In this technique, a radio transmitter is connected to the base receiver, which is fixed over the known point. A radio receiver is connected to the rover receiver, which is typically worn in a backpack. A data rate as high as 1 Hz (one sample per second), similar to the traditional kinematic GPS method, is necessary. Through the communication (radio) link, the base receiver measurements and coordinates are sent to the rover receiver (Langley, 1993). The GPS measurements gathered at the base and the rover are combined and processed by the rover receiver's built-in software to obtain rover coordinates (Hofmann et al. 2001).
- iii. **Precise Point Positioning (PPP):** PPP is a high-precision mode that doesn't rely on a reference station. Instead, it uses precise satellite orbit and clock corrections from global networks to achieve centimeter-level accuracy. PPP is used in applications like geodesy and scientific research. A PPP-capable GNSS receiver collects signals from multiple satellites and integrates these observations with the precise correction data it receives from

global networks. The receiver calculates its position by considering not only satellite positions but also factors such as atmospheric delays and Earth's gravity field (Hofmann et al. 2001).

- iv. Relative Positioning:** is a GNSS technique that involves determining the relative positions of two or more GNSS receivers in relation to each other. This approach is used for various applications that require measuring the separation or movement between receivers. In relative positioning, the receivers may not need access to correction data from reference stations or global networks, as is often the case in techniques like PPP or RTK. Instead, they rely on the measurements between themselves and do not require precise knowledge of satellite orbits or clocks. Applications of relative positioning include baseline measurements in surveying, where the distance and direction between two receivers are determined with high accuracy. It's also used in deformation monitoring, where multiple receivers track slight shifts or movements in structures or land masses over time (Ogaja, 2022).

#### **2.4.5 GNSS Positioning Mode Adopted for the survey**

The chosen positioning mode for the survey was Real-Time Kinematic (RTK), which utilized a connection to a Continuously Operating Reference Station (CORS) instead of deploying reference receivers on control stations. The CORS station provided centimeter-level accuracy, which proved to be sufficiently high for the survey's requirements. In addition to its high accuracy, using a CORS station provided several other advantages. These benefits included convenience, as CORS stations are part of an existing network, eliminating the need for setting up and maintaining multiple reference receivers. CORS stations also offered wider coverage, making it possible to conduct surveys over the project study area without the logistical challenges of deploying numerous

reference receivers. The CORS stations also ensured consistency and reliability in correction data, as they provided real-time correction services.

Overall, the choice of connecting to a CORS station not only delivered high accuracy but also offered cost savings, convenience, and access to a well-maintained and comprehensive correction network, enhancing the efficiency and reliability of the survey.

## **2.5 REVIEW OF A RELATED STUDY**

Leonardo Aminigbo conducted a Detailed Perimeter Survey of the Igwuruta Flood Plain in Greater Port Harcourt City, Rivers State, using a total station. The survey commenced by positioning and centering the total station at Control Station RVC 06, followed by placing the reflector at Control Station RVC 05. Subsequently, survey pegs were placed along the route. The survey covered a total distance of 848.170 meters, encompassing an area of 36,995.700 square meters. The acquired data was then processed and plotted using AutoCAD Land Companion 2009, resulting in a perimeter plan at a scale of 1:2000, which was presented on a standard A3 paper. A notable challenge encountered during the survey was intervisibility issues between the total station and the reflector, a problem not faced by GNSS receivers (Aminigbo, 2021).

# CHAPTER THREE

## 3.0 METHODOLOGY

### 3.1 THE STUDY AREA

The project site is the Junior Staff Quarters, University of Benin Ugbowo Campus, located within three Local Government Areas i.e. Egor, Ovia north-east and Ikpoba-Okha Local Government Area, Benin City Edo state, Nigeria. The project area is geographically located in Egor local government area within longitude  $5^{\circ}37'10.89''\text{E}$  and latitude  $6^{\circ}23'44.66''\text{N}$  and longitude  $5^{\circ}37'13.75''\text{E}$ , and latitude  $6^{\circ}23'38.10''\text{N}$ .

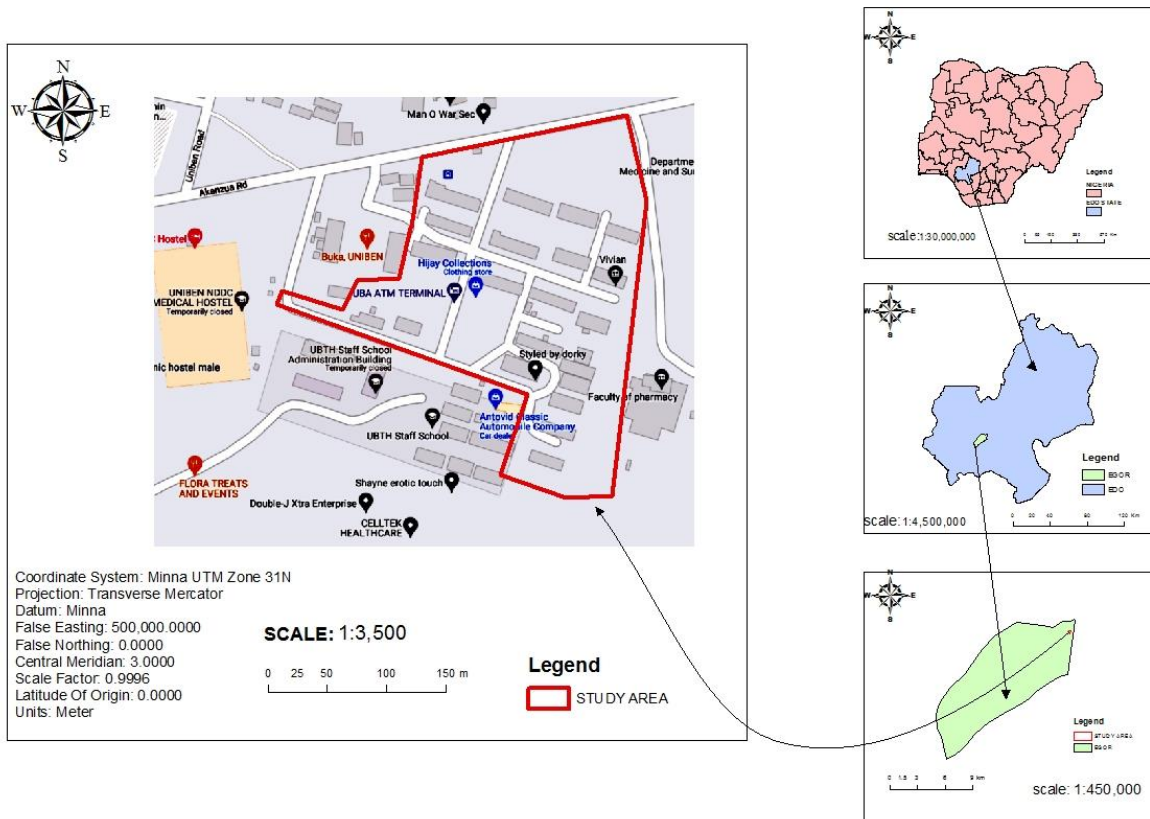


Figure 3.1: The Study Area

## 3.2 PROJECT WORKFLOW

This procedure started with the reconnaissance stage which involves both the field and office reconnaissance. This reconnaissance survey involves the field visitation to scrutinize the main features of the area but not in detail. The field reconnaissance includes the general overview of the project area. The office reconnaissance phase was carried out in the office where other planning needs to be carried out like the closest CORS station to project area. The field data acquisition was carried out using the GNSS Real Kinematics (RTK mode). The flow diagram of the project, which is the summary of all the stages involved in executing this project is shown in figure 3.2

