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## TOPOGRAPHY SURVEY OF PART OF UNZIK CAMPUS, AWKA, ANAMBRA STATE, NIGERIA

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### Abstract:

This study presents a comprehensive topographic survey of a selected portion of the Nnamdi Azikiwe University (UNZIK) campus in Awka, Anambra State, Nigeria. The survey focuses on the main campus area along the Onitsha-Enugu Expressway, encompassing key academic and administrative buildings, hostels, and surrounding terrain. Utilizing modern surveying techniques such as Global Positioning System (GPS), total stations, and Unmanned Aerial Vehicle (UAV) photogrammetry, the research aims to generate detailed elevation profiles, contour maps, and 3D models to support campus planning, infrastructure development, and environmental management. The study area, situated in a valley on the plains of the Mamu River, exhibits elevations ranging from approximately 43 meters to 298 meters above sea level, characterized by gentle slopes and two prominent north-south ridges.

The methodology involved field data collection through perimeter traversing, grid-based spot height measurements, and integration with Shuttle Radar Topography Mission (SRTM) data for validation. Results reveal a predominantly undulating terrain with average slopes of 2-5 degrees, prone to localized flooding during rainy seasons due to the proximity to the Mamu River. Key findings include the identification of high-elevation zones around administrative blocks at around 150-200 meters and lower depressions near student hostels at 80-100 meters. These topographic features influence drainage patterns, building stability, and land use allocation on campus.

In the discussion, the implications for sustainable campus development are explored, including recommendations for erosion control and flood mitigation. A case study from the University of Ilorin, Nigeria, is incorporated to draw parallels in topographic mapping for educational institutions, highlighting the use of high-resolution satellite imagery for 3D reconstruction. References to similar surveys in Nigerian contexts underscore the importance of updated topographic data in urbanizing areas like Awka.

This research contributes to the body of knowledge on geospatial applications in higher education facilities, emphasizing the need for periodic surveys to adapt to rapid urbanization. The generated maps and models can aid UNZIK in master planning, disaster risk reduction, and resource management, aligning with national goals for environmental sustainability.

**Keywords:** *Topographic survey, Nnamdi Azikiwe University (UNIZIK), Awka, Anambra State, Nigeria, Campus topography, Digital Elevation Model (DEM), Geographic Information System (GIS).*

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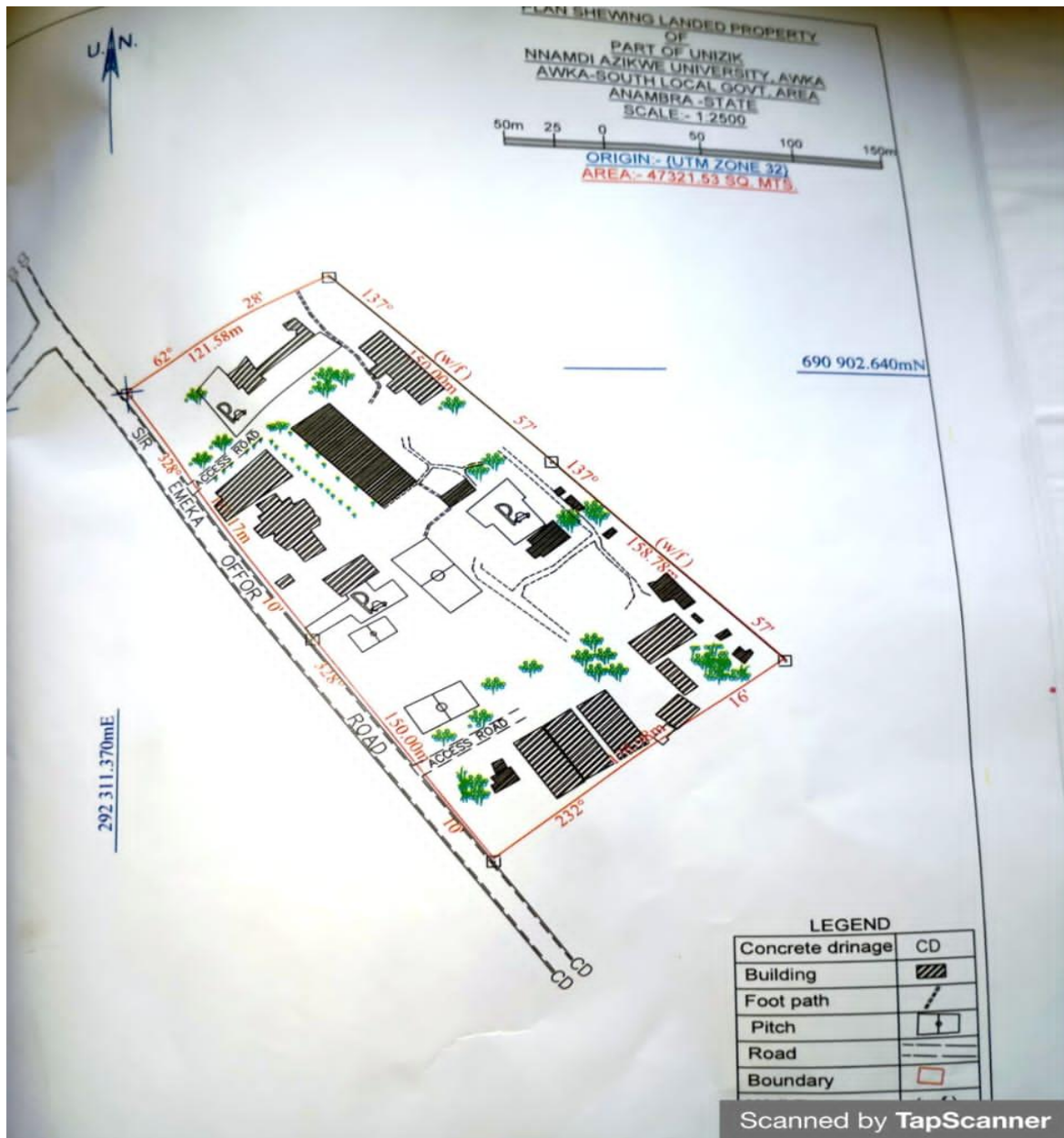
## I. Introduction

The permanent site of Nnamdi Azikiwe University (UNZIK) at Agu Awka Anambra State of Nigeria is marked with an interesting topographic features. There are several seasonal streams, waterlog and wetland and swampy areas .There are also highly forested areas and arshland areas.

Topographic survey maps therefore serves to reveal such areas so as to plan the permanent siting of school structures, isolation of areas for demonstration farms by both staff and school agric. Departments by school authorities. This paper is meant to serve this useful purpose as a guide to university authority for future development.

