DEVELOPMENT OF A MODEL FOR DETERMINING AFFORDABLE AND SUSTAINABLE SANITATION DEMAND IN DENSE SETTLEMENTS OF SOUTH AFRICA

Report to the

WATER RESEARCH COMMISSION

by

Richard Martin
Pieter Pansegrouw

on behalf of

Sigodi Marah Martin
Development and Engineering Consultants

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EXECUTIVE SUMMARY

Background

The current political climate in South Africa requires that the provision of services to millions of people still residing in dense settlements must be accelerated considerably. The lack of housing and other services was cited as one of the major causes of xenophobic attacks in South Africa during 2008.

It is government policy to upgrade and integrate the informal settlements of South Africa into its urban fabric as soon as possible. For this reason, it is necessary to determine the demand for all services – and particularly for the different levels of services such as for various sanitation options – as a matter of urgency among the residents of dense settlements in South Africa.

Main objectives

The main objective of this research study was to determine the effective sanitation demand of residents in dense settlements by making use of the adjusted Sigodi Marah Martin (SMM) computer housing program. This computer model determines the effective demand for services according to the integrated affordability of all the services to the residents of dense settlements by making use of a cognitive process called contingent valuation. It is, as far as could be ascertained, a world first in terms of the integration of the affordability of all the services to determine the sustainable demand for these services.

The most important objective of this study was to determine how well this computer model establishes the effective demand for sanitation among the residents in dense settlements, but also to test whether it yields better results than the conventional methods by taking integrated affordability of all services (housing and all other infrastructure services) into consideration.

Methodology

The research study methodology of this study consisted of the following steps:

1. A literature study to establish whether there were any examples in international literature of other studies which followed an integrated affordability approach to determine sanitation demand among the residents of dense settlements.

2. The computerized SMM housing model was then adjusted to cater for alternative sanitation options. Thus adjusted, the model was renamed the Sanitation and Housing Applied Priorities Enquiry (SHAPE) Model.

3. Subsequently, surveys were done among 263 households in three selected dense settlement areas of South Africa.

4. Thereafter two case studies were carried out to confirm or invalidate the findings of the surveys.

5. Subsequently, the results of both the surveys and the two case studies covering altogether 275 households were analyzed and findings were made.

6. Finally, a number of important conclusions were drawn and recommendations made. These recommendations included the identification of some areas for further research.

Literature study

Since no real examples of determining sanitation demand by means of an integrated affordability process could be found in literature, attention was directed to cases where the contingent valuation method had been applied in a non-integrated affordability fashion to determine sanitation demand. Attention was also focused on approaches to determine sanitation demand in general, and experiences gained with these methods.

The study of local literature sources also included a survey of officially accepted sanitation options in South Africa and their characteristics. These included their use, popularity, cost and the general experience gained with their performance in the past.

The surveys among residents

Altogether 263 households were surveyed in three selected dense settlement areas of South Africa, namely 81 at Schmidtsdrif in the Siyancuma Local Municipality area, 50 at eThekwini (Durban) and 132 at Ekurhuleni (East Rand area near Springs). These areas could be regarded as a good representative selection of urban and rural dense settlement areas in South Africa.

The surveys were done by means of questionnaires which were completed by the residents while being briefed in detail on all the sanitation and other services options. Colourful posters were used to demonstrate the different sanitation and other service options and how they operated.

The case studies

After having completed the surveys, two case studies were carried out to confirm or contradict the findings of the surveys. The case studies were done at Soshanguve and at Temba/Hammanskraal in the jurisdiction of the City of Tshwane Metropolitan Municipality.

During the case studies the same questions were posed to participants as during the surveys, but the answers were entered directly into the SHAPE Model on a laptop computer.

Taking the 12 households participating in the case studies into consideration, a total of 275 households therefore participated in this research study.

Key findings

The key findings of this research study can be summarized as follows:-

1. The most important finding of this study is that the integrated affordability approach followed when the SHAPE Model is applied, yields considerably more accurate demand figures for all services than the conventional non-integrated methods. This is illustrated by the fact that virtually all respondents surveyed in this study eagerly preferred waterborne sewerage systems, but when integrated affordability considerations started to play a part, about 30% of the participants accepted on-site sanitation options.

2. The overall sanitation demand patterns yielded by both the surveys and the case studies were for all practical purposes the same, namely:-

    a. Just over a quarter of the participants chose ventilated improved pit latrines (VIPs).

    b. Very few participants (only about 3%) showed any interest in the composting toilet.

    c. Roughly 70% of the participants were very adamant about water-borne toilets. About 60% chose the shallow waterborne system and roughly 10% opted for the conventional full-bore waterborne system.

3. The fact that the overall sanitation demand patterns of the case studies corresponded with those of the surveys, clearly showed that the case studies confirmed the results of the surveys.

4. An important by-product when applying the SHAPE model is the fact that the demands for housing and all other infrastructure services are established simultaneously “in one go”. This is an enormous advantage to government and other authorities responsible for delivering services to the residents of dense settlements.

5. Many of the residents of the dense settlements surveyed, were willing to accept smaller houses in exchange for higher levels of water and sanitation services in their homes, since they could expand their homes in future, but could not upgrade their services in future on their own.

6. The respondents regarded an electricity supply of paramount importance – even more important than water supply or waterborne toilets in their homes.

7. Local authorities often take policy decisions which exclude on-site sanitation systems for new housing schemes. If these decisions are not dictated by physical conditions like high water tables or specific soil conditions, they negate central government policy and the Batho Pele ("People First") principles.

8. The poor coordination and contact between local authority officials, councillors, ward committee members and the residents of the dense settlements led to considerable delays and placed a question mark in relation to community involvement in South Africa today.

9. The respondents unknowingly applied the linear programming technique cognitively when they made integrated affordability decisions according to the contingent valuation method. A clear cascade of values among the participants consequently emerged, namely preference for an electricity service, followed by preferences for water supply and sanitation and then a demand for elementary housing and lastly roads and street lighting.

10. The Application of the SHAPE Model during the research sessions led to far greater community involvement and realism among the inhabitants of dense settlements as far as services are concerned. Far more appropriate and realistic choices were made by the households which they actually could afford – not only as far as sanitation was concerned, but also with regard to housing and all the other infrastructure services.

Key Recommendation

Taking the key findings of this study into consideration, it is recommended that the integrated affordability approach as demonstrated by the SHAPE Model must be followed to establish sanitation and all other service demands of residents in dense settlement areas of South Africa henceforth. This will prevent erroneous demand patterns being established like in the past by non-integrated methods which do not take the integrated affordability of all services into consideration.

Recommendations for further research

A number of topics for further research have been identified through this study, namely:

- A survey should be done in future to determine how often and in which way the integrated affordability of services is taken into account when services such as housing and all other infrastructure services are offered to the residents of dense settlements in South Africa. Should

these residents not be able to afford these services, non-payment, boycotts, demonstrations and even violence may erupt.

- It is recommended that more research should be done to familiarize prospective users with the different sanitation options available. Sanitation technology demonstration centres should be considered for residents of dense settlements – especially in urban environments.

- Investigations should be done to determine whether authorities still adhere to the Batho Pele ("People First") principles when water and sanitation services are supplied to the residents of dense settlements in South Africa.

Hopefully this research study will have a positive influence on the establishment of affordable and sustainable sanitation and other service demands among the residents of dense settlements in South Africa – especially now that the supply of housing and infrastructure services to these residents is of utmost importance in South Africa.

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The members of the Reference Group responsible for this study were:

Mr JN Bhagwan	Water Research Commission – Chairperson
Mr R Martin	Sigodi Marah Martin (SMM) – Project Leader
Prof JP Pansegrouw	Sigodi Marah Martin (SMM)
Dr MB van Ryneveld	University of Johannesburg
Mrs G Schoeman	Afrosearch
Mr MJ Timm	The Mvula Trust
Ms K Palmer	The Palmer Development Group
Mr TG Gounden	eThekwini Metropolitan Municipality
Mr FG Tsibani	Mthengenya & Associates (Pty) Ltd
Ms A Manus	Department of Water Affairs and Forestry
Dr NP Mjoli	Hlathi Development Services

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Mr Lansana Marah, managing director of the company SMM, is thanked for the support he rendered to this study.

The large number of respondents who participated enthusiastically and seriously in the surveys, are also thanked. They usually arrived at the venues of the surveys neatly dressed and eager to participate. Without their contributions, this research study would not have been possible.

<u>Outputs produced by this study</u>

This study produced the following products:

1. This main WRC Report No 1664/01/09

2. A separate User Manual and Guidelines explaining the SHAPE Model (WRC Report No TT 379/08)

3. Software to run the SHAPE Model available on the website:

   http://www.wrc.org.za/ResearchReports/ProjectSoftware/SHAPE

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1. INTRODUCTION

1.1 Background

The South African government is giving increasing priority to addressing the problems of residents living in dense settlements, otherwise also known as informal settlements. The Department of Housing's Policy document of September 2004 states:

> "The new human settlements plan moves away from the current commoditised focus of housing delivery towards more responsive mechanisms which addresses the multi-dimensional needs of sustainable human settlements[1]. This approach is intended to provide maximum flexibility and will ultimately enhance the mobility of households[2]. The movement towards increased flexibility and demand responsiveness inevitably increases tension between uniform subsidy payments and increasingly non-uniform housing products as policy moves away from allocative equity to demand responsiveness and flexibility." [3]

It also states

> "The Department will accordingly introduce a new informal settlement upgrading instrument to support the focused eradication of informal settlements. The new human settlements plan adopts a phased in-situ upgrading approach to informal settlements, in line with international best practice. Thus, the plan supports the eradication of informal settlements through in-situ upgrading in desired locations, coupled to the relocation of households where development is not possible or desirable." [4]

The Department of Water Affairs and Forestry's Strategic Framework for Water Services (September 2003) states that "as a priority, it is the responsibility of the water services authority to make sure that adequate and appropriate investments are made to ensure the progressive realization of the right of all people to receive at least a basic level of water and sanitation services within a reasonable period of time." Concerning technology, it states that in areas such as dense settlements, appropriate water and sanitation technology which is financially viable and sustainable to the users, must be

[1] This plan must respond to the needs and circumstances of communities through a diversified range of support measures which are able to accommodate qualification and affordability variations, tenure preferences and investment priorities. There is also a need to stimulate the supply of a more diverse set of housing environments and settlement types through greater choice of housing types, densities, location, tenure options, housing credit, and delivery routes (e.g. self-help, mutual self-help, contractor supply, etc.).

[2] This approach will also enhance the ability of citizens to more effectively negotiate the value of the asset of the home and the settlement with its concomitant location and degree of integration into urban and rural economies. This would also means that people living in situations of poverty would be able to build social and physical assets, thus enhancing housing as an economic instrument once transferred to beneficiaries.

[3] Department of Housing "Breaking New Ground" section 2.2, September 2004.

[4] Breaking New Ground, section 3.1

identified. It states that in most instances, on-site sanitation systems are likely to be the most appropriate solution. It warns that care must be exercised when choosing waterborne sanitation systems. Upgradeability from one service level to the next is also considered as a very important aspect which must be taken into due consideration by the water services authority.

Community consultation was institutionalised with the introduction of a new system of local government in 2000.[5] This was followed by the introduction of the Batho Pele ("People First") policy which stipulates that citizens should be given a choice when services are offered to them. The level and quality of the services they are to receive must also be discussed with and accepted by the community members. Quite important are also the economic considerations of these principles, namely that services must be provided economically and efficiently in order to give citizens the maximum value for money.

Experts have long noted the importance of determining the "effective demand" for services such as sanitation as expressed by the willingness of users to pay for these services. Too often the solutions proposed are inappropriate in terms of what the people want. As a result sanitary facilities are misused, badly maintained or even vandalized. If they are too expensive, the bills will not be paid which may give rise to the discontinuation of services and consequently to riots and/or violence. If the solutions do not meet the social norms, they will not be used. **Finding the right solution is therefore fundamental in our quest for sustainability.**

1.2 Motivation of the study

In the light of this and the government's policies, there is an urgent need to identify how users respond to the different options in terms of sanitation. In this regard, there are two potentially conflicting needs to be satisfied. The first is for a hygienic, convenient and acceptable solution; the other is for sanitation which is affordable. Affordability is used here to denote the "effective demand"[6] for a service – as indicated by the ability or willingness of users to pay for the service.

Effective demand is the result of a reconciliation by the users of the attraction of healthier and more convenient solutions on the one hand and the limitations of income on the other. This can only be gauged within the context of a household's total expenditure, and competing claims for those funds.

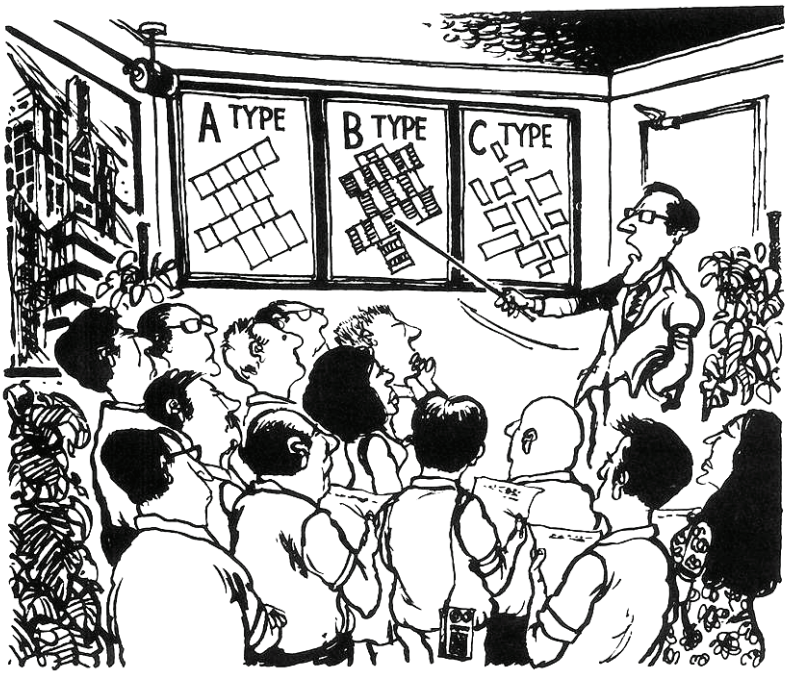
[5] For example the Municipal Systems Act, 2000, section 16, states that "A municipality must (a) encourage and create conditions for the local community to participate in the affairs of the municipality including . . . strategic decisions regarding the provision of municipal services. . . (b) contribute to building the capacity of the local community to enable it to participate in the affairs of the municipality."

[6] Effective demand is, of course, a term used by economists to denote what people are willing to pay for the specific service or commodity.

In using the term effective demand we must be very clear that a distinction must be drawn between what people want and what they are willing to pay for. It would be a rare family indeed that did not want full waterborne sanitation, which has such obvious advantages over pit latrines. There is therefore little point in asking people what they want. This study tackles the matter from a different angle – given that housing and infrastructure services represent a package of services, each component of which has a cost attached, the question is asked what package would people opt for within their means? Within this package, what sanitation solution do people prefer?

The international literature regarding alternative sanitation solutions is voluminous. However, virtually no attention is paid in literature to the question of determining the effective demand for different sanitation options in an integrated way with several services competing against each other – or the so-called **integrated affordability approach**.

In the past, many have warned that "effective demand" as defined here, is not an appropriate criterion on which to base sanitation programmes. They argue that public health must be an overriding concern, and that it is not appropriate to give consumers choices in this matter. This has engendered a top down approach in which professionally selected solutions are "sold" to the users as illustrated in Figure 1.



"We want real community participation in this decision. Plan A is too expensive. Plan C is inefficient. Now, which plan do you prefer?"

Figure 1: Professionally selected solutions "sold" to users

One must however acknowledge that due to the nature of the infrastructure requirements of most sanitation solutions in practice, a multiple variety of individual choices cannot be offered. This means that a completely open and free-market approach with unlimited choices which will satisfy the demand of each and every individual household cannot be entertained in the sanitation field.

Understanding the priorities and aspirations of consumers is an important ingredient in making a selection that will be welcomed by them. What is needed, therefore, is a study that will give reliable results concerning the response of potential users to actual sanitation alternatives in view of their true capital, operational and maintenance costs and the affordability of these alternatives to the potential users.

2. OBJECTIVES, APPROACH AND METHODOLOGY

2.1 Main objectives of the study

The main objective of this research study was to determine the effective sanitation demand of residents living in dense settlements by making use of the adjusted Sigodi Marah Martin (SMM) computer housing program which was then renamed to the Sanitation and Housing Applied Priorities Enquiry (SHAPE) Model.

This computer model determines the effective demand for housing and services such as sanitation demand according to the integrated affordability of all the services to the residents in dense settlements by making use of a cognitive process called contingent valuation (CV), and is, as far as can be ascertained, a world first in terms of the methodology.

Subsequently, it was important to determine how well this computer model established the effective sanitation demand of the residents living in dense settlements in comparison with the conventional methods by taking integrated affordability of all services (housing and all other infrastructure services) into consideration.

2.2 Approach: a four-pronged approach necessary

In order to obtain reliable results concerning the response of potential users to actual sanitation alternatives, a three pronged approach was initially applied in this study to determine effective sanitation demand. The three prongs consisted of a professional technical appraisal of the project, a community evaluation of the sanitation alternatives and the individual household's selection of the appropriate sanitation choice.

During this research study it was established that another prong exists, namely the overriding policy and viewpoints of political office bearers. To determine sanitation demand, a staggered four-pronged approach emerged from this study. The first and longest prong is the political policy followed by the second professional or technical prong, the third community prong and the fourth individual prong.

The schematic illustration of the four prongs shown in Figure 2 below, has consequently been devised through this study.

***Figure 2*: The staggered four-pronged approach to determine sanitation demand**

The four prongs can be described in more detail as follows:

(a) The first political prong can dominate all the other prongs. For example, it was established that some cities in South Africa do not allow any other type of toilet than waterborne sanitation with their new housing schemes, for instance. Therefore, no matter whether other sanitation options are technically, socially or individually acceptable, only the politically preferred option is acceptable. No systematic consumer surveys were undertaken before such political decisions were taken, and it should be asked whether this political control should be exercised without consultation. The importance of this research is that it provides a methodology to systematically obtain the views of the electorate, and thereby inform political choices. Thus, although politicians may often be tempted to assume that they know what people want, they now have a tool to obtain informed input regarding preferences.

(b) If there are no overriding political considerations, an evaluation must also be made by the technical team of alternative sanitation options for the particular dense settlement area based purely on technical grounds. Aspects that would typically be taken into consideration are – for instance – soil conditions, potential for pollution, topography and sewage disposal facilities. While engineers typically prefer waterborne sanitation, care must be taken to restrict such assessments to a purely technical level, carefully avoiding any bias. A typical example of this situation was found in Cape Town where the Cape Metro decided that waterborne toilets are the only acceptable toilets due to the high water table during the winter months in the Cape (often reaching the surface on the Cape Flats and causing ponds on the surface). If communicated honestly, the communities and individuals usually accept the technical decisions of professionals, but only if they feel that they are not being deceived.

