

EXAMINING THE VIABILITY OF TRANSPORTATION DEVELOPMENT TO REDUCE  
URBAN POVERTY IN THE DEVELOPING WORLD THROUGH ACCESSIBILITY:  
THE CASE OF KIBERA - NAIROBI, KENYA

By

AMY CAVARETTA

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To my family, for always standing beside me, supporting my studies, and encouraging me to chase my dreams

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## LIST OF ABBREVIATIONS

CBD	Central Business District
FPE	Free Primary Education
GIS	Geographic Information Systems
GoK	Government of Kenya
KENSUP	Kenya Slum Upgrading Program
MDG	Millennium Development Goals
NGO	Non-Governmental Organization
ODA	Official Development Assistance
SEC	Settlement Executive Committee
UN	United Nations
UNDP	United Nations Development Program
UNFPA	United Nations Population Fund
UN-HABITAT	United Nations Human Settlement Program

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Amy Cavaretta

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As the capital of one of the largest and most populous African countries, Nairobi, Kenya is also one of the poorest African cities. Nairobi's most infamous slum – Kibera – is the second largest slum in Africa and third largest in the world. This research uses Geographic Information Systems (GIS) to examine current levels of spatial, economic, transportation, education, and healthcare accessibility in Kibera. Access to economic land uses, education, and healthcare is low, and improved access is recommended. Existing informal taxibus, “matatu,” networks and public bus lines provide networks of public transport around the City of Nairobi. While these systems appear to be able to serve the travel needs of Kibera residents who are willing and able to walk to the stops on the Kibera boundaries, they could provide even more access to healthcare, education, and employment, if they were extended through Kibera as part of the Government of Kenya slum upgrading plans. In partnership with the proposed development of a commercial road corridor through Kibera, this research strongly recommends that a detailed analysis of matatu and bus routes explore the potential formalization of service through Kibera, focusing upon providing residents direct access

to the CBD, Industrial Area, and healthcare uses. The scale of urban poverty in cities like Kibera not only demands local attention from local and national government, but also increased international support and a sustained commitment by several parties to improve the quality of life for billions of people living in slums across the world.

## CHAPTER 1 INTRODUCTION

### **Urban Poverty**

As rapid urbanization continues to change the face of the planet, the phenomenon of rampant poverty in urban centers continues to grow at a frighteningly close pace. Along with other global challenges, urban poverty has remained a critical planning issue due to the magnitude of effects it has on the quality of life of a quarter of the world's population, and half of the population of developing countries (The World Bank, 2002). Poverty hinders daily life for billions of people with serious issues of disease, sanitation, unemployment, hunger, and crime.

One of the most consistent factors that contribute to urban poverty is lack of access. Residents of urban slums severely lack access to basic necessities, goods, services, protections, and employment. It is evident that relationships between urban poverty and accessibility are significantly complex and multi-faceted, and nearly impossible to be adequately examined in a research thesis; let-alone a doctoral dissertation or years of research in the field. However, immense value can be gained from an exploration of these complex relationships through a narrowed case study. For these purposes, this research examines the relationship between urban poverty and accessibility within the single case of Kibera slum in Nairobi, Kenya.

### **Why Kibera?**

As one of the largest and most populous African countries, Kenya's capital and largest city, Nairobi, is also one of the poorest African cities (Government of Kenya [GoK], 2008). Nairobi's most infamous slum – Kibera – is the second largest slum in Africa and third largest slum in the world (GoK, 2008). Overcrowded housing, rampant

disease and HIV/AIDS pandemics, and extremely high unemployment rates have continued to brand Kibera as the poster child for the “worst slum” in the world.

In response to the magnitude of poverty within their nation, the Government of Kenya (GoK) partnered with the United Nations Human Settlement Program (UN-HABITAT) in 2000 to create the Kenya Slum Upgrading Program (KENSUP) (Mulcahy & Chu, 2008). As a multi-faceted project aimed at re-development and improved housing and access within Kenyan slums, the GoK chose to begin work in Kibera. KENSUP focuses upon project implementation across the country to improved housing and access to basic services, secure tenure, and opportunities to generate income, particularly in slums like Kibera (Mulcahy & Chu, 2008). KENSUP policies developed by the GoK, the City of Nairobi, and UN-HABITAT take into account economic, sanitation, housing, and tenure factors, and plans addressing transportation accessibility in the first Kibera projects provide solely for construction of commercial road corridor. While paved roadways and vehicular access will be an improvement from current transportation conditions in Kibera, the vast majority of Kibera’s residents walk and are unable to afford or access transportation of any other mode (Mulcahy & Chu, 2008).

Significant potential exists for increased effectiveness of KENSUP through an evaluation of transportation accessibility for Kibera, and the consideration of public transit or alternative transportation strategies in the KENSUP plans for redevelopment of Kibera. History shows that government redevelopment projects, while well-intentioned, can lead to a wide range of effects, from dynamic success to catastrophic failure. For KENSUP to be truly successful in terms of goals of improving services and accessibility for residents of Kibera, significant worth exists in examining if the

incorporation of public transit or alternative transportation strategies could increase KENSUP's effectiveness and lead to further levels of poverty reduction through increased access.

To examine the viability of public transit and alternative transportation strategies for incorporation into the KENSUP Kibera redevelopment program, several steps in this study ultimately support the development of recommendations for Kibera. First, the study of existing literature presents valuable background information about challenges faced by cities in developing countries such as Kenya, the relationships between poverty and accessibility, and the role transportation development can play in poverty. Secondly, a quantitative analysis of Kibera, using mapping tools through Geographic Information Systems (GIS), evaluates levels of current accessibility of Kibera through analysis of distances from Kibera to several categories of land uses: economic, educational, institutional, and healthcare. Findings address the different levels of accessibility for Kibera and make recommendations on ways that public transit or alternative transportation modes could improve specific types of access for Kibera in the KENSUP Kibera redevelopment.

At this critical turning point in its history, Kibera is an excellent case study for this exploration of the relationships between transportation accessibility and urban poverty. Though this study is directly aimed at development of policy recommendations for the Kenyan government in the case of KENSUP and Kibera, it has significant applications and lessons learned for other areas in Kenya, Africa, and broader contexts for areas of urban poverty across the world.

## CHAPTER 2 LITERATURE REVIEW

### **Summary Of Literature Review**

To address concerns of poverty reduction for both current and future residents of Kibera, the ultimate objective of this analysis is to evaluate accessibility in Kibera, and determine if the incorporation of public transit or alternative transportation strategies as part of the KENSUP Kibera redevelopment project would contribute to poverty reduction by providing increased levels of access. Before diving into analysis of Kibera specifically, it is important to first establish a framework of existing knowledge on the qualities of accessibility, specifically spatial and transportation accessibility, in relation to slums and poverty reduction across the globe, relating to access to basic goods, services, and employment opportunities.

### **Definitions**

Though a clear image can come to mind when the words poverty and slum are used, it is imperative that operational definitions of these key words are established for the purposes of this study. The term “slum” can refer to many types of housing, and is often used interchangeably with other terms such as “shantytown”, “informal settlement”, “squatter housing”, and “low-income community” (Oxfam Great Britain, 2009, p. 5; Turkstra & Raithelhuber, 2005; United Nations Population Fund [UNFPA], 2007, p. 16;).

Oxfam defines a slum as “a contiguous settlement where the inhabitants are characterized as having inadequate housing and basic services. A slum is often not recognized and addressed by public authorities as an integral or equal part of the city” (Oxfam, 2009, p. 5). UN-HABITAT defines a “slum household” as a “group of individuals

living under the same roof in an urban area who lack one or more of the following: durable housing, sufficient living area, access to improved water, access to sanitation and secure tenure” (UN-HABITAT, 2010b, p. 3).

As Oxfam Great Britain (2009) notes, “the urban poor are not equated with informal settlement or slum residents. It should be noted that not all poor people live in informal settlements and not all people living in informal settlements are poor; but the overlap between the urban poor and slum-dwellers is so great that for this report it can be assumed that in the vast majority of cases they are one and the same” (Oxfam Great Britain, 2009, p. 5). Along these definitions, this study uses the term “slum” to reference temporary, low-income housing in poor areas and more specifically Kibera.

The urban scene has contained slum areas for thousands of years, and their basic features have not changed. However, the difference in today’s slums are one of scale (Turkstra & Raithelhuber, 2005). What was once a few thousand slum dwellers in cities across the globe has now grown to a global slum population of a billion people – one out of every 3 city dwellers as of 2007 (UNFPA, 2007, p. 16). The United Nations Human Settlements Programme (UN-HABITAT) estimated, in a publication titled *The Challenge of Slums* (2003), that only 6 years before (2001), about 870 million people were living in urban slums in developing countries. The report argues that if current trends continue, that number will grow to 1.43 billion by 2020 (UN-HABITAT, 2003).

Slums and urban poverty often exist together, however the expansive notion of poverty is narrowed for the purposes of this study. The World Bank (2002) summarizes poverty in a quite basic way, as the “inability to access jobs and services.” In a 2002 report on poverty measurement and quantification, Coudoeul, Hentschel, and Wodon

(2002) similarly refer to poverty as need-based - “whether households or individuals possess enough resources or abilities to meet their current needs” (p. 3).

### **How Can Poverty be Evaluated?**

Coudoeul et al. (2002) evaluates the measurement and analysis of “poverty, inequality, and vulnerability.” In the report, poverty is quantified for several purposes: analytical (to understand the factors), policymaking (to design interventions best adapted), and evaluation (effectiveness of status quo and future policies) (Coudoeul et al., 2002). Though a perfect comprehensive model of poverty would be based upon several factors - income, consumption, education, and other attributes - the most frequently used indicators of poverty are typically based upon quantitative measures such as income or consumption (Coudoeul et al., 2002).

Several authors have debated the use of either income or consumption rates for poverty measurement. According to Coudoeul et al. (2002), consumption is a better indicator of poverty measurement than income, because it is not tied to other factors such as access and availability and is relatively stable (2002). However, Coudoeul et al. (2002) notes that measuring poverty according to income does hold benefits because it is typically more frequently reported than consumption, and can distinguish between different sources of income (2002). The United Nations and the World Bank use income data to develop and evaluate countries and cities against standardized poverty thresholds.

Though different dimensions of poverty can be evaluated solely when setting and evaluating against a particular poverty line, “composite indexes of wealth” can also be used to evaluate more than one dimension of poverty. Using these multi-dimensional indexes of poverty, as described by Coudoeul et al. (2002), can “create measures that

take into account income, health, assets, and education...and other dimensions” (p. 7). However, limitations exist to using these composite indexes, primarily the definition of a poverty line. Coudoeul et al. (2002) offers ways to address those, however, through analysis by quintile or other percentile remains possible (2002, p. 7).

### **How Is Poverty Evaluated in This Study?**

For the purposes of this study, several aspects of poverty could be applied to the case of Kibera. My background in civil engineering and transportation has led me to a particular interest in evaluating the spatial accessibility dimension of poverty. However, evaluating the somewhat harder-to-define concept of accessibility is not as straightforward as an evaluation of income that Coudoeul et al. (2002) or the World Bank suggest with straight-forward poverty indicators.

Therefore, characteristics of urban poverty and slum areas that involve access and transportation infrastructure will be the primary focus of this study. The existence of both urban poverty and slum areas can be sustained by a lack of physical access to essential goods, services, education, and employment that can result from a lack of accessible transportation infrastructure. Though access to goods, services, and opportunities is not the sole characteristic that defines and sustains urban poverty, it has significant contribution and is a valuable characteristic to examine.

The relationships between poverty, access, and transportation infrastructure are intricate ones. Infrastructure provides the “basic functions of a society that are necessary to transport resources...provide essential services, and ultimately reduce poverty” (Global Poverty Project, 2012). Taken for granted in many developed nations around the world, transportation infrastructure is important in the study of poverty

because it is how the poor have access to a wide array of economic and social services, healthcare, and “greater possibilities for livelihood” (Global Poverty Project, 2012).

The United Nations Population Fund (UNFPA) bases several of their poverty-focused policies upon this access-based focus and the “explicit concern with the land needs of the poor...and access to water, sewage, power and transport...”, and strongly urges “planning for such spatial and infrastructure requirements” (UNFPA, 2007, p. 3). Without access to modern infrastructure, poor populations “rely primarily on traditional substitutes...consuming water from local rivers, meeting sanitation needs in the open air, lighting their homes with candles, cooking with fuel wood from local forests, and traveling over long distances to pass on message to distant relatives or business associates” (Foster & Araujo, 2004, p. 5).

Proposed programs and policies that aim to reduce urban poverty in slum areas often involve the improvement of short-term basic needs, such as lack of clean water, food, or sanitation. without investment into the underlying, longer-term causes for the conditions they attempt to remedy. Though it is often more explicit to diagnose the most obvious and immediate problems that are associated with urban poverty, such as disease, malnutrition, and housing tenure, to reverse poverty at its root, it is essential that the deepest causes of the problem be explored.

For proposed policies or partnerships to have a reversing effect on the phenomenon of urban poverty in any context, especially in areas of extreme poverty, it is essential that a comprehensive array of solutions to urban poverty be developed with a strong focus on accessibility through the development of transportation infrastructure. The Global Poverty Project (2012) explicitly agrees with this recommendation, stating

“the answer to treating cholera in this case is not medicine or doctors, it’s a bridge” (Global Poverty Project, 2012). In this study on urban poverty in the context of Kibera, those deep roots appear to be closely tied to physical access and transportation infrastructure. To formulate a basis on which to examine potential solutions, a composite index of poverty and access define and explore the inter-related nature of several factors of accessibility.

### **Increasing Accessibility as a Solution to Urban Poverty**

Accessibility and provision of transportation infrastructure play a crucial role in the phenomenon of urban poverty, in terms of spatial, transportation, economic, and social accessibility. Each of the previously described dimensions of accessibility are inextricably linked back to a lack of spatial access, supporting the theory that increased spatial and transportation access could provide significant benefits to residents of slum areas in poverty reduction.

Developing countries hold 39% of the world’s population, but only 13% of the world’s infrastructure stock, according to Briceno-Garmendia, Estache, and Shafik (2004). The most serious gaps in infrastructure occur in the transportation sector (Hilling, 1996). The Global Poverty Project (2012, n.p.) states that “investment in infrastructure development and maintenance is essential to address these as well as other factors that contribute to poverty.” The United Nations Development Program (UNDP) also supports these notions for development, particularly in the context of Africa - “Sub-Saharan Africa must provide universal access to decent jobs and social services if it is to achieve decisive development progress...on global anti-poverty goals” (UNDP, 2012a, n.p.). The UNDP urges Sub-Saharan Africa’s policymakers to “put greater

emphasis on improving access to quality jobs, social services, and safety nets” (UNDP, 2012a, n.p.).

These notions regarding investment in transportation infrastructure development to improve accessibility are not new. Governments have long turned to transportation infrastructure as a remedy for development problems and economic growth tool (Hilling, 1996). Investment in transportation infrastructure development is often seen by countries, regions, and cities as a key element of spurring economic growth (Hilling, 1996), and on the global scale, has been recently emphasized for poverty reduction through the United Nations (UN) Millennium Development Goals program (MDGs) (Briceno-Garmendia et al., 2004).

The UN MDG program is composed of eight (8) primary initiatives, aimed at poverty reduction across the globe in developing countries and urban centers. Positive reductions in poverty and accomplishment of different MDG goals have already been realized since the MDG Summit in 2000, however the slums of several urban centers, such as Nairobi, Kenya, have encountered significant challenges in achieving the MDG targets. This comes as no surprise to UNFPA, who predicted in 2007 that “as the developing world becomes more urban and as the locus of poverty shifts to cities, the battle to achieve the MDGs will have to be waged in the world’s slums” (UNFPA, 2007, p. 15).

### **What Leads to Increased Accessibility?**

Several studies have examined the impact of transportation infrastructure development on poor populations around the world. Gachassin, Najman, and Raballand (2010) examine these notions that improved transportation infrastructure can automatically lead to poverty reduction in the case of Cameroon, a country in southern

Africa. Through analysis of roadway development, Gachassin et al. (2010) conducted a household travel survey to estimate the connections between poverty, isolation, location, access to markets, human capital, and employment opportunities. The authors found that poverty was reduced nation-wide as a result of the improved road access, however rural areas experienced a significantly lesser amount of improvement compared with urban areas (Gachassin et al., 2010).

Briceno-Garmendia et al. (2004) examined the economic elasticity of overall infrastructure improvements to outputs in developing countries, and found that these investments lead to an overall positive effect on developing economies. International aid agencies have developed “social rates of return” to predict how investments return to the developing economy (Briceno-Garmendia et al., 2004). These social return indicators found that returns to “market enlarging” sectors – information/communication technology and transportation infrastructure – were higher than more service/welfare sectors like water or sanitation, though both are required for improvement of overall quality of life and reduction of poverty (Briceno-Garmendia et al., 2004).

### **Defining and Measuring Dimensions Of Accessibility**

Several types of accessibility play significant roles in the access of slums to goods and services, which are related to social, spatial, political, and socio-economic factors.

#### **Place-Based Accessibility**

The reason that accessibility is so vital to people is not for its own sake, but because of what can be accessed as a result. Place-based accessibility refers to the levels of accessibility between two physical locations, and can be examined through a measurement of distance and physical access. Physical access is necessary to populations for basic goods and services, stable employment, and social and cultural

relations. Complex tradeoffs exist in spatial accessibility between residential location, distance, income, economic opportunities, and modes of transportation (Hilling, 1996).

The physical characteristics – location, topography, land use, natural qualities, etc. - of a slum can greatly affect spatial accessibility to other areas within the region. In many urban areas around the world, slums have frequently developed on unwanted government land, riverbanks, or floodplains that often have severe risk for flood, washout, and high vulnerability to natural disasters. These physical characteristics of slum areas not only provide substantial challenges to safety and health, but also to spatial accessibility, where residents often have no other options than live among and travel through these dangerous land conditions (Hilling, 1996).

Not only do the physical characteristics of land affect spatial accessibility, but also patterns of urban growth that have affected the amounts of physical distance between points of interest (employment centers, schools, hospitals or clinics, etc.). While many slum areas initially developed adjacent to Central Business Districts (CBDs) in the colonial era through the early twentieth century, many cities have progressively “pushed” these illegal settlements progressively further and further outside the city into unwanted locations and abandoned lands (Hilling, 1996; The World Bank, 2002). Combined with the growing reliance upon automobiles as the primary mode of transportation, these factors have translated into dramatic changes of the average physical size of cities and urban centers.

Sprawling land use patterns designed around the highway and vehicular access have created conditions where journeys to employment can be excessively long and costly, creating polar cases of tradeoffs between transportation costs and residential

quality (The World Bank, 2002). In South Africa, the average distance from middle-class residential neighborhoods to the CBD is 17.4 miles (The World Bank, 2002). However, middle-class residents of urban regions typically have more spatial flexibility due to income, and can move to other areas of the city or further out if they so desire. Lower-income residents of slum areas are often financially constrained to remaining in their current housing situation, and are unable to move further out of the city because they lack the financial ability to pay for commuting costs into and out of the city center.

Not only have these physical distances between places of interest increased between city centers and suburbs, but also substantially within urban areas. These large distances greatly affect the residents of urban centers, particularly those residents of slum areas who typically walk, use informal networks of public transportation, or use bicycles. Poor populations in developing urban areas are frequently left with two options: residing in informal slum developments, which are “relatively” close to city centers, or residing in suburban and rural areas to inhabit affordable space, at the cost of high travel costs and travel times. Surveys in Mexico City indicate that 20% of workers spend more than 3 hours commuting, and 10% spend more than 5 hours (The World Bank, 2002).

### **Transportation Mobility**

Transportation mobility is a type of accessibility that directly refers to the ease and ability for people to move spatially between points of interest using various modes of transportation. An urban area with relatively small distances and several affordable transportation options can provide high levels of transportation accessibility to its residents, while an area with large distances and little to no affordable transportation options would likely provide low levels of transportation accessibility.

In a Strategy Review on Urban Transportation (2002), The World Bank examined transportation patterns of the urban poor. “Income poor” populations make the majority of their trips by walking, since it is a free mode of transportation, and are thereby somewhat restricted to goods, services, and employment that can be accessed within walking distance. Compared with higher-income populations, the urban poor were found to make 50% of the number of trips of higher-income populations, primarily by non-motorized transportation modes or walking. The World Bank (2002) also found that reasons for trips by the urban poor are more restricted in nature - usually for work, education, or shopping. Though the burden of transportation on budgets of the urban poor has been difficult to determine, it has been estimated to vary greatly depending on location, circumstance, and other social factors (The World Bank, 2002).

Not only does reliance upon walking increase commuting time for the urban poor, but it also has significant personal safety risks. Nonmotorized trip making, through walking or bicycling, has been shown to significantly increase vulnerability of pedestrians to both travel accidents and personal violence (Dovom, Saffarzzdeh, Dovom, & Nadimi, 2012; Odero, 2002). A recent report by the Institute of Transportation Engineers on pedestrian accidents in developing countries states that since “walking in developing countries is an essential transport mode (Dovom et al., 2012, p. 1)...pedestrians have become the most vulnerable road users.” If a pedestrian is hit by a vehicle, their injuries are far more serious than those of vehicle drivers, explaining why the largest group of road user fatalities in developing countries are pedestrians, at approximately 400,000 deaths per year worldwide (Dovom et al., 2012, p.1).

## **Economic Accessibility**

One of the reasons that accessibility is so important to residents of slum areas is to gain access to economic opportunity - access to goods, services, employment, or other income-generating opportunities. Place-based accessibility and transportation mobility often define what selection of economic opportunities are accessible to the population of an urban slum.

Many factors can severely limit economic accessibility for residents of slums, causing many to experience a significant lack of economic accessibility to basic goods, services, and employment opportunities. The first, and most obvious, factors are spatial restrictions that result from the physical location of slums in relation to other key economic land uses within the city. Since most residents of slums walk as their primary mode of transportation, they become restricted to goods, services, employment opportunities that are located within walking distance or require multiple modes of transportation. Large distances between residence and employment equate to significantly high travel costs for slum residents – in terms of several aspects - money, time, and energy.

**Informal Economies.** Population density also plays a role in economic access, and has been one of the reasons behind the growth of informal economies in the developing world and many slum areas. One challenge to economic development in the centers of the developing world is the dominance of the informal economic sector. African slum areas, as well as other regions of the world are known for the dominance of informal economic activities.

The populations of urban slums are generally significantly high in comparison to the amount of land area, resulting in very high population density levels. Between

extremely high population densities and limited spatial accessibility, strongly competition emerges for the accessible economic opportunities, leading many residents to turn to the informal economic sector.

Another result of this combination significantly affects the employment market. Economically speaking, slum areas have the potential to provide high concentrations of workforce supply, but are unable to disperse that population into areas of demand. Due to high population densities, slums have an oversupply of workers and the jobs accessible within walking distance are only able to employ a very limited number of the population they serve. It would also be likely that other economic opportunities a few miles away would also be significantly oversaturated by the market.

**Time Costs.** High travel costs compared to income can be highly challenging for slum residents, combined with costs of basic food, shelter, sanitation, and clean water. Commuting time costs are closely related to a decrease of economic productivity and efficiency, in terms of time spent related to employment and time off, and can also equate to increased activity and economic tradeoffs. Long journeys to employment can make residents of slums “time poor,” with some travel times in developing urban areas exceeding 3 hours (The World Bank, 2002).

Time is an extremely valuable resources, and if spent entirely upon long commutes for access to a part-time economic opportunity, increases the tradeoffs that can be spent in many other productive ways. For instance, collection of fuel or clean water can be significantly time consuming for slum residents, taking time from more productive pursuits such as paid employment, education, or health purposes (Foster & Araujo, 2004, p. 36). Devoting such significant amounts of time to transport and

acquisition of basic necessities comes at the expense of other activities, which Foster and Araujo found in their research to be paid work or leisure (including sleep) (2004, p. 39).

Long walking distances have been proven to significantly reduce productivity by adding a dimension of “energy-poverty” (The World Bank, 2002). Having walked several miles and back to work a mediocre and labor-intensive job, some people would typically lack energy to do much else but rest, let alone develop a garden, produce a craft, or an alternate economically beneficial activity. While this is the case with many slum residents, many have no other option, and must work multiple jobs or provide for their families in other ways to stay alive.

### **Educational and Institutional Accessibility**

Another aspect of access is to social and institutional services and goods, which can include education, civic life, and opportunities for social development. Access to these services is essential, and several authors agree that access to education is key “for progressive existence in society” (Achoka, Odebero, Maiyo, & Mualuko, 2007). Regional and physical barriers, such as geographic access, can combine with financial and economic factors to make education inaccessible for a large portion of slum populations.

Gender disparities have been noted to play a crucial role in hindering access to social services, particularly education. Achoka et al. (2007) notes that “the most affected children are those whose parents live in rural and urban-slum households.” In many regions, “primary schools are sparsely located,” and children have difficulty accessing these schools (Achoka et al., 2007, p. 279). Even if children are able to afford “matatu” buses, it is difficult for children to access schools (Achoka et al., 2007).

## **Transportation Development and Accessibility**

For the most part, the literature is strongly supportive of the positive impacts of transportation infrastructure investment in developing countries. However, several significant challenges can hinder the planning, design, and funding of transportation infrastructure development for slum areas of developing countries. Along with challenges of cost and funding, several barriers and challenges can exist to the practical nature of development, particularly in developing urban centers experiencing high levels of poverty.

## **Political Feasibility of Transportation Investments**

Financing aside, another significantly challenging aspect of transportation investments is political feasibility within a developing country. Political economies in developing countries pose great challenges to accomplishing drastic policy change and implementation of policies are often very difficult to achieve (Gulyani & Talukdar, 2008). This is no different for policies regarding poverty, economics, and infrastructure developments.

In addition, the voice of the slum residents is often not the first to be heard by the government in determining funding of transportation investments. The poor often lack power to input ideas and information to policymakers, both at their local and national levels (Gulyani & Talukdar, 2008). In slum areas, a significant lack of official information systems, social, economic, and demographic data often exists, contributing to a continued lack of attention and funding by their public officials. High levels of irregular and informal land occupation can severely limit the ability of municipal governments to obtain sound data for geographic or planning analysis, and hinder the public processes that could address their development and accessibility needs.

**Challenge of Land Tenure.** Lack of housing tenure provides a huge obstacle to funding infrastructure investment in developing countries and slums. Since most government agencies see slums are “temporary or illegal,” they are typically very reluctant to invest in the extension of public services or infrastructure investments (Gulyani & Talukdar, 2008, p. 1920; UN-HABITAT, 2003). In this case, Gulyani and Talukdar (2008) suggest that one of the first steps to improving services and living conditions is to “deem settlements legal” and use a “title first” approach (Gulyani & Talukdar, 2008, p. 1920). This approach can encourage not only private investment in housing units, but also public investment in infrastructure (Gulyani & Talukdar, 2008, p. 1920).

An alternative view of the tenure issue argues that if constructed, infrastructure can “lead or even replace efforts to formalize tenure in slums,” and provide *de facto* tenure and security (Gulyani & Talukdar, 2008; The World Bank, 2002). In this case, infrastructure investment is a signal of “acceptance” or formal recognition of the slum by government, significantly reducing the perceived risks or threats of demolition and encouraging residents to invest in their units. However, it also assumes that most residents already “own” or have rights to their unit, while many do not. Gulyani and Talukdar do not argue for either side of the tenure argument, but “posits that either one can lead to improvements in the other” by examining multiple directions of causality (Gulyani & Talukdar, 2008).

