INFLUENCE OF INFORMALISATION OF PLANNED HOUSING NEIGHBOURHOODS ON MANAGEMENT OF PUBLIC INFRASTRUCTURE ASSETS:

A CASE OF BURUBURU ESTATE, NAIROBI, KENYA.

David Omwando Songoro.

A Research Project Report Submitted in Partial Fulfilment of the Requirements for the Award of the Degree of Master of Arts in Project Planning and Management of The University of Nairobi.

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DECLARATION

This research project report is my original work and has not been presented for any award in any other university.

Signed: é é é é é é é é é é é

Date: é é é é é é é é é é é é é

David Omwando Songoro

L50/65873/2010

This research project report has been submitted for examination with my approval as the university supervisor.

Signedé é é é é é é é

Dateé é é é é é é é é

Dr. John Mbugua.

Lecturer.

Department of Extra Mural Studies.

University of Nairobi.

DEDICATION

This research is dedicated to all the people who inspired, supported and encouraged me in the duration of this study.

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I also express my sincere gratitude to my family which stood with me during difficult times, special thanks to my wife Janet, my daughter Sifa and Son Jabali. I give Special thanks to my Mother who has kept interest in my all my academic endeavors.

I take full responsibility for what is written. Mistakes, Omissions and Misrepresentations that may be in the project report are mine. I trust that they are not gross and they will not mislead any planner or scholar of Public Infrastructure Management.

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LIST OF ABBREVIATIONS AND ACRONYMS

CBD:	Central Business District.
UN:	United Nations.
WHO:	World Health Organisation.
KPLC	Kenya Power and Lighting Company.
NCC	Nairobi City County.

ABSTRACT.

The study investigated informalisation of planned neighbourhoods and its influence on the management of public infrastructure assets in Buruburu estate of Nairobi, Kenya. An analysis for the influence of these informalisations and their general consequences for the planned neighbourhood were carried out.

The aim of this research was to investigate the influence of informalisation of planned neighbourhoods on management of public infrastructure assets. The research was guided by four objectives namely: to establish the influence of uncontrolled house extensions on public infrastructure management; to establish the influence of commercial activities along estate roads on management of public infrastructure assets; to consider the influence of light industrial activities along estate roads on the management of public infrastructure assets and to investigate the influence of new building types on the management of public infrastructure assets in Buruburu estate, Nairobi. The research was guided by relevant literature on management of public infrastructure assets.

The general approach to this study was exploratory, descriptive and inductive, based on mixed research techniques because the quantitative enquiries helped to explore the extent or magnitude of the situation or phenomenon under study while the qualitative enquiries helped to explore the diversities in a situation or phenomenon. The cross sectional survey method was employed using questionnaires and interview schedule. The respondents were 245 residents of Buruburu estate, stratified and randomly selected from the five phases of Buruburu estate. The data collected was subjected to statistical analyses using frequencies, percentages regression and correlation analysis.

The results revealed that the estate consists of households with diverse social and economic backgrounds living together. This meant that over time, the estate had become heterogeneous in composition as against the original residents who were lower middle income earners. The results showed that 66% of the total residents had house extensions and the road reserves along the main street in the estate are littered with both light industrial activity and commercial activities. The study further established that new house types are gaining currency rapidly in the estate.

The result of the inferential analysis revealed that all four variables used for the study indeed influenced the management of public infrastructure assets. The implication of this is that these variables can be used to predict some issues concerning the management of public infrastructure assets in the study area. The variables included uncontrolled house extensions, proliferation of formal and informal commercial activities along estate roads, light industrial activities along estate roads and emergence of new house typologies.

It was established that each form of informalisations influenced the management of public infrastructure assets differently. For example uncontrolled house extensions influenced the demand for electricity and water infrastructure assets. The proliferation of formal and informal commercial activities influenced the type, quantity and method of disposal of solid waste in the planned neighbourhood. Particularly dumping of waste on storm water drainage was noted, influencing directly the management of storm water management infrastructure assets. Light industrial activity along estate roads was found to contribute to reduced pedestrian spaces and to defacing of aesthetic and environmental quality of the planned neighbourhood. New house types, particularly multi storeyed residential apartments were found to contribute to increased population and increased vehicular congestion on estate roads.

Measuring residentsô reaction to certain types of informalisation which were conspicuous in the study areas showed that their acceptance level in spite of the services they presently render to the residents was quite low. The study concluded that informalisation of planned neighbourhoods influence the management of public infrastructure assets. Further it concludes that the quality of service obtainable from public infrastructure assets had deteriorated as consequence of various informalisation activities and processes in the planned neighbourhood studied.

CHAPTER ONE
INTRODUCTION

1.1 Background to the study.

Human settlements are in a continuous process of change and re-adjustment of its different parts, which are spontaneously developed or deliberately planned under different socio-economic and political conditions in different period.

Over the past decades, several planned residential neighbourhoods of Nairobi, Kenya, have undergone various physical and functional informalisations. It is observed that in spite of development controls, the planned residential areas of Nairobi city have experienced physical and spatial informalisation in the spatial layout to adapt emerging community needs. As a result, the planned residential neighbourhoods have tended to become informalised into an unplanned state in relation to their physical layout and distribution of planned functions.

Rapid urbanization has led to increase of urban population leading to demand for additional housing units to accommodate the population. This however is highly inhibited by various factors, one of which is the limited land available for expansion of housing stock in our cities. This has created pressure on existing housing stock and physical infrastructure resources in the city (Sheuya, 2004).

In response to the challenges of urbanization, the existing planned neighbourhoods in the city of Nairobi have become characterized by informal developments liberally interspersed in the planned estates as evidenced by alterations of the existing planned housing and erection for temporary shelters with no respect to the existing infrastructure resulting in stressful and unhealthy living conditions.

Matindi (2007) observes that housing estates surrounding Nairobiôs Central Business District are characterised by old residential buildings, overstretched infrastructural services and illegal extensions which have resulted in informalisation of the formally planned neighbourhoods. This is happening without clear regard to the existing development regulations in the city.

Currently, the demand for housing and commercial space in the city has put the estates in a continuous state of change in response to rapid urbanization. This has given rise to the

emergence of multi-family dwellings and light commercial developments in the neighbourhoods that were planned for residential use. Adaptability of the houses is a critical in this area as it forms the first phase of informalisations, a ócchange of useô.

The original planned dwelling houses with single family occupancy provided optimal utilization of public infrastructure while the current often higher occupancy developments have no consideration for the strain on and capacity of public infrastructure assets. Originally the ground coverage was 50% but with the emergence of informal additions the actual ground coverage in most of the plots has increased to 80% in most of the instances. (Nairobi City County; Development Control Policy, 2004).

Therefore this research seeks to study and analyze the influence the informalisation of the neighbourhoods has on management of public infrastructure assets in Buruburu estate, Nairobi. It also seeks to formulate guidelines for management of infrastructure in the face of rampant housing transformations in the city.

Rweyemamu**,** (2013) states that informalisation of the planned neighbourhoods has for a long time been a challenge to the management of infrastructure and a concern of many urban planners. He finds that informalisation is driven by different motives like the quests for better urban life, search for economic sustainability, and adaptability of forms for changing functions. Upgrade of Public infrastructure has generally been ignored even as informalisations are allowed to go on unabated.

This research project intends to contribute to this discussion on neighbourhood planning and management of public infrastructure. In order to do this, various forms of informalisation are identified and assessed for their ability to influence change in quality of service obtainable from public urban infrastructure assets measured.

1.2 Statement of the problem.

According to the Central Bureau of Statistics, the city of Nairobi in Kenya is urbanising at a rate of 3.64% annually. This makes Nairobi one of fastest growing cities & urban areas in the world. The process of urbanisation is one of the most important dimensions of economic, social and physical change (United Nations Centre for Human Settlements ï UNCHS, 2001). Rapid urban population growth means an increasing demand for urban land resources, particularly for housing, but also for various other urban functions. Although urbanisation provides opportunities for urban communities, an increase in population also places

enormous stress on urban housing resources and existing social services and infrastructure assets (Mulder, 2006).

A city is largely defined by its residents. It is estimated that 60% of residents Nairobi are youthful of the age of between 18 and 54 years (Central Bureau of Statistics, 2009).This age structure presents unique challenges for the urban planners. This is the age bracket where families are establishing themselves socially and economically. In this age bracket, households are seeking for gainful engagement to supply for the diverse needs of their young families. Urban planners in cities with such a demographic profile are tasked with developing infrastructure to supply rapidly growing populations with housing, water, and sanitation to support their varied enterprises.

Following the global recession and economic reforms of the 1980s and 1990s, characterised by structural adjustment programmes (SAPs) in Kenya, the bulk of new employment in recent years, has been in the informal economy. Most people have been going into the informal economy because they cannot find formal employment or are unable to start businesses in the formal economy (Mukiibi, 2008). As a result many households in the city housing estates are predominantly engaged in the informal sector mostly in small businesses on a subsistence basis. Home-based enterprises in this case contribute to householdsô incomes, and provide some level of social security. Owuor et al (2008) contends that the informalisation of the economy in Nairobi, Kenya has pervaded all sectors in society, including new developments in previously planned urban housing neighbourhoods.

It has been recognized that there exists a relationship between informalisation of urban housing development and the management of public infrastructure assets service offering. Sheuya (2004) noted that, ñcontinued informalisation of urban housing development and ócchange of useô which are triggered by need for economic gains and which are not guided by statutory urban planning regulations may lead to poor infrastructure service offeringò.

However, the influence exerted by informal urban development in planned neighbourhoods on the quality of public infrastructure asset service offering is not always obvious. Certain aspects of the influence might seem obvious by exterior inspections but it is necessary to go beneath the surface and understand the motivations; economic planning, institutional or other factors and their impacts on their infrastructure and services (De Chiara et al 1995).This study sought to explore the influence exerted on public infrastructure assets management by informal development in planned housing neighbourhoods.

1.3 Purpose of the Study.

The purpose of this study was to investigate the influence of informalisation of planned housing estates on the management of public infrastructure assets.

1.4 Objectives of the Study.

This study was guided by the following objectives:-

i. To enquire into how uncontrolled house extensions, as informalisations of planned neighbourhoods, influence the management of public infrastructure assets in Buruburu estate.

ii. To determine how the proliferation of informal commercial activities along the main estatesô road reserves, as informalisations of planned neighbourhoods, influence public infrastructure asset management in Buruburu estate.

iii. To consider how thriving light industrial activities along estate roads, as informalisation of planned neighbourhoods, influence the management of public infrastructure assets in the estate.

iv. To establish how the emergence of new building typologies, as informalisation of planned neighbourhoods, influence the management of public infrastructure assets in Buruburu estate.

1.5 Research Questions.

The planned housing neighbourhoods in Nairobi trace their genesis to the production strategies of construction professionals. However, these planned housing estates inevitably undergo informalisation due largely to prevailing socio-economic situation and laxity by development control authorities in the city.

To assess the influence of the informalisation of planned neighbourhoods on public infrastructure assets, the research questions are:

i. How do the uncontrolled house extensions, as a form of informalisation of planned neighbourhood, influence of the management of public infrastructure assets in Buruburu estate?

ii. How does the proliferation of formal and informal commercial activities along estate road reserves, as an informalisation of planned neighbourhood, influence the management of public infrastructure assets in Buruburu estate?

iii. How do the thriving light industrial activities along estate roads in Buruburu estate, as an informalisation of planned neighbourhood, influence the management of public infrastructure assets in the estate?

iv. How does the emergence of new building typologies, as an informalisation of planned neighbourhood, influence the management of public infrastructure assets in Buruburu estate?

1.6 Significance of the Study.

This research is pursued with the twin aims of contributing to theory development and to chip in to the current practice of public infrastructure asset management. These contributions take two primary and interrelated forms.

Asset management is an emerging discipline. A review of current literature shows that the discipline is fragmented. To this end theoretical development in this area has been patchy and a unifying platform has to yet to be found that would provide a base for an incremental building up of knowledge. Consequently, this project report represents a pioneering academic investigation into the practice of public infrastructure asset management in Kenya.

At a practical level, the research hopes to provide useful findings that will guide public infrastructure planners and managers in developing the more appropriate and critical development control strategies for the urban entity. To this end, one of the key aims of this study is to identify critical impacts on public infrastructure caused by informalisation of a planned neighbourhood. This can be useful in helping managers to identify the resources they should seek to manipulate in order to manage infrastructure assets better in the face of unstoppable neighbourhood informalisations.

1.7 Basic assumptions of the study.

The study was premised on the assumption that all planned neighbourhoods are provided with public infrastructure assets that are adequate to support the planned population needs. It is further assumed that this equilibrium state between planned population in a planned neighbourhood and planned public infrastructure assets is affected by any informal development activity in the planned neighbourhood.

1.8 Limitations of the Study.

One needs to appreciate certain limiting aspects of the study. The limited resources affected the collection of the data required in the study. Unwillingness of residents in providing required information on the study was another limitation. Finally, there were time limitations in collecting and analysis data for the study.

Institutional bottlenecks in collecting data from various public institutions especially local authority. The long procedures in getting permission and improper data keeping in various institutions hindered the collection of data for the study.

1.9 Delimitations of the Study.

The area under study is the region identified as Buruburu estate. It is one of many residential neighbourhoods within Nairobi city. Buruburu was designed as a planned middle income estate and it is situated in the eastern side of Nairobi city. Buruburu estate is bounded by Jogoo road on the southern side and Outering road on the eastern side. Buruburu estate was designed in 1974 and construction was completed in the mid 1980s. The house units were either bungalows or maissonnettes.

However a lot of changes have taken place in the neighbourhood giving rise to numerous informalisations. Further the original built forms have either been modified or additions done to them. It is with these considerations that Buruburu estate was selected as a suitable case for the study because it exhibits most of the characteristics of interest to the researcher in this study.

1.10 Definition of Significant Terms

The terminologies below provide meanings and explanations of technical words, as used in this study.

Informalisation: In this study informalisation of planned neighbourhood is used in describing and accounting for forms of shelter or living arrangements that are unlawful, unregulated, or not afforded protection of the state. These include illegal house extensions, roadside kiosks, roadside garages and other forms of jua kali activity.

Planned Housing Neighbourhood: For purposes of this study, a planned neighbourhood is a settlement that is developed according to all required urban planning, design, and development regulations. These include land ownership rights, development approval, and occupancy permit.

Infrastructure assets: In this research project, ñinfrastructureò refers to all core assets which are integral to the delivery of municipal services, including water supply, sanitation, road

transport and storm-water drainage, solid waste removal, electricity supply, and community facilities.

Public Infrastructure Asset Management: In this study Public Infrastructure asset management refers to the all the systems, processes and activities of monitoring and maintaining the quality of public infrastructure service offering.

1.11 Organisation of the Study.

This study is organized in two principal parts; part one comprising chapter one is basic introduction covering the introductory background to the study, chapter two is the research literature review and chapter three is research methodology.

Part two of the research report is the fieldwork research and analysis which is covered in chapter four, the last chapter is chapter five giving the summary of research findings, conclusions and recommendations and the references.

CHAPTER TWO
LITERATURE REVIEW.

2.1 Introduction.

In this Chapter, available literature was reviewed along subject matter of the research project, which is informalisation of planned neighbourhood and management of public infrastructure assets. To address the theme, this Chapter undertook a review of literature on individual components of the central theme and combinations of such individual components, as basis for developing the researcherôs ideas on the general concept of the study.

Specifically, emphasis was on previous writings on themes such as uncontrolled house extensions, commercial activities in residential zones, light industrial activities along estate roads and management of public infrastructure assets. The review of literature, in addition, aims at providing detailed account of earlier studies in order to identify the gap that exists in the literature, which the thesis attempted to fill.

2.2 Some important concepts on planned neighbourhoods and public infrastructure asset management.

2.2.1 Neighbourhood.

Several convergent definitions have been given to the term Neighbourhood. For example, Kallus (2000) defined it as ña place with physical and symbolic boundariesò while Morris and Hess (1975) labeled it ña place and people with common sense limit as the area one can easily walk overò. On the other hand, Golag (1982) sees it as ña physical or geographical entity with specific boundariesò. Hallman in his approach, attempted to integrate social and ecological perspectives by defining neighbourhood as ña limited territory within a large urban area, where people inhabit dwellings and interact socially (Hallman, 1984). Warren (1981) defines it as a social organization of a population residing in a geographically proximate locale where there exists a common named boundary, more than one institution identified with area, and more than one tie of shared public space or social network.

All these definitions presume either a certain degree of spatial extent and or social interrelationship within that space but it must be realized that there exists other features of the local residential environment that clearly affect its quality from the perspective of the residents, property owners and other observers as expressed by Schwirian (1993), Hallman (1984) and Temkin and Rohe (1996). In this research, we would like to rely on the definition of neighbourhood as given by Pitkin (2001) which states that ñneighbourhood is a

multidimensional bundle comprised of spatially based attributes associated with clusters of residences, sometimes in conjunction with other land uses.