(c) The third step or prong is to explain the features of the different sanitation options, their costs and their maintenance requirements, to the residents. They must know exactly what each sanitation option will demand from them in terms of costs, labour, behaviour, etc. They must also be informed which aspects the local authority will be responsible for in the case of each sanitation option. With this information, the residents can then make an informed decision when they have to select their personal sanitation system. What is also important in this phase, is that the upgradeability of sanitation alternatives must always be kept in mind by the engineer or the technical team when deciding with the community members on the alternative sanitation options available to the individual households. In this regard, the so-called ladder of sanitation options in South Africa as shown in Figure 8 of Chapter 3, is applicable and should be kept in mind by all stakeholders, especially the technical team.

(d) During this last phase, the attention is focused on the affordability of the different sanitation alternatives to the individual household. **Taking the technical options from the professional analysis and the community preferences into consideration, it is ultimately the**

individual household which has to decide on what sanitation option to adopt. Despite the different technical or "community" sanitation options available for consideration at this stage, it is the individual household that has to decide which sanitation option it can afford – **in conjunction with the housing and other services (water, electricity, roads, etc.) it has to pay for on a monthly basis.**

2.3 Methodology

2.3.1 Literature study

The first step of this study was to carry out a comprehensive literature survey to ascertain whether examples of determining the sanitation demand of residents in an integrative way through the application of the contingent valuation (CV) method, could be found in the international and national literature. The aim was to find examples of projects where the sanitation demand patterns of residents have been determined in conjunction with their demand patterns for housing and all other infrastructure services. This is the procedure usually followed in South Africa when service demands are established during the provision of new housing schemes to residents in dense settlements. The literature study was thus focused on finding examples in literature where sanitation demand patterns have been established in an integrative way together with all the other service demand patterns in the past.

2.3.2 Adapting the SMM housing model

The first need of this study was to adapt the SMM housing model to determine the costs of specific sanitation options correctly. The model was adapted to include a greater variety of sanitation options, and the sequence of questions, so as to introduce sanitation at an earlier stage. As noted above, the amended model was renamed the Sanitation and Housing Applied Priorities Enquiry model (SHAPE).

The sanitation options selected were taken from the Department of Water Affairs and Forestry's official sanitation options and included single and double Ventilated Improved Pit latrines (VIPs), composting or desiccating UDS (urine diversion system) toilets; and shallow, as well as conventional, waterborne sanitation systems.

Cost calculations were done for these options based on the current (2008) construction rates for each area in which the surveys and case studies took place.

2.3.3 Survey of residents in selected dense settlement areas

Participants were selected on a random basis from within three selected dense settlement areas. These areas were situated in Ekurhuleni (urban and rural), Schmidtsdrif (rural) and eThekwini (urban).

All the research areas in this study were dense settlements in non-formal areas according to the official classification system of the National Department of Housing. Non-formal areas are again subdivided into a number of categories of which informal settlements is one. All the areas where research sessions were carried out for this research study were dense settlement areas with the following characteristics:

Ekurhuleni:	Gugulethu/Everest: The research was conducted on the outskirts of Springs, but farm animals like horses and cows graze in the areas between the informal dwellings.

Figure 3: Aerial view of Gugulethu/Everest, Ekurhuleni

Schmidtsdrif:	Rural. This dense settlement is about 70 km west of Kimberley and 39 km east of the small village of Campbell. There are no other towns in the vicinity and the research area was therefore typically rural.

eThekwini:	Urban. The different dense settlement areas where the research sessions were conducted, were all in urban areas. As a matter of fact, most of the dense settlement areas in eThekwini are in between other formal urban suburbs. They therefore actually form part of the urban fabric of the city.

The aim was to involve close to a hundred households in each area. They were invited to attend briefing sessions in groups. The concept was

explained to them and colourful posters were used to assist the participants to visualize the sanitation options.

Forms were distributed which gave a limited choice of options but which still allowed each individual a huge range of different options and expenditure levels. These forms are reproduced in the appendices.

Each participant was first required to state his or her name, occupation, monthly household expenditure and income. The next step was to request the participants to choose the options in terms of sanitation, housing, and all the other infrastructural needs. The net monthly cost was then calculated, and if the participant was not happy with the result, typically because the option selected was too expensive, another iteration would be done.

The solutions arrived at through this process, represented the housing package, including the sanitation solution, of each individual household.

2.3.4 Case studies in two selected dense settlement areas

After the sanitation demand patterns of the households of the dense settlement areas had been established through the surveys, two qualitative case studies were carried out in selected dense settlement areas of the City of Tshwane Metropolitan Municipality. The selected areas were Soshanguve Extension 6 (urban) and Temba/Hammanskraal (semi-rural). Their characteristics were as follows:

Soshanguve Ext 6: This is an area on the northernmost outskirts of Pretoria. It could therefore be best described as a typical “peri-urban” area.

Temba/Hammanskraal: These are dense settlement areas in a rural environment about 40 km north of Pretoria. Although the areas are rural, there is such a concentration of dense settlements in this area that the typical rural character of Temba/ Hammanskraal has disappeared in comparison with Schmidtsdrif, for instance.

The number of residents participating in the case studies was much smaller than in the case of the surveys and was limited to only between five and seven respondents in each area to make the confirmation or the rejection of the survey results more robust.

2.3.5 Analyzing the results and arriving at findings

Following the surveys and case studies, the results were analyzed and the findings of this research study formulated. The sanitation demand patterns of

the surveys and case studies could consequently be compared. Comparisons could then be drawn and the reliability of the results established.

All other findings with regard to the method of integrated affordability applied in this research study could likewise be made. This included the simultaneous establishment of the demand patterns for housing and all the other infrastructure services of the residents surveyed.

In conclusion, the findings also concentrated on the appraisal of the integrated affordability method versus a non-integrated affordability approach. The important requirements of co-operative governance and community participation and involvement (the so-called Batho Pele or "People First" principles) were also investigated and findings made.

2.3.6 Drawing conclusions and making recommendations

Finally, conclusions were drawn and recommendations made based on the findings of this study. The conclusions concentrated on the features of the integrated affordability method as emphasized by the results of this research study.

Conclusions were also made as far as the ultimate sanitation demand pattern of all the residents observed in this study, is concerned. The demand patterns of the other services and some of their most obvious influences on or interaction with the sanitation demand pattern of the residents living in the dense settlements were established. Conclusions about co-operative governance and the sanitation policy with regard to new housing schemes were also drawn.

Recommendations were made in line with the conclusions drawn in this study. These included recommendations to make stakeholders such as authorities and professionals who work in the field of service provision, aware of the findings of this study. Certain recommendations for more in-depth future research were also made, mainly concentrating on the application of the integrated affordability method, co-operative governance and the Batho Pele principles when sanitation and other services are provided to residents living in dense settlements in South Africa.

3. DEVELOPMENT OF THE SHAPE MODEL

3.1 Background of the model

This study uses the adjusted computer-based Sigodi Marah Martin (SMM) housing model which was renamed the Sanitation and Housing Applied Priorities Enquiry model (SHAPE) to weigh housing and costs for services against each other and to help the household to decide which sanitation option is affordable to the household. This model has been used for similar applications in South Africa, Kenya, Botswana and Swaziland in the past.

Briefly, this model allows the individual to select various options, such as sizes of rooms, types of finishes, types of water and sanitation services, types of roads and street lighting and automatically converts these into actual costs, so that the user can adjust his or her choices depending on what his or her household can actually afford. Costs are totally inclusive, and the figures are also presented in monthly format, which is the way people tend to *think* about housing expenditure. this method is called the **cognitive evaluation** or **contingent valuation method,** whereby decisions taken by users/clients based on information supplied to them can then be evaluated by them and subject to as many iterations as are required to reach a well-thought through decision which best meets their needs within the limits of their means.

Since the term “cognitive evaluation” is mainly used in the social, medical and educational sciences, and “contingent valuation” in the more technical planning field, the term “contingent valuation” (CV) will henceforth be used in this research study. In the case of the SHAPE model, it calculates the monthly payback amount based on the given loan repayment (“bond” or “mortgage”) rate and period taking governmental subsidies into account. The fact that many residents living in dense settlements of South Africa are entitled to housing and other types of subsidies from government makes this method very relevant and the only way to determine the effective demand for sanitation, housing and other services in a mutually dependent and integrated way taking the financial circumstances of the individual household into account.

Since the SMM housing model had been used widely before, it presented a unique opportunity to obtain a statistically valid indication of the demand by residents of informal settlements for sanitation solutions that they can afford.

3.2 The model: what it is, and how it works

Housing costs are made up from a considerable number of variables. These include the land, the servicing of the land (which will vary depending on the size of the erf, and the standard and type of servicing provided), the number of rooms, and the standard of fittings, finishes and services. In addition there are the costs of the overheads, such as contractor's profits, professional fees,

selling and administration costs, and many more. The equation would not be complete unless we deduct any subsidy paid by the Government and calculate capital repayments at prevailing interest rates and add Local Authority service charges and rates to arrive at the net cost of a house per month.

Selecting a house that meets the spatial needs of one's family which is also affordable is impossible for everyone in the low income strata. It is paradoxical that in spite of this fact such a high percentage - if not all - expenditure on housing solutions is made without consultation with the users. Demands for better housing are part of the normal currency of politics, and often a specific target is used in slogans, for example the four room house. But while the slogan may present a laudable target it is often unattainable from the economic point of view, and people must have the right to choose what they want.

Crude measures of cost are often used by developers and other for estimates, for example a square metre cost for housing, and a fixed sum for a serviced erf. The apparent precision of these estimates hides the crude basis on which the calculations are made, and prevents anything more than a token involvement in decisions on the housing package.

This model presents the costs in such a way that any variable may be considered in real time, so that beneficiaries may make informed decisions. This is what the SHAPE Model does. Before describing it in detail, we shall briefly describe some of the antecedents of the model and the ways in which it has proved effective.

3.2.1 What the model entails

The methodology on which the concept is based, goes back many years. Early attempts to obtain consumer reaction to housing options included an analogue computer in 1972 in Zambia, and a model using weighted symbols for walls, windows and services in 1973. In 1984 a 1:20 model was developed in Kenya which comprised building elements (such as walls, roofs, windows, etc.) the mass of each of which was in direct proportion to their cost. Thus, when a design had been built in model form, it was possible to obtain the cost by simply weighing the model. A further, and very much simplified version was designed as a survey tool for use in Botswana. This incorporated models of rooms at 1:100 which could be carried in a special briefcase. These models were not weighted, but corresponding prices were given for each element which could be added up quite simply to arrive at a gross cost. In all these situations it was found remarkable that even though people are always appalled at the actual cost of building they quickly come to terms with it and begin to engage in the difficult process of working out what their minimum solution would be.

The computerised model described here, is a further refinement of the concept. It was first used in Kenya and later developed into a much more

powerful tool in South Africa. It is very quick, very accurate and very flexible, and ideally would be used linked to drawings of the solution selected. The model has since been adapted for use specifically as a means for testing community preferences in sanitation.

The basic objective is to allow the user to specify their sanitation preferences within the context of an overall cost for the housing solution. The literature survey in the next chapter refers to several studies of sanitation preferences, but the decisions which are taken in such cases are inevitably limited by the fact that only one component in the total package of housing preferences is being studied. For all income groups, but most particularly for the poor, trade-offs are made between stand size and servicing, house size, and standard of fittings and finishes. The value of this model is that, for the first time, as far as we are aware, a comparatively accurate estimate of the actual cost of all components allows such tradeoffs to be made. Moreover, due to the user-friendly interface, it does not require prior training. Indeed, experience has shown that even illiterate people quickly grasp the concepts.

The computerised model presented here, is based on the concept of all-inclusive prices to obtain an aggregate price. Thus, we may obtain a price for a single room, for two rooms, any number of rooms, etc. Obviously serviced areas such as kitchen and bathrooms are more expensive for their size than non-serviced areas. For electricity there is a connection cost and a wiring cost for each room. The costs are presented in monthly form – which is the way that people think about housing expenditure – and are totally inclusive. That is to say, they include not only all construction costs (including professional fees, interest during construction, facilitation costs, administration of sales and conveyancing, etc.), but also monthly service charges and rates. Thus the model includes higher monthly water charges for waterborne sanitation than for a standpipe; in respect of electricity there is a big difference between the monthly charge included for those with hot water and those without.

Sanitation is a major factor in such decisions, and the model allows comparison between the cost-in-use of six different sanitation solutions. In other words the user is not required to evaluate the relative capital and running costs – the model incorporates monthly amortisation of capital costs as well as water consumption, etc. thus allowing all costs to be presented as a single monthly outgoing.

Two problems arise in practice when trying to apply the model. The first is the diversity that can emerge from a group: for example a person with a large family might prefer to go for space as an absolute priority, and minimise expenditure on services, while a person in the same income group who has no family will prefer the convenience of good services and will not treat space as an overriding objective. To serve both these needs on contiguous erven is impractical, so there must inevitably be clustering of those with similar objectives. Thus the model can be used to channel those with similar needs into similar projects or parts of projects. In this context, the original objective of the Goldev project's Housing Clubs is a useful concept that is capable of further development. This was that each group of 20 families would determine

the layout, internal servicing and, possibly, house design within their "Club". The strength of this concept is that it provided a structure within which diversity could be managed. In this respect, it echoes the system used in the Lusaka Squatter Upgrading Project, where it was applied with great success in the overspill areas, where each group of 25 families was free to prepare its own layout. The concept gains added practicality if the housing is built under the control of the householder, either by self-help or small contractor.

The second problem is that of understanding the choices. No one can pretend that working with a computer is either user-friendly or communicative. Therefore, as a start, the model should be supported by cardboard – or similar – models that illustrate the type of solutions being chosen.

3.2.2 How the model works

The starting point for any realistic assessment of sanitation and housing demand must be the amount of money available for housing, and subsequent decisions should all be referred back to that commitment. Therefore, whether the model is being used by a person or a group of people, it is essential to think very carefully about the question of affordability.

Once this has been done, the model asks a series of questions. In this instance, where the focus is on sanitation, the first question to be addressed. A range of different options need to be explained, after which the householders can make their preliminary choice. Thereafter the model follows the natural progression of thought of most people when it comes to housing: for example the number and type of rooms, and progress through detail on the house to the erf size and servicing details. Throughout the process the total capital cost and monthly cost of the solution proposed are displayed on the screen. At any time the person can change to previous decisions, or may decide to do several quite different ones just to see what the results are, and then compare the print-outs.

The costs displayed are based on construction costs supplied by a quantity surveyor, engineer or other knowledgeable person.[7] The beneficiary may also select rental or purchase, which will also affect the level of monthly cost, but the purposes of this study, only purchase options were used, reflecting the current housing policy.

In this study, the model was used in three ways.

The most detailed and effective method for individual consultations is to work with the client on the computer. However, many people are intimidated by computers and find it easier to visualise the options by means of models. The scales of about 1:50 or 1:20 have been found to be effective. In such

[7] The pricing undertaken for this study was done by quantity surveyors with experience in the field of low income housing. Data were taken from current contracts. The pricing of the sanitation options in this study was done by a civil engineer.

circumstances the computer is used to obtain the costs quickly and effectively and to print out the results.

The second option is to work with groups who can debate the options and arrive at consensus regarding their requirements as far as, for example, sanitation and road standards are concerned.

The third option which has been used with success is to use a miniature model kit as the basis for individual interviews. In such cases the computer is not used, but limited-choice costed options are used which can be added by the interviewer.

The chart below shows the structure of the model in a simplified format.

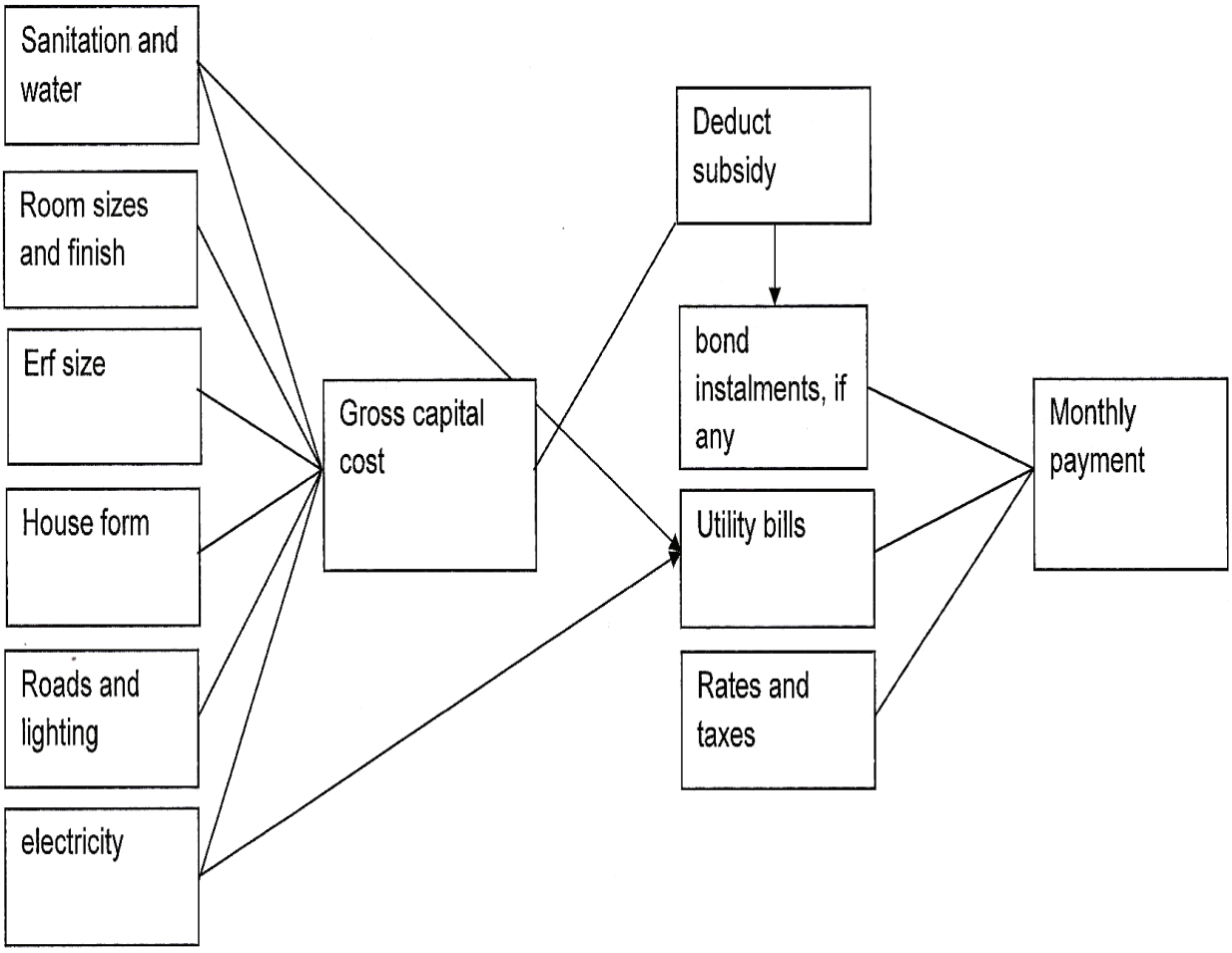


***Figure 4*: Flow chart of the SHAPE Model**

4. LITERATURE STUDY

4.1 Introduction

Whereas the **contingent valuation (CV) method** is often used to determine the market and non-market related value of services, and therefore the effective demand for specific services among users, no evidence could be found in literature of this method being applied in an integrated way in the housing field where services such as electricity, water, sanitation and the number and sizes of rooms compete against each other in terms of monthly expenditure or affordability. This is somewhat astonishing, because it is in the housing arena where individuals have to integrate their preferences simultaneously and decide on their effective demand for the services they require. This may be the most important physical decision a resident living in a dense settlement may make in his/her entire life.

