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INYUVESI YASETHEKWINI YEZOBUCHWEPHESHE

AN INQUIRY INTO THE SOCIO-ECONOMIC INFLUENCE ON THE ARCHITECTURE OF THE QUARRY ROAD WEST INFORMAL SETTLEMENT, ETHEKWINI MUNICIPALITY.

By

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DECLARATION

I declare that this dissertation and data presented has been composed solely by myself and has not been previously submitted for any degree. Any work borrowed from other authors and researchers has been referenced and acknowledged accordingly.

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Date: 21 April 2023

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DEDICATION

To the one who raised me:

Nosipho *'Magogo'* Matangana née Mathandabuzo.

Ndiyabulela.

ABSTRACT

Informal settlements are present worldwide under various names, forms and typologies. According to the UN-Habitat (2015a), over half of the world's population lives in cities with over a billion people living in informal settlements. The global south appears to be experiencing a dramatic urban population growth, with sub-Saharan Africa expected to double its numbers in the next two decades. In South Africa, the lack of access to adequate and affordable housing in the city forces low-income and urban poor to resort to building their own homes. These dwellings are built precariously, from recycled and affordable materials with sometimes poor performance, given the low wage group of the builders. These dwellings are built to cater to the residents' immediate housing needs, while also conveying a narrative and meaning through the aesthetics and the configuration of the physical form, defined by their socioeconomic realities. Despite various interventions put in place by developing cities to curb the spread of informal settlements, they continue to grow (UN-Habitat 2015a).

This research is an enquiry into how the socio-economic status of an informal settlement community influences the architecture of their environment. The analysis of foundational theories on human settlements and housing in the 20th century and literature review, assist to establish a quality benchmark as a reference. Further, the research advances an inquiry into the spatial patterns and dwelling configuration that influence human comfort and security, through a qualitative review of existing spatial studies, interviews with key informants and the use of a case study. The building materials and techniques used to build the structures, which define the built form narrative, is scrutinised from a spatial, technical and economic perspective, and put into context within the city and national building standards. The outcome of this research is intended to give guidance on an alternative design framework that is based on the findings from the analysis of the existing socio-economic parameters and built form. The Quarry Road West Informal Settlement (QRWIS) which is located in the city of Durban, South Africa is selected as a case study.

Keywords: Informal Settlements; Architecture; Construction Technology; Built form

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LIST OF ACRONYMS

BNG	Breaking New Ground
CABs	Communal Ablution Blocks
CBD	Central Business District
DHS	Department of Human Settlements
GDP	Gross Domestic Product
Ha	Hectare (1 ha = 10,000 m^2)
IDP	Integrated Development Plan
KM	kilometre (1 km = 1,000 m)
KZN	KwaZulu-Natal
LSM	Living Standards Measure
LUMS	Land Use Management Systems
M^2	Square meter
MDG	Millennium Development Goals
NGO	Non-Governmental Organisation
NPO	Non-Profit Organisation
NUA	New Urban Agenda
PPT	Project Preparation Trust (Non-profit organisation)
QRWIS	Quarry Road West Informal Settlement (Case study)
R/ZAR	South African Rand ($1 USD = R16.92 in July 2022)
RDP	Reconstruction Development Programme
RSA	Republic of South Africa
SDGs	Sustainable Development Goals
SDI	Shack Dwellers International
SMME	Small, Medium and Micro-sized Enterprises
STATSSA	Statistics South Africa
UN	United Nations
UN-Habitat	United Nations Human settlements program
WB	World Bank
WHO	World Health Organisation
VIP	Ventilated Improved Pit

INTRODUCTION

1.1 Background of the study

Informal settlements are a global phenomenon and have been part of the urban landscape for a very long time. However, it is mostly an urban phenomenon which John Turner described as being a solution to the housing challenge in urban the parts of developing countries (Boyars & Turner 1976). Despite 'informal', these settlements are well integrated within their urban context, be it economically, spatially, socially and developing cities are unsustainable without them (Dovey & King 2011). This suggests that there are certain skill sets which are offered by people living in informal settlements that contribute towards the positive growth of a city. The development and proliferation of informal settlements is attributed to rapid population growth in urban areas. Rural-urban migration is highlighted as one of the major reasons for this rapid growth (Wekesa, Steyn & Otieno 2011). For people living in rural areas, migrating to the city has always been seen as a way to gain some level of success, thus improving their quality of life. Recent studies have noted the inability for cities to deal with rapid rise in urban population and the failure to provide adequate housing. To date, over one billion people live in informal settlements worldwide (United Nations 2018), with most of this growth occurring rapidly in developing countries.

Informal dwellings represent a housing response for poor people migrating into the city, in search for economic opportunities. These dwellings also serve as a transitional space for the urban poor while they wait for the promised 'formal' housing by the government. While others wait, those who have abandoned the idea of a free and formal house resort 'formalising' their informal dwelling by incrementally building it into a more permanent state. These informal settlements therefore develop into spaces of a kind of architectural production, which responds to the immediate needs of the dwellers, an envelope that has been defined as "architecture degree zero" (Pareyson 1987), and is a result of actions rather than planning. The informal dweller may be understood as a new social class in the urban landscape, and the informal settlement becomes the realm of unique spatial complexities within its boundaries. This is aptly captured in the statement by architect John Turner who

stated that, “The poor in such settlements demonstrate great energy and intelligence in the use of resources and in evaluating priorities” (Kellett & Napier 1995).

For people living in these settlements, social and economic activities take place as a symbiotic relationship created by the immediate community and the surrounding environments. This is partly attributed to how informal settlement dwellers interact with their neighbouring environments. However, these informal settlements are rarely perceived as positive spaces within the formal urban environment in which they exist. Kellett and Napier (1995) attest that they are usually viewed as being inadequate, disorganized and only fit for eradication. They are rarely viewed in a positive light, as indicators of the resilience of human spirit, from where knowledge of how to build better for the poor, can be extracted.

1.2 Research problem

Despite the global experience of the informal settlement phenomenon in urban areas, the United Nations (UN) recognizes that the provision of adequate housing for the poor in the urban context has not been effectively addressed (UN-Habitat 2015a). This inefficiency could partly be attributed to the lack of understanding of the dynamics of both, spatial organisation and form. Settlement upgrading programmes address the aesthetic aspect which are buildings, without a holistic understanding of the cause of the existing built form. This research contributes to the body of work which is aimed at understanding the spatial and aesthetic complexities that shape the architecture of informal settlements. While also interrogating this phenomenon, Elleh (2011) points out that the problem has been so severe that these ensembles have progressed into their very own architectural type and language.

This study interrogates informal settlements as places of opportunity, whereby place-based knowledge, systems and complexities can be understood. This in turn informs a tailor-made responsive design approach in housing delivery. Typically, studies of informal settlements tend to focus on the superficial visual analysis of the informal built form with not much emphasis on the economic and social conditions which make up these spaces (Kellett and Napier 1995). This suggests that a deeper understanding of the role of architecture in informality, with a multifaceted approach, must be explored in order to assist in the development of responsive design and policy frameworks – a critical gap.

Officially, construction of informal dwellings contravenes the parameters of 'architecture' as they do not follow municipal guidelines or comply with official regulations. There are several requirements such as; structural, spatial, and health and safety which go unchecked. The role of architecture may assist in formulating a research-based, participatory process in which architects work hand-in-hand with communities in order improve the condition of their dwellings and living spaces. This research advocates for a people-centred approach, in which the end-user partakes in the process of pro-creating their own space.

1.3 Research aim and objectives

Most of the literature pertaining to informal settlements tends to deal with the social consequences of this phenomenon: urban poverty, inequality, corruption, inclusivity, etc. Assessment of the actual built form of these settlements has hardly captured the attention of researchers thus far. It is equally important to consider the urban challenges as well as the potential for learning from informal settlements, to suggest an alternative to housing delivery solutions. The aim of this research is to define an inclusive design framework based on the analysis of the built form, in response to socio-economic parameters present in the Quarry Road West Informal Settlement (QRWIS). I it envisaged that this will assist policy makers and municipal managers in the provision of adequate housing for the poor in South African cities. The exploration of the informal built form is thus expected to assist in the understanding of the socio-economic parameters which lead to the consequential built form of the QRWIS.

The study will explore informal settlement at its' urban scale, whilst being mindful of the immediate peripheral urban fabric. It will progressively scale down into spatial organisation, examining how dwellers interact with the built form and public space within the settlement. Lastly, the research will delve into the physical structure of the informal dwelling in order to uncover the intricacies pertaining to the assembling of such structures. This is critical to understand how socio-economic realities impact the resulting built form of the dwelling unit within the settlement to inform a responsive approach to design.

This study intends to contribute to a wider body of work conducted by multiple scholars in the search to understand informal settlements in the context of cities in the global south.

Objectives:

1. To understand how socio-economic factors influence urban informality.
2. To inquire how the socio-economic factors shape the informal built form.
3. To understand what determines the technological and aesthetic expression in informal settlements.
4. To determine the key challenges to architecture in the context of informal settlement.
5. To define principles of a responsive design framework for in informal settlements.

1.4 Key research questions

How can the exploration of socio-economic dynamics together with the built form, assist in the understanding of the architecture of informal settlements?

Sub questions:

1. How have socio-economic realities influenced urban informality in Durban, South Africa?
2. How have socio-economic constraints influenced the built form of informal settlement?
3. What are the key factors that influence the technological and material expression of informal dwellings?
4. What are the key architectural challenges facing the informal dwelling?
5. What are the key impediments which affect the architecture of informal dwellings in informal settlements.

1.5 Limitations of the study

The research focuses on the relationship between socio-economic realities and the built form of informal settlements. The study area is located in Durban, as it is most accessible to this study. The research is confined to online tools and methods, due to the COVID-19 pandemic. These tools include literature review, interviews, maps, satellite imagery, photographs and a case study.

1.6 Definition of key terms

Architecture – According to the Britannica dictionary, it is the art and technique of designing and building, as distinguished from the skills associated with construction.

Apartheid – A system of segregation and discrimination based or race.

Community – The collaboration of the social connection of the stakeholders living in a particular location within a settlement and the physical infrastructure they inhabit and utilize, which they categorize as their local hub.

COVID-19 – An infectious disease caused by the coronavirus

Informality – The absence of a formal or organised structure

Informal settlement – An unplanned settlement which has been illegally occupied by its inhabitants through the construction of informal dwellings.

Informal settlement community – A collective of people residing in an informal settlement

Informal dwelling – An unplanned informal structure loosely termed a shack or 'umjondolo', built out of cheap, readily available and recycled material where dwellings have been constructed without following the national building regulations and without the approval of the local planning authority.

Unemployment – Refers to those who did not work at the time of the census, but were actively looking for work. The people who are out of the labour market or who are not economically active and are between the ages of 15 to 65 years (definition from Statistics South Africa).

Tectonic – It is the art or science which relates to how the built form is used and expressed. It is how the building material and technology is used to express the quality, creativity, culture and aesthetics of a building structure.

Sustainability – The ability to maintain in order to avoid depletion or deterioration of an entity.

1.7 Structure of dissertation

Chapter 1. Introduction

This chapter introduces the research problem and the need for this research to explore various ways to better understand the built form of informal settlements and thereafter, designing accordingly.

Chapter 2. Conceptual and theoretical framework

Chapter two presents the theoretical framework, discussing the most critical concepts and theories related to human settlements, the architecture of dwelling and lastly, urban resilience as fundamental notion bonded to the dwelling experience in an informal settlement.

Chapter 3. Research Methodology

Chapter four describes the research methodology, elaborating on the strategies and instruments used in collecting data, together with sampling methods, data analysis, and ethical consideration.

Chapter 4. Literature review

This chapter interrogates the background to the development of informal settlements, the socio-economic profile of the inhabitants, including the socio-economic conditions of the informal settlements. This chapter gives an historical overview on the development and proliferation of these settlements. It further critically analysis the existing body of knowledge related to their built form.

Chapter 5. Case Study and analysis of the Quarry Road West Informal Settlement.

This chapter describes in detail the socio-economic parameters of the Quarry Road West Informal Settlement (QRWIS), together with the built form and spatial organisation of the settlement.

Chapter 6. Results and discussion

This chapter presents and discusses the research results. The use of drawings, figures and tables helps to clearly articulate the findings.

Chapter 7. Conclusion and recommendations

The conclusion will evaluate the research findings against the research questions and formulates recommendations based on the analysis of the data.

2. CONCEPTUAL AND THEORETICAL FRAMEWORK

It is important for this research to establish the benchmark through which a set of features in a given human settlement and dwelling is considered acceptable for habitation. Moreover, understanding the parameters through which lifestyle influences the aesthetic decisions of users and vice versa, how users' limitations determine the architecture in which their lives evolve. Informality represents one of the key parameters that characterise Southern African cities. Informal settlements in particular, are associated with danger, chaos, and disease. They also lack the public space needed for human interaction and moreover, economic prosperity (Clos 2016).

The aforementioned benchmark is developed in this section, and is based on a set of influential theories proposed from the early 20th century on, when architecture is consciously seen as a tool with social impact. From Garnier to Koolhaas, including Le Corbusier and Norberg-Schulz, among others, this section presents a diverse body of thought which focuses on the qualities of the city as an adequate habitat for humans to settle, and the qualities of a building that is adequate for habitation.

These theories assist in the articulation of a framework that includes pertinent and accepted ideas by scholars. They include topics such as human settlement, human residence and urban resilience. Therefore, the theoretical framework assists in understanding the composition of the urban space, the definition of dwelling and the resultant architectural formation, as well as the perpetuation of such urban systems. Ultimately, revision of these theories establishes what can be considered a formal, safe, healthy and prosperous human settlements.

2.1 Human habitat

The concept of human habitat that is used in human ecology and urban planning is similar to that of the ecological concept of habitat. This concept refers to a group of institutions, material factors that influence the existence of a contained or localised, human settlement. In architecture, the term refers to built spaces and urban spaces in which human life is developed.

In most instances, cities are viewed through generalised global north and urban paradigms. This is done without taking into consideration the different narratives which form part of city formation in the global south (Pieterse 2019 ; Odendaal 2003). The ethnographic account of city life or urban experience of people in the global south, for whom city design is imported. Moreover, an imported city in which their needs are ignored is yet to be explored, in its full context.

Informal dwellings provide the very bare minimum condition for habitation in the urban environment. Despite the overwhelming amount of constraints that this dwelling option has, it is obvious that most people manage to develop a routine of urban life. Therefore, it is important to clearly identify the parameters through which any habitat turns into a human one: Seeking protection from the climate and predators, identifying climate hazards and safety from urban predators. The access to resources such as water, energy and food primarily, but also proximity to economic opportunities and income; and the same time satisfies proximity to other people and the need for inclusion in the community (Gladwell 2000). These basic features drive their establishment and endurance.

2.1.1 Human settlement form and patterns

Settling in a specific location translates to delimiting the area, as a place. Wandering stops and a choice is made to settle: Here! And then the 'inside' is created within the surrounding 'outside'. For poor people moving into the city, the informal settlement becomes a point of arrival, what Taubenböck, Kraff and Wurm (2018) have cited as the 'arrival city'. The very experience of arrival which implies a relationship to what is left behind, a place of origin (Norberg-Schulz 1993). The transformation of the arrival site into a place for dwelling is achieved by means of built form and organized space. Both aspects are considered in some detail in order to understand the nature of the settlement (Norberg-Schulz 1993)

Norberg-Schulz (1971) identifies three settlement patterns: the cluster, the row and the enclosure (see Figure 1). The cluster consists of elements (buildings) which are organized by means of simple proximity, without possessing any kind of geometrical order or symmetry. In the row they are placed along a continuous line, whose curvature remains "free." In the enclosure, the elements form a closed figure around a space. In any case however, the basic

aim is to establish a meaningful relationship between the configuration of the site and the spatiality of the human fellowship (Norberg-Schulz 1993).

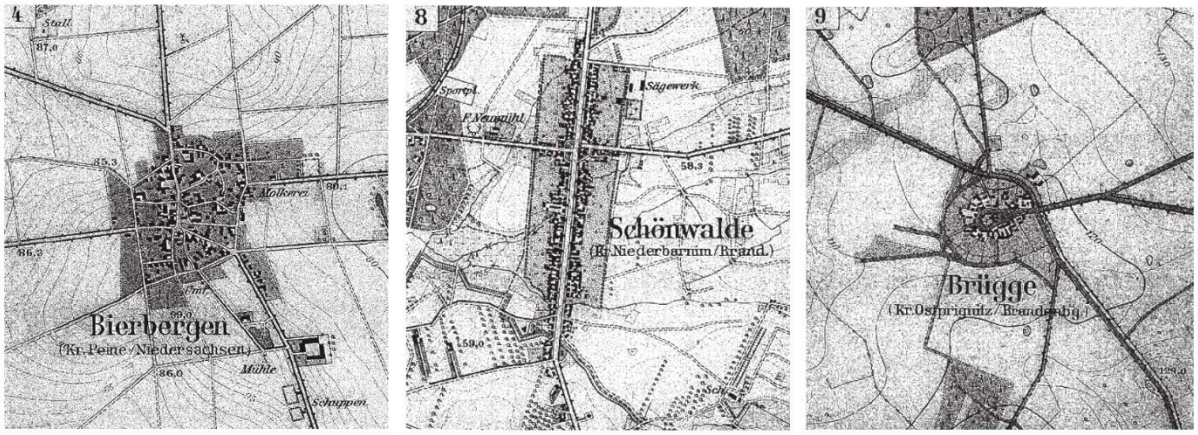


Figure 1. Settlement patterns by Norberg-Schulz, 1971

Two interrelated properties define the figural value of the settlement: form and a space, structured as centres, paths and domains, with a clear interrelation: the built form constitutes and provides charisma to the spatial elements. Together, built form and organized space constitute a place, on a certain environmental level. The comprehensive level of "settlement," thus, comprises several sub-levels, which are known as 'farm', 'village', 'town' and 'city' (Norberg-Schulz 1980).

The act of settling is always collective, but the settlement is not a mere "expression" of society. Rather it shows how a fellowship has understood the given environment where its life takes place, and been able to set this understanding into work as a settlement, that is, as a built spatial form which brings the inhabited landscape close (Norberg-Schulz 1993). Human togetherness implies that life takes place by means of an appropriate spatial organization. The figural value of a settlement, therefore, is not only established by its boundaries and by the single elements that form its skyline, but also, by the way in which components are grouped. Evidently the grouping is conditioned from without and from within, that is, by the configuration of the given site as well as the social structure of the fellowship (Norberg-Schulz 1993). The place, thus, brings together a group of human beings. "It is something which gives them a common identity and hence a basis for a fellowship or society. The permanence of the place is what enables it to play this role" (Norberg-Schulz 1993).

2.1.2 The concept of the modern city

The eruption of the industrial revolution and subsequent adjustments to a new reality led to a social discomfort. New forms of production were developed and the need for labour in cities intensified rural-urban migration. However, the adaptation of dwelling forms did not occur at the same rate. Challenging living conditions sparked the discussion on changes in the urban realm. In this context, the proposal for an 'Industrial City' by Tony Garnier in 1917 reflected on the economic and technical principles for the foundation of a modern city (Garnier 1917). The radical syndicalism and socialism present in Lyon, the city in which Garnier was born, lived and worked, are the result of one of the most progressive industrial hubs at that time. At the core of this new approach was the improvement of social conditions that the legal framework did not allow at that time. Garnier noted that, "a number of by-laws have been proposed for the better satisfaction of material and moral needs of the man". Cultural values are equally considered in his ideal city. Garnier acknowledged the sense of belonging with the inclusion of a medieval city around which the modern city is developed (Garnier 1917). In this regard, African cities typically lack such connection to ancient cultural references (Low 2019). However, African cities align to what Rem Koolhaas defined as the 'Generic City' (Koolhaas 1995), in which the burdens of maintaining a centralized identity that is no longer relevant, and is highly problematic.

In the location of his 'modern city', Garnier paid attention to the proximity of raw materials that could be used for production, natural forces as sources of energy such as hydroelectric power, as well as transport connectivity with other cities. Moreover, Garnier gave detailed instructions regarding the use of steel and concrete as key construction materials in the modern city (Frampton 1980).

Despite Garnier's ideas not materializing in a real city, his principles had continuation and influence in the urban planning of the early 20th Century. This urban organization foresaw what would become one of the principles of the Athens Charter in the CIAM of 1933: the 'differentiated zoning' (Frampton 1980).

The work of Le Corbusier, a relevant example of Garnier's influence, present in two of Le Corbusier's theoretical planning proposals: the '*Ville Contemporaire*' (contemporary city) in

1922 and the *'Ville Radieuse'* (Radiant city) in 1933. The former was an utopian community for three million inhabitants, three times the population of Paris at that time. The 24 sixty-story cruciform skyscrapers are the key elements of the plan, combining offices and dwellings, detached from each other by large green spaces. Around this central area, a series of suburbs house individual dwellings, what Le Corbusier refers as '*Cité Jardin*' (garden city): "an instrument to recover mentally from the effects of the modern life". At the core of the city, Le Corbusier positions the transportation hub including underground routes organized in five levels (Boesiger W.; Girsberger 2001). His vision glorifies the use of automobiles as key for modern transportation, and separated pedestrians from vehicles (Boesiger 2006).

The *'Ville Radieuse'* (Radiant city) is a city based upon economic criteria, referring to the quantitative parameters of mass production (Frampton 1980), and the ideas of the linear city by Arturo Soria y Mata. He replaced the traditional centre-periphery urban organization with an engineered linear distribution of infrastructure. The *'Ville Radieuse'* has a linear layout as the abstract shape of the human body. Le Corbusier had four purposes for his *'Ville Radieuse'*: to ensure large areas of vegetation all over the city; to offer efficient communication networks; to increase access to daylight; and to reduce urban traffic. Through these, its ultimate goal is to favour "living, working, circulation as well as care of the body and spirit, in this order and hierarchy", "representing an unquestionable ideal of personal freedom" (Le Corbusier 1933).

For Le Corbusier, the residential blocks are the core of urban life. They are available for all inhabitants; no longer reserved to the elite. The egalitarian nature of the inhabitants also turns into visual via identical times of approach between both, the building complex and the industrial areas, as well as the residential neighbourhoods and the city (Nelles 2013). Le Corbusier suggested that, "If the city were to become a human city, it would be a city without classes" (Le Corbusier 1933). In order to transfer his new ideas of town construction, Le Corbusier advocated for the removal of traditional cities (Mallgrave 2008). These ideas did not materialize in physical cities but influenced urban planning such as Brasilia in 1956. In 1947, Le Corbusier designed the *'Unité d'Habitation'* in Marseille, highly influenced by these values, and intended as a forerunner for expansive development.

What happened next is well highlighted by Schnaidt (1967) in his lecture 'Architecture and political commitment': "In the days when the pioneers of modern architecture were still young they thought like William Morris that architecture should be an 'art of the people for the people'. Instead of pandering to the tastes of the privileged few, they wanted to satisfy the requirements of the community. They wanted to build dwellings matched to human needs, to erect a *'Cité Radieuse'*. But they had reckoned without the commercial instincts of the bourgeoisie who lost no time in arrogating their theories to themselves and pressing them into their service for the purpose of moneymaking. Utility quickly became synonymous with profitability. Anti-academic forms became the new decor of the ruling class. The rational dwelling was transformed into the minimum dwelling, the *'Cité Radieuse'* into the urban conglomeration, and austerity of line into poverty of form" (Schnaidt 1967).

Since the 1960s, architecture has played an ambivalent role: architects conceived of architecture either as a tool for social action or enjoyment as a form of art (Frampton 1980). Schnaidt denounced how the spirit of modern architecture initially aiming to "set man free so that he could enjoy the good things of life, has ended up enslaving and alienating him" (Schnaidt 1967). While architects around the world focus on aestheticism, particularly in globalised and much more diverse societies, the quality of the environment and everyday life is steadily deteriorating. The growing megalopolises suffer from overburdened infrastructures. The rechannelling of funds from humanitarian projects to fulfil 'aestheticism' hampers on the improvement of living conditions of the urban poor.

Further on the contemporary city, the concentration of industries and their head offices in and around the metropolises compels those working there to live further away due to high rental. This translates to most of the workers time spent on travelling to and from work. "A man sets off at dawn from his village, his suburb, his satellite town which provides the labour needed by the big city. He is away the whole day and he comes home in the evening depleted of energy and longing for nothing else but peace and quiet. And for this reason, it is rare for him to contribute anything to the community in which he lives; he has no ideas, no criticism,

no impetus to give it. As far as his environment is concerned he might just as well be dead" (Schnaidt 1967).

The basic grounds of city attraction for many is the infrastructural readiness that draws business and residential development. However, this creates pressure on existing infrastructure and basic services such as water, electricity, sewage and public transport. With the increased urban population, the shortage of public services become apparent, and the deterioration exposed through built structures and services offered. Nowadays, infrastructure is no longer a more or less delayed response to a more or less urgent need but a strategic benchmark, a prediction aligned to specific individual interests (Koolhaas 1995).

In recent decades, cities worldwide have experienced a process of convergence into a uniform urban conceptualization, as a result of the capitalist globalization. This convergence is possible only at the price of shedding identity (Koolhaas 1995). In the 'Generic City', as Koolhaas (1995) names them, "housing is not the problem, it has either been completely solved or totally left to chance; in the first case it is legal, in the second 'illegal'; in the first case, towers or, usually, slabs, in the second (in perfect complementarity) a crust of improvised hovels. One solution consumes the sky, the other the ground. It is strange that those with the least money inhabit the most expensive commodity — earth; those who pay, what is free — air". Other than resilient, Koolhaas (1995) identifies the 'Generic City' as "a sketch which is never elaborated, is not improved but abandoned. The idea of layering, intensification and completion are alien to it: it has no layers. Its next layer takes place somewhere else". To understand this disconnect, we now need to consider more deeply the built form in relation to the multiply layers of local context, mostly understanding the needs of the people, in this instance.

2.2 The architecture of dwelling

The construct of the 'Primitive Hut' stresses the origins of architecture and its practice. The idea considers the relationship between human and the natural environment from an anthropological perspective, as the basis for the invention of architecture. The fundamental basis of the 'Primitive Hut' is that architectural form is the incarnation of nature. Marc-Antoine Laugier (1753) proposed in his "Essay on Architecture" that "noble and formal

architecture" was not found in ornamentation, but in what was necessary for shelter and its true underlying fundamentals. He argues that the "primitive man's" dwelling is created instinctively based on the human need of shelter from nature. Consequently, architecture lays on what is natural, intrinsic and part of natural processes.

The dwelling forms that are part of this discussion are associated with forms of production within a given urban context. However, a brief look at the generic southern African dwelling prior to the arrival of Europeans is relevant to understand the process of appropriation of persistent forms of domestic architecture present in the informal settlements. Traditionally, the landscape has played an important role, and settlements were carefully chosen near water streams and grasslands, together with the availability of construction materials. The architectural form derives from the cosmological believes of the people, as well as the hierarchical relationships, within the same polygamous family unit, between husband and wives, wife and wife, parents and children (Frescura 2018). Frescura suggests that a group of cone-on-cylinder constructions set carefully uphill in a circular organization, facing east towards the rising sun, evoke a sign of rebirth. The cattle located in a central byre, which was also a place for burial and sacrificial rituals, reinforced the spiritual bond believed between the cattle, adult males and their ancestors (Frescura 2018). In line with this concept, Vesaas (1952) perceives the house with a social meaning; "both woman and man would like to have a place to be united, as everywhere on Earth."

'Dwelling' is usually defined as a roof of your head occupying a decently sized plot. This is understanding the concept of dwelling in quantitative and materialistic terms. However, when looking into the interpretation of dwelling in qualitative terms, it means to belong into that particular place. This place might be environmentally pleasing, and possess all the things which may cause a sense of comfort (Norberg-Schulz 1993).

Le Corbusier's (1923) analysis of the approach to the problem of housing may seem current almost a century later: "Everybody, quite rightly, dreams of sheltering himself in a sure and permanent home of his own. This dream, because it is impossible in the existing state of things, is deemed incapable of realization and so provokes an actual state of sentimental

hysteria; to build one's own house is very much like making one's will… When the time does arrive for building this house, it is not the mason's nor the craftsman's moment, but that moment in which every man makes one 'poem', at any rate, in his life" (Le Corbusier 1923). This 'poem' represents the qualitative sense of dwelling as basic condition of humanity. Norberg-Schulz (1993) states, "When we identify with a place, we dedicate ourselves to a way of being in the world. Therefore, dwelling demands something from us, as well as from our places. We have to have an open mind, and the places have to offer rich possibilities for identification" (Norberg-Schulz 1993). Dwelling is therefore associated to the very human nature of spirituality.

"The purposes of human life are not found at home; the role of each individual is part of a system of interactions which take place in a common world based on shared values. To participate, we have to leave the house and choose a path. When our social task is accomplished, however, we withdraw to our home to recover our personal identity. Personal identity, thus, is the content of private dwelling" (Norberg-Schulz 1993).

The relationship between house and landscape is visualized by the use of materials and type of construction, and hence by the built form of the wall, together with the shape of the roof (Norberg-Schulz 1993). Giedion (1929) suggests that, "The present development in building is undoubtedly focused on the dwelling and in particular on the dwelling for the common man… Neither the public building nor the factory is today of equal importance. That means: we are again concerned about the human being," (Giedion 1929), this is echoed by the later words of Le Corbusier & Pierrefeu (1942) that, "Human beings are badly housed, that is the profound and real reason for the present upheavals" (Le Corbusier & Pierrefeu 1942). Dwelling as the existential and residence are addressed

2.2.1 Residential design

In his 1966 essay titled, 'Social Theory in Architectural Design' as architectural determinism in that, "architectural design has a direct and determinate effect on the way people behave (...) Maurice Broady states that those human beings for whom architects and planners create their design are simply moulded by the environment which is provided for them" (Broady 1966).

Since the 19th century, architecture is consciously used as a tool for social change (Dascălu, Bălan & Ionescu 2015). The *phalanstère* (phalanstery) of Charles Fourier represents a utopia of an integrated community in which 500 to 3000 dwellers coexist and work together for mutual benefit. Through planning, different activities take place simultaneously (Fourier 1808). Fourier imagined the perfect society, and then built its palace. The architectural principles of the phalanstery are as follow: the phalanstery is a perfect, finished and finite building as the society that aspires to host. The phalanstery could not be extended; the phalanstery is isolated from the environment, as a social experiment; the phalanstery recreates streets and street life on the interior; the phalanstery combines work and housing in the same structure; for efficiency and social purposes, a good part of domestic functions are externalized in common spaces (Fourier 1808). Deviation is impossible and inacceptable. This architectural determinism clashes with the freedom of the individual (Baltazar & Kapp 2009). In fact, the user of the phalanstery does not certainly exist but is to be found or created: the perfect collaborative and altruistic neighbour.

In the 20th century, Le Corbusier adapted the concept of the phalanstery in the design of the *Unité d'Habitation* in 1952 (Coleman 2005). The unprecedented need for housing in post-World War II Europe became the driver of these large-scale projects. Le Corbusier conceived the building as a "city within a city". Designed for about 1,600 residents, Le Corbusier developed the concept of 'vertical garden city'. Not only residential uses but amenities such as a roof with a garden terrace, running track, club, gym, and a shallow pool, together with communal services such as a kindergarten, shops and medical facilities were part of a complex programme that is spatially, as well as, functionally optimized for the residents. Previously, Le Corbusier had already set the intellectual path to mass-production housing (Le Corbusier 1923). He stated that a new approach was needed to respond the demand for housing in the interwar period, embracing standardization as key for mass-production, together with financial and social organization. The house became a 'tool' available for everyone to better their lives. Despite now being over a century old, Le Corbusier's (1923), vision is valid even today. Highlighting the power of housing to solve social problems, he noted that:

“The machinery of Society, profoundly out of gear, oscillates between an amelioration, of historical importance, and a catastrophe. The primordial instinct of every human being is to assure himself of a shelter. The various classes of workers in society to-day no longer have dwellings adapted to their needs; neither the artisan nor the intellectual. It is a question of building which is at the root of the social unrest of to-day; architecture or revolution” (Le Corbusier 1923)..

In line with the idea of tool and mass-production, the *Deutscher Werkbund*, an association founded in 1907 by German artists, architects, designers and industrialists, organized an international exhibition titled *Die Wohnung* (the dwelling) directed by Mies Van Der Rohe in Stuttgart in 1927 to showcase trends and new ideas in housing at that time. The exhibition was developed in the *Weißenhofsiedlung* (*Weissenhof* Estate) as an estate with twenty-one buildings comprising sixty dwellings, designed by seventeen European architects including Le Corbusier, and advertised as a prototype as future workers' housing (Kirsch 1987). A variety of typologies was tackled: apartment blocks, detached and row houses. One of the conditions was the quick erection of buildings through the use of prefabricated elements, which took only five months to build.

After World War I, the socio-economic landscape changed drastically. On one hand, architectural extravagance was no longer affordable. On the other hand, the consolidation of the era of industrialization resulted in a population shift from rural areas to urban hubs, with the consequent need of safe and healthy cost-effective housing solutions. The *Weißenhofsiedlung* would the basis of housing conceptualization for an extensive part of the 20th century, as a theory of ‘minimum standards’ to allow for a fulfilling life.

2.3 Urban resilience

Urban resilience is defined as the capacity of a city’s systems, businesses, institutions, communities, and individuals to survive, adapt, and grow, no matter what chronic stresses and acute shocks they experience (100 RC Bristol Resilience Strategy 2016)

However, there is a conceptual haziness in the terms ‘resilience’ that allows it to be perceived as a “boundary object”, shared by multiple social fields and therefore, able to promote interdisciplinary collaborations. This plasticity in its meaning lets different actors to connect

around a common term without even sharing the same view as to the meaning of resilience, which may render it difficult to measure (Meerow, Newell & Stults 2016a).

The modern theory of resilience is commonly associated with the research paper on resilience of ecological systems "Resilience and Stability of Ecological Systems" (Holling 1973). The author, who used resilience to outline the capacity of an ecological system to functionally "persevere" when altered, but not to unavoidably stay the same. On the contrary, 'engineering resilience' conceptualizes resilience as the capacity of a system in equilibrium to recover such state of equilibrium after a disturbance. Additionally, 'social resilience' considers resilience as the ability to absorb disruption and reorganize at the same time, maintaining functionality.

'Urban resilience' literature is extensive and covers a large variety of fields, from urban theorists, and urban ecologists, to social scientists. Urban resilience can be grouped in two principal categories: conflicts attributed to climate change, or hazards and disasters. 'Urban resilience' refers to the ability of urban systems to withstand or rapidly recuperate, a capable functional status after facing a disturbance, and its ability to acclimatize and adapt to future demands (Meerow et al. 2016a).