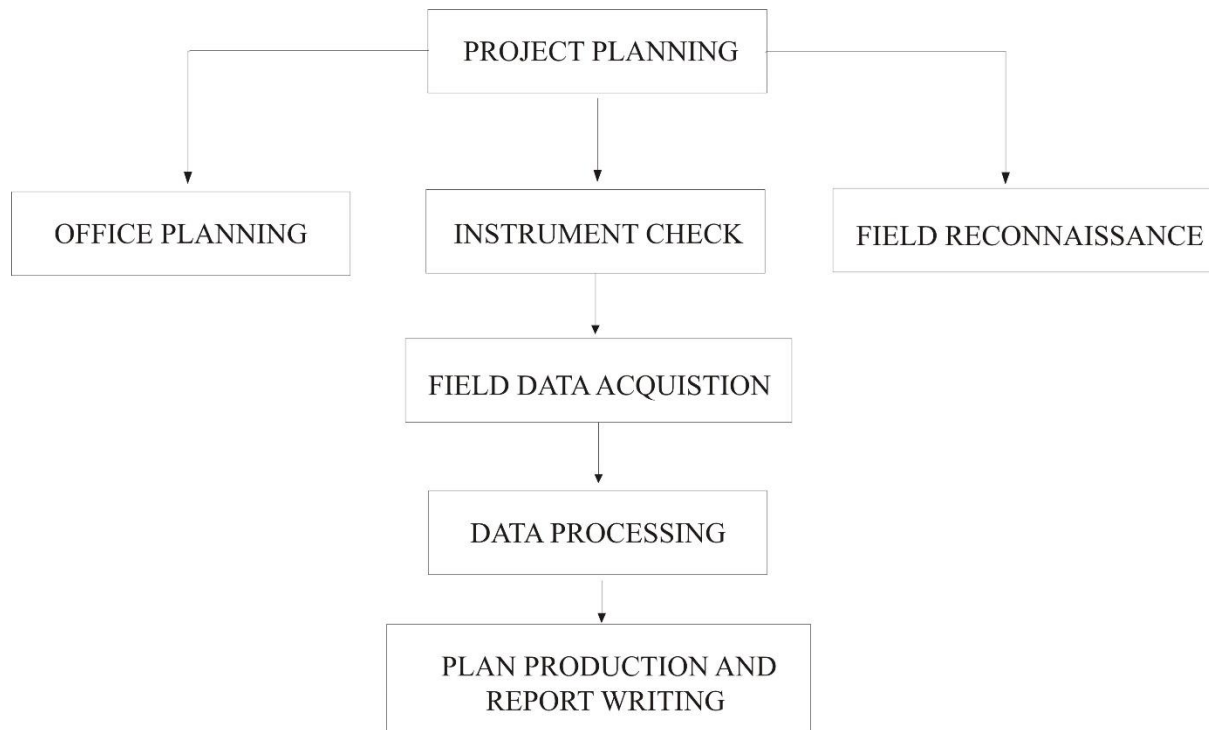


Figure 3.2: Flow Diagram of the Project

## 3.3 OFFICE PLANNING AND RECONNAISSANCE

### 3.3.1 Office Planning

In the context of office planning, also known as desk study, the initial step involved the collection of all pertinent information and records essential for facilitating the project's execution. This

encompassed the acquisition and retrieval of available data and information pertaining to the project site. The primary goal was to discern any existing infrastructures or established features within the project boundary. This comprehensive data gathering served to enhance the organization of the upcoming field survey.

Regarding fieldwork logistics, focus was directed toward determining the most efficient route for navigating the area. A systematic approach was adopted by implementing a numbering or ID system, following a clockwise directional path along the project boundary. This method was chosen to provide a structured perspective for survey efforts, ensuring a methodical approach to data collection.

### **3.3.2 Reconnaissance**

My involvement in the field reconnaissance began with a visit to the project site, aiming to gain a comprehensive understanding of the project area. Utilizing the findings from the office planning and data search, the process was guided effectively. A pivotal aspect addressed during the initial planning stages of the project revolved around the selection of new arbitrary point locations. The criteria for choosing these new arbitrary points were established with the overarching project objectives in mind.

During this process, several key considerations emerged. These considerations included the need to ensure that the chosen arbitrary points aligned seamlessly with the projects overall goals and requirements. Additionally, an evaluation of the accessibility of these points for surveying purposes was conducted to ensure efficient data collection. Furthermore, confirming that the chosen locations accurately represented the entire project area emerged as a crucial step in the planning process. The process also took into account any potential logistical challenges or

constraints associated with these points, recognizing the need to address them effectively to ensure the project's success.

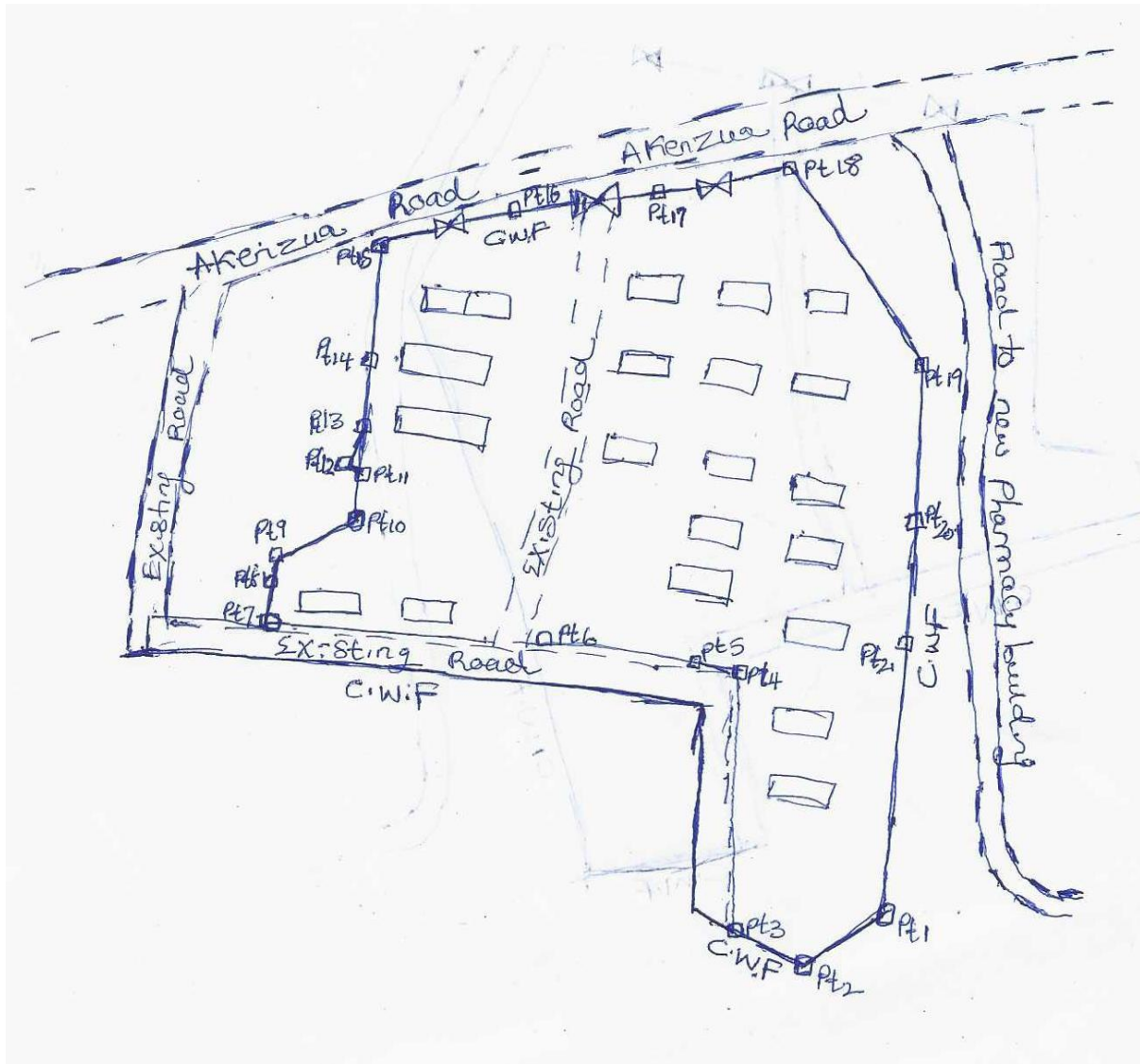


Figure 3.3: Recce Diagram of the Project Area.