In literature, the contingent valuation method is applied in a variety of ways to determine effective demand for services, but mostly in a non-integrated way specific to a single service. For example, on one single website (www.sscnet.ucla.edu/ssc/labs/cameron/nrs98/cvinv.htm) under the title "Recent Literature on Contingent Valuation Methods", no less than 493 contingent valuation studies are cited, but virtually all of them address the effective demand of only one service. The studies on this website are also biased towards the establishment of the willingness to pay for environmental issues such as waste management and environmental protection where the contingent valuation method is often applied in practice.

The realistic and practical method proposed in this study whereby an integrated approach is followed to determine the effective sanitation demand of residents in dense settlements, could not be found in the international literature. The SHAPE model is therefore proposed as a contribution in the field of determining sanitation demand of residents living in dense settlement areas of South Africa and abroad.

Despite the fact that the effective demand for several interrelated services such as electricity, water, sanitation, roads and housing is not addressed in an integrated way in the international literature, the most important recent contingent valuation studies in the sanitation field are nevertheless cited here. These studies invariably concentrate on only one or at the most two services (e g water and sanitation), being evaluated at a time and could therefore not be regarded as integrated studies, but rather as "segregated" research studies.

4.2 Application of the contingent valuation method in the sanitation field

In the past few years, the contingent valuation method has been applied extensively to a variety of public programmes in developing countries. Contingent valuation surveys have been conducted to obtain the willingness of households to pay for different sanitation options such as VIP toilets, connections to the sewage reticulation system and region-wide wastewater treatment in Burkina Faso (Altaf and Hughes, 1994), in Ghana (Whittington *et al.*, 1993) and the Philippines (Choe *et al.*, 1996). No other services were evaluated for determining the demand of the households for such services in an integrated way.

Most contingent valuation studies in developing countries have relied on **in-person, one-on-one interviews.** The reason for the reliance on face-to-face interviews is that the literacy levels in some developing countries are still too low to permit mail or self-administered surveys. Telephones are also not available to much of the population (especially in rural areas), and – even if telephone connections were available – it is doubtful whether the residents of certain developing countries would be willing to participate in mail or telephonic surveys. Even with in-person interviews there have also been reports of difficulties: for instance, Shultz *et al.* (1998) found that Costa Ricans reacted with apprehension to the request of participating in a contingent valuation survey, and when they eventually agreed, exaggerated their reported willingness to pay in an attempt to impress the interviewers.

What is quite clear from the literature review, however, is that no mention is made of determining the demand for alternative sanitation options by means of a computerized model like the SHAPE model which integrates all the important services for residents living in dense settlements.

Whittington *et al.* (1992) identifies a number of difficulties when conducting studies in certain developing countries. Firstly, logistical considerations and the lack of listings for the population from which a sample can be drawn, have often forced researchers to limit the sample to relatively small areas – whether in a rural environment or in a large metropolitan area. This has certainly increased the likelihood that respondents may talk to one another, thus receiving the survey questionnaire with pre-formed judgements influenced by other residents' opinions. Whittington reports that in one instance, local neighbourhood officials and chiefs reacted furiously to the survey in progress, to the point of bursting into an interview in progress and trying to influence the opinions of the respondents. Whittington concludes that it is imperative to secure the co-operation of local officials and authorities before the onset of the survey to ensure that responses will not be unduly influenced by pressure placed on the respondent or the community. In the case of the SHAPE model used in this research study, the likelihood of externally influenced judgements is small, since the respondent must actually consider his/her actual income when making a commitment for long term repayment of the services chosen.

The whole concept of securing the co-operation of local officials and authorities before a contingent valuation survey is done, was found to cause enormous delays in this study. Contact was first made on 8 October 2007 with officials and authorities, and only resulted in actual contact being made with the community members at grass-root level on 20 February 2008. It therefore seems that the contingent valuation method requires at least three to four months as an initializing period before the method can actually be applied in practice in South Africa. The inefficiency of communication and coordination at local government level in South Africa leads to enormous delays in surveys, and ultimately in service delivery, all over the country at this stage (2008).

In developing countries some respondents have struggled with the notion of “maximum willingness to pay” for a service. Whittington reports that one respondent in Haiti wondered whether "the most he would be willing to pay" meant in the event that a gun was held against his head!

When applying the SHAPE model, it is usually not difficult for respondents to decide the maximum amount they can pay for different services like sanitation each month, since it is directly linked to their monthly income, in other words, to their affordability.

Another difficulty is that in some developing areas the cash available to individuals to carry out transactions, is very limited. This situation forces households to refrain from committing themselves to expenditures that are to be incurred on a regular basis. In the case of residents living in dense settlements of South Africa, this situation is slightly different in that they usually have some cash available either from social grants or income from other members of the household to commit themselves to the longer term payments.

In general, contingent valuation practitioners trying to estimate the willingness to pay for improved sanitation services have faced difficulties explaining respondents how improved sanitation will be attained and which benefits will accrue to them. Altaf and Hughes (1994) concentrated on describing the commodity and its benefits to respondents in Ouagadougou, Burkina Faso. This urban area lacked sewer systems. Waterborne toilets, when available (12.5% of the households interviewed), fed into septic tanks. Pit latrines were available (over eighty percent of the sample), but none was of the ventilated, improved type. Lack of familiarity with the improved technologies prompted Altaf and Hughes to describe the attributes of the technologies that would be applicable to the respondents, rather than the technologies *per se*. For instance, improved pit latrines were described as follows:

> *There exists a ventilated improved pit latrine that has been introduced and is working satisfactorily in other countries. The principal characteristics of such an improved latrine are the following:*
>
> 1. *It is odourless and fly-proof.*

2. *It is permanent and can be installed inside the house, if desired.*
3. *It does not require a piped water connection for operation.*
4. *The excreta are transformed through a natural process into compost which is not harmful to health.*
5. *The pit needs to be emptied every three years. It can be emptied manually without having to touch fresh excreta.*
6. *Household wastewater can be disposed of in this system.*

These descriptions gave the potential users an idea of the new type of pit latrine.

The characteristics of the waterborne toilet system were described as follows:

> *There is another type of improved sanitation with the following principal characteristics:*
>
> 1. *It is odourless and fly-proof.*
> 2. *It is permanent and is usually installed inside the house.*
> 3. *It requires a water closet for operation.*
> 4. *It requires a piped water connection for operation.*
> 5. *The household does not need to dig or empty pits. The excreta are taken away from the neighbourhood for treatment through underground pipes.*
> 6. *Household water can be disposed of in this system.*

Although the analysis of the responses from this survey was not very sophisticated from a statistical modelling point of view, it nevertheless provided interesting insights about the preferences for sanitation in Burkina Faso. One important finding was, for instance, that the higher the existing level of sanitation and wastewater disposal was, the greater the willingness of households to pay for the next level of improvement. This implies that the marginal willingness to pay for sanitation services generally increases as people are exposed to these services.

Of the respondents who declined to pay the amounts suggested to them, most stated that they were unwilling to commit themselves to regular payments in the long run.

While Altaf and Hughes did not go into detail about how they described sanitation improvements to respondents, study participants were shown photographs of ventilated improved pit and pour flush latrines towards the end of each answering session. Assuming that the cost of the two technologies was the same, most people preferred the waterborne sewerage system for hygienic, convenience and modernity reasons.

A conventional approach was adopted by Whittington and Lauria (1990), who queried respondents in Kumasi, Ghana, about three different levels of sanitation: (i) Public latrines; (ii) Bucket latrines; (iii) Other types of latrines.

Respondents were then asked to report their willingness to pay only for an immediate improvement over their current situation.

The survey showed that 25% of the households had bucket latrines and 38% relied on public latrines. A few households had waterborne sewer systems, but the rest had other types of toilets, or even no toilets at all (used open land areas).

The survey asked respondents how much they would be willing to pay in the form of a monthly charge for an improved latrine. Figure 5 shows that those who were using public latrines were willing to pay more for an improvement than those with bucket latrines, reflecting the inconvenience and unacceptability of the public latrines.

Whittington and Lauria (1990) found that willingness to pay was well correlated with individual characteristics and with the convenience of the sanitation alternative.

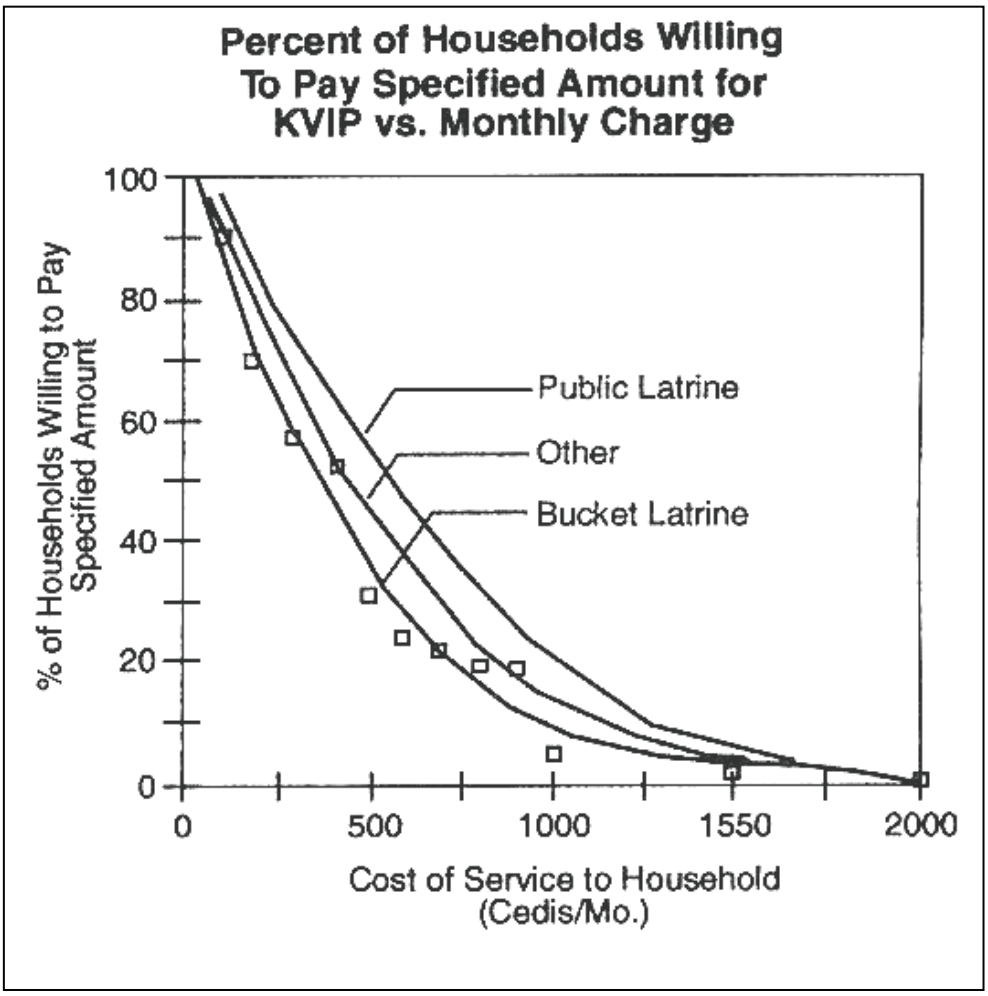


***Figure 5**: Demand curves depicting willingness to pay for sanitation options, Kumasi, Ghana*

Whittington and Lauria (1990) experimented with altering conditions under which respondents made decisions about the figures they were willing to pay. Specifically, a subset of the respondents were given time to think about their willingness to pay before they had to declare their willingness to pay to the enumerators. In contrast with a study by Whittington *et al.* (1992) which concluded that giving respondents time to think lowered their willingness to pay bids, no systematic effects were associated with longer periods to think about the choices in the Kumasi study.

The contingent valuation method is also dealt with on the very useful website (http://www.tcd.ie/Civil_engineering/Staff/Laurence.Gill/SS%20Hyrdraulics/) called "Tools for Sanitation Choice" where it is mentioned that this method is very suitable to provide a way of estimating willingness to pay for different levels of a certain service. An example of the application of this method to determine the willingness to pay for solid waste disposal in Chennai, India, is cited and it is mentioned that contingent valuation is very appropriate for assessing the willingness to pay for different levels of environmental protection. However, there is no reference made on this website to any example to ascertain the demand for infrastructure services such as sanitation in an integrated way simultaneously with other services like in the case of the SHAPE model. The results of the Chennai solid waste disposal contingent valuation study might therefore have been skewed considerably if the contingent valuation had been applied in an integrated way covering all the other infrastructure and housing services of the respondents together with their waste disposal service.

Despite this discrepancy, the "Tools for Sanitation Choice" website offers valuable insights into many aspects of this research study. It provides four tools (or chapters) for sanitation choice, namely:

- Approach to the sanitation choice
- Selecting the suitable sanitation choice
- How to cost the viable options
- Estimating the willingness and ability to pay.

The first chapter on the "approach to the sanitation choice" covers the first part of the four-pronged approach described in paragraph 1.2 of chapter 1 of this study, but only concentrates on the last three prongs (professional/ technical, community and individual).

It is interesting to note that the key principles of making sanitation choices, are:

- affordability
- acceptability to the potential users, and
- appropriateness to the situation.

It is also stated that circumstances of the beneficiaries, objectives of the sanitation and the costs of the alternative options, affect the sanitation choice. These choices are not made in a vacuum and the starting point for sanitation choices must therefore be good information about the sanitation options, the

institutions, practices and social attitudes of the beneficiaries. It is further stated that there are three conventional, but flawed approaches to sanitation selection, namely: “the professional knows best,” “the user knows best” and purely “market related” approaches.

The approach of “the professional knows best” does not take the knowledge and preferences of the intended beneficiaries into consideration (see Figure 1 in Chapter 1) and runs the risk of giving people what they do not want. On the other hand again, “the user knows best” approach runs the risk of under-estimating the value of professional knowledge and may lead to disastrous projects based on ad-hoc preferences of beneficiaries at the expense of sound technical considerations or overall planning objectives. The purely “market related” approaches assume that the beneficiaries can act independently of one another with each achieving the optimum market related result for the particular household. In practice this is rarely the case and households must be grouped together if the best results are to be achieved. In the case this research study only five sanitation options were offered to the potential users in order to make them cognitively manageable and the services practically achievable with not too many permutations resulting.

The number of choices will normally depend on a range of other technical factors such as soil conditions, slopes and topography as well.

It is mentioned in “Tools for Sanitation Choice” that shared decision-making is the best approach to sanitation selection involving the following:

“The best choices are likely to be those that take into account the knowledge, concerns and priorities of both professionals and users. When all factors are taken into consideration, there will generally be a best sanitation option in any given situation. The challenge is for users and professionals to work together and to pool their knowledge so as to choose the best option.”

An illustration of the process of shared choice, is given in Figure 6 below.

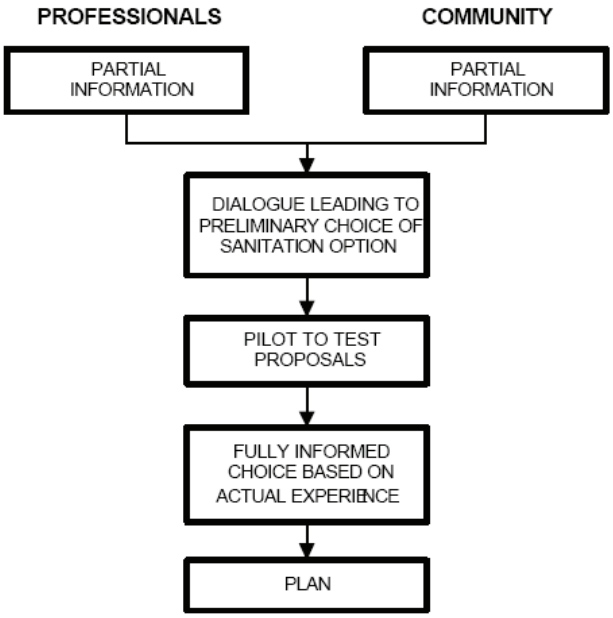


Figure 6: Shared approach to sanitation choice

The step “pilot to test proposals” in Figure 6 is further described and it is stated that “pilot projects provide a useful means of testing ideas on a relatively small scale before introducing them more widely.”

It is further pointed out that “stakeholders from both the professional and the community sides must help to choose the pilot project options and that they are committed to acting upon the lessons learnt from it.”

An important flaw in this chapter of “Tools for Sanitation Choice” is the omission of economic considerations in cases where political leaders indicate a certain sanitation choice which also happens to be the choice of the communities and the technical professional, but not of the economists. This is the situation which is developing in South Africa at the moment where waterborne sewers are specified for new housing projects in many cities and towns without full consideration of the interests of either the users or the economic consequences of the different systems. However, the Department of Water Affairs and Forestry recognises that pit latrines are much lower cost and often more appropriate in a water scarce country like South Africa (especially in the dry, remote areas of the country where there are no purification works yet). The voices of the economists which do not tend to be very strong in the sanitation field of South Africa, are overwhelmed by the billions of additional Rand are spent on waterborne toilets instead of pit latrines. Meanwhile, millions of people in South Africa are still without sanitation services (2008).

In the chapter describing the selection of the suitable sanitation choice on the website “Tools for Sanitation Choice”, five broad basic choices are indicated for individual household sanitation facilities not to be shared communally. They are: ‘wet’ or ‘dry’ sanitation options, ‘on-plot’ or ‘off-plot’ disposal or a ‘hybrid of on-plot and off-plot’ disposal systems. These options are basically covered in this study by the sanitation options given in Table 1 of Chapter 3. In “Tools for Sanitation Choice” it is mentioned that the sanitation choice will be influenced by:

- The availability of water
- The likelihood of pollution of either ground or surface water
- The capital and recurrent costs of the various options
- The skills needed to construct, operate and maintain the different options
- The co-operation needed between the different stakeholders (users, local authorities and others)

In the chapter devoted to methods of costing the viable sanitation options described in “Tools for Sanitation Choice”, principles and methods are given how the capital and recurrent costs of sanitation options may be calculated. A bill of quantities is supplied to determine the capital cost of building a sanitation option, while a table shows the typical recurrent costs such as operational and maintenance costs for different types of sanitation choices. The relevant costs indicated in this section have all been taken into account

by professionals such as technical staff and a quantity surveyor in the SHAPE model for the different sanitation choices available.

The fourth chapter of the "Tools for Sanitation Choice" website is the tool describing the estimation of the willingness and ability to pay for a certain sanitation choice. In this section the contingent valuation method is described, but – as already mentioned – no reference is made to the application of this method in an integrated way to determine the demand for infrastructure and housing services of potential beneficiaries simultaneously.