Recently, resilience has become a core topic in any debate on urban development. It has been adopted by international institutions for development together with humanitarian matters as core for strategic intervention at technological and economic level. The considerant future scenarios and how they respond makes resilience a constituent part of sustainable urban development (UN-Habitat 2015b). Notwithstanding the increasing focus on resilience theory as a reference to address important changes in climate and urbanization patterns, 'urban resilience' remains a disputed concept due to its contradictions and vagueness (Meerow et al. 2016a). Therefore, the following sections summarise the different perceptions of the concept and trends in its application.

2.3.1 Urban resilience narratives

The multifaceted essence of the concept of urban resilience presented in the previous section may be distilled in a group of narratives based on how different interpretations of the term

focus on specific fields. Therefore, 'Natural Hazard', 'Social Cohesion', 'Technocratic Resilience', 'Participatory Resilience', 'Emancipation', 'Full Display' and 'Environmental Feedback Loops', breakdown the understanding of resilience. These visions inform the application and prioritization, of certain components of the 'urban system' and at detriment of another, as presented in section 2.3.2.

For the narrative of 'Natural Hazards', readiness and responsive strategies to face natural hazards are the fundamental features of resilience. Tools to identify and monitor geo-hazards are essential for safety planning. 'Natural Hazards' driven initiatives tend to oversee aspects of resilience related to the wellbeing of people, social and economic consideration. Technology and infrastructure design represent the spine of this narrative, and engineers are the ultimate decision makers. Geo-hazard mapping is occasionally used by city managers as a tool to motivate the eviction of poor communities, frequently blamed and criticized for polluting the environment, and justifying removal (Blanco-Montero 2021)

The narrative of 'Social Cohesion' is normally endorsed by civil society. Resilience of communities is based on the strength of social networks, and therefore putting local communities at the front of planning, for instance, allowing inhabitants to settle near their families and workplace.

'Technocratic Resilience' implies the use of technology as a shortcut to directly engagement with citizens in participatory events. "The ultimate aspiration is to provide objective knowledge whose validity is universal true everywhere no matter the context" (Davies & Burgess 2004). GIS substitutes field work, detaching officials from the sense of physical conditions. Top-down initiatives disengage poor and digitally disconnected people from planning authorities. The use of GIS and mapping, as a main driver for planning, increases existing divides and inequalities.

The alternative to 'Technocratic Resilience' is that of 'Participatory Resilience', bringing together multiple members of society at all levels through engaging strategies, such as participatory tools (mapping, planning and qualitative data collection) to create common

knowledge (Borie, Pelling, Ziervogel & Hyams 2019). This process facilitates multiple interpretations, considering the same elements from different perspectives that might be unnoticed by others, expanding the response scenario.

Driven by NGOs, urban activists, and researchers, this narrative of 'Emancipation' supports the mainstream application of resilience on sustaining social inequalities, and criticises the abuse of the word 'resilience' by power clusters (Parnell & Pieterse 2019). It resembles 'Participatory Resilience' although its key role is driven by quantitative data and contains room for multiple conceptualizations of resilience, as opposed to mapping, which brings oversimplification, reductionism and decontextualization, barely capturing social networks and people's experiences (Dovey & Ristic 2017).

Informal settlements are hardly registered in official cartography. The narrative of 'Full Display' represents the exhibition of the weak, poor and silenced sectors of the community. Science and technology is applied as an uncapping strategy by organised civil society. NGOs and urban activists, challenge official data with household surveys, making visible the urban poor. A reaction from city managers is expected to address the needs of the most vulnerable areas is expected but often problematic. Blanco-Montero (2021) suggests that accessible technology such as social media has proven to be very effective in engaging with communities to generate participatory maps (Blanco-Montero 2021)

The positive impact of parks, public spaces and a functional public transport network, not only as a booster for economic growth for public health is highlighted by the narrative of 'Environmental Feedback Loops'. Reduction of pollution levels implies fewer incidences of diabetes, respiratory disease, and promote numerous indirect benefits in term of public health. This is a long-term strategy and its implications are considered holistically (Mutai 2020). In this instance, silo organization among public sector technocrats represents the biggest barrier for the implementation of this vision.

Addressing resilience is not limited to a holistic comprehension of risk and immediate effects of a shocking event. It is also fundamental to foresee consequences that these events might cause for communities, geographical borders and economy (UN-Habitat 2015a). Although

some of these narratives are incompatible with each other, some are be able to coexist in different scenarios at physical or governmental level. The use of the term 'resilience' finds resistance in several instances for individuals or organisations which consider it aligned to mainstream dominant powers and it therefore has a dual meaning (Borie et al. 2019).

Interdependence is strongly associated with resilience. Urban systems do not work independently and failures of one or more spheres will impact others, whether government corruption, social unrest, health pandemics, economic recession, or lack of performance at individual level will weaken the entire system. Consequently, resilience strategies require for an understanding of the inherent collaborative association of components (UN-Habitat 2015b).

2.3.2 Trends in urban resilience

The application of the multiple conceptualizations and narratives of resilience described in section 2.3.1 create tensioned scenarios in which it is possible to identify opposed approaches.

a) Top-down vs. Bottom-up

The tension between top-down versus bottom-up approaches is a constant discussion regarding environmental challenges. The rating of one particular risk depends on who values it. What is minor for some actors, may be of main concern for others (Borie et al. 2019).

Typically, information addressing natural hazards presented by natural sciences are perceived as more reliable and therefore, easily accepted than other approaches to understand the phenomenon. The agenda of complex technologically implemented plans as the foundation of holistic solutions is pushed by technocrats; as a result, disadvantaged and disconnected segments of the population are left out. In opposition to this direct science-policy strategy, some authorised voices call for the need to reorder knowledge and acknowledge local understanding (Borie et al. 2019).

b) Conservative vs. Transformative

The notion of resilience as a primarily protective strategy clashes with the idea of disputing the established practices, with the aim of transformation. Narratives focused on natural

hazards and engineering tend to prioritize strategies that aim to upgrade the existing status quo, instead of making room for new alternative strategies (Borie et al. 2019). As a result, infrastructure and security are the main drivers for conservative approaches.

On the contrary, transformative trends highlight the values of nonprofessional knowledge and participatory processes that may have the capacity to empower alternative actors. Transparency is considered key to guarantee that resilience is accepted as genuine by communities (Borie et al. 2019). Emancipation narratives in association with bottom-up approaches, articulate resilience as an instrument to challenge conventional positions and conservative public plans for the city (Borie et al. 2019).

c) Modernization vs. Environment

Modernization implies the use of science and technology, based on their capabilities to observe, anticipate and foresee, to strength the idea of progress in resilience planning. Despite these strategies being accurate and efficient, their tendency is to eclipse alternative, emerging opinions.

Purely quantitative approaches to problem solving detach these proposals from environmental issues that are related to the interaction of people-environment. Expanding the understanding of environment enlarges the scope of resilience, including diverse scenarios interacting in multiple feedback loops.

d) Security vs. Social justice

Security trends align to ideas of protection, either the economic or natural ecosystem. They are usually founded on a technocratic philosophy, which is structured by systematic approaches based on science. However, qualitative knowledge, typically omitted, discloses other relevant factors and perceptions of resilience. This assist, for example, in establishing reasons for persistent settlement in areas indicated as risky in geo-hazard maps (Borie et al. 2019).

Planning for resilience must pay attention to issues of justice, place, identity, inequality and poverty. Participatory processes combined with conventional planning instruments can assist in the understanding of diverse visions and values, and build up more inclusive methods (Meerow, Newell & Stults 2016b). Trends that are social justice-oriented develop more open science methods linked to transformative approaches, giving voice to the marginalized and vulnerable.

3. RESEARCH METHODOLOGY

Revisiting historical events which have led to the current setting of informal settlements lays a very important foundation for this research. Located in eThekwini municipality, the Quarry Road West Informal settlement (QRWIS) was used as a case study for desktop research, using secondary sources for spatial research data. The COVID-19 pandemic during the research period demanded a desktop study using published data and remote sensing.

The QRWIS expresses a complexity of built form that can enrich an understanding of urban informality. This is evident in its location, topography, technologies, materiality and aesthetic expression, and may assist in understanding of the role of architecture in the informal context. As mentioned previously, this study relied on the past in order to comprehend the present, with the aspiration of contributing in the discussion about designing for future social housing projects.

3.1 Mixed methods research

Due to the social nature of this research, a mixed-method approach, combining quantitative and qualitative methods, was employed. The study relied heavily on existing data from previous studies and official reports, while the qualitative aspect focused on literature, and open-ended interviews with key informants to understand the problem deeper, at an ethnographic level.

3.1.1 Quantitative research

Quantitative methods assess and examine variables related to the socio-economic characteristics that influence the built form of the informal settlement. This was analysed in order to determine the social attributes of the built form, and was achieved through remote mapping (google earth / maps / photos) of the layout of the informal dwellings within QRWIS. This process aimed to understand the spatial relationships within the settlement, as well as understand the materiality of the buildings.

3.1.2 Qualitative research

The purpose of a qualitative research study is to understand the socio-economic impact on the lived reality of individuals or groups in the context of informality, and more specifically in informal settlements. Past research and open-ended interviews were used. In collected data, the interview responses assisted in explaining the relationship between the socio-economic status of the dwellers, how it reflected the architecture of their dwellings and contributed to the informal settlement as a whole.

3.2 Data collection strategies

The COVID-19 pandemic compromised social engagement. Following national and local government protocols, any physical interaction with people living at the QRWIS was not allowed. In order to overcome such challenge, existing research and key informant techniques were considered as the primary tool for data collection.

3.2.1 Secondary data collection

The selection of secondary data was multi-faceted, starting with critical review of the most relevant scholarly work related to informal settlements and the built form. This specific topic contextualised a broader literature review considering urban matters concerning the global south. Relevant secondary data related to informal settlement and built form in Durban, was reviewed to gain deeper insight into the socio-economic variables that influence informal dwellings, to understand the complexities of the QRWIS.

Existing statistical and census data were sourced from previous studies, the municipality and non-profit organisations who conduct research on the QRWIS for an extensive period of time. This data was drawn from housing and dwelling surveys in order to establish the socio-economic conditions of the residents of the QRWIS. In addition, maps of the study area were mined as data sources together with the literature review.

3.2.2 Primary data collection

A. Interview with key informants

The key informant technique was used as the primary tool for data collection. Marshall (1996) states that, key informants, as a result of their personal skills, or position within a society, are

able to provide more information and a deeper insight into what is going on around them. Due to their close proximity and experience within the community, the key informants were best positioned to add valuable information to this study. In addition, acquiring information in this way was not time-consuming, and thus supports what Marshall (1996) highlights, as being a time and cost saving exercise. For this research, key informants were interviewed in order to provide insight on the as to the socio-economic conditions of the settlement and the dwelling construction process. Information with key informants was shared through telephone, emails and a virtual meeting platform (Section 6.3).

3.3 Data analysis

The data was analysed and presented in a form of themes, a process which Creswell (2013) describes as coding. “Coding is the process of analysing qualitative text data by taking them apart to see what they yield before putting the data back together in a meaningful way” (Creswell 2013). Coding thus was able to assist in summarizing the findings in a meaningful and graphic manner, which fully expressed the essence of the study.

3.4 Evaluation of the methodology

3.4.1 Validity and reliability

Being a mixed method study with both qualitative and quantitative data, it is important to note that the former has limitations. Qualitative research methods are typically criticised for not being objective in constructing significance without influencing the subject or site of study (Lincoln and Guba, 1985; Farmer *et al.*, 2006). Therefore, it is important to present the methods used clearly in order to guarantee validity and reliability through the analytical rigour of the researcher. Denzin and Lincoln (1998) identify a combination of varied methods, sources, researchers and theories to validate a study. This study made use of comprehensive observations, testimonials, and photography as data collecting techniques.

3.4.2 Inclusion and exclusion criteria

The study focused on the built environment particularly, in understanding the impact of the socio-economic status of the residents of informal settlements and how this impacts the

architecture. It does not emphasize aspects that are considered as social, thus excluding sociology. Key informants, scholars, researchers, community leaders and NGOs that could provide valuable expert information to the study were included, whilst many residents of QRWIS were excluded due to challenges presented by the pandemic.

3.4.3 Limitations of study

The study is limited to requirements for case study research at master's degree level, which translates to limited resources and research experience. The research focused on the relationship between socio-economic realities of the dwellers and the current built form of the specific QRWIS. However, although the findings are specific, the principles and theories developed can be extrapolated to other geographical realities with similar urban features.

The tools based on internet sourced information and GIS do not guarantee completeness, correctness or accuracy. However, the information can be confirmed as accurate through comparison methods with other data collected for this study. The ethics policies as adapted by the Durban University of Technology during the COVID-19 pandemic impeded fieldwork or physical engagement with the case study community.

3.4.4 Elimination of bias

No discrimination against participants based on ethnicity, disability, gender, race, national origin, health or marital conditions, or any other applicable bias prescribed by law has taken place within the boundaries of this research. The research includes all data collected. The data transcripts have been created with diligence after collection. Detailed records of the data are kept for future consultation. The research has not been sponsored or funded by any institution external to the Durban University of Technology.

4. LITERATURE REVIEW

This chapter presents the phenomenon of urban informality and revisits the past, mainly focusing on the industrial and apartheid eras which saw the emergence of informal urban conditions, which also include the development of informal settlements. The purpose is to have a broader understating as to how the architecture of informal settlements has been influenced by the socio-economic conditions of the community.

4.1 Introduction to informality and informal settlements

Informality is a worldwide phenomenon that is not limited to cities within the 'global south'. Most activities in different spaces begin as informal and thereafter are regulated and formalised in order to bring law and order (Dovey and King 2011). Generally, informality is perceived as a chaotic 'mess' that requires either formalisation or eradication. However, the overwhelming scale at which informality exists in the Southern African urban context means that eradication is a titanic task, and finding ways to coexist is mere appropriate for future urban development in the region.

The contribution of the informal to the Gross Domestic Product (GDP) sector exceeds over 50% in some countries within the global south. It also contributes towards employment: 66% of the population, outside of the agricultural industry employment (Skinner & Watson 2019).This has put pressure on governments, that rather than acknowledging and negotiating a way of co-existence, tend to criminalize the informal sector economy, while engaging with formal sector lobby groups. As a result, informality is tagged as illegal (Skinner & Watson 2019). Notwithstanding the numbers, existing policy trends addressing the informal economy creates a condition in which it merely survives, instead of growing as an autonomous sector (Rogerson 1992).

Many cities in Southern Africa were founded by the British and based on their spatial models, and aspirations of modernity, without considering local conditionings. This is a legacy of their colonisation of this region. Their traditional zoning demarcation was split into five land use areas, which were: residential, education, tourism, business and industry (Watson 2014). The result of this monochromatic zoning, lacking of multifunctionality, is a highly car-dependent

mobility. This strategy overlooks the overwhelming reality in South Africa that only 30.6% of the population possess a driver's license (StatsSA 2020).

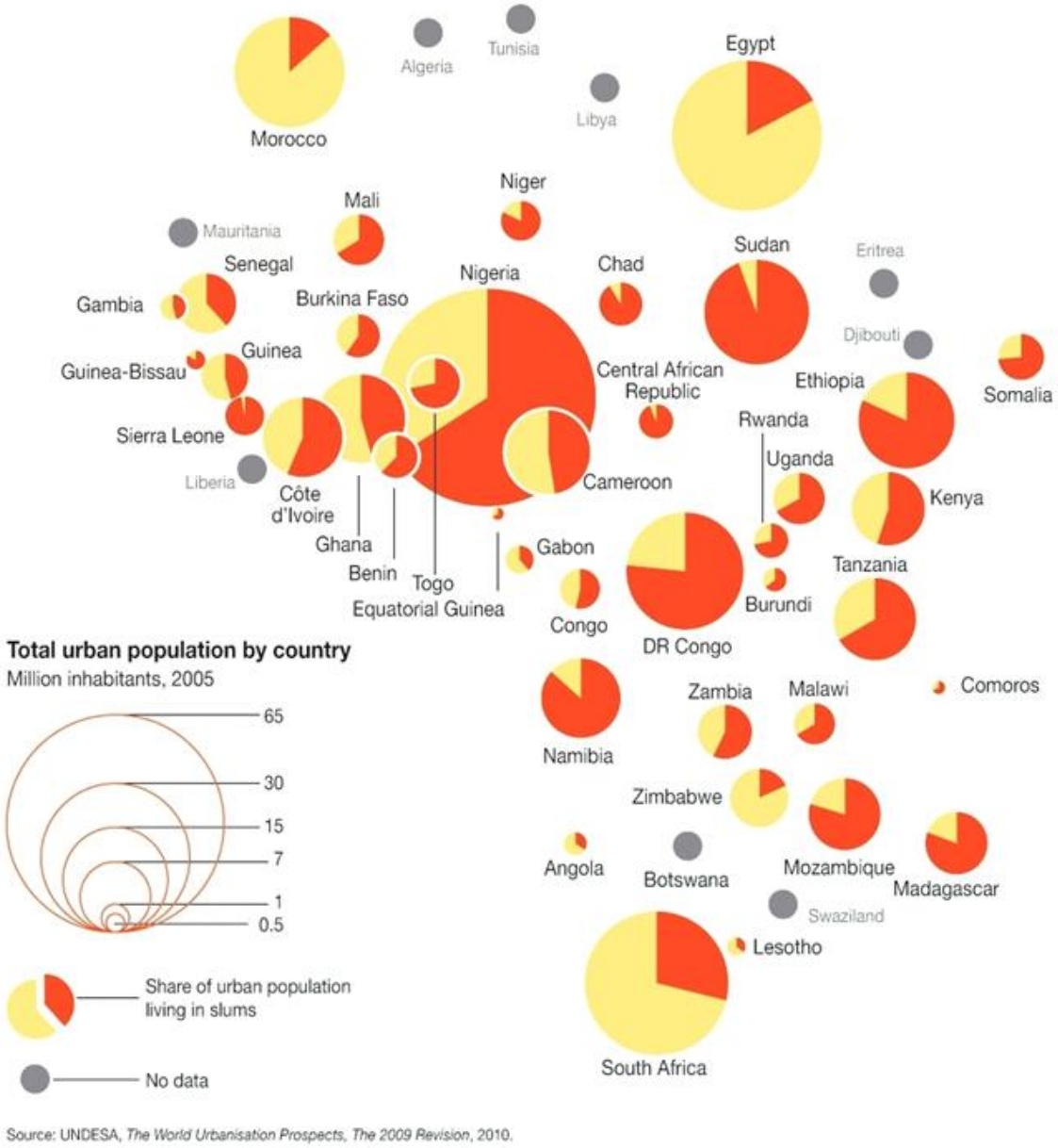
The clash between top-down planning approaches and local realities is manifested in the appearance of informality. For instance, a car-dependent mobility strategy together with the lack of an efficient public transport system that acknowledges the aforementioned 30.6% of driver's licenses results in an informal mobility system based on the minibus taxi. At the same line, farming was conceived as primitive and urban gardens were banned in this planning, depriving the right to affordable healthy food to low-income families (Skinner & Watson 2019). The justification for this ban being framed as public health concerns, prohibited any opportunity for people to participate in informal economic activities.

Informal settlements refer to those areas that developed through unauthorized occupation of land outside a legal, regulatory, planned and professional framework (Huchzermeyer & Karam 2006). They function as places of comparatively inexpensive living that open up the possibility to become part of an urban society (Taubenböck et al. 2018).

The UN-Habitat (2015c) has estimated that at least 67.1% of the African urban population lives in informal settlements. Operations of the land on which these settlements are built is managed by 'under-cover' leaders who operate in the informal sector and have gained control legally or illegally over the land. In order for these leaders to retain this role, they must retain control of those given access to settle. This means that land ownership is not accepted, which leads to insecurity of tenure and the inability to prove residency on paper or follow up on financial trails during their stay (Bhan, Goswami & Revi 2017). An additional burden to tenure insecurity is land which is owned by tribal leaders close to cities earmarked for city expansion, experiencing similar scenarios. Tribal leaders become gatekeepers of the land, impeding future planning. The land therefore is constituted as a source of power and any change to its laws endangers the individuals involved (Boaden & Taylor 1992).

Informal settlements are categorized as places of poverty, with insecurity of tenure, comprising informal dwellings which are not adequately serviced. They suffer from over-

crowding (SERI 2018). However, the construction of informal dwellings is a response for a substantial amount of people who cannot afford adequate housing in the city. People move into informal settlements with hopes to secure employment in the city. These places are symptoms of poverty, as observed by Visagie & Turok (2017), they are potent means for escaping poverty because they enable migrants to integrate into the city's economy.



Source: UNDESA, *The World Urbanisation Prospects, The 2009 Revision*, 2010.

UN-HABITAT defines a slum household as a group of individuals living under the same roof in an urban area who lacks one or more of the following: 1. Durable housing of a permanent nature that protects against extreme climate conditions. 2. Sufficient living spaces, which means not more than three people sharing the same room. 3. Easy access to safe water in sufficient amounts at an affordable price. 4. Access to adequate sanitation in the form of a private or public toilet shared by a reasonable number of people. 5. Security of tenure that prevents forced evictions.

Figure 2. Slum population in Africa. Source: UNDESA, 2010

Due to lack of adequate accommodation, informal settlements become welcoming environments for poor job-seekers. According to Misselhorn (2008), they often represent the first point of arrival and encounter with the city, for rural migrants. Informal settlements therefore become places which provide relatively inexpensive living spaces serving as possible access to the city, to its society and to its functions. Scholars identify this phenomenon with the term 'arrival city', as they become the first point of access for the poor rural migrants to the city. In most cases, the 'arrival city' becomes a permanent dwelling place for years. People are therefore subjected to poverty, while they search and wait for better life prospects. Poverty and vulnerability are directly linked and constrain the ability of individuals, households and communities, to improve their living conditions (Hope 2009).

A number of features and characteristics define the harmony and also the uniqueness. of a particular place, compared to other places. Thus, the identity of one place does not only refer to its uniqueness, but also to its resemblance to other places (Figure 3).

Figure 3. Dwelling density within the QRWIS. Source: Shaikjee, A 2018

The physical characteristics of informal settlements tend to vary widely across cities, depending on the income levels of the inhabitants (Wekesa et al. 2011). However, they share common physical features: mostly low-rise, single-storey dwellings constructed from cheap building material, highly densified and mostly located in the outskirts or unsuitable land. As stated by Misselhorn (2008), informal settlements are complex in terms of their development

and the particular set of social relationships which operate within them; they are not homogenous. For this reason, the author is curious to understand to what extent the socio-economic status of the informal dweller is able to drive the architectural manifestation of their dwellings and surroundings, in the context of Durban, South Africa.

Factors that contribute to define the physical character and identity of informal settlements are location, materialization of the built form and the state of service provision:

a) Location

Informal settlements are typically located in marginal areas within the urban fabric and exposed to a variety of challenges and hazards (Ojo-Aromokudu 2018). They often grow in areas which are not suitable for construction, being at risk of geographical adversities or from lack of inclusion in planning. Flooding and landslides are threats which are often present in these areas, in addition to other environmental threats, ranging from high exposure to polluted environments such highways and industrial zones, or drinking and washing with water extracted from polluted rivers (Ojo-Aromokudu 2018).

Different locations in which these settlements are erected may typically require sophisticated construction methods, building materials and technology in order to ensure structural safety for the inhabitants. The Quarry Road West Informal Settlement (QRWIS) study area of this particular research is located in a floodplain, in which the land stability and structural integrity is already problematic, also it suffers from various hazards due to the Palmiet River running through the settlement, as well as its location next to the M19 highway which goes from the western suburbs to Umgeni Park Business Precinct (Figure 4).

Figure 4 QRWIS in relation to the M19 Road and Palmiet River

b) Materialization of the built form

Whelan (2016) describes informal settlements to be comprised of different dwelling which are often labelled as inadequate and temporary. These unplanned structures are usually built from scrap metal, recycled or very cheaply bought building materials (Whelan 2016). The builder at most times, tend to become the end-users of these dwellings and, according to Aravena (2015), are also able to improve their built environment eventually, without any design training. Informal dwellings are generally constructed without any form of regulations and by people who do not have an overall foresight of the final picture. Alternatively, they build incrementally by adding one component on top of the other. The end result and structural integrity are typically determined by the type of available building material, and basic construction techniques employed.

The structural integrity of these dwellings therefore, comes into question as their safety and durability are not guaranteed due to the lack of adequately trained and/or qualified professionals supervising its construction (Ojo-Aromokudu 2018). This process of self-built homes has been characterized by a unique form of architecture that, according to Elleh (2011), even historians have had difficulties in defining. Pareyson (1987) defines the concept of "architecture degree zero" as the basic experience of architecture as a body envelope. It is a space-action, a body extension and also a constructive experience. This experience is lived as a fact without a preceding plan or vision for the future. The realization is a physical result, which is based on operational schemes and productive actions (Pareyson 1987). For the author, it is vital to understand from where the form, layout and spatial organisation of a

typical dwelling is derived. The UN-Habitat attests to the fact that these are spaces of opportunity for low income households. This is not limited to city living but also opportunity for people to participate in economic activities and creating social capital (UN-Habitat 2015a). Therefore, understanding informal settlements in this context is needed, as it has a significant effect on the architectural production, which consequently has an impact on the quality of life of the inhabitants.

The understanding of informal housing does not have to automatically translate to 'shack' or informal dwelling. Rather, informality is perceived as a compilation of elements which are used to respond to a challenge of inadequate housing delivery through official channels, generalised in Southern Africa. Informal dwellings also do not have to translate to being 'illegal' for the mere fact of non-compliance with the legal framework. Self-building at times encompasses the use of low-quality building material which lacks compliance, falls short of the regulated building standards and without any security of tenure, which are all features of informal dwellings within informal settlements (World Bank Group 2015)

c) Service provision

The rights to basic services such as adequate housing, water and social services are embedded in *'The Constitution of the Republic of South Africa'* (1996). From the municipal management perspective, informal settlements are usually considered problematic. This perspective suspends future plans for infrastructure investment on service delivery in such areas of the city. However, the overwhelming growth of slums has put immense pressure on other formal areas of the city, pushing city managers and decision makers to acknowledge their presence, and respond with special initiatives. On the other hand, Ahmed (2020) attests that privatization of services is typical in neoliberal capitalism exacerbates poverty and social inequality as public services, such as education, sanitation and water, are regarded as commercial commodities for profit-making which, in turn, are difficult to access by the poorer classes with meagre income. This then suggests that the urban poor have little choice or alternative, to informal settlement living.

4.2 Socio-spatial dynamics of informal settlements

The analysis of socio-spatial dynamics of informal settlements helps to understand the residents' spatial behaviour, how they socially organize and interact with their built form and the public space. Through this analysis, the connection between social and physical factors, and also how the residents of informal settlements are able to accommodate various practices and activities within this space in an effort to deal with their day-to-day urban challenges can be appreciated (Okyere, Diko, Hiraoka & Kita 2017). For instance, the analysis of spatial organization has been used to identify the distribution, structure, and residents' use of pathways, networks and public space, in order to assess spatial patterns in different human settlements. This paper thus considers the shape, and size of the dwellings and also access and connectivity to networks within the settlement.

Human activities in open spaces are necessary to understand human behaviour and needs while interacting with the physical environment around them. There are various activities which are performed within these public spaces, from economic activities and income generation, to social gatherings and physical play, such as that performed mostly by children. These activities also tend to shift, depending on the different times of the day.

Circulation problems are acute in many informal settlements due to the limited public space and the unplanned, irregular spatial arrangement of dwellings. Where pathways exist, they are often narrow and affected by dwellings spilling over into the public space. This results in an overlap or sharing of this space. In spite of this constraint, public space plays a crucial role of being an economic conduit for some of the families residing in informal settlements. And this, according to Dovey (2013) is a practice of economic production which is not easily retained in the transformation to formalised housing. The residents tend to venture into entrepreneurship, utilizing the public space, in order to self-sustain and generate some income. This is known as 'necessity' entrepreneurs, with revenues covering the most basic needs. It becomes a preferred form of income generation, as informally employed people lack the stability and security of a formal employment contract (Skinner & Watson 2019; Abdychev et al. 2018). They try out various opportunities which range from trading, hair salons, clothes repairing, caretaking of children and vehicle repairs, amongst others. These activities tend to

spill over into the public space, and according to Dovey and King (2011), becomes an innovative trade-off between private and public space.

The organic growth of informal dwellings coupled with high density, poses a challenge in the planning and regulation of public space by informal settlement communities. Due to the limited living space and overcrowding within dwellings, life expands into communal spaces, which is also generally limited to 12% (UN-Habitat 2015c) of the entire area of the informal settlement (Figure 5). Small streets and pathways tend to be the only available public space, which in turn also serve as an extension of the household.

These public spaces, therefore become areas for social interaction and economic transactions, which tends to improve the development and desirability of the informal settlement community. Accessibility to urban gardens, typically associated with financial power, needs to be guaranteed to all social strata suggests Popoola, Medayese & Olaniyan (2016). The UN-Habitat has also listed the commitment to promote public spaces as drivers of social and economic development as one of their New Urban Agenda 2016 declarations (United Nations 2017).This coupled with Target 11.7 of the 'Sustainable Development Goals' (SDGs), which calls for universal access to safe, inclusive and accessible, green and public spaces by 2030.

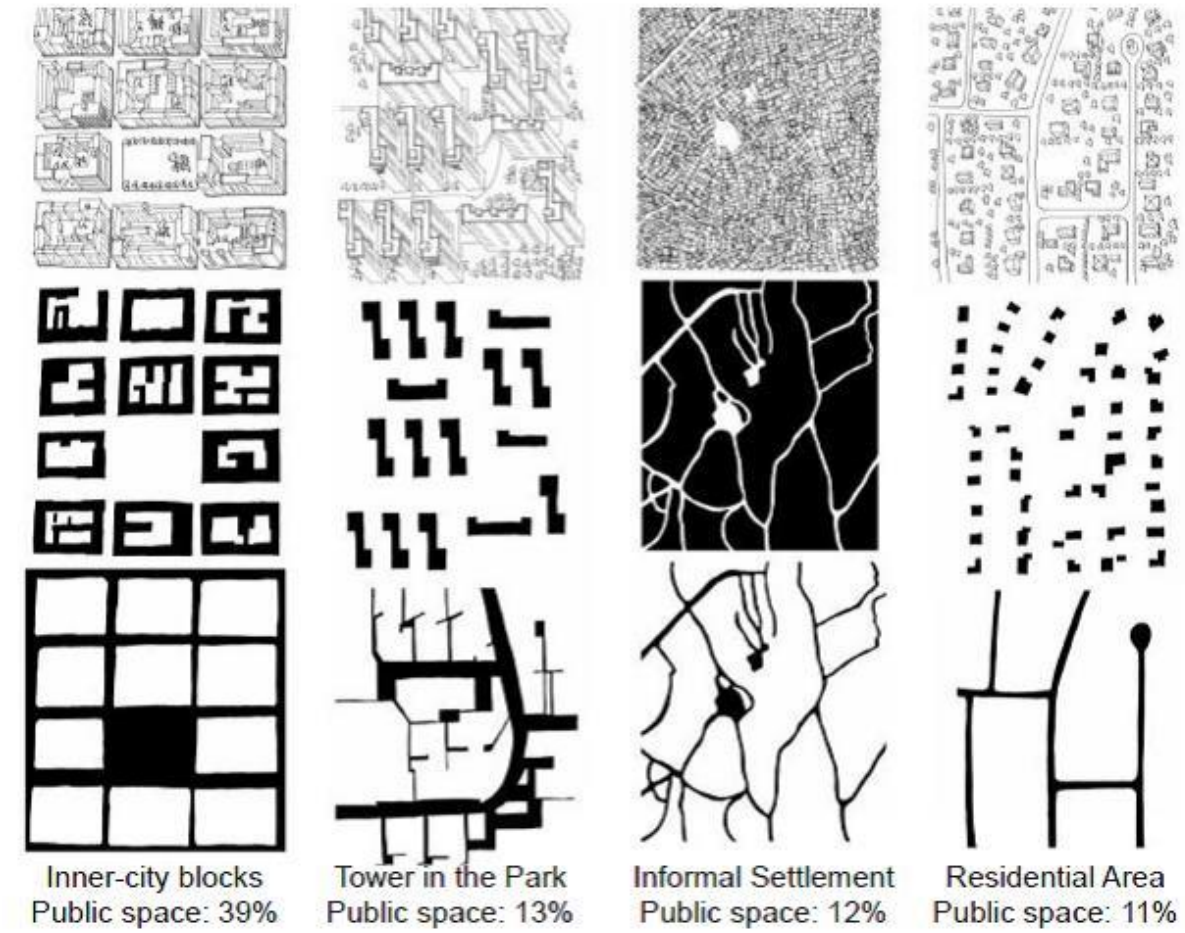


Figure 5. Percentage of public space in informal settlements. Source: Habitat III issue papers, #11 Public space 2016

Due to high densification, public space limitations and the unsuitable location of informal settlements, the economic activity in most is limited to only a few and strategic points within the settlement and therefore, the 12% of generalized public space is highly reduced (UN-Habitat 2015c). Public spaces, walkways as socializing space and playgrounds, become interacting spaces for people, and are also used as play areas by young children, a play area which is sometimes extended to the road for more playing space. These places are poorly maintained and are often dirty. The absence of municipal services such as road repairs, waste collection or sweeping represents a key factor in the deterioration of public space, which often becomes hazardous and poses health risks to children. In addition, inefficient, and sometimes inexistent, basic infrastructure such as street lighting also poses a risk for children and women when moving around the settlement at night time (UN-Habitat 2015c).

Circulation and more general public spaces are also important to gain access to different dwellings in the event of a fire. However, in some instances, this becomes a challenge which produces devastating results for the community. Moreover, the illegal occupation of land affects the diligence of public services in attending emergencies, haphazard planning and perceived dangers means that there is little urgency to provide services (Huchzermeyer & Karam 2006). While social cohesion of the community is often highlighted as being a positive element within informal settlements, the reality is that, this does not extend to the upkeep of public spaces. Therefore, public programs which are aimed at providing open public spaces must consider the socio-economic realities of residents within these settlements (Pojani 2019).