A neighbourhood also as defined by Pitkin (2001) is associated with spatially based attributes such as Structural characteristics of residential and non-residential buildings: type, scale, materials, design, state of repair, density, landscaping. A neighbourhood is also characterised by Infrastructural characteristics which include roads, sidewalks, streetscaping, utility services, etc.

Demographic characteristics of the resident population define a neighbourhood. This has to do with age distribution, family composition, and racial, ethnic, and religious types. The Class status characteristics of resident population refer income, occupation and educational composition of a neighbourhood.

Neighbourhoods are also defined by Environmental characteristics which are the degree of land, air, water and noise, population topographical features, views. Also Political characteristics refer to the degree to which local political networks are mobilized, residents exert influence in local affairs through spatially rooted channels or elected representatives. Social interactive characteristics in the neighbourhood refer to local friend and kin networks, degree of inter-household familiarity, type and quality of interpersonal associations, residentsô perceived commonality, and participation in locally based voluntary associations, strength of socialization and social control forces.

All the attributes above may not be present in a particular neighbourhood but Avery (2006) and Hunter (1974) emphasize that while most of them are, the quantity and composition of constituent attributes typically vary across neighbourhoods within a single metropolitan area. This implies that, depending on the attribute package they embody, neighbourhoods can be distinctly categorized by type and or by quality. These details on the dimension over which neighbourhood can be classified is necessary for one to understand neighbourhood change.

A neighbourhood can be envisioned as a consumable commodity from which four different types of users potentially reap benefits (Galster, 2001). These users are firstly for households. Households consume neighbourhoods through the act of occupying a residential unit and using the surrounding private and public spaces, thereby gaining some degree of satisfaction or quality of residential life. Neighbourhoods are also beneficial for businesses. Businesses consume neighbourhood through the act of occupying a non-residential structure (store, office, factory), thereby gaining a certain flow of net revenues or profit associated with that venue. Property

owners also draw benefits from neighbourhoods. This group of users consume neighbourhood by extracting rents and/or capital gains from the land and buildings owned in that location. Lastly Local Governments are also users of neighbourhoods. To this group of users, consumption is done by extracting tax revenues, typically from owners and tenants based on assessed values of residential and non-residential properties.

Pitkin (2001) and Galster (2003) noted that neighbourhoods change by the very act of consuming them and this can occur directly or indirectly. Directly, as households consume neighbourhoods by occupying residences in it, they may simultaneously alter demographic and/or social economic status profile of the neighbourhood if the in-moving households differ systematically from longer-term residents. Indirectly, changes in the occupancy and /or ownership profiles of a neighbourhood not only change its current attributes but may trigger longer-term changes in a wider variety of attributes (Temkin and Rohe 1996).

2.2.2 Neighbourhood Planning.

The term ñneighbourhood planningò has myriad definitions. It is conceived as ña mixture of science and art. It encompasses many different disciplines and brings them all under a single umbrella. The simplest definition of neighbourhood planning is that it is the organization of all elements of a neighbourhood or other urban environmentò. Keeble (1996) defined it as ñThe art and science of ordering the use of land and the character and siting of buildings and communicative routes, primarily deals with land and not economic, social or political planning, though it may greatly assist in the realization of the aims of these kinds of planningò Thus as a discipline of its kind it links and touches different aspects like housing, transport and environment in view of the social, economic and political aspects.

Neighbourhood planning aims at creating a balanced and conducive situation for the people, in that respect it focuses on economic efficiency, social acceptability, compatibility and equity. The planning therefore should address and find a balance to attain justice and equity in the areas of housing and accessing the livelihood. In addition to that, it should be acceptable by the affected (communities/individuals) so that it is applied amicably. In detailed drawings the neighbourhood plans put in place what should be developed and where. However this is at the macro scale and the architectural works come in at a micro stage.

In the context of this study the term neighbourhood planning means how the land is allocated for different use such as distribution of use over a certain piece of land. Jacobs (1961) finds that it is imperative to have mixed use development. When pure use development is adopted,

spontaneously the mixture will surface in real life hence rendering unexpected results. She stresses that mixture of uses is good for sustenance of neighbourhoods, neighbourhood safety, public contact and cross-use needs.

2.2.3 Housing.

Housing is defined as the total residential neighbourhood/environment or micro district including the physical structure, all necessary services, facilities and apparatus for the total health and social well-being of the individual and family (Salau, 1992). It is seen as the physical environment in which the family and societyôs basic units must develop. Housing structures are enclosures in which people are housed for lodging, living accommodation or even work places.

According to Abram (1964), ñhousing is not only a shelter but also part of the fabric of the neighbourhood life and of the whole social milieuò. It touches upon many facets of economic activity and development. Thus housing provides social contacts, good image, a sense of belonging and an indicator of social status.

Economically, housing represents a major portion of the family budget or that of an establishment, yet in the realm of private and public investment, the built environment represents a manôs most tangible material asset (Kinyungu, 2004).

The 2003 National Housing Policy for Kenya identified shelter as the most essential human need after food. While adequate housing is crucial for effective performance of man, a considerable proportion of Kenyans live in sub-standard and poor housing as well as deplorable unsanitary residential environments (Onibokun, 1985).

To this end, one can deduce that housing is the process of providing a large number of residential buildings on a permanent basis with adequate physical infrastructure and social services in planned, decent, safe and sanitary neighbourhoods to meet the basic and social needs of the population and is intended to provide security, comfort and convenience for the users (National Housing Policy, 2004; Osuide, 2004).

The general definition of housing as the continuing activity of providing shelter within a defined geographical area to people who being productive are able and willing to pay for and use a defined quality of shelter, needs to be revisited because housing in its true sense goes beyond shelter. It includes all the services and community facilities significant to human comfort (Onibokun, 1982. It is, however, important to note that housing goes beyond simple shelter; it includes services, facilities, utilities within and without, on-site and off-site.

According to Onibokun (1982) housing is not only a basic human need; it constitutes a vital component of manôs welfare, life sustenance and survival. In the hierarchy of manôs needs, housing has been ranked second to food. It has a profound influence on the health, efficiency, social behavior satisfaction and general welfare of the community. Housing is universally acknowledged as one of the most basic human needs, with a profound impact on the life-style, health, happiness as well as productivity of the individual (Dunn, 2000).

According to Stafford (1978), the concept of housing is generally defined for statistical purposes as dwelling units (Housing unit occupied separately by households) comprising a great variety of quantities and qualities. Aroni (1982) and Achuenu (2002), point out that housing should be a home, a resting place with fundamental purpose of a secured, rewarding, happy or at least a liveable space. In the context of socio-cultural functionality, housing is viewed as ñan area for recreation and identificationò(Gallent et al, 2004) and can be regarded as psychological identity, a foundation for security and self respect (Aroni, 1982) societal support (Johnson, 2006), and the setting for the formation of social relationships (Amole, 1997).

One of the most intractable socio-economic problems facing the Nairobi today is acute shortage of comfortable and affordable housing for the people. The major causes of the problem have been identified and frantic efforts have been made and huge financial resources have been expended, but strangely, enough, it has defied sustainable solution (Adedipe, 2009).

Housing as an investment has a significant role to play in the individual, local and national economy. In most cases, it constitutes the first major capital investment and life ambition of individuals (Bello, 2003). The desire to own a house constitutes one of the strongest incentives for savings and capital formation (Ozo, 1990). 23

In more complex centers today with a maze of activities sometimes defying geography, housing needs should desire quality and quantity from the quality and quantity of urban activities. It is for this reason that housing is a subsystem of activities whose nature is clearly defined in a proper planning framework which comprises a complex bundle of considerations, including privacy, location, environmental amenities, symbolic characteristic and investment (Milanovich, 1994)

Housing is considered a consumable item by Lawrence (1995), because he believes that when households dwell in a house, they interact even with the surrounding, therefore consumption takes place. When they consume housing, they purchase or rent more than the dwelling units

and its characteristics; they are also concerned with such diverse factors as health, security, privacy, neighbourhood and social relations, status, community facilities and services, access to job, and control over the environment. Therefore, ill-housing can be taken to mean deprivation along any of these dimensions discussed above. Characteristically, housing whether adequate or ill, is unique among consumer goods. It is potentially very durable, with a useful life span of around 70 years.

2.2.4 Infrastructure Assets.

Howes and Robinson (2005) have defined infrastructure as referring to a wide range of things from military installations, information technology, buildings to physical networks such as transportation and water systems. Development economists often refer to infrastructure as social overhead capital described as investments in networks such as transportation, water, sewerage, power, and communication and irrigation systems.

Jochimsen (1966) cited in von Hirhhausen (2002) has defined infrastructure as the sum of all basic material structures, institutional conditions and human resources available to society, needed for the proper functioning of the economic sector. Jochimsen further distinguished between three components of infrastructure that are interrelated - institutional infrastructure, personal infrastructure and physical infrastructure. This is illustrated in Figure 2.1.

Based on Jochimsenôs broad classification of infrastructure, Howes & Robinson (2005) further classified physical infrastructure, trade infrastructure and social infrastructure, comprises the long-lived networked, capital intensive and engineered structures indirectly supporting economic production. Trade infrastructure represents the facilities directly used for the production of goods and services such as factories, warehouses, shops and offices.

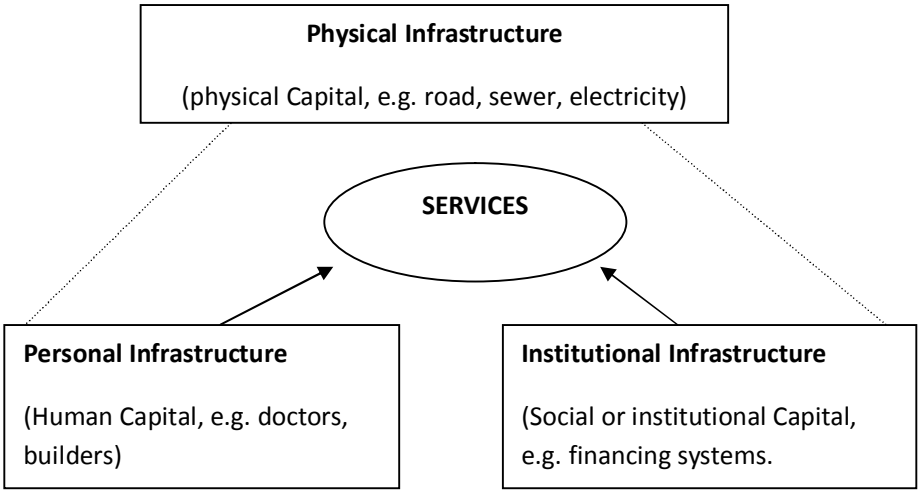


Figure 1: Interdependencies of infrastructure Companies. (Adapted From Howes & Robinson, 2005)

In order to provide services, Technical (Economic) Infrastructure can be further sub-classified into Transport, Utility and Information (Van der Mandele et al., 2006). Transport infrastructure includes railways, roads, bridges, airports, ports and waterways. Utilities include power, water supply, piped gas, sewerage and wastewater. Information includes telecommunication (wired and wireless).

Many authors have sought to identify the characteristics of infrastructure (e.g. Firth et al., 1999; Grimsey & Lewis, 2004; Van der Mandele et al., 2006). It is generally agreed that several characteristics are central to the economic concept of infrastructure. These characteristics are best summarized by Firth et al. (1999, pp.22-23) and are reproduced below.

Firstly, Infrastructure networks consist of nodes and links, which are complementary to one another and have to be combined to create a service. The understanding of the relationship between these components is crucial for the delivery of infrastructure services. For example, in the context of transportation services, providing good roads, rails etc are not sufficient. It is the service derived from the use of such facilities (physical infrastructure) through integrating hard and soft facilities management that is crucial. There is therefore a need for a service-focused approach in the development of infrastructure projects. This interdependence results in a need for central coordination. Governments often serve the role of controller or regulators of infrastructure networks.

Further, Infrastructure networks often require large capital investment with a delay in returns, although the returns continue for a long time. There is a high degree of sunk costs, which means

that if infrastructure is abandoned, it cannot be sold for other uses. Because of the risks of returns and the lack of other uses, a tendency exists for the market to under provide infrastructure in the absence of intervention.

The production of infrastructure services is subject to steeply increasing returns to scale. This implies a natural tendency toward monopoly, since large-scale firms can exploit cost advantages that are not available to smaller firms. Monopoly carries the risk of low services and high prices and thus has often stimulated policy makers to impose regulations.

Infrastructure generates public goods. This means the benefits are shared across the community in such a way that those who do not wish to buy the services cannot be excluded from the benefits created by those who do. Generally, competitive markets will tend to under produce these services. The use of infrastructure services is therefore subject to some degree of non-rivalness and non-excludability. This outcome again usually leads to demand for government funding and regulation.

Finally, almost invariably, infrastructure networks have many stakeholders, including their users, operators and service providers, investors and owners, and ultimately, the general public. Many of these infrastructure assets are of great strategic and military importance to the countries in which they function.

These characteristics explain why the public sector role is critical in infrastructure delivery to achieve development objectives such as national security and public services obligations, and to minimize the effects of market failure and externalities (Grimsey & Lewis, 2004; Howes & Robinson, 2005). Hence the provision of infrastructure has always been subjected to the kind of intervention that has not always been imposed on other facilitators of economic activity. For this reason, the ownership has, traditionally, often been in the hand of government or semi-government organizations.

2.3 Uncontrolled House Extensions and Management of Public Infrastructure Assets.

A house extension is defined as an addition that extends from a main house; it is a room or rooms added to an existing building. House extensions or alterations are often undertaken by the occupants of the ócore-housingô unit(s). These extensions or alterations are generally viewed as óhelping to create slumsô, by urban development managers and have policies which are meant to stop such changes.

However, house extensions tend to avail more rooms as well as more room per person, increased house size and improved service levels and physical conditions. They also increase the value of the housing and contribute to an increased supply of cheap and relatively good quality rental accommodation (Tipple, 1995)

Conversely, it has been observed that housing conditions are worse after the informalisation activity by house extension than they were before it. Such housing conditions would include issues of infrastructure services available, physical condition of buildings, and neighbourhood and house layout including availability of privacy, open space (Rweyemamu, 2013).

We may, however, posit several assumptions which underlie these observations about house extensions: Firstly that the new buildings are of poor quality. Further that they degrade the general conditions of the formerly satisfactory neighbourhood (the ñthere goes the neighbourhoodò syndrome); or that they create poor conditions in the midst of otherwise satisfactory neighbourhoods; It is also thought that property values would deteriorate; or investment would be withdrawn from the area through lack of maintenance of public infrastructure, lower rents for the extended houses.

2.4 Commercial activities in Residential zone and Management of Public Infrastructure Assets.

Street trading is one of the activities plaguing the public open spaces in third-world cities. The effects of the activity on accessibility in city centres have transformed them into contested places for incompatible functions.

The street trading activity has serious negative impacts on accessibility, erection of illegal structures, traffic congestion, solid waste generation, auto-accidents and defacing of urban aesthetics.

Street vending activities have been associated with improper disposal of refuse like in Nairobi megacity which represents the extreme case of the accumulation of rubbish heaps in road mediums. This and other negative consequences of street trading and informal commercial structures are most likely to increase. Skinner (2010) argues that ñthe combination of urbanization, migration and economic development trends suggests that there has been a rapid increase in the number of street traders operating on the streets of African cities.ò Consequently, eviction of street traders and demolition of informal structures is an international trend just as there are already cases of street traders being removed in South Africa. According to Mitullah, (2006), the council inspectors in Nairobi were constantly bribed by street traders to avoid eviction and arrests.

In Lagos metropolis, ñinformal entrepreneurs tend to construct their make-shift kiosks along drainage channels and also dump domestic wastes indiscriminately into storm water drains; thereby causing blockage and consequently floods are frequently experienced. It was also posited that informal enterprises is a great threat to the environment, usually operating without authorization on public or private land, engage in illegal subdivision and rental of land and carry out unauthorized construction of informal structures. The study of Adeyinka et al,(2006) on land use implications of informal sector in Lagos State equally revealed that kiosks, shops, temporary structures and open spaces are used for trading activities and are constructed of planks, bricks and blocks. The result of the study showed haphazard and uncoordinated development, encroachment of structures on streets and walkways with attendant reduction of road capacity especially at night resulting into congestion, pollution and filtration. A Similar study in Nairobi revealed the linear pattern of the informal sector enterprises using illegal structures along major transportation corridor and argued that the sector provides supplementary services to the major land uses making it ñimperative that the sector is well integrated into land use planning processò.

2.5 Light Industrial Activity in Residential zone and Management of Public Infrastructure assets.

Light industry is industry that is usually less capital intensive than heavy industry, and is more consumer-oriented than business-oriented (i.e., most light industry products are produced for end users rather than as intermediates for use by other industries). Light industry facilities typically have less environmental impact than those associated with heavy industry, and zoning laws are more likely to permit light industry near residential areas. It is the production of small consumer goods.