**Policies to Ensure Accessibility.** It is essential that transportation infrastructure investments not solely consider the facility or system design, but also the development of rules, regulations, and policies that will surround the operation, maintenance, and

user costs of the system. In the case of urban poverty reduction, transportation infrastructure investments do not automatically correspond to affordability for users, safety, security, and physical accessibility to services, destinations, and employment centers. Therefore, transportation infrastructure investments must also include policies that ensure affordability, within fiscal, political, and socio-cultural constraints of the appropriate country (Gulyani & Talukdar, 2010). Often combined with infrastructural policies and programs, economic development policies that aim to improve the general viability are key to the reduction of poverty levels by generating economic activity and employment opportunities (The World Bank, 2002).

The World Bank (2002) strongly supports the development of more poverty-focused infrastructure policy, challenging governments to take a stricter look at infrastructure policies, particularly those that shape transportation and land use investments. Elements of poverty-focused policies in developing countries, such as Kenya, should include: costs properly charged for all vehicle movements, importance of walking and special needs of mobility impaired in design, careful evaluation of fare controls, support of competition in the private market, careful management of multimodal integration, and integration with broad strategies involving housing, health, education, and other social service policies (The World Bank, 2002). In summary, the World Bank (2002, p. 50) argues that “a poverty-oriented urban transport strategy needs to concentrate on movement of people rather than vehicles.”

### **Financial Feasibility of Transportation Improvements**

Along with political feasibility, funding for infrastructure investments is one of the largest challenges to transportation infrastructure investments in developing countries. “When local governments finally try to provide [slum residents] with minimal services,

the economic costs can become impracticable” (UNFPA, 2007, p. 39). As in any construction, retrofitting existing communities typically costs significantly greater than initial costs on a greenfield site - “lack of planning, inadequate location, the lack of access roads, and the sheer accumulation of miserable conditions make it more difficult to retrofit poor neighborhoods with water, sanitation, electricity, access roads and waste management (UNFPA, 2007, p. 39).

**Project Funding.** Briceno-Garmendia et al. (2004) describe the funding of the infrastructure sector in developing countries, comparing trends from the 1990s with 2004. Their findings indicated that the infrastructure sector in developing countries is financed through three major sources: public sector, private sector, and official development assistance (ODA). During the 1990s, 70% of infrastructure investment in developing countries was funded through the public sector, 5-10% through ODA, and 20-25% through the private sector (Briceno-Garmendia, 2004). Since the 1990s, governments have significantly reduced their contributions to infrastructure investments, in hopes that private sector or ODAs will finance the rest. However, the decline of public sector investment has been compounded by a sharp fall in ODA since 1995, fueling a significantly overall drop in investment (Briceno-Garmendia et al., 2004).

Current trends in developing countries indicate that public sector infrastructure spending is between 2-4% of the national Gross Domestic Product (GDP), with exact values varying from county to country. Briceno-Garmendia et al. (2004) argue that those values are 3% less than should be used for maintenance, let alone new construction. Similarly, in the context of Nairobi and Kenya, Gulyani and Talukdar (2010) argue that small interventions towards urban poverty are “insufficient”, and that to truly bring forth

change, governments “need a big push forward.” Most developing countries have a long way to go in establishing an environment to stimulate both private and ODA investment.

**Affordability.** In addition to funding, service affordability is one of the greatest challenges to infrastructure accessibility. Briceno-Garmendia et al. (2004) are quick to highlight that access to transportation infrastructure can have little effect if services are not affordable, especially for the urban poor. The cost of infrastructure is relatively high, and oftentimes, those high costs can be passed along to users, of whom affordability might present a serious issue. “For infrastructure to have an impact, funding and resources must be provided for it to be properly constructed and maintained” (Global Poverty Project, 2012, n.p.). Transportation infrastructure developments should take careful consideration of cost, as they need to ensure the affordability of fares and user fees for those it was constructed for – in this case, the residents of urban slum areas.

**Privatisation.** Another financial challenge to transportation infrastructure development can be privatisation. Though the involvement of private companies can facilitate more cost-effective and efficient development than other schemes of development, they often use “user pay” schemes and other business practices that can be disadvantageous to the poor. The Global Poverty Project (2012, n.p.) notes that “privatisation is only an effective means towards the achievement of [poverty reduction] if it is done in the context of an appropriate market and regulatory framework.”

Project funding schemes that share financing between state government, donor agencies, and private institutions can provide significant benefits to both funding and maintaining an infrastructure project. These shared schemes can also provide overlap

and checks and balances that ensure high cost services and user fees do not prevent access for the poor (Global Poverty Project, 2012).

### **Spatial Feasibility of Transportation Investments**

If an infrastructure project is able to acquire funding, political support, and pro-poor policies for its implementation, there likely remain other challenges. The presence and location of housing, roads, public transportation, power, and water supplies determine the directions in which cities and neighborhoods grow (UNFPA, 2007, p. 75), and it is essential that their development be oriented with environmental and demographic criteria. This can be completed by using demographic data, spatial data, and other relevant data in GIS to “help orient urban expansion of a given localities in a more favorable direction” (UNFPA, 2007, p. 75). The evaluation of demographic growth trends related to elevation, slope, soils, land cover, or hazard risks data is critical to determining where proposed transportation infrastructure projects should be located or avoided.

Large transportation infrastructure projects typically require government land that may currently be informally settled as home to large communities of slum residents. As in any construction, retrofitting existing communities typically costs significantly greater than initial costs on a greenfield site, and “lack of planning, inadequate location, the lack of access roads, and the sheer accumulation of miserable conditions make it more difficult to retrofit poor neighborhoods with water, sanitation, electricity, access roads and waste management” (UNFPA, 2007, p. 39). Retrofitting existing slum areas also frequently leads to direct displacement, when governments physically force residents of informal settlements off land they previously occupied. Displacement can also result indirectly. If infrastructure is upgraded near an existing slum area, costs of living and

services could rise considerably and financially force the slum residents to move to a less expensive area, often a new slum. To avoid both direct and indirect displacement, it is essential that governments and organizations involved in infrastructure development “take responsibility for the compensation and resettlement of those communities” (Global Poverty Project, 2012).

Several challenges exist to the proposal of transportation infrastructure developments in developing countries, and keys to implementation should ensure a development’s success and reduction of poverty levels. The Global Poverty Project agrees, suggesting that simply developing transportation infrastructure is not enough. “Infrastructure must be pro-poor and gender sensitive to ensure that it benefits those who depend on it to escape extreme poverty” (Global Poverty Project, 2012). Design considerations of the transportation infrastructure project should address several issues regarding safety for all uses, social norms, and gender differences. There exist several differentiated needs by gender - for services and different aspects of personal safety and security, particularly at night.

Participatory development in the planning, design, construction, and implementation phases is crucial to the development’s success. This is true not only of transportation infrastructure projects in the developing world, but of any project in any location around the world. City leaders, regional, and civic leaders are key to building support and ownership by the local population, and has been proven to improve the long term sustainability of a project (Global Poverty Project, 2012). Participatory approaches to increase community involvement in poverty strategies and transportation infrastructure investments are strongly encouraged, as they offer greater levels of

advocacy and control for slum areas to have over potential development projects and scenarios (UNFPA, 2007, p. 73).

### **Summary of Literature Review**

Accessibility and provision of transportation infrastructure play a crucial role in the global phenomenon of urban poverty, in terms of spatial, transportation, economic, and social accessibility. Each dimension of accessibility is inextricably connected to mobility, supporting the theory that increased spatial access through transportation infrastructure provision could provide significant benefits to residents of slum areas in poverty reduction. This literature review sets the stage for an application of these theories to the case study of Kibera Slum in Nairobi, Kenya.

## CHAPTER 3 METHODOLOGY

### **Methods of Research**

As an examination of a case study for this exploration of the relationships between accessibility and urban poverty in Kibera, this case study primarily relies upon an analysis of geographic data to represent the study population. Several steps ultimately support the development of policy recommendations for incorporation into the Government of Kenya's Slum Upgrading Redevelopment Plan for Kibera.

Background information for this study relies upon case study literature relevant to Sub-Saharan Africa, urban poverty, accessibility, and transportation development. Forming the foundation for analysis of different types of accessibility in Kibera, the literature review explores the documented value of accessibility in poverty reduction, specifically in cases of transportation infrastructure development. The primary study design involves analysis of quantitative geographic data from Kibera through the use of GIS to determine spatial trends and accessibility relationships between Kibera and key locations of interest – economic land uses, institutional land uses, healthcare land uses. The presence and location of existing housing, roads, public transportation, power, and water supplies can help inform where transportation access projects in KENSUP can be located for the most impact for Kibera's residents. Using spatial tools such as GIS can "help orient urban expansion of a given localities in a more favorable direction" (UNFPA, 2007, p. 75).

### **Data Sources**

For the GIS analysis, shapefile data was acquired from three sources: the Map Kibera project, the University of Nairobi, and the World Resources Institute. The Map

Kibera project was created in November 2009, when a group of Kibera residents and students from the United States mapped and produced the first complete free and digital map of Kibera (Map Kibera, 2010). Surveying with GPS and digitization of satellite imagery led to the creation of feature types and map data after 3 weeks of physical data collection (Map Kibera, 2010). Several GIS shapefiles are available for download for free on their website, and were downloaded for the purposes of this study. Specific data shapefiles downloaded from the Map Kibera website for this study includes: Kibera Boundary, Education, Health, and Transport (Map Kibera, 2012).

The University of Nairobi Department of Urban and Regional Planning (DURP) developed 2010 Land Use GIS files and 2005 Roads for the City of Nairobi under guidance from DURP professors, using city toposheets, city boundaries, road network files, railway network files. For the purposes of this study, GIS shapefiles for 2010 Land Use and 2005 Roadways in Nairobi were downloaded from the University of Nairobi website (University of Nairobi, 2013a, 2013b).

The World Resources Institute has an extensive database of geographic data for Kenya, including data on population, poverty, agriculture, land cover, land form, base data, elevation, rainfall, biodiversity and wildlife, tourism, water, irrigation, and hydropower (World Resources Institute, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2013g, 2013h). For the purposes of this study, GIS shapefile data was downloaded from the World Resources Institute including population, poverty, and base data (World Resources Institute, 2013a, 2013b, 2013c, 2013d, 2013e, 2013f, 2013g, 2013h).

### **Data Classifications**

Several classification groups were created to facilitate organization and understanding of the GIS analysis and results. Since the data from Map Kibera was

already classified by type, the Land Use shapefile from the University of Nairobi was first re-classified into several categorized shapefiles using GIS.

- The “education” data set was assigned for polygons listed as “college, kindergarten, paramilitary training school, school, training centre, university, and youth centre.”
- The “healthcare” data set was assigned for polygons listed as “clinic, health centre, hospital, water tank, or well.”
- The “economic” data set was assigned for polygons listed as “commercial, mixed CI, or industrial”
  - The “commercial” designation includes “bank, bakery, bar, casino, cinema, club, funeral home, guest house, hostel, hotel, market, media, petrol station, restaurant, supermarket, shops, shopping centre, travel agency.”
  - The “industrial” designation includes “brewery, construction, crematorium, dairy farm, dump, factory, feed farm, greenhouse, industrial bakery, mills, mortuary, oil depot, oil tank, oil refinery, pig farm, plant nursery, quarry, ranch, slaughterhouse, tannery, timber yard, warehouse.”
  - The “mixed CI” designation includes “permanent buildings that were larger than those in residential sections, did not have front and back yards, were relatively densely clustered, did not resemble residential estates or slum, and did not have any labels suggesting industrial uses. Structures that were labeled “[x] House” and appeared to be multi-story office buildings were categorized as mixed CI. Mixed CI uses include (but are not limited to) the following: arcade, high rise building, office building, plaza.”
- The “institutional” data set was assigned for polygons listed as “animal hospital, church, community centre, consulate, diplomatic residence, dispensary, embassy, fire station, garrison, government offices, institute, library, mausoleum, monument, mosque, museum, non-governmental organization (NGO), nursery, nursing home, orphanage, police booth, police depot, police post, police station, post office, prison, public hall, shrine, synagogue, temple, utilities.”

### **Spatial Analysis Tests**

To analyze the relationships between existing locations of economic areas, transportation, education, and healthcare, this study uses several statistical tests within GIS Spatial Analysis and Spatial Statistics. These tests examine mean centers, standard distances, and directional distributions to answer questions regarding

accessibility and distances from Kibera to economic uses, educational facilities, healthcare facilities, and institutional uses within Kibera and in the greater Nairobi area.

### **Distance Within Kibera**

The first spatial analysis test calculates different levels of distance within Kibera. Different distances between Kibera's 12 neighborhoods and between transit access points are calculated and illustrated in Figure 4-14

### **Distance from Kibera**

The second spatial analysis test determines different levels of distance from Kibera, at 0.3, 0.6, 1.0, 1.5, 2.0, 2.5, and 3-mile distance radii from the mean center of the Kibera neighborhood. For this analysis, 0.3-mile was selected as the first limit for distance, with 0.6 and 1.0 miles being the next segments. However, in the cases of Kibera and other slum areas where walking is the primary mode of transportation, residents have no other option than to walk longer distances than 0.3 mile to access goods, services, and employment. Buffered rings from the mean center of Kibera show the location of economic uses, healthcare facilities, educational facilities, and institutional uses. Breakout maps of the buffered distance are split up by economic uses, educational uses, healthcare, and institutional uses, followed by a discussion of the locations of each of these uses in relation to Kibera residents.

### **Directional Distribution**

The third spatial analysis test determines the Directional Distribution of the four land use categories. To do this, the Mean Center of each land use category is first calculated. The Mean Center test uses an average of x and y coordinates to determine the geographic center of the data points in a set, and is found under the Spatial Statistics and Measuring Geographic Distributions tool in GIS. The Mean Center is

calculated for each of the four categories, and is displayed on the Directional Distribution figures.

Once the Mean Center is determined for each category, the Directional Distribution test is run for each category. The Directional Distribution test measures whether a distribution of features exhibits a directional trend, and can be found under the Spatial Statistics tools in GIS. This test uses the form of an ellipse to represent the first standard deviation location of the data, where 68% of the points or polygons in the data set are located, and is centered around the Mean Center of the data set. The Directional Distribution ellipse is determined for each of the following land use category data sets: Economic Uses, Educational Uses, Institutional Uses, and Healthcare Uses. Once these are calculated, the direction and span of the ellipse for each land use type is then analyzed in comparison with the location of Kibera. The closer that Kibera falls to the ellipse, the better the access for residents to the majority of those land uses. In addition, if Kibera falls far from the ellipse, the direction and distance of the directional distribution can suggest the direction of transportation access needed from Kibera to that land use ellipse.

### **Expected Results**

The ultimate objective of this study is to evaluate current levels of place-based accessibility in Kibera, and determine if incorporation of public transit or alternative transportation strategies in the KENSUP Kibera redevelopment project would increase poverty reduction through improved access. Expected results include transportation accessibility analysis and recommendations that can be considered for incorporation into the KENSUP project. As an examination of transportation accessibility and poverty reduction strategies in the developing world, this study contributes to the body of

knowledge that currently exists on transportation systems and urban poverty in the developing world. Results from this study can be of critical use in the examination of governmental and transportation policies for the specific cases of Nairobi and Kibera, but more broadly, other areas of urban poverty across the world.

## CHAPTER 4 FINDINGS

Background information for this analysis section relies upon case study literature relevant to urban poverty, slums, accessibility, and transportation development. Setting the stage for analysis and application of transportation strategies to Kibera, the literature review explored the documented value of accessibility in poverty reduction, specifically transportation development relating to employment and access to basic services. Upon this knowledge of poverty and accessibility, the analysis can now turn directly to the case of Kibera in Kenya's capital city of Nairobi.

### **Background**

One of the world's largest and fastest growing continents is also one hardest hit by the phenomenon of urban poverty - Africa. Many other developing countries and regions have been able to pull ahead into relative economic stability and higher qualities of life, but Africa has had significantly more difficulty jumping over the hurdles. According to the World Bank, the international poverty line is now US \$1.25/per person/per day (Ravallion, M; Shaohua, C., & Sangraula, P; 2009). Compared to the global poverty rate of 22%, the continent of Africa leads the world with a 47.5% poverty rate, as of 2012 (UNDP, 2012b).

In addition to the highest poverty rates in the world, Africa's urban population is set to triple over the next 40 years, according to a recent report by UN-HABITAT (2010a) that estimates the continent's urbanization rate at 3.09%. Currently, urban residents in Africa represent around 11% of the world's urbanized people, but by 2050, they are estimated to represent around 20% (Berg, 2012). By 2050, "60% of Africans will be living in cities;" and most of that growth is estimated to take place in slum areas (UN-

HABITAT, 2010a, n.p.). UNFPA (2007, p. 3) concurs with UN-HABITAT's predictions, stating that "poor people will make up a large part of future urban growth."

However, Sub-Saharan Africa has been strongly challenged by the beginnings of rapid urbanisation, population growth, and new slum formation. Joan Clos, Executive Director of UN-HABITAT, describes these complex challenges of longer-term planning for Africa's urban centers, stating that "...Africa is not only confronted with the challenge of improving the lives of slum dwellers, but also the challenge of preventing the formation of new slums" (UN-HABITAT, 2010a, n.p.). UNFPA strongly argues in favor of action by developing countries and world leaders, asserting that "ignoring [poverty] will make it impossible either to plan for inevitable and massive city growth or to use urban dynamics to help relieve poverty" (UNFPA, 2007, p.3). Among reports by the UN, UN-HABITAT, and The World Bank, strong advocacy exists for national governments, together with international organizations, to take large steps in anticipation of these urban population increases, in efforts to "make a huge difference for the social, economic, and environmental living conditions of a majority of the world's population" (UNFPA, 2007, p. 3).

### **Goals of Analysis**

In light of the current challenges affecting slum areas in Africa's urban centers and the predicted challenges of population growth, this study has a two-fold purpose. Not only do current conditions and levels of poverty in Nairobi, and Kibera specifically, imply needs for continued attention by the GoK and City of Nairobi, but projections for urban population increases place urgency upon those needs for poverty reduction and capacity for these incoming populations.

To address concerns of poverty reduction for both current and future residents of Kibera and Nairobi, the ultimate objective of this analysis is to evaluate current levels of accessibility in Kibera, and determine if the incorporation of public transit or alternative transportation strategies as part of KENSUP would contribute to poverty reduction. To develop a working knowledge of Kibera, Nairobi, and Kenya in general, a brief description of Nairobi, Kibera, and KENSUP is followed by the GIS analysis.

### **Kibera**

*“Although slums universally invoke images of squalor, not all are equally bad. Slums vary – some have better access to water, others offer better quality housing units, and some are physically safer”* (Gulyani & Talukdar, 2008, p. 1918).

The case study for this study, Kibera, is located in a capital city with rich heritage and diversity. The 2006 Human Development Report estimated the population of Kenya at 33.5 million, with roughly a third of that population being urban. By 2020, the urban population of Kenya is projected to rise to 50% of the country’s population (Oxfam Great Britain, 2009, p. 8). Located in eastern central Kenya, the capital city of Nairobi has a population of between 3 and 3.5 million people (Oxfam Great Britain, 2009, p. 8; Scruggs, 2010). Nairobi has experienced significant growth in the past thirty years, and is estimated to continue rising at rapid rates – hitting a population of 5 million by 2020 and 6 million by 2025 (Oxfam Great Britain, 2009, p. 9).

While much of Nairobi has experienced economic success, almost  $\frac{3}{4}$  of Nairobi’s population lives below the International Poverty Line of US \$1.25/person/day and at least 60% of Nairobi is estimated to reside in a slum (Gulyani & Talukdar, 2010; Gulyani, Talukdar, & Jack, 2009; Oxfam Great Britain, 2009). According to Mulcahy and Chu (2008, n.p.), “Nairobi’s slums are among the most dense, insecure, and unsanitary

in all of Africa, and Kibera...has the unfortunate distinction of being the worst of the worst.” Many cite these deprived and unsanitary conditions as a result of “decades of indifference and neglect by both municipal and national governments,” states Mulcahy and Chu (2008, n.p.).

Historic ownership patterns, dating back to highly controlled and constrictive land policies under colonial British control, have contributed to the continued growth of Kenya’s slums (Mulcahy & Chu, 2008). A 2005 article by BBC News describes the history of Kibera dating back to 1920 when “British colonial government let a group of Nubian soldiers settle on a wooded hillside of Nairobi, with no title deeds” (BBC News, 2005). Though residents of Nairobi were given no deeds, the Kenyan government allowed the soldiers to build homes, set up businesses, and name the village Kibra – meaning jungle (Harding, 2002).

As years passed, and practices of “land grabbing” – politicians giving away public land to individuals for political support – reached its height in the 1990s, Nairobi never had the opportunity to develop proper housing markets, and residents of the Kibera area were never given any rights for land tenure after decades of informality. As rural-urban migrations began in the 1990s and continue into the 21<sup>st</sup> century, illegal migrations onto uninhabited government land in Nairobi led to the spread of slum areas around the city, increasing the population of Kibera from a few thousand to close to a million people (Harding, 2002).

### **Demographic Characteristics of Kibera**

One of the most debated and difficult to ascertain characteristics of Kibera is its population. In the 1999 Kenyan national census, Nairobi’s slums (including Kibera and other smaller slum areas) accounted for 640,000 people, however by 2004, was

estimated to have grown to 810,000 (Gulyani & Talukdar, 2008). While the GoK has estimated the current population of Kibera to be between 800,000 and 1.2 million people, other sources such as Map Kibera project estimates a significantly smaller population value - between 235,000 and 270,000 - based on door to door surveys and population density information (Carolina for Kibera, 2012; Map Kibera, 2010). It seems the definitions of “living” in Kibera account for much of the population debate, with informal housing and transient employment.

The average household size in Kibera is between 3-5 people, a relatively low rate that has been partly attributable to the high proportion of single-person households (almost a third (32%) of all households) (Gulyani & Talukdar, 2008). The majority of Kibera’s households are headed by men (72%), and Kibera’s population has a greater percentage of male residents than female residents, at a 55:45 ratio (Gulyani & Talukdar, 2008). Around half of Kibera’s population is estimated to be under 15 years old, due in part to the HIV/AIDS epidemic and large number of orphans in the city (Carolina for Kibera, 2012).

### **Spatial Characteristics of Kibera**

Kibera is located approximately 3.1 miles to the southeast of Nairobi’s Central Business District (CBD), and houses between 800,000 and 1.2 million people on 1 square mile of land (630 acres) (Mulcahy & Chu, 2008). While population estimates in Kibera have varied widely, it is said to be around 30 times as dense as central New York City (Mulcahy & Chu, 2008; Salon & Aligula, 2012). The Ngong River, Nairobi Dam, and Kisumu rail line serve as borders of Kibera, and physically limit the expansion of the slum. Terrain in the area is hilly, sometimes steep, and due to proximity to the Ngong River, several villages within Kibera frequently flood during the rainy season.

Figure 4-1 illustrates the location of Nairobi within the county of Kenya, and also the location of Kibera within Nairobi. Figure 4-2 illustrates the location and size of Kibera with respect to the City of Nairobi CBD. Kibera is comprised of 12 “villages”, which are illustrated in Figure 4-3: Lindi, East Soweto, West Soweto, Makina, Kianda, Mashimoni, Gatuikira, Kisumu Ndogo, Laini Saba, and Siranga.

### **Economic Characteristics of Kibera**

Kenya’s economy has been enduring its worst recession since independence in 1963 (Harding, 2002). The average income of Kibera’s residents is less than 10,000 Ksh. per month (around US \$114/month and \$1.25/day) – below the international standard of poverty (Mulcahy & Chu, 2008, p.11). The unemployment rate among Kibera residents is relatively high – 26% overall, 46% for youth, and 49% for women (Mulcahy & Chu, 2008). Household enterprises are operated by 31% of Kibera households, employing 19% of Kibera adults.

**Kibera’s Informal Economic Sector.** Not only has the recession trickled down into Nairobi, but also into Kibera as well. Several sources cite the dominance of the informal employment sector in Nairobi (Harding, 2002; Mitullah, 2003; Oxfam Great Britain, 2009), which continues to grow as Nairobi’s formal wage employment has been cited as static or on the decline. In Nairobi, along with many other large cities in Africa, the informal sector has continued to generate more employment than the formal sector (Mitullah, 2003, p. 4; Oxfam Great Britain, 2009, p. 11). The 2002 Economic Survey (GoK, 2002) estimated that during 2001, Nairobi’s informal sector employment grew by 176%, while the formal sector employment declined at -0.43% (Mitullah, 2003, p. 4). Oxfam also cites the enormous growth of Kenya’s informal employment, rising from 5.5 million in 2003 to 6.4 million in 2005 (2009, p. 11)

Most economic activities in Nairobi, and Kibera, are within the informal sector, which compete well to earnings that can be made in urban unskilled or agricultural wage employment (Mitullah, 2003). Categories under the informal sector that are common in Nairobi include: wholesale trade, retail trade, hotels and restaurants, manufacturing, industry, community, social and personal services, transport and communication, and construction (Oxfam Great Britain, 2009, p. 12). Kibera is home to a large number of small business activity, of every type imaginable for residents to earn an income.

While the informal sector can often be criticized, it has been shown to significantly contribute to Nairobi's economy, both for commercial and public enterprises (Mitullah, 2003). Figure 4-4 illustrates the formal economic uses in Nairobi, and Figure 4-5 illustrates the formal economic uses within 2 miles of Kibera – primarily shopping centers, restaurants, supermarket, and petrol stations. Map Kibera did not provide information about economic uses within Kibera, as most are informal and difficult to map. The majority of Nairobi's economic uses lie within the CBD and to the southeast, where there exist several factories and industrial sectors. However, both of those districts are at least a 3-mile distance from the nearest village of Kibera.

### **Transportation and Infrastructure Characteristics of Kibera**

Transportation infrastructure in both Nairobi and Kibera has been cited as “visibly below minimum standards” (Gulyani & Talukdar, 2008, p. 1921) and “exacerbating travel challenges for residents across all income groups” (Salon & Aligula, 2012, p. 65). Gulyani cites an “almost universal agreement – between policymakers, academics, city residents, development agencies, and other experts – that Nairobi's slums have inadequate infrastructure” (Gulyani & Talukdar, 2008, p. 1921).

**Modal Split.** Salon and Aligula (2012) found that “the vast majority of Nairobi residents walk or use public transport as their “most frequent means of travel”” (p. 67). While this modal split is similar to other African cities, Salon and Aligula (2012) note that while other cities in the developing world also have high levels of walking and public transportation use, “there is often also significant use of bicycling and motorized two- and three- wheelers” (2012, p. 69). However, in Nairobi, the presence of motorized two- or three-wheeled vehicles is not as prevalent or influential to transportation in the city as in other African cities.

### **Road and Bus Network**

Kibera has no paved road network, and very limited vehicular infrastructure. Transportation within Kibera is primarily served by several informal walking paths throughout dirt paths between huts. “...*without any public transportation and a lack of roads leading to and from the city, physically leaving Kibera is quite challenging*” (Reidy History, n.d., n.p.). Poor transportation accessibility – created by “an organic urban pattern with narrow, uneven roads and footpaths that are prohibitive to vehicles” – has continued to magnify the environmental, social, economic, and health issues that Kibera faces (Mulcahy & Chu, 2008, p. 12).

Major roadways to enter and exit Kibera are located on the eastern and western sides of the area, and the north and south borders are significantly more difficult to enter or exit. Two government-operated bus lines currently traverse roads that neighbor Kibera – including Joseph Kangethe Road/Kibera Road (through Northwest Kibera) that connects Western Nairobi with the Nairobi CBD. Figure 4-6 illustrates the location of the nearest bus stops and location of walkways through Kibera.

