CHAPTER IV

4 ADAPTING THE SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT)

Sub-problem 2 The second sub-problem is to test the SBAT towards achieving sustainable building design principles for medium density, middle-income housing in Gauteng (the FOURways house).

Hypotheses 2 The second hypothesis is that the adapted SBAT will produce criteria towards achieving sustainable building design principles for the FOURways house.

4.1 Evolution of the SBAT

The Green Buildings for Africa (GBFA) launched in 1998 by the CSIR Boutek takes into action the Green Building Initiative by assessing projects for their environmentally responsible usage.

The GBFA represents South Africa in the Green Buildings Challenge (GBC) and is developing the GBTool for local use. Furthermore, the July 28 issue of Engineering news reports (2000:21), "The programme has also seen the development of an assessment tool, known as the building environmental assessment rating system, which measures the effect of building have on the environments, as well as the various indoor components of the building". The tool originally known as the BEARS (Building Environmental Assessment Rating System) has developed into the current prototype Sustainable Building Assessment Tool (SBAT) (see Appendix 4).

The CSIR currently offers two tools for assessing the sustainability of a building, the GBTool and the prototype (still under development) SBAT. The CSIR is developing the SBAT as a local, widely accessible derivative of the GBTool. SBAT is identified by Neil Oliver of the CSIR as, "a high-level, quick and easy sustainable buildings assessment tool". It is being developed as a tool that stimulates and guides discussion from the outset of a project by the whole project team including the client, architect, developer etc. It does not require specific tools of measurement, but rather sets out parameters when adhered to achieve a more sustainable building.

The SBAT uses three column definition of sustainability (see Appendix 4) which separates criteria into the categories, "social", "economic" and the obvious "environmental issues". The CSIR Boutek recommends that: "the SBAT forms an integral part of the briefing process at project initiation, and can be equally usefully applied during design development" (SBAT prototype 2001).

It is the prototype that forms the focus of this chapter. With kind permission of the CSIR the tool may be used for academic purposes even though the SBAT is still being developed further and not currently commercially available.

4.2 The SBAT and the three target criteria descriptors

The target criteria descriptors have been allocated under the three main headings as per the three column definition being "social", "economic" and "environmental" criteria. The three criteria are each sub-divided into five specific criteria. The SBAT Diagram divides a circle into three sectors and lists the headings under each criterion. Concentric division into segments will allow for future rating of criteria once the prototype is further developed. The original SBAT diagram illustrated in Figure 4.1 shows the division of the various social, economic and environmental criteria.

The SBAT has been converted to a typed format for the purpose of this study but the original computer version inter-links the responses. The opportunity is given to rate priority of the particular description according to target values described as: *"none, low, medium, high, essential"*, criteria for achieving sustainability of a building.
The full unchanged SBAT is shown in Appendix 4.
The criteria have been tabulated for comparative purposes in Table 4.1.

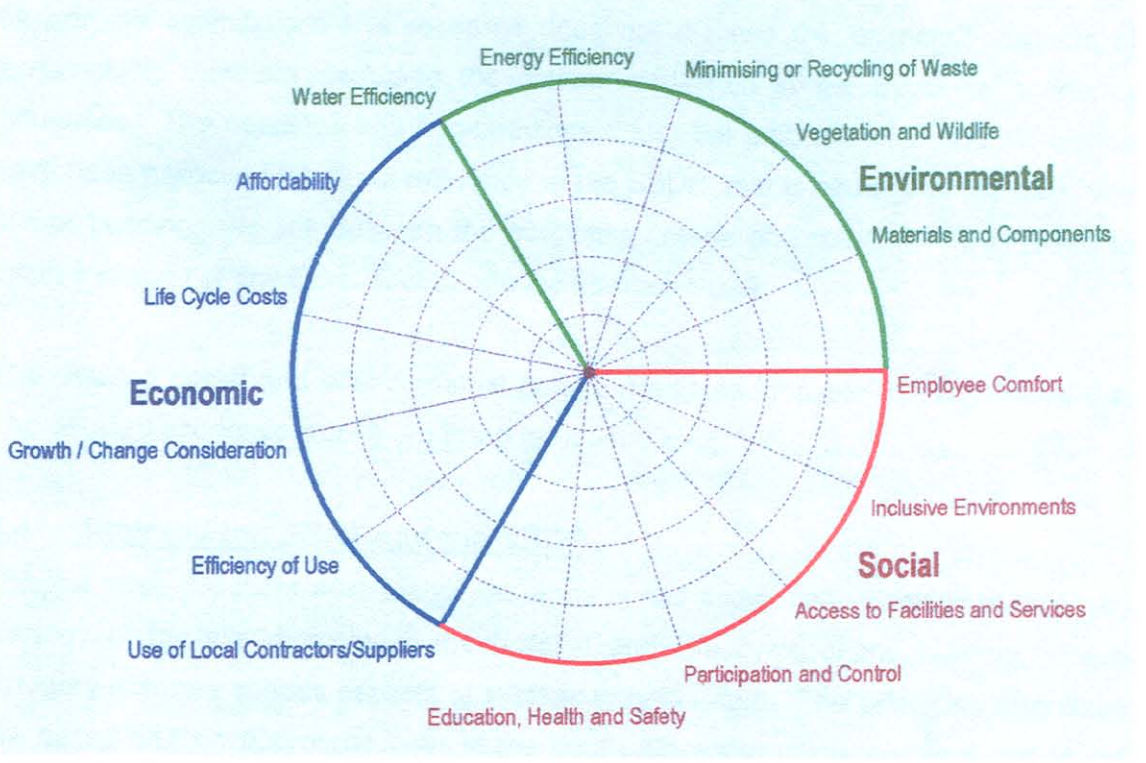

Figure 4.1 – The original SBAT Diagram (CSIR 2001)

Table 4.1 - SBAT category definition

Social Criteria	Economic Criteria	Environmental Criteria
Employee Comfort	Use of Local Contractors/Suppliers	Water Efficiency
Inclusive Environments	Efficiency of Use	Energy Efficiency
Access to Facilities and Services	Growth / Change Consideration	Minimising or Recycling of Waste
Participation and Control	Life Cycle Costs	Vegetation and Wildlife
Education, Health and Safety	Affordability	Materials and Components

4.3 Criteria for inclusion and exclusion of criteria

Each of the sub-headings in the categories social, economic and environmental criteria as listed in Table 4.1 form an integral part of sustainability.

The first criterion for inclusion is appropriateness to the South African situation. The SBAT is developed in South Africa by one of the foremost research facilities in the country, the CSIR, and can be accepted as applicable towards achieving sustainability of the FOURways house.

As per the delimitations this research does not discuss the economic aspects of sustainability therefore excluding the column dedicated in the SBAT to economic influences. The headings and sub-headings under the umbrella of economic criteria have been assessed for direct relevance to the SBDP, that is ecology of the user, site and/or building. No link between the economic criteria and the SBDP was found to justify inclusion of any items directly into the adapted SBAT.

The detailed social and environmental criteria are listed in Table 4.3 and Table 4.4. The detailed economic criteria are listed in Appendix 4.

4.4 Inter-linking SBAT and the SBDP

Chapter three describes sustainability in terms of four categories - Ecology of the user, Ecology of the site, Ecology of the building and Life cycle of the building. Each category explores various aspects of sustainability in depth. The principles discussed are based on their appropriateness to the South African situation, but have not as yet focused on the FOURways house.

The two SBAT target criteria "social" and "environmental" that will be used in this study have many synergies with the SBDP. The social criteria are seen as inter-linked with the living environment. A healthy living environment supports and promotes well-being and therefore is not dealt with separately in the research of SBDP. The social criteria dealt with separately in the SBAT from part of the body of information as integrated in the SBDP.

The SBAT, while being a specifically South African document remains generally applicable to a broad spectrum of building types and is currently not available with guidelines.

There is a correlation between the SBAT as a discussion tool that introduces important criteria and the body of information in the SBDP that discusses the criteria in greater depth. Chapter three, together with the SBAT will be adapted for use on the FOURways house and be tested in chapter five on a case study.

Table 4.2 - Categories arising from GSBDP research

Ecology of the User	Ecology of the Site	Ecology of the Building	Life Cycle of the Building
	Location	Relationship of Building to Site	Life-cycle of building materials
	Site Features and Natural Environment	Orientation of the building	Re-use of building materials
	Orientation	Generic Climate	Re-cycling of building materials
	Climate	Energy of the building	
	Energy	Water and the building	
	Water	Waste and the building	
	Waste	Building Materials	
	Fauna and Flora	Construction Methods	

4.5 Comparative analysis of social criteria and environmental criteria

The Table 4.3 and Table 4.4 list the various SBAT sub-headings on social and environmental criteria to cross-reference with the sections in chapter three and assess the relevance to the FOURways house.

The numerous links established by the tables between the two bodies of information illustrates the role of the SBAT to stimulate discussion from the outset of a project and the SBDP guidance to further steps to be taken towards achieving a sustainable built environment.

Table 4.3 - Comparative analysis of "social" criteria

SBAT Employee Comfort	Natural lighting	Natural ventilation	Low noise	Views (all work positions min 6m from external window)	Access to amenities: WC, refreshments (tea making point
GSBDP	3.4.3 & 3.5.2	3.4.4 & 3.5.3	3.4.1 & 3.5	Figure 3.6	no
FOURways	Relevant	Relevant	Relevant	Review	Review
SBATI Inclusive Environments	Easy access to disabled friendly public transport	All routes in and between buildings smooth and even (i.e. wheelchair accessible)	All changes in levels routes in and between buildings include ramps with 1:12 fall, hand rails and/or lifts	Required number of disabled accessible WC(s) available	Edges (i.e. between walls and floors) and stair nosing clearly distinguished with contrasting colours
GSBDP	Not a focus in this research, however, all urban design should consider these criteria.				
FOURways	Specific houses for the disabled must be designed accordingly				
SBAT Access to Facilities and Services	Crèche	Banking	Shops	Communication Facilities (Post, Public Telephone, email)	Government / tax / licensing information
GSBDP	3.4.1	3.4.1	3.4.1	3.4.1	3.4.1
FOURways	Relevant	Relevant	Relevant	Relevant	Relevant
SBAT Participation and Control	Personal control over light, temp and ventilation levels	Users involved in design / construction process	Users involved in the design, refurbishment of their spaces	Users able to adapt their spaces to suit themselves (i.e. furniture / privacy)	Space and / or equipment shared with local community
GSBDP	3.3	3.3	3.3	3.3	3.3
FOURways	Relevant	Relevant	Relevant	Relevant	Relevant
SBAT Education, Health and Safety	Space available for group training sessions/access to learning packages	Fully compliant with fire escape requirements	Access to Sports facilities	Access to nutritious food (restaurant, vegetable gardens etc)	Materials used, screened for hazardous compounds (i.e. VOCs)
GSBDP	Not applicable	Pre-requisite	3.4.1	3.4.1 & 3.4.2	3.5.7
FOURways	Not Relevant	Relevant	Relevant	Relevant	Relevant

Table 4.4 - Comparative analysis of "environmental" criteria

SBAT Water Efficiency	Rainwater harvesting	Water efficient devices: low flush WCs and urinals	Greywater reuse	Minimising runoff: absorbent external surfaces	Low water demand landscaping
GSBDP	3.4.6	3.5.5	3.5.6	3.5.1	3.4.8
FOURway	Relevant	Relevant	Relevant	Relevant	Relevant
SBAT Energy Efficiency	Located near public transport / all users within walking distance (4km)	Passive environmental control system for ventilation	Passive environmental control systems for heating and cooling	Low energy appliances / fittings	Solar control
GSBDP	3.4.1	3.4.4	3.4.3	3.5.4	3.4.3
FOURway	Relevant	Relevant	Relevant	Relevant	Relevant
Minimising or Recycling of Waste	System for recycling	System for reusing	Sewerage	Provision for dangerous toxic waste	Systems set up to minimise/reuse waste produced during construction process
GSBDP	3.5.6	3.5.6	3.5.6	3.5.6	3.5.6
FOURway	Relevant	Relevant	Relevant	Relevant	Relevant
SBAT Vegetation and Wildlife	Use of a 'brownfield' site	Range of plants	Range of habitats provided	Effect on neighbouring buildings: light etc (buildings kept apart minimum 10m for 1 s, 15m for 2s+)	Minimal external inputs required for maintenance of landscaping (i.e. ferlizers/ pesticides)
GSBDP	Relevant	3.4.8	Relevant	3.5.1	3.4.8
FOURway	Relevant	Relevant	Relevant	Relevant	Relevant
SBAT Materials and Components	80% of materials have low embodied energy	No material / component used manufactured through process which harms the environment	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
GSBDP	3.5.7	3.5.7	3.5.6	3.5.7	3.5.7
FOURway	Relevant	Relevant	Relevant	Relevant	Relevant

4.6 The GSBDP and the adapted SBAT

The research illustrates that the two bodies of information, SBDP and SBAT are complementary. Refinement towards a sustainable built environment in the medium density, middle-income house in Gauteng can be achieved using tools that introduce the criteria and then discuss the requirements of sustainability.

The prototype SBAT is recognised as a compact document introduced at the project outset in order to stimulate discussion on the topic of sustainability and work towards achieving a sustainable building design. Due to the continued disregard of sustainable principles by the project team, the introductory role of the adapted SBAT must be recognised as essential towards achieving sustainability in the building industry.

To avoid becoming cumbersome, the brevity of the initial discussion document, the adapted SBAT, is essential. The adapted table of criteria will consequently be edited to fit on one A4 page, supplemented by the adapted SBAT diagram (see Figure 4.3). Table 4.5 lists the adapted categories and points of discussion.

The SBAT diagram makes use of three parts divided into five segments each. Each segment has five concentric divisions. The five requirements under each criterion of the original SBAT can be rated in priority as: "essential, high, medium, low, none" (SBAT Prototype, 2000). The adapted SBAT makes use of the original diagram with adaptations as listed above. The original division of criteria into five requirements has been maintained but the three parts have been removed. The priority rating is removed in the adapted SBAT as it is postulated that all criteria and each subsequent requirement must be met to achieve a sustainable building.

The prototype SBAT and original SBAT documents and diagram are adapted as follows:

i) The economic criteria are excluded.

ii) The criteria are adapted to the domestic market, specifically the FOURways house.

iii) The place specific criteria is introduced, i.e. Gauteng.

The petal principle

The adapted SBAT diagram includes a scoring illustration of a flower with a petal representing each criterion. Every criterion is rated out of five. If all five criteria requirements are met then the rating is five out of five (5/5) if none are met the total is

zero out of five (0/5). A score of three or less renders that criterion not sustainable and will render the whole not sustainable.
The petals, as the original diagram, are divided into five concentric rings. Starting at the centre of the flower, a division is coloured in, on the specific petal for that criterion, for each requirement met. No requirement has priority over another. The sustainability of a building is measured by assessing to what extent each criterion has been met. The various requirements as listed are scored on the criteria (petals).

The more complete the flower, the greater the sustainability of the building. Figure 4.4 illustrates different scenarios to show the effectiveness of using the flower diagram known as the petal principle to quickly assess the sustainability of a building.
Table 4.6 list random results for four different possible scenarios. Figure 4.4 illustrates the results and visual effect of the petal principle when different results are compared.

The metaphor is taken from nature (Figure 4.2), the more complete the flower is the greater chance of survival there is, that is to say, the more completely the requirements of the criteria are met, the greater the sustainability of the assessed building.
The flower can also be used as a measure whether or not the building supports overall well-being by its sustainability.

Table 4.5 – The adapted SBAT including "social" and "environmental" criteria

CRITERIA (a –j)	Requirement A	Requirement B	Requirement C	Requirement D	Requirement E	SCORE
a) Occupant Comfort	Natural lighting	Natural ventilation (air quality)	Low noise	Views (all rooms external window)	Access to amenities, compact layout	__ 5
b) Access to Facilities and Services	Crèche Schools	Banking, Shops, Restaurant	Proximity to parks and sports facilities	Communication Facilities (Post, Public phone, email)	Government / tax / licensing information	__ 5
c) Participation and Control	Educate to control over light, temp and ventilation levels	Users involved in design / construction process	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	__ 5
d) Health and Safety	Community centre and community spaces	Fully compliant with fire requirements	Proximity to Police station, Fire station, hospital etc.	Access to nutritious food (restaurant, vegetable gardens etc)	Free of air, electro, ground, noise, and water pollution	__ 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	__ 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)	__ 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	__ 5
h) Vegetation and Wildlife	Use of a 'brownfield' site	Range of plants that are indigenous	Dziversity in flora and fauna habitats	Effect on neighbouring buildings: light etc	Low maintenance landscaping (e.g. ferlizers)	__ 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	__ 5
j) Location identification	Site features and natural environment	Identify existing flora and fauna	Climate and orientation	Natural water	Area Layout (incl. inclusive environments)	__ 5

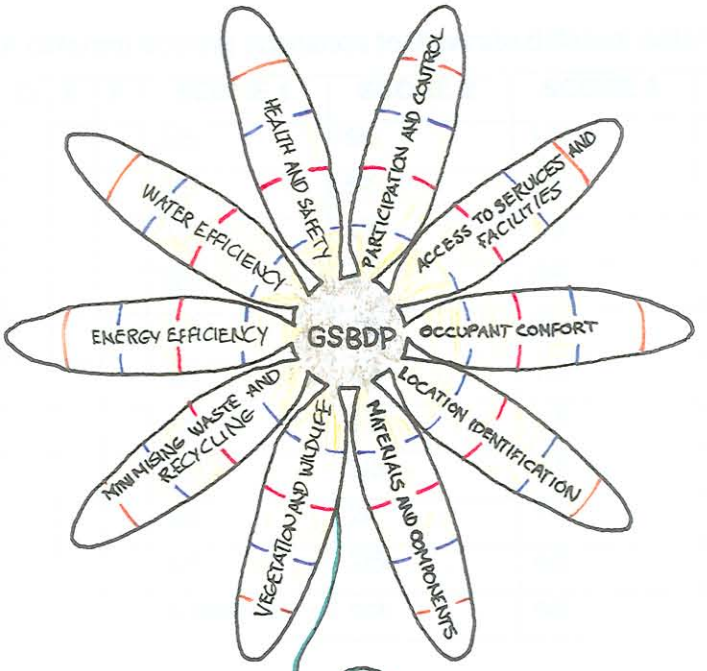

Figure 4.2 - adapted SBAT diagram

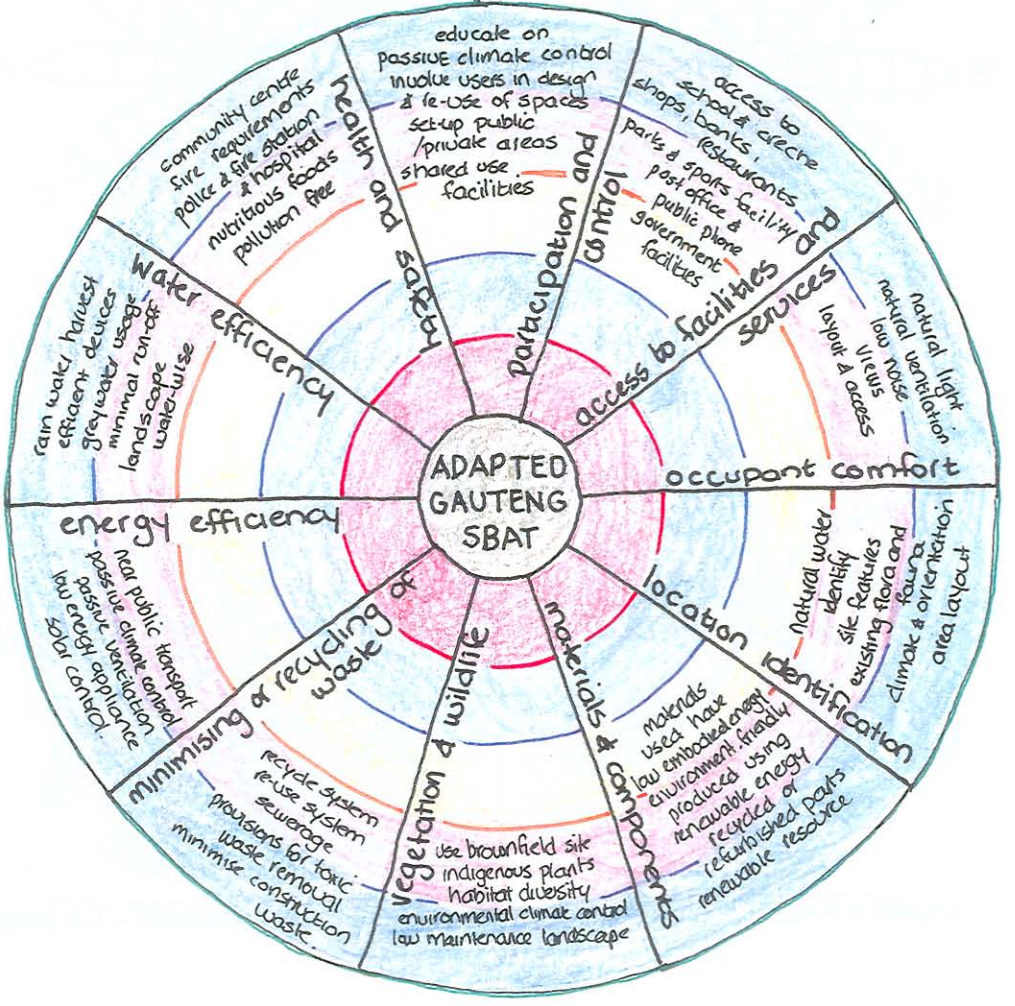

Table 4.6 – Four different scoring scenarios to illustrate different petal principle results

	A	B	C	D	E	F	SCORE 1	SCORE 2	SCORE 3	SCORE 4
a)							4/5	5/5	1/5	3/5
b)							4/5	5/5	4/5	3/5
c)							3/5	4/5	2/5	3/5
d)							3/5	4/5	5/5	4/5
e)							4/5	3/5	2/5	4/5
f)							4/5	4/5	1/5	4/5
g)							4/5	4/5	4/5	3/5
h)							5/5	3/5	5/5	5/5
i)							3/5	2/5	1/5	3/5
j)							4/5	2/5	4/5	3/5
Results							sustainable	not	not	sustainable

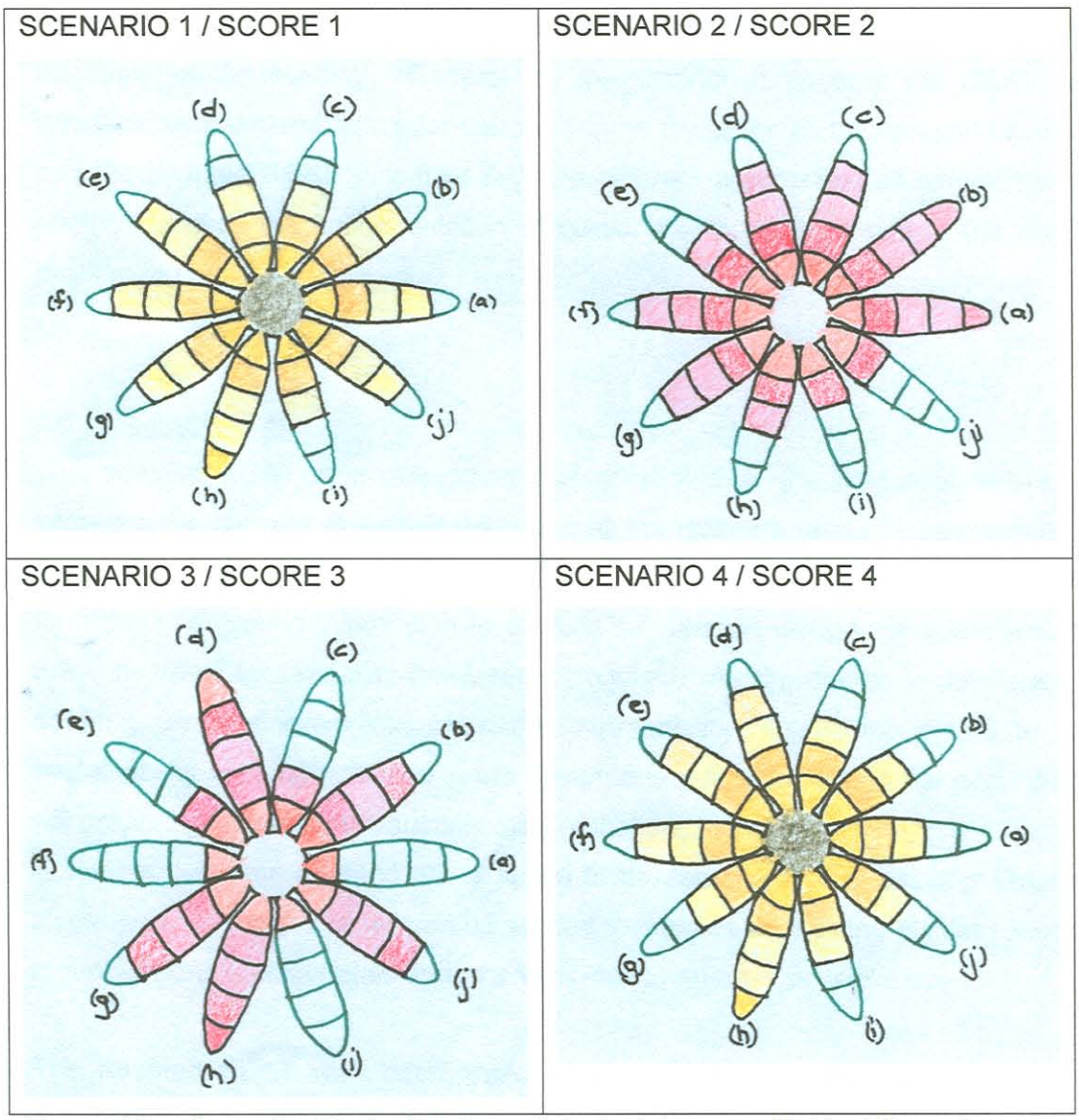

Figure 4.3 – Scenarios illustrating the petal principle as per Table 4.6 results

4.7 Summary

The fourth chapter analyses the SBAT in relation to the discussion of working towards principles for sustainable building design in chapter three. The SBAT is tested for relevance to location and house-type, specifically the FOURways house.

The SBAT is based on the three column definition of sustainable development that includes social, economic and environmental criteria. The SBAT is a systematic and symmetrical analysis of criteria deemed important to sustainable design. It has (as yet) not been made specific to location nor house type.

The original SBAT has been adapted in this chapter for criteria relevant to the FOURways house and has been developed graphically to inter-link the two bodies of information. In chapter three sustainable design is discussed broadly under the inter-linked headings of ecology of the user, ecology of the site, ecology of the building and life cycle of the building. Considering the original purpose of the SBAT as an introduction to present topics for discussion, the principles as background information and the adapted SBAT as a final test, the different approaches all complement one another towards the implementation of sustainable building design in the domestic building market.

4.8 Conclusion

The adapted SBAT is a discussion tool presented at the outset of a design to introduce the concept of sustainability and all the relevant issues to be considered in the design. The sustainable building design principles (discussed in chapter three) form the background information to explore the detailed design considerations once the concept of sustainability has been introduced. As the design is developed, the adapted SBAT diagram can be used to graphically assess the extent to which sustainability is being achieved in the design and a final test using the petal diagram will graphically illustrate the sustainability of that situation.
A system using the adapted SBAT tables to assess and test an existing situation is also relevant. The principles can be applied to improve an existing building according to the weakest criteria/petals and wherever improvement is possible.

The adapted SBAT with background information and graphic testing provides a complete tool to implement and test an envisaged or completed house design for its sustainability.