Sullivan, (2003) posits that light industry is a "manufacturing activity that uses moderate amounts of partially processed materials to produce items of relatively high value per unit weight". Examples of light industries include the manufacturing of clothes, shoes, furniture, consumer electronics and home appliances.

Amenya (2007) says that among the urban poor, engaging in informal light industrial activity is negatively associated lack of basic amenities such as piped water, low education levels, access to electricity, access roads, sanitation facilities and length of stay in the settlement. He further says that the garbage generated by the informal industrial activity is not well disposed

and the dumping places are breeding areas of diseases such as cholera and malarial mosquitoes.

Light industrial enterprises have fewer employees, they operate for a shorter period, and have poor access to water and electricity and few sell outside the establishments where the entrepreneurs live (World Bank, 2006,). There have been efforts by the Kenyan government to provide shades for the various jua kali artisans in the different urban centres of Kenya. In spite of these efforts, the jua kali workers remain largely isolated and marginalised.

The informal jua kali industries can hardly be ignored in Kenya. According to UNHSP-HABITAT (2006), the informal economy is comprised of enterprises which produce and distribute basic goods and services in unregulated competitive markets that lie outside the regulatory framework of either national or municipal governments.

KôOmollo, et al (2010) argues that a major problem associated with informal activities is the conflict of use, between these activities and designated uses, which largely results from lack of regulation. These include encroaching on the road reserves as in the case of Jogoo road and Buruburu estate road facades. The resultant developments reflect a state of fear to these people as to when, not if**,** they will be evicted. This has led the traders to construct make-shift, ugly-looking structures that are poorly serviced by public infrastructure, aesthetically unfriendly and environmentally unstable, from where they cannot reap the maximum economic benefits of their trade.

2.6 New building Typologies in Planned Residential Neighbourhood and Management of Public infrastructure Assets.

A typology is a systematic classification of building types that have characteristics or traits in common. Houses can be built in a large variety of configurations. A basic division is between free-standing or Single-family houses and various types of attached or multi-user dwellings. Both sorts may vary greatly in scale and amount of accommodation provided. Although there appear to be many different types, many of the variations are purely matters of style rather than spatial arrangement or scale (Wang, 2013).

Neighbourhood planning is a subset of urban planning. It encompasses many different disciplines and brings them all under a single umbrella. The simplest definition of urban planning is that it is the organization of all elements of a town or other urban environment. Land use planning aims at creating a balanced and conducive situation for the people, in that respect it focuses on economic efficiency, social acceptability, compatibility and equity (Taylor, (2007). The planning therefore should address and find a balance to attain justice and

equity in the areas of housing and accessing the livelihood, In addition to that, it should be acceptable by the affected (communities/individuals) so that it is applied amicably.

Jacobs (1961) finds that it is imperative to have mixed use development. Spontaneously the mixture will surface in real life hence rendering unprecedented results. She stresses that mixture of uses is good for sustenance of cities, city safety, public contact and cross-use needs. In the course of this research informalisation is understood as a spontaneous mixing of uses in dealing with understanding the diversity of activities/uses in planned neighbourhoods. As the uses are changed informally, understanding of what people create contrary to what were planned and how the changes relate to infrastructure may inform utility managers.

Yekeen Sanusi, (2011), elaborates that unregulated and uncontrolled change of use to planned single dwelling houses to high-rise apartments puts pressure on existing infrastructure assets and their non optimal performance can lead to occupational health hazards, indoor pollution, poor sanitation, reduced household privacy, and reduced accessibility (Sheuya, 2004).

Acioly and Davidson (1996; quoted by Sheuya, 2004) argue that in situations where there is shortage of housing and plot sizes allow housing extensions, there will be a inevitable densification of settlements.

2.8 Theoretical Framework.

The discourses on informality and formality concepts are enormous, and have been viewed in different perspectives depending on the discipline in question or concerned programme. These debates started in 1970ôs by anthropologists and the centre of discussions was the existence of duality in socio-economic structures of the urban community (Lupala, 2012). Lupala (2012) observed that the term informal development refers to the houses developed outside the official procedures, like developments in unplanned areas and areas where housing development controls are not enforced effectively or not at all.

However, the definition of informal developments that put on board all aspects of urban settlements and yet unveil it as context specific is by UN Habitat Programme as picked by WHO as, ñresidential areas where a group of housing units has been constructed on land to which the occupants have no legal claim, or which they occupy illegally, unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing)ò.

2.8.1 Housing Adjustment Theory.

The theory of housing adjustment behavior is a framework for understanding the process by which households seek to maintain equilibrium, the causes of disequilibrium, and the consequences of existing in a state of disequilibrium. In this sense, equilibrium refers to a state in which the householdôs current housing is in accordance with the norms of both society and the household itself, and it fits the needs of the household. Housing norms include space, tenure and structure type, quality, expenditure and neighbourhood. When one or more of these norms is not met by the householdôs current housing, the household experiences a housing deficit.

A deficit is a ñcondition or set of conditions that is subjectively defined as undesirable in comparison with a normò (Morris & Winter, 1996). Usually, a typical space norm is the expectation that the dwelling will have enough rooms that opposite sex children will not have to share a bedroom once they reach a certain age. However, if a dwelling does not have enough rooms for this norm to be upheld, the household will experience a deficit. Deficits lead to feelings of dissatisfaction with oneôs current housing, and chronic dissatisfaction may cause the household to engage in change behavior in the form of adjustment, adaptation, or regeneration. However, the householdôs preferred change behavior is predicated on overcoming any constraints that impose on the householdôs ability to remedy the situation. A household may experience constraint in one or more of the following areas: resources, predispositions, discrimination, market, or household organization. On the other hand, a deficit in one area, such as the bedroom example above may be offset by a positive deficit in another area, for example a really large backyard. Thus, the household will have to determine which dissatisfactory to them and make their changes based on that decision.

The theory of housing adjustment has been well-validated through studies conducted over two decades. However, an important criticism to consider when discussing the use of theory is the risk of decelerating or narrowing the development of any field of research by adhering to one principal theory. As Elaine Pedersen (2007) has succinctly stated, ñtheory is everywhere,ò yet not every theory used will be as prevalent or well-validated as Morris and Winterôs theory of housing adjustment.

2.8.2 John Turner's (1976) Participatory Housing Theories.

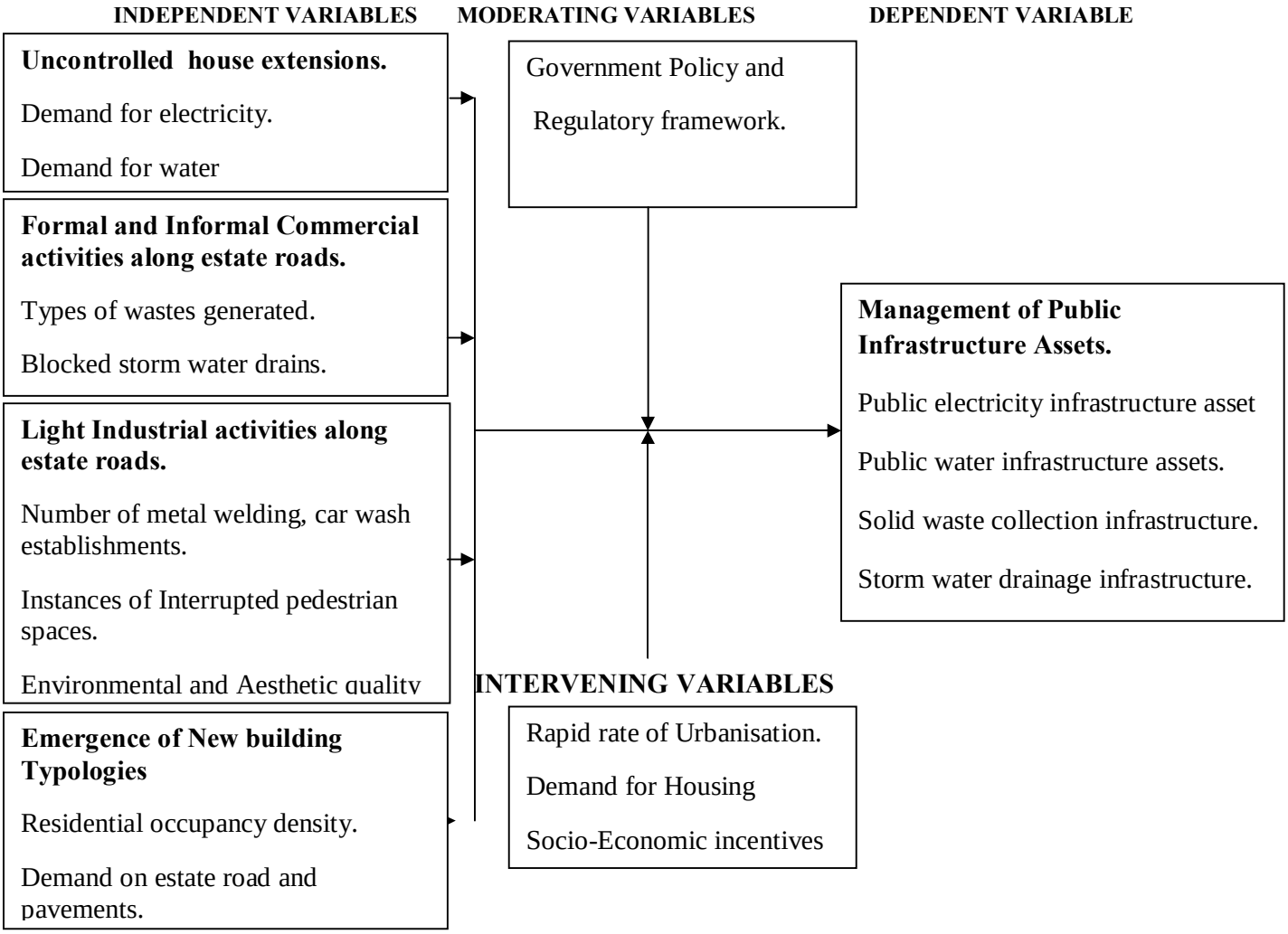
These are three theories that were developed by Turner (1976) who took part in many housing projects and researches around the world especially in developing countries. The theories are basically on issues to do with top down standards and methods of provision of houses for the poor. They entail the issues of involving the people from the first place in the construction and process of their houses and management of the resulting environment. They emphasise on what people might really need vis-à-vis what development regulations demand.

The first Turnerôs theory advocates peopleôs involvement and freedom throughout housing construction and management processes. Informalisation is usually an outcome of peopleôs interventions in their neighbourhoods, attempting to make them more responsive to their needs. Though critiques of this theory such as Hamdi, (1991) underscore the role of the government in housing development processes, needs of the people cannot be sidelined. However, a balance between peopleôs decisions and the governmentôs contribution is very important. While the second theory insists on peoples benefit from their properties depending on how they use and shape them, the third theory advocates aspects of collaborative planning where residentsô values are incorporated into formal development regulations and space standards. In this way, users may have a feeling of responsibility and ownership of the resulting built environment, whether good or bad. In line with Turnerôs theories, this study is inclined towards the influence of residentsô involvement in incremental and informal developments in a formally planned neighbourhood on the management of public infrastructure assets in Buruburu estate, Nairobi, Kenya.

2.9 Conceptual Framework.

A conceptual framework is described as a set of broad ideas and principles taken from relevant fields of enquiry and used to structure a subsequent presentation. When clearly articulated, a conceptual framework has potential usefulness as a tool to scaffold research and, therefore, to assist a researcher to make meaning of subsequent findings. The framework is a research tool intended to assist a researcher to develop awareness and understanding of the situation under scrutiny and to communicate this. As with all investigation in the social world, the framework itself forms part of the *agenda for negotiation* to be scrutinised and tested, reviewed and reformed as a result of investigation.

Figure 2: Conceptual framework.



In this study, management of public infrastructure in a planned neighbourhood is the dependent variable. However, it has been acknowledged that various modifications will inevitably take place in the planned neighbourhood, contributing to informalisation of the original formal plan. When uncontrolled, the modifications may be non-formal and are as a result of residentsô interventions by way of developing new house types that correspond more closely with their changing aspirations. Family size changes and new socio-economic realities may motivate people to develop house extensions, engage in cottage industry and street trading. These were the independent variables for this study.

It is further acknowledged that all the informalisation activities take place in an environment where there is government policy governing all developments in a planned neighbourhood and stipulating requirements that should be satisfied. Government policy is often countermanded by

strong socioeconomic forces such as rapid urbanization, high housing demand and financial incentives that are difficult to control in the immediate environment.

2.10 The Research Gap.

The emergence of informalisations to planned neighbourhoods discussed in this section suggests that managers of public infrastructure asset organisations need to pay attention to three key issues in order to improve their performance. Firstly, informalisation needs to be viewed as efforts by residents of the planned neighbourhoods to adjust their environment to respond more accurately to their needs. Secondly, there is a need for a clearer understanding of what constitutes public infrastructure asset management, i.e., the key activities and processes. Thirdly, socio-economy and development regulation mechanisms complicate the working dynamics and effectiveness of the many parties involved in public infrastructure asset management.

An integrated approach to public infrastructure asset management provides a better understanding of how to align the asset portfolio so that it best meets the service delivery needs of residents, both now and in the future. An understanding of the causes and effects of informalisation of buildings and public open spaces in a planned neighbourhood, the actors, the process and the motivations is helpful for the public infrastructure asset portfolio manager.

The current approaches to formal urban neighbourhood planning and public asset management in the rapidly urbanizing cities is driven by policy goals and objectives based on performance and sustainability. To adopt an integrated approach, it is important to establish the influence that changes in planned neighbourhoods, which accommodate residentsô socio-economic requirements in housing, exerts on public infrastructure asset capabilities. This is one of the gaps the current research project aims to bridge.

2.11 Summary of Literature Review.

This chapter was devoted to reviewing relevant literature that pertains to this study with the aim of identifying gaps which exist and highlighting the exact nature of the fast growing phenomenon. The chapter reviewed theories and concepts in order to set the foundation on which this research was based. It stated and analyzed the basic concepts upon which the study was pivoted to draw out a concise framework that guides this study. The key words used in this study were all defined in several perspectives to position each of one of them in its operational context so as to express the full essence of their uses in the course of study.

CHAPTER THREE.
RESEARCH METHODOLOGY.

3.1 Introduction

This chapter is aimed at providing information about the applied research process for this study. This includes the target population, sample size and sampling procedures. It also includes research instruments, data collection procedures, data analysis techniques and ethical consideration.

3.2 Research design.

Research design is the blueprint of research (Yin, 2002). It is the specification of methods and procedures for acquiring the information needed for solving the problem. The function of a research design is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible. Research design, ñdeals with a logical problem and not a logistical problemò (Yin, 1989: 29).

The general approach to this study was exploratory and descriptive employing an inductive approach that starts with data and tries to derive a theory about the phenomenon of interest from the observed data. Both qualitative and quantitative data was used to help generate unique insight into a complex social phenomenon. This is because the qualitative enquiries helped to explore the diversities in a situation or phenomenon while the extent or magnitude was determined through the quantitative means. Such a combined approach was thought to minimize limitations that could originate from either research techniques individually and contribute positively towards testing and increasing the validity and reliability of the data.

A field survey was used to conduct this study. Field surveys are non-experimental designs that do not control for or manipulate independent variables or treatments, but measure these variables and test their effects using statistical methods. Field surveys capture snapshots of practices, beliefs, or situations from a random sample of subjects in field settings through a survey questionnaire or less frequently, through a structured interview. The strengths of field surveys are their external validity (since data is collected in field settings), their ability to capture and control for a large number of variables, and their ability to study a problem from multiple perspectives or using multiple theories.

The cross-sectional survey method of research was adopted for the purpose of this research because it has advantages in that one can generate sufficient data in a short time and at a reasonably low-cost. Also, it can easily produce relevant data which can be generalized to a wider population and it also makes it possible for the researcher to reach an appropriate conclusion on issues concerning physical characteristics and socio- economic state of a population.

The cross sectional survey method afforded the researcher good control over the measurement / ascertainment process. The researcher had greater control over precision of estimates in subgroups or strata.

3.3 Target Population.

The target population was taken to be all the 6350 approved plots/ households in Buruburu estate, plus all the informal entrepreneurs operating their enterprises along streets in the estate. The accessible population included tenants, landlords, resource persons, traders, utility agency officers, NCC administration, church leaders, and key informants.

In both the main house and extensions, questionnaires were administered to either the landlord, head of the family (father/mother) or a grown up person (18 years and above) living within the house and has a blood relationship with the family occupying the house visitors, house helpers, children under 18 years were not interviewed.

In each subgroup, the study focused on households living in extensions and those living in the main house and also considered those operating businesses on encroached land such as road reserves.

3.4 Sample size selection and Sampling Procedure.

Sampling is the process of obtaining information about the entire population by examining only part of it (Kothari, 1985). The sampling procedures are methods that are used to select an element from the population that is included in the sample.

Sampling frame refers to complete list of all units in the population under study, and determines the structure of enquiries (Olaseni, 2004). The sampling frame was the list of all approved plot numbers of Buruburu estate.