4.3 The architecture of the informal dwelling: Spatial configuration and physical manifestation

The spatial organization correlates with the structural distribution of informal dwellings within the settlement and the residents' use of the streets, in order to evaluate spatial patterns and human connectivity. This analysis also physically establishes pathways, streets, public spaces and dwellings in order to observe the relationship between people and urban space in informal settlements (Okyere et al. 2017). Consequently, researchers such as Okyere et al. have used it to map out the physical layout and the character of dwellings with the purpose of understanding living environments in informal urban areas. Spatial relations are very important in the creation of dynamic urban spaces along with strengthening social relations within these urban informal settlement (Okyere et al. 2017).

4.3.1 Configuration of the informal dwelling form

Informal dwellings come in different forms. However, the one room, single storey type tends to be one of the most dominant and profoundly rooted characteristics of an informal settlement (Dovey and King 2011). Due to the constricted landscape of informal settlement locations, the construction of dwellings on such sites tends to follow a very organic pattern which is dependent of the topography of the site. When the morphological conditions of the site are ignored or misunderstood during construction, the risk of accidents and disasters is very high.

Upon observation of informal settlements across the globe, one of the main features is rectilinear form that self-built informal dwellings develop. Regardless of the choice in building material, they are always rectilinear. This observation was also highlighted by Kellett and Napier (1995) when analysing informal settlements in Inanda township, in Durban, and noticing the popularity of this form. This form may be the first choice of residents due to its' practicality, compared with the domed circular shape in which some have lived in their places of origin. It also fits in with the urban context. However, due to gradual improvements overtime, the initial form transforms.

This transformation tends to be overlooked by local governments when implementing design projects to house the poor. And this, according to Sutherland et. al (2019), results in limited understanding of the dwelling and the experience of the inhabitants. This oversight also misses key information related to the internal configuration: the number and composition of the individual households. Informal dwellings are typically single room homes which serve as living, eating and sleeping spaces for the household. This means that the internal spaces are flexible and adaptive, with the disadvantage of the deprivation of personal and privacy. Another disadvantage, the poor construction quality of informal dwellings also has an impact on the health condition of residents who often suffer from low air and water quality related diseases (Popoola et al. 2015).

4.3.2 Building material and construction techniques of the informal dwelling

Much of the construction processes of informal settlements still remains a mystery for researchers (Celentano & Habert 2021). Stakeholders are reluctant to divulge information related to a building process that might have a level of illegality. These illegalities could be related to the building material procurement processes and the verbal employment agreements between stakeholders and informal labourers. For the purposes of this study, this paper considers the socio-economic dynamics of informal settlements and the connection between construction, building materials and the construction technology and the techniques employed.

The general understanding of informal settlements is associated with people living in poverty. These living conditions tend to be hazardous and are accompanied by activities that reinforce

or result from such activities. However, recent studies dismiss such claims, as they fail to highlight the symbiotic relationship between the formal and informal urban sectors, and the level of impact that governance and service provision has on the informal sector (Okyere et al. 2017). The intended transitory nature of informal dwellings leads to a 'temporary type' of construction. However, due to a lack of adequate housing alternatives, temporary built does often results in longer stays, and these subsequent adaptation of the structure into permanency.

a) Building material

Though diverse through local context, there are still general features which can be easily identified in different informal settlements across the world. Some of the most identifying general features are the informal layout of dwellings on site, building materials and the precarious construction techniques of the dwellings (Kellett & Napier 1995). The most commonly used construction material is corrugated iron sheeting, with the inclusion of a variety of lightweight materials such as timber and plastic boards, supplemented with pre-fabricated building materials such as brick and concrete blocks. The use of earth-based building materials is prevalent in older informal settlements. This can be observed through the wattle and daub wall and mud brick walls. The lack of building resources with regards to material and technique results in residents being creative and resilient in the way in which they approach construction of their dwellings, by using informal skills which have been acquired through both indigenous knowledge and culture (Celentano & Habert 2021).

Informal settlement dwellers use various ways to procure building material. Some material is procured from hardware stores, while the rest is sourced from scrapyards, waste sites and also construction waste from construction sites. Recycled waste materials range from various plastic products, to steel, rubber, and timber. These materials vary with different regions and cultures, economy, density, climate and geography. Though different across the different conditions, the basic criteria are that they must be cheap and easy to carry. (Dovey & King 2011). One example is that of South America, where the typical informal settlement landscape comprises of brick and mortar buildings while lie unfinished on hilly areas outside of cities. In contrast, in Southeast Asia, people use corrugated metal sheets and bamboo,

which are easily sourced and transported. Therefore, in most cases, informal settlement dwellers possess the ability to repurpose discarded material, a skill which should be commended (Pojani 2019).

Depending on the economic status and duration of stay for the dwelling owner, building materials can either be durable or perishable. The collective use of such materials creates a coherent visual pattern with the dwelling structures. Materials to build are salvaged from different places and this process of repurposing reduces the overall environmental and economic impact of construction (Halliday 1997). Poverty inhibits meaningful impact on the built environment other than the production of the barest shelter.

b) Construction techniques and technology

While construction of informal dwellings is incremental in nature, the process of construction has not been explored at length. Conventional ways of building and technologies, are out of reach for informal settlement dwellers due to poverty, which then translates into lack of affordability (Wekesa et al. 2011). The technologies employed in the building of informal dwellings emanate from a need to respond to site challenges. In the case of QRWIS, the site is transected by the Palmiet River and it is thus located on a floodplain. The level of building techniques and the technology in settlements is mostly dependant on the skill and ability of the dwelling owner. Furthermore, finding a locally sourced and affordable builder plays a very important role during the construction process. Residents build their homes in evolutionary fashion, without complying with formalities such as plan drafting, permits, and approvals (Pojani 2019). The lack of resources in informal settlements offers an opportunity for builders to be resourceful and innovative, while also finding value in another people's waste. Panels are cut into smaller pieces, and thus are no longer in their original sizes. Their variety of different sources, thus creates an assemblage. Ironically this reduces the carbo footprint, as Ahmed (2020). Low-energy design techniques, increases in recycling and a reduction in travel time are all present in informal settlements (Ahmed 2020). Locally sourced materials help reduce the environmental footprint of any building or dwelling. Many informal communities also use passive design to ensure their homes are better equipped to withstand the environments of their respective geographies. Recycled building materials have implicit

design principles that are independent of the culture in which they are used such as corrugated sheeting used for both roof and walls. The construction process dictates the function of material.

c) Self-building

Dwelling construction in informal settlements is usually achieved through self-building methods which are often temporary and incremental in nature, with a very diversified and localised construction process. Dwellings in informal settlements are usually built by a combination of self-help and paid labour without any pre-determined or approved architectural drawings. According to Pojani (2019). more dwellers than ever before are responsible for creating their own housing environments within a wide range of economic, climatic and cultural circumstances and constraints. Informal dwellers therefore, respond to these constraints through self-building in order to respond to their immediate housing needs. However, through-out this process, they do not necessarily have a vision of the bigger picture with regards to the spatial planning of the settlement as a whole. Due to people constantly moving into the settlement, building and improving their dwellings, construction skills, consequently becomes an important part of the informal economy. These dwellings are built by people without any form of architectural skill and very little building capacity and resources. The outcomes are usually determined by basic construction and availability of materials.

d) Challenges related to building material and construction technology

Fire hazards are aggravated by some building materials used to build informal dwellings and the close proximity of other dwellings due to the density. One of the major challenges faced by informal settlement dwellers is the number of fires which occur frequently, due to paraffin use and illegal electricity connections. These fires spread rapidly between dwellings due to the construction materials used to build those dwellings (Ojo-Aromokudu 2018).

Risk of fire and the adaptation of new building materials continues to be a challenge. The process of rebuilding involves the use of the same type of materials destroyed in the fire. The ability to fully bounce back from fires, though the rebuilding process might be slow, reflects

the resilience of the community members (Williams et al 2019). A needed gap is to educate residents on techniques which they can employ in order to minimise the impact of fire during construction and post construction. This knowledge may also assist in making better material purchase choices.

The need for sensitivity to regional variations is also important where alternative standards that do not meet the accepted standards are considered in the short-term (Wekesa et al. 2011). Restructuring of building codes and standards to accommodate construction which is affordable to the poor and which can gradually be upgraded is an idea which has been submitted by the United Nations (Wekesa et al. 2011).

4.4 Socio-economic characteristics of informal settlements

Informal settlements are often vibrant centres of economic activity, with a mesh of small-scale enterprises and home-based work that serve both local populations and the wider city at times. According to the UN-Habitat (2018), income generating activities range from, but are not limited to space-related activities such as convenience stores, urban agriculture, manufacturing and repairs, hairdressing and community focused activities such as education and healthcare.

The purpose of employing a socio-economic lens for this research is to consider all issues relating to the social and economic status of the residents, through understanding the different parameters such as occupation, income, skill-sets and community participation. These, in turn, assists in gauging some of the elements which shape the architecture of the built form, such as: land tenure, affordability, technical capacity, building precedent, acceptable living standards and climate.

The socio-economic status of people living in informal settlements comprises of low-income group with very a low level of education, which limits people from attaining a higher social status. Access to resources is largely determined by access to education, income and social currency. In the absence of these resources, people are trapped in poor socioeconomic conditions, which, according to Singh and Farooquee (2019) lack basic social amenities, functional skills, educational status, source of the income, hygiene and health resources.

4.4.1 Unemployment and livelihood

Education is considered as one of the important factors which has the ability to improve the livelihood of households (Williams et al 2019). Informal settlement households possess very low levels of education and skill, which results in people securing jobs in the lowest level of the employment hierarchy. This supports the statement made by various researchers, of informal settlements acting as 'arrival cities' which accommodate those who seek an entry point into the labour market. They are characterized by poverty due to high levels of unemployment (UN-Habitat 2018). People typically work in low paying jobs in order to make a living. They rely on the volatile economic situations with ambiguous employment agreements for survival, which sometimes results in uncertain or irregular incomes. Such employment opportunities include working in the textile industry, solid waste recycling, domestic servants, home based enterprises, and security guards (UN-Habitat 2015a) while also participating in the informal economy.

Informal trading plays a crucial role in developing countries and this is one of the tools which billions of poor people use in order to make a living, thus contributing to local and national economy. The 'informal economy' refers to any form of economic production that exists outside the set economic regulations, in which people trade with unregistered enterprises (Blanco-Montero 2021). Economic activities of households within informal settlements occur within their own homes: this has a dual function of economic production. However, this duality poses challenges for family living, as privacy is significantly reduced by the income generating activity. On the other hand, this dual function is mutually supportive, as the dwelling possesses potential to generate great income for the household, which in turn can be used to improve the living conditions (UN-Habitat 2018). This implies a very close relationship between the dwelling and income generation, and that the improvement of the dwelling could also increase the potential for generation of income. The formalisation of these businesses becomes a burdensome exercise, as the dwellings in which the residents operate do not comply with official building standards (Visagie & Turok 2020). Such efforts by informal settlement communities to break the cycle of poverty and unemployment are continually thwarted by the official bylaws.

South Africa continues to struggle with very high levels of unemployment, which results in high levels of poverty. According to Statistics South Africa (2021), it is reported that approximately 34.5% of the population remains unemployed, with eThekwini Municipality estimated to be around 28.4% (StatsSA 2022). 41% of people live below the poverty line, at an average of R1,335 ($87) per person per month. This translates to about R45 ($3) per day. It is estimated that 13.3% of households in eThekwini Municipality are informal dwellings (eThekwini Municipality 2021), which comprises approximately a quarter of its population. The case of eThekwini echoes what Koolhaas (1995) termed the 'Generic City', in which housing is not a problem. It has either been completely solved or totally left to chance; in the first case it is legal, in the second 'illegal'.

The economic challenges faced by residents of informal settlements suggests that living conditions together with the dwelling structures are perilous. This challenge extended to health of the residents, as informality itself is a source of food. Informal food markets have a decisive role on types of food and quality offered to people and at the same time, they provide food security. Difficult access to fresh produce forces residents to consume highly processed foods with poor nutrition, resulting in obesity and other food-related diseases (Bhan et al. 2017; Rogerson 1992).

4.5 Precedents on informed architectural response to adequate housing for the urban poor

The role played by informal settlements in the urban setting is significant as they provide shelter to over a quarter of the global population (UN-Habitat 2015a). As these settlements continue to proliferate, cities have to develop solutions which assist in curbing this proliferation. As such, the practice of architecture in this context requires a multi-disciplinary approach which extends beyond the conventional boundaries of the architectural profession. This may be achieved by paying attention to building the capacity of all participants in the urban sphere, working together in order to find solutions in providing adequately designed and liveable spaces for poor and low-income urban residents and households. In his article titled, 'It's time to rethink the entire role and language of architecture', architect Alejandro Aravena (2015) stresses the need for architects to start engaging in other fields, such as

economics, security and environment. This may assist in understanding of complexities at play when planning and designing decent living conditions. This, in turn, requires that architectural professionals engage in activities beyond the scope of the prescribed architectural conventions, such as engaging with the client at a level which far exceeds protocols, to using non-conventional building material and techniques.

This next chapter looks at the different housing projects which have been built for low-income to poor households in the global south. These projects demonstrate how a collaboration between architects and various stakeholders can provide adequate housing solutions for people in poor socio-economic conditions. They illustrate the engagement with different stakeholders with the guidance of the architect, has the ability to yield positive results. The design approach of these projects is closely aligned to understanding the socio-economic conditions of the residents. This is revealed through how architects opt to build the houses in the very same location they reside, informally, thus, ensuring that the existing social and economic relations are maintained and not disrupted by any form of relocation. The projects explore different and unconventional design strategies and construction methods in order to provide structurally sound buildings with minimal resources. The architects demonstrated how material manipulation and negotiating skills become useful skills when building houses on a tight budget. The projects also highlighted how different housing delivery models can be best used in the transformation of informal settlements to better communities.

4.5.1 Quinta Monroy 'half house' housing project - Iquique, Chile

Quinta Monroy is a housing project which was completed in 2003, and comprises 93 units occupying 5000m² of land in the inner city of Iquique, northern Chile (O'Brien & Carrasco 2021). The project was initiated in order to adequately settle families who had illegally occupied the same site for about thirty years. Elemental Studio, an architectural firm whose focus is on alternative social housing strategies, was appointed to undertake this project.

The project architects, being mindful of existing socio-economic conditions of the community, opted for in-situ upgrading, instead of relocating residents to the periphery of the city. This foundational gesture reformulates the democratic principles of new urbanism from the early 20th century: opening the city, previously reserved to the elites, to all inhabitants (Le Corbusier

1933). However, the strategy was costly. 25% of the $10 000 of the unit price had to go towards land acquisition as the site was well located in the inner city. As a result, only $7 500 could contribute to the building of each unit (O'Brien & Carrasco 2021).The initial design proposal of a 30m² unit which could be built within the set budget was met with displeasure by the community. They complained about overcrowding in their existing dwellings of about the same size. The architects were therefore tasked with finding alternative ways to build a bigger unit without exceeding the set budget of a 30m² unit.

a) Design process and analysis

Elemental Studio started the design process by engaging the community in a series of public dialogues at which ideas could be exchanged in order to find a suitable housing model for all. These dialogues created a space for the architects and the community to engage in the process of co-creation strategies and capacity building. This process was conducted in order to ensure community participation, especially when making decisions and with the end-user being satisfied with the final product (Aravena 2014). One of the motivating factors for the community undertaking this process of engaging with the architects was the fear of being relocated to periphery, thereby, breaking their existing social and economic networks (Aravena 2014). Faced with the dilemma of designing a bigger house, Elemental Studio started investigating options of providing partially completed apartment units that allowed for future expansion and improvements. This process went through various design concepts and scrutiny until all parties involved finally decided on the 'half house'.

The design concept proposed the building of one half of the house while leaving the rest as a hollow box which allowed for further self-construction and incremental improvement. This concept, similar to Le Corbusier's 'Plan Obus' design in the 1930s required home owners to complete the interior of their own apartments within a concrete and steel framework (O'Brien & Carrasco 2021). This design concept was meant to cater for the rising poor urban population in the capital town of Algeria, Algiers during the age of industrialization which saw many people moving into the city for work and economic prosperity.

The superstructure of 'Quinta Monroy' apartments was constructed to include the most essential parts of a house which required extensive work, especially the kitchen and bathroom. These essential parts were included due to plumbing complexities, which had to be executed by a skilled professional.

Figure 6 The completed half-house. Source: Elemental Studio, 2003

Figure 7 The half-house after incremental improvement by the owner. Source: Elemental Studio, 2003

b) Project irregularities

In a research paper titled 'Contested incrementalism: Elemental's Quinta Monroy settlement fifteen years on' by O'Brien and Carrasco (2021), details a number of post-construction challenges face by the community of 'Quinta Monroy', to date. The project is lauded as a success for the strategy that allowed house beneficiaries the freedom to incrementally extend their houses without compromising the quality of the design. The architects demonstrated alternative 'bottom-up' strategies when dealing with design of this nature, yielding successful results instead of policy dictated schemes with poor results and a lower quality housing standard. However, the undated photographs (Figure 9) taken on site paint a gloomy picture of the current state of the project, and highlights some aspects which may have been overlooked during the design and participatory stage of the project. Various unregulated building alterations have taken place since the completion of the project. Figure 8 and Figure 9 reveal encroachment on the initial design aesthetic, with some parts of the units protruding from the intended architectural design. Some of the courtyard spaces which were meant to be for public use are now occupied by the different structural additions to some of these

units. The longer-term effects of this change are not clearly highlighted; however, this raises questions as to whether the quality of space has been compromised by these structural modifications.

The architects had provided guidelines in order to assist residents in understanding the different way in which they could conduct the extension of their units. However, the observations made on the current state of the units suggest that these were not considered. Elemental Studio did not anticipate that home owners would extend their units beyond the provided frame of 72m². Yet, fifteen year later after occupation of the half-houses, 93 houses were extended, with 60 of those expanding beyond the frame defined by the architects (O'Brien & Carrasco 2021). The idea of allowing for incremental building of the other 'porous' half of the house was a success: however, the over-ambition of incrementalism was accompanied by a negative reaction, namely the over-extension of the unit beyond the set frame. This incremental building included extensions in the communal courtyard, cantilevered rooms over public spaces and new floor added to create a fourth floor, all of which were never planned in the initial design (Figure 8).

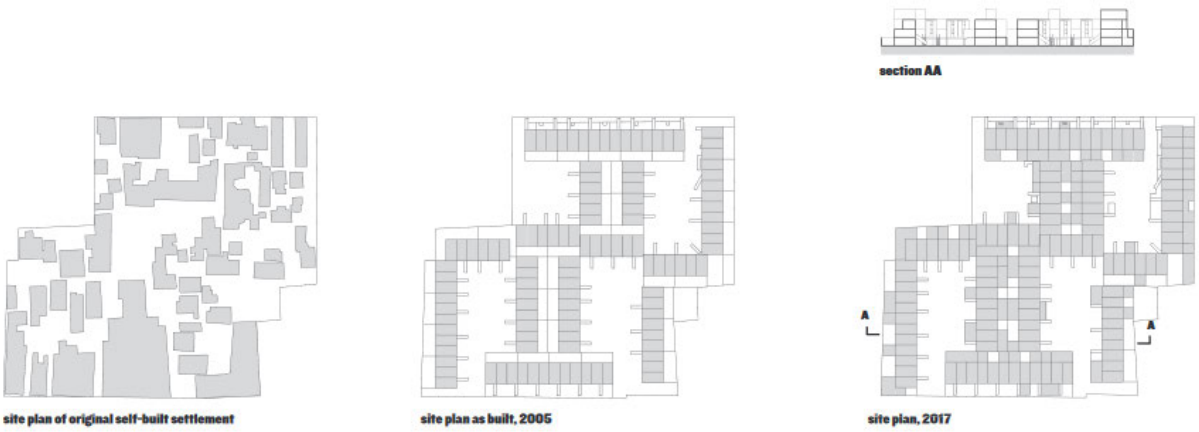


Figure 8 Images of the existing site plan before architectural intervention, what was designed and the incremental growth after design. Source: https://www.architectural-review.com/buildings/housing/revisit-quinta-monroy-by-elemental

Figure 9 Image depicting the unregulated incremental growth of the units. Source: O'Brien and Carrasco, 2021

c) Project summary

'Quinta Monroy' highlights some of the successes that can be achieved through collaborative work. The project demonstrates how different professional disciplines, with the guidance of an architect, can help provide suitable housing design and delivery for low income to poor communities. It also provides insight as to how housing can be provided at a very minimal cost, without compromising the quality of the building materials and living space.

As Meerow, Newell & Stults (2016b) highlight, participatory processes combined with conventional planning instruments can assist in the understanding of diverse visions and values, and build up more inclusive methods. This project contributes to increasing resilience, and pays attention to issues of justice, place, identity, inequality and poverty.

The concept of incremental building construction has been partially successful in allowing homeowners to improve their homes. However, research undertaken by O'Brien and Carrasco (2021) indicates that 'Quinta Monroy' did not materialize into the ultimate 'collective building' vision that the architects may have had in mind during the design and construction stages. The design stage of the project did not take into consideration the unforeseen population growth factors which led to structural reconfiguration of the units. It

is therefore challenging for architects to anticipate the transitional behaviour of the community from informal, to a more formalised living structure. This is a lesson for future projects which deal with housing the urban poor, in architects need to have foresight and a long-term vision for any particular settlement and people for whom they design.

4.5.2 The Empower Shack – Khayelitsha township, Cape Town – South Africa

The 'Empower Shack' project is located in township of Khayelitsha in the Western cape province of South Africa. Established in the 1980s under the apartheid regime, it is the country's second largest 'township' after Soweto in Johannesburg. In South Africa, 'township' is a term that is used to refer to urban residential neighbourhoods where African people live. The growth in population necessitated the development of backyard dwellings which have subsequently led to an unregulated growth and expansion of informal dwellings, also creating pockets of informal settlements within the township. To date, the majority of the households in this Khayelitsha live in highly densified informal dwellings which are plagued with high levels of overcrowding (Figure 10). These unfavourable conditions come with constant threats which exposes the community unfavourable living and health conditions. Limited sanitation and access to portable water promote the rapid spread of disease as witnessed in other settlements of this nature.

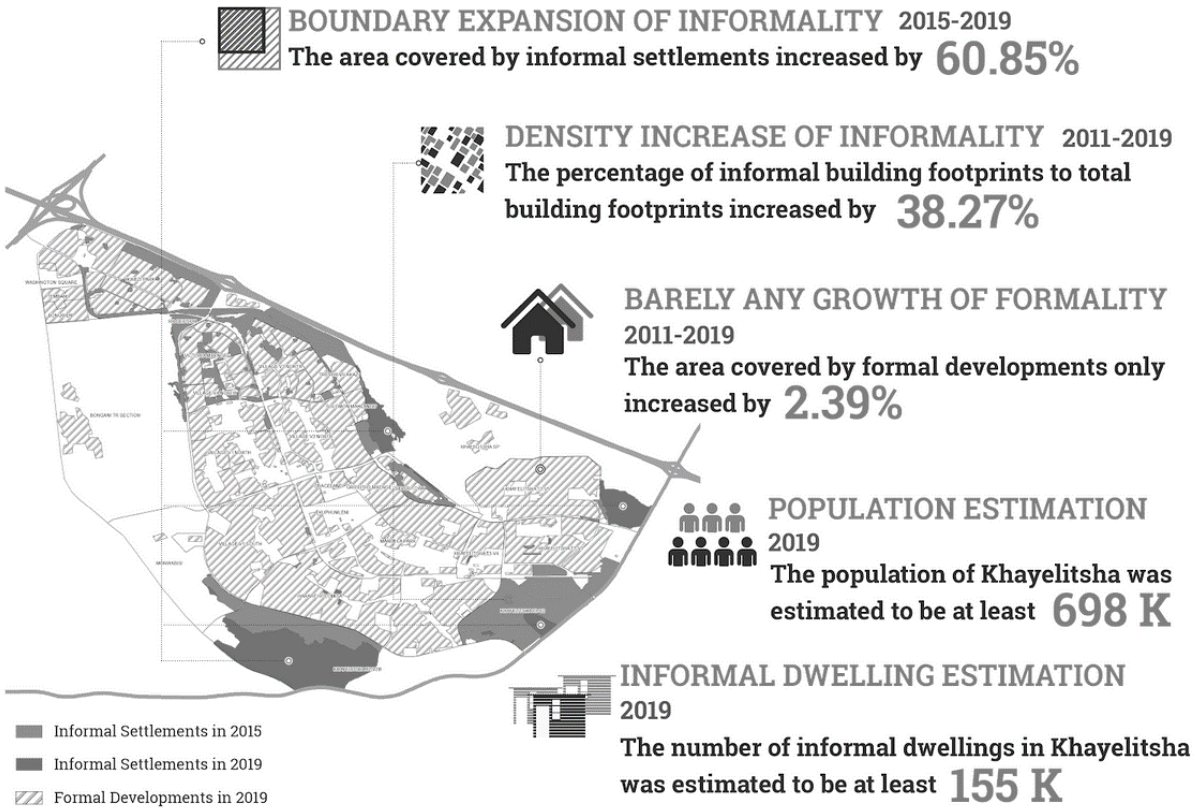


Figure 10 Map depicting the housing challenges of Khayelitsha township. Source: http://www.endevictionscampaign.org/maps

With the city of Cape town located 35 kilometres away from the township, people spend much time and money commuting to work, and searching for employment opportunities in the city. The location far away from the city means that people are isolated from economic opportunities, which results in very high unemployment levels which further exacerbates the high levels of poverty. Even though the township has a CBD and small manufacturing businesses, it does not have the capacity to provide enough employment for the entire community.

'Urban Think Tank' (UTT), an inter-disciplinary company was appointed by 'iKhayalami', a local NGO in order to find upgrading solutions to deal with high density and overcrowding. This multi-disciplinary company provides research-driven design solutions which allow them to solve practical issues to the complex housing challenges through various skill sets from their professional team. 'Urban Think Tank' were assisted by iKhayalami to conduct interviews with

the residents in order to see beyond the living conditions and understand the living experience and housing aspirations. Site C, an informal settlement within Khayelitsha, was chosen as the site on which to construct this housing alternative prototype.

a) Design process and analysis

The concept of the 'Empower Shack' was to use the footprint of the existing informal dwelling with the addition of a top floor in order to ease congestion of the single-storey dwelling. The shack was designed as a double-storey timber structure comprising of sanitation core, with the entire structure cladded in corrugated sheeting. The layout of this double-storey dwelling created a private space on the top floor and a more private public space on the ground floor, which could also be used for income-generation purposes. The development of the top storey was also envisaged to improve pedestrian mobility between the dwellings, thus assisting in reducing the impact of fire. The internal space was left free for the residents to configure according to their needs using, prefabricated facades. This pilot project consisted of four houses which were completed in 2015.

Figure 11 The timber frame structure of the empower shack. Source: https://uttdesign.com/works/empower-shack--6

Figure 12 The external facade of a completed empower shack. Source: https://uttdesign.com/works/empower-shack--6

The initial 'Empower Shack' project was deemed a success by all role players, especially the stakeholders, through user-experience. This led to U-TT architects being appointed to work on the next phase of the project, with the introduction of more durable and permanent

building materials. This next phase included the incremental clearance of the existing informal dwellings, while developing 72 new units. This development also came with the construction of a community centre with a landscaping aspect, water management system and piloting power generation through solar power. Concrete blocks and a floating slab were introduced for the construction of the superstructure of the units. The rest of the façade was clad with corrugated sheeting, which created a visual contrast between the heavy and light materials.

Figure 13 Internal living space of empower shack 2.0. Source: https://uttdesign.com/works/empower-shack--6

Figure 14 Empower shack 2.0 construction out of more durable material. Source: https://uttdesign.com/works/empower-shack--6

b) Project summary

The project was aimed at finding alternatives at solving a housing challenge in an extremely densified setting. success. Although it was a commendable project, it was delivered through collaborative action, and cannot be solely attributed to single entity. This suggests that the solution of housing in informal settlements needs to embed the social, economic and political conditions of that particular place. Architects therefore, when placed as mediators between governments and communities in such processes, offer potential to drive positive housing results. Design in itself can be used as a tool which can bring solutions for communities, while showing City Managers the opportunities for alternative solutions to the housing challenge in the urban context.

4.5.3 'Kambi Moto' slum upgrading program - Kibera, Nairobi – Kenya

The city of Nairobi is estimated to have 70% of its' population living in informal settlements, largely attributed to rural-urban migration and natural population growth. For that reason, it is also home to the biggest slum in Africa, Kibera. Due to the overwhelmingly high level of

informal dwellings and overpopulation in Nairobi, various non-profit organisations and built environment professionals constantly engage with communities in order to find better housing solutions. A slum clearance program was initiated back in the 1970s, followed by a physical slum upgrade programme in the 1980s and 1990s, all fell short in addressing the housing challenge. The failure of these initiatives may be their top-down nature, attributed to the failure by the local authority to consult and co-ordinate with the communities (Bowler & Desrocher, 2005). To date, a number of upgrading projects are taking place within Nairobi, with a few non-profit organisations leading the programmes.

'Kambi Moto' is one of the smaller informal settlements, on the north eastern side of Nairobi. It is located within formally planned social housing. The site occupied by the settlement was originally designated as parking for people in formal houses, but was gradually occupied by the urban poor. Due to the unhygienic living conditions and crowding, the surrounding community members pleaded with the government to intervene by providing basic services and possible housing upgrades. The city council invited various built environment professionals, NGOs and politicians, to assist in an upgrading program. With the assistance of COOPI (*Cooperazione Internazionale*) and a local trust named Pamoja, the people occupying parking with informal dwellings were able to create a money saving scheme which could assist in the upgrading program.

a) Design process and analysis

The first step taken in the upgrading process was mapping; a demographic and infrastructure survey of the existing conditions of the site. This included logistical planning on the order of the upgrades. Further data information was collected during the community engagement meetings, which included the Department of Architecture, researchers and architecture students from the University of Nairobi. This project was solely driven by the community, with different professionals providing guidance whenever it was needed. The professionals recognised that the involvement of the community was very important to the sustainability of the project.

Information collected by the students during the design studio exercise resulted in preliminary design concepts for the different housing typologies being developed. The students collaborated with different architects who were also part of the project and helping the community. Participatory process meetings were held at which the final designs were shared with community members. They encouraged the community to make comments and confirm whether the designs were suitable for their needs and to raise any constraints which might exist. Drawn sketches used as a simple method of communication as most of the community members lacked technical knowledge. This process also included the construction of life-sized house models from timber cardboard and plastic (Figure 15). The rudimentary sketches produced by the community were then translated into proper construction drawings for the builders.

Figure 15 A life-sized house model built for community engagement meetings. Source: Mukeku, J 2015

The different floor plans could be built incrementally, depending on affordability. (1) The ground floor includes a kitchen sink and its plumbing, (2) the first floor has a toilet and shower and (3) the second floor is another bedroom with a small balcony (
Figure 16).

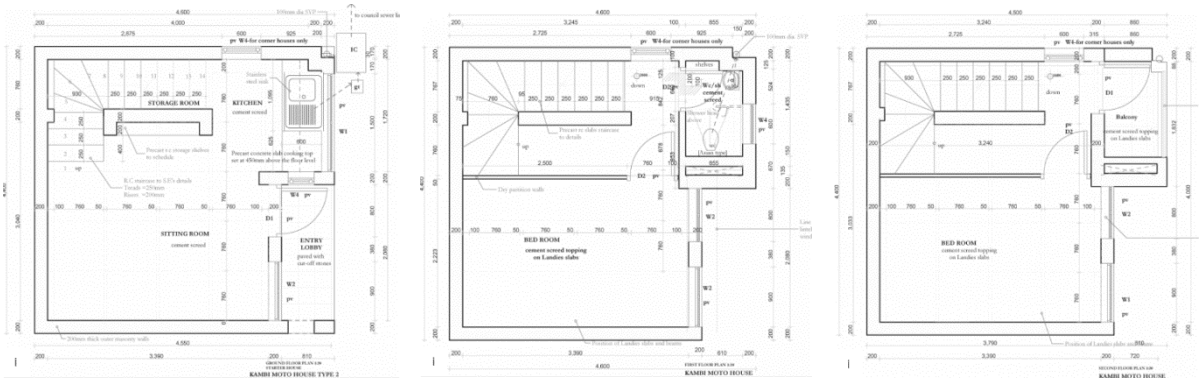


Figure 16 The different floors of the house: ground, first and second floors.

Source: Tecta consultants - Architects, 2005

Due to the lack of space on the site, the vertical construction route was chosen, with the ground floor room to be used as an economic generator due to its close proximity to 'foot traffic'. In terms of Le Corbusier (1923b), the house becomes a 'tool' for life improvement. Each house was built according to the owner's ability to repay the building loan, with the houses varying from single to double storey. The owners were also given the opportunity to lower their loan repayment costs by being part of the construction team, assisting with the actual construction work. The different floors allowed for incremental building and improvement.

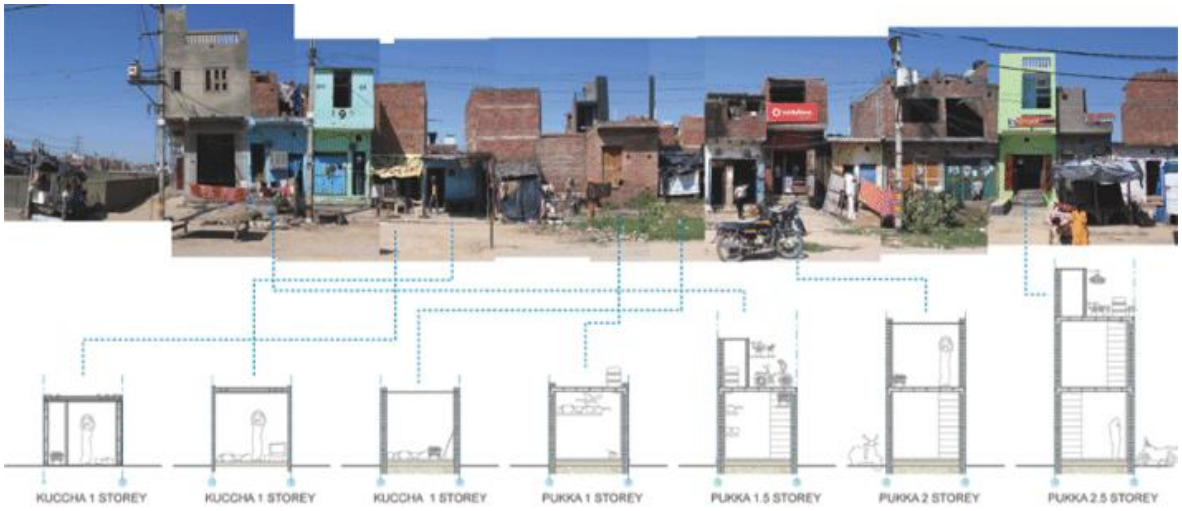


Figure 17. Diagram of the process of incremental building construction typical of cities throughout the world.

Source: King, 2011

The basic housing unit comprises a single room on the ground floor with other two rooms layered vertically. The space on the ground floor functions as a lounge and measures 16m². These houses are laid out in a series of interconnected clusters made up three to five housing blocks, with a shared common public space (
Figure 20).

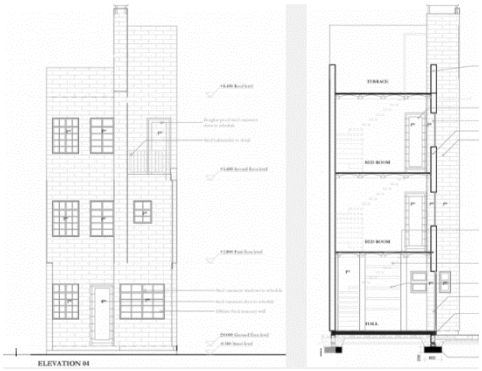


Figure 18 Section and elevation of a typical unit showing the different floors.
Source: Tecta consultants, 2005

Figure 19 Elevation of the houses showing the vertical incremental building strategy.
Source: Tecta consultants, 2005

b) Summary of the project

The aim of the program was to create a housing typology which would eventually be modelled for different households and settlements. As much as it was lauded as being a success, it was also discovered that this model did not cater for extremely poor households in the community, as they could not contribute the minimum of 20% of the total construction funds required in order to qualify for an upgrade. Those who managed those funds still ended up with the lowest phase of construction, mainly the ground story, and could not extend their houses further.

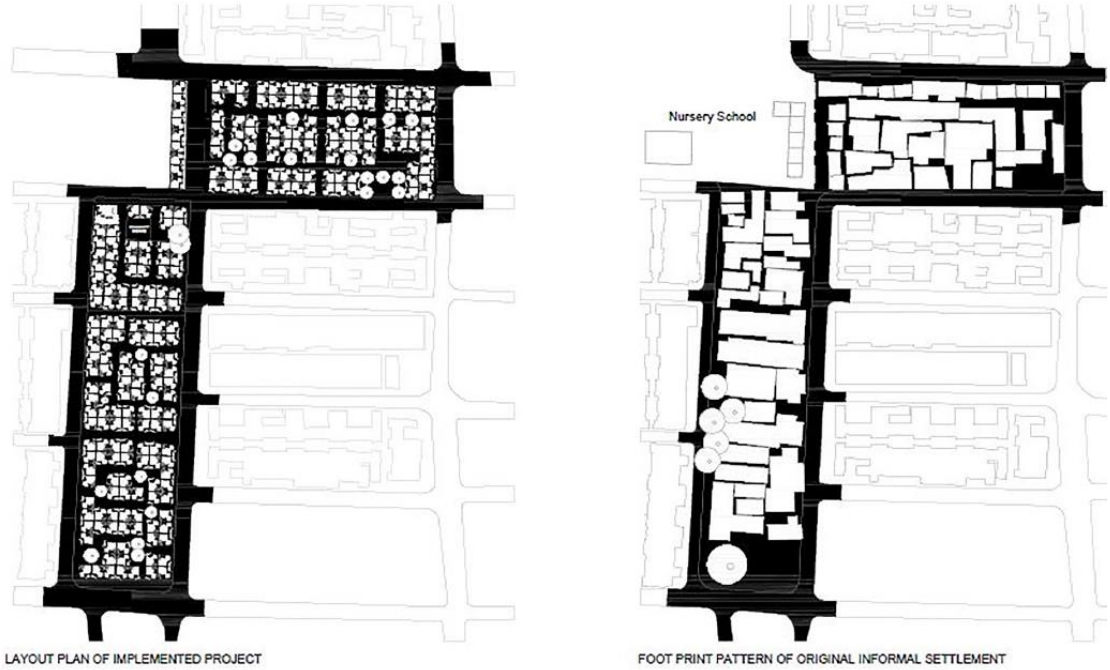


Figure 20 The before (right) and after (left) footprint of the settlement. Source: Tecta Consultants /Aaron Wegmann – Architects 2005

The 'Kambi Moto' in-situ housing upgrade project was presented as being affordable due to below the market construction costs. However, additional costs which were not publicised that made the project look affordable, even though that was not the case. Particularly, 'sweat' equity which was not factored in the total cost of construction. This was provided by each member of the scheme working manually on the project in order to cover funds they could not contribute. In addition, technical support costs pertaining to the design were absorbed by the NGO working with the community. Importantly, the land was provided by the city council at no cost to the community, which also lowered the expenses for the project.

As with the other examples presented, which relied on the success of the initial 'pilot' project, the same theme was also applied. What was originally aimed to be a construction of 70 houses was further extended to 400 more houses, using the same community-focused.

4.5.4 Conclusion on precedent studies presented

The precedent studies presented seek to represent at general level, the benchmark established in the theoretical framework of this research (see section 2) in terms of quality of

human settlements and habitability of dwelling. They also highlighted important parameters to be considered when undertaking housing design and delivery for low income communities with respect to quality and habitability. They identified both the successes and the failures of community participation approach. The failures assist professionals deal better address housing provision in future, given that the participatory approach has the ability to reveal unsaid challenges which are faced by the housing recipients. This allows for architects and different role players to have an idea on site specific issues faced by the community, their aspirations and dreams, and therefore provide designs accordingly, using customized concepts and project implementation.

The settlement is no longer just a point of arrival in terms of Taubenböck, Kraff and Wurm (2018), but a place of dwelling permanently. This transition, as Norberg-Schulz (1993) states, is possible by means of built form and organized space: the architectural project, which in these cases is in partnership with the dwellers. Therefore, the architectural project becomes the instrument that has a direct and determinate effect on the way people live, pointed out by Broady (1966) as architectural determinism. Giving voice to the dwellers while partnering with planning experts opens the door to diverse visions and values that include in the conversation justice, place, identity, inequality and poverty. This reinforces more inclusive methods to find solutions to informal settlements (Meerow et al. 2016b), which ultimately impacts in strengthening resilient communities.

The settlements in this section are not to be considered cities as a whole but part of the cities in which they are located. This way, the approach to maintaining the dwellings in the same location reveals a desire to be part of the functional city in the terms established by Garnier (1917) and Le Corbusier (1933). These precedents represent a step ahead in considering solutions to the QRWIR, as they consolidate the settlement and acknowledge the residents' right to the city, as opposed to QRWIS in which the sense of temporariness due to lack of commitment by the authorities or constant fear of flooding exists. Despite the challenges and possibly not excluding the expectations created for the residents, these precedents use and consolidate the sense of belonging. This is at the core of the strategy: ensuring participation

of the residents and including them in the discussion, not only at design level but also at financial level.

When Le Corbusier (1923b) identified standardization as the key strategy to respond to the unprecedented need for housing in the Post-World War Europe, he set the pathway to future residential development in cities. The benefits of standardisation not only impacted cost and time of construction, but established a sense of equality. The three projects namely, 'Quinta Monroy', 'Empower Shack' and 'Kambi Moto', present adequate response to informal settlement improvement, and place standardisation at the very core of the approach. The conceptualisation of the house as a tool is also envisioned by Le Corbusier (1923b), "A place to live and prosper economically." This is clearly included in the 'Kambi Moto' intervention. The next section focuses more specifically on the challenge of informal settlements in eThekwini Municipality, Durban. It looks at the various factors which allowed for their formation and proliferations.

4.6 Contextualising informal settlements in eThekwini municipality

According to UN-Habitat (2015a), numerous factors have contributed to the emergence of informal settlements. These factors being rapid population growth, rural-urban migration, and lack of affordable housing in cities. The aspect of weak governance has also been cited in various studies, more specifically in policy making and city management. (UN-Habitat 2015c). In South Africa, as it is the trend in any developing country, the emergence of informal settlements in cities has been associated with migrant labour as a result of industrialization. This triggered a large number of people to move to the city to offer their labour. This move also complicated socio-economic-technical networks of urbanization and sustainability (Niva, Taka & Varis 2019).

The City of Durban, located under eThekwini Municipality, is the second largest industrial hub in South Africa, after the city of Johannesburg. It has the busiest port in Africa (eThekwini Municipality 2021). Consequently, faces the challenge of high migration rates, with people in search for economic prosperity.

Durban is the largest city in the province of KwaZulu Natal and the third largest city in South Africa. According to 'eThekwini Municipality's Integrated Development Plan' (eThekwini Municipality 2021), the Metro is estimated to have a population of approximately 4 082 208, in which a quarter of the population lives in informal settlements. The Municipality is home to approximately 580 informal settlements, which houses 287,000 households (eThekwini Municipality 2021). Currently, the Municipality suffers from a housing backlog, expected to take over 90 years to resolve if the current strategies based on state-subsidized housing model roll-out do not change (eThekwini Municipality 2021) (See Table 1).

Table 1 Housing backlog. Extracted from (eThekwini Municipality 2021)

Basic service	Ex. Backlog Dec. 2019	Delivery per annum	Timeframe based on current housing model
Housing	440 000	5000	90+ years

Housing delivery is implemented through various national governmental programmes and subsidies. Programmes targeting specifically the poor to low-income households are the Reconstruction Development Program (RDP) and the Informal Settlement Upgrading Program (ISUP), among others. The Municipality has been unable to achieve favourable housing delivery due to various financial and administrative challenges (eThekwini Municipality 2021). However, this challenge is not only experienced locally, but also at a national level.

4.6.1 Informal settlements in the apartheid-era

The challenge of housing pre-dates the current government. South African cities were planned and shaped by colonial and apartheid principles which excluded Black (African, Indian and coloured) people from economic and geographic centres of the city. This segregation of race has historically been a central characteristic of social, economic and spatial organization of the city. This, according to Visagie and Turok (2017) created a mismatch between the geography of the population and the location of jobs. This suggests that South African cities were designed without the other ethnicities (except white) in mind, whilst their labour was still required in economic production.

The central city developed around a central core, based on imported models of city planning and conveniently related to the social and economic functions of the city (Figure 21 and Figure 22). Due to a need for labour to support the manufacturing and the domestic sector, black people were housed in controlled compounds, hostels and servant's quarters (Davies 1981).

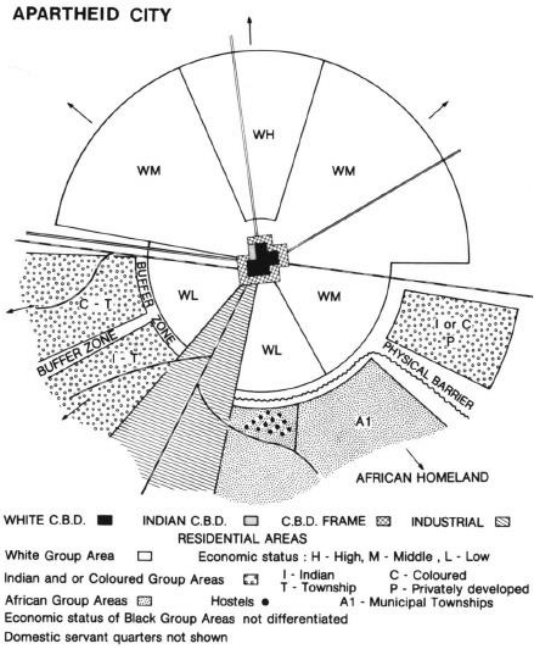


Figure 21 The apartheid city model. Source: Davies, 1981

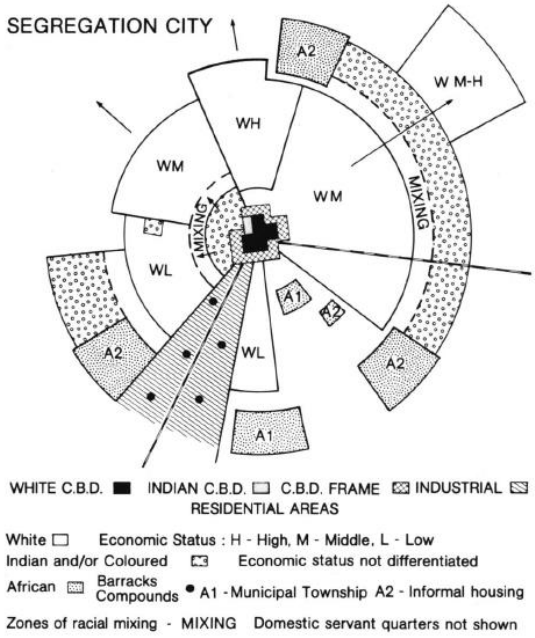


Figure 22 The segregated city model. Source: Davis, 1981

The rise in industrialization in the 20th century resulted in a significant rural-urban migration trend, which caused a sharp increase of people in the city without adequate housing to accommodate them. For Africans, designated hostels became overcrowded. This translated as dense and overpopulated sites which required increasing maintenance. Lack of maintenance led to rapid deterioration. This resulted in precarious construction of informal dwellings within the boundaries of hostels. The growth of Indian neighbourhoods in peripheral zones such as Cato Manor in the late 1940's also allowed Indian people lease small portions of the land to African people. They realised they could make more profits by becoming 'shack-lords' (Maharaj, Khan & Desai 2017). The late 1950's also saw the development of informal settlements in areas surrounding the industrial zones.

Under the 'Group Areas Act' (GAA) of 1950, the Nationalist Government built public housing as a response to housing shortage for black people in urban areas. These houses were located across railways and highways in order to enforce separation of races but also allowed accessibility to public transport for black people travelling to work in the city. Black people were relegated to less convenient neighbourhoods in the urban periphery (Davies 1981), and this meant high travelling costs to their places of employment. Today, even with the strategic location of these areas, it is estimated that low income households typically spend between 20-40% of their monthly earnings on transport costs (Kerr 2017). In response to this mobility challenge, coupled with the growth in population, black labour started building informal dwellings in the urban buffer zones in order to be closer to the city and other areas with employment opportunities. The 1980s saw the growth of backyard dwellings in townships, which extended into vacant land and sometimes into buffer zones and fringing more affluent areas.

4.6.2 Proliferation of informal settlements in post-apartheid Durban

The post-apartheid era is recognised as a period of reconstruction which addresses the socio-spatial injustice and inequalities associated with the effects of apartheid. This included the demise of segregation laws, which triggered a rapid in-migration of people into the city, which perpetuated informal forms of housing even further (Low, 2019).

After 1994 the new ANC (African National Congress) political party introduced a national housing programme (Sutherland et al. 2019) with the inclusion of a subsidy afforded to low income households. The ambitious housing programmes produced millions of houses, yet it still failed to turn around the housing crisis. While the city fails to cope with the influx of rural-urban migrants and the rapid increase in urban population growth, informal settlements continue to proliferate.

These settlements are socially, politically geographically and economically detached from broader urban systems and generally absent from urban opportunities and decision-making (UN-Habitat, 2015f). Therefore, the proliferation of informal settlements is primarily the result of inefficient housing planning by the city government, due to insufficient financial funds and lack of coordination among different governmental departments in terms of land

allocation, urban planning and economic development (Chen, 2021). In addition, the real estate market profits more from the provision of middle instead of low-income dwellings, which exacerbates the need for informal construction by those who cannot afford access to formal middle-income houses.

4.6.3 Poverty and inequality as drivers towards informality in south Africa

According to the World Bank (2022), South Africa is the most unequal country in the world, in which the top 1% of the population receive 20% in earnings, while the rest of the 90% take home only 35% of all income. The key driver of this inequality is attributed to the legacy of apartheid, which resulted in inequality of opportunity for the population. The majority of people remain disadvantaged through the unequal distribution of wealth and land, the large earning gaps and lack of access to quality education for most of the population (The World Bank 2022). This structural inequality undermines people's efforts to elevate themselves out of poverty, and is particularly relevant in the South African context given the legacy of apartheid (Williams et al 2019). In the context of eThekwini Municipality, it has reported the highest number of people living below the food poverty line compared to the other metropolitan municipalities in South Africa (eThekwini Municipality 2021).

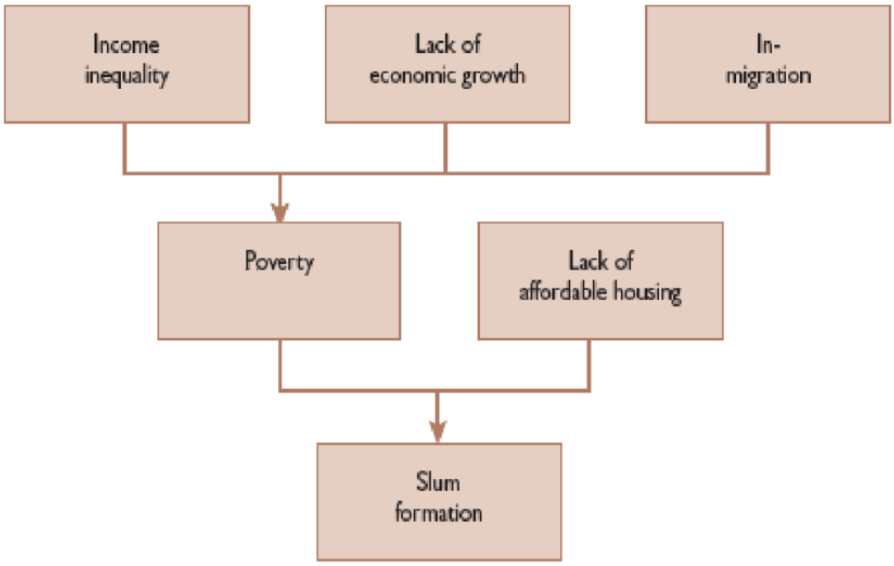


Figure 23. Inequality – Poverty – Slum formation (UN-Habitat, 2003b)

4.6.4 Rural-urban migration and urbanisation: The case of eThekwini

The rise in informality in the urban context is not a practical solution to housing the urban poor but it is a sign of a dysfunctional system of governance (UN-Habitat 2018). This dysfunctionality signifies that cities cannot keep up with the pace and rate of in-migration. The decision to create informal dwellings and live informally therefore, becomes a solution for those who are unable to gain access to adequate urban housing.

As a result, estimates suggest that a billion people live in slums and informal settlements today, representing about 30 per cent of the world's urban population (UN-Habitat 2018). The high rates of urbanization in Durban are the consequence of a complex set of historical and contemporary political, economic, social, environmental and spatial relations (Williams et al. 2019). According to the census of 2011, eThekwini municipality received the highest number of migrants, with most of them taking up residence in informal settlements (eThekwini Municipality 2021).

About a quarter of the Durban population lives in informal settlements, with the majority of these residents coming from rural areas (Williams et al. 2019). This migration is in response to a well-functioning labour market that signals higher demand in cities, (World Bank Group 2015) as indicated on Table 2 below. However, others do not necessarily migrate to the cities by choice, but due to existing circumstances. Industrialization, thus, becomes one of the most powerful drivers of urbanization.

Table 2. Factors affecting rural-urban migration (World Bank Group 2015)

Push factors	**Pull factors**
Unemployment and poverty	Money earning opportunities
Absence of industries	Easy access to transport connection
Lack of social services	Improved social amenities and services
Food insecurity due to natural disasters	Access to informal economic sector

4.6.5 Municipal services and infrastructure in informal settlements in eThekwini

In 2000, eThekwini municipality introduced the 'Interim Services Program' which was aimed at temporarily providing basic services to informal settlements. Water supply, sanitation or fire hose point, were located on the periphery of settlements in order to be accessed by all the residents (iQhaza lethu 2021). These services were intended as a temporary solution until the eventual relocation of residents to formalised housing occurred. Due to the on-going considerations of incremental upgrading of informal settlements, the municipality has listed the provision of incremental services as one of their priorities (eThekwini Municipality 2021). These are as follows:

a) Water supply

Households in informal settlements are not serviced with piped water, but, have access to communal standpipes within the settlement, from which residents collect water in buckets for household purposes.

b) Electricity supply

Most households have illegal electrical connections, which pose a risk of fire and destruction of dwelling structures. People rely on LP (Liquefied Petroleum) gas cylinders and paraffin stoves for cooking. The unaccounted consumption of electricity and the inability to contribute towards payments due to high levels of poverty, means that the municipality bears the brunt of this expenditure (eThekwini Municipality 2021).

c) Waste management: Disposal and collection

Waste management and waste collection is a visible problem in informal settlements, which requires participation from both, the residents and the municipality, in order to be resolved (Figure 24). Ironically, informal settlement are considered to be sustainable due the minimal waste they produce when comparing them to the rest of the formalised housing in cities (Tsheleza *et al.* 2019). This is also where most materials are salvaged and repurposed by the residents (UN-Habitat 2015c).

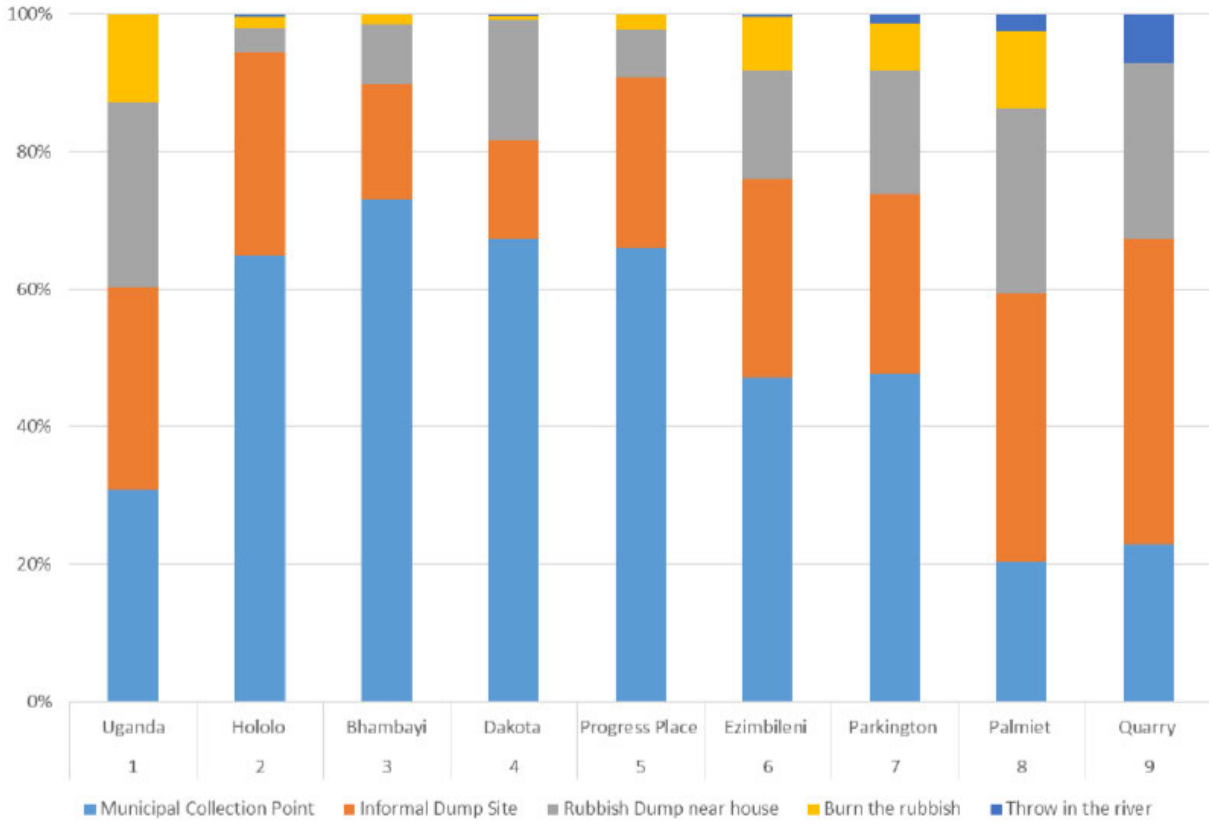


Figure 24. Waste disposal in selected informal settlements in eThekwini Municipality. Source: iQhaza lethu socio-economic report, 2021)

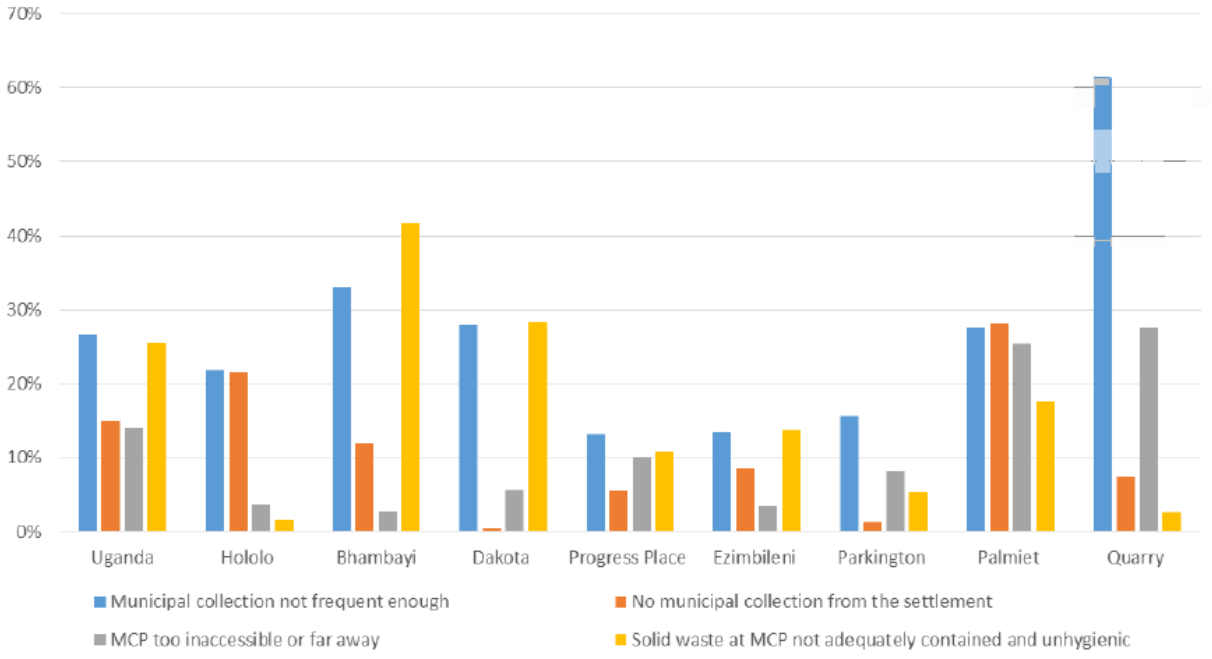


Figure 25. Waste collection in selected informal settlements in eThekwini Municipality (iQhaza lethu socio-economic report, 2021)

d) Sanitation

There is a general lack of adequate sanitation systems in informal settlements, which aggravates the spread of communicable diseases (Williams et al. 2019). This adversely affects the health and socio-economic development of communities. Women in particular, experience unique sanitation challenges, while still being expected to participate in socio-economic roles. (Singh and Farooquee 2019). As a result, women living in informal settlements face particularly challenging sanitary requirements. The provision of CABs (Community Ablution Blocks) by the municipality in informal settlements assists in curbing sanitation challenges. Nevertheless, due to lack of maintenance at times and other safety related issues, people find alternative ways to relieve themselves which usually leads to outbreaks of disease.

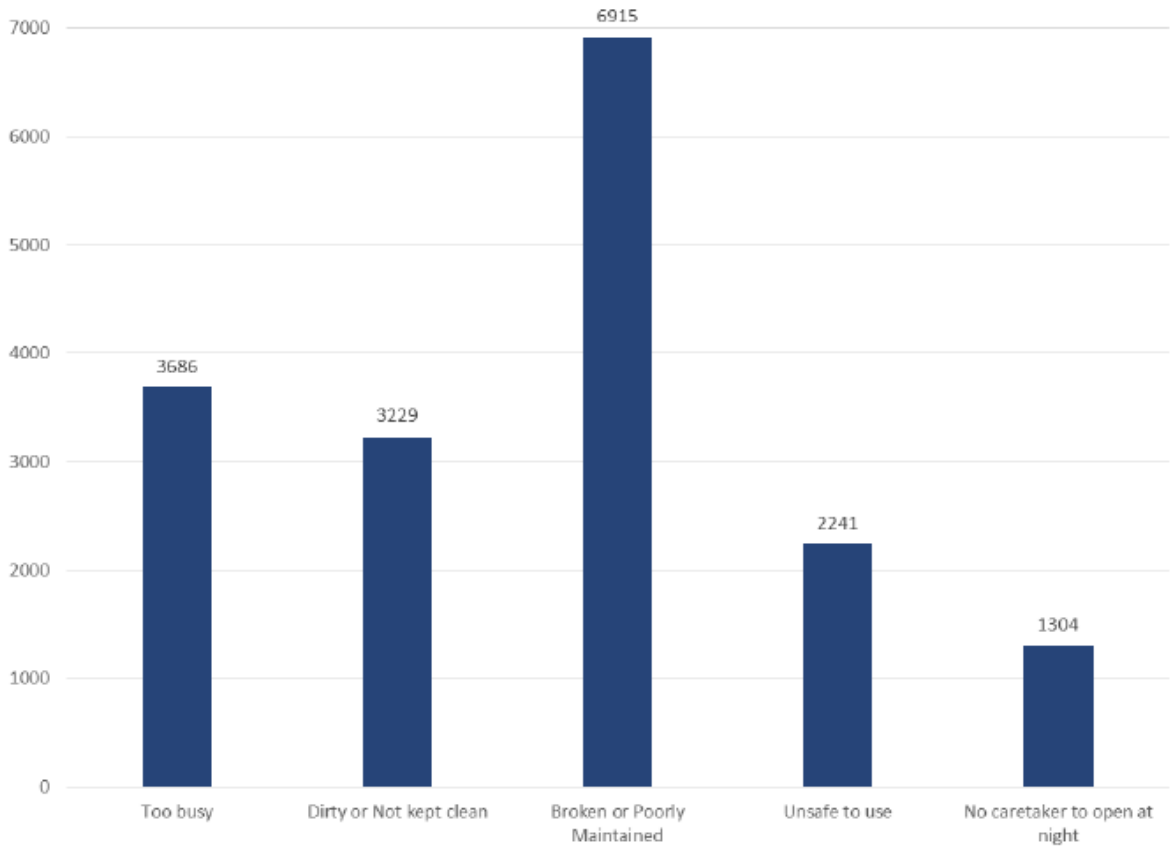


Figure 26. Communal ablution blocks supplied by eThekwini municipality. (Source: iQhaza lethu socio-economic report, 2021)

4.7 Summary of Literature review

The section presents the concept of informality and more importantly, the scale of the phenomenon in the global south, narrowing down the focus from global considerations and the introduction of samples worldwide, to finally address the situation in eThekwini Municipality. These structures represent the 'International Style' of the urban poor, present in most African cities, in numerous large cities in South America and Asian (Elleh 2011).

The literature reflects the impact of informality in the built environment and the influence on socio-economic relations in the urban realm. The physical expression of informal dwellings is a consequence of the volatility, insecurity and uncertainty of life in the informal settlement. The adaptation of form by adding more rooms, personalization and even ornamentation of the outside space, is attributed to the improvement of employment conditions that lead to an increase in wages of the dwelling owner.

Far from being dormant environments in which residents find shelter waiting for the next working day, informal settlements have evolved as micro-urban ecosystems providing social and economic opportunities. Social bonds and conflicts, trade and services coexist with dwelling. Unlike monochromatic formal planning processes in which different zones are separated, especially those planned in the British colonial era, informal settlements represent a spontaneous expression of urban mixed-use.

The conclusion derived from the socio-economic section of this dissertation is that housing and living conditions of informal settlement dwellers is generally very poor. The manifestation of the informal dwelling is an autonomous development, driven by a need for shelter, regardless of what the outcome may be. This process occurs without the assistance of the municipality or planners, but is carried out by the residents themselves.

This then raises the question as to how residents build these homes and create spaces around them. It asks how the community adapts and responds to the environmental conditions of the site on which they are located, while taking social, economic, physical and climatic conditions into consideration. Despite a lens of local heritage which sometimes classifies

informal settlements as vernacular architecture, the resident's choice of architectural expression and aesthetics is one which aspires to modernisation. The way in which their buildings are designed and decorated, in an effort to hide material poverty, informal dwellers are looking at being recognised as full participants and fellow builders of the city and its society (Pojani 2019). This section considers the components which make up the built form: materials, techniques, structure, shape and size. This enquiry is driven by the purpose to understand these aspects in order to suggest ways in which they can be repackaged. Given that the literature supports eThekwini as a paradigm of the Southern African city, and is thus extendable to Sub-Saharan Africa. Therein lies multiple opportunities to investigate phenomena associated with urban informality at many levels.

5. CASE STUDY: QUARRY ROAD WEST INFORMAL SETTLEMENT

5.1 Introduction

QRWIS is located on the western side of Durban, originating in 1984 (Williams et al. 2019). The settlement is strategically nestled between the suburb of Palmiet/Clare Estate and the M19 highway. This location allows people easy access and possible employment opportunities in Umgeni Business Park, Springfield Industrial Park, the University of KwaZulu-Natal and the surrounding residential neighbourhoods. However, this strategic insertion of the settlement between these economic hubs is not unique to this case study. It is representative of many other informal settlements around the globe. This site, which is located in the core of urbanity is also close to transportation networks such as the M19 highway and the N2 freeway (Figure 28). This also allows residents easy access to the CBD and social services sites without spending large amounts on transportation.