### 3.4 EQUIPMENT AND MATERIALS USED

Table 3.1: List of the Tersus David Receiver Accessories

Device Name	Quantity
David GNSS Receiver	1
Ranging Pole	1
Bracket for Tc20	1
Tc20 Controller	1
Antenna	1
Power Bank	1

- i. 50m Steel Tape
- ii. Field sheet

### 3.5 HARDWARE AND SOFTWARE

#### 3.5.1 Hardware

- i. HP 2000 Laptop
- ii. Flash drive

#### 3.5.2 Software

- i. ArcGIS 10.4 software
- ii. SAS planet and Google Earth pro
- iii. Notepad
- iv. AutoCAD 2012
- v. Excel 2013
- vi. Microsoft office 2013

### 3.6 DATA ACQUISITION

Detailing is the act of representing features on the surfaces of the earth e.g., buildings, Electric poles, transformers, Roads, etc. The details of the study area would be fixed by GNSS RTK positioning mode.

The Real-Time Kinematic (RTK) method or technique of the Tersus David GNSS equipment was used for data acquisition and collection.

The following steps/procedures were taken in using the Tersus David GNSS equipment to acquire the data.

- i. The GNSS Receiver components was assembled, which include AX3702 GNSS antenna, Ranging pole, TC20 Controller, power bank, COMM1-Bluetooth module, Bracket for rover, David GNSS receiver, DC-2pin to USB power cable.
- ii. Then the TC20 Controller was turned on, the Bluetooth module was connected to the COMM1 port of David. Then Connected the AX3702 GNSS antenna to David with the GNSS antenna cable. Then Powered on the David receiver with its power bank. Run Nuwa app, click [Device] -> [Connect].
- iii. Select [Bluetooth] in the option list of Connect Type. Clicked [Connect Config] -> [Search]. The SSID is BT420T-xxxxxx\_xxxxxx . Then I Clicked [Connect] to enable the communication with the David.
- iv. From the TC20 controller drag the drop down menu and turn on the Wi-Fi so it can get cellular network. Then click [Device] -> [Rover]. And then choose the CORS station which was "Geosystem".

- v. Then a new project was created and assigned the coordinate system International Terrestrial Reference Frame (ITRF), then click on Survey, place your instrument height, point ID etc. After all necessary setup was done, the Rovers would hence be successfully connected and Rover would be able to communicate with the Continuously Operating Reference Station CORS through signal transmission. The Rover was then taken to the Study area.
- vi. The survey began with a perimeter survey starting from the south end, which shared a fence with the golf course, marked as point 1. Subsequently, moving along the fence edge to collect other points. It is important to note that all bends along the fence were acquired and saved in the Tc20 controller. Then, the road was crossed, proceeding back to the fence surrounding the food court until the first gate, and then continued clockwise back to point 1. In total, 21 points were acquired and stored around the study area.
- vii. Following this, the detailing phase began around the study area. The focus was on the edges of features such as buildings and drains. The data acquired was saved on the device. Initially, one section divided by the road towards point 1 was covered, and then the other section. Features like streetlights, drains, transformers, and gates were acquired and saved."
- viii. The following features were measured using the Rover and appropriate codes were used to denote these features, these features, and their denotation codes are;

Table 3.2: The Features Code for Storing the Acquired Data from the GNSS Receiver

S/N	FEATURES	CODE
1	Edge of drainage	DR
2	Edge of road	RD
3	Street light	STL
4	Transformer	TRF
5	Buildings	BD
6	Fence	FE
7	Gate	GT

After this, the data was collected from the TC20 Controller via Xender, due to its android functionality. The data was saved in excel format and then exported.

### 3.6.1 Downloading the Satellite Imagery from SAS Planet

SAS planet is more increasable used over Google Earth Pro for satellite imagery acquisition by Gis Analyst, because SAS planet imagery when downloaded already has geo-referenced property.

The following steps were followed in downloading the Satellite Imagery from SAS Planet.

- i. The study area was located by searching the address.
- ii. Then Shift-snap to active grid.
- iii. Then clicked on the drop down order
- iv. Click “Stitch” then toggle on “w”



Figure 3.4: Downloaded Image of the Study Area

## **3.7 PLOTTING**

### **3.7.1 Plotting of Perimeter and Detailing**

The XYZ coordinates obtained from the field was collected in CSV hence the need to convert it to the form acceptable by the AutoCAD which is Eastings, Northings, Elevation. Then the following steps were applied.

- i. Setting all the necessary formats for the “UNITS” tab.
- ii. Then change to the appropriate “POINTSTYLE” on the tab.
- iii. Then highlight all the points on excel and run in autocad after typing “Multiple “ then “POINTS”

- iv. Then bound the perimeter points with a polygon, road with a line etc.
- v. Then generate all distances and bearings within the project area from the perimeter points obtained.

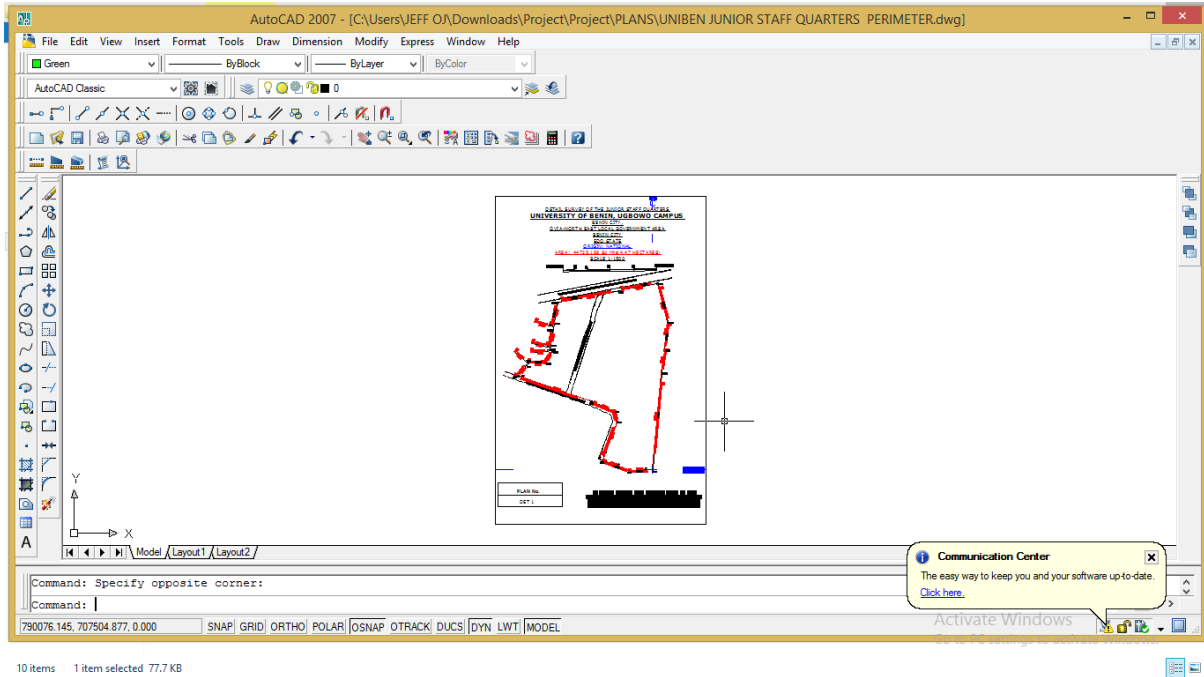


Fig 3.5: The Plotting of the Perimeter Plan

After plotting the perimeter plan, detailing in the AutoCAD begin by typing “MULTIPLE” and sequentially typing “POINT” on the command bar. After this, the excel document was copied and run, then various shapes were delineated based on what they represented. e.g. fence, residential building, poles, shed etc.