Six bus stops serve the Kibera territory along Kibera Road, which are within walking distance from most of the Northern and Western neighborhoods of Kibera. The only other bus line accessible for Kibera residents is to the East of Kibera, along Mbagathi Road by the Kimalei Primary School, and at the intersection of Mbagathi Way and the entrance to the Soweto neighborhood of Kibera at the very east. Four bus stops are located within walking distance of Eastern Kibera neighborhoods, however all four are outside of Kibera, with two along a major roadway, Mbagathi Way, and two within a residential neighborhood.

### **Walking in Kibera**

The majority of Kibera's residents use walking as their most frequent mode of transport. While this is a good thing from an environmental and congestion perspective, it has both productivity and safety impacts. Since Kibera's residents are forced to walk long distances "because they cannot afford motorized modes, the high fraction of walking also reflects a physical and time burden for basic travel needs" (Salon & Aligula, 2012, p. 72).

### **Matatus**

Informal fleets of privately-owner "matatu" taxi buses are the major means of public transportation around Nairobi, and function as the paratransit system of Nairobi; no formal system exists, according to Salon and Aligula (2012). Matatus are typically 14- and 25- seater minivans, and are known for being very quick at bringing people from points of interest (McKinley, 1996). Close to two thirds of Kibera residents say they use these informal "matatus" for work-related travel, followed by buses and walking (Salon & Aligula, 2012). The average roundtrip price of a matatu trip is estimated to be around

Ksh. 50 (US \$0.57), but prices can vary depending on location or time of day (Mitullah, 2003, p. 14).

However, matatus have notoriety for breaking traffic rules and low levels of safety (McKinley, 1996). “Drivers are legendary for their recklessness, and the police blame them for Kenya’s high death toll on the road – 2,617 last year [2008]” (Polite Notice, 2011). Compared to the average price of rent in Kibera, around Ksh. 750 (US \$8.56) per month, the prices of “matatus” are not cheap when taken every day to and from work.

Table 4-1. Comparative Avg. Monthly Prices for Kibera Residents

Category	Average Price (Ksh.)	Average Price (US \$)
Education	2,500	\$28.50
Food	5,000	\$57.07
Healthcare	750	\$8.60
Housing	750	\$8.60
Income	6,000	\$68.50
Matatu Round Trip	50	\$0.57
Water	200	\$2.28

(Mitullah, 2003, p. 14)

While matatus are ubiquitous on paved roadways throughout Nairobi, very few are physically able to enter into Kibera due to the lack of paved roadways. Therefore, to find and board a matatu, residents must leave Kibera or exit to one of the major adjacent roadways. Only a few matatu lines stop in Kibera. The 32 Route Matatu, the Kibera (via Argwings Kodhek Rd) line, takes Kenyatta Avenue, Serena, Panafric, Valley Road, Argwings Kodhek Road, Hurlingham, Kilimani, Yaya Centre, Ring Road Kilimani, Adams Arcade, Kibera Drive, and Kibera Ayany Estate (Jambo Nairobi, 2011a).

The Government of Kenya (GoK) and City of Nairobi have debated for years if they should regulate the matatu industry or convert it into a cooperative structure, but have received significant amounts of criticism (McKinley, 1996). While the regulation

could provide benefits for residents, it could also make transport relatively more expensive and force many matatu operators out of their jobs. While other large African cities have provided precedent of regulated bus lines (such as Cape Town and Johannesburg, South Africa), many argue that Nairobi's matatu operators don't have expertise required to run cooperative industries (Polite Notice, 2011).

Despite public criticism, the City of Nairobi made significant and controversial changes to Nairobi's matatu ownership structure in January 2011. The changes essentially forced all single-owner matatus to form special associations ("saccos") to "encourage more responsibility and accountability among owners and drivers to whom they rent out their vehicles" (Polite Notice, 2011). While many support the changes, others claim an emphasis on accountability will inevitably incur additional costs that will be passed down to matatu users, making transit more expensive and encouraging the use of private cars or taxis.

### **Rail Transportation**

The Kisumu Rail Line is a regional rail line that originates in the city of Kisumu, to the west of Nairobi, and connects with Nairobi and neighboring country of Uganda. The Rail Line passes through Kibera as it approaches Nairobi, and separates the north and south neighborhoods of Kibera. Stations in Kibera were active until 2008, when they were closed due to safety, vandalism, and high operating costs. As a result, the Kisumu Rail Line makes no stops in Nairobi until it reaches the Nairobi Railway Station (Sanga, 2008).

### **Transportation Safety in Nairobi**

Traffic safety is a significant issue in Kenya, and Nairobi especially. A 2002 report by Odero, Khayesi, and Heda (2002) claimed that over 3,000 people are killed annually

on Kenyan roads (Odero et al., 2002). Nairobi tops the global list of pedestrian fatality rates, at 65% (Khayesi, 2005), seconded by 54% (Donroe, Tincopa, Gilman, Brugge, & Moore, 2008) in Latin America, 42% (Ackaaha & Adontengh, 2011) in Ghana, compared to 12% in the United States (Dovom et al., 2012, p.1).

Nationally, Kenya has one of the highest road fatality rates compared to vehicle ownership in the world, at an average of 7 deaths per the 35 crashes that occur each day (Assum, 1998), amounting to around 3,000 deaths on Kenyan roads each year. As Odero et al. (2002, p. 53) notes, Kenya's rates are between 30-40 times greater than other "highly motorized countries." Not only are these rates high when compared to other countries, but these rates have continued to experience rapid increases not only in number, but in terms of magnitude and mortality (Odero, 200, p. 53).

In addition to overall increases in crash numbers, the mean number of casualties per crash increased, reflecting the frequent involvement of matatus and buses with higher passenger loads than private vehicles. As the third leading cause of death in Kenya (after malaria and HIV/AIDS), traffic safety presents a major public health concern not only to citizens who own and travel via private vehicle, but also pedestrians and passengers of matatus. In Odero et al. (2002), pedestrians and passengers were found to be the most vulnerable group of roadway users, accounting for 80% of vehicle related deaths in Kenya (Odero, 2002, p. 53).

In Nairobi specifically, Odero et al. (2002) and Salon and Aligula (2012) both examined detailed traffic safety patterns and found several applicable trends that can further inform transportation recommendations. In the Nairobi region, 68% of fatalities were pedestrians, compared to other more rural regions where passengers were the

primary casualties involved in the crash (p. 54). The Kenyatta National Hospital in Nairobi has also reported overrepresentation of pedestrians (64.5%) and passengers (22.8%) (Said, 2000). Crashes that involve pedestrians are 17% of the total Nairobi crash levels, with 8.8% involving driver fatality and 3.2% involving bicyclist fatalities (Odero et al., 2002, p. 56, based on data from National Road Safety Council, 1992). In Nairobi, the majority of the fatality and injury victims from these crashes are between the ages of 15 and 44 years (76%) – as Odero et al. (2002) notes, “the economically active and productive population” (2002, p. 57).

In Nairobi, 62% of all reported crashes involved public transportation vehicles, which can be attributed to the number of buses and matatus involved in the urban region of Nairobi (Odero, 1995, p. 54). While matatus and buses only account for a small portion of traffic crashes, buses constitute only 3.7% of the total registered vehicles in Kenya. For matatus, vehicle registration is based upon the make of the vehicle, not whether they are used for carrying passengers.

**Implications.** Not only do these high pedestrian fatality rates indicate dangerous environments for pedestrian travel within Nairobi, but they could also suggest a lack of emergency services and access to medical treatment after crashes. Salon and Aligula (2012) also cite high risk for pedestrians and bicyclists while traveling in Nairobi - “the widespread lack of pedestrian and bicycle infrastructure increases the risk that they face when traveling” (Salon & Aligula, 2012, p. 65).

Odero et al. (2002) attributes the rising numbers of traffic injuries and fatalities in Kenya to “...poor public transport system with special reference to buses and matatus; deficiencies in road network development and maintenance; and deficiencies in road

safety planning, management, and interventions” (2002, p. 59). Odero et al. (2002) also cites the basic lack of safety features that most buses and matatus have - “the frequent involvement of buses and matatus in road crashes also indicates their general lack of basic safety features for passengers...these vehicles are overloaded, poorly built, have easily detachable seats, and are often driven recklessly at excessive speed” (2002, p. 60). Though it is likely that the lack of matatu safety features contribute to crash rates and fatalities, transportation safety interventions should take a closer examination of crash rates within Nairobi. A more detailed analysis has not been conducted to evaluate the location of crashes to determine the nature of relationships between crash location, access to emergency services (ambulance, hospital, clinic), and fatality rates.

### **Housing Characteristics of Kibera**

Housing in Kibera is crowded, unsanitary, and primarily impermanent and illegal. Since Kibera is located entirely on land owned by the GoK, Kibera’s residents do not have secure tenure and occupy land informally. Of Kibera’s population, only 8% are owner-occupiers, and, of those, 60% are residents. Another 5% of Kibera’s population are “absentee landlords,” who do not live in the slums but collect rent (Gulyani & Talukdar, 2008, p. 1921).

The average size home in Kibera is 10’ x 10’, with an average of 1.2 rooms per household, and 2.6 persons per room (Gulyani & Talukdar, 2008). Homes are typically constructed as mud huts, and paths between houses are irregular, often with ditches running down the middle. The vast majority (88%) of homes have impermanent walls and tin roofs (98%) (Gulyani & Talukdar, 2008). Despite their impermanent status, rent prices are significant when compared to the average income of Kibera residents at an average of US \$11/month (26% of Nairobi’s average income).

**Informal Land Tenure.** Nairobi's land tenure system provides one of the largest and most complicated challenges to improving Kibera and other slums in the city. Nairobi's informal land tenure began in the 1920s when the British colonial government allowed a group of Nubian soldiers from Sudan to settle on the land that is now Kibera – temporarily. After World War One, the British decided to allow the Nubians to remain on the land, but they never gave them the title deeds to their new land.

Since that time, a large number of people have moved into Kibera, some managing to acquire their own piece of land to squat on, and the majority renting their huts from landlords. With no rightful title deeds in Kibera, “absentee landlords” pay no taxes on collected rent, and have no legal requirement to provide any services – sanitation, water, electricity, trash, infrastructure, housing – to tenants (Mulcahy & Chu, 2008, p. 11). Landlords are said to own as many as 1,000 units in Kibera, receiving “a significant amount of tax-free rent” (Mulcahy & Chu, 2008, p. 14). According to a study by the University of Nairobi, out of 120 of the landlords interviewed, 57% were either government officials or politicians (Affordable Housing Institute, 2005). In conclusion, very low incomes, combined with high rates of irregular employment and lack of land tenure contribute to a complicated economic situation that has severely hindered progress in Kibera (Mulcahy & Chu, 2008).

### **Sanitation and Utility Access**

One of the greatest challenges in such a dense informal settlement is provision of sanitation and utility access. In an article by BBC News (2005), a 67-year-old Kibera resident describes his living conditions within Kibera, sharing one room with his eight children and wife. Sentiments expressed by this article and several others describe “the rich stench of almost 1 million people living in this ditch – in mud huts, with no sewage

pipes, no roads, no water, no toilet, in fact, with no services of any kind” (BBC News, 2005). The intense overcrowding and severe lack of utility and sanitation in Kibera “present the greatest physical challenges” to poverty reduction (Mulcahy & Chu, 2008, p. 11).

**Sanitation.** Several of Kibera’s villages border the Ngong River - particularly the Soweto East village, where the dumping of waste has caused “perpetual degradation of the environment and water quality” (Mulcahy & Chu, 2008, p. 11). Pollution resulting from pit latrines, ditches, and dust from unpaved roads and footpaths has also contributed to disease and waste problems, and severely affects the quality of nearby drinking water sources. Studies by the Nairobi Cross-Sectional Slums Survey of 2000 and the Kenya Demographic Health Study of 1998 found that Kibera’s residents are far worse off when compared to residents of Nairobi in general (Mitullah, 2003).

Water is scarce in Kibera, and where it is plentiful, it is contaminated. Kibera’s water scarcity can be traced to a number of factors, including political exclusion, water mafias, water rationing, and poor infrastructure. Of the approximately 650 water vendors in Kibera, 98% (637) are private enterprises and 2% (13) are run by community based organizations and NGOs (M-Maji, 2013). The price of a 4-gallon can of water is typically around Ksh. 2-3, however during shortages, the prices can skyrocket to Ksh 5-10 or even Ksh 30 (M-Maji, 2013). During these shortages, residents can spend all day looking for water, and if they do not find clean water, will consume potentially contaminated water from free yard taps or springs (M-Maji, 2013).

**Utilities.** Around 24% of slum households in Nairobi were estimated to have access to piped water, as compared to 92% of the entire Nairobi population (Mitullah,

2003, p. 11). As of 2008, around 25% of Kibera residents were found to have access to piped water, private toilet, public sewer, working drain, public garbage collection, or electricity, according to Gulyani and Talukdar (2008, p. 1922). Within the Soweto East village, approximately 70,000 residents live with access to only 100 toilets and 50 baths (Mulcahy & Chu, 2008, p. 11).

Dating back as long as 1993, a commentator on urban issues for the Nairobi City Council observed, “the provision of basic urban services has not kept pace with the rapid growth of the city [Nairobi]. The vast majority of the urban poor do not have access to such services, which are inadequate and not properly maintained. Whereas the urban population has doubled in size during the past decade, infrastructure development has proceeded far more slowly” (Mulcahy & Chu, 2008, p. 10).

**Sanitation and Utility Costs.** While Kibera lacks severe access to sanitation, water, and utilities, the costs for these services are significantly higher than other regions of Nairobi, even wealthy neighborhoods. Several studies have shown that Kibera’s residents often pay higher fees for water or sanitation services such as toilets (Mitullah, 2003, p. 11). In addition to extremely high water and sanitation costs, fees for electricity are also high. “Stealing” electricity off of legitimate power lines on the western edges of Kibera has fueled a market for electricity that can run around Ksh 300 per month (between US \$8 and \$9) (Odbert, 2011).

Kibera households can spend up to 20% of their income on water – equal to the cost of rent (M-Maji, 2013). Control of water vendors and water supply by private vendors and cartels is one reason behind the extremely high prices of water within Kibera (M-Maji, 2013). To raise profits, vendors and cartels can create artificial

shortages, or ration concentrations of water to a select number of vendors within Kibera to create scarcity.

### **Educational Characteristics of Kibera**

Though Kibera residents face daily challenges in sanitation and housing quality, Kibera boasts high rates of primary education. Approximately 75% of Kibera's population have completed primary school, a rate that rivals Kenya's national education rate (Oxfam Great Britain, 2009, p. 10). At the secondary school level, however, the education rate drops to less than 33% of Kibera's population. Since the majority of Kibera's population have relatively high primary education and literacy levels, several organizations have acknowledged "high potential for capitalizing on [Kibera's] human capital assets" (Oxfam Great Britain, 2009, p.10).

High rates of primary literacy in Kibera, and Nairobi in general, can be primarily attributed to the Free Primary Education (FPE) program developed by the GoK in 2003. A significant need was acknowledged by the GoK for improved access to basic education, and currently, 92% of Kenya's children from age 6 to 14 are enrolled in primary school (Achoka et al., 2007). The primary education cycle in Kenya lasts 8 calendar years and the FPE has encouraged the transitions from primary to secondary school, improving rates from 40% to 70% between 2003 and 2008 (Achoka et al., 2007). As a result, 95% of Kibera's children are literate, and 78% have completed primary school (Gulyani & Talukdar, 2008). While Kibera's children are literate and capable of further technical training, many adult residents of Kibera missed the FPE program and have lower levels of literacy and basic skills for employment. While the FPE program has improved literacy levels for today's children in Kibera and Nairobi,

Mitullah (2003) points to the severe lack of adult training establishments accessible to Kibera residents.

Gender gaps also exist in Kibera's educational sphere. For the most part, Kibera men have higher levels of education than Kibera women (Mitullah, 2003, p. 14). One 1997 interview of female Kibera residents by Mitullah found that none of the 10 interviewees had secondary education, 7 had attended primary school, and the remaining 3 were illiterate (Mitullah, 2003). More recently, the Pamoja Trust Database (2001; in Mitullah, 2003) confirmed this trend in an enumeration of slum students in school, stating that more boys than girls were enrolled in Kibera schools.

Kibera has several government-run public schools – the Olympic Primary School, Kibera Primary School, PCEA Silanga High School, Raila Educational Centre, and Olympic Secondary School. Figure 4-7 shows the location of the educational uses in Nairobi, and Figure 4-8 shows the location of the educational uses within Kibera. The PCEA Emmanuel Technical Training Centre offers self-employment skills to Kibera residents, and is one of many schools owned by the Presbyterian Church of East Africa. While Kibera has relatively close access to a few colleges and universities, these have high tuition fees and not available to children with only primary education backgrounds. Achoka et al. (2007) concludes that many of Kibera's education centers are often informal and located in random buildings, behind shops, part of churches, and that these schools are "far away from homes of the learners, who must then walk long distances only to arrive when they are too tired to access meaningful education" (Achoka et al., 2007, p. 279). Many of the schools within Kibera are owned and operated by churches and NGOs.

## Healthcare Characteristics of Kibera

The highly dense, congested, and unsanitary living conditions within Kibera have contributed to a dangerous health environment for residents. Kibera suffers from very high rates of infectious disease, and the presence of solid waste, degraded water and environmental quality, and pollution contribute to persistent contamination (Mulcahy & Chu, 2008, p. 11). Figure 4-9 shows the location of healthcare facilities in Nairobi, and Figure 4-10 shows the location of healthcare facilities within 2 miles of Kibera. Though a handful of large hospitals are located close to Kibera, several challenges exist for Kibera's residents, primarily financial and spatial. Besides the provision of hospitals outside of Kibera, one large health care centre is located within Kibera, and several other clinics within Kibera. No government hospitals or clinics can be found in Kibera. Medical facilities within Kibera are owned and operated by churches, international aid organizations, or NGOs.

**HIV/AIDS.** The HIV/AIDS pandemic continues to have a large impact on Kibera, with 10-25% of residents currently estimated to be infected with the virus (Carolina for Kibera, 2012). The pandemic has had significant effects upon demographics, mortality rates, economics, and access to education for primary age children and orphans. Over 600,000 of Kenyan children, in 2003, were living with HIV/AIDS and a majority of those are assumed to be living in Kibera (Achoka et al., 2007, p. 280). The HIV/AIDS pandemic has also been linked to the rapid growth in the number of orphans, an increase in number of street children, and massive strain on extended family and public welfare services (Achoka et al., 2007, p. 280).

## **Institutional Characteristics of Kibera**

Kibera is home to a multitude of churches, mosques, non-governmental organizations, and several other institutions that fuel the cultural and social lives of its residents. As previously noted, many of Kibera's churches and institutions play multiple roles, as schools, health clinics, and community centers. Figure 4-11 shows the location of the institutional uses in Nairobi, and Figure 4-12 shows the location of the institutional uses within 2 miles of Kibera.

### **Government of Kenya Plans for Slum Improvement**

The GoK embarked upon creating their first *Medium Term Plan (MTP) – Vision 2030* in 2008 (GoK, 2008). The MTP addresses several aspects of economic development, infrastructure development, acknowledging the “large disparities in incomes and access to education, health and land, as well as to basic needs, including: clean water, adequate housing and sanitation” (GoK, 2008, p.3). Infrastructure is the first “foundation for national transformation” that the GoK relies upon as “enablers,” claiming they create and sustain economic growth (GoK, 2008, p.16).

As of 2008, the MTP estimated national infrastructure sector spending to be 2.6% of the Kenya GDP and 13.4% of overall GoK expenditure (GoK, 2008, p. 16). A National Integrated Transport Policy (NITP) was created in 2004 to address challenges in the Kenyan sub-sector, and covers issues like transport infrastructure planning, development and management, legal, institutional and regulatory frameworks, safety and security, funding, gender mainstreaming, as well as environmental considerations. (GoK, 2008, p. 17).

Between 2008-2012, the GoK describes several of their program initiatives:, including a National Span Plan, National Integrated Transport Master Plan, Nairobi

Metropolitan Region Bus Rapid Transit (BRT) System, Development of Light Rail for Nairobi and its Suburbs, and others (GoK, 2008, p. 20). Following in the steps of many large cities, the Government has identified 3 different corridors to use for BRT in Nairobi: Athi River Town to Kikuyu Town (approximately 38km), Thika Town to the CBD (approximately 50km), and Jomo Kenyatta International Airport to the CBD (approximately 25 km) (GoK, 2008, p. 21). The proposed Nairobi Light Rail service covers similar areas, and expects to stretch from Nairobi Railway Station to Embakasi/Jomo Kenyatta International Airport – 15.6 kilometers and serving around 150,000 daily passengers (GoK, 2008, p. 21).

### **National Infrastructure Plans**

As part of the GoK's *First Medium Term Plan – Vision 2030* (2008, p. x), the GoK states that “the development of high quality national physical infrastructure is a critical foundation...” The MTP includes nine infrastructure strategies (GoK, 2008, p. 20):

1. Strengthening the institutional framework for infrastructure development;
2. Developing and maintaining an integrated, safe, and efficient transport network;
3. Benchmarking infrastructure with globally acceptable standards;
4. Integrating information communication technology in infrastructure services provision;
5. Implementing infrastructure projects that support development in neglected areas;
6. Development of a plan to optimize the development and utilization of infrastructure facilities and services;
7. Modernizing and expanding inland port facilities;
8. Identifying, developing, and retaining the requisite human resource to maintain infrastructure; and
9. Enhancing private sector participation in the provision of infrastructure.

Not only does the Government acknowledge needs for a stronger institutional framework for infrastructure development in Kenya, but also the efficiency and quality of infrastructure and speed with which it can be implemented (GoK, 2008). Within 5 years, the GoK aimed to have 64,500 kilometers of “well-maintained and motorable roads with a total of Kshs. 186 billion (US \$2.122 billion) spent on road construction and upgrade” between 2008-2012 (GoK, 2008, p. x). Other major transportation infrastructure projects noted include “the development of a Rapid Bus and light rail system in the Nairobi Metropolitan area, which is expected to serve as a prototype for the other main urban areas in the country” (GoK, 2008, p. x).

The commitment of several international agencies to the global reduction of poverty, primarily through the MDG program, has been reflected by the nation of Kenya, as well as the City of Nairobi. The MDGs appear Kenya’s national development plans, and are highlighted as a “key task in the National Economic Recovery Strategy” (Government of the Republic of Kenya, 2003). The living conditions in Kibera have led to a significantly diminished quality of life and incredibly stressful living environment for Kibera’s residents (Mulcahy & Chu, 2008, p.11). As one Kibera resident said, “life is tough here...it’s full of challenges, poverty and stress, that’s what it’s about here” (BBC News, 2005). In combination with an extensive history of government-promised upgrade projects, current conditions have left a large majority of Kibera residents skittish and distrustful of government intervention for redevelopment.

### **Nairobi Railway City Development**

A large projects that could have significant effect upon Kibera in the near future is the proposed “Railway City Development.” As the host to many international companies and organizations, the City of Nairobi is proposing the creation of a 200-acre Railway

City to serve as a heart of business, financial, and government within the current CBD. Occupying around 35% of the existing CBD, the proposed development will include a hub for commuter inter-city and regional passenger rail traffic and a direct rail link to Jomo Kenyatta International Airport (Kenya Railways Corporation, 2008, slide 3). The Railway City is also planned to include a variety of commercial buildings, a business park for light manufacturing, 2 hotels with conference facilities, shopping arcades, malls, restaurants, parking silos, and adequate infrastructure to support development. Railway access to the new Nairobi Railway City could be tied with future rail expansion plans of the Kisumu Rail Line through Kibera or development of alternate rail routes.

### **Kenya Slum Upgrading Program**

Acknowledging the magnitude of poverty and need for action, Amos Kimunya, Kenya's land minister, submitted a proposal for upgrading slums in Nairobi to the Cities Alliance Program in 1999 (GoK, 2007). The next year, President Moi met with the executive director of UN-HABITAT to create the Kenya Slum Upgrading Program (KENSUP) (Mulcahy & Chu, 2008, p. 10; University of Pennsylvania School of Design, 2008; Scruggs, 2010). KENSUP was created as a national program administered through the Kenya Ministry of Housing, and funding has been provided through the Ministry (University of Pennsylvania School of Design, 2008). The funding breakdown of the initial project included US \$240,000 from Cities Alliance, US \$60,000 from Kenya's Ministry of Roads, Public Works, and Housing, and US \$110,000 from UN-HABITAT.

### **Goals of KENSUP**

The goals of KENSUP focus upon project implementation in slums areas around Kenya that need improved housing and access to basic services, secure tenure, and opportunities to generate income (GoK, 2007; Mulcahy & Chu, 2008, p. 10; Scruggs,

2010). A new national Housing Policy was passed by parliament in 2004, recognizing that “all people have the right to housing and secure tenure” and establishing the key components of slum upgrading (University of Pennsylvania School of Design, 2008, n.p.).

The program aims to “do more than just converting cardboard boxes into concrete boxes” and accomplish a “comprehensive upgrading of the slum” (BBC News, 2005). At the beginning of the project, KENSUP committed around \$6.6 million to “sort out the lives of people living in Kibera...through a comprehensive program of upgrading the slum beyond just putting up new houses” (BBC News, 2005; GoK, 2007). The plan aims to improve the lives of residents by providing new housing, education facilities, playing grounds, job opportunities, and HIV/AIDS prevention and protection programs.

Ministries of the Kenyan national government involved with KENSUP include: Housing, Office of the President, Lands, Local Government, Roads and Public Works, Finance and Planning, Trade and Industry, Health, Water and Irrigation, Information & Communication (Government of Kenya Ministry of Housing, 2013).

Several of KENSUP’s village-specific projects aim to facilitate the provision of secure tenure, improved housing, income-generating activities, and physical and social infrastructure (Mulcahy & Chu, 2008, p.10). Partnerships at the agency and local levels have been critical in development of the institutional structure and process, and have continued to evolve as the project continues (Mulcahy & Chu, 2008, p.10). The project is not only aimed at physical improvements to Kibera, but also working with the residents to ensure successful implementation (GoK, 2007). The executive director of UN-HABITAT, Anna Tibaijuka, commented that “if you really want to benefit the poor,

you have to spend time on what we call social organization, otherwise you might upgrade the slum and people who have better incomes will come and take over” (BBC News, 2005). According to her, “physical construction is actually the easiest part” (BBC News, 2005).

### **KENSUP Soweto East Pilot Project**

The first KENSUP project is in Kibera, in the Soweto Neighborhood. The Kibera Soweto Pilot Project was launched in 2004 and has been estimated to require approximately US \$11.5 billion to complete through 2020 (University of Pennsylvania School of Design, 2008). The Soweto East neighborhood is the neighborhood furthest to the east of Kibera, and is closest to Nairobi CBD. Thus far, the Kenya Ministry of Housing has allocated Ksh 485 million (US \$5.53 million) on the Soweto site, and Ksh 90 (US \$1.03 million) to a 0.5-kilometer roadway in the Soweto East neighborhood.

Between the years of 2004 and 2004, several studies were completed in Kibera, including socio-economic mapping, physical mapping, enumeration, and a proposed master plan (University of Pennsylvania School of Design, 2008). These plans also include community involvements and education to residents about KENSUP (Fernandez & Calas, 2010). In Fall 2005, construction began on a temporary housing site for residents of Soweto East to be placed while new housing is constructed (GoK, 2007). In 2006, the Kibera Integrated Water, Sanitation, and Waste Management project was initiated, and has been addressing Kibera’s infrastructural needs: water, sanitation, draining, and garbage (Fernandez & Calas, 2010; GoK, 2007; University of Pennsylvania School of Design, 2008).