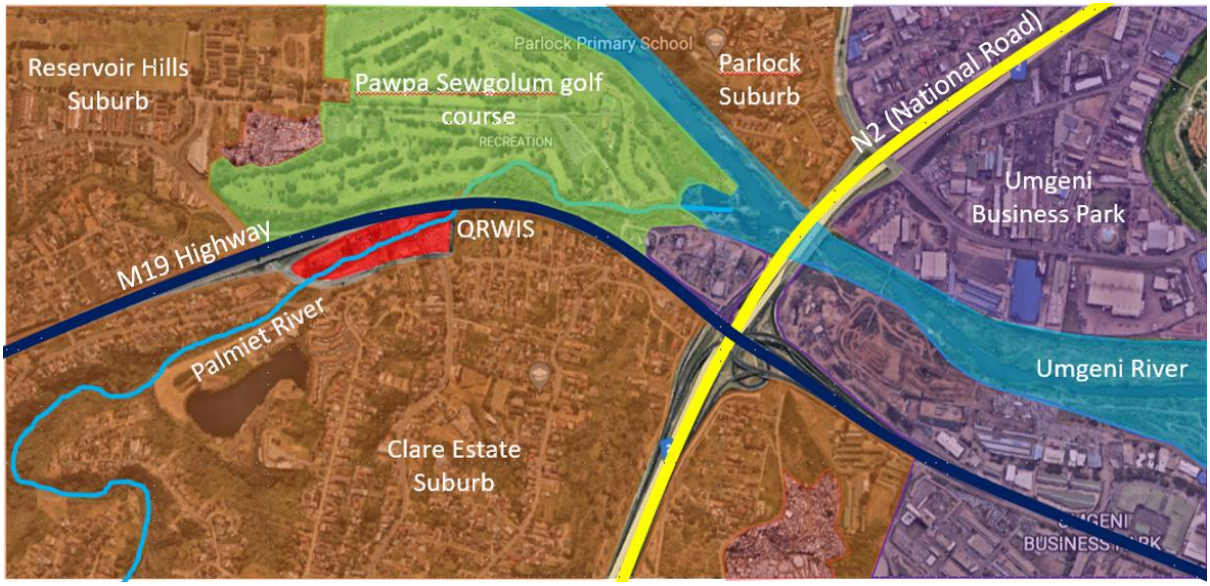


Figure 27 Location of QRWIS in relation to surrounding suburbs and industries (Source: Google earth, accessed 14.01.22)

QRWIS comprises of about 1119 built structures, inhabited by 1169 households (see Table 3), with approximately over 3000 residents (Sutherland et al. 2019). This suggests that some dwelling structures are shared among the different households, estimated to be around 50 shared dwellings for this settlement, with an average of 2.6 people per household.

Table 3. Structures currently in existence on the settlement. Source: iQhaza lethu socio-economic report, 2021

Settlement	Total number of Households	Number of Structures
Parkington	427	324
Havelock	306	296
Palmiet	1200	1135
QRWIS	**1169**	**1119**
Uganda	1695	1130
Dakota Beach	1386	924
eZimbileni	782	664
Total Mapped: 7	Total: 6965	Total: 5592

This illegally occupied site has significant challenges: besides being located on a floodplain, some portions of the land belong to a private owner and the site is also restricted by means of a national road servitude, which runs along the M19 highway. Despite all these challenges, the community still continues to build new dwellings while also rebuilding and improving existing ones. The settlement was previously divided into four sub-sections, named by residents as Mcondo 1 (top left), Mcondo 2 (top right), Mampondweni (bottom left) and Mamsuthu (bottom right) (Figure 28).

Figure 28 An aerial view of QRWIS. Source: Author (Image: Govender, V 2019)

The constant growth of the settlement resulted in the merger of Mcondo 1 and 2 around 2019, which were previously separated by a vacant plot (Figure 28 and Figure 29). The naming of the different sections stems from the expansion of the settlement, which also allows for easy orientation and identification by the community, researchers and municipal workers due to the lack of permanent landmarks or street names.

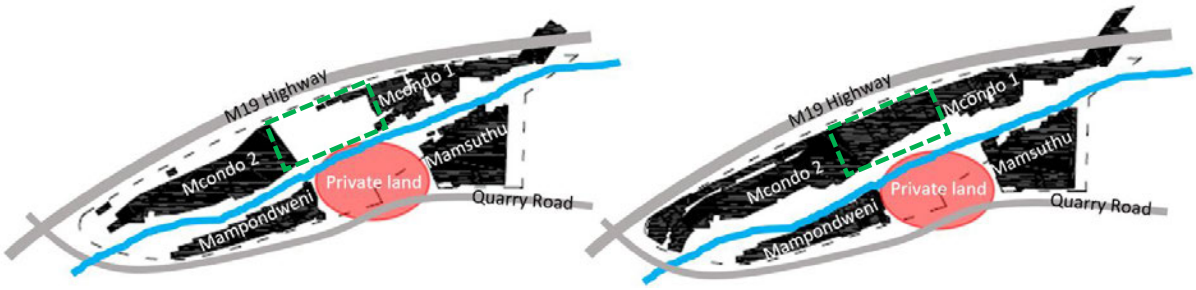


Figure 29 The different sections of QRWIS between 2018-2021. Source: Author

Another section of the site that shows evidence of expansion are the newer dwellings which are situated under the M19 highway as shown in Figure 30. Although the settlement still continues to grow (Figure 30), eThekwini municipality Human Settlements Unit has categorised it as 'deferred location' due to its high risk and hazardous location. This means that the settlement in its' current state needs to be dismantled and residents relocated to a safer site. The narrow 100-year flood line of the Palmiet River makes the settlement prone to flooding which usually occurs after every storm event.

Figure 30 Stretching of the settlement under the M19 highway (Source: Google earth, accessed 14.01.22)

In 2004, the eThekwini Municipality proposed the relocation of the community to Parkgate low cost housing project, which is located approximately 30 kilometres away from the settlement. Some residents relocated to this state subsidized housing, although the majority complained about the move due to the disadvantages that the new location would bring in comparison to QRWIS, which is close to urban opportunities. With the current relocation

resistance, housing backlog and roll-out, it is unlikely that the residents will be relocated any time soon.

5.2 Justification of choice

This case study was selected for analysis as a result of the large amount of data which has been co-produced by researchers in collaboration with the community, eThekwini municipality and various NGOs over a long period of time. The settlement has been part of the 'iQhaza lethu' Partnership Project funded by the European Union. This project engages with communities to participate in the upgrading and improvement of their living conditions, together with basic services delivery in informal settlements (Sim et al. 2019). Another motivating factor for choosing QRWIS as a study area is how the settlement, as an informal entity has managed to exist for decades within a formalised urban context. Instead of slum clearance, as per norm with illegal structures within the city, people now pay more attention to these settlements. Understanding informal settlements and the underlying factors that cause them to exist in such a manner is the reason for this attention, and the body of work exploring ways to assist in their improvement gradually increasing. The improvement of their immediate built environment is a catalyst in enhancing living conditions, thus also improving quality of life. Due to the desktop nature of this study, the researcher uses this data to successfully conduct this study.

Various strategies are being explored by eThekwini municipality in order to determine if in-situ upgrading is possible, given the broad socio-economic benefits the location of the site offers its residents (Sim et al. 2019a). With the focus of this research on the key challenges to the architecture of informal settlements while attempting to define principles of a responsive design framework, the case study has been selected to test whether this aim could be attainable, or offer possible alternatives in the near-future. This is also in line with the municipality's aspiration (eThekwini Municipality 2021), to create new housing forms and urban design solutions which promote densification, social cohesion, and a more sustainable urban form.

5.3 Socio-economic profile of Quarry Road West informal settlement

A foundational document is the socio-economic survey report of 2021, compiled by 'iQhaza lethu' Upgrading Partnership Initiative. The report presents an in-depth survey of the residents including their households.

5.3.1 Demographic profile

The settlement is predominantly occupied by people originating from the Eastern Cape (60%) with 31% from Kwazulu-Natal, 6% outside of South Africa, while only 1% originates from eThekwini municipality. 92% of the community, as illustrated in Figure 31 attributed proximity to job opportunities as the main reason for settling in this community. In a previous study (Williams et al. 2019), residents mentioned that this location also allowed them access to urban resources such as schools, public services, basic infrastructure and medical facilities. These were some of the main reasons which led them to migrate from rural areas to the city (Figure 31).

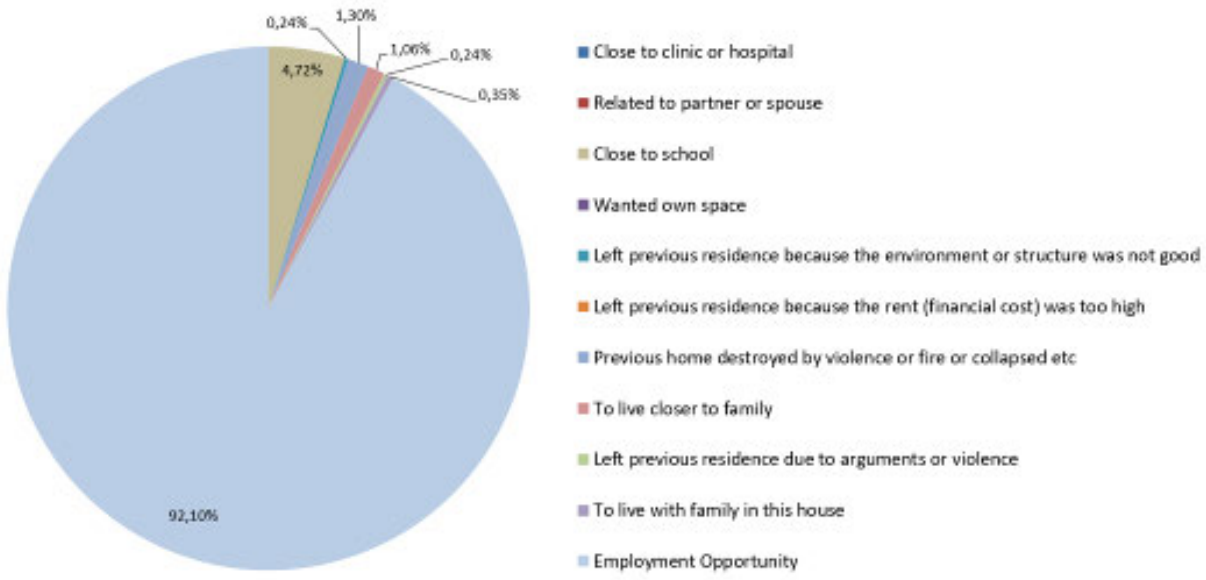


Figure 31 Reasons for living in QRWIS. Source: Author, data extracted from iQhaza lethu socio-economic report 2021.

5.3.2 Access to education

The lack of access to education and low levels of education are a common problem that is associated with informal settlements. A higher level of education is often linked to a higher income, which in turn leads to an improved lifestyle and living conditions. The report showed that 69% of household heads within the settlement do not possess a high school/matric certificate. These levels of education have an influence on the income and employment statistics of the community, which in turn influences the built environment.

5.3.3 Employment/Unemployment status

South Africa has the highest unemployment rate. In the fourth quarter of 2021, unemployment was sitting at 35.3%. This rise in unemployment figures pushed people to travel into the city for economic opportunities and better life prospects. Wages acquired are used to support family members left behind through remittance, aiming to break the cycle of poverty. The most common work that people normally find when moving into the city is general work such as, domestic work, general labour in industries, construction and security work. Other residents work as driver, shop assistants, municipal workers, gardeners and some are self-employed. Figure 32 below shows the employment rate and the different types of employment of people living in QRWIS.

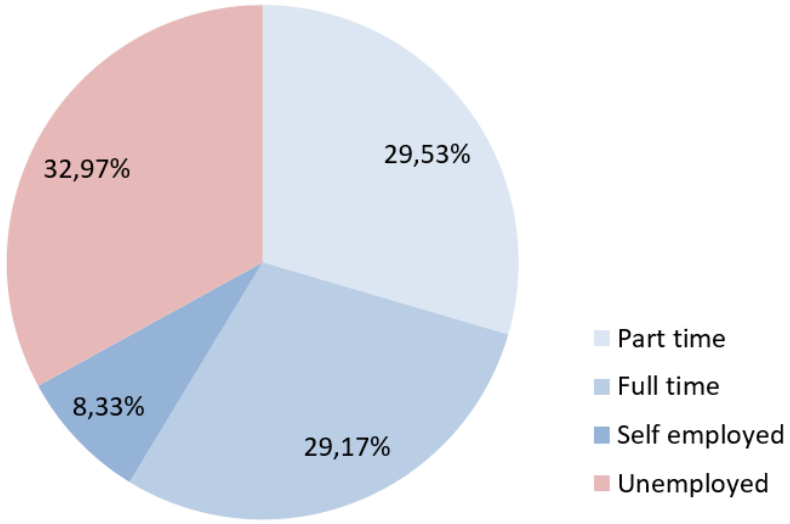


Figure 32 Employment status of QRWIS residents. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

5.3.4 Sources of income

a) Wages and social grants

A significant number of residents in QRWIS survive on wages and social grants as a source of income. The income levels show that 35% of households earn below R1,500, while 20% earns between R1,501-R2,500 (Figure 33). Of the income generated, most goes towards groceries, cash, education and only 6% goes to house improvements.

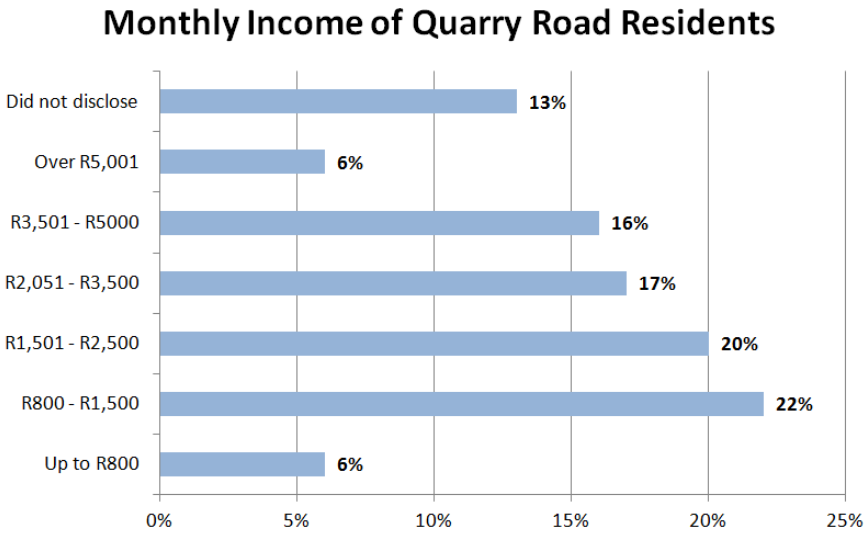


Figure 33. Monthly income of QRWIS residents. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

One of the main reasons for the proliferation of informal settlements is the need for poor people to gain access to employment opportunities in the city. This statement confirms that the community of QRWIS is located there in order to gain access to places of employment as majority of the population is still young and of prime working age. Figure 34 shows the different types of ways in which the community is able to make means.

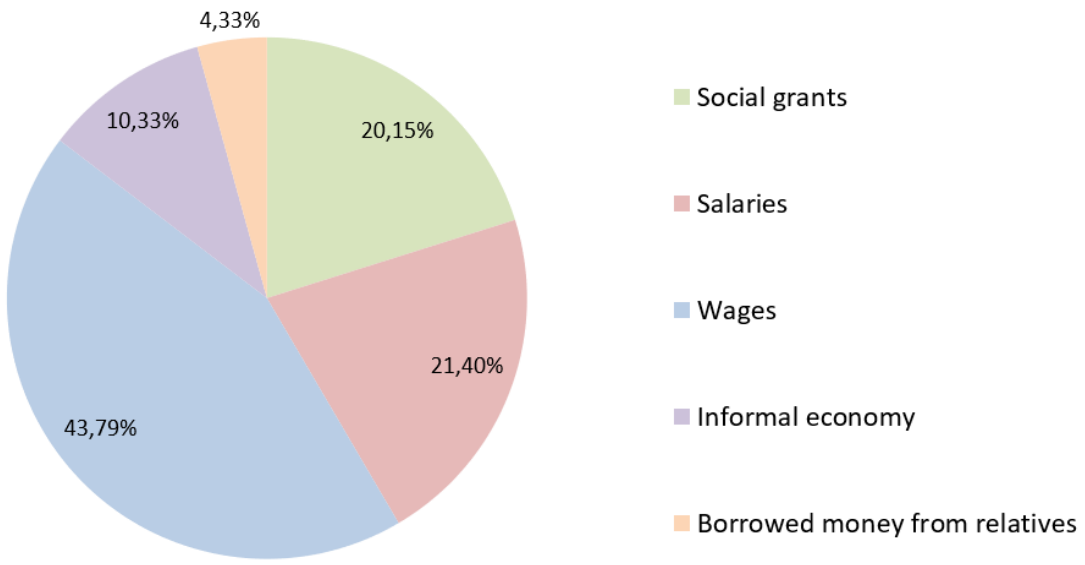


Figure 34 Livelihood status of QRWIS residents. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

b) Rental

Renting is an extended practice of tenure in some informal settlements, predominantly for new migrants to urban areas (UN-Habitat 2018). The study also showed that only 21% of the residents in QRWIS rent out their dwellings at an average of between R201 and R500 per month (Figure 35). These rental rates respond to the economic levels of migrants that otherwise, could not afford to rent any form of formal housing in the market. Therefore, this makes the rented dwelling an asset which generates income for the owner or slumlord who is in charge of the maintenance and upkeep of the dwelling. Some of the owners of the rented dwellings reside within the settlement, while others live elsewhere and only come for money collection.

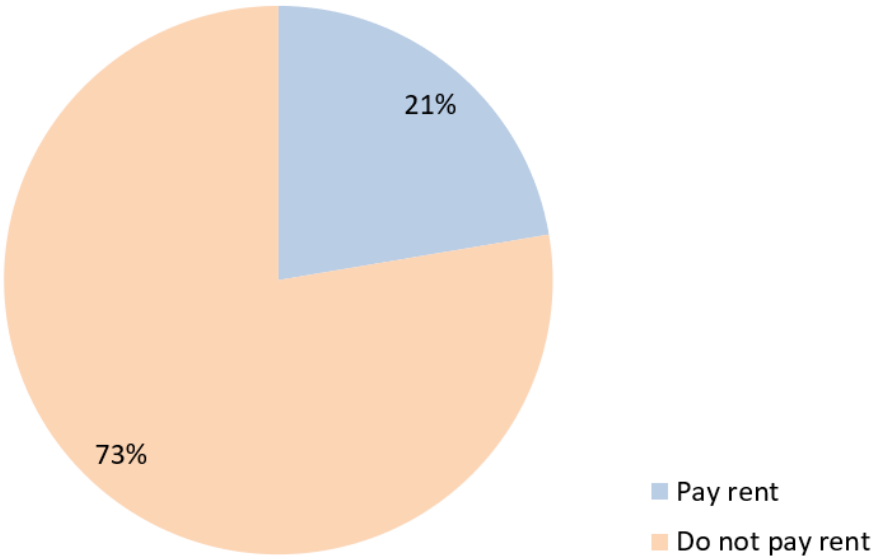


Figure 35 Percentage of households which pay rent in QRWIS. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

c) Informal economy

91% of respondents on the survey indicated that their structure was only used for residential purposes. The remaining 9% use their structure as a 'spaza' shop (27%) which is a little informal convenience store, for religious purposes (8%), a 'shebeen' which is a local drinking house (5%), with the rest unspecified (54%) (See Figure 36).

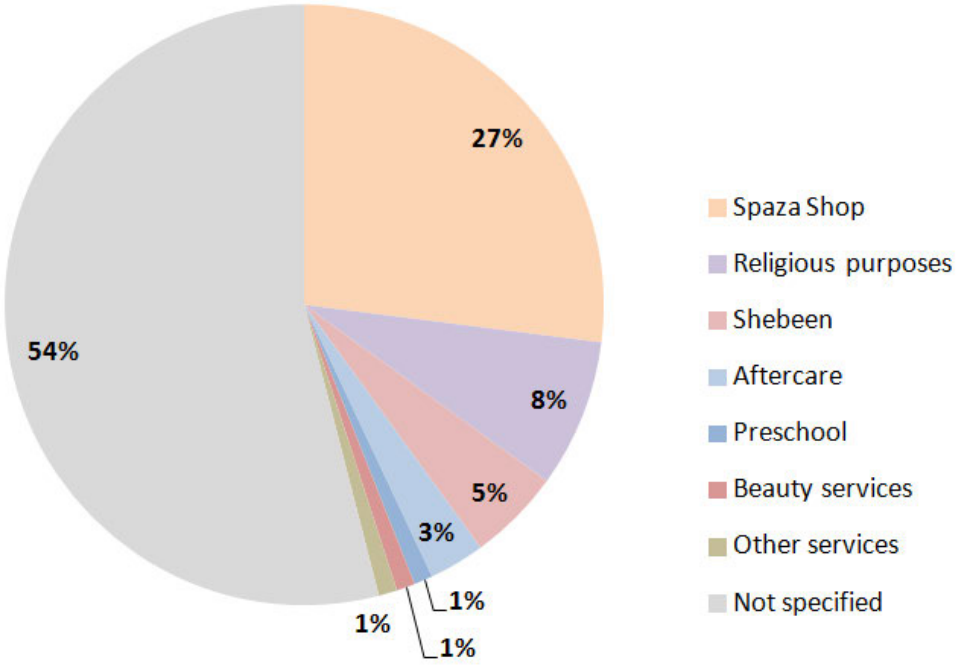


Figure 36. Additional uses of the dwelling in QRWIS. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

5.4 The current built form of Quarry Road West informal settlement

The settlement presents a fairly homogenous built form, however, upon close inspection, one is able to pull apart a few details with regards to the different dwellings on the different sections of the settlement. Mamsuthu section, which is situated on the bottom right of the settlement appears to be the initial area of settlement. This is demonstrated by the building material and techniques utilised, mostly wattle and daub, with corrugated sheeting and timber boards often used to cover damaged areas of the structures (Figure 37). This means that earth is still an abundant building material source, prior to the complete occupation of the settlement (Figure 37).

Figure 37 Earth-type construction method. Source: Blanco-Montero A 2022

Figure 38 Earth-type construction method. Source: Ojo-Aromokudu, J 2018

QRWIS, like most informal settlements, is characterised by poor living conditions. The constant flooding of the river and fire disasters are a major concern and threat to the existing built form. With each devastation that occurs, there is a change and reconfiguration of the buildings. One example in this particular settlement is a portion of Mampondweni (Figure 39 and Figure 40), located on the lower left section of the settlement. A fire broke out in 2016,

destroying the existing dwellings. Thereafter, the municipality replaced them with emergency shelters and provided electricity for each unit, while the rest of the settlement remained illegally connected to the municipal grid. These new buildings are rationally, rather than organically ordered which is not seen in the rest of the settlement.

Figure 39 Emergency housing in Mampondweni.
Source: Govender, V 2019

Figure 40 Legal electrification in Mampondweni.
Source: Blanco-Montero, A 2022

Mcondo 1 and 2, which make up the top section of the settlement, present a more contemporary and modern-day informal settlement. This is echoed by the double storey structures, not very common in informal dwelling construction in the past (Figure 41 and Figure 42). The configuration of the facades also expresses contemporary aesthetics, reinforced by the finishes used. The sheer density and growth of the settlement has prompted people to build vertically. This is done though the extension of the existing structure by adding a timber platform in order to create a floor for the additional rooms above.

The construction methods of dwellings reflect the temporary nature of the dwellings at the time of their initial construction. However, people have lived in this type of building for years and therefore, thus debunking the temporariness. The variation in material usage demonstrates how the people have managed to create their dwellings out of the very minimal resources that they could acquire. To support a sense of permanence, the municipality has also provided the residents with communal ablution blocks for washing, toilets and laundry purposes.

Figure 41 One of the double-storey dwellings within the settlement. Source: Blanco-Montero, A 2022

Figure 42 Staircase installed to enter upper floor of the dwelling. Source: Blanco-Montero, A 2022

Residents with dwellings located on the banks of the river have also found innovative ways to avert, in some way, flooding of their homes during floods. This has been achieved by raising the floors off the ground on timber platforms. Others have installed old tires and sandbags on the river banks to prevent them from eroding during flooding and heavy rains (Figure 43 and Figure 44).

Figure 43 Dwelling raised on platform as a water prevention measure. Source: Blanco-Montero, A 2022

Figure 44 Sandbags on the river bank used as a retaining wall. Source: Blanco-Montero, A 2022

The hazardous living conditions through lack of basic services, exacerbates the severe socio-economic stress of the dwellers as well as the environmental pollution, especially with the polluting of the Palmiet River, which cuts across the settlement.

Frequent flooding and fires have thus become dominant determinants of the physical change in the urban form, destroying sections of the settlement only to see them re-emerge in a different form as noted previously. Some dwellings situated closer to the river undergo a permanent process of constant change in response to flooding, resulting in a municipality constructed emergency housing, loosely referred to as 'transit camps.' Dwellings that are much closer to the flood plain are normally placed on higher timber platforms in order to prevent them from flooding.

5.5 Typical building techniques of the informal dwelling

Building techniques and resources identified in QRWIS are characterised by heterogeneous solutions, with the use of multiple materials that are, in general terms, lightweight, fast to erect and easy to work with. Furthermore, these solutions do not require of high levels of skill. The different parts of the settlement present various building techniques as presented in the previous section.

While modest in nature, symbols of dignity and pride are reflected in the way the residents choose to embellish their dwellings and the spaces which surround it. This is done through the creation of different finish patterns on the walls and also the introduction of different elements to the front of the house, ranging from a small garden to creating a mini entrance porch. There different elements are employed not only for beautification of the dwelling but also to express individuality and demonstrate a level of prosperity. However, the southern portion of the site exhibits a very sterile and train-like layout of the dwellings. These structures were provided by the municipality as emergency shelters, in response to a fire outbreak that occurred in 2016. There are no visible dwelling additions or aesthetic improvements on the facades.

5.5.1 Building materials

Despite the Vanden appearance of the construction methods and materials for the dwellings, some trends can be identified. Corrugated iron sheeting is the predominant material and appears as the preferred cladding and roofing material. This is presented in many different shapes, sections and colours. Timber is used for structural purposes as well as roofing and cladding. Different types of plastic sheets and membranes are used for waterproofing. Finally, concrete in the form of slabs and blocks, used for flooring, footing and walls.

a) Concrete

One of the major challenges of building in this settlement is the constant flooding of Palmiet River which often results in obliteration of most dwellings closer to the river, while causing major structural damage to others. In order to avoid water entering the buildings during a flood, the residents responded by raising their dwelling from the ground through the use of concrete pillars and timber poles, in some instances (Figure 45). Concrete beds are chosen by some dwellers as an improvement of compacted earth for flooring. These slabs are seldom reinforced and usually crack due to small differential settlements in the soil, allowing for the infiltration of water and humidity.

Figure 45. Flooring support by concrete bed present in QRWIS. Source: Author

A few dwellings in the settlement are built out of blockwork. These are usually owned by people who have a higher economic capacity as compared with others in the community. Dwellings of this nature are somehow protected from fire threats which are a common occurrence in informal settlements. This is a result of the fire resistance capacity of blockwork.

b) Timber

Timber is used primarily for structural framing and cladding (Figure 46). Currently, the timber-clad dwellings are of inferior quality as the residents use random timber boards, either to clad or cover damaged areas. Although a better insulation, timber is highly combustible which poses a risk within the settlement during a fire.

Figure 46. Typical timber frame structure in QRWIS. Source: Author

Figure 47. Plywood cladding in QRWIS. Source: Author

Plywood panels are also used as cladding material instead of corrugated sheeting (Figure 47). These panels are placed as an assemblage, with the result of a collage-like façade.

Workability and fast erection are the main reasons using timber frames. However, timber cladding is not as durable and waterproof as metal sheets, and those clad in timber are typically covered by a plastic membrane as an exterior layer.

c) Corrugated iron sheeting

It is the most visibly dominant material within the settlement due to its workability, durability and fast erection. It is used for wall cladding and roofing, nailed onto a timber frame structure, and usually fixed without any additional finish as demonstrated in Figure 48. Most of the iron clad structures are in a better condition compared to those clad in timber, cardboard and plastic. The material does not possess any acoustic insulation properties, which results in elevated noise levels and other disturbances emanating from outside the dwelling. Indoor comfort is furthermore challenged by the inadequate thermal performance of the material, resulting in extremely hot indoor temperatures over summer, but can also be uncomfortably cold in winter. Despite the weak performance of the corrugated sheeting as a building material, it still remains a preference amongst residents. This is due to ease and speed of construction and rapid assembly and disassembly in case of eviction. Corrugated iron sheets tend to be sourced from different places. Some are salvaged from construction sites as left-over scrap, while others are bought from the surrounding hardware stores.

Figure 48. Corrugated iron sheet cladding in QRWIS. Source: Author

d) Plastic

PVC vinyl sheeting and tiles are found as flooring solutions for most of the dwellings (Figure 49). Despite workability and durability, these materials offer little insulation capacity. These are also highly combustible which increases the risk of spread of fire.

Figure 49. Concrete screed laid on hardened earth, finished with a PVC and/or vinyl flooring in QRWIS. Source: Author

Air tightness and waterproofing are challenging to achieve with the building techniques used in the construction of the informal dwellings. PVC tarpaulin sheets are often installed as roof coverings in order to serve two purposes: one, to cover partially damaged roof structures to avoid leaks during rainy days; and two, to reflect heat, which therefore reduces temperature and cools down the internal dwelling space. In some instance, the sheet is extended to the walls where it also covers damaged areas (Figure 50)

Figure 50. PVC membrane as additional waterproofing and air tightening solution in QRWIS. Source: Author

e) Earth-based material and technology

Some dwellings have been constructed using the wattle and daub technology (Figure 38). This system comprises of lightweight timber frames erected without foundations. The thicker corner posts are inserted deeper into the ground in order to offer sturdy structural support. They also work as support structure for the smaller horizontal timber wattle packed with a mix of earth and fibres. Earthen walls provide better thermal and acoustic insulation compared to corrugated sheeting. However, only a small number of dwellings within the settlement possess this construction method.

Although this construction method has all the positive material performance, it is very difficult to maintain. Moreover, this method is difficulty in sourcing earth to repair the dwelling and construction takes too long. It represents a permanent structure, unlike the metal sheeting that can be dissembled and put in place somewhere else if required. There is an additional drawback to this typology: as it is a material that is associated with poverty and rurality in which self-building with earth was a common technique and is considered old-fashioned. For all these reasons, residents prefer to use corrugated sheeting.

f) Used car tyres

The use of old car tyres is characteristic of informal dwellings. They help the roof to withstand wind loads, by adding mass to the lightweight structure of the roof (Figure 51). The residents

of QRWIS also found the tyres useful as a type of a retaining wall and in the in the stabilisation of the river bank and protection of soil erosion. However, this has proved to be ineffective to strong currents and flooding, and the result is that they washed out weakening the supporting structure.

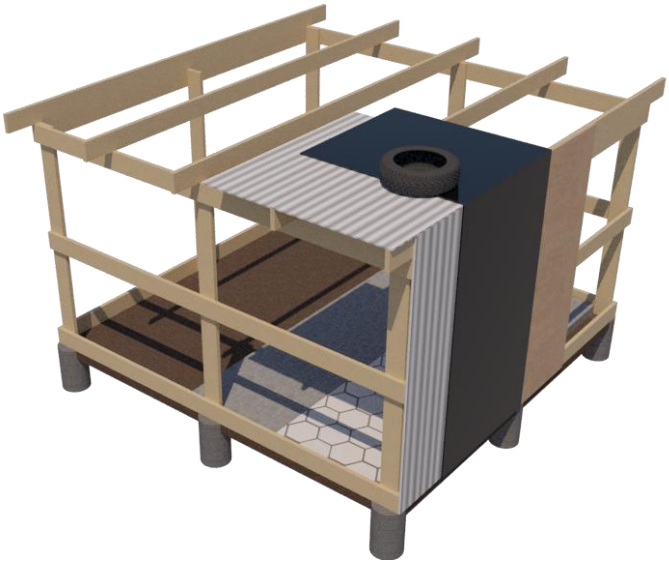


Figure 51. Use of tyres as structural element against wind loads in QRWIS. Source: Author

5.5.2 Construction technology and processes

The construction of the dwellings is usually carried out by the owner and in most instances, with assistance from paid help who possess building knowledge. The structural erection process is usually done using hand-held tools and machinery. Weight wise, no aid of cranes or mechanical tools is accessible.

Shallow foundations are also reflective of these handmade processes. When present (under the supporting poles in the best-case scenario) they are shallow and are only a few centimetres below the surface. It is only along the river banks in which some of the dwellings are suspended much higher from the ground using timber poles. This being used to avoid flooding.

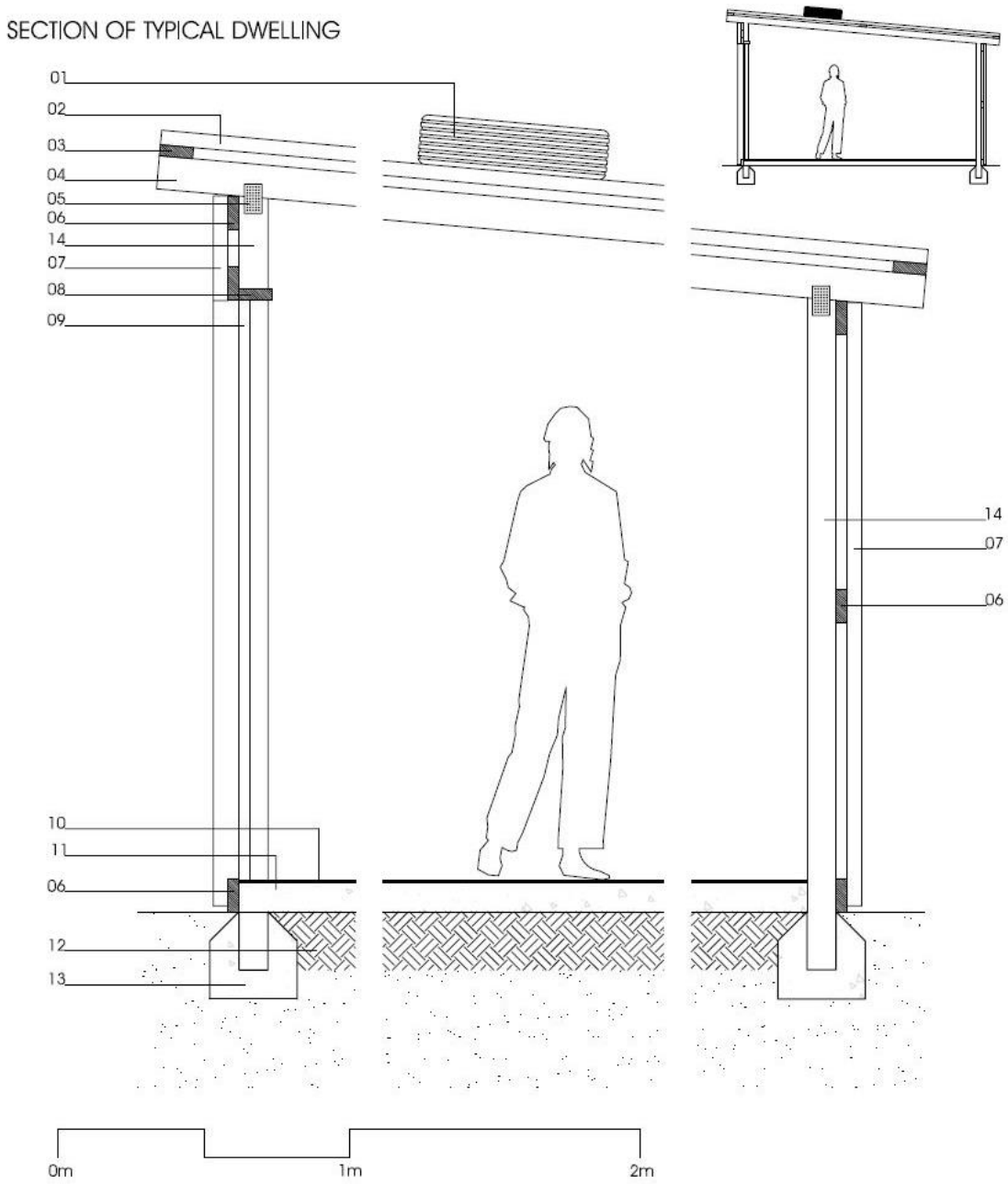
The settlement undergoes continuous transformations, both due to reconstruction after a disaster, improvements and expansion. New constructions are developed either as re-

constructions after fire outbreaks or eviction or as incremental extensions. Currently, buildings are growing vertically due to the lack of available space.

Construction accuracy is hard to achieve and the installation of materials lack adequate processes. Despite most materials being used for their intended purposes, the solution for construction components are typically incomplete, missing ancillary elements such as mounts, gaskets, washers, and the like lead to insufficient performance and quick decay. For instance, external walls lack a supporting layer of blockwork or adequate studs, resulting in poor stability, weak insulation and fire protection and leaks. The joints between components, particularly roof-external walls and floor-external walls, lack sealing capacity, allowing for water and air leaks as well as the infiltration of dust, rodents and insects.

With the use of timber and corrugated sheeting, the construction time is reduced considerably in comparison to wattle and daub or brickwork. The immediate liveability of the dwelling has priority over other considerations. The estimated time for the wattle and daub varies from one to two days whereas brickwork can take over a week to finalise the structure. This urgency compromises the performance and stability of the dwelling and forces constant maintenance.

A typical dwelling is detailed in Figure 52. The use of a formal architectural draughting style in the drawing helps to evidence the missing elements that should be included, due to either good practices or building standards requirements: weak structural elements are under-dimensioned, and lack of key components such as reinforcement in the concrete foundation, or adequate tie structural members; absence of thermal and acoustic performance based on the composition of the envelope; inexistent windows in most of the dwellings in the settlement that affect air quality and lighting; absence of performance improvement components such as underlayment, expansion and sealing joints, waterproofing and vapour barriers; and soil drainage.

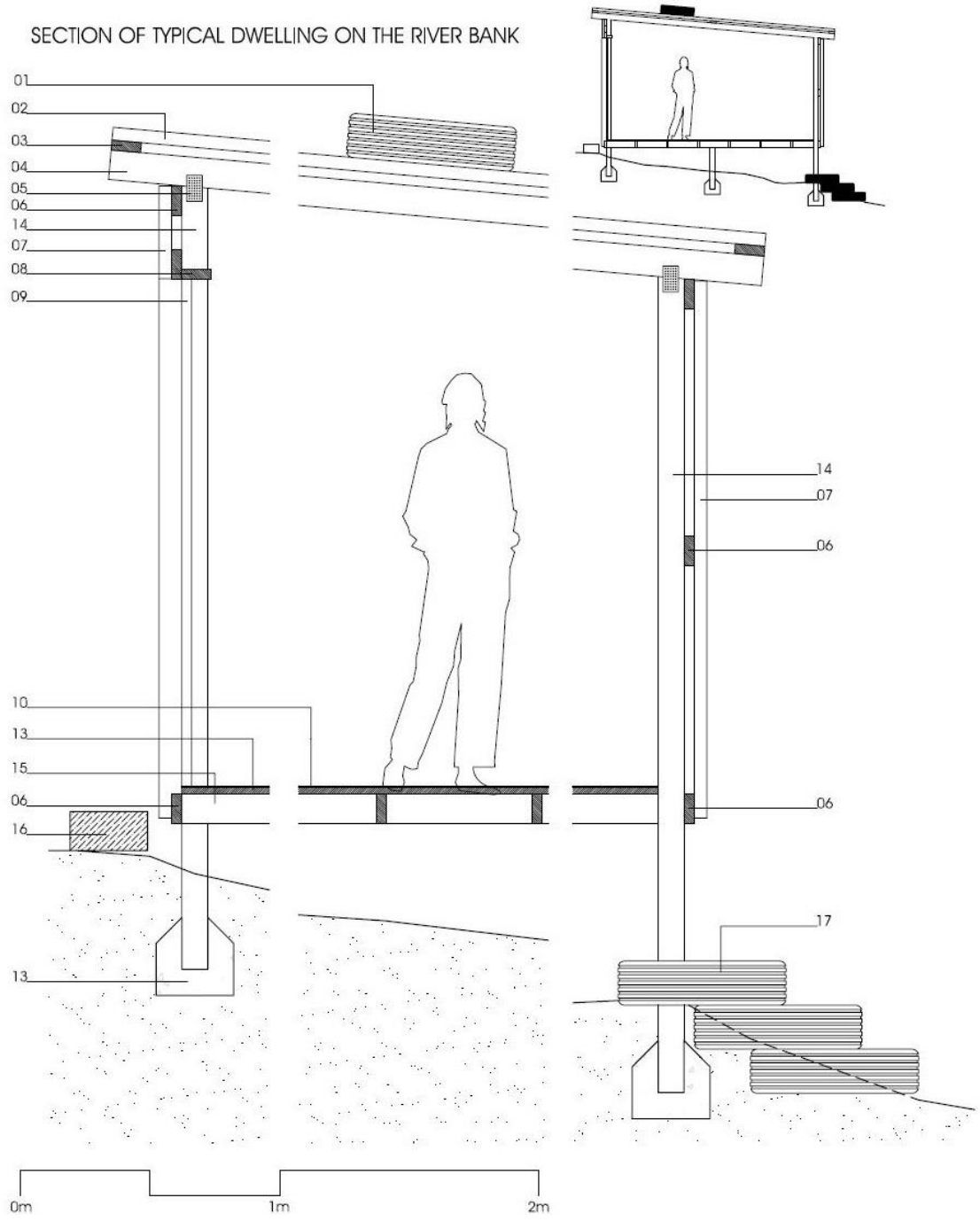


01- Used tyre for withstanding wind loads; 02 - Corrugated iron sheeting roof; 03 - 114x38mm timber rafter; 04 - 114x38mm timber purlin; 05 – Gang-nail; 06 - 114x38mm timber frame; 07 - Corrugated iron cladding; 08 - 114x38mm timber lintel; 09 - Entrance door; 10 - PVC-sheet flooring; 11- 50 mm to 100 mm mass concrete bed (best case scenario); 12 - Compacted existing soil; 13 - Mass concrete foundation pad; 14 - 114x38mm timber frame

Figure 52. Detailed section of a typical dwelling at QRWIS. Source: Author

Dwellings by the river bank show a particular configuration of which reinforce the supporting structure so as to withstand floods and rain (Figure 53). In this case, the floor of the dwelling

is detached from the ground, and used tyres are placed near the footing of the poles closer to the river bank as a barrier against the current of flood water.



01 - Used tyre for withstanding wind loads; 02 - Corrugated iron sheeting roof; 03 - 114x38mm timber rafter; 04 - 114x38mm timber purlin; 05 – Gang-nail; 06 - 114x38mm timber frame; 07 - Corrugated iron cladding; 08 - 114x38mm timber lintel; 09 - Entrance door; 10 - PVC-sheet flooring; 11 - 50 mm to 100 mm mass concrete bed (best case scenario); 12 - Compacted existing soil; 13 - Mass concrete foundation pad; 14 - 114x38mm timber frame; 15 - Suspended timber flooring; 16 - Stepping stone for access; 17 - Used tyre pile for retaining wall; 18 - Timber floor board on suspended poles

Figure 53. Detailed section of a typical dwelling on the river bank. Source: Author

5.6 Socio-spatial analysis of Quarry Road West informal settlement

The analysis of social interaction in QRWIS is important to understand how residents construct meaning from the social perspective, how the built environment influences their social life and how this social interaction, based on the interplay of cultural, political, economic, and social forces, articulates the built environment.

5.6.1 Spatial relations of pathway networks

The settlement is very dense, with very narrow but walkable opens spaces between the dwellings. It fits into Norberg Schulz's definition of 'cluster by elements' buildings which are organized by means of simple proximity, without possessing any kind of geometrical order or symmetry (Norberg-Schulz 1971).

There is a visible hierarchy of the walkable spaces within the settlement, highly dependent on the width of the pathway. There are more trading dwellings and spaces in all major and wider pathways which experience high volumes of foot traffic. These pathways are used by residents as public connections between dwellings and other residents. However, due to limited public space within the settlement, especially for economy generating purposes, residents now use Quarry Road, running along the south side, for such activities. Inner narrow spaces are therefore primarily used for socializing and relaxing. The multi-layered use of these pathways shows the importance of these spaces, not only as movement and connection, but also as places for social interaction and urban life (Figure 54).

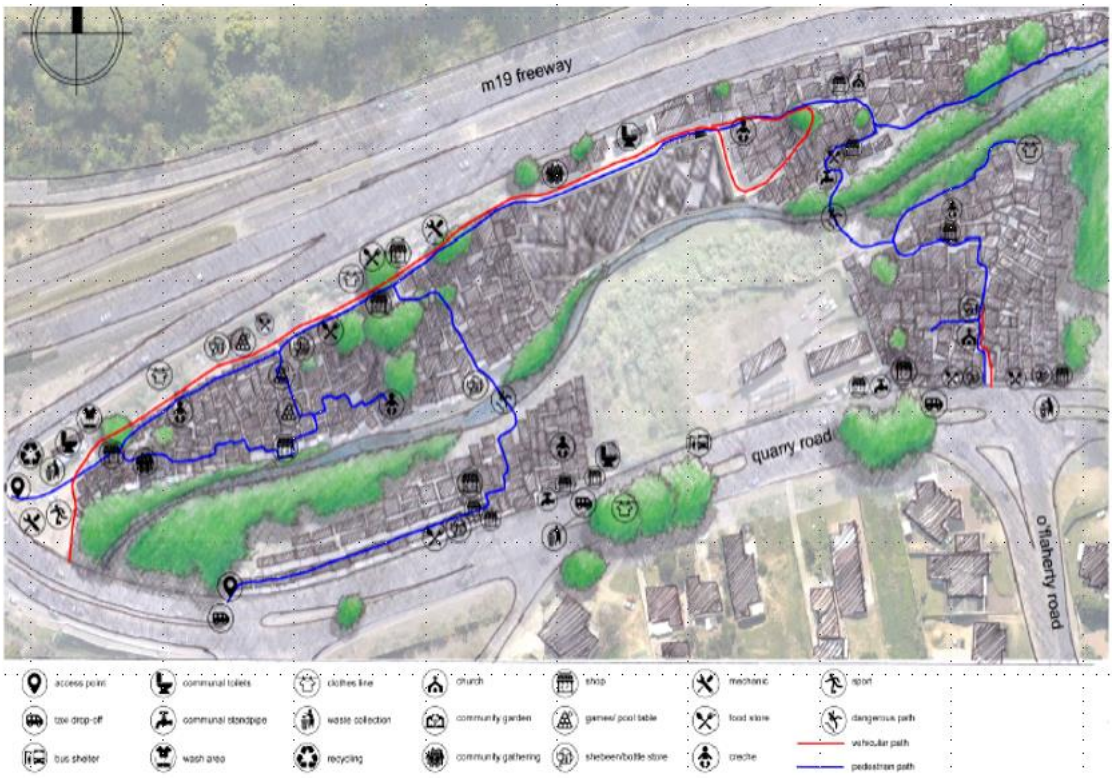


Figure 54 Map showing pathways (pedestrian and vehicular) and activities occurring within the settlement.

Source: Shaikjee, A 2018

Notwithstanding the multiple opportunities that these paths might provide for the residents, there is still the underlying issue of safety. The irregular, narrow width of these pathways pose a recurring experiences in cases of fire or flooding. As a result of these disasters, the settlement goes through constant physical changes as the residents have to rebuild.

5.6.2 Open public spaces

The different public spaces around the settlement also play different and multi-functional roles: they act as a space for parking vehicles, car workshop or panel-beating, a church in a form of a pitched tent, to mention a few. Due to the minimal internal spaces of the homes that lacks climate control, public space plays a very important role. Residents seek shelter from the sun by extending the roof sheet of their dwellings in order to create a longer overhang, which they use for shading. Although this provides immediate shelter from the heat, the lack of vegetation and trees to shade which may improve the environmental conditions of open spaces in hot weather is, could be a route that residents could investigate.

The residents create their own meaning and function for the different spaces within the settlement, as opposed to the organised and imposed ones in formalised suburbs and neighbourhoods. Due to lack of recreational public spaces within the settlement, children make use of the open pathways and spaces between the dwellings as one big play area.

The use of open spaces for economic opportunities evidences how the community uses rent-free areas around the dwellings to engage in informal economic activities that generate income. The social and economic use of open spaces in QRWIS strengthens the idea of open spaces as a driver for prosperity, beyond the mere functionality as channels for movement (Okyere et al. 2017).

5.6.3 Social function of dwellings and developmental priorities

As mentioned in section 5.3.4, some structures are not only residential. In most cases, these are businesses such as shops or service providers. There is an evident lack of open-air area dedicated to the public, and useful spaces such as playgrounds and waste dump sites, do not cover their immediate needs.

Table 4. Public facilities in QRWIS. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

Type of facility	**Quantity**	**Description**
Child-care facilities	2	All Child-minding facilities, there is no land in the settlement for dedicated ECD facility.
Spaza shops	8	There is one 1 saloon and 3 barbershops. This shows there is a strong business interest and energy in the community, people creating their livelihood strategies.
Church/s	2	One of the churches was washed away during the big floods and hasn't been rebuilt yet, due to loss of land near the river.
Parks/ Playgrounds	1	There are no dedicated playgrounds inside the settlement. Children play pathways in the community. There is one playground outside the settlement, but this is only used by children from Mamsuthu area. There is a need to invest in public space in the community so that the children have a dedicated space that they can use instead of hanging out at the shebeen especially during school holidays.

Waste Dump sites	16	Big challenge waste management. The community only gets 300 black bags for waste collection at house hold level a week. These are not enough in numbers further, there are no dedicated organized dump sites either.

The aforementioned lack of services has a correlation with the aspirations for development within the community. The survey study conducted by 'iQhaza lethu' highlights the development wishes of the residents, prioritising the provision of toilets and the improvement of their houses.

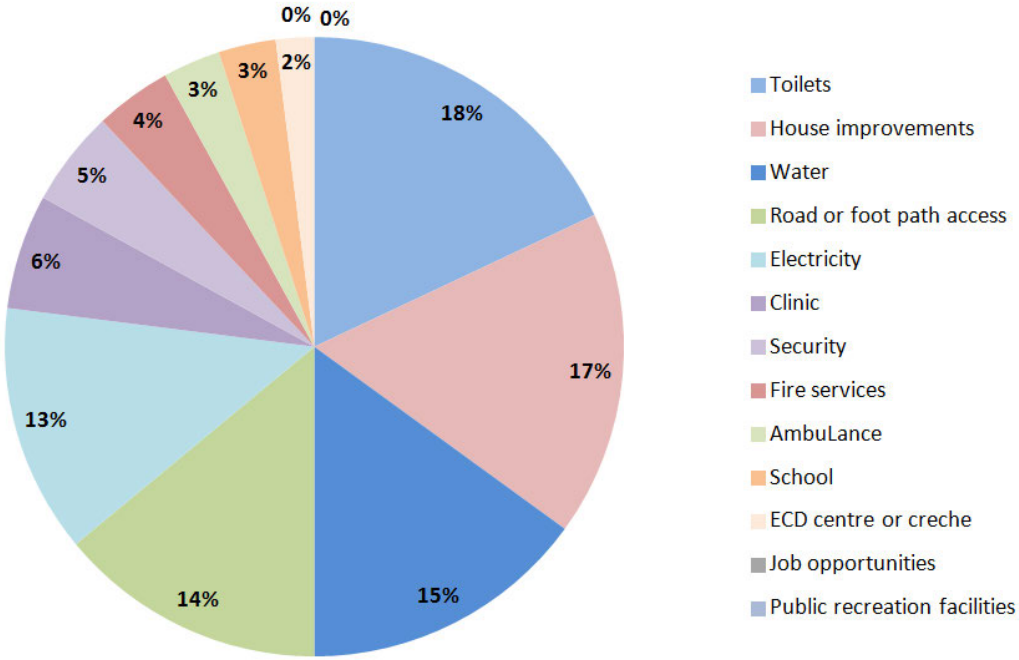


Figure 55. Developmental priorities as communicated by the informal settlement dwellers. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

5.6.4 Social interaction of the residents

A deeper understanding of the complexity of the lives of informal dwellers is crucial in order to compile the best method required to solve their housing needs. Sutherland et al. (2019) describe the residents as a cohesive community. This may be attributed to shared cultural ties and identity emanating from the place of origin. Most of the residents come from the rural areas of KwaZulu Natal and the Eastern Cape, and have strong ties with their rural homes

(Williams et al. 2019). Due to poor living conditions, people are somehow 'forced' to form relationships in order to enable interactive communal support. The close proximity of the dwellings also forces neighbours to interact continuously. The self-organization of informal settlements reflects the significant problem-solving capacity and innovative skills of a collection of individuals who have been forced to rely on themselves.

The community is well organised, has well established political structures and its area-committee meets regularly to discuss community matters (Sim et al. 2019). New social relations are also formed and strengthened in certain spaces within the settlement, such as drinking houses, games rooms, water taps and washing areas at which a large number of people congregate. This sense of community has encouraged the residents to take care of their settlement and also to take over the upkeep of public services where the municipality have failed them.

The sense of community, at times is threatened by criminal activities within the settlement. The survey indicates that, after crime and violence as greatest threats, roof leaks and shocks by exposed electrical wires, the latter two built environment and construction related, were also some of their greatest concerns (Figure 56).

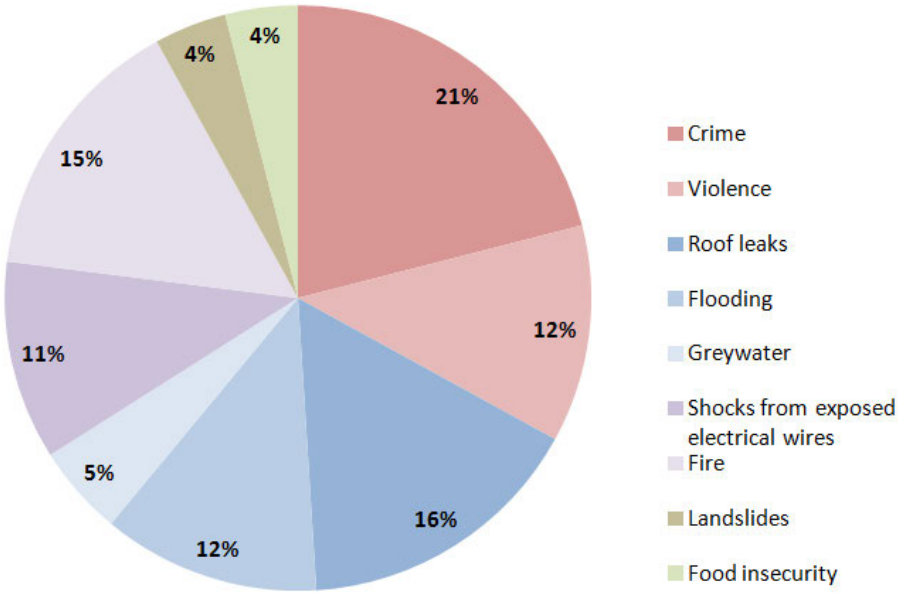


Figure 56. Top threats and vulnerabilities perceived by residents in the QRWIS. Source: Author, data extracted from iQhaza lethu socio-economic report 2021

5.7 Conclusion on the case study

Though informal settlements are often viewed as an aesthetic eyesore, they are also viewed as a personal accomplishment by others, especially the residents who have personally constructed their dwellings despite their low wages. QRWIS provides more than just housing to its residents; it is maturing (in planning terms) into a mixed-use settlement that serves a range of needs beyond shelter and basic services (Sim et al. 2019).

In the study conducted by Sim et al (2019), the residents praised QRWIS for its good location in the core of the city: its proximity to employment and many other social services such as school and clinics. The ability to walk to work in piece jobs around the neighbourhood without having to spend a lot of money on commuting was also appreciated by the residents. The informal settlement is therefore a spontaneous manifestation of what Le Corbusier (1933) envisioned. The epicentre of urban life is available for all inhabitants of the city and no longer subjected to the elite. However, instead of the equability of the population, what informal settlements reflect is a greater social and rampant inequality.

The informal nature of this self-built settlement has allowed for a mixed-use environment to develop, providing opportunities for residents to generate income, while also providing a range of services in close proximity to the community (Sim et al. 2019). The low income also means that most residents cannot achieve the desirable, durable state of the dwelling but low quality and temporary-looking dwelling character.

6. RESULTS AND DISCUSSION

This chapter presents all the data collected on the QRWIS case study and thereafter, analyses and discusses the findings. The data was collected through literature review, semi-structured interviews with key informants, maps and photographs. The interview with key informants were divided into five themes: (1) Socio-economic realities which influence urban informality, (2) socio-economic constraints influencing the built form of informal settlements, (3) key factors that influence the technological and material expression of informal dwellings, (4) key architectural challenges facing the informal dwelling and, (5) key impediments which affect the architecture of informal dwellings in informal settlements. Key informants were selected due to their knowledge of the site and their own research experience.

6.1 Evolution of Quarry Road West Informal Settlement in the last two decades

This section analyses the evolution and growth of QRWIS from 2001 until 2021. Figure 57shows the footprint of the built form in the settlement with data sourced from the Google Earth historic satellite imagery. The footprint perimeter has been traced with a Computer Aided Design software (CAD) and the area calculated per annum. This data has been quantified to produce the growth charts which will be measured against the city's socio-economic variables, whether they have any impact on the size of the footprint of the settlement.

Most structures are single-storey which means that footprint can be correlated to bulk area within an acceptable tolerance. The boundary of the settlement is defined by the M19 Highway and Quarry Road. Initially, the informal dwellings were organized in three main sections: two predominant sections, Mamsuthu and Mampondweni, adjacent to Quarry Road separated by a fenced petrol station positioned centred in the south side, and a small section, Mcondo 1 and 2 to the north across the Palmiet River, adjacent to the highway. This has evolved over the years to consolidate a coherent north urban space, leaving the two groups in the south separated by privately owned land, now primarily occupied by informal panel beaters (Figure 29).

In the course of twenty years, three significant events are evident. The area occupied by informal dwellings has decreased one fifth between 2003 and 2004 and remained stable for the next three years. Then, it started to grow slowly but steadily until 2014, when a significant increase doubled the growth of the precedent year. From 2014 to 2019, the size of the settlement remains almost constant, with minor growth in 2018 and 2019. In 2020, coincident with the outbreak of the COVID-19 pandemic, the settlement experiences another significant 20% in growth. By the end of 2021, the total growth of the footprint of the built form amounts 31,436 m², an increase of 235.65% from the 9,374 m² in 2001 (See annexure 5).

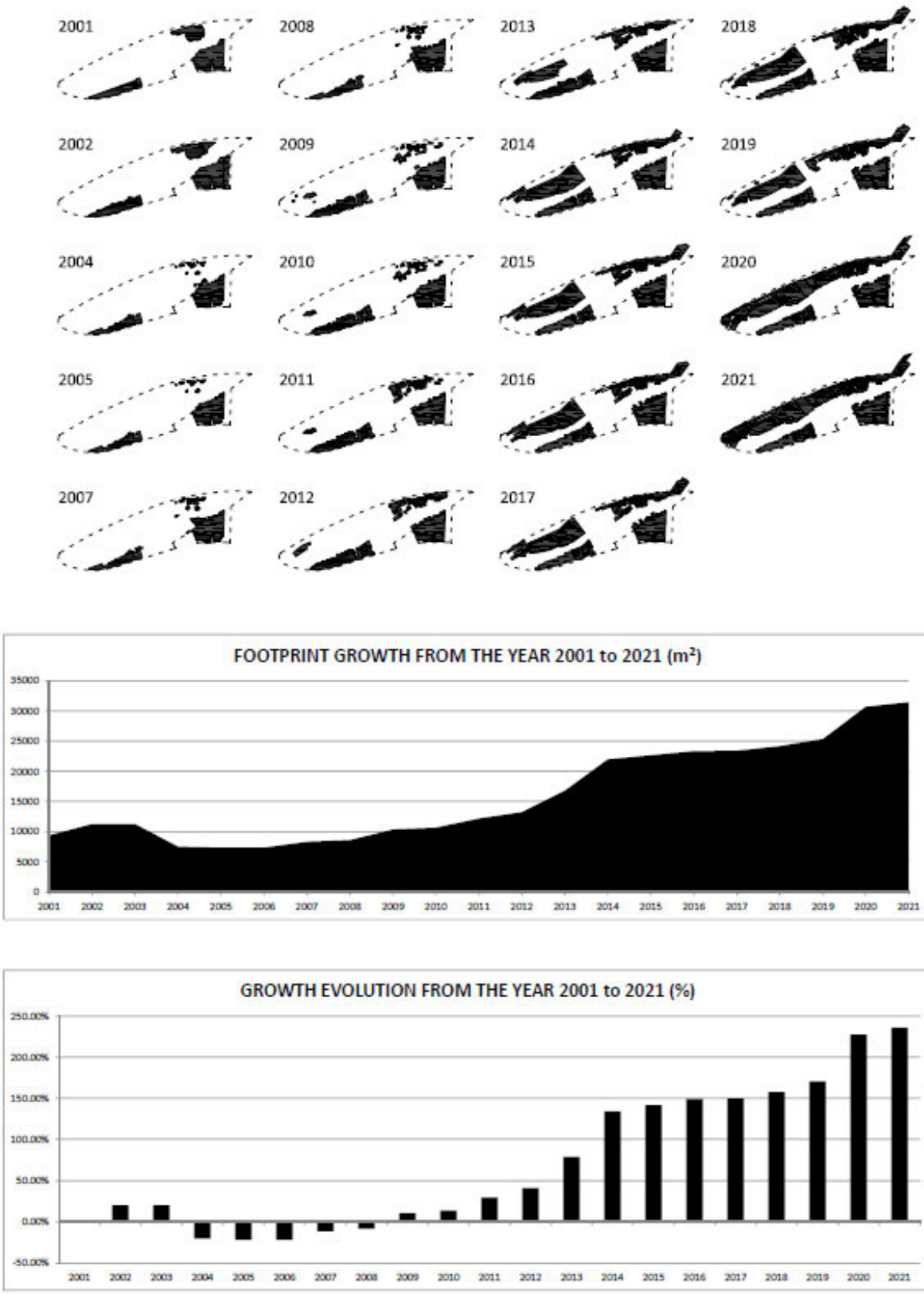


Figure 57. Evolution of QRWIS footprint growth since 2001. Source: Author

Some planned interventions have taken place in the settlement in these two decades. Some examples of these include the introduction of the CABs system for better sanitation for the residents and also the electrification of the different parts of the settlement. A fire devastated Mampondweni, south-eastern part of the settlement in 2016, with a consequent decrease in footprint area.

The growth dynamics presented in this section is compared to the economic performance of eThekwini in the two decades, between 2001 and 2021 in section 6.2, in order to find if economic factors are the motivation of the migration and settling in the QRWIS as a pulling parameter, or on the contrary, pushing parameters may be behind leaving the rural areas and moving to the city.

6.2 Potential correlation between the evolution of QRWIS and indicators of economic performance in eThekwini Municipality since 2001

Two basic indicators of economic performance of the eThekwini Municipality were considered are the Gross Domestic Product (GDP) and unemployment rate from 2001 to 2021. Overlapping these with the data related to the growth of the settlement is a useful tool in establishing synergistic response.

Figure 58 shows a clear correlation between the growth of both, the footprint area and the GDP of eThekwini for two decades. A lack of housing delivery may indicate that despite the economic growth, eThekwini Municipality has other priorities. Other reasons might be mismanagement, lack of planning and corruption, which perpetuate the status quo and the invisibility of the poor.

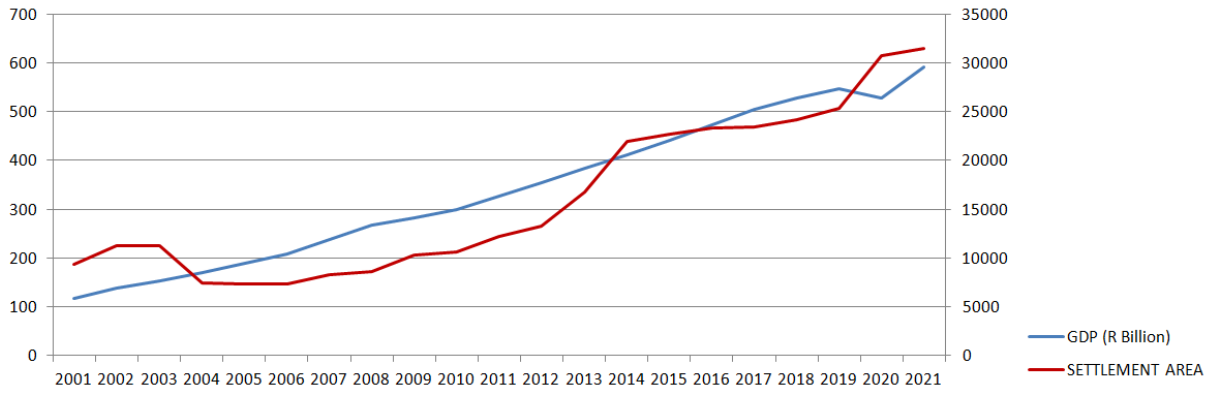


Figure 58. Evolution of QRWIS footprint growth and GDP trend of eThekwini Municipality since 2001. Source: Author

Despite economic growth, unemployment figures remain constant, with an average of 365,000 unemployed people in the city between 2001 to 2014. Significantly the biggest growth event of the settlement is followed by an increase of unemployment in eThekwini in 2021 (Figure 59) as a result of COVID. A similar methodology may be applied in other informal settlements in the urban metro in order to determine if these waves of migration had a broader impact on the economic performance rates of eThekwini, and most importantly, if these migration trends represent an opportunistic gamble for newcomers to the city.

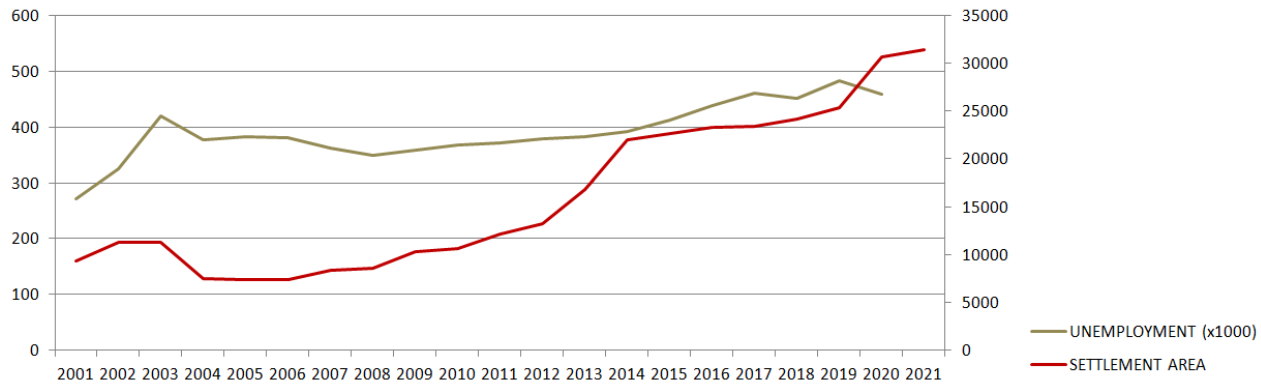


Figure 59. Evolution of QRWIS footprint growth and unemployment trend of eThekwini Municipality since 2001. Source: Author

6.3 Interview outcomes with key informants

Numerous organisations, scholars and suppliers work with the QRWIS community. The aim of the interviews with key informants was to fill in the gaps missed in the literature review. These gaps included information pertaining construction processes and the economic implications relating to it. Part of this research included some aspects which look into the lived experience in the study area, questions which were answered by a community leader living in the settlement. The semi-structured questions were split into different themes, listed in the introduction of this chapter. The interviews were comprised of four key informants, contributing in the different aspects of the research.

Interview with Key informant 1

A researcher working for a non-profit organisation conducting research on various informal settlements in eThekwini Municipality. The informant also provided a socio-economic report which has been cited in this study. The responses given by the key informant were able to fill the gaps which are naturally present in desktop research, and also to give insight on the socio-economic aspect of the research, an area which the researcher for this study is unfamiliar with.

a) **How do you think that poverty and inequality have an influence on the proliferation of informal settlements?**

The informal settlement is a bridge between newcomers to the urban areas from rural or other areas to possible employment and a new and better life away from abject poverty. In that respect, we find that many people moving into the city settle in informal settlements first before moving to other formalized parts.

b) **Do you think that rapid urbanization of African cities has an overwhelming impact on city managers and their inability to respond on time to such demand of services, including housing?**

In South Africa it is all about keeping your job in government together with a political motivation to promote rural development over urban informal settlements. For this reason, Municipalities and Provincial Governments have prioritized the delivery of RDP type housing to rural areas, as this gets more votes, and you can report an indicator on your performance

contract far easier through delivering a rural house next to the existing homestead, than delivering housing or services to informal settlements. So, municipalities and housing managers historically focus on 'easy' rural housing delivery as opposed to difficult informal settlement upgrading. This together with a historic political will to 'eradicate informal settlements', has led to a lack of knowledge and motivation for municipalities to deal with the proliferation of informal settlements.

c) **Do you think that the conditions that affect the urban poor are fully considered in the process of housing design and delivery?**

Not usually, understanding the specific conditions of families and their specific settlement conditions enables a development to respond to these conditions. But usually this is not done, housing requirements for social information is see as a tick box exercise.

d) **How would you define the socio-economic status of Quarry Road West Informal Settlement?**

Poor conditions of poverty, little or no solid waste management leading to unhygienic conditions, poor prospects for employment with the ever threat of flooding.

Questions relating to the statistical data of the study were referred to the iQhaza lethu socio-economic report which were later converted into the statistic graphs contained in this research.

Interview with Key informant 2

An architect, university lecturer and researcher, who has conducted numerous studies in the area, including utilizing drone technology for mapping.

a) **What are the technical constraints emanating from the building material and technology employed?**

"it is the lack of knowledge on how these building materials are put and fixed together. The understanding of what to put where and the basic techniques of construction e.g. knowing that you cannot just lay tiles on compacted earth, without a concrete screed, which is the case in one of the dwellings. The residents are missing the knowledge of how to construct. Materiality used can work but the lack of construction method is what is needed. Who builds?

Some build themselves while others rent their dwellings out. Renting is a big business for the older residents, hence they resort to erecting another structure for extra income.

b) How is the structural stability and thermal performance of the building envelope?

On structure: "Not good at all. On our shack prototype, we have tried to push for cross bracing which could help with lateral support. Typically, the construction comprises of the two poles in the corners with board running across. However, some residents have now realised the need for cross bracing and you can see it being installed in some of the dwellings. This re-enforces the structural stability of the informal dwelling. On thermal performance: "Absolutely poor. In fact, it is non-existent. Gaps in the doors, no windows. Cross-ventilation is not something that is ever considered and the main thing for the inhabitants is to keep the internal space dry. Due some discomforts which occur on the internal space, residents tend to live their everyday lives in the outside public space and tend to utilise the dwelling for domestic purposes such as cooking and sleeping. More of a need for an outside living.

c) Do you think that society has grown a thick skin when it comes to facing the struggles of the urban life in Durban: (i.e. load-shedding, lack of service delivery, inadequate mobility system, crime etc.) so that informal settlements are now accepted as a housing alternative?

"For the most part, informal settlement dwellers understand that getting adequate housing will take a long time, they have accepted that. They are now more willing to buy into upgrading and not in terms of the housing, just the settlement upgrading, bringing it up to a better standard. They do not invest in the structure which could be attributed to insecure land tenure. The knowledge that they could be evicted prohibits them from improving their dwellings. Dharavi in India, which is the biggest slum in the world contributes to the GDP because of the various businesses which are housed there. So, if the slum fails, the city also fails, plus they now have security of tenure. Maybe if the same type of model was adopted in South African slums, the opening up and acceptance of informal economy, security of tenure, this would probably change the building character of informal settlements.

d) Do the residents hold back when it comes to fully developing their buildings due to: (a)The temporary nature of their stay in the settlement and (b) The tenure modality that does not allow for land ownership?

The investment promotes the need to improve one's informal dwelling, such as, shop owner in Isipingo with a fully furnished dwelling advanced due to profits made in the shop.

e) **Are the materials and technologies employed, limitations to fully developing proper homes?**

The building materials are not necessarily what limits the residents from constructing a good building but rather the lack of techniques, the indigenous building "know how."

f) **How do public space and recreation rank in the scale of priorities of informal settlement dwellers?**

The Havelock informal settlements community built a creche at the entrance of the settlement and everyone understood that the public space outside the creche was a play area dedicated to the children. The community understood the importance of this space as it allowed mothers to be at work with the knowledge that their children were safe and taken care of. It is also used as a community 'meeting' space. Though not visible via mapping and site plan analysis, there is always a designated meeting spot for the community within any informal settlement, which is known to the residents. The density of the settlement also makes it harder to identify those spaces. Left over space is used, building of shacks takes priority.

Interview with Key informant 3

The owner of a hardware store which is strategically located close to QRWIS. The owner is familiar with the typical building materials that are bought by the residents and provides additional instructional services on purchased products.

a) **What are the construction materials that they have no option but to buy brand new?**

Corrugated iron, timber, cement, tile grout, roof plastic, and repair kits for the plastic.

b) **In terms of your informal settlement clients, are your sales once-off or recurrent?**

Recurrent.

c) **In terms of sales volume, what are the best-seller materials for informal settlement dwellers?**

A number of the most purchased building materials bought by the residents are corrugated sheeting, cement, tile grout, roof plastic (PVC) and repair kits for roof plastics. However, cement and roof plastic are the materials which the residents buy most frequently.

d) **Do you allow for payment agreements plan or customers once-off? If Yes, what percentage for payment agreement?**

No, because the transitional mind set of people living in Quarry makes it difficult to even consider that as an option. The administrative process of following up with loan payments would pose a challenge to his business and also because residents are not in any position to provide loan guarantees or some type of collateral should they fail to repay the building loan.

e) **What would you say is the average fraction of customers no technical/construction knowledge and do they ask for advice?**

About 50% of my buyers are from the construction sector with some level of technical knowledge, while the typical residents are self-builders who possess very basic to no knowledge of the material that they buy. I usually request one of my employees to advise the customers and sometimes to translate instructions on the products that they buy. Others bring a skilled person who will help them build to come buy the material.

f) **Is it a coincidence or a strategic move that the store is located across from the informal settlement?**

The store was established in the early 1980s by my father, before the occupation of the site by informal settlement dwellers. It services the entire area of Clare Estate and even though most residents of the informal settlements purchase their building material from the store, they do not have the most purchase power. This is because they buy the most basic materials and at times would go for cheaper options. They do not buy in bulk, and also because they build incrementally and not all at once.

Interview with Key informant 4

A community leader who resides in the settlement. The questions posed to him explored their social experience of living in QRWIS. The popular construction techniques, dwelling assemblages, and a personal experience of living in QRWIS.

a) **Who decides on the site?**

Generally, it is the responsibility of the community leaders to pick a site for any prospective resident. However, if a plot is owned by someone, it is therefore negotiated for a small fee.

b) Who determines the size of the dwelling unit?

There is no specific rule book on the size but a verbal suggestion from the neighbours which is called four-by-four (4X4=16m²). I don't know who came up with four-by-four but it is a known size for everyone in the settlement. Your dwelling cannot be bigger than that but also the size is not cast in stone as you might be squeezing through a space which cannot accommodate that size, but less. When building we are also mindful to leave enough space for others who might come and build in future.

c) Who decides on the material to be used to build?

There is no unanimous decision on what material to use but one that a person can afford.

d) Where do people source their building material?

We buy the important stuff like timber, cement and corrugated sheeting in the hardware store across the street. There are also informal businesses within the settlement which sell second-hand building material such as doors and windows. The rest of the material is left overs and cut-offs sourced from construction sites, salvaged from waste dumping sites. While it is not good to admit, we also get young men entering the settlement to sell us some of the "nice to have" house things, which are acquired through criminal activities.

e) Who builds the informal dwelling?

Those who can build do it by themselves but if you cannot, you hire a builder to put the shack together for you. There are construction and general workers living within the settlement and offer the building service. The inconsistency of construction employment contracts means that there will always be someone available to offer building services.

f) How do you determine/accept the minimum building standards?

There are no set standards as to how to build and what material to use. We mostly look at how others have built and then attempt to do the same. Sometimes people look at the style of homes where they work as gardeners and domestic helpers and try to emulate the fancy style. You see how others have tiles on the floor and some are using zinc to create a fancy look at their entrances just so that their shack looks different and fancy. Also, while you are already living within the dwelling you tend to identify some issues which need to be fixed. For example, if things are not fitting according to plan, then you adjust the structure. If there is

some shaking or movement in the structure, you add extra timber and tie things together in order to avoid any structural snags.

g) Are there any restrictions/preferences on the type of building material to be used on the settlement?

No, we always use what is easily available and what we can afford to build.

h) How do the residents finance their dwelling construction projects and do they have access to housing finance?

We all build our houses out of savings from our salaries. At times we approach loan sharks for money during emergencies, for example, when there are unavoidable leaks or security issues with the structure. The problem with this financial transaction is the exorbitant interest rates, which is sometimes 50% of the loan amount, and increases if unpaid.

i) Do residents live comfortably within their dwellings, during the different climatic and weather changes?

When it's cold it's cold and when it's hot, it's hot. So, we tend to live outside more in hot days. We use paraffin heaters and extra layers of blankets during cold winter months.

j) Do you have a sense of privacy and security inside your dwelling?

Comfort is a luxury we do not have due to the thin tin walls but life has to go on, even without it. There are no major break-ins of the dwellings, only petty crimes like stealing clothes from the washing line. So, the lock on the door is always enough.

k) Do you have any mechanisms put in place to warn you against disasters (floods and fires) before they occur?

Unfortunately, we don't. We always act on instinct. Sometimes we hear of weather predictions via the radio or TV but there is honestly not much we can do but hope and pray that nothing happens to our homes.

l) How do you prevent against floods and fire outbreaks and what happens to those residents whose dwellings get either washed away or even destroyed by the floods?

The only intervention we have during fire outbreaks is the water provided by the CABs system as we do not have water inside our houses. If the fire gets out of control then we allow it, as long as there are no lives lost. The reinforcement of the river bank with tyres is the only mechanism we've put in place in order to prevent floods. I have not experienced any major flooding which washed away dwellings since I moved into the settlement. However, those

residents whose homes suffer major damage during fires and floods are housed by the rest of the community until they can rebuild.

m) Do you feel safe and what kind of security measures have been put in place within settlement and dwelling units?

I feel safe inside my shack and within the settlement. As a community we always unite against acts of criminality and violence amongst the residents. Pickpocketing and robberies occur once one is on the roadside, which is a very public space.

n) Given a choice, would you relocate to a better house away from the city or are you happy in QRWIS?

There's nothing to be happy about with living in a shack but we are here because we do not have a choice and we try to make life as comfortable as it can be since we are stuck here. Obviously, I have to provide all the things I need in order to be able to live comfortably, and that means spending money. I would move to a new house, provided that it offers me all the opportunities that QRWIS does. I have access to most things while living here and that makes me stay, no matter the situation.

6.4 Cost implications of building an informal dwelling

Establishing an estimated cost for the standard section is challenging given the multiple ways in which dwellers approach the erection of the structure, and the acquisition of materials. The researcher has approached the calculation of the cost through a Bill of Quantities (see annexure 4) based on Figure 52. Labour costs are based on the Build aid Building and Price guide of 2021 Buildaid (2021) and also through the establishing costs from local suppliers.

Based on formal ways of sourcing, the estimated cost of a typical dwelling amounts to R32,404.89. Table 5 presents a breakdown of trades and processes with the total amount. A Bill of Quantities is provided in annexure 4.

Table 5. Cost estimate of a 16m² dwelling based on formal sourcing

DESCRIPTION	COST (VAT excl.)
Earthworks	R125.28
Foundations	R2,553.88

Structure	R13,213.08
Roofing	R1,902.54
Cladding	R4,566.10
Flooring	R3,240.68
Fenestration	R2,469.59
Electrical Installation	R4,333.74
TOTAL	**R32,404.89**

Figure 60 shows the impact of the several trades and processes in the overall cost of the typical informal dwelling present in QRWIS. The structure, together with cladding and roofing, (the envelope and its supporting structure) represent two thirds of the total cost of the dwelling. The cost of labour in the overall cost of the dwellings, calculated in the Bill of Quantities in annexure 3, is 2.13%.

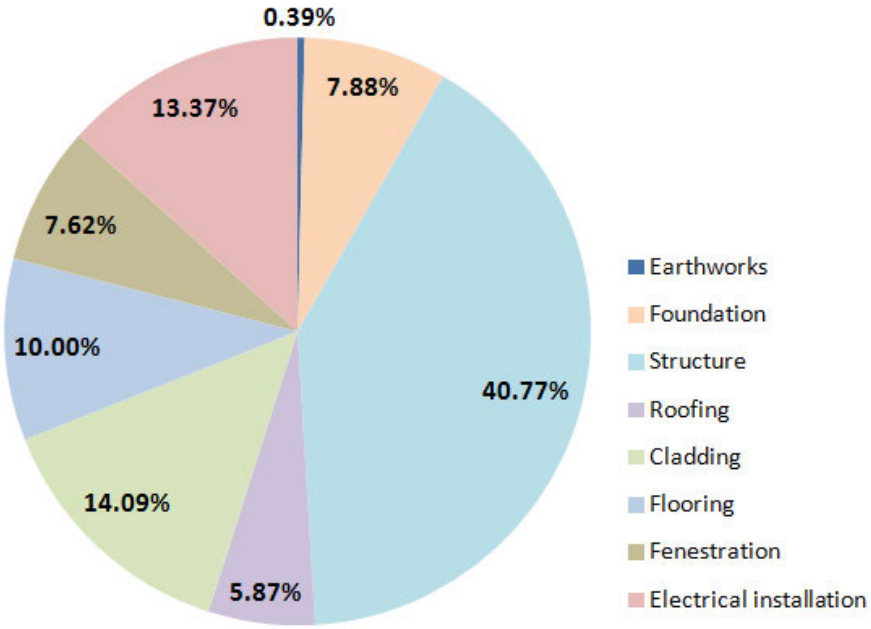


Figure 60. Distribution of the cost estimate by trades and processes in a typical dwelling in QRWIS. Source: Author

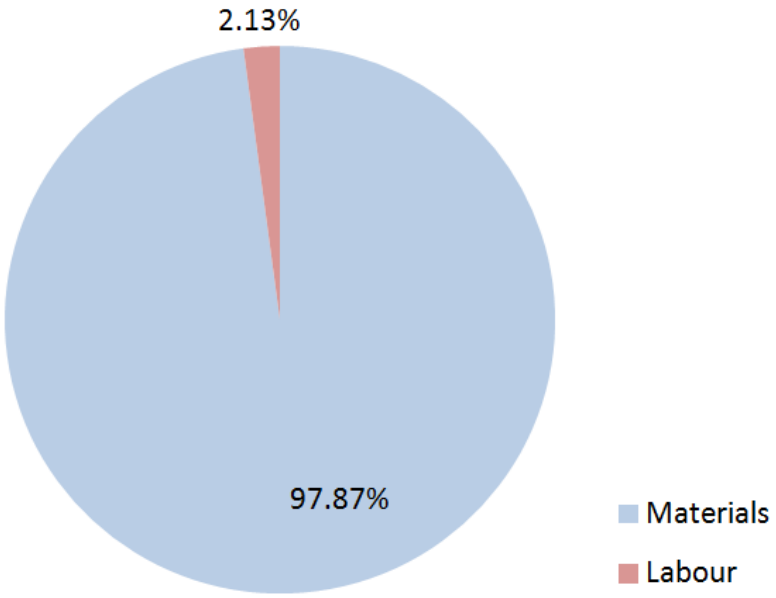


Figure 61. Proportional cost of labour and materials for a typical dwelling in QRWIS. Source: Author

This is a compelling result as it represents an unavoidable economic challenge: the cost of the dwelling as per typical structures found in QRWIS, including a VAT rate of 15%, amounts to R37,265,62, which is ten times the 2022 national minimum wage per month (R23.19 for each ordinary hour worked). Sourcing new materials would take the salary of more than a year for most of the residents, spending 100% of the salary in the construction of the dwelling. The results align with the technology and materials used: no need for rental of large equipment or extremely specialized labour, with carpenter, electrician and plumber the only specialities needed.

In the next section, the QRWIS informal dwelling is assessed through the lens of the current housing policy in South Africa. The impact of the minimum housing standards in the cost rate of the dwellings is analysed and compared to the cost rate per square metre of the informal dwelling.

6.4.1 Comparative analysis of minimum formal standards versus informal dwellings in QRWIS

The legal framework that regulates the requisites of housing and residential buildings in South Africa is informed by:

- Housing Act 107 of 1997 (RSA 1997)
- Housing Consumers Protection Measures Act 95 of 1998 (RSA 1998)
- Housing Consumers Protection Measures Amendment Act 17 of 2007 (RSA 2007)

Moreover, buildings norms and standards put forward the minimum building requirements which are intended for the health and safety of inhabitants and communities. In South Africa, these guidelines are set out in the South African National Building Regulations and Building Standards, also referred to as SANS10400 and SANS204. Table 6 presents a comparison of norms and standards for homes intended for low income households and those financed through the National Housing Program and a typical dwelling in QRWIS. The minimum housing standard example is located in a greenfield, in which basic municipal infrastructure is non-existent, in order to gain a fair comparison with QRWIS.

Figure 62 A typical RDP standalone house. Source: http://www.dhs.gov.za/content/government-subsidised-houses

Figure 63 A typical informal dwelling unit. Source: Blanco, A 2021

This assessment of minimum standards was measured against subsidized housing, commonly known as RDP (Reconstruction Development Programme), aimed at housing low-income families. One of the criteria for RDP is that each household must earn less than R3,500 (233 USD) per month. In South Africa, the cost of building an RDP house varies by province, however the cost in eThekwini is R228,914.00 at an average of R5,000/m² (Parliamentary Monitoring Group 2018).

Table 6 Minimum housing standards data extracted from Part 3 of the RSA National Housing Code of 2009

Criteria	**Minimum Housing Standard**	**QRWIS trend**
Security of tenure	Yes	None
Geotechnical investigation	Yes	None
Floor area	40m²	16m²
Floor area rate per person	10m²	6.15m²
Foundations and floors	400mm deep concrete strip footings, 75mm concrete.	Shallow dug poles and cement, concrete/timber/earth flooring.
Walls	140mm masonry units	Corrugated sheeting, timber slats, wattle and daub, cardboard etc.
Wall height	2400mm	2000mm
Roof coverings	5mm hard galvanised corrugated roof sheets, fixed onto timber purlins at 600mm spacing with ridge purlin.	3mm galvanised corrugated sheeting, fixed on timber frame structure and mid purlin. Sheeting overlaid with a PVC sheet in some instances.
Natural light	5% of floor area	Not considered
Ventilation	5% of floor area with one opening having an area of at least 0,1m².	Not considered
Thermal efficiency	Controlled through orientation, window and overhang design.	None
Insulation	None	None
Fire protection	None	None
Electrical installation	Yes	A quarter of the settlement is partially connected while the rest is illegally connected.
Water supply	Stand-alone pipe per house / water conserving tank.	A communal standpipe next to CABs system.
Sanitation	1x toilet, 1x Shower, 1x basin and 1x kitchen sink (in serviced areas only).	CABs

The RDP housing model is already a compromised housing alternative. The fact that it is 'legal' does not save it from lacking many of the basic features of comfort and durability required by the minimum standards. The lack of these basic features imposes additional maintenance responsibilities, and therefore expenses, to their allocated owners. Whilst accepted that the

government should respond to specific needs for housing supply in a particular social context at a given time in South Africa, the expectation is that in the future, this model will be discontinued. The RDP model sets a benchmark for minimum standards that are impossible for informal dwellings at all levels: spatially, structurally, service and comfort wise.

However, unlike RDP housing, QRWIS represents an advantage in terms of location, being closer to urban services and workplaces. Land speculation may be one of the reasons why RDP homes were not built where they are needed to solve the problems of the urban poor. They prefer to stay in informal settlements despite the harsh condition, than to live slightly more comfortably in a community and area which is irrelevant.

6.5 Summary of findings and the case for 'architecture'

As mentioned in section 4.6.4 of the literature review, 'push-pull' factors influence rural-urban migration. This study found that there is no clear correlation between the increase of the informal settlement population and the employment rate in eThekwini municipality (see section 6.2). This may suggest that the reason for migration are not 'pulling' reasons to come into the city but adverse conditions at the places of origin that pushes people to leave. Further research may be conducted to specify the particular factors affecting QRWIS.

The socio-economic realities that are presented in section 5.3 describe a population with very limited financial resources: low productivity jobs, job insecurity, and unstable to very low income. This situation causes high levels of financial vulnerability. The residents of informal settlements do not have access to financial services from banks, such as building loans due to their lack of repayment guarantee, as expressed in section 6.3. According to Key Informant 4 in section 6.3, the residents rely on their small savings for any building improvements. At times, when in financial distress with the dwelling requiring immediate repairing, they would also approach 'loan sharks' whose repayment plan is high. This has an impact on the way residents face dwelling: financial limitations lead to technical limitations. Therefore, dwellers drop the standards of housing to a bare minimum in order to achieve shelter in an urban environment. The comparison in section 6.4.1 between a formal housing model that already has limited cost and technologies (RDP) and what is present in QRWIS shows a deficit in terms of quality and comfort.

The construction of informal dwellings in QRWIS has evolved as a new real-estate model through which some residents are now building additional dwellings as a source of income, becoming informal 'developers', to some extent. This profitable activity may have an impact on both the growth and perpetuation of the settlement.

The location of the informal settlement is determinant to the level of maintenance required to keep the dwelling structurally sound. QRWIS in this particular case situated on the Palmiet River, is situated in a hazardous location which requires constant structural improvements and upkeep. This exacerbates financial pressure in comparison to other settlements.
Despite the vulnerability of the dwelling, exposure to extreme climatic events such flooding, heatwaves or accidents such as fire, residents still show strong resilience. Their preference is to rebuild, reinforce and stay. This may be due to lack of public alternatives in the area, without forgetting that the choice to settle was initially based on proximity to employment opportunities. In addition, social bonds strengthened over time could play a key role in the decision to stay, particularly social assistance during times of distress. Further qualitative research could address the relationship between social bonds and the conversion to permanence of the dwelling structure in the informal settlement. Should financial constraints be overcome, would the bond still be strong on the decision to stay? The answer to this question could indicate that a very different approach to informal settlements in terms of housing alternatives, in which the existence of the social ecosystem has very little to do with the formal conception of housing imposed by western planning ideas.

The built environment described in section 5.4 together with the economic activities indicated in section 5.3 suggest that there is a limitation in possibilities to exercise economic activities within the available space, reducing potential to providing basic services such as beauty salons, drinking houses and spaza shops. Small craft activities such as metalworks or carpentry for instance, could possibly find room in such built environments, based on the spatial organisation of the environment. However, the lack of reliable basic municipal services such as electrical or water supply impede activities in these fields. For basic farming, some of the

residents use leftover spaces around their dwellings to grow their own vegetable and herbs (Sim et al. 2019).

With all the challenges faced by living in informal settlements, residents still choose to stay (see section 6.3). The despondency which results in permanent improvement of some of the informal dwellings is after the realization that the government-promised houses are taking much longer than expected. The extremely long waiting period for RDP houses forces residents to undergo constant maintenance of weak structures that were initially considered to be temporary. This imposes an additional financial burden, in which residents are forced to spend savings in repairing their informal dwellings, limiting economic prosperity.

Earth-based construction is one of the technologies used by residents who migrate from rural areas to the city. In section 5.5.1 the construction method and the exceptional material performance against the climate is explained. However, the availability of suitable earth, and time to dedicate and maintain this type of construction, in addition to other factors, have recognized a limitation in this technique. The translation of traditional construction techniques to an urban environment clashes with two factors, namely the lack of availability of material due to condition of the urban environment such as pavements (built infrastructure), density and availability of earth and secondly, the amount of spare time that migrant workers have to meet the maintenance requirements of such technology is substantially limited, compared with that offered by a rural lifestyle. The thermal performance of the widely used corrugated sheeting means that the dwellings lack climatic control resulting in dwelling discomfort.

The aesthetics and responses displayed in informal settlements evokes a need to identify and recognise the different types of architectures which exist outside of the formal and prescribed discourse. Architecture is to construction what literature is to writing. A shopping list is not a poem, an informal dwelling is not architecture. We may find glimpses of architecture in that elements of dignity and pride are reflected in the way the residents choose to beautify their dwellings and the spaces which surround it, as mentioned in section 6.4. Nevertheless, looking for architecture as an intellectual process through which space is moulded is an

optimistic and futile exercise. The process of conceptualising building dwellings is closer to response to need for shelter in a given environment, in this case being the urban context. Possibly, and considering the concept of architecture by Marc-Antoine Laugier (1753), architecture is founded on what is natural, intrinsic and part of natural processes. “Noble and formal architecture” was not found in ornamentation but in what was necessary for shelter and its true underlying fundamentals. The ‘Primitive Hut’, as it is the shack, is created instinctively based on a human need for shelter.

The demanding lifestyle of self-sustenance, remittance and repairs imposes financial pressure that denies most for prosperity and therefore keeps the residents stuck a state of constant limitation. In addition, the education profile of the residents is very limited. Fundamentally, the situation renders it impossible to spark architecture.

Architecture is a conscious activity that requires intellectual training. A spontaneous form of architecture does not come from conscious practice but from a later intellectual interpretation. The opposite would imply that architecture is genetically printed in our DNA. Therefore, the construction made by the weaver bird is not considered architecture despite their skills coming genetically printed in the DNA of these animals.

The key impediments found to achieve architecture in informal settlements could be summarised as firstly, the lack of intellectual training and secondly, lack of financial resources. Without any of these two, but mostly the former, architecture cannot be achieved.

Examples of renowned architecture produced with very limited resources show that the intellectual component is prevalent over financial abundance. However, the exercise to produce what can be considered architecture at the rate of R2000 per sqm could be a good exercise for schools of architecture to consider an informed housing response at that rate.

Further, two factors may represent a barrier for the involvement of architects supporting the design of extremely cost-effective solutions. The one is working with propositions that are outside of the minimum building standards. Whilst, perfectly safe and capable. The second is

how architectural fees relate to the building cost. This way, a practice which is more intellectually demanding may be penalised with a lower fee, representing a lack of balance and therefore a deterrent for practitioners.

7. CONCLUSION AND RECOMMENDATIONS

This dissertation aimed to explore the socio-economic parameters present in the QRWIS in order to understand the consequential architecture manifested through the informal built environment. Moreover, the relevance of this research is critical, given the rapidly rising population growth in South African cities, with researchers already working towards design solutions to deal with this phenomenon. In order to understand the connection between the socio-economic status of the community and the built form of the settlement, various studies focusing on these two aspects were approached. The main methodology adopted to analyse data for the research was through a series of secondary data, which comprised a literature review, data from previous studies, maps, photographs, and a case study. In addition, primary data collected from interviews with key informants, completed the methodological approach.

Gaining understanding of the socio-economic dynamics of the settlement required more in-depth knowledge of the profile of the residents, together with their households. This considered the population and household demographics, education levels, unemployment, income source and livelihood of the residents. In addition, the researcher particularly looked at the presence of building skills and capacity within the community. This knowledge contributed in the understanding of the strategic choice in settlement location by the residents. Furthermore, it also assisted in the understanding of the configuration and materiality of the built form and the placement of these informal dwellings within the settlement. The result of the investigation also confirmed that informal settlement dwellers do not have enough financial power to create desirable dwellings which are structurally sound for a longer period of time.

This dissertation resulted in various nuanced findings which revealed that the economic status of informal settlement dwellers ranges from poor to low income earners, while some have uncertain employment agreements. Two thirds of the residents have incomes below the national minimum wage. This information provided an insight into the manner in which they approach the construction of their dwellings, which is usually incremental in nature due to minimal and erratic availability of funds.

Residents of the QRWIS reduce the building features of the dwelling to a bare minimum out of necessity. They build enough to provide a rather compromised shelter in an urban environment, given the hazards and insecurities this housing 'set up' implies. The challenges faced within the dwellings are associated with the choice of building material and techniques used to construct them. For instance, the prominent corrugated sheeting compromises the comfort inside the dwelling, due to its poor thermal performance and sound insulation.

The aforementioned scarcity together with the lack of access to services such as reliable energy supply or sewage, and the river bisecting, have influenced the built form of the QRWIS, not only at dwelling level but also the overall settlement. Unlike other settlements in eThekwini, the public space is reduced to the circulation alleys without playgrounds and very small individual plots next to the dwelling. The footprint of the dwellings covers the entire precinct. Possibilities of easing the pressure from food expenses by 'growing you own' are denied to residents of the QRWIS. Given the advantage of sourcing water from the river, a more efficient distribution of the dwellings could allow for small-scale farming. The installation of small-scale electrical turbines in the river stream or photovoltaic panels in order to supply electricity may at face value be naïve due to the crime rate in eThekwini. However, projects addressing an increased sense of ownership and self-policing, may open the opportunity to proposals that could be implemented with sufficient community agreements, and care.

With respect to the built form, the key factors that influence the technological and material expression of informal dwellings can be summarized as the lack of economic resources, technical capacity and sense of temporality. It is clear that dwellers, particularly newcomers, do not give financial priority to expenses such as building materials for a stay that is expected to be temporary. A compelling situation exists when skills and technologies originating in rural areas are brought to the city. This proves knowledge and skills for building such as basic understanding of structural stability and materials performance. However, the direct translation to the city environment is not free of challenges. Sourcing of materials and maintenance is difficult due to the different conditions in the city. Dwellers with this

knowledge have the potential to be trained through adaptation workshops, achieving better results than dwellers with no previous building knowledge and experience.

The involvement of the municipality in housing interventions becomes a sporadic and makeshift exercise. This is evident in that after every natural disaster which included destruction of dwellings. Those lost through disasters were replaced by the municipality with the very same corrugated sheeting dwelling typology, only constructed in a much more skilled manner. Different studies are producing formulas for the improvement such as re-blocking and informal settlement upgrading. However, when these projects materialise, they are typically low-budget, resulting in extremely low professional fees. Therefore, capable architects, able to bring cutting-edge solutions and bright ideas, get demotivated by the low fees. The implementation of new proposals through ideas competitions with a fixed fee regardless the building cost, would awaken the interest of the profession to get involved in finding better solutions for informal settlement.

In the case of the QRWIS, the identified architecture is close to the concept of the 'Primitive Hut', based on the human need for shelter. In this case, the natural environment is the urban environment. The informal dwelling is a direct response to basic needs, developed within a context of scarcity at all levels. It represents a paradigm of 'Architectural Utilitarianism' which implies an improvement from homelessness. Despite the risk of interpreting these words cynically, the intention is to highlight the reality that this built form represents: a cap for prosperity, given that improvement and limitations are strongly bonded. The result is a 'limbo' in which informal dwellers get to spend their lives.

The observation and analysis of the socio-economic and physical reality of the QRWIS together with the engagement with key informants confirm a series of impediments that affect the architecture of informal dwellings in informal settlements: lack of planning, organic and random growth, weak structures that demand constant maintenance, lack of municipal services, exposure to hazards, both natural and social, and vulnerability. This has raised additional questions. Firstly, could the informal dwelling perform better, from an architectural perspective, in a formally planned settlement? Secondly, could the provision of a planned and

serviced precinct serve as a ‘motherboard’ for the self-construction of dwellings? Pilot projects on municipal land could address this alternative option, in order to gauge the impediments that dwellings face to fully perform as possible ‘architectures’.

With the information gathered by this research, the researcher aspires to assist the city in providing a framework, in order that a responsive design approach to informal settlements may be achieved. The findings of the study, lead to various key recommendations as discussed below:

The idea of ‘motherboard sites’ is that they would be fully fitted in terms of bulk infrastructures and a municipal office would instruct new dwellers in the art of self-construction. The advantages of this proposal may result in better management of public spaces and the control of hazards such as landslides, floods or fires due to over-densification. Furthermore, the availability of reliable services means that residents would have the ‘freedom to build’ dwellings that reflected their own priorities and budgets. This should result in better building quality that would translate in reduced expenses in maintenance. Similarly, would lead to making available a minimum fee for communal maintenance managed by the municipality. This is envisaged to awaken awareness of the notion of the public sphere; and reduce harassment from informal settlement war lords or traditional leaders. A step further may be to provide a structural skeleton that complies with SANS in terms of structural stability, and ensures resistance to fire, seismic and wind loads, or even allows for an additional upper storey.

In the selection of locations for ‘motherboard sites’, public entities must avoid pressures from private developers. Marginal and neglected plots only exacerbate the problem. These sites should comply with a number of requisites, some of them ultimately coincident with the reasons why the locations of informal settlements are chosen: proximity to workplaces, accessibility to transport hubs and community building. In addition, benefits from planned site selections would add to the above mentioned: access to sanitation, energy, safety and chances for prosperity and break the cycle of poverty. Prime locations should be managed with a spirit of integration.

In addition, academic institutions may play an important role in supporting at low cost housing projects. The case of Kambi Moto slum upgrading program in Kibera, Nairobi, presented in section 4.5.3, is a good example of students engaging with real projects, supporting their learning experience. With one third of the urban population living in informal settlements in eThekwini, the scale of the problem is such that the solution is not likely to come from understaffed and underfunded municipal departments, and requires the engagement of professionals and academics at all levels. Fundamentally, the challenge of informal settlements for cities, transient and limited living for migrants is only going to increase. It is therefore an endeavour that requires an integrated response from all relevant actors of the society.

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ANNEXURES

Annexure 1. Ethical clearance and gatekeeper's letter

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

27 August 2021

Miss K Matangana
4115 Ntwasa Road
Lamontville
4027

Dear Miss Matangana

An inquiry into the socio-economic influences on the architecture of the Quarry Road informal settlement.
Ethics Clearance Number: IREC 110/20

The Institutional Research Ethics Committee acknowledges receipt of your gatekeeper permission letter.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely

Prof J K Adam
Chairperson: IREC

For Attention:
Chair of Institutional Research and Ethics Committee
Research and Post-graduate directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

RE: LETTER OF SUPPORT TO K. MATANGANA STUDENT NO. 20406693 – GRANTING PERMISSION TO USE QUARRY ROAD WEST INFORMAL SETTLEMENT AS A STUDY SITE FOR A MASTER'S RESEARCH

The office of the ward 23 councillor has considered a request from Ms. K. Matangana to use Quarry Road informal settlement as a research study site in fulfilment of a Master's in the Built environment (MBE) with a topic entitles: **An inquiry into the socio-economic influence on the architecture of the Quarry Road informal settlement, eThekwini Municipality.**

We wish to inform you of the acceptance of this request and hereby assure the student of our utmost co-operation towards achieving her research goals: the outcome which we believe will help the municipality improve on services using research outputs. The student is reminded of ethical consideration when conducting research. In turn, we stipulate as conditional that the student presents the results and recommendations of this study to the related units/offices upon completion.

Councillor Xolani Nala
Ward No. 23
Wishing Miss Ms Matangana all the best.....
COMMISSIONER OF OATHS
ETHEKWINI MUNICIPALITY
EX OFFICIO DISTRICT OF DURBAN IN
TERMS OF SECTION 6 OF ACT 16 OF 1963
(AS AMENDED) CITY HALL SECRETARIAT
Dr Pixley Ka Seme Street, Durban, 4001.
Ward 23 Councillor, eThekwini Municipality

14/09/2021
Date

Contact details:

Annexure 2. Letter of information and consent from key informants

Appendix B

LETTER OF INFORMATION

Title of the Research Study: An inquiry into the socio-economic influence on the Architecture of The Quarry Road informal settlement

Principal Investigator/s/researcher: Khayakazi Matangana, B-Tech in Architectural Technology

Supervisor: Dr B. Tecle-Misghina, PhD

Co-supervisor: Dr. D. Whelan, PhD

Brief Introduction and Purpose of the Study:

Greetings,

My name is Khayakazi Matangana, a Masters student in the built environment at the Durban University of Technology. I would like to invite you to participate in this research.

Abstract:
Informal settlements are present worldwide under various names, forms and typologies. According to the United Nations, over half of the world's population lives in cities and over a billion people live in informal settlements (UN-Habitat, 2016). In South Africa, the lack of access to adequate and affordable housing in the city influences informal settlement dwellers to resort to building their own dwellings from recycled material and some which is purchased with their minute salaries. These dwellings are built to cater to their housing needs, while also conveying a narrative and meaning through the aesthetics and internal spatial configuration of the built form, defined by the socio-economic realities of the dwellers.

This research is an enquiry into how the socio-economic status of an informal settlement community influences the architecture of their environment. The technology used to construct these structures define a built form narrative while influencing human comfort and security. The Quarry Road informal settlement in Durban has been selected as a desktop (Case) study, as it presents a complexity of socio-economic influences on the built form.

Outline of the Procedures:
The research aims to analyze the architectural attributes: form, function and technology which are present in the Quarry Road informal settlement that emanated from the nuanced socio-economic context. The study will approach the settlement from macro-scale, looking at the immediate peripheral urban fabric and progressively scale down to the spatial organization of the settlement, to finally focus at a micro scale of the dwelling unit which will be analyzed trough existing architectural drawings. This is critical to understand how socio-economic realities impact the situation and built form of the dwelling unit within the settlement in order to inform a responsive approach to design in informal settlement. The main objective and research question is to understand how socio-economic factors influence the built form and therefore uncovering how the built form of informal settlement influence responsive design approaches.

Interviews with key informants will be the main tool for primary data collection. Included, as key informants, are scholars, researchers, community leaders and NGOs, that can provide valuable expert information to the study. The general dwelling inhabitants of the study area (the Quarry Road informal settlement) have been excluded due to the challenges presented by the Covid19 pandemic.

Risks or Discomforts to the Participant: You will not be subjected to any harm, discomfort or forced to give out any information unwillingly.

Explain to the participant the reasons he/she may be withdraw from the Study: You may withdraw from the study if you no longer wish to participate and there will be no consequences on the withdrawal.

Benefits: Your contribution will be acknowledged and a final draft of the dissertation which will be shared with you for approval prior and post submission.

Remuneration: There will be no remuneration for participating in the study.

Costs of the Study: You will not be requested to pay any fee towards the study.

Confidentiality: Your identity will not be linked to your responses. For purposes of referencing, the researcher will seek consent prior to publishing your identity.

Results: Your contribution will be acknowledged and a final draft of the dissertation will be shared with you for approval prior and post submission. The final dissertation will be made available through the DUT physical library and website and the NRF database.

Research-related Injury: The study has no risk of injury

Storage of all electronic and hard copies including tape recordings: The data collected will be kept for five years within the discipline and then disposed of.

Persons to contact in the Event of Any Problems or Queries: Please contact the researcher on +27 76 184 2404 or matanganak@gmail.com. My supervisor is available on BelulaT@dut.ac.za or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

DUT DURBAN UNIVERSITY OF TECHNOLOGY

INSTITUTIONAL RESEARCH ETHICS COMMITTEE

CONSENT

Full Title of the Study: An inquiry into the socio-economic influence on the Architecture of The Quarry Road informal settlement

Names of Researcher/s: Khayakazi Matangana

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Khayakazi Matangana about *the nature, conduct, benefits and risks of this study*
  Research Ethics Clearance Number: **IREC 110/20.**
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Robert Mann	08/04/22	11:45	
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I Khayakazi Matangana herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Khayakazi Matangana	05 April 2022	
Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

02 March 2021

DUT DURBAN UNIVERSITY OF TECHNOLOGY

INSTITUTIONAL RESEARCH ETHICS COMMITTEE

CONSENT

Full Title of the Study: An inquiry into the socio-economic influence on the Architecture of The Quarry Road informal settlement

Names of Researcher/s: Khayakazi Matangana

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Khayakazi Matangana about the nature, conduct, benefits and risks of this study
  Research Ethics Clearance Number: **IREC 110/20.**
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
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- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

NIVEN GOVENDER	8 APRIL 22		
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I Khayakazi Matangana herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Khayakazi Matangana	05 April 2022	
Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

02 March 2021

CONSENT

Full Title of the Study: An inquiry into the socio-economic influence on the Architecture of The Quarry Road informal settlement

Names of Researcher/s: Khayakazi Matangana

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Khayakazi Matangana about the nature, conduct, benefits and risks of this study
  Research Ethics Clearance Number: **IREC 1 10/20.**
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

DR V GOVENDER	05 APRIL 2022	13:00	
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I Khayakazi Matangana herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Khayakazi Matangana	05 April 2022	
Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

DUT DURBAN UNIVERSITY OF TECHNOLOGY

INSTITUTIONAL RESEARCH ETHICS COMMITTEE

CONSENT

Full Title of the Study: An inquiry into the socio-economic influence on the Architecture of The Quarry Road informal settlement

Names of Researcher/s: Khayakazi Matangana

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Khayakazi Matangana about the nature, conduct, benefits and risks of this study
  Research Ethics Clearance Number: **IREC 110/20.**
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Lungisa	10 April 2022	12:00	
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I Khayakazi Matangana herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

Khayakazi Matangana	05 April 2022	K Matyumza
Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

Name: Dr. Viloshin Govender
Phone: 0817732777
E-mail: GovenderV3@ukzn.ac.za

Release of Copyright-Fees

I hereby confirm to be rightfully holding or solving the copyright to all photos, renderings and drawings that were released for use to Ms. Khayakazi Matangana for the realization of her master dissertation, ePublishing or digital publishing and its directly related lucrative activities and possible license-versions. Furthermore, I confirm that by making these materials available to Ms. Matangana, no rights of a third party have been violated. Therefore, I agree to solve possible disagreements from my side and settle all arising claims. I accept the offer that Ms. Matangana might use the data for other publications and confirm that the release of copyright fees is also valid for these.

Confirmation of Authorship

I confirm to be the rightful authors of the photographs that are being put at Ms. Matangana's disposal, and that no rights of a third party concerning the authorship have been violated by me by making these materials and information available.

"I acknowledge that Ms. Matangana has briefed me about the use of the photographs prior to signing it and that I understand it contents."

Durban, 27th June 2022

Dr. Viloshin Govender

Name: Dr. Antonio Blanco-Montero
Phone: 0782998941
E-mail: blancomonteroa@ukzn.ac.za

Release of Copyright-Fees

I hereby confirm to be rightfully holding or solving the copyright to all photos, renderings and drawings that were released for use to Ms. Khayakazi Matangana for the realization of her master dissertation, ePublishing or digital publishing and its directly related lucrative activities and possible license-versions. Furthermore, I confirm that by making these materials available to Ms. Matangana, no rights of a third party have been violated. Therefore, I agree to solve possible disagreements from my side and settle all arising claims. I accept the offer that Ms. Matangana might use the data for other publications and confirm that the release of copyright fees is also valid for these.

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"I acknowledge that Ms. Matangana has briefed me about the use of the photographs prior to signing it and that I understand it contents."

Durban, 27th June 2022

Dr. Antonio Blanco-Montero

Annexure 3. Bill of quantities of a typical dwelling in QRWIS

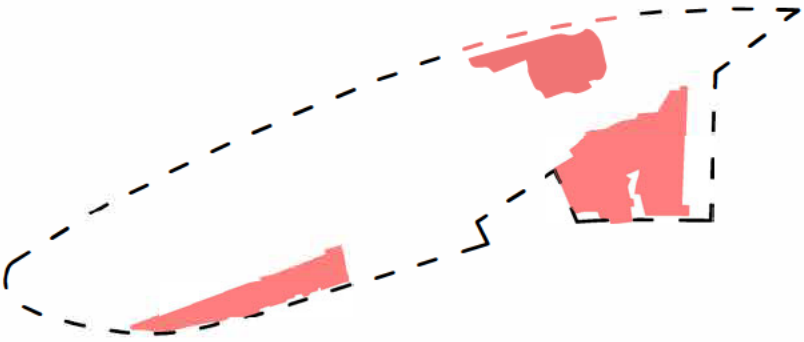
ID		DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL (VAT excl.)
		Informal dwelling as per QRWIS typical	Item	1		**32,404.89 ZAR**
SEC 01		**EARTHWORKS**				**125.28 ZAR**
	1.1	Soil level	m^2	16	3.92 ZAR	**62.64 ZAR**
		Labour general worker	h	3	20.88 ZAR	62.64 ZAR
	1.2	Pads excavation	m^3	0.512	122.34 ZAR	**62.64 ZAR**
		Labour general worker	h	3	20.88 ZAR	62.64 ZAR
SEC 02		**FOUNDATIONS**				**2,553.88 ZAR**
	2.1	**Mass concrete foundation pad**	m^3	0.512	1,491.75 ZAR	**763.78 ZAR**
		Mass concrete	m^3	1	1,455.00 ZAR	1,455.00 ZAR
		Labour general worker	h	0.6	20.88 ZAR	12.53 ZAR
		Labour concretor grade 2	h	0.6	40.37 ZAR	24.22 ZAR
	2.2	**75 mm mass concrete bed**	m^3	1.2	1,491.75 ZAR	**1,790.10 ZAR**
		Mass concrete	m^3	1	1,455.00 ZAR	1,455.00 ZAR
		Labour general worker	h	0.6	20.88 ZAR	12.53 ZAR
		Labour concretor grade 2	h	0.6	40.37 ZAR	24.22 ZAR
SEC 03		**STRUCTURE**				**13,213.08 ZAR**
	3.1	**Timber column 114x38mm**	m	20	183.52 ZAR	**3,670.30 ZAR**
		Pinewood 114x38mm board	m	1	20.87 ZAR	20.87 ZAR
		Labour carpenter	h	0.5	48.73 ZAR	24.37 ZAR
		Labour skilled worker	h	1.1	34.80 ZAR	38.28 ZAR
		Assembly material	Item	2	50.00 ZAR	100.00 ZAR
	3.2	**Timber beam 114x38mm**	m	12	183.52 ZAR	**2,202.18 ZAR**
		Pinewood 114x38mm board	m	1	20.87 ZAR	20.87 ZAR
		Labour carpenter	h	0.5	48.73 ZAR	24.37 ZAR
		Labour skilled worker	h	1.1	34.80 ZAR	38.28 ZAR
		Assembly material	Item	2	50.00 ZAR	100.00 ZAR
	3.3	**Timber tie-beam 114x38mm**	m	40	183.52 ZAR	**7,340.60 ZAR**
		Pinewood 114x38mm board	m	1	20.87 ZAR	20.87 ZAR
		Labour carpenter	h	0.5	48.73 ZAR	24.37 ZAR
		Labour skilled worker	h	1.1	34.80 ZAR	38.28 ZAR
		Assembly material	Item	2	50.00 ZAR	100.00 ZAR
SEC 04		**ROOFING**				**1,902.54 ZAR**
	4.1	**Corrugated galvanized steel sheeting roof**	m^2	16	118.91 ZAR	**1,902.54 ZAR**
		Corrugated galvanized steel sheet	m^2	1	95.00 ZAR	95.00 ZAR
		Labour skilled worker	h	0.16	34.80 ZAR	5.57 ZAR
		Labour general worker	h	0.16	20.88 ZAR	3.34 ZAR
		Assembly material	Item	1	15.00 ZAR	15.00 ZAR
SEC 05		**CLADDING**				**4,566.10 ZAR**
	5.1	**Corrugated galvanized steel sheeting cladding**	m^2	38.4	118.91 ZAR	**4,566.10 ZAR**
		Corrugated galvanized steel sheet	m^2	1	95.00 ZAR	95.00 ZAR
		Labour skilled worker	h	0.16	34.80 ZAR	5.57 ZAR
		Labour general worker	h	0.16	20.88 ZAR	3.34 ZAR
		Assembly material	Item	1	15.00 ZAR	15.00 ZAR
SEC 06		**FLOORING**				**3,240.68 ZAR**
	6.1	**PVC-sheet flooring**	m^2	16	202.54 ZAR	**3,240.68 ZAR**
		PVC-sheet	m^2	1	165.22 ZAR	165.22 ZAR
		Labour skilled worker	h	0.18	34.80 ZAR	6.26 ZAR
		Labour general worker	h	0.18	20.88 ZAR	3.76 ZAR
		Adhesive	Kg	0.35	78.00 ZAR	27.30 ZAR

SEC 07	**FENESTRATION**				**2,469.59 ZAR**
7.1	**Entrance door**	Item	1	1,072.84 ZAR	**1,072.84 ZAR**
	Woodden door 2000x800mm	Item	1	304.35 ZAR	304.35 ZAR
	Tmber frame pinewood 114x38mm board	m	4.8	20.87 ZAR	100.18 ZAR
	Labour carpenter	h	1	48.73 ZAR	48.73 ZAR
	Labour skilled worker	h	1	34.80 ZAR	34.80 ZAR
	Lock	Item	1	434.78 ZAR	434.78 ZAR
	Assembly material	Item	1	150	150.00 ZAR
7.2	**Window**	Item	1	1,234.52 ZAR	**1,234.52 ZAR**
	Woodden glass window 600x600mm	Item	1	1,043.48 ZAR	1,043.48 ZAR
	Tmber frame pinewood 114x38mm board	m	0.36	20.87 ZAR	7.51 ZAR
	Labour carpenter	h	1	48.73 ZAR	48.73 ZAR
	Labour skilled worker	h	1	34.80 ZAR	34.80 ZAR
	Assembly material	Item	1	100.00 ZAR	100.00 ZAR
7.3	**Clazing window 600x600mm**	m^2	0.36	450.65 ZAR	**162.23 ZAR**
	Anneled float glass 4mm	m^2	1	365.21 ZAR	365.21 ZAR
	Labour skilled worker	h	0.3	34.80 ZAR	10.44 ZAR
	Sealing silicon clear	m	2.4	25.00 ZAR	60.00 ZAR
	Assembly material	Item	1	15.00 ZAR	15.00 ZAR
SEC 08	**ELECTRICAL INSTALLATION**				**4,333.74 ZAR**
8.1	**Distribution board**	Item	1	1,090.68 ZAR	**1,090.68 ZAR**
	Rack module	Item	1	391.30 ZAR	391.30 ZAR
	Main switch 40A	Item	1	217.39 ZAR	217.39 ZAR
	Fuse 40A	Item	1	52.17 ZAR	52.17 ZAR
	Circuit breaker 20A	Item	2	117.39 ZAR	234.78 ZAR
	Circuit breaker 10A	Item	1	117.39 ZAR	117.39 ZAR
	Labour electrical wireman	h	1	62.65 ZAR	62.65 ZAR
	Assembly material	Item	1	15.00 ZAR	15.00 ZAR
8.2	**Power circuit 20A**	m	10	253.06 ZAR	**2,530.60 ZAR**
	PVC conduit 20mm	m	1	0.52 ZAR	0.52 ZAR
	Copper cable 1.5mm^2 750V	m	2	22.61 ZAR	45.22 ZAR
	Power socket	Item	3	62.61 ZAR	187.83 ZAR
	Labour electrical wireman	h	0.2	62.65 ZAR	12.53 ZAR
	Labour skilled worker	h	0.2	34.80 ZAR	6.96 ZAR
	Assembly material	Item	1	15.00 ZAR	15.00 ZAR
8.3	**Lighting circuit 10A**	m	8	89.06 ZAR	**712.46 ZAR**
	PVC conduit 20mm	m	1	0.52 ZAR	0.52 ZAR
	Copper cable 4mm^2 750V	m	2	4.35 ZAR	8.70 ZAR
	Light points	Item	3	21.74 ZAR	65.22 ZAR
	Labour electrical wireman	h	0.15	62.65 ZAR	9.40 ZAR
	Labour skilled worker	h	0.15	34.80 ZAR	5.22 ZAR
	Assembly material	Item	1	15.00 ZAR	15.00 ZAR

Annexure 4. Evolution of QRWIS in the last two decades

EVOLUTION OF THE QRWIS IN THE PLAST TWO DECADES

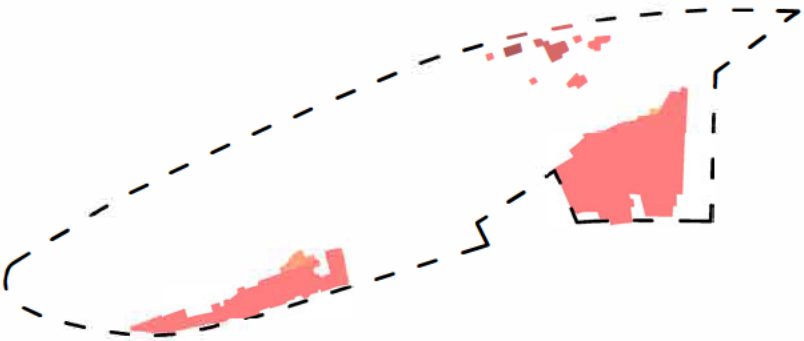
SCALE 1:5,000



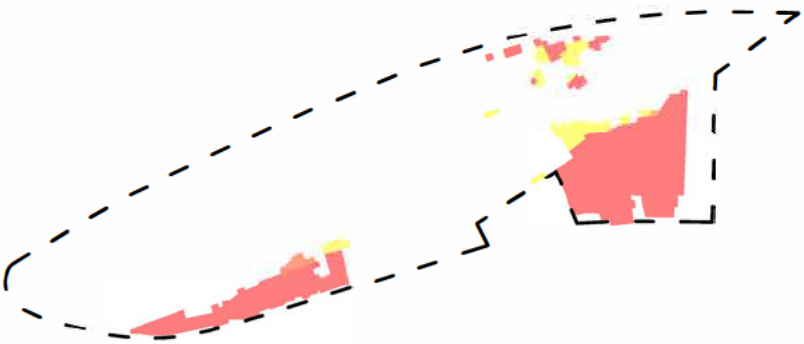
Year: 2001
Area: 9,374 m²
Average dwelling size: 16m²
Estimated population: 1,406
Growth: N/A

Year: 2002
Area: 11,243 m²
Average dwelling size: 16m²
Estimated population: 1,686
Growth: 19,94%

Year: 2004
Area: 7,478 m²
Average dwelling size: 16m²
Estimated population: 1,122
Growth: 20.23%



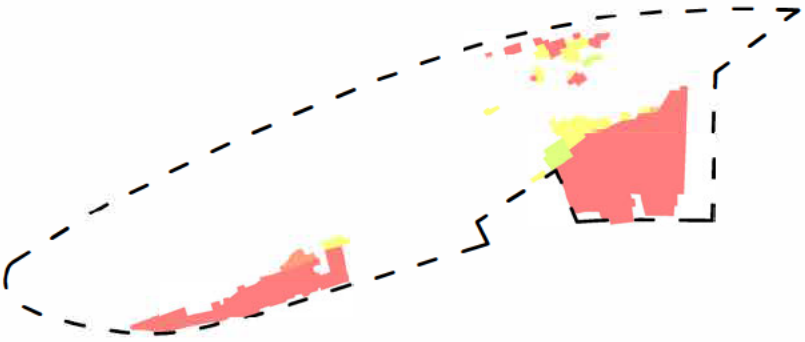
Year: 2005
Area: 7,334 m²
Average dwelling size: 16m²
Estimated population: 1,100
Growth: 21.76%



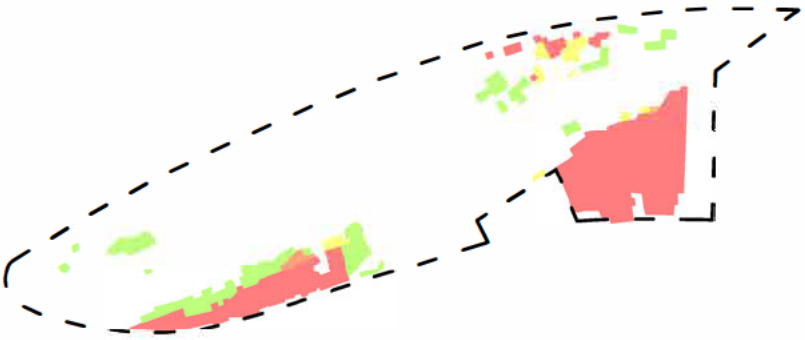
Year: 2007
Area: 8,312 m²
Average dwelling size: 16m²
Estimated population: 1,247
Growth: 11.33%

EVOLUTION OF THE QRWIS IN THE LAST TWO DECADES

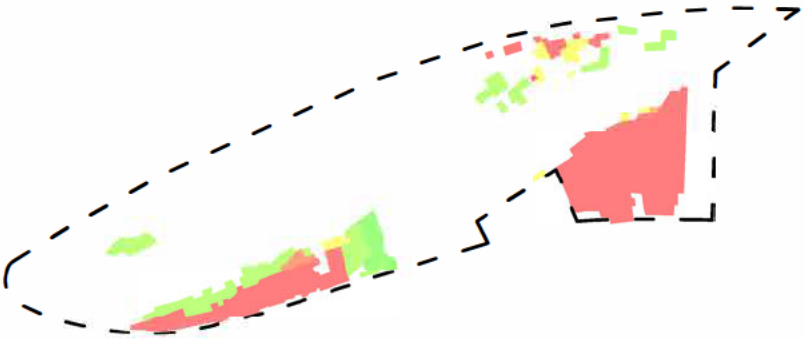
SCALE 1:5,000



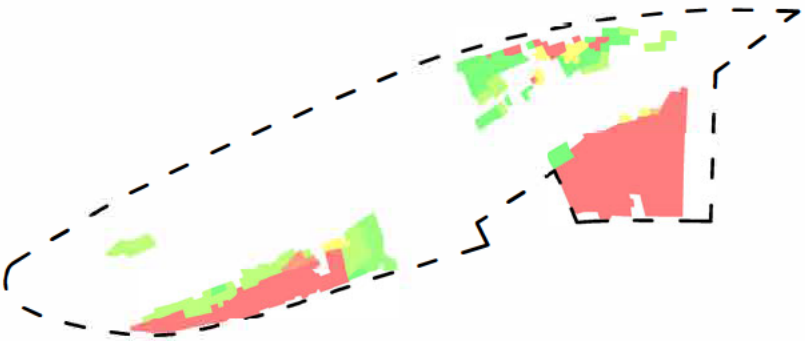
Year: 2008
Area: 8,585 m²
Average dwelling size: 16m²
Estimated population: 1,288
Growth: 8.42%



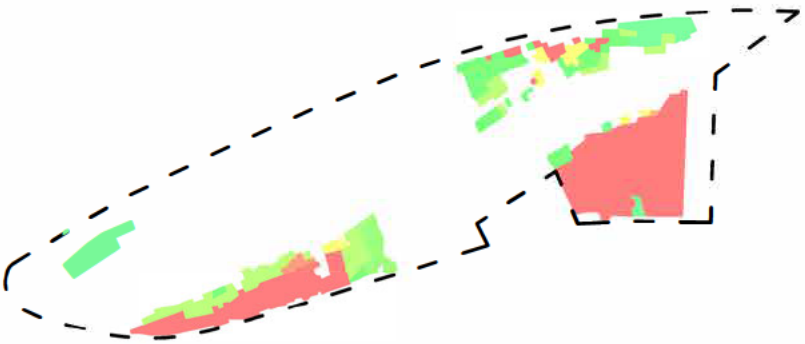
Year: 2009
Area: 10,347 m²
Average dwelling size: 16m²
Estimated population: 1,552
Growth: 10.38%



Year: 2010
Area: 10,646 m²
Average dwelling size: 16m²
Estimated population: 1,597
Growth: 13.57%



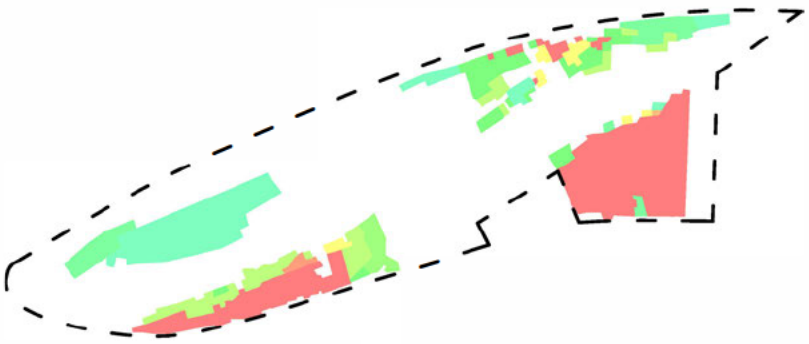
Year: 2011
Area: 12,157 m²
Average dwelling size: 16m²
Estimated population: 1,824
Growth: 29.69%



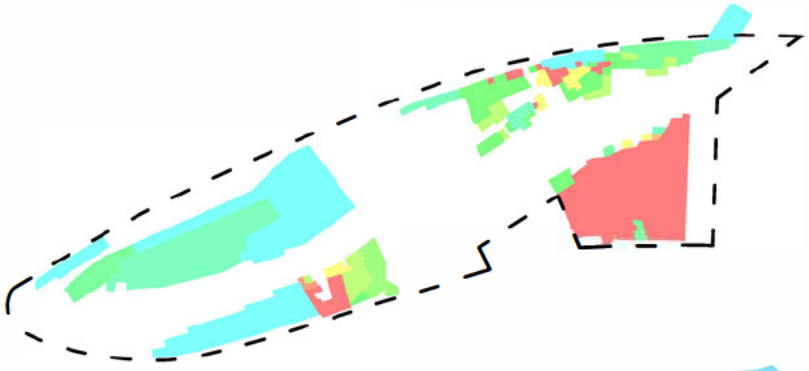
Year: 2012
Area: 13,230 m²
Average dwelling size: 16m²
Estimated population: 1,985
Growth: 41.14%

EVOLUTION OF THE QRWIS IN THE LAST TWO DECADES

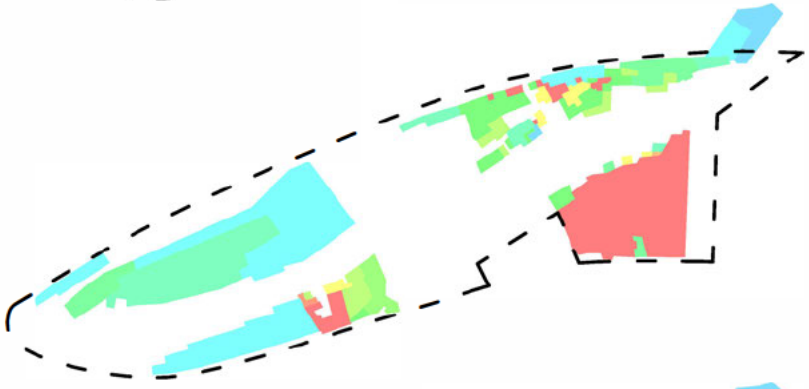
SCALE 1:5,000



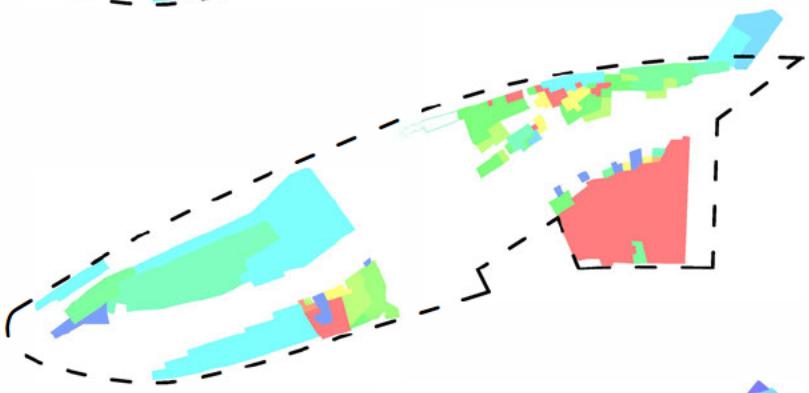
Year: 2013
Area: 16,781 m²
Average dwelling size: 16m²
Estimated population: 2,517
Growth: 79.02%



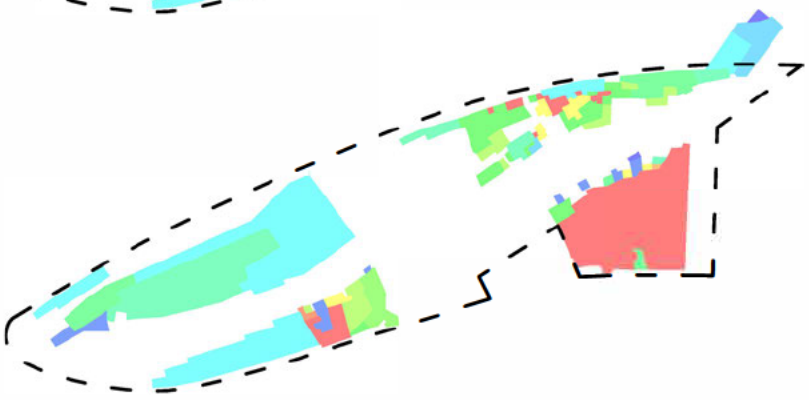
Year: 2014
Area: 21,977 m²
Average dwelling size: 16m²
Estimated population: 3,296
Growth: 134.45%



Year: 2015
Area: 22,649 m²
Average dwelling size: 16m²
Estimated population: 3,397
Growth: 141.61%



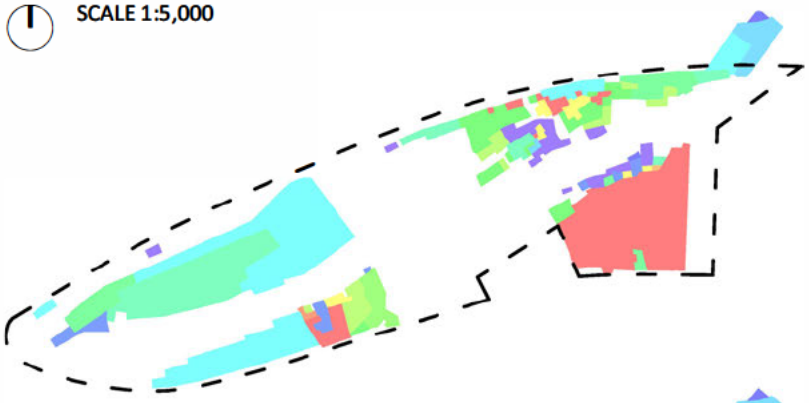
Year: 2016
Area: 23,328 m²
Average dwelling size: 16m²
Estimated population: 3,499
Growth: 148.86%



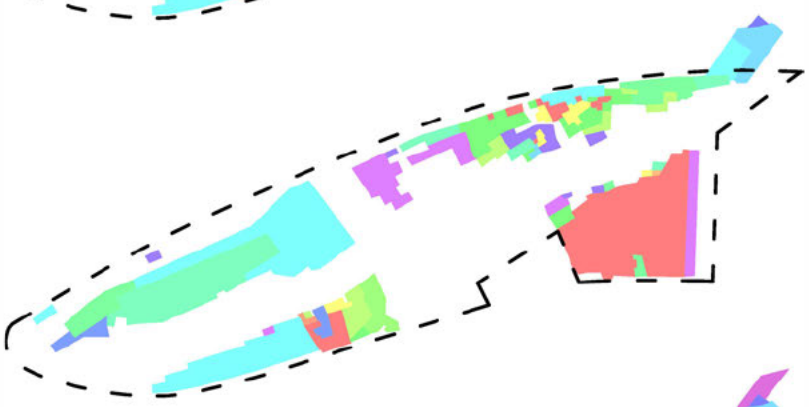
Year: 2017
Area: 23,407 m²
Average dwelling size: 16m²
Estimated population: 3,511
Growth: 149.70%

EVOLUTION OF THE QRWIS IN THE LAST TWO DECADES

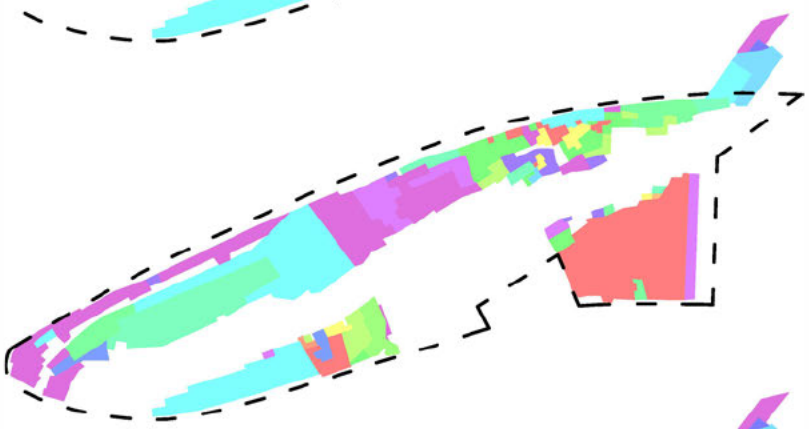
SCALE 1:5,000



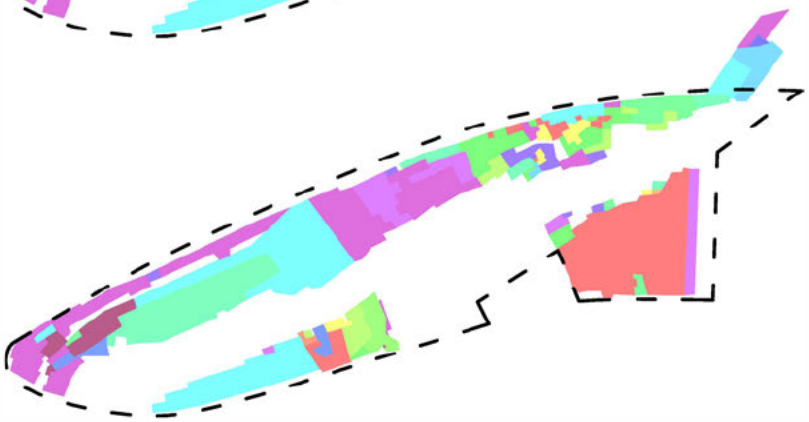
Year: 2018
Area: 24,163 m²
Average dwelling size: 16m²
Estimated population: 3,624
Growth: 157.77%



Year: 2019
Area: 25,350 m²
Average dwelling size: 16m²
Estimated population: 3,803
Growth: 170.44%



Year: 2020
Area: 30,695 m²
Average dwelling size: 16m²
Estimated population: 4,604
Growth: 227.46%



Year: 2021
Area: 31,463 m²
Average dwelling size: 16m²
Estimated population: 4,720
Growth: 235.65%