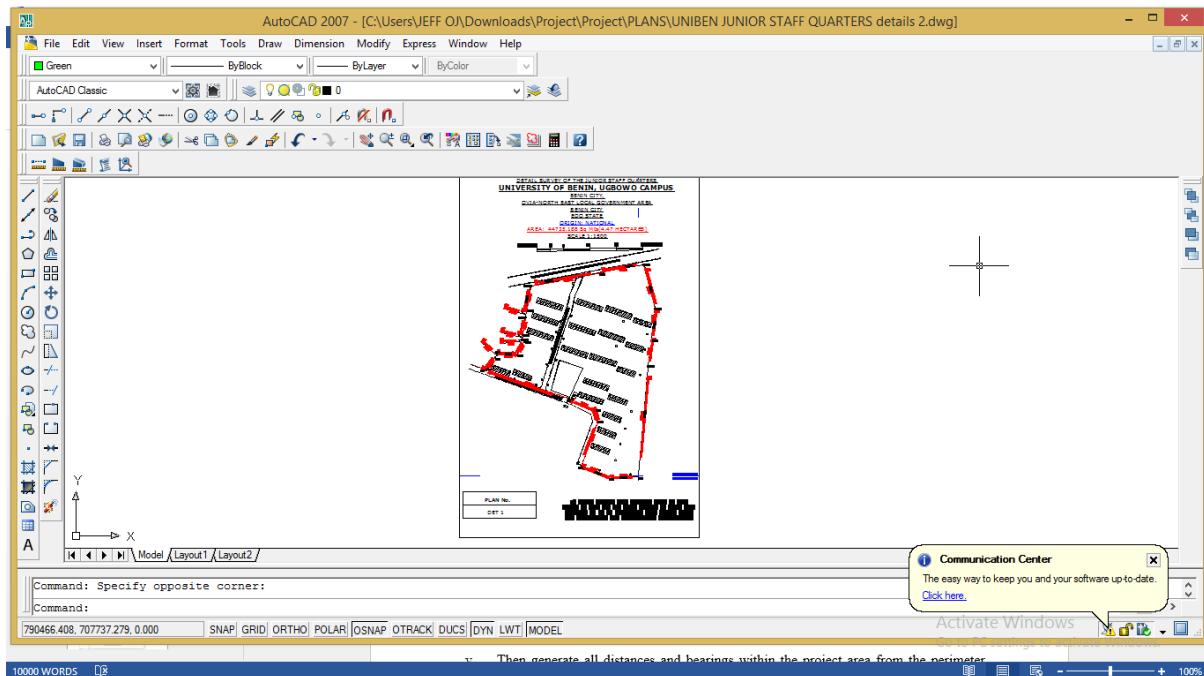


Fig 3.6: Plotting of the Detail Plan

### 3.7.2 Creating a Digitized Map Using ArcGIS

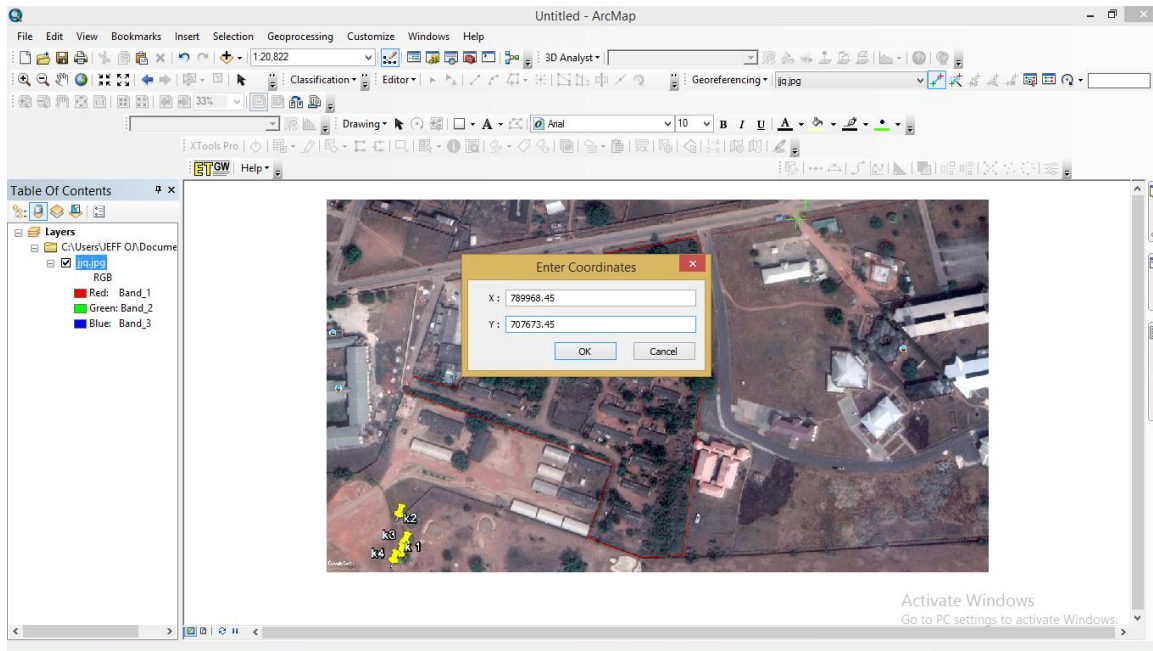
The acquired field data from Tersus David GNSS receiver was processed using Microsoft Excel and then subsequently imported into ArcGIS environment for mapping processes.

#### 3.7.2.1 Geo-referencing Image

- i. The downloaded Satellite image was imported into ArcGIS.
- ii. Set the coordinate reference system on the map by navigating through the properties of the image then change the coordinate system to WGS 84 UTM Zone 31N

Geo-reference the downloaded images by assigning coordinate that was gotten from GNSS Data Logger to notable places which are clearly shown on ground and on the satellite image.

- i. Click on rectify and click on Update Geo-referencing.



Figure

### 3.7: Geo-referencing the Satellite Imagery on the ArcMap Environment

#### 3.7.2.2 Importing Data to ArcMap

- i. In Arc Map, add data was clicked, the csv. coordinates file was chosen and added to the workspace after adding, the file appears in the table of contents, after right clicking, display XY data is selected, the appropriate fields were selected to represent X and Y fields, where x is Easting and Y is Northing. WGS 84 UTM Zone 31N as the input coordinates system and click OK.

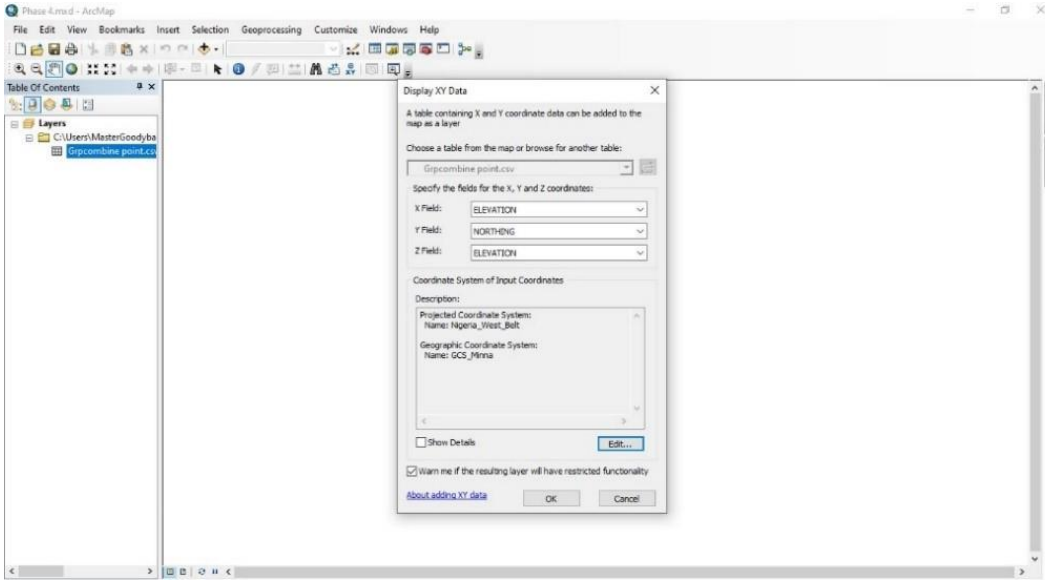


Figure 3.8: Importing the CSV Data into ArcMap Environment

**3.7.3.3 Creating shapefiles**

In Arc Catalog, right click on home, go to new, click on Shapefile, the type, name and coordinate system of the feature is chosen and OK