Sample size in a research is the total number of items from which the required information is extracted. In choosing the sampling size and secure representativeôs responses, the size of the sample was based on statistical estimation theory considering degree of confidence that is expected on the research of this nature.

3.4.1 Sample size.

In this study the sample size was determined using a statistical formula (Yamane, 1967) as shown:

$$N = \frac{z^2 pq}{d^2}$$

Where: N = the desired sample size (if the target population is greater than 10,000)

Z = the standard *normal* deviate *at the required confidence level*

p = the proportion in the target population estimated to have characteristics being measured.

Q = l-p

d = the level of statistical significance set

The study assumed the characteristics of interest as 20% for Buruburu neighbourhood to get valid data as recommended by Fiscer et al.

Thus, Z statistic will be 1.96

Desired accuracy - 0.05 level

$N = (1.96)^2 (0.8 \times 0.2) / (0.05)^2$

= 245 households.

3.4.2 Sampling Procedure.

Sampling is the process of selecting a few numbers from a bigger group which will be used as a basis for estimating or predicting the prevalence of an unknown piece of information, situation, or outcome regarding the bigger group (Ranjit kumar 2005). A sample therefore is a representative sub group of the population one is interested in.

A combination of four sampling methods were considered appropriate for this research because it synchronizes the advantages of each one of them to present a more formidable representative analysis. These four sampling methods are firstly purposive which involved choosing the Estate that would specifically address the objectives of this study from amongst so many other middle -Income planned neighbourhoods within Nairobi, the stratified which entailed listing out all the five different phases as strata of the planned housing neighbourhood, the systematic sampling was used to select the specific house units for collecting data from each strata and finally sampling randomly according to each of the form of informalisation.

Stratified sampling was used to select the phase of the estate and Systematic sampling was used to select the specific house units for collecting data. Buruburu estate is geographically divided into 5 phases; phase 1,2,3,4 and 5. The study denoted these phases as subgroups or strata. This method was applied since the residential plots of Buruburu are numbered along numerical order in each phase.

In each stratum, the study identified the first twenty plots according to the numerical labeling. The study used twenty pieces of paper, similar colour and sizes to write each number on a paper to represent the first twenty plots. The papers were mixed and put into a paper bag which was thoroughly shaken. Then, the study randomly drew one piece from the bag containing twenty pieces. This number was taken to represent the first residential plot to administer the questionnaire. The study then picked every twentieth plot thereafter. This was repeated to all the five phases / strata. This allowed each plot within Buruburu to have equal chance of being selected.

3.5 Data collection Instruments.

A good research design should have amongst other features, the ability to generate data that is capable of establishing facts, refuting or validating a prior expectation or hypothesis if any. For this reason, the types of data required for the pursuit of the research are in two categories viz:

i. Primary data

ii. Secondary data

The Primary data was sourced through primary sources with the use of instruments which include the following;

3.5.1 In-depth interviews

This instrument was used on households particularly their heads, officials of the residents' association and officials of the respective agencies managing infrastructure assets in Buruburu (Nairobi City County, Nairobi Water and Sewerage Company and Kenya Power and Lighting Company). The interview sessions were guided by a detailed interview schedule targeted at capturing issues that could not be exhaustively examined through the questionnaire. These interviews as scheduled took place between 4.00 pm and 6.00pm on week days and Saturdays between 8.00am and 10.00am. This strategic timing helped to ensure that the expected respondents would have enough time to spare and furnish the researcher with sufficient information that will aid the extraction of data.

3.5.2 Structured Questionnaire.

This instrument was a list of structured questions which formed a basis for the extraction of information from respondents on age brackets, household sizes, socioeconomic class, level of education and career, etc of the residents. These questions were as much as possible self explanatory and interactive to encourage maximum cooperation from the respondents. The questionnaire was administered to household heads or their representatives to obtain relevant information to fulfill the objectives of this study.

The questionnaire was administered in two ways:

i. Self-administered.

This method was considered vital because its combination with other instruments of data collection is most appropriate for a research of this sort as the advantages derivable from appropriate multiple approach includes high response rate, opportunity for clarification request if any and a detailed investigation of the physical structures on ground.

ii. Collective Administration:

This was done through the assistance of officials of the Buruburu estate residents association. A target audience was achieved during their monthly residents' meeting, where various issues are addressed. This helped to ensure a quick and high response rate.

The secondary data used was sourced from secondary sources including the following;

3.5.3 Documentary/Historical Materials (From Archives).

A visit was made to the Nairobi City County to obtain secondary data such as neighbourhood plan, details of the approved house typologies and their architectural drawings, infrastructure master plan and total number of approved plots/households amongst others in Buruburu estate. This extracted information was used to identify the individual building by their numberings and their locations on the master plan which served as a guide to the sampling method adopted for the study. Statistical data and information were collected from public and private institutions at local and national levels.

3.6 Research validity and reliability.

All research needs to be executed using accepted and rigourously applied research methods. To ensure that the findings are based on critical investigation, it has to be validated. Validating an argument or research process means showing it is well founded and sound. It requires that data analysis procedures are objective and the theories universally applicable. Objectivity corresponds to the statistical concepts of reliability and validity.

3.6.1 Pilot Testing.

A pilot survey is a preliminary test of a research instrument done with a small sample of the population, to help troubleshoot the instrument about the instrumentôs format and potential problems. This is also important because, ñthe impressive economy of the questionnaire is partially offset by the researcherôs inability to clarify the meaning of termsò (Sommer and Sommer, 1991, p. 138).

The questionnaire used in this study underwent a pilot test on April 4, 2015 to help reduce ambiguity and confusing questions. The questionnaire was found to be sufficient because no serious problems were found during the pretesting process (Sommer and Sommer, 1991) and where any problems were detected, changes were made to the questionnaire as necessary. The questionnaire then underwent a review by the researcher and was subsequently finalized.

3.6.2 Validity of the instruments.

Mugenda and Mugenda (1999), defines validity as the accuracy and meaningfulness of inferences which are based on the research results. Validity is the degree to which results obtained from analysis of the actually represent the phenomenon under study. It is the correctness and reasonability of data.

For face and content validity of the instrument (content-related evidence), senior academics, specialists and experts on the topic were consulted to determine the appropriateness of the items of the instrument. This was to find out if the instrument covered the breadth of the content area and ascertain if the format used in designing it is appropriate for obtaining the required information.

3.6.3 Reliability of the instruments.

Mugenda and Mugenda (1999), defines reliability as a measure of the degree to which a research instrument yields consistent results or data after repeated trials. . It is concerned with how consistent the result obtained with the instruments are and that the instrument gives similar, close or the same result if the study is replicated under the same assumptions and conditions (Asika, 1991).

The use of consistent and systematic line of questions for even unanticipated areas is particularly important for and possibly for replication of a study. The researcher used consistent and systematic questions in the questionnaires. The questions were related to the subject of the study and organized into themes in the study.

Statistical levels of measurement, also called rating scales were used in this study. They refer to the values that an indicator can take but says nothing about the indicator itself. The Likert items allowed for more granularities and hence more finely tuned responses were obtained from the respondents.

In this research project, reliability was enhanced by the Test Retest Technique. The same instrument was administered twice to the same group of subjects allowing a time lapse between the first test and second test. A reliability coefficient of 0.84 was obtained indicating

there was a high degree of reliability of the data used in this research project. The positive results of the test retest support the efforts made by the researcher and the design of the study to control for factors outside the control of the respondents.

To enhance reliability further, the researcher did not predetermine the respondentsô opinion or response or ask guided questions; and the questionnaire was crafted so that the questions are clear and precise and they cannot be interpreted in many different ways.

3.7 Data Analysis Techniques.

Data collected in this research project was analyzed using statistical tools in two different ways. Firstly, descriptive analysis of the data was done systematically by representing the data obtained as frequency and percentages in tables for each theme under study. Further, Inferential analysis, which refers to the statistical testing of research questions (theory testing), was done.

Raw data from the field survey was first prepared for analysis. This data was converted into a machine-readable, numeric format in a spreadsheet, so that they could be analyzed by computer program called SPSS. Data preparation followed the following steps.

First the data was coded. A codebook was created to guide the coding process. A codebook is a comprehensive document containing detailed description of each variable in a research study, items or measures for that variable, the format of each item, the response scale for each item, and how to code each value into a numeric format. In this study, we had a measurement item on a five-point Likert scale with anchors ranging from ñstrongly disagreeò to ñstrongly agreeò, we coded items as 1 for strongly disagree, 3 for neutral, and 5 for strongly agree, with intermediate anchors in between.

Coded data was then entered into a spreadsheet before entering directly into SPSS. It was better to enter data into a spreadsheet or database, where they could be re-organized as needed, shared across programs, and subsets of data can be extracted for analysis. The entered data was frequently checked for accuracy, via occasional spot checks on a set of items or observations, during and after entry. Furthermore, while entering data, the coder watched out for obvious evidence of bad data, such as the respondent selecting the ñstrongly agreeò response to all items irrespective of content, including reverse-coded items. When found, such data was entered but was excluded from subsequent analysis.

Missing data is an inevitable part of any empirical data set. Respondents did not answer certain questions if they found them ambiguously worded or too sensitive. During data entry, SPSS

automatically treated blank entries as missing and simply dropped the entire observation containing even a single missing value. Research data that was so prepared was then presented in tables representing the frequency and percentages of individual values for that variable. The researcher also tested the statistical significance of the means obtained from data for the separate four variables used in the study.

3.8 Ethical Issues.

The researcher assured the respondents on the confidentiality of information given by them. Respondents were informed of the purpose of the study. Information was collected from respondents with their consent and voluntarily. Further, Permission was also sought from the relevant authorities to allow collection of information from respondents.

3.9: Operationalization of Research Variables.

Operationalization is a process of defining the measurement of a phenomenon that is not directly measurable, though its existence is indicated by other phenomena. It is the process of defining a fuzzy concept so as to make the theoretical concept clearly distinguishable or measurable, and to understand it in terms of empirical observations. In this study, Indicators of the main variables under the study were identified in order to render the variables measurable.

Table 3.1: Operational Definition of Variables.

Objective	Variable	Indicator	Measurement Scale
Enquire influence of house extensions on public infrastructure asset management.	Uncontrolled House Extensions.	Frequency for water flow in the pipes. Frequency for electricity outages. No of House unit(s) extended from the main house unit.	Nominal
Determine influence of roadside informal, formal commercial activity on public infrastructure asset management.	Commercial activities along estate roads.	Quantity and type of solid waste along estate roads. Frequency of blockages of storm water channel.	Nominal
Consider influence of roadside light industrial activity on public infrastructure asset management.	Light industrial activities along estate roads.	Type of water connections. Type of electricity connections.	Nominal
Find out influence of new house types on public infrastructure asset management.	New house typologies.	Frequency of traffic jam on estate roads Population resident in the estate. Quantity on water and electricity assets used in the estate.	Nominal

Source: Author, 2015.

CHAPTER FOUR
DATA ANALYSIS, PRESENTATION, INTERPRETATION AND DISCUSSIONS.

4.1 Introduction.

The purpose of this research was to investigate the influence of informal developments in formally planned neighbourhoods on the way public infrastructure assets are managed in Buruburu estate. This Chapter presents an analysis of the data collected from questionnaires and interview schedules administered in Buruburu estate, Nairobi.

The Chapter also deals with presentation of results, which begins with description of the participants' bio-data. The research formulated for this study guided the arrangement of the tables. Each research question focuses on the variables identified (house extensions, street trading, jua kali activities and new house types as independent variables and management of public infrastructure assets as dependent or criterion variable). An analysis of the main findings on each aspect of enquiry follows and in addition and where relevant, selected findings from the personal data collected are used to inform and contrast the findings.

4.2 Response Rate.

The response rate is the proportion of the sample that participated in the research as intended in all research procedures. The study targeted the landlords, tenants and people who have set up various business activities within the estate. A total of 245 questionnaires were administered to the respondents from the target population in collecting data with regard to the influence of informalisation on management of public infrastructure assets in a planned neighbourhood of Buruburu estate, Nairobi County. The questionnaire return rate results are shown in Table 4.1.

Table 4.1:Response rate.

Response	Frequency	Percentage
Responded	211	86
Not Responded	34	14
Total	**245**	**100**

From the study 211 out of 245 target respondents filled in and returned the questionnaires contributing to 211(86%).This is a positive response rate. The reason for this could probably be that the elite, professionals and enlightened respondents were concentrated in the study

area and because of their literacy level they understand the importance of interview and administration of questionnaires and responded promptly.

The questionnaires that were not returned were due to reasons like; the respondents not being available to fill them in at the time and with persistent follow-ups there were no positive responses from them. The response rate demonstrates a willingness of the majority of the respondents to participate in the study.

4.3 Demographic Characteristics of the respondents.

The study mainly targeted heads of households, their spouses or business owner drawn from Buruburu estate, Nairobi County. As such the results on demographic characteristics of the respondents were investigated in the first section of the questionnaire. They are presented in the following sub-sections as age of respondents, level of education and occupation of the respondents.

4.3.1 Age of Respondents.

This study sought to investigate the composition of the respondents in terms of age to understand their familiarity with the influence of informalisation of planned neighbourhood on the management of public infrastructure assets in Buruburu estate. Table 4.2 shows the results of the findings on the age bracket of the respondents.

Table 4.2: Age of Respondents.

Age bracket	Frequency	Percentage
18-27	11	5
28-37	17	8
38-47	34	16
48-57	46	22
58-67	74	35
Above 67	29	14
Total	**211**	**100**

According to the results depicted in table 4.2, majority of the respondents 74 (35%) were aged between 58 and 67 years, 46(22%) of them were aged between 48 and 57 years, 34(16%) were aged between 38 and 47 years, 30(14 %) of them were aged above 67 years

while 17(8%) of the respondents were 28 and 37 years and 11(5%) of them were between 18 and 27 years old.

From these results it is clear that the respondents were well distributed in terms of age and hence can provide useful and relevant information on the influence of informal developments on the management of public infrastructure assets in the planned neighbourhood of Buruburu estate, Nairobi County.

4.3.2 Level of Education of the Respondents.

The level of education is a major indicator on the level of oneôs level of literacy and reliability of their opinions on the subject under study. In this study, the influence of informal developments on management of public infrastructure assets in Buruburu estate was investigated and education being an indicator of literacy becomes an important factor to investigate.

Table 4.3: Highest Formal Education of respondents.

Academic Qualifications	Frequency	Percentage
Secondary and below	40	19
College	55	26
University	89	42
Postgraduate	27	13
Total	**211**	**100**

The difference in the level of education might contribute to differences in the quality of responses in regard to reliability given by the respondents. This study therefore sought to investigate the education levels achieved by the respondents. The respondents on this question are depicted in table 4.3

The study results reveal that 89(42%) of the respondents had acquired University level of education, 55(26%) of the respondents indicated that they had acquired college level of education, 40(19 %) of the respondents had acquired secondary school level of education, while 27(13%) of the respondents had acquired postgraduate level of education. The results imply that majority of the respondents had at least a college and university level of education and hence his literacy level enables him to understand the information sought by the study.

The results further imply that all the respondents were literate and also familiar with the issues sought by the study and could be engaged in stemming the undesirable influence of

informalisation on the management of public infrastructure assets in Planned neighbourhoods.

4.3.3 Marital Status of the Respondents.

The target respondents are distributed in various age brackets hence their marital status are likely to be different. As such the research study sought to establish the marital status of these respondents since marital status or family responsibilities are factors that can influence one to engage in activities perceived as contributing to informalisation of the planned neighbourhood.

Table 4.4:Marital Status of the Respondents.

Marital Status	Frequency	Percentage
Single	40	19
Married	154	73
Others	17	8
Total	**211**	**100**

Majority of the respondents, comprising 154 (73%) indicated that they were married, 40 (19%) of the respondents were single, 17 (8%) of the respondents were other marital statuses like separated and widowed.

The findings imply that the respondents are mainly married or had been in a marriage relationship. Their statuses are an indication that they have financial responsibilities which to some extent may push them to seek additional income for their families.

However it is worth noting that a good proportion 40 (19%) of the respondents is single. These ones may have inherited the houses from their parents or are recently employed and staying in the extensions to the main houses. The results in general indicate that the people engaged in the process of informalisation of the planned neighbourhood are in various marital statuses.

4.3.4 Occupation of the Respondents.

The respondents were further required to indicate their occupations. This was in an effort to establish their economic statuses that could contribute to their ability and availability to engage in activities perceived as contributing to the informalisation of the planned neighbourhood.

Table 4.5:Occupation of respondents.

Occupation	Frequency	Percentage
College student	13	6
Employed	127	60
Self employed	53	25
Jobless	19	9
Total	**211**	**100**

According to the research results depicted in table 4.5, majority of the respondents were employed contributing127 (60%), 53(25%) of the respondents indicated that they were self employed, 19(9%) indicated they were jobless and 13(6%) of them indicated that they were college students.