Thus far, the project has reached out to the Soweto community extensively, electing a committee of 18 for the Settlement Executive Committee (SEC) to represent

various community groups – structure owners, tenants, youth, disabled, non-governmental organizations (NGOs), and widows (GoK, 2007; University of Pennsylvania School of Design, 2008). As discussed in the literature review, it is essential that any infrastructure project have a key element of community involvement and participation. The SEC looks to the “the link between the community, KENSUP, and the government,” and must continue allowing the project to be sensitive to the Kibera community (University of Pennsylvania School of Design, 2008).

With such a large project bringing transformational changes, major issues have arisen in the project since its launch in 2004, and are expected to continue (Fernandez & Calas, 2010). Clashes between KENSUP, UN-HABITAT, and Kibera residents over ideology and approach have escalated, with the University of Pennsylvania School of Design claiming “the UN advocated for in situ upgrading, rather than the form of redevelopment that KENSUP and Ministry of Housing have planned” (2008). Questions of permanence of the development concern UN-HABITAT, while other concerns regarding the staff, funding, and knowledge capacity to fulfill the proper implementation have also arisen. Concerns regarding the SEC have also arisen regarding the presence of communication, quality of information, and process by which SEC representatives were elected (Scruggs, 2010; University of Pennsylvania School of Design, 2008).

### **KENSUP Transportation Improvements**

While the Soweto East Project is quite comprehensive, addressing infrastructure, housing, and health, it also includes transportation infrastructure. The Soweto East Pilot Project will include a new 2.6-mile roadway and associated infrastructure parallel to the Kisumu railway line passing through Kibera (Fernandez & Calas, 2010; GoK, 2007; GoK Ministry of Housing, 2011). Proposed physical infrastructure include: roads and

walkways, stormwater drainage, water reticulation, street and security lighting, sewer infrastructure, business stalls, bus stops, public toilets, and environmental and solid waste management (Fernandez & Calas, 2010; GoK Ministry of Housing, 2011). The majority of funding and physical area required for the KENSUP project allocated to transportation is for construction of this commercial road corridor parallel to the Kisumu rail line. These proposed transportation improvements can be seen in Figure 4-13.

Though the emphasis by KENSUP seems to be on vehicular transportation developments, the vast majority of Kibera's current residents use walking as their primary mode of transportation (UN-HABITAT, 2007). The current feasibility of vehicle ownership and use is very low in Kibera due to several factors - cost, spatial parking and use constraints, and lack of roadway facilities (Mulcahy & Chu, 2008, p. 17), and it seems likely that the incorporation of transit or alternative strategies could be more appropriate for the resident's current primary mode of transportation.

### **How Can KENSUP's Transportation Plans Be Improved?**

In this next section, the KENSUP plans for Soweto East are spatially analyzed along with current levels of spatial, economic, infrastructure, education, and healthcare accessibility. Current levels of accessibility and distances between Kibera and key points of interest are determined, which further provide the data background for the use of several GIS spatial analysis tests. The results from the spatial analyst tests greatly inform the final stage of analysis, in which GIS is used to examine potential transportation and land use strategies that KENSUP could incorporate into their plans for Kibera, for increased effectiveness and poverty reduction.

## **Results of Spatial Analysis Tests**

The use of GIS was instrumental in displaying several spatial relationships between Kibera and Nairobi resulted in many findings that can inform the levels of current access that Kibera residents have to the four different land use categories in this study: economic uses, educational uses, institutional uses, and healthcare. The analysis also illustrated the general size and direction of these land use categories. By evaluating these spatial trends, well-informed recommendations can be made about locations that types of public transportation or alternative transportation strategies recommended as part of KENSUP should be oriented towards.

### **Economic Access**

As previously mentioned in this study, the majority of employment and economic activities in Nairobi and Kibera are in the informal sector, and are not represented through this GIS analysis. Trends in formal employment, however, can be explored in the analysis of the formalized economic development data. The location of most formal economic development in Kibera appears to align with the location of Nairobi's Central Business District, and is around 3 miles in distance from the center of Kibera.

Based upon the spatial analysis, Kibera overall lacks access to formal economic opportunities. The average distances from the center of Kibera to various economic uses are displayed in Figure 4-16 and Figure 4-17. Within 0.3 miles, the only formal economic opportunities include a hotel, market, shop, and two shopping centers. As distance from the center of Kibera increases, so does the number of economic opportunities that can provide potential employment.

The number of formal economic uses and select uses is illustrated in Figures 4-18 and 4-19, with a total of 256 economic opportunities within a 3 mile radius of Kibera.

The greatest number of individual economic uses in this category, within 3 miles of Kibera, are petrol stations (55), hotels (45), factories (29), and shopping centers (18), detailed in Table 4-2. The number of hotels, petrol stations, and factories increase significantly between 2.5 and 3 miles from Kibera, as seen in Figure 4-19.

For some economic activities, such as factories, a few exist within a mile of Kibera, and within 3 miles, 30 factories are present (in the Industrial Area to the East). Mitullah agrees, stating that “Kibera, one of the largest slums [in Nairobi] has access to the Industrial Area. Most slum dwellers walk to work in the morning to the industrial area and nearby sources of employment” (Mitullah, 2003, p. 8). A handful of office buildings and shopping centers, are within a mile of Kibera, but most are located between 2-3 miles from Kibera’s city center, in and around the CBD.

### **Educational Access**

Based upon the spatial analysis, Kibera has significant access to educational opportunities. The average distances from the mean center of Kibera to a variety of educational uses are displayed in Figure 4-20 and Figure 4-21. Kibera boasts a large number of schools when quantitatively compared to other categories - 160 within a 3-mile radius - as opposed to 256 overall formal economic uses and 36 healthcare uses – listed in Table 4-3. Nineteen schools are located within a 0.3-mile radius of Kibera, however as noted by Gulyani and Talukdar (2008), this number may or may not include informal institutions and schools operated by NGOs and churches. Figures 4-22 and 4-23 illustrate the exponential growth in the number of schools as the distance from Kibera increases. The only colleges, universities, and higher levels of learning are at least a mile away, with University of Nairobi Kenya Science Campus around 4 miles to the West and Strathmore Business School 1 mile to the East.

Compared with economic access, the patterns of schools are spread more evenly across the greater Nairobi area and throughout Kibera as well. While this ensures greater access to a greater number of residents, it also makes it more difficult to estimate transportation patterns and determine transportation system needs for modification of any existing transit services, such as the public buses and matatus. The location of most formal educational uses in Kibera is more expansive in nature than that of economic uses. This indicates that Kibera offers broader and more far-reaching availability to its residents for education than economic uses. While this is good news for the half of Kibera's population below the age of 15, it can also presents opportunities for adults to take part in adult education programs at institutes, technical centers, or community centers

Compared to the large number of schools (160) within 3-mile radius of Kibera, only twelve kindergarten facilities are located in the same area. This is likely due to cost constraints, as most families raise their children in the home until primary school. While there does seem to be a lack of access to higher-education facilities (only 19 in a 3-mile radius), this gap is more explained by the trend that universities and colleges are traditionally fewer in number and larger in size. Since post-secondary education costs for Kibera residents are quite high, it is likely that the market for colleges to locate near Kibera is not high enough. In the future, if more students living in Kibera can afford post-secondary education, a greater number of colleges and universities may relocate nearer to Kibera. Or on the contrary, there may be increased demand by Kibera residents for transportation access to existing colleges and universities in Nairobi. Additional access

issues for Kibera residents to educational facilities could be related to cost, school capacity, or other undocumented factors.

### **Healthcare Access**

Based upon the spatial analysis, Kibera has moderate access to healthcare and medical opportunities. The average distances from the center of Kibera to various healthcare uses are displayed in Figure 4-24 and Figure 4-25. Four large hospitals are located within 2 miles of Kibera –Kenya Medical Research Institute, Armed Forces Memorial Hospital, Mbagathi District Hospital, and Nairobi Women’s Hospital – Adams, which are detailed in Table 4-4. In addition, healthcare centers and clinics operated by churches and NGOs, both documented in this study and undocumented informal clinics. Similar to education, Kibera boasts a large number of health clinics when quantitatively compared to other categories, however many of these are likely to be informal and quite small. The detailed numbers of clinics, healthcare centers, and hospitals can be seen in Figure 4-26 and 4-27.

While spatial access to clinics and the large hospitals may support the assumption that Kibera residents have a reasonable access to healthcare, the rates of HIV/AIDS and infectious disease within Kibera remain high. Therefore, other factors might exist that inhibit access for Kibera residents to receive treatment at these healthcare facilities. These barriers are likely related to affordability and facility capacity. The lack of paved road network within Kibera can complicate healthcare needs such as emergency medical needs or provision of fire trucks. While it is difficult to traverse to a hospital from Kibera in good health, let alone having to walk 2 miles to the nearest hospital under an emergency circumstance.

## **Institutional Access**

Based upon the spatial analysis, Kibera has moderate access to institutional opportunities. The average distances from the mean center of Kibera to institutional uses are displayed in Figure 4-28 and Figure 4-29. Within 3 miles of Kibera, 438 institutional uses are located with the radius, and are further detailed in Table 4-5 – and 39 within 0.3-mile radius. The greatest number of institutional uses are churches (200), institutes (62), government offices (58), and embassies (27), as illustrated in Figure 4-30 and Figure 4-31. With 26 documented churches within Kibera city limits alone and 200 documented churches within 3 miles of Kibera's center, it is evident that the presence of church organizations is a large factor in Kibera, and perhaps Nairobi in general. Along with the large presence of churches, mosques and temples are also present within a 1-mile radius of Kibera (3), and within a 3-mile radius (19). Other documented institutions located within a 3-mile radius of Kibera include: institutes (62), government offices (58), and embassies (27).

Contrary to their popularity in slum areas like Kibera, very few documented community centers are located within a 1-mile range (1) of Kibera, and within a 3-mile radius (11). No libraries are located within Kibera, but 4 are located between 2 - 3 miles from Kibera. Utility provision and basic services are also included in this section, and include several interesting finds. Two police stations are located within a 1-mile radius of Kibera, and 10 within a 3-mile radius, 10 police stations exist. Only 2 post offices are located in the area, between 2 -3 miles away. Only 2 fire stations are located near to Kibera, both between 2.5 - 3 miles away.

## **Directional Distributions**

The size and location of directional distributions for each of the land use categories plays a large role in their relationships to Kibera. The directional distribution of formal economic uses in Nairobi does not completely cover Kibera (in the southwest corner of the ellipse), illustrated in Figure 4-32. The directional distribution for educational uses in Nairobi, illustrated in Figure 4-33, contains all of Kibera. This indicates that Kibera has relatively good access to educational systems, and the prevalence of primary and secondary level schools within and nearby Kibera aligns with the recent initiatives by the FPE program of 1999 to raise primary education rates across the country. Similarly, the directional distribution for healthcare, illustrated in Figure 4-34, contains all of Kibera, and is the closest out of the four land use categories to the center of the directional distribution ellipse. The location of Kibera within the healthcare ellipse indicates that Kibera has adequate spatial access to healthcare. The directional distribution for the last category, institutional uses, also contains all of Kibera, illustrated in Figure 4-35.

The directional distribution of formal economic activity in Nairobi is the smallest in size of the four land use categories examined, indicating that formal economic activity in Nairobi is more spatially concentrated than healthcare, education, or institutions. Similar to educational uses, institutional uses have more of a geographic distribution than other uses (such as the CBD). While this ensures greater access to a greater number of residents, it also makes it more difficult to estimate transportation patterns and determine transportation system needs for modification of any existing transit services, such as the public buses and matatus.

## **Limitations of the Analysis Results**

Using GIS to explore the spatial relationships between Kibera and Nairobi in general resulted in many interesting relationships and findings, however some significant limitations exist to the results of the analysis. One limitation involves the consistency and classification of the land use shapefiles four categories: economic uses, educational uses, healthcare, and institutional uses. A small percentage of polygons were found in each of the four data sets that were not labeled with a land use type, such as the land use types classified in Table 4-1 through Table 4-4 (i.e. bank, hospital, oil tank, university). For the purposes of this study, those polygons were not included in the calculations and were all assigned as undeveloped. If they are in fact developed, which we can assume some are, the amount of study it would have taken to find their exact land use would have taken more time than the expected effect on the data results. Because of this limitation, values estimated in Table 4-1 through Table 4-4 are not expected to reflect exact real-world data, but are rather estimates based on the best available data (MapKibera, 2009; University of Nairobi, 2013a, 2013b) for analysis. In the past three years, it is certain that these values have changed.

Another limitation is related to the lack of data for informal economic activity. Since the majority of economic activity in Nairobi (and Kibera) is informal, this data can only be used to interpret the levels of access for Kibera residents to formal economic uses, not the informal sector. If data could one day be acquired for the informal sector, a more comprehensive analysis of economic uses in Nairobi could be conducted.

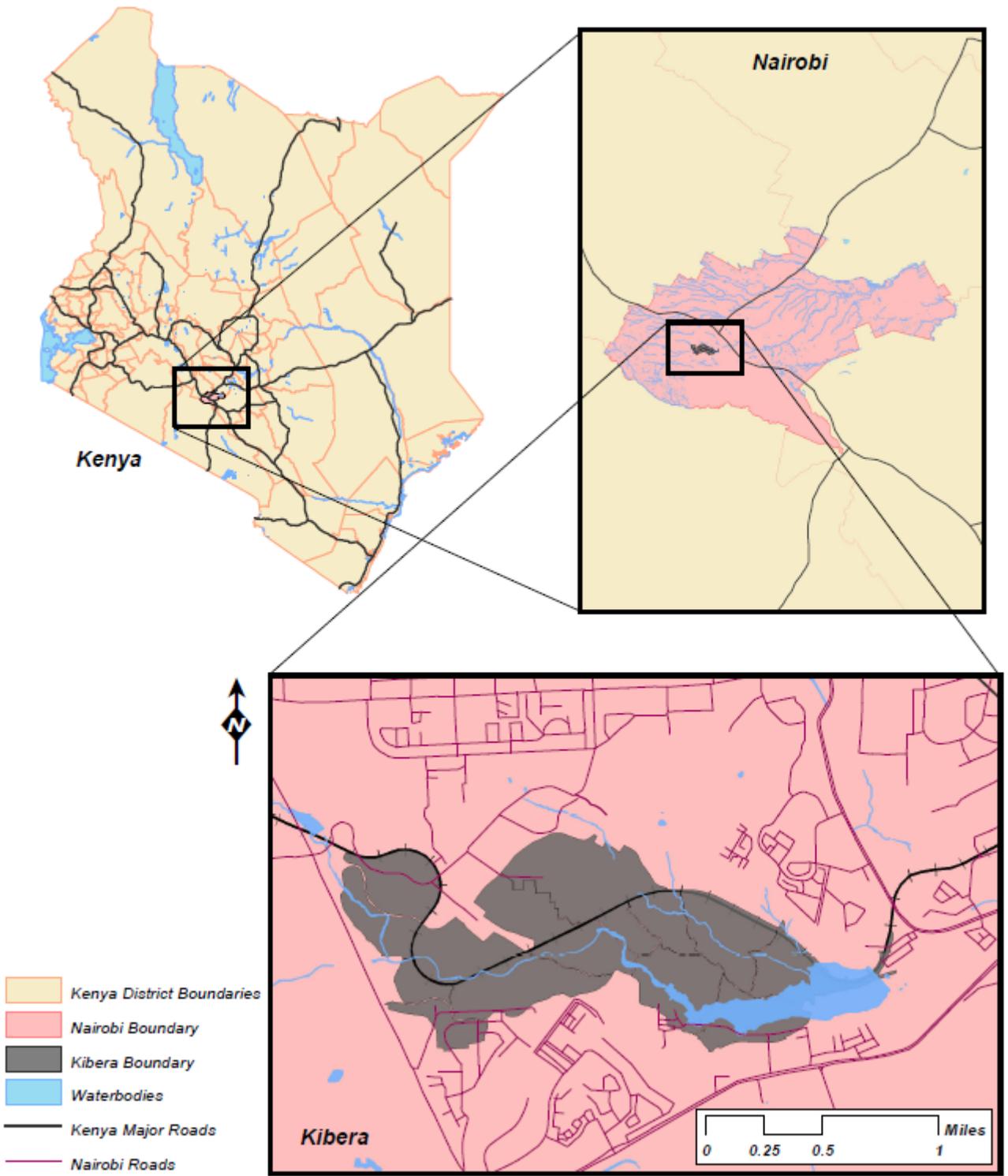


Figure 4-1.Context Map of Nairobi and Kibera

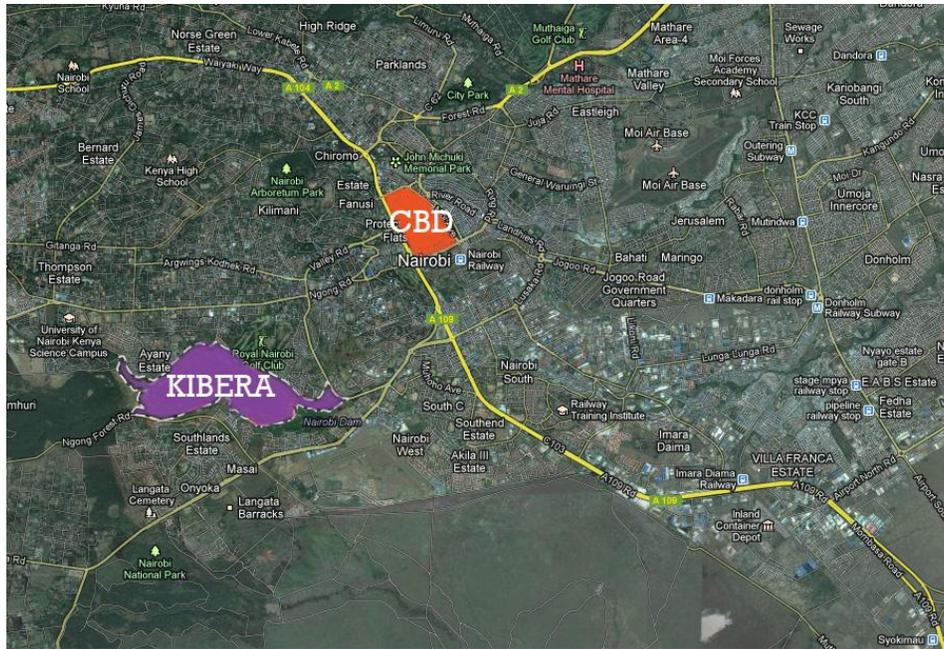


Figure 4-2. Kibera and the Nairobi CBD

(Google Maps)