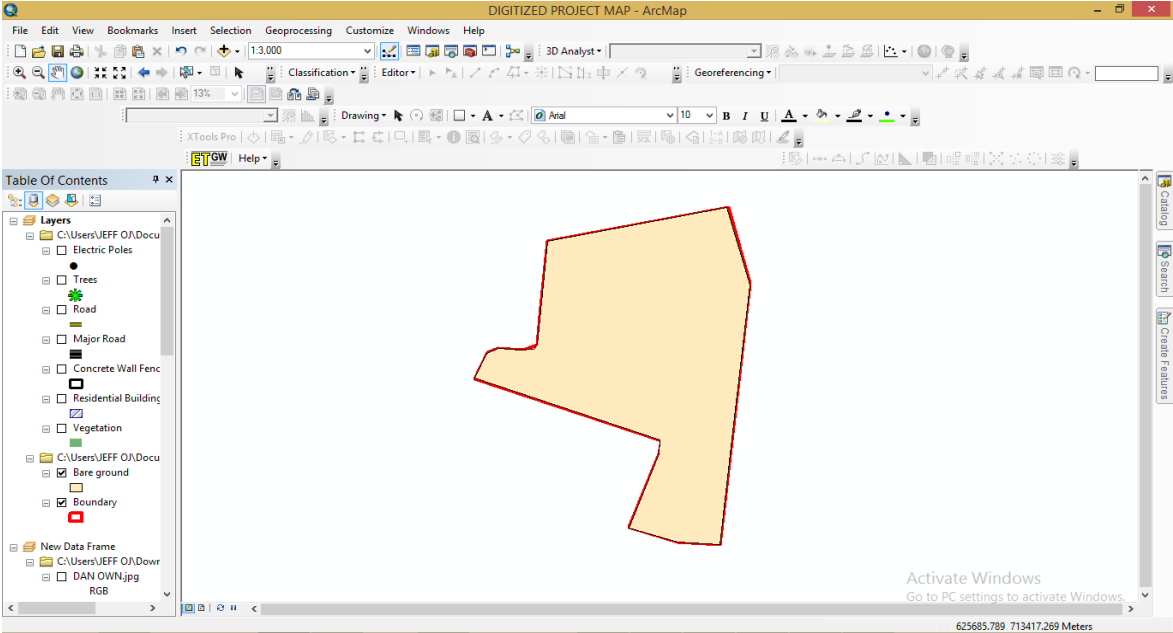


Figure 3.9: The Creation of the Shapefile

### 3.7.3.4 Digitizing Features

The SAS Planet image of the study area was imported, the image was geo-referenced, and geo-referencing involves registering the image using some points chosen on the image and the coordinate gotten from our survey to serve as control points. Shapefiles like buildings, trees, parking spaces, footpaths, grassland and road were created. These shapefiles were edited to represent features on the surface of the ground by a method referred to as digitizing.

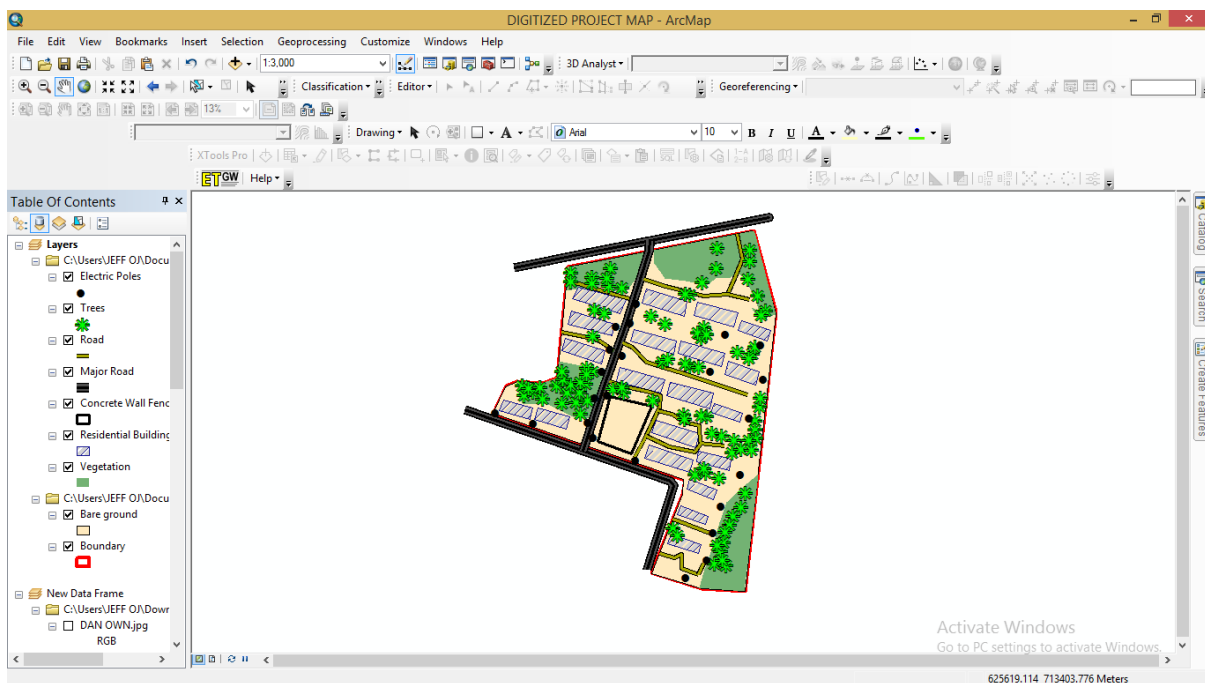


Figure 3.9.1: The Creation of the Digitized Features

## CHAPTER FOUR

### 4.0 RESULTS AND DISCUSSION

#### 4.1 RESULTS

The following result/maps were produced after analysis were carried out on the acquired data.

- i. Perimeter plan of the study area.
- ii. A detailed map of the study area.
- iii. A digitized map of the study area.
- iv. Contour map of the study area.

#### 4.1.1 Computation Of Area Using Criss Cross Coordinates Method

Table 4. 1: Coordinates of the Perimeter Boundary

REMARKS	NORTHINGS (m)	EASTINGS (x)(m)	PRODUCTS	
			Left Hand Side	Right hand side
PT 1	707421.850	789953.460		558829619229.452
PT 2	707420.940	789913.340	558801956322.479	558814531742.852
PT 3	707437.770	789868.730	558769679453.206	558834807289.469
PT 4	707503.394	789893.092	558800207542.885	558865816063.106
PT 5	707520.830	789888.520	558848808781.637	558876471467.496
PT 6	707538.415	789849.217	558834773586.690	558882541297.787
PT 7	707581.307	789725.186	558760906388.020	558809430344.474
PT 8	707599.860	789738.520	558804214169.846	558822348935.480
PT 9	707604.270	789746.060	558824201491.551	558827336783.410

PT 10	707603.83	789771.26	558845515899.280	558860284621.842
PT 11	707622.97	789782.92	558853419060.584	558871749922.157
PT 12	707627.040	789779.160	558865874843.305	558874270195.776
PT 13	707633.600	789780.700	558870718990.128	558896128024.807
PT 14	707659.896	789784.306	558877911678.282	558907603619.266
PT 15	707671.195	789786.296	558900088089.585	558937290183.272
PT 16	707706.999	789792.021	558913063302.535	558957510428.101
PT 17	707727.472	789900.741	559018283710.887	559043649793.383
PT 18	707739.113	789962.155	559077918933.822	559034905494.482
PT 19	707673.022	789979.451	559099355938.967	559009238243.115
PT 20	707625.037	789973.749	559043110255.499	558974899182.168
PT 21	707586.676	789968.487	559001479842.209	558840968515.241
PT 1	707421.85	789953.46	558960542956.099	

$$\text{AREA} = \Sigma \text{L.H.S} - \Sigma \text{R.H.S} / 2$$

$$\text{AREA} = 11736772031237.501 - 11736771941787.127$$

$$\text{AREA} = 89450.376$$

$$A = 89450.376 / 2$$

$$A = 44725.188 \text{ m}^2$$

Area in Hectares was calculated thus:-

$$A = 44725.188 / 2$$

A = 4.473 hectares

Thus Area of project site = 4.473 hectares

## **4.2 DATA PRESENTATION**

This is the last stage in surveying and it is the presentation of measurements made in surveying in the form of maps, plans or diagrams with the information recorded in a suitable manner on drawings or diagrams.