This is an indication that there is a large population of the target population that was employed and thus had has an income to invest in an activity, such as a business, that could increase the family income. Further there is a significant population that is self employed and thus had the income and motivation to engage in creative activities to improve their financial position.

4.4 Influence of Uncontrolled development of House Extensions on the Management of Public Infrastructure Assets.

The study further sought to understand the proportion of house extensions in the planned neighbourhood. This was in an effort to establish their influence of house extensions on public infrastructure assets in the estate.

Table 4.6:Proportion of plots with extensions.

Plots	Frequency	Percentage
With extensions	139	66
Without extensions	72	34
Total	**211**	**100**

According to the Buruburu field study 139 (66%) of the plots have extensions and 72 (34%) do not have extensions. This could have been contributed due to housing demand from the increasing population, government withdrawal from housing provision, economic recession in the early and mid 1990s, and SAP (structural adjustment programme) programme in the

1990s among other reasons that necessitated the need for supplementary sources of incomes to be sought. Most house owners in Buruburu established house extensions next to the planned and authorized house thus improving their incomes. This shows the trend of houses moving from original plan to houses with extensions.

As a consequence of the occupation of the house extensions, the population of Buruburu has increased with no indication of additional amenities such as widening of circulation routes and water pipes among others.

The study further sought to understand the number of house extensions in each plot in the planned neighbourhood. This was in an effort to establish their extent of house extensions and by extension population densification in the estate. Population density has a bearing on pressure exerted on public infrastructure assets in the estate.

Table 4.7:Number of extensions within a plot.

Number of extensions	Frequency	Percentage
One extension	101	48
Two extensions	85	40
Three extensions	25	12
Total	**211**	**100**

The field research indicated that 101 (48%) of the respondents have one unit extension, 84 (40%) have two units extension while 25 (12%) have three units extension. The two units extension is mostly in one block taking the design of the main-house usually a marionette. The number of extension is dependent on the available space and the design of the main house.

In the residential house extensions a large number of the houses had more than four occupants. This can be attributed to the fact that the researcher observed that most of the housing extensions are occupied by young married couples or singles sharing while only a small number of the house extensions were occupied by the single dwellers.

With such a large number of the residents within the residential plots this increases the demand on infrastructure facilities and services in the estate. There is looming danger in overstretch demand on amenities if this is not controlled and regulated strategically, Quality of infrastructure service offering will deteriorate within a short period.

The study also sought to know the rent payable on house extensions in the planned neighbourhood. This was in an effort to establish the motivation for the uncontrolled growth of house extensions and by extension population densification in the estate. Financial motivation has a bearing on number of extensions and by extension the pressure on public infrastructure in the estate.

Table 4.8:Rent per month for an extension.

Rent per house extension	Frequency	Percentage
> 25,000	21	10
20,001-25,000	53	25
15,001 -20,000	93	44
<15,000	44	21
Total	**211**	**100**

The amount of rent charged for the extension house ranges Ksh. 10,000 - 25000.The majority of the residents 93 (44%) in the extension houses stated that they pay between Ksh. 15,001-20,000 as the monthly rent for the houses while 53 (25%) stated that the amount of rent paid for the houses was between Ksh. 20,001-25,000. The lowest amount of rent is paid for the single room units as the rent for such kind of houses is below 7500, this shows that the rents charged for the extension contributes a substantial amount of the money for the landlords in the estates. This may be one of the factors, which has contributed to the high number of the housing extensions in the estate.

The extensions in the neighbourhood are complete housing units with the number of bedrooms per housing extension ranging from between 1-3 rooms. According to the field survey 1, 2 and 3 roomed extensions were equally distributed in the estate. This shows that the demand for the three kind of housing is high in the estate and each of the units has its own kind of clientele.

The connection of water to the residential plots was found to through their own connection meter for 172 (70.2%) of the residents. These pay their own water costs separately from that charged to the other houses within the same plot. The tenants connected to the water meter supply to that of the other houses within the same residential plot were 73 (29.8%).

Table 4.9:Water connection method for house extensions.

Method of extension	Frequency	Percentage
Singly connected	148	70.2
Separately connected	63	29.8
Total	**211**	**100**

In such plots the bills for all the houses are paid from a common meter. The residents reported that there have been frequent cases of low water pressures especially evenings, morning and weekends. This could be explained by overstretch water supply by the current population. According to one of the respondents,

ñ *the level of service offered by the Nairobi Water and Sewerage Company is below expectations by their customers. Water flows in the pipes only one or two days a week as opposed to daily when we moved into these houses. This greatly inconveniences our family operations, especially those with young babies, and could lead to disease outbreak".*

The original water supply was meant to be for one family use but the number of families and sizes has increased. There has been no upgrading of water system since initial construction of the neighbourhood.

The system used for water supply is a circuit system. The quality of water provided in the estate was satisfactory according to majority of the residents of the estate. This water is provided by the Nairobi water and sewerage company and this shows that the company is performing a good job in ensuring the access to clean water by all the residents of the city. However, the frequency of water availability is not satisfactory to most of the respondents.

The field study shows that for the electricity connecting, the majority of the tenant residents has their own electric meters and therefore pays the bills separately. According to the field study this represented 148 (70.2%) of the respondents. The remaining residents (29.8%) are connected from the same supply as that of their landlords and the electricity costs are integrated with those of the rents charged.

A large number of the tenants in the estate use the electricity supply mainly for lighting of the housing and running of general electric equipment such as televisions and radios. A smaller number of the residents said that they used the electricity for mainly running other specialised

electric powered equipment and less for lighting and cooking. One of the respondents, reported that,

ñ*these days there are frequent power outages. Initially there was enough power to supply the estates' electricity needs, and blackouts were rare. In these days where households depend on electronic gadgets this situation of frequent and unpredictable outages is unacceptable".*

However, majority of residents interviewed indicated that they have been having frequent power blackouts, but this also happens to other neighbouring estates. This could be explained due to overstretched demand of the power supplied from KPLC.

Although the power provided within the household is three phase, it has a limit on how it can be used at a given time.

The residents of the estate are required to put their wastes in the provided collection bags which are then picked up by the garbage trucks. However the survey established that this form of waste collection was not appropriate as the households wastes are not sorted into the bio waste which results in the poor recycling or recovery of the wastes. The collection frequency for the wastes by the Nairobi city county and private companies is once a week.

The study shows that the estate relies mainly on the private waste collectors for the management of the domestic solid wastes. According to the survey the number of the households relying on the private waste collectors was 173(82%) while the rest of the residents relied on the collection services offered by the Nairobi city county.

This may show the failure of the county in the management of the solid waste from the estate which should be a key role for the councils. The Nairobi City County is involving public-private partnership in its delivering of service, but it has been slow in implementing this concept.

Table 4.10: Method of Solid Waste Collection.

Method of collection.	Frequency	Percentage
Private collection	173	82
Municipal collection	38	18
Total	**211**	**100**

The house extensions in the estate are seen as beneficial with regard to the provision of houses for the city residents. However according to 28.8% of the residents the extensions had lowered the quality of the estate since there was no Control of the persons occupying a rental house while the nature of the estate had been significantly changed by the extensions. Some of the residents also said that the extensions had led to the congestion and thus made the supply of water lower and the water pressures were lower especially in the pts where landlords had constructed more than on extension.

The respondents were required to indicate their perception as to how they thought house extensions in the estate influenced the management of public infrastructure assets. As such a scale of 1-5 was provided whereby 5 was strongly agree, 4 was Neutral, 3 was Agree, 2 was Disagree and 1 was Strongly disagree.

Table 4.11:Means, standard deviations for items on influence of house extensions on public infrastructure assets.

Responses on Influence of house extensions on public infrastructure.	strongly Disagree	Disagree	Neutral	Agree	strongly agree	Mean	std dev
Uncontrolled house extensions influence public water supply.	6.3	7.6	19.9	36.4	29.8	3.76	0.52
Uncontrolled house extensions have influence electricity supply management	1.7	11.2	18.9	32.1	36.1	3.79	0.61
Uncontrolled house extensions have influence solid waste management.	7.1	6.4	19.7	27.6	39.2	3.52	0.37
Uncontrolled house extensions influence public infrastructure assets	0.6	5.5	22.4	31.7	39.8	4.04	1.61
Uncontrolled house extensions influence road traffic congestion	1.4	0.8	24.0	33.2	40.6	4.14	1.31

From the study, majority of the respondents agreed that house extensions influences management of water infrastructure supply to residents as shown by a mean score of 3.76.A standard deviation of 0.52 against a mean of 3.76 shows a very narrow dispersion of responses. This shows there is a general agreement by respondents that house extensions influence the management of public water supply infrastructure assets.

Further the study showed that house extensions influenced the management of mains electricity supply infrastructure as shown by a mean of 3.52. A standard deviation of 0.43 against a mean of 3.52 shows a very narrow dispersion of respondentsô responses on whether uncontrolled house extensions influence management of mains electricity supply. This can be

interpreted to mean that the respondents largely agree that uncontrolled house extensions influence the management of mains electricity supply.

The study data shows that house extensions influenced the management of solid waste infrastructure assets as shown by a mean of 4.14. A standard deviation of 0.371 against a mean of 4.14 shows a very narrow dispersion of respondentsô responses on whether uncontrolled house extensions influence management of solid wastes in the estate. There is general agreement that house extensions influence management of solid waste management infrastructure assets in the estate.

With a mean of 3.90, the study also shows majority of the respondents agreed that house extensions influences the management of public infrastructure assets in the estate. A standard deviation of 1.61 against a mean of 3.90 shows a very narrow dispersion on respondentsô responses on whether uncontrolled house extensions influence public infrastructure assets in the estate. There is a general agreement from respondents that uncontrolled house extensions influence management of public infrastructure assets in the estate.

The study investigated whether house extensions collectively influenced public infrastructure assets. This was done through analysis of the Coefficient of determination. This measured the percentage of variation which changes in the management of public infrastructure assets could be explained by uncontrolled house extensions.

Table 4.12:Coefficient of Determination (R2) for relationship between House extensions and management of public infrastructure assets.

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	1.000[3]	1.000	0.948	3.45366

The analysis shows that the model is a good fit and is useful in predicting the influence of uncontrolled house extensions on public infrastructure as shown above. The results show that house extensions explain 94.8% of the challenges experienced in the management of public infrastructure in planned neighbourhoods.

The study further sought to investigate the extent to which the variables separately and individually influenced the management of public infrastructure assets.

Table 4.13:Correlation Analysis of extent to which individual variables measuring uncontrolled house extensions influence on the management of public infrastructure assets.

	House extensions affect water supply to residents	House extensions affect electric supply to residents	House extensions affect solid waste waste management	House extensions affect public infrastructure	House extensions affect road traffic congestion.
House extensions affect water supply to residents	1 5	0.971** 0.006 5	0.965** 0.008 5	0.956* 0.011 5	0.960** 0.010 5
House extensions affect electricity supply to residents.	0.971* 0.006 5	1 5	0.890* 0.043 5	0.994** 0.000 5	0.988** 0.002 5
House extensions affect solid waste management	0.965** 0.008 5	0.890* 0.043 5	1 5	0.853 0.66 5	0.854 0.066 5
House extensions affect public infrastructure.	0.956* 0.011 5	0.994* 0.000 5	0.853 0.066 5	1 5	0.998** 0.000 5
House extensions affect public road congestion.	0.960** 0.010 5	0.988** 0.002 5	0.854 0.066 5	0.998 0.000 5	1 5

** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed)

The analysis indicates that there is a correlation of 0.994 for the effect of house extensions on electricity supply infrastructure to residents (r=0.994, p-value= 0.956).The reported correlation was statistically significant. The closer the r coefficient approaches ±1, regardless of the direction, the stronger is the existing association indicating a more linear relationship between the two variables.

This implies that as the number of house extensions increase, the demand on electricity infrastructure assets increases in tandem. This further means that if the public electricity supply infrastructure assets do not expand as fast as the increase in number of house extensions, there will be challenges experienced in the quality of public electricity supply. This may explain the frequent power outages reported by respondents earlier in the study.

The analysis indicates that there is a correlation of 0.956 for the effect of house extensions on water supply infrastructure to residents (r=0.956, p-value= 0.011).The reported correlation was statistically significant. This is to say that the influence of house extensions is felt in the management of public water infrastructure assets. The r coefficient is close to ±1 indicating a strong association between the two variables.

This implies that as the number of house extensions increase, the demand on public water supply infrastructure assets increases in tandem. This further means that if the public water

supply infrastructure assets do not increase as fast as the increase in house extensions, there will be challenges experienced in the quality of public water supply. This may explain the frequent dry taps reported by respondents earlier in the study.

4.5 Influence of the Proliferation of Commercial Activities along estate roads on the Management of Public Infrastructure Assets.

The study revealed that street trading activities which influence management of public infrastructure assets include activities such as; restaurants, 32 (15.2%); Groceries/vegetables/ fruit seller, 75 (35.6%); boutique/ second hand clothes seller, 66 (31.2%); Entertainment/ DVD / Movie Library, 38 (18.0%).

Table 4.14:Types of trading activities along estate roads.

Street trading activity.	Frequency	Percentage
Restaurant/cake shop	32	15.2
Groceries/Vegetables/fruit seller	75	35.6
Boutique/Second hand clothes	66	31.2
Entertainment/ DVD/Movie Library	38	18
Total	**211**	**100**

The street trading activities are closely related to the types of waste so generated as follow: papers only, 42(20.1%); organic waste, 25(11.7%); polythene/nylon only, 92(43.6%); polythene/nylon and paper, 38(17.9%); hair 14(6.7%).

Table 15:Types of waste generated by street trading.

Type of waste generated.	Frequency	Percentage
Paper only	42	20.1
Organic waste	25	11.7
Polythene/Nylon only	92	43.6
Polythene/Nylon and Paper	38	17.9
Hair	14	6.7
Total	**211**	**100**

This study also reveals the disposal methods of these wastes by the street traders as follows: burning, 51(24.5%); refuse collector, 86(40.8%); dump on road/drainage channel 53(25.3%); refuse dumps elsewhere, 20(9.4%). This clearly shows that street trading activities have

negative impact on the urban cleanliness quality and should be a concern in the environmental management.

Table 16:Method of disposal for waste generated from street trading.

Method of disposal.	Frequency	Percentage
Burning	52	24.5
Refuse collector	86	40.8
Dump on road/Drainage channel	53	25.3
Refuse dumps elsewhere	20	9.4
Total	**211**	**100**

One of the respondents, complained that,

ñ*these road side kiosks generate so much waste than that which is generated in the homes. Initially when the estate was new and we didn't have the roadside businesses, City council cleaners could sweep and the trucks used to collect all the solid waste. Even though the wares they sell are needed in the homes, the contribution of roadside business activities to general littering is unacceptable".*

This clearly shows that street trading activities have negative impact on the public cleanliness quality and public environmental infrastructure management. Drainage channels are blocked leading to unwarranted floods, low life span of tarred roads because of the affected drainage and worst still, urban roads turned into street markets are littered with heaps of waste after heavy downpours being/ transported by run-off water.

Access to social amenities by street traders at the trading points was also investigated by the study. 77(36.9%) had access to pipe borne water, 134(63.1%) had no access to pipe borne water. Furthermore, 135(64.2%) had access to electricity supply, 76(34.6%) had no access to electricity supply.

Table 4.17:Amenities available at street trading points.

Amenity available at street trading points.	Frequency	Percentage
Pipe borne water	77	36.7
Non pipe borne water	134	63.3
Total	**211**	**100**

Generally, the electricity supplies to those who have access to it have been acquired illegally being connected from nearby residential supply. In this way, the street traders are not paying commercial bills if they ever pay on the use of public social amenities. The same also applies to water supply which was primarily planned for the adjacent residential or institutional neighbourhoods.

The problem of inaccessibility at street trading points is encapsulated and manifested in busy and heavy traffic volumes that lead to congestion of the streets. Table 4.18 shows the incidence of congestion at the trading points due to incompatible vehicular, trading, pedestrian and cyclistsô activities. This could be as a result of increase of population and number of vehicles on the roads which have not been expanded since initial construction.

A middle aged responded that,

ñ*these road side kiosks are constructed on road reserves that are meant for road expansion and pedestrian walkways. Pedestrians now have to walk on the roads because kiosks have blocked the walkways, forcing motorists to slow down to avoid knocking them down. As the road space is effectively reduced by roadside businesses, the kiosks have contributed to motor accidents and traffic jams in Buruburu".*

Table 4.18:Congestion at street trading points.

Incidence of congestion at street trading Point.	**Frequency**	**Percentage**
Experienced congestion once	20	9.5
Experienced congestion frequently	134	63.3
Experienced congestion occasionally	45	21.8
Never experienced congestion	12	5.6
Total	**211**	**100**

These patterns of incidences of congestion at street trading points and their streetscapes clearly demonstrates the inconvenience residents and street traders are exposed to on daily basis which calls for proactive interventions of the road infrastructure management agencies in Nairobi.