The website (http://wedc.lboro.ac.uk/projects/new_projects3.php?id=36) dealing with "Designing water and sanitation projects to meet demand in rural and peri-urban areas – the engineer's role" compiled by Paul Deverill, Simon Bibby, Alison Wedgwood and Ian Smout of the WEDC in the United Kingdom is also quite useful. The contingent valuation method is demonstrated by these authors on this website in a case study to determine the demand for water and sanitation in Dar es Salaam, Tanzania. This case study stressed the importance of using local people like local artists to illustrate the alternative sanitation and water supply options when the contingent valuation method is applied. The end result of the contingent valuation survey in Dar es Salaam showed that 65% of all the respondents were not willing to pay for sanitation at all. Once again, the contingent valuation survey was carried out in separate components for determining the effective demand for water and sanitation services and there was no integration of other infrastructure services which would have skewed the survey results substantially.

Deverill *et al.* (2001) nevertheless approach many aspects in the sanitation demand field quite analytically which make these aspects worthwhile considering with regard to those particular issues relevant to this research study. First of all, the following definition for demand is given:

> Demand is an informed expression of desire for a particular service, measured by the contribution people are willing and able to make to receive this service

This definition originated during a WEDC conference in Dhaka during November 2000. It fits in very well with the approach of the SHAPE model where the monthly contribution which the residents can make to receive several infrastructure services, is determined in an integrated way. In the case of the SHAPE model, the willingness to pay for several services is determined simultaneously in an integrated way. The above-mentioned definition of demand is similar to the one given by Diop (2004) in "Demand-side issues of sustainable sanitation approaches" for the Water and Sanitation Programme Africa, namely:

> Demand is the felt need expressed by people for a sanitation service or product, which they are willing and able to support with a meaningful contribution

Deverill *et al.* (2001) continues by stating that the definition reflects the economic characteristics of effective demand. It should however be qualified by stating that the right to a basic level of service should not be compromised by meeting demands for higher levels of service. This viewpoint is also reflected in the "Sanitation Policy for the City of Johannesburg."

Deverill *et al.* (2001) states that demand can be met or 'captured' by ensuring that people receive the service they want and are willing and able to support and pay for. They mention that for practical reasons, user choices are limited to a range of feasible options. It is very important that the options are appropriate and provide potential users with a meaningful choice. This concept of giving potential users meaningful choices, but to limit the choices to a manageable number, is an important principle on which this research study was based.

Deverill *et al.* (2001) states that the process of meeting demand can be described in four stages:

(1) Identifying and developing a range of appropriate service options. This must include the options of all the infrastructure services considered by the potential users when they decide on the affordability of their housing and other infrastructure service demands. This is exactly the integration which takes place when the SHAPE model is applied.

(2) Ensuring that people are informed about the benefits and costs of each option. This should be done when integrative models such as the SHAPE model is applied. When the residents living in dense settlements have to decide on new housing and services, these options must consist of integrated packages of housing and infrastructure services and not only of the sanitation service in isolation.

(3) Enabling people to choose the services that they can afford. This is exactly what the SHAPE model does in an integrative way when residents decide on the housing and other services they can afford.

(4) Negotiating with users to agree on technically feasible designs. This is done before the SHAPE model is actually applied by asking residents which package of services from those that have been identified as technically feasible, they prefer and can afford.

Deverill *et al.* (2001) points out that effective communication between the implementing organization, potential users and other stakeholders is vital if sanitation projects are to be successful. The following two objectives must be met in this regard:

- Potential users must be enabled to express their demand for sanitation service options measured in terms of their willingness to pay. This is exactly what the SHAPE model does.

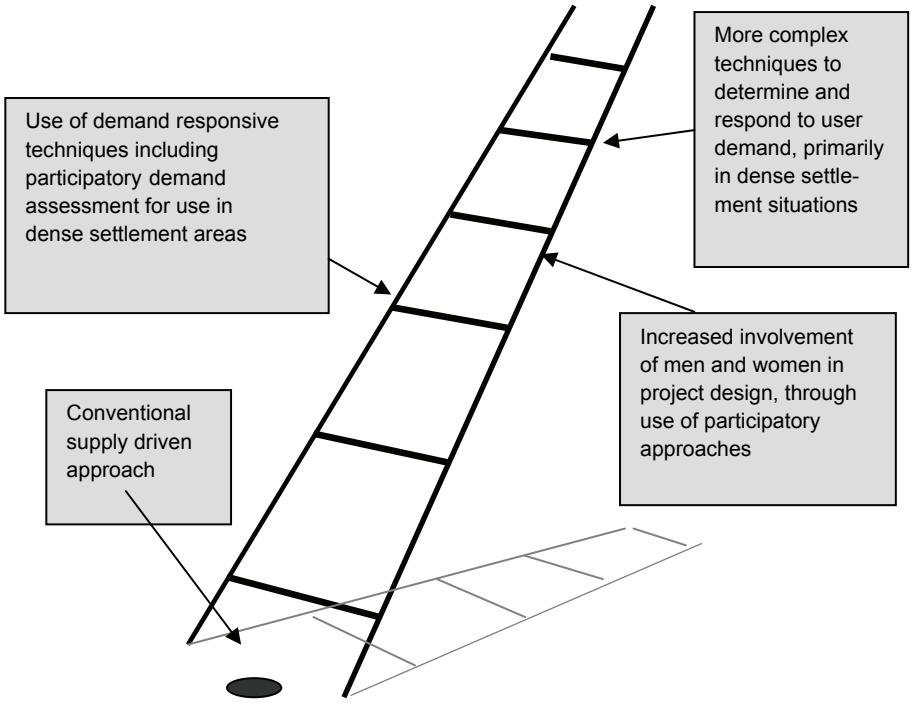
- People must be fully informed of the relative costs and benefits of each option, compared to their present situation. This is done when the SHAPE model is applied in practice.

Deverill *et al.* (2001) points out that perceptions of being able to communicate easily with households, individually and collectively, are often wrong. This was confirmed by the efforts and time consumed to organise communication with the people at ground level via the local authorities in South Africa. In this research study it took anything up to five months to organize contact with the residents at ground level via the local authorities and local political office bearers. In reality, it should take no longer than about three to four weeks to organize consultation meetings such as these with residents at grass root level.

Field visits conducted by Deverill *et al.* (2001) indicated that when the people at ground level are finally reached, they find it difficult to participate: the poor often have to work long hours far away from home, whilst women may be inhibited from attending meetings or expressing their views. The poor are usually the least likely to have the confidence to come forward to articulate their demand. They therefore face the double jeopardy of not being actively included as well as excluding themselves from the consultative process. In this regard the application of the SHAPE model has a distinct advantage, since the individual or household actively participates and is actively consulted when the model is applied. Many residents living in dense settlements are currently also unemployed in South Africa and are therefore readily available for public consultation processes. The experience in South Africa was that participants were very eager to participate, since decisions about new housing and services represent some of the most important physical decisions they may take for the rest of their lives.

According to Deverill *et al.* (2001), a rather unique type of approach is required to establish what potential users would be prepared to pay for a range of service options. This can be achieved by presenting people with different service options, and asking them what they would be prepared to pay for these options. According to Deverill *et al.*, this can be done by applying the contingent valuation methodology (CVM). This process emphasizes “the need to treat potential users as clients, to focus efforts at household level and to adopt a multi-disciplinary approach.” This exact methodology is applied when the SHAPE computer model is used in practice where potential users are treated as clients and where the focus is at household level in a multi-disciplinary environment.

Finally, Deverill *et al.* (2001) points out that many organisations are in a process of transition from being supply driven to **demand responsive** and have limited capacity. The initial stages of coordinating with the potential users will consequently occupy the lower and middle rungs of the schematic ladder shown in Figure 7. As the involvement of the beneficiaries becomes more sophisticated, more elaborate techniques may be used and the upper rungs of the “ladder of meeting demand” shown in Figure 7, are then reached.



<u>Figure 7</u>: The ladder of meeting demand according to Deverill et al.

During the initial planning stages of sanitation projects, the demand ladder supplied by Deverill *et al.* may be quite applicable, but when it comes to the decisions individuals must take when purchasing a house with its associated services, the user suddenly finds that complicated, integrated decisions must be taken simultaneously. The individual therefore reaches the top of the ladder much sooner when the SHAPE model is applied. While good information on the different sanitation options must be supplied to the resident under these circumstances, the individual reaches the preferred upper levels of individual involvement and decision-taking much sooner when the SHAPE model is applied than with many other approaches to determine sanitation demand.

The fact that local authorities, professionals and politicians typically specify waterborne toilets is due to the conventional supply driven approach being accepted. Whether this approach will actually lead to South Africa falling into a pit according to the ladder of Deverill *et at* (Figure 7) remains to be seen in future. It will certainly lead to many billions of additional Rand being required for sanitation in South Africa and possibly that millions of people in the country will not be able to receive sanitation services as soon as would have been the case when more pit latrines were installed in the country. Many people may even be denied the possibility of receiving housing and a new sanitation service in South Africa in the near future due to excessive spending on waterborne sewers.

There are numerous other projects cited in literature and lessons learnt in the field of consumer demand for different sanitation options.

Cairncross (1992) mentions examples of sanitation demand projects in Bangladesh, Nepal, Nigeria, Brazil, Lesotho, India, Tanzania, Kenya and Haiti. The principal lesson from these projects is that continuing success of sanitation projects depends on responding to consumer demands based on their ability to pay for their sanitation choices. Cairncross (1992) states that the designers and managers of sanitation programmes "must understand that they are selling a product. Where sufficient demand exists, the facilities and services offered must be tailored to that demand; where demand is weak, it must be stimulated." In many of the sanitation demand studies in the aforementioned countries, it is interesting to note that sanitation demand cannot always be assumed as a given, but must actually be stimulated or marketed where the demand is low. In this whole process, consumer education with regard to health and other aspects such as financing and maintenance of sanitation options, feature prominently in the effective demand for a certain sanitation option.

To summarize, it is clear that the contingent valuation method has been applied widely in developing countries to determine sanitation demand in a non-integrative way. As mentioned before, there is a vast lack of evidence in the international literature, however, that sanitation demand is determined in an integrated way in competition with the other important household services as is the case in practice.

Apart from literature sources, available computer programs were also scrutinized during the literature survey. The WRC Sanitation Decision Support Model (WRC Report K5/1632) was found not to integrate the different infrastructure services like the SHAPE model does; it only concentrates on the sanitation service and its associated water requirements. It could consequently not be used as a comparative tool in this study.

The Site Sanitation Planning and Reporting Aid (SSPRA) program (WRC Report No 586/2/00 of June 2001) is a higher level planning tool and – to quote directly from its user manual – "is not intended for use directly by communities." It could therefore likewise not be applied in this research study since interaction with the individual members of communities is the main focus and aim of this study. It is intended for use by planners, supply agencies and providers of services, but not by individuals or households. It could be described as a regional computer model concentrating on the planning of sanitation services *per se* without integrating the different infrastructure services as the SHAPE model does.

No other South African studies could be found in the literature where sanitation demand has been determined in an integrated way in conjunction and in competition with housing and other services.

Goldblatt's study (1999) of assessing the effective demand for improved water supplies in the Orange Farm and Finetown informal settlements near Johannesburg, concentrated on the provision of water supply without taking competing housing and other services into consideration. Likewise, the strategic approaches and sanitation demand studies for unserviced informal

settlements by Lagardien and Cousins (2004 & 2005), concentrated on the establishment of sanitation demand without integrating the competing services.

The result is that no South African studies could be found with which the SHAPE could be compared. It was therefore quite remarkable that the percentage distribution of households preferring different types of sanitation options in dense settlement areas could not be traced in any integrated demand study in South Africa.

An important objective of the literature study was – amongst others – to obtain a reliable idea of the alternative sanitation options recognized by authorities in South Africa today. These current sanitation options available in South Africa have been identified and are summarized in the next chapter.

4.3 Summary of key findings of the literature study

The following are key findings of the literature study done for this research project:

- The literature study indicated that the field has been covered in many different ways – it would be surprising if a subject as important as sanitation options had not been approached from different angles.

- The concept of contingent valuation has also been well covered in literature, though there are few examples of well structured case studies.

- There are useful studies regarding consumer behaviour in sanitation choices and the methodology of contingent valuation studies.

- The weakness of all these studies undertaken to date has been that the surveys may suffer from bias due to the fact that sanitation was treated in isolation.

- No examples of contingent valuation techniques being applied to sanitation as part of the total package of housing choices and monthly expenditure could be found in literature through this research study.

5. ALTERNATIVE SANITATION OPTIONS FOR SOUTH AFRICA

5.1 Alternative sanitation options

The Department of Water Affairs and Forestry's official alternative sanitation technology options form the basis of the different types of sanitation options offered to residents of dense settlements in South Africa today. These alternative sanitation options are the following:

Dry on-plot systems

1. Ventilated Improved Pit (VIP) toilets
2. Ventilated Improved Double Pit (VIDP) toilets
3. Composting or desiccating (e g Urine Diversion System) toilets

Wet on-plot systems

4. Loflos or aquaprivy toilets with soakaways
5. Septic tank toilets with soakaways

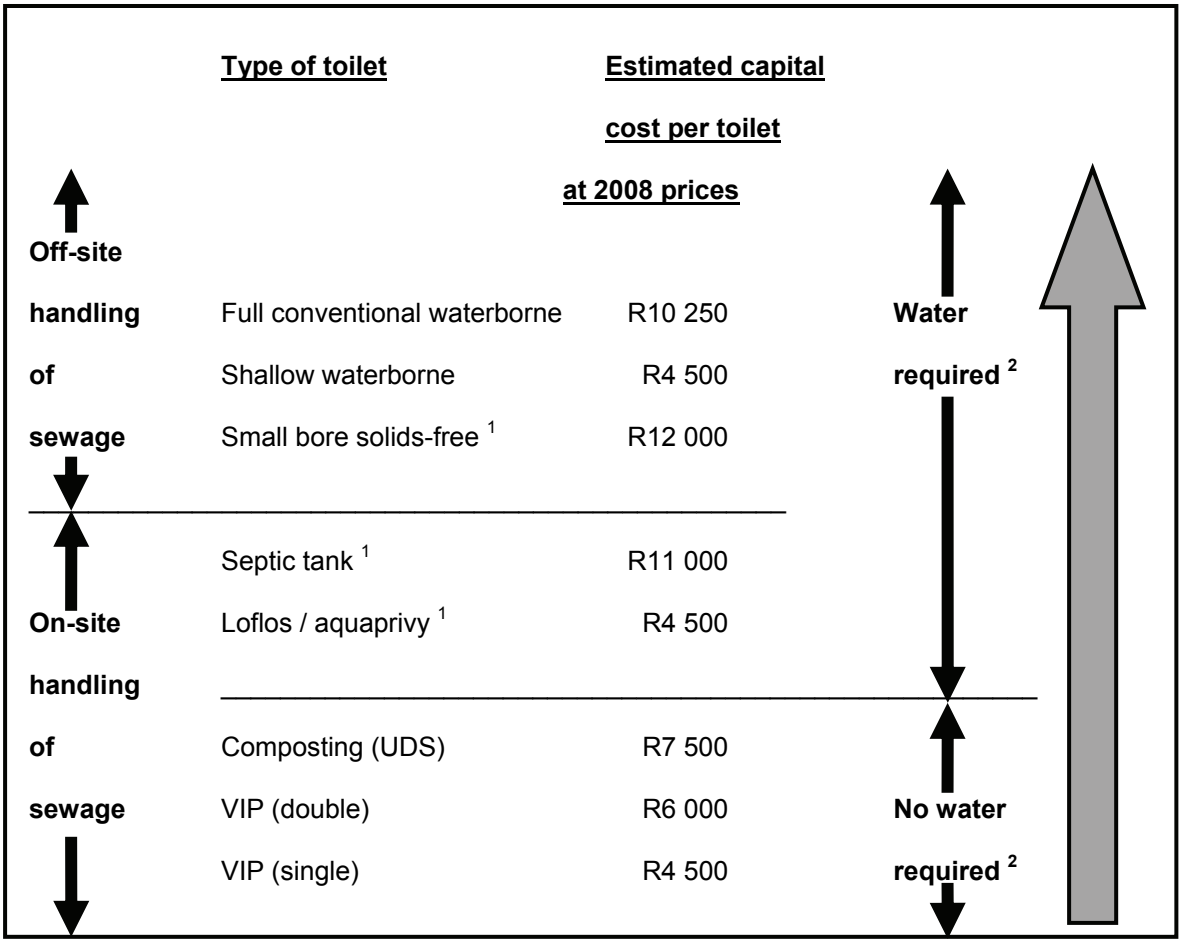
Wet off-plot systems

6. Small bore solids-free sewers
7. Shallow waterborne sewerage systems
8. Conventional full waterborne sewerage systems

5.2 Ladder of sanitation options

These sanitation options are often arranged in a so-called "ladder of options" signifying a general increase of service levels.

As far as the preceding eight options are concerned, they may be arranged according to the ladder of options as shown in Figure 8 on the next page. This figure has been developed through this research study.



1. Sewage handled on-site and off-site (off-site de-sludging, although not always done in practice)

2. By the toilet *per se*

***Figure 8*: The ladder of sanitation options in South Africa**

The current (2008) *capital and maintenance costs* of these alternative toilets appear in Table 1. These costs vary from one location to another and from one municipal area to the next. Consequently, fairly high rounded-off costs have been adopted for the alternative options in order to compare their costs at the same level and also to allow for any possible adverse conditions which may influence the costs negatively.

Furthermore, published *consumer responses* to each of these alternative sanitation options, are supplied briefly with each option.

The *application requirements* of each of these options determining which solutions are feasible to apply, are likewise given in abbreviated format with each sanitation option.

***Table 1*: Sanitation options for South Africa**

[Source of diagrams: DWAF's "Sanitation is Dignity: Sanitation Technology Options"]

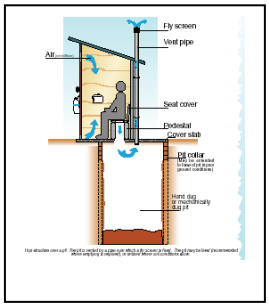
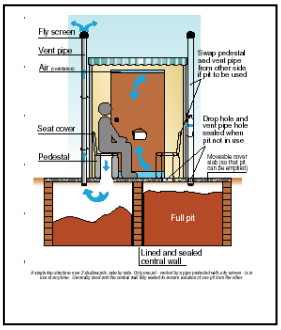
Type of Sanitation Option	Capital cost (2008)	Maintenance cost p. a. (2008)
1. Ventilated Improved Pit (VIP) toilet:  Consumer responses: Widely used in dense settlement areas of SA. Application requirements: No water or sewer networks needed. Suitable in arid and semi-arid areas (most of South Africa).	R4 500	R250 p.a.
2. Ventilated Improved Double Pit (VIDP):  Consumer responses: Excellent and affordable solution, but emptying the full pit is not always acceptable to consumers. Application requirements: No water or sewer networks needed. Suitable in dry conditions and where soil conditions make deeper excavations for a single pit infeasible.	R6 000	R150 p.a.