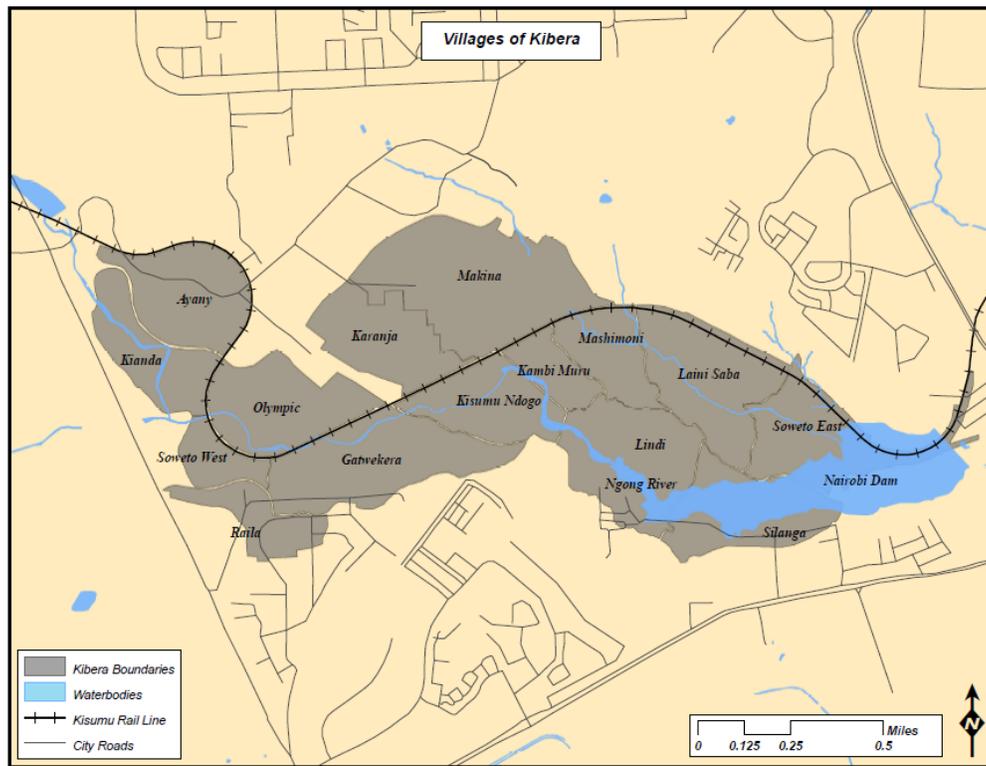


Figure 4-3. Villages of Kibera

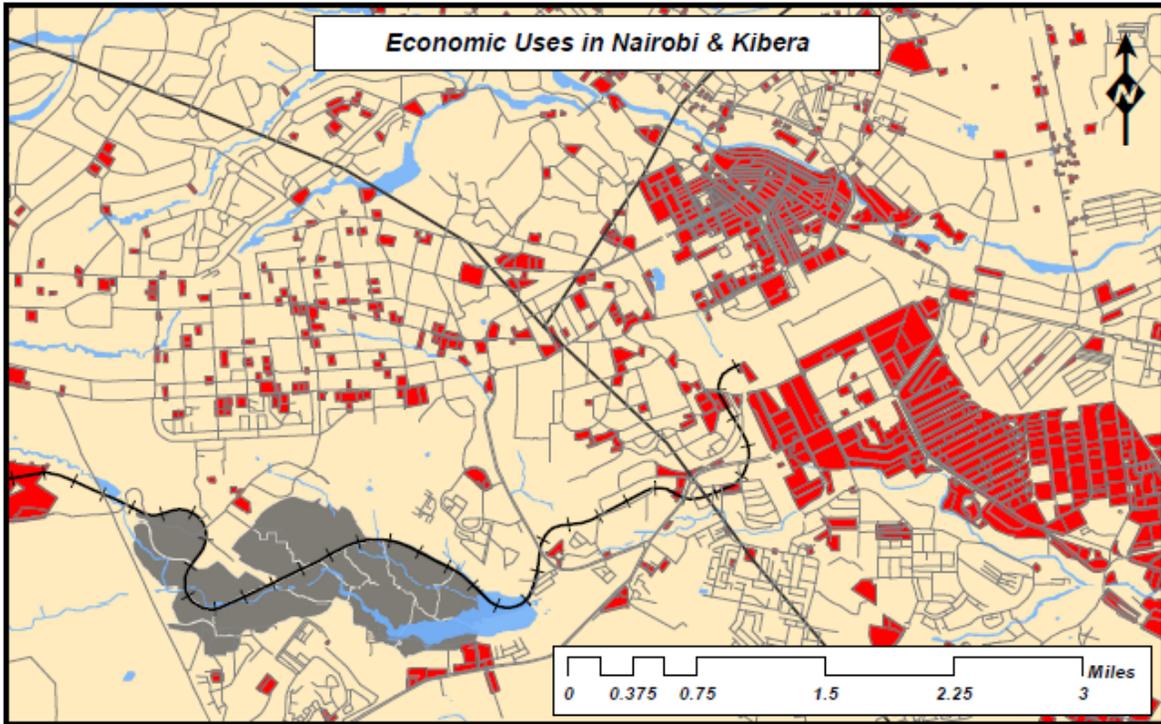


Figure 4-4. Formal Economic Uses in Nairobi and Kibera

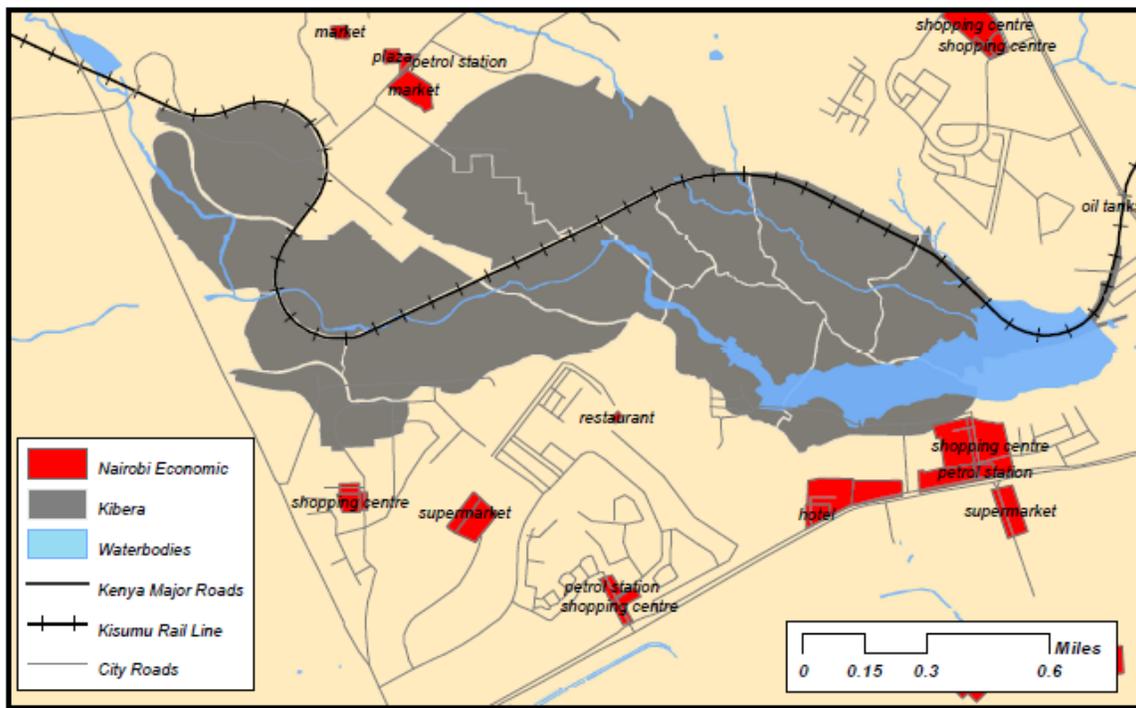


Figure 4-5. Formal Economic Uses in Kibera

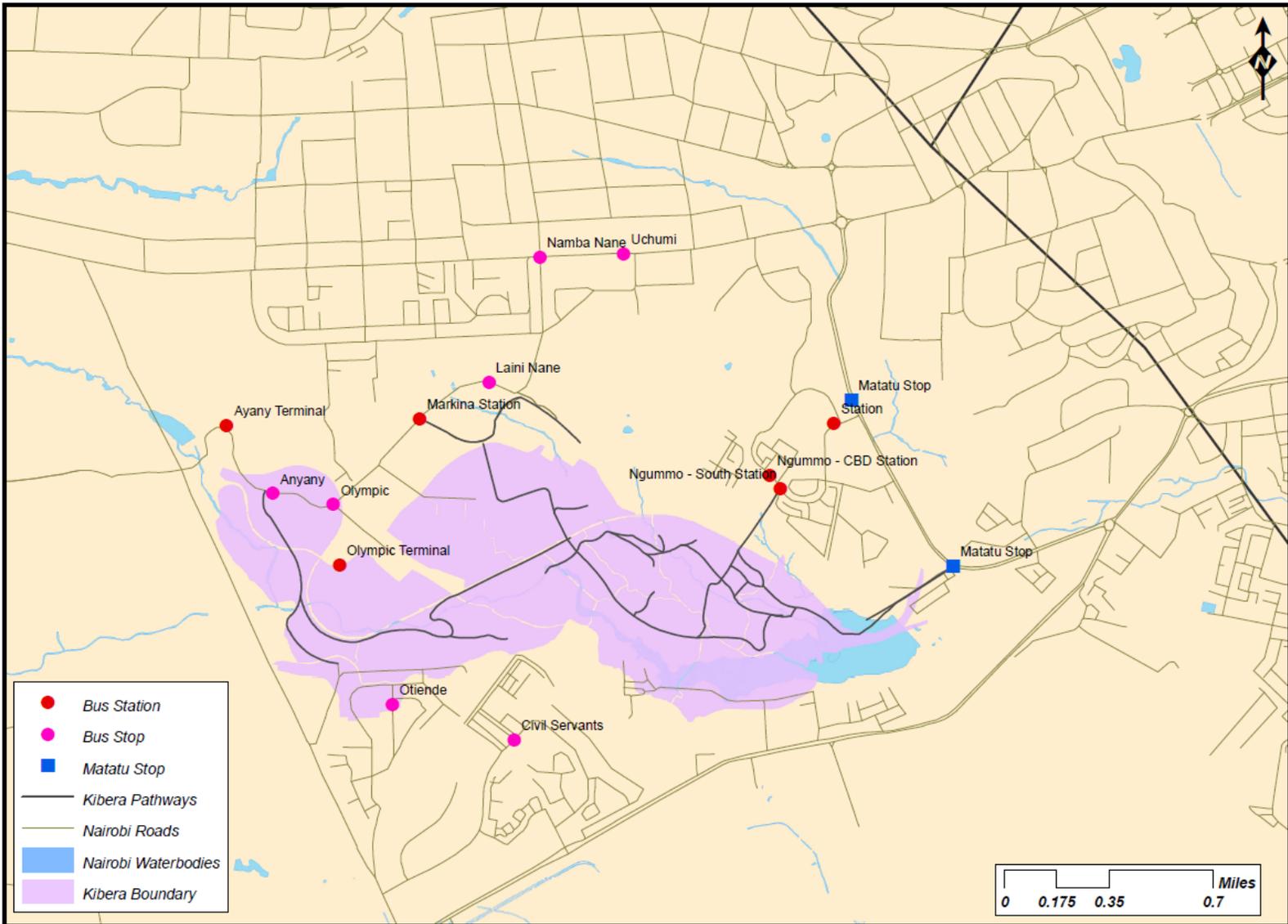


Figure 4-6. Current Transportation Routes near Kibera

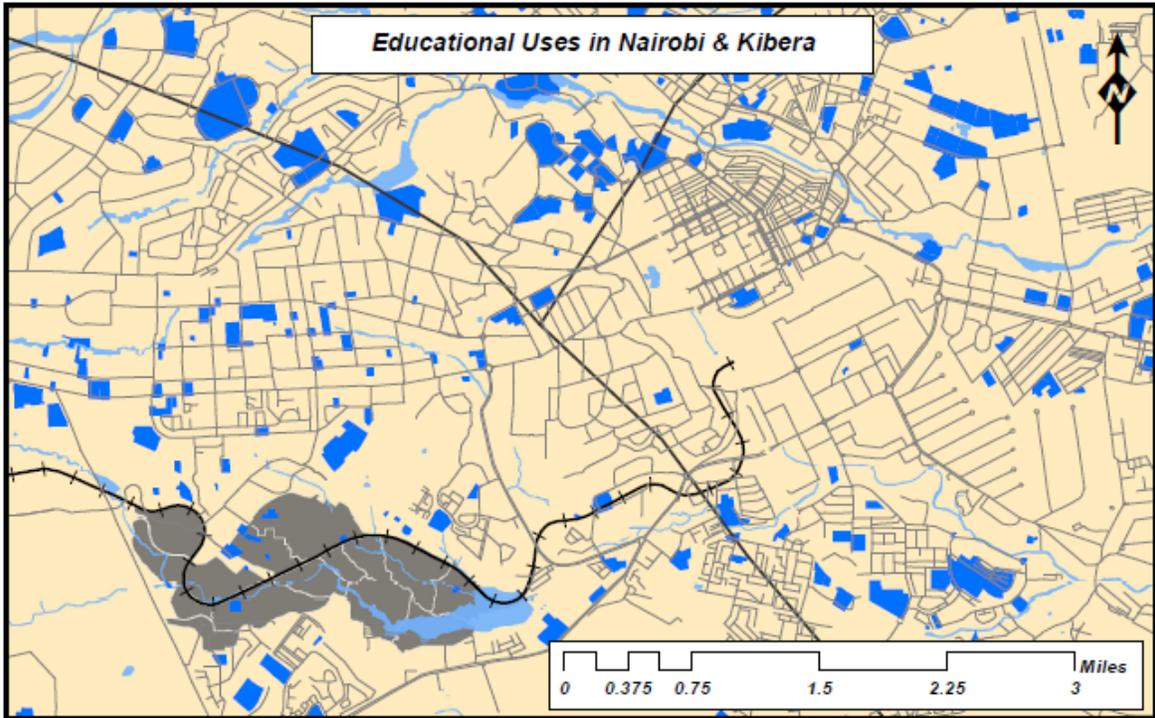


Figure 4-7. Educational Uses in Nairobi and Kibera

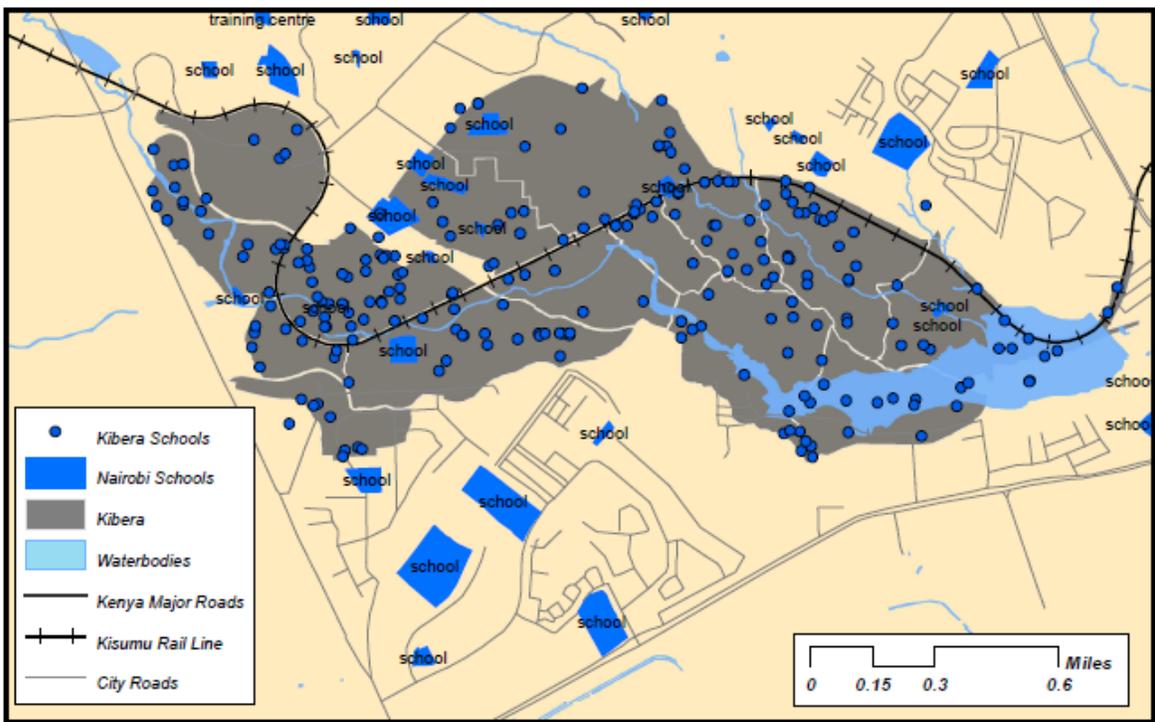


Figure 4-8. Educational Uses in Kibera

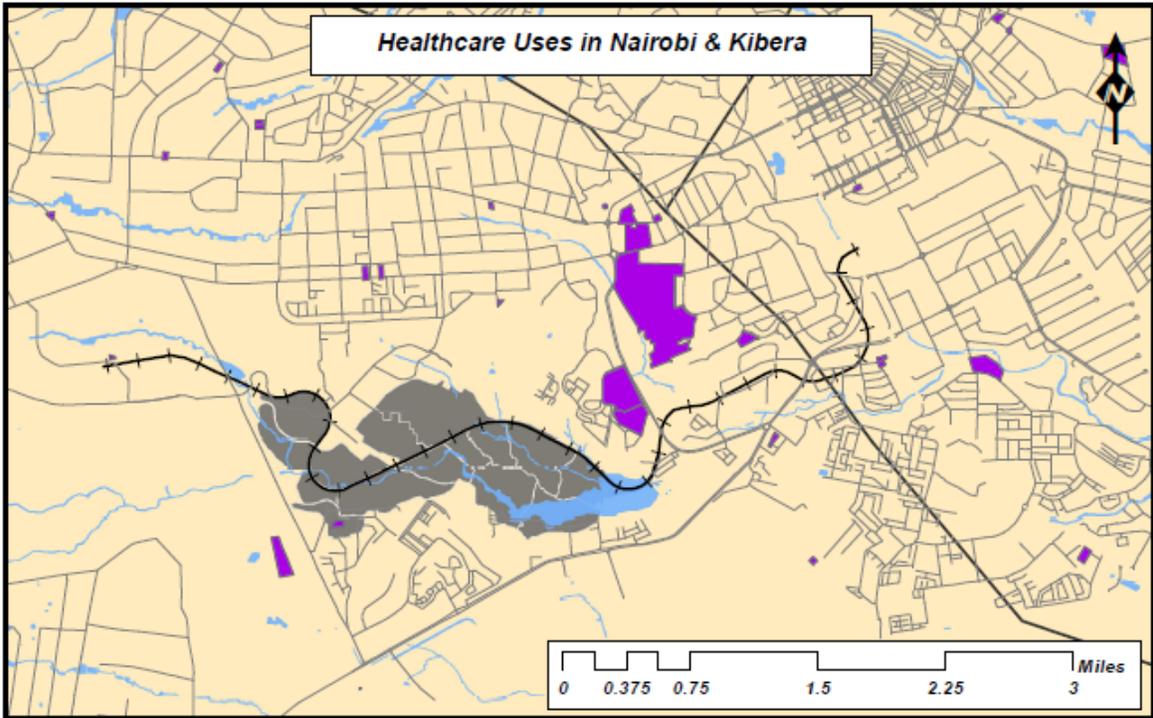


Figure 4-9. Healthcare in Nairobi and Kibera

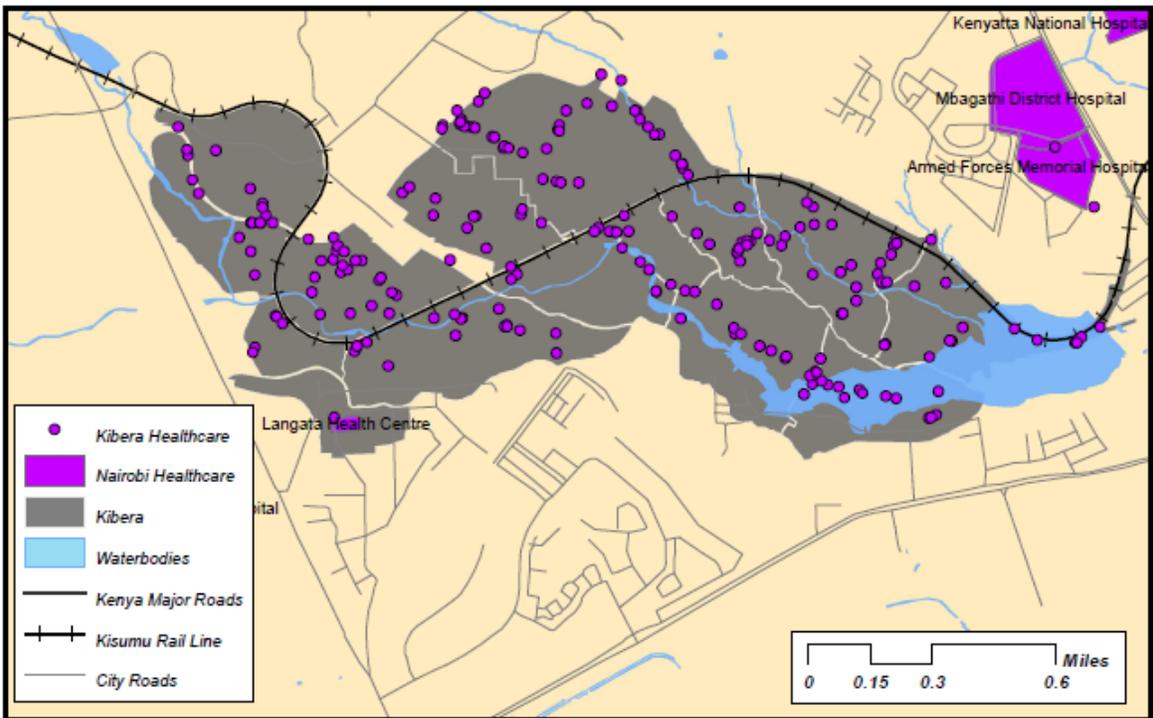


Figure 4-10. Healthcare in Kibera

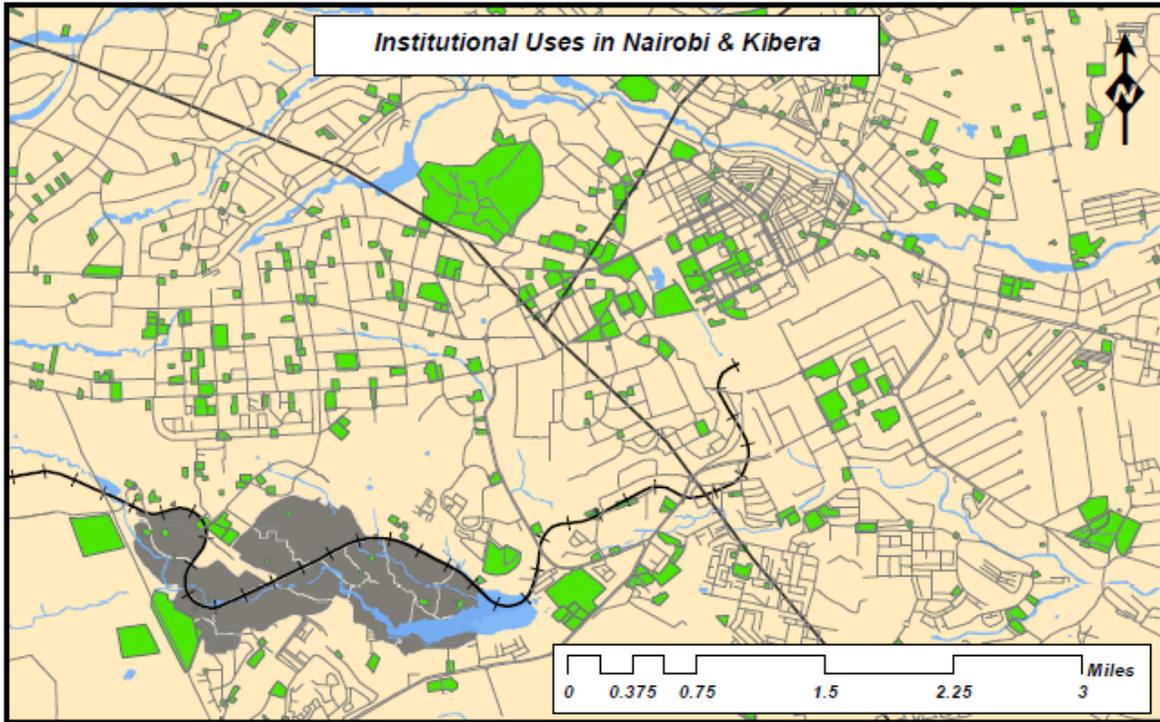


Figure 4-11. Institutional Uses in Nairobi and Kibera

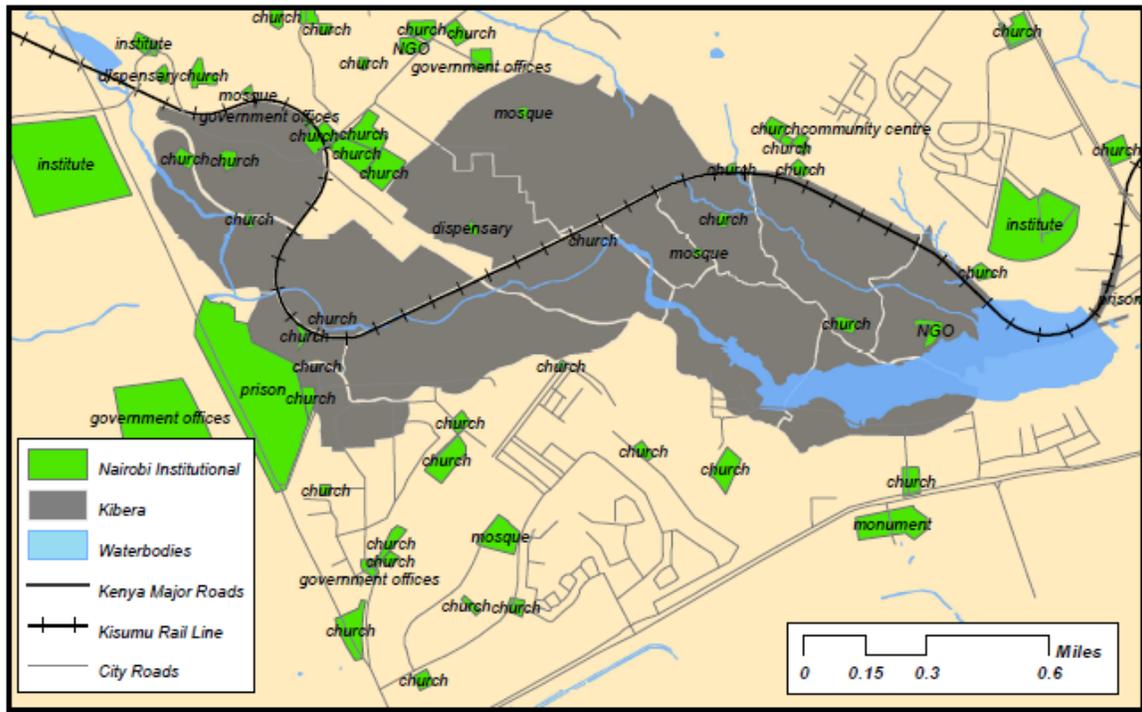


Figure 4-12. Institutional Uses in Kibera

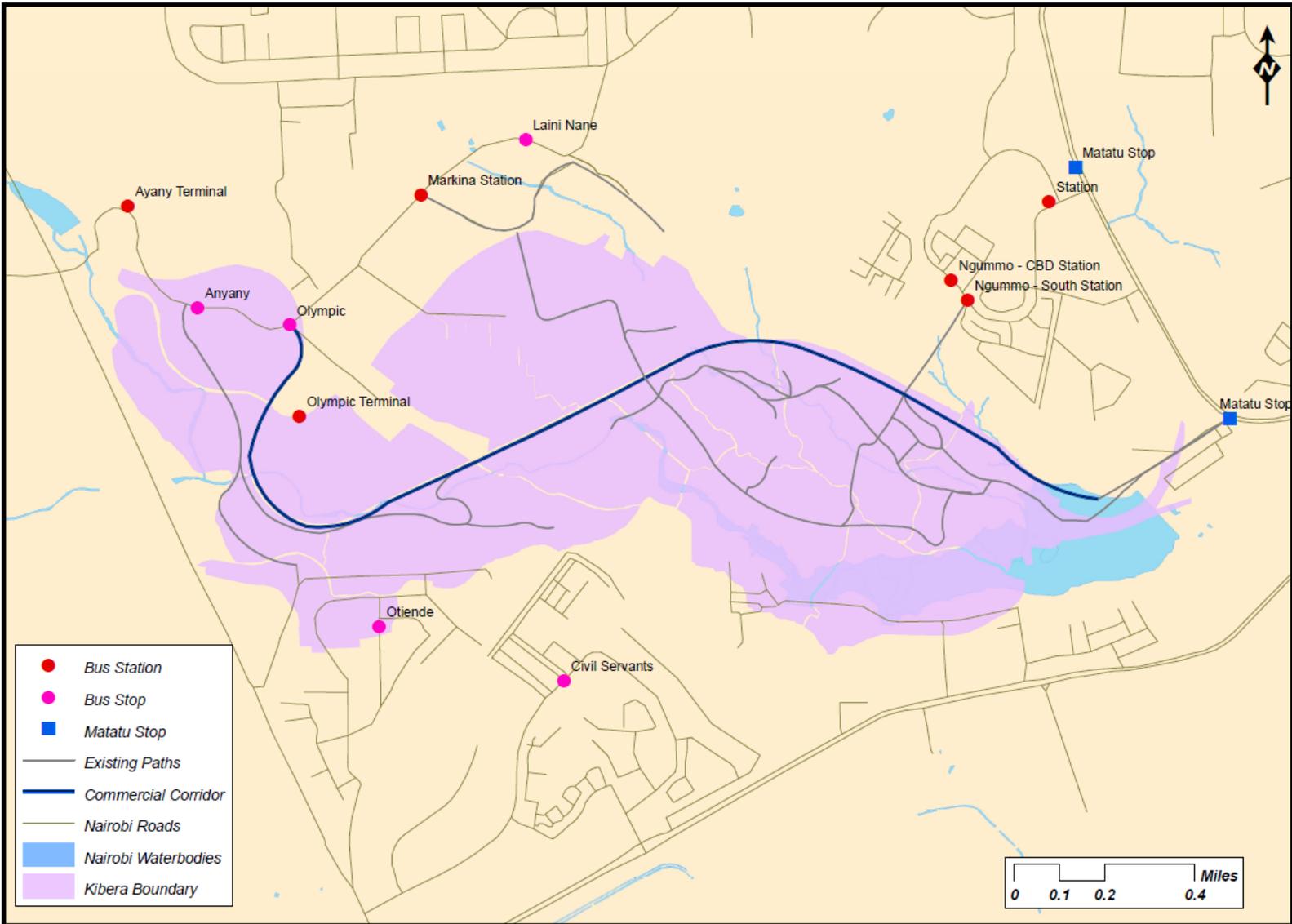


Figure 4-13. KENSUP Transportation Plans

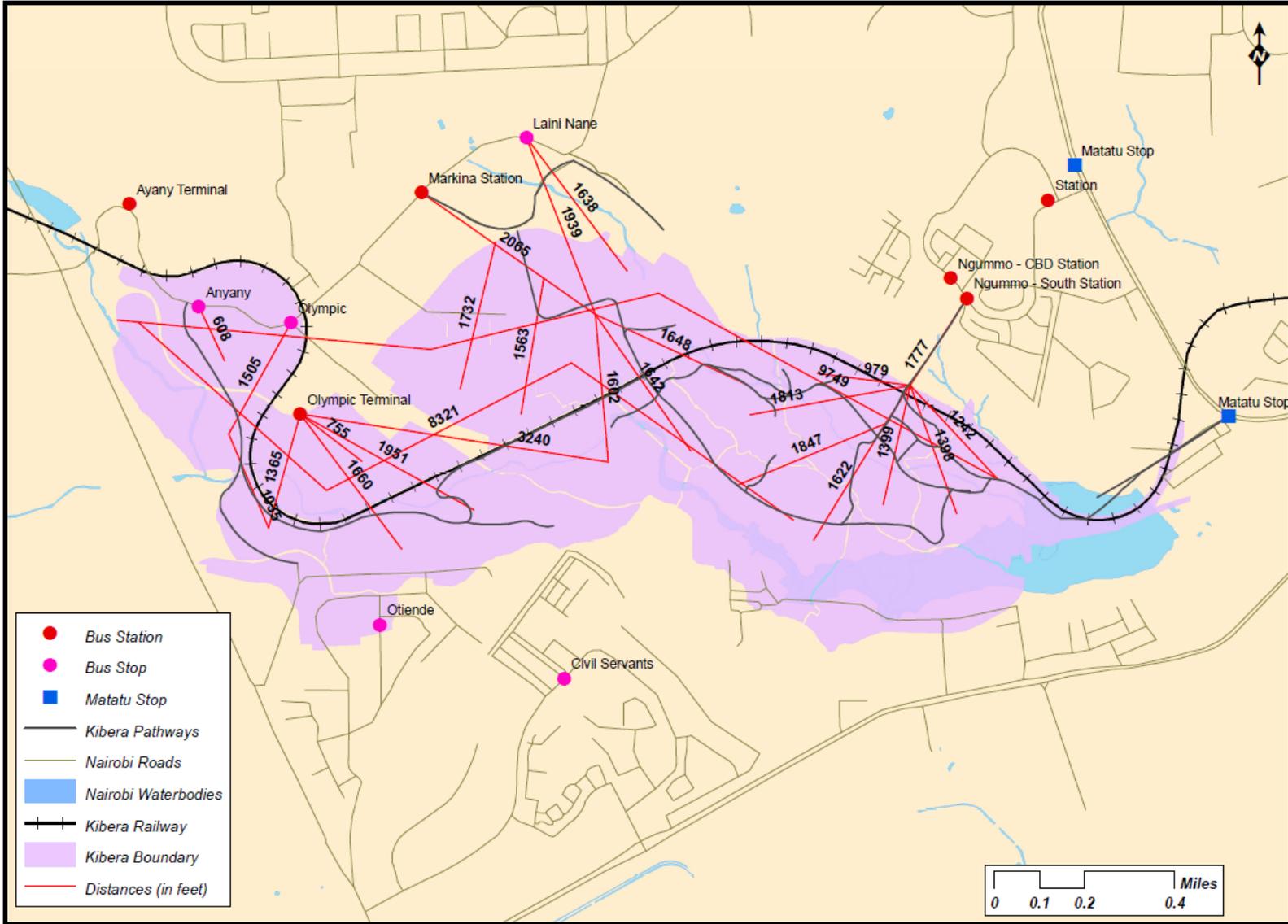


Figure 4-14. Current Distances to Transportation within Kibera

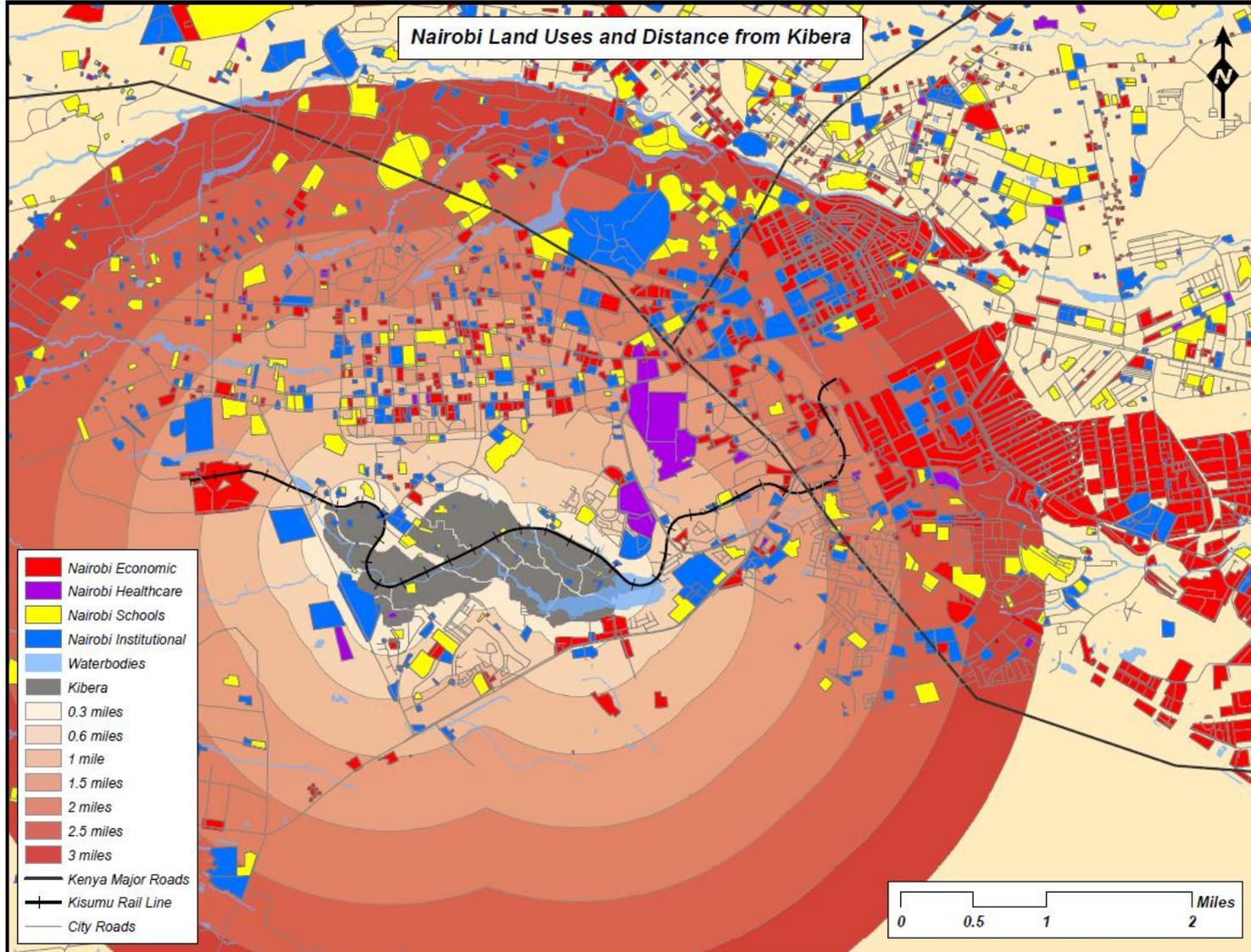