The respondents were required to indicate their perception as to how they thought commercial activity along estate roads influenced the management of public infrastructure

assets. As such a scale of 1-5 was provided whereby 5 was strongly agree, 4 was Agree, 3 was Neutral, 2 was Disagree and 1 was Strongly disagree.

Table 4.19: Means, standard deviations for items on Influence of street trading on management of public infrastructure assets.

Perception on Influence of street Trading on public infrastructure.	strongly Disagree	Disagree	Neutral	Agree	strongly agree	Mean	std dev
Commercial activities on estate roads influence public infrastructure.	3.7	8.8	19.5	36.1	31.9	3.84	0.52
Commercial activities on estate roads influence solid waste management	5.7	7.3	18.9	38.6	29.5	3.79	0.61
Commercial activities on estate roads influence blockage of storm water drains	2.4	5.1	20.2	33.9	38.4	4.01	0.32
Commercial activities on estate roads contribute to dumping of waste in drains	1.7	4.1	24.4	39.5	30.3	3.93	1.25

From the study, majority of the respondents agreed that street trading influences management of public infrastructure assets in the estate as shown by a mean score of 3.84. A standard deviation of 0.51 against a mean of 3.84 is within the limit and we can conclude that there is a close correlation between street trading and challenges experienced in management of public infrastructure assets. There is therefore a general agreement from respondents that street trading influence management of public infrastructure assets in the estate.

The standard deviation helps in ascertaining as to how much the regression equation is a description of the average relationship between two variables. The smaller the value of standard deviation the better is the fit of the given data. If the standard deviation is zero there is a perfect match and it is a case of perfect correlation.

Further the study confirmed that commercial activity along estate roads influenced the management of solid waste infrastructure as shown by a mean of 3.79. A standard deviation of 0.61 against a mean of 3.79 is within the limits and we can conclude that there is a close correlation between street trading and influences the management of public infrastructure assets. There is therefore a general agreement from respondents that street trading influence management of solid waste infrastructure assets in the estate.

Respondents agree that it street trading influenced the blockage of storm water channels on estate roads as shown by a mean of 4.01. A standard deviation of 0.61 represents a small dispersion of responses (0.61%) and we can conclude that there is a positive correlation

between street trading and challenges experienced in management of storm water infrastructure assets along roads in the estate.

With a mean of 3.93, the study also shows majority of the respondents agreed that commercial activity along estate roads encourages illegal connections for water and electricity infrastructure thereby making its management more difficult. A standard deviation of 1.25 against a mean of 3.93 is fairly close to zero and we can conclude that there is a fairly close correlation between street trading and challenges experienced in management of water and electricity infrastructure assets in the estate.

The study investigated whether commercial activities along estate roads collectively influenced public infrastructure assets. This was done through analysis of the Coefficient of determination. This measured the percentage of variation which changes in the management of public infrastructure assets could be explained by proliferation of commercial activities along estate roads.

Table 4.20: Coefficient of Determination (R2) of relationship between street trading and management of public infrastructure assets.

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	1.000[3]	0.909	0.907	4.045384

The results show that the model is a good fit and is useful in predicting the influence of commercial activities along estate roads on public infrastructure. It indicates that the factors used to investigate the influence of street trading on management of public infrastructure assets have very close association with the variable.

The results show that respondents think that commercial activities along estate roads explain 90.7% of the challenges experienced in the management of public infrastructure in Buruburu planned neighbourhood.

Correlation analysis is a statistical test used to determine mathematically whether there are trends or relationships between commercial activities along estate roads and management of public infrastructure assets. The tests provide a statistical yes or no as to whether a significant relationship or correlation exists between the independent and dependent variables.

The entry or criterion is selected according to the number of items or data pairs in the set. If the coefficient is greater than or equal to the selected criterion, then there is a significant correlation or relationship between the two data sets

The correlation analysis for street trading activities indicates that the correlation in respect of solid waste management (r=0.994, p-value= 0.001). Thus, street trading activities have a very high and significant correlation with waste management and therefore influence management of solid waste infrastructure assets. The r-value implies that as street trading activities along estate roads increase the management challenges for solid waste collection increases.

This may explain the high rate of private collection of solid waste reported by respondents earlier in the study, as a pointer to public waste collection agencies being unable to expand their operations in tandem to cope with the additional solid waste load occasioned by street trading activities. Some of the roadside traders do not cope with payments for the private collectors and opt to dispose of the waste themselves. Unfortunately they often resort to dumping the waste under culverts on storm water drains. They do not appreciate the potential disadvantages of this kind of disposal.

Table 4.35:Correlations for commercial activity along estate roads and management of public infrastructure assets.

	commercial activities affect public infrastructure management	commercial activities affect solid waste management	commercial activities affect storm water management	commercial activities affect informal water/ electricity management
Commercial activities affect Public infrastructure assets	1 5	0.994** 0.001 5	0.985** 0.002 5	0.988** 0.001 5
Commercial activities affect solid waste infrastructure asset management.	0.994** 0.001 5	1 5	0.961* 0.009 5	0.994** 0.001 5
Commercial activities affect storm water infrastructure assets management	0.985** 0.002 5	0.961* 0.009 5	1 5	0.957 0.10 5
Commercial activities affect Water / electricity Infrastructure assets.	0.988** 0.001 5	0.994* 0.001 5	0.954 0.010 5	1 5

** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed)

Further the analysis indicates that there is a correlation of 0.985 for the effect of street trading on storm water infrastructure on estate roads (r=0.985, p-value= 0.002).The reported

correlation was statistically significant. This is to say that the influence of street trading is felt in the management of public storm water infrastructure assets. The r coefficient is close to ±1 indicating a strong association between the two variables.

This implies that as the number of street trading points increase, the challenges in management on public storm water infrastructure assets increases in tandem. This further means that if the public storm water infrastructure assets do not increase as fast as the increase in street trading points, there will be challenges experienced in the quality of public storm water management. This may explain the frequent storm water overflows whenever it rains reported by respondents earlier in the study.

4.6 Influence of Light manufacturing activities along estate roads on Management of Public Infrastructure Assets.

Various types of light manufacturing activities are present along the streets of Buruburu estate. This is summarised in Table 4.22 of light manufacturing activities from the study.

Table 4.22: Types of light manufacturing activity along estate roads.

Type of light industrial activity	Frequency	Percentage
Carpentry	62	29.2
Garage/Vehicle repair	82	38.7
Metal fabricators	47	22.6
Food processing/Baking	20	9.5
Total	**211**	**100**

High in the incidence of light industrial activities along estate streets on major essentials of urban life are food processing, 20(9.5%); metal fabrication, 48(22.6%); Garage/Vehicle repair, 82(38.7%); Carpentry stores, 72(29.2%; This pattern supports their middle income preferential requirement of mobility and investment in the hierarchy of human needs even though food is also very important, this being an residential estate.

One respondent said that,

ñI observe that *these jua kali places mostly are located on the road reserve. The rate of their establishment doesn't seem to be coordinated. A local leader is said to be the one encouraging youth to establish the businesses on the road reserve. City hall does not evict*

them either. However, I don't sense that there is coordination between City Hall, local leadership and utility service providers such as KPLC and NAWASCO".

Data from the study reveals the type of wastes from the light industrial activity along estate streets. The light manufacturing activities are closely related to the types of waste so generated as follow: saw dust, 37(17.3%); oil waste, 44(20.7%); metal waste, 39(18.5%); rubber waste 20(9.4) and polythene/ paper, 72(34.1%).

Table 4.23: Types of waste generated by light industrial activity along estate roads.

Type of waste generated.	Frequency	Percentage
Saw dust waste	36	17.3
Oil waste	44	20.7
Pieces of metal only	39	18.5
Rubber (car tyres) waste	20	9.4
Polythene and paper waste.	72	34.1
Total	**211**	**100**

This list of waste shows that light industrial activities on estate roads produce waste that is significantly different from the waste ordinarily produced in residential homes, which is what Buruburu estate was planned for. Disposal of light industrial waste is significantly different from disposal of domestic waste. Environmental management agencies in the city should adjust their management strategies to accommodate these wastes.

This study also reveals the disposal methods of wastes produced by the light manufacturing establishments as follows: burning, 67(27.5%); refuse collector, 78(31.9%); dump on road/drainage channel 87(35.4%); refuse dumps elsewhere, 13(5.2%).

Table 4.24:Method of waste disposal around light industrial activity points.

Method of disposal	Frequency	Percentage
Burning	58	27.5
Refuse Collector	67	31.9
Dump on road/drainage channel	75	35.4
Refuse dumps elsewhere	11	5.2
Total	**211**	**100**

Burning as a waste disposal method used for industrial waste, such as car tyres, is really noxious to the environment and residents comfort is hugely compromised. Environmental

management infrastructure and agencies in Nairobi are really compromised professionally to allow this practice in a middle income planned neighbourhood like Buruburu estate.
This shows that light industrial activities on estate roads have negative impact on the urban cleanliness quality and should be a concern in the environmental management agencies in the city. Further it clearly shows that commercial activities along estate streets have negative impact on the urban environmental quality and environmental infrastructure assets management.

Drainage channels are blocked leading to unwarranted floods, low life span of tarred roads because of the affected drainage and worst still, urban roads reserves have been turned into light manufacturing zones that are littered with heaps of waste after heavy downpours being/ transported by run-off water.

The respondents were required to indicate their perception as to how they thought light industrial activity along estate roads influenced the management of public infrastructure assets. As such a scale of 1-5 was provided whereby 5 was strongly agree, 4 was Agree, 3 was Neutral, 2 was Disagree and 1 was Strongly disagree.

Table 4.25:Means, standard deviations for items on influence of light industrial activity on management of public infrastructure assets.

Responses on Influence of light industry on public infrastructure.	strongly Disagree	Disagree	Neutral	Agree	strongly agree	Mean	std dev
Light industrial activity on estate roads influence public infrastructure assets.	3.4	5.7	19.1	34.6	37.2	3.97	0.85
Light industrial activity on estate roads influence public energy management	2.7	4.2	14.9	37.6	40.6	4.09	0.37
Light industrial activity on estate roads influence solid waste management.	9.3	11.6	18.1	35.2	25.8	3.57	0.24
Light industrial activity on estate roads influence public water supply management	3.9	4.2	32.4	31.8	27.7	3.75	0.45

From the study, majority of the respondents agreed that light industrial activity along estate roads influences management of water infrastructure with illegal water connections as shown by a mean score of 3.97. A standard deviation of 0.85 is a small dispersion about a mean of 3.97 and we can conclude that there is a close correlation between light industrial activity along estate roads and challenges experienced in management of public infrastructure assets.

Further the study showed that light industrial activity along estate roads influenced the management of solid waste infrastructure as shown by a mean of 3.57. A standard deviation of 0.24 is within the limits and leads us to conclude that there is a close correlation between light industrial activity along estate roads and challenges experienced in management of solid waste infrastructure assets in the estate.

Further, the study confirms that light industrial activity influenced the illegal water connections on estate roads as shown by a mean of 3.75. A standard deviation of 0.45 indicates a small dispersion about the mean and leads us to conclude that there is a close correlation between light industrial activity along estate roads and challenges experienced in management of public water supply infrastructure assets in the estate.

With a mean of 4.09, the study also shows majority of the respondents agreed that light industrial activity along estate roads encourages illegal connections for electricity infrastructure thereby making its management more difficult. A standard deviation of 0.37 is small dispersion about the mean and leads us to conclude that there is a close correlation between light industrial activity along estate roads and challenges experienced in management of mains electricity infrastructure assets in the estate.

A respondent said,

ñ*these jua kali places along the road may be helping the owners earn a much needed income. However they are unsightly and contribute to aesthetic degradation of the estate. They operate from road reserves. I don't know why city hall licences them to operate from public land intended for public amenities!"*

Coefficient of determination explains the extent to which changes in the dependent variable (Management of public infrastructure assets) can be explained by the change in the independent variable (uncontrolled house extensions).

Table 4.26: Coefficient of determination of relationship between Light Industrial activities along estate roads and management of public infrastructure assets.

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	1.000[3]	1.000	0.899	2.92202

In this case, the model is a good fit and is useful in predicting the influence of light industrial activity on public infrastructure as shown above. It indicates that the factors used to investigate the influence of light industrial activities along estate roads on management of public infrastructure assets have very close association with the variable.

The results show that respondents think that light industrial activities along estate roads explain 89.9% of the challenges experienced in the management of public infrastructure in Buruburu planned neighbourhood as represented by R^2.

Correlation analysis for light industrial activities along estate roads are statistical tests to determine mathematically whether there are trends or relationships between light industrial activities along estate roads and management of public infrastructure assets. The tests provide a statistical yes or no as to whether a significant relationship or correlation exists between the variables.

Table 4.27: Summary statistics of Regression of light industrial activity and management of public infrastructure assets.

Model	Unstandardised coefficients		Standardised coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	3.382	2.460		1.375	0.400
Light industrial activity influence demand for electrical energy.	0.805	0.056	0.904	14.301	0.044
Light industrial activity influence Solid waste management.	-0.125	0.099	-0.094	-1.265	0.426
Light industrial activity influence Water supply management.	0.252	0.061	0.203	4.112	0.152

Dependent Variable: Jua kali activities influence public infrastructure asset management.

Of the regression variables, the most significant in the model is the illegal electricity connections with a p-value of 0.044. The other variables are not as significant.

4.7 Influence of Emergence of New Housing Typologies in Planned neighbourhood on the Management of Public Infrastructure Assets.

From archival investigation the study established that Buruburu neighbourhood was designed to have maisonettes and bungalow typologies only. All the five phases have both houses typologies. According to the Buruburu development plan, the number of maisonettes was 3520 and bungalow 2830 making a total of 6350 houses. The houses were designed for family occupation of mean size of five members.

From the study the maisonettes mostly have three bedrooms and one sitting room. The bungalows were designed to have three rooms comprising of two bedrooms and a sitting room. The original design targeted one family for each plot, but the study revealed that now more than one family live in a plot.

The field study also shows that that the majority of the houses in the neighbourhood have four dwelling units which include; the living room, and the bedrooms. This implies that three bed roomed houses are the majority in the neighbourhood. These houses are the original or the initial houses which had been constructed for sale by to the residents of the estate. The remaining housing units have less than four dwelling units and these are the housing extensions which have been constructed in the estate.

Table 4.28: New Housing typologies in the planned neighbourhood.

New housing typologies.	Frequency	Percentage
Multi storey flats	175	83
Entertainment	25	12
Church	10	4.6
Petrol station.	1	0.4
Total	**211**	**100**

This study also reveals that of the emerging new typologies, Residential flats (concentrated around shopping centre) are the most popular at a score of 83% while entertainment and refreshment establishments are next with a score of 12%.This may be explained by the desire for additional revenues for the landlords. Churches stand at 4% while there is one petrol station in the estate.

A respondent who has stayed in Buruburu estate since the 70s said that,

ñ*There were no flats in Buruburu when we bought these houses. Now people with influence are converting their plots to apartment blocks for the potential income. Flats have increased the population in the estate significantly. Now water usage, sewer line usage and electricity usage is so increased. As the flats in the estate increase, the quality of these services gets poorer in Buruburu".*

The respondents were required to indicate their perception as to how they thought light industrial activity along estate roads influenced the management of public infrastructure assets. A scale of 1-5 was provided whereby 5 was strongly agree, 4 was Agree, 3 was Neutral, 2 -Disagree and 1 was Strongly disagree.

Table 19: Means, standard deviations for items on influence of New house types on management of public infrastructure assets.

Responses on Influence of new House typologies on infrastructure.	strongly Disagree	Disagree	Neutral	Agree	strongly agree	Mean	std dev
Influence of new house typologies on demand for water supply assets.	5.6	8.3	15.4	31.8	38.9	3.90	0.23
Influence of new house typologies on demand for water supply assets.	4.2	7.6	14.9	32.6	40.7	3.98	0.98
Influence of new house typologies on Road traffic congestion.	1.4	8.7	15.1	35.2	39.6	4.03	0.44
Influence of new house typologies on management of public infrastructure.	6.6	9.5	17.4	29.1	37.4	3.81	0.32

From the study, majority of the respondents agreed that new house typologies influences management of water infrastructure with increased demand as shown by a mean score of 3.90. A standard deviation of 0.23 is a small dispersion about a mean of 3.90 and we can conclude that there is a close correlation between new house typologies and challenges experienced in management of public infrastructure assets.

Further the study showed that new house typologies influenced the demand for increased electricity energy infrastructure as shown by a mean of 3.98. A standard deviation of 0.98 is close to zero and leads us to conclude that there is a close correlation between new housing typologies and challenges experienced in management of demand for increased electricity energy infrastructure assets in the estate.

The study also confirms that light new house types influenced the number of vehicles using estate roads as shown by a mean of 4.03. A standard deviation of 0.44 indicates a small dispersion about the zero and leads us to conclude that there is a close correlation between

new house typologies and challenges experienced in management of public road infrastructure assets in the estate.