The kind of operation carried out on this project is OVERLAY, overlaying of the detail map and perimeter plan of the study area on each other as well as arc laying of different map layers on one another was done to produce. The products generated for this project work are actually plans, but they have various tremendous areas of application as it relates to the human environment. Firstly, the products are as follows;

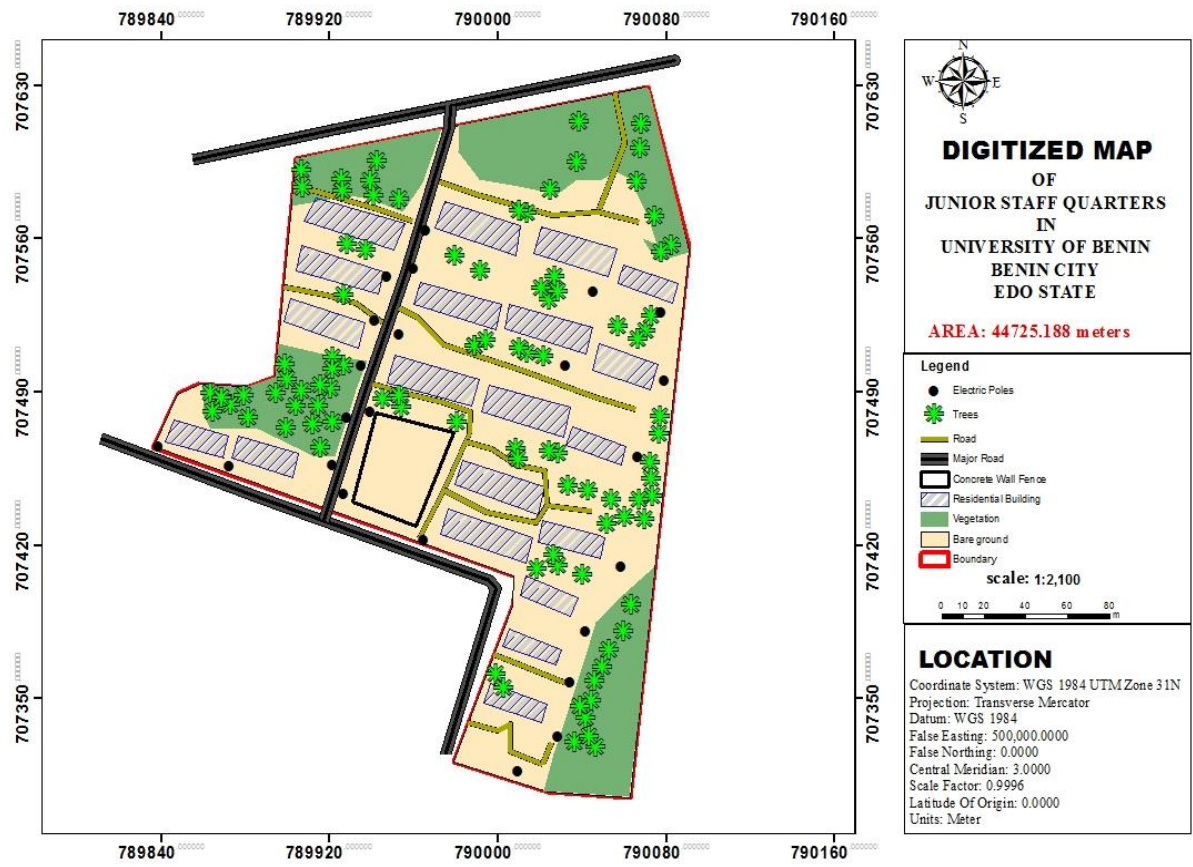


Fig 4.1: A Digitized Map of the Projected Area

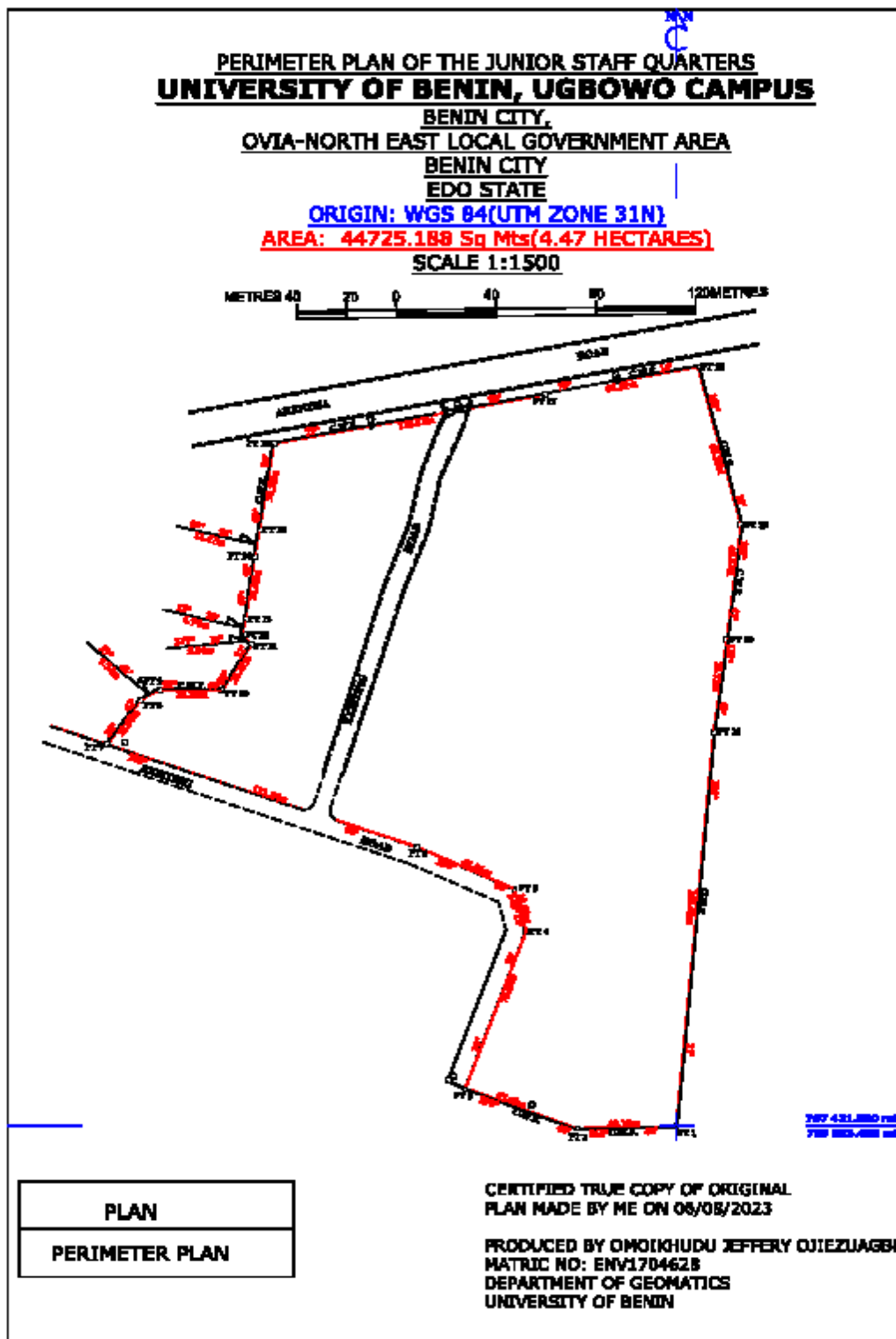


Figure 4.2: Perimeter Plan of the Project Area

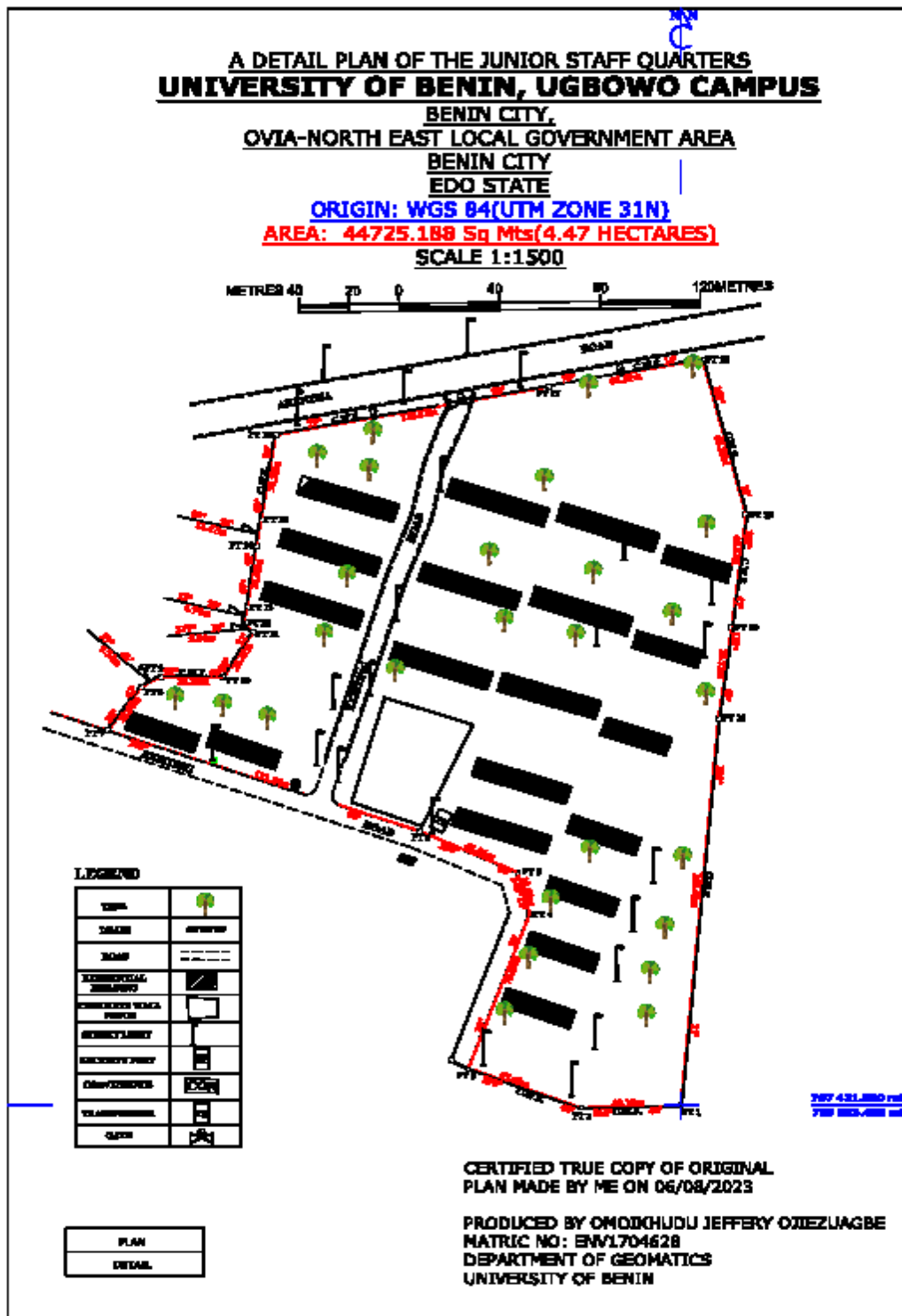


Figure 4.3: Detailed Plan of the Project Area

### **4.3 DISCUSSION**

After producing both plans in AutoCAD and ArcGIS, the results obtained from the field survey data plotted in AutoCAD revealed a perimeter of 1009.891 meters and an area of 4.47 hectares. In contrast, the satellite imagery processed in ArcGIS indicated an area of 4.68 hectares and a perimeter of 1113.25 meters. It's evident that there are disparities between the field survey measurements and the imagery data. This discrepancy can be attributed to differences in resolution and distortions, which affect the accuracy and efficiency of delineating features like the fence surrounding the study area.

It's essential to acknowledge that field survey data is the preferred choice when precise infrastructure planning or construction assessment is required. Field surveys offer superior accuracy and precision, ensuring that construction projects are based on reliable measurements. On the other hand, satellite imagery, while valuable for studying and analyzing the broader area, may not be suitable for construction assessment due to its limitations in accuracy and resolution.

## **CHAPTER FIVE**

### **5.0 CONCLUSION AND RECOMMENDATIONS**

#### **5.1 SUMMARY**

This project was carried out according to the project workflow. Several survey procedures were applied in the execution of this. The process involved in the execution of the project ranges from, office planning and reconnaissance which was done at the office and on site. And lastly perimeter survey and detailing was carried out using the Tersus David GNSS receiver using the RTK mode of observation and acquisition.

The final coordinates gotten from the acquired field data were used for the production of various maps. Where the information generated were presented in the form of plans, contours, watershed, DTM and tables, using AutoCAD software, surfer, ArcGIS 10.5 and Qgis. All these were done in line with survey rules and department's instruction with assistance from our project supervisor, project coordinator and lecturers of the department, at the end of the survey digital maps of the area were also produced.

#### **5.2 PROBLEMS ENCOUNTERED**

During course of execution of this project some of the problems encountered are as discussed below.

- i. Vehicle Obstruction: During the conduct of the GNSS (Global Navigation Satellite System) survey in RTK (Real-Time Kinematic) mode, the goal was to collect high accurate positioning data in real-time. However, this process became challenging when vehicle

obstruction and traffic flow began increasing, the field work had to be on hold until there was a reduced flow.