Figure 4-15. Nairobi Land Uses and Distance from Kibera

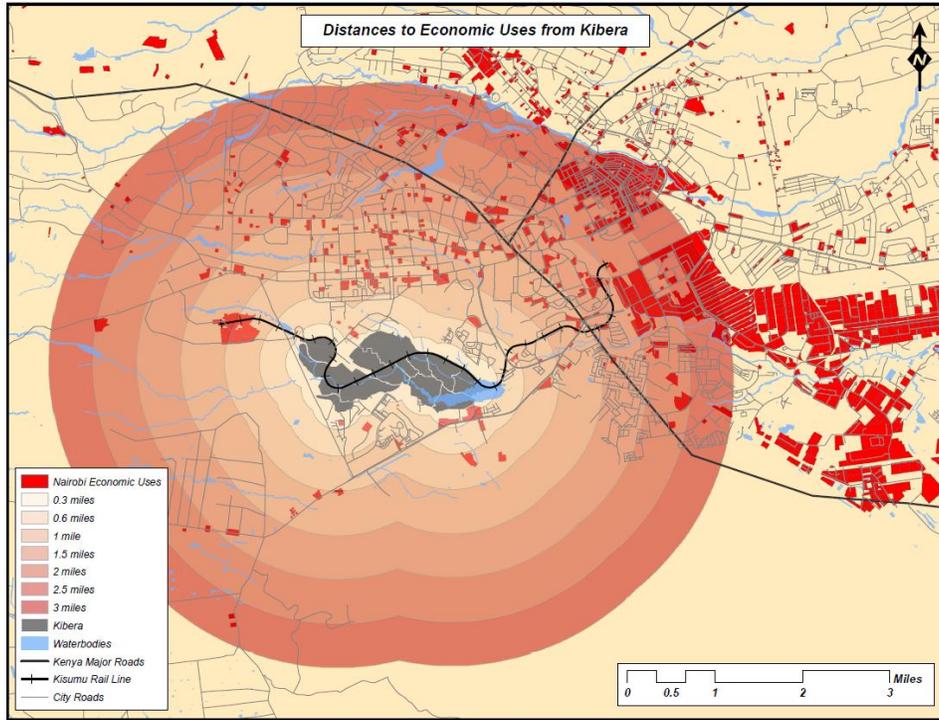


Figure 4-16. Distances to Economic Uses from Kibera (Large Scale)

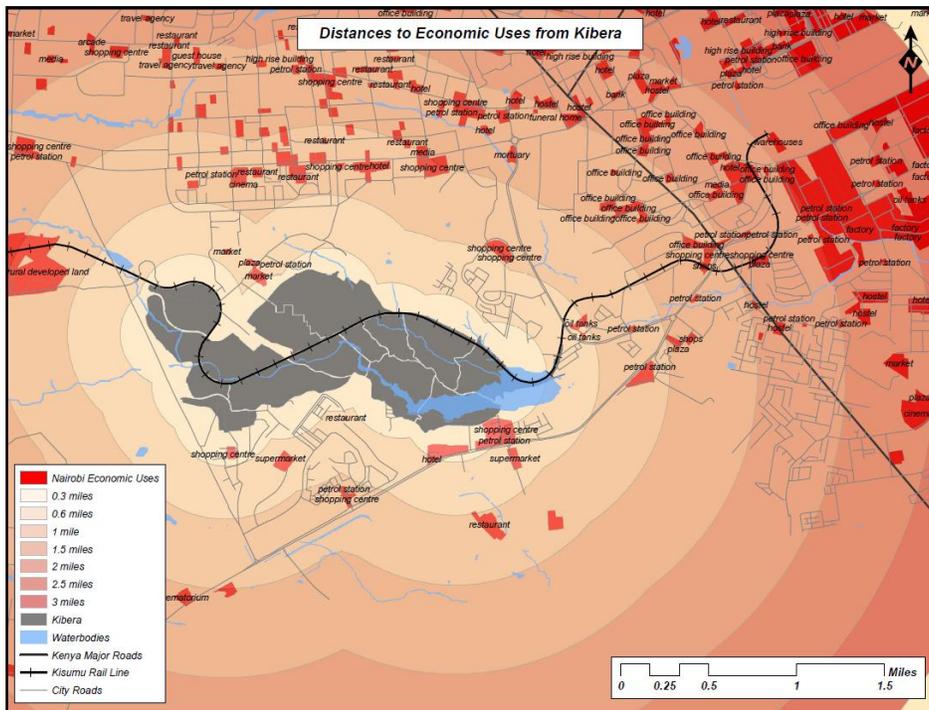


Figure 4-17. Distance to Economic Uses from Kibera (Small Scale)

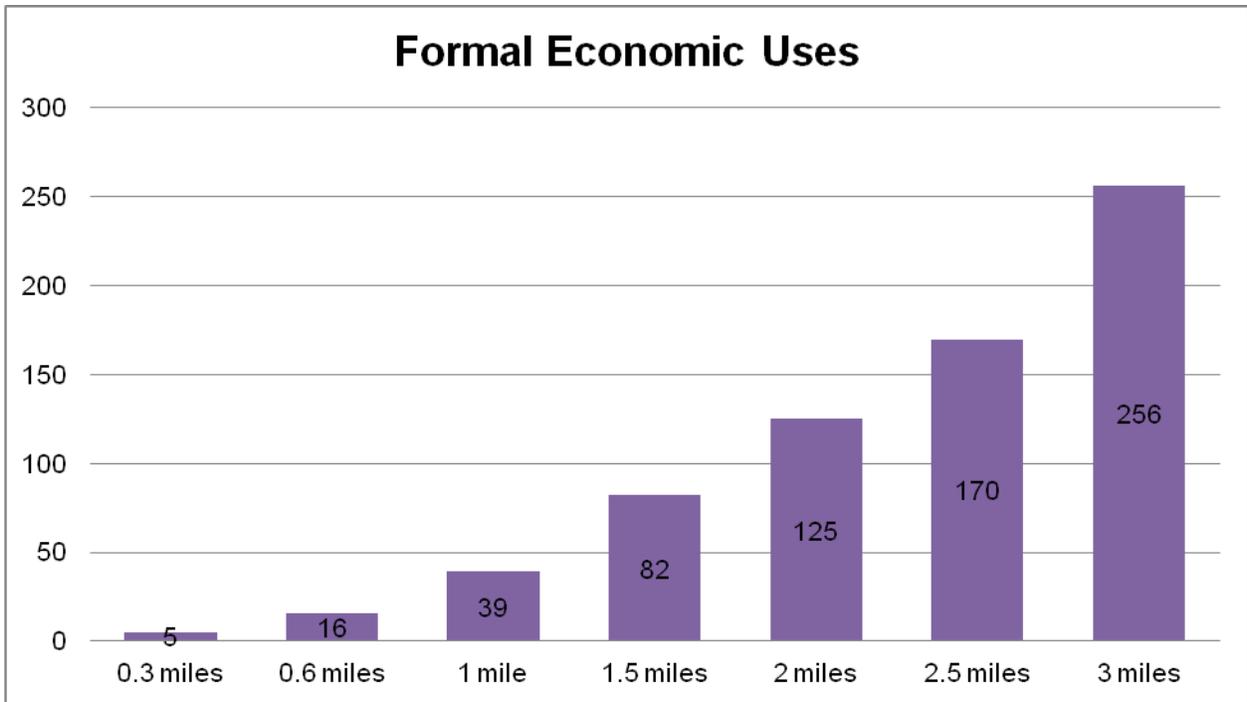


Figure 4-18. Formal Economic Uses near Kibera

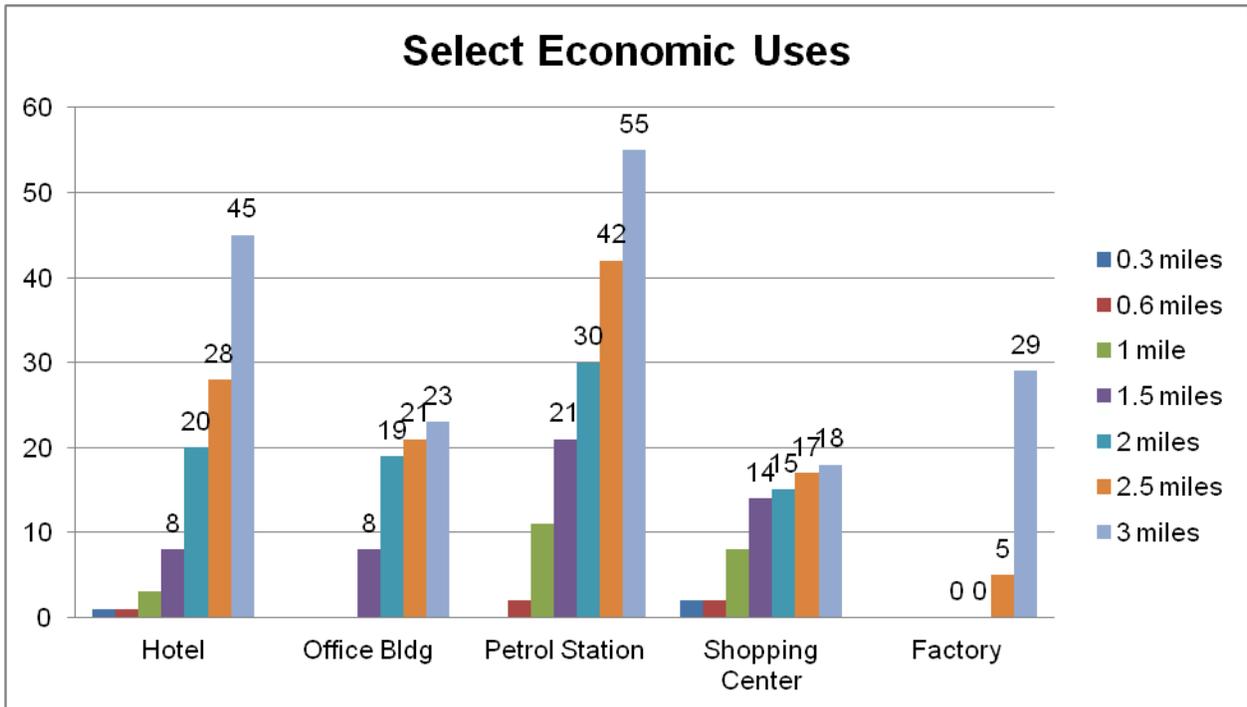


Figure 4-19. Select Economic Uses near Kibera

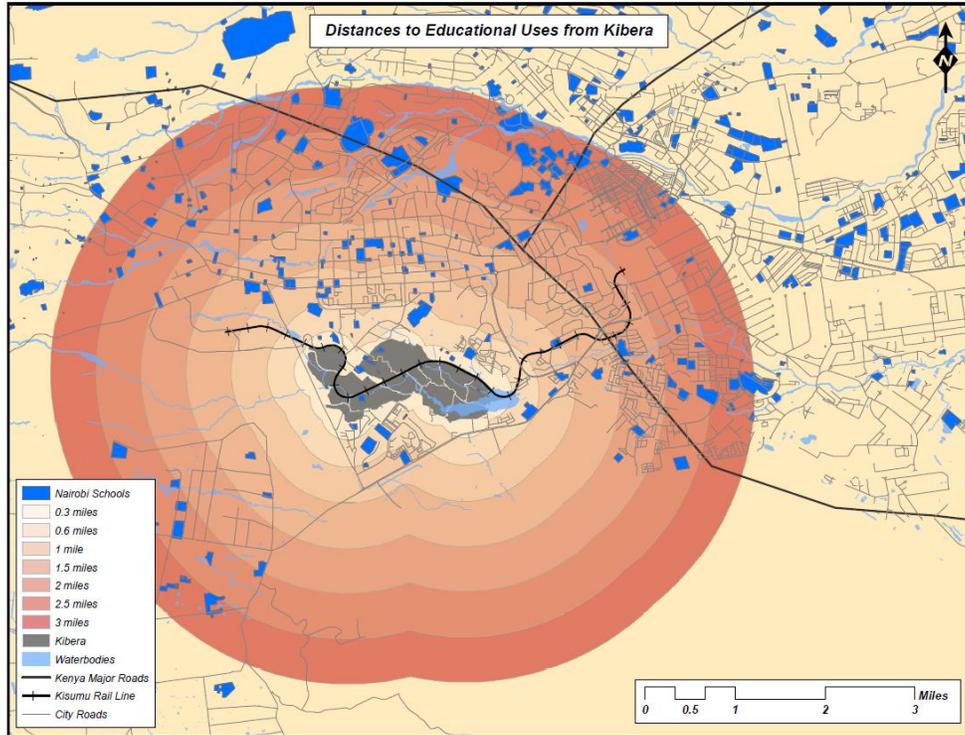


Figure 4-20. Distances to Educational Uses from Kibera (Large Scale)

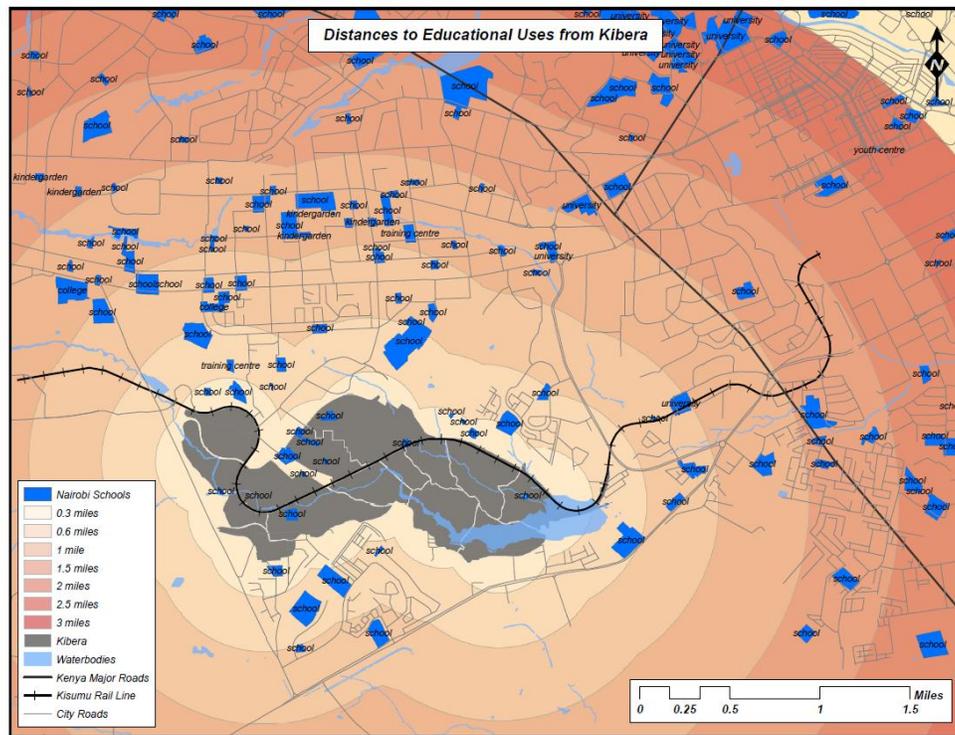


Figure 4-21. Distances to Educational Uses from Kibera (Small Scale)

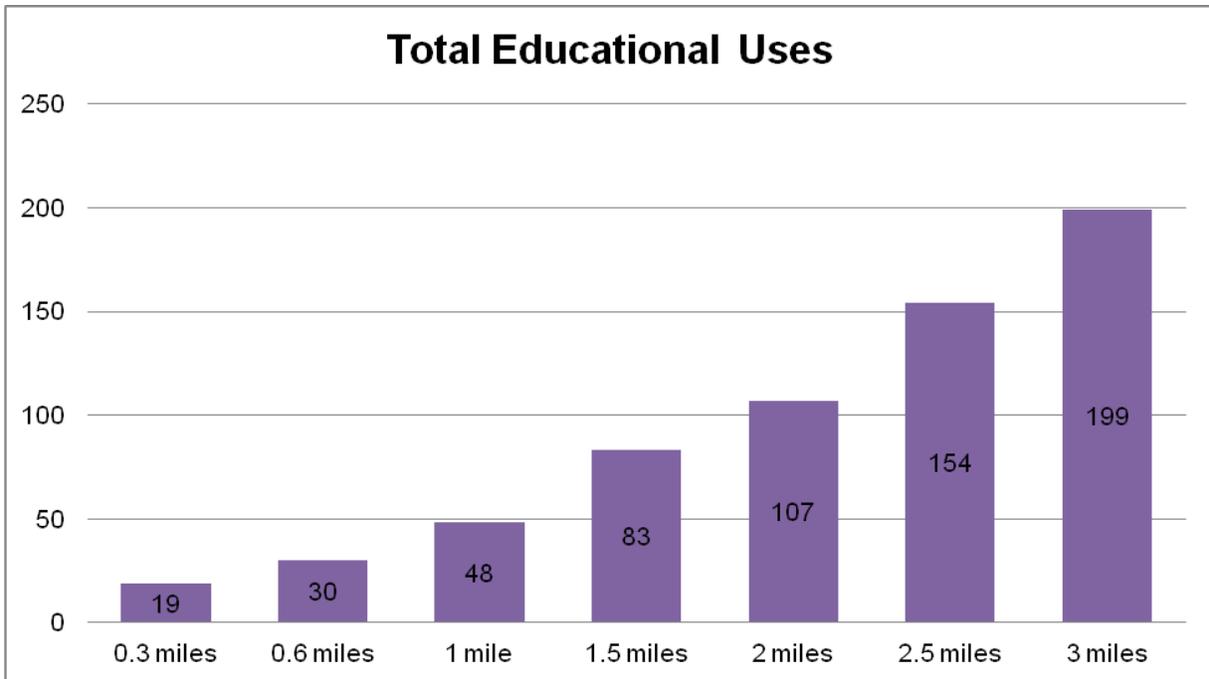


Figure 4-22. Total Educational Uses near Kibera

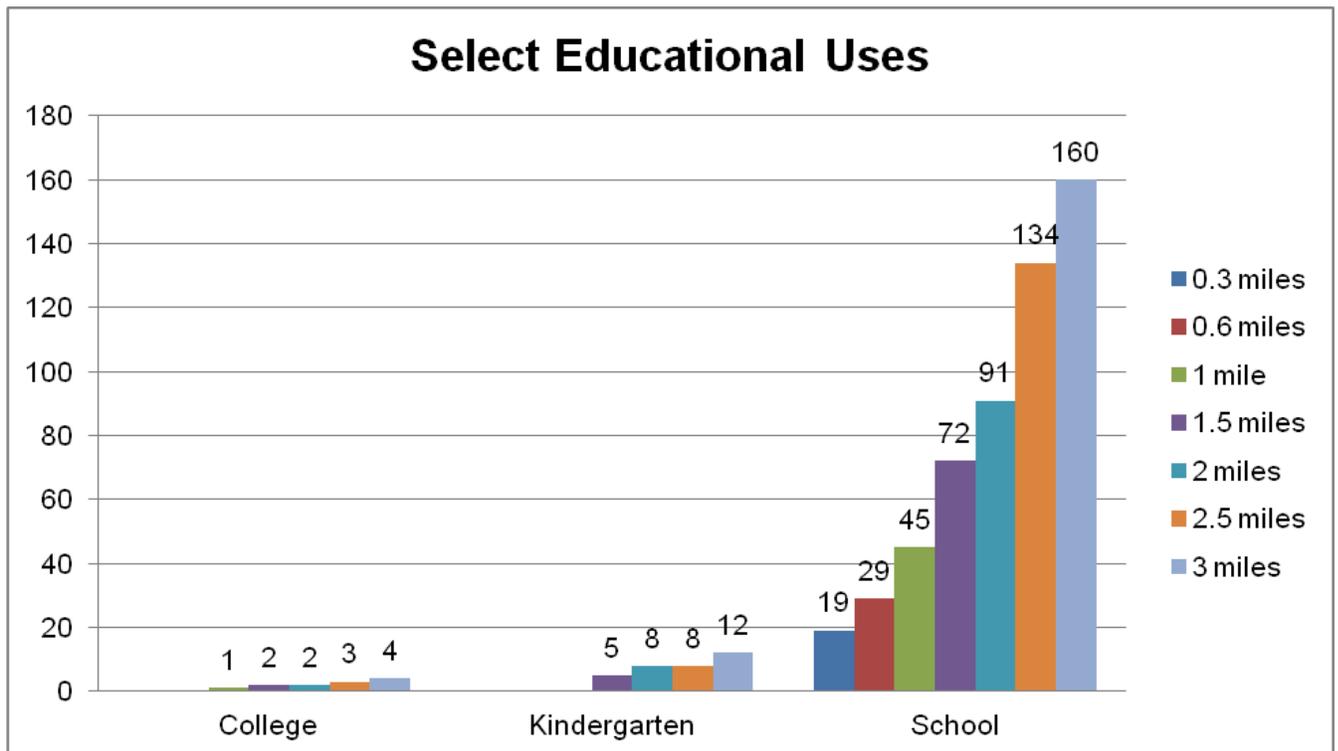


Figure 4-23. Select Educational Uses near Kibera

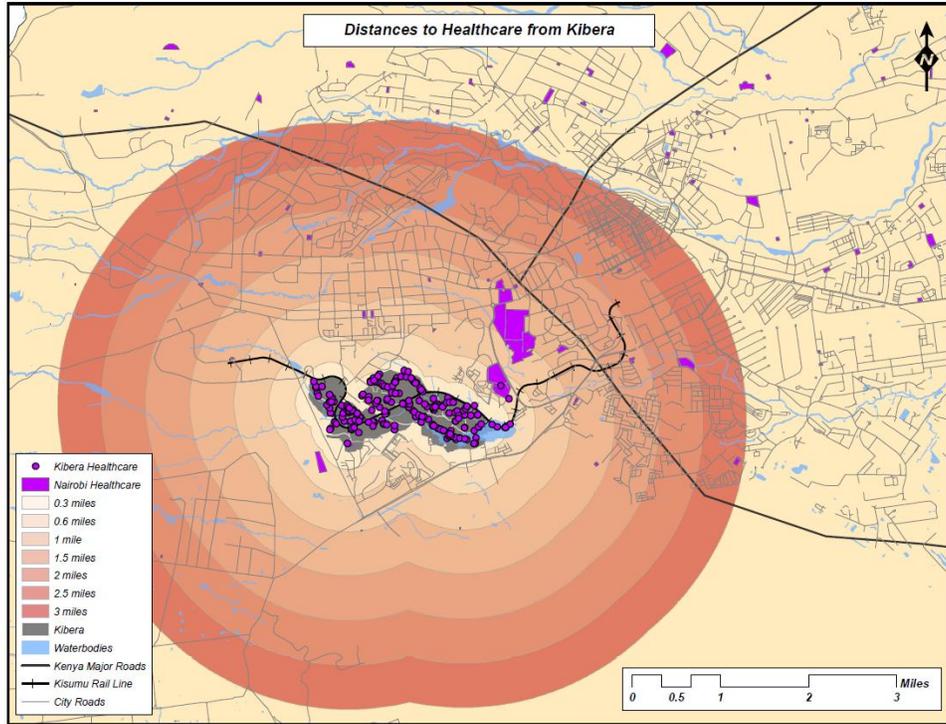


Figure 4-24. Distances to Healthcare from Kibera (Large Scale)

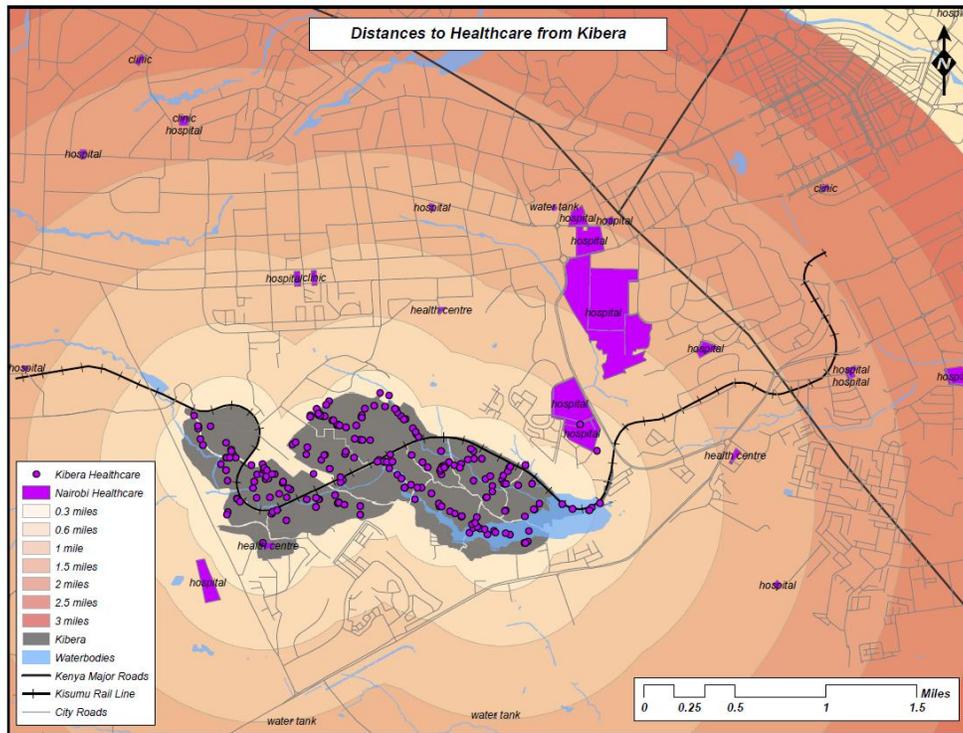


Figure 4-25. Distances to Healthcare from Kibera (Small Scale)

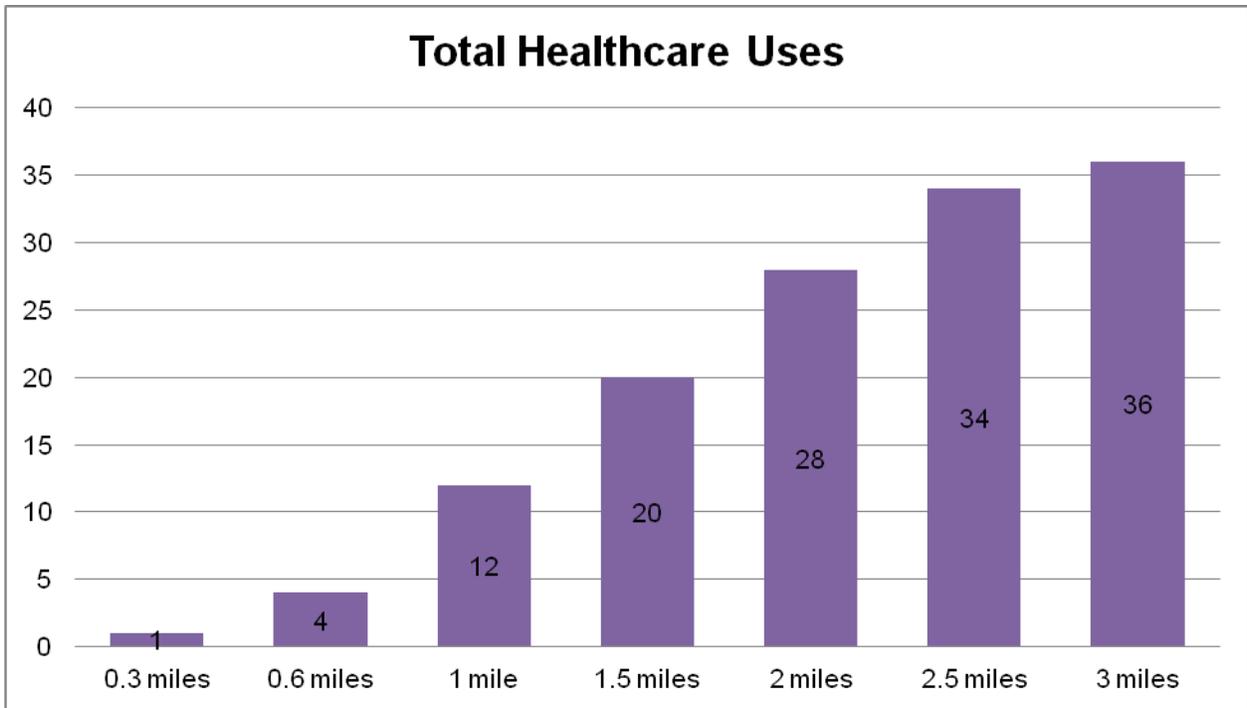


Figure 4-26. Total Healthcare Uses near Kibera

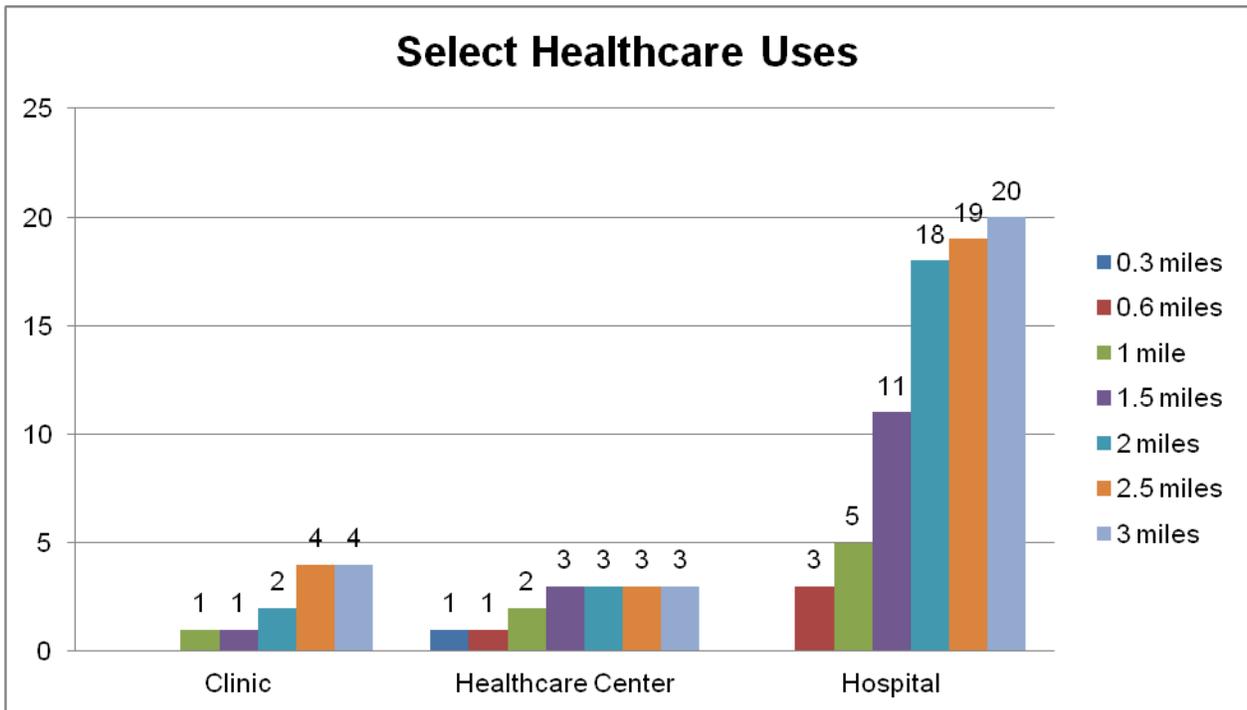


Figure 4-27. Select Healthcare Uses near Kibera

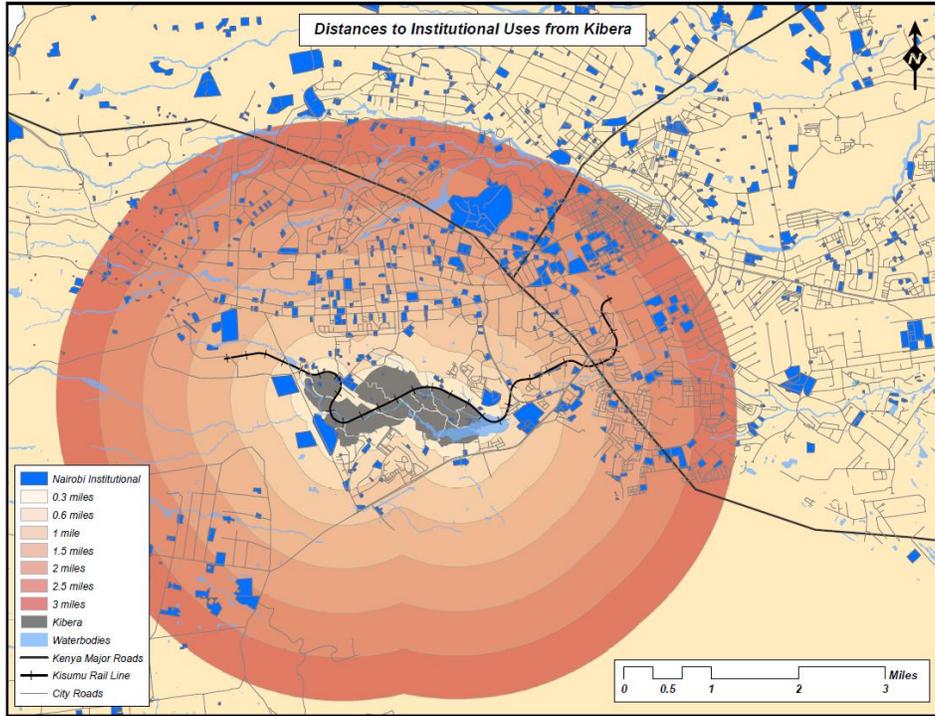


Figure 4-28. Distances to Institutional Uses from Kibera (Large Scale)

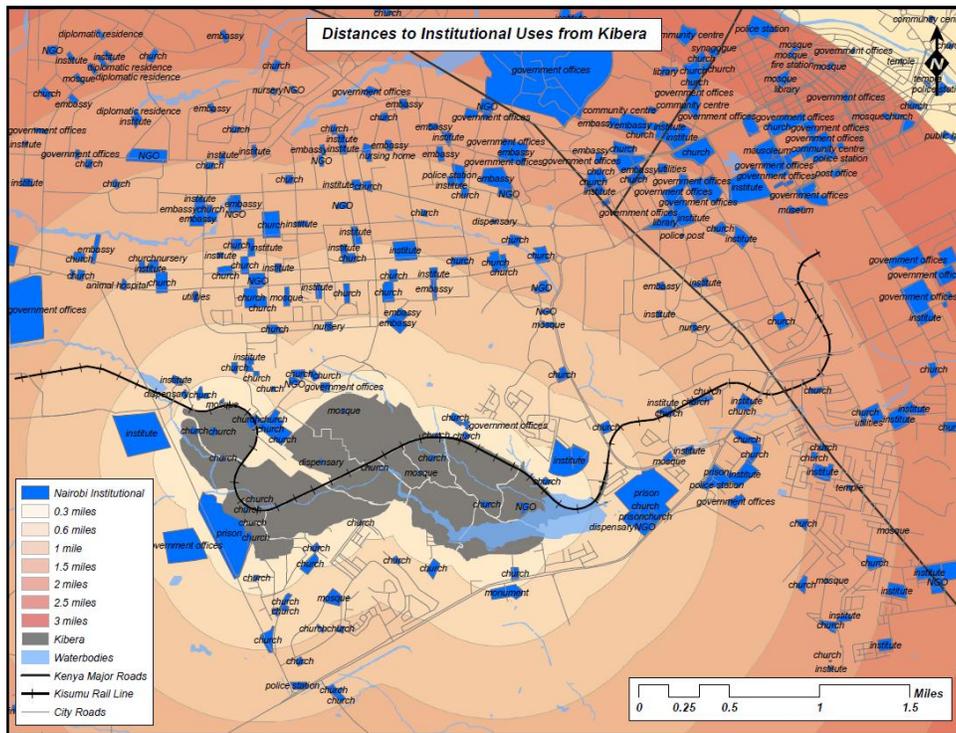


Figure 4-29. Distances to Institutional Uses from Kibera (Small Scale)

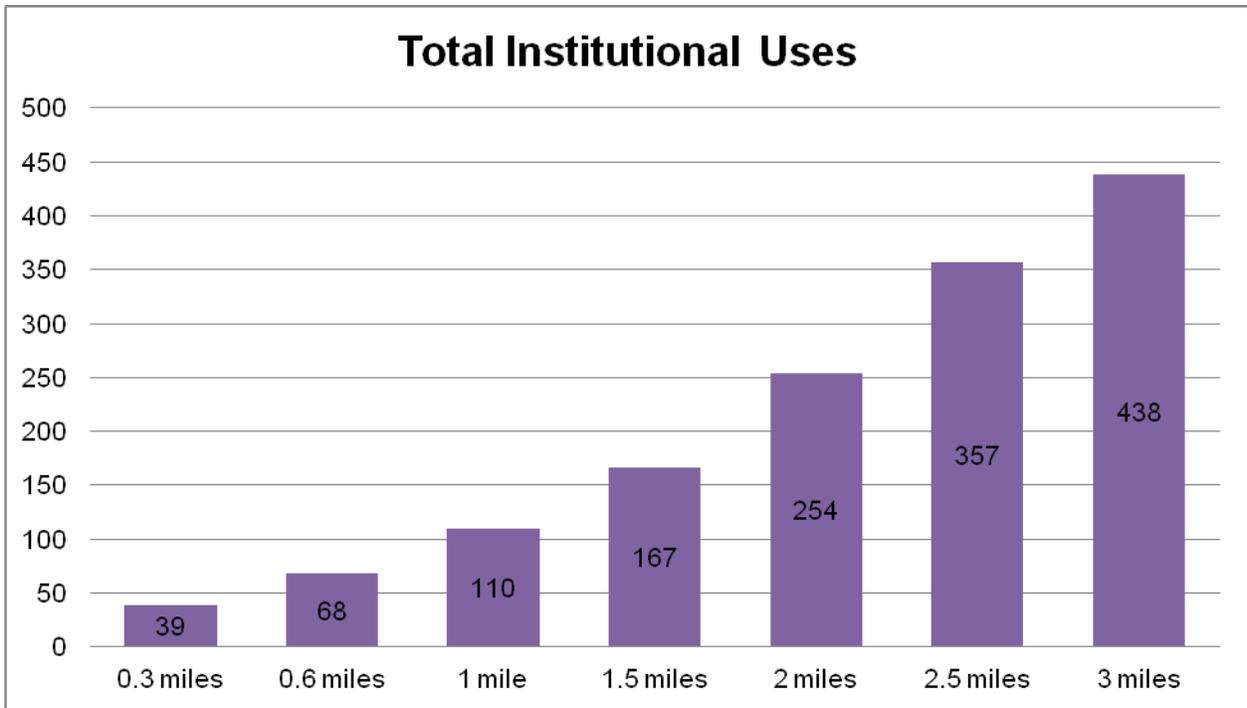


Figure 4-30. Total Institutional Uses near Kibera

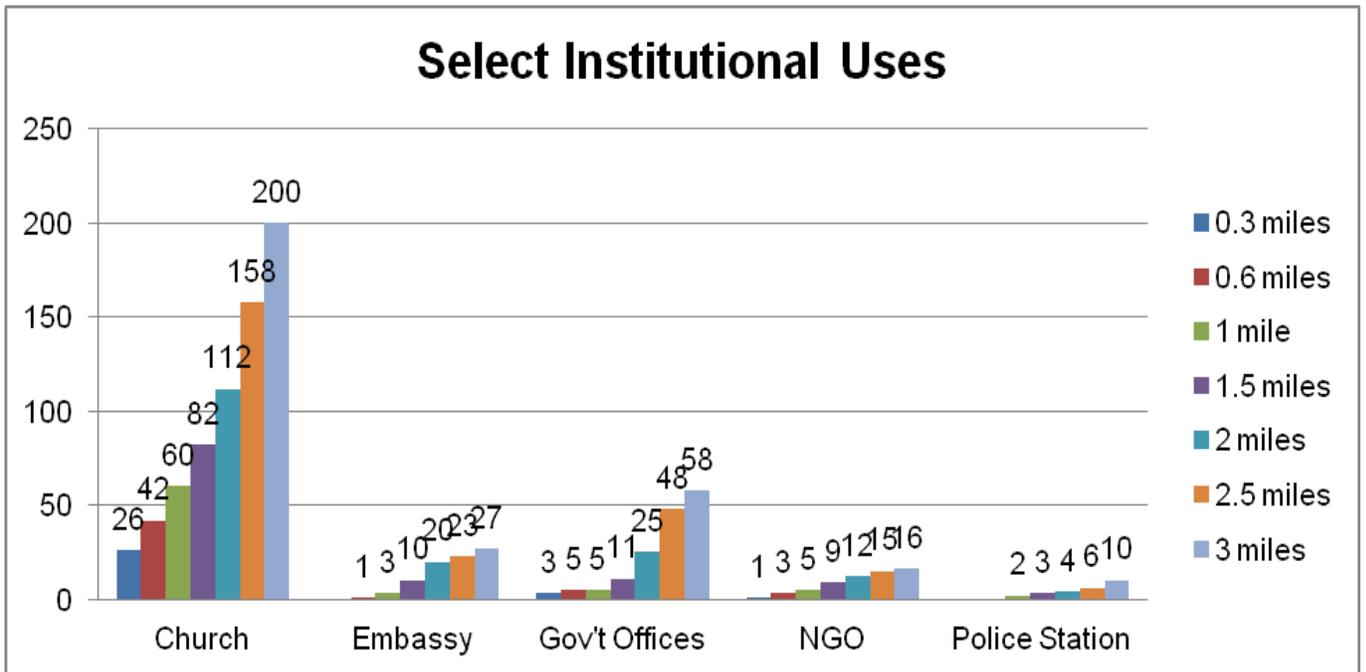


Figure 4-31. Select Institutional Uses near Kibera

Table 4-2. Formal Economic Uses near Kibera

Economic Uses	0.3 miles	0.6 miles	1 mile	1.5 miles	2 miles	2.5 miles	3 miles
Bank					1	4	15
Cinema			1	1	1	2	6
Factory						5	29
High Rise Building				1	2	4	6
Hotel	1	1	3	8	20	28	45
Market	1	2	2	2	5	7	11
Office Building				8	19	21	23
Oil Tank		2	2	5	5	5	5
Petrol Station		2	11	21	30	42	55
Plaza		1	1	2	4	10	13
Restaurant		2	6	11	13	15	15
Shop	1	1	1	3	3	3	7
Shopping Center	2	2	8	14	15	17	18
Supermarket		3	4	4	4	4	5
Travel Agency				2	3	3	3
Total	5	16	39	82	125	170	256

Table 4-3. Educational Uses near Kibera

Educational Uses	0.3 miles	0.6 miles	1 mile	1.5 miles	2 miles	2.5 miles	3 miles
College			1	2	2	3	4
Kindergarten				5	8	8	12
School	19	29	45	72	91	134	160
Training Center		1	1	2	3	3	3
University			1	2	3	6	19
Youth Center							1
Total	19	30	48	83	107	154	199

Table 4-4. Healthcare Uses near Kibera

Healthcare Uses	0.3 miles	0.6 miles	1 mile	1.5 miles	2 miles	2.5 miles	3 miles
Clinic			1	1	2	4	4
Healthcare Clinic	1	1	2	3	3	3	3
Hospital		3	5	11	18	19	20
Water Tank			4	5	5	8	9
Total	1	4	12	20	28	34	36

Table 4-5. Institutional Uses near Kibera

Institutional Uses	0.3 miles	0.6 miles	1 mile	1.5 miles	2 miles	2.5 miles	3 miles
Animal Hospital			1	1	1	1	1
Church	26	42	60	82	112	158	200
Community Center	1	1	1	2	5	8	11
Dispensary	2	4	4	5	5	5	5
Embassy		1	3	10	20	23	27
Fire Station							2
Government Offices	3	5	5	11	25	48	58
Institute	2	4	15	29	46	60	62
Library					1	2	4
Mosque	3	4	7	7	9	11	18
NGO	1	3	5	9	12	15	16
Nursery		1	2	3	6	7	9
Orphanage						1	1
Police Station			2	3	4	6	10
Post Office						1	2
Prison	1	3	4	4	4	4	5
Temple					1	1	1
Utilities			1	1	3	3	3
Total	39	68	110	167	254	357	438

