

## Spatial Distribution and Magnitude of Building Setback Violations in Makama New Extension Area of Bauchi Metropolis

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### **Abstract**

*Building setback regulations are essential instruments of development control that promote safety, ventilation, accessibility, drainage, privacy and orderly urban development. However, non-compliance with prescribed setback standards remains a major challenge in Nigerian cities. This study assessed the spatial distribution and magnitude of building setback violations in Makama New Extension Area of Bauchi Metropolis. The study adopted a quantitative approach and descriptive survey research design, combining geospatial measurements and questionnaire administration. Primary data were obtained through GPS mapping, tape measurements of front, rear and side setbacks, and structured questionnaires administered to household heads whose buildings have violated the setback standards. Secondary data were obtained from relevant literature, official report of Bauchi State Physical Planning and Development Control Board (BSPPDCB) regarding prescribed setback standards, and approved layout of the study area. Using the Krejcie and Morgan Sample Size Determination Table, 281 household heads were selected through simple random sampling across 26 residential blocks. Out of the questionnaires administered, 247 were correctly completed by the household heads and used for analysis. QGIS was employed to map the spatial distribution of violations, while mean score analysis and one-sample t-tests were used to assess the magnitude of violation and level of compliance with prescribed standards. The findings identified 1,044 buildings with setback violations and 916 compliant buildings among the 1,960 buildings in the study area, indicating widespread non-compliance. The mean front, rear, left-side and right-side setbacks were 2.97 m, 2.67 m, 1.53 m and 1.55 m, respectively. Statistical tests revealed significant differences between observed and prescribed setback standards, particularly for front and rear setbacks. The study concludes that building setback violations are widespread in Makama New Extension, highlighting gaps in development control implementation. It recommends strengthened monitoring, regular site inspections, strict enforcement of planning regulations and the application of GIS-based monitoring to improve compliance with approved setback standards.*

**Keywords:** *building, setback; development control; violation; assessment*

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## 1. Introduction

Building setbacks are important components of urban planning and development control because they regulate the minimum distance between buildings and property boundaries, roads, and other structures (Omollo, 2020). They are intended to ensure adequate ventilation, natural lighting, privacy, fire safety, accessibility, and the provision of space for essential infrastructure (Zhu & Ben-Joseph, 2026). Building setbacks also contribute to orderly urban development by preventing excessive building encroachment, reducing congestion, and maintaining the character of residential and commercial neighbourhoods (Shaikh *et al.*, 2019). Compliance with prescribed setback requirements is therefore essential for achieving sustainable urban development and creating safe, functional, and aesthetically pleasing urban environments (Kumar, 2015). However, in many developing countries, including Nigeria, compliance with building regulations remains a significant challenge, particularly in rapidly expanding urban areas where development pressures often exceed the capacity of planning authorities to monitor and control physical development effectively (Jimoh *et al.*, 2017).

Urbanisation in Nigeria has resulted in increasing demand for residential accommodation, commercial properties, and other urban facilities. This demand has encouraged intensive land utilisation, particularly in areas experiencing rapid population growth and physical expansion. Consequently, some property developers construct buildings without adhering to approved building plans and development standards. Building setback violations occur when structures are erected closer to property boundaries, roads, or adjacent buildings than permitted by applicable planning regulations (Ibrahim & Mai, 2020). Such violations may arise from inadequate awareness of planning requirements, high land values, pressure to maximise the use of limited plots, weak enforcement mechanisms, delays in obtaining development permits, and deliberate disregard for planning regulations (Joseph, 2025). The consequences include restricted access, inadequate ventilation and lighting, difficulties in providing infrastructure, increased fire risks, and conflicts between neighbouring property owners. These problems can undermine the functionality, safety, and environmental quality of urban neighbourhoods.

In Nigeria, development control is guided by statutory planning provisions, including the Nigerian Urban and Regional Planning Act of 1992, as well as applicable state and local planning regulations. These legal and institutional frameworks provide the basis for regulating land use, approving building plans, and ensuring that physical development conforms to established planning standards (Obadoba & Tifwa, 2020). However, the effectiveness of these provisions depends on the capacity of planning institutions to monitor construction activities, identify non-compliant developments, and enforce corrective measures. In many urban centres, rapid development, inadequate personnel, limited monitoring resources, and institutional challenges may contribute to the persistence of unauthorised construction and building setback violations (Adeyemi *et al.*, 2023). Understanding the spatial pattern and magnitude of these violations is therefore important for strengthening development control and improving urban land management. Bauchi Metropolis has experienced urban expansion associated with population growth, increasing housing demand, and the development of residential and commercial activities. This expansion places considerable pressure on available land and creates challenges for managing building construction in accordance with planning standards. Makama New Extension, as an area of interest within the metropolis, provides a suitable setting for examining the relationship between physical development and compliance with prescribed building setbacks. Where buildings encroach upon

required setback spaces, the resulting development pattern may compromise accessibility, environmental quality, safety, and the orderly arrangement of buildings within the neighbourhood. Despite the importance of setback regulations, identifying the locations and measuring the magnitude of violations require systematic spatial investigation rather than relying solely on visual observations or administrative records of State planning authorities. Geographic Information Systems (GIS), satellite imagery, Global Positioning System (GPS) technology, and field measurements can support the mapping of buildings, assess setback compliance, and identify the areas with concentrated violations. These techniques can also facilitate the measurement of encroachment distances and reveal variations in the severity and distribution of non-compliant structures. Against this background, this study examines the spatial distribution and magnitude of building setback violations in Makama New Extension Area in Bauchi Metropolis with a view to improve development control, and promoting compliance with building setback regulations.

## **2. Literature Review**

### **2.1 Development Control and the Nigerian Urban and Regional Planning Act of 1992**

Development control is the legal process by which planning authorities regulate the use and development of land so that it conforms to approved plans and standards. In Nigeria, its main statutory basis is the Nigerian Urban and Regional Planning Act of 1992 (Decree No. 88, amended in 1999). The Act established a three-tier planning system of federal, state and local planning authorities. It gave these bodies the power to prepare planning schemes, set development standards and control physical development within their areas (Sani, 2022). It also created the Urban and Regional Planning Tribunal to hear disputes and appeals arising from planning decisions.

The development control content of the Act rests on a few core provisions. First, no person may carry out development without obtaining a development permit from the appropriate planning authority (Fagbemi, 2017). Development covers building operations as well as changes in land use. Second, permits are granted against approved layouts, building lines, plot coverage, height and other planning standards, which is where setback requirements come in. Third, the authority may inspect sites and monitor construction (Ademola, 2025). Fourth, where development is carried out without a permit or contrary to its conditions, the authority may issue contravention or enforcement notices, stop-work orders and demolition orders (Adeyemi et al., 2023). It may also impose fines and other sanctions on defaulters.