- ii. Scarcity of survey equipment: This was quite a major problem in the execution of this project, this is because the survey equipment available in the department are limited and a lot of students had to use these equipment to carry out their various project which eventually resulted in delay of the execution of this project.
- iii. Buildings and Tall Trees: Buildings and tall trees present in the project area usually lead to obstruction of satellite signal, this problem makes the GNSS receiver to experience loss of initialization. Because of this problem i had to acquired multiple times a particular point several times so we can get the required accuracy and this eventually lead to delay in the project work.

### **5.3 CONCLUSION**

The surveying process was carried out with the indispensable aid of GNSS equipment, specifically the Tersus David system. This technology played a pivotal role in achieving precise measurements of both natural and man-made features within the project area. The total land area covered by this survey encompasses approximately 4.47 hectares, with a perimeter measuring approximately 1,009.89 meters. Subsequently, meticulous attention to detail was applied in creating the perimeter and comprehensive plans using AutoCAD software. These plans were developed with a scale of 1:1500 and were presented on standard A3 paper. This meticulous approach was instrumental in ensuring the accuracy and clarity of the project's documentation and representation. This project has afforded me a comprehensive grasp of survey principles and procedures relevant to our objectives. It has provided me with a robust foundation in both theoretical and, significantly,

practical aspects of the surveying profession. Overall, my proficiency in utilizing digital instruments and contemporary software for analysis and manipulation has greatly advanced, enriching my knowledge of this field. With this accomplishment, I firmly believe that, if this report is studied and its recommendations followed, the task can be effectively executed, meeting its intended purpose.

#### **5.4 RECOMMENDATIONS**

- i. From my findings large portions of the Junior Staff Quarters land have been used as farmlands and I would like to recommend that the school should utilize it for building more housing.
- ii. The Department should enhance its efforts in authorizing the procurement of additional instruments for student use. Any damaged instruments should ideally be repaired, and if not feasible, replaced. Ensuring the availability of instruments to students will significantly enhance their practical experience. Furthermore, the database should be regularly updated by future student project groups. This will provide both students and department staff with ample opportunities to tackle the challenges relevant to the modern era of instrumentation and computerization.
- iii. The Department should conduct periodic reviews of its instruments, both before and after their use, aligning with established maintenance practices. This practice will contribute to prolonging the lifespan of these instruments, ensuring they remain in good working condition.
- iv. The Department should actively seek to recruit additional trained technical personnel. These professionals can play a crucial role in training and preparing students in various fields.

