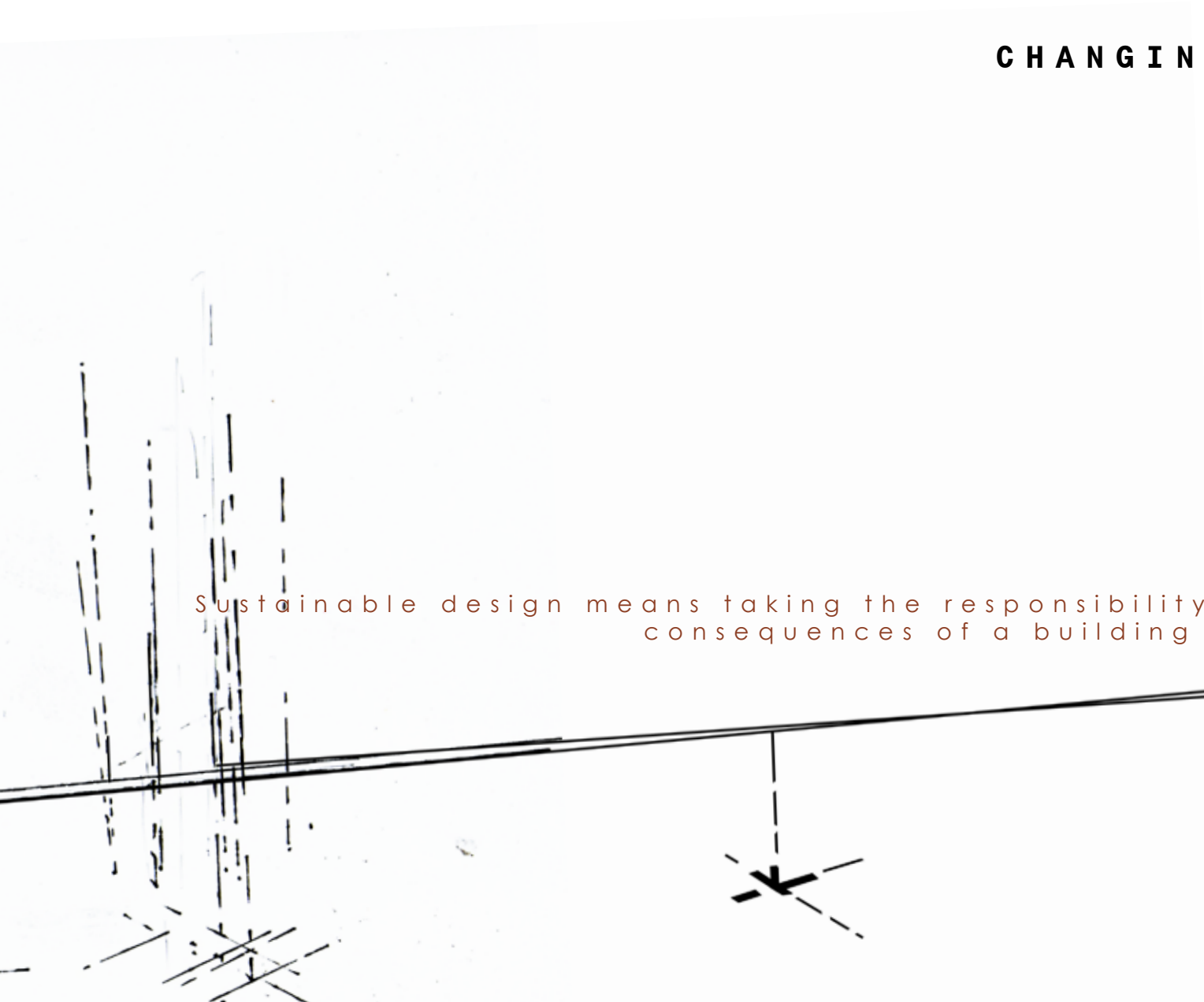




## CHANGING PARADIGMS

Sustainable design means taking the responsibility to anticipate the wide consequences of a building proposal...

[Bennet 2003:126]



As reported by AM Omar [2007:2354] an average temperature increase of between 1.5 - 4.5 ° C will cause a series of environmental impacts. The impacts will range from rising sea levels, extreme weather conditions, floods, draughts, loss in biodiversity and mass migration of environmental refugees

## | To develop or not

In many developing countries climate change is still not recognised as an immediate problem. These countries rather focus on their social and economic development [Roaf et al 2009:127]. In an utilitarian paradigm this becomes a difficult ethical choice:

- \_ choosing not to develop, which would essentially lead to no future for anyone
- \_ or overdeveloping and as consequence having no future either.

Even with improved technologies that reduce greenhouse gasses, globally, there have been very little reduction in greenhouse gas emissions. This can be accounted to global development occurring at a very fast rate [Bennetts, Radford & Williamson 2003:120].

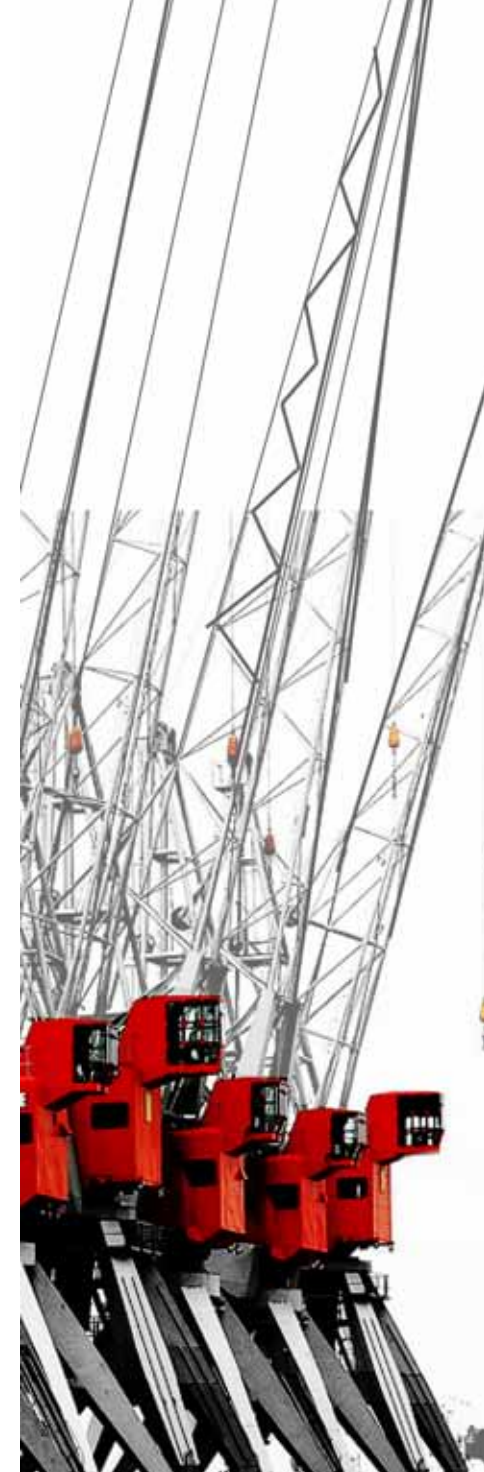


Figure 1-01: Develop! How much is too much?  
[Source: B Mickewaith [www.brianmickethwait.com]]

## 1.1 INTRODUCTION

Changes occur daily.

Fast!

Other times very slowly.

Out of changes revolutions are born.

The human race is at a point in history where paradigms are going to be shifted, societies will change, and lifestyles are going to be turned around.

And the unimaginable will become a daily ritual.

Climate change will alter the face of the planet and so will the humans' understanding of the future and their interaction with the planet. **If we don't adapt, the planet will adapt without us.**



## |Sustaining all

Sustainability can be defined as a response to economical, sociocultural and environmental factors [Bennetts et al 2003:xi]. In developing countries institutional sustainability becomes ever more important in order to meet and implement sustainable practices. As clearly stated in the Bruntland report, sustainability and development are integrally connected [Bennetts et al 2003:xi]. One cannot succeed without the other.

Yet climate change and the depletion of non-renewable energy resources, as well as the scarcity of materials and water, are disastrous to development [P Jones 2009:380]. This means that the Bruntland report has serious implications. **Unless these issues regarding climate change and resource depletion are addressed, development will be limited if possible at all.**

## |Tshwane dislocated

Within this context of climate change and the possible effects that are predicted for South Africa, quick and efficient adaptations must be made at a national and detail level. Many cities in South Africa, Tshwane being a typical example, are still promoting the Apartheid city layout. It was aimed at segregating people into racial zones separated by buffer zones [Du Plessis et al 2003:243]. This **created large displaced districts where the population with the lowest income lives the furthest from the city centre.** This spatial layout has led to heavily subsidised public bus and rail transport systems which, because of the decentralised low-density nature of these cities, are inefficient and unsustainable [Du Plessis et al 2003:243].

Figure 1-02: Dividing the population [Source: Collage by Author]

## | Vision and intervention

In South Africa<sup>1</sup> 20% of all energy used is spent on transport [Winkler et al 2006:24]. In the light of this the vision of the Bus Rapid Transit [BRT] system for Tshwane is to develop a more sustainable, efficient and accessible public transport system. As the vehicles use cleaner fuels and transport higher numbers of commuters than conventional bus systems [Wright & Hook 2007:702-705]. This will contribute to the mitigation of climate change in South Africa.

Architects have a specific role to play in the mitigation of climate change, as buildings are directly responsible for the depletion of natural non-renewable resources and the production of greenhouse gas emissions [Bennett et al 2003:03]. According to the International Energy Agency [2009:49] in South Africa buildings contribute up to 10% of the national CO<sub>2</sub> emissions due to energy consumption. Taking the construction of these structures in account this figure can rise up to 30% globally [UNEP SBCI 2009:03].

This thesis project focuses on the design of a low-carbon BRT station and terminal building.

The BRT station is proposed to be prototypical and will theoretically be constructed throughout Tshwane. A low-carbon prototype is aimed at having a low embodied energy and to be energy efficient, to limit the overall environmental impact of the transport system.

The site for the intervention is the Pretoria Main Station. It is a very busy modal interchange that has rich architectural and historical value. It is the termination point of the cardus maximus that links the site with the heart of the city [Holm 1998:61]. With the increase in transport systems and connectivity the precinct will develop substantially over the next 30 years. At the moment it is an illegible, over congested and defragmented site that needs to be addressed [Seabrook 2009:38].

**This project aims to address issues regarding climate change, the carbon footprint and the embodied energy of architecture. The objective is to develop a low carbon prototypical transport building type that would contribute to the mitigation of climate change in South Africa.**

1: South Africa's Energy consumption in 2000. [Winkler et al 2006:24]

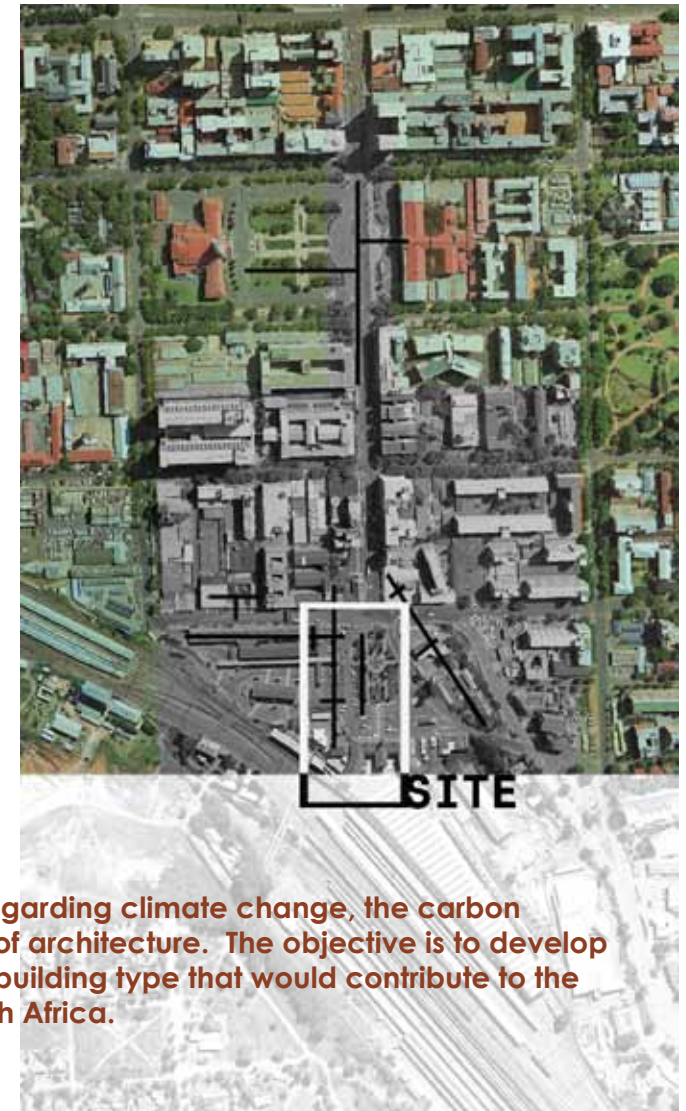


Figure 1-03: Site choice [Source: Author]

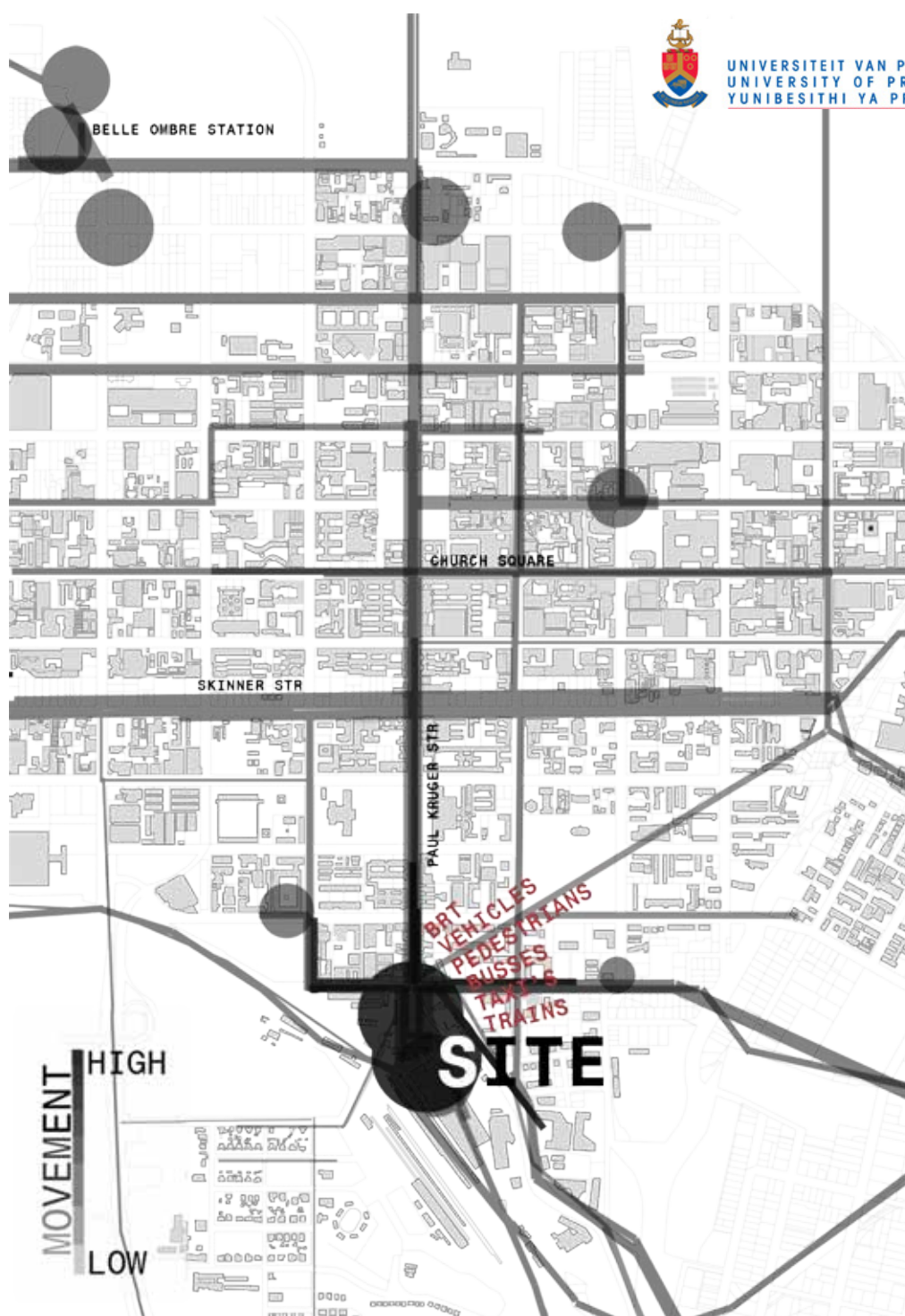


Figure 1-04: Movement patterns in the city centre [Source: Author]

This study is undertaken in partnership with the UNDP-GEF and the Environmental Potential Study Unit of the Department of Architecture, UP. The goals for this study as proposed by the UNDP-GEF is to promote public transport systems in South Africa that reduce greenhouse gas emissions, while promoting a long term change towards more efficiency and less pollution. Through this project the UNDP-GEF aims to increase the knowledge and understanding of the designing, management and constructing sustainable transport systems.

Client [for the project]:

**City of Tshwane  
Public works and Infrastructure  
Development Department  
- Transport Division**

Site owners/clients:

**Transnet**

Client [for the research project]:

**UNDP-GEF**

## 1 . 2 A I M S & O B J E C T I V E S

The objective is the design of BRT terminal building that responds to the historical and current context while adapting over time.

**The structure aims to become a seam that links Salvokop with the rest of the city.** Functions will be placed on the linking structure to ensure that the seam becomes permeable a border that will ensure the future growth and sustainability of Salvokop.

**This project aims to address the urban context, historically and culturally, with development guidelines that will lead to lower greenhouse gas emissions,** as proposed as a specific target area by Jones [2009:381]. These guidelines will be informed by New Urbanism approaches as well as the Green Star SA guide in order to achieve a transport interchange that will function efficiently within its context.

As the site is of cultural and historic value, the design will be sensitive and must enhance the heritage resources and the setting. **The design will add new functions to the existing and historical in order to ensure the sustainability and adaptability of the station.**

The design will incorporate “bioclimatic” design approaches as proposed by Omar [2007:2334] that include energy conservation during construction and the use of renewable energy sources. This will contribute to a **lower embodied energy and lower carbon footprint for the structure.**

**The life cycle performance of the materials will be analysed, informing the use of materials and the design of the structure.** This inturn will inform techniques of reusing and recycling materials. Components of the design will be designed to be prototypical and possibly adaptable, as suggested by theories of ecological construction approaches.

**A new low-carbon BRT station/terminal prototype can be developed from this project to assist in informing the future development of sustainable transport systems.**

## 1.3 METHODOLOGY

### 1.3.1 Theoretical premise

The project will be approached by using theories of. Yet as Bennetts et al [2003:13] state that these theories, like Hanover principles, are very conceptual and vague.

To inform and guide the design the principles of New Urbanism, ecological design theories and the Green Star SA Office Design and Office Manual/ rating system will be implemented to ensure a low-carbon design will be achieved.

These three theories or approaches will be combined with a grounded theory approach. This means analysing the context, the effects of climate change in Tshwane, the users' needs, material properties and low-carbon construction technologies. Even though the first and second theories does not address climate change and low carbon technologies, the research process would make use of their ideas and approaches.

Theory 1: New Urbanism

New Urbanism is a response to functionalist city planning that disregards the communities and users within cities. It is aimed at promoting more liveable, sustainable societies [Gehl 2006:7].

New urbanism focuses on the notion that societies or buildings are never isolated but are made up from a series of patterns that are interdependent and supportive of each other [Alexander 1977:xii]. At the same time it addresses the need for urban regeneration in a fair and community centred manner as advocated in *Death and Life of great American cities* [Jacobs 1961].

The work of these theorists will be used to inform the urban framework and the urban response of the proposed intervention.

Even though New Urbanism theories do not address carbon and climate change issues in particular, the suggested urban typologies do advocate lifestyles and environments that will mitigate climate change.

Theory 2: Ecological design and construction

Construction ecology is defined by Kilbert, Sendzimir and Guy [2003:19] as a process of "biomimicry" where by human industries or designs use nature or concepts of nature as a new paradigm to work within as well as inform their designs. They propose studying processes and problems at different scales, aiming to achieve a diversity of systems to attain sustainable cyclical process or design [Kilbert et al 2003:18]. Kilbert et al [2003:16, 21+24] promote a cradle to cradle concept for the use of material while also looking into the possibilities of adaptable architecture.

Only certain aspects and approaches regarding materials use and tectonics can be used to inform the project.

### 1.3.2. Responding to the design problem

Theory 3: Green star SA  
– Office Design and Office – As Built v1 2008.

The Green Star SA handbook [2008:xiii] aims to encourage new and innovative design approaches and uses of technology. The handbook promotes and discusses more sustainable approaches that aim to reduce the built environment's environmental impacts.

It is a rating system that creates a benchmark from which projects can be judged, it also aims to create co-operation between the different professionals in the building industry. The rating system assigns responsibilities to the various parties involved.

The manual and rating system will be used to guide the design. The BRT prototypical station [assessed in its a-contextual setting] will also be assessed using the rating system.

#### **Problem – Understanding and contextualising**

Climate change and its effects within the urban environment will be researched and contextualised to Tshwane and the local climatic changes that can be expected. From this an architectural response can be developed, to inform design decisions.

#### **Response – Mitigation strategies**

Mitigation strategies to lower the carbon footprint of Tshwane will be analysed. The first strategy that will be researched is changing the public transport system. The proposed Bus Rapid Transit system for Tshwane will be analysed. The building program will be derived from this research as well as limitation and specifications for the BRT prototypical station.

Strategies to achieve a low carbon intervention will be researched making use of New Urbanism, Ecological construction, Sustainable architecture, low carbon theories and the Green Star rating handbook.

#### **Frameworks**

From the literature study and site analysis a series of frameworks will be developed:

##### **a) Precinct framework.**

Integrating New Urbanism theories with a context analysis. It will also assess previous frameworks for the area to inform the new framework.

##### **b) Historical response framework**

An architectural response to the historical resources on site will be developed by researching the history and development of the site and Tshwane in general. From this the value of the different components will be ascertained to inform the type and impact of the intervention.

The framework will incorporate the Burra Charter as a guide to developing heritage resources.

##### **c) Material use framework**

Using embodied energy calculators, the embodied energy of the possible materials for the BRT prototype will be analysed and calculated.

The embodied energy and carbon footprint of the Rea Vaya BRT prototype station in Johannesburg will be calculated. From this a material use framework and a benchmark for the proposed BRT prototype will be developed.



### | 1.3.3. Precedents

Precedent studies will be done for the following aspects:

#### **a) BRT prototype designs**

- \_ planning and integration in urban context
- \_ legibility
- \_ material use

#### **b) Station designs and transport system integration**

- \_ urban integration
- \_ movement layering and layout
- \_ material use

#### **c) Planning and form generation**

- \_ planning
- \_ movement through spaces
- \_ thresholds
- \_ manipulating movement & integrating movement patterns

#### **d) Sustainable interventions**

- \_ design & planning strategies
- \_ energy use and generation
- \_ material use

#### **e) Resource efficient designs**

- \_ sectional layout
- \_ facade detailing
- \_ ventilation systems
- \_ energy generation

### | 1.3.4. Delimitations

The existing site conditions as on February 2010 will be accepted as the basis for the new intervention. Any further developments will be disregarded.

The embodied energy of materials is ascertained by using UK and Australian quantities, as no recent South African energy quantities are currently available or easily accessible. One South African study by Daniel Urirah has been done but it is outdated.

### | 1.3.5. Assumptions

- There are permanent markets towards to west of the Station.
- Pedestrian and vehicular bridges connects Salvokop to the city.
- There is a taxi rank and southern BRT lines within Salvokop .
- The following transport systems are in operation: Gautrain, Metrorail, taxi's, long distance busses and BRT systems
- All 6 proposed BRT transport routes are in operation.
- The Gautrain will use the BRT as feeder system
- A new parking structure towards the east of the Gautrain structure will be built.

## 1.4 PROJECT & DOCUMENT LAYOUT

Laying out the process used in the research project.

### FINDING FOCUS INTRODUCTION

# 1

- Establishing the focus of the study
- Starting from the basic premise of sustainable design
- Justifying the project and chosen site



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### PRE PLANNING

# 2

- Research and definition of theory /approaches/technologies for the project:
- Establish the effect climate change.
- Its effect in urban context - specifically Tswane
- Specify climate change mitigation strategies
- Establish the need for transport and why BRT system is good solution
- Developing a series of low carbon strategies and technologies
- from the urban scale to the detail
- Choosing an appropriate rating system

### FRAMING PRECEDENTS frameworks

# 3

- Analyse the context
- Research precedents to inform the direction of the project
- Developing frameworks
  - Establishing guidelines for the urban intervention
  - the historical response
  - Research\ material use and systems/approaches to guide the intervention.

# PROJECT DESIGN+

architectural intensification  
concept+approach

+ design development



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Research existing precedents to inform the design and process

- Develop a concept
- Develop a design and through to a technical level
- design through an iterative process
- Evaluating design using methods of assessing spatial performance, material use, carbon footprint and environmental performance

5

documentation

6

CONCLUSION