With a mean of 3.81, the study also shows majority of the respondents agreed that new house types influences the management of public infrastructure assets in the estate. A standard deviation of 0.32 is small dispersion about the zero and leads us to conclude that there is a close correlation between new house types and challenges experienced in management of public infrastructure assets in the estate.

The Coefficient of determination explains the extent to which changes in the dependent variable (Management of public infrastructure assets) can be explained by the change in the independent variables (emergence of new house types).

Table 20: Coefficient of determination of relationship between new housing typologies and management of public infrastructure assets.

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.999[a]	0.867	0.994	5.7269

The multiple correlation (shown as R) is the correlation coefficient. The R square is the coefficient of determination. The adjusted R Square gives the ñunbiasedò value of the coefficient of determination and is the one to be used in comparing how useful a model is.

In this case, the model is found to be a good fit and is useful in predicting the influence of new house typologies on public infrastructure as shown above. It indicates that the factors used to investigate the influence of new house typologies on management of public infrastructure assets have very close association with the variable.

The results show that respondents think that new house typologies explain 86.7% of the challenges experienced in the management of public infrastructure in Buruburu planned neighbourhood as represented by R^2.

Table 21: Summary of statistics of Regression analysis of relationship between New Housing typologies and management of public infrastructure assets.

Model	Unstandardised coefficients		Standardised coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	6.483	3.754		1.727	0.226
New house types influence demand for electricity	1.186	0.473	1.343	2.506	0.129
New house types influence road traffic congestion.	-0.305	0.474	-0.346	-0.645	0.585

The positive sign for demand for electricity coefficient (1.186) indicate that as the number of house types increases the demand for electric energy increase. The negative sign for vehicles (-0.305) indicate that as new house types increase challenges in the management of public roads infrastructure assets worsens.

Table 22: Correlations of the significance of relationship between new house types and management of Public Infrastructure assets.

	New house Types affect public water infrastructure management	New house types affect public electricity supply infrastructure management	new house types influence public road traffic congestion management	new house types influence the management of public infrastructure assets.
New house types influence demand for Public water infrastructre assets.	1 5	1.000** 0.000 5	0.998** 0.000 5	0.998** 0.000 5
New house types influence demand for public electricity infrastructure asset management.	1.000** 5	1 0.000 5	0.997* 0.000 5	0.998** 0.000 5
New house types influence Public road traffic congestion management	0.998** 0.000 5	0.997* 0.000 5	1 5	0.994 0.001 5
New house types influence Management of public Infrastructure assets.	0.998** 0.000 5	0.998* 0.000 5	0.994 0.001 5	1 05

** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed)

The correlation analysis for new house typologies indicates that the correlation in respect of management of public infrastructure is r=0.998, with a p-value= 0.000. Thus, new house typologies have a significant association with public infrastructure assets and therefore influence management of public electricity infrastructure assets. The r-value implies that as new house typologies increase the management challenges for public infrastructure increases.

Further, the analysis for new house typologies indicates that the correlation in respect of number of vehicles using estate roads is r=0.998, with a p-value= 0.000. Thus, new house typologies have a significant association with number of vehicles using estate roads and therefore influence management of public road infrastructure assets. The r-value implies that as new house typologies increase the management challenges for public road infrastructure increases.

4.8 Discussion of Findings.

This study was interested in examining the influence exerted by informalisation of planned neighbourhoods on the management of public infrastructure assets in Buruburu estate, Nairobi, Kenya.

4.8.1 General Discussion of Findings.

From the analysis of the findings, it is evident that informalisation of planned neighbourhoods influences the way public infrastructure assets are managed. Informalisation is a product both of the laxity of the development control authorities and the residentsô desire to draw benefits from their properties as they use them. This is in agreement with Turner (1976) who held that residents should benefit from their properties.

The activities that residents engage in which constitute informalisation in the planned neighbourhoods such as constructing extensions, engaging in commercial activities and building high rise apartments is evidence of the desire by residents to derive benefits from their neighbourhoods. It is also evident that the informal developments by residents are characterised by makeshift developments. These study findings are supported by Rweyemamu et al (2013) in his study, *Architectural Perspectives on Informalisation of Formal Settlements: Case of Sinza Neighbourhood in Dar es Salaam*. His study finds that residents engage in informalisation as a source of livelihood for the household.

The study further found that informalisations in Buruburu estate are all generally related with income generation motive in complete disregard to other neighbourhood planning considerations. Residents see the beauty of their neighbourhood through the ability of such a neighbourhood to adjust and accommodate their familiesô needs for shelter as well as their desire to participate in the informal economy reflecting current socio-economic realities prevailing in the wider society. In this perception houses and their surrounding spaces are as objects to live in and to live on, rather than being mere objects of aesthetic interest. These empirical findings are also supported by Turnerôs (1972) in *Freedom to Build, dweller control of the housing proces*s. In this seminal study Turner focuses on what is a state of a

house, what it does and to whom? His study finds that how people benefit from their properties determines how they shape and use them.

4.8.2 Informalisation of Planned Neighbourhood by Uncontrolled development of House extensions Influences Public Infrastructure Asset Management.

The study found that uncontrolled construction of house extensions in the planned neighbourhood influences the management of public infrastructure assets. The pattern of construction of house extensions is mainly dictated by everyday social and economic needs. Extension of houses is also necessitated as the children become adults and got married and stay within the same premises. This is also supported by Winter and Morris (1996) theory on housing adjustment. They argue that a householdôs preferred change behavior is predicated on overcoming any constraints that impose on the householdôs ability to remedy the situation. A household may experience constraint in the number of bedrooms and may seek to offset the deficit through construction of an extension to the planned house.

4.8.3 Informalisation of Planned Neighbourhood by Proliferation of formal and informal commercial activities Influences Public Infrastructure Asset Management.

The study found that single dwelling residential spaces, public open spaces and road reserves had been transformed progressively to accommodate commercial spaces as well light industry within a middle income neighbourhood demonstrates a planning spirit which focuses on the fulfillment of the immediate socio-economic needs. All the informalisation activities have a very active participation of residents and grass root leaders. However we do not find a matching degree of involvement by residents in the management of public infrastructure assets.

These empirical findings are in agreement with Too (2009) whose findings in the study, *capabilities for strategic infrastructure management,* state that stakeholder connectivity is important in developing the ability of infrastructure asset to adjust in response to changing demand. Where all stakeholders are not sufficiently engaged in management of infrastructure assets, the residents tend to pursue goals that may have negative influences on the capabilities of infrastructure assets.

4.8.4 Informalisation of planned neighbourhood by the emergence of new building typologies influences the management of public infrastructure assets.

The study found that informalisations in a planned neighbourhood take the form of emergent preference by developers to construct high density flats. The locations affected are around the commercial centre and along the spine road. The development of high density flats is not accommodated in the approved neighbourhood plan for Buruburu estate. The fact that these developments are emerging informally points to the possibility that neighbourhood planners did not anticipate residentsô real needs at the planning stage.

The seeming inevitability of informalisation as supported by the case studied should form a strong basis for mainstreaming the residentsô involvement in neighbourhood planning and development control authorities. Neighbourhood planning proposals should envisage growth initiated informally by the residents. This should take cognisance of the likely infrastructure expansion demands for the likely population.

Conventional neighbourhood planning is concerned with ordering the use of land and the character and siting of buildings and communicative routes, primarily deals with land. However, residents are often more concerned with economic and social aspects of their neighbourhood planning than the aesthetic aspects often pursued in conventional planning.

These findings are confirmed by Makachia (2012) in his study, *Design strategy and informal transformations in urban housing*. Makachia argues that, neighbourhood planning proposals should envisage growth initiated by the residents. Makachia posits that a design strategy that is responsive to the varied objectives of economy, social and physical spatial demands of housing should inform concepts in neighbourhood planning.

CHAPTER FIVE:
SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS.

5.1 Introduction.

The attempt in this Chapter is to draw inferences from the data analysis and elucidate the findings using a format that is constructive and beneficial for policy implementations. This is followed by recommendations and concluding comments, while attempt is also made towards identifying opportunities for future research.

5.2 Summary of Findings.

A number of findings were made from data analysis, this are highlighted as follows: Firstly the study found that uncontrolled house extensions influence the management of public infrastructure assets in Buruburu estate. A majority of respondents (66%) indicated that they had house extensions in their plots. The respondents agreed that the uncontrolled house extensions had a great influence on the infrastructure assets in the estate and the way they are managed. Analysis of data indicated that uncontrolled development of house extensions explain 94.8% of the management challenges experienced in public infrastructure assets. Uncontrolled development of house extensions was largely driven by a financial motive and had little regard for the effects on public infrastructure assets.

Respondents in the research agree that house extensions encouraged illegal water connections or shared a water meter with the main house. A shared water meter between two or more distinct users represents a challenge to monitoring an individualôs demand for public water supply assets. Similarly a significant number of the house extensions shared a meter for electricity supply. KPLC generally supply separate meters for distinct individual users and the sharing may indicate that the connection was done without involvement of the Utility Company.

The study also established that uncontrolled house extensions influenced the increased number of vehicles using public road infrastructure assets in the estate. This they explained to be as a result of an increase in population occupying the additional house units availed by the house extensions.

The research also found that the majority of respondents agree that a proliferation of commercial activities along estate roads influence the management of public infrastructure assets. The respondents agreed that the nature of wastes generated by the commercial

activities along estate roads and the manner in which the waste is disposed contributed to (mis)management of public infrastructure in the estate. Further majority of the respondents (72.6%) agree that the commercial activities along estate roads influence the congestion of estate roads. This could be due to use of pedestrian walkways for kiosks and motorists slowing down, parking on the sidewalk to buy, thereby narrowing the road and causing a traffic jam.

Analysis of data from the study indicates that the respondents agree (99.7%) that indeed light industrial activity along estate roads influence the management of public infrastructure assets in the estate. Respondents agree that Illegal water connections and illegal electricity connections are prominent contributors to the (mis)management of the public infrastructure assets. The researcher observed that the light industrial activities are located on the road reserves and water and electricity utilities cannot legally connect the establishments. Respondents indicated that for them to function properly the light manufacturing establishments must have water and electricity connections.

Lastly the research established that new house typologies influence the management of public infrastructure assets. The research identified the most influential new house typologies on public infrastructure assets as multi storey flats (83%), Restaurant cum entertainment joints (12%), churches and a petrol station. Respondents indicated that the new house types influenced the increased demand for public water supply infrastructure assets. Similarly, Respondents agreed that the new house types influenced the increased demand for public electricity infrastructure assets. Respondents also indicated that the new house types contributed to an increase in the number of vehicles using public road infrastructure in the estate.

5.3 Conclusions from the study.

The study concludes that informalisation of planned neighbourhood influences the management of public infrastructure assets in the housing estate. Various forms of informalisation such as uncontrolled house extensions, proliferation of commercial activities along estate roads, new house types and Jua kali activities along estate roads were identified as influencing the management of public infrastructure assets in planned neighbourhoods.

The respondents who participated in this study are residents and traders in Buruburu. They experience the challenges to public infrastructure experienced in the estate. The public infrastructure assets that were greatly challenged include public water supply infrastructure, public electricity supply infrastructure and public road transport infrastructure.

The study further concludes that informalisation of planned neighbourhoods is a product of the laxity of the development control authorities in Nairobi and the residentsô unawareness of the negative influences of informal developments that are matched with capacity of infrastructure assets but rather the financial benefits accruing to them. Informalisation of public open spaces in the planned neighbourhoods is fueled by the socio-economic incentives as well as practical requirements for additional space. Some influential house owners are able to bend the rules and regulations to construct deviant structures and once other residents observe such maneuvers they do the same under the feeling that they will be protected by the political and administrative systems just like the influential chaps.

It was established through the study that informalisation through extension of houses is carried out as the family grew up, as the sons decide to marry and stay within the premises, and as demand of commercial spaces heat up. These findings are supported by Morris and Winterôs (1996) theory on house adjustment behaviour. Residents see the beauty of buildings on plots through the ability of such plots to accommodate their families as well as rental commercial spaces for their livelihoods rather than being mere objects of aesthetic interest. In this perception houses and their surrounding spaces are seen as objects to live in and to live on.

The study established there are financial benefits of incremental and informal extensions in formally planned neighbourhood in Nairobi. The empirical findings are also supported by Turnerôs (1976) focus on what is a state of a house, what it does and to whom? The theory presumes that how people benefit from their properties determines how to shape and use them.

The study revealed the existence of several distinct agencies which are supposed to regulate and control construction activities which do not adhere to development regulations. The quality control institutions are supposed to make sure that all construction activities are permitted by the concerned local authority. Such institutions include Nairobi City County, Kenya urban roads authority, Kenya Power and lighting authority and Nairobi water Sewerage Company. These institutions evidently had not carried out their collective and

individual mandates in Buruburu estate. The study found that there is little or no coordination between the numerous agencies.

5.4 Recommendations of the study.

The research recommends that there is a need to strengthen the development control and regulation function for local authorities. This will help to stem the informalisation of planned neighbourhoods and make management of public infrastructure assets more predictable. The study established that there exist numerous agencies which are supposed to regulate construction activities which do not adhere to development regulations, and urban design. Such organizations are under both the devolved government and the national government. These agencies, however, are not coordinated and often work at cross-purposes with each other. The development control institutions are supposed to make sure that all development activities are permitted by the relevant agencies, and that it satisfies a predetermined criteria that safeguards the way infrastructure assets are managed.

The study also recommends that neighbourhood planning philosophies should be reviewed. Buruburu estate was planned as a purely residential neighbourhood. The thinking that a single use zoning for a neighbourhood can be sustainable has been strongly challenged by the spontaneous emergence of other uses such as commercial and cottage industry uses. The reality seems to suggest that planned neighbourhoods should be planned to accommodate mixed uses. This is to accommodate residents changing economic fortunes over time and also socio economic challenges in the wider society over the life of the planned neighbourhood.

Open spaces and road reserves are useful functional spaces in any planned neighbourhood. They are an important component of the infrastructure assets for the neighbourhood. A strong framework should be developed to protect open spaces both from land grabbers and from casual invasion as is the case with informal street traders who tend to operate from road reserves. Invasion of road reserves puts pressure on existing infrastructure and lowers the quality of living experience for residents in the planned neighbourhood.

Neighbourhood Planners need to appreciate that a neighbourhood is a living organism. It will go through phases of change that is inevitable. Such change may be due to general changes experienced in the wider society or even more subtle changes that households resident in the neighbourhood go through from day to day, season to season. Such changes

(informalisations) need to be anticipated in the neighbourhood plans and adjustments in infrastructure assets management strategies accommodated.

The study further recommends that new approaches are needed to plan and coordinate the emerging individual efforts of change and Public infrastructure management as observed in Buruburu. Infrastructure asset management agencies need to be actively involved in the development control and regulation effort in the city. Any changes occasioned by sanctions and lapses in development control, ultimately has an effect on the public infrastructure assets. This implies that any change in development, either formal or informal, of a planned neighbourhood will have an impact on the infrastructure assets that utility agencies are managing. A more active role in the control and regulation of informal developments would help them have up to date development data that would be helpful in better managing the public infrastructure assets under their care.

5.5 Suggestions for Further Studies.

This study is probably a pioneering research into the influence of informalisation of planned neighbourhoods on management of public infrastructure assets in Buruburu, Nairobi, Kenya. Further research efforts need to be carried out in other planned neighbourhoods and cities of Kenya, to ascertain the general application of present findings.

Further, this research assessed the influence of informalisation of planned neighbourhoods on management of public infrastructure assets. It was established that the informalisation and of the planned neighbourhood is largely a result of residentsô activities. Their motivation to modify their planned environment may be varied. The researcher therefore recommends that study efforts should be directed to investigate the extent of participation by the residents and other stakeholders in the development control and infrastructure asset management of planned neighbourhoods in Nairobi and the rest of the country.

I would also recommend a study aimed at establishing an integrated system of development control and utilities management with a view to harmonise any changes, formal or informal that may occur in planned neighbourhoods. The recommended study should look at ways in which the various stakeholders working in an integrated manner are able to detect any modifications in the planned neighbourhood to manage the infrastructure assets accordingly.

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APPENDICES.

Appendix I: Letter of introduction

Date:

TO WHOM IT MAY CONCERN.

Dear sir/Madam,

REQUEST FOR COLLECTION OF DATA.

I, David Omwando Songoro, am a post graduate student at the School of Distance and Continuing Education, University of Nairobi. I am conducting a research study titled, ñ*The influence of informalisation of planned neighbourhoods on public infrastructure asset management: The case of Buruburu estate, Nairobi, Kenya".*

You have been selected to form part of this study. Kindly assist by providing answers to the attached questionnaire. The information given will be treated in strict confidence and will be purely used for academic purposes.

A copy of the final report will be availed upon your request.

Your assistance and cooperation will be highly appreciated.

Yours sincerely,

David O. Songoro (Student)

L50/65873/2010.

Appendix II (a): Interview Schedule.

Appendix II (a): Interview Questions for House Extensions.

The aim of this part of the interview is to understand the influence of house extensions on public infrastructure asset management in Buruburu estate.