In Bauchi State, these powers are exercised by the Bauchi State Physical Planning and Development Control Board (BSPPDCB). It prescribes setbacks by density class and plot size, approves building plans and enforces compliance. The Act relates to this study in three ways. It provides the legal basis for the setback standards used as the benchmark, so the magnitude of violation measured in Makama New Extension is a measure of non-compliance with the law. The spatial distribution of violations across the residential block's points to gaps in the monitoring, inspection and enforcement powers the Act places on the BSPPDCB.

### **2.2 Building Setback Violations**

A building setback is the minimum distance a structure must keep from property boundaries, roads or other designated features (LeGates & Stout, 2016). A setback violation occurs when a structure encroaches closer than this mandated distance, whether at the front, rear or side (Grant, 2018). Studies in Nigeria show that front setbacks are the most commonly encroached. Onauwu (2020) found that 83.8% of buildings in Auchi, Edo State, fell below the minimum road setback.

Violations are caused by lack of awareness of regulations, economic pressure to maximise usable floor space, inadequate enforcement, rapid urbanisation and unclear or overlapping rules (Smith & Johnson, 2023; Thompson, 2019 and Lee, 2021). In Nigerian cities, informal land transactions and weak monitoring also contribute to building setback violations (Garba, 2013).

The consequences include increased fire risk, restricted emergency access, poor drainage, flooding, loss of green space, neighbour disputes, lower property values and weakened public trust in planning authorities (Grant, 2011; Brown *et al.*, 2024; and Evans, 2011).

### **2.3 Rational Planning Theory**

Rational Planning Theory according to Thomas (1979) is associated Meyerson and Banfield (1955) and Faludi (1973). Its core idea is that planning is a logical, step-by-step process of defining problems, setting goals, generating and evaluating alternatives, choosing the best option, implementing it and monitoring the results (Sheikhi & Mohammadnejad, 2026). Decisions are guided by clear and measurable standards. The theory assumes that planners have complete information, that goals are agreed, that outcomes can be predicted, and that plans are implemented and obeyed as designed (Zhang *et al.*, 2025). These assumptions are also its main limitations. Complete information is rarely available, and the theory overlooks politics, competing public interests, economic pressure and weak enforcement (Song *et al.*, 2019). It also ignores public participation and informal practices, which are common in Nigerian cities. The theory is relevant to this study because the setback standards prescribed by the BSPPDCB are rational, measurable planning benchmarks that were set to secure access, ventilation, drainage and safety. The study compares the setbacks observed in the field with these standards, and then maps the spatial distribution of violating buildings to show where implementation has departed from the approved layout of the study area. This points to the need for stronger development control mechanisms to close the gap between planning intentions and actual development in Makama New Extension.

### **2.4 Deterrence Theory**

Deterrence Theory is traditionally associated with the classical criminologists Cesare Beccaria (1764) and Jeremy Bentham (1789). Later scholars such as Gary Becker (1968) developed it into an economic model of rule-breaking. Its core idea is that people obey rules when the expected cost of breaking them outweighs the expected benefit (Pratt *et al.*, 2017). This cost depends on three things: the certainty of detection, severity of punishment and the swiftness with which sanctions are applied. The theory assumes that individuals are rational and weigh costs against benefits before acting. It also assumes that they know the rules and penalties, and that authorities can detect violations and apply sanctions consistently (Paternoster, 2018). Its limitations are that it overlooks ignorance of regulations, social norms, poverty and informal land practices. It also fails where institutions lack the resources to monitor and punish. The theory is relevant to this study because widespread setback violations suggest that property owners see a low chance of detection or sanction from the BSPPDCB. The mapped spatial distribution of violations shows where monitoring has been weakest, and it can guide targeted inspections. GIS, remote sensing and drone monitoring would raise the certainty of detection and strengthen deterrence in Makama New Extension.

## 2.5 Spatial Distribution and Magnitude of Building Setback Violations

Building setbacks are minimum distances that structures must keep from boundaries and roads to secure access, ventilation, drainage and safety. When buildings encroach on these spaces, the result is a setback violation. Its spatial distribution shows where in a neighbourhood non-compliance occurs. Geospatial tools such as GPS and GIS make it possible to locate violating buildings, map them and show whether they cluster in particular zones or spread widely across an area.

The magnitude of violations is measured by comparing observed setback distances with prescribed planning standards. Nigerian studies show that front setbacks are the most encroached, followed by rear and side setbacks (Adejumo & Badiru, 2024). A wide spatial spread signals weak monitoring and enforcement, while severe departures from standards increase risks of fire, flooding, poor drainage and restricted emergency access. Understanding both the distribution and the magnitude of violations therefore gives planning authorities reliable evidence for targeted inspection and stronger development control.

## 3. Study Locale and Methodology

Makama New Extension Area is situated in the southwestern part of Bauchi Metropolis in Nigeria (Figures 1 – 3). Its precise location lies between Latitude  $10^{\circ}17'37''\text{N}$  & Longitude  $9^{\circ}49'51''\text{E}$  and Latitude  $10^{\circ}16'57''\text{N}$  & Longitude  $9^{\circ}50'23''\text{E}$ . The area is bordered by Makama in the North, Zango in the South, Part of Sabon Unguwan Railway in the East and Federal low-cost in the West (Figure 4). Its location within the metropolis makes it susceptible to the pressures of urban expansion and development, which are key factors in the prevalence of building setback violations. The area has 1,960 buildings with an estimated population of 9,595.



