

An Undivided Landscape
Dissolving Apartheid buffer zones in Johannesburg, South Africa

by

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I hereby declare that I am the sole author of this thesis.

This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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ABSTRACT

Progressive spatial segregation of Whites from other ethnic races in South Africa started in 1886. Apartheid rulers evicted three and a half million Blacks, Coloureds and Indians from white urban and residential areas between 1904 and 1994. Apartheid planners used natural, mining, industrial, and infrastructural buffer zones to spatially enforce segregation. They based their apartheid spatial governance on separation and control and not on urban development. Today remnants of apartheid remain deeply embedded in the urban framework, where large buffer zones continue to enforce segregation and disrupt economic growth.

Victims of apartheid legislation believed the eradication of apartheid in 1994 meant the right to live in the city and the end of forced evictions. Since then the post-Apartheid government has conducted 2 million evictions, reminiscent of the 3.5 million evictions during the apartheid years. In an attempt to make Johannesburg a `world class city`, the municipality forcefully removed the poor from the city, and relocated them to rural locations where their livelihoods are severely challenged. To many, a new `apartheid` has been born; one that segregates the rich and the poor.

The government has released several strategies to provide land for the poor near the city, but the high cost of land in urban areas has disrupted implementation.

The thesis proposes a three-fold strategic design intervention to provide land for the poor near the city and dissolve the apartheid-designed buffer zone between Soweto and Johannesburg. The site, a landmark from the apartheid spatial legacy and part of the Witwatersrand gold mining belt, separates Soweto, home to four million Blacks, from the city of Johannesburg. About one and a half million people commute to the city each day passing by the 14 km stretch of this toxic mining land.

The thesis proposes three urban design strategies to transform the site into a community, which the local people would build: Remediation strategies to address the toxic mining landscape, infrastructural strategies to provide basic services and economic strategies to promote economic growth. These strategies operate in a co-dependent structure. Co-op centres implement these strategies, transferring strategy technologies to the local community.

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Dedication

I dedicate this thesis to Jesus Christ, my Lord and my Saviour. To my husband: Thank you Marius for your immeasurable support, love and sacrifices that you have made since we arrived in Canada, four years ago. To my parents, you have gone above and beyond to support and encourage me. I thank you both for your unconditional love and amazing example.

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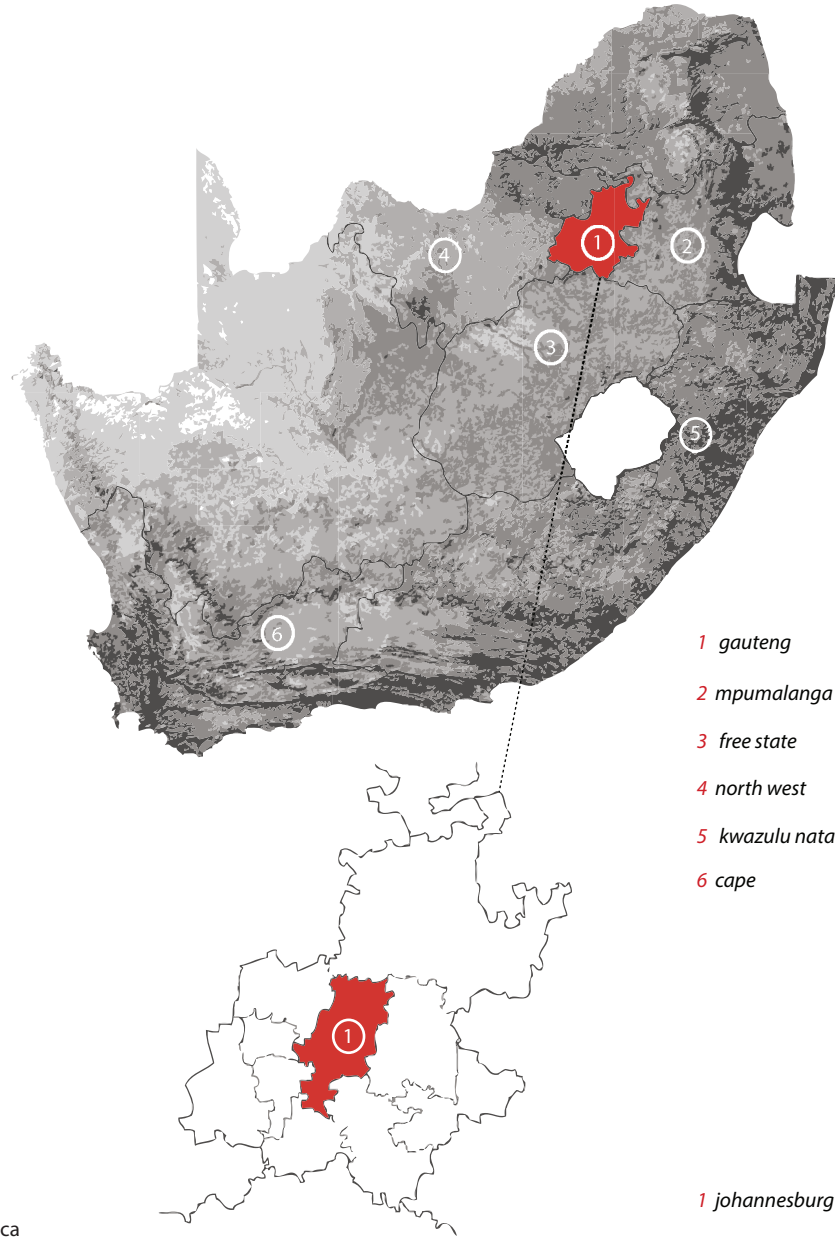
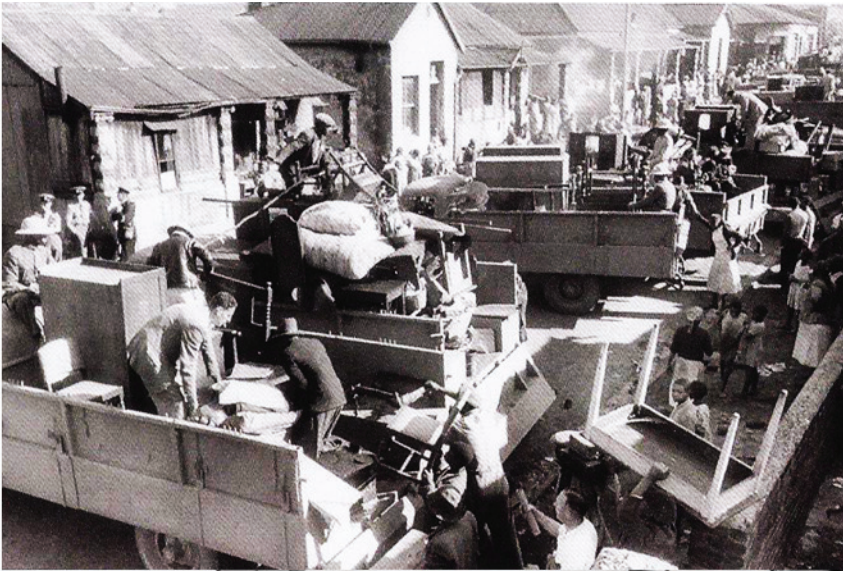


Figure 0.1 Johannesburg, Gauteng, South Africa



■ *apartheid evictions*

■ *post - apartheid evictions*

Figure 0.2 post apartheid and apartheid evictions

01

THE VOID

POST-APARTHEID CONTEXT

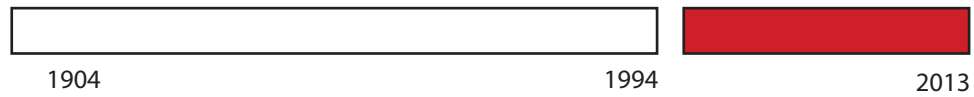




Figure 0.0 The Landless people of South Africa

01-1

JOHANNESBURG 2013

The Post-Apartheid City

The Post-Apartheid city of Johannesburg grew from an “all-White” City of 250, 000 people during the Apartheid era to a racially integrated city of 3.277 million today. The Blacks evicted by the Apartheid regime, returned to city in masses. Population growth has outgrown the city's infrastructure, and thousands are homeless. Public spaces are thought of as unsafe and many of the city's Apartheid ruins have been inhabited by the poor.¹

During the 1990's the city started to re-design itself as a “world class African City.” The movement toward a world-class city promoted decentralization. The council developed the wealthy northern suburbs into areas resembling New York, London and Paris. Sandton, located to the north of the Central Business District developed into the financial and corporate centre.²

During the late 1990's, the municipality realized the enormous infrastructural wealth in the inner city and started to repossess it. Private developers purchased expensive buildings for much less than their value during Apartheid. Private developers and municipalities began to redevelop large portions of the financial district. Several corporate headquarters moved back to the inner city. Inner-city repossessions steered by private and municipal financial interest, led to mass forced evictions of the poor.

Post-Apartheid segregation

Every day, Johannesburg's municipality forcefully evicts the poor from the city to make way for municipal development strategies to move the city towards world-class status.³ With no notice the municipality forcefully evicts the poor from buildings at night.

The council conduct such evictions in the context of *The Johannesburg Inner City Regeneration Strategy (ICRS)* and the poor who are mostly woman and children are left on the streets. The Black authorities conduct evictions, reminiscent of the Apartheid era. The Apartheid vehicle, previously driven by the White racist government, is now driven by privileged Blacks, against their own people. Seventy-two percent of the homeless people in Johannesburg are Blacks, followed by Coloureds and insignificant numbers of Whites, Indians and Asians.⁴

Post-Apartheid municipalities erroneously view the poor as hostile criminals that obstruct the vision of the city.⁵ The Department of housing has developed strategies and policies to provide housing for the poor. The lack of funding and the scarcity of affordable land near the city disrupt housing policy implementation at municipal level. Government fraud and illegal spending, bad financial management of contractors and developers, and bad building methods further disrupt housing delivery.⁶ Consequently, South Africa's housing backlog has increased from 1.5 million units in 1994 to over 2.1 million units, leaving 12 million people homeless.⁷ Informal dwellers, who represent 29% of Johannesburg's residents,⁸ are left to fend for themselves by erecting makeshift shelters on whatever vacant land they can find. The current focus of the municipality is to eradicate informal settlements and counter land invasions with forced evictions,⁹ this slows economic growth and drives the poor deeper into poverty.

Divided City

The strong apartheid influence in the shaping of Johannesburg constructed a divided urban fabric. Soweto, home to some 3-4 million people living in an area of 120 square kilometres - an estimated 65% of Johannesburg's poorest residents - is divided from central Johannesburg with a 14km stretch of toxic mining land.¹⁰ Designed for segregation and control, Soweto lacks economic infrastructure.¹¹ Consequently, an estimated 1.5 million people commute to central Johannesburg each day.¹² Land in Soweto is scarce, and there is no land available for future development. Housing backlogs, forced evictions, and unaffordable land near the city forces many of Johannesburg's poor informal dwellers to live far from the city. Expensive transportation costs, and long hours of travel, increase unemployment and poverty. The poorest people in Johannesburg are spatially divided from the city.

Dissolving buffer zones

This thesis proposes urban design strategies to provide land for the poor near the city while simultaneously dissolving the apartheid buffer zone - a 14km stretch of mining land - dividing Soweto from Johannesburg. It proposes design interventions to develop the site area into non-toxic habitable land for residential and commercial use, and instigate the growth of self-sufficient communities.

A three-fold strategic design intervention makes the land habitable, while promoting self-reliant community development. Co-op centres train the local community in these instructions. Three urban design strategies transform the site into a self-sufficient community built by the labour of the local people. Remediation strategies address the toxic mining landscape, infrastructure strategies provide basic services, and financial strategies promote economic growth.

Remediation Strategies

Remediation strategies involve four spatial interventions: urban forests, water canal, reed-beds, and allotment gardens.

The study area forms part of the Central Rand in the Witwatersrand gold mining belt. The site has undergone years of intensive mining which has led to significant pollution: dust emissions from MRA's (mine residual areas), water and soil pollution from AMD (acid mine drainage) and radio-activity, geotechnical instability - sink holes and unstable ground - caused by underground mine workings and open mine shafts.

The thesis uses the "Woodlands Mines project" case study to guide the remediation process. Remediation strategies promote informal economy activities.

Infrastructure Strategies

Three infrastructures - water, electricity and sanitation - provide basic services. Co-op workers build these infrastructural systems and train others at co-op centre workshops.¹³

Economic Strategies:

Three economic activities - collecting, producing, and trading - make up the economic strategy.

The study area is next to Soweto, an overpopulated residential township, that generates large amounts of waste and one of the largest landfill sites in the city locates to the east of the study area. There is significant opportunity for the collection of waste. Informal dwellers use collected waste to produce goods and trade them. Strategies borrowed from the “trash to cash” system referenced by Robert Neuwirth¹⁴ move the poor out of poverty, and tap into Johannesburg's informal economy of cash-only street traders and vendors - “arguably the largest informal economy in the world, second only to Beijing's informal sector”.¹⁵ Informal dwellers develop permanent social relations, maintain livelihoods and construct their own secure communities.

Where municipalities resort to forced removal and relocation of the poor, the plan here provides land for the poor near the city. The plan involves local communities, employing sweat equity and transferring technologies to local people, promoting the preservation of Johannesburg's infrastructure by keeping the poor from illegally occupying spaces in the city and by using labour efforts to profit them.

01-2

BLACKS RETURN TO THE CITY

Post-Apartheid Johannesburg has evolved into a city characterized by “socio-spatial stratification, racial inequality and marginalization.”¹⁶ In 1986, the municipality relaxed Apartheid influx controls and poor and displaced persons infiltrated the city. Johannesburg soon became one of the most racially integrated cities in South Africa. Crime levels in Johannesburg increased rapidly, residential property owners increased rents and cut maintenance to buildings. (Fig. 1.0, p7) New Black occupants did not argue over higher rent for fear of being evicted from the city. Eventually, White residents left the city, fearful of increased crime and political turmoil. Crime spread to the upper-class and middle-class suburban areas, and Whites fortified their homes.¹⁷ (Fig. 1.1, p8) Commercial property owners followed by building high walls around their properties and installed “high-tech” security systems.¹⁸ These safety mechanisms not only altered the aesthetics but also caused an instantaneous social and visual segregation.

While wealthy residents either protected themselves or left, the urban poor fended for themselves, taking up occupancy in whatever void or abandoned space they could find, filling most parks, abandoned buildings, cemeteries and other open spaces. (Fig. 1.2, p8) Informal dwellers, refugees, illegal immigrants, runaway youth and young mothers are among the poor in the city. It became evident that there were no legal residential options for the poor in post-Apartheid Johannesburg.¹⁹

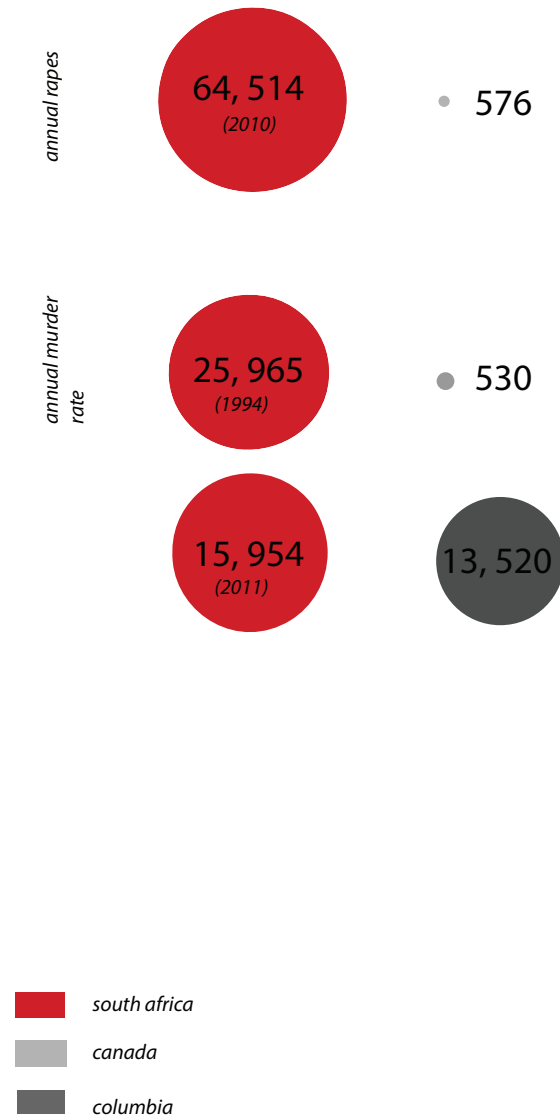


Figure 1.0 Overview and comparison of crime statistics for south africa



Figure 1.1 Residential house in Johannesburg fenced in with razor wire, spikes, and chicken wire.

Figure 1.2 Informal dwellers in Johannesburg

Figure 1.3 The poor occupy slum buildings in Johannesburg's inner city

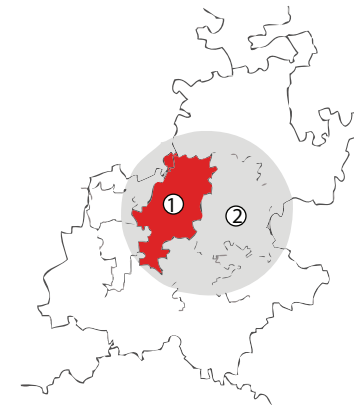
Figure 1.4 Johannesburg aims to become a world class city

The following conditions have contributed to informal settlement growth and inner-city building invasion.

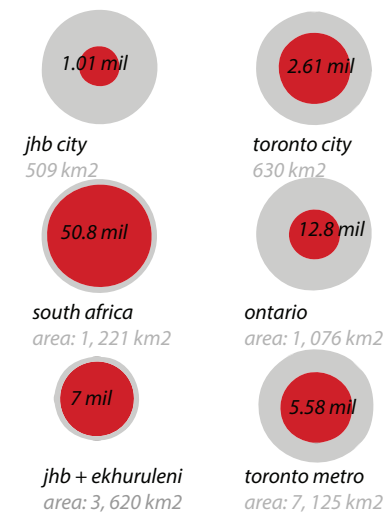
- Urban population growth in the city outweighs wage-paid employment (Fig. 1.5, p 9)²⁰
- 20,000 persons have arrived in the city each month since 1994 from rural areas, northern African countries and surrounding towns.²¹
- Population increased with 25 percent in greater Johannesburg in the first 10 years after the end of Apartheid²² while Graeme Gotz predicts that the number of households in greater Johannesburg will double in the next twelve years.²³

Since the end of Apartheid informal settlement growth has increased significantly; informal dwellings increased with 42 percent between 1996 and 2001 and today, 29% of Johannesburg's residents do not have formal shelter.²⁴

- Forty percent of Johannesburg's residents live in inadequate housing.²⁵
- By 2005 South Africa's housing experienced a shortage of near three million units.²⁶
- By 2010, 250,000 illegal immigrants occupied slum buildings in the inner-city of Johannesburg.²⁷ (Fig. 1.3, p8)
- The average daily income is less than \$7.74.²⁸



1 johannesburg pop. 3.775 mil area: 1645km2
 2 ekhuruleni pop. 3.144 mil area: 1975km2



■ population
 ■ area

Figure 1.5 comparative population of south africa



Figure 1.6 Red Ants conduct mass evictions

Figure 1.7 The Red Ants confiscate the belongings of the poor

Figure 1.8 Red Ants forcefully evict the poor

Figure 1.9 The Red ants wear trademark red helmets and overalls

01-3

MUNICIPALITIES EVICT POOR BLACKS FROM THE CITY

When city officials realized the severity of infrastructural invasion and degradation caused by the rising levels of the poor in the city, they passed eviction policies to reverse the process. City officials, driven to reverse the growth of informal settlements in the city steered regeneration and revitalization strategies to develop Johannesburg into “a world-class city”, catering to lifestyles suited for the wealthy and middle-class and ignore the poor.²⁹ (Fig. 1.4, p8) In 2001 city officials celebrated the launch of *The Inner City Regeneration Strategy* forcing evictions of the poor, using city bylaws, building codes, and safety regulations to justify their actions.³⁰ Municipalities, formal laws and courts enforce the removal of the poor from the city.³¹ Currently only 1.01 million of the 3.775 million Johannesburg residents live in the 509 square kilometres that make up central Johannesburg.³²

In 2004, the department of housing pledged to eradicate all informal-settlements by 2014.³³ This target is not mentioned in *The 2004 Breaking New Ground policy*, but municipalities adopted it as a national target in 2005.³⁴ Since 1994 the government has conducted an estimated two million forced evictions³⁵ - according to *COHRE (Centre on Housing Rights and Evictions)*, 840,000 between 1995 and 2006.³⁶ These evictions happened without a court order or alternative housing provisions. This violates both *The Prevention of Illegal Eviction Act* and the South African constitution.³⁷ These evictions look little different from those of the previous Apartheid governments.³⁸

The Red Ants Eviction Squad

The government hires the ruthless “Red Ants.” (A private security firm recruits thousands of armed men to forcefully evict and demolish informal settlements and empty out slum buildings). (Fig. 1.8, p10) Informal dwellers gave the “Red Ants” their name because of their violent acts, red overalls, and red helmets. (Fig 1.9, p10)



Figure 1.10 Shack dwellers movement

Figure 1.11 Landless peoples movement

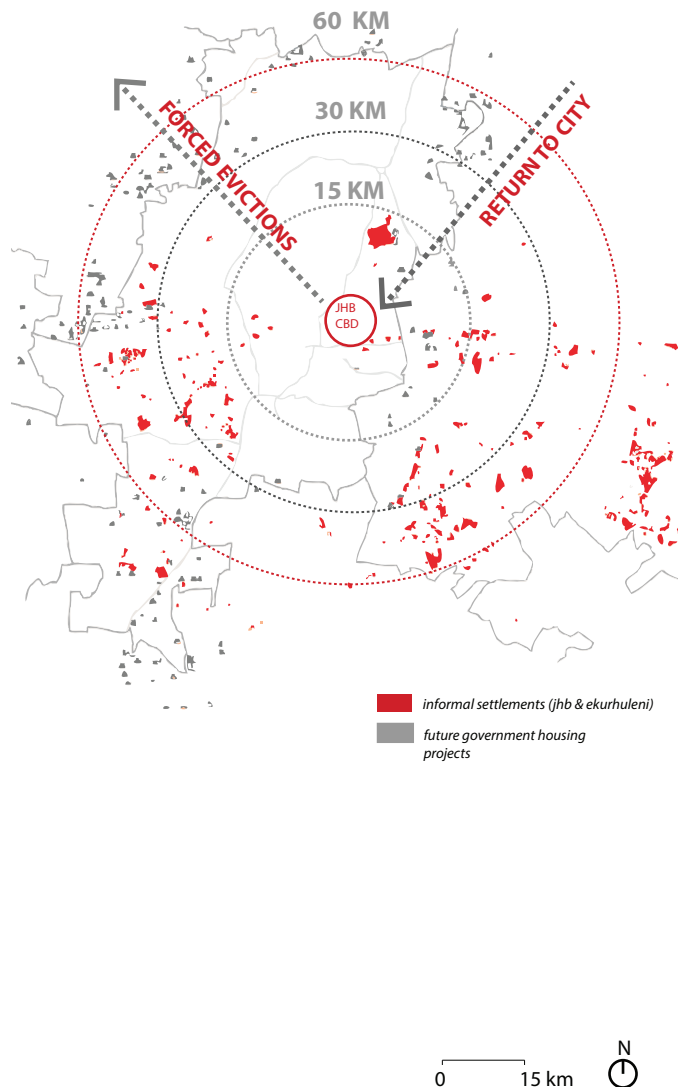


Figure 1.12 Most evictees return to the city within days

Several films and images (Fig 1.6 p10) expose the eerie satisfaction with which the Red Ants do their job:³⁹ they confiscate the belongings of the poor and destroy their mediocre shelters.⁴⁰ (Fig. 1.7, p10)

Voicing the rights of the poor

Abahlali baseMjondolo, a shack dwellers movement and the landless people's movement are the largest activist movement in Post-Apartheid South Africa. (Fig. 1.10, p11) They are voicing the rights of the poor masses. The landless people's movement authored the slogan "No Vote, No Land" during the 2004 municipal elections.⁴¹ (Fig 1.11, p11)

Our government is concerned about developing spaces, not population development, so as they develop spaces, they move away people, they say people should move away to pave way for development to happen. So by building this stadium they are moving people away from the cities and away from their original places even rural areas because they want to build malls big malls, they want to build freeways. - Rev. Mavuso Mbhekiseni from Rural Network in South Africa, leader of Abahlali baseMjondolo movement⁴²

Unlike the Apartheid government, the post-Apartheid authorities face exposure of their actions due to technology advances and the affordability of cellphones with camera's and video cameras. An award-winning film "Dear Mandela" released in 2012, supported by the Abahlali movement, brings to light the shocking number of evictions since 1994. The film exposes the illegal government-driven forced evictions, and gives a voice to the Abahlali movement. Mazwi Nzimande, from the shack dwellers movement, says that *The Slums Act* released in 2006 prohibits any resistance to forced evictions. Municipalities threaten persons that resist eviction with a R20,000 fine or five-year jail term.⁴³ Abahlali exposed the legalization of mass evictions in *The Slums Act* and brought their case to Constitutional Court in South Africa.⁴⁴

01-4

NO HOUSES FOR THE POOR IN THE CITY

A Dumping Ground For The Poor

Municipalities do not provide adequate re-settlement arrangements for the victims of eviction.⁴⁵ They are taken to areas on the metropolitan edge, up to 60 km outside the city.⁴⁶ Many 'evictees' return to the city within days and those who remain behind become unemployed and live in impoverished conditions. (Fig. 1.12, p12)

Housing Is A Right For All South African Citizens

The constitution of South Africa states that all South African citizens have a right to adequate housing, which logically means a right to land.⁴⁷ The foundational principles for the current housing delivery policy, established in 1994, have resulted in a "market driven, developer- led provision of shelter."⁴⁸

Post-Apartheid Government Fails To Provide Houses For All

The post-Apartheid city of Johannesburg contradicts the image painted by the African National Congress in 1994. The ANC promised to transfer 30% of White-owned land to Black ownership.⁴⁹ Today, only 2 or 3 percent of land has shifted to Black ownership.⁵⁰ The Post-Apartheid authorities delivered 1.6 million formal housing units, but between 1995 and 2004 the largest cities in South Africa experienced a 30% growth in informal-settlements.⁵¹ The housing backlog increased from 1.5 million in 1994 to over 2.1 million units, leaving 12 million people homeless.⁵²

FIG. 1.13 Proposed Location For Future Public Housing

Proposed future government housing projects are located on the metropolitan edge instead of in the city. This promotes the existing divided landscape, created by the Apartheid government and disrupts economic growth. Post-Apartheid housing delivery methods increase poverty because of long distance commutes to employment.

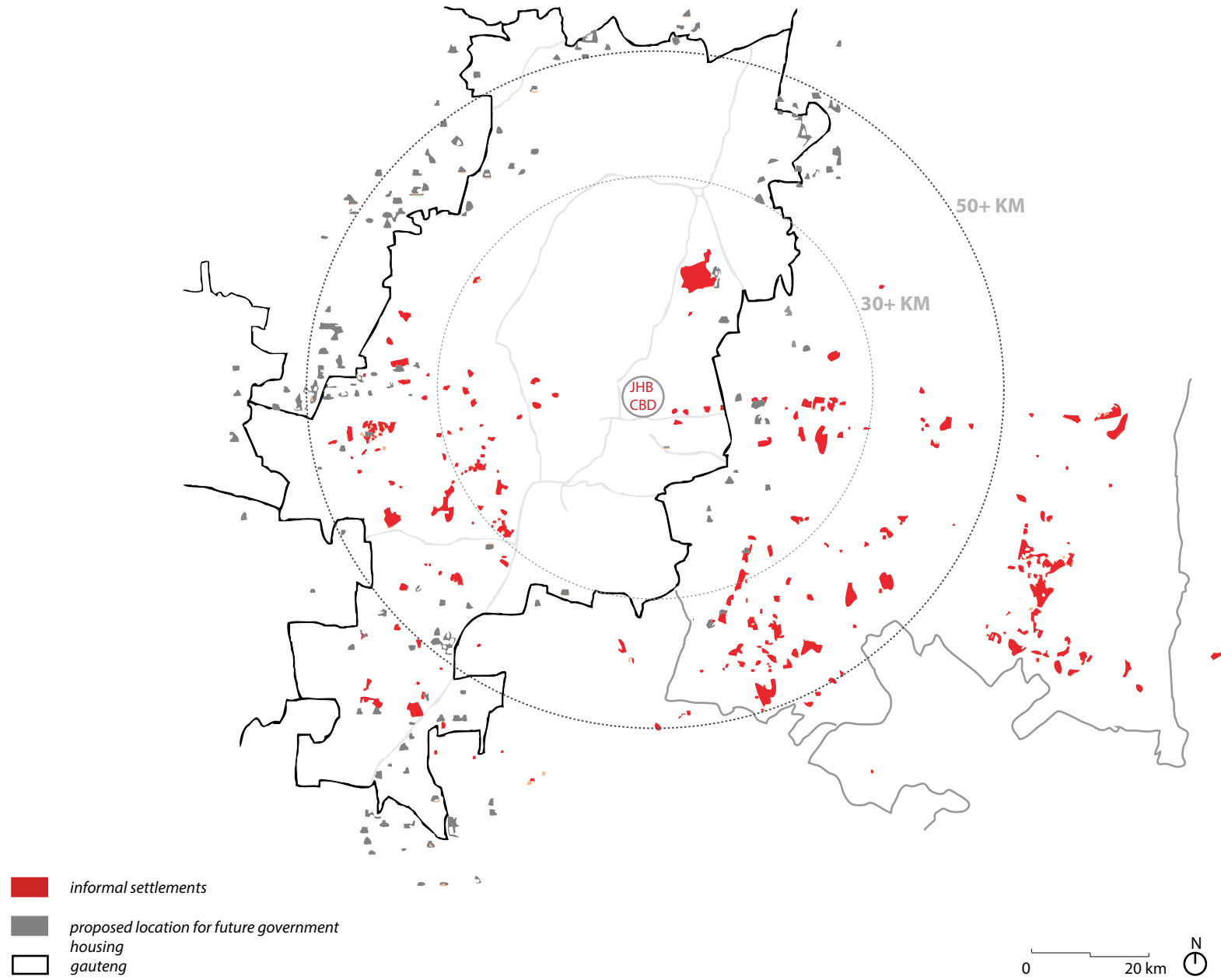


Figure 1.13. proposed future government housing location

FIG. 1.14 Informal Settlement Location

Many of Johannesburg's poorest residents are forced to live on the urban periphery and commute up to 40km on foot or taxi to work each day. Many others remain unemployed, as the cost of transportation outweigh their wages.

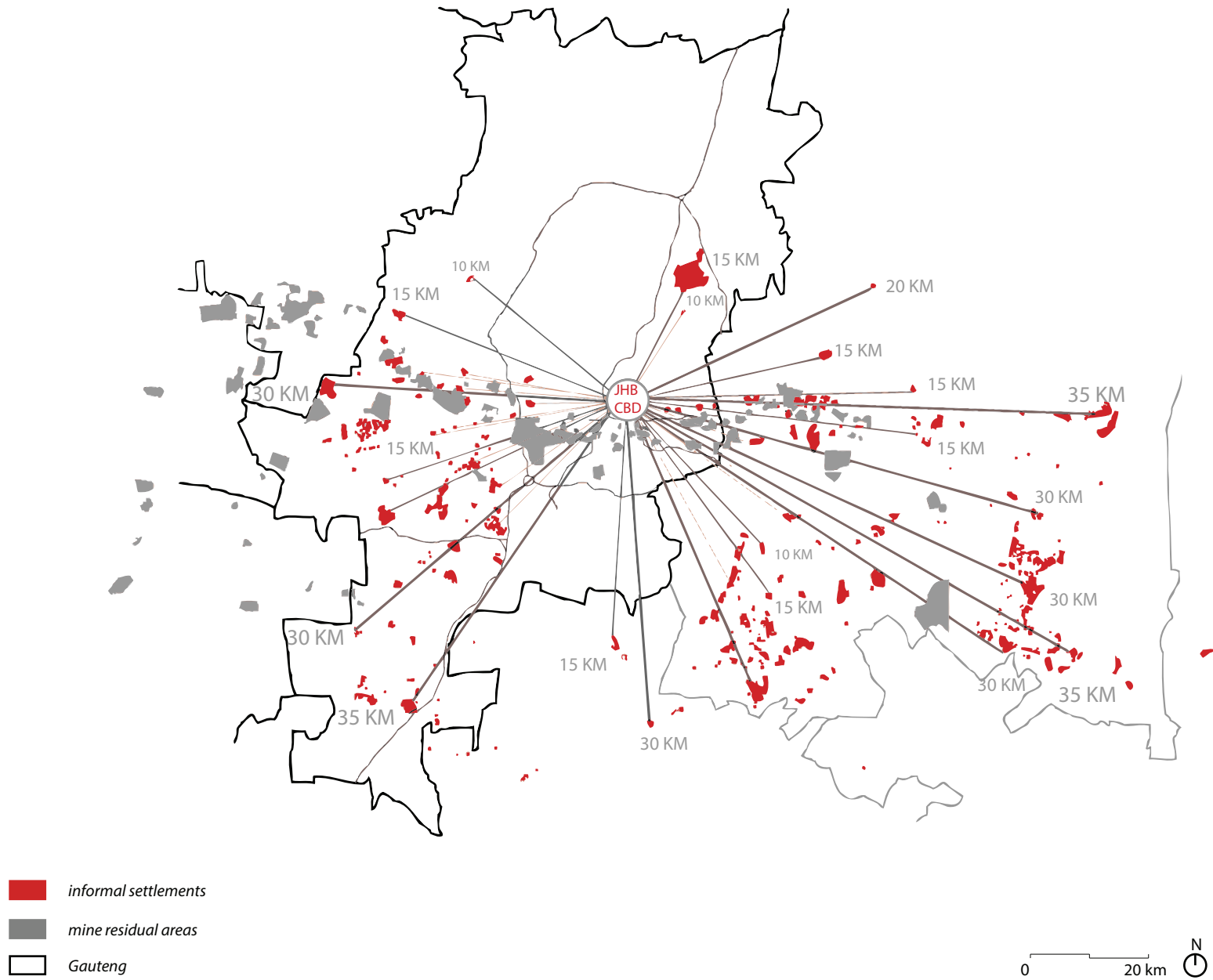


Figure 1.14 informal settlement location and distance from Johannesburg CBD

The lack of adequate housing in the post-apartheid era is not merely a product of apartheid, but of the failure of the democratic government to respond to the basic needs of the poor.⁵³ The Government's failure to provide housing for the poor is revealed by the number of informal settlements, overcrowded townships, increasing number of backyard shacks and illegal squatting in abandoned buildings and public spaces.⁵⁴ The housing programmes and policies of municipalities have failed to resolve the enormous housing backlog.⁵⁵ The simple truth is that the government of South Africa lacks the resources required to eradicate informal housing with the provision of formal housing.⁵⁶

Today, the city of Johannesburg has no well-located housing for the poor. The majority of Johannesburg residents without decent housing locates South-West of central Johannesburg.⁵⁷ (Fig. 1.17, p21)

Shortcomings Of Post-Apartheid Housing Delivery

Current government housing projects do not abide by the official commitment to high-density cities. Proposed future government housing projects are located on the metropolitan edge instead of in the city. (Fig. 1.13, p15) This emphasize the divided landscape created by the Apartheid government.⁵⁸ Furthermore, Government funded housing developments are mass mono-functional site and service schemes with low density "match box houses" built on disconnected barren parcels of land. Post-Apartheid housing cause mass "socioeconomic hardships" because of long distance commutes to employment and harsh informal-settlement conditions.⁵⁹ The current product and the market-driven approach toward housing provision and informal settlement eradication ignore the voices of the poor. Mono-functional housing projects exclude local initiatives and disturb the already fragile livelihoods of informal dwellers. Housing-based intervention has primarily focused on informal-settlement removal and the prevention of land or building invasion.⁶⁰ In 2004, the Department of Housing released a new programme that promotes *in-situ* upgrading of informal settlements. *The Informal Settlement Upgrading Programme* demotes relocation by bringing formal housing and services to the site.⁶¹

Reasons For Non-Implementation Of Housing Strategies

The Housing Department has documented numerous reasons that justify the failure of housing strategies. Municipalities blame high housing backlogs on “social and developmental component” deficiencies to address past inequalities, high cost of well-located land, and the lack of private investment.⁶² “Illegal spending, fraud by government officials, financial discrepancies by contractors and developers, bad building methods, and illegal bribes to jump waiting lists have further disrupted housing delivery.” The shortage of land for residential use plays an important role.⁶³

Lack Of Secure Tenure

Although the municipality made title deeds for properties available since 2000, many Johannesburg residents may never have security of tenure.⁶⁴ A community survey conducted in Johannesburg in 2007 reports that only 22% of Johannesburg’s informal residents own their dwellings, 62 % occupy land rent-free, and 14% pay rent.⁶⁵ The same survey reveals that 60% of informal households in the Gauteng province live rent-free in informal settlements.⁶⁵ (Fig. 1.15, p 19)

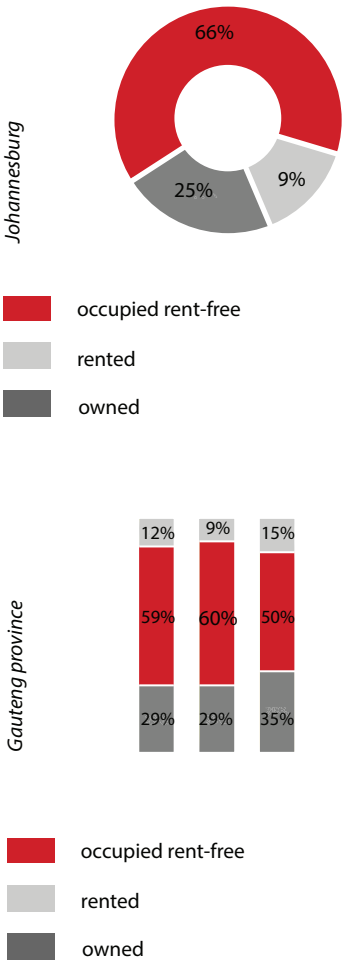


Figure 1.15 Informal dwelling tenure

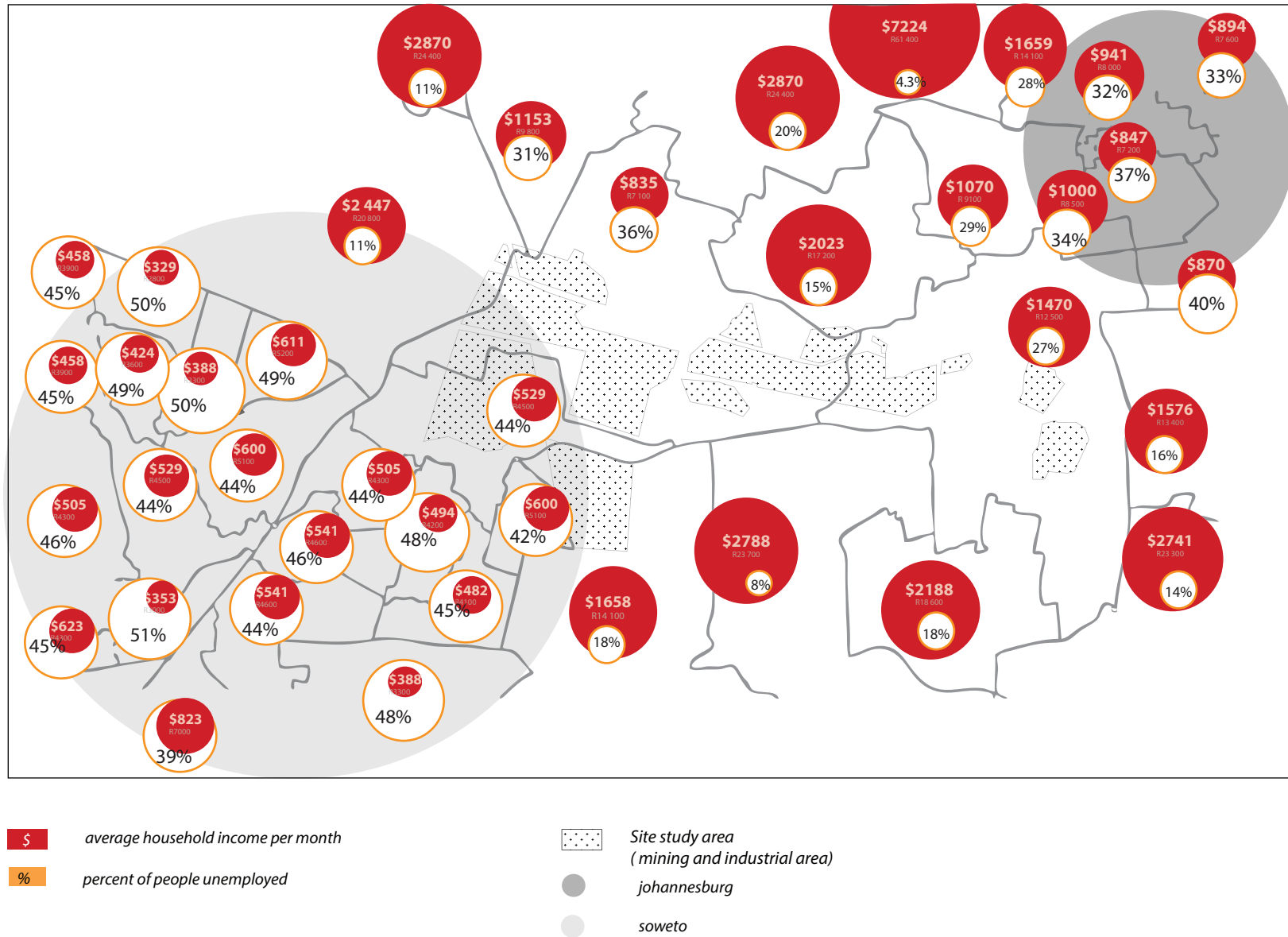


Figure 1.16 Monthly household income (\$) and percent of unemployment (%)