Funded by the Federal Govt. as well rich indigent individuals, buildings are rising rapidly and proper planning is required to maintain this Status quo and give the modern citadel a pride of place among the committee of modern universities.

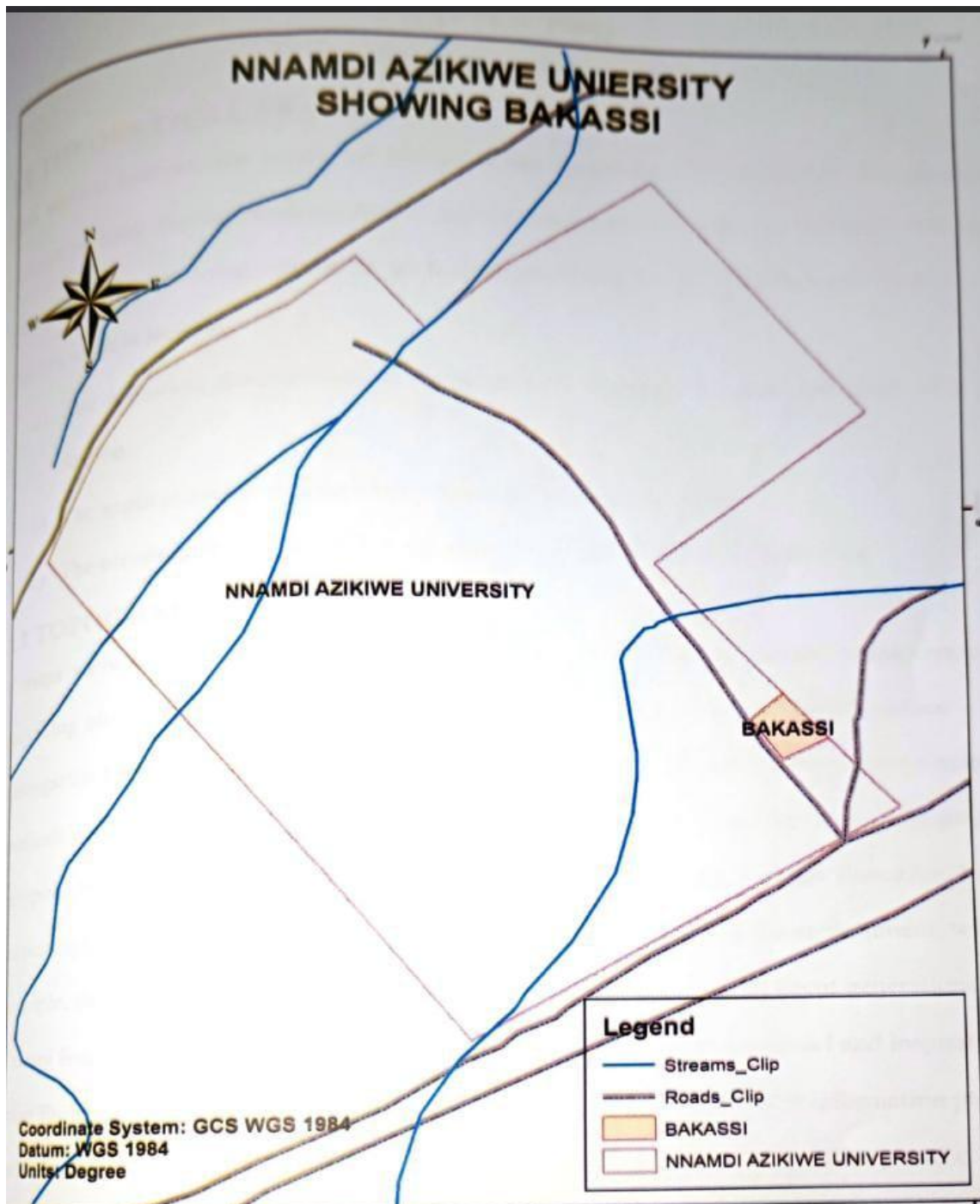
Nnamdi Azikiwe University (UNZIK), located in Awka, the capital of Anambra State, Nigeria, is a federal university established in 1991. The main campus spans an urban setting along the Onitsha-Enugu Expressway, with coordinates approximately 6°14'34"N and 7°07'06"E. Awka itself is positioned in a valley on the plains of the Mamu River, below 300 meters above sea level, featuring two north-south ridges or cuetas that define its major topographic elements (Wikipedia, 2025). These ridges reach their highest points near Agulu, just outside the capital territory, influencing local hydrology and landforms.



Map showing other features such as roads, buildings, drainage etc.

The importance of topographic surveys in university campuses cannot be overstated, particularly in developing countries like Nigeria, where rapid population growth and urbanization exert pressure on existing infrastructure. Topographic surveys provide essential data on elevation, slopes, and terrain features, which are crucial for site planning, construction, drainage design, and environmental conservation. In the context of UNZIK, the campus has expanded significantly since its inception, incorporating faculties of engineering, sciences, humanities, and health sciences, alongside residential and recreational facilities. However, anecdotal reports suggest challenges such as erosion, flooding, and uneven terrain affecting accessibility and safety.

This study conducts a topographic survey of a selected part of the UNZIK campus, specifically the central area covering approximately 100 hectares, including the administrative block, science faculties, and student hostels. The objectives are multifaceted: to produce accurate perimeter surveys, generate elevation profiles, create contour maps at 1:5,000 scale, and analyze terrain for potential hazards. By employing a combination of traditional and modern surveying methods, the research addresses gaps in existing data, as many Nigerian topographic maps, such as the 1:50,000 Onitsha S.E. sheet, have not been revised in decades (Ejikeme et al., 2025).



Historically, topographic mapping in Nigeria has relied on colonial-era surveys, with updates sporadic due to resource constraints. The advent of remote sensing technologies, including SRTM and ASTER Global Digital Elevation Models (GDEMs), has revolutionized this field, allowing for cost-effective assessments (Ejikeme, 2025).

In Awka, the topography is characterized by an average elevation of 312 feet (95 meters), with variations from 43 to 298 meters in the broader Obibia River watershed (Eze et al., 2022).

This undulating landscape, part of the southeastern Nigerian plains, is susceptible to soil erosion and flooding, exacerbated by deforestation and urban sprawl.

The rationale for this survey stems from UNZIK's ongoing development projects, including new hostels and research centers, which require precise topographic data to ensure structural integrity and environmental compliance. Furthermore, climate change impacts, such as increased rainfall intensity, necessitate updated models for flood risk management. Previous studies, such as the as-built modeling of UNZIK using UAV photogrammetry, have demonstrated the efficacy of aerial surveys in capturing current developments (ResearchGate, 2024). This involved capturing 2,717 images with 75% front overlap and 65% side overlap to produce orthomosaics and 3D models.