**Figure 1: Location of Bauchi State in Nigeria**

**Source:** Bauchi State Ministry of Land and Survey (2026)

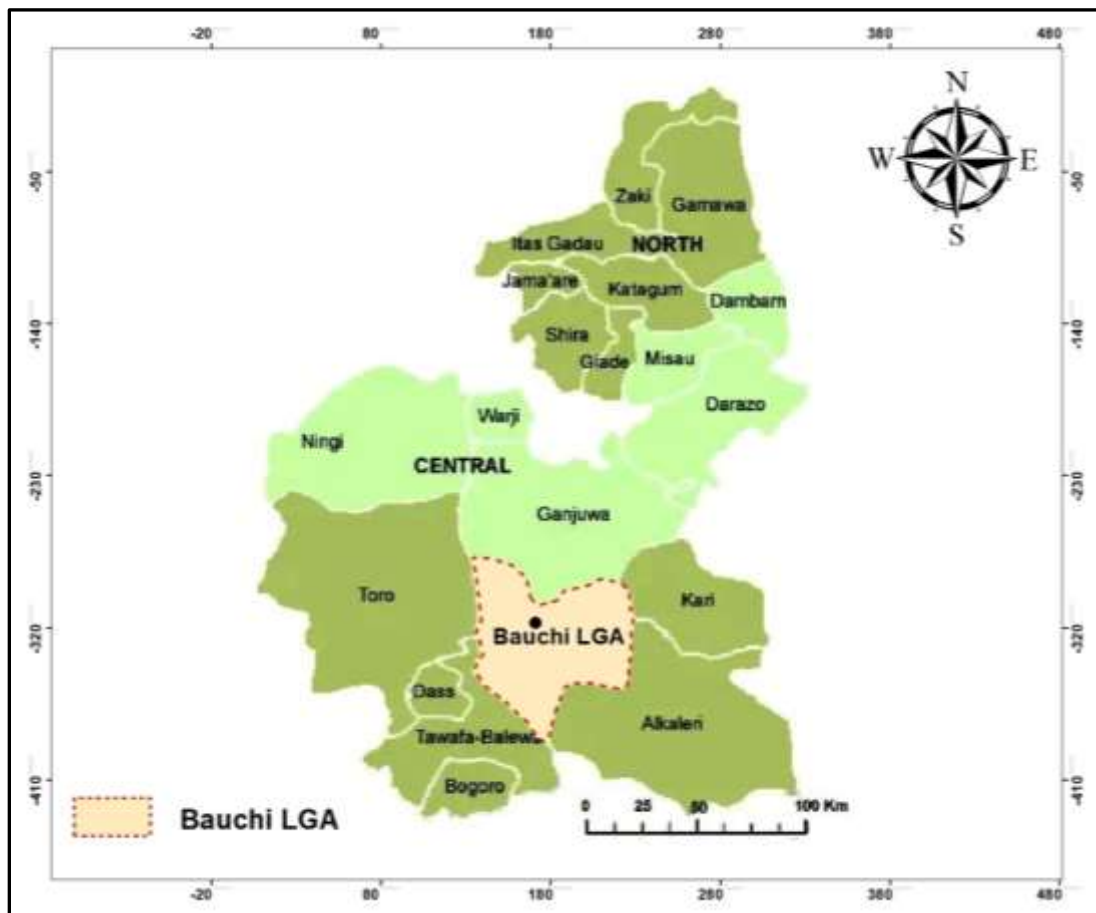


**Figure 2: Location of Bauchi LGA in Bauchi State**

**Source:** Bauchi State Ministry of Land and Survey (2026)

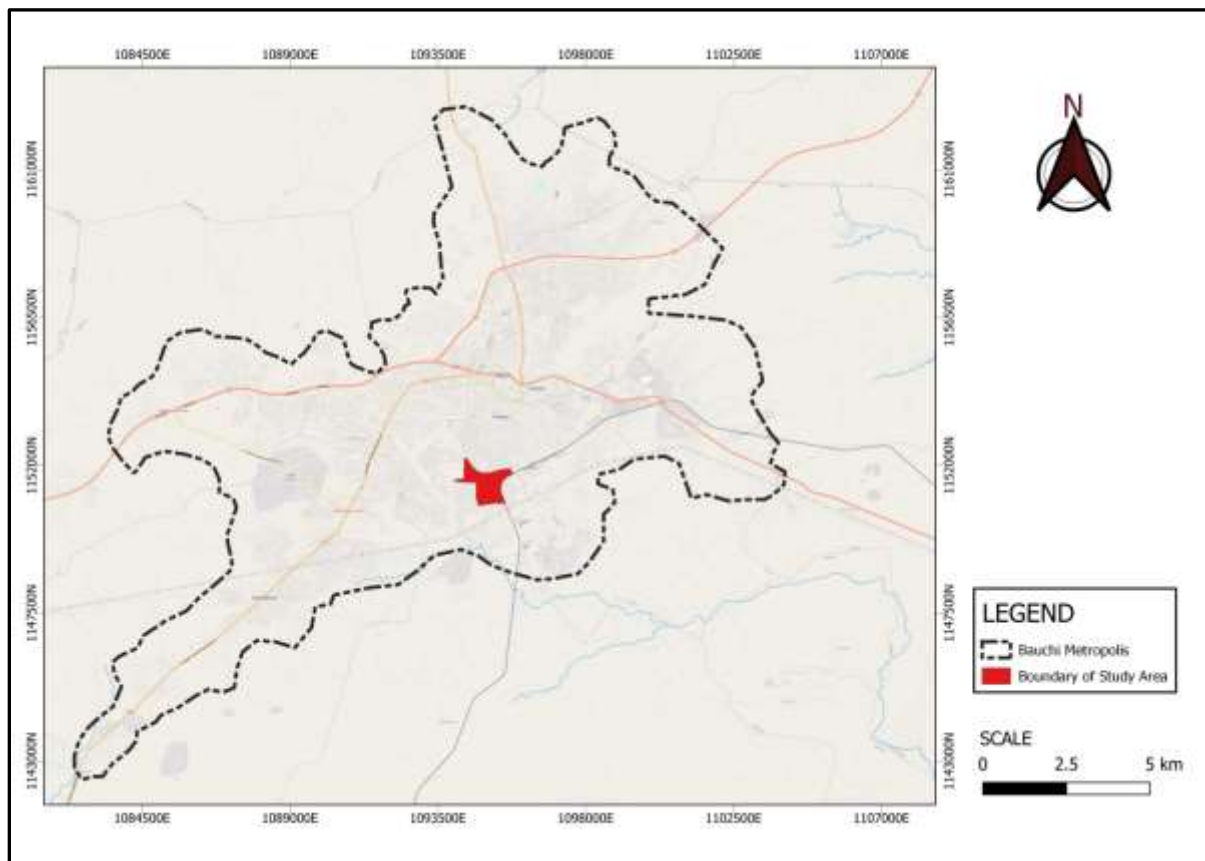


**Figure 3: Study Area in Bauchi Metropolis**  
**Source:** QGIS 7.3 Digitized by Researcher' (2026)

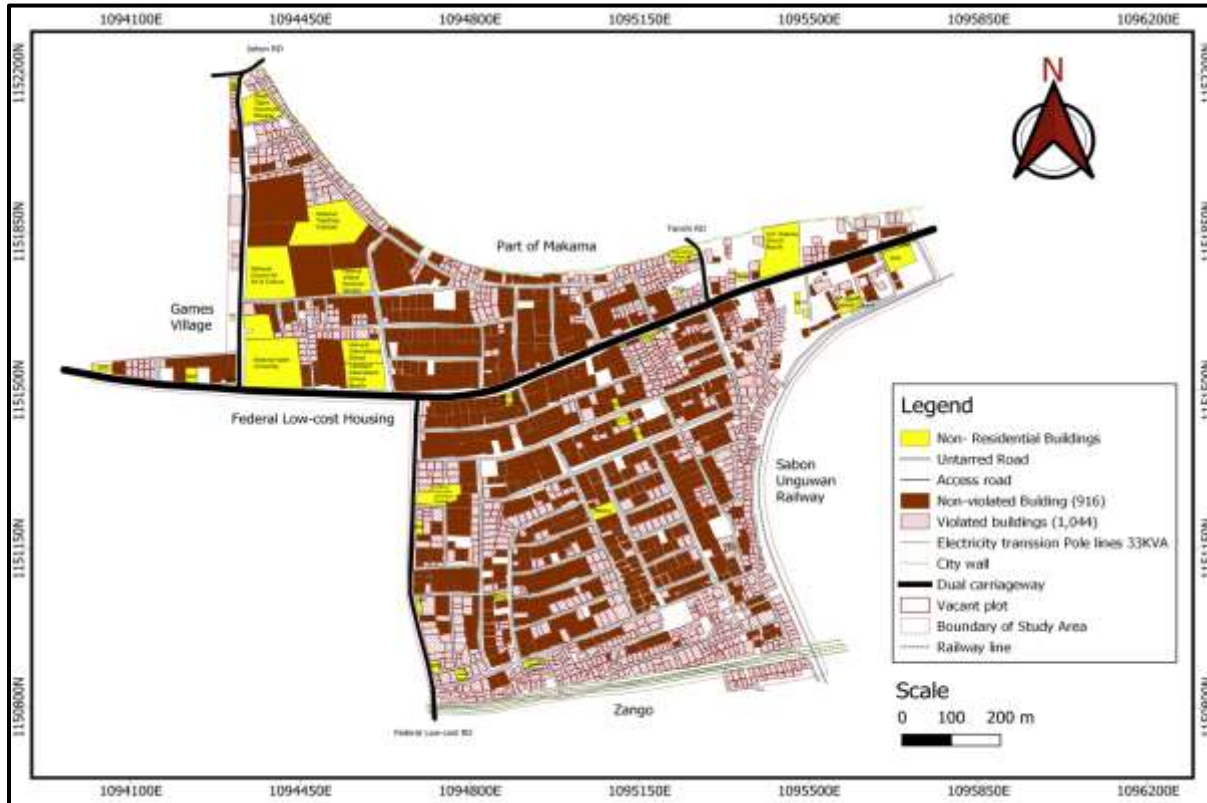


**Figure 4: Residential and Non-residential Buildings in the Study Area**

**Source:** QGIS 7.3 Digitized by Researchers' (2026)

The study adopted a quantitative approach and descriptive survey research design, combining geospatial measurements and questionnaire administration. Primary data were obtained through GPS mapping, tape measurements of front, rear and side setbacks, and structured questionnaires administered to household heads whose buildings have violated the setback standards. Secondary data were obtained from relevant literature, official report of Bauchi State Physical Planning and Development Control Board (BSPPDCB) regarding prescribed setback standards, and approved layout of the study area. The population of this study comprised household heads of Makama New Extension Area whose buildings have violated the building setback regulations. The researchers labeled each residential block within the study area with alphabets (A-Z) so as to determine the total number of violated buildings in each block (Tables 1 – 2 and Figure 7) which is the sampling frame for the study. A total of 26 residential blocks were identified in the study area. For example, in Block A, sixteen (16) buildings were identified to have violated the setbacks. In order to determine the sample size of the study, the total number of buildings that have violated the setbacks were considered. There are 1,044 building that have violated the setback in Makama New Extension Area. Krejcie and Morgan Table (1970) was used to determine the sample size. The population of violated buildings (1,044) falls within the range of 1,000 and 1,100. Since the Krejcie and Morgan Table did not specifically state the sample size for a population of 1,044, the sample sizes of a population of 1,000 which is 276 and that of 1,100 which is 285 was added and divided by two (Appendix I). The result of this procedure is 281 which is the sample size for the study. In other to determine the sample size for a given building block, the number of violated buildings in

that block was divided by the total number of buildings that have violated the prescribed setback which was then multiplied by 281. For example, for Block A, the sample size was calculated by divided 16 by 1,044 and then multiplying the result by 281. Therefore, a total of 281 copies of structured questionnaire were administered to household heads in the study area through a simple random sampling technique.

**Table 1: Sampling Frame for Household Heads**

| Category               | Number of Buildings | Assumption of One Household Head Per Violated Building |
|------------------------|---------------------|--------------------------------------------------------|
| Non-Violated buildings | 916                 | -                                                      |
| Violated buildings     | 1,044               | 1,044                                                  |
| Total                  | 1,960               | 1,044                                                  |

**Source:** Researchers' (2026)

**Table 2: Distribution of Violated Buildings and Sample Size**

| Names of Buildings Blocks | Number of Violated Buildings | Sample Size |
|---------------------------|------------------------------|-------------|
| Block A                   | 16                           | 4           |
| Block B                   | 54                           | 15          |
| Block C                   | 56                           | 15          |
| Block D                   | 28                           | 8           |
| Block E                   | 48                           | 13          |
| Block F                   | 33                           | 9           |
| Block G                   | 69                           | 19          |
| Block H                   | 26                           | 7           |
| Block I                   | 31                           | 8           |
| Block J                   | 50                           | 13          |
| Block K                   | 45                           | 12          |
| Block L                   | 21                           | 6           |
| Block M                   | 43                           | 12          |
| Block N                   | 30                           | 8           |
| Block O                   | 65                           | 17          |
| Block P                   | 37                           | 10          |
| Block Q                   | 29                           | 8           |
| Block R                   | 55                           | 15          |
| Block S                   | 38                           | 10          |
| Block T                   | 32                           | 9           |
| Block U                   | 38                           | 10          |
| Block V                   | 50                           | 13          |
| Block W                   | 41                           | 11          |
| Block X                   | 27                           | 7           |
| Block Y                   | 56                           | 15          |
| Block Z                   | 26                           | 7           |
| <b>Total</b>              | <b>1,044</b>                 | <b>281</b>  |

**Source:** Researchers' Fieldwork (2026)

Out of the 281 copies of questionnaire, 258 were retrieved, giving a retrieval rate of 91.82%, while 23 questionnaires were not returned, representing 8.19% of the total questionnaires administered. Among the retrieved questionnaires, 11 (3.92%) were found to be badly completed and were therefore discarded from the analysis. Consequently, 247 copies of structured questionnaires, representing 87.90% of the total questionnaires administered, were correctly completed and considered usable for data analysis (Table 3).

**Table 3: Distribution of Questionnaire**

| Questionnaire   | Household Heads | Per cent |
|-----------------|-----------------|----------|
| Administered    | 281             | 100      |
| Retrieved       | 258             | 91.82    |
| Badly completed | 11              | 3.92     |
| Not returned    | 23              | 8.19     |
| Usable          | 247             | 87.90    |

**Source:** Researchers' (2026)

Prior to the commencement of the data collection, official approval was obtained from the Bauchi State Physical Planning and Development Control Board (BSPPDCB) to gain access to relevant records and maps. A reconnaissance visit was conducted to familiarize the researchers with the study area and make the necessary logistic arrangements for the exercise. Violated buildings were then identified, and permission was sought from the household heads before the setback measurements were taken on individual properties (Figures 5- 6). The front, side, and rear setbacks of the buildings in each block were measured using appropriate measuring tapes. The 281 copies of questionnaires were administered daily between 9:00 am and 5:00 pm by the researchers and five (5) trained field assistants, who were briefed on the objectives of the study and procedures for questionnaire administration to ensure consistency and accuracy. The field assistants were assigned specific blocks within the study area and provided with sampling guides and measurement tools. For data analysis, QGIS was used for the spatial distribution of building setback violations while mean score analysis and one-sample t-tests against the prescribed standards of 5m, 3m, 1.5m and 1.5m were used to determine the magnitude of building setback violations.



**Figure 5: Front Setback Field Measurement**  
**Source:** Researchers' Field Observations (2026)



**Figure 6: Side Setback Field Measurement**  
**Source:** Researchers' Field Observations (2026)

#### 4. Results and Discussions

##### 4.1 Spatial Distribution of Building Setback Violations

The Bauchi State Physical Planning and Development Control Board (BSPPDCB) specifies setback standards according to residential plot sizes and density classifications. Low-density plots require front setbacks of 10–15 m, rear setbacks of 5 m, and side setbacks of 5 m. Medium-density plots require front setbacks of 7.5–10 m, rear setbacks of 3–5 m, and side setbacks of 3 m. High-density plots require front setbacks of 5 m, rear setbacks of 3 m, and side setbacks of 1.5 m (BSPPDCB, 2026 and Table 4). Makama New Extension Area of Bauchi Metropolis is a high density residential neighbourhood.

**Table 4: Setbacks Standards for Residential Plot Densities and Sizes**

| Class of Density | Plot Size | Front Setback | Rear Setback | Side Setback |
|------------------|-----------|---------------|--------------|--------------|
| Low Density      | 75 x 50m  | 15m           | 5m           | 5m           |
|                  | 60 x 40m  | 15m           | 5m           | 5m           |
|                  | 60 x 30m  | 10m           | 5m           | 5m           |
| Medium Density   | 45 x 30m  | 10m           | 3-5m         | 3m           |
|                  | 45 x 25m  | 7.5m          | 3-5m         | 3m           |
|                  | 40 x 20m  | 7.5m          | 3-5m         | 3m           |
|                  | 45 x 30m  | 10m           | 3-5m         | 3m           |
| High Density     | 30 x 20m  | 5m            | 3m           | 1.5m         |
|                  | 30 x 15m  | 5m            | 3m           | 1.5m         |
|                  | 20 x 10m  | 5m            | 3m           | 1.5m         |

**Source:** BSPPDCB (2026)

Figure 7 revealed that geospatial identification was carried out using QGIS to map out the buildings that complied with or violated the prescribed setback standards in Makama New Extension Area of Bauchi Metropolis. The analysis compared the location of building footprints with the required 5m front, 3m rear and 1.5m side setbacks. The map shows 1,044 violated buildings and 916 non-violated buildings, indicating that violations are widely distributed across the study area. The spatial distribution shows that setback violations occur across several residential blocks rather than being concentrated in one particular location. The findings were supported by the field measurements, which recorded an average front setback of 2.9m and rear setback of 2.67m, both below the prescribed standards. The side setbacks were closer to compliance, with average left and right setbacks of 1.53m and 1.55m, respectively (Tables 5 -8).

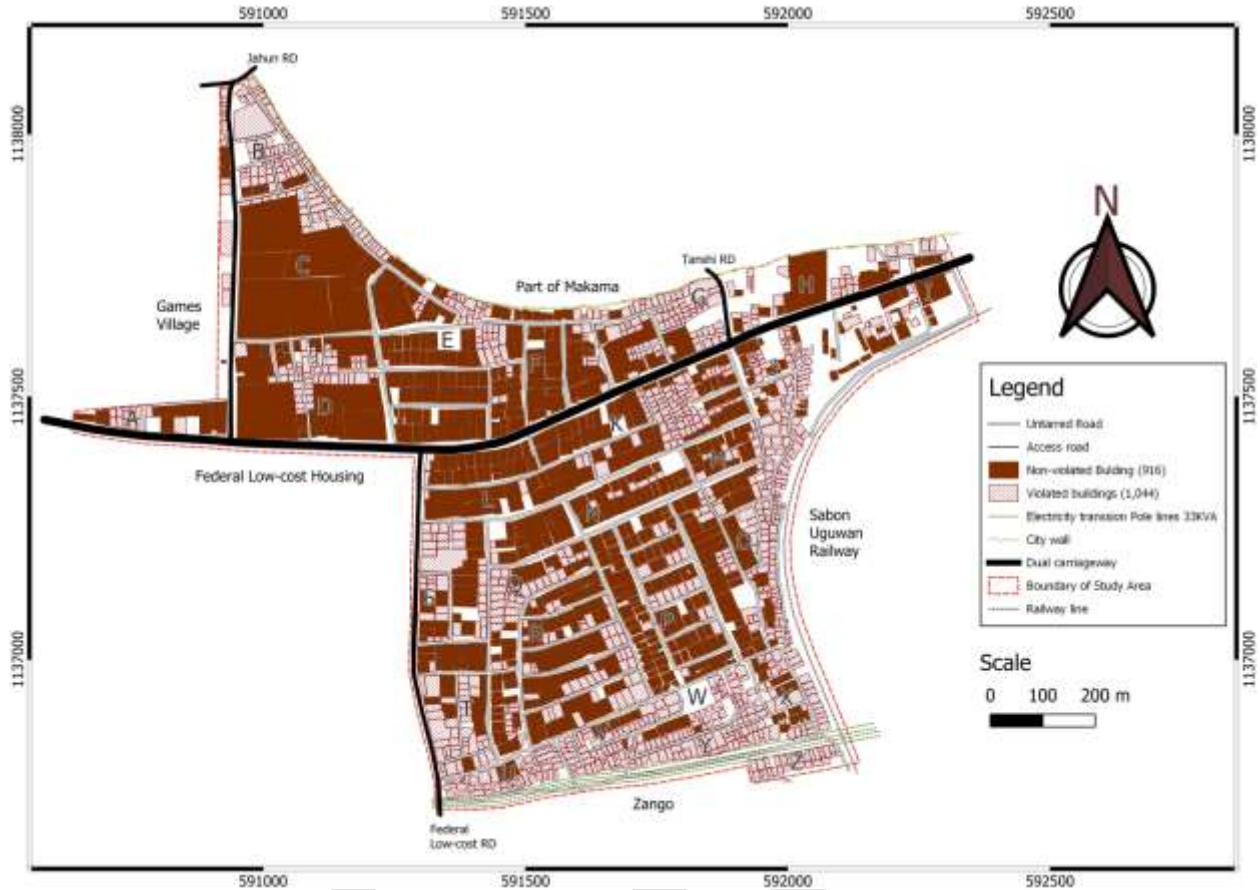


**Figure 7: Number of Buildings with Setback Violations and Compliance**

Source: QGIS 7.3 Digitized by Author (2026)

#### 4.2 Magnitude of Building Setback Violations

The results in Table 5 show variations in front building setback measurements across Makama New Extension. Block P recorded the highest mean score (3.75), while Block F had the lowest (2.02). The overall mean was 2.97, with a standard deviation of 1.69, indicating differences across blocks. These variations may reflect pressure to maximise plot space and weak enforcement of planning regulations. The findings agree with Arimah and Adeagbo (2000), Adejumo and Badiru (2024), and Garba (2013), who identified setback violations as a persistent development control challenge in Nigerian cities.

**Table 5: Mean Score Analysis of Front Building Setback Measurements**

| BLOCK        | N           | Mean        | Std. Deviation | Rank             |
|--------------|-------------|-------------|----------------|------------------|
| A            | 16          | 2.52        | 1.82           | 21 <sup>st</sup> |
| B            | 54          | 2.10        | 1.83           | 25 <sup>th</sup> |
| C            | 56          | 2.68        | 1.89           | 20 <sup>th</sup> |
| D            | 28          | 2.15        | 1.41           | 24 <sup>th</sup> |
| E            | 48          | 3.13        | 1.63           | 11 <sup>th</sup> |
| F            | 33          | 2.02        | 1.65           | 26 <sup>th</sup> |
| G            | 69          | 2.84        | 1.54           | 18 <sup>th</sup> |
| H            | 26          | 3.15        | 1.21           | 10 <sup>th</sup> |
| I            | 31          | 3.01        | 1.74           | 13 <sup>th</sup> |
| J            | 50          | 3.43        | 1.76           | 4 <sup>th</sup>  |
| K            | 45          | 3.24        | 1.62           | 7 <sup>th</sup>  |
| L            | 21          | 2.22        | 1.44           | 22 <sup>nd</sup> |
| M            | 43          | 3.32        | 1.79           | 6 <sup>th</sup>  |
| N            | 30          | 2.20        | 1.46           | 23 <sup>rd</sup> |
| O            | 65          | 3.57        | 1.74           | 2 <sup>nd</sup>  |
| P            | 37          | 3.75        | 1.65           | 1 <sup>st</sup>  |
| Q            | 29          | 3.20        | 1.79           | 9 <sup>th</sup>  |
| R            | 55          | 2.98        | 1.54           | 15 <sup>th</sup> |
| S            | 38          | 3.51        | 1.79           | 3 <sup>rd</sup>  |
| S            | 27          | 3.37        | 1.62           | 5 <sup>th</sup>  |
| T            | 32          | 2.69        | 1.50           | 19 <sup>th</sup> |
| V            | 50          | 2.93        | 1.49           | 16 <sup>th</sup> |
| W            | 41          | 3.07        | 1.67           | 12 <sup>th</sup> |
| Y            | 56          | 3.21        | 1.54           | 8 <sup>th</sup>  |
| Y            | 38          | 2.87        | 1.51           | 17 <sup>th</sup> |
| Z            | 26          | 3.00        | 1.65           | 14 <sup>th</sup> |
| <b>Total</b> | <b>1044</b> | <b>2.97</b> | <b>1.69</b>    |                  |

**Source:** Researcher' Fieldwork and Analysis (2026)

The results in Table 6 presents the mean rear building setback measurements across the blocks in Makama New Extension. Block L recorded the highest mean of 2.97, followed by Blocks D (2.90) and E (2.89). Conversely, Block A recorded the lowest mean of 2.12, followed by Block Y (2.38) and Block J (2.50). The overall mean was 2.67, with a standard deviation of 0.64. These variations indicate differences in rear setback measurements across the blocks, suggesting uneven patterns of compliance with prescribed building setback standards. This finding corroborates Yakubu *et al.* (2026), who attributed widespread setback violations in Ekiti State to inadequate enforcement and pressure to maximise land utilisation.

**Table 6: Mean Score Analysis of Rear Building Setback Measurements**

| BLOCK        | N           | Mean        | Std. Deviation | Rank             |
|--------------|-------------|-------------|----------------|------------------|
| A            | 16          | 2.12        | 0.91           | 26 <sup>th</sup> |
| B            | 54          | 2.71        | 0.64           | 10 <sup>th</sup> |
| C            | 56          | 2.75        | 0.66           | 8 <sup>th</sup>  |
| D            | 28          | 2.90        | 0.37           | 2 <sup>nd</sup>  |
| E            | 48          | 2.89        | 0.44           | 3 <sup>rd</sup>  |
| F            | 33          | 2.61        | 0.86           | 18 <sup>th</sup> |
| G            | 69          | 2.79        | 0.57           | 6 <sup>th</sup>  |
| H            | 26          | 2.87        | 0.48           | 4 <sup>th</sup>  |
| I            | 31          | 2.79        | 0.51           | 7 <sup>th</sup>  |
| J            | 50          | 2.50        | 0.68           | 24 <sup>th</sup> |
| K            | 45          | 2.71        | 0.59           | 11 <sup>th</sup> |
| L            | 21          | 2.97        | 0.13           | 1 <sup>st</sup>  |
| M            | 43          | 2.86        | 0.35           | 5 <sup>th</sup>  |
| N            | 30          | 2.67        | 0.65           | 12 <sup>th</sup> |
| O            | 65          | 2.64        | 0.67           | 14 <sup>th</sup> |
| P            | 37          | 2.62        | 0.67           | 16 <sup>th</sup> |
| Q            | 29          | 2.52        | 0.69           | 23 <sup>rd</sup> |
| R            | 55          | 2.62        | 0.70           | 17 <sup>th</sup> |
| S            | 38          | 2.64        | 0.64           | 15 <sup>th</sup> |
| S            | 27          | 2.58        | 0.62           | 21 <sup>st</sup> |
| T            | 32          | 2.54        | 0.72           | 22 <sup>nd</sup> |
| V            | 50          | 2.66        | 0.63           | 13 <sup>th</sup> |
| W            | 41          | 2.59        | 0.68           | 19 <sup>th</sup> |
| Y            | 38          | 2.74        | 0.54           | 9 <sup>th</sup>  |
| Y            | 56          | 2.38        | 0.79           | 25 <sup>th</sup> |
| Z            | 26          | 2.59        | 0.71           | 20 <sup>th</sup> |
| <b>Total</b> | <b>1044</b> | <b>2.67</b> | <b>0.64</b>    |                  |

**Source:** Researcher' Fieldwork and Analysis (2026)

The results in Table 7 shows variations in left-side building setbacks across Makama New Extension. Block I recorded the highest mean (1.86), while Block B had the lowest (1.39). The overall mean was 1.53 (SD = 0.31), indicating limited variation. These low measurements suggest buildings are positioned close to adjoining boundaries, potentially restricting ventilation, maintenance access, and fire safety. The findings agree with Akingbade *et al.* (2021) and Adejumo and Badiru (2024), who identified side-setback encroachment as a challenge associated with poor compliance and efforts to maximise plot utilisation.

**Table 7: Mean Score Analysis of Left Side Building Setback Measurements**

| BLOCK        | N           | Mean        | Std. Deviation | Rank             |
|--------------|-------------|-------------|----------------|------------------|
| A            | 16          | 1.42        | 0.16           | 24 <sup>th</sup> |
| B            | 54          | 1.39        | 0.22           | 26 <sup>th</sup> |
| C            | 56          | 1.51        | 0.40           | 13 <sup>th</sup> |
| D            | 28          | 1.43        | 0.21           | 23 <sup>rd</sup> |
| E            | 48          | 1.48        | 0.25           | 17 <sup>th</sup> |
| F            | 33          | 1.48        | 0.09           | 18 <sup>th</sup> |
| G            | 69          | 1.48        | 0.21           | 19 <sup>th</sup> |
| H            | 26          | 1.84        | 0.65           | 2 <sup>nd</sup>  |
| I            | 31          | 1.86        | 0.67           | 1 <sup>st</sup>  |
| J            | 50          | 1.41        | 0.19           | 25 <sup>th</sup> |
| K            | 45          | 1.60        | 0.38           | 5 <sup>th</sup>  |
| L            | 21          | 1.46        | 0.19           | 21 <sup>st</sup> |
| M            | 43          | 1.57        | 0.24           | 10 <sup>th</sup> |
| N            | 30          | 1.59        | 0.28           | 7 <sup>th</sup>  |
| O            | 65          | 1.66        | 0.41           | 3 <sup>rd</sup>  |
| P            | 37          | 1.45        | 0.19           | 22 <sup>nd</sup> |
| Q            | 29          | 1.52        | 0.06           | 11 <sup>th</sup> |
| R            | 55          | 1.52        | 0.29           | 12 <sup>th</sup> |
| S            | 27          | 1.60        | 0.28           | 6 <sup>th</sup>  |
| S            | 38          | 1.47        | 0.25           | 20 <sup>th</sup> |
| T            | 32          | 1.61        | 0.34           | 4 <sup>th</sup>  |
| V            | 50          | 1.50        | 0.15           | 15 <sup>th</sup> |
| W            | 41          | 1.58        | 0.26           | 8 <sup>th</sup>  |
| Y            | 38          | 1.51        | 0.22           | 14 <sup>th</sup> |
| Y            | 56          | 1.50        | 0.18           | 16 <sup>th</sup> |
| Z            | 26          | 1.58        | 0.25           | 9 <sup>th</sup>  |
| <b>Total</b> | <b>1044</b> | <b>1.53</b> | <b>0.31</b>    |                  |

**Source:** Researcher' Fieldwork and Analysis (2026)

Table 8 presents variations in right-side building setbacks across Makama New Extension. Block A recorded the highest mean (3.14), while Block B had the lowest (1.36). The overall mean was 1.553 (SD = 0.8267), indicating spatial variations. Most blocks exhibited relatively similar measurements, suggesting widespread side-setback encroachment, potentially driven by efforts to maximise building space. The finding agrees with Arimah and Adeagbo (2000) and Garba (2013), who identified setback violations as persistent development control challenges associated with inadequate monitoring and enforcement in Nigerian cities.

**Table 8: Mean Score Analysis of Right-Side Building Setback Measurements**

| BLOCK        | N           | Mean         | Std. Deviation | Rank             |
|--------------|-------------|--------------|----------------|------------------|
| A            | 16          | 3.14         | 4.64           | 1 <sup>st</sup>  |
| B            | 54          | 1.36         | 0.32           | 26 <sup>th</sup> |
| C            | 56          | 1.58         | 0.38           | 6 <sup>th</sup>  |
| D            | 28          | 1.47         | 0.24           | 20 <sup>th</sup> |
| E            | 48          | 1.43         | 0.29           | 23 <sup>rd</sup> |
| F            | 33          | 1.50         | 0.14           | 17 <sup>th</sup> |
| G            | 69          | 1.51         | 0.24           | 15 <sup>th</sup> |
| H            | 26          | 1.49         | 0.04           | 19 <sup>th</sup> |
| I            | 31          | 1.50         | 0.26           | 18 <sup>th</sup> |
| J            | 50          | 1.41         | 0.25           | 24 <sup>th</sup> |
| K            | 45          | 1.52         | 0.23           | 13 <sup>th</sup> |
| L            | 21          | 1.37         | 0.26           | 25 <sup>th</sup> |
| M            | 43          | 1.63         | 0.49           | 3 <sup>rd</sup>  |
| N            | 30          | 1.46         | 0.14           | 21 <sup>st</sup> |
| O            | 65          | 1.51         | 0.14           | 16 <sup>th</sup> |
| P            | 37          | 1.56         | 0.29           | 8 <sup>th</sup>  |
| Q            | 29          | 2.09         | 3.06           | 2 <sup>nd</sup>  |
| R            | 55          | 1.54         | 0.29           | 12 <sup>th</sup> |
| S            | 27          | 1.611        | 0.3297         | 5 <sup>th</sup>  |
| S            | 38          | 1.56         | 0.30           | 9 <sup>th</sup>  |
| T            | 32          | 1.63         | 0.37           | 4 <sup>th</sup>  |
| V            | 50          | 1.55         | 0.27           | 10 <sup>th</sup> |
| W            | 41          | 1.52         | 0.1965         | 14 <sup>th</sup> |
| Y            | 38          | 1.58         | 0.25           | 7 <sup>th</sup>  |
| Y            | 56          | 1.541        | 0.2172         | 11 <sup>th</sup> |
| Z            | 26          | 1.438        | 0.1472         | 22 <sup>nd</sup> |
| <b>Total</b> | <b>1044</b> | <b>1.553</b> | <b>0.8267</b>  |                  |

**Source:** Researcher' Fieldwork and Analysis (2026)

### 4.3 Hypotheses Testing

Tables 9 and 10 present the hypothesis test results comparing observed building setbacks with prescribed planning standards using a one-sample t-test. The findings revealed statistically significant differences across all four setback categories (front, rear, left, and right), indicating non-compliance with development control regulations in Makama New Extension Area.

#### Hypothesis One

**H<sub>0</sub>1:** There is no significant difference between the observed front building setback and the prescribed planning standard of 5m in Makama New Extension Area.

Table 9 revealed a statistically significant difference between the observed front setback and the prescribed standard ( $t(1043) = -38.875, p < .001$ ). The mean difference of  $-2.0292$  m indicates that the average front setback was approximately  $2.03$  m below the required standard. This demonstrates substantial encroachment into prescribed front setback spaces. Consequently, the null hypothesis was rejected, confirming significant front setback violations in the study area.

**Table 9: One-sample T-test Result for Magnitude of Front Building Setback Violations**

| Planning Standard | t       | Df   | p     | Mean Difference | Test Value | Decision |
|-------------------|---------|------|-------|-----------------|------------|----------|
| Front             | -38.875 | 1043 | 0.000 | -2.0292         | 5m         | Rejected |

Significant at  $p < 0.05$

Source: Researcher' (2026)

### Hypothesis Two

**H<sub>02</sub>:** There is no significant difference between the observed rear building setback and the prescribed planning standard of  $3$  m in Makama New Extension Area.

The results in Table 10 revealed a statistically significant difference between the observed rear setback and the prescribed standard of  $3$  m ( $t(1043) = -16.642, p < .001$ ). The mean difference of  $-0.331$  m indicates that the average rear setback was approximately  $33$  cm below the required standard. Although the deviation was smaller than that observed for front setbacks, rear setback violations remained evident. Therefore, the null hypothesis of no significant difference between observed and prescribed rear setbacks in Makama New Extension was rejected.

**Table 10: One-sample T-test Result for Magnitude of Rear Building Setback Violations**

| Planning Standard | t       | df   | p     | Mean Difference | Test Value | Decision |
|-------------------|---------|------|-------|-----------------|------------|----------|
| Back              | -16.642 | 1043 | 0.000 | -0.331          | 3m         | Rejected |

Significant at  $p < 0.05$

Source: Researcher' (2026)

### Conclusion and Recommendations

The study assessed the spatial distribution and magnitude of building setback violations in Makama New Extension Area of Bauchi Metropolis. The findings revealed that setback violations are widespread across the study area, with  $1,044$  buildings violating the prescribed standards compared with  $916$  compliant buildings. The spatial analysis further established that violations occur across the  $26$  residential blocks rather than being concentrated in specific locations, indicating a general pattern of non-compliance with development control regulations. The mean front, rear, left-side and right-side setbacks were  $2.97$  m,  $2.67$  m,  $1.53$  m and  $1.55$  m, respectively, demonstrating varying levels of conformity with the applicable planning standards. The one-sample t-test results also revealed statistically significant differences between observed setback measurements and prescribed standards, particularly for front and rear setbacks. These findings indicate gaps in the implementation and enforcement of development control regulations by the Bauchi State Physical Planning and Development Control Board (BSPPDCB). The study concludes that persistent setback violations undermine orderly urban development and may compromise accessibility, ventilation, drainage and safety. The study recommends that the BSPPDCB strengthen development control through regular site inspections, particularly during

building construction, to identify and prevent encroachment into prescribed setback spaces. Property owners and developers should be sensitised to the importance of complying with approved building plans and statutory setback requirements. The Board should also enforce appropriate sanctions against offenders, including contravention notices, stop-work orders and other legally permitted penalties. Furthermore, the integration of Geographic Information Systems (GIS), GPS and other geospatial technologies into routine monitoring would improve the identification, mapping and tracking of violations across residential blocks. The planning authority should maintain an updated database of approved developments and periodically assess compliance. These measures would strengthen institutional accountability, improve adherence to planning regulations and promote a safer, more orderly and sustainable urban environment in Makama New Extension Area.

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## APPENDIX I

### Krejcie and Morgan Table (1970)

| <i>N</i> | <i>S</i> | <i>N</i> | <i>S</i> | <i>N</i> | <i>S</i> |
|----------|----------|----------|----------|----------|----------|
| 10       | 10       | 220      | 140      | 1200     | 291      |
| 15       | 14       | 230      | 144      | 1300     | 297      |
| 20       | 19       | 240      | 148      | 1400     | 302      |
| 25       | 24       | 250      | 152      | 1500     | 306      |
| 30       | 28       | 260      | 155      | 1600     | 310      |
| 35       | 32       | 270      | 159      | 1700     | 313      |
| 40       | 36       | 280      | 162      | 1800     | 317      |
| 45       | 40       | 290      | 165      | 1900     | 320      |
| 50       | 44       | 300      | 169      | 2000     | 322      |
| 55       | 48       | 320      | 175      | 2200     | 327      |
| 60       | 52       | 340      | 181      | 2400     | 331      |
| 65       | 56       | 360      | 186      | 2600     | 335      |
| 70       | 59       | 380      | 191      | 2800     | 338      |
| 75       | 63       | 400      | 196      | 3000     | 341      |
| 80       | 66       | 420      | 201      | 3500     | 346      |
| 85       | 70       | 440      | 205      | 4000     | 351      |
| 90       | 73       | 460      | 210      | 4300     | 354      |
| 95       | 76       | 480      | 214      | 5000     | 357      |
| 100      | 80       | 500      | 217      | 6000     | 361      |
| 110      | 86       | 550      | 226      | 7000     | 364      |
| 120      | 92       | 600      | 234      | 8000     | 367      |
| 130      | 97       | 650      | 242      | 9000     | 368      |
| 140      | 103      | 700      | 248      | 10000    | 370      |
| 150      | 108      | 750      | 254      | 15000    | 375      |
| 160      | 113      | 800      | 260      | 20000    | 377      |
| 170      | 118      | 850      | 265      | 30000    | 379      |
| 180      | 123      | 900      | 269      | 40000    | 380      |
| 190      | 127      | 950      | 274      | 50000    | 381      |
| 200      | 132      | 1000     | 278      | 75000    | 382      |
| 210      | 136      | 1100     | 285      | 100000   | 384      |

Note.—*N* is population size. *S* is sample size.