1. When did you acquire this house?

2. Was the house adequate for your familyôs needs when you were purchasing it?

3. If your answer is Yes to no.2 above, why did you decide to construct the extension to the house?

4. Did you get approval from Nairobi City County for construction of the extension? Do you have an occupation certificate for the extension from Nairobi City County?

5. How does the proliferation of extensions to the main house affect the population living in Buruburu?

6. How does the population in no. 5 above affect the public infrastructure assets in Buruburu estate?

7. How does the proliferation of unapproved structures / extensions in Buruburu affect level of service offered by the public water utilities available in Buruburu?

8. What in your opinion is the effect of construction of house extensions on household recreation space within the household compound?

Appendix II (b): Interview Questions for Influence of commercial activities.

The aim of this part of the interview is to understand the influence of sprawling commercial activities along estate roads on public infrastructure asset management in Buruburu estate.

1. When did you acquire this house?

2. Was the house intended for commercial use when you purchased / built it?

3. If your answer is No to no.2 above, why did you decide to change the use to the house?

4. Did you get approval for the change of use from Nairobi City County for the new use?

5. How does the emergence of changed uses, usually to commercial use, affect the population using the house/plot?

6. How does the proliferation of unapproved changed uses to commercial activity along Buruburu streets affect the infrastructure utilities available in Buruburu?

7. How do the informal structures and businesses on road reserves along Buruburu streets affect the infrastructure assets available in Buruburu?

8. What in your opinion is the effect on informal commercial activities on the pedestrian walkways along the estate roads?

9. How does the proliferation of informal commercial activities affect the performance of storm water drains along estate roads?

Appendix II (c): Interview Questions for new house typologies.

The aim of this part of the interview is to understand the influence of New Building typologies on encroached land / previously public recreation space on public infrastructure asset management in Buruburu estate.

1. Did you get approval for the change of use from Nairobi City County for the construction of the new building structure on land that initially had a different use?

2. How does the emergence of new building structures, usually of commercial or multi dwelling residential use, affect the population using the house/plot?

3. How does the population in 2 above affect the demand on utility services in Buruburu estate?

4. How does the emergence of new building structures, usually of commercial or multi dwelling residential use, affect the infrastructure utilities available in Buruburu?

Appendix III: QUETIONNAIRE.

SECTION A: GENERAL INFORMATION

1. Location/House Addressé ..

2. What is your occupation?

- Retired
- Consultant
- Businessman
- Self employed (specify)é é . é
- Civil servant
- Artisan (specify) é é é é é é
- Others (specify).

3. Gender:

- Male
- Female

4. How old are you?

- 25-40,
- 41-50,
- 51-60,
- 61-70,
- 71- Above.

7. Marital status:

- Single
- Married,
- Widow,
- Widower,
- Divorced,
- Separated

8. What is your level of education?

- No formal education,
- Primary only
- Up to secondary only ,
- Ordinary National Diploma ,
- Bachelors Degree ,
- Others (specify) é é é é é é .

9. Give us an idea of your monthly income (Ksh).

- 10,000-20000 ,
- 21,000-40,000 ,
- 41,000-60,000,

- 61,000-100,000,
- 101,000-200,000,
- Above 200,000.

10. What was your household size including resident dependants at the initial time of occupying this house.

- 1-3 ,
- 4-6 ,
- 7-10 ,
- more than 10
- others specify é é é é é

Male é é . Female é é é

11. What is your present household size including resident dependants?

- 1 ï 2,
- 3 ï 4,
- 5 ï 6,
- 7 ï 8,
- Above 8

Male é é ., Female é é é , Children é é

12. How many people who are not normally part of your household come and stay here as guest in a year?

- 1-2,
- 3-4 ,
- 5-7 ,
- 7-above

SECTION B: QUESTIONNAIRE ON HOUSE EXTENSIONS.

The aim of this part of the Questionnaire is to understand the influence of House extensions on management of public infrastructure assets in Buruburu estate.

1. Please rate your level of satisfaction with the original plan of this house when you moved in.
    - Very satisfied
    - Satisfied
    - Neutral
    - Not satisfied
    - Strongly Dissatisfied

2. Have you added or transformed your house in anyway?
    - Yes
    - No

3. How many bedrooms have you added to the original plan?
    - One more
    - Two-bedroom

- Three bedrooms
- None
- Others (Specify)

4. (a)If yes to Qn. 2 above, why did you extend?

é ..

(b) If No to Qn. 2 above, why didnôt you transform? .é é é é é é é é é é é é é é

5. In what other ways do you think the house extensions influence the public infrastructure?

é é
é é

6. In what other ways do you think the house extensions influence the way public infrastructure in Buruburu estate is managed?

é é
é é
é é

7. How is public water supply into the house extensions in Buruburu estate?

- Single connections with main house.
- Separate connection from the main house.

8. How is solid waste from the plots in Buruburu estate collected?

- Private company
- County Collection.

9. In your opinion, do house extensions have an influence on public water supply in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

10. Do you think house extensions have an influence on mains electricity supply in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

11. Do house extensions, in your opinion, have an influence on traffic congestion on estate roads in the estate?

- Strongly disagree
- Disagree.
- Neutral

- Agree
- Strongly agree

12. In your opinion, do house extensions have an influence on public infrastructure assets in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

13. In your opinion, is the management of public infrastructure assets in Buruburu estate influenced by increased demand for public water services created by uncontrolled house extensions?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

14. In your opinion, is the management of public infrastructure assets in Buruburu estate influenced by increased demand for public electricity services created by uncontrolled house extensions?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

15. Would you say you are satisfied with the quality of traffic flow management on estate roads in view of the increased number of vehicles using estate roads as a result of increased population from house extensions in the neighbourhood?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

16. Would you say you are satisfied with the quality of public electricity management on estate roads in view of the increased number of illegal connections to house extensions in the neighbourhood?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

17. Would you say you are satisfied with the quality of public water supply management on estate roads in view of the increased number of illegal connections to house extensions in the neighbourhood?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

SECTION C: QUESTIONNAIRE ON COMMERCIAL ACTIVITIES ALONG ESTATE ROADS.

The aim of this part of the Questionnaire is to understand the influence of proliferation of formal and informal commercial activities along estate roads on management of public infrastructure assets in Buruburu estate.

1. Which of these forms of change of use do you find necessary along the estate roads in Buruburu? (Tick as many as you consider necessary).

- Restaurant/Cake shop.
- Groceries/ Vegetables/Fruit seller.
- Boutique/ Second hand clothes.
- Entertainment/ DVD/Movie Library.
- Others specify é é é é é é é é é é é é é é é é é ..é é é é é

2. After the modification of existing spaces on the road reserve/addition of Extra spaces through transformation of your dwellings which of this Home Based Enterprises do you have? (Tick as many as you consider necessary).

- Hair dress/barbing shop
- Petrol station
- Restaurant
- Stationeries/Photocopies
- Furniture sale displays
- None at all
- Others (specify) é é é é é é é é é é é .é é é é é é é é é é é

3. What are the types of waste generated by street trading?

- Papers only
- Agricultural waste
- Polythene/nylon waste
- Polythene/nylon and paper
- Hair

4. What are the methods of disposal for waste generated in street trading?

- Burning
- Refuse collector.
- Dump on road/ drainage channel.
- Refuse dumps elsewhere.

5. Which of the following communal facilities were available within the Estate at the time you moved in?

- Health centre (medical centre)
- Market / Shopping centre
- Educational facilities
- Recreational facilities
- Religious buildings

6. What social amenities are available at the street trading points within the estate?

- Pipe Water
- No Piped water
- Electricity Supply
- No electricity supply
- No response/ Comment.

7. In your opinion, does street trading have an influence on public water supply in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

8. Do you think street trading along estate roads have an influence on mains electricity supply in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

9. Does street trading, in your opinion, have an influence on traffic congestion on estate roads in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

10. In your opinion, does street trading have an influence on public infrastructure assets in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

11. What would be your reaction to the statement that infrastructure assets are well managed in Buruburu estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

12. Do you think that management of infrastructure assets in Buruburu estate is influenced by solid waste generated and disposed by street traders?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

13. Would you say you are satisfied with the quality of solid waste management on estate roads in view of the increased number of informal businesses along estate roads in the neighbourhood?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

14. Would you say you are satisfied with the quality of storm water management on estate roads in view of the increased number of informal businesses along estate roads in the neighbourhood?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

SECTION D: Questionnaire on Proliferation of light industrial activities along estate roads.

The aim of this part of the Questionnaire is to understand the influence of proliferation of light industrial activities along estate roads on management of public infrastructure assets in Buruburu estate.

1. Are you a resident in Buruburu estate?

- Yes.
- No.

2. What is your opinion about the siting of Garages and Carpentry establishments along estate roads in the estate?

é é
é é
é é

3. Why are these establishment located along the road on road reserves in the estate?

- ☐ Nairobi City County allows it.
- ☐ The residents provide a ready market for the goods and services.
- ☐ Raw materials are readily available on site.
- ☐ For convenience of the residents.

4. What are the types of waste generated by street trading?

- ☐ Wood pieces only
- ☐ oil waste
- ☐ pieces of metal waste
- ☐ Polythene/nylon and paper

5. What are the methods of disposal for waste generated in street trading?

- ☐ Burning
- ☐ Refuse collector.
- ☐ Dump on road/ drainage channel.
- ☐ Refuse dumps elsewhere.

6. In your opinion, do these light industrial activities have an influence on public water supply in the estate?

- ☐ Strongly disagree
- ☐ Disagree.
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

7. Do you think light industrial activity have an influence on mains electricity supply in the estate?

- ☐ Strongly disagree
- ☐ Disagree.
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

8. Do light industrial activity, in your opinion, have an influence on traffic congestion on estate roads in the estate?

- ☐ Strongly disagree
- ☐ Disagree.
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

9. In your opinion, do light industrial activities along estate roads have an influence on public infrastructure assets in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

10. Would you say you are satisfied with the quality of public water supply management in the estate in view of the increased number of informal connections to car wash establishments along estate roads in the neighbourhood?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

11. Would you say you are satisfied with the quality of public electricity supply management in the estate in view of the increased number of informal connections to metal welding establishments along estate roads in the neighbourhood?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

SECTION E: QUESTIONNAIRE ON NEW BUILDING TYPOLOGIES.

The aim of this part of the Questionnaire is to understand the influence of New Building typologies on management of public infrastructure assets in Buruburu estate.

1. Buruburu was mainly a residential estate comprised of single family bungalows and maisonettes mainly. Is this the prevailing situation currently?

- Yes
- No

2. There was space that was allocated for a market, a post office & childrenôplayfields in the original planning of the estate. These have since been encroached and converted to other uses. Do you think these transformation activities have impacted on the Infrastructure assets in Buruburu estate?

- Yes
- No

4. In what ways?

.....

5. Apartment building typology is increasingly being adopted for some plots in Buruburu. Do you think this transformation activities impact on the Infrastructure assets in the estate?

- Yes
- No

6. In what ways?

é .....

7. Do you think the adoption of apartment buildings has an effect on the population in Buruburu estate?

- Yes
- No

8. How does the population in 7 above impact:

- Public water servicesé é
- Public sewerage services.é é
- Vehicular parking spacesé é
- Solid waste managementé é

9. Will you suggest to government to relax the enforcement of building regulations and encourage transformation for Buruburu estate?

- Yes
- No

10. In your opinion, do new house typologies have an influence on public water supply in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

11. Do you think new house typologies have an influence on mains electricity supply in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

12. Do new house typologies, in your opinion, have an influence on traffic congestion on estate roads in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

13. In your opinion, do new house typologies have an influence on public infrastructure assets in the estate?

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

14. The quality of public electricity infrastructure assets management is satisfactory in view of the increased demand as a result of introduction of multi storey flats in the neighbourhood.

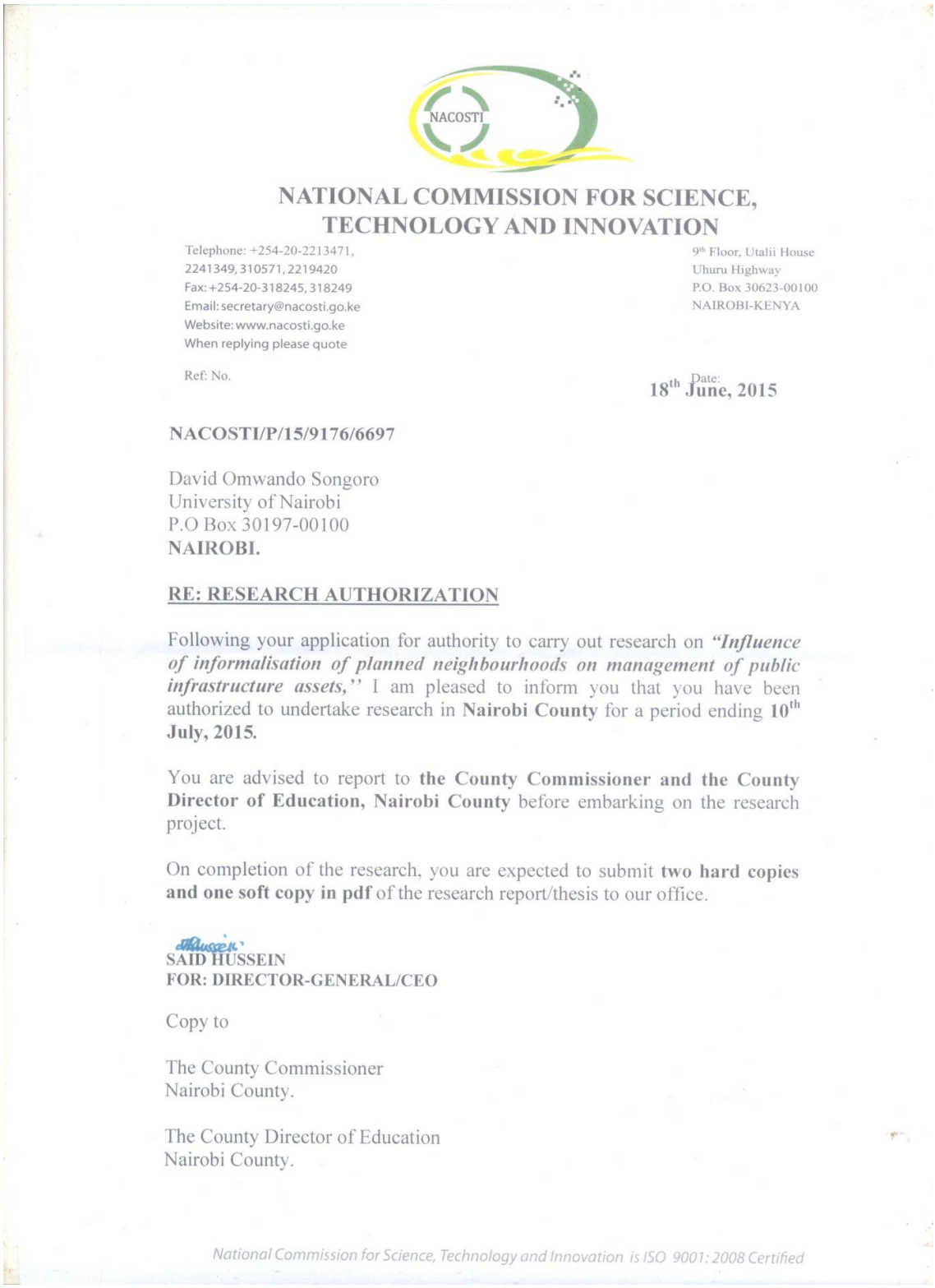
- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

15. The quality of public water infrastructure assets management is satisfactory in view of the increased demand as a result of introduction of multi storey flats in the neighbourhood.

- Strongly disagree
- Disagree.
- Neutral
- Agree
- Strongly agree

Appendix IV. Research Permit.

RESEARCH PERMIT.



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Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date: 18th June, 2015

NACOSTI/P/15/9176/6697

David Omwando Songoro
University of Nairobi
P.O Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Influence of informalisation of planned neighbourhoods on management of public infrastructure assets,"*** I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for a period ending **10th July, 2015.**

You are advised to report to **the County Commissioner and the County Director of Education, Nairobi County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

SAID HUSSEIN
FOR: DIRECTOR-GENERAL/CEO

Copy to

The County Commissioner
Nairobi County.

The County Director of Education
Nairobi County.

National Commission for Science, Technology and Innovation is ISO 9001: 2008 Certified

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit
2. Government Officers will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one(1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No. A 5430

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:
MR. DAVID OMWANDO SONGORO
of UNIVERSITY OF NAIROBI, 25625-100 Nairobi,has been permitted to conduct research in *Nairobi County*

on the topic: *INFLUENCE OF INFORMALISATION OF PLANNED NEIGHBOURHOODS ON MANAGEMENT OF PUBLIC INFRASTRUCTURE ASSETS.*

for the period ending:
10th July,2015

Permit No : NACOSTI/P/15/9176/6697
Date Of Issue : 18th June,2015
Fee Recieved :Ksh 1000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation