CHAPTER V –

5 THE ADAPTED SBAT ANALYSIS OF THE FOURways CASE STUDY

Sub-problem 3 The third sub-problem makes use of the first and second sub-problem findings to analyse the use (or lack) of sustainable building design principles in current examples of the FOURways house. This sub-problem highlights the difference between buildings that do and do not make use of sustainable building principles.

Hypotheses 3 The third hypothesis is that typical FOURways houses in Gauteng currently do not make use of sustainable building design and construction.

5.1 General Introduction to the FOURways case study

The development Ravenna arose out of an independent feasibility study conducted by the developers. No general feasibility studies conducted by a research body are available for the area. Each new development is approached independently by the various developers who generally base the final decision on their personal experience and intuition of the building market.

The selected growth point is typified by new medium density developments of townhouses and cluster houses. The availability and affordability of land in this area has made it popular for developing homes in the price category R100 000 to R600 000. The majority of the developments are aimed at the first time homebuyer with prices between R100 000 and R250 000. Houses are single or double storey, with lofts being very popular as additional space which is otherwise lost as roof space.

The Ravenna development is composed of simplex cluster homes with a variety of two and three bedroom layouts with the option for a loft area. Stands vary in size from 440 square metres to 750 square metres. The designs are completed before any property is sold. Following a sale the selected site and house type is positioned and the design adapted to the individual needs of the purchaser. (see Figure 5.1). An average limit of three variations for each house type cuts design costs. The house size varies between 50 and 150 square metres.

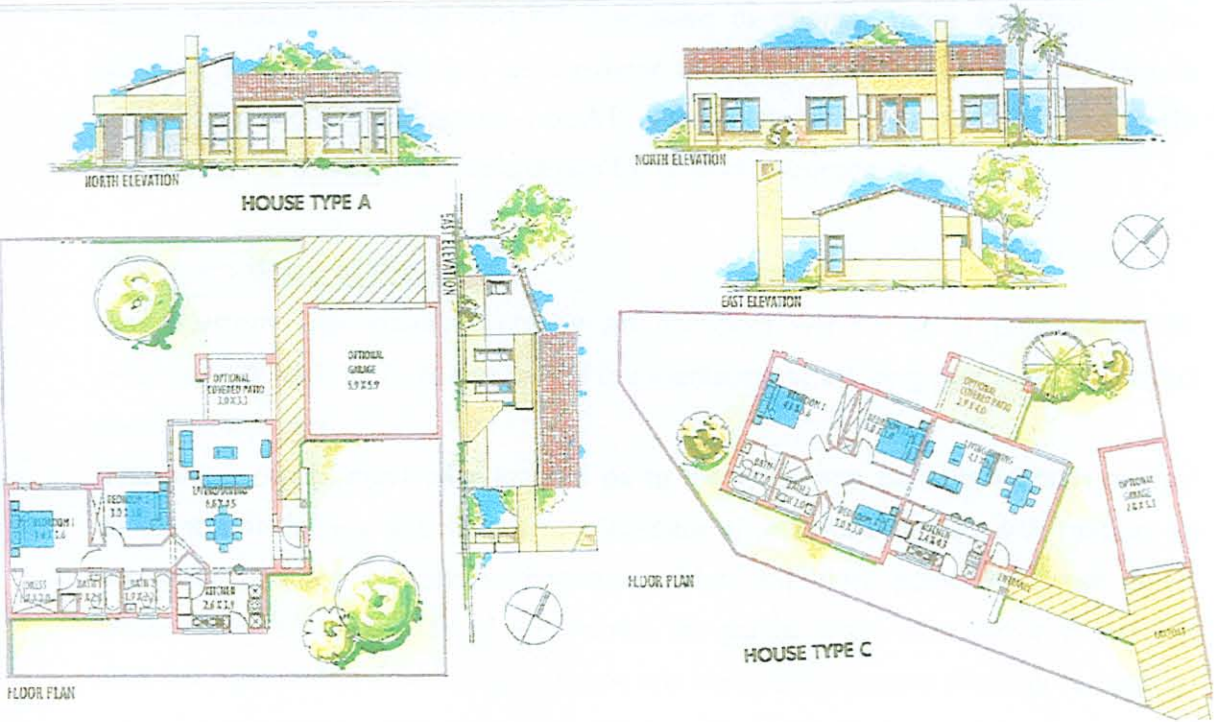


Figure 5.1 - Example of two available house designs in the development Ravenna.

5.2 Introduction to the case study

Two examples have been selected from the development for further study. The buildings are typical examples of the house type being developed in the area. The first example will be studied in depth with a final test of sustainability being done using the adapted SBAT. The same criteria apply to both examples and since the two buildings are within close proximity, with only an orientation variation, the sustainability of the second example will be tested using only the adapted SBAT.

5.3 Case study – Use of the adapted SBAT on a FOURways house

The application of sustainable building design principles can be applied from the outset of a project as design philosophy or as retrofit. Both the retrofit possibilities for completed houses and the principles applied at the design stage are considered in this analysis.

In the case of the examples of Ravenna homes analysed the delivered building is often incomplete with the non-essential finishes being purchaser's prerogative. Fortunately this provides an opportunity to improve the living environment after delivery of the building, however, many parts are complete and can not be reversed without substantial retrofit costs being involved.

Firstly, case study one will be analysed in depth according to the sustainable building design principles (SBDP) discussed in chapter three followed by the adapted sustainable building assessment tool (SBAT) test. Case study two is assessed using only the adapted SBAT. Where relevant illustrations of case study two will be included in the first analysis for reference purposes.

5.4 Ecology of the user

Any concern with sustainability by an occupant will be on a personal level. Sustainability did not form any part of the marketing or building principles employed by the developers.

The home owner must be educated as to the long term benefits of both energy efficient installations and finishes to facilitate an informed choice with respect to insulation, fixtures and even materials. Other important points to stress when encouraging sustainable living are the role the garden plays as a setting to living in and not against the environment. There are numerous aspects such as re-cycling, air flow regulation, rainwater penetration and small scale ecological cycles of insects, birds, lizards and so on that must be brought to the attention of the homeowner.

Users of a house can be generally defined as human beings functioning in a modern world. This entails both commercial and physiological needs. That is requirements dictated by the monetary nature of building possession and also the needs of the human body as an organ.

The commercial aspect of home ownership

First time homeowners are no longer satisfied with basic accommodation, as urban dwellers and consumers the economic value and a variety choice are important. The homebuyer's choice is guided by the basic requirement for a specific number and type of rooms as well as aesthetic and lifestyle preferences.

The selected case study is a typical example of current development aimed at the market priced from R149 000 (price for 1998). The house is sold as a package price inclusive of transfer costs, stand, house, open brick-patio, single carport with facade, paved driveway, walling, lawn street frontage and intercom. The development satisfies the current requirement for increased security in the form of an area that is secured i.e. in an enclosed medium density development with central facilities (see Figure 5.2).

Figure 5.2 - The secured property development

The occupants of the houses in Ravenna generally fall into the category middle-income earners[16]. The houses are designed to accommodate the definition of type, for example to include space for the washing machine, microwave and so on.

Modern urban people are continually increasing their basic demands and thereby increasing the pressure to produce consumable goods. The increase in production is directly related to the pressure on both renewable and non-renewable resources. This case study is one example, of many developments, where the developer has tried to satisfy the consumer orientated needs of the purchaser and disregarded any notion of sustainability. Often the consumer attitude is to the detriment of the natural environment. South African consumers are only slowly warming to the idea of sustainability. Housing is a basic requirement and cannot be negated, but the preservation of nature is also very important. Human survival is essential and must go hand in hand with sustainable development.

5.5 Ecology of the site

The first step to living sustainably is to choose a healthy location free from the influence of air, electo-, ground, noise, water pollution and geopathic stress. Logically it is senseless to build a structure of sustainable materials if the area itself is poisonous to the occupants. Conversations with the developers did not reveal any concern with sustainability.

The area must also display a balance between public and private, open spaces and built forms and accommodate a mixed group from singles, young families through to the aged young and old. Mixed use areas with schools, shopping centres, recreation areas, playgrounds and homes are not within walking distance. Ravenna is located within driving distance of all the above with the car being an essential component of living in this development. There is no social control through mixed use. It is a modern South African enclosure that is occupied by fear of the outside world. Modern living environments appear to be socially a giant step backwards with developments displaying a return to mediaeval life with electric fences and access control gates instead of fortified walls and draw-bridges. Ravenna is a typical example of the modern idiom of the homes as a cocoon.

The case study displays disinterest in the specifics of the particular environment where the development is situated. The buildings are not a response to the site, merely a market reaction to the need for housing in this specific sector. The quality of the living environment appears not to have played a role in the design and construction process. The cleared site provides a clean canvas for building on with houses that sit on the site and are not an integrated part of this piece of land.

5.5.1 Location

The area was until recently a farming area outside of the city but has become a hot spot for housing and related developments. People are travelling greater distances with increased traffic resulting in more road infrastructure and traffic jams, expensive energy wastage on transport, rendering areas unsafe traffic zones not suitable for domestic life. The mobility results in separating life into zones around the city for homes, office parks, recreational facilities, shopping centres and so on. Figure 5.3 illustrates the trend where the city is vacated and natural surrounding areas are being encroached upon

The area north-west of Johannesburg is mostly characterised by large-scale development in the medium density house type. Developments in this area are growing towards the natural area, the Magaliesberg. Development should be restricted, as this is a natural, physical and visual haven from the urban area that must be preserved for future generations to appreciate, enjoy and benefit from. The local authority should make requirements to maintain a percentage of open natural space before a situation arises where buildings dominate the whole area.

[16] *vide* 2.5.3:23

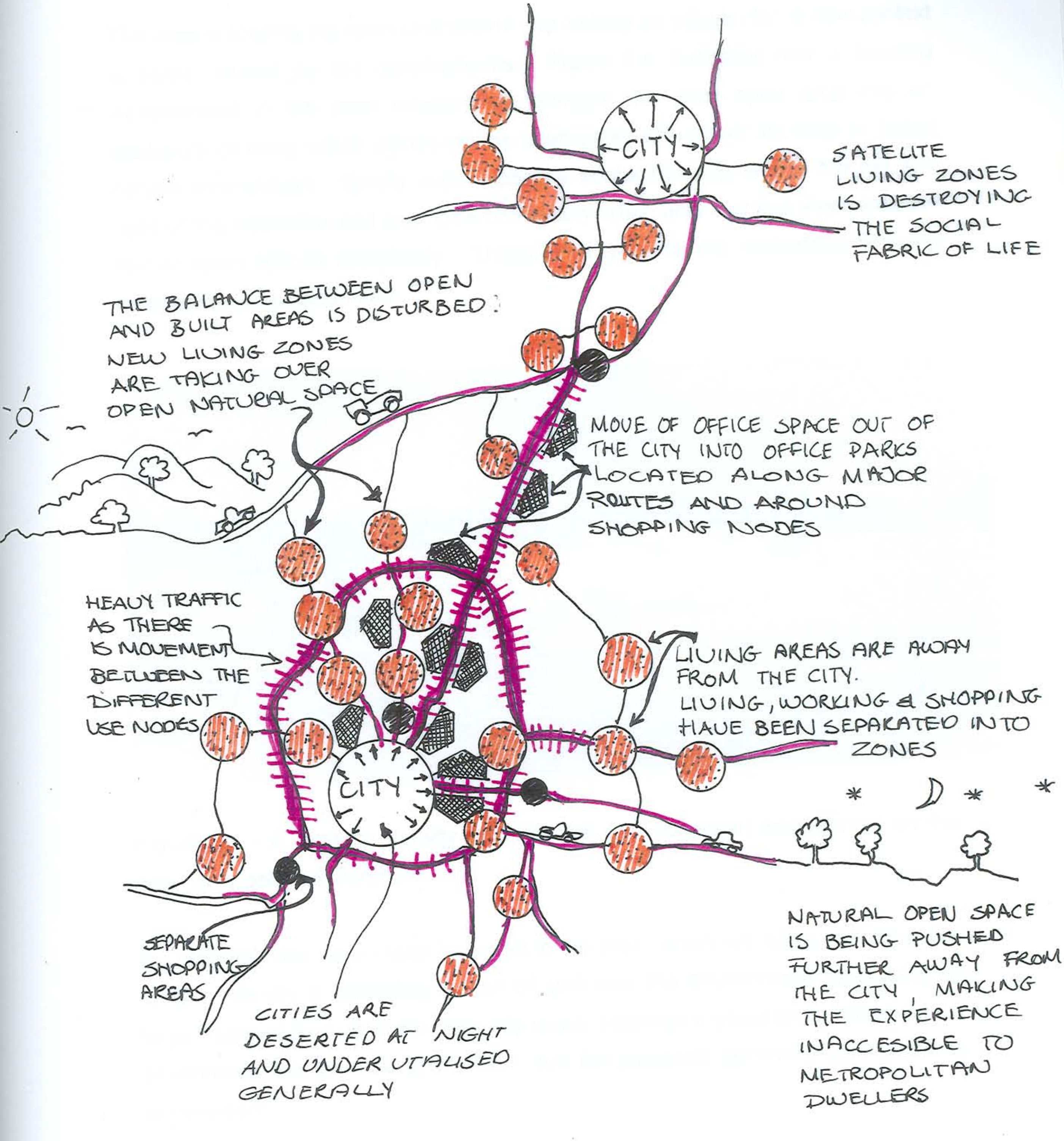


Figure 5.3 - Illustrates the trend where the city is vacated and natural surrounding areas are being encouraged upon.

The area is loosing the open character it was initially so popular for, a new context is being created by the developments. Figure 5.4 illustrates how a housing development in the area substantially changes the once open area into an enclosure of living space devoid of any relationship with either the near or broad natural environment. Simply superimpose a similar development to the left and right on the illustration and one has a completely urban area that has eradicated the former open spaces completely. These developments are enclosures of living comparable to a human zoo.

Figure 5.4 - A medium density development (not Ravenna) encroaching on the previously open environment

No provision has been made for parks in the area, which will retain specific green lungs. The city is spreading like an oil slick over the environment, swallowing up large tracks of land while the inner city slowly becomes a ghost town. What kind of environment are we moving towards? Are the prospects becoming too frightening to consider?

An analysis of the area revealed that fortunately the site is not toxic. This analysis should have taken place before any detailed planning took place. The site situation has no immediate air, noise, ground or electro pollution problems. The nearby industrial area must maintain the light industry character to avoid future problems from developing. The highway does not carry audible noise pollution to the site but should be considered a source of air pollution, especially as traffic increases. Figure 5.5 analyses the services in the area of the development.

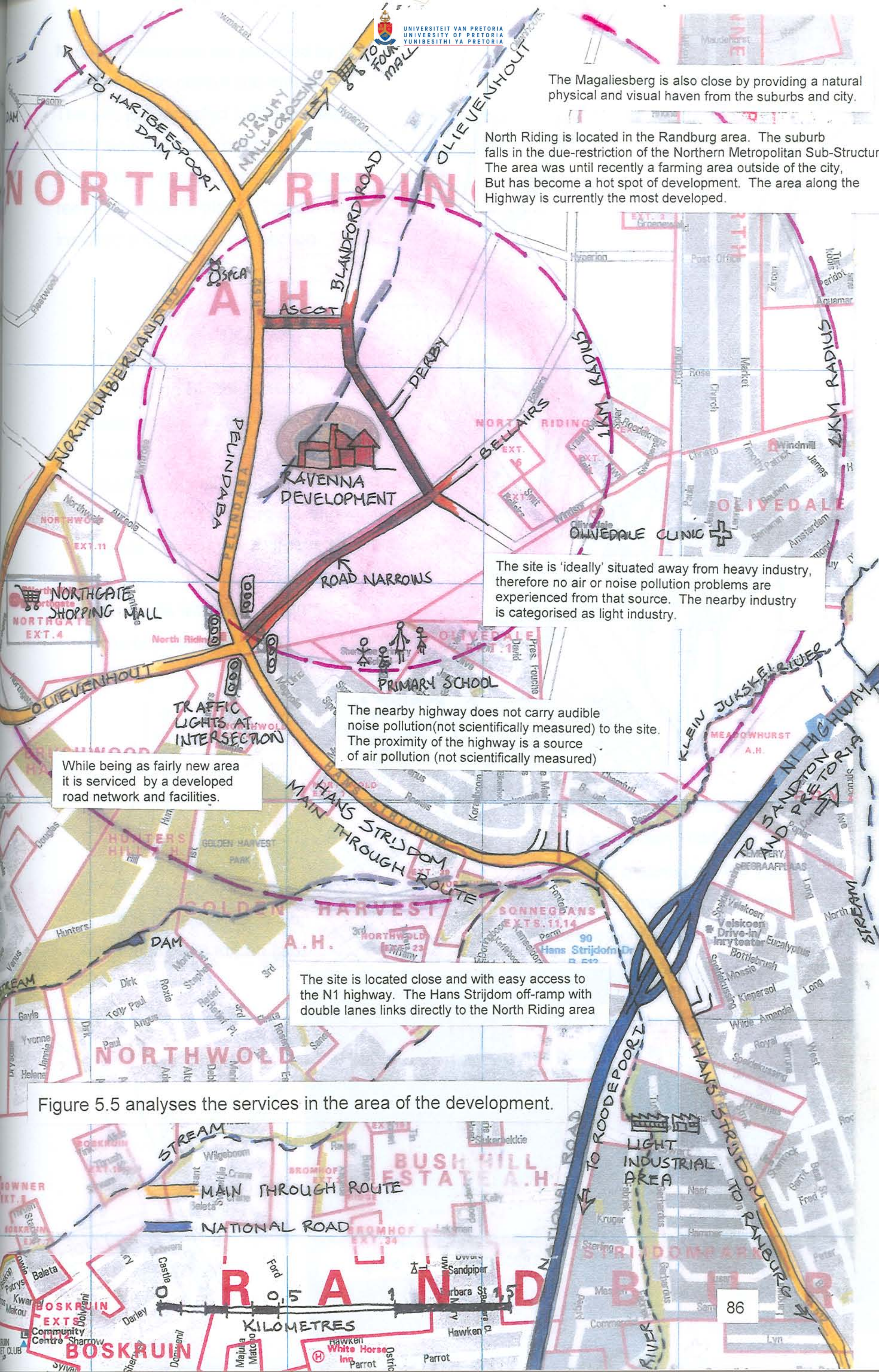
Vegetation, ponds and open areas established on the site provide filters for pollution. Adjacent to the site is a perennial stream, however it appears to flow with very heavy rainfall only. The streambed supports a variety of plants and provides a natural zone of visual and natural relief in this fast developing area.

The nuclear power station Pelindaba even though many kilometres away, could be considered a health hazard, as it has not been fully dismantled. Individuals have different varying resistance to radiation and the individual must decide if they wish to consider the effects of the Pelindaba nuclear plant or not.

A developed infrastructure services the site and makes access possible but, attention must be paid to the quality of the roads in terms of dealing with rainwater run-off. In an area such as this which is partially disowned farmland juxtaposed with fully developed sites the quantity of rainwater run-off must be actively managed. Currently dirt roads and cleared but undeveloped sites are leading to erosion and the loss of valuable top-soil. (see Figure 5.6)

No provisions have been made for pedestrian or bicycle traffic. There are no parks in the area or a play area in the vicinity or within the development. Fortunately enough open areas remain that can be dedicated for parks and recreational areas. The area has not been developed considering the needs of children, elderly or infirm but for the childless, mobile executives that commute to their workplaces each in their own vehicle, which is reinforced by the absence of a connection to the public transport system.

Developments such as this case study provide an opportunity to reduce traffic. The security controlled entrance ensures that vehicles that have no business in the development can not drive through the area. Traffic can be laid out to slow traffic and restricted to single, one way traffic or alternatively the car can even eliminated by creating a central car park that gives pedestrian access to the homes.



The Magaliesberg is also close by providing a natural physical and visual haven from the suburbs and city.

North Riding is located in the Randburg area. The suburb falls in the due-restriction of the Northern Metropolitan Sub-Structur The area was until recently a farming area outside of the city, But has become a hot spot of development. The area along the Highway is currently the most developed.

The site is 'ideally' situated away from heavy industry, therefore no air or noise pollution problems are experienced from that source. The nearby industry is categorised as light industry.

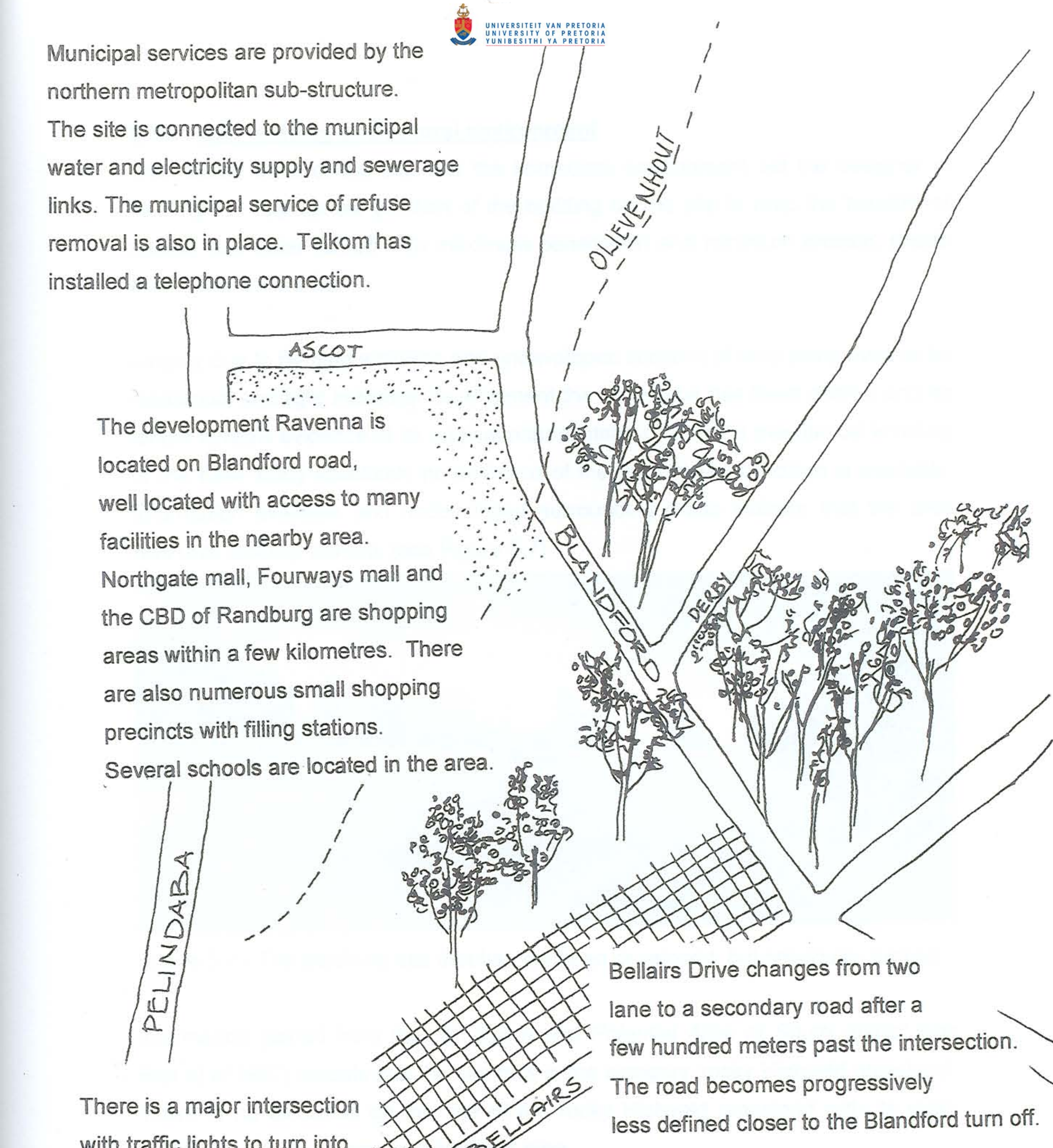
The nearby highway does not carry audible noise pollution(not scientifically measured) to the site. The proximity of the highway is a source of air pollution (not scientifically measured)

While being as fairly new area it is serviced by a developed road network and facilities.

The site is located close and with easy access to the N1 highway. The Hans Strijdom off-ramp with double lanes links directly to the North Riding area

Figure 5.5 analyses the services in the area of the development.

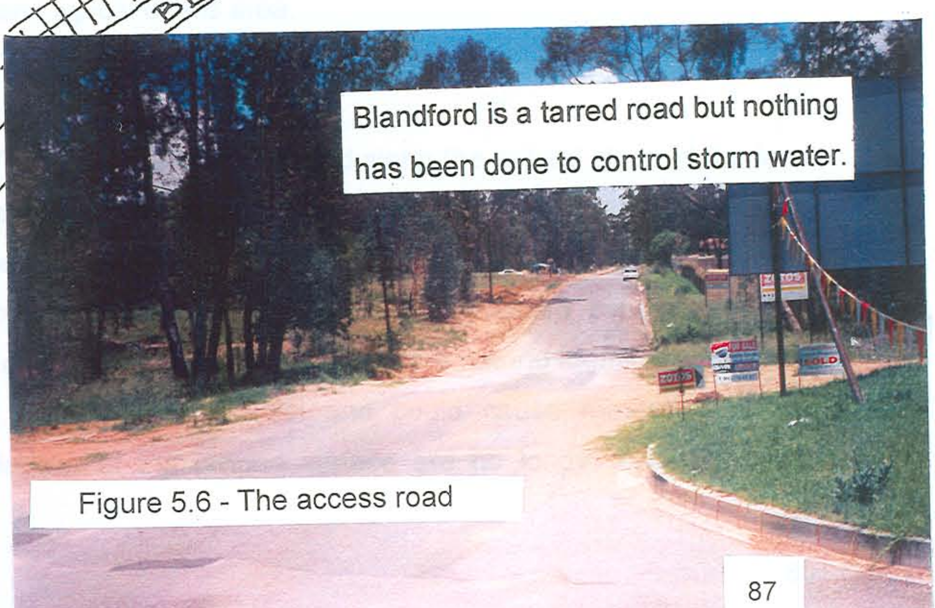
Municipal services are provided by the northern metropolitan sub-structure. The site is connected to the municipal water and electricity supply and sewerage links. The municipal service of refuse removal is also in place. Telkom has installed a telephone connection.



The development Ravenna is located on Blandford road, well located with access to many facilities in the nearby area. Northgate mall, Fourways mall and the CBD of Randburg are shopping areas within a few kilometres. There are also numerous small shopping precincts with filling stations. Several schools are located in the area.

Bellairs Drive changes from two lane to a secondary road after a few hundred meters past the intersection. The road becomes progressively less defined closer to the Blandford turn off.

There is a major intersection with traffic lights to turn into Bellairs Drive.



Blandford is a tarred road but nothing has been done to control storm water.

Figure 5.6 - The access road

5.5.2 Site features and natural environment

The natural state of the site and the immediate environment aid the designer in locating the appropriate position of the building on the site to reap the benefits of natural rain-water run-off with maximum penetration and minimum erosion, shade from trees and so on.

Largely due to farming activities and undeveloped sections of land being overrun by residential and light industrial development the landscape has been altered and no longer reveals evidence of its original natural state. Due to the mechanical levelling of the case study absolutely no evidence of the original site condition is available. Information available and undeveloped surrounding areas indicate that the area was until recently farmed. (see Figure 5.7)

Figure 5.7 - The adjoining site that has not been developed, but previously farmed

Information gained from the *"Environmental Potential Atlas of South Africa"* (van Riet *et al.*1997) reveals that the site falls in the category 'rocky Highveld grassland'. There is no evidence on the site of the rocky Highveld grassland with its rocky surface bed and grasses typical of this area.

Topography

The site of 'Ravenna' was mechanically levelled along the natural slope of the land towards the road and retaining the natural fall towards the entrance. Complete flattening of the site would have resulted in too great a difference in height between the extreme ends of the development. The levelling eased construction and simplified the layout of the site but has stripped it of a natural identity. Across the entire development the fall is substantial and could cause rain-water run-off problems. The variations of the ground surface are no longer evident as the mechanical levelling has created one inclined surface of compacted soil without variation, witch reduced the porosity and is resulting in erosion.

There is a loss of variety of appearance and landscaping opportunities due to the removal of rocks and land undulations. No large trees or for that matter any vegetation was retained on the site. The natural drainage patterns are replaced by roads that channel the rainwater run-off. The internal road is tarred and does not provide the opportunity to assist water penetration, resulting in the road becoming a rain water channel that flows out onto the yet no tarred public road. The porosity of the soil has been reduced due to compaction and the natural contours for run-off have been eradicated resulting in an increased risk of erosion. A site visit on a rainy day revealed that no attempt had been made to prevent erosion in the area. The topsoil was running off the undeveloped sites along the newly tarred roads, out onto the public dirt road, lost to the site. The site does not fall in a high-risk area for erosion but wastage of soil is nevertheless senseless.

The creation of a clean palette to build on robs the site of any natural vegetation that might have given it a unique character as well as beneficial natural environment. Retaining the character of the site and adapting the layout to the specific features present would have allowed for the drainage patterns, natural rocky outcrops and vegetation to be incorporated in the new purpose of the land, namely residential use. An individual response to demarcated sites would have resulted in greater visual and ecological variety in the complex. Each stand on the site would have a unique character resulting from the response of building to the site that respected existing features present.

The road edge of the development has been grassed over. Each sale includes a small amount for landscaping, which is only adequate to cover the cost of grass and a few plants. Fortunately most completed stands have lawns and a few plants reducing run-off. (see Figure 5.8) The undeveloped sites are ready for construction. When the area is further developed the planted areas will hopefully reduce the risk of erosion.

Paving the internal road instead of the impenetrable tarred surface would promote water penetration rather than erosion. The site does not fall in a high-risk area for erosion due to the clearing it has became a problem on the undeveloped stands on the site. Wastage of top soil is a senseless loss of available resources and reduces the ability for new gardens to establish.

Figure 5.8 - The developed and undeveloped stand

The opportunity to study the local geo-hydrology was not taken. Information such as good soil areas for planting, where drinking water can be found, possibilities for local rainwater disposal and local sewage treatment should be viewed not as constraints, but rather as the information that can assist in allowing the building and its occupants to respond to their immediate environment.

5.5.3 Orientation

The clearing of the site gave the planners free range to layout the site on a theoretical basis, enabling the north frontage to dictate the layout and making maximum use of the east-west path of the sun in the house designs. The triangular shape of the site and road layout has also ensured that each site is located with the longest side facing north (see Figure 5.9). In reality the perpendicular/parallel placement of buildings to the road has taken precedence over the maximum use of the sun's daily path. Theoretically the siting of building on the stand should be influenced by the presence of developed trees that create shade areas providing welcome relief in this warm climatic region, but this was no longer an option.

The site's exposed surface slopes towards the north with maximum solar radiation reaching the extent of the site. The houses are all small relative to the stand size and the positioning avoid any shadow to be cast onto adjacent sites.

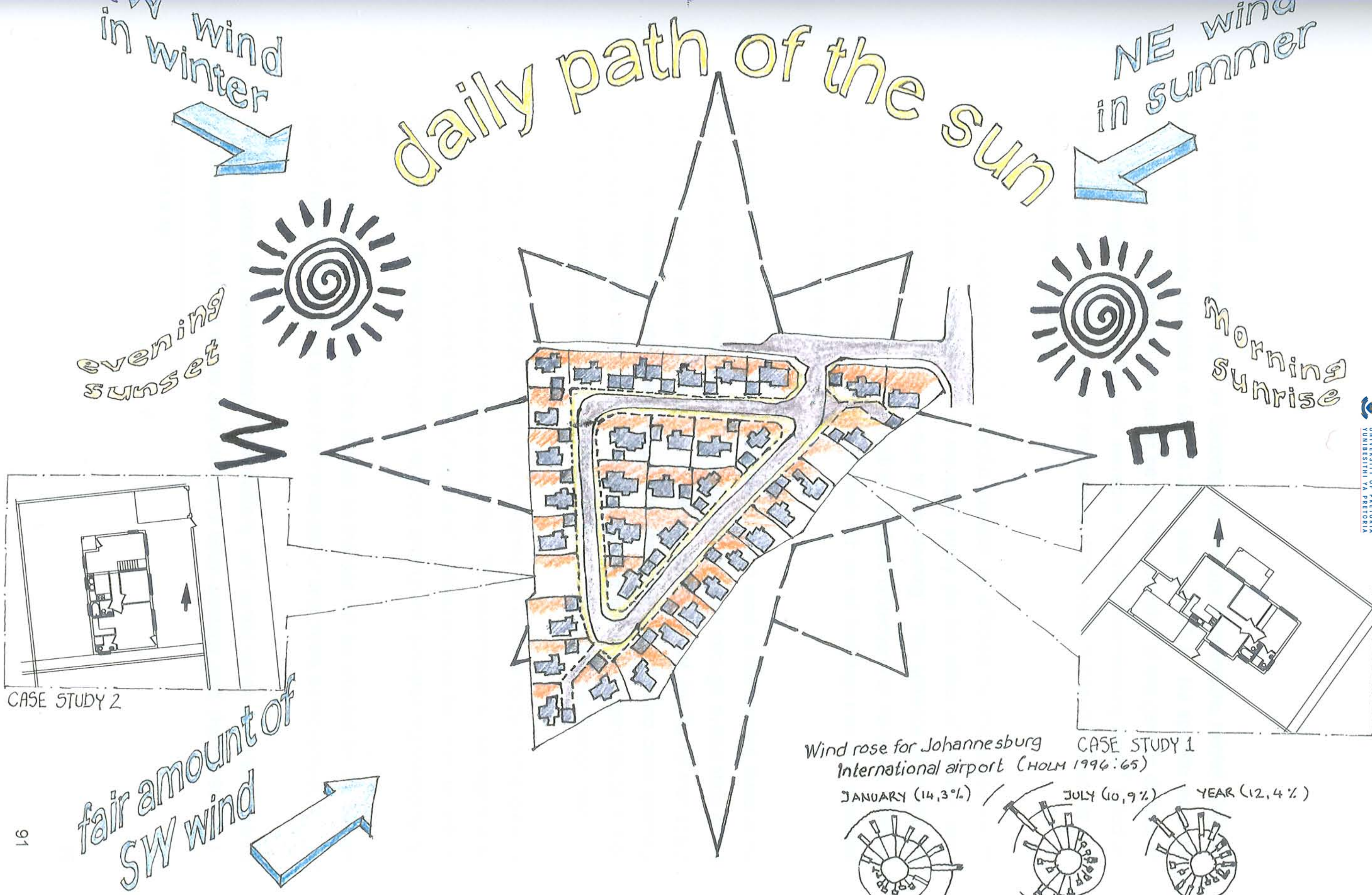


Figure 5.9 – Orientation of the development and buildings thereon

5.5.4 Climate

The site falls in the area known as Gauteng, the average temperature, rainfall, sunlight hours and humidity are listed in Section 2.5.1 and Table 5.1. No specific readings were taken on site although this would be the true reflection of the generic climate of the site therefore the climatological averages for the Johannesburg area[17] listed in Table 3.2 are taken as accurate for the purpose of the research based in Gauteng and not North Riding specifically.

The climate experienced on a specific location is affected by the presence of vegetation, water and landforms. In the case study the full effect of the sun, rain, humidity and wind are experienced due to the clearing. The absence of developed trees or dominant landforms provide neither localised protection nor have any effect to vary the local climate. The area is residential with no tall buildings that cast shadows over the site or affect the generic climate.

Northward orientated of the stands facilitates full sun most of the day but there is no vegetation to provide shade or surface water on site that through evaporation could vary the humidity and air movement. There are no significant landforms that could affect the localised air movement or provide shaded area. Planting quick growing indigenous trees and creating water features on the site would reintroduce a bio-diversity and affect the relationship between the new building and the environment.

The rainfall and characteristic heavy thunderstorms fall with full force on the cleared site. There is no vegetation that acts as a buffer. The evaporation will be high due to the impenetrable surfaces and lack of vegetation; measures must be taken to reduce loss of water. The vegetation must be replaced and run-off rainwater channelled for re-use.

During a heavy rainfall season the climate on the site will be affected by the stream south of the site, this will act to cool the immediate air and create air movement.

Summer winds are predominately north-easterly, and winter winds are predominantly north-westerly, but there is also a fair amount of south-westerly wind. (Holm 1996: 64)

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[17] *vide* 3.4.4:40

5.5.5 Energy

This section looks at the presence and use of both artificial and natural energy on the site including grid electricity and the natural sources of energy such as solar power.

Geopathic stress

The geopathic stress of the site has not been scientifically measured field, as this would require a specialist with a magnometer, which is beyond the financial constraints of this research. Indications of geopathic stress can be derived from the surroundings but due to the clearing, no visual clues can be gained on site.

Analysis of the broader environment did not reveal disturbances to the energy field, there were no gnarled trees or distorted growth patterns. There are also no deep foundations, high-tension power lines or other man-made disturbances in the immediate area. The site was not checked for underground water, which can also disrupt the natural magnetic force of the site. Evidence of boreholes in the area indicates that underground water is available. The Olivienhoutspruit is in close proximity to the site but is surface water and therefore not problematic.

Though no natural features reveal any evidence, the characteristic underground mining in the area can be considered problematic. Man-made equipment can distort natural magnetic fields and render them malignant, possible influences should be identified and assessed for effect. The transmission station Sentech at Radiokop, a few kilometres west of the site, are another potential hazard with satellite dishes and transmission towers. Since they are further than two kilometres away do not affect this particular site. The site services such as water, sewerage and electricity run underground around the site but do not cross the stands. The transformer house is located a substantial distance from the site and will not cause problems. None of the possible man-made equipment appears to be problematic.

These stresses are important to the well-being of those occupying the area. They should form part of the original analysis that determines whether a site is appropriate for development and the measures to be taken to reduce the risks involved in living in an area experiencing geopathic stress. The purchaser/user should be aware of the different forces in the area and make an educated choice of situating their home.

5.5.6 Water

Water, essential to the survival of humans on this planet is a renewable resource, but nevertheless must be considered a precious resource not to be squandered since it depends on the average rainfall. A decrease in natural catchment areas due to urban sprawl and changing climatic conditions can render it a scarce resource. Water provision and usage should be well managed.

The site receives water from the rainfall and the municipal supply of purified water.

Surface water

No surface water is present on site. North of the site is a natural stream with a dam. The dam is not for domestic water supply and is too far away to be a viable supply for other purposes than consumption. The stream south of the site (see Figure 5.10) appears to only flow with very heavy rainfall (seasonal) and is not a reliable source.

Ground water

The site was not checked for underground water and no use is made of a bore-hole and ground water. A comprehensive site analysis should have investigated the possibilities especially since evidence in the area such as old tanks and wind-mills suggest the presence of underground water. To drill a borehole or purify stream water is expensive for a single home, however, a larger development such as Ravenna can cost effectively make use of available alternatives.

Rainwater

No attempt has been made on site to reduce or harvest rainwater run-off. The initial layout should have provided for harvested rainwater for reuse in a central system to irrigate gardens and flush toilets with this resource. Individual households can still install a purification system to make use of harvested rainwater in the house but this is an expensive alternative. Gutters and water tanks can be installed retrofit to still in the future benefit from harvested rainwater for use in the garden.

The altered drainage pattern channels rainwater along the tarred internal road and off the site (see Figure 5.10) where it becomes useless to the occupants. Alternatively paving which allows for water penetration on site could benefit the gardens and prevent erosion where there is no infrastructure or planting. In this development, the gardens of the developed sites are lawned reducing run-off and promoting rainfall water penetration. A dam constructed to collect the run-off from the storm water drain would allow for additional garden irrigation.

Figure 5.10 - The non-perennial stream south of the site

Gardens and water

Landscaping can reduce the amount of erosion caused by run-off. Gardens should be planned to use a minimum of supplementary irrigation and reduce loss of ground moisture to evaporation. Plants should be chosen appropriate to the climate and naturally available water.

Surface water can temper the climate. Water features should be incorporated in the layout of the site. The individual garden layouts should incorporate ponds and pools. The swimming pools should not use harmful chlorine systems but rather make use of alternatives such as salt systems or natural pond ecosystems. Unsold stands should be developed as open green space with ponds or vegetable gardens in the complex.

5.5.7 <u>Waste</u>

The condition of the original state of the site, if there was any waste dumped, is unknown to the researcher due to site clearing. The developers have removed all rubble and vegetation from the site. No site rubble was re-used on site. The developer claims to distribute the rubble according to where it is required on one of their projects and never to dispose of it as land-fill. Where necessary soil can be shifted on site for cut and fill. It is recommendable to avoid disturbing the surface bed. Woking with the site as a given area rather than clearing it completely would result in far less waste on site.

The sewerage pipes supplied and maintained by the municipality are in place and service the site. The refuse removal is also a weekly service provided by the local authority.

Garbage

Households produce waste in the form of black and grey water, garbage and garden refuse. Modern lifestyles often do not consider waste beyond its removal from site. Waste is not totally useless. It is not the sole purpose of a landfill to fill it as quickly as possible. The central waste area is a requirement set by the authorities for this site. The waste area is a simple enclosure for garbage bins with street access for collection. No provision has been made in the enclosure for a composting facility or collection of re-cycleable waste products. The initiative to re-cycle depends on the individual.

Occupants of the development should be educated to the benefits of re-cycling. The waste area should be divided into zones to facilitate the disposal of waste according to type and re-cycling potential. Establish a plastic, paper, glass and compost zone in the waste area and encourage the use thereof. The regular removal of waste by various organisations only requires prior arrangement; it should not be a deterrent to living in an environmentally conscious way.

5.5.8 Fauna and flora

The fauna and flora of a site contribute to the aesthetic appeal and climate of the area. It provides the site with both character and protection from the natural elements. The clearing of the site has destroyed the possibility to retaining original planting; especially the developed trees which provided shade, wind buffers, pollution filter and promote privacy. Ideally, the site retained existing vegetation giving character and prevented erosion as well as being a natural design generator.

Continuous development with site clearing is encroaching on natural areas and a subsequent developed ecology of flora and fauna is lost (see Figure 5.11).

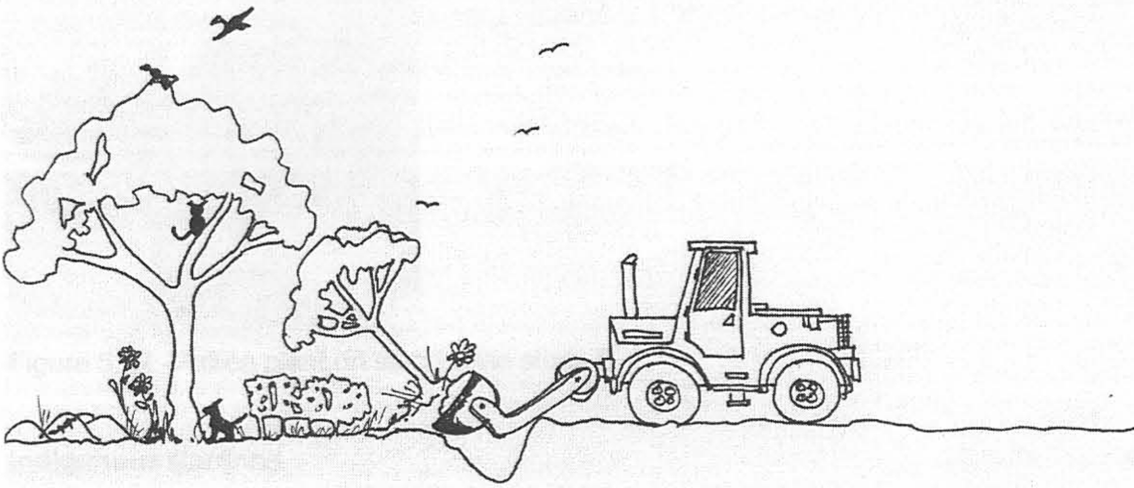

Figure 5.11 – The clearing of the site

The area has been cleared in the past for farming, which changed the pristine natural habitat, however a substantial portion of untouched nature was always retaining. The developments are clearing the last of the untouched areas at a frenzied rate and eradicating the natural feel that first made this area so popular. The result of the extensive, uncontrolled development is a loss of bio-diversity. The natural fauna and flora are forced increasingly further away from the urban core and becoming alien to urban dwellers.

The surrounding vegetation in the area reveals limited clues about the original condition of the soil, flora and fauna with no evidence on the site of the rocky Highveld grassland with its rocky surface bed and grasses typical of this area. The tree guide to the Highveld gives many examples of trees indigenous to this area, however none could be identified in the area. The only original plant is a lonely Protea plant illustrated in Figure 5.12.

There is ample space for planting gardens as the ratio of site to building is balanced. The maximum coverage remains very low as the buildings are relatively small compared to the stand size. Flanking the road edge are wide grassed areas fronting the garden wall of the individual stands giving the impression of open space and greenery. If well managed the whole development has the potential to become green.


Figure 5.12 -Protea plant on stand case study B

Indigenous gardens

The gardens are new and therefore only act at a fraction of their true value to the environment[18]. In time as the gardens develop this situation hopefully will improve.

No policy to plant an indigenous or water-wise garden has been adopted by the developers. Generally, people are not aware of the variety of indigenous plants available and that these plants can be used in a variety of landscaping styles. Indigenous gardens have the benefit of growing quickly, having a low plant loss as the plants are suited to the soil and climate, require less water than exotic gardens and attract natural wildlife. The newly planted trees and plants are mostly exotic. The few stands that have adopted an indigenous approach are flourishing while the exotic gardens are battling to develop. This in itself is evidence of which garden type is more appropriate.

Lawns on the road edge/ and gardens are also an integral part of the developments landscaping. Different grass types require different climates and irrigation. The grassed road edge should be of a suitable grass type that requires a minimum of supplementary irrigation and is hardy to the climate.

Food production – Permaculture

This is a commercial development and carries none of the perm-culture motivations.

No specific area in the complex has been set aside for vegetable or fruit propagation; this concern is for individuals to integrate on their property.

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[18] *vide* 3.4.8:46

5.6 Ecology of the building

The individual houses built in the development are mostly adaptations of the original marketing designs that have been revised according to the needs and budget of the purchaser. The building structures of this development all fall within the same aesthetic style which gives the complex a unified appearance. This complex of houses could be categorised popularly as the Tuscan aesthetic, even though it is a simplified version thereof, with terracotta painted plaster finish, orange/ terracotta tiled roofs with overhang. All windows of living spaces are large timber window and door frames. There are many standardised elements recognisable throughout the development such as standard height garden walls.

A single style development such as Ravenna standardises the building structures of providing the opportunity to build a prototype sustainable, eco-friendly home and repeat the lessons learnt. Such an initiative would make a sustainable home cost-effective and not a one-off experiment.

The case study is analysed in Figure 5.13 and Figure 5.14

5.6.1 Relationship of building to site

Ideally the building acknowledges the site and the surrounding area. This design should be a response to the area specific and not a theoretical abstract artificially implanted on a cleared piece of ground, devoid of any reference.

Further than acknowledging the benefits of north frontage the case studies make no other reference to the specifics of the location. The stands are small and due to the levelling process provide no tangible reference to the location of the site in the broader environment that surrounds the development. The buildings stand within their own context devoid of any relationship with the natural environment.

The individual buildings are placed on a concrete platform to accommodate the fall on each stand by superimposing an artificial level. Neither the base of the building, nor the floor layout makes reference to the slope of the ground. A design that responds to the site would facilitates a link to the original natural contours and features with appropriate construction for the conditions.

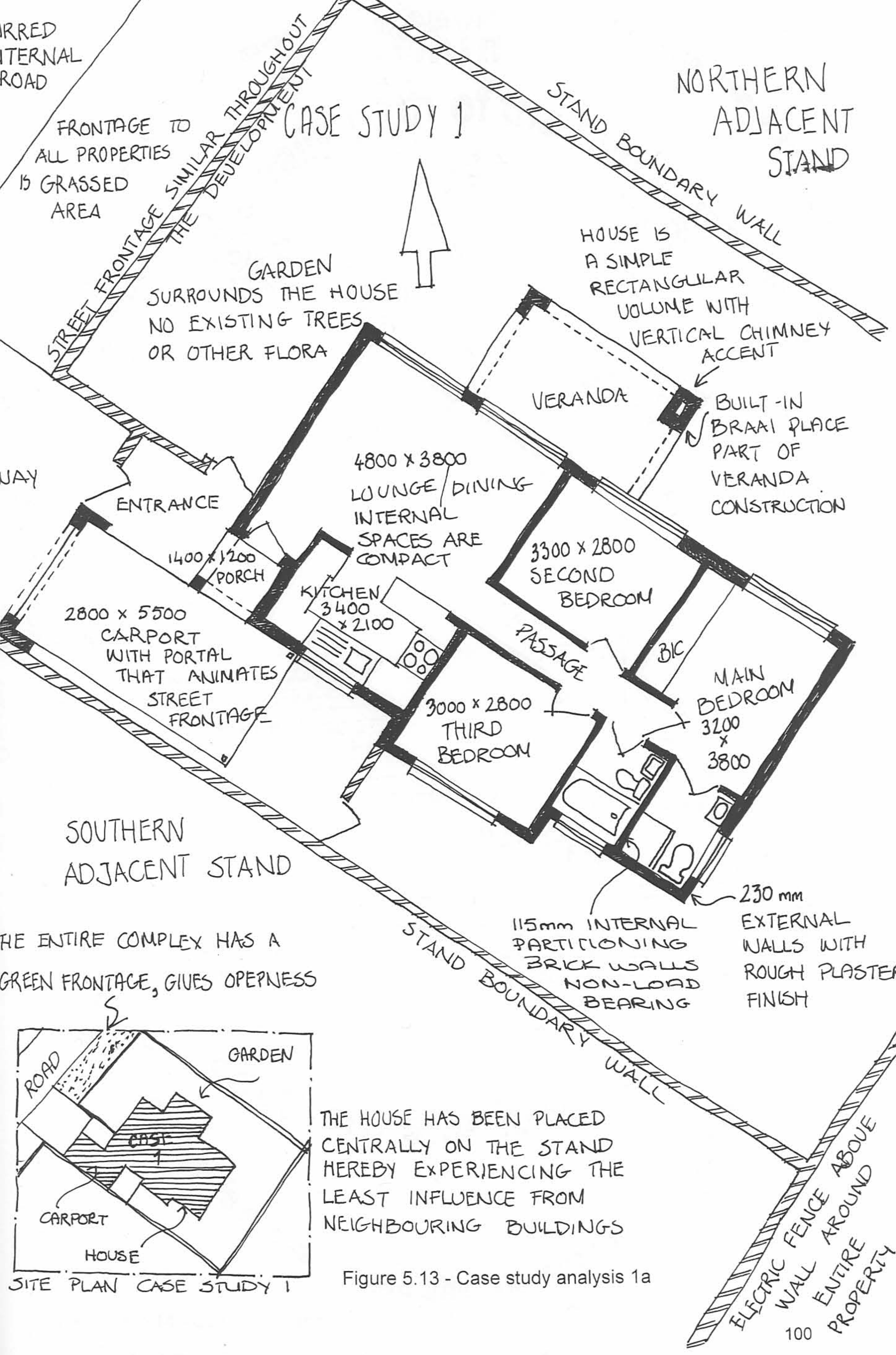

Figure 5.13 - Case study analysis 1a

The limited size of the sites is balanced by the smaller house size. Site coverage is between 18 and 37% depending on the house and stand size chosen. This low percentage of coverage allows for a substantial garden around the building and minimises the influence neighbouring buildings could have on the shade versus sunlight of the building. There is no crowding of the sites, maintaining a sense of openness on this site. The balance between open area and built forms in the whole complex must not be allowed to erode through time by continued extensions.

The position of case study A and B are illustrated in Figure 5.9.
The absence of any growth or landscape features such as rocky outcrops facilitates the theoretical placement of the house on the stand from the viewpoint of the site drawing and does not require understanding of the real site situation in its natural form. The site was divided into stands as defined on the site plan. Each house was laid out on the stand making reference to that specific stand's boundaries.

5.6.2 Orientation

All houses are situated on the stands to make maximum use of the north facing facade. There is no view to acknowledge, or landscape feature to give reference to. To keep the houses affordable the layout is compact resulting in certain spaces facing unfavourably.

Certain months of the year are more windy or cold. The south-west facing rooms cannot enjoy much passive solar benefit. The limited stand size and the mild average Highveld climate were given as justification by the architect for unfavourably placed rooms. Limited financial resources for the purpose of design results in the minimum time being spent on finding solutions to potential problems. Economic and spatial constraints also make it impossible to solve certain design problems

Hugo Vanderstadt (1996:61) suggests that at least one window in the house allows UV penetration. His suggestions are for the central European climate. In South Africa and specifically Gauteng the climate is mild and use can be made of a sliding door which is kept open for a few hours of sunshine to penetrate the interior spaces. Both case studies have sliding doors that can be utilised to allow the full sun spectrum to enter the lounge area.

5.6.3 Generic climate

No conscious decision was made to use the natural climatic forces of the site for natural climate control.

The layout of the case studies are conducive to air circulation and the bathrooms are located on exterior walls with opening sections allowing ventilation without requiring a ventilation fan system. Thermal comfort - the range of temperature versus humidity within which the body is comfortable[19] is partially achieved in a sustainable way by the case studies. Two of the three bedrooms and the living spaces are orientated northwards. The north orientation and window size relative to the width and depth of the room allows the maximum sunlight to warm and light the internal spaces.

The wind can be used as a design tool to aid ventilation of the homes. The current ventilation of the home is merely a coincidence. Air movement where the wind and openings are used to facilitate ventilation and exchange air must be given conscious consideration. This can act as a natural cooling method in summer, and by careful planning be prevented from removing the warmed internal air in winter. Every room has opening sections which when regularly opened are adequate to ventilate as well as cool the rooms by natural air circulation.

Walls are often referred to as the third skin. Standard 230mm thick walls enclose the externally and internal walls are 115mm. The wall thickness was determined structurally. No consideration was given to the thermal properties of this third skin.

The location of the main rooms on the north side allows for the use of passive solar energy that assists in maintaining an interior temperature that falls within the 'comfort zone'. Considering the high number of sunshine hours in Gauteng, the optimal relationship of orientation and layout results in a comfort zone that requires no additional artificial control. There should not be many times in year that an additional source of warmth energy or cooling is required.

The orientation and layout can be further be optimised by consideration and use of thermal insulation principles in the ceiling space, walls and openings. Insulation keeps out the heat in summer and retains the internal heat in winter. A lack of

19 *vide* 3.5.3:51

insulation allows the heat to escape. In winter when heat gained from solar energy is lost it must be compensated by an artificial produced source of heat which requires the use of other forms of energy, which have cost and resource implications. In order to save building costs no use has been made of insulation principles in this building development.

The house style does not have large overhangs therefore no significant shade is provided for the windows during summer. There are no developed trees on site provide shade either. The building experiences the full effect of all the natural climatic fluctuations.

5.6.4 Energy

Conventional electrical supply

All energy on site is supplied by the main electrical grid supply, Eskom. No use is made of alternate forms of energy such as passive or active solar power. Wind strength is insufficient to generate energy but is passively used for ventilation.

Solar energy

The case studies are north facing therefore cut cost of heating the space during the colder winter period, however the lack of insulation results in the loss of heat gained from passive solar heating. There is no venting system of the roof space that allows heat to escape in summer. To cut cost on the house price no insulation products have been used to assist in the energy performance of the house. No use has been made of the possible building construction details that could assist in reducing the energy requirements of this building. The individual home owners are expected to complete the house as requirements arise out of habitation, implying further expenditure.

Sustainable living means not wasting energy on artificial climate control. To achieve the comfort zone the occupants should install an insulation layer. When supplementary heating is required use should be made of the most energy efficient heating equipment.

Use can be made of both passive and active solar power, as there is an average of eight sunshine hours per day in Gauteng. Photovoltaic cells can be installed retrofit as a supplementary source of energy. They can be linked to the electric supply for artificial lighting necessary at night. There are no solar water heaters used in the houses. Solar panels can be installed to heat the water for the household, saving energy supplied by the use of non-renewable resources.

A central lighting system fitted with standard electrical light fittings is used along the roads of the site (see Figure 5.15). This system could also have been operated using photovoltaic cells.

Figure 5.15 - The development with tarred road and central lighting, grassed frontage and new planting. The electrical supply and telephone exchange box are visible

Electrical energy for mechanical lighting

Consideration must be given to the type of electric fittings selected. There are fixtures available that require less energy to operate. Vanderstadt states that our eyes use 60% of or energy warning that low energy use lighting must be considered carefully as it cuts out a portion of the light spectrum which is actually necessary for a sense of well being. It is therefore important to have a high light quality. Unfortunately energy saving lamps should be avoided as they cut out a portion of the light spectrum and in so doing tier the eyes.

The windows are large relative to the room area and wall surface therefore ample light fills the interior during the day. Spotlights have been installed as electrical light fixtures in this case study. The choice of light fixtures is from the pre-selection of the developers. No provision has been made to provide a choice of energy efficient light fixtures. The initiative to request these has been left to the potential purchaser.

Electrical energy for heating

The provision of hot water is by means of a geyser. The geyser has been placed centrally in the roof space, as this is the most economical position for pipe distances to the supply points of the kitchen and bathrooms. The positioning is determined by a concern for building costs alone and not environmental issues such as the distance versus energy and water wastage and to supply hot water to the outlet. The geyser type was selected based o price and availability and not energy efficiency and long term cost benefits. Certain producers have set their own environmental standards, which are passed on as a benefit to the new home owner, though they may be unaware of the benefits.

Embodied energy

Energy is also an essential component in the manufacturing of building materials and products[20]. Sustainable buildings make use of materials that do not require large amounts of energy to produce for example timber and loam or mud bricks.

5.6.5 Water

Water, though renewable, is a precious commodity. The conservation of water has not played a role in the development layout or the house designs and there appears to be no attempt to conserve water on the site. Rainfall runoff is not captured for use in the home and garden. There is also no borehole on the property

An ambivalent attitude has been applied to resource management. The essential issue at hand is to cut building costs in order to provide affordable housing. Sanitary fittings are once again from the developer's showroom with the purchaser selecting fixtures from the available selection. No provision has been made to include water saving fixtures in the standard range of available products.

Domestic water supply requires in-house purification due to the pollution of our natural water supply. Our water characteristically is filled with chemicals and unnatural bacteria that are harmful to us. It is possible to install a natural water purification system. Ponds, septic tanks, sand filters and percolation are a few of the techniques that can be used to purify water on site. Installation of a water purification system for one household is expensive, shared in the complex by a number of houses it becomes a cost effective and viable alternative.

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[20] *vide* 3.5.7:57

Household waste water enters the municipal sewer system and no provision has been made to re-cycle water. The geyser's position minimises distance to outlets reducing the wastage required to provide hot water to the outlet.

5.6.6 Waste

There are different types of waste arising from habitation such as water, material and organic waste. Grey and offal water were discussed in the previous section. Waste arising from household consumables and from the building itself all form part of what can be considered wastage arising from habitation. Organic waste from the kitchen can be used in a composting system for use in the garden. Recyclable materials should be sorted and brought to the relevant depots. Dangerous waste, such as batteries, chemical cleaning substances, fats, medicines etc. should be purchased and used conservatively. Unfortunately the municipal waste collection is an excuse not to bring the relevant waste to the recycle depot, as this requires an effort. Provision should be made on a complex such as this for glass, paper, tin, plastic and organic disposal and collection facilities.

The building site after the mechanical clearance and building construction was strikingly clean and tidy. The company policy of the developer is to keep the site clear of building rubble. Building rubble is used as fill where required on site or is removed to be used by the same construction company on other projects. The rubble is generally used and never sent to a dumping site. The rubble is not sorted to remove elements that could be harmful to the natural environment if used as fill.

The focus of the company is to build affordable houses therefore all forms of waste and damage of materials and components is cut to the minimum. Building material is purchased in bulk as all buildings on site are built by the same contractor avoiding unnecessary expenditure on over-supply of material. Extra material can always be used on other projects
In specifying building components no consideration is given to the original source and process of manufacture. Whether these processes where wasteful and come from a non-renewable resource does not play a role in the structural design of the buildings. The building itself should also have the potential to be recycled at the end of its life cycle[21].

[21] *vide* 5.7:111

5.6.7 Materials and construction methods

All buildings are made up of physical materials suitable for the purpose of constructing walls, floors and roofs which are sourced from various suppliers and manufactures. The availability, cost and actual physical properties are of primary importance, their sustainability has not been considered.

The homogenous finish of the whole development simplifies the building process for the contractor. To summarise the construction aesthetic is rough brushed plaster on stock brick walls concrete tiled roofs with an overhang. The colour finished is orange/ terracotta with timber window and door frames. The primary choice of finishes (carpets, tiles, sanitary fixtures and so on) is made by the construction company. The secondary choice lies with the purchaser who makes his/her selection within the predetermined budget from the developer's showroom. If the client wishes to have alternatives is possible at an extra cost.

The building trade and the components used in buildings tend towards being non-renewable with most materials falling into the seven main groups stone, timber, brick, iron and steel, concrete, glass and plastics[22]. A general description of the building materials and construction indicates that standard building practices are followed without any attention given to building in a sustainable way with materials that are environmentally friendly (see Figure 5.16). The timber frames for example were bought from a local supplier with the source of the timber unknown. Any material or process that could be considered sustainable is purely incidental. The economic aspect is the most predominant factor in determining the choice of all building materials required for this development.

The first house built is essentially the prototype for the whole development. The site is deemed to have the same soil type and stability as the prototype stand. The construction process with its required concrete strength and so on are to South African Bureau of Standards (SABS) minimum requirements.

Site preparation

The site preparation was composed of a soil test and the mechanical clearing of the entire site with no filling or cutting took place. The property retains a gentle natural slope but the natural contouring variations have been removed. The houses are

[22] *vide* 3.5.7:57

designed using only one level with the base on a single platform without any steps to accommodate the slight natural slope.

Before any construction work is commenced insecticide is sprayed where any signs of termite activity is identified. The soil poisoning must legally be carried out in terms of SABS 0124, however this standard makes no reference to protecting the natural environment or being environmentally friendly.

The prior site clearance and simplicity of design facilitated the layout using a basic system of pegs, rope and spirit-level. The foundation trenches were dug manually.

Building the platform

Pre-mixed concrete was used for the strip foundation footing and floor slab and mortar for the walls and the plaster mixture were hand mixed on site using Portland cement. A hardcore fill was compacted in layers to form the base of the floor. The hardcore layer is composed of material originating from the mechanical clearance of the site. A 100mm thick concrete floor of pre-mixed concrete with a screed was cast on top of the standard plastic damp proof membrane.

Building the shell (see Figure 5.16)

All brickwork (footings, structural walls, internal walls, sills, lintels, and beam filling) is concrete stock bricks. The 230mm exterior walls are the only structural walls and are built in stretcher bond with no cavity. No special reinforcement being required as the soil is stable and the walls are standard single and double brick walls. The internal spaces are divided into rooms with single brick 115mm stretcher bond walls that are non-load bearing. All walls have been plastered and finished in a rough brushed texture. Walls are finished with plaster and paint or tiles. The plastered wall surface is prepared with a universal undercoat followed by two coats of PVA. Standard tile adhesive is used to fix the tiles. The floor/wall edge has been finished off with hardwood Meranti skirting.

Timber trusses where manufactured off-site and designed for the maximum spacing and minimum pitch specified by the tile manufacturer. No use has been made of a waterproofing sheet or any other insulation material. The 600mm roof overhang provides some shade. Nailed rhinoboard ceilings are finished with rhinoboard cornices.

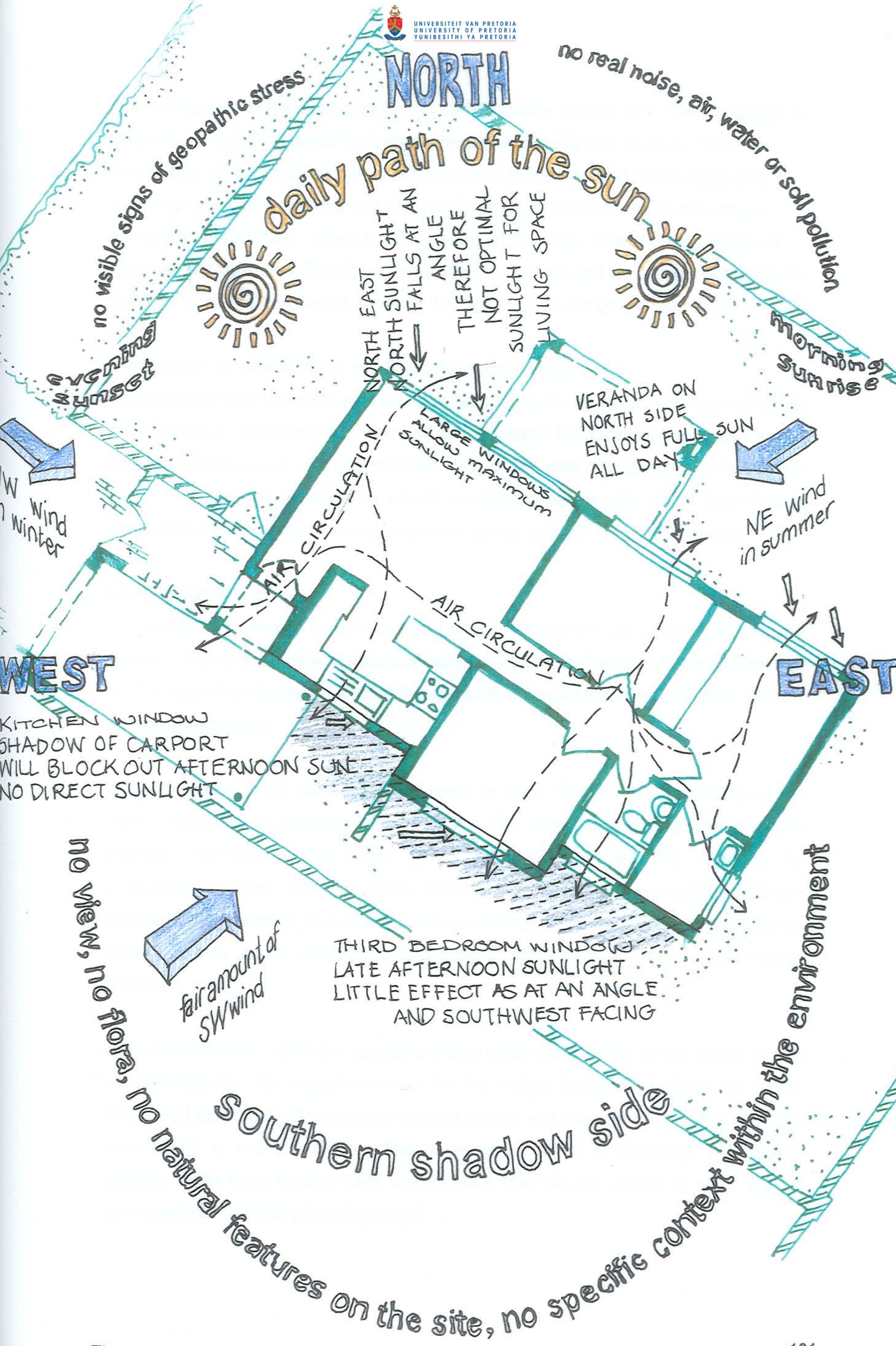

Figure 5.14 - Case study analysis 1b

All openings are rectangular with external and internal sills of plastered brickwork A standard plastic d.p.c. has been used at the window opening. Windows frames and the front door are varnished timber except the sliding door which is aluminium. . Internally the doors are hollow-core with metal frames, all painted finish. Clear 6mm glass has been used therefore there is no UV penetration. The sliding doors for safety reasons make use of shatterproof glass. The bathroom windows are textured to exclude the view through while still allowing light to penetrate. Brass and steel ironmongery is used.

Case study A is single story. Case study B has a loft room constructed of a pre-cast concrete and beam system floor. Case study B accesses the loft room via a timber staircase, which was pre-assembled off-site and installed once the internal construction was complete.

Services

The electrical cabling, plug points, switches, telephone wires and all other material pertaining to the electrical supply in the house are standard available materials from a building and electrical supplier.

Plumbing makes use of standard supply PVC and copper components, galvanised gutters and sanitary fixtures selected from the pre-selected range. An electric geyser is used to heat the water, which has been installed in the roof space in a position that minimises the distances between the outlets.

In the kitchen the units are melamine coated chipboard with formica tops and a stainless steel sink. The bedrooms have built-in-cupboards of melamine coated chipboard.

5.7 Life-cycle of the building

5.7.1 Life-cycle of building materials

The developer/builder aims to offer a good quality building at an affordable price. The developer has been in the market for twenty-five years and it is essential to their reputation to provide a quality building. The building materials used and finishes offered are all of SABS approved, good quality materials. Standard fixtures and sizes have been used that if a component is broken replacements should be available. The materials and building practices result in a building that should be around "for many years" and have a long life-span even though no target life time has been described.

5.7.2 Re-use of building materials

There were no previous buildings on site that needed consideration. No consideration was given to the re-use of building materials. When an old building is demolished the parts of the building are sorted and sold directly off site by the appointed demolishing company. It is however not a prerequisite of the developers to appoint a demolishing company that offers the opportunity to make building items available for re-use.

There was no use made of any natural materials found on site.

5.7.3 Re-cycling of building materials

The appointed demolishing company aims to collect maximum financial gain from the demolishing project. It is however once again not a prerequisite of the developers to appoint a demolishing company that offers the opportunity to make building items available for re-cycling. The developer does make use of rubble for fill on projects where necessary rather than dumping the material as landfill. This decision is economic, as the purchase of soil for landfill is more expensive. No consideration is given to items that might pollute the soil by becoming fill on site.

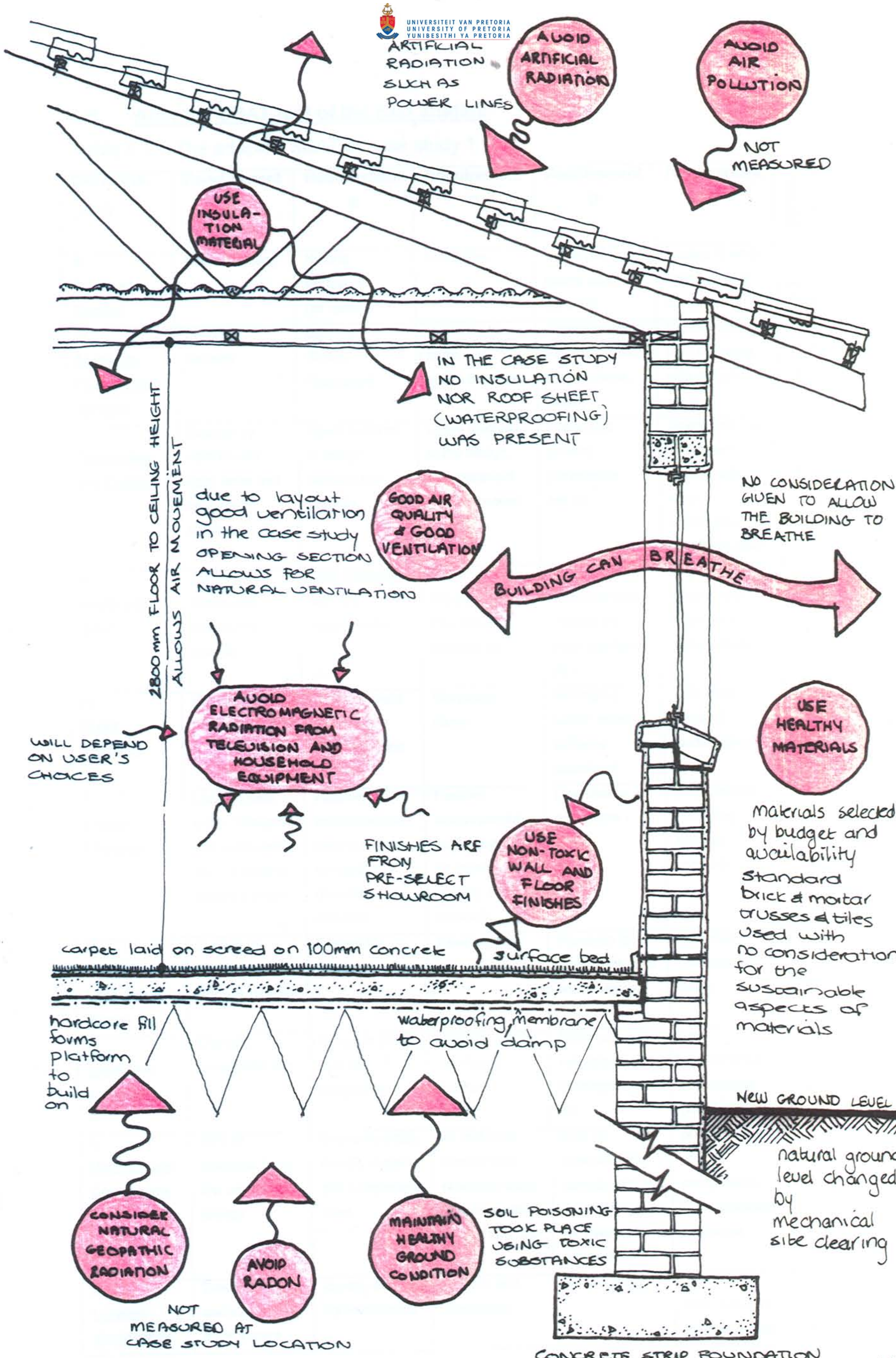

Figure 5.16 - Section of case study

5.8 Adapted SBAT test of the cast studies

Table 5.1 – The adapted SBAT of case study 1

CRITERIA (a –j)	Requirement A	Requirement B	Requirement C	Requirement D	Requirement E	SCORE
a) Occupant Comfort	Natural lighting yes	Natural ventilation (air quality) yes	Low noise yes	Views (all rooms external window) yes	Access to ame-nities, lay-out compact yes	5/5
b) Access to Facilities and Services	Crèche Schools yes	Banking, Shops, Restaurant yes	Proximity to parks and sports facilities	Communication Facilities (Post, Public phone, email)	Government / tax / licensing information	2/5
c) Participation and Control	Educate to control over light, temp and ventilation levels yes	Users involved in design / construction process yes	Users involved in the design, refurbishment of their spaces	Public and privacy parameters set-up	Space and / or equipment shared with local community e.g. Swim pool	1/5
d) Health and Safety	Community centre and community spaces	Fully compliant with fire requirements yes	Proximity to Police station, Fire station, hospital etc.	Access to nutritious food (restaurant, vege. gardens etc) yes	Free of air, electro, ground, noise, and water pollution	2/5
e) Water Efficiency	Rainwater harvesting	Water efficient devices: low flush WCs and urinals	Greywater reuse	Minimising runoff: external surfaces absorbent	Low water demand landscaping yes	0/5
f) Energy Efficiency	Located near public transport / all users within secure walking distance (4km)	Passive environmental control system for ventilation (thermal comfort)	Passive environmental control systems for heating and cooling (thermal comfort)	Low energy appliances / fittings	Solar control (including thermal comfort)	0/5
g) Minimising or Recycling of Waste	System for recycling (recycle depots)	System for reusing	Sewerage	Provision for dangerous toxic waste removal	Minimise construction waste yes	1/5
h) Vegetation and Wildlife	Use of a 'brownfield' site	Range of plants that are indigenous	diversity in flora and fauna habitats	Effect on neighbouring buildings: light etc yes	Low maintenance landscaping (e.g. ferlizers)	0/5
i) Materials and Components	80% of materials have low embodied energy	Environmentally friendly material and component used	All materials / components produced using only renewable energy sources	80% of materials and components for the buildings recycled / refurbished	80% materials and components from renewable resources	0/5
j) Location identification	Site features and natural environment	Identify existing flora and fauna	Climate and orientation yes	Natural water	Area Layout (incl. inclusive environments)	1/5

Table 5.2 – The adapted SBAT of case study 2

CRITERIA (a –j)	Requirement A	Requirement B	Requirement C	Requirement D	Requirement E	SCORE
a) Occupant Comfort	Natural lighting yes	Natural ventilation (air quality) yes	Low noise yes	Views (all rooms external window) yes	Access to amenities, lay-out compact yes	5/5
b) Access to Facilities and Services	Crèche Schools yes	Banking, Shops, Restaurant yes	Proximity to parks and sports facilities	Communication Facilities (Post, Public phone, email)	Government / tax / licensing information	2/5
c) Participation and Control	Educate to control over light, temp and ventilation levels yes	Users involved in design / construction process yes	Users involved in the design, refurbishment of their spaces	Public and privacy parameters set-up	Space and / or equipment shared with local community e.g. Swim pool	1/5
d) Health and Safety	Community centre and community spaces	Fully compliant with fire requirements yes	Proximity to Police station, Fire station, hospital etc.	Access to nutritious food (restaurant, vege. gardens etc) yes	Free of air, electro, ground, noise, and water pollution	2/5
e) Water Efficiency	Rainwater harvesting	Water efficient devices: low flush WCs and urinals	Greywater reuse	Minimising runoff: external surfaces absorbent	Low water demand landscaping yes	0/5
f) Energy Efficiency	Located near public transport / all users within secure walking distance (4km)	Passive environmental control system for ventilation (thermal comfort)	Passive environmental control systems for heating and cooling (thermal comfort)	Low energy appliances / fittings	Solar control (including thermal comfort)	0/5
g) Minimising or Recycling of Waste	System for recycling (recycle depots)	System for reusing	Sewerage	Provision for dangerous toxic waste removal	Minimise construction waste yes	1/5
h) Vegetation and Wildlife	Use of a 'brownfield' site	Range of plants that are indigenous	diversity in flora and fauna habitats	Effect on neighbouring buildings: light etc yes	Low maintenance landscaping (e.g. ferlizers)	0/5
i) Materials and Components	80% of materials have low embodied energy	Environmentally friendly material and component used	All materials / components produced using only renewable energy sources	80% of materials and components for the buildings recycled / refurbished	80% materials and components from renewable resources	0/5
j) Location identification	Site features and natural environment	Identify existing flora and fauna yes	Climate and orientation	Natural water	Area Layout (incl. inclusive environments)	1/5

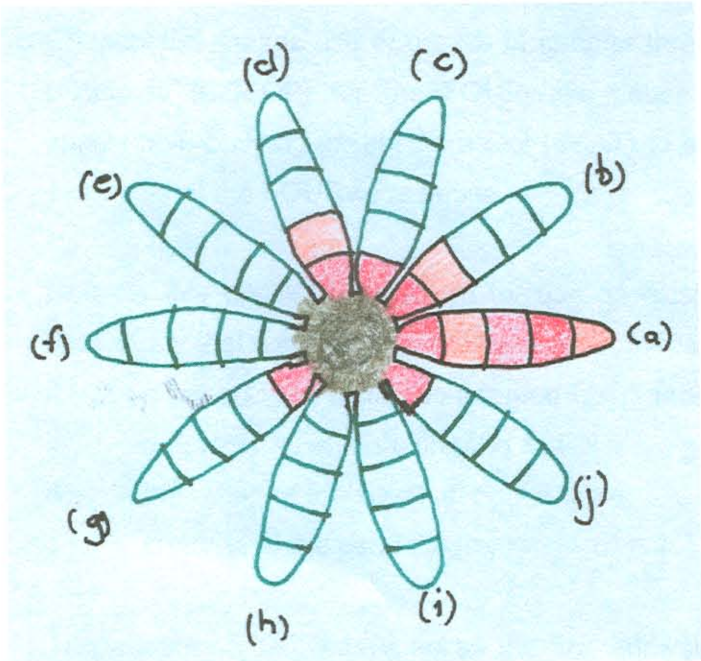

Figure 5.17 – The adapted SBAT diagram for case study 1

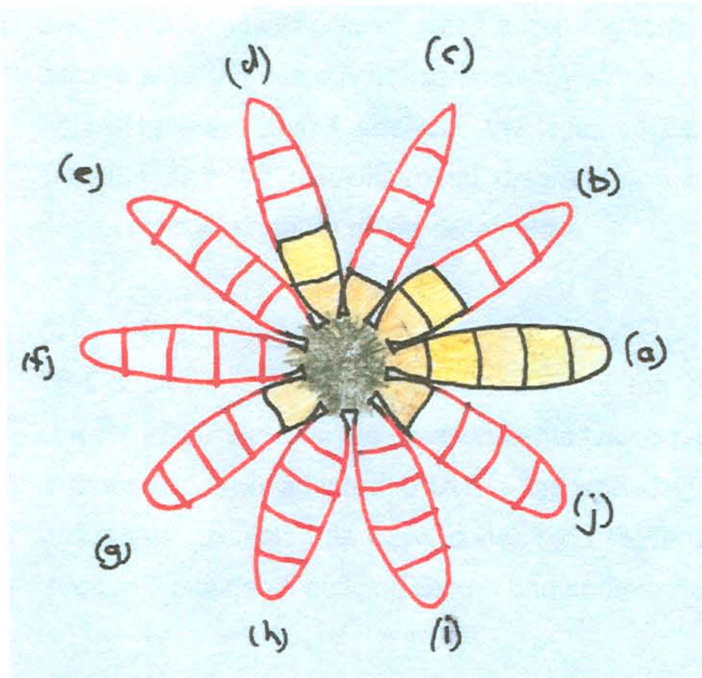

Figure 5.18 – The adapted SBAT diagram for case study 2

Both the SBDP and adapted SBAT analysis indicate that the case studies can not be considered sustainable. The only criterion that has been met fully is the occupant comfort. This criterion alone does not produce a healthy environment. Occupant comfort is not interchangeable with thermal comfort.

5.9 Summary

Chapter five makes use of results of chapter three, the sustainable building design principles (GSBDP) for the FOURways house and chapter four, the adapted sustainable building assessment tool (SBAT) to assess the sustainability of current examples of the FOURways house.

Chapter five applied the system for use on existing building (chapter four) to the case study that consists of the following four steps:

i) a general test using the adapted SBAT table
ii) a detailed analysis using the SBDP
iii) the rating of the situation on the table
iv) charting of the petal diagram

The adapted SBAT was used as the first analysis to gather information about the case study development. The SBDP was then used to analyse the development and the buildings in greater detail according to the same division of the interacting ecosystems, the ecology of user, ecology of the site and ecology of the building.
Following the detailed analysis, the adapted SBAT table was used to rate the situation and the resulting petal diagram was charted to graphically reveal the degree of sustainability of the case study.

5.10 Conclusion

This analysis leads to the conclusion that the case studies clearly indicate that current FOURways house developments taking place do not consider sustainability a criterion. The adapted SBAT, table and diagrams illustrate that although the occupants' comfort has been considered the provision of a healthy environment through sustainable building design and construction is not a priority.

Concluding from the research the current FOURways house is not a sustainable building environment to live in. It does not foster well-being nor act as a role model for lower LSM's to aspire to. Considering the scale and speed that the FOURways house is continued to be developed steps must be taken to ensure sustainability becomes an issue.
Local government, the developers and most of all the users should focus on this issue. The continued encroachment on the natural landscape linked with the building of an unsustainable building will certainly have disastrous consequences for both the environment and human beings.