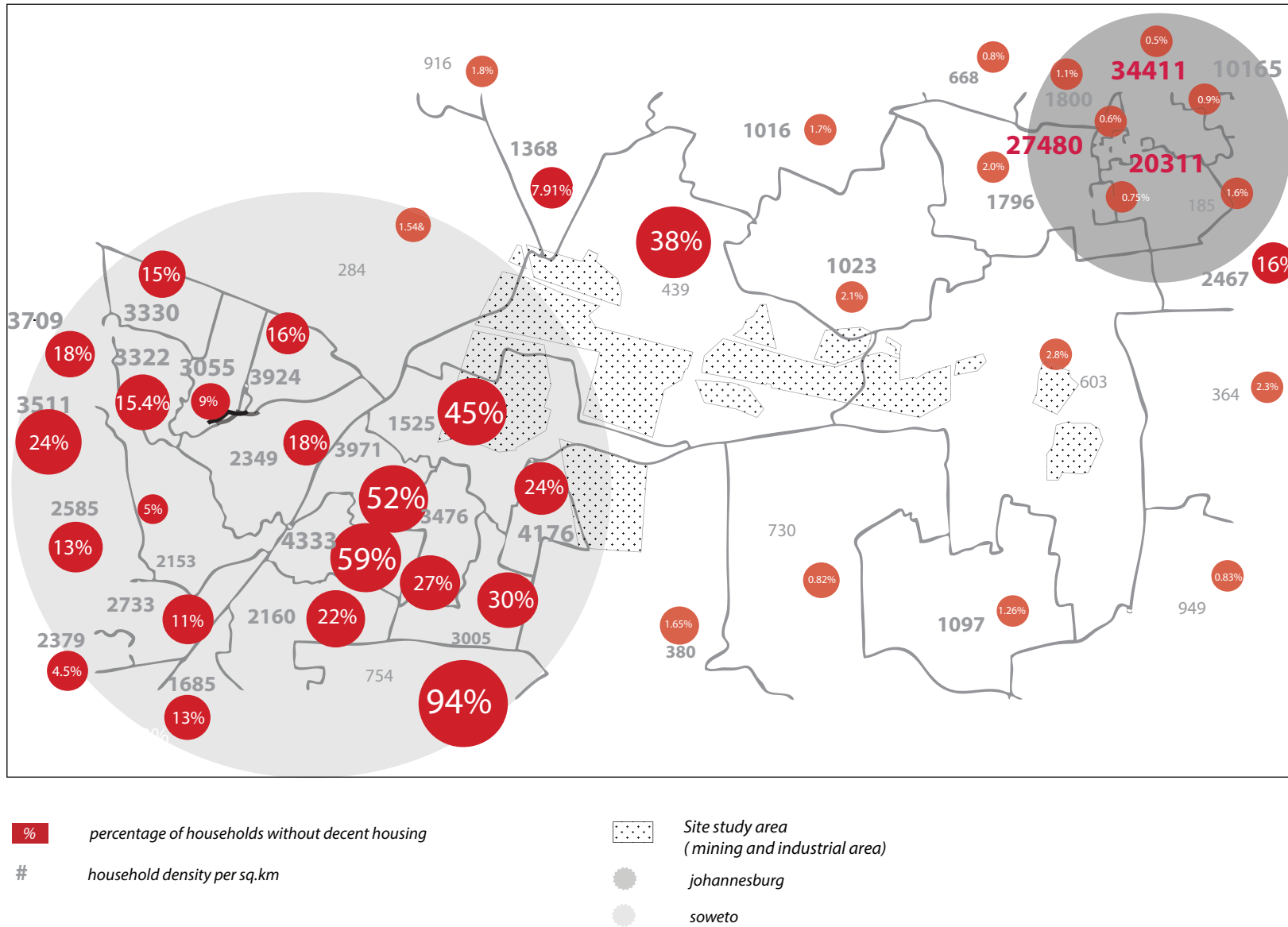
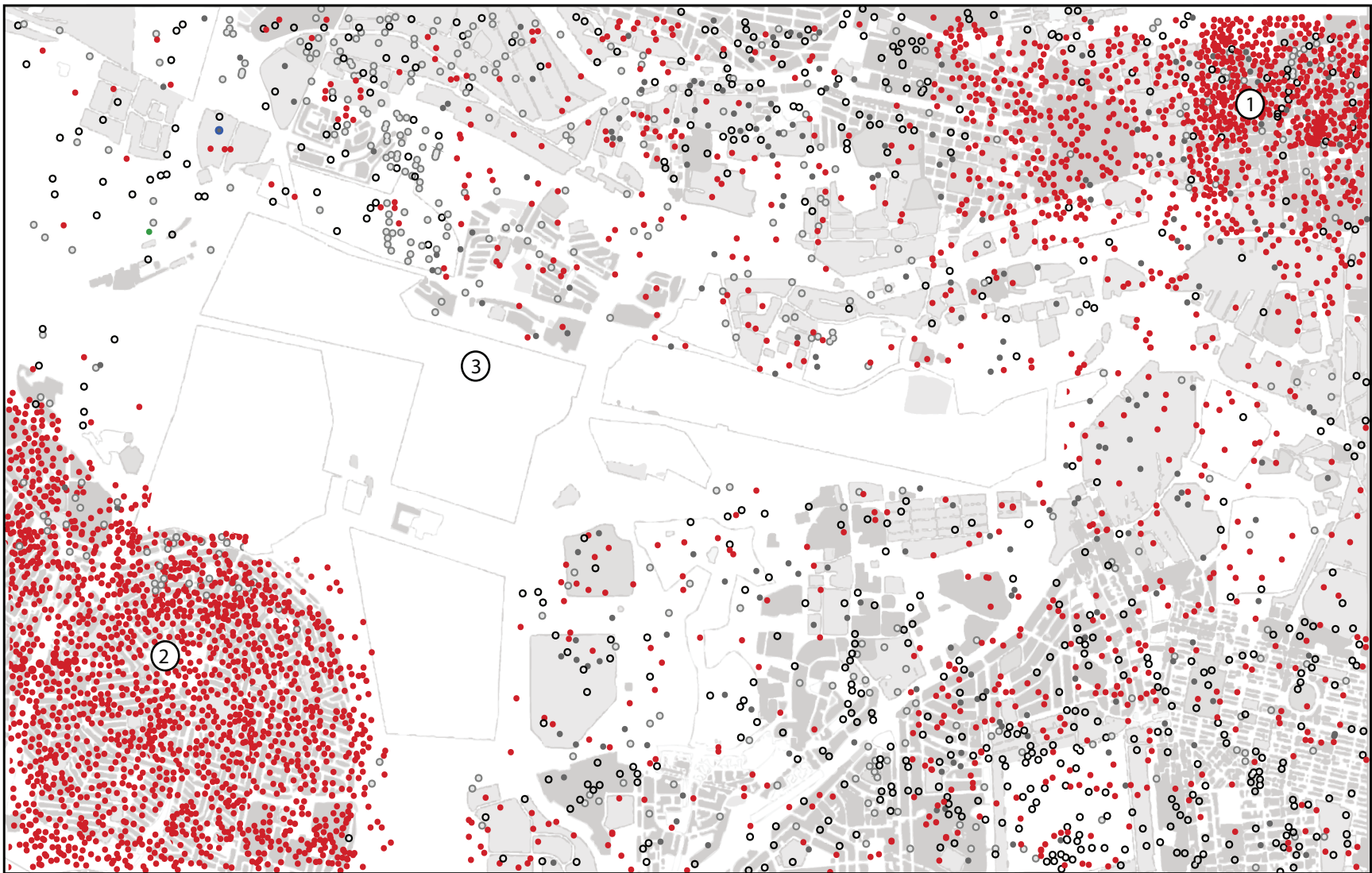


Figure 1.17 households without decent housing (%) and household density per sq.km

FIG. 1.18 Ethnic Race Distribution

Soweto, is the most populated urban residential area in the country. The population of Soweto is primarily Black and represents most of the 11 official languages of South Africa. Although several sources put Soweto's population at 3 to 4 million people, statistics put it just above 1 million. Toxic mining land blocks the intensely overpopulated Soweto from overflowing into and integrating with central Johannesburg and 1.5 million people are believed to commute from Soweto to Johannesburg each day.



- residual mine areas
 - 1 johannesburg cbd
 - 2 soweto
 - 3 mining and industrial area
 - blacks
 - whites
 - coloured
- 1 dot = 100 people

Figure 1.18 Ethnic distribution in Johannesburg by ward(2011)

01 - 5

SEGREGATED LANDSCAPE OF THE POST-APARTHEID CITY

The urban landscape of post-Apartheid Johannesburg consists of “fragmented, scattered” spaces that enable safe movement for middle-class citizens while prohibiting movement of the urban poor.⁶⁷ The highest-populated poor areas and informal settlements are primarily located south-west of the central business district, and most new employment opportunities exist in the fast growing North. Soweto, home to an estimated 65% of Johannesburg’s poorest residents is located 14 Kilometres South-West from central Johannesburg.

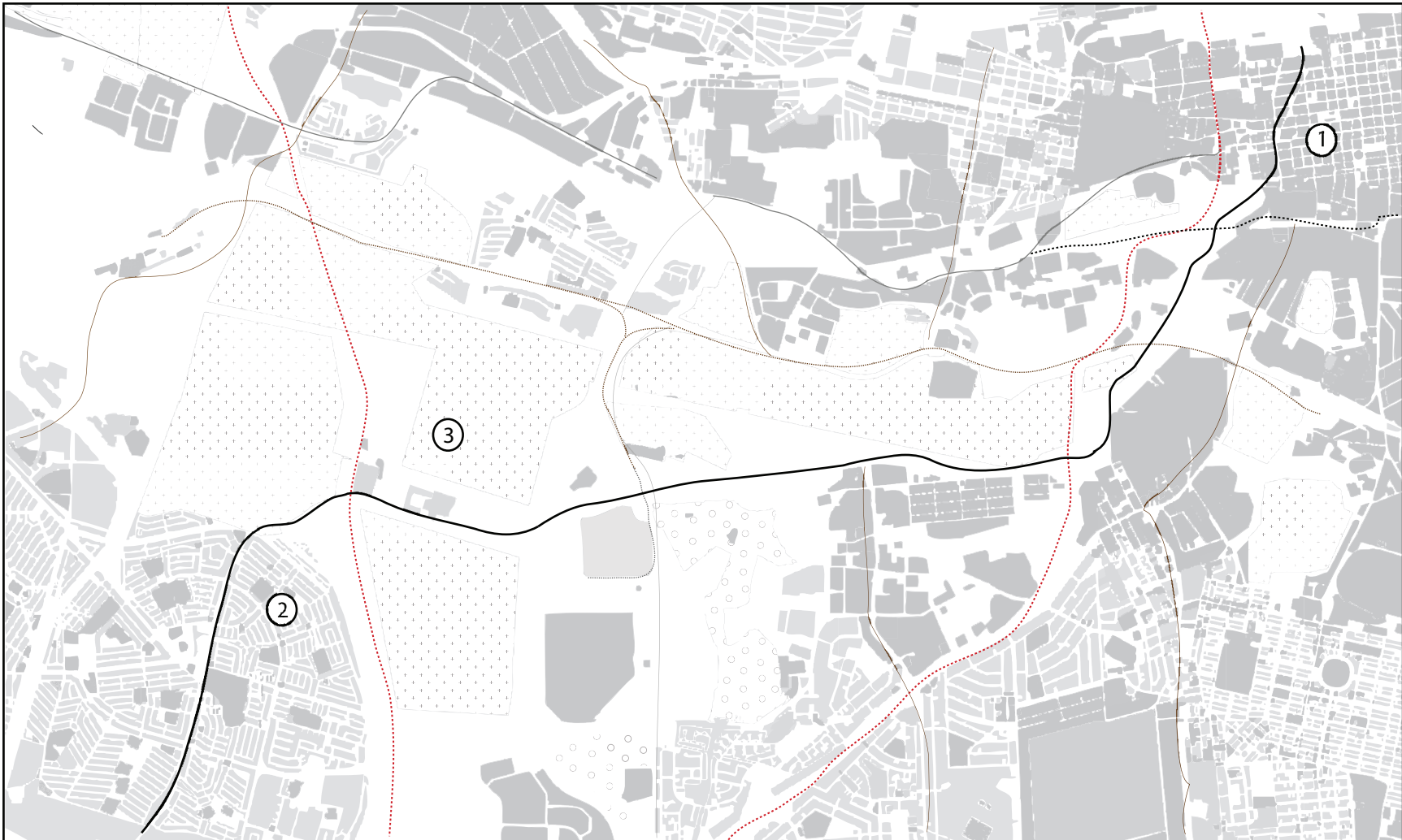
Soweto - South Africa’s Largest Township

Soweto, sized at about 120 square kilometres, is the most populated urban residential area in the country.⁶⁸ Toxic mining land blocks the intensely overpopulated Soweto from overflowing into and integrating with central Johannesburg. The population of Soweto is primarily Black and represents most of the 11 official languages of South Africa, with Zulu, Sotho, Tswana, Venda and Tsonga most frequent spoken languages.⁶⁹ (Fig. 1.18, p23) Although several sources put Soweto’s population at 3 to 4 million people,⁷⁰ statistics put it at 1,250,310.⁷¹ Soweto has many informal settlements, with the largest being in Doornkop, Thulani. Infrastructure has lagged behind due to apartheid legislation. Almost all employed Sowetans are forced to commute up to 30 km to work in central Johannesburg. Most commuters travel by foot, minibus taxis and trains. The Soweto highway and improved Mbatha Bus route allow improved commutes into central Johannesburg. According to a recent report the key issues to be addressed in Soweto include severe housing backlogs, unemployment, shortage of healthcare in Protea Glen and Slovoville, lack of healthcare education, lack of sport and recreation activities and environmental degradation.⁷²

Area Map

FIG. 1. 19, p 25

The Crown Gold mining area sits to the north of Soweto, agricultural land to the west, the N1 national highway to the east and the N12 freeway to the south. Soweto sits south and west of all major economic activity. The Central business district of Johannesburg is located north east of Soweto.












- | | | | | | | | |
|---|---|---|---------------------------------|---|---------------------|---|-----------------|
| 1 | johannesburg cbd |  | open space |  | parks/golf course |  | mbatha busway |
| 2 | soweto |  | commercial/Industrial/Municipal |  | residual mine areas |  | railway |
| 3 | Site study area
(mining and industrial area) |  | residential |  | primary roads |  | secondary roads |

Figure 1.19 Area Map

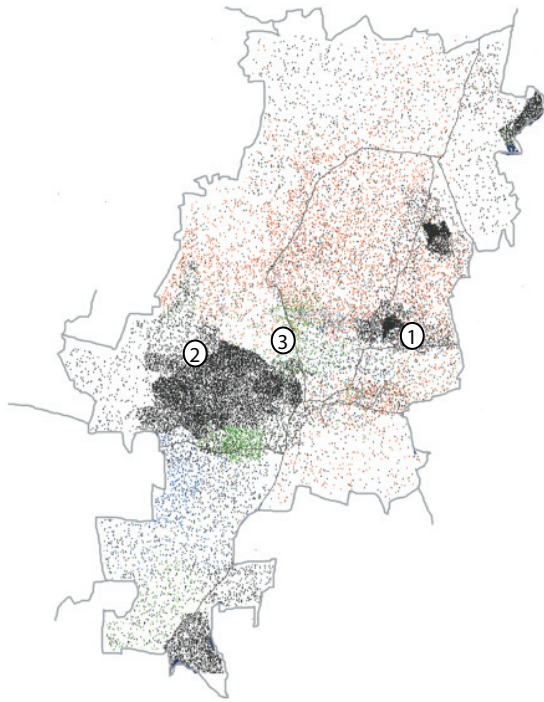


FIG. 1.20 Race Distribution
 FIG. 1.21 Population of Johannesburg
 FIG. 1.22 Unemployment in Johannesburg

These three maps compare the demographics, unemployment and population conditions between Johannesburg and Soweto. The maps also show the vacant Apartheid buffer zone inbetween Johannesburg and Soweto.

- The majority of Blacks in Johannesburg live in Soweto
- 65% of Johannesburg residents live in Soweto
- The majority of unemployed residents in the city live in Soweto

- 1 johannesburg cbd (pop. 1.01 mil)
- 2 soweto (pop. est 3-4 mil)
- 3 mining buffer zone
- black
- white
- coloured
- indian

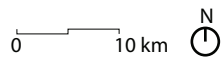
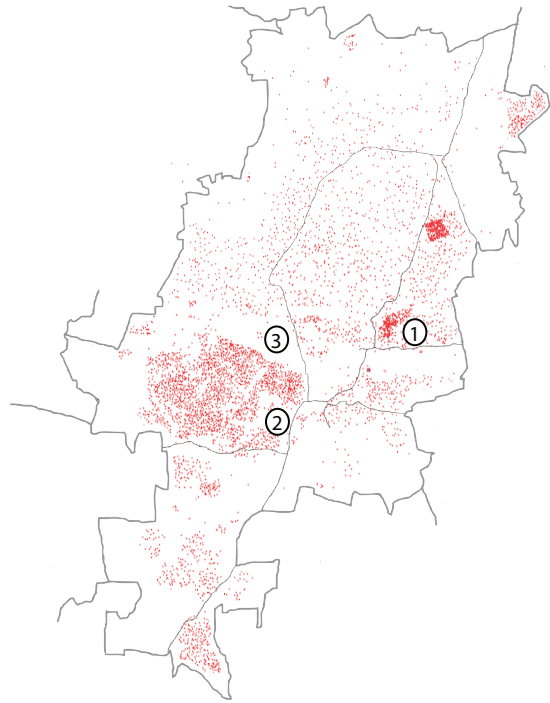


Figure 1.20 Johannesburg race distribution

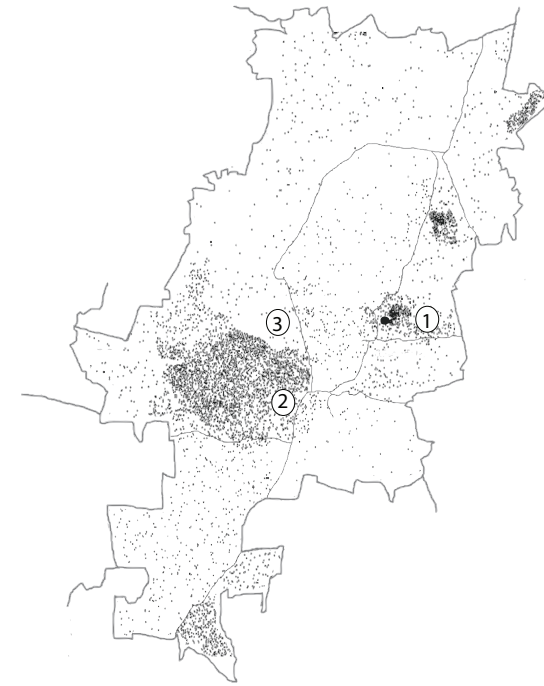


- 1 johannesburg cbd (pop. 1.01 mil)
- 2 soweto (pop. est 3-4 mil)
- 3 mining buffer zone

• population
1 dot = 500 people

0 10 km N

Figure 1.21 Johannesburg's Population



- 1 johannesburg cbd (pop. 1.01 mil)
- 2 soweto (pop. est 3-4 mil)
- 3 mining buffer zone

1 dot = 100 unemployed people
• unemployed

0 10 km N

Figure 1.22 Unemployment in Johannesburg

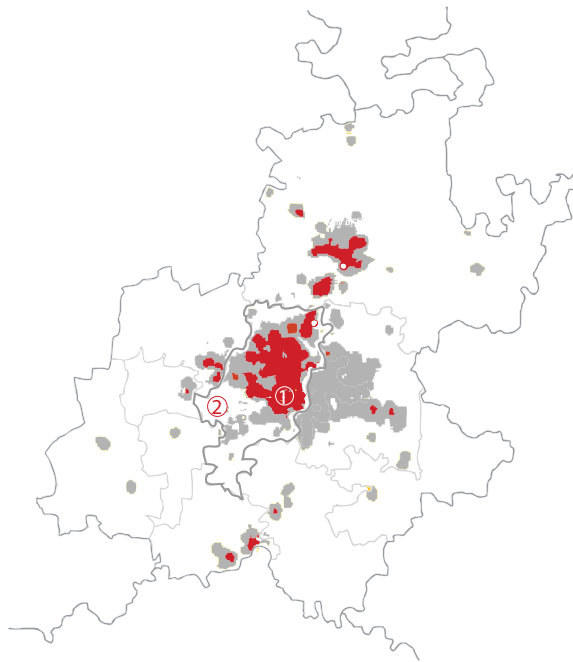


FIG. 1.23 Johannesburg's Formal Economic Activity

The Apartheid government planned Soweto without a commercial and infrastructural base to maximise control. Consequently, Soweto is void of significant economic activity. During the 1990's the city started to re-design itself as a ``world class African City.`` The movement toward a world-class city promoted decentralization. The council developed the wealthy northern suburbs into financial nodes.

- 1 johannesburg (cbd)
2 soweto

- high economic activity
■ moderate economic activity
□ no significant economic activity

Figure 1.23 Johannesburg's formal economic activity

Illegal Land Invasions

In the early 1990's, land and building invasions increased rapidly and municipalities legalized forced evictions of all informal-settlements developed after 1994.⁷³ The poor and landless people of South Africa have grouped together to find creative ways to survive in a country where legal housing is not an option. Crude opportunists such as shack lords, desperate farmers, and greedy businessmen provide illegal forms of secure tenure.⁷⁴

There are three popular ways that these con-men take advantage of the vulnerable poor. First, shack lords operate in networks to organize mass illegal land invasions of over 5,000 people in a single night. Shack lords can charge up to R80 monthly for land they do not own. This fee includes R50 for rent, R20 for protection and security, and R10 for possible legal fees in the case of municipal forced evictions.⁷⁵ In 2004, the rapid growth of illegal land occupation led to the creation of provincial level policy. The new policy legalized municipal forced evictions 48 hours after the act of land invasion.⁷⁶

A second form of illegal land provision is where self-titled landlords rent out poorly erected shacks in overcrowded informal settlements with no basic services. These landlords often rent to new-comers to the city, charging high rental fees for inhumane living conditions.

The third form of illegal land provision is shack farming. Shack farms are mainly operated by white farm owners who rent out portions of their land to over 10,000 shack dwellers at a rental fee of R250 per month without any basic services.⁷⁷ White farmers often resort to shack farming after their land value has decreased due to nearby land invasions. Farmers that operate shack farms have a monthly income of up to \$100,000.⁷⁸ In an attempt to decrease the number of land invasions, the government has made it a criminal act to organize or receive funds from land invasions.⁷⁹

Backyard shacks are an existing form of illegal housing provision that started during the apartheid-era. Formal house owners rent out the land in their backyards to shack dwellers for a monthly rental fee. Informal dwellers then create illegal service connections to existing municipal connections.

Friction Between The Rich And Poor Johannesburg

Johannesburg has become a ``dual city``, where a formal and an informal economy exist simultaneously. On the one hand the city boasts of expensive restaurants and on the other hand are run-down drug hotels. This multiple personality- the wealthy minorities and the poor- has caused friction in the post-Apartheid city.⁸⁰ The informal economy, made up of cash-only street traders and vendors is arguably the largest informal economy in the world, possibly only second to Beijing's informal sector.⁸¹ The city also boasts of a highly developed formal economy. The consumer sector well portrays this duality with high-class "low volume" products and services in the formal economy versus the low-class "high-volume" products and services flowing through the informal economy. Where informal economic activities take place on street corners, dark alleys, and open public spaces, formal economic activities take place in well-designed secured building spaces.⁸²

02 DEVELOPMENT OF THE VOID

APARTHEID



FIG. 2.0 The Void – A Product of Apartheid

The void, located between Johannesburg and Soweto, is a product of apartheid planning. The void is 14 kilometres long and 700 metres to 1.5 kilometres wide. In 1886, when Johannesburg residents discovered gold the site formed part of the Central Rand mining belt. Early apartheid activists initially evicted Blacks from the central city to the other side of the mining belt in 1904. From 1904 to the end of the Apartheid era the site acted as a buffer zone between Blacks and Whites.⁸³ Mining activities ended during the 1900's and recent surface mining activities have come to a close. Today, the site is a large void space located on valuable but toxic land and it continues to separate some three million people from the city.



□ Void / Open space 1 Johannesburg cbd
■ Built up area 2 Soweto

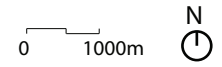


Figure 2.0 Void inbetween Soweto and Johannesburg

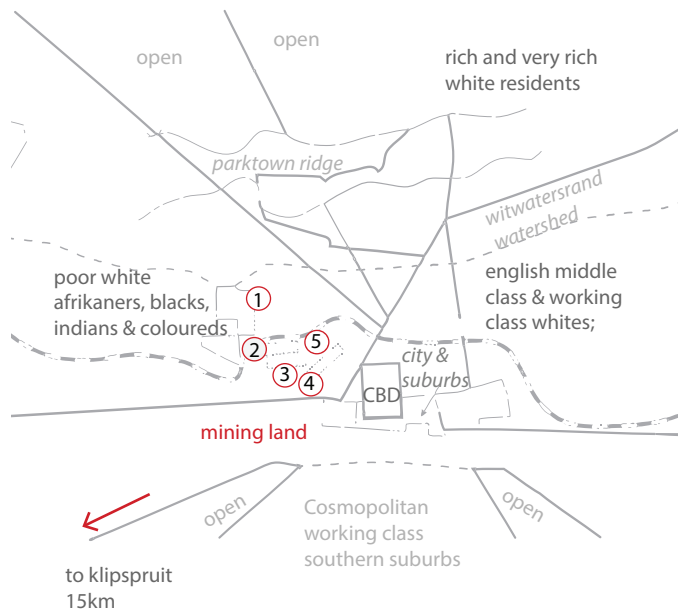


FIG. 2.1 Early beginning of spatial segregation

As aforementioned, the early Apartheid activists first evicted Blacks to Klipspruit, Soweto in 1904.⁸⁴ This marked the start of a forty-four year process of segregated spatial development in Johannesburg.⁸⁵

- 1 vreededorp
- 2 malay location
- 3 kafir location (blacks)
- 4 coolie location (indians)
- 5 brickfields

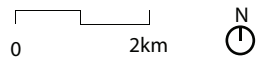


Figure 2.1 Apartheid spatial planning

02 - 1

SOWETO

Soweto: a temporary holding area for blacks

From its inception, Soweto operated primarily as temporary housing for labourers who worked in central Johannesburg. In an attempt to maximize control and policing, the government planned Soweto without commercial and industrial facilities.⁸⁶ In order to minimize movement, the government designed roads with many dead ends, few exits and little through-routes. This has increased control and obstructed Black economic growth.⁸⁷ Soweto, a cluster of many townships developed over the span of 76 years. (Fig. 2.2 p37)

Apartheid Housing Provision

- 1904 - The government provides temporary, corrugated shelters for Blacks in Klipspruit, which developed into permanent residential area for 30 years.⁸⁸
- 1930 - City council buys land in Klipspruit and constructs a township to house 80,000 people and 5800 houses in Pimville and Kliptown.⁸⁹
- 1939 – First informal-settlements develop in Soweto, as a result of increased employment demands in the city caused by WWII⁹⁰
- 1940 - Government builds houses in present-day Soweto rather than in the city⁹¹ During this time the government allocates only 2% of building material available toward public housing⁹².
- 1944 – City council builds the townships of Jabavu and Dube.⁹³
- 1950's - Apartheid government build single sex hostels in the townships to evict all Blacks from the city.⁹⁴

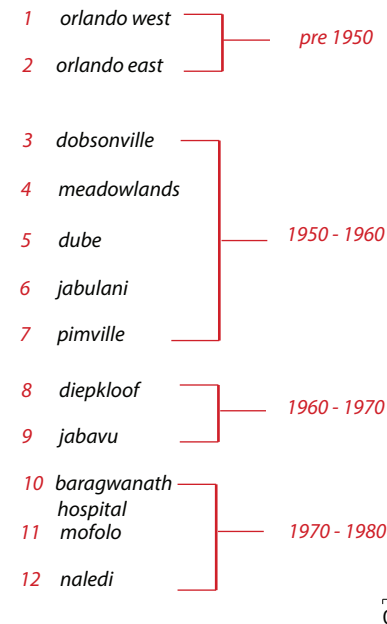
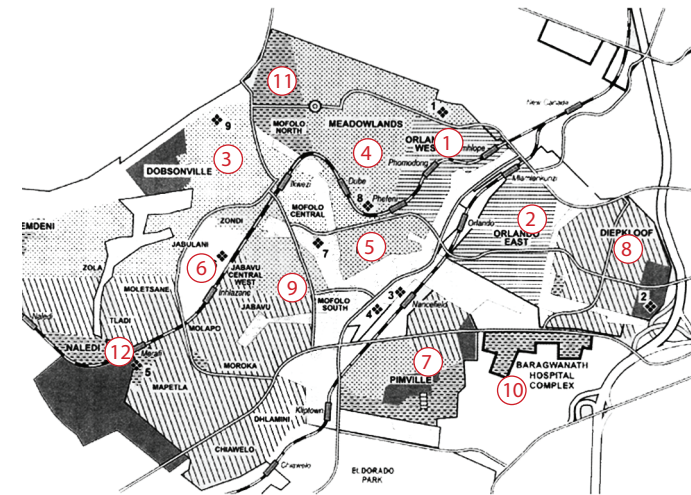


Figure 2.2 The growth of Soweto 1904 - 1980

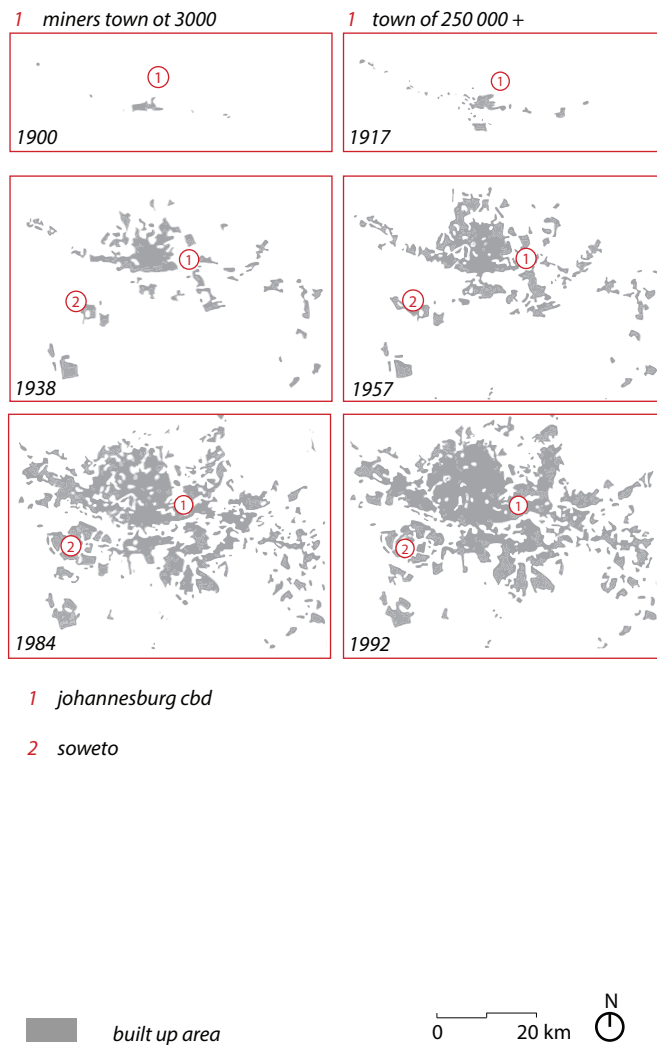


Figure 2.3 Spatial Formation 1900 - 1992

Self-Built Homes

By 1954, the housing shortage was critical and Apartheid architect, Hendrik Verwoerd, introduced a "Site and Service" scheme for eligible Blacks. The project provided land parcels in Black areas with one water tap and toilet facility for every four lots. The government did not provide houses and residents constructed their own homes.⁹⁵ As a result of the services levy fund, the government established the townships of Jabulani, Meadowlands, Diepkloof and Dobsonville.⁹⁶

From 1951, *The Bantu Building Workers Act* prohibited Blacks from performing skilled work in the city to protect jobs for White workers. As a result, skilled workers were available by the hundreds in townships. These skilled workers built 50,000 houses and 88,000 schools in surrounding townships between 1954 and 1969.⁹⁷ Houses were built, based on the prototype, NE 51/6 (non-European), developed by the *National Building Research Institute*. The design included four rooms with no bathroom or toilet and was later replaced by the 51/9 which included toilet facilities.⁹⁸ Anglo Gold and other mining companies gave funds to the government for low-income housing projects. However, Verwoerd allocated these funds to non-functional single-sex hostels for mine workers.⁹⁹

Illegal Land Invasion

Increased housing backlogs, overpopulation, unemployment and poor infrastructure led to the first illegal land invasion in Soweto. In 1944, the homeless masses illegally erected informal settlements on municipal land, adjacent to Soweto, near present day Orlando West. Informal dwellers constructed hundreds of shacks of hessian, canvas, maize, plant stems, pressed cookie tins and scraps of corrugated iron. This settlement grew to 20,000 residents within one month.¹⁰⁰

Later that year, the municipality erected temporary emergency shelters for residents, constructed with "breeze-block" and corrugated iron. The municipality also provided seventy-three pit latrines and a few health clinics.¹⁰¹ In 1946 a second land invasion occurred when a group of informal dwellers illegally occupied a newly-completed government housing scheme. Again, obliged by *The Urban Areas Act 1923* the council provided land for 2,000 informal dwellers, south-west of present day Orlando East. Another 10,000 informal dwellers received emergency housing in 1947 further south of Orlando East. By 1947, an estimated 131,808 Blacks occupied land in Soweto in the suburbs of Jabavu, Moroka, Pimville and Orlando.¹⁰²

Housing Tenure

Blacks living in the city in houses provided by the government, received only leasehold and rental tenure options. The lack of secure tenure options established the temporary environment of Black urban labourers in the city.

Freehold townships, previously occupied by elite Blacks were re-zoned as White areas.¹⁰³ *The 1923 Urban Areas Act* allowed freehold property rights for the elite and educated Blacks. As a result, the government designed a so-called “elite” township between Jabavu and Orlando, called Dube. Here the government provided 1,500 lots, sized 464 square meters to house 7,000 residents.¹⁰⁴ However, the city council discovered a clause in the title deeds for Dube that prohibited secure legal tenure and elite Blacks received 99 year lease agreements instead.¹⁰⁵ In 1940, the city council allowed sub-tenancy in Orlando East.¹⁰⁶ In 1950, the apartheid activist and minister of Native Affairs, Hendrik Verwoerd prohibited all Black freehold properties in so-called White areas and terminated the 99 year lease in exchange for a 30 year lease agreement. By 1960, the apartheid government eradicated all leasing rights. Verwoerd re-designed Dube by significantly decreasing lot sizes. Elite and educated Blacks were stripped from their freehold property rights in Alexandra and Sophiatown, north-east of Johannesburg. As a result the elite Black groups also relocated to Dube. Regardless of Verwoerd's attempt to downgrade Dube the township became one of the wealthiest suburbs of Soweto.¹⁰⁷

02 -2

JOHANNESBURG

Johannesburg, a city without a mountain, river or dam grew spatially divided from its inception. The city took its first breath in 1886 with the discovery of gold in the Witwatersrand region. Establishment of the first mining camp occurred on Turffontein farm near Fordsburg Dip based on its close vicinity to the only water source in the city. On September 20th, 1886 South African president, Paul Kruger proclaimed Johannesburg a public gold digging area.¹⁰⁸ By the late 1890's the wealthy Whites had claimed the land north of the present-day city centre. The middle class English-speaking population occupied the eastern border, while the poor Afrikaans-speaking population occupied the western border. The Blacks, Indians and coloureds occupied the overcrowded north-western areas of the city centre.¹⁰⁹ The discovery of gold resulted in rapid population growth and the town of Johannesburg grew to 250,000 residents by 1914.¹¹⁰

Early Apartheid Legislation

- *The Kruger Republic's Gold Law* of 1885 set in place racial segregation by prohibiting black ownership of land allocated for mining.¹¹¹
- *The Native Urban Areas Act of 1923*, established rules of segregated principles by racial zoning and demoted secure tenure for Blacks.

In 1918 the Black population in Johannesburg grew significantly with urbanization and economic growth, beyond gold mining. In the early 1930's, local authorities were concerned about the multi-racial nature of inner city slums, which included Whites, Indians, Africans and Coloureds. By 1931, an estimated 1,200 mixed-race families occupied inner-city slum properties. In 1934 authorities used *The Slums Act* to eradicate slums that housed Blacks, Coloureds and Indians to prevent poor White

families from living among other races and to open land for urban development. Alternative housing was only provided for White families and other races got evicted to surrounding overcrowded townships. By the 1940's the housing backlog in the city grew to 42,000.¹¹² In 1940, 150,000 people left the city to take part in WWII and the municipality relaxed influx controls to increase employment. Blacks, Indians and Coloureds returned to the city, and the Black population increased to 244,000 men, with three men for every woman.¹¹³

High Apartheid

High Apartheid, (1948-1976)¹¹⁴ marked the act of formalizing apartheid strategies. In 1950 the skeleton for spatial segregation was firmly in place. Apartheid planners designed the urban fabric of the city to accommodate mining, banking, industry, commerce and leisure in "racially ordered" urban spaces.¹¹⁵ (Fig. 2.7, p46) In 1948 the National Party came into power and they officially adopted the Apartheid policy. During this time the Apartheid government evicted all Black residents from White areas and relocate them to present-day Soweto.¹¹⁶

FIG 2.4, 2.5 Apartheid Designed Buffer Zones

Progressive segregation took place from 1904-1994. The Apartheid planners used mining and industrial buffer zones to segregate Blacks from White areas. Maps show the development of buffer zones from 1955 to 1973.



- commercial & industrial land
- mining land
- black residential land
- white residential land
- railway

1 johannesburg
2 soweto

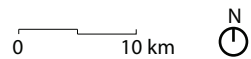
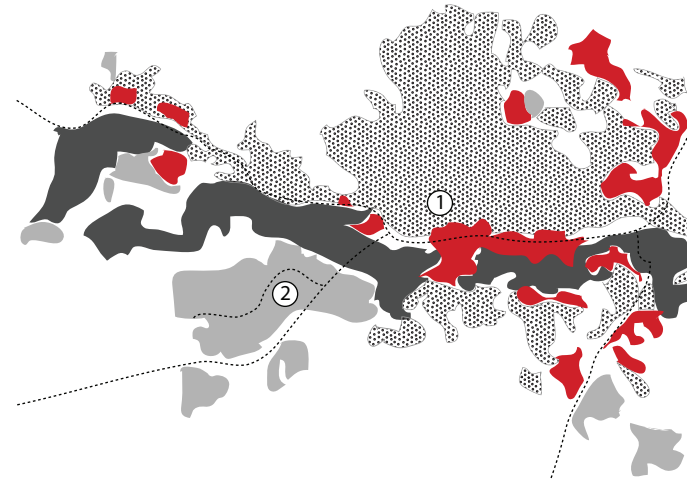


Figure 2.4 Racial segregation with buffer zones 1955



- commercial & industrial land
- mining land
- black residential land
- white residential land
- railway

1 johannesburg
2 soweto

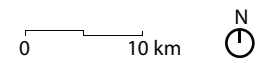


Figure 2.5 Racial segregation with buffer zones 1973

FIG 2.6 Buffer Zones Today 2013

Apartheid planners used natural and man-made buffer zones to develop and reinforce racial spatial segregation. Planners used highways, industrial zones and mining buffers to separate Johannesburg from Soweto. Soweto, a Black township, developed as a temporary holding area for Blacks during Apartheid. Apartheid planning resulted in a divided landscape, separating the Blacks, Coloureds, and Indians from the city.

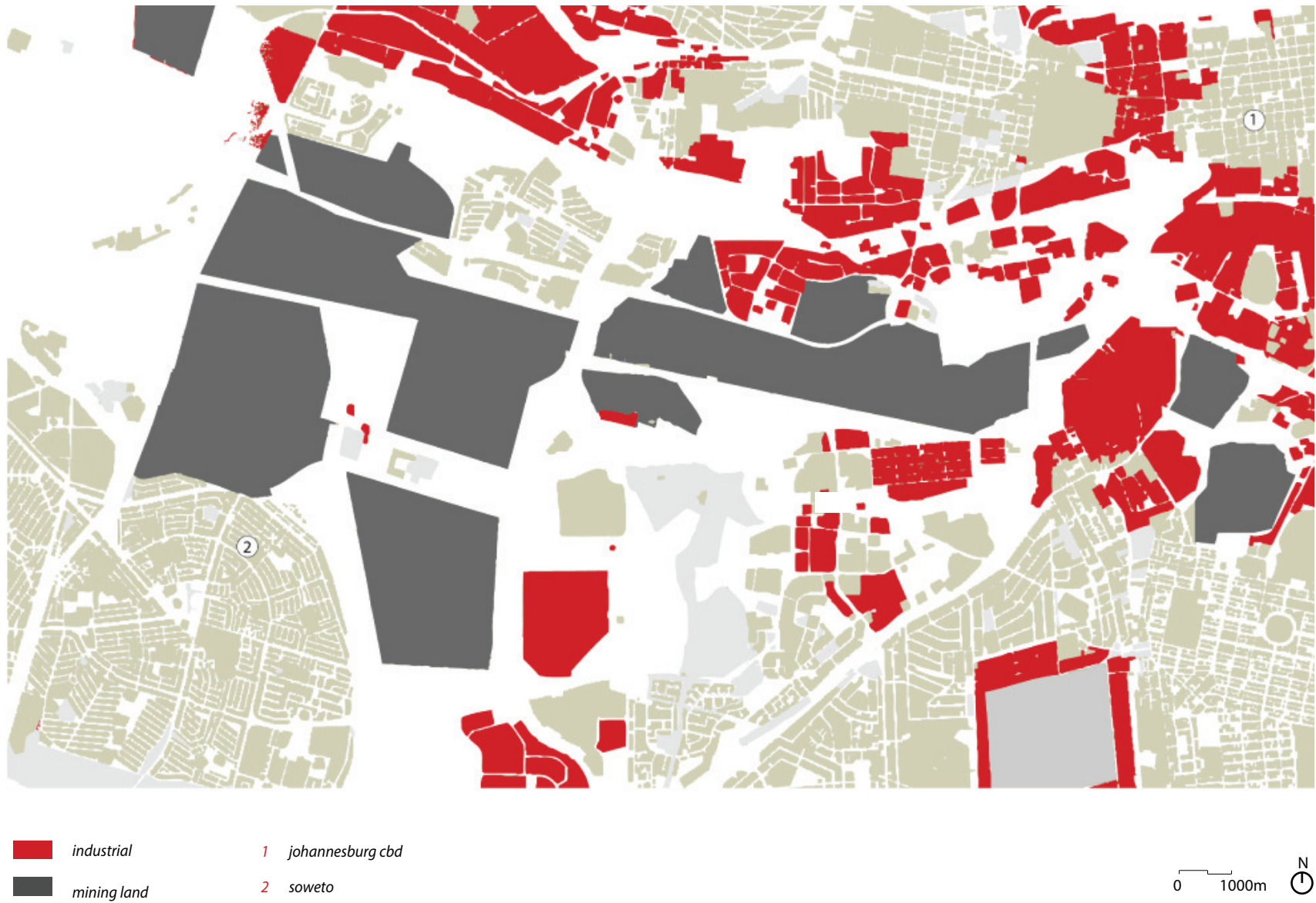


Figure 2.6 Natural, infrastructural and mining buffer zones used to promote spatial segregation in Johannesburg



Figure 2.7 Segregated residential areas based on the Groups Areas Act of 1950

High Apartheid Legislation

- *The Population Registration Act of 1950* assigned each South African to one of four racial groups. The four racial groups included Blacks, Coloureds, Whites and Indians/Asians.¹¹⁷
- *The Group Areas Act (no. 41 of 1950)*, allocated separate group areas for each racial group and replaced *The Native's Urban Areas Act of 1923*.¹¹⁸
- *The Native Urban Areas Act of 1952* ruled that all urban areas were White and Blacks who entered urban areas had to carry a valid passbook.¹¹⁹
- *The National Party's "homeland" policy* that complimented *The Group Areas Act* developed four "quasi-independent homelands" and seven "self-governing territories" to house excess Black people who were not required for labour in the city.¹²⁰

Apartheid Forced Evictions

The government evicted four million people during Apartheid.¹²¹ Forced removals were kept secret by the government officials but the SPP (Surplus People Project) conducted intense studies to reveal the scale of Apartheid-driven forced evictions. (Fig. 2.8, p47) The majority of forced removals took place between 1960 and 1983 which physically and politically shaped the geography of the country.¹²²

The government used *The Groups Areas Act* to remove almost 860,000 people to racially separate areas and enhance division and control. They relocated the Blacks to segregated townships in distant locations up to 30 km outside urban areas.¹²³ The government justified their acts by tagging Blacks as a "traditional tribal group" who were out-of-place in the White city.¹²⁴

In 1951 the Apartheid government declared a clearing of the western areas and evicted 54, 000 blacks to Meadowlands and Diepkloof in present-day Soweto. Housing construction in Meadowlands started in 1954 and by 1957 the government relocated 33,000 people and built 7,700 houses. The government relocated one thousand four hundred single men to the highly criticized single-sex hostels in Diepkloof.¹²⁵ The

government forcefully evicted thousands of Blacks during the 1960's to the so-called homelands or Bantustans designed by the apartheid government to promote segregation.¹²⁶

Apartheid Government Exports Blacks To New Countries

In 1958 the policy of "separate development" instigated the development of homelands or Bantustans.¹²⁷ The government designated Bantustans for all Blacks that did not have employment in South Africa. Officials located these homelands far from urban areas along the northern borders and coastlines. Unlike *The Urban Groups Areas Act* the government evicted only Blacks to the independent homelands.¹²⁸ Under *The Bantu Homelands Citizenship Act (no. 26 of 1970)*, citizens of independent Bantustans became illegal immigrants in South Africa. The act established the temporary nature of Blacks in Johannesburg.¹²⁹ The government prioritized housing funds toward the Bantustans, which caused housing backlogs in Soweto to increase. More people faced homelessness and informal-settlements and backyard shacks increased. Informal dwellers lived in harsh conditions, without services and in constant fear of being evicted to Bantustans:¹³⁰ The apartheid government argued that this was not an act of racial discrimination but rather the allowance for each individual "nation" to grow independently.¹³¹

Apartheid Government Disrupts Black Economic Growth

Between 1923 and 1976 Black-owned businesses in Soweto could only provide for the "reasonable" needs of the community. Eligible Black-owned businesses included a "general dealer, eating house, restaurant, milk shop, fruit vegetable and plant dealer, hawker, wood and coal merchants and undertakers." Municipalities permitted one business type for every 1,000 families and prohibited the operation of dry-cleaners, stationers and pharmacies. After the 1976 Soweto uprising, permitted business categories increased to 19 and by 1977, 39 businesses got added to the list. The elimination of this discriminatory legislation took place in 1977.¹³²

Divided Landscape

By the late 1970's the segregated spatial layout in Johannesburg had been successfully implemented.(Fig. 2.10, p49) Apartheid planning resulted in a divided landscape, separating the Blacks, Coloureds and Indians from the city. Planners used natural and created buffer zones to develop and reinforce racial spatial segregation.¹³³

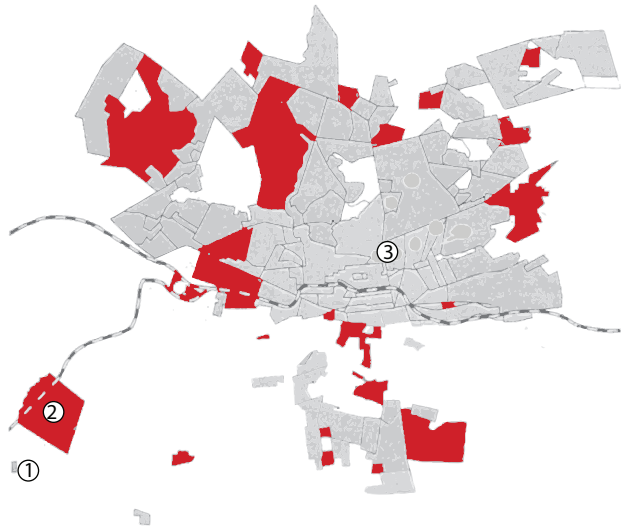
Groups Areas Act	834,400
Township relocation in bantustans	730,000
Eviction of squatters in informal urban settlements	112,000
Eviction of farm workers and labour tenants	1,129,000
Black-spot and other evictions for bantustan consolidation	687,500
Removals within and between bantustans	30,000
ESTIMATED FORCED EVICTIONS DURING APARTHEID	
3,522,900	

removals under the pass laws, which are difficult to quantify are not included. The figures for black-spot and other evictions for consolidation include evictions for infrastructural and strategic projects

Figure 2.8 Statistics of apartheid Forced Removals

FIG 2.9, 2.10 Segregated Formation of Johannesburg 1886 - 1976

Johannesburg grew progressively segregated from 1904. Maps show the formation of Johannesburg in time and stipulates the growth of Black townships in Soweto. The maps reveal that the majority of development in Soweto took place before 1960.



- 1886 - 1910
- 1911 - 1939
- 1 klipspruit, soweto
- 2 orlando, soweto
- 3 johannesburg cbd

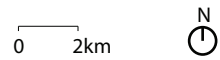
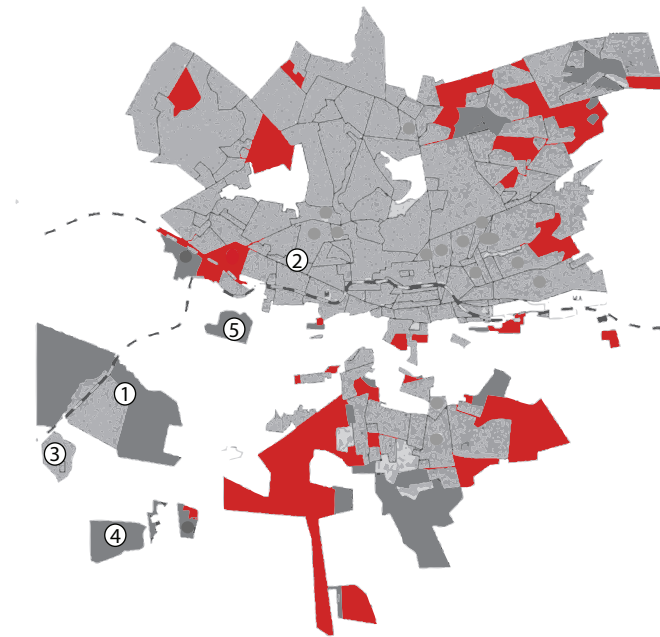


Figure 2.9 Segregated formation of Johannesburg (1886 - 1939)



- 1886 - 1940
- 1941 - 1960
- 1961 - 1976
- 1 soweto
- 2 johannesburg
- 3 klipspruit
- 4 eldorado park
- 5 riverlea

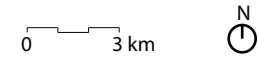


Figure 2.10 Segregated formation of Johannesburg (1886 - 1976)



Figure 2.11 Boy shot by police during the Soweto Uprising, 1976

Toward The End Of Apartheid

It took 62 years for the racially divided urban framework to develop in Johannesburg. During the 1980's, economic crisis, external pressures and internal tensions amounted to a disentanglement of apartheid legislation. President P.W. Botha permitted Black local authorities to rule over townships.¹³⁴ In 1978, Blacks received 99 year leases that enabled them to own, rent and sell properties.¹³⁵ By 1976 the ratio for the Black population in Johannesburg stood at 2 to 1 to the White population. Johannesburg's Central Business District provide services and shops which did not exist in Soweto and other townships.¹³⁶ It became clear that Johannesburg's CBD would become the major service centre for Blacks in the future.

Black Opposition

In 1973, the Apartheid government moved the managerial roles of Soweto to the West Rand Administration board. This marked the start of a crisis period in Soweto. Blacks believed they were contributing to White economies because the new administration board sourced goods and services from outside Soweto. Consequently, Blacks refused to pay services.

We should not give the Natives any academic education. If we do, who is going to do the manual labour in the community?" - JN le Roux, National Party politician, 1945¹³⁷

- 1953: The Apartheid government passed *The Bantu Education Act* which replaced mathematics and science with domestic and agricultural courses.¹³⁸
- 1959: *The University Education Act* banned Black people from studying at White universities.¹³⁹
- 1962 - 1971: Apartheid government prohibited building and operation of any new schools.¹⁴⁰
- 1970's: Apartheid government told Black high school students they would be taught in Afrikaans.¹⁴¹

Soweto Uprising

The Soweto uprisings took place in June 1976. Initially, the march was peaceful, but White policemen aggravated students by releasing teargas. In turn students threw rocks at the police force. A White policeman who randomly fired a shot without warning killed an innocent 15 and 13-year-old student. (Fig 2.11, p50) This led to days of riots and the death of hundreds of innocent people. Army and police forces used cold blood shooting as the primary method of crowd control, which raised the death toll significantly.¹⁴² (Fig. 2.12, p51)

Soweto: A Permanent Home For Blacks

Legislation that enforced the permanency of Soweto:

- *The Community Councils Act of 1977*
- *The Black Local Authorities Act of 1982*
- *The Black Communities Act of 1984*
- *The Regional Services Act of 1985.*¹⁴³

In 1983 Soweto received its own City Council status. The new council had a huge battle ahead: Soweto did not have an economic or infrastructural base, it lacked funds and it had huge housing backlogs and did not experience economic growth. At that time, the finances were mostly from "rents and service charges."¹⁴⁴ At the end of Apartheid non-racial administrations replaced the Black local authorities and Johannesburg and Soweto amalgamated.

Anti-apartheid legislation

- *The Local Government Transition Amendment Act of 1993*
- *The Watershed Municipal Structures Act of 1998*¹⁴⁵

Today large housing backlogs in Johannesburg grow. There is no land available in Soweto for future development and current plans have proven unsuccessful in providing housing for the poor.¹⁴⁶ Low cost housing schemes have fallen victim to increased construction and maintenance costs. Only higher income families can afford it.¹⁴⁷

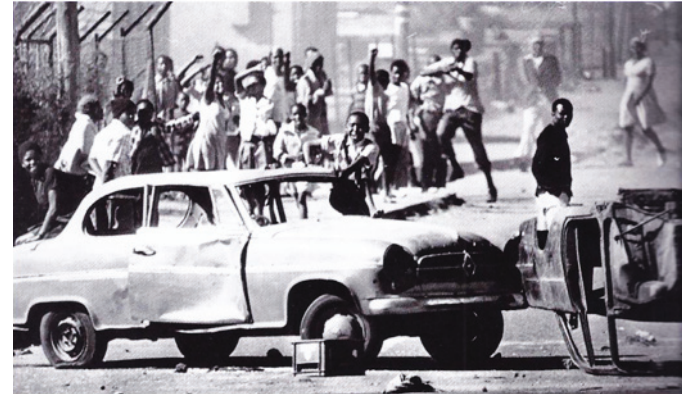


Figure 2.12 Soweto uprising, 1976

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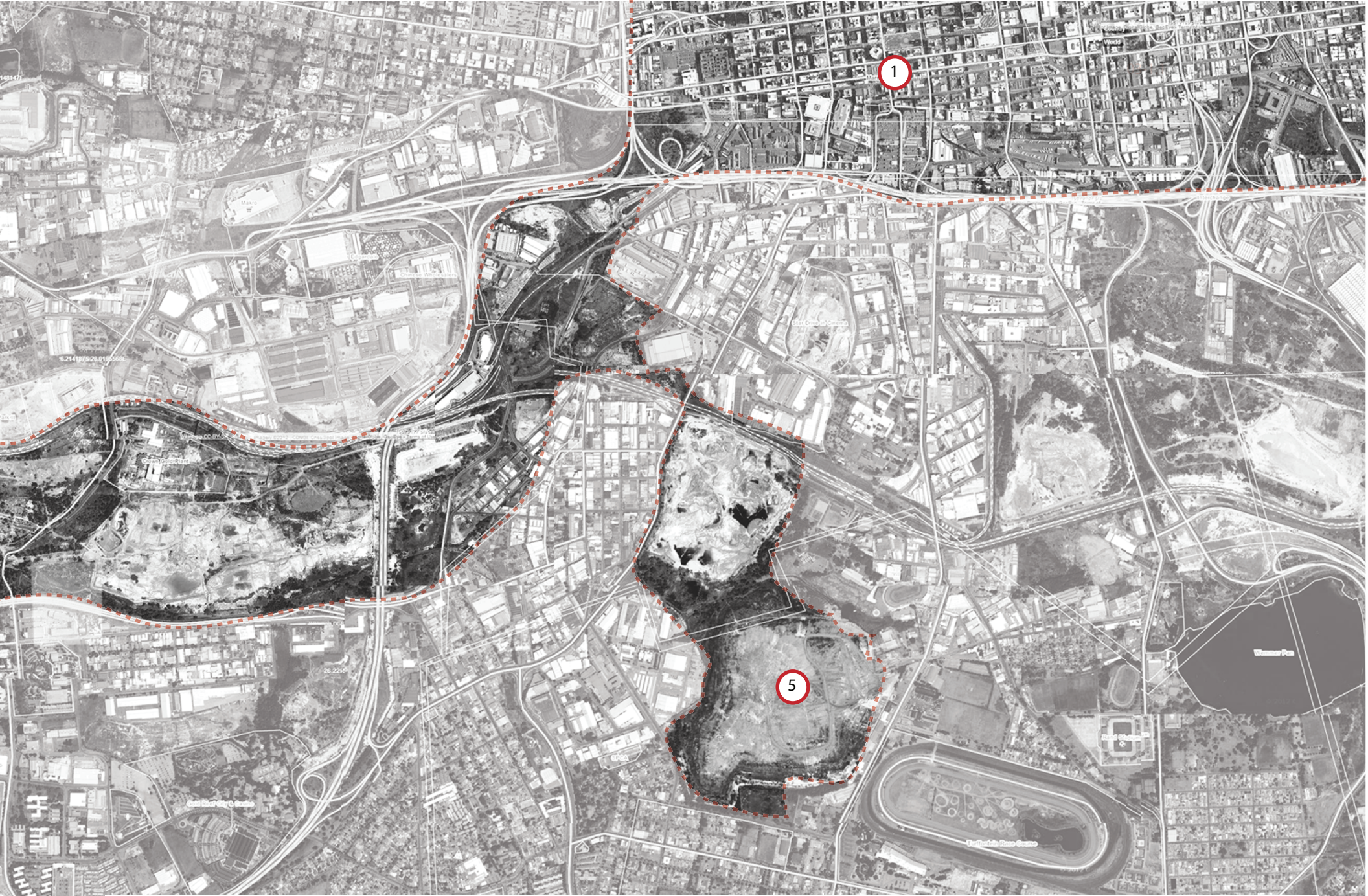
FILLING THE VOID

INFORMAL DWELLERS





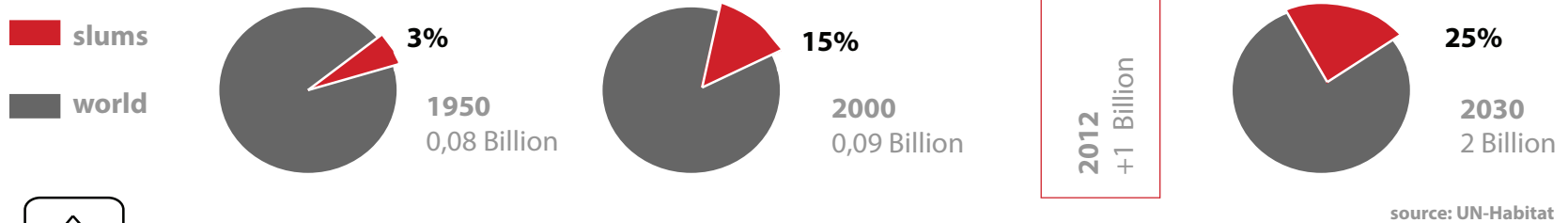
Figure 3.0 Site + Study area, Johannesburg, South Africa



SITE + STUDY AREA
a residual mine area & apartheid buffer zone

- 1 Johannesburg CBD
- 2 Soweto
- 3 Residual mine area (RMA)

- 4 Crown deposition site
- 5 Robson deep landfill site



29% of Johannesburg residents stay in informal dwellings



+ 65% of Johannesburg's population live in the township of Soweto in **68 km²**



190 informal settlements in Jhb **209, 381** shacks, **795, 647** people

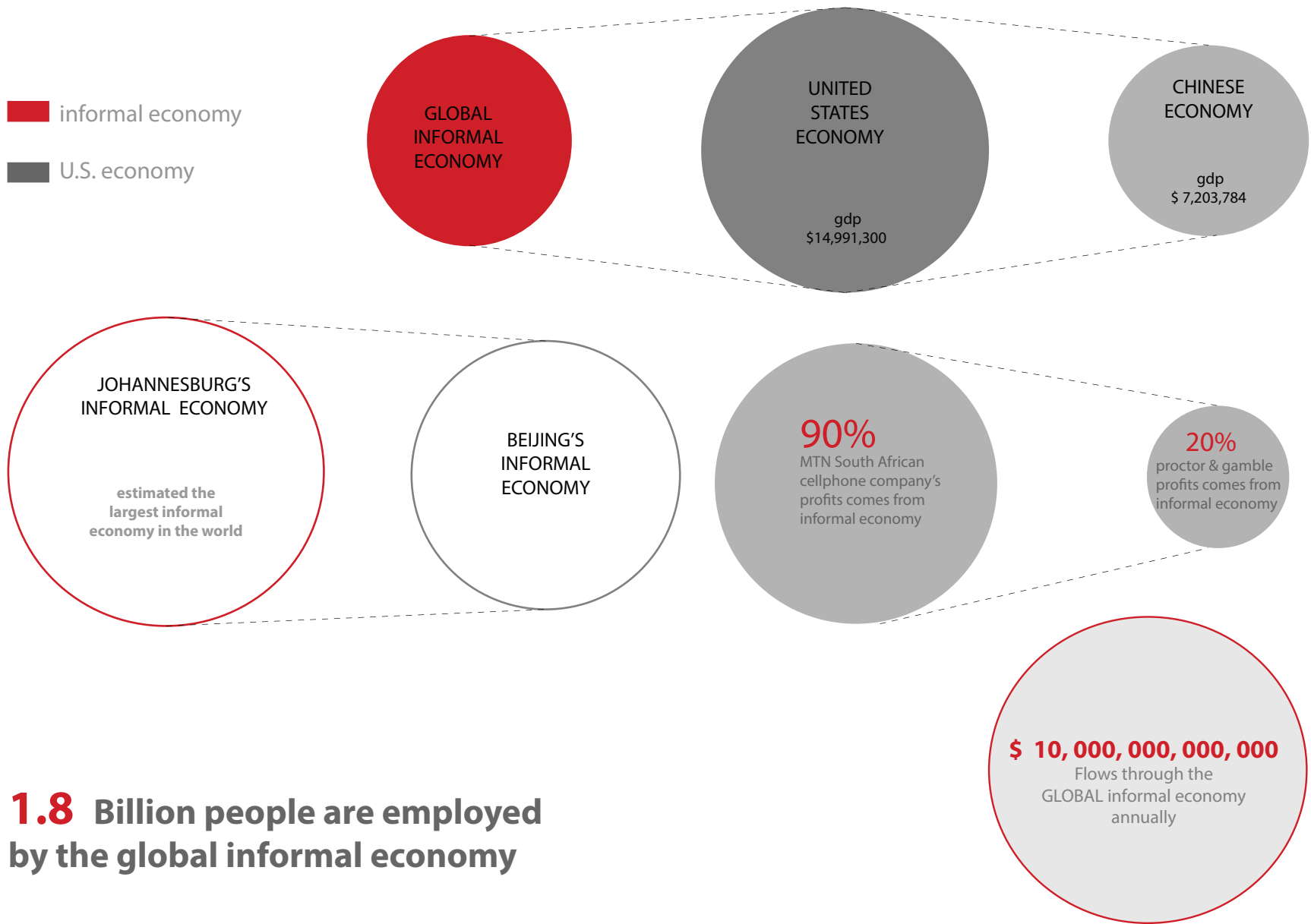


68 km² area of Soweto	—————	1, 600 km² area of Johannesburg
12 000 people per km ² in Soweto	—————	1, 960 people per km ² in Johannesburg
3 - 4 million residents in Soweto	—————	1, 01 million residents in central Jhb



6.7% foreign born residents

Figure 3.1 Johannesburg infographics



1.8 Billion people are employed by the global informal economy

Figure 3.2 Informal Economy infographics



Figure 3.3 Neatly kept shack exterior

03 - 1

INFORMAL DWELLERS

Who should fill the void?

There is no housing for the poor in Johannesburg and informal dwellers, including many women and children make up 29% of the city's population.¹⁴⁸ Most of the poor in Johannesburg illegally occupy vacant spaces in the city constantly fearing the municipality may evict them by force and relocate them up to 60 kilometres outside the city.¹⁴⁹ Evictions happen every day and in the process livelihoods are destroyed, driving the poor deeper into poverty.

Informal dwellers are here to stay – a global perspective

Today one billion informal dwellers construct hundreds of new shacks each day.¹⁵⁰ Alfredo Brillembourg predicts that the number of informal dwellers will double by 2020.¹⁵¹ Currently one out of every 5 people on earth lives in informal shacks and in 2050 this is expected to increase to 1 in 3; that means that 3 billion people will live in informal settlements deprived of infrastructure and basic services.¹⁵²

Globally, every year 70 million people move to cities.¹⁵³ Each week 1.3 million people move to urban areas and more than 50% of the global population live in cities.¹⁵⁴ As global urbanization continues governments across the globe fail to provide housing and infrastructure for the poor. With diminished government funds for formal housing and infrastructure, informal dwellers are making the new urban world.¹⁵⁵

Informal settlements in Johannesburg

Talk to us, not about us.

Landless People's Movement¹⁵⁶

We want to be in the shacks, we want to be close in the city...I mean that's what we want; we want the government to provide houses where the people are, close to our working place, close to our schools, close to hospitals. Plus we have a right to be close to the city.

Mazwi Nzimande leader of the Shack Dwellers Movement, Abahlali baseMjondolo¹⁵⁷

In 2005, there were 190 informal-settlements in Johannesburg housing an estimated 795,647 people in 209,381 shacks.¹⁵⁸ The largest informal settlement in Soweto called Thulani is located on the north-western edge and contains 14,500 shacks.¹⁵⁹ In *Stealth of Nations*, Robert Neuwirth refers to Lagos, Nigeria as a city that outgrew its colonial infrastructure.¹⁶⁰ This is the situation in Johannesburg. Urbanization and the rate of illegal migration from Northern African countries have startled the government of Johannesburg over the last two decades.¹⁶¹

- The Population in Gauteng: 10 million people with an average annual growth of 212,140 people.¹⁶²
- The Population of Johannesburg: 3,888,180 people, with an average growth of 110,480 people per year.¹⁶³
- The Population of Gauteng to double by 2043¹⁶⁴
- Households earning less than R3,500 per month increased with 101,949 between 2008 and 2010.¹⁶⁵

With the growing backlog in housing and rapid population growth the growth of informal settlements in Johannesburg is inevitable.

Settlement patterns of the informal dweller

When we view informal-settlements on aerial photographs they look like "formless assemblages of makeshift shacks" distributed in random patterns by chance.

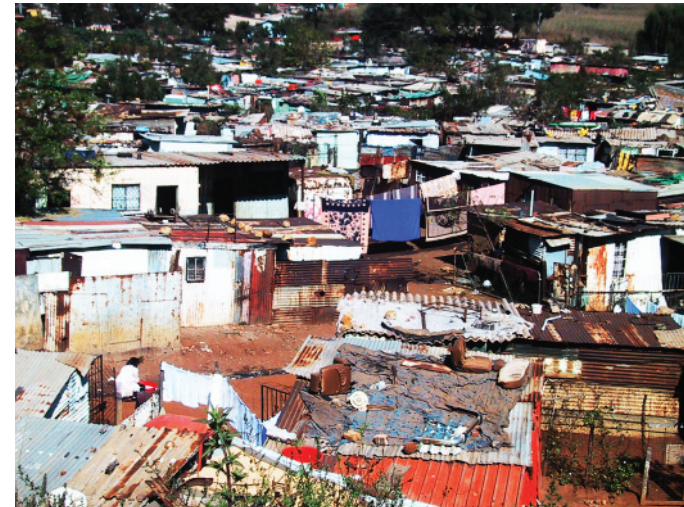


Figure 3.4 Informal Settlement in Soweto



Figure 3.5 Informal settlement at the foot of a tailings storage facility

Informal-settlements however, are laid out according to specific patterns that enforce “a collective desire” for safety, order and convenience. (Fig. 3.4, p59) Informal dwellers order shacks in rows with pathways linking to informal businesses called “spazas”, outdoor communal meeting areas, communal water taps and public roads. Both spatial and social organization of informal settlements are deliberately set in place by “informal peer pressure”, and the mutual agreement of community members on codes and procedures of establishment. Informal dwellers cluster shacks together in obedience to unwritten verbal agreements that promote the location of shacks next to neighbours.¹⁶⁶

Most cultures and language groups of South Africa are represented in informal settlements, drenching such communities with complex but unique social structures. Due to fast and desperate nature of land invasions, informal settlements rarely have communal spaces for sport, recreation and community events.¹⁶⁷ The lack of exterior spaces in informal settlements has led informal shack interiors to represent that which the exterior spaces cannot. Informal dwellers use the interior spaces for informal businesses, community meetings and storage of informal consumer goods.¹⁶⁸

Municipal approach to informal settlements

Informal settlements have been a foundation of Johannesburg since 1904. Although informal settlements in the city have consistently been replaced by the formal, the informal have always re-emerged elsewhere.

Municipalities erroneously view informal settlements as hostile, crime infested, webs of illegal immigrants too impatient to wait for housing. (Fig. 3.5, p60) Municipalities argue that informal settlements disrupt public housing delivery and counter urban renewal schemes. Until 2004 settlement upgrading had been overlooked by the housing policy and municipalities had focused on eradicating informal settlements.¹⁶⁹ Municipalities justify the eradication of informal dwellings with “health and safety” concerns, and often sell these parcels of land to developers or use the land to build freeways.¹⁷⁰ Communities resist relocation and prefer *in-situ* upgrading processes.

Recently the Minister of Housing, Lindiwe Sisulu voiced the commitment to in-situ upgrading.¹⁷¹ However, the municipality of Johannesburg deemed one hundred and three of the one hundred and ninety settlements in the city not suitable for upgrading and marked them for wholesale relocation. The municipality reserved forty two for *in-situ* upgrading and thirty five unsuitable for upgrading due to overpopulation. Ten informal settlements are not mentioned in the municipal database.¹⁷²

03-1.1

SITE ANALYSIS

SOWETO, JOHANNESBURG, SOUTH AFRICA





Figure 3.6 View of Crown Gold Tailings deposition site, Soccer City on the bottom left & the site area to the right. Mbatha busway & Soweto highway is at the centre.





Figure 3.7 25 km, high quality pipeline (steel and high density polyurethane) from existing mining infrastructure exist on the site. The design proposes new way to use the pipeline.





Figure 3.8 An areal view of a tailings storage facility that is undergoing remediation. The slopes have been profiled, a top layer applied and vegetation is starting to grow.





Figure 3.9 A top view of the slope of a tailings storage facility that have not been rehabilitated.





Figure 3.10 Gold mining infrastructure at a plant near the site study area. The design proposes the re-use of this infrastructure to construct new building technologies.



03 - 1.1

THE SITE

Gold Discovery In Johannesburg

Gold was first discovered in Johannesburg in the year 1886 leading to the creation of the world-renowned Witwatersrand Basin.¹⁷³ The Witwatersrand Basin gold fields cover an area of about 25 000 km² in the north-central region of South Africa. Mining companies have produced fifty thousand tonnes of gold since 1886. Two hundred and forty tailings storage facilities exist in the Witwatersrand¹⁷⁴ and contain 6 billion tonnes of tailings.¹⁷⁵ The discovery of gold resulted in rapid economic development in South Africa. Mining authorities deposited tailings hydraulically into unlined tailings storage facilities¹⁷⁶ leading to severe environmental damage - air, soil and water pollution.¹⁷⁷

Site: Central Rand

The Central Rand is located in the centre of the Witwatersrand mining belt near the Central Business District of Johannesburg.

- The Central Rand stretches 45 km in an east-west direction.
- Deep shaft mining in the central Rand reaches depths of about 3000m.¹⁷⁸
- Seventy of the 240 tailing dams in the Witwatersrand are in the Central Rand.¹⁷⁹

The Crown Gold tailings deposition site is made up of three large tailings dams. They are located on the western border of the site. (Fig. 3.11, p75) The three tailings dams are 500m apart near a non-perennial stream and next to Soccer City, the official 2010 world cup soccer stadium. The N1 national highway runs through the centre of these three and an estimated 44 000 people live within 1km of the Nasrec and Diepkloof tailings storage facilities. Several slimes and sand reserves exist on the site. The Crown Plant is located on the north-eastern border of the study area.

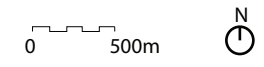
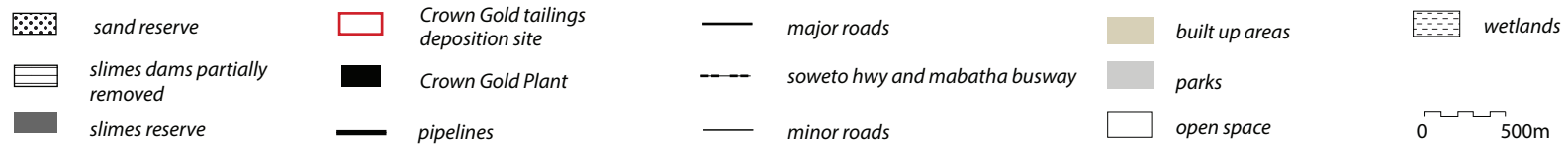
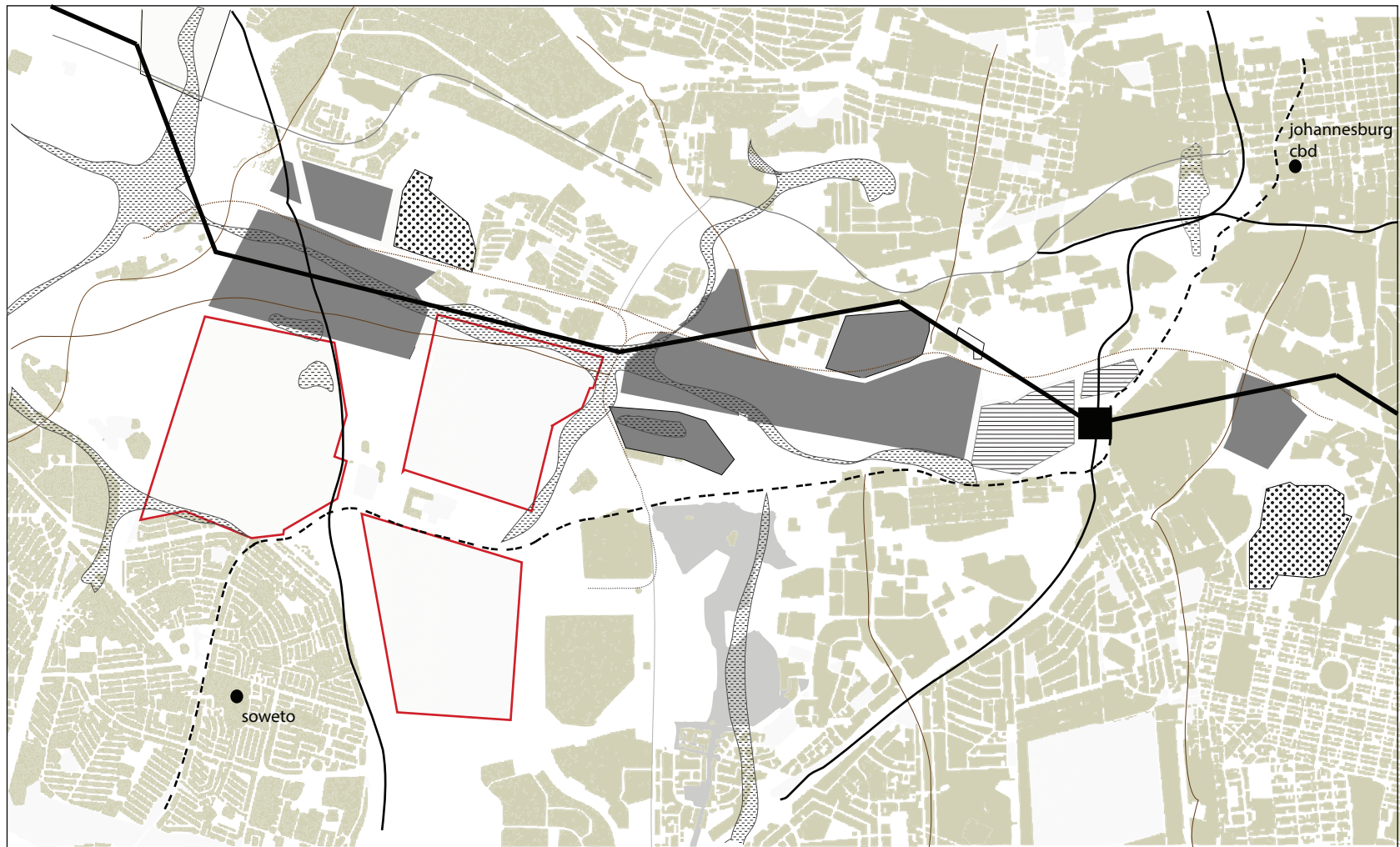


Figure 3.11 Residual mine areas by type on the site

Mine Closure

DRD Gold Limited is in the process of decommissioning the Crown Gold tailings deposition site and has already decommissioned the Crown Gold Plant. They are depositing their entire tailings flow into the Brakpan and Withok tailings facilities¹⁸⁰ and their major project is the Top Star tailings dam located to the south of Johannesburg's CBD.¹⁸¹ DRD Gold is busy remediating the Crown Gold tailings deposition site and the Crown plant serves only to mill and pump tailings material to the Brakpan plant.¹⁸²

Remediation

The primary consideration during mine remediation is to stabilize the mine dumps to avoid wind or water transportation of toxins. Initial rehabilitation, started in 1960 by the Chamber of Mines of South Africa has proven unsuccessful and mine closure procedures have been adapted. The Mines Woodland project overseen by the University of the Witwatersrand under the lead of Isabel Weiersbye of the School of Animal, Plant and Environmental Sciences proposes phytoremediation rather than engineering methods.¹⁸³ The project, supported by Anglo Gold Ashanti South Africa and the University of Witwatersrand, has implemented phytoremediation through the use of alternative materials. The project uses waste materials such as compost, domestic kitchen waste, sewage sludge, garden refuse, clays, gravels, and other rubbles on the tops of tailings dams instead of the traditional method that uses lime, fertilizer and irrigation. This method is cost-effective and sets in motion nutrient-cycles and prevents erosion.¹⁸⁴ This thesis uses this "Mines Woodlands Project" as basis for remediation strategies.

Toxicity

Tailings storage facilities cause the greatest environmental damage.¹⁸⁵ (Fig. 3.12, p 77) Tailings, a by-product of the extraction process are stored in tailing storage facilities or slimes dams. Water "acidifies" due to the "oxidation of pyrite" (FeS₂) found in tailing storage facilities. Polluted groundwater causes pH levels to drop.¹⁸⁶ Groundwater in the Central Rand has a domination of Mg²⁺, Ca²⁺, SO₄²⁻ and Cl⁻ ions. Sulphate is the dominant component in surface water. The major pollutants caused by mining activities are sulphates, chlorides, and various heavy metals and radioactive ions.¹⁸⁷

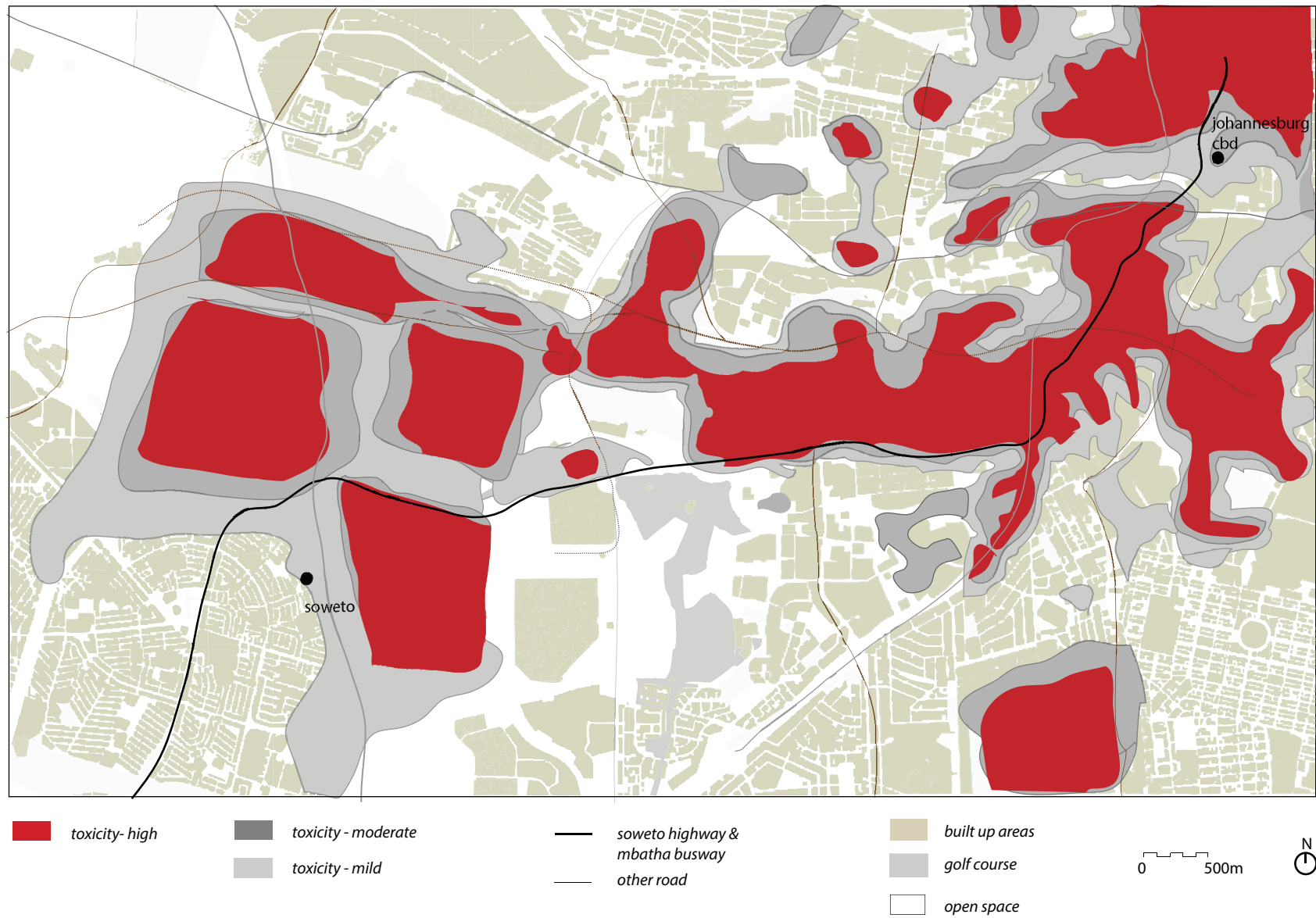
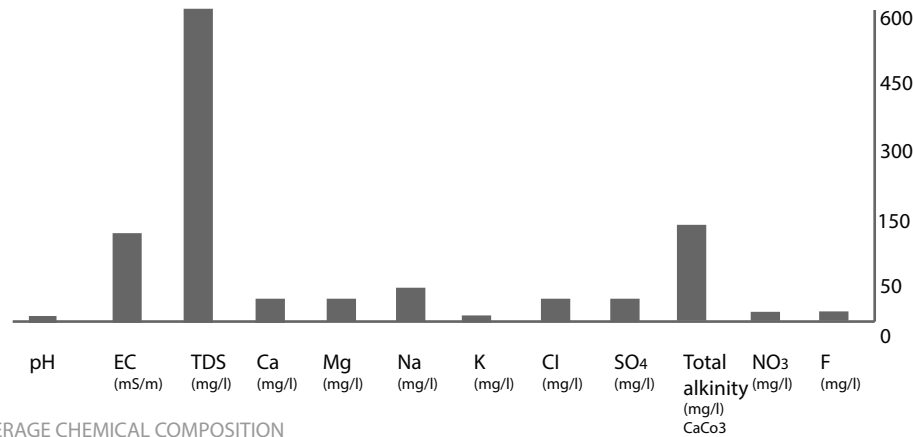
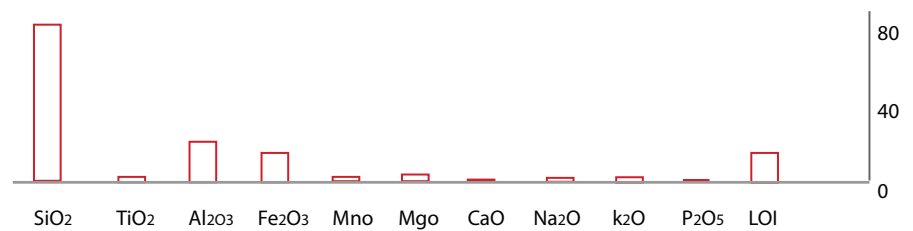
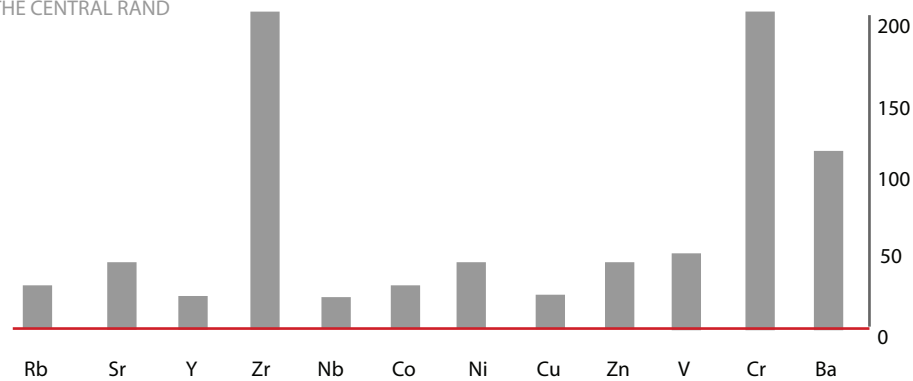


Figure 3.12 Radioactivity in the Central Rand

TYPICAL GROUNDWATER QUALITY IN THE CENTRAL RAND



AVERAGE CHEMICAL COMPOSITION OF TAILINGS DAMS AND FOOTPRINTS IN THE CENTRAL RAND



source: Central Rand Goldfield Regional Mine Closure Strategy

FIG. 3.13 (a) Site: Toxicity data

Top left: Typical groundwater quality of the Central Rand Group aquifers was revealed by *The Central Rand Goldfield Regional Mine Closure Strategy*. Mining Closure strategies, are developed to kick-start rehabilitation processes when mining operations end.

Left: *The Central Rand Goldfield Regional Mine Closure Strategy* have gathered data to express the chemical composition of tailings facilities in the central rand to determine toxicity levels.

The chart to the left reveal the results.

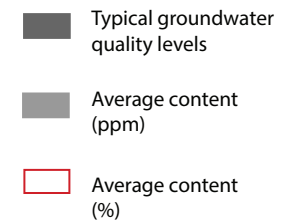


Figure 3.13 (a) Toxicity Chart

FIG. 3.13 (b) Site: Toxicity data

Mining operations of gold and uranium started more than 120 years ago on the site. The site is currently undergoing decommissioning. Mining activities have caused very wet conditions to develop on the site: Artificial wetlands have developed during mining. Stormwater and underground water systems have filled the void spaces below the surface.

Mining operations have caused:

- Ph levels to drop
- Radioactivity to increase
- Presence of problem chemicals

In *a perspective on water in South Africa (2010)*, CSIR evaluated several conditions of rehabilitation in the Witwatersrand:

- mine water treatment requirement
- current aquatic environmental state
- volume of water to be treated
- priority for water supply of ecosystems
- Environmental impact if water left untreated

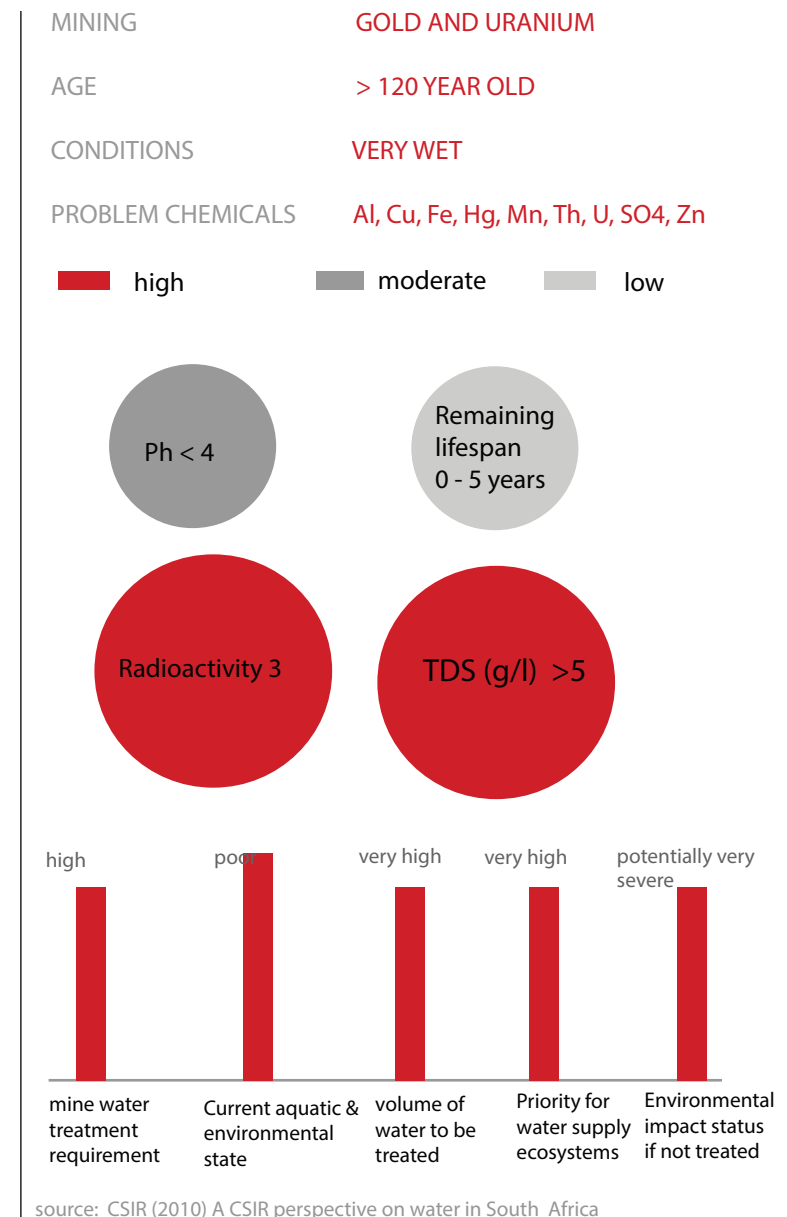


Figure 3.13 (b) Toxicity Chart

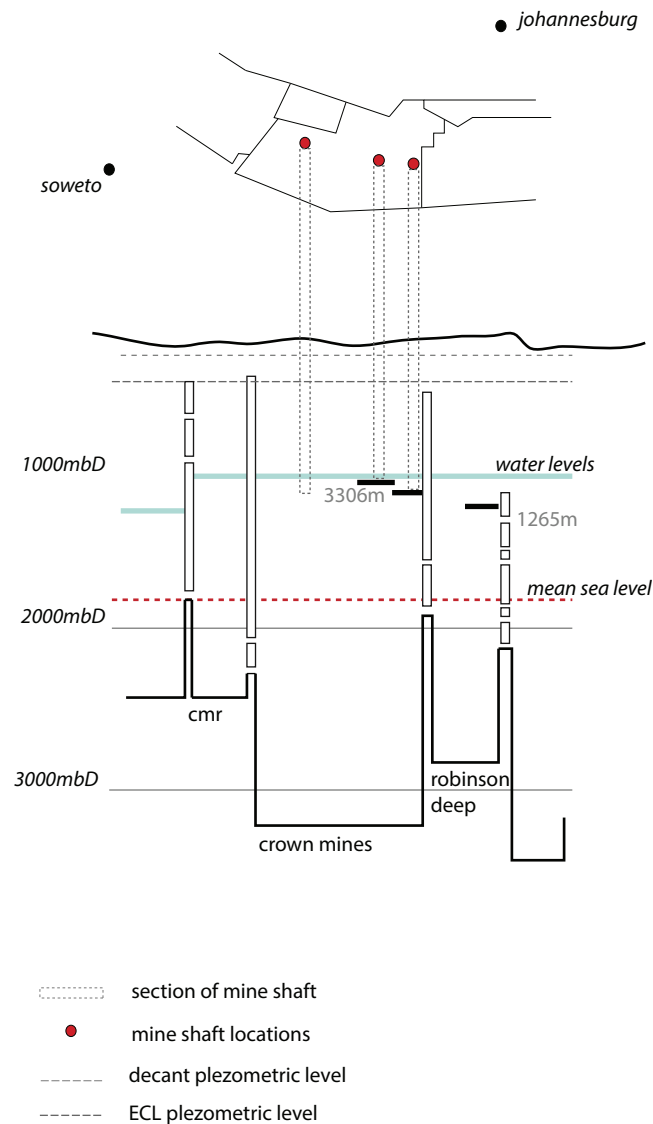


Fig. 3.14 Mine voids and acid mine drainage

Mining activities created deep aquifer systems in the Central Rand. (Fig. 3.14) During underground mining, the mining companies regularly removed water accumulating in these voids. When underground mining stopped, so did the emptying of the voids. The water in the underground voids is called Acid Mine Drainage (AMD) due to its high levels of contamination. Water levels in the voids are rising at about 15 metres per month and pose severe flood risks for central Johannesburg.

The deep aquifer systems link hydraulically and studies have not been conducted to comprehend the dynamics of water flow in and out of the deep groundwater systems. To avoid deep mine water levels from rising higher the government has researched methods to pump the water to the surface. Pumped water may be treated and used in the city. This thesis assumes these water pumping systems are provided on the site and the water purification co-op centre would conduct water treatment and purification.

Figure 3.14 Deep Aquifer Systems in Central Rand

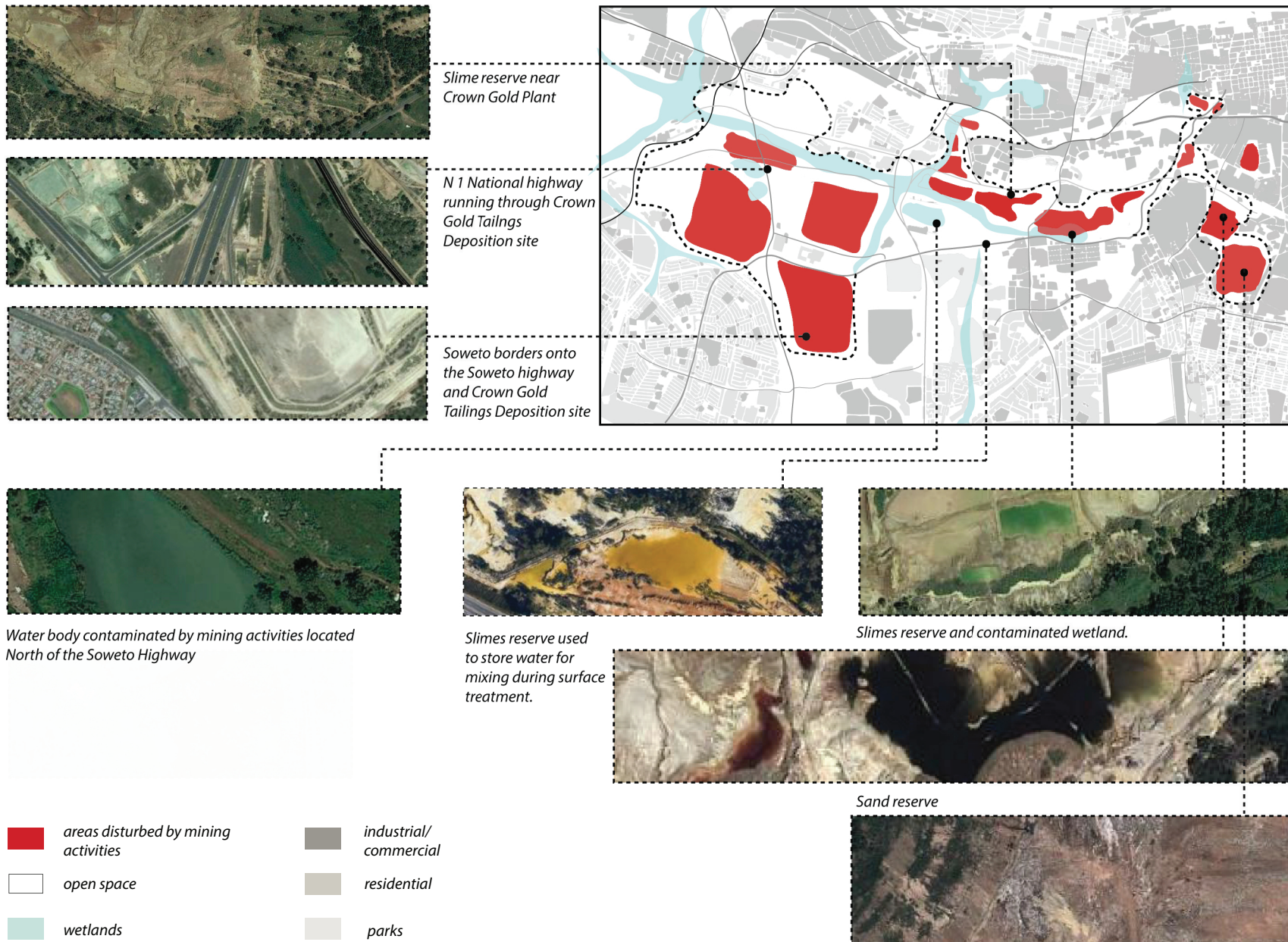


Figure 3.15 View of surface conditions at the study area

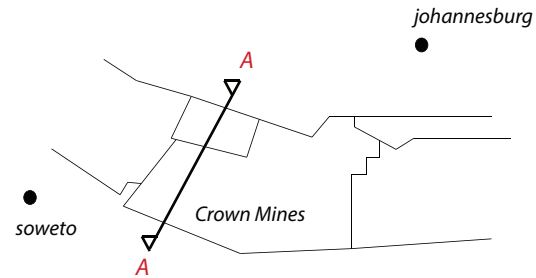


FIG. 3.16 , 3.17 Geology of the Central Rand

The geology of the Central Rand is termed the Central Rand Group. It hosts the gold mineralization and has a thickness of more than 2880m. The Central Rand Group is composed of quartzite and gold bearing conglomerates that dominates over shale and overlies the West Rand Group.

Figure 3.16 is a section through the site area and explain the underlying geological composition.

Figure 3.17 shows the location of the various geological components on the site in plan view.

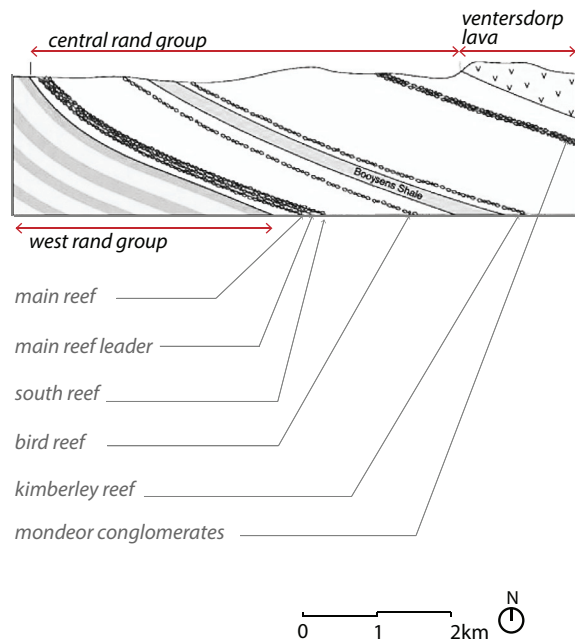
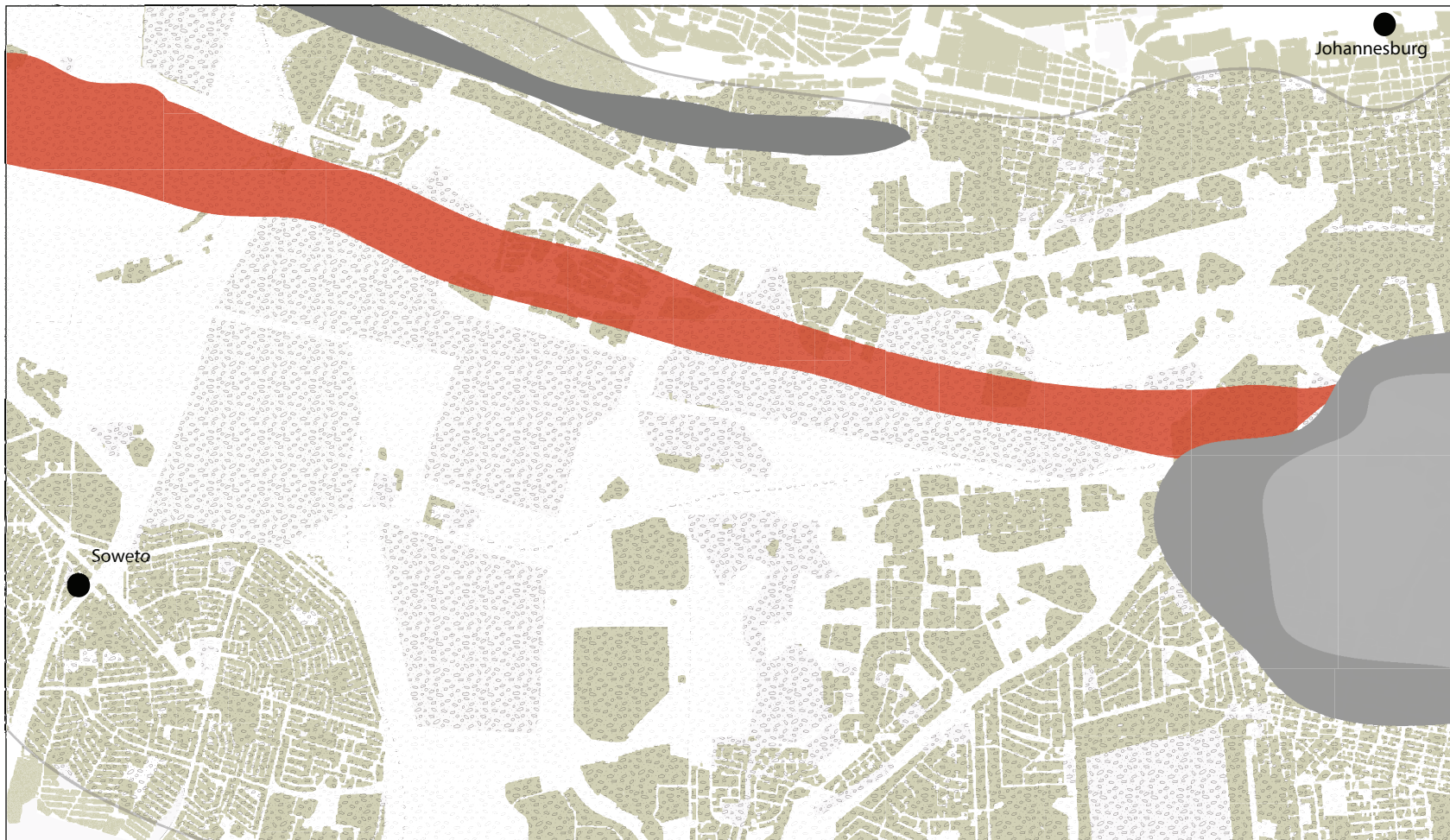


Figure 3.16 Section through gold bearing conglomerates



- residual mine areas
 - quartzite subordinate conglomerate shale/ amygdaloidal lava
 - fine to coarse grained sandstone, shale, coal seams
- quartzite subordinate conglomerate & shale
 - diamictonite (polymictic casts, set in poorly sorted fine-grained matrix) with varved shale mudstone with dropstone and fluvioglacial gravel common in the north

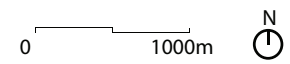


Figure 3.17 Geology map

FIG.3.18 Transport and municipal refuse locations

This map shows how the existing transportation routes connect with proposed footpaths. Trading and recreational areas are proposed where footpaths intersect with primary and secondary transportation routes. New bus/minibus taxi stops are proposed along the Mbatha busway/Soweto highway at footpath intersections. Although some may use minibus taxi's , most informal dwellers are pedestrians and do not have cars. The map shows the proposed pedestrian pathway that connects Soweto with Johannesburg. Secondary pathways intersect with the main path and integrate into the existing urban grain. The map shows the existing municipal waste services. This interacts with the proposed waste collection strategies of the site.

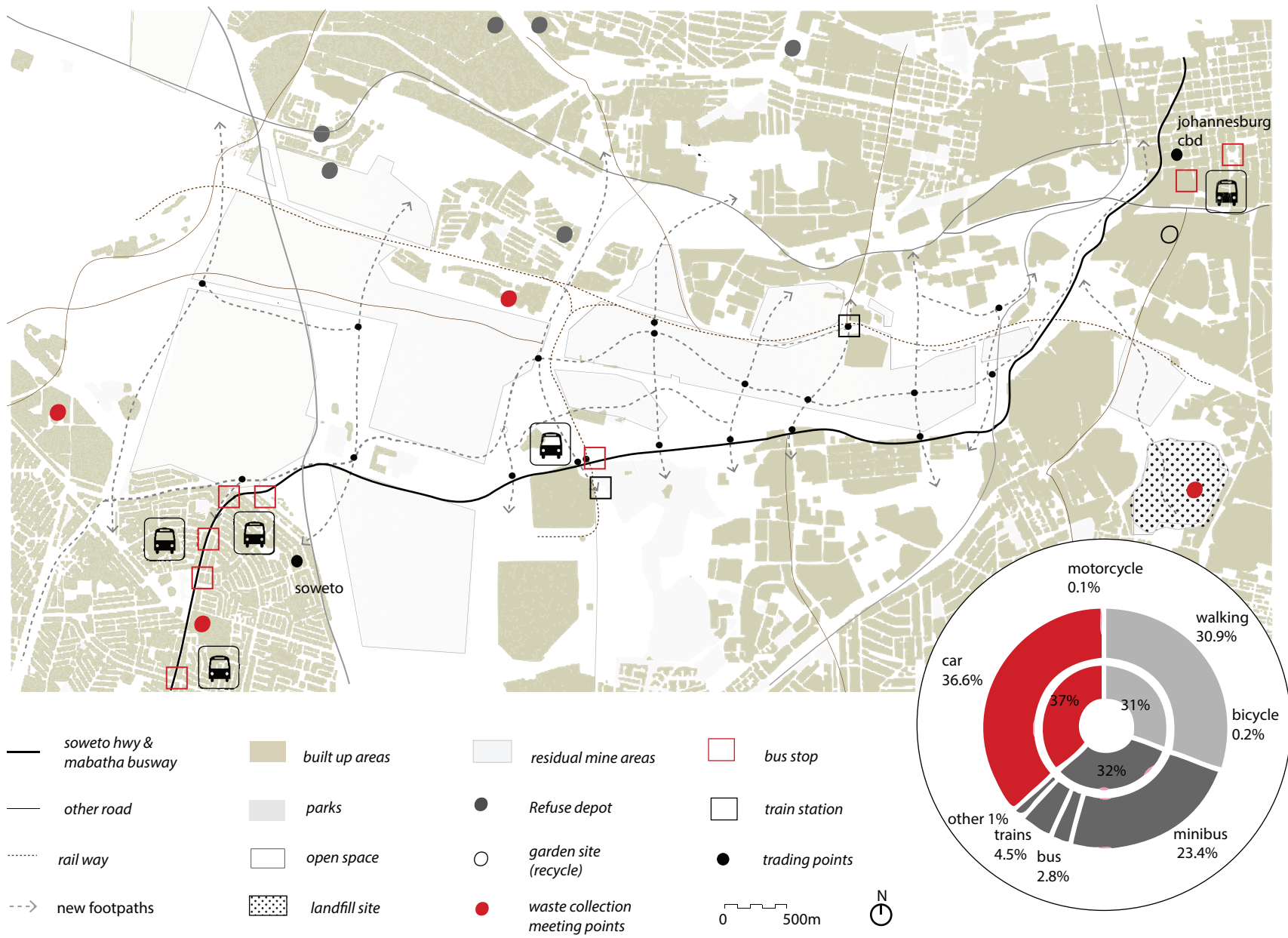


Figure 3.18 Transport and municipal refuse locations

03-2

FILLING THE VOID

DESIGN-STRATEGY



03 - 2.0
DESIGNER'S APPROACH

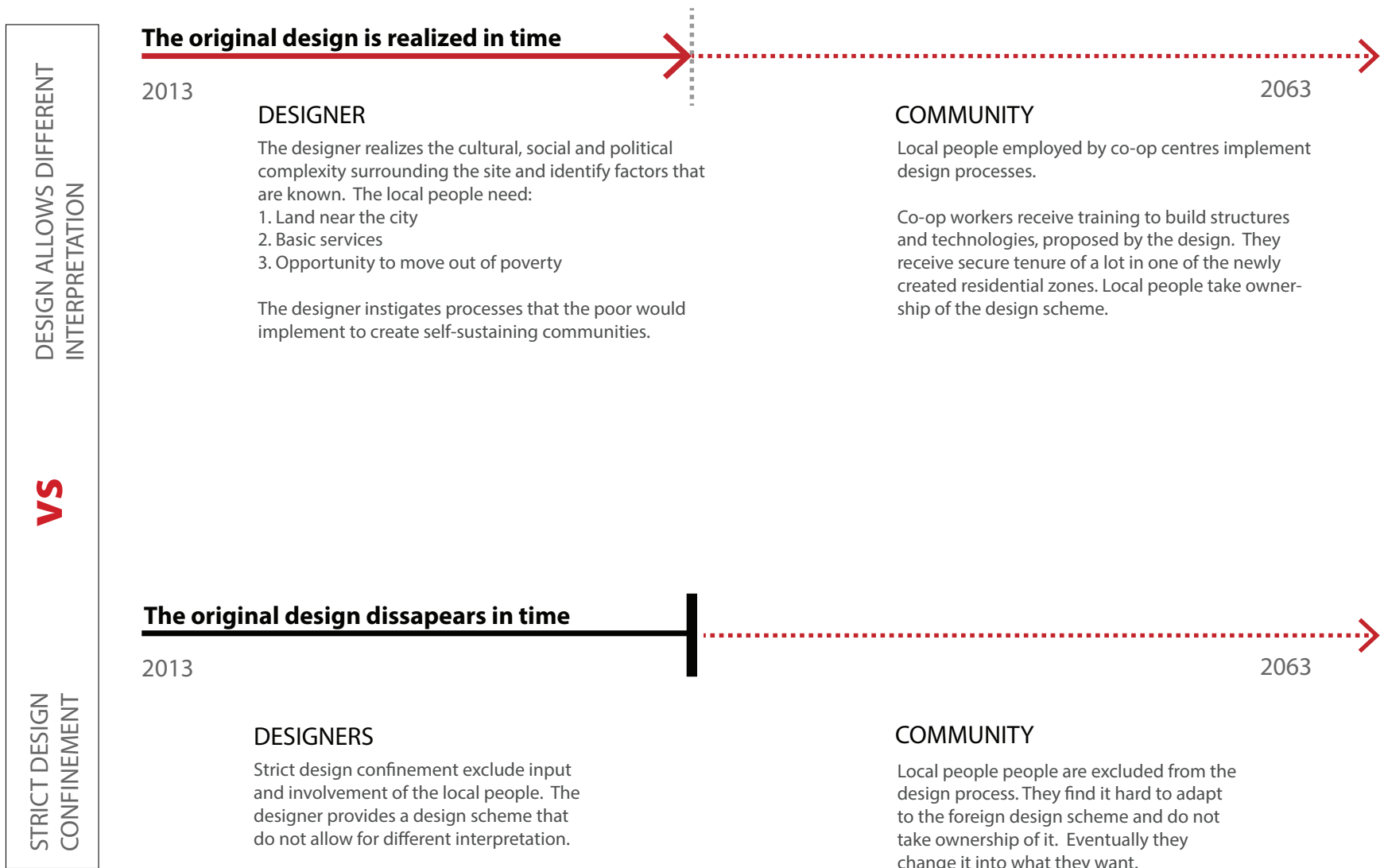


Figure 3.19 Designers Approach

03 - 2.0

DESIGN APPROACH

The Influence of Complex Cultural Context On Strategy Implementation

The poor in Johannesburg are mostly Blacks speaking most of the 11 different languages and come from many different backgrounds and cultures.¹⁸⁸ Many are illegal immigrants and refugees from North African countries, and while some were born in Johannesburg others migrated to the city from rural areas in Gauteng and other provinces. Deeply embedded complexities exist even within one culture due to apartheid, westernization and urbanization.¹⁸⁹

The designer cannot predict the specific needs, desires, likes and dislikes of such a diverse group of people; the design should instigate processes implemented by local people. (Fig. 3.19, p 88) Several projects in South Africa failed without the input and assistance of the local people. Walter Sisulu Square clearly indicates the dysfunction of such a project. The scale of the project is out of context and interior spaces are intimidating.

Designer's Role

The designer's role is to identify the factors that are known and to use them to steer the design strategy:

- 1-2 million people in Johannesburg would work if given the opportunity.
- 1-2 million people need housing, basic services and would like to move out of poverty.

The designer knows that the poor regardless of their background want to live near the city, need basic services, and want to move out of poverty. Remediation of the mining area

provides land near the city, infrastructure systems provide basic services and financial strategies help the poor to move out of poverty. Stewart Brand says that informal dwellers are not concerned about housing, phone services, employment, hunger or access to medical care. These services are provided by informal entrepreneurs, and health care by traditional medicine clinics. Stewart Brand says that informal dwellers are concerned about security of tenure, land near employment, basic services – water, sanitation and electricity – and protection from crime.¹⁹⁰

The question is how to provide employment and housing for the poor with limited funds and no land near the city. Because of limited funds, unskilled and semi-skilled labour and re-cycled and waste products for building materials a confined design strategy will not answer the question. The thesis makes the site a habitable space that promotes economic growth and equips the poor with technologies to construct and maintain their environment. The design instigates processes of development through the labour of the local people. The design intervention is realized over time, transferring labour intensive technologies and equipping the poor through co-op employment centres.

03-3

FILLING THE VOID

DESIGN-IMPLEMENTATION




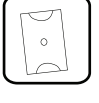


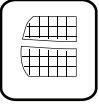


















03 - 3.0

ICON LEGEND

Using icons

These icons are used throughout the project to represent and explain components and intervention strategies. This logo legend below tells you what each icon represent.

	<i>MAINTENANCE</i>		<i>SANITATION</i>		<i>REED-BED</i>		<i>RECREATION</i>
	<i>MANUAL-LABOUR</i>		<i>ELECTRICITY</i>		<i>ALLOTMENT GARDEN</i>		<i>RESIDENTIAL</i>
	<i>COLLECT</i>		<i>WATER</i>		<i>CO-OP CENTRES</i>		<i>BUILDING MATERIALS</i>
	<i>PRODUCE</i>		<i>WATER CANAL</i>		<i>TRADING SHEDS</i>		<i>EXISTING INFRASTRUCTURE</i>
	<i>TRADE</i>		<i>URBAN FOREST</i>		<i>PLANT PRODUCTS</i>		<i>RECYCLED PIPELINES</i>
			<i>INFORMAL TRANSPORT OF GOODS</i>		<i>INFORMAL STORAGE FACILITY</i>		<i>PUBLIC WASHROOM</i>

03-3.0

3 X URBAN DESIGN STRATEGIES

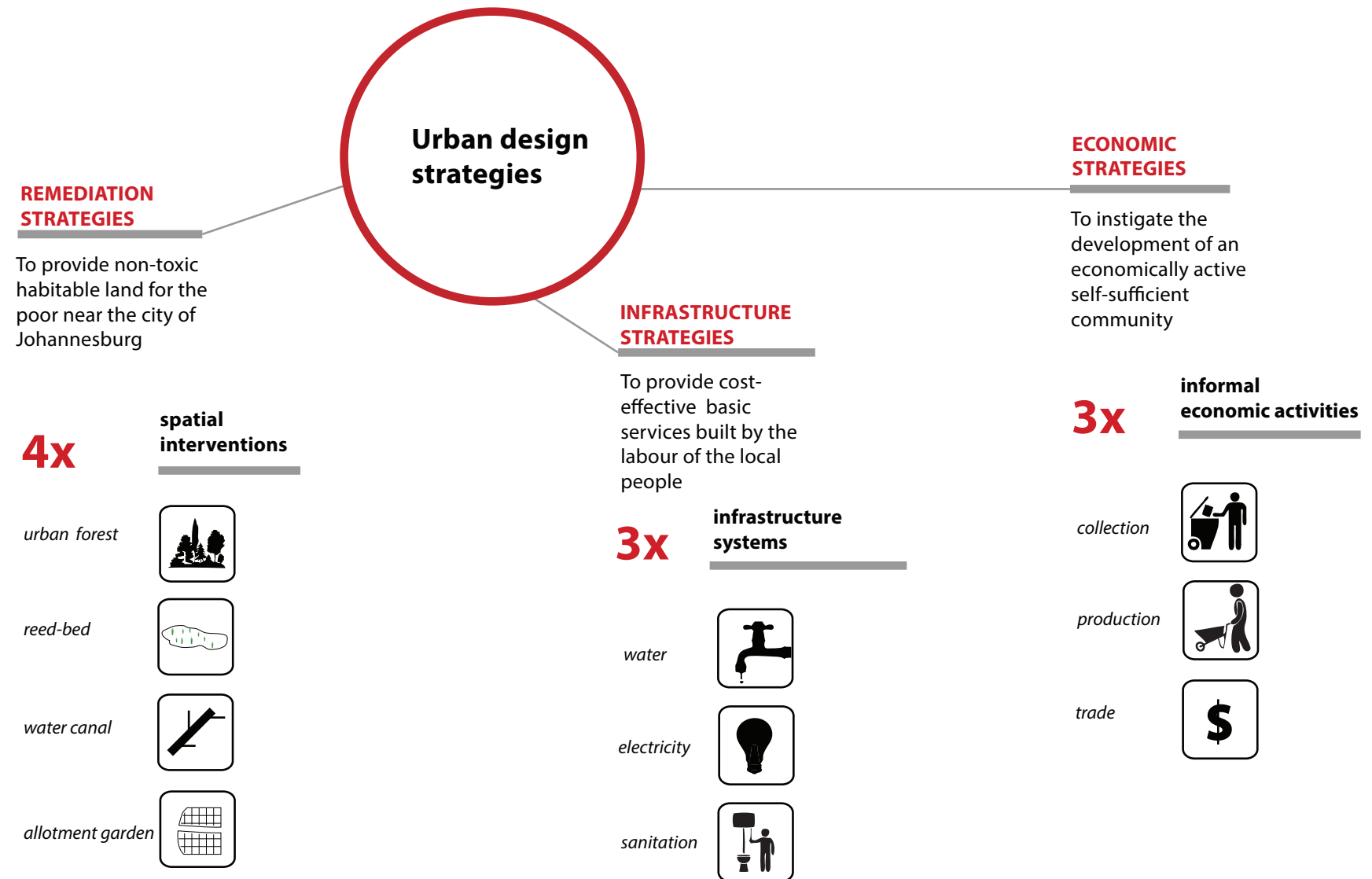


Figure 3.20 Design Strategy diagram

03 - 3.1

DESIGN PROPOSAL

Eroding Apartheid Buffer Zones And Providing Land For The Poor Near The City

Both the 2001 census and 2007 community surveys reveal that more than 60% of informal residents in Johannesburg live rent-free. With little affordable housing available in or near the city for the poor,¹⁹¹ the thesis proposes to re-mediate a MRA (mine residual area) located between Soweto and Johannesburg's central business district, developing the site into self-sufficient residential communities.

The study area has a history of complex physical, political, and social structures. It is a longstanding artifact of the apartheid spatial legacy and formed part of the mining industry. Apartheid planners used the site as a spatial buffer zone between Soweto and Johannesburg. Today, eighteen years after the eradication of apartheid the site continues to operate as a segregation buffer zone, disrupting economic growth, separating over one and half million people from the central city.¹⁹² The site that is located on valuable but toxic land is a visible void in the urban grain.

A three-fold strategic intervention instigates processes to provide land for the poor near the city and erode the apartheid buffer zone between Soweto and Johannesburg. Three strategies propose to transform the site into a self-sufficient community built by local labour. Remediation strategies address the toxic mining landscape, infrastructure strategies provide basic services, and economic strategies promote economic growth. The three strategies operate in co-dependent structures.(Fig. 3.20, p95) Co-op centres train the local community.

Implementation

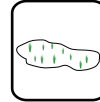
Strategies are implemented through Co-op centres that train the local community. Co-op workers are informal dwellers who apply to employment advertisements in local newspapers and other relevant media. Soweto has an average unemployment rate of 40%.¹⁹³ The plan decreases soaring unemployment rates by sweat equity, applying it to the down-payment of a lot in the newly created residential zone, sold at a set price. Co-op workers receive training constructing building technologies, dwellings on site.

03-3.2
URBAN
DESIGN

URBAN
FOREST



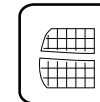
REED
BED



WATER
CANAL



ALLOTMENT
GARDEN



REMEDICATION

4 X SPATIAL INTERVENTIONS

1. Remediation implementation

- Allotment Gardens grows *rehabilitation plant products* to be sold to other mining closure projects and to remediate tailings and slimes dams on the site. These plants perform better when grown in toxic soils. Allotment gardens are placed in areas with the highest toxicity levels. Plant products grown in allotments also remediate this soil.
- Urban Forests are planted on the three tailings storage facilities on the site. Trees selected mops up nitrates, phosphates, sulphates and various heavy metals from the soil contaminated by mining activities.
- Reed-beds are located inbetween the water canal and wetlands. Water from contaminated wetlands, acid mine drainage, greywater and stormwater from tailings is route through the wetlands. After water has moved through wetlands it can be used for irrigation and domestic use. Water for drinking water is routed to the water treatment co-op.
- Water canals are located parallel to existing wetlands, and flow in the direction of the existing waterflow, transporting contaminated water to reed-beds, wetlands and water treatment co-op.

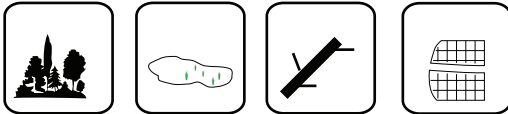
2. Areas with highest toxicity

This map shows the areas with the highest toxicity. The placement of remediation interventions is determined by the level of toxicity. Areas with the least amount of toxicity are reserved for future residential lots. Allotment gardens and pathways are placed on areas with highest toxicity because they are not inhabited for extensive periods of time.

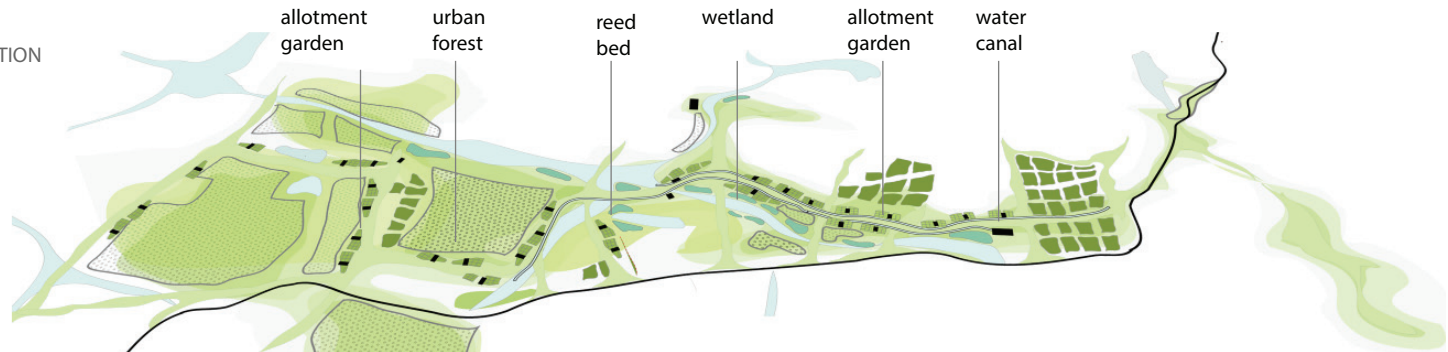
3. Areas where surface conditions are severely disturbed

Areas on the site that have been used as tailings storage facilities, slimes dams or sand reserves are severely disturbed. They have high toxicity levels and are usually very wet. Reed-beds, water canals and allotments are located in these areas.

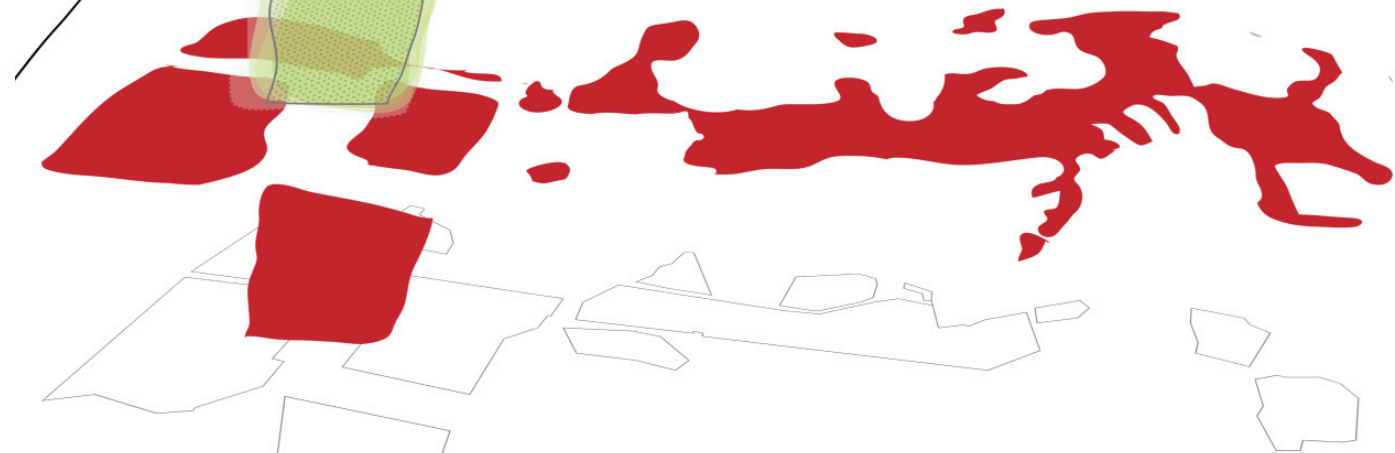
03-3.2
REMEDIATION



1. REMEDIATION IMPLEMENTATION



2. AREAS WITH THE HIGHEST TOXICITY



3. AREAS WHERE SURFACE CONDITIONS ARE SEVERELY DISTURBED

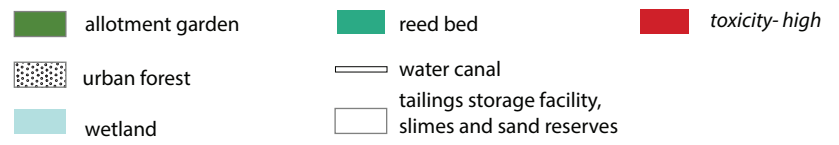
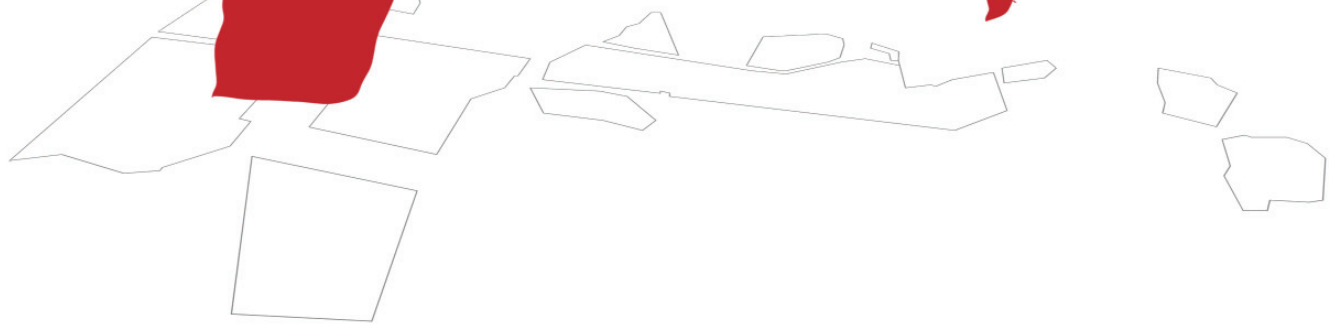




Figure 3.21 Remediation Co-ops

Allotment Garden budget:
R50 000 monthly¹⁹⁶

03 - 3.2

REMEDIATION - INFRASTRUCTURE - ECONOMIC

Four remediation strategies:

Allotment Garden, Urban Forest, Water Canal, Reed-bed

Phytoremediation

Three primary issues pose challenges for inhabiting in the Central Rand basin: poor air quality due to dust emissions from MRA's (Mine residual area); water and soil pollution (Acid Mine Drainage) and the transportation of radio-active matter; geo-technical instability caused by underground mines and open unsealed mine shafts.¹⁹⁴

Biological technologies integrate remediation and rehabilitation simultaneously and operate at low risk with low capital investment. Phytoremediation offers opportunity for sweat equity supporting economic growth. Phytoremediation technologies use metallophyte, halophyte and acidophil flora that have a high tolerance for metals, salinity and acidity in soils.¹⁹⁵ Remediation strategies follows phytoremediation processes.

1. Allotment Garden

Plant seedlings grown in toxic soils - to be replanted on tailings storage facilities - have a higher tolerance to contaminated soils and greater remediation capability.¹⁹⁶ For this reason, the allotment gardens are located in areas of the site where the contamination is the highest. Selected plant species are grown in the allotment garden as *rehabilitation plant products*.¹⁹⁷ When plant products reach a certain age – able to withstand winds and unstable conditions of tailings storage facilities - co-op workers replant them. Co-op buildings provide secure storage of tools and equipment. Co-op centres train workers to plant, harvest and maintain plant products. (Fig. 3.21, p102) Allotment gardens are sized at 20m x 20m or 400 square metres.

2. Urban Forest

Some plant species grow better in contaminated soils and have a greater ability to take up the contaminants from toxic soils. Plant species are selected based on level of contaminant uptake, growth rate, level of evapotranspiration, fire resistance, and rotation time. Exotic trees are fast growing and replanted to tailings storage facilities first. They have short rotations and the harvested wood is used for on-site building technologies. Indigenous trees grow slow and will take longer to reach the age for replanting.¹⁹⁸ These trees remain in the allotment gardens longer and remediate this soil before being replanted to tailings storage facilities. (Fig. 3.22, p103)

Selected tree species:

Exotic

Eucalyptus spp (dunnii, macarthurii, camaldulensis, grandisXcamaldulensis, melliodora, grandisXnitens)

Indigenous

Bushwillow (combretum species) combretum erythrophyllum, Searsia (Rhus) lancea, S. Pendulina, Tamarix usneoides)

Selected Grass Species:

Eragrostics curvula (weeping love grass)

Cynodon dactylon (cough grass),

Agrostic tef (teff), lucerne

Hyparrhenia hirta (thatching grass).¹⁹⁹

Process Timeline:

- year 0-2 Top soil cover (domestic kitchen waste, sewage sludge, refuse) and slope adjustment
- year 2-3 Dig holes, fertilize, plant trees and install irrigation systems (urine and human waste)
- year 3-20 Prune and oversee growth and utilize economic potential (timber, biofuels, pharmaceutical chemicals, traditional medicinal products, fibres and other natural products, rehabilitation plant products)¹⁹⁹
- year 20 Harvest and repeat cycle



Figure 3.22 Rehabilitation of slope at tailings storage facility

Urban Forest Budget:

Designer Plant and Tree Species
Budget: \$259 (R2000) per hectare¹⁹⁸

Reed-bed Budget:

\$ 714 (R5 000) Monthly



Figure 3.23 An example of a Water Canal during Construction



Figure 3.24 Woman pushing hippo rollers containing drinking water

3. Reed-bed

Phragmites Reed-Beds

Phragmites australis is used for phytoremediation water treatment. Stormwater run-off from tailings storage facilities, and acid mine drainage that is pumped to the surface are routed to move through the artificially constructed reed-bed. Water from pit latrines and greywater from kitchens move through pipelines to wetlands and artificial reed-beds. In the reed-bed, nutrients in biotransformation are removed through Bioremediation bacterial action on the top of roots and leaf litter. Water that passed through the reed-bed is suitable for irrigation and domestic use.²⁰⁰ Co-op workers remove water from reed-beds and take it to the water treatment co-op. Here the water is treated to be sold as drinking water. Co-op centres train workers to construct the reed-bed from recycled materials, used tires and gravel.

Existing Wetlands Rehabilitation

Wetlands purify and store water, recharge groundwater, regulate flood water, promote recreational activities and conserve plants and animals. Natural wetlands act as bio-filters removing sediments and pollutants such as heavy metals from the water and would therefore treat Acid mine drainage. The following rehabilitation processes aim to rehabilitate wetlands polluted by mining activities:

- Block drainage to prevent outward flow of polluted water with gabions
- Use gabion and vegetation to stabilise soil and reduce erosion.
- Reduce the speed of water and promote water and soil settlement with gabions
- Co-op workers construct gabions with recycled tires and other rubble.²⁰¹

4. Water Canal

Co-op workers construct water canals along the central and secondary pathways of the project. (Fig 3.23, p104) Water canals transport greywater, stormwater and mine water (AMD) to the water treatment co-op. Co-op workers treat water and distribute it to informal traders to sell as non-drinking water at local water depots and trading areas. They use “hippo rollers” to transport water from the treatment plants to trading areas. (FIG. 3.24, p104) The water canal acts as a barrier between the site and the walking paths to promote safety and protect pedestrians from criminal activities.

03 - 3.2

A case study:
Mines woodlands project

Project description:

The Mines Woodlands case study is a research programme conducted by AngloGold Ashanti and the University of Witwatersrand in the Witwatersrand basin from 1996 with more than \$1.42 million invested in the first ten year period. The project combines ecological engineering with phytoremediation technologies to re-mediate MRAs for future sustainable development. Various species of trees, plants and grasses are tested for their tolerance to toxic soils, ability to remove toxins in soils and water and their ability to control dust emissions. Since 2001, over 300 000 trees have been planted to enable the identification of tree and plant species that most effectively re-mediate soils, groundwater and tailings as well as those with highest economic potential.²⁰²

Primary methodologies:

- Reduce the slope of tailings to reduce planting costs, erosion and increase lifespan of all plant species.
- Replace the conventional topsoil cover method (lime, fertilizer and compost) with domestic kitchen waste, sewage sludge, garden refuse, clays, gravels and various rubbles. This significantly cut costs and allow vegetation cover at only \$210 (R2000) per hectare.
- Select “designer plants” for planting, characterized by low water usage, high tolerance, and excellent remediation capabilities.
- Grow plant and tree species in toxic soils and transplant them to areas that requires remediation. Such plants have higher tolerance and better remediation capabilities.
- Harvest trees planted on tailings (age 20 years) for remediation purposes of other MRAs to increase plant and tree tolerance and remediation capabilities: *Rehabilitation Plant Products*
- Use selected indigenous plant species that have high commercial potential and low radio-active risks.²⁰³



Figure 3.25 Woodlands Mines Project

03 - 3.3
SYSTEMS
DESIGN



INFRASTRUCTURE

3 X TECHNOLOGIES

03 - 3.3

REMEDIATION - INFRASTRUCTURE - ECONOMIC

Infrastructure:

Water, Sanitation, Electricity

The plan proposes infrastructure constructed by the labour of the local people, trained at co-op centres.²⁰⁴ Strategies to eradicate or even reduce informal settlements have failed and conventional infrastructure has simply become unaffordable. South Africa has spent millions of dollars since the end of apartheid on formal RDP housing communities but has barely put a dent in the housing crisis. Alfredo Brillembourg argues, “Don’t build houses, build services”. Brillembourg is opposed to the idea of replacing the informal with the formal. Brillembourg encourages a bottom-up practice driven by the local people implemented through co-ops.²⁰⁵

This thesis follows this philosophy by equipping the local community with technologies implemented through local co-op centres. Infrastructure and house building co-ops teach and train co-op workers to construct, operate and maintain independent systems. Basic infrastructure includes water, sanitation and electricity. Secondary infrastructure includes community and recreational facilities, developed in phases. Later phases may include clinics and educational facilities.

Water

Johannesburg is a semi-arid water scarce city. The average rainfall in the province is 670mm, accumulated primarily during short-lived thunderstorms. Water in Johannesburg is scarce and many waterways have been polluted by mining activities.²⁰⁶



Figure 3.26 Plants grown in recycled tires

Five primary water sources exist in the study area

These are:

Wetlands, streams, rainfall, acid mine drainage in deep aquifer systems and stormwater run-off from tailings storage facilities.

Acid Mine Drainage is a growing threat in the city and toxic water levels threaten to rise and flood the central city.²⁰⁷ Strategies to pump water to the surface are in place and funded by the government. This thesis will assume that the government has pumped water to the surface by municipal efforts and technologies. The “MineWeekly” released an article that CRG (Central Rand Gold) finally tested pumps to successfully de-water the Central Basin.²⁰⁸ DRD Gold, who is currently conducting surface mining in the Central Basin have also taken responsibility to pump the water to the surface.

Twenty five kilometres of high quality pipelines made of high density polyurethane and steel used for mining infrastructure exist on the site.²⁰⁹ Co-op workers, trained to use the existing infrastructure from gold mining activities, construct water towers from steel and install pipelines to transport grey water and sewage sludge. Government funded systems pump water to the surface and water pipes obtained from the existing gold mining infrastructure transfer water to co-op facilities. Co-op workers are trained in passive remediation methods to purify water for general use.

1. Water System:

Water Tower

Co-op workers construct water towers to collect water. Co-op workers construct water farms by building large numbers of water towers in the specified area. Water canals transport the water collected by the water towers to the water treatment co-op.

Crop Farms:

Areas inbetween the water towers are levelled and used for crop farming. Crops are grown in drums and tires.(Fig 3.26, p 109) Holders are filled with non-toxic soil to grow crops. Water towers act as wind barriers to eliminate dust pollution and to provide water for crop farms.

2. Sanitation

Flushable Pit Latrine System

Pipelines connect pit latrines with the bio-gas co-op centre. Pipelines transport sewage sludge to the bio-gas co-op centre where human and plant waste are processed. Co-op workers place pipes, dig pits and construct the sanitation facility. (Fig. 3.27, p 111)

3. Electricity

Bio-gas system

Co-op workers construct bio-gas systems at sanitation facilities located in each residential site. Local people manually transport livestock and plant waste to the biogas digester. Human waste and grey water are transported through pipelines to the biogas digesters.

The system is based on the Cyangugu prison biogas case study. The Cyangugu prison is located in Rwanda, Africa. The Kigali Institute of Science and Technology (Centre for Innovations and Technology transfer) developed a 150 cubic fixed dome digester on the Cyangugu prison grounds. The digester is buried with a landscaped garden on the surface.²¹⁰

- Digester is fed with human waste generated by 1500 prisoners
- Biogas system produces 50% of the energy needed to cook for up to 10 000 inmates²¹¹

Biogas is an eco-friendly fuel that is renewable and economic. Biogas is produced by anaerobic digesters. Biogas is composed of moisture, carbon dioxide, hydrogen sulfide and methane gas.²¹²

Biogas is obtained through a PVC pipe at the digester outlet. Academic research and studies reveal that biogas can be bottled.²¹³ The design proposes that bottled biogas is sold in informal trading areas. Biogas will provide enough energy for basic cooking and lighting requirements.²¹⁴

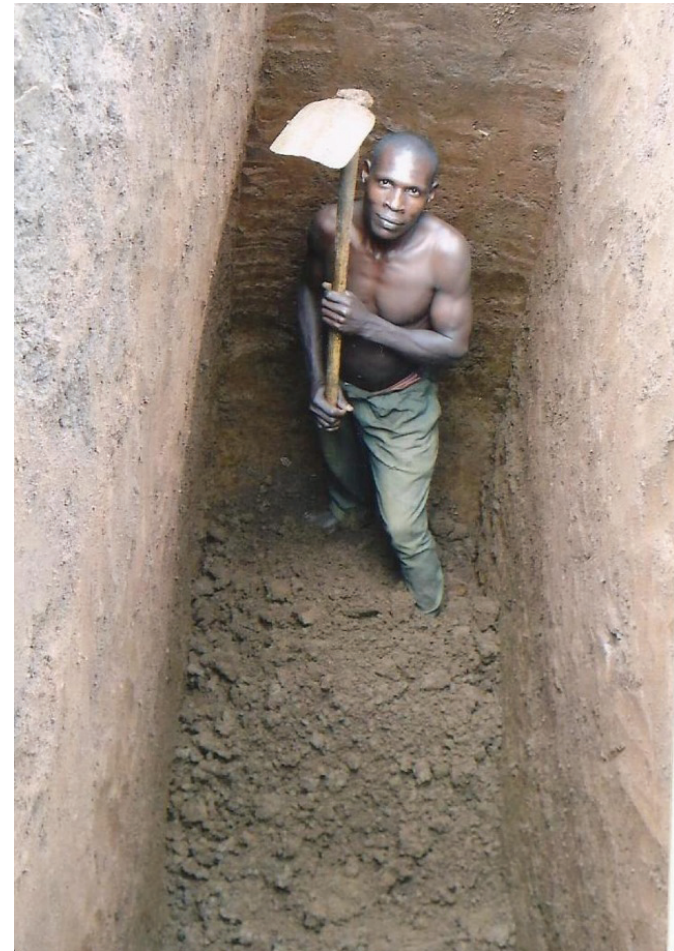
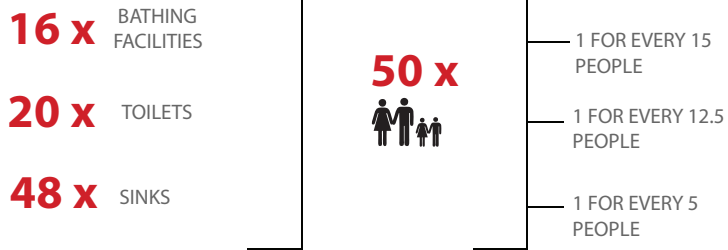


Figure 3.27 Local labour constructs pit latrines

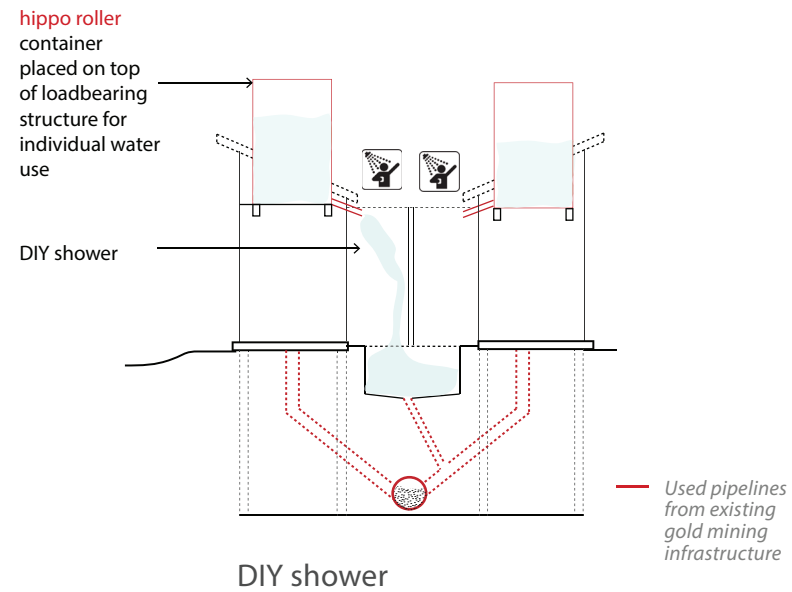
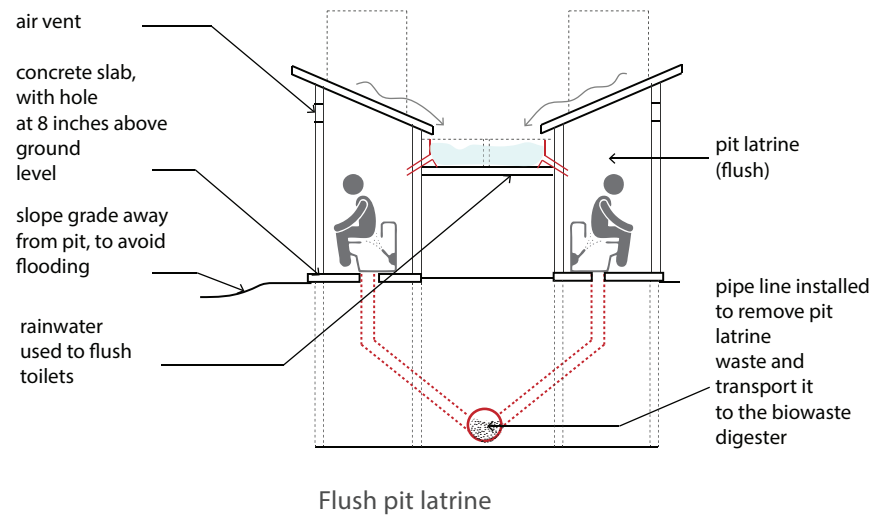
03 - 3.3
PIT LATRINE SYSTEM
 with DIY shower



Above:
 Each sanitation facility has 16 showers, 20 toilets, and 48 sinks. Each residential site have 50 households with one sanitation facility. The above diagram shows the ratio of services to people.



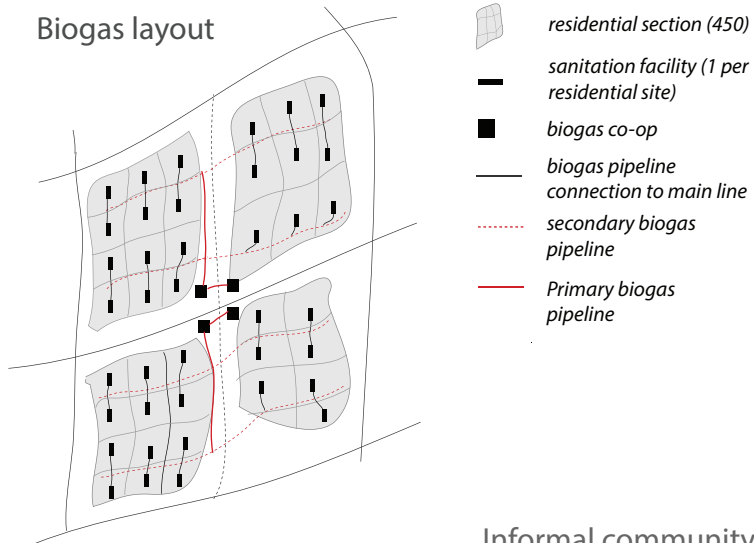
Figure 3.28 Hippo Rollers for DIY showers



03-3.3 SANITATION FACILITY with informal community garden



Biogas layout



Informal community garden

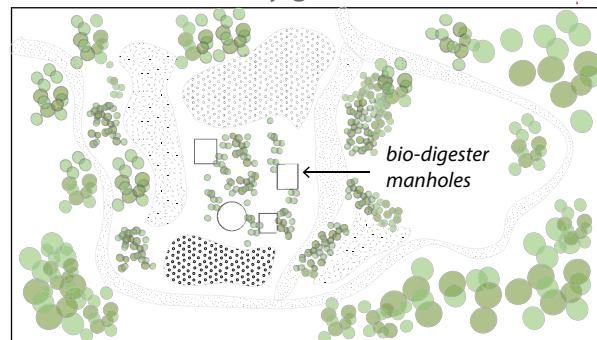
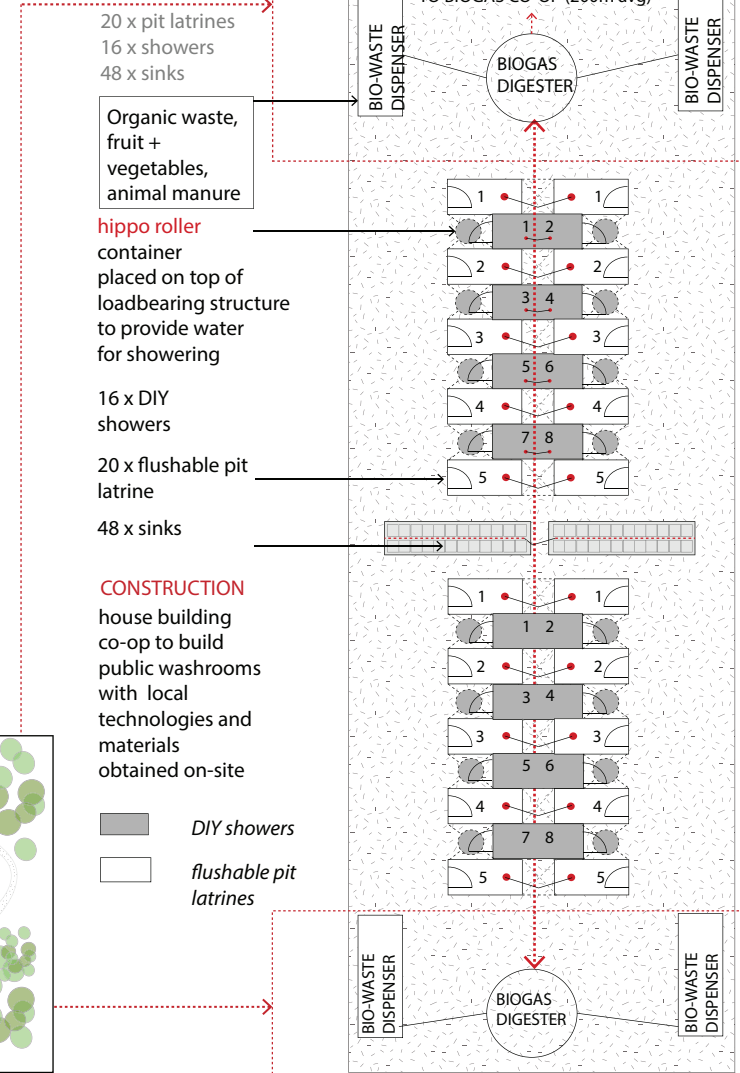


Figure 3.29 Garden above biogas digester

Sanitation facility



03 - 3.3
BIOGAS
SYSTEM

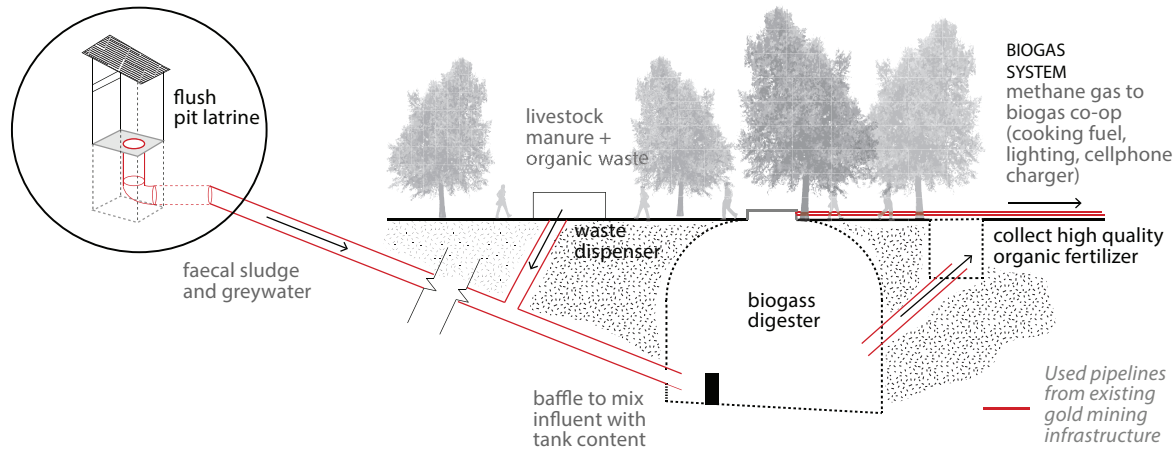


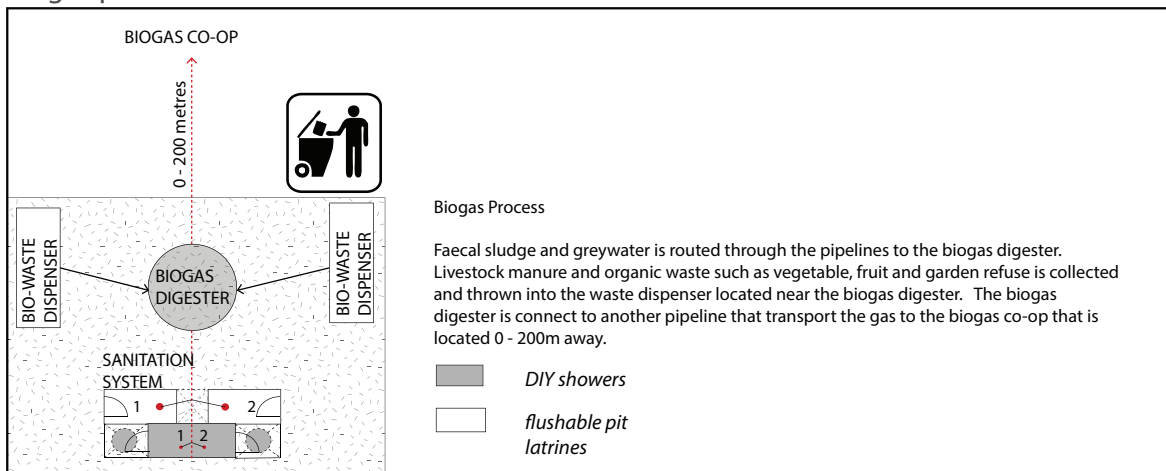
Figure 3.30 Biogas digester during construction



Biogas digester during construction.

The excavated area is filled with soil and rubble. After construction, only small manholes are visible on the surface for operation and maintenance. The surface above the digester is landscaped into a garden used for informal community gatherings.

Biogas process



BIOGAS DIGESTER

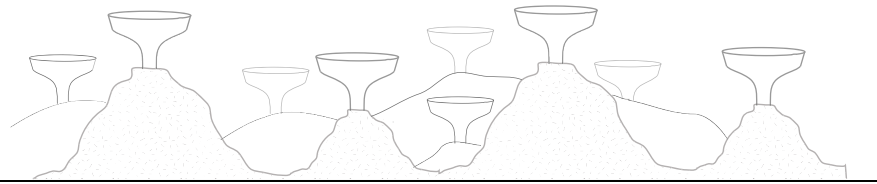
03 - 3.3
WATER SYSTEM



Figure 3.31 water tower constructed with steel



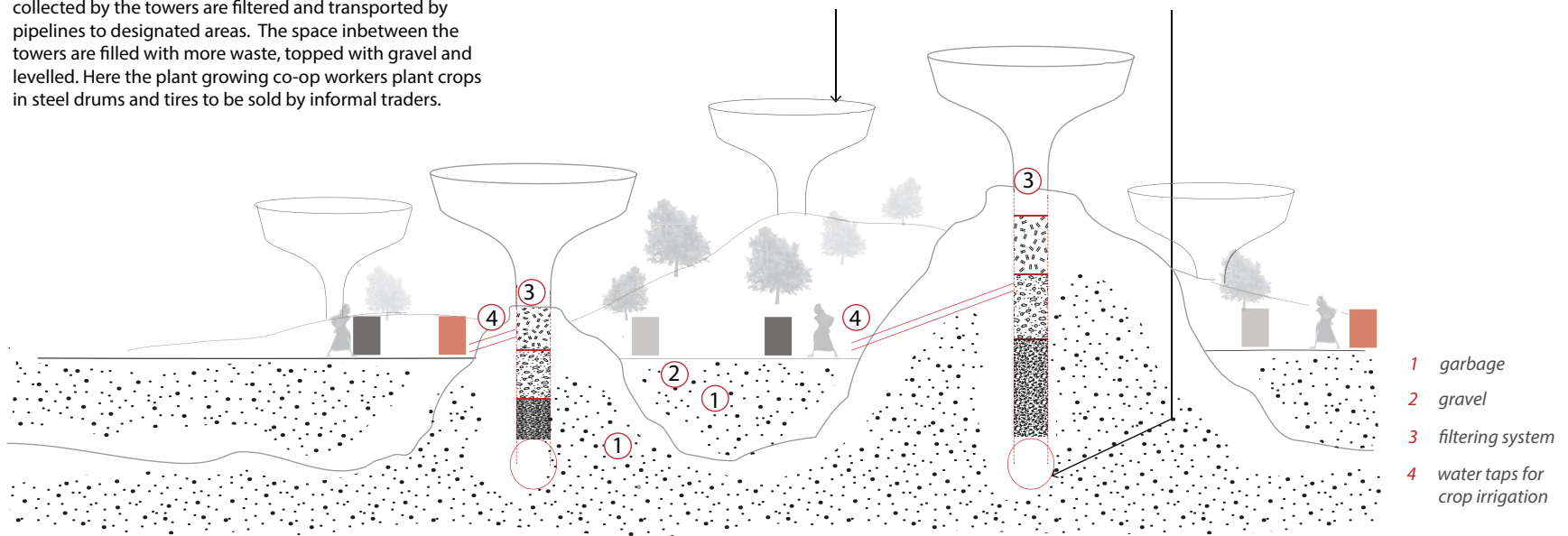
An example of how water towers may be constructed with the existing mining infrastructure.



The water system is a water tower constructed with steel from the existing mining infrastructure. To elevate the towers from the toxic landscape they are built on top of waste. The water farm is constructed over a period of time and operate as a landfill site in the long term. Water collected by the towers are filtered and transported by pipelines to designated areas. The space inbetween the towers are filled with more waste, topped with gravel and levelled. Here the plant growing co-op workers plant crops in steel drums and tires to be sold by informal traders.

rain water collection towers constructed from existing gold mining infrastructure

pipelines from existing mining infrastructure transport water to water treatment co-op



- 1 garbage
- 2 gravel
- 3 filtering system
- 4 water taps for crop irrigation

WATER farm + landfill site

SECTION

03 - 3.3
CROP
FARM



Spaces inbetween the water towers are used to grow crops. Crops are grown in steel drums and used tires in non-toxic soil. Co-op workers plant, irrigate and harvest crops. Crops are sold by informal traders.



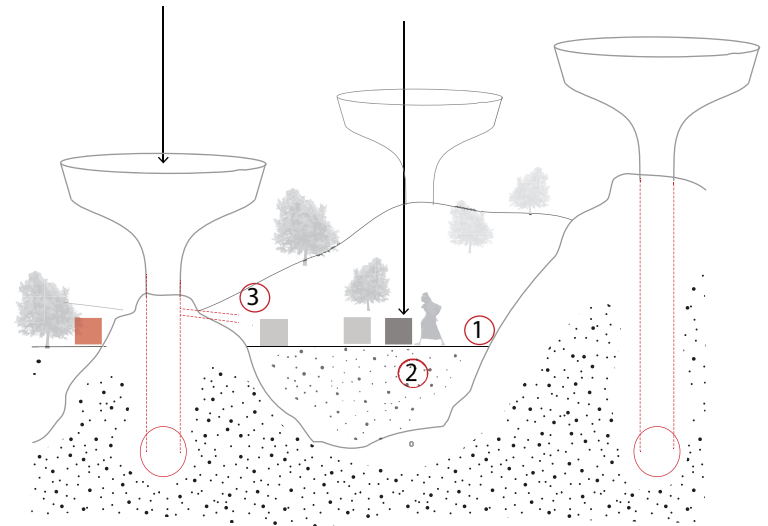
Figure 3.32 (a)(b) Crops grown in tires and steel drums



water towers provide water for irrigation and protect crops farm from dust pollution




crops grown in steel drums and tires in non-toxic soil

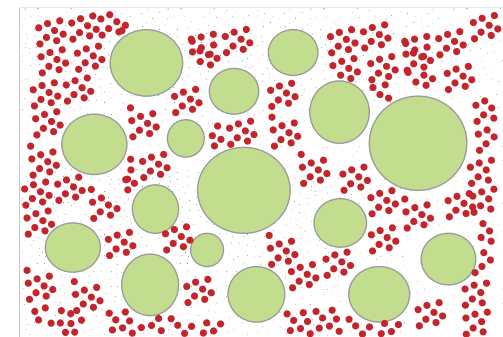
- 1 crop growing
- 2 compacted waste with gravel layer
- 3 irrigation from water tower



CROP farm

SECTION

-  crops grown in steel drums tires
-  open space
-  water towers



PLAN

03 - 3.4
STRATEGIC
DESIGN

COLLECT



PRODUCE



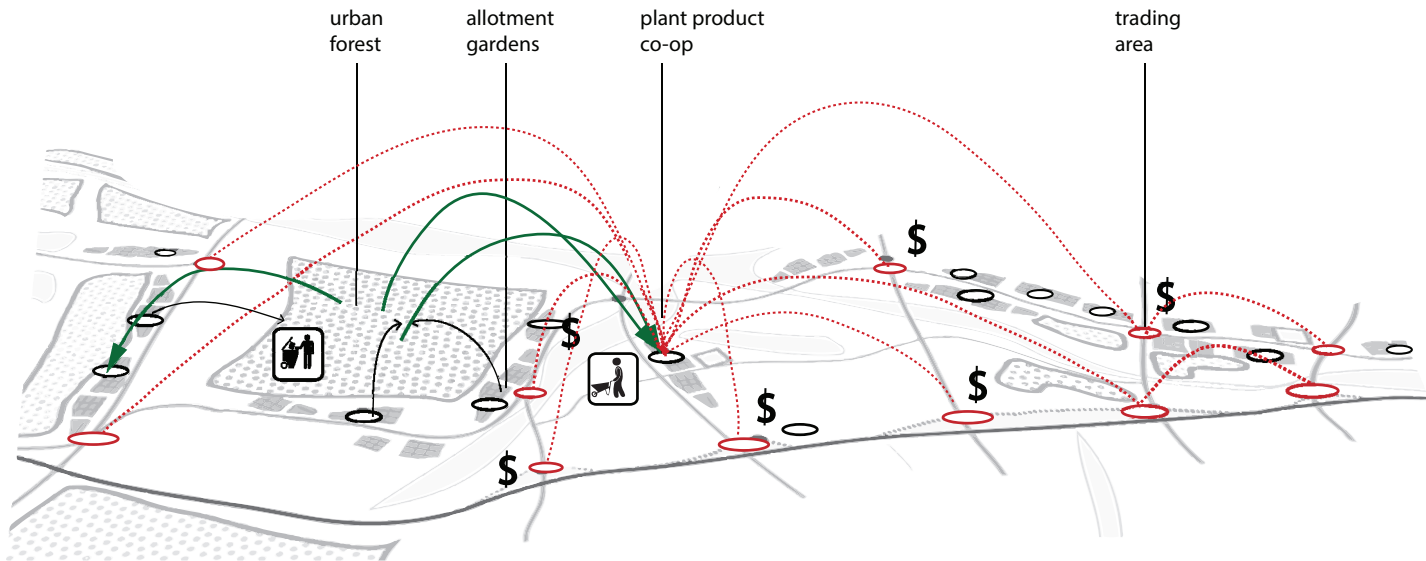
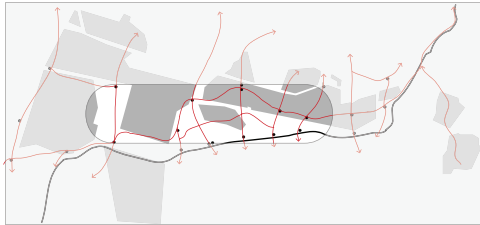
TRADE



ECONOMIC

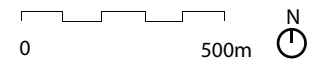
3 X INFORMAL ACTIVITIES

03-3.4 INFORMAL ECONOMY

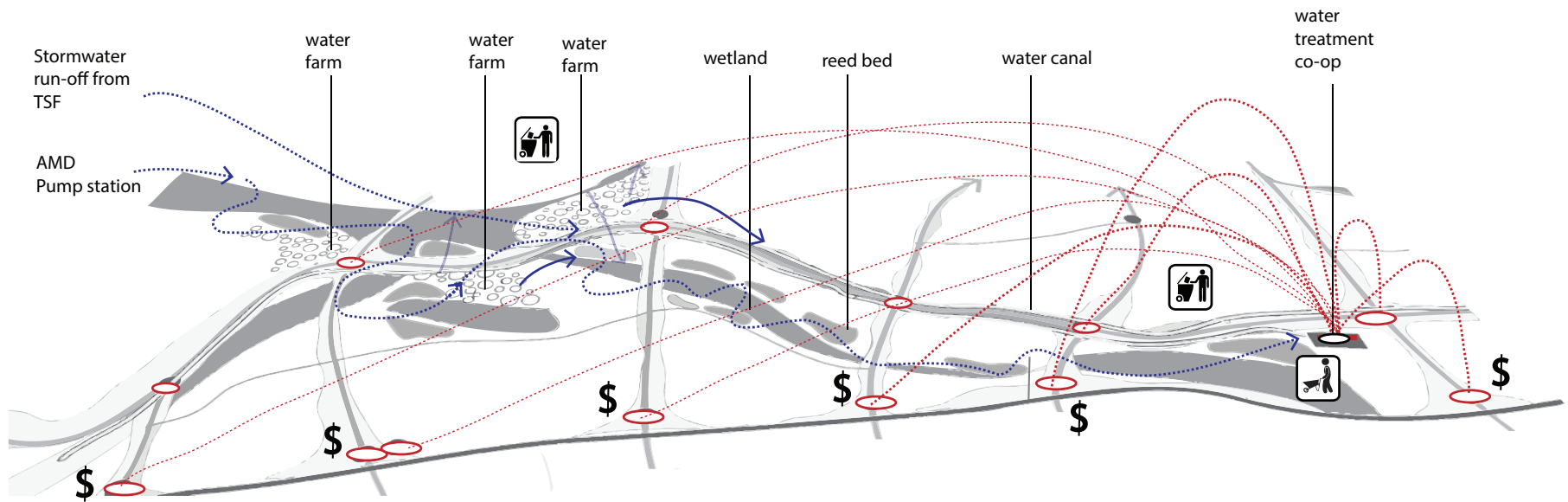
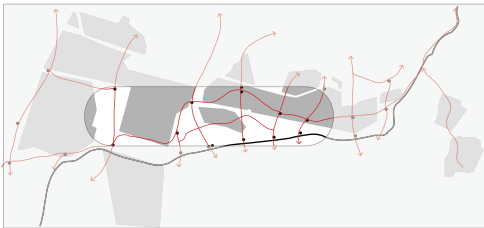


- trees harvested at allotment gardens and replanted in urban forest
- trees harvested and taken to co-op
- plant products to trading areas
- allotment gardens

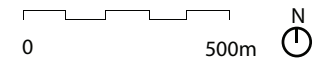
- trading areas
- plant product co-op
- pathway
- major road



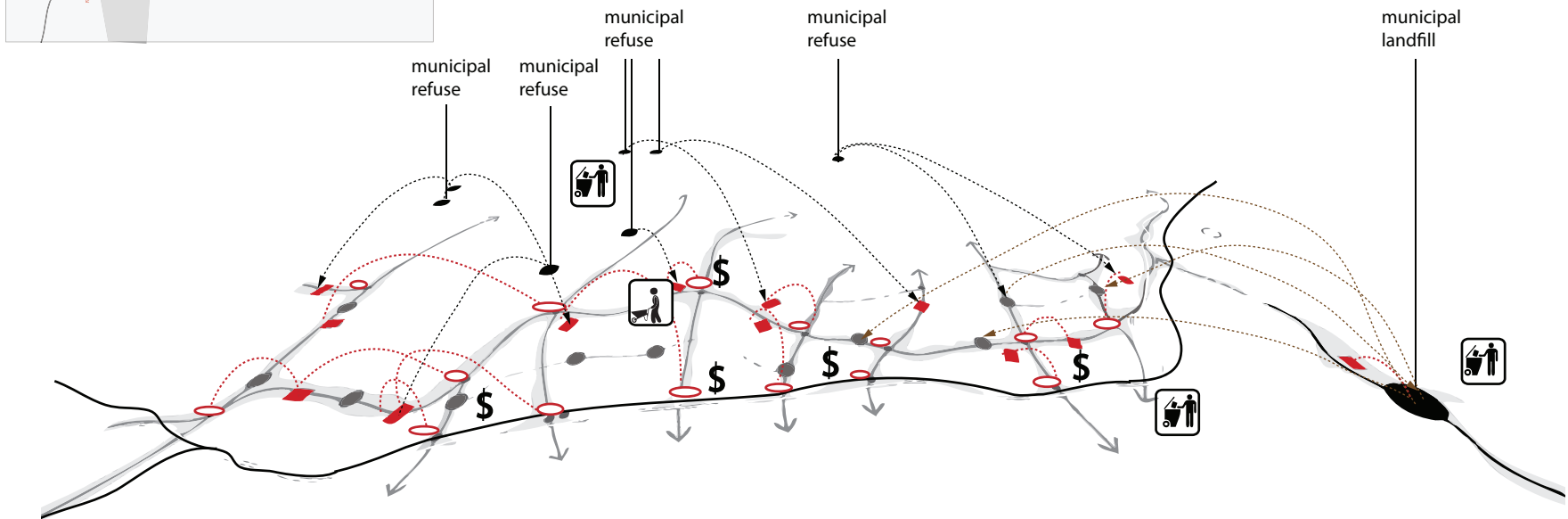
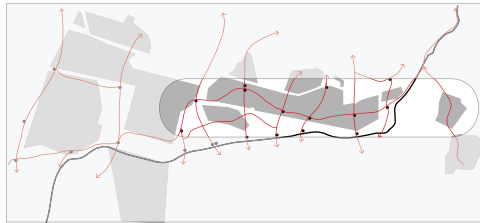
03-3.4
INFORMAL
ECONOMY



- wetland
- reed bed
- water to trading area
- AMD/ stormwater flow
- water flow
- trading areas
- water treatment co-op
- pathway
- major roads



03-3.4
INFORMAL
ECONOMY



-▶ garbage from landfill
-▶ garbage from municipal refuse
- products to trading areas
- co-op centres

- trading areas
- garbage collection sites
- pathway
- major roads

0 500m



03 - 3.4

REMEDIATION - INFRASTRUCTURE - ECONOMIC

Informal/ Grey Economy

The grey or informal economy has developed globally in most poor urban communities. The informal economy operates in unseen realms, it is hard to know how it works, but it is huge, and it exists.²¹⁵ If funds moving through the global informal economy is placed under one political system, it will be the second largest economy in the world after the United States. Ten trillion dollars flow through the informal economy annually.

This unregulated economy employs 1.8 Billion people globally.²¹⁶ Several formal companies have realized lucrative opportunities in the informal economy. Twenty percent of Proctor & Gamble's and 90% of MTN, a South African cellphone provider, profits come from the informal economy.²¹⁷

Informal settlements characteristics

Basic services do not exist in most informal settlements. Informal settlements often have no water services, electricity, sewers, paved roads or walkways. Settlements are void of all municipal services such as schools, clinics, police and emergency facilities. Informal dwellers often seek creative ways to fulfil their most basic needs, independent of municipal assistance.²¹⁸ Community members provide many informal services on site. Globally, informal-settlements or slums are vibrant economic nodes where dwellers work in a unity as a group.

- Informal dwellers are *intensely urban and very creative*.²¹⁹
- To obtain services informal dwellers tap into existing electricity and water lines.²²⁰

Informal dwellers are not concerned about housing, phone services, employment, starvation or access to medical care. Entrepreneurial efforts are steered to meet the basic needs of community members. Food is provided through the informal economy and traditional medicine clinics are plentiful. (Fig. 3.33, p 125) Cash and trading mechanisms drive the informal economy.²²¹

Grey Economy Enterprises

Food stall, Internet, Cafe, Bar, Hair Dresser, Church, Shoe repair, Clothes shop, Copy centre Videos (pirated), Music (pirated), gadget shop, mini-school, public transport, traditional medicine, clinics, dentist, day care²²²

Informal dwellers are most concerned about security of tenure, land near employment, basic services such as water, sanitation and electricity and protection from crime. According to Stewart Brand informal dwellers progress either toward the formal economy or toward crime. It is essential for the urban planner, architect or municipality to assist moving the informal economy away from crime.²²³ The concept of the informal economy is a crucial aspect to protect and develop the livelihoods of the poor. Governments should steer the informal economy and not eliminate it.

System strategies in this thesis proposes to direct the informal economy toward a form of legal informal trade and cash flow.

Economy In Soweto

1. Formal economy

Soweto's contribution to Johannesburg's formal economy, GDP (Gross Domestic Product) is very low with no significant formal economic activity. The GVA of the region is only R6.4 billion, making up only 4% of the city's formal economic activity. The lack of formal economic infrastructure development in Soweto during the apartheid years, caused this poor economic performance and disturb economic growth.²²⁴

2. Informal Economy Already In Place

When considering the informal economy the picture looks vastly different. Large numbers of Soweto's residents work in the informal economy in Johannesburg.²²⁵ As aforementioned, Johannesburg has one of the largest informal economies in the world.²²⁶



Figure 3.33 Informal fruit and vegetable trader

The informal sector has grown immensely in Soweto and has become an essential “mode of income” and employment. The informal economy in Soweto has a major role within the regional economy. With an average unemployment rate of 40%²²⁷ residents find creative ways to make money through the informal sector. Informal vendors and traders exist in areas where a high demand exists for specific products or services. Informal activities exist at major intersections and at interchanges with large pedestrian movement or near major shops, malls or government buildings. (Fig. 3.34, p 127) Informal businesses tap into the traffic flow generated by the formal businesses and government facilities.²²⁸

Shortcomings that hinder the informal economy:

- lack of washroom facilities
- lack of storage for consumer products
- lack of allocated trading places
- no protection from crime.²²⁹

Competition in the informal economy has sky rocketed, as more and more entrepreneurs join the informal economy. The most popular products and services: fruit & vegetables, snacks, street garages, public telephones, shoe repairs, hair cutting traditional doctors, meat products, second-hand clothes.²³⁰

Informal customers

- City commuters by taxi or train
- pedestrians
- public workers
- residents
- major business clients

Informal businesses fit into two groups. Businesses that operate from homes and those located in public spaces. Bakeries and traditional doctors normally operate out of homes while other customer dependent businesses locate in busy streets and in taxi ranks. Informal dwellers organize their own micro economy for their own convenience. With little infrastructure or amenities in Soweto, informal dwellers have developed micro-economies to sustain their livelihoods.



Figure 3.34 Informal transportation of goods

To provide for their basic needs, informal dwellers have developed creche`s, hair salons, shebeens (bars) and spaza`s (shops). Globally, municipalities have come to accept this illegal form of trading with a measure of tolerance.²³¹

Economic Strategies:

The thesis proposes urban design strategies to create self-reliant communities built by the labor of the local people, "a self-made place, a DIY city".²³² With almost half the population of Soweto unemployed there is a great need for communities to become self-sufficient by providing employment within the community.²³³ The implementation of remediation and infrastructure strategies rely on the economic strategies for their intervention.

Three Informal Economic Activities

Collect, Produce, Trade

The study area is located next to the highly populated residential township that produce a lot of waste.²³⁴ Furthermore, one of the largest land fill sites in the city is located near the study area. These factors bring significant opportunity for the informal economical to grow. Robert Neuwirth calls it a trash to cash future.²³⁵ Money is generated, while landfills are emptied.

1. Collect

Items that co-op workers collect to implement design strategies.

Garbage, recyclable waste, garden refuse, domestic kitchen waste, human waste, plant waste, reeds, water, tires and glass bottles, pipes (from gold mining infrastructure) and Steel (from gold mining infrastructure)

2. Produce

Technologies, structures and products that co-op workers produce

Urban Forest, Allotment gardens, Water canal, Reed-beds, pathways, houses, pit latrines, trading sheds, co-op centres, informal trading carts, gabians, Hats, mats and handbags plant and tree planting devices (tires), waste collection trolleys, medicine from plants and wind breakers to counter dust emmissions

3. Trade

Trading areas are provided at trading nodes near bus and taxi stops along the Mbatha bus route that border the southern edge on the study area. Local trading areas are provided in the residential zone and along both the primary and secondary footpath intersections.

Informal trading carts

Informal trading carts are built by co-op employees. Informal trading carts are designed to fit into the stalls provided at the trading sheds. Informal traders store informal trading carts at the trading sheds and move them around the site to areas where business is most lucrative. For instance, informal trading carts may be moved to the recreation nodes during sport or social gatherings.

03 - 3.5
STRATEGIC INTERVENTION

KIT OF PARTS

8 X STRATEGIC INTERVENTIONS

03 - 3.5
8 X KIT OF PARTS

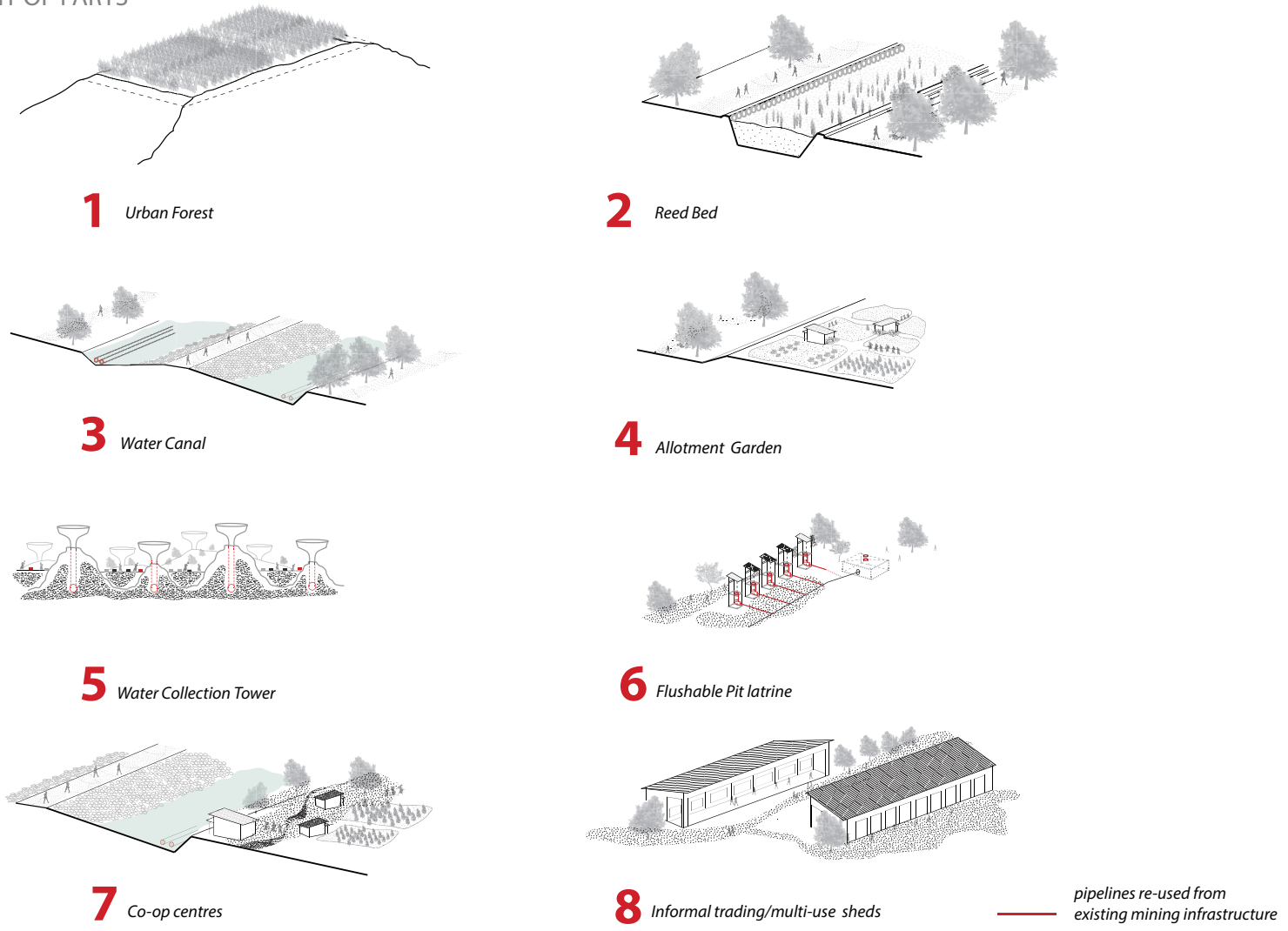
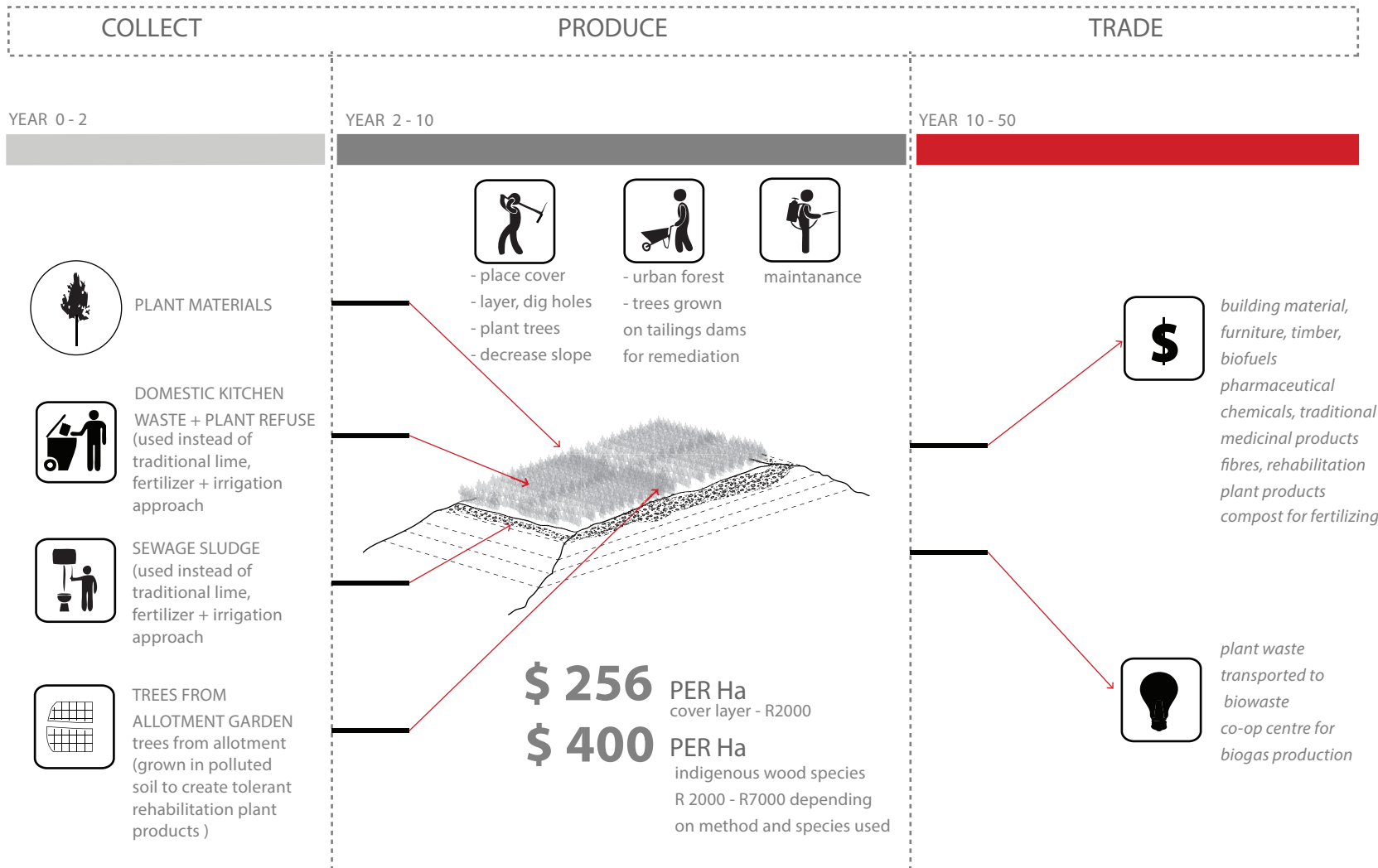


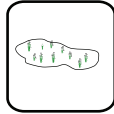
Figure 3.35 Kit of Parts diagram

1

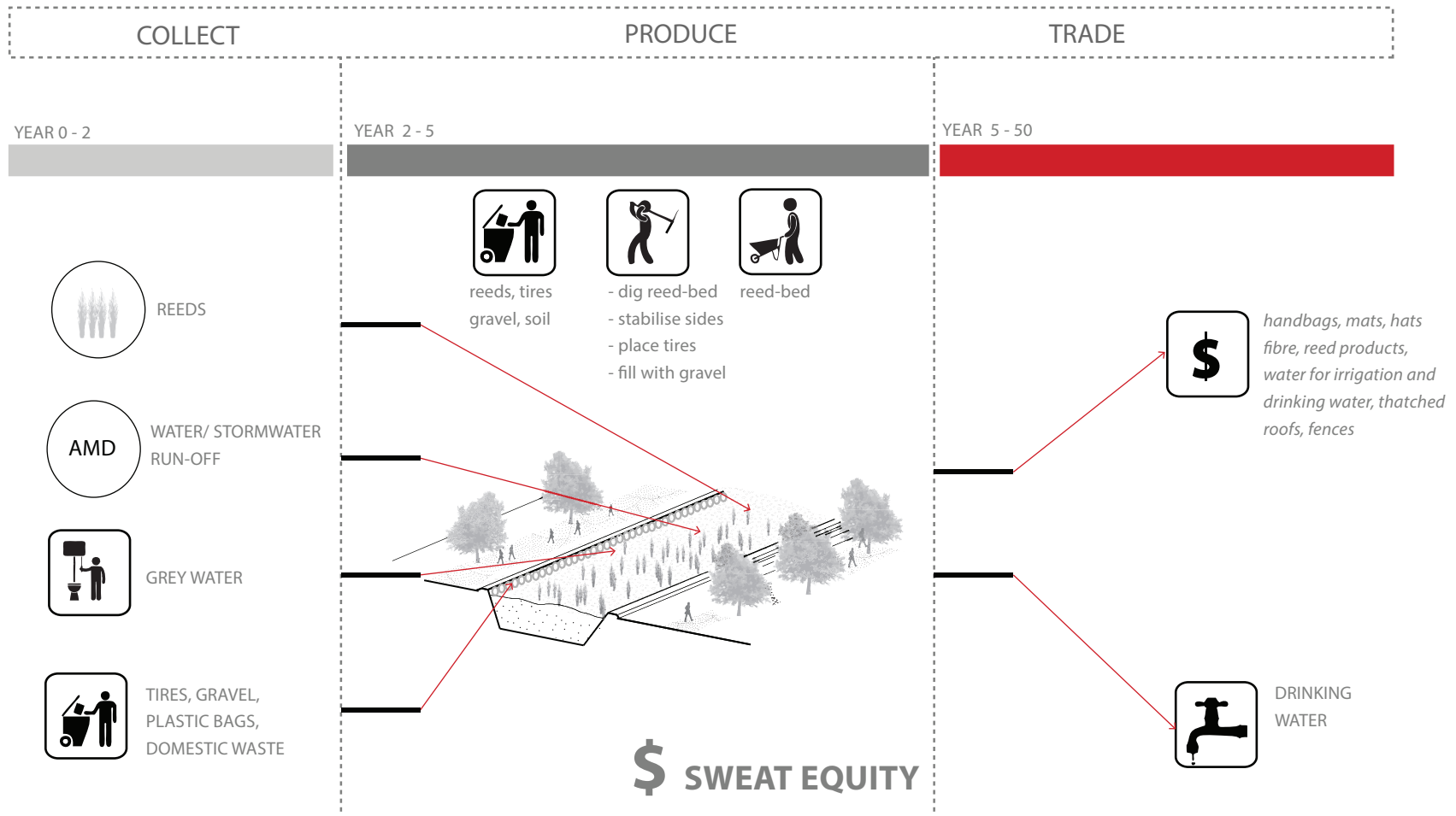
URBAN FOREST



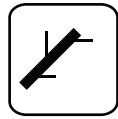
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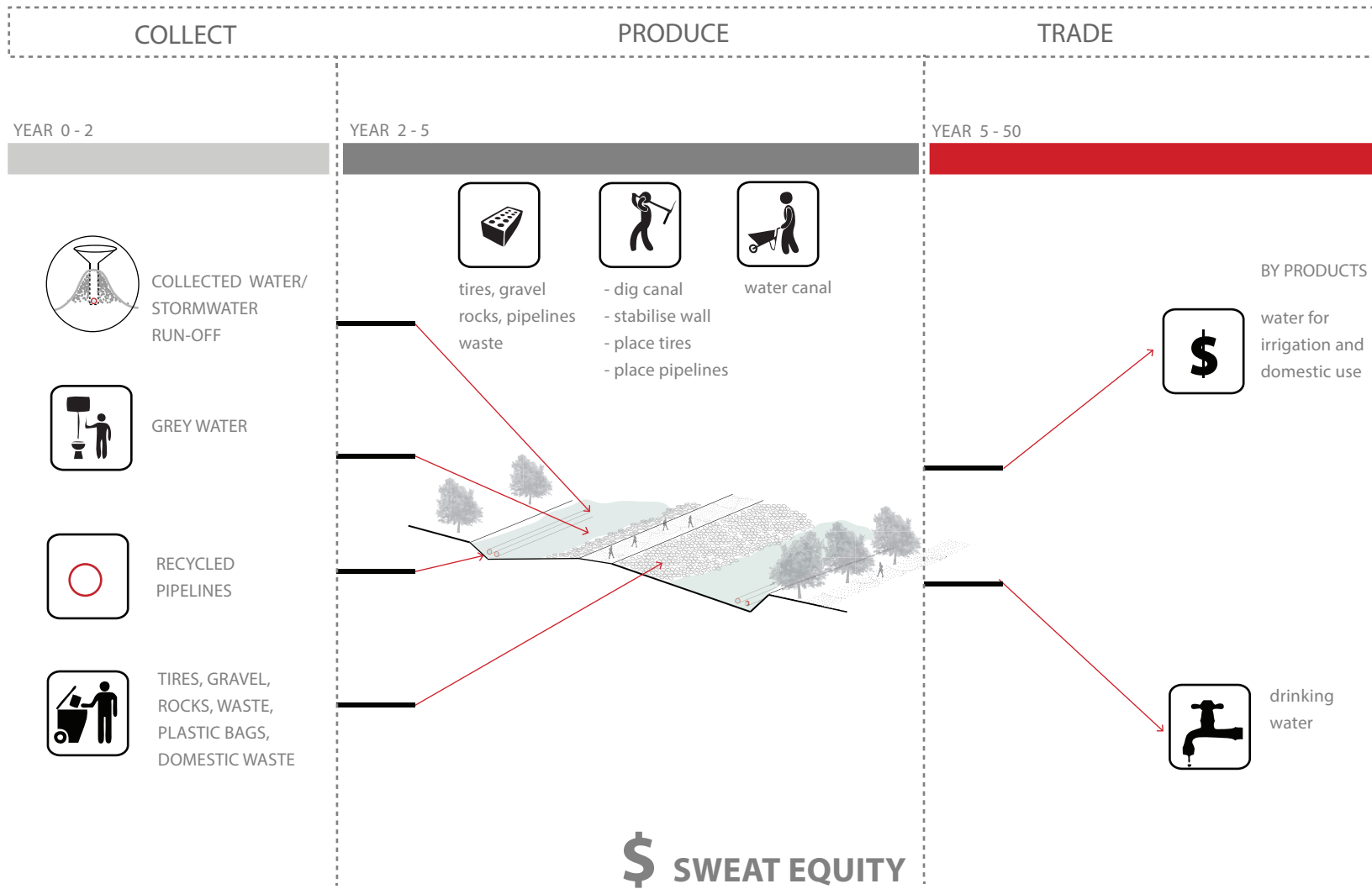
REED BED



3

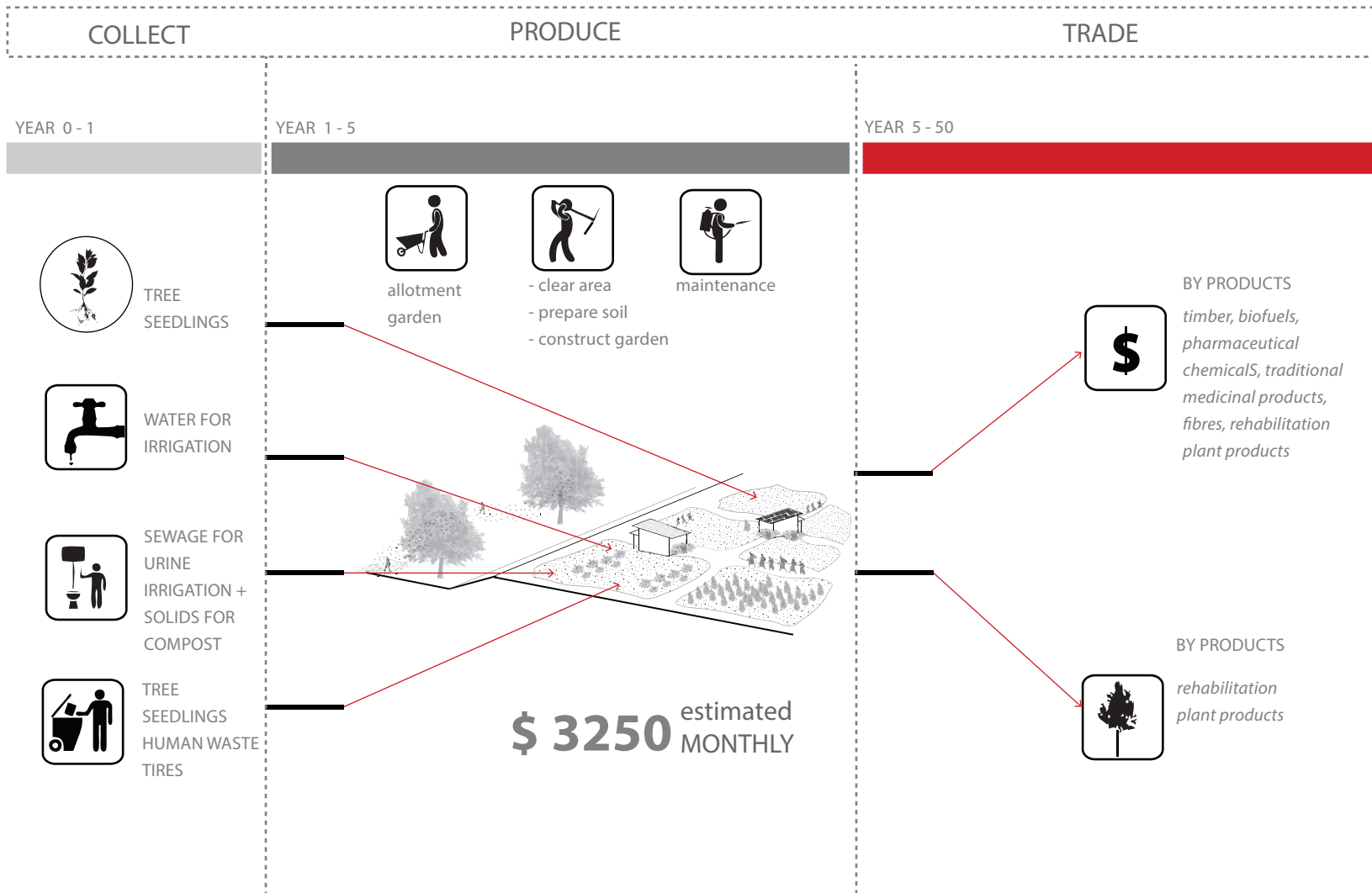
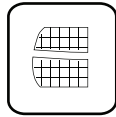


WATER CANAL



4

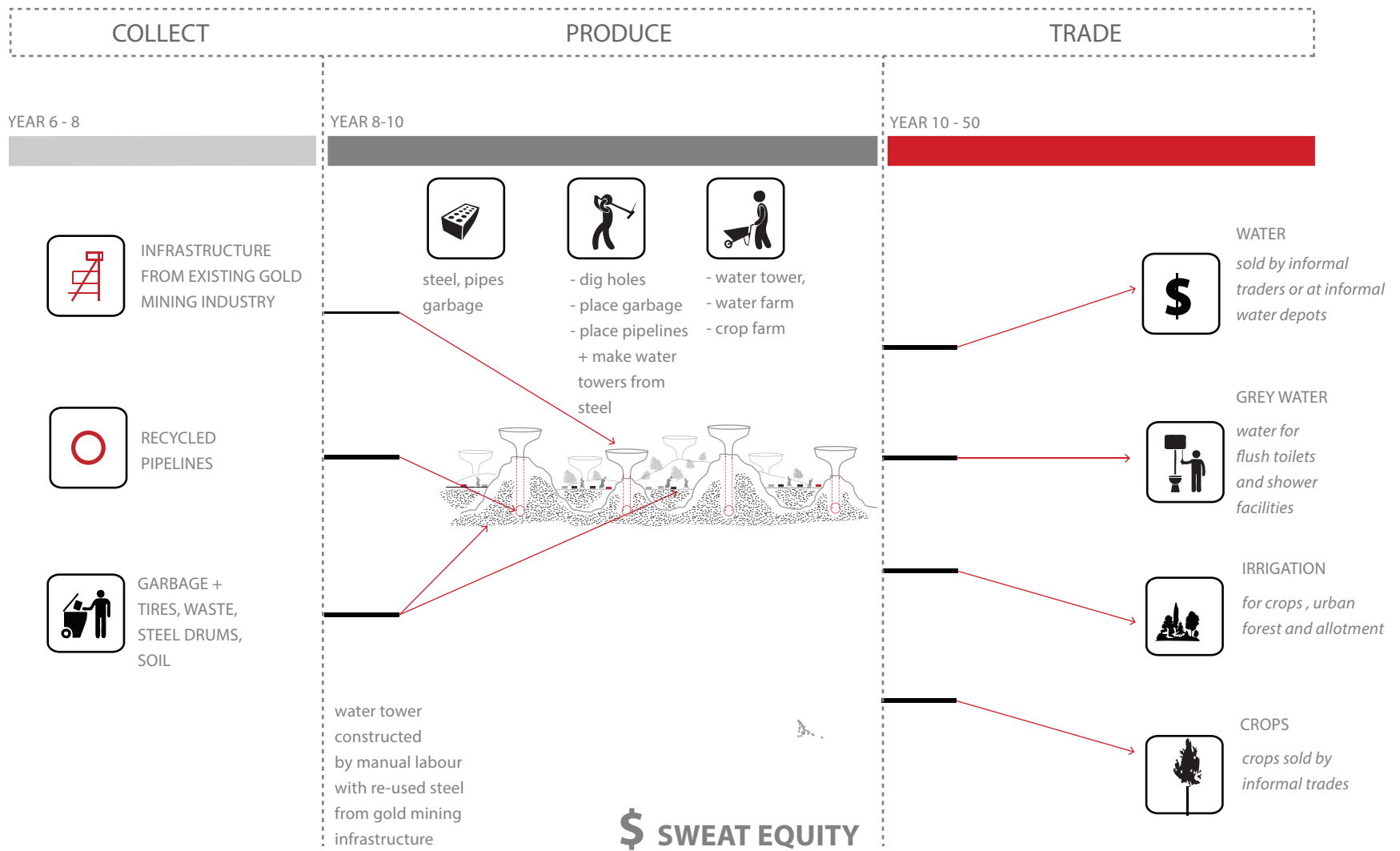
ALLOTMENT GARDEN



5



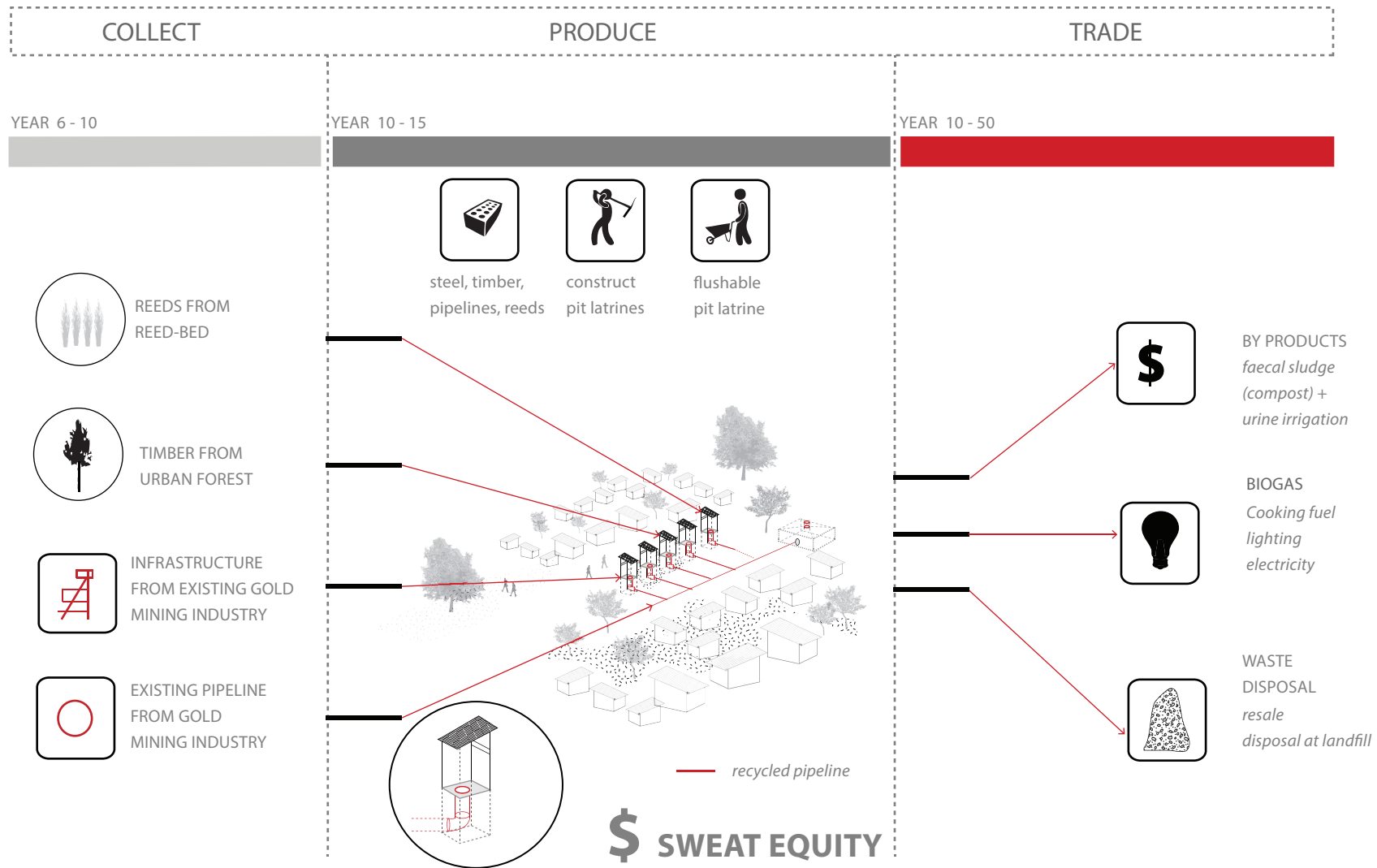
WATER TOWER



6

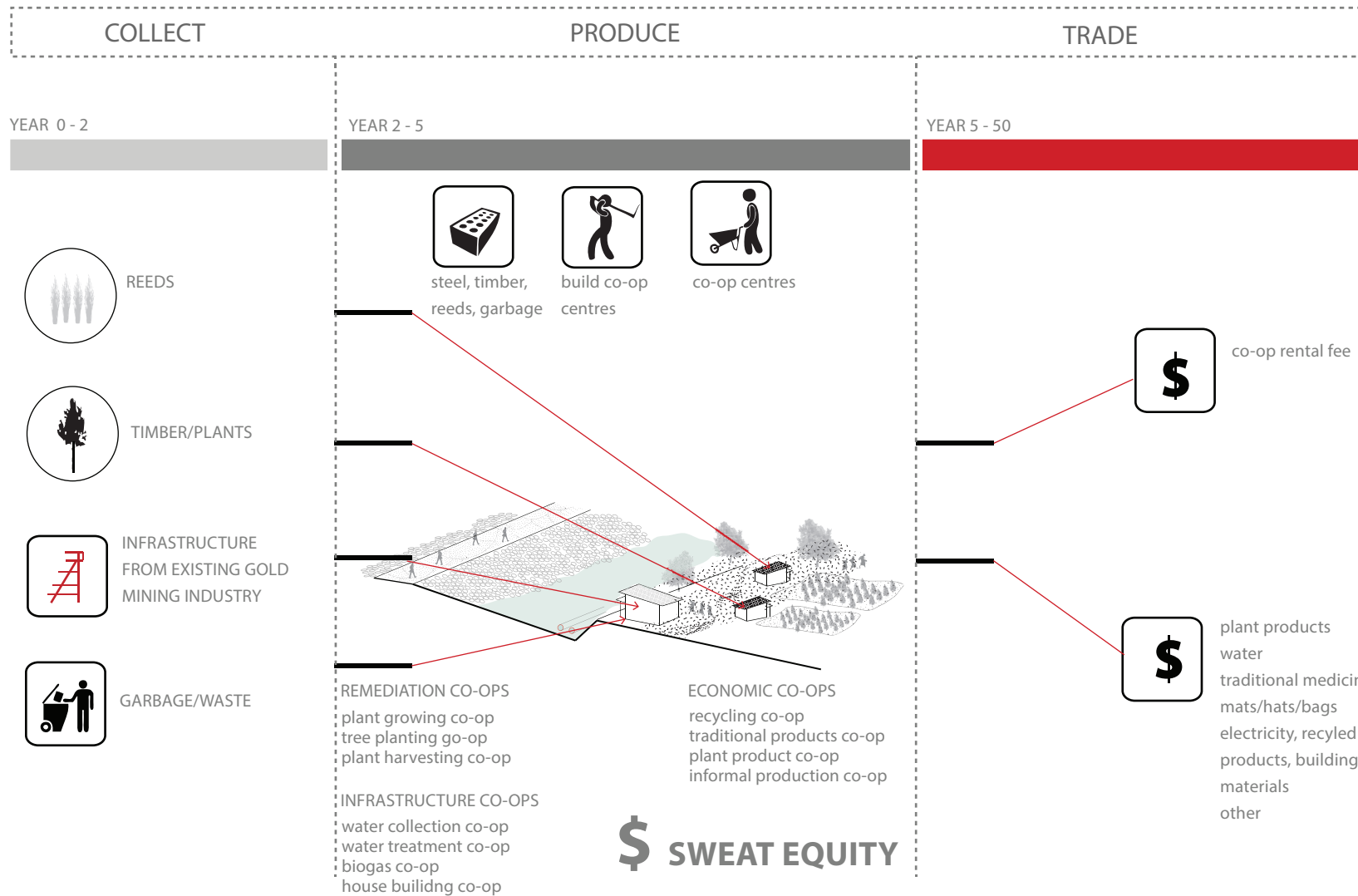
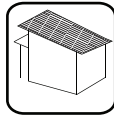


PIT LATRINE

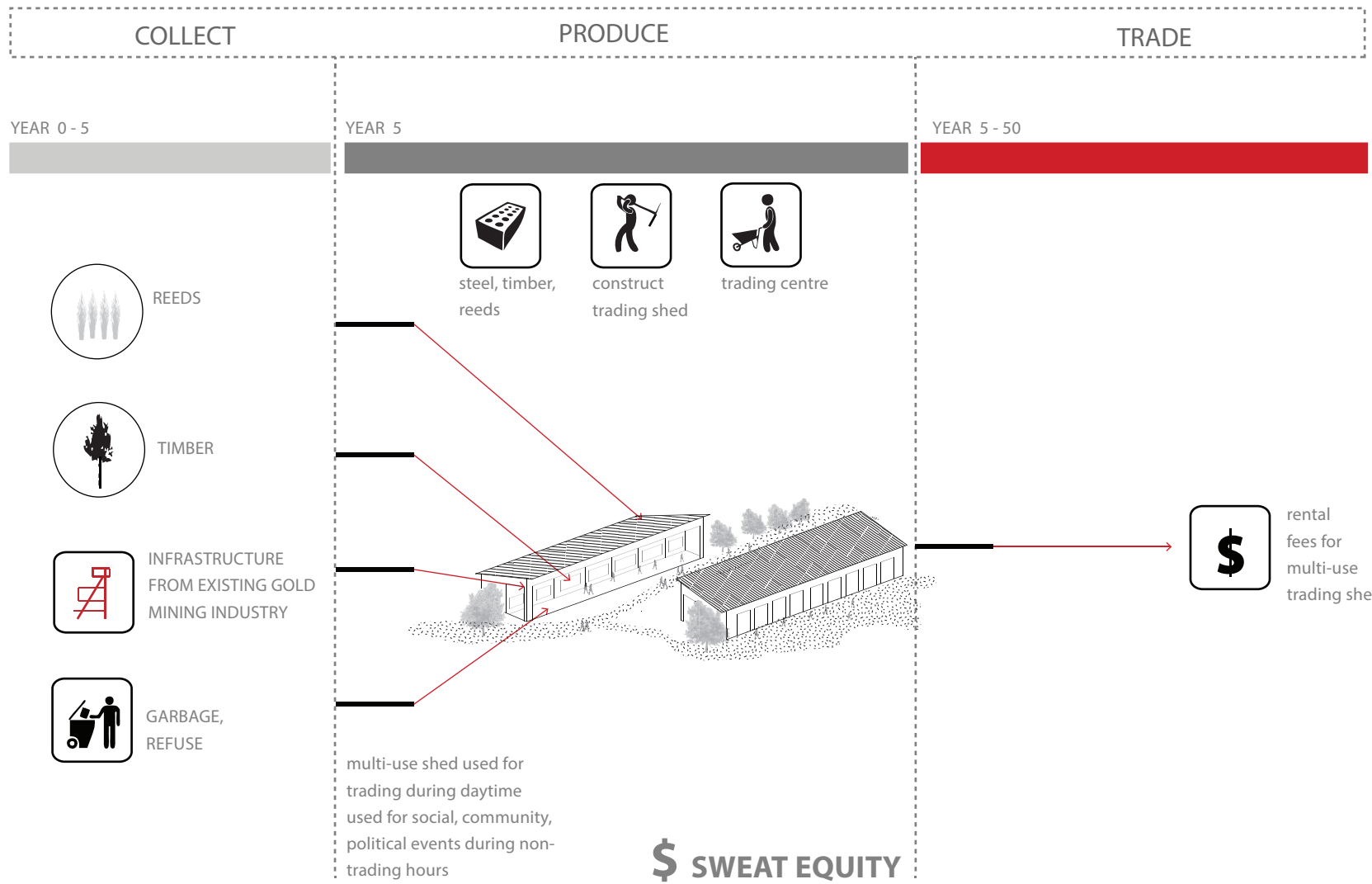


7

CO-OP CENTRES



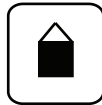
8 TRADING CENTRE



03-3.6

NODES
DESIGN

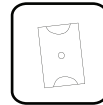
RESIDENTIAL



CO-OP
CENTRE



RECREATION



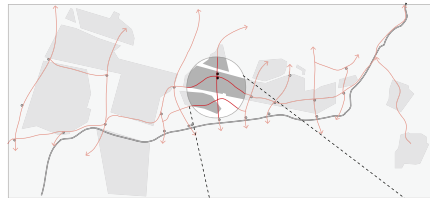
TRADING



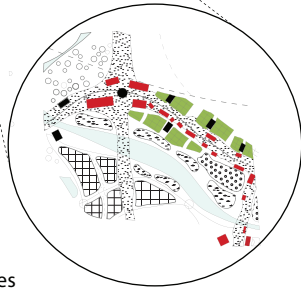
SITE NODES

DESIGN

03-3.6
TRADING



Site Context



Informal trading businesses

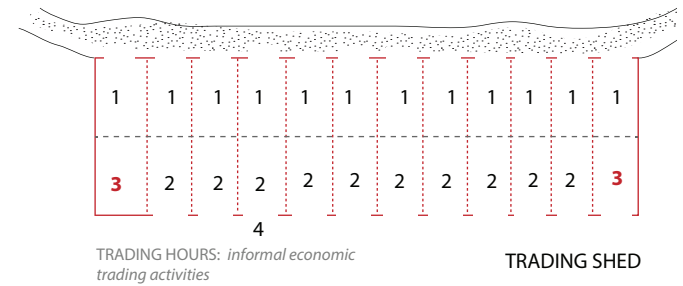


Figure 3.36 (a)(b) Informal Businesses

- primary footpath
- secondary footpath
- informal trading sheds
- informal services

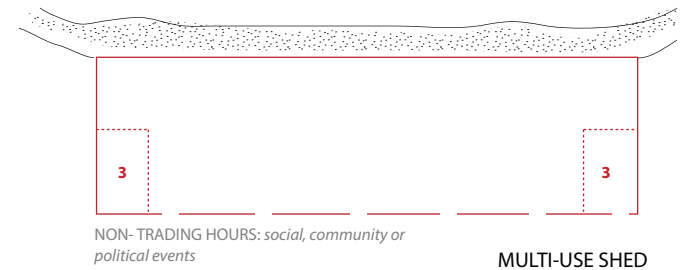


SHED SIZE: 24 M X 6 M
Individual stalls size: 2mx3m



- 1 informal trading space
- 2 informal trader storage
- 3 washroom facility
- 4 trolley station + drop-off

pedestrian pathway

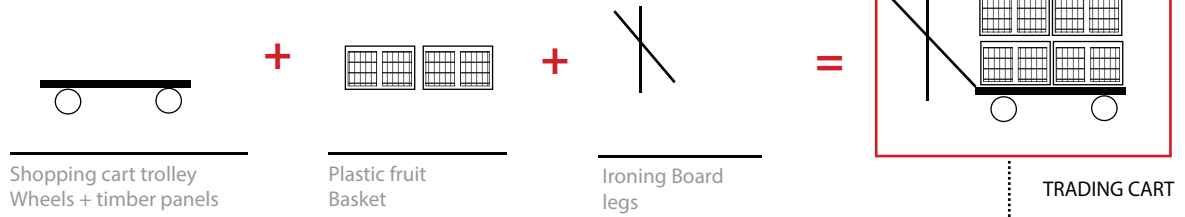


03-3.6 INFORMAL TRADING CART



SHORTCOMINGS OF INFORMAL TRADING IN SOWETO

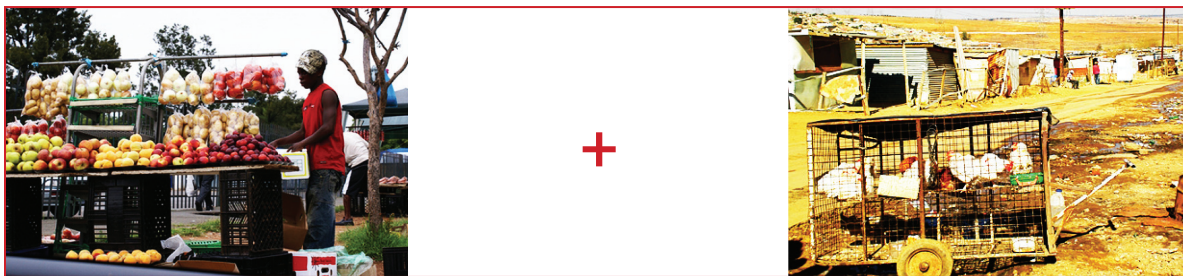
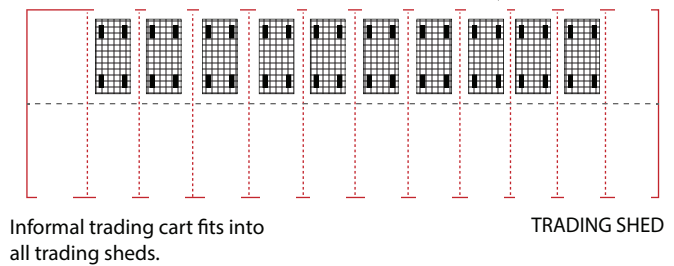
“Shortcomings that hinder the informal economy range from the lack of washroom facilities, lack of storage for consumer products, lack of allocated trading places and no protection from crime.”



INFORMAL TRADING CART

Shopping carts, fruit baskets and ironing boards are waste materials commonly found at garbage dumps and landfill sites. The informal trading cart transports 4 - 8 fruit baskets, and allows informal traders to have a mobile business.

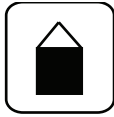
Informal traders may park the cart in one of the many trading sheds on the site, or move it around to where their business is most lucrative. Informal trading carts are stored in secure spaces at trading sheds at night.



Design informed by “Recycle change” - The South African Informal City

Figure 3.37 (a)(b) Informal trading cart examples

03-3.6
RESIDENTIAL

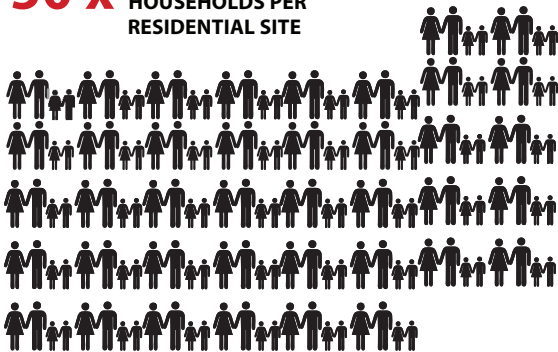


Site context



RESIDENTIAL SECTION:
16 X RESIDENTIAL SITES PER SECTION

50 X HOUSEHOLDS PER
RESIDENTIAL SITE



- toilet & bathing facilities
- water depot
- waste collection
- local trading area
- primary footpath
- secondary footpath

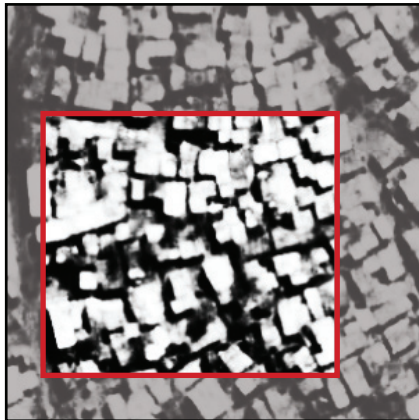
800 X HOUSEHOLDS PER SECTION

RESIDENTIAL SITE:
50 X LOTS PER SITE



03-3.6








RESIDENTIAL



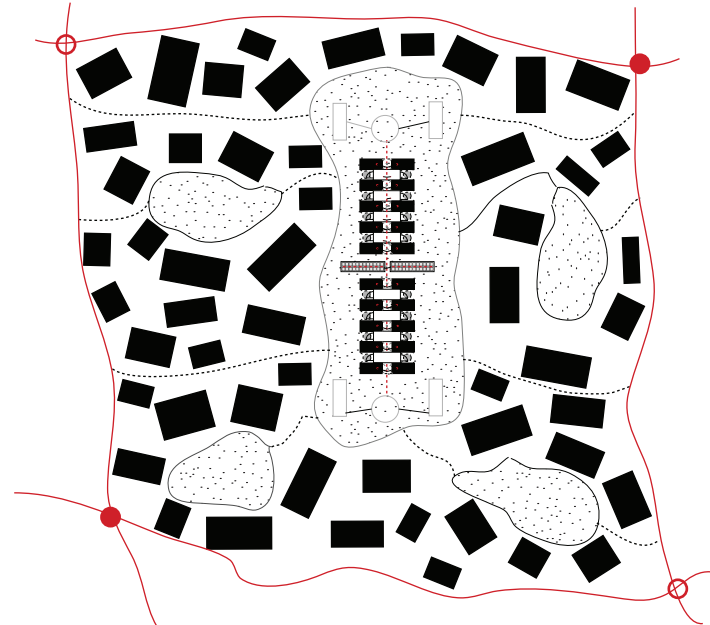
INFORMAL SETTLEMENT
DENSITY IN SOWETO
AREA: 50mX50m = 50 SHACKS

RESIDENTIAL SITE

- 50 x** LOTS
- 1 x** SANITATION FACILITY
- 16 x** SHOWERS
- 20 x** FLUSHABLE PIT LATRINES
- 48 x** SINKS

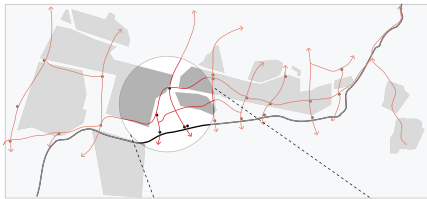
-  dwelling
-  toilet & bathing facilities
-  water depot
-  waste collection
-  primary footpath
-  secondary footpath
-  communal area for gardens and livestock

50m x 50m RESIDENTIAL SITE



03-3.6

CO-OP CENTRE



Site Context



- primary footpath
- secondary footpath
- co-op centres
- informal trading
- ≡ footbridge
- rehabilitating plant products
- allotment gardens



Above: Plan shows the spatial relationship between the urban forest, allotments and plant growing co-ops

Ivory Park Eco city case study:

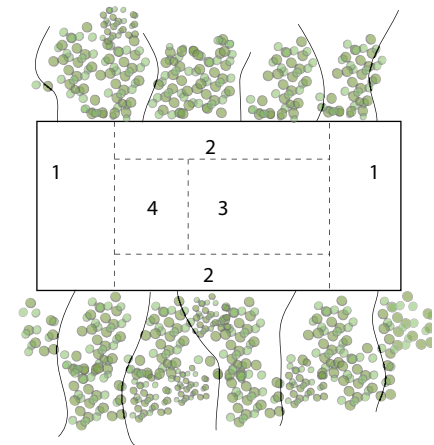
The Ivory Park eco city project, uses co-op centres to run proposed small businesses. This thesis applies the concept in a different way. Co-op centres are responsible for implementing the design strategies and operates by sweat equity.



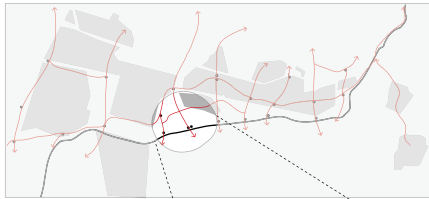
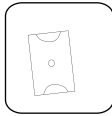
Figure 3.38 Ivory Park case study

Plant growing co-op centre

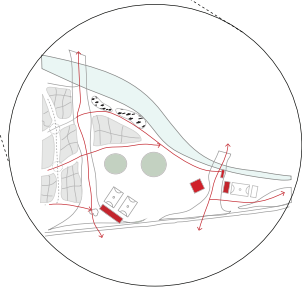
- 1 collection (plant material, waste supplies)
- 2 training and teaching
- 3 workshops
- 4 washroom and communal facilities



03-3.6 RECREATION



Site Context



RECREATION PARK

SOCCOR AND INFORMAL MARKET

outdoor soccer

informal gym

kickboxing classes

gym

outdoor pilates

child care

shops and services

OUTDOOR RECREATION CENTRE

Outdoor exercise classes operated by fitness co-op centre



Figure 3.39 Informal outdoor fitness centre

03 - 3.7
DESIGN TIMELINE

DESIGN PHASES

STAGES OF IMPLEMENTATION (0 - 50 Years)

03-3.7 INTERVENTION STRATEGIES (YEAR 0 - 8)

YEAR 5 - 8

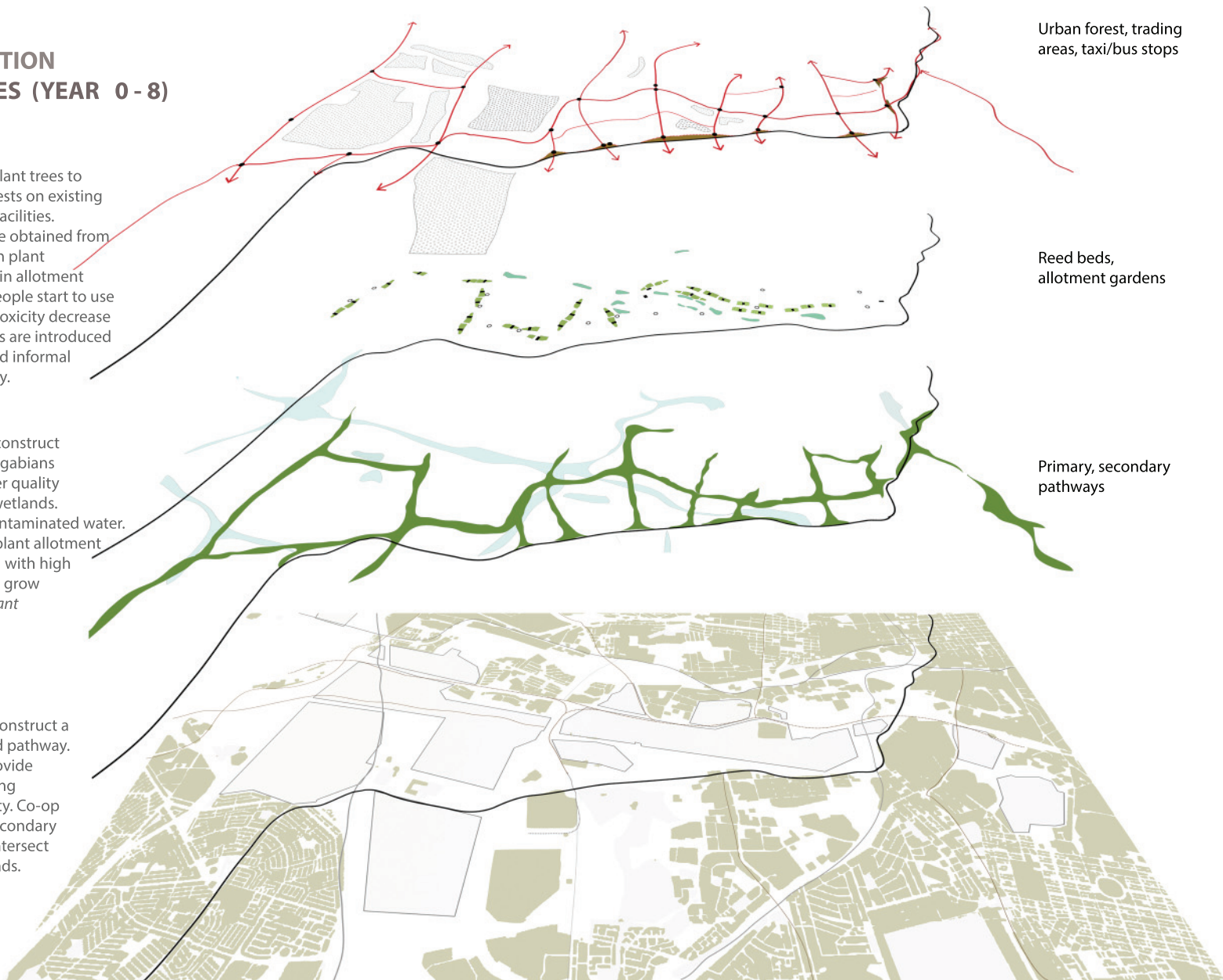
Co-op workers plant trees to create urban forests on existing tailings storage facilities. Trees & plants are obtained from the rehabilitation plant products grown in allotment gardens. More people start to use the site daily as toxicity decreases and trading areas are introduced, causing increased informal economic activity.

YEAR 2 - 5

Co-op workers construct reed-beds and gabions to improve water quality of the existing wetlands and treat the contaminated water. Co-op workers plant allotment gardens on land with high toxicity levels to grow *rehabilitation plant products*.

YEAR 0 - 2

Co-op workers construct a one metre raised pathway. The pathway provides a safe, fast walking route into the city. Co-op workers build secondary pathways that intersect with existing roads.



Urban forest, trading areas, taxi/bus stops

Reed beds, allotment gardens

Primary, secondary pathways

03-3.7 INTERVENTION STRATEGIES (YEAR 8-15)

YEAR 0 - 50

Local residents construct informal businesses on main pedestrian arteries and crossings.

YEAR 10 - 15

Co-op workers construct residential lots on areas with the lowest toxicity. Co-op workers install pipelines for sanitation and water, obtained from gold mining infrastructure. Co-op workers construct flushable pit latrine systems on residential lots. Co-op workers construct biogas co-ops. Co-op workers start to occupy site.

YEAR 8 - 10

Co-op workers build water farms, (water infrastructure system) from steel obtained from gold mining infrastructure. Co-op workers build recreation facilities(soccer fields, children play area, shops and open-air gymnasiums)



Informal businesses (spaza's)
Food stall, Internet Cafe, bar
Hair Dresser, Church
Shoe repair, Clothes shop
Copy center, Videos (pirated)
Music (pirated), gadget shop
mini-school, dentist, day care

Residential lots
sites occupied by
eligible co-op workers

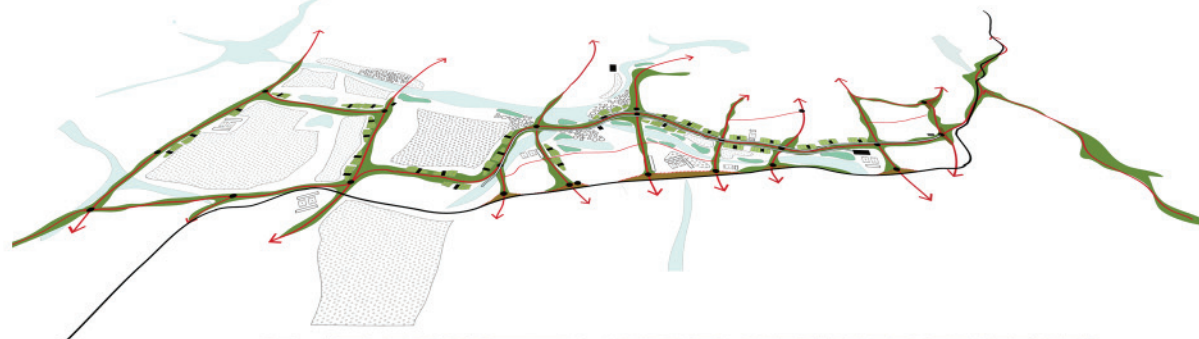
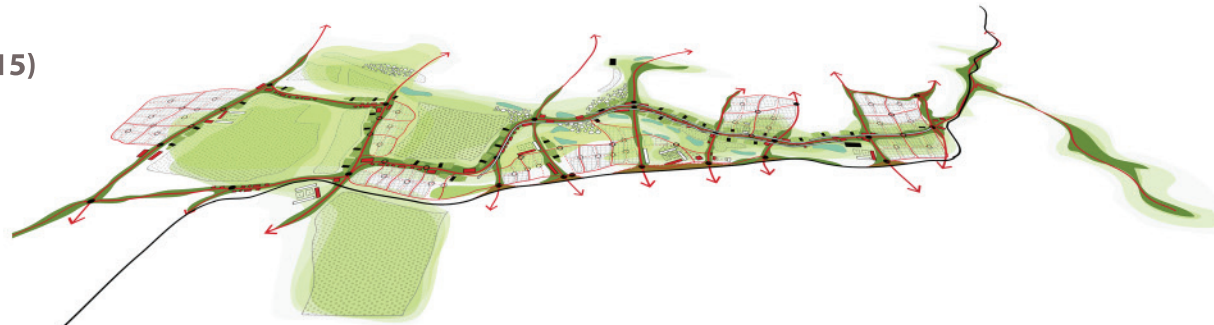
Water farms, crop farms
and recreation facilities
(soccor fields, open-air
gymnasiums, children play
areas and shops)

03-3.7 INTERVENTION STRATEGIES (YEAR 8-15)

YEAR 10 - 50

24 - HOUR USE

Co-op workers start to occupy residential lots with the lowest toxicity and continue to work at co-ops. Eventually all the residential lots are occupied. Economic activities include, forestry, plant production, water purification, biogas and informal businesses that serve pedestrians, commuters and local people.



YEAR 0 - 10

DAY USE ONLY

Daily activities include informal shops, recreation activities, safe walking route to and from the city



03-4

FILLING THE VOID

SITE PLAN



03 - 4.1

SITE PLAN

FIG. 3.40 Master Site Plan

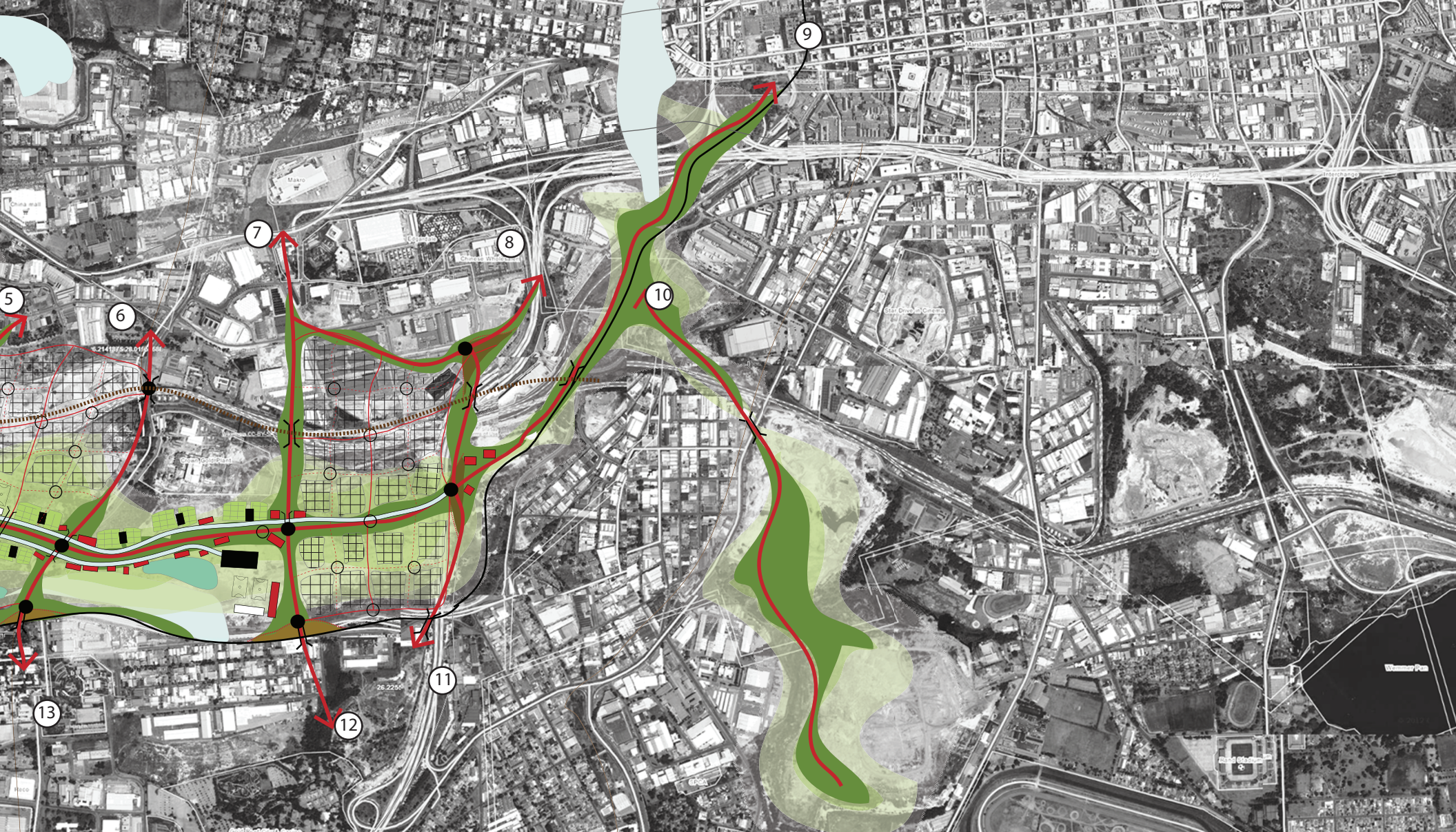
The master plan reveals how the site would function and how all components would interact once the project is complete. All intervention strategies are present. The plan illustrates the interaction between the proposed design and the existing urban framework. The map shows the pedestrian pathway that connects Soweto and Johannesburg. Secondary pathways are directed toward nodes in the surrounding urban framework to integrate the project with its context. Trading and recreation nodes are placed at major and secondary intersections. Residential lots are located on areas with lowest toxicity and water canals, reed-beds and allotment gardens are located in areas with the highest toxicity.

Site Plan - Number Legend**Fig. 3.40, p 156 - 157**

- | | |
|----|---|
| 1 | <i>North Cliff, Randburg and Roodepoort</i> |
| 2 | <i>Industria West (industrial)</i> |
| 3 | <i>Riverlea (education/residential)</i> |
| 4 | <i>Mayfair West (residential)</i> |
| 5 | <i>Amalgam</i> |
| 6 | <i>Fordsburg</i> |
| 7 | <i>Mayfair</i> |
| 8 | <i>Newtown (urban residential)</i> |
| 9 | <i>Sandton and Wealthy Northern suburbs</i> |
| 10 | <i>Johannesburg Central Business District</i> |
| 11 | <i>Gold Reef City (entertainment)</i> |
| 12 | <i>Evans Park (residential)</i> |
| 13 | <i>Ormond (residential)</i> |
| 14 | <i>Nasrec (industrial)</i> |
| 15 | <i>Crown Gold Golf course (Recreational)</i> |
| 16 | <i>Soccer City (Recreational)</i> |
| 17 | <i>Soccer City (Recreational)</i> |
| 18 | <i>Diepkloof: Zone 4 (Soweto)</i> |
| 19 | <i>Diepkloof: Zone 1 (Soweto)</i> |
| 20 | <i>Central Soweto</i> |



Figure 3.40 Site Plan



raised pathway	railway	future residential lots	wetlands
main footpaths	taxi rank	recreation/community	toxicity - severe
secondary footpaths	trading points	allotment garden	toxicity - moderate
loop roads	collection points	reedbed	toxicity - mild
soweto hwy/mbatha busway	co-op centres	water farm	
other roads	informal businesses/services	urban forest	



03-4.1

FILLING THE VOID

HABITATION



03-4.1

HABITATION

SECTIONS

Sections illustrates the implementation, use, scale, interaction, and spatial relationships of design interventions.

Section 1-1: Reed-bed, allotment garden and water canal

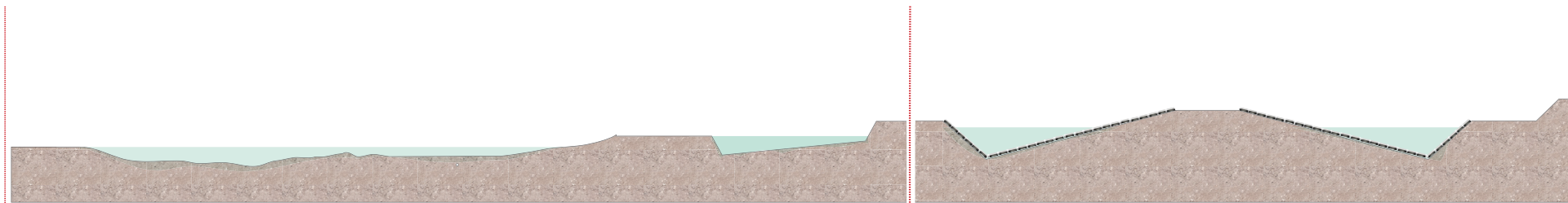
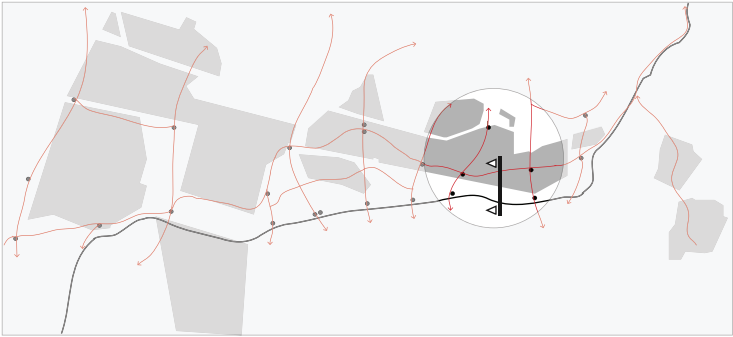
The Reed-bed, allotment garden and water canal work dependently to remediate water and soil. The three nodes interact spatially and through the implementation of design strategies.

The raised pathway with water canals on both sides provide a safer journey into the city. Water Canals prevent criminals from being able to surprise pedestrians. Pedestrians have a much better view of potential dangerous situations.

Section 2-2: Urban Forest, water canal and recreation nodes

This section compares two nodes that express the diversity of the project. On one hand people gather for fitness and sporting activities and on the other hand, a process to remediate toxic mine land.

03 - 4.1
SITE SECTION 1-1



1 - Wetland

2 - Water Canal



Section 1-1: Reed-bed, allotment garden and water canal

1. Reed-bed:

The reed-bed remediates contaminated water, and is built with waste materials by the labour of the local people. The reed-bed also provides an area for recreation. The reed-bed is deliberately placed between the existing wetlands and constructed water canal. Contaminated water from both the existing wetlands and water transported by the newly created water canal is routed through the reed-bed for decontamination. After water moved through the wetland, it may be used for irrigation and domestic purposes. Co-op workers transport some of this water to the water treatment to be treated and sold as drinking water.

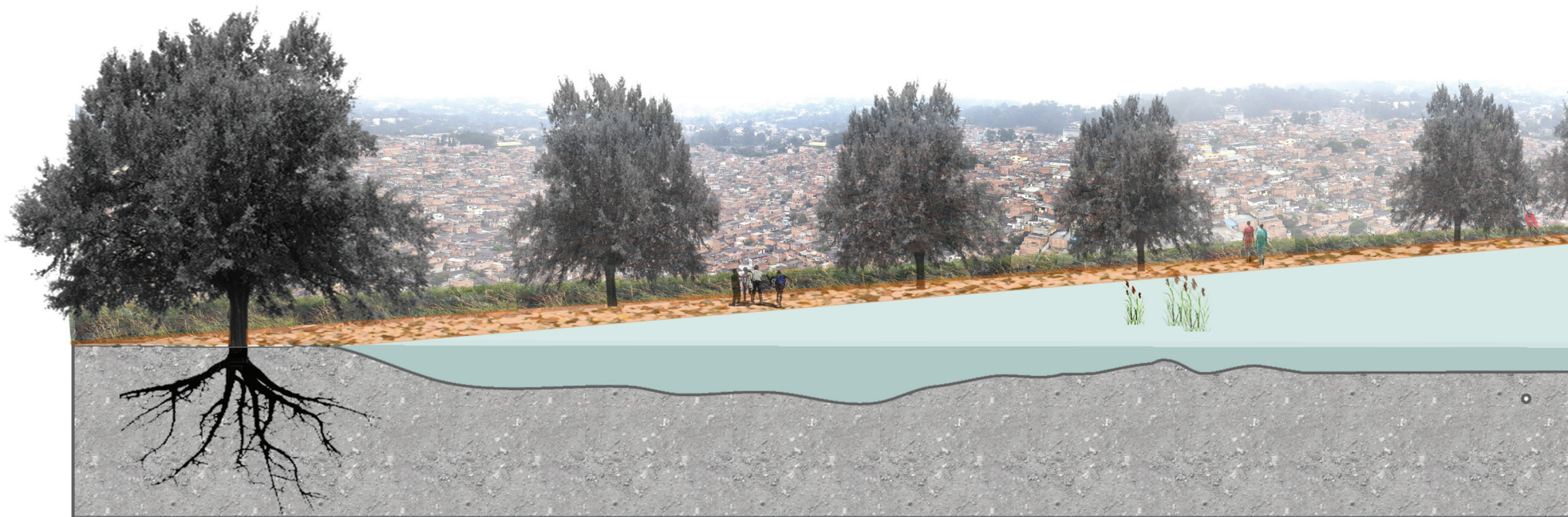
2. Water Canal:

The water canal transports acid mine drainage, greywater and stormwater run-off from tailings to the reed-bed and water treatment co-op. The water canal also functions as a safety mechanism from crime. The water canal prevents criminals from hiding in bushes alongside pedestrian paths. Pipelines are placed in the water canal to be protected from theft.

3. Allotment garden:

The Allotment garden is located on an elevated level from the water canal to allow for water drainage. Co-op workers plant selected tree species in the allotment gardens. Trees remediate the soil in allotment gardens and are used as *rehabilitating plant products* for remediating tailings storage facilities. Upon maturity the trees are replanted to the urban forest.

03 - 4.1
REEDBED



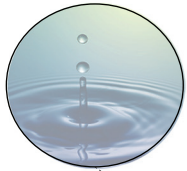
Recycled tires

Reedbed walls supported with retaining wall. Retaining wall is constructed with tires



Water

Acid Mine Drainage (AMD) greywater is purified by reedbed



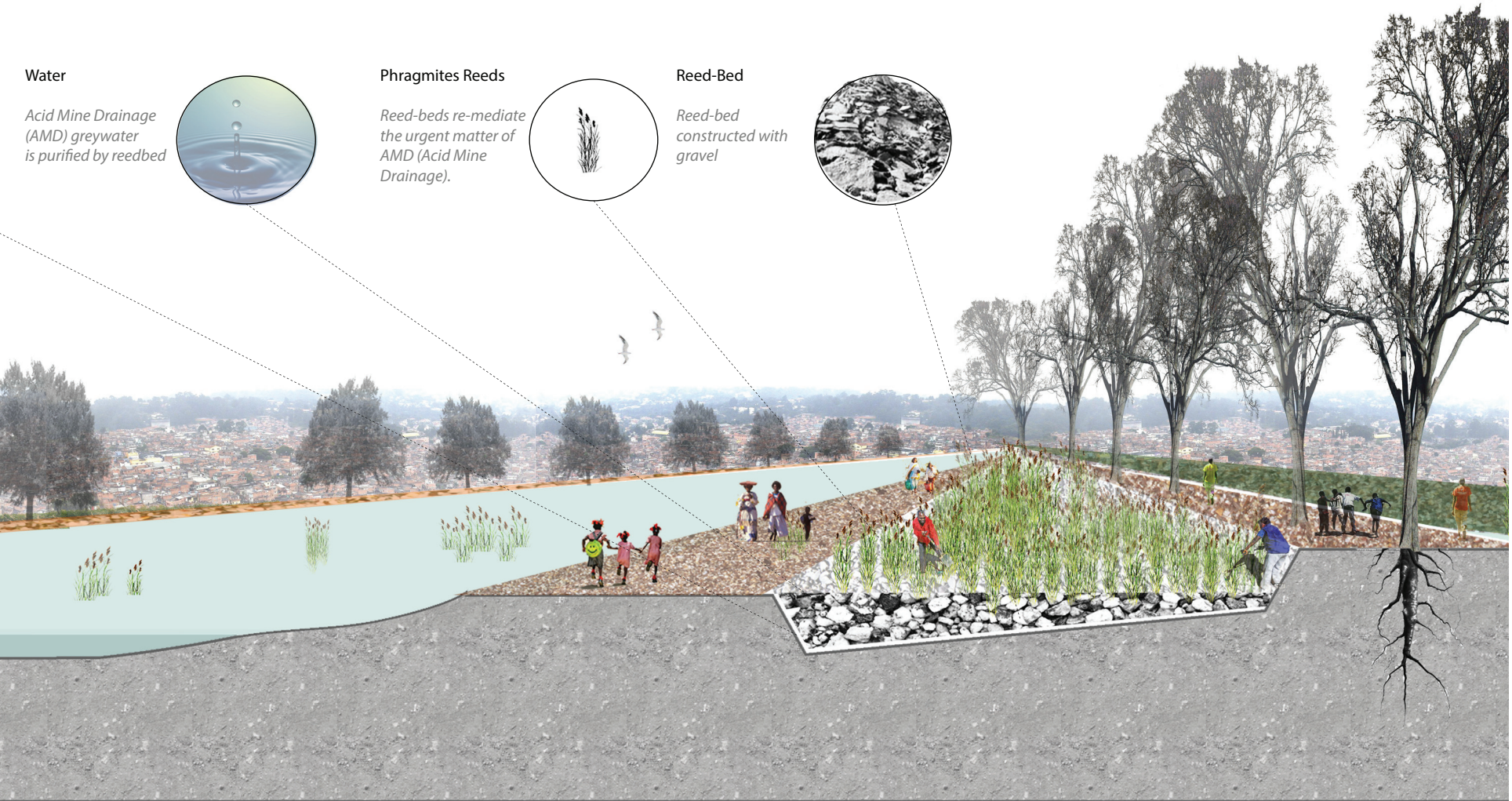
Phragmites Reeds

Reed-beds re-mediate the urgent matter of AMD (Acid Mine Drainage).



Reed-Bed

Reed-bed constructed with gravel



03 - 4.1

WATER CANAL

Recycled tires

Retaining wall built from used tires



Raised walkway

Built with construction waste, broken concrete/gravel, garbage



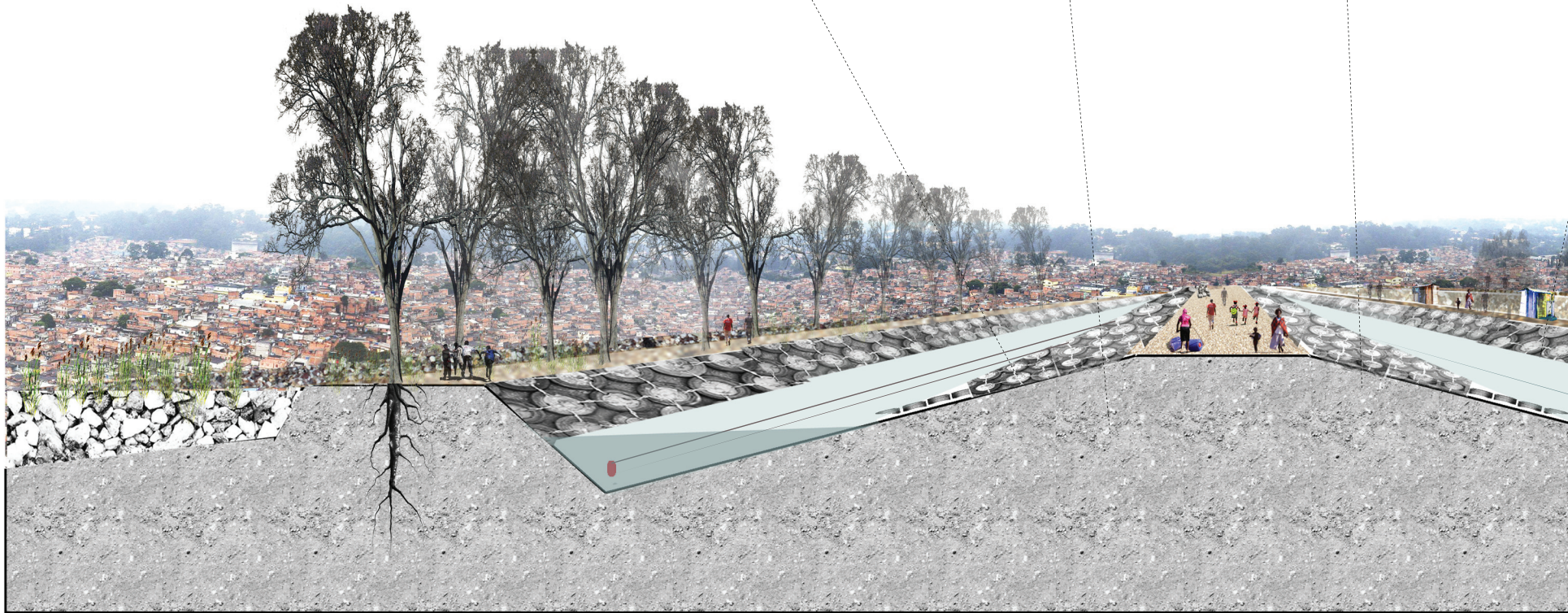
Raised walkway

Garbage is used to form the base of the raised walkway.



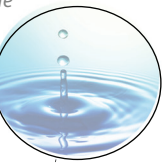
Water Canal

The water canal transports grey water and stormwater to the water purification system and the pipeline transport water from the water farm



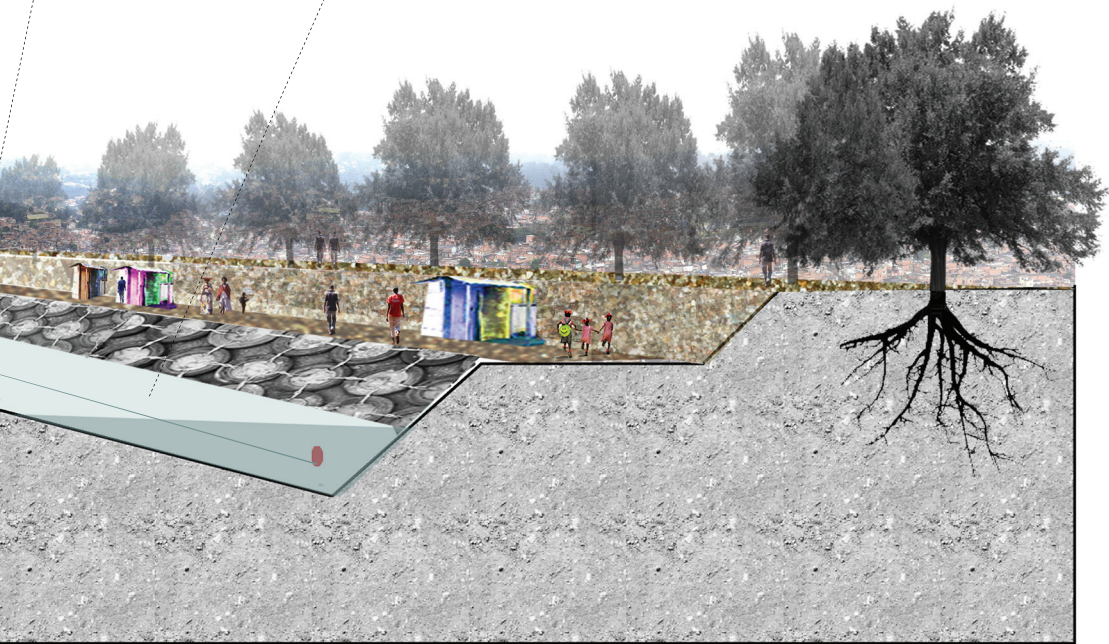
Pipeline

The pipeline is obtained from the existing mining infrastructure and re-used.



Protection from crime

Raised pathway with a water canal on both sides enhance pedestrian safety. The path provides a clear view of activities in the surrounding area. Pedestrian bridges to site nodes are provided at primary intersections.



03 - 4.1

ALLOTMENT GARDEN

Rhus Lancea - African Sumac

slow growth, moderate ET, contaminant uptake moderate to very high, moderate fire resistance, long rotations



Grass species

Eragrostis curvula (weeping love grass)
Cynodon dactylon (cough grass),
Agrostis tef (teff), lucerne
Hyparrhenia hirta (thatching grass).



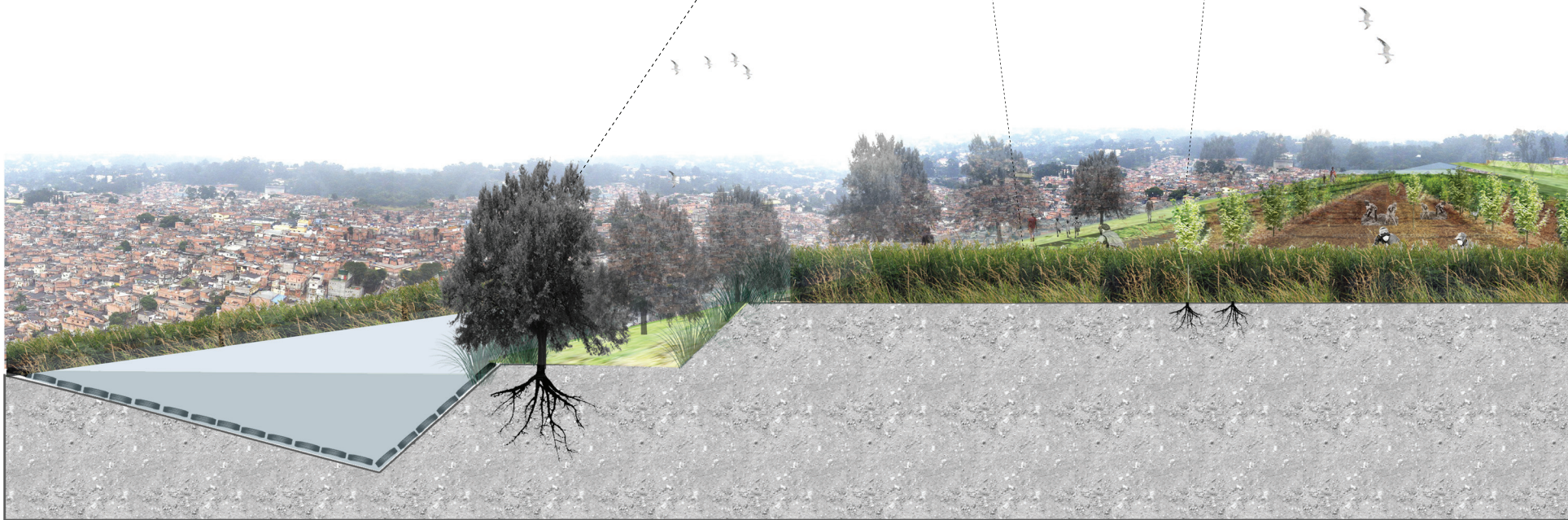
Rehabilitation Plant Products grown in allotment gardens

Indigenous Rehabilitation plant products

- Bushwillow (combretum species)
- Karee species (rhus lancea)
- Indigenous tamarisk (tamarix usneoides)
- Searsia (Rhus) lancea
- S. Pendulina
- Tamarix usneoides
- Combretum erythrophyllum

Exotic

- Eucalyptus spp
- dunnii, macarthurii, camaldulensis, grandisXcamaldulensis, melliodora, grandisXnitens

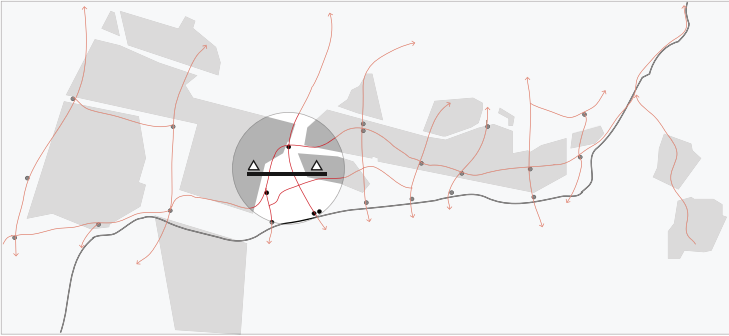


Eucalyptus species (selected)

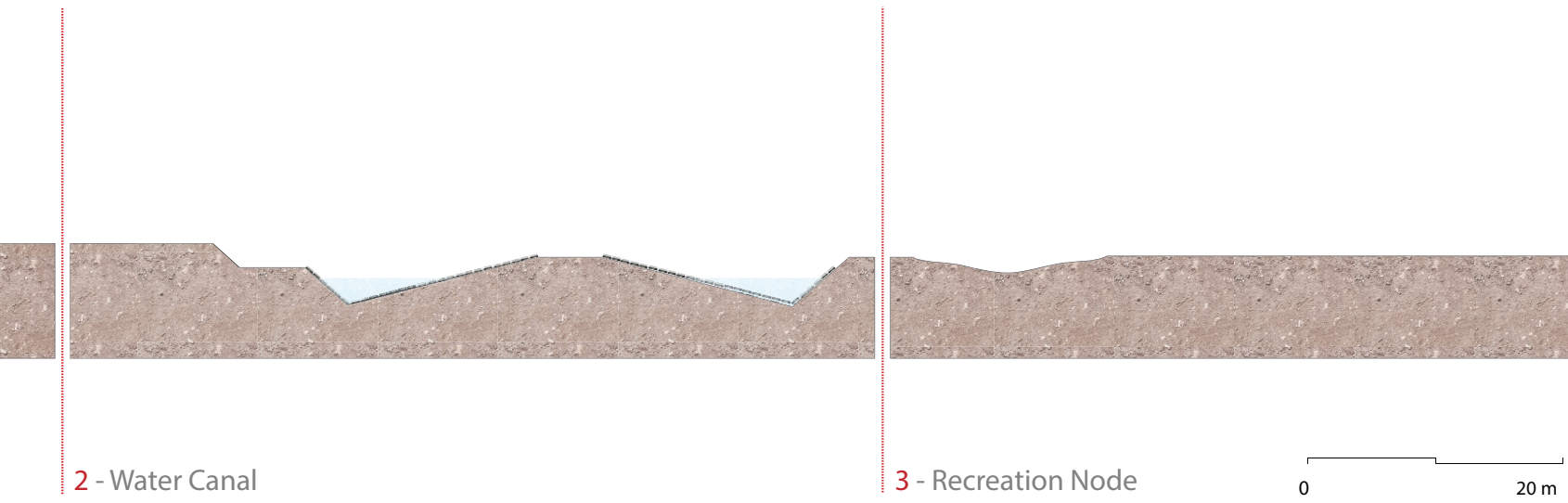
fast growth, high biomass, High ET, fire resistant, low contaminant uptake, short rotations



03 - 4.1
SITE SECTION 2 - 2



1 - Urban Forest



2 - Water Canal

3 - Recreation Node



Section 2-2: Urban Forest, Water Canal and Recreation node

1. Urban Forest:

Trees are planted on each of the three tailings storage facilities as well as severely disturbed areas of land. Specific trees are selected and planted to mop up the contaminants in the soil caused by mining activities. Co-op workers are responsible for planting, maintaining and harvesting the urban forest. The remediation of mining land normally requires expensive engineering and materials, however phytoremediation is a viable cost-effective alternative with low risk. The phytoremediation is labour intensive but is the right tool for this project. Instead of using traditional materials, the process is kick-started with materials like sewage sludge, garden refuse and domestic kitchen waste.

2. Water Canal:

The water canal transports acid mine drainage, greywater and stormwater run-off from tailings to the reed-bed and water treatment co-op. The water canal also functions as a safety mechanism from crime. The water canal prevents criminals from hiding in bushes alongside pedestrian paths. Pipelines are also placed in the water canal to be protected from theft.

3. Recreation node:

Soccer fields and open air fitness programs are provided by the urban fitness co-op. Here volunteers provide their services to lead groups of people in various fitness activities. The site is adjacent from Soccer city, the 2010 World cup soccer stadium. Soccer is the most popular recreational activity among informal dwellers. At the recreation node, volunteers run soccer training camps for children, youth and adults.

03 - 4.1

URBAN FOREST

Rehabilitation Plant Products grown on tailings dams for remediation

Indigenous:

Bushwillow (combretum species)

Karee species (rhus lancea)

Indigenous tamarisk (tamarix usneoides)

Searsia (Rhus) lancea

S. Pendulina

Tamarix usneoides

Combretum erythrophyllum

Exotic:

Eucalyptus spp

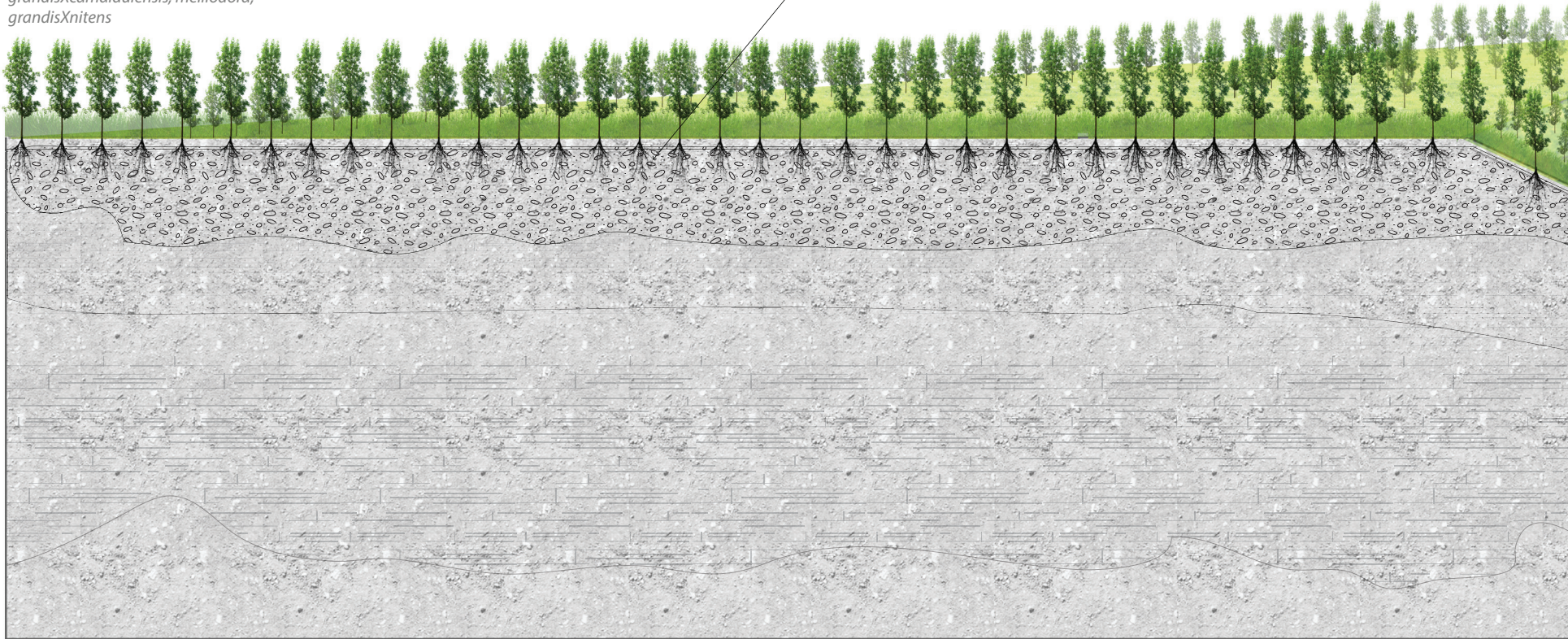
dunnii, macarthurii, camaldulensis,

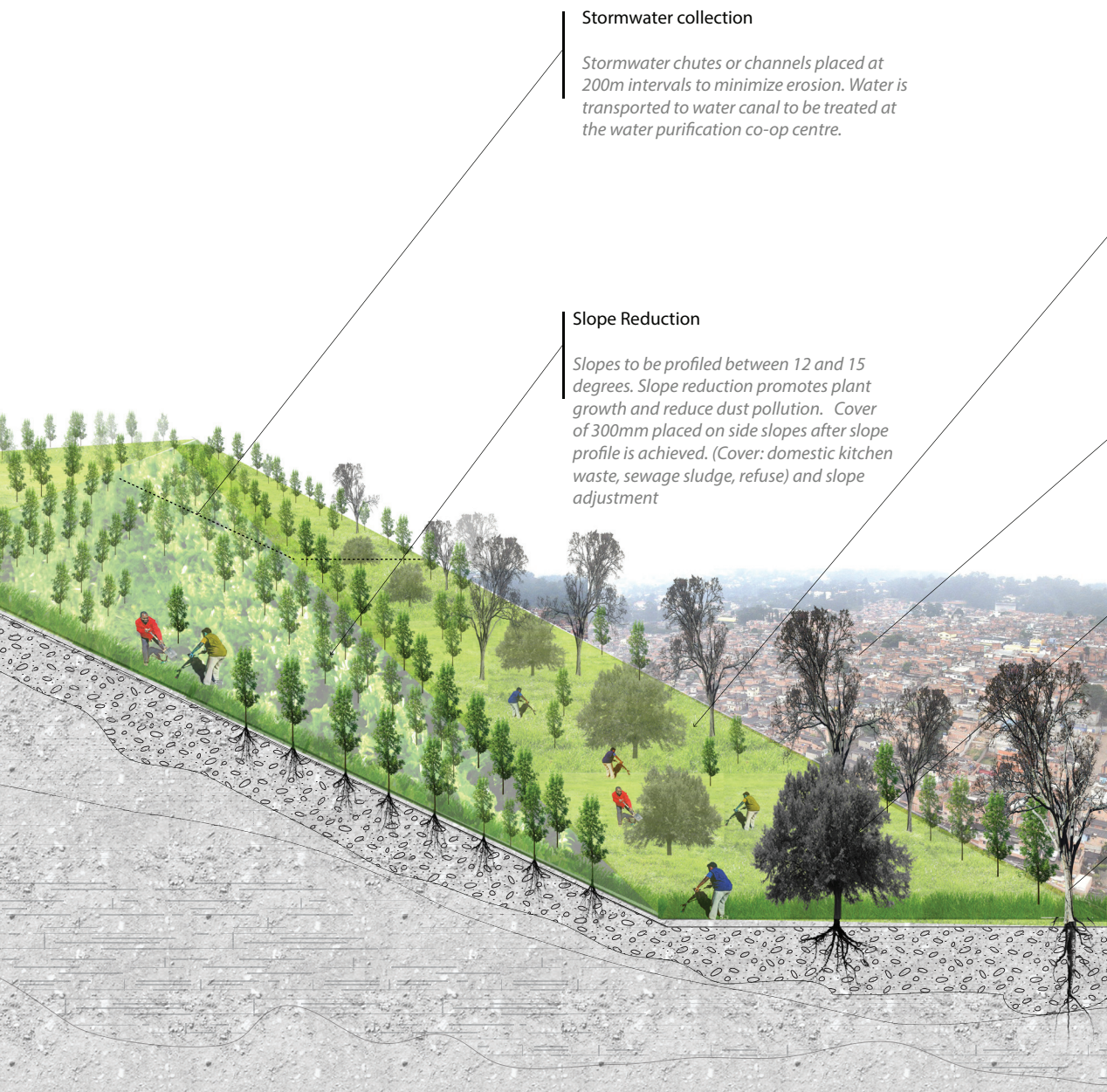
grandisXcamaldulensis, melliodora,

grandisXnitens

Top Cover

Top layer cover
(domestic kitchen
waste, sewage sludge,
refuse)





Stormwater collection

Stormwater chutes or channels placed at 200m intervals to minimize erosion. Water is transported to water canal to be treated at the water purification co-op centre.

Slope Reduction

Slopes to be profiled between 12 and 15 degrees. Slope reduction promotes plant growth and reduce dust pollution. Cover of 300mm placed on side slopes after slope profile is achieved. (Cover: domestic kitchen waste, sewage sludge, refuse) and slope adjustment

Grass species

Eragrostics curvula (weeping love grass)
Cynodon dactylon (cough grass),
Agrostic tef (teff), lucerne
Hyparrhenia hirta (thatching grass).
Chloris gayana
Digitaria Eriantha

Eucalyptus species (selected)

fast growth, high biomass, High ET, fire resistant, low contaminant uptake, short rotations


Rhus Lancea - African Sumac


slow growth, moderate ET, contaminant uptake moderate to very high, moderate fire resistance, long rotations Trees planted on slimes dams and below on seepage. Here trees allow for evapo-transpiration from the seepage and groundwater

Phytoremediation

Trees planted on slimes dams and below on seepage. Here trees allow for evapo-transpiration from the seepage and groundwater

Woodlands mop up nitrates, phosphates, sulphates, heavy metals etc. Urban forest provides windbreaks to reduce the transportation of dust.

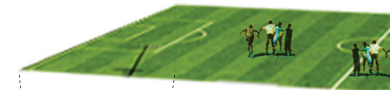
 Sulphide + low Ph levels.
 Top cover (waste materials)

 Ground water with high levels of Mg²⁺, Ca²⁺, SO₃²⁻ and Cl⁻ ions.

03 - 4.1
RECREATION NODE

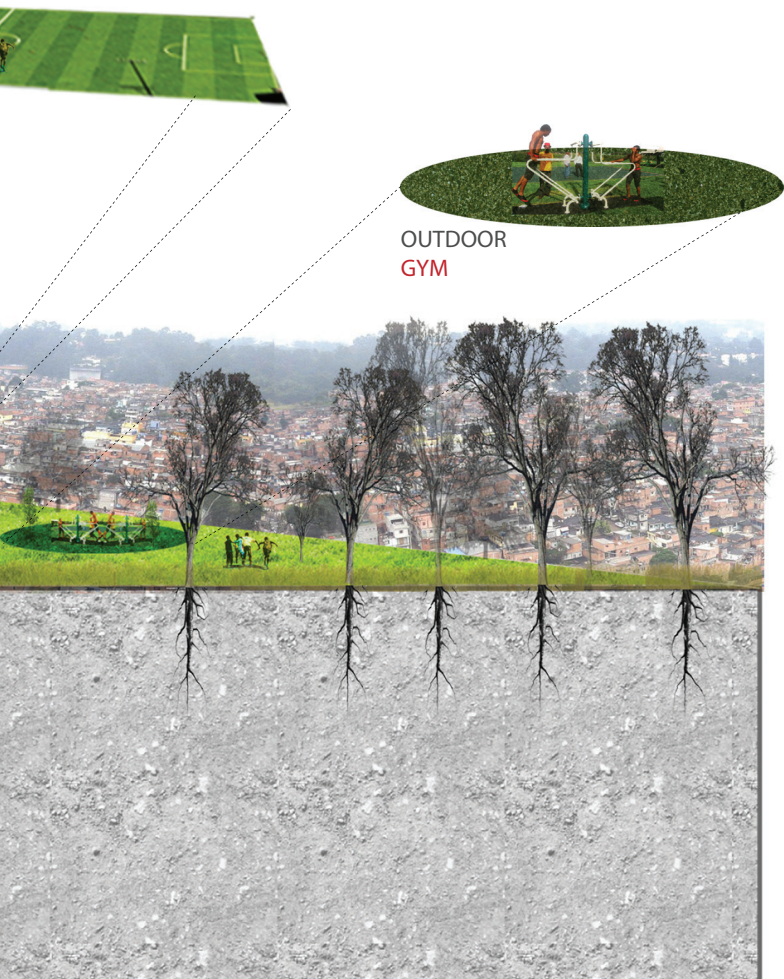


OUTDOOR
FITNESS CLASSES



SOCCER
FIELD





CONCLUSION





Figure 3.32 Landmark Cooling Towers in Soweto

CONCLUSION

Project Objectives

The project proposes tools for the poor to drive themselves out of poverty in a significantly cost-effective manner. The plan provides the poor with strategies that set them in motion to create their own secure livelihoods, permanent settlements and employment. By providing specific technologies and training allows them to work together in large numbers toward a single goal. The design proposes the use of existing mining infrastructure and waste materials that are readily available on landfills or recycle yards to build technologies on the site. Start-up costs are very low due to the availability of free materials, donations or obtaining these at low prices. The phases for implementation occur during a twenty year span, which spreads out funding requirements.

The project has significant potential to generate funds that would fund and sustain the project in the long run. The design identifies materials of value on the site and implements strategies to increase their value and maximize their profits. Water, timber and waste materials have significant economic potential. Trees, funded initially by the mining companies would be harvested, sold or reworked into valuable items. An abundant water supply exists below the surface of the site; with potential treatment it promises to serve the need for domestic and irrigation purposes. Excess water supply would be sold to the city. Waste materials obtained from residential areas with little waste collection facilities and the Robinson Deep landfill site has an immense potential to be reworked and sold.

The future occupants do the work and that eliminates expensive labour costs. They construct their own environment and receive secure tenure of a residential lot as reimbursement. In some ways the site would pay for itself. Potentially workers would be paid small wages to sustain them during the early stages of the project.

The site is owned by the government. DRD Gold is currently leasing the site from the government for surface mining operations. DRD is currently decommissioning the majority of their operations on the site. There is no cost to for the government to obtain the land, and the project aligns with the national development plan for South Africa.

The National development plan is working toward a vision for 2030 to free the poor from being trapped on the urban periphery and to prevent most of households spending 30% of their time and money on commuting to work. They aim to replace decaying infrastructure, free the inner cities from being held captured by slum lords and crime and discontinue housing provision on faraway barren urban landscapes. Considering Tokyo Sexwale, the housing minister's admission that funds are extremely scarce this vision for 2030 sounds unattainable. This project presents a realistic and viable vehicle to attain the goal outlined in the National development plan.

To move the poor from poverty the plan addresses the divided landscape caused by Apartheid planners. Apartheid planning moved the largest portion of the population to places far away from work making them unable to participate in the economy. By designing processes to rehabilitate the mining land between Soweto and Johannesburg, the poor can live near the city and the people themselves can work to erode the Apartheid buffer zone.

Project Approach

Obtaining municipal support, funding and informing the target group would form the basis of start-up planning. Project objectives, advantages and challenges are presented to the municipality to share the project vision and get them on board. Several stakeholders would be approached at the start of the project.

Municipal involvement

In order to get the municipality on board one needs to highlight the advantages that the project brings to the city of Johannesburg. The project would protect the infrastructural wealth of the city by removing the poor from vandalizing and inhabiting buildings of value. The project employs an enormous amount of people that would cause unemployment to decrease significantly. By

removing the poor from illegally occupying spaces in the city, crime would decrease. The project would lower housing backlogs significantly. The scheme has the potential to provide water and timber for the city. It also provides a safe pedestrian and cycling pathway from Soweto to Johannesburg that would cater for the population growth and lower maintenance on existing highways. The design uses sweat equity to provide basic services for a lot of people which means the municipality would not be responsible for services.

Waste collection co-ops would absorb the city's waste and transform it into products of value. The project poses significant potential to increase the number of economically active individuals. The project aligns with the national development plan of South Africa and provides concrete mechanisms to attain the vision of both the city and the country of South Africa.

Informing the target group

The city scape of Johannesburg is known for its bold billboards used to share the vision of the city and the country. The project would use this vehicle to inform the public of the project and advertise employment opportunities. Employment would also be advertised in local newspapers. Municipal boards are responsible to recruit and employ workers as well as the staff that would oversee training and technology implementation. The target group would apply for work on-site at a co-op recruitment centre. Co-op workers are interviewed and placed in specific co-op centres according to their interest and skill-set.

Who will oversee implementation?

The National Nuclear Regulator is responsible to oversee remediation projects of residual mine areas in Gauteng. The government would fund the management of the remediation project. The local municipalities would ideally operate Co-op centres. Involving the city in the management of the project would advance the vision of the project. The municipality would appoint a board for each co-op centre that answers to municipal authorities. The boards are responsible to recruit and oversee the staff of the co-op centres. There is also an opportunity for co-ops to be operated through private investors and entrepreneurs.

Potential Challenges:

With a deeply embedded past of segregation in South Africa the act to create a community that only caters for the poor may create an idea of the “others”. The project caters for the poor, represented by all races and cultures. The project's aim is not to provide a dumping ground for the poor, rather it provides processes to drive the poor out of poverty. The successful implementation of the project would cause the poor to accumulate wealth and upgrade their settlements. Eventually this settlement would become spatially and socially integrated with the city, and the surrounding suburbs.

At the beginning of the project the site would be uninhabitable due to high toxic levels. Looking at the intensity with which land invasions occur in the city, the site maybe at risk to illegal land invasions. Informal dwellers have settled near or even at tailings storage facilities unaware of risks that this would pose. It would be important to educate the poor on the serious health risks that illegal settlement on mining land would cause.

The presence of shack lords is a potential risk to the project. Evidence reveals that shack lords often bribe municipal authorities to implement their goals. Shack lords are at the top of the food chain implementing structures of authority. In the case where white farmers rent out their land to informal dwellers, shack lords are appointed to collect rents. By the same token authorities may appoint persons in paid positions to establish order.

The success of the project depends on large numbers of people who are willing to follow a programme that promises to give to them houses and jobs. The project provides jobs right away, but secure tenure of a lot in the newly created residential zone will be earned. The post-Apartheid government has broken their promise to provide houses for all over and over again. This fact may cause the poor to distrust the project. The scheme does provide jobs, a safe pathway into the city and recreation facilities during the early stages of the project. Trust would build as the scheme allows the people to participate in the development and as they see the project come to life.

Who pays?

Government funding:

In-situ upgrading of informal settlements is now included in the national housing policy and the government funds it. The government allocated in excess of 3 billion USD to the programme for the period of 2011 - 2014. The programme benefits persons residing in informal settlements. Funds are provided for land acquisition, geotechnical

investigation, detailed town planning, project management, surveying, services and other project implementation costs. Tokyo Sexwale, the minister of human settlements admitted in his budget speech in 2011 that the upgrading of informal settlements is high on their agenda as there is not enough money to build houses for everyone at the same time. The demand for houses is very high and resources are limited. The focus of the government is to upgrade informal settlements. In-situ upgrading means providing basic infrastructure to existing settlements.

Private equity investors:

IHS (International Housing Solutions) invested 1.9 Billion Rand into the affordable housing market in South Africa during the past five years. Water resources on the site are valuable and there is definitely an investment opportunity here. With the rising water levels posing a risk to the downtown core the government is forced to provide a solution fast. Thousands, perhaps even millions of litres of water are ready to be pumped to the surface for treatment. Water is a huge asset in a city that has a fast growing population with inadequate water supply. The project may use water as an agent for funding.

Urban poor fund international: (UPFI)

Shack/slum dwellers international (SDI) launched the fund in support of poor communities developing their own environments. It is the first global fund that gives the urban poor direct control over the urban environment. The project has provided 17.8 million dollars in funding urban projects developed by the poor.

Mining companies:

Mining companies are responsible to remediate mining landscapes at mining closure. Government closure certificates require long-term control measures to reverse environmental pollution. Companies like DRD Gold have extensive mining closure plans in place with trust funds for each area to be rehabilitated. The cost of remediation strategies would be covered by DRD Gold.

ENDNOTES



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