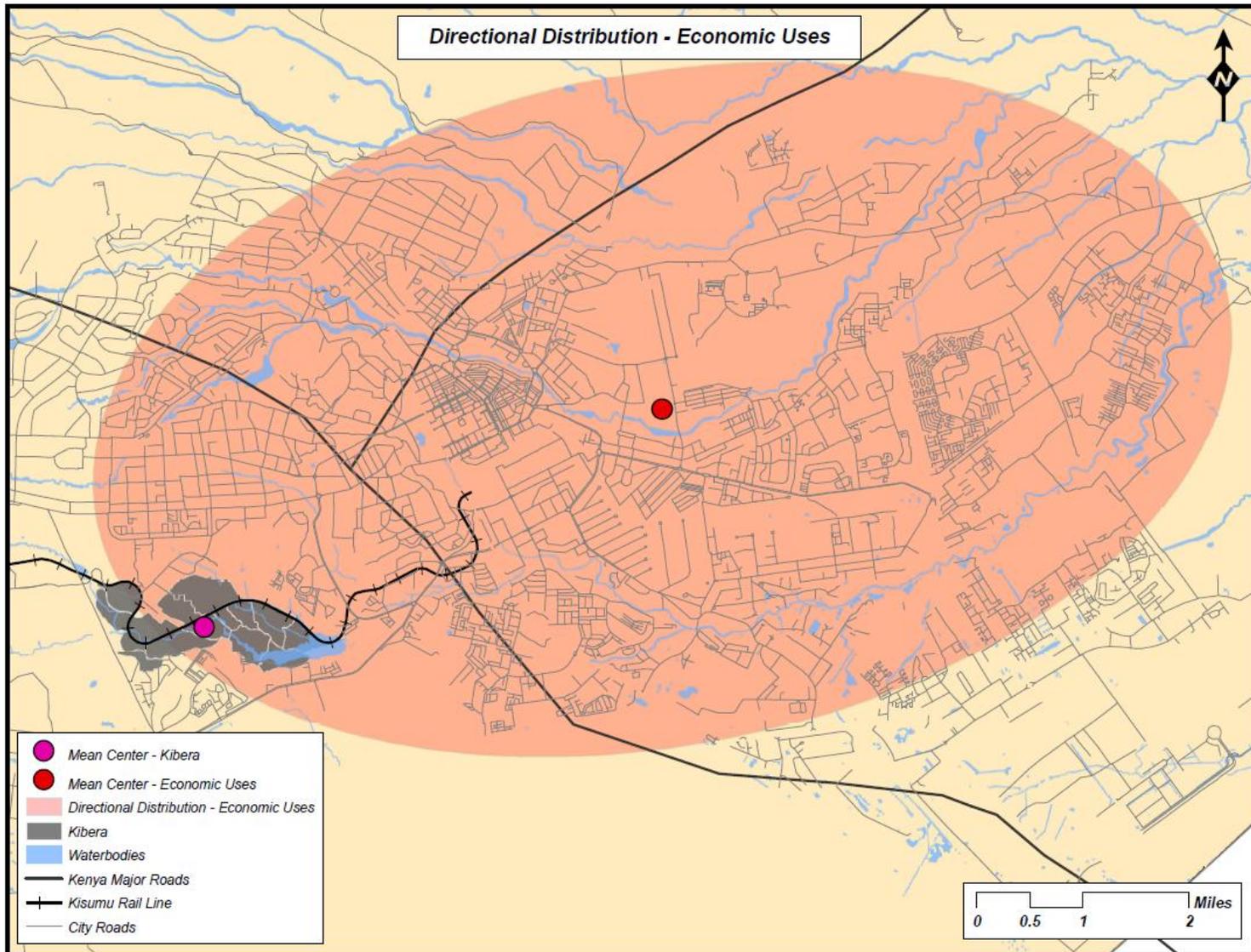


Figure 4-32. Directional Distribution: Economic Uses

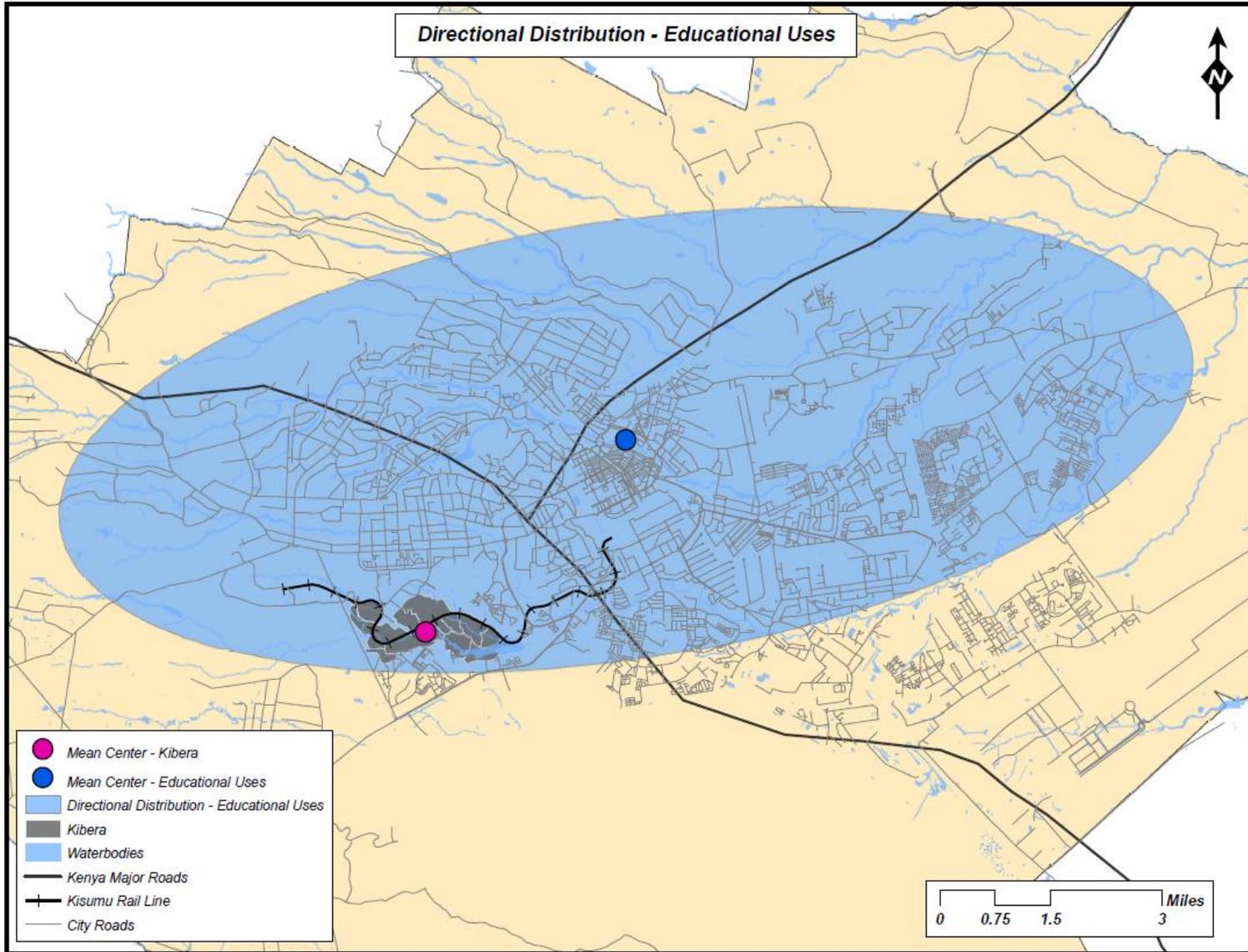


Figure 4-33. Directional Distribution: Educational Uses

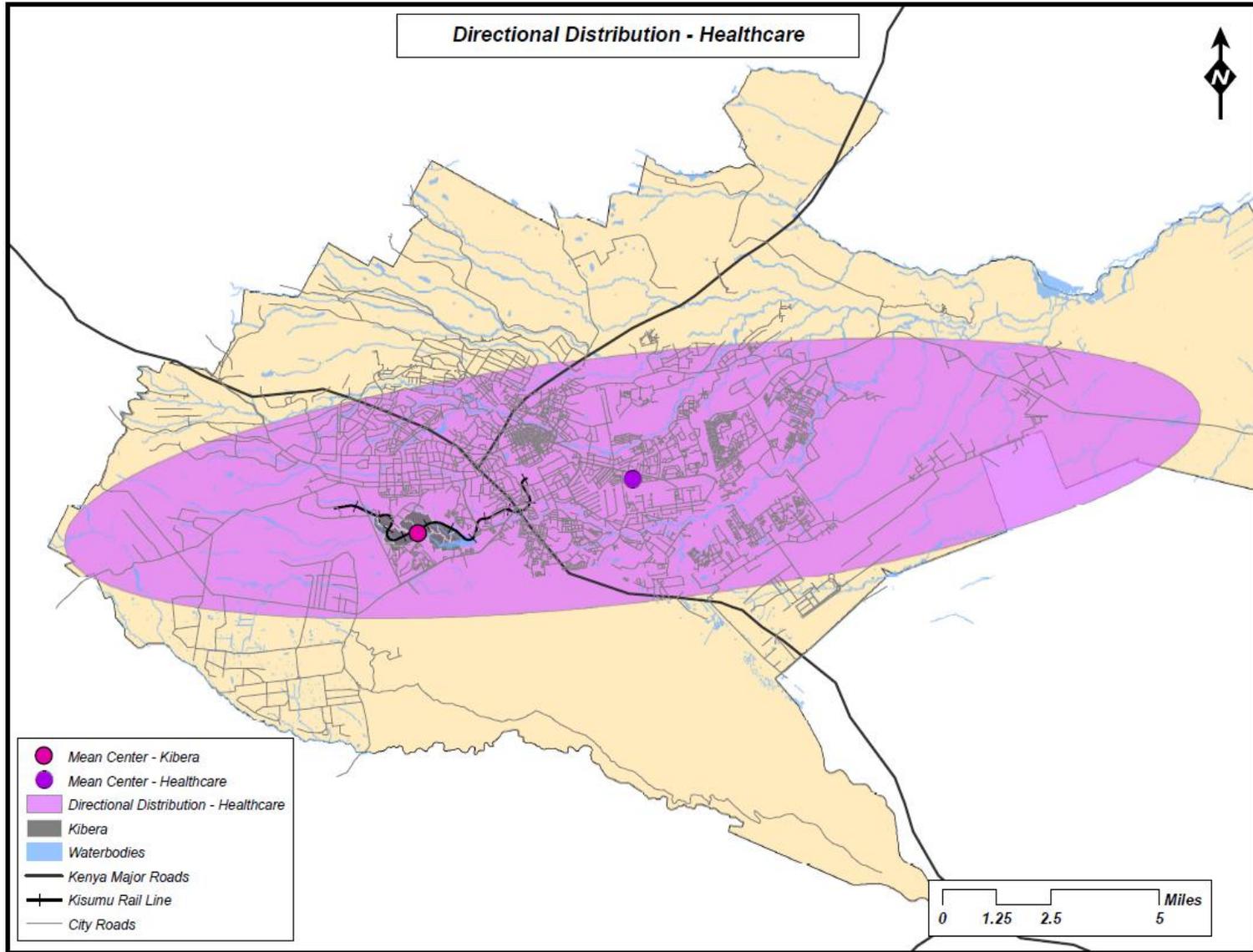


Figure 4-34. Directional Distribution: Healthcare

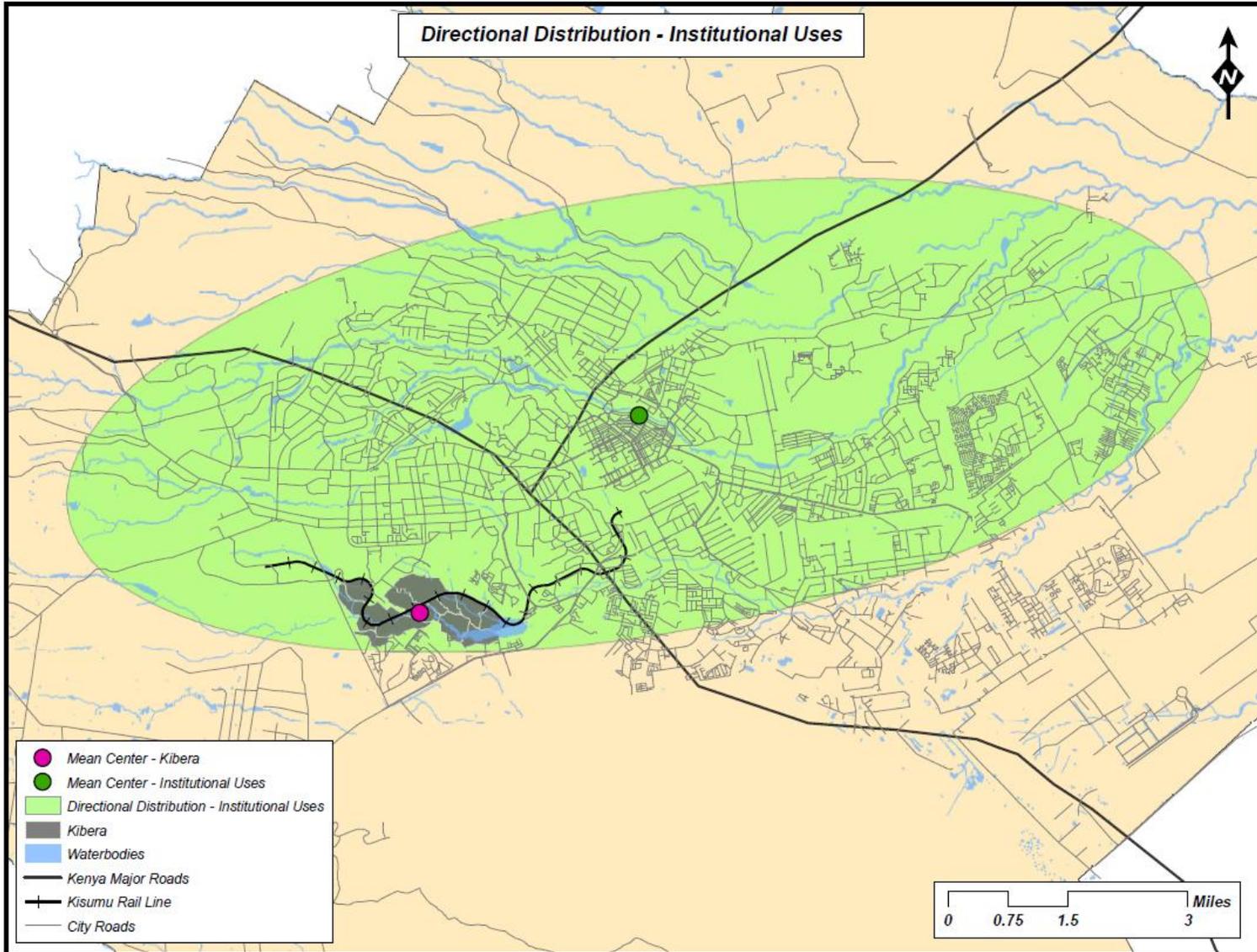


Figure 4-35. Directional Distribution: Institutional Uses

## CHAPTER 5 DISCUSSION

This next section presents a discussion based upon the literature review, further discussion of slum upgrading in other similarly sized African cities, and an evaluation of the ways that Kibera's levels of access can be improved.

### **Discussion of Results**

Overall, the results of the analysis point to a severe spatial mismatch between Kibera and the rest of Nairobi. These results are not surprising, and are largely consistent with expectations based off the literature review of other developing cities and accessibility. However, the analysis also displayed an extremely uneven distribution of services across Nairobi and with respect to Kibera. Much of Kibera has restricted access to the center of the economic area, or the Nairobi CBD. The large role of the informal employment sector in Nairobi, and Kibera as well, likely has a huge undocumented influence on the spatial presence of economic uses that cannot be addressed by the magnitude of this study.

This mismatch has also been referenced in other studies on Nairobi, with Salon and Aligula (2012) stating that "the majority of Nairobi residents have a low mobility lifestyle. Although this lack of physical mobility is a choice for some, it is likely forced upon others because they cannot afford to pay for motorized transport modes" (Salon & Aligula, 2012, p. 67). With respect to these findings, how should access and mobility be provided to residents of Kibera?

### **Slum Upgrading in Other African Cities**

While the challenges faced by Kibera are large in scale, the area does not face unique challenges as a slum area in a developing country. In fact, there exists much

similarity between Kibera and other slum areas in African cities, namely Khayelitsha in Cape Town, South Africa and Makoko in Lagos, Nigeria. Briefly examining the characteristics of the two areas can greatly inform how governments have or have not intervened to reduce poverty in these slum areas.

**Khayelitsha.** Cape Town, South Africa is the largest city in South Africa, and the city's largest slum area, Khayelitsha, is home to around 400,000 people on 16.8 square miles of land (Department of Social Services and Poverty Alleviation, 2005). Khayelitsha has a similar population size to that of Kibera, however that population is spread over a significantly larger land area. Khayelitsha is around 12 miles from the Cape Town CBD, even further from the majority of the Cape Town suburban neighborhoods. Around 53% of Khayelitsha's population is employed, and 89% of households are "moderately or severely food insecure). The slum is located on a flat area of unwanted government land, and is divided into 22 sub-neighborhoods. One of the ways that Khayelitsha differs from Kibera is its establishment is its establishment as a region – it has relatively good transportation infrastructure, including access to bus services, Metrorail trains, and many taxis within the township and to/from the Cape Town CBD. According to several sources, trains are the cheapest and most relied upon modes of transportation.

The government of South Africa, Cape Town have pushed through various anti-poverty programs, however up until recently, has not been as proactive as the City of Nairobi and Kibera. Part of that reason could simply be due to proximity to the city centers – Kibera is 3.1 miles from the City of Nairobi CBD, and Khayelitsha is around 12 miles from the City of Cape Town CBD. Another reason could be magnitude and prominence of the poverty conditions in Khayelitsha.

On New Year's Day 2013, Khayelitsha endured its worst disaster to date – a fire that consumed over 700 family dwellings and claimed the lives of several residents (Lobel, 2013). Since that time, City of Cape Town authorities have been “determined to stop the haphazard rebuilding beginning in the area” after the fire, with hope that “a new, ground-breaking housing scheme may soon rise from the ashes” (Lobel, 2013). Several aspects of the Cape Town's governments plan for Khayelitsha echo that of KENSUP, including “aligning plots in rows, leaving three metres between them for emergency vehicle access,” “the provision of essential services,” and “increasing employment among the dwellers” (Lobel, 2013).

**Makoko.** Lagos, Nigeria continues to experience the highest population growth rates in all of Africa, and by 2015, the Government of Nigeria estimates that Lagos will have 25 million residents, making it the 3<sup>rd</sup> largest city in the world (IRIN News, 2006). However, Lagos is also experiencing high rates of slum growth – currently, two out of three Lagos residents live in a slum with “no reliable access to clean drinking water, electricity, waste disposal – even roads” (IRIN News, 2006). Makoko, one of Lagos' largest slums, is home to approximately 500,000 residents. The slum is illegally constructed, and an unique characteristic of Makoko is how residents have constructed their wooden shacks not on government land, but on stilts over Lagos Bay. As such, wooden canoes are the primary mode of transportation within the slum and to access other regions of Lagos (IRIN News, 2006).

After numerous poverty reduction programs, the Government of Nigeria and Lagos State decided to knock down the Makoko slum in July 2012, in efforts to revamp the waterfront and stimulate economic activity. Residents of Makoko were given 72 hours to

vacate their properties before demolition, under the premise that “illegal constructions constitute an environmental nuisance, security risk and an impediment to the economic and gainful utilization of the waterfront” (BBC News, 2012). Since that time, the City of Lagos has begun construction on a light rail system, road widening projects, and is making strides to “get the city ready for its predicted population of 40 million people” (BBC News, 2012). This method of reducing poverty through slum eradication is quite different from the methods of the City of Cape Town and the KENSUP plan.

### **How to Provide Access?**

Since the GoK and City of Nairobi agree upon taking measures that reduce poverty for Kibera and improve quality of life, rather than demolishing and eradicating residents, it is essential that access is part of their poverty reduction initiatives. While it is evident that Kibera desperately lacks access to several types of goods and services, the question remains: how can this access best be provided? There seem to be two primary methods to improve access to Kibera: better transportation options, provided by improving Kibera residents’ mobility to access existing services; or disperse existing services by enticing new services to open up within Kibera as part of KENSUP. Both of these methods will be presented and discussed in further detail as they apply to Kibera.

### **Increased Transportation Options**

While bus lines and matatu routes currently run from Kibera to both the CBD and Industrial Area, a very limited number of access points exist for Kibera residents to access those bus lines and matatu routes. A Kibera resident must currently walk from their neighborhood either to the northern or eastern edges of Kibera to access a matatu. While the conditions of Kibera currently are closed off from vehicular access and

thereby any form of public transit, this also directly limits economic growth in the region by limiting physical access to employment.

A household travel survey of Nairobi residents conducted by Salon and Aligula (2012) found that 36% of walkers desired the provision of more and differentiated transit services, 32% of walkers desired improved public transportation vehicle quality, and 28% desired improved transportation infrastructure (Salon & Aligula, 2012, p. 73).

Existing matatu network and public bus lines provide networks of public transport around the City of Nairobi. While these systems appear to be able to serve the travel needs of Kibera residents who are willing and able to walk from their neighborhood to the stops on the Kibera boundaries, this could be between a 5-minute or 30-minute walk (100 feet to 1.5 miles). If a formal matatu/bus network is incorporated to pass through Kibera, it is likely that even more access to healthcare, education, and employment could be offered to Kibera residents. In their household travel survey of Nairobi residents, Salon and Aligula (2012) asked a set of questions about public transportation in Nairobi. Response from the survey indicated that there exists substantial agreement among Nairobi residents for the government to have a “larger and more direct role in the public transit system – though the transit riders and walkers feel more strongly about this than the car drivers” (Salon & Aligula, 2012, p. 72).

In partnership with the proposed development of a commercial road corridor parallel to the Kisumu Rail Line, it is strongly recommended that a detailed analysis of matatu and bus routes explore the potential formalization of matatu service through Kibera, focusing upon providing residents direct access to the CBD, Industrial Area, and healthcare uses. While KENSUP is still in the implementation and design phase, the

City of Nairobi and GoK has an opportunity to seriously consider and evaluate the incorporation of subsidized public transit strategies connecting Kibera through a loop system and with key areas in Nairobi – namely the CBD, Industrial Area, and major hospitals.

The incorporation of matatu and bus routes through Kibera as part of KENSUP should include not only mere provision of bus stops, but also steps to ensure financial accessibility for residents. If an additional bus line is developed and funded for the specific purpose of connecting Kibera residents with the Nairobi CBD, but becomes unaffordable for residents, it becomes a waste of funds for the City, GoK, residents, and other financial supporters of KENSUP.

While the expansion of the commercial road corridor parallel to the Kisumu rail line will serve the middle of Kibera, it does not access the individual neighborhoods and not connect them with the outside roads. Construction of new housing and utilities will require emergency access and service roads. In Figure 5-1 on the next page, a rough location of the new KENSUP commercial corridor is illustrated along with proposed locations of paved pathways and new bus stops from this analysis. These locations are based simply upon increasing the number of access points within Kibera, and actual design and construction would require further detailed analysis of the area and further knowledge of the specific KENSUP development and site layout plans.

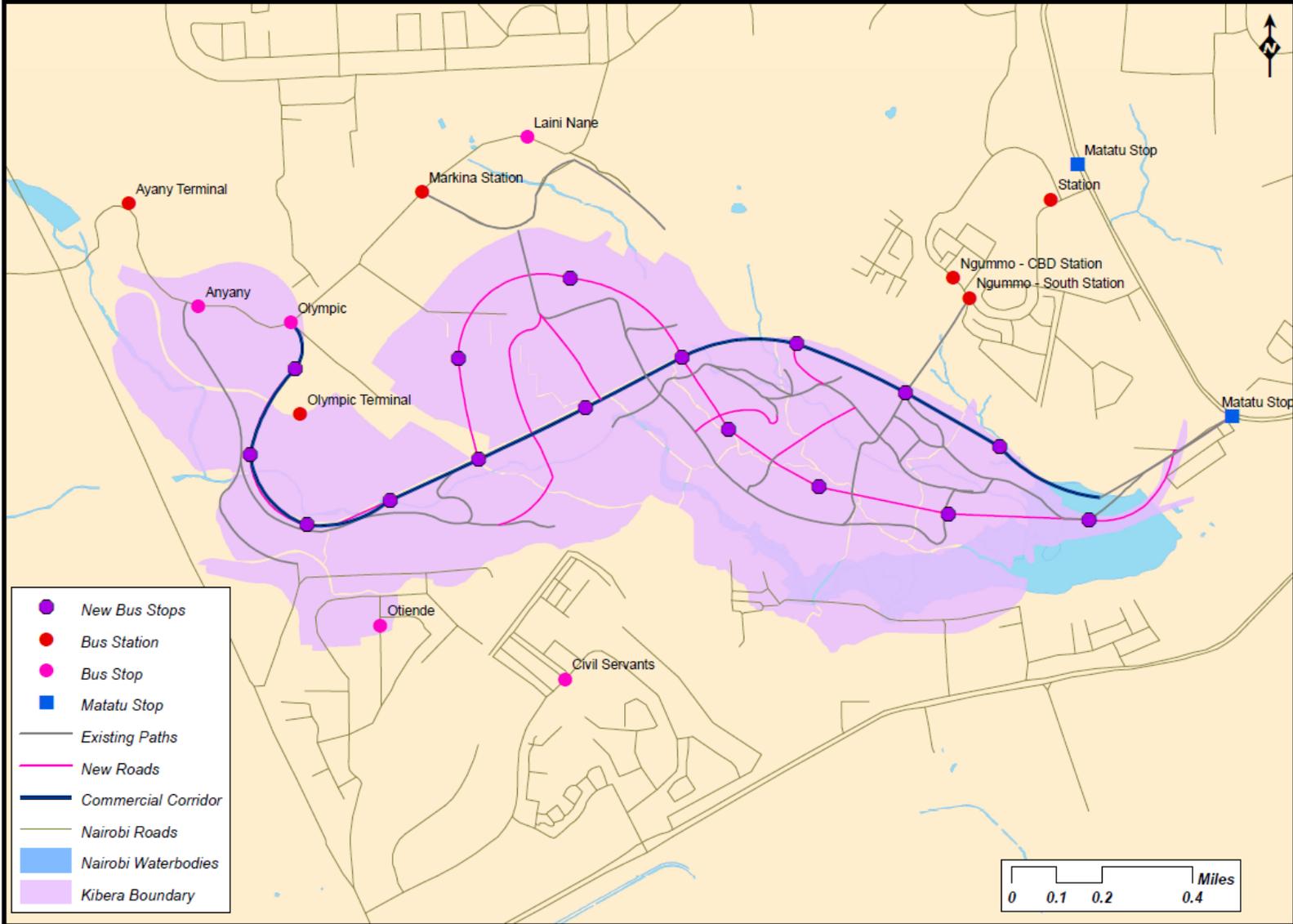


Figure 5-1. Proposed Transportation Developments within KENSUP

## **Increased Service Dispersion**

The alternative to increasing direct transportation access within Kibera is bringing formal land uses and services into Kibera, such as schools, healthcare clinics, hospitals, or formal employment opportunities such as businesses. While this alternative avoids issues of moving Kibera's population for slum upgrading, it also presents significant challenges with land tenure and formalization can play a major deterring role.

The concept of "retail following rooftops" can be used in this case to make an argument against this alternative. Generally, economic activities (retail) will follow the development of residential development (rooftops), to serve its residents. However, in the case of informal slum settlements such as Kibera, without formal land tenure, utilities, or transportation access, too much risk exists for formal economic uses to move into Kibera under current conditions.

If a grocery store, for instance, decided to move from the suburbs into Kibera, it would encounter significant challenges in terms of gaining revenue, paying cost, and safety. First, finding a parcel of land would be difficult, expensive, and ultimately, temporary. The acquisition of electricity and running water would also be expensive, and somewhat unreliable. On top of these challenges, the costs for the land rental, electricity, and water would be significantly higher compared to other locations with existing amenities or utilities. The store would have no legal rights to its investment into their facility, and would have little financial security with which to protect itself.

This option seems to have been the preference of the GoK for several decades, waiting for economic activity and formal structures to take over Kibera through the free market. However, with KENSUP, the GoK has made significant moves towards improving Kibera through government interaction and slum redevelopment.

## **Character of Government Action**

The City of Nairobi and Government of Kenya can play a role in increasing access to Kibera in several ways. The implementation of these recommendations will largely depend upon the character of several actors in the KENSUP process and through to implementation and monitoring. While the implementation and exploration of transit options as part of the KENSUP plan for Kibera will likely provide reductions in poverty through increased access, it will come with several political challenges and costs to the Government of Kenya, City of Nairobi, UN-HABITAT, and international aid agencies.

Hook and Howe (2005) argue that since African cities are lower income, less dense, and have less roadway infrastructure than other cities in the developing world, it can be very expensive to provide public transportation service because of pressures for affordability (Salon & Aligula, 2012, p. 72). Hook and Howe (2005) therefore conclude that “more formal forms of public transport are unlikely to be successful in Africa without government actions that change these underlying conditions” (Hooke & Howe, 2005, in Salon & Aligula, 2012, p. 72). Therefore, it is essential that for KENSUP to be a successful project and achieve its goals, the City of Nairobi and Government of Kenya should continue investing time, research, and funding into the physical redevelopment of the slum, as well as the underlying conditions of land tenure, employment, sanitation, and basic services.

Since independence, African governments have been partners with many other entities assisting in the improvement of quality of life and poverty reduction in their countries. These international aid agencies such as UN-HABITAT, UNDP, the private sector, and NGOs all have valuable roles to play in Kibera’s continued development and improvement. While specific roles and levels of funding will depend upon the KENSUP

project and location characteristics, it is recommended that KENSUP and the GoK continue to utilize both resources and financial support from these international aid agencies and NGOs as KENSUP projects move through the design, implementation, and monitoring phases.

### **Challenges to Implementation**

Idealistic views of how a region such as Kibera can be transformed through the effects of one project alone can be useful in project planning, however, it is essential that challenges to implementation be seriously evaluated and taken into account in project design and recommendations. As evidenced by the interwoven set of factors explored in this study (and others merely mentioned), Kibera is a very complex and challenging place, and any project intending to relieve poverty by some method will encounter challenges. The spatial trends examined in this study solely reflect spatial access based upon physical distances, and do not represent any social, political, or financial barriers to goods or services, though significant challenges are known to exist.

**Political Feasibility.** The KENSUP program was initiated by a governmental regime that was and continues to be supportive and proactive towards poverty reduction programs and policies. However, it is possible that modifications in Kenya's political environment could drastically change overall political support for poverty reduction or the KENSUP program. As one of the more recently stable African countries, it is less likely that a dramatic change like this could occur, but if so, would present significant challenges to the funding and effectiveness of a long-term slum redevelopment and poverty reduction program like KENSUP.

**Cost.** The KENSUP program involves significant investment by the City of Nairobi, GoK, and UN-HABITAT into the future of not only Kibera, but Nairobi and the country of

Kenya as a whole. To continue these improvement projects in Soweto East and beyond into the other 11 neighborhoods of Kibera, continued investments shall be made into KENSUP projects by not only the City, GoK, but also international aid agencies or other neighboring countries. Though funding for long-term projects like these can be difficult to sustain, it is essential that continued funding is guaranteed for KENSUP to reach its intended effects through redevelopment and access provision for Kibera residents.

**Affordability.** In addition to funding by the project sponsors, it is essential that housing and transportation plans developed by KENSUP be affordable to Kibera residents. While KENSUP's proposed developments and transportation plans should be physically accessible to the residents of Kibera on both the beginning and ending points of their journey, local and national policies developed by the City of Nairobi and GoK must take close care to ensure the affordability and safety of the system. The household travel survey of Nairobi residents conducted by Salon and Aligula (2012) found that while residents did support government intervention in public transportation systems, their top condition (for 69% of walkers and transit users) on which the government could improve the public transport network was for them to "regulate fares and introduce a fare policy" (Salon & Aligula, 2012, p. 73). Comparatively, around half of that number (36%) desired the provision of more and differentiated transit services, 32% desired improved public transportation vehicle quality, and 28% desired improved transportation infrastructure (Salon & Aligula, 2012, p. 73). Maintaining service affordability is one of the most essential aspects of this slum redevelopment program, and is key to achieving poverty reduction by improving affordable access.

**Gentrification.** Slum populations across the world have experienced both positive and negative reactions to upgrading projects similar to KENSUP, and it is essential KENSUP take into account the challenges of gentrification that could result. Tied closely to affordability, the GoK and the City of Nairobi should ensure that land, housing, and transportation costs after redevelopment are not raised so high that current residents cannot afford to remain in Kibera. Predicting the economic variations that a slum redevelopment project such as KENSUP can have upon land values and costs for Kibera residents is a significant challenge, but must be evaluated and further examined by the GoK and City of Nairobi.

**Physical Accessibility.** Redevelopment plans formulated by the GoK and City of Nairobi must not only be affordable, funded, and not produce excessively high land values, they must also be physically accessible for Kibera residents. In particular, housing and transportation plans should focus upon improving access for specific population groups within Kibera such as the youth, the elderly, and the medically handicapped. As discussed previously in the literature, the priority of an elderly or a medically handicapped population to have access to healthcare facilities is greater than access to education or employment facilities, and the design of the redevelopment plans should take these into account.

## CHAPTER 6 CONCLUSION

Finding a way to consolidate several discussions about the current state of a complex place as Kibera is about as challenging as navigating the complexity of Kibera itself. Kibera poses a set of several challenging circumstances, evident in the literature review, background and current conditions of the region, spatial analysis, and results. While the recommendations of this study and conclusions echo similar themes in other development literature, this study does point to the continued need for investment of resources and study into centers of urban poverty such as Kibera.

### **Further Research**

While Kibera has been the focus of much study by international aid agencies in the past few decades, the high rates of disease and poverty rates have remained. Though it is challenging to document geographic and spatial data in developing nations, it is even more challenging to document these conditions in informal settlements with informal pathways, housing patterns, and informal land tenure, such as Kibera. MapKibera and the University of Nairobi have taken huge strides forward in beginning the process of documenting several aspects of Kibera, and these efforts should be not only continued into the future, but also expanded by these agencies, the City of Nairobi, and ultimately the Government of Kenya. The more data available on Kibera is more information that can inform study and critical decisions by government officials, potential investors, and international aid agencies. Another layer of further research that holds significant potential for its effect upon land use and transportation decisions for Kibera should be interviews. Talking with Kibera residents could also be very helpful in identifying day-to-day access patterns to employment opportunities, education, and healthcare. In

addition, resident interviews would likely reveal underlying factors or challenges that are not mentioned in this study.

### **Summary of Conclusions**

While the scale of the poverty challenges within Kibera can seem overwhelming, it is essential that this type of proactive attention continue to be given to improving the quality of life and reducing poverty for Kibera's residents. The scale of urban poverty in slum areas around the world, like Kibera, not only demand attention from local and national governments, but increased international support and a sustained commitment by several parties to improve the quality of life for billions of people across the planet (Briceno-Garmendia et al., 2004). Through clear national priorities and local policies, the City of Nairobi, the Government of Kenya, and international aid organizations have the opportunity to guide the use of their resources towards investment in infrastructure and transportation networks that will be able to spur forth increased access for Kibera's residents, and reductions in poverty levels and improved quality of life for generations of Kiberans to come.

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## BIOGRAPHICAL SKETCH

Amy Cavaretta is a candidate for her Master of Arts degree in Urban and Regional Planning from the University of Florida. She received her Bachelor of Science degree in Civil Engineering from the University of Florida in 2011, with a Concentration in Transportation, and minor in Urban and Regional Planning. She has interests in transportation engineering, planning, and policy in the developing world after visiting the slums of Brazil during high school. She hopes to work in transportation policy in Washington, D.C. after graduation in May 2013, and hopes to one day put her transportation knowledge to work internationally.