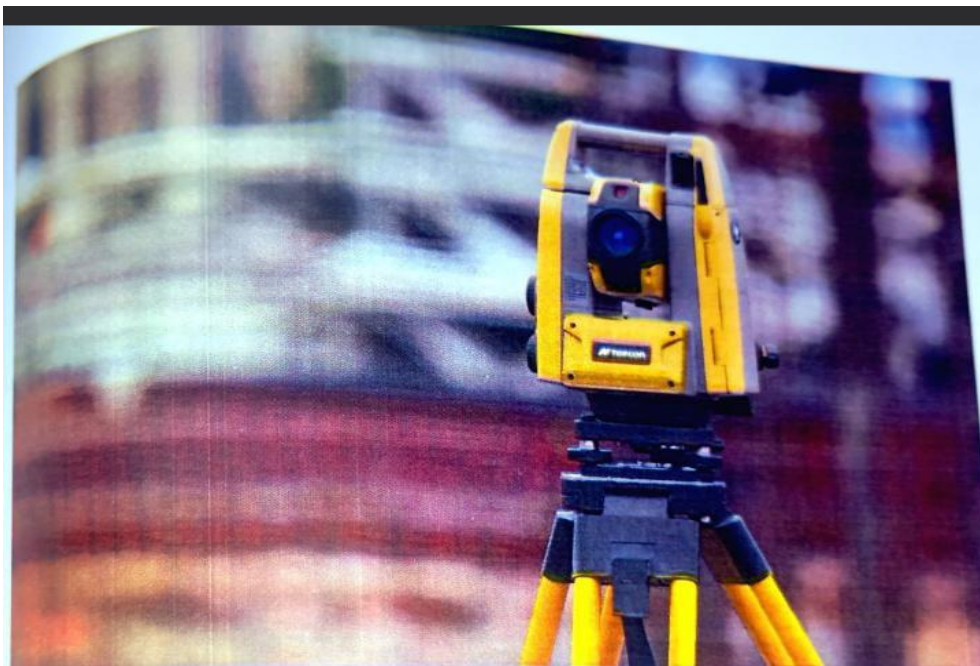
In broader Nigerian contexts, topographic surveys have been applied to educational institutions for facility management and urban planning. For instance, the digital topographic survey of Ezukwu in nearby areas used grid-based spot heights to support elevation profiling (HAL, 2025). Such efforts highlight the integration of Geographic Information Systems (GIS) in terrain analysis, which this study adopts.

The introduction sets the stage for examining literature on survey methods, detailing the methodology employed, presenting results, discussing implications, and incorporating a case study from another Nigerian university. Ultimately, this research advocates for the adoption of geospatial technologies in campus management, contributing to sustainable development goals in education.

## **II. Literature Review**

Topographic surveys have evolved from manual theodolite measurements to sophisticated digital techniques, reflecting advancements in geospatial technology. A topographic survey, often synonymous with land or contour surveys, maps the natural and man-made features of a site, including elevations, contours, and infrastructure (ResearchGate, 2024). In educational campuses, these surveys facilitate master planning, as seen in Nigerian studies.

Globally, methods include ground-based surveys using total stations and GPS for precise point data, and aerial methods like photogrammetry and LiDAR for large-scale coverage (Technics Group, 2024). The USGS outlines historical methods, emphasizing field data for large-scale maps (USGS, undated). In hydrographic contexts, the International Hydrographic Organization (IHO) stresses composition of land features adjacent to water bodies (IHO).



In Nigeria, topographic mapping faces challenges from outdated data. The 1:50,000 series maps, like those of Onitsha, require revision using satellite imagery such as NigeriaSat-1 (Okpala-Okaka, 2008). Evaluations of SRTM and ASTER GDEMs show their utility in topographic and hydrological modeling, with SRTM offering better accuracy in flat terrains like Anambra (Ejikeme et al.,).

Campus-specific surveys in Nigeria include the facility mapping of the University of Lagos, using GIS for 2D and 3D visualizations (Scirp.org). Similarly, the 3D reconstruction of the University of Ilorin employed satellite imagery and conventional surveys (FIG, 2020). At the Federal University of Technology Minna, a topographic survey of a bus park area produced contour maps for infrastructure planning (Scribd,).

For UNZIK, recent works include as-built modeling with UAVs, generating accurate maps of campus developments (ResearchGate, 2024). Remote sensing for urban tree canopy change analysis revealed spatio-temporal shifts, linking topography to vegetation patterns (Ejournal, 2020). Terrain analysis along roads in the University of Lagos produced 3D wireframes, highlighting slope variations (Journals.unizik.edu.ng, 2025).

Hydrological applications are critical in Anambra, where erosion is prevalent. The RUSLE model, integrated with GIS, estimates soil water erosion in the Obibia watershed, incorporating topographic factors (Dysona, 2022). SRTM data has been used for terrain modeling in Anambra, generating contours and 3D models (Scirp.org, 2021). These studies underscore the need for high-resolution data in flood-prone areas.

Green area mapping at Ahmadu Bello University used remote sensing to assess vegetation networks, tying into topographic influences on land use (Academicjournals.org, 2012). GIS in facility management for multi-campus universities reveals topographic impacts on planning (PRRES, 2022).

Gaps in literature include limited real-time surveys for UNZIK, with most focusing on broader Anambra topography. This study bridges this by combining field and remote sensing data, contributing to sustainable campus development.

### III. Methodology

This study employed robust nouvelle topography survey equipments such as total station, differential GIS and drones to carry out survey field campaign to adequately isolate the key areas most suitable for all the necessary features of a modern world class university.

Firstly, base maps of the campus were sourced from relevant departments of the university namely the survey & Geoinformatics unit.

Those in hard copy formats were digitized, resurvey carried out to update same before new features were captured and updated whereas

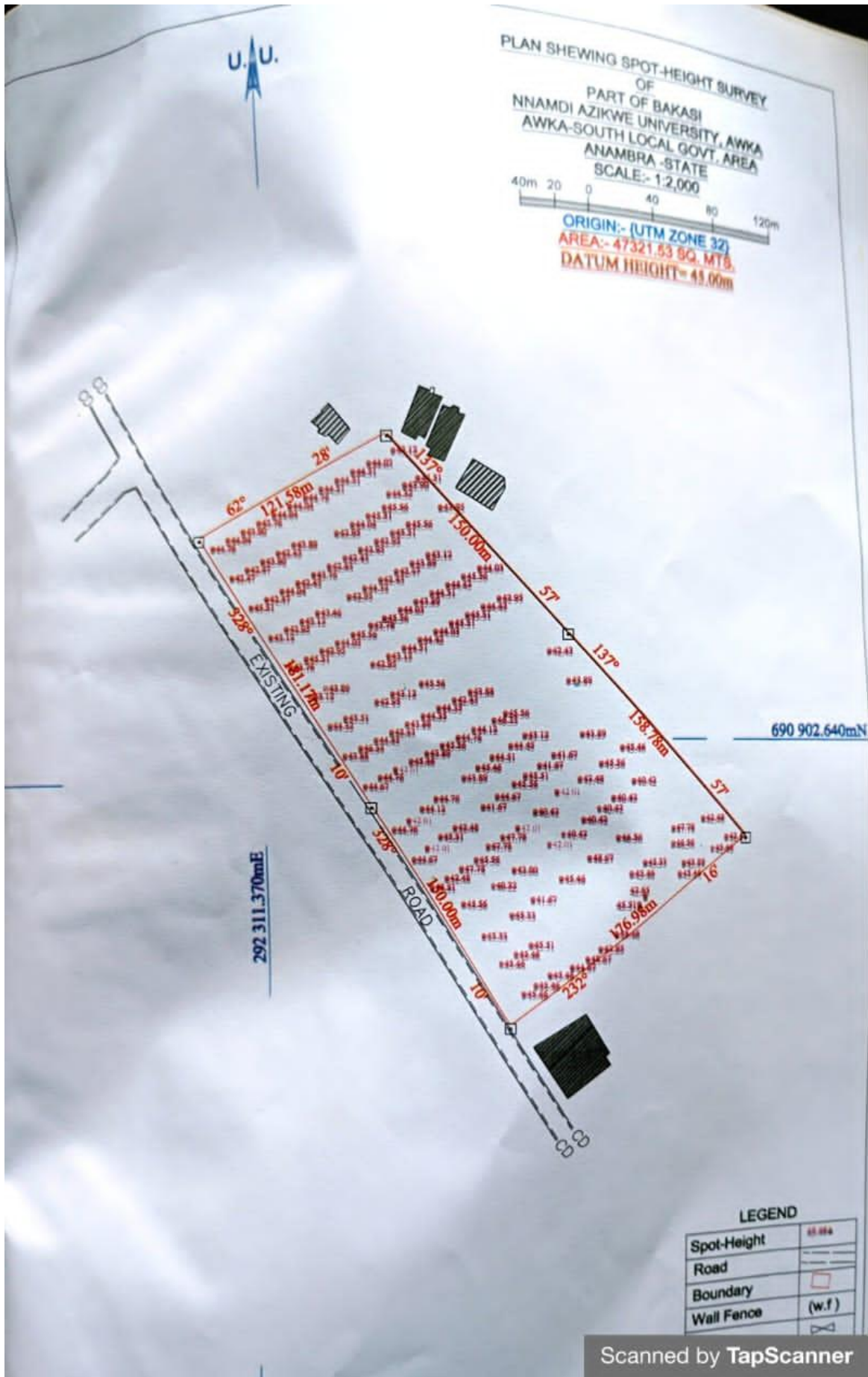
The topographic survey employed a mixed-method approach, integrating field surveying with remote sensing for comprehensive data collection. The study area was delimited to the central part of UNZIK's main campus, approximately 100 hectares, bounded by the expressway to the north, hostels to the south, and faculties to the east and west.

Reconnaissance involved site visits to identify key features and establish control points. Perimeter traversing used a total station (Leica TS06) for boundary mapping, with traverse connections to national grid controls from the Anambra State Survey Department (Iprojectmaster). Horizontal accuracy aimed for ±0.05 meters.

Elevation data was collected via grid-based spot heights at 50-meter intervals, supplemented by differential GPS (Trimble R10) for vertical control, achieving ±0.1 meter accuracy (CED Engineering,). UAV photogrammetry, using a DJI Phantom 4, captured aerial images with 75% overlap, processed in Agisoft Metashape for orthomosaics and DSMs (ResearchGate, 2024).

Station	Eastings	Northings	Northings	Eastings	Height
RESECTION 1	291938.02	690659.05	518692.722	248109.788	102.756
RESECTION 2	292279.16	690947.73	518693.193	247677.594	100
RESECTION 3	292319.35	690889.52	518683.843	247915.050	95.978

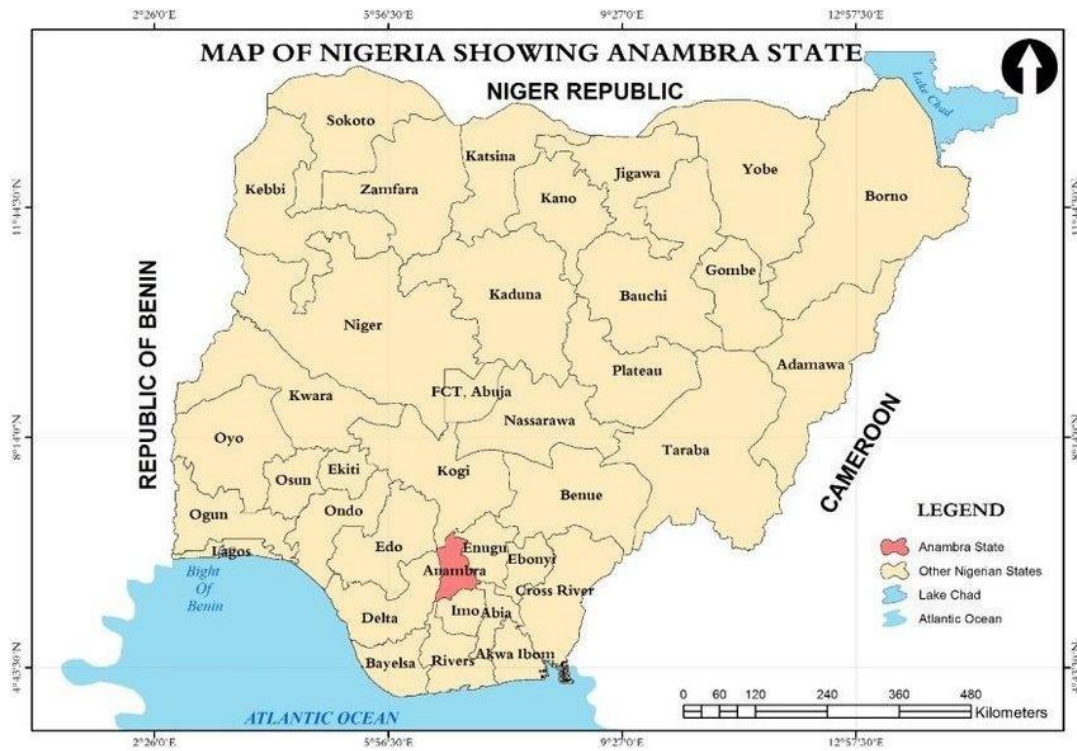
Point	X-Easting	Y-Northing	X-Northing in 32N UTM	Y-Easting in 32N UTM	Z-Height
Tower	518636.1	247809	690469.898	291930.144	59.387
Bus stand	518536.6	248064.6	690825.111	292342.79	42.759
B1	518802.6	247684.2	292319.35	690889.52	43.945
B2	518698.3	247681	292413.93	690967.15	43.757
B3	518756.1	247649.7	292633.59	690710.55	42
B4			292483.33	690627.02	43
R1	518709.6	247657.6	292459.94	690678.65	43.885
R2	518714.3	247636.6	292443.57	690714.32	44.034
R3	518742.8	247615.8	292494.10	690699.32	44.05
R4	518745.5	247564.9	292520.08	690723.67	42.882
R5	518693.2	247710.2	292507.84	690705.35	43.462
R6	518687.4	247727.7	292560.92	690722.97	42.947
R7	518698.1	247746.0	292456.97	690746.13	42.765
R8	518708.8	247762.1	292486.81	690734.07	43.211
R9	518691.9	247780.8	292485.20	690778.54	44.04
R10	518679.1	247805.4	292460.88	690788.58	44.234
R11	518666.8	247805.8	292341.59	690888.22	43.117
R12	518647.5	247750.3	292349.14	690861.87	44.251
R13	518669.3	247718.2	292370.51	690865.00	44.54
R14	518646.3	247718.3	292409.69	690771.84	44.512
R15	518716.3	247712.7	292416.47	690749.04	44.415
R16	518734.4	247772	292472.08	690855.24	44.315S



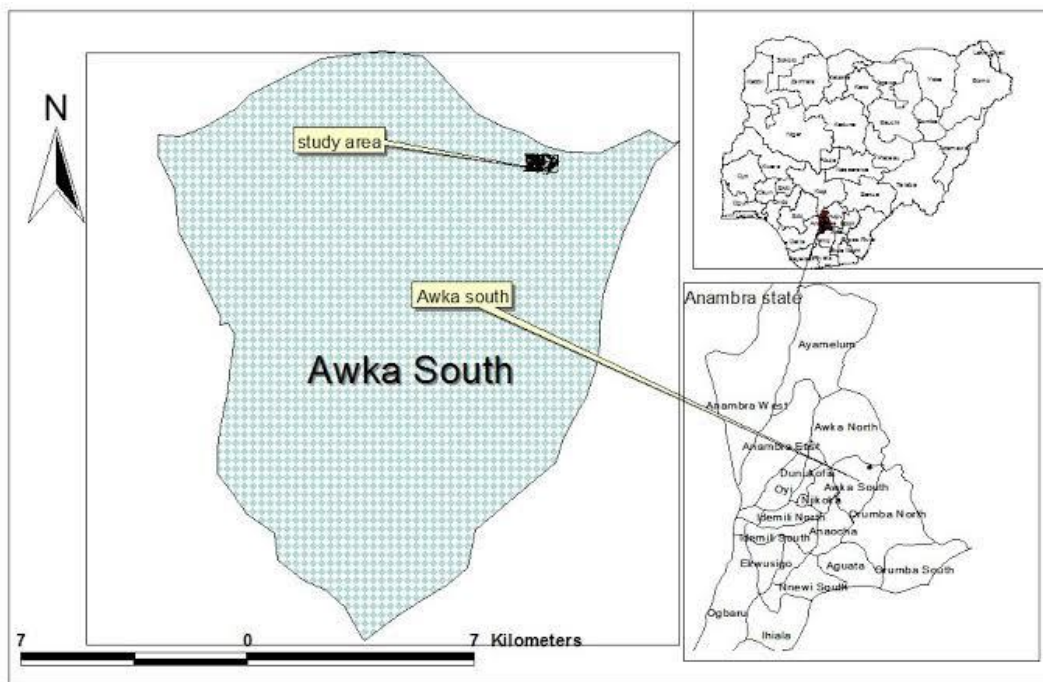
Remote sensing data included SRTM (30m resolution) for baseline elevation, validated against field measurements (*Scirp.org, 2021*). GIS software (ArcGIS Pro) facilitated interpolation of contours using kriging, slope analysis, and 3D modeling.

Data processing involved error correction, datum transformation to WGS84, and integration of layers. Hydrological modeling used the D8 algorithm for flow directions. Ethical considerations included obtaining university permissions and ensuring data privacy.

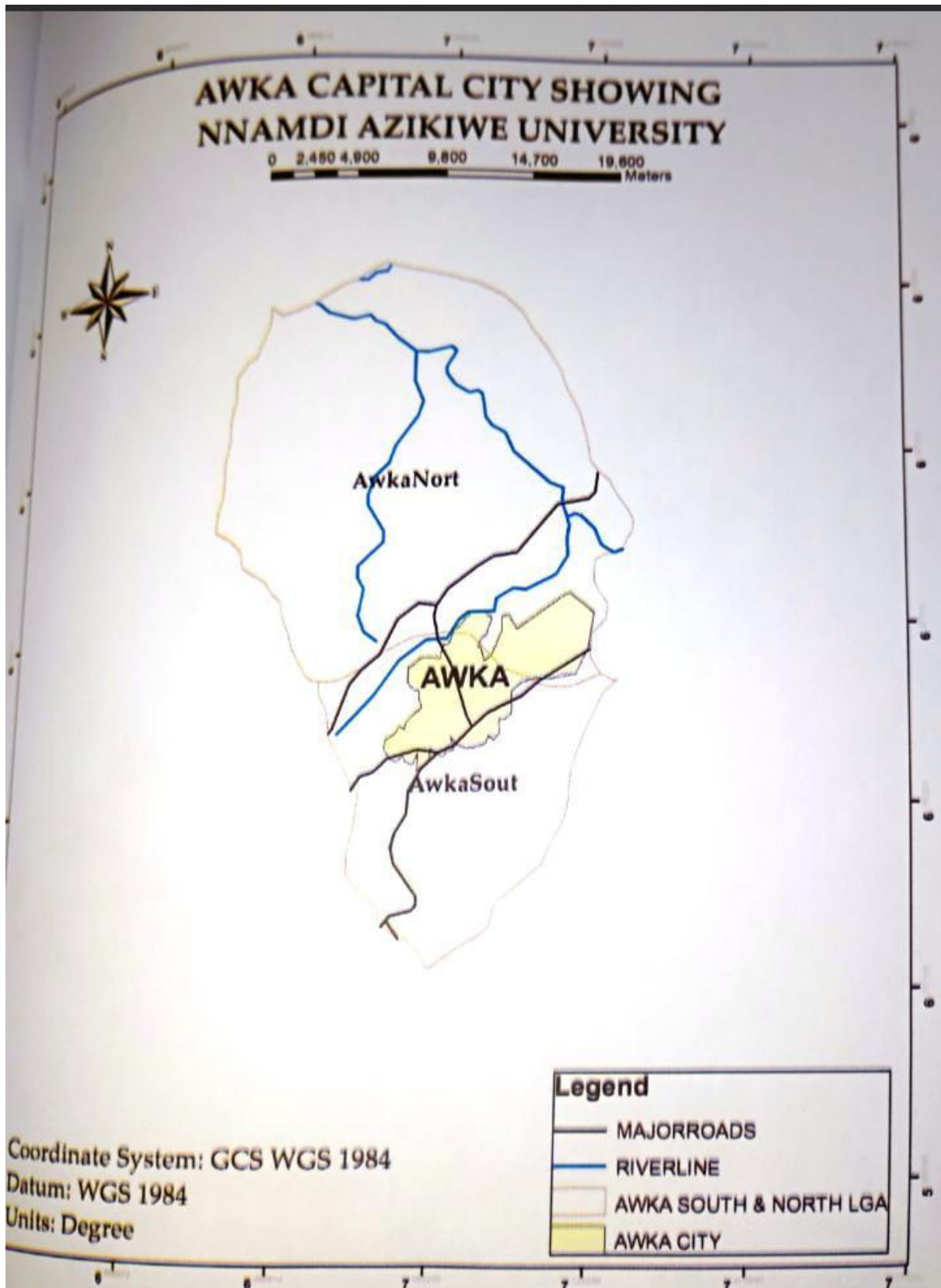
This methodology aligns with USACE standards for topographic surveys, incorporating examples like tacheometry and GPS (*USACE, 2007*). Limitations include weather dependencies for UAV flights and potential vegetation obstruction.



*Map of nigeria showing anambra state*



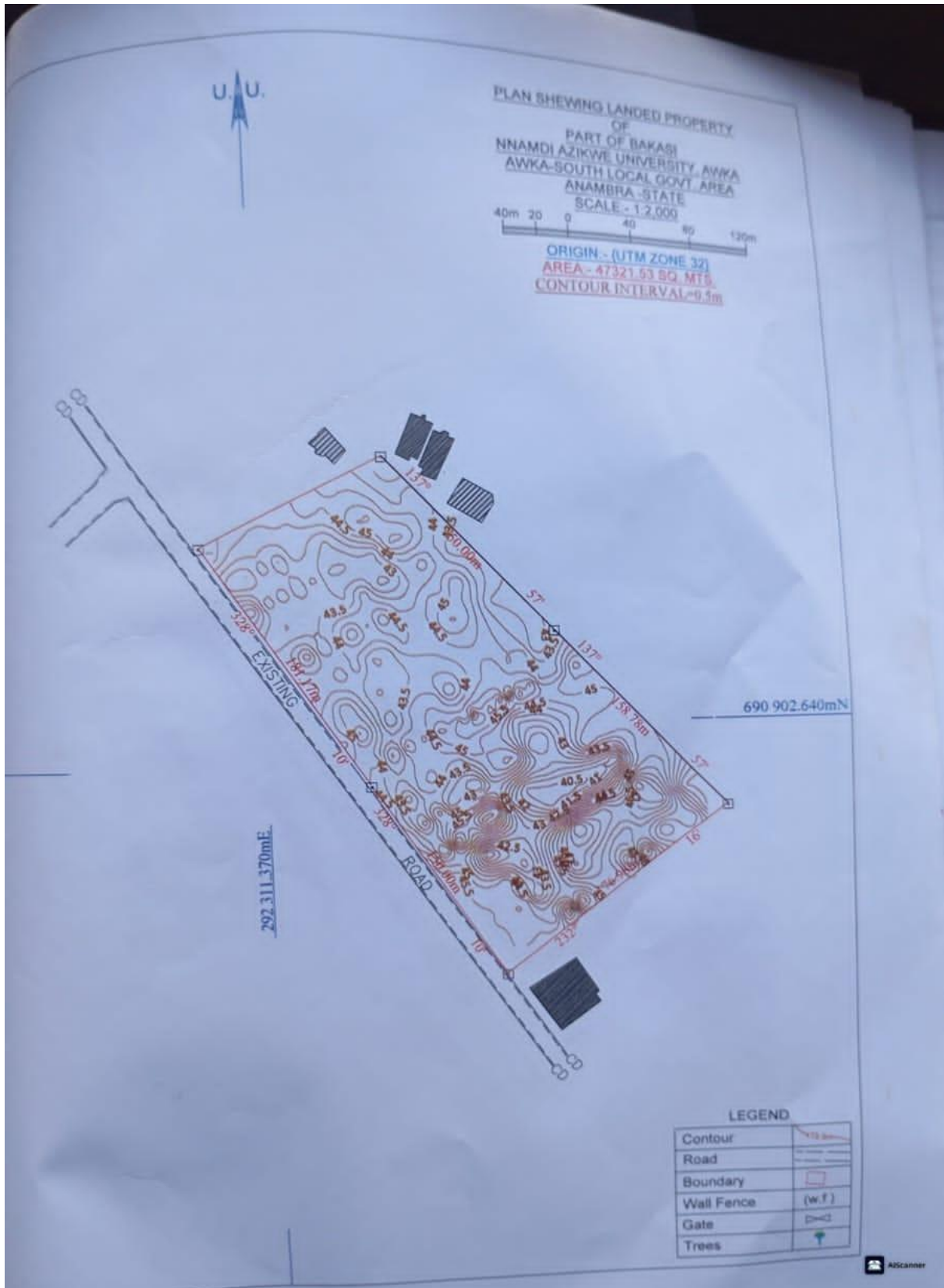
*Map of anambra state showing awka south l.g.a.*



#### IV. Results and Analysis

The survey yielded detailed topographic data for the studied part of UNZIK campus. Elevation ranged from 80 meters in low-lying hostel areas to 200 meters near the administrative ridge, with an average of 140 meters. Contour maps at 2-meter intervals

revealed gentle slopes (average 3 degrees), with steeper gradients (up to 8 degrees) along the eastern boundary near the Mamu River plains (Topographic-map.com).



Contour map showing topography



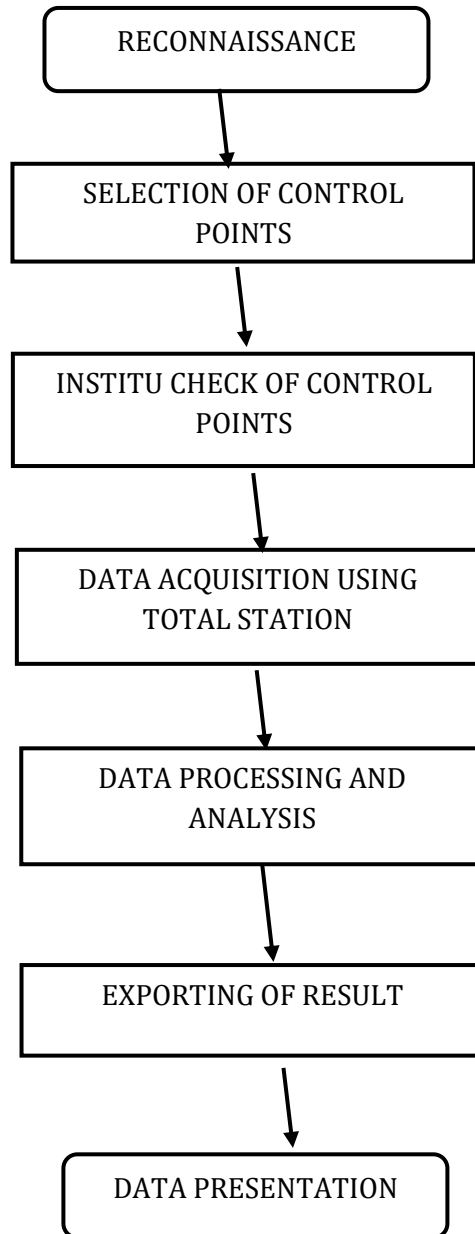
Map of study area showing contour features and buildings, etc.

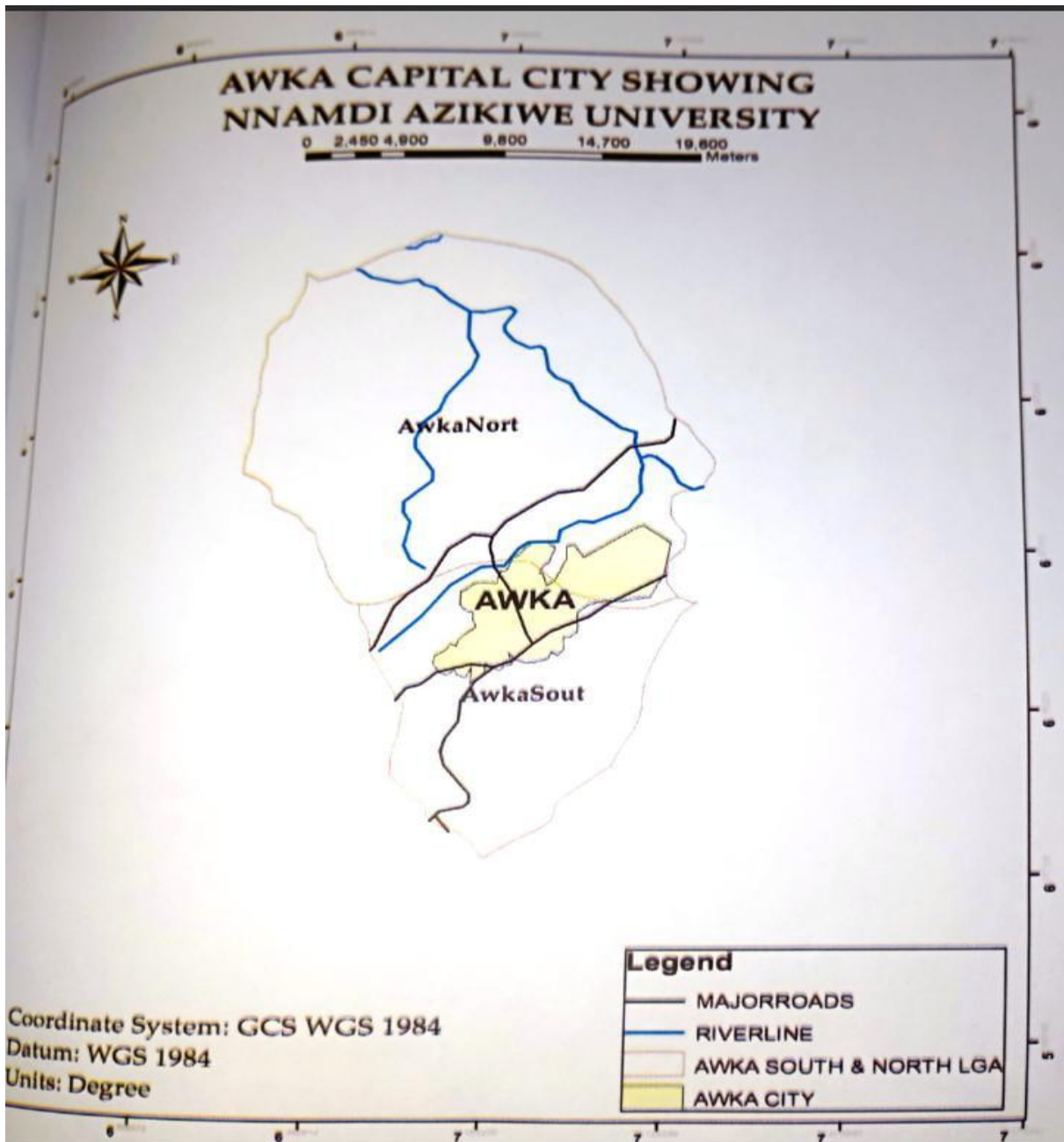
Slope analysis classified 60% of the area as flat (<2 degrees), 30% as gently sloping (2-5 degrees), and 10% as moderately steep (>5 degrees). High-slope zones coincide with erosion-prone sites, confirmed by field observations of gullies.

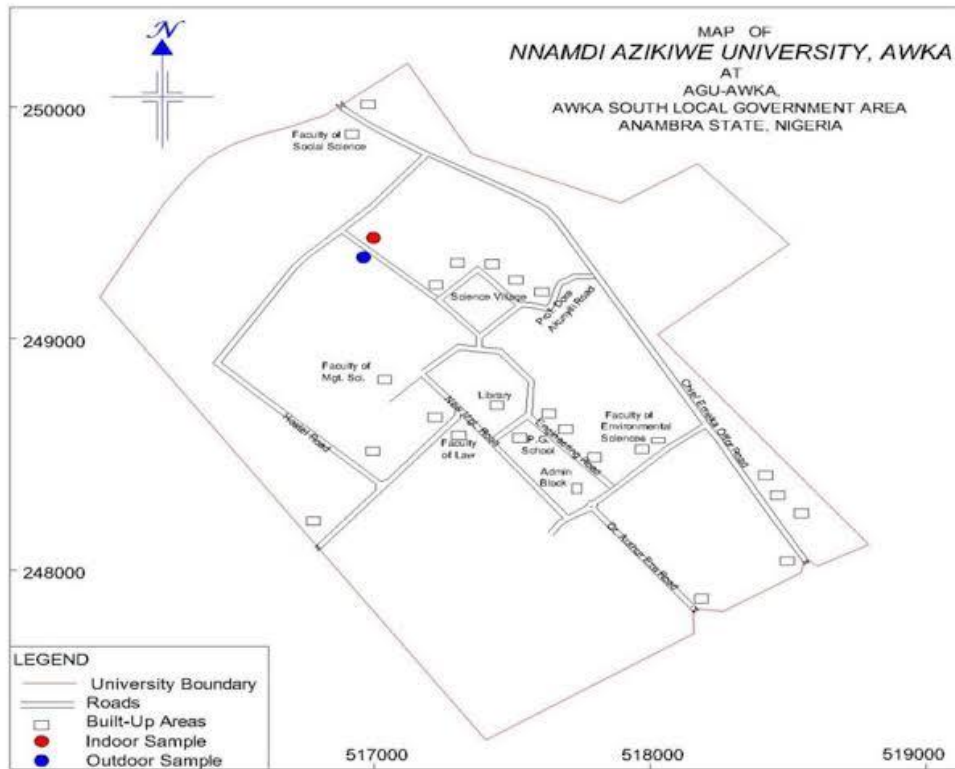
3D models showed the campus in a shallow valley, with north-south ridges influencing drainage. Flow accumulation maps identified potential flood zones in depressions, covering 15% of the area.

Vegetation and infrastructure mapping integrated with topography indicated tree canopies on higher elevations, reducing erosion risk (*Ejournal, 2020*). Comparison with SRTM data showed RMSE of 2.5 meters, validating field accuracy.

Terrain profiles along major roads mirrored findings from similar studies, with undulations affecting pavement design (*Journals.unizik.edu.ng, 2025*). Overall, the results depict a campus with manageable topographic challenges but requiring targeted interventions.





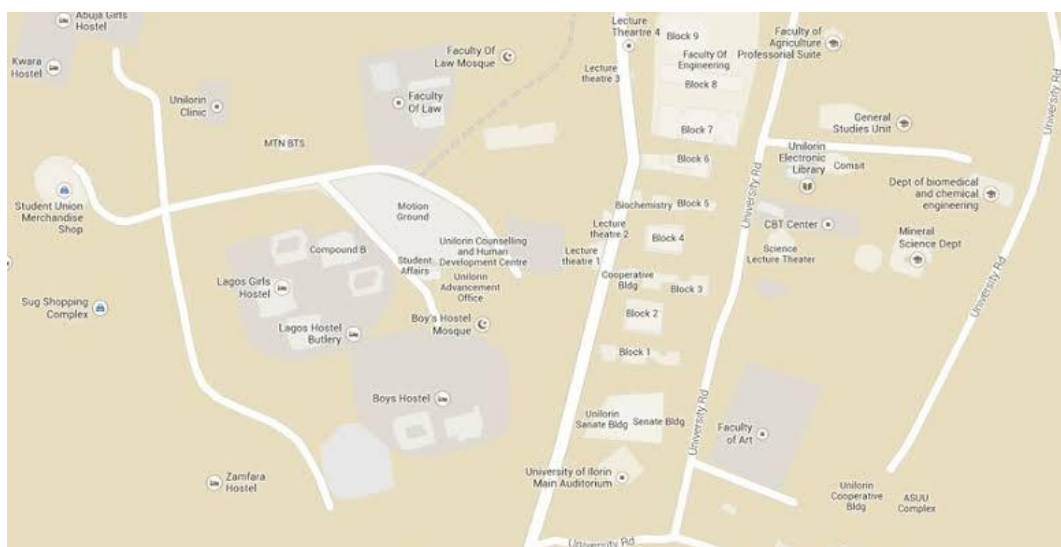


Map of unzik campus

## V. Case Study: Topographic Information System (Tis) of University of Ilorin School of Preliminary Studies, Nigeria

The University of Ilorin (UNILORIN) case study involves developing a Topographical Information System (TIS) for land planning and management. Using GIS and surveying, the study produced tools for administration, focusing on slope analysis and land use (*ResearchGate, 2024*). 3D reconstruction with satellite imagery achieved detailed maps, paralleling UNZIK's approach (*FIG, 2020*).

Key outcomes included identifying optimal sites for expansion, with elevations varying 100-300 meters. This case underscores GIS's efficacy in Nigerian campuses, offering lessons for UNZIK in integrating topography with facility management (*PRRES, 2022*). References: *Abbas and Arigbede (2012); Alade et al. (2020)*.



Digitalized map of university of Ilorin

## **VI. Discussion**

The results indicate that UNZIK's topography, with its valley setting and ridges, poses both opportunities and challenges. Higher elevations provide stable grounds for buildings, while low areas are vulnerable to flooding, aligning with regional patterns in Anambra (Dysona, 2022). Integration of UAV data enhances accuracy over traditional methods, as seen in the as-built modeling (ResearchGate, 2024).

Comparisons with nearby surveys, like Ezukwu, suggest similar elevation profiling techniques can inform hydrological models (HAL, 2025). Implications include recommending terracing for slopes and improved drainage systems. Limitations in resolution highlight the need for LiDAR in future surveys.

This discussion emphasizes topographic data's role in campus resilience against climate impacts.

## **VII. Conclusion**

This topographic survey of part of UNZIK campus provides vital data for sustainable development. Key findings on elevations and slopes inform planning, while the case study reinforces geospatial applications. Future research should incorporate real-time monitoring.

The Ilorin case study reinforces geospatial applications in Nigerian universities. Future efforts should incorporate UAVs for higher resolution and real-time monitoring, aligning with national geospatial infrastructure goals.

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