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## APPENDICES

### APPENDIX I: Acquired Data from the Tersus David GNSS Equipment

DESCRIPTION	NORTHINGS (m)	EASTINGS (m)	ELEVATION (m)
PT 1	707421.85	789953.46	118.9618
PT 2	707420.94	789913.34	117.3079
PT 3	707437.77	789868.73	117.2462
PT 4	707503.394	789893.092	118.808
PT 5	707520.83	789888.52	118.855
PT 6	707538.415	789849.217	118.6417
PT 7	707581.307	789725.186	118.6144
PT 8	707599.86	789738.52	118.7908
PT 9	707604.27	789746.06	118.5988
PT 10	707603.83	789771.26	117.3776
PT 11	707622.97	789782.92	117.2014
PT 12	707627.04	789779.16	117.2272
PT 13	707633.6	789780.7	117.2647
PT 14	707659.896	789784.306	119.554
PT 15	707671.195	789786.296	118.223
PT 16	707706.999	789792.021	118.125
PT 17	707727.472	789900.741	118.774
PT 18	707739.113	789962.155	117.362
PT 19	707673.022	789979.451	117.456
PT 20	707625.037	789973.749	118.546
PT 21	707586.676	789968.487	118.5337
G1	789830.7921	707714.269	118.6829
G2	789831.9912	707714.5799	118.7545
G3	789861.1866	707719.3151	118.8221
G4	789868.0967	707720.7632	118.7354
G5	789868.8816	707720.836	118.9338
G6	789869.8771	707721.21	118.9618
G7	789929.1143	707732.6043	117.3079
G8	789930.1732	707732.7171	117.2462
RD12	789868.2822	707728.5524	118.808
DR1	789869.0325	707728.6037	118.855
DR2	789857.1782	707726.4332	119.0947
DR3	789856.5101	707726.2695	119.0914
DR4	789866.3919	707712.8122	118.6578
DR5	789866.9555	707712.3677	118.6615

DR6	789858.7483	707714.2872	118.6417
DR7	789858.1232	707714.3212	118.6144
STL 2	789855.4853	707711.1032	118.7908
DR8	789858.4296	707692.6551	118.5988
DR9	789858.985	707692.2541	118.5832
DR10	789851.212	707694.0121	118.7254
DR11	789850.6724	707694.1341	118.6984
BD1	789862.2517	707688.4564	118.2757
BD2	789859.9582	707681.0333	118.2804
STL1	789857.2574	707682.7825	118.464
BL3	789906.1957	707678.1725	117.3776
BL4	789901.0937	707675.5221	117.2014
BL5	789903.8929	707670.5862	117.2272
BL6	789898.6546	707668.2856	117.2647
BL7	789945.0424	707665.0255	116.8208
BL8	789947.9894	707660.0332	116.6438
BL9	789973.8875	707651.4794	116.5341
BL10	789841.1132	707677.4872	118.6039
BL11	789838.8459	707670.0036	118.6082
BL12	789802.6991	707689.5598	118.8693
BL13	789786.3131	707671.1977	119.2574
BL14	789786.2958	707671.1948	119.3048
BL15	789795.4781	707667.0709	118.7947
BL16	789793.2573	707659.667	118.9167
BL17	789827.0836	707632.5428	118.5924
STL2	789830.38	707638.1172	118.7014
BL18	789831.7293	707647.579	118.6653
DR12	789835.9687	707647.5024	118.5264
DR13	789836.58	707647.3455	118.502
DR14	789843.977	707646.2043	118.3705
DR15	789844.5702	707646.1074	118.3808
BL19	789848.5019	707645.1674	117.8946
STL3	789837.1444	707653.7191	118.57
BL19	789887.0465	707632.5663	117.2828
BL20	789889.3897	707639.8269	117.2957
BL21	789892.4139	707635.0064	117.953
BL22	789894.2014	707642.3171	118.151
BL23	789931.0959	707622.7929	116.9039
BL24	789936.1844	707624.257	116.9555
BL25	789933.4754	707616.8046	116.9049
BL26	789968.4741	707586.6625	116.6274

BL27	789950.0274	707578.0404	116.5837
BL28	789882.7281	707605.7818	117.5284
BL29	789878.504	707605.8304	117.3051
BL30	789876.1303	707598.6702	117.4177
BL31	789921.6954	707593.7589	116.9623
BL32	789924.0787	707586.7912	116.9604
BL33	789919.234	707586.3837	116.9314
BL34	789921.3841	707579.5678	117.1057
BL35	789909.8953	707557.3488	116.9355
BL36	789907.4097	707550.0201	116.6729
BL37	789910.4441	707545.4043	116.6931
BL38	789908.0954	707538.1005	116.5565
BL39	789902.9841	707536.4204	116.8698
BL40	789901.7201	707519.303	116.9187
BL41	789899.1181	707511.7966	117.0461
DR16	789890.0533	707504.8146	117.1411
DR17	789889.6708	707503.8865	117.3201
STL4	789891.7766	707519.9131	117.3339
BL42	789893.7216	707495.7839	116.7679
BL43	789891.5996	707488.2754	117.0485
STL5	789917.3775	707441.2442	116.7111
STL6	789895.4575	707430.719	116.8692
BL44	789909.0307	707454.5338	116.4964
BL45	789909.1872	707454.6225	116.6578
BL46	789911.394	707461.8669	116.5527
BL47	789917.6236	707479.5722	116.4366
RD 1	789880.2292	707471.3139	117.5707
BL48	789842.1625	707528.8204	118.0295
BL49	789840.8007	707526.2264	118.1522
BL50	789847.8128	707526.6795	117.9197
RD2	789849.5783	707529.0504	117.7949
RD3	789852.0546	707534.4975	117.8156
BL51	789858.5527	707537.9328	117.3522
BL52	789861.735	707541.8873	117.2566
DR18	789830.4684	707603.4577	118.5832
DR19	789830.947	707603.1397	118.4959
DR20	789821.8566	707599.5852	118.6523
RD4	789818.5812	707570.1271	118.4035
RD5	789812.39	707569.9901	118.5335
BD53	789800.7375	707555.4262	118.8802
BD54	789797.9818	707556.0694	118.6034

BD55	789798.9213	707560.3942	118.6209
TR1	789957.954	707731.939	117.334
TR2	789916.342	707723.485	117.445
TR3	789898.664	707683.695	118.454
TR4	789963.319	707663.985	117.567
TR5	789876.792	707652.046	118.114
TR6	789918.252	707644.313	118.577
TR7	789949.636	707626.354	118.2475
TR8	789882.731	707623.588	118.7411
TR9	789911.235	707617.263	118.345
TR10	789963.097	707592.362	118.748
TR11	789839.324	707602.183	117.2457
TR12	789916.907	707525.658	117.789
TR13	789953.836	707522.652	116.966
TR14	789901.145	707504.529	117.841
TR15	789946.734	707493.186	118.8775
TR16	789940.883	707474.199	118.121
TR17	789892.39	707480.541	118.3214
TR18	789882.793	707456.742	118.455
TR19	789939.42	707455.699	118.412
TR20	789751.604	707590.756	118.321
TR21	789770.513	707587.786	118.416
TR22	789788.359	707582.271	118.756
TR23	789810.954	707617.66	118.745
TR24	789820.046	707642.511	118.365
TR25	789828.879	707688	118.234
TR26	789808.279	707693.812	118.455
TR27	789830.446	707703.872	118.723
STL7	789858.73	707682.784	119.334
STL8	789931.758	707653.864	119.44
STL9	789966.819	707634.873	119.513
STL10	789963.746	707612.28	118.546
STL11	789920.815	707617.138	119.546
STL12	789841.081	707628.23	119.547
STL13	789830.613	707595.968	117.5675
STL14	707595.968	707573.701	118.543
STL15	789830.613	707595.968	118.515
STL16	789817.785	707559.198	118.547
STL17	789855.281	707537.921	118.231
STL18	789943.458	707516.547	119.545
STL19	789935.302	707495.863	118.544

STL20	789928.85	707474.685	118.211
STL21	789920.094	707445.653	118.542
STL22	789910.715	707425.781	117.542
STL23	789875.659	707438.924	119.542
STL24	789767.789	707568.807	118.875
STL25	789809.204	707566.269	117.362
STL26	789815.932	707590.255	118.543
FE1	789835.377	707595.454	118.577
FE2	789870.737	707583.85	118.465
FE3	789850.484	707540.55	117.1233
FE4	789822.155	707550.716	118.155
TRF1	789858.553	707537.933	118.546
TRF2	789853.453	707540.303	117.3354
TRF3	789857.38	707548.02	118.585
TRF4	789862.48	707545.65	118.846
SP1	789798.992	707560.504	118.235
SP2	789801.735	707559.802	117.223
SP3	789800.808	707555.536	118.232
SP4	789798.052	707556.18	118.785
TOL 1	789842.162	707528.82	118.325
TOL 2	789847.813	707526.679	117.454
TOL 3	789846.451	707524.085	118.212
TOL 4	789840.801	707526.226	118.455

APPENDIX II: Photos from Field Work



APPENDIX III: Photos of Tersus David GNSS Receivers