***Table 1*: Sanitation options for South Africa (continued . . .)**

[Source of diagrams: DWAF's "Sanitation is Dignity: Sanitation Technology Options"]

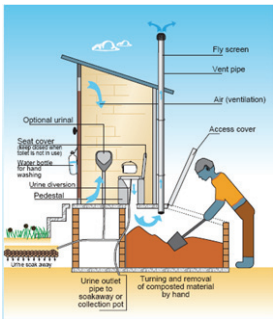
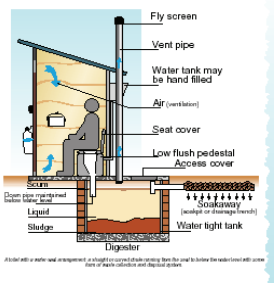
3. Composting or desiccating (e g UDS) toilet  Consumer responses: Not in wide use in SA yet – still being monitored and tested. More expensive than VIPs. Application requirements: No water or sewer networks needed. If moisture is not kept separate and controlled, this toilet may become malodorous. A bit sensitive to handle.	R7 500	R650 p.a.
4. Loflos or aquaprivy toilet with a soakaway:  Consumer responses: Not widely used in SA. Many failures occurred. Application requirements: Water is required and soil conditions must be favourable – otherwise the soakaways get clogged.	R4 500	R400 p.a.

***Table 1*: Sanitation options for South Africa (continued . . .)**

[Source of diagrams: DWAF's "Sanitation is Dignity: Sanitation Technology Options"]

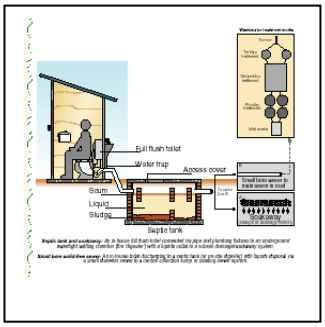
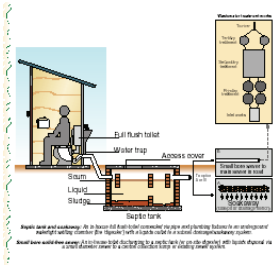
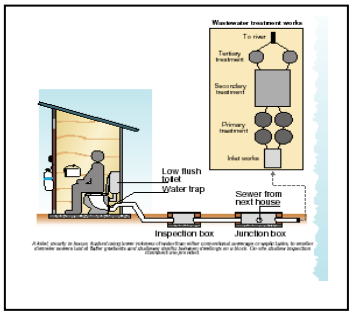
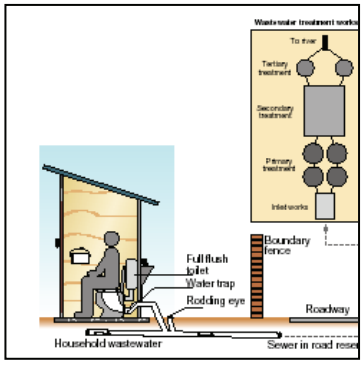
5. Septic tank toilet with a soak-away:  Consumer responses: Widely used in remote areas (rural households, resorts, clinics and farming areas) in SA where water is available. Application requirements: Expensive and water is required. Soil conditions must be favourable – soakaways may get clogged, especially in the long run.	R11 000	R600 p.a.
6. Small bore solids-free sewers:  Consumer responses: Not widely used in SA. Application requirements: Water and sewer reticulation networks are needed as well as wastewater treatment works. Expensive. Soil conditions must be favourable – soakaways may get clogged, especially in the long run.	R12 000	R700 p.a.

***Table 1*: Sanitation options for South Africa (continued . . .)**

[Source of diagrams: DWAF's "Sanitation is Dignity: Sanitation Technology Options"]

7. Shallow waterborne sewerage system:  Consumer responses: A new concept in South Africa. Application requirements: Water and sewer reticulation networks are needed as well as wastewater treatment plants. Shallow pipes may break due to external loads, despite much lower costs than full conventional waterborne systems.	R4 500	R600 p.a.
8. Full conventional waterborne sewerage system:  Consumer responses: Top of the range. The aspiration of most South Africans, although not affordable to many. Cost recovery sometimes problematic. Application requirements: Both water and sewer networks are needed, as well as wastewater treatment plants. Very costly. Health consequences of failure of wastewater treatment plants are enormous in comparison with failure of dry, on-site sanitation systems.	R10 250	R1 100 p.a.

It should be pointed out that the migration up the ladder of sanitation options in Figure 8 is only indicative of higher service levels which may be achieved, but it does not mean that the upgrading of sanitation options will necessarily follow this sequence. It only signifies the general trend of perceived improvement in sanitation service levels moving from no water requirements to fully-fledged wet systems.

In practice, the ladder of sanitation options is illustrated very well by the acceptable levels of sanitation options for the City of Johannesburg given in Table 2 below. These acceptable service levels for sanitation in Johannesburg appear in the "Sanitation Policy for the City of Johannesburg" approved by the Johannesburg Mayoral Committee in November 2002.

Table 2: Description of sanitation options which may be considered for Johannesburg

Sanitation Option: VIP - *dry on plot*

Description:

Comprises a top-structure over a pit. The pit is ***vented*** via a vent-pipe, which is covered with a screen to control and eliminate flies and odour. The pit may be lined or unlined.
Pits may be emptied manually or by vacuum tanker and appropriate treatment and disposal of sludge is required.

Advantages/Disadvantages:

Low capital cost, suited to labour intensive construction, provides minimum level of sanitation.
Environmental pollution may result, but only in very specific circumstances.
Access to pits required for emptying vehicle. Operation and maintenance costs are moderate.
TOILET CANNOT BE INSTALLED INSIDE THE HOUSE AND SYSTEM DOES NOT ACCEPT SULLAGE AND MAY NOT BE SUITABLE FOR DOLOMITIC AREAS.

Institutional requirement:

Requires tank desludging service.

Experience:

The VIP is used widely internationally and in dense settlement areas of South Africa. Few failures have been due to inadequate user education or poor design and construction.

Table 2: Description of sanitation options which may be considered for Johannesburg (continued . . .)

Sanitation Option: Composting / Desiccating / Urine diversion - *dry on plot*

Description:
Consists of a top-structure over a container with access to remove decomposed waste. These (generally proprietary) systems are based on capture and biological breakdown (composting) and/or drying-out (desiccating) of human waste into material that is safe for handling and disposal. In some cases urine is diverted to assist the process.
The resulting material must be removed and may be used as compost.

Advantages/Disadvantages:
Provides a basic level of service, which is designed to be used without water. Sullage and hard cleansing materials must be disposed of separately. Access to the system is required for removal of material. Community handling of decomposed human waste may not be consistent with local cultural customs and further treatment is required before use of the material as fertiliser.
SYSTEM DOES NOT ACCEPT SULLAGE, BUT MAY BE INSTALLED INSIDE THE HOUSE. THE SYSTEMS ARE DEPENDENT UPON TO CORRECT OPERATION.

Institutional requirement:
Requires removal of decomposed material by the community or local authority.

Experience:
Various proprietary systems have been constructed throughout South Africa, but failures occur with inadequate user education.

Sanitation Option: LOFLOS (Aquaprivy) - *low water on-plot*

Description:
Comprises a top-structure over a watertight container (septic tank), which drains to a subsurface drain (soakaway). The toilet is flushed using as little as 3*l* of water, which is carried to the toilet by the user (i.e.: is not necessarily piped). Solids are settled out and retained in the tank; liquids soak into the surrounding soil.
Tanks must be emptied by vacuum tanker and appropriate treatment and disposal of sludge is required.

Advantages/Disadvantages:
Provides basic level of sanitation and accepts sullage. Additional water has to be carried by user. Environmental pollution may result. Access to tanks for vehicle required. Operation and maintenance costs are moderate. **CANNOT BE INSTALLED INSIDE THE HOUSE AND SHOULD NOT BE USED IN DOLOMITIC AREAS OR WHERE PERMEABILITY IS LOW.**

Institutional requirement:
Requires tank de-sludging service.

Experience:
Widespread use in Gauteng. Many failures, generally due to inappropriate application, inadequate user education, poor design and workmanship.

Table 2: Description of sanitation options which may be considered for Johannesburg (continued . . .)

Sanitation Option: Conservancy or Septic Tank & soakaway - *high water on-site*

Description:
Comprises an in-house toilet flushing to a septic or conservancy tank draining into a soakaway. Human waste is deposited in a sealed toilet from which it is flushed by 6 -15 litres of water into a septic tank (or "digester") into which domestic grey water is generally also discharged. After passing through the septic tank, the liquid effluent soaks into the surrounding soil through the soakaway.
Tanks must be empties by vacuum tanker and appropriate treatment and disposal of sludge is required.

Advantages/Disadvantages:
Provides a high level of service and user convenience and accepts sullage and can be used without bulk sewer system. Toilet can be installed inside the house. Cannot be used for high settlement densities or with soils with lower permeability.
Requires large volumes and a reliable and uninterrupted supply of water. Capital costs are high. Operation and maintenance costs are high, especially in respect of the cost of the water used to flush.
FAILURE OF WATER SUPPLY OR INAPPROPRIATE OPERATION CAUSES THE SYSTEM TO FAIL AND SHOULD NOT BE USED IN DOLOMITIC AREA OR WHERE PERMEABILITY IS LOW.

Institutional requirement:
Requires tank de-sludging service.

Experience:
Septic tanks are widely used by formal rural households on the outskirts of the city, which get water supply from boreholes or formal reticulation.

Sanitation Option: Small-bore solids-free sewers - *medium water on/off-site*

Description:
Consists of a toilet flushing to a septic tank, with liquid effluent draining to small diameter (50 - 75mm) sewers. The effluent is collected in a central sump where it can be pumped or transported by tanker to the existing conventional sewer or treatment works. Alternatively, the small-bore sewer discharges effluent directly into an existing sewer system; this is referred to as a STED (Septic Tank Effluent Drainage) system.
Tanks must be emptied by vacuum tanker and treatment is required for both the sludge and liquid effluent from the sewers.

Advantages/Disadvantages:
Provides a convenient system, which can accept sullage associated with in-house water supply. The toilet can be constructed inside the dwelling. Capital costs are particularly high, while operational costs are also high, due to the requirement for de-sludging and effluent treatment.
OPERATION AND MAINTENANCE REQUIREMENTS FOR BOTH THE SEPTIC TANK AND SEWERS. SHOULD ONLY BE USED AS AN UPGRADE OF EXISTING SEPTIC TANK SYSTEMS.

Institutional requirement:
Both tank de-sludging and sewer maintenance are required.

Experience:
This system has not been widely applied in South Africa, except in cases where existing septic tank system has been upgraded.

Table 2: Description of sanitation options which may be considered for Johannesburg (continued . . .)

Sanitation Option: Shallow simplified sewerage - *medium water off-site*

Description:
Consists of a top structure (usually in-house) with lower flush toilets draining to smaller diameter (100mm) sewers laid at flatter gradients and shallower depths (than conventional sewerage) between dwellings on a block. High levels of connection are required to provide adequate flushing of the block sewers. These connect to street sewers and on to treatment facilities.
Treatment facilities are required, while maintenance of block sewers is often delegated to the residents.

Advantages/Disadvantages:
Provides a convenient sanitation option. Toilet can be constructed in the dwelling. Can be used with lower levels of water supply (30 litres//capita/day) and can accept sullage. Can be laid out in irregular informal settlements. Capital and operating costs are less than full water borne. Appropriate use is necessary, which required intensive consultation and user education.
REQUIRES HIGH CONNECTION RATES AND DENSER SETTLEMENTS WITH LOCAL MAINTENANCE TO BE COST EFFECTIVE AND SUSTAINABLE.

Institutional requirement:
Low-technology block sewer maintenance delegated to residents, supported by skilled operation of the bulk system.

Experience:
Has not been applied in South Africa, but has had wide application and success in settlements internationally, particularly where local residents take responsibility for the system.

Sanitation Option: Full-bore waterborne sewerage - *high water on/off-site*

Description:
The waterborne sewerage system comprises a top-structure with a flush toilet. The toilet is connected to a sewer (pipe) network, which drains to a wastewater treatment facility. Pipes flow only partially full.
Pump stations may be required. Treatment facilities are required.

Advantages/Disadvantages:
Provides high level of sanitation and user convenience and accepts sullage. Toilet can be installed inside the house. Requires large volumes and a reliable and uninterrupted supply of water. Capital costs are high. Operation and maintenance costs are high, especially in respect of the cost of the water used to flush. Cannot be used in spatially irregular settlements.
FAILURE OF WATER SUPPLY, OPERATION AND MAINTENANCE OR LOCAL AUTHORITY FINANCIAL LIQUIDITY RESULT IN RAPID COLLAPSE OF THE SYSTEM AND SPREAD OF DISEASE.

Institutional requirement:
Skilled, organised and effective operation and maintenance capability required.

Experience:
Widely used in South Africa. It is the goal of all South Africans, but is very costly.

Realizing that at least water and sanitation services are connected and interrelated, the City of Johannesburg has defined the water and sanitation service packages as given in Table 3.[8]

Table 3: Water and sanitation service packages for Johannesburg (2002)

Service Package	**Sanitation option**[1]	*Water Supply Level*[2]
Emergency or temporary services	**Communal VIP** (temporary <12 month measure) *Chemical toilets should be avoided, except in emergency situations*	**Communal tank or standpipe** *Water tankers may be used under emergency situations*
Basic level	**Household VIP** (on-plot dry) *Composting-desiccating systems may be used where the advantages and community acceptance are proven*	**Communal standpipe** *Yard connections may be used at lower densities*
Low level	**LOFLOS** or aquaprivies (on-site low flush)	**Low volume yard connection** (such as yard tanks)
Intermediate level	**Shallow sewerage** (off-site medium flush) *Small-bore sewerage may be used where septic tanks already exist in more than 80% of plots*	**Yard connection** **House connection may be used if this is affordable**
High level	**Full-bore sewerage** (off-site full flush) *Septic (or conservancy) tanks may be used in sparsely populated areas, such as semi-rural small-holdings* *Small-bore sewerage may be used where septic tanks or aquaprivies already exist in more than 80% of plots*	**Yard or House connections** *These may range from trickle feed to full pressure systems, depending upon affordability and water availability.*

Note 1: Apart from communal facilities for emergency or temporary services, a household sanitation facility is implied for these service levels. A number of households on a plot with a single toilet (such as for backyard shacks) cannot be interpreted as an adequate level of service.

Note 2: Although the preferred level of water supply is indicated in bold, this may be flexible in that a higher level of water supply may be considered, as indicated in italics

Taking Tables 2 and 3 into consideration, it should be clear that different service levels should be available to potential users like residents of dense settlements to suit their ability and willingness to pay. To accommodate these, the service levels as given in these tables, are available for **water and sanitation services** in Johannesburg. It should be pointed out, however, that infrastructure service levels are integrated and interrelated; they comprise more than just water and sanitation services since they include services such as roads, electricity, lighting and – very importantly – housing for which the potential users must pay either directly or indirectly. The service packages given in Table 3 could therefore be expanded to include these services as well. The permutations of available service levels would then become too large to handle by way of tables and one would have to resort to the practical approach of the SHAPE computer model making the choices of integrated services manageable and understandable for the residents of dense settlements.

In practice, it is when these residents are offered new housing options that they make an actual choice between different “service packages” from the full

[8] Not all options are currently being used

range of infrastructure services. In order to contain these "service packages" to a manageable quantity, only a limited number of options can be allowed for each infrastructure service, since it will otherwise give rise to too many permutations. If, for instance, only three levels of service were allowed for each infrastructure service and six basic infrastructure services were provided for new housing, hundreds of different service packages would be required, which is technically impractical and impossible.

5.3 Selection of sanitation options for this research study

In view of this consideration, and to avoid residents in dense settlements from having to decide between too many confusing sanitation options, a selection of five options were made for use in this study. These options were based on their general use in South Africa and the fact that the residents living in the dense settlement areas generally have knowledge of most of these options, namely:

1. The single VIP latrine
2. The double VIP latrine
3. The composting (UDS) toilet
4. Shallow waterborne sanitation system
5. Conventional full-bore waterborne system

In view of the surveys, the SMM computer model was suitably adapted to cater for these five sanitation options in the different survey areas. These options have been endorsed by DWAF and form the basis on which this research study was based.

6. SURVEYS

6.1 Introduction

This research study used the contingent valuation method which links service planning options to affordability, thus allowing for realistic choices to be made. In this sense, it is both an economic and a community analysis tool addressing issues of maximum benefit to the households within the financial means of the households.

As already indicated, the surveys were conducted in three areas, chosen for their distinctive characteristics. The reasons for selecting these areas are the following:

- Ekurhuleni in Gauteng has soils and topography suitable for conventional VIPs as well as for waterborne sanitation;

- Schmidtsdrif is a remote rural community and has been chosen to represent the rural residents living in dense settlement areas; and

- eThekwini (Durban) has areas with steep topography resulting in extra costs to virtually all sanitation and other services options.

263 interviews were conducted in total in these three areas.

6.2 Identification of survey sites

Identifying the survey sites provided some challenges. The Cape Metro was contacted with a view to carry out the surveys on the Cape Flats where the sandy conditions create special circumstance for constructing houses and services. After some negotiations with officials of the Cape Town Metropolitan Municipality, it was established that this Metro only allows waterborne sewerage systems due to high water tables during the winter months. Houses must also be plastered and painted to avoid dampness going through the walls during the wet winter period. As a result of these circumstances, the surveys were not done on the Cape Flats, since there were no real sanitation choices which the prospective participants could exercise.

Subsequently the cities of Port Elizabeth, Bloemfontein and Kimberley were also contacted with the view of conducting the surveys in their areas, but they all indicated that they basically all have the policy of supplying waterborne flush toilets with their new housing schemes. Determining sanitation demand in these cities would therefore not have been useful. Thus, attention was focused on Schmidtsdrif, a rural informal settlement 70 km west of Kimberley where on-site and waterborne sanitation systems are all still being considered.

The identification of the settlements surveyed in each region (Ekurhuleni, Schmidtsdrif and eThekwini) was done in consultation with the relevant officials of the local authorities concerned. Based on the Department of Housing's eligibility criteria for the housing subsidy, the intention of the selection was to cover a reasonable cross section of socio-economic levels of residents, and to exclude settlements where sanitation systems have already been installed.

6.3 Survey method

The SHAPE model was originally developed for individual one-to-one interviews, but this was not suitable for the magnitude of surveys undertaken here. After a number of pilot runs it was found that an individual "scoring sheet" methodology works best. The system used, was to put the participants into groups of about 20 – 40. Sanitation options were communicated in the form of choices which could be made. The posters of these sanitation options were displayed and the operation of these toilets explained in detail to the participants. Questions were invited and after they had all been answered, the participants indicated that they had a good idea of what each alternative type of toilet entailed when they made their choices.

***Figure 9**: Scenes from pilot studies undertaken in Ekurhuleni* *(The cardboard models used to illustrate the choices are clearly visible)*

Thereafter, the "scoring sheet" (or Survey Questionnaire as it appears in Appendices A, B and C for the surveys at Schmidtsdrif, eThekwini and Ekurhuleni respectively) was explained.

It consists of:

(a) Questions about the respondents' characteristics (for example: the name of their dense settlement, their name and surname, their occupation and income levels).

(b) A question which brought out the willingness to pay an additional amount for the services to be provided.

(c) A description of the services being valued and the circumstances under which they are made available to the respondent taking subsidies into consideration where they apply. Colourful posters were used to

elucidate the different sanitation options which were available to the respondents.

Each of these options had a cost attached, and once the first iteration had been undertaken, the costs could be added up. Normally this package was substantially above the limits the respondent has set for him-/herself, and a second or third iteration had to be undertaken.

As the surveys progressed, the questionnaires used for the surveys in Ekurhuleni, Schmidtsdrif and eThekwini were improved systematically taking the experiences from the previous survey into consideration. The questionnaires used at Schmidtsdrif had to be in Afrikaans due to the fact that very few members of the local community could understand English.

From Appendices A, B and C it can be observed that the number of different stand sizes was first reduced from four to two, since participants wasted a lot of time deciding which stand size they preferred. This distracted their attention from the real issues, namely making choices between *services* and weighing their costs up against one another.

Subsequently, the costs of the first and subsequent rooms of the same size were also averaged, because the participants found it extremely difficult to handle different costs for the same room size.

Finally, the forms were improved further by splitting the columns of the two ensuing optional stand sizes in such a way that they could not be confused with the two columns of the housing options.

These were major improvements and yielded a questionnaire which did not pose any further problems when the last surveys were done.

During the surveys a number of thought-provoking questions were asked by the residents, as shown in the boxes below.

"I have bricks, cement, windows and doors of my own. Can the Department of Housing use my material and give me a discount so that I may use my housing subsidy for higher service levels or to improve my standard of living in some other way?"
Resident of Schmidtsdrif

"We don't want these matchbox houses of the Department of Housing. We have much bigger houses at the moment – even though they are informal houses."
Resident of Schmidtsdrif

Another participant was very demanding and when informed that the cost of her choices of housing and services were far too high, she insisted on her choices by saying: ***"I am not prepared to accept fewer rooms than three and I insist on water-borne sewerage services as well as water and electricity services in my home and tarred roads with lights alongside the roads – nothing less."***
Resident of Gugulethu/Everest, Ekurhuleni

"I am poor and anything I may receive from government, I am grateful for. So, I don't mind whether I get a VIP or a yard tap, as long as I get something, I'll accept it with gratitude."
Resident of Gugulethu/Everest, Ekurhuleni

The influence of temperament, personality and attitude when applying the contingent valuation method, was illustrated very well by the remarks made by the two contrasting participants of the Ekurhuleni Metro (Gugulethu/Everest) as shown in the two last preceding boxes. For any process where participants must make trade-offs, the attitude of the second last respondent causes problems, because the respondent's decisions are rigid and there is no possibility of one choice being changed or substituted for another. Such an attitude will also cause problems when housing and services of different service levels are actually supplied in practice.

6.4 Observations made during the surveys

Some specific observations were made during the surveys. These are deemed important and are consequently discussed in further detail:

(a) In all areas (Ekurhuleni, Schmidtsdrif and eThekwini) many residents of the dense settlements unknowingly applied the linear programming technique when they made decisions about their homes and infrastructure services. Their mode of thinking followed more or less the following pattern:

- first they identified the service which was most important to them
- then they would look at the lowest cost option of that particular service acceptable to them and would choose it
- subsequently, they would consider the next service which was slightly less important to them, then choose the lowest cost option of that service acceptable to them and choose it
- then they would proceed to the next service which was still somewhat less important to them than the previous service they had considered
- Again, they would then look at the lowest cost option available and continue to the next service until they have exhausted the amount of money available to them each month

This was quite an interesting phenomenon observed during the surveys.

(b) The respondents at Ekurhuleni and eThekwini were less stressed than those at Schmidtsdrif while making their choices. The reason for this was mainly because the urban respondents have more money available due to more of them having jobs or having household members who have jobs. They therefore could make more costly choices like waterborne sanitation with much more confidence.

(c) It was very interesting to observe that the relation or contact between the local authority officials and the community members was not always

as “familiar” as one would expect it to be. They, for instance, did not always know one another and the community members often found the local authority officials complete strangers.

(d) Looking at the completed questionnaires, it was realized that this research study yielded many more useful results than only the sanitation demand of the respondents. The completed questionnaires also gave an indication of the demand for all the other infrastructure services among the residents of the dense settlements surveyed. For instance, the demand of the surveyed residents for water services (standpipes, yard taps and full water supply in their homes), for roads (widths of roads and their surface materials), for electricity and for the type of street lighting, have all been established through this study. **It should therefore be deemed as a very important “by-product” of the SHAPE Model that the demand of the residents for housing and all the infrastructure services are established simultaneously “in one shot” when applying the SHAPE Model. This is an enormous advantage of the application of this model.**

(e) One participant of the Ekurhuleni Metro stressed the fact that street lights along roads are prone to vandalism, since criminals can put the street lamps out of action by throwing stones at them and damaging them, whereas tower lights are not that easily affected by vandalism, since they are very high above ground level. With street lights down, crime can flourish more vigorously.

6.5 Summary of important facts pertaining to the surveys

The following important facts emerged from the surveys:

- **Understanding of the concept**

  Once the alternative models had been explained, the participants seemed to grasp the concept very well, and used the opportunity of successive iterations of the process to arrive at an informed choice. They demonstrated that they can take informed and sensible decisions as consumers.

- **Speed**

  The process takes time mainly because of the need to explain the alternative sanitation options. For this reason, it quickly became clear to the researchers that the process should be undertaken in groups and not on an individual basis. However, once the explanations had been completed, people worked fairly quickly. A survey of a relatively large dense settlement can – for instance – easily be completed during a single morning or afternoon.

- **Community pressure/sloganeering**

  In some groups there emerged social pressure to adopt one or other solution. This was presumably in the expectation that if sufficient community pressure was exerted, then additional resources would be made available to provide the higher standard of waterborne sanitation for all. Alternatively, these pressures were used on the assumption that all members of the community would be bound to accept the same solution. More time should perhaps have been spent to explain that the community did not need to adopt a single position, and that the point of the survey was to understand the many differences which might exist within the community.

- **Interaction between group members**

  The interaction between the participants also had a positive side, namely that they discussed and considered options among one another and arrived at decisions where they usually felt much more at ease than taking individual decision in "isolation" in front of a computer.

- **Empowerment**

  One of the major consequences of applying the SHAPE Model was the empowering effect of the information which it provided for the participants. To be shown how much money is required to provide a house or road, or the relative cost in use of, for example, waterborne sanitation, gave the participants a new sense of control over their choices. It was not just the knowledge of the facts which gave this sense of empowerment; it was also being given the opportunity to use these facts to arrive at decisions which would affect their lives substantially which they found exhilarating.

***Figure 10*: Scene from a research session in Ekurhuleni**

- **Proposal for a practical sanitation demonstration site**

Ideally as a recommendation, it may be mentioned that a very beneficial idea in practice is to construct all the relevant sanitation options beforehand next to each other in a "show" fashion so that households can experience the options in actual reality beforehand. This is sometimes done in practice as can be seen in Figure 11 which shows a sanitation demonstration site with different kinds of latrines in Dakar, Senegal (taken from "Demand-side issues of sustainable sanitation approaches" by O.E. Diop for the Water and Sanitation Programme Africa, 2004).

This might be a good idea for urban areas where the members of several communities of a number of dense settlements may visit the demonstration site to get first-hand experience of the sanitation options in practice.

***Figure 11*: A sanitation demonstration site with different kinds of latrines**

7. CASE STUDIES

7.1 Conducting the case studies

Two case studies were conducted to confirm or contradict the results obtained from the surveys. The case studies were carried out in Soshanguve Extension 6 and Temba/Hammanskraal which are two dense informal settlements in the municipal area of the City of Tshwane Metropolitan Municipality.

Soshanguve Extension 6 has the character of an urban dense settlement area, while the dense settlement at Temba/Hammanskraal is much more rural. Neither area has been serviced yet so they were both quite suitable for carrying out the case studies, since they were comparable with the areas covered in the surveys.

As in the case of the surveys, permission was obtained from officials of the Informal Settlement Division of the Housing Department at the City of Tshwane Metro. They subsequently coordinated the actions with the local councillors and ward committees to make the case studies possible.

The case study at Soshanguve Ext 6 involved seven households, while there were five households at Temba/Hammanskraal. There were thus twelve households participating in the case studies answering the same questions as those posed to the participants of the surveys, but using the SHAPE computer model instead of questionnaires. Answers were consequently not supplied on forms, but were answered orally and then entered into a laptop computer. The individual sessions lasted about forty minutes per participant and allowing for travelling time and introductions, the two case studies took two days in total. After each individual session, the results were discussed with every participant and the necessary changes made during the next round to accomplish affordability.

The final results were then printed and given to each participant as a summary of his/her choices. This had a strong regulatory effect on the reliability of the results of the case studies, since the results were made available to and spread among the community members (participants) and could therefore not be tampered with afterwards.

7.2 Responses from some of the case study participants

During the case studies, the following noteworthy responses were forthcoming from some of the participants:

(a) One of the respondents from Temba/Hammanskraal remarked that he regarded all the on-site sanitation options as similar to the bucket system which had been eradicated in South Africa recently. He said that all these on-site sanitation options (single and double VIPs and composting toilets) were therefore unacceptable and that he cannot

believe that communities can still opt for sanitation systems other than waterborne ones.

(b) A young participant of Temba/Hammanskraal made the observation that the water bottle for washing hands as indicated on the diagram for the shallow waterborne sanitation option, is unnecessary, since water must in any case be provided inside the home for this type of sanitation system. He pointed out that the official diagram of the shallow waterborne toilet with the outside water bottle as shown in Table 1 is incorrect.

(c) As in the case of the Ekurhuleni survey, one of the participants from Soshanguve Extension 6 said that she had no work and had three children and four grandchildren to care for with the result that she was so poor that any service provided to her and her household by government, would be accepted with gratitude. She indicated her choices of services, but added that she was quite prepared to downgrade any of the services she had chosen as long as she and her household could receive "something" from government in the near future.

(d) One of the participants of Soshanguve Extension 6 mentioned that he had two young children and that he needed a fairly large stand where his children could play without necessitating them to move elsewhere like to other "dangerous or evil places."

7.3 Results of the case studies

The quantified results which were obtained during the case studies are summarized in Table 5 in the next chapter and were compared with those of the surveys in Table 4 (also in the next chapter). They indicated the following:

- Excellent correlation was found between the results of the surveys and the case studies. The average values of the two sets of results coincided for all practical purposes if one takes the samples sizes of the surveys and the case studies into consideration.

- The case studies provided a useful counter-check on the results, as well as a much fuller insight into the criteria and thought processes of the participants to arrive at informed choices. In general, there was no conflict between the results of the case studies and the surveys.

- Among the insights obtained from the case studies was that income is not, in itself, a good guide to the choices which people might make. **Disposable income** is a far better guide. It is a function of family size and factors such as the cost of transport to work and many other factors. The surveys were not designed to elucidate these factors in detail, and future work should examine these variables in more detail.

8. ANALYSIS OF DATA AND FINDINGS

8.1 Basic data

The results of the surveys and case studies are firstly summarized and the other important findings pertaining to the entire study and its approach/ methodology are thereafter discussed in this chapter.

The results of the surveys undertaken in dense settlement areas of South Africa are summarized in Table 4 below.

Table 4: Results of the surveys carried out in dense settlement areas of South Africa to determine effective sanitation demand

THE SURVEYS							
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**SANITATION OPTIONS**					
		Single VIP	**Double VIP**	**Composting (UDS)**	**Shallow Waterborne**	**Conventional Waterborne**	**TOTAL**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	20	25	5	69	13	132
		15%	19%	4%	52%	10%	100%
Siyancuma Local Municipality	Rural area: Schmidts-drif	11	4	1	61	4	81
		14%	5%	1%	75%	5%	100%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	5	3	3	31	8	50
		10%	6%	6%	62%	16%	100%
SUMMATIVELY		**36**	**32**	**9**	**161**	**25**	**263**
		14%	**12%**	**3%**	**61%**	**10%**	**100%**

The results of the two case studies carried out in dense settlement areas of the City of Tshwane Metropolitan Municipality are summarized in Table 5 below.

***Table 5*: Results of the two case studies carried out in dense settlement areas of the City of Tshwane Metropolitan Municipality to determine effective sanitation demand**

CASE STUDIES							
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**SANITATION OPTIONS**					
		Single VIP	**Double VIP**	**Composting (UDS)**	**Shallow Waterborne**	**Conventional Waterborne**	**TOTAL**
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	2	2	0	3	0	7
		29%	29%	0%	42%	0%	100%
	Rural area: Temba / Hammanskraal	0	0	0	4	1	5
		0%	0%	0%	80%	20%	100%
SUMMATIVELY		**2**	**2**	**0**	**7**	**1**	**12**
		17%	**17%**	**0%**	**58%**	**8%**	**100%**

Taking into account that the case studies represented a sample of only 12 participants in comparison with the 263 participants of the surveys, it is remarkable how closely the sanitation demand pattern of the case studies corresponded with the sanitation demand pattern obtained from the surveys (see the summative percentages in the last row of Tables 4 and 5).

As a matter of fact, the small differences can be attributed to rounding off percentages due to the much smaller number of participants taking part in the case studies. When analyzing the percentages, it is clear that percentages of the various sanitation choices obtained during the surveys were for all practical purposes the same as the percentages of the case studies. The small differences which did emerge were only due to the much smaller sample size of the case studies. One can therefore conclude that the sanitation demand patterns of the surveys and the case studies corresponded for all practical purposes leading to an excellent correlation between the results of the surveys and the case studies.

Since the surveys and the case studies basically yielded the same sanitation demand patterns, the results of the surveys and the case studies were combined in Table 6 on the next page to arrive at the ultimate sanitation demand figures obtained by this research study.

***Table 6**: Summary of the results of the research conducted in dense settlement areas of South Africa to determine effective sanitation demand*

SUMMARY OF RESULTS OBTAINED BY THIS RESEARCH STUDY							
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**SANITATION OPTIONS**					
		Single VIP	**Double VIP**	**Composting (UDS)**	**Shallow Waterborne**	**Conventional Waterborne**	**TOTAL**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	20	25	5	69	13	132
		15%	19%	4%	52%	10%	100%
Siyancuma Local Municipality	Rural area: Schmidtsdrif	11	4	1	61	4	81
		14%	5%	1%	75%	5%	100%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	5	3	3	31	8	50
		10%	6%	6%	62%	16%	100%
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	2	2	0	3	0	7
		29%	29%	0%	42%	0%	100%
	Rural area: Temba / Hammanskraal	0	0	0	4	1	5
		0%	0%	0%	80%	20%	100%
ULTIMATE SUMMATIVE FIGURES OF THIS STUDY		**38**	**34**	**9**	**168**	**26**	**275**
		14%	**12%**	**3%**	**61%**	**10%**	**100%**

The fact that the combined sanitation demand percentage figures of the different sanitation options in Table 6 remained exactly the same as the figures in the last row of Table 4, confirmed the fact that the sanitation demand patterns of the surveys and the case studies are for all practical purposes the same. Together with the figures in the last row of Table 5, this re-confirms the results of the case studies, namely that these figures validated the results of the surveys.

8.2 Findings

The direct findings emanating from the results of this study as summarized in Table 6, are the following:

(a) About a quarter of all the respondents chose either the single or double VIPs. The single and double VIPs were more or less equally popular.

(b) The surveys revealed that there was little interest in the composting toilets (only about 3% of all the respondents). None of the respondents of the case studies indicated any interest in the composting toilets. The 3% of respondents who chose this type of toilet in the surveys, had other motives; the one respondent who chose this type of toilet at Schmidtsdrif found this toilet interesting and wanted to test its operation, while the eight respondents of Ekurhuleni and eThekwini saw the opportunity of selling the compost and making money by selecting this toilet. No other rural respondents of Schmidtsdrif or Temba/Hammanskraal opted for this type of toilet, since they are living further remote from urban areas and have no potential customers to sell the compost to on small scale.

(c) Taking the previous two findings into consideration, altogether about 30% of all the participants chose on-site toilets (single or double VIPs or composting toilets). A very important finding in this regard is that most of these participants indicated orally during and after the research sessions that they would not have chosen these types of toilets if they had not been forced to do so due to affordability reasons. They actually preferred water in their homes and waterborne toilets much rather if they could afford these services.

(d) About 70% of all the respondents chose waterborne flush toilets. About 60% chose the shallow waterborne system and about 10% the conventional full-bore waterborne system. The popularity of the shallow waterborne sewer system was due to its lower cost in comparison with the conventional waterborne system while rendering the same service as the conventional system. The respondents were, however, somewhat sceptical towards the shallow waterborne system, since they had not seen it in South Africa yet and wondered whether lorries or buses would not damage the shallow pipes when crossing the shallow sewer pipelines in practice. But they nevertheless chose this type of system due to the service it renders at a reduced cost in comparison with the conventional full-bore waterborne sanitation system.

(e) The basic **sanitation demand pattern** described in paragraphs (a) to (d) above, was the “average” pattern yielded by both the surveys and the case studies. This indicates that the results of this research study are statistically reliable, since only minor variations were observed between the average sanitation demand patterns of the surveys and the case studies due to the much smaller sample size of the case studies.

(f) The vast majority of residents unknowingly applied the *linear programming* technique when they made decisions about their homes and infrastructure services. This is described in sub-paragraph 6.4 (a) in detail.

(g) By weighing up all relevant alternative services simultaneously, the participants had to make trade-offs between these services to decide which of these services they really could afford. This is an important advantage of the approach followed in this research study. If one does not follow this approach, one will invariably arrive at other erroneous sanitation demand patterns which do not reflect the actual affordability of the sanitation service to the community to be serviced.

8.2.1 Correlation between income and services selected

All participants declared their ability to contribute a monthly amount towards the cost of their homes and services on their survey form. It is well known that these amounts are consciously and unconsciously distorted by a number of factors, including a tendency to ignore family transfers as "income" or "expenditure"; a tendency by some people to exaggerate their income to impress, and a parallel tendency by others to minimise it, either to attract (in their minds) government subsidies or grants.

The income levels of the participants were consequently very broadly classified for processing purposes. Figure 12 shows the approximate income distribution of the respondents participating in this research study.

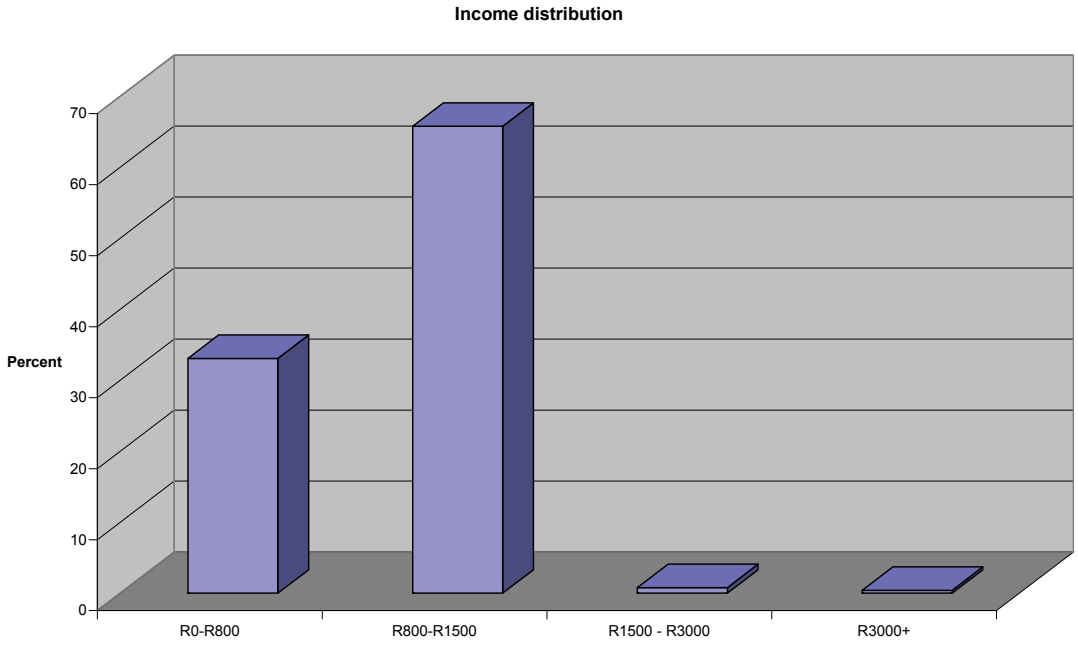


Figure 12: Income distribution of respondents

To what extent did the lower income people select the lowest cost options? Three criteria were applied to explore this question: the selection of sanitation type, the number of rooms, and the road surface. Since only 1% of the participating households earned more than R1 500 per month, they were excluded from Figures 13, 14 and 15 to simply the figures considerably.

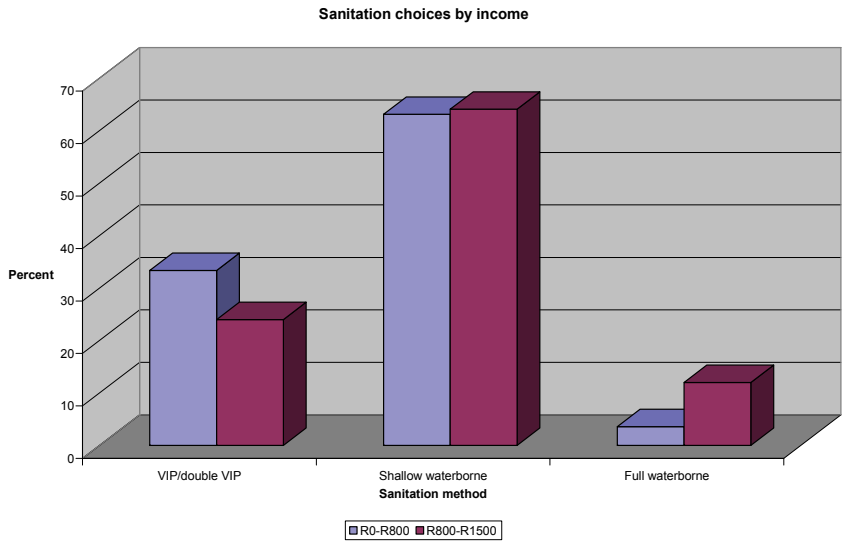


Figure 13: Sanitation choices by income group

As Figure 13 shows, there was a tendency for full waterborne sanitation to be selected by the higher income group, but there was not a very obvious correlation between low incomes and VIP toilets. Factors that might have been at play, were for example that the trade-off between increased house size and economies in sanitation might have influenced the upper income group to sometimes select VIPs. It was remarkable how many of the higher income group actually did select VIPs.

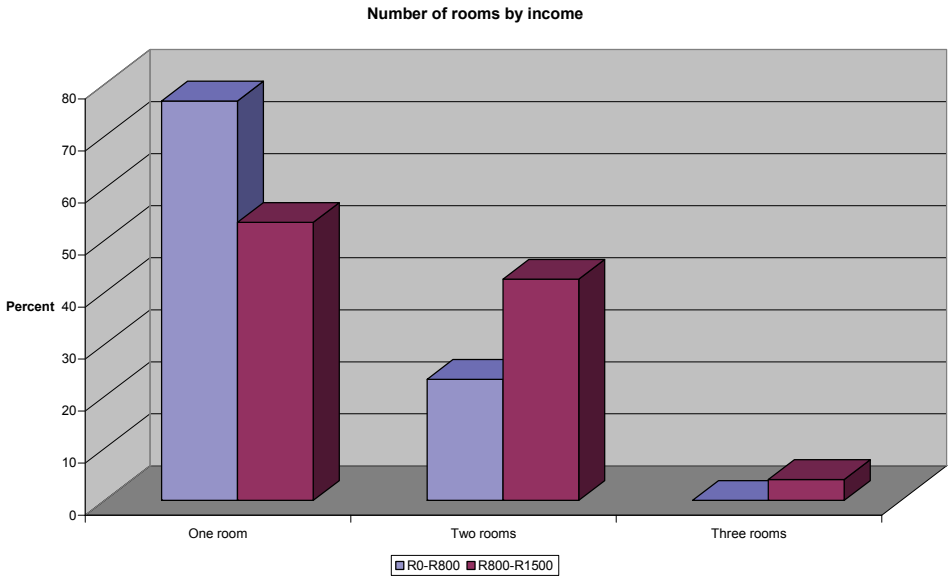


Figure 14: Number of rooms selected by income group

There was a clearer relation between the number of rooms selected and the income groups, but as Figure 15 shows, there was only a moderate correlation between income and the road surface selected.

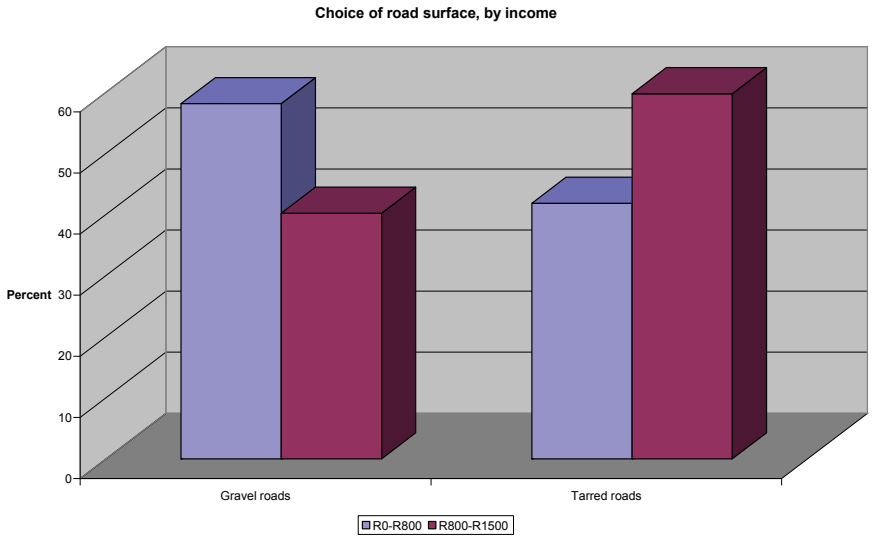


***Figure 15*: Choice of road surface by income group**

8.2.2 Findings with regard to all services

The following findings were made with regard to housing and services choices:

- Probably the most important finding of this research study is the fact that it yielded many more useful results than simply the sanitation demand patterns of the respondents. It also yielded their demand for housing as well as other infrastructure services, which provides an insight into the overall service demands of the inhabitants of the dense settlements. The service demand patterns for housing and infrastructure services are given in Appendices D to I. Since these demand patterns fall outside the scope of this study, they are discussed only briefly. They do, however, bear some significance in relation to the sanitation services chosen and are therefore summarized in the sub-paragraphs below. As pointed out already, the establishment of these demands is an extremely useful by-product of the application of the SHAPE model, since the demand for housing and all other infrastructure services are established "in one go" when applying this model. The following main findings were made in this study as far as the demand for the other services are concerned:

    - 95% of all the participants argued that they would be satisfied with small houses (one or two inhabitable rooms) as long as they could receive higher levels of water and sanitation services. With smaller families than in the past, many participants argued

that they may build an extra room or two in future themselves and add it to their initial small homes as time goes on. They realized that the upgrading of services like water and sanitation services posed considerably more problems to upgrade later-on than expanding their homes in future on their own.

- About 90% of all the participants chose small stands (8m x 16m or 10m x 20m), because they realized that all the services are more expensive for larger stands. Despite this fact, 28% of the rural respondents of Schmidtsdrif and Temba/ Hammanskraal chose bigger stands, since they are used to more space than their urban counterparts and indicated that they would find small stands unacceptable.

- About three quarters of all the participants requested water in their homes. In this respect, an important consideration was the fact that approximately 70% of all the participants opted for waterborne toilets which necessitated water in their homes. The remaining 30% of the participants who chose on-site sanitation (VIPs or composting toilets) opted for stand pipes or yard taps. Almost all the members of the latter group indicated that they were forced to make this choice due to affordability reasons and not because they preferred the on-site sanitation options together with stand pipes and yard taps. They certainly also preferred water in their homes with waterborne toilets, but could not afford these options. As a last resort, 85% of the respondents who chose out-of-home water options, indicated that they would at least prefer their water supply by way of a yard tap on their own premises.

- 65% of the participants chose the narrowest roads available, namely 3m in width. About 54% of all the participants indicated that they preferred tarred roads. Especially in the urban areas, the participants indicated that they were tired of dongas and pools of water standing in the roads around their present informal houses. A third of the participants at Schmidtsdrif opted not to have any roads at all, since they have fewer cars than their urban counterparts and are used to sand roads which they “construct” and maintain themselves.

- The participants regarded electricity as an extremely important service – even more important than waterborne sanitation. More than 80% of the participants indicated that they require electricity, while about 70% chose waterborne toilets in their homes. All the participants wanted electricity except 51 participants of the rural Schmidtsdrif area where they are used to not having electricity. Only about 42% of the participants who indicated that they did require electricity, opted for hot water (geysers). The reason for this being that they often do not have

the money available each month to pay for the electricity required by the geyser during the month.

- Only about 30% of the participants opted for street lights along their roads, while 48% opted for tower lights. These participants argued that tower lights are not as prone to vandalism as ordinary street lights and cost less than ordinary street lights. The urban participants also frequently indicated that they were already used to tower lights. About three quarters of the rural participants of Schmidtsdrif regarded street lighting as un-necessary, because they were not used to any street lighting and did not experience as much crime as their urban counterparts.

8.2.3 Values of the inhabitants of the dense settlements

Taking the results in Appendices D to I into consideration, the basic values of the inhabitants of dense settlements in South Africa transpired from this research study. Interactions during the surveys and case studies confirmed these values as well as the trade-offs respondents made when they were forced to accept lower level services due to affordability constraints. Some prominent broad values consequently emerged during this research study. These values were generally so "universal" and prominent that they could be described as general values among the inhabitants of the dense settlements.

The vast majority of respondents valued housing and services as matters of extreme importance to them. Several of the respondents indicated that – except for their religious and family values – they valued the acquisition of housing and infrastructure services as the most important considerations in their lives. They therefore greatly appreciated any assistance they received from anyone to inform them about these service.

It could be stated that the respondents have values which aspire to obtain the best and highest possible levels of housing and services for them. Quite often, these expectations were unrealistic and extravagant, but through these research sessions, they did realize that there were limitations to what they could realistically afford.

Considering the values which were observed during the research sessions, the following cascade of values transpired:

- The respondents valued an electricity supply as the most important service to them. Even if they would not receive housing, they still wanted electricity. They indicated that they were tired of struggling with candles, paraffin, gas or even firewood. Although they valued an electricity supply as of paramount importance to them, they did indicate that a geyser consumed too much electricity and that they therefore could not afford it.

- The respondents valued a clean and stable water supply as of great importance to them. Sanitation was also very important for their dignity, and according to their value system, they were extremely interested in decent toilets. The vast majority of the inhabitants of dense settlements preferred water and waterborne sewerage systems in their homes, despite the fact that they often could not afford these services. They would even opt for unknown, less costly waterborne systems (like the shallow waterborne system) than accepting any of the on-site sanitation options.

- Housing is also very important to the inhabitants of the dense settlements, since they mostly live in discomfort in the elementary homes they have built for themselves. Although they valued space and inhabitable rooms as important to them, many of the inhabitants would be prepared to accept only one inhabitable room at the start and then extend their homes later on at their own expense.

- The respondents often valued good electricity, water and sanitation services as more important than a bigger house, since they realized that the upgrading of the infrastructure services might be uncertain or impossible in future. Very few inhabitants therefore opted for plastered and painted homes, since they generally valued some more elementary kind of housing structure with better infrastructure services as more important than bigger and more luxurious homes with lower levels of infrastructure services.

- As far as stand sizes are concerned, the inhabitants generally indicated that they were not particularly adamant about having large stands, although there were some (especially in the rural areas) who insisted on large stands.

- Roads were second last on the priority list of the respondents. Although the majority of inhabitants – especially in the urban areas – preferred tarred roads and indicated that they were tired of muddy pools during the rainy season and dongas all around them, they were generally prepared to accept gravel or even no roads at all if it compromised their receiving better infrastructure services and housing.

- Street lighting was usually last on the priority list of the respondents. The general feeling according to their value system was that street lighting and roads should be provided by the local authority and that they should not directly pay for these services. Those who valued street lighting as important, were mostly the urbanites who regarded it as important for security reasons to help preventing crime.

8.2.4 The need for prior assessment of practical alternatives

It became clear that the political and technical role players involved in the process of determining sanitation demand and supplying services (i. e. the upper two prongs described in paragraph 2.2) must be ready and prepared to service the particular community or communities when the SHAPE model is applied.

An assessment of the practicability of the alternative types of toilets and the cost calculations of all the services must already have been completed by technical experts before the SHAPE model is applied. This has the advantage that the members of the political and technical teams are ready to service the particular "target" community when the model is applied. There is no aimlessness by asking community members such vague questions as: "Which type of toilet do you prefer?" when the SHAPE model is applied.

8.2.5 Four-pronged approach needed

It was confirmed that the four-pronged approach as described in paragraph 2.2 to determine sanitation demand, has to be followed to arrive at the alternative sanitation options for a particular dense settlement area when the SHAPE model is applied. This also applies to housing and all the other infrastructure services as well.

8.2.6 Governance relationships with the community members of dense settlements

The internal co-ordination within local authorities and externally between local authorities, political representatives (such as councillors and ward committees) and community members was found to be very slow and cumbersome. Whereas one would expect that organizing public consultation sessions would only take about two to three weeks to finalize, it sometimes took more than four months to actually address the respondents at grass root level (for instance, typically from 8 October 2007 until 20 February 2008 from the date of first contact with the local authority officials until the date that the particular survey session actually could take place).

Table 7 summarizes the co-ordination and involvement of local authority officials and councillors during the surveys in a quantified way.

Table 7: ***Quantification of the coordination and involvement of local authority officials, councillors and ward committees during the research sessions***

QUANTIFICATION OF THE CO-ORDINATION AND INVOLVEMENT OF LOCAL AUTHORITY OFFICIALS, COUNCILLORS AND WARD COMMITTEES DURING THE RESEARCH SESSIONS						
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**CO-ORDINATION AND INVOLVEMENT**				
		Co-ordination Three weeks as a % of the time taken (in weeks) to reach the participants (%)	**Involvement of** Local Authority Officials (%)	**Involvement of** Councillors (%)	**Involvement of** Ward/Street Committees (%)	**TOTAL %**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu/ Everest	100%	25%	50%	50%	56%
Siyancuma Local Municipality	Rural area: Schmidts-drif	50%	0%	100%	0%	38%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	15%	100%	0%	0%	29%

In Table 7 the coordination between local authority officials, councillors and ward/street committees has been quantified as the relation (in percentage) of the period of three weeks which is deemed sufficient to organize public participation actions and the number of weeks it actually took to reach the community members at ground level.

The involvement of the local authority officials, political office bearers (councillors) and ward/street committees has been expressed as the percentage of time they were present during the research sessions. It also echoes certain non-quantifiable components such as role players often being complete strangers to one another and to the community members.

8.2.7 Top-down decision making in respect of sanitation systems

During the negotiations with some of the bigger local authorities in South Africa to carry out the surveys in their areas of jurisdiction, it was found that some local authorities have adopted a policy where all their new housing schemes must have waterborne sewer systems. Typical examples of the cities where this policy was encountered, was Cape Town, Port Elizabeth and Kimberley.

While this policy may have legitimate and acceptable reasons such as specific physical conditions such as high water tables or dolomitic soils, it cannot be accepted summarily in all circumstances. It contradicts the Department of Water Affairs and Forestry's Strategic Framework for Water Services which states that in most instances, on-site sanitation systems are likely to be the most appropriate solution and that care must be exercised when choosing waterborne sanitation systems. In a water-scarce country like South Africa, it also contradicts the Batho Pele principle which states that public services must be provided as economically as possible. If waterborne sewers are summarily prescribed, the important consultation principle of Batho Pele, which stipulates that citizens must be given a choice of the level of service through a process of public consultation, is also violated.

8.2.8 Critical Success Factors for implementing the SHAPE Model

There are certain factors influencing the efficiency of implementing the SHAPE Model which transpired during the surveys and case studies. Most of these are external factors which do not relate directly to the Model itself:

- The most important critical success factor is the efficiency with which the public participation sessions are organized. If the local authority officials, councillors and ward/street committees could efficiently and effectively organize the sessions within a reasonable period of time and could succeed in involving the vast majority of households, the battle is halfway won. These sessions must usually be organized to take place on Saturdays when most households are available to attend.

- Having enough questionnaires in hard copy format available, is also a critical factor during the surveys, because without them, one cannot proceed with the process in group context

- The better and clearer posters one has available at any session to explain the different housing and service options to the participants, the more streamlined and successful the session is.

- Another critical success factor is to have a facilitator with command of the local languages or an interpreter available to address the participants in their own local languages.

- It is very helpful to have a person assisting with tasks such as distributing and collecting the questionnaires, pencils, rubbers, etc. This person can also assist those people who are disabled (sometimes blind) and especially those who cannot read or write. Whereas the facilitator may cater for the illiterate after the sessions by quickly repeating the entire session in abbreviated format to them, it does pose a problem if other participants still want to ask the facilitator urgent questions after the sessions while he/she is busy completing the forms for the illiterate. It is therefore advantageous to have a specific person available to assist the disabled and illiterate during the sessions.

- The only factor associated with the Model itself requiring attention each time it is applied in another dense settlement area, is estimating the costs of the housing and other services as dictated by the local circumstances. This may appear to be quite demanding, but it has to be done for any method aiming at determining housing and service demands based on the Batho Pele principles anyway. These principles state – amongst others – that people should be afforded the opportunity to make choices between different services and between different service levels for each service they wish to acquire.

8.2.9 A world first

It was found that there was no evidence in literature that the integrated approach followed in this study, has been applied to determine sanitation demand elsewhere.

As already mentioned, this is probably the most important finding of this study, namely that the SHAPE Model determines the demand of residents for housing and all other associated infrastructure services in an integrated way. In practice, this is the way in which demands for all services are expressed and determined when housing and services are supplied in dense settlement areas of South Africa. The demand for housing and all the other services is established by means of the SHAPE Model according to what the residents living in dense settlements can **afford** paying for the services.

9. CONCLUSIONS

Considering the findings of this study, the following conclusions can be drawn:

9.1 Effectiveness of the model

The effective sanitation demand of residents living in some representative dense settlement areas of South African could be determined in an integrated way by means of the SHAPE model.

The fact that virtually all of the approximately 30% participants who chose on-site sanitation options in this study, indicated that they would have chosen waterborne sewerage systems if they had not been forced to choose the on-site toilets due to affordability reasons, clearly proves that wrong sanitation demand patterns would have been obtained if an integrated affordability approach had not been followed. The SHAPE Model therefore yields different sanitation demand patterns than non-integrated methods which are not based on affordability considerations. One can consequently draw the important conclusion that the type of approach followed in this study is the only reliable approach when sanitation and other service demand patterns are determined.

9.2 Pattern of sanitation demand

The ultimate sanitation demand pattern which emerged from this study can be described as follows:

- About a quarter of all the participants chose either a single or double VIP due to affordability reasons. Virtually all these participants indicated that they would actually have preferred waterborne sanitation systems.
- Very little interest was shown in the composting toilet (only about 3% of all the participants). If chosen, there were mostly other motives than sanitation such as the possibility of making money from the sale of compost.
- About 70% of all the participants were quite adamant about their decision to choose waterborne sanitation systems. About 60% opted for the shallow waterborne system, while about 10% chose the conventional full-bore waterborne system.

The overall sanitation demand patterns yielded by both the surveys and the case studies were for all practical purposes the same and resembled the ultimate demand pattern described above. Although the patterns differed for the individual dense settlement areas covered by this study, the average demand percentages for the different sanitation options were virtually the same for all the dense settlement areas covered by the surveys and the case studies of this research study. This is an important conclusion, since it confirms that the results of this study are statistically reliable.

9.3 Value of the integrated method

The application of the SHAPE Model establishes the demand for housing and all other infrastructure services "in one go." This is an extremely important by-product of this research study, since all the demand patterns are obtained immediately to give authorities a significant insight into the housing and other service demands of the residents living in dense settlements.

9.4 Problem resolution by linear programming principles

Most residents unknowingly applied the linear programming technique during their thought processes when making integrated and simultaneous decisions about their homes and infrastructure services.

9.5 Priorities

- **House size**

  Many of the residents in the dense settlements were willing to accept small houses in exchange for higher levels of water and sanitation services. The reason for this being that they would rather opt for building an extra room or two in future and add them to their initial small houses as time goes on, whereas they realized that upgrading their sanitation and water services might be virtually impossible for them to do on their own in future.

- **Electricity**

  The residents of the dense settlements surveyed regard electricity supply as the most important service – more important than water supply or waterborne sewers in their homes. If one would exclude the 51 participants from Schmidtsdrif who indicated that they did not mind sacrificing an electricity service, since they are already used to living without electricity, 100% of the other respondents indicated that they did require electricity. In contrast to this, only about 70% of the participants indicated that they would like a waterborne sewerage system and only 76% expressed their desire for water to be supplied in their homes. One could therefore conclude that electricity is more important to residents in dense settlements of South Africa than a waterborne sewerage system or water in their homes.

10. RECOMMENDATIONS

Considering the findings and conclusions of this study, the following recommendations are made:

- The SHAPE model should be used to establish the sanitation and other service demands of residents in dense settlements since it is the only reliable approach which takes integrated affordability of the residents into account. By applying the SHAPE Model, central government policy such as the Batho Pele principles is also automatically adhered to. Furthermore, the housing and all other infrastructure service demands of the residents of the dense settlements are determined simultaneously in an integrated way. This prevents the establishment of erroneous demand patterns due to non-integrated affordability approaches being followed.

- The model can be used by National Departments to investigate community demands for alternative service demands such as sanitation and water provision requirements. It can also be an effective tool for training and informing regional staff on the economic and social implications of different service alternatives.

- Local authorities should keep sanitation choices open to the residents of dense settlements by refraining from adopting policies which do not allow on-site toilets with new housing schemes. The only exception should be when physical and/or technical considerations such as high water tables or specific soil conditions do not permit the use of on-site toilets.

- The SHAPE Model gives political representatives the information required to take more informed decisions. Not only does it allow them the opportunity to hear the informed choices of their electorate, it also gives them access to information regarding the financial implications of the decisions taken by their electorate.

- The model gives the households a tool with which to bargain with developers, thus reversing the traditional “take-it-or-leave-it” relationship. Although the top-down method of project design has been used most frequently in low income housing developments thus far, the model can also be applied with great effect in middle and upper income housing developments.

- Taking the findings and conclusions of this research study into consideration, the following topics can be recommended for further in-depth research:

  - A survey should be done to determine how often and in which way the integrated affordability of services is taken into account when such services are offered to the residents of dense settlements in South Africa. By "integrated affordability" is meant whether these residents are consulted to determine in an integrated way whether they can afford the housing and all other services offered to them (usually as a total monthly payment). Should they not be able to afford these services, unsustainable service delivery results and non-payment, boycotts, demonstrations and other problematic situations usually develop.

  - An in-depth economic appraisal of the decision taken by some local authorities not to allow on-site sanitation methods with new housing schemes in their areas of jurisdiction should be carried out. Areas where there are legitimate physical reasons for such a decision, like for instance high water tables or specific soil conditions not suitable for on-site sanitation systems, must be excluded from such an appraisal. The economic analysis should include a quantification (as far as possible) of the decision not to allow on-site sanitation on monetary, human and environmental resources. The operational and maintenance considerations of wastewater treatment plants and the scarcity of water in South Africa should therefore be taken into account during such an appraisal. The economical cost of additional water sources, mal-functioning or ill-operated water and wastewater treatment works with regard to especially the environment, will also have to be factored into such an appraisal.

  - It is recommended that more research be done to familiarize prospective users with the different sanitation options available. Sanitation demonstration sites should be considered for the residents of dense settlements where extensive housing schemes are planned. Depending on practical considerations, portable demonstration sites may also be of great advantage to the residents of further remote dense settlements.

  - A study should be undertaken of the experiences of community consultation in the field of water and sanitation services to residents of dense settlements in South Africa. Aspects that should be analyzed in such an investigation or investigations are the following:

    (i) Whether the principles of consultation as required by the Batho Pele principles and the Municipal Systems Act, which specify that citizens should be given a choice when services are offered to them, are adhered to.

(ii) Whether the Batho Pele principles of information dissemination and service standards are adhered to which stipulate that full and accurate information should be given to citizens about the level and quality of public services they may receive.

(iii) Whether the Batho Pele principle of value for money is adhered to which stipulates that public services should be provided economically and efficiently in order to give citizens the best possible value for money. The appraisal of this principle will definitely have cross-cutting linkages with an investigation of the economic implications of a policy which excludes on-site sanitation options as proposed on the previous page.

Hopefully this research study will have a positive influence on the determination of sustainable sanitation and other service demands among residents of dense settlements in South Africa by adhering to central government policy such as the Batho Pele principles which state that citizens must be given a choice of services, must be informed of the quality and level of the services they may receive and must be serviced as economically and as efficiently as possible.

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APPENDIX A
Schmidtsdrif Survey Questionnaire

(note: the English version of this questionnaire can be found in Appendices B and C)

1. Plaaslike Owerheid	Siyancuma Plaaslike Munisipaliteit
2. Plek	Schmidtsdrift
3. Naam	
4. Van	
5. Werk	
6. Hoeveel kan u bekostig om elke maand uit u eie sak aan behuising en dienste te bestee?	R

BEREKENING VAN

TOTALE BESKIKBARE BEDRAG PER MAAND

Staatsubsidie per maand	R 680
Eie bydrae per maand	R
TOTALE BESKIKBARE BEDRAG PER MAAND	R

DIE SHAPE-MODEL om die bekostigbaarheid van behuising en dienste te bepaal

HOP standaarde	Bewoonbare kamers:	Basies	Gepleister en geverf			Keuse 1	Keuse 2
R296	3 m x 3 m (Eerste)	R296	R363				
R172	3 m x 3 m	R172	R223				
	3 m x 3 m	R172	R223				
	4 m x 3 m (Eerste)	R379	R440				
	4 m x 3 m	R216	R277				
	4m x 4 m (Eerste)	R427	R499				
	4 m x 4 m	R263	R335				
	4 m x 5 m	R290	R372				
	Erfgrootte:	8 m x 16 m	10 m x 20 m	12 m x 24 m	14 m x 28 m		
R26	Grondkoste:	R26	R38	R54	R72		
	Waterdiens:						
R36	Staankraan	R36	R44	R50	R58		
	Kraan op erf	R50	R56	R64	R70		
	2 m x 1 m Wasbak + Stort	R182	R209				
	Twee kamers: Wasbak + Stort	R284	R390				
	2 m x 2 m Badkamer	R348	R400				
	Tipes Toilette:						
R88	1. VIP (Enkel)	R88	R100				
	2. VIP (Dubbel)	R88	R100				
	3. Kompos (UDS)	R88	R100				
	4. Vlak Spoeltoilet	R254	R273	R296	R318		
	5. Gewone Spoeltoilet	R338	R364	R394	R424		
	Paaie:						
	3 m Gruis	R27	R34	R41	R48		
R56	3 m Teer	R56	R70	R85	R99		
	5 m Gruis	R36	R45	R54	R64		
	5 m Teer	R79	R98	R118	R137		
	8 m Gruis	R50	R62	R74	R87		
	8 m Teer	R112	R139	R167	R195		
	Elektrisiteit:						
	Volle elektrisiteit	R86	R106	R130	R156		
	Addisioneel: Warm water	R17					
	Straatligte:						
	Langs paaie	R55	R67	R78	R90		
R6	Toringligte	R6	R13	R21	R26		
R680	TOTAAL						
R680	TOTALE BESKIKBARE BEDRAG PER MAAND						

APPENDIX B
eThekwini Survey Questionnaire

1. Local Authority	eThekwini Metro
2. Name of your dense settlement area	
3. Name	
4. Surname	
5. Occupation	
6. Which amount can your household afford to pay extra for housing and services per month?	R

CALCULATION OF

TOTAL AMOUNT AVAILABLE PER MONTH

Housing subsidy per month	R680
Own contribution per month	R
TOTAL AMOUNT AVAILABLE PER MONTH	R

THE SHAPE MODEL to determine the affordability of housing and other services

RDP Standards	Habitable rooms:	Basic	Plastered and painted		First choice	Second choice
R234	3 m x 3 m	R234	R293			
R234	3 m x 3 m	R234	R293			
	3 m x 3 m	R234	R293			
	4 m x 3 m	R298	R359			
	4 m x 3 m	R298	R359			
	4m x 4 m	R345	R417			
	4 m x 4 m	R345	R417			
	4 m x 5 m	R411	R484			
	Stand size:	8 m x 16 m	12 m x 24 m			
R72	Land cost:	R72	R128			
	Water service:					
R19	Stand pipe	R19	R25			
	Yard tap	R25	R32			
	Water in home:	R197	R252			
	Types of Toilets:					
R88	1. VIP (Single)	R88	R88			
	2. VIP (Double)	R88	R88			
	3. Composting (UDS)	R88	R88			
	4. Shallow Waterborne	R118	R138			
	5. Ordinary Waterborne	R169	R197			
	Roads:					
R27	3 m Gravel	R27	R41			
	3 m Tarred	R56	R85			
	5 m Gravel	R36	R54			
	5 m Tarred	R79	R118			
	8 m Gravel	R50	R74			
	8 m Tarred	R112	R167			
	Electricity:					
	Full electricity	R86	R130			
	Additional: Hot water	R17				
	Street lighting:					
	Along roads	R55	R78			
R6	Tower light	R6	R21			
R680	TOTAL					
R680	TOTAL AMOUNT AVAILABLE PER MONTH					

APPENDIX C
Ekurhuleni Survey Questionnaire

1. Local Authority	Ekurhuleni Metro
2. Name of your dense settlement area	
3. Name	
4. Surname	
5. Occupation	
6. Which amount can your household afford to pay extra for housing and services per month?	How many people are there in your household? ☐ R

CALCULATION OF

TOTAL AMOUNT AVAILABLE PER MONTH

Government's housing and services subsidy per month	R680
Own contribution of your household per month	R
TOTAL AMOUNT AVAILABLE PER MONTH	R

THE SHAPE MODEL to determine the affordability of housing and other services

RDP Standards	Habitable rooms:		Basic	Plastered and painted		First choice	Second choice
R167	3 m x 3 m		R167	R229			
	3 m x 3 m		R167	R229			
	3 m x 3 m		R167	R229			
R213	4 m x 3 m		R213	R274			
	4 m x 3 m		R213	R274			
	4 m x 4 m		R247	R319			
	4 m x 4 m		R247	R319			
	4 m x 5 m		R294	R370			
	Stand size:	8 m x 16 m			12 m x 24 m		
R45	Land cost:	R45			R63		
	Water service:						
R19	Stand pipe	R19			R25		
	Yard tap	R25			R32		
	Water in home	R174			R216		
	Types of Toilets:						
R76	1. VIP (Single)	R82			R82		
	2. VIP (Double)	R82			R82		
	3. Composting (UDS)	R82			R82		
	4. Shallow Waterborne	R118			R138		
	5. Ordinary Waterborne	R169			R197		
	Roads:						
	3 m Gravel	R24			R37		
R51	3 m Tarred	R51			R77		
	5 m Gravel	R33			R49		
	5 m Tarred	R71			R107		
	8 m Gravel	R45			R68		
	8 m Tarred	R102			R152		
	Electricity:						
R86	Full electricity	R86			R130		
R17	Additional: Hot water	R17			R17		
	Street lighting:						
	Along roads	R55			R78		
R6	Tower light	R6			R21		
R680	TOTAL						
R680	TOTAL AMOUNT AVAILABLE PER MONTH						

APPENDIX D
Housing: demand for number of rooms

HOUSING: Number of rooms					
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**HOUSING OPTIONS: Number of rooms**			
		One room house	**Two room house**	**Three room house**	**TOTAL**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	44	81	7	132
		33%	62%	5%	100%
Siyancuma Local Municipality	Rural area: Schmidtsdrif	69	11	1	81
		85%	14%	1%	100%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	48	2	0	50
		96%	4%	0%	100%
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	0	4	3	7
		0%	57%	43%	100%
	Rural area: Temba / Hammanskraal	0	3	2	5
		0%	60%	40%	100%
SUMMATIVELY		**161**	**101**	**13**	**275**
		58%	**37%**	**5%**	**100%**

APPENDIX E
Demand for stand sizes

STAND SIZES SELECTED						
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**STAND SIZE OPTIONS**				
		8 m x 16 m	**10 m x 20 m**	**12 m x 24 m**	**14 m x 28 m**	**TOTAL**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	132	0	0	0	132
		100%	0%	0%	0%	100%
Siyancuma Local Municipality	Rural area: Schmidts-drif	56	5	4	16	81
		69%	6%	5%	20%	100%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	46	0	4	0	50
		92%	0%	8%	0%	100%
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	6	0	1	0	7
		86%	0%	14%	0%	100%
	Rural area: Temba / Hammans-kraal	1	0	4	0	5
		20%	0%	80%	0%	100%
SUMMATIVELY		**241**	**5**	**13**	**16**	**275**
		87,5%	**1,5%**	**5%**	**6%**	**100%**

APPENDIX F
Demand for water services

WATER SERVICES					
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**WATER SERVICE OPTIONS**			
		Stand pipe	**Yard tap**	**Water in home**	**TOTAL**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	5	34	93	132
		4%	26%	70%	100%
Siyancuma Local Municipality	Rural area: Schmidtsdrif	3	12	66	81
		4%	15%	81%	100%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	1	7	42	50
		2%	14%	84%	100%
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	1	3	3	7
		14%	42%	42%	100%
	Rural area: Temba / Hammanskraal	0	0	5	5
		0%	0%	100%	100%
SUMMATIVELY		**10**	**56**	**209**	**275**
		4%	**20%**	**76%**	**100%**

APPENDIX G
Demand for road types

ROAD TYPES SELECTED									
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**ROAD OPTIONS**							
		3 m Gravel	**3 m Tarred**	**5 m Gravel**	**5 m Tarred**	**8 m Gravel**	**8 m Tarred**	**No roads required**	**TOTAL**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	34	76	3	17	1	1	0	132
		26%	58%	2%	13%	0,5%	0,5%	0%	100%
Siyancuma Local Municipality	Rural area: Schmidtsdrif	26	12	10	5	0	0	28	81
		32%	15%	12%	6%	0%	0%	35%	100%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	15	17	0	10	1	3	4	50
		30%	34%	0%	20%	2%	6%	8%	100%
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	0	0	0	0	5	2	0	7
		0%	0%	0%	0%	71%	29%	0%	100%
	Rural area: Temba / Hammanskraal	0	0	0	0	0	5	0	5
		0%	0%	0%	0%	0%	100%	0%	100%
SUMMATIVELY		**75**	**105**	**13**	**32**	**7**	**11**	**32**	**275**
		27%	**38%**	**5%**	**11,5 %**	**3%**	**4%**	**11,5 %**	**100%**

APPENDIX H
Demand for electricity

ELECTRICITY					
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**ELECTRICITY SERVICE OPTIONS**			
		Require electricity	**Do not require electricity**	**TOTAL**	**Require a geyser (hot water)**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	132	0	132	66
		100%	0%	100%	50%
Siyancuma Local Municipality	Rural area: Schmidtsdrif	30	51	81	19
		37%	63%	100%	23%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	50	0	50	30
		100%	0%	100%	60%
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	7	0	7	0
		100%	0%	100%	0%
	Rural area: Temba / Hammanskraal	5	0	5	1
		100%	0%	100%	20%
SUMMATIVELY		**224**	**51**	**275**	**116**
		81%	**19%**	**100%**	**42%**

APPENDIX I
Demand for street lighting

STREET LIGHTING					
LOCAL AUTHORITY	**DENSE SETTLE-MENT AREAS**	**STREET LIGHTING OPTIONS**			
		Lights along roads	**Tower lights**	**No street lights required**	**TOTAL**
Ekurhuleni Metropolitan Municipality	Mix between urban and rural area: Gugulethu Everest	55	77	0	132
		42%	58%	0%	100%
Siyancuma Local Municipality	Rural area: Schmidtsdrif	4	17	60	81
		5%	21%	74%	100%
eThekwini Metropolitan Municipality	Urban areas: Boxwood, Cato Crest (Areas 2, 3, 4 and 5), Jamaica, Johanna Road, Kenville, Seacow Lake	18	27	5	50
		36%	54%	10%	100%
The City of Tshwane Metropolitan Municipality	Urban area: Soshanguve Ext 6	1	6	0	7
		14%	86%	0%	100%
	Rural area: Temba / Hammanskraal	1	4	0	5
		20%	80%	0%	100%
SUMMATIVELY		**79**	**131**	**65**	**275**
		29%	**48%**	**